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A Modified Stochastic Location Update Scheme In Mobile Ad-hoc Networks

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***Abstract*— One of the major issues in MANETs is to track the location of the users. Since mobile users are free to move within the coverage area, the network can only maintain the approximate location of each user. When a connection needs to be established to a particular user, the network has to determine the user's exact location. The operation of the mobile terminal informing the network about its current location is known as location update, and the operation of the network determining the exact location of the mobile user for the purpose of call notification is called terminal paging or searching. Over the past few years several location update schemes have been developed. Here we can see a modified stochastic location update scheme which is better than other methods.**

***Index Terms*—MANETs, location update, paging, stochastic location update.**

I. Introduction

A "mobile ad hoc network" (MANET) is an autonomous system of mobile routers connected by wireless links. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. One of the major issues in MANET is to track the location of the users. Since mobile users are free to move within the coverage area, the network can only maintain the approximate location of each user. When a connection needs to be established to a particular user, the network has to determine the user's exact location within the cell granularity. The operation of the mobile terminal informing the network about its current location is known as location update, and the operation of the network determining the exact location of the mobile user for the purpose of call notification is called terminal paging or searching.

In MANETs each node needs to maintain its location information by 1) frequently updating its location information within its neighboring region, which is called neighborhood update (NU), and 2) occasionally updating its location information to certain location server in the network, which is called location server update (LSU). If both NU and LSU operation carried out by each node it should possess control and cost overhead. Over the past few years several location update schemes have been developed. Location update algorithms can be divided into two main groups: static and dynamic. In a static algorithm, location update is triggered based on the topology of the network. Examples include the conventional location area (LA)-based scheme used in GSM. In a dynamic algorithm, location update is based on the user's call and mobility patterns. Examples include the distance-based, time-based, and the movement-based schemes.

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II. Literature Survey

A location update is used to inform the network of a mobile device's location. This requires the device to register its new location with the current base station, to allow the forwarding of incoming calls. Each location update is a costly exercise, involving the use of cellular network bandwidth and core network communication; including the modification of location databases. A wide variety of schemes have hence been proposed to reduce the number of location update messages required by a device in a Ad Hoc network. Location update schemes are often partitioned into the categories of static and dynamic.

Static Location Update Schemes

Static schemes define the frequency and occurrence of location updates independently from any user characteristics. Cells within a network are grouped into Location Areas (LAs). Users are free to move with a given location area without updating their location, informing the network only when transitioning to a new LA. If a call is to be forwarded to a user, the network must now page every cell within the location area to determine their precise location [1].

Dynamic Location Update Schemes

Unlike static location management strategies, a location update may be performed from any cell in the network, taking into consideration the call arrival and mobility patterns of the user. The important dynamic location update schemes are time-based, movement-based, distance-based, hybrid schemes and stochastic location update [1].

A. Time-Based Update

The time-based strategy requires that users update their location at constant time intervals. This time interval may then be optimized per-user, to minimize the number of redundant update messages sent. This only requires the mobile device to maintain a simple timer. The network is able to determine if a mobile device is detached if it does not receive an update at the expected time. This scheme does however entail a high degree of overhead in a number of situations, such as when a user has only moved a very small distance or has not moved at all.

B. Movement-Based Update

This scheme requires mobile devices to update their location after a given number of boundary-crossings to other cells in the network. This boundary-crossing threshold may be assigned per-user, optimized for individual movement and call arrival rates. The required paging area is restricted to a neighborhood of radius equal to the distance threshold around the last updated location. The paging area requirement is reduced through this scheme, although unnecessary updates may still be performed as a result of repeated crossings over the same cell boundary. hen you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables. partitioned into the categories of static and dynamic.

C. Distance-Based Update

In a distance-based scheme the mobile device performs a location update when it has moved a certain distance from the cell where it last updated its location. Again, this distance threshold may be optimized per-user according to movement and call arrival rates. Distance-based update strategies are quite difficult to implement in a real-world network. Each mobile node is required to track its location and determine the distance from the previously updated cell. This not only requires the device to retain information about its starting position, but also to possess some concept of a coordinate system, allowing the calculation of distance between the two points.

D. Hybrid Location Update

In the hybrid scheme, a mobile user updates its location after the following two events have occurred: First, the mobile crossed n cell boundaries, and then, a time interval T elapsed (NAT). We also examine the inverse scheme, where an update is performed after the n boundary crossings occur subsequent to the time interval T (TAN) [2].

