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Designing Mobility using Distance Routing Effect Algorithm

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Abstract

An ad-hoc network signifies a solution designed for a specific problem or task and it is an independent network that provides usually temporary peer-to-peer connectivity without relying on a complete network infrastructure. It allows users to communicate while forming a temporary network, without any form of federal administration. Each node participating in the network performs the host and router function, and willing to forward packets for other nodes. For this a routing protocol is needed. An approach utilizes the individuality of such a network a DISTANCE ROUTING EFFECT ALGORITHM FOR MOBILITY.

The protocol uses the distance effect and the mobility rate as a means to assure routing accuracy. When data needs to be exchanged between nodes, the directional algorithm sends messages in the recorded direction of the destination node, guaranteeing the delivery by following the direction. The improved algorithm suggested within this paper includes an additional parameter, direction of travel, as a means of determining the location of a destination node. When data needs to be exchanged between two nodes, the directional algorithm sends messages in the recorded direction of the destination node, guaranteeing the delivery. The result is an enhancement to the delivery ratio, sent to the received packet. This allows the reduction in the number of control packets that need to be distributed.

Keywords: Dream, Routing, Protocol, ad-hoc

Introduction

Wireless communication between mobile users is becoming more popular than ever before. This has been fed by the growing technological advances in laptop computers and wireless data communication devices, such as wireless modems and wireless LANs. Conceptually, two different kinds of wireless networks exist, but the difference between them may not be as obvious as it may seem. The first kind and most often used today is a wireless network built on top of a “wired” network and thus creates a reliable infrastructure wireless network. The wireless nodes connected to the wired network and able to act as bridges in a network of this kind are called base-stations. The major issue in such a network is related to the concept of handoff, where one base station tries to handoff a connection to another seamlessly, without any noticeable delay or packet loss. Another practical problem in networks based on cellular infrastructure is that it is limited to places where there exists such a cellular network infrastructure. The other kind of network is one where there is no infrastructure in place except for the participating mobile nodes. This is referred to as an infrastructure less network or more commonly an ad-hoc network. The term ad-hoc translates to “improvised” or “not organized” and refers to the dynamic nature of such a network. All or some nodes within an ad-hoc network are expected to be able to route data-packets for other nodes in the network who want to reach nodes beyond their own transmission range. This is called peer level multi hopping and is the base for ad-hoc networks that constructs the interconnecting infrastructure for the mobile nodes.

This form of networking is limited in range by the individual nodes’ transmission ranges and is typically smaller compared to the range of cellular systems. This is not to imply that the cellular infrastructure approach is superior to 2 the ad-hoc network approach. Ad-hoc networks have several advantages compared to traditional cellular systems. These advantages include:

- On demand setup
- Fault tolerance
- Unconstrained connectivity

Ad-hoc networks do not rely on any pre-established infrastructure and can therefore be deployed in places lacking traditional infrastructure. This is useful in disaster recovery situations and places with non-existing or damaged communication infrastructure where rapid deployment of a communication network is needed. Given the dynamic nature of the ad hoc network, routing protocols used in ordinary wired networks are not well suited for this kind of an environment. They are usually

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built on periodic updates of the routes and create a large overhead in a relatively empty network and also cause slow convergence to changes in the topology. Currently, there does not exist any standard for a routing protocol for ad hoc networks, instead this is a work in progress. Many protocols are in the process of evaluation. This thesis attempts to study one of the many proposed routing protocols and attempts at making some performance enhancing improvements on the protocol design.

Ad-hoc networking protocols can be broadly classified as either proactive or reactive. Proactive protocols maintain up to date route information for all nodes within the network. When data needs to be sent to a destination node, the sender node most usually has the route path information, generally the next hop to it, and can be used immediately. On the other hand, reactive protocols obtain a route to the destination node only when a message needs to be sent in an "on-demand" fashion. Regardless of whether a protocol is proactive or reactive, current routing protocols for ad hoc networks are required to store route information similar to routing protocols for static networks, essentially as a sequence of nodes. In proactive protocols, this information is generally in the form of a next hop table lookup at each node along the route. In a reactive protocol the result of a route discovery control message is the route to be used as an explicit sequence of nodes in order to reach the destination.

