India's 5G Future – Maximising Spectrum Resources

September 2021

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with almost 400 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, Africa, Los Angeles and Shanghai, as well as the Thrive Series of regional conferences.

For more information, please visit the GSMA corporate website at **www.gsma.com.**

Follow the GSMA on Twitter: **@GSMA** and **@GSMAPolicy**

GSMA Intelligence

GSMA Intelligence is the definitive source of global mobile operator data, analysis and forecasts, and publisher of authoritative industry reports and research. Our data covers every operator group, network and MVNO in every country worldwide – from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily.

GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions and third-party industry players, to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself.

Our team of analysts and experts produce regular thought-leading research reports across a range of industry topics.

www.gsmaintelligence.com

info@gsmaintelligence.com

Authors
Kalvin Bahia, Principal Economist
Stefano Suardi, Economist

Contributors
Laurent Bodusseau, Senior Director - Spectrum
Luiz Felippe Zoghbi, Spectrum Policy Manager
Mehul Bhandari, Senior Manager, Spectrum & Policy (India)

Published September 2021

Contents

1. Executive Summary

In the past five years, India has been one of the fastest-growing mobile broadband markets, with 4G networks available to almost 99 per cent of the population and consumers benefitting from some of the lowest prices for mobile services and devices in the world. However, low average revenue per user (ARPU) levels and high regulatory costs have limited operators' ability to invest in upgrading their networks. This is already impacting network quality and is expected to affect 5G roll-out, which will require more capital-intensive investments than 4G.

The issue of spectrum management policy has never been more vital. Making sufficient amounts of affordable spectrum available is central to expanding and upgrading mobile broadband services – and will be core to the success of 5G in India. However, instances of spectrum licences being sold for extremely high prices, or going unsold due to the high reserve prices, are a cause for concern. These outcomes undermine not only consumer mobile services and the wider digital economy, but also impact India's effort in becoming a $5 trillion economy.

The causes of extremely high prices are often policy factors that appear to prioritise other objectives, such as maximising short-term state revenues, above long-term support for the digital economy through improved mobile services. Key issues arise when regulatory authorities:

- Fail to make sufficient amounts of mobile spectrum available, which creates scarcity and artifically inflates prices;
- Set excessive auction reserve prices, final prices or annual spectrum fees; and
- Hold assignment processes that discourage participation via complicated procedures or a lack of transparency.

Spectrum is a valuable and scarce public asset that must be put for public use in a timely manner. The primary goal for the Indian government should therefore be to encourage the timely and best use of spectrum in widespread, high quality networks. Efficient spectrum awards maximise access to affordable mobile broadband services, which, in turn, drive a significant impact on the digital and the overall economy.

In this report we take a closer look at how effective spectrum pricing can support India's National Digital Communications Policy and help boost the country's economy. The key findings are:

- India has some of highest prices for spectrum in the world, which have led to key spectrum bands going unsold and directly limits the industry's ability to invest in upgrading mobile networks. This is already impacting network quality and it is expected to affect 5G roll-out.
- Deploying 5G networks in India will require capital-intensive investments. The mobile industry will only be able to roll-out 5G in a cost-efficient manner across all service areas if they have sufficient spectrum and if the cost of access does not limit operators' ability to make the necessary network investments.
- 5G can play a vital role in India's economy, with benefits of at least $455 billion in the next two decades – but poorly designed spectrum policies will put that at risk. Ensuring that more than 300 MHz of mid-band spectrum is available for 5G during the next auction at a reserve price that allows industry to deploy across all service areas could result in more than 200 million additional 5G connections and increase the overall economic benefits of 5G by at least $75 billion.

2. Indian market overview

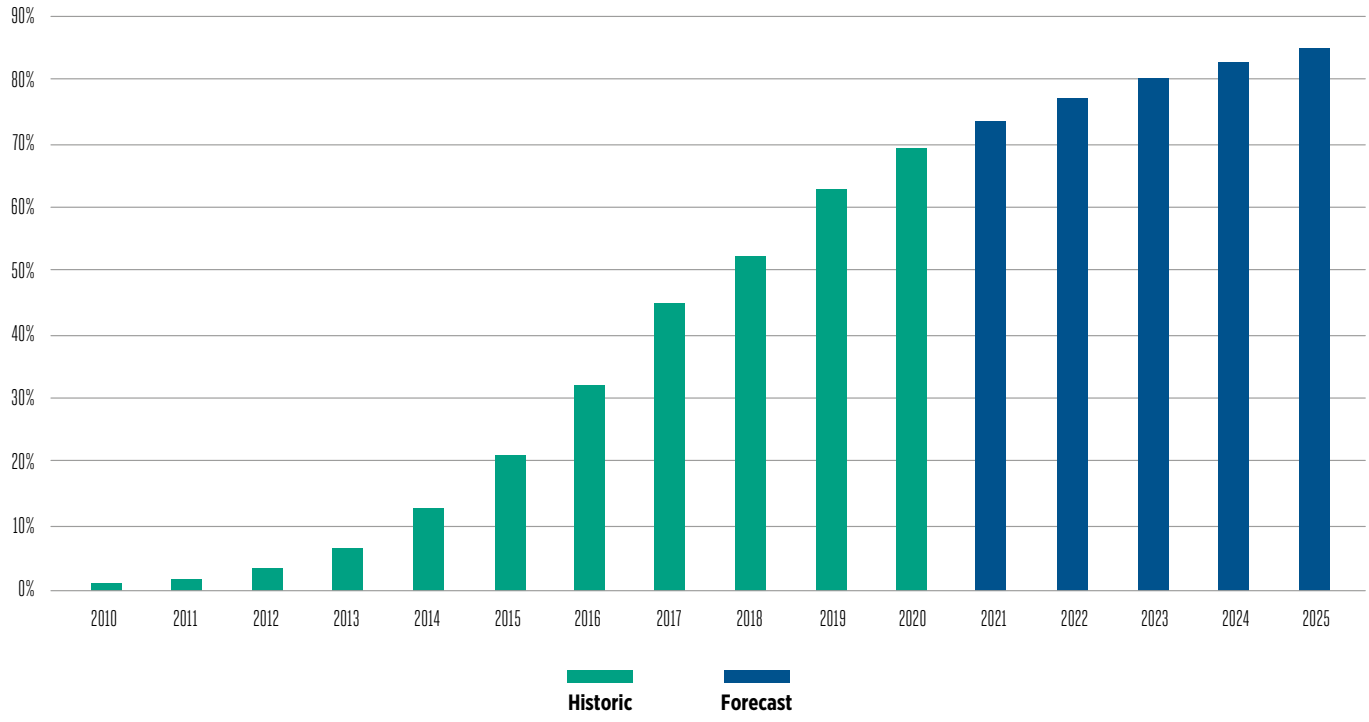
India has been one of the world's fastest-growing mobile broadband markets in recent years, but a digital divide persists

India had 731 million unique subscribers and 500 million mobile internet subscribers at the end of 2020.[1] Over the next five years, it is expected there will be more than 155 million new mobile internet users. India is also seeing rapid migration to mobile broadband, driven by the expansion of 4G coverage to almost 99 per cent of the population as well as by some of the most affordable handsets and data plans in the world.[2] This ongoing shift to 4G is reflected in the rapid adoption of smartphones in India, where mobile data usage per smartphone is mong the highest in the world.[3] Between 2016 and 2020, smartphones as a share of total connections more than doubled, from 33 per cent to almost 70 per cent. By 2025, India is projected to become the second-largest smartphone market in the world.

