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A Novel Concept of MANET Architecture for Location Based Service Using Circular Data Aggregation Technique

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Abstract:
MANET is an autonomous system of mobile nodes connected by wireless links. Localization in MANET refers to the problem of finding the locations of non-GPS enabled nodes based on limited information like locations of some known beacons and measurements such as ranges or angles among the neighbors. In this paper a circular system model is proposed and it decreases location management overhead in the network. The simulation results show that under a specific environment the protocol delivers packets efficiently and also the proposed routing scheme scales well with large network area.

Key words: *MANET- Mobile Ad-hoc Network, Location management, mobility model*

1. Introduction

Mobile Adhoc Networks [1] [2] [3] are collective arrangement of mobile nodes that can communicate with one another without the aid of any centralized point. Adhoc networks make practical and effective use of multi hop radio relaying and radio communication channel. It [4] is very important for one mobile host to enlist the aid of other hosts in forwarding a packet to its destination, due to the limited range of each mobile node's transmission. With the enhancement of technology, this network could be managed by end users, rather than single authority and they may be used for extremely sensitive applications. In adhoc networks, node mobility is an important issue due to adhoc characteristics such as dynamic network topology, shared medium, limited bandwidth, multihop nature and security etc. Thus, there is requirement of effective mobility management scheme i.e. seamless mobility in adhoc networks. Seamless mobility provides easy access and effective communication among nodes present in the network. A Mobile Ad Hoc network (MANET) is a kind of wireless network with no access point. In a MANET it is assumed that the nodes are free to move and are able to communicate with each other, often through multi-hop links, without the help of a fixed network infrastructure. The network topology is dynamic. The movement of a node out of or in the Communication ranges of other node changes not only its neighbour relationships with those other nodes, but also changes all routes based on those relationships. Signalling overhead traffic for establishing and maintaining routes in a MANET is proportional to the rate of such link changes. Thus the performance of a MANET is closely related to the efficiency of the routing protocol in adapting to changes in the network topology and the link status [5], [6] For the performance evaluation of a routing protocol for a MANET, it is imperative to use an appropriate mobility model to simulate the motion of the nodes in a network [7]. In this paper we present some mobility models that have been proposed, or used in, the performance evaluation of Ad Hoc network protocols. The models presented are the random waypoint mobility model [5], the random Gauss-Markov model [8], [9], and the reference point group mobility model [10].

Mobility models in adhoc networks depict [10] movement pattern of mobile users and how their location, velocity, speed, direction and acceleration change over time. In these networks, mobile nodes communicate directly with each other. Communication between two nodes does not produce effective results if both nodes are not in same transmission range. This problem can be resolved by using intermediate nodes with routing. Thus, routing is very important in mobile adhoc networks where mobility models must be evaluated with respect to end to end delay and efficient data transmission. Mobility models are intended to focus on individual movement patterns due to point to point communication in cellular networks [11], [12] [9] whereas adhoc networks are designed for group communication. Such models [13] are suggested to maintain movement, and efficient transmission among nodes in real life applications. In addition to this, these models mainly focus on the individual motion behaviour between mobility eras with minimum

simulation time in which a mobile node moves with constant speed and direction. These models represent the features of the mobile nodes in an adhoc network like speed, direction, distance and node movement. Mobility models [7] can be categorized based on the following criteria which is based on dimension, scale of mobility, randomness, geographical constraints, destination oriented and by changing parameters (discussed in next section). Generally, there are two types of mobility models (i) Trace based mobility models and (ii) Synthetic mobility models. Trace models provide mobility patterns based on deterministic approach whereas synthetic models presents movements of mobile nodes in realistic manner. In section 2 we give an overview of related work which identifies all the major research work being done in this area. Section 3 highlights about the proposed system. Module description is discussed in Section 4 followed by implementation and analysis in Section 5. Section 6 discusses some concluding remarks.

