Reliable and high-quality mobile services are vital for consumers and businesses and deliver major socio-economic benefits. They rely on adequate amounts of affordable spectrum to support faster broadband speeds and rapidly growing data demand. Given there is a limited supply of mobile spectrum, it is vital that governments and regulators prioritise spectrum awards to licensees who will use it most efficiently to generate the highest social and economic value.

Effective spectrum licensing can be a critical regulatory tool at the disposal of administrations to meet the rapid rise in demand and enhance the quality and range of mobile services offered to citizens. Different aspects of licensing, including spectrum pricing, the amount of spectrum made available and the terms and conditions governing its use, are key determinants of whether the industry will have sufficient capacity to meet this demand while maintaining the quality and affordability of services.

Other policies revolve around spectrum and its capability of opening doors to new technologies and enhanced user experience, such as global harmonisation via regional groups and WRC decisions, in conjunction with reasonable pricing, a well-structured roadmap, an incentivised coverage plan and well-founded technical conditions, including synchronisation frame structures.

## General licensing considerations

**There are two main approaches used for assigning the rights to use a particular spectrum band**:

Auctions can deliver strong social benefits as long as they are properly designed. Auctions are a proven means of awarding spectrum to those who are most likely to put it to the best use. However, poor auction design can lead to spectrum being assigned inefficiently or in a way that undermines competition. Failures are frequently due to the design of the auction or wider regulatory issues. These include high reserve prices, non-carefully considered obligations, artificial spectrum scarcity and auction rules which prevent price discovery or flexible bidding amongst others.

The authority can also assign the spectrum to the candidate that is considered to best meet a number of criterias (direct assignment or beauty contest) such as financial resources, industry experience, technology and rollout plans and, in some cases, price offers. Those may be suitable in cases where there is less demand, an authority wishes to consider multiple objectives, or where an authority wishes to avoid high licence costs which could impact network investment.

There is no single best assignment approach but rather a need to assess the merits of each on a case-by-case basis. Whether an auction or administrative assignment is adopted, the implementation of the approach is important, considering the below:

- **Predictable and timely spectrum licensing encourages long-term network investment**. Predictability can be supported when governments publish (i) national broadband plans setting out targets for widespread broadband and (ii) a spectrum roadmap providing a schedule for forthcoming spectrum releases to meet the government's plan as well as other demands on spectrum. In particular, a spectrum roadmap is an important means of ensuring sufficient spectrum to meet the requirements driven by changing technology and demand. Information on future spectrum is critical for businesses to prepare investment plans.

- **A presumption of licence renewal encourages long-term network investment**. Uncertainty over future rights to use the spectrum may lead to operators ceasing investment and may also harm service continuity or quality of service to users. A decision not to automatically renew a licence should only be made where there is a reasonable prospect that the benefits from reassigning spectrum would exceed the costs. Timely renewal decisions (ideally 3-5 years in advance of licence expiry) can facilitate network investment and enable planning.
- **Spectrum licences should be technology and service neutral**. This enables spectrum to be used efficiently by mobile operators rather than tied to declining technologies. The most important development is the ability to 'gracefully refarm' bands so they are used simultaneously for several technologies – including 4G and 5G. This allows for the introduction of newer technologies while, at the same time, supporting legacy users. For regulators, this means that refarming won't leave legacy users unserved. Introduction of charges for change of use should be avoided and regulatory updates should be taken immediately.
- **Licence duration should be at least 20 years to incentivise network investment.** The longer the duration of a licence, the greater the certainty provided for operators to undertake long-term investments in rolling out networks and in deploying new services. Investors would be reluctant to undertake investments if the licence runs for a shorter period than the expected payback period and if there is uncertainty over whether the licence will be renewed again.
- **Competition can be supported by licensing as much spectrum as possible and limiting charges and other barriers to services, including set-asides**. Making available additional spectrum in capacity and coverage bands is key to supporting better quality, widespread, affordable mobile broadband services while setting spectrum aside may create artificial spectrum scarcity and limit the reach of the services by limiting to a separate industry, while MNOs have the expertise to realise those new applications, also via sharing and trading.
- **Spectrum harmonisation is needed**. Spectrum harmonisation refers to the uniform allocation of radio frequency bands and the adoption of common channel arrangements across entire regions — not just individual countries. Uniform allocation comes with many advantages. It minimises radio interference along borders, facilitates international roaming and reduces the cost of mobile devices. Without spectrum harmonisation, it is unlikely that mobile would have become the success it is today.

## Spectrum pricing impact

Maximising revenues from spectrum awards should not be a measure of success, as seeking to maximise state revenues from spectrum can have negative socio-economic costs. Competition in communications markets can be undermined and there is a risk of higher retail prices and lower network investment. Recent studies demonstrated higher spectrum prices have played a significant role in slowing the rollout of next-generation mobile networks, had a significant effect in reducing the network quality experienced by consumer, and are associated with higher consumer prices.

The primary objective should be to assign spectrum to those users that will be able to extract most value from this finite resource for the benefit of society. Licensing authorities should set reserve prices conservatively, also discounting obligation costs, to allow the market to determine a fair price and to reduce the risk of leaving spectrum unassigned. Where spectrum is auctioned, ongoing charges should be limited to recovering the cost of spectrum management, including for renewal.

