Consultation Title	**Public Consultation on the Draft RSPG Opinion on ITU-R World Radiocommunication Conference 2023**
Deadline	12 August 2022
Geographical Scope	European Union
Co-Signatories	Broadcom Inc., Cisco Systems Inc., Hewlett Packard Enterprise (HPE), Meta, Microsoft
Date	12 August 2022

Dear Colleagues,

The undersigned companies, representing an important cross-section of the world's leading silicon vendors, system manufacturers, and application providers, welcome the opportunity to respond to the Radio Spectrum Policy Group's opinion on the ITU-R World Radiocommunication Conference 2023 (WRC-23). This input focuses on the WRC-23 Agenda Item 1.2 for the 6 425 - 7 125 MHz band.

Executive summary position

The undersigned companies respectfully ask the Radio Spectrum Policy Group to recommend Option 2 on the band 6 425 - 7 125 MHz - "No IMT identification". The justification for this request is contained in the following sections.

Wi-Fi is integral to Europe's connectivity objectives.

Wi-Fi is at the heart of our increasingly digital economy. There are more than 18 billion Wi-Fi devices in use worldwide. Approximately 92% of fixed broadband traffic in Europe is relayed via Wi-Fi, according to ASSIA[1].

In 2021, 95% of internet traffic in Germany was transmitted over fixed networks and just 5% over mobile networks, according to a report by regulator BNetzA[2]. These numbers show that the absolute volume of Wi-Fi traffic is far greater than that handled by cellular technologies. In Germany, at least, the breakdown by technology is approximately 88% Wi-Fi, 7% Ethernet and 5% cellular.

[1] Source: the ASSIA "State of Wi-Fi" report, http://dynamicspectrumalliance.org/wp-content/uploads/2021/06/ASSIA-DSA-Summit-Presentation-v7.8.pdf
[2] Source: Tätigkeitsberichte Telekommunikation, https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Berichte/2021/TTB2020.pdf

As fibre networks expand, Wi-Fi will likely carry an even higher proportion of traffic. The FTTH Council Europe[3] anticipates that full fibre connectivity will cover 309 million homes by 2027 in the EU39, up from 217 million in 2022. It notes that fibre is increasingly being deployed in less densely populated areas. Some of these fibre networks will be capable of delivering 10 Gbps to a building in both the uplink and the downlink[4]. Wi-Fi enables this bandwidth to be easily shared by multiple users simultaneously.

UK regulator Ofcom has forecast that Wi-Fi demand in residential environments could grow between six and ten times between 2020 and 2030, driven by increased video quality and the adoption of virtual reality devices. In public venues, such as arenas or concert halls, demand could increase up to 15 times over the same period.[5]

The economic benefits are vast and growing. A study by Telecom Advisory Services found that Wi-Fi added over €406 billion to the EU economy in 2021, a number it expects to grow to €565 billion by 2025.[6]

In light of the above, the European Commission's decision to enable Wi-Fi access to the 5 945 – 6 425 MHz band (lower 6 GHz band) is a welcome development.[7] That decision has partially mitigated the spectrum shortfall facing Wi-Fi, but access to the remaining 6 GHz (6 425 – 7 125 MHz band, known as the upper 6 GHz band) is urgently needed to enable Europeans to take full advantage of the advanced Wi-Fi connectivity available today. Access to the full 6 GHz band is also critical for future-proofing Wi-Fi connectivity, noting that Wi-Fi 7 will be able to support multiple 320 MHz channel bandwidths.

Countries representing more than 40% of the global gross domestic product (GDP) have opened, or have proposed opening, the full 6 GHz band for licence-exempt use[8]. As a result, the number of Wi-Fi 6E[9] devices that work across this spectrum is growing rapidly. Research firm IDC anticipates that more than 350 million Wi-Fi 6E products will enter the market in 2022[10].

