Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Measuring the Channel Characteristics at 300 GHz - Preliminary Results
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Abstract: A likely application for THz communication systems is the wireless interconnection of different electronic devices for ultra fast file transfer. For this use case the channel behavior at distances less then 1 meter has been characterized experimentally and compared to a simple model for frequencies between 290 and 300 GHz. This paper describes the preliminary results of his comparison.

Purpose: Input to THz Channel Modeling at IEEE 802.15 IG Thz

Measuring the Channel Characteristics at 300 GHz - Preliminary Results

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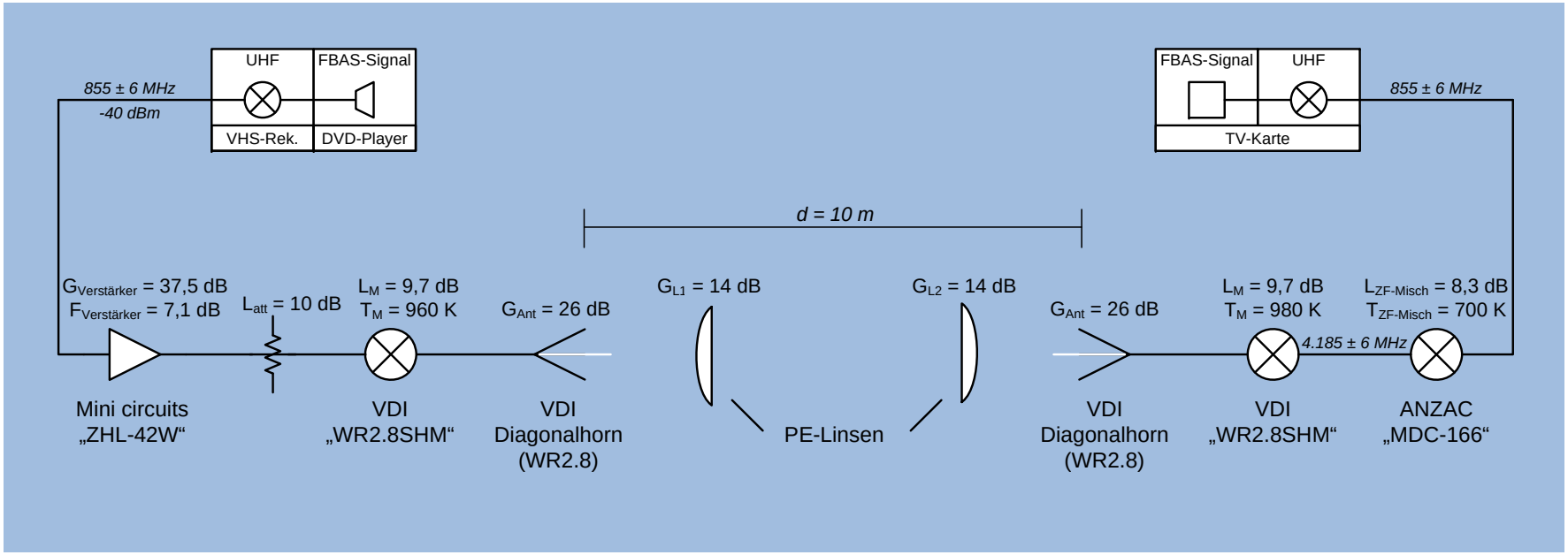
Content

- 300 GHz Transmission System
- Measurement System
- Wideband Measurements
  - Influence of metallic parts of RF front end
  - Two-Ray Propagation Scenario
- Outlook

