

The background of the cover features a photograph of three young women with long dark hair, smiling and looking at a smartphone held by one of them. The image is overlaid with a large, stylized graphic of a blue and yellow shape that resembles a speech bubble or a stylized 'C'.

The Mobile Economy China 2019



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

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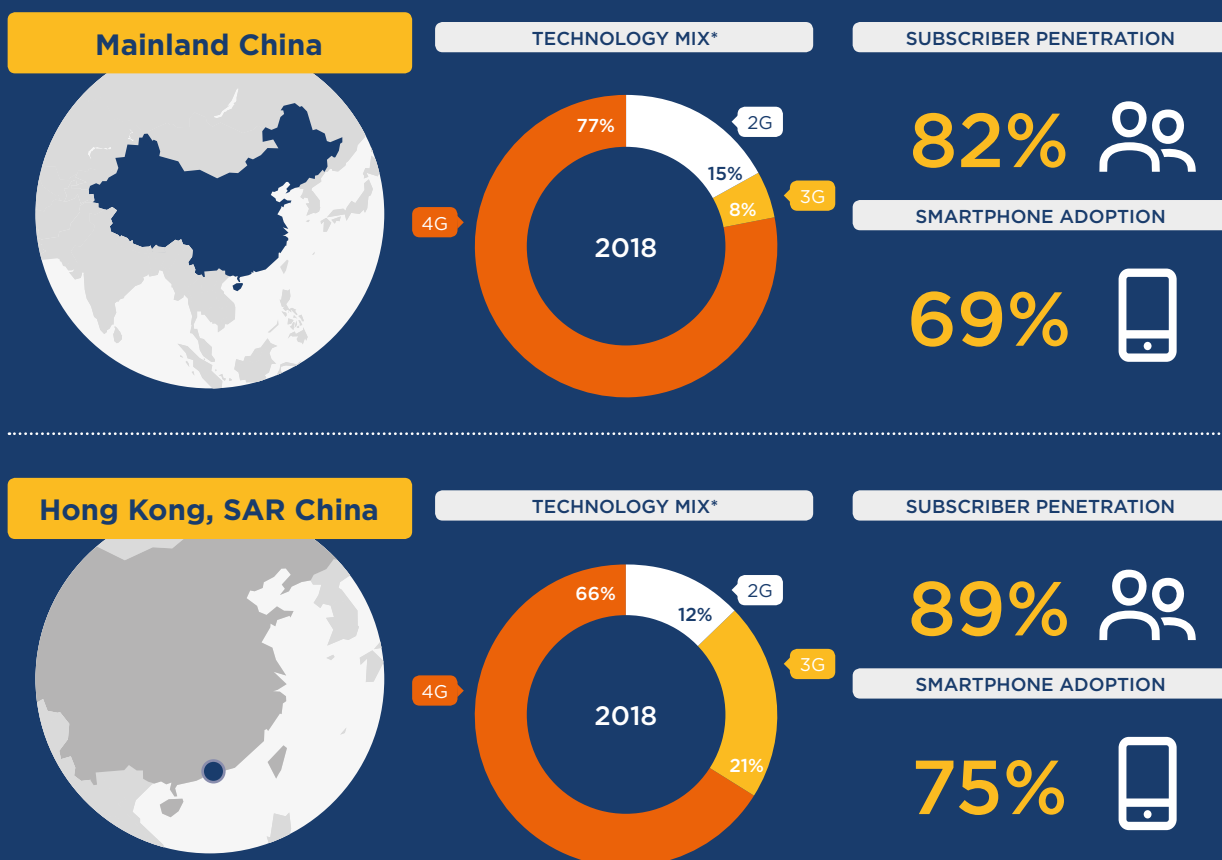
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China in context

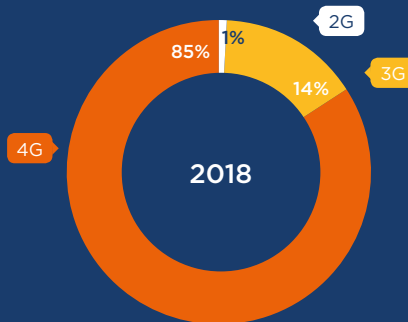
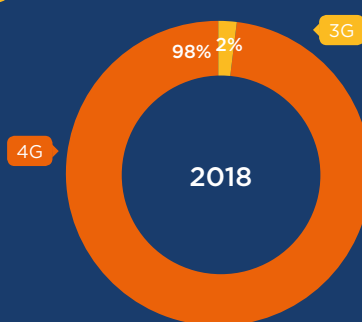
China is a huge mobile market, nearly four times the size of North America, with 1.2 billion unique subscribers at the end of 2018. Over 97% of these come from mainland China, with the remainder spread across three other markets – Hong Kong, Macao and Taiwan.

Hong Kong, Macao and Taiwan are all advanced telecoms markets; they were relatively early adopters of mobile services and technology, which has resulted in high unique subscriber penetration and smartphone uptake. This maturity means that

the scope for future subscriber growth appears limited. With 4G entrenched as the dominant mobile technology across the board, the prospects for meaningful revenue uplifts over the coming years will rely heavily on operators' ability to use 5G to expose new income streams. Looking ahead, all three markets will be towards the forefront of 5G commercialisation, launching services in 2020. In 2025, 5G adoption is expected to be well above the global average as consumers and businesses seek to utilise the myriad benefits next-generation networks can deliver.



**Percentage of total connections*

Macao, SAR China**TECHNOLOGY MIX*****SUBSCRIBER PENETRATION**
88% 
SMARTPHONE ADOPTION
82% 
Taiwan, Province of China**TECHNOLOGY MIX*****SUBSCRIBER PENETRATION**
90% 
SMARTPHONE ADOPTION
76% 

While the mobile industry dynamics of these markets are interesting in and of themselves, this report focusses on mainland China, with comparisons to larger markets such as Japan, South

Korea and the US, as well as leading European nations. Therefore, where subsequent analysis, data points or charts relate to China, we are referring to mainland China only.





Executive Summary

China powers into 5G era





Mobile underpins rapid transition to a digital society

China is the world's second largest economy, accounting for close to a fifth of global gross domestic product (GDP). Through a combination of government policies and market forces, the economy has expanded massively since the late 1970s, with industries such as steel, automotive and telecoms developing rapidly. Today, China's broad and diverse mobile ecosystem underpins its digitisation strategy and is having a profound impact on consumers, businesses and wider society.

With close to 1.2 billion subscribers, China is the largest mobile market globally. Particularly impressive is the rate of growth in mobile internet penetration, which reached 58% at year-end 2018, having trebled over the course of a decade. Consequently, China's growing middle class are purchasing more goods online, amplifying the country's already huge e-commerce market and reducing the prevalence of cash transactions. China is home to many millions of tech-savvy consumers who are keen adopters of social media and users of a variety of apps, placing greater demands on operators for improved network performance.

Despite trailing many developed markets in launching 4G, Chinese operators have invested heavily in their networks, recognising the positive correlation between user experience and data consumed. This has resulted in improved mobile data speeds, while subscribers in China have migrated to 4G services at a faster pace than those in Australia and the US, creating a mass market and economies of scale in a short timeframe. Operators are now working to bring 5G to market and are set to lead much of the world in this space. China will host the 2022 Winter Olympic and Paralympic Games, which will serve as further motivation to accelerate 5G deployments.

The country has also grown a massive smartphone manufacturing industry, with household names and lesser-known brands experiencing success domestically and around the world. Meanwhile, with growing global concern regarding security, Chinese network infrastructure vendors face challenges in maintaining their footholds in certain markets.



Government and policymakers enable a platform for digital progression and pioneers

In a testing geopolitical climate, the government remains steadfast in pushing forward the country's digitisation journey, considering traditional sectors such as retail and health as ripe for disruption. The state is also investing in a range of emerging technology industries such as AI, leading to a surge in external financing. Meanwhile, internet tech players and mobile operators alike are at the cutting edge of innovation, often partnering to develop and apply pioneering solutions, which can improve efficiency and realise cost savings, as well as expose new revenue streams.

In parallel, Chinese policymakers have taken important steps to modernise the country's regulatory framework for telecoms, establishing a platform for further digital progression. Though further reforms should be considered, many technological advancements are on the horizon and more industries will adopt and commercialise digital solutions. Operators appear resolved to provide the superior connectivity required to power China in the 5G era, supporting the country's transition to a leading digital society and its presence on the international stage.

Mobile Economy China

Unique mobile subscribers



2018

1.17bn



82%

PENETRATION RATE
(% of population)

85%

CAGR
2018-25

1.22bn

0.6%
↑

2025

SIM connections

(Excluding licensed cellular IoT)



2018

1.5bn



109%

PENETRATION RATE
(% of population)

115%

1.7bn

0.9%
↑

2025

CAGR
2018-25

Smartphone adoption

69% 88%



2018

2025



4G adoption 2025

72%



5G connections 2025

460m

28%

of total

Licensed cellular IoT connections 2025

1.9bn



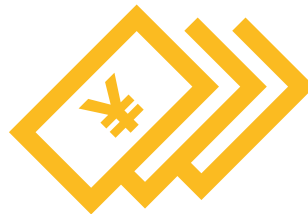
Total operator revenues

Capex as a proportion of revenue

RMB1.1tn

2018 — 2025

RMB1.2tn



Mobile
sector
contribution
to GDP

RMB5.2tn ²⁰¹⁸

5.5%

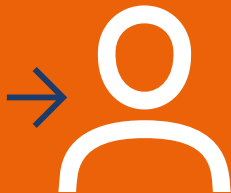
RMB6.0tn ²⁰²³

Public funding

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

RMB583bn

2018



Employment



2018

8.5m

DIRECT AND INDIRECT



Jobs

supported by the mobile ecosystem



01 Industry overview



1.1

Many of the world's new subscribers will come from China

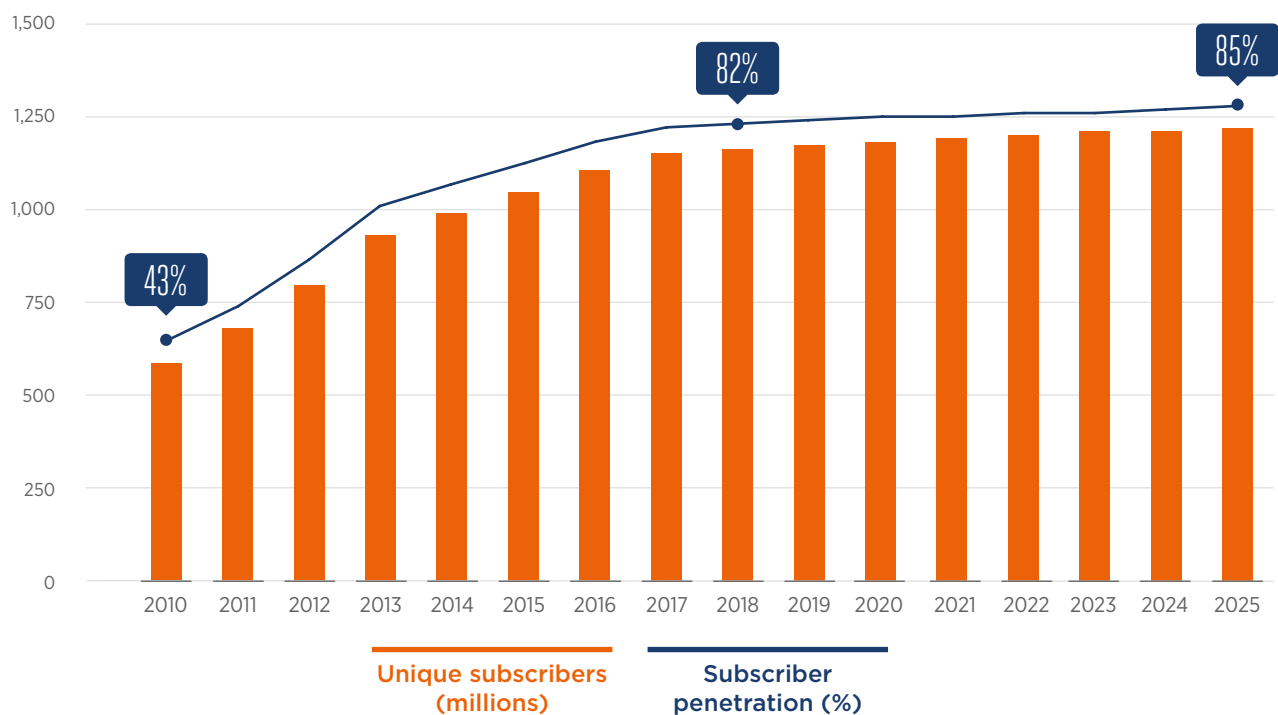
At the end of 2018, China was the largest mobile market in the world, with nearly 1.2 billion unique mobile subscribers.¹ This is equivalent to a penetration rate of 82% of the population, compared to 86% in Europe and 85% in the US; China will reach similar levels in around five years' time. The rapid take-up of mobile services in China has seen unique subscriber penetration increase from just 4% in early 2000 – at this time, the figure was already above 30% in the US and several European countries.

