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Effect Of Routing Packet Overheads On Routing Protocols

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Abstract-

Mobile Ad-Hoc networks (MANETs) are collection of mobile nodes that dynamically forming a temporary network without preexisting network infrastructure and communicate with its neighbors to perform peer to peer communication and transmission. It offers unique benefits and versatility for certain environments and certain applications. Since there is no prerequisite fixed infrastructure and base stations, they can be created and used anytime, anywhere. Propagation models focused on predicting the average received signal strength at a given distance from the transmitter, as well as the variability of the signal strength in close spatial proximity to a particular location. The accuracy of any particular propagation model in any given condition will depend on the suitability among the constraints required by the model and depend on terrain. A number of propagation models like Free Space and Two Ray ground have been exist. In this paper, we present comparative study on the behavior of various routing protocols with path loss propagation models, various performance metrics used for this comparison such as packet delivery fraction, average jitter, throughput and average end to end delay. The studies would be helpful in choosing the correct protocol for any active operating environment.

Keywords: Ad-Hoc network, AODV, DSR, Network model,overhead

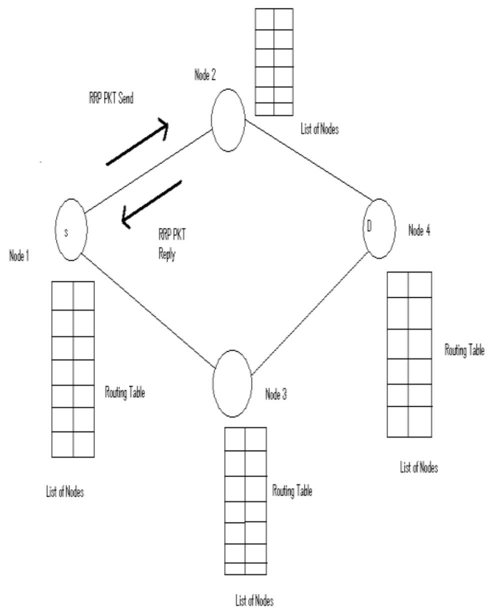
I. INTRODUCTION

Mobile Ad-hod Networks (MANETs) are collections of wireless mobile nodes, constructed dynamically without the use of any existing network infrastructure or centralize dad ministration. Due to the limited transmission range of wireless network interfaces, multiple hops may be needed for one node to exchange data with another one across the network. MANETs are characterized by limited power resource, high mobility and limited bandwidth. Routing in MANETs can be accomplished through either single path or multiple paths. When using single-path routing protocols, the traffic is distributed through one route and is therefore less flexible than in multi-path routing protocols. The problem of two entities communicating using multiple paths has been considered widely in various contexts for wired networks[1][2][3] It was shown that multi-path routing mechanism provides better throughput than single-path routing protocols . Although research on multi-path routing protocols has been covered quite thoroughly in wired networks, similar research for wireless networks is still in its infancy. Some multi-path routing protocols for MANETs have been proposed in However, the performance of these protocols are only assessed by simulations in certain limited scenario. Although some recent papers provide analytical models for multi-path routing. they are limited on a single aspect of multi-path routing such as route discovery frequency or error recovery. To the best of our knowledge, there has been no paper which provides an analytical model which allows comparing the performance of reactive shortest single-path routing and multi-path routing with load balance. In this paper, we propose models to analyze and compare reactive single-path and multi-path routing protocols in terms of overheads, traffic distribution and connection throughput. Thereafter, the terms "single-path routing"and "multi-path routing" are equivalent to "shortest single-path routing" and "multi-path routing with load balance" respectively. In addition, we focus our analysis only on reactive routing mechanism. The overhead analysis in this paper is only applicable for reactive routing mechanism. However, the results regarding the traffic distribution and connection through put is applicable for both proactive and hybrid routing mechanisms. The outcome from analytical models is further validated by simulation. In this paper is organized as follows .Section I provides general information on reactive routing mechanism. Section II gives a detailed analysis of overhead for both single-path and multi-path routing techniques.

II. RELATED STUDY

1.Route Discovery

In this phase, the source node S broadcasts a route request packet (RRQ) to locate the destination D in the network. The first node receiving the RRQ that has a valid route for node D initiates a route reply packet (RRP) back to node S containing a list of nodes a long the path from node S to node D as shown in figure .



Route Maintenance:

The Route Maintenance phase ensures that the paths stored in the Route Cache are valid. If the data link layer of a node detects a transmission error, the node creates a route error packet (ERR) and transmits it to the source. For error detection, several acknowledgment mechanisms may be used such as ACK packet in 802.11 . . . When receiving ERRs, the sources check their route caches and delete routes containing the failed links. They can either attempt to use other alternate routes in their caches or invoke another *Route Discovery*.

