# GSMA

# The Mobile Economy China 2023

# GSMA

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# Executive summary

## 5G underpins China's digital ambitions

China's economy is on the road to recovery, following the easing of Covid-19 restrictions from late 2022. Mobile connectivity served as a lifeline throughout the pandemic and will play an even more crucial role in enabling the safe return to social interaction and the restart of many economic activities. To this end, authorities across China have outlined plans to integrate digital technologies, underpinned by advanced mobile connectivity, into every aspect of society to sustain China's competitiveness in an evolving global economy. In 2022, mobile technologies and services generated 5.5% of China's GDP – a contribution that amounted to $1.1 trillion of economic value added.

5G will underpin future mobile innovation and services, building on current deployments and adoption. The number of 5G base stations in China exceeded 2.3 million at the end of 2022, including approximately 887,000 built during the year. China will be the first market with 1 billion 5G connections, reaching the milestone by 2025. By 2030, 5G connections in China will reach 1.6 billion, accounting for nearly a third of the global total. The technology will add $290 billion to the Chinese economy in 2030, with benefits spread across industries.

**Authorities have outlined plans to integrate digital technologies, underpinned by advanced mobile connectivity, into every aspect of society**

# Key trends shaping the mobile ecosystem

## 5G enterprise services to see greater commercial scale in 2023

Mainland China is the largest 5G market in the world, accounting for more than 60% of global 5G connections at the end of 2022. With strong take-up of 5G among consumers, the focus of operators is now increasingly shifting to 5G for enterprises. This offers opportunities to grow revenues beyond connectivity in adjacent areas such as cloud services – a segment where operators in China have recently made significant progress.

## Dedicated networks on the rise

Private and dedicated wireless network solutions are back in vogue, as 5G's enhanced capabilities move deployments beyond low-profile, niche offerings. Manufacturing and mining are two sectors where demand for private and dedicated 5G networks in China looks particularly strong. A number of use cases are currently in testing or live operation, including mobile robotics, automated guided vehicles (AGVs) and drones. For growth to continue, solutions need to become cheaper as well as easier and faster to install and operate. This will drive demand for pre-integrated solutions.

## Innovation underpins China's digital ambitions

China's digital ambitions are driven by a combination of external and internal factors, notably a slowdown in growth of the real economy. The digital ecosystem, including start-ups, will be at the forefront of efforts to realise China's digital ambitions, with innovation and investments driving the creation of new solutions across the focus areas of China's 14th Five-Year Plan (2021–2025) and the Long-Range Objectives Through the Year 2035.

## The mobile industry shifts towards circularity

Across the telecoms ecosystem, sustainability has extended beyond corporate social responsibility (CSR) to become a core strategic priority. Industry players are increasingly adopting a model of production, service offering and consumption that involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products for as long as possible. This circular approach is important for networks to operate in a more sustainable and energy-efficient way, and for the industry to make progress towards realising its climate goals.

## Fintech presents opportunities for mobile industry players

China has developed a lead in fintech services over the past decade, driven by investments in an expanding portfolio of products and surging public demand for electronic payment options. As fintech innovators increasingly leverage emerging technologies (such as big data, AI and cloud computing) to enable more complex and customised solutions, operators have an opportunity to play a greater role in fintech.

**Mainland China is the largest 5G market in the world, accounting for more than 60% of global 5G connections at the end of 2022**

# China: key mobile industry milestones to 2030

**2023**
- **1.3 bn** mobile subscribers
- **45%** 5G adoption
- **1.8 bn** mobile connections

**2024**
- **85%** mobile internet penetration
- **5G** adoption overtakes 4G
- 4G adoption falls below **50%**

**2025**
- **1 bn** 5G connections
- **1.65 bn** smartphone connections
- 2G & 3G adoption fall to **near-zero**

**2026**
- **1.2 bn** 5G connections
- **65%** 5G adoption
- **90%** smartphone adoption

**2027**
- **70%** 5G adoption
- 4G adoption falls below **30%**
- **1.3 bn** mobile internet subscriptions

**2028**
- **1.7 bn** smartphone connections
- **1.4 bn** 5G connections
- **75%** 5G adoption

**2029**
- **80%** 5G adoption
- **1.5 bn** 5G connections
- 4G adoption falls below **20%**

**2030**
- **1.6 bn** 5G connections
- **88%** 5G adoption
- **1.73 bn** smartphone connections

# Policies for growth and innovation

Spectrum availability and effective licensing are critical to encourage the investment required to expand mobile access, meet growing demand for data services and enhance the quality and range of services offered. In 2023, all eyes will be on Dubai, where the ITU's World Radiocommunication Conference 2023 (WRC-23) will take place in November/December. WRC-23 offers the chance to expand the availability of affordable 5G services and ensure future growth and innovation. It is an opportunity to build a spectrum roadmap into the 2030s, address the digital divide and ensure 5G can benefit billions of people.

Successful spectrum licensing has always been about long-term planning. Putting in place the right resources for 6G is no different. The mobile industry is already studying how 6G will shape the future of mobile. For regulators, ministries, operators, vendors and researchers, spectrum policy for 6G is becoming increasingly important. 2023 marks the beginning of a long journey, as new studies begin when the WRC-27 cycle starts.

**Spectrum availability and effective licensing are critical to encourage the investment required to expand mobile access**

# The Mobile Economy China

## Unique mobile subscribers

2022 **1.29bn**

2030 **1.33bn**

**87%** 2022   **89%** 2030

**Penetration rate**
Percentage of population

**CAGR** 2022-2030 | **0.4%**

## Mobile internet users

2022 **1.17bn**

2030 **1.33bn**

**79%** 2022   **89%** 2030

**Penetration rate**
Percentage of population

**CAGR** 2022-2030 | **1.7%**

## SIM connections
(excluding licensed cellular IoT)

2022 **1.74bn**

2030 **1.87bn**

**Penetration rate**
Percentage of population   **118%** 2022   **125%** 2030

**CAGR** 2022-2030
**0.9%**

## 4G Percentage of connections
(excluding licensed cellular IoT)

2022 **64%**

2030 **12%**

## 5G Percentage of connections
(excluding licensed cellular IoT)

2022 **36%**

2030 **88%**

## Smartphones
Percentage of connections (excluding licensed cellular IoT)

2022 **81%**
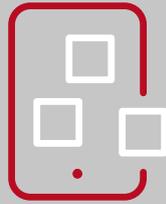
2030 **93%**

## Licensed cellular IoT connections
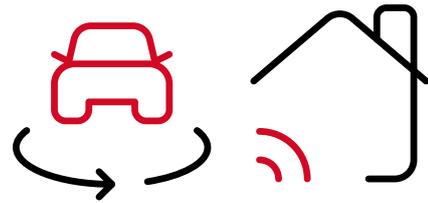
2022 **1.8bn**

2030 **3.6bn**

## Operator revenues and investment

2022 **$207bn**

2030 **$219bn**

Total revenues

### Operator capex

**$291bn**

2023 ● 2030

Over **95% on 5G**

## Mobile industry contribution to GDP

2022 **$1.1tn**

2030 **$1.3tn**

**5.5%** of GDP

## Public funding

2022 **$110bn**

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

## Employment

# 3 million jobs

Directly supported by the mobile ecosystem in 2022

**3 million jobs** supported indirectly

## Mainland China

**Technology mix***

2022
- 3G: <1%
- 4G: 64%
- 5G: 36%

2030
- 4G: 12%
- 5G: 88%

3G ● 4G ● 5G

**Subscriber penetration**
- 2022: 87%
- 2030: 89%
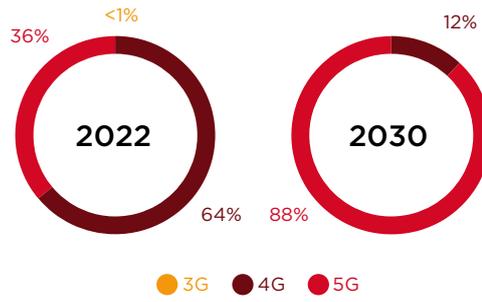
**Smartphone adoption**
- 2022: 81%
- 2030: 93%

## Hong Kong, SAR China

**Technology mix***
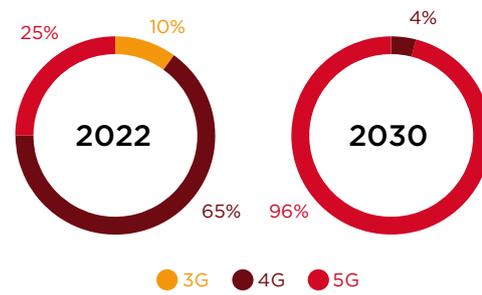
2022
- 3G: 10%
- 4G: 65%
- 5G: 25%

2030
- 4G: 4%
- 5G: 96%

3G ● 4G ● 5G

**Subscriber penetration**
- 2022: 94%
- 2030: 94%

**Smartphone adoption**
- 2022: 86%
- 2030: 93%

## Macao, SAR China

**Technology mix***

2022
- 3G: 1%
- 4G: 96%
- 5G: 4%

2030
- 4G: 5%
- 5G: 95%

3G ● 4G ● 5G

**Subscriber penetration**
- 2022: 91%
- 2030: 93%
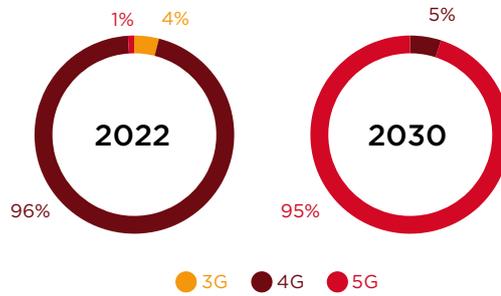
**Smartphone adoption**
- 2022: 92%
- 2030: 94%

## Taiwan, Province of China

**Technology mix***

2022
- 4G: 72%
- 5G: 28%

2030
- 4G: 4%
- 5G: 96%

3G ● 4G ● 5G

**Subscriber penetration**
- 2022: 95%
- 2030: 96%
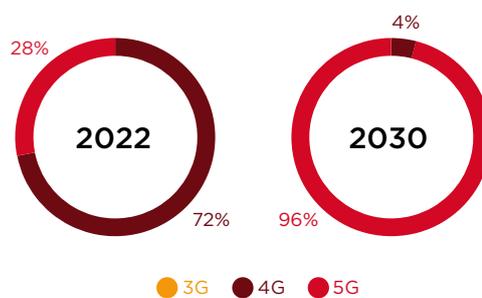
**Smartphone adoption**
- 2022: 85%
- 2030: 96%

*Percentage of total connections
Note: Totals may not add up due to rounding

# 01

## The mobile industry in numbers

# Unique mobile subscribers in China will total 1.33 billion by 2030

Unique mobile subscriber growth is beginning to plateau in China as the mobile market approaches saturation. China will see an additional 41 million subscribers by 2030, taking the mobile penetration rate to 89%.

Mobile adoption has largely peaked among the adult populations in urban areas. As a result, the majority of new subscribers in the coming years will be young users and rural populations subscribing for the first time.