With subscribers owning on average 1.3 SIM cards in China, there were more than 1.5 billion connections at year-end 2018,² representing a market penetration of close to 110%. The Chinese mobile market features three licensed network operators: China Mobile, China Telecom and China Unicom. China Mobile is the largest player, with a 60% share of connections. The other two operators currently hold around 20% each.

Figure 1

Source: GSMA Intelligence

Unique mobile subscribers in China



The pace of growth in unique subscriber numbers and the corresponding penetration rate have slowed in recent years as saturation of the total addressable market has edged closer and operators face the challenge of connecting those in poorer or more rural communities. Future growth in China will therefore be more modest than the rate the country experienced between 2008 and 2013, for instance, when total unique subscribers more than doubled.

China will nonetheless record an additional 57 million subscribers during the 2018-2025 period, and 313 million more mobile internet subscribers as consumers progress from using basic mobile services. The country will be one of the biggest single contributors to global mobile internet subscriber growth in the coming years, accounting for over a third of total additions worldwide.

1. Total unique users who have subscribed to mobile services at the end of the period. Subscribers differ from connections such that a unique user can have multiple connections.
 2. Total unique SIM cards, excluding licensed cellular IoT, that have been registered on the mobile network at the end of the period.

1.2

China grows smartphone adoption domestically and globally

By year-end 2018, the number of smartphone connections in China surpassed 1 billion, pushing the adoption rate (proportion of total connections, excluding licensed cellular IoT) close to 70%. While adoption lags behind South Korea (84%), the US (82%) and the UK (79%), China is one of a handful of markets still growing in absolute terms. China added 210 million smartphone connections in 2018, accounting for more than 30% of new connections globally.

Looking out to 2025, we expect China to retain its status as the largest smartphone market in the world, with more than 1.4 billion connections. Adoption will reach 88%, three percentage points behind the US and South Korea, but ahead of the EU5.³

China is also home to several smartphone manufacturers, including Huawei, Vivo, Oppo and Xiaomi. Demand from Chinese consumers for the latest flagship devices remains strong; the replacement lifecycle is relatively short, with 99% of mobile phones new at the point of purchase compared to 90% globally.⁴

As well as being the largest domestic vendor, Huawei is the second biggest globally, having overtaken Apple in 2018. Oppo has now launched handsets in five European markets, while Shenzhen-based Transsion leads in terms of smartphone shipments to Africa.

1.3

4G leads, with 5G on the horizon

4G will continue to dominate as earlier technologies are phased out

Between 2013 and 2016, mobile operators in China accelerated capital spending as they aimed to roll out 4G networks across the entire country. Coverage of 4G services passed 99% of the population at the end of 2018, compared to just 10% in 2013 when 4G launched. The 4G lifecycle is not yet over; recent investment has focussed on network upgrades, with China Mobile, China Telecom and China Unicom all launching LTE Advanced Pro technology.

4G has been successful in enabling the transition from the connected consumer to the digital consumer, typified by an increasing willingness among users to engage with social media platforms and a range of online services. At year-end 2018, there were 1.2 billion 4G connections in China, representing 77% of total connections.⁵ During the period to 2022, widespread coverage, affordable smart devices, greater use of data-intensive services and demand for higher speeds will all help add a further 260 million 4G connections and see 2G and 3G all but disappear. 4G adoption will subsequently decline as consumers transition to 5G services.

3. France, Germany, Italy, Spain and the UK

4. Chinese consumers at the forefront of digital technologies: 2018 Deloitte China Mobile Consumer Survey

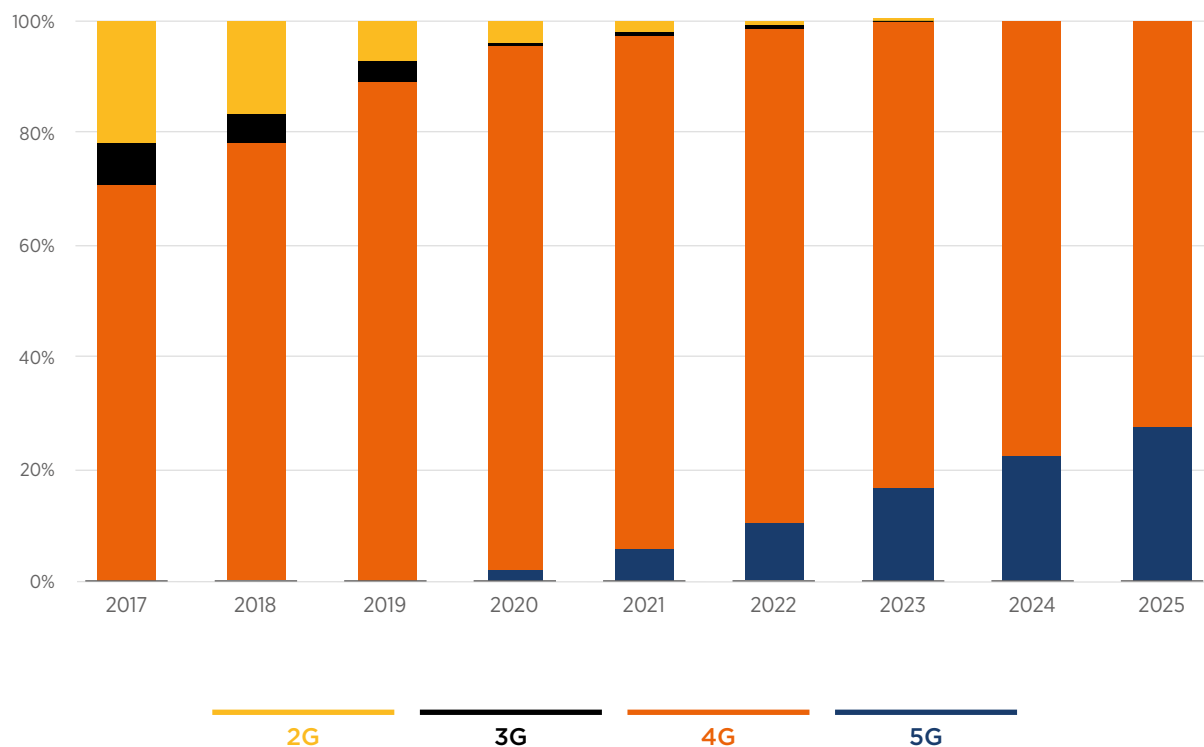
5. Excluding licensed cellular IoT

Figure 2

Source: GSMA Intelligence

Connections in China by technology

Percentage of connections



Commercial launches of 5G services in sight

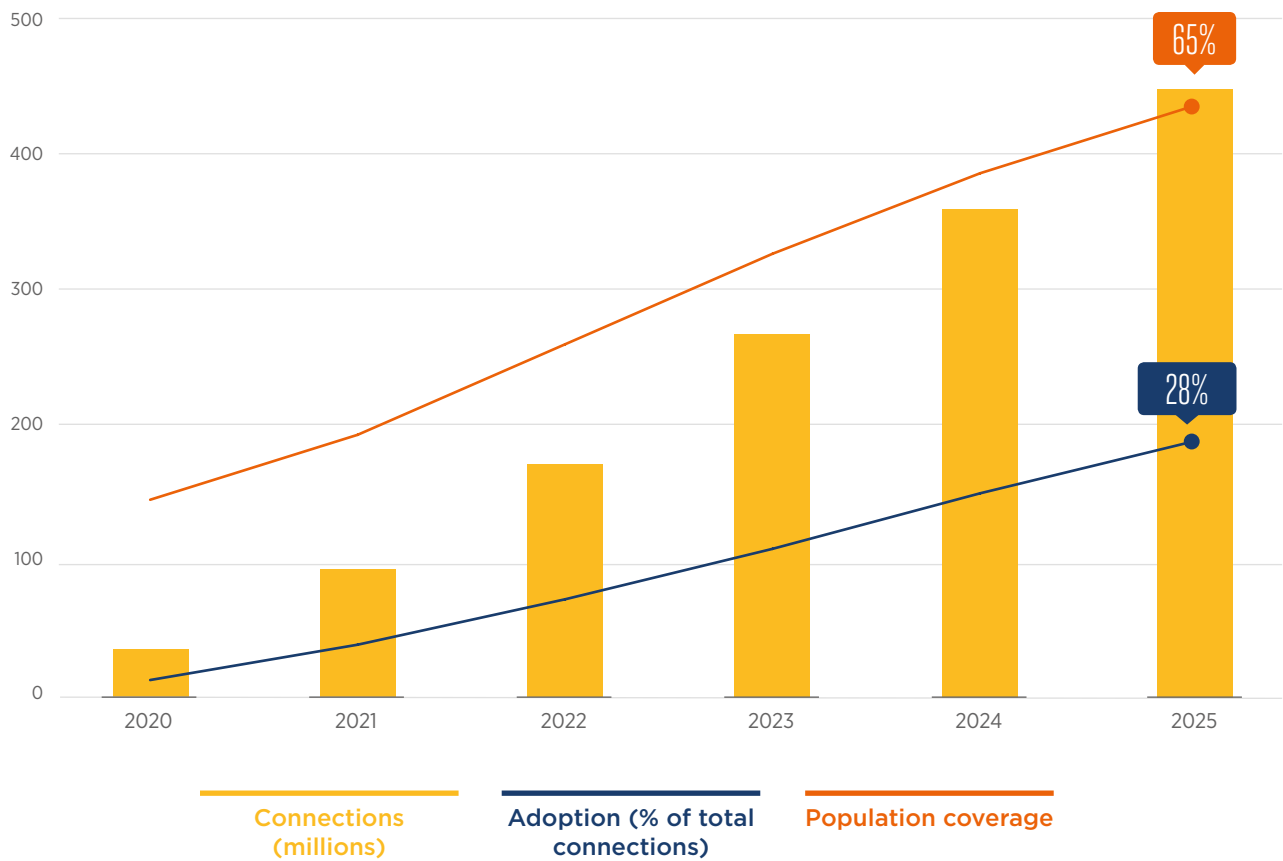
Along with Japan, South Korea, the US and certain Gulf states, China will be a frontrunner in terms of commercialising mobile 5G and will lead coverage rollout. Following widescale launches of 5G services from 2020, China will host the 2022 Winter Olympic and Paralympic Games in Beijing, where operators plan to deploy technologies such as facial recognition and VR video streaming based on 5G networks. GSMA Intelligence forecasts that China will account for by far the largest number of 5G connections in 2025, greater than North America and Europe combined. We expect China to reach 460 million 5G connections by the end of 2025, accounting for 28% of total connections in the country.

Mobile operators in China are currently evaluating the pros and cons of standalone and non-standalone models for 5G. China Telecom has confirmed its preference for a standalone architecture, which would require the construction of a new network, including base stations, backhaul links and a core network. This approach contrasts with operators in some other markets that are adopting a non-standalone model for 5G, incorporating existing 4G infrastructure and targeted small cells in hotspot areas. A standalone 5G network will allow 4G and 5G services to run in parallel and remove the complexity of LTE integration, while providing economies of scale. However, the new network build-out means that this option is likely to be more expensive, at least in its early stages, despite expectations of network optimisation and improvements in spectral efficiency resulting in a lower cost per unit of data for 5G than for 4G.

Figure 3

Source: GSMA Intelligence

5G in China



Massive data traffic growth supporting the digital economy

Robust, high-speed mobile connectivity is a foundational element of a modern digital society and thriving digital economy. Coupled with unique digital identity, it is a vital component of economic, financial and social development. Connectivity

enables citizens to access and interact anytime and anywhere with public and private services, leading to increased efficiency and productivity for themselves and institutions, resulting in a better quality of life.

