eBook

An introduction to eSIM

Global IoT Connectivity
Made Effortless

Pelion

eSIM

What is it?

Most people are familiar with the everyday, traditional SIM card, which is more technically known as the Universal Integrated Circuit Card (UICC) and has its roots in consumer cellular solutions.

In their efforts to innovate and improve on pre-existing SIM technology, the Global System for Mobile Communications Association (GSMA) introduced eSIM as a capability that enables connectivity profiles – the unique identity that allows access to a cellular network – to be delivered over-the-air, giving users the ability to download, swap, and enable profiles remotely.

eSIM, also generically known as Remote SIM Provisioning (RSP), is a service that delivers replaceable network access profiles to a SIM card, giving users the ability to download, attach, enable, and disable profiles remotely and securely.

Myth-busting: UICC and eUICC, SIM and eSIM

Keeping things simple, think of the UICC or eUICC – its RSP-capable equivalent – as the hardware and the SIM or eSIM profile as software. And just like the UICC, an eUICC can be delivered as a traditional "triple-cut" removable plastic card or as a specialized fixed version that's soldered directly onto a circuit board. So, you can have a SIM profile "hardcoded" onto a removable or fixed UICC, or you can have an eSIM installed onto the equivalent RSP-capable hardware options.

How it works

Like a conventional SIM, an eSIM profile holds a device's unique identity and is used to match the customer's subscription agreement with a specific network operator. By enabling an eSIM profile, the eUICC SIM is granted access to the operator's network. This profile is replaceable and is provisioned on an eUICC SIM using the Remote SIM Provisioning process. eSIM profiles broadly fall into two categories: an initial activation profile – what Pelion refers to as the Bootstrap profile – and Operational profiles. Pelion's Bootstrap profile is the base eSIM profile, preconfigured to an eUICC SIM.

The bootstrap profile guarantees that when the device is first powered up, it can obtain connectivity, regardless of its geographic location, and be used to download local network profiles to a device. Once the Bootstrap profile has enabled initial network access, customers will typically download an Operational profile optimized for local access and avoid potential roaming restrictions. It's important to remember that with eSIM, while more than one Operational profile can be downloaded to and stored on the eUICC, only one can be active at any one time.

// Download an operational profile optimized for local access to avoid potential roaming restriction //

The bootstrap profile is also a fallback option should there be network issues in the device's location. This level of resiliency is especially handy for certain use cases, such as smart tracking devices that require automatic initial connectivity as they cross geographical regions.

How it works

The various ecosystem functions needed to support the RSP process are handled with Platform Management. This includes eSIM profile generation and personalization, secure profile storage and transport, and profile provisioning actions such as download, install, enable, disable, and delete.

Platform Management involves orchestrating of several entities – MNOs, eUICC Manufacturers, and eSIM SM-DP and SM-SR service providers. The SM-DP (Subscription Manager Data Preparation) and SM-SR (Subscription Manager Secure Routing) services are crucial elements of the RSP ecosystem. The SM-DP securely prepares eSIM profiles and stores them awaiting provisioning to eUICCs. That preparation includes encrypting profiles using digital certificates. The separate SM-SR service performs the actual over-the-air secure transmission of profiles to devices.