Figure 1

## China: mobile subscribers and penetration

MIllion, percentage of population
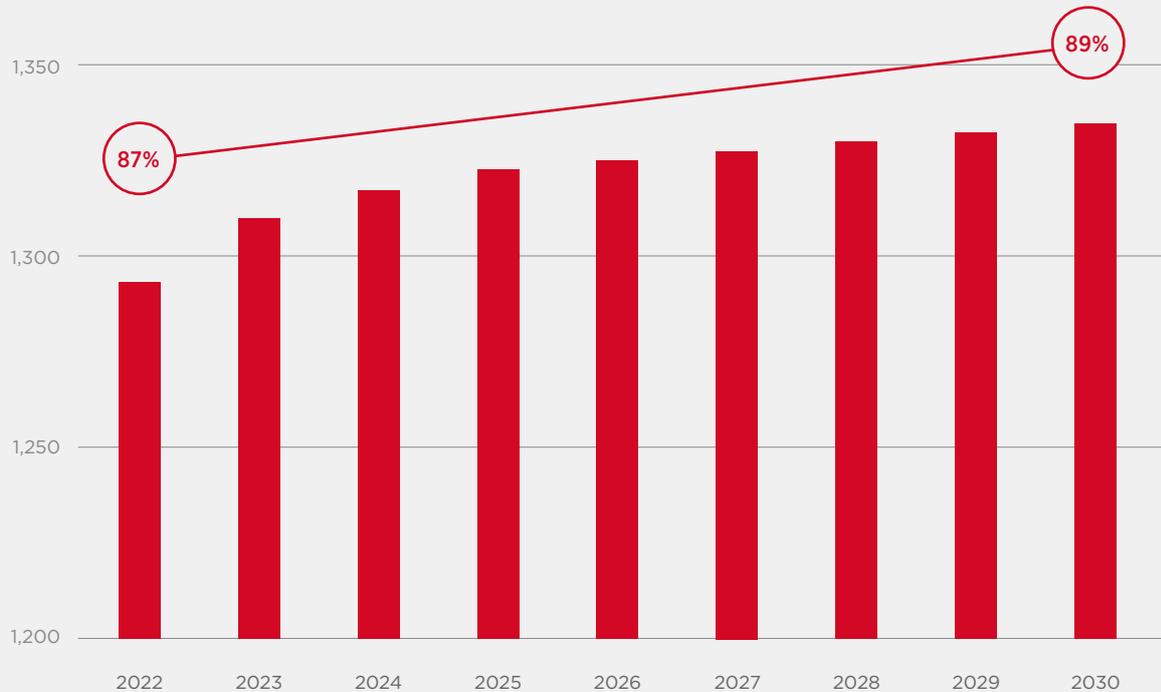


Source: GSMA Intelligence

# There were 1.17 billion mobile internet subscribers in China in 2022, equivalent to 79% adoption

The mobile internet usage gap in China has narrowed markedly in the last five years – from 37% in 2017 to 20% in 2022. More people rely on the internet for many daily activities, especially in the wake of the Covid-19 pandemic.

The usage gap in China is greatest among the elderly, mainly due to low levels of digital skills. According to the China Internet Network Information Center (CNNIC), internet penetration among those aged 60 years and above was 43% in 2021. Video content and social media platforms, such as WeChat, are among the main services bringing the elderly online.

Figure 2
## Mobile internet adoption by region, 2022

Percentage of population

| Region | Coverage gap | Usage gap | Connected |
|---|---|---|---|
| Global | 4% | 41% | 55% |
| Europe | 1% | 14% | 85% |
| North America | 1% | 16% | 83% |
| China | 1% | 20% | 79% |
| CIS | 5% | 28% | 67% |
| Latin America | 3% | 35% | 62% |
| Asia Pacific* | 4% | 47% | 49% |
| MENA | 6% | 55% | 39% |
| Sub-Saharan Africa | 17% | 60% | 23% |

● Connected  ● Usage gap  ● Coverage gap
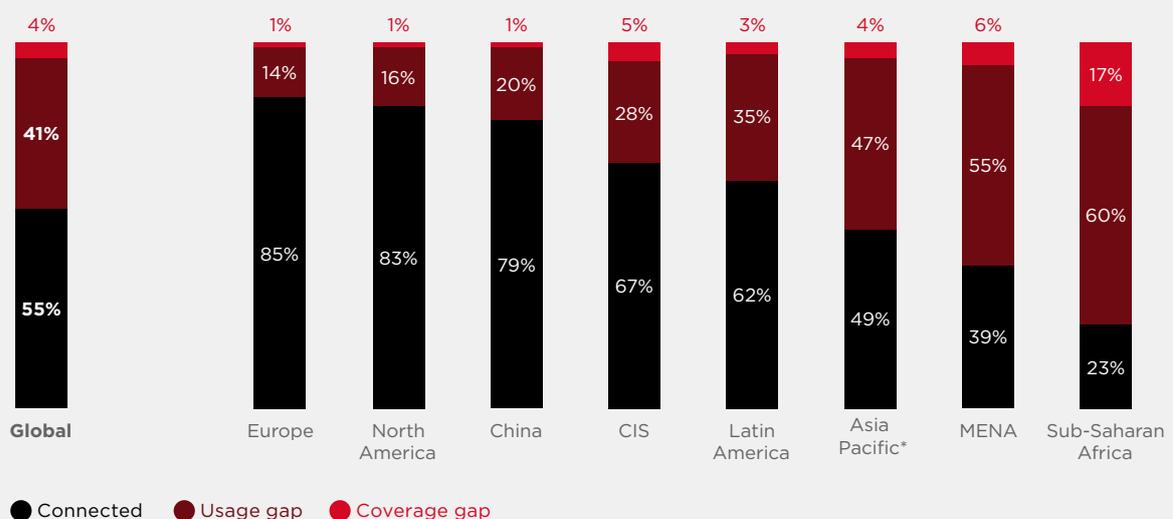
*Excludes China
Source: GSMA Intelligence

# 5G will overtake 4G in 2024 to become the dominant mobile technology in China

5G adoption continues to rise, following new network deployments and more affordable devices. China's 5G base stations exceeded 2.3 million at the end of 2022, including around 887,000 built during the year.[1] Chinese-made devices were among the 1,431 commercially available 5G devices globally as of the end of 2022.[2]

4G and 5G dominance in China means legacy networks (2G and 3G) are now being phased out. While most users have been migrated to 4G and 5G, legacy networks continue to support various IoT services. However, some estimates suggest that legacy networks could be almost entirely shut down in China by 2025.

Figure 3
## China: mobile adoption by technology

Percentage of total connections



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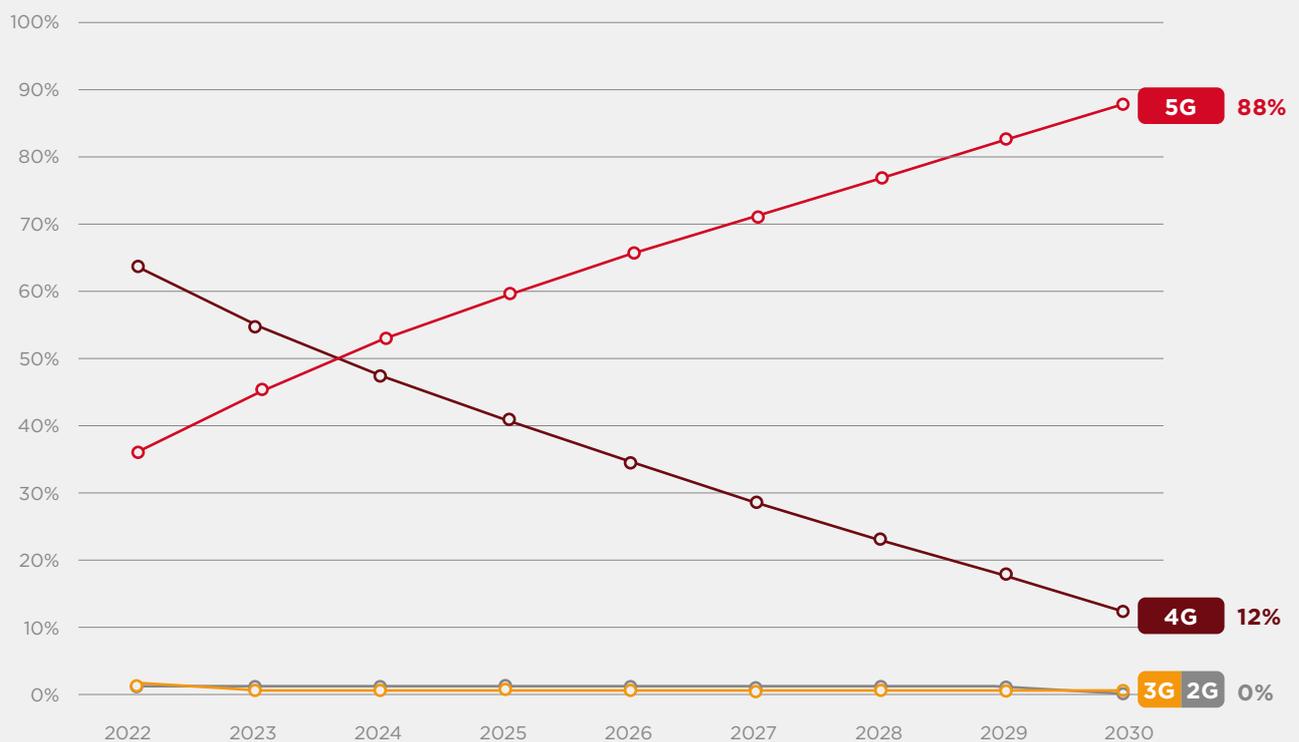
1.  "China's telecom industry reports steady expansion in 2022", english.gov.cn, January 2023
2.  5G-Ecosystem January 2023 Member Report, GSA, 2023

# China to be among leading 5G markets globally, with 88% adoption by 2030

China will be the first market with 1 billion 5G connections, reaching the milestone by 2025. 5G connections in China will reach 1.6 billion by 2030, accounting for nearly a third of the global total.

5G adoption in China will be considerably higher than the global average of 54%. Although 5G adoption in mainland China will marginally lag some of its peers by 2030, Hong Kong, Macau and Taiwan will have similar adoption levels to the global leaders.

Figure 4

## 5G adoption in 2030

Percentage of total connections

| | | 5G connections (2030) |
|---|---|---|
| GCC Arab States | 95% | 89m |
| US | 95% | 392m |
| South Korea | 95% | 61m |
| Germany | 94% | 118m |
| UK | 93% | 85m |
| Japan | 92% | 168m |
| France | 91% | 65m |
| China | 88% | 1,647m |
| Global average | 54% | 5,285m |
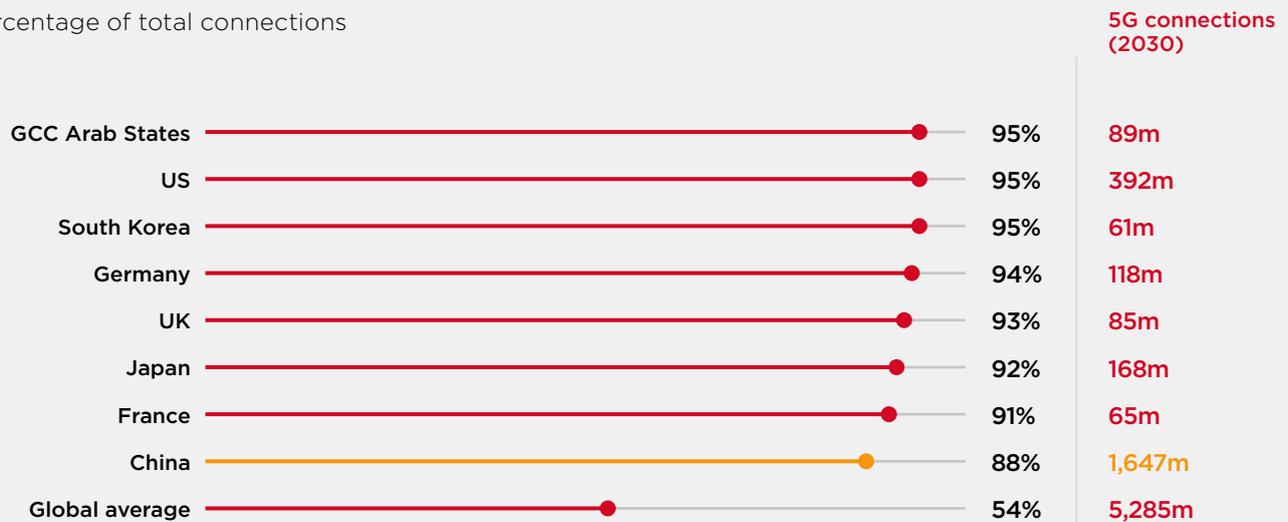
Source: GSMA Intelligence

# Smartphone connections will total 1.73 billion in China by 2030, accounting for 93% of connections

Industry data indicates that smartphone sales volumes contracted in 2022, partly due to Covid-19 controls and the resulting slowdown in the economy, as well as a global shortage of chips. However, the outlook is upbeat as China reopens and exits its zero-Covid policy.

