

THE TRUE VALUE PROPOSITION OF THE ESIM

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TATA COMMUNICATIONS



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1. INTRODUCING THE ESIM AND CONNECTIVITY OPPORTUNITY

1.1. The Evolving eSIM Form Factor

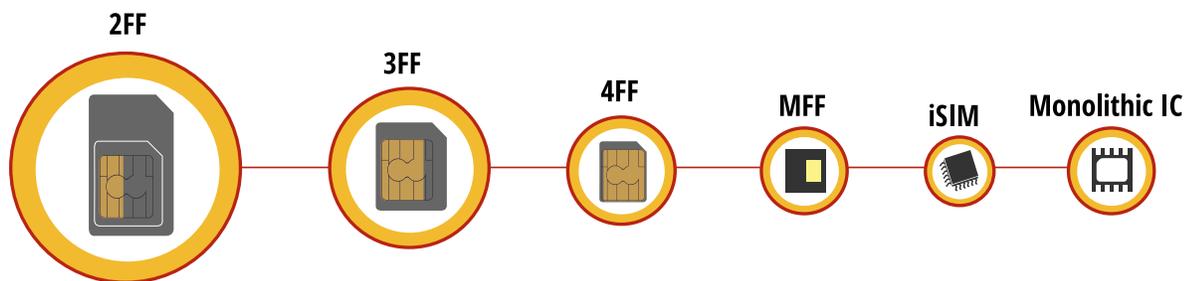
Cutting across a multitude of different device types, covering both consumer and M2M/IoT end markets, the eSIM is a technology that is extremely transformative in nature. The eSIM will change the shape, dynamics, and the entire SIM and cellular connectivity value chain as we know it today, impacting the business models, sales channels, and processes across secure IC, smart card, MNO, MVNO, and OEM ecosystems.

It is also a market that is quickly evolving, not just in terms of creating ecosystem change, but also in terms of form factor. The true value of the eSIM resides in its Remote Provisioning (RP) capabilities, which in turn is providing a digitized platform from which Mobile Network Operators (MNO) can offer new levels of flexibility, simplicity, and

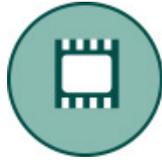
convenience. This, paired with simple and singular price points for data consumption and anywhere, anytime connectivity via guaranteed and reliable connectivity, is creating a powerful connectivity tool, in turn shifting power into the hands of the end user.

It is the RP capabilities that define the eSIM and can be integrated into a myriad of different SIM form factors, covering the different flavors of removable SIMs, MFF, iSIM, and monolithic ICs, designed to offer SIM capabilities alongside other use cases such as secure storage. It is important to note that RP is not a hardware concept, but a software component used to define how operator profiles are delivered and managed on a SIM, regardless of form factors. Embedded by name does not mean embedded by nature.

1.2. The Different eSIM Flavors

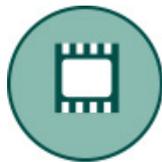


1.2.1. The Standalone eUICC



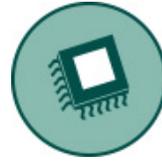
The standalone Embedded Universal Integrated Circuit Card (eUICC) is the eSIM form factor that is utilized in the majority of devices/things today. It is a standalone chipset in either an MFF1 or MFF2 form factor and is physically embedded into a device. Typically, an eUICC will have more memory than a non-MFF form factor (typically a minimum of 512 kb) to allow the storage of multiple operator profiles at any one time. Although today not all MFF form factors support RP, this is rapidly changing alongside the rise of embedded IoT devices and aligned with the standardization work completed by the GSMA covering both M2M and consumer applications.

1.2.2. The Monolithic Chipset



Although a relatively new concept, the monolithic approach refers to an eSIM form factor where SIM functionality is combined with other functions, typically security-centric. Designed to address a combination of mobility and security requirements, this form factor will likely be more suited to feature-rich devices within the high-computing, processing category or within device types where multiple applications are executed.

1.2.3. iSIM



The iSIM is an approach whereby SIM functionality is integrated at the MCU/application processor level, in essence creating a containerized secure location from which operator profiles can be stored and managed. The iSIM is also often referred to as the iUICC. Due to its integrated approach, small footprint, and with functionality integrated into an existing chipset, the iSIM is viewed as a form factor to help bring cellular connectivity to low-end/computing, processor-capable devices and/or those within the LPWA category.

