The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Workshop Introduction: The problem of 2-150kHz conducted EMI in public electricity networks.

Paul Wright, NPL

SupraEMI M18 Workshop, November 2020

Talk Outline

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- The problem with 2-150 kHz conducted emissions.
- Regulation and Standardisation.
- CISPR-16 method used for conducted emissions from electrical products.
- The requirements for a new grid measurement method for the 2-150kHz frequency range.
- Overview of the EU EMPIR SupraEMI Project and its work packages.

Increasing 2-150kHz Emissions on public electricity networks

EMPIR
EURAMET
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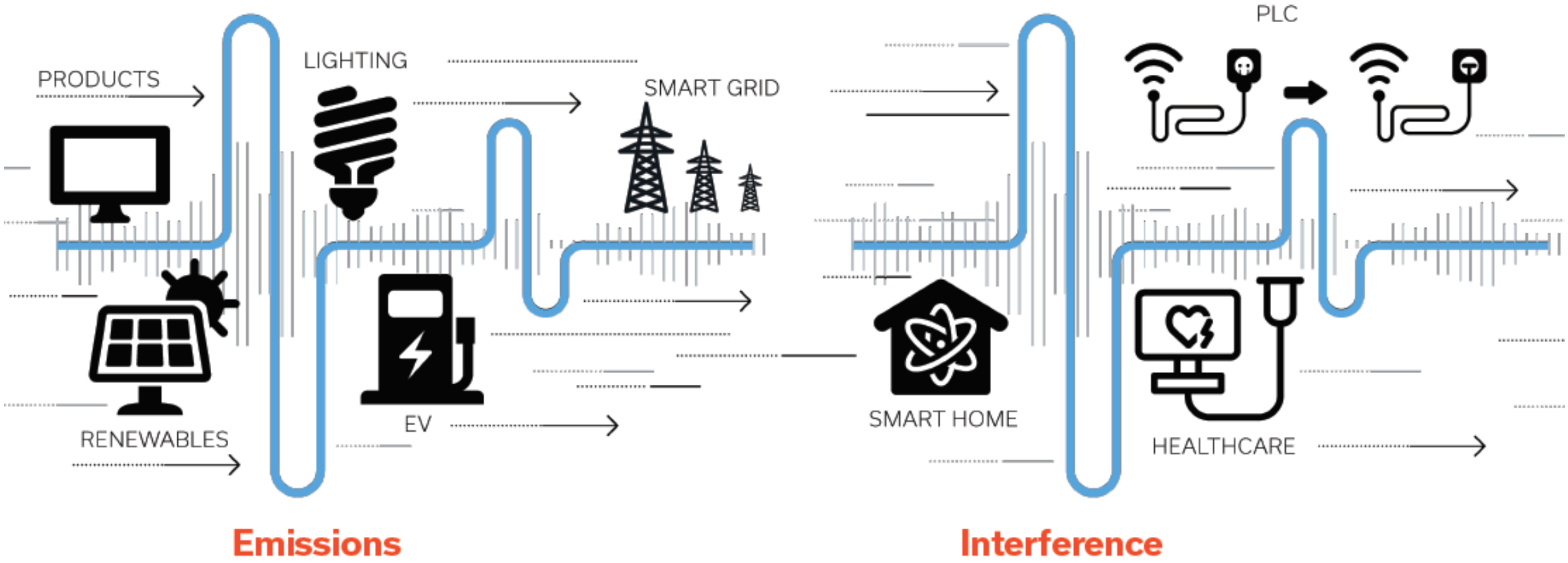

Why at 2-150kHz Emissions Important

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Robust Smart Grids

Prevent interference with grid control and data signals.

Reliable Power Line Communications

Regulate interference and reduce data errors.

Dependable Critical Infrastructure

Avoid malfunction of social and economically critical systems.

Reduced Product Malfunction

Protect manufacturer's reputations and avoid consumer inconvenience

Increased Product lifetime

Prevent emissions related product ageing.