Over the period to 2030, China will record an additional 300 million new smartphone connections, taking the total to 1.73 billion. 5G will be a key driver of new smartphone sales, as consumers upgrade from previous generations.

Figure 5
## Smartphone adoption

Percentage of connections (excluding licensed cellular IoT)

| | US | UK | Japan | Germany | China | France | South Korea |
|---|---|---|---|---|---|---|---|
| 2030 | 89% | 91% | 93% | 93% | 93% | 94% | 96% |
| 2022 | 84% | 85% | 73% | 82% | 81% | 86% | 86% |

● 2022  ● 2030
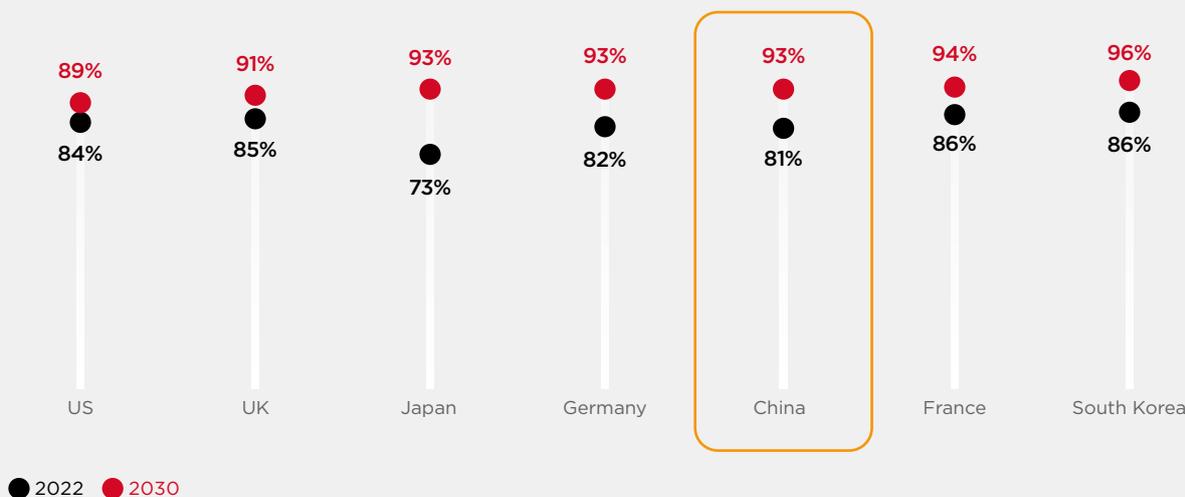
Source: GSMA Intelligence

# Smartphone data traffic in China to more than double over the period to 2028

Mobile traffic growth in China is driven by a combination of factors, notably live video streaming, live e-commerce and online gaming. By June 2022, around 68% of internet users in China had used a live streaming service.[3]

5G is also a key growth driver of mobile data traffic, 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.[4]

Figure 6
**Mobile data traffic per smartphone**

GB per month



| North America | |
|---|---|
| 2022 | **17.4** |
| Increase | **3.2×** |
| 2028 | **55** |

| Western Europe | |
|---|---|
| 2022 | **19** |
| Increase | **2.7×** |
| 2028 | **52** |

| China | |
|---|---|
| 2022 | **18** |
| Increase | **2.6×** |
| 2028 | **47** |

| Global average | |
|---|---|
| 2022 | **15** |
| Increase | **3.1×** |
| 2028 | **46** |
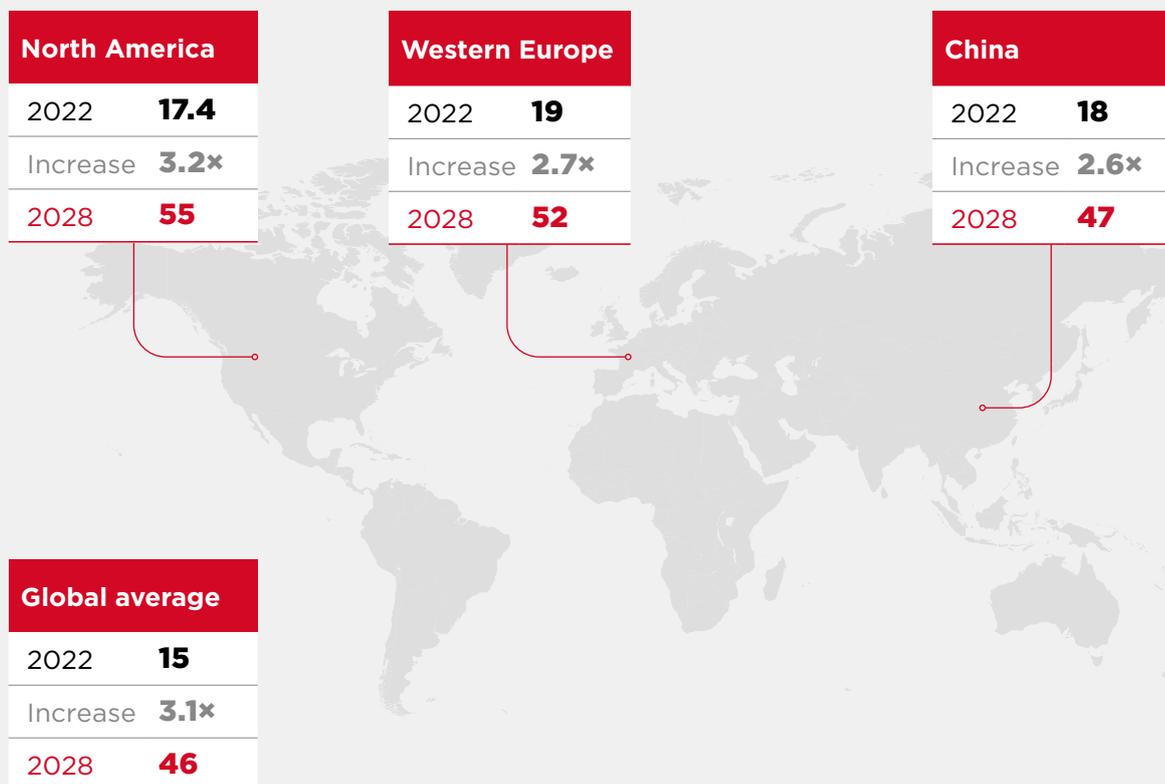
Source: GSMA Intelligence based on Ericsson Mobility Report November 2022

3. Statista
4. Analysing the behaviour of early 5G users: 10 things to know when planning consumer 5G strategies, GSMA Intelligence, 2022

# Licensed cellular IoT connections in China to double to 3.6 billion by 2030

China recorded 1.84 billion cellular IoT connections in 2022, according to the Ministry of Industry and Information Technology (MIIT), making it the first major economy to record more cellular IoT connections than mobile users. NB-IoT accounts for the largest proportion of IoT connections in China.

MIIT data shows that water meters, gas meters, smoke detectors and tracking each account for over 10 million connections. Agriculture, streetlights and five other use cases have crossed the 1 million mark, while public services, connected vehicles, smart retail and smart home applications dominate end-user services, with a combined 1.4 billion connections.

Figure 7
## China: licensed cellular IoT connections

Million

China will account for **67%** of the global total in 2030. Europe and the US will jointly account for **21%**
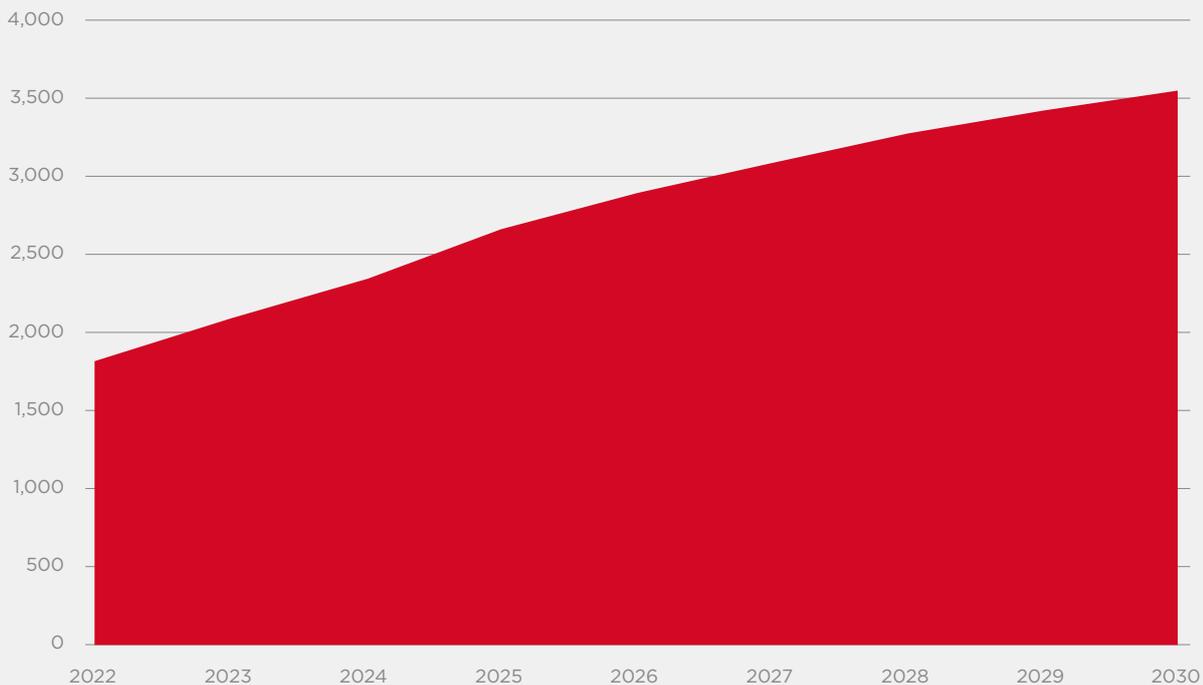


Source: GSMA Intelligence

# Revenue growth is set to moderate in China over the coming years as 5G adoption reaches maturity

Diversification of services has become a strategic imperative for operators amid slowing growth from core communications services. Gaming, financial services, cloud and security are among the leading areas in terms of operator activity.

China's transition to enterprise digital services (cloud, data centres, digital transformation and 5G) has become a significant growth driver for operators, with China Telecom and China Mobile reporting digital enterprise and cloud services revenue growth of 17% and 40%, respectively, in the first nine months of 2022.

