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Reduce the probability of blocking for handoff and calls in cellular systems based on fixed and dynamic channel assignment

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ABSTRACT

In cellular systems the high probability of blocking represents a big problem for users, the proposed solution by reducing the blocking probability and investigation cellular systems by method channels assignment. The aim from apaper is studying the effect the channel assignment on the value of blocking probability. The results showed that the fixe channeld assignment gives a large probability of blocking for high loads, while (FCA) reduce probability of blocking for handoff and calls according to cluster size. The cellular system representation in the case of (DCA), in (3-cell reuse) and (7-cell reuse), the results showed the first best way to reduce blocking probability and lead to reduce to approximately zero when loads that are less than 200%. Increasing the cluster size causes to reduce blocking probability. The results showed that the probability blocking for handoff less than from probability of blocking for new calls.

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1. INTRODUCTION

Cellular networks are based on dividing the area to be serviced into a number of cells. Cells in cellular systems are divided into groups of each group consisting of a number of cells [1]. The channels assigned to the cellular system are used entirely in the group and reused in another group in an orderly manner to ensure that there is no overlap between similar channels in adjacent cells. In order to maximize capacity using the same number of channels and to reduce overheating, several channel assignment strategies have emerged. Call blocking occurs when a vacant channel is not available base station (BS) to be allocated to the user [2]. There are two types of blocking calls; the first is to block new calls and the second blocking the transfer of any continuous call because of the movement of the user and move from one cell to another or from one section to another.

In 2001, the researchers [3] presented a study on call entry control methods. The importance of these methods in wireless networks with a small cell size where handoffs are frequent. These methods have demonstrated high efficiency in providing the best quality of service (QoS) for HO calls with little and slight decrease in new calls. In 2003, the researchers [4] studied methods of determining the bandwidth of a multi-service cellular network and the dynamic segmentation method, showing that both methods worked well with the correct dealings with the control parameters. The former provided (QoS) acceptable but with more requirements. The second is higher channel channel efficiency.

In 2004, Markopoulo et al [5] introduced a set of algorithms for transport with the help of location and safe space information to make correct transport decisions that were implemented in GSM systems. Swing, in 2005, researchers [6] reviewed a theoretical summary of the initiation of the handoff and the decision to carry out the discussion of the different types of handoff. In 2012, the researchers in [7] studied a system for improving channel assignment in cellular communications. The study was about the performance of the DCA distribution scheme for cellular networks (multi-agent system) compared to the distribution of the FCA scheme, where simulations showed methods another is to understand the DCA distribution scheme more efficiently than the FCA distribution scheme. In 2017, researchers in [8] studied design complicated control systems using nano-based devices. Besides, since there is a critical manner of temperature in QCA devices. In 2019, the researchers in [9] show that A number of case studies will be present to demonstrate the efficiency and effectiveness of the system.

2. PROBABILITY OF BLOCKING HANDOFF AND CALLS

Mobility is the most important feature in cellular communication systems and usually the continuation of the service is accomplished by assigning delivery from one cell to another. Signal in the communication channel, when new calls arrive, MS should contact the appropriate BS and also when there are symptoms within the cell boundaries that require a transfer within the same cell of the acceptable link quality so that it can interfere with adjacent and channels using the same frequency [10]. Cell handoff intra is desirable when the connection to the BS server is affected by excessive interference while another connection to the same BS can be equipped with better quality [11, 12]. The transfer process involves two phases: the first is to assess the quality of communication and initiate the transfer and the second allocation of radio network resources. [13] Cell systems that are smaller in cell sizes are faster and more evaluated for reliable communication quality and transport algorithm. The amplitude is low due to excessive interference in channels using the same frequency [14, 15].

2.1. Reason of handoff

The transfer process is initiated by the base station (BS) or (MS);

a. Type of Carriage The radio communication transport is caused by the mobile (MS) technology within the coverage area [16].
- Number of MSS per cell.
- Number of new calls in the cell.
- The number of calls taken to the cell from neighboring cells as a result of the transfer.
- Number of incomplete calls.
- Dwell time on cell.

b. Network management works on the transfer in the event of an imbalance in the density of traffic between neighboring cells, there is the best balance of channels and other resources required between those cells [17].

c. Service-related transfers occur as a result of poor service.

