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Submission Title: Measuring the Channel Characteristics at 300 GHz - Preliminary Results

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Re: [doc.: IEEE 802.15- 15-09-0496-00-0thzr1-channel-measurements]

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 than 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. In the revised version (r1) the measurements depicted on slide 12 and 13 have been redone as a follow-up of the discussion during presentation at IG THz.

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

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Measuring the Channel Characteristics at 300 GHz - Preliminary Results

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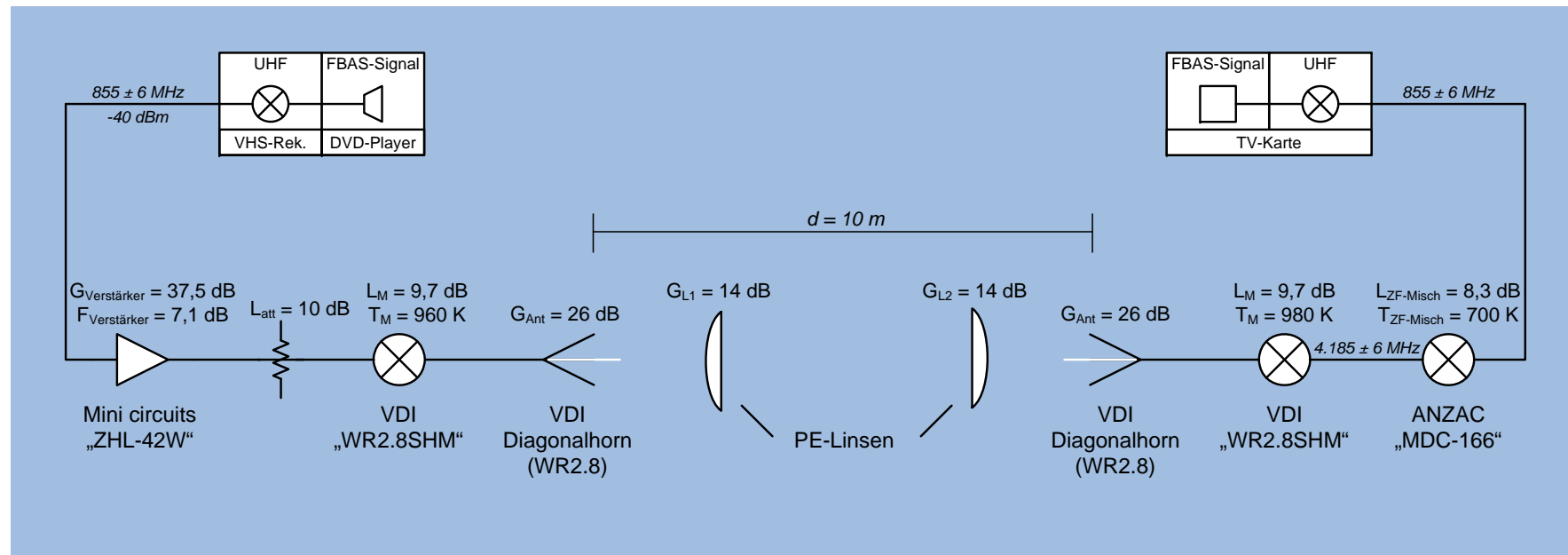
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Content

