Stefanus.wirdatmadja@tut.fi
232722

TLT-6106 Basic Course on Wireless Communications

Exam 4.2.2013 / T. Isotalo

You can use Faculty's calculator or your own calculator. You can answer in English or Finnish. A list of equations is attached to the exam paper.

Use clear handwriting and show all the calculations. Boltzmann's constant: 1.380658×10^{-23} J/K

1. Convert **(1 point)**
   a) 14 watts to dBm
   b) 4 dBm to milliwatts
   Explain briefly the following terms related to wireless communications: **(5 points)**
   c) Shadowing
   d) Free-space loss
   e) Frequency reuse
   f) Spreading factor
   g) Multipath propagation

2. i) Below you have link budget for GSM1800 system (carrier frequency 1.8 GHz, system bandwidth 200 kHz) Calculate and fill in the missing values, and calculate the maximum isotropic path losses.
   ii) Calculate maximum cell range using Okumura-Hata path-loss formula (tunable parameter = 44 and correction factor = 0).

UPLINK	Unit	Value
Mobile station		
RF power	dBm	a)
Cable loss	dB	b)
Tx antenna gain	dBi	c)
Peak EIRP	dBm	d)
Base station		
Rx antenna gain	dBi	e)
Cable loss	dB	f)
BTS sensitivity	dBm	g)
Minimum reception level	dBm	h)
Isotropic path loss	dB	i)

DOWNLINK	Unit	Value
Base station		
RF power	dBm	j)
Cable loss	dB	k)
Tx antenna gain	dBi	l)
Peak EIRP	dBm	m)
Mobile station		
Rx antenna gain	dBi	n)
Cable loss	dB	o)
MS sensitivity	dBm	p)
Minimum reception level	dBm	q)
Isotropic path loss	dB	r)

At the base station end, the transmitter has 20 W maximum power, antenna height and cable length are 33 m, antenna cable has loss of 6 dB/100 m, and base station antenna has 15 dBi gain. Mobile station maximum power equals to 1 W, cable loss can be approximated to 0 dB, and antenna can be assumed to be isotropic. Base station noise figure is 4 dB and mobile station 8 dB, and signal-to-noise requirement for both directions is 7 dB.
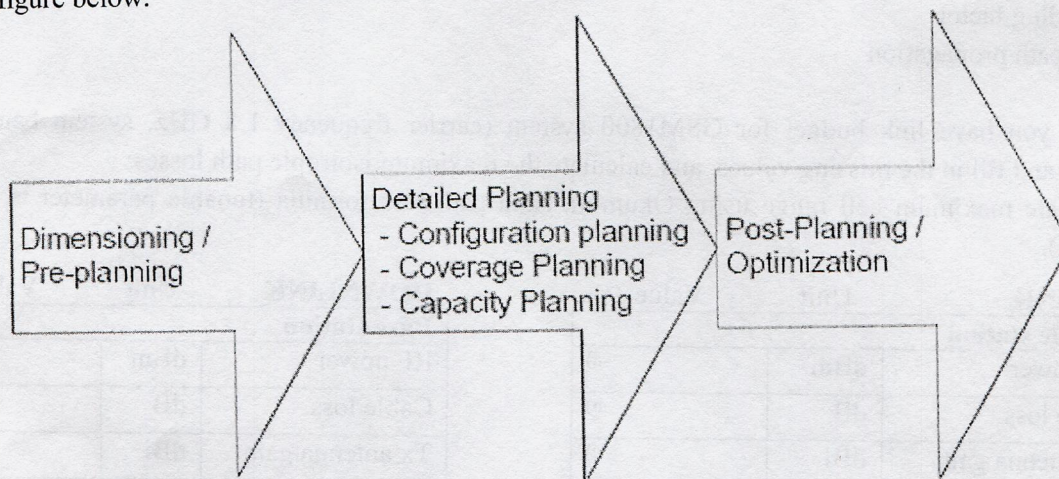
(9 points)

3.
   a) A mobile phone subscriber generates on average 1.2 min voice traffic during the busy hour. How many subscribers in a cell having 30 traffic channels will cause a blocking probability of 1 % **(1 point)**
   b) How many subscribers can be served at the different blocking levels? **(1 point)**
   c) Compare the trunking efficiency in the following two alternative configurations: (i) 1 group of 10 channels, (ii) 2 groups of 5 channels, both with 1% blocking probability. **(1 point)**

You can use Faculty's calculator or your own calculator. You can answer in English or Finnish. A list of equations is attached to the exam paper.

4.

a) Compare briefly (in terms of propagation characteristics) the High Frequency range (3-30 MHz) with Super High Frequency range (300-3000 MHz). Think about the common and distinct properties in each of these two ranges.
(3 points)

b) Explain what impacts do sectoring, antenna downtilt and antenna height have on cellular network coverage and capacity.
(3 points)

Answer to question 5 OR 6. If you answer to both, the one giving LESS points will be taken into consider.

5. Explain the figure below:
(6 points)

6. Explain radio resource management, transmit power control, load control, admission control, and mobility (handover) control.
(6 points)