

eUICC / Embedded SIMs A Perfect Future for IoT?

A pragmatic discussion of the issues involved in implementing eUICC technologies.

01

The Embedded Universal Integrated Circuit Card (eUICC)

Traditional and portable 'plastic-mounted' single and multi-network SIM cards remain well-proven and offer few risks if supplied by a trusted, fully managed service provider. It is recognised, however, that they do add material and structural cost to an Internet of Things (IoT) deployment. One instance being that 'physical' SIMs must be exchanged in devices if a new network provider is desired. In widely distributed IoT devices, this is often a time-consuming, costly, and often therefore impractical process.

The embedded SIM ('eUICC') is, therefore, widely seen as the future method for providing more flexible means of connectivity, by enabling the remote changing of the mobile network provider for devices. Promising greater inter-operability and selection of a superior array of network services. Enabling manufacturers and service providers to reduce their device costs or switch network provider depending upon shifting needs or future temporal considerations.

eSIM standards and technologies, however, are not new and while being touted as the solution to IoT connectivity, there remain few concrete examples of true global success for the technology as yet. There are some fundamental reasons for this slow uptake and this paper, therefore, pragmatically discusses the structural, commercial and operational issues to be addressed when implementing eUICC technologies.



02

Traditional SIM Cards (UICC) and eSIM (eUICC)

UICC Traditional or 'Physical' SIM Cards

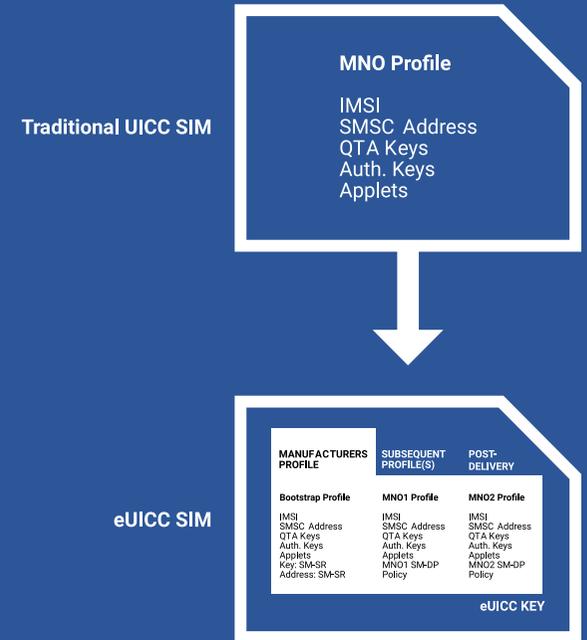
The core functions of the universal integrated circuit card (UICC) standards are to provide the security frameworks for a subscriber identity module; universally known as a SIM card. Providing a choice of size-formats they, if compatible, enable the transfer of UICC SIMs between different IoT devices. Each SIM securely stores the international mobile subscriber identity (IMSI) number, which together with its associated key are used to identify and authenticate subscriber devices and enable them to successfully connect to a mobile network system. SIM cards can also be used to store some device or user information related to security, functionality, or the services available to the device.

A traditional SIM securely holds its specified profile and is encrypted during manufacture. Each SIM also has a unique ID (ICCID), entered on the issuing mobile network's Home Location Register ('HLR'), conferring its access rights and billing. Through commercial negotiations, a single mobile network operator SIM, however, may also be enabled to roam onto other operator's networks, for example when travelling to other countries. Its unique ID being validated and entered on that network's Visitor Location Register

('VLR'). This functionality is widely used within the IoT sector for enabling multi-network roaming. Providing greater geographical coverage and the ability to switch to another network if one is not available.

eUICC eSIM Technologies

The eUICC standards, offer another method of providing this flexibility. Embedded UICCs ("eUICC" or "eSIM"), differ from traditional SIMs, as they enable devices to be remotely provisioned to a new network profile after deployment via remote download. Meaning a manufacturer can apply their original 'bootstrap' profile to a device which is changeable by the customer once received and activated. One operator may also allow another operator's profile to replace their own using a third-party eUICC management system.



