



Spectrum Sharing

GSMA Public Policy Position

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Executive Summary

The continued rise in data traffic means mobile services rely on access to growing amounts of spectrum to meet demand. However, it is increasingly difficult to completely clear new frequency bands for future mobile use. Spectrum sharing may be a way to help, when clearing a band is not possible, by enabling mobile access to additional bands in areas, and at times, when other services are not using them.

While spectrum sharing holds potential, it cannot supplant the need for exclusively licensed mobile spectrum. The global success of mobile services has been built on a foundation of exclusively licensed spectrum as it supports widespread services and the certainty needed for long-term heavy network investment and high-quality service. However, sharing can play a complementary role to traditional spectrum licensing by allowing mobile services to access new bands where there are no other reasonable alternatives.

It is essential that regulators think carefully about which bands suit sharing and select the right sharing framework to ensure innovative and affordable mobile services can be supported. Firstly, the proposed band should provide sufficient spectrum in areas where mobile operators are seeing growing demand. Secondly, the sharing framework should be understandable, usable and tailored to the needs of the users (e.g. certainty of access, sufficient block sizes etc).

This paper provides background on spectrum sharing and outlines the GSMA's positions:

- 1. Spectrum sharing is an opportunity to open up access to new spectrum for mobile services but needs careful planning to succeed**
- 2. Exclusive licensing has been central to the success of mobile services and must continue. Spectrum sharing decisions should be mindful of the need for additional exclusive spectrum**
- 3. Sharing will only be useful for operators if the proposed band is harmonised for mobile use. It also must be available and usable in sufficient quantities in areas and at times where needed**
- 4. Operators favour a simple sharing framework that is investment-friendly and supports reliable, high quality mobile services**
- 5. Mobile operators should not be prohibited from voluntarily sharing their spectrum to support faster services, improve coverage and drive innovation**
- 6. Sharing can play a role in the 5G era but poor implementation risks harming its potential**
- 7. Regulators need to help incentivise incumbents in attractive bands to share**
- 8. The framework should balance the current and future requirements of incumbents and sharers**

Background

The continued growth of mobile data traffic¹ and demand for faster broadband services means additional mobile spectrum is vital.¹ Traditionally, regulators have cleared incumbent users out of a portion of spectrum across a whole country before licensing it to mobile operators. However, where this is not feasible or practical in the short term, spectrum sharing can help by enabling mobile access to additional frequency bands in areas, and at times, when other services are not using them.

Sharing is only possible if regulations don't prohibit it, commercial measures incentivise it, and it is technically practical (i.e. different users can operate effectively without interference). Most importantly, the places where licensees and potential sharers wish to use the spectrum must be substantially different, in order for their uses of spectrum to be complimentary rather than conflicting.

Regulators can enable sharing by giving incumbent users the right to share their spectrum voluntarily through commercial agreements or by awarding rights to use spectrum in areas and/or at times when the incumbent is not using it. However, where sharing is not voluntary, secondary usage rights should be set out in the incumbent's primary spectrum licence. This way, incumbent licence holders are aware that sharing is possible and under what conditions. So, when they acquire a licence, that can be factored into their business plan. Sharing spectrum will also impose opportunity costs on incumbents, so there will generally need to be remuneration for sharing their spectrum (e.g. financial costs or rewards), especially if they have paid for access to that spectrum.

As a part of standard spectrum management, regulators have systems in place to coordinate usage of the same spectrum between different users in order to minimise interference.² Spectrum sharing may require some modifications to these systems to support effective coordination. This coordination should establish exactly where spectrum can be shared and put in place technical usage conditions (e.g. transmission power levels, locations and times, exclusion zones, guard bands etc) that minimise interference. In recent years, specialist Spectrum Access Systems (SAS) have been developed to automate much of this process.

The first major test of spectrum sharing, including SAS management, focused on the broadcast television spectrum that is unused in certain areas and at certain times - known as TV whitespace (TVWS). A key aim was to use this spectrum for broadband services, but it has not been commercially successful due to several factors. There has been a lack of long-term certainty surrounding access to TVWS, and limited international momentum has harmed the development of a strong equipment ecosystem. Furthermore, the business case for the planned rural or remote wireless broadband services is often challenging due to the lack of affordable supporting infrastructure (e.g. backhaul, power etc.) and the relatively small number of potential customers.

