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An Efficient Approach Based On Cluster system on MANETs Routing Protocol

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ABSTRACT

In this paper is a very efficient work have done with the sevral computing environments it can be expected based on the recent progresses and advances in computing and communication technologies. And the nextways of mobile communications will include both prestigious infrastructure wireless networks and novel infrastructure less mobile ad hoc networks (MANETs). A MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. The special features of MANET bring these technology great opportunities together with severe challenges. This thesis describes the fundamentals of ad hoc networking by giving its concept, features, and applications of MANET. And few of the technical challenges MANET poses are also presented. The routing protocols meant for wired networks can not be used for mobile ad hoc networks because of the mobility of nodes. The ad hoc routing protocols can be divided into two classes :-the table-driven and on-demand. Routing in wireless mobile ad-hoc networks should be time efficient and resource saving. One approach to reduce traffic during the routing process is, to divide the network into clusters. This work mainly focuses on cluster-based routing protocol CBRP) and its comparative analysis with two other on demand routing protocols Adhoc On Demand Distance Vector and Dynamic Source Routing which partially use cluster based mechanism for routing .The results presented in this thesis illustrate the importance in carefully evaluating and implementing routing protocols so in that case we find a beter results in this approachs.

Keywords: MANETs, Routing, CBRP, DSR, AODV Active ,proactive protocole.

1. INTRODUCTION

Wireless ad hoc network is a collection of mobile devices forming a network without any supporting infrastructure or prior organization. Nodes in the network should be able to sense and discover with nearby nodes .Due to the limited transmission rangeof wireless network interfaces, multiple network “hops” may be needed for one node to exchange data with another across the network. There are number of characteristics in wireless ad-hoc networks, such as the dynamic network topology, limited bandwidth and energy constraint in the network. Mobile ad hoc network is useful for different purpose e.g. military operation to provide communication between squads, emergency case in out-of-the-way places, medical control etc.

Routing protocol plays very important part in implementation of mobile ad hoc networks. Due to the nature of mobile ad hoc networks it is non-trivial problem to find path from source to the destination and perform the communication between nodes for a long period of time. A number of routing protocols using a variety of routing techniques have been proposed for use in MANETs .Adhoc On demand Distance Vector Routing (AODV) [1], Dynamic Source Routing (DSR) [2] , Temporally Ordered Routing Algorithm (TORA) [3], Location Aided Routing (LAR) [4] (in which nodes search for or maintain a route only when route is needed), and periodic (proactive) protocols such as Destination Sequence Distance Vector (DSDV) [5], Distributed Bellman Ford [6] (in which nodes periodically exchange routing information and than can always know a current route to each destination). Also, several protocols uses both reactive and proactive mechanism such as Zone Resolution Protocol (ZRP) [7], Cluster Based Routing Protocol (CBRP) [8].

The basic idea of on-demand routing protocols, is that a source node sends a route request and makes routing decision based on received route reply, which may be sent by destination or intermediate node. On-demand routing have several advantage, such as simplicity, correctness and flexibility. However, on-demand routing algorithms has the disadvantage of increasing per-packet overhead. This extra network overhead decreases the bandwidth available for transmission of data, increases the transmission latency of each packet, and consumes extra battery power in the network transmitter and receiver hardware. Due to manner of propagation route request (flooding), it is difficult to limit dissemination of unnecessary packets.

The basic idea of proactive routing is periodically updating routing table via exchanging routing information. According to routing table, source node knows path or next hop to destination anytime when route needs. In proactive routing, route information is available when needed, resulting in little delay prior to data transmission. However proactive routing protocols are likewise not appropriate for mobile ad hoc networks, as they continuously use a large portion of the network capacity to keep the routing information current. Proactive routing protocols tend to distribute topological changes widely in the network, even though the creation/destruction of a new link at one end of the network may not be significant piece of information at the other end.