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[3] FTTH Forecast for EUROPE - Market forecast 2022-2027, FTTH Council Europe, https://www.ftthcouncil.eu/knowledge-centre/all-publications-and-assets/1462/ftth-market-forecasts-2022-2027
[4] For example, Virgin Media O2 plans to bring 10 Gbps fibre connections to more than 14 million homes in the UK. https://news.virginmediao2.co.uk/virgin-media-o2-bolsters-future-network-with-fibre-upgrade-plan/
[5] See UK Ofcom Improving Spectrum Access for Wi-Fi, July 2020, at ¶ 3.24, available at https://www.ofcom.org.uk/__data/assets/pdf_file/0036/198927/6ghz-statement.pdf
[6] Discover Wi-Fi: Value of Wi-Fi, Wi-Fi Alliance, https://www.wi-fi.org/discover-wi-fi/value-of-wi-fi
[7] Commission Implementing Decision of 17.6.2021 on the harmonised use of radio spectrum in the 5 945-6 425 MHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs), available at: https://digital-strategy.ec.europa.eu/en/library/6ghz-harmonisation-decision-more-spectrum-available-betterand-faster-wi-fi
[8] http://dynamicspectrumalliance.org/wp-content/uploads/2021/08/6GHz-License-Exempt-Band-Why-1200-MHz-and-Why-Now.pdf
[9] Wi-Fi 6E refers to Wi-Fi 6 operating in the 6 GHz band.
[10] IDC Research, January 2022.

Wi-Fi 6E can support various demanding use cases, such as ultra-HD video streaming, smart home automation, hotspot access, automation of city-wide services, augmented/virtual/ extended reality (AR/VR/XR) applications, health monitoring, wearables, and seamless roaming. Moreover, Wi-Fi 6 is the only cost-effective option to distribute gigabit connectivity within schools and hospitals for eEducation and eHealth services.

Wi-Fi 7 is critical to the connectivity objective of the Digital Decade Policy programme.

The EU recently adopted the Digital Decade Policy Programme. The connectivity goals are to ensure that all end users at a fixed location are covered by a Gigabit network.

While gigabit connectivity socket will be available in every premise in Europe by 2030, the challenge for end users will be to distribute this connectivity within the premises, including to terminals such as laptops, tablets and smartphones.

Opening new spectrum for Wi-Fi will enable European governments to show that the push to deploy fibre can actually deliver measurable and future-proof benefits to citizens. Adding advanced Wi-Fi technology to the end of fibre deployments will help close the loop between government planning and benefits to citizens and governments[11].

Wi-Fi 6E, and the forthcoming Wi-Fi 7 standard, need access to the entire 1200 MHz to utilise the full extent of their capabilities and support evolving and emerging innovative use cases, now and in the future. Opening only 480/500 MHz in the lower 6 GHz band would mean that Wi-Fi networks in dense deployments would have to continue employing small channel bandwidths, as only one 320 MHz channel or three 160 MHz channels would be available. With access to 1200 MHz, more of these wide channels could be accommodated, significantly improving the performance available to each user. For more detail, see the Intel report *Spectrum needs of Wi-Fi 7*.[12]

Wi-Fi provides affordable connectivity to close the digital divide.

As noted in the European Commission's *2030 Digital Compass: the European way for the Digital Decade*, a new digital divide has emerged between those who can fully benefit from an enriched, accessible and secure digital space with a full range of services and those who cannot. The European vision for 2030 is a digital society where no one is left behind.

[11] In June 2022 the University of Michigan announced to have completed the upgrade of their Ann Arbor and Dearborn campuses, by replacing more than 16,000 wireless access points in over 225 indoor and outdoor locations. See https://michigan.it.umich.edu/news/2022/06/28/u-m-first-in-nation-to-offer-wifi-6e-universitywide-accomplishment-is-aninvestment- in-the-future/

[12] https://www.intel.com/content/www/us/en/wireless-network/spectrum-needs-of-wi-fi-7.html (last visited 15 July 2022).

As users do not need to pay licence fees to use the spectrum, Wi-Fi is one of the most cost-effective ways to provide connectivity. Wi-Fi also enables multiple people to share a single broadband connection, reducing the cost of connectivity for everyone. As the Wi-Fi 6E market grows, economies of scale are realised, ensuring that the technology will be highly affordable, like its predecessors.

Many regulators believe withholding the upper 700 MHz of the 6 GHz band would damage this dynamic. ISED in Canada said such a move would "hinder access to affordable broadband services for Canadians in rural and urban areas and would negatively impact the opportunities for innovation."

