ARGUMENTS IN FAVOUR OF LICENCE-EXEMPT 6 GHZ RADIO SPECTRUM

Based on the latest industry information, this document is designed to provide national regulatory authorities (NRAs) in Europe, Middle East and Africa (EMEA) with a compendium of arguments in favour of licence-exempt use of the entire 6 GHz band. The document features:

1. Demand for spectrum
2. Socio-economic impact
3. The roles of 5G and Wi-Fi
4. Co-existence with other services
5. The regulatory process

1. DEMAND FOR SPECTRUM

1.1 What is the evidence that Wi-Fi requires access to the full 1200 MHz of the 6 GHz band?

Despite the enormous growth in Wi-Fi traffic over the past two decades, no new mid-band spectrum was made available on a licence-exempt basis between 2003 and 2020. As a result, congestion has been increasing, impacting the end-user experience.

More than 18 billion Wi-Fi devices are now in use (360 times as many Wi-Fi devices as were in use when WRC-03 provided access to the 5 GHz band), with 4.4 billion new devices shipped every year, according to research firm IDC[1].

With the ongoing rollout of high-speed fibre connectivity, fixed line Internet traffic is rising rapidly, increasing demand for Wi-Fi. In the Middle East and North Africa, for example, traffic per fixed broadband connection is set to rise from 101 GB per month in 2020 to 176 GB per month in 2024, according to Analysys Mason[2].

The vast majority of this fixed-line traffic is distributed via Wi-Fi using licence-exempt spectrum. Studies by Quotient[3], Qualcomm and ASSIA have each pointed to major spectrum shortfalls for licence-exempt technologies, with ASSIA highlighting how congestion in both the 2.4 GHz band and the 5 GHz band has been impacting quality of service.

From these studies, it becomes obvious that the 500 MHz of licence-exempt spectrum in the lower 6 GHz band (5925 MHz – 6425 MHz) will not be sufficient to satisfy the mid- and long-term capacity needs. Given the pivotal role that Wi-Fi plays for the broadband ecosystem and its continuing growth, there is a need to make the full 1200 MHz in the 5925-7125 MHz (6 GHz) band available on a licence-exempt basis to support the ever-increasing demand and enable nations to meet their broadband goals and objectives for a digital society.

Since the WRC-03 (2003) decision to enable access to new spectrum in the 5 GHz range, there have been revolutionary changes in Wi-Fi technology, use cases, and demand. Wi-Fi has become essential to enable businesses and people to get online in urban, suburban and rural areas. At the same time, the devices running on Wi-Fi networks have become increasingly powerful with each generation making greater demands on Wi-Fi network capacity from video resolution, processing power, camera capabilities and more.

[1] Source: https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-2022-wi-fi-trends
[2] Source: https://www.analysysmason.com/globalassets/x_migrated-media/media/analysys_mason_fixed_forecast_mena_jul2019_sample_rdmb02.pdf
[3] Steve Methley and William Webb, Quotient Associates Ltd., Wi-Fi Spectrum Needs Study 26 (2017); Rolf de Vegt et al.,

Prepared by Policy Impact Partners Ltd. on behalf of the 6 GHz Coalition, which is supported by multiple companies.

More and more governments, including those of Brazil, Canada, Saudi Arabia, South Korea and the U.S., have recognized the urgent need for licence-exempt access to the entire 6 GHz band (5925-7125 MHz), while others have taken the initial step of making at least part of the 6 GHz band available on a licence-exempt basis.

Without sufficient spectrum for Wi-Fi, users will not be able to fully leverage the performance of advanced Internet apps. The latest standard, Wi-Fi 6, can support a variety of demanding use cases, such as ultra HD video streaming, smart home automation, hotspot access, automation of city-wide services, augmented/virtual/extended reality (AR/VR/XR) applications, health monitoring, wearables and seamless roaming. Moreover, Wi-Fi 6 is the only cost-effective option to distribute gigabit connectivity within schools and hospitals for eEducation and eHealth services.

The successful development of both the industrial and consumer metaverses will depend heavily on Wi-Fi 6 and Wi-Fi 7 having access to sufficient spectrum. As usage of extended reality and holopresence services grows, Wi-Fi will be transmitting vast amounts of data to the headsets and handsets used to access these services.

Realising the full potential of fibre

Wi-Fi needs access to 1200 MHz in the 6 GHz band to fully leverage the potential of the growing number of fibre connections. High-capacity fibre access networks need to be complemented by an equally performant wireless local connectivity solution to be economically viable and provide the envisioned user benefits.

Fixed broadband connections are growing steadily across the world. The number of fixed broadband subscriptions rose to 1.29 billion in 2021, up from 1.14 in 2019, according to the World Bank.[4]

Increasingly, these fixed broadband connections are high-capacity fibre links. High-speed fibre is now the primary fixed broadband technology in 19 out of the 38 OECD countries[5], following a 12.3% rise in fibre broadband subscriptions between June 2021 and June 2022. Overall, fibre now accounts for 36% of fixed broadband subscriptions in the 38 OECD member countries, up from 22% five years ago.

