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Presentation for the UK Spectrum Policy Forum

Future use of millimetre waves – outcome of WRC-15 and study priorities for WRC-19

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30 years

The WRC-15 outputs provide a good indication of future millimetre-wave priorities, in the context of bands to be studied ahead of WRC-19

From the agenda for WRC-19, contained in ITU Resolution COM6/16 (WRC-15):

	Scope
AI 1.6[1]	Development of regulatory framework for non-GSO FSS[2] in the bands 37.5–39.5GHz (S-E), 39.5–42.5GHz (S-E), 47.2–50.2GHz (E-S) and 50.4–51.4GHz (E-S)
AI 1.13	To consider identification of frequency bands for the future development of IMT[3] including possible additional allocations, in accordance with Resolution COM6/20
Resolution COM6/20 (WRC-15)	Studies on frequency-related matters for IMT including possible additional allocations to the mobile service on a primary basis in portions of 24.25–86GHz spectrum
AI 1.14	Based on ITU-R studies in accordance with COM6/21, to consider appropriate regulatory actions for gateway and fixed terminal links for HAPS[4] (38–39.5GHz globally)

1 *AI = Agenda Item of WRC-19*
2 *ISS = Fixed Satellite Service*
3 *IMT= International Mobile Telecommunications, including future development of IMT beyond 2020 (i.e. 5G)*
4 *HAPS = High Altitude Platform Stations. HAPS study also includes study in 21.4–22GHz and 24.25–27.5GHz in ITU Region 2*

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Resolution COM6/20 invites studies of sharing and compatibility between 5G and existing services in selected bands above 24.25GHz, under AI 1.13

Scope/considerations

- IMT systems are being evolved to provide diverse usage scenarios including enhanced mobile broadband, machine-type communications and ultra-reliable, low-latency communication
- Ultra-low-latency and high-bit-rate applications will require larger contiguous blocks of spectrum
- Shorter wavelength bands better enable use of advanced antenna systems
- Any identification of frequency bands for IMT should take into account the use of the bands by existing services. There should be no additional regulatory or technical constraints imposed on services to which the band is currently allocated on a primary basis

Study outputs

- Spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 and 86GHz, including the timeframe in which the spectrum is needed
- Sharing and compatibility studies on feasibility of 5G use in selected bands
- Consideration at WRC-19 of additional allocations to the mobile service on a primary basis, and identification of bands for IMT

Bands selected for 5G study

- **24.25–27.5GHz, 37–40.5GHz, 42.5–42.5GHz, 45.5–47GHz, 47.2–50.2GHz, 50.4–52.6GHz, 66–76GHz and 81–86GHz**, which have allocations to the mobile service on a primary basis
- **31.8–33.4GHz, 40.5–42.5GHz and 47–47.2GHz**, which may require additional allocations to the mobile service on a primary basis

- When conducting studies in the 24.5–27.5GHz band, there is a need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the allocation to the Earth Exploration Satellite Service (EESS) and Space Research Service (SRS)

Resolution COM6/18 describes considerations for the FSS regulatory framework in 37.5–39.5GHz, 39.5–42.5GHz, 47.2–50.2GHz and 50.4–51.4GHz

Scope/considerations

- There is a need to encourage development and implementation of new technologies in the FSS at frequencies above 30GHz
- Non-GSO FSS shall not cause unacceptable interference to GSO FSS and BSS networks and shall not claim protection from them
- Technical sharing studies are required to ascertain the feasibility and conditions for non-GSO FSS systems sharing the bands 37.5–42.5GHz (space to Earth), 47.2–50.2GHz (Earth to space) and 50.4–51.4GHz (Earth to space) with GSO satellite networks and with other non-GSO satellite networks

Study outputs

- Technical and operational issues and regulatory provisions for the operation of non-GSO FSS networks in the stated bands
- Necessary requirements to protect EESS in 36–37GHz and 50.2–50.4GHz and protection requirements for radio astronomy in 42–5–43.5GHz, 48.94–49.04GHz and 51.4–54.25GHz

Bands under study for non-GSO FSS

- 37.5–42.5GHz (space to Earth)
- 47.2–48.9GHz (feeder links only)
- 48.9–50.2GHz and 50.4–51.4GHz (space to Earth)

Resolution COM6/21 is about additional spectrum needs for gateway and fixed terminal links for HAPS in 38–39.5GHz globally

Scope/considerations

- High altitude platform stations are one possible means of providing fixed broadband connectivity in remote areas and with minimal ground infrastructure
- Tests are being made of broadband delivered using lightweight, solar-powered aircraft and airships at altitudes of 20–50km
- WRC-97 added a global identification for HAPS in 47.2–47.5GHz and 47.9–48.2GHz, and WRC-2000 agreed on a HAPS identification in 27.9–28.2GHz (fixed downlink) paired with 31.0–31.3GHz (fixed uplink) outside Region 2, and on additional spectrum identifications for HAPS under S5.388 (IMT) in some countries

Study outputs

- Additional spectrum needs for gateway and fixed terminal links for HAPS to provide broadband connectivity in the fixed service
- Suitability of existing frequency identifications
- Study on use of 38–39.5GHz (globally) and 21.4–22GHz and 24.25–27.5GHz in Region 2 for gateway and fixed terminal links for HAPS, to meet any spectrum needs not satisfied by existing identifications

