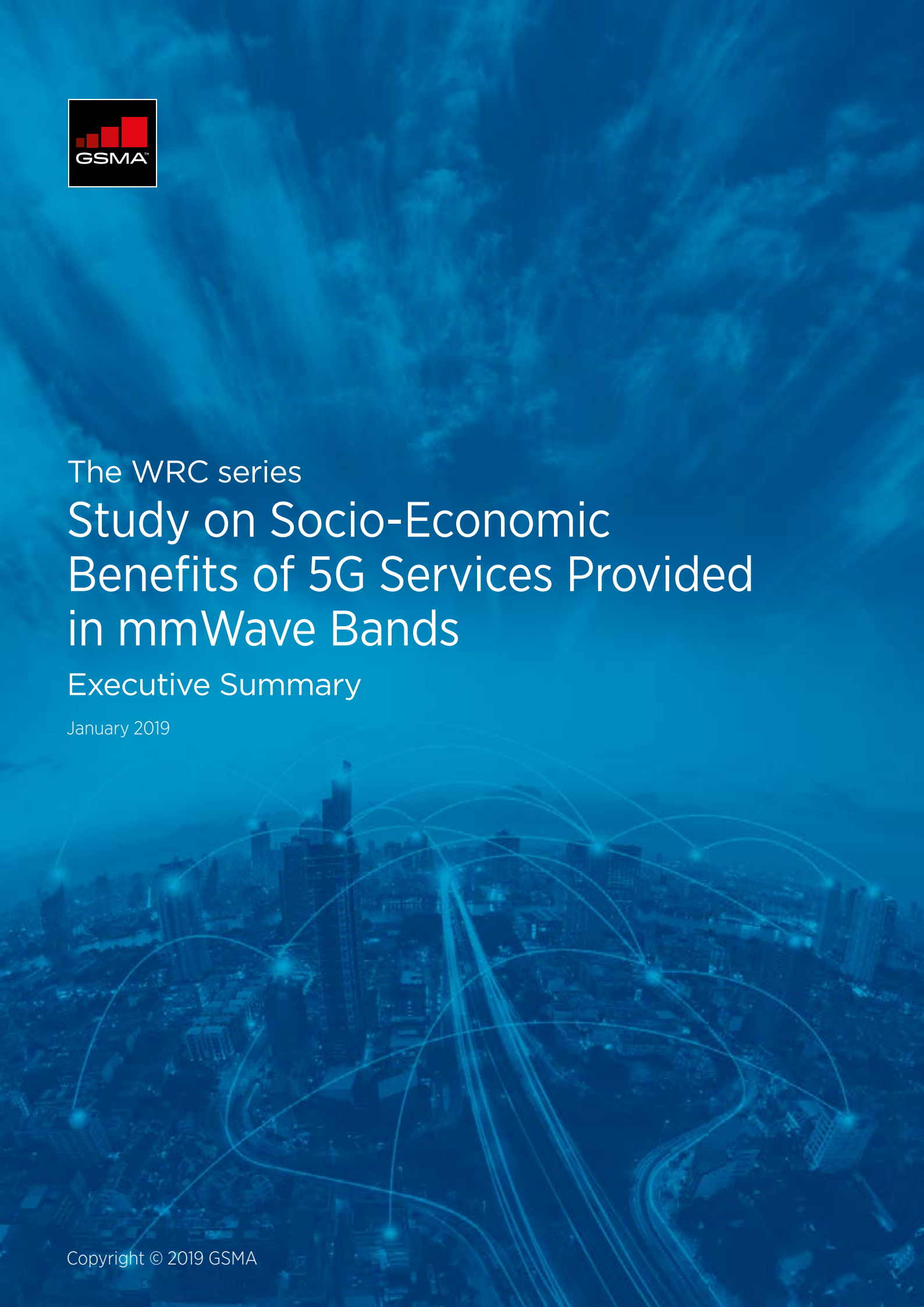

The WRC series

Study on Socio-Economic Benefits of 5G Services Provided in mmWave Bands

Executive Summary

January 2019

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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Contents

Executive Summary

Mobile networks are an essential part of our everyday lives. They increase our working productivity, represent a central means of social interchange for our friends and family, assist in the management of our homes and businesses, enable financial transactions, and even facilitate how we manage our healthcare.

