

**Name: Apeksha Chauhan**

**UID: 115035027**

## **Project Report**

### **ENTS 656: Introduction to Cellular Communication**

#### **Objective:**

Simulating the effects of admission control on a single cell in a mobile cellular network in Python

#### **Description:**

The application has 1000 Users being serviced by a Base Station in a 10 Km radius. The System is highly congested and with more users on call the Interference level increases and number of calls getting dropped due to not qualifying the minimum SINR increase significantly. Admission control system tackles the problem. Admission control system lowers the EIRP of the pilot channel when the system demand is too high.

#### **Statistics for different cases:**

1. Users: 1000, Cd=57 and Ci=0 i.e no admission control:

```
=====
Total Call attempts with no retry: 11649
Total Call attempts with retries: 12129
Total calls dropped due to SINR: 4098
Total calls blocked due to signal strength: 4407
Total calls blocked due to channel not available: 0
Total successful calls: 3123
Total calls in progress: 19
Total failed calls: 8505
Current Cell radius: 9.49364684012
=====
```

2. Users:10000, Cd=57 and Ci=0 (No Admission Control):

```
=====
Total Call attempts with no retry: 120400
Total Call attempts with retries: 126045
Total calls dropped due to SINR: 71132
Total calls blocked due to signal strength: 46155
Total calls blocked due to channel not available: 979
Total successful calls: 2099
Total calls in progress: 30
Total failed calls: 118266
Current Cell radius: 9.21668871504
=====
```

3. User: 1000, Cd=20 and Ci = 20(Admission Control):

```

=====
Total Call attempts with no retry: 11678
Total Call attempts with retries: 18611
Total calls dropped due to SINR: 636
Total calls blocked due to signal strength: 8562
Total calls blocked due to channel not available: 0
Total successful calls: 2463
Total calls in progress: 14
Total failed calls: 9198
Current Cell radius: 6.32708335094
=====

```

#### 4. Users 10000, Admission Control

```

=====
Total Call attempts with no retry: 119752
Total Call attempts with retries: 225455
Total calls dropped due to SINR: 6435
Total calls blocked due to signal strength: 110538
Total calls blocked due to channel not available: 0
Total successful calls: 2753
Total calls in progress: 26
Total failed calls: 116973
Current Cell radius: 2.93452082297
=====

```

Below are the responses based on the Statistics of generated in the project:

1. Ratio of the number of dropped calls to the number of completed calls without admission control for 1000 Users:  
 Number of dropped calls at the end of the simulation: 4081  
 Number of completed calls at the end of the simulation: 3132
  - a. Ratio: 1.303
  - b. The main reason behind the call failures is as the number of users on call increase, the active number of users increases and hence the interference from other users. Which results in lowering the SINR to below the minimum threshold thus the calls do not get completed and get dropped while in the call duration.
  - c. There are no blocks for channel capacity
2. After applying admission control i.e changing Cd to 20 and Ci to 15, Following are statistics:  
**Statistics:**  
 Total Call attempts with no retry: 11673  
 Total Call attempts with retries: 18654  
 Total calls dropped due to SINR: 626  
 Total calls blocked due to signal strength: 8583  
 Total calls blocked due to channel not available: 0  
 Total successful calls: 2448  
 Total calls in progress: 14  
 Total failed calls: 9209  
 Current Cell radius: 5.73968804183
  - a. The ratio to dropped to completed call: 0.2557
  - b. The number of blocked calls have significantly increases, it has almost doubled from the previous count when admission control wasn't applied.
  - c. The Cell Radius reduced after applying admission control

### 3. No Admission Control:

Blocked channel Capacity: The calls begin to get blocked due to channel capacity i.e for my simulation the number of blocked calls were 896 at the end of 7200 iterations.

With Admission Control:

The total calls dropped due to channel capacity reduces significantly i.e for my simulation it reduced to 4 at the end of 7200 iterations.

### Code Functionality:

#### Methods used in the code:

- shadow\_value\_computation(x,y)
- cal\_EIRP\_admission\_control(EIRP\_pilot,Cd,Ci,Number\_of\_Channels\_in\_use)
- BS\_distance\_calculation(x,y)
- path\_loss\_calculation(distance)
- call\_duration\_cal():
- RSL\_Calculation(EIRP\_channel,distance,shadow\_value):
- SINR\_cal(distance,shadow,Number\_active\_users,EIRP\_channel)

### Algorithm:

#### For one Iteration: goes over 7200 times for 1000 users

1. Check for the number of Users out of the available users(free users) wish to make a call
2. Iterate over the willing to call users to check if they qualify to get connected to the base station depending on each user's RSL value
3. If the  $RSL > RSL_{min}$  then add User to an active user list and initialize their SINR attempt to 0 and if the user doesn't then add user to list of users attempting to make a call and keep a track of the call attempts
4. In the next step check for all the users in the attempting user list if they cleared the RSL level and if they did, add them to the active user list else check for 3 times and then remove the user from the call attempt list
5. In the next step of the code check for all the active user the following:
  - SINR attempt count
  - SINR level -> if above minimum and check for call duration, if call duration == 0 remove user from active user call list and free the channel. If the call duration is not zero decrease the call duration.
  - If the  $SINR < minimum$ , increase the SINR attempt counter
  - If the SINR attempt count becomes 3 remove the user from the active user list and free the channel
6. Keep a track of the Number of channels in use, cell radius and Number of calls in progress for every iteration.

7. Depending on the Number of channels in use compute the EIRP value for the pilot channel for every iteration.