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Intelligent Waterdrop and Partitioning Scheme for New Call and Handoff Call Management

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Abstract: ***As technological advances are made in the world, communication needs tend to extend with the technology available. Mobile communications has potential for very rapid growth. Many researchers are participating in ventures, experiments, and developments that will expand mobile communications services globally. This paper discusses progress made in cellular systems, satellite systems, and the networking between them. The usefulness of the cellular system and the satellite system is clarified, trailed by a description of a simulation study involving the hand-off aspect between the cellular and satellite systems. As indicated by past methodologies the event of traffic congestion and blocking probability in network is analyzed. Under this study it was found that on varying demand size (small or large), delay, loss rate and load balancing problem exists in network. To minimize the traffic congestion and improving network performance the traffic demand is split over multiple paths and also routing algorithm is presented. Enhance QoS in view of parameters like delay, probability of blocking, channel use and load adjusting. By presenting intelligent water drop algorithm in the system for the call blocking as well as call dropping in highly congested cell can be improved.***

Keywords: Cellular System, Handoff, Multi-Protocol Label Switching (MPLS), Intelligent Water Drop (IWD), Matlab

1. Introduction

Cellular systems saw their conception in the 1940's. The concept of cellular radio stemmed from radio broadcasting which was used by police in the early 1920's. Extensive planning and development took place in the 1960's and the first analog system was deployed in the 1980's. With the deployment in the 1980's, the early stage of mobile communications was a slow booming business. In today's market, mobile telephony is looked upon as one of the places for rapid investment and growth. However like any other business, mobile telephony has suffered its share of ups and downs due to several major reasons such as:

- Multipath Fading
- Co-Channel Interference
- Limited System Bandwidth and Capacity

In order to understand why some of these difficulties arise, a full overview of cellular systems and their operational environment will now be discussed. Some of the problems mentioned above will be examined in greater depth.

2. Cellular System

The concept of cellular mobile systems developed with the advent of mobile radio systems. The cellular system consists of three main components: Mobile Switching Center (MSC), Cell Site (Base Station Equipment), and Mobile User Equipment. The three components work together to provide cellular service. The system can be visualized functionally as seen in figure 1(Walker, 1988). The MSC coordinates all cellular system activities between mobile users, cell sites and the Public Switched Telephone Network (PSTN). These activities include establishing connections, assigning channels, verification of users and handoff coordination to name a few. These activities and others will be discussed in further detail later in this chapter. The MSC incorporates the features of a regular telephone switching center with added capabilities to handle the activities throughout the system. The MSC software controls the necessary signaling needed to perform the activities which are sent to the cell sites and the mobile users. Cellular systems operate in the frequency region of 825-890 MHz with a difference of 45 MHz between transmitting and receiving frequencies. In the cellular system, the MSC provides connection to the PSTN via land lines and to the cells sites and other MSC's via land lines or microwave links.

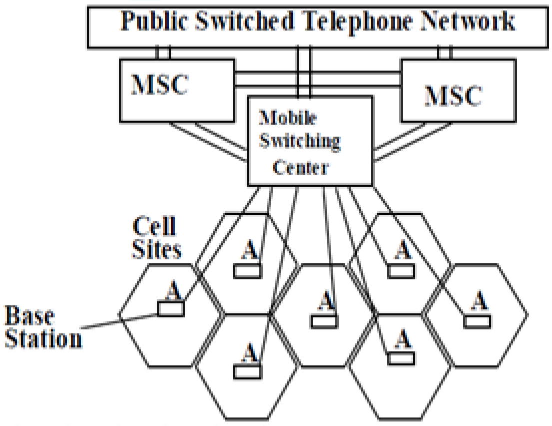

Figure 1: Cellular System Structure.

