GSMA Intelligence

The economics of mmWave 5G

An assessment of total cost of ownership in the period to 2025

Executive summary

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Published January 2021

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Executive summary

5G is now a commercial reality. Despite the Covid-19 pandemic, adoption of 5G will reach 200 million connections by the end of 2020; this is forecast to grow to more than 1 billion connections by the end of 2023 and nearly 2 billion globally by the end of 2025. 5G can deliver 10× faster data rates and 100× more capacity, at latencies up to 10× shorter, compared to 4G networks, allowing it to handle growing mobile data traffic. The 5G opportunity for enterprise digital transformation is massive and includes industrial applications, automotive, robotics and healthcare, to cite a few examples. But 5G will also have a profound impact on consumers. It will enable higher-quality services, such as in video streaming and video conferencing, the possibility of fast home broadband services through fixed wireless access (FWA), and new consumer and business services such as edge computing and augmented and virtual reality (AR/VR).

In this study, we evaluate the cost effectiveness of deploying millimetre wave (mmWave) 5G solutions in six different scenarios, including dense urban areas, FWA and indoor deployments. The results have clear implications for all actors in the mobile ecosystem. Operators that underestimate the role of mmWave in the short term run the risk of finding themselves at a disadvantage to competitors when offering 5G services. Governments looking to capitalise on 5G as a catalyst of economic growth need to make clear plans for the assignment of mmWave bands to mobile services. As broader economic benefits are realised and mmWave 5G solutions achieve greater scale, a wider choice of consumer devices and equipment is poised to further reduce deployment costs, increase the choice of affordable devices available and facilitate greater adoption.

Most 5G launches globally so far have relied on mid-band spectrum, with very few exceptions. But as adoption increases and more consumers and diverse services migrate to 5G networks, these will need spectrum across low (e.g. 700 MHz), mid (e.g. 3.5 GHz) and high (e.g. mmWave) bands in order to deliver enough capacity to support the full 5G experience. In particular, due to the massive spectral bandwidth available, mmWave bands are key to meeting high traffic demand and at the same time maintaining the performance and quality requirements of 5G services. So far, mobile operator bids in auctions for mmWave bands have not been as high as for lower frequency bands. This means that mmWave bands are at present generally cheaper in $/MHz/pop terms.

Despite its potential, the utilisation of mmWave in mobile has had to overcome major technical challenges: mmWave signals travel relatively short distances compared to signals of lower-frequency bands; can be susceptible to attenuation from trees and other obstacles; and have difficulties in penetrating concrete building walls (often necessary to reach indoors). However, the continued growth of mobile data traffic plays to the strengths of mmWave bands, as mmWave can accommodate more capacity and bandwidth than any other band.

While commercial mmWave 5G networks have already been launched in three countries as of the end of Q3 2020 (US, Japan and South Africa),[1] mmWave 5G solutions are poised to achieve more scale.

Two important signs of market readiness are as follows:

- **mmWave spectrum is now becoming more widely available.** Countries such as the US, Italy, Finland, Japan and South Korea have already released mmWave spectrum for 5G, and a number of other countries are about to follow suit. This is particularly remarkable considering that mmWave spectrum was only internationally allocated to mobile services at the recent World Radiocommunication Conference in November 2019 (WRC-19).
- **A sufficiently wide choice of consumer devices and equipment.** Reliable network solutions are already available today, with almost all tier-1 and tier-2 equipment vendors offering mmWave equipment products as part of their portfolio of solutions to mobile operators. Consumer devices in particular have recently seen remarkable growth, with the launch of the new mmWave-capable iPhone 12 series in 2020 giving a boost to the wider adoption of the technology. While only a few mmWave handsets and FWA customer premise equipment units (CPEs) were available in 2019, consumers can expect more than 100 mmWave 5G handsets and more than 50 FWA CPEs to be available in 2021.

As 5G rollouts and adoption progress quickly, and with the mmWave ecosystem showing signs of readiness, the main question that the mobile industry faces today is where and when mmWave solutions can be cost effective. In this report, we focus on the critical question of its deployment costs.

We identify a range of scenarios where the high throughput and network capacity of mmWave, both downlink and uplink, can lead to cost-effective targeted deployments in the period between now and 2025. We then explore and dissect the conditions under which these deployments could be cost effective. In particular, we evaluate the cost effectiveness of deploying mmWave 5G solutions in six different scenarios:

- Two scenarios consider the deployment of outdoor sites in a hypothetical dense urban area in Greater China and Europe.
- Three scenarios consider the deployment of FWA in a hypothetical urban area in China, suburban area in Europe and a rural town in the US.
- One scenario considers the deployment in a hypothetical enterprise office space.

