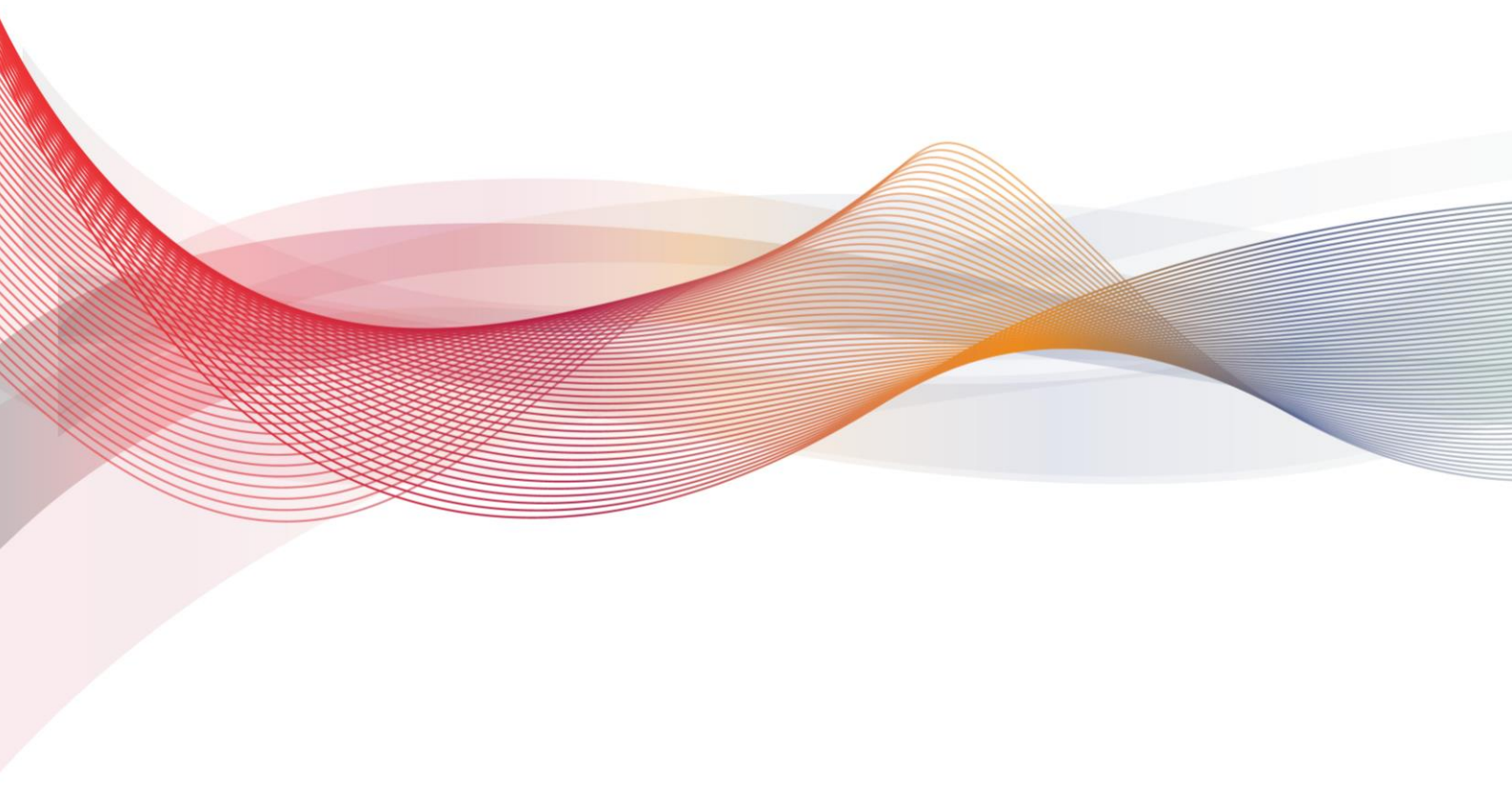
GSMA Public Policy Position

5G Spectrum

June 2016



Summary

Context

The GSMA regards '5G' as a currently undefined set of requirements for future mobile networks that could dramatically improve the delivery of mobile services and support a variety of new applications. The mobile industry, academic institutions and national governments are currently actively investigating what technologies could be used in 5G networks and the types of applications these could and should support. The speed and reach of 5G services will be heavily dependent on access to the right amount and type of spectrum.

