An Information Theoritic Approach For Zone Routed Network

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ABSTRACT

We extend an information theoretic approach for finding a minimum cost in tracking the motion state in an dynamic adhoc network. . The motion state information of a network is composed of parameters such as location, velocity and link state. The communication network states keeps change over time because of its dynamic nature. In dynamic network with mobile nodes the motion state information is tracked. Motion state is tracked by the master node, in which the master node is taken as random. Under Brownian motion and Gauss-Markov mobility models, we achieve to evaluate lower bounds of tracking the motion state information of nodes. We apply the obtained results to analyze the Zone routing overhead in mobile adhoc network. Thus the minimum overhead incurred by maintaining the zone information of nodes in terms of node mobility, packet arrival process, and distortion bounds.

Keywords: *minimum cost, motion state, lower bounds.*

1 INTRODUCTION

IN this paper, we study communication networks whose state keeps changing over time. Here, the state information of a network may be composed of link states, node locations, velocity of nodes, etc. In many cases, keeping track of the state information of a dynamic network so as to maintain a timely view of the network is a crucial task. For example,

- In a mobile ad hoc network, a geographic routing protocol requires to maintain node locations (and velocities in some cases, e.g.,) in order to make proper routing/forwarding decisions for data packets.
- In a military wireless network (or a rescue and recovery mission), a commander may need to know the locations of all the (mobile) soldiers in a dynamic chaotic environment.

A mobile *Ad hoc* network (MANET) consists of wireless mobile nodes (MNs) that cooperatively communicate with each other without the existence of a fixed network infrastructure. Depending on different geographical topologies, the MNs are dynamically located and continuously changing their locations. The fast-changing characteristics of MANETs make it difficult to discover routes between MNs. It becomes important to design efficient and reliable routing protocols to maintain, discover, and organize the routes in MANETs. Recent interest in the design of *ad hoc* routing algorithms include applications for the military, intervehicle communication, personal communication services, and sensor networks.

Mobility models are represented by the movement of mobile users, and they change their location, velocity and acceleration over time. These models are used for simulation purposes. For mobility modelling, the activity of a movement of user can be described using both analytical and simulation models. When evaluating mobility models for wireless ad hoc networks with respect to performance or functional correctness, several assumptions have to be decided upon. Such assumptions may include the size and shape of the area used by the wireless devices, their transmission ranges and their movement patterns including allowed directional changes and speeds.

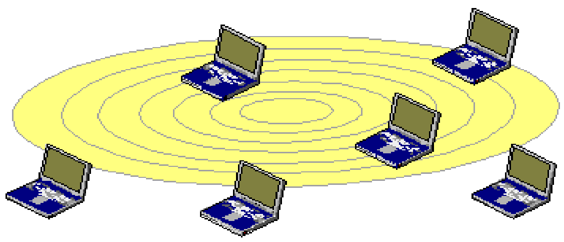

Fig. 1: *Adhoc client to client*

Infrastructure based networks pass information through a central information hub which can be a hardware device or software on a computer. An ad hoc network is infrastructure less network that is one where there are no access points passing information between participants. It can be thought of as a peer-to-peer network for the wireless age. Peer-to-peer or workgroup style networks were used to create a network environment for early Windows computers. This allowed these early computers to connect to each other to exchange information, usually in a smaller office environment without the need for domains and the additional management.