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

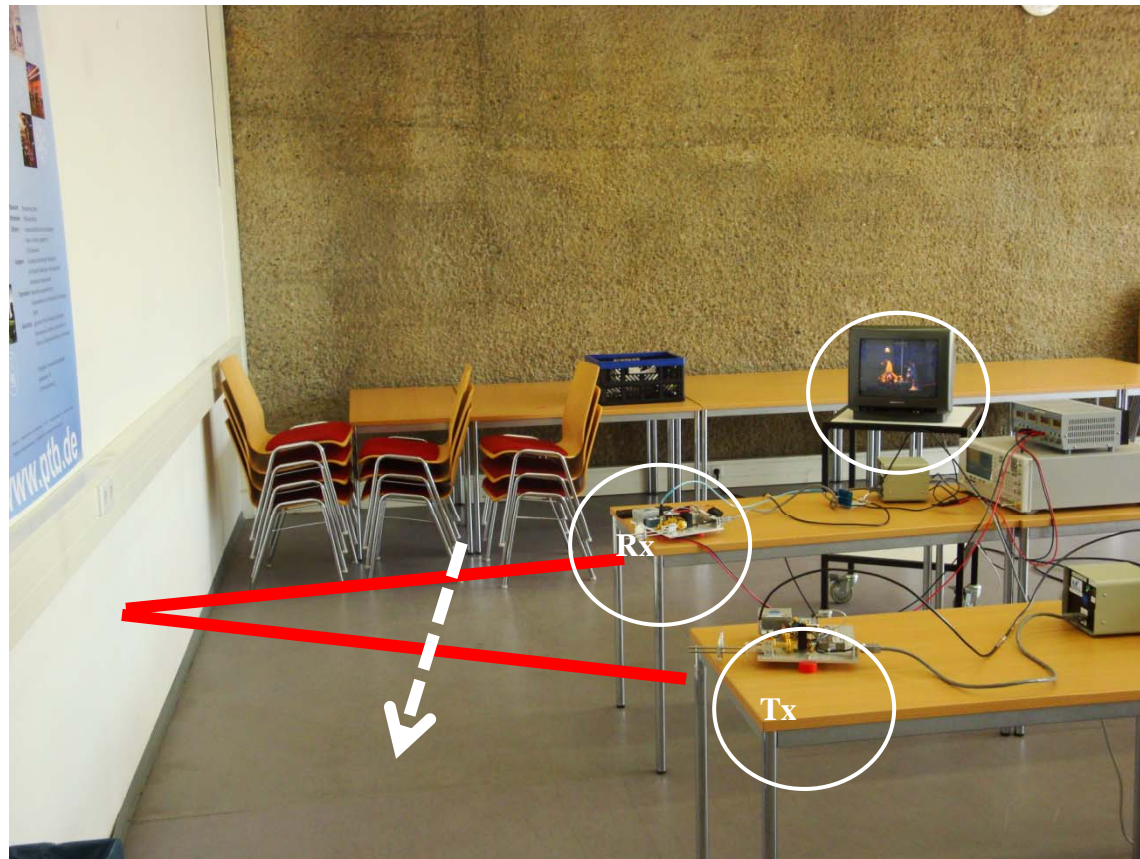
300 GHz Transmission System



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



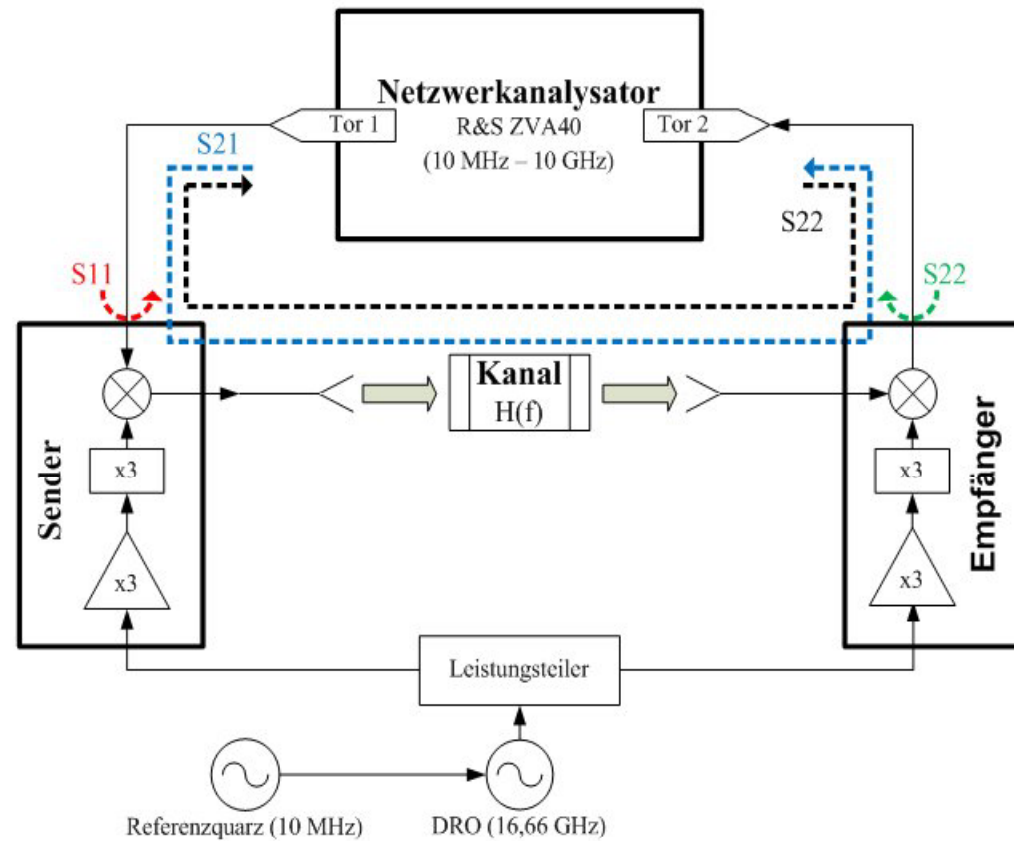
Need for more detailed Channel Measurements

- 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

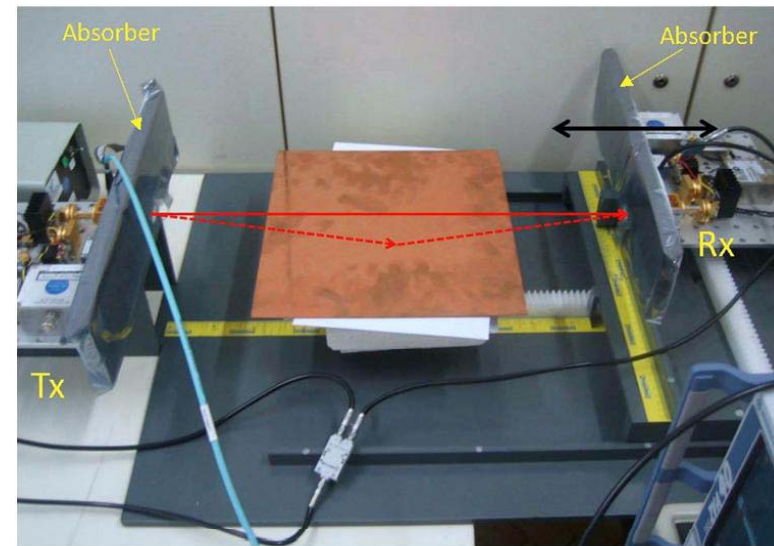