The aim of this paper is to discuss the performance and benefits of a location based routing protocol, which uses the location information stored within the routing table of each node, for all other nodes within the network. The location information refers to the geographic coordinates that can be obtained from and by the use of the Global Position System. The location-based protocol specifically considered here is the Distance Routing Effect Algorithm for Mobility or DREAM. The DREAM protocol can be considered proactive in the sense that a mechanism is defined for the dissemination and updating of location information. When the sender node S needs to send a message to the destination node D, it uses the location information for D to obtain D's direction, and transmits the message to all its one hop neighbors in the direction of D. The subsequent nodes repeat the same procedure until the destination node is reached. This effectively results in using a reactive approach, as individual nodes in the path determine the next hop in an on-demand manner.
In the DREAM algorithm, each node participates in the transmission of control messages containing the current location of a particular node to all other nodes within the network, in the form of Location Update messages. The frequency of such updates is determined by the distance factor and mobility rate of each node. The enhancement proposed within this thesis introduces the direction of travel information of the particular node in addition to the location and time information, within the location update message. This allows the sender node S to calculate the direction of the destination node D with a greater accuracy. This would also ensure that a lesser number of next-hop neighbors are chosen when a data packet is sent, effectively reducing the overhead caused by the collaborative transmission mechanism inherent to an ad hoc network.

Literature Study

Wireless Ad-Hoc Networks

In areas in where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use, wireless mobile users may still be able to communicate through the formation of an ad-hoc network. In such a network, each mobile node operates not only as a host but also as a router, forwarding packets for other mobile nodes in the network that may not be within direct wireless transmission range of each other. Each node participates in an ad-hoc routing protocol that allows it to discover "multi-hop" paths through the network to any other node. The idea of ad-hoc networking is sometimes also called infrastructure less networking. Figure 2-1 Local Ad-Hoc Network shows a simple ad hoc network with three nodes. The outermost nodes are not within transmitter range of each other. However the middle node can be used to forward packets between the outermost nodes. The middle node acts as a router and the three nodes form an ad-hoc network.

Figure 2.1 Local Ad-Hoc Networks

Ad-hoc networks are also capable of handling topology changes and malfunctions in nodes. It is fixed through network reconfiguration. For instance, if a node leaves the network and causes link breakages, affected nodes can easily request new routes. Although there are incremental delays, the network continuous to remain operational.

Wireless ad-hoc networks take advantage of the inherent nature of the wireless communication medium. In a wired network, the physical cabling is done a priori, restricting the connection topology of the nodes. Provided two mobile nodes are within transmission range of each other, this restriction is easily overcome within the wireless domain, forming an instantaneous communication link.

Routing

Given that all packets in the network have to traverse several nodes before reaching the destination node, a routing protocol is essential for the existence of an ad-hoc network. The routing protocol has two main functions, selection of routes for the various source-destination pairs and the delivery of messages to the intended destination. The second function is conceptually straightforward, using a variety of protocols and data structures. This paper is based on applying and evaluating a protocol for the former purpose in order to make the latter possible.

Distance Vector

In distance vector, each node only monitors the cost of it outgoing link, but instead of broadcasting this information to all nodes, it periodically broadcasts to each of its neighbors as estimate of the shortest distance to every other node in the network. The receiving nodes use this information to recalculate the routing tables, by using a shortest path algorithm.

Compared to link state, distance vector is more computationally efficient, easier to implement and requires much less storage space. It is well known that distance vector can cause the formation of both short-lived and long lived routing loops. The primary cause for this is that nodes choose their next hops in a completely distributed manner based on information that could be stale.

