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**Re:** n/a

**Abstract:** This contribution reports about a more flexible concept for the spectrum management at THz frequencies taking into account the use of this spectrum by competing as well as collaborating services.

**Purpose:** Information of IEEE 802.15 SC THz

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## A Concept for an Agile and Flexible Spectrum Management for THz Communications

12 November 2024

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- This presentation is based on the following publication:

T. Kürner, A Concept for an Agile and Flexible Spectrum Management for THz Communications, Proc. IRmmW-THz 24, Perth (Australia), September 2024

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# Outline

- Status Quo on Spectrum for THz Communications
- Sharing Situations beyond 275 GHz
- Traditional Spectrum Management Approach
- A new „Sandbox“ approach
- Conclusions and Outlook



# Status Quo on Spectrum for THz Communications based on the Output of WRC 19

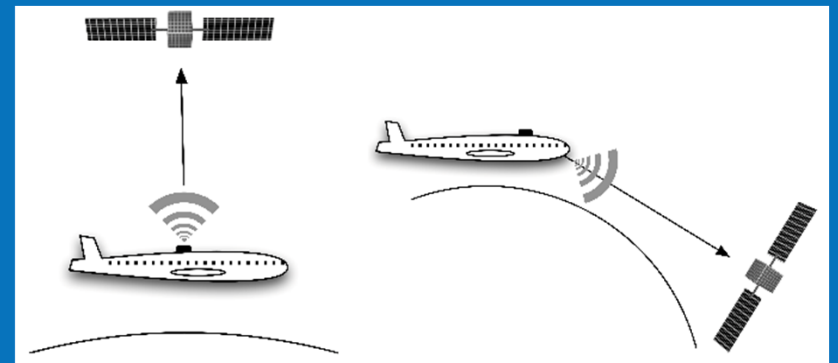
Frequency in GHz	Bandwidth in GHz	Status in the Radio Regulations
252-275	23	Allocation for land mobile and fixed service on a co-primary basis
275-296	21	Identification for use for the implementation of land mobile and fixed service according to FN 5.564A. No specific conditions are necessary to protect EESS applications. Specific conditions to protect RAS may apply. Such conditions are for example a minimum separation distance and/or avoidance angles.
306-313	7	
318-333	15	
356-450	94	
296-306	10	May only be used by fixed and land mobile service applications when specific conditions to ensure the protection of EESS applications are determined in accordance with Resolution 731 (Rev.WRC-19) . Specific conditions to protect radio astronomy may apply, see above.
313-318	5	
333-356	23	

T. Kürner, A. Hirata, On the Impact of the Results of WRC 2019 on THz Communications, Proc. International Workshop on Mobile THz Systems, 2-3 July 2020

# There are still open issues on sharing between passive Services and THz Communications.....

- Still **15 GHz** of spectrum around 300 GHz and **23 GHz** between 333 and 356 GHz have been **not yet identified** for the use by THz communication and is subject to further sharing studies in the context of ITU-R Resolution 731 Rev. WRC-23
- **Allocation** of spectrum for THz Communication between **275 and 325 GHz** are on the **preliminary agenda for WRC-31**

