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sense and simplicity

Digital Dividend from the point of view of a TV manufacturer

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Content

- Present Electromagnetic (EM) environment
- Present standards
- EM environment with Digital Dividend
- Expected interferences
- Measurements
- Solutions and time frame

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Present EM environment under control

- UHF band 470-862 MHz protected for broadcast
- Broadcast transmitter frequency and power planning, taking into account the characteristics of commercial tuners
- Analogue switch off.
  Digital broadcast: DVB-T
- Present TV standards offer adequate protection
- Close to DVB-T transmitters some co-channel interferences to cable channels.
  Solution: high quality cabling (Kabelkeur)

Source: http://www.radio-tv-nederland.nl/historie/eindhoven/eindhoven.html

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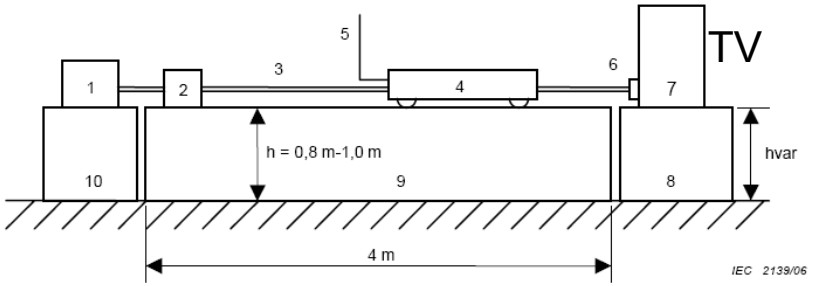
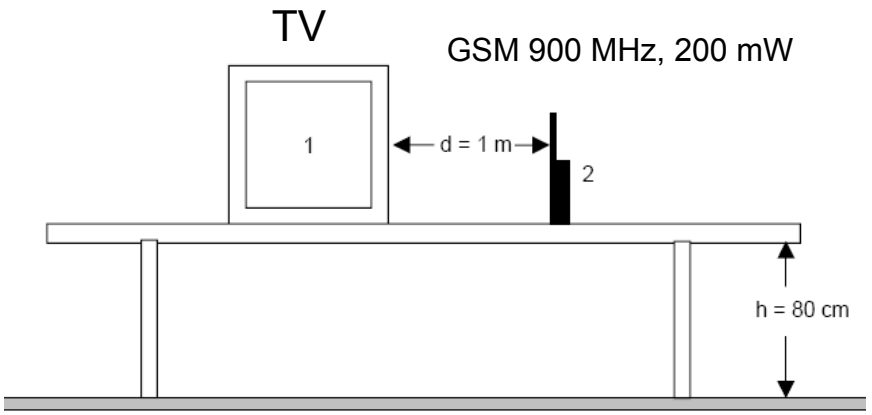
TV standards adequate in present environment

- Immunity standard for broadcast receivers: EN 55020 (= CISPR 20)
  - Screening effectiveness 50 dB
  - Adjacent channel rej. 23 dB
  - Image rejection 8 dB
  - Out of band test: GSM 900 MHz, 200 mW ERP, 3 V/m @ 1m. Actual 2 W ERP, hence 3 m separation distance.
- Voluntary standards for DVB-T tuners: NorDig, E-Book, D-Book
  - D-Book (UK) is leading
  - Adjacent channel rej. 28 dB
  - Image rejection 33 dB



