Cisco Systems Belgium
sprl/bvba
Pegasus Park
De Kleetlaan 6A
B-1831 Diegem
Belgium
Direct: +32 2 704 60 00
www.cisco.com

23 December 2024

VIA EMAIL (cnect-rspg@ec.europa.eu)

Radio Spectrum Policy Group
RSPG Secretariat, office L-51 05/DCS
European Commission
1049 Brussels
Belgium

Cisco Comments on Draft RSPG Opinion
6G Strategic Vision (RSPG24-030 FINAL)

Introduction

Cisco is a leading provider of hardware, software, and services to create Internet solutions. Every day, we strive to provide services of the highest quality to electronic communications providers, cloud hyperscalers, and enterprises across Europe and around the world so that our partners may deliver seamless and reliable connectivity to the market. In doing so, we have observed first-hand the challenges and opportunities faced by participants across the industry, and we are therefore grateful for the opportunity to contribute to the Radio Spectrum Policy Group's draft report on its 6G Strategic Vision.[1]

Cisco has a broad perspective on 6G spectrum policy because 6G will be a critical component of global connectivity for all our customers. As the Draft Report states, technologies like commercial 5G, Wi-Fi, satellite, and private wireless networks are converging to provide ubiquitous connectivity, each contributing to Europe's economic and societal success and 2030 Digital Decade Targets. We encourage the RSPG and other policymakers to embrace this trend with technology neutral spectrum policies that focus on the needs of European businesses and consumers.

Connectivity is critical to Europe's economic and social progress. As observed in former Italian Prime Minister Mario Draghi's recent report on European competitiveness:

> Broadband connectivity (fiber, 4G and 5G) drives the competitiveness of industrial and service companies.... Data streaming for consumers and businesses, data exchanges across companies and institutions, machine-to-

[1] Radio Spectrum Policy Group, "6G Strategic Vision: Draft RSPG Report," RSPG24-030 FINAL (13 Nov. 2024) ("Draft Report").

machine (M2M) and internet of things (IoT) connections, AI for industrial applications and robotics, will all require faster, lower-latency, more ubiquitous and secure connections across enterprises, SMEs, public offices and homes.[2]

To achieve this outcome, policymakers must adopt spectrum policies focused on meeting Europe's connectivity goals.

Whilst Europe has made great progress towards meeting its 2030 Digital Decade goals, recent data shows that it will likely fall short at the current pace. As the Draft Report appears to recognize, accelerating this progress in preparation for 6G will require a new approach towards spectrum policy. Public mobile cellular networks will be a critical part of 6G, particularly for use cases requiring mobility or outdoor connectivity. But policymakers must consider 6G as more than just another generation mobile network in isolation. Europe's economic and social development requires policies framing 6G as an integration of public, unlicensed, and private wireless networks capable of securely handling high data volumes with high throughput and low latency from origination to termination.

This ongoing convergence reflects the interests of European end users. Consumers and businesses primarily care about the quality of their network connection, not the underlying technology. Their needs will drive the Continent's economic and social development, and policymakers should adopt spectrum policies that encourage the best combination of wireless technologies to meet those needs. That means encouraging the use of sharing, whether across different operators or different technologies. In particular, policymakers should adopt 6G spectrum policies that allow for the integration of private networks using 5G (and 6G) and unlicensed technologies to provide a seamless delivery of service across these multiple platforms for end users – whether businesses or consumers.

One area of particular focus is the upper 6 GHz band (6425-7125 MHz). As the Draft Report states, mobile network operators (MNOs) and other advocates want the band for 5G/6G. While Cisco agrees that spectrum resources are critical to the future of the MNOs, we strongly believe that the upper 6 GHz band is better suited for unlicensed use.

---

[2] Mario Draghi, "The Future of European Competitiveness," Part B at 70 (September 2024) ("Draghi Report"), https://commission.europa.eu/document/download/ec1409c1-d4b4-4882-8bdd-3519f86bbb92_en?filename=The%20future%20of%20European%20competitiveness_%20In-depth%20analysis%20and%20recommendations_0.pdf. *See also* Enrico Letta, "Much More Than a Market" at 55 (April 2024), https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf.

