Mixed Signals: the technical and economic impact of 6 GHz band configurations

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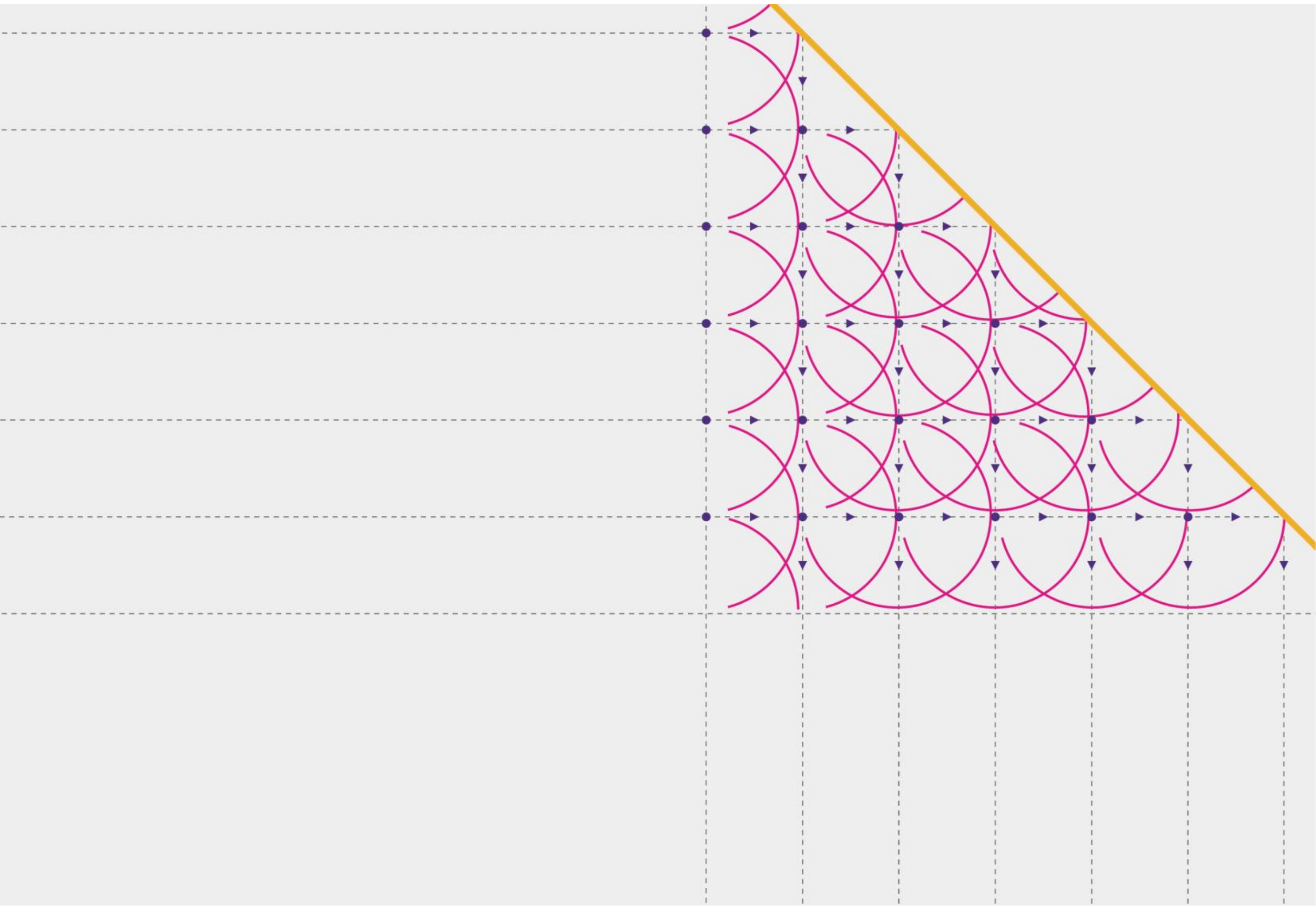

About Plum

Plum offers strategy, policy and regulatory advice on telecoms, spectrum, online and audio-visual media issues. We draw on economics and engineering, our knowledge of the sector and our clients' understanding and perspective to shape and respond to convergence.

About this study

This study is designed to consider the potential impact of IMT use of the upper 6 GHz band being limited to 600 MHz, rather than expanded to a full 700 MHz or even awarded alongside the lower 6 GHz band. We look at the competitive market in Europe, the ways in which 6 GHz spectrum may be awarded, and attempt to quantify impacts on service quality, competition and macroeconomic indicators.

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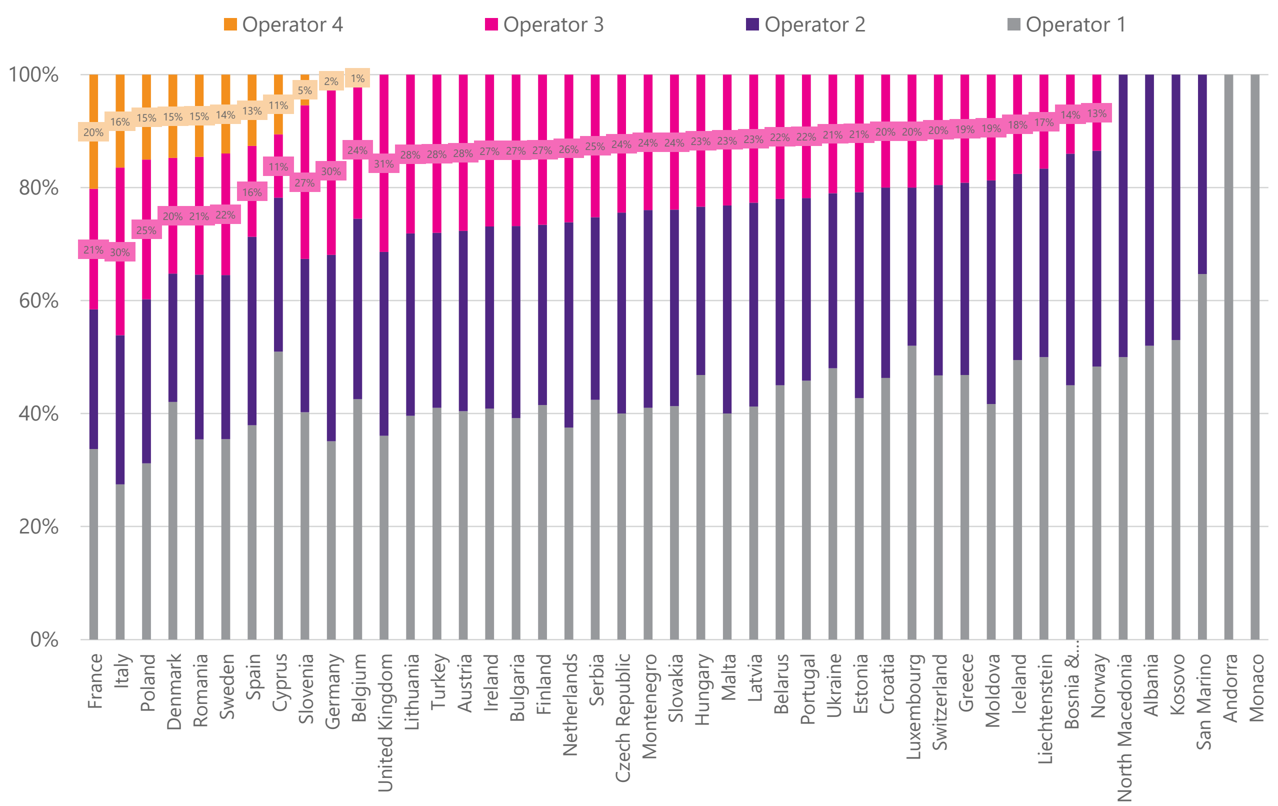
Summary

This report examines the implications of IMT spectrum allocation in the upper 6 GHz band for the European telecommunications market. More specifically it addresses whether the IMT European market can viably operate with only three spectrum blocks to be shared by operators. This question carries particular weight in countries which have more than three active network operators, raising concerns about spectrum sufficiency and competitive equity. To address this, the report adopts a dual analytical lens, combining technical and economic impact assessment. The goal is to provide a nuanced, evidence-based evaluation of whether a three-channel framework is sustainable across Europe's heterogeneous regulatory and competitive landscape.

To do so, we first consider the mobile market in Europe, and use this to identify how much spectrum would need to be prioritised for IMT to meet requirements. The GSMA have stated that each operator will need 200 MHz of spectrum to run an effective 6G service, citing use cases such as high definition video, cloud gaming, and generative AI, but we have not verified these calculations or considered the proportion of the population for which this is a valid demand case. Instead, we have worked on a baseline of 200 MHz per operator, and considered how varying from this may impact on network quality and use.

Within Europe, we note that the majority of countries – and the majority of the population – are currently covered by a maximum of three operators. Figure 1 illustrates that only eleven countries have four operators. Therefore, for most countries in Europe an allocation of 600 MHz of spectrum would allow all operators to have their own 200 MHz block. In fact, of these eleven countries, one (France) is currently in the process of consolidation down to three operators.

Figure 1: Market shares in European countries[1]

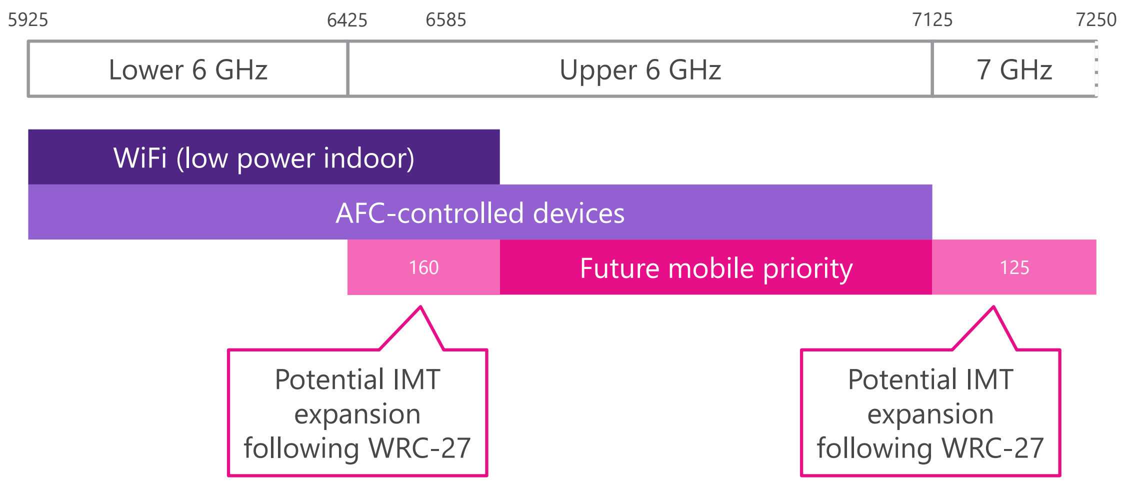


[1] Sources: GSA GamBOD database, operator annual reports and websites. Most recent data available used, typically from 2025.

