Huawei response to the RSPG public consultation on the draft "Opinion on the ITU-R World Radiocommunication Conference 2023"

Summary

We thank the RSPG for the opportunity to comment on this important public consultation.

There are a number of IMT-related WRC-23 agenda items in relation to low, mid, and high bands which present important opportunities for the European Union to achieve Europe's Digital Decade targets for connectivity through timely and adequate availability of harmonised spectrum for the roll out of future-proof mobile communication networks.

Our recommendations on these agenda items are summarised below and elaborated in the main body of this document. We are at RSPG's disposal to provide any further clarifications.

On WRC-23 Agenda Item 1.2: 3300-3400 MHz (amend footnote in Region 1)

We believe that the Radiolocation use of this band in the EU would not be affected by a change in the conditions of the footnotes, and therefore recommend the EU not to oppose the potential request from the countries in the footnotes to vary those conditions.

On WRC-23 Agenda Item 1.2: upper 6 GHz IMT identification (6425-7025 MHz in Region 1, 7025-7125 MHz globally)

Our response on this agenda item complements the multi-company response[1] to RSPG submitted by members of the mobile industry.

We agree with Option 1 that supports IMT identification, and recommend that RSPG adopts this option.

The upper 6 GHz band (6425-7125 MHz) represents the only opportunity to help meet the identified need for additional wide and contiguous mid-bands spectrum for 5G evolution in the foreseeable future, and to enable enhanced performance and capacity.

The RSPG and European Commission played a central role in the global introduction of 5G by their early recognition of the importance of mid-bands and the definition of the 5G primary band at 3400-3800 MHz. We consider that the time is now right for the RSPG and European Commission to adopt a spectrum roadmap to maintain the European Union's policy leadership by recognizing the upper 6 GHz band as the primary band to support the evolution of 5G.

On WRC-23 Agenda Item 1.2: 10 000-10 500 MHz (Region 2)

We consider that Radiolocation and EESS (passive) uses in the EU would not be affected by IMT use in the 10-10.5 GHz band in Region 2. We therefore recommend the EU not to oppose the IMT identification of 10-10.5 GHz in Region 2.

[1] Bouygues Telecom, Deutsche Telekom, Elisa, KIGEiT, Orange, O2 Czech Republic, P4, SFR, Telefonica, Telia Company, TIM, T-Mobile Netherlands, Vodafone, Ericsson, Huawei, Nokia, "Multi-Company response to the Radio Spectrum Policy Group public consultation on the Draft "Opinion on the ITU-R World Radiocommunication Conference 2023" – Focusing on the IMT identification of 6425-7125 MHz under Agenda Item 1.2", 8 August 2022.

On WRC-23 Agenda Item 1.3: 3600-3800 MHz

We recommend that the EU does not take a position against IMT identification at WRC-23. It is well known outside of the EU that the band is already in use for IMT within the Union, and hence opposition from the EU to IMT identification could be seen as inconsistent.

On WRC-23 Agenda item 1.5: UHF review (470-694/698 MHz in Region 1)

We request that RSPG recommends to the European Commission to propose an EU position supporting a co-primary Mobile allocation of the 470-694 MHz band in Region 1 and IMT identification of the entire band, or parts thereof, for the countries of Region 1 wishing to do so. We also request that RSPG recommends to the Commission that Member States should not object to the potential requests from countries outside of Region 1 to add their names to the existing or new footnotes of the Radio Regulations related to the 470-694/698 MHz band at WRC-23.

Studies in relation with RR Article 21

We observe that the request developed in WRC-19 was to study the applicability of Radio Regulations Article 21.5 to IMT stations that use antenna arrays of active elements in the 26 GHz band, with the term "power" interpreted as conducted power by a transmitter, and any specification of a reference bandwidth defined by supporting studies. We also consider that the studies should be focused on 26 GHz band as requested.

WRC-23 Agenda Item 10: (agenda items for WRC-27)

We consider that the availability of bands that can support much broader and contiguous bandwidths for IMT-2030 should be explored, including from a) within the 7.125-24 GHz range – the so-called "cm-wave bands" – to enable the envisaged capacity-demanding IMT-2030 use cases which involve wider area mobility, and b) from within the 92-300 GHz range – the so-called "sub-THz bands" – to enable the extremely high data rates (of the order of Tbit/s) and extremely low latencies that would be needed for some of the lower mobility IMT-2030 use cases.

It is critical to emphasise the complementary nature and purpose of the 7.125-24 GHz and sub-THz ranges. Furthermore, as part of this exploration, the potential for coexistence between IMT-2030 and existing uses of the above frequency ranges will need to be addressed.

We acknowledge that the ranges 7.125-24 GHz and 92-300 GHz are very wide and studies of the entire ranges towards WRC-27 would not be feasible in practice. We expect that specific sub-bands from the above two ranges will be identified prior to WRC-23, and we note that a number of studies are already under way in this respect.

Agenda Item 1.2: 3300-3400 MHz (amend footnote in Region 1)

The RSPG draft Opinion states: "*Given the global interest of Member states in the frequency bands 3.3-3.4 GHz and 10 GHz, the RSPG recommends that the EU Member States should oppose to any IMT identification in the bands 3.3-3.4 GHz and 10-10.5 GHz as a common policy approach.*"

We recognise the importance of 3300-3400 MHz for the common security and defence policy of the EU; and we understand the difficulties associated with a possible IMT identification within the Union.

However, we would like to underline the importance of this band for Region 1 countries outside of the EU. In particular, in Africa many countries south of parallel 30 degrees north have allocated the band to the Mobile Service on a primary basis, and identified it for IMT. This is reflected in footnotes 5.429A and 5.429B in the Radio Regulations (RR). These countries may seek to vary the regulatory conditions in these footnotes at the WRC in accordance with Agenda Item 1.2. We believe that the Radiolocation use in the EU would not be affected by a change in the conditions of the footnotes, and therefore recommend the EU not to oppose the potential request from the countries in the footnotes to vary those conditions.

Agenda item 1.2: upper 6 GHz IMT identification (6425-7025 in Region 1, 7025-7125 globally)

We recommend that RSPG selects a single option in its Final Opinion, and that Option 2 "no IMT identification" should **not** be considered.

