1) Scenario

SNR , $\frac{E_B}{N_0}$

2) How to implement
  - functions
  - I/O

Parameter

3) What to simulate

4) How to document

2 lectures/intro

5 - 10 questions

– [✓ yes] no maybe 10% → read

– 50% → read

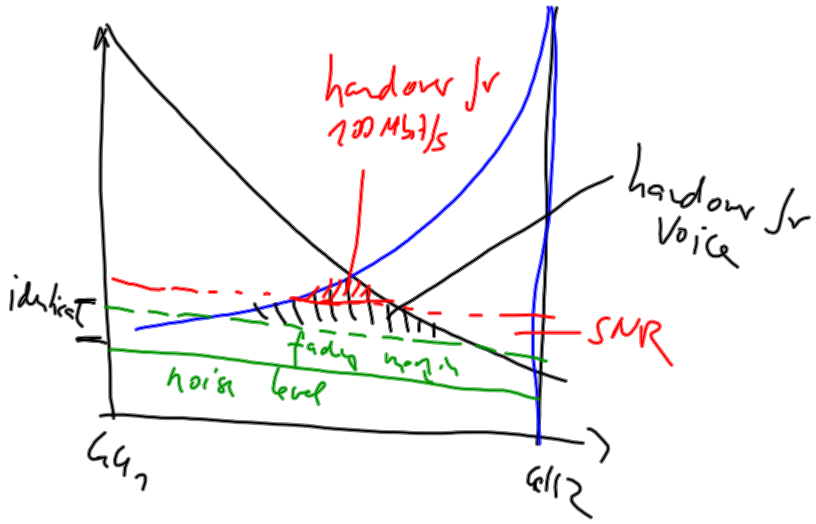
– ↑

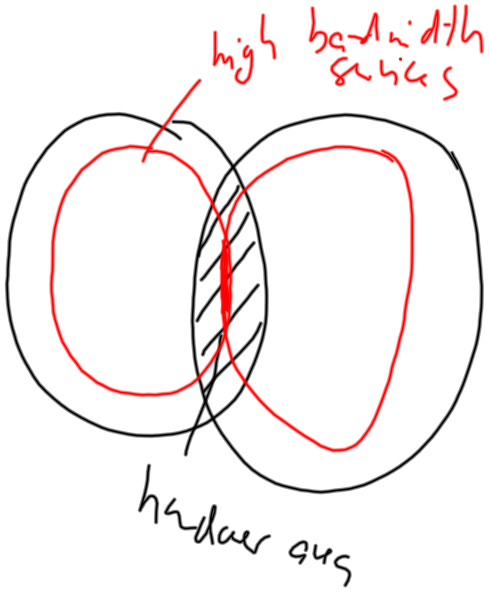
– measure

– self evaluation

Scenario 1: UMTS — GSM

UMTS





Input:

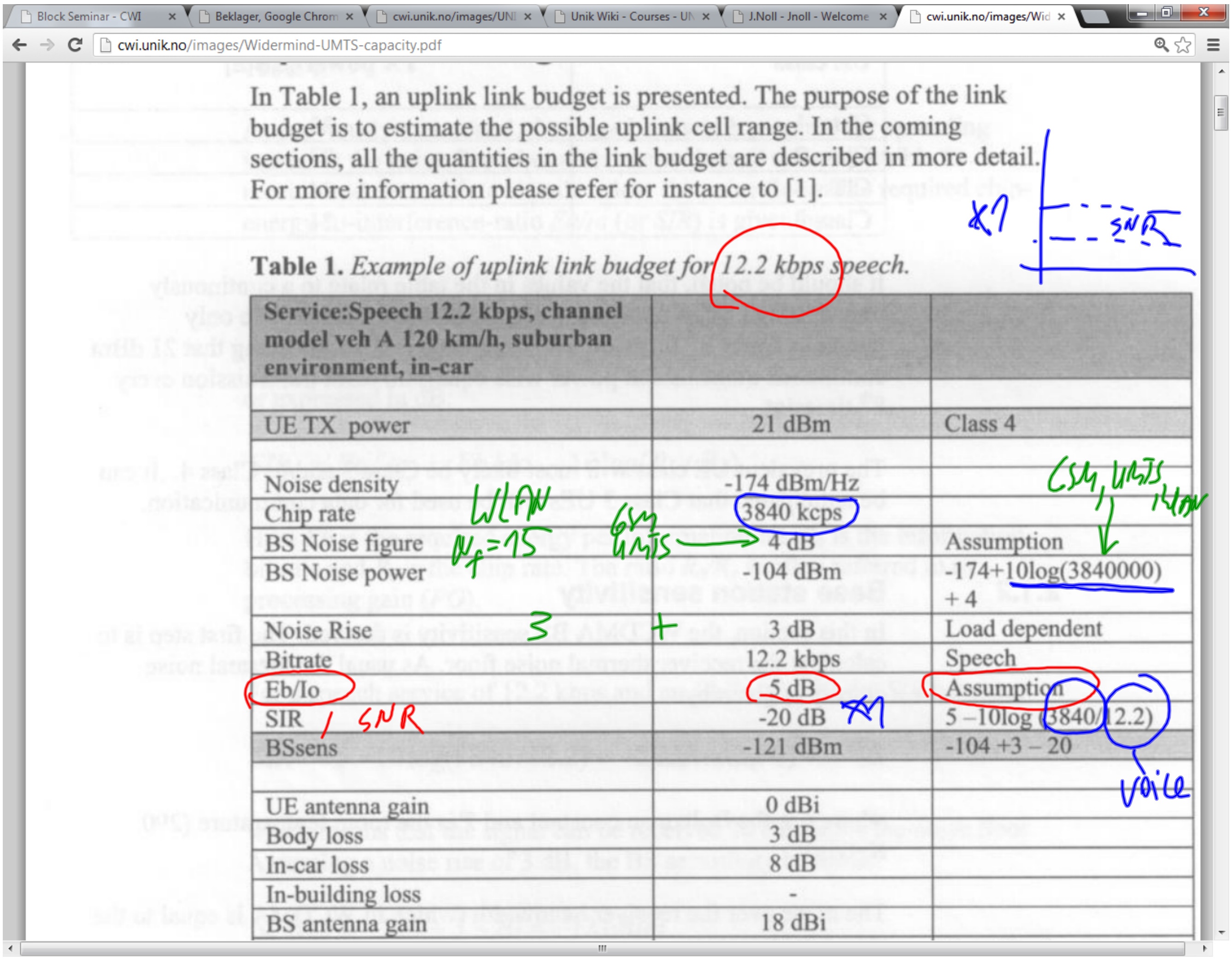
Cell structure, $\vec{v}$

Output

overlapp area (range)

↳ time aspect

20 Mbit/s SNR↑



In Table 1, an uplink link budget is presented. The purpose of the link budget is to estimate the possible uplink cell range. In the coming sections, all the quantities in the link budget are described in more detail. For more information please refer for instance to [1].

Table 1. *Example of uplink link budget for 12.2 kbps speech.*

Service:Speech 12.2 kbps, channel model veh A 120 km/h, suburban environment, in-car		
UE TX power	21 dBm	Class 4
Noise density	-174 dBm/Hz	
Chip rate	3840 kcps	
BS Noise figure	4 dB	Assumption
BS Noise power	-104 dBm	-174+10log(3840000) + 4
Noise Rise	3 dB	Load dependent
Bitrate	12.2 kbps	Speech
Eb/Io	5 dB	Assumption
SIR	-20 dB	5 – 10log (3840/12.2)
BSsens	-121 dBm	-104 +3 – 20
UE antenna gain	0 dBi	
Body loss	3 dB	
In-car loss	8 dB	
In-building loss	-	
BS antenna gain	18 dBi	

WLAN $N_f = 15$

GSM UMTS → 4 dB

GSM, UMTS, WLAN

3 +

/ SNR

x↑

voice

Noise figure   Boltzmann

290k

Noise density $k \cdot T = -174 \frac{dBm}{Hz}$.