03

Deployment of an eUICC Service

eUICC management systems, therefore, provide the capability to transform individual or groups of SIMs from their 'bootstrapped' manufactured profile to another profile or make subsequent changes through the device's life cycle. The simplest instance being the conversion of a generic/standardised manufactured device into a single-network 'native' SIM on its first deployment in a particular country. Providing the benefit of using the network pricing tariffs associated with that local 'native' SIM profile.

When a device with an eUICC SIM is first activated in this new country or region, it attaches to an available local network through its manufacturer's "Bootstrap Profile", which is typically a roaming profile. The bootstrap profile is therefore a critical element as it enables the device to connect from potentially anywhere in the world back to its profile subscription manager on first activation. If the device is able to connect to its profile manager, it will then request a remote download of the local operator profile expected for this location. The eUICC SIM will then receive a new profile which matches the connectivity requirements for that device and its position.

Clearly, this offers significant advantages for IoT device manufacturers and potentially service providers as well. Deploying eSIMs, however, also requires the implementation of an eUICC management platform with the ability to securely download the new SIM profile for each instance that a device is deployed. The device hardware and firmware also need to form an intrinsic part of the management of the communications and the transferring of profiles. Requiring development, integration and testing to prior to live deployment into the field.

The effective implementation of eUICC technologies, therefore, requires a complementary series of activities involving; device manufacturers, network operators and service providers to integrate the service. Processes potentially complicated if the IoT device is bespoke or designed independently around a specific application.



04

The Benefits of eUICC SIMs to Device Manufacturers and IoT Service Providers

eUICC SIMs have long-term benefits for IoT device manufacturers and service providers. Offering several benefits over traditional SIMs, which are expanded here:

1. Improved Device Design:

Even the smallest format SIM cards such as the “nano” require extra space on the printed circuit board (PCB) to accommodate a push-fit SIM holder. Adding to the cost of manufacturing and creating further steps in the production process. For applications where devices can benefit from further miniaturisation or battery optimisation, eUICC therefore offers the possibility to advance and improve designs. Obviously, no SIM holder is needed, and more integrated circuits can help improve power efficiency and reduce battery drain. Prolonging the cycle time between maintenance visits and reducing the small chance of contact breakage for the most extreme environments or use cases.

2. Reduced Inventory

Traditional SIMs require manufacturers to segregate stock for each customer, country, or region. eUICC offers the possibility of streamlining stockholding and thereby reducing procurement complexity. Providing the possibility of utilising a standardised chipset across product-lines. Devices with eSIMs subsequently being ‘localised’ to a network profile once deployed.

3. Reduced Post-Production Handling

eUICC reduces the likelihood of re-handling processes or retrofitting SIMs post manufacture. An activity often undertaken by IoT service providers wishing to install SIMs of their choice. Pertinent, however, also for those devices where retrofitting SIMs is impossible post-manufacture. For example, due to the device being hermetically sealed for security or environmental protection as part of the manufacturing process.

4. A ‘Free-Market’ for Connectivity:

eUICC offers the possibility of creating a ‘free market’ for IoT connectivity services. Providing the means to switch Mobile Network Operator (MNO) or Mobile Virtual Network Operator (MVNO) provider profile during the life cycle of the device or service. Meaning service providers can seek ever better deals on their connectivity from competing network providers.

The Benefits of eUICC SIMs to Device Manufacturers and IoT Service Providers

5. Risk Mitigation & Future Autonomy:

IoT deployments require the planning and deployment of devices which can become dispersed and more difficult to manage as the population grows. The ability, therefore, to deploy a technology now, which offers the promise of autonomous decision making and flexible future connectivity plans is therefore an attractive proposition.

6. Operational Control of Connectivity:

eUICC enables IoT service providers to modify the connectivity profile of devices based upon their function and setting. In theory, meaning devices can be grouped so that they are allocated the optimum network profile, or enjoy the cost and service benefits resulting from being registered as a 'Home' and not 'Visiting' SIM.

7. Roaming into Difficult Regions:

Some countries and individual mobile network operators restrict permanent roaming of devices. Either due to government policy or in the case of particular MNO's, to restrict devices or signalling traffic using a competitor's roaming services on their network. The ability to switch network profile offers the possibility to react and circumnavigate cases where such circumstances exist or appear.