A lack of IMT identification and non-allocation of the upper 6 GHz band to IMT services would leave Europe behind in the technological connectivity race as it would leave Europe without any alternatives for mobile expansion in mid-bands, placing the fulfilment of the EU's Digital Decade goals at risk and ultimately impacting negatively on Europe's societal and economic needs.

We agree with Option 1 that supports IMT identification, and recommend that RSPG adopts this option.

The upper 6 GHz band (6425-7125 MHz) represents the only opportunity to help meet the identified need for additional wide and contiguous mid-bands spectrum for 5G evolution, and to enable enhanced performance and capacity in the foreseeable future.

With regards to appropriate conditions for the use of the upper 6 GHz for IMT, we note that these are still under discussion and will have to be based on the outcome of the sharing studies at ITU-R. Aligned with the general practice at CEPT, we consider that any such conditions should be "least restrictive" while ensuring co-existence with existing services.

We would also like to underline the importance of the **multi-company** submission[2] to this public consultation – which we have co-signed – and which provides a comprehensive feedback supported by a large share of the European mobile industry.

With the intent to avoid redundancies, we take the opportunity here to share some additional complementary information, in full alignment with the said multi-company feedback.

[2] Bouygues Telecom, Deutsche Telekom, Elisa, KIGEiT, Orange, O2 Czech Republic, P4, SFR, Telefonica, Telia Company, TIM, T-Mobile Netherlands, Vodafone, Ericsson, Huawei, Nokia, "Multi-Company response to the Radio Spectrum Policy Group public consultation on the Draft "Opinion on the ITU-R World Radiocommunication Conference 2023" – Focusing on the IMT identification of 6425-7125 MHz under Agenda Item 1.2", 8 August 2022.

The RSPG draft Opinion states: *"The band 6425-7125 MHz may respond to additional spectrum demand in mid-band for IMT since it has similar propagation conditions to the band 3400-3800 MHz, noting in particular that the IMT family concept encompasses various mobile technologies (e.g. 4G, 5G and beyond)."*

We agree with the RSPG's Opinion.

Demand for additional mid-bands spectrum for 5G

The need for additional mid-bands spectrum for IMT (5G NR) is driven by the end users' traffic growth and their increasing demand for quality (e.g. lower latency and higher reliability)[3].

Considering the tremendous demand for connectivity by consumers, households, businesses, and industries, GSMA recently published a report on its vision of the future needs for mid-bands spectrum[4]. The study examined 36 cities globally, and quantified their mid-bands spectrum needs accounting for factors such as population density, existing spectrum available for IMT, inter-site distance between macro-cellular IMT base stations, 5G spectral efficiency, massive MIMO upgrades, offload to high bands, indoor small cells and Wi-Fi, and end users' activity factor. Figure (1) shows a sample of the results.

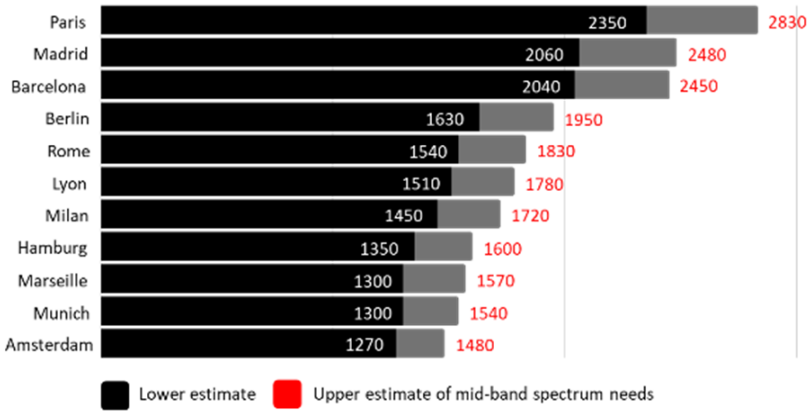


Figure 1: Mid-band spectrum needs for a sample of cities studied by the GSMA.
(Source: GSMA)

The report concludes that "The GSMA recommends governments and regulators to plan to make 2 GHz of mid-band spectrum available in the 2025-2030 timeframe. This is the average value needed to guarantee the IMT2020 requirements for 5G", and that "…spectrum is required to deliver the 5G vision of downlink user experienced data rate of 100 Mbit/s across the city, i.e. citywide "speed coverage", and also to satisfy the 50 Mbit/s uplink target."

The report clarifies that mid-bands spectrum is required in addition to the mid-bands that are available to mobile networks today (which the study assumed will eventually be re-farmed for use by 5G), and that this is necessary to achieve the IMT-2020 5G data rates specified by the ITU-R for the delivery of high-capacity coverage across cities and along major transport routes in the 2025-2030 timeframe in support of mobile broadband, smart city, automotive and industrial use cases.

[3] As one example, mid-band spectrum is expected to serve as an important component of the *Metaverse*, by enabling economically viable high-capacity citywide mobile communications implemented through macro-cellular networks. The Metaverse will involve high data rate AR/VR/XR both in indoor and outdoor scenarios. Accordingly, wide-area outdoor mobility is expected to play an important role in the Metaverse, whereby smartphones and XR headsets would need to connect to 5G NR macro-cellular mobile networks with sufficient bandwidth at mid-bands. Short-range connections (e.g., between smartphones and XR headsets) can be addressed with either Wi-Fi, WiGig, or IMT-sidelink at 60 GHz, or with Wi-Fi at 5 GHz and the lower 6 GHz.

[4] GSMA, "5G Mid-Band Spectrum Needs – Vision 2030," report, July 2021.

The upper 6 GHz band (6425-7125 MHz) represents the only opportunity to help meet the identified need for additional wide and contiguous mid-bands spectrum for 5G evolution, and to enable enhanced performance and capacity in the foreseeable future.

The RSPG and European Commission played a central role in the global introduction of 5G by their early recognition of the importance of mid-bands and the definition of the 5G primary band at 3400-3800 MHz.

We consider that the time is now right for the RSPG and the European Commission to adopt a spectrum roadmap to maintain the European Union's policy leadership by recognizing the upper 6 GHz band as the primary band to support the evolution of 5G.