E. Stochastic Location Update

The location update problem at a node can be formulated as a Markov Decision Process (MDP), under a widely used Markovian mobility model. As the location update decision needs to be carried out in each time slot, it is natural to formulate the location update problem as a discrete-time sequential decision problem. Under the given Markovian mobility model, this sequential decision problem can be formulated with a MDP model. An MDP model is composed of a 4-tuple {S, A, P(./s, a), r(s, a)}where S is the state space, A is the action set, P(./s,a) is a set of state- and action-dependent state transition probabilities, and r(s,a) is a set of state- and action- dependent instant costs.

The objective of the location update decision problem at a node can be stated as finding a policy to minimize the expected total cost in a decision horizon. By analyzing the location update problem using MDP model it can be partitioned into two sub problems: the NU decision sub-problem and the LSU decision sub-problem, and they can be solved separately without loss of optimality. In MDP model the mobile nodes which have high velocity should only perform the LSU operation, instead of updating all nodes. So the total cost will be reduced [3].

III. Mobility Models

The mobility pattern also plays an important role when evaluating the performance of a location management scheme. A mobility model is usually used to describe the mobility of an individual subscriber. Sometimes it is used to describe the aggregate pattern of all subscribers. The following are several commonly used mobility models [1].

A. Fluid Flow Model

The fluid flow model has been used to model the mobility of vehicular mobile stations. It requires a continuous movement with infrequent speed and direction changes. The fluid flow model is suitable for vehicle traffic in highways, but not suitable for pedestrian movements with stop-and-go interruption.

B. Coordinate system

The distance based scheme needs to possess some concept of a coordinate system, allowing the calculation of distance between the two points. In order for the terminal to easily identify LA boundary crossings, base stations can be placed in a coordinate system, which identifies their geographic location in the network. The coordinate system used should reflect the layout of the network taking into account cells shapes and network boundaries. Beginning from the center cell each neighboring cell is given a relative coordinate in two dimensions. It is then very simple for a terminal to determine the distance from any given cell from the initial cell using a simple vector operation: r = [y x] current - [y x] center [4].

C. Random walk model

The random walk mobility model is regularly used to model the movements of users in a cellular network. It assumes that the direction of each user-movement is completely random, and hence each neighboring cell may be visited with equal probability. This model is easily implemented, as it requires no state information to predict the next cell occupied by a user. In a two-dimensional random walk model, it is capable of representing both cell crossing rate and cell residence time, for either square or hexagonal cells.

D. Modified Random walk model

In this model, when the MT leaves its current cell, it moves to one of its six neighboring cells with probability 1/6. In the proposed model a single parameter, a, will provide directionality to the MT. The cells are divided into two sets. In the first set, there are cells that limit with three neighboring cells in their contiguous outer ring. Such cells are labeled as (x; 0). In the second set, cells are bordered by two neighboring cells in the outer ring. The transition probabilities from one cell to another are defined according to the movement of a given MT that implies a movement to the outer ring (P outer ring), a movement to the same ring (P same ring) and a movement to the inner ring (P inner ring). Then, for cells of type (x; 0) with x = 1,2,… the p outer ring = a/3(1+a) and p same ring = p inner ring = 1/3(1+a). Similarly for cell of type (x, i) for x=1, 2, … p outer ring = a/2(2+a) and p same ring = p inner ring = 1/2(2+a) [5].

E. Markovian Movement Model

It defines distinct probabilities for movement from a given cell to each of its neighbors. These probabilities are dependent on individual user movement histories. This scheme is based on the assumption that a user moving in a given direction will continue in a similar direction with greater probability than a divergence from course. Under Markovian analysis, the time-based scheme is found to perform better. Under a Markovian mobility model, the location update decision problem is modeled as a Markov Decision Process (MDP). MDP is a discrete time stochastic control process. At each time step, the process is in some state , and the decision maker may choose any action that is available in state.

IV. Modified Stochastic Location Update Scheme

The basic idea behind this approach is MDP approach. But here the difference is that the entire region is divided into sub regions. Each sub region consists of one location server labeled as LS. For the entire region there will be one Main Server (MS). Every node within a sub region will send their location server update messages to their LS. And periodically these LSs will send these messages to the Main Server. So the traffic can be reduced very much.