The slow progress of spectrum sharing to date has provided valuable lessons for regulators to take forward as they look towards using sharing to support the growing popularity of 4G and 5G networks. A key focus is on the sharing framework, which controls who can share the band and defines the usage rights and limitations. The key variables normally include:

- The number of access tiers: Two tier models include the incumbent and one class of shared user. Some models add a third tier with further reduced access rights (e.g. low power uses);
- Access guarantees: The framework outlines the access guarantees that the tiers of users can expect. These can include traditional licensing to provide strong guarantees and high QoS; and
- Access terms, technical conditions and fees (if any): These define over what geographic area users may operate and where necessary for how long and at what cost (e.g. when a tier is licensed). These includes technical conditions (e.g. power levels) which affect coverage.

1. Mobile traffic grew 18x from 2011 to 2016. It will grow 7-fold from 2016 to 2021. Source: Cisco (2016)

2. Many regulators already use databases to manage spectrum access and to minimise interference



Three frameworks are commonly discussed:

1. CBRS-type approaches: The planned 'Citizens Broadband Radio Service' approach in the United States in the 3.5 GHz band aims to support three tiers using dynamic sharing. The top tier is made up of the incumbents (e.g. radars, satellite companies and wireless ISPs) who have the most protection. The secondary tier includes Prioritised Access Licence (PAL) holders, who will pay to buy rights to use a portion of the available spectrum where it is not in use by the top tier. The third tier comprises General Authorised Access (GAA) and is available to anyone but will have the least protections. Portions of the spectrum are reserved for GAA and PAL tiers in areas where the incumbent is not using the spectrum. PAL and GAA users can access each other's reserved portion of spectrum where it is not registered as being used in the SAS database.

2. Licensed Shared Access: Incumbent licence holders can sub-license spectrum to other users in a controlled way. The traditional model was developed in Europe for the 2.3 GHz band. It has two tiers including the incumbent and secondary users (e.g. mobile operators) who are permitted to use the spectrum in areas when it is available. More advanced models are being developed.³

3. Concurrent Shared Access (e.g. club licensing): Unlike the approaches above, this only allows one class of user but allows them to share spectrum with each other in a coordinated way. This allows sharing between mobile operators to improve data speeds and spectrum efficiency.⁴

Policy makers increasingly see spectrum sharing as a means of opening up additional spectrum for 4G and 5G mobile services. Their decisions regarding bands and frameworks for sharing directly impact the potential of the resulting mobile services which in turn will determine the level of investment mobile operators are willing to make.

3. e.g. ETSI is working on 'evolved LSA' which is a modified, band agnostic approach to LSA

4. It is permitted and operates in around 10 countries

Positions

1. Spectrum sharing is an opportunity to open up access to new spectrum for mobile services but needs careful planning to succeed

Spectrum sharing can help address rising demand for mobile services by opening up access to vital new spectrum in areas where it is in-demand and where it is under-used by incumbent users. However, sharing has yet to be proven as an effective way to provide additional spectrum for mobile broadband, so careful planning is necessary to craft approaches that will offer access to sufficient amounts of spectrum under conditions that support mobile broadband. While it may appear simple, the sharing approach should consider complex issues such as whether and how different classes of users will be protected. It should also include the necessary enforcement mechanisms in cases where protection rules are violated.

It is important to ensure sharing does not undermine the long-term evolution of spectrum. For example, portions of broadcast spectrum are gradually being repurposed to support affordable, wide area mobile services. This process can be complicated if broadcast spectrum is shared with TVWS services that also need to be migrated without compromising their ability to offer services. In this way, spectrum sharing can risk creating overly fragmented bands which makes refarming more complex and can undermine international spectrum harmonisation.

2. Exclusive licensing has been central to the success of mobile services and must continue. Spectrum sharing decisions should be mindful of the need for additional exclusive 4G and 5G licensed spectrum.