1.2.4. The Removable eSIM



The removable eSIM refers to the traditional removable form factor in either 2FF, 3FF, or 4FF format, with additional RP capabilities. Because RP is not a hardware concept, it is possible to integrate RP capabilities onto a removable SIM. The most notable example of a removable eSIM to date was that of the Apple SIM, originally released in 2014.

1.3. eSIM Devices on the Rise

The MFF form factor initially designed and utilized within the M2M space for applications including automotive was conceived by the requirement for a new physically embedded *SIM form factor capable of dealing with a set of unique requirements/challenges, covering harsh environments where vibrations and high temperatures are common*. Initially a hardened SIM form factor, additional functionality was added, with the ability to remotely provision and manage SIM profiles Over the Air (OTA). The eSIM concept was designed to help automate systems and provide a solution whereby operator switching was possible in new applications where physically switching/replacing the SIM was not possible, particularly in devices/things located in remote, unsupervised areas.

Although originally designed for the M2M domain, and more specifically the automotive space, the rise of the hyper-connected world has brought with it new opportunities as it relates to the wider IoT. A market once dominated by automotive is now being joined by new M2M/IoT use cases and applications. It not only covers things that are on the move, including asset tracking/track-and-trace, but also fixed location devices where a level of automation is required. A good example is the smart metering market, used to automate meter reading collection to

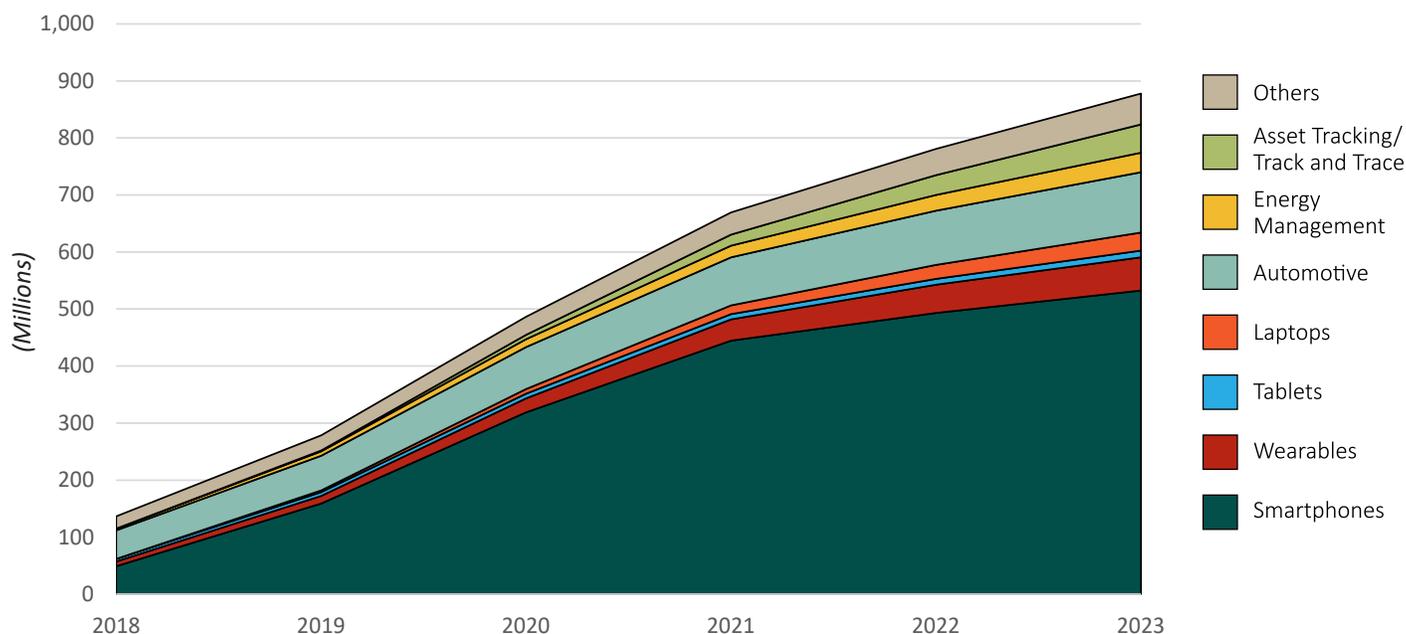
help streamline processes and reduce operational costs, and now additionally to guarantee connectivity regardless of device location.

