

S-72.3275 Cellular Radio Network Planning and Optimization

Exercise Set 2

Deadline: 26.2.2008 at 16.00

Handover1

1. What is meant by Hard Handover, Soft Handover and Softer Handover?
2. What is the difference of selection combining and maximum ratio combining?
3. Considering uplink, what kind of combining method is used in each different handover scheme of question 1?
4. Why isn't maximum ratio combining utilized in uplink of handover?
5. What is meant by active set (AS)?
6. What is meant by Neighbor Set (NS)/Monitored set (synonyms)?
7. What is meant by Detected Set (DS)?
8. Is it good to have a big DS?
9. What is meant by soft handover window?
10. Give some drawbacks if SHO window is too big?
11. Give some drawbacks if SHO window is too small?

Handover2

A short return to probability theory: Consider an arbitrary communications system using transmission blocks of B bits. Derive the equation for BER in function of $BLER$ and B .

Now assume a wireless communications system with a single BPSK modulated radio bearer (RAB) from BS to MS with following characteristics $BLER = 10^{-4}$, $B = 100$ bits, what is the required BER?

Consider that the same requirements should be met by using two RABs in soft handover (SHO) manner with selection combining. What is the required block error ratio $BLER_{SHO}$ for both RABs now?

How about the corresponding bit error ratio BER_{SHO} ?

Now with the Q-value table provided below, calculate what is the gain achieved in reduced SNR requirement of one RAB. Remember:

$$P_e(BPSK) = Q(\sqrt{2SNR})$$

Now, remember that in SHO we still use two RABs, e.g. twice the power. So based on this analysis, compared with single RAB operation, what can you say about the efficiency of the SHO?

How to improve the efficiency?

Q(x)	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
X	1.28155	2.32635	3.09023	3.71902	4.26489	4.75342

Handover3

(Hint: Read first the whole paper to get the big picture of the task - an approach typically yielding the best results!)

In the following analysis, we consider the downlink direction only. A WCDMA UE is operating in soft handover (SHO) with two radio bearers (RABs 1 and 2) from different base stations BS 1 and BS 2. The corresponding received signal to interference ratios are denoted SIR_1 and SIR_2 .

Keeping the SIR_1 as a reference level, let the SIR_2 be 0 dB, 2 dB, 3 dB, 6 dB, and 10 dB weaker. Assuming maximum ratio combining (MRC) and perfect channel estimation, what is the corresponding SIR gain in decibels, achieved by adding the weaker RAB 2 to the active set?

Next assume that all the RABs are sent with equal power from the BSs. What is the rise in interference in the soft handover zone due to addition of RAB 2 compared to operating only with RAB 1?

Finally, you may determine the net gain of DL SHO assuming diversity gain $G_D = 4$ dB (reduced fast fading + reduced shadowing margin) and a reduction in MRC gain due to imperfect channel estimation of $L_{ChEst} = 1.5$ dB.

When carrying out the task, following table might be useful:

SIR_1	$SIR_2 - SIR_1$	MRC gain	Rise in I	G_D	L_{ChEst}	Net gain
Ref	0					
Ref	-2					
Ref	-3					
Ref	-6					
Ref	-10					

Based on your analysis, what would be an appropriate SHO window size?

Handover4(Bonus)

You have just carried out a drive test from a 3G network. The measurement software indicates that a handover failure was occurred in a certain location. Due to the failure a call drop was experienced. How would you begin your troubleshooting? (This one is probably the most typical engineering task related to 3G-optimization!)