The cell site serves as the location for the base station equipment. The base station equipment consists of antenna (about 30 to 91 m. or 100 to 300 ft. high), transmitters, receivers, combiners and a power supply. The cell site also has a computer processor equipped with software to handle the necessary functions it has to perform. The cell site has 16 about channels, 1 control channel for signaling and 15 voice channels. These channels are usually full duplex allowing two way communications and having two different frequencies ranges, one for transmitting and one for receiving. At the base station, it is possible to have an amplifier for each channel that feeds into a single combiner for a transmitting antenna or a single amplifier for all channels that use a single transmitting antenna. The first scenario is known as a channelized scheme and the latter scenario is known as a frequency division multiplexed scheme as seen in Figure 2. The dashed lines in each scheme are control channels. The base station antenna has several set ups, the most common being an omnidirectional combination of antennas, with two antennas for receiving and one for transmitting. Depending on the placement of the antennas, cells are considered center excited, edge excited, or umbrella cells. The center excited cells use the omnidirectional configuration discussed above. Edge excited cells use directional antennas placed in the corner of a cell site, which is best for co-channel interference.

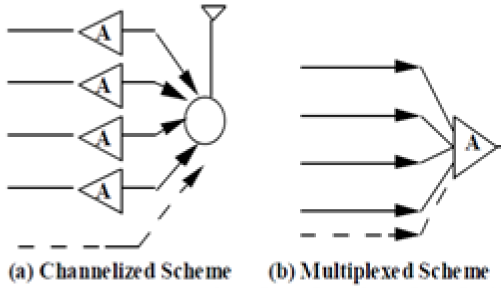

Figure 2: Channel Schemes.

The umbrella cells use tilted beam pattern antennas that provide a shadow effect of the cell site area. The amplifier(s) in each scheme provide enough gain to each channel frequency. The combiner then serves the function of combining all individual channels and sending them to the transmitting antenna. The receivers at the base station receive the incoming electromagnetic signals and convert them to perceptible forms.

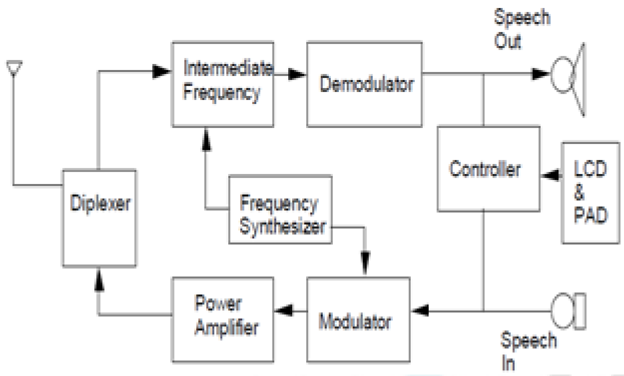

Figure 3: Mobile Equipment.

The mobile user unit equipment consists mainly of an antenna, transceiver circuitry, diplexer, feed line with handset. The handset consists of a microphone, an earphone, a liquid crystal display and an array of buttons. The transceiver circuitry has the main functions of frequency synthesizing, intermediate frequencies, and power amplifier. Within the mobile unit there are also demodulator and modulator units. These functional components can be seen in Figure 3. There are three main types of mobile unit antennas: roof mounted whips, roof mounted gain, and glass mounted gain antennas. The roof mounted whips are the least used antennas because of the low gain that is achievable. The roof mounted gain provides better service, however, the mounting usually requires the user to drill a hole into the roof top of the vehicle. Therefore, this is the least popular among consumers. The most common antenna used is the glass mounted gain. The antenna is coupled to the transceiver through the glass with the pad on the outside and the coupler on the inside. There are also portable mobile units available with built in circuitry, an antenna and rechargeable power batteries.

3. Handoff

During the call, the mobile user will probably move throughout several cells. As the mobile user travels from cell to cell within the cellular network, the call will be transferred between base stations within the network. This process is known as handoffs. The process is initiated when the signal strength of the mobile users call fall below a certain threshold level, usually around 32 dB.

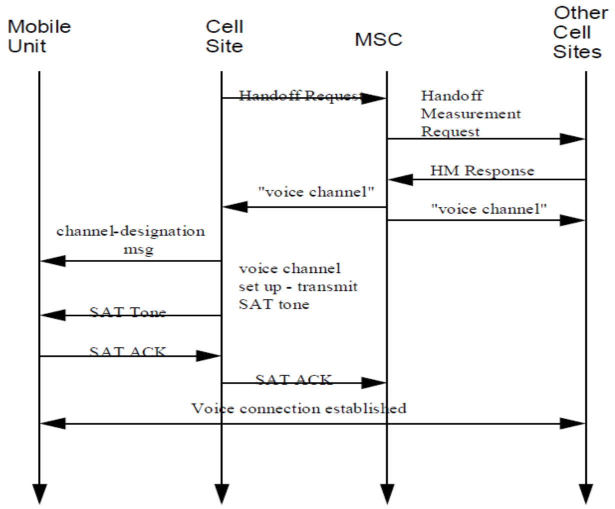

Figure 4: Mobile Call Handoff.

