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Assessment of the EMI radiated by PLC installations inside buildings

In-situ measurements carried out in the Swiss city of Solothurn

OFCOM

November 2004

HomePlug - Modems
4.5 – 21 MHz

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PLC regulation
Technical guide NT-2721, issued sept. 2001

- **PLC equipment** have to comply with the essential EMC requirements (e.g. harmonised standard EN55022)

- **Access networks**:

  Allocation of a « telecommunication service licence » to the PLC network operator.
  Restrictions:
  - PLC transmission forbidden through overhead lines
  - Frequency bands used for safety services or government services are not allowed (police, military, embassy)
  - If necessary, geographical restrictions
  - If necessary, operational restrictions

- **Provisions in case of disturbances:**

  Have to comply with the limit value given by the provisions NB30 at the location of the receiving antenna

Objectives of the measurement campaigns carried out by the OFCOM

- Statistical assessment of the level of interferences radiated by:
  - PLC access network in urban areas in the city of Fribourg (2003).
  - PLC private networks inside buildings connected to HomePlug modems in the neighbourhood of the city of Solothurn (2004).

- Statistical assessment of the degradation of the radio reception (S/N ratio)

- Comparison of the statistical level (CISPR 80%) of interferences radiated by PLC installations, with the limiting value of the German provisions NB30.

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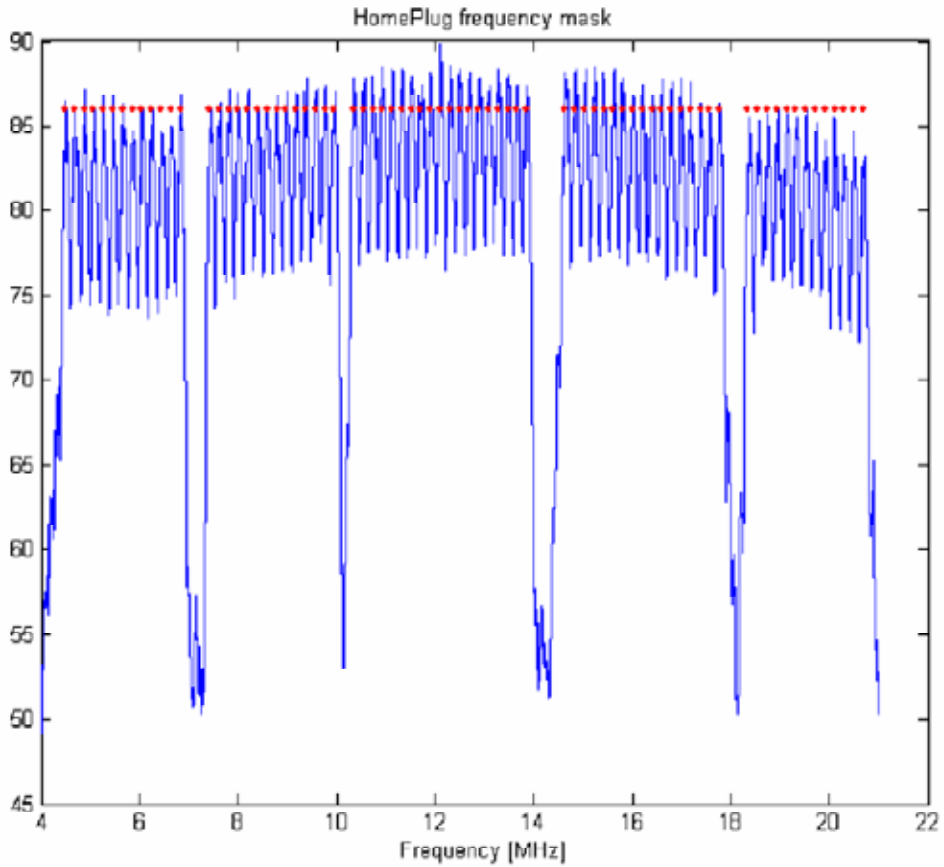
HomePlug standard