Wi-Fi deployments in both the home and industrial/enterprise scenarios already provide cost-effective networks with reasonable levels of Quality Of Service (QOS), including in general lower latency and better Jitter performance than can be achieved by public cellular 4G/5G networks today. This has resulted in Wi-Fi becoming the dominant technology for the origination and termination of wireless traffic – particularly indoors -- whether the underlying broadband connection is fiber, 4G/5G, satellite, or another technology. As a result of this success, existing unlicensed bands are becoming congested and due to a variety of factors (e.g., an enormous device ecosystem coupled with backward compatibility), performance in the current bands has begun to suffer.

Access to the lower 6GHz band and improvements in equipment performance through the introduction of the Wi-Fi 6E and Wi-Fi 7 standards have alleviated some of these congestion issues in the short term. But in the mid to long term, without additional spectrum in the upper 6 GHz band, Europe will struggle to compete with countries that have already made 1200 MHz available in the 6 GHz band, and to deliver new applications and services that will require indoor networks with higher bandwidths and lower latency. This gap will be particularly acute in the industrial and enterprise spaces.

The upper 6 GHz band is better suited for unlicensed use than IMT because Wi-Fi operations can coexist with incumbent operations in the band without the more disruptive sharing choices necessary for IMT operations in the band. Indoor unlicensed operations will also be more sustainable than macro-cellular public IMT in providing future indoor networking service in the 6 GHz band. The market seems to recognize these limitations, as evidenced by Hong Kong's disappointing 6 GHz auction.

The RSPG and other policymakers should consider other spectrum bands and other strategies for the provision of indoor services for 6G. While densification may present some challenges, operations using a combination of existing 4G/5G and Wi-Fi networks are already evolving in ways that may mitigate these issues for 6G, including increased Wi-Fi offloading, the introduction of Pass point and Open Roaming for smartphone users, and the use of shared infrastructure, neutral hosting, and shared spectrum. These trends and additional initiatives like emergency calling on Wi-Fi networks, will help MNOs and end users take advantage of ongoing network convergence trends to deliver the most cost effective, secure and seamless connectivity outcomes for Europe.

Discussion

I. 6G Spectrum Policy Should Embrace Convergence and Spectrum Sharing

Cisco is committed to the EU's achievement of its 2030 Digital Decade Targets, including that all Europeans have access to 5G communications and Gigabit connectivity by 2030. The 2024 report of the EU Commission on the Digital Decade[3], however, shows that the collective efforts of Member States are currently falling short of those goals, particularly for high-quality connectivity. The EU has set a goal of Gigabit coverage by 2030, yet the report shows that only 64% of households have access to fiber, with the rate of progress (13.5%) being far less than needed to reach the target. Moreover, only 18.5% of households with such access subscribe to those Gigabit connections. Similarly, coverage of high-quality (pioneer band) 5G extends to only 50% of EU territory, with a relatively small percentage of standalone 5G deployments.

As the Draft Report acknowledges, convergence of different communications technologies is key to achieving full connectivity for Europe.[4] That perspective is reflected in the Draghi Report's recommendation for a holistic approach to spectrum policy, seeking "the release of additional WiFi-dedicated bands into the spectrum guidelines, allocating enough spectrum to 5G and 6G, while preserving the viability of private WiFi in the long term."[5]

Thus, in developing 6G spectrum policy, the RSPG and other policymakers must not approach the 6G technology debate in isolation. Instead, policymakers should adopt technology neutral spectrum policies that allow the best suited technology – whether 5G/6G, unlicensed, satellite, etc. -- to meet Europe's connectivity needs.[6] As the Draft Report states:

> Understanding and accepting the roles of different wireless technologies without biases, especially in the context of indoor usage, is important. End users use a variety of wireless technologies in a variety of spectrum bands under different spectrum access models without noticing it or the need to notice it. Unnecessary confrontations emphasizing communities (e.g.,

[3] European Commission, 2024 State of the Digital Decade Report at 16 (6 November 2024), https://digital-strategy.ec.europa.eu/en/factpages/state-digital-decade-2024-report.

[4] *See, e.g.,* Draft Report at 33 ("The convergence of non-3GPP and 3GPP networks presents a compelling opportunity to weight the strengths of different technologies and by combining the best of their characteristics, will potentially create a unified network that delivers a superior user experience.")

[5] Draghi Report at 75.

[6] *See, e.g.,* European Council Conclusions on the EC White Paper, "How to Master Europe's Digital Infrastructure Needs," at 12 ("NOTES that technology-neutral spectrum harmonisation in the EU facilitates developments at national and Union level and favourable investment conditions.").

