Mini-Project

Cellular Network Deployment

Context Description

- You have been delegated by a telecommunication operator to answer a tender call for radio planification, dimensioning and deployment of a cellular 4G network.
- The network is deployed on a frequency carrier of 2.6 GHz and the base stations are connected among each others using microwave links (Faisceaux Hertziens).
- There are different options considering different bandwidth size : 5, 10, 15 and 20 MHz. This corresponds respectively to 25, 50, 75 and 100 radio-resources.

Mini-Project Objectives

- Based on the following data, you need to define :
  1. The maximal tolerated path-loss in the uplink and in the downlink
  2. The radio coverage radius in the uplink and the downlink in cases in rural and urban zones
  3. Considering bandwidth sizes (5, 10, 15, 20) MHz, determine for rural and urban zones :
     a) The size of the cell that guarantees that the cell is well dimensioned
     b) The cell size that respects both radio and dimensioning constraints
     c) The optimised transmission power
     d) The cost of the network considering different bandwidth.
     e) The evolution of income/outcome and economical profitability.

Environment Description

- Carrier frequency = 2600 MHz
- The zones to cover include :

Zone	Area	Population	Penetration rate	Path-loss (dB)	Shadowing + Fading (dB)
Urban	105,4 km^2	1 750 000	10%	$113 + 35 \log_{10} d$	8 + 2
Rural	5176 km^2	17 500	10%	$100 + 35 \log_{10} d$	4 + 2

- We estimate that each client uses in average the network **during 10 minutes each hour .**

Equipment Radio-Characteristics

Radio planning	Base station	Power of the Base station	46	dBm
		Antenna gain	17	dB
		Cables and connectors loss	3	dB
		Duplexer	2	dB
		Receiver diversity	5	dB
		Low received power amplifier	2	dB
		Sensisivity of reception	-120	dBm
	Mobile	Power of the mobile	21	dBm
		antenna gain	0	dB
		Internal loss	0	dB
		Sensitivity of reception	-105	dBm

Resources

Ressources	**Ratio of Signal / Interference C/I (no unit)**	1,14			
	Frequency reuse pattern size	1			
	Bandwidth (MHz)	5	10	15	20
	Number of radio resources per cell	25	50	75	100
	Blockage probability	2%	2%	2%	2%
	Traffic in Erlang per cell				
	Traffic per client				
	Number of clients per cell				

Costs

Income / Outcome	Costs
Fees for use of 2.6 GHz frequency in the uplink and downlink (5 MHz UL / 5 MHz DL)	2500 k€
Fees for the use of 18 GHz frequency for microwave links to connect the base-stations	100 k€
Capex : costs for installing the sites	15 k€
Opex : operating Investments (electricity, maintenance, etc)	5 k€
Price of client suscription	20 €