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Abstract: This document presents the results on Agenda Item 1.15 of WRC-2019 and discusses the impact on THz communications.

Purpose: Information of the Technical Advisory Group THz

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Results of WRC 2019 AI 1.15 and their impact on THz Communications

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This document is based on [1] and [2]

Outline

- Introduction
- Outcome of WRC 19
- Total available Spectrum for THz Communications
- Assessment of WRC 19 outcome
- Possible next steps in IEEE 802
- Conclusions

Introduction (1/2)

- Development of IEEE Std. 802.15.3d-2017 uses the band 252-321 GHz and has been based on the 2016 version of the Radio Regulations (RR) [3]:
 - The RR include an allocation of the bands from 252 to 275 GHz for the use by land mobile and fixed service
 - Use of band between 275 GHz and 1000 GHz is ruled by footnote 5.565 requiring that passive services such as earth exploration satellite service (EESS) and radio astronomy (RA) have to be protected from harmful interference by any active service, such as THz communications
- Almost all bands above 275 GHz are used either by EESS or RA
 - => Sharing studies are required

Introduction (2/2)

- World Radiocommunication Conference WRC 2015 had invited ITU-R to perform “Studies towards an identification for use by administrations for land-mobile and fixed services applications operating in the frequency range 275-450 GHz”

=> WRC AI 1.15

- focus on the sharing studies in preparation to WRC 2019 has been on EESS, see e.g. [4,5], since earlier studies have shown, that RA is less critical.

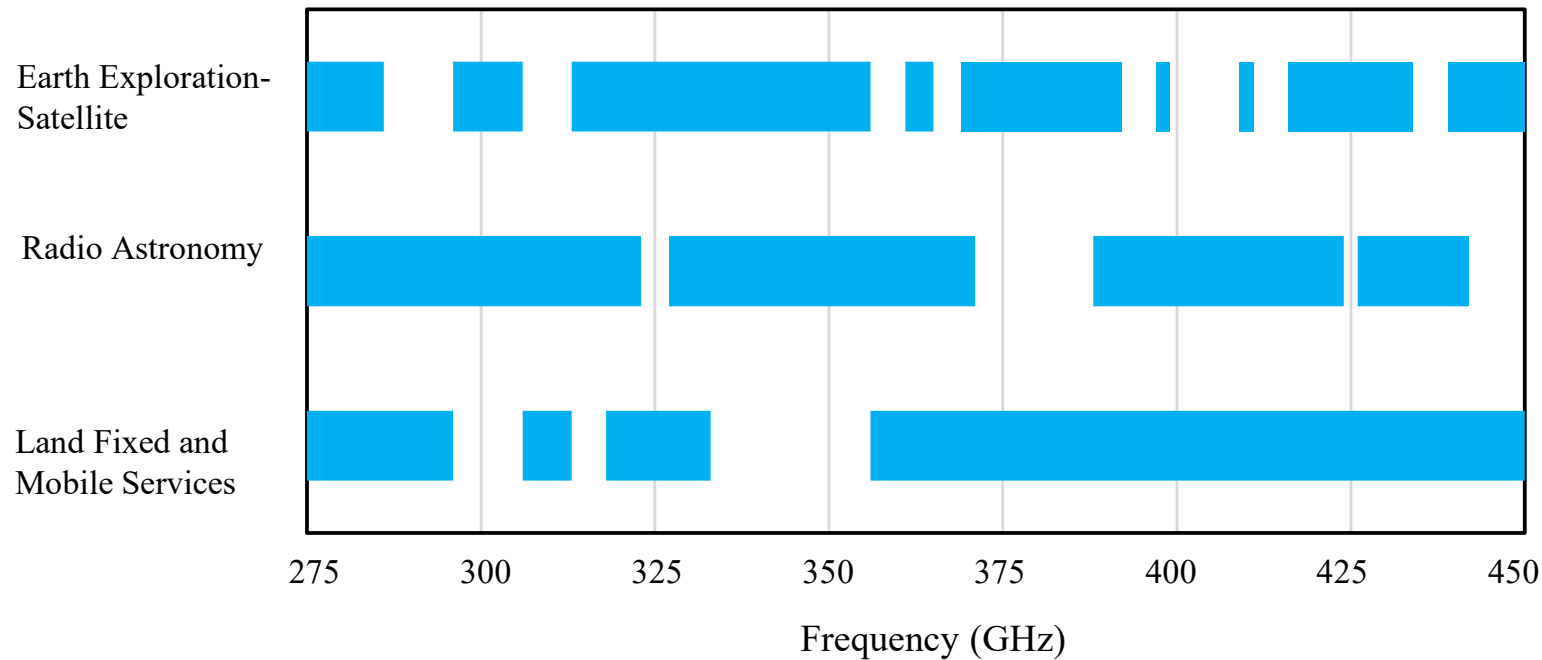
Outcome of WRC 2019 (1/2)

- The outcome is described in the Final Acts of WRC 2019 [6], where the specific outcome of AI 1.15 is the introduction of a new footnote 5.564A, which contains four key items
 - In total, **137 GHz in the band 275 to 450 GHz** have been identified for use for land mobile and fixed service, where **sharing** with EESS is possible and **no specific conditions are necessary to protect EESS**
 - The remaining **68 GHz of spectrum** may only be used by fixed and land mobile service applications when **specific conditions to ensure the protection** of Earth exploration-satellite service (passive) applications are met.

