GSMA

The Mobile Economy Asia Pacific 2023

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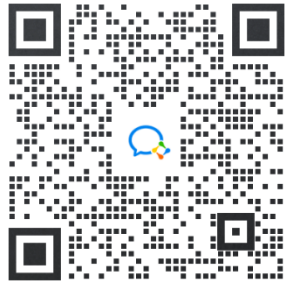

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GSMA

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

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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.

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Executive summary

5G momentum builds in Asia Pacific

Mobile connectivity continues to be at the core of digital innovation in Asia Pacific,[1] enabling a wide range of transformative technologies for individuals and enterprises, and helping governments to deliver positive impacts for society. Authorities across the region are implementing initiatives to integrate mobile-enabled technologies across every aspect of society, from improving healthcare and actualising Industry 4.0 to supporting vulnerable communities facing challenging situations, including climate-related and geophysical disasters. The impact of mobile connectivity is evidenced by its contribution to the economy; in 2022, mobile technologies and services generated just under 5% of Asia Pacific's GDP – a contribution that amounted to $810 billion of economic value added.

5G will underpin much of the innovation and new services on mobile-based platforms in the coming years, helped by the rapid rollout and adoption of the technology in the region. Asia Pacific is home to pioneer 5G markets, such as Australia, Japan, Singapore and South Korea, where the technology has become mainstream. The region also has some of the fastest growing 5G markets today, notably India, which is set to add tens of millions of 5G connections in 2023. By the end of 2030, there will be around 1.4 billion 5G connections in Asia Pacific, equivalent to 41% of total mobile connections. 5G is expected to benefit every sector of the Asia Pacific economy, especially services and manufacturing.

In 2022, mobile technologies and services generated just under 5% of Asia Pacific's GDP – a contribution that amounted to $810 billion of economic value added

1. Asia Pacific in this report excludes China unless stated otherwise.

Key trends shaping the mobile ecosystem

5G: the growing monetisation imperative

As 5G adoption grows, the monetisation imperative will escalate. A 'wow' factor is required to attract new customers or incentivise existing ones towards higher spend. Extended reality (XR) is a strong candidate here, having the potential to usher in a new age of immersive consumer experiences that benefit from 5G's advanced capabilities around speed, latency and capacity. 5G fixed wireless access (FWA) services provide a further incremental revenue opportunity, particularly in markets with low fixed broadband penetration or where the fixed broadband technology mix skews towards xDSL. While the consumer segment represents the largest contributor to operator revenues, enterprise is the main growth driver as operators target the digital transformation of industries. 5G standalone (SA) and private 5G networks will be pivotal to enterprise 5G monetisation.

The rise of generative AI

Mobile operators have utilised AI for a while now to varying degrees. However, the emergence of generative AI has pushed the envelope on AI capabilities and thrust AI technology into boardroom conversations globally. Operators will use advanced AI models, such as ChatGPT, beyond network functions to deliver a smarter and more personalised customer experience. Developments in AI will also have profound effects on other sectors of the economy. Initial use cases have pertained to content development, but a further wave of tools will contextualise the use of large language models for specific industries and applications. However, ethical concerns around the technology still need to be addressed. AI regulation will therefore continue to move up the policy agenda as governments develop frameworks for regulating the use of new AI tools.

The shift to circularity gathers momentum

The concept of circularity has risen to the top of the agenda for policymakers and industry players in light of growing concerns around the generation of e-waste and unsustainable levels of consumption of natural resources. Although the technical lifespan of a mobile device is now between four and seven years, the average use period of mobile devices is only around three years. Governments and industry players have a role to play in incentivising consumers, such as by building new channels and suppliers to collect, refurbish and resell devices and implementing awareness campaigns on sustainability. Operators and other ecosystem players in Asia Pacific are already taking a lead in this regard, with initiatives to drive circularity in mobile phones and other digital devices.

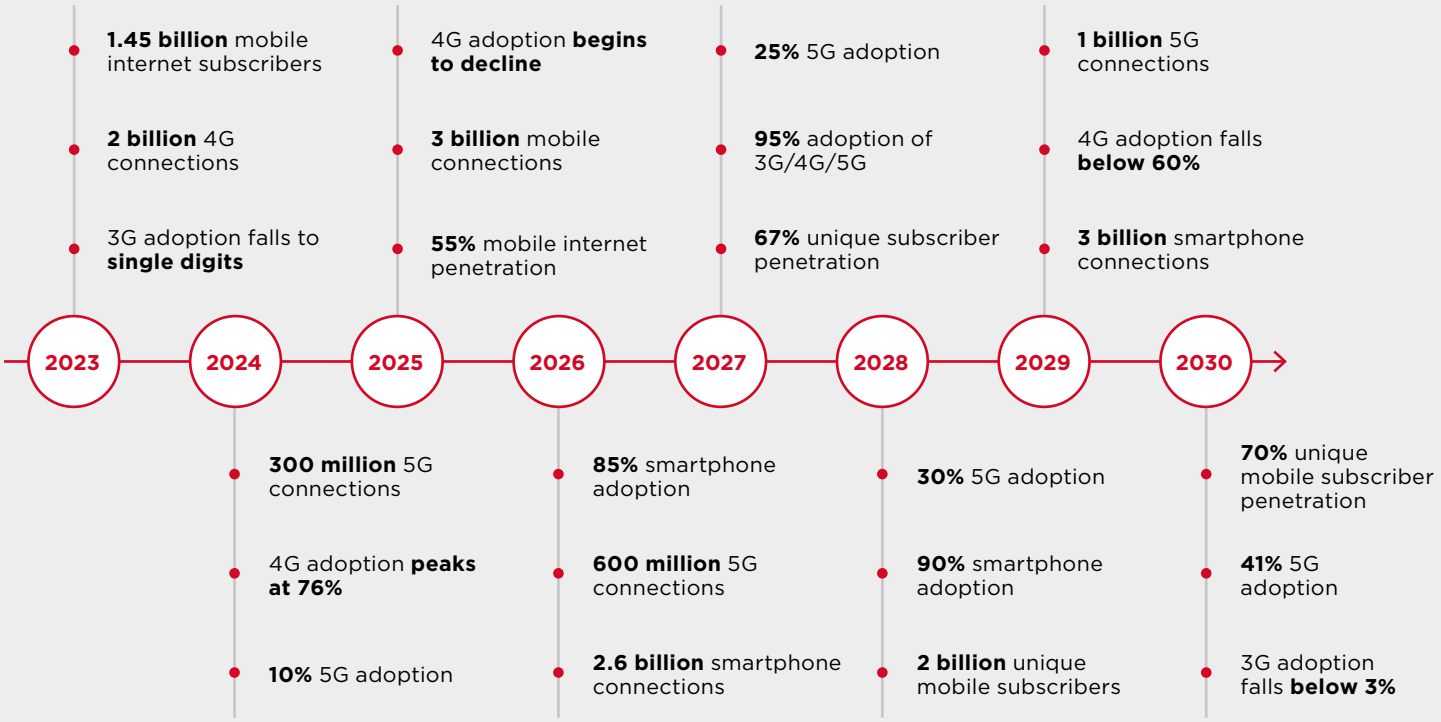
Consolidation drives scale and efficiency

The wave of telco consolidation in Asia Pacific has continued into 2023, with the announcement that Dialog Axiata and Bharti Airtel plan to merge their operations in Sri Lanka. Driving this trend is the need to ramp up investments to fuel 5G rollout, improve network performance for customers and achieve efficiency gains amid growing competition and narrowing margins, as evidenced by the initial outcomes from some recent deals. In the 5G era, scale has become increasingly important for operators as they look to muster the capital expenditure required for extensive network deployment, distribute and monetise new 5G services. For policymakers, adopting an evidence-based approach to assessing consolidation deals is crucial to achieving the best outcomes for consumers and industry players.

Mobile is fuelling fintech

Regionally, Asia Pacific has one of the fastest-growing fintech industries, including massive mature markets such as India and emerging ones such as Vietnam and Indonesia. The continued growth in the fintech sector, especially since the Covid-19 pandemic, has improved the level of financial inclusion in the region, resulting in an increase in mobile money accounts, point of sale terminals and B2B sales, among others. Operators have been partnering with ecosystem players to diversify products and offer options such as 'buy now, pay later'. At the same time, investors in Asia Pacific have continued their focus on fintech to improve access to a variety of financial products for both individuals and small businesses – such as microlending, SME lending and B2B payments. Wealth management geared at lower-wealth segments has also gained some attention.

Key mobile industry milestones to 2030



Policies for growth and innovation

To maximise the potential for growth and innovation in the region, policymakers can take action to rebalance the digital ecosystem and create fairer business conditions for mobile operators. Such moves can ensure that operators invest in resources to build out remaining 4G infrastructure, as well as 5G networks, at scale and pace. It can also ensure the introduction of new network services that will enable the digital economy in the coming decades.

In practice, this means putting in place the right incentives to promote the long-term growth of the value chain, implementing an optimal tax framework to foster the development of the digital economy, reducing the regulatory compliance burden on operators, taking steps to close the digital divide (including for women and other vulnerable populations), and protecting citizens and businesses online.

Meanwhile, the ITU's World Radiocommunication Conference 2023 (WRC-23) will take place from 20 November to 15 December 2023 in Dubai. WRC-23 will offer an opportunity to build a spectrum roadmap going into 2030, address the digital divide and ensure 5G can benefit billions of people around the world. The chance to expand the availability of affordable 5G services is crucial, as such services, along with regulatory policy support, will help ensure future growth and innovation.

The Mobile Economy Asia Pacific

Unique mobile subscribers

2022 **1.73bn**

2030 **2.11bn**

Penetration rate
Percentage of population

62% 2022

70% 2030

CAGR 2022-2030 **2.5%**

Mobile internet users

2022 **1.36bn**

2030 **1.84bn**

Penetration rate
Percentage of population

49% 2022

61% 2030

CAGR 2022-2030 **3.8%**

SIM connections
(excluding licensed cellular IoT)

2022 **2.80bn**

2030 **3.34bn**

Penetration rate
Percentage of population

100% 2022

112% 2030

CAGR 2022-2030 **0.9%**

4G
Percentage of connections (excluding licensed cellular IoT)

2022 **70%**

2030 **55%**

5G
Percentage of connections (excluding licensed cellular IoT)

2022 **4%**

2030 **41%**

Smartphones
(percentage of connections*)

2022 **76%**

2030 **94%**

Licensed cellular IoT connections

2022 **119m**

2030 **284m**

Operator revenues and investment

2022 **$189bn** Total revenues

2030 **$212bn**

Operator capex

$259bn

2023 → 2030

Mobile ecosystem contribution to GDP

2022 **$810bn** 4.8% of GDP

2030 **$990bn**

Public funding

2022 **$90bn**

Mobile ecosystem contribution to public funding (before regulatory and spectrum fees)

Employment

7.2 million jobs

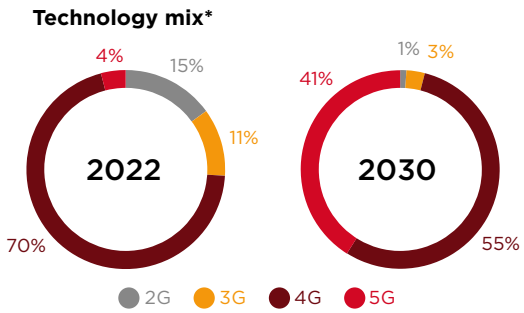
Directly supported by the mobile ecosystem in 2022

3.6 million jobs

supported indirectly

Subscriber and technology trends for key markets

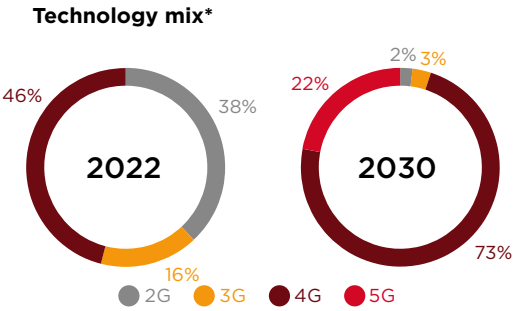
Asia Pacific



Subscriber penetration	
2022	62%
2030	70%
Smartphone adoption	
2022	76%
2030	94%

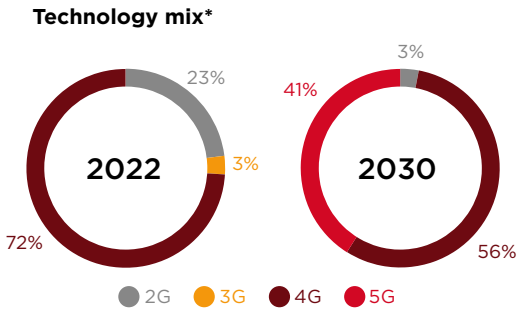
Leading Nations programme[2]

Bangladesh



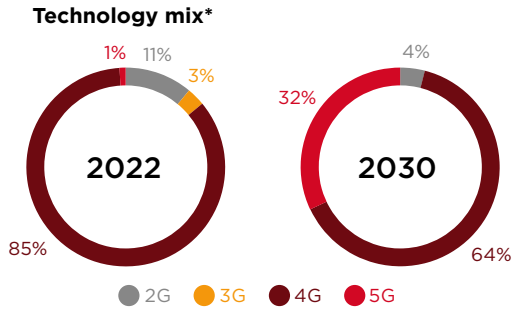
Subscriber penetration	
2022	58%
2030	66%
Smartphone adoption	
2022	50%
2030	82%

India



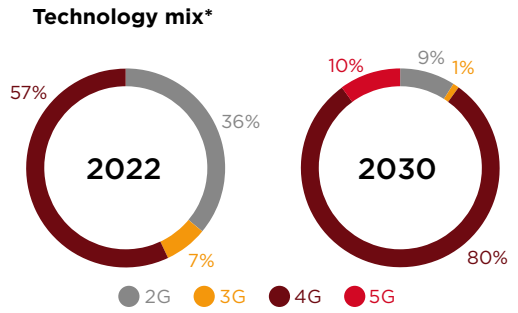
Subscriber penetration	
2022	63%
2030	74%
Smartphone adoption	
2022	77%
2030	95%

