Questionnaire on Long-term vision for the upper 6 GHz

Ericsson appreciates the opportunity to respond to the questionnaire on upper 6 GHz to support the RSPG to develop the draft Opinion on this band.

Ericsson is one of the few truly global European technology leaders, a trusted partner, and key contributor to the region´s economy and society. In fact, Ericsson is one of Europe's five largest technology companies by revenue (Fortune 500 Europe). Ericsson brings EUR3 billion annual R&D investments and 21 Research & Development centres in Europe, with a total of nearly 30,000 engineers and inventors – more than 60% located in Europe.

Ericsson is a European leader on mobile connectivity with 50% of the world´s 5G traffic outside mainland China carried over our networks[1]. Ericsson is the biggest European provider of Fixed Links (FS) with over 50 years of experience in this market and is also one of the top two FS providers in Europe.

We, at Ericsson, wish to see Europe retaking global leadership on connectivity and believe that proper action on upper 6 GHz is key to help achieving that goal.

- Upper 6 GHz is of strategical importance for Europe to address traffic growth, both for traditional mobile broadband and for new use cases.

- Upper 6 GHz is a unique opportunity for economically viable expansion of mobile networks. It will enable Europe to benefit from the growing ecosystem following the WRC-23 decision to identify the band for IMT. In fact, countries that identified and attempted IMT identification of the band represent 60% of the world's population.

- The upper 6 GHz is the last remaining mid-band (below 7 GHz) spectrum in Europe and thus, Ericsson recommends careful consideration on the usage of this band. While higher spectrum can be used for short range communications, mid-band is the sweet spot of coverage and capacity for mobile deployments. Ericsson recommends the RSPG to prioritize MFCN/ECS[2] over WAS/RLAN in this band also noting that Europe has just

[1] Ericsson Annual Report 2022

[2] We note that the questionnaire refers to MFCN while the Commission usually refers to ECS. For simplicity, we will use MFCN in this response.

released 500MHz of spectrum to WAS/RLAN (5925-6425 MHz) which still needs to be exploited.

- Allocating the upper 6 GHz to MFCN will contribute to reach the Digital Decade Policy Programme 2030 (DDPP) targets on fixed and mobile connectivity.

- Without Upper 6 GHz, Europe will not be able to reach the DDPP target on mobile connectivity.

- Given that 1Gbps is distributed to all households (DDPP target on fixed connectivity), the Commission has already enabled the possibility for users to achieve such speed in the "last-leg" by opening the lower 6 GHz band (5925-6425 MHz) for license exempt use. This needs to be followed by the adoption of the latest WAS/RLAN standards[3] and the improvement of the current deployments[4] to enable Gigabit connectivity at home.

- Ericsson sees the allocation of upper 6 GHz for MFCN as a first step to create a strong spectrum baseline for mobile expansion. Regions with the greatest potential to benefit from 6G will be those that deploy the most advanced 5G networks by the end of this decade.

- New usage of the upper 6 GHz should enable flexibility for FS. While coordination is possible with MFCN networks, this is impossible with WAS/RLAN. Interference from WAS/RLAN will increase as market penetration grows. If RLAN is enabled in the band, we expect that investment on FS will stop or links will need to be moved to another frequencies.

[3] IEEE 802.11be: Wi-Fi 7 Multi-link operation (MLO) feature.

[4] Cisco Meraki, Best Practice Design: High-Density Wi-Fi Deployments (link), Aruba Networks, Very High-Density 802.11ac Networks: Planning Guide (link)

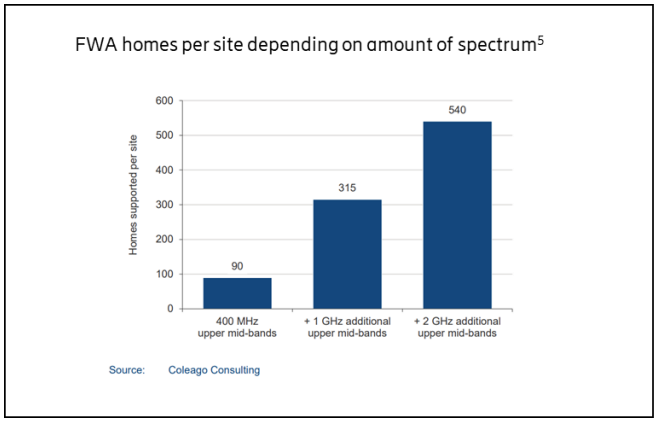
Questions directed to the MFCN and the WAS/RLAN stakeholders:

