eSIM in China: the road ahead
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www.taf.org.cn
tafrb@taf.org.cn

Contributors

Haixia Zheng, Research engineer, CAICT
Jiaying Guo, Research engineer, CAICT
Yan Zhu, Research engineer, CAICT
Ji Dong, Research engineer, CAICT
Hui Su, General Office of the Secretariat, Engineer, TAF

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www.gsmaintelligence.com
info@gsmaintelligence.com

Authors

Pablo Iacopino, Director of Ecosystem Research
David George, Head of Consulting
Yiru Zhong, Lead Analyst, IoT & Enterprise

Contributors

Kevin Pang, Head of Strategic Engagement, China
Henry Ge, Head of Strategic Engagement, Greater China
Joe Guan, Head of Public Policy, Greater China
Hong Liu, Head of Technology, Greater China
Jessie Chang, Head of Marketing, Greater China
Jean-Christophe Tisseuil, Head of SIM Technology
About this report

This report looks at current and future developments in the eSIM ecosystem across several perspectives: technology, use cases, trials and commercial launches, market outlook and challenges, and policy & regulation. The report offers a global perspective before focusing on the eSIM market in China.

Considering the significant differences in use cases, technology requirements and timelines, we look at the future outlook for eSIM across three segments: consumer electronics (wearables, tablets and laptops), smartphones and the Internet of Things (IoT).

To inform the report and complement our research, we conducted an eSIM survey. Focused primarily on China, the survey allowed us to gather insights and views from Chinese companies across the wider mobile ecosystem, including mobile operators, SIM vendors, original equipment manufacturers (OEMs), IoT companies, technology players and organisations from a number of vertical industries. Survey results and company views are presented in aggregate.

The GSMA appreciates the important insights provided by the following:

- Audi
- China Mobile
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- China Unicom
- China-ASEAN Information Harbor (CAIH)
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- Gotell
- Hengbao
- HPE
- Huawei
- Infineon Technologies
- Little Genius
- Microsoft
- Mobvoi
- Redtea Mobile
- Samsung
- Showmac
- Valid

Defining eSIM terminology

In this report we use the term **eSIM** to refer to a SIM embedded in the device and the associated, nascent ecosystem. From a technology perspective, we use the following definitions:

- **A universal integrated circuit card (UICC)** is the hardware used in mobile devices that contains SIM, USIM and CSIM applications enabling secure access to mobile networks. An embedded UICC (eUICC) refers to a UICC embedded in a device at the manufacturing stage. eUICC technology can be implemented on any SIM form factor, including embedded and removable SIMs.

- **Remote SIM provisioning** is the ability to remotely download and manage a profile on a deployed eSIM without having to physically change the eSIM itself. This capability is hardware-agnostic and can also be deployed on removable SIMs. A profile comprises the operator data related to a subscription, including the operator’s credentials and potentially operator or third-party SIM-based applications – essentially the same data already stored on today’s removable SIMs.

- **An embedded SIM (eSIM)**, also known as eUICC, is a SIM form factor that supports remote provisioning.
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Executive summary

Over the last two years, there have been significant developments in the global eSIM ecosystem. In the consumer space, more than 90 mobile industry players support GSMA specifications for remote SIM provisioning of consumer devices, showing growing ecosystem alignment towards a single, de facto, standardised approach. This helps overcome industry fragmentation and interoperability issues, driving developments and allowing consumer choice.

While smartwatches led the first wave of consumer deployments, eSIM functionality is increasingly being deployed in tablets, laptops and smartphones (both Apple and Google have introduced eSIM functionality in some smartphones, for example). Apple’s launch of eSIM in its newest iPhones represents a milestone for the eSIM ecosystem, with a growing number of mobile operators already supporting the feature. Other leading handset vendors are likely to introduce eSIM technology, but it may take some time for a full range of devices to be announced considering the typically annual nature of smartphone releases.

In the Internet of Things (IoT), automotive is at the forefront of eSIM deployments. eSIM functionality is available in a growing proportion of new cars, while partnerships between auto manufacturers and mobile operators are on the rise worldwide. Since April 2018, built-in connectivity has been a specific requirement in Europe following the Emergency Call (eCall) initiative.
China is laying the groundwork for its eSIM ecosystem

There has been significant progress in both remote SIM provisioning and eSIM technologies in China in recent years. The most progress has been seen in consumer electronics (particularly smartwatches) and IoT, driven by mobile operators, OEMs, SIM vendors, IoT companies and technology players. In the smartphone market, eSIM deployments in China lag behind other major countries, with eSIM functionality not commercially available at present.

Industry collaboration is playing an important role in driving eSIM developments in China. There are several examples of initiatives and forums that involve operators, other mobile ecosystem players, government and regulatory bodies – such as the Ministry of Industry and Information Technology (MIIT) – and global/local industry associations such as the GSMA, the China Academy of Information and Communications Technology (CAICT), the Telecommunication Terminal Industry Forum Association (TAF) and the China Communications Standards Association (CCSA).

Consumer electronics: smartwatches dominate early eSIM deployments in China

Smartwatches with eSIM technology are gaining momentum in China. Vendors including Apple, Huawei, Mobvoi and Samsung continue to innovate, while mobile operators allow smartwatch access to cellular networks in certain locations. To drive adoption, Chinese operators also allow consumers to use their smartwatches as secondary devices with one mobile subscription (One Number for Dual Terminals).

According to the GSMA Intelligence Consumer Survey, smartwatch adoption grew by three percentage points in China in 2018, to 9% of adults. Although eSIM smartwatches account for a small percentage of total smartwatch ownership, their consumer adoption is likely to increase over the next few years. The number of Chinese cities where eSIM smartwatch services are commercially available is growing, while smartwatches will increasingly offer new value-added services beyond fitness and healthcare, with eSIM allowing them to be untethered from smartphones.

eSIM is expected to see wider application in the broader field of consumer electronics over the coming quarters in China, to include devices such as laptops and tablets. With work on the move becoming the norm for millennials and organisations, and the rise of business travellers and freelance workers, the opportunity to buy data plans online – as opposed to in-store – offers greater flexibility and streamlines the purchasing process.

The Chinese mobile industry is still in an early phase of eSIM development in which both proprietary solutions and those based on the GSMA specifications coexist. While there is widespread expectation in the Chinese mobile ecosystem that GSMA specifications will emerge as the de facto choice (as highlighted by our survey), the transitional period could last for a few years as the Chinese ecosystem gains eSIM experience and addresses the need for local technology solutions and specifications that best fit short-term market requirements. Several Chinese companies have also noted the potential for a dual approach in the short term, with a global standard applicable for cross-border transnational business scenarios, and a simpler, cheaper standard deployed for domestic solutions.
Smartphones: eSIM yet to be commercially launched in China – mainstream adoption several years away

There has been no formal adoption of eSIM in the Chinese handset market to date, despite interest from smartphone manufacturers and growing operator support for eSIM in the wearables market. Beyond regulatory approval, mainstream adoption will likely take a number of years due to supply- and demand-side factors. There will be a period of reconfiguration as the ecosystem gains eSIM experience and adjusts to new manufacturing, logistical and supply-chain processes, as well as a phase of customer education and associated customer service.