In a global survey of broadband service providers in early 2022, Omdia found that 60% offered connections of at least 1 Gbps, compared with 45% in 2019. In future, fixed broadband speeds are set to rise to 25 Gbps and beyond.

The need for wider channels

In particular, Wi-Fi 6E, and the forthcoming Wi-Fi 7 standard, need access to the full 1200 MHz to utilize the full extent of their capabilities and support evolving and emerging innovative use cases. Opening only 480/500 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 1200 MHz, 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 systems. A shortage of wider channels would have a detrimental impact on real-time video services and high-bandwidth immersive services, such as AR/VR/XR services. Enterprise networks (in manufacturing, education, healthcare and other sectors) which optimise the use of spectrum by enabling different data rates, latencies, and quality of service, depend on the large number of channels and the diversity of channel widths (20/40/80/160 MHz) that become available with 1200 MHz of spectrum. In the near future, Wi-Fi 7 will rely on access to 320 MHz channels to further improve latency, throughput, reliability and quality of service relative to Wi-Fi 6E.

There are numerous use cases that could benefit from standard power (SP), sometimes also referred to as '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 Wi-Fi typically operates in conjunction with an automated frequency coordination (AFC) geolocation capability, which is aware of incumbent

[4] Source: https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=ZQ
[5] Source: https://www.oecd.org/sti/broadband/broadband-statistics-update.htm

user operations and can safely authorize licence-exempt operation on available channels at a particular location while protecting the incumbents from harmful interference. As the AFC will block certain frequencies in order to protect incumbents, access to the full 1200 MHz will be important to ensure there is a sufficient number of available channels to support standard power operation.

1.2 To what extent is 6 GHz Wi-Fi equipment available?

The Wi-Fi Alliance has named Wi-Fi 6 products capable of operating in the 6 GHz band as "Wi-Fi 6E" devices and released a certification plan for global interoperability in January 2021. More than 1,000 Wi-Fi 6E products that work in the 6 GHz band have since become available from the world's leading electronics manufacturers. This fast-growing ecosystem means that individuals and organisations can use Wi-Fi 6E today and will be able to benefit immediately from Wi-Fi 7 when it is released in 2024.

As the market grows, economies of scale are kicking in, ensuring that Wi-Fi 6E will be highly affordable. As with previous generations of Wi-Fi, the technology is set to be included in almost every phone, tablet and laptop, as well as other appliances, such as printers, televisions, cameras and wearables. Grand View Research 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.

1.3 Does licensed 5G require more mid-band spectrum? Why the 6 GHz band? What is the evidence? What are the alternatives?

Usage of 5G to date shows that additional mid-band spectrum is not required. A study of mobile data usage in 2021 in Europe by Rewheel[6] found that, even in the top 5% of the busiest sectors, 5G traffic runs at only 7.7% of capacity on average.

In many markets, the growth in mobile data traffic is slowing. In Western Europe, mobile data traffic is set to grow 19% per annum between 2022 and 2028, compared with 28% in 2022, according to Ericsson[7]. In Central and Eastern Europe, Ericsson is forecasting mobile data traffic growth of 18% per annum between 2022 and 2028 (down from 30% in 2022), 27% in the Middle East and North Africa (32% in 2022), and 39% in Sub-Saharan Africa (60% in 2022).

The large amount of spectrum below 5 GHz that has already been identified for IMT could, and should be, harnessed to improve coverage, before specifically identifying more spectrum for IMT. Successive WRCs have identified specific frequency bands for the deployment of IMT systems and this spectrum constitutes a good mix of 'coverage' bands (below 5 GHz) and capacity bands (mmWave spectrum above 24 GHz).

In all three ITU Regions, IMT has access to at least 1368 MHz of prime spectrum below 5 GHz – far more than is available for WAS/RLAN. Much of this IMT spectrum isn't utilised today. The 3.6 GHz band, which has been allocated for 5G services by many administrations across the world, isn't being heavily used. Even when the utilization of 3.6 GHz increases, adjacent mid bands could provide ample additional capacity for 5G to cover the use cases that need a licensed technology.

Most countries in the EMEA region are also considering making the 3300-3400 MHz, 3800-4200 MHz and 4800-4990 MHz bands available for licensed spectrum use. Whilst not all countries can make all of these bands available due to existing usage, this is a significant potential resource for licensed mid-band spectrum in the medium term for many EMEA countries. In areas with low or no network coverage, the priority should be to roll out networks and leverage the existing 5G priority bands and/or existing IMT identified bands. In the Middle East and Africa, administrations have yet to make the 2300-2400 MHz band available, even though it has an IMT identification.