The hybrid routing protocols pretends to inherit the best parts of both reactive and proactive routing protocols. The main idea of the hybrid routing protocols is the limiting the set of forwarding nodes and using the proactive routing algorithm for nearly placed nodes which usually forward data to far placed nodes. This thesis work investigates how the clustering

in ad hoc networks can result in time efficient and resource saving routing. It describes the structure and working of an on demand routing protocol that is cluster based routing protocol in detail. In CBRP the nodes of a wireless network are divided into several disjoint or overlapping clusters.
Each cluster elects one node as the so-called clusterhead. These special nodes are responsible for the routing process. CBRP is implemented using ns2[9] as a simulation environment and its results are compared with the protocols AODV and DSR , the protocols which don't use clustering mechanism. Advantages and disadvantages of CBRP are highlighted . Some suggestions are also made toovercome the limitations when cluster based routing is used in MANETs.

2. RELATED WORK

Computer networks are originally developed to operate by connecting computers together with wires and transmitting data over these wires. Network sizes and occurrences increased creating a requirement for inter network communication. This led to development of the internet and suite of protocols. The use of the internet and its applications became ubiquitous. A need for providing network access to entities while not physically attached to the wired network arose. To enable this wireless networking was developed, providing devices with methods to connect to a wired network using radio wave technologies through wireless access points. Simultaneously telephone networks were going a similar transformation. Cellular network technologies[10] were developed to allow mobile phones to connect via base stations and communicate in a circuit switched environment. In general , mobile
wireless networks can be classified into two types:

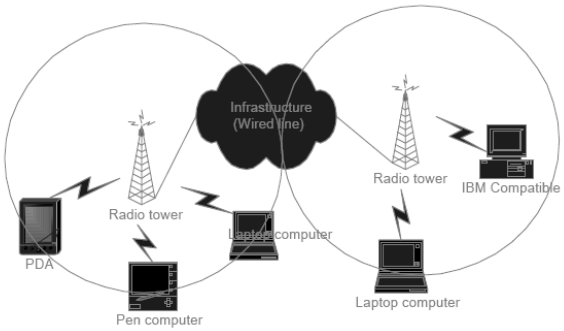

Figure 1: Infrastructured Network

Infrastructured networks Wireless mobile networks have traditionally been based on the cellular concept and relied on good infrastructure support, in which mobile devices communicate with access points like base stations connected to the fixed network infrastructure(Figure 1). Typical examples of this kind of wireless networks are GSM[10], UMTS[11],WLL[12], WLAN[13] , etc.

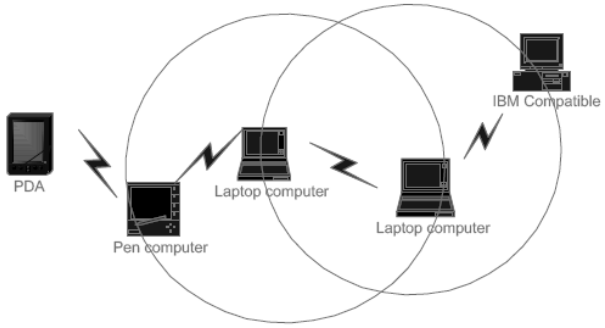

Figure 2: Infrastructureless Network

Infrastructure less mobile network (Ad-hoc networks)Wireless nodes can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure(Figure 2)This is a veryimportant part of communication technology that supports truly pervasive computing, because in many contexts information exchange between mobile units cannot rely on any fixed network infrastructure, but on rapid configuration of a wireless connections
on-the-fly.

Mobile Ad hoc networks

The area of mobile ad-hoc networking deals with devices equipped to perform wireless communication and networking, but without any existing infrastructure such as base stations or access points. Wireless devices form a network as they become aware of each others presence. They communicate directly with devices inside their radio range in a peer-to-peer nature. If they wish to communicate with a device outside their range, they can use an intermediate device or devices within their radio range to relay or forward communications to the device outside their range. An ad-hoc network is self-organising and adaptive. Networks are formed on-the-fly,devices can leave and join the network during its lifetime, devices can be mobile within the network, the network as a whole may be mobile and the network can be deformed onthe-fly. All this needs to be done without any system administration and without the requirement for any permanent devices within the network. Devices in mobile ad-hoc
networks should be able to detect the presence of other devices and perform the necessary set-up to facilitate communications and the sharing of data and services.