Fast forward to 2018, and the consumer market has reached a significant milestone, thanks to Apple's inclusion within its XR/S range of devices, expanding beyond the cellular-enabled Apple Watch that the firm previously offered. This movement, paired with significant work and partnerships in the market, such as the strategic partnership between Microsoft and Qualcomm to enable cellular laptops, is creating a diverse consumer market where cellular is touching upon multiple device types. In turn, the consumer market is shifting to one of the cellular device families whereby sharing data across that family is becoming possible using RP to switch profiles securely from one device to another, a concept relevant for both consumer and enterprise applications.

1.3.1. eSIM Is on the Rise: The Primary Applications

ABI Research has been tracking the eSIM market for more than 8 years, covering the M2M market and the more recently emerging consumer devices segment. Table 1 outlines ABI Research's forecast expectations for eSIM device shipments across both M2M and consumer applications for the MFF1 and two form factors in standalone eUICC or monolithic form, alongside the iSIM form factor.

Table 1
Total eSIM Shipments by Device/Application
World Market Forecast: 2018 to 2023



Source: ABI Research



Asset Tracking/Track-and-Trace:

Overall, the asset tracking market is one of considerable diversity, cutting across multiple end markets and industries. High-value field assets required to ensure continued enterprise operations as well as containers/pallets to help track and trace items and in some instances used to provide further accuracy within supply chain and inventory management applications are primary drivers. Current examples where cellular connectivity is being used within an asset tracking or track-and-trace application include ThinkRace GPS tracking, Flex cargo tracking, UlikeKorea livestock tracking, Trimble for vehicle tracking, and CalAmp for asset tracking. Not only cutting across a variety of end verticals, but the ability to

alongside cellular LPWA technologies to address lower value, computing and processor-capable devices will see the eSIM asset tracking market grow from 1.6 million shipments in 2019, to near 50 million in 2023.



Energy Management:

Significant movement in the energy management sector is already evident with smart meter initiatives already well established, including the Indian pre/post-paid electric smart metering project as one key example, paired with significant metering migration projects at various stages of completion in Sweden, Belgium and the Netherlands. Although not all projects are using an eSIM form factor today, the eSIM is a natural connectivity evolution to ensure guaranteed connectivity even in rural areas, without

the need to physically replace the SIM. Tenders for eSIM smart meters have already been released, and it is ABI Research's expectation that these tenders will translate into significant volumes, moving the market from shipping 7.5 million units in 2018, forecast to exceed 34 million by 2023.



Automotive: With the eSIM specifically developed with the automotive segment in mind, it comes as no surprise that automotive dominates the early stages of the forecast period. The automotive sector received a significant boost in the wake of the eCall initiative, requiring all consumer vehicles within the European Union to integrate an eSIM in order to automate communication to emergency services in the event of an accident/emergency. Automotive eSIM shipments stood at 50 million in 2018, but the ability to utilize the eSIM for OTA firmware updates to help reduce product recall, as well as for infotainment purposes and for V2X via 5G for vehicle-to-vehicle and vehicle-to-infrastructure communications in future autonomous, ride hailing, safety, and smart city applications will help grow shipments to levels exceeding 105 million units in 2023, as the market moves from a singular to dual eSIM inclusion to address a combination of eCall, OEM, and consumer functions.



Laptops: In the short term, low-level cellular shipment numbers for eSIM-enabled laptops are expected, but moving forward, Microsoft, with a clear strategy of selling cloud services, looking to seed the market with cellular-enabled laptops, and its always-connected PC program, will drive the market towards the 8 million mark by 2020. In addition, the wake of 5G and strategic targeting by Qualcomm alongside a closing in the price differentiation between Wi-Fi-only and cellular variants is expected to provide an additional market boost from 2022.