## Enhancing coverage via investment incentives

Increasing access to the internet is one of the great challenges of our time. Currently, around half of the world's population is not connected. This restricts access to jobs, education, healthcare and, more widely, the information needed to fully participate in social, political and economic life.

Spectrum licences have traditionally contained a range of non-price terms and conditions which go beyond those necessary to manage interference between users. Providing for flexible spectrum use by limiting licence conditions enables spectrum be redeployed at a time of rapid technology and market changes and brings down the cost of service provision. The conditions imposed in licences – including coverage and other quality of service obligations – should always be carefully considered. Conditions that are unrelated to avoiding interference should be kept to a minimum or removed entirely. Imposing onerous and inflexible conditions that may be impractical or impossible to meet can jeopardise investments and incentivise consumer price rises. Instead, regulators should engage in a dialogue with licence holders to arrive at more practical solutions, in order to possibly set coverage obligations that are impactful, but also commercially and technically feasible. There are examples where obligations can be an efficient tool when done together with measures to lower the cost.

To make rural network operations sustainable, real partnership is required between the government and the private sector, with clear objectives for better coverage. The need to reduce policy and regulatory barriers, create pro-investment environments, and examine new sources of financing and shared deployment models are just some of the options that can have lasting impact.

- Assignment of sufficient amounts of mobile spectrum to operators in a timely manner - including coverage bands;
- Accessible spectrum, including trade-offs between reduced spectrum fees and obligations;
- Avoidance of licence terms and conditions that discourage network investment, innovation and increase costs;
- Reduced mobile-specific taxes and fees, to improve rollout and internet affordability, and, ultimately, service uptake;
- Provision of non-discriminatory and timely access to public infrastructure;
- Simplified and streamlined planning approval processes to speed-up deployments;
- Competition policy which supports investment in high quality mobile networks;
- Voluntary infrastructure sharing; and
- State intervention only when all market-driven mechanisms have been exhausted.

## 5G spectrum and the future of IMT

5G supports significantly faster mobile broadband speeds and significantly improved latency. The technology will also help enable the full potential of the Internet of Things, from virtual reality and autonomous cars, to the industrial internet and smart cities, 5G will be at the heart of the future of communications. Today's most popular mobile applications also benefit from 5G by ensuring continued growth and quality.

Most notably, the speed, reach and quality of 5G services will be heavily dependent on governments and regulator support to provide timely access to the right amount and type of spectrum, and under the right conditions. Therefore, governments, regulators and the mobile industry should cooperate to make this next-generation network technology a success via a roadmap that considers:

- 5G needs a significant amount of new harmonised mobile spectrum so defragmenting and clearing prime bands should be prioritised across low, mid and high ranges to deliver widespread coverage and support all use cases. Regulators should aim to make available a minimum of 80-100 MHz of contiguous spectrum per operator in prime mid-bands (e.g. 3.5 GHz) and around 1 GHz per operator in high-bands (e.g. mmWave spectrum);
- Exclusively national interference-free licensed spectrum should remain the core 5G spectrum management approach. Spectrum sharing and unlicensed bands can play a complementary role;
- Setting spectrum aside for verticals in priority 5G bands (i.e. 3.5/26/28 GHz) could jeopardise the success of public 5G services and may waste spectrum. Sharing approaches like leasing are better options where verticals require access to spectrum;
- Especially for 5G, that will require a higher amount of investment, Governments and regulators should avoid inflating 5G spectrum prices as this may limit network investment and drive the cost of services up. This includes excessive reserve prices or any type of annual fees, limiting spectrum supply, excessive obligations and poor auction design; and
- Regulators must consult 5G stakeholders to ensure spectrum awards and licensing approaches consider technical and commercial deployment plans.

## The role of TDD synchronisation

To increase flexibility as well as make spectrum usage more efficient, Time Division Duplex (TDD) is becoming increasingly common and important. TDD uses the same frequency for each duplex direction, with a frame that includes different time periods and slots for uplink or downlink communications. By changing the duration of these, network performance can be tailored to meet different needs and help provide the best possible experience.

However, for this to work all TDD networks, either LTE or 5G, operating in the same frequency range and within the same area have to be synchronised. Base stations need to transmit at the same fixed time periods and all devices should only transmit in dedicated time periods. Failure to do so creates interference, which has a major impact on performance as well as coverage.

Current recommendations focus on the way in which the network is configured with respect to the timing of Download (D), Special slot (S) and Upload (U) elements in each period of time (the frame). The frame format the GSMA supports is delineated as DDDSU. This approach provides a good compromise between download and upload speeds with a low latency, for current requirements.

---

General Licencing: https://www.gsma.com/spectrum/resources/learn-mobile-spectrum/
Set-asides: https://www.gsma.com/spectrum/resources/mobile-networks-for-verticals/
Spectrum Pricing: https://www.gsma.com/spectrum/resources/effective-spectrum-pricing/
Coverage Expansion: https://www.gsma.com/expanding-mobile-coverage/
Spectrum for 5G: https://www.gsma.com/spectrum/resources/5g-spectrum-positions/
TDD Synchronisation: https://www.gsma.com/spectrum/resources/3-5-ghz-5g-tdd-synchronisation/