Considering the huge number of smartphone connections in China (more than 1 billion at the end of 2018), it is reasonable to assume that a huge installed base with a removable SIM will remain in circulation for several years (a dual-SIM model). According to a GSMA Intelligence scenario analysis for eSIM adoption, China will begin its transition to eSIM in the smartphone market later than other major countries and regions, but will catch up in the medium term. By 2025, between around 20% (low adoption) and 35% (high adoption) of smartphone connections could be eSIM in China. The country will also be the largest eSIM smartphone market by 2025, accounting for around a fifth of global eSIM smartphone connections by that point.

IoT: significant room for eSIM adoption in China, with automotive leading the way

eSIM adoption in the Chinese IoT market – and across the world – is still low compared to its long-term potential, as remote SIM provisioning technology is still in its infancy and the IoT market remains highly fragmented and diversified. However, our eSIM in China survey showed widespread agreement among Chinese companies that eSIM adoption is crucial to driving IoT market developments over the next five to 10 years.

All three Chinese mobile operators – China Mobile, China Telecom and China Unicorn – are developing eSIM solutions and gathering joint development forces across the ecosystem to create tactical development paths. They have launched cellular M2M and IoT eSIM platforms as part of their overall IoT strategies, and are conducting tests with partners. Overall, according to our eSIM survey, three vertical industries stand out in terms of expectations for eSIM adoption in China: automotive, logistics and energy & utilities.

While cellular networks serve a minor share of total IoT connections – both in China and at the global level – the explosion of the IoT market provides significant room for growth in the cellular IoT space and, within it, eSIM adoption. According to GSMA Intelligence, there will be nearly 2 billion licensed cellular IoT connections (cellular M2M and licensed LPWA) in China by 2025, a three-fold increase from year-end 2018 (around 700 million).

China plays a key role in driving IoT developments globally. It is not only the largest IoT market in the world by number of licensed cellular IoT connections; it is also a major global supplier of the technologies required to drive developments and growth in IoT, including sensors, microchips and other components.
Streamlined regulation is key to driving large-scale developments in the Chinese eSIM ecosystem

Although eSIM does not require fundamental changes to the existing SIM regulatory framework, Chinese companies participating in our survey claimed that a number of actions would help facilitate deployments in the local eSIM ecosystem. In particular, streamlining procedures and setting clear, unified rules on eSIM requirements for consumer and industrial devices, credentials management, designation of root certificate issuing, security and cross-border interoperability are considered important to accelerate deployment. The government should also facilitate trials of eSIM services, particularly in the nascent area of industrial IoT, promoting an open eSIM ecosystem.

Significant work is under way in China to help set a favourable regulatory framework for eSIM deployments. As well as global organisations such as the GSMA, local institutions are contributing to this work. In particular, the TAF released two separate documents in December 2018 containing guidelines for eUICC and eUICC ID (EID) implementation respectively. The TAF is also working on finalising a unified certification issuing (CI) framework, which includes guidelines for its implementation across different use cases. Meanwhile, all three mobile operators in China support GSMA specifications for remote SIM provisioning of consumer devices and have established remote provisioning platforms that comply with the TAF’s unified CI policy.
2.1 Mobile ecosystem embraces eSIM for consumer and enterprise applications

Since the publication of a GSMA Intelligence report on the future of the SIM\(^1\) two years ago, there have been significant technology and market developments in the global eSIM ecosystem.

**Continuous work and collaboration on industry specifications**

More than 90 mobile industry players support GSMA specifications for remote SIM provisioning of consumer devices.\(^2\) These include mobile operators with large footprints worldwide, major device and SIM vendors, infrastructure and chip providers, and global technology companies (see Figure 1). This ecosystem collaboration shows that the mobile industry is looking to align towards a single, de facto, standardised approach, which helps overcome industry fragmentation and interoperability issues, driving market acceptance and allowing consumer choice.

Considering the significant number of mobile players involved across the eSIM value chain, ecosystem alignment on global standards and specifications is key. It helps drive developments on a global scale, ensuring that smaller operators, OEMs and providers of IoT services and solutions continue to have equal access to market opportunities.

The range of players involved also shows the breadth of ecosystem engagement around the world. All categories of mobile stakeholder are supporting technical developments and introducing a range of commercial products and solutions to serve early market demand for eSIM.

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\(^1\) The future of the SIM: potential market and technology implications for the mobile ecosystem, GSMA Intelligence, 2017

\(^2\) For more information about remote SIM provisioning technology, see The what and how of Remote SIM Provisioning, GSMA, 2018.
Mobile industry players supporting GSMA Remote SIM Provisioning specifications for consumer devices

90+
Major industry players support the initiative

Proliferation of devices with eSIM technology

A range of device vendors, including Apple, Huawei, Mobvoi and Samsung, have launched eSIM-enabled smartwatches (see Figure 2), while an increasing number of mobile operators provide smartwatch access to their cellular networks. These smartwatches typically share the phone number and operator subscription with a smartphone, allowing users to make and receive calls, send and receive SMS, stream music, make payments and use a range of digital services usually consumed on smartphones. Beyond wearables, eSIM functionality is also increasingly seen in other consumer electronics such as connected tablets (e.g. Apple, Asus and Huawei), laptops (e.g. Lenovo and Microsoft) and smartphones.

For more information about remote SIM provisioning technology, see The what and how of Remote SIM Provisioning, GSMA, 2018.
Devices with eSIM functionality commercially available

<table>
<thead>
<tr>
<th>Smartwatches</th>
<th>Laptops, notebooks and tablets</th>
<th>Smartphones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Watch Series 3 and 4</td>
<td>iPad Pro tablet (3rd generation)</td>
<td>iPhone XR, XS and XS Max</td>
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<tr>
<td>Huawei Watch 2</td>
<td>Huawei dtab tablet</td>
<td>Google Pixel 2, 2 XL, 3 and 3 XL</td>
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<tr>
<td>Samsung Galaxy Watch</td>
<td>Samsung Gear S3</td>
<td>Microsoft Surface Pro</td>
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<tr>
<td>Mobvoi TicWatch 2</td>
<td>Asus Transformer Mini</td>
<td>Lenovo Mix 630</td>
</tr>
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</table>

Note: not exhaustive
Source: GSMA Intelligence

eSIM technology now available in iPhones

Apple’s introduction of eSIM functionality into its high-end smartphones represents a milestone for the eSIM ecosystem. In September 2018, Apple announced that its newest iPhones (XR, XS and XS Max) feature dual-SIM technology with both a Nano SIM and an eSIM. This allows people to use two mobile subscriptions and phone numbers – for example, one for business and one for personal use – though the eSIM can serve as the only mobile plan. It also allows people to add a local data plan when travelling abroad, and have separate voice and data plans.³

Although the Apple announcement attracted widespread publicity, Google was actually the first to launch a smartphone with eSIM functionality in late 2017, with the Pixel 2 and 2 XL. At the time, the feature only worked on Google’s MVNO service (recently rebranded to Google Fi); however, with its latest releases in October 2018 (Pixel 3 and 3 XL) Google has enabled the feature to work on other networks. With Apple introducing eSIM into its smartphones, other major and smaller vendors are likely to feature eSIM technology. However, it may take some time for a full range of competing devices to be announced, considering the typically annual nature of new smartphone releases.