Position Statements

1. Given that the definition of 5G, and a clear agreement on the technologies involved and likely coverage requirements, is still under development, it is not currently possible to accurately predict the spectrum requirements.

2. It is important that 5G spectrum discussions begin in earnest because of the timeframes involved in making new spectrum available.

3. New spectrum will be required for 5G services in order to deliver enhanced capabilities including new usage scenarios.

4. To ensure 5G services provide good coverage that extends beyond small urban hotspots, it will be important to ensure that there is sufficient spectrum available for this important purpose (i.e. sub-1 GHz).

5. Progressive refarming of existing mobile bands should be both possible and permitted to accommodate future 5G use and to maximise spectrum efficiency.

6. The GSMA's position is that three key frequency ranges are currently worthy of consideration for different 5G deployment scenarios: Sub-1 GHz, 1-6 GHz and above 6 GHz.

7. Exclusive licensing remains the principal and preferred regime for managing mobile broadband spectrum in order to guarantee quality of service and network investment. However, the licensing regime in higher frequency bands, such as above 6 GHz, could be more varied than in previous mobile technology generations to suit more flexible sharing arrangements.

Background

The continual drive to overcome technological barriers has been central to the success of the mobile industry. The GSMA believes that this focus on innovation is essential and fully supports research into future technologies, such as 5G. However, the focus on 5G must not distract the mobile industry and governments from the nearer-term needs of consumers.

The clear majority of the world's mobile connections are still 2G (i.e. 63%) leaving around a third on 3G (32%) and only 5% on 4G. Given the transformative socioeconomic impact of mobile broadband, there is an urgent need to dramatically widen access to the latest networks. Central to this endeavour is licensing additional spectrum especially in low frequency 'coverage' bands such as 700 MHz and 800 MHz.

Ahead of 5G deployments, mobile operators are expected to invest $1.7 trillion in improving mobile broadband access from 2014-2020[1] - much of which will be in cutting edge 4G networks. Over this timeframe the mobile industry, academic institutions and governments will invest significant time and money on 5G research and development.

The key initial focus needs to be on achieving consensus on what 5G is and what unique new applications it should support. There are currently two broad visions for 5G (that can overlap):

- **The service-level view:** Aimed at providing extremely reliable, near universal, high speed mobile broadband services that can cost-effectively support rapidly growing data traffic, especially from audio-visual content. This view would also include better support for the Internet of Things.
- **The traditional generational view**: Aimed at achieving significantly higher data rates (e.g. above 1Gbps to an individual user) and lower latency. This presents significant technical and deployment challenges and currently there are few proven applications which warrant these ambitious requirements (e.g. virtual reality, the tactile internet and autonomous/connected cars).

Given that the outcome of these discussions will have a major impact on spectrum requirements, it is essential that all participants in the 5G debate consider the amount of spectrum that may be required under different scenarios, in which bands and under what licensing regime.

Position Rationale

Given that the definition of 5G, and a clear agreement on the technologies involved and likely coverage requirements, is still under development, it is not currently possible to accurately predict the spectrum requirements: The expected data rates for high speed 5G services, the level of coverage expected, and the requirements surrounding support for low-power internet of Things applications, among other areas, will all have a major impact on spectrum requirements. Until these can be better defined, it will be difficult to define the spectrum requirements including what additional international spectrum allocations may be necessary.

It is important that 5G spectrum discussions begin in earnest because of the timeframes involved in making new spectrum available: Before optimum 5G services can be launched, new IMT spectrum must first be identified for mobile broadband at the ITU's World Radiocommunication Conference (WRC), equipment then needs to be built, existing users may need to be moved and the terms of spectrum licences agreed and then auctioned. It may be possible to shorten the timeframes involved by refarming existing mobile spectrum, or new bands which were agreed at the WRC in 2015, but this may not provide sufficient spectrum to support all the possible 5G usage scenarios and performance requirements on its own.

