CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

The field of wireless communication is one of the fastest developing segments of the telecommunication industry in recent years. The communication systems such as cellular, cordless phones, satellite phones and Wireless Local Area Networks (WLAN) have found extensive use and become an integral part in the everyday life of most people, both professional and personal.

In this present century, wireless communication technologies which provide telephone and internet access have shown vast developments. It is amazing to notice many people use these technologies for conferencing, social networking, reading news and email, surfing the World Wide Web and playing, in their daily life. These activities are not only for spending their spare time, but also for collecting useful information for their professional career. Smart phones, tablets and laptops, are all equipped with wireless interface cards, which allow the user to communicate and control other networked-devices.

Radio based wireless networks tend to attain great popularity by the end-users because of their flexibility in connecting mobile nodes. With
no wire connection, the end-users are capable of moving around, in-line with the connecting network if the wireless radio range provides sufficient coverage. Wireless networks provide more flexibility to the end-users, incorporating more mobile nodes, as no wires are needed to be laid down to extend the network.

1.2 WIRELESS COMMUNICATION SYSTEM

The wireless communication system techniques have evolved into distributed multi-hop networks that operate over a wide geographical area. Without wire connections, the users can roam-around while still being connected to the internet. The focal drawback is the limited coverage range of these wireless devices. A number of wireless devices together forms multi-hop networks. The term multi-hop implies that the mobile devices forward data packets to other mobile nodes, by creating a temporary multi-hop path through the network. Such a network is called as Ad hoc wireless network. This system was mainly designed to self-organize, self-configure and to detect the radio connectivity for dynamic operation of a routing protocol, without any support from a fixed infrastructure. In 1980, on realization of the open standards, a working group within the Internet Engineering Task Force (IETF) termed the Mobile Ad-hoc NETworks (MANET) working group, in the emerging area of computer communication. In 1994, the advent Bluetooth brought a pervasive connectivity with various devices. It transfers packets and needs to travel several succeeding wireless links to arrive at destinations, as obviously illustrated by William Stallings (2007).

1.3 AD HOC WIRELESS NETWORKS

An ad hoc wireless network consists of a set of nodes equipped with wireless interfaces, which communicates among them in the absence of
any type of network infrastructure. Each node behaves as a host, in the sense that it can send and receive data messages to implement a service. At the same time, each node also acts as a router for forwarding data messages on behalf of other nodes in the network. In fact, one of the most salient features of ad hoc wireless networking is the enhanced concept of wireless multi hop communications, as the data flow might traverse several intermediate nodes (hops) within the ad hoc network till they eventually reach the destination.

Ad hoc networks are based on the concept of self-ruling network. In many cases, these networks are suddenly created without requiring any prior network planning. They can also adapt themselves towards changing network topologies, so as to provide continuous communication services to the users. Self-organization and self-adaptation of ad hoc networks could save enormous network resources. In recent years, the general concepts of ad hoc multi-hop communications have evolved into a number of particularizations for different kinds of networks. (Figure 1.1)

Figure 1.1 Ad hoc Wireless Networks

These specializations differ mainly on the mobility of the nodes, their processing power, criticality of energy efficiency, and other reasons.
Although they all possess similar basic principles of wireless multi-hop communications, they also have enough peculiarities in preventing universal solutions from being practical. By analysing the literature, the following kinds of ad-hoc networks have been found to be in existence.

1. Mobile Ad hoc Network (MANET).

1. Mobile Ad-hoc Network (MANET)

This is the universal type of ad hoc network, consisting of a group of wireless nodes with random mobility patterns. It is assumed to be a natural network without former planning. Mobility of nodes and wireless signals variation make the network topology to get varied over time. Nodes are usually battery-operated, energy efficiency being one of the important design issues.

2. Wireless Sensor Network (WSN)

A WSN consists of a set of small wireless devices with sensing capabilities. Each sensor has very limited energy, little computation power and small amount of memory. Therefore, energy efficiency is of paramount importance in this type of sensor networks, and mainly employed to monitor the environmental parameters.

3. Vehicular Ad hoc Network (VANET)

This is a specific case of MANET, relating to vehicles and largely influences the assumptions that could be made for a VANET. Vehicles cannot move freely, as they have to adhere to the topology of roads/streets and the
current traffic conditions. They could reach high speeds, making the network topology very unstable on some occasions.

