To: National Media and Infocommunications Authority (NMHH)
1133 Budapest, Visegrádi u. 106
Hungary

Date: September 12, 2025

Re: Opportunities and market needs related to frequency bands that can be used to provide wireless broadband services

From: Amazon Inc.
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Broadcom Inc.
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Extreme Networks
Hewlett Packard Enterprise
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Introduction

The undersigned companies, representing an important cross-section of the world's leading silicon vendors, system manufacturers and application providers, welcome the opportunity to comment on the National Media and Infocommunications Authority (NMHH) consultation regarding "Opportunities and market needs related to frequency bands that can be used to provide wireless broadband services." We fully support NMHH's efforts to ensure "that the availability and usability of the frequency set, as a scarce resource, does not constitute a bottleneck in either the short or the medium term for the development of the digital ecosystem."

We commend NMHH for implementing the European Commission decision on the 5945-6425 MHz band (L6 GHz band) related to the implementation of wireless access systems, including radio local area networks (WAS/RLAN). This was an important first step that will assist NMHH to achieve its goal of ensuring "everyone, everywhere (including rural and remote areas) [has] access to good-quality (excellent and secure) connectivity."

We encourage NMHH to continue its support of WAS/RLAN services as it considers the future use of the 6425-7125 MHz band (U6 GHz band). We appreciate NMHH's recognition of the importance of the U6 GHz band for WAS/RLAN services and for its acknowledgement that identification of this band for IMT neither gives priority to IMT in the Radio Regulations nor excludes continued use by the services to which the band is allocated.

As NMHH continues its analysis of the results of the ongoing U6 GHz band compatibility studies and positions of market players with respect to use of the band by either or both WAS/RLAN and IMT, we recommend that NMHH focus on industry growth, broader societal needs, and fostering international cooperation. This approach will ultimately contribute to the successful and sustainable deployment of advanced wireless technology and services, strengthen Hungary's position in the global digital economy, and help achieve its Gigabit-speed connectivity targets.

Importance of the 6 GHz Band for Local Broadband Connectivity

Wi-Fi has become indispensable to broadband connectivity. It is widely recognized that Wi-Fi boosts GDP growth by providing low-cost broadband access and helping to bridge the digital divide by making the most of whatever backhaul connectivity solution is available. It is also a fundamental building block of the digital economy, allowing organisations to deliver a multitude of digital services that benefit citizens and fuel economic growth. Furthermore, given that Wi-Fi allows a number of individuals to share a single broadband Internet connection, the service becomes more affordable, thereby increasing Internet penetration and digital participation.

Over 21.1 billion Wi-Fi devices are currently in use worldwide, with 4.1 billion shipped annually, according to research firm IDC.[1] The technology has consistently enabled affordable internet access and facilitated business operations. New Wi-Fi advancements, such as Wi-Fi 6E and Wi-Fi 7, and soon Wi-Fi 8, are expanding these benefits further, driving both social and economic progress.

Traffic in existing licence-exempt bands (i.e., 2.4 GHz and 5 GHz) has intensified significantly in recent years. In many markets, Wi-Fi use of the 2.4 GHz band has become impractical given the myriad other short range that access the same frequencies. Similarly, the 5 GHz band is becoming increasingly crowded with surveillance/doorbell cameras. Dynamic frequency selection (DFS) restrictions make use of the 5 GHz band for certain broadband services particularly challenging in some locations and impossible for very low power portable operations.

The need for additional licence-exempt spectrum is becoming increasingly urgent. Governments worldwide have harnessed the transformative potential of Wi-Fi by unlocking access to the full 6 GHz band. Hungary has an excellent opportunity to follow this proven model by ensuring sufficient spectrum is available to support the latest generations of Wi-Fi technology. The undersigned companies anticipate that a minimum of fifteen 80 MHz channels or seven 160 MHz channels will be needed to exploit the full capabilities of the Wi-Fi 7 and future Wi-Fi 8 protocols for a variety of wireless broadband and very low power applications. We expect even more spectrum to be required in the future to support a minimum of four 320 MHz channels.