Figure 4

Source: GSMA Intelligence

Key components of a digital society or economy⁶



Digital Citizenship

Interaction between government, businesses and citizens specifically in the provision and use of public services over digital channels



Digital Lifestyle

Use of smart devices to access locally relevant content and non-core communication solutions that offer a more convenient experience



Digital Commerce

Simplifies a commerce activity by expanding access to marketplaces, replacing physical cash, and facilitating the processing and delivery of orders over digital channels



Digital Identity

Proof of identity is a prerequisite to socio-economic development and essential to accessing basic services. Mobile technology is uniquely positioned to enable accessible and inclusive digital identity



Connectivity

Fast, reliable and continuous individual access to the internet is the foundation for the creation, distribution and consumption of digital applications and services

In China, increasing smartphone adoption and the wide availability of 4G have led to a surge in mobile internet use, supporting the country's movement up the digital society value chain. According to Ericsson, total mobile data traffic in China reached 8.6 exabytes (EB) per month in 2018, more than trebling the 2.7 EB per month recorded in 2017⁷

and dwarfing 0.5 EB per month in 2015.⁸ Driven by the permeation of 5G services and the use of innovative mobile apps and content, total traffic is forecast to reach 29 EB per month by 2024, a CAGR of 22% over the period. This equates to 19 GB per smartphone, per month in 2024 – up from 7.2 GB per smartphone, per month in 2018.

6. Digital identities: advancing digital societies in Asia Pacific, GSMA Intelligence, 2018

7. Ericsson Mobility Report November 2018

8. Ericsson Mobility Report June 2017

1.4

Financial outlook modest as 5G investment programmes get underway

Mobile revenues increasing but set to plateau

Across Asia Pacific's more developed markets, including Japan and South Korea, core mobile revenues have been under pressure from limited subscriber growth and competition from the wider digital ecosystem (IP messaging services, for example). In China, annual mobile revenues have continued to rise in absolute terms throughout the current decade and are expected to reach almost \$177 billion (RMB1.2 trillion) by 2020.⁹ Operators in China will see annual revenues increase at a CAGR of 1.2% between 2018 and 2025, and the country will

account for 16% of global growth in mobile revenue during the period.

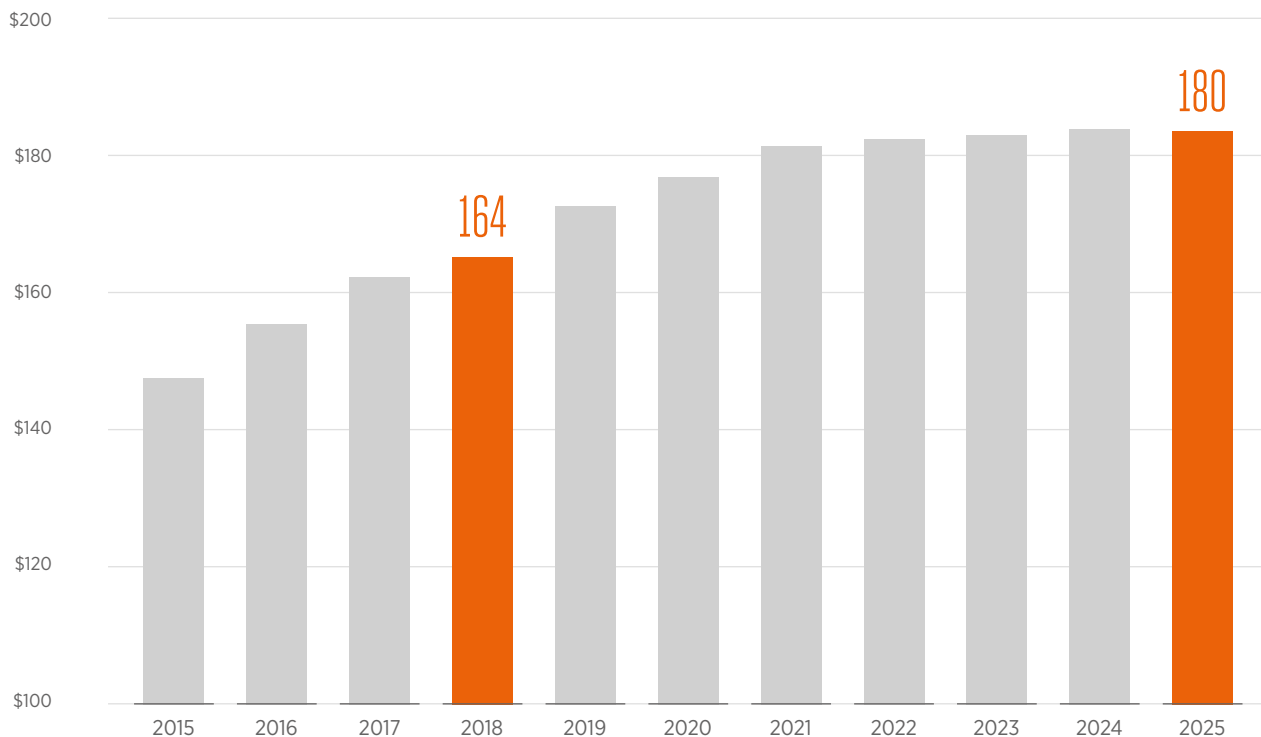
Annual revenue growth has been slowing for a number of years; in light of intense competition and retail price regulation, it will be 1% in 2021 compared to 4% in 2017 and more than 14% in 2013, and will become flat as we approach 2025. As such, the 7.1% CAGR in annual mobile revenues experienced between 2010 and 2017 will not be replicated over the next seven-year period, underlining the modest outlook out to 2025.

Figure 5

Source: GSMA Intelligence

Mobile revenues in China

Billions



9. Currency conversions in this report use the Q4 2018 RMB/\$ exchange rate stated here: <https://www.gsmainelligence.com/currencies/?report=5c3e9c84e7338>

Operators begin the next wave of capital spending

Between 2010 and 2018, mobile operators in China spent more than \$268 billion (RMB1.9 trillion) on capex projects. Investment was highest in 2015, ramping up over the three years prior as operators sought to provide near-ubiquitous coverage of 4G services. Capex was significantly lower during 2016-2018 once this goal had been achieved, with spending shifting to 4G network upgrades to deliver performance improvements and faster throughput speeds.

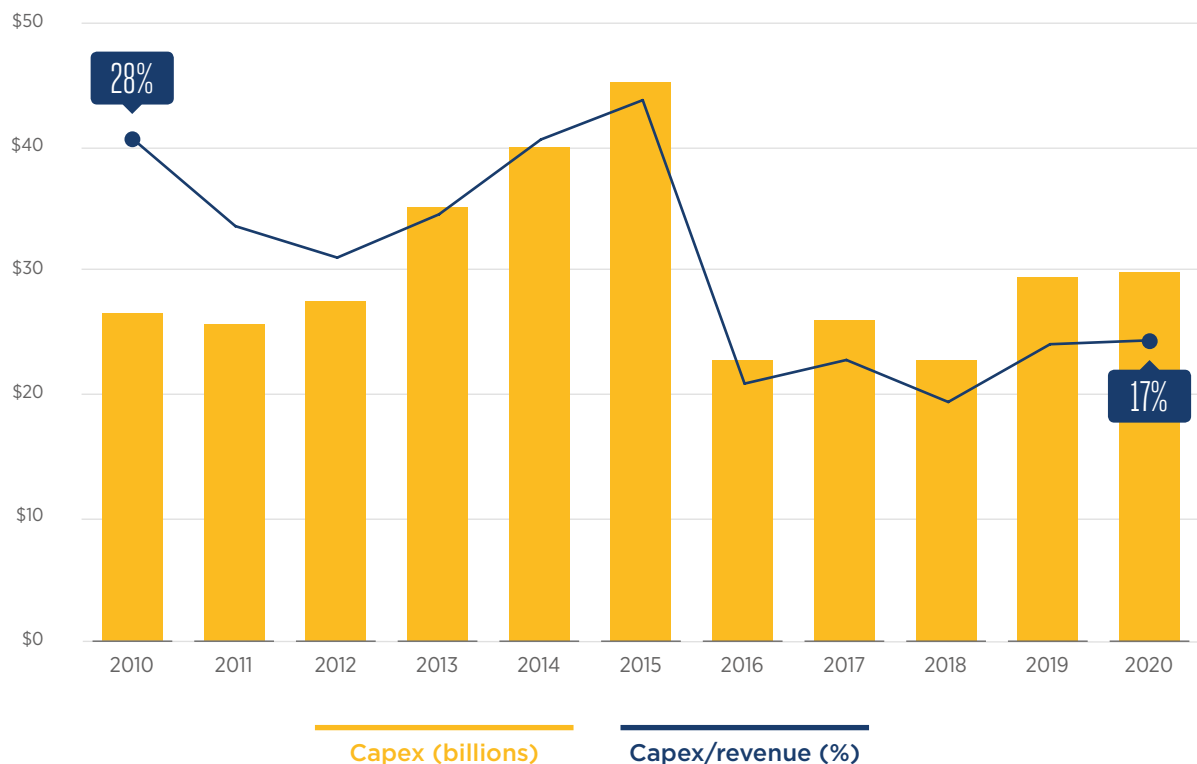
The investment level is forecast to increase in 2019 and 2020 to a combined \$58 billion (RMB401 billion) as operators prepare for and begin 5G rollouts.

However, there are differing opinions on the capex needed to deliver on China's 5G ambitions. China Telecom has claimed the total figure could amount to \$275 billion (RMB1.9 trillion) between 2020 and 2030, while the Ministry of Industry and Information Technology (MIIT) has provided an estimate of \$405 billion (RMB2.8 trillion) for the same period, with spending projected to peak at \$45 billion (RMB313.3 billion) in 2023. Either way, investment is likely to rise further post-2020 as the industry focusses on 5G deployments, which could intensify the current capex/revenue ratio of 13%.

Figure 6

Source: GSMA Intelligence

Capex and capital intensity in China



02

Mobile's positive socioeconomic impacts



The mobile ecosystem makes a significant contribution to the Chinese economy, with an economic value added of \$750 billion (RMB5.2 trillion, or 5.5% of GDP in 2018). This includes the direct impact of the mobile ecosystem as well as the indirect impact and the increase in productivity brought about by increased use of mobile services and technologies.

2.1

Mobile contributing to economic growth and jobs

Direct economic contribution

The mobile ecosystem consists of mobile operators; infrastructure service providers; retailers and distributors of mobile products and services; mobile handset manufacturers; and mobile content, application and service providers. The direct economic contribution to GDP of these firms is estimated by measuring their value added to the economy, including employee compensation, business operating surplus and taxes.

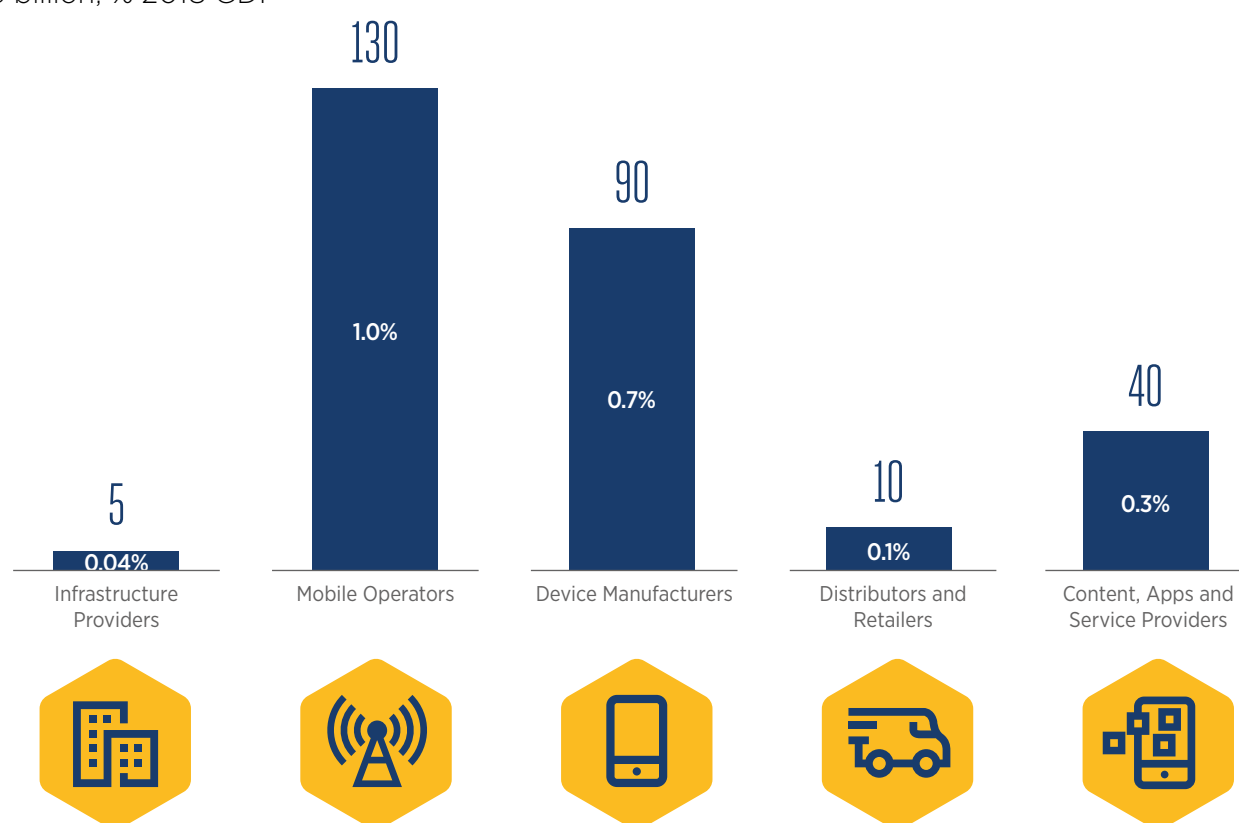
In 2018, the total value added generated by the mobile ecosystem in China was \$280 billion (RMB1.9 trillion, or 2.1% of GDP), with network operators accounting for around 50%. Device manufacturing contributes significantly to GDP, with \$90 billion (RMB650 billion), Chinese device manufacturers alone accounted for 70% of the \$125 billion of value add generated by device manufacturers globally in 2018.