2.2. Types of handoff

There are two types of handoff [18, 19];

- Hard handoff: means the connection before cutting any contact with the new cell before disconnecting from the servant cell. The user can communicate with more than one cell during the transfer process and complete when BS selects its target from the BSs. This transfer is important because the BS will select the strongest signal from the existing BSs.
- Soft handoff: Disconnection before connecting means any disconnection from the servant cell before contacting the neighboring cell, as the MS does not connect to more than one base station at any time and is continuous and discontinuous. Actual because MS connects to only one BS at any time [20].

2.3. Handoff initiation

The transfer decision is based on the BS signal over time and based on the average measurements of the received signal, ie the relative signal strength. If the signal is weak and below the threshold limit, the two strongest BSs to be transmitted are compared at the point where the signals are equal if the threshold is higher than this value (equal point) [21]. If the threshold limit is less than this value (T2), the MS will delay the transfer until the signal level crosses the threshold at position B. In the case of T3, it may be delayed so that the MS reaches a new cell. In case the received signal is strong and with the backend by the mobile station, the transfer occurs at point C, and this prophylaxis prevents the effect of frequent swings and transfers between BSs caused by rapid fluctuations in the signal strength received from BSs. If the received signal strength with the hysteresis is the threshold limit, then the transfer to a new cell is performed only when the received signal from the servicing base station falls below the threshold limit and the signal received from the MS to which the MS will move is greater than the received signal, the handover will occur at point whene the MS reach to receved signal domaine [22, 23].

2.4. Blocked calls cleared

When the user requests the service arrives directly to the channel if there is an available channel and the reverse of the call request is blocked directly and that the arrival of calls is calculated by the Bosnian distribution (Poisson distribution) and assume that there is an unlimited number of users in addition to follow-up, and there is a store does not store requests employed for all users includes. Blocking user requests for the channel at any time and the probability of the channel operating for users follow the exponential distribution and there are a limited number of channels available in systems containing the theory of participation, and these systems use the Erlang B model to calculate the probability of blocking calls and measure the degree of service [24, 25]. The probability of repelling is calculated under;

$$\text{Pr [blocking]} = \frac{\frac{A^C}{c!}}{\sum_{k=0}^{c} \frac{A^k}{k!}}$$

Pr: probability.
Pr: probability.
Ac: Traffic load per channel.
C: Number of channels per cells.

2.5. Blocked call delay

Waiting is used when there is no vacant channel. The service request is delayed until a vacant channel is available. It measures the degree of service and defines the probability of blocking the call after waiting for a specified time in the queue. The form for calculating the probability of delaying the call is Erlang C as follows [26]:

$$\text{Pr [delay} > 0] = \frac{\frac{A^C}{c!}}{[\{1-\frac{A}{C}\}C!\sum_{K=0}^{C-1}\frac{A^k}{K!}+A^C]}$$

If there is no channel available, the call is delayed and the probability of delaying the call lasts more than t seconds according to the following [21]:

$$\text{Pr [delay} > t] = \text{Pr } [delay > 0] * \text{Pr } [delay > t/delay > 0]$$

3. CHANNELS ASSIGNMENT

There are several ways to assign channels when new calls arrive, or attempt to transmit. The efficient channel assignment algorithm produces high spectrum efficiency for a specific service score that includes call quality, the probability of blocking the new call and the probability of short termination. Figure 1 shows the assignment of channels [27].

- Fixed chanel assignment: In this strategy, a set of voice channels is allocated to any communication attempt within the cell that can be served by unused channels in the cell. If all channels in the cell are busy, calls will be blocked. There are several variations of the fixed channel strategy and one method is called a hypothetical strategy that allows the cell to borrow channels from the adjacent cell if the channels are busy. The MSC supervises the lending method to avoid interference with any call in the donor cell [28]. In the FCA system, a fixed set of channels is allocated and cannot be changed for efficient operation and also reduces the interstitial haemorrhage that uses the same channel to reduce the reuse distance. The problem with the FCA system is due to irregular traffic in the BSs network. K users in the first cell will be blocked by calls while m channels in the second cell will not be used, this method is applied at a widespread level [28, 29].
- Dynamic channel assignment: In this strategy, the frequency channels are not pre-assigned to the cell of the cellular network and all frequency channels are kept in a central storage. When there is a channel demand at one of the base stations, MSC selects the appropriate frequency channel that gives the highest channel efficiency. The channel is allocated during the duration of the call and after the call is returned

to the central store of channels or allocated again to a user within the same cell that was controlled by the channel before. This strategy reduces the problem mentioned above in the FCA when traffic is irregular. In DCA systems, there is no relationship between channels and cells. When the channel is required in the cell, it is allocated under the requirements of frequency reuse provided that it is not violated. There are two problems in this type: first, this method contains a degree of random participation between users, and the second that includes complex algorithms to determine the available channel that is more efficient [30, 31].