For the remaining countries with four operators, in almost all cases there is an imbalance in the market, with one or two larger operators and the remainder sharing a smaller market share. This may be due to smaller operators targeting discrete markets, historical customer loyalty, or (in the case of Belgium and Germany in particular) new entrants who are yet to establish market share. If all operators were to be awarded 200 MHz of spectrum there would need to be 800 MHz available, but our analysis (outlined below) indicates this is not necessary.

Having understood the market size that is impacted, we then look at how spectrum may be identified to different services. The Radio Spectrum Policy Group (RSPG), an advisory group that assists the European Commission in the development of radio spectrum policy, has published an opinion on the use of the upper 6 GHz band which proposes allocating 540 MHz at the top of the band to IMT (on a priority use basis), and advocates waiting for the outcomes of WRC-27 before deciding on other spectrum. This is shown at a high level in Figure 2; either 125 MHz of the 7 GHz band, or 160 MHz of the upper 6 GHz band, could be identified for IMT.

Figure 2: Proposed division of 6 GHz spectrum in Europe



In all cases, the RSPG proposals would lead to between 665 MHz and 700 MHz of spectrum available for mobile operators, which would allow for three 200 MHz blocks plus appropriate guard bands with adjacent services and applications. For the majority of countries in Europe, this would be a suitable division; however in those countries with four operators there would not be enough blocks for each operator to have their own.

In this paper we have looked at the impact of this. Since in almost every country, there is an imbalance in market shares between larger and smaller operators, we have considered a situation where the two smallest operators must share one 200 MHz block; either by operating a formal RAN and spectrum sharing scheme, or by holding 100 MHz each. While exact details of how 6G networks will use spectrum are not yet available, an examination of the current 6G specifications and targets indicates that, for an operator with half the number of subscribers, then operating a network with half the spectrum will lead to no discernible drop in service quality. Indeed, almost all metrics scale linearly with spectrum availability, meaning that the only disadvantage experienced on a standalone 100 MHz network would be a higher latency – although even this would be marginal since radio access latency represents only a fraction of the total latency in the network. Further, a formal RAN share which allows both smaller operators to access the 200 MHz block would overcome even this disadvantage.

With no material change in service quality, we find there is no impact in consumer experience, no impact on competition or churn, and no impact on economic welfare. We also examine likely impacts on spectrum prices, and again find that the market structure in the few countries affected would not give any significant increase in total value if more spectrum were available.

Overall, given the structure of the European market and the availability of alternative spectrum (including in mmWave bands), we find that there is no requirement for regulators to make more than three spectrum blocks (equivalent to 600 MHz of spectrum) available to IMT in the upper 6 GHz band. Furthermore, if WRC-27 identifies the 7125-7250 MHz band for IMT, WiFi could benefit from an expansion into the 6425-6585 MHz band, and thus European regulators can ensure that both WiFi and 6G networks are able to make optimum use of the spectrum.

1 Introduction

This independent paper considers the potential economic impact of different configurations of the upper 6 GHz band in Europe. Ahead of decisions to be made at WRC-27 on the identification of the 7125-7250 GHz band, the European Union has considered a number of ways in which the upper 6 GHz band can be split, or prioritised, between licence-exempt use and IMT, with a firm conclusion pending the outcomes of the 7 GHz band discussions. In particular, there are conflicting proposals on how the lower 160 MHz of spectrum in the band should be allocated between licence-exempt use (including WiFi) and IMT. This study provides analysis of how the IMT-prioritised spectrum configuration would impact on consumers and the economy as a whole, to inform the European Commission's discussions.

One particular concern within Europe is the amount of spectrum available for IMT identification. In countries where there are many mobile operators, assigning all operators an exclusive licence of spectrum could mean that there is insufficient spectrum for any one operator to run a network at maximum efficiency; however, there are likely to be mitigations against this, and it is debateable how much this will impact on consumer experience.

In this study, we look at how different configurations of the upper 6 GHz band (termed as the 'U6 band' in the remainder of this paper) may impact on the way that operators in markets deploy the spectrum, whether there will be a significant impact on service quality, and how this may lead to changes in consumer welfare and economic outcomes.

To do this, this paper is structured as follows.

- First, we consider the market in which the U6 bands may be used; in particular looking at how mobile competition across Europe may impact on its deployment. We consider proposed spectrum requirements from the GSMA, the interaction between 6G and existing technologies, and the way that the U6 band may be used alongside existing spectrum holdings.

- Second, we identify the potential configurations of the 6 GHz band. We look at where regulators or governments have already made statements or decisions on the use of the band, and how this may change over time.

- Third, combining our analysis of the configuration options with the state of competition, we will identify how the band could be allocated under a number of competition scenarios, taking account of the number of operators, the market shares, and the impact on capacity.

- Fourth, we examine the impacts of these configurations on service quality, consumer experience, competition, and macroeconomic indicators. We consider whether there will be adverse impacts from any particular configuration, and how this can be mitigated.

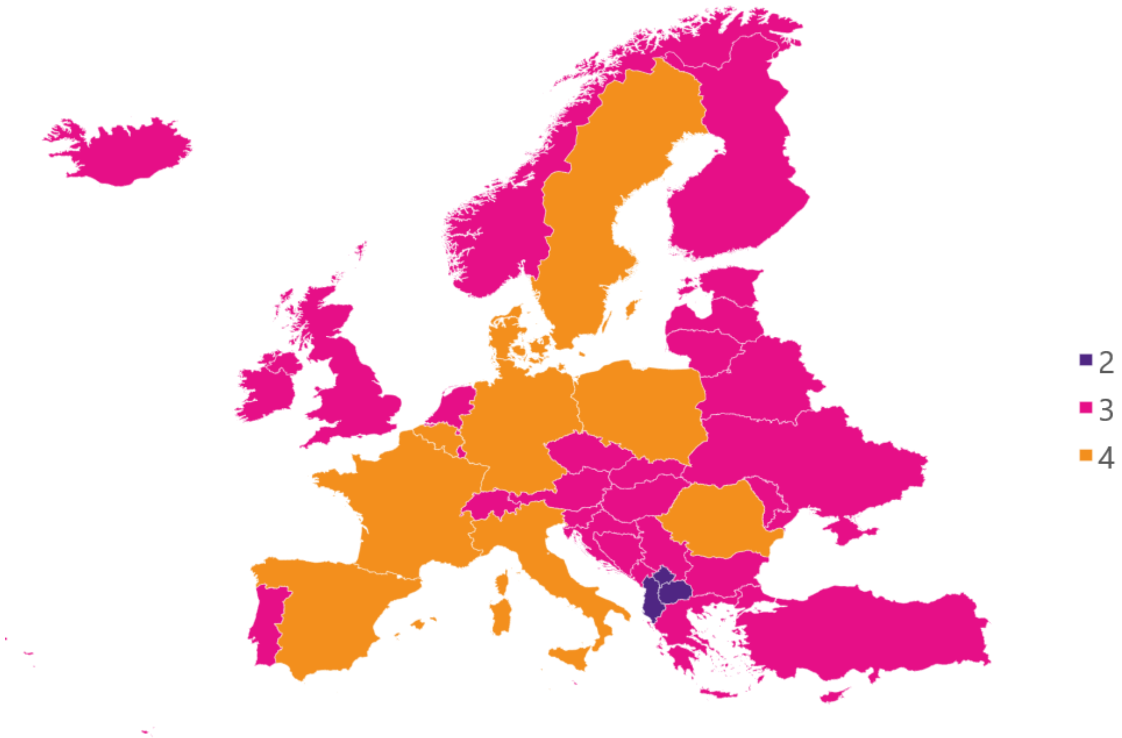
- Finally, we conclude how this spectrum can be best configured, and outline recommendations that come from this.

2 The state of competition across Europe

Three and a half decades after digital mobile networks were first launched in Europe, the market is mature and reaches the vast majority of European citizens; most countries have a mobile penetration rate well in excess of 100%, meaning there are more devices and subscriber lines than there are people.

Following a period of rapid expansion during the 1990s and early 2000s, the 2010s and 2020s have seen a steadier growth rate, with fewer shocks to market structure from new entry or operators going out of business (although there have been a number of mergers, as shown below). Of the 52 countries in Europe[2], thirty have three operators, and eleven have more than this; countries with fewer than three tend to be smaller countries or have had recent mergers.

Figure 2.1: Number of operators in European countries[3]



While this illustrates that the majority of countries have at most three operators, with only 17% having four, when compared to the general international benchmarks European countries are slightly more likely to have a larger number of operators. Over all countries recognised by the UN, just under 14% have more than three operators, with significant numbers having only one or two. Competition in European markets is likely to be more intense, which may have led to the historically lower ARPUs and swift introduction of new technologies.