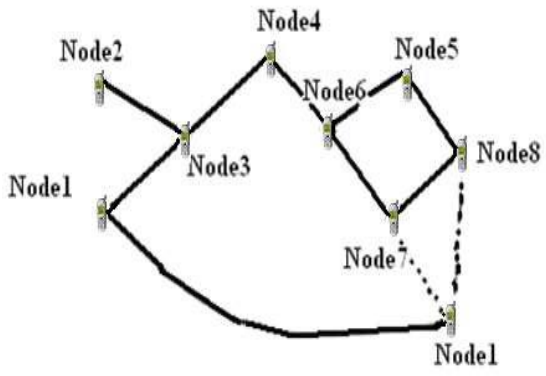

Fig.2: Movement in Adhoc Network

A number of *ad hoc* routing protocols have been developed for MANETs. The topology-based routing protocols can be categorized into proactive (such as destination sequence distance vector and wireless routing protocol (WRP) a reactive algorithms (such as *ad hoc* on-demand distance vector routing, dynamic source routing (DSR), temporally ordered routing algorithm (TORA), associatively-based routing (ABR), and signal stability based adaptive routing. The proactive routing protocols periodically maintain tables at each MN. The routing tables record persistent and up-to date information within the changing network topologies. The proactive algorithms offer reliable routing information between the MNs, while the overhead for maintaining the routing tables can be rapidly increased as the expansion of the MN's numbers and mobility within the network. The reactive algorithms initiate route discovery processes based on the request from the source node. The routing tables are only maintained within the requested routes from the source to the destination nodes. The on-demand characteristics of the reactive algorithms generate less routing overhead compared with the proactive routing protocols. However, additional delay has been incurred by the route discovery processes within the reactive algorithms.

This paper is organized as follows: Section 2 discusses proposed system. Section3 discusses the schemes relevant to those proposed in this paper. Section 4 draws conclusions.

2 PROPOSED SYSTEM

The existing system is already implemented in geographic network. In this paper, we consider dynamic networks with mobile nodes where the state information being tracked is the motion state of nodes. Here, the motion state of a node can be (any combinations of) the location, velocity and/or acceleration of the node. The minimum overhead is the minimum amount of state information rate needed such that the current state of nodes of the network can be identified within a certain distortion bound.

Consider the scenario where the motion state of nodes of a dynamic network is tracked by a network master at a sequence of time instants. Here, the network master could be any node of the network and is also called "the master node." In the analysis, the actual motion state of a node and the motion state perceived by the master node are both treated as random processes. Here to find the minimum cost in tracking the motion state in an dynamic network, is by implementing in Zone routed network, since they follow a mater and slave methodology. The master node will be

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responsible for the data transmission and to communicate with the other slaves nodes in the adhoc network.

In zone network the zone managers who will act as a master nodes to communicate with the other network managers. To reduce the overhead of nodes in the dynamic network, the master node(which is taken as random)will prioritize the velocities of all the slave nodes and will fix up a threshold value for velocity so that if a slave nodes velocity is greater than the threshold value the master will intimate to the slaves.

3 RELATED WORK

Tracy Camp, Jeff Boleng, Vanessa Davies., studied a survey of Mobility Models for Adhoc Network. In the performance evaluation of a protocol for an ad hoc network, the protocol should be tested under realistic conditions including, but not limited to, a sensible transmission range, limited buffer space for the storage of messages, representative data traffic models, and realistic movements of the mobile users (i.e., a mobility model).

This paper is a survey of mobility models that are used in the simulations of ad hoc networks. We describe several mobility models that represent mobile nodes whose movements are independent of each other (i.e., entity mobility models) and several mobility models that represent mobile nodes whose movements are dependent on each other (i.e., group mobility models*)*. It also presents the simulation results that illustrate the importance of choosing a mobility model in the simulation of an ad hoc network protocol. Specifically, illustrate how the performance results of an ad hoc network protocol drastically change as a result of changing the mobility model simulated.

In order to thoroughly simulate a new protocol for an ad hoc network, it is imperative to use a mobility model that accurately represents the mobile nodes (MNs) that will eventually utilize the given protocol. Only in this type of scenario is it possible to determine whether or not the proposed protocol will be useful when implemented. Currently there are two types of mobility models used in the simulation of networks: traces and synthetic models. Traces are those mobility patterns that are observed in real life systems. Traces provide accurate information, especially when they involve a large number of participants and an appropriately long observation period. However, new network environments (e.g. ad hoc networks) are not easily modelled if traces have not yet been created. In this type of situation it is necessary to use synthetic models. Synthetic models attempt to realistically represent the behaviors of MNs without the use of traces. It present several synthetic mobility models that have been proposed for (or used in) the performance evaluation of ad hoc network protocols.

A mobility model should attempt to mimic the movements of real MNs. Changes in speed and direction must occur and they must occur in reasonable time slots. For example, we would not want MNs to travel in straight lines at constant speeds throughout the course of the entire simulation because real MNs would not travel in such a restricted manner. This section discusses seven different synthetic entity mobility models for ad hoc networks: Random Walk Model, ii) Random Way Point Model, iii) Random Direction Mobility Model, iv) A Boundless Area Simulation Model, v) Gauss Markov Mobility Model, vi) Probabilistic version of Random Walk Mobility Model, vii) City Section Mobility Model. Among these Mobility models Random Walk Model and Gauss Markov model are taken into consideration.

