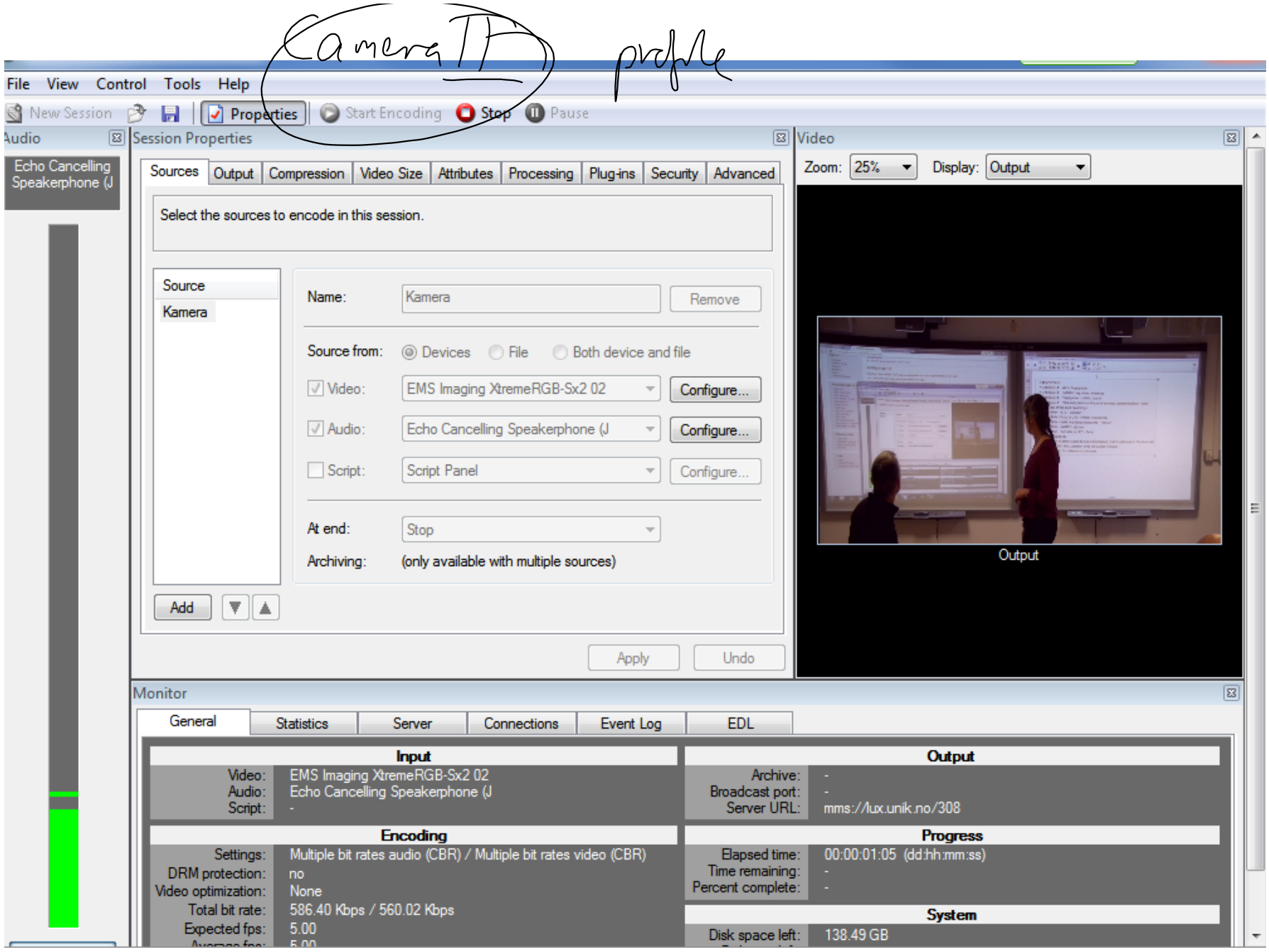
- Interference
- 12Sep2014 - Wave Propagation
- 19Sep2014 - Radiation equation, Antennas
- 26Sep2014 - Propagation models: Yun Ai
- 26Sep2014 - Frequency rande and type of wireless communications - Raul
- GSM and UMTS (cell breathing)
- 17Oct2014 - LTE - Solomon
- 17Oct2014 -Voice in LTE - Mikhail Yakubovich
- 10Oct2014 - WiFi long lange standards - Mohsen
- 10Oct2014 - WiMAX - Qihaoli
- 10Oct2014 - Security in NFC - Seraj
- System capapcity
- Basic Internet (free access to basic information (text & pictures) on the Internet)
- inverse MVNO: the customer owns the access network
- WLAN system for video communication