2.1 Imbalances in competition

This is not to say that competition is equal. When spectrum awards led to new entrants, especially at the time of 3G auctions at the start of the 21st Century and with the introduction of spectrum for LTE in the later 2000s, in

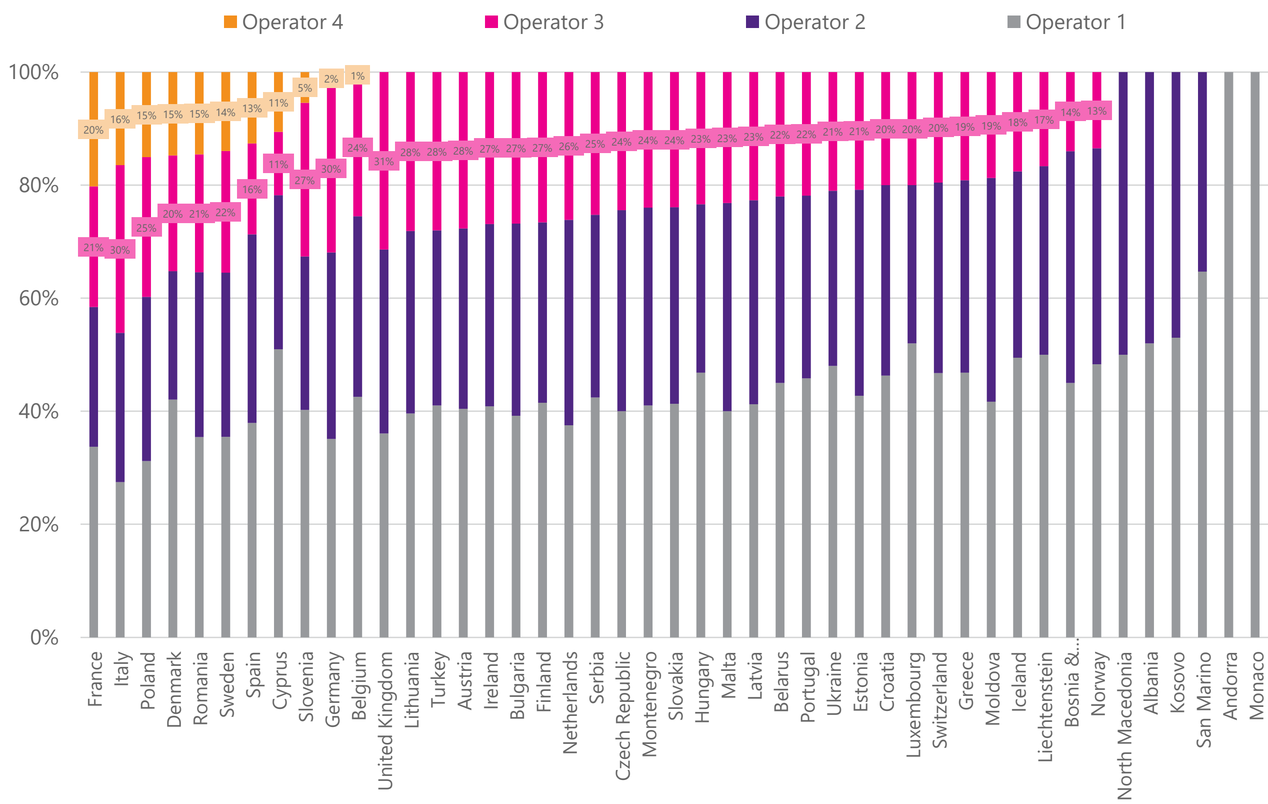
[2] For some countries the data on the number of operators is unclear – for example, some cable networks report mobile subscribers which are actually MVNO traffic carried on another network, and some countries have awarded spectrum to new entrants who are yet to build a network.

[3] Source: GSA GamBOD database, data as at 1 April 2026. Note that in Italy there are four main operators, and Fastweb (which has taken over Vodafone's operations) is slowly decommissioning its own standalone network.

order to gain market share these new competitors typically launched innovative services or targeted a defined subset of consumers. In many cases these new entrants maintain a smaller number of subscribers to this day. In other countries, some incumbent operators have been marginalised by new entrants offering more efficient and better quality networks, leading to increased churn and lower subscriber bases. In almost every country with four or more operators, there are significant imbalances in market shares, with two operators typically sharing a large majority of subscribers, and other operators sharing the rest.

The figure below shows the market shares in European countries for which data is available. In almost all cases the two largest operators (in grey and purple) have a combined market share well in excess of 60%, and the next two largest operators (in magenta and orange) have significantly lower numbers of customers. The main exceptions to this analysis are Italy, which has recently seen the takeover of Vodafone's operations by Fastweb (which was previously operating as a small fifth operator), and France, which will move to a three-operator market in the near future in any case.

Figure 2.2: Market shares in European countries[4]



Given this market structure, a combination of infrastructure sharing, spectrum sharing, or other collaborative deployment models between these two operators could ensure that smaller networks continue to offer competitive services, meeting their capacity needs, without requiring a fourth dedicated nationwide spectrum block, or even separate networks. This approach would maximise spectral efficiency, supports sustainable investment, and reflects existing regulatory and commercial practices across Europe. Potential impacts of this sharing are considered further in this paper.

[4] Sources: GSA GamBOD database, operator annual reports and websites. Most recent data available used, typically from 2025.

2.2 Imbalances in spectrum holdings

This imbalance between operators is crucial when studying the allocation of spectrum. When determining the optimum and efficient allocation, regulators and operators will consider spectrum in two ways:

- A coverage layer, which provides a baseline of service to the maximum possible number of subscribers, often using lower-frequency spectrum (in UHF bands, for example) for its longer propagation radius; and

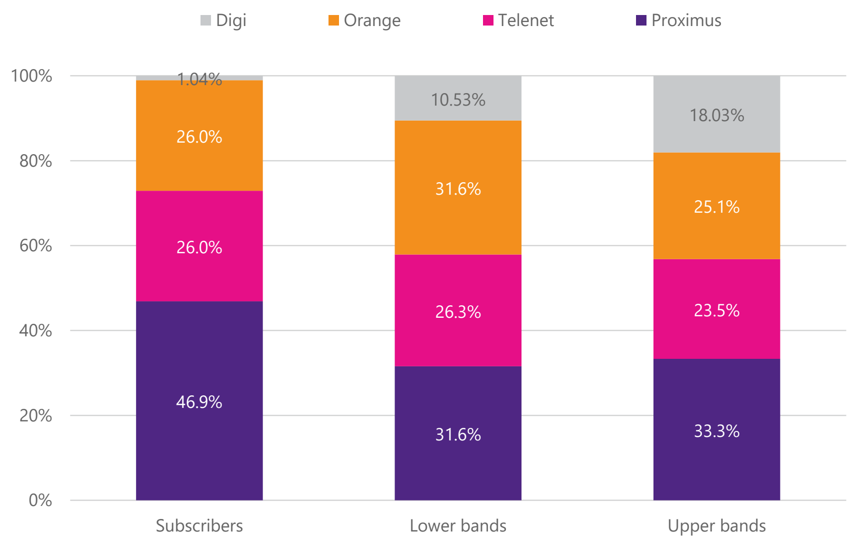
- A capacity layer, which uses more spectrum in more populated areas to give consumers enough bandwidth to access services, or provides higher quality of service where base stations are appropriately dense.

The amount of spectrum needed for a coverage layer does not depend on the number of subscribers, and regulators have often sought to share lower frequency bands equally between operators to reflect this. This has been done in some countries through direct awards, through spectrum caps in auctions, or by bundling different frequency bands into single lots, ensuring that each operator has the same baseline of coverage.

On the other hand, spectrum required for the capacity layer does depend on the size of the operator – in terms of the number of subscribers, and also on the average usage of those subscribers. This is particularly important with more modern technologies, from LTE through to potential 6G interfaces. Data transmission requires a certain spectrum block size, and the spectrum which is available is shared between all users in range of a particular base station. The more users, the greater the bandwidth needed to provide an acceptable service. Conversely, the more spectrum, the better service quality for a defined number of subscribers.

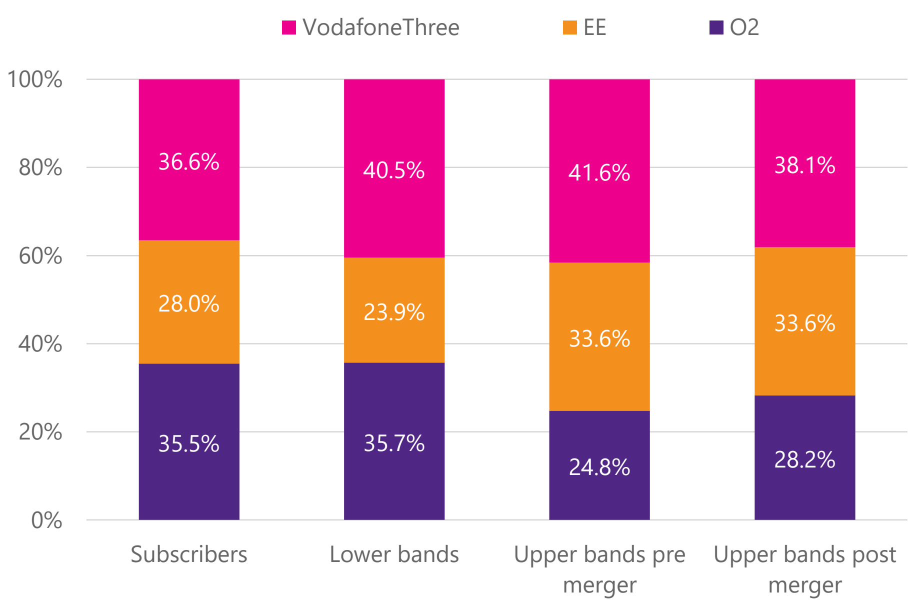
This split between coverage and capacity spectrum can lead to many markets in which spectrum holdings are seemingly unbalanced, but in reality these reflect the size of subscriber base. In Belgium, Proximus has traditionally held a larger share of higher-band spectrum than its competitors, but this is used to serve a significantly larger market share of subscribers and traffic. The share of coverage spectrum is much more balanced, as this is not driven by traffic demands. The new entrant, Digi, has been allocated a smaller share of both low-band and higher-band spectrum, which may constrain its ability to grow to the same size as existing operators.

Figure 2.3: Market shares and spectrum holdings in Belgium[5]



In many cases, particularly in Europe, this imbalance has come about due to historic market dynamics, where larger operators have been formed from the merger of two smaller firms. In these cases regulators have tended to require that there be some redistribution of spectrum, allowing the (now) smaller operators to better compete. For example, the recent merger between Vodafone and Three in the UK has led to some divestment of spectrum in the upper bands, where ownership has been transferred to O2, recognising that prior to the merger O2 had noted it had a disproportionately low amount of spectrum for its market share.

Figure 2.4: Market shares and spectrum holdings in the UK, before and after the 2025 merger[6]



[5] Source: GSA GamBOD database
[6] Source: GSA GamBOD database, Ofcom

2.3 Mergers and acquisitions

Indeed, there have been a significant number of mergers across Europe over the past decade. The figure below describes the majority of these mergers, as well as some other acquisitions with fixed line telecommunications or cable companies.

In particular, there were two main trends that can be seen.

- The "4-to-3" wave occurred largely between 2012 and 2020. This was a specific period where the European Commission cleared several mergers that reduced national markets from four players to three (including in Austria, Germany, Ireland). Regulators often demanded remedies, such as selling spectrum to new entrants or providing wholesale access to virtual operators. This trend is continuing with recent developments in France.

