



Unleashing cellular connectivity for IoT applications



TATA COMMUNICATIONS

Published by

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WORLD LIVE

With IoT and machine-to-machine applications set to deliver on years of promise for both consumer and business-to-business applications, vendors and mobile network operators (MNOs) need a new way to coordinate the innovations on offer. A key weapon in their armoury is Embedded SIM, which will enable radical changes in the dynamics of the market around the way connectivity services are contracted and managed.

Embedded SIM

Embedded SIM is an evolution of the physical subscriber identity module (SIM) cards familiar to mobile users since the dawn of GSM. While conventional SIM cards are replaceable, requiring users to swap in order to switch between service providers, Embedded SIM sees a fixed module integrated into the device, with over-the-air provisioning and updating used to enable switching, delivering more flexibility in choice of operator to the end user.

In the machine-to-machine (M2M) market, this approach can offer significant benefits, not least of which is the ability to more easily swap connectivity providers. Networks can be selected after the production, shipment and deployment of connected devices, thus bringing flexibility in choosing the best option for a destination country and taking into account factors including cost, coverage and regulatory requirements.

But as with any new technology, Embedded SIM brings with it challenges, particularly around interoperability and connectivity management. This includes complexities in managing Embedded SIM profiles across different MNOs, as well as with differing approaches taken by vendors in conforming to GSMA standards.

While the flexibility and choice offered by Embedded SIM-enabled cellular IoT can deliver real benefits for enterprises, nevertheless managing multiple IT system interfaces (such as MNO connectivity and device management interfaces), contractual and billing relationships can be an unwelcome additional burden.

Market opportunity

According to GSMA Intelligence figures, at the end of 2018 there were more than 9 billion IoT connections (comprised of cellular and non-cellular technologies), with smart home use cases in the consumer space, and smart buildings and utilities in the enterprise market at the forefront. This is just the tip of the iceberg: by 2025, this number will grow to more than 25 billion IoT connections, with the market opportunity across connectivity; applications and platforms; and professional services topping \$1.1 trillion.

The increasing availability of cellular IoT networks means that technologies such as NB-IoT and LTE-M are set to grow their share of IoT connections, benefitting from the economies of scale and interoperability delivered by standards-based solutions.

As of April 2019, there were 110 commercial networks using these technologies, which deliver low power consumption while benefitting from broad geographic availability – key factors in enabling the adoption of cellular IoT (although it is worth noting NB-IoT does not currently offer roaming capabilities at present, making it less suited to the Embedded SIM business case).

Nevertheless, despite accelerating adoption of IoT and M2M, for the enterprises, which stand to benefit from the adoption of these applications, there are still significant challenges to resolve. For many, it will not be easy to address these issues on their own.

Tough choices

While cellular IoT offers clear advantages as the connectivity enabler for M2M, including cost effective, pervasive and secured connectivity, it also requires choices to be made which will impact the way a device is connected over a lifetime that could be measured in decades. For example, it can be difficult to select a particular MNO at the point of device or module manufacture, because at that stage it may not be known where or how the device will be deployed or used.

Once in the field, it is difficult to change connectivity providers due to interoperability challenges associated with using multiple vendors and MNOs, for example related to network certification or integration with back-end platforms. In addition, devices may be deployed in remote or hard-to-reach locations, posing a costly physical challenge to swap one SIM for another in the event of changing connectivity provider.

Add in the need to comply with regional or national regulatory frameworks, which may impose limitations regarding permanent roaming that effectively mandate the use of a local MNO, and it becomes a significant undertaking to design-in connectivity at manufacture.

While Embedded SIM provides the potential to ease some of the pain-points associated with deploying and managing cellular IoT at scale, it

brings some challenges of its own. It can be difficult to provide a consistent user experience in an environment where multiple service providers may provide connectivity, and companies offering services which cross borders require systems which will work across countries and regulatory environments.

A good example is a logistics company, which needs consistent information on the location and condition of its goods, regardless of where those products are currently. In this case, multiple service providers will be called upon to deliver connectivity to the devices handling tracking, and an Embedded SIM would be required to switch seamlessly between MNOs and be capable of roaming onto partner networks to maintain monitoring.

The same challenges arise in industries such as commercial vehicle fleet management. Research company, Berg Insight, said there were 7.7 million active fleet management systems deployed in Europe alone at end-2017; and, it predicts the number will hit 15.6 million by 2022, representing a potentially huge number of connected IoT devices.

And these are just two examples of vertical markets requiring broad IoT connectivity. Other potential sectors include automotive, healthcare; retail; and smart homes, smart buildings and smart city applications.

Implementation challenges