The present Location management is an important problem in distributed mobile computing. Location management consists of location updates, searches and search-updates. An update occurs when a mobile host changes location. A search occurs when a mobile host needs to be located [14]. The requirements of several location-intensive mobile commerce applications and integrated location management architecture are required to support these requirements. A novel two-dimensional (2-D) random-walk mobility model can be used for studying and analyzing the location-area crossing rate and dwell time of mobile users in wireless networks [16].

A location management system is able to gather process and manage location information from a variety of physical and virtual location sensors [17]. The static LM schemes are becoming increasingly out of date [18]. A novel architecture and mechanism for Context Based Location management (CBLM) using mobile agent through sensors processed parameters values that determined the cluster head creation and updates if required and Location Management. The concept for representing location vocabularies, matching and mapping them, how these vocabularies can be used to support better privacy for users of location-based services, and better location sharing between users and services [20]. A complete and novel location management scheme which addresses the weaknesses present in previous proposals, while maintaining a high level of implementation feasibility [21]. The classification of location management methods published up to now and presents results of a related extensive performance comparison of the most important paradigms for location management in cellular networks [22]. In a cellular network, a service coverage area is divided into smaller areas of hexagonal shape, referred to as cells. The cellular concept was introduced to reuse the radio frequency [23]. The weak points have been identified and discussed the schemes to eliminate or reduced these weak points. This chapter has reviewed several individualized and dynamic schemes that are able to more evenly distribute the signaling burden of location updates [24]. A surveyed research on location management in cellular networks shows the effectiveness in terms of high delivery ratio [25]. By applying the distributed database selection technique of GLS, a hierarchical location management scheme may be realized for MANETs based on link state routing that equitably distributes location server functionality among network nodes [26]. Two novel location management strategies are identified hierarchical and de-centralized [27]. A theoretic framework is used to show the asymptotic scalability of three location management protocols. They also carry out extensive simulations to study the performance of these protocols under practical considerations [28]. An approach to the total cost estimation of variable velocity mobile location management for ad hoc mobile networks with missing measurements shows the cost effectiveness of different location management schemes [29].

2. Proposed System

The main aim of the proposed system is to design an architectural framework for modeling a robust scalable location management service for routing in mobile adhoc network which ensures very low overhead. In this project work, the focus is on presenting the proposed technique, a scalable location management service for routing in mobile ad-hoc networks that uses a circular system model and also provide security for the same. It has to show that the proposed system saves the communication overhead when all nodes are constantly up without losing the performances compared with the previous efficient location-based routing protocols especially in dense networks. The functional requirements of the proposed system are as follows:

- The system should able to deploy the nodes in random manner in n cylinders as well as total of 2n sectors in the cylinders.
- The system should able to design a mobility model using random waypoint model.
- The system should able to implement the routing protocols for location update packages that moves along the cylinder and location query packages move along the sector.
- The system should have an efficient updating process for the location server and packets of information being transacted by them.
- The system should not increase the network overhead (byte overhead) if the proposed algorithms are implemented in real sense.

This method supposes that nodes moves around and relay each other packet in a circular environment. This circle is divided into equal sectors and cylinders. Each area has a unique id. The proposed system architecture of the project work is shown in the Figure 1.

The architecture shows how the location management scheme is divided into different layers. Initially it considers all simulation parameters and in the next level it frames the location server. The location server in the basic sector is responsible for initiating the updating process. The two main process are location query and location update. In location query the sender needs to find out the location of destination and in location update all the mobile nodes location information is getting updated. It is very important to periodically update the location in MANET since the nodes are mobile which means it is keep on moving with random speed. Finally it needs to use a routing algorithm to send the packet from source to destination node. The last layer in the architecture shows the evaluation of results.

