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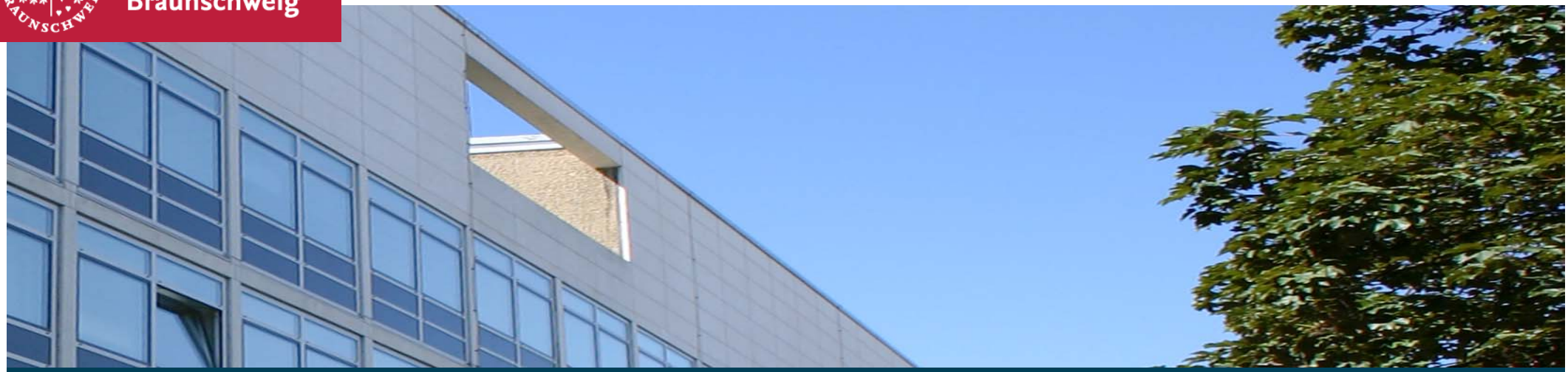
Abstract: This contribution reports about first measurements of passive reflective intelligent surfaces at 300 GHz , which have been carried out in the framework of the European 6G-SNS-JU TERRAMETA and TIMES projects.

Purpose: Information of IEEE 802.15 SC THz

Technische Universität Braunschweig

Institut für Nachrichtentechnik



Initial Assessment of THz Indoor Channel with Passive Reflective Intelligent Surfaces

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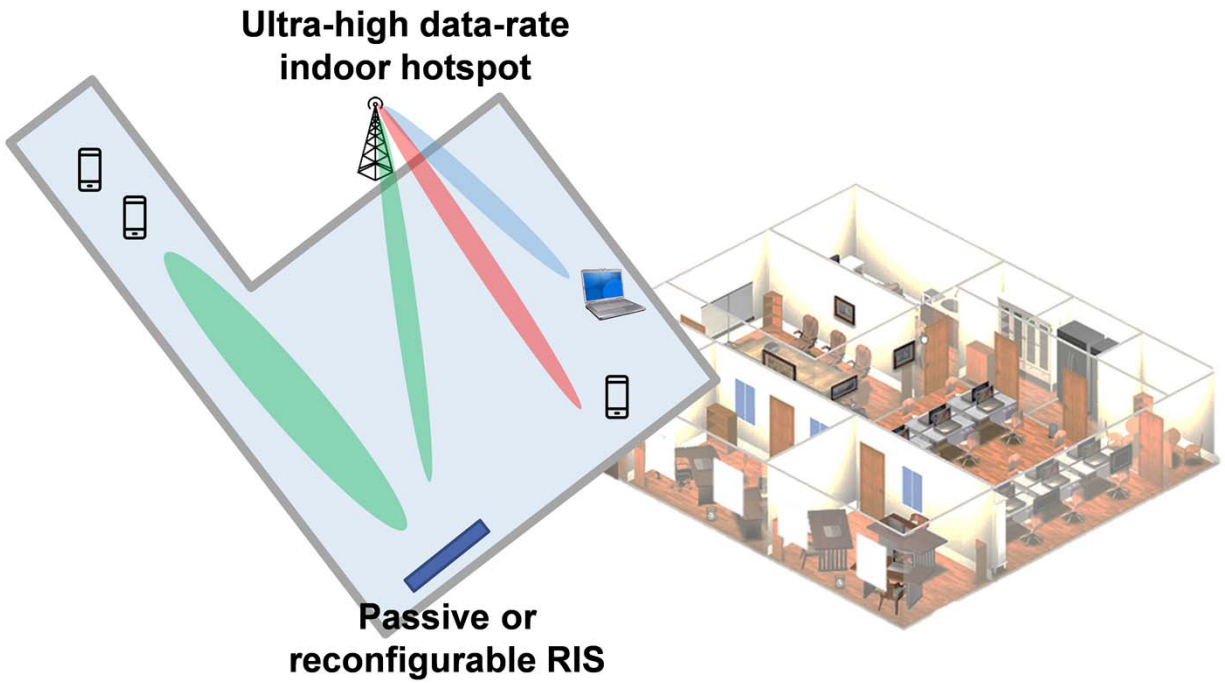
This work has been carried out as part of a collaborative measurement campaign between the TERRAMETA and the TIMES project, which have received funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101097101 and No 101096307, respectively, including top-up funding by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee for TERRAMETA