Camera ID
profile
File View Control Tools Help
New Session
Properties
Start Encoding
Stop
Pause
Audio
Echo Cancelling Speakerphone (J
Session Properties
Sources Output Compression Video Size Attributes Processing Plug-ins Security Advanced
Select the sources to encode in this session.
Source
Kamera
Name: Kamera
Remove
Source from: Devices File Both device and file
Video: EMS Imaging XtremeRGB-Sx2 02
Configure...
Audio: Echo Cancelling Speakerphone (J
Configure...
Script: Script Panel
Configure...
At end: Stop
Archiving: (only available with multiple sources)
Add
Apply
Undo
Video
Zoom: 25%
Display: Output
Output
Monitor
General Statistics Server Connections Event Log EDL
Input
Video: EMS Imaging XtremeRGB-Sx2 02
Audio: Echo Cancelling Speakerphone (J
Script: -
Output
Archive: -
Broadcast port: -
Server URL: mms://lux.unik.no/308
Encoding
Settings: Multiple bit rates audio (CBR) / Multiple bit rates video (CBR)
DRM protection: no
Video optimization: None
Total bit rate: 586.40 Kbps / 560.02 Kbps
Expected fps: 5.00
Progress
Elapsed time: 00:00:01:05 (dd:hh:mm:ss)
Time remaining: -
Percent complete: -
System
Disk space left: 138.49 GB

last week 10 Oct 2014

- short range communication

Bluetooth, ANT+, ZigBee, ...

main features: "body shield"