1 Since then, a mmWave 5G network has been launched in Italy and a launch has been announced in Singapore.

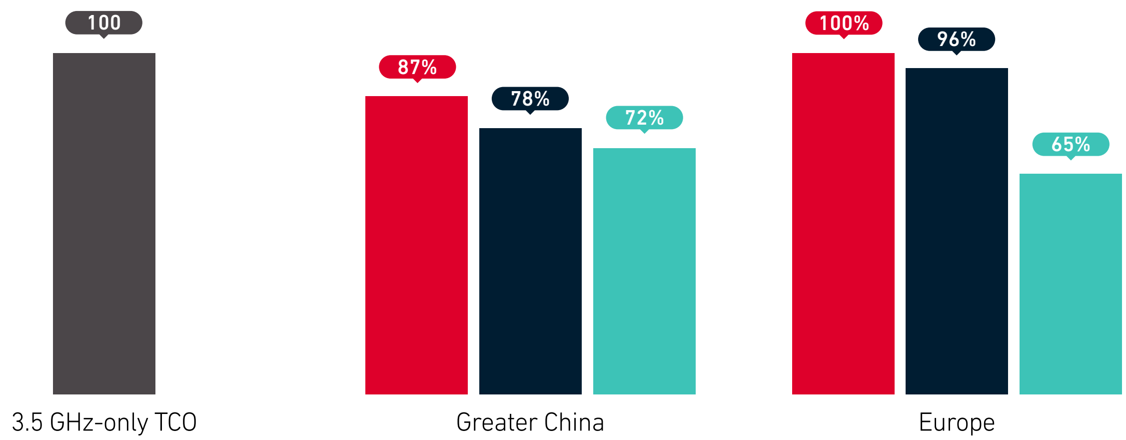
The modelling exercise shows the following:

- **Dense urban scenarios (Greater China and Europe):** We find that a mixed 3.5 GHz and mmWave network can be cost effective in delivering at least 100 Mbps download speeds for 5G services in this period, when compared to a 3.5 GHz-only network. As soon as mmWave spectrum becomes available in Greater China and large-scale deployments take place, we estimate that deploying mmWave solutions to deliver this additional capacity layer could bring cost efficiencies, compared to the use of only 3.5 GHz in central scenarios. This is assuming the percentage of connected users is above 5% at the peak demand hour and that 800 MHz of mmWave and 100 MHz of 3.5 GHz spectrum are available per operator. In Europe, assuming that 400 MHz of mmWave and 80 MHz of 3.5 GHz spectrum are available per operator, we estimate that a mixed 3.5 GHz and mmWave 5G solution could be cost effective if the percentage of connected users at peak in the area is 10% or above in central scenarios.

Figure i

Net present value (NPV) of total cost of ownership (TCO) for a 3.5 GHz plus mmWave 5G network