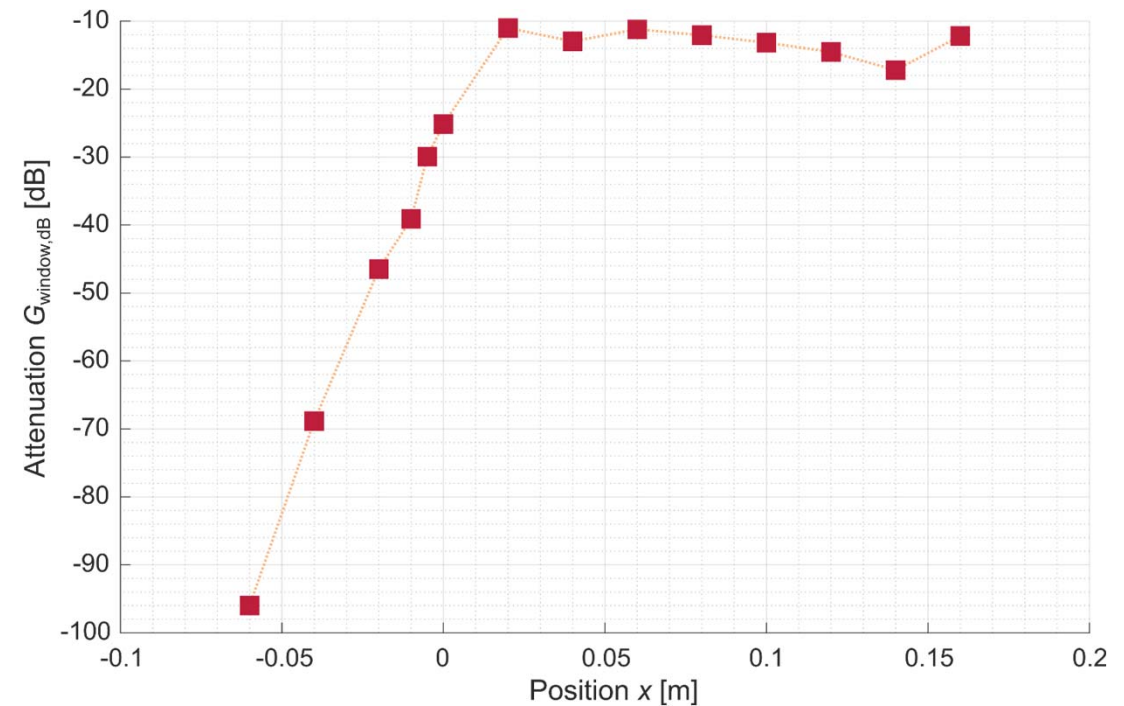
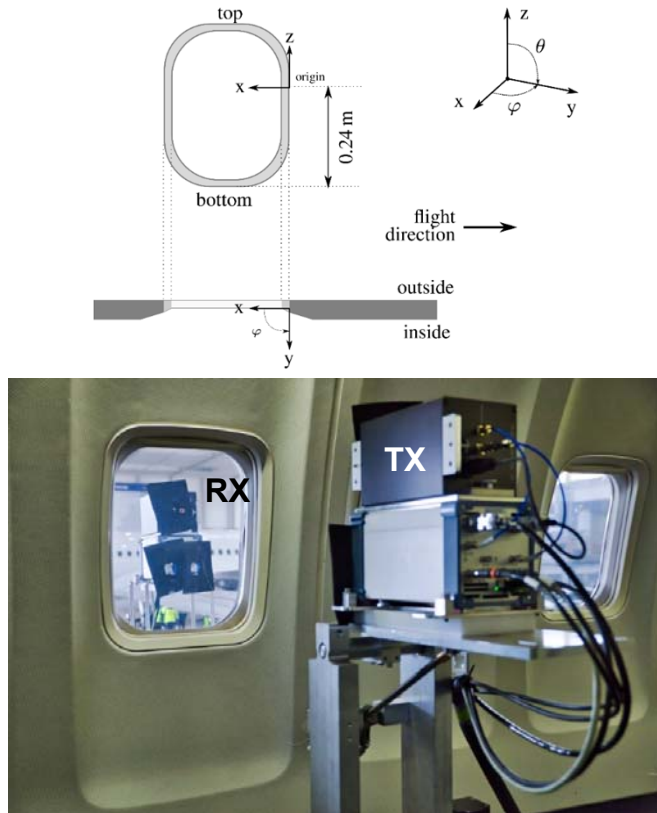
THz Communications in **non-terrestrial networks (NTN)** has been **excluded in WRC 19** studies



S. Priebe *et al.*, "Interference Investigations of Active Communications and Passive Earth Exploration Services in the THz Frequency Range," in *IEEE Transactions on Terahertz Science and Technology*, vol. 2, no. 5, pp. 525-537, 2012