Although the U.S. has made the entire 6 GHz band licence-exempt, the mobile operators there have plenty of spectrum to meet demand for 5G. For example, leading U.S. telecoms operator Verizon is seeing strong growth in 5G fixed wireless access connections in the C-band (3.7–4.2 GHz). In July 2022, Hans Vestberg, Chairman and CEO of Verizon Communications, told analysts on an earnings call: "The capacity in the network is there, there's no problem. … we have deployed 60 MHz of the C-Band. We have, in average, 160. So, we have so much more to go."

[6] Source: Analysis based on the 82 5G networks considered in EU27 by Rewheel research's study "Mobile data usage in 2021 and 4G & 5G operator capacity potential", published in March 2022. https://research.rewheel.fi/downloads/Mobile_data_usage_2021_capacity_potential_170_operators_50_countries_PUBLIC_VERSION.pdf

[7] Source: https://www.ericsson.com/en/reports-and-papers/mobility-report/key-figures

In summary, there is no need to also consider the 6 GHz band for IMT, particularly as the less favourable propagation characteristics make it less suitable for wide area coverage.

1.4 If additional mid-band spectrum is not made available for IMT, will the cost of public mobile network deployments increase, or will we see a degradation in network quality?

The simple answer is no. The cost of deploying public mobile networks is related to several factors, including the amount that operators need to pay for the spectrum, the cost of the infrastructure they are deploying and the density of their networks. If mobile operators pay a licence fee for 6 GHz spectrum, that will increase their costs. The cost of developing and deploying 3GPP equipment that can support the 6 GHz band will also have a negative impact on operators' business cases, potentially pushing up prices for end users.

The amount operators need to spend on 5G infrastructure will depend on the level of demand for 5G, which will depend on many variables, including whether high-quality Wi-Fi is available. The most efficient way to deliver high-speed connectivity indoors will be to use Wi-Fi, which is optimised for this use case. If Wi-Fi has access to sufficient spectrum to meet this demand, operators will not need to spend large sums trying to improve indoor 5G coverage.

More broadly, it is up to mobile operators to price their services in a way that enables them to cover their costs. As demand for 5G rises, operators will be able to amortise the additional costs of deploying 5G across more users.

1.5 There are claims that 5G is more spectrally efficient than Wi-Fi 6. Is that the case?

The theoretical peak spectral efficiencies of Wi-Fi 6 and 5G NR are essentially the same. In real world deployments, spectrum efficiency is chiefly determined by the network topology, rather than the underlying technology. In practice, most 5G networks, which are optimised for wide area coverage and have to balance several objectives, are unlikely to be as spectrally efficient indoors as a Wi-Fi network optimised to support this use case.

More broadly, licensing spectrum excludes most users and therefore undoubtedly reduces overall usage of the spectrum in question. In that sense, licensing spectrum reduces efficiency.

Tellingly, licence-exempt services are hugely popular with consumers, partly because they enable the end-user to decide how to connect to broadband in their homes or public spaces. Mobile networks in Germany delivered 5.2 million GB per MHz of spectrum allocated in 2021. By comparison, Wi-Fi, operating exclusively over 2.4 and 5 GHz during 2021, delivered approximately 167 million GB[8] per MHz per year, i.e., Wi-Fi used the available spectrum 32 times more efficiently than mobile networks.

To penetrate building walls, 5G services need to expend high levels of power. As a result, connecting an indoor 5G device to an outdoor base station will use a disproportionate amount of energy and also result in shorter recharge cycles, increased battery wear, and additional electronic waste.

It is also the case that low power, mainly indoor, RLAN services, such as Wi-Fi, can share more easily (than outdoor 5G can) with other services, such as satellite earth-to-space links.

The ITU-R Radio Regulations (Section 0.3) state that spectrum: "must be used rationally, efficiently and economically", reflecting the fact that there are several important metrics regarding the efficient use of spectrum, such as economic, or environmental impact, as well as pro-competitive benefits.

1.6 Will 6G require new spectrum?

The first question to be answered is "What will 6G be"? Will it be a network of networks and not tied to a particular technology, or will it be just another 'G' (IMT-2030)? Reserving spectrum for what may be the IMT 'flavour' of a future 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 (which allows the use of both 4G and 5G on the same spectrum).

6G spectrum requirements are not 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.

[8] Source: Derived from data from Tätigkeitsberichte Telekommunikation. This estimate assumes that 90% of the fixed-line traffic recorded by BnetzA travels over Wi-Fi

While there have been suggestions that the upper 6 GHz band could be used for 6G, this spectrum will not be able to support significantly 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[9]).

Making the upper 6 GHz a priority band for 6G would prevent harmonisation and reduce economies of scale, as well as weaken alignment on a low-cost ecosystem. That would impact both end-users and innovators. In short, selecting the upper 6 GHz band as a 6G priority band would significantly and negatively impact 6G's innovation potential.