Outcome of WRC 2019 (2/2)

- For the **whole frequency band 275-450 GHz**, specific conditions to **protect radio astronomy service** may apply.
- The use of the identified bands for land mobile service and fixed service **does not preclude the use** of the bands by other application or radio service, e. g. radar or imaging

Total available Spectrum for THz Communications



The frequency bands identified for use by administrations for the implementation of LMS and FS applications.

Conditions for the Use of Spectrum for THz Communications

Frequency in GHz	Status in Radio Regulations
252-275	Allocation for land mobile and fixed service on a co-primary basis [3]
275-296	Identification for use for the implementation of land mobile and fixed service according to FN 5.564A;
306-313	
318-333	
356-450	no specific conditions are necessary to protect Earth exploration-satellite service (passive) applications [6].
296-306	may only be used by fixed and land mobile service applications when specific conditions to ensure the protection of Earth exploration-satellite service (passive) applications are determined in accordance with Resolution 731 (Rev.WRC-19) [6].
313-318	
318-356	

Assessment of WRC 19 outcome

- Outcome of WRC 2019 provides a sound regulatory framework for the implementation of future THz communication systems in the frequency band 252 to 450 GHz.
- Within this band, four contiguous bands are available with bandwidths of
 - 44 GHz between 252 and 296 GHz
 - 7 GHz between 306 and 313 GHz
 - 15 GHz (between 318 and 333 GHz) and
 - 94 GHz between 356 and 450 GHz
- Due to its atmospheric conditions, the band 252 to 296 GHz is favorable for fixed outdoor links with several hundred meters link distances
- The other three bands can be also used for example for short range indoor applications, e. g. wireless links in data centers.

Possible Next Steps for IEEE 802

- IEEE Std. 802.15.3d-2017 covers the frequency bands 252 to 321 GHz. Two potential future activities may be triggered in the context of this standard:
 - The continuing use of the frequency bands 296-306 GHz and 313-318 GHz by this standard will be only possible, if additional sharing studies in accordance with Resolution 731 (Rev.WRC-19) show that no harmful interference to EESS occurs
=> potential regulatory activities towards WRC 2023
 - to make use of the large chunk of spectrum between 356 GHz and 450 GHz, an amendment to IEEE 802.15.3d-2017
=> potential standardisation activities in IEEE 802.15

Further long-term activities

- Potential agenda item at WRC 2027 on the identification of spectrum for radio location applications in the range 275-700 GHz

⇒ Sharing studies with THz communications as the incumbent application.

⇒ Potential regulatory activity towards WRC 2027.

Conclusions

- Outcome of WRC 2019 w.r.t. THz communications is described.
- A new footnote to the radio regulations, which describes the conditions for the use of the spectrum between 275 and 450 GHz by land mobile and fixed services.
- Totally, 160 GHz of spectrum are now available for THz communications, where no specific conditions are necessary to protect EESS including two big contiguous spectrum bands with 44 GHz and 94 GHz bandwidth, respectively.
- This provides a sound basis for the future implementation of THz communications.
- A couple of future regulatory and standardization activities have been identified.

References

- [1] A. Hirata, T. Kürner, Analysis of the Consequences of the Results of WRC 2019, ThoR Deliverable D5.3; available at <https://thorproject.eu/results/>
- [2] T. Kürner, A. Hirata, On the Impact of the Results of WRC 2019 on THz Communications, accepted for publication in Proc. International Workshop on Mobile THz Systems, 2-3 July 2020
- [3] World Radiocommunication Conference, „Radio Regulations, Edition of 2016,“ [Online]. Available: <https://www.itu.int/pub/R-REG-RR>
- [4] S. Rey, „Initial results on sharing studies, ThoR Deliverable D5.1,“ [Online]. Available at <https://thorproject.eu/results/>
- [5] <https://mentor.ieee.org/802.15/dcn/19/15-19-0095-00-0thz-h2020-thor-initial-results-on-sharing-studies.pdf>
- [6] World Radiocommunication Conference 2019 (WRC-19) Final Acts; [online]: https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.14-2019-PDF-E.pdf

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