Consultation Title	**Public Consultation "Preparing the future of mobile networks" by Arcep**
Deadline	23 September 2022
Geographical Scope	France
Co-Signatories	Broadcom Inc., Cisco Systems Inc., Hewlett Packard Enterprise (HPE), Meta Platforms Ireland Limited
Date	23 September 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 consultation "Preparing the future of mobile networks" issued by the *Autorité de régulation des communications électroniques, des postes et de la distribution de la presse* (Arcep) on the 23rd of May 2022. The inputs provided in this document focus on the 6425 -7125 MHz band.

Executive summary

The undersigned companies respectfully ask Arcep to consider making the 6425-7125 MHz band available for usage by WAS/RLAN (wireless access systems/radio local access networks) on a licence-exempt basis. The justification for this request is contained in the responses to the relevant questions below.

In this connection, we further ask Arcep to support a European position of "No change" with respect to an IMT identification of the 6425-7025 MHz and 7025-7125 MHz bands under Agenda Item (AI) 1.2 of the 2023 World Radio Conference (WRC-23).

Responses

Section 1.2 – 5G: a disruptive innovation evolving steadily towards 6G

Question 2[1]: *What are the most significant developments brought by 5G Release 18, 6G, and Wi-Fi 7? What is the timeline for these developments to become available on networks and devices? If applicable, what new frequency requirements will these developments generate?*

Wi-Fi 7 – to be available in 2023

Wi-Fi 7 is scheduled for official launch in 2024, and some manufacturers are expected to launch products in 2023. Supporting throughput speeds of up to 46 Gbps, Wi-Fi 7 will also provide highly responsive connectivity, as well as greater flexibility in using network and spectrum resources. It is designed to support use cases with strict latency and reliability requirements at scale.

In the enterprise market, Wi-Fi 7 will be particularly valuable for Internet of Things applications, such as industrial automation, surveillance, remote control, extended reality (XR) and other video-based applications. In the consumer sector, Wi-Fi 7 will enhance gaming, XR and video applications, and smart-home services. Further, Wi-Fi 7 and 5G will work together to introduce edge computing, distributed and cloud architectures, virtualization, and digitalization in private wireless networks.

More generally, Wi-Fi 7 will continue to expand the availability of Wi-Fi, which carries most of the wireless traffic in enterprise, public and residential environments, in a cost-effective way and further improve spectrum efficiency.

To bring about the required performance improvements, Wi-Fi 7 will use MU-MIMO to support up to 16 spatial streams, up from 8 streams in Wi-Fi 6. Furthermore, the maximum channel width will be doubled to 320 MHz.

As with Wi-Fi 6E, Wi-Fi 7 will need access to the entire 1180 MHz (5945-7125 MHz) that would be available in the 6 GHz band in Europe to utilize the full extent of its capabilities and support innovative use cases. Opening only the lower 480 MHz of the 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 the full 1180 MHz of spectrum, a larger number of these wide channels could be accommodated, significantly improving the performance available to each user.

Wider channel bandwidths increase spectrum efficiency and deliver high-bandwidth applications and services while maintaining the ability to share spectrum with incumbents and other licence-exempt

[1] Edited for clarity.

systems. A shortage of wider channels would have a detrimental impact on real-time video services and high-bandwidth immersive services, such as XR applications.

As outlined above, being able to access multiple non-overlapping very wide channels is important also for the enterprise market. However, it is the large number of channels and the diversity of channel widths made available by 1180 MHz of spectrum, that are probably even more important. Depending on capacity and QoS requirements, channels of different widths can be grouped and assigned to specific services, allowing to run a variety of services over one 6 GHz Wi-Fi network. A typical example would be a hospital network where high-bit rate low latency imaging applications are run over multiple 160 MHz channels, administrative and other data applications over 40 or 80 MHz wide channels, and voice services over multiple 20 MHz wide channels. In addition, data and voice services for guests could be run over the 5 GHz legacy network.

6G – still to be defined

It is not yet clear whether 6G will be a network of networks that is not tied to a particular technology, or whether will it be just another 'G' (IMT-2030).