# ...how about In-Flight Entertainment Systems and Interference from Leakage through Aircraft Windows?

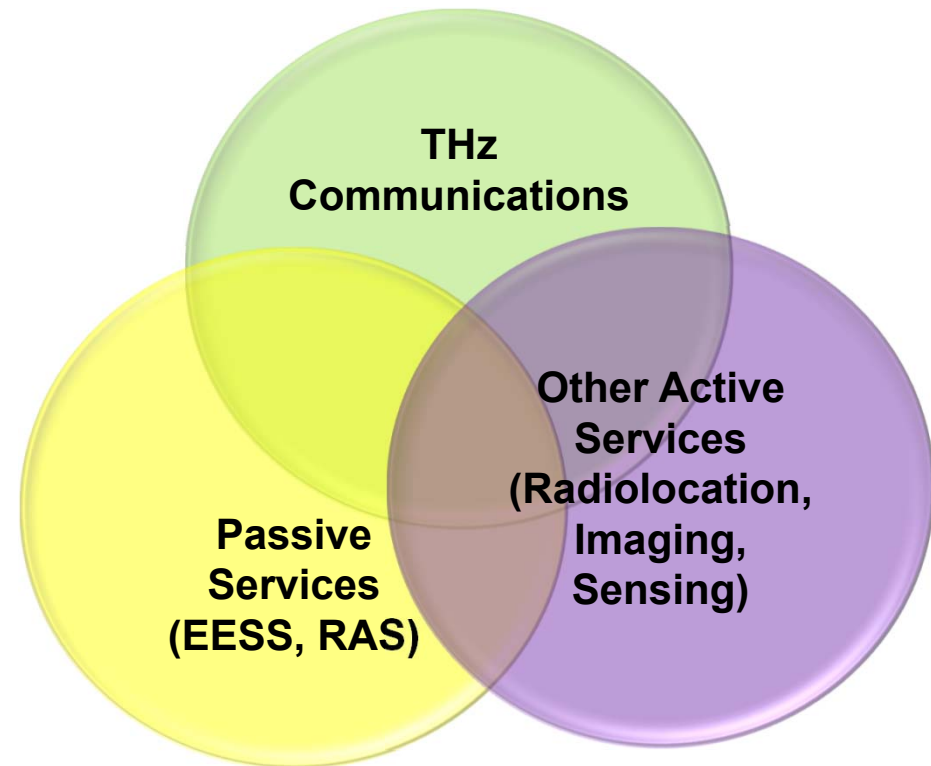


minimal attenuation  $G_{\text{window,min,dB}} \approx -11.01 \text{ dB}$

J. M. Eckhardt, T. Doeker and T. Kürner, "Indoor-to-Outdoor Path Loss Measurements in an Aircraft for Terahertz Communications," *2020 IEEE 91st Vehicular Technology Conference (VTC2020-Spring)*, Antwerp, Belgium, 2020, pp. 1-5, doi: 10.1109/VTC2020-Spring48590.2020.9128849.