Destination Sequenced Distance Vector Routing (DSDV)

The Destination-Sequenced Distance-Vector Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements to make it suitable for wireless schemes. Every mobile node maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish state routes from new ones and thus avoid the formation of loops. The nodes periodically transmit their routing tables to their immediate neighbors. A node also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven.

The routing table updates can be sent in two ways: - a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence numbers have changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing network, incremental packets can grow big so full dumps will be more frequent. Because DSDV is dependent on periodic broadcasts it needs some time to converge before a route can be used. This convergence time can probably be considered negligible in a static wired network, where the topology is not changing so frequently. In an ad-hoc network on the other hand, when the topology is expected to be highly dynamic, this convergence time results in a lot of dropped packets before an invalid route is detected. The periodic broadcasts also add a large amount of overhead into the network.

Dynamic Source Routing (DSR)

Dynamic Source Routing Protocol is a source-routed on-demand routing protocol. Every node maintains a route cache containing the source routes that it is aware of. The node updates the entries in the route cache if there is a better route, as it learns about new routes.

DSR requires that each packet keep its route information, thus eliminating the need for every node in the network to do periodic route discovery advertisements. DSR performs a route discovery and takes required actions for maintaining that route. DSR depends on the support of the MAC layer. The two basic operations of DSR are route discovery and route maintenance.

Route Discovery

The route discovery phase is used when a mobile node needs to send information to a particular destination node. The source node X first consults its internal source route cache to determine if it already has a route to the destination node. If an unexpired route exits, it will use that as the route to be used for all packets. However, if no such route exits, node X requests a route by broadcasting a Route Request (RREQ) packet. The RREQ packet contains information about the destination node, the source node and a unique identification number. Every node receiving the RREQ packet searches through its own route cache to see if it has a route to the destination. If no route is found, the intermediate node forwards the RREQ packet further, after adding its own address to the route record of the packet. To limit the number of route requests propagated, a node processes a route request packet only if it has not already seen the packet and its address is not present in the route record of the packet.

A route reply is generated when either the destination node itself is reached, or an intermediate node containing route information of the destination. The selected return route may either be a list reversal of the route record within the packet, or using another existing route in the destination node's table. Thus the route may be considered unidirectional or bidirectional. DSR nodes stay awake and listen to everything that is of importance to their routing tables in promiscuous mode, so that route discovery may speed up.

Route Maintenance

Route maintenance is the mechanism by which a sender detects if the network topology has changed and can no longer use the route to a particular destination. A failed link is determined either actively by monitoring acknowledgements or passively by running in promiscuous mode, overhearing that a neighboring node forwards a packet.

When route maintenance detects a problem with a route in use, a route error packet is sent back to the source node. When this error packet is received, the error in the hop information is removed from its host's route cache, and all routes that contain this hop are truncated at this point. DSR uses the key advantage of source routing. Intermediate nodes do not need to maintain up-to-date routing information in order to route the packets they forward. There is also no need for periodic routing advertisements messages, which leads to reduced network bandwidth utilization, particularly during period where little or no host movement taking place. Battery power is also conserved on the mobile hosts; both by not having to send the advertisements as well as receiving them, and a host could then go into a sleep mode if required. This protocol has the advantage of learning routes by scanning for information on packets that it is handling. A route from A to C through B, implies that A has learnt the route to C, but also implicitly learns the route to B. The source route also means that B learns the route to A and C, and C learns the route to both A and B. This form of active learning is very good and reduces the overhead in the network. However each packet carries the slight overhead containing the source route of the packet. This source route grows when the packet has to go through more hubs to reach the destination. So the packets will be slightly bigger, because of the overhead. Running the interfaces in promiscuous mode is a serious security threat. Since the address filtering on the interface is turned off, and all packets are scanned for information. A potential intruder could listen to all packets, and scan them for useful information such as security passwords or credit card numbers. The security aspect has to be dealt with by the application in this case by ensuring the data is encrypted prior to transmission. The routing protocols are prime targets for impersonation attacks and must therefore also be encrypted. DSR also has the support for unidirectional links by the use of piggybacking the source route a new request. This can increase the performance in scenarios where we have a lot of unidirectional links. However, the MAC layer protocol must also support this.