CENELEC TR 50627:Study Report on Electromagnetic Interference between Electrical Equipment/Systems in the Frequency Range Below 150 kHz

Regulation through Standardisation

Motivation and current state of standardisation

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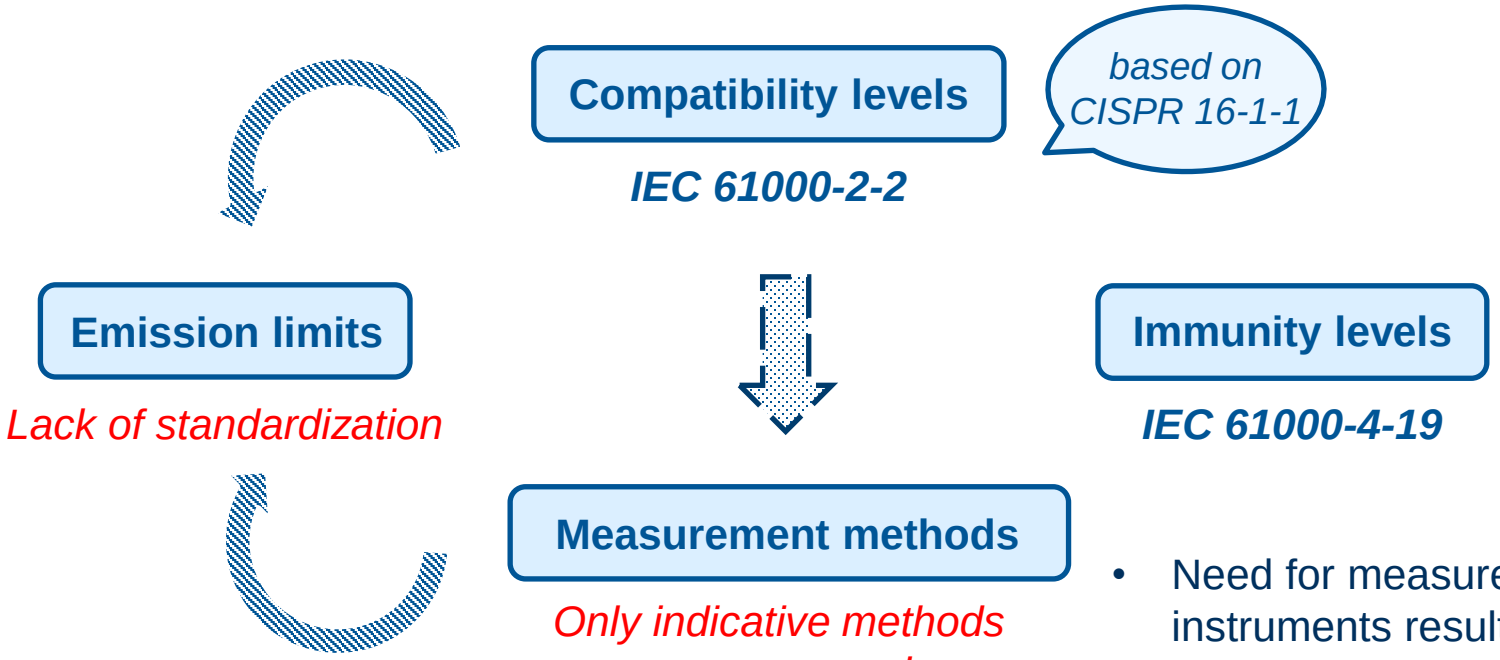
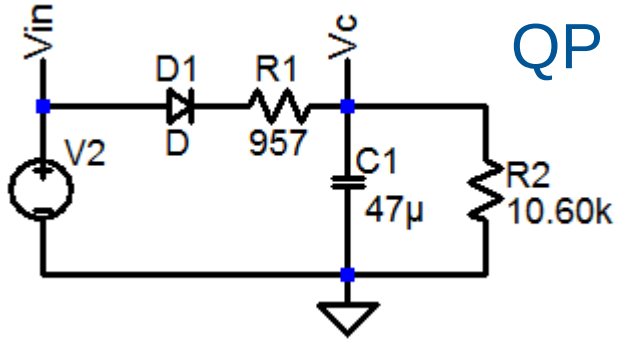
- Increasing emission due to modern device technologies devices
- Intense work on EMC standard framework
- Current practice: Comparison of actual levels with compatibility levels
- CISPR 16-1-1 developed for emission assessment in laboratory