- Hybrid Channel Assignment: This type mixes the two types above.
- Flexible Channel Assignment: each cell allocates a fixed set of channels, but the channel repository is retained for flexible allocation. This is either specific or predictive. The specific allocation schemes depend on the known change in the shape of traffic. Of cells according to measurements [32].

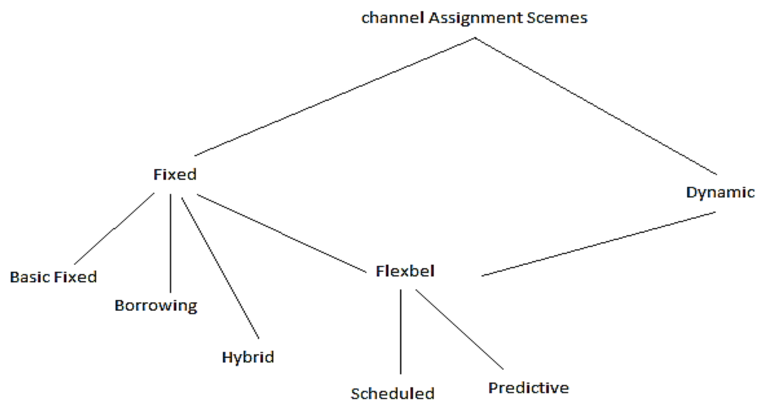

Figure 1. Channels assignment

4. SIMULATION AND RESULTS

A simulation model of a cellular system was constructed to study the effect of channel assignment on the probability of repulsion in WCDMA. The mobile stations were represented in these cells and distributed randomly on a regular basis. The number of mobile stations using communication channels in each cell is variable depending on the instantaneous load but is less than or equal to the number of channels in each cell (20) channels. The number of calls during the simulation period depends on the traffic load value shown in the following equation:

Traffic Load = (new call arrived * holding time)/number of channels

This law shows the traffic load within one hour that the used parameters in the simulation are shown in Table 1. For mobile stations, they move at a speed ranging from (0-20) m/sec with a uniform random distribution, the speed and direction of users change with different probabilities for special angles (45 and 90). This change in direction occurs periodically every 60 seconds. The probability of a change in direction, stop, and speed change is in accordance with an approved movement model. Table 2 shows the possibility of changing the direction and angles used in this paper through simulation, the location of mobile stations is tracked periodically every 1 second and the location measurement is assumed to be already known by GPS.

Table 1. Used parameters on simulation

Value	Parameter
2000 m	Cell radius (R)
3	Number of cells
20	Number of channels per cell
3.84 M chip per sec.	Bandwidth
[0- 20] m/sec	Speed
1 sec.	Period time of measurements
15%	Soft handoff overhead
50	Number of simulations runs
5 hours	Time of simulation
180 sec.	Holding time
(60–150)	Traffic load

Table 2. Probability of change direction and angle

Parameter	Value
Probability with which a MS stops	10%
Probability of keeping original moving direction	60%
Probability of making a 45° turn	10%
Probability of making 90° turn	20%

Through the location and speed of the mobile station, it is possible to know the arrival of the station to the transport area. The simulation model of the cell system was represented for 6 hours as the simulation time. A rate of 45 readings was taken because they represent randomly distributed results since the system is basically represented by random distributions and the correct values can only be known after finding the average of the results values.