FIGURE 1

Source: GSMA Intelligence

Smartphone connections as a share of total connections in India, 2010–2025



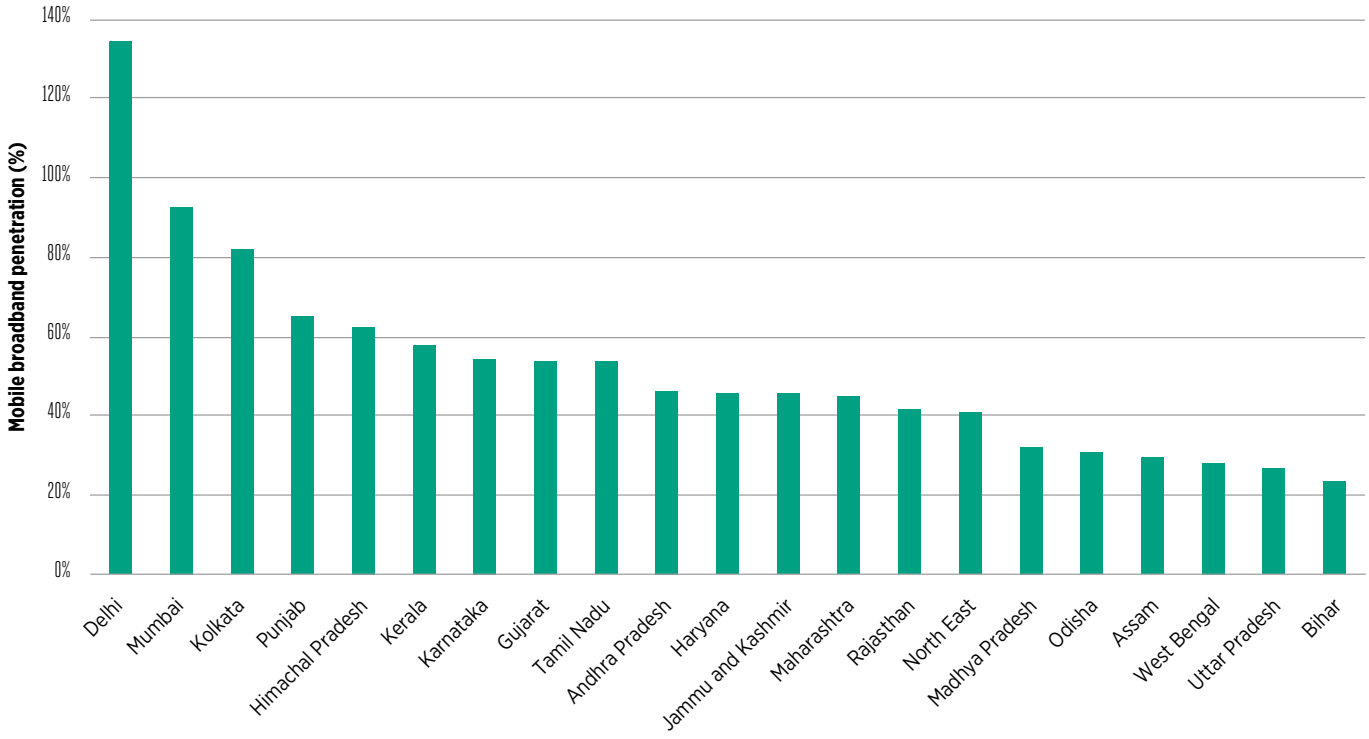
Despite this progress, however, there are stark differences in the adoption of mobile broadband by telecom service areas (Figure 2). Within the service areas, there are also significant divides as rural populations are 28 per cent less likely to use mobile internet than urban residents.[4] If this digital divide persists, it will lead to unequal information access and will also exacerbate wider socio-economic inequalities.

1. This refers to the number of unique subscribers, rather than connections or SIM cards, and so is less than the number of subscriptions reported by TRAI and DOT. This is because individuals can own and use multiple SIM cards.
2. Source: GSMA, State of Mobile Internet Connectivity Report 2020 and GSMA Mobile Connectivity Index
3. Source: Ericsson Mobility Report, June 2021
4. Source: GSMA Intelligence Consumers in Focus Survey 2020

FIGURE 2

Source: GSMA Intelligence analysis of data sourced from DoT. Penetration is calculated based on the number of connections (not unique subscribers).

Mobile broadband penetration by service area (2019)



Low ARPUs combined with high spectrum and regulatory costs are impacting the mobile industry's ability to invest in 4G expansion and 5G deployment

The expansion of 4G connectivity and roll-out of 5G provides an opportunity to close the digital divide. This is reflected in India's National Digital Communications Policy (NDCP), which sets out a positive vision for the industry to attract investment of $100 billion to enhance India's digital infrastructure and to provide universal broadband connectivity to every citizen. The government intends to achieve this objective by supporting the next generation of digital services (including 5G) and by scaling up 30 digital themes across nine key areas, based on its vision of providing citizens with ubiquitous and affordable internet and digital access. Mobile will play a central role in realising these ambitions and is crucial to achieving the NDCP's goals to connect, propel and secure India.