The global impact of 4G brought about increases in mobile usage and network performance. 5G will build on this momentum, bringing substantial network improvements, including higher connection speeds, mobility and capacity, as well as low-latency capabilities. In doing so, it enables new use cases and applications that will positively impact different industry sectors.

Spectrum plays a critical role in realising the full extent of these new capabilities. Thus, 5G's full socio-economic impact is dependent on access to a variety of spectrum resources, including millimetre wave (mmWave) bands between 24 GHz and 86 GHz. The mmWave spectrum allows for the increases in bandwidth and capacity that numerous 5G applications require. It will play a key role in meeting the demand for many enhanced mobile data services as well as new wireless broadband use cases such as remote object manipulation, industrial automation, virtual and augmented reality and next-generation connectivity for vehicles. These use cases will continue to increase the impact that mobile services have on societies and economies.

While the socio-economic benefits of mobile services and broadband connectivity have been studied for some time, quantifying the impact of high-capacity mmWave spectrum represents a new opportunity. To date, some of the mmWave bands have been made available for mobile services in some countries. Bands between 24 and 86 GHz are also under evaluation and will be considered for identification for International Mobile Telecommunications (IMT) at the ITU World Radiocommunication Conference in 2019 (WRC-19) in order to support 5G network development. The lengthy process to move spectrum from WRC agenda item to the day it is actually assigned underscores the need for all administrations to consider 5G spectrum needs now, especially in mmWave bands.

This emphasises the importance of a mmWave specific analysis, supporting the timely actions that administrations should take in order to realise the many opportunities afforded by 5G in the future. As such, this study leverages the wide variety of research done to date on the expected benefits of mobile broadband, the implementation of 5G and the role of mmWave in that implementation. This is done to forecast the contribution to gross domestic product (GDP) and tax revenue that is expected by making mmWave bands available for the deployment of 5G applications.

Global impact

During the last decade, numerous studies have focused on quantifying the socio-economic benefits of mobile broadband and 5G technologies on local, national, and regional economies. This study focuses on the impacts of making mmWave bands available for 5G.

The economic impacts of mmWave spectrum are quantified over a 15-year period, 2020-2034, assuming mmWave bands are successfully identified at WRC-19 and made available in a timely manner at the national level.

The results of this study support three key findings:

- 5G is expected to provide important economic benefits globally,
- mmWave spectrum will grow to become a significant piece of this impact over time, and
- Although economic benefits are greater in the early adopting economies over the period studied, the rate of contribution of mmWave in later adopting economies outpaces that of early adopters in the later years of the study.

The study concludes, under conservative assumptions, that by 2034 mmWave spectrum will underlie an increase of $565 billion in global GDP and $152 billion in tax revenue, producing 25% of the value created by 5G (see Figure 1):