Recent trends are evidence of the need for additional licence-exempt spectrum. For example, across Europe, about 90% of Internet traffic travels via fixed lines and is relayed to end users via Wi-Fi.[2] This trend is expected to continue for the rest of this decade and beyond 2030. As fixed-line and Wi-Fi traffic grow rapidly, licence-exempt access to the entire 6 GHz band will be necessary to meet consumer and enterprise demand.

The volume of traffic carried by Wi-Fi is growing much faster than the volume of traffic carried by mobile networks. In Germany, for example, the absolute increase in the volume of fixed traffic in 2023 (11 billion GB) was more than four times the absolute increase in the volume of mobile traffic (2.4 billion GB) in the same year.[3] Across most of Europe, the difference in volume between fixed and mobile data traffic is huge (see Table 1 below), and substitution is

[1] Source: https://www.wi-fi.org/beacon/the-beacon/wi-fi-by-the-numbers-technology-momentum-in-2023.

[2] Approximately, 92% of fixed broadband traffic in Europe is relayed via Wi-Fi, according to the ASSIA "State of Wi-Fi" report.

[3] Source: Jahresbericht Telekommunikation 2023.

rarely strong, according to a paper by Analysys Mason.[4] This analysis shows fixed networks are the more likely beneficiaries of any surge in growth brought about by widespread adoption of augmented reality (AR) and virtual reality (VR), whereas high mobile usage (in practice fixed wireless access) is driven by the absence or unaffordability of fixed networks, which is usually a temporary phenomenon, rather than applications.

Table 1: Data traffic based on official administration reports.
The variation compared to the previous year is represented in EB and indicated in parentheses.

Country	Fixed data traffic [EB/year] (absolute increase from previous year)	Mobile data traffic [EB/year] (absolute increase from previous year)
Czech Republic (2023)	16.0 (+1.9)	1.3 (+0.4)
Denmark (2023)	13.1 (+0.9)	2.3 (+0.4)
Finland (2023)	6.4 (+2.2)	4.8 (+0.8)
Germany (2023)	132.0 (+11.0)	9.1 (+2.4)
Italy (2023)	54.9 (+8.4)	15.0 (+3.3)
Portugal (2023)	15.5 (+2.3)	1.2 (+0.3)
Romania (2023)	18.4 (+2.7)	2.5 (+0.6)
Spain (2022)	62.0 (+8.3)	6.2 (+1.6)

According to the FTTH Council for Europe,[5] the number of subscribers to FTTH/B (fibre-to-the-home or building) services in Europe is set to rise to 201 million by 2029 from 121 million in September 2023. At the same time, the number of homes passed will jump to 312 million in 2029 from 244 million in September 2023 as telcos lay more fibre in the ground.

According to cable.co.uk,[6] average broadband speeds across the EU increased by 37% per year between 2017 and 2024. The average downlink speed is now more than 109 Mbps. In February 2025, the difference between the average median country speed of fixed and mobile networks in the EU was 31.2 Mbps for download and 56.3 Mbps for upload, according to Ookla,[7] which also says that the average median latency and jitter on fixed networks were, respectively, 12.7 and 5.3 ms lower than on mobile networks.

UK Ofcom has forecasted 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.[8]

As these statistics demonstrate, the L6 GHz band on its own will be insufficient to meet the fast-rising demand for indoor wireless connectivity. In Europe, there are currently only five 160 MHz channels available for licence-exempt usage, two of which are in the 5 GHz band and have DFS and backward compatibility restrictions making them unavailable or having significant reductions in capacity for the most part.[9] With access to only the L6 GHz band, Wi-

[4] Source: https://www.analysysmason.com/research/content/articles/bandwidth-overproduction-crisis-rdns0/.

[5] Source: https://www.ftthcouncil.eu/resources/blog/ftth-market-forecasts-2023-2029.

[6] Cable.co.uk collated and analysed over 1.5 billion speed tests in 12 months ending 30 June 2024 to reveal broadband speeds in 229 countries. Source: https://www.cable.co.uk/broadband/speed/worldwide-speed-league/.