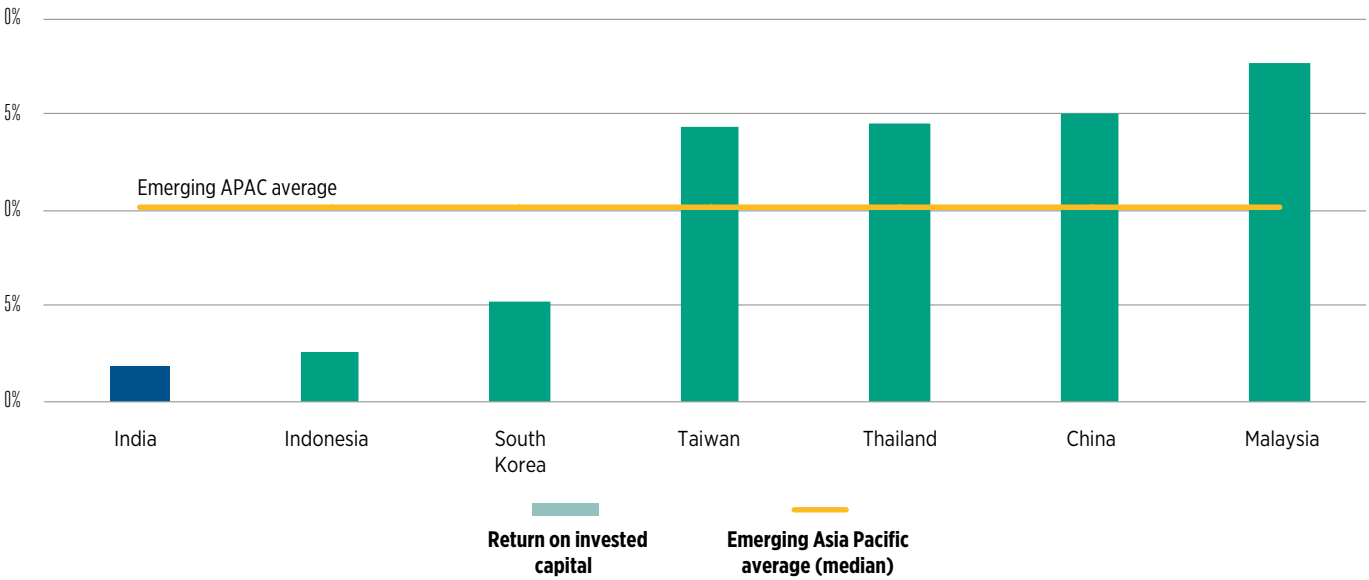
However, while the mobile industry has helped to accelerate connectivity in the past five years, low ARPUs[5] combined with high regulatory and spectrum costs have resulted in lower returns on investment compared to other countries (Figure 3). This impacts operators' ability to invest and innovate, which affects Indian consumers who, for example, have some of the lowest average download speeds in the APAC region (Figure 4). Slow speeds impact the user experience and result in inequality in terms of timely access to data rich information. Going forward, low investment returns will also impact 5G network deployments, with India expected to lag behind other large emerging economies such as China, Brazil, Russia and Indonesia in the roll-out of 5G coverage.

5. Average revenue per user: When calculated per unique subscriber, India had one of the lowest ARPUs worldwide in 2020, at around $2.70.

FIGURE 3

Source: Thomson Reuters, GSMA Intelligence, MarketScreener

Return on invested capital

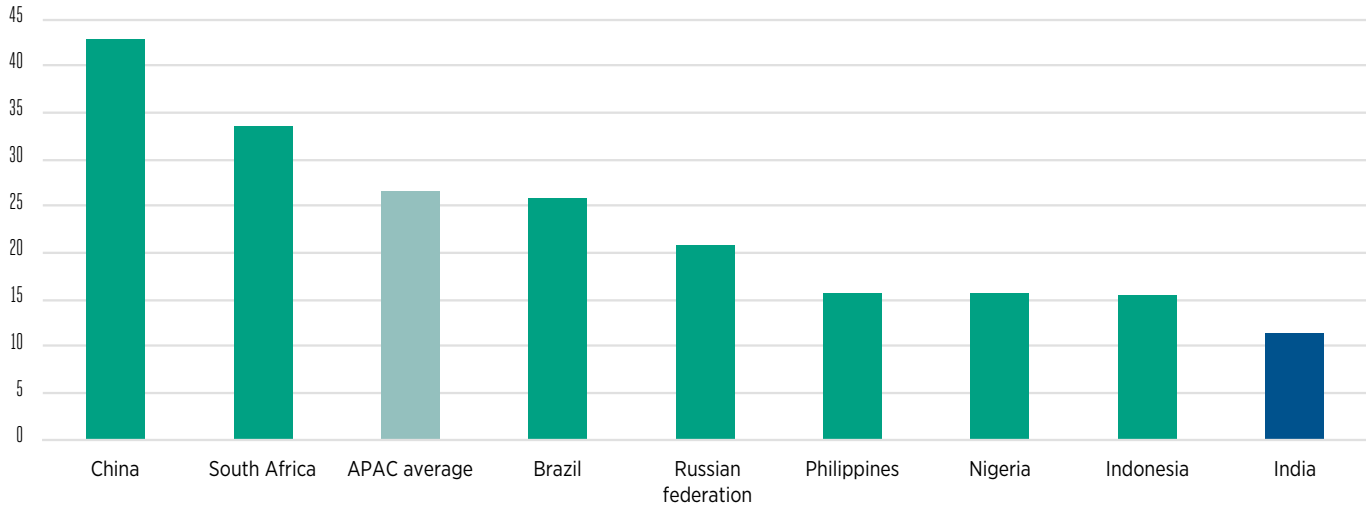


Return on invested capital (ROIC) is a financial measure that quantifies how well a company generates cash flow relative to the capital it has invested in its business; expressed as a percentage and calculated as ROIC = (Net Operating Profit – Adjusted Taxes) / Invested Capital. For each country, the ROIC is calculated based on the average for operators where data is available.

FIGURE 4

Source: GSMA Intelligence calculations based on data provided by Ookla® Speedtest Intelligence®, 2020

Average download speeds – Mbps (2020)



3. The state of spectrum in India

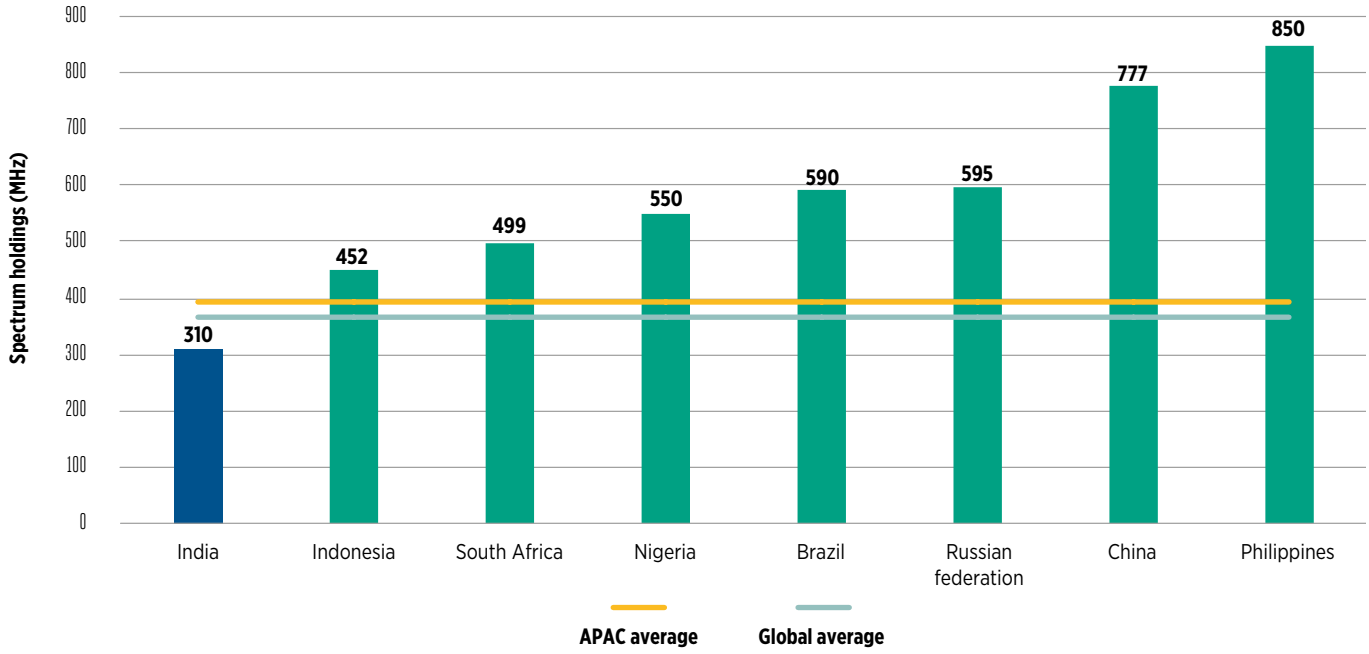
India assigns less spectrum than other countries, which impacts the user experience