Work on 5G spectrum must not harm the ongoing process towards identifying additional spectrum for IMT at WRC-15: The focus on 5G must not distract the mobile industry and governments from the nearer-term needs of consumers. Global mobile data traffic increased 45-fold between 2008 and 2013. Unless more spectrum is made available for today's networks then they will struggle to cope with rising traffic before 5G networks and devices become widely available.

[1] Source: GSMA paper, 'Understanding 5G: Perspectives on Future Technological Advancements in Mobile'

Additional new spectrum will be required for 5G services in order to deliver enhanced capabilities including new usage scenarios: Considerable research is currently being conducted into the use of much higher frequency bands for 5G than are used for existing mobile services. These range from 6 GHz to as high as 300 GHz, according to some reports, which are capable of supporting the very wide bandwidths that would be required for the fastest possible 5G data rates. However, due to their radio propagation characteristics, these bands are likely to be heavily reliant on small cells and could have limited practical usage potential beyond urban areas.

To ensure 5G services provide good coverage, that extends beyond small urban hotspots, it will be important to ensure that the right spectrum is available (i.e. sub-1 GHz): Significant cooperation between the mobile industry, international standards-setting bodies and national and regional regulatory bodies/governments is required to agree on the likely requirements for 5G coverage levels. For example, it is possible that if extremely fast data speeds form the basis of the 5G standard, these may be extremely difficult to deliver outside of urban areas without significant amounts of new low frequency spectrum.

Progressive refarming of existing mobile bands should be possible and permitted to accommodate future 5G services and ensure spectrum is used as efficiently as possible: The success of refarming is best illustrated by the 1800 MHz band which is now the most common LTE band worldwide and was previously used for 2G services. This refarming is best accomplished by ensuring that spectrum licences are issued on a technology neutral basis. The possibility of refarming would help operators to ensure 5G services roll out swiftly and provide a reasonable mixture of coverage and capacity – although these bands may not be able to support the very highest potential 5G data rates.

The GSMA's position is that three key frequency ranges are currently worthy of consideration for different 5G deployment scenarios:

1. **Sub-1 GHz:** This ideal coverage band could provide a very useful means of extending a superior 5G user experience into rural areas and deep inside buildings. While the band could not support extremely wide bandwidths and therefore enable the fastest possible data rates, it may help prevent a new digital divide by ensuring the improved experience reaches more people in both developed, and especially developing, markets.
2. **1-6 GHz:** There are numerous existing mobile bands between 1 GHz-2.6 GHz, and when 5G technology is ready to deploy there may be others between 2.6 GHz and 4 GHz. However, although these bands offer a reasonable mixture of coverage and capacity they are unlikely to be able to support the highest potential 5G data rates without carrier aggregation.
3. **Above 6 GHz:** This spectrum could support very wide channel sizes and therefore extremely fast data rates, and massive additional mobile network capacity, making it fertile territory for 5G research. This spectrum must be identified at the WRC in 2019, which will require that governments work together extensively to agree a common set of harmonised new bands. However, heavy reliance on these bands without complimentary lower frequency spectrum may mean 5G services are limited to small urban areas and inside buildings as its radio propagation qualities would favour small cell sizes.

The licensing regime for 5G could be more varied so could suit different opportunities in higher frequency bands, targeting above 6GHz: Exclusive licensing remains the principal and preferred regime for managing lower frequency 5G spectrum to guarantee quality of service and network investment. In case 5G operates also in higher frequency bands, this may introduce the possibility of employing different licensing regimes if needed to support specific scenarios, e.g. when using small cells, assuming that this scenario, at high frequencies, could be less susceptible to interference. Anyway, such potential different arrangements will need to support a level of predictability (i.e. quality of service guarantees) in order to provide mobile subscribers with a positive experience while also incentivising network investment by mobile operators.

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