UNIK 4700 suggestions

present at 5/6. lecture

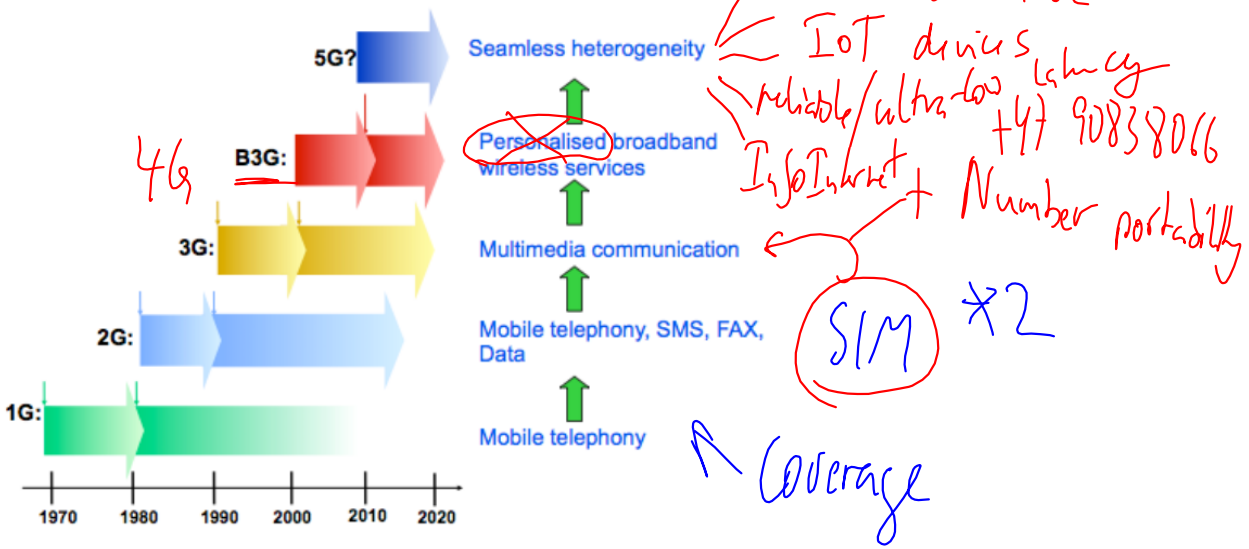
1. presentation
   - list of given papers
   - free topic / paper

universities like
- group discussions
- questions

pre determined

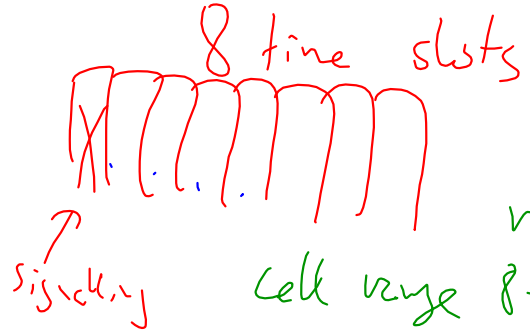
while 1G and 2G were all about radio interfaces,

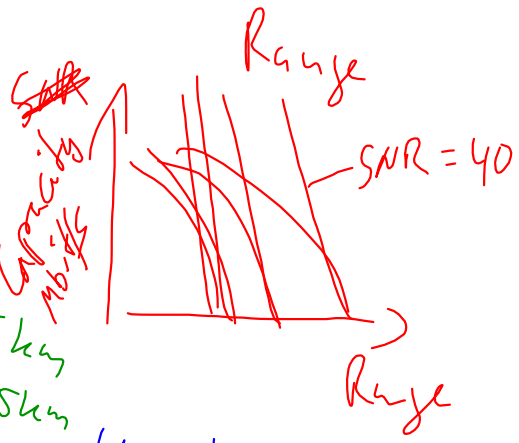
- 3G and Beyond 3G (B3G) are all about services
- 4G is using mobile broadband everywhere
- 5G will be truly heterogeneous network