Counter-Perspectives of the Mobile Network Operators (MNOs)

Mobile network operators invest significantly in their infrastructures, and must therefore balance revenues, demand for services, network capacity with service levels. Low data forms of IoT with their low Average Revenue Per Unit (ARPU) has many attractions for MNOs but also some down-sides. As an example, IoT is a high-growth market and provides opportunities for MNOs to grow or further commercialise important relationships with major corporate clients. Generating other accruals from high-profile relationships; or fashioning ongoing revenues from very large-scale deployments with the expectation of extremely low churn rates.

Most IoT deployments, however, require a multi-network roaming solution to provide the geographical coverage needed for such dispersed devices. Providing, also, higher operational service levels by remaining connected during an individual MNO's local, core or national-level service fluctuations. This, as well as the need to manage device connections and SIMs remotely, makes the IoT sector a major, but specialised area of the mobile industry. Requiring, trusted and expert solution providers (such as Caburn Telecom), to ensure these important services are delivered reliably, securely and effectively.

Market structures within the Mobile Industry and between MNO's, however, means the advent of eUICC presents both opportunities and threats for each operator. Providing the possibility of attracting greater market share, but also threatening existing client bases. eSIM potentially relinquishes a MNO's complete control of secure access to its network. Their tightly held security credentials would need to pass through third-parties or be administered by eUICC management platforms. This is important, as these credentials must not only be technically secure, but remain within the jurisdiction of the MNO. Usage of their network infrastructure usage remaining privileged and requiring concrete commercial agreements to be fully in place which permit forms of devices and their traffic profiles. Typically, being ones that are attractive to the network operator, through their reciprocity or revenue profiles. Having characteristics which act to conserve their infrastructure/assets, do not infringe their intellectual property or significantly weaken their competitive position. In the multi-network or roaming environment, these relationships are more complex and require separate commercial agreements, particularly for those devices which are classified as IoT and not consumer products.



Mobile Network Operator (MNO) Perspectives [continued]

The strategic risk to MNO's of implementing eUICC across the whole IoT industry, consequently, remains a significant constraint on the wholesale adoption of eUICC for device manufacturers and IoT service providers. Whereas, the principal consumer smartphone or vehicle manufacturers/brands have the loyal consumer bases and bargaining power to drive MNO's adoption of eUICC via the need to connect those ubiquitous devices to their network; sharing in the brand association and retail activities which attract major, global commercial revenues and help conserve their competitive position through long contracts; large, medium or niche IoT users, or those requiring multi-network services, as yet do not. Individually lacking the ability to pressure major MNO's into releasing their credentials to untrusted third parties, which might enable the MNO's profiles to be replaced by competitors or other 'unfriendly' regional operators.

In terms of matching or overcoming roaming SIMs as the 'de facto' standard for IoT, resistance by MNO's, excessive start-up costs, a lack of multi-network capability, inter-operability and transferability of profiles have proved barriers for the technology so far. As eUICC represents the future direction of the industry, however, there is the need for MNO's to invest in eUICC systems and the commercial relationships which enable the technology to be deployed effectively. This is tensioned against the prospect of price-erosion and the

possibility of losing control of the integrity and security of their systems and platforms. eUICC, if unconstrained, loosens their grip on their key corporate customers and a sense of ontological control towards the future means of access to their network; whether direct or via trusted channel partners. Meaning, unsurprisingly, many operators will attempt to keep this within their grasp as much as possible, unless there is a compelling and strategic reason to divert from this tacit strategy.

MNOs, however, also recognise that eUICC also provides opportunities to develop and grow their businesses and provide new and enhanced services for clients. MNOs are therefore increasingly seeking to utilise the benefits of eUICC technologies where they offer tangible competitive advantage. For example, where there is opportunity to build new high-growth relationships and uses of IoT, the ability to build in flexibility and service enhancements, or as a method of deploying multiple 'in-house' IMSI profiles for certain clients. Currently, many are achieving this by creating new bi-directional alliances with complimentary MNOs; to allow new forms of single-network access for their partners and clients in new regions or emerging markets at a lower cost than a roaming SIM. Others are considering providing flexible services by enabling multiple IMSI's of their own network profiles, to provide enhanced services for trusted channel partners and their clients.



eUICC - Practical Considerations for IoT Service Providers

In summary, there remains several issue and constraints which must be considered prior to the deployment of eUICC:

Limited Availability of Networks & Coverage:

As discussed, due to the market structures and competitive aspects within the mobile network industry, a free market for eUICC SIM profiles does not yet exist. Indeed, the choice of mobile operators whose SIM profiles are available for the purchaser to consider post-manufacture remains dictated by the commercial relationships between the eUICC SIM provider and the MNO infrastructure providers. Indeed, most major MNOs have so far made their eUICC SIM 'IMSI' profile available only to their most trusted and selected partners such as Caburn Telecom, and in some cases to none.