Reserving spectrum for what may be the IMT flavour of a future wireless network would undermine the objective to use spectrum as efficiently as possible. Moreover, existing IMT spectrum could be employed by 6G using dynamic spectrum sharing techniques such as those allowing the use of both 4G and 5G in the same spectrum.

In the absence of clearly defined use cases and applications, 6G spectrum requirements have not been defined yet, but experience suggests that each generation needs much wider channels than previous generations to deliver a step increase in performance. 3G leveraged 5 MHz channels, 4G leveraged 20 MHz and 5G 100 MHz. The upper 6 GHz band (6425 -7125 MHz), which has been mooted as a potential priority band for 6G by some, will not be able to support much wider channels than the 3.6 GHz band.

Furthermore, propagation in the upper 6 GHz band is inferior to that in the 3.6 GHz band. Mobile operators would always use the band with the most favourable propagation characteristics to deploy their new network. This is what happened in Europe where 4G was deployed in the 1800 MHz band rather than in the 2600 MHz band. The EU 5G Observatory also indicates that 5G is mostly being deployed in lower bands, rather than in the 3.6 GHz band (only 3% of EU base stations are equipped with 3.6 GHz).

IMT services in the upper 6 GHz band would also suffer from severe restrictions, according to ITU studies. Coexistence with incumbent services requires a stringent limitation of base station density, deploying the base stations below rooftops and deploying only in urban and suburban areas. Even if

administrations were to remove all fixed links from the upper 6GHz band, a costly and damaging process, they would still need to protect satellite services.

Countries in all ITU regions have made the 5925-7125 MHz band available for licence-exempt use. Making the upper 6 GHz a priority band for 6G in Europe would prevent harmonization and reduce economies of scale, as well as weaken alignment on a low-cost ecosystem. That would negatively impact both end-users and innovators.

Section 1.4 – Expected applications and required features

Question 10: *Among these applications, are some more likely to develop specifically within a fixed environment, e.g. indoors, or rather in a mobile situation? If so, for what reasons?*

Traffic patterns in Europe to date indicate that most of these applications will be used indoors and delivered via a combination of fixed-line networks and Wi-Fi. In 2021, 95% of internet traffic in Germany, for example, was transmitted over fixed networks and just 5% over mobile networks, according to a report[2] by regulator BnetzA. Statistics published by other European administrations confirm that the vast majority of internet traffic is transferred over fixed networks.

Furthermore, equipment maker Huawei[3] has said "more than 70% of services in 4G occur indoors, and industry predictions show that this percentage will surpass 80% as 5G spread service diversity and extends business boundaries." To meet the enormous demand for indoor connectivity, mobile network operators greatly benefit from Wi-Fi's capacity to offload traffic from cellular mobile devices. Because of the attenuation of signals from outdoor 5G base stations (building entry loss), 5G indoor coverage and performance are severely limited. To achieve performance levels closer to those provided by fibre networks, the number of outdoor BS would have to be increased significantly. Providing 5G gigabit connectivity indoors would require the deployment of a completely new infrastructure, parallel to the existing Wi-Fi one which will be prohibitive from both a commercial and an environmental point of view. Both approaches would result in an unnecessarily high consumption of resources and increase energy consumption considerably.

Question 12: *What new frequency requirements have you identified to enable these applications using existing technologies and, if applicable, with the introduction of new technologies? For what reasons (capacity, speed, coverage...)?*

Wi-Fi 6E (an existing technology) and Wi-Fi 7 (a forthcoming technology – see answer to question 2) can support a variety of demanding use cases, such as ultra-HD video streaming, smart home

[2] Source: Tätigkeitsberichte Telekommunikation
[3] Source: Indoor 5G Scenario Oriented White Paper, October 2019

automation, industrial automation, hotspot access, automation of city-wide services, extended reality (XR) applications, health monitoring, wearables and seamless roaming. 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 XR headsets. Outdoor enterprise use cases can be realised by employing automated frequency coordination (AFC) systems which allow Wi-Fi 6E and Wi-Fi 7 to operate at higher than VLP power levels whilst protecting the operation of incumbent fixed links.

