ETNO responses to

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

The European Telecommunication Network Operators' Association (ETNO) welcomes the opportunity to provide input to the RSPG work on Long-term vision for the upper 6 GHz band.

A. Questions directed to the MFCN and the WAS/RLAN stakeholders

ETNO members are pan-European operators providing mobile and fixed broadband services[1], including Wi-Fi access solutions, and responsible of around 70% of the total sector's investment in Europe. Thus, the responses below represent our views as both MFCN and WAS/RLAN stakeholders.

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

The European consumption of digital services is continuous and reflected in steady growth of cellular and fixed data, with mobile traffic expected to increase at a slightly higher pace than fixed over the next decade, pending on market[2].

Fixed traffic is currently, on average, around ten times higher than mobile traffic. A large part of that fixed broadband traffic is terminated over WAS/RLAN (Wi-Fi), and therefore, on absolute terms, traffic for Wi-Fi is larger than for mobile. Adding to that, comparison of spectrum demand is not like-for-like because:

- In a cellular MFCN network, the spectrum is used in a base station that serves up to thousands of users within its service area of hundreds of meters or kilometres. That large coverage area, together with the possibility of seamless hand over between base stations, provides a fertile foundation for a wide range of future unknown applications, including, critical applications that require assured Quality of Service (QoS) or in which end users are moving or outside their home Wi-Fi.
- In WAS/RLAN networks, a Wi-Fi access point typically serves 1-5 persons indoors in a single household, providing the last metres of over-the-air connectivity to the fixed infrastructure on a best-effort basis.

MFCN Demand

Traffic growth: By the end of the decade, we expect between 2 and 7 times more traffic in European cellular networks than today, depending on the country. For example, Ericsson's latest Mobility Report[3] estimates data traffic per active smart phone in Western Europe to grow, on average, at a compound annual growth rate (CAGR) of 17% from 19 GB in 2023 to 49 GB in 2029 per month. This is growth by factor of 2.6 by end of decade, and excludes traffic generated by Fixed-Wireless Access (FWA) and Internet of Things (IoT), which we expect both to contribute to the traffic growth in cellular networks. Other sources have higher estimation, and ADL[2] for example estimates a CAGR of 25% on average for mobile uses (i.e. excluding FWA but including mobile-only homes), a growth factor of 4.75 on average for the EU, with

[1] Analysis Mason to ETNO, State of Digital Communications 2023, Jan, 2024
[2] Arthur D Little report The Evolution of Data Growth in Europe, May 2023, expects a CAGR of approximately 25% a year on mobile and 20% per year on fixed until 2030.
[3] Ericsson Mobility Report, June 2024

current low-usage countries like Germany, Greece or Belgium experiencing growth factors above 7 times.

Cellular networks serve users with seamless mobility and continuity of service in both outdoor and indoor environments. Even if today over 70% of traffic in cellular networks is delivered to/from indoor locations, users rely on broadband data while on move and expect availability of the seamless mobility. The European 5G networks are already providing 89.3% population coverage and target achieving the 100% coverage before the end of the decade. We expect cellular traffic in indoor and in mobility scenarios to grow in-line with total growth, i.e. at least triple by end of decade, demanding for mobile networks to assure coverage and QoS in all circumstances.

In 2030s, we expect traffic to continue growth in cellular MFCN networks. 6G and new use cases it enables may trigger increase for annual growth rate in 2030s. Beyond 2030, however, it is difficult to make accurate forecast. A prioritisation of the upper 6 GHz for licensed IMT is more flexible and preferable than a usage by unlicensed Wi-Fi, because IMT is capable to address broadband traffic growth in any circumstance, while Wi-Fi realistically handles traffic only indoors and at home or in familiar environments.

Deployment situation and demand: European operators have deployed 3.6 GHz band actively – out of the 89.3% 5G population coverage, over 50% of EU population has 5G coverage provided with 3.6 GHz band today[4]. These deployments will continue to increase the 5G outreach and additional capacity. Where mobile traffic demand is expected to reach or overpass the network capacity, addition of supplementary capacity is planned and can be achieved either by adding new bands in existing sites, and/or adding new sites. MNOs have already densified networks and continue to do that in areas with capacity shortages. However, extreme densification is not a viable solution neither technically, economically, nor ecologically. Thus, we expect that new spectrum that supports provision of additional capacity with existing grid will be needed sometimes even before the end of decade.