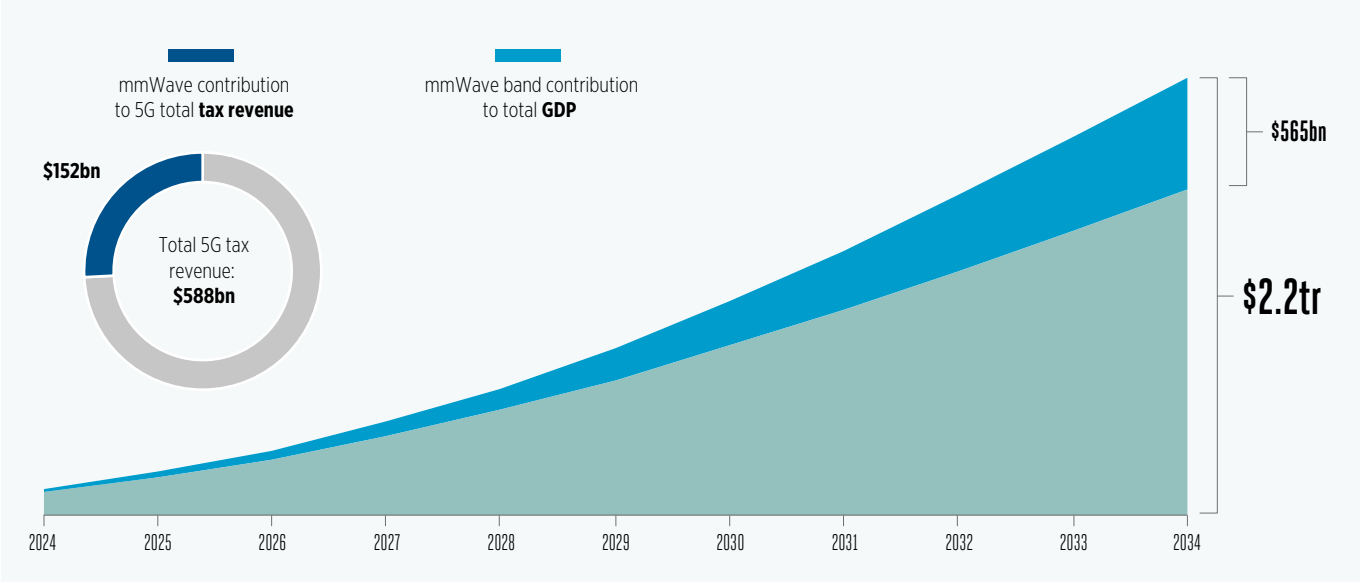
Recommendations

The key findings of this study show that, by 2034, 5G can be expected to generate $2.2 trillion in GDP, and $588 billion in tax revenue, with an increasing share of this benefit related to mmWave spectrum. Beyond the measurable impacts of mmWave 5G technology and services, numerous other benefits are expected, including improved access to healthcare and education, increased public security and response times, safer driving conditions, and reduced pollution, among others.
In order to realise the potential benefits analysed in this study, countries should plan accordingly for the timely availability of spectrum for mobile services, considering they are a key factor for their adequate deployment. Furthermore, the significant socio-economic benefits found by this study underscore the importance of mmWave spectrum for the development of the overall 5G ecosystem.

In this context, the consideration of a number of mmWave bands at the upcoming WRC-19 is a critical opportunity to identify this spectrum for IMT, helping 5G meet its full potential irrespective of where users are located and what mmWave-powered applications and services they want to use. It is recommended that governments take the following actions:

- Review and support the different conditions and proposals for WRC-19 related to 5G, particularly the recommendation to identify the 26 GHz, 40 GHz and 66-71 GHz bands for IMT.
- Support the regional and global process for the harmonisation of the use of these different bands, with due consideration for their frequency arrangements and minimum block sizes.
- Review the national regulatory frameworks with the goal of allowing these bands to be deployed within the country.
- Assign adequate amount of mmWave spectrum to operators, avoiding inflating 5G spectrum prices to allow for heavy network investments and continuous reduction of cost of devices.
- Aim to make available 80-100 MHz of contiguous spectrum per operator in prime 5G mid-bands (e.g. 3.5 GHz) and around 1 GHz per operator in millimetre wave bands (i.e. above 24 GHz).