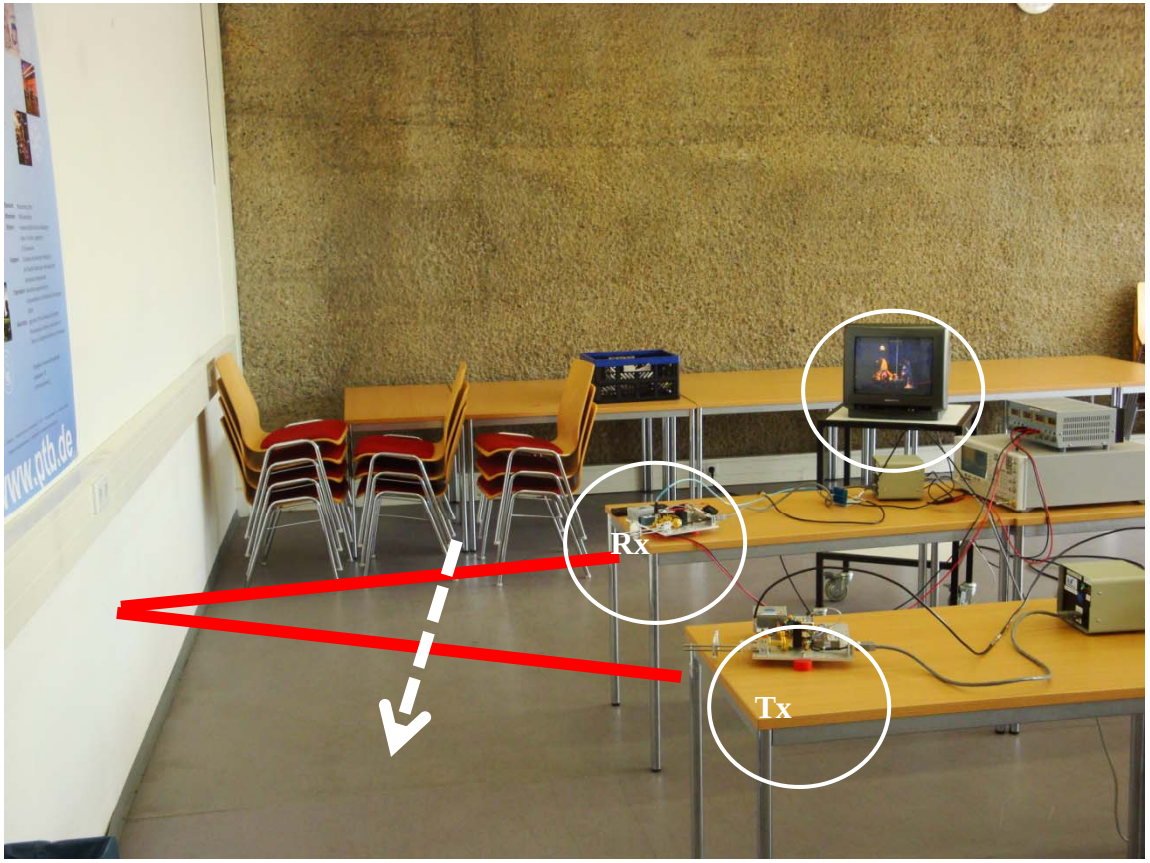
300 GHz Transmission System



Jastrow, C., Münter, K., Piesiewicz, R., Kürner, T., Koch, M., Kleine-Ostmann, T., ‘300 GHz transmission system’, IEE Electronics Letters, Vol. 44, No. 3, January 2008, pp. 213-214.