$P_R = P_T \cdot G_T G_R \cdot \left(\frac{\lambda}{4\pi R}\right)^2$

$C = W \cdot \log_2(1 + SNR)$

P_{sens}

$\sim f = 2.4\,GHz$

$\approx -85\,dB_m$

Wifi $-95\,dB_m$

frequency range

Bandwidth

$\lambda = \frac{c}{f} = \frac{30\,cm}{f[GHz]} \approx 12\,cm$

$W = 1\,MHz$

$C \approx 720\,kbit/s$

Bluetooth

$P_T[dB_m]$	$R[m]$
0	1-2 m
4	~4 m
20	10-20 m

NFC $f = 13.56\,MHz$

- passive mode "card"
- active mode ("AutoPass") not NFC $f = 5.8\,GHz$

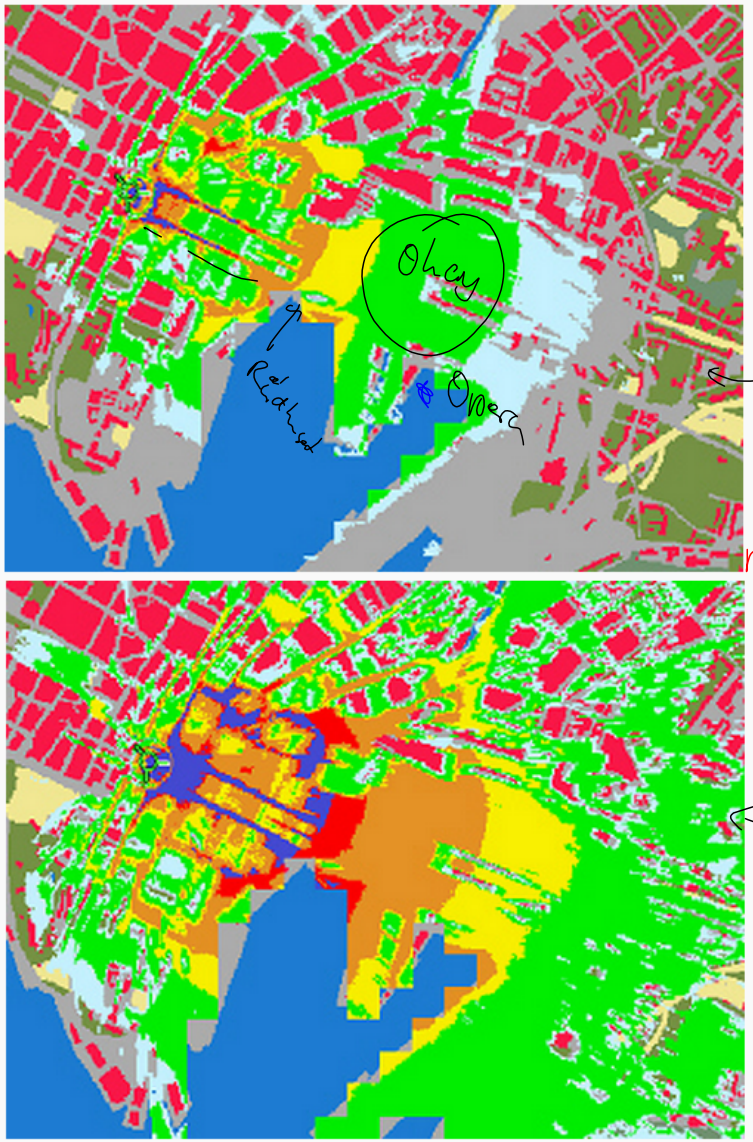
ECMA 340

$Power \sim \frac{1}{r^4}$ static magnetic field

activate card start communication

$\sim \frac{1}{r^2}$ under communication

⌘Oslo simulations, performed for GSM at 1800 MHz



$P_{Tx} = 25 dBm$

$L = 80 dB$

$P_R = -55 dBm$

red "low receive power"

buildings

indoor

≈20dB less

modern office

-30-40dB less than outdoor

$P_{Tx} = 35 dBm$

more interference

File:Scaleimage.png

how much does the range decrease when reducing the power by 10 dB?

GSM: 900, 1800 MHz

⌘Difference GSM - UMTS : 1900 – 2100 MHz

- Frequency
- Receiver structure
- GSM sliding window of 16 $3\mu s$
- UMTS Rake receiver

wideband CDMA

Q16ratio:The ratio of the power inside to the power outside a window of duration 16 $3\mu s$. For each IR the window is slid to find the position with highest power inside the window.

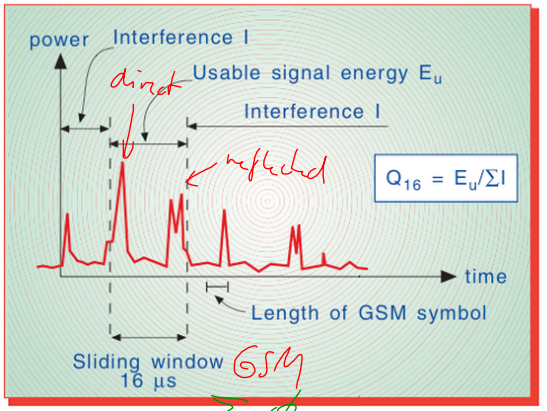
(Source:R Rækken, G. Løvnes, Telektronikk)

⌘Results of link level simulation

Simulations to achieve minimum W-CDMA using given QoS parameter: here voice service

(Source: Eurescom P921, D2)

⌘UMTS cell planning



UMTS power

Rake receiver

5-finger Rake receiver

$\Sigma \phi$ incoming rays

Phase varies

coherent summary

$E_{total} = E_1 + E_2 + E_3 + \ldots$

$\phi = 180°$

GSM $\vec{E}_{total} = \int_{rays} \approx \Sigma \vec{E}_1 + \vec{E}_2 + \vec{E}_3 \ldots$ negative

UMTS Rake $E_{total} = (E_1) + (E_2) + (E_3) + \ldots (E_5)$

Core UMTS:

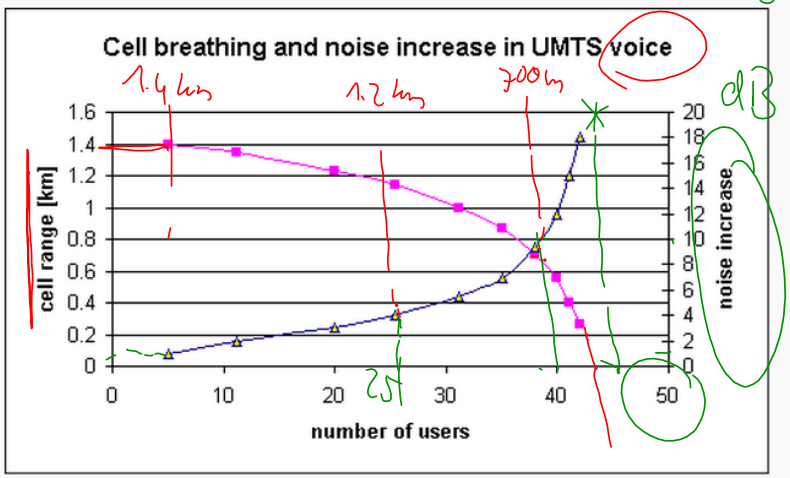
Wide band → Spread spectrum ⇒ 5 MHz BW

Cell breathing (UMTS)

example voice 16 kbit/s → spread → 5 MHz

Codes: C_1 user 1, C_2 user 2, C_3 user 3 } interference "not orthogonal"