> WiFi/3GPP/satellite community) are not helpful in promoting digitalisation of societies but have created barriers.[7]

Policymakers like the RSPG should make spectrum decisions based on rigorous assessments of technical, economic, public safety, and other public interest considerations. Some use cases may be best served by full-power, exclusive licensing of 5G or 6G operations in a particular band. Such deployments when using the correct spectrum bands for coverage excel at delivering mobile or outdoor connectivity. Other use cases may be better suited for shared or unlicensed service at lower power in other bands; for example, indoor connectivity for residential or enterprise. Satellite may be the best technology for certain remote or unserved areas. Ultimately, however, end-to-end connectivity in most cases will be delivered by a combination of technologies with various characteristics and requirements.

As the Draft Report recognizes, 6G spectrum policymaking must not only

> identify which frequency band(s) should be made available for the launch of 6G mass market but also to support development of various vertical markets. The emphasis lies on inter-service spectrum sharing which involves sharing between different radiocommunication applications. With the growing pressure on spectrum, inter-service sharing is becoming increasingly important.[8]

Spectrum coexistence frameworks are well suited for the changing nature of 6G wireless use cases. As the Draft Report states, "spectrum sharing is a strategic pillar of spectrum management."[9] Indeed, earlier this year, France, Sweden, Finland, the Czech Republic, and the UK signed a joint statement with several other major global economies committing to advance "6G technologies that use spectrum efficiently and incorporate spectrum sharing mechanisms by design to coexist with incumbent service providers."[10]

Shared spectrum, with lower power limits and smaller geographic license sizes, enables more players to enter the marketplace, creating opportunities for innovative wireless services, which typically require high capacity in localized areas. Spectrum sharing – whether via 5G/6G, unlicensed, or some combination of these or other technologies -- will drive the private wireless networks that are not only critical to the manufacturing, automotive, agriculture, energy, retail, communications, media, and supply chain industries—but also vital for schools, libraries, and civil society groups.

---

[7] Draft Report at 32.

[8] Draft Report at 3.

[9] Draft Report at 17.

[10] Press Release, "Finland Agrees on Principles Guiding 6G Development with Partner Countries," (2 February 2024), https://lvm.fi/en/-/finland-agrees-on-principles-guiding-6g-development-with-partner-countries.

In the United States, for example, the spectrum sharing framework in the Citizens Broadband Radio Service ("CBRS") band has enabled an influx of diverse uses and participants in the band, increasing overall connectivity in education, healthcare, agriculture, manufacturing, and the military. Further, the market for CBRS services and devices is vibrant and growing, with approximately 400,000 CBRS base-station devices in use as of July 2024.[11] This experience should be instructive for future European policymaking.

As the Draft Report notes, unlicensed spectrum is another important complement to fixed and traditional mobile networks.[12] Over 90 percent of internet traffic travels over Wi-Fi.[13] Wi-Fi is relied on nearly everywhere—from homes and offices to universities, hospitals, and sports and entertainment venues, to factories and other industrial settings—for high-speed, inexpensive indoor and outdoor wireless connectivity. Even most mobile traffic is offloaded to Wi-Fi networks.[14] In today's 5G environment, there is significant coordination and collaboration between unlicensed and exclusive-licensed technologies. The use of Wi-Fi to offload 4G/5G traffic, for example, demonstrates how the technologies and network access models converge to maximize connectivity. 6G environments should build upon this coordination and collaboration.

Wi-Fi and cellular networks can complement each other to form a strong and pervasive mobile access fabric. Wi-Fi deployments may be strong in locations where the local cellular airspace is overcrowded or the indoor cellular signal is unreliable. In some locations it may not be financially realistic for MNOs to densify their networks to achieve strong indoor connectivity. In these situations, Wi-Fi and cellular networks can reinforce each other by using Wi-Fi to offload cellular traffic while providing dependable service, particularly in crowded locations like airports, sports venues, and retail locations. As Cisco's Wireless CTO recently stated:

> From a cost-per-bit standpoint, the way I look at it is these are collaborative technologies, 5G and Wi-Fi, and if you're a service provider that's doing a macro 5G network, what you really want to do is to leverage those Wi-Fi

---

[11] Douglas M. Boulware and Anthony W. Romanielo, NTIA, "An Analysis of Aggregate CBRS SAS Data from April 2021 to July 2024," NTIA Report 25-575 at 3 (Nov. 18, 2024), https://www.ntia.gov/report/2024/analysis-aggregate-cbrs-sas-data-april-2021-july-2024. While the Draft Report expresses an interest in "avoid[ing]" the "complexity" of CBRS (Draft Report at 20), US regulators have initiated changes to capitalize on the successes of the CBRS band and increase operations.