I) Explain the demand for MFCN or WAS/RLAN in the upper 6GHz band before and beyond 2030

In the context of the Digital Decade Policy Programme 2030(DDPP), Ericsson is of the view that the allocation of 6 GHz to MFCN will have the largest impact on the Digital Decade connectivity targets for the deployment of networks with gigabit speeds.

- *DDPP target on fixed connectivity: all end users at a fixed location should be covered by a gigabit network up to the network termination point.*

This targets calls for the Fixed Broadband infrastructure to deliver 1Gbps to all fixed users, which can be achieved with either fiber or fixed wireless access (FWA). While in the dense urban areas, fiber dominates, its usage decreases the further one moves from the center. In fact, outside the cities (e.g. villages), FWA is the predominant solution. Allocating the upper 6 GHz to MFCN can improve the business case for FWA by increasing the bandwidth and thus speeds for users, bringing digital equality and improving possibilities to users outside the city. GSMA has estimated that an additional of 1 GHz of mid-band spectrum would enable coverage for 4 times as many households compared to only using Cband[5].



Given that 1Gbps is distributed to all households, we believe that the Commission has already enabled the possibility for users to achieve such speed in the "last-leg" by opening the lower 6 GHz band (5925-6425 MHz) and in this way more than doubling the amount of spectrum available for RLAN. This needs to be followed by the adoption of the latest WAS/RLAN standards[6] and the improvement of the current deployments[7] to enable Gigabit connectivity at home before considering additional spectrum for WAS/RLAN technologies.

[5] Estimating-Mid-Band-Spectrum-Needs.pdf (gsma.com)

[6] IEEE 802.11be: Wi-Fi 7. Multi-link operation (MLO) feature: aggregation of multiple channels across different frequency bands or within the same band into a single connection

[7] Cisco Meraki, Best Practice Design: High-Density Wi-Fi Deployments (link), Aruba Networks, Very High-Density 802.11ac Networks: Planning Guide (link)

- *DDPP target on mobile connectivity:* All populated areas should be covered by a next-generation wireless high-speed network with performance at least equivalent to that of 5G

  Public wide-area networks in the upper 6 GHz will allow operators to bring the "5G performance", i.e. IMT-2020, widely within the cities in an economically feasible manner A study by GSMA estimates that on average 2 GHz of mid-band spectrum is necessary to deliver this performance. The analysis assumes densification in current mid-bands both indoors and outdoors and high-bands as well as Wi-Fi offload. Europe has harmonized 960 MHz of spectrum in the mid-bands range (1.8 GHz, 2.1 GHz, 2.3 GHz, 2.6 GHz and 3.5 GHz) and thus the upper 6 GHz is a requirement to enable the Commission to fulfill its mobile connectivity target. Without this spectrum, Europe will not be able to reach the "5G performance" as the additional densification needed would be economically, environmentally, and technically unfeasible.

  In fact, the same report analyzed the economical impact of densification to reach such target in specific cities, concluding that without additional mid-band spectrum in Europe, it would cost up to 4 times more to reach such goal, which is not feasible considering the economics of the European mobile market. Note that this calculation ignores the technical feasibility of such densification.

Ericsson estimates that upper 6 GHz is needed for the near-term expansion of current 5G networks (2025-2030) to address the traffic growth of traditional mobile broadband and to enable new use cases, such as Extended Reality (XR). We note that the Union has set an objective to reinforce its global technology leadership and sovereignty in mobile connectivity towards 6G. We see the allocation of 6 GHz for mobile as a first step to create a strong spectrum baseline for 5G-Advanced. This baseline can be further expanded to unleash the full potential of 6G[8]. In fact, the regions with the greatest potential to benefit from 6G will be those that deploy the most advanced 5G networks by the end of this decade. The same view has been expressed by Mr. Letta[9] "*allocating this band for IMT use is crucial for facilitating the high-performance and quality development of 5G services, which, in turn, will lay the groundwork for 6G technologies."*

II) Provide information about the sustainability of the above explained demand, especially the:

1) Environmental impact assessment

In order to achieve the DDPP target on mobile connectivity either extreme densification or new mid-band spectrum is needed. Analysis by the GSMA[5] concludes that in Europe densification would increase the power consumption up to x2.2 by densifying current networks rather than adding new spectrum to existing sites. Note that this calculation ignores the technical feasibility of such densification.