Currently, eUICC therefore offers a limited number of operator profiles. Typically, a multi-network 'bootstrap' IMSI profile, and a limited selection of single operator profiles (usually - one per country where available which limits their scope, affordability and types of suitable use cases).

Costs of Service in IoT Multi-Network Deployments:

What many fail to realise is that eUICC deployments incur license fees. This is typically for the cost of the eUICC license, but also for every subsequent intervention or reconfiguration. This can mean that the cost of eUICC is higher than the use of a traditional SIM through the life cycle. Additionally, use of a bootstrap multi-network IMSI typically incurs high data charges, and may be used as a fall-back where no local IMSI is available.

Device Compatibility:

Implementing eUICC capability, requires application of the eUICC standards on the device itself, which is expected to form part of the communications and management process. Many IoT devices are still in the exploratory or development stage of implementing these standards and have not been tested in a live setting.



eUICC - Current Opportunities for IoT Service Providers

Despite many MNO's understandably guarding their competitive position, some are now brokering bilateral and reciprocal arrangements. These deals, however, still seek to control and limit the choice for the IoT service provider, involving certain prohibitions and constraints. Nonetheless, they can provide benefits which should interest some of Caburn Telecom's existing and new customers in some regions and for some use-cases.

Those devices requiring roaming between multiple major networks in every key country or region, complete with the requisite; bootstrap profile, MNO profiles and exchange agreements, however, are unlikely yet to be suitable for an eUICC SIM deployment. Offering important practical, operational, or commercial deficiencies when compared to a traditional SIM with roaming profile. It is therefore critical for the SIM purchaser to understand which network operator profiles are on offer, which networks are covered in each country by those profiles, and what the real processes and costs are to switch between them are before embarking on this course for a deployment. If this is not fully explained, then it is possible for IoT service providers to become more locked-in or constrained than they would be with a traditional service.

The opportunity does exist, however, for IoT service providers to build new revenue streams and evolve their business via eUICC. For example, Caburn Telecom are working with several clients to deploy eUICC services either in areas where roaming is not a viable option or where there exists a significant reciprocal opportunity. We are also working with several of our specialist service providers to garner the benefits of eUICC in providing innovative new product features. MVNO's such as Caburn Telecom, being in a stronger position to aggregate demand for our clients in bringing eSIM solutions to the market by leveraging our large installed base and close relationships with the major Mobile Network Operators.



10

eUICC - Discussion

Although the eUICC SIM is a simple concept and has been in the realm of mobile standards and subsequent industry conversations for some time, global standards are still evolving. Market structures and forces mean not all MNO's have fully established their position or how they will deliver specific solutions within their

infrastructure and client ecosystems. The cost and complexity of the management systems required to deliver effective eUICC performance means that, unless an enterprise is looking at a solution where building and managing the technology themselves can be justified at scale, MNOs or MVNOs such as Caburn Telecom are

needed to provide this service to ranges of customers. Of course, the enterprise CIO / CTO considering adoption of eUICC is still faced with a familiar choice of Build vs Buy, and Independent vs Large Scale Provider. Each having its associated benefits, costs and constraints:

	Bootstrap coverage 	Available Profiles 	Set Up & Mgt. Costs 	Speed to Market 
Build your own	Dependant on Profile	Low/Individually Negotiated	High	High
Independent MVNO	Dependant on Profile	Dependent on MVNO Negotiation	Low	Low
Global Operator Alliance	High	High	Low	Low