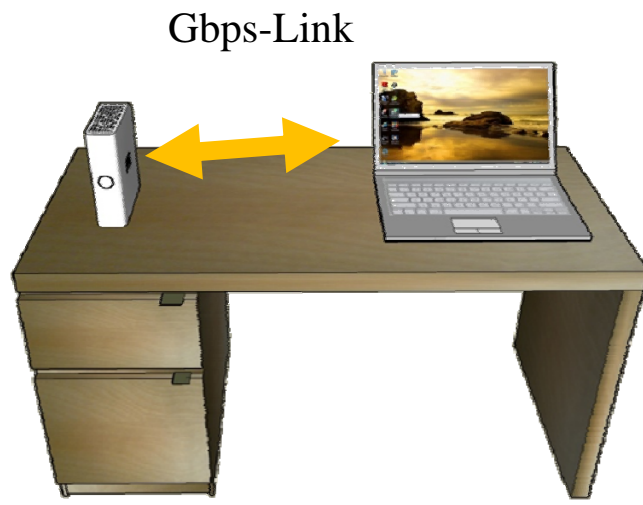
- R & S ZVA40 Vector Network Analyzer
- External 300 GHz transmitter (Tx) and receiver(Rx) front ends
- Core component: subharmonic schottky diode mixer
- Same external local oscillator (DRO) (16.66 GHz x3 x3) for Tx and Rx for phase synchrony
- 26 dBi Horn antennas (HPBW 5°)
- Frequency range: 290 –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