Routing

Routing of data between devices outside their RF range. The routing protocols usedon wired networks do not perform well on networks involving mobility and rapid membership changes. More effective routing protocols are required. In Ad Hoc networks, we need new routing protocols because of the following reasons:

:- Nodes in Ad Hoc networks are mobile and topology of interconnections between them may be quite dynamic.
:- Existing protocols exhibit least desirable behavior when presented with a highly dynamic interconnection topology.
:- Existing routing protocols place too heavy a computational burden on each mobile computer in terms of the memory-size, processing power and power consumption.

:- Existing routing protocols are not designed for dynamic and self-starting behavior as required by users wishing to utilize Ad-Hoc networks.
:- Existing routing protocols like Distance Vector Protocol take a lot of time for convergence upon the failure of a link, which is very frequent in Ad Hoc networks.
:- Existing routing protocols suffer from looping problems either short lived or long lived.
:- Methods adopted to solve looping problems in traditional routing protocols may not be applicable to Ad Hoc networks.

Overview of Ad hoc routing protocols

Since the advent of DARPA packet routing networks in the early 1970s,numerous protocols have been developed for ad hoc mobile networks ,which include high power consumption, low bandwidth and high error rates. An Ad hoc protocol is a convention or standard that controls how nodes come to agree which way route packets between computing devices in a mobile ad-hoc network .

Routing protocols in MANETs can be classified as :
:- Proactive(Table driven)[12]
:- Reactive (On demand)[12]
:- Hybrid[12]
MANET is a dynamic network, which means node can change with time,new node can join the network and other nodes can leave the network. A MANETS is expected to be of large size than the radio range of wireless antenna ,because of this reason it
could be necessary to route the traffic through a multihop.

Proactive protocols
These are called table driven protocols .In these protocols ,each node maintains routing information to every other node in the network.The routing information is usually kept in number of different routing tables .These tables are periodically updated if the network topology changes.Thediffernce between these protocols exists in the way the routing information is updated,detected and type of information kept at each routing. Some of these protocols are :
:- Destination Sequenced Distance Vectored (DSDV)
:-Distribtued Bellman- Ford (DBF)
:- Wireless Routing Protocol (WRP)
:-Clusterhead Gateway Switch Routing (CGSR)
:- Source Tree Adaptive Routing (STAR)
:- Hazy Sighted Link State Routing ((HLSR)
:- Hierarchical Stare Routing (HSR)
:-Intrazone Routing Protocol (IZR)

Reactive Protocols

These are called on demand protocols. These are designed to reduce the overhead by maintaining the information for active routes only at the expense of delay due to route search. This means that routes aredetermined and maintained for nodes that require send data to particular destination. Route discovery occurs by flooding a route request through the network .This scheme is significant for Ad hoc environment since the battery power is conserved both by not sending the advertisements and by not needing to receive them(A host could otherwise reduce its power consumption by putting itself into sleep or standby mode when they are not busy with other tasks.

Some of the protocols are:
:- Associativity Based Routing[(ABR)
:- Dynamic Source Routing (DSR)
:- Temporary Ordered Routing Algorithm. (TORA)
:-Adhoc On Demand routing protocol (AODV)
:- Cluster Based Routing Protocol (CBRP)
:- Relative Distance MicrodiscoveryAdhoc Routing (RDMAR)
:- Signal Stability Routing (SSR)
:- Caching And Multiptath Routing (CHAMP)
:- Ant-based Routing Algorithm (ARA)

3. PROBLAM MOTIVAION

Traditional routing protocols based on the link-state or distance-vector algorithms are aimed at finding optimal routes to every host in the network, and topological changes of the network can only be reflected through the propagation of periodic updates. These protocols are not suitable for ad hoc networks. Indeed, finding and maintaining routes to every host is too expensive and almost always not necessary as each host only communicates with a subset of the hosts in the network. Furthermore, the periodic updates cannot promptly reflect the frequent topological changes in ad hoc networks, which in turn will cause a lot of undelivered packets and undermine the quality of communication. As a consequence, a mobile ad hoc networking (MANET) working group has been formed within the Internet