The customers request high performing mobile broadband capacity which requires the usage of high channels bandwidth. Beside the already deployed 3.6 GHz spectrum only the upper 6 GHz spectrum band could provide such additional capacity provision with good propagation characteristics for macro networks. It has been demonstrated in several trials that high data rates with coverage levels comparable to 3.6 GHz band can be reached while using the same site grid. Also, outdoor-to-indoor propagation has been demonstrated which is important considering over 70% of IMT mobile network data traffic is delivered to/from indoor locations. It will be important to allow the use of upper 6 GHz band for cellular macro networks without imposing additional constrains on allowed power to support an economically viable macro deployment.

WAS/RLAN Demand

As already noted the ETNO members also provide WAS/RLAN solutions to their customers as part of their fixed-service offering. So, it is also in the interest of telecom operators to provide high quality WAS/RLAN service to our customers.

Traffic growth: As noted earlier, we expect traffic in fixed networks to grow at a slightly lower pace than in mobile networks. However, we do not expect broadband capacity to be limited by WAS/RLAN spectrum in foreseeable future. This is because a Wi-Fi Access Point, which provides wireless access to broadband, serves only a limited number of users in a small area.

Deployment situation and demand: Wi-Fi 6 using 2.4 GHz and 5 GHz bands is a standard Telco commercial offering today. It supports throughputs up to 4 Gbps, i.e. it supports access to gigabit speed network already (noting that the Digital Decade Policy Programme 2030[5] goal

[4] State of the Digital Decade 2024 report, July 2024
[5] Decision 2022/2481 - Digital Decade Policy Programme 2030.

for gigabit network is up to network termination point). Newer Wi-Fi 6E support also lower 6 GHz.

A large proportion of the WAS/RLAN equipment in the market support older/legacy Wi-Fi generations, some still relying exclusively on the 2.4 GHz band. Thus, a Wi-Fi performance can often be improved by replacing the Wi-Fi access point with newer (not even the newest) equipment. Considering that spectrum used by WAS/RLAN is shared among multiple users, spectrum efficiency is improved by ensuring that more users upgrade their equipment timely. In addition, newer equipment with latest software updates is more robust towards security threats.

The newest Wi-Fi generations have features supporting higher capacity, e.g. Wi-Fi 7 supports Multi-Link Operation allowing simultaneous reception and transmission across different frequency bands and channels (2.4 GHz, 5 GHz, 6 GHz). The upcoming Wi-Fi 8 is expected to support new frequencies in the mm-wave frequency range, 42-71 GHz, and to provide data rate up to 100 Gbps.

Beyond 2030, network densification is a way to improve capacity and spectrum efficiency in locations with high-capacity demand. We expect that Wi-Fi network densification with Fiber To The Room (FTTR) solution start to appear in such locations. Denser Wi-Fi configurations could also take advantage of higher frequencies in the 42-71 GHz range for providing extremely high throughputs.

Furthermore, a recent Wi-Fi indoor connectivity test[6] concluded, that using the already available Wi-Fi spectrum (2.4, 5 and lower 6 GHz) are under any conditions sufficient to be consistent with the European Union Digital Decade Policy Programme connectivity objectives for 2030 for all end users at fixed locations. The test shows that the key constraint for Wi-Fi is coverage which can be effectivity addressed through densification of access points instead of additional spectrum resources.

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

1) Environmental impact assessment

Spectrum policy decisions can have a large impact on the environmental footprint of mobile networks[7]. Sufficient spectrum availability and avoiding fragmented assignments and unjustified deployment limitations support delivering the mobile connectivity in ecologically viable manner: increasing the amount of spectrum frequencies per site is a more environmental-friendly way to increase capacity than increasing the number of sites, because of fewer equipment in the network create less energy and environment burden in deployment, operation, and network upgrade phases. Large contiguous spectrum blocks (compared to fragmented blocks) support better performance with less complex deployment and operation. Deployment limitations, e.g. on base station transmit power or EMF limits also lead to the need for increasing the number of sites.