FIGURE 1. ESTIMATED GLOBAL IMPACT ATTRIBUTABLE TO MMWAVE SPECTRUM ON GDP AND TAX REVENUE



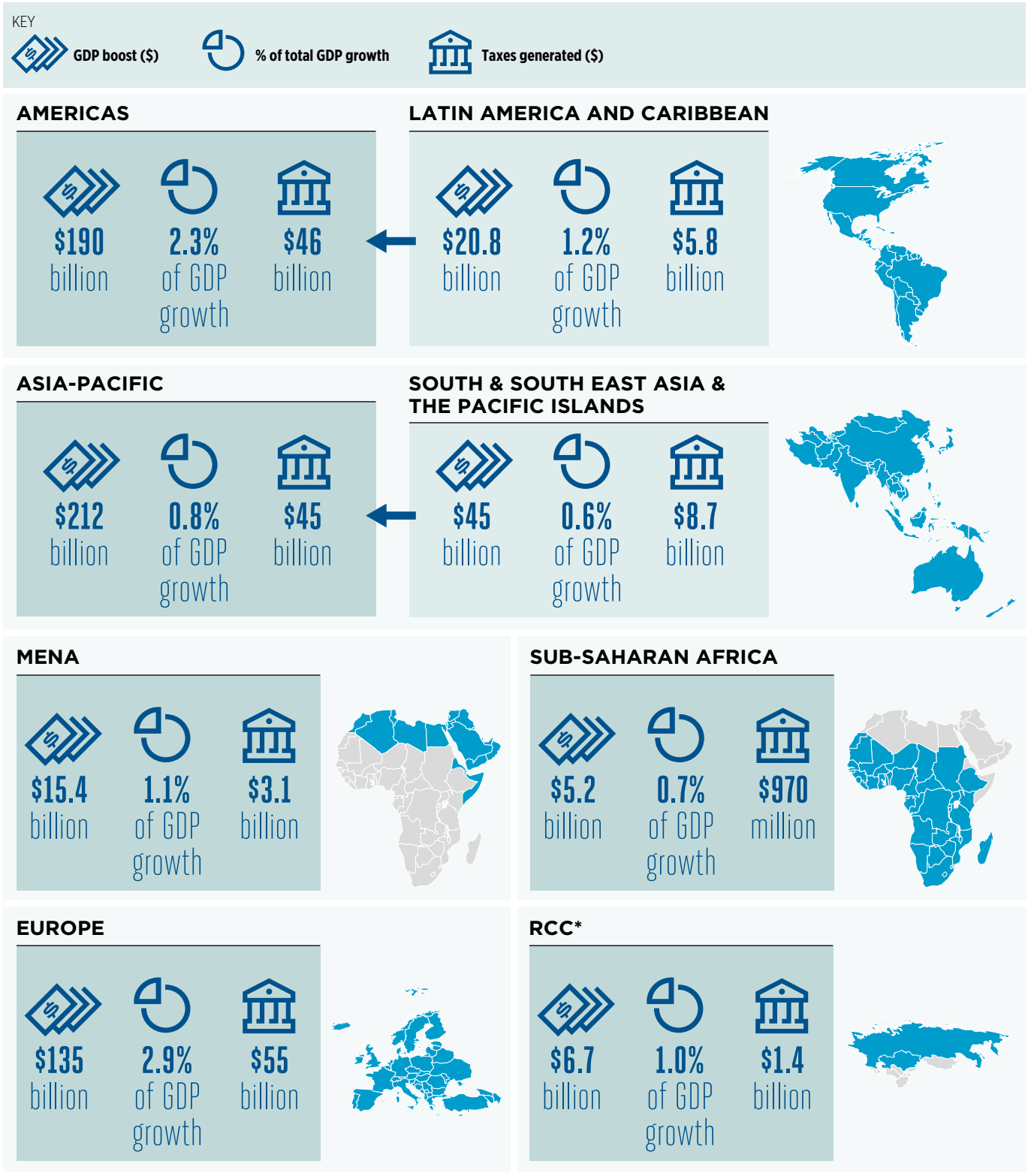
Source: TMG.

Regional breakdown

From a regional perspective, the study shows the following over the period 2020 to 2034 (see Figure 2 and Figure 4).

- The Asia-Pacific and Americas regions are expected to generate the greatest share of the total contribution of mmWave 5G to the GDP, $212 billion and $190 billion, respectively.
- One fifth ($45 billion) of the Asia-Pacific total ($212 billion) is the contribution made by the region after excluding early adopters China, Japan, the Republic of Korea, Australia and New Zealand.
- In the Americas region, a tenth ($20.8 billion) of the total ($190 billion) is contributed by the Latin-American and Caribbean countries.
- Europe has the highest percentage of GDP growth attributable to mmWave 5G than any other region (2.9%).
- The Americas region generates the second highest percentage of GDP growth attributable to mmWave 5G (2.3%).
- Once 5G has taken off in regions such as Sub-Saharan Africa, the annual gain from mmWave 5G will grow much faster from 2026 onwards, closing the gap between the early and late adopters.