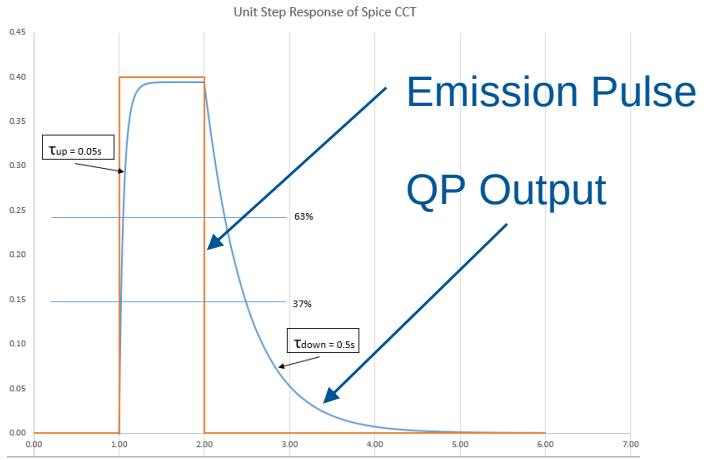


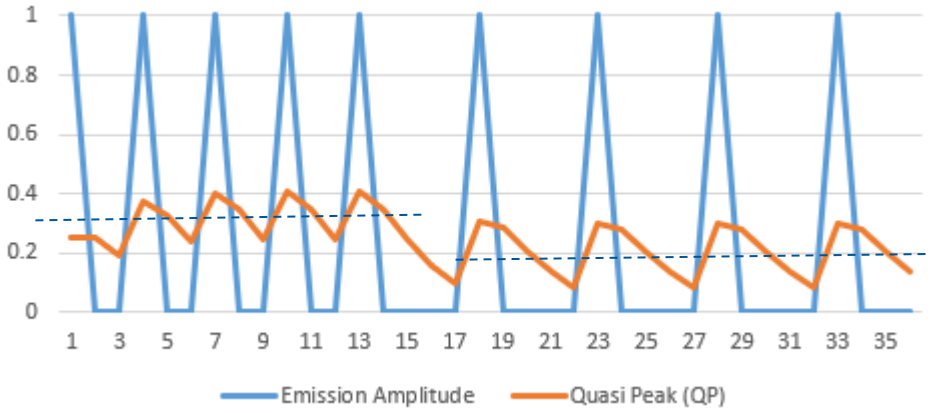
- Need for measurement instruments resulted in different (not comparable) implementations

The CISPR-16 Method

- Based on a tuned receiver instrument (super heterodyne).
- Performs a sweep across the frequency spectrum (to 150kHz in this case).
- Emissions may fluctuate and/or switch on and off.
- Measure: Peak (P), Quasi Peak (QP) and Average (A) values for the emission.
- For steady (non-fluctuating) emissions, P=QP=A
- For fluctuating: P≥QP≥A; Limits published for QP and A.
- The QP value depends on repeat rate of an emission, → the faster it repeats, the higher the QP value.
- Analogue and digital CISPR-16 instruments are available.
- CISPR-16 is a laboratory measurement and uses a Line Impedance Stabilisation Network (LISN) to emulate the mains impedance (Artificial Mains Network).







The Requirements for a 2 to 150kHz Normative Grid Measurement Method

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- IEC SC77A WG8 have discussed using the CISPR-16 method to measure the compatibility levels for IEC61000-2-2.
- IEC SC77A WG9 and TC85 WG20 need to find a suitable grid measurement method to add to IEC61000-4-30 – power quality (PQ) measurements in grids.

A new grid method, open questions:

- CISPR16 is complex and was designed for laboratory use – can it be used in grids?
- Can CISPR16 be implemented and retro-fitted on existing PQ instrumentation platforms for real time measurements?
- Are existing simpler FFT methods used in PQ, such as IEC61000-4-7, compatible with CISPR-16?
- What about statistical PQ surveys which run 24/7?
- Can CISPR-16 be tightly specified to ensure it gives repeatable results between implementations? (accuracies between 5% and 10% are required).
- Is QP suitable for grids? (rms values → heating; peak values → malfunction)

EU EMPIR Project *SupraEMI*

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Purpose: Support standardisation with necessary input to develop an widely agreed method for grid compliance assessment in the frequency range 2-150 kHz

- Start date: May 2019 for 3 years. (This is the mid-project workshop)
- Pre-normative R&D project. Funded by H2020/EMPIR, EMN SEG →
- National Metrology Institutes of UK, FR, NL and CH.
- University Partners:

  TU Dresden (DE), UPV/EHU (ES) and U of Campania (IT).
- Chief Stakeholder: Dr. Michael Schwenke, IEC77A WG9 Convener

EUROPEAN METROLOGY NETWORK

SMART ELECTRICITY GRIDS

A normative measurement method for IEC 61000-4-30 “Power quality in grids”

