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Cellular Network Planning and Optimization
Part XII: Examples

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Note

- All exercises are potential examination problems
- All examples in lectures are potential examination problems
- Not all examination problems are computational in nature

Example problems

- The signal fading: Explain the following terms in few sentences and answer to the questions.
  - Path loss. Name two path loss models.
  - Shadow fading. What distribution is used to model shadow fading?
  - Fast fading. What is fast fading coherence distance?

Example problems

- Path loss can be given in a generic form

  (1) $$L = A + 10 \cdot n \cdot \log_{10}(R)$$

  Explain the meaning of parameters n and R. What is the interval [a,b] where n is expected to vary?

- Consider the Okumura-Hata model and compute the decrease in path loss when base station antenna is increased by 5 meters. Carrier frequency and mobile station antenna height remain the same.

$$L = A + B\log_{10} f_c - 13.82\log_{10} h_b - a(h_m) + (C - 6.55\log_{10} h_b)\log_{10} d$$

Example problems

- Explain the following terms using few sentences
  - co-channel interference
  - adjacent channel interference

Problem

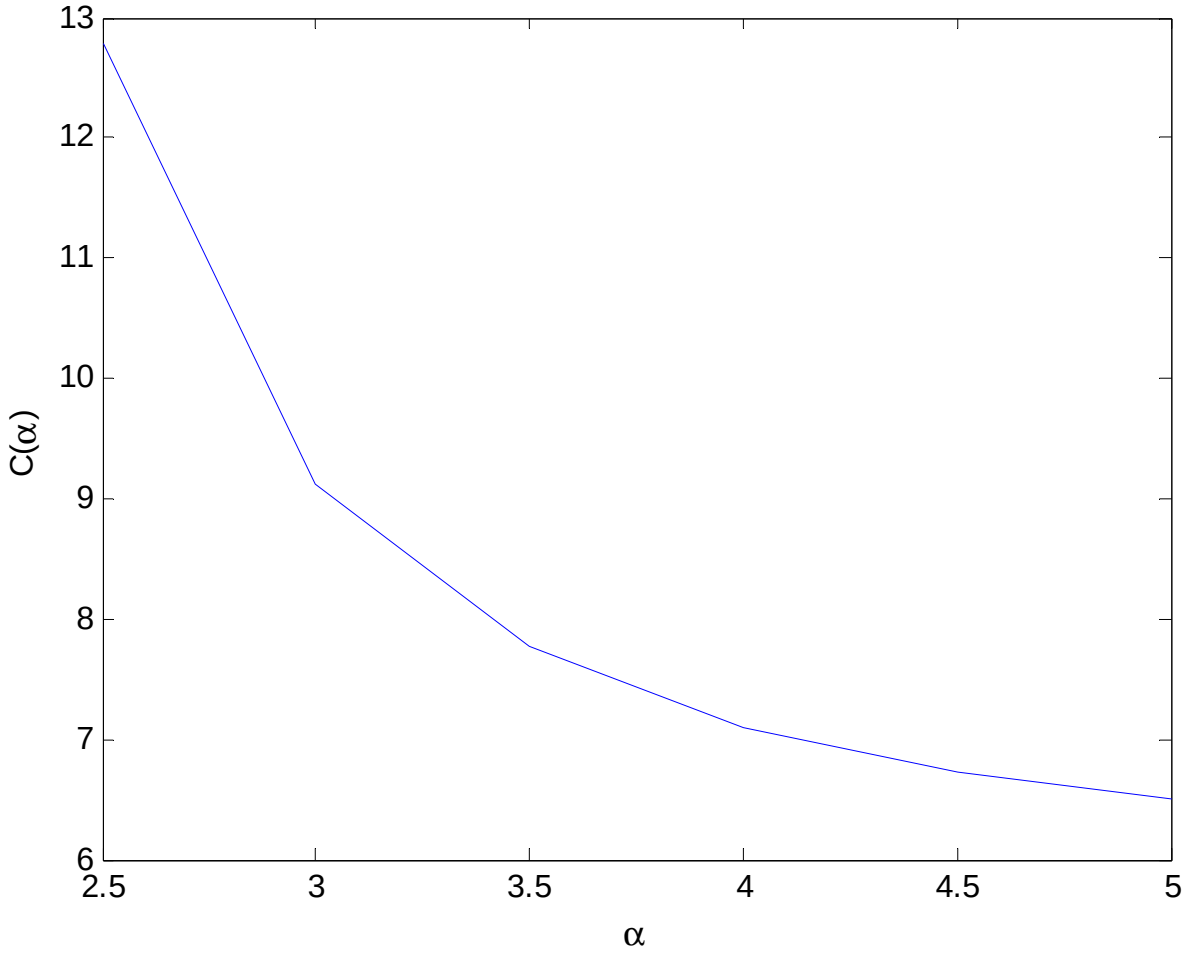
- Let the SINR be given as

$$\Gamma = \left(\frac{D}{R}\right)^{\alpha} \frac{1}{C(\alpha) + \frac{N}{P} D^{\alpha}} \qquad D = \sqrt{3K}R$$

  where R is the cell range, D is the reuse distance (distance to nearest co-channel cell), N is noise power and P is transmission power.