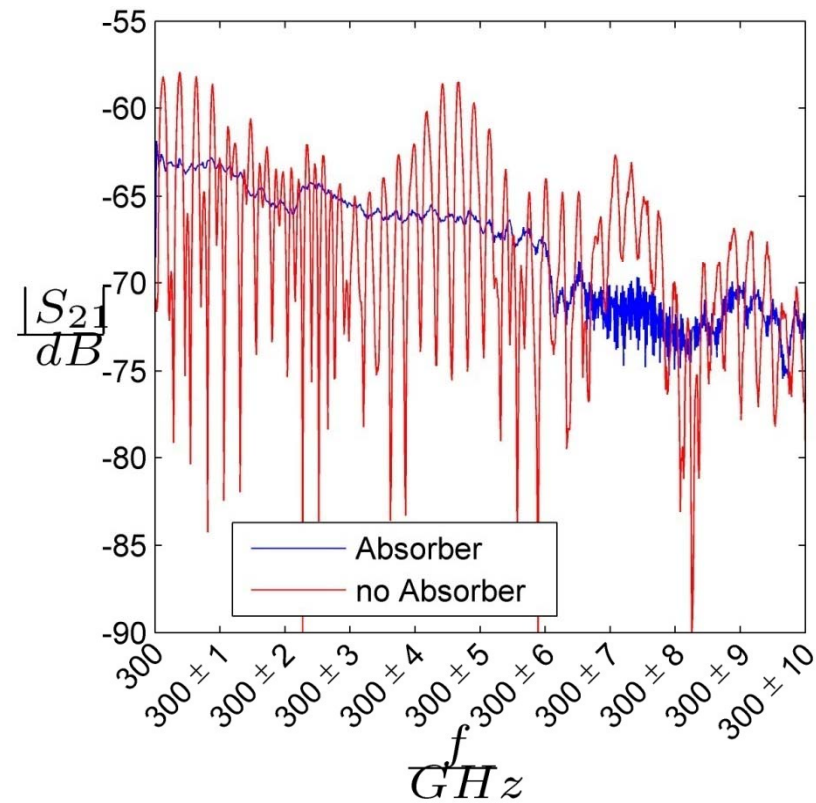


Measurement Set-up

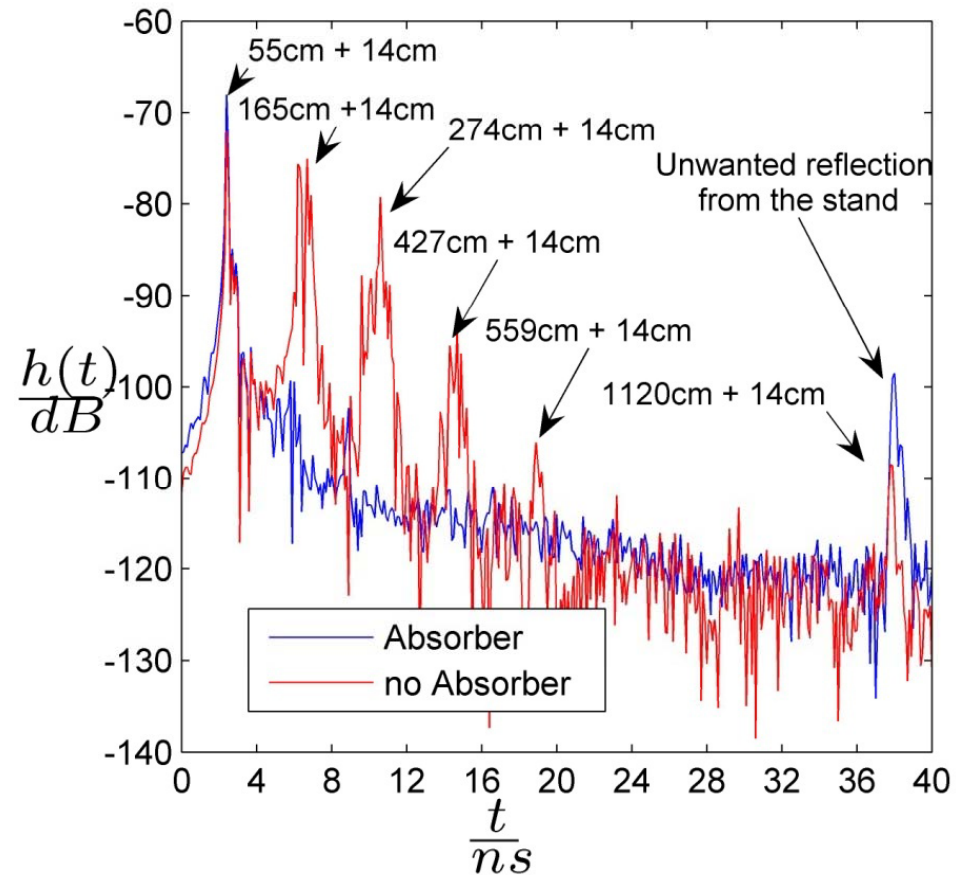
- In the following two measurement set-ups are applied
 - Set-Up 1 (Influence of metallic parts of RF front end):
 - Tx and Rx at a distance of 55 cm
 - Metal plate at ground removed
 - Measurements with/without absorber at Tx and Rx