Pelion eSIM-as-a-Service Architecture
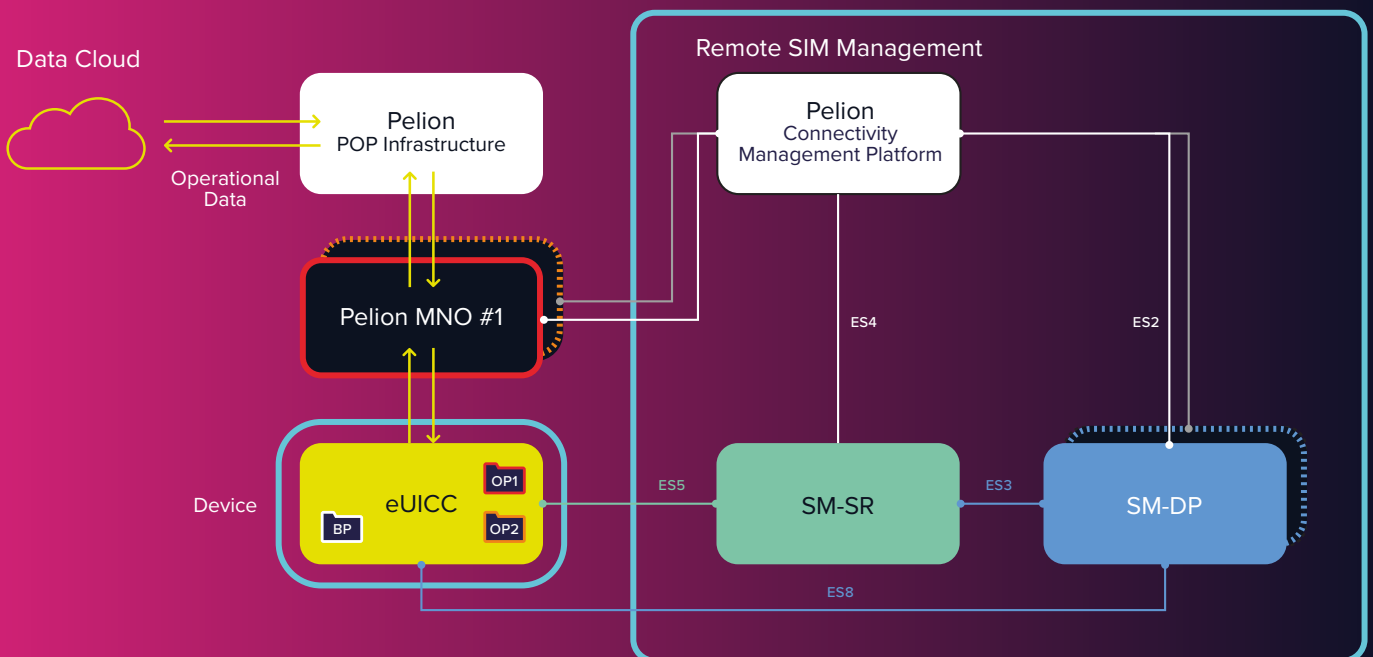
The case for eSIM

A conventional cellular connectivity solution requires users to provision, stock, and ship various SIM cards based upon every combination of regional or network access requirements.

IoT/M2M applications tend to gravitate to one of the three connectivity alternatives: permanent local, flexible localization, or ad hoc roaming. While each model has advantages and drawbacks, there's no one-size-fits-all option. For example, some use cases work perfectly well permanently linked to one preferred network operator, and this is all they'll ever likely need.

Remote provisioning via eSIM enables the over-the-air download, enable, disable, and delete of network operator profiles, opening the door to a range of use-cases that conventional SIMs can't support. For example, it allows a device manufacturer to insert or embed an eSIM at the point of assembly.

Then, when the device is activated, it can connect to a local cellular network, making the device ready to use immediately, regardless of where in the world it has been deployed.

Instead of holding SIM cards, each matched to a different network operator across the globe and coordinating which card to install into which device, every device can use the same type of physical eSIM and then have the correct profile applied in the field.

// eSIM delivers numerous business advantages with lower overheads, greater efficiency and game-changing agility //

Furthermore, suppose the network operator profile on a deployed device needs to be changed. In that case, it can be downloaded to the eSIM and enabled over the air. This capability is a significant improvement, especially when compared to conventional SIM cards, which require physically swapping the SIM card to enact a network change. The resulting operational efficiencies provided by eSIM can't be overstated, with considerable time and resources being saved. eSIM delivers numerous business advantages with lower overheads, greater efficiency, and game-changing agility when deploying and managing IoT solutions.