Since 2010, India has had several auctions that resulted in limited assignments due to high reserve prices. Consequently, the spectrum holdings of India's mobile operators are lower than those of comparable economies as well as the global and regional averages.

FIGURE 5

Source: GSMA Intelligence. Spectrum holdings included above 600 MHz and below 3700 MHz

Total spectrum assignments to operators in selected countries (below 3700 MHz)

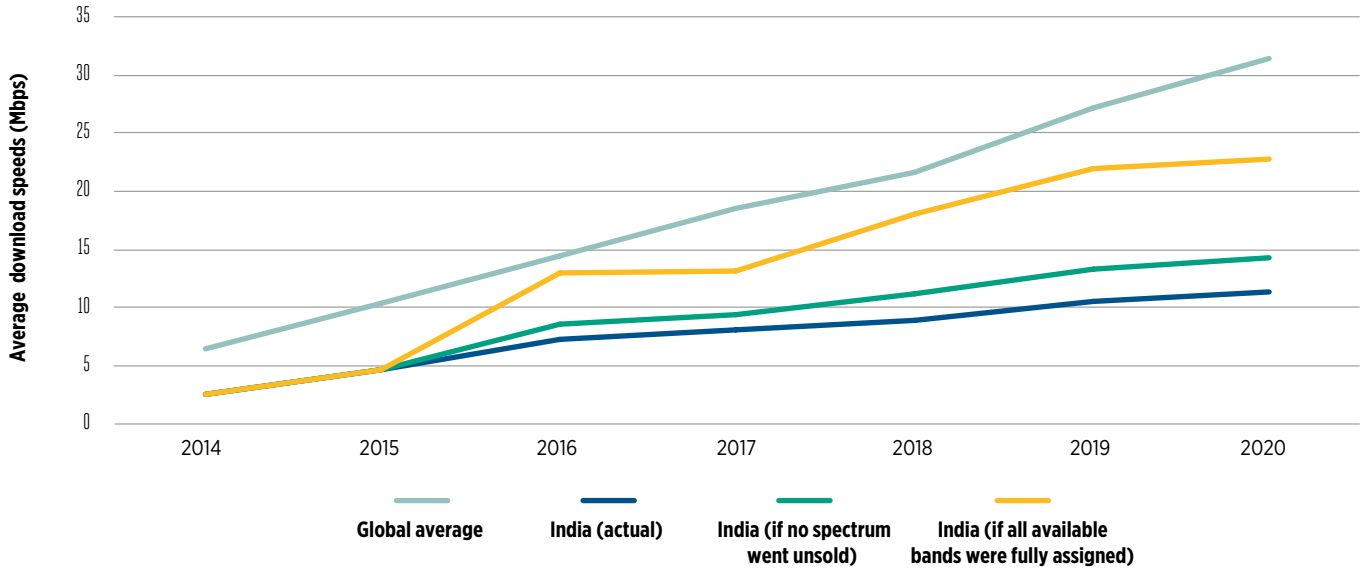


This has had a direct impact on consumers. In 2020, average download speeds in India were less than half the global average. If all the available bands had been fully assigned, download speeds may have doubled and been much closer to other countries (though still not at the same level, see Figure 6).

FIGURE 6

Source: GSMA Intelligence calculations based data provided by Ookla Speedtest Intelligence. Scenarios are based on an assumption that an additional 10MHz of spectrum increases download speeds by 1Mbps.[6]

Download speeds in India – spectrum scenario analysis



6. This assumption is based on the results of an econometric analysis, which quantifies the link between download speeds and spectrum holdings. See, 'The impact of spectrum prices on consumers: Technical Report' (GSMA, 2019)

Furthermore, the correlation between spectrum availability and network quality and coverage is highlighted by regional spectrum assignments in India, as telecom circles with better networks are also likely to have larger amounts of spectrum assigned (Figure 7). This means that the consumer experience outcomes are much better in those circles with more assigned spectrum.

FIGURE 7a

Circle holdings and download speeds (Mbps)

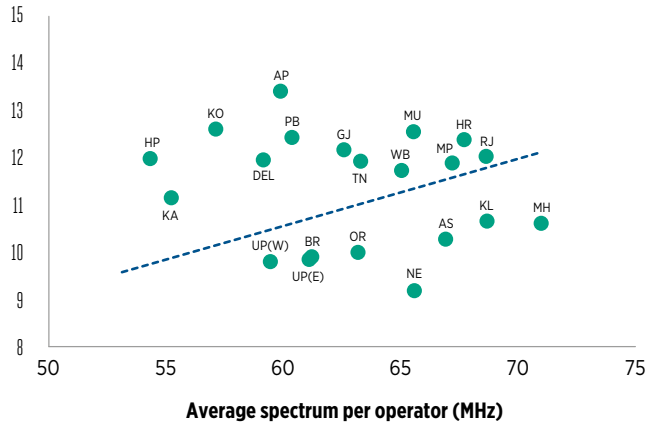
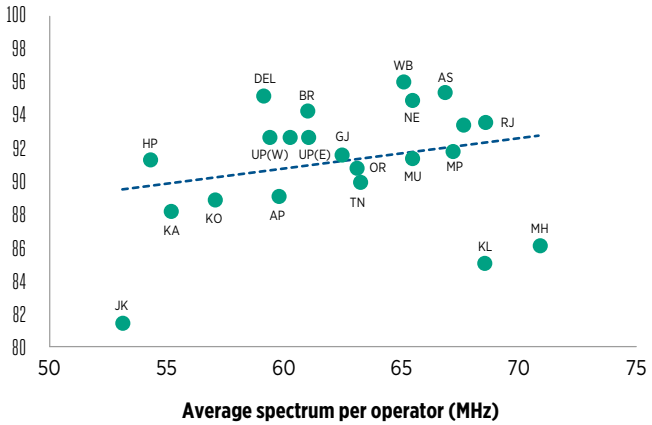


FIGURE 7b

Circle holdings and 4G availability (%)



Source: GSMA Intelligence, DoT, TRAI and Speedtest data sourced from Ookla (2020). 4G availability refers to the proportion of operators' known locations where a device has access to a 4G LTE service. Holdings in each circle reflect the average assigned to the main four operators in 2020.

