Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Will THz Communication Interfere with Passive Remote Sensing?
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Abstract: According to the current ITU spectrum regulations, active THz communication systems can be operated simultaneously in the same frequency bands from 300 to 1000 GHz as passive services as long as theses services are precluded from any interference. Therefore, interference investigations become crucial on the way to a coexistent spectrum usage. Whereas the affection of radio astronomy by THz communications has been considered in doc. 15-10-0829-00-0thz, this presentation introduces thoughts on which scenarios are critical regarding remote sensing and suggests countermeasures against interference.

Re: 15-10-0829-00-0thz-sharing-between-active-and-passive-services-at-thz-frequencies.ppt

Purpose: Input for THz spectrum allocations

Will THz Communication Interfere with Passive Remote Sensing?

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Outline

1. **Introduction**
2. Interference-Critical Scenarios
3. Interference Mitigation Concepts
4. Summary/Outlook

Introduction (1)

- Current spectrum allocation in the THz band:

ITU Radio Regulations Footnote 5.565

The frequency band 275-1000 GHz may be used by administrations for experimentation with, and development of, various active and passive services.

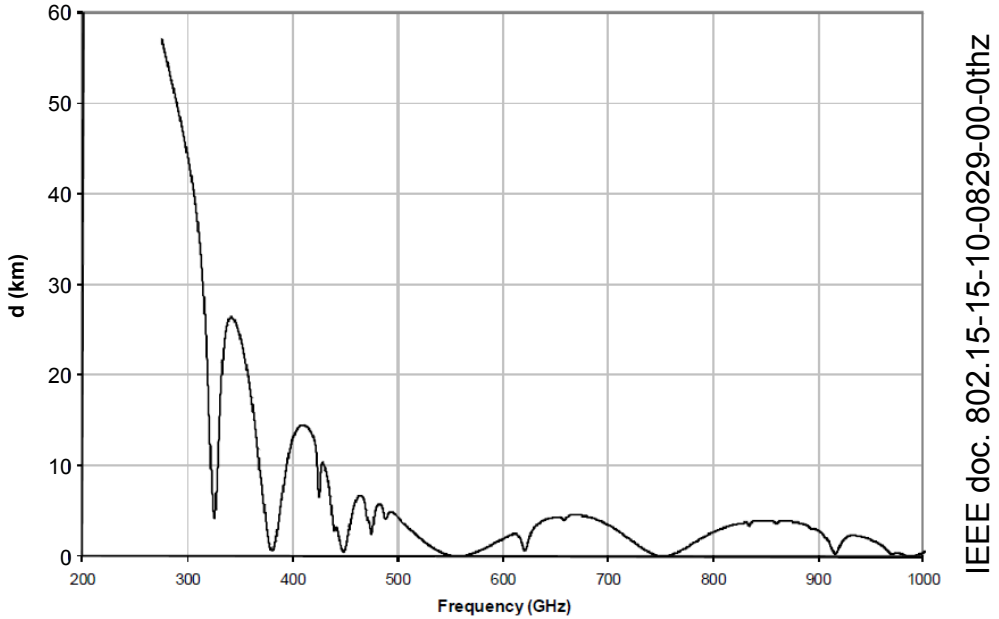
- Radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, [...]
- Earth exploration-satellite service and space research service 275-277 GHz, 294-306 GHz, 316-334 GHz, [...]

Administrations are urged to take all practicable steps to protect these passive services from harmful interference.

→ Coexistent spectrum usage favourable
→ Interference studies crucial for the standardization of THz communication systems

Introduction (2)

- Interference with radio astronomy:
  - Investigations carried out by the National Science Foundation
  - Distance of THz transmitter from telescope for interference-free conditions:



→ Interference very unlikely in face of typical telescope locations on high mountains

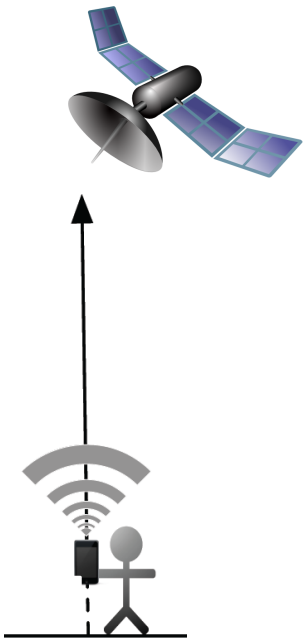
→ How about spaceborne Earth exploration services?