*2 USA 2G: IS95 CDMA → 3G CDMA2000 +

2G





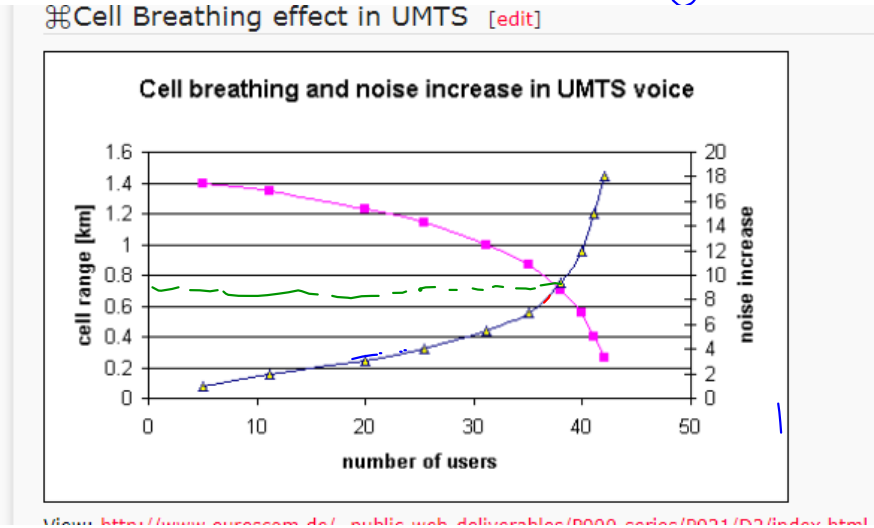
3G

3.8 MHz broadband carrier

spreading codes

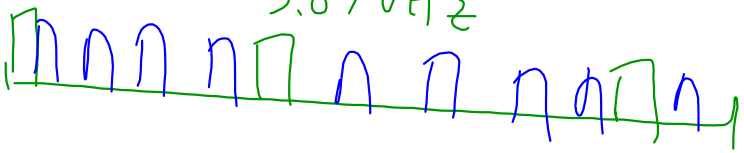
- VIP own code classes
- softly degrade SNR↓
- emergency (noddrett on 3G)

→ cell breathing



Spreading code — Code classes — 95% orthogonal

3.8 MHz



60% orthogonal

→ Spreading

→ Coding +3

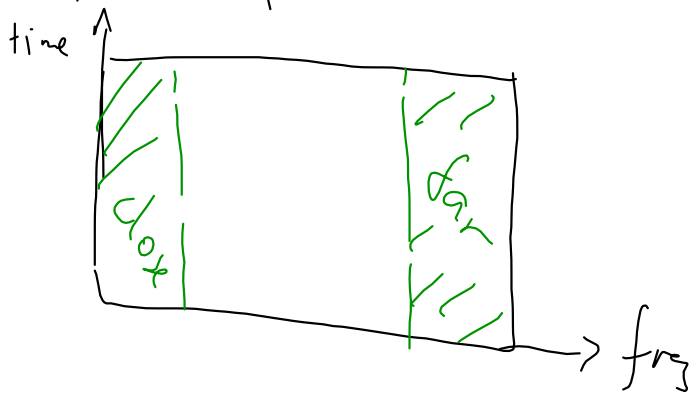
3G High Speed HSPA much more flexible

7.2, 14.4 Mbit/s D

4G

×10

freq, time, code



Core network

all IP

IPsec

5G

Mobile + X network

SDN "operator control"

radio: minor upgrade

ODMA

OFDM

LTE in U.S.