Maximizing the benefits of eSIM

Consolidating to a single eSIM

| Simplifies procurement, logistics and provisioning | Minimizes admin and complexity, reducing costs |

Pre-loading with Global Bootstrap Profile

| Ensures network access regardless of location | Guarantees zero-touch activation and onboarding |

Remotely downloading the initial Operational Profile

| Optimizes for the best access and data rates | Minimizes operating costs and maximizes availability |

Changing Operational Profiles, as required

| Empowers access, coverage and cost optimization | Future-proofs network flexibility and tariff choice |

The ability to change network operators without physical interaction is a significant benefit of eSIM. A global network of MNOs is an essential part of the eSIM ecosystem because no single operator provides the coverage to support a global operation. As an example, a manufacturer of smart logistics devices can equip the device with the bootstrap profile and let their customers choose the network that best supports their needs post-deployment or remotely change operator as their needs change.

For managing the logistics of a complex global deployment, when the sheer number of devices would continue to scale exponentially, eSIM is critical. A software platform that efficiently and effectively manages eSIM is key to scaling IoT deployments. The simplicity and automation provided by a connectivity management platform make it possible to enroll, deploy, maintain and track thousands of devices remotely.

Maximizing the benefits of eSIM

As the adoption of IoT advances, Pelion strongly believes that eSIM is the key to scale. Usually, each cellular-enabled IoT device requires a different SIM to ensure connectivity and compatibility with regional mobile networks. The cost of producing and shipping numerous devices and managing the mobile network operators (MNO) in each territory worldwide can increase cost and limit scalability.

eSIM reduces the complexity that can be a barrier to larger deployments and provides seamless IoT connectivity. It is embedded at the point of manufacture and can be deployed automatically out-of-the-box in any geographical region. The move to eSIM dramatically simplifies the supply chain for logistics and offers an elegant, robust, and almost infinitely scalable solution to the challenges of legacy SIMs in IoT applications.

The benefits

1 *Simplify manufacturing, procurement, logistics, and provisioning*

2 *Ensure network access regardless of location*

3 *Optimize for the best local network access and tariffs*

4 *Empower lifelong optimization of access, coverage, and costs*

5 *Future-proof interoperability, portability, and agility*

eSIM security

Trust and identity are the cornerstones for authenticating legitimate access to cellular networks. The conventional SIM delivers this by implementing a physical Secure Element, as part of the GSMA's Security Accreditation Scheme (SAS), playing a vital role in the security of the network, the subscriber's account, and related services and transactions.

With the development of eSIM and its enabling components, the GSMA has applied the same principles. While the SIM profile's role in subscriber-to-network identity, authentication, and trust is not changing, eSIM establishes a new mechanism to load it into devices, with profiles securely downloaded over-the-air.

To enable this, the GSMA has facilitated an ecosystem of trusted platforms and players, with only fully accredited manufacturers and service providers permitted to participate. Crucially, it offers a security level and protection which is equivalent to that provided by the conventional SIM card. This trusted ecosystem approach ensures robust security, proven identity, cross-vendor interoperability, service portability, and solution longevity.

> **// This trusted ecosystem approach ensures robust security //**

Pelion's Managed eSIM-as-a-Service

Unlike a conventional SIM strategy that permanently defines the network access profile at manufacturing, eSIM flips the script. Pelion's managed eSIM service provides the lifelong flexibility to update or change profiles remotely. This agility to change profiles – as and when required – means that you can adapt your connectivity due to changes of network region or coverage requirements, network operator choice, or other operational or economic factors.
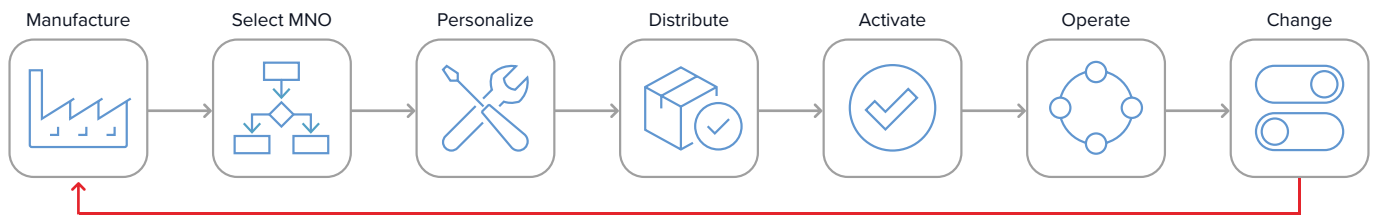
The value of Pelion is that we accelerate speed to market. As a result, organizations get all the eSIM benefits in days, rather than investing months or even years mastering the technology and building multiple relationships up and down the service stack. Correspondingly, Pelion enables companies to reap eSIM's benefits without diverting precious, finite resources into becoming experts on the labyrinthine global MNO landscape.