As explained in our answer to question 2, Wi-Fi 6E and Wi-Fi 7 need access to the full 1180 MHz (5945-7125 MHz) that would be available in Europe in the 6 GHz band. Opening just the lower 6 GHz band (less than half of the total available spectrum in the band) would mean that Wi-Fi networks in dense deployments be limited to employing small channel bandwidths, as only one 320 MHz channel or three 160 MHz channels would be available. With access to the full 1180 MHz, a larger number of non-overlapping wide channels could be accommodated, significantly improving the performance available to each user, and increasing spectrum efficiency.

Section 2.2 – Innovation and economic development

Question 13: *What outlook does 5G offer for France's economic and industrial fabric? To what extent will the expected advances (lower latency, massive number of connected objects, faster speeds) be necessary to enable all of the technology's planned business applications? What size market do these advances represent? What economic benefits can be expected from verticals' appropriation of these new services, in general, and/or by your sector in particular?*

Whilst 5G has a role in France's economic and industrial fabric, the vast majority of Internet traffic within enterprises takes place indoors where Wi-Fi is the connectivity technology of choice. Most 5G networks, which are optimized for wide area coverage and have to balance several objectives, are unlikely to use spectrum as efficiently indoors as a Wi-Fi network that has been optimized to support this use case.

In a recent report[4], LS Telecom explored the potential socio-economic benefits of deploying IMT technologies, such as 5G, in the upper 6 GHz band (6425-7125 MHz) in Europe. It concluded that the only industrial sector that would experience a significant benefit from an extensive IMT deployment in the band would be agriculture. That is because IMT is primarily designed to support outdoor and mobile connectivity. By contrast, deploying Wi-Fi in the upper 6 GHz band would bring about capacity and quality of service improvements that would greatly benefit the construction, manufacturing, education and public services segments.

[4] Socioeconomic benefits of IMT versus RLAN in the 6425-7125 MHz band in Europe

The LS Telecom report puts the deployment costs for Wi-Fi in the full 6 GHz band at between €9.8 billion and €13.3 billion across the EU – less than 20% of the €73 billion cost of deploying IMT networks in the 6 GHz band in densely populated urban areas (the report did not consider nationwide deployments because of the risks of interfering with incumbent services[5]). If IMT networks were to be extended to non-urban areas to support agriculture, for example, the deployment costs would be even higher.

Section 3.1 – Public network coverage and quality of service

Question 26: *What role does Wi-Fi play in all of the solutions for providing service indoors? If applicable, are there uses for which Wi-Fi is not technologically appropriate, and for what reasons?*

Approximately, 92% of fixed broadband traffic in Europe is relayed via Wi-Fi, according to network management specialists ASSIA[6]. As fixed networks carry almost 20 times as much traffic as mobile networks (based on 2021 figures from Germany's regulator BnetzA), Wi-Fi delivers approximately 90% of all Internet traffic in Europe.

Even smartphones make much greater use of Wi-Fi than cellular connectivity. For example, UK regulator, Ofcom's analysis[7] of crowdsourced data from Android smartphones found that 73% of the traffic they generated travelled over Wi-Fi and 27% over mobile networks between January and March 2021.

As they operate in licence-exempt spectrum, Wi-Fi hotspots do not require a potentially expensive license or prior registration. Wi-Fi can be deployed by anybody who needs an efficient and low-cost way for their family or employees to access a wide range of internet-based services, including vital healthcare advice, educational content, and financial services.

If they have access to sufficient spectrum, both Wi-Fi and 5G NR equipment can provide a very high quality of service, both in terms of data rate and latency. Wi-Fi 6E is capable of delivering speeds of up to 9.6 Gbps. The actual throughput will depend on the spectrum available and the level of congestion. In locations where 5G is providing a better experience than Wi-Fi, that would suggest that 5G has a significant spectrum advantage.

Licence-exempt services are hugely popular with consumers as they can then decide how to connect to broadband in their homes or public spaces. In crowded locations, Wi-Fi is also likely to provide a

[5] To enable IMT services to co-exist incumbent fixed and fixed satellite services in the upper 6 GHz band will likely require mitigation techniques that would limit the deployment of IMT in this band.
[6] Source: the ASSIA "State of Wi-Fi" report
[7] https://www.ofcom.org.uk/research-and-data/telecoms-research/mobile-smartphones/mobile-matters

better end-user experience: Whereas cellular technologies have been designed to deliver coverage to allow mobility, Wi-Fi has been designed to deliver capacity/density.