The base station then notifies the MSC that a call handoff will be necessary The MSC then sends out a handoff measurement request to the adjacent base stations for a measurement of the strength on a specific channel. In return, all the base stations send the signal strength level on the channel. The MSC then goes through a selection process to select the base station with the best signal level. Once the base station is selected, it is notified of the call transfer that is necessary and the channel it will be on. The MSC also forwards the same information to the base station that is currently carrying the call, which forwards the information about the new channel to the mobile unit. Once the mobile is tuned to the new channel the process is completed. This process may happen several times within a call due to the mobile user's movement. Since the handoff process is initiated by a drop in signal strength, base stations generally look for a consistent pattern of decrease in the signal strength around 10 dB per decade. The assumption made by the base station monitoring this pattern is that the mobile unit is moving toward the boundary of the cell. Figure 1.10 shows the process of a call handoff within the coverage of a single MSC. Within the network, several things affect a call and its signal strength. The most common of these problems include:

- Propagation Path Loss
- Co-Channel Interference
- Multipath Fading
- Raleigh Fading
- Doppler Shifts

Propagation path loss is the dropping of the signal level due to the terrain and manmade noise (buildings, bridges, etc.). The main drivers of propagation path loss are the distance of the mobile unit from the base station and the frequency of the channel. Co-channel interference involves disturbances occurring from two mobile units operating on the same channel. Another type of channel interference is adjacent channel interference, which occurs when energy from a carrier spills over into another carrier. Solutions to deal with channel interference involve a method of channel schemes either multiplexed or channelized, which was previously discussed. Multipath Fading involves disturbances due to the multiple paths of the signals between the transmitter and the receiver as a result of the terrain and man-made noise. Raleigh Fading are rapid fluctuations in the signal strength that occur in statistical distribution known as Raleigh. Finally, Doppler Shifts are variations in the frequency of the received signal caused by the relative motion of the mobile unit. These problems all bear an effect on the signal strength of the mobile unit.

4. Methodology

There are following steps as follow as:

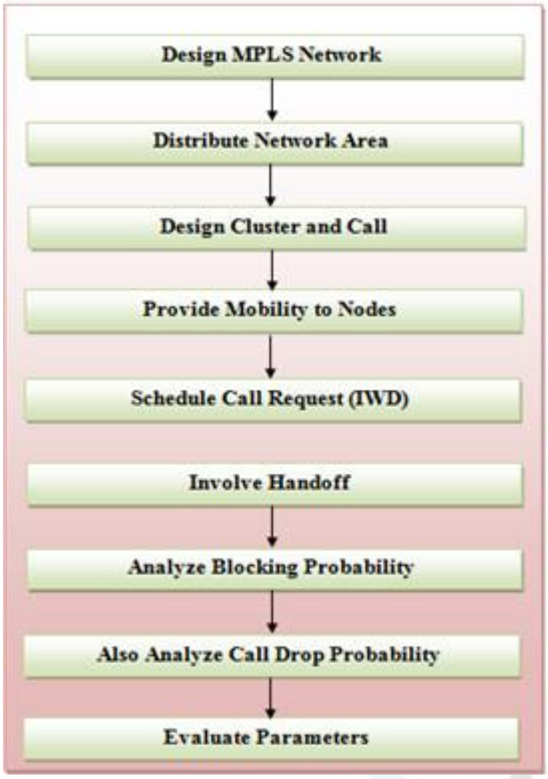

Figure 5: Methodology Steps.