Reserving a portion of the 6 GHz band for a later decision on whether to allow IMT (or not) would forego the immediate economic gains that would have accrued from opening the entire 6 GHz band to licence-exempt operations. In an August 2020 report[13], Coleago Consulting estimated that 5G would not be deployed in the 6 GHz band for at least a decade. In a subsequent report[14] published in July 2022, the GSMA calls for the 6 GHz spectrum to be available for 5G by 2030. Between now and then, the global economy would forego the vast economic value that Wi-Fi 6E would generate.

If the entire 6 GHz band is made licence-exempt, it could be used by a variety of wireless technologies to provide high-speed Internet access to buildings that have not yet been reached by fibre networks. Community Wi-Fi networks, for example, are widely used to bring Internet access to multiple households. This flexibility would be lost if the spectrum were to be licensed to a small number of MNOs for IMT services alone.

Enabling Europe to shift towards sustainability.

Digital technologies, including Wi-Fi, will play a pivotal role in achieving the objectives of the European Green Deal. Connectivity can be used to curb greenhouse gas emissions, as well as humans' broader impact on the environment.

At a more fundamental level, digital connectivity can also reduce travelling, enabling people to fulfil tasks and conduct meetings remotely, rather than driving or flying. As it can deliver high-speed and very responsive connectivity, Wi-Fi 6E is also well suited to delivering VR/AR services that can help people interact effectively without being physically present in the same location. VR/AR is increasingly used for training and education and to help field engineers make repairs or install new equipment. Most of these applications will be used indoors, where Wi-Fi is the technology of choice. In outdoor scenarios, Wi-Fi will be widely used to connect smartphones to VR/AR headsets.

In cases where travel is necessary, Wi-Fi can help make public transport more appealing, thereby

[13] See section 7.3 of the report: The 6 GHz Opportunity for IMT, which says "recognizing the 10+ year timeframe anticipated for 5G at 6 GHz".
[14] 6 GHz in the 5G Era, see Page 5.

reducing congestion and emissions caused by private cars. Wi-Fi can make travel time more enjoyable and productive for passengers by providing onboard connectivity on trains, buses, trams, and stations. Wi-Fi connectivity is now a standard feature on board trains in developed markets.

At the same time, Wi-Fi is becoming more efficient, thanks to new features, such as target wake time and the OFDMA radio interface, which reduce power consumption. Most Wi-Fi networks operate at much lower power levels than cellular systems, so they could be the most energy-efficient connectivity option in many scenarios.

Indeed, the French regulator ARCEP[15] found that the combination of fibre and Wi-Fi is the most efficient solution in terms of energy consumption, performance, and flexibility. Energy efficiency will be particularly important in the light of the emerging energy crisis caused by the conflict in the Ukraine, while also helping the EU to achieve its sustainability targets. Employing Wi-Fi, rather than IMT, in the 6 GHz band will require less power, helping Europe to make better use of scarce energy resources.

The ITU has forecast[16] that the energy used by mobile networks around the globe will emit 73.0 Mt CO2 equivalent (CO2e) in 2025, compared with 35.2 Mt CO2e for fixed networks. Considering the share of mobile data and fixed broadband lines in Europe, around 4.8 Mt CO2e will be emitted from fixed networks and 10 Mt CO2e from mobile networks in the EU. That suggests fixed networks produce less than half the CO2e of mobile networks, even though they transport more than ten times the amount of data.