Research Methodology

Related Work

Existing work on security-enhanced data transmission includes the designs of cryptography algorithms and system infrastructures and security-enhanced routing methods. Their common objectives are often to defeat various threats over the Internet, including eavesdropping, spoofing, session hijacking, etc. Among many well-known designs for cryptography based systems, the IP Security (IPSec) and the Secure Socket Layer (SSL) are popularly supported and implemented in many systems and platforms. Although IPSec and SSL do greatly improve the security level for data transmission, they unavoidably introduce substantial overheads, especially on gateway performance and effective network bandwidth.

Proposed Work

We will propose a dynamic routing algorithm that could randomize delivery paths for data transmission. The algorithm is easy to implement and compatible with popular routing protocols, such as the Routing Information Protocol in wired networks and Destination-Sequenced Distance Vector protocol in wireless networks, without introducing extra control messages. A classification of existing algorithms for dynamic routing has been done. A number of evaluation criteria were chosen to provide an objective comparison. For some algorithms different implementations are available. The evaluation phase these have been considered, checking their status and activity of the development group.

Classification

Routing algorithms can be classified according to different parameters and functionalities. The fundamental characteristic is the method used to build and maintain the routing tables. Two approaches exist:

a) Proactive: The topology of the entire network is maintained and updated on fixed time intervals of a few seconds. All nodes know how to reach each other every instant.

b) Reactive: The routing path is built every time it is needed and a cache is used for frequently used paths. These algorithms have a characteristic delay every time a packet needs to be sent to a new destination.

A proactive approach allows a fast communication without delays; it requires a constant bandwidth and node's resources over head on the network to keep the routing table updated. On the other hand it is suitable for those scenarios where all nodes want to communicate between themselves without preferred paths. On the contrary a reactive approach will

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establish a routing path only when it is needed, limiting the use of resources to the bare minimum. However the cache needs to be very active to prevent delays caused by new Connections or changes in topology.

Algorithm / Technique used

Distance-vector-based algorithm for dynamic routing.

Algorithm Description

A distance-vector-based algorithm for dynamic routing to improve the security of data transmission. We propose to rely on existing distance information exchanged among neighboring nodes for the seeking of routing paths. In many distance-vector-based implementations, e.g., those based on RIP, each node Ni maintains a routing table in which each entry is associated with a tuple and Next hop denote some unique destination node, an estimated minimal cost to send a packet to t, and the next node along the minimal-cost path to the destination node.

Security

Given the nature of the wireless environment, it may be relatively simple to snoop network traffic, replay transmissions, manipulate packet headers, and redirect routing messages, within a wireless network without appropriate security provisions.

Algorithm for Mobility

Mobile Ad-Hoc Network protocols can be broadly classified as either proactive or reactive. Each node builds a routing table, similar to a static network, representing a topology of the network and sequence of next hops that would enable information to traverse the network to the desired destination. In the case of proactive protocols, the sequence of nodes is not explicit, rather a next hop reference to be used for a particular destination. Reactive protocols resort to a route discovery mechanism, which results in a sequence of nodes to be explicitly followed in order to reach a particular destination. Regardless of the protocol class, these determined routes become defunct when a node moves out of its position and is no longer in the routing path to a destination. Given the mobility of the nodes, an intrinsic nature of an ad-hoc mobile environment, these scenarios become highly probable, and nodes have to resort to repopulating their routing tables. Increased mobility result in rendering these protocols more inefficient, with constant control and route discovery packets flooding the network, increased overheads and lost transmission of packets.