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 quality of service (QoS) levels, particularly in managed networks. 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.

Section 3.2 – Digital sustainability

Question 29: *Do you have any proposals (levers for action, means, strategies, etc.) to share regarding spectrum management or frequency assignments that would help reduce networks' environmental impact, and help promote digital sustainability in general? What demands or prerequisites would be needed to activate this lever, if possible (availability of data, methodological consistency, monitoring/a posteriori audit, etc.)?*

In general, low-power wireless connectivity technologies, such as Wi-Fi, will be more energy-efficient than higher-power technologies, such as IMT in public cellular networks. Most Wi-Fi networks operate at much lower power levels than cellular systems and do not have to contend with external building entry loss, so they can be considered to be the most energy-efficient connectivity option in many scenarios. Indeed, Arcep[8] itself found that the combination of fibre and Wi-Fi is the most efficient solution in terms of energy consumption, performance, and flexibility. Further, Wi-Fi is becoming more efficient, thanks to new features, such as target wake time and the OFDMA radio interface, which reduce power consumption.

The ITU has forecast[9] 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.

[8] https://en.arcep.fr/uploads/tx_gspublication/achieving-digital-sustainability-report-dec2020.pdf
[9] Source: ITU, Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement, 2020.

Section 4 – Specific questions by frequency bands

Question 34: *Of all the frequency bands listed above and detailed below, which rank highest for their ability to meet your needs?*

Of the frequency bands listed, we consider the 6425 – 7125 MHz band the most critical to ensure Wi-Fi can realise its full potential to provide maximum benefits to French consumers and businesses.

Section 4.4.2 – The 6425 – 7125 MHz (aka 6 GHz) band

Question 91: *What is your assessment of the development outlook for these uses (Wi-Fi, IMT)? Can you identify other uses that are likely to develop in this band?*

Countries in all ITU regions that are representing more than 40% of the global gross domestic product (GDP) have opened, or have proposed opening, the full 6 GHz band (5925-7125 MHz) for licence-exempt use[10], and international harmonization of that band for licence-exempt use is progressing fast.

Under Agenda Item (AI) 1.2, the 2023 World Radio Conference (WRC-23) will discuss a potential IMT identification of the 6425-7025 MHz band (Region 1 only) and the 7025-7125 MHz band (globally). As the 6425-7125 band already has a mobile allocation in the Radio Regulations, an IMT identification will not only be unnecessary but severely restrict administrations' freedom of choice for the future usage of that band. With a large part of the world already having opened the 5925-7125 MHz band for licence-exempt use, an IMT identification of that band in Region 1 could lead to dis-harmonization, reduced economies of scale, and increased costs for citizens and businesses in France and the rest of Europe.

A certification plan for global interoperability of Wi-Fi 6 products capable of operating in the 6 GHz band, named "Wi-Fi 6E" devices by the Wi-Fi Alliance, was released in January 2021. As of August 2022, there were approximately 800 client devices and access points supporting Wi-Fi 6E, including more than 390 laptop models, 120 desktop PCs, dozens of consumers and enterprise access points, and more than 60 smartphones, as well as 21 smart televisions, according to Intel[11].

As the market grows, economies of scale are kicking in, ensuring that Wi-Fi 6E will, like previous generation Wi-Fi products, be highly affordable. The Wi-Fi Alliance projects more than 350 million Wi-Fi 6E devices will enter the market in 2022. As with previous generations of Wi-Fi, the technology

[10] https://www.dynamicspectrumalliance.org/whitepapers-reports/
[11] Disclaimer: This data is compiled from vendor websites, press releases, and third-party device reviews. Intel provides this assessment for informational purposes only, does not guarantee its accuracy, and it is subject to change without notice.

is set to be included in almost every phone, tablet and laptop, as well as in a multitude of other appliances, such as printers, televisions, cameras and wearables, as well as in industrial products, from hardened APs to sensors and robots. Grand View Research has forecasted that the Wi-Fi 6E chipset market will grow rapidly. It projects that almost 4 billion Wi-Fi 6E chipsets will be shipped in 2028 globally, with an annual CAGR of 40.9% from 2021 to 2028.