Motivation



- THz communications is expected to be an essential part of the future mobile communication
- One of the limitations is the requirement for a strong multi-path component
- Reconfigurable intelligent surface (RIS) shows its great potential

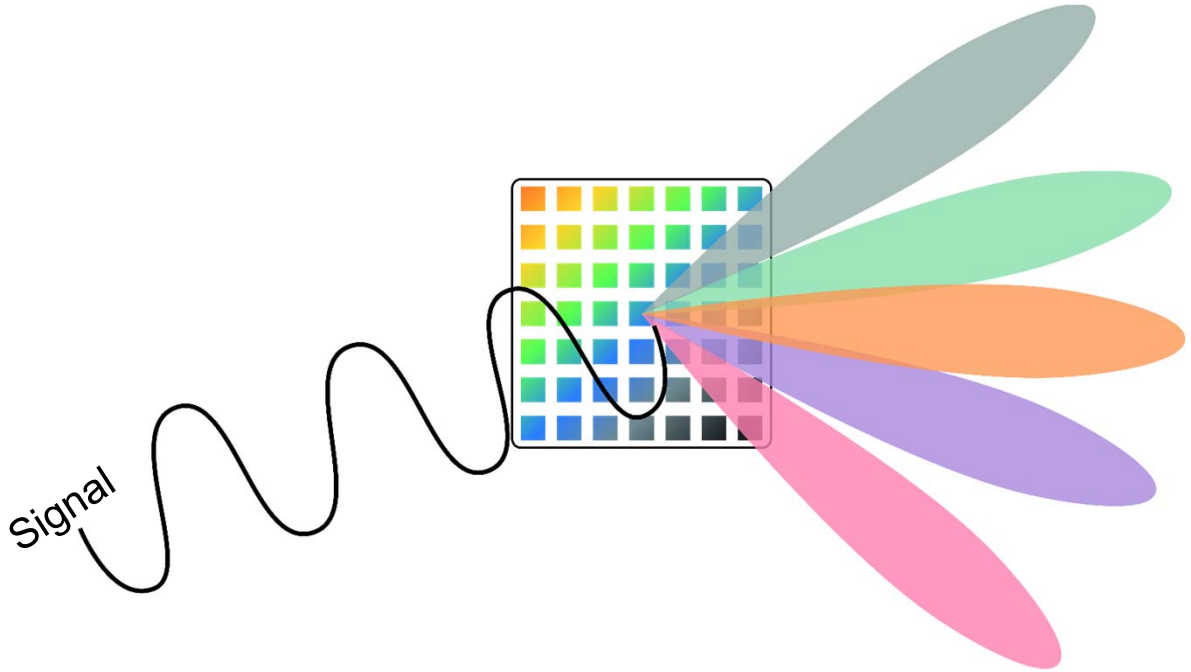
TERRAMETA Deliverable D2.1, „Requirements, use cases, and scenario specifications“, June, 2023, available: https://terrameta-project.eu/wp-content/uploads/2023/09/TERRAMETA-Deliverable-D2.1-Requirements-use-cases-and-scenario-specifications.pdf

What is a RIS?