 - 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

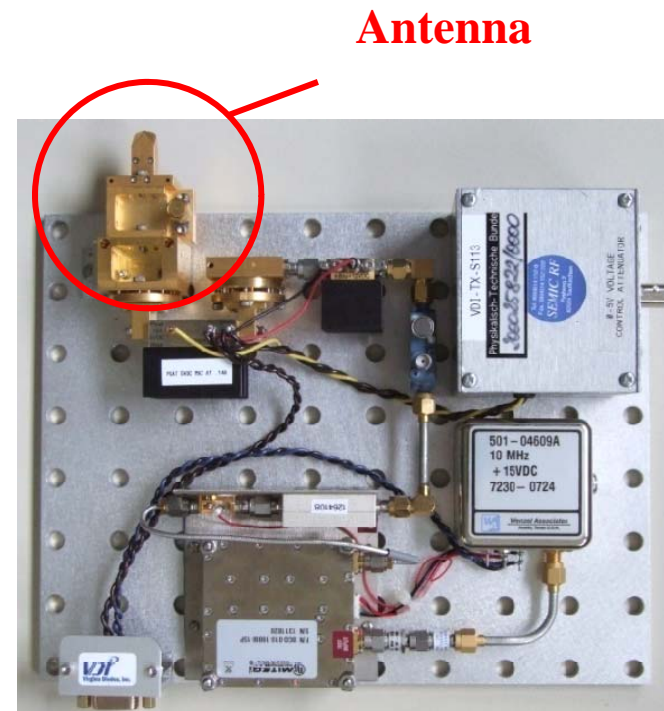


Associated Impulse Responses



Conclusions on Influence of Metallic Parts of RF Front End

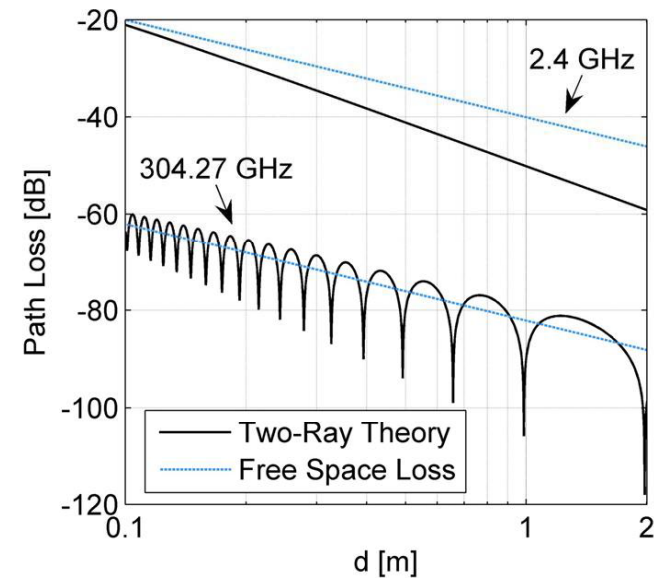
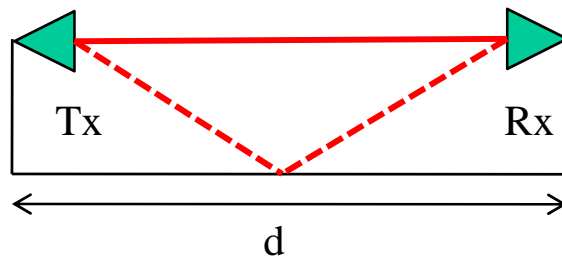
- Absorber plates are mandatory
- without absorbers multiple reflections mainly at metallic parts of the front end occur yielding
 - unwanted peaks in time domain
 - oscillation and attenuation in frequency domain