Figure 8

## China: mobile operator revenue and year-on-year growth

Billion



● Revenue ▬ Annual growth (%)
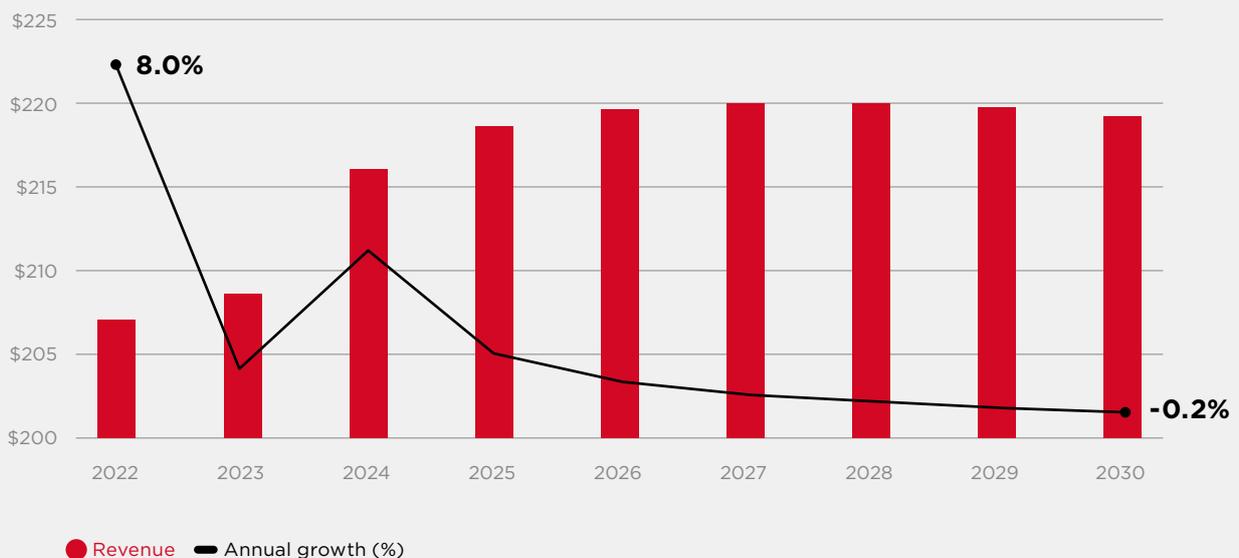
# Operators in China will spend $291 billion on their networks during 2023–2030, with most on 5G

Following extensive 5G network buildout over the last few years, resulting in record capex intensity in China, overall capex will begin to trend downwards in the coming years as operators turn their focus to generating returns on investment.

Figure 9
**China: mobile operator capex**

Billion
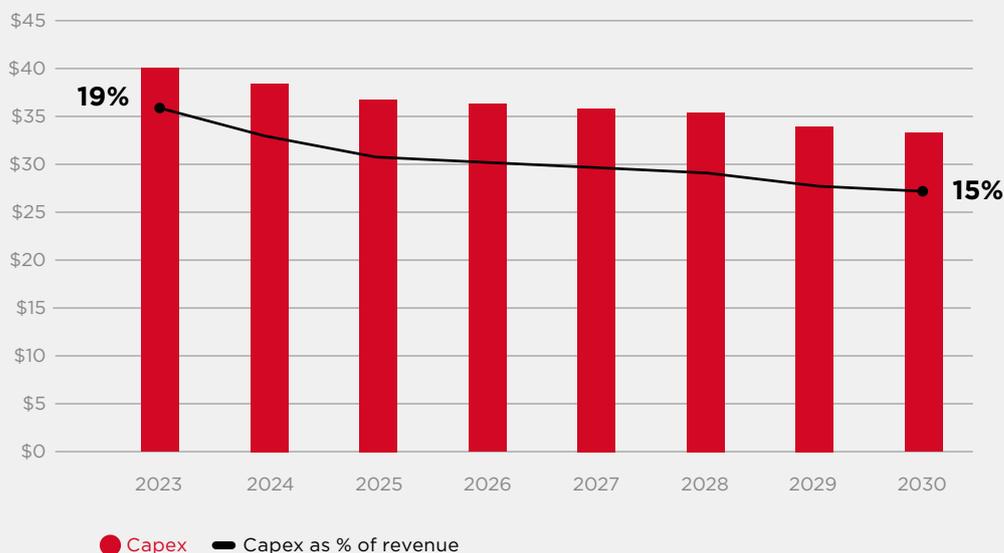


Source: GSMA Intelligence

# The mobile sector added $1.1 trillion of economic value to the Chinese economy in 2022

In 2022, mobile technologies and services generated 5.5% of GDP in China – a contribution that amounted to $1.1 trillion of economic value added. The greatest benefits came from the productivity effects, which reached $720 billion, followed by the rest of the mobile ecosystem, which generated $160 billion.

Figure 10

## Total economic contribution of the mobile industry in China, 2022

Billion, percentage of GDP



| | Mobile operators | Rest of mobile ecosystem | Indirect | Productivity | Total |
|---|---|---|---|---|---|
| | $120 / 0.6% | $160 / 0.8% | $100 / 0.5% | $720 / 3.6% | $1,100 / 5.5% |

Mobile ecosystem = Mobile operators + Rest of mobile ecosystem
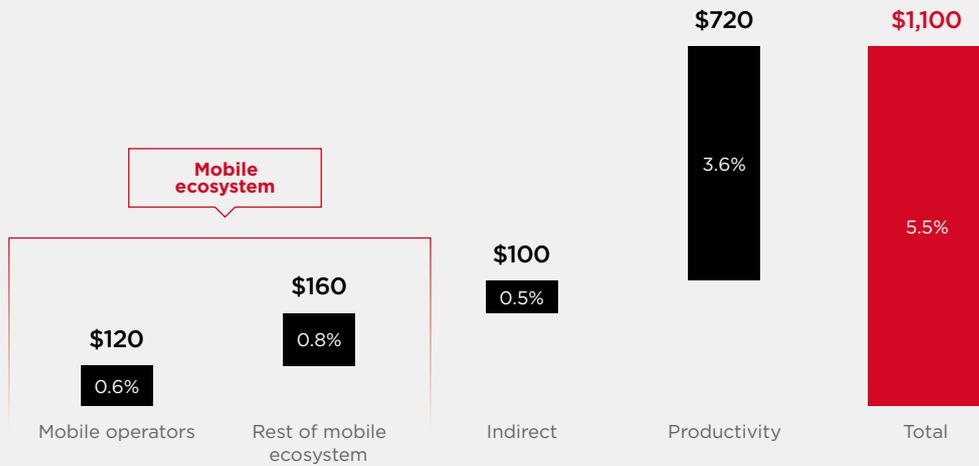
Source: GSMA Intelligence

# At the end of the decade, mobile's economic contribution will reach $1.3 trillion

By 2030, mobile's contribution will reach approximately $1.3 trillion in China, driven mostly by the continued expansion of the mobile ecosystem and verticals increasingly benefitting from the improvements in productivity and efficiency brought about by the take-up of mobile services.

Figure 11

**Economic impact of mobile in China**
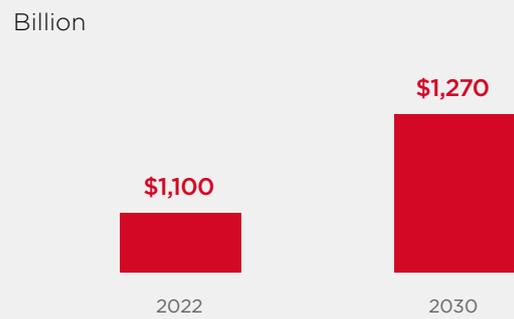
Billion



Source: GSMA Intelligence

# The mobile ecosystem in China supported 6 million jobs in 2022

Mobile operators and the wider mobile ecosystem provided direct employment to around 3 million people in China in 2022. In addition, economic activity in the ecosystem generated 3 million jobs in other sectors.

Figure 12

**Employment impact of the mobile industry in China, 2022**

Jobs (million)
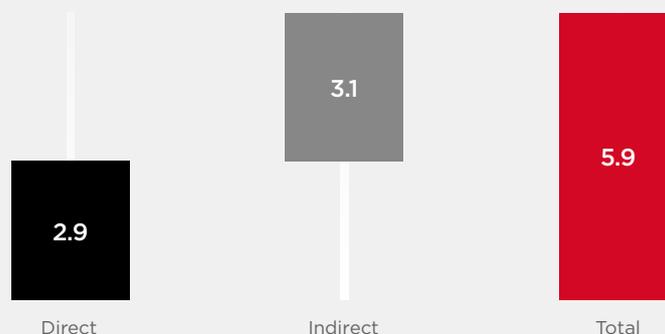


Note: Totals may not add up due to rounding
Source: GSMA Intelligence

# The fiscal contribution of the mobile ecosystem reached $110 billion in 2022

In 2022, the mobile sector in China made a substantial contribution to the funding of the public sector, with around $110 billion raised through taxes. A large contribution was driven by services, VAT, sales taxes and excise duties, generating $40 billion, followed by employment taxes and social security at $30 billion.

Figure 13

**Fiscal contribution of the mobile industry in China, 2022**

Billion



| | | | | |
|---|---|---|---|---|
| $40 | $20 | $20 | $30 | $110 |
| Services VAT, sales taxes and excise duties | Handset VAT, sales taxes, excise and customs duties | Corporate taxes on profits | Employment taxes and social security | Total |
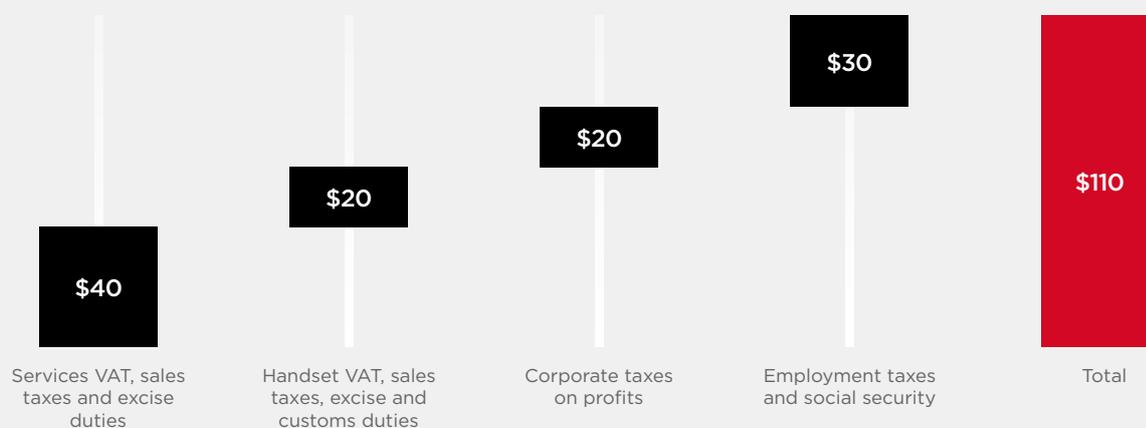
Source: GSMA Intelligence

# 5G will add almost $290 billion to the economy in China in 2030

5G is expected to benefit the Chinese economy by $290 billion in 2030, accounting for more than 22% of the overall economic impact of mobile. Much of the benefit will materialise over the next five years.

Towards the end of the decade, 5G economic benefits will level off as the technology starts to achieve scale and widespread adoption.