[12] Draft Report at 9 ("In recent years, there has been a growing demand for high-speed and reliable connectivity leading to a significant densification of IMT networks and fixed broadband networks served by WAS/RLAN.").

[13] Dynamic Spectrum Alliance, "How Do Europeans Connect to the internet" at 4, 8 (2022), *available at* http://dynamicspectrumalliance.org/wp-content/uploads/2022/06/DSA-WhitePaper-How-do-Europeans-connect-to-the-Internet.pdf.

[14] Dynamic Spectrum Alliance presentation, "6 GHz Band for Wi-Fi: Source of value for consumers, industry, GDP and social impact" (June 2022). *See also* Nokia, www.nokia.com/networks/mobile-networks/small-cells ("90% of time typically spent indoors; 80% mobile traffic originating indoors").

> networks.... When's the last time you walked in a building and Wi-Fi didn't exist? It's already there. It's already deployed.[15]

Open roaming arrangements will allow for secure and seamless coverage across different environments—including different indoor and outdoor settings serviced by Wi-Fi and future 6G vendors and systems. Cisco's OpenRoaming project, for instance, allows an end user to connect a device to Wi-Fi and roam easily between networks—including Wi-Fi and cellular—controlled by multiple parties.[16] This arrangement ensures that "a user or a device can have 'always on' connectivity without requiring any user intervention or a user-driven configuration change," and allows service to be delivered economically, advancing digital inclusion.[17] Because of Wi-Fi's lower power levels, such internetworking can also lower the total energy footprint associated with connectivity to a given location. Such continuous connectivity would also enhance public safety by creating redundancy for emergency communications when one or more connectivity options become unavailable.[18]

In addition to encouraging spectrum sharing adoption, the RSPG should support research and development to improve dynamic spectrum sharing technologies for 6G. To increase spectral efficiency, the goal should be to build upon, rather than restrict, existing spectrum sharing technologies. Such sharing would increase efficiency in both a single network, as well as in situations where multiple parties share the same frequencies. For example, 3GPP has introduced a Dynamic Spectrum Sharing ("DSS") feature for 5G NR that "enables 4G LTE and 5G NR to operate in the same frequency band on the same carrier simultaneously."[19] This could be further developed for next-generation systems "to incorporate more, or all, possible dimensions, including across locations, frequencies, time, users, and applications."[20]

For 6G, the dynamic sharing concepts reflected in the current 3GPP standard could be expanded to facilitate sharing among different systems and incorporating new technologies, "such as advanced spectrum sensing, interference analysis and avoidance, AI/ML-based sharing control, inter-system/inter-user direct signaling for spectrum sharing, and hierarchal spectrum management system for DSS."[21] Such sharing is already taking place in the unlicensed context, with standard power Wi-Fi operations in the 6 GHz band

---

[15] Monica Alleven, "Here's How Cisco's Wireless CTO Sees Wi-Fi and Private 5G," Fierce Network (Nov. 21, 2024), https://www.fierce-network.com/wireless/heres-how-ciscos-wireless-cto-sees-wi-fi-and-private-5g.

[16] *See OpenRoaming*, Cisco, https://www.cisco.com/c/en/us/solutions/enterprise-networks/802-11ax-solution/openroaming.html (last visited Aug. 20, 2024).

[17] Purdue Univ. *et al.*, *6G Global Roadmap: A Taxonomy* at 21 (2023), *available a*t https://www.purdue.edu/newsroom/releases/2023/Q4/purdue-and-six-companies-chart-a-taxonomy-of-6g-technologies.html ("6G Global Roadmap Report").

[18] *See, e.g.*, Commc'ns Sec., Reliability, and Interoperability Council VIII, *Report on 911 Service Over Wi-Fi*, at 10 (2023), https://www.fcc.gov/sites/default/files/CSRIC8-Report-911overWi-Fi032123.pdf.

[19] 6G Global Roadmap Report at 20.

