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E-SIM for consumers— a game changer in mobile telecommunications?

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Traditional removable SIM cards are being replaced by dynamic embedded ones. What might this disruption mean for the industry?

Wearable gadgets, smart appliances, and a variety of data-sensor applications are often referred to collectively as the Internet of Things (IoT). Many of these devices are getting smaller with each technological iteration but will still need to perform a multitude of functions with sufficient processing capacity. They will also need to have built-in, stand-alone cellular connectivity. E-SIM technology makes this possible in the form of reprogrammable SIMs embedded in the devices. On the consumer side, e-SIMs give device owners the ability to compare networks and select service at will—directly from the device.

From industry resistance to acceptance

In 2011, Apple was granted a US patent to create a mobile-virtual-network-operator (MVNO) platform that would allow wireless networks to place bids for the right to provide their network services to Apple, which would then pass those offers on to iPhone customers.[1] Three years later, in 2014, Apple released its own SIM card—the Apple SIM. Installed in iPad Air 2 and iPad Mini 3 tablets in the United Kingdom and the United States, the Apple SIM allowed customers to select a network operator dynamically, directly from the device.

This technology gave users more freedom with regard to network selection. It also changed the competitive landscape for operators. Industry players were somewhat resistant to such a high level of change, and the pushback may have been attributable to the fact that operators so heavily relied on the structure of distribution channels and contractual hardware subsidies. In fundamentally changing the way consumers use SIM cards, Apple's new technology was sure to disrupt the model at the time.

As a technology, e-SIM's functionality is similar to that of Apple's MVNO and SIM, since it also presents users with all available operator profiles. Unlike Apple's technology, however, e-SIM enables dynamic over-the-air provisioning once a network is selected. Today, the industry is reacting much more favorably. One driver of the shift in sentiment is the recent focus on the push by the GSMA to align all ecosystem participants on a standardized reference architecture in order to introduce e-SIMs. What's more, machine-to-machine (M2M) applications have used this architecture for built-in SIM cards for several years now with great success.

[1] Tony Fadell. Dynamic carrier selection. US Patent 20,110,130,140, filed February 7, 2011, and issued June 2, 2011.
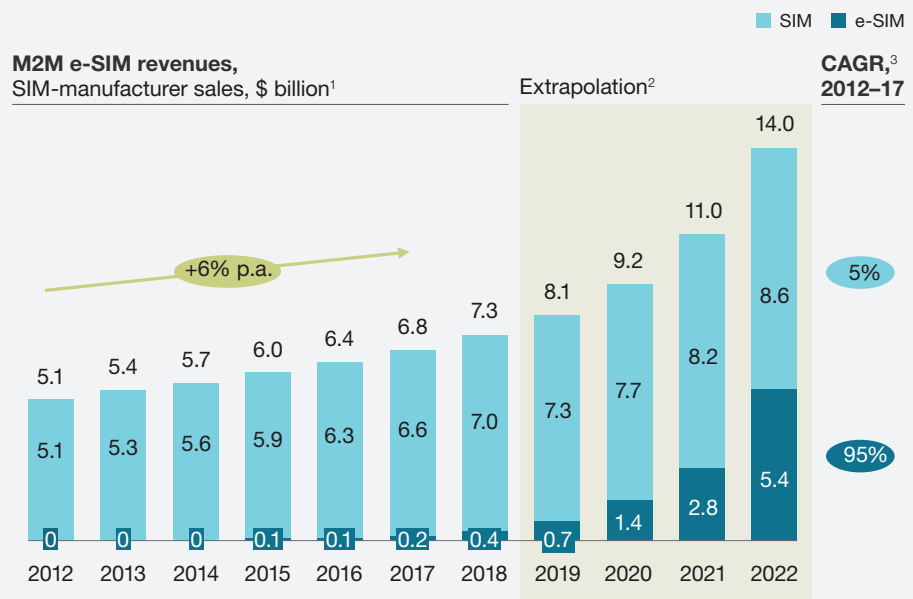
Consumer devices will require a more dynamic pull mode to request electronic profiles than the passive push mode of M2M technology. This requirement translates into a big incentive for device manufacturers and over-the-top players to support the industry-wide adoption of e-SIM standards. Finally, it is becoming increasingly clear that future consumer wearables, watches, and gadgets should ideally be equipped with stand-alone mobile-network connectivity. Together, these developments have contributed to strong industry support from mobile operators for the GSMA's Remote SIM Provisioning initiative.