³While both numbers can make and receive voice calls and send and receive messages, the iPhone can only use one mobile data network at a time.
Mobile operators supporting eSIM for smartphones

The number of mobile operators supporting eSIM functionality in the new iPhones has grown significantly since September 2018. As of the end of January, several operators across the US, Europe, the Middle East and Asia Pacific offer cellular plans on an eSIM. One exception is mainland China, where iPhone XR and XS Max are dual SIM with two Nano-SIM cards. Outside of mainland China, users in Hong Kong or Macau can use the eSIM functionality in the iPhone XS only. A number of operators also support eSIM service in Google’s Pixel 3 and 3 XL across various markets such as the US, Germany, India and the UK.

Looking ahead, operator support for eSIM functionality is likely to continue to grow, both as sales of the iPhones increase and as other smartphone manufacturers launch their devices with eSIM capability. According to a GSMA Intelligence scenario analysis for eSIM adoption (see Figure 3), by 2025 between around 25% (low adoption) and 40% (high adoption) of smartphone connections could be eSIM worldwide, with around a third a medium adoption case. Our scenario analysis is based on the following assumptions:

- Most global and regional major smartphone vendors introduce smartphones with eSIM functionality in 2019-2021, following Apple and Google.
- The proportion of new smartphone shipments that are eSIM enabled grows over time. Each scenario has different assumptions – in the high adoption scenario, we assume it reaches 85–95% by 2025 across most regions. This is also driven by increasing operator support of eSIM service.
- There are constant competitor and market dynamics (it does not account for operators’ commercial strategies and assumes constant vendor share of the smartphone market out to 2025).

Figure 3

Scenario analysis for worldwide adoption of eSIM in the smartphone market

eSIM smartphone connections (installed base) as a percentage of total smartphone connections added since 2007

Source: GSMA Intelligence

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4 Nearly 50 mobile operators across more than 20 countries. Apple: https://support.apple.com/en-gb/HT209096
5 This scenario analysis is largely an OEM-driven model which factors in a number of drivers – at regional levels – such as timelines for commercial launches of smartphones with eSIM functionality, smartphone replacement rates and proportions of vendors’ smartphone shipments that are eSIM enabled. It covers the period out to 2025. The analysis is based on the number of smartphone connections added since 2007.
Clear signs of progress in certain IoT industries

Automotive is one of the leading industries in terms of IoT deployments, and this is also the case when specifically considering remote SIM provisioning. eSIM functionality is available in a growing proportion of new cars. Since April 2018, built-in connectivity has been a specific requirement in Europe following the Emergency Call (eCall) initiative.

Collaboration between mobile operators and auto manufacturers is gaining momentum worldwide as many automakers deploy, or look to deploy, eSIM technology in their cars. Notable examples include Audi, BMW, Volvo, Toyota and the PSA and Volkswagen groups.

Other eSIM technology companies – including Gemalto, Giesecke+Devrient (G+D), IDEMIA, STMicroelectronics and Valid – are also supporting eSIM developments in connected cars across both consumer and M2M applications. Gemalto offers an embedded LTE solution that allows the driver, passengers and car to use a range of mobile services and features simultaneously. For instance, the driver and passengers can use 4G voice and data services while the car’s navigation system provides the route to a destination complete with satellite imagery and route suggestions to avoid heavy traffic. This solution also enables an integrated mobile Wi-Fi hotspot for up to eight devices – all with the same LTE IP connection.6

In early 2018, G+D Mobile Security presented an eSIM management enabled solution that allows car owners to download their private mobile subscriptions to a second SIM soldered into the car’s telematics box. The new solution, developed with BMW, Intel, Deutsche Telekom and AT&T, allows car owners to use their existing mobile data plans and access information services by using the car as the mobile device.7 Some automakers are now choosing to use the consumer remote SIM provisioning specification to deliver the entertainment and driver information component of their services, while using the M2M specification for telematics.

Beyond cars, several M2M/IoT eSIM products are available across a range of use cases, including bikes, smart meters and security cameras. Deployments for aircraft are also now emerging. For example, Transatel, an IoT connectivity solutions provider, was selected by Airbus to provide global cellular connectivity for its open data cloud-based platform, Skywise. This platform, which uses 4G connectivity at various airport locations, systematically gathers operational, maintenance and aircraft data from aircraft during layover between flights. Transatel’s role is to enable seamless and secure data transmission (data captured by on-board sensors) from aircraft to Airbus data centres, wherever the passenger airliners have landed.

While cellular networks serve a minor share of total IoT connections (14% by 2025, as shown in Figure 4), the explosion of the IoT market provides significant room for growth in the cellular IoT space and, within it, eSIM adoption. According to GSMA Intelligence, the number of licensed cellular IoT connections – including cellular M2M and licensed LPWA – will more than triple between 2018 and 2025, reaching 3.5 billion globally.

6 Gemalto. M2M Case Study: Connected Cars.
**2.2 Technology developments continue, driven by use case requirements**

From a technology perspective, the mobile industry reached significant milestones in recent years. The separate release of GSMA Remote SIM Provisioning specifications covering both device categories – M2M and consumer – was a key achievement, allowing companies to test and implement commercial solutions using a standardised approach.

To ensure ecosystem trust in the security of remote SIM provisioning for embedded SIMs, the GSMA Security Accreditation Scheme (SAS) model in place for UICC production (SAS-UP) has been extended to cover embedded SIM production. A scheme for security auditing and accreditation of the providers of embedded SIM subscription management services (SAS-SM) has also been established. These two schemes are open to all UICC and embedded SIM suppliers as well as providers of subscription management services, regardless of location. An increasing number of companies have SAS-SM and/or SAS-UP accredited sites for eUICC, including Gemalto, Giesecke+Devrient (G+D), IDEMIA, STMicroelectronics and Valid. There is also a growing number of Chinese companies with accredited sites.9

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9 For a full list of accredited companies see GSMA web page.
There is a question as to what extent the two GSMA specifications (M2M and consumer) will continue to coexist, with the example of the automotive sector showing that some car makers are now adopting both solutions in their vehicles. While this has limited cost implications, there may come a point from a subscription and service management perspective when both car owners and service providers would prefer a single SIM capable of dealing with all the vehicle communication requirements. This could lead to convergence of the consumer and M2M specifications, through a single GSMA Remote SIM Provisioning specification that would work on any device on any network, regardless of the device application. The GSMA will continue to monitor developments in the industry, assessing the need for harmonisation of these specifications into a single remote SIM provisioning specification, if required by the ecosystem.