RIS?

Any programmable surface that can manipulate electromagnetic waves

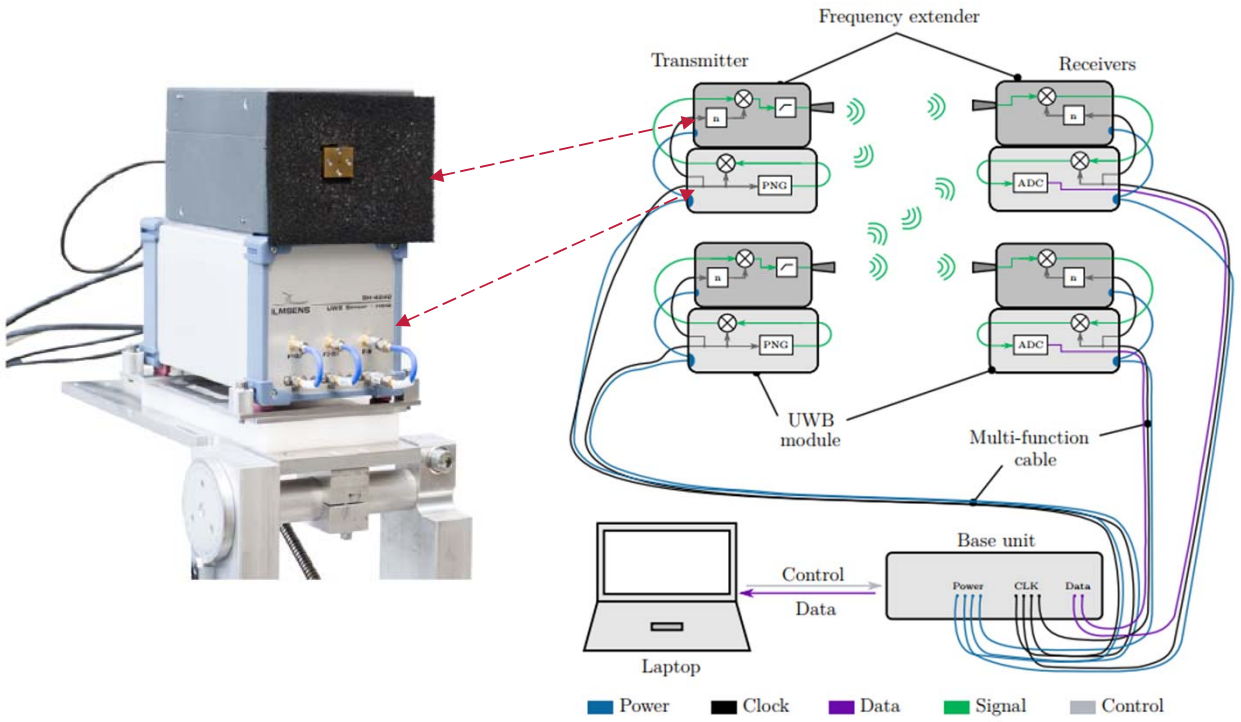
How can the use of RIS improve THz backhaul networks?



Motivation of Channel Measurement at 300 GHz

- Sub-THz communication for future mobile communication system
- Reconfigurable Intelligent Surfaces (RIS) to overcome limitations
- Chanel sounding for insights of the propagation channel, including RIS