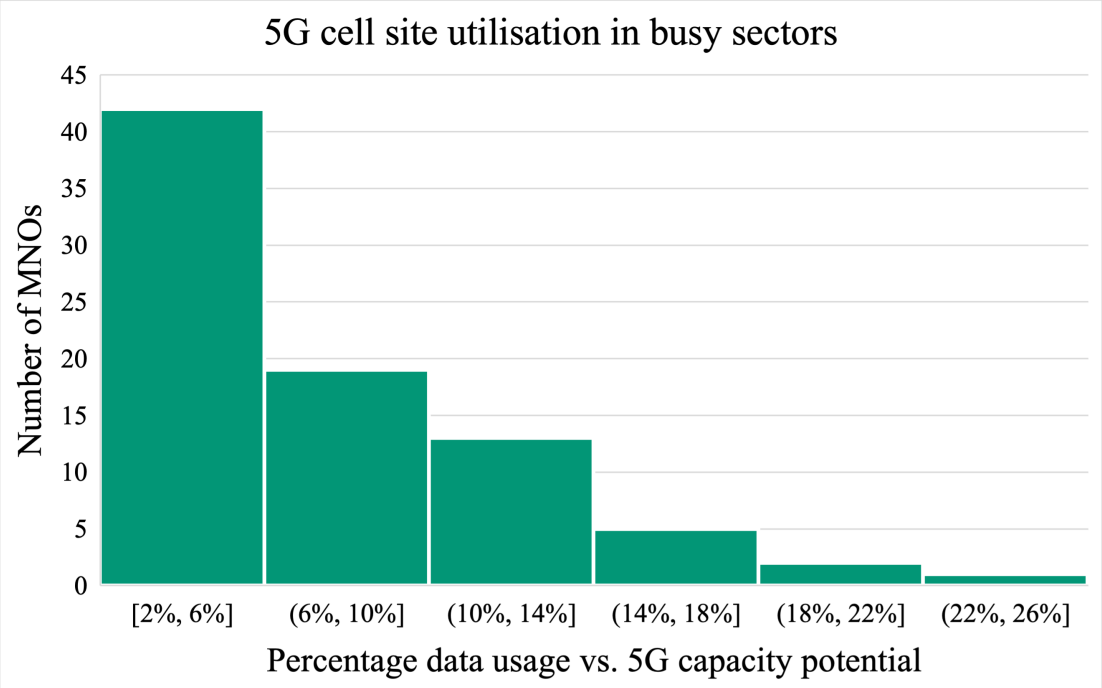
Furthermore, Wi-Fi 6 introduces new features to support IoT deployments, such as support for large numbers of simultaneous connections. As a result, more IoT devices will be able to send more information and use less power.

5G already has access to sufficient spectrum.

Today, Europe's 5G networks are operating well below capacity. A study of mobile data usage in 2021 by Rewheel found that, even in the top 5% of the busiest sectors, 5G traffic runs at only 7.7% of capacity on average[17]. In other words, usage of 5G to date shows that additional mid-band spectrum is not required.

[15] https://en.arcep.fr/uploads/tx_gspublication/achieving-digital-sustainability-report-dec2020.pdf
[16] Source: ITU, Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement, 2020.
[17] Analysis based on the 82 5G networks considered in EU27 by Rewheel research's study "Mobile data usage in 2021 and 4G & 5G operator capacity potential", published in March 2022. https://research.rewheel.fi/downloads/Mobile_data_usage_2021_capacity_potential_170_operators_50_countries_PUBLIC_VERSION.pdf

The graph below shows an aggregated analysis of 82 mobile operators based on the research by Rewheel. As we can see, over 60% of EU27 mobile network operators operate below 10% of their capacity in their 5G busiest sectors, which means that the average nationwide is even lower.



Successive WRCs have identified specific frequency bands for the deployment of IMT systems, and this spectrum constitutes a good mix of 'coverage' bands (below 5 GHz) and capacity bands (mmWave spectrum above 24 GHz). In Europe, 1018.5 MHz of low and mid-band spectrum can be used by Wi-Fi, whilst 1368 MHz is allocated for IMT services. In Europe, CEPT has already made all the IMT mid-bands technology neutral, allowing the use of this spectrum for 5G.

The large amount of spectrum below 5 GHz already identified for IMT could, and should be, harnessed to improve coverage before specifically identifying more spectrum for IMT. As of 31 August 2021, only 56% of the EU harmonised radio spectrum for 5G had been awarded across the Member States[18]. According to the latest 5G Observatory Quarterly Report, 22% of the EU27 countries have yet to assign the 3.5 GHz pioneer band[19]. For those countries where the 3.5 GHz has been assigned to operators, only a small portion of the overall 5G networks of those operators run on 3.5 GHz. Indeed, the number of 5G sites using 3.5 GHz is equivalent to only 3.6% of all 4G sites, whilst the most common type of 5G base station makes use of 4G bands in a dynamic spectrum sharing configuration.

As the 3.5 GHz band isn't being heavily used, it won't be congested anytime soon. Even when the utilisation of 3.5 GHz increases, the 3.8-4.2 GHz band should provide ample additional capacity for 5G

[18] The bands are 700 MHz, 800 MHz, 900 MHz, 1.5 GHz, 1.8 GHz, 2 GHz, 2.6 GHz, 3.4-3.6 GHz, 3.6-3.8 GHz, and 26 GHz. Source Digital Economy and Society Index (DESI) 2021.
[19] 5G Observatory Quarterly Report 16 July 2022 - https://5gobservatory.eu/5g-observatory-releases-new-july-2022-report/

to cover the use cases that need a licensed technology.