Tablets: eSIM tablets are already available, with today's market primarily driven by Apple's cellular-enabled iPad Pro, alongside Amazon's cellular range of Kindles. As MNOs continue to move to shared device subscription packages, enabling the use of a single subscription agreement and sharing across multiple devices, and as the cost of Wi-Fi and cellular tablets closes, shipments of eSIM-enabled tablets are forecast to grow to 11.4 million by 2023.



Wearables: Outside of tablets and laptops, wearable devices are where the eSIM started from a consumer perspective, with the first device, the cellular-enabled Samsung Galaxy S2 smartwatch, launching in 2014. Moving forward, Apple introduced a cellular-enabled smartwatch in 2017, its LTE series 3 device and the release of its eSIM-enabled XR and S range of smartphones in 2018, which further stimulated demand for its new cellular series 4 watch variant. The wearables market is considered one of great diversity, not only being dominated by vendors including Apple and Samsung, but also including other new innovative startups such as the doki smartwatch. In addition, the wearables opportunity will not be limited to the smartwatch form factor, encompassing wearable cameras, headphones, sports and fitness trackers, and smart clothing, which will help grow eSIM-enabled wearable device shipments from 13.4 million in 2019, to more than 58 million by 2023.



Smartphones: Although Google launched the first eSIM-capable smartphone in 2017, it was arguably the release of the Apple XR and S range of devices that marked the significant milestone, moving the market to one in the supply of a few million units towards a market capable of shipping in excess of 200 million annually.

Other OEMs are expected to follow and begin supporting eSIM in their respective flagship handsets, most notably Samsung and Huawei, which by 2023, will generate eSIM smartphone shipments in excess of 500 million units, representing just under 30% of the total handset market.



Others: The others category encompasses multiple other end device types, spanning a multitude of end markets within the overarching consumer, industrial, and M2M categories. eSIM will be used to address not only other “things” on the move, but also fixed-position devices. Primary markets within ABI Research’s others category include other transport, covering fleet management applications, public mass transit such as trains and subways as well as planes, banking and retail for ATMs, POS and kiosks, healthcare, portable gaming devices, connected toys, speakers, industrial grade modems, and routers and gateways, to name but a few. Outside of fleet management, ABI Research believes the others category will remain largely a niche low-level volume opportunity in the short term, but a market capable of growing towards shipments levels of 54 million annually by 2023.

2. THE ESIM: TRANSFORMING CONNECTIVITY AND DRIVING DISRUPTION

2.1. RP Drivers and Beyond RP Capabilities

Although it is the RP capabilities that define an eSIM form factor and are a driver in their own right, the market drivers are not limited to RP and the ability to seamlessly and remotely switch operator profiles on a digital platform. Alongside this is a host of other driving forces that can be split into three main categories, although there is some crossover, covering operational efficiencies; remote management and automation; and enterprise strategy, ambitions, and competition as outlined below:

2.1.1. Operational Efficiencies

- Reliable and cost-effective connectivity, simplifying processes, and creating cost efficiencies related to network issue identification and resolution
- Accelerate time to market, reduce complexities, and break down barriers as it relates to the creation of multiple MNO partnerships
- Enable the formation of MVNOs without the need for capital infrastructure investment; the eSIM can enable access to new end markets and verticals, which in turn will increase connectivity competition and pricing for end users

2.1.2. Remote Management

- Connectivity platforms can be combined with other technologies such as AI to enable real-time decision-making, creating new levels of autonomy and automation, in turn reducing costs and creating efficiencies

- Remote monitoring, critical in applications where safety and/or maintenance are required, particularly in remote, unsupervised locations
- Improve device/thing visibility and control, becoming increasingly more important as the IoT moves into the millions/billions of devices, using cellular to manage fleets of things
- Simultaneously manage and monitor devices within a fleet in real time

2.1.3. Enterprise Strategy, Ambitions, and Competition

- Requirement for high quality, guaranteed, and reliable connectivity to improve service and user experiences
- Increasing requirement for data on a borderless scale to enable global expansion strategies
- Rapid scalability to allow enterprise to execute on global expansion strategies
- Expansion into new markets via already agreed connectivity price points that are operator-agnostic, eliminating the risk of operator lock in, while aiding in global product launches and simplifying the user experience
- Connectivity is changing the way that people manage, interact, and engage with their things and also how businesses interact with their end users; enterprise needs to embrace this digital transformation in order to remain relevant
- Mobile startups now have the opportunity to disrupt the traditional MNO status quo, putting them on a level playing field