Although the embedded UICC (eUICC) is expected to become the mainstream solution in the medium term, new form factors are being explored in the industry, including the integrated eUICC, trusted execution environment (TEE), soft SIM and embedded secure element (eSE), as shown in Figure 5. TEE, soft SIM and eSE are not currently defined by GSMA specifications. Security is a fundamental requirement across all technologies. A previous GSMA Intelligence report highlighted that most companies in the mobile industry had concerns about the security of solutions based on soft SIMs. Two years later, most respondents to our eSIM in China survey confirmed that security is still a major concern for applications run on soft SIMs.

At present, the eSIM, which uses a hardware-based secure element, is considered by most companies in the mobile ecosystem as the most secure solution available in the market and is fit for purpose. In the longer term, further evolution of the SIM form factor and the deployment of alternative solutions will be driven by use case requirements in the IoT markets, but there are barriers to overcome in terms of security, certification, regulation, industry acceptance and collaboration among industry players.

**Embedded UICC and other technologies**

<table>
<thead>
<tr>
<th>Embedded UICC (eUICC)</th>
<th>Trusted execution environment (TEE)</th>
<th>Embedded secure element (eSE)</th>
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<tbody>
<tr>
<td>An embedded UICC (eUICC) refers to a UICC embedded in a device at the manufacturing stage. eUICC technology can be implemented on any SIM form factor, including embedded and removable SIMs.</td>
<td>TEE is a secure area of the main processor in a smartphone or connected device which ensures that sensitive data is processed and protected in an isolated, trusted environment.</td>
<td>An embedded secure element (eSE) is a tamper-resistant platform, embedded in mobile devices, capable of securely hosting applications (e.g. payment, identity) and their confidential and cryptographic data. Secure elements can be found in a mobile device in different forms: as a chip embedded directly into the device’s hardware (eSE), in the UICC or in a micro SD card that can be inserted into the mobile device.</td>
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</table>

**Integrated eUICC**

An integrated eUICC is an eUICC managing operator credentials which is integrated into a larger chip, such as a system-on-chip (SoC). It is implemented on an integrated Tamper Resistant Element (TRE) - a certified secure element using the Common Criteria PP-0084 Protection Profile, augmented to support remote NVM. It operates as an eUICC conforming to GSMA SGP01/02/21/22 eSIM specifications.

**Soft SIM**

The soft SIM is not standardised and there are varying definitions of the concept. For the purposes of this report, a soft SIM is a collection of software applications and data that performs all the functionality of a SIM card but does not reside in any kind of secure data storage or use a secure processor. Instead, it is stored in the memory and processor(s) of the communications device itself (there is no SIM hardware).

*Source: GSMA Intelligence*

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10 More details on these technologies and an overview of their merits and drawbacks are provided in The future of the SIM: potential market and technology implications for the mobile ecosystem, GSMA Intelligence, 2017
Some companies in the mobile ecosystem are already working on a system-on-chip approach, such as an integrated eUICC. In the integrated eUICC model, there is no separate component as the system-on-chip solution combines the secure processor (for eUICC), the baseband processor and potentially other processors into one discrete hardware component. The solution can satisfy today’s security requirements but occupies no extra space in the device.

System-on-chip technology is also likely to evolve and, as a result, may encompass all secure platforms in the device and be the trusted element for the SIM and other secure elements. In February 2018, ARM introduced a new product family – Arm Kigen – that delivers integrated SIM functionality to IoT system-on-chip designs. The company also provides a remote provisioning server solution for the IoT ecosystem, receiving GSMA certification in November 2018. Gemalto is collaborating with Qualcomm Technologies to integrate its mobile connectivity and remote subscription management solutions (including eSIM) with the new Secure Processing Unit (SPU) on the Snapdragon mobile PC platform, with the first wave of always-connected PCs expected as early as 2019. In order to meet growing market expectations for deeper integration of functionality, the GSMA established a proof of concept (PoC) to perform evaluations of technical solutions, easing the migration of UICC technology within systems-on-chips.\textsuperscript{11}

Meanwhile, ETSI started a work item called Smart Secure Platform (SSP), which is set to be a standard for encompassing secure platforms within a single chip. Technical realisation of the SSP consists of two deliverables, constituting the first parts of a multi-part specification. The first deliverable addresses generic portions of the SSP, regardless of its form factor and the physical interfaces it supports. The second will address a specific class of the SSP – the SSP integrated on a system-on-chip.\textsuperscript{12}

\textsuperscript{11}UICC POC Group Primary Platform requirements Approved release, GSMA White Paper, 2017
\textsuperscript{12}For more information, see https://www.etsi.org/
3.1 Four major trends are shaping the mobile ecosystem in China

China has a unique mobile market, both in terms of size and revenue growth. With nearly 1.2 billion unique mobile subscribers at the end of 2018, the country is by some way the largest mobile market in the world, accounting for more than a fifth of the world’s total mobile subscribers. Despite mobile revenue growth slowing in recent years, overall performance remains above most other developed markets in the world. Indeed, China will account for around 15% of global mobile revenue growth between 2018 and 2025, with revenues totalling more than $180 billion by the end of the forecast period.
Four major trends are shaping the wider mobile ecosystem in China:

• **5G work continues ahead of commercial launch in 2019/2020** – While 4G is approaching an expected customer adoption plateau in the range of 75–80% of connections, the Chinese mobile industry continues to make progress with 5G across several areas: field trials, spectrum consultations, R&D and network deployments. All three Chinese mobile operators plan to launch early commercial services in 2019/2020, focused on a limited footprint of dense urban centres. China will have the largest 5G market by 2025, with more than 450 million 5G connections. This accounts for nearly 30% of the total number of mobile connections in China (excluding fixed wireless and licensed cellular IoT) and around a third of the number of 5G connections globally. China has made 5G a national priority, with the 5G connectivity layer helping drive broader digital transformation of the economy.