Base 100: 3.5 GHz-only TCO



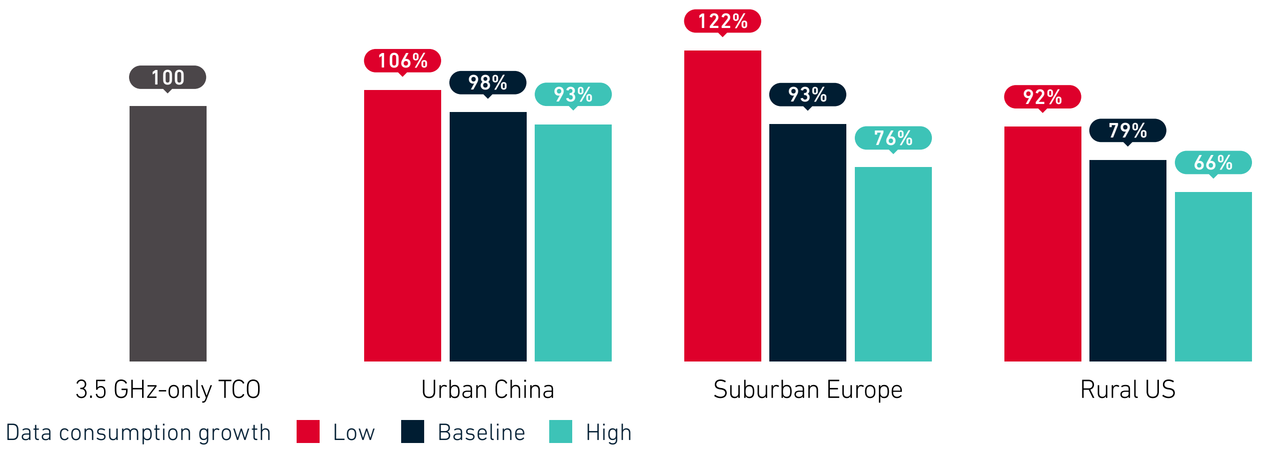
Source: GSMA Intelligence

- **FWA scenarios:** Deploying a 5G FWA network using mmWave spectrum can also be cost effective in this period when compared to a 3.5 GHz 5G FWA network. The cost effectiveness of mmWave networks is sensitive to assumptions on traffic demand and the ratio of uplink to downlink traffic. Under central assumptions, mmWave FWA deployments in urban China, suburban Europe and a rural US town are a cost-effective strategy if 5G FWA is able to capture a good percentage of the residential broadband market demand (see Figure ii). The results are particularly sensitive to overall traffic demand and the share of downlink and uplink in total traffic at the peak demand hour. For example, fast growth in the share of uplink in total traffic during the period would result in a material increase in the cost savings from deploying a mmWave-only FWA network when compared to a 3.5 GHz-only FWA network. An alternative scenario where mmWave is used as a capacity layer alongside a 3.5 GHz coverage layer is also a possible deployment strategy for 5G FWA. Our sensitivity analysis shows that the cost savings could be greater in this case: 16% in urban China, 15% in suburban Europe and 27% in a rural US town for the baseline sensitivity case, compared to a 3.5 GHz-only network (see Figure 12). The validity of the assumptions underlying this sensitivity will vary for different cases though, as the results are only valid where capacity gaps emerge in a few localised spots in the area.

Figure ii

NPV of TCO for a mmWave FWA network

Base 100: 3.5 GHz-only TCO



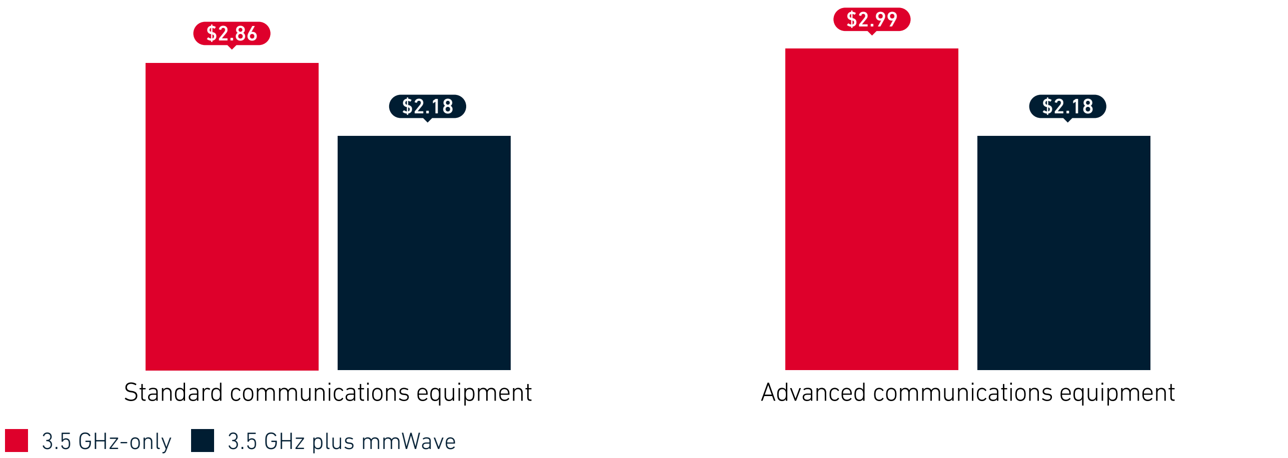
Source: GSMA Intelligence

- **Indoor office scenario:** On central assumptions a mmWave indoor 5G network is cost effective and generates cost savings for operators between 5% and 20%. We also find that when a significant share of data traffic from devices is supported by indoor 5G services, a mmWave network could generate cost savings of up to 54%. The precise value in the range depends on the share of devices concurrently active and on whether and to what extent there is the need to provide connectivity to next-generation video communications equipment.

Figure iii

Cost per square metre in an indoor office space scenario

TCO per square metre (USD)



Source: GSMA Intelligence

While our TCO analysis looks at the period to 2025, we expect mmWave 5G deployments to further accelerate in the second half of the decade as equipment and devices with higher performance and lower costs proliferate. By 2030, we estimate that 5G will generate an annual boost to global GDP of 0.6%, adding approximately $600 billion annually to the global economy,[2] with mmWave playing an increasingly important role in the delivery of these benefits. mmWave solutions will therefore be key to 5G deployments, both in the short and longer term.

2 Mobile Technology and Economic Growth, GSMA, 2020

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