2. Routing Protocols in Ad-Hoc Network: For mobile A*d-Hoc* networks, the issue of routing packets between any pair of nodes becomes a challenging task because the nodes can move randomly within the network. A path that was considered optimal at a given point in time might not work at all a few moments later. Moreover, the stochastic properties of the wireless channels add to the uncertainty of path quality [6] Traditional routing protocols are proactive in that they maintain routes to all nodes, including nodes to which no packets are being sent. They react to any change in the topology even if no traffic is affected by the change, and they require periodic control messages to maintain routes to every node in the network. An alternative approach involves establishing reactive routes, which dictates that routes between nodes are determined solely when they are explicitly needed to route packets. This prevents the nodes from updating every possible route in the network, and instead allows them to focus either on routes that are being used, or on routes that are in the process of being set up.

1. Dynamic State Routing (DSR) The DSR protocol [7,8]requires each packet to carry the full address (every hop in the route), from source to the destination. This means that the protocol will not be very effective in large networks, as the amount of overhead carried in the packet will continue to increase as the network diameter increases. Therefore, in highly dynamic and large networks the overhead may consume most of the bandwidth. However, this protocol has a number of advantages over other routing protocols, and in small to moderately size networks (perhaps up to a few hundred nodes), this protocol performs better. An advantage of DSR is that nodes can store multiple routes in their route cache, which means that the source node can check its route cache for a valid route before initiating route discovery, and if a valid route is found there is no need for route discovery. This is very beneficial in network with low mobility, because the routes stored in the route cache will be valid for a longer period of time. Another advantage of DSR is that it does not require any periodic beacon (or **hello** message exchanges), therefore nodes can enter sleep node to conserve their power. This also saves a considerable amount of bandwidth in the network.

2. Ad-Hoc On-demand Distance Vector Routing (AODV) The AODV routing protocol[9][10] is based on DSDV and DSR algorithm. It uses the periodic beacon and sequence numbering procedure of DSDV and a similar route discovery procedure as in DSR. However, there are two major differences between DSR and AODV. The most distinguishing difference is that in DSR each packet carries full routing information, whereas in AODV the packets carry the destination address. This means that AODV has potentially less routing overheads than DSR. The other difference is that the route replies in DSR carry the address of every node along the route, whereas in AODV the route replies only carry the destination IP address and the sequence number. The advantage of AODV is that it is adaptable to highly dynamic networks. However, node may experience large delays during route construction, and link failure may initiate another route discovery, which introduces extra delays and consumes more bandwidth as the size of the network increases.

Fig :- Key Comparison Of Dynamic State Routing & Ad-Hoc Distance Vector Routing.

SR. NO	Dynamic State Routing	Ad-Hoc Demand Distance Vector Routing	Points
1	YES	NO	Multiple Route
2	SHORTESH PATH	FREASHROUTE OR SHORTEST PATH	Route Method
3	ROUTE CACHE	ROUTE TABLE	Where to maintain route

Limitation of Wireless Network Interface

1.Limited Transmission Range.

2.Multiple hop May be needed for one node to exchange data with another one across the networks

Limitation of Mobile Ad-Hoc Networks

1.Limited Power Resource.

2. High Mobility.

3. Limited Bandwidth.

3. Overview of Propagation Model :A propagation model is a set of mathematical expressions, diagrams, and algorithms used to represent the radio characteristics of a given environment [4]. Propagation model are three types empirical model, semi deterministic model, deterministic model Empirical models are based on measurement data, simple, use statistical properties, and not very accurate. Semi-deterministic models are based on empirical models and deterministic aspects. Deterministic models are site-specific, require enormous number of geometry information about the cite, very important computational effort, accurate. Path loss can be expressed as the ratio of the power of the transmitted signal to the power of the same signal received by the receiver, on a given path. It is a function of the propagation distance. Estimation of path loss is very important for designing and deploying wireless communication networks. Path loss is dependent on a number of factors such as the radio frequency used and the nature of the terrain [5].

・ **Network Model:**

We assume that mobile nodes are distributed uniform with node density δ inside a disk of radius R. We also assume that there are N nodes in the network. N is related to the node density and the disk radius by the following expression $N = \pi R2\delta$. Each link has a link breakage rates of μ, i.e. a link lasts $1/\mu$ seconds on average. Furthermore, we assume that the average route length (in terms of number of hops) for single path routing is Ls and for multi-path routing is Lm. Since single-path routing uses shortest routes, we obviously have $Lm > Ls$. In addition, Le is the length of the route from the source to the node where a link breakage occurs. For multi-path routing, Nu represents the number of paths for each source-destination pair. In addition, the number of active connections per node is denoted by Ac for both routing mechanisms. Furthermore, the size of RRQ, RRP and ERR are respectively denoted as Mrq, Mrp, Me respectively. Finally, a *Route Discovery* takes T seconds to find the routes to the destination. All the parameters are summarized in following table

