Giesecke+Devrient

IoT eSIM Handbook 2025

Switch Networks. Zero Touch. Frictionless Management.

When more is in fact more with IoT eSIM

Introduction

The GSMA's SGP.32 standard for IoT embedded SIMs, is available now. The specification introduces a first 'made-for-IoT' technical foundation for enabling connectivity for IoT devices across the globe. With the arrival of SGP.32, a new IoT-focused embedded SIM (eSIM) can enable zero-touch connectivity for devices regardless of location. The standard accommodates features of both M2M (SGP.02) and consumer eSIM specifications (SGP.22) and enables deployments to directly incorporate an embedded universal integrated circuit card (eUICC) into the device, allowing profile switching between networks.

The commercial introduction of IoT-specific standards, such as SGP.32 and its consumer variant SGP.22, are set to streamline and simplify eSIM deployments. These will transform use cases from automotive to smart metering, enabling enterprises to frictionlessly choose cellular connectivity for their devices. With both SGP.32 and SGP.22 there is no longer a requirement for plastic SIM cards and, with SGP.32 in particular, SIM functionality can be efficiently – and automatedly – deployed anywhere in the world.

This enables devices to be deployed with a single stock-keeping unit (SKU) number, thanks to increased adoption of eSIM technology. With this, enterprises no longer need to manufacture or deal with the logistical complexities of country-specific variants and can make devices in massive volumes, secure in the knowledge they can be shipped and deployed anywhere in the world. This new simplification radically reduces complexity for IoT organisations and is poised to further stimulate eSIM uptake and usage by enterprises.

Eradicate complexity

Complex remote SIM provisioning (RSP) standards have impeded optimised usage of eSIMs in IoT and within other types of devices in the market. This is often because the SGP.02 standard was based on SMS with messages sent in the application protocol data unit (APDU) format which is not supported by many IoT devices. Regardless of this, the volume of SGP.02 devices deployed has been substantial and a significant increase in device connections is expected with SGP.32.

Both SGP.32 and SGP.22 are based on IP communication protocols, which are much more efficient. For example, they allow a profile to be downloaded in the field, which is only theoretically possible with SGP.02. SGP.32 and SGP.22 support RSP, while SGP.02 actually only supports remote SIM management (RSM) which only accommodates management of previously loaded profiles.

The divergent standards between consumer devices and IoT technologies have further hampered uptake. The arrival of SGP.32 is therefore a critical enabler of a new wave of simplified, global, cellular connectivity for enterprises.

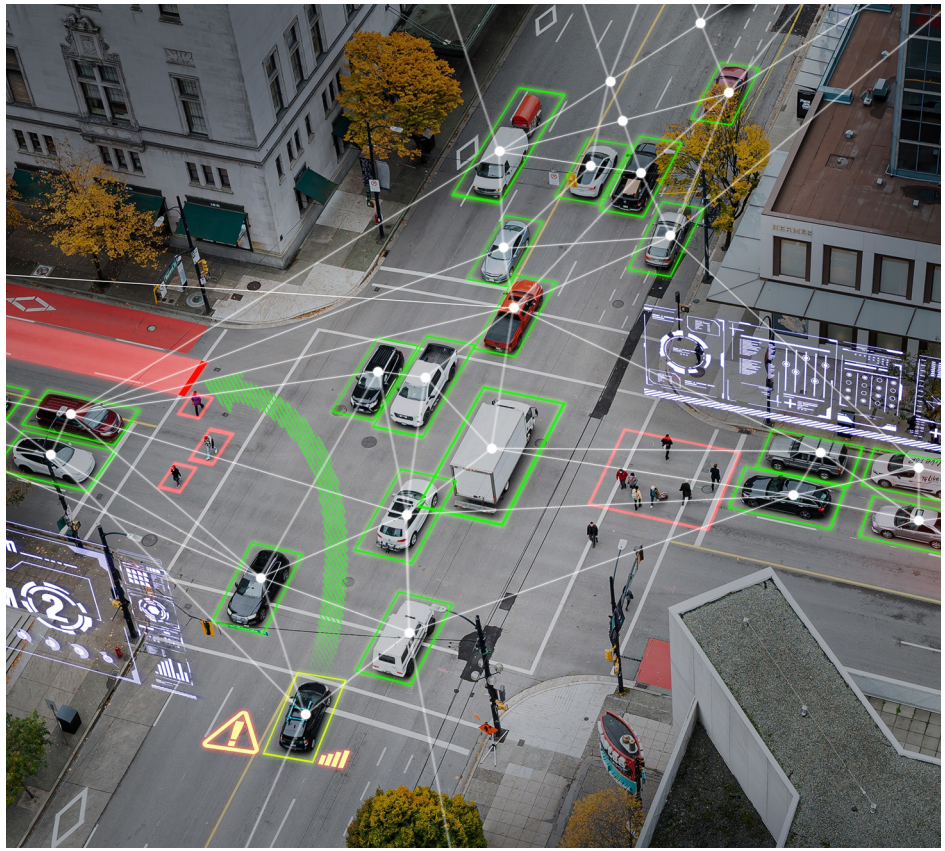
In contrast to other local wireless technologies such as LoRaWAN, Wi-Fi, Bluetooth, Zigbee and others, which demand in-location management and can require individual product variants that are created for countries and regions in which devices are deployed, cellular connectivity now provides a unified, globally standardised connectivity option. Indications are that the market has been waiting for the security, automation and operational advantages that eSIMs can offer and substantial growth in eSIM uptake in the enterprise sector is projected.