Over the past 10 years, spectrum prices in India have been significantly higher than those of other countries, both in Asia and other developing countries. This is reflected in the median unit price of spectrum per population (adjusting for inflation and purchasing power parity) and especially when adjusting for operator revenues, which captures the value of the mobile market in the short-to-medium term (Figures 8a and 8b). When considering spectrum pricing at a circle-level, more than half of the prices paid have been above the global average since 2010, while almost 20 per cent have been at very high prices.[7]

As a result, mobile operators in India pay significantly higher costs for spectrum compared to other large emerging markets and high-income countries (Figure 9). This directly impacts operators' return on investments and their ability to invest in upgrading networks.

7. 'Very high prices' are classified based on a set of spectrum pricing data for 114 countries, covering 529 assignments. They are defined as a price greater than the third quartile plus three times the inter-quartile range. See for example, 'Effective Spectrum Pricing in Africa' (GSMA, 2020) and, 'Spectrum pricing in developing countries' (GSMA, 2018)

FIGURE 8a

Median unit prices: India versus global and regional comparators, 2010–2021 ($/MHz/year/population[8])

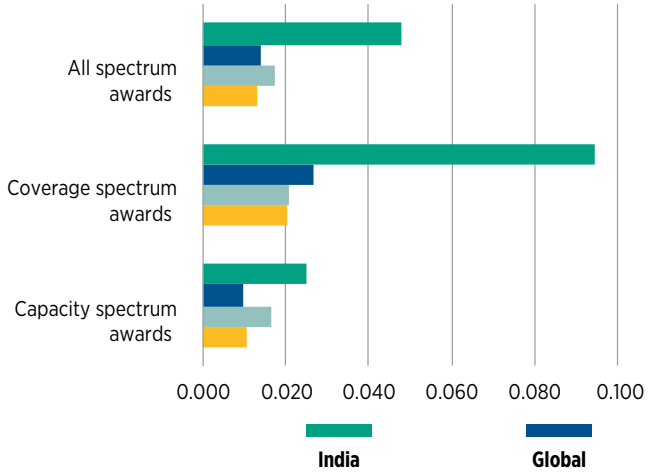
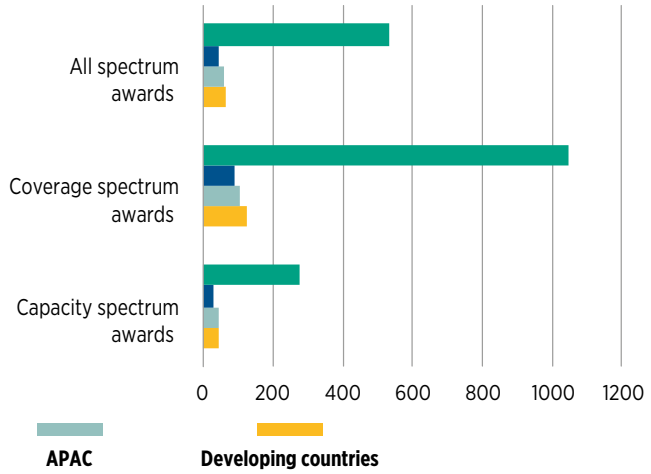


FIGURE 8b

Median unit prices: India versus global and regional comparators, 2010–2021 (per million of revenue ($)[9])

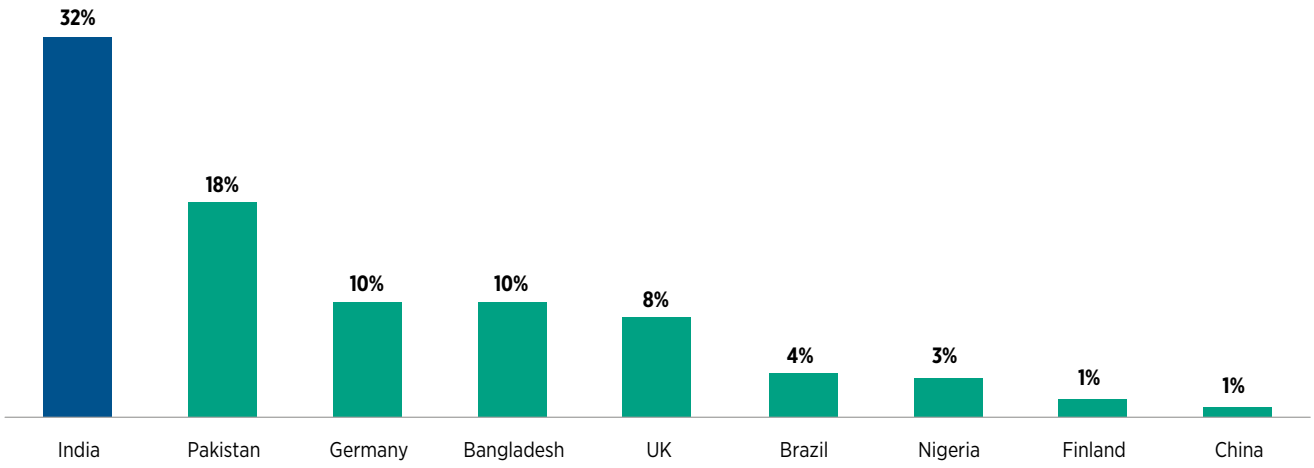


Source: GSMA Intelligence, based on spectrum pricing data for 114 countries. Spectrum prices have been adjusted for inflation, PPP and license duration (Figure 8a) and operator revenues and license duration (Figure 8b).

FIGURE 9

Source: GSMA Intelligence and Coleago[10].

Spectrum costs as a proportion of annual recurring revenue, 2019



Note: Spectrum costs combine annual spectrum fees as well as auction payments. The latter are annualised based on the license length and the weighted average cost of capital (WACC). WACC estimates for the telecoms sector in each country are sourced from WACC Expert.

8. This metric calculates the unit price of an individual assignment of spectrum (at country level) based on the amount paid (in constant dollars adjusted for purchasing power parity) divided by the amount of MHz assigned, the license length and the country's population. It represents an estimate of the unit spectrum cost based on the market size that operators can address.
9. This metric calculates the unit price of an individual assignment of spectrum (at country level) based on the amount paid divided by the amount of MHz assigned, the licence length and annual operator revenues. It represents an estimate of the unit spectrum cost based on the existing value of the market.
10. Estimates for Germany, United Kingdom and Finland are sourced from Coleago, 'Sustainable spectrum pricing' (2019). The remaining countries are based on calculations carried out by GSMA Intelligence.