[20] *Id.*

[21] *Id.*

using Automated Frequency Coordination (AFC) technology and databases to coexist with incumbent fixed-link operations. For 6G, regulators should encourage similar innovations that allow dynamic shared spectrum beyond traditional contention-based access models.

II. The Upper 6GHz Band Should Be Used for Unlicensed Operations – not 6G

As noted above, the overwhelming majority of all internet traffic – including smartphone – travels over Wi-Fi. The Digital Decade Targets to achieve complete FTTH coverage will only increase the need for robust Wi-Fi networks that serve as the last leg for fiber connections. This requires continued attention to the spectrum allocated to Wi-Fi, particularly in the upper 6 GHz band. Provided sufficient spectrum is allocated, Wi-Fi can be a reliable and important tool in the race to roll out new mobile networks. Allocating the upper 6 GHz band for 6G, however, would undermine this progress and Europe's social and economic growth.

The ITU last allocated spectrum for license-exempt operations more than 20 years ago. As discussed earlier, people spend 90 percent of their time indoors, and the overwhelming majority of the resulting data traffic traverses Wi-Fi networks. Users of the most popular global streaming app – YouTube – now consume 2.5 GB per day via their fixed networks over Wi-Fi – seven times the amount consumed via mobile.[22] Enterprises rely on Wi-Fi for their internal networks – managing ticketing and point-of-sale operations, operating robotics and health care devices, monitoring inventory and security, streaming educational and training content, etc. Wi-Fi traffic now doubles every 3 years, to the point that the existing 2.4 GHz and 5 GHz Wi-Fi bands have become congested. This puts at risk Europe's technological leadership, notably on emerging technologies like AI and Cloud, and the ability of European citizens to take advantage of their high-speed fiber connections.[23] Indeed, without additional license-exempt spectrum, service quality will soon begin to suffer[24], affecting nearly every aspect of internet traffic, including future traffic on 5G and 6G networks.

Cisco applauds Europe's allocation of the lower 6 GHz band for unlicensed operations. But 500 MHz of license-exempt spectrum will not allow Europe to compete with countries that take full advantage of the capabilities of the newest generations of Wi-Fi, which can support channel sizes of up to 320 MHz. Densely populated areas may have hundreds of Wi-Fi networks per square kilometer, with dozens of networks operating in close proximity.

---

[22] Sandvine, "2024 Global Internet Phenomena Report" (April 2024), https://www.sandvine.com/blog/sandvines-2024-global-internet-phenomena-report-global-internet-usage-continues-to-grow.

[23] Dynamic Spectrum Alliance, "Lessons from the Assia Report on 'Wi-Fi and Broadband Data'" (October 2021), *available at* http://dynamicspectrumalliance.org/wp-content/uploads/2021/11/Lessons-from-the-Assia-Report-on-Wi-Fi-and-Broadband-Data.pdf.

[24] *See* John Cioffi, ASSIA, "State of Wi-Fi Reporting – DSA 2021 Global Summit" (June 8, 2021), *available at* https://dynamicspectrumalliance.org/wp-content/uploads/2021/06/2021-DSA-Summit_Spectrum-Value_John-M.-Cioffi.pdf

As data demand continues to rise, these densely deployed Wi-Fi networks will need channel diversity to optimize operation and avoid congestion. With access to only 500 MHz additional spectrum, however, these networks will be stuck at 40 MHz channel sizes (state of the art in 2006) for enterprise networks that utilize a 7-channel reuse pattern.

The Draft Report correctly observes that "[v]irtual worlds for homes and consumer use could be served by unlicensed bands."[25] But Wi-Fi is not only a consumer technology, and residential use is only part of the Wi-Fi story. Unlicensed spectrum will also deliver advanced applications for enterprise. Without the upper 6 GHz band, however, those users will not get effective use of the wider channels available in the latest Wi-Fi iterations, particularly in dense deployments like hospitals, factories, and universities, and will be unable to fully support next-generation technologies at scale like robotic assembly lines and warehouse management, AR/VR and 8K video streaming.

Consumer and enterprise grade wireless networks can currently support real-time voice and video, which require latencies on the order of 100 ms. Robotics and AR/VR have much tighter requirements, however, with latency requirements that could be less than 10 ms. As such, making the full 6 GHz band available for unlicensed operations is not just about improving the Wi-Fi experience of today, but is also about European businesses and consumers realizing the benefits of the applications of tomorrow with Wi-Fi capable of high throughput and, most importantly, ultra-low latency.