The Distance Routing Effect Algorithm for Mobility protocol is essentially a location based protocol. This implies that each node contains the location information for every other node within the network, as an entry against each node. This location information may be obtained from GPS, which enables a mobile node to know its physical location. In real life scenarios however, the position information provided by GPS has a margin of error, which is calculated as the difference between the GPS calculated coordinates and the real coordinated. It is assumed that all mobile nodes know their current location precisely. DREAM may be considered part proactive and part reactive in nature. The nodes within a DREAM environment have a means of disseminating and collectively updating the location table entries for each other, behaving as a proactive protocol. When an information packet needs to be transported form node A to node B, node A looks up the location of B from within its tables and forwards the packet to nodes "in the direction" of B, as the next hop node. These intermediate nodes in turn perform a lookup and forward the packet "in the direction" of B. This results in the protocol mechanism reflecting a reactive nature.

As a proactive protocol, each DREAM node disseminates and updates other nodes within the network with its current location information. The frequency of generation and distribution of information within the location packets is determined by two phenomena addressed by the DREAM protocol, the Distance Effect and Mobility rate.

Distance Effect

The distance effect may be conceptually compared to the parallax phenomena. The parallax phenomena maybe summarized as the "apparent change in position of distant objects, due to the actual change in position of the observer". In practicality, this results in the fact that further the distance between two points, the slower they seem to move with respect to each other.

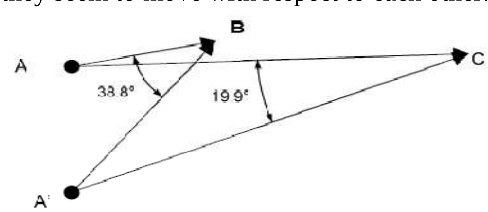

Figure 3.1 Distance Effect

As can be seen from the figure above, Node A moves from position A to position A'. There are two nodes B and C, who are stationary with respect to A, where node B is closer to node A than node C. As is evident from the illustration, node A has moved a greater angular distance with respect to node B (38.8 deg) as compared to the farther node C (19.9 deg). This results in the fact that, for the same distance traversed and same speed, node A "appears" to be moving more slowly from C's perspective, as compared from B's perspective. With the above information in mind, it can be realized that nodes that are farther apart, need to update each other with their location information less frequently as compared to nodes which are closer. Therefore, when a

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node distributes a location information packet, it can now specify an *age* for such a control packet. The age may be in terms of distance, the control packet is not propagated into network beyond a certain distance, or in terms of time, the packet is not propagated within the network after a certain timeout period.

Mobility Rate

The mobility rate addresses the question of how often a node should generate and disseminate location information packets. A node essentially updates other nodes within the network with its location information. Ideally, every time the location of the node changes, it should generate and distribute a location packet. However, as an optimum method, each node generates a location update packet at a periodic interval. This periodic interval is governed as a function of the mobility rate of the node itself i.e. the faster a node travels, the more frequently it distributes location update messages. This effectively allows each node to optimize the route dissemination frequency, thus transmitting route information only when needed, without sacrificing the route accuracy.

While addressing the distance and mobility rate within the protocol behavior, the DREAM protocol effectively reduces the amount of control packet overhead which can become quiet excessive in proactive protocols. Similarly, it also overcomes the initial delays of the route discovery phase as experienced by reactive protocols.

Model for DREAM

The model for DREAM defines a method of determining a probabilistic guarantee of finding a destination node in a given direction. Prior to this, the location information dissemination mechanism ensures that each node has relatively fresh location information tables. When a source node S wants to send information packets to a destination node D, it retrieves the location information of D stored within it location tables. Using this location information as a reference, S determines those nodes amongst its neighbors who are "in the direction" of D, and forwards the message packet to them. On receipt of this information packet, the intermediate neighboring nodes in turn perform a lookup into their location tables to retrieve the location entry for the destination D. The intermediate nodes in turn forward the message packet to those nodes, amongst its neighbors who are in the direction of D, similar to S. This process continues until the destination D is eventually reached. This method of selecting neighbors within a given direction range, results in a certain probabilistic guarantee of p, $0 < p < 1$, that destination B will be reached.