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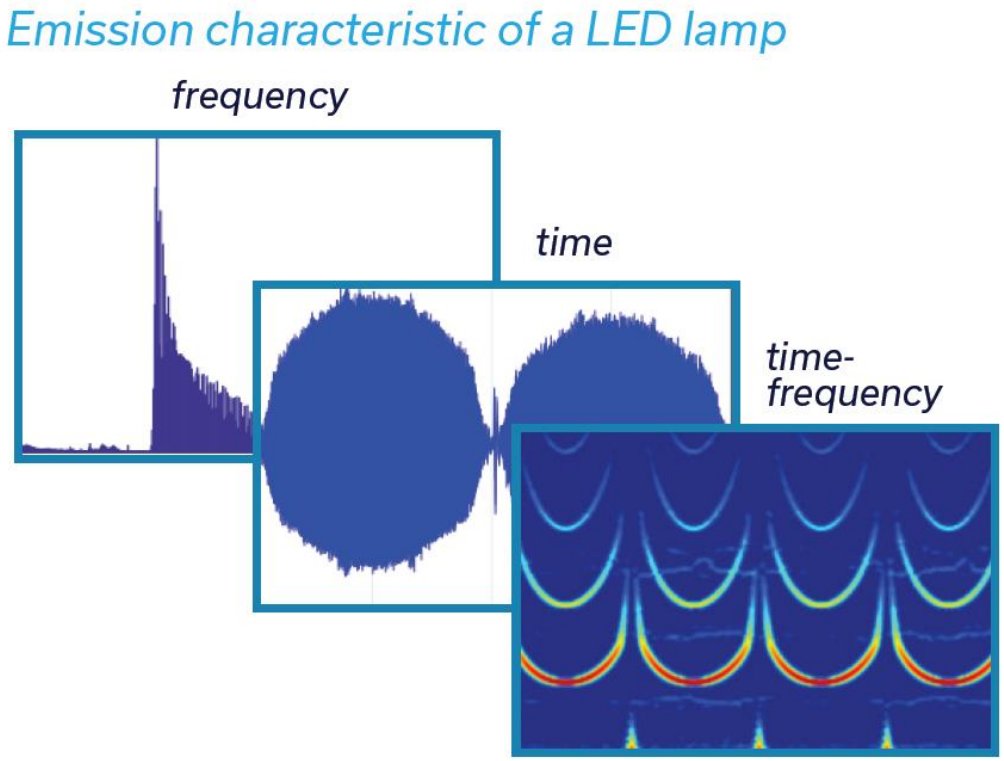

Challenges, Open Question and Compromises:

- Transducers/probes and digitisers.
- What accuracy and reproducibility is required.
- Gapless algorithms.
- Time resolution (200ms ?).
- Frequency resolution (200Hz ? = 741 Freq. lines).
- Real-time processing. Processor impact.
- Data volume.
- CISPR compatibility (including QP ?).
- Statistical surveys.

Development of new methods may adapt or optimise existing methods or could be a new method.

