

(one6G)

OPEN LECTURES

Lecture 3/5

6G testbed / simulation

15 September 2022 - 14h00 CEST

**Testing waveforms, beamforming and applications
for a next generation of mobile communications**

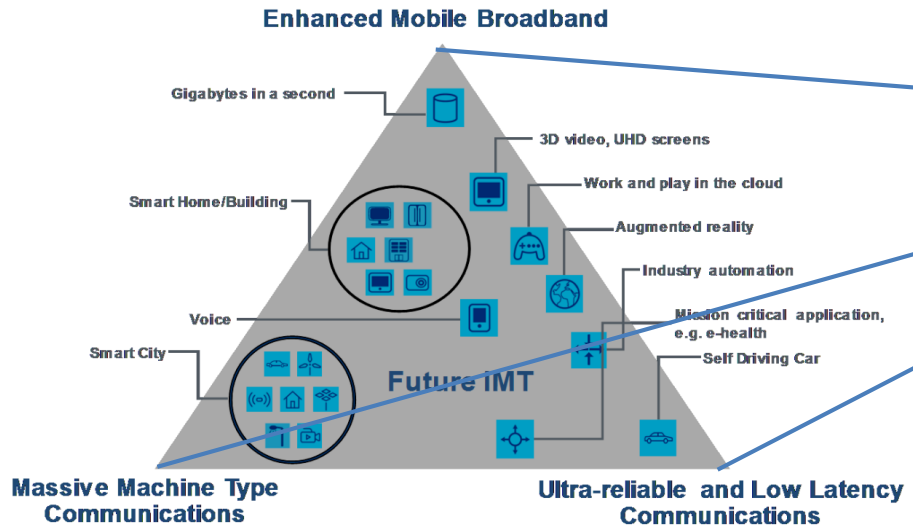
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Towards 6G

Digital World

5G Usage scenarios



Physical World

Human World

- Sustainability
- Global coverage

New challenges call for new technologies

- Waveforms
- Frequencies
- Adaptation and flexibility – new degrees of freedom
- Need realistic simulations, prototyping and measurements to design and analyse new physical layer techniques and their suitability to support emerging applications.

Three examples



Massive machine-type
communications

waveforms



Enhanced mobile
broadband

mmWaves



New degrees of freedom

Liquid antennas

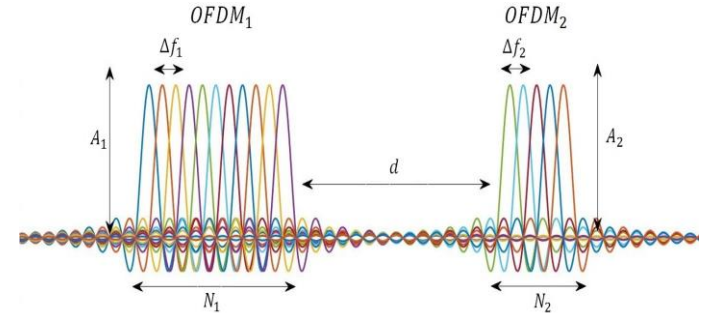
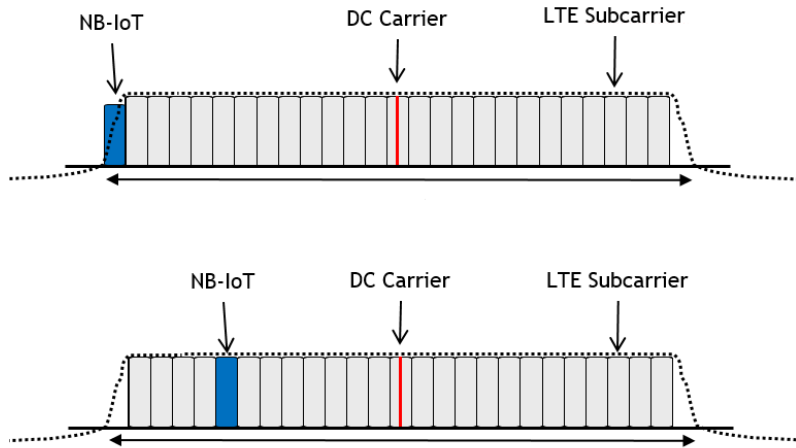
4G

5G

6G

Example 1 - Multicarrier waveforms for MTC

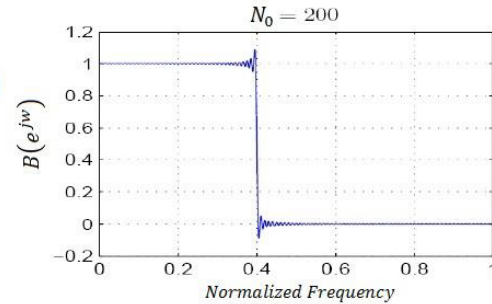
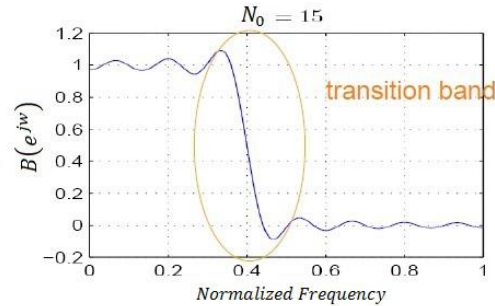
Need to reduce the out-of-band emissions