2: SOCIO-ECONOMIC IMPACT

2.1 What are the socio-economic benefits of making the 6 GHz band licence-exempt?

Licence-exempt usage throughout the full 6 GHz band will yield many socio-economic benefits, such as helping to address the digital divide, improving rural connectivity, accelerating innovation, and delivering greater quality of service to the users. With Wi-Fi embedded in a wide array of client devices, from laptops to tablets and smartphones, consumers can choose the right device capabilities and price for them.

Businesses also make extensive use of Wi-Fi to cover a variety of applications and use cases, be it for in-office communication, in the hospitality sector, in healthcare and education, in large public venues, and in logistics and industrial settings where Wi-Fi is used to provide remote monitoring and control of machinery and appliances within factories, warehouses and other facilities.

Assuming regulators open the full 6 GHz band, the US$3.3 trillion of value Wi-Fi added to the world's economy in 2021 will rise to US$4.9 trillion in 2025, according to research conducted by Telecom Advisory Services for the Wi-Fi Alliance.

Licence-exempt spectrum promotes innovation and competition by lowering barriers to entry, helping small and medium enterprises (SMEs) in particular. If regulators allow for technical innovation, individuals and companies can choose the technology that best suits them. As users do not need to pay licence fees to use the spectrum, Wi-Fi is one of the most cost-effective ways to provide connectivity.

Regulators have flagged the benefits of licence-exempt technologies. For example, ISED in Canada has said: "Making the full 6 GHz band available for licence exempt use as soon as possible will maximize the social and economic benefits that Canadians will derive from this spectrum…The additional licence-exempt spectrum will provide the improvements needed in Wi-Fi throughput for homes and businesses and reduce congestion between neighbours living in close proximity. The additional spectrum will also support the ability for small wireless internet service providers to provide cost-effective enhanced broadband connectivity in rural and remote areas." In rural areas lacking wireline, fibre or cellular infrastructure, Wi-Fi can deliver local broadband connectivity using fixed wireless or satellite broadband links to provide backhaul.

2.2 What are the benefits or opportunity costs of Wi-Fi and 5G in the 6 GHz range?

Reserving a portion of the 6 GHz band for a later decision on whether to allow IMT (or not) would forego the immediate economic gains that would have accrued from opening the full 6 GHz band to licence-exempt operations. In an August 2020 report, Coleago Consulting estimated 5G will not be deployed in the 6 GHz band for at least a decade.

[9] Source: https://5gobservatory.eu/observatory-overview/eu-scoreboard/

During that time, the global economy could forego trillions of euros of economic value that could be generated by Wi-Fi 6E.

UK regulator Ofcom has forecast 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. With Wi-Fi traffic doubling every three years[10], Wi-Fi will need all 1200 MHz available in the 6 GHz band in both the consumer and enterprise markets.

For much of the past decade, the IMT community has called for 100 MHz per operator in the 3 GHz range to support 5G needs. As regulators globally have made the 3 GHz band available for 5G, a wide variety of compatible equipment is available on the market. The IMT community is now calling for the upper 6 GHz band to be identified for IMT, with the GSMA recommending regulators "support harmonized mid-band 5G spectrum". But countries representing more than 40% of the global gross domestic product (GDP) have opened, or have proposed opening, the full 6 GHz band for licence-exempt use.

As a result, these frequencies will not be harmonized for licensed 5G. In fact, an identification of the upper 6 GHz band for IMT could disrupt global harmonization efforts for licence-exempt use and potentially cause major economic damage. Many regulators believe that withholding the upper 700 MHz of the 6 GHz band for future consideration for IMT is inadvisable. ISED in Canada said such a move would "hinder access to affordable broadband services for Canadians in rural and urban areas and would negatively impact the opportunities for innovation."

In Saudi Arabia, the Communications, Space & Information Technology Commission (CST) has said[11] that the 3 GHz band "will be sufficient to cover the mid-band spectrum needs of IMT for the foreseeable future. The existing mid-bands for exclusive IMT use have robust ecosystems already as well as superior propagation characteristics."

2.3 Will the benefits of 6 GHz Wi-Fi not be highly dependent on the availability of high-speed fixed broadband?

Both the availability and uptake of high-speed fixed broadband are growing quickly in most EMEA countries (see section 1.1).

In those countries with a lack of fixed-line infrastructure, IMT services could be used to help extend access to broadband. For this purpose, it will be important that the IMT services offer good coverage and are able to penetrate walls. That will require them to use the lower frequency bands in which the propagation characteristics are superior to the 6 GHz band.