Figure 7

Source: GSMA Intelligence

Direct GDP contribution of the mobile ecosystem

\$ billion, % 2018 GDP



Note: totals may not add up due to rounding

Indirect and productivity impacts of mobile technology

In addition to their direct economic contribution, firms in the mobile ecosystem purchase inputs from their providers in the supply chain. For example, handset manufacturers purchase inputs from microchip providers, and mobile content providers require services from the broader IT sector. Moreover, some of the profits and earnings generated by the mobile ecosystem are spent on other goods and services, stimulating further economic activity in those sectors. We estimate that in 2018, this additional economic activity generated a further \$100 billion (RMB677 billion) in value added, or 0.7% of GDP.

The use of mobile technology also drives improvements in productivity and efficiency for workers and firms. Different types of mobile technology have their own impact on the productivity of the national economy:

- Basic mobile voice and text services allow workers and firms to **communicate more efficiently and effectively** (for example, reducing unproductive travel time).

- 3G and 4G technologies allow workers and firms to use mobile data and internet services. This **improves access to information and services**, which in turn drives efficiency in business processes across many industries, including finance and health.
- M2M and IoT allow for the **digitisation of services and improvement of industrial processes**. As these technologies become increasingly adopted, we expect them to create significant benefits by driving cost savings and operations efficiency gains in areas such as manufacturing, logistics and retail.

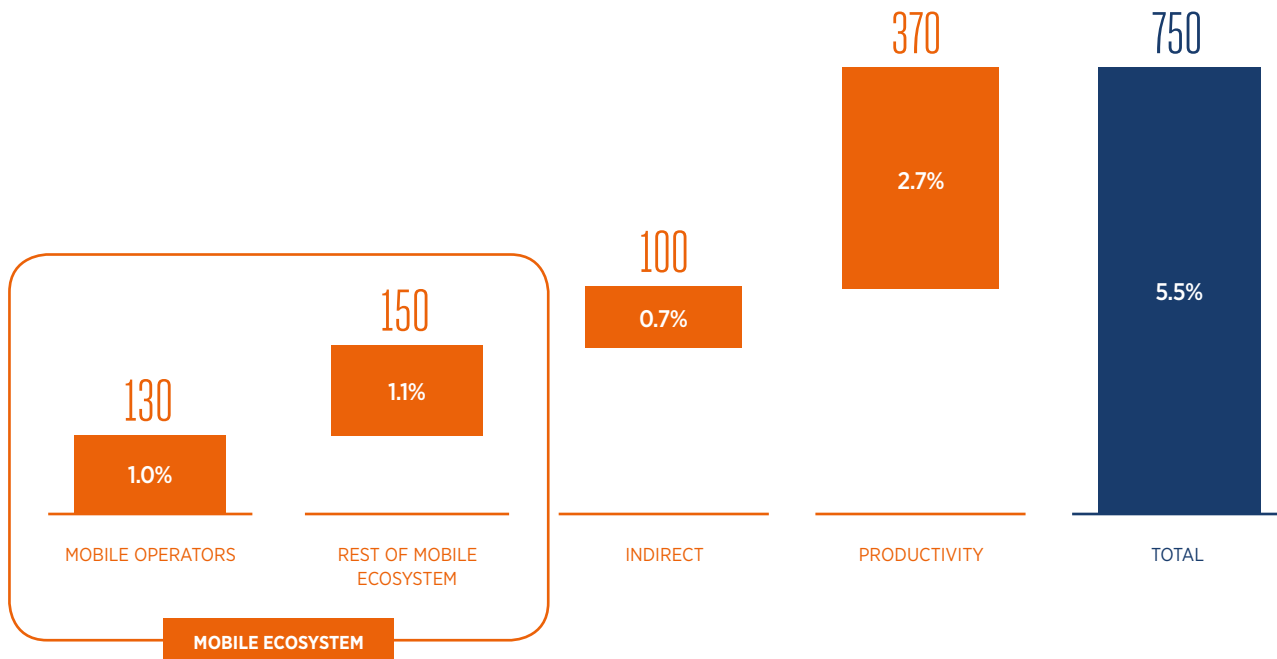
Together, these productivity impacts generated \$370 billion (RMB2.5 trillion) in 2018, or 2.7% of GDP. Overall, taking into account the direct, indirect and productivity impacts, in 2018 the mobile industry made a total contribution of \$750 billion (RMB5.2 trillion) in value added terms, equivalent to 5.5% of GDP in China.

Figure 8

Source: GSMA Intelligence

Total (direct, indirect and productivity) contribution to GDP

\$ billion, % 2018 GDP



Note: totals may not add up due to rounding

Employment

In 2018, mobile operators and the wider mobile ecosystem provided direct employment to almost 3 million people in China. In addition to this, economic activity in the ecosystem generated jobs in other sectors. Firms that provide goods and services as production inputs for the mobile ecosystem (for example, microchips or transport services) will employ more workers as a result of the demand

generated by the mobile sector. Furthermore, the wages, public funding contributions and profits paid by the mobile industry are spent in other sectors, which provide additional jobs.

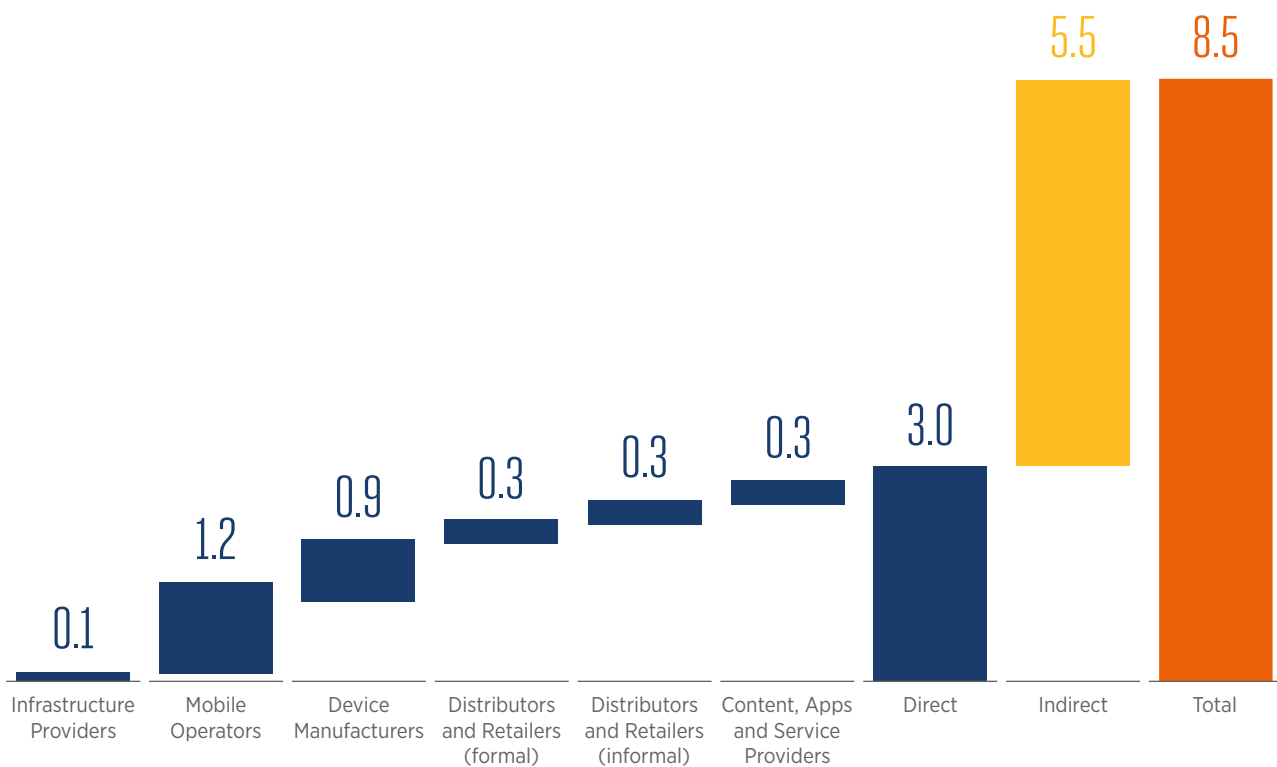
We estimate that in 2018, 5.5 million additional jobs were indirectly supported in this way, bringing the total impact (both direct and indirect) of the mobile industry to more than 8.5 million jobs.

Figure 9

Source: GSMA Intelligence analysis

Employment impact

Jobs, millions, 2018



Note: totals may not add up due to rounding

Public sector funding

The mobile ecosystem also makes a significant contribution to the funding of the public sector through general taxation. This includes value added tax, corporation tax, income tax and social security

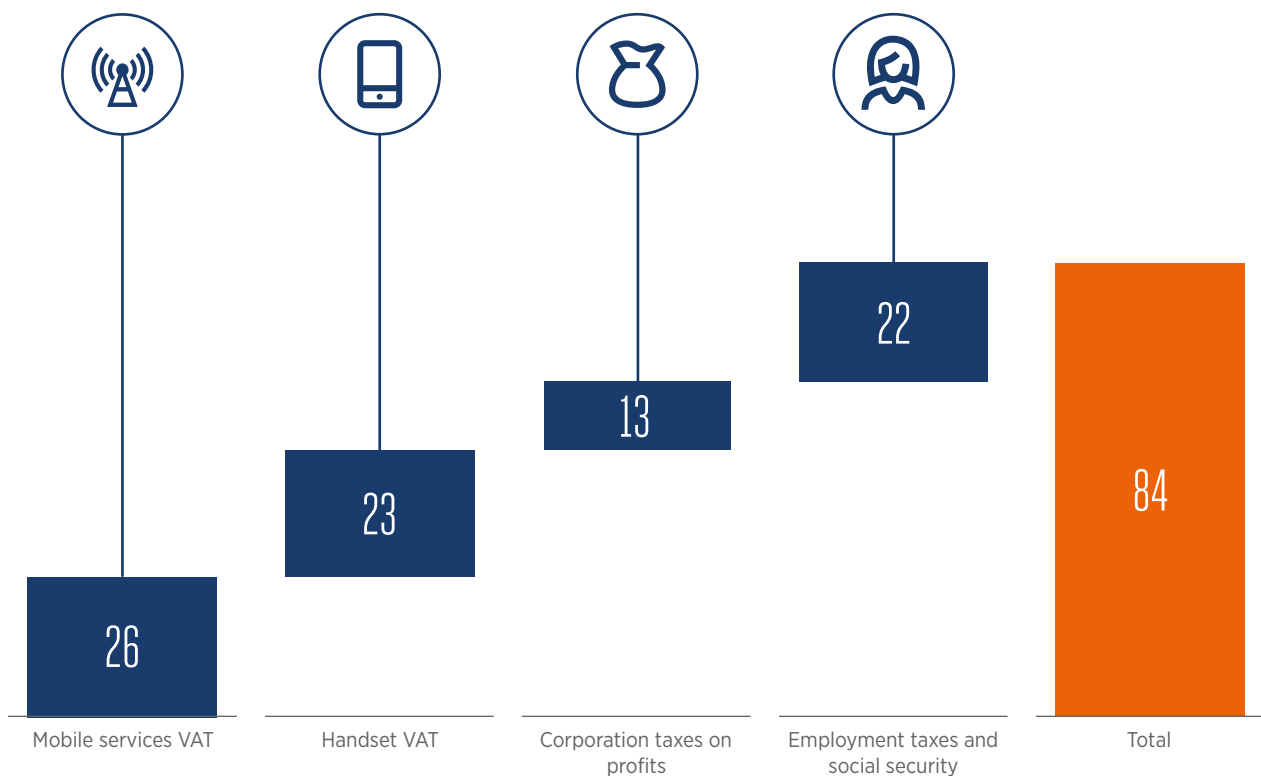
from the contributions of firms and employees. We estimate that the ecosystem made a tax contribution to the public finances of governments of \$84 billion (RMB583 billion) in 2018.