Figure 14
**Annual global 5G contribution by industry in China**

Billion



Services (public administration, finance, healthcare, education)  Manufacturing

ICT  Utilities management, construction, oil and gas, agriculture
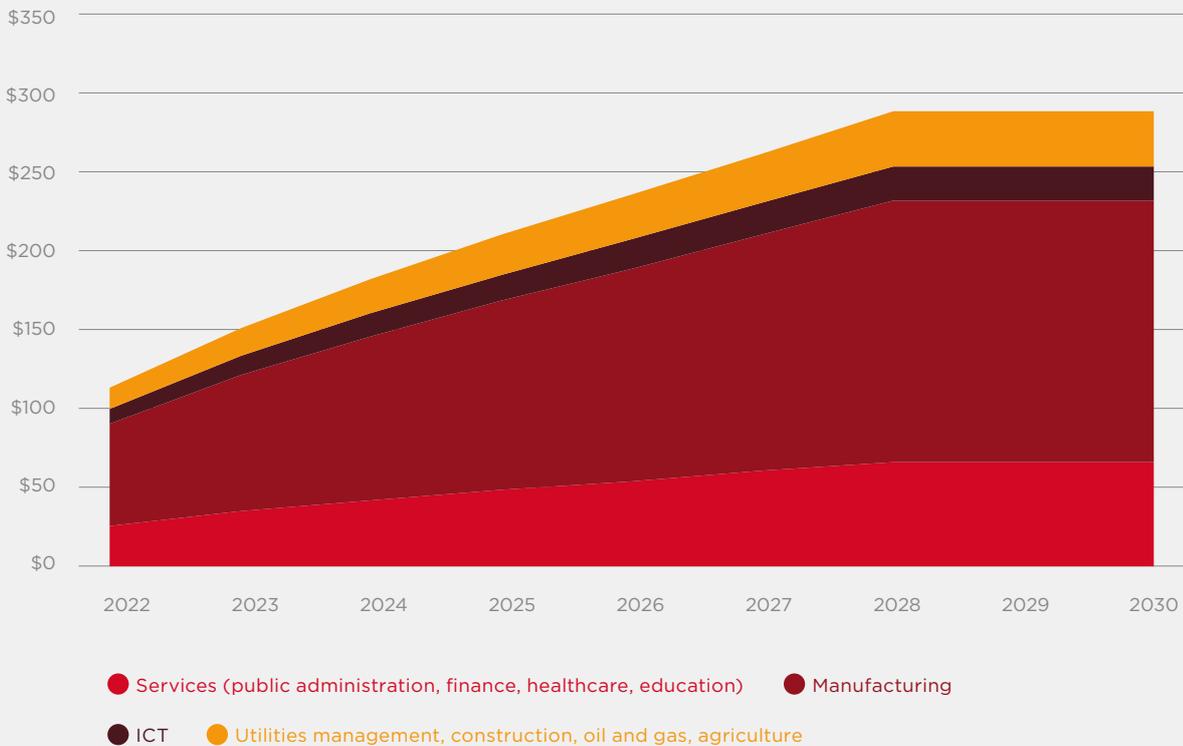
Source: GSMA Intelligence

# Manufacturing and services will benefit the most from 5G in 2030

5G is expected to benefit most sectors of the Chinese economy, depending on their ability to incorporate 5G use cases into their business. In 2030, 57% of the benefit is expected to come from the manufacturing sector, and 23% from the services sector, driven by applications including smart factories, smart cities and smart grids.

Figure 15

## 5G contribution by industry in China, 2030

Percentage of total benefit



- Utilities management, construction, oil and gas, agriculture — 12%
- ICT — 8%
- Services (public administration, finance, healthcare, education) — 23%
- Manufacturing — 57%
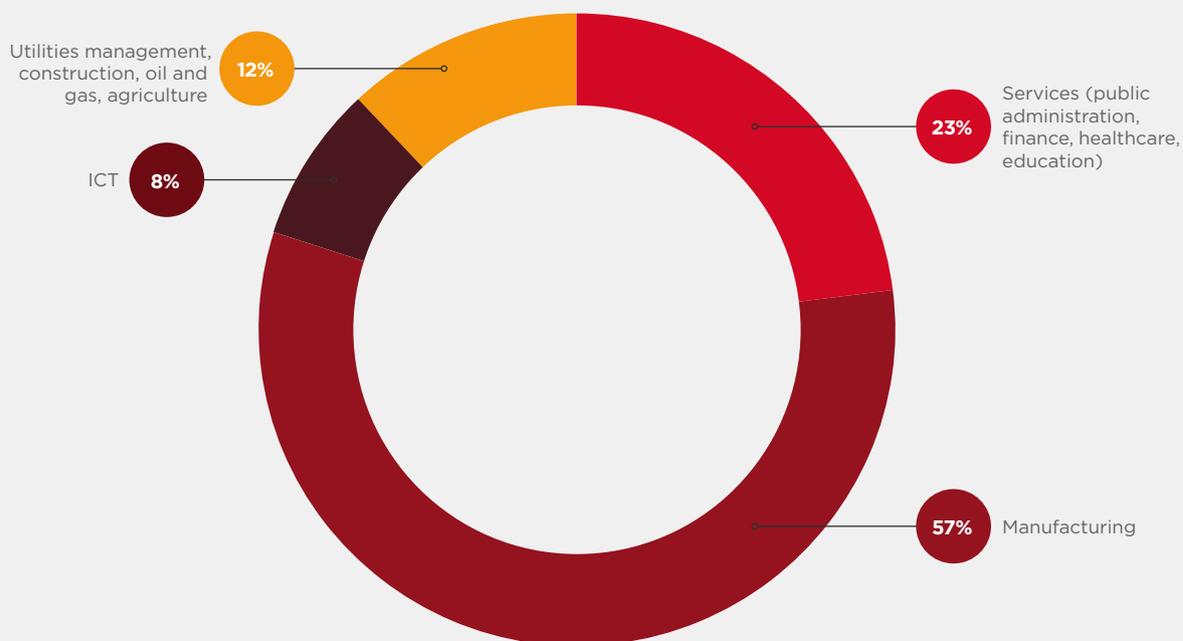
Source: GSMA Intelligence

# 02

# Mobile industry trends

# 2.1
# Operators home in on the 5G enterprise opportunity

Demand for 5G services continues unabated in China, with the number of 5G connections reaching 545 million (32% of total connections) at the end of Q3 2022. Mainland China leads the way on 5G adoption, closely followed by Taiwan and Hong Kong. The three markets rank among the top seven markets globally for 5G adoption. 5G is also making progress in Macao, where the government issued 5G licences with eight-year terms to China Telecom and CTM at the end of 2022.

With strong consumer adoption of 5G, the focus of operators in China is increasingly shifting to 5G for the enterprise. 5G networks offer various benefits to enterprises, enabling a range of new use cases. Accordingly, operators are reshaping their enterprise strategies to better serve customers. This includes a shift in their 5G value propositions towards edge computing and network slicing as deployments of 5G standalone (5G SA) networks expand.
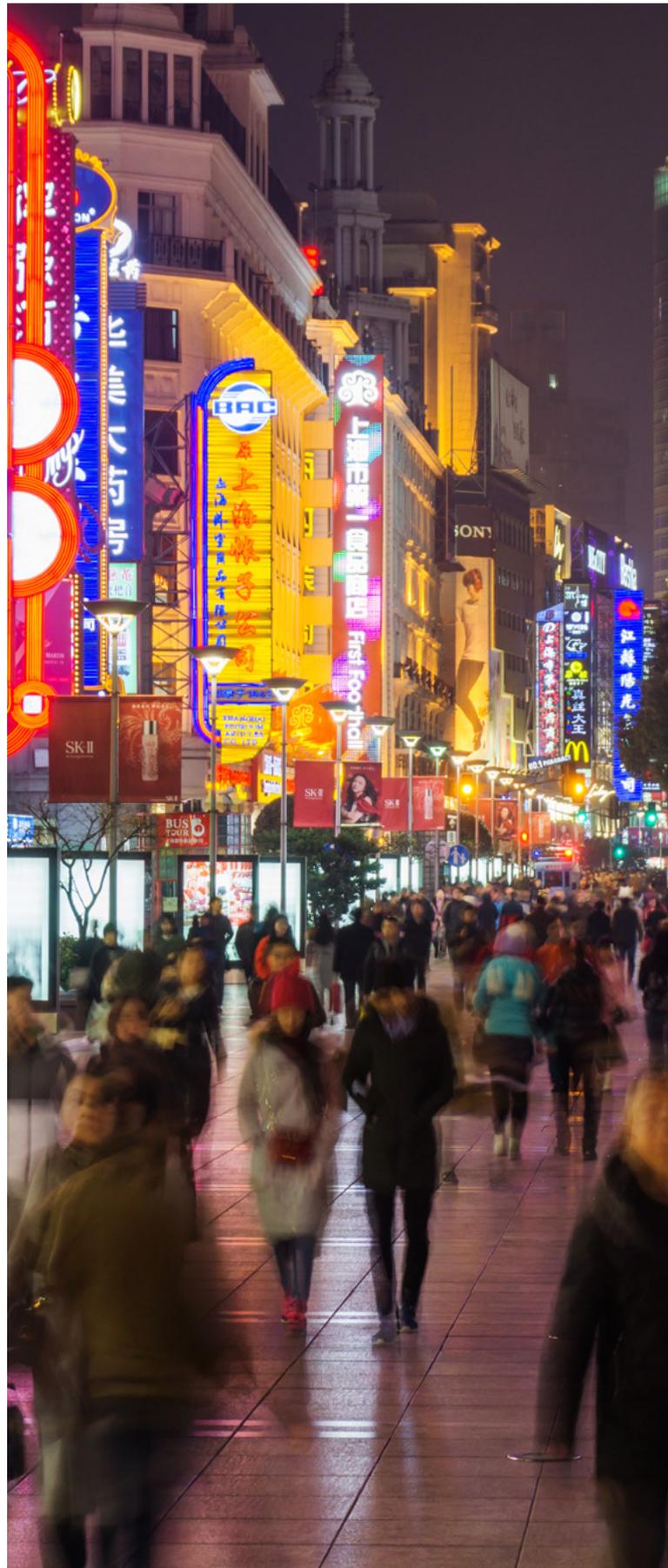
## 5G enterprise services to continue growth in 2023

In 2021, the MIIT launched the "Set Sail" Action Plan for 5G applications, which outlined targets for China's 5G industry to reach by the end of 2023. This includes a goal of 3,000 dedicated 5G network deployments and a target for large industrial enterprises to reach 35% 5G penetration. Fuelled by the government's ambition, operators in China have made strong progress:

- **China Mobile** reported a 40% uplift in digital transformation revenue in H1 2022, underpinned by growth in 5G solutions for vertical sectors, mobile cloud and smart home services. The operator has signed agreements for more than 11,000 5G commercial projects, representing a contract value of CNY16 billion ($2.4 billion).

- **China Telecom** reported that its industrial digitalisation business, which includes cloud, data centre and smart solutions, grew 19% year-on-year to CNY59 billion ($8.7 billion) in H1 2022. The new contract value for 5G B2B projects has grown 80% year on year, as the operator focuses on scalable and replicable use cases in sectors such as 5G city, healthcare and manufacturing.

- **China Unicom**'s enterprise revenue reached CNY37 billion ($5.5 billion) for the first six months of 2022, representing a year-on-year increase of 32%. 5G industry applications accounted for more than 10% of total enterprise revenues for the operator, driven by strong uptake of 5G virtual private networks.

## Convergence of 5G and cloud provides opportunity to diversify revenues

Growth in revenue sources beyond connectivity in China is being driven by cloud and other value-added services for enterprise customers. Almost a quarter of operators' incremental revenue beyond connectivity in China came from cloud in 2020.