- Fixed-Mobile convergence has been a common theme. Many recent deals (like Virgin Media O2 in the UK or Vodafone and Liberty Global in Germany) were driven by the desire to offer quad-play bundles, combining mobile, broadband, TV, and landline services into a single package.

Figure 2.5: Mergers and acquisitions in European telecommunications (mobile-only deals in bold)

Year	Country	Merging Entities	Outcome / Impact
2026 (ongoing)	**France**	**SFR into all other MNOs**	**This is currently ongoing; the three competing MNOS (Bouygues Telecom, Free, and Orange) are currently bidding to acquire and split up SFR. If finalised, Bouygues would assume 42% of SFR (taking over enterprise operations and some rural networks), Free would take 31%, and Orange would take 27%. Consumer operations and spectrum would be split among all three operators.**
2025	**UK**	**Vodafone & Three UK**	**Merger approved in late 2024; Vodafone took full control of the entity (VodafoneThree) in May 2026 for £4.3bn. The two were the smallest operators in the market following the 2010 merger.**
2024	**Spain**	**Orange & MásMóvil**	**Created a 50-50 joint venture, forming one of Spain's largest operators. Prior to the merger, MásMóvil was the smallest operator in the market.**
2021	UK	Virgin Media & O2	A "fixed-mobile convergence" merger between Liberty Global's Virgin Media and Telefónica's O2 UK.
2019	Germany	Vodafone & Liberty Global (Unitymedia)	Though primarily a cable acquisition, it consolidated Vodafone's infrastructure to support its mobile network.
2016	**Italy**	**Wind & 3 Italy (Hutchison)**	**Merged to form Wind Tre, reducing the Italian market from 4 to 3 MNOs (until Iliad entered later). Wind and 3 were the third and fourth largest operators, with strong MVNO presence across the market.**
2016	UK	BT & EE	BT (incumbent fixed-line) acquired EE (the largest mobile operator) to re-enter the mobile market.
2015	**Ireland**	**Three & O2 Ireland**	**CK Hutchison (Three) acquired O2 Ireland from Telefónica. Before the merger, Three had a 9% market share.**
2014	**Germany**	**Telefónica (O2) & E-Plus**	**Consolidated the German market from 4 to 3 major players; E-Plus was previously owned by KPN. E-Plus and O2 were the smallest operators by revenue share, with both competing heavily on price.**

Year	Country	Merging Entities	Outcome / Impact
2013	**Austria**	**Three & Orange Austria**	**Reduced the Austrian market to 3 players; Hutchison 3G Austria acquired Orange. Before the merger, Orange had a market share of around 18% while Three has around 10%; the combined entity remained the smallest operator.**
2010	**UK**	**T-Mobile & Orange UK**	**The two operators merged to form Everything Everywhere (EE); in a market with five players each had a market share of around 17%, meaning the merged entity became the largest operator in the market.**
2007	Italy	Vodafone & Tele2 Italy	Vodafone acquired the Italian and Spanish operations of Tele2 – these were not traditional mobile networks.
2006	Norway	Telenor & Vodafone Sweden	Telenor acquired Vodafone's Swedish subsidiary (Vodafone Sverige).

Not all merger attempts were successful. Notably, the proposed merger between Telia and Telenor in Denmark (2015) was abandoned due to strict EU regulatory demands, and the initial attempt for Three to buy O2 UK (2016) was blocked by the Commission.

It is clear from this table that mergers typically involve smaller operators, likely driven by commercial pressures. Across Europe, operators have experienced falling revenues per subscriber, alongside increased capital costs from deploying multiple network technologies. Sharing the cost of networks (and spectrum) across a larger subscriber base ensures that network operators can remain competitive.

Given this, an analysis of Figure 2.2, identifying countries which have four operators (in Europe, as well as worldwide), would indicate that there may well be more merger activity between smaller operators. While not a natural monopoly, the high costs of network operation (combined with network externalities and economies of scale in support functions) would imply a relatively small number of operators is optimum, as long as there is regulation to ensure competitive pressure – such as switching support, information campaigns, and regulated interconnection. Even without full mergers, sharing costs of network, sites or spectrum can help to make the market more sustainable. In many cases operators have started to operate joint ventures or other formal agreements under which sites, towers, or antennas can be shared, sharing parts or all of the radio access network, and even sharing some spectrum holdings. This can help to spread the fixed cost of the coverage network, making operators more efficient and profitable.

Indeed, at the time of this report and as mentioned above, commercial pressure in France is leading to another situation where the market is moving from four to three players, although the proposal in this case is for three of the operators (Orange, Bouygues, and Free) to acquire and split SFR's assets and customer base. Arcep was notified on 6 June 2026[7] of the intention for this market consolidation, and will be working through competition concerns of spectrum allocation as well as working with competition authorities in France and the EU.

[7] Arcep (2026)

3 Potential use of the 6GHz band

The 6 GHz spectrum band refers to frequencies between 5925 MHz and 7125 MHz. Its history reflects the broader evolution of microwave communications, fixed links, satellite systems, and, more recently, next-generation WiFi. During the mid-20th century, regulators and telecommunications operators began using portions of the 6 GHz range for terrestrial microwave relay systems. These links carried long-distance telephone traffic, television distribution, and later data communications. The band was attractive because it offered:

- Relatively large contiguous bandwidth;
- Reliable propagation over medium distances;
- Manageable antenna sizes; and
- Lower rain fade than higher microwave bands such as 11 GHz or 18 GHz.

In countries such as the United States and the United Kingdom, 6 GHz became heavily populated with fixed point-to-point microwave infrastructure from the 1950s onwards. However, by the 1960s and 1970s, parts of the 6 GHz band were incorporated into C-band satellite communications; the short-term licences used for microwave links enabled governments and regulators to quickly transition the band to this new use. This became foundational for international telecommunications and broadcast distribution networks. Organisations such as Intelsat relied heavily on these frequencies.

Over subsequent decades, national regulators and the International Telecommunication Union have divided the 6 GHz range into multiple allocations, including fixed services, fixed-satellite services (uplink and downlink), broadcast auxiliary services, public safety links, and utility and transport communications. The band became strategically important because many incumbent systems depended on highly reliable microwave links, including electricity grids, railways, emergency services, and mobile network backhaul, but this usage is decreasing. In addition to this, there are other applications in this band including Radioastronomy and Sea Surface temperature monitoring (EESS passive).

3.1 Current changes to use

The modern transformation of the 6 GHz band began in the late 2010s. Existing WiFi bands at 2.4 GHz and 5 GHz had become congested due to massive growth in wireless devices and video traffic, and regulators were seeking a potential expansion into other spectrum.

The first country to open the 6 GHz band to WiFi usage was the **USA**, when it made 1200MHz of spectrum (5925-7125MHz) available on a licence exempt basis in April 2020[8]. Two types of 6 GHz unlicensed devices were authorised: standard power devices and low power indoor devices. Standard-power devices operate at fixed locations under the control of automated frequency coordination systems which protect incumbent licensed services in the 6 GHz band. Low power indoor devices are restricted to indoor operation and operate at lower power to protect licensed incumbent users. Following this, the FCC adopted rules in 2023 for a third type of 6GHz band unlicensed device, very low power unlicensed devices, which operate at even lower power levels than low power indoor devices but can be used anywhere without the need for an automated frequency coordination system[9]. This expansion of spectrum available for WiFi was designed to enable the deployment of

[8] FCC (2020)

[9] In January 2026, the FCC expanded this authorisation to include Geofenced Variable Power (GVP) devices, which are allowed to operate outdoors at higher power levels than previous low-power standards – these devices must possess active geolocation capabilities and location-tracking systems to automatically adjust or suppress power outputs when approaching restricted, FCC-approved geographic exclusion zones.

WiFi 6E and WiFi 7, using wider 160 MHz and 320 MHz channels to provide higher quality and more reliable wireless connections.

However, assignment of the entire U6 band to WiFi is not globally accepted. As of March 2026, twenty countries have adopted the entire U6 band for licence-exempt services[10]. Many other countries have either assigned part of the 6 GHz band to mobile broadband, or are delaying such a decision while spectrum demand is established. The WiFi Alliance is pushing for more countries to allocate the full band to WiFi use, or at least allow its use for low-power indoor WiFi use[11].

In the **UK**, Ofcom published a statement and further consultation in January 2026[12], with decisions finalised in July 2026. Within their consultation, Ofcom proposed:

- the lower 6GHz band (5925-6425MHz) should be authorised for WiFi use;
- the lower 160MHz of the upper 6GHz band (6425-6585 MHz) is a WiFi priority spectrum available on the same basis as spectrum in the lower 6GHz band, and includes indoor and very lower power WiFi, and also outdoor and higher power WiFi provided this is under the control of an Automated Frequency Coordination (AFC) system; and
- the upper 540MHz of the upper GHz band (6585-7125 MHz) is a mobile priority band where an early access for WiFi which is under the control of an AFC system is allowed, and this ensures that WiFi can be cleared out in the locations and channels where mobile systems are deployed later on.

Ofcom had also considered a situation where the lower 160 MHz of the U6 band is assigned purely to licence-exempt devices, without the need for AFC; they noted that this would likely to only be possible if there is a definite identification in the 7 GHz band for IMT. Overall, Ofcom's proposals seek to make spectrum available for IMT when it is needed, but they encourage sharing of the spectrum up to that point, enabling WiFi devices to make efficient use of any unused spectrum.

Across the **European Union**, the lower 6 GHz band (5945-6425 MHz) is harmonised for licence-exempt use, including WiFi; in particular use is confined to low-power indoor (LPI) with 23 dBm EIRP, and very-low-power (VLP) outdoor with 14 dBm EIRP[13]. The future use of the upper 6 GHz band (6425-7125 MHz) is under discussion. CEPT SE45 and PT1 have been investigating the impact of WiFi and IMT sharing on incumbents, and the harmonised technical conditions for the band respectively. The final reports are expected to be published in July 2027.

The Radio Spectrum Policy Group (RSPG) published an Opinion on the long-term vision for the upper 6GHz band in November 2025 after a public consultation process[14]. The Opinion noted that five options can be considered for the additional introduction of IMT (termed as mobile/fixed communications networks, MFCN, throughout the work) and WAS/RLAN in the upper 6 GHz band.