Figure 10

Source: GSMA Intelligence analysis

Contribution to public funding by the mobile industry

2018, \$ billion



Note: totals may not add up due to rounding

Future outlook

We expect the economic contribution of the mobile ecosystem in China to continue to increase in both relative and absolute terms. In value-added terms,

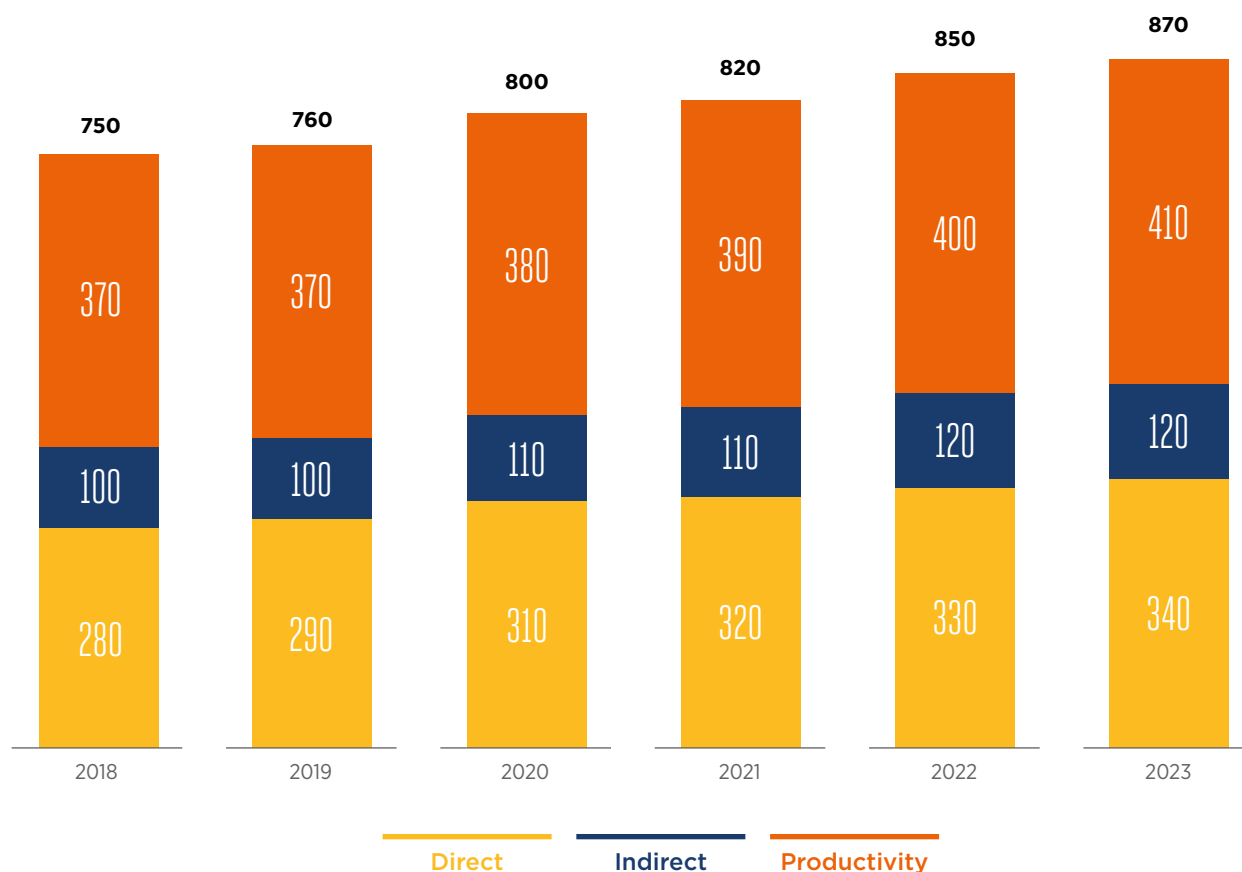
we estimate that mobile will contribute \$870 billion (RMB6.0 trillion) to the Chinese economy by 2023, up from \$750 billion (RMB5.2 trillion) in 2018.

Figure 11

Source: GSMA Intelligence

Economic contribution of mobile ecosystem: outlook to 2023

\$ billion



2.2

Consumer engagement with mobile services

GSMA Intelligence's annual Consumer Survey measures the level of engagement among smartphone and non-smartphone owners across 26 use cases and services in 10 categories. Based on the usage patterns of 36,000 people,¹⁰ consumers have subsequently been clustered into four distinct segments to reflect their mobile engagement levels:

- **Aficionados** – early adopters with the highest recorded engagement across all use case categories
- **Pragmatists** – high usage across most areas but still experimenting with certain use cases, such as financial services
- **Networkers** – moderate usage across fewer use cases than the above groups
- **Talkers** – laggards with low usage across all use cases except traditional communications, such as voice calls and SMS.

10. 1,000 respondents aged over 18 years old in 32 surveyed countries, plus 2,000 in each of China and India.

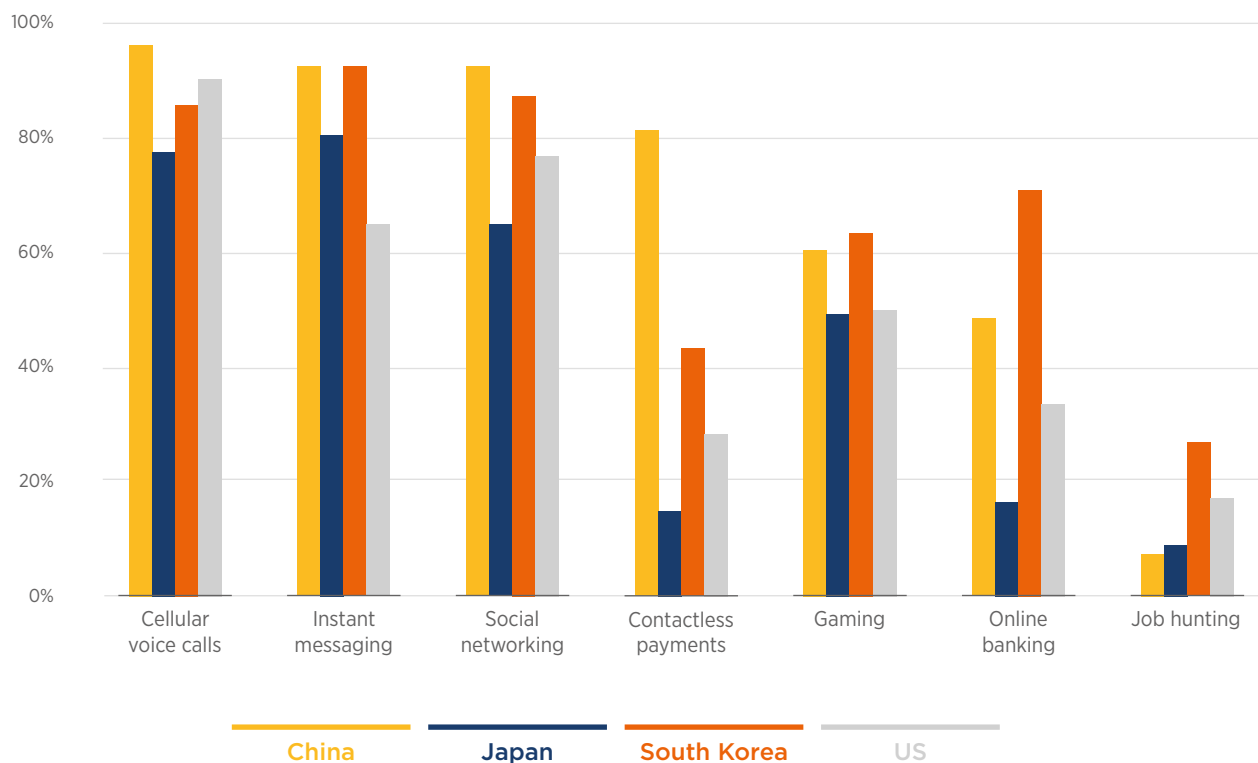
Key findings from the 2018 GSMA Intelligence Consumer Survey

- Of the 34 countries surveyed, China has a particularly high monthly engagement score for **cellular phone calls**. Some 97% of smartphone owners make or receive calls transmitted over a mobile network each month, whereas 90% do so using VoIP services. In terms of messaging, Chinese consumers have a preference for **IP-based apps** such as WeChat and QQ over **SMS**. This is particularly true for those in the 18-34 age bracket, where over 96% use instant messaging apps on a monthly basis.
- Digital commerce is a key focus area for mobile operators and ecosystem players in China. Some 81% of smartphone owners (860 million people) use their device to pay for goods using **contactless mobile payment** technology at least once per month, compared to 15% in Japan and 12% in France. Engagement is highest at 94% for mobile users aged 18-34 who live in urban centres. Many physical retailers in China accept payments through platforms such as WeChat Pay and AliPay.
- A relatively large proportion of Chinese smartphone users play **games** and consume **free music and video** content on a monthly basis. However, China shows a lower level of engagement with searching for **jobs** or accessing **government services** using a mobile phone compared to some of the leading European markets.