Indonesia



Subscriber penetration	
2022	56%
2030	64%
Smartphone adoption	
2022	83%
2030	94%

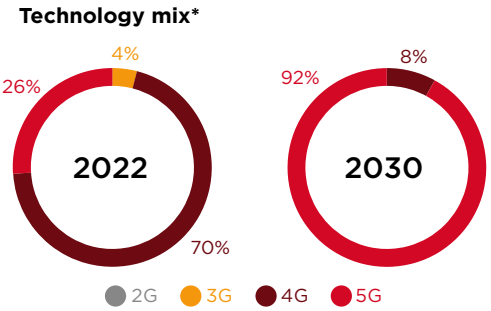
Pakistan



Subscriber penetration	
2022	40%
2030	43%
Smartphone adoption	
2022	59%
2030	80%

APAC 5G Forum[3]

Japan



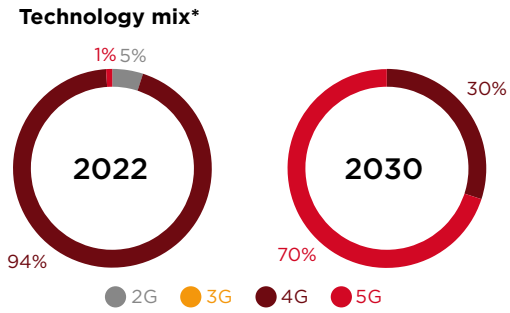
Subscriber penetration

2022	89%
2030	94%

Smartphone adoption

2022	73%
2030	93%

Malaysia



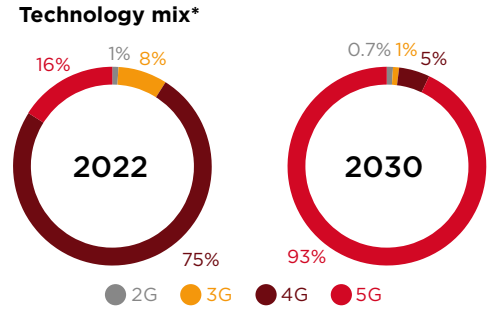
Subscriber penetration

2022	78%
2030	85%

Smartphone adoption

2022	90%
2030	96%

Singapore



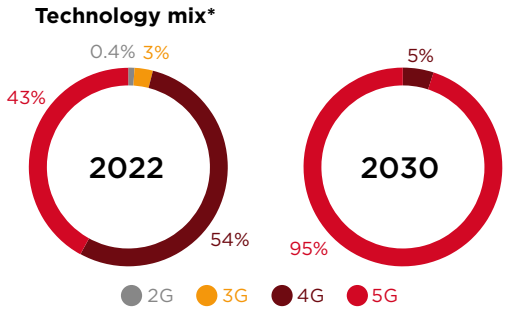
Subscriber penetration

2022	94%
2030	95%

Smartphone adoption

2022	90%
2030	96%

South Korea



Subscriber penetration

2022	96%
2030	96%

Smartphone adoption

2022	86%
2030	96%

* Percentage of total connections

2. The GSMA Leading Nations engagement (comprising Bangladesh, India, Indonesia and Pakistan) seeks to accelerate the growth of the digital economy and advance the mobile industry's sustainability by lobbying for regulatory modernisation with relevant stakeholders.
3. The GSMA APAC 5G Forum is a 5G industry engagement community platform to help 5G-pioneering operators and governments to collaborate in order to promote and foster the timely deployment and rollout of commercial 5G networks and services (B2C, B2B, B2G) through the promotion of active sharing of knowledge, experiences and know-how of best practices related to 5G technologies, commercial strategies and industry policies.

01

The mobile industry in numbers

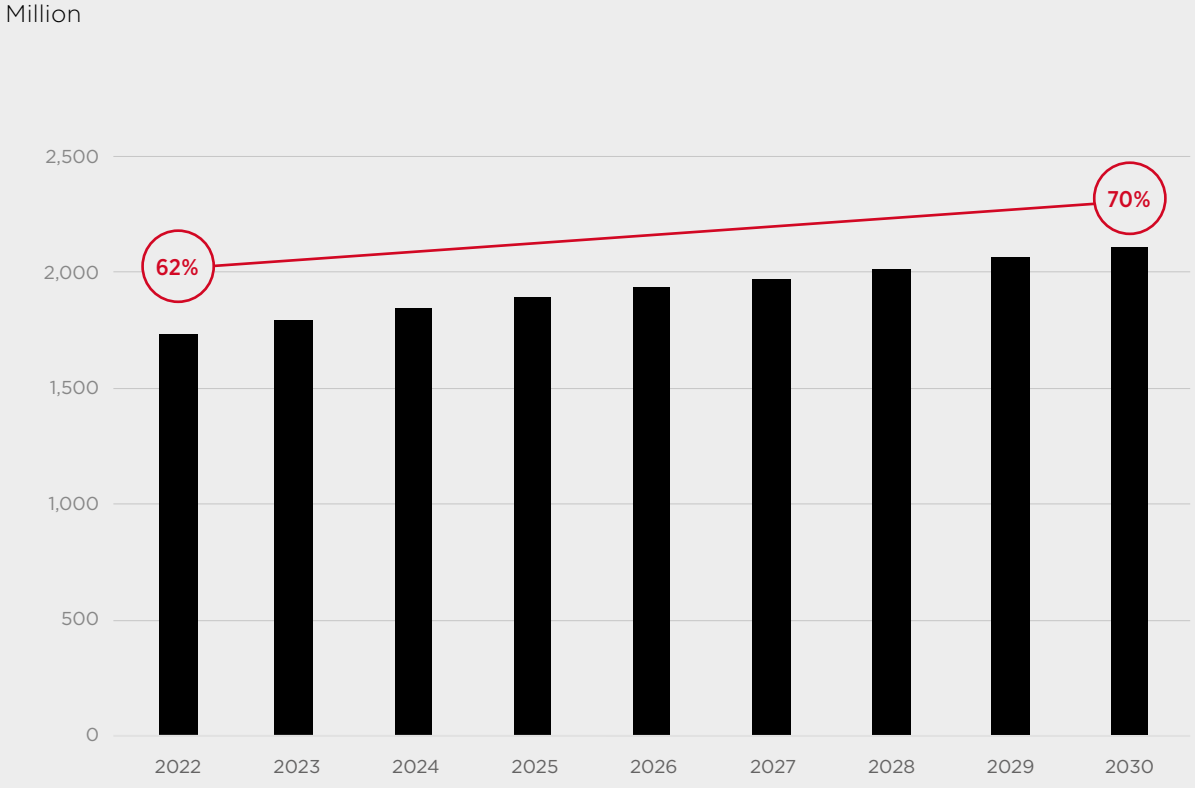
Unique mobile subscribers in Asia Pacific totalled 1.7 billion in 2022, rising to 2.1 billion by 2030

There has been steady growth in unique mobile subscribers in Asia Pacific. Over the next seven years, nearly 400 million new subscribers are expected to be added. South Asia accounts for around two thirds of total mobile subscribers in Asia Pacific, and the majority of new subscribers over the period to 2030 will also come from the sub-region.

Mobile penetration in Asia Pacific will reach 70% by 2030, compared to the global average of 73% by the same year. The penetration rate is highest in Northeast Asia and Oceania at 82% and 79%, respectively.

Figure 1

Asia Pacific: mobile subscribers and penetration



Source: GSMA Intelligence

There were 1.36 billion mobile internet subscribers in Asia Pacific in 2022

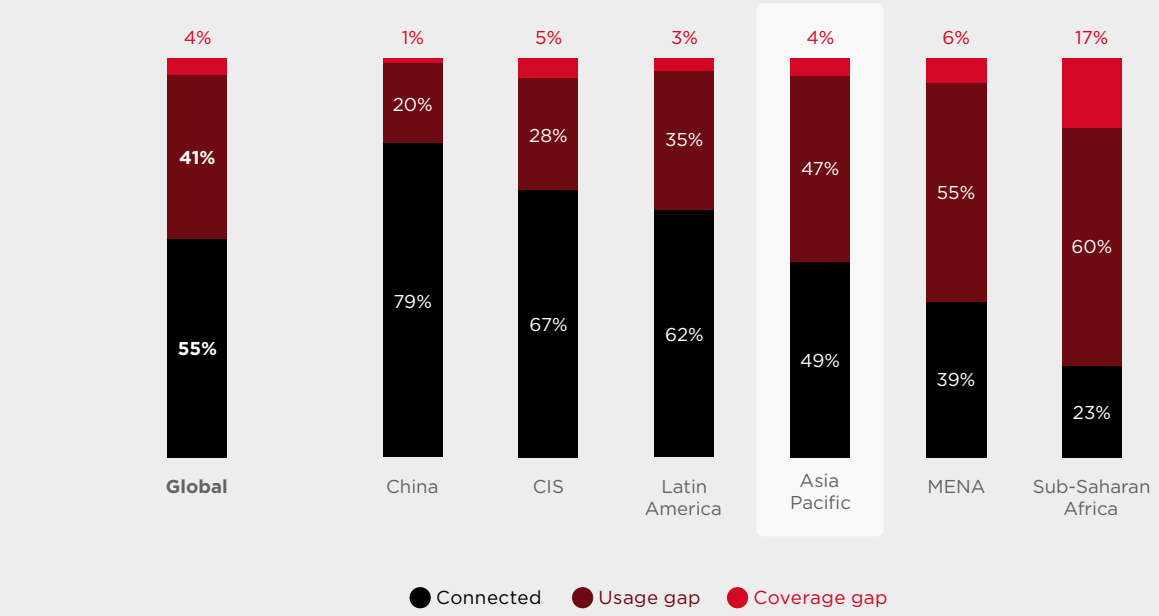
Almost half of the population in Asia Pacific is connected to the mobile internet. The mobile internet usage gap in the region has narrowed significantly from 60% in 2017 to 47% in 2022, reflecting the increasing affordability of devices and improving digital skills. Additionally, more people now rely on the internet for many daily activities, which has been partly driven by the Covid-19 pandemic.

The mobile internet landscape in Asia Pacific is diverse: mature markets such as Australia, South Korea and New Zealand have adoption levels of over 80%, while barriers continue to impact access and usage in other markets. These include poor digital skills (especially among older populations), lack of affordability of devices and services, and online safety concerns.

Figure 2

Mobile internet penetration by region, 2022

Percentage of population



Source: GSMA Intelligence

5G will account for more than two in five mobile connections by 2030

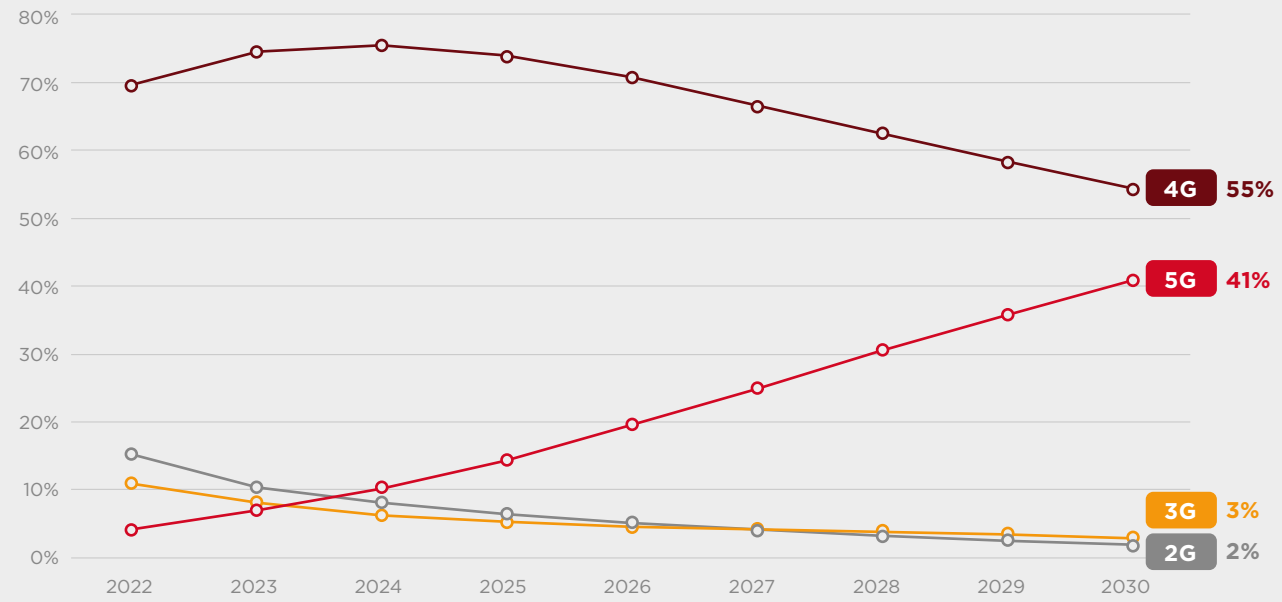
5G is gaining momentum across Asia Pacific, driven by a combination of factors, including rapid network expansion in many markets (such as India), the fall in average selling price of 5G devices and operators' marketing efforts. From now to 2030, 5G adoption will rise nearly sixfold to 41%.

Despite the growth of 5G in mature markets, 4G will remain the dominant technology at a regional level for the foreseeable future, accounting for more than half of total connections by 2030. Meanwhile, legacy networks (2G and 3G) are on their way to being phased out. Operators in several countries, including Australia, Japan and the Philippines, have recently announced plans to shut down legacy networks in the coming years.

Figure 3

Asia Pacific: mobile adoption by technology

Percentage of total connections



Source: GSMA Intelligence

Countries in Asia Pacific are among global leaders in 5G adoption

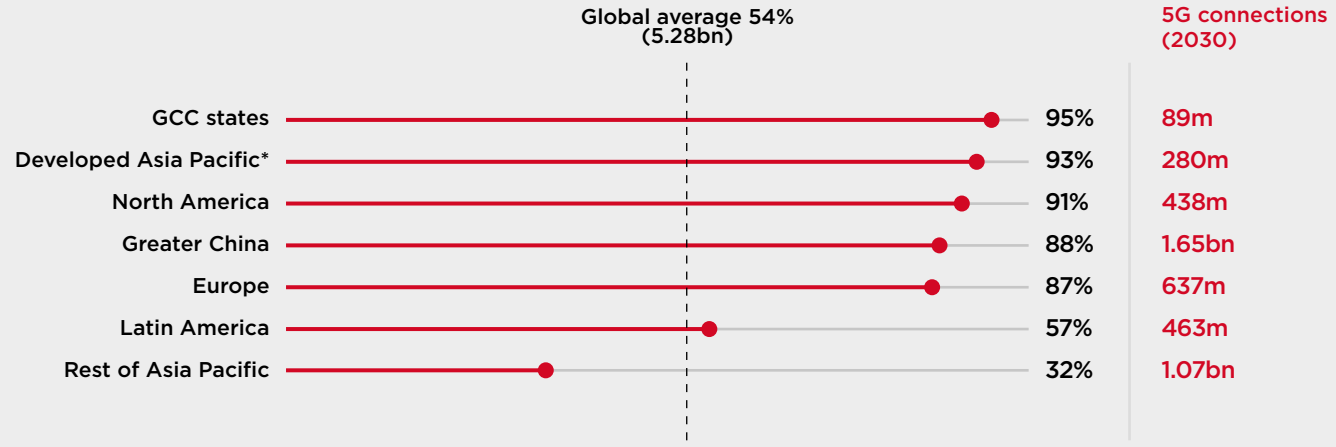
The first wave of 5G growth was dominated by pioneer markets in North America, Western Europe, Northeast Asia and the Gulf. By the end of 2023, 5G adoption will have hit the mass market in Australia (42%), Japan (47%) and South Korea (53%), putting them on par with global peers such as China (45%), Germany (35%) and the US (59%).