- For a given SINR requirement and path loss exponent, compute SNR on the cell edge for different cluster sizes.

Given figure



Problem

- Use SINR model where

$$\Gamma = \left(\frac{D}{R}\right)^{\alpha} \frac{1}{C(\alpha) + \frac{N}{P} D^{\alpha}} \qquad D = \sqrt{3K}R$$

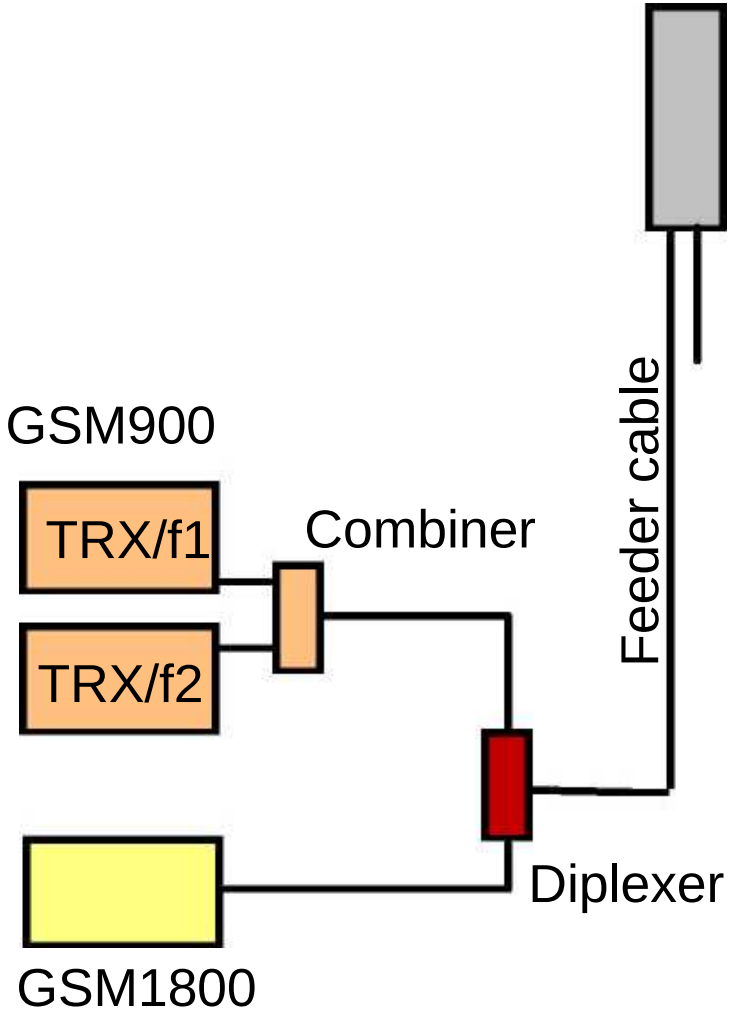
Assume that system is interference limited and number of given channels is 20, required SINR is 9dB and propagation exponent (path loss exponent) is 4. Compute the cluster size. What is the number of channels per cell?

Problem

- Assume an antenna in which there are 6 λ/2 dipoles on top of each other so that narrow vertical beam can be formed.
  - What is antenna gain (in dBi's) of an ideal panel antenna when horizontal 3dB beam width is 65 degrees (3-sector site)?

Example

- GSM 900 with 20 W output
  - Losses and gains
  - Combiner: -3 dB
  - Diplexer -0.5 dB
  - Feeder cable -2.5 dB
  - Antenna gain +17 dBi
  - Total +11 dB
- Effective Isotropic Radiated Power (EIRP)
  - EIRP = 43dBm + 11 dB = 54dB (=251W)



Problem

- Assume that
  - Operator has 5 MHz available for GSM
  - Operator makes the TCH frequency plan according to specifications (SINR > 9dB) but add 6dB marginal for BCCH SINR.
  - Propagation exponent is 4, system is interference limited
- Problems
  - What are the cluster sizes for BCCH and TCH?
  - How many TRX’s are needed
  - What is the number of TCH/F and TCH/H speech channels per cell?

