



ETSI Research Conference 2023

Maximizing the Impact of European 6G
Research through Standardization

Overview of ETSI ISG THz: Research to Standards Story

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7/2/2023





Agenda



- Some Background on THz Communications
- Motivation to form ETSI ISG THz
- Approved Work Items
- Expectations from Research Projects

Why should we work on THz Communications?



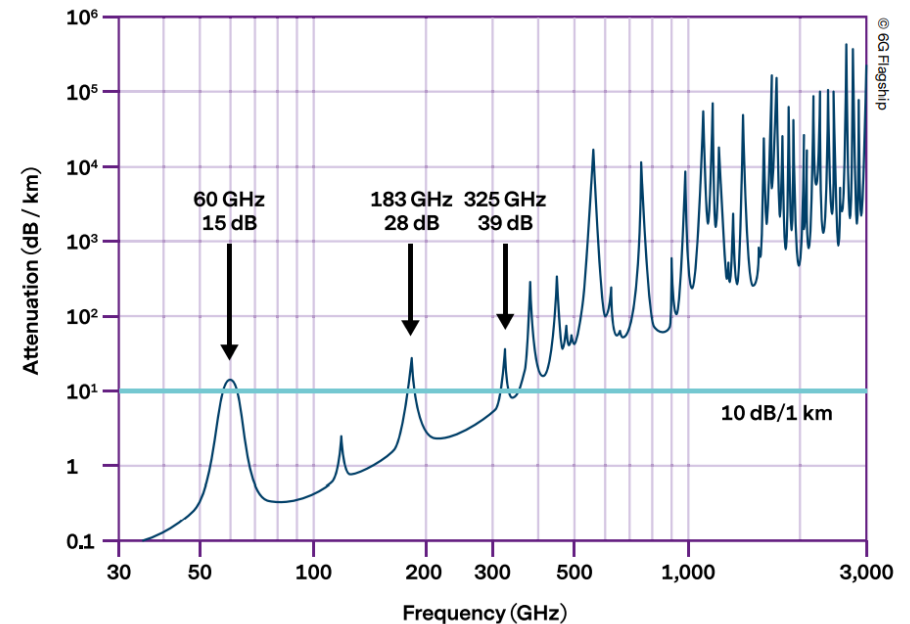
“ 6G research should look at the problem of transmitting up to **1 Tbps per user**. This is possible through the efficient utilization of the **spectrum in the THz regime**. Extended spectrum towards THz will enable merging communications and new applications such as 3D imaging and sensing. However, **new paradigms for transceiver architecture and computing** will be needed to achieve these – there are opportunities for semiconductors, optics and new materials in THz applications to mention a few.”

Source: <http://jultika.oulu.fi/Record/isbn978-952-622354-4>

THz Bands: Properties



- **High attenuation** at THz bands (0.1 - 10 THz)
- Frequency-dependent **atmospheric attenuation**
- Strong **directionality** needed to overcome impairments
- **Lower coverage** but **also lower interference**
- Due to small wave lengths **objects with small size** may have impact.
- Propagation via **diffraction** can be **neglected**



Source: Pärssinen, A., Alouini, M., Berg, M., Kürner, T., Kyösti, P., Leinonen, M. E., Matinmikko-Blue, M., McCune, E., Pfeiffer, U., & Wambacq, P. (Eds.). (2020). White Paper on RF Enabling 6G – Opportunities and Challenges from Technology to Spectrum [White paper]. (6G Research Visions, No. 13). University of Oulu. <http://urn.fi/urn:isbn:9789526228419>