Figure 12

Source: GSMA Intelligence

Percentage of smartphone users engaging with certain use cases each month



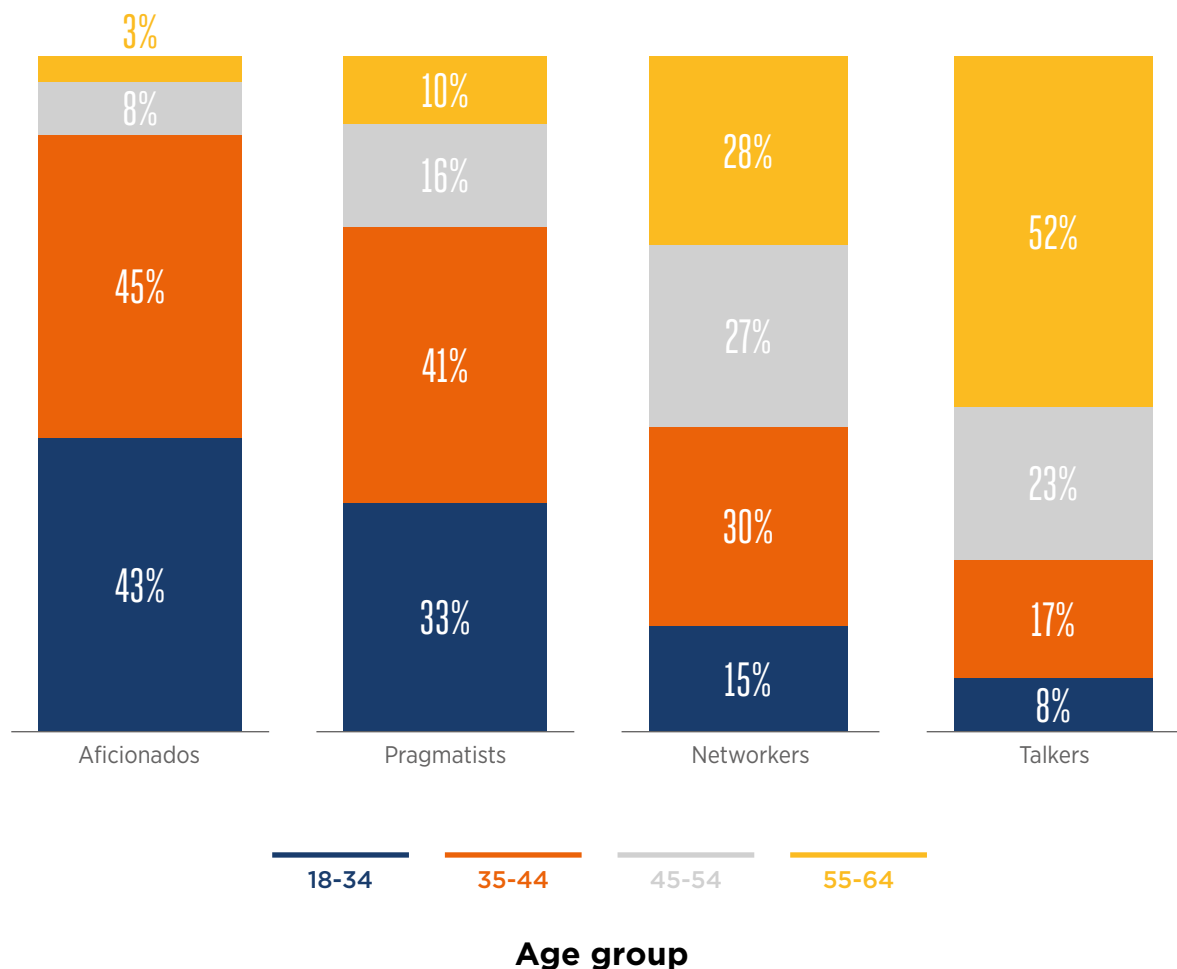
Consumer behaviour continues to evolve as mobile devices get smarter, digital services grow richer and societies become more connected. In China, today's digital consumers will likely become tomorrow's augmented customers in the 5G era; they will increasingly adopt emerging technologies such as immersive reality; technology solutions and applications for smart homes, cities and buildings; and new services such as drone delivery, consumer robotics and autonomous cars.

China provides a clear example of lower engagement levels in older age brackets (i.e. they are mostly Talkers or Networkers). The vast majority of millennials (approximately 30% of the population) are Aficionados or Pragmatists. As millennial and Generation Z mobile users get older, the prevalence of highly engaged consumers will gradually increase across China. While this presents an opportunity for mobile operators, the challenge remains to balance network investment and the monetisation of rising data traffic.

Figure 13

Source: GSMA Intelligence

Consumer segmentation in China



2.3

Mobile addressing social challenges

Connecting the unconnected

Despite the growth in mobile internet penetration from 20% at the start of 2010 to around 60% today, 2.4 billion people in Asia Pacific remain offline, mostly in low- and middle-income countries. While the digital divide is greatest in markets such as Bangladesh, Pakistan and India, China still has the largest overall number of mobile subscribers without access to the mobile internet. Based on the country's population of more than 1.4 billion, every percentage increase in mobile internet penetration connects an extra 14 million people.

According to the GSMA's Mobile Connectivity Index,¹¹ China outperforms the regional average in each of four main indicators. In fact, China has moved into the Advanced cluster over the past three years, and is close to meeting the threshold for the Leaders cluster. As challenges around infrastructure, affordability, consumer readiness and content are addressed, we expect an additional 313 million people to gain access to the mobile internet across the country by 2025, bringing the total to more than 1.1 billion, or 79% of the population.

Achieving the Sustainable Development Goals

Like other UN member states, China has adopted the 17 SDGs that seek to end poverty, protect the planet and ensure prosperity for all. Mobile is playing a key role in tackling various social and economic challenges outlined by the SDGs, including poverty, health, education, gender

equality, employment, safer cities, climate change and identity. Mobile technology provides access to tools and applications that help address these issues, and enables innovative approaches to building more efficient and environmentally sustainable societies.

SDG 2: Zero hunger – end hunger, achieve food security and improved nutrition, and promote sustainable agriculture

Operators are increasingly facilitating access to value added services (VASs) related to agricultural and nutritional practices, and to financial services via mobile payment technology. Meanwhile, the use of smart drones and IoT solutions to monitor weather patterns is helping farmers become more resilient to climate change.

China Mobile's Targeted Poverty Alleviation System¹²

Through China Mobile's TPAS, government anti-poverty staff can use smartphones to collect information on rural families in poverty (to understand their health, diet and drinking conditions) and enable the government to manage poverty alleviation work more effectively. Concurrently, information and resources from NGOs and the government is shared (via an app) among the rural population, so that people can learn about poverty alleviation policies, apply for jobs and access vital information (such as health advice or educational opportunities). TPAS also enables rural

poverty families to market and sell their agricultural produce through e-commerce channels, helping them generate an income.

To date, the system has been applied in 60 cities and counties in 10 provinces, covering 7.2 million impoverished people and serving 710,000 poverty alleviation cadres. By 2020, China Mobile aims to cover 10 million impoverished people in China, to provide intelligent tools, link thousands of welfare resources to government staff, and help the government run targeted poverty alleviation policies.

11. <https://www.mobileconnectivityindex.com/>

12. 2018 Mobile Industry Impact Report: Sustainable Development Goals, GSMA, 2018

SDG 9: Industry, innovation and infrastructure – build resilient infrastructure, promote sustainable industrialisation and foster innovation

The mobile industry has a critical role to play in SDG 9, both as a provider of network infrastructure and a catalyst for the evolution of other industries. Having invested heavily in 3G and 4G technology, operators are pursuing innovative solutions to deploy networks in remote areas and make mobile services more affordable to the poorest individuals.

Chinese operators connecting rural areas

Guided by the MIIT, in 2004 China Mobile launched the Village Connected Project to promote universal access in rural areas. Under the programme, China Mobile enabled mobile phone access for around 122,000 remote villages and provided fixed broadband access to 386,000 administrative villages by year-end 2017.

In 2016, China Telecom continued building communication networks for rural areas and remote villages and towns. It participated in government-led universal service pilot projects and has expanded fibre broadband infrastructure to 85% of administrative villages. By the end of 2017, China

Telecom had completed about 40,000 network construction tasks in administrative villages, also establishing local service points to promote e-commerce and economic development.

Since 2016, China Unicom has expanded coverage of fibre broadband and 4G networks in remote and western regions. It has now undertaken broadband construction work in more than 16,000 administrative villages. China Unicom has also launched various affordable mobile tariffs, allowing users in rural areas such as farmers to access telecoms services for RMB8 per month.



03

Mobile enabling and driving innovation across China



3.1

Smart cities and the industrial Internet of Things

At the end of 2018, the number of licensed cellular IoT connections in China reached 672 million, accounting for more than 90% of IoT connections in Asia Pacific and 60% of IoT connections globally. By 2025, China will be home to almost 1.9 billion licensed cellular IoT connections, with growth driven by various industry vertical applications. Narrowband IoT (NB-IoT) technology has been selected for nationwide deployment to support use cases such as smart cities (for example, utility meters), connected bikes and smart agriculture. Large-scale deployments, and the resulting high-volume chipsets, are expected to reduce chipset prices, which will further fuel the growth in cellular IoT connections.

A number of smart city initiatives have arisen in response to China's 13th Five Year Plan. For example, in 2017, Shenzhen Gas, China Telecom, Huawei and Goldcard jointly trialled NB-IoT gas meters, while China Mobile has conducted successful pilots of a smart parking solution in Yunnan and Guizhou.¹³ ZTE's Shanghai World Expo Smart City project uses the vendor's multi-layered IoT platform architecture to provide various solutions such as smart street lighting and air quality monitoring. In addition, the GSMA is working with the mobile industry to establish an IoT big data ecosystem to make harmonised datasets from multiple sources

available to developers and third parties through common application programming interfaces (APIs). Contributions from China Mobile and China Unicom mean that datasets on air quality and weather in China are now available.¹⁴

Industrial modernisation is another key pillar of the government's plan. The goal is to retool factories with connected machinery to allow for advanced robotics and to conduct skills training for staff with augmented reality (AR). Ericsson, for instance, has attached real-time motion sensors to NB-IoT modules across its Nanjing manufacturing plant to improve the calibration process of expensive, high-precision screwdrivers.¹⁵ Elsewhere, China Telecom, Hebei Wuwei Avionics Technology and Yantai Hengyuan Intelligent Technology launched a digital management transformation project utilising NB-IoT networks and real-time data analysis to shorten product manufacturing cycles, accelerate manufacturing speeds and reduce costs.

Accordingly, GSMA Intelligence forecasts that Asia Pacific will account for more than 530 million smart manufacturing connections in 2025 (over 50% of the global total), up from around 70 million at year-end 2018.¹⁶ The initiatives of Chinese mobile operators, cloud players and vendors will drive much of this growth.

13. Mobile Internet of Things case study: Greater China, GSMA, 2018

14. <https://apidirectory.iot.gsma.com/>

15. Mobile IoT Case Study: Ericsson Smart Industrial Factory, GSMA, 2018

16. IoT: the next wave of connectivity and services, GSMA Intelligence, 2018

3.2

Tech investment and the start-up ecosystem

In 2017, private firms in China invested \$90 billion (RMB622 billion) in tech start-ups and other emerging companies. China's share of global external financing is increasing due to the presence of a number of large investors such as Sequoia Capital China, Matrix Partners China, IDG Capital and ZhenFund, which financed more than 100 deals each over the last few years. Baidu, Alibaba and Tencent (known as the BAT trio) have also moved beyond their core businesses to invest in, or acquire, firms in content and media, gaming, the sharing economy and fintech. Huawei, meanwhile, has sought to develop its international presence in digital technologies, for example acquiring two Israeli start-ups: HexaTier, a database security company; and Toga Networks, a software-based system design and chip design firm.

In addition, telco corporate venture capital activity is on the rise as operators look to accelerate innovation and steel themselves against disruption. In Q4 2017, China Telecom created two investment units (China Telecom Group Investment Co. Ltd and Tianyi Capital Holdings Ltd) to manage assets

of more than RMB80 billion (\$12 billion), while the China Mobile Innovation Industry Fund has led a number of rounds of funding, two of which were valued at \$100 million (RMB692 million) each. China Unicom has established a subsidiary Unicom Venture Capital Co. Ltd, and has been a recipient of strategic investments from the BAT trio.

Many Chinese cities are now tech hubs, providing start-ups with business support and access to critical resources such as talent, networking and digital tools. Zhongguancun in Beijing was originally founded 30 years ago to replicate Silicon Valley – it is now an incubator for nearly 9,000 tech firms and has produced numerous 'unicorns'. These hubs have enabled Chinese firms, including Ofo and Mobike, to move beyond the country's borders. Similarly, Meitu, a selfie app with image-editing software, has become popular with young consumers; the company has opened overseas offices in Brazil, India, Indonesia, Japan, Singapore, South Korea, the UK and the US.

3.3

China's expanding e-commerce market

China has become the world's largest market for retail (or business to consumer, B2C) e-commerce, with a turnover of \$245 billion (RMB1.7 trillion) in 2017 – 30% growth on the previous year.¹⁷

China's mobile internet users are among the most engaged globally on e-commerce platforms. Here, 69% of smartphone owners use their devices to purchase goods and services online every month, with a further 16% doing so on a less frequent basis.¹⁸ Chinese consumers are particularly active on Singles' Day on 11 November, which is a larger online shopping day than Black Friday and Cyber Monday combined. On this day in 2018, the value of transactions on Alibaba's e-commerce platform alone was RMB213.5 billion (\$31 billion).

Wide mobile broadband availability, growing 4G adoption and higher smartphone uptake (particularly in rural areas) will support further development of the Chinese digital commerce market, as well as greater use of payment platforms such as AliPay and WeChat Pay, which are now ubiquitous. As e-commerce develops, cross-border trade will become increasingly lucrative – in China alone, this is set to exceed \$125 billion (RMB865 billion) in 2017.¹⁹ Around 64% of Chinese consumers report their intention to increase online spending, which will likely result in positive knock-on effects across the wider economy.