4.1. Effect channels assignment on probability of blocking

The fixed assignment of channels was applied to the simulation model to calculate the ratio for probability of blocking and the new call, in addition to the handoffs equipment and for different loads ranging from 70% to 160%, as shown in the Figures 2 and 3. We note from the Figure 2 that the probability of blocking increases with increasing load and is very little at loads close to 70%. We also note that the probability of blocking new calls is greater than the rate of blocking the handoff due to the presence of a priority for the transfer over new calls, if a new call comes, you look at the vacant channels If there is a vacant channel, it gives to this call (the user), but if all the channels are busy, the call will be blocked, as will the case for the handoff operations. It is known that the probability of blocking handoff should be less than the possibility of blocking new calls, because for the subscription, the continuation of the call is a priority over the new call. In Figure 3 we note that an increase in the load leads to an increase in the number of handoffs, and this is a logical result. When the load increases, the incoming calls will increase and this leads to an increase in the number of handoffs. The strategy of dynamic channel assignment was applied to two types of cellular systems, the first of 3cells (3-cell reuse) and the second of 7 cells (7-cell reuse) to study the effect of channel assignment on the probability of blocking.

In Figure 4, we see that the blocking probability is a very low value when the loads are less than 100% and when the traffic load increases, we increase the probability of blocking and reach a rate of approximately 1.7% for new calls and 0.25% for the carriers when carrying 160%. These results show a large reduction rate in probability of blocking compared to FCA strategy. As for the FCA strategy at 100% load, it is close to 0% in this system, and the reason for this is that a single cluster that includes 3 cells will contain a store of all channels so that they are available in the cluster, and for any request (for transfer or call) in any cell. We also see in the figure above that the probability of blocking the carry is less than the possibility of blocking the new call, because there is an advantage to carry over the new call.

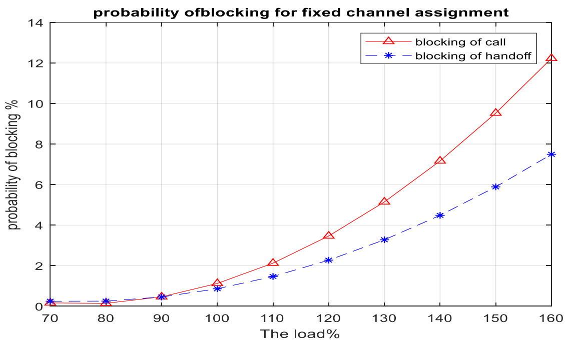

Figure 2. Probability of blocking for fixed assignment of channels vs load changing

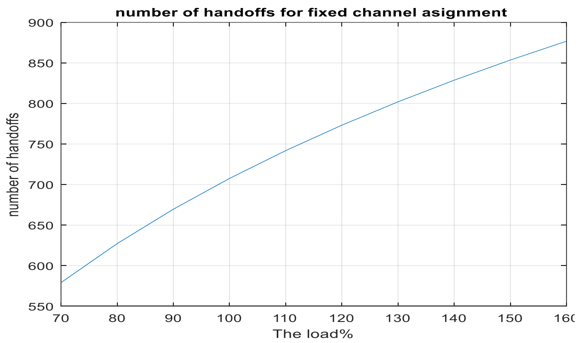

Figure 3. Handoffs ratio vs fixed assignment of channels

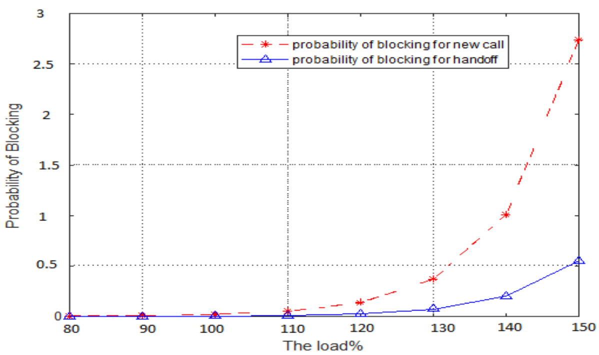

Figure 4. Probability of blocking vs traffic load

5. CONCLUSION

When the traffic load increases, the probability of blocking and the number of handoffs increases. When comparing the strategies of FCA and DCA, we see that the probability of blocking in the use of DCA is much lower than the probability of blocking in the case of FCA. The size of the cluster in the cellular system affects the value of the probability of repulsion in the case of the use of DCA. The larger the cluster, the lower the probability of repelling. In the DCA strategy, the probability of repelling in very few loads is very low to zero. The probability of blocking a carriage is significantly lower than the probability of blocking new calls in the case of DCA due to the priority of the carriage.

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