$kTB = kT \cdot$

- GSM 200 kHz
- UMTS 3.84 MHz
- WLAN 20 MHz

+ Noise figure → 1.5 ... 4 ③

FM: 93.45
93.50
93.55

$\Big\} B_{FM} \ll 50\ kHz$

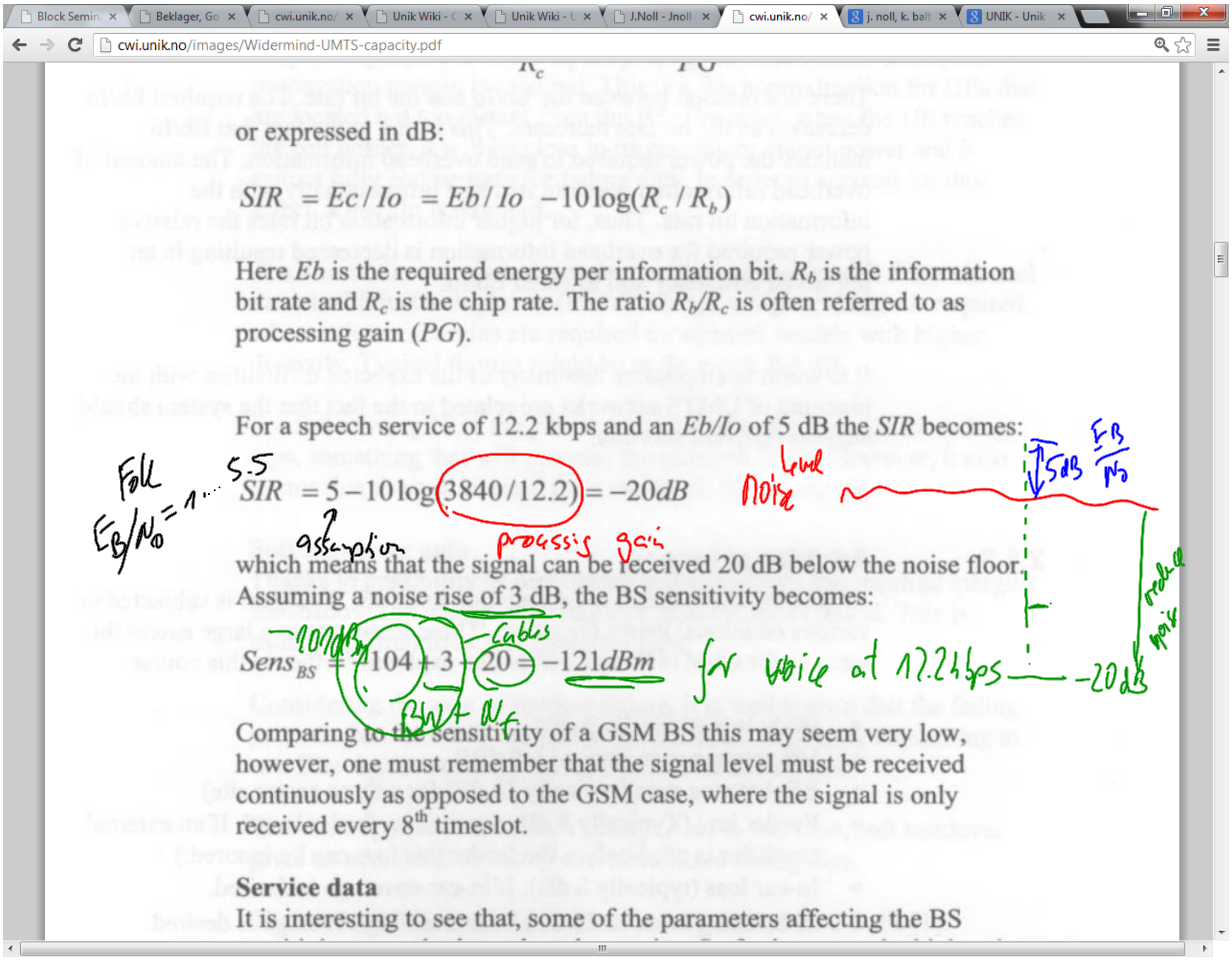
Processing gain

$$UMTS_{12.2\ voice} = \underbrace{\frac{E_b}{I_o}}_{1 \ldots 5.5} - 10\log\left(\frac{\text{chip rate}}{\text{voice rate}}\right)$$

select ⑤

Voice	GSM	12 kbit/s	/ 200 kHz	
	UMTS	12	3.8 MHz	3.8 Mbit/s
	WLAN	12	20 MHz	3.8 Mbit/s

data



or expressed in dB:

$$SIR \;= Ec/Io \;= Eb/Io \;-10\log(R_c/R_b)$$

Here *Eb* is the required energy per information bit. R_b is the information bit rate and R_c is the chip rate. The ratio R_b/R_c is often referred to as processing gain (*PG*).

For a speech service of 12.2 kbps and an *Eb/Io* of 5 dB the *SIR* becomes:

Folk $E_B/N_0 = 1 \ldots 5.5$

$$SIR \;= \underset{\text{assumption}}{5} - 10\log\underbrace{(3840/12.2)}_{\text{processig gain}} = -20dB$$

Noise Level

5dB $\frac{E_B}{N_0}$

reduce noise

which means that the signal can be received 20 dB below the noise floor. Assuming a noise rise of 3 dB, the BS sensitivity becomes:

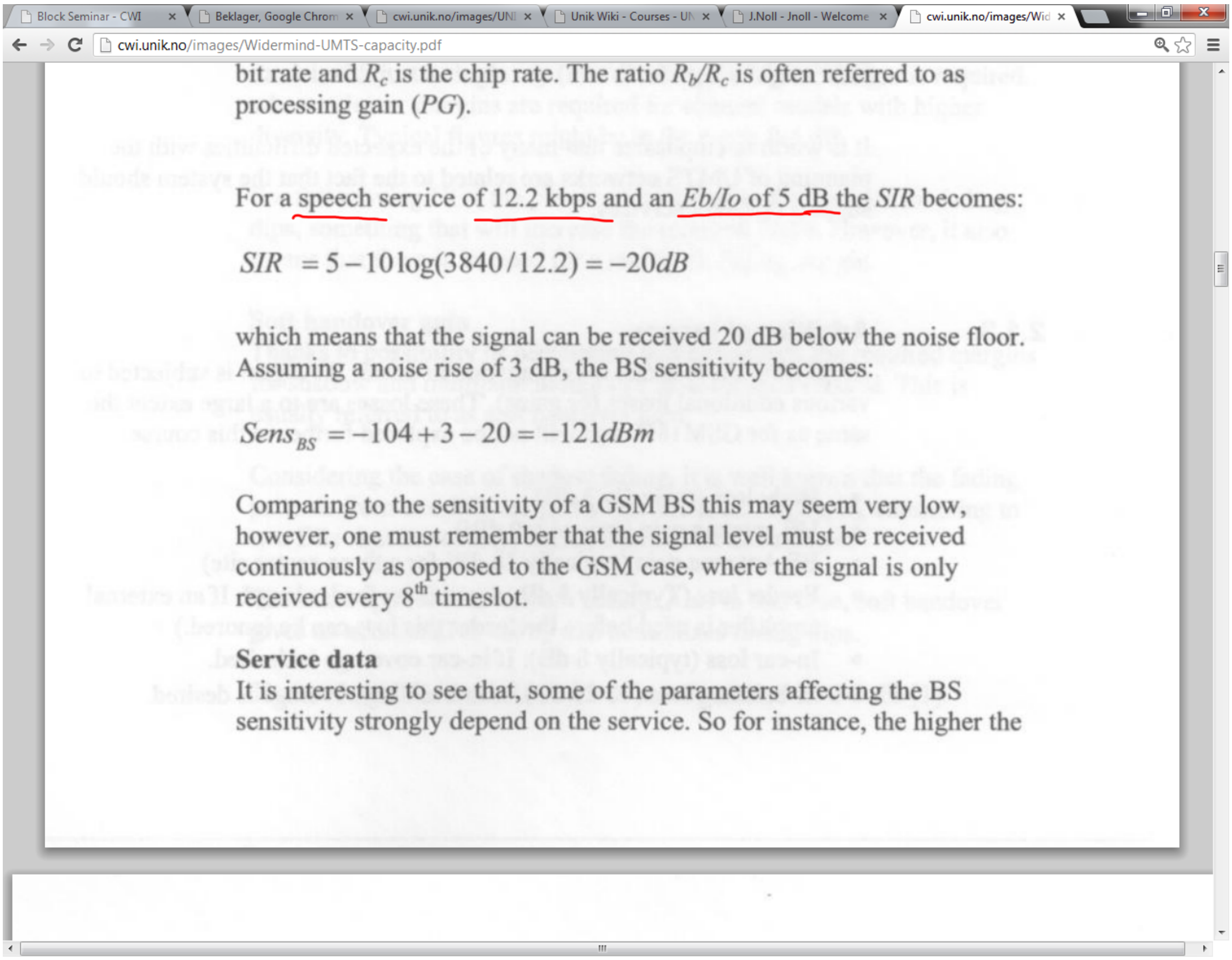
$$Sens_{BS} = \underbrace{\overset{-107dBm}{-104+3}}_{BW + N_f} - \overset{\text{Cables}}{20} = \underline{-121dBm}$$