Step 1: Study the QoS parameter in depth.
Step 2: Analyze network using MPLS to improve QoS.
Step 3: QoS of network based on MPLS depends on three parameters fault tolerance, performance characteristics, security.
Step 4: Performance of MPLS based system is inversely proportional to blocking probability.
Step 5: Design MPLS based network with initial parameters Mean arrival time, call duration, call duration, traffic intensity and channel utilization.
Step 6: Analysis of blocking probability on the basis traffic intensity versus traffic load on given number of channels.
Step 7: Performance evaluation of proposed Erlang b method with existing frequency reuse based RCT method on the basis of parameters like blocking probability and number of channels.

5. Intelligent Watrer Drop Algorithm

Intelligent Water Drops algorithm or the IWD algorithm or calculation is a swarm-based nature-inspired optimization algorithm or advanced calculation. This algorithm contains a few essential elements of natural water drops and actions and reactions that occur between river's bed and the water drops that flow within. The IWD calculation may fall into the class of Swarm intelligence and Meta-heuristic. Intrinsically, the IWD algorithm can be used for combinatorial optimization. However, it may be adapted for continuous optimization too. The IWD was first introduced for the traveling salesman problem in 2007. From that point forward, large number of specialists has concentrated on enhancing the calculation for various issues. Almost every IWD algorithm is composed of two parts: a graph that plays the role of distributed memory on which soils of different edges are preserved, and the moving piece of the IWD calculation, which is a couple of number of intelligent water drops. These Intelligent Water Drops (IWDs) both compete and cooperate to find better solutions and by changing soils of the graph, the paths to better solutions become more reachable. It is specified that the IWD-based calculations require no less than two IWDs to work.
The IWD algorithm has two types of parameters:

- Static and
- Dynamic parameters.

Static parameters are constant during the process of the IWD algorithm. Dynamic parameters are reinitialized after each iteration of the IWD algorithm.

The pseudo-code of an IWD-based algorithm may be specified in eight steps:
Step 1: Static parameter initialization

- Problem representation in the form of a graph
- Setting values for static parameters

Step 2: Dynamic parameter initialization: soil and velocity of IWDs

Step 3: Distribution of IWDs on the problem's graph

Step 4: Solution construction by IWDs along with soil and velocity updating

- Local soil updating on the graph
- Soil and velocity updating on the IWDs

Step 5: Local search over each IWD's solution (optional)

Step 6: Global soil updating

Step 7: Total-best solution updating

Step 8: Go to step 2 unless termination condition is satisfied

6. Simulated Results

In this section, the proposed system is evaluated via computer simulation using MATLAB simulator. All simulation results are obtained by using reusibility method for previous approaches and for proposed approaches use intelligent water drop algorithm. Figure 6 show the clusters/cells area distribution for cellular network using reusibility method.

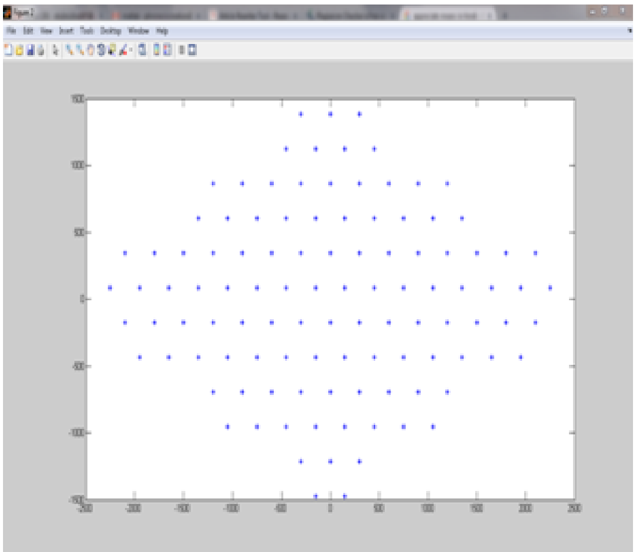

Figure 6: Reusibility Method for Cluster/Cells Area Distribution

Figure 7 show the channel utilization on the basis of system load for cellular network using reusibility method.