RF Front End

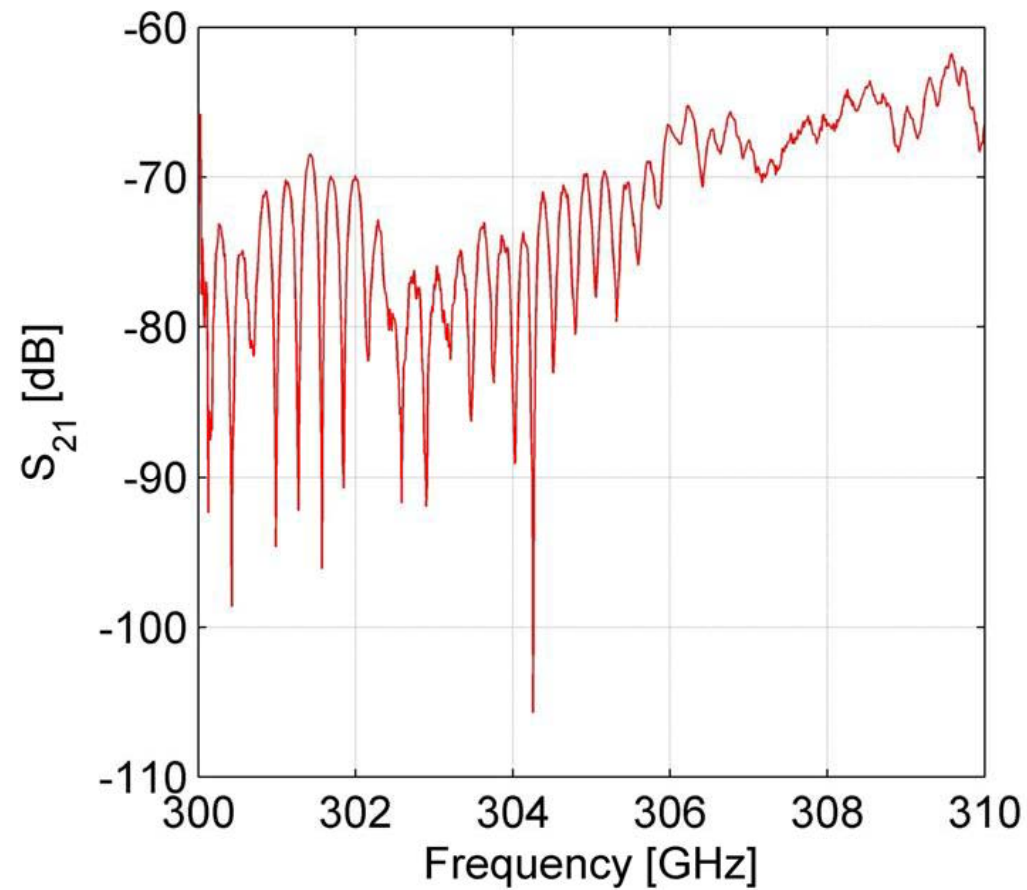
Two-Ray Propagation Scenario

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