Measurement Equipment: channel sounder



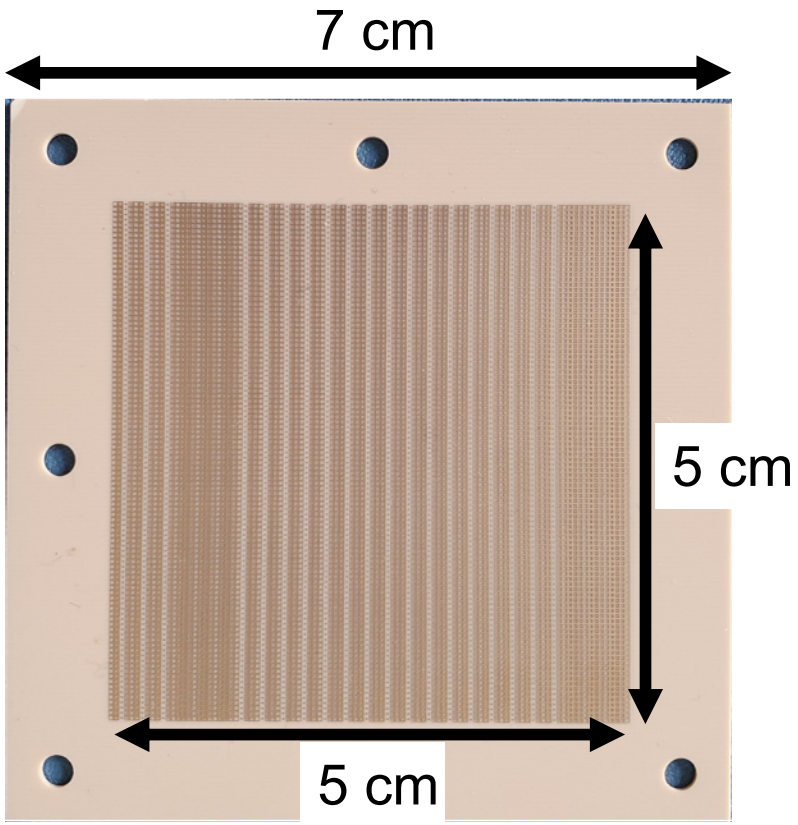
Parameter	Value
Center Frequency	304.2 GHz
Clock Frequency	9.22 GHz
Bandwidth	approx. 8 GHz
Chip duration	108.5 ps
Order of M-Sequence	12
Sequence length	4095
Sequence duration	444.14 ns
Subsampling factor	128
Measurement Rate	17,590 CIR/s
TX/RX antenna gain	26.4 dBi
TX/RX antenna HPBW	8.5°

S. Rey, J. M. Eckhardt, B. Peng, K. Guan and T. Kürner, "Channel sounding techniques for applications in THz communications: A first correlation based channel sounder for ultra-wideband dynamic channel measurements at 300 GHz," 2017 9th International Congress on Ultra Modern Telecommunications and Control Systems and Workshops (ICUMT), Munich, Germany, 2017, pp. 449-453

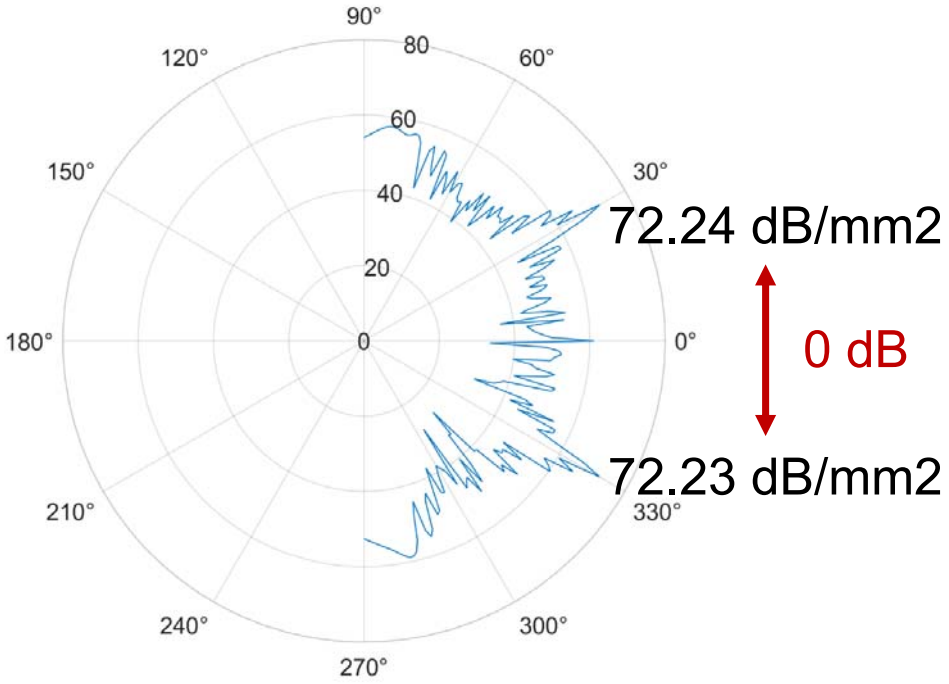
J. M. Eckhardt, A. Schultze, R. Askar, T. Doeker, M. Peter, W. Keusgen, T. Kürner, "Uniform Analysis of Multipath Components From Various Scenarios With Time-Domain Channel Sounding at 300GHz," IEEE Open Journal of Antennas and Propagation, vol. 7, pp. 446-460, March 2023