Screening Effectiveness test



Keyed Carrier test

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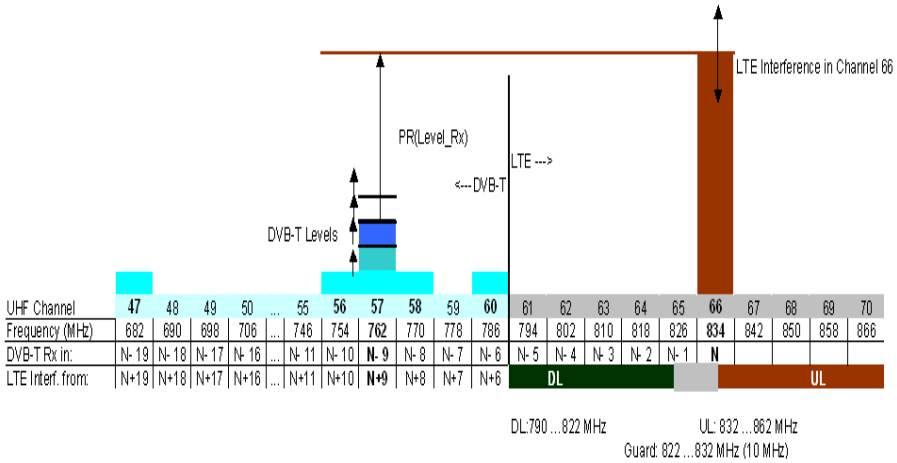
Digital Dividend: challenging EM environment

- Digital Dividend in upper UHF band 790-862 MHz
- From broadcast to mobile broadband
- From High Power – High Tower to High Power – Low Tower
- In-band emissions:
  High emission levels form mobile LTE devices close to TV, cabling and indoor DVB-T antenna in the frequency band for which the receiver is designed



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Field strength of LTE signals

- Commission Decision:
  Mobile: Max mean in-block Total Radiated Power: 23 dBm (200 mW)
  Tolerance for extreme environmental conditions: +2 dB
- Assumptions:
  - small antenna with low directivity (isotropic)
  - normal operating conditions
  - low production spread
- Then Effective Radiated Power of LTE mobile is ≤ 200 mW
- Hence the interfering field strength is ≤ 1 V/m at 3 m distance
- TC210/WG10 reports on EM environment show field strengths of base transmitters well below 1 V/m inside a building.

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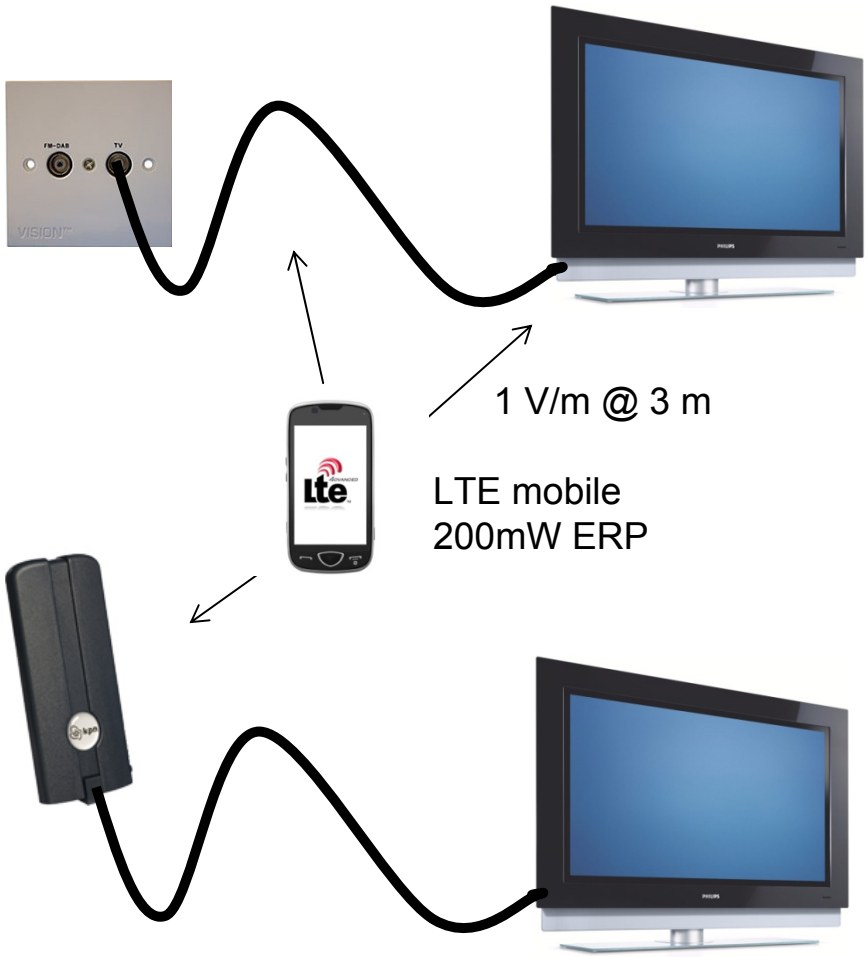
Expected interferences to TV channels

