TERAPOD

Simulation demo: THz links in a data centre environment

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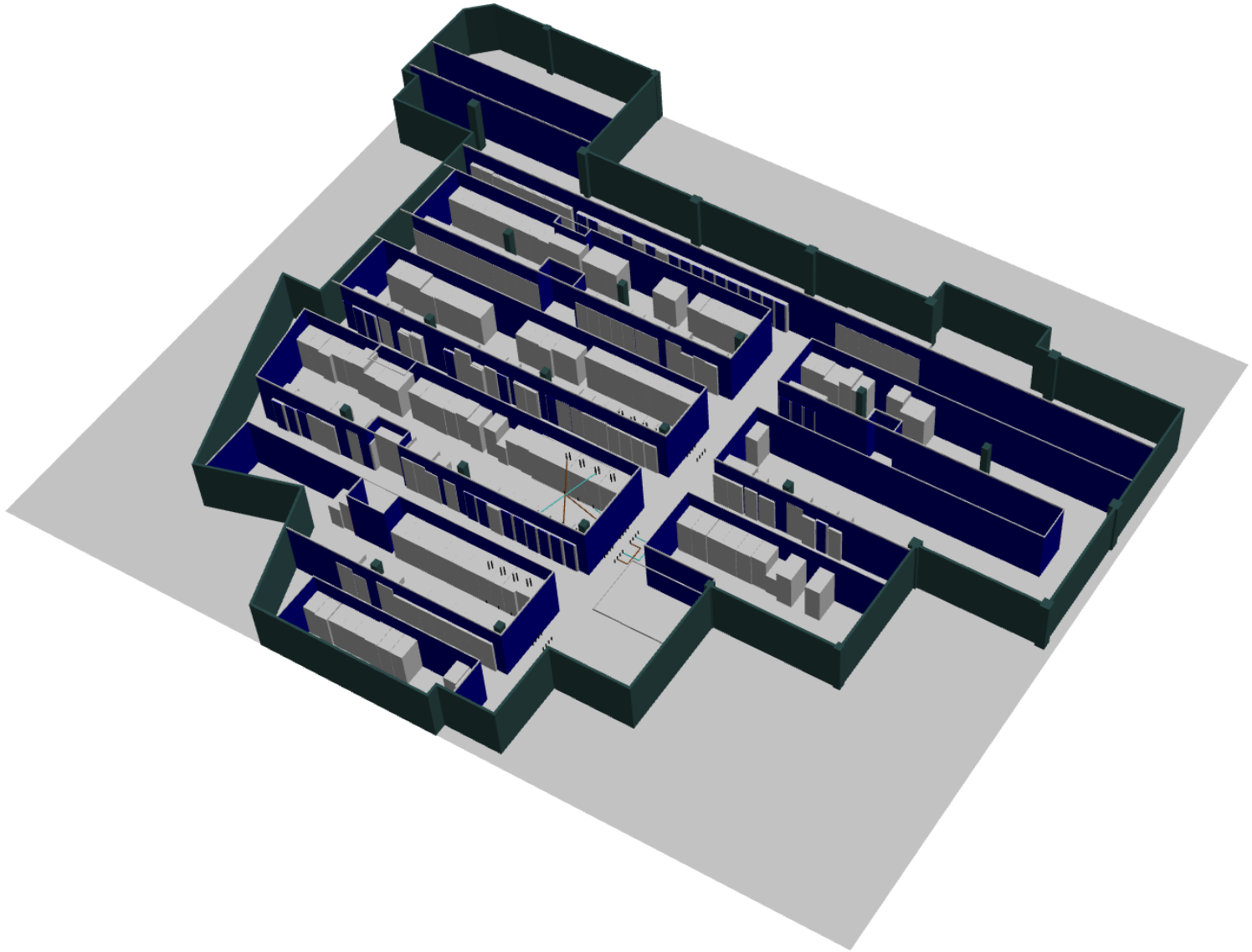
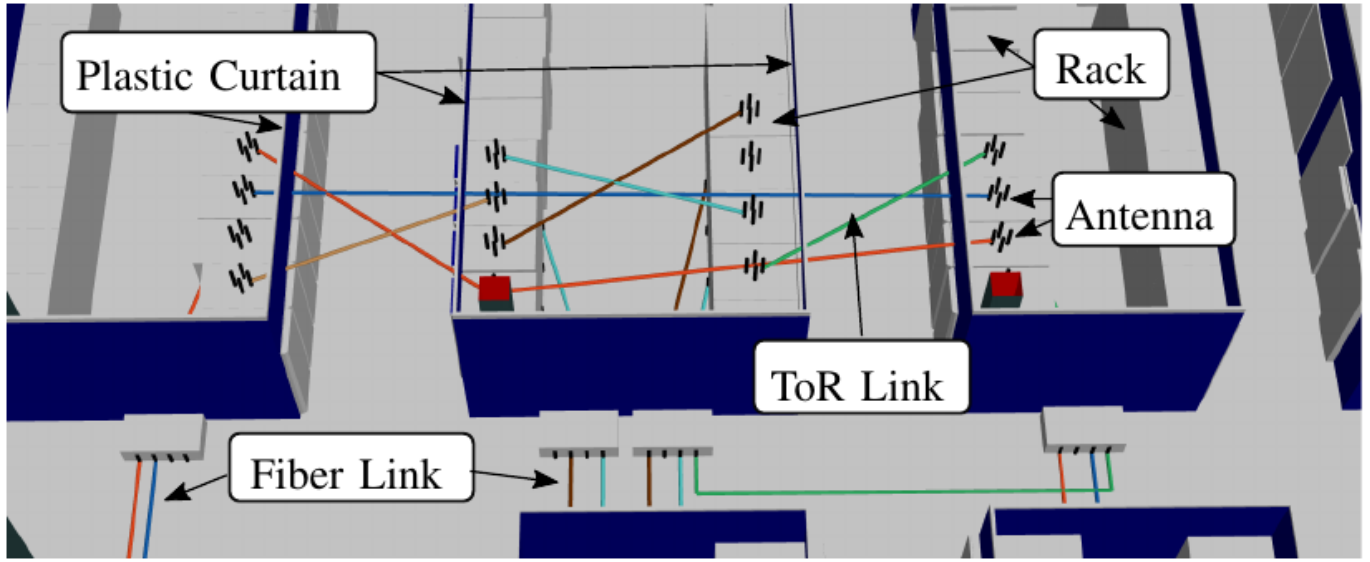
Presentation overview