5 - x GHz

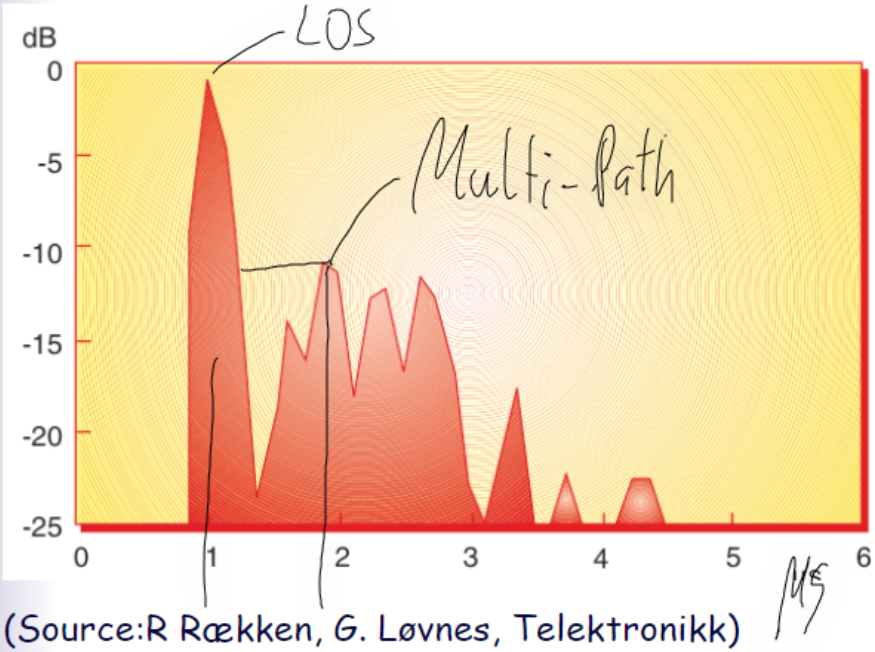
$C = W \log_2(1 + SNR)$

30 60 80 GHz

- home
- industry

1800 MHz

- Typical IR from Farm_1, 1718 Unik/MHz. Total received power was -84 dBm, 20 dB above GSM sensitivity level



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

$1\,\mu s = 1E{-}6\,s$

$s = c \cdot t = 3E8\,\frac{m}{s} \cdot 1E{-}6\,s$

300m

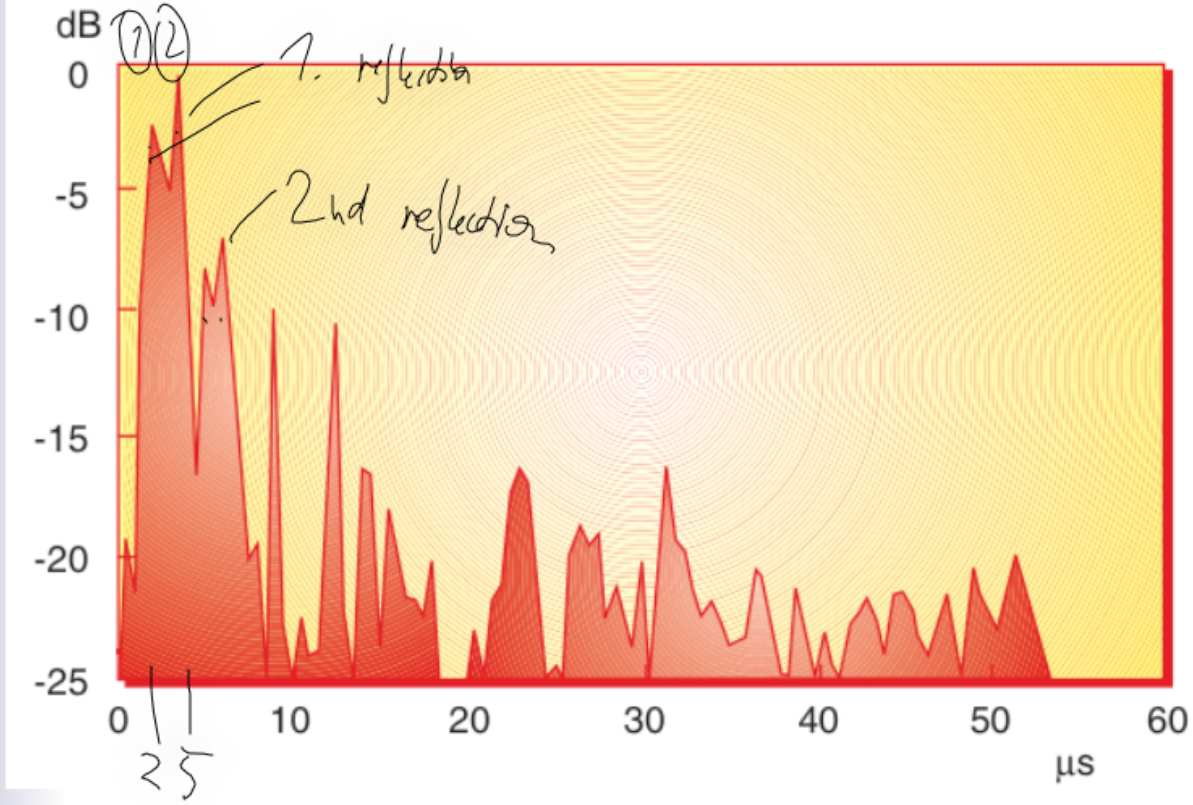
These questions are valid for all of the following impulse responses