Each location update packet, and therefore the associated location entry for a given node represented by a location packet, contains the location, the time of sending the update message and the velocity of an individual node. Given the information of D within the location table of S as entry LT (D) = *t0*, as detailed in figure below, it is now easily possible to calculate the distance *Dr* (from node S to D) and the angle D_{θ}.

When node S needs to send information packets to the destination node D at some later time *t1*, where *t1* > *t0*, S needs to choose its neighbors to which it can forward the packet. Neighbors A are chosen by S such that, A_{θ} i.e. the direction vector of A, lies within the range [e+α, e-α]. The value of T must be chosen in such a manner that the probability of finding the destination D is the sector *C* is maximized. The sector *C* is centered about the line segment connecting *S* and *D* and defined by [e+α,e-α].

Within the time interval *t1- t0*, the maximum distance node D can travel at velocity *v* can be calculated as *x* = *v* (*t1* - *t0*). If a circle *P* is drawn with the radius as *x*, centered on the position of node D at time *t0*, the circle borders the confines of the new position of node D at time *t1*. This implies that node D cannot be anywhere outside of circle *P* after the time interval *t1* - *t0*. Given that the direction of travel of node D is not specifically known, D can move in any direction β uniformly chosen between o and 2_! Therefore the optimum or minimum value of α need to be chosen such that, the maximum distance *x* that D can travel within *t1* - *t0* at velocity *v* is within the sector *C*. The value of α needs to be at a minimum essentially because next hop neighbors are chosen such that they are within the sector determined by α. A smaller value of α result in a smaller sector area, resulting in fewer number of next hop nodes bring present within the sector. This further implies that fewer next hop nodes are transmitted the message to forward to the destination. This effectively results in a lower overall network bandwidth and resource utilization i.e. improved efficiency.

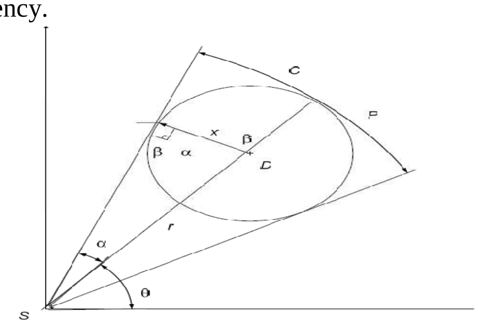

Figure 3.2 Graphical Description of DREAM

The value of _ is clearly dependant on the speed *v* of D. Therefore, if either the average or maximum speed of the node D is known, then it is straightforward to calculate the value of _ which guarantees that D will lie within the direction [V+T, V-T],

$$\alpha = \frac{\arcsin v(t_1 - t_0)}{r}$$

It is evident, that if the distance x traveled by D is greater than the distance r i.e. the distance between S and D, then D could be anywhere around S. In this case, π would = α If v is not known and only a probability density function of $f(v)$ is available, we need to find an X such that the probability of finding D in the direction range [V+X, V-X] is greater than or equal to p, for a given p, $0 < p$ Y 1. More formally, we need to determine X such that,

$$P(x \leq (t_1 - t_0)v) \geq p$$

In this case, since geometrically,

$$\frac{x}{\sin\alpha} = \frac{r}{\sin(\beta - \alpha)}$$

and, since

$\beta - \alpha = \pi/2$, the above equation become $x = r \sin\alpha$

we need to find ά so that,

$$P(x \leq (t_1 - t_0)v) = P(r \sin ά \leq (t_1 - t_0)v)$$

$$= \frac{P(v \geq r \sin ά)}{(t_1 - t_0)}$$

$$= \int_{\frac{r\sin\alpha}{t1-t0}}^{\infty} f(v)dv$$

Results & Analysis

Model for Improved DREAM

The basic mechanics of the working of the DREAM protocol. The base protocol mechanics discusses a means by which the destination nodes current location is calculated within a circle centered on the last known location of the node (as updated within the location tables from location information packets received from the destination node). The model for improved dream includes the direction of travel of the destination node, in addition to the location, the time of sending the update message and the velocity of an individual node.