1. Entire upper 6 GHz band for WAS/RLAN.
2. Entire upper 6 GHz band for IMT.
3. Band split: Each application has access only to its designated portion of the upper 6 GHz band.

[10] A current list of countries can be found at http://6ghz.info.
[11] Aria Consulting (2026)
[12] Ofcom (2025)
[13] CEPT (2020), CEPT (2021), European Union (2021)
[14] European Commission (2025)

4. Segmented band split: Each application has access to its designated portion of the upper 6 GHz band and, with specific restrictions, to a third shared portion within the upper 6 GHz band. In the shared segment, neither WAS/RLAN nor low power IMT have priority, and both could potentially operate concurrently.

5. Prioritised band split: Each application would have non-prioritised access to the portion of the band assigned to the other application, if it does not cause harmful interference to the other application.

Having considered the responses to the public consultation and the preferences expressed by member states, the RSPG agreed a prioritised use of the band 6585-7125 MHz for IMT. Further, RSPG recommends that CEPT should investigate the non-prioritised WAS/RLAN usage within this full power IMT segment, ensuring that such operation does not cause harmful interference to IMT. CEPT should, within the scope of the EC Mandate, study protection of WAS/RLAN in the frequency band 5945-6425 MHz. Finally, in parallel the RSPG Opinion recommended that the 6425-6585 MHz band should be frozen to prevent usage ahead of a decision on its use following WRC-27. This scenario could be the basis for an EC implementing decision following the mandate from EC to CEPT limited to the frequency band 6585-7125 MHz, or potentially 6425-7125. CEPT has not yet completed its assessment of the technical possibilities and limitations related to sharing and coexistence, therefore the non-prioritised operation is dependent on the feasibility of such mechanisms.

Following WRC-27, therefore, RSPG intends to decide on the exact use of the 160 MHz (6425-6585MHz). If WRC-27 identifies the 7125-7250 MHz band for IMT and no significant new developments or insights suggest otherwise, there is a strong case for designating the 6425-6585 MHz band for primary WAS/RLAN use. On the other hand, if WRC-27 does not identify the 7125-7250 MHz band for IMT, it is more likely that this lowest 160 MHz of the upper 6 GHz band could be used to expand the mobile footprint. The nature of potential sharing in these bands through prioritised use will depend on the CEPT findings.

A third approach comes from countries which are prioritising mobile use of the spectrum.

China added IMT identification for the upper 6 GHz band (6425-7125MHz) to its National Table of Frequency Allocations in July 2023. The lower 6 GHz band status is under discussion.

Hong Kong concluded the world's first auction of the band for IMT in January 2025. The regional regulator OFCA offered 400 MHz of spectrum in the upper part of the 6 GHz band. However, only 300 MHz was sold, raising around $81 million (HK$630 million), marginally above the reserve price. Three incumbent carriers each obtained 100 MHz, with China Mobile Hong Kong, Hong Kong Telecommunications (HKT), and SmarTone paying an identical HK$210 million in fees. The fourth existing operator, Hutchison Telephone Company, chose not to participate and there were no new entrants. Even at reserve price, the spectrum appeared unattractive to operators.

In January 2026, **India** released the lower 6 GHz band (5925-6425MHz) for the purpose of low power indoor and very low power outdoor WiFi systems on a non-interference, non-protection and shared (non-exclusive) basis[15]. The updated national frequency allocation plan (published in December 2025) has identified the upper 6GHz band (6425-7125MHz) for IMT services[16].

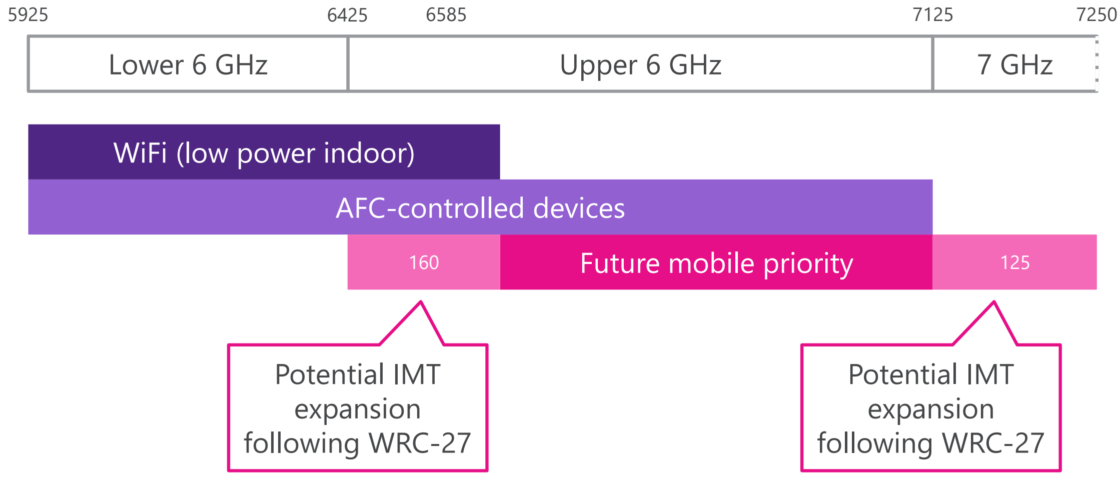
3.2 Split configurations in Europe

Given the above experience, and the consultations currently underway across Europe (including the UK's proposals), there is a clear preference for a split of the 6 GHz band, with prioritisation given to different services at different frequencies. However, this split does not currently fall at the traditional division between the lower

[15] TÜV Rheinland (2026)
[16] Kumar A (2025)

and upper 6 GHz bands; rather, a total of 540 MHz is recommended as IMT prioritised, with the lowest 160 MHz of the upper 6GHz band initially prioritised for WiFi services. The RSPG notes that if, at WRC-27, there are further IMT bands identified in the 7 GHz band, then this lowest 160 MHz can be retained for WiFi, but if not then a reassignment would be needed to ensure there was enough spectrum available for IMT. In the diagram below, the RSPG would recommend that only the upper or the lower light magenta block is prioritised for IMT, but not both.

Figure 3.1: Proposed division of 6 GHz spectrum in Europe



With the RSPG noting that either the 7GHz band or the lowest portion of the 6 GHz band should be prioritised for IMT, we can assume that in the medium term, there will be at least 600 MHz of spectrum identified for IMT in Europe, even if a portion of this is on a shared basis[17]. If 7125-7250 MHz is identified for IMT, there will be an additional 160 MHz available for WiFi networks plus at least 600 MHz for IMT, with significant guard bands. If 7125-7250 MHz is not identified, then the prioritised band in the lower U6 spectrum would not be exclusively available for WiFi expansion.

3.3 Required block sizes for 6G

Spectrum in the 6 GHz band is posited for use either to extend capacity for 5G networks, or to provide a clean band for 6G. Currently operators in Europe typically use around 20 MHz of lower frequency spectrum for their 5G coverage network, and between 80 and 100 MHz of spectrum (usually in the 3500 MHz band) for capacity. In city centres many countries have made the mmWave bands available for mobile use, but there has been limited uptake of this. This largely aligns with the GSMA's recommendations that operators should have at least 100 MHz of spectrum to run a suitable 5G network with significantly more needed for capacity[18]. However, despite a recent acceleration in 5G takeup, few operators have highlighted a need for more spectrum for 5G, even in urban areas, indicating the GSMA's predictions for spectrum needs may be on the high side.

For 6G, the GSMA proposes that at least 200 MHz of spectrum is needed for each operator[19], noting that "[f]uture evolution of mobile will be optimised for wider 200 – 400 MHz channels per operator, and 6 GHz is one of the few spectrum bands that can support multiple operators at these channel sizes"[20]. There is little analysis

[17] The 7125-7250 MHz band is allocated in Europe for fixed links and for government or military communications. The main NATO band sits above 7250 MHz, and CEPT has in the past opposed studying the 7 GHz band for IMT use, although the band below 7250 MHz is an exception to this. Even though this part of the band has been noted as a possibility for IMT shared access, it would retain a primary status for defence and scientific uses.
[18] GSMA (2021) – note that the GSMA states that "[a]ll countries must plan to make 2 GHz of mid-band spectrum available by 2030".
[19] GSMA (2025b)
[20] GSMA (2025c)

provided by the GSMA to support this figure, and this present study does not seek to verify these calculations. The GSMA have stated that these larger bandwidths will be required for new services such as ultra high-definition video streaming, generative AI, and AR services, but currently there is no public discussion or analysis of demand for these services.

The current position of multiple countries, such as China, India and the UAE, to identify 700 MHz of the upper 6 GHz band, allow for up to three operators to reach the GSMA's target, but in countries with four or more operators there would be at least one operator with a suboptimal holding. In Europe, with 540 MHz of spectrum currently proposed, this would enable only two operators to hold a 200 MHz block, with a third operator restricted to 140 MHz or having to share spectrum. However, following WRC-27 there is likely to be a recommendation made to increase the bandwidth over which IMT has prioritisation to 600 MHz or even 700 MHz. Even in these cases, it will not be possible for four operators in a country to each have 200 MHz for their 6G networks[21].

However, as noted above, the GSMA have not clearly set out the need for 200 MHz blocks; instead they have stated that such high bandwidths are needed since 6G will "provide capacity for mass-market augmented reality (AR), intensive AI use and other new applications". It is also not clear whether this bandwidth is needed in mid-band spectrum or whether it could be served by mmWave. This will be considered in the next section.

Again, this study has not sought to verify the 200 MHz requirements as claimed by the GSMA, but rather takes it as an assumption only to assess the possible configurations in the upper 6 GHz band.

3.4 Scenarios for analysis

Given the above, we assume that 600 MHz of spectrum could be made available for assignment, with the current 540 MHz of upper 6 GHz spectrum joined either by 125 MHz in the 7 GHz band, or by the lower part of the remaining U6 band. Under this assumption, a market with three operators would be able to provide each with a 200 MHz block, but a market would four operators would not. In this latter case, there are three potential outcomes:

- The two smallest operators each have 100 MHz of spectrum, leading to lower network capacity and potentially lower quality of service (which will be investigated below);
- The two smallest operators share a 200 MHz block, allowing the maximum quality of service but shared amongst their subscriber base; or
- One of the smallest operators is assigned 200 MHz, and the other assigned has no spectrum assignment.

Here we assume that it is the smaller operators set to acquire less than the full 200 MHz of spectrum. If awarded by auction, then those operators with a lower spectrum valuation will be likely to gain a smaller holding, and these tend to be the smallest operators. While it is possible that a larger operator may bid incorrectly, we will not consider this scenario in our analysis.