see also: doc.: IEEE 802.15-15-08-0336-01-0thz-thz-communications.pdf

Transmitting a TV Signal at 300 GHz using a single Reflection at a Wall



Influence of moving People

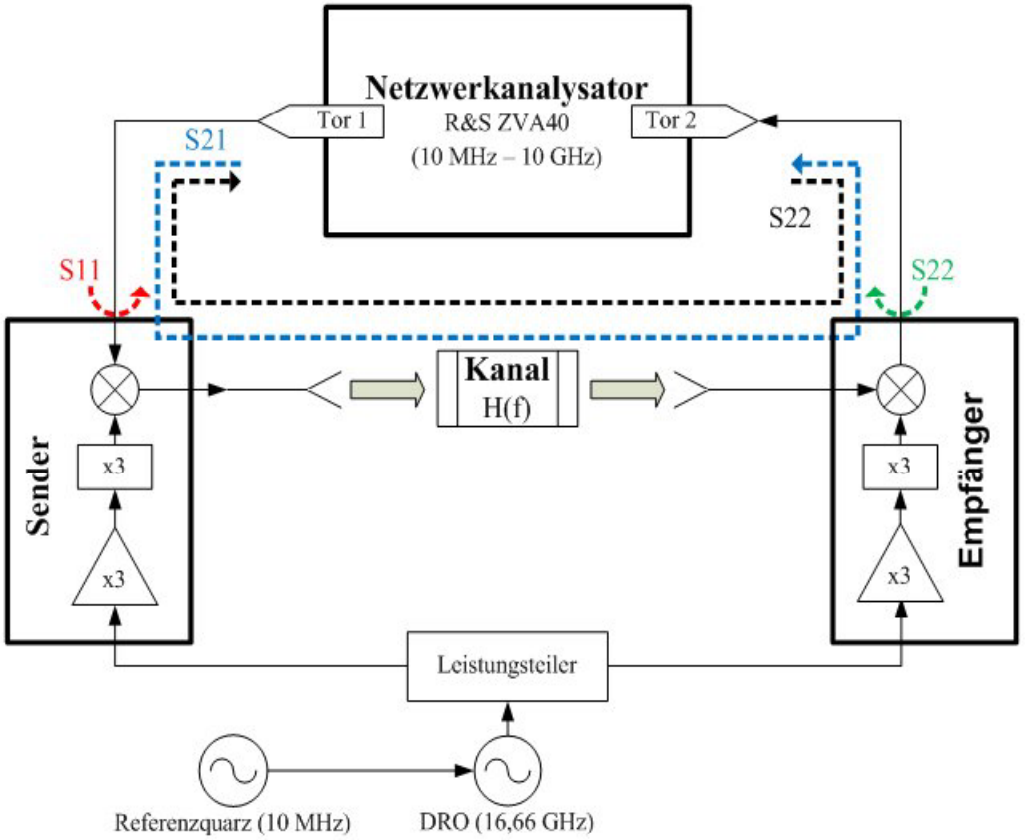
Need for more detailed Channel Measurements

- Feasibility of wireless communications at 300 GHz shown by 300 GHz transmission system
- Insights into basic propagation phenomena
- Full understanding of propagation channel at 300 GHz requires more detailed measurements

300 GHz Radio Channel Measurement System - 1

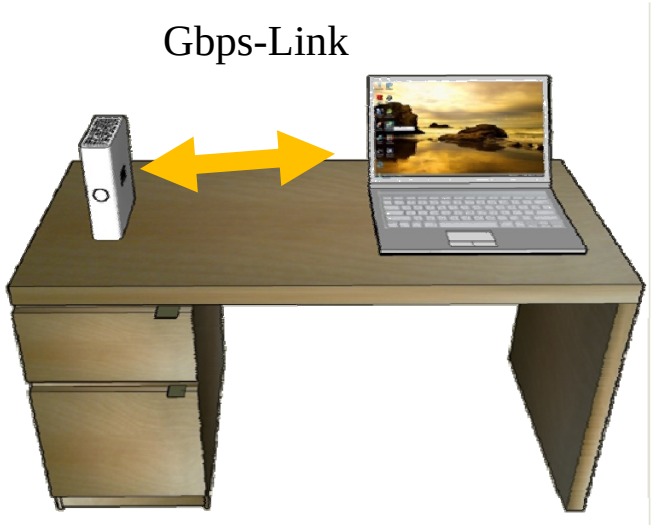
- R & S ZVA40 Vector Network Analyzer
- External 300 GHz transmitter (Tx) and receiver(Rx) front ends
- Core component: subharmonic schottky diode mixer
- Same external local oscillator (DRO) (16.66 GHz x3 x3) for Tx and Rx for phase synchrony
- 26 dBi Horn antennas (HPBW 5°)
- Frequency range: 290 – 310 GHz
- Frequency Domain → Time Domain

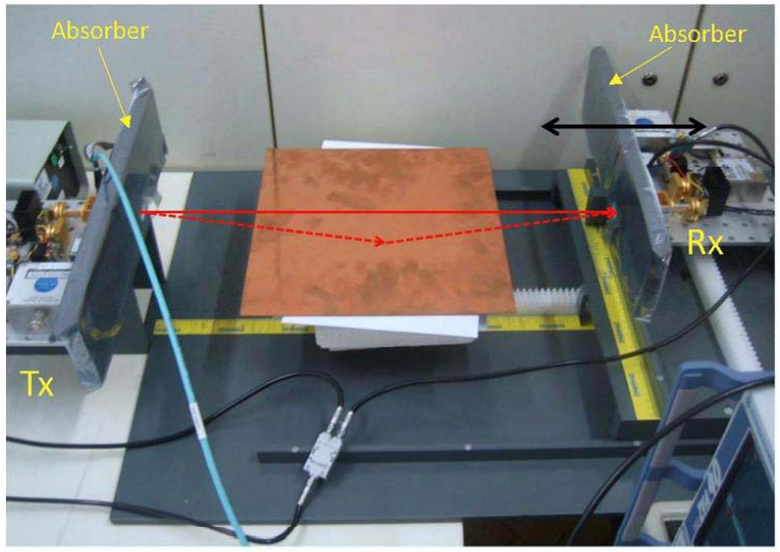
300 GHz Radio Channel Measurement System - 2