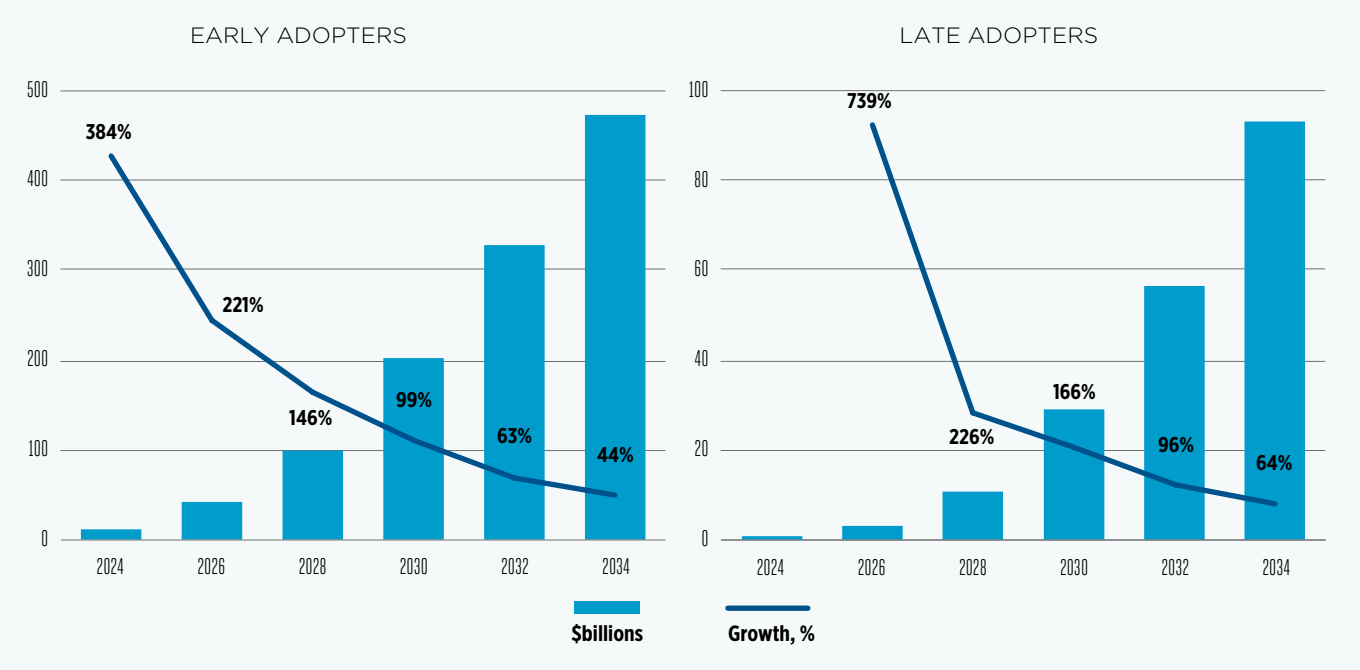
FIGURE 2. PROJECTED REGIONAL IMPACT OF MMWAVE SPECTRUM BY 2034



Source: TMG.
(*) Regional Commonwealth in the field of Communications, which includes eleven countries from the former Soviet Union.

While the greater share of the mmWave 5G contribution to GDP growth comes from larger economies, the economies that are adopting 5G at a later stage also have much to gain from backing mmWave bands for mobile. By 2034, the 5G ecosystem will have matured in terms of availability of equipment, deployment costs, and business case viability. These later adopters outperform the early adopters in terms of rate of growth in the later stage of the study period (see Figure 3).