[7] Source: https://www.speedtest.net/global-index (updated March 2025).

[8] See UK Ofcom Improving Spectrum Access for Wi-Fi, July 2020, section 3.24.

[9] Also, in practical deployments, smaller channel widths will generally be selected at 5 GHz to give more channel reuse options and accommodate legacy devices.

Fi can only support gigabit coverage for approximately 50-60% of a residential building area.[10] To provide a higher likelihood of wireless gigabit broadband a minimum of seven 160 MHz channels in the 6 GHz band are necessary. However, to provide the highest likelihood of whole-building coverage, NMHH would need to provide sufficient spectrum to support 320 MHz channels. Therefore, Wi-Fi access to both the L6 GHz and U6 GHz bands is imperative to support the goals of the EU's Gigabit Infrastructure Act and the Digital Decade Policy Programme 2030.[11]

Access to the Full 6 GHz Band Will Accelerate Adoption and Meet Increasing Demand

The widespread availability of compatible equipment means most Wi-Fi users will see an immediate benefit from licence-exempt access to the 6 GHz band. Even users without 6 GHz compatible equipment will benefit from the new spectrum, as legacy bands become less congested with traffic moving to the 6 GHz band.

To cope with greatly increasing demand for local wireless broadband connectivity, enterprises have been upgrading their networks with Wi-Fi 6E and Wi-Fi 7 equipment.[12] And, in countries that opened the full 6 GHz band, there has also been an enormous interest from universities, hospitals, manufacturing and logistics to upgrade their Wi-Fi infrastructure with 6 GHz capable equipment.[13] In Hungary, there are over 60 higher education institutions, including universities, with more than 328,000 students, which could greatly benefit from an upgraded full-6 GHz Wi-Fi infrastructure.

With access to the full 6 GHz band, Wi-Fi 6E and Wi-Fi 7 can support industrial applications, such as factory robots and sensors, AR, healthcare monitors and wireless medical equipment, that have stringent QoS (quality of service) requirements. Unlike previous generations of Wi-Fi, Wi-Fi 6/6E and Wi-Fi 7 are based on OFDMA technology and are thereby able to achieve very high QoS levels, particularly in managed networks. According to Intel,[14] AR/VR applications require a minimum throughput of between 400 Mbps and 2.35 Gbps and a maximum streaming interactive latency in the order of 10ms.

For enterprise applications (such as large public venues, healthcare, education, hospitality, logistics, and manufacturing), a large number of available channels and a wide range of channel widths (from 20 MHz to 320 MHz) enable performance enhancements and the realisation of new services and architectures. Examples include multi-layer operation, service segmentation and prioritisation, context-aware wireless networks, and hyper-aware access points. If a sufficient amount of additional spectrum in the U6 GHz band in not made available, the business case for these types of networks and use cases will be less cost effective than in countries where 1200 MHz has been made available. And, in some instances, the business case

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[10] "Wi-Fi Spectrum Requirements" by Plum Consulting. Source: https://plumconsulting.co.uk/wi-fi-spectrum-requirements/.

[11] See Gigabit Infrastructure Act at https://digital-strategy.ec.europa.eu/en/policies/gigabit-infrastructure-act; Europe's Digital Decade Policy Programme available at https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade.

[12] IDC Research notes that Wi-Fi 6E accounted for 31.7% of the enterprise access point market's revenues in the third quarter (3Q24). https://my.idc.com/getdoc.jsp?containerId=IDC_P23464&_gl=1*505bgk*_gcl_au*ODk3NzE5MzUwLjE3NDQ2NTk1NDY.*_ga*MjEwMzg4NTU5MC4xNzQ0NjU5NTQ2*_ga_541ENG1F9X*MTc0NDY1OTU0Ni4xLjAuMTc0NDY1OTU0Ni42MC4wLjA.

[13] https://edtechmagazine.com/higher/article/2024/08/how-higher-ed-taps-wi-fi-6e-expand-wireless-access.