Problem

- What is frequency hopping? Why it is used? Explain at least two gain mechanisms. What are common band strategy and dedicated band strategy for frequency hopping in GSM network?

Problem

- Link budget calculation for GSM

Problem

- What are the differences between WCDMA spreading and scrambling codes? For what purposes spreading and scrambling codes are used in WCDMA?

Problem

- Name WCDMA QoS classes and give an example application for each class. Name also QoS parameters.

Problem

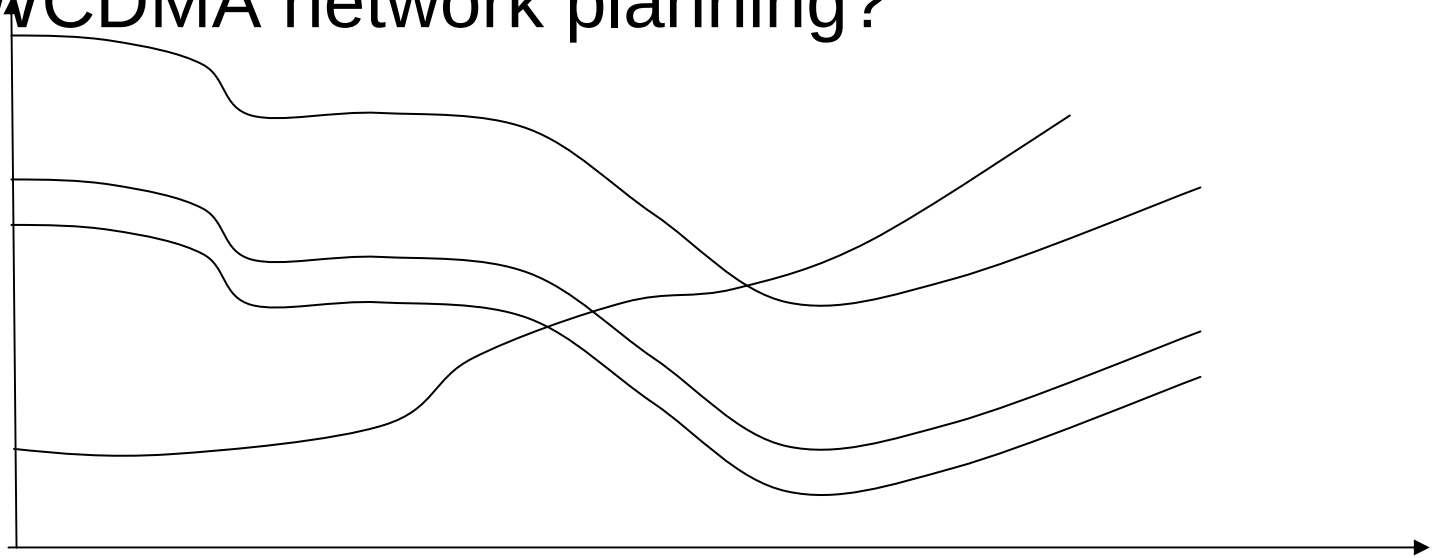
- Why Radio Resource Management (RRM) is so important for WCDMA? What are main RRM functions?

Problem

- Explain briefly the purpose of the following functions
  - Fast power control (=transmit power control) in UL
  - Outer loop power control in UL
  - Soft handover in UL. What is difference between soft and softer handover?
  - Admission control
  - Congestion control
  - Packet scheduler

Problem

- Explain briefly SHO reporting events 1a and 1b and related reporting ranges. What happens in the given figure (not explicitly stated in this example)? Why these parameters are important in WCDMA network planning?



Problem

- WCDMA UL/DL link budget calculation problem
- UL load equation problem
- DL load equation problem
- Deduce UL load equation
- Deduce DL transmission power needed in base station
- Name all parameters in equations

Problem

- Related to WCDMA link budget computation explain briefly
  - Fast fading margin (=power control headroom)
  - Shadow fading margin
  - Interference margin
- How WCDMA coverage and capacity are connected?

Problems

- Why correct antenna tilt is so important for WCDMA? Name two ways to implement the antenna tilt. What is the difference between methods?
- What is pilot pollution in WCDMA? How the so-called active set and pilot pollution are related? What network planning and optimization means we have against pilot pollution in WCDMA?
- What are soft and softer handover in WCDMA? Explain both uplink and downlink soft and softer handovers. Why soft handover optimization is important in WCDMA? What is active set? What is monitored set (=neighbour list)

Problems

- What are the main differences between WCDMA and HSDPA systems?
- What is Channel aware scheduling? Explain what multi-user diversity is. Draw a figure in order to support your explanation.
- Explain hybrid automatic repeat request
- Explain adaptive modulation and coding