Zero Latency is an Australian-based VR gaming company with locations around the world and throughout Europe. The company relies on 6 GHz Wi-Fi spectrum to enable cloud rendering between its access points and VR headsets. The 6 GHz band has transformed its business model, as its operations in the 5 GHz band were unable to reliably enable cloud rendering between the access point and the headset due to congestion and external interference, affecting 92% of VR gaming sessions. This forced customers to carry a heavy backpack containing a PC with wires connected to their VR headset. In Europe and other areas where the lower 500 MHz of the 6 GHz band is available, players can now compete without this bulky setup. This not only improved the gaming experience, but also reduced costs and power consumption, revolutionizing the Zero Latency business model.

However, even that additional spectrum is not enough to realize the full potential of Zero Latency and other AR/VR companies, compared to operations in countries where 1200 MHz is available. European players face limited graphics and content due to operating on 40 MHz channels, unlike counterparts in countries with the full 6 GHz band available for Wi-Fi, which allows for 80 MHz channels. In countries with the entire 6 GHz band available, Zero Latency can provide the best user experience to more players simultaneously.

[25] Draft Report at 14.

Similarly, a recent study of the use of AR/VR/MR solutions at a teaching hospital in Thailand shows how providing sufficient Wi-Fi spectrum in the 6 GHz band can affect operational costs and practices. The study showed that using the full 6 GHz band to deliver AR/VR lectures reduced the hospital's network congestion and supported advanced AR/VR technologies while ensuring stable and fast connections crucial for real-time medical applications and data-intensive trainings.[26] Data collected during the pilot showed that, with use of the full 6 GHz band, network data throughput more than doubled, while latency was reduced by 80 percent. That performance was reflected in user satisfaction scores, which tripled with the full 6 GHz band as compared to operations using only the lower 500 MHz.

In addition, with the upper 6 GHz band available for unlicensed, higher (standard) power operations in the band become more feasible. These operations, governed by an AFC system, allow for more flexible unlicensed deployments. Standard power deployments can not only solve the indoor wireless connectivity issues associated with large, high ceiling structures but can also offer affordable outdoor connectivity for campuses, ports, mining and broadband to the home.[27]

While the upper 6 GHz band is already demonstrating value for unlicensed operations, that spectrum has significant technical limits for IMT use, particularly outdoor-to-indoor connectivity. Studies have found that the 6 GHz band has less favorable propagation conditions for IMT outdoor-to-indoor connectivity.[28] Indeed, one European regulator found that even outdoor cell sites using the 3.4-3.8 GHz band can only provide sporadic and inefficient indoor coverage.[29]

---

[26] *See* "Wi-Fi Alliance and Faculty of Medicine Ramathibodi Hospital Drive 6 Ghz Wi-Fi Innovation in Thailand," (Dec. 9, 2024), https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-and-faculty-of-medicine-ramathibodi-hospital-drive-6-ghz-wi-fi.

[27] Cambium Networks, "How North America's Largest 6 GHz Network Was Deployed," (Aug. 6, 2024), https://go.cambiumnetworks.com/l/428442/2024-08-06/59pgg8 (coverage discussed at 3:35; speeds discussed at 7:07).

[28] *See, e,g.,* Policy Impact Partners and Dynamic Spectrum Alliance, "How to Realise the Full Potential of 6 GHz Spectrum: A White Paper," Figure 13 (September 2021), *available at* https://6ghz.info/wp-content/uploads/2022/02/6GHz-EMEA_White-Paper_Sept21-EN.pdf.

[29] *See* Ofcom, "Hybrid Sharing: Enabling Both Licensed Mobile and Wi-Fi Users to Access the Upper 6 GHz band," at 14-15 & Figure 2 (6 July 2023), https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/263766-hybrid-sharing-enabling-both-licensed-mobile-and-wi-fi-users-to-access-the-upper-6-ghz-band/associated-documents/condoc-upper-6ghz-review-june23-v2.pdf?v=329853 ("Ofcom Consultation").