Network densification cannot meet the demand economically

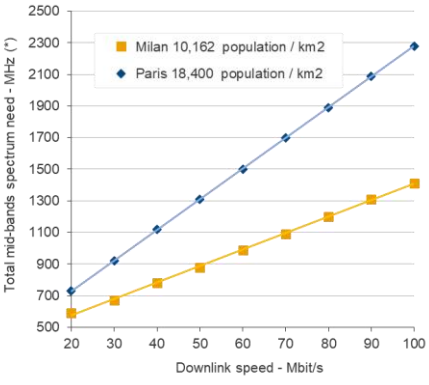
Importantly, the GSMA report shows that in the absence of the required additional mid-band spectrum, the mobile radio networks would need to be substantially densified (numbers of base station sites increased) in order to deliver the 5G data rate targets, and that this would lead to a significant increase in **energy consumption** and radio **network cost**. Specifically, for a typical large European city, the implication would be a doubling of power consumption, and a four-fold increase in total network costs. This is in addition to the carbon footprint involved in the manufacture of the greater number of equipment.

It should also be noted that such substantial densification of sites would in any case be unfeasible due to the difficulties in acquiring new sites, and the unavoidable increase in inter-site interference due to the decreased inter-side distances.

Insufficient availability of mid-bands spectrum will not allow the full socioeconomic benefits of 5G to be realised in densely populated areas

Further analysis was carried out by the authors of the GSMA report to quantify the reduction in downlink and uplink data rates in cities in the absence of the required additional mid-bands spectrum and in the absence of the "extreme" network densification that would be unsustainable citywide. Figure (2) shows the total amount of required mid-bands spectrum vs. user experienced data rates. As indicated, in the absence of additional mid-bands spectrum, and given the economic and technical limits to extreme network densification, MNOs would not be able to deliver the IMT-2020 minimum requirements of 100 Mbit/s downlink and 50 Mbit/s uplink in densely populated European cities. Governments would have to accept that their nations will not realise the full socioeconomic benefits of 5G if additional mid-bands are not made available.

Total available mid-bands spectrum - including baseline (MHz) vs. associated downlink and uplink user experienced throughput (Mbit/s) - city average													
City	Pop. density (per km²)	Dense area km²	Downlink and uplink user experienced throughput (Mbit/s)										Mid-band baseline spectrum
			100 DL	90 DL	80 DL	70 DL	60 DL	50 DL	40 DL	30 DL	20 DL	10 DL	
			50 UL	45 UL	40 UL	35 UL	30 UL	25 UL	20 UL	15 UL	10 UL	5 UL	
			Total (including baseline) available mid-bands spectrum (MHz)										
Amsterdam	8,386	117	1230	1140	1050	**960**	**880**	790	700	630	560	540	**935**
Munich	8,836	92	1280	1180	1090	1000	**900**	**810**	720	640	570	540	**835**
Marseille	9,035	43	1300	1200	1110	**1010**	**910**	820	720	640	570	540	**935**
Hamburg	9,289	69	1320	1220	1130	1030	**930**	**830**	730	650	580	540	**835**
Milan	10,162	141	1410	1310	1200	1090	**990**	**880**	780	670	590	540	**935**
Lyon	10,595	73	1460	1350	1240	1120	**1010**	**900**	790	680	590	540	**935**
Rome	10,955	171	1500	1380	1270	1150	**1040**	**920**	810	700	600	540	**935**
Berlin	11,859	163	1590	1470	1340	1220	1090	970	**840**	**720**	610	540	**835**
Barcelona	15,576	179	1980	1820	1660	1490	1330	1170	**1000**	**840**	680	550	**935**
Madrid	15,773	303	2000	1840	1670	1500	1340	1180	**1010**	**840**	680	550	**935**
Paris	18,400	243	2280	2090	1890	1700	1500	1310	**1120**	**920**	730	570	**935**



(*) Total mid-bands spectrum (including an assumed 935 MHz of baseline mid-bands spectrum in Europe) needed to meet the downlink throughputs on the x-axis, in addition to an uplink throughput equal to 50% of the downlink throughput.

Figure 2: End user downlink throughput depending on the total mid-bands spectrum availability, in densely populated cities. (Source: Coleago)

Cities with lower population densities will also benefit from the additional mid-bands spectrum availability

While Figure (2) refers to areas within cities with population densities above 8000 inhabitants per square km, cities with lower population densities can also benefit from additional mid-bands spectrum availability. With reference to less densely populated cities, Figure (3) shows how the availability of additional mid-bands spectrum enables higher throughputs that can be experienced by the end users, going beyond the IMT-2020 minimum performance requirements as defined in ITU-R.

The additional mid-bands spectrum can also be used in less densely populated cities to minimize the number of sites, thereby lowering deployment costs, reducing visual impact, and power consumption, with the most appropriate cost vs. speed trade-off.

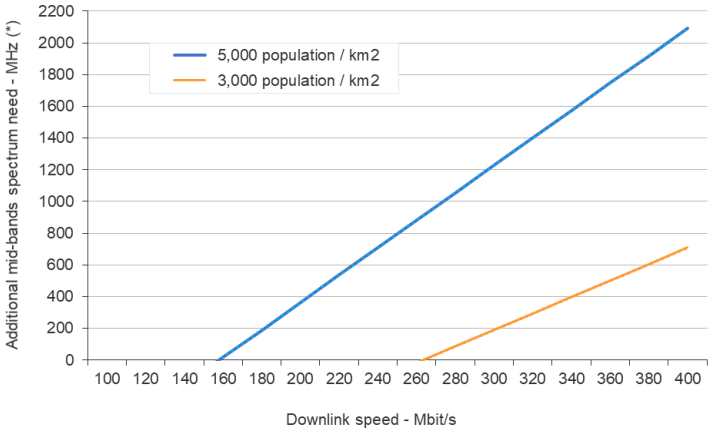


Figure 3: End user downlink throughput depending on the additional mid-bands spectrum availability, in lower population densities. (Source: Coleago)

The RSPG draft Opinion states: *"In terms of spectrum, the "mid-band" range enables a good compromise between capacity and coverage and RSPG recognises that there may be additional spectrum requirements in the "mid-band" for future development."*

We agree with the RSPG's Opinion.