As operators advance the use of cloud technologies in their 5G networks (a priority for 66% of operators according to the GSMA Intelligence Operators in Focus Network Transformation Survey 2022), cloud offerings for enterprise customers will continue to grow. This will allow operators to build on their early success in the cloud market. For example, China Mobile had signed more than 3,500 major contracts for cloud services as of the end of June 2022. These generated revenues of over CNY13 billion ($1.9 billion).

Revenue beyond connectivity as a percentage of total revenues varies significantly among operators globally, at 15–40%.[5] This is to be expected as there is no 'one size fits all' in terms of strategy and timeline for diversification. In China, operators are making significant progress on revenue diversification. However, revenues beyond connectivity as a share of total revenues still rank among the lowest due to their large mobile businesses, which dominate the revenue mix.

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5.  Operator revenue diversification: growth beyond core continues as Covid-19 spurs digitisation, GSMA Intelligence, 2021

# 2.2
# Dedicated 5G momentum builds

Private wireless networks are not new, having been deployed on LTE spectrum for several years. However, until recently, installations have mostly been low-profile, niche offerings that lack the capabilities that 5G now offers. Private wireless solutions are back in vogue as they are a key means of monetising 5G in the enterprise segment.

China has been at the forefront of dedicated 5G developments globally. In May 2022, the MIIT claimed there were more than 5,300 dedicated 5G networks operating in the country. While this figure includes a range of deployment scenarios beyond dedicated private 5G networks (e.g. hybrid networks and mobile edge computing), it demonstrates growing demand from enterprises in China for greater customisation, control and security with regard to connectivity.

State support and collaboration between mobile operators and local equipment vendors (e.g. Huawei and ZTE) has underpinned growth in private 5G. To maintain momentum, solutions need to become cheaper as well as easier and faster to install and operate. This is driving demand for pre-packaged solutions that include service management tools and billing systems, edge and cloud integration, and mechanisms for handling data authentication and security.

## Key verticals, use cases and stakeholders

Dedicated 5G networks can be deployed across a range of vertical industries. Manufacturers have been among those setting the pace in China, with factories and warehouses a natural setting for private wireless networks. This reflects the need in these locations for precision operations and data analytics that run across a densely linked network of localised assets. There has also been strong demand from the mining sector, which often requires connectivity in rural and hard-to-reach areas (such as underground).

Multiple use cases involving dedicated 5G are currently in testing or live operation in China. These include mobile robotics (for site inspections), AGVs (for transporting goods), drones (for site survey) and 4K video streaming (for safety and security applications). AR-based software is also being considered because of its latency demands (sub-20 ms).

As shown in Figure 16, operators and network vendors have been the main contractors of dedicated 5G deployments in China. However, in November 2022, MIIT granted the first 5G private network licence in the country to Commercial Aircraft Corporation of China (COMAC), the manufacturer of the C919 – the country's first domestically developed, single-aisle passenger jet. While spectrum set-asides offer the possibility of enterprises building their own private networks, the experience of operators and network vendors in this space means a collaborative approach between operators, vendors and enterprises that have their own spectrum assets is the most likely deployment scenario.
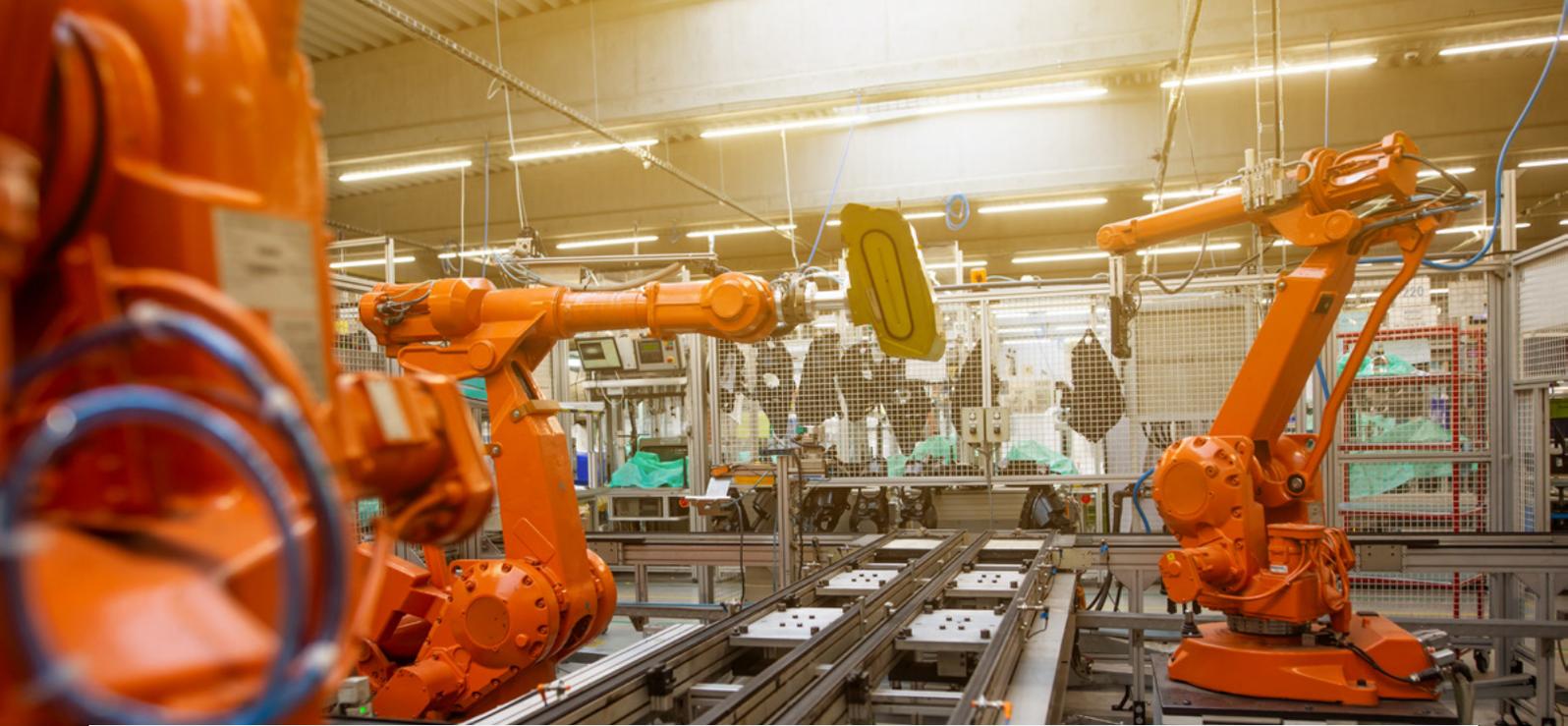
Figure 16

## Selected private 5G deployments in China

| Location | Sector | Customer | Companies involved | Primary use case(s) |
|---|---|---|---|---|
| **Jilin province, China** | Agriculture | Jilin Company | China Mobile, ZTE | Drones for monitoring the health of crops, and remote control of farm equipment |
| **Guangdong, China** | Education | Guangzhou Municipal People's Government | China Unicom, Huawei | Video conferencing, allowing students to access mobile academic resources |
| **Binjiang, China** | Manufacturing (consumer electronics) | ZTE | China Telecom, ZTE | Autonomous mobile robots, and remote control of production process using 4K video streaming |
| **Ningbo, China** | Manufacturing (packaging) | Hotel Star | China Mobile, ZTE | Autonomous mobile robots, and image recognition for quality inspection |
| **Yanjiahe Coal Mine, China** | Mining | Shanxi Xiangning Coking Coal Group | China Unicom, Huawei | Real-time video streaming of underground HD cameras for risk identification |
| **Dahaize Coal Mine, China** | Mining | China Coal Group | China Mobile, China Broadnet, ZTE | Autonomous mobile robots for inspections, AGVs and smart wearables |

Source: GSMA Intelligence, GSMA 5G Transformation Hub

# 2.3
# Innovation underpins China's digital ambition

China's 14th Five-Year Plan (2021–2025) and the Long-Range Objectives Through the Year 2035 centre on innovation, and position technological independence as a strategic pillar of national development. The goal is to promote the integration of the digital economy and the real economy, with modern, high-quality industrial development and technology-driven industrialisation, informatisation, urbanisation and agricultural modernisation.

China's digital ambitions are driven by a combination of external and internal factors. External factors revolve around a challenging global macro environment. Internally, the growth of the real economy is slowing, as evidenced by sluggish output in recent years across several major industries, such as manufacturing, agriculture and construction. In the context of slowing economic growth and sluggish growth in several major industries, accelerating industrial modernisation and digitalisation as well as promoting high-quality industrial development has become a strategic focus of the Chinese government. Figure 17 highlights the key focus areas of China's digital ambitions.

Figure 17

**Overview of the 14th Five-Year Plan and Long-Range Objectives Through the Year 2035**

| Pillars | Example focus areas |
|---|---|
| **Implement strategy to lead in manufacturing** | Technology leadership in areas such as AI, quantum computing, biotechnology and space research. |
| **Develop and expand strategic emerging industries** | Enhanced manufacturing competitiveness in areas such as robotics, agricultural machinery and equipment, zero-emissions vehicles, and innovative medicine. |
| **Build a modern infrastructure system** | Modern infrastructure to support next-generation digital technologies, advanced biotechnology, and environmentally friendly energy and transportation solutions. |
| **Create new opportunities in the digital economy** | New opportunities in cloud computing, big data, IoT, blockchain, AI, VR and AR. |
| **Accelerate the pace of digital society development** | Digital solutions in areas such as agriculture, transport, energy, manufacturing, tourism, public services and education. |

Source: GSMA Intelligence based on fujian.gov.cn

The digital ecosystem, including start-ups, will be at the forefront of efforts to realise China's digital ambitions. China is a global hub for tech start-ups, with innovative solutions across a range of industries. Many of these have become 'unicorns',[6] serving both the domestic and international markets. Although the US is home to more than half (54%) of the 1,205 unicorns tracked by research firm CB Insights, China is in second place with 14.3%, ahead of India (5.7%) and the UK (4.2%). China-based ByteDance, which operates content platforms such as TikTok and Toutiao, reached a peak valuation of around $400 billion in 2021.

In 2022, the US added 182 unicorns, accounting for more than half the world's 330 new unicorns, followed by China with 74 new unicorns.[7] China's number of unicorns grew during the year despite an overall fundraising slump amid economic headwinds, including pandemic-related supply chain disruption. Around 70% of China's new unicorns come from four areas: clean technology, renewable energy, healthcare and smart logistics. More than 10 semiconductor companies also made the list, while automotive transportation, smart manufacturing, gaming and the metaverse were among the other sectors represented.

6.   A unicorn startup is a private company valued over $1 billion.
7.   "China added 74 unicorns in 2022, maintaining steady pace of growth despite fundraising crunch", South China Morning Post, February 2023

# 2.4
# Fintech presents opportunities for mobile industry players

China's economy is largely cashless, reflecting high levels of penetration of fintech services. China has developed a lead in fintech services over the past decade, largely driven by investments in an expanding portfolio of products and growing demand for electronic payment options. The Covid-19 pandemic served as a catalyst for the surge in digital services, including e-commerce, with fintech services supporting many online transactions. In China, mobile payments are not only used by the relatively tech-savvy urban population; they are increasingly used by those in rural areas too.

Unsurprisingly, digital payments are the leading market segment in terms of transaction value. However, several other product categories, such as asset management, insurance and inclusive finance, are beginning to gain traction. Meanwhile, China has been rolling out a central bank digital currency that has undergone several pilot programmes, including during the 2022 Winter Olympics, with the potential to drive innovation in new fintech products and services.