![Figure 6](image)

**5G customer adoption in select countries/regions, 2025**

Excluding licensed cellular IoT and fixed wireless

![Chart](chart)

Source: GSMA Intelligence

• **Leadership in mobile developments and tech innovation reaches unprecedented levels** – China is increasingly demonstrating its technological innovation and is emerging as a leading place to test and implement new technologies, including eSIM-enabled products and services. Benefitting from enormous economies of scale, the Chinese tech ecosystem is giving rise to a large number of start-ups and innovative companies in mobile and beyond. The government’s ambition to make China a leading country in high-tech industries (as part of the Made in China 2025 strategic plan) is a major force in driving forward digital evolution. All three Chinese mobile operators play a key role and are investing in emerging technologies such as artificial intelligence (AI), blockchain, drones and autonomous driving, as well as new fields such as IoT.

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13**5G in China: the enterprise story**, GSMA Intelligence, 2018
• **China set for global leadership in the IoT market** – As highlighted in a recent GSMA report\(^{14}\), China is both the largest IoT market in the world by number of licensed cellular IoT connections and a major supplier of the technologies required to drive developments and growth in IoT, including sensors, microchips and other components. As of June 2018, China Mobile had around 400 million licensed cellular IoT connections, while China Telecom and China Unicom had around 100 million each. China is also producing start-ups, such as landing.ai (founded by Baidu’s former chief AI scientist Andrew Ng), K2Data and RootCloud, which could play a key role in the development of the industrial internet. Many of the IoT components and services developed in Greater China are deployed locally. Indeed, China’s manufacturing sector is also a major customer for IoT solutions – a trend that is likely to strengthen with the digital transformation of the broader economy, and manufacturing in particular.

• **Chinese mobile consumers are highly engaged in the digital world** – With more than 800 million mobile internet users at the end of 2018, China boasts the world’s largest consumer base in the era of digital services and content. As well as mobile operators, the Chinese ‘BAT’ trio – Baidu, Alibaba and Tencent – plays an important role in the rise of the digital consumer. They are present in nearly every aspect of the Chinese online ecosystem, with businesses ranging from web search and social media to messaging, e-commerce and entertainment. Many urban areas of China are already effectively cashless, with extensive use of mobile payment. eSIM adds another element to the wider digitisation of consumer interaction.

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**3.2 How eSIM relates to the evolution of the wider Chinese mobile ecosystem**

As the Chinese mobile ecosystem continues to innovate and evolve, new use cases for eSIM are emerging, particularly in consumer electronics and IoT. The Chinese companies participating in our eSIM survey broadly agree that eSIM will help support developments in both the consumer and industrial markets over the next five to 10 years.

eSIM functionality built into laptops and tablets adds new possibilities to be always connected on the move, reducing dependence on Wi-Fi networks (not always available or sufficiently secure) or tethering. This is critical for some categories of Chinese mobile users such as business travellers and freelance workers. With work on the move becoming the norm for millennials and organisations, the opportunity to buy data plans online – as opposed to in-store – in certain locations offers greater flexibility and streamlines the purchasing process.

eSIM may also spur greater sales of companion devices in the consumer market in China, through different channels (OEMs, retailers, operators). Chinese mobile operators, for example, can add companion devices such as eSIM-enabled wearables, tablets or connected cars to a consumer’s main data plan, improving take-up rates for those services and strengthening their customer acquisition and retention activities. They could also offer convergent plans with multiple devices under a single contract more easily than they would with traditional, removable SIMs.

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\(^{14}\) *How Greater China Is Set To Lead The Global Industrial IoT Market*, GSMA, 2018
IoT has long been seen as a promising area for eSIM adoption as the eSIM provides significant space reduction in the device compared to traditional removable SIMs, and can be updated remotely using over-the-air (OTA) technology. The small size of an eSIM provides flexibility in designing products and makes it well suited to IoT deployments, significantly increasing the range and nature of devices that can be connected. The rise of IoT and China’s leadership in this space will drive a proliferation of new devices, platforms, applications and services – for both individuals and enterprises – that require secure authentication, connectivity and, in most cases, remote management. As such, the eSIM is a viable option for certain IoT use cases, including smaller devices, connected vehicles and mobile use cases in remote locations.

There are also expectations that 5G use cases will promote eSIM adoption by driving developments in the IoT ecosystem, particularly in those industries expected to benefit from the faster speeds and/or lower latencies promised by 5G networks such as automotive, healthcare and manufacturing (Industry 4.0), as well as smart cities. Some respondents to our eSIM survey highlighted that 5G-based applications in massive IoT and ultra-reliable, low-latency communications (URLLC) will likely spur adoption of IoT devices, which in turn will drive penetration of eSIM in China.

From a smartphone design perspective, the eSIM allows significant space reduction in the device compared to the removable SIM – an important factor in the 5G era as the new mobile network technology requires more space for antennas and larger batteries, especially in early device versions. There is also a two-way link between eSIM and 5G in the smartphone market. Some companies highlighted that eSIM may help the transition from 4G to 5G as customers upgrade their mobile subscriptions online, provided that their devices are 5G ready from the beginning, while others believe that 5G will trigger device renewals, which represents an opportunity to launch devices with eSIM functionality.
4.1 Laying the groundwork for a growing and evolving eSIM ecosystem

There have been significant developments in both remote SIM provisioning and eSIM technologies in China in recent years, particularly in consumer electronics and IoT. Different categories of mobile ecosystem player are driving progress, including mobile operators, OEMs, SIM vendors, IoT companies and technology players. All three Chinese mobile operators – China Mobile, China Telecom and China Unicom – are undertaking a number of eSIM projects and initiatives. These include building eSIM infrastructure, gathering joint development forces across the eSIM ecosystem to create tactical development paths, and working iteratively to improve the development of eSIM-enabled products. Chinese operators have also released White Papers on eSIM and remote SIM provisioning technologies, articulating solutions, application scenarios, technical requirements and suggestions for business cooperation.
4.2 Consumer electronics: smartwatches dominate early eSIM developments

Smartwatches lead early eSIM developments in the Chinese consumer electronics market; other products such as laptops and tablets are likely one or two years behind. Several smartwatches with eSIM technology are commercially available to Chinese consumers in selected locations, provided by vendors such as Apple, Huawei, Mobvoi and Samsung.

China Unicom was the first Chinese mobile operator to support eSIM functionality on the Huawei Watch 2 Pro and the Apple Watch Series 3 in late 2017. In November 2017, China Unicom introduced the eSIM-enabled Huawei Watch 2 Pro in Shanghai as a standalone trial with its own mobile subscription and number. With the Apple Watch Series 3, China Unicom also allowed consumers to use secondary devices (smartwatches) with one mobile subscription and one mobile phone number (One Number for Dual Terminals).
The availability of eSIM smartwatch services varies by operator and city. In June 2018, China Mobile announced the launch of an eSIM-enabled smartwatch (Huawei Watch 2) in Tianjin, Shanghai, Hangzhou, Guangzhou, Shenzhen and Chengdu. Since October 2018, China Telecom has supported eSIM functionality for the Apple Watch, providing limited eSIM service for locally registered phone numbers in Shanghai, Guangzhou, Chengdu and Nanjing. As of November 2018, China Unicom provides eSIM services in seven cities: Shanghai, Guangzhou, Changsha, Shenzhen, Tianjin, Wuhan and Chengzhou.