Our analysis therefore considers whether the smaller operators will be significantly impacted by them being limited to sharing a 200 MHz block (meaning that further spectrum should be identified for IMT), or whether there will be no noticeable competitive disadvantage or impact. We do not make an assumption over the form of this sharing agreement, but we note there are numerous examples of RAN sharing agreements across Europe which have successfully maintained competition at the retail level while reducing network costs. For example, in Romania, Orange and Vodafone agreed to build an Open RAN network with RAN sharing in rural parts of

[21] GSMA (2025d)

Europe where they both have mobile networks. The first commercial sites were deployed in a rural area of Romania, near Bucharest. In this case, while the radio infrastructure is shared, each operator retains independence at the software level, allowing each operator to independently manages its own RAN software on a common cloud infrastructure. This means that while the cost of network is reduced, operators do not lose the flexibility to tailor services and capacity to specific customer needs.

This potential for sharing means that any cost efficiencies from using 200 MHz blocks over 100 MHz blocks will be obtained by the smaller operators. Even without network and spectrum sharing, since smaller operators are unlikely to be operating their 6G networks at full capacity, there will be no noticeable differences in spectrum efficiency from being restricted to 100 MHz of spectrum.

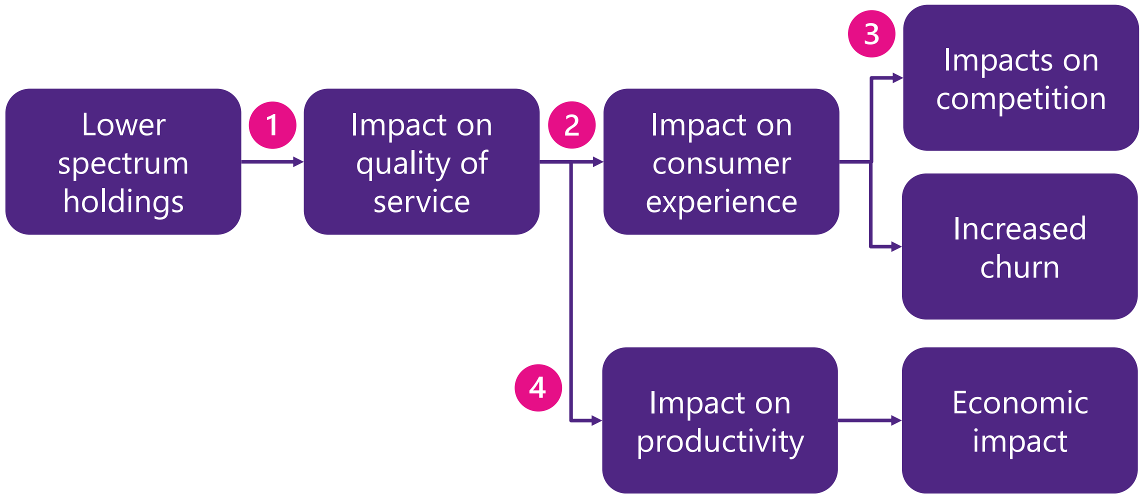
Finally, although unlikely, there remains the possibility that no additional spectrum will be identified for IMT – either in the 7 GHz band or the lower U6 band. In this case, only 540 MHz of spectrum would be available for assignment between all operators, and even in countries with only three operators the smallest would be faced with a reduced bandwidth. We will consider how our analysis can be applied to this scenario as well.

4 Impacts of unequal allocations

As described in Section 3.4, given the amount of spectrum available the upper 6 GHz band, in a market with four operators it will be necessary for smaller operators to either use a lower bandwidth or share spectrum. Either option here could possibly put the operator at a disadvantage compared to a competitor holding 200 MHz. There would need to be intense coordination between operators, and each would lose flexibility in how spectrum was deployed. However, it is not necessarily the case that this imbalance would lead to significant worsening of economic indicators or consumer experience.

To examine the potential impacts of spectrum holdings we have developed a chain of impacts as shown below.

Figure 4.1: Hypothesised chain of impacts



The remainder of this section examines each of these relationships in turn. We look at the impact of operators needing to share spectrum, under the following assumptions:

- The market is of four players;
- Market shares are unbalanced, and there are two larger and two smaller operators – reflecting the market dynamics examined in Section 2[22];
- Spectrum valuation for the smaller operators is lower, meaning that they will need to share spectrum while the larger operators will win exclusive spectrum at auction; and
- The larger operators will hold 200 MHz of spectrum each, while the smaller operators will need to share 200 MHz of spectrum – either as a formal sharing arrangement, or with 100 MHz awarded to each operator.

4.1 Impacts on service quality

Exact parameters for 6G networks are still unknown, but if assuming 6G air-interface targets as set out in IMT-2030 with 64-QAM baseline, 4×4 MIMO, then service quality metrics will be of the order as shown below. These are illustrative estimates only but do provide an indication of how performance will alter with differences in

[22] The one exception to this assumption is Italy, which is discussed in Section 4.6.

spectrum availability. 6G networks will be able to implement higher-order modulation and MIMO schemes but the relative performance between spectrum bandwidths will stay the same.

Figure 4.2: Indicative metrics for 6G networks

	Using 100 MHz	Using 200 MHz
Peak throughput[23]	4 Gbps	8 Gbps
Latency estimates[24]	0.30 ms	0.15 ms
Potential users per cell with 10 Mbps	300	600

In general, as with 5G systems, the key insight is that doubling the channel width from 100 to 200 MHz delivers roughly proportional gains in throughput and capacity. The potential impact of sharing spectrum between operators will, therefore, depend on the relative size of the userbase. If two smaller operators combined would have approximately the same market share as a larger operator, for example, then each would have no disadvantage in capacity through operating on a 100 MHz bandwidth when compared to the larger operator. Throughput scales almost linearly with bandwidth, so 200 MHz blocks double peak rates. However, this is shared capacity: in a crowded cell, both configurations degrade at the same rate per added user

It should be noted that there are three areas in which service quality is not directly variable with subscriber numbers.

- Latency improves for all users with wider channels for two reasons: the subcarrier spacing can be larger (a shorter symbol duration, so less inherent air-time delay); and there is more room in the scheduler to prevent queues before they build up. At low load the difference is not perceptible, but at high load, this difference can be quite significant; at an 80% load, a 200 MHz network may be able to stay below a latency of 1.5 ms, while a 100 MHz network would not be able to achieve this. This relates to the physical layer latency only, which makes up on a small part of total network latency, meaning that differences would actually be imperceptible[25].

- On the other hand, wider channels are more likely to experience interference, especially at the cell edge, and in order to overcome this there may need to be a further densification of networks – increasing infrastructure cost.

- On rare occasions where most subscribers are not using the network, the maximum connection speed could be much higher if spectrum is pooled between operators rather than each operator having a distinct 100 MHz block. This theoretical network performance is unlikely to be a significant factor to operators when considering how best to optimise networks for their customers.

In a market with two smaller operators, therefore, there could be a decision to be made over whether to share a 200 MHz block of spectrum (which would optimise for peak performance in terms of latency), or to run a separate network over 100 MHz (to maximise the cell radius in rural areas). In reality, the U6 band will not be used in isolation, with operators using other parts of their spectrum portfolio for rural coverage. In either case,

[23] Values here come from applying Shannon-Hartley capacity scaling (that is, doubling bandwidth doubles theoretical capacity) anchored to IMT-2030 peak rate targets (ITU-R M.2160, published 2023), which set a 1 Tbps/m² area traffic capacity goal and multi-Gbps per-user peaks. These are rounded illustrative figures, not outputs of a specific link budget calculation.

[24] These values are based on IMT-2030's 0.1 ms target, and are estimated from how subcarrier spacing scales with bandwidth in NR-style numerologies. These are not taken from a published 6G simulation. This is the physical layer latency only, and will form a small part of the overall latency budget that drives user QoS perception.

[25] In fact, taking into account the end-to-end latency the difference between having 100 MHz or 200 MHz can lead to a maximum difference of 6%. The largest components of end-to-end latency are the application server and backhaul, neither of which are affected by spectrum in the access network.

since capacity varies linearly with bandwidth, with 200 MHz of spectrum used by the two operators there is unlikely to be a noticeable difference in connection speed.

Larger operators will potentially use 200 MHz of spectrum to serve their customers directly. These larger operators will be able to configure their spectrum to take best advantage of lower latency in urban areas, and potentially give greater propagation in suburban areas – although as noted above, other spectrum in an operator's portfolio is likely to be better suited for less densely populated coverage. The differences in service quality will be marginal, and any cost savings are also likely to be modest.

It is important to note that while the above analysis has been compiled looking at 6G systems, the same conclusions would also be reached if applied over 5G networks (although at lower speeds and higher latencies).

4.2 Impacts on consumer experience

The study of mobile network quality is divided into two distinct frameworks:

- Quality of Service (QoS), which measures technical network performance, which was examined in the previous section; and
- Quality of Experience (QoE), which measures the user's subjective psychological and behavioural response.

There is a core link between these two metrics, which has been examined by both technical journals and psychological academics. In Zhang & Li (2024), facial expression extraction was used to prove that network performance (QoS above) directly correlates to visible user frustration, and a worsening QoE. It establishes that "Mean Opinion Scores" (MOS) are heavily dictated by video buffering and jitter, helping operators prioritise their network optimisation. At the same time, various studies by Reichl have noted that QoE is not just a technical extension of QoS but is influenced by user expectations and the specific application context (for example, a 2-second delay in a voice call is a "failure," but in an email, it is "unnoticeable"). Kushwaha et al (2024) sets out a framework of how a maximum capacity model is needed to make sure that customer experience meets expectations for specific high-bandwidth applications, including VoIP and streaming of ultra high definition video.

These studies therefore establish that with an impact on network service quality, there will be a direct impact on consumer experience, in particular when looking at service availability.

However, even when the bandwidth requirements of these services are considered, there is little difference in availability between the two scenarios of 100 MHz or 200 MHz blocks when used for 6G. Under realistic forecast traffic assumptions, QoS issues will not arise from bandwidth exhaustion, but instead from cell-edge propagation signal drops. These will be almost identical for the different bandwidths, instead dependent on the overall frequency of the band. Even in these cases, other spectrum in an operator's portfolio should be able to take on additional capacity.