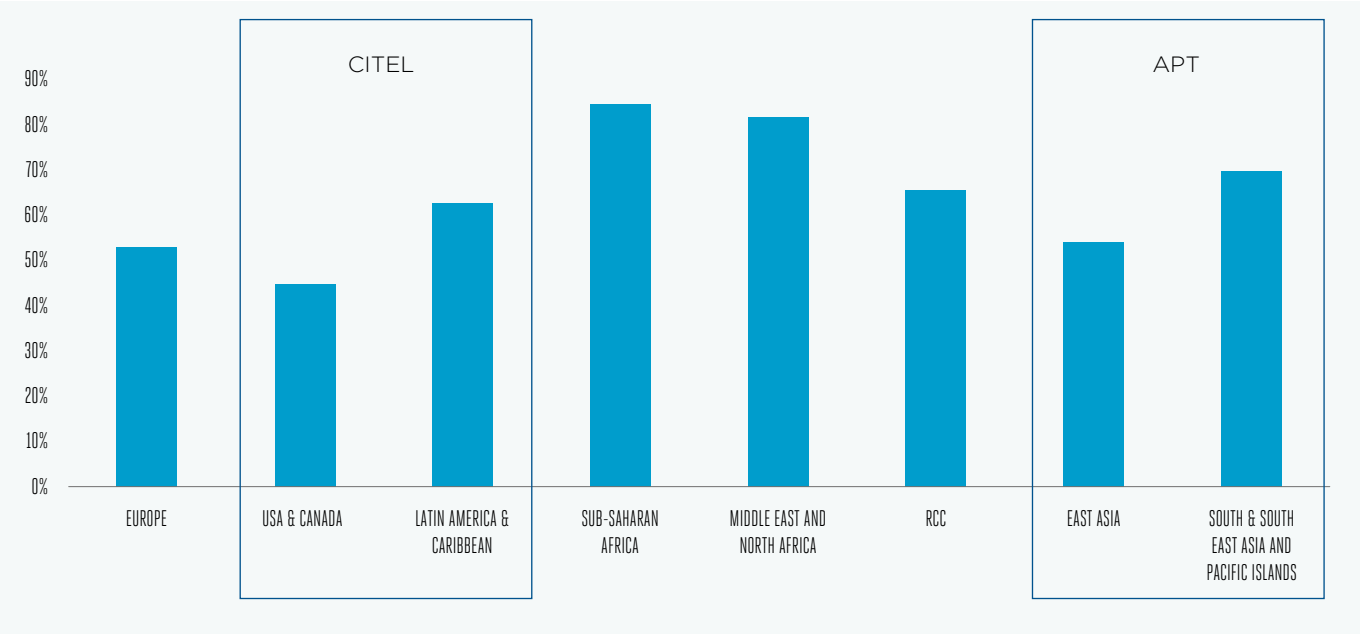
FIGURE 3. MMWAVE CONTRIBUTION TO GDP, FROM 2024-2034



Source: TMG

Figure 4 below shows this effect by region. Over the 2024-2034 period, the average annual growth in contribution of mmWave 5G to GDP is over 80% in Sub-Saharan Africa versus 53% in Europe.

FIGURE 4. ANNUAL AVERAGE GROWTH IN 5G-MMWAVE CONTRIBUTION TO GDP, 2024-2034



Source: TMG

Like previous generations of mobile technology, 5G has an impact on the daily lives of people, irrespective of where they live, in a number of different ways. However, not all of these benefits are reflected in GDP. According to the different use cases and verticals, additional potential benefits include increased access and availability to more advanced healthcare and education; reduced pollution and increased efficiency in transportation; and enhanced public safety response capabilities (see Figure 5).