2.2. eSIM Adoption Driving New Digital Transformation Connectivity Requirements

Any technology that is transformative in nature will ultimately create some level of disruption. It is digital transformation that drove the development of RP to address a specific use case for applications operating in harsh environments and/or unsupervised areas. However, it is not just the RP application that is driving disruption, but also the other aspects related to eSIM, including life-cycle management and the ability to provide OTA updates, paired with the fact that it is a platform that simplifies the way in which MNOs are chosen and how subscription packages are consumed.

In turn, and with the rise of the IoT, new connectivity demands are being forged as device OEMs, service providers, and enterprises look towards the IoT opportunity, paired with cellular connectivity as a means of expanding operations on a global scale. This requires reliable and scalable connectivity solutions in order to execute on such strategies, using an operator-agnostic approach to enable cross-continent connectivity.

These new demands are driving a shift away from traditional connectivity routes and partnering with local MNOs, towards partnering with connectivity providers that already have well-established local access agreements to maximize connection quality, flexibility, and overall simplify the route to cellular connectivity enablement. This shift will ultimately place more control into the hands of enterprises, providing optimum visibility and giving enterprises the opportunity to essentially become MVNOs themselves.

Connectivity choice is also addressable via RP capabilities, and contributes to achieving operational cost efficiencies, letting enterprises harness already established and pre-priced agreements to ensure the optimal connection regardless of location. In summary, connectivity flexibility, choice, simplicity, and reliability are the new must-have features in order to serve the appetites of enterprises looking towards digital transformation in order to realize new missions relating to global expansion, automation, accuracy, and creating operational cost efficiencies, while ensuring guaranteed and reliable access to connectivity-based services.

2.3. Market Models and Connectivity Routes

The traditional market model has been to agree to a connectivity arrangement with an MNO (typically a local MNO) for a select period of time, buy data in bulk at a set price, or go pre-paid via pre-defined data and voice price points. In this respect, not much will change with the transition to the eSIM, although a shift is likely, with more emphasis being placed on the access and wholesale side of traditional operator businesses as enterprise looks towards connectivity players with near-global coverage and RP capabilities used to ensure optimal connectivity regardless of location.

Flexibility, simplicity, and seamless integration and activation will be key components to success, which will lead a shift towards borderless cellular “connectivity-as-a-service,” where global connections will push connectivity demand towards those vendors with already pre-existing/defined agreements with MNOs. Paired with a service/platform, this shift will not only reduce the need for in-house infrastructure investment, but will also reduce the requirement for in-house applications and services related to billing, promotions, and other value-add services.

The localized nature of traditional MNOs is somewhat constraining enterprises that want to take advantage of digital transformation on a global scale without the need for significant infrastructure investment, where enterprises need to avoid unreliable, limited coverage and complex roaming agreements. The eSIM is a platform from which enterprises can take advantage of globally established MNO agreements, significantly simplifying the route to cellular connectivity enablement, while giving more control and visibility via complementary platforms and services.

2.4. From Shipments and Hardware, to Platforms and Services

With the rise of the hyper-connected world, the way in which data and connectivity is consumed and, more important, where it is consumed is shifting. But this shift is not only being driven by already well-established multinational organizations, but additionally by local enterprises that wish to extend and broaden their reach outside of the local market, using cellular connectivity as a route to operational expansion. This opens up potential for new revenue channels via the creation of

complementary platforms and services, paving the way for a shift in market dynamics, which was largely dominated by hardware revenue generation, and is now pivoting towards a recurring revenue model via new and innovative subscription services, thanks to the RP capabilities that open up the “connectivity-as-a-service” opportunity.

As already outlined, it is the RP capabilities that can open up this opportunity, but the advantages are not limited to profile-switching capabilities and the associated revenues attributed to subscription management. New management and life-cycle services via dedicated platforms designed to enable security access and OTA updates, new levels of automation, near real-time decision-making processes, and new levels of visibility are all additional benefits from which enterprise can benefit.