User behaviour in 2026 centres on high-bandwidth, low-latency apps, and as a result the bandwidth requirements for future services – which are cited by the GSMA as key drivers for 6G capacity – can be extrapolated.

Figure 4.3: Bandwidth requirements of advanced services

	Requirements	Impacts of reduced spectrum
High definition video	15-25 Mbps	Unlikely to be significant. While guaranteed simultaneous users tend to be measured at 10 Mbps, in reality most networks are built to cater for higher speeds; even 8K video at 25 Mbps should be possible, although virtually never used by most consumers.
Cloud gaming	25 Mbps, latency <20ms	Largest impacts will be on latency, particularly on variation in latency over time. 6G targets should still give reasonable experiences, even with 100 MHz bands.
Generative AI	40 Mbps in small bursts	Reduced bandwidth would lead to increases in scheduling delays, meaning that experience suffers from a lack of instantaneous feedback. Downloads of generated content may be frustrating. However, again the use cases requiring such high bandwidths – such as video editing, AR video annotation, or translation services – will be rarely used.

Given these constraints, it is clear that the impact of a smaller operator having only 100 MHz of spectrum will be trivial, since even the greatest current requirements are easily accommodated within this capacity, and the smaller operator will have a reduced number of active users sharing the channel. By sharing spectrum, the two smaller operators may be able to offer ever greater bandwidth to some consumers, but this is unlikely to have any measurable impact on consumer experience. Instead, quality of experience will depend on other network decisions such as densification, edge computing services, or partnerships with application providers.

4.3 Impacts on competition and churn

A key concern for governments and regulators, in the administration of spectrum, is ensuring there is no significant impact on competition in the market – that is, the regulation itself enables competition and does not create further market failure. If decisions on spectrum lead to one or more competitors being at a fundamental disadvantage in the market, this can be considered a malfunction of regulation. That is not to say that regulators should prioritise competition above all else – dividing spectrum into small lots can lead to an overall worsening in quality of service for consumers.

We first consider how changes in service quality impact on the perceived value of consumers. If a regulatory decision were to make one operator suffer a loss of service quality, this would mean consumers were more likely to choose alternative network operators.

Academic papers have identified different factors that impact on consumer perceived value.

- In Sharma & Padashetty (2025), the study found that reliability is the most critical dimension for consumers. It finds that high service quality directly increases perceived value, making users less likely to switch to competitors.
- In Susanto et al (2025), research into the transition to 5G showed that speed and ubiquity (coverage) were the primary drivers for consumer intention to upgrade.
- In Al-Karaghouli (2022), research findings showed that customers rate speed as the second most significant component of service quality after call quality, when choosing a mobile telecom provider.

Network quality is often used as a non-price competitive tool. When prices have been lowered, operators compete on infrastructure to maintain their revenue levels. A reduction in competition can then lead to lesser investment in the network.

In Bourreau & Sun (2022), the French market is examined and concludes that quality is endogenous to strategic investment. The paper argues that while competition usually drives quality up, certain market mergers can lead to undersupplied quality, as the incentive to out-invest rivals diminishes. In DSIT (2026), recent evidence suggests that as markets move from four to three major players, the focus shifts toward standalone 5G quality to differentiate brands, rather than just competing on data allowances.

Competition in network quality directly leads to churn in the market. In Meng & Sego (2020), research showed the network reliability had direct impacts on the positive word of mouth and customer loyalty, meaning that consumers were less likely to change networks even if prices increased. Du Preez & van Staden (2026) identifies Reliability and Responsiveness as the two pillars that most significantly impact a user's emotional commitment to a brand, and therefore a lower propensity to churn.

However, this link is not absolute. Lee et al (2026) argues that in mature markets, network quality has already reached a saturation point, and marginal improvements are not noticed. Even if quality of service were lowered, the customer experience is already at a sufficiently high level that other contractual items, such as loyalty rewards, have a much higher impact on customer retention. This reflects the comments on consumer experience in Section 4.2.

Indeed, as 5G matures, research is shifting from basic connectivity to specialised experience. Pons et al (2023) is a review of how network optimization affects smart city and Internet of Vehicles (IoV) user experiences. It notes that for high-stakes applications, network quality is no longer a luxury but a safety-critical requirement, and is therefore expected rather than considered.

Given the above, it is clear that there are many potential impacts on competition and churn, from changing network quality and consumer experience. There is a noticeable impact on competition feasibility if network quality of service is reduced – but this is in part mitigated by the fact that quality of experience is already at a high level, meaning that consumers have a much lower desire to switch networks. Nevertheless, if unequal spectrum holdings were to lead to significant differences in experience, consumers would have a higher propensity to move to competitors.

Our analysis in previous sections indicates that this will not, however, be the case. We have identified that a reduction in available spectrum for smaller operators in the market will not cause a material difference in service quality, which in turn will lead to no difference in consumer experience. Therefore we believe that an unequal holding of spectrum, with smaller operators only able to use 100 MHz, will not impact on market competitiveness or churn levels.

4.4 Impacts on economic indicators

Access to high quality mobile broadband has frequently been shown to have positive impacts on macroeconomic indicators. A substantial number of studies have found a significant increase in GDP as a result of higher fixed or mobile broadband adoption while others have identified some positive impacts on employment. Most research studies on the economic impact of service quality have focused on speed and its impacts on GDP. In general the conclusion is that faster broadband access has a positive impact on GDP growth, and this can be explained by two effects of better connectivity, namely:

- Contribution to productivity gains as a result of the adoption of more efficient business processes, such as improved access to markets and supply chain optimisation; and

- Acceleration of the introduction of new products, services and facilitation of innovative business models.

A number of recent studies have looked at how specific technical features (like low latency and high capacity) unlock new economic value, or examine how network improvements such as the transition between technologies can lead to higher economic welfare.

Mohanty & Reynolds (2023) report found that 5G integration (specifically using mmWave spectrum) has the potential to boost global productivity by 1.7% of global GDP by 2030. It highlights that 5G's quality drivers (low latency and high traffic capacity) are more important for GDP than simple coverage. However, this paper assumes that possible increases in productivity through wireless networks are only possible through 5G mmWave use, rather than a potential substitution with other technologies such as WiFi.

GSMA (2026) estimates that mobile technologies and services contributed $7.6 trillion to global GDP in 2025 (representing 6.4% of total GDP). It projects this will rise to $11.3 trillion (8.4% of GDP) by 2030 as 5G and AI-enabled networks mature. Similarly, World Economic Forum (2024) breaks down GDP impact by sector, finding that Manufacturing represents over a third of the potential output gains from high-quality 5G networks due to "smart factory" automation. Again, these studies are likely to have significantly overestimated the direct benefits of 5G networks, since they do not adequately consider a counterfactual where there is an alternative technology, nor do they consider what the output would be if LTE networks remained. Nevertheless, there is a clear benefit to the availability of high quality mobile broadband.

Other studies have use econometric modelling to quantify the value of mobile broadband quality improvements. Edquist (2022) found a significant correlation between mobile broadband speed and labour productivity. Specifically, a 10% increase in mobile broadband speed correlates to a 0.2% increase in labour productivity with a one-year lag. Koutroumpis (2009) confirmed a "critical mass" effect, where the positive impact of network quality on GDP becomes exponentially stronger once a certain threshold of infrastructure coverage is met across a population. Strusani et al (2013) found that doubling mobile data use per connection – itself driven by improved connection quality – increases GDP growth by 0.5 percentage points.

Arthur D Little (2011) found that doubling the broadband speed for an economy increases GDP by 0.3 per cent. Hassan (2025) used Ookla speed test data and World Bank GDP metrics to prove a positive correlation between median download speeds and national economic prosperity. The study argues that speed acts as a multiplier for business efficiency and e-commerce growth. Using global datasets, ITU (2025) found that a 10% increase in mobile broadband penetration yields an average 1.5% to 2.5% increase in GDP per capita, with the highest impacts seen in Africa and the Americas.

Using published broadband-speed elasticities and the operator market shares observed in Europe, it can be shown that the estimated GDP difference between a 3×200 MHz arrangement with sharing and a 4×200 MHz exclusive arrangement is likely to be close to zero and, even under conservative assumptions, below the level that could be considered material at a European macroeconomic scale. Figure 4.4 provides a summary of other studies which identified a link between economic welfare and broadband speed. It should be noted that not all studies are centred on mobile services, particularly because these were carried out at a time when mobile broadband lagged significantly behind fibre connections.

Figure 4.4: Estimates of impact of broadband speed

Authors (date)	Impact of broadband speed	Context and comment
Edquist (2022)	• There is a strong association between productivity and one-year lag of mobile broadband speed. • 10% increase in speed is associated with 0.2% productivity increase in the following period • Results are mainly valid for developing countries or where service quality is low	Panel data of 116 countries from 2014 to 2019
Carew et al. (2018)[26]	• A doubling of broadband speed results in a 1.37% increase in real GDP.	Panel data for USA from 2010 to 2017.
Briglauer and Gugler (2018)[27]	• A 10 per cent increase in basic broadband adoption was found to increase GDP by about 0.15% • A 10 per cent increase in ultrafast (FTTx) broadband adoption led to an incremental increase of 0.02-0.05% of GDP.	Panel data on EU27 Member States from 2003 to 2015.
Koutroumpis (2018)[28]	• An increase of broadband speed from 2Mbps to 8Mbps over 10 years leads to an increase in annual GDP by 0.1%. • A same increase in speed achieved over 5 years leads to an increase in annual GDP by 0.22%.	Panel data 35 OECD countries from 2002 to 2016.
Kongaut and Bohlin (2014)[29]	• A 10% increase in broadband speed produces an increase in GDP per capita of 0.8% for a general sample of countries, 1.0% for low-income countries and 0.6% for high income countries.	Panel data for 33 OECD countries from 2008 to 2012.
Rohman and Bohlin (2012)[30]	• A doubling of broadband speed contributes 0.3% to GDP growth from base year.	Panel data for 33 OECD countries for 2008 to 2010. Speed based on blended mobile and fixed broadband download speed.

All these estimates should be treated with caution. While it is useful to consider relative changes in broadband speed (so in terms of doubling, for example), even this does not take into account the baseline. A country with an average speed of 10 Mbps will see a significantly greater impact of speed doubling (to 20 Mbps) than a country which is starting at 1 Gbps. For mobile users, increases beyond a certain speed (say 10 Mbps, which allows for streaming of high definition video) are unlikely to be as beneficial as improvements in coverage. These calculated impacts on GDP may well overestimate the impact in developed countries across Europe.