Specifically, we note that, as a rule, the favourable radio propagation characteristics at mid-bands frequencies makes them critically important for wide-area, high-capacity, mobile communications. This is in contrast to the high bands (such as mm-waves) which are more suitable for high-capacity short-range or local area (hot-spot) communications. As such, the authorisation of large swathes of mid-bands spectrum, such as the 5925-7125 MHz band, for use by WAS/RLAN would be an inefficient use of a valuable resource.

Importantly, our recent field trials of 5G at 6 GHz have indicated that advanced active antenna systems (AAS) allow the delivery of spectral efficiencies that are comparable with those at 3.4-3.8 GHz both for outdoor-to-outdoor and outdoor-to-indoor (shallow indoor) coverage. We present the trial results below.

Coverage capabilities of macro-cellular IMT networks at 6 GHz

It is well-known that radio signals suffer from increasing propagation path loss and building penetration loss at higher frequencies. This poses the question of whether 5G deployments in the 6 GHz band would be suitable for macro-cellular coverage in order to address high-capacity citywide demand.

To answer this, we performed a number of field tests in 2021 to compare the performance of macro-cellular IMT deployments at 3.5 GHz and 6 GHz. These tests involved two 5G NR base stations operating at 3.5 GHz and 6 GHz, respectively, both co-sited at an existing commercially deployed rooftop macro-cell site[5].

Specifically, we investigated the enhancements provided by active antenna systems (AAS) and MIMO at the 5G NR base stations. The 3.5 GHz base station used 64Tx/64Rx MIMO, whereas the 6 GHz base station used 128Tx/128Rx MIMO, on account of the smaller inter-element antenna spacings possible at the higher frequency (lower wavelength). The user equipment in both bands used 2Tx/4Rx MIMO.

Downlink and uplink spectral efficiencies were measured for outdoor-to-outdoor (O2O) and outdoor-to-indoor (O2I) scenarios. Apart from the higher-order MIMO used at 6 GHz, the two base stations used the same bandwidth and total radiated power (TRP) at 6 GHz and 3.5 GHz, respectively.

Figure (4) shows the route taken by the user equipment for the O2O measurements. With an average building height of around 20 metres, this implied non-line-of-sight (NLOS) propagation between the rooftop base stations and the user equipment at street level in over 80% of the route. Figure (5) shows the distributions of the measured downlink and uplink spectral efficiencies along the route.

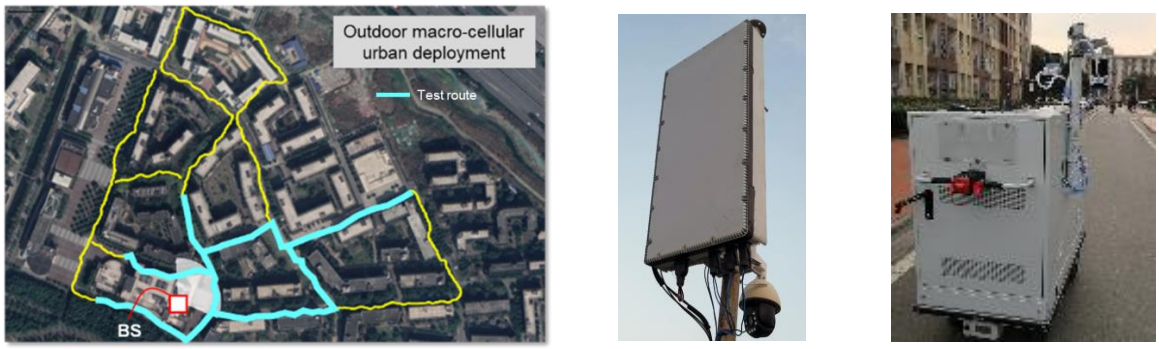


Figure 4: Outdoor-to-outdoor field test scenario.

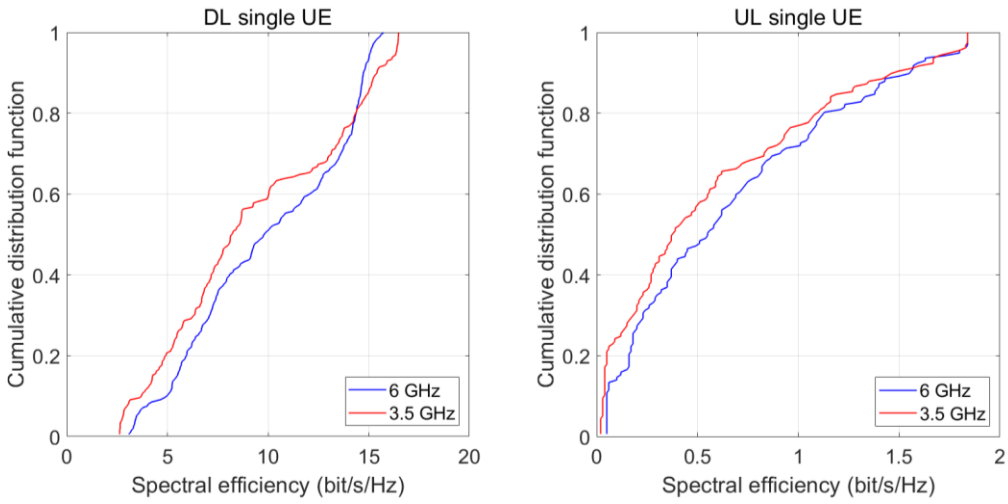


Figure 5: Cumulative distributions of measured outdoor-to-outdoor spectral efficiencies.

Figure (6) shows measurements of downlink and uplink spectral efficiency with the user equipment located indoors and in the proximity of a window, in what we refer to as a "shallow" rather than "deep"

[5] Inter-site distances in the area are 350 to 600 metres.

indoor environment. The 5G NR base stations were located a distance of 150 metres outside the building and in non-line-of-sight. Figure (7) shows measurements along a corridor, and how the downlink throughout reduces with distance from a door at the end of the corridor.