- **The HomePlug Powerline Alliance was developed in the year 2000 in USA.**
  HomePlug standard:
  Current Version:V1.0; soon: AV; planed: BPL

- **99 % of the indoor PLC modems available on the market in Europe are specified “HomePlug”.**



HomePlug Standard V1.0:

- Frequency band: 4.49 – 20.7 MHz
- OFDM modulation (Orthogonal Frequency Division Multiplexing)
- 76 carriers (BW 195.3 kHz) permanently switched on
- Power density of a carrier (constant): -50 dBm/Hz
- The carriers in amateur radio frequency bands are permanently switched off
- Dynamic management of the carriers (if the transmission is disturbed)
- Data rate: max. 14 MB/s
- Transmission range: 300 m

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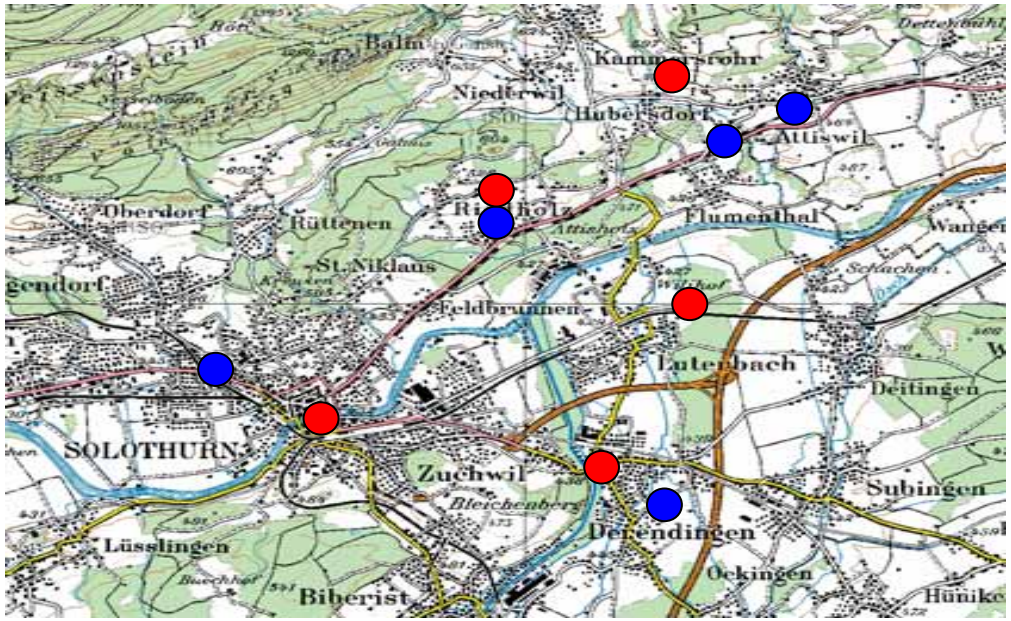
Selection of the buildings