A recent study[8] has assessed the impact of carbon emissions of 5G over 2022-2032 with and without additional mid-band spectrum - assuming the network meets connectivity targets and demands in both cases. In both cases, existing network grid is assumed to be densified, but in the absence of additional spectrum, the required densification is greater due to less spectrum being available. It concludes that when upper 6 GHz is available for 5G mobile networks, the carbon emission savings from having less network densification are at least 2.9 times greater

[6] COMTEL: https://www.comtelitalia.it/files/docs/indoor_connectivity_test.pdf
[7] GSMA, Spectrum: the Climate Connection, May 2023
[8] Analysys Mason to Huawei, Impact of additional mid-band spectrum on the carbon footprint of 5G mobile networks: the case of the upper 6 GHz band, June 2023

than the carbon emission costs of deploying and operating the new mid-band radios. The same study also estimates the impact of Wi-Fi networks and indicates that the availability of the upper 6 GHz band for Wi-Fi would not translate into any reduction in carbon emissions when targeting an aggregated throughput of at least 1 Gbps per premises.

2) Social economic impact

Digital technologies are playing a crucial role in Europe as economies advance their efforts to embrace green and digital transformation. 5G connectivity is serving as a catalyst for GDP growth and a powerful tool to help combat climate change through enablement effect. GSMA Mobile Economy report[9] estimates that in 2030, 5G connectivity and services will generate economic benefits of €153 billion in Europe. However, it is crucial that policy makers take necessary actions to support continued investment and the long-term sustainability of the mobile industry to support European society demands and the Digital Decade goals, also through effective spectrum policy. Mobile industry contribution to European GDP is estimated to grow from €910bn (which is 4.3% of GDP) in 2022 to €1 trillion in 2030. 1.3 million jobs were directly supported by mobile ecosystem in Europe in 2022, and indirectly 0.9 million jobs. Unique mobile subscriber penetration in Europe will grow from 90% to 92% (496 to 507 Million) between 2022 and 2030.

A detailed economic impact assessment by GSMA Intelligence[10] of the different allocation scenarios of the 6 GHz band across 24 countries, including Germany, France and Italy, found that optimal socio-economic benefits are achieved from the allocation of at least 700 MHz, namely the whole of upper 6 GHz band, for licensed 5G use. Even in countries with extensive fibre broadband penetration, the allocation of 500 MHz of spectrum for unlicensed use in the lower 6 GHz band (5.925-6.425 GHz) will be sufficient to address expected Wi-Fi demand. In Europe the lower 6 GHz is already allocated for unlicensed use, and it roughly doubled the supply of license-exempt spectrum for WAS/RLAN.

The key takeaway is that the probability of congestion in mobile networks is much higher than the probability of congestion in fixed networks. To illustrate this point, the report shows the potential economic benefits of the entire 6 GHz band in different scenarios: whole 6 GHz band to licensed, whole 6 GHz band to license-exempt, and lower 6 GHz (500 MHz) to license-exempt, upper 6 GHz (700 MHz) to licensed mobile use in 24 countries, including Germany, France and Italy, as a percentage of GDP in 2035 for a range of theoretical FTTP download speeds (1, 5 and 10 Gbps). The distinction is relevant because the benefits of additional licence-exempt spectrum for Wi-Fi are tied to the capability of fixed line connectivity speeds.

The results clearly demonstrate that licensed 5G mobile is the most optimal use of either the whole 6 GHz or the upper 6 GHz band in all scenarios. Even in cases with fixed broadband speeds of 10 Gbps, assigning the upper 6 GHz for licensed 5G, instead of licence-exempt use (RLANs/Wi-Fi), delivers at least a 50% higher benefit in terms of GDP impact by 2035. Allowing licence-exempt technologies in the entire 6 GHz band will never be the most beneficial option.