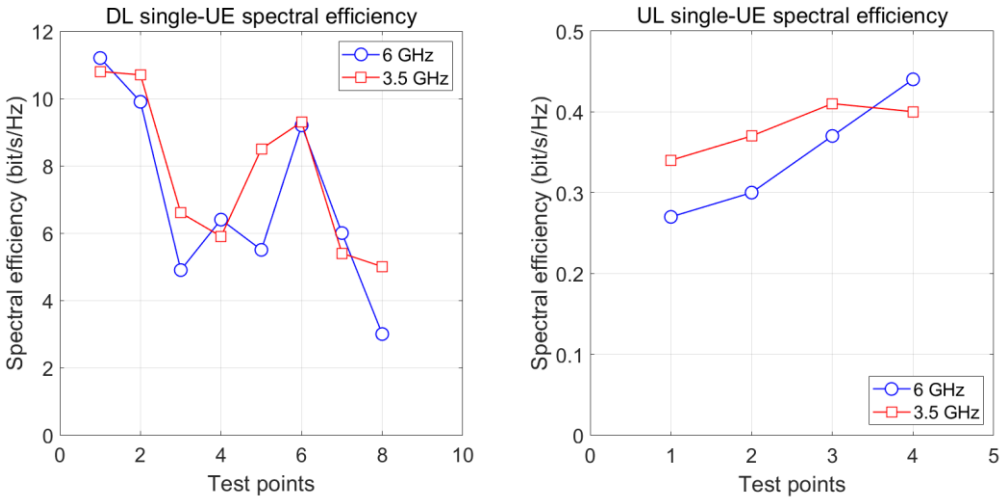


Figure 6: Measured outdoor-to-indoor spectral efficiencies.



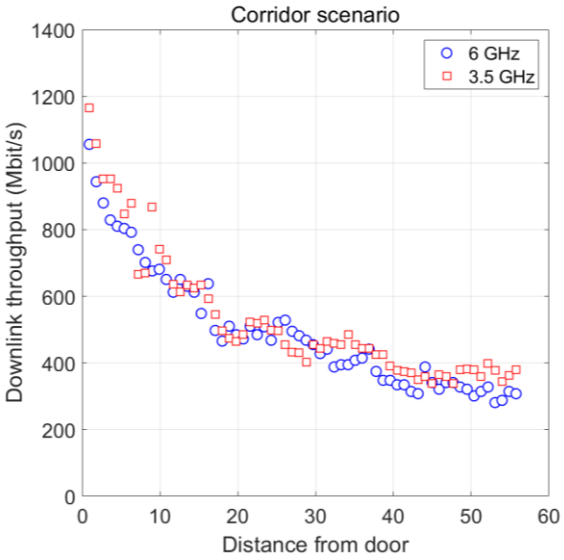


Figure 7: Measured outdoor-to-indoor throughput vs. distance from a window at the end of a corridor.

Our field tests indicate broadly similar downlink and uplink spectral efficiencies for both outdoor-to-outdoor and outdoor-to-indoor (shallow indoor) scenarios in the 6 GHz and 3.5 GHz bands. This is justified by the higher-order MIMO implemented in the 6 GHz base station.

In addition to AAS and MIMO, further user equipment and base station physical layer enhancements are being investigated and developed.

The RSPG draft Opinion states: *"The RSPG is of the view, that a future European policy strategy on 6425-7125 MHz should be based on a consideration of a number of questions regarding the best spectrum use for Europe, the spectrum demand for IMT (including IMT-2030) and WAS/RLAN in the medium term perspective, possible sharing options between radiocommunication services and applications in the band, including between IMT and WAS/RLAN."*

Co-channel operation of IMT (5G NR) and WAS/RLAN (Wi-Fi) is not feasible without substantial mutual harmful interference

IMT (5G NR) and WAS/RLAN (Wi-Fi) are not substitutes and both have important – yet distinct – roles to play. That said, 5G NR and Wi-Fi are fundamentally different by design, and are optimised for licensed and licence-exempt authorisation models respectively. For this reason, they cannot share the same frequencies in the same geographic area without substantial mutual harmful interference:

- Specifically, 5G NR – as an IMT technology – has a deterministic/scheduled medium access control (MAC) designed for use in licensed spectrum (free of interference from other co-channel 5G networks). 5G NR is designed to deliver mobility with managed quality of service and reliability. Specifically, 5G NR can deliver ultra-reliable and low-latency communications across large macro-cells or small cells. These capabilities are not purely a matter of technology; but also rely on availability of licenced spectrum.

- In contrast, Wi-Fi – as a WAS/RLAN technology – is designed to operate in licence-exempt spectrum. As such, Wi-Fi relies on a stochastic MAC in order to manage the unpredictable presence of an indefinite number of co-channel Wi-Fi networks and equipment. Wi-Fi is not designed to ensure predictable quality of service, and can only address low-mobility and low-range use cases. Wi-Fi delivers a best-effort service and suffers from non-graceful degradation when subject to congestion.

NR-U is not an IMT technology

NR-U is sometimes – erroneously – cited as an example of how IMT/5G can operate co-channel with Wi-Fi in the same geographic area. However, this is a false example, likely based on a mis-understanding of the nature of NR-U. While NR-U is indeed a 3GPP technology, it **is not** an IMT technology. In fact, NR-U (like Wi-Fi) is a WAS/RLAN technology and, just like Wi-Fi, has a stochastic MAC designed for low-power short-range communications in licence-exempt spectrum and cannot achieve the same performance as IMT 5G NR (i.e., cannot deliver managed QoS, continuous macro-cellular coverage, seamless mobility, and security).

In short, NR-U and Wi-Fi operating co-channel in the same geographic area is an example of two very similar and competing WAS/RLAN technologies sharing the spectrum resource in the same geographic area for low-power short-range communication. This has absolutely **no relation** to the possibility of co-channel sharing of spectrum between IMT (5G NR) wide-area macro-cellular networks and WAS/RLAN (Wi-Fi or NR-U) for low-power short-range communications.

Indoor coverage by IMT at 6 GHz

There have also been suggestions that indoor Wi-Fi and outdoor macro-cellular IMT (5G NR) deployments can operate co-channel in the same geographic area. This is also contrary to available evidence.

As described earlier, our recent field trials of 5G NR at 6 GHz have indicated that advanced active antenna systems (AAS) allow the delivery of spectral efficiencies that are comparable with those at 3.4-3.8 GHz both for outdoor-to-outdoor and outdoor-to-indoor (shallow indoor) coverage. The implication of this important finding is that any indoor use of Wi-Fi in the upper 6 GHz would undoubtedly result in mutual harmful interference with respect to macro-cellular 5G NR deployments, resulting in poor performance or failure of both types of system. In short, the building penetration loss at the upper 6 GHz is not sufficient to isolate the indoor and outdoor use of spectrum.