Example Application –Fast Data Transfer

- Realistic application Gbps-Link between two electronic devices
- Propagation scenario
  - Superposition of reflection from the desktop and direct path
- Investigated experimentally and by simulations

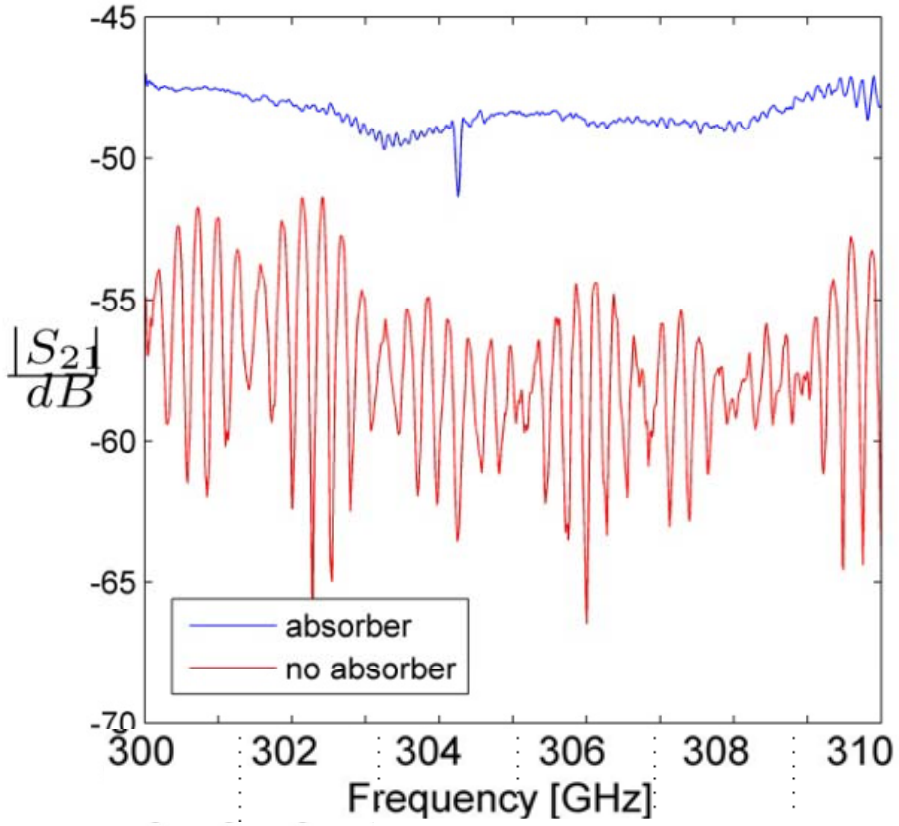




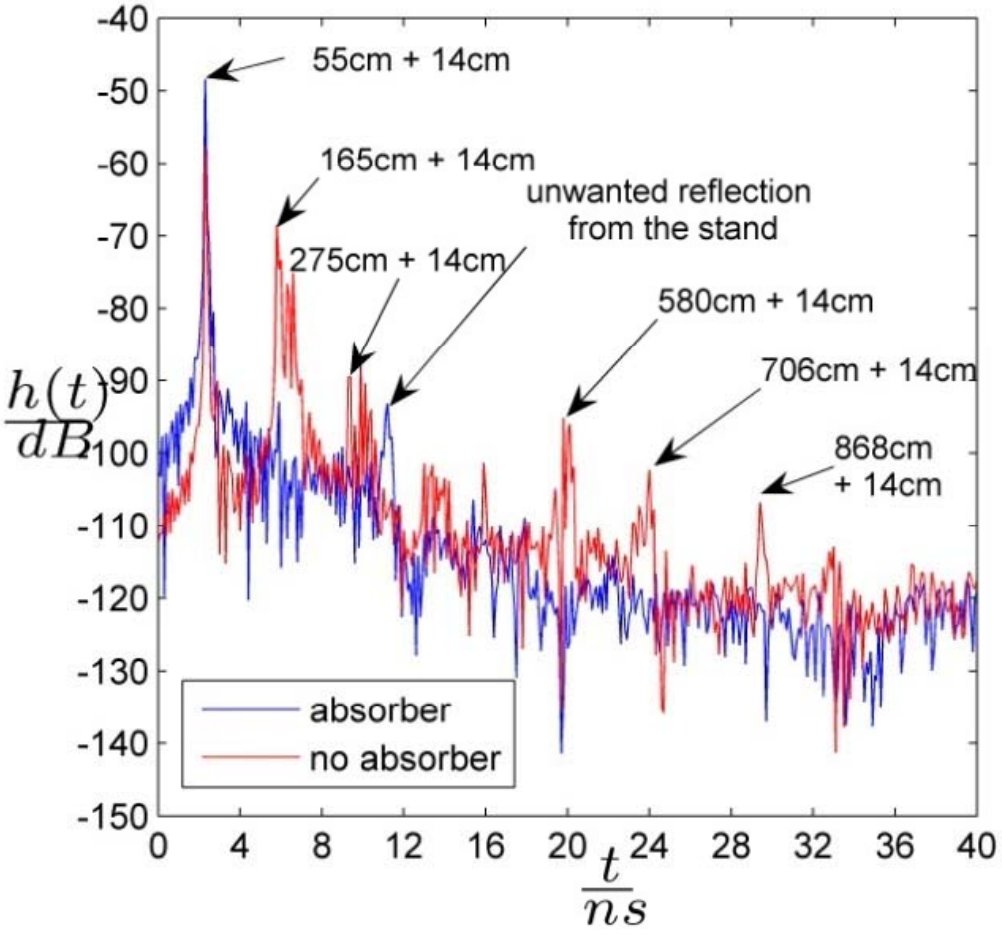
Measurement Set-up

- In the following two measurement set-ups are applied
  - Set-Up 1 (Influence of metallic parts of RF front end):
    - Tx and Rx at a distance of 55 cm
    - Metal plate at ground removed
    - Measurements with/without absorber at Tx and Rx