3.1 Random Walk Mobility Model

The Random Walk Mobility Model is a widely used mobility model, which is sometimes referred to as Brownian Motion. In its use the model is sometimes simplified. In this mobility model, an MN moves from its current location to a new location by randomly choosing a direction and speed in which to travel. The new speed and direction are both chosen from pre-defined ranges, [*speedmin*; *speedmax*] and $[0;2\pi]$ respectively. Each movement in the Random Walk Mobility Model occurs in either a constant time interval t or a constant distance traveled d, at the end of which a new direction and speed are calculated. If an MN which moves according to this model reaches a simulation boundary, it “bounces” off the simulation border with an angle determined by the incoming direction. The MN then continues along this new path.

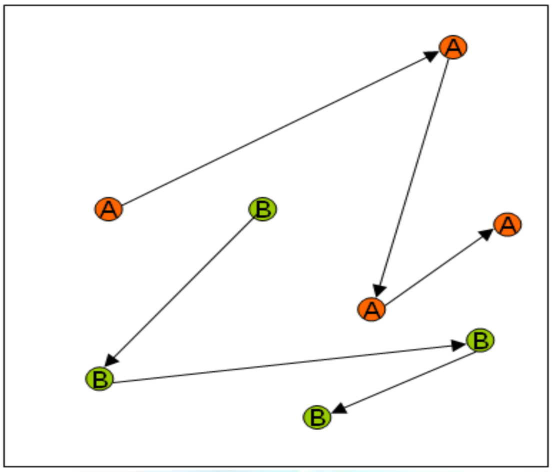

Fig.3: Movement under RWM

In the Random Walk Mobility Model, an MN may change direction after traveling a specified distance instead of a specified time. For example, the MN travels for a total of 10 steps (instead of 60 seconds) before changing its direction and speed.

3.1 Discussion

The Random Walk Mobility Model is a memory less mobility pattern because it retains no knowledge concerning its past locations and speed values. The current speed and direction of an MN is independent of its past speed and direction. This characteristic can generate unrealistic movements such as sudden stops and sharp turns.

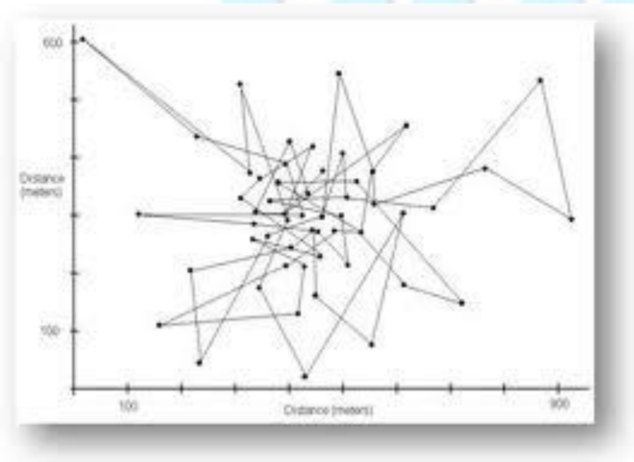

Fig.4: *Travelling pattern of MN in RWM*

If the specified time (or specified distance) an MN moves in the Random Walk Mobility Model is short, then the movement pattern is a random roaming pattern restricted to a small portion of the simulation area. Some simulation studies using this mobility model set the specified time to one clock tick or the specified distance to one step. The Random Walk Mobility Model when the MN is allowed to move 10 steps (not one) before changing direction; as shown, the MN does not roam far from its initial position.

In summary, the goal of the performance investigation is to evaluate a semi-static network, then the parameter to change an MN's direction should be given a small value. Otherwise, a larger value should be used.