In any case, both Wi-Fi access points and cellular base stations increasingly depend on fibre for backhaul to the internet or other networks. The availability (and capacity) of these backhaul links will be a limit on the amount of traffic either technology can transmit to and from the Internet. In other words, both 5G and Wi-Fi will be constrained by the quality of the fixed-line infrastructure/fixed wireless links in the vicinity.

As things stand today, the end-user experience of Wi-Fi is far more likely to be determined by the local radio conditions and interference from other users, than the backhaul capacity. This is particularly true in the case of public Wi-Fi hotspots (of which there will be 628 million worldwide in 2023[12]) and in apartment buildings where multiple Wi-Fi networks may overlap.

But spectrum congestion can also be a major issue in less densely populated residential areas where householders are increasingly using Wi-Fi to connect all kinds of devices from tablets and televisions to printers and music systems.

In short, there simply isn't sufficient licence-exempt spectrum available to ensure users enjoy a good quality of service. Making the entire 6 GHz band available on a licence-exempt basis will alleviate this congestion.

Note, that some Wi-Fi 6 traffic will be entirely local in the sense that it will travel between two devices in the vicinity of each other – transmitting video images from a smartphone to a VR/AR headset, for example. For these use cases, there is no need for a high-speed fixed line.

[10] Source: https://lp.assia-inc.com/hubfs/summit-v7.7.pdf
[11] Source: https://www.cst.gov.sa/en/mediacenter/pressreleases/PublishingImages/Pages/2021033001/Spectrum%20Outlook%20for%20Commercial%20and%20Innovative%20Use%202021-2023.pdf
[12] Source: https://newsroom.cisco.com/press-release-content?articleId=1967403

2.4 How sustainable are Wi-Fi and IMT technologies?

Digital technologies and connectivity are playing a pivotal role in curbing greenhouse gas emissions, as well as humans' broader impact on the environment. Connectivity can be used to capture real-time information that can be used to make all kinds of processes more efficient and less energy-intensive. For example, digital connectivity can reduce the need to travel, by enabling people to fulfil tasks and conduct meetings remotely, rather than driving or flying.

As it can deliver high-speed and very responsive connectivity, Wi-Fi 6E is well suited to delivering high-resolution video streams and VR/AR services that can help people interact effectively without being physically present in the same location. VR/AR is increasingly used for training and education and to help field engineers make repairs or install new equipment. Most of these applications will be used indoors, where Wi-Fi is the technology of choice.

In cases where travel is necessary, Wi-Fi can help make public transport more appealing, thereby reducing congestion and emissions caused by private cars. Wi-Fi can make travel time more enjoyable and productive for passengers by providing on-board connectivity on trains, buses, trams, and stations. Wi-Fi connectivity is now a standard feature on board trains in developed markets.

Wi-Fi is likely to be the most energy-efficient connectivity option in many scenarios. The power that devices use to upload data to a nearby Wi-Fi access point is far less than that needed to transmit to a distant cell tower. In short, connecting an indoor device to an outdoor base station consumes a disproportionate amount of energy, while also resulting in shorter recharge cycles, increasing battery wear, and additional electronic waste.

France's Agency for Ecological Transition (ADEME) has launched a campaign[13] to encourage French citizens to use Wi-Fi rather than 4G. ADEME says that using Wi-Fi reduces CO2 pollution 23-fold. Similarly, mobile operator Orange France says[14] it will remind customers to switch to use Wi-Fi at home during periods of peak energy consumption. "Per Gb of traffic, mobile networks have close to three times the footprint of fixed networks for all the environmental indicators studied," notes the French regulator ARCEP in a report[15] published at the beginning of 2022.

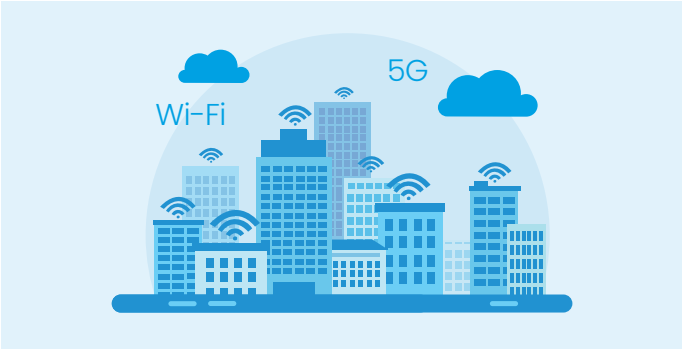
Employing Wi-Fi, rather than IMT, in the 6 GHz band will require less power, helping to make better use of energy resources. The ITU has forecast that the energy used by mobile networks around the globe will emit 73.0 Mt CO2 equivalent (CO2e) in 2025, compared with 35.2 Mt CO2e for fixed networks. That suggests fixed networks will produce less than half the CO2e of mobile networks, even though they transport more than ten times the amount of data.