  - Set-Up 2 (Two-ray propagation scenario):
    - Variation of distance between Tx and Rx
    - Metal plate at ground used
    - Absorbers at Tx and Rx

Results from Set-up 1: Measured Transfer Functions

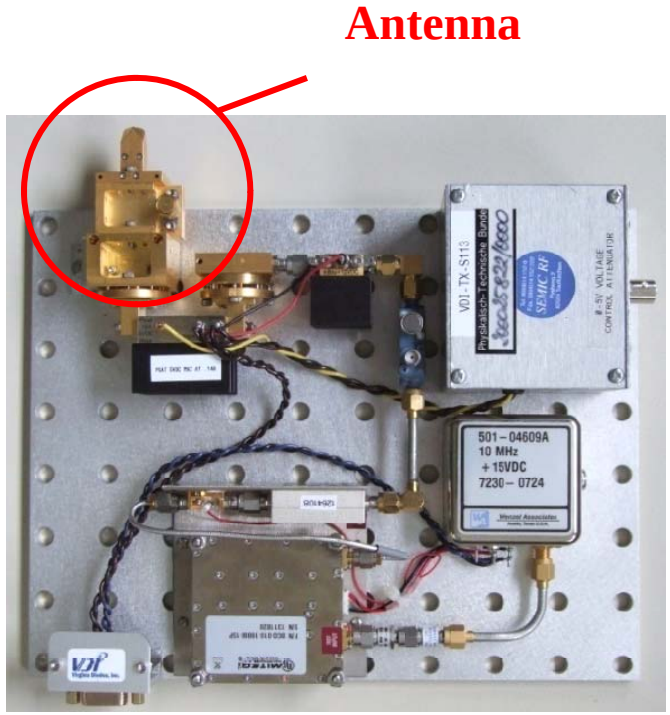


Associated Impulse Responses



Conclusions on Influence of Metallic Parts of RF Front End

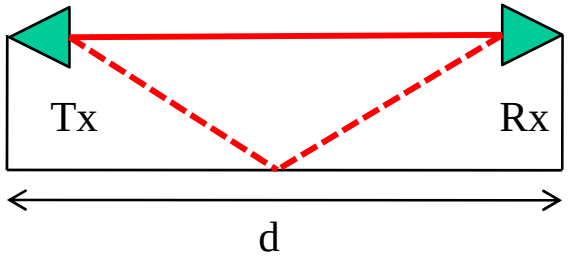
- Absorber plates are mandatory
- without absorbers multiple reflections mainly at metallic parts of the front end occur yielding
  - unwanted peaks in time domain
  - oscillation and attenuation in frequency domain