Measurement Equipment: Reflective RIS

- RIS (passive surface) designed for 300 GHz
- Emulation of a single pattern of unit cells
  - 0° incidence angle and 30° reflection angle
- A dimension of 5 cm by 5 cm RIS
  - (100 by 100 unit cells)
- Three different types of RISs
  - 1, 2, and 3-bit



Measurement Equipment: Reflective RIS

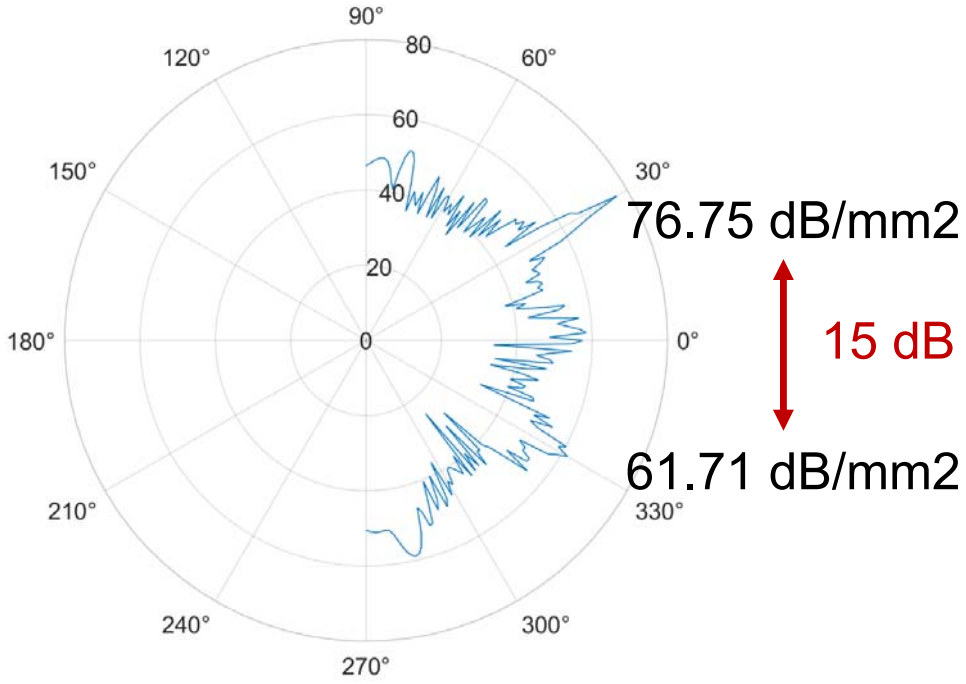


72.24 dB/mm2

0 dB

72.23 dB/mm2

1-bit



76.75 dB/mm2

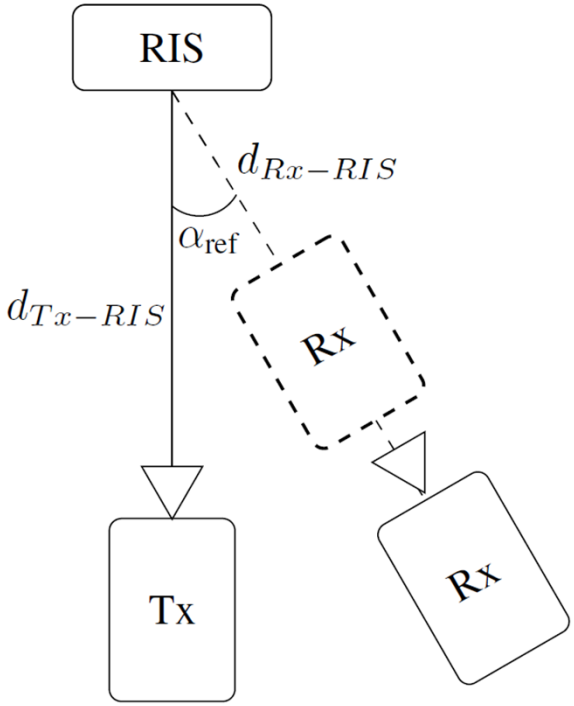
15 dB

61.71 dB/mm2

3-bit

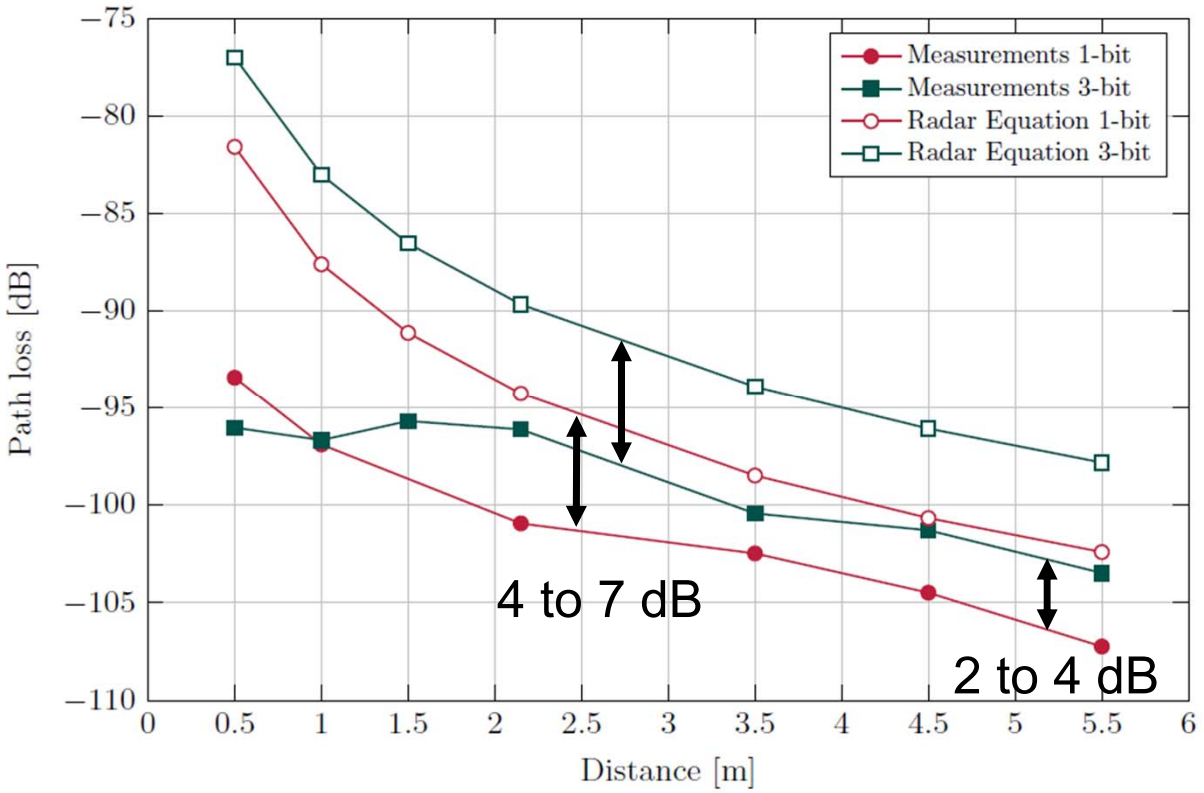
Measurement Scenarios: Single Directional