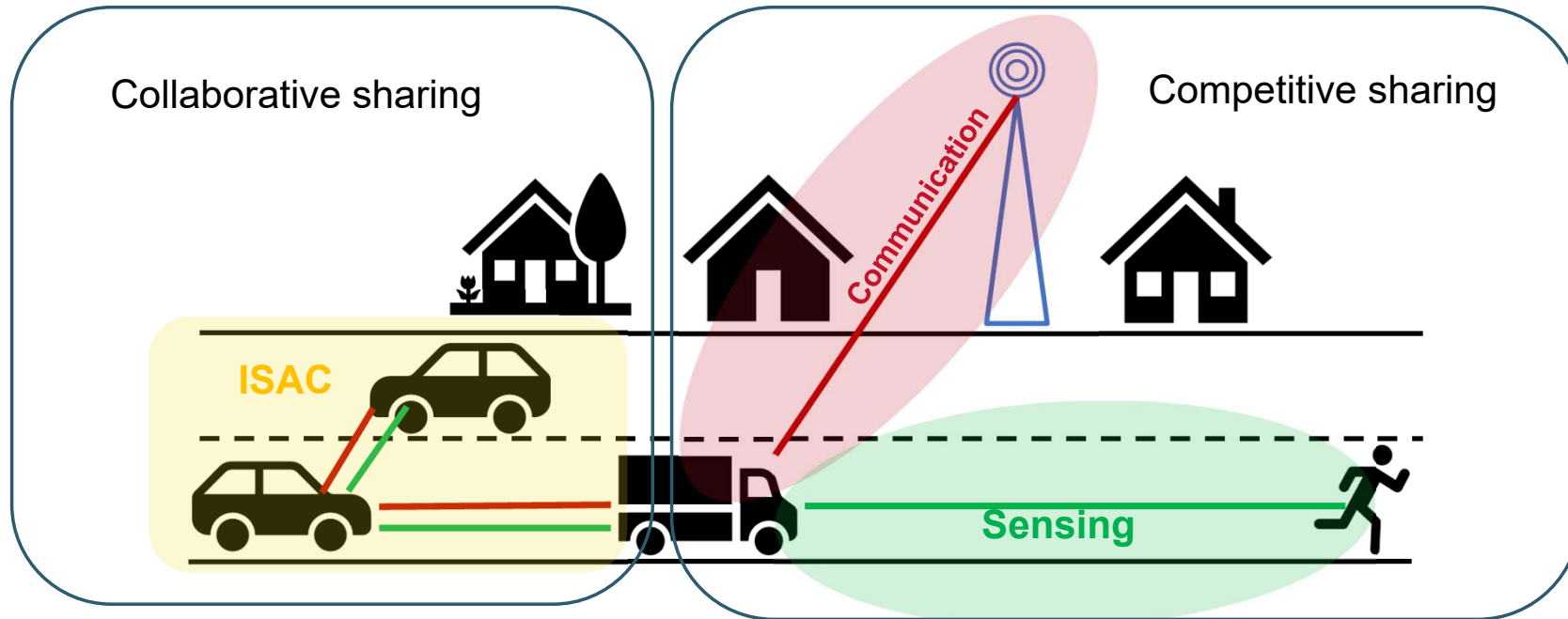
# Future Sharing Situations beyond 275 GHz – increasing Complexity

- WRC 19: Sharing between THz Communications and Passive Service
- Ultra-large bandwidths available beyond 275 GHz makes this spectrum range attractive for several services
- Identification of spectrum for RLS is on the agenda for WRC-27 between 231.5 and 700 GHz





# An example for future sharing situations in automotive Situations



- Communication channel
- Sensing (e.g. radar) channel

**ISAC** Integrated Communications and Sensing

# Required Coexistence Studies towards WRC-27/WRC-31

## Coexistence Studies @WRC-27/WRC-31 Preparation Phase



## Identification / Allocation @WRC-27 / WRC-31

## A new „Sandbox“ Approach

- **New methods for spectrum regulation are an option to handle complex sharing situations.**
- The THz frequency range is a “new” spectrum for almost all services, which means that **no or only a few already established regulatory rules** have to be taken into account enabling a **“Sandbox Approach”**
- This enables a **paradigm change** for the rules and procedures for THz spectrum regulation.
  - Status quo: Performing interference calculations based on **static worst case scenarios** yielding **fenced land** for each service
  - Future: **New technologies** are paving the way for **agile and flexible methods**.

# Building Blocks of new Technologies allowing a more Agile and Flexible Spectrum Management

**Careful Steering of narrow Radio Beams**

**Measurements for Interference Detection**

**Interference Cancellation Techniques**

**Sophisticated Online Platforms**

**Protocols for coordinating Spectrum Use across different Services and Users**

## Conclusions and Outlook

- **Future sharing situations at THz spectrum will be quite complex**
- For the use of THz spectrum in 6G, especially in the context of Integrated Sensing and Communication, **flexible and agile spectrum management techniques** are a **promising option**.
- However, due to the ambitious time-line given by the agenda items of the up-coming WRC-27 and WRC-31 a two-way-approach has to be pursued in parallel:
  - **Traditional simulation and measurement based sharing studies** are required during the preparation of the two next WRCs,
  - **Methods for agile and flexible spectrum management technique** have to be developed, which may then be applied at WRC-31 or later.

***If successful THz Spectrum Management has the Potential to serve as a blue Print for other Frequency Bands***

# Thank you for your kind attention

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