4. **Wireless Mesh Network (WMN).**

   This is a particular case of ad hoc network in which the nodes are static base stations which are able to communicate among themselves by using multi-hop routes. They provide a communication backbone for mobile client devices which can switch among mesh nodes as they move around. Although they are static, network topology is still dynamic given the intrinsic characteristics of wireless signals. As such the network has to self-adapt to a varying environment.

### 1.4 ROUTING CHALLENGES AND DESIGN ISSUES IN MOBILE AD HOC NETWORKS

The main functionality of a routing protocol is the exchanging of route information, thereby finding a possible path to an intention based criteria such as hop count, low power energy required, and link lifetime. Collect information about the path breaks, mention of the broken paths expending low processing power and utilizing by low bandwidth for connecting the MANET to the Internet.
In addition, these challenges have greater influence on the design of routing algorithm and improving its performance. The above factors are to be carefully accounted in the roll of challenges and design in the Figure 1.2. These issues are generally bidirectional, and unidirectional links is one among the challenges encountered in MANETs. The bidirectional and unidirectional links are formed among the wireless nodes in a certain radio wave range.

1.5 CHARACTERISTICS OF MOBILE AD HOC NETWORKS

The mobile nodes are connected by an air medium or wireless link for data transmission. MANET are autonomous and a dynamic topology network. It does not have any fixed communication architecture and no common centralized control. The devices or systems are linked with each other in an unpredictable manner.

i. It must be adaptive to frequent topology changes caused by the node mobility.
ii. It should be localized as global state maintenance involves large state propagation control overhead.

iii. It must have coverage to optimal routes, once the network topology becomes stable and the convergence should be quicker.

iv. It should effectively use the resources such as bandwidth, computing power, memory, and battery power.

v. It should be able to provide a certain level of quality of service (QoS), as demanded by the applications, and should also offer support for time sensitive traffic.

1.6 QUALITY OF SERVICE IN MOBILE AD HOC NETWORKS

The MANETs are becoming more popular, its application in modern decades stretches from an analog mobile phone system to digital satellite broadcasting. The most significant challenge is the support to high QoS for delivering and receiving the data such as text, voice and video.

The QoS depends upon various parameters in delivering data in a wireless network, as several things might happen while data packets travel from source to destination, resulting in low control overhead, packets delivery ratio, average end-to-end delay, latency, jitter and out-of-order delivery.

A normal user is concerned about how a particular service is provided or with any other aspects of the QoS. Hence, it becomes essential to provide good quality service by the service provider to the user. The network performance is an account of connecting relevant elements employed to deliver a service. It is measured in terms of various parameters that are needed for a service provider. These are useful for the system design, system
configuration, system operation and overall maintenance. The wireless system design consists of a number of nodes and various routing protocols.

The wireless network performance also depends on a virtual path layout problem, and the solutions provide means to choose the suitable set of virtual paths and thereby to ensure an acceptable QoS. The virtual path layout restricts the hop count and the load parameters of a network. The hop count of a network refers to a data which passes from source to destination node through an intermediate node. A number of virtual paths could be shared by physical links. The foremost objective of QoS is to ensure guarantee on the proficiency of a network to bring predictable results. The enhancement of QoS can be progressed with advanced concepts of different standards like VoIP (Voice over Internet Protocol), Video on-demand and other consumer required services. QoS in Mobile Ad hoc Networks are related with some combined aspects like; service support performance, service operability performance, severability performance, service integrity and other related factors for every single service.

1.7 APPLICATIONS OF MOBILE AD HOC NETWORKS

The concept of MANET’s play a very important role in new generation communication technology architecture and its competences in networking reliability is worth mentioning. The application of MANET is more efficient, widespread and different from all the parts of information technology. The necessity of MANET’s service leads to more rapidly and modern applications.
## Table 1.1 Applications of Mobile Ad Hoc Networks