Outline

1. Introduction
2. **Interference-Critical Scenarios**
   - **Nomadic Links**
   - **Fixed Links**
   - **Airborne Systems**
   - **Multiple Interferers**
3. Interference Mitigation Concepts
4. Summary/Outlook

Nomadic Links

- Nomadic devices operated outdoor may accidentially be mispointed:



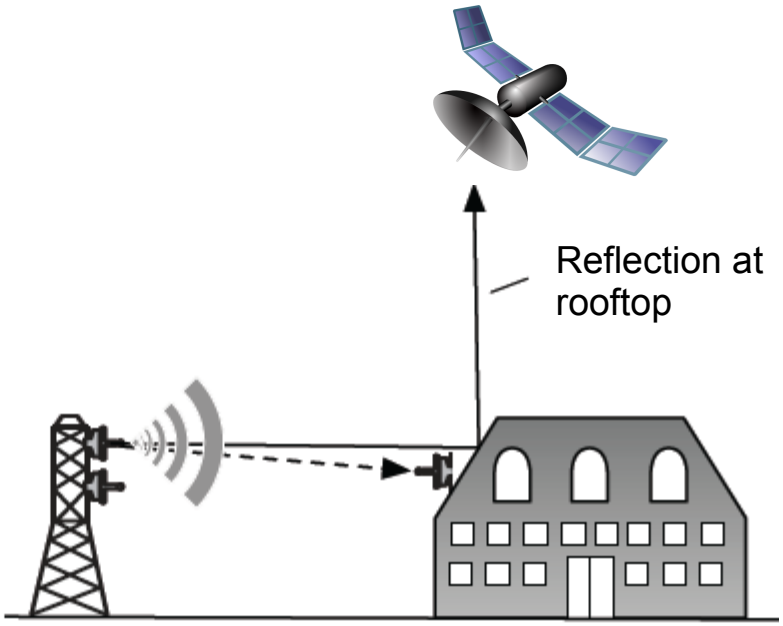
- Points to be studied:

→ How much interference power will reach satellites in the worst case?

→ Which maximum interference power can be tolerated?

Fixed Links

- Directional links with reflecting/scattering objects close to ray path:

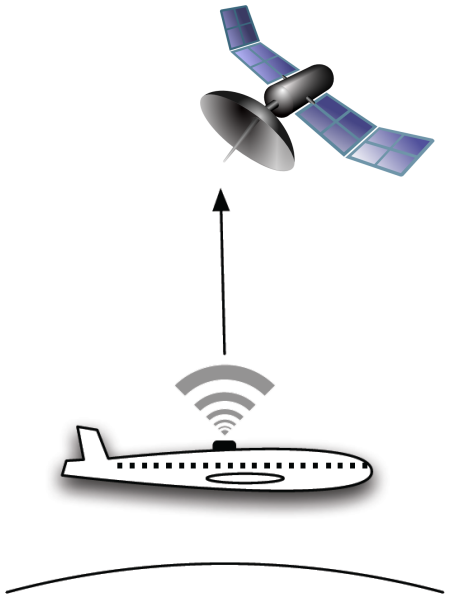


→ Interference possible despite highly directive antennas

→ Environmental conditions relevant

Airborne Systems

- THz systems operated inflight:



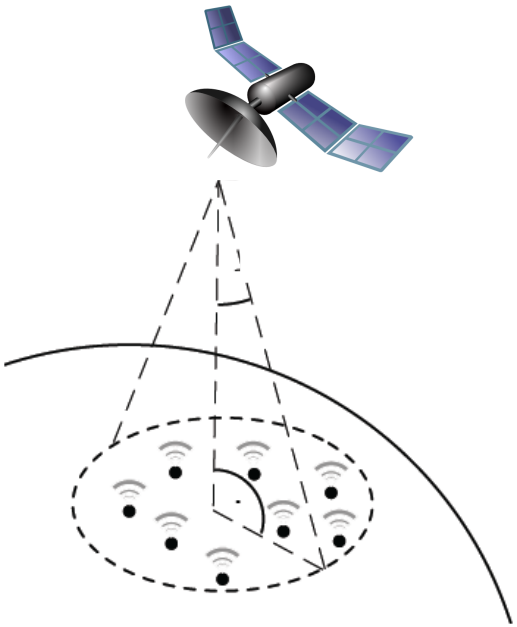
→ THz up-/downlinks or in-cabin connections thinkable

→ Transmission of THz radiation through windows or composite fuselages

→ Critical due to lower atmospheric attenuation

Multiple Interferers

- Interference from multiple stations may reach the satellite:



→ Superposition of signals from multiple interferers

→ Significant increase of total interference power

→ Stochastic models for interference caused by multiple stations required (e.g. interference probability of one station)

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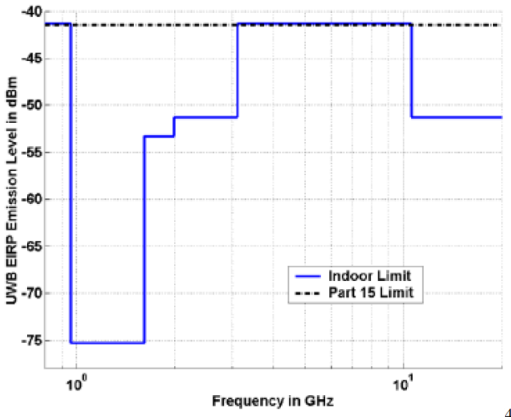
Interference Mitigation Concepts (1)

1. Transmit power limitations
   - Which is the worst case?
   - Which interference powers will be allowed at maximum?
   - In which way do the transmit powers depend on the scenarios?
   - Which frequencies will be affected?
   - Are there preferable bands for transmission?

→ Transmit power control



Example: UWB spectrum mask
(source: ECCx Report 64)

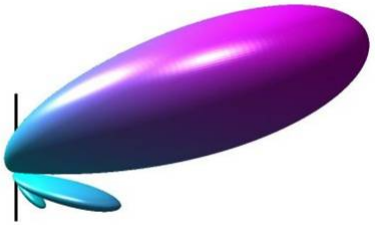
2. Intelligent transceiver units
   - How can the TX be switched off automatically in case of skyward orientation?
   - How can devices utilize their orientation and position?
   - How can satellite position data be respected?

→ Sensor data usage

Interference Mitigation Concepts (2)

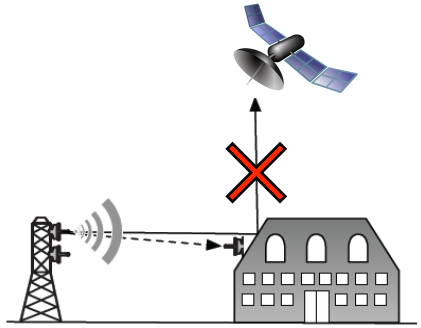
3. Highly directive antennas
   - How likely is radiation in skyward direction at any rate?
   - Can steerable antennas help?

→ Smart antennas



4. Environment control: Fixed links
   - How does the TX and RX positioning affect the propagation?
   - How can the propagation environment be utilized?

→ Careful transeiver placement and absorbers



5. Environment control: Airborne systems
   - How transparent are composite fuselage and windows in the THz range?
   - What can be achieved with purposeful TX positioning?

→ Absorbing materials/coatings

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Summary/Outlook

- Interference between active communication services and passive remote sensing must be prevented
- Critical scenarios are:
  - Nomadic devices operated outdoor
  - Fixed links with reflecting objects close to ray path
  - Airborne systems
  - Superposition of multiple interferers

Necessary steps:

→ Worst-case estimation of interference powers in the scenarios

→ Determination of maximum allowed interference powers

→ Development of interference avoidance concepts

- Transmit power control
- Intelligent transeiver units
- ...

Thank you for paying attention.

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