Engineering Task Force (IETF) to develop a routing framework for IP-based protocols in ad hoc networks. Today, a number of routing protocols have been proposed for ad hoc wireless networks , derived from distance-vector or link-state routing algorithms. Such protocols are classified as proactive or reactive, depending on whether they keep routes continuously updated or react on demand. While each protocol has its own advantages and disadvantages, none of them can be claimed as absolutely better than the others. Routing in wireless mobile ad-hoc networks should
be time efficient and resource saving. One approach to reduce traffic during the routing process is, to divide the network into clusters
.
Following tasks must be done to achieve primary objective.
• Get a general understanding of ad -hoc networks.
• Get a general understanding of simulation environment that could be used for
analyzing ,evaluating and implementing ad hoc routing protocols
• Implement some of the routing protocols for wireless ad-hoc networks.
• Analyze the protocols theoretically and through simulation based on some parameters.
• Based on the above analysis suggest some improvements in protocols design to overcome some of the limitations in routing protocol.

```
IF N is member
    IF D is in the neighbour table
send RREQ to D
ELSE IF N is gateway to clusterhead C
forward RREQ to C
ELSE
discard RREQ
```

ENDIF
ELSE IF N is clusterhead
IF RREQ already seen
discard RREQ
ELSE
record ID in cluster address list of RREQ
IF D is neighbour OR D is two hops away
send RREQ to D
ELSE
FOR EACH neighbouringclusterhead C DO
IF NOT C in address list of RREQ
record C in cluster address listof RREQ
ENDIF
ENDFOR
ENDIF
broadcast RREQ
ENDIF
ENDIF

4.RESULT ANALYSIS

There are different mobility models which are used for simulating the ad hoc networks in different environments . The most commonly used are

- Random waypoint mobility model
- Reference point group mobility model
- Freeway
- MANHATTEN mobility model

Performance Metrics

Three key performance metrics are evaluated in our experiments:

:- Throughput—This is the ratio of the data packets delivered to the destination to those generated by the CBR sources.

:- Average end-to-end delay of data packets—This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer time.

:- Normalized routing overhead—This metric has two variants: packet overhead is the number of routing packets "transmitted" per data packet "delivered" atthe destination, and byte overhead is the number of bytes of routing packets "transmitted" per data byte "delivered" at the destination. Each hop-wise transmission of a routing packet is counted as one transmission.

Throughput

The two source routing protocols demonstrate high quality in delivering packets—more than 97% in the case of 80 nodes. AODV has difficulty when the nodes are moving fast (corresponding to smaller pause time), with a throughput less than 84.67%. Source routing reveals more information in one route discovery than AODV. Therefore, within the same time, more routes are discovered and so more packets can be delivered. AODV catches up when the mobility of the nodes gets lower.This is because routes become more stable, and so eventually everybody can find all the routes it ever needs. Between DSR and CBRP, CBRP has
a better throughput for a larger network size. This better scalability comes from its largely reduced flooding for route discovery.

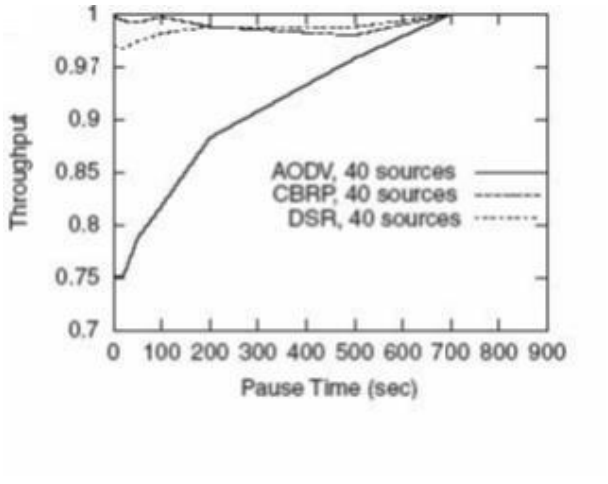

Figure 1:- Data packet throughput: 80 node model with various no of trafficsources.

Delay

Among the three protocols, AODV has the shortest end-to-end delay of no more than 0.04 seconds. Besides the actual delivery of data packets, the delay time is also affected by route discovery, which is the first step to begin a communication session.The source routing protocols have a longer delay because their route discovery takes more time as every intermediate node tries to extract information before forwarding the reply. The same thing happens when a data packet is forwarded hop by hop. Hence, while source routing makes route discovery more profitable, it slows down the transmission of packets. CBRP is even more time-consuming because of its two-phase route discovery. The task of maintaining cluster structure also takes a piece of each
host's CPU time.