eUICC - Discussion

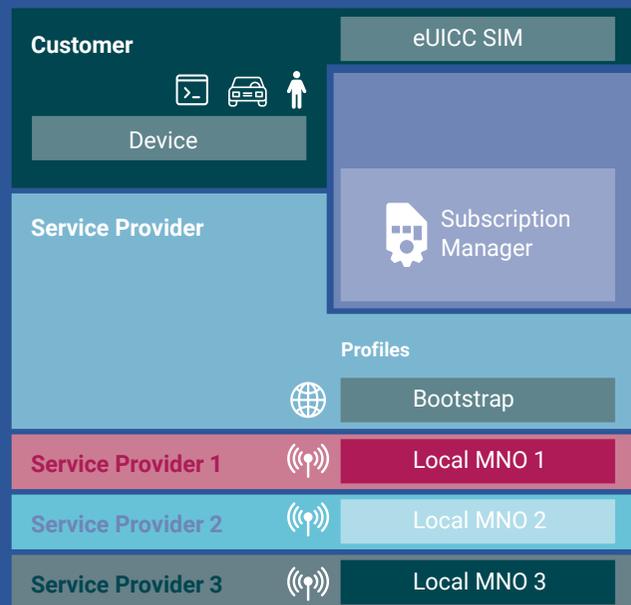
eUICC can, however, be implemented in several ways and in structures that emphasise integrated 'in-house' elements or by positioning via strategic partnerships.

Service Provider Led



For instance, the whole eUICC system and process can be provided as a service by a specialist eSIM Service Provider; being rapid to set up and simple to operate. The downsides being that the Service Provider will own the MNO relationships and therefore the client risks vendor lock-in.

End-User Led



Another approach is where the whole eUICC system and process is built and managed by the end user company. This provides full control of all elements of the platform and greatly reduces the chances of vendor lock-in. All connectivity profiles, however, must be individually negotiated with network operators and requires major upfront investment in systems and a large ongoing management overhead.

eUICC - Discussion

Deploying these technologies, however, still requires the full engagement with mobile network service providers to advise on the integration of the technology within the device selected and the use-case scenario. A failure to understand the technical implications and the broader mobile network and system interactions, can cause subsequent issues which could limit service availability or cause further delays and costs. Further, the choice of available MNO eUICC profiles at present is often limited. Despite heavy promotion, many MVNOs remain evasive in specifying which operator profiles are provided

with their eSIM solution. This is with good reason, as to date there are few, if any solutions that deliver on the promise to put the power in the hands of the end user in selecting freely from a wide range of operators in every country. This is largely due to the major Tier-1 multi-network providers not, as yet, wishing to release their profiles to third parties, unless there is a specific and strategic need to do so. This means that many eSIM offerings, risk a lower subset of multi-network features at a higher cost than other SIM solutions.