for voice at 12.2kbps → -20dB

Comparing to the sensitivity of a GSM BS this may seem very low, however, one must remember that the signal level must be received continuously as opposed to the GSM case, where the signal is only received every 8th timeslot.

Service data

It is interesting to see that, some of the parameters affecting the BS



bit rate and R_c is the chip rate. The ratio R_b/R_c is often referred to as processing gain (*PG*).

For a speech service of 12.2 kbps and an *Eb/Io* of 5 dB the *SIR* becomes:

$$SIR \ = 5 - 10\log(3840/12.2) = -20dB$$

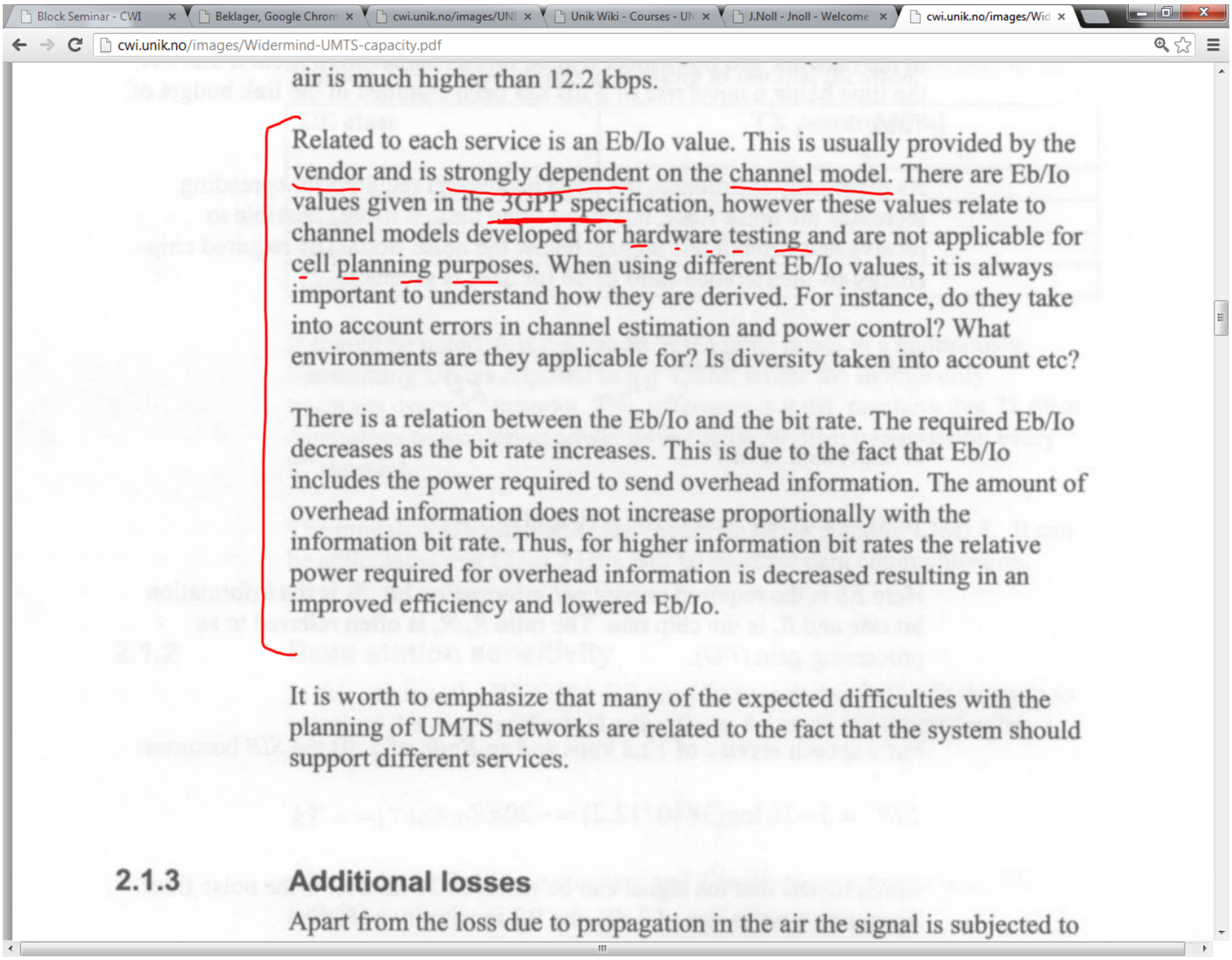
which means that the signal can be received 20 dB below the noise floor. Assuming a noise rise of 3 dB, the BS sensitivity becomes:

$$Sens_{BS} = -104 + 3 - 20 = -121dBm$$

Comparing to the sensitivity of a GSM BS this may seem very low, however, one must remember that the signal level must be received continuously as opposed to the GSM case, where the signal is only received every 8th timeslot.