In addition, 5G and 6G transmissions using the upper 6 GHz band may require higher power levels to penetrate double-paned windows without significant signal loss.[30] According to a recent study, allocating the upper 6 GHz band for exclusive mobile use would lead to 16% higher energy consumption overall, as compared to permitting Wi-Fi operations in the band.[31] As the authors state:

> This translates to an additional 2230 million kWh of energy consumption per month and based on the estimated future energy mix, an additional 3.2 megatons of CO2 emissions per year (which corresponds to 4-6% of the current CO2 emissions by the complete ICT sector in Europe).[32]

Such an outcome would run counter to Europe's sustainability goals, including achieving the EU's legally binding target of Net Zero emissions by 2050. Using this spectrum for 6G communications could exacerbate the harm, as the technology will likely require a dense network of outdoor antennas and base stations, increasing cumulative energy demands and/or necessitating higher-power macro base stations.

Sustainability is not the only challenge to 5G or 6G operations in the upper 6 GHz band. The lower power levels and spectrum sharing protocols associated with unlicensed operations protect against interference to the fixed links and satellite services already in the band. IMT services, however, operate at higher power and do not easily coexist with other operations.[33] As Ofcom has concluded, the urban areas with the greatest need for additional mobile spectrum capacity may also be areas with critically important fixed links. The regulator found that, "if the upper 6 GHz band were to be deployed on these [high traffic macro] sites at higher power, about half of the fixed links in the UK could potentially suffer some interference."[34]

Even if regulators somehow accommodate the incumbent operations in the 6 GHz band, it is unclear when and how much MNO investment in the band would occur, as evidenced by the response to the recent 6 GHz spectrum auction in Hong Kong. As one expert stated,

---

[30] *See* Ofcom Consultation at 14 ("Whilst it is clearly important for mobile networks to provide good indoor coverage from their outdoor base stations, the upper 6 GHz band may not be the best band for this purpose because the level of indoor coverage achieved may be relatively modest, particularly in thermally efficient buildings.").

[31] Ing Peter Koon, Ilsa Godlovitch, and Dr. Thomas Plückebaum, WIK Consult, "Sustainability Benefits of 6 GHz Spectrum Policy" at 35 (31 July 2023), *available at* https://www.wi-fi.org/system/files/SustainabilityBenefitsof6GHzSpectrumPolicy202307.pdf.

[32] *Id*. *See also id*. at 33 (noting that even "the higher energy consumption for Wi-Fi 6E access points . . . is still 63 times smaller than the energy consumed by a 5G small cell per transported GB of data")."

[33] *See* Ofcom Consultation at 5 ("coexistence between fixed links and licensed mobile base stations deployed outdoors is likely to be a challenge").

[34] *Id.* at 37. *See also id*. (similarly concluding that whilst sharing between mobile and FSS operations may be possible, mobile network densities would have to "remain relatively low.").

"[t]he operators told the regulator [Office of the Communications Authority] that they thought the auction was premature as there is no 6 GHz equipment. Only three quarters of the 400 MHz of spectrum was successfully auctioned. And the spectrum was auctioned at one tenth the value of MHz/POP as the 2.3 GHz band which was auctioned at the same time."[35] These anemic results occurred even though Hong Kong law allowed the carriers to deduct the full amount of their bids from their taxes – effectively getting the spectrum for free. Hong Kong's experience raises questions about the future of IMT in the upper 6 GHz band given that the densely urbanized city-state would seem to be an ideal candidate for the spectrum.

These events suggest that MNOs may hesitate before investing substantial financial resources in a spectrum band that still lacks a robust ecosystem and will not be in wide use until after 2030, if then. Even setting aside the technical issues with 6 GHz IMT service, countries that allocate the upper 6 GHz band for 5G/6G could be looking at long delays before actual service begins. These countries will effectively pause their own wireless innovation as the spectrum sits unused, waiting for operators and equipment vendors to catch up, even as countries allocating the full band for unlicensed see their consumers and enterprises benefit from the spectrum.[36] Such countries will capitalize on 6 GHz's ongoing rapid growth, with more than 807.5 million 6 GHz devices shipped worldwide in 2024.[37] Traffic numbers show that these devices are expected to carry most Wi-Fi traffic in the USA this year[38] and 66 percent by 2025.

Finally, while extensive densification investments may present financial challenges for some MNOs, targeted densification efforts might be both feasible and effective. For example, multiple studies have shown that mobile traffic peaks requiring the provision of additional capacity are limited to a small percentage of urban areas and only for short periods of time.[39] In addition, as noted above, spectrum sharing and offloading from IMT to

---

[35] RCR Wireless News, "Where Does Global 6 GHz Adoption Stand?," https://www.rcrwireless.com/20241212/spectrum/global-6-ghz-adoption (quoting Chris Szymanski, Broadcom).