17. China Internet Watch, Q2 2017. Also see Digital identity: trends and news in China and South East Asia, GSMA, 2018

18. GSMA Intelligence Consumer Survey 2018

19. The Cross-border E-commerce (Haitao) Opportunity in China, Frost & Sullivan and Azoya Consulting, 2018

GSMA Intelligence's latest annual Consumer Survey shows China to be a contactless, or mobile payment, superpower. Early launches of digital wallets on Chinese social media and e-commerce platforms mean the country has the highest monthly usage of contactless payments globally; 81% of smartphone

owners use their device for contactless payments at least once per month, compared to 44% in South Korea and 29% in the US. Consequently, the value of Chinese mobile payments reached RMB120 trillion (\$17 trillion) in 2017, doubling from a year earlier.²⁰

3.4

Strategies for artificial intelligence

The global AI industry is currently dominated by the big tech players in the US and China, who are investing and recruiting heavily in this space. Tencent has opened AI labs in Shenzhen and the US state of Washington, and launched its Xiaowei smart speaker in May 2017, offering similar skills to Western counterparts. One of the firm's major AI priorities, however, is healthcare. Tens of thousands of medical institutions now have a WeChat account, allowing patients to book appointments online and Tencent to use that data to help train AI algorithms for the development of virtual healthcare assistants.

In Q4 2017, Alibaba announced plans to spend \$15 billion (RMB104 billion) researching “foundational and disruptive technology”, and has launched commercial products utilising AI, such as FashionAI. Through the Damo Academy, its R&D arm, Alibaba is also working to produce its first in-house AI chips and quantum processors. Meanwhile, Baidu offers a range of AI-powered services such as Baidu Brain and is looking to further develop and commercialise AI to support group strategy across verticals – for example, the Apollo project for autonomous vehicles. It too has a voice assistant, DuerOS, which has now reached over 200 million devices. Beyond the BAT companies, at its conference in Shanghai in October 2018, Huawei presented its AI strategy, as well as launching the new Ascend series of AI chips. Huawei intends to deploy the Ascend 910 chips in the servers behind its nascent cloud computing business, while the 310 chips have been designed to support connected devices, including smartphones and wearables.

As these companies progress a number of AI initiatives, the Chinese government is lending considerable support, including creating funds to encourage research. In 2017, China published its Next Generation Artificial Intelligence Development Plan, which set out the country's ambition to be

the global leader in AI by 2030, with a domestic industry worth RMB1 trillion (\$145 billion). The first of the plan's three stages is to obtain parity with the US and to cultivate a backbone of world-leading AI enterprises by 2020. A good measure of this is private financing; in H1 2018, Chinese AI companies raised \$31.7 billion (RMB219 billion), almost three-quarters of all funding worldwide.²¹ The second phase is about formulating legislation and making breakthrough applications of AI to medicine, manufacturing, agriculture and more by 2025, which, it is hoped, will spur China's progression to global leadership during the course of the third five-year stage.

In parallel, the three Chinese mobile operators are recognising AI's strategic importance for future business and digital transformation as well as driving autonomous and intelligent networks. Responding to the government's AI strategy, China Mobile launched an open platform for developers called Empyrean in December 2017 and has since signed a memorandum of understanding with Nokia to research the use of AI and machine learning for 5G network security and reliability. The operator is also combining big data and AI techniques to combat telecoms fraud, which cost consumers more than RMB13 billion (\$1.9 billion) in 2017.²²

Meanwhile, China Telecom is working with Nokia and Intel to develop an AI-supported cloud network for the delivery of mass-market services with extremely low latency, and is leading an ETSI working group alongside Huawei. Finally, China Unicom is targeting “niche AI opportunities” and has agreed a strategic partnership with Baidu, which aims to apply AI and other leading technologies to future products and services. China Unicom is also serving as deputy directing unit of the AI Industry Development Alliance of China, which held its inaugural conference in Beijing in October 2017.

20. “Chinese merchants refuse cash as mobile payments take off”, FT, January 2019

21. “Briefing: Chinese AI companies raised \$31.7 billion in the first half of 2018”, technode, December 2018

22. “China Mobile uses big data and AI to curb telecom fraud”, China Daily, September 2018

3.5

Blockchain initiatives in China's TMT sector

While blockchain initially focused on financial payments and transactions, attention is now shifting to broader uses incorporating the principles of trust and ownership. These include identity management, traceability of assets, transparency of supply chains and executing smart contracts. With more than 32 million Chinese people currently unregistered,²³ blockchain could also be employed to facilitate the provision of officially recognised identification, which could then be used by citizens to obtain a mobile SIM card or access certain services online.

Beyond identity, various use cases are being considered for telecoms, including fraud prevention, content delivery over mobile devices and business process efficiency (e.g. for mobile number portability, billing or eSIM provisioning). China Unicom's Research Institute began exploring blockchain theory and technology in 2015, and the operator had registered 113 patents by the end of 2018, many of which relate to IoT. China Mobile is planning to leverage blockchain to expedite the data top-up process for its customers, easing current pressure on its data centres. In addition, China Telecom is providing blockchain-based solutions to the agricultural sector which aim to lower costs, improve efficiency and increase traceability throughout the value chain.

In 2018, the three Chinese mobile network operators announced that they had worked together to drive forward a blockchain initiative aimed at fostering

the development of the technology and its use across the telecoms industry. It is hoped that the project, which forms part of the China Academy of Information and Communications Technology's wider body of work, could help reduce operational costs and bolster network security. This could represent a fillip for operators as they prepare for the deployment of 5G infrastructure.

The country's webscale tech firms are also engaged in this space. JD.com, for example, began to invest in blockchain in 2016 and built the open platform, Zhizhen Blockchain, to provide services to cooperate clients. Alibaba's Ant Financial trialled its blockchain-based cross-border remittance service in June 2018 and is in the process of launching an enterprise-focussed 'backend-as-a-service' platform underpinned by the technology. Meanwhile, Baidu has established a company in Hainan province principally to develop online games using blockchain, which will build on the "Laici dog" project unveiled in Q1 2018.

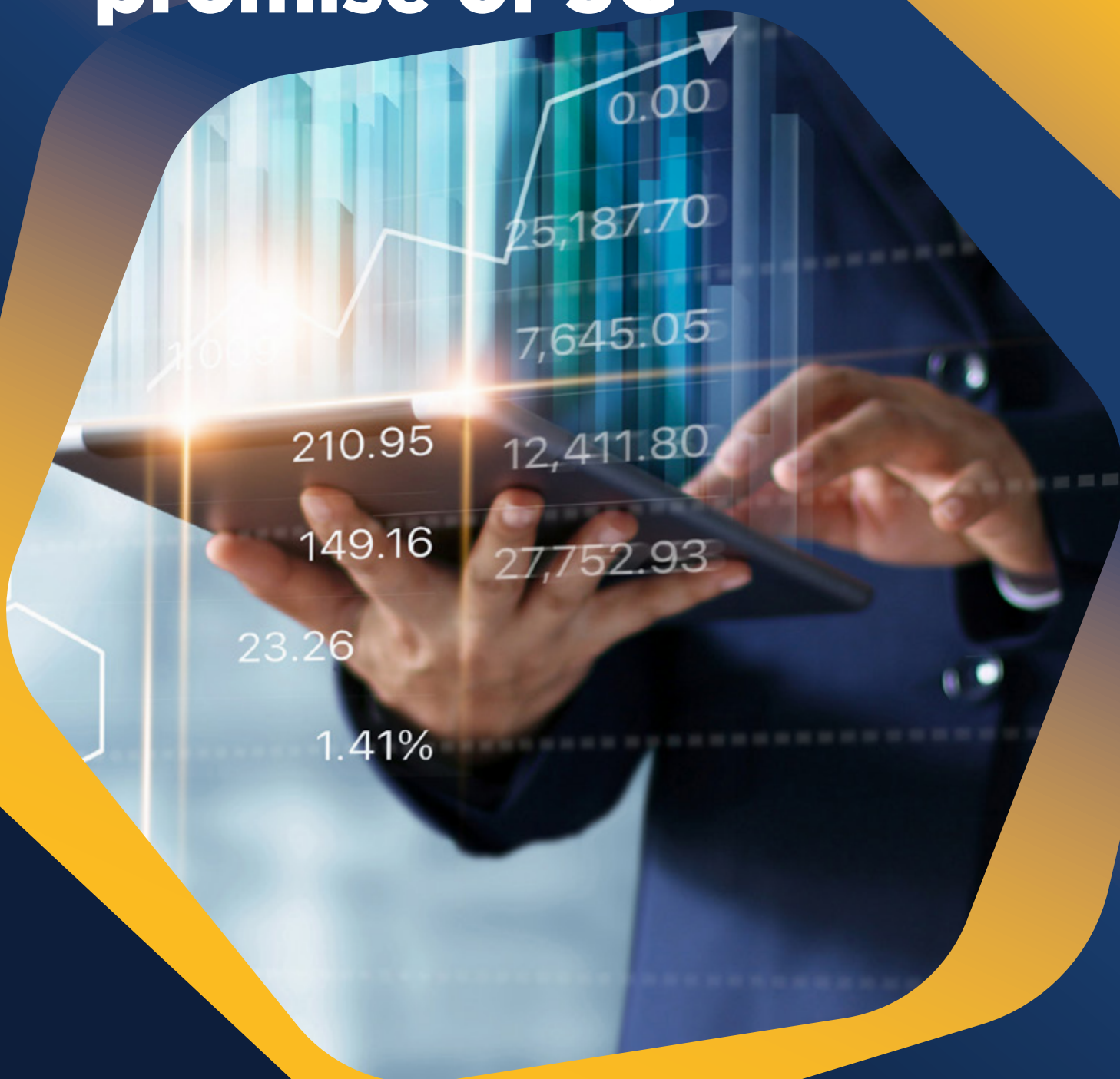
Further, a host of Chinese firms, including Baidu, Huawei, JD.com, Lenovo and Tencent, are member organisations of Hyperledger, an open source collaborative effort created to advance cross-industry blockchain technologies. It is a global association, hosted by The Linux Foundation, including leaders in finance, banking, IoT, supply chains, manufacturing and technology.²⁴

23. Global ID4D Dataset 2018, World Bank

24. Blockchain – Operator Opportunities: Version 1.0, GSMA, 2018

04

Shaping policy to deliver on the promise of 5G



4.1

5G spectrum policy

Around the world, the telecoms industry is on the cusp of the 5G era, with dozens of operators announcing launch plans and a few now offering services commercially. In the US, the government is eager to support 5G rollout by bringing spectrum, including millimetre wave (mmWave) frequencies, to auction as soon as possible. Meanwhile, the European Commission launched the 5G for Europe Action Plan in 2016 and established the 5G Infrastructure Public Private Partnership in conjunction with the region's wider ICT industry.

All three South Korean operators launched 5G services for enterprises in December 2018, and Japan will deploy 5G networks in time for the 2020 Olympics. China is also aiming to be part of the first wave of 5G commercialisation, with operators currently considering whether to pursue a standalone or a non-standalone model for 5G. A standalone architecture would require the construction of a new network, while a non-standalone approach could be lower cost (at least in the early stages) as 5G networks would be supported by existing 4G infrastructure. While 5G-based fixed wireless will be an initial use case in the US and the Middle East, it is not the main focus of Chinese operators, as fibre has been rolled out extensively.²⁵

Irrespective of the approach taken to bring 5G to market, spectrum will be a common policy issue across national borders. Spectrum is an enabler for growth and competitiveness in the digital age: assigning the right frequencies, at the right time and under the right conditions is a prerequisite for enabling the investments needed to deliver 5G leadership and the next wave of mobile innovation for Chinese citizens and businesses.

Both the government and the MIIT appear to recognise the need to ensure the timely release of spectrum and promote its efficient use. For example, the MIIT has issued test licences for 5G trials in the 2.6, 3.5 and 4.9 GHz bands, signalling its commitment to supporting pre-commercial deployments and the maturity of China's 5G value chain. In 2019, the MIIT will also issue temporary 5G network licences in some cities.

With the increased need for spectrum to support high data traffic and new innovative services in a 4G and 5G world, China should continue to evaluate new spectrum and appropriate conditions, especially in mmWave frequencies, to support sustainable growth as 5G coverage expands. Meanwhile, exclusive licensing will become ever more important to support efficient spectrum allocation and engender healthy investment in networks. To deliver on the promise of 5G, China must champion best-practice spectrum policy, allowing operators to make the most of a vital and scarce resource.

