ETSI GR THz 003 V1.1.1 (2024-12)

TeraHertz modeling (THz);
Channel measurements and modeling in THz bands

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Executive summary

The present document focuses on channel measurements and modeling in THz bands. Specifically, it first summarizes the key channel measurement scenarios and frequency bands for THz communications and sensing systems. It identifies the key THz-specific propagation aspects, such as effects of atmospheric absorption, micro-mobility, specifics of scattering and surface roughness, impact of large arrays and near-field propagation, and material characterization in THz bands. It summarizes relevant channel measurements and open measurement datasets performed in THz bands. Next, it details the relevant channel modeling approaches, including deterministic, stochastic, hybrid, and machine learning models and introduces updates to the existing geometry based stochastic channel model defined by 3GPP with extensions required to support THz frequency bands. Finally, it introduces key channel modeling considerations for Integrated Sensing And Communications (ISAC) and Reconfigurable Intelligent Surfaces (RIS).

Introduction

The emergence of TeraHertz (THz) communication and sensing systems has garnered significant attention as a promising solution to meet the increasing demand for ultra-high data rates, low-latency applications, and enhanced spectrum utilization in future wireless networks. Positioned between millimetre-wave and infrared frequencies, the THz band (0,1 THz to 10 THz) offers an expansive amount of untapped spectrum. This potential makes it a strong candidate for enabling technologies such as 6G, ultra-fast wireless backhaul, and other advanced use cases that require high-capacity links.

However, despite its promise, the deployment of THz communications presents unique challenges. THz waves experience higher path losses, atmospheric absorption, and sensitivity to obstacles compared to lower frequency bands. To ensure robust and reliable THz communications, it is critical to develop a comprehensive understanding of the propagation characteristics and to model the radio channels accurately under various environmental conditions and deployment scenarios.

The present document summarizes channel measurement scenarios, frequency bands, and radio propagation characteristics specific to the THz range. Furthermore, it extends state-of-the-art channel modeling techniques - ranging from geometry based stochastic, deterministic, to machine learning models - to support communication and sensing in THz bands. Furthermore, it discusses the key considerations related to channel modeling for ISAC and RIS.

Overall, the present document aims to provide a comprehensive framework for understanding THz-specific propagation effects and the development of accurate channel models, consequently contributing to ongoing efforts to enable reliable THz communication and sensing systems.

1 Scope

The present document focuses on channel measurements and channel modeling in THz frequency bands.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

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