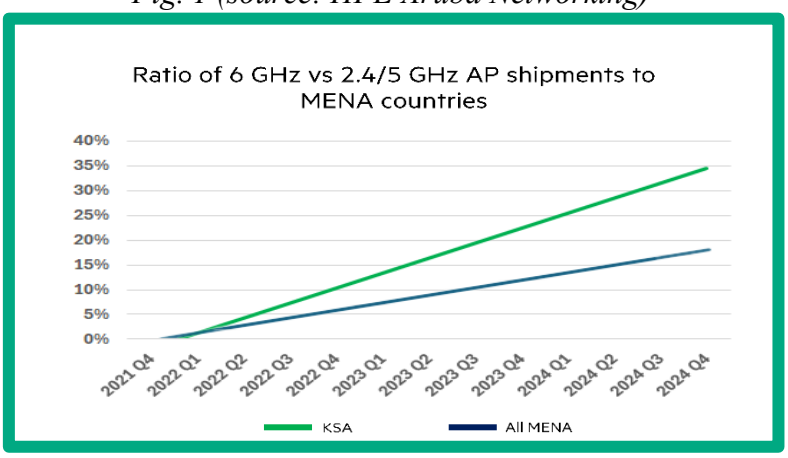
[14] Source: Spectrum Needs of Wi-Fi 7.

may not be economically viable at all once a cost/benefit analysis of upgrading the existing Wi-Fi network occurs.

With access to 320 MHz channels, Wi-Fi can reliably support a wide range of demanding use cases, from telesurgery and haptic applications to controlled vehicles and augmented reality. Wide channels also enable Wi-Fi to identify the position of a connected asset within one meter, enabling enterprises to better track and monitor their equipment and inventory. Finally, 320 MHz channels enable whole premises wireless residential broadband coverage, even at some distance from the Wi-Fi access point.

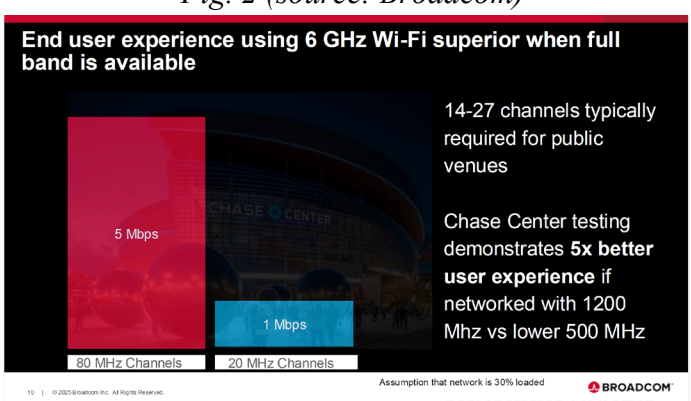
Enterprise use of the 6 GHz band globally for Wi-Fi is growing quickly. It is notable is that countries that have adopted the full 1200 MHz for WAS/RLANs are seeing the fastest uptake (see Fig. 1 below comparing the Kingdom of Saudi Arabia vs the rest of the MENA region). Key use cases for this adoption are in education, hospitality, industrial/manufacturing, public services, retail, and finance.

Fig. 1 (source: HPE Aruba Networking)



The difference in user experience between access to the full 1200 MHz vs. the lower 500 MHz is also dramatic. For example, the Chase Center in San Francisco, which is a major sports arena with a seating capacity of 18,064 that also contains 580,000 sq. ft. of office and lab space and 100,000 sq. ft. of retail space, has deployed Wi-Fi operating in the 6 GHz band. Chase tested the user experience using the lower 500 MHz vs. the full 1200 MHz and found that with 80 MHz-wide channels, which is achievable with access to 1200 MHz, users experience five times better performance than they do with 20 MHz-wide channels (see Fig. 2 below).