3.3 Gauss Markov Model

The Gauss-Markov Mobility Model was originally proposed for the simulation of a PCS. However, this model has been used for the simulation of an ad hoc network protocol.
The Gauss-Markov Mobility Model was designed to adapt to different levels of randomness via one tuning parameter. Initially each MN is assigned a current speed and direction. At fixed intervals of time, *n*, movement occurs by updating the speed and direction of each MN. Specifically, the value of speed and direction at the *nth* instance is calculated based upon the value of speed and direction at the (*n*-1)*st* instance and a random variable using the following equations:

$$sn = \alpha n-1+(1-\alpha)s+ q(1-\alpha 2)sxn-1$$
$$dn = \alpha dn-1+(1-\alpha)d+ q(1-\alpha 2)dxn-1$$

where *sn* and *dn* are the new speed and direction of the MN at time interval *n*; α, where 0 <= a <= 1, is the tuning parameter used to vary the randomness; *s* and *d* are constants representing the mean value of speed and direction as *n* -> α; and *sxn*-1 and *dxn*-1 are random variables from a Gaussian distribution. Totally random values (or Brownian motion) are obtained by setting α = 0 and linear motion is obtained by setting α = 1. Intermediate levels of randomness are obtained by varying the value of a between 0 and 1. At each time interval the next location is calculated based on the current location, speed, and direction of movement. Specifically, at time interval *n*, an MN's position is given by the equations:

xn = xn-1+sn-1 cosdn-1
yn = yn-1+sn-1 sindn-1

where (*xn*;*yn*) and (*xn*-1;*yn*-1) are the *x* and *y* coordinates of the MN's position at the *nth* and (*n*-1)*st* time intervals, respectively, and *sn*-1 and *dn*-1 are the speed and direction of the MN, respectively, at the (*n*-1)*st* time interval.
To ensure that an MN does not remain near an edge of the grid for a long period of time, the MNs are forced away from an edge when they move within a certain distance of the edge. This is done by modifying the mean direction variable *d* in the above direction equation. For example, when an MN is near the right edge of the simulation grid, the value *d* is changed to 180 degrees. Thus, the MN's new direction is away from the right edge of the simulation grid.

Kai-Ten Feng, have proposed the proposed velocity-aided routing (VAR) algorithm determines its packet forwarding scheme based on the relative velocity between the intended forwarding node and the destination node.
The proposed velocity-aided routing (VAR) algorithm determines its packet-forwarding scheme by calculating the relative velocity between the potential forwarding nodes and the destination node. This scheme forwards the data packets via those intermediate nodes that are faster approaching the destination node. The Gauss–Markov mobility (GMM) model and the constant speed mobility (CSM) model are utilized in the design of the VAR algorithm to calculate the MN's speed and moving angle. The benefit of using the GMM model is that it can be utilized to adaptively emulate possible moving behavior with certain levels of linear and Brownian motions.

3.4 VAR Protocol

GMM Model: The GMM model is adapted in this paper to represent the motion of each MN. The moving direction α_k (with respect to the positive *x*-axis) and the speed V_k of each MN at a discrete time instant t_k can be formulated as

$$\alpha_k = \gamma_1 \alpha_{k-1} + (1 - \gamma_1).\alpha + \_(1 - \gamma_{21}) X_{\alpha_{k-1}}$$
$$V_k = \gamma_2 V_{k-1} + (1 - \gamma_2) \,.\, V + \_ \,(1 - \gamma_{22}) X_{V_{k-1}}$$

The benefit of using the GMM model for the MN's movement is that it preserves certain levels of 1) motion randomness and 2) memories from previous time steps as the parameter γ_i varies.

3.5 VAR algorithm

The proposed algorithm determines the feasible MNs for packet forwarding based on the relative velocity between the forwarding node N_i and the destination node *D*. The VAR algorithm is designed by predicting the motion of *D* using either the GMM model or the CSM model as follows:-

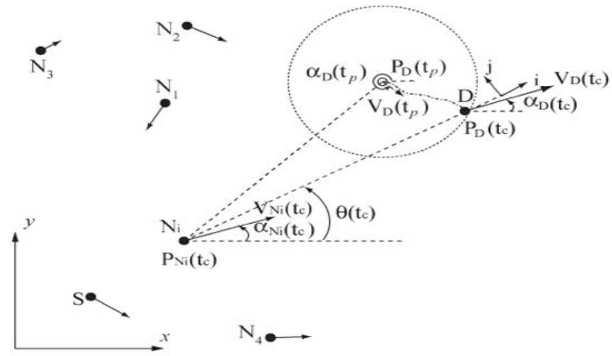

Fig.5: Schematic of the VAR scheme using the GMM model

VAR Using the GMM Model (VAR-GMM)

Fig. 5 shows the schematic of the VAR algorithm using the GMM model. The source node S initiates a route discovery process to the destination node D via some of the intermediate nodes N_i. After beaconing within the neighborhood of S, an RREQ packet is sent to an intermediate node N_i at the time instant t_c.