The second wave is now underway and is being driven by the rollout of 5G networks in large emerging markets, such as India. Although 5G's share of mobile connections will remain higher in first-wave markets by 2030, second-wave markets will record a much higher number of new 5G connections, taking the global total to 5 billion by 2030.

Figure 4

5G adoption in 2030

Percentage of total connections



* Australia, Japan, New Zealand, Singapore and South Korea
Source: GSMA Intelligence

Smartphone adoption will rise by double digits on average over the period to 2030

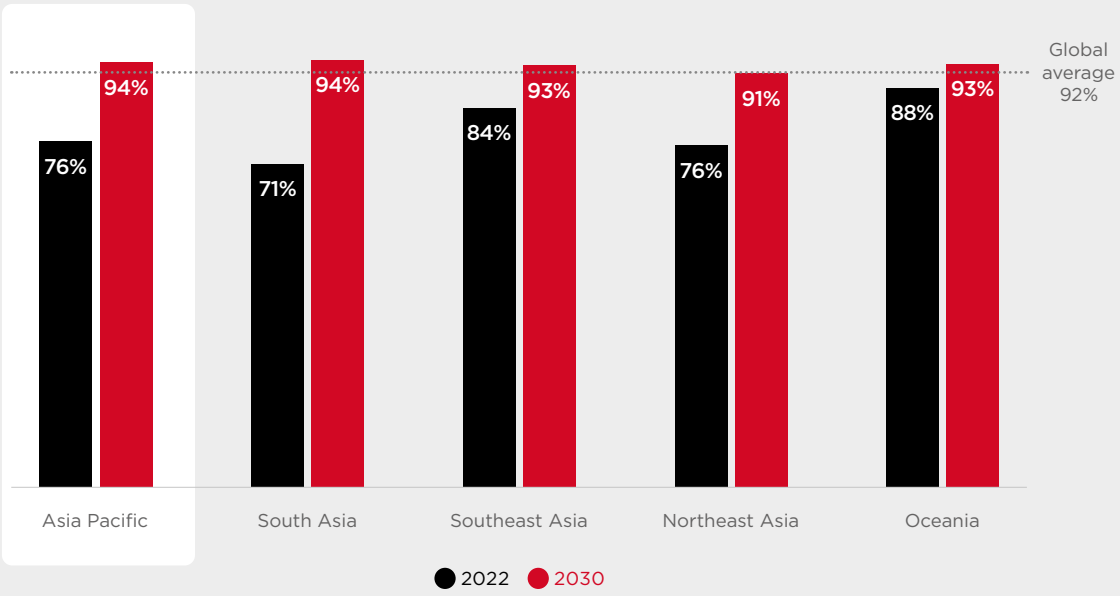
There will be over 3 billion smartphone connections in Asia Pacific by 2030. This will translate to a smartphone adoption rate of 94% for the region, compared to the global average of 92%. The increase in smartphone connections is consistent across the region, with both mature and emerging markets seeing significant increases in adoption rates.

Availability of affordable smartphones and improved digital literacy both play a key role in smartphone adoption and usage. Some countries in Asia Pacific have launched initiatives to enhance digital skills among vulnerable groups, such as women and the elderly. In its 2023 budget, the government of India reduced customs duty on the import of some inputs for phone manufacturing,[4] a positive step for the production of more affordable phones.

Figure 5

Smartphone adoption

Percentage of connections (excluding licensed cellular IoT)



Top three smartphone markets in Asia Pacific (smartphone connections, 2030)

India **1.3 billion**

Indonesia **381 million**

Japan **168 million**

Source: GSMA Intelligence

4. "Budget 2023 impact: Mobile phones expected to get cheaper in India", India Today, February 2023

Asia Pacific is home to markets with some of the highest mobile data traffic

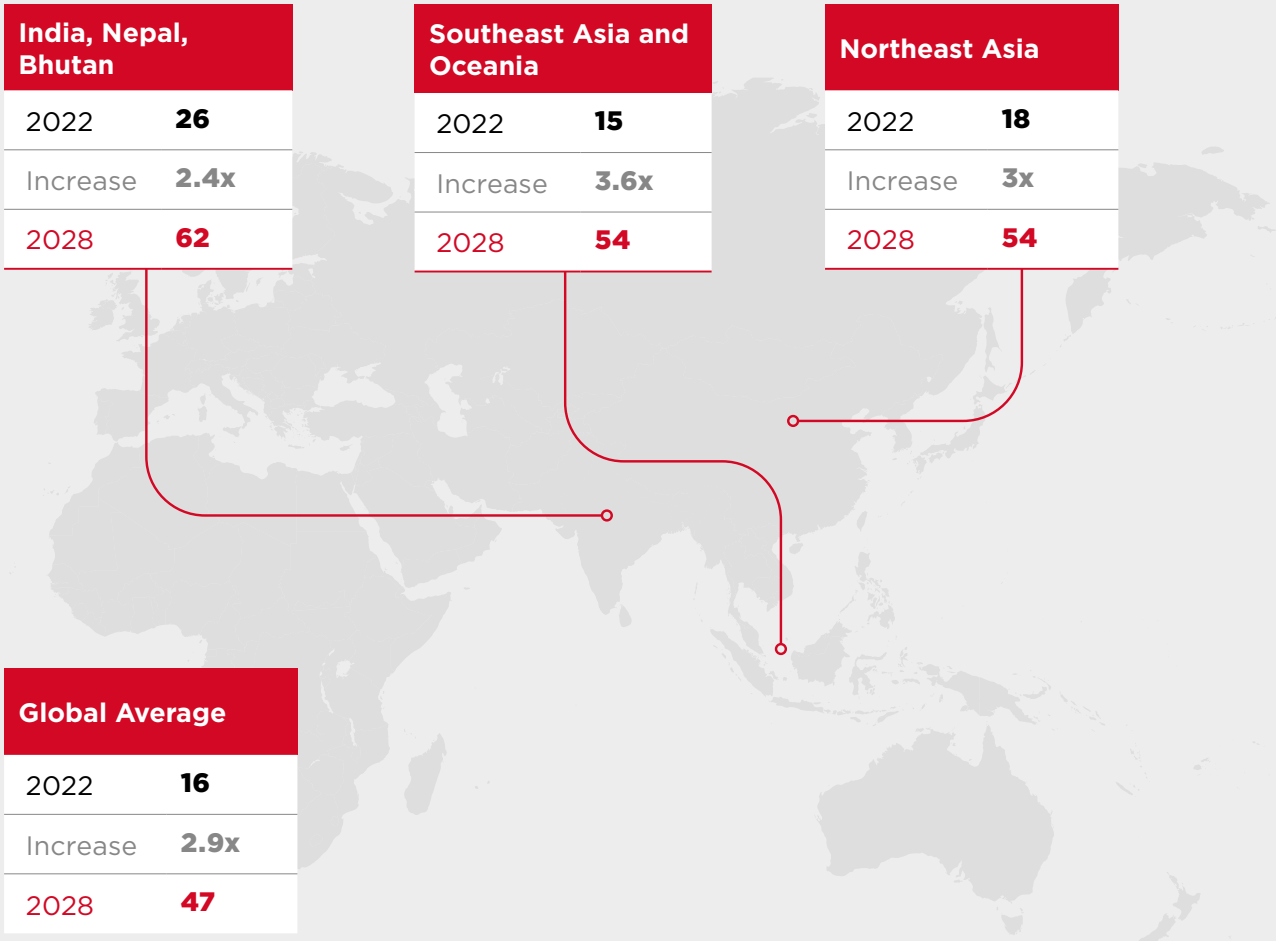
Mobile data traffic will more than double in countries across Asia Pacific over the period to 2030. 5G is a key driver of mobile data traffic growth, as evidenced by the technology's growing share of overall mobile data traffic. According to a GSMA Intelligence survey, 5G subscribers are more interested than 4G users in adding services and content to their mobile contracts.

In Asia Pacific, video and online gaming are among the top services and content utilised by 5G users. For example, Telkomsel's Dunia Games, the leading e-sports organiser in Indonesia, holds the Dunia Games WIB Championship, which is attended by over 45 professional teams and more than 14 million online viewers.

Figure 6

Mobile data traffic per smartphone

GB per month



Source: GSMA Intelligence based on Ericsson Mobility Report June 2023

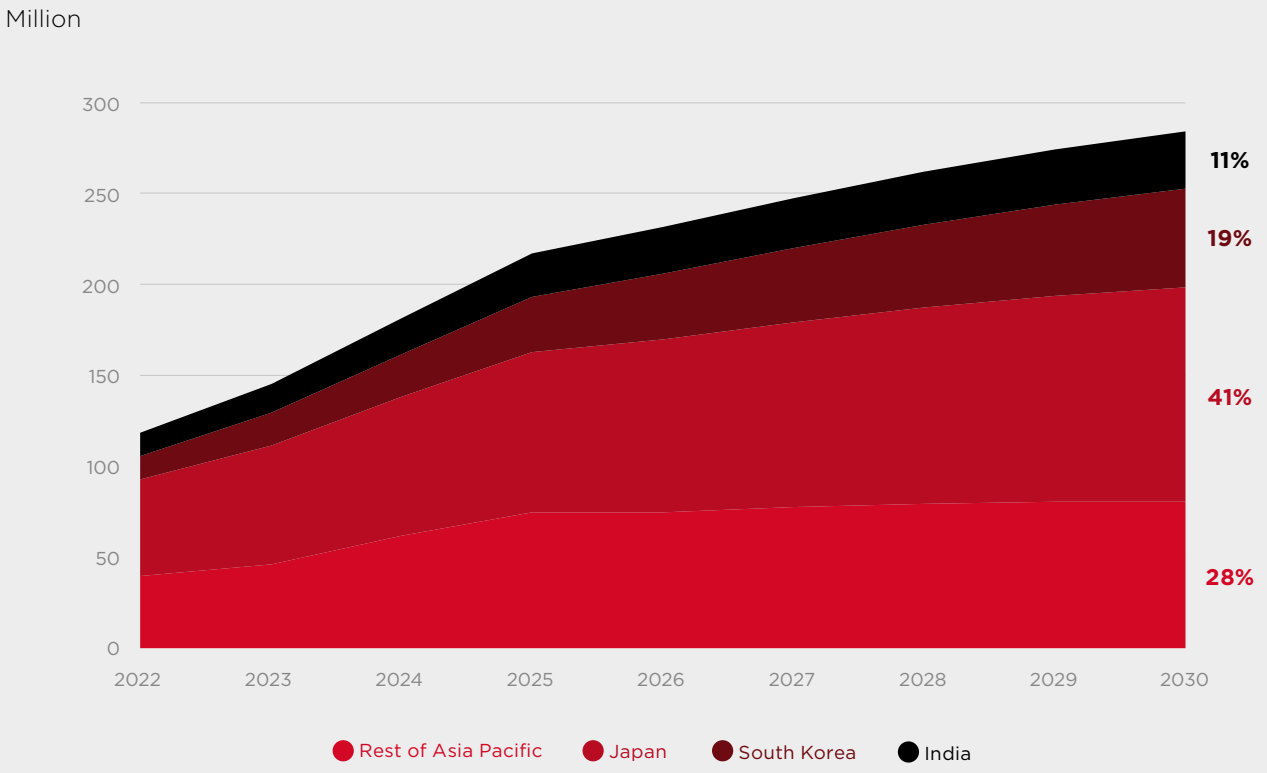
Licensed cellular IoT connections will more than double by 2030

There will be more than 280 million cellular IoT connections in Asia Pacific by 2030. India, Japan and South Korea will account for nearly three quarters of these connections. There will be a boost to IoT applications as 5G networks expand across the region because 5G enables new IoT use cases based on its low-latency and high-capacity capabilities.

IoT will be crucial to the realisation of the digital transformation ambitions of countries across Asia Pacific, as it will enable a wide range of initiatives such as smart manufacturing, smart cities, energy-efficient construction and low-impact industrialisation.

Figure 7

Asia Pacific: licensed cellular IoT connections



Source: GSMA Intelligence

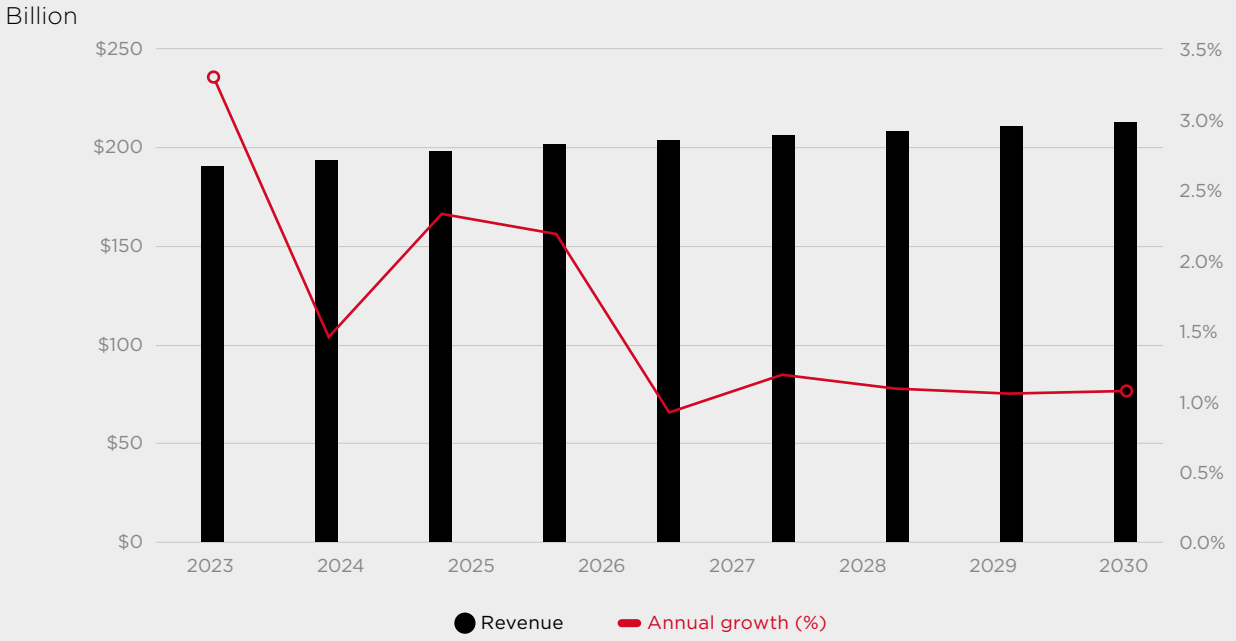
Service diversification supports revenue growth in some markets

Revenue growth in Asia Pacific is expected to remain in positive territory, despite increasing competition, as operators continue to diversify their services and generate new revenue streams.