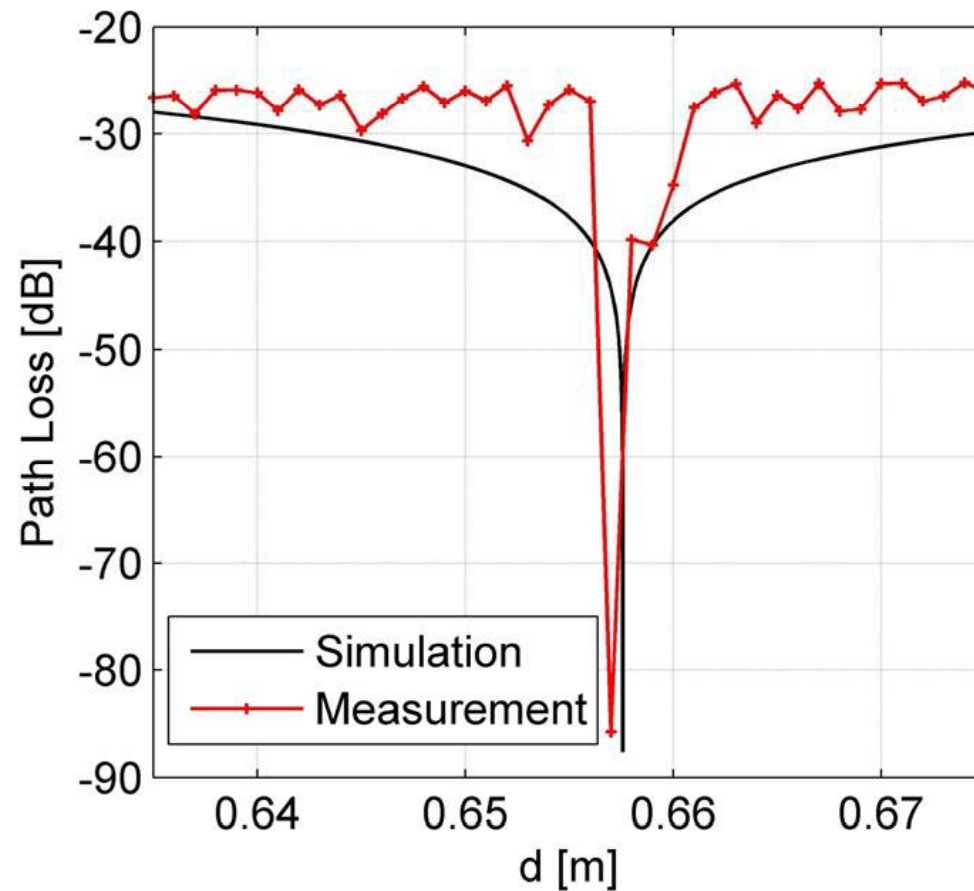


Simulation Results

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)