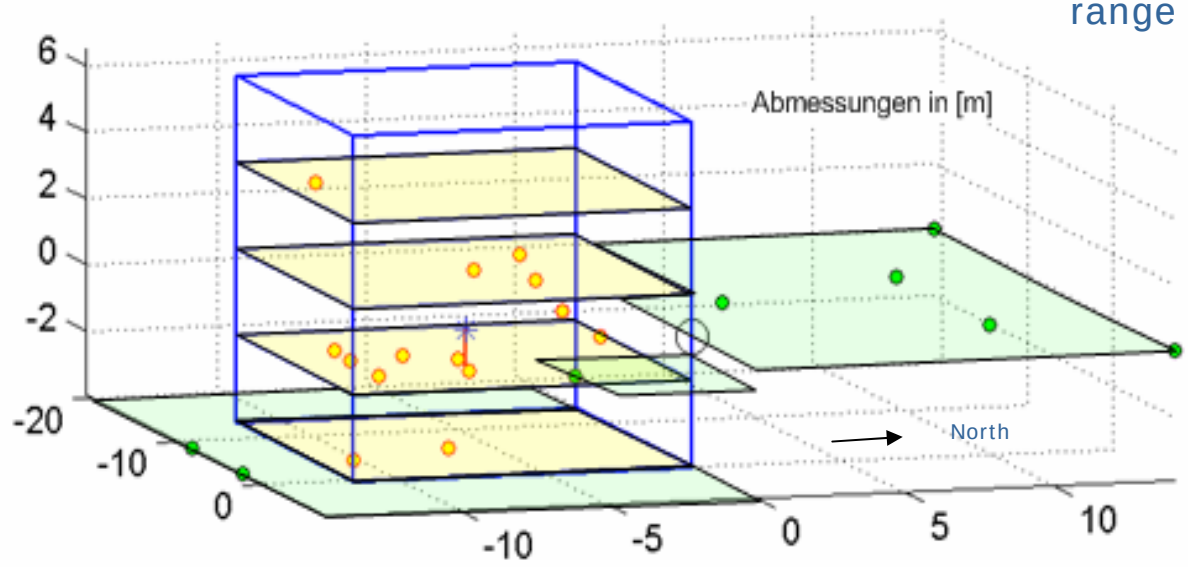




- 5 single dwellings
- 5 multiple dwellings

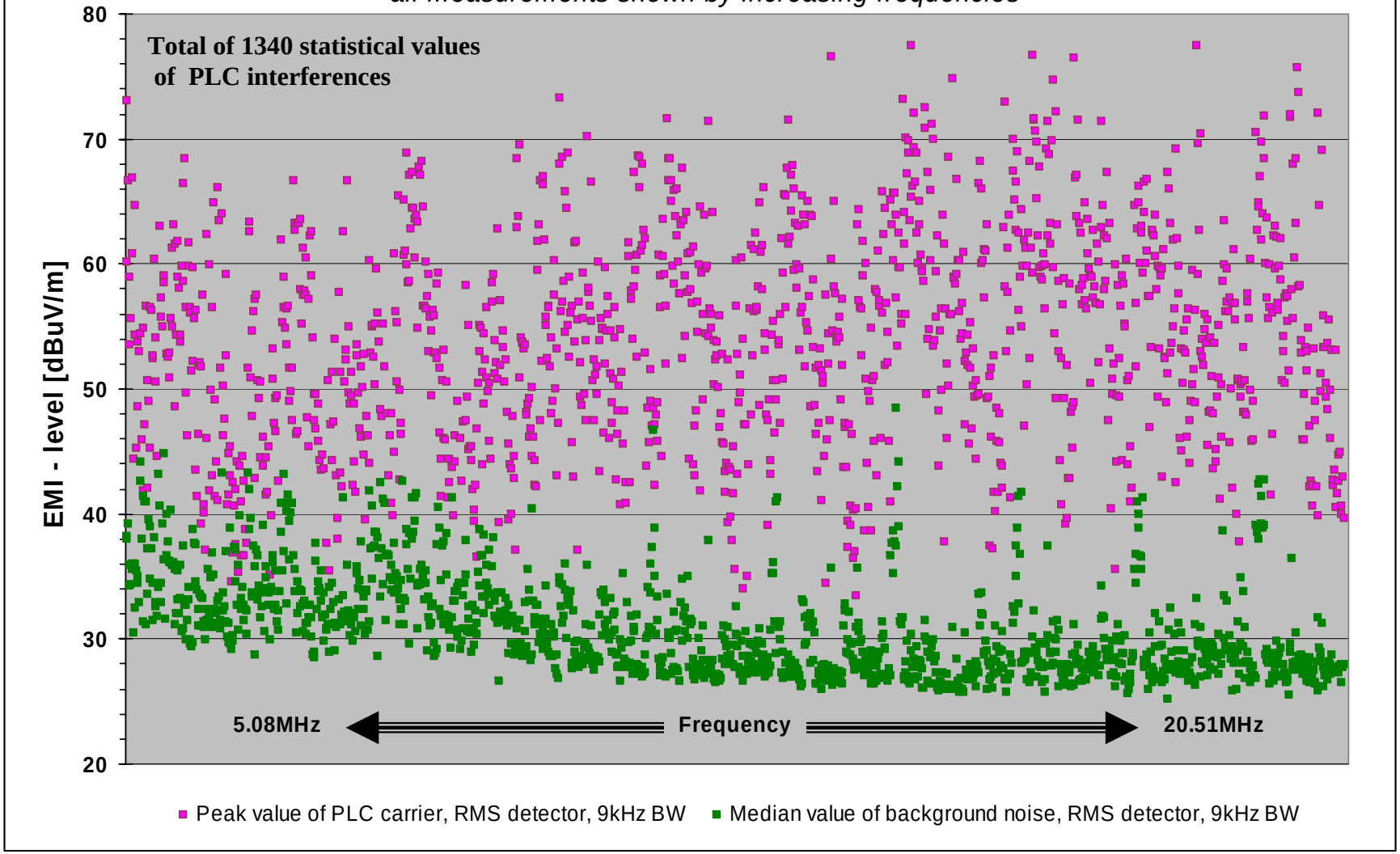

Distribution of the measuring locations

- up to 16 locations inside the building (one