Notation	Meaning
N	Number of nodes
Nu	Number of routes per source-destination pair
Le	Average length of error route
μ	Link breakage rate
Ls	Average length of a route for single-path routing
Lm	Average length of a route for multi-path routing mechanism
Ac	Number of active routes per node
Mrq	Size of the request packet
Me	Size of error request packet
Mrp	Size of reply packet
€	Inter arrival rate
P	Overhead portion of a data packet
Md	Size of the data packet
T	Average delay for route creation

• **Overheads due to RRQs:**

Single path routing: Assuming that N nodes each broadcast a RRQ λs times per second, the total overhead created by RRQs is obviously$Mrq\lambda sN2$.λs (i.e the route discovery frequency) is related to link breakage as $\lambda s = \mu Ls$. Hence, the amount of overheads due to the RRQs is $Mrq\mu LsN2$.

Multi-path routing: Using a similar argument as above, the amount of overheads due to RRQs is$Mrq\lambda mN2$ where λm is the frequency of Route Discovery for multi-path routing.

• **Overheads due to RRPs**:

Single path routing: Reply packets follow Ls hops to return back to the source. Since the rate of sending the RRPs is the same as the rate of sending RRQs, the overhead created by the RRPs, is $Mrp\mu L2sN$.

Multi-path Routing: Since the destination node replies to Nu RRQs, the overhead due to RRPs is $Mrq\lambda mLmNNu$. Note that the fact that λm is smaller than λs balances the fact that the number of RRPs are increased by a factor of Nu compared to single path routing.•

• **Overheads due to ERRs:**When a link is broken, an Error Packet is produced and an ERR is sent back to the source to signal the link breakage. Recall that Le is the average length of the path from the broken link to the source ($Le < Ls < Lm$). Since the error packet has to travel Le links to the source, this effectively produces Le error packets per route broken.

Single path Routing: for each node, the break age rate of the active routes is μAc . Therefore, in a N-node network, the average number of overheads due to error packets is $\mu LeAcNMe$.

Multi-path Routing: In multi-path routing in each source-destination pair maintains Nu routes,the overheads due to error packets is $Nu\mu LeAcNMe$

• **Overheads due to Data Transmission:**The overheads created during data transmission is due to the overhead portion of data packets. We assume that the each Route Discovery is accomplished in T seconds on average. Further more,each mobile node is a simple source with data transmission rate of _ once the route discovery is completed.

Single-path Routing: Since the route discovery rate is λs, the interval between each route discoveries is on average $1/\lambda s$. Each route discovery takes on average T seconds. Therefore, the actual time for data transmission is $(1/\lambda s - T)$ seconds. The number of data packets sent during that interval is $(1/\lambda s - T)$_. Thus, data packets are sent with an average rate of λs_$(1/\lambda s - T)$packets/sec. Since each data packet has to travel Ls hops to the destination, the total amount of overhead is $\lambda s\_(1/\lambda s - T)PLs = \mu Ls\_(1/(\mu Ls) - T)PLs$

Multi-path Routing: Using a similar derivation as above, the total amount of overheads for multi-path routing is $\lambda m\_(1/\lambda m - T)PLm$ where λm

• **Summary:**

The total amount of overheads due to RRQs, RRPs,ERRs and data packets for single path and multi-path respectively denoted by *Ovs* and *Ovm* can be expressed as-:

$Ovs = Mrq\lambda sN2 + Mrp\lambda sLsN + \mu LeAcNMe + \mu Ls\_(1/(\lambda s - T)PLs$ (2)

$Ovm = Mrq\lambda mN2 + Mrq\lambda mNLmNu$ (3)+ $\mu LeAcNMeNu + \mu\_(1/\lambda m - T)PLm$ (3)

In figure 1, we have plotted *Ovs* and *Om* as functions of the number of paths *Nu*. One can see that there is no significant increase in overheads for *Nu* up to 3. This confirms the fact that in the literature, authors often mentioned that *Nu* =3 provides an optimum trade off. This claim is usually based on simulation results and the study provided in this paper confirms this observation

, *Nu* = 3 and *Ovs* and *Ovm* are compared as the link breakage is varied. It is interesting to note that the maximum increase in overhead is approximately 20% (for a link breakage rate of 50%). Otherwise, for link breakages less than 10%, the increase in overhead is approximately 10%. One might argue that the figure is not insignificant. In fact, assessing whether this increase in overhead is acceptable or not really depends on the advantages brought out by multi-path routing. This is why a theoretical study such as the one proposed in the following is necessary.

VI CONCLUSION

In this paper, we have compared single path and multi-path routing algorithms. We have first concentrated this study on the issue of overheads, inherent to multi-path routing. We have follow how the amount of overheads increases with the number of multi-paths and we have seen that when this number exceeds three, the overheads increase dramatically..

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