- Channel measurement over RIS
- Distance between TX and RIS remain unchanged 2.15m
- Varying the distance between RIS and RX from 0.5m to 5.5m
- Measuring +30° and -30° angle of reflection



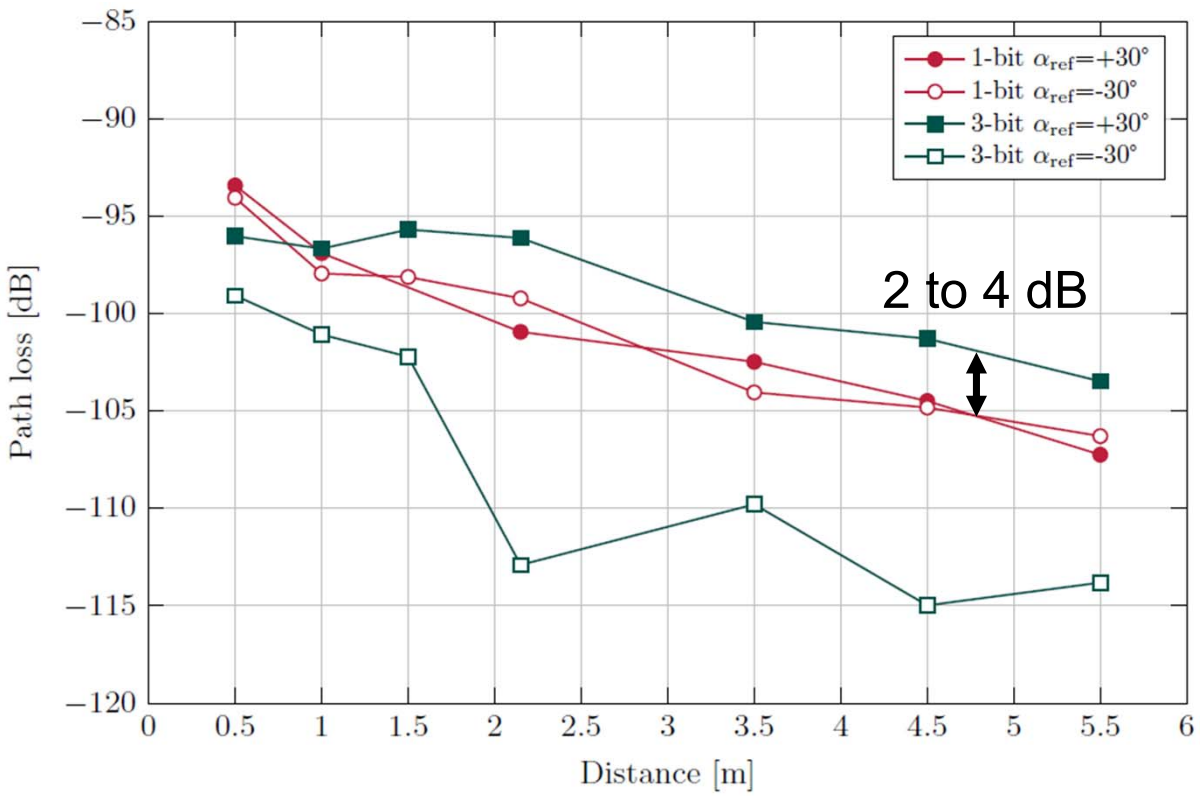
Measurement Result

- Good agreement
  - between measurement result and mathematical prediction model
- Systematic error (4 to 7 dB) due to misalignment, measurement setting, and production error