When utilizing Pelion's managed eSIM-as-a-Service offering, customers benefit from a single vendor managing numerous complex relationships, all within an agreed regulatory framework. In addition, Pelion's approach to integrating strategic technologies translates into establishing and building functional relationships more quickly, giving customers ready access to eSIM's diverse range of capabilities. For manufacturing organizations considering ways to future-proof an IoT/M2M rollout globally, robust security, proven identity, cross-vendor interoperability, service portability, and solution longevity are vital capabilities. As such, Pelion confidently proposes its eSIM as-a-Service offering to truly future-proof IoT/M2M connectivity with a fully managed and standards-based implementation that guarantees complete interoperability and flexibility.
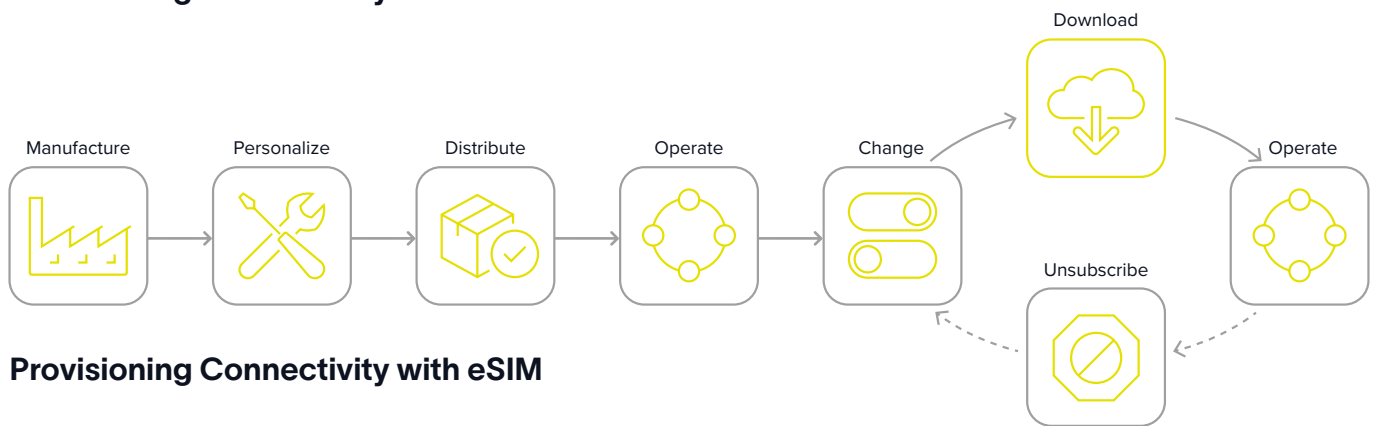
Customers benefit from a single vendor managing numerous complex relationships

Life Cycle Comparison: SIM versus eSIM

Manufacture → Select MNO → Personalize → Distribute → Activate → Operate → Change

Provisioning Connectivity with Conventional SIM

Manufacture → Personalize → Distribute → Operate → Change → Download → Operate → Unsubscribe

Provisioning Connectivity with eSIM

Pelion eSIMs are agnostic to the device hardware and don't require any special software. Compared with SIMs, where the onus is on you to precisely and proactively architect your connectivity provisioning logistics, Pelion's managed eSIM-as-a-service effortlessly handles this task. As a result, we make your transition to eSIM quick and easy. Additionally, the underlying technology that enables remote SIM provisioning is very sophisticated, requiring interactions between multiple entities. It would be a very daunting and time-consuming burden for organizations – that merely seek eSIM's benefits – to invest in an eSIM ecosystem of their own. Pelion delivers the gain without the pain, and there's no need to master completely new technology

Glossary of terms

eSIM

eSIM is a term that often acts as a catch-all that describes all of the elements, including SIM hardware (the eUICC), eSIM profiles, and the platform functions (the SM-DP and SM-SR) that facilitate SIM profiles to be remotely provisioned. Pelion's implementation of a remote SIM provisioning architecture follows the GSMA's specification.

