Algorithm for Finding the Mobile Phone in a Cellular Network

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Summary
A cellular network is a wireless network made up of a number of cells. Each cell is served by a fixed transmitter known as a Base Station(BS). These cells are used to cover different areas in order to provide more coverage area in the network. This paper proposes an algorithm, which deals with finding a mobile phone within a cell based on the cell-id, signal strength and hello-packet delay. The proposed model is simulated and tested under various conditions and it has shown excellent results while finding mobile phone in the network.

Key words:
Mobile phone, cell-id, location management, signal strength

NOMENCLATURE
S=Speed of radio wave($3x10^8$ m/s)
T=Time taken to receive hello packet at BS(μsec)
D=Distance between mobile phone and BS(m)
A=Arc length of mobile phone(m)
Γ_j=Signal ratio(dBμ)
θ_{jm}=Normalized cross-correlation signal between mobile phone and BS(dBμ)
P_j=Transmission power is used by BS(watts)
G_{ij}=Signal interference
N=Receiver noise level at BS(dBμ)

1. INTRODUCTION

Location management is a key factor for the cellular networks[1]. Structure of the cells in the cellular network is shown in Fig.1. Third generation cellular network is used by more number of mobile users[2]. Different location updating methods are used in the cellular networks. Classification of location update strategies is shown in Fig.2. Static and Dynamic automatic location area management schemes are very much used in the cellular networks[3]. The static and dynamic updating methods are used to locate a mobile phone in the network[4]. In the static update strategy, there is a predetermined set of cells which updates the location[5]. In the dynamic update strategy, endpoint determines when an update should be generated based on mobility.

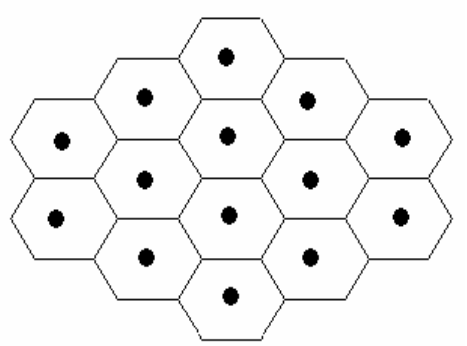

Fig.1.Structure of cells in cellular network.

The paper presents an algorithm for positioning a mobile phone within a cell. The rest of the paper is arranged as follows. Section 2 presents some of the existing works. Proposed model and needs are discussed in section 3. Simulation of the proposed model is presented in section 4. Section 5 presents the results of our proposed model. Conclusions and further work are discussed in section 6.

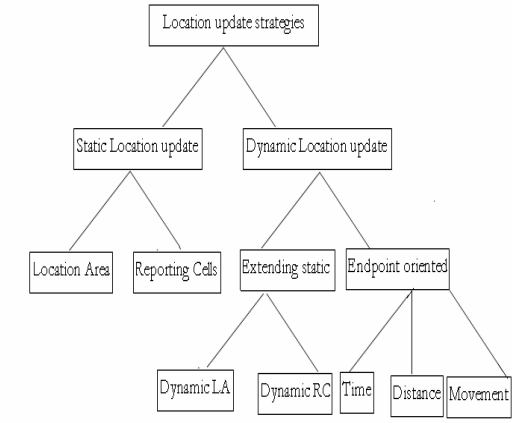

Fig.2. Classifications.

2. EXISTING WORK

Location tracking methods of second-generation cellular networks such as GSM[6] and IS-95[7-8] are used for finding mobile phone. In[9], a set of dynamic programming equations are used to determine an

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optimal updating policy for endpoint. A distance-based update scheme and a complementary paging scheme that guarantee a predefined maximum delay on locating an endpoint are described in[10]. In[11], a hierarchy of regional directory is described where the directory is decomposed into regions. Here, the purpose of i^{th}-level regional directory is to enable tracking of any user residing within the distance of 2^i. The organization of location database takes an account of user profile of endpoint[12].

3. PROPOSED MODEL

The proposed model finds a mobile phone within a cell in the network. This model uses cell-id(BS) for positioning a mobile phone. Each cell in the network is represented by hexagonal shape. The proposed model considers 25 BSs and each BS has 6 receivers to receive the signal strength for finding a mobile phone in a cell as shown in Fig.3.

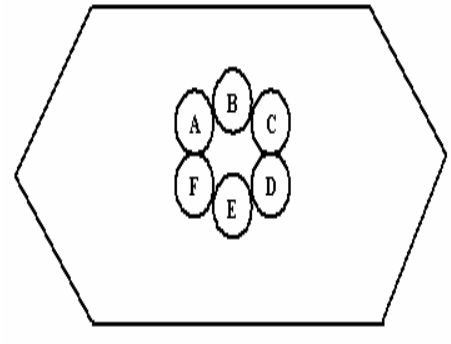

Fig.3. Proposed model.