- from delay, calculate reflection factor and free space attenuation
- describe characteristics of reflection

Measurements In Rural Farmland

900MHz

- Typical IR from Farm_2, 953MHz. Total received power was <93dBm

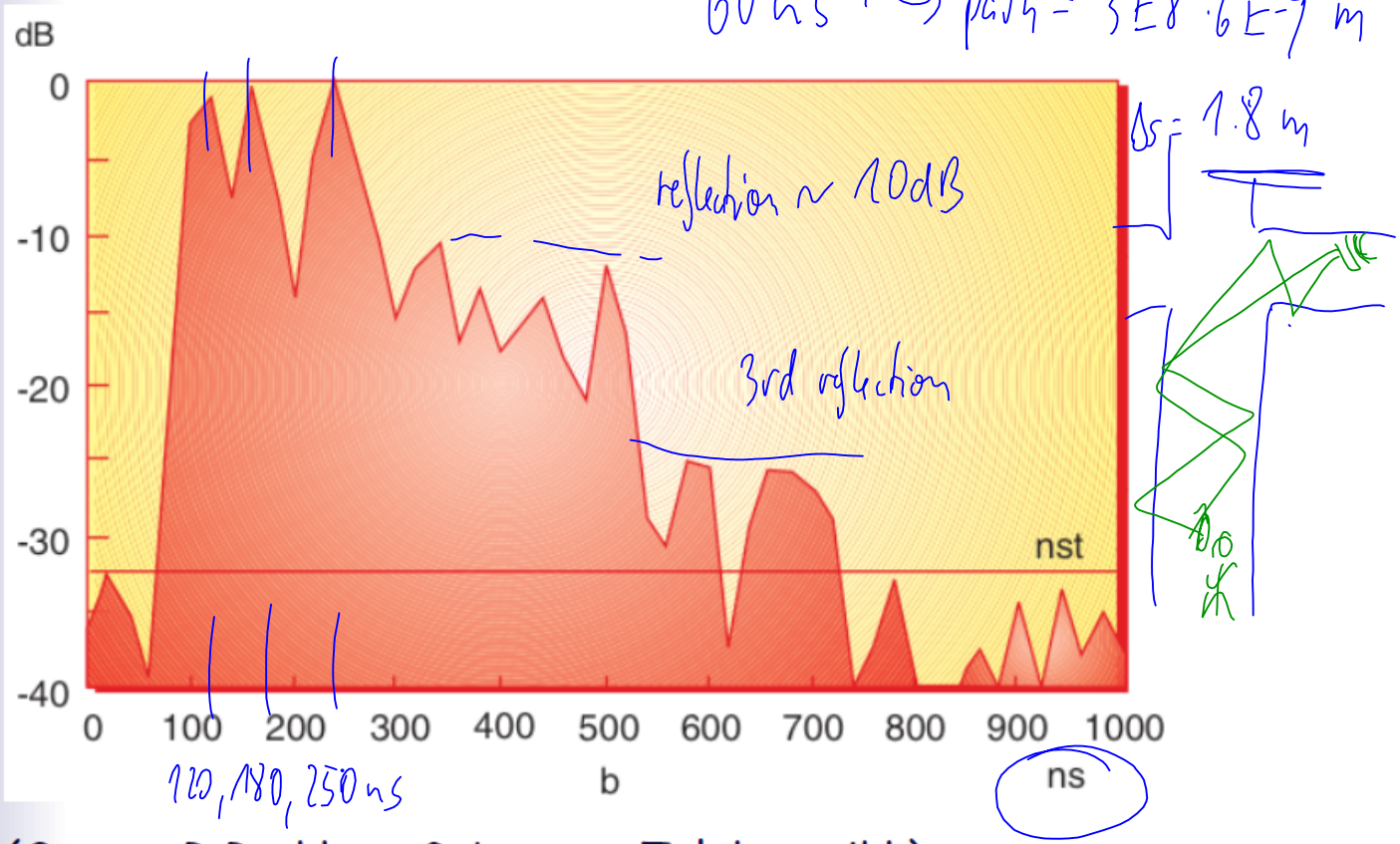


ΔS ~ 900m

NLOS

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

- Typical IR from City street measurements, 1950 Unik/MHz, Os
  25 dBm (in mW?). Omnidirectional $\lambda/4$-Dipoles used as transmit
  antennas.