- Interference to analogue (PAL) and digital (DVB-C) cable channels
  - Quality of shielding
  - Mainly co-channel (66, 67, 68 and 69) due to uplink
  - PAL: 6-10 dB worse
  - Bad cabling: 30 dB worse

- Interference to terrestrial digital broadcast channels (DVB-T)
  - Mainly to indoor reception
  - Image & top channels 59-60
  - Active antennas (40 dB gain)



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TV (DVB-C) immunity measurements in Kolberg

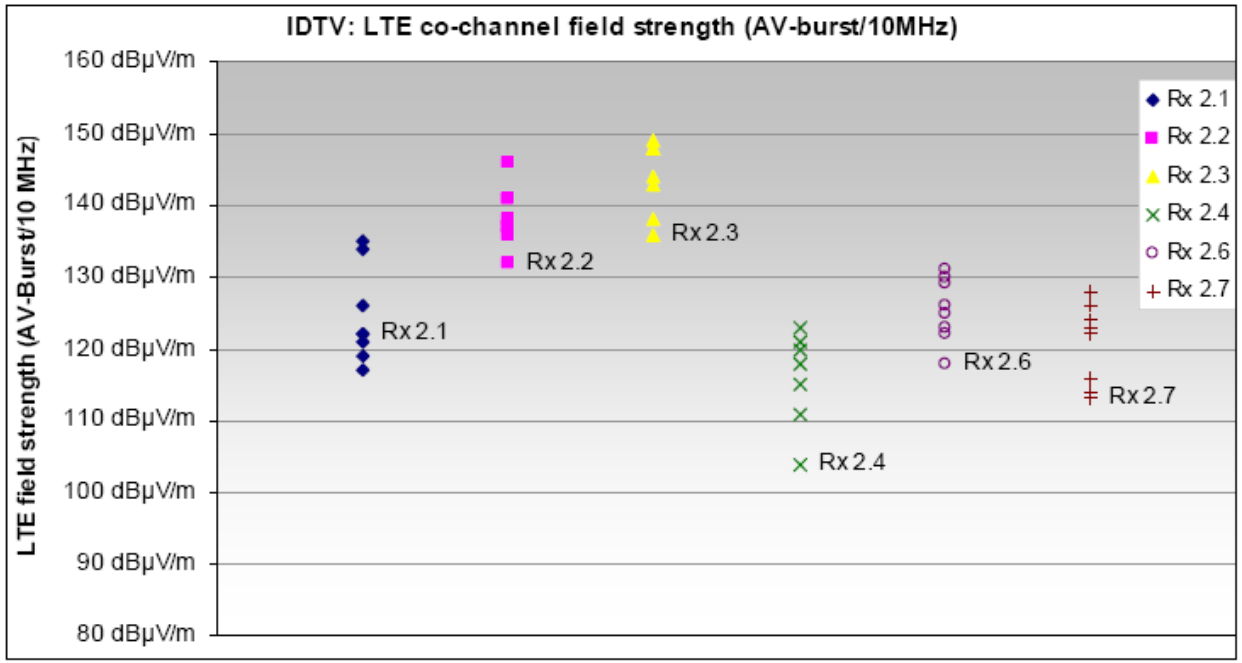

Figure 6: Minimum LTE field strength at the location of the DUT in co-channel causing disturbance to IDTVs (default signal configuration)