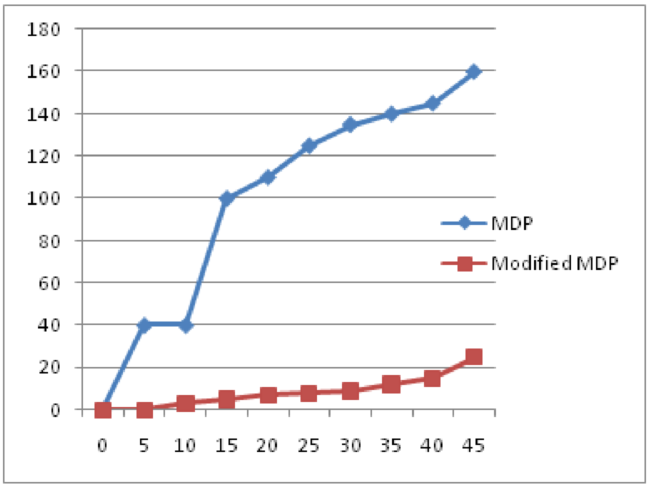

Figure 1:Comparison Graph For Drop

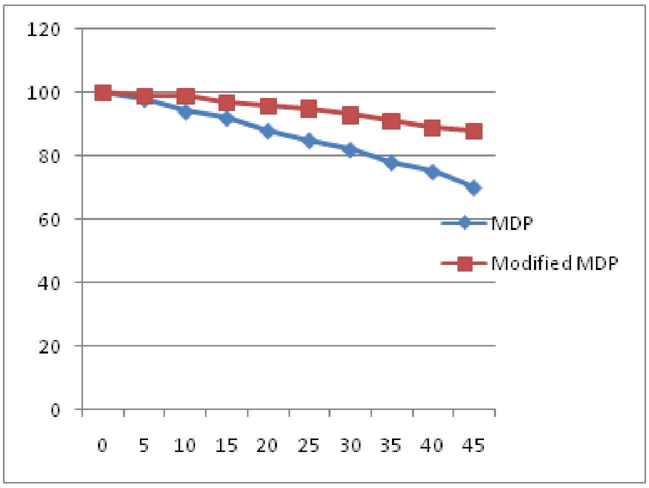

Figure 2:Comparison Graph For energy

V. Results

For comparing different methods we can use the parameters like the number of packets dropped, the throughput of the system, and the energy levels of the nodes etc. If we are considering the total number of packets dropped, in MDP based approach the drop is very much less than the time-based approach as the time goes. The energy level of the nodes in MDP approach is higher than time-based approach at the end of the transactions. Because the number of update messages sent in MDP model is less than the other model. If we consider the throughput also, the MDP approach has high throughput. So, from the comparison graphs we can say that the MDP approach is better than the time-based approach.

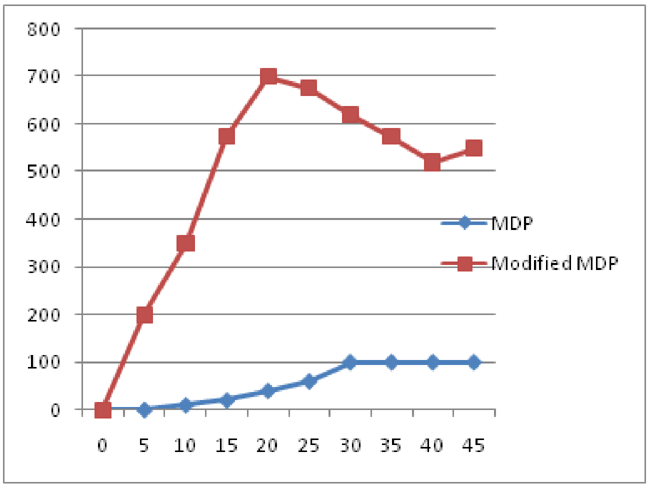

Figure 3:Comparison Graph For throughput

Next consider the comparison between the MDP based approach and modified approach. If we are considering the total number of packets dropped, in MDP based approach the drop is high than the modified approach as the time goes as shown in Figure 1. The energy level of the nodes in MDP approach is less than modified approach at the end of the transactions which is shown in Figure 2. Because the number of update messages sent in modified model is less than the other model. If we consider the throughput also, the modified approach has high throughput. So, from the comparison graphs we can say that the modified approach is better than the time-based approach and MDP approach.

VI. Conclusion

This paper has surveyed research on location management in MANETs. Location management involves two operations: location update and paging. There are several location update strategies have been proposed. We have also seen various mobility models used to describe the user's mobility pattern. Out of these the modified stochastic location update strategy based on markovian mobility model reduces the traffic and thus cost and control overhead.

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