location for a surface of about 10 m2) All locations are located at a distance of 1 meter from the wall
- Up to 9 locations outside the building located at distances of 3, 10, 20 meters
- Measurement of 10 PLC carriers distributed over the whole frequency range (4.49 to 20.7MHz)



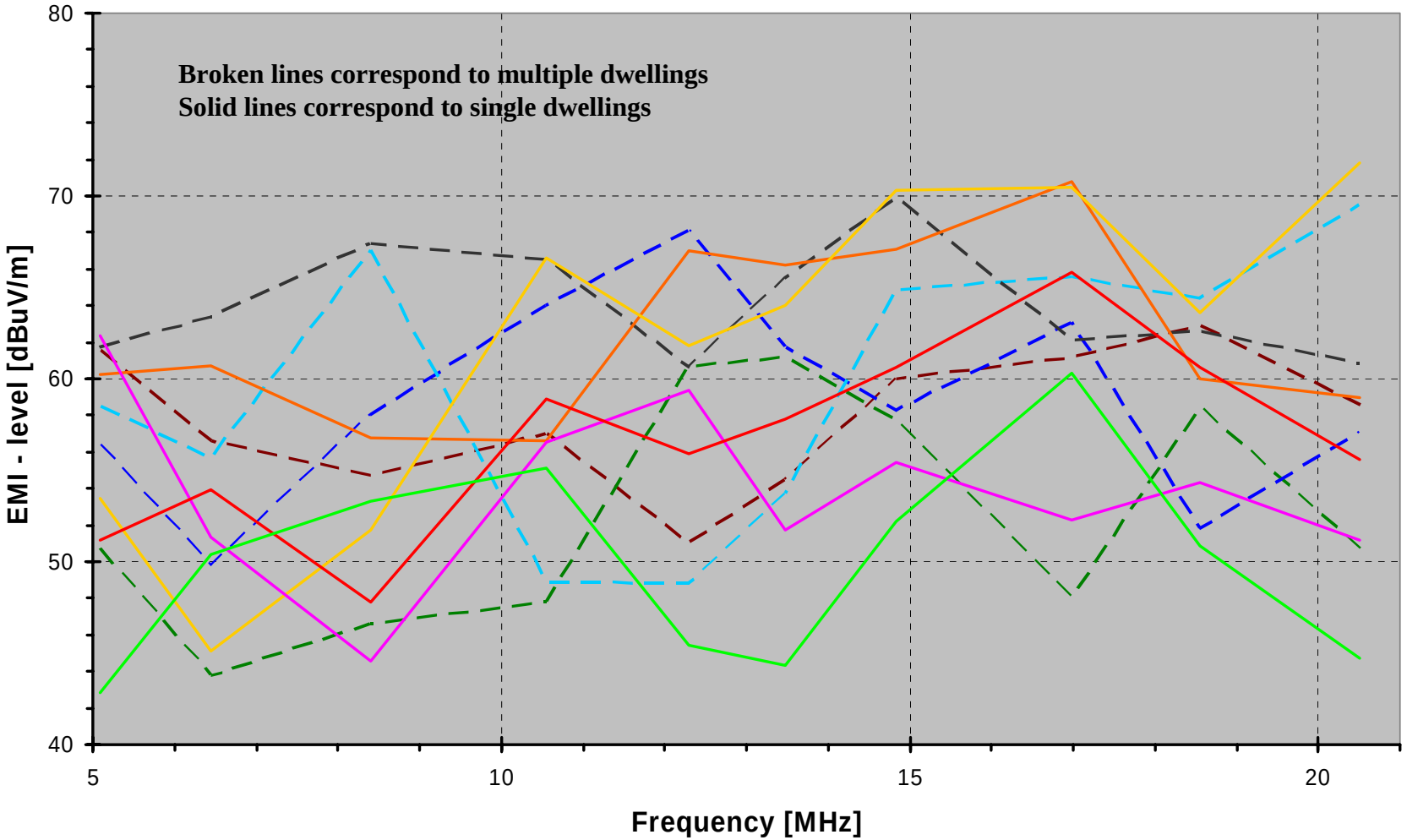
Statistical values of PLC radiated interferences coupled with the related background noise inside buildings