At the same time, Wi-Fi is becoming more efficient, thanks to new features, such as target wake time and the OFDMA radio interface, which reduce power consumption. Furthermore, Wi-Fi 6 introduces new features to support IoT deployments, such as support for large numbers of simultaneous connections, which can then be used to monitor environmental conditions. With the new features in Wi-Fi 6, more IoT devices will be able to send more information and use less power.

Adopting an IMT identification in the 6425-7125 MHz band would increase the environmental footprint of mobile networks. Utilizing this spectrum for IMT would require an extensive build-up of new base stations and new antennas, while also driving consumers to purchase new 5G devices, as none of the existing 5G equipment supports the 6425-7125 MHz band.

[13] Source: https://www.youtube.com/watch?v=6PGrnx-P28s
[14] Source: Orange plays its part to support the energy saving plan in France, October 2022 press release
[15] Source: Findings of the ADEME – ARCEP joint task force to measure the digital environmental footprint in France

3: THE ROLES OF 5G AND WI-FI



3.1 To what extent are Wi-Fi and IMT complementary, necessitating an outcome that spectrum policy must support both?

IMT (4G, 5G) and Wi-Fi are complementary technologies that work together to meet citizens' and businesses' connectivity needs. Regulators should ensure each of these technologies has access to sufficient and appropriate spectrum. While IMT technologies are designed to meet the connectivity needs of people moving around, Wi-Fi is designed to meet the connectivity needs of people within a single locality. The vast majority of internet traffic is generated and consumed by users that are located inside homes, offices and other buildings, and using Wi-Fi. Fixed network/Wi-Fi traffic continues to see strong year-on-year growth.

In markets with extensive fixed-line infrastructure, people tend to use Wi-Fi for productivity-related tasks, such as video conferences and exchanging large files, in the workplace and for watching television and movie or playing games on-demand in the home. Cellular networks, by contrast, are typically used by people on the move to check social media, watch short videos or exchange messages.

Mobile network operators (MNOs) greatly benefit from Wi-Fi's capacity to offload traffic from cellular mobile devices; if this capacity were not available, IMT/5G networks would be more costly, as mobile operators would need to deploy many more small cells in dense urban areas to offer gigabit throughput and provide adequate quality of service. Given the attenuation of signals from outdoor 5G base stations (building entry loss), 5G indoor coverage and performance would be severely limited. To penetrate building walls, 5G services need to consume high levels of power (see 2.4).

Providing 5G gigabit connectivity indoors would require the deployment of a completely new small cell infrastructure, parallel to the existing Wi-Fi one which will be prohibitive from both a commercial and an environmental point of view. These small cells would also need to be backward compatible with the huge existing base of Wi-Fi equipment.

3.2 Can a licence-exempt 6 GHz band support a 5G future?

Yes. The best way to harness 6 GHz spectrum for the benefit of 5G is to authorize licence-exempt use throughout the entire 1200 MHz of the 6 GHz band. Such a move would allow for mobile offload and 5G NR-U operation. Licence-exempt technologies support a substantial amount of mobile traffic offloads for indoor environments, saving operator capital expenses and conserving licensed mobile spectrum.

Further, even after permitting licence-exempt use, incumbent fixed services can remain in the 6 GHz band, meaning these links will be available to support 5G networks. Regulators globally have recognized the important and critical role that licence-exempt technologies, such as Wi-Fi, play in furthering the 5G market and cite this as a reason to allocate the entire 6 GHz band to licence-exempt use.

3.3 Do users not get significantly better speeds and reliability, and lower latency on 5G than on Wi-Fi?

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 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 spaces, Wi-Fi is also likely to provide a better end-user experience: whereas cellular technologies have been designed to deliver coverage, Wi-Fi has been designed to deliver capacity/density.

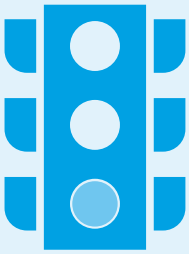
More broadly, with public wide-area networks, the requirement to synchronise networks makes it impossible to both avoid interference and have flexible networks. An operator that attempts to offer very low latency would have to create interference to other operators, or to its own network, unless every network nationally operates at very low latency, which is not efficient for macro-cells. The configuration of a nationwide network is the result of compromises between coverage, capacity, latency and the cost of the network. As a result, it is not realistic to expect public wide area 5G networks to deliver low latency.

IMT proponents may argue that industrial applications, such as factory robots and sensors, and augmented reality (AR), healthcare monitors, wireless medical equipment, and other enterprise applications, need to operate in licensed spectrum because of stringent quality of service (QoS) requirements. While there may be some very specific applications that could benefit from a licensing regime, the large majority of the aforementioned applications can be realised with licence-exempt technologies, and specifically Wi-Fi 6E and Wi-Fi 7.

In order to use spectrum most efficiently, applications necessitating a licensed regime could instead utilize the 3.8-4.2 GHz band, which has been made available for use by private and local networks and is already supported by 5G NR.