In January 2022, the People's Bank of China released its second Fintech Development Plan for 2022–2025, which seeks to further develop China's fintech sector and drive the digital transformation of the finance sector. The plan builds on the Fintech Development Plan for 2019–2021 and is in line with the 14th Five-Year Plan and Long-Range Objectives Through the Year 2035. The fintech plan focuses on a number of areas, including regulatory supervision, privacy and data protection, low carbon and green fintech, and fair and inclusive growth.

Other markets are also implementing initiatives to capture new opportunities in the domestic and international fintech markets. In Hong Kong, key stakeholders, including financial regulators and public agencies, are collaborating on efforts to enhance fintech infrastructure, provide an enabling regulatory framework, encourage financial innovation and nurture talent:

- The Hong Kong Monetary Authority (HKMA) and Securities and Futures Commission (SFC) have introduced sandboxes to promote fintech development.

- The HKMA has launched its Fintech 2025 strategy to drive fintech development, alongside other initiatives to position the city as the ideal platform for evolving and expanding fintech businesses.

- InvestHK, a department of the Hong Kong government responsible for attracting foreign direct investment, has a dedicated fintech team looking to attract the world's top innovative fintech firms to set up and scale their business via Hong Kong into mainland China and Asia.

- In December 2022, InvestHK soft-launched the FintechHK Community Platform, a centralised fintech platform to connect local and global tech companies with 'corporate, investor and service champions' to drive growth of Hong Kong's fintech ecosystem.

An important feature of the fintech landscape across China is the prevalence of B2B fintech and a high level of adoption among small to medium-sized enterprises (SMEs). In Hong Kong, 66% of the 800+ fintech companies[8] in the market focus on the B2B segment.

8.  https://www.oases.gov.hk/en/strategic-industries.html

# Opportunities for 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, fintech innovators are increasingly leveraging a number of emerging technologies to enable more complex and customised solutions to serve customer needs. Figure 18 highlights the distribution of technologies among leading fintech companies in China.

Many of the technologies provide long-term growth opportunities for operators in China. Operators have invested extensively in core telecoms technologies (e.g. 5G, IoT and edge computing), all of which can facilitate important fintech solutions, such as real-time transactions. However, a growing focus on adjacent areas, such as big data, AI, and cloud computing, is set to position operators to capture greater value from fintech.

Some operators are also playing a more active role in the fintech space through direct investments and partnerships. For example, in January 2023, Next Commercial Bank, a digital bank backed by Chunghwa Telecom, launched its operations in Taiwan, with plans to register 300,000 customers within nine months of opening. In March 2022, China Mobile launched its own fintech subsidiary to expand its presence in the Chinese fintech sector. And in 2020, HK Telecom launched a fintech project with a variety of solutions, including mobile payments, merchant services and insurance packages.

Figure 18

## Main technologies used by China's leading fintech enterprises, 2022

| Technology | % |
|---|---|
| Big data | 76% |
| AI | 68% |
| Cloud computing | 41% |
| Knowledge graph | 34% |
| Deep learning | 33% |
| Blockchain | 33% |
| Natural language processing | 29% |
| Computer identification | 11% |
| IoT | 10% |
| 5G | 10% |
| Robot process automation | 9% |
| Biometrics | 8% |
| Virtual/augmented reality | 1% |
| Edge computing | 1% |
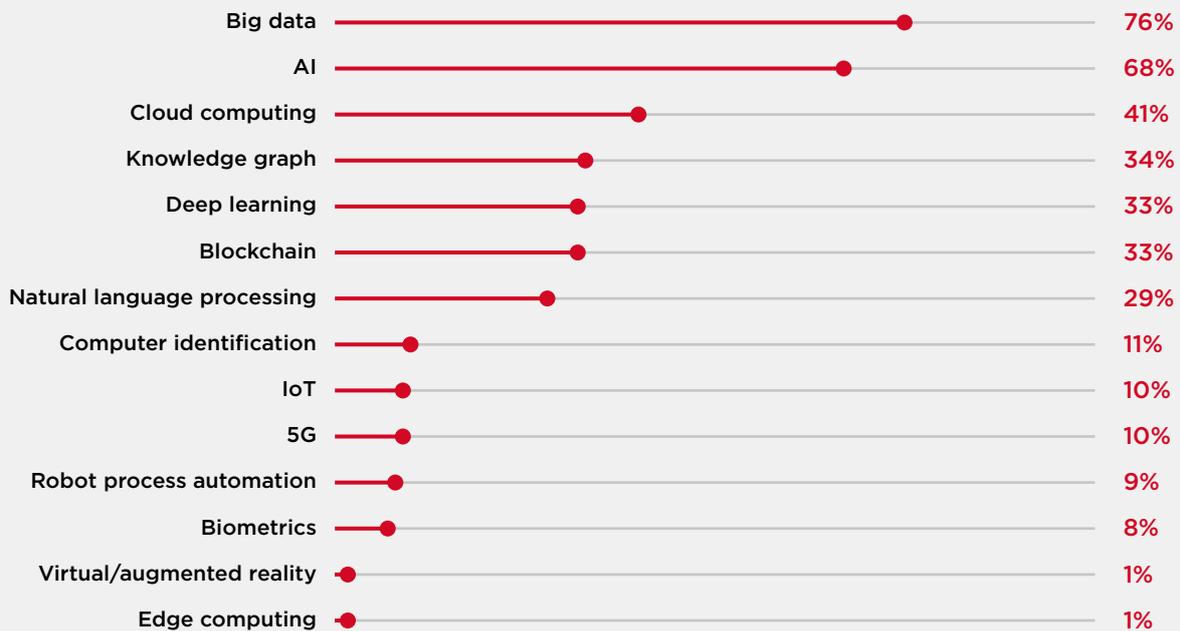
Source: Statista

# 2.5
# China shifts to a circular economy

Adoption of 5G is rising more quickly than with any previous wireless technology. Demand for telecoms equipment and services is therefore greater than ever. Three of the top five biggest network operators by subscribers globally are based in China, and account for almost 1.7 billion connections. This means China is uniquely placed as one of the largest consumer markets for devices as well as a leading country for telecoms equipment and device manufacturing.

In view of the growing demand for telecoms equipment, the concept of a circular economy has been developed as a transformative model to reuse products, parts, components and materials in successive production cycles to reduce waste and pollution. Here, the guiding principles of reuse, recycle and refurbish are used to extend the life of a product and, consequently, reduce or eliminate waste in the production and usage cycle.

Figure 19

**The concept of the circular economy**



Recycle

Refurbish

Reuse

Extraction and raw material → Product manufacturing → Product distribution → Customer usage → Disposal → Landfill and greenhouse gas emissions
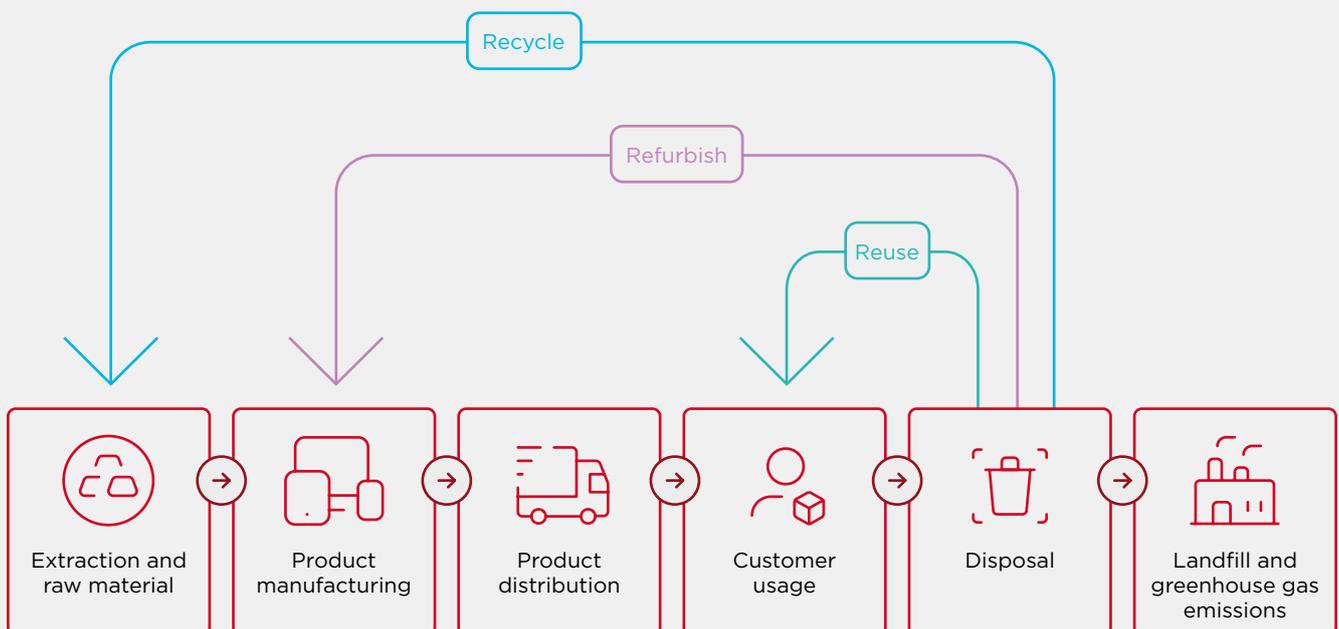
Source: GSMA

The benefits of the circular economy and its necessity for telecoms equipment will take centre stage in 2023 and beyond. The shift towards sustainability requires all industries to examine how they use resources. This is particularly crucial for growing sectors, such as telecoms. Authorities in China recognise the importance of the circular economy and have incorporated its principles into the 14th Five Year Plan. The Development Plan for the Circular Economy, which fits into the broader framework of the 14th Five Year Plan, aims to boost circularity across the economy with various initiatives, such as promoting recycling, remanufacturing, green product design and renewable resources.

Chinese device and equipment vendors are involved in the shift to the circular economy. For example, as a member of the UN Global Compact, ZTE has committed to optimising waste management to support the circular economy and contribute to carbon neutrality. Meanwhile, Huawei promotes circularity in its network design in various ways, such as minimising the resources and raw materials used throughout the product lifecycle, using more renewable materials, increasing product durability, easing disassembly and optimising products for recycling.

## Accelerating the journey to circularity: example initiatives from Huawei

- **Reusing pallets to save plywood** – Plywood pallets have traditionally been used for product shipment and transport. However, these are not ideal for long-term use in many complex logistics environments and require a considerable amount of wood. Huawei developed lightweight plastic-steel pallets for packaging 5G base station equipment and other products, and promoted the reuse of these pallets. Compared to traditional pallets, they can reduce the total weight transported, saving both wood and $CO_2$ emissions.

- **Recycling and reusing smartphones** – China produces 300–500 million used phones every year. Device manufacturers can increase the scalability and serviceability of products by using more durable components and providing upgrade and maintenance services. Huawei has built a global recycling system that allows consumers to recycle their used electronics

and reduce their environmental impact. The vendor has also scaled up its product trade-in programme and introduced a new online recycling programme that gives coupons to consumers in China in return for recycling.

- **Multi-density cushioning process for lightweight packaging** – Huawei introduced an integrated moulding process for cushioning materials with different densities. This enables the seamless integration of materials with different densities in the same mould and has been applied to protect wireless base station equipment and servers. The process provides the same level of protection as traditional single-density foam but with 30% less packaging and 20% less weight, on average. Using the multi-density cushioning process for packaging of 5G MIMO equipment has shrunk the volume of packaging by 38%.