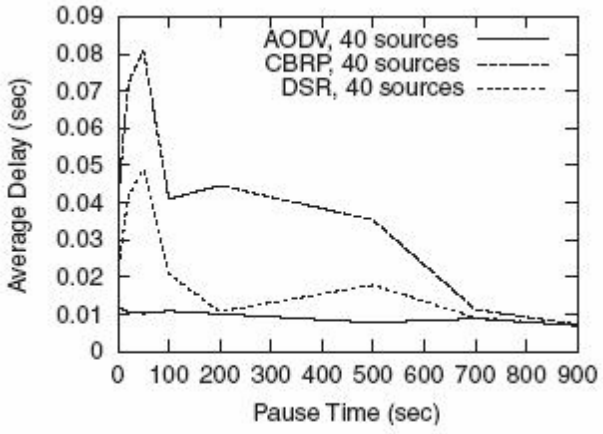

Figure 2:- Average data packet delay : 80 node model with various no of traffic
sources.

Overhead

Without any periodic hello messages, DSR outperforms the other two protocols in terms of overhead. In most cases, both the packet overhead

and the byte overhead of DSR are less than half of the overhead of CBRP and less than a quarter of AODV's overhead. AODV has the largest routing load (in the 50-node cases, as many as 6.5 routing packets per data packet and 2 routing bytes per data byte) because the number of its route discoveries is the most, and the discovery is network-wide flooding.CBRP has a much smaller flooding range; the number of its route requests and replies is constantly half that of DSR. But its hello messages outweigh this gain. And since the size of CBRP hello messages can be large, its byte overhead is still more than DSR's (in the 50-node cases, more than twice as much as DSR's). When there are more connections,more routing is needed, and so the proportion of hello messages in the total overhead becomes smaller. As the result, CBRP and AODV get
closer to DSR.

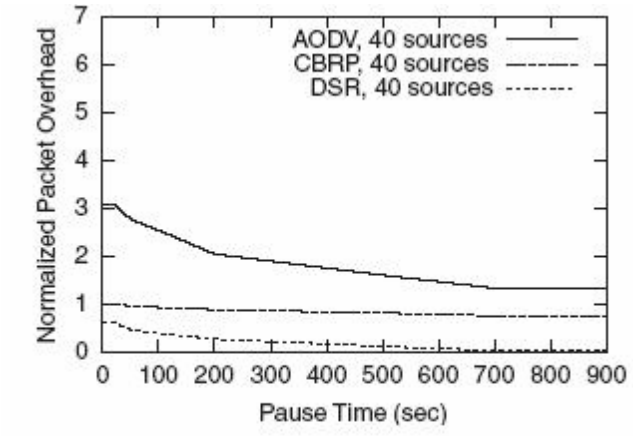

Figure 5.5 Normalized byte overhead : 80 node model with various no of traffic sources.

5. Conclusion & Future Work

In this work, we focused on the routing problem in ad hoc networks. Routing in wireless mobile ad-hoc networks should be time efficient and resource saving. One approach to reduce traffic during the routing process is, to divide the network into clusters. We have seen the structure and the working of the cluster-based routing protocol. We also described the working of two other routing protocols ad hoc on demand distance vector and dynamic source routing. We have presented an extensive simulation study to compare three on-demand ad hoc routing protocols (DSR, AODV, and CBRP), using a variety of workloads such as mobility, load, and size of the ad hoc networks. Our results indicate that the two source routing–based protocols, DSR and CBRP, have very high throughputs while the distance-vector-based protocol, AODV, exhibits a very short end-to-end delay of data packets. Furthermore, despite its improvement in reducing route request packets, CBRP has a higher routing overhead than DSR because of its periodic hello messages. DSR has much smaller routing overhead than AODV and CBRP, and AODV has the largest overhead amongthe three protocols. Currently the proposed work studies only one routing protocol based on clustering that is CBRP , there are other protocols which use cluster based routing such as CGSR can also be studied. In our simulation study only one propagation model (random way point) is used, other propagation models can also be used.

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