By contrast, there is no IMT ecosystem, and no IMT equipment is available for use in the 6 GHz band. In an August 2020 report[12], Coleago Consulting estimated that 5G would not be deployed in the 6 GHz band for at least a decade.

Question 92: *What rules for cohabitation with existing uses (microwave transmission, satellite services) in this band would be necessary?*

The European Commission Implementing Decision (EU) 2021/1067 of 17 June 2021 established the regulatory conditions necessary for the operation of wireless services in the 5945-6425 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 incumbent satellite and fixed services.

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, due to the severe restrictions on IMT operation that regulators would have to impose (examples: antenna heights must be below rooftop level, the number of base stations must be limited and monitored on supranational level, base station antenna beams must be directed downwards),

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 densities of IMT base stations, etc.).

Even if some technical studies suggest 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 that such constraints will most likely curb the funds governments would hope to raise for the spectrum

[12] See section 7.3 of the report: The 6 GHz Opportunity for IMT – "recognizing the 10+ year timeframe anticipated for 5G at 6 GHz"

licences.

Together, satellites and Wi-Fi bring connectivity to people and communities that are underserved by cellular and fixed-line networks. If the full 6 GHz band was made available for licence-exempt use, Wi-Fi networks would be able to harness the spectrum to enable people in underserved areas to share the broadband connectivity delivered via satellite.

Question 93: *Do you think the band is a good candidate for implementing dynamic spectrum sharing to handle the planned uses for it?*

There is no need for dynamic spectrum sharing in the 6 GHz band to enable licence-exempt services such as low power indoor and very low power (indoor and outdoor) Wi-Fi. For higher power applications, automated frequency coordination (AFC) systems could be used to enable spectrum sharing in future.

There are numerous use cases that could benefit from standard power (SP) or 'higher power' Wi-Fi. Subject to the results of appropriate sharing studies, it may be possible in future to deploy outdoor SP Wi-Fi systems to support use cases in manufacturing, logistics, agriculture, and rural broadband/community networks, or for enhanced indoor coverage in higher education, hospitality, healthcare, and other sectors. Standard power typically operates in conjunction with an AFC geolocation capability, which is aware of incumbent user operations and can safely authorise licence-exempt operation on available channels at a particular location while protecting the incumbents from harmful interference.

As the AFC will block specific frequencies to protect incumbents, access to the entire 1180 MHz in the 6 GHz band will be important to ensure a sufficient number of available channels to support standard power operation.

Whilst the development and implementation of rules to allow higher power applications would take time, opening up the band for low power applications now would immediately bring benefits: The currently available Wi-Fi 6E equipment can easily make use of the entire 6 GHz band where regulations allow it.

Conclusion

In conclusion, the undersigned companies respectfully ask Arcep to open the 6425-7125 MHz band for usage by WAS/RLAN (wireless access systems/radio local access networks) on a licence-exempt basis. We further ask Arcep to support a European position of "No change" with respect to an IMT identification of the 6425-7025 MHz and 7025-7125 MHz bands under Agenda Item (AI) 1.2 of the 2023 World Radio Conference (WRC-23).

Respectfully submitted,

/s/

Signatories

Christopher Szymanski
Director, Product Marketing
Wireless Communications and Connectivity Division
Broadcom Inc.
Email: chris.szymanski@broadcom.com
Phone: +1 949 690 5231

Scott Blue
Director, Global Wireless Policy
Cisco Systems, Inc.
Email: scblue@cisco.com
Phone: +358 469200364

Detlef Fuehrer
Senior Manager, Spectrum Management and Regulatory Affairs, EMEA
Hewlett Packard Enterprise
Email: detlef.fuehrer@hpe.com
Phone: +352 691 880 836

Guillaume Lebrun
Global Connectivity Policy
Meta Platforms Ireland Limited
Email: guillaumelebrun@fb.com
Phone: +49 1733668177