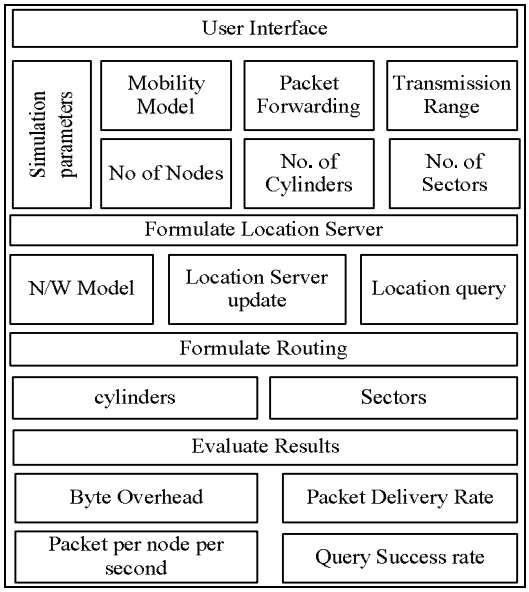

Figure 1: Proposed Architecture

The proposed system assumes a central point in each area. Nearest nodes to this central points in each area are selected as local server. Each local server is responsible for response to location queries for all owner member nodes. Location update packages move along the cylinder and location query packages move along the sector. These update and query propagation method decrease system response time, because the query packet traversed only one sector. One of the sectors is considered as basic sector. Location servers in basic sector periodically start to send location update packets in two directions. These packages gather updates of local servers from each area. All packages are sent by geographic method.

3. Module Description

The proposed system consists of following 3 modules:

3.1. System Model

Network area is modeled as a circle-shaped. This circle is divided into cylinder and sector as shown in figure 2. Each area is created by intersection between sectors and cylinders. Each node at any moment can stay in one of these areas.

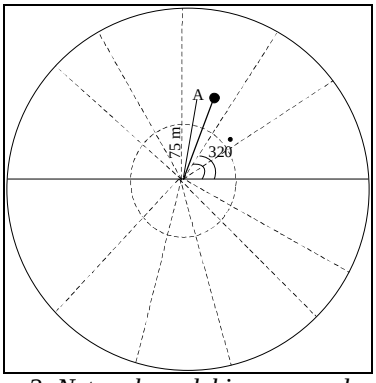

Figure 2: Network model in proposed system

Size of each zone must be set so that all nodes within that region will be in radio broadcast of local area server. Due to the local servers are located approximately at the center of each area. At the worst case the local server may not be located in the middle of area and may be in one of the corners. Then all the nodes within the area are in location server radio broadcasts. Each node with beaconing process can obtain direct neighbors locations. It calculates its own distance to area center and other neighbor nodes too. Closest node to area center point well is that location server. Therefore the local server of each area will be selected.

3.2. Location Server Update

In the proposed work, servers are located in central areas. One sector considered as basic sector to start location server update process as shown in figure 3. Selection of basic sector is predefined in network model. Server update packet is sent periodically. These periods grows as the cylinder size grows. These update packets use synchronize aggregated method and we use this method with a little change.

Location servers in each area in basic sector send two packets in clockwise and anti clockwise directions along on cylinder are on that. Each node that receive this packets if it is not server just forward packets to server on its area. Then apply member nodes location information changes and forward those to the next area. Update packets forward continues until packets reach to the basic sector again. Unlike conventional methods, so that once they attempted to gather information and then information collected will be sent. Receiving these update packets by server nodes in basic sector means that all location servers in cylinders are update and can respond to location queries.