<table>
<thead>
<tr>
<th>Applications</th>
<th>Probable scenarios/services</th>
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| **Tactical Networks** | • Military communication and functions  
• Automated battlefields urgent situation services  
• Search and save operations  
• Tragedy recovery  
• Alternative of fixed infrastructure in case of environmental disasters  
• Opinionated doctors and nurses in hospitals |
| **Commercial and Civilian** | • E-commerce: electronic payments anytime and wherever situations  
• Business: Energetic database access, mobile agency  
• Vehicular services: road or mishap control, transmission of road and climate condition, taxi cab network, inter-vehicle networks  
• Sports stadiums, trade fairs, shopping malls  
• Networks of visitors at airports, home and enterprise |
| **Networking** | • Home/office wireless networking  
• Conferences, meeting rooms  
• Personal area networks(PAN),Personal networks (PN)  
• Universities and campus settings, Virtual classrooms  
• Ad hoc communications during meetings or lectures |
| **Entertainment** | • Multi-user games  
• Wireless P2P networking  
• Outdoor Internet access  
• Robotic pets |
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<th><strong>Sensor networks</strong></th>
<th>• Theme parks</th>
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<tr>
<td></td>
<td>• Home applications: smart sensors and actuators embedded in consumer electronics</td>
</tr>
<tr>
<td></td>
<td>• Body area networks (BAN)</td>
</tr>
<tr>
<td></td>
<td>• Data tracking of environmental conditions, animal movements, chemical/biological detection</td>
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<tr>
<td><strong>Context aware services</strong></td>
<td>• Follow-on services: call-forwarding, mobile workspace</td>
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<td></td>
<td>• Information services: location specific services, time dependent services</td>
</tr>
<tr>
<td></td>
<td>• Extending cellular network access</td>
</tr>
<tr>
<td></td>
<td>• Linking up with the internet, intranets, etc.</td>
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It has an aptitude that comprises planning, design operation, keeping of prevailing communication networks; in the number of research activities and several standards are integrated through wireless LAN (WLAN), Personal Area Networks (PAN), Sensor Networks, cellular /mobile networks, satellite Communication services. (Table 1.1)

**1.8 DIFFERENT TYPES OF ROUTING PROTOCOLS IN MOBILE AD HOC NETWORKS**

A mobile ad hoc network is organized as a collection of various mobile nodes. It is formed spontaneously and causes delay in the network as well as in the cost, as in flooded areas, earthquake affected areas, etc. As the nodes are mobile, there is no fixed infrastructure in MANET. The mobile ad hoc network is composed of portable nodes, notebooks and palmtops. This portability brings greater significant issues of mobility. This is a focal challenge in ad-hoc networks. The nodes in the mobile ad hoc networks are
constrained to use limited resources. They have low battery power, limited user interface and low quality display.

The nodes in the mobile ad hoc networks can communicate with one another using some routing protocols, which decide the way to route the information from source to destination. According to the seven layered OSI model a routing protocol belongs to the network layer. A routing protocol establishes the data routing characteristics of the network. It also defines the logical communication infrastructure, presents nodes with the network topology and defines communication rules among the member nodes.

In Mobile Ad Hoc Networks, the routing infrastructure is established in a distributed manner. In ad hoc networks, a routing protocol is responsible for neighbour discovery, route discovery, route management, computing optimal routes and traffic forwarding. Murthy and Manoj (2004) have discussed the design goals of Mobile Ad Hoc Networks routing protocol. An ad hoc routing protocol is designed with the following key expectations: provides stable loop-free connectivity, reduced control traffic overhead, responds to changes in topology and link connectivity and offers mobility management.

MANET’s offers excellent scalability, flexible enough to incorporate QoS extensions and security mechanisms. The main components of an ad-hoc routing protocol are the routing table, that contains full or partial topology information, the control messages for discovering and maintaining routes, and the mechanism for identifying optimal routes. MANET routing protocols can be grouped into three primary classes as shown. (Figure 1.3)
Proactive routing protocol

A proactive routing protocol maintains topology information by sending periodic control messages, and nodes maintain routing tables that conveys the topology information. OLSR (Optimized Link State Routing), DSDV (Destination Sequenced Distance Vector Routing) and CADV (Congestion Aware Distance Vector Routing) are examples for proactive routing protocols.