As a result of both the strong growth in the number of M2M and IoT devices and the development of consumer e-SIM specifications by the GSMA, the distribution of e-SIMs is expected to outgrow that of traditional SIM cards over the next several years by a large margin (Exhibit 1).

The GSMA is expected to present the outcome of ongoing alignment negotiations later in 2015. The association announced that "with the majority of operators on board, the plan is to finalize

Exhibit 1

Machine-to-machine (M2M) e-SIM revenues are set to increase dramatically in the next seven years.

SIM   e-SIM

M2M e-SIM revenues,
SIM-manufacturer sales, $ billion[1]

Extrapolation[2]

**CAGR,[3]
2012–17**

+6% p.a.

Year	SIM	e-SIM	Total
2012	5.1	0	5.1
2013	5.3	0	5.4
2014	5.6	0	5.7
2015	5.9	0.1	6.0
2016	6.3	0.1	6.4
2017	6.6	0.2	6.8
2018	7.0	0.4	7.3
2019	7.3	0.7	8.1
2020	7.7	1.4	9.2
2021	8.2	2.8	11.0
2022	8.6	5.4	14.0

5%

95%

[1]Figures may not sum, because of rounding.
[2]Assumes researched growth rates for 2012–17 continue.
[3]Compound annual growth rate.

McKinsey&Company | Source: Strategy Analytics; McKinsey analysis

the technical architecture that will be used in the development of an end-to-end remote SIM solution for consumer devices, with delivery anticipated by 2016."[2]

Architecture and access

The future standard will most likely require a new or nonprovisioned device to connect to an online service (for example, an e-SIM profile-discovery server) to download an operator profile to the handset. Final details on the e-SIM operating model—including the required components for a provisioning architecture—are being finalized by OEMs, network operators, SIM vendors, and the GSMA.

While no change to the current environment is expected for most of the architecture components, the industry group needs to agree on a solution for how the online discovery service will establish the initial connection between the handset and the profile-generating units. Independent ownership is preferred from a consumer perspective to ensure that all available operator profiles (and tariffs) are made available for selection without the need to state a preference for a specific provider. Enabling over-the-air provisioning of operator profiles requires a standardized architecture with agreed-upon interfaces and protocols across all ecosystem participants.

The use of consumer e-SIMs means that the chipset manufacturers will negotiate with hardware OEMs such as Apple and Samsung directly, and the industry value chain might be reconfigured. The manufacturing and distribution of physical SIM cards becomes (partially) obsolete, although preconfiguration and profile-handling services already form a significant part of the value created for traditional SIM-card vendors. Physical SIM cards, however, are not expected to disappear from the market within the next few years. Instead, a relatively long phase of parallelism between existing SIM technology and the new standard is expected. Countless existing devices will still have to be served continuously, and developing markets, in particular, will have long usage cycles of basic, traditional SIM phones and devices.

Depending on the outcome of the GSMA's ongoing alignment negotiations, the resulting architecture recommendation might require a slight update of the model described in Exhibit 2, but it is quite likely that the following components will be present.

Profile-generation unit. E-SIM profile generation will take place via the same processes used for SIM profile development. SIM vendors will use authentication details provided by network operators to generate unique network access keys. Rather than storing these details on physical SIM chips, they will be saved in digital form only and will await a request for download triggered by the embedded universal integrated circuit card (e-UICC) in the consumer's handset.