THz Technology Characteristics



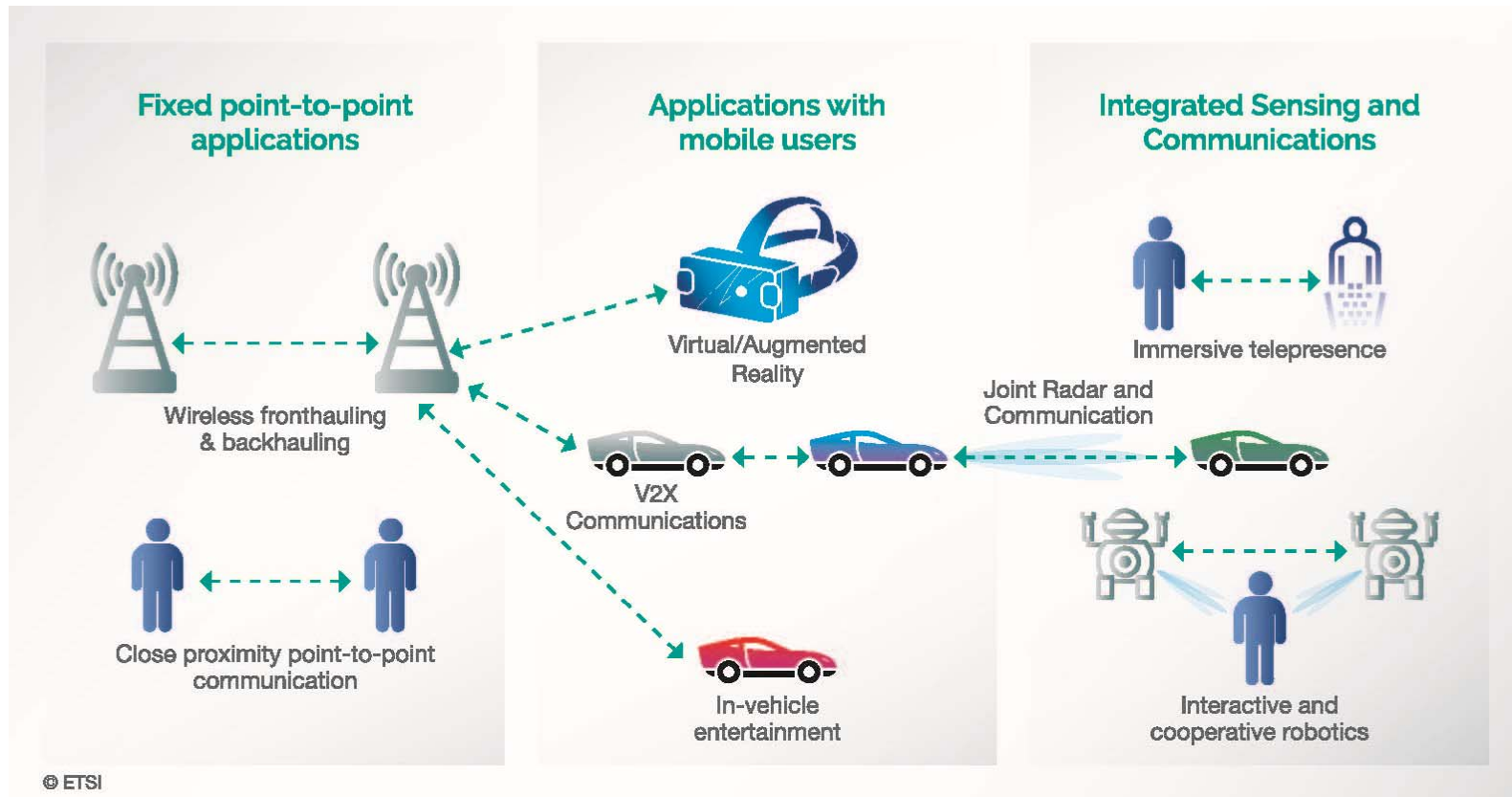
Huge amount of bandwidth available in THz bands (ITU has identified 137 GHz of spectrum between 275 and 450 GHz), it is possible to achieve **extremely high data rates** and **ease spectrum scarcity problems**.

Small wavelength of THz signals enables the realization of **compact and miniaturized devices and antennas**. It is possible to pack **many antenna elements** within a limited form factor and realize **pencil-sized beams**.

Peculiar propagation properties of THz signals enable **accurate sensing and imaging capabilities**, can be exploited for **integrated sensing and communication** functionalities.

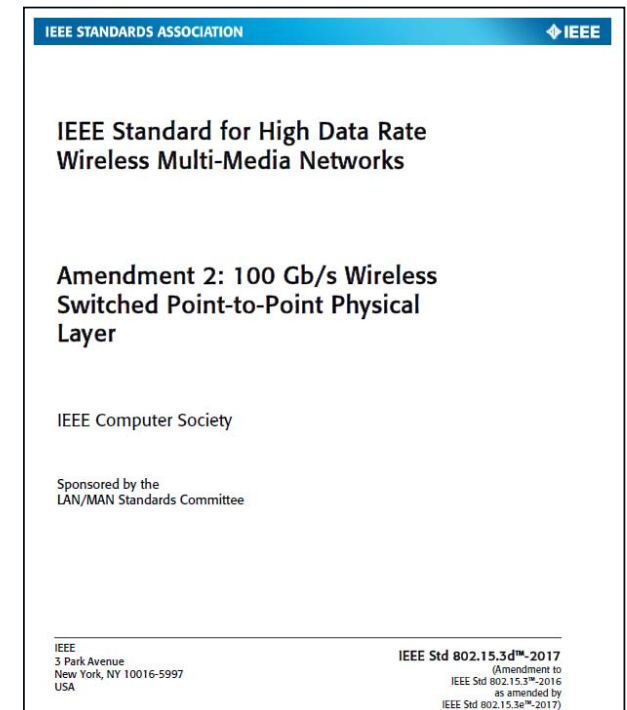
Advancements in semiconductor industry and **emergence of new materials** are facilitating the realization of THz devices. Three main fabrication approaches: **electronic** (high output power), **photonic** (low noise), **plasmonic** (energy efficient).