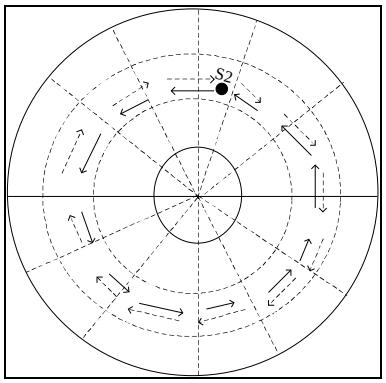

Figure 3: Servers update process in proposed system

3.3. Location Query

Location query process in the proposed system is done by sending a query packet in two different directions along the sector as shown in figure 4. When a source node wants to send the data to a destination node, if it doesn't become aware of destination's location, it should send a query packet to its location server. If the local server doesn't have destination position, had to find that. Intermediate nodes that receive the query packet, if they themselves have the destination's location, reply to query and send destination's location to source node, otherwise resend query packet to previous direction. The destination node is located in one of the cylinder; therefore one of the local servers has information of destination location. So finally one of the two packages can be answered and the source node will be aware destination location. To prevent the exit of location servers from the sector the first cylinder (cylinder number zero) and the last cylinder when receive query packet, don't resend it and if it cannot respond to query packet, it sends back an error message to requested node.

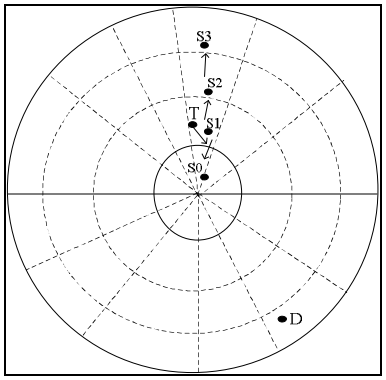

Figure 4: Location query process in proposed system

4. Implementation & Analysis

The proposed system is implemented in 32 bit Windows OS with 1.84 GHz Processor. The design environment is selected in Matlab. The process flow chart of the implementation phase is as shown in Figure 6. The mobile nodes use IEEE 802.11 radio and MAC model with bit rate 11Mbps and each radio range is approximately a disc with a 250 meter radius. The size of each simulation universe is chosen to maintain an average node density of around 100 nodes per square kilometer as shown in figure 8. Each simulation runs for 300 simulated seconds. Each simulation runs for 300 simulated seconds. Each node moves using a random waypoint model. The node chooses a random destination and moves toward it with a constant speed chosen uniformly between one and a maximum speed (10 m/s unless noted otherwise). When the node reaches the destination, it chooses a new destination and begins moving toward it immediately. All simulations use a pause time of 0 second. For two location service protocols, we chose a beacon period of 2 seconds and the value update period was fixed at 25s.

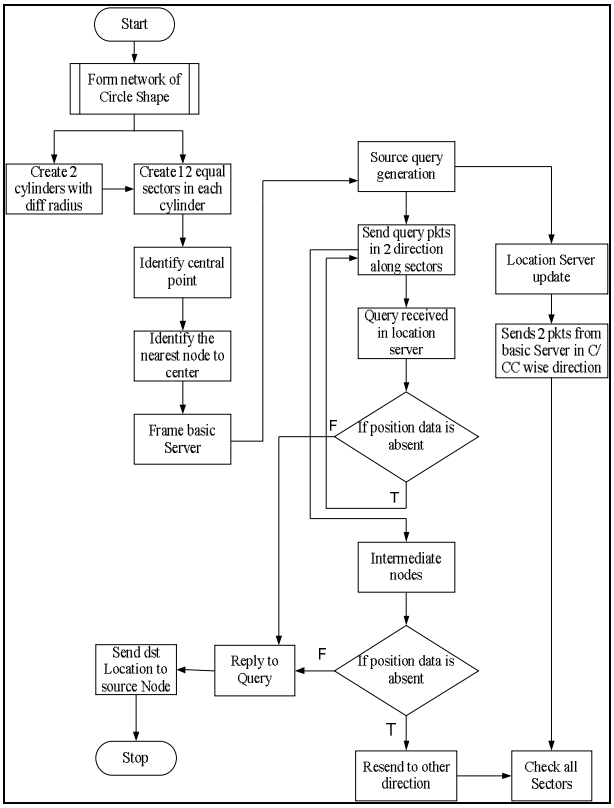

Figure 5: Implementation process diagram

The metrics Location Service protocol overhead, Packet delivery ratio and Query success ratio for location services are the parameters considered for performance analysis. The protocol overhead includes the number of location service protocol packets or bytes that transmitted during the simulation time, note that this excludes the overhead due to beaconing. The query pattern is chosen to study the efficiency of the query and update mechanism of two protocols. Every node in the network initiates certain number of queries to look up the location of randomly destinations at times randomly distributed between certain intervals of time. Also, if a query is not successful, no retry is initiated. To measure the accuracy of the query reply, when the query reply is received, each source sends a single data packet of size in bytes to that destination using the replied location, this for routing done after finding a route to destination. Hence the performance is highly optimized for the proposed system