Reactive routing protocol

A reactive routing protocol performs route discovery on demand: i.e., communications begin with route discovery and usually nodes do not maintain the network topology (e.g., routing table). Examples of reactive routing protocols are DSR (Dynamic Source Routing) and AODV (Ad hoc On-Demand Distance Vector).
Hybrid routing protocol

Hybrid routing protocol aims to combine the key features of both proactive and reactive protocols. ZRP (Zone Routing Protocol) is a hybrid routing protocol. Each type of routing protocol has its own strengths and weaknesses. The reactive approach generates less control traffic but may experience higher latency at the beginning of transmission. Performance degrades in high mobility environments due to increased rate of route discovery. The proactive routing protocol, on the other hand, generates considerably higher (periodic) control traffic but forms a better choice for dense networks with high node mobility. An ad hoc routing protocol performs forwarding through source routing or in a multi-hop manner.

1.9 GATEWAY ROUTE DISCOVERY SCHEMES

This communication among the mobile nodes occurs for retrieving the essential information needed. When a mobile node wants any information outside the mobile ad hoc network in which they are present, they have to use some mechanism other than routing protocol. The communication between mobile ad hoc networks and the Internet occurs through some special mechanism called as gateway discovery. Kumar R (2012) proposed that the gateway acts as an interface between the mobile ad hoc network and the internet. As the nodes are highly mobile, the topology of MANET changes frequently. Therefore, managing permanent connection to the Internet is a critical issue in mobile ad hoc networks. Gateway eliminates this difficulty by handling all the communication between MANET nodes and the Internet. All the incoming and outgoing traffic between the MANET and internet passes through the gateway thereby forwarding, it to the appropriate destination. Different mechanisms have been proposed to integrate MANETs and the Internet.
Figure 1.4 Protocol Architecture for Interconnection between the Mobile Ad Hoc Network and The Internet Host.

Figure 1.4 shows two networks: one is the mobile ad-hoc network and the other is the Internet. The communication among the mobile nodes is easier and the nodes can communicate directly, while the communication between mobile node and an internet server is only through the gateway. Tarek R Sheltami (2006) focused on gateway discovery method, which allows a mobile node to discover an Internet Gateway (IGW) to which traffic for the Internet can be delivered and received. Quan Le-Trung and Paal E. Engelstad (2009) bring to a closed that commonly gateway discovery mechanisms can be classified into three categories: proactive, reactive and hybrid. Sajendra Kumar and Sachin Chaudhary (2012) described the proactive approach, where every IGW broadcasts at regular intervals advertisement, while in the reactive approach a mobile node sends a solicitation and waits for reply from the IGW. Proactive approach requires much traffic overhead on the MANET.

Hossam El-Moshrefy and Mangoud M.A (2007) proposed that the reactive approach causes higher delay. Koushik Majumder and Sudhabindu Ray (2011) proposed the hybrid approach, in which each IGW at regular intervals broadcasts the advertisement inside the radius of a number of hops.
Mobile nodes that are located a number of hops away from the IGW, must use the reactive approach to discover the IGW. Another gateway discovery approach which is being used in recent years is the adaptive gateway discovery, which dynamically adapts itself. Tarek R Sheltami (2006) proved that the gateway selection is used when a mobile node discovers multiple internet gateways for accessing the Internet.

Ahmed Mustafa Mahmoud et al. (2008) evaluated that the minimize hop count is the number of intermediate hops from the mobile node to the gateway. Johnson D et al. (2004) proved that Load-balancing is used for mobile nodes within the same MANET domain, to send intra MANET traffic to choose the different immediate node to destination while for inter-MANET traffic, the mechanism is carried out by choosing different internet gateways for forwarding traffic from MANET to the Internet and vice versa. Belding-Royer E et al. (2001) showed that the Euclidean distance is the spatial distance between the MANET node and the internet gateway. Whenever any node in the MANET wants to send the traffic towards an internet node, it must be transmitted via the gateway. The gateway has to carry out translation between these two different protocols and should understand both. Therefore, implementation of both the MANET protocol stacks and the TCP/IP suite must be carried out as worked out by Sajendra Kumar and Sachin Chaudhary (2012).

Erik Nordstrom et al. (2004) demonstrated that Internet gateway forwarding is used to forward traffic within the MANET, out of the MANET to the Internet, or from the Internet to the MANET. It can be considered into Inter-MANET and Intra-MANET forwarding strategies. Inter-MANET forwarding strategies uses two main methods: default routes and tunnelling. Default routes are used by the default next-hop to send packets to those nodes which do not have any explicit entry in their routing tables. Usually, the
default route is used to forward packets towards an internet gateway, where packets are further forwarded towards the destination in the Internet. Gateway Forwarding and Tunnelling are the IP-in-IP encapsulation techniques which are used to get traffic into and out of the MANET. The outer IP header is for the tunnelling connection between the source MANET node and the internet gateway, while the inner IP header is for the connection between the source MANET node and the destination.