4. Enabling 5G with supportive spectrum policy

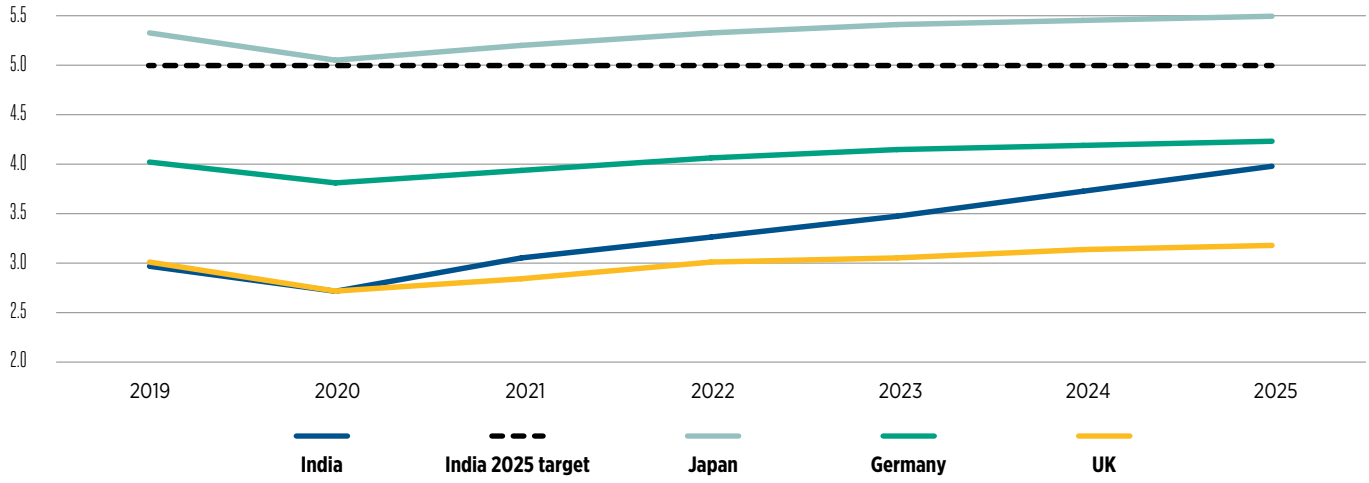
5G has the potential to accelerate growth and drive a post-pandemic recovery

COVID-19 has unleashed an economic and human development crisis, both in India and globally. India's economy contracted by 8 per cent in 2020, although the government remains committed to India becoming a $5 trillion economy by 2025. This ambitious aim will require a post-pandemic acceleration in growth. As a general purpose technology, mobile can enable other sectors to work towards this goal. Studies have shown that a 10 per cent increase in mobile broadband penetration can increase GDP by 1-2 per cent.[11]

FIGURE 10

Source: IMF

GDP forecast for India compared to select countries and India's 2025 target, 2019–2025 ($ trillion, 2020 prices)



5G presents an opportunity to propel India to the next generation of digital connectivity and deliver significant social and economic benefits. Over the next 20 years, 5G is expected to contribute around $455 billion to the Indian economy, accounting for more than 0.6 per cent of GDP by 2040 (Figures 11a and 11b). What makes the opportunity so significant is 5G's ability to drive innovation across all sectors powered by four use cases: enhanced mobile broadband; ultra-reliable low-latency communications; massive Internet of Things; and fixed wireless access. In India, benefits are expected to be realised in the manufacturing sector, representing 20 per cent of the total benefit, and in the retail, ITC and agricultural sectors. The public administration sector, including healthcare and education, is also expected to benefit from 5G, thanks to smart cities and smart government 5G-enabled applications. The pandemic has only highlighted the need for reliable and resilient connectivity for all sectors of the economy. Practical use cases will also be developed post spectrum awards, as many sectors and organisations prepare for a significant shift in the way they behave, operate and transact. In order to change, however, they need strong connectivity.

11. See for example GSMA Intelligence, 'Mobile technology: two decades driving economic growth' (2020) and ITU, 'Economic Impact of Broadband, Digitization and ICT Regulation' (various)

FIGURE 11a

Expected economic contribution of 5G in India (billion)

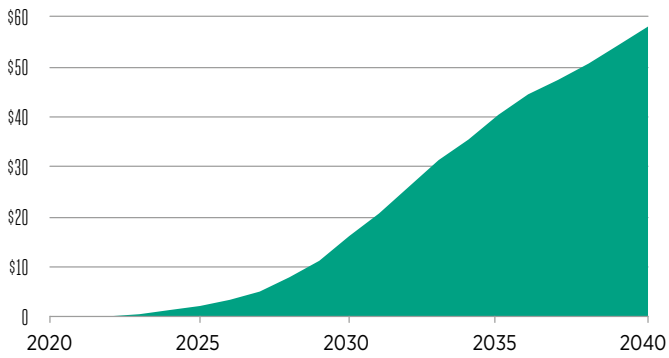
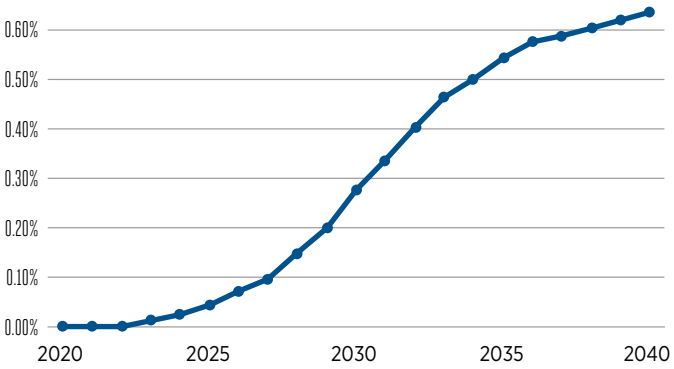


FIGURE 11b

Source: GSMA Intelligence[12]

Expected economic contribution of 5G in India as a percentage of annual GDP



The impact of 5G will be influenced by spectrum policy

Policymakers can play a significant role in enabling the impacts of 5G by providing timely access to the right amount and type of spectrum at affordable prices across all service areas. Worldwide, there is already a significant variation in the amount of spectrum assigned by countries, and the prices paid at auctions, which means the potential of 5G services will vary between countries. This, in turn, directly impacts the socio-economic benefits of 5G and the competitiveness of national economies.

12. For further details on how these economic impact estimates are calculated, see 'The Impacts of mmWave 5G in India' (2020)

5G needs a significant amount of harmonised spectrum

In order to get the most out of 5G, spectrum is needed across low-, mid- and high-bands to deliver widespread coverage and support all use cases. Frequencies in the 3.5 GHz range (3.3-4.2 GHz) have in particular been used as the basis for the first roll-outs of 5G globally, driving the wider ecosystem, device diversity and competition. The range is at a balancing point between coverage and capacity that provides the perfect environment for the earliest 5G connectivity.