According to the GSMA Intelligence Consumer Survey 2018, adoption of wearables is growing in China and other countries around the world (see Figure 7), but there is widespread agreement in the mobile industry that take-up has somewhat underperformed compared to initial expectations (five or more years ago). The survey does not reveal adoption of smartwatches with eSIM functionality – but it is reasonable to assume that this accounts for a small percentage of total smartwatch ownership, given that eSIM smartwatches have limited commercial availability and are a premium product for tech-savvy consumers.

While the November 2016 release of GSMA specifications covering all consumer mobile devices (including handsets) has the potential to spur greater adoption of companion devices, allowing consumers to connect all their mobile devices to a single mobile operator subscription, the addressable market for eSIM smartwatches represents a fraction of the total number of mobile subscribers in China. One of the key challenges in the wider cellular connected wearables market is the development of core functionality and standalone value-added services beyond fitness and healthcare, as well as the capability to be used independently of a smartphone.

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**Figure 7**

Smartwatch adoption in selected countries

![Smartwatch adoption chart](chart.png)

Source: GSMA Intelligence Consumer Survey
From the current operator-led trials and commercial launches of eSIM smartwatches in selected cities, eSIMs are expected to see wider application in the broader field of consumer electronics over the coming quarters, to include consumer devices such as laptops and tablets. To date there has been limited demand from laptop manufacturers, but as eSIMs become more standardised and accepted in China and around the world, demand is likely to grow.

Overall, our eSIM in China survey showed broad agreement among operators and other Chinese companies across the mobile ecosystem that the adoption of eSIM smartwatches in the smartwatch market will be faster than the adoption of eSIM in other consumer electronics markets (see Figure 8). Some respondents to our survey highlighted that up to half of cellular wearables could be eSIM equipped in the longer term (exact timelines unspecified).

**Figure 8**

Mobile ecosystem expectations for eSIM adoption in consumer devices in China

Question: In your opinion, how will eSIM adoption grow in the following consumer devices?

Range 0-5 (where 0 is very slow and 5 is very fast)

Source: GSMA Intelligence eSIM in China survey 2018
4.3 Smartphones: eSIM yet to be commercially launched – mainstream adoption several years away

While the speed of eSIM development in consumer electronics and IoT in China is as fast as that in other major countries and regions, Chinese companies who participated in our eSIM in China survey agree that eSIM developments in the smartphone market are happening slowly.

There has been no formal adoption of eSIM in the Chinese handset market to date, despite some interest from smartphone manufacturers and growing operator support for eSIM in the wearables market. The latest Apple iPhones do not include the eSIM capability in mainland China, but rather will have dual, removable SIMs.

International roaming is an area that has seen some deployment of eSIM, though the solutions are typically soft SIM-based and not compliant with GSMA specifications. A number of OEMs, including Huawei (Skytone) and Xiaomi (Mi Roaming), have developed proprietary soft SIM solutions which are applied to international data roaming. These have been used in both handsets and IoT devices. Huawei’s Skytone, for example, is installed in some of the company’s high-end smartphones such as the Mate 7 and Honor 6 Plus. Skytone allows mobile users registered as Chinese citizens to access mobile data services when travelling abroad without buying a new SIM card, keeping their physical, removable SIM as the main subscription. This service is currently supported in around 20 countries across Europe and Asia and available on a limited number of handsets.

Looking ahead, several factors will determine the speed of adoption of eSIM in the Chinese smartphone market, as shown in Figure 9. At this stage, regulatory timelines for the introduction of eSIM functionality in handsets are unclear, despite the huge popularity of dual SIM phones in the country and the launch of smartphones globally with dual eSIM/removable SIM capabilities (iPhones are popular among the more affluent in China).

Beyond regulatory approval, mainstream adoption will likely take a number of years due to supply- and demand-side factors. There will likely be a period of reconfiguration as ecosystem companies gain remote SIM provisioning experience and adjust to new manufacturing, logistical and supply-chain processes. A phase of end-user education is also needed – particularly for consumers that are not tech-savvy – through customer-service support and simple, enhanced digital interfaces.
eSIM in China: the road ahead

Market outlook: the future of eSIM in China

Given the huge number of smartphone connections in use in China (more than 1 billion at the end of December 2018), it is reasonable to assume that a huge installed base with a removable SIM will remain in circulation for the next five to 10 years. According to a GSMA Intelligence scenario analysis (see Figure 10), China will begin its transition to eSIM in the smartphone market later compared to other major countries and regions in the world, due to current regulatory barriers to the commercial launch of eSIM service, but it will catch up in the medium term.

By 2025, between around 20% (low adoption) and 35% (high adoption) of smartphone connections could be eSIM in China. China will be the largest eSIM smartphone market by 2025, accounting for around a fifth of global eSIM smartphone connections by that point. In all three scenarios, we assume that most global and local major smartphone vendors will launch eSIM services in the country by the end of 2021, although regulatory timelines for the introduction of eSIM functionality in the Chinese smartphone market are still unclear.

Finally, as in other countries around the world, it is reasonable to assume a gradual transition to eSIM in China, in which multiple SIM solutions co-exist. The initial array of smartphones incorporating eSIM functionality will contain a removable SIM card slot (the Apple example). This rationalises the manufacturing requirements for OEMs, which can distribute one device to work globally, accommodating markets where embedded SIMs may take longer to be embraced. In the medium term, smartphones will likely have eSIM solutions only, with no removable SIM.

Key factors driving eSIM adoption in smartphones in China

<table>
<thead>
<tr>
<th>Vendors</th>
<th>Operators</th>
<th>Governments</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch dates of smartphones with eSIM functionality (global and local vendors)</td>
<td>Number of operators demanding smartphones with eSIM functionality and supporting eSIM technology</td>
<td>Government regulation on eSIM and associated timelines (i.e. barriers, potential eSIM mandate)</td>
<td>Mobile churn rate and customer base mix (prepaid/contract)</td>
</tr>
<tr>
<td>Proportion of new smartphone shipments that are eSIM enabled (this increases over time)</td>
<td>Operators’ commercial strategies with regards to eSIM for smartphones (for consumers and businesses)</td>
<td>MVNO regulation</td>
<td>Smartphone replacement rates by type of market (high-end, low-end)</td>
</tr>
<tr>
<td>Future competitive dynamics (i.e. vendor share of smartphone market)</td>
<td>Future competitive dynamics (operator share of smartphone connections)</td>
<td>Ability to enforce cooperation among operators</td>
<td>Customer propensity to embrace eSIM and associated phase of education</td>
</tr>
<tr>
<td>Local vs. global dynamics (i.e. global vendors selling in China and local vendors selling globally)</td>
<td>Operators’ commercial strategies with regards to eSIM for companion devices (tablets, wearables, laptops)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: GSMA Intelligence
Scenario analysis for adoption of eSIM in the smartphone market in China

eSIM smartphone connections (installed base) as a percentage of total smartphone connections added since 2007

![Graph showing adoption scenario analysis for eSIM in the smartphone market in China]

4.4 IoT: significant room for eSIM adoption, with automotive leading the way

To date, there has been limited eSIM adoption in the Chinese IoT market – and across the world – as remote SIM provisioning technology is still in its infancy and the IoT market remains highly fragmented and diversified. However, our eSIM in China survey shows widespread agreement among Chinese companies that eSIM adoption is crucial to driving IoT market developments over the next five to 10 years.