**Handoff in MANET-Internet Connectivity**

A node performs a handoff if it modifies its internet gateway while communicating with a correspondent node in the Internet as verified by Hongbo Zhou and Matt W. Mutka (2012). In predictable mobile networks for example Wireless LANs, the quality of the wireless link between a mobile node and the neighbouring Access Points (APs) detects the handoff performance from one AP to the other. The performance of these types of handoffs depends on the mobility management protocol in the access network.

A handoff can occur only if an ad hoc node itself or any intermediate ad hoc node travels and breaks the active path. In common, if the path between an ad hoc node and the internet gateway breaks and there is no other path to the similar internet gateway, the ad hoc node has to perform internet gateway discovery to set up a new path to a different internet gateway. Multi-hop handoff methods can be classified into forced handoff and route optimization-based hand off by Kun Zhu et al. (2009).

Forced handoff occurs when the path between the source or destination mobile node and the internet gateway node during data transmission due to the node mobility. So, a new path to the internet has to be set up. Route optimization-based hand-off is a handoff that results from route
optimization. If the source or target MANET node observes that a shorter path to the internet becomes available while communicating with a corresponding node, the active path will be optimized. When the shorter path goes via a different internet gateway, a route optimization-based handoff occurs. There are several approaches for gateway discovery is shown in the Figure 1.5.

**Figure 1.5  Classification of gateway route discovery schemes.**

1. **Proactive Gateway Discovery Scheme**

Harpreet Kaur Sandhu and Roopali Garg (2012) demonstrated that the scheme makes use of a special message called as gateway advertisement. Khaleel Ur Rahman Khan et al. (2009) showed that the Gateway discovery is initiated by the gateway itself. The Gateway broadcasts a gateway advertisement message which is rebroadcasted after a certain time interval called as the advertisement interval. The time between two intervals is chosen in such a way that the network is not overwhelmed by the traffic. The nodes which are in the range of the gateway receive the advertisement message. On receiving the message the nodes which do not have a route to gateway create a route entry for it in their routing table. Consequently, the nodes which have a route to gateway update their routing information.
2. Reactive Gateway Discovery Scheme

Geetha M and R. Umarani (2010) proved that in the reactive gateway discovery scheme, the nodes demand route to the gateway reactively. Whenever any node wants to collect some information from the Internet, it broadcasts a Route Request message (RREQ) to the IP address of a group of all gateways in the mobile ad-hoc networks using ALL_MANET_GW_MULTICAST address. This message will be received and replied only by the gateways. The intermediate nodes do not reply to this message, rather just rebroadcasts them. The advantage of this approach is that control messages are generated only when a mobile node needs information about reachable gateways. On receiving RREQ message gateways reply source node with the corresponding Route Reply (RREP) messages by unicasting them.

3. Hybrid Gateway Discovery Scheme

Geetha M et al. (2010) proved that the hybrid gateway discovery scheme is the combination of both proactive and the reactive approaches. Initially, the gateway broadcasts the Gateway Advertisement message proactively to an area confined to a limited number of hops, which is called with the TTL value of the message. The TTL is set to advertisement zone so that the advertisement message can be forwarded only up to this maximal number of hops through the ad hoc network. This area is called as the proactive zone. The nodes that are outside the proactive zone establish connection to the gateway reactively.

The main issue in the hybrid gateway discovery is how to find out a best proactive area. While the proactive area is large, additional overhead is sustained in preserve routes in a wider area. Alternatively, while proactive area
is small, then less preservation overhead is sustained but extra delay in Gateway Discovery is qualified. In the typical hybrid gateway discovery approach, the TTL is set statically and remains unchanged. This guides to an exacting accomplishment of the proactive area. Existing integration tactics which use the hybrid approach set the proactive area statically and do not dynamically adjust it, which may not turn out to be a proper range anymore for changing network conditions.