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

why almost equal distribution? What effect?

Mobile

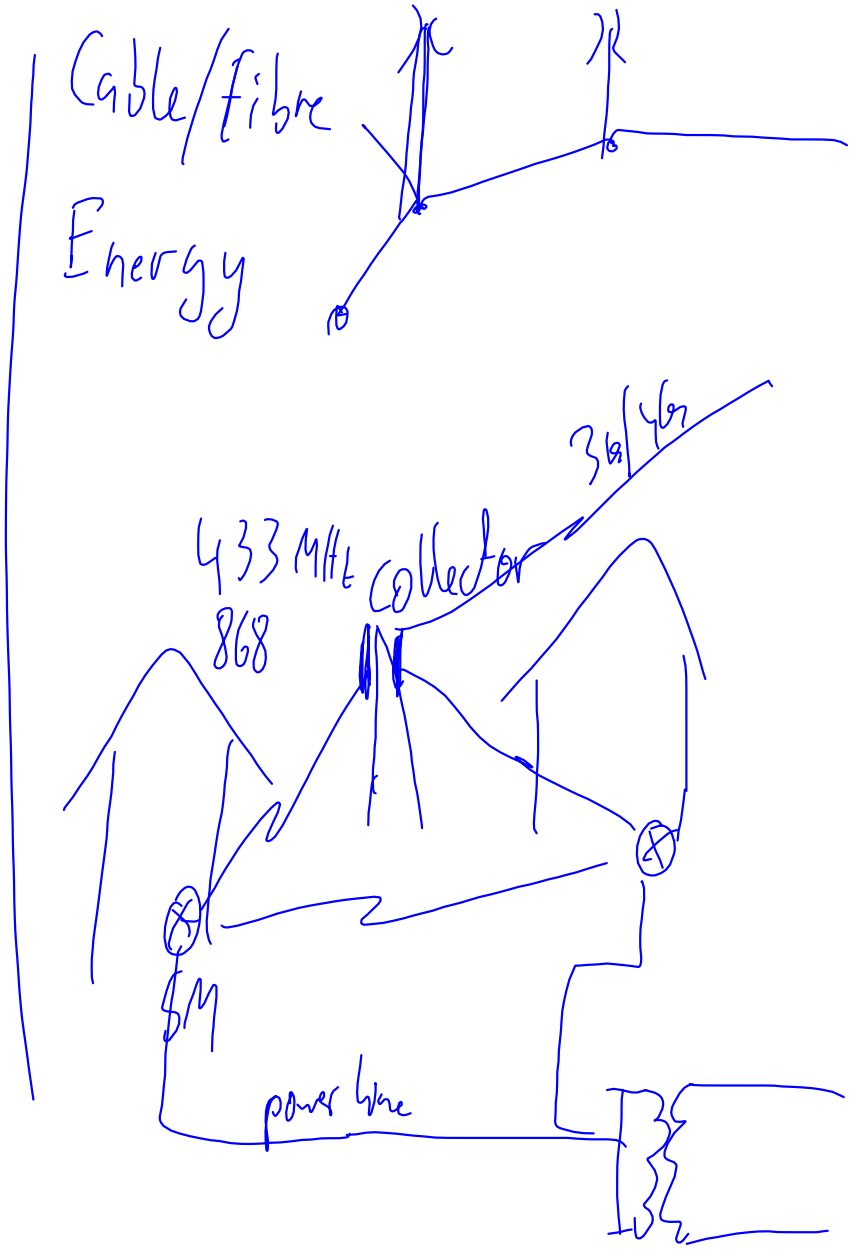
Towers → Small cell

5G

Home

Cable/fibre

Energy



$$P_R = P_t\, g_t\, g_r\, L_{free}\, L_{obst}$$

$$L_{free\ space} = 32.4 + 20\log[r(km)] + 20\log[f(MHz)]$$