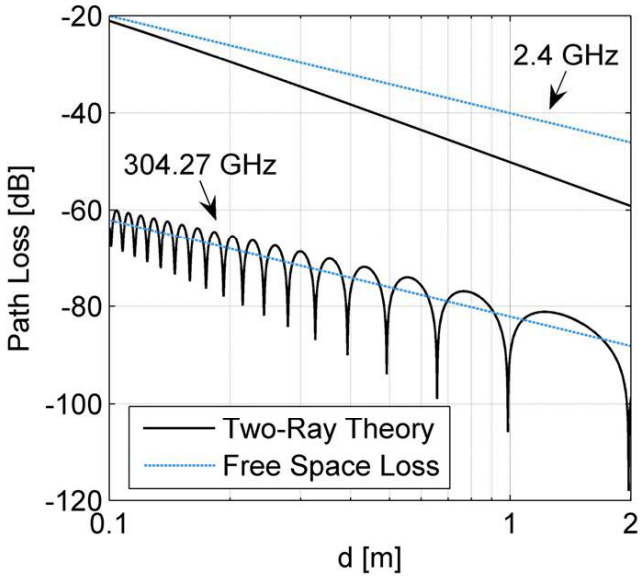


RF Front End

Two-Ray Propagation Scenario

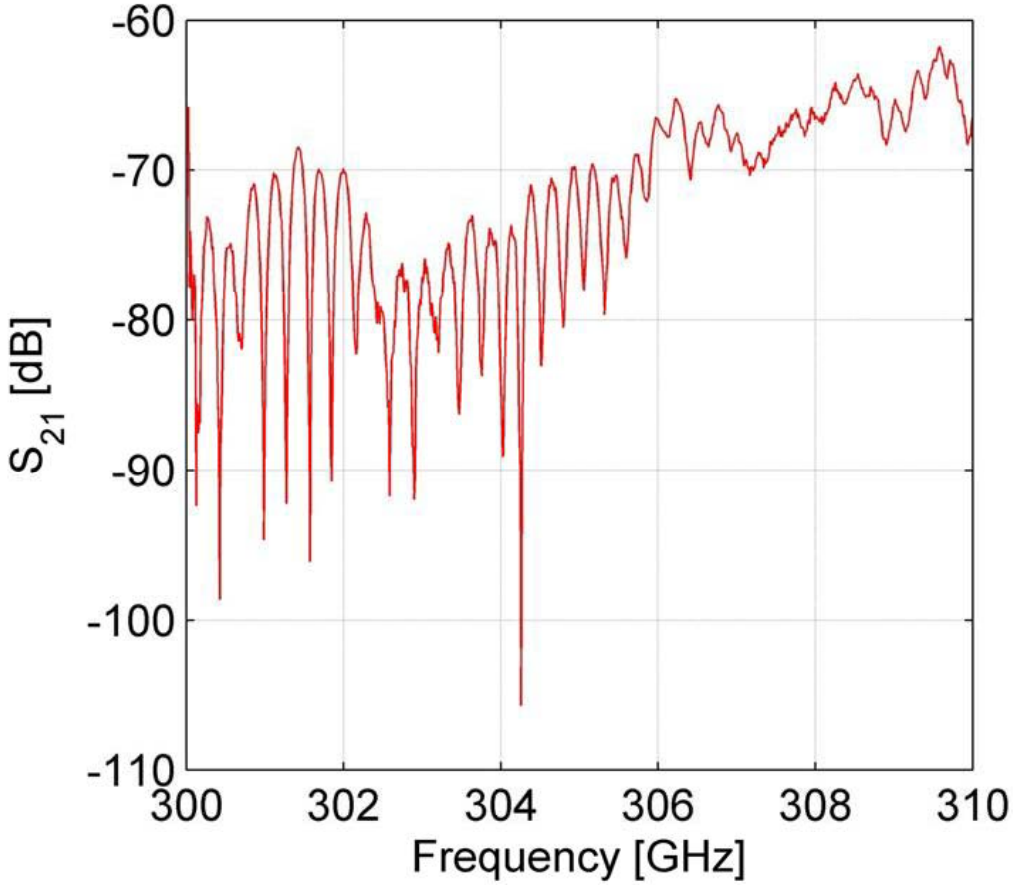
- Superposition of direct signal and signal reflected from desktop taking into account proper phase of both signals
- Metal plate → reference for maximum expected signal fluctuations
- 50% →Path Loss 1 dB lower than free space Loss, BUT Fading Dips
- Different behaviour than for lower frequencies