Conclusion

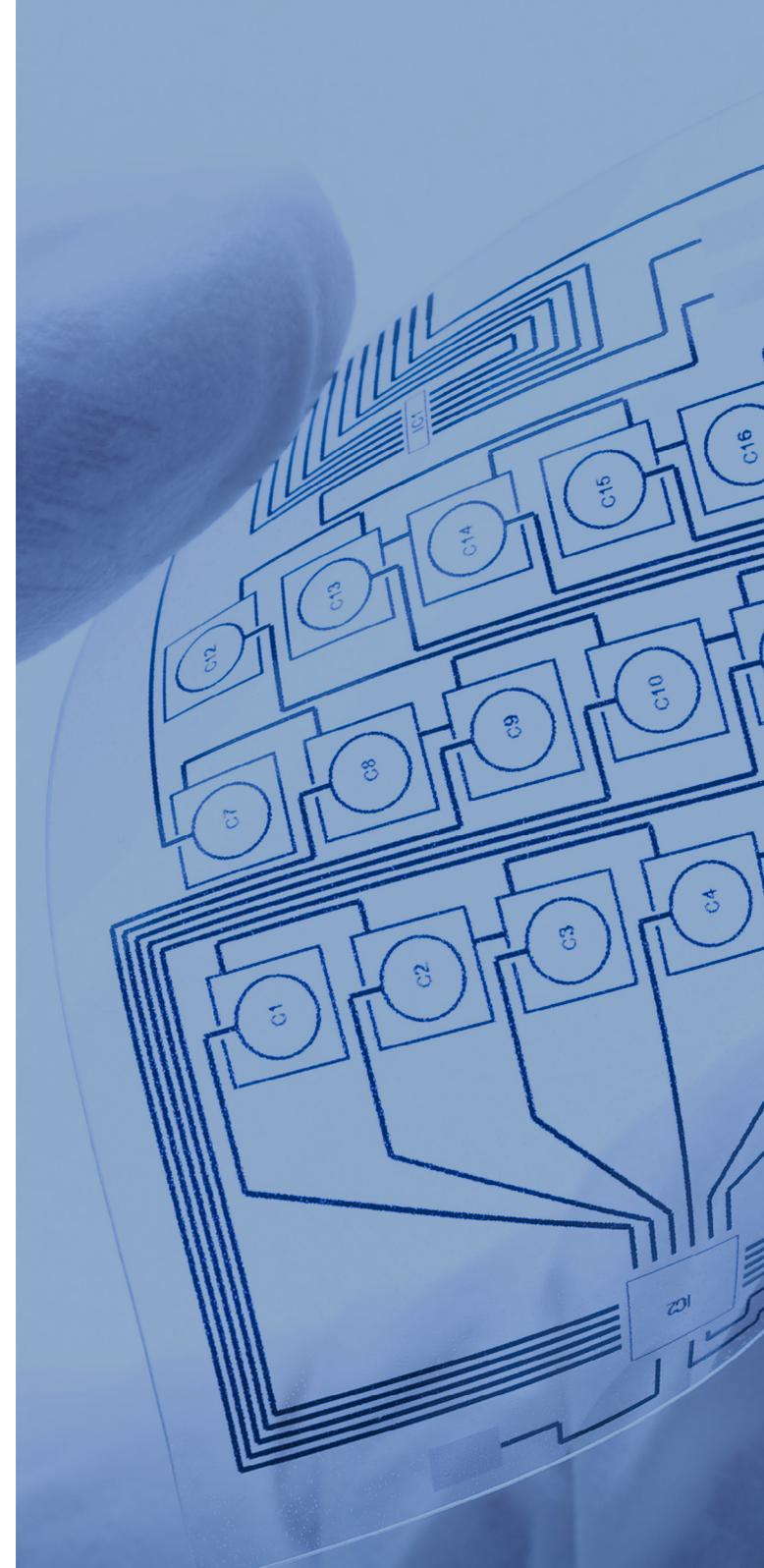
Ultimately, whether to adopt eUICC will depend on the scale, nature, and timing of each enterprise's requirements as well as the underlying mesa and macro structural forces that exist in a region for the principal mobile operators. In the short-term, enterprises may incur additional costs and a reduced set of network roaming pathways if they adopt eUICC. There are, however, regions and use cases where eUICC has justifiable benefits.

For example, Caburn Telecom are actively deploying eUICC solutions now, where there is a clear need to do so. Working with our Tier-1 partners to provide network solutions in difficult regions or where a full range of multi-network capability is a lesser requirement. We are also working with our partners on new applications for eUICC solutions which solve certain client problems within specific IoT sectors.

Due to the added costs of eUICC, both in terms of license fees and charges per profile intervention, enterprises who adopt the technology may not immediately experience a short-term payback. In the

longer term, those who intelligently and selectively implement eUICC solutions based upon benefits to the client's, while considering the needs of MNO's, will help develop eUICC market adoption. Meaning clients will be better placed to take advantage of the full range of benefits that the technologies can ultimately deliver; a vibrant market where eUICC solutions free-up IoT service providers to selectively develop their roadmap for their devices and fully integrate optimised forms of connectivity.

Caburn Telecom are, therefore, keen to discuss our current program of eUICC activities and the opportunities for implementing these technologies accordingly with clients. Please contact us at info@caburntelecom.com or via our website if you would like to connect with one of our specialists or experts.



Support

support@caburntelecom.com

0800 246 1521

or +44 1257 543916

Sales

info@caburntelecom.com

0800 246 1578

or +44 1257 543917

caburntelecom.com

UK HQ

Caburn Telecom

Blackthorn House

Skull House Lane

Appley Bridge

Lancashire

WN6 9DB

EU Office

Caburn Telecom B.V.

Weena-zuid 130

3012 NC

Rotterdam

Nederland

USA Office

Hoboken Riverfront Center,

221 River Street, 9th Floor,

Hoboken

New Jersey 07030

Offices In

Singapore

Thailand

Costa Rica (affiliate)

caburntelecom.com

Caburn Telecom Limited

Global IoT Connectivity & SIM Management