III) Provide information about:

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

For MFCN, the upper 6 GHz band is currently the only opportunity for initial 6G deployments expected for 2030. However, some members in selected countries may need it even before the end of the decade to accommodate 5G traffic growth.

Features similar to the Dynamic Spectrum Sharing (DSS) allowing the use of a single frequency band to be dynamically used by 4G and 5G are expected to enable both 5G and 6G

[9] GSMA Mobility Report Europe 2023

[10] GSMA Intelligence. The socioeconomic benefits of the 6 GHz band: considering licensed and unlicensed options, June 2022.

service in this band where necessary. As explained above, it is of paramount importance that the upper 6 GHz is made available for macro deployment of cellular MFCN networks in due time and with conditions that allow efficient deployment, i.e. by using the same grid as 3.6 GHz band. The 6 GHz band supports unleashing the full potential of 5G SA in the second half of the decade where needed, and in the longer perspective enables the telecom operators to deploy the best technology in the band for the next telecommunication generation, 6G.

Regarding WAS/RLAN, the lower part of the 6 GHz band has already been designated for license-exempt operations and so far there is only little use of it. As explained above, we expect that the demand for WAS/RLAN use cases can be met by using currently available mid- and high-band spectrum. Thus, the upper 6 GHz band will not play a significant role on supporting WAS/RLAN use cases.

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

In relation to MFCN, we expect future demand to be driven by mobile broadband serving a high number of use cases and applications. For example, various augmented and virtual reality applications with sensing, sensors, multimedia are expected to enhance 5G use cases or being new 6G use cases. All of those require mobility being provided by cellular MFCN networks.

Spectrum demand to serve these use cases increases steadily. We expect a demand for additional spectrum in the upper 6 GHz even before the end of this decade, noting that the demand is market specific, varying per country, even per operator. It is the intention to deploy upper 6 GHz infrastructure by reusing the 3.6 GHz grid pending on capacity demands in the network. Likely, first deployments will be done where early 3.6 GHz deployments happened. Typically, capacity demands appear at high traffic sites serving many users in urban/ suburban areas, but new type of use scenarios, e.g. FWA may equally impact the demands.

In relation to WAS/RLAN, use cases are likely driven by broadband also in Wi-Fi networks. Timeframe on equipment availability depends on spectrum availability but also standardization and implementation effort needed to meet of possible additional requirements for EU-market. We cannot estimate market adoption rate of access point equipment, but in lower 6 GHz it has not been very fast, noting the spectrum was made for WAS/RLAN available in 2021, and comparing to 5G deployments which started around that time in Europe (5G household coverage now stands at 89% across the EU. Of this, network coverage that relies specifically on the high-performance 3.6 GHz band has reached 51%[11]).

IV) Provide information about standardization and technology impact

For cellular networks, standardization and development have started and several trials have been conducted by mobile vendors and operators. Wi-Fi equipment supporting full 6 GHz band is available for US market.

The decision on the use of the band in EU and the defined conditions will have implications for the standardization, implementation, technology availability, and cost. The conditions will also impact on possibilities to use the band efficiently to serve the demands, which impacts on market interest and thus even to development and implementation timelines for equipment that will be suitable for European market. Europe should not define conditions and requirements which prevent efficient use of the band for meeting the European society demands. The solution should be both technically and commercially viable.

[11] 5G Observatory releases latest report, July 2024

B. Questions directed to the stakeholders providing incumbent services

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

ETNO notes that the coexistence of MFCN with incumbent services has already been studied in preparation of the WRC-23. Several mitigation measures have been developed, in particular noting the EIRP mask to protect FSS uplink and being part of the WRC-23 decision. Furthermore, we would like to emphasize that some of the mentioned services, e.g. UWB, have by definition a secondary status.

In the following we provide our view on the FS which is also used by telecom operators in the 6 GHz band.

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

Many ETNO members have fixed links in 6 GHz band in some of their markets, demand varying per market. Generally, these are long-haul links with high relevance in less populated areas. Use of the 6 GHz for fixed links may continue beyond 2030 - pending on national licensing decisions, possibilities for alternative solutions, and alternative demands of this spectrum in our networks. We have elaborated our conflicting interests e.g. in an input to CEPT WGSE[12].