The location table entry within each node now contains the speed, location, time and direction of travel for every node within the network. When a node needs to send packets to a particular destination node, it calculates the correct location of the destination with the above information. The direction of the travel of the destination now allows estimation of the current location of a node with greater accuracy than the original model of Dream.
When a source node S wants to send information packets to a destination node D, it retrieves the location information of D stored within it location tables. This location information of the destination node is adjusted, given the direction of travel of the destination node.

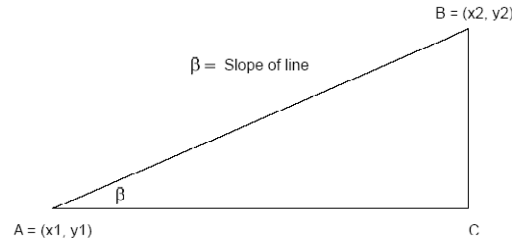

Figure 4.1 Calculating Direction of Travel

A node disseminating a location packet calculates it direction of travel by keeping a record of its location over successive intervals of time. If at time t0 the location of a node is (x1, y1) and at time t1 (when it has to send a location update packet) the location is (x2, y2), the direction of travel can be represented by the slope of the line joining the two location coordinates (Figure 4-3 Calculating Direction of Travel). Therefore the direction of travel is calculated as;

$$\beta = \frac{y2 - y1}{x2 - x1}$$

When node S needs to send information packets to the destination node D at some later time $t2$, where $t2 > t1$, S needs to choose its neighbors to which it can forward the packet. Neighbors A are chosen by S such that, *A.* i.e. the direction vector of A, lies within the range [V+T, V-T], as shown in the previous figure. However, before calculating the neighboring nodes, node S first adjusts the location information of D, by calculating the most accurate position coordinates of D.

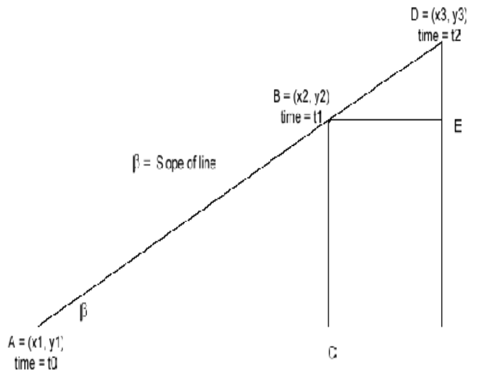

Figure 4.2 Adjustment to Determine New Location Coordinates

The distance between position B at time *t1* and position D at time *t2* can be calculated using the *x' = v*(*t2 – t1*). Similarly,

$$\cos(\beta) = \frac{BE}{BD}$$

Where $BD = x' = v(t_2 - t_1)$ and

$$BE = v(t2 - t1)\cos(\beta)$$

Therefore,

$$x_3 = x_2 + v(t_2 - t_1)\cos(\square$$

Similarly,

$$y_3 = y_2 + v(t_2 - t_1)\cos(\beta)$$

With this new location information for node D, node S can now determine the neighbors for node D as per the original model for the Dream protocol. We can now modify the diagram as per figure, to be a more accurate means of determining the location of D, (Figure 4-5 Representation of Improved DREAM).