Although the U.S. has made the entire 6 GHz band licence-exempt, the mobile operators there have plenty of spectrum to meet the demand for 5G. For example, leading US telecoms operator Verizon is seeing strong growth in 5G fixed wireless access connections in the C-band (3.7–4.2 GHz). In July 2022, Hans Vestberg, Chairman and CEO of Verizon Communications, told analysts on an earnings call[20]: "The capacity in the network is there, there's no problem. … we have deployed 60 MHz of the C-Band. We have, on average, 160. So, we have so much more to go."

Furthermore, most countries in the EMEA region are considering making the 3 300 – 3 400 MHz, 3 800 – 4 200 MHz and 4 800 - 4 990 MHz bands available for licensed spectrum use.

Mobile network operators (MNOs) greatly benefit from Wi-Fi's capacity to offload traffic from cellular mobile devices; if this capacity were not available, IMT/5G networks would be more costly, as mobile operators would need to deploy many more small cells in dense urban areas to offer gigabit throughput and provide adequate quality of service, and this would be to mobile users only. Because of the attenuation of signals from outdoor 5G base stations (building entry loss), 5G indoor coverage and performance would be severely limited. Providing 5G gigabit connectivity indoors would require deploying entirely new infrastructure parallel to the existing Wi-Fi one, which will be prohibitive from both a commercial and an environmental point of view.

Mobile operators would be very unlikely to use spectrum in the 6 GHz band nationwide. Given the characteristics of the upper 6 GHz band, the spectrum would likely be used by MNOs to provide additional outdoor coverage in dense urban and, to a lesser extent, suburban areas - locations with extensive deployments of FTTH. Regardless of whether 5G has access to the 6 GHz spectrum, these fibre networks, together with Wi-Fi, will be used to provide indoor coverage – employing outdoor IMT base stations for this purpose is not technically or economically feasible.

More broadly, with public wide area networks, the requirement to synchronise networks makes it impossible to avoid interference and have flexible networks. An operator that attempts to offer very low latency would have to create interference to other operators or to its network unless every network nationally operates at very low latency, which is not efficient for macro-cells. The configuration of a nationwide network results from compromises between coverage, capacity, latency and the cost of the network.

Indeed, demanding industrial applications, such as factory robots and sensors, augmented reality (AR), healthcare monitors, and wireless medical equipment, can be realised with licence-exempt technologies, specifically with Wi-Fi 6E and Wi-Fi 7. Unlike previous generations of Wi-Fi, Wi-Fi 6/6E and Wi-Fi 7 are based on OFDMA technology and can achieve very high quality of service (QoS)

[20] https://www.verizon.com/about/investors/quarterly-reports/2q-2022-earnings-conference-call-webcast

levels, particularly in managed networks run by enterprises.

There are various other QoS-enhancing mechanisms and features, particularly in Wi-Fi 7, such as multi-link operation that will improve throughput by aggregating links, enhance reliability by transmitting multiple copies of the same frame in separated links, decrease channel access delay by selecting the first available link in terms of latency, and enable isolation of time-sensitive traffic from other network traffic.

To use spectrum most efficiently, applications necessitating a licensed regime could instead utilize the 3.8-4.2 GHz band, which was made available for use by private and local networks and is already supported by 5G NR.

A common EU position on WRC-23 Agenda Item 1.2 (6425-7125 MHz).

The Commission Implementing Decision (EU) 2021/1067 of 17 June 2021 established the regulatory conditions necessary for operation in the 5 945 – 6 425 MHz frequency band. The decision was taken following extensive technical studies which determined that low-power indoor and very low-power portable licence-exempt networks (e.g., Wi-Fi) can coexist with important incumbent operations. Whilst technical studies on the operation of 5G/IMT services in the upper 6 GHz band are ongoing, they will almost certainly conclude that incumbents in the upper 6 GHz band will need similar levels of protection. Such requirements would allow licence-exempt networks (e.g., Wi-Fi) to operate in the band, but would make deployments of 5G/IMT networks commercially unviable.