Measurement Result: R-RIS

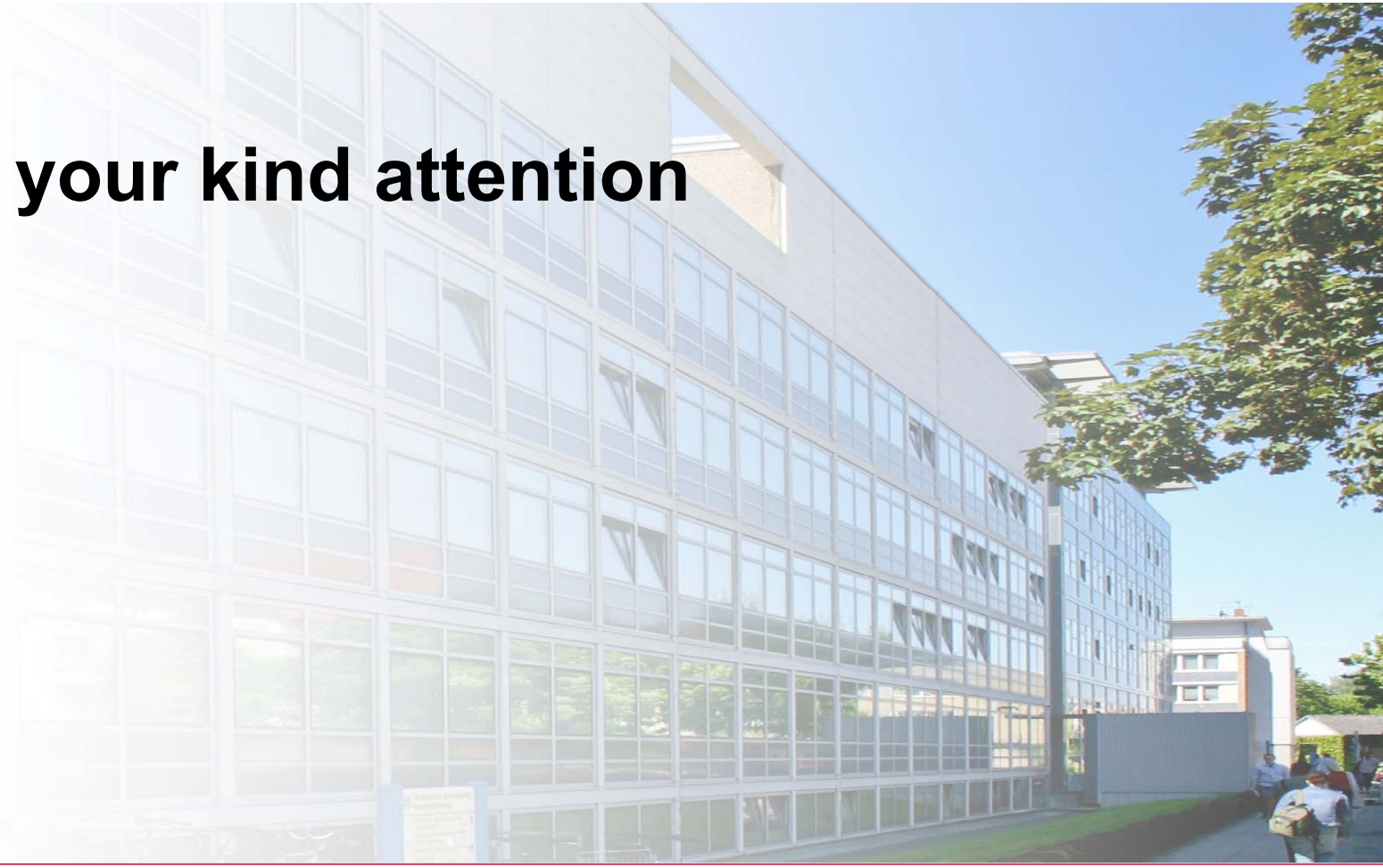
- 1bit result is expected to exhibit same value
- 3bit result is expected to exhibit 15 dB difference
- Good agreement for 1bit case
- Some unexpected deviations are observed in the case of 3bit at -30°



Conclusion

- Channel measurements including RIS were performed in an indoor environment
- Single direction channel measurements showed a good agreement with the expected values obtained from the bi-static radar equation
- Alignment will be a challenging task for future wireless communications using RIS
- A comprehensive evaluation of the measurement will follow

Thank you for your kind attention



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