⌘Cell Breathing effect in UMTS



25 users = SNR = SNR − 4 dB

40 users = 9.5 dB

45 users = 20 dB

View: http://www.eurescom.de/~public-web-deliverables/P900-series/P921/D2/index.html for "live simulation" and "Cell Ranges for GSM1800 and UMTS Services"

(Source: Eurescom P921, D2)

⌘Network planning

GSM versus UMTS

- UMTS is interference limited
- GSM is build on frequency reuse in the cells, while UMTS has the same frequency in neighbouring cells
- UMTS range is capacity limited
- UMTS requires simultaneous cell planning and network dimensioning
- handover is network based, the handset announces, network performs the handover
- In UMTS a mobile phone can be connected to two cells at the same time, the handover is then called soft handover. Handover between sectors in of the same antenna are called softer handover

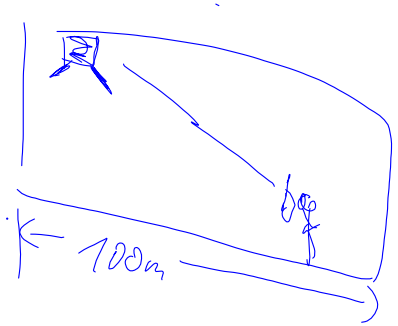
WiMax and Wi-Fi

	WiMax	Wi-Fi (802.11n)
Standard	802.16	802.11n, 802.11ac
Range	50km (at the maximum range)	Indoor 70m, outdoor 250m
Scalability	From one to hundreds consumers	From one to tens
Bit rate	Between 34 Mbit/s and 1 Gbit/s	150 Mbit/s (1 spatial stream)
Frequency band	Licensed/Unlicensed 2G to 11GHz	2.4GHz/5GHz
Channel Bandwidth	Adjustable from 1.25M to 20, 25, 28MHz,	Per channel 40Mhz
Radio technology	OFDM (256-channels)	OFDM
Modulation	Mobile WiMax (802.16e)	Cannot move fast
Mobility	Request/Grant	CSMA/CA or AP-uncontention
Access Protocol		

Reference from: H. Labiod, H. Afifi, C. DE SANTIS, "WI-FI, Bluetooth, Zigbee, and WiMAX", published by Springer,

*1 Measures done at UNH WiMax 3.5 GHz
point to multipoint $G_T = 14$dB $G_R = 17$dB
$R_{max} \approx 5-7$km (802.16d)

*4



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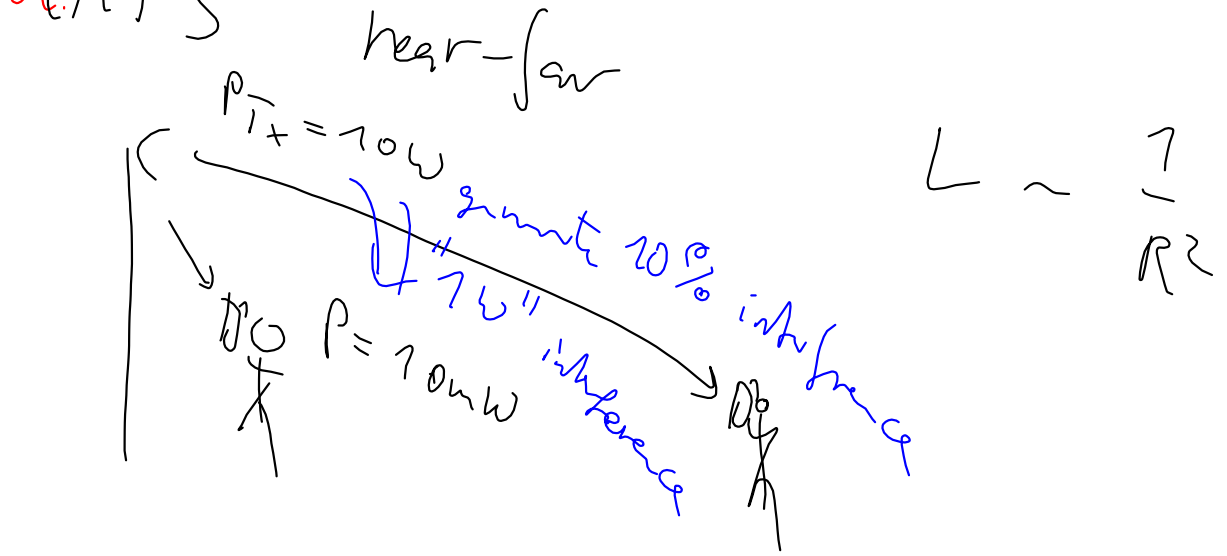
LTE basics

next week

UMTS



$L \sim \frac{1}{R^2}$