There are increasing efforts from Chinese companies across the eSIM value chain to identify the technical needs, operational processes and business models required to deploy eSIM solutions on a larger scale in China. All three Chinese mobile operators have launched cellular M2M and IoT eSIM platforms as part of their overall IoT strategies, and are conducting tests with partners. The three operators have similar customer targets for eSIM in IoT and are looking at automotive as a key focus and priority.

Three vertical industries stand out in terms of expectations of eSIM adoption in China: automotive (connected and autonomous vehicles), logistics and energy & utilities (smart metering). See Figure 11.
**Mobile ecosystem expectations for eSIM adoption by vertical industry in China**

**Question:** In your opinion, how will eSIM adoption grow in the following vertical industries?

**Percentage of respondents**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Very fast</th>
<th>Fast</th>
<th>Moderate</th>
<th>Slow</th>
<th>Very slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>21%</td>
<td>37%</td>
<td>16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logistics</td>
<td>12%</td>
<td>65%</td>
<td>12%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy and Utilities</td>
<td>6%</td>
<td>33%</td>
<td>33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>6%</td>
<td>17%</td>
<td>22%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare</td>
<td>6%</td>
<td>17%</td>
<td>17%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6%</td>
<td>17%</td>
<td>17%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: GSMA Intelligence eSIM in China survey 2018*

Automotive leads current eSIM developments in the Chinese IoT space. As in other countries around the world, there is strong interest in the potential of eSIM from the automotive segment. All three Chinese mobile operators are working on vehicle telematics, connected cars and the wider ‘Internet of Vehicles’. China Unicom and China Mobile are working with auto manufacturers including Volkswagen and BMW to offer eSIM solutions. China Telecom has an agreement with KDDI to offer eSIM capabilities for Toyota cars imported into China from Japan. At MWC Shanghai 2018, China Mobile announced that its Connected Car platform has been integrated with Cubic Telecom’s IoT Connectivity platform to offer eSIM services to the latter’s automotive customers in China.

In June 2018, China Mobile and NTT Docomo launched an IoT multi-vendor eSIM solution that enables cross-vendor SIM profile switching from Docomo to China Mobile. The solution enables Docomo customers from Japan with IoT equipment in China to switch the mobile numbers (profiles) of their IoT equipment from Docomo to China Mobile even with different SIM vendors, thus eliminating the need to replace removable SIMs. The new system enables smooth switching between mobile networks when companies send connected automobiles or machinery from Japan for use in China.
Logistics is the next biggest sector in terms of eSIM adoption expectations in China, because of its roaming requirements and the need for greater traceability audits in a smart supply-chain era. When logistics, particularly supply-chain tracking, involves devices that travel across national, regional and international areas, the optimal connectivity in terms of availability, reliability and costs may not be provided by the same few operators. Logistics is also one of the most mature M2M applications and thus has the volume to keep eSIM costs to a more reasonable level.

The third sector is utilities, particularly smart metering for gas and water. This is in line with Chinese mobile operators’ efforts to encourage NB-IoT deployments where eSIM becomes either a customer requirement or part of the operator’s IoT strategy. For example, mobile operators could leverage worldwide momentum in NB-IoT meter deployment to offer best practices for deployment in China. The volume of smart meters for gas and water is sufficiently high to overcome current cost concerns as a barrier to eSIM adoption.

It is important to consider the role of cellular connectivity in the IoT ecosystem as several connectivity options are being deployed to suit a variety of devices, use cases, network requirements (reliability, availability and latency) and other needs (such as low/high data volumes, low/high device/service cost, low/high energy consumption). While the majority of IoT devices – typically in indoor environments – will likely be connected by radio technologies, such as Wi-Fi and Bluetooth, which operate on unlicensed spectrum and are designed for short-range connectivity, other IoT devices that require wide-area network coverage, coverage on the move, lower latency and ultra-reliability will primarily be connected by cellular networks using licensed spectrum.

This cellular connectivity will be provided by either traditional cellular networks (2G/3G/4G/5G) or the emerging LPWA networks. According to GSMA Intelligence, there will be nearly 2 billion licensed cellular IoT connections in China by 2025, a threefold increase from year-end 2018 (around 700 million). This makes China the largest market globally.

**Figure 12**

**Licensed cellular IoT connections in China**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of licensed cellular IoT connections (million)</th>
<th>China share of global (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>200</td>
<td>32%</td>
</tr>
<tr>
<td>2016</td>
<td>400</td>
<td>32%</td>
</tr>
<tr>
<td>2017</td>
<td>600</td>
<td>32%</td>
</tr>
<tr>
<td>2018</td>
<td>800</td>
<td>32%</td>
</tr>
<tr>
<td>2019</td>
<td>1,000</td>
<td>32%</td>
</tr>
<tr>
<td>2020</td>
<td>1,200</td>
<td>32%</td>
</tr>
<tr>
<td>2021</td>
<td>1,400</td>
<td>32%</td>
</tr>
<tr>
<td>2022</td>
<td>1,600</td>
<td>32%</td>
</tr>
<tr>
<td>2023</td>
<td>1,800</td>
<td>32%</td>
</tr>
<tr>
<td>2024</td>
<td>2,000</td>
<td>32%</td>
</tr>
<tr>
<td>2025</td>
<td>2,200</td>
<td>32%</td>
</tr>
</tbody>
</table>

Source: GSMA Intelligence
5 Policy and regulation

5.1 Streamlined rules key to driving large-scale eSIM developments in China

Most Chinese companies across the wider mobile ecosystem agree that, while the pace of technological developments for eSIM in consumer electronics and IoT is broadly in line with other major countries or regions, regulators in China have been slow to embrace eSIM. According to most respondents to our survey, regulation is the primary barrier to mainstream adoption of eSIM in China (see Figure 13).