The location information of N_i, including its position PNi (tc), velocity VNi (tc), and heading angle αNi (tc), is obtained from its positioning system at the current time instant tc. On the other hand, the location information of [i.e.,PD(tp), VD(tp),and αD(tp)] was obtained by S at a previous time instant tp and was forwarded to N_i via the RREQ packet. By adopting the GMM model, the current location information of D [i.e.,PD(tc), VD(tc), and αD(tc)] can therefore be calculated from the previous time instant tp .

The main concept of the VAR algorithm is to compare the velocity information between the intermediate node Ni with that of D while the RREQ packet has arrived in Ni at the current time tc. The proposed VAR algorithm utilizes the following two criterions to determine if the intermediate node Ni is suitable as the forwarding node for packet delivery. The first criterion of the VAR algorithm indicates that the potential forwarding node Ni should move toward the destination node D along their connecting line (i.e., the ith direction as shown in Fig. 5), while the second criterion is used to limit the relative speed between Ni and D along their perpendicular direction.

Tanweer Alam and B.K Sharma proposed a new Optimistic Mobility model for Adhoc Network. In their paper they developed a complete environment in which network protocols can be studied on the basis of numerous performance metrics and they also observe that the performance of ad hoc network protocols is affected when different mobility scenarios are utilized.

Proposed New Mobility Model and Path finding Algorithm.

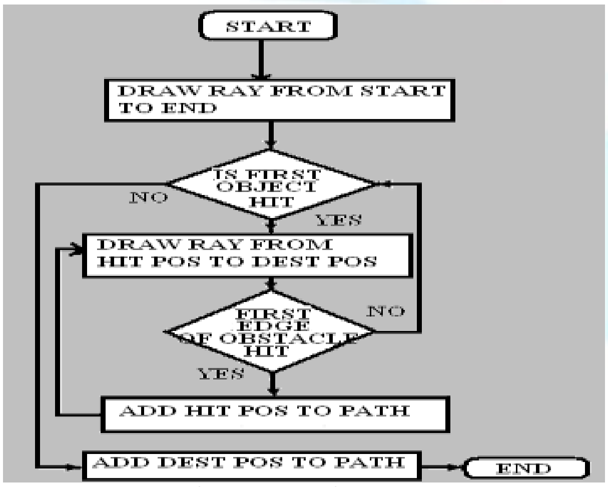

Fig.6 Path finding process flow

A path is a set of location points which form adjacent segments and no segment intersects with an obstacle in the environment.
The algorithm is as follows.

Step 1: Initialize the starting and ending point.
Step 2: Draw ray between these two points.
Step 3: is first object hit? If yes go to step 4, otherwise go to step 7.
Step 4: draw ray from hit position to destination position.
Step 5: Now check first edge of obstacle hit. If it is then go to step 6 otherwise go to step 3.
Step 6: add hit position to path. Go to step 4.
Step 7: add destination position to path. Go to step8.
Step 8: stop.

4 CONCLUSION

In a dynamic adhoc network when nodes are deployed each node in the network has their own characteristic (speed, velocity and location)called the motion state. Here, the motion state of a node can be (any combinations of) the location, velocity and/or acceleration of the node. The minimum overhead is the minimum amount of state information rate needed such that the current state of nodes of the network can be identified within a certain distortion bound. Since it's a dynamic network nodes keeps on changing the direction and speed. The overhead can be controlled by reducing the speed of the nodes in the network. In adhoc network the master node will be responsible in giving the needed information to the slave nodes in the adhoc network. The master in the adhoc network is fixed with their highest energy node in the network. The overhead can be reduced by prioritizing the velocities of all the slave nodes and master node will fix up a threshold value for velocity so that if a slave nodes velocity is greater than the threshold value the master will intimate to the slaves.

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