Product emissions in the lab with emissions in grids

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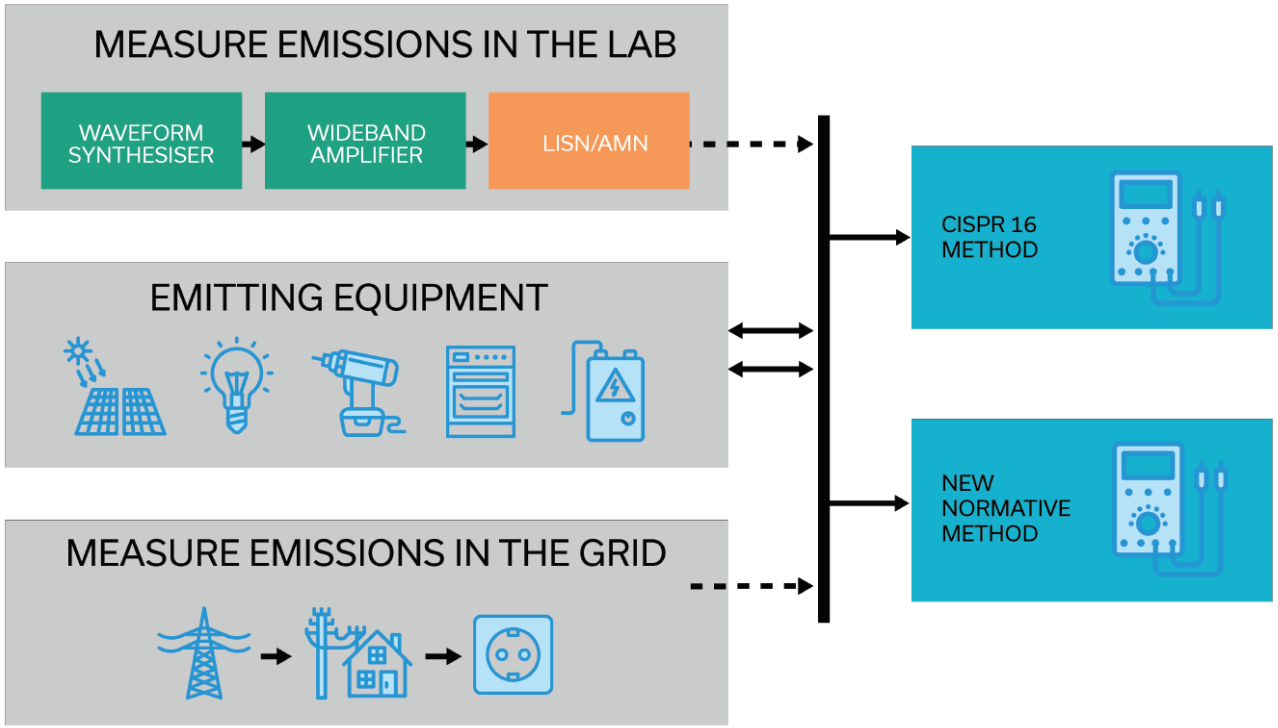
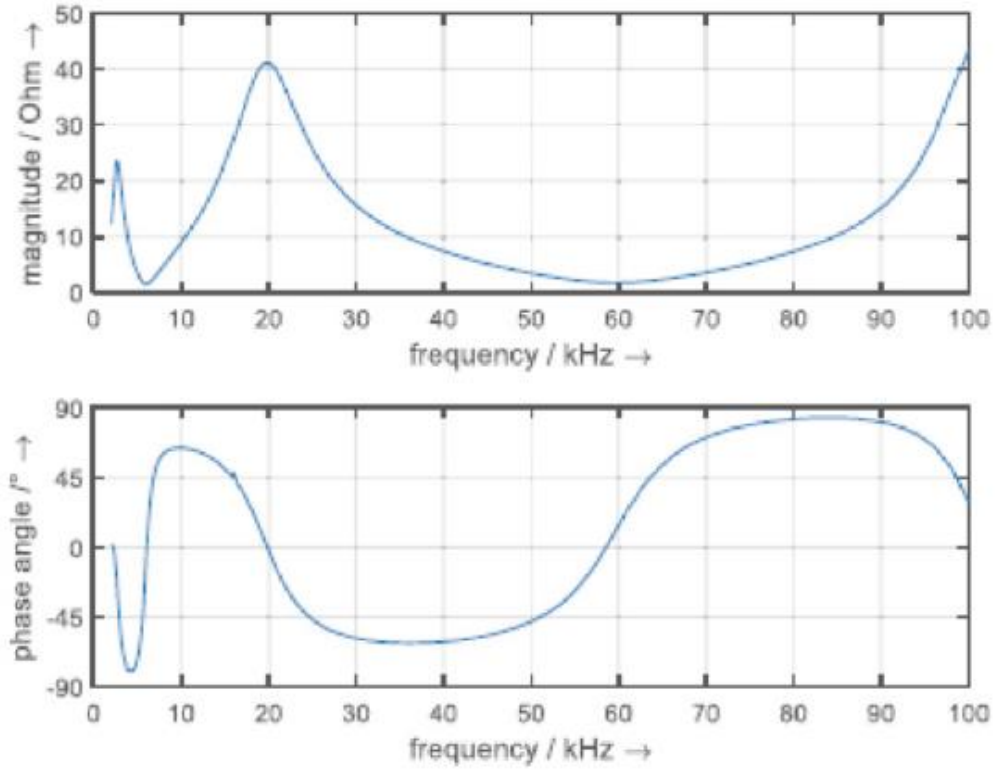


1. *Measure appliances in the lab with CISPR and new method*
2. *Measure same appliances in grids with new method and digital CISPR*

How well does the lab AMN represent the grid? How do supraharmonics propagate? Effect of appliance mix?

Artificial Mains Network → *Critical to emission levels*



- Measure grid impedance by injection
- Amplitude and phase to 150 kHz
- Source and sink impedance
- Impedance fluctuates
- Build and test new AMNs
- New normative specification for AMNs