In the enterprise market, a recent GSMA Intelligence survey[1] uncovered a consensus among telecoms operators that enterprise demands for eSIM-enabled solutions will grow across most industries during 2024-2025, with the smart cities category leading growth. The firm found that telecoms operators expect eSIMs to account for 37% of the total number of cellular IoT connections by 2030, followed by iSIMs at 34% and traditional removable SIMs at 29%.

The marketplace is now well-seeded with eSIM-enabled devices, both in the consumer and enterprise markets. However, the full functionality of these is often unused as device owners await standardisation to enable them to extract optimal benefits from their eSIM devices. Research firm IoT Analytics estimates that the installed base of eSIM-capable, including integrated SIM (iSIM), IoT connectivity modules reached 650 million in 2023[2]. Even so, it acknowledges that, in spite of the predicted benefits, eSIM adoption has been slower than expected because of the challenges and complexities of activation and provisioning. This is where the new SGP.32 standard is needed, with its slicker, easier-to-operate functionality, and why enterprises are welcoming its commercial arrival.

[1] https://www.gsma.com/solutions-and-impact/technologies/esim/wp-content/uploads/2024/07/GSMA-Welcome-and-eSIM-Market-China-and-Beyond.pdf

[2] https://iot-analytics.com/role-of-esim-for-iot-better-security-simplified-roaming-easier-provisioning/



Raised standards

A root cause of enterprise concern has been the limitations of SGP.02, the GSMA's specification for RSP in machine-to-machine devices. This standard has architecture that requires multiple functional entities, including subscription manager data preparation (SM-DP) and subscription manager secure routing (SM-SR), to enable eSIMs. The need to include these functions increases the complexity of deployments and adds operational overheads, posing challenges for massive IoT deployments and limiting flexibility to switch profiles or operators because of static profile management.

SGP.02 was created in a different time before the existence of mass-market IoT so it is no longer fit for purpose as it is based on the slow and inefficient SMS communication APDU format. These limitations have been recognised in the development of the GSMA's SGP.32 specification which might replace the SGP.02 specification in the mid-term.

In contrast to SGP.02, SGP.32 supports a wide variety of IoT protocols including constrained application protocol (CoAP) and message queuing telemetry transport (MQTT), delivering huge advantages for the IoT industry in the form of development and operational flexibility. While SGP.02 is a complete and separated ecosystem, with SGP.32, customers can utilise the existing eSIM management ecosystem for consumers (SGP.22) to manage connectivity and related eSIM profiles.

Giesecke+Devrient's (G+D) AirOn360 IoT Suite, for example, allows an enterprise to manage both SGP.02 and SGP.32 as well as SGP.22 via a single platform. Serving as the backbone for large-scale IoT deployments, it enables businesses to manage and optimise their mobile ecosystems with precision – from single devices to entire fleets – across current and next-generation technology. With this centralised platform, companies can seamlessly handle update campaigns, securely download applications, apply region-specific connectivity settings and automate rule-based registrations.

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Key components for SGP.32

SM-DP+ = Subscription Manager Data Preparation Plus: The central server-side platform of the consumer remote SIM provisioning architecture that securely stores profiles, makes them available for and negotiates their secure download to the target eUICC via the device IPA (see below).

SM-DS = Subscription Management Root-Discovery Service: The universally available platform within the IoT RSP architecture that may be used to inform an eUICC that a profile has been made available for download and on which SM-DP+.

IPA = IoT Profile Assistant: The IoT Profile Assistant (IPA) is a utility for remotely managing SIM profiles on the device. It offers simpler control over connectivity. The IPA can be embedded on the eSIM (IPAe) or it can run on the device (IPAd). That gives OEMs the choice of out-of-the-box functionality or more in-house control.

eIM = eSIM IoT Remote Manager: eSIM IoT Management Solution is a standardised eSIM provisioning tool designed for the large-scale deployment and management of eSIM-enabled IoT devices.