Next issue is determining the periodicity of the Gateway ADVertisements messages (GWADV). The periodicity of the GW_ADV message determines the number of GW_ADV messages that will be flooded into the MANET per second. A high periodicity leads to more control messages in a sparse MANET whereas low periodicity may result in starvation of Internet connectivity to mobile nodes in a dense MANET. To overcome these difficulties, propose a new gateway discovery scheme is proposed which is apt for real-time applications that adjust the frequency of gateway advertisements dynamically. This adjustment is related to the gain of real-time sources that have quality of service problems because of excessive end-to-end delays and scalability with respect to mobility as well as the impact of best-effort traffic load which analysed.

1.10 ADAPTIVE GATEWAY DISCOVERY

A modified hybrid gateway discovery mechanism which dynamically adjusts value of TTL and periodicity of GW_ADV messages depending on the MANET characteristics in order to achieve a good trade-off between performance and network overhead is called an Adaptive gateway discovery mechanism. There is a need for gateway discovery mechanisms that maintain several Heterogeneous Wireless and Mobile Networks (HWMN) applications. The communication between mobile ad hoc networks and
infrastructure-based networks is essential to extend Internet beyond its traditional scope, to remote inaccessible areas, making Web services in ad hoc networks available anytime, anywhere. The nodes in a mobile ad hoc network must be able to detect available gateways and select one of them if they want to have Internet access.

On the other hand, real-time applications have special Quality of Service (QoS) requirements that must be satisfied to function properly and they are expected to maintain their quality level in heterogeneous networks. The main motivation is to design a new gateway discovery protocol that assists real-time flows in wired cum-wireless circumstances to preserve their quality of service parameters. Various approaches have been developed in literature, which propose different gateway discovery schemes, but none of them is related to service differentiation. They designed a new gateway adaptive discovery protocol that is able to cooperate with real-time flows to improve and maintain their desired quality of service. Due to multi-hop nature of MANET, there might be several reachable gateways for a mobile node at some point of time. If a mobile node receives gateway advertisements from more than one gateway, it has to decide which gateway to use for its connection to the Internet. This study proposes an efficient gateway discovery protocol that enables a mobile node to select an appropriate gateway to communicate with a fixed node in the Internet using some new metrics. Adaptive gateway discovery mechanism must address both the issues of dynamically adjusting the TTL value as well as the periodicity of GW_ADV messages. Such a strategy must take into account network conditions like traffic load and node density, as well as signal strength. The adaptive gateway discovery strategy must not only address Internet integrated MANET, but must also work with more heterogeneous architectures envisage in future 4G networks.
1.11 IMPORTANCE OF QUALITY OF SERVICE PARAMETERS

In Mobile Ad Hoc Networks, active nodes are connected to gateway with a lead path. The gateway discovery schemes are defined for an efficient path created and provide low overhead with an increase in scalability. The QoS parameters support routing and service differentiation for sessions with different QoS requirements in the network.

1. **Packet Delivery Ratio**: This can be defined as the ratio of the total number of packets delivered to the destination. It shows the level of data delivered to the destination node from the source node. The maximum value of a packet delivery ratio indicates the better performance of the protocol.

2. **Normalized Routing Load**: It is defined as the fraction of all routing control packets sent by all nodes over the number of received data packets at the destination nodes. In other words, it is the ratio between the total numbers of routing packets sent over the network to the total number of data packets received.

   \[
   \text{Normalized Routing Load} = \frac{\text{Total Data Packets Received}}{\text{Total Routing Packets Send}}
   \]

3. **Average End-to-End Delay**: This is basically defined as the ratio between the summation of the time difference between the packets received time, and the packet sent time and the summation of data packets received by all the nodes.

4. **Routing Control Overhead**: It is expressed as the average number of control packets transmitted at each node during the data transmission. Multiple short transmissions (hop to hop) might result in a significant overhead and routing complexity, thereby the network resources leads to increase the overall energy consumption.
Routing Control Overhead = \frac{\text{Percentage of non-\text{application} bytes}}{\text{frame synchronization and protocol} \over \text{Total number of bytes in the data message}}.

5. Gateway Discovery Messages Overhead: The sum of all sent or forwarded auto-configuration messages. These metric measures the efficiency of the protocol that is, its internal efficiency.