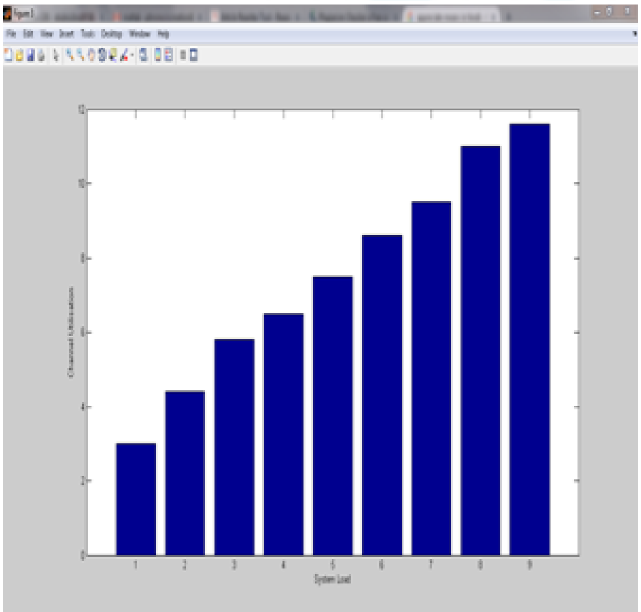

Figure 7: Channel Utilization versus System Load using Reusibility Method

Figure 8 show the new call blocking probability on the basis of system load for cellular network using reusibility method.

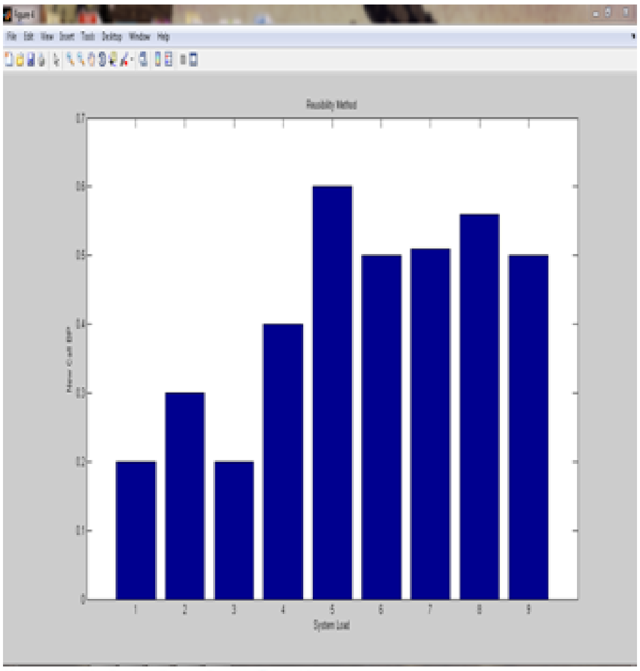

Figure 8: New Call BP versus System Load using Reusibility Method.

Figure 9 show the handoff blocking probability on the basis of system load for cellular network using reusibility method.

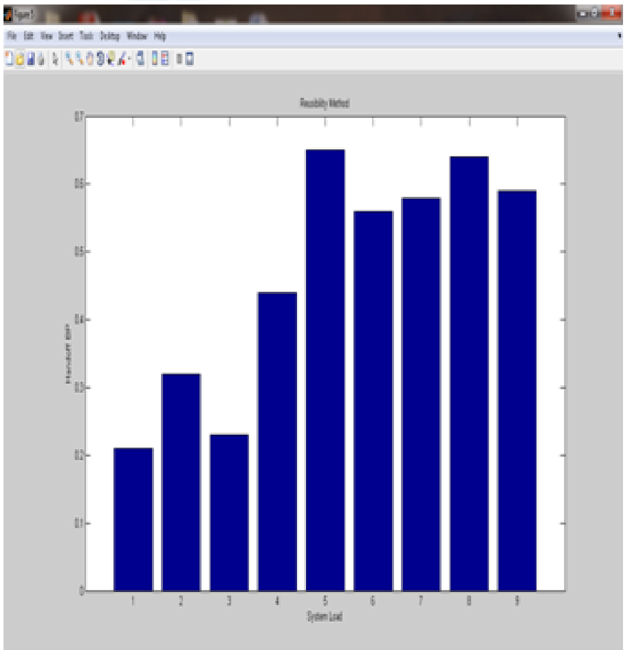

Figure 9: Handoff BP versus System Load using Reusibility Method.