- Scenario
- Methodology
- Parameters
- Live Demo



Simulation Scenario

- 3D Model of the Dell EMC Research Data Centre
- 16 racks
- Each rack with 4 Top-of-Rack antennas (90° steering range)
- 3 events simulated
  - Link failure detection and boost procedure
  - Interference detection
  - Short & long link flexibility

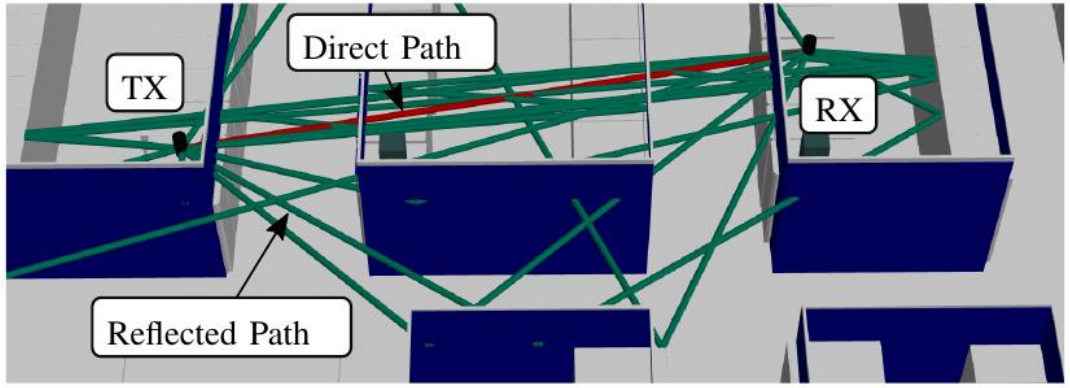


Simulation Methodology

- Define events

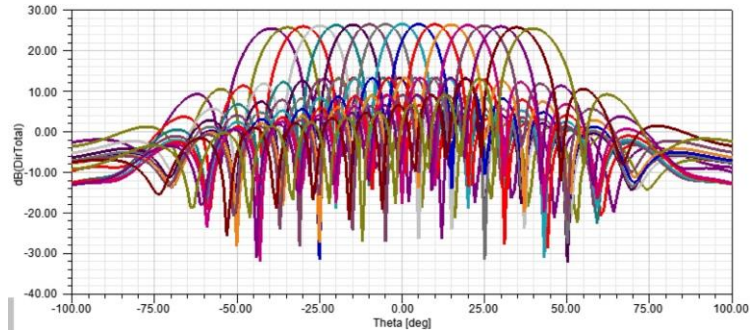
- PHY layer simulation
  - Ray tracing of the scenario
    - 15 x 15 impulse responses for each TX – RX pair
      - 57600 IRs
  - Segmentation to quasi-static states
  - Link level simulation of interference links
  - Superposition of interference according to states
  - Link level simulation of signal links
  - Evaluation of BER, SINR, data rate

- DLL and NET based on PHY results

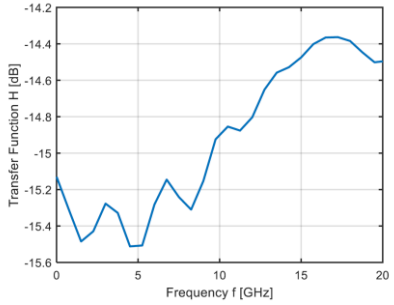


Simulation Parameters

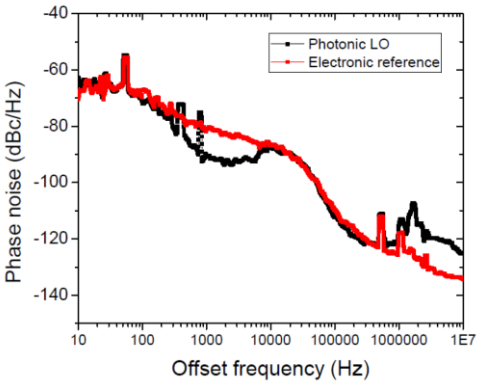
- TERAPOD
  - -8 dBm TX power
  - INESC 16 x 16 patch antenna array, 24 dBi, HPBW 7°
    - Simulated antenna pattern as a function of steering angle
  - ACST LNA characteristics: noise figure and S-parameters
- IEEE 802.15.3d THz-SC PHY
  - LDPC 11/15
  - QPSK
  - 2.16 GHz channel bandwidth
- General
  - 1 Gbit transmitted → best BER of $1 \cdot 10^{-9}$
  - 300 GHz carrier frequency
  - Thermal noise, k*B*T*F, -68.51 dBm
  - Power amplifier and phase noise characteristics from ThoR



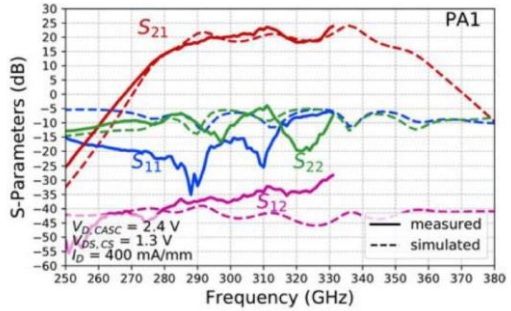
Antenna pattern for different steering angle



LNA characteristics



Phase noise characteristics [2]



PA characteristics [1]

Simulation Demonstrator

- Let’s have a look at the demonstrator.

Conclusions

- Interference limits performance
  - Interference mitigation by frequency multiplexing
  - Side lobes can be decreased in future

- Balanced link budget
  - Assure clear direct path (line-of-sight)
  - Reduce multipath propagation
  - Higher TX power would allow higher bandwidth
    - TX power increased during the project from ≈-25 dBm to -10 dBm

Thank you for your attention!

[1] L. John, A. Tessmann, A. Leuther, P. Neininger, T. Merkle and T. Zwick, "Broadband 300-GHz Power Amplifier MMICs in InGaAs mHEMT Technology," in IEEE Transactions on Terahertz Science and Technology, vol. 10, no. 3, pp. 309-320, May 2020.

[2] Dan, I., Ducournau, G., Hisatake, S., Szriftgiser, P., Braun, R., & Kallfass, I. (2020). A superheterodyne 300 GHz wireless link for ultra-fast terahertz communication systems. International Journal of Microwave and Wireless Technologies, 12(7), 578-587.

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