In turn, this has shifted the goal posts, with connectivity vendors and those operating within the cellular ecosystem pairing hardware-based components with additional services and platforms. The goal is to enable an agnostic approach to cellular connectivity in a simple and flexible manner.

It has also opened the door to MVNOs, which via RP platforms can compete against large incumbent local MNOs, without the need for significant infrastructure investment and in some instances without the need for significant software investment, driven by the “cellular-connectivity-as-a-service” offering being delivered by vendors such as Tata Communications.

3. CASE STUDIES

3.1. Introducing the Case Studies

As part of the research preparation phase, ABI Research conducted a case study questionnaire process with two companies, Infineon and Linksfeld, relating to the benefits of RP. The following case study answers were in direct response to the questionnaire put to the respective parties representing Infineon and Linksfeld.

3.2 Infineon



Infineon Technologies is considered one of the world leaders in the supply of semiconductors. Headquartered in Germany, Infineon addresses multiple end markets via the development and supply of chipset solutions to address specific markets, covering automotive, cellular infrastructure, commercial, construction and agriculture, consumer, data processing, Industrial, LED lighting, motor control, power supply, power transmission and distribution, smart card and security, smart home, solar and wind energy applications to name but a few.

Separately, Infineon is one of the leading suppliers of smart cards and secure ICs, having a significant and historical presence in the supply of secure elements used across SIM, payment, government ID and ticketing applications. Its eSIM product portfolio falls under the smart card and secure IC umbrella of products and Infineon is using its established market presence and expertise in the supply of traditional removeable SIM cards to develop and provide solutions for the more recently emerging eSIM market.

3.2.1. What applications are you targeting with your eSIM product portfolio?

Infineon is targeting a myriad of applications and end market verticals, across consumer applications, encompassing handsets, wearables, tablets, notebooks and laptops as well as the rising M2M/IoT opportunity. Energy management (e.g. Smart Meter), security management, asset management but also healthcare devices and smart city related applications are few examples of the targeted markets on the M2M/IoT side.

Leveraging 10 years of expertise serving the consumer, M2M and automotive market, Infineon offers an extensive family of high-performance security controllers (SLM37/76/97) which are ideal for operation in harsh conditions inherent to industrial or outdoor environments. These devices can operate over a wide range of temperatures from -40 to 105°C with eSIM able to offer extended endurance and product life time, enabling secure and reliable cellular connectivity for industrial M2M applications. The products fully comply with the eUICC specifications according to ETSI and GSMA and are available in a variety of form factors ranging from the traditional 2FF and MFF2 to miniaturized Chip Scale Packages.

3.2.2. What are the primary pain points & advantages that eSIM is addressing?

Embedded SIMs were initially developed to address specific pain points within the broad M2M/IoT category. By physically embedding and soldering it onto a PCB board, the eSIM was designed to address applications which operate in harsh environments, where a requirement for

additional protection to address vibrations, humidity, temperature and dust was a prerequisite. This was on top of the ability to manage MNO subscriptions remotely, a significant benefit for things operating in remote environments.

More recently, and from a consumer standpoint, the primary benefits are fourfold:

1. *Miniaturization & integration* - The ability to create smaller form-factors to enable the cellular connection of small footprint devices such as wearables.
2. *Simplified Logistics* - OEM and system integrators can now benefit from the global coverage of the temporary bootstrap profile combined with the ability to load operator credentials over the air. With that, one single device SKU can be deployed everywhere in the world.
3. *Freedom and service quality* - A convenient and flexible solution whereby the management of operator services is fully digitized and can be executed Over the Air.
4. *Anti-theft* - Being now soldered on the device, the eSIM cannot be removed and misused.

Moving recently, the eSIM is a solution which can address the convergence between cellular connectivity and security via the development of eSIM products which combine eSE functionality. The combining of functions has the ability to address security at point of manufacture via the addition of secure tamper resistant storage to provide a device root of trust.

3.2.3. What can eSIM achieve/enable from an operational results/ROI perspective?

The eSIM is enabling new levels of digital transformation and the benefits and results can be measured across multiple parts of the ecosystem spanning from OEM, service providers and operators.