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. 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.

4: COEXISTENCE WITH OTHER SERVICES



4.1 What are the repercussions of introducing licence-exempt technologies in the 6 GHz band?

Low power indoor (LPI) and very low power (VLP) licence-exempt equipment can coexist with incumbents without any further mitigation measures. For standard power (also referred to as 'higher power') and outdoor operation, mitigation techniques exist which have already been outlined by many regulators worldwide. The licence-exempt industry has no objection to reasonable, evidence-based mitigations and has saluted the decisions of regulators around the globe to make the entire 6 GHz band available on a licence-exempt basis with such conditions.

The same regulatory conditions, relating to indoor and outdoor usage and power levels, can be applied across the whole 6 GHz band. If jurisdictions still have concerns about the impact on incumbent services, they should conduct the necessary sharing studies on a timely basis. In the EU, for example, a new ECC work item will assess WAS/RLAN/Wi-Fi coexistence with incumbent services operating in 6425-7125 MHz in CEPT.

4.2 To what extent can IMT and Wi-Fi co-exist with incumbent services in the 6 GHz band?

IMT services in the upper 6 GHz band would have to be subject to severe restrictions to avoid interference with incumbent fixed satellite services (FSS) and fixed services (FS). The ITU sharing studies to date suggest that base station density would be severely limited, and base stations would have to be sited below rooftops and deployed only in urban and suburban

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

The satellite industry has expressed[16] serious concerns about the potential interference from IMT services.

The studies that have been presented to ITU-R WP 5D have come to very different conclusions about the aggregate level of interference power likely to be received by FSS satellites from IMT because of widely differing assumptions:

- One study assumed IMT base station deployments will cover just 0.07% of total land area covered by the FSS, while another assumed 0.65%. The difference in these parameters results in a 10 dB difference in impact. Administrations should consider the studies based on a high-level deployment scenario, as that is more relevant.
- Some studies have assumed an elevation angle of 30° (FSS satellite w.r.t. earth's surface at IMT base station locations) rather than 5° recommended by ITU-R WP4A. The impact from not using the recommended value is estimated at 5-7 dB. Administrations should consider the studies based on recommendations of the ITU-R expert group WP4A .
- Some studies have applied a clutter loss model of "3K/178" rather than the ITU-R Rec P.2108. The impact from not applying the correct model is estimated at 2-10 dB. Administrations should consider the studies that use ITU-R Rec P.2108, which is the recommendation in force.
- FSS system parameters provided by ITU WP4A have been adjusted in some studies, resulting in an estimated difference of up to 5.5 dB in impact, without agreement from the appropriate ITU R expert group (WP4A). Administrations should consider the studies based on the FSS system parameters recommended by WP4A.
- As fixed services (FS) also use the 6425-7125 MHz band, co-primary allocations reduce the required IMT interference protection threshold by 3 dB. Administrations should give these existing FS users equal rights.

In summary, studies of coexistence of IMT and FSS uplink in the 6425-7125 MHz band should use realistic assumptions, which impact interference protection by 20-35 dB. The requirement for such protection would severely restrict the deployment of IMT base stations, resulting in very limited usage of this valuable spectrum.

In addition, there is a need to protect Appendix 30B rights of equitable access to orbital resources, which covers spectrum from 6725-7025 MHz. It is noteworthy that Regions 2 and 3 are only considering the use of IMT above 7025 MHz for WRC-23 AI 1.2.

Studies focused on IMT sharing with the FSS downlink have indicated that separation distances are required in order to protect the operation of non-GSO FSS earth stations. These separation distances, which range from a few kilometres to tens of kilometres, are site-specific and depend on several elements, such as the propagation parameters, local terrain topography, surrounding clutter (including changes in vegetation across the seasons), the station and orbital parameters of the non-GSO system, and satellite selection strategy.

The first set of studies focused on sharing with fixed services (FS) has shown that separation distances of up to 68km would be necessary in the FS main lobe, and may be reduced below 10 km for the side lobe. One study, which investigated the impact of the clutter through a deterministic approach, has shown a necessary separation distance of 59 km when the IMT base station is placed inside the clutter, and up to 122 km if the IMT base station is located above clutter with typical FS parameters. Given these constraints, it may be necessary to clear the band of FS usage to allow for the deployment of commercial IMT services.

In summary, sharing will be very difficult between IMT and incumbent services in the upper 6 GHz band. It is highly likely the technical constraints required for coexistence would prevent the operation of commercially-viable mobile services that bring significant socio-economic benefits to citizens and businesses.

