Faculty of Information Engineering & Technology
The Networking Department
Course: Network Planning [NETW 1003]
Dr. Mohamed Ashour

Project C-RAN Allocation Problem

Deadline: 14/6/2020

Maximum team of 3

Introduction

Cloud Radio Access networks (C-RAN) is a promising architecture for 5G providing cost-effective and on demand high quality of service to users. The Decoupling the Signal base band processing in a centralized Base Band Unit Pool (BBU) from the Remote Radio Head (RRH) physically deployed, allows the flexibility of allocation and reallocation of resources to the user Equipment. Resource allocation and management is one the most challenging aspects of C-RAN deployment. Resources in this research include BBUs, RRHs and Resource Blocks. These mentioned resources must be efficiently assigned to users while maintaining a required QoS expressed in terms of a minimum SINR threshold requirement per user. The challenge arises as the higher the QoS requirement the more resources must be offered. How much resources assigned affects the system energy consumption and processing delay, both of which play a huge role in C-RAN optimization. The RRH Reports to the BBU pool for signal processing of a user connected to the RRH. BBUs have a limit to its computational capacity function of the Resource Blocks and RRHs have a limit to the number of users it can serve. **The objective of this formulation is to optimally allocate the users to the RRHs to minimize the number of Resource Blocks.**

A user connects to the RRH **requires a certain number of Resource Blocks (RB) in order to cover its rate requirement.** The system has a **limit to the maximum number of RBs that should be used.** The problem formulation designs a function of the user to RRH allocation with the aim minimizing the number of used RBs. Given that the RBs is a representation of system bandwidth which is of limited availability. A user of a further distance form an RRH requires a hire coding scheme than a closer user thus requiring a higher processing power per RB.

Below are the following system requirements

1. A user K must connect to one RRH h
2. A RRH h has a maximum number of RBs Q that it can handle

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3. A user K has a rate requirement equals 2 Mbps.
4. A user K receives a power per Resource Block (RB) given the following equation

$S(\text{dbm}) = Pt - 10 \times \log_{10}(NRB) + Gt + Gr - 20 \times \log_{10}(f\ MHz) - 10\eta \log_{10}(d) - WallLoss(d) + 28$

Where:

where $Pt = 5\ dBm$ is the maximum RRH transmit power, $NRB = 25$ is the maximum number of resource blocks per BBU, $Gt = Gr = 0\ dB$ are the antenna gain of the transmit and receive antenna respectively, $f = 2350\ MHz$ is the carrier frequency in MHz, $\eta = 3$ is the pathloss exponent, $WallLoss(d) = 6 \times \lfloor d/5 \rfloor\ (dB)$ (i.e., a ray on average hits one wall every five meters of propagation) and d is the distance between the mobile terminal and the nearest RRH in meters "you can generate random position for users and RRH in order to calculate the distance".

For each user k connected to a certain RRH h, the Rate/RB for each user k connected to RRH h

$$C_{k,h} = B \times \log_2\left(1 + 10^{\frac{(S/N)}{10}}\right)$$

where $B = 180\ KHz$ is the bandwidth of one LTE resource block, $N = -174 + 10 \times \log_{10}(B)$ is the background noise in dBm and S is the received signal power that is computed in dBm

For each user k connected to a certain RRH h it receives a Certain number of RBs $R_{k,h}$

$$R_{k,h} = \frac{2\text{ Mbps}}{C_{k,h}}$$

You can assume any variable with random number if needed while designing the system.

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Tasks

1. Write the problem formulation (decision variables, objective function and constraints) taking in consideration the above constraints and any extra constraints that you might find crucial while designing the system.
2. Generate a code using local search (generate all combination and choose the best one which means the one with the minimum number of resource blocks) to find the optimum solution of resource allocation.
3. Generate a code using any method that you have taken in the course (genetics, Tabu, Ant Colony, swarm,..) to find near optimal solution and decrease the complexity of the local search.
4. Compare the result of the local search done in step 2 and the add heuristic done in step 3 while running different number of users. So the x axis will be the number of users and the y axis will be the number of resource blocks used.

If you have any problems or questions just send me an email
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Good Luck.