all measurements shown by increasing frequencies



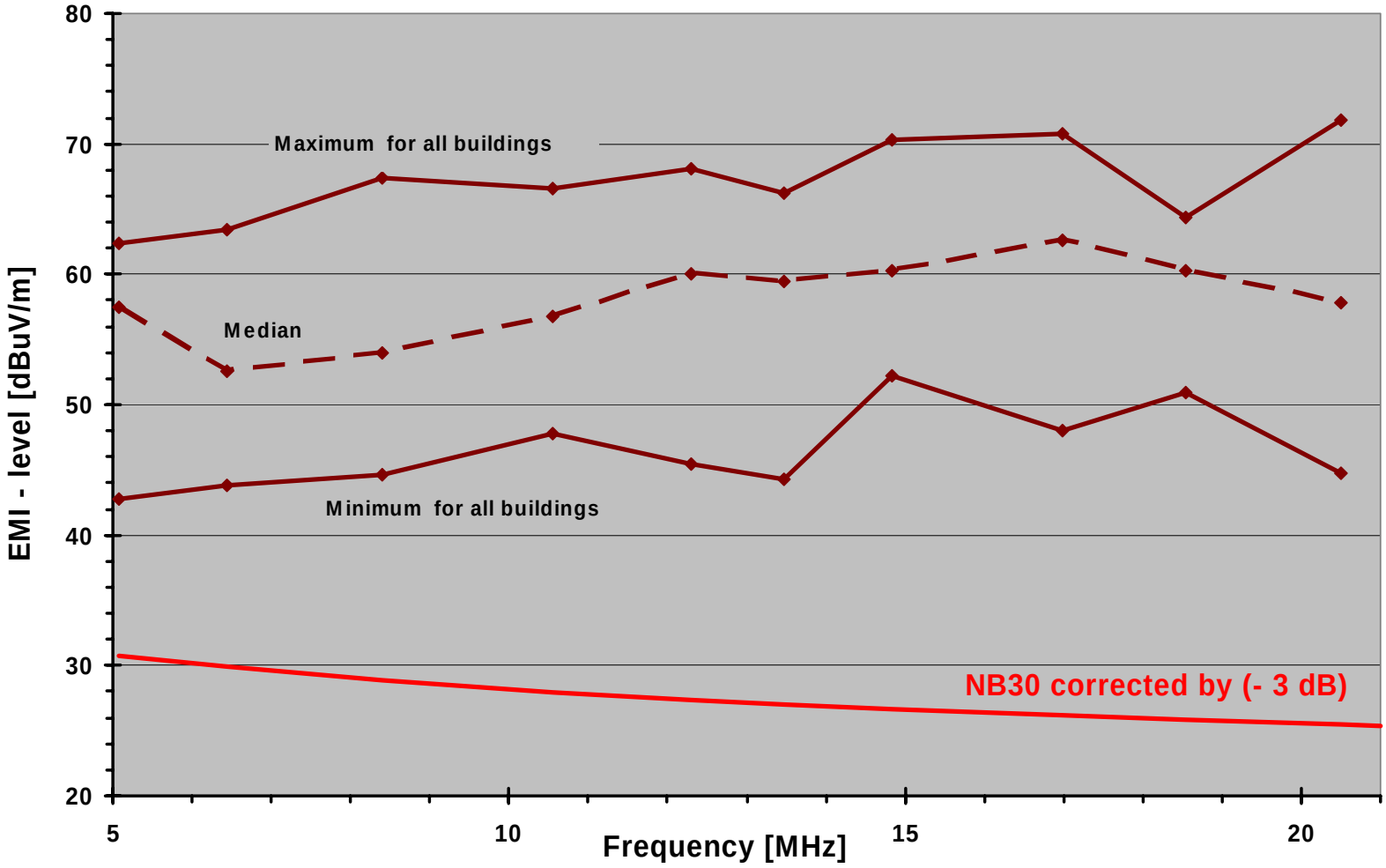
Statistical results of PLC radiated interferences inside buildings