In mature mobile markets in the region, there is strong interest in online gaming, cloud and 5G-enabled immersive applications. Elsewhere, growing demand for mobile data and mobile financial services have emerged as key revenue growth drivers for operators. In Bangladesh, for example, some operators continue to record double-digit growth in data revenues on increased usage and growing subscriptions. However, this is offset by slower growth in other countries, resulting in sluggish overall revenue growth in the region.

Figure 8

Asia Pacific: mobile revenue and year-on-year growth



Source: GSMA Intelligence

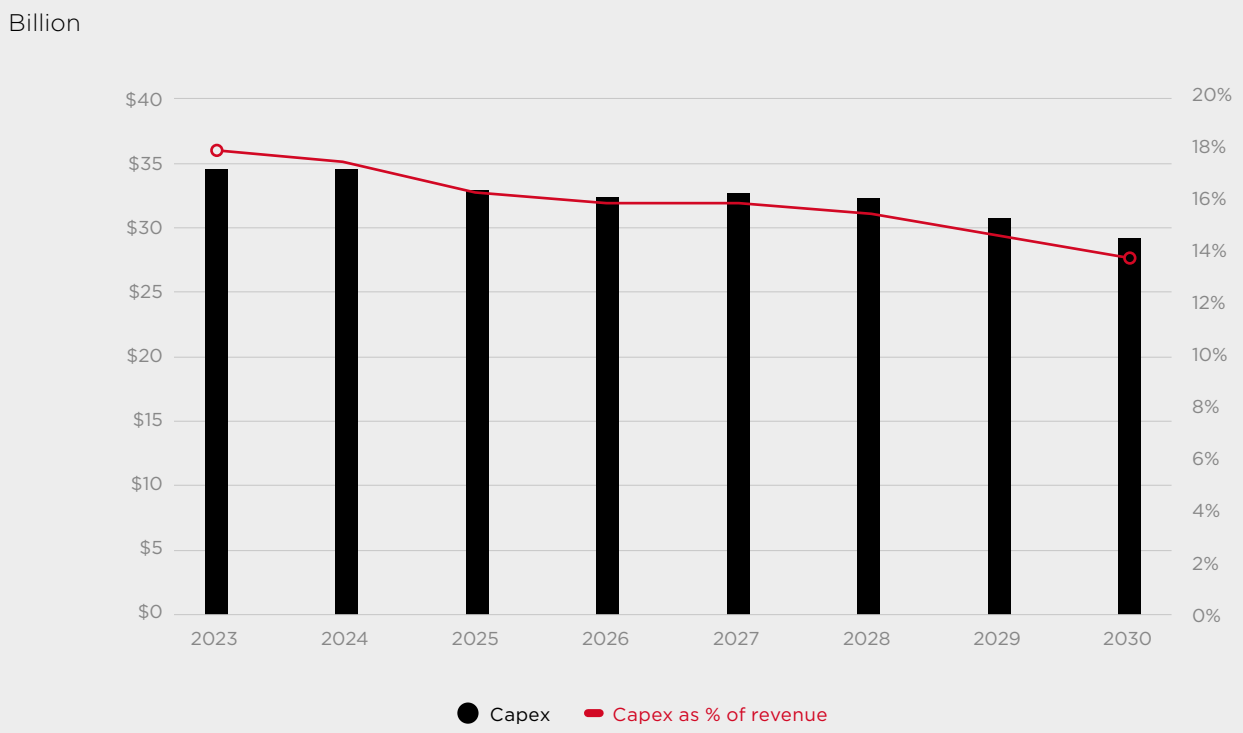
Operators will spend $259 billion on their networks during 2023–2030, mostly on 5G

Following extensive 5G network buildout over the last few years in pioneer 5G markets, resulting in record capex intensity in some markets, capex levels in these markets will begin to moderate. The focus will instead shift towards 5G monetisation as operators seek returns on significant capital outlays.

While frontier markets in the region will ramp up investments in 5G in 2023, the pace of 5G rollout will not be sufficient to stem the overall decline in capex. This is because earlier network generations, such as 3G and 4G, will remain integral to the connectivity landscape for the foreseeable future.

Figure 9

Asia Pacific: mobile operator capex



Source: GSMA Intelligence

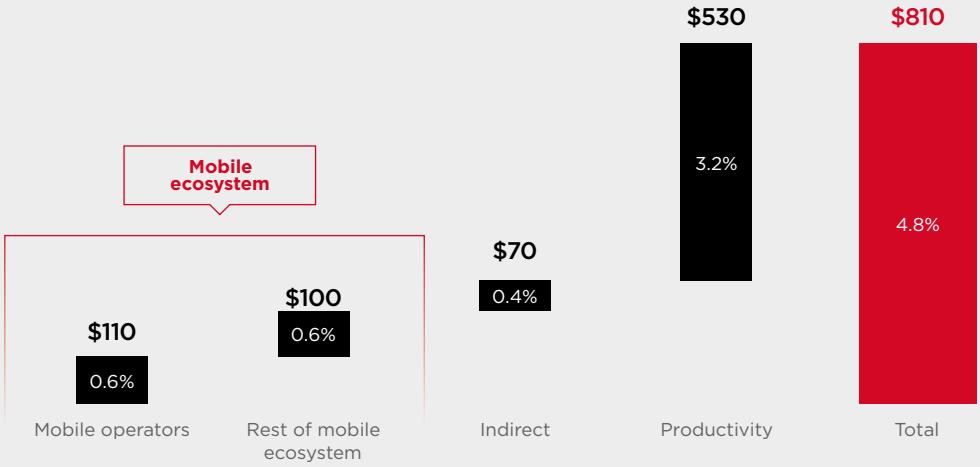
In 2022, the mobile sector added $810 billion of economic value to the Asia Pacific economy

In 2022, mobile technologies and services generated 4.8% of GDP across Asia Pacific, a contribution that amounted to around $810 billion of economic value added. The greatest benefits came from productivity effects reaching $530 billion, followed by the rest of mobile ecosystem, which generated $210 billion.

Figure 10

Total economic contribution of the mobile ecosystem in Asia Pacific, 2022

Billion



Source: GSMA Intelligence

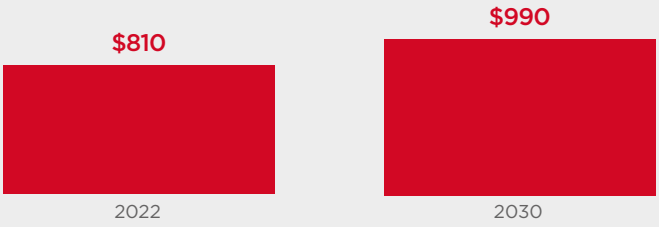
At the end of the decade, mobile's economic contribution will reach almost $1 trillion

By 2030, mobile's contribution will reach approximately $990 billion in Asia Pacific, driven mostly by the improvements in productivity and efficiency brought about by the increased take-up of mobile services.

Figure 11

Economic impact of mobile in Asia Pacific

Billion



Source: GSMA Intelligence

The Asia Pacific mobile ecosystem supported around 11 million jobs in 2022

Mobile operators and the wider mobile ecosystem directly employed around 7 million people across Asia Pacific in 2022. In addition, the economic activity in the ecosystem generated around 4 million jobs in other sectors, meaning that nearly 11 million jobs were directly or indirectly supported.

Figure 12

Employment impact of the mobile industry in Asia Pacific, 2022

Jobs (million)

Source: GSMA Intelligence

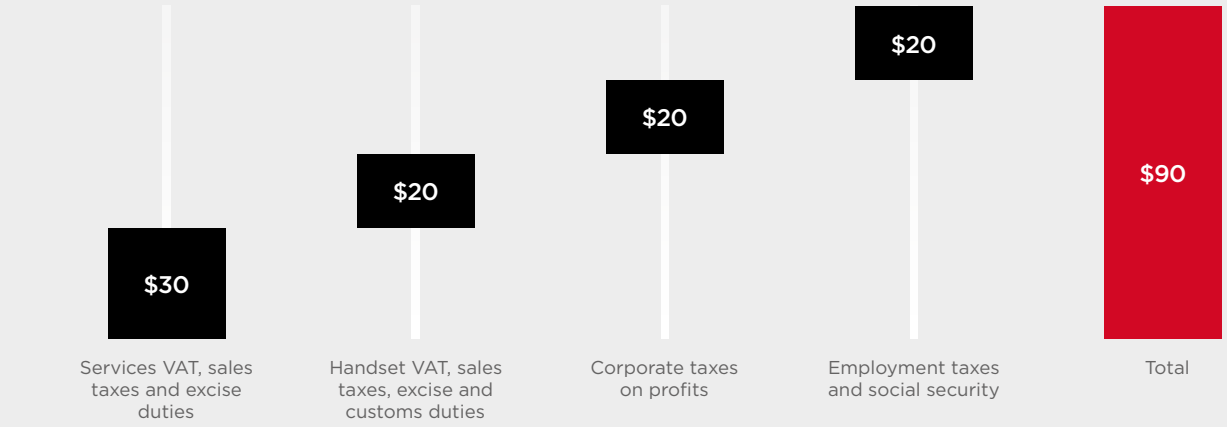
In 2022, the fiscal contribution of the mobile ecosystem reached $90 billion

In 2022, the mobile sector made a substantial contribution to the funding of the public sector, with around $90 billion raised through taxes on the sector. This was driven by services VAT, sales taxes and excise duties, which generated $30 billion, followed by handset VAT, corporate taxes on profits and employment taxes at $20 billion each.

Figure 13

Fiscal contribution of the mobile industry in Asia Pacific, 2022

Billion



Source: GSMA Intelligence

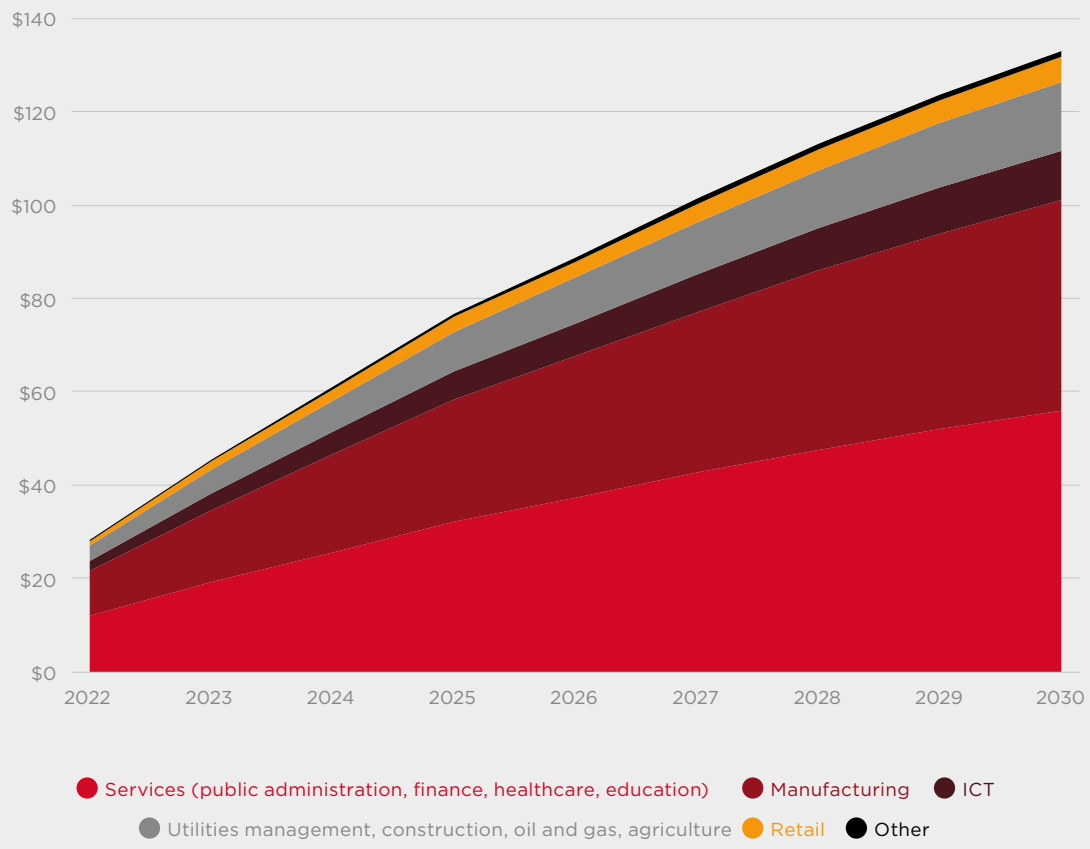
5G will add more than $130 billion to the Asia Pacific economy in 2030

5G is expected to benefit the Asia Pacific economy by $133 billion in 2030, or more than 13% of the overall economic impact of mobile. Much of the 5G benefits will materialise over the period to 2030, as some countries are in early stages of deployment and 5G economic benefits will increase as the technology starts to achieve scale and widespread adoption.