# 03

## Mobile industry impact

# 3.1
# The mobile industry's impact on the SDGs

According to the most recent analysis, the mobile industry accelerated its impact on the Sustainable Development Goals (SDGs) in China, despite the challenges of global events. SDG 6 (Clean Water & Sanitation) and SDG 9 (Industry, Innovation and Infrastructure) scored highest in 2021 thanks to growing mobile internet adoption and rising use of mobile-enabled services.

Figure 20

**Mobile's impact on the SDGs in China, 2021**



Source: GSMA Intelligence

## Improving quality of life and education

SDG 6 focuses on ensuring the availability and sustainable management of water and sanitation for all. Mobile technology enables communication and payment channels that improve water delivery and sanitation provision. Increasing mobile internet adoption in China, with 81% of total connections based on smartphones, helps citizens directly connect with utilities and other public services.

The mobile industry also facilitates the logistics of waste and sewage management and treatment of non-sewered sanitation services. For example, China Mobile undertook domestic waste and sewage treatment work for 306 villages under its 'Seven rural digital-intelligence projects', implementing a national rural revitalisation strategy.

Another of the seven projects promotes access to high-quality remote learning sources in rural areas, contributing to SDG 4. China Mobile created 5G online classrooms with its Hunan subsidiary, bringing the curriculum to village schools via interactive live streaming. By the end of 2021, the 5G online classroom had offered 33 large lectures and more than 500 small classes, benefiting nearly 10 million primary and secondary school students in Hunan province.[9]

9.  Examples from China Mobile Limited Sustainability Report 2021

# 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 are expected to contribute significantly to the global economy, especially through countries with large manufacturing sectors such as China.

5G can combine network capabilities with AI, cloud, machine vision and VR technologies. As an example, China Telecom has worked with various ecosystem partners to establish the Conch Group 5G Smart Manufacturing project. The project applies to the production process for cement, including raw material mining, production and shipment. It provides evidence of the important role played by 5G technology in the process manufacturing field.

The combination of 5G, robotics and AI can improve productivity in manufacturing plants by more than 10%. For example, Thundercomm, ThunderSoft, Qualcomm and Chinese mobile operators increased productivity by using 5G industrial transfer robots at an automobile plant in Beijing.[10]

# 5G supporting digital health services

SDG 3 (the fifth highest-scoring SDG in China) focuses on ensuring healthy lives and promoting well-being for all. Mobile technology contributes to this by optimising healthcare service delivery and providing frontline workers with the skills and infrastructure needed for early disease detection through analytics.

Improving network performance and connectivity with 5G and growing IoT deployments have advanced healthcare facilities in China. Examples include the following:

- China Unicom, Huawei and Hainan province launched the '5G Smart Healthcare Lights Up Hainan Healthy Island' project. This is one of the largest 5G commercial applications in China and the first provincial 5G-based remote diagnosis project in which all primary healthcare institutions are digitalised. A hierarchical diagnosis and treatment platform has been constructed to provide remote consultation and technical assurance for primary medical institutions.

- China Mobile, Huawei and other partners have jointly advanced 5G and smart healthcare projects in Shenzhen. Using a dedicated 5G network, they have developed remote emergency care, remote consultation, mobile diagnosis and treatment, community first-aid guidance, and smart ward applications based on efficient and safe information sharing among medical institutions in the district.[11]

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10. How 5G can boost industrial productivity, GSMA
11. 5G use cases for vertical China 2021, GSMA, 2021

# 3.2
# Mobile's impact on disaster management and response

As 5G infrastructure continues to expand across China, operators have been instrumental in using it to deliver vital services for the benefit of society.

Services cover a range of areas, including disaster response and management.

## China Mobile and Ericsson's disaster management solution

China Mobile Zhejiang and Ericsson have partnered to deploy a 5G-enabled solution for disaster management in Lishui City. The systems and equipment use 5G network slicing and edge computing to support a converged communication platform. The platform connects front-end mobile visualisation devices, such as IoT sensors, with communication channels, such as satellites and 5G drones, that monitor the progress of major disasters in real time.

The platform includes features such as early warning of disasters, remote search and rescue, and real-time monitoring. As the city suffers from a range of natural disasters, the visualisation system serves as the basis for handling emergencies. Early warnings and large-scale search and rescue can help minimise casualties and support decision-making at crucial times.

## China Mobile and ZTE's solution for rapid response

China Mobile deployed ZTE's All-in-One Nomadic 5G base stations in the flooded areas of Henan and at the earthquake-hit Luding County in Sichuan. The nomadic 5G base stations allowed the operator to continue providing wireless service to those affected, and increase the efficiency of the rescue and clean-up operations. At the earthquake site, the operator restored the 4G/5G networks for voice, SMS and data service in just an hour, improving communications channels.

In emergency scenarios, the rapid recovery of mobile communications is vital to connect vulnerable people to much-needed help and facilitate the activities of first responders.

Beyond disaster relief, the All-in-One Nomadic 5G solutions come with explosion-proof mechanisms for deployment in challenging scenarios across different sectors, such as mining and smart construction. With the required 5G functions defined by 3GPP, the solution supports IoT data collection, video surveillance and voice/SMS communication, allowing for uninterrupted connectivity in unstable environments.

# 04

# Mobile industry enablers

# 4.1
# Safeguarding 5G momentum and setting the stage for 6G evolution

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. In 2023, all eyes will be on Dubai, where the ITU's World Radiocommunication Conference 2023 (WRC-23) will take place in November and December. WRC-23 is a chance to expand the availability of affordable 5G services and ensure future growth and innovation. It is an opportunity to build a spectrum roadmap into the 2030s, address the digital divide and ensure 5G can benefit billions of people.

## The future of mid-band spectrum

Of the three spectrum ranges – low, mid- and high bands – that are required for 5G, the mid-bands will deliver the most economic value. Ensuring there is enough capacity must therefore be a priority for all governments that want their countries to be competitive. To thrive, mobile requires 2 GHz of mid-band spectrum bandwidth to meet demand by 2030. The mobile industry is as agnostic as possible about how that mid-band demand can be met. However, it has become increasingly clear that the 6 GHz band is the best option for meeting demand.

Included on the agenda of World Radiocommunication Conference 2023 (WRC-23) is the IMT identification of 6425–7025 MHz in ITU Region 1 (Europe, the Middle East and Africa) and 7025–7125 MHz in all ITU regions. While the WRC-23 agenda discusses the entire 6425–7125 MHz band in only the EMEA region, there is growing support for this process throughout the world – including in Asia Pacific, where 5G has grown strongly in parts of the region.

A GSMA Intelligence study conducted cost-benefit analysis for different authorisation models for the 6 GHz band. The study implemented a supply and demand framework for the 2021–2035 period to determine where 6 GHz spectrum will have its most productive and efficient use, taking into account current and expected demand for 5G and Wi-Fi. Considering three policy scenarios, the report finds that assigning the full 6 GHz band for licensed IMT use would drive the largest socioeconomic benefit across most countries analysed. Failure to allocate any 6 GHz spectrum for licensed use could mean higher operator costs and/or lower network quality, and would make it impractical to deliver on the full characteristics of 5G (IMT-2020).

The outlook for the 6 GHz IMT ecosystem is robust, according to the report from GSMA Intelligence. The report found there are no technical barriers to developing and commercialising 6 GHz IMT solutions. Device and infrastructure solutions can operate in the band, just like any other. Players in the device, component and network infrastructure ecosystems are also ready to develop 6 GHz IMT products in line with customer demand. From the start of development, ecosystem players expect to have solutions ready in 6–12 months.

To safeguard 5G growth and innovation, the GSMA's global recommendations are as follows:

- 6425–7125 MHz should be identified for IMT across regions and countries at WRC-23

- 6425–7125 MHz should be made available for licensed 5G by 2030

- 5925–6425 MHz should be considered for licensed 5G, or licence-exempt on a technology-neutral basis.

> Mobile requires 2 GHz of mid-band spectrum bandwidth to meet demand by 2030

The GSMA's vision for the 6 GHz band is as follows:

- Mobile networks will need, on average, 2 GHz of mid-band spectrum per country by 2030. This is challenging to achieve without 6 GHz.

- 6 GHz capacity will be required to meet increasing customer demand at the required speeds of ITU IMT-2020 as 5G matures for both consumer and enterprise customers.

- Mobile networks are already highly densified, but 6 GHz can enable the growth of sustainable 5G capacity on existing sites to enable cost-effective deployments.

- Timely availability of 6 GHz, at reasonable conditions and price, will drive cost-efficient network deployment, help reduce the broadband usage gap and support digital inclusion.

## 600 MHz: expanding the benefits of 5G

The future of mobile connectivity, including applications such as massive IoT, still relies on the wide coverage that low bands provide. Low bands (or UHF spectrum) are the cornerstone of digital equality and a driver of broad and affordable connectivity. The bands propagate further, making them a crucial national asset. Low bands can help ensure the impact of mobile's economic and social benefits is felt across all communities.

However, availability of low-band spectrum is limited. Today, regional assignments vary, but a maximum of only 2×95 MHz of mobile spectrum is available between 700 MHz and 1 GHz, with up to 20 MHz

of supplemental downlink in some cases. Current proposals for more low-band spectrum in the 600 MHz band will allow for between 2×35 and 2×40 MHz of additional low-band capacity. This equates to an improvement in speeds of 30–50% where low band is the only spectrum available.

There are already commercial 600 MHz deployments in the US, and in Asia a new extended 600 MHz band plan is being standardised at the 3GPP. This will offer additional capability for operators to reach more people and businesses with better quality 5G.

## 5G innovation depends on mmWave access

Mid-band spectrum, especially the C-band, has helped launch 5G. However, as capacity needs continue to grow and applications become more advanced, mmWave spectrum is also needed. Gigabit speeds can be delivered by 5G mmWave in even the most densely populated hotspots. The wide bandwidth available in mmWave bands such as 26 GHz can help enable high-capacity eMBB applications for consumers in hotspots, on top of the existing capacity provided by low and mid-band spectrum.

mmWave can play a primary role in the deployment of networks at stadia and in factories. The range is a good fit for these environments due to the low risk of interference and the significant bandwidth available for traffic-intensive use cases. It is also a good fit for applications where concurrent traffic is high and uplink requirements are particularly important, such as a high density of video cameras for computer vision, AR/VR applications and automated guided vehicles (AGVs). By 2030, an average of 5 GHz of mmWave spectrum per market will be needed to satisfy demand and drive innovation.

## Setting the stage for 6G

Successful spectrum licensing has always been about long-term planning. Putting in place the right resources for 6G is no different. The mobile industry is already studying how 6G will shape the future of mobile. For regulators, ministries, operators, vendors and researchers, spectrum policy for 6G is becoming increasingly important. 2023 marks the beginning of a long journey as new studies begin when the WRC-27 cycle kicks off.

6G is expected to become the primary mobile technology in the 2030s and will offer an enhanced user experience over previous generations. It promises ultra-fast data rates with lower latency, significant energy efficiency improvements and greater reliability.

6G comes with new spectrum considerations. Among these are the additional capacity and frequency ranges needed, from low to very high bands, to support next-generation services. This entails research into the use of terahertz spectrum. A new frequency range under consideration for 6G is 7–24 GHz, with a special focus on 7–15 GHz. This direction is supported by the GSMA following discussions with the mobile community, and represents a potential solution for the WRC-27 study cycle at the ITU.

<span style="color:red">The mobile industry is already studying how 6G will shape the future of mobile.</span>