Potential Use Cases



Source: T. Kürner, TeraHz – A candidate for 6G; Enjoy – The ETSI Magazine – January 2023, p. 14-15; [online] <https://www.etsi.org/e-brochure/Magazine/January-2023/mobile/index.html#p=14>

THz in Standards – Early Attempts



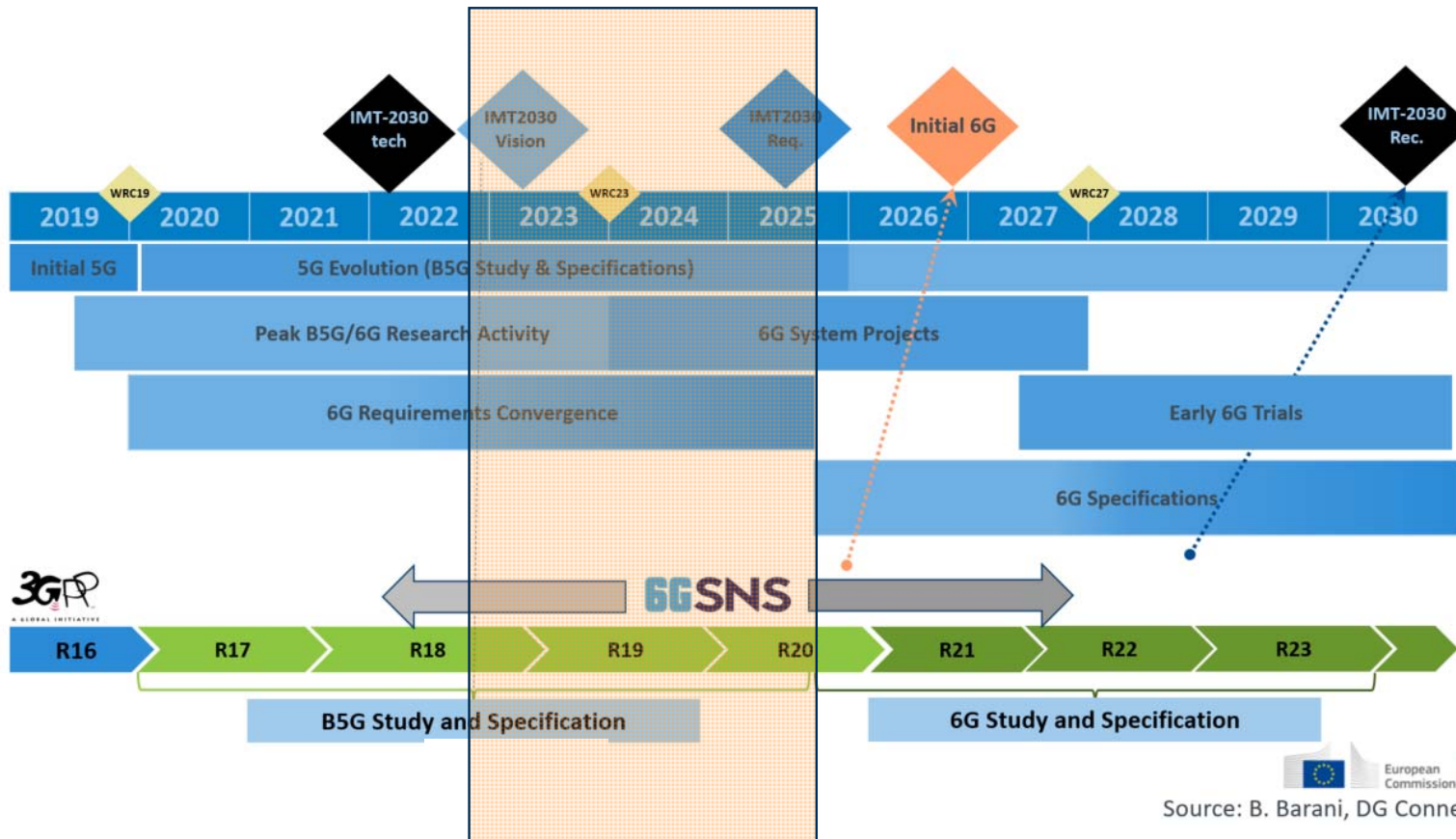
Source: T. Kürner, V. Petrov, I. Hosako, „Standards for THz Communications“ in T. Kürner, D. Mittleman, T. Nagatsuma (Eds.) *THz Communications - Paving the Way Towards Wireless Tbps*, Springer 2021