There may also be impacts associated with broadband speed which are not captured by a GDP measure. For consumers, higher speed broadband generally means better user experience, time savings and access to wider range of online applications and services. Some of these aspects may not be reflected in "productive" activity (for example, more time on leisure activities which are not valued by the market) and thus not captured by GDP. These benefits are usually estimated in the form of consumer surplus, or welfare. For example, a 2009 study on consumer benefits of broadband connectivity in the USA estimated the benefits of a 10-fold in broadband speed from 5Mbps to 50Mbps are around USD6 billion per year for existing broadband households, equivalent to a surplus of around USD80 per household.[31]

[26] Carew et al (2018)
[27] Briglauer & Gugler (2018)
[28] Koutroumpis (2018)
[29] Kongaut & Bohlin (2017)
[30] Bohlin & Rohman (2012)
[31] Dutz et al (2009)

Overall, the impact of improved service quality on macroeconomic indicators appears to be significantly positive, meaning that if a policy were to cause a reduction in quality there would be a negative impact on economic prosperity. The size of this impact varies, and appears to be driven by:

- The development of the country (with less developed countries benefitting more);
- The baseline quality of service; and
- The speed of quality improvement.

Most studies have looked only at speed, without quantifying impacts of increased reliability or latency. However, it is likely that these would also lead to positive economic impacts.

Despite this positive relationship, the lack of differences to service quality (proven above), caused by sharing 200 MHz of spectrum between two operators, means that there is unlikely to be any direct impact on economic welfare. Even a doubling of connection speeds from a low baseline is estimated to have a small impact on GDP (in the range of 0.5%), so marginal differences on a baseline of existing high quality connections will likely be insignificant.

Moreover, economic value is generated by carrying traffic. Since traffic demand is proportional to subscriber base and market share, allocating identical nationwide spectrum resources to operators with substantially different traffic loads does not maximise spectrum efficiency. A capacity-weighted allocation, achieved either through spectrum sharing or infrastructure sharing, is therefore expected to provide similar user performance while making more efficient use of scarce spectrum resources.

On the other hand, as per the RSPG recommendation, the remaining spectrum could be allocated to licence-exempt use. The traffic offload, enterprise productivity gains, and consumer surplus from higher indoor WiFi enabled by the 6425–6585 MHz band, could generate significant positive indirect economic value. Weighing this against the marginal, if not zero, benefits from increasing the IMT allocation to 800 MHz, it is clear that there is a positive economic argument for leveraging both WiFi and mobile technologies in the band.

4.5 Impacts on spectrum prices

The value of spectrum to a mobile operator is related to the profit that can be obtained from the use of this spectrum – either through increases in revenue, or reductions in cost. When looking at the U6 band, these are likely to manifest as follows.

- Historically, consumers have resisted increases in prices from the introduction of new technologies. ARPU across Europe was largely flat over the course of the introduction and rollout of LTE, despite a number of operators initially attempting to increase subscription fees. There has been a steady decrease in ARPU since this time, with only a sight impact following the introduction of 5G networks – although this coincided with the Covid-19 pandemic, during which time mobile connectivity became increasingly important and consumer willingness to pay likely increased. It is unlikely that the introduction of 6G services on the U6 band will lead to any particular increases in revenue.

- Capacity on 6G networks – or, if the U6 band is used in this way, on expanded 5G networks – is significantly more cost effective if obtained through additional spectrum rather than through network densification. Operators will consider the avoided cost from use of new spectrum when calculating their value. Due to uncertain demand, the value of the first block of spectrum for each operator will likely be higher than the second block, meaning that spectrum is more valuable (and will lead to greater government revenues) if split between multiple operators. However, this impact is likely to be small.

The world's first and only auction (up to date) of upper 6 GHz spectrum for IMT, took place in Hong Kong in January 2025. Its results are the only available evidence for this band. A total of 400 MHz of spectrum was offered in the auction, of which 300 MHz (75%) was successfully assigned. The auction generated HK$630 million in total revenue, corresponding to an average payment of HK$210 million per 100 MHz block. The final auction prices were only marginally above the reserve price, indicating limited competitive bidding and suggesting that operator demand was broadly aligned with the minimum valuation established by the regulator. Notably, Hutchison, which holds approximately 14% of the mobile market, chose not to acquire spectrum.

In general, when estimating value of spectrum, we have previously used an econometric model to identify the drivers of spectrum value and to estimate how reserve prices or bidding behaviours should be set. In this econometric model we include a number of explanatory variables, which are then identified using a statistical process as significant or not. Typically we have found the following to be major drivers of spectrum value.

Figure 4.5: Drivers of spectrum value from econometric analysis

Variable	Impact
Bandwidth	Positive (larger spectrum bands are valued more)
Band identifier	Negative (higher frequencies are valued less)
Population	Positive (greater population is valued more)
Population density	Positive (greater density is valued more)
Spectrum stock	Negative (more existing spectrum leads to lower value)
Time	Negative (more recent spectrum auctions have lower value)
ARPU	Positive (higher ARPU leads to greater value)
Number of bidders	Positive (more bidders drive up auction values)

However, the impacts of each driver vary significantly for different bands. Bandwidth is important up until the point at which operators have excess supply, at which point adding in additional bandwidth provides no profit and therefore no additional value – this is true for capacity bands in newer technologies which are not being used to their fullest, such as mmWave and 3500 MHz in some territories, and is likely to be true for the 6 GHz band as well. While time tends to have a negative correlation, some bands (such as the AWS-3 band in Region 2) are slightly increasing in value as there are more potential uses for them. As a result, the 3.5 GHz band commands an anomalously high price because it was the only available 5G mid-band at time of auction; those market conditions are unlikely to apply to 6 GHz, which will be auctioned after operators have already secured 3.5 GHz and mmWave holdings. Among previous European spectrum awards, the 2.6 GHz band may provide the closest economic analogue: a new, higher-frequency capacity band auctioned into a market where operators already held mid-band spectrum, but with uncertain demand and an immature device ecosystem.

There are few academic studies looking at the value of spectrum for newer technologies, in particular considering how different amounts of spectrum will impact on the value. In general, if there is no impact on revenues or costs, which is likely given the lack of other impact derived above and the unclear demand for capacity, then there would be no impact on spectrum value or pricing. Operators will bid for spectrum at a price that reflects the value to the business, and if the same value comes whether 100 MHz or 200 MHz is deployed, then these will lead to the same price. Therefore, there will be no impact on the overall price paid for spectrum if smaller operators obtain 100 MHz each rather than 200 MHz.

4.6 The Italian case

Italy represents the principal outlier among the European four-operator markets considered in this analysis. In all other four-operator countries, it is possible to make sure that the two smaller operators receive a proportionate share of capacity which is approximately relative to their market shares, which can then be utilised to provide a proportionate capacity. However, in Italy the market shares are much more equal, with the largest operator (the combined Fastweb and Vodafone) having a 29% market share, the second (TIM) and third (WindTre) largest at 27% and 26%, and the smallest (Iliad) at 17%.

There are a number of potential outcomes from distribution of the 600 MHz band in Italy.

1. An equal split of 150 MHz per operator, this achieves near-balance across all four operators with a residual capacity ratio gap of only 8% between the most and least favoured operator, but at the cost of carrier aggregation for all four operators and a reduction below the natural 200 MHz allocation per operator.

2. RAN sharing between the two smallest operators on a pooled 200 MHz block, but this could be problematic given the closeness of market shares between the second and third largest operators. This would likely give reasonable outcomes until networks became suitably capacity constrained.

3. Two RAN sharing agreements, each allocated 300 MHz of spectrum, to provide economies of scale within the market and access to large spectrum bandwidths.

4. 100 MHz per operator with 200 MHz retained for Italy's dense fixed microwave link infrastructure. This provides operators with an equal playing field, protects existing fixed service incumbents, and requires no carrier aggregation, making it the most practical option where fixed service constraints are significant. However, it may mean that consumers are provided with a lower quality of service, particularly on larger operators, than would otherwise be expected.

The best option for Italy will require careful consideration, but it is clear that a single outlier country is not an argument for expanding the allocation all over Europe, but an argument for smarter regulatory design within it.

5 Conclusions

Our study has looked in detail at the potential impact of restricting IMT to 600 MHz of spectrum within the upper 6 GHz and 7 GHz bands. We have considered the ways in which this spectrum may be shared between operators in a market, noting that in Europe markets with more than three operators will generally have two larger operators and the remainder of the market shared between smaller operators.

Based on these configurations, we have looked at a chain of consequences. Firstly, we examined how differences in bandwidth for operators would lead to differences in service quality – taking into account the differences in subscriber bases. The key conclusion at this point is that, given existing and predicted use, **there will only be small marginal differences between consumer experience from smaller operators having 100 MHz or 200 MHz of bandwidth**; indeed, given the standard profile in market shares across Europe, a smaller operator having access to 100 MHz is likely to give the same quality of service as a larger operator holding 200 MHz. Further, it is possible for smaller operators to combine and share their holdings to lead to deployment of a 200 MHz band, in the event that wider bandwidths are needed in the future, or to overcome the slight increase in latency that a 100 MHz deployment would lead to (although this is only a small part in itself of the total latency in the network).

Therefore, **providing larger operators with 200 MHz and smaller operators with 100 MHz each (or a shared 200 MHz) will have no significant disadvantages**. Although we identify that several academic studies do conclude that differences in service quality can lead to increased churn, lower productivity, and a poorer consumer experience, the fact that these differences in service quality are so small allows us to conclude that there would be no noticeable impact from these imbalanced spectrum holdings. Further, we note that dividing spectrum in this way will likely have no impact on the prices paid for spectrum compared to the situation where four operators are awarded 200 MHz each.

Given this, there is therefore **no need to expand IMT identification beyond 600 MHz within the 6 GHz and 7 GHz bands**. The GSMA has stated that operators will require 200 MHz of dedicated spectrum for 6G services, but this demand is as yet unproven. Under the proposed configuration, larger operators will have access to this spectrum bandwidth in any case, with smaller operators holding an equivalent for the size of their subscriber base, and an option to combine holdings if needed. If the 7125-7250 MHz band is identified for IMT, then the lower part of the U6 band can be used for WiFi with no negative impact on the mobile market, and this would also allow a sizable guard band (of 60 MHz) to prevent further interference between the two technologies. This would then allow both technologies to take full benefit of the 6 GHz band.

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