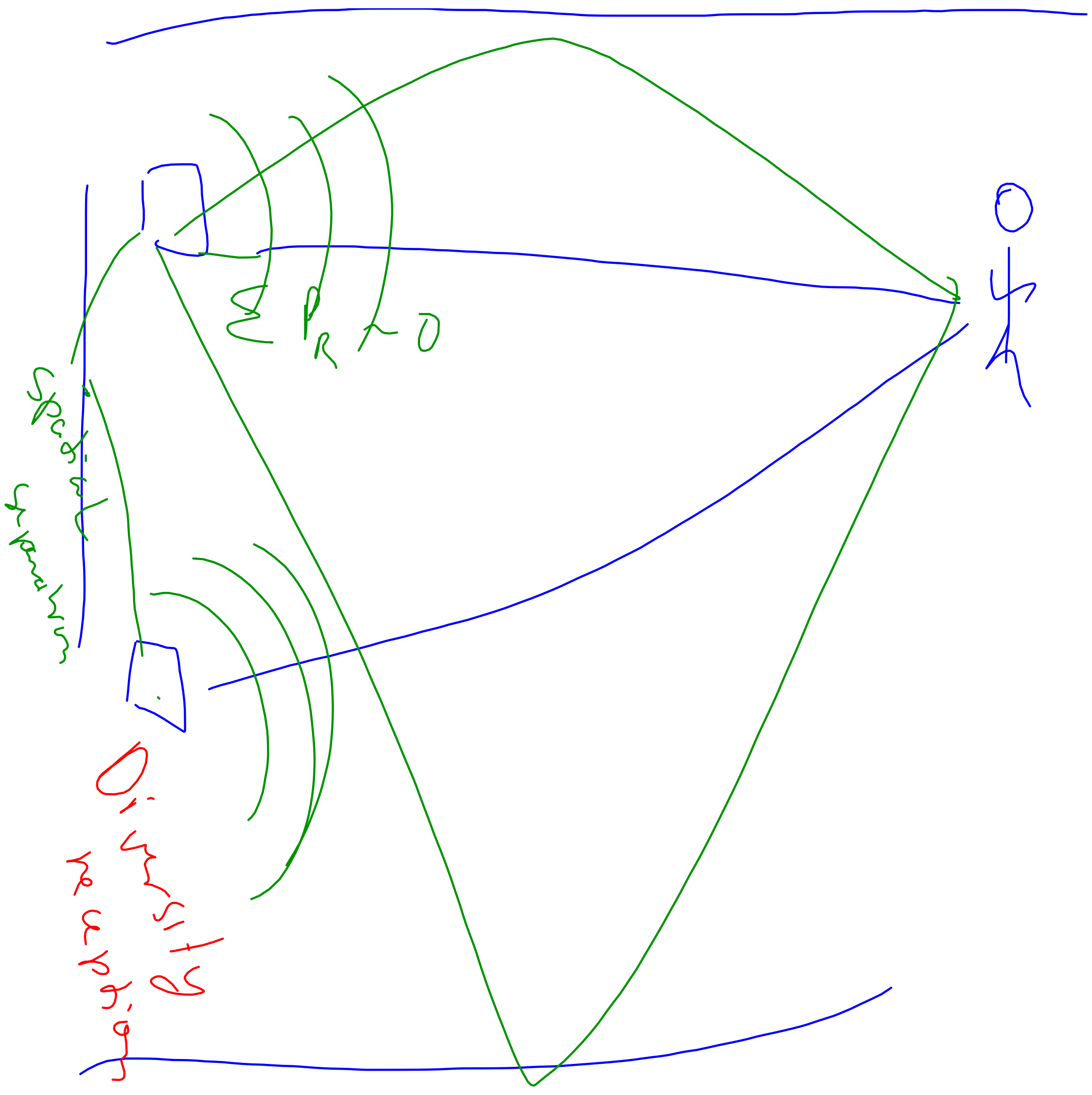
$$P_R > P_{Fade} + P_{sens}$$

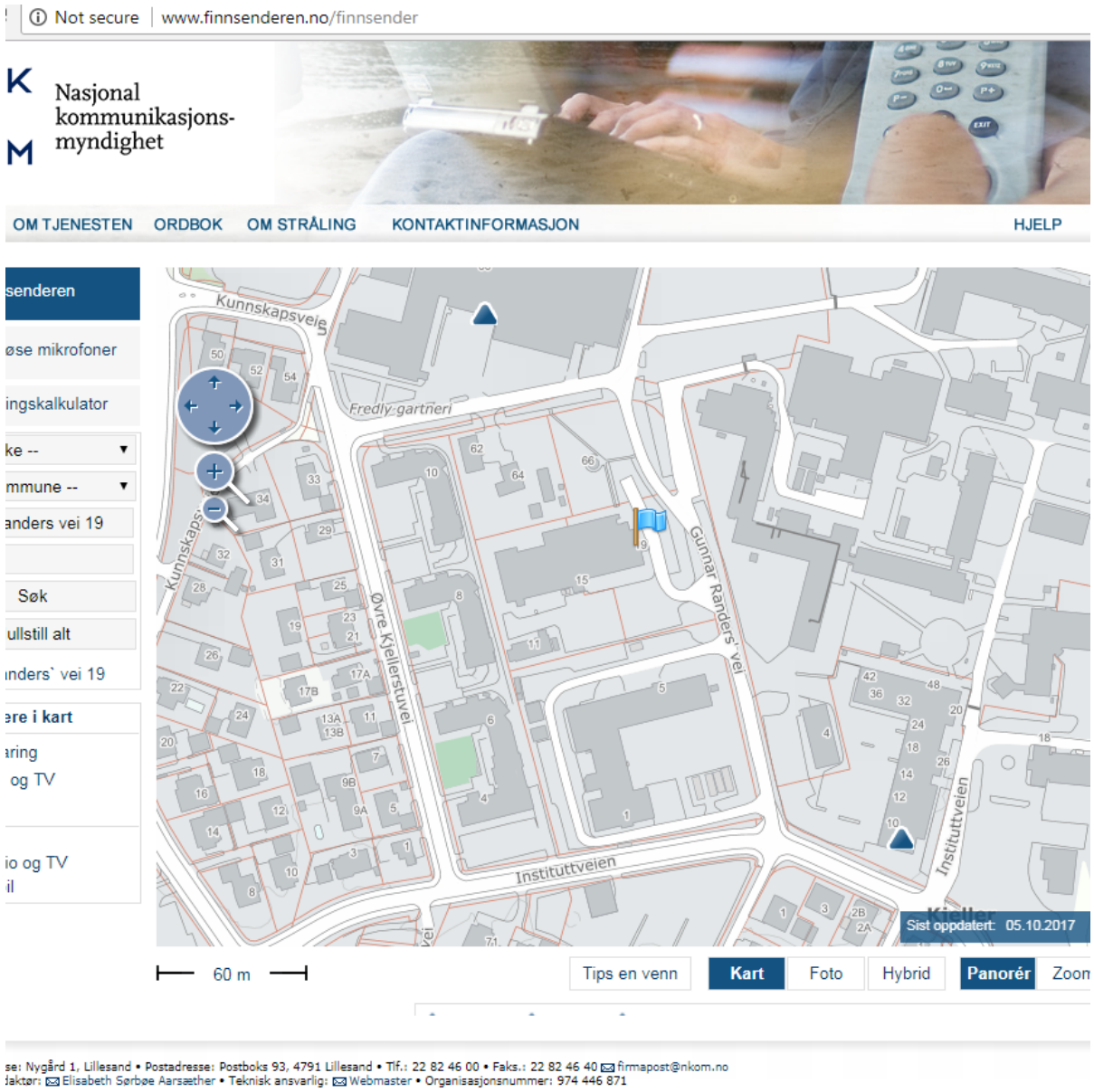
ETSI

$$Urban\ L = 49 + 40\log r + 30\log f$$

ETSI Indoor Office Test Environment

- derived from COST 231
- *r* is transmitter-receiver distance in m; *n* is number of floors in the path
- path loss *L* should always be more than free space loss. Log-normal shadow fading standard deviation of 12 dB
- Path loss model: $L_{indoor} = 37 \log r + 18.3\ n^{((n+2)/(n+1)-0.46}$ [dB]

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