Profile-delivery unit. The connection between the e-UICC in the device and the profile-generation service is established by the profile-delivery unit, which is responsible for encrypting the generated profile before it can be transmitted to the device. While theoretically, all participants in the new e-SIM ecosystem could operate the profile-delivery service, those most likely to do so will be either the SIM vendors or the mobile network operators (MNOs)—physical and virtual—themselves.

[2] Tim Bradshaw and Daniel Thomas, "Apple, Samsung in talks with telecom groups to launch e-Sim card," *Financial Times*, July 16, 2015, ft.com.

Exhibit 2

Each stakeholder can control an aspect of e-SIM architecture.

✓✓ Likely solution   ✓ Possible solution   ✘ Unlikely solution

	Universal-discovery (UD) server	Profile-generation unit	Profile-delivery unit
Independent third party	✓✓	✘	✓
OEM	✓	✘	✓
SIM vendor	✓	✓✓	✓
MNO/MVNO[1]	✘	✓	✓✓
Key reasons for most likely solution	• Might need to contain full list of e-SIM profile-generation providers • DNS[2] model possible (as IP[3] network) • OEMs, MNOs, and SIM vendors may have fewer incentives to operate	• Maintains current capabilities in producing SIM profiles • Strong trust-based relationship between SIM vendors and MNOs	• Operational merge with e-SIM profile generation exploits synergies • Responsible for profile routing and encryption; therefore, MNO or independent ownership preferred

[1]Mobile network operator/mobile virtual network operator.
[2]Domain name server.
[3]Internet Protocol.

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Universal-discovery (UD) server. The UD server is a new key component in the e-SIM architecture; previously, it was not required for provisioning physical SIM cards or M2M e-SIM profiles. In a consumer e-SIM environment, customers will obtain either a device that is not associated with an operator or one that has been preprovisioned. In the former case, they will be required to select a provider, and in the latter, they may have the option to do so. In both cases, the UD plays a pivotal role, as it is responsible for establishing the link between the device and the profile-provisioning units. Consumers would most likely prefer that an independent party be responsible for operator-profile discovery to ensure that all available profiles in a market (with no restrictions on tariffs and operators) are presented without commercial bias.

A possible alternative to a separate UD server might be a model similar to today's domain-name-server (DNS) service. This would provide the same level of objectivity as the UD, but it would require more intensive communication between all involved servers to ensure that each provides comprehensive profile information.

Stakeholder advantages in an e-SIM environment
Adoption of e-SIM as the standard across consumer devices brings several advantages for most stakeholders in the industry: IoT-enabled product manufacturers (for example, connected-

car or wearables manufacturers) would have the ability to build devices with "blank" SIMs that could be activated in the destination country. This functionality would make for easy equipment connectivity and allow manufacturers to offer new products in new market segments.

By adopting e-SIM technology, mobile network operators can benefit from the opportunity to take a leading role in the IoT market. They would also have the ability to provide convergent offers with multiple devices (for instance, the smart car and smart watch) under a single contract with the consumer more conveniently than they would using physical SIM cards.

Consumers benefit from the network-selection option that embedded connectivity technology provides. The ability to change providers easily means that e-SIM customers don't have to carry multiple SIMs, have full tariff transparency, and can more easily avoid roaming charges.

Mobile-device manufacturers may be able to take control of the relationship with the customer because e-SIM, at least technically, allows for disintermediation of network operators from the end-to-end relationship. E-SIM also frees up valuable device "real estate," which gives manufacturers an opportunity to develop even more features using the space once occupied by traditional SIM cards.

SIM vendors don't lose in the e-SIM scenario either. Their competency in security and profile creation positions them to be valuable players in the new ecosystem. Key architecture activities, such as managing the e-SIM-generation service, are among the roles that SIM vendors are uniquely qualified to take on.