Figure 14

Annual 5G contribution by industry in Asia Pacific

Billion



Source: GSMA Intelligence

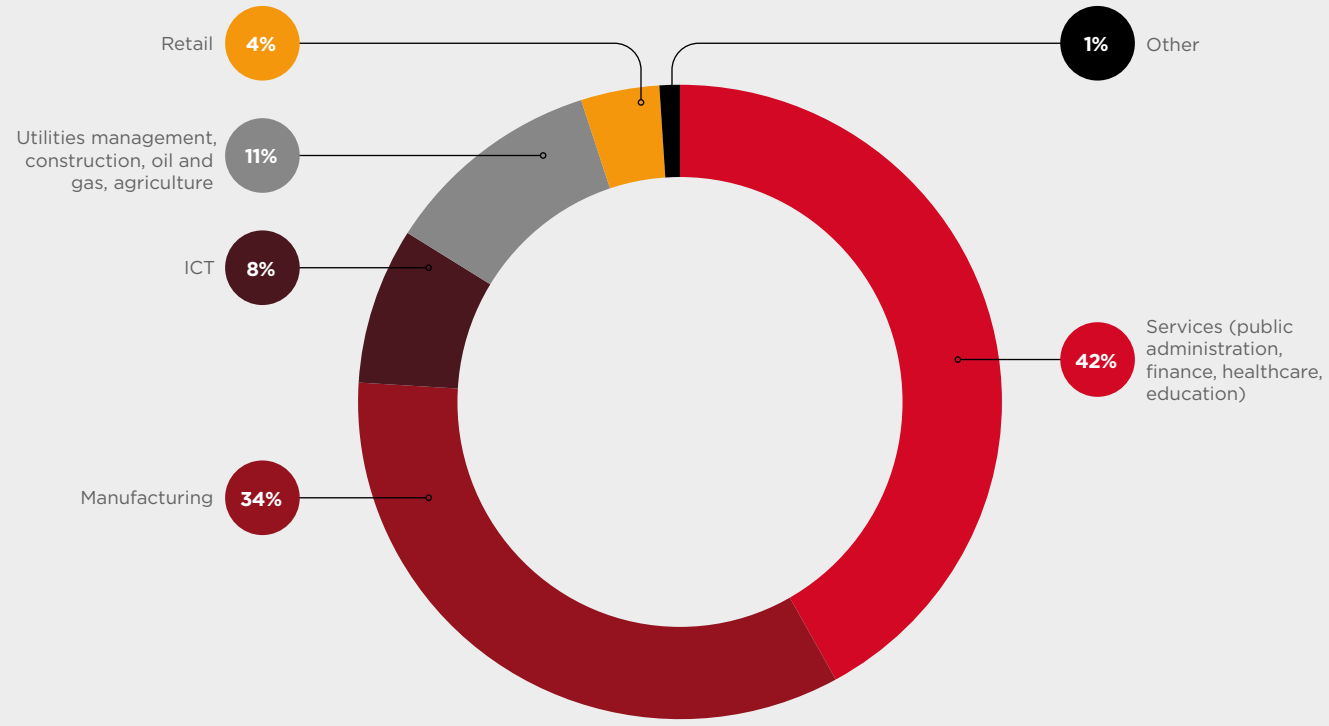
The benefits of 5G in 2030 will focus on the services and manufacturing industries

5G is expected to benefit most sectors across the Asia Pacific economy, depending on their ability to incorporate 5G use cases in business. In 2030, 42% of the benefits are expected to originate from the services sector and 34% from manufacturing, driven by applications that include smart factories, smart cities and smart grids.

Figure 15

5G contribution by industry in Asia Pacific, 2030

Percentage of total benefit



Source: GSMA Intelligence

02

Mobile industry trends

2.1
The 5G monetisation imperative grows

At the end of March 2023, 29 mobile operators in 15 markets across Asia Pacific had launched commercial 5G mobile services. Across the region, and elsewhere, the focus is shifting towards 5G monetisation from both the consumer and enterprise segments as operators seek returns on significant capital outlays. Encouragingly, insights from the GSMA Intelligence Consumer in Focus Survey 2022 show that the majority of 5G consumers continue to express satisfaction with their 5G network experience, with faster speeds being the top reason, and remain willing to pay extra for their mobile subscription compared to what they currently pay for their current 4G subscription.

However, faster speeds alone are unlikely to sustain pricing premiums and, by extension, long-term revenue growth – a 'wow' factor is required to attract new customers or incentivise existing ones towards higher spend. XR is a strong candidate here, having the potential to usher in a new age of immersive consumer experiences that benefit from 5G's advanced capabilities around speed, latency and capacity. The proliferation of eSIM-enabled smartphones and other devices means that operators can upsell customers to higher-value data plans by offering 5G bundles that link XR devices to a main smartphone subscription.

Several operators in Asia Pacific are taking steps in this direction:

- **NTT Docomo** has created a new unit called Qonoq that will develop XR hardware and software products.
- **Jio's** subsidiary, Jio Tesseract, is building its own XR hardware.
- **LG Uplus** has developed over 3,500 pieces of high-quality 3D VR content such as movies, sports and comics.

5G FWA momentum builds

As of March 2023, 17 operators in eight Asia Pacific countries offered 5G FWA services. Markets where the fixed broadband technology mix is skewed towards xDSL, such as Australia, and those with low total fixed broadband penetration, such as the Philippines, are expected to lead the growth of 5G FWA in the region. In May 2023, Globe Philippines reported that FWA accounted for a quarter of its home broadband revenues, with the solution used in rural areas and as an alternative in urban areas where fibre broadband is not yet available. 5G FWA is also growing in other parts of Southeast Asia, such as Indonesia and Thailand, with the potential to drive incremental revenue opportunities for operators.[5]

Telkomsel partners with Ericsson and Qualcomm for 5G FWA solution

In February 2023, Telkomsel, Ericsson and Qualcomm revealed plans to develop a 5G-based FWA technology roadmap in Indonesia. Having received clearance from the Ministry of Communications and Informatics (KemKominfo), the operators and their partners will conduct advanced 5G technology trials using new frequency spectrum of 3.5 GHz and 26 GHz via a temporary permit. The 5G FWA roadmap aims to deliver 5G SA NR-DC (new radio dual connectivity), combining 100 MHz bandwidth at the 3.5 GHz frequency and 800 MHz bandwidth at the 26 GHz frequency for ultra-capacity, lower-latency capabilities and peak throughput speeds of up to 7.37Gbps.[6]

5. The 5G FWA opportunity: a scenario for Southeast Asia, GSMA Intelligence, June 2022
6. "Telkomsel, Ericsson, and Qualcomm strengthen collaboration on 5G-Based Fixed Wireless Access technology roadmap development to enhance digital experience in Indonesia", Ericsson, February 2023

The enterprise sector will be pivotal to 5G monetisation

While the consumer segment represents the largest contributor to operator revenues, the enterprise segment will be the main revenue growth driver as operators target the digital transformation of industries. 5G SA will be central to operators' future enterprise strategies, enabling them to unlock the full range of 5G functions, including massive machine-type communications (mMTC), improved network slicing and ultra-reliable, low-latency capabilities. Allowing developers to directly tap into network capabilities via exposed APIs (which connect into network functions) can accelerate 5G monetisation. The GSMA's Open Gateway is the latest industry move in this direction.[7]

Globally, Asia Pacific leads the way on 5G SA commercialisation, with deployments in seven countries (Australia, India, Japan, the Philippines, Singapore, South Korea and Thailand). In Singapore, for example, operators have used 5G SA to target new revenue opportunities in a range of sectors, including maritime and live entertainment.[8,9]

Figure 16

Operator rankings of the benefits of 5G standalone in Asia Pacific

Rank the following benefits of deploying 5G standalone in your network (ranking score percentage, among Asia Pacific respondents)

Source: GSMA Intelligence Operators in Focus: Network Transformation Survey 2022

7. Signatories in Asia Pacific to the GSMA Open Gateway MoU include Axiata, Bharti Airtel, KDDI, KT, Singtel, STC, Telenor and Telstra.
8. "M1 doubles down on maritime 5G", Computer Weekly, April 2023
9. "Singtel welcomes F1 to Singapore with enhanced and immersive experiences across the island for locals and visitors", Singtel, September 2022

StarHub and Google highlight the power of combining 5G SA and edge compute

In February 2023, StarHub announced its collaboration with Google Cloud to create an open and scalable cloud-native network for businesses to accelerate their digital transformation in Singapore. This joint effort involves piloting Google Distributed Cloud Edge (GDC Edge) and the Nokia 5G Standalone Core to establish a software-based 5G cloud core network. GDC Edge allows StarHub to run core network functions at the edge, enhancing the delivery, scalability and performance of services while reducing operational costs. Through this collaboration, StarHub aims to improve customer experience, explore new business models and increase revenue opportunities by providing secure, low-latency and optimised software-driven 5G networks to subscribers and enterprise customers in various industries such as manufacturing, retail, hospitality and transportation.

Private 5G is also gaining traction as verticals accelerate their digital transformation plans. To date, private 5G activity in Asia Pacific has been concentrated in the region's mature markets, such as Australia, Japan, South Korea and Singapore, reflecting the higher levels of digitalisation across the public and private sectors. Elsewhere, momentum is beginning to grow, such as in India and Thailand. A GSMA Intelligence survey found that 16% of operators in Asia Pacific expect private networks to account for over 20% of enterprise revenues by 2025. The contribution of private wireless to operator enterprise revenues will likely rise in the second half of the decade as private 5G network equipment and devices become more readily available.[10]

The competitive implications of private 5G networks are complex and varied. This is in part because the technology is still being developed, and even more so because of 'co-opetition' among ecosystem players, whereby companies targeting the private 5G opportunity must take a balanced approach by maintaining relationships with existing clients competing in the space. For operators, and the wider ecosystem, collaboration is crucial to build synergies and leverage key strengths to realise the private 5G opportunity. Examples of such collaboration include the following:

- In May 2023, **Singtel** announced a partnership with **Microsoft** to make the Azure public multi-access edge compute (MEC) available for all enterprises.
- In March 2023, **Indosat Ooredoo Hutchison** partnered with **Nokia** to build a wide-area private wireless network in key regions in East and Central Java, Sumatra and Kalimantan.

Singtel partners with Nokia for 5G IP transfer network slicing

In March 2023, Singtel and Nokia announced the successful implementation of IP transport slicing across an end-to-end 5G network. The proof of concept took place in Singtel's 5G Garage, a live test facility, training centre and ideation lab, involving 5G radio, 5G core and Nokia's IP transport network slicing solution. It focused on evaluating the solution's capabilities to deliver end-to-end service performance for different network slices and optimise network resources on demand.

The solution is expected to reduce operational expenditure by improving management and utilisation of network resources. End-to-end network slicing would also allow consumers and enterprises to access differentiated service performance and enable Singtel to provide new services, including 5G VPN and slicing for enterprise applications, as well as enhanced gaming, HD streaming and XR.

10. Exploring 5G private network opportunities in Asia Pacific, GSMA Intelligence, 2023

2.2
Generative AI on the rise

Mobile operators have utilised AI for a while now to varying degrees, from improving network operations[11] and customer service to achieving efficiencies and cost savings.[12] However, the emergence of generative AI has brought new AI capabilities to the fore, beyond basic functionalities such as responding to simple queries, call routing and smart handover to agents. Emerging generative AI use cases for operators include the potential to automate more complex functions that require a better understanding of context, given the improved ability of AI to follow a conversation, and advanced synthesis of information. In South Korea, for example, KT has built such capabilities into its generative AI tool, known as MI:DEUM, which it plans to launch in the second half of 2023.

Beyond the application of advanced AI capabilities within network operations, operators and enterprises in different sectors are moving to integrate generative AI into their business operations to deliver a more personalised service to customers. In Japan, the government is developing a national AI strategy that aims to harness the potential of AI to tackle various economic and social challenges, such as those associated with an ageing population. SoftBank plans to develop a Japanese equivalent of ChatGPT, while NTT has announced that it will develop its own large language model that it will offer to other enterprises.[13] In South Korea, SK Telecom plans to launch 'A.', its AI chatbot and alternative to ChatGPT, in 2023. It plans to integrate the technology into various services, including e-commerce and music streaming in order to create more customised bundles of services for customers in real time and on demand.[14]

Infusing AI applications into enterprise use cases

Early applications of generative AI in enterprises pertain to content development. In the short term, generative AI will assist those producing content or code, by minimising time spent on research and write-up. Beyond this, upcoming AI tools will be able to produce business strategy slides, summarise long legal documents, produce charts from complex data, shoot original video content, write social media posts and help with software development.[15]

A further wave of tools will contextualise the use of such large language models for specific industries and applications. These will enable enterprise interaction through API connections. Goldman Sachs estimates that as natural language processing tools make their way into businesses and society, they could drive a 7% increase (almost $7 trillion) in global GDP and lift productivity growth by 1.5 percentage points over a 10-year period.[16]

In May 2023, Tata Consultancy Services selected Google Cloud's generative AI tools to launch its own offering aimed at developing customised services for its enterprise clients across the retail, smart manufacturing and robotics sectors.[17] In Singapore, Singtel is collaborating with Microsoft and Nvidia to combine AI and 5G so that enterprises can boost their innovation and productivity. Using Nvidia's full-stack accelerated computing platform optimised for Microsoft Azure public MEC, the operator is creating solutions that allow customers to leverage AI video analytics for multiple use cases and to deploy 5G conversational avatars powered by large language models.

11. The essential role of AI in improving energy efficiency, GSMA Intelligence, 2021
12. ChatGPT and other advanced AI for operators: smarter and more personalised customer experience, GSMA Intelligence, 2023
13. "Japan looks to play catch-up on generative AI", Japan Times, May 2023
14. "A South Korean telco giant has its own A.I. chatbot — and says it's a 'super app' version of ChatGPT", CNBC, April 2023
15. Generative AI gets to work: the enterprise opportunity, GSMA Intelligence, 2023
16. "Generative AI could raise global GDP by 7%", Goldman Sachs, April 2023
17. "TCS tools up for generative AI with Google Cloud", Mobile World Live, May 2023

Figure 17

Examples of different sectors and businesses already utilising generative AI

Country	Sector	Example
Australia	Graphic design	Canva, an Australian graphic design platform, integrates generative AI to simplify the design process. Its 'Magic Design' feature uses generative algorithms to assist users in creating aesthetically pleasing designs by suggesting layouts, colours and elements.
India	Logistics	Locus, an Indian logistics optimisation platform, employs generative AI for route planning and fleet management. Its algorithms generate optimised delivery routes, considering factors such as traffic, weather conditions and vehicle capacities.
Japan	E-commerce	Rakuten has deployed online chatbots and recommendation systems that utilise generative models to provide personalised customer experiences.
Singapore	Financial services	Advance.AI leverages generative AI for fraud detection and risk assessment in financial services. Its models analyse large volumes of data to identify patterns and anomalies, helping businesses mitigate risks.