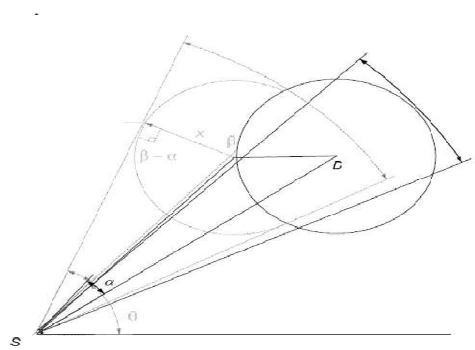

Figure 4.3 Representation of Improved DREAM

Where the new location is given by D. The calculation for the angle _ and _ are carried as normal, according to the original protocol calculation means. However, given that we have a most accurate location of destination D, the angle α can now be made smaller. This results in a smaller sector of neighbors chosen to forward the packet. Fewer neighbors imply fewer packets are introduced into the network resulting in a reduced overall transmission overhead within the network.

The value of alpha can now be reduced within the algorithm of the packets. We can now determine the effect of this reduced value of α on the probability of a packet being delivered to the destination node D. From the previous discussion, the probability of finding the node D was given

$$P(x \le (t_1 - t_0)v) = \int_{\frac{r\sin\alpha}{t1-t0}}^{\infty} f(v)dv$$

However, the new value of α^* , where $\alpha^* < \alpha$, implies that

$$\alpha^* < \alpha$$

hence, $\sin(\alpha^*) < \sin(\alpha)$

and $r\sin(\alpha^*) < r\sin(\alpha)$

$$\int_{\frac{r\sin\alpha}{t1-t0}}^{\infty} f(v)dv \quad < \quad \int_{\frac{r\sin\alpha'}{t1-t0}}^{\infty} f(v)dv$$

Because the left side probability function is now integrated over a larger interval, given that the lower integral has a smaller value, the probability of finding the destination node D with the new location information and smaller alpha, is higher.

Therefore:

$$P'(x \le (t_1 - t_0)v) \quad > \quad P(x \le (t_1 - t_0)v)$$

Conclusion

The area of ad-hoc networking has received growing attention from researchers with the advent of powerful mobile computing devices, and the ability to implement the technology. A variety of ad-hoc routing protocols have been discussed, with particular focus on location based routing protocols. The focus of this study, within the location based protocols, has been the Distance Routing Effect Algorithm for Mobility. The introduction of this vector enhanced the ability of the location based protocol to determine the location of a destination with greater accuracy, and therefore brought about greater efficiencies to the original DREAM protocol

An attempt has been made to enhance the DREAM protocol, with the proposal of the Improved DREAM protocol. The Dynamic Source Routing (DSR) protocol has also been studied as a comparison to traditional source routing based protocols. Results from simulations conducted showed that iDream introduced a slight improvement on the Dream protocol, in each case studied particularly, improvement was pronounced at

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higher speeds, indicating that the iDream protocol is more efficient at higher speeds. Therefore, iDream may be better suited in a high mobility environment.

The end-to-end delays introduced by iDream was also studied as a part of the theses and found to be lower than the Dream protocol. End-to-end delay signifies the time taken for a data packet to reach its destination, once generated by the source. The lower end-to-end delays for the iDream protocol indicates that data packets reach the destination faster at higher speeds as compared to the Dream protocol.

Control and data packet overheads were also studied, as the number of these packets represents the overall efficiency of the protocol. For both the Dream and iDream protocols the overhead is found to be similar given that the underlying algorithms of the protocols remain the same.

It is seen that at higher speeds, both Dream and iDream protocols perform better or equal to the DSR protocols. Therefore, Dream and iDream protocols may be better suited in a high mobility environment. In addition to the above conclusions, there are areas where research may be conducted to further understand the nature and application of the iDream protocol.

In the current implementation, when data is received by the destination, it may be beneficial for the data and packets to record the exact nodes in all the hops. Once this route has been determined, the source node can specify this path information to the next data packets and limit the multicasting of data packets to too many nodes. This would improve the data packet overload within the network.

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