Fig. 2 (source: Broadcom)



Another example is Sidra Medicine (https://www.sidra.org), one of Qatar's leading hospitals. Sidra increasingly relies on digital solutions to enhance patient care, optimize operational efficiency, and facilitate smooth communication and collaboration among its healthcare professionals. Sidra uses Wi-Fi extensively for over 160 different applications, ranging from Electronic Health Records access and management and advanced diagnostics, over logistics handled automatically by automated guided vehicles, critical environmental monitoring, and intelligent building management, to enhanced medical team communications. To be able to satisfy the ever-growing demand for Wi-Fi capacity, the hospital densified its Wi-Fi Network by increasing the number of access points from 1500 to 3000 and upgraded to 6 GHz operation. Now that the limit for densification is reached, Sidra requires the full 6 GHz band to be able to fully exploit the capability of its network to deliver the additional capacity required during the next seven to ten years.

Where the full 1200 MHz in the 6 GHz band is made available on a licence-exempt basis, there are already thousands of Wi-Fi 6E and Wi-Fi 7 products available that can operate across the entire band.[15] These commercial products operate using all three modes of the Wi-Fi standards: low power indoors (LPI), very low power (VLP), and standard power (SP). We encourage NMHH to review the 6 GHz Wi-Fi Information Center on the Wi-Fi Alliance website (available at: https://www.wi-fi.org/discover-wi-fi/6-ghz-wi-fi-information-center) to see the latest information regarding available Wi-Fi 6E and Wi-Fi 7 equipment and to permit access to the full 6 GHz band by all three modes to meet the needs of citizens, enterprises, and wireless Internet service providers in Hungary.

RSPG Opinion on Long-term vision for the upper 6 GHz band

As NMHH correctly notes, the European Radio Spectrum Policy Group (RSPG) is expected to issue a Final Opinion on the "Long-term vision for the upper 6 GHz band" later this year. It is anticipated that this Final Opinion will recommend a prioritized band-split that would permit administrations to deploy either or both Wi-Fi and IMT in the U6 GHz band.

We reaffirm the importance of ensuring licence-exempt access to the entire 6 GHz band for WAS/RLAN operations (Scenario 1 of the RSPG Draft Opinion), particularly if Europe aims to remain competitive globally and fully realise the benefits of next-generation WAS/RLAN. Opening the entire 6 GHz band to WAS/RLAN will enable European citizens and businesses, including those in Hungary, to take advantage of current and future Wi-Fi technologies.

That said, given the diverse needs and positions expressed by European administrations in the RSPG Draft Opinion, a split of the upper 6 GHz band with sufficient prioritised spectrum given to WAS/RLAN use with flexibility for additional access[16] (e.g., Scenario 5 of the RSPG Draft Opinion), could be an option for countries that may want to allocate a portion of the upper 6 GHz band to enable IMT rollout in geographically limited areas.

Were NMHH to pursue a prioritized band split approach, we could support a multi-phased approach that begins with allocating the first 160 MHz of the U6 GHz band for Wi-Fi in the immediate future under the same conditions as the L6 GHz band followed by the UK Ofcom

[15] More than 5,000 Wi-Fi device models (either Wi-Fi 6E or Wi-Fi 7) that support 6 GHz operation were announced or made available between 2021-2024, according to Intel (https://wifinowglobal.com/news-and-blog/massive-market-adoption-5000-wi-fi-devices-now-support-6-ghz-1230-support-wi-fi-7-intel-says/).

[16] Based on the comments of EU countries in the RSPG opinion, flexibility to enable member states to allow WAS/RLAN use not only in the WAS/RLAN prioritized part of the band, but across the whole (or additional parts) of the upper 6 GHz band, seems to be justified.

proposal to permit Wi-Fi opportunistic access to the remainder of the U6 GHz band, which would be consistent with NMHH's preference for a shared approach. In later phases, other sharing/coordination mechanisms in addition to those previously studied could be considered to enable sharing between business-critical WAS/RLAN enterprise networks and IMT networks across the rest of the U6 GHz band.