Source: GSMA Intelligence

The rise of generative AI tools comes at a time when enterprises across various sectors are seeking ways to achieve efficiency and productivity gains. Using these tools, enterprises will create significant demand for data traffic and reliable network-based services, such as edge compute and ultra-low-latency applications, which 5G networks are well placed to deliver. As highlighted in a recent GSMA Intelligence report,[18] operators have the potential to seek growth in this space through relevant services, for example by integrating 5G services with support for generative AI.

AI regulation will be a growing priority

Despite the potential to reap significant benefits from the application of advanced AI in business and society, there are valid ethical concerns around the technology that still need to be addressed. In June 2023, a group of technology companies (including Google, Microsoft and OpenAI) co-signed a statement with other stakeholders warning of the risks of AI. The statement, published by the Center for AI Safety, states that the need to mitigate the risk of extinction from AI is a global priority.

Threats include the spread of misinformation and violations of data privacy laws associated with how generative AI models generate new outputs based on the data they have been trained on, and concerns around the impact of new AI tools on employment and education. As enthusiasm for AI development and the desire to be at the forefront of deployments gain momentum, AI regulation is likely to continue to move up the policy agenda, with governments and other authorities looking to develop frameworks for regulating the use of new AI tools.[19] Operators and vendors are among those who will reap the benefits of AI deployment; therefore, it is essential for them to be involved in initiatives that promote AI ethics and limit the risks.

18. Generative AI gets to work: the enterprise opportunity, GSMA Intelligence, 2023
19. For example, see "India planning to regulate AI platforms like ChatGPT", Times of India, May 2023

2.3
The shift to circularity gathers momentum

There are nearly 3 billion active feature phone and smartphone connections across Asia Pacific, a figure that will rise by more than 300 million by the end of this decade. Against this backdrop, the concept of circularity has risen to the top of the agenda for policymakers and industry players in light of growing concerns around the generation of e-waste and unsustainable levels of consumption of natural resources. For example, the circular way of thinking is becoming the norm in the production of mobile phones, with OEMs developing long-life devices and using recyclable and recycled materials as a means to reduce the number of devices and components that end up as waste.

As a result, the technical lifespan of a mobile device is now between four and seven years.[20] However, this is not yet matched by the average use period of mobile devices, which is around three years.[21] This suggests that the biggest barrier to reducing waste is consumer behaviour. As such, incentivising consumers will be crucial to success, although this could be complicated by a variety of factors that affect their choices, such as affordability, information availability, social norms and personal preferences.

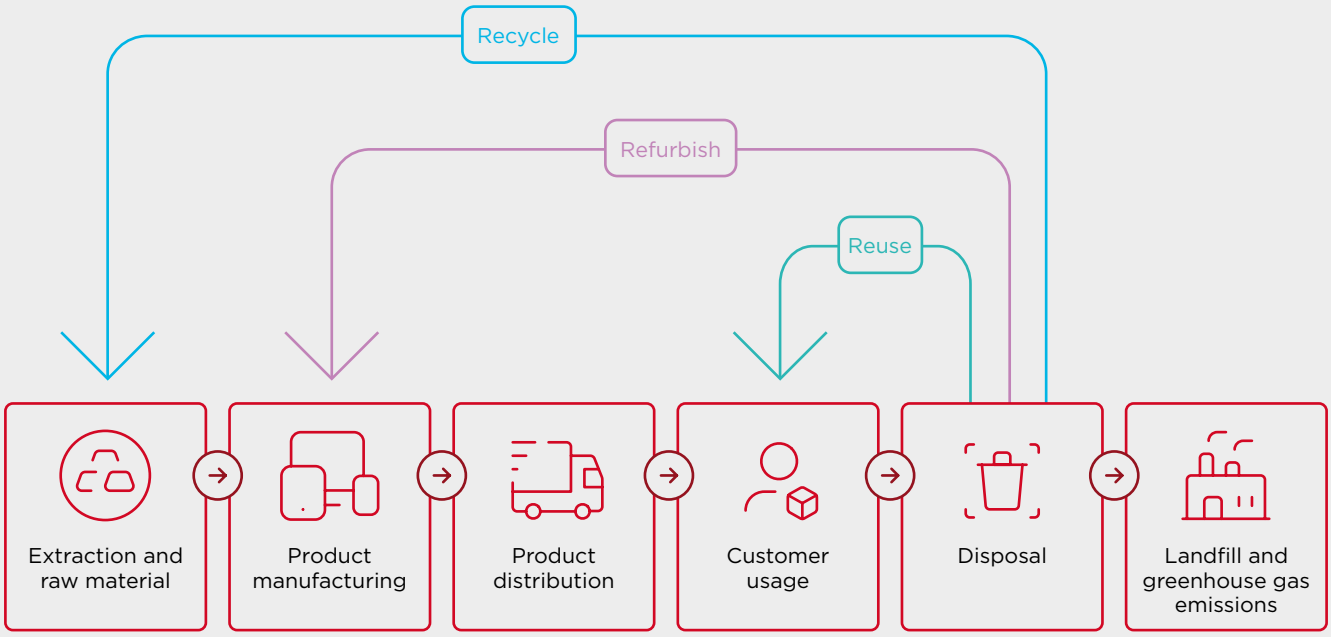
Governments and industry players have a role to play in incentivising consumers. For example, there is an opportunity to build new channels and suppliers to collect, refurbish and resell devices, as well as educate consumers and implement awareness campaigns on sustainability. Operators and other ecosystem players across Asia Pacific are already taking a lead in this regard, with initiatives to drive circularity in mobile phones and other digital devices.

The circular way of thinking is becoming the norm in the production of mobile phones, with OEMs developing long-life devices and using recyclable and recycled materials as a means to reduce the number of devices and components that end up as waste.

20. Miliute-Plepiene, J. and Youhanan, L. (2019), E-waste and raw materials: from environmental issues to business models, IVL Swedish Environmental Research Institute.
21. Statista

Figure 18

The concept of the circular economy



Source: GSMA

Initiatives to drive circularity

The GSMA partners with mobile operators to tackle the problem of dormant phones

In June 2023, the GSMA teamed up with 12 global operators, including Globe, KDDI and Singtel, to take back and recycle or repair more than 5 billion unused mobile phones in an effort to tackle e-waste. The initiative builds on efforts by the mobile industry to move away from the traditional 'take-make-dispose' approach to the materials used in mobile phones and highlights the importance of working collectively to accelerate the transition to greater circularity.

In November 2022, the European Chemical Society (EuChemS) identified 30 elements usually used in smartphones. Out of these, 11 were identified as elements with limited availability, which may cause risks to future supply, while the unsustainable usage of seven elements used in smartphones would pose a serious risk in the next 100 years. The GSMA estimates that a refurbished phone can have an 87% lower climate impact than a newly manufactured phone, and if properly recycled, 5 billion mobile phones could recover $8 billion worth of gold, palladium, silver, copper, rare earth elements and other critical minerals, and enough cobalt for 10 million electric car batteries.

Australia: national take-back scheme

MobileMuster is accredited under the Australian government's Recycling and Waste Reduction Act 2020, which stipulates annual key performance indicators (KPIs) related to the volume of mobile phones and accessories collected, annual collection rate, landfill diversion rate, recycling rate and program accessibility. The initiative has reported meeting its KPIs, including achieving a collection rate of 62.5% and meeting a recycling rate of 99%.

Australia: Optus recycling initiative

Optus launched its Circular Economy Roadmap with a target to make all Optus-branded products packaging 100% recyclable, reusable or compostable by 2025. In 2023, the operator launched an environmentally friendly modem, made from 95% recycled plastic and 100% recyclable packaging with no single-use plastics. New 5G SIMs are now 52% smaller than before, removing up to 10 tonnes of single-use plastics from circulation. Optus customers can also recycle or repurpose their old handsets, modems, smartwatches and devices through Optus' Donate Your Device and MobileMuster programmes. Some of these devices are repurposed and made available to disadvantaged members of the community; similarly, data allowances from customers are made available to disadvantaged members through Optus' Donate Your Data programme.

Japan: NTT Docomo waste-neutral initiative

In February 2023, NTT Docomo announced its latest Arrows N F-51C smartphone, an environmentally friendly 5G smartphone within FCNT's (formerly Fujitsu Connected Technologies Limited) Arrows brand of devices. FCNT is the first smartphone manufacturer in Japan to launch waste compensation services paired with a mobile phone. The Arrows N F-51C smartphone comes with waste compensation, which means that a new phone is linked to the collection and recycling of a scrap device. The waste reduction is used to 'compensate' the new device, making it waste-neutral.

Japan: KDDI waste service collaboration

KDDI has established a programme for waste treatment and collects e-waste in partnership with certified local companies, fulfilling the criteria that are based on Japan's Green Purchasing Act. KDDI also offers a paid membership service that provides customers with support in the event of malfunction, loss, theft or other incidents that may occur with smartphones or tablets.

Philippines: Globe E-Waste Zero initiative

Globe's E-Waste Zero focuses on the responsible disposal and recycling of electronic waste, which is one of the fastest-growing waste streams in the Philippines today. The recovery and recycling programme ensures that e-waste – old mobile phones, broken chargers and other electronic gadgets – do not end up in landfills. It aims not just to promote proper disposal but also to educate people about the potential harm of e-waste to the environment.

Thailand: e-waste drop points initiative

Thailand's Ministry of Natural Resources and Environment (MONRE) has joined forces with AIS to create over 2,300 e-waste drop points around the country and raise awareness on proper disposal. Mobile phones, tablets, batteries, power banks, chargers and headphones are some of the e-waste that can be disposed of at AIS shops, department stores, universities, MONRE provincial offices and Samsung service centres nationwide. Once collected, the e-waste goes to waste separation plants to be dismantled according to type (such as circuits, batteries, steel, silver, gold, and plastic) and then recycled into plastic beads, steel plates, gold and silver bars, and other materials.

2.4
Consolidation is driving scale and efficiency

In May 2023, Dialog Axiata and Bharti Airtel entered into a binding term sheet to combine their operations in Sri Lanka, subject to shareholder and regulatory approvals. This marked the continuation of a wave of telco consolidations that has swept across Asia Pacific in recent years, changing the competitive landscape in several markets. An underlying factor is the need to ramp up investments to fuel 5G rollout, improve network performance for customers and achieve efficiency gains amid growing competition and narrowing margins. Some examples and their initial outcomes are highlighted in this section.

Indonesia: Indosat Ooredoo Hutchison records improved financial performance post merger

Indosat Ooredoo and Hutchison 3 Indonesia announced their $6 billion merger in September 2021 and completed the process in February 2022. The deal gave the entity, Indosat Ooredoo Hutchison (IOH), a market share of 28% and the scale it needed to reach millions of additional customers, particularly in rural and hard-to-reach areas. In March 2023, the company's financial results showed that total revenue increased by 49% to IDR46.7 trillion ($3.119 billion) in the year after the merger, attributable to an increase in data and interconnection revenue, while net profit grew by 76% to IDR1.5 trillion ($100 million) in the same period.

Meanwhile, data from analytics firm Opensignal[22] shows there has been a positive impact on users' mobile network experience, based on improved download speeds since the merger. Following the successful integration of more than 46,000 sites, using multi-operator core network (MOCN) technology, smartphone users have seen a marked increase in 4G speeds and now spend more time connected. This, in turn, contributes directly to improved commercial performance.

Figure 19

Indosat Ooredoo Hutchison: scale before and after merger

	CK Hutchison	Indosat	Indosat Ooredoo Hutchison
Market share	11%	17%	**28%**
Position	3	2	**2**

Source: GSMA Intelligence

22. "IOH users see a substantial boost in mobile network experience following the merger", Opensignal, June 2023

Malaysia: CelcomDigi targets $1.2 billion in network savings

Celcom and Digi, subsidiaries of Axiata and Telenor respectively, announced a $10 billion merger in April 2021, completing the process in November 2022 to form the largest telco in Malaysia. In May 2023, the new entity, CelcomDigi, outlined a three-year network integration plan designed to expand 4G coverage but with fewer base stations. The operator will decommission 7,000 sites and build 2,000 new ones to increase population coverage to 98%. The move will reduce network operating costs by MYR5.5 billion ($1.2 billion) and IT expenses by MYR1.1 billion ($235 million) over three years.

Figure 20

CelcomDigi: scale before and after merger

	Celcom	Digi	CelcomDigi
Market share	21%	24%	**45%**
Position	3	2	**1**

Source: GSMA Intelligence

Thailand: True-Dtac merger leads to faster broadband speeds for subscribers

Total Access Communication (Dtac) and True Corporation announced an $8.6 billion merger (which retained the name True Corporation) in November 2021, completing the process in February 2023 to form the largest telco in Thailand. Post merger, customers are now benefiting from improved network quality and access to high-speed 5G with 2600 MHz and better 4G/5G coverage on 700 MHz in all 77 provinces of Thailand.

A study by Opensignal shows a marked improvement in 5G speeds for Dtac customers, from 29.6 Mbps in December 2022 to 82.1 Mbps in March 2023 after the merger.[23] This was attributed to Dtac gaining access to TrueMove H's 2.6 GHz spectrum, given that it did not secure any frequencies in this band in the 2020 spectrum auction and had deployed 5G in the 700 MHz band. The newly combined operator also aims to accelerate the realisation of revenue synergies, by utilising cross-selling and upselling opportunities and cost efficiencies to ensure sustainable future growth.

Figure 21

True Corporation: scale before and after merger

	Dtac	True Corporation	True Corporation (post merger)
Market share	21%	33%	**54%**
Position	3	2	**1**

Source: GSMA Intelligence

In the 5G era, scale will become increasingly important for operators as they look to muster the capital expenditure required for extensive network deployment, distribute and monetise new 5G services to consumers and enterprises, and drive cost efficiencies within their operations. This is reflected by the proposed merger between Dialog Axiata and Bharti Airtel in Sri Lanka, as the new entity expects to leverage Airtel's vast presence in the country, including a distribution network of more than 50,000 retailers.

As part of the necessary approvals, local authorities have, in most cases, put conditions in place aimed at protecting end users and addressing concerns about the potential impact on competition, prices and quality of service. In Thailand, for example, the National Broadcasting and Telecommunications Commission set conditions for Dtac and True, including price controls, separate rates for voice, data and messaging, and the independent verification of costs and service pricing. The merged entity is also required to roll out a 5G network to 75% of the population within three years.