Exclusive licences have provided the certainty of access to spectrum, a critical component of mobile networks, to support huge investments in high quality, wide area mobile networks worldwide. This exclusive licensing approach has been central to connecting well over 5 billion people to mobile services worldwide. Mobile technologies continue to evolve to make the most efficient use of licensed spectrum to deliver better services to more people in more places.

Spectrum sharing presents a complementary approach to exclusive licensing that, when well planned, could help gain access to more spectrum for future mobile services. However, sharing does not replace the need to clear bands and assign them for mobile use – and is not always a better option. For example, clearing some UHF TV spectrum and exclusively licensing it for 4G services has connected far more people to affordable broadband than the use of TV whitespaces.

Great care should be taken to ensure that spectrum sharing approaches do not unnecessarily limit access to sufficient amounts of exclusive licensed spectrum for mobile services where this is possible. Mobile broadband services are dependent on wide frequency bands to offer high speeds and when little spectrum is made available then spectrum prices can also be artificially inflated which in turn harms consumers⁵. Sharing should only be implemented following a Regulatory Impact Assessment (RIA) to ensure the costs do not outweigh the socioeconomic benefits of traditional licensing approaches for consumers and the wider economy.

5. See the GSMA's positions on 5G spectrum and spectrum pricing for more information

3. Sharing will only be useful for operators if the proposed band is harmonised for mobile use and is available and usable in sufficient quantities in areas and at times where needed

Shared spectrum is only viable for mobile operators if the band is well harmonised for mobile services so that equipment is affordable and supports roaming. The spectrum should also be available in sufficient quantities to support the desired services (e.g. wide bands for 5G); in the areas that require it (e.g. often this will be busy urban hotspots); and at the right times (e.g. cells sites can be especially busy at certain times). Shared spectrum also needs to be usable in practical and commercially viable deployments. For example, the conditions of use should not unduly constrain usage of the band (e.g. power emission levels, indoor restriction, exclusion zones etc).

4. Operators favour a simple sharing framework that is investment-friendly and supports reliable, high quality mobile services

Mobile operators typically favour frameworks with simple, stable, predictable sharing conditions and clear rules that provide licensed-based access which:

- Provides guaranteed access to sufficient spectrum to support 4G and 5G services;

- Provides protection from interference including clear and enforceable rules;
- Covers sufficiently long-time periods (e.g. a minimum of 20 year licence duration with an expectation of renewal) to justify long-term network investment;
- Covers reasonably wide areas to facilitate rollouts because small licence areas risk patchy coverage and create challenges such as synchronising and coordinating networks to avoid interference;
- Contains technical conditions (e.g. power emission levels) that maximise the usefulness of the band for various deployments (e.g. wide area macrocells, indoor and outdoor hotspots, fixed wireless and potentially backhaul); and
- Minimises administrative and technical burdens, by closely replicating existing licensing procedures so the approach can easily be integrated with minimal additional effort and cost

Complex sharing frameworks, such as those with three tiers, are likely to be less desirable to mobile operators. They may limit the amount of spectrum for prioritised licensed access – which may make a band unsuitable for 5G (see position 3). They can also introduce conditions (e.g. relatively low power limits, small licence areas and short licences) that restrict deployment options (e.g. for macrocells or fixed wireless access) and discourage significant long-term wide-area network investment. In this way, complex approaches may negatively impact public access to cutting-edge mobile broadband services.



5. Mobile operators should be permitted to voluntarily share spectrum to support faster services, improve coverage and drive innovation

Mobile operators often have voluntary infrastructure sharing arrangements to help lower the cost of extending and densifying their networks. Regulators can enable faster speeds for consumers through wider channels sizes and/or improved carrier aggregation by permitting voluntary spectrum sharing.

Spectrum sharing can be especially valuable in rural areas as operators can create wider channels, rather than relying on individual narrow blocks of spectrum in the sub-1GHz 'coverage' bands. The approach can also support superfast 5G services operating in millimetre bands as coverage areas will often be small so operators can use each other's spectrum where the other is not using it. This can include the concept of 'club licensing' where operators buy access rights to a portion of spectrum, but can also use another operator's spectrum where it is unused and/or pool spectrum in shared networks (e.g. in shopping centres etc.).