Here, two parameters are considered to measure signal strength and distance. The signal strength is computed based on following equation.

$$\Gamma_i = \frac{P_j G_{ij}}{\Sigma P_m G_{im} \theta_{jm} + N} \qquad (1)$$

The distance between mobile phone and BS is calculated using following equation.

$$D = S*(T/2) \qquad (2)$$

The equation(2) gives hello packet-delay.

$$A = \frac{2*\prod*D}{2* \text{No.of receivers}} \qquad (3)$$

The above equation(3) is used to compute the distance of mobile phone from BS.

4. SIMULATION MODEL

The proposed model has considered topology size as 3000m. In this model, the signal strength are generated by mobile phone at different receivers is taken randomly. We have considered 25 BSs, 5000 mobile users and each BS has 6 receivers. The direction of the mobile phone has been calculated based on signal strength at the different receivers. The signal strength is received by neighbor-receivers used to find the approximate position of a mobile phone. The simulation of our proposed model is shown in Fig.4. The position of the mobile phone in given cell is indicated by RED-box. The maximum delay of hello packet is 20μsec.

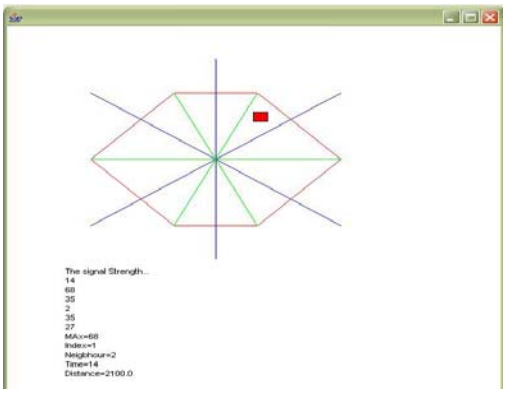

Fig.4a.

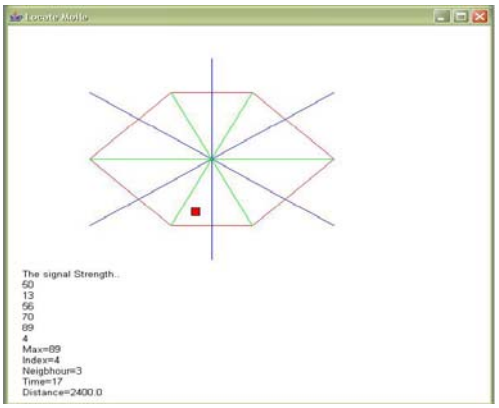

Fig.4b.

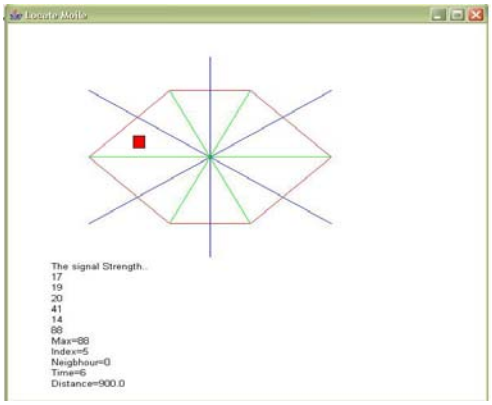

Fig.4c.

Fig.4. Simulation of proposed model.

5. SIMULATION RESULTS

Distance of the mobile phone from BS is calculated based on the hello packet-delay. The graph is linear, as time taken by the hello packet to reach BS is directly proportional to the distance of the mobile phone is sown in Fig.5. Probability of finding a mobile phone in the cell is very less, if the hello packet-delay is more.

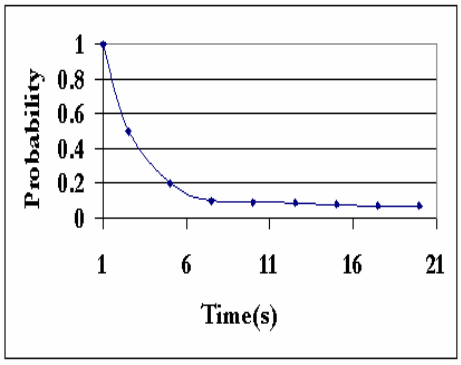

Fig.5. Time versus probability.

Fig.6 shows number of receivers against probability. Here, probability of locating the mobile phone is more, if the BS has more number of receivers (more than 5).

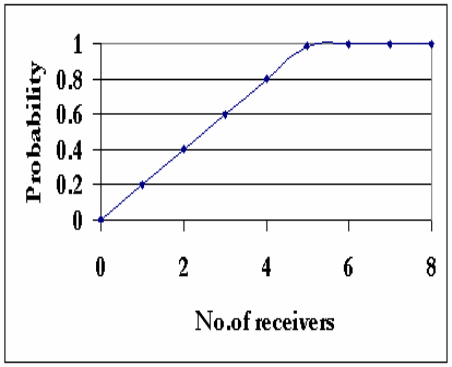

Fig.6. No. of receivers versus probability.

6. CONCLUSIONS AND FURTHER RESEARCH WORK

In this model, transmission range and parameters are fixed. Here, we have considered maximum signal strength as 90dBμ. It has 25 BSs and each BS has 6 receivers in the network. The maximum delay of the hello packet is 20μsec.

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