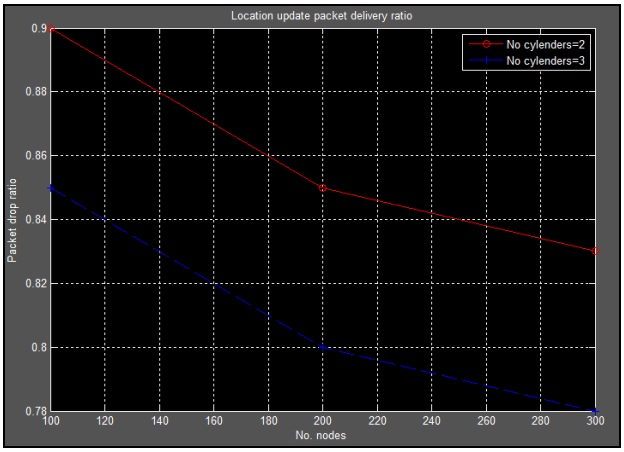

Fig 6: Location update packet delivery ratio

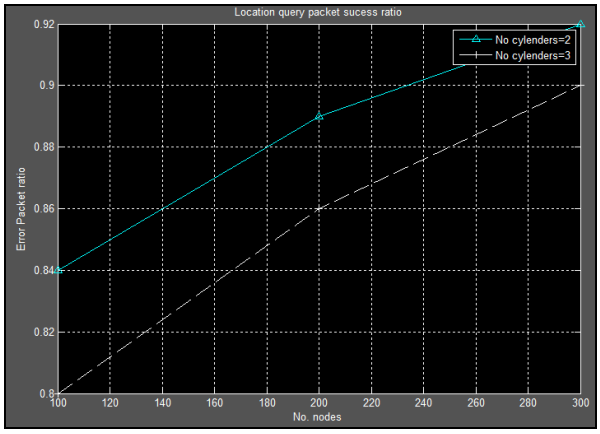

Figure 8: Location query packet success ratio

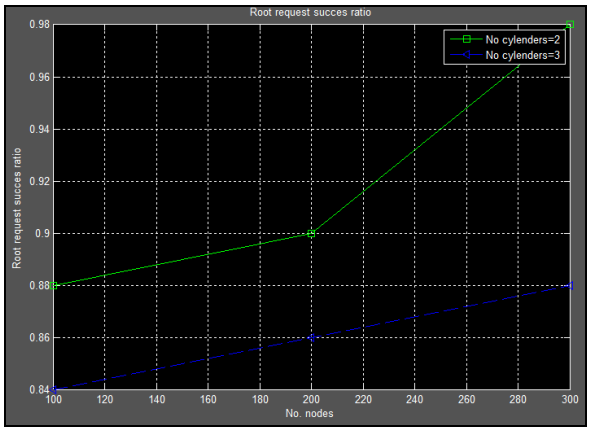

Figure 9: Root request success ratio

5. Conclusion

We have presented a scalable location management service for routing in mobile ad-hoc networks that uses a circular system model. The location management in mobile ad-hoc network is critical since the nodes are kept on moving. In this routing scheme the results shown that even though the network area increases it gives better performance in terms of update packet delivery ratio, location query packet success ratio and root request success ratio. The query packet traverses in only one sector so it takes less time to find the destination packet. It is concluded that our routing scheme scales well with good success ratio.

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