In any case, the results of the IMT coexistence studies need to be supplemented with further research to make an informed decision on the future of the upper 6 GHz band. Indeed, each national administration needs to assess the extent to which the assumptions and criteria used in the studies apply to their own country. In many cases, the national regulatory authority will have to consider whether to run the studies with the actual data for their country (e.g. location of the fixed links, more precise assumptions on the likely density of IMT base stations, etc.).

Even if the technical studies suggest that limited IMT services could coexist with the incumbent services, it will still be necessary to assess whether the technical constraints of coexistence would be enough to support commercial mobile services that bring socio-economic benefit to citizens and businesses. Note, such constraints will most likely curb the funds governments would hope to raise for the spectrum licences.

More broadly, Europe needs to consider how reserving the upper 6 GHz band for licensed IMT services could hold back its digital economy. If, as a result of the WRC-23 proceedings, Region 1 were to identify the upper 6 GHz band for IMT, there is a danger that Europe would be left trailing behind

other parts of the world in terms of connectivity. Whereas the Wi-Fi ecosystem has already certified hundreds of devices that can operate across the full 6 GHz band and the market has already seen large Wi-Fi 6E deployments[21], the IMT ecosystem would have to invest considerable time and resources to develop and deploy compatible devices, following lengthy and complex licence assignment processes.

The upper 6 GHz band is not an appropriate 6G priority band for the EU.

The RSPG suggests spectrum demand for IMT-2030 (i.e. 6G), as one question to be answered when considering the future European policy strategy on 6 425 - 7 125 MHz. All data available so far suggests that the upper 6 GHz band is not an appropriate 6G priority band for the EU.

Some administrations suggested that the upper 6GHz band could respond to 6G spectrum demand, due to its similarity with the 3 400 – 3 800 GHz band. 6G spectrum requirements are not defined yet, but experience suggests that each generation needs much wider channel than previous generation to deliver a step increase in performance. 3G leveraged 5MHz, 4G leveraged 20MHz and 5G 100MHz. The upper 6GHz will not be able to support much wider channels than the 3.6 GHz band.

Furthermore, the upper 6 GHz would support inferior propagation compared with the 3.6 GHz band. MNOs would always use the band with the most favourable propagation characteristics to deploy their new network. This is exactly what happened in Europe where 4G was deployed in the 1 800 MHz rather than in the 2 600 MHz band. The EU 5G observatory also indicates that 5G is mostly deployed in lower bands, including the 1800MHz, rather than in the 3.6 GHz band (only 3% of EU base stations are equipped with 3.6GHz).

IMT in the upper 6 GHz band will suffer from severe restrictions, according to ITU studies. Coexistence requires a stringent limitation of base station density, deploying the base stations below rooftop and deploying only in urban and suburban areas. Even if Europe was to remove all fixed links from the upper 6 GHz band, a costly and damaging process for many EU Member States, it would still need to protect satellite services. Adopting this band as 6G priority band would prevent 6G in most suburban and rural areas. 6G in Europe would be limited to an urban hotspot deployment.

Finally, this would prevent harmonisation of the EU 6G ecosystem with most western countries. The loss of harmonisation and economies of scale, as well as the alignment on a low-cost ecosystem, would impact both EU end users and innovators.

While some EU Member States may prioritise the protection of their non-IMT national interest in other

[21] In June 2022 the University of Michigan announced to have completed the upgrade of their Ann Arbor and Dearborn campuses, by replacing more than 16,000 wireless access points in over 225 indoor and outdoor locations. See https://michigan.it.umich.edu/news/2022/06/28/u-m-first-in-nation-to-offer-wifi-6e-universitywide-accomplishment-is-aninvestment- in-the-future/

bands, the selection of 6G priority band for the EU should consider both the 6G spectrum requirements and the economic benefits of harmonisation.

Selecting the upper 6GHz band as the EU 6G priority band would significantly and negatively impact Europe's ability to leverage 6G's innovation potential.

In conclusion, the undersigned companies respectfully ask the Radio Spectrum Policy Group to recommend Option 2 on the band 6 425 - 7 125 MHz - "No IMT identification" for WRC-23 Agenda Item 1.2.

Respectfully submitted,

/s/

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