Service data

It is interesting to see that, some of the parameters affecting the BS sensitivity strongly depend on the service. So for instance, the higher the



air is much higher than 12.2 kbps.

Related to each service is an Eb/Io value. This is usually provided by the vendor and is strongly dependent on the channel model. There are Eb/Io values given in the 3GPP specification, however these values relate to channel models developed for hardware testing and are not applicable for cell planning purposes. When using different Eb/Io values, it is always important to understand how they are derived. For instance, do they take into account errors in channel estimation and power control? What environments are they applicable for? Is diversity taken into account etc?

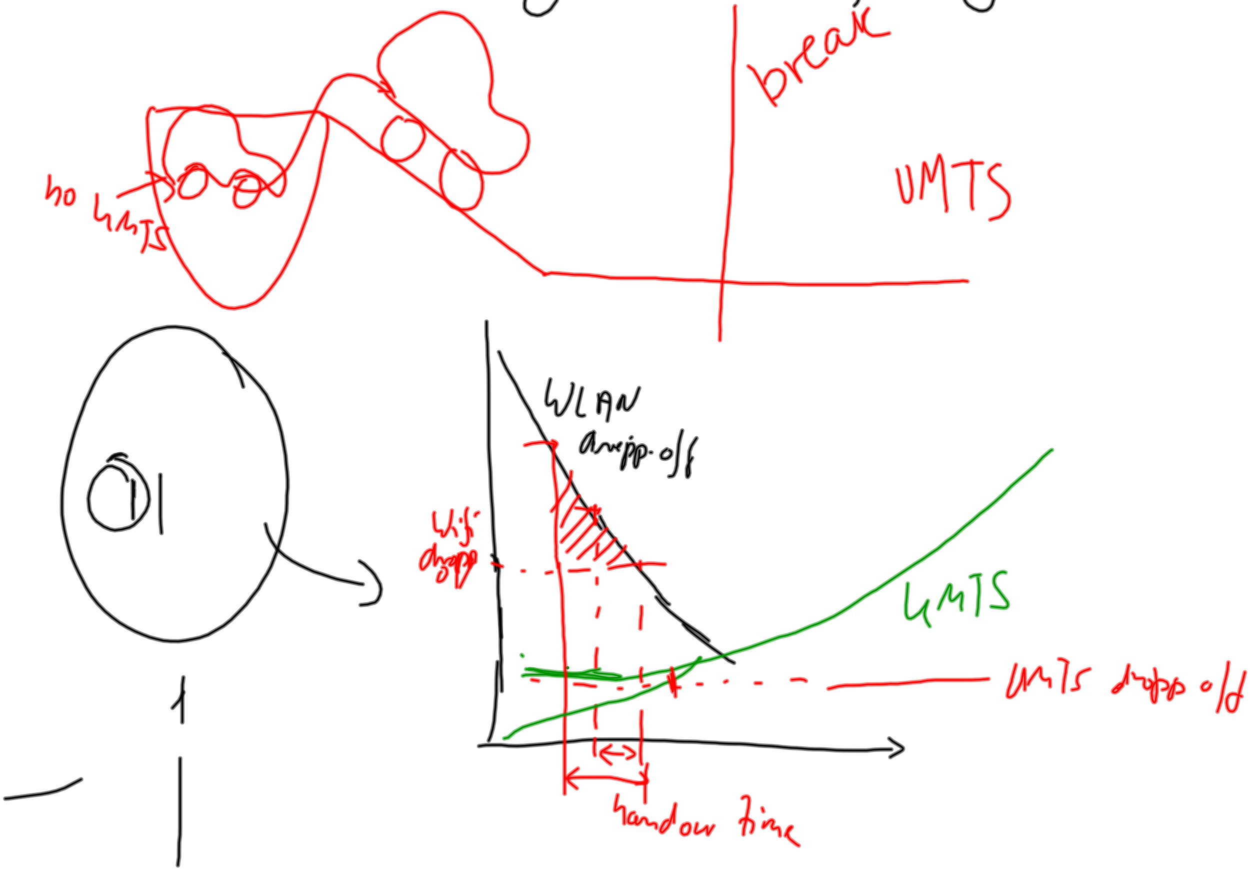
There is a relation between the Eb/Io and the bit rate. The required Eb/Io decreases as the bit rate increases. This is due to the fact that Eb/Io includes the power required to send overhead information. The amount of overhead information does not increase proportionally with the information bit rate. Thus, for higher information bit rates the relative power required for overhead information is decreased resulting in an improved efficiency and lowered Eb/Io.

It is worth to emphasize that many of the expected difficulties with the planning of UMTS networks are related to the fact that the system should support different services.