An extensive GSMA study of the impact of the Hutchison/Orange merger in Austria on network coverage and quality, which has ramifications beyond that market, showed that the merger had a significant positive impact overall for consumers in terms of network innovation and quality.[24] For policymakers, adopting an evidence-based approach to assessing consolidation deals is crucial to achieving the best outcomes for consumers and industry players.

23. "Telecom merger boosting 5G speeds", Bangkok Post, June 2023
24. An evaluation of the Hutchison/Orange merger in Austria, GSMA, 2017

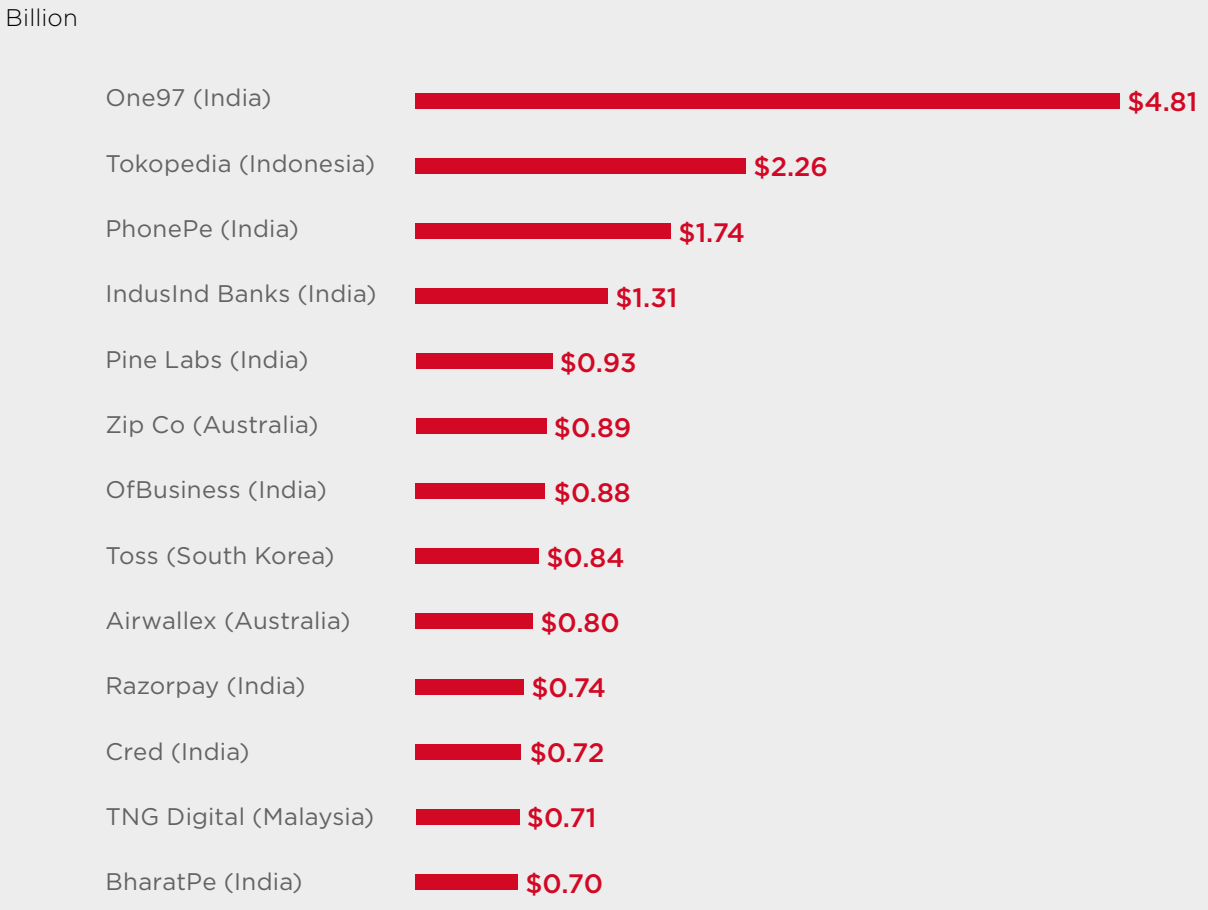
2.5
Mobile connectivity fuelling fintech solutions

Fintech has become more prominent in recent years, partly due to the impact of the Covid-19 pandemic on digital services. As more consumers take a digital-first approach to lifestyle services (e.g. shopping and entertainment), and new services and applications become mainstream (e.g. the metaverse and Web3), fintech will be an increasingly important tool for people and businesses to fulfil transactions in a digital environment.

As a result, the fintech space is, unsurprisingly, attracting innovation and significant amounts of investment. For example, 2021 was a bumper year for fintech companies globally, with KPMG figures placing total investments at $225 billion.[25] While investor sentiment fell in 2022 due to the deteriorating global political and macroeconomic environment, resulting in a 30% decline in overall funding, the Asia Pacific region bucked the trend with a marginal 0.6% increase in venture capital funding to $50.5 billion in 2022.

Figure 22

Major fintech companies in Asia Pacific by total funding amount as of 2022



Source: Crunchbase via Statista

25. Statista

The growing shift to digital lifestyles and enabling regulations are among the factors that underpin the strong performance of the fintech sector in Asia Pacific. For example, the Monetary Authority of Singapore (MAS) and the State Bank of Pakistan have set up regulatory sandboxes that let financial institutions and fintech companies experiment with products and services in a safe and controlled environment without the need for regulatory approval. Meanwhile, in February 2023, the MAS and the Reserve Bank of India linked up their respective digital payment systems, Singapore's PayNow and India's Unified Payments Interface, to enable customers in both countries to send and receive funds between bank accounts or e-wallets in real time.

Digital payments continue to be the most widely available and adopted fintech service, driven by the demand for faster, safer and lower-cost payment solutions from consumers and businesses. An array of digital payment solutions – including mobile payments, QR code payments and contactless payments – are on rise. Among these, cross-border QR linkages will further strengthen cooperation for payment connectivity to support faster, cheaper and more transparent payments. In November 2022, the central banks of Indonesia, Thailand, Malaysia, Singapore and the Philippines signed an MoU that reaffirms Asia's fintech ambitions.

Several other segments are beginning to gain traction in Asia Pacific as well. One such segment is buy now, pay later (BNPL) services, a type of short-term financing that allows consumers to make purchases and pay for them in instalments, often interest-free, over a period of time. Leading BNPL fintech companies in Asia Pacific include Singapore-based Atome, which currently partners with over 15,000 online and offline retailers in 10 different markets in the region, and Indonesia-based Akulaku, which serves over 26 million users across Indonesia, the Philippines and Malaysia.

The rise of super-apps

The concept of the 'super-app' – a one-stop app that a fintech provider uses to provide access to multiple services through a single interface to create new financial solutions – has come to the fore in recent years, as digital platforms increasingly seek to diversify their service offerings.

Grab and Gojek, arguably the two biggest super-app developers in Asia Pacific, have successfully diversified from just ride-hailing services to include a suite of other services, including fintech.

Popular Vietnamese e-wallet MoMo is also entering super-app territory by allowing users to buy insurance, pay bills, buy cinema tickets, pay for Netflix subscriptions and shop online. Similarly, India's Paytm is expanding beyond QR code and mobile payments to enable a wide range of services, including payments for utility bills, cinema and event tickets, credit card bills and school fees. Super-apps will define the way people access digital services in the future and fintech will play a central role by allowing users to fulfil transactions within a digital environment.

Opportunities for mobile operators

Connectivity is the primary enabler for fintech services. Furthermore, the ubiquitous nature of mobile networks and growing adoption of smartphones puts mobile connectivity at the heart of many fintech solutions. Beyond basic connectivity, mobile operators in some markets in Asia Pacific have ventured into the fintech space through various models, including mobile money, direct investments, and partnerships with fintech companies and financial institutions. For example, the Philippine's Smart Communications has teamed up with US-based fintech company Plentina to allow its subscribers to access a BNPL service that enables them to conveniently take out a micro consumer loan.

Enabling policy and regulatory measures have played a part in enabling fintech solutions by encouraging businesses to offer mobile money as a payment mode and offering licences to operators to initiate financial services. Enabling regulations go beyond just permitting operators to be active in this space – they also enable collaborations with other ecosystem players. Alongside an enabling regulatory environment, other factors that will sustain the growth of fintech products and services in Asia Pacific include changing consumer behaviours, improving connectivity and growing access to smartphones.

03

Mobile industry impact

3.1
Mobile's impact on SDGs

In 2022, the mobile industry accelerated its impact on the UN Sustainable Development Goals (SDGs) in Asia Pacific as countries took steps to help economies recover.

Within the region, SDG 9: Industry, Innovation and Infrastructure, SDG 4: Quality Education and SDG 5: Gender Equality scored highest because of growing mobile internet and smartphone adoption and rising digital literacy.

Figure 23

Mobile's impact on the SDGs in Asia Pacific

Source: GSMA Intelligence

Boosting industry, innovation and infrastructure

SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialisation, and deliver affordable internet access for all. Mobile technology contributes significantly to innovation and industrial development in terms of critical infrastructure and as a catalyst for other sectors. Connectivity enables industrial processes and manufacturing to utilise enhanced technological advancements such as AI, IoT and blockchain. 5G technologies will continue to play a major role in bringing innovation to various sectors – including healthcare, finance, transportation and education – by strengthening the capability of operators to provide seamless connectivity and exceptional network performance. Operators across Asia Pacific have been working with other ecosystem players to explore new use cases for 5G and other transformative technologies, such as the following:

- **CelcomDigi** and **SK Telecom** have signed an MoU to explore and develop an operator-led mobile metaverse platform in Malaysia. The focus is to develop and offer metaverse and AI use cases in various verticals, such as education, health, retail and entertainment, optimised for Malaysia via CelcomDigi's innovation centre.
- **Dtac** introduced 5G IoT solutions for smart factory, smart logistics and smart utilities to contribute to Thailand's digital transformation objectives. The operator also introduced private 5G network solutions for enterprises to take advantage of edge computing and other features such as IoT, AI, machine learning, AR, VR and real-time data processing.

Improving access to education

SDG 4 focuses on ensuring inclusive and equitable quality education and lifelong learning opportunities for all. Mobile technology helps students, teachers and employees to learn/teach from any location and on the move. Educational content, as well as educational administration and management, is increasingly being made available over mobile networks to tablets, smartphones and feature phones. For example, Indian operator Jio offers a range of education platforms by partnering with institutions across the country. These include virtual classrooms and the Open edX platform, which are available to both students and teachers in government schools, enabling students to participate in real-time classroom settings from any location.

Connectivity is pivotal to enhancing the digital learning experience. Operators' continued efforts to improve connectivity and access to the internet has enhanced the quality of education in schools. In Nepal, Nepal Telecom provided 4G services for schools in Simkot and Namkha, helping over 30 schools in rural municipalities to connect to the internet.

Ecosystem partnerships, such as the ones highlighted below, are also crucial to drive innovation and advanced solutions to support the education sector:

- **Xiaomi India** and non-profit organisation United Way India are working together to support digital learning for over 4,000 students across 12 government schools and 1 government-aided school. They plan to establish innovative tinkering labs to provide better insight into digital education and improve the learning experience of students.
- **Dialog Enterprise** has unveiled Convergence Tech Identity (CTI), a digital education credentials service, in partnership with Convergence Tech in Sri Lanka. CTI digital certificates will be based on standards promoted by the Digital Credentials Consortium and enable students to receive cryptographically secure and unforgeable digital credentials.

Empowering female entrepreneurs

Mobile phones provide ongoing access to information, healthcare, education, e-commerce, financial services and income-generating opportunities. Yet, the digital divide within Asia Pacific remains considerably high. SDG 5 focuses on achieving gender equality and empowering all women and girls. The mobile industry contributes to SDG 5 by increasing women's access to and use of mobile technology to enhance their lives and increase their level of participation and leadership in the technology industry.

Empowering women with mobile phones also helps to accelerate social and economic development.

Micro-enterprise is one of the sectors contributing significantly to economies, and using a mobile phone for business can allow female micro-entrepreneurs to combine family and work life, as they can connect with customers and business contacts and conduct marketing, sales and financial transactions more conveniently. A GSMA survey in Indonesia indicated that using a mobile phone helped micro-entrepreneurs to increase their customer base, as existing clients connected them with new clients by passing on their mobile number, and also showed that micro-entrepreneurs used GPS to locate customer addresses more easily for delivery.[26]

Cambodia: women-focused bookkeeping app

Kotra Riel, a digital bookkeeping app in Cambodia, allows users to track business income, expenses, inventory and cash flow, as well as create data visualisations and generate business transaction reports. The app is helping to educate female entrepreneurs on financial literacy and to digitise bookkeeping behaviour. The ability to document business records digitally allows women to produce the necessary documentation to process loan applications.

26. Empowering women micro-entrepreneurs through mobile, GSMA, 2023

3.2
Mobile operators improving public service delivery

The rollout of 5G and IoT facilitates the collection of real-world data in real-time as well as the processing of this data using AI capabilities. Mobile operators are using anonymised mobile data and AI to deliver valuable products and services that can help governments and public agencies to build their capacities and address pressing global challenges, such as improving healthcare delivery and achieving sustainable development. Across Asia Pacific, local authorities are increasingly using data and insights developed by mobile operators to enable better planning and service delivery in different sectors, such as the following examples:

- Vietnam's Sóc Trăng province has unveiled an intelligent operations centre in partnership with mobile operator **Viettel**. The centre will help improve governance and contribute to the implementation of smart city services.
- **XL Axiata** with PT Jakarta Infrastruktur Propertindo plan to build a digital solution for waste management, smart buildings and licence plate recognition in Indonesia.

Mobile operators, along with other ecosystem players, have also been at the forefront in terms of providing the required connectivity for the innovative delivery of utility services, including smart metering, wastewater monitoring and clean cooking solutions.

This includes the following:

- **Telkomsel** has collaborated with government-owned water utility Perusahaan Daerah Air Minum (PDAM) to design an IoT-based smart metering system in Indonesia. The system provides pressure, temperature and water level data directly to PDAM every 30 minutes. The solution uses NB-IoT technology and has the potential to connect up to 300,000 devices.
- **Spark** announced that water services provider Watercare has rolled out smart loggers on water meters for commercial premises in Auckland, New Zealand. The smart loggers are part of a managed service platform by Spark IoT that includes a device and SIM management platform to manage devices and data at scale. Water meters connected on the Spark NB-IoT network provide usage information to Watercare in real time.
- In February 2023, the Pakistan government, in partnership with **Huawei**, launched the Smart Village Pakistan project to digitally transform remote and rural communities with internet connectivity and provide residents with access to digital services. The pilot project is a part of the nationwide Smart Villages of Pakistan initiative launched by the Ministry of Technology and Telecommunication, together with Universal Service Fund (USF), the International Telecommunication Union and Huawei.