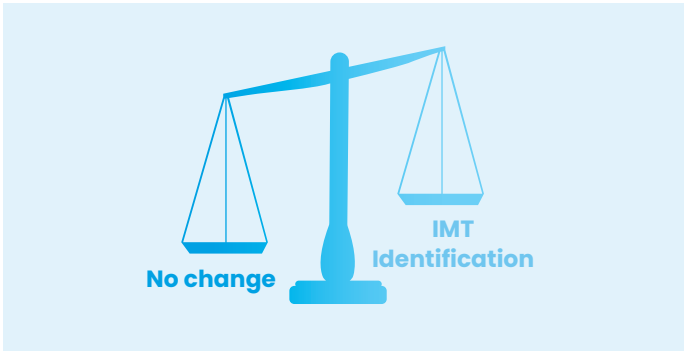
[15] Source: https://gsoasatellite.com/news/2619/

4.3 Could IMT and Wi-Fi share the upper 6 GHz band?

IMT and Wi-Fi cannot effectively share the upper 6 GHz band, according to a recent study by LS Telcom. To coexist with other users and share spectrum fairly, IMT would have to fundamentally change its channel access mechanism. As IMT signals penetrate walls, the building entry loss would in many cases be insufficient to avoid harmful interference to Wi-Fi operating indoors.

In urban environments, it will not be possible to maintain large separation distances that would be required between high-power outdoor IMT base stations and low power indoor Wi-Fi. Furthermore, there would be no way to prevent IMT user equipment from operating indoors where its signal would disrupt Wi-Fi operation.

5: THE REGULATORY PROCESS



5.1 Should WRC-23 identify the upper 6 GHz band (6425-7125 MHz) for IMT?

No, the World Radiocommunication Conference in 2023 (WRC-23) should adopt a 'No Change' position. If WRC-23 were to identify the upper 6 GHz band (6425-7125 MHz) for IMT, the 6 GHz band will be fragmented. An IMT identification in 6425-7125 MHz, which typically aims at harmonizing the use of the band around a specific ecosystem, cannot achieve this goal, as it would only concern Region 1.

With a large part of the world already having opened the 5925-7125 MHz band for licence-exempt use, an IMT identification of the 6425-7125 MHz band in Region 1 would lead to unnecessary fragmentation, reduced economies of scale, and increased costs for citizens and businesses.

Even in Region 1, many countries have other priorities in the band (incumbent systems and support for licence-exempt technologies). Saudi Arabia, for instance, already opened the entire 6 GHz band for licence-exempt use, and on the request of several European countries, the conditions for potential licence-exempt operation in the upper 6 GHz band are being studied by the CEPT.

Given the enormous demand for Wi-Fi connectivity, it is important to make the upper 6 GHz band available on a licence-exempt basis today.

The existing mobile allocation gives administrations the flexibility to make the best decision for their countries. By contrast, an IMT identification signifies the exclusive usage of mobile spectrum by IMT, paving the way for clearing and auctioning spectrum for exclusive IMT use. This situation would create uncertainty that will stall the development of equipment and freeze any new spectrum use until the regulatory framework is adopted, the band is cleared, and IMT equipment is made available (while WAS/RLAN equipment is already widely available).

An IMT identification would also limit the evolution of existing services in the band, as FS and FSS would not be able to expand. Further, any deployment of IMT services would present a high risk of interference with these incumbent services (see 4.2).

Given the current mobile allocation already in force, a 'No Change' outcome will lead to the most efficient use of the band.

5.2 If an administration makes the 6 GHz band licence-exempt, would the decision be reversible?

Opening the band for licence-exempt use would be difficult to reverse. But administrations are unlikely to want to take the step, given that the band could be harmonised globally for licence-exempt use: countries representing more than 40% of the world's GDP has already moved in that direction.

Similarly, it is very difficult to reverse an IMT allocation, as most IMT spectrum licenses tend to have a duration of between 10 and 20 years. Moreover, once IMT base stations have been deployed they need to operate for a long period to enable operators to make a return on their capital investment.

Ultimately the decision needs to be taken on a risk/opportunity basis. Given the momentum behind Wi-Fi 6E, making the entire 6 GHz band licence-exempt would maximise the opportunities to meet the growing demand for high quality connectivity, while minimising the risks associated with fragmentation.

5.3 Does a 'No Change' outcome at WRC-23 mean the end of IMT in the upper 6 GHz band?

An IMT identification is not mandatory to operate IMT: There are examples of IMT being deployed on a national or regional basis, even in the absence of an IMT identification in the Radio Regulations. Many countries have deployed IMT services in parts of the 3.3-4.2 GHz band without a corresponding IMT identification[17].

Furthermore, a 'No Change' outcome at WRC-23 would not preclude a future WRC reconsidering an IMT identification in the upper 6 GHz band, as per ITU Resolution 804.

To review a comprehensive evidence base on licence-exempt 6 GHz visit 6GHz.info

[17] Source: https://www.gsma.com/spectrum/wp-content/uploads/2021/10/3.5-GHz-for-5G.pdf