1.12 OBJECTIVES OF THE PROPOSED WORK

An objective of the gateway discovery is to provide the mobile nodes connecting to the Internet and various protocols for this purpose. Each of them tries to improve the efficiency of the internet access through the gateway node. The protocol which should be chosen for gateway discovery should improve the packet delivery ratio and should minimize the latency of data transmission from the Internet to mobile ad hoc networks and vice-versa. The Gateway discovery is a new and emerging research area in the field of mobile ad hoc network. Various new protocols on gateway discovery have been proposed from time to time. The most popular gateway discovery protocol which is being used in recent days is the adaptive gateway discovery protocol. In the near future, various enhancements to this approach will arrive. This work is to improve the efficiency of the adaptive gateway discovery process by increasing the network performance and reducing the control overhead.

The discovery of gateway with modified ad-hoc routing protocols is a major objective of this thesis. The other task of this thesis is to propose enhanced adaptive gateway discovery algorithms in order to increase the packet delivery ratio and reduced overhead to mobile ad hoc nodes. The main aim of this thesis consists in developing data dissemination and enhanced adaptive gateway discovery protocol, which are appropriate for the
challenging environment of hybrid mobile ad hoc networks. Given the intrinsic characteristics of these networks, the proxied adaptive gateway discovery is very efficient and scalable gateway discovery protocol for MANETs which proactively advertises gateway information in a restricted portion of the network. Ad-hoc nodes which are located outside the proactive area can request for Internet connectivity in an on-demand basis. Any node which already knows a gateway replies on behalf of it, thereby is reducing the gateway discovery overhead. The proactive area is dynamically adapted according to current network conditions, hence avoiding manual configuration and allowing the usage for a wide variety of scenarios. This approach shows a great reduction in protocol overhead compared with previous approaches in the literature. Furthermore, it scales as the number of data sources and/or gateways in the MANET increases.

A methodology for conserving the low Control Overhead of individual nodes is critical. The Minimize Control Overhead can be achieved to modify the routing protocol to route nearby nodes with reduced power costs. In wireless networks, various communication schemes exist like unicast, multicast and geocast. Unicast method is used for one-one transmission. Conversely, the multicast can transmit the data packets to particular users as well as to send multiple users at one time. Hence, there is a need for a unicast and multicast communication based analysis in the Hybrid MANET’s. The performances of different routing algorithms have been studied and modified in the existing protocol with respect to adaptive gateway discovery schemes. The following protocols have been studied to enhance the Hybrid MANET’s performance.

Proxied Adaptive gateway discovery Based DSDV (PAB-DSDV), Proxied Adaptive gateway discovery Based DSR (PAB-DSR) and
Proxied Adaptive gateway discovery Based AODV (PAB-AODV) using enhanced gateway discovery in hybrid Mobile Ad hoc Networks.

Contention aware Adaptive gateway discovery Based OLSR (CAB-OLSR), Contention aware Adaptive gateway discovery Based CADV (CAB-CADV) and Contention aware Adaptive gateway discovery Based QAODV (CAB-QAODV) using cross layer based enhanced gateway discovery in hybrid Mobile Ad hoc Networks.

Modified Adaptive gateway discovery Based ZRP (MAB-ZRP) and Modified Adaptive gateway discovery Based MZRP (MAB-MZRP) using unicast and multicast communication in hybrid Mobile Ad hoc Networks.

1.13 FRAMEWORK OF THE DISSERTATION

The first chapter begins with a brief introduction about mobile ad-hoc networks and describes the background, motivation and outline of the thesis to give in detail the various concepts of mobile ad hoc networks routing protocols, importance of QoS parameters, gateway discovery functions and the data transmission in the extension of Hybrid MANET’s. It consists of certain proposed gateway discovery routing algorithms to enhance the overall network performance in the Hybrid MANET’s communication.

The second chapter illustrates the literature survey on MANET’s for connecting Internet environment and describes the related works on Internet gateway discovery methods. The concept of gateway discovery routing protocol with an Optimization of Gateway Discovery Process in mobile ad-hoc networks of Gateway Selection for Hybrid MANETs has been discussed. Gateway Discovery Protocols based on multiple QoS Path Parameters between Mobile Node and Gateway Node with an improvement
for working outside the MANET through extension of MANET Routing Protocol has been carried out. The adaptive gateway discovery for Hybrid MANETs has been clearly discussed. Consideration on the efficient transmission of gateway discovery functions with QoS parameters and different data transmission scenarios by various authors have been elaborated. The literature study provides a complete lead for a new approach with valuable beliefs and hints in the field of research.