Figure 10 show the clusters/cells area distribution for cellular network using intelligent water drop method.

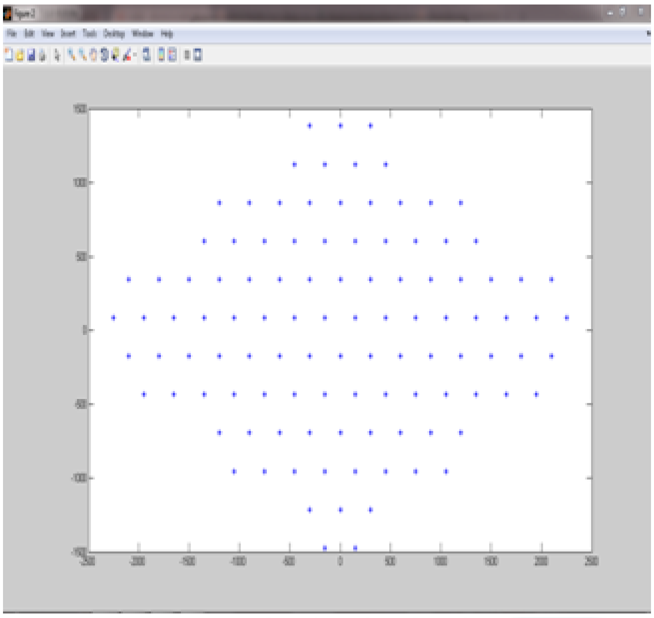

Figure 10: Intelligent Water Drop Method Method for Cluster/Cells Area Distribution.

Figure 11 show the channel utilization on the basis of system load for cellular network using intelligent water drop method.

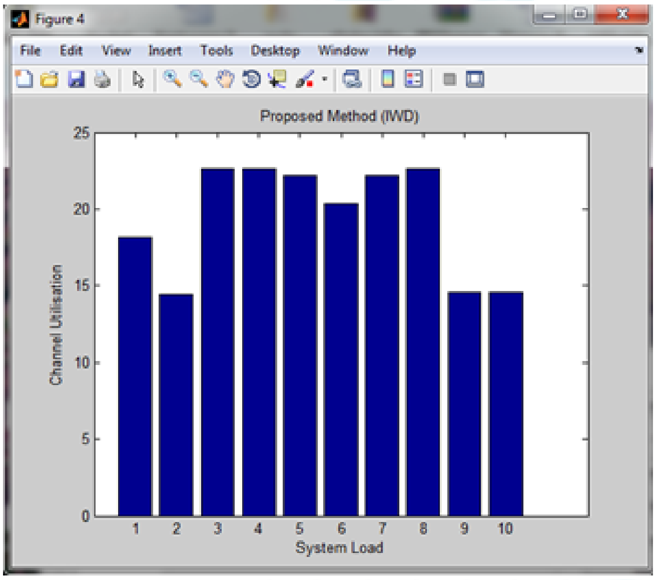

Figure 11: Channel Utilization versus System Load using Intelligent Water Drop Method.

7. Conclusion

The variations of the new call blocking probabilities for the central main cell with the increasing offered load and the variations of the handoff call dropping probabilities for the central main cell with the increasing offered load is reduced to zero. As user uses static guard channels, numbers of available channels for new calls are less than previous approach. The proposed approach performs better in reducing handoff blocks at the cost of increased new call blocks. This is due to the fact that the intelligent water drop scheme scheduled the channel in the inner tier of all the cells. As a result it utilizes channels effectively to decrease the call blocks in inner tier. Further, the unused channels of the least congested neighbour cells are also utilized to serve the call requests originated in main cell, if needed. Hence, it can serve more call requests than the total number of available channels. At the same time, during congestion most of the unused channels from neighbour cells are also utilized in serving the call requests from the main cell. Further, since dynamic numbers of guard channels are used, channel utilization is efficient. Due to this, observe more channel utilization in case of the proposed scheme. For further extent of work, an efficient Artificial Intelligence (AI) can be utilized for channel utilization and call blocking probability in cellular network. Even more parameter can be used for new algorithm to improve handoff probability.

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