Remote SIM Provisioning

Remote SIM Provisioning is a service that delivers an eSIM profile to an eUICC SIM. RSP gives users the ability to download securely, attach, enable, and disable eSIM profiles remotely. Platform Management is the term used to describe the various functions needed to support the RSP process.

Platform management

The term Platform management describes the various functions needed to support the RSP process. These include profile generation and personalization, secure profile storage and transport, and eSIM profile provisioning actions such as download, install, enable, disable, and delete. Platform Management involves orchestrating several entities – MNOs, eUICC Manufacturers, SM-DP and SM-SR providers – and Pelion, as an M2M Service Provider, acts as a single point of integration.

eUICC

An eUICC is an embedded Universal Integrated Circuit Card. The development of the eUICC - with its dedicated system and read/write capabilities – enables eSIM profiles to be remotely provisioned over-the-air using the RSP process, and removes the requirement to change the device's SIM card physically. Although the original UICC term defined only the removable SIM form-factor, eUICC is a generic term. Thus, it applies equally to both removable and fixed SIM form-factors that support the RSP capability. eUICCs are available in all form-factors: the commonly available removable triple cut and the fixed surface-mounted option.

Glossary of terms

EUM

An eUICC Manufacturer fabricates physical eUICC SIM hardware delivered with the eUICC Operating System software and associated components, the Bootstrap Profile (defined by the connectivity service provider), and – optionally – one or more Operational Profiles.

eSIM profile

An embedded SIM profile represents a subscription agreement with a specific network operator. Enabling an eSIM profile on the eUICC SIM grants it access to the operator's network. An eSIM profile is replaceable and is provisioned on an eUICC SIM using the Remote SIM Provisioning process.

Bootstrap profile

Pelion's bootstrap profile is the base eSIM profile preconfigured to an eUICC SIM. It serves two purposes. Firstly, it allows the provisioning of operational profiles to the eUICC SIM, and secondly, it acts as the fallback profile. This enables global roaming to Pelion's worldwide network of operator partners should the network access defined by the operational no longer be available.

Operational profile

An operational profile represents a subscription agreement with a specific network operator. Attaching and enabling an operational profile on the eUICC SIM grants it access to the operator's network. In the Pelion model, the bootstrap profile delivers initial network access, enabling the downloading of an operational profile. Typically, a customer uses an operational profile in preference to the bootstrap profile to obtain local tariffs rather than defaulting to global roaming. More than one operational profile can be downloaded to and stored on the eUICC SIM, however, only one can be active at any one time.

Glossary of terms

Subscription Manager Data Preparation (SM-DP)

As part of the RSP process, the Subscription Manager Data Preparation (SM-DP) securely prepares eSIM profiles and stores them awaiting provisioning to the eUICC. Preparation includes the encrypting of profiles using digital certificates. The separate SM-SR entity performs the actual over-the-air transport of profiles.

Subscription Manager Secure Routing (SM-SR)

As part of the RSP process, the Subscription Manager Secure Routing (SM-SR) securely performs over-the-air transport of eSIM profiles to the eUICC. The SM-SR entity complements the separate SM-DP, which is responsible for eSIM profile preparation and storage.

M2MSP

An M2M Service Provider acts as a single point of integration and orchestration between the various functions needed to support the remote SIM provisioning ecosystem. These include eUICC fabrication (EUM), profile generation and personalization (MNOs), secure profile storage and transport, and eSIM profile provisioning actions such as download, install, enable, disable, and delete (SM-DP and SM-SR). In the context of eSIM, Pelion acts as the M2MSP, abstracting the various relationships and interactions, delivering an eSIM-as-a-Service offering.

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