E-SIM's potential impact on channels and operating models

Most network operators have already started initiatives to explore not only the impact of the architectural requirements on the organization—including changes to existing IT systems and processes—but also the potential effect on channels, marketing, and proposition building.

Marketing and sales. Targeting new clients through promotional activities may be as easy as having them sign up by scanning the bar code of a print advertisement and activating the service immediately—without ever meeting a shop assistant or getting a new SIM card. By conveniently adding secondary devices such as e-SIM-enabled wearables and other IoT gadgets to a consumer's main data plan, operators might improve take-up rates for those services. On the other hand, the ease of use and ease of operator switching has the potential to weaken the network operator's position in the mobile value chain, as customers may demand more freedom from contractual lock-ins, as well as more dynamic contractual propositions.

Customer touchpoints. The entire customer journey and in-store experience may also be affected. For example, e-SIM eliminates the need for customers to go to a store and acquire a SIM card when signing up for service. Since face-to-face, in-store interactions are opportunities to influence customer decisions, operators will need to assess the potential impact of losing this customer touchpoint and consider new ways to attract customers to their sales outlets.
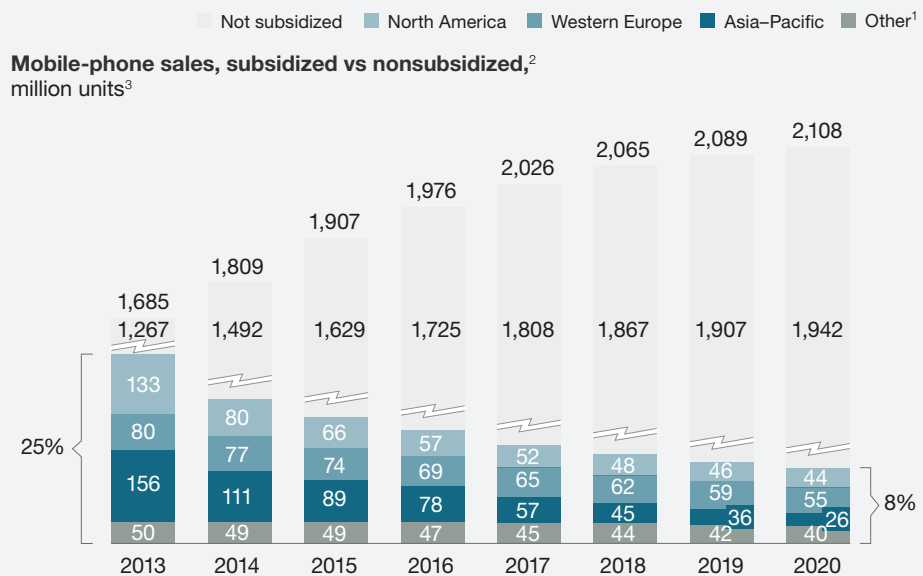
Logistics. Many services will need to be redesigned, and customer-service and logistics processes will be widely affected. For example, secure communication processes for profile-PIN delivery will be required.

Churn and loyalty. The customer may be able to switch operators and offers (the prepaid client base, at least) more easily, and short-term promotions may trigger network switching. This means that churn between operators in a strong prepaid ecosystem will likely increase. But this does not necessarily mean that a customer who isn't locked into a contract will churn networks more often or spend less. Consumers may still prioritize a deal that offers a superior user experience and acceptable call quality. Satisfied clients will likely stay with their operator as long as locked-in customers do.

Prepaid versus contract markets. E-SIM's impact may be greater in markets with more prepaid customers than in markets with a high share of subsidized devices. While device-subsidy levels will remain an important driver of customer loyalty in developed markets, investment in device subsidization is expected to fall dramatically over the next couple of years—from approximately 20 percent of all devices sold to less than 8 percent in 2020 (Exhibit 3).

Exhibit 3

Sales of subsidized devices are expected to decline through 2020.