Motivation for the ETSI ISG THz



- Provide an opportunity for ETSI members to coordinate their **pre-standards** research efforts on **THz technology** across various **EU/UK collaborative projects**, extended with relevant **global initiatives**, towards paving the way for **future standardization** of the technology.
- Prepare **systematic output** on channel models, system parameters, and evaluation assumptions, for subsequent **evaluation of THz communications systems by 3GPP**

Window of Opportunity



Source: B. Barani, DG Connect

Formation of ETSI ISG THZ



- ETSI ISG THz has been approved by the ETSI Board in **September 2022**
- Kick-Off-Meeting has been held on 8 December 2022 in Sophia Antipolis
- 25 founding members
- 38 members as of 1 February 2023
- Officers:
 - Chair: Thomas Kürner, TU Braunschweig IST.hub
 - 1st Vice-Chair: Mate Boban, Huawei TECH GmbH
 - 2nd Vice-Chair: Sana Salous, Durham University
 - 3rd Vice-Chair: Sharad Sambhwani, Apple France
 - Secretary: Javier Lorca, InterDigital
 - Technical Officer: Nicolae Madalin Neag, ETSI
- ETSI-internal collaboration with **ETSI ISG mmWT** and **ETSI ISG RIS** are planned

Four approved Work Items



- DGR/THz-001 (GR) Identification of use cases for THz communication systems;
 - Rapporteur: Cristina Ciochina-Duchesne, Mitsubishi Electric

- DGR/THz-002 (GR) Identification of frequency bands of interests for THz communication systems;
 - Rapporteur: Per Hjalmar Lehne, Telenor

- DGR/THz-003 (GR) Channel measurements and modeling in THz bands
 - Rapporteur: Mate Boban, Huawei

- DGR/THz-004 (GR) RF Hardware Modeling
 - Rapporteur: Sharad Sambhwani, Apple France

DGR/THz-001 (GR) Identification of use cases for THz communication systems; (Final Report due 11/2023)



This work item will:

- Investigate and identify the use cases that are relevant for THz communication systems including integrated communications and sensing (ISAC);
- Identify possible deployment scenarios;
- Map the identified use cases and deployment scenarios to relevant channel measurements scenarios;
- Identify requirements and principles for THz communication systems including ISAC

DGR/THz-002 (GR) Identification of frequency bands of interests for THz communication systems; (Final Report due 11/2023)



This work item will:

- Identify frequency bands of interest.
- Describe the current regulatory situation in the frequency bands of interest
- Identify the incumbent services to be considered for coexistence studies

DGR/THz-003 (GR) Channel measurements and modeling in THz bands (Final Report due 11/2024)



This work item will:

- Analyze specific radio propagation aspects for THz communication, such as molecular absorption, effect of weather conditions (e.g., rain), effect of micro-mobility, specific considerations for scattering, reflections, and diffractions, and considerations for near-field propagation effects;
- Analyze data from earlier measurement campaigns published in relevant literature;
- Perform channel measurements for the identified channel measurement scenarios and frequency bands;
- Develop channel models for the identified channel measurement scenarios and frequency bands.

DGR/THz-004 (GR) RF Hardware Modeling (Final Report due 11/2024)



This work item will:

- Assess the state-of-the-art materials for THz communication e.g., electronics, photonics, plasmonics
- Study the feasibility of different channel bandwidths considering component technologies, circuits and systems
- Study the effects of non-linear and frequency selective hardware
- Characterize RF/analog impairments based on simulations/measurements and obtain suitable RF impairment models in THz frequency range
- Study low complexity large antenna array and packaging technologies
- Assess overall device complexity and cost impact
- Study the state of art for RF subsystems (transceiver, front end, antenna) in the THz frequency range
- Study the energy efficiency of state-of-the-art materials and RF subsystems on transmission and/or reception.

Collaboration with Research Projects



- ISG THz provides an excellent platform to create impact from research projects to standardization
- Six SNS projects are dealing with THz
 - **TIMES***, **TERRAMETA***, **Tera6G**, **6GTandem***, **Hexa-X***, **SUPERIOT***
 - These projects are working on topics related to the approved working items of ETSI ISG THz
 - At least one partner of **TIMES**, **TERRAMETA**, **Tera6G**, **Hexa-X** and **SUPERIOT** is participating in **ETSI ISG THz**
- Several national projects, e.g. **BMBF 6G-RIC** (Germany), **6GFlagship** (Finland) or **TRACCS** (United Kingdom) are working on topics relevant for ISG THz
 - Partners from the mentioned projects are participating in ISG THz
- Further representatives from the listed projects or any other project working on THz are more than welcome to join ISG THz

***See also project presentations on 8 February 2023 at the ETSI Research Conference**



Thank you for your attention