Peak value of PLC carriers, probability distribution 80%, RMS detector, 9kHz BW

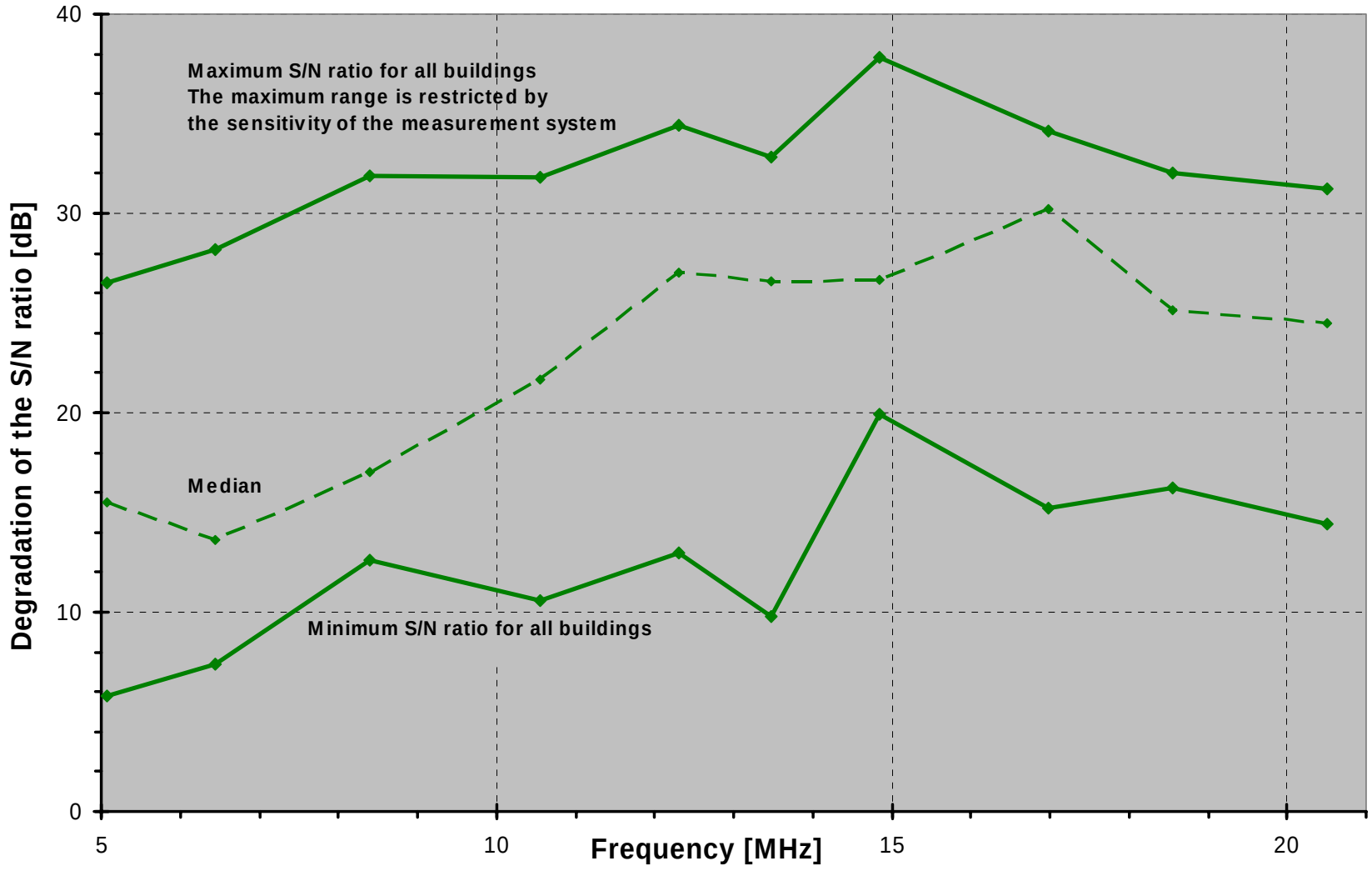


Comparison of the PLC radiated interference level with the limit value NB30 inside buildings