Legend: Not subsidized | North America | Western Europe | Asia–Pacific | Other[1]

Mobile-phone sales, subsidized vs nonsubsidized,[2] million units[3]

	2013	2014	2015	2016	2017	2018	2019	2020
Total	1,685	1,809	1,907	1,976	2,026	2,065	2,089	2,108
Not subsidized	1,267	1,492	1,629	1,725	1,808	1,867	1,907	1,942
North America	133	80	66	57	52	48	46	44
Western Europe	80	77	74	69	65	62	59	55
Asia–Pacific	156	111	89	78	57	45	36	26
Other	50	49	49	47	45	44	42	40

25% (2013) → 8% (2020)

[1]Central and Latin America, Central and Eastern Europe, Africa, and the Middle East.
[2]Handset-subsidy definition: difference between the wholesale (trade) handset cost and the final retail price the subscriber paid at operators or retailers; sales refers to "sell-through" of devices.
[3]Figures may not sum, because of rounding.

McKinsey&Company | Source: Strategy Analytics; McKinsey analysis

Disruptive business models enabled by e-SIM

Recently, a number of new business models have developed around e-SIMs. Specifically, dynamic brokerage and potential spot-price platform markets are piquing the interest of the mobile community.

Wholesale service provision. Wholesalers contracting with several network operators in a market could offer a tariff selection without disclosing which network is providing the connectivity. The customer could then be "auctioned" dynamically among network operators for a period of time. Electronic profiles could even be switched among operators seamlessly for the client.

Social-media and Internet-content service providers. The voice services that social-media platforms offer rely on available Wi-Fi connectivity to provide voice services either entirely via a data connection or by using a temporary connection to a cellular network. Call quality depends in part on the seamless switching between those connectivity avenues, and e-SIMs would facilitate smoother "handovers" with dynamic (and automatic) operator selection.

One of the potentially highest-impact and most disruptive new ventures of this type is surely Google's Project Fi, an MVNO offer, recently launched in the United States, that strives to provide the best available data-network performance on mobile devices by combining mobile data and Wi-Fi connectivity. The decision regarding which network to connect to will be based on the fastest available speed and bandwidth. Additionally, social-media voice services mean that mobile-phone numbers are no longer the only unique client identifiers. A user's online communication account (for example, Hangouts) is enough to set up a phone call.

New pricing schemes. While most operators already provide mobile Internet telephony services, technically referred to as voice over IP (VoIP) or voice over LTE (VoLTE), many operator tariff schemes still have potential for disruption on the commercial side. In addition to offering competitive rates, new players may further increase margin pressure by including refunds of unused, prepaid minutes in their pricing models. For advertising-centric players or social-media companies entering the MVNO market, the advertising value or additional call-behavior data may even lead to cross-subsidizing offerings in the short term.

Global roaming services. Last but not least, other players are primarily targeting the still-expensive global data-roaming market for end users. Strong global brand power paired with the technology of reprogrammable e-SIMs—supporting over-the-air provisioning of multiple electronic user profiles of global operators—can be turned into easy-to-use offers for global travelers. These transparently priced global roaming services will allow users to choose a local network with a few clicks on the device. Current global roaming offers based on reprogrammable SIMs are priced near the upper end of the market, but providers in emerging markets may soon offer similar services and more competitive global tariff schemes.

The GSMA is working with global network operators to develop a standardized reference architecture for the implementation of e-SIM technology. The process under way may lead to widespread industry adoption of e-SIMs in the very near future.

New entrants and new sales and service models will drive e-SIM's impact on the mobile-telecommunications market in the next two to five years. Revenue is at stake, and operators' approaches to new propositions, shared data-tariff portfolios, potential new revenue streams, and handset-subsidy strategies across multiple markets will play a big role in how they fare in the new e-SIM ecosystem. Whether an operator decides to take a role as a smart follower or an early mover, an overall strategy and associated initiatives need to be shaped thoughtfully now. ☐

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