2.1.3 Additional losses

Apart from the loss due to propagation in the air the signal is subjected to

Scenario 2: Leaving the ferry



Scenario 3: Walking in the park

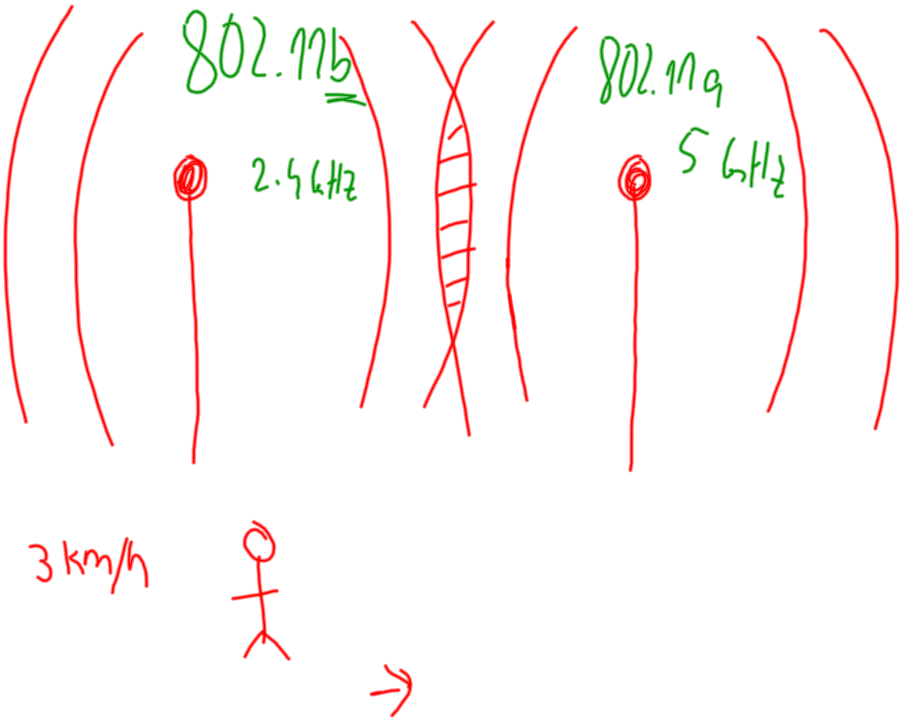
Handover:

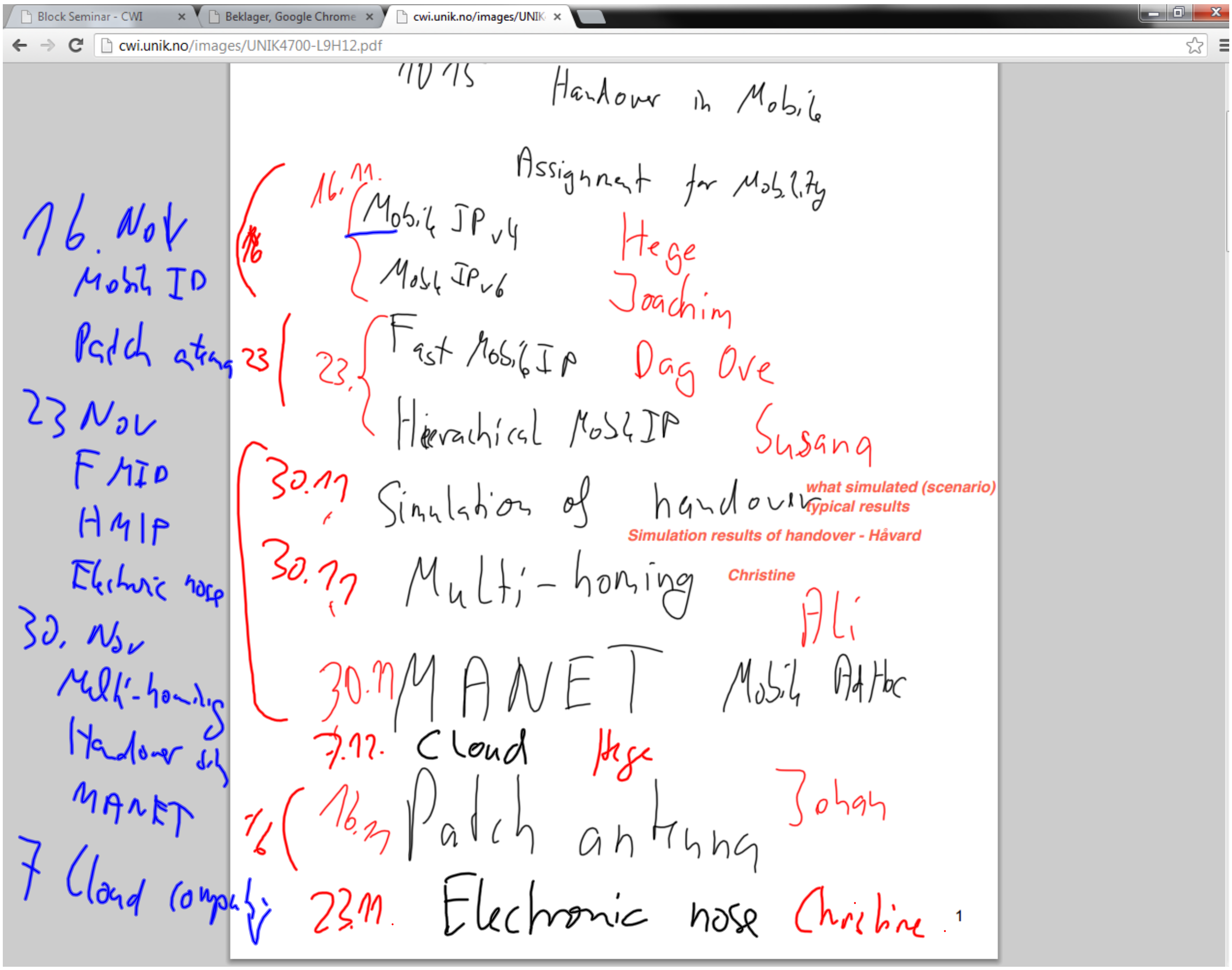
50 ms,

100 ms

1 sek

2 sek





10 15 Handover in Mobile

Assignment for Mobility

16.11. Mobil IPv4 Hege
Mobil IPv6 Joachim

23. Fast Mobil IP Dag Ove
Hierachical Mobil IP Susana

30.11 Simulation of handover

what simulated (scenario)
typical results

Simulation results of handover - Håvard

30.11 Multi-homing Christine

Ali

30.11 MANET Mobil Ad Hoc

7.12. Cloud Hege

16.11 Patch antenna Johan

23.11. Electronic nose Christine

16. Nov
Mobil ID
Patch atang

23 Nov
FMIP
HMIP
Electronic nose

30. Nov
Multi-homing
Handover sim
MANET

7 Cloud computing

30.11.2012

Essay = Wiki documentation

→ typical understanding

Håvard: noise level

→ characteric values

-104 dB (3.8 MHz)

→ assumptions

Combining the data
↳ short

Input

what is seen

Scenario < specific

graph (general)

What goal Hege
↳ Scenario Christine

Joachim
Propagation models ↳ typic
- main assumptions
free → rural → indoor
→ urban
values typical

Dag Ove
Antennas, typical values
Omni - directive < V
h

noise level Håvard
@ rec. sys.

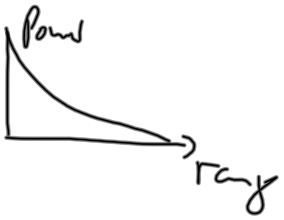
understanding
Fading < typical values
↳ fade margin