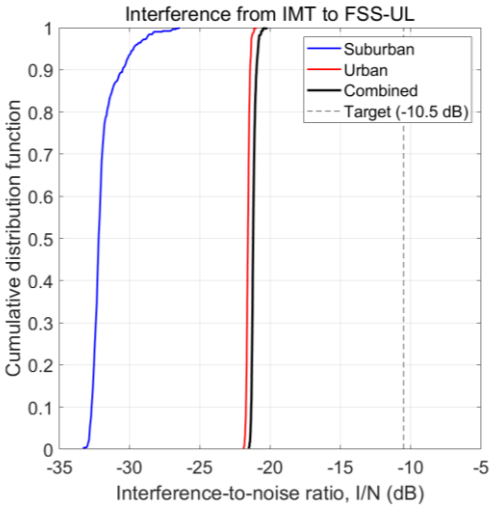
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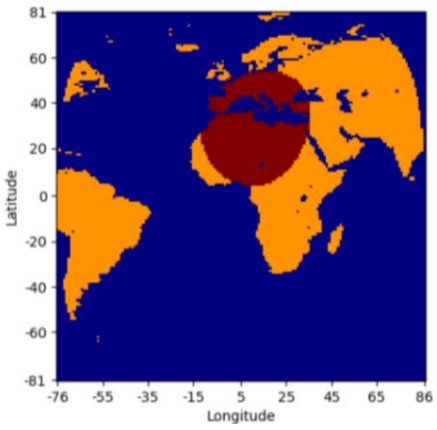
As explained above, the co-channel use of IMT (5G NR) and WAS/RLAN (Wi-Fi or NR-U) in the same geographic area would substantially degrade the performance of both systems, with the harmful mutual co-channel interference disrupting the operation of their respective deterministic and stochastic MAC protocols.

The RSPG draft Opinion states: *"The frequency band 6425-7075 MHz is used for Fixed Satellite Service (FSS) in the uplink (6425-7075 MHz) and in the downlink (6700-7075 MHz) direction, noting that the protection of satellite uplink(s) is intrinsically of international nature."* and that: *"It appears from sharing studies that there is possible opportunity for sharing between IMT (including macro base stations) and fixed satellite service allocated to this band."*

We agree with the RSPG Opinion that the protection of FSS is an obligation under the Radio Regulations. Although studies are still on-going, the vast majority[6] of contributions submitted to ITU-R by administrations and industry have concluded that macro-cellular IMT (5G NR) deployments can coexist with the FSS uplink when accounting for key factors including a) the realistic geographic density of IMT base stations, b) the influence of clutter loss in mitigating interference, c) the impact of IMT base station active antenna systems (AAS) in directing interference towards desired directions (away from the incumbents), and d) realistic incumbent receiver antenna characteristics.

Figure (8) below shows an example of our studies[7] for the case of interference from IMT to the Fixed Satellite Service (FSS) uplink, indicating an 80th percentile interference-to-noise ratio (I/N) of -21 dB at the satellite receiver, compared to a target I/N of -10.5 dB, implying that sharing is feasible.





IMT scenario	80th percentile I/N (dB) experienced at satellite receiver
Suburban	-31.6
Urban	-21.5
Combined	**-21.1** (protection target as agreed at ITU-R: I/N = -10.5 dB)

Figure 8: Interference from IMT deployments falls below the agreed protection threshold.

[6] Cameroon et al (5D/782, 996, 1231, 1299); Japan (5D/1021, 1082, 1303); France (5D/1042, 1138); China (5D/874, 1069); Senegal (5D/1323); Mali et al (5D/1224); Russian Federation (5D/1089, 1244, 1238); UAE et al (5D/1148, 1285); Ericsson (5D/1032, 1127, 1250); Reliance Jio et al (5D/1215); Huawei (5D/1322); Nokia (5D/1146, 1278). The contributions are available at https://www.itu.int/md/R19-WP5D-C/en.

[7] See Huawei contribution to ECC PT1, ECC PT1(21)225, September 2021.

Studies have further indicated that co-existence with FSS downlink[8] and the Fixed Service (FS) is also feasible on a national level through coordination and/or geographic separation on a case-by-case basis.

Agenda Item 1.2: 10 000 – 10 500 MHz (Region 2)

> The RSPG draft Opinion states: "The frequency band 10-10.5 GHz under consideration for Region 2 is used by military radars and therefore relevant to the Common Security and Defence Policy (CSDP) and is adjacent to the band 10.6-10.7 GHz, which is also planned to be used globally by CIMR.*"*

We recognise the importance of 10-10.5 GHz for the common security and defence policy of the EU. Coexistence studies show that sharing between IMT and radar systems in the same geographic area can be challenging. However, considering the significant geographic separation between Region 2 countries and EU countries, it is very unlikely that IMT use in Region 2 would cause harmful interference to radar use in EU countries.

With regard to the protection of CIMR used in the band 10.6-10.7 GHz, we would like to bring the attention of the RSPG to the following two facts:

1) There is a 100 MHz separation between the 10-10.5 GHz and 10.6-10.7 GHz bands, which will help to alleviate adjacent band interference caused by the use of IMT; and more importantly,

2) According to Resolution 751 in the RR, the sharing criterion for operation of the Mobile Service in the band 10.6-10.68 GHz corresponds to an in-band conducted power of -17 dBW per station of the Mobile Service, which is significantly greater than the *aggregate* IMT base station out-of-band EIRP of -40 dBW from the 10-10.5 GHz band as calculated in WP 5D sharing studies.

We consider that the Radiolocation and EESS (passive) use in the EU would not be affected by IMT use in 10-10.5 GHz in Region 2. Some administrations in Region 2 have already expressed their willingness to identify this band for IMT. We therefore recommend the EU not to oppose the IMT identification of 10-10.5 GHz in Region 2.