To access cellular networks, devices with eSIM functionality require pre-approval from the MIIT. To date, the MIIT has only approved commercial launch of eSIM in wearables in selected Chinese cities. Commercial launch of eSIM in the automotive sector (connected cars, for example) is under review and yet to be approved, while regulatory timelines for the introduction of eSIM functionality in the smartphone market are still unclear.
While eSIM does not require fundamental changes to the existing SIM regulatory framework, Chinese companies believe that a number of actions would help facilitate deployments. These include streamlining procedures and setting clear, unified rules on eSIM requirements for consumer and industrial devices, credentials management, designation of root certificate issuing, security and cross-border interoperability. The government should also facilitate trials of eSIM services, particularly in the nascent area of industrial IoT, promoting an open eSIM ecosystem.

Significant work is under way in China to help set a favourable regulatory framework for eSIM deployments. As well as global organisations such as the GSMA, local institutions are also contributing to this work. In particular, the TAF released two separate documents in December 2018:

- Guidelines for eUICC implementation management. The guidance sets out four key points: 1) TAF will include any eUICC-enabled products that meet its stated requirements in an “Approved eUICC Products” list. It will also recommend the use of these approved and qualified products in any domestic commercial activities. 2) The TAF is responsible for managing this list of qualified eUICC products. 3) It sets out the application process needed for eUICC-enabled products to be approved, including the requirements on material and audit conditions. 4) The TAF states the conditions needed for maintaining qualified list status.

- Guidelines for eUICC ID (EID) implementation management. The guidance clearly states that EID is the world’s only eUICC identifier. It also sets out the following: 1) TAF is the sole entity responsible for EID issuance and management in China. 2) It will manage prospective applications on its website. 3) EID is issued only to card vendors. 4) The qualification conditions and filing requirements expected for card vendor applications. 5) The filing requirements expected for eSIM device manufacturers.

### Key challenges to eSIM adoption in China

Question: How do you rate the main barriers to adoption of eSIM?

<table>
<thead>
<tr>
<th></th>
<th>Percentage of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation</td>
<td>67% 22% 11%</td>
</tr>
<tr>
<td>Ecosystem fragmentation</td>
<td>47% 24% 29%</td>
</tr>
<tr>
<td>Security</td>
<td>24% 29% 47%</td>
</tr>
<tr>
<td>End-user acceptance</td>
<td>17% 11% 72%</td>
</tr>
<tr>
<td>Simplicity of integration</td>
<td>11% 56% 33%</td>
</tr>
<tr>
<td>Slow innovation</td>
<td>11% 45% 44%</td>
</tr>
</tbody>
</table>

Source: GSMA Intelligence eSIM in China survey 2018

While eSIM does not require fundamental changes to the existing SIM regulatory framework, Chinese companies believe that a number of actions would help facilitate deployments. These include streamlining procedures and setting clear, unified rules on eSIM requirements for consumer and industrial devices, credentials management, designation of root certificate issuing, security and cross-border interoperability. The government should also facilitate trials of eSIM services, particularly in the nascent area of industrial IoT, promoting an open eSIM ecosystem.
The TAF is also working on identifying how a unified certification issuing (CI) framework may look and how it can be implemented across different use cases. To that end, the Chinese organisation is currently working on the approval and release of a unified CI policy. Meanwhile, all three mobile operators in China have established remote SIM provisioning platforms that comply with the TAF’s unified CI policy.

The regulatory framework for eSIM in the IoT market is also supportive, reflecting the overarching goal of establishing China as a global technology leader. In late 2017, the MIIT, together with the Standardisation Administration of China (SAC), issued the final Guidelines for the Establishment of National Standards System of Telematics Industry (Intelligent & Connected Vehicles). While there is no specific eSIM regulation within these guidelines, the MIIT, the China Certification & Inspection Group (CCIC) and the CCSA, are working with industry, academics and technology ecosystems to establish and drive the use of eSIM for intelligent and connected vehicles and related services.

On specifications, there is widespread agreement among Chinese companies participating in our eSIM survey that adopting a single, standardised approach to eSIM is key to moving from small to large-scale developments in the mobile ecosystem, and that the GSMA specifications for remote SIM provisioning provide the most valid option considering their international recognition and benefits in terms of security and compatibility. However, some companies also accept that no single eSIM solution fits every device or application, particularly in the IoT market. Several also noted the potential for a dual approach in the short term, with a global standard applicable for cross-border transnational business scenarios, and potentially a simpler, cheaper standard to be deployed for domestic solutions.

However, this fragmentation (a number of different proprietary standards) can increase costs and raises challenges around cooperation and interoperability of different solutions and platforms, which in turn could hinder uptake. As such, specifications and regulations should be harmonised with global standards to avoid device and ecosystem fragmentation, ensure international interoperability and promote development of eSIM technology in China and globally.
Considering the size of the Chinese consumer and industrial markets, the country’s leadership in tech innovation and its role as a major supplier of the technologies required for consumer electronics and IoT, eSIM deployments in China are important not only for the country’s ecosystem but also for scale worldwide. Beyond the technology and market dynamics discussed earlier in this report, a number of other factors will support or even risk slowing the pace of eSIM deployments and market adoption in China over the next few years.
• **Worldwide industry collaboration on standards and specifications.** While China on its own has significant scale to develop its local rules and deployments, collaboration at a global level is key to allow businesses to fully reap the benefits of eSIM – particularly enterprises that have global footprints and commercial offerings. As such, China is collaborating with global organisations to develop an eSIM ecosystem that is aligned to global practices for specifications and is contributing to developments of eSIM and other technologies (TEE and eSE).

• **Coordinated work between regulators, industry associations and companies.** In an environment characterised by different standards, regulatory challenges and high demand for fast eSIM deployments, there is a need for coordinated collaboration between regulators, industry associations and companies across the eSIM value chain to drive advancements. As well as global organisations such as the GSMA, local institutions are contributing to this work. The TAF’s initiatives discussed earlier (the release of guideline documents for eUICC, eUICC ID and unified CI) are, for example, a positive step forward and may accelerate eSIM developments and commercialisation across all use cases.

• **Understanding opportunities and challenges for ecosystem companies.** The transition to eSIM will have implications for business models that will occur over many years. For consumers, eSIM is likely to be unambiguously positive; for businesses, it brings opportunities and challenges. Workshops on how Chinese enterprises can benefit from eSIM technology and industry collaboration, and how they must change their operational processes, could help the development of the eSIM ecosystem, particularly in early years. Many respondents to the eSIM in China survey observed that the use of eSIM is attractive in IoT, but opportunities and business models have not been clarified. There is a role here for mobile operators and industry associations to help guide the various stakeholders through this rapidly evolving environment.

Creating a favourable technology, market and regulatory environment will ultimately determine the pace of eSIM adoption in China and worldwide. In 2019 and beyond, the GSMA will continue to bring together all stakeholders in the global mobile industry to support further progress with eSIM on several fronts: standards and specifications, technology developments and market acceptance. It will also continue to monitor customer adoption of eSIM across the consumer and industrial segments.