The third chapter provides a brief description on connectivity properties of MANET’s mobile ad-hoc Networks to the Internet and the methodology of Proxied Adaptive gateway discovery in Hybrid MANETs using proactive and reactive protocols. It describes how an efficient discovery gateway functions for data packet transmission from mobile nodes to the Internet with the proposed gateway discovery algorithms dynamically adapted, its behaviour depending on the active traffic sources in MANET, which makes use of accessible local information (proxied) to further reduce the control overhead. The protocol overhead generated by this algorithm and search for cost-effective gateway discovery path has been developed. The scope of this chapter is to test routing performances of gateway discovery mechanism.

The results of the proposed algorithm has been compared with Proxied Adaptive gateway discovery Based DSDV (PAB-DSDV), Proxied Adaptive gateway discovery Based DSR (PAB-DSR), Proxied Adaptive gateway discovery Based AODV (PAB-AODV) protocols and few existing protocols like DSDV, DSR and AODV using NS2 simulator, and the proposed scheme outperforms the existing methods in terms of overhead reduction and provides a high packet delivery ratio. Moreover, this scheme showed an increase in the number of nodes and gateways.
The fourth chapter describes the methodology of contention aware approach on the adaptive gateway discovery scheme for Hybrid MANET’s. This study provides the performance analysis of proposed contention aware adaptive gateway discovery routing protocol with standard protocols like proactive and reactive protocols. The main objectives of the chapter is the formation of Internet connectivity in MANETs and routing packets effectively inside and outside a MANET and many endeavors have been given to the design of routing protocol to attain higher Packet Delivery Ratio (PDR) over MANET - Internet connection. Ultimately, the routing protocol provides information obtainable through the network layer to route packets. Here, the proposed protocols, manipulating the information gained at the link layer as well as to the information obtainable through the network layer, achieves higher PDR compared to the existing protocols.

The scope of this chapter is to test the routing performance of adaptive gateway discovery with the proposed Contention aware Adaptive gateway discovery Based OLSR (CAB-OLSR), Contention aware Adaptive gateway discovery Based DSDV (CAB-DSDV) and Contention aware Adaptive gateway discovery Based QAODV (CAB-QAODV) protocols to compare with few existing protocols like OLSR, DSDV and QAODV using NS2 simulator, and the proposed scheme outperforms the existing methodologies in terms of overhead reduction and provides a high packet delivery ratio. Moreover, this scheme attains an increase in the number of sources and gateways.

The fifth chapter presents wireless Internet access to connect the Internet to all the devices. To achieve wireless connectivity to the Internet, integration of the Internet and hybrid mobile ad-hoc networks has been carried out. A very important issue in wireless Internet access is to discover an efficient and reliable Internet gateway. This chapter describes a Modified
Adaptive gateway discovery approach that exploits the hybrid wireless 
network conditions. Modified Adaptive gateway discovery scheme 
incorporating hybrid protocol like that of Zone Routing Protocol (ZRP) 
dynamically adjusts proactive zone according to network condition, and a 
protocol named as Modified Adaptive gateway discovery Based Zones 
Routing Protocol (MAB-ZRP) has been proposed. The simulation results 
clearly show that the proposed protocol MAB-ZRP outperforms the existing 
approach ZRP. It decreases network diffusion but at the same time it achieves 
lower routing overhead, end-to-end delay and maximized packet delivery ratio.

The next level of this research work is to enhance the data 
communication in multicast with Modified Adaptive gateway discovery 
function, Modified Adaptive gateway discovery Based Multicast Zone 
Routing Protocol (MAB-MZRP) has been proposed. The simulation results are 
presented to verify and compare the enhancement of the proposed routing 
method with regular MZRP. Furthermore, it describes that the methodology of 
Modified Adaptive gateway discovery routing in Hybrid Mobile Ad Hoc 
Networks.

The sixth chapter concludes the overall research work and shows 
how to generalize the proposed enhanced gateway discovery algorithms to 
decide a certain kind of routing condition. It also elaborates the choosing of 
efficient discovery of gateways and meets the reduced overhead requirements 
in either unicast or multicast data communication in the Hybrid Mobile Ad 
Hoc Networks. It also provides necessary guidelines for further enhancements.