> The RSPG draft Opinion states: "In addition, the frequency band 10.0-10.4 GHz are or will be used for the operation of European Synthetic Aperture Radar (SAR) satellites for imaging across the globe. Therefore, these satellite missions need global protection from any IMT system to deliver high-quality data for monitoring the status of the Earth.*"*

We agree with the RSPG's Opinion that EESS (active) operating in the band 10-10.4 GHz should be adequately protected. According to the results of some of the current sharing studies in WP 5D, the deployment of IMT may cause harmful interference to EESS (active) service in the absence of any interference mitigation measures. Some administrations have proposed antenna side lobe suppression as an interference mitigation technique in order to control the interference from IMT base stations towards EESS satellites, and have illustrated that sharing is consequently feasible. From an implementation point of view, it is practical to implement the required antenna side lobe suppression, and as such, we believe that it is possible to protect EESS (active).

We therefore recommend the EU not to oppose the IMT identification of 10-10.5 GHz in Region 2.

[8] Ericsson, "Simulations presented at WP 5D show separation distances in the order of 13-15 km between FSS earth stations and IMT base stations for both long and short term protection criteria," 5D/1017.

Agenda Item 1.3: 3600-3800 MHz (in Region 1)

The RSPG draft Opinion states: "*The RSPG recommends that the European Commission proposes an EU position to the Council to update the allocation of the 3 600-3 800 MHz frequency band to a primary mobile allocation, as this will facilitate coordination negotiations between EU and non-EU countries at the EU borders, where non-EU neighbouring countries have a different use of the frequency band.*

The position should take proper account of the following conditions:

- *as the 3 400-3 600 MHz and 3 600-3 800 MHz bands have similar characteristics, the upgrade should follow similar technical and regulatory conditions already adopted for the 3 400-3 600 MHz band;*
- *existing primary services in the 3 600-3 800 MHz band (FSS and FS) should be protected and allowed to continue operations, without undue constraints on their future development;*
- *IMT identification in this band should be considered outside the scope of this agenda item.*"

We agree with the RSPG recommendation that the EU position should be to upgrade the Mobile allocation to primary in Region 1. This will better reflect in the Radio Regulations the reality of use of the band in the EU today. We agree that, from an EU perspective, the primary allocation would bring benefits in terms of easier coordination with non-EU countries.

ITU-R WP5A has finalised the draft of the CPM text. Several methods are proposed, from No Change to identification for IMT. We believe that the method that best suits the EU interests is method C2, which involves upgrade to primary with conditions based on a PFD limit at the border. It must be noted that these regulatory conditions are in line with the conditions for 3400-3600 MHz in the Radio Regulations.

With regards to identification for IMT, we note that some administrations believe this is out of scope of the agenda item, while others believe that IMT is the most likely application of the Mobile Service in this band and hence it would be appropriate to identify the band for IMT at WRC-23 under this agenda item. We recommend that the EU does not take a position against IMT identification at WRC-23 on the basis of an interpretation of the text of the agenda item. We note that it is well known outside of the EU that the band is already in use for IMT within the Union, and hence opposition from the EU to identification could be seen as inconsistent.

Agenda item 1.5: UHF review (470-694/698 MHz in Region 1)

The RSPG draft Opinion states: "*The RSPG recommends that the European Commission proposes an EU position to the Council to ensure that the decision of WRC-23 on this Agenda item is compliant with the Decision (EU) 2017/899 providing priority to broadcasting and PMSE usage until at least end 2030.*

Note: The RSPG is of the view that the above outlined recommendation is ensured by various options. One can be No Change at WRC-23, with a possible agenda item for WRC-27 or WRC-31. Another one can be a co-primary allocation to the mobile service which should become effective at a later stage (e.g. 31.12.2030). It is further noted that the EU Position on this agenda item should avoid ambiguity."

As regards Agenda Item 1.5 of WRC-23, it is notable that a focused discussion at the ITU level on repurposing the 470-694/698 MHz band for mobile use began more than ten years ago, when WRC-12 established an agenda item of WRC-15 aimed at identifying new spectrum for IMT. Now, with a rapid development of 5G in Europe and globally, it has become evident that providing additional low-band spectrum to 5G and its evolution in a timely manner is a condition for an efficient implementation of EU polices related to digital equality, high-speed wireless broadband, affordable wide-area connectivity and

deep indoor coverage. In particular, repurposing of the 470/694/698 MHz spectrum would significantly contribute to reducing the cost of covering rural roads for 5G-connected vehicles, would improve the business case for 5G FWA to remote rural buildings, would enable truly wide-area smart agriculture, and cost-efficient 5G capacity solutions for areas where mid-bands do not reach (e.g. urban deep indoor coverage)[9].

From the current European regulatory perspective, Decision (EU) 2017/899 indeed ensures the availability of the 470-694 MHz band at least until 2030 for the terrestrial provision of broadcasting services, including free television and PMSE, on the basis of national needs. At the same time the Decision also allows Member States to authorise alternative uses, such as terrestrial wireless broadband electronic communications services in the 470-694 MHz band, provided that such use is "compatible with the national broadcasting needs" and protects the broadcasting services in neighbouring Member States. It is important that the Decision does not limit alternative usages of the band to downlink-only communications.

Also, the obligation of the European Commission to report to the European Parliament and to the Council on developments in the use of the sub-700 MHz frequency band established by the Decision highlights the importance of carefully assessing the current clear trend of a steady reduction of DTT consumption in Europe set against the background of growing demand for wireless broadband services. The Decision also points out that "reducing the digital divide, in coverage as well as in knowledge, is an important aspect that has to be a priority". In this regard, the availability of the 470-694 MHz band for wireless broadband services in Europe would further support the availability of nearly ubiquitous eMBB services and would also provide economically viable solutions for broadband connectivity.

Accounting for the above considerations, we recommend that RSPG in its Opinion on WRC-23 highlights the trend of decreasing DTT consumption in Europe against the background of growing demand for wireless broadband services requiring wide and deep coverage, as well as the growing role of fixed broadband services in delivering video content (e.g. via the OTTs' platforms, but also via the broadcasters' streaming platforms).

In this regard, we request that RSPG recommends to the European Commission to propose an EU position supporting a co-primary Mobile allocation of the 470-694 MHz band in Region 1 and IMT identification of the entire band, or parts thereof, for the countries of Region 1 wishing to do so. We also request that RSPG recommends to the Commission that Member States should not object to the potential requests from countries outside of Region 1 to add their names to the existing or new footnotes of the Radio Regulations related to the 470-694/698 MHz band at WRC-23.