FIGURE 5. ADDITIONAL BENEFITS OF MMWAVE 5G

Source: TMG

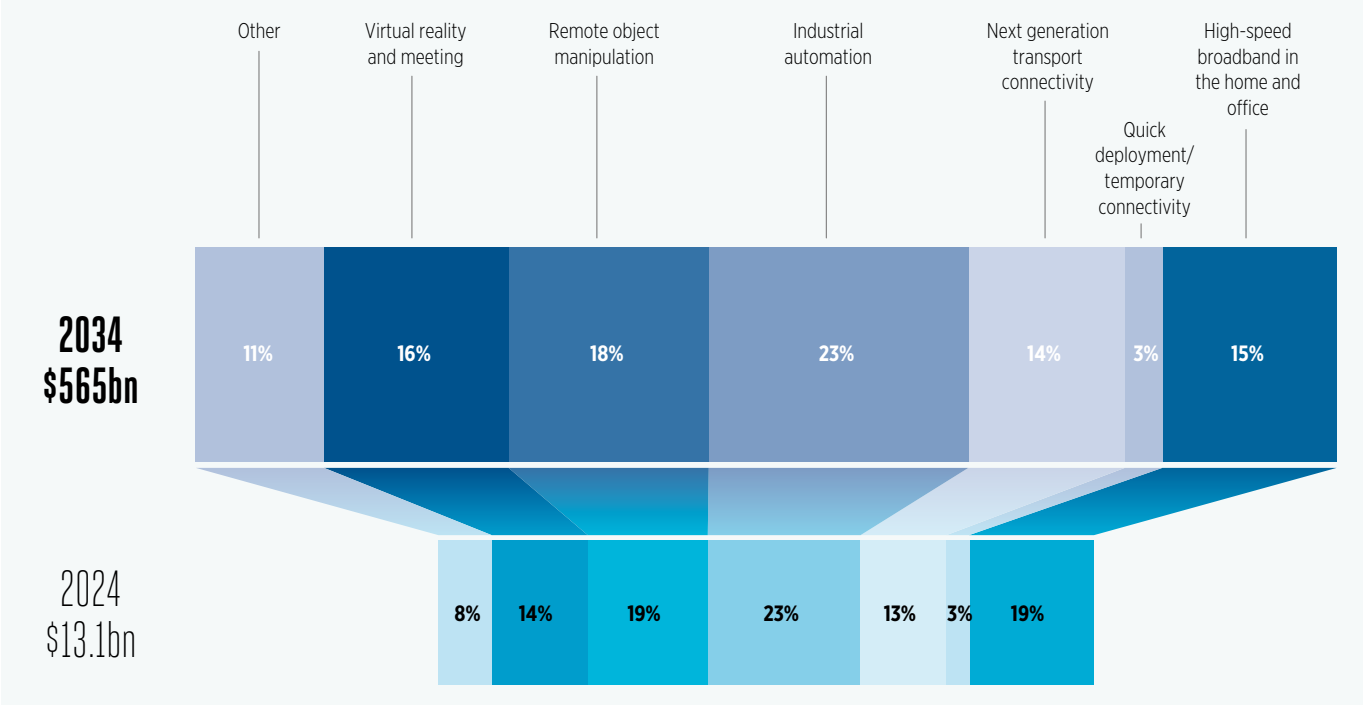
Use cases and industry verticals

In our personal and work lives, several use cases are likely to be the chief beneficiaries of mmWave 5G and will generate more value. These use cases generally require a large amount of data throughput in a small coverage area or face scarcity of spectrum in lower frequency bands.

To highlight the growth attributable to use cases and verticals, the study focuses on two key years: 2024, the year when 5G is expected to begin displaying a measurable impact on growth; and 2034, the final year of the study. Globally, remote object manipulation, industrial automation and virtual reality and meeting applications are expected to account for over 50% of the mmWave 5G contribution to GDP (see Figure 6). Over time, next-generation connectivity gains an increasing share.

The global impact of mmWave grows from $13.1 billion in 2024 to $565 billion in 2034. Remote object manipulation and industrial automation represent the biggest contributors to global output at both ends of the study period. The relative value of the use cases is anticipated to remain mostly stable over the ten-year period, with mmWave spectrum increasing its relative value in transport, the virtual space and other use cases as more sophisticated applications are introduced.