To meet the IMT-2020 requirements, an initial 100 MHz per operator is needed in 5G-enabled mid-bands. Making less spectrum available will impact service quality, decrease peak data rates and increase the necessary network investments. For example, moving from 40 MHz to 100 MHz in 5G mid-bands will result in double peak data rates, while moving from a 100 MHz to 60 MHz spectrum assignment will increase the number of cell sites required by up to 64 per cent.[13]

In India, it is important that more than 300 MHz of spectrum in the mid-bands is made available to the mobile industry, as it will mean operators having access to the spectrum necessary to meet the ITU 5G target parameters. If this is not available, operators will not have sufficient spectrum to deploy 5G in a cost-efficient manner that benefits consumers and the wider economy.

However, this is just the first step towards building resilient connectivity. Many countries – including South Korea, Japan and most of Europe, North America and the Middle East and North Africa - have already moved beyond the Radio Regulations to assign even more mid-band spectrum, especially in 3.3-4.2 GHz.[14] This is important in urban areas with high population densities, as operators will have to densify the network with small cells to deliver the 5G downlink and uplink data rates. More mid-spectrum available reduces the need for cell site densification, which sometimes isn't even possible, thus reducing infrastructure investment and also delivering important environmental benefits. In the medium-to-longer term, it is therefore important that India releases around 2 GHz of mid-band spectrum for 5G going forward, including in the 3.5 GHz range and the 6 GHz band.

13. '3.5 GHz in the 5G Era' (GSMA, 2021)
14. '3.5 GHz in the 5G Era' (GSMA, 2021)

Modest reserve prices are needed

Reserve prices can have an important role in discouraging speculators and frivolous bidding, recovering the administrative costs of the award process and limiting collusion incentives amongst bidders. However, they should also allow room for price discovery, encourage participation and avoid spectrum going unsold. Given what has happened in previous Indian auctions, including the March 2021 auction when 62 per cent of available spectrum went unsold, the primary objective should be to ensure that all available spectrum is assigned in a manner that maximises consumer welfare and economic efficiency.

Given that more spectrum will be required to fulfil consumer demand, an auction should be seen as a frequent affair where operators have flexibility to manage demand at regular intervals. Affordable pricing is key to manage the level of enthusiasm for more investments and catering to the socio-economic needs of the country.

In 2018, TRAI recommended a price of INR 4.9 billion (around $67 million) per MHz for spectrum in the 3.3-4.6 GHz bands. When adjusting for purchasing power parity, market size and licence length, this is higher than reserve prices in almost all other countries that have assigned the band so far (Figure 12a) – and higher than most of the actual prices paid. When taking revenues into account, the reserve price is significantly higher than what has been set in other markets (Figure 12b).

The current pricing for 3.5 GHz therefore puts the future of the band in jeopardy and there is a risk it will end up being another example of a band that is not used efficiently in India. This will make it more challenging for the industry to deploy 5G throughout the country, which risks exacerbating the digital divide and hindering the wider socioeconomic impacts. Fortunately, the government still has an opportunity to change course.

5G must be seen as a mass technology, as it is capable of not only supporting mobile broadband subscribers but also millions of IoT chipsets that will directly affect and shape the lives of Indians post-pandemic.

FIGURE 12a

Source: GSMA Intelligence

Comparison of reserve prices in the 3.5GHz band ($/MHz/pop/year)

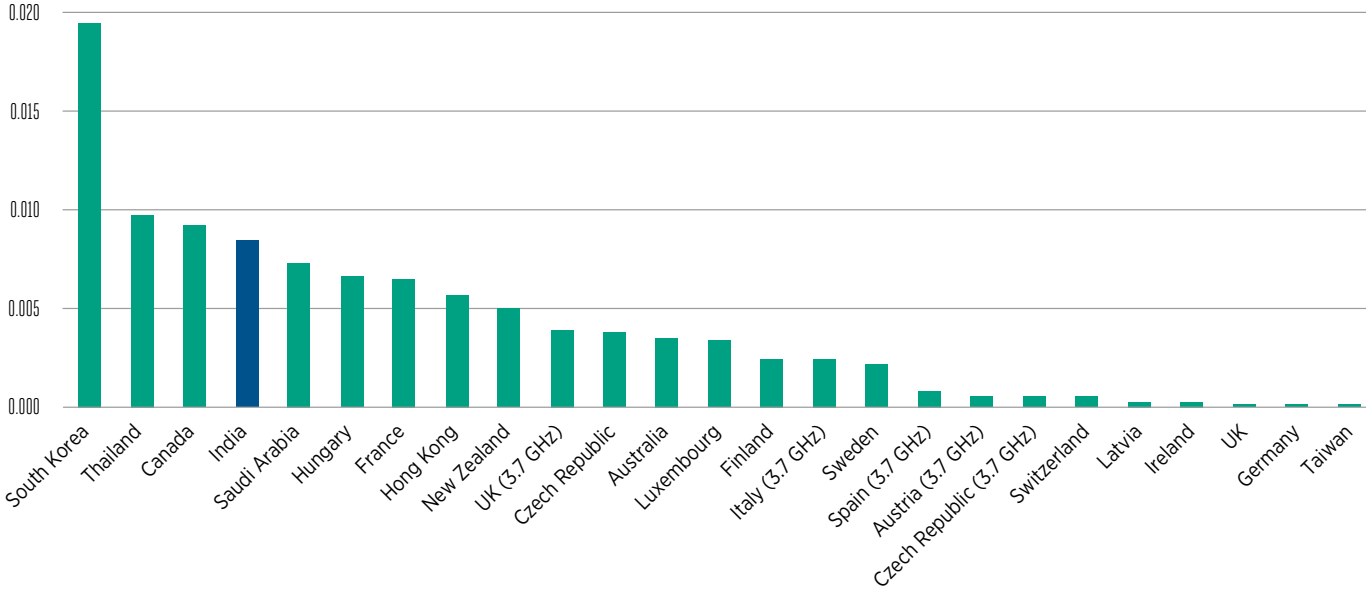
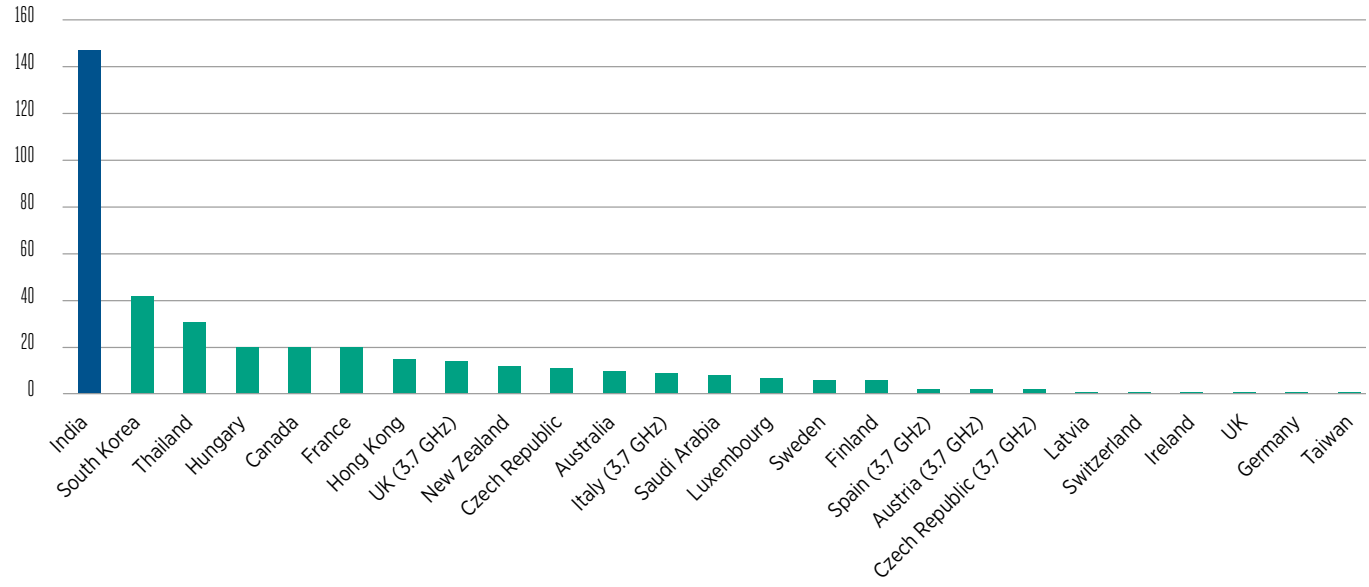