Club licensing is especially attractive in situations when spectrum is scarce by allowing operators to access wider channels than would otherwise be possible. However, club licensing is a new model and therefore needs careful management to ensure each operator's rights of use are respected, to accurately establish accessibility and prevent interference etc. It also needs to be clear at the outset who has access to the licences, under what terms and how to resolve disagreements or interference. It should also be noted that although it can mitigate spectrum scarcity issues, it cannot overcome them. If there is insufficient total spectrum available to meet demand in an area then services are likely to suffer.

Operators should also be permitted to voluntarily establish commercial agreements to lease spectrum to other types of operators in areas where it is not currently being used. For example, this could include leasing spectrum to wireless internet service providers in rural areas or to support localised private networks for use by industry verticals. However, it should be noted that sharing may not always be possible in areas where mobile spectrum is currently unused.

For example, mobile operators may already be planning to use the spectrum in future as part of improvements to network coverage, including to meet licence obligations. Also, sharing may be impossible without causing interference to existing mobile services in nearby areas. It is also notable that new cellular technologies (e.g. beam forming) are only starting to appear and this may help support the use of mobile spectrum in more areas. Therefore, approaches which undermine operators' certainty of access to spectrum, such as mandating that existing licensed spectrum is shared in ways that create an uncertain business environment, risk jeopardising long-term, wide area network investment.

6. Sharing can play a role in the 5G era but poor implementation risks harming its potential

Mobile operators will need a core foundation of exclusively licensed 5G spectrum, including in the millimetre wave bands, to support wide area services, heavy network investment and good quality of service. However, shared spectrum can play an important complementary role if the band and sharing framework is carefully designed and opens up spectrum that would otherwise be unavailable.⁶

If spectrum sharing means an insufficient amount of licensed spectrum is available to mobile operators (see position 2) where and when they need it then sharing may limit, or eliminate, the potential for 5G in the band. More widely, sharing approaches should not unnecessarily limit access to sufficient amounts of exclusive licensed spectrum for 5G.

The GSMA recommends at least 80-100 MHz of contiguous spectrum is needed per operator in initial 5G mid-bands (e.g. 3.5 GHz) and 800 MHz per operator in initial millimetre wave (mmWave) bands (e.g. 26/28 GHz). Significant subsequent awards in both ranges should be planned in future to help 5G scale over time.

Mobile operators also require flexibility in deployment to support urban and rural services, indoor and outdoor use, small cells and macrocells, and to serve fixed wireless and potentially in-band backhaul use cases. 5G services will suffer if the sharing framework impedes deployments, especially by imposing power restrictions which make wide area 5G rollouts more challenging.⁷ It is therefore vital that regulators carefully consult the mobile industry to ensure that sharing schemes are best designed to support optimum 5G services.



6. See the GSMA's 5G spectrum position paper for more information

7. For example, the CBRS approach in the United States is unlikely to be capable of supporting high-speed 5G services as there is only a limited amount of spectrum available for licensed access (i.e. PALS)

7. Regulators need to help incentivise incumbents in attractive bands to share

Spectrum sharing will not succeed unless incumbent users are encouraged to share their spectrum in areas where it is underused and there is clear, and commercially viable, demand from other users. One key incentive for efficient use is to charge fair but meaningful fees for spectrum access. Mobile operators routinely pay significant financial sums for mobile spectrum but other users often pay significantly less, if anything, and as a result do not have the same incentive for efficient use. One approach for calculating fees for these users is Administrative Incentive Pricing (AIP). There are numerous ways this can be calculated and it could be possible to include a sharing component that is increased or reduced based on the incumbent making spectrum available to share on fair and reasonable terms.

8. Regulators need to carefully balance the current and future requirements of incumbents and sharers

The success of spectrum management has been contingent on providing reliable, guaranteed access to spectrum users to allow long-term investment and enable technology evolution. It is vital that sharing does not undermine this success. Regulators should properly consult stakeholders – both incumbents and potential new users - to ensure that proposals are technically and commercially feasible and attractive. Sharing proposals, and the subsequent responses to consultations, should be evidence-based, consider the evolution of technology and services and have comprehensive business cases. Clear objectives should be outlined at the outset to ensure the right band and sharing framework are selected.





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