The new standard – SGP.32 – addresses the previous limitations of eSIM activation by replacing SM-SR with a subscription manager discovery server (SM-DS) and an IoT profile assistant (IPA) in the architecture. The IPA takes away the need for user interaction during provisioning, radically simplifying IoT connectivity.

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What's available now?

The specification of SGP.32 is set and has been available since 2024. Commercial launch is underway right now. G+D has been the first to standardise SGP.32 to the eUICC and already has an end-to-end solution that is commercially available, AirOn360 IoT.

In addition, G+D is the first company to finalise the security certification process for the eUICC (eSIM). The company has become the first to have its eUICC for IoT, or eSIM IoT products, assured through the GSMA eSA scheme and eSIM Compliance programme, achieving certification in less than two months from the specification release.

Further to this, G+D and Murata unveiled the world's first connectivity module to apply the new SGP.32 RSP specification of iSIM technology in November 2024. This solution is built upon Murata's innovative Type 2GD Cat.M1/NB-IoT connectivity module supporting the ETSI and 3GPP Release 17 standards and G+D's highly-secure SGP.32-compliant SIM OS. This package is designed to support OEM IoT deployments, including point of sale (POS) products, asset tracking, healthcare solutions and wearable devices, as well as smart city, agriculture and home devices.

During production, the customer's desired SIM profile along with G+D's SIM OS can be flashed onto the module's iSIM element, eliminating the need for customers to carry out this process manually, thereby streamlining IoT device production. The iSIM provisioning, provided by G+D, also allows for convenient reconfiguration if there is a need to change the SIM profile once the IoT device has been deployed, further simplifying and reducing the costs of IoT cellular deployments. G+D's OS and management solution enables the complete lifetime remote provisioning of the SIM profile in cellular IoT devices, allowing customers to upload, manage or change the SIM profile of a new device, regardless of its global location.

How SGP.32 fits into the ecosystem

Combining SGP.32 with connectivity management platforms (CMPs) and other technologies enables offerings to be assembled into packages so customers can get everything they need, including the eUICC hardware, in one place. The ecosystem behind this already has all the pieces available to fit the needs of specific use cases and to enabled tailored offerings to be developed.

Potential use cases are limitless and include the verticals below in addition to every type of massive IoT and consumer electronics use case. It's fair to say that RSP can power countless IoT use cases with its secure, scalable capabilities.

Automotive industry

Manufacturers can enable connected vehicles with mobile network profiles to support seamless global communication, telematics and fleet management.

Smart cities and smart buildings

Authorities, construction companies and building managers can utilise SGP.32 to achieve simplified deployment and administration of devices that are to be used globally and/or whose connectivity is to be managed centrally.

Transport and logistics

Companies in these industries can use SGP.32 to provide connectivity for trackers and battery-powered IoT devices, allowing real-time tracking and monitoring across global supply chains.

Smart metering

Utilities can deploy smart electricity, gas and water meters or sensors, that can be configured and activated directly at the point of use for accurate data collection.

Healthcare devices

Vendors can equip medical devices with secure, reliable connectivity to enable consistent data transmission and remote monitoring for enhanced patient care.

Industrial IoT

Optimal connectivity for industrial sensors and machinery can be assured, enabling real-time data exchange, monitoring and control in critical environments.

Conclusion

The flexibility of SGP.32-based IoT eSIMs has the potential to deliver on the promise of frictionless IoT connectivity with flexibility, greater choice and ease of management as added benefits. An IoT eSIM is part of an ecosystem composed of IoT device makers, network providers and connectivity management platforms to create unified solutions that truly enable enterprises to switch profiles at massive scale. This ecosystem in support of SGP.32 is well-advanced and ready to help enterprises accelerate their developments and support increased uptake of SGP.32 from now onwards.

Providers like G+D are at the forefront of this. In addition to the industry-firsts mentioned earlier, G+D is unique in providing a full-stack solution, spanning SIM hardware, secure connectivity, embedded security elements and a robust connectivity management platform, all from a single provider.

In addition to providing the AirOn360 IoT Connect Connectivity-as-a-Service, G+D also offers AirOn360 In-Factory eSIM, a solution for in-factory profile provisioning (IFPP). This allows device manufacturers and OEMs to batch download profiles directly at the time of manufacturing without the need for a permanent online connection while enabling a single SKU process.

In addition, G+D's AirOn360 IoT Suite acts as the connectivity management platform to enable IoT organisations to simplify, automate and enable truly frictionless cellular connectivity for IoT devices across the globe.

To learn more about Giesecke+Devrient's solutions: **https://www.gi-de.com/en/digital-security/connectivity-iot/iot/airon360-iot**