Detailed bands under study

- **38–39.5GHz** (globally)
- **21.4–22GHz** and **24.25–27.5GHz** in Region 2

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Indefinite-duration licences for 32GHz and 40GHz were auctioned in 2008, whereas Ofcom issues individual fixed-link licences in 24GHz and 38GHz

Frequency range	International allocations	UK use
24.25–27.5GHz	▪ Fixed ▪ Fixed satellite ▪ Radio navigation (Regions 2 and 3)	▪ 24.5–26.5GHz is an Ofcom-managed band for **fixed link use** ▪ EC Decision 2005/50/EC on the harmonisation of 21.65–26.65GHz for time–limited use for automotive short-range radar equipment applied in the UK until 2013
31.8–33.4GHz	▪ Fixed ▪ Radio navigation ▪ Space research	▪ This is the '32GHz band' auctioned as part of the 10–40GHz auction in 2008 (along with 10GHz, 28GHz and 40GHz) ▪ Licence holders are MLL, BT, EE and Hutchison 3G. **Licences were awarded indefinitely and are technology-neutral and tradable**
37–40GHz	▪ Fixed ▪ Fixed satellite ▪ Mobile ▪ Earth exploration satellite (secondary)	▪ 37–39.5GHz is an Ofcom-managed band for fixed-link use ('38GHz band') ▪ **37.5–42.5GHz is under study at WRC-19 for facilitating non-GSO FSS (AI 1.6 and COM 6/18)** ▪ **38–39.5GHz is under study at WRC–19 for HAPS (AI 1.14 WRC-19 and COM 6/21)**
40.5–42.5GHz and 42.5–43.5GHz	▪ Fixed ▪ Fixed satellite ▪ Mobile (secondary) ▪ Broadcasting satellite ▪ Broadcasting	▪ This is part of the '40GHz band', also auctioned as part of the 10–40GHz auction ▪ Licence holders are MLL, UK Broadband, EE and Hutchison 3G ▪ **37.5–42.5GHz is under study at WRC-19 for facilitating non-GSO FSS (AI 1.6 WRC-19 and COM 6/18)**

Ofcom's 5G consultation indicated that 45.5–47GHz is largely unused in the UK and Europe. There is an Ofcom-managed fixed-link band at 52GHz

Frequency range	International allocations	UK use
45.5–47GHz	▪ Mobile ▪ Mobile satellite ▪ Radio navigation ▪ Radio navigation satellite	▪ **Largely unused** both in the UK and Europe, according to Ofcom's consultation *Laying the foundations for next generation mobile services, update on bands above 6GHz* of April 2015
47–47.2GHz	▪ Amateur ▪ Amateur satellite	▪ Allocated to amateur and amateur satellite only
47.2–50.2GHz	▪ Fixed ▪ Fixed satellite ▪ Mobile	▪ **Used for FSS earth stations** and feeder links, and also available for PMSE[1] use (also HAPS in 47.2–47.5GHz from WRC-97) ▪ **47.2–50.2GHz is under study for facilitating non-GSO FSS (AI 1.6 WRC-19 and COM 6/18)**
50.4–52.6GHz	▪ Fixed ▪ Fixed satellite ▪ Mobile	▪ 50.4–51.4GHz is allocated for military use ▪ **51.4–52.6GHz is an Ofcom-managed band for terrestrial fixed links** ▪ **50.4–51.4GHz is under study for facilitating non-GSO FSS (AI 1.6 WRC-19 and COM 6/18)**

[1] *Programme-Making and Special Events*

Management of the E-band (71–76GHz and 81–86GHz) has been modified to increase Ofcom's management of the band, based on industry feedback[1]

Frequency range	International allocations	UK use
66–76GHz	▪ 66–71GHz: – Mobile – Mobile satellite – Radio navigation – Radio navigation satellite ▪ 71–76GHz: – Fixed – Fixed satellite – Mobile – Mobile satellite	▪ **66–71GHz is unused** according to Ofcom's consultation on spectrum bands for 5G ▪ The following bands are used for fixed links: – Ofcom-coordinated: 71.125–73.125GHz – Self-coordinated: 73.375–75.875GHz
81–86GHz	▪ Fixed ▪ Fixed satellite ▪ Mobile ▪ Mobile satellite ▪ Radio astronomy	▪ The following bands are used for fixed links: – Ofcom-coordinated: 81.125–83.125GHz – Self-coordinated: 83.375–85.875GHz

[1] *Ofcom originally made the E-Band available in the UK on a light licensed basis but modified regulations in 2013 such that part of the band is now managed by Ofcom, to provide more active interference management and higher link availability. This change was based on industry feedback, to provide greater certainty on spectrum access for 'carrier grade' fixed-link applications*

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The key questions leading up to WRC-19 are how to establish the UK industry's priorities for 5G within a broadly defined agenda item

Understanding the need for 5G spectrum (in bands ranging from 24.25GHz to 86GHz) – What key characteristics of 5G millimetre-wave technology might influence spectrum need and assist with selecting the preferred bands (e.g. transceiver design, required bandwidth, range, band configuration, etc.)?

Support for CEPT and ITU processes – How can UK industry best help Ofcom and CEPT to conduct the necessary studies on 5G spectrum need? What other priorities does UK industry foresee for the bands being studied for 5G (e.g. non-GSO FSS)?

Priorities for sharing studies – What technical sharing studies need to have priority (e.g. 5G with fixed links, EESS, FSS, other)? How can UK industry contribute to these studies? What are priority bands (if any) among those under study, and/or how can these be determined?

Some key questions on the future of microwave spectrum in the UK following WRC-15

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