Firstly, the eSIM is a standardized solution, and thanks to globally qualified and certified solutions, puts all players on a level playing field.

From a service provider perspective, new business models can be enabled as it relates to digital and lifecycle device management, alongside the ability to further automate systems to enable new levels of operational efficiencies.

For OEMs, out of the box cellular connectivity can be achieved, a significant benefit to smaller OEMs who are looking to expand operations globally via a solution which offers a near borderless connectivity option.

The facilitation of secure OTA updates means that devices can be updated in the field, remotely and without the need for physical inspection which inherently reduces device TCO and can be used to help combat specific devices where product recalls are prevalent.

For startups, the eSIM presents a significant advantage via bootstrap profiles to expand global presence via a solution which offers a borderless connectivity solution.

3.2.4 How/where is your eSIM solution being implemented?

Infineon eSIMs are currently being implemented across multiple application types, having notable success within the industrial and automotive segments.

According to ABI Research, and based on global eSIM issuance in 2018, Infineon's market share was in excess of 40%.

3.2.5 Why did you choose to partner with Tata Communications?

Tata is globally recognized as a reliable and flexible connectivity provider which can offer seamless connectivity solutions, via multiple operator agreements and supporting management tools which are well suited to an eSIM environment which requires out of the box connectivity and ongoing management.

Tata's position, strategic and well-established operator partnerships and platform support via its MOVE solution perfectly fits market needs for eSIM.

3.2.6 Infineon Conclusion

Infineon's market position resides at the inception point of the eSIM supply chain, developing and creating security modules which will ultimately be used to facilitate RSM and RSP capabilities.

Infineon's experience in not only the traditional smart card and secure IC market space but also its presence in the supply of other semiconductor types such as sensors, RF wireless controllers, MCUs, transceivers, transistors and diodes across rising eSIM vertical opportunities including industrial and automotive means that Infineon is well versed in specific end-market requirements. Alongside this is Infineon's security expertise, which it is leveraging to offer monolithic chipset solutions combining both cellular connectivity and security functionalities.

The creation of an eSIM ecosystem is paramount to ensure the continual success of the eSIM and this has not gone unnoticed by Infineon. Secure IC, smart card vendors, device OEMs and operators need to be in sync and aligned to ensure eSIM integration and connectivity enablement is a smooth and non-cumbersome process. Despite Infineon's primary role as a hardware provider, clearly recognized is its responsibility in helping create the required supporting ecosystem to ensure service simplicity and scale, by strategically partnering with vendors which can help reduce restricting market factors and bring to fruition simple cellular enablement capabilities.

3.3. Linksfeld Looking towards the iUICC



3.3.1. Linksfeld

Linksfeld is a leading SoftSIM provider, offering global connectivity and management platforms, with its SoftSIM solution embedded into a device at point of manufacture. Linksfeld considers itself an end-to-end connectivity provider, able to provide connectivity for device vendors, regardless of device type or location.

Part of Linksfeld's portfolio of solutions is its RSP platform enabling remote operator profile switching, using its platform to enable the management, monitoring, and control of the SIM and data usage in real time. Linksfeld is also active within the component space, integrating, via iUICC, into many mainstream 2G, 3G, and 4G cellular chipsets and modules to enable new levels of rapid scalability and connectivity out of the box.

3.3.2. What Is the Application?

Linksfeld's eSIM solution uses an iUICC form factor, integrating SIM or, more important, RP functionality at the IoT communication chipset level. Prior to this, communication cycles involved three components: the SIM card, the chipset, and the network.

In order to identify connectivity issues, Linksfeld engineers had to work on all three aspects. However, with the iUICC, there is no physical SIM, and all SIM profiles are integrated inside the chipsets, thus reducing complexities, with engineers only having to target two aspects, the chipset with iUICC and the network in order to identify and remedy network issues. This

is helping Linksfeld reduce operational costs, while improving visibility in order to reduce service/connectivity downtime.

3.3.3. What Was the Pain Point, and Why Was eSIM the Solution?

Linksfeld began exploring the iUICC in order to eliminate historical issues related to the removable plastic SIMs, in terms of compatibility, contact point, lifetime, and sizing issues. With many IoT devices utilizing low-end chipsets, compatibility of removable SIM applets is a primary area of concern, with 20% of all Linksfeld connectivity issues resulting from applet compatibility issues.