25. 5G in China: outlook and regional comparison, GSMA Intelligence and CAICT, 2017

4.2

Regulatory modernisation

Mixed-ownership reform

In September 2016, China Unicom announced plans to take part in the government's mixed-ownership reform programme for state-owned enterprises (SOEs). The programme aims to open up SOEs, especially those in state-led industries such as telecoms, to private sector finance and management to improve their efficiency and competitiveness.

China Unicom released the final approved plans in August 2017. Under the new structure, China Unicom now holds 36.7% of total shares, with a third held by strategic investors, including the country's four largest internet firms, Alibaba, Baidu, JD.com and Tencent. The remainder is owned by public shareholders and employee incentive shares, making it the most aggressive SOE mixed-ownership reform to date. However, though the shareholding is now more diversified, the combined shareholding of China Unicom, state-owned insurance company China Life and the state-owned China Structural Reform Fund still afford the government majority control.

Analysts and investors generally considered that the mixed-ownership reforms would inject funding into SOEs, enabling new strategic partners to collaborate on innovative products and services that leverage each other's strengths. As such, it is expected to drive China Unicom's push towards new business models and market channels. Further, the operator's reform is seen as a major milestone and a flagship trial for the country's SOE reform initiative, especially as it is:

- the first mixed-ownership reform at the group level (past cases largely focussed on subsidiaries or sections of a business)
- the first influx of private investment into a state-led industry and a state-owned telecoms company.

The experiences and lessons from the China Unicom reform case will help improve and shape the future reform process of other SOEs in telecoms and other sectors.

China Unicom's transformation with help from its new strategic investors will also provide useful case studies on operator transformation in the era of convergence and the digital economy. Globally, mobile operators are exploring new ways to evolve their business models to stay competitive with tech and internet players. For example, China Mobile is investing in the fledgling autonomous vehicle industry, conducting research and tests with Huawei and Audi. Meanwhile, China Telecom's Zhongshan Industrial IoT Open Platform provides a cloud infrastructure and computing platform to help traditional manufacturing enterprises transform to meet the opportunities and challenges of the future.²⁶

Further afield, Turkcell launched digital brand Lifecell in 2017, providing a platform for services such as music, TV and IP communications, while several European operators, including Vodafone, Orange, Telefónica and Deutsche Telekom, all have lines of business dedicated to IoT.

26. How Greater China is set to lead the global industrial IoT market, GSMA, 2018

MVNO licensing

With the retail mobile market in China dominated by three nationwide network operators, in January 2013 the regulator issued a consultation which launched a mobile virtual network operator (MVNO) pilot scheme. This allowed private firms to enter the market as MVNOs on a trial basis, with each state-owned operator required to host at least two virtual players. Trial licences were initially granted to 11 firms, although this gradually increased to 42.

At year-end 2017, virtual players had amassed 50 million subscribers between them, equivalent to 3.5% of the total Chinese mobile market.²⁷ As a result, some new-entrant MVNOs have switched their business focus to other market segments, considering that international roaming, IoT or enterprise could potentially be more lucrative. The failure of some to comply with China's real-name registration system has left many of their numbers occupied by scammers, affecting consumer trust. Despite many probationary MVNOs failing to generate adequate growth or record a profit, in July 2018, the regulator issued full commercial MVNO licences to 15 companies, including Xiaomi, Alibaba and JD.com.

Barriers to MVNO user acquisition included wholesale prices for mobile traffic and falling retail tariffs of the three mobile operators, which were the result of fierce competition and the government's "raise speed, reduce tariff" directives. It has therefore been difficult for MVNOs to attract China's price-sensitive customers en masse, despite offering plans that have no monthly fees or plans that roll over consumers' unused data to the following month. At the same time, collaboration between internet companies and mobile operators on co-branded SIM cards with zero-rated services has also weakened the value proposition of MVNOs.

This reflects the challenges for policymakers looking to encourage innovation, inject greater dynamism and intensify mobile market competition. With connections penetration now 109% and competition between network operators ramping up, the consumer market in China is a challenging one for MVNOs. The combination of unfavourable commercial conditions (relatively low average revenue per user and a high proportion of prepaid connections), regulatory barriers and the size of the three mobile operators may make it difficult for MVNOs to scale and thrive.

Universal service

Across Asia Pacific, policymakers have created universal service funds (USFs), which function by collecting levies on operators and using those funds to finance connectivity initiatives. While theoretically appealing, implementation issues, including inadequate governance, a lack of political independence, ill-conceived objectives or a lack of defined targets, can impair the effectiveness of USFs.²⁸ A GSMA study of 64 USFs found that, at the time of writing, more than a third had not yet disbursed any of the levies collected from operators.²⁹

USFs that do not disburse any funds are effectively a sector-specific tax for the telecoms sector, which increases operators' overall costs and reduces their ability to reinvest, thus weakening the business case of improving coverage "on the margin". To ensure the good operation of USFs, governments must adopt best practices, including:

- establishing an autonomous and independent fund structure, along with a fund administrator who is accountable to an impartial party
- adopting a legal and regulatory framework that is flexible, and technology and service neutral
- agreeing clearly specified and measurable objectives prepared in consultation with stakeholders
- being highly transparent from a financial reporting perspective, and allocating funds through competitive bidding processes
- having guidelines and procedures for working with other funding sources (e.g. development banks).

27. "China's virtual telcos will finally get the official green light, but it might already be too late", technode, January 2018

28. Enabling rural coverage: regulatory and policy recommendations to foster mobile broadband coverage in developing countries, GSMA, 2018

29. Survey of universal service funds: key findings, GSMA and Ladcomm Corporation, 2013

An operator-led approach to filling coverage gaps and supporting the digital economy would be to introduce a ‘pay or play’ incentive for USF contribution. Under such an arrangement, mobile operators would be allowed to withhold their USF contributions so long as they commit to, for example, building a number of sites in a certain area – in other words, they opt to ‘play’ rather

than ‘pay’. While Chinese operators are SOEs and therefore subject to the will of the government, this option could provide incentives for efficient deployment and cost minimisation as operators could choose if they want to pay a contribution to the fund or directly invest in areas aligned with the fund’s objectives.

Digital dividend and beyond

The digital dividend is the 700 MHz spectrum band to be made available for alternative uses following the switchover from analogue to digital terrestrial television. It is ideal for mobile broadband as it consists of lower frequency bands that can cover wider areas with fewer base stations. This lowers deployment costs and allows operators to provide broader, more affordable coverage, especially in rural and remote areas.

The digital switchover (DSO) in China has been a focus of the regulator in the past few years but has progressed slowly, partly due to the complex incumbency across multiple agencies and stakeholders. Although the analogue switch-off was originally planned for 2015, it has been pushed back and is now likely post-2020.

Aligning with the globally harmonised Asia Pacific Telecommunity’s band plan (the APT700 Band Plan³⁰) will give an optimal 2×45 MHz of spectrum for mobile broadband. As 4G continues to mature and with 5G on the horizon, it will be important to expedite the DSO and release the 700 MHz band so that operators can provide cost-effective mobile broadband in rural and remote areas to reduce the digital divide.

With the new capabilities brought by 5G, the switchover to digital television will support the delivery of high-definition broadcast content via enhanced mobile broadband. Recently, China Central Television partnered with China Mobile, China Unicom, China Telecom and Huawei to establish a national “5G new media platform” to promote the use of 5G technologies in 4K broadcasting, including the corresponding technical framework, specifications and new innovative use cases.³¹ This is a good example of new models and new dynamics in convergence. In addition, the incumbent broadcast television network operator has shown interest in venturing into the mobile play, and the MIIT is said to be crafting a 5G licence for the broadcaster to better use its 700 MHz band for converged services.

Recognising the complexity in clearing the 700 MHz band in China, the GSMA strongly encourages the MIIT to expedite the DSO process, working in close partnership with the broadcast authority, so that this premium spectrum can be released for mobile broadband sooner. It will greatly enhance access to mobile broadband and the digital economy for people in rural and remote parts of China. The regulatory framework will also need to catch up with the fast-paced evolution of innovative converged models so that consumers can enjoy both better mobile broadband and digital content.

30. Position paper for Asia Pacific on Digital Dividend/UHF band plans, GSMA, 2011

31. http://www.xinhuanet.com/politics/2018-12/28/c_1123921034.htm

4.3

Cross-industry policy for verticals

The imminent arrival of commercial 5G mobile networks in China has shifted debate from the aspirational to the practical. While much of the hype has focussed on consumer applications, the enterprise space is an arguably larger opportunity. The use of 5G technology in vertical sectors carries a number of implications for a supportive public policy environment.³² Some of these are vertical specific, though there is a general need for a collaborative approach between industry and government to balance the potential benefits of 5G to the economy with investment capital required for scaled deployments.

In terms of national spectrum planning, requests for spectrum allocation from different verticals will cause spectrum fragmentation, resulting in inefficiency and a slowing of innovation. Regulations should avoid further spectrum fragmentation and, under a technology and service neutrality

scheme, allow commercial IMT networks to provide 5G services to verticals. Assigning spectrum to mobile operators, which are most experienced in maximising spectral efficiency, will ensure best use of this scarce resource. Moreover, assigning internationally harmonised spectrum for 5G will help drive economies of scale, which manifest in the form of lower handset costs, other things being equal.

In terms of cross-sectoral regulation, the convergence of 5G in vertical sectors will challenge existing regulatory frameworks. The traditional telecoms ministry will soon need to regulate services in other sectors that may have their own regulation and regulators. A national coordination mechanism is needed to manage cross-sectoral policymaking and enforcement, particularly for verticals such as automotive, drones and manufacturing, where China is demonstrating global leadership.

32. 5G in China: the enterprise story, GSMA Intelligence and GTI, 2018



4.4

Artificial intelligence and ethics

AI is a strategically important technology for China. The government views AI as a means of reinvigorating industries and is aiming to support the creation of a RMB1 trillion (\$145 billion) AI ecosystem by 2030. Yet, as its applications multiply across the world, potential pitfalls have emerged. Facial recognition technology is raising questions around privacy and surveillance; challenges have arisen around the determination of liability and the responsibilities of people and algorithms in autonomous driving; and there are concerns that machines that learn from our preferences could be used to increase biases and influence public opinion. Ethics in AI is fast becoming a critical issue for policymakers, consumers and businesses.

To that end, the European Commission is already considering the ethical dimension. Following its communication “Artificial intelligence for Europe”,³³ the Commission put forward a European approach to AI. This is based on three pillars, of which one pertains to ensuring an appropriate ethical and legal framework for AI. In addition, the Commission’s High-Level Expert Group on AI has proposed draft ethical guidelines around the use of the technology within the bloc.³⁴

The European approach could offer direction for other state institutions and the wider mobile industry when considering how to empower sustainable development of AI. Along with its ambition to become a global AI powerhouse, China should engage further with the matter of ethics as the technology matures. Though hastily introducing regulation could hamper innovation, establishing a framework for AI to flourish will require Chinese policymakers to open a dialogue with a broad group of stakeholders.

There are already well-established laws and regulations that protect individuals and minimise risks. Where appropriate, these could be applied to address regulatory issues in the context of AI

services and technologies. Governments should apply these frameworks in ways that promote self-regulation and encourage the adoption of appropriate approaches to AI. The GSMA believes key principles underpinning AI regulation should include the following:

- **Compliance with ethical principles:** the development and deployment of AI systems should comply with concepts such as ‘do no harm’, ‘do good’, ‘be fair’ and ‘operate transparently’.
- **Consistency with existing legal frameworks:** it is important to ensure that AI regulation leverages existing regulatory frameworks such as the China Cybersecurity Law, rather than duplicating them.
- **Accountability and flexibility:** implementation guidelines should avoid a one-size-fits-all approach for the mobile industry and allow organisations to flexibly innovate while also maintaining accountability.
- **Clarity and predictability:** rules or guidelines must provide industry players with clarity and predictability.

AI will be a central feature of the age of ‘intelligent connectivity’ and a lynchpin of increasingly autonomous next-generation networks. As AI investment magnifies around the world, especially in China, Europe and the US, so does the need for regional cooperation in addressing a range of ethical and legal issues. As shown by existing regulation such as General Data Protection Regulation (GDPR), a well-defined rules-based framework will help to shape global markets to the benefit of the consumer. Chinese policymakers and operators must therefore consider collaborating with their peers to embed the right values and governance framework at the core of the AI debate, particularly as the internationality of the technology grows.

33. Communication Artificial Intelligence for Europe, European Commission, 2018

34. Draft Ethics Guidelines for Trustworthy AI, High-Level Expert Group on Artificial Intelligence, 2018





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