FIGURE 6. PROJECTED GLOBAL CONTRIBUTION OF MMWAVE SPECTRUM TO GDP BY USE CASE



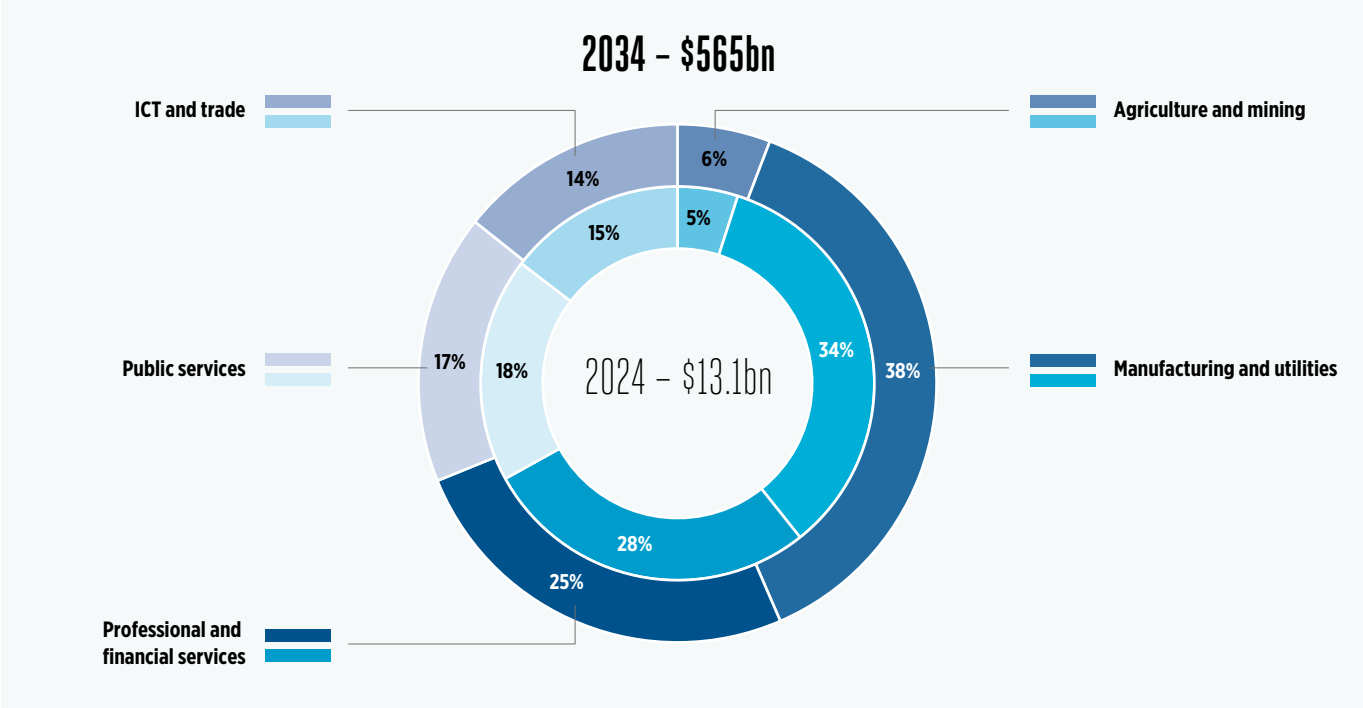
Source: TMG.

The growth in any particular vertical builds upon the diffusion and expansion of 5G through new and existing use cases. The study estimates the impact of mmWave 5G on 13 verticals of the economy, which are consolidated, for presentation purposes, into five sectors: manufacturing and utilities; professional and financial services; public services; ICT and trade; and agriculture and mining.

Within the five sectors, manufacturing and utilities is expected to be the largest beneficiary of 5G services which make use of mmWave spectrum. Contributions from manufacturing and utilities are projected to increase over the period 2024-2034. This is primarily due to two factors:

1. **The relatively large size of the sector in the global economy; and**
2. **The strong role expected to be played by industrial automation and remote object manipulation in this sector.**

FIGURE 7. ESTIMATED GLOBAL CONTRIBUTION OF MMWAVE BANDS ON GDP BY SECTOR



Source: TMG.

5G Use Cases – Why Millimetre Waves Matter

Behind these numbers, 5G will be deployed across several new areas. Many 5G use cases will depend on mmWave spectrum to reach their full potential.

High-speed broadband in the home and office

High-speed mobile broadband to homes, offices and public spaces is one of the first 5G use cases being implemented. Fibre-like ultra-high speeds will need the capacity of mmWave 5G.

Quick deployment/temporary connectivity

The transmission of live events and disaster response efforts require ultra-high speeds and low latency to deliver a high-quality experience to all kinds of users.

Industrial automation

Large-scale industrial automation relies on mmWaves. That's because next-generation manufacturing will produce large amounts of data. Low-latency communication is also crucial.

Remote object manipulation

Low latency and data rate requirements mean mmWave connectivity is expected to play an important role here including advanced healthcare applications.

Virtual reality and meeting

Thanks to latency and peak data rate requirements, mmWaves will benefit virtual and augmented reality. For example, educational applications are likely to produce high volumes of data that will rely on mmWave 5G.

Next-generation transport connectivity

High data volumes and high-density real-time communications must be addressed by a combination of mmWave and lower bands to enhance services, especially in cities with dense traffic.

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