While Europe considers regulatory approaches to respond in a flexible manner to its unique needs, it will be important for European citizens, businesses, and public institutions to leverage the full capabilities[17] of existing and future WAS/RLAN standards. As mentioned above, countries that have enabled licence-exempt use of the full 6 GHz band for WAS/RLAN are already beginning to realise the full benefits that can be achieved by these new standards, especially in enterprise[18] networks. Countries opening less than the full band for WAS/RLAN will only see a limited set of these benefits and risk missing societal objectives.

Therefore, a flexible approach that allows countries to authorise WAS/RLAN use on a permanent, opportunistic or secondary basis in IMT-prioritised spectrum before or after IMT networks are rolled out will be critical for Europe to maximise the use of the 6 GHz band. Such an approach could also allow national administrations to co-ordinate between IMT networks and WAS/RLAN enterprise networks in the future using sharing mechanisms implemented in WAS/RLAN access points (APs) (through software updates and/or cloud management systems, for instance) and/or IMT base stations.

Therefore, as stated in our comments recently submitted to the RSPG, we urge European administrations to look at methods (e.g., by means of an ETSI Harmonised Standard) to allow WAS/RLAN use across the full upper 6 GHz band. For example, in EN 301 893 v2.2.1 there is already a flexible approach enabled for WAS/RLAN equipment capable of operating in parts of the 5 GHz band (i.e., use in 5.8 GHz band on a national basis) to be certified for placement on the European market. EN 303 687 v1.1.1 already defines "initiating" and "responding" devices for use in the L6 GHz band. A combination of existing solutions from these Harmonised Standards could be used to cover any additional WAS/RLAN use in the IMT-prioritised part of an U6 GHz band split. Similar terminology could be adopted to restrict APs to the role of "initiating, supervising and/or controlling" devices, while terminal or client devices would function as "responding, supervised and/or controlled" devices. Making this supervised mode mandatory for client devices above the upper 6 GHz band-split could enable rapid certification for placement on the European market.

Initially, WAS/RLAN devices (e.g., mobile phones) under VLP device rules or that enable peer to peer communication (such as for setting up Wi-Fi hotspot) could be mandated to operate in the IMT-prioritised portion of the U6 GHz band only in "supervised" mode, i.e. only when connected to a WAS/RLAN "supervising" device (e.g., AP).

[17] For example, the main advantages to be gained are in relation to the additional capabilities that have been introduced to facilitate seamless operations and make the Wi-Fi experience more predictable. This means with sufficient spectrum, the new Wi-Fi standards will be able to cater for use cases today and in the future that require higher throughput and/or better determinism regarding bounded latency and jitter.

[18] The term "enterprise" denotes a large variety of use cases and applications such as education, healthcare, manufacturing, logistics, hospitality, transport, entertainment, sports, and many more use cases which use Wi-Fi and other WAS/RLAN technologies.

Conclusion

To deliver on Hungary's connectivity ambitions and Europe's Digital Decade objectives, it is essential that NMHH secure robust licence-exempt access to the U6 GHz band for Wi-Fi, complementing the previously opened L6 GHz band. While we continue to believe that full-band access for Wi-Fi offers the greatest socio-economic benefit, we recognise that the forthcoming RSPG Final Opinion in November 2025 may favour a prioritised split between WAS/RLAN and IMT. In such a scenario, it will be critical that sufficient contiguous spectrum is safeguarded for Wi-Fi to enable at least four 160 MHz channels and at least two 320 MHz channels needed for next-generation applications, while ensuring any IMT allocation does not undermine the business case for advanced Wi-Fi networks in homes, enterprises, and public institutions. A regulatory approach that maximises licence-exempt use, while providing flexibility for IMT, will best position Hungary to benefit from the global momentum behind Wi-Fi 6E, Wi-Fi 7, and beyond. This will ensure that citizens and industry alike can fully exploit the capabilities of gigabit connectivity.

We are committed to supporting NMHH in its efforts to ensure access to spectrum is not a bottleneck to the development of a digital ecosystem and that all citizens have access to high-quality connectivity. We look forward to working with NHMM on the successful and sustainable deployment of advanced wireless technology and services and strengthening Hungary's position in the global digital economy.

/s/

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