> Across Asia Pacific, local authorities are increasingly using data and insights developed by mobile operators to enable better planning and service delivery in different sectors.

3.3
Mobile addressing climate change issues

Asia Pacific is vulnerable to climate change risks, especially for several densely populated coastal cities that are susceptible to rising sea water levels and large rural populations that rely on agriculture for their livelihood. In South Asia, for example, the agriculture sector, which accounts for the largest share of total employment, faces multiple risks. These include flooding, droughts and saline intrusion, worsened by rising sea levels.[27]

Mobile operators are leveraging their assets and offering new services and solutions to combat climate change issues, from supporting farmers and tech startups working on climate-related issues to enabling new solutions for disaster management. Mobile operators are jointly developing solutions to forecast weather patterns and predict future population displacement. Mobile money is also being used to deliver climate finance, such as loans or insurance, or for relief aid for communities especially impacted by climate change.

For example, in Japan, KDDI and SBI Investment have jointly established a green fund to invest up to JPY5 billion ($36 million) over five years and contribute to the carbon neutrality goals of both KDDI and society. Meanwhile, in Indonesia, XL Axiata worked with the Jakarta municipal government and Nodeflux to develop a flood detection solution to monitor and evaluate water levels in dams, sewers and waterways, along with groundwater levels. The solution leverages AI to help the government to better predict floods and respond effectively by citizen alerts, resulting in less injury and reduced loss of life and property.

27. Bangladesh's Agriculture, Natural Resources, and Rural Development Sector Assessment and Strategy, Asian Development Bank, 2023

04

Mobile industry enablers

4.1
Policies for growth and innovation

Countries in Asia Pacific continue to advance along the path to fully fledged digital nations. As the region continues to bounce back from the Covid-19 pandemic, connectivity will remain crucial to rebuilding economies and making them more resilient to future shocks. 5G networks, cloud services, edge computing, AI, big data and IoT will all play a key role in realising the full potential of a post-pandemic digital economy.

5G adoption has been largely driven by relatively mature markets and consumer use cases, but this trend is now changing. Within Asia Pacific, future growth is expected to come from key markets such as India,[28] which recently launched 5G networks with the expansion of services from Airtel and Jio in 2023. Meanwhile, some countries in the region, including India, Japan and South Korea, have begun setting their 6G vision, with plans to implement the technology by the end of this decade.

To realise these ambitions and maximise the potential for growth and innovation in the region, policymakers can take action to rebalance the digital ecosystem and create fairer business conditions for mobile operators. Such moves can ensure operators invest in resources to build out remaining 4G infrastructure, as well as 5G networks, at scale and pace and introduce new network services that will enable the digital economy in the coming decades.

The investment challenge

The volume of data crossing telecoms networks is growing exponentially as more people take advantage of broadband connectivity and the demand for data-heavy digital content proliferates. To accommodate the rising flow of digital traffic and sustain service performance, mobile operators must constantly invest to expand their network capacity, close coverage gaps and deploy new technologies. Between 2023 and 2030, mobile operators in Asia Pacific are set to invest $259 billion, most of it in 5G deployments.

All segments of the internet ecosystem should have the opportunity to make fair returns in a competitive marketplace. Business leaders and policymakers need to consider the interdependence of the many services on the internet to ensure that market distortions, regulatory requirements or other factors do not limit the ability of participants across the internet ecosystem to make sufficient returns. They should also make sure that the right incentives are in place to promote the long-term growth of the value chain.

Depending on individual market circumstances, sector-specific regulatory and fiscal requirements, combined with market imbalances, put additional pressure on operators' ongoing investments to maintain, expand and evolve their networks to meet the expectations of their customers and achieve broader public policy objectives. Examples of such requirements include asymmetric regulatory obligations, sector-specific taxes and fees, and network deployment costs and restrictions.

Different approaches may be appropriate in different markets to address any market imbalances, but the goal is the same: to deliver and sustain digital connectivity for everyone for decades to come.

To realise these ambitions and maximise the potential for growth and innovation in the region, policymakers can take action to rebalance the digital ecosystem and create fairer business conditions for mobile operators.

28. "Second wave of 5G: 30 countries to launch services in 2023", GSMA, February 2023

Reconciling mobile-sector taxation with digital policy objectives

A lean and well-structured tax regime for telecommunications will promote the health and sustainability of the mobile sector while generating reasonable revenues for the government. In contrast, a poorly structured tax regime will have a distortive impact, reducing affordability of mobile services, undermining operators' investment in mobile infrastructure and decreasing government revenues over the long run. For example, a recent GSMA study[29] reviewing mobile taxes and fees in Bangladesh reveals that the mobile sector in the country is subject to a considerably large and complex tax burden, which constrains both investment into the network and consumer uptake of mobile services and could jeopardise the realisation of the government's vision for Smart Bangladesh.[30]

For many countries in Asia Pacific, mobile-sector taxation reform would lead to greater adoption and use of mobile connectivity. This would generate higher GDP and tax receipts for governments in the medium term from the resulting rise in economic activity and productivity across the economy.

Governments should therefore balance the objectives of government funding through mobile-sector taxation with fostering digital development. Based on internationally accepted principles of taxation, an optimal tax framework should incorporate the following recommendations:

- Sector-specific levies should be reduced or removed, making the tax regime more equitable and broadly based, thereby improving the financial sustainability of the industry.
- The tax regime should be simple, easily understandable and enforceable to minimise compliance costs.
- The overall tax burden on mobile consumers (e.g. SIM activation, excise taxes, additional VAT on handsets) should be reduced to improve affordability and demand for mobile services.
- Taxes on profits should be preferred to taxes levied on revenues.

Reducing the regulatory compliance burden

Rigid licensing regimes and other regulatory constraints such as local permit requirements for rights of way (RoWs) continue to be bottlenecks for the rollout of 4G and 5G networks. Policymakers and regulators can fuel growth and innovation by finding the proper balance in the regulatory environment to support mobile network deployment and operations.

Specifically, policymakers should take the following steps:

- They should implement technology-neutral and simplified licensing procedures, documentation and other requirements to enhance the 'ease of doing business'.
- They should harmonise domestic radiofrequency electromagnetic field (RF-EMF) limits with international guidelines based on scientific studies produced by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[31] 5G networks will make greater use of higher frequencies, small cells and active antennas to provide higher capacity with greater energy efficiency. So that 5G networks can be effectively and fully deployed and make best use of these technologies, countries need to update the RF-EMF compliance framework in line with scientifically studied limits to avoid hurdles caused by unduly restrictive limits.
- RoW rules have historically been a bottleneck in infrastructure rollout in many countries. Timely approvals at low or no cost and a system that is uniformly implemented at all levels of governance in countries are crucial for successful infrastructure creation. Small cells are a key enabler of 5G deployment and the ease of their deployment on street furniture should be an important policy consideration for countries. India amended its RoW rules in August 2022 to introduce some reforms to this effect.[32]

For many countries in Asia Pacific, mobile-sector taxation reform would lead to greater adoption and use of mobile connectivity.

29. Review of mobile taxes and fees in Bangladesh, GSMA, 2023
30. Bangladesh's Digital Flagship Program a2i Places Country Closer to Becoming a Developed Nation by 2041", Newsfile, May 2022
31. The ICNIRP (1998) guidelines are WHO approved and the basis of EMF protection policy in more than 130 countries around the world.
32. Indian Telegraph Right of Way - Amendment Rules, 2022

Policy actions to close the digital divide

Mobile connectivity is the key pillar for connecting people, helping businesses tap into the digital economy and enabling governments to realise their digital transformation ambitions. While 96% of the population in Asia Pacific live in areas covered by a mobile broadband network, just under half do not yet subscribe to a mobile internet service. The key barriers to internet adoption, along with examples of actions that policymakers in Asia Pacific are taking to close the digital divide, are as follows:

- **Knowledge and digital skills:** Reliance Jio and the GSMA have rolled out a nationwide Digital Skills Program under the GSMA Connected Women Commitment initiative to provide need-based training to rural women and individuals from marginalised or low-income groups to help them make meaningful use of digital access.
- **Affordability of handsets and data:** Kistpay, a financing platform in Pakistan, enables interest-free financing at scale for pay-as-you-go handsets, making smartphones more accessible.
- **Availability of local content:** Hamro Patro is a popular and comprehensive Nepali app for staying updated with Nepali content and events.
- **Gender usage gap:** The GSMA's latest data shows a further slowdown in digital inclusion for women. In South Asia, women are now 41% less likely than men to use mobile internet.

Safeguarding online spaces

Amid the growth of digitalisation, people face numerous issues that undermine a safe online experience, including cyberthreats, abuse, bullying, misinformation and disinformation. Government agencies and companies have undertaken various initiatives to enhance digital trust. For example, Australia's national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), is helping to tackle the growing threat of cyberattacks by providing free research and development support to businesses working in the cybersecurity sector.[33]

In the 5G era, the importance of cybersecurity in mobile communications is likely to rise exponentially. Quantum cryptography is emerging as a solution for safeguarding critical information because it is not possible to copy data encoded in a quantum state. In South Korea, KT has commercialised a quantum cryptography-based virtual private network technology to increase security in a wireless environment, in cooperation with AhnLab, a cybersecurity solution developer.[34]

Public discourse, digital literacy programmes and advancements in network and service security will help to keep new online environments safe and secure. These ongoing safety and security efforts can stimulate innovation and the adoption of new technologies. For example, in Singapore, the Infocomm Media Development Authority (IMDA) has taken steps to create a safer online environment by placing OTT platforms, which have to take licences from the IMDA, under light-touch regulation.

Call for collaboration

To effectively address the above policy issues, substantive actions from all stakeholders will be needed. The full potential of mobile technologies cannot be realised without the active participation of governments and regulatory authorities, working together with the private sector to enable vibrant, competitive markets and to help shape the digital environment. Collaboration between governments and industry through a whole-of-government approach, as well as digital cooperation internationally, is necessary to accelerate progress in this journey.

33. "CSIRO's offer to SMEs working in cyber security", CSIRO, June 2022
34. "GSMA, IBM and Vodafone Establish Post-Quantum Telco Network Taskforce", GSMA, September 2022

4.2
Effective spectrum policy: meeting future connectivity demand

Spectrum availability and effective licensing continue to be critical to encourage the investment required to expand mobile access, meet the increase in demand for data services and enhance the quality and range of services offered. This year, all eyes will be on Dubai at the end of 2023, where the WRC-23 will take place from 20 November to 15 December.

WRC-23 will serve as a chance to expand the availability of affordable 5G services and ensure future growth and innovation. Spectrum in low and mid-bands is on the conference agenda, making this is an opportunity to build a spectrum roadmap going into 2030, address the digital divide and ensure that billions of people can benefit from 5G.

For countries in Asia Pacific, mid-band spectrum will be a key focus at WRC-23. On average, a total of 2 GHz of mid-band spectrum will be required per market to support the growth of 5G by 2030. In mid-bands, further harmonisation of the 3.5 GHz band is expected, but getting to the required 2 GHz of mid-band spectrum is challenging without 6 GHz capacity.

> By taking positive steps to identify the 6 GHz band for IMT at WRC-23, governments can help address their 5G mid-band spectrum needs across the rest of this decade.

One of the measures of the success of WRC-23 will be in its ability to secure 5G's future through the identification of 6 GHz spectrum for IMT. There has already been meaningful progress and decisions on the band's future in Asia Pacific. Cambodia, China, Mongolia and Myanmar have formally expressed interest at recent meetings. China has also formalised the addition of the upper 6 GHz band (6425–7125 MHz) to IMT in the country's table of frequency allocations, taking effect from 1 July 2023. This announcement is a significant driver of the commercial 6 GHz ecosystem. Other countries in the region of all sizes, from Singapore to India, are evaluating their options ahead of WRC-23.

By taking positive steps to identify the 6 GHz band for IMT at WRC-23, governments can help address their 5G mid-band spectrum needs across the rest of this decade. This would ensure fast, affordable and sustainable mobile broadband services while unlocking digital growth and industrial development through 5G-enabled innovation and use cases.

Spectrum licensing, pricing and conditions

While 5G networks are well established in advanced Asia Pacific markets such as Australia, Japan and South Korea, the pace of 5G development differs significantly across the region. 5G deployment is expanding rapidly in India following a successful auction in 2022, while the 5G journey is only just beginning in other countries, including major markets such as Indonesia and Vietnam and smaller Pacific Island states.

For planning efforts to make a real difference, countries should develop spectrum roadmaps that reflect the growing demand for mobile services. 5G will support a wide range of consumer and enterprise use cases and these diverse needs can only be addressed through a combination of frequencies across low (sub-1 GHz), mid- (1–7 GHz), and high bands (above 24 GHz). Clarity on spectrum releases is critical to allow businesses to prepare investment plans, secure financing and develop arrangements for deploying different technologies.

The cost of spectrum also has a major impact. Governments and regulators should assign 5G spectrum to support their digital connectivity goals rather than as a means of maximising state revenues. Effective spectrum pricing policies are vital to support better quality and more affordable 5G services. In turn, this will help address issues such as usage gaps. High reserve prices, artificially limited spectrum supply (including set-asides) and poor auction design can all have a negative impact (i.e. slower mobile broadband and suppressed network investments).

To maximise the benefits of 5G, governments and regulators should:

- make available sufficient 5G spectrum and avoid limiting the supply via set-asides
- set modest reserve prices and annual fees to let the market determine spectrum prices
- carefully consider auction design to avoid unnecessary risks for bidders (e.g. avoiding mismatched lot sizes, which create artificial scarcity)
- develop and publish a 5G spectrum roadmap with the input of stakeholders to help operators plan effectively around future availability
- consult stakeholders on the award rules and licence terms and conditions, and take them into account when setting prices (onerous obligations reduce the value of spectrum).

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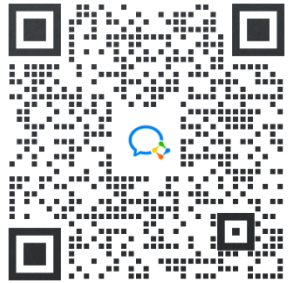

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