FIGURE 12b

Source: GSMA Intelligence

Comparison of reserve prices in the 3.5GHz band (per million of revenue ($) per MHz per year)



Assigning at least 300 MHz of spectrum at affordable prices could increase the economic impact of 5G by an additional $75 billion

To illustrate the impact of potential spectrum policies in India, one can consider two scenarios.

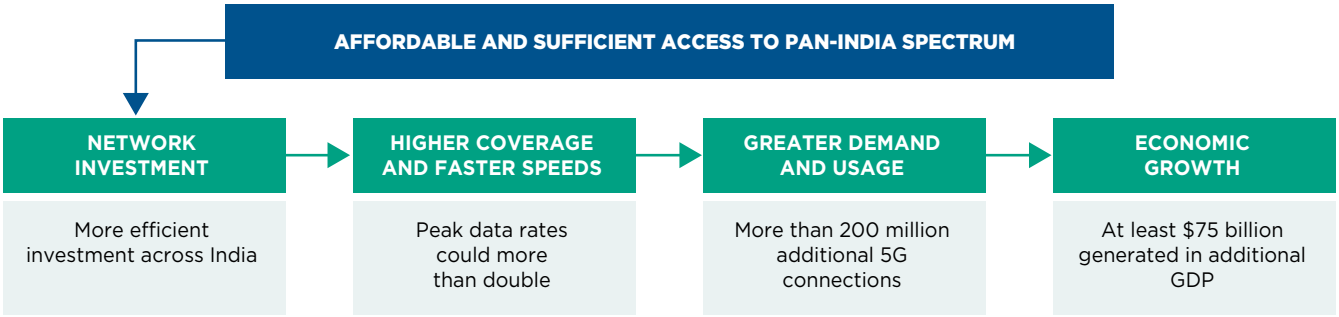
- **Baseline** – Mid-band spectrum is put up for auction at the current reserve price. At this price, there is a significant risk that 5G deployments are restricted to India's metro circles and that, in other areas, operators will have little-to-no access to any mid-band spectrum.
- **Scenario** – At least 300 MHz is put up for auction at a reserve price that enables industry to access mid-band spectrum across all service areas. This means that operators can take a more holistic view and deploy 5G in a uniform and time-bound manner across all circles.

When a larger share of mid-band spectrum is assigned at affordable prices, based on the above scenario, operators can roll out coverage more quickly and improve network quality – thereby increasing demand and the associated economic benefits. In India, this could result in more than 200 million additional 5G connections and increase the overall economic benefits of 5G by by at least an additional $75 billion (Figure 13).[15]

FIGURE 13

Source: GSMA Intelligence

Economic impact of releasing at least 300 MHz of mid-band spectrum at affordable prices



15. In order to model the impact of this scenario, we assume that 300 MHz would be assigned across all circles (compared to the baseline where it is assigned only in Metro circles). To quantify the impact of additional spectrum access on adoption, we assume that an additional 10MHz of 5G spectrum per operator would increase 5G coverage and adoption by 1.5 percentage points. This is based on the results of an econometric analysis, which quantifies the link between 4G coverage and spectrum holdings (see GSMA, 'The impact of spectrum prices on consumers: Technical Report' (2019)). This increase in adoption then drives additional economic benefits, in line with the analysis presented in Figure 11. Given the network densification requirements for 5G, this approach may understate the benefits of ensuring that at least 300 MHz of mid-band spectrum is assigned at affordable prices.

Other enabling factors will also be important for 5G

While an enabling spectrum policy framework will be critical in the development of 5G, there are other factors that will also be important.[16] These include:

- Flexibility to establish network sharing;
- Facilitating access to site locations;
- Enabling small cell deploments;
- Facilitating backhaul deployments by awarding spectrum, particularly in the E band, and by enabling fibre roll-out (including a reduction in rights of way); and
- Harmonising power density limits.

16. See GSMA, 'Realising 5G's full potential: Setting policies for success' (March 2020)

5. Recommendations for policymakers

As this report highlights, 5G can play a vital role in India's economy. To make the most of this opportunity, increasing mid-band spectrum allocations and striking the right balance between raising revenues and delivering efficient spectrum awards will be key. In terms of next steps, the GSMA's policy recommendations are as follows:

1. Make available more than 300 MHz of spectrum in prime 5G mid-bands, with at least 100 MHz of contiguous spectrum per operator;
2. Ensure that 5G spectrum is available across low, mid and high spectrum ranges to deliver widespread coverage and support all use cases;
3. Avoid inflating spectrum prices, eliminate spectrum usage charges and prioritise the assignment of all spectrum;
4. Adopt national spectrum policy measures to encourage long-term heavy investments in 5G networks; and
5. Ensure a policy framework that helps minimise any regional differences between circles, enabling equal and timely 5G access to the public.

Floor 2, The Walbrook Building
25 Walbrook, London EC4N 8AF UK
Tel: +44 (0)207 356 0600

spectrum@gsma.com
www.gsma.com