Peak value of PLC carriers, probability distribution 80%, RMS detector, 9kHz BW

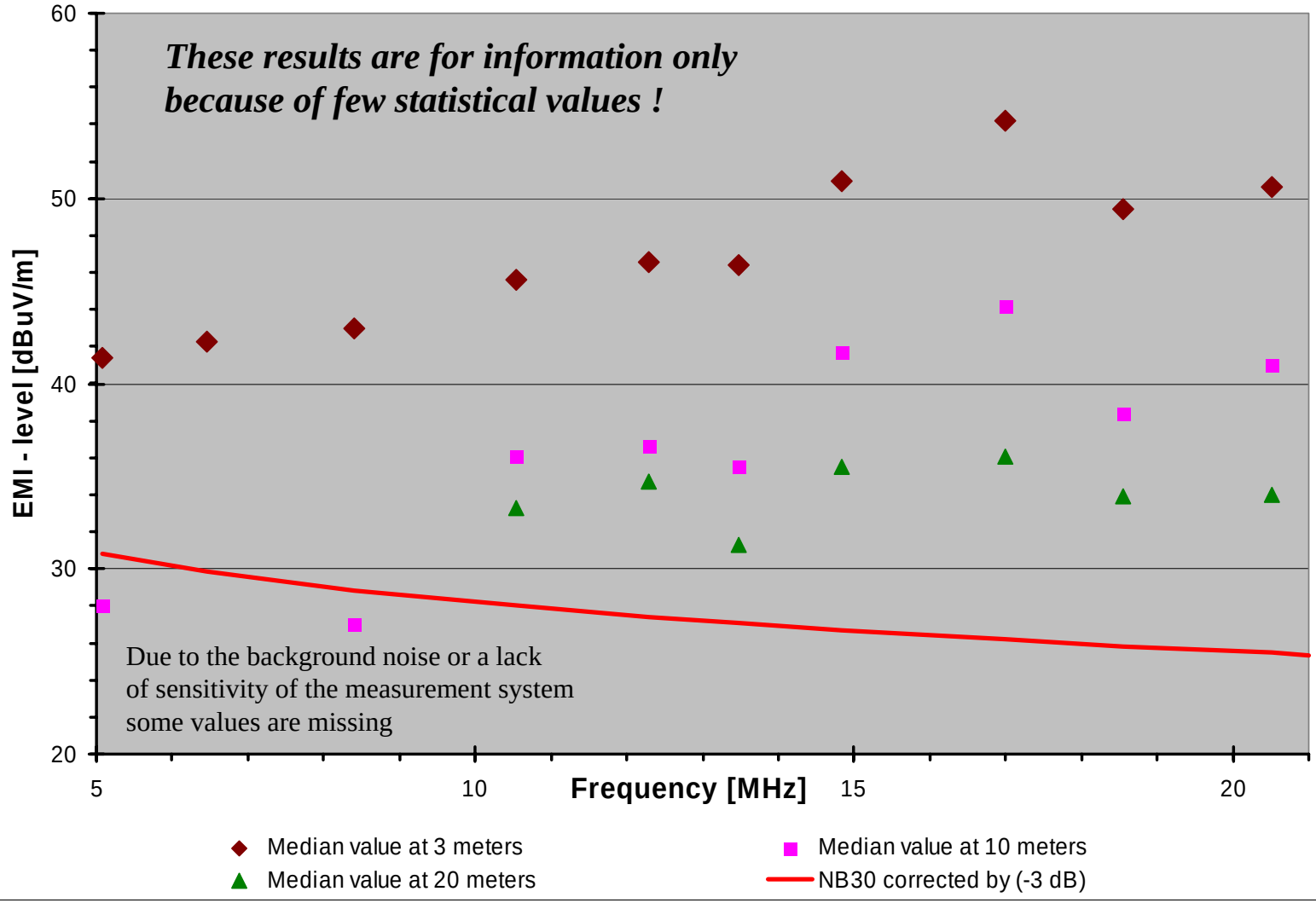


Degradation of the S/N ratio related to the peak value of the PLC carrier inside buildings



PLC radiated interferences at distances of 3/10/20 meters outside buildings

Peak value of PLC carriers, probability distribution 80%, RMS detector, 9kHz BW



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Conclusions of the measurement campaign carried out in Solothurn

- The study shows that the increase of radio noise due to the operation of a “HomePlug” installation ***leads to a reduction in the reception quality*** so that reception becomes difficult or even impossible inside buildings. Even reception of strong signals from long distant transmitters might be affected.

- In addition the study shows that the statistical level of radiation of PLC installations inside buildings ***strongly exceeds the limits of the provisions of the German NB30*** throughout the whole frequency range. Radiation is also excessive outside buildings up to an approximate distance of 20 metres.

- The significant infringement of the limit of the NB30 regulations as well as an assessment of the modems in laboratory permits to raise the ***assumption that these modems are not in conformity with the EMC essential requirements.***

Risk of interference

- The risk of interference is the result of the balance between the number of spectrum users and the disturbance power of a source of interferences like PLC in a concerned frequency band.
- The risk of interference is more important in the amateur radio and broadcasting frequency bands.
- At the time being, we don't expect a significant increase of the risk of interference, because the number of spectrum users is still decreasing in the broadcasting frequency bands up to 30 MHz, and the amateur radio bands are excluded in most parts of PLC equipment.
- The attractiveness of new broadcasting services (e.g. DRM) in this frequency band could reverse the trend and therefore increase the risk of interference for the future.
- The planned increase of bandwidth for PLC equipment is likely to reach 100 up to 200 Mb/s and should use frequency bands over 30 MHz.

How could we save frequency spectrum?

- PLC modems have to implement a frequency mask in order to exclude the amateur radio and the broadcasting bands.
- PLC Modems have to control permanently its output power to the minimum needed.
- We should accept the limit value of NB30 with a distribution probability of 80% (time and space)

In case of interferences:

- Programming of frequency notches
- Reducing the output power over the whole frequency range to a roof level in answer to a poor quality of the network (to fulfil NB30)

What should we do now