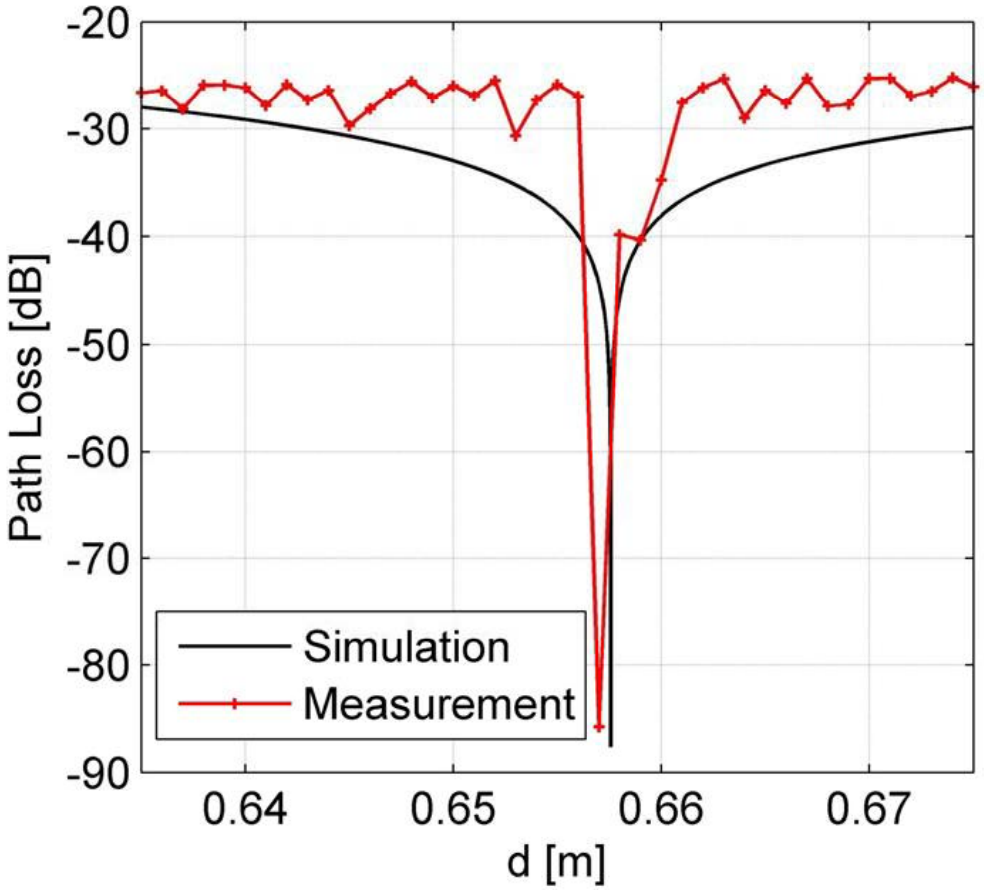


Simulation Results

Results from Set-Up 2: Measurement @ 67 cm



Results from Set-Up 2: Measurement @ 304.75 Gz



Conclusions on Two-Ray Propagation Scenario

- Multipath propagation
  - Interference between direct ray and reflected ray causes strong frequency selective behaviour
  - Signal fluctuations in spatial domain

- Measured fading dips occur at the same distance between Tx and Rx as predicted by the simple two-ray model

Outlook

- Wideband measurements in a small room
- Quantitative investigation of reflection and scattering processes from walls
- Verification of ray-tracing approach
- Using ray-tracing to derive statistical channel models (comparable to channel modeling activities taking place in IEEE 802.11 TGad)