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

MFCN: Cellular networks are deployed on nationally licensed spectrum. Decisions on licensing, license conditions, and timelines are taken by the national regulator after evaluating and consulting on the demands. Licenses allow setting conditions to protect existing use (e.g. protection/coordination zones) if needed. As fixed links belonging to operators in the 6 GHz bands are typically long-haul links in less populated areas, and mobile capacity demand is typically highest in populated urban/suburban areas, coexistence of services may be feasible. Equally, we also expect to replace fixed links in upper 6 GHz band with other solutions, e.g. fibre, other FS bands, where and when needed to facilitate our cellular demands.

WAS/RLAN: WAS/RLAN operate typically on license-exempt spectrum with low power. Demand is mainly in populated areas whereas fixed links are primarily in less populated areas, and therefore the impacts might be low. However, as WAS/RLAN use is license-exempt, in reality it is impossible to ensure the use is as allowed (e.g. low power indoors, very low power outdoors). For example, WAS/RLAN interferences to Meteorological radars in 5 GHz band were brought up in ECC meeting in June 2024. Problems were caused by illegal use of WAS/RLAN, either wrongly configured networks, or equipment that are not allowed in European market.

CEPT SE45 is studying the possible impact of WAS/RLAN to FS. The work has not been finalized yet. There have been long discussions on parameters for the studies, e.g. WAS/RLAN activity factor and market adoption factor. Based on the draft, almost all studies seem to conclude that WAS/RLAN are not causing harmful interference to FS (Long Term Protection Criterion and Fractional Degradation Performance is respected). However, work is still being carried out in SE19 to provide a generic methodology for deriving protection criteria for any source of time-varying interference into an FS receiver. This work studies how current FS receivers perform in the presence of pulse/burst type interference, with and without ACM (Adaptive Coding and Modulation). There are indications that pulsed/bursty signals (e.g. beacon signals with and without traffic on top) may have a more noticeable interference effect than noise-like/continuous signals at the same I/N level. The conclusions of the ongoing work may have impact on the results of the WAS/RLAN - FS sharing. Considering these discussions,

[12] SE(23)059, European Mobile Network Operators' considerations for 6 GHz studies, May 2023

and that in US, there are several FCC filings on WAS/RLAN interference in 6 GHz band[13], we may expect interference cases from WAS/RLAN to FS.

3) What measures could improve compatibility from your perspective?

We consider that licensed use of radio services, with national evaluation of demands, and appropriate conditions is the best approach to ensure compatibility. Only a licensed spectrum usage enables administrations and operators to ensure compliance with the respective usage conditions.

[13] FCC ex-parte filing, AT&T, Unlicensed Use of the 6 GHz Band (9 September 2022) (First claim), FCC ex-parte filing, AT&T, Unlicensed Use of the 6 GHz Band (3 October 2022) (Analysis of the improper Cable Labs study), FCC ex-parte filing, AT&T, Unlicensed Use of the 6 GHz Band (19 December 2022) (Final conclusion), FCC ex-parte filing, Fixed Wireless Communications Coalition, Unlicensed Use of the 6 GHz Band (14 December 2022), FCC ex-parte filing, Fixed Wireless Communications Coalition, Unlicensed Use of the 6 GHz Band (6 June 2023), FCC ex-parte filing, Miami-Dade Security Department, Unlicensed Use of the 6 GHz Band (22 November 2022), FCC ex-parte filing, APCO, Petition for reconsideration (28 May 2020), FCC ex-parte filing, attached report, Southern Company, Test Report on the Effects of 6 GHz Unlicensed RLAN Units on Fortson to Columbus Microwave Link (21/23 June 2021) (filing, report), FCC ex-parte filing, Southern Company, Unlicensed Use of the 6 GHz Band (24 October 2022), FCC ex-parte filing, FirstEnergy, 6 GHz Additive Interference Study (12 October 2022), FCC ex-parte filing, FirstEnergy, 6 GHz Additive Interference Study, Phase 2 – Winter (9 May 2023)