Thomas

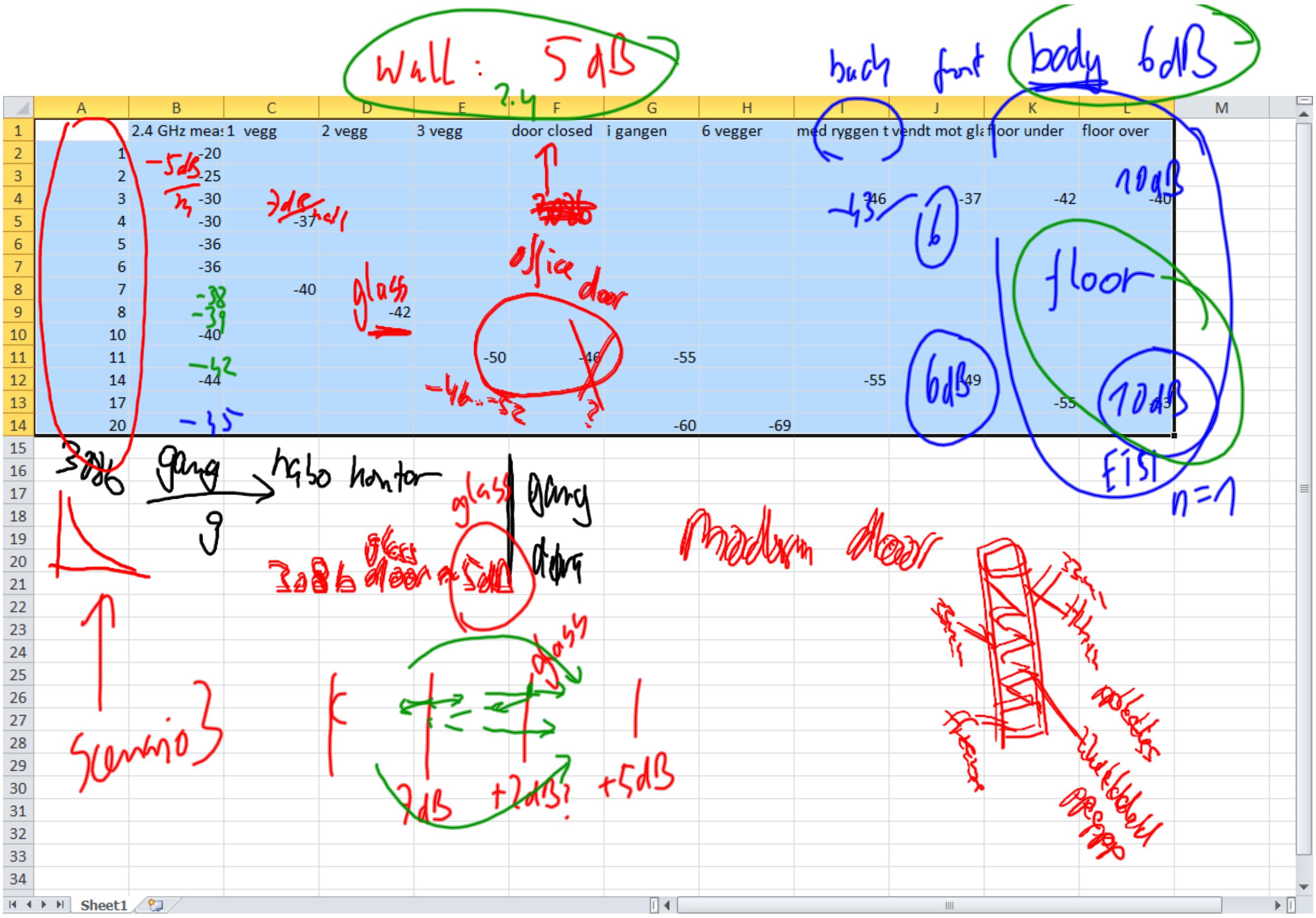
QoE Susana

Measurements 802.11a, b

- model



- person
- wall
- floor
- omnidirectional vs directional

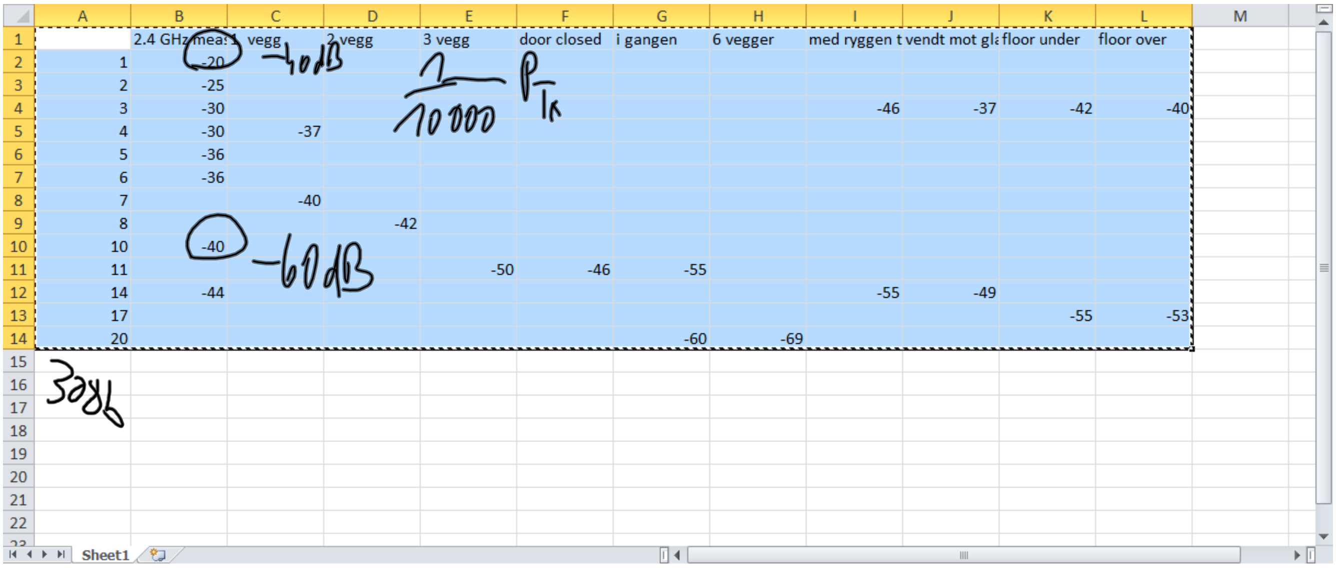


	2.4 GHz meas	1 vegg	2 vegg	3 vegg	door closed	i gangen	6 vegger	med ryggen t	vendt mot gla	floor under	floor over
1	-20										
2	-25										
3	-30							-46	-37	-42	-40
4	-30	-37									
5	-36										
6	-36										
7		-40									
8			-42								
10	-40										
11				-50	-46	-55					
14	-44							-55	-49		
17										-55	-43
20						-60	-69				

for 5.4 GHz attenuation x2

	2.4 GHz measure	1 vegg	2 vegg	3 vegg	door closed	i gangen	6 vegger	med ryggen til glassdø	vendt mot glassdø	floor under	floor over
1	-20										
2	-25										
3	-30							-46	-37	-42	-40
4	-30	-37									
5	-36										
6	-36										
7		-40									
8			-42								
10	-40										
11				-50	-46	-55					
14	-44							-55	-49		
17										-55	-53
20						-60	-69				

~~Ave~~ output power P_{TX} : 17...20 dBm $+G_{TX}$ = 3...4dB



	A	B	C	D	E	F	G	H	I	J	K	L
1		2.4 GHz meas 1	vegg	2 vegg	3 vegg	door closed	i gangen	6 vegger	med ryggen t	vendt mot gl	floor under	floor over
2	1	-20										
3	2	-25										
4	3	-30							-46	-37	-42	-40
5	4	-30	-37									
6	5	-36										
7	6	-36										
8	7		-40									
9	8			-42								
10	10	-40										
11	11				-50	-46	-55					
12	14	-44							-55	-49		
13	17										-55	-53
14	20						-60	-69				

-40dB

$\frac{1}{10000} P_{TX}$

-60dB

30dB

Utgifter

utgifter.doc

bank ~~doc~~ Σ

send til Hellfrid

- billetter / ~~bestilling~~ / kvittering
- boarding pass