Finally, we would also like to highlight that a potential decision of WRC-23 on a co-primary mobile allocation and IMT identification of the 470-694 MHz band in Region 1 will not require an immediate regulatory action. The timeframe for using the 470-694 MHz band, or parts thereof, for mobile broadband could be decided at national, sub-regional or regional level according to the situations in the respective geographical areas.

Studies in relation with RR Article 21

> The RSPG draft Opinion states: "*The overall EU interest in this matter is to strike the balance in frequency bands used for satellite reception and shared with equal rights with 5G/IMT stations using active antenna systems. Any solution should ensure that it does not impact the protection of satellite reception but too constraining restriction may impair the development of 5G/IMT.*
>
> *Note: The RSPG notes the current development regarding the above described topic and invites further input by the stakeholders*."

[9] GSMA, "Vision 2030: Low-Band Spectrum for 5G," report, June 2022.

Considering the studies in relation to Radio Regulations Article 21, we observe that the request contained in WRC-19 document 550[10] was to study the applicability of Radio Regulations Article 21.5 to IMT stations that use an antenna that consists of an array of active elements in the 26 GHz band; consequently, the studies should be focused on 26 GHz band.

Furthermore, we believe that the following elements should be taken into account:

- The **power** delivered to a transmitter should be interpreted as "the conducted power from a transmitter" to the antenna, consistent with the letter of the Article.
- There is no reference **bandwidth** specified in Radio Regulations Article 21.5; any specification of a reference bandwidth should be supported by specific studies concerning coexistence with satellite systems.
- Any update of Radio Regulations Article 21 should balance the due protection of satellite systems with the avoidance of undue constraints to the development of 5G/IMT systems.

Agenda Item 10 (agenda items for WRC-27)

The RSPG draft opinion states: *"Regarding Agenda Item 10, the RSPG is monitoring the development closely and may provide a view in the final Opinion."*

Background

The deployment of IMT-2030 networks beyond the year 2030 is expected to enable new use cases and applications associated with a considerable increase in wireless data traffic, and will require access to spectrum resource greater than what is currently available, or what is expected to be soon available (e.g., upper 6 GHz), for IMT-2020.

Noting the fairly long regulatory processes involved in the allocation or identification of new bands at the ITU-R and their subsequent assignment at national level, as well as the long lead times between the availability of a band and actual deployments, we consider that the time is right to look ahead towards WRC-27, and the potential harmonisation of new spectrum to meet the demands of IMT-2030.

ITU-R already began its forward-looking work in 2021 by examining future technology trends, and with the aim of producing a report which is expected to be completed this year[11]. Furthermore, the ITU-R 6G Vision Group has been tasked with defining the technology and its capabilities as the industry moves towards 6G standardisation. There has also been a flurry of recent announcements related to 6G, with governments and industry players outlining plans to move the concept beyond just a vision, and to identify use cases and roadmaps.

IMT-2030 use cases

Applications and services enabled by IMT-2030 will benefit from advances in new human-machine interfaces such as extended reality (XR) displays, haptic sensors, actuators, e-smell and e-taste capabilities, and even brain interfaces, whereby connected people can enjoy truly immersive experiences of events that are happening remotely in real time or are virtually generated. In addition, connected intelligent machines will be automated so that they can move in an ultra-fast and ultra-precise manner, facilitated through advances in machine perception, robotics, and artificial intelligence (AI).

[10] WRC-19 Document 550: "Note by the Chairman of Ad Hoc Group 4A of Plenary on agenda item 1.13 "Verification of No. 21.5 for the notification of IMT stations operating within the 26 GHz frequency range which use and antenna that consists of an array of active elements".

[11] ITU-R M.[IMT.FUTURE TECHNOLOGY TRENDS OF TERRESTRIAL IMT SYSTEMS TOWARDS 2030 AND BEYOND].

In the real physical world, humans and machines will continue to interact with each other through digital worlds that extend the real world by using a plethora of advanced sensors. Such digital worlds would not only replicate, but would also interact with, the real world, providing virtual experiences to humans and computer control to machines. These systems need to be trustworthy and at the same time enable significant computing power across networks and devices.

To interconnect the real physical world with digital worlds, IMT-2030 networks will play an important role in the communications infrastructure to:

1) collect real-time sensory data from everywhere in the physical world,
2) compute real-time immersive senses for humans, and controls for automated machines, and
3) deliver this computed data back to the physical world so that humans and machines can continuously interact with each other.

Examples of the above are depicted in Figure (9) [12].



Figure 9: Examples of 6G services.

IMT-2030 spectrum needs

To meet the capacity and coverage demands of IMT-2030 and to serve the diverse set of envisaged and emerging services and applications, multiple frequency ranges would be required – from the low to the very high frequencies.

While IMT-2030 will no doubt provide greater spectral efficiencies than IMT-2020 and will also utilise – in time – existing spectrum identified for past generations of IMT, this is not expected to be nearly sufficient to compensate for the demand for additional bandwidth for the implementation of IMT-2030 use cases. For this reason, the availability of spectrum bands that could support much broader and contiguous bandwidths for IMT-2030 should be explored:

- Spectrum from within the 7.125-24 GHz range – the so-called "cm-wave bands" – is essential to enable the envisaged capacity-demanding IMT-2030 use cases. We note that the lower portion 7.125-15 GHz achieves a superior balance between good coverage and high capacity, both of which are essential for IMT-2030 use cases which involve wider area mobility.

- The 7.125-24 GHz range should be complemented by spectrum from within the 92-300 GHz range – the so-called "sub-THz bands" – to enable the extremely high data rates (of the order of Tbit/s) and extremely low latencies that would be needed for some of the lower mobility IMT-2030 use cases, including direct device-to-device communications, sensing and recognition, as well as other local area use cases.

[12] Source: GSA presentation at The 8th Annual Asia-Pacific Spectrum Management Conference.

It is critical to emphasise the complementary nature and purpose of the 7.125-24 GHz and sub-THz ranges. Furthermore, as part of this exploration, the potential for coexistence between IMT-2030 and existing uses of the above frequency ranges will need to be addressed.

We acknowledge that the ranges 7.125-24 GHz and 92-300 GHz are very wide and studies of the entire ranges towards WRC-27 would not be feasible in practice. We expect that specific sub-bands from the above two ranges will be identified prior to WRC-23, and we note that a number of studies are already under way in this respect.