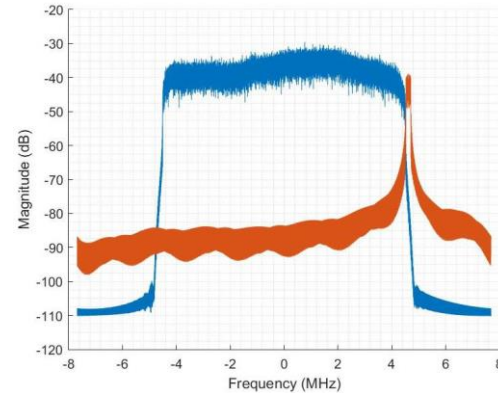
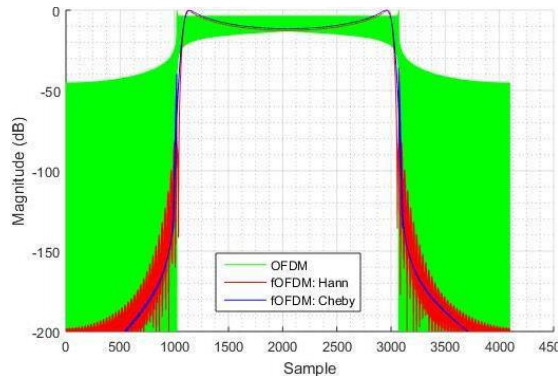
- Filter Bank Multi Carrier (FBMC)
- Generalised Frequency Division Multiplexing (GFDM)
- Universal Frequency Division Multiplexing (UFDM)

Filtered OFDM

Idea →



Simulations →



Kun Chen Hu, Ana García Armada, "SINR Analysis of OFDM and f-OFDM for Machine Type Communications", IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Sep 2016

Testing f-OFDM with OpenAir Interface

- Will it work in real life?

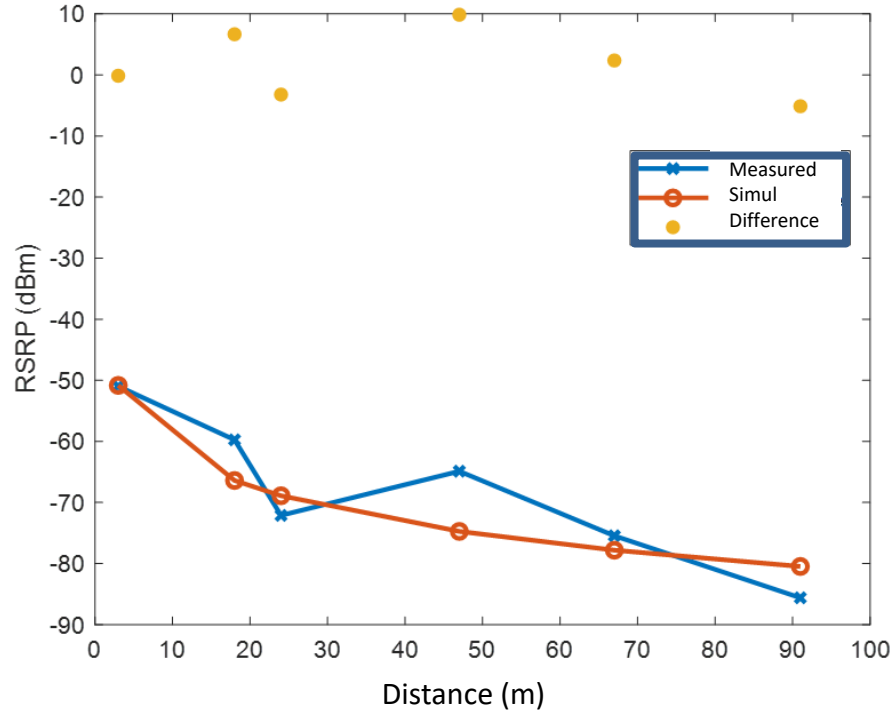


Example 2 – mmWaves for eMBB

- **AMATISTA project: Immersive music therapy based on virtual reality in a nursing home using 5G NR at mmWaves**
 - Simulator to understand best MCS, numerology, beamforming configurations
 - Validation with measurements
 - Immersive music therapy application

AMATISTA

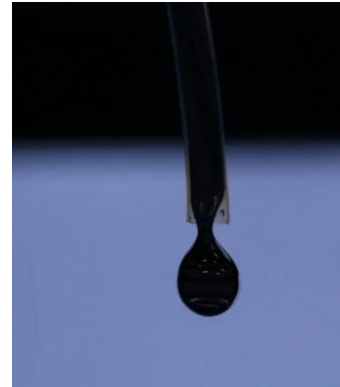
Validating the simulator



Example 3 – Arrays of liquid antennas

- Reconfigurability
- Changing the channel rather than adapting to its characteristics
- New degrees of freedom

Can we build an array of liquid antennas?



eGain is liquid at room temperature

Experiments in the lab



Conclusions

- Importance of simulations, prototyping and measurements to evolve mobile communications
- Three illustrative examples
 - MTC
 - eMBB
 - New degrees of freedom ..

Thank you!

**Projects: AMATISTA, TeamUp5G,
TERESA, IRENE-EARTH**



TeamUp5G project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie project number 813391.

Pictures and images from:

- ITU-R M.2083-0 (09/2015): IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond
- <https://pixabay.com/>
- <https://www.pexels.com/>
- www.freepik.es