[36] This situation could become an unfortunate reprise of Europe's adoption of 5G Standalone and its advanced features. As the Draft Report acknowledges, "there are still a significant number of European MNOs in an intermediate stage of 5G adoption, as they maintain the massive use of 5G NSA without a clear perspective for adopting 5G SA. This implies relevant limitations, innovative features of 5G, including network slicing based on the 5G SA version, preventing the deployment of relevant use cases." Draft Report at 5.

[37] Catherine Sbeglia Nin, "What is the Global Status of 6 GHz Wi-Fi?," (Dec. 9, 2024), https://www.rcrwireless.com/20241209/fundamentals/global-of-6-ghz-wi-fi.

[38] Telecoms Advisory Services, *Assessing the Economic Value of Wi-Fi in the United States* at 26 (Sept. 2024), https://wififorward.org/wp-content/uploads/2024/09/Assessing-the-Economic-Value-of-Wi-Fi.pdf.

[39] *See, e.g.,* Fengli Xu, Yong Li, Huandong Wang, Pengyu Zhang, Depeng Jin, "Understanding Mobile Traffic Patterns of Large Scale Cellular Towers in Urban Environment," IEEE Xplore (April 2017), *available at* https://ieeexplore.ieee.org/document/7762185; Ofcom, "Connected Nations 2020, Scotland Report" at 2,

Wi-Fi and other private networks might help bridge the coverage and capacity gaps for 6G networks and reduce the need for additional spectrum resources.

Moreover, 6G networks may have characteristics that could further reduce the need for costly and less sustainable network buildouts. For example, 6G networks will see an acceleration of end-to-end virtualization, which will support the more effective operation of shared network infrastructures. Network virtualization is the evolution of a network's hardware elements to a software-based virtual machine. As 6G networks achieve end-to-end virtualization, they will support the growing trend toward cloud-based orchestration of the network—allowing for the sharing of radio access networks. This is the case because a virtual network permits a shared network to "run network functions as highly disaggregated and distributed microservices."[40]

Additionally, neutral hosts can serve as network service providers, enabling infrastructure sharing among multiple service providers.[41] One of 5G's major challenges has been the cost of deploying the new infrastructures required for the evolution and expansion of the mobile network. Neutral host solutions will reduce that cost and allow MNOs to expand fixed wireless access deployments, which are becoming an important broadband connectivity option. Use cases for neutral host networks include "rural areas, university campuses, public events, and indoor spaces."[42] They will also help meet indoor connectivity needs. Sharing indoor networks provides high-performing, fast indoor connectivity, and allows customer service providers and enterprises to reduce capital expenditure, equipment footprint, and power consumption.

Ultimately, 6G densification may be necessary even if the upper 6 GHz band is allocated for IMT. These trends should help reduce the costs of that densification, regardless of the bands involved. But the impact of these costs is vastly outweighed by the impact of not allocating the full 6 GHz band for unlicensed operations.

If there are any questions, please contact the undersigned.

---

available at https://www.ofcom.org.uk/__data/assets/pdf_file/0021/209442/connected-nations-2020-scotland.pdf; Ofcom, "Connected Nations 2021 – England Report" at 17, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0022/229720/connected-nations-2021-england.pdf.

[40] 6G Global Roadmap Report at 18.

[41] *See, e.g.*, Andrew Froelich, *An Introduction to Neutral Host Networks Using Private 5G*, TECHTARGET (June 28, 2022), https://www.techtarget.com/searchnetworking/tip/An-introduction-to-neutral-host-networks-using-private-5G.

[42] João P. Ferreira et al., *A Flexible Infrastructure-Sharing 5G Network Architecture Based on Network Slicing and Roaming*, 15 INFO. 213, 215-16 (2024), https://www.mdpi.com/2078-2489/15/4/213.

Respectfully submitted,

Cisco Systems, Inc.

Bill Davenport
Senior Director, Technology and Connectivity Policy
bidavenp@cisco.com

Diane Mievis
Head of EU Sustainability and Telecoms Policy
dmievis@cisco.com

Andy Gowans
Leader, Spectrum Regulatory
angowans@cisco.com