[8] 6G spectrum - future mobile life - Ericsson

[9] Enrico Letta - Much more than a market (April 2024) (europa.eu)

It has been claimed that a transfer of traffic from fixed to mobile would drastically increase the energy consumption of wireless networks[10]. Ericsson would like to note that this conclusion is based on the wrong assumption that energy use and data transmission is linear[11]. One example on the non-linearity relationship is that during the Covid-19 pandemic, data transmission in mobile networks grew by 50% while the electricity consumption remained flat[12].

2) Social economic impact

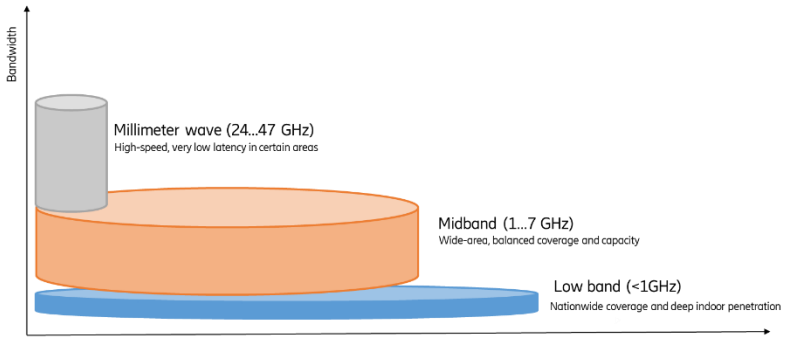
A decision in favor of MFCN (i.e. licensed band enabling macro Base Stations) will not only contribute to the EU Digital Decade goals but to the overall European economy. In 2030, 5G is expected to generate $960 billion in GDP, with the majority of benefits driven by mid-band spectrum (65 % or $610 billion). This could decrease from $960 billion to $600 billion (i.e. by 40%) if additional mid-bands are not made available[13].

Turning to 6 GHz in particular, a decision on licensed usage of the upper 6 GHz band will drive the highest economic benefit for Europe, as concluded by the GSMAi[14]. This study assumed fixed broadband speeds between 1 and 10 Gbps as well as different environments representing European cities (apartment and house settings). We also note that this study concluded that allocating the range 5925-7125 MHz to license-exempt is never the most beneficial spectrum policy decision (compared to the allocation of the band for licensed usage or deciding on a split approach – 5925-6425 MHz for license exempt and 6425-7125 MHz for licensed).

III) Provide information about:

1) the possible role of the upper 6GHz for MFCN or WAS/RLAN

The upper 6 GHz will be a capacity expansion layer over existing operators' assets, and in particular, C-band (3400-3800 MHz) deployments. We note that even though upper 6 GHz is higher than 3.5 GHz in frequency, technology improvements (e.g. BS antenna beamforming, UE enhancements, etc) facilitates to reach similar coverage levels, this includes reaching indoors users via a macro BS as well as uplink coverage.



[10] SustainabilityBenefitsof6GHzSpectrumPolicy202307.pdf (wi-fi.org)

[11] Network energy use not directly proportional to data volume: The power model approach for more reliable network energy consumption calculations - Mytton - 2024 - Journal of Industrial Ecology - Wiley Online Library

[12] GSMA | COVID-19 Network Traffic Surge Isn't Impacting Environment Confirm Telecom Operators - GSMA Europe

[13] The socio-economic benefits of mid-band 5G services

[14] Socioeconomic benefits of the 6 GHz band

2) use cases, expected deployments (e.g. number of BS for MFCN) and timeframe

Use cases in the 2025-2030 timeframe:

- Traditional mobile both indoors and outdoors.
- XR (Extended Reality) both indoors and outdoors.
  Today, early XR devices target localized usage with all processing happening on-device. Smaller, lighter and more stylish XR devices (e.g. AR glasses) are expected to come to market in the medium term, allowing a shift from local to wide-area use. Initially XR glasses will be tethered to a smart phone for connectivity and heavy processing tasks. Towards 2030, devices are expected be more attractive, and be used all day. In fact, XR could be the next paradigm shift after the smartphone, and many believe XR glasses will overtake the smartphone as the main device type in cellular networks long-term. XR will impose significant performance and capacity increase requirements in mobile networks as an XR user will consume more data relative a to mobile broadband user today due to continuous high-resolution video streams as well as edge cloud computation offload. Anytime, anywhere mobile network connectivity for XR and other evolved services will be fundamental for digital societies and economies, enhancing work, education, health and social communication and interaction. Immersive applications have the potential to greatly reduce the need for traveling and could therefore contribute to reducing greenhouse gas emissions.
  Allocating the spectrum to WAS/RLAN would then limit the benefits of XR to confined locations and best effort use cases, and thus reducing the value for the European society.
- Capacity on the highways.
  As mobile communications evolve, capacity needs expand to whenever people are, including when travelling. The upper 6 GHz can add capacity to cover busy roads.
- FWA where fiber cannot reach (see A.I)).

We expect additional use cases beyond 2030 in the 6G timeframe (as for example holographic communication) for which additional spectrum to what is available today and expected to be available by 2030 (upper 6 GHz)[8].

IV) Provide information about standardization and technology impact

3GPP has already standardized n104 (6425-7125 MHz) for the licensed use of the band, 5G NR. Additionally, 3GPP is expected to finalize the conformance test for the EIRP expected mask defined at WRC-23[15] by Dec 2024, ensuring protection of satellite use in the frequency band.

[15] RP-240829.

B. Questions directed to the stakeholders providing incumbent services in the upper 6 GHz Band.

Ericsson answers the following questions from the fixed service incumbent perspective.

I) Explain impact of possible future usage of the upper 6GHz for MFCN and/or WAS/RLAN on existing services:

MFCN: both MFCN and FS are by nature licensed services, allowing for coordination. Studies agreed towards WRC-23 reflects that separation distances between 1-10 km are needed for the FS side lobe interference scenario. This band is used for long-hops links, meaning that only one link is expected to be in the same area as the MFCN large scale deployments, enabling both services to remain in the band with coordination.

RLAN: The market penetration of WAS/RLAN devices directly impacts the probability of interference towards Fixed Service (FS). As the adoption of WAS/RLAN in the upper 6GHz band increases, particularly in densely populated areas, FS services are more likely to experience interference from nearby WAS/RLAN devices. Studies submitted to ECC SE45 have documented such interference. Additionally, there are specific scenarios where a single WAS/RLAN device may cause interference to FS due to its geographical proximity to the line of sight of the FS service.

The deployment of a FS infrastructure requires large investments and thus reliability of an interference-free environment. This cannot be secured when mixing an unlicensed system in the band because their location is unknown and thus, we expect that investment in the band will stop or links will need to be moved to another frequencies. In most cases, higher frequency bands would need to be used, resulting in decreased performance or more costly deployments.

II) What are your current and future spectrum needs (before and beyond 2030) in the upper 6GHz band?

Ericsson will continue to provide fixed service equipment in this band globally. Spectrum below 10 GHz is needed to provide long-hops, with 6 GHz being the band used for the longest links. We believe that it is important to provide the opportunity to use this band for fixed services if and when necessary. These links usually need large bandwidths to achieve multi-Gbps links and needs to be combined with other frequency bands to achieve 10 Gbps links.,

III) What impact on your service do you expect from the introduction of MFCN and/or WAS/RLAN in the upper 6GHz band?

MFCN: Ericsson expects coordination between MFCN and FS if both are in the same geographical area. This can be done by the stakeholders or with help from the regulator.

RLAN: Ericsson expects interference from RLAN increasing over time and a cease on FS investment in this band.

IV) What measures could improve compatibility from your perspective'

MFCN: Assistance from the regulator can be of help to coordinate in certain cases as locations of both FS and MFCN BS are known and fixed.

RLAN: No measures can improve compatibility as the main issue of locations unknown remains.