In addition, the contact surface of the traditional removable SIM can get oxidized after some time, which means physically replacing the SIM, which increases operational costs. In addition to the contact surface is a traditional removable SIM's lifespan, which is often less than the device itself, which could be field operational from 10 to 20 years. Lastly, the SIM card occupies a large space, which is not conducive to smaller devices such as wearables, where design space comes at a premium, and the iUICC helps Linksfeld resolve this barrier.

3.3.4. What Is the Role of Connectivity within the Application?

Connectivity plays two primary roles within Linksfeld's iUICC:

- Used in its bootstrap to download operator profiles
- Used for local data transport

3.3.5. How Was/Will eSIM Implemented?

Linksfeld is integrating SIM functionality at the IoT chipset/module level, opting to support the iUICC form factor to enable RP capabilities. Linksfeld has identified a variety of different requirements and implementation types, dependant on chipset, and claims to have development iUICC solutions covering more than 70% of the most popular IoT chipsets.

3.3.6. How Was a Vendor/Partner Chosen?

Linksfeld partner requirements were to identify a partner that fully understands the connectivity requirements within the M2M/IoT space, which it considers to be significantly different from the connectivity requirements within the consumer domain. With a full focus on IoT, Linksfeld sought a partner that could offer a connectivity footprint on a global scale to ensure anywhere, anytime connectivity, regardless of device/thing location.

Working with a partner such as Tata Communications allows Linksfeld to target the growing IoT opportunity, address growing fleets of devices, and provide reliable borderless connectivity, at scale. In addition to this, Tata Communications is well versed in eSIM technology and advancements. Paired with flexible, scalable connectivity, Linksfeld considers Tata to be a partner that can keep up the technological pace that Linksfeld is setting.

3.3.7. What Are the Operational Results Achieved So Far? Is There a Clear Benefit/ROI?

Operationally, Linksfeld has utilized its iUICC in order to lower the costs of connectivity, via the remote management of IMSIs to ensure optimal pricing,

dependent on device location. In addition, the operational costs associated with network issue identification and resolution have been significantly improved thanks to SLAs agreed with Tata Communications, addressing issues including lower latency rates and a wider choice of connectivity options. Tata Communications is helping Linksfeld to not only address global scale, but additionally use its MOVE portal in order to address latency, monitor and control networks, and escalate any network issue to Tata Communications to ensure network resolution is executed in a rapid, efficient, and effective manner.

3.3.8. Linksfeld Conclusion

Fully focused on IoT use cases, Linksfeld is looking to place itself at the center of the rising hyper-connected world, developing connectivity solutions specifically designed to address global coverage and the subsequent requirement for remote management. For this reason, Linksfeld has taken the development path of the iUICC form factor, recognizing the requirement for a reduced footprint solution in order to connect and manage the connectivity of the vast range of emerging IoT devices, some of which are low-cost, small in nature, and/or constrained by low-end processing capabilities, likely to be operational for many years.

By partnering with Tata Communications, Linksfeld now has the capability to simplify connectivity processes and reduce complexities and directly address a reduction in operational costs. Thanks to this partnership, Linksfeld has not only taken advantage of its global connectivity reach, but has also simplified the identification and resolution of network issues using Tata Communications's MOVE portal.

4. APPENDIX

AI	Artificial Intelligence
API	Application Programming Interface
ATM	Automated Teller Machine
eSIM	Embedded Subscriber Identification Module
eUICC	Embedded Universal Integrated Circuit Card
IC	Integrated Circuit
IoT	Internet of Things
iSIM	Integrated Subscriber Identity Module
LPWA	Low Power Wide Area
M2M	Machine to Machine
MFF	Machine to Machine Form Factor
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
OEM	Original Equipment Manufacturer
OS	Operating System
OTA	Over the Air
POS	Point of Sale
RP	Remote Provisioning
RSP	Remote Subscription Provisioning
SIM	Subscriber Identification Module
SLA	Service Level Agreement
SM-SR	Subscription Manager - Secure Routing
TEE	Trusted Execution Environment
V2X	Vehicle to X
vSIM	Virtual Subscriber Identification Module

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