- 4 out of 6 TV-sets do not comply with 1 V/m (120 dBµV/m)
- Screening effectiveness needs improvement
- Physically possible for TV-sets

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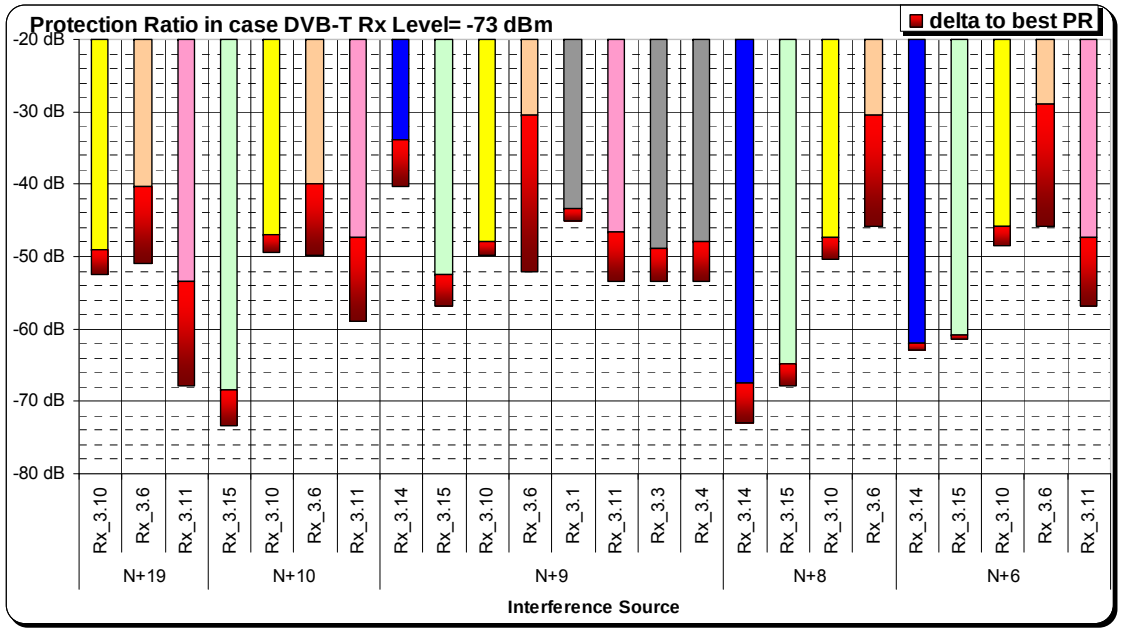
CEPT DVB-T/LTE-UL ratio measurements



- D-Book minimum field strength wanted DVB-T signal: 51 dBµV/m
- D-Book minimum image C/I: - 33 dB
- Required Protection Ratio C/I: 51-120 = - 69 dB
- Measured Protection Ratio between -40 and -70 dB
- Most tuners need 20-30 dB additional suppression of the 1 V/m LTE-signal for interference free indoor reception of DVB-T

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Solutions and time frame

- Installed base:
  (for solution responsible stakeholder should be defined)
  - improve in-house cabling (Kabelkeur)
  - at least 3 m distance between LTE-mobile and TV/cabling/antenna
  - install external LTE filters in antenna cable
  - active indoor antennas with built-in LTE filter
  - prevent PAL cable channels at LTE uplink frequencies
- New TV-sets:
  - improve DVB-C Screening Effectiveness in LTE band: 1 V/m
    (EN 55020, define universal 'LTE' test signal)
  - investigate selectable LTE filter in the tuner: -70 dB C/I (D-Book?)
- Time frame:
  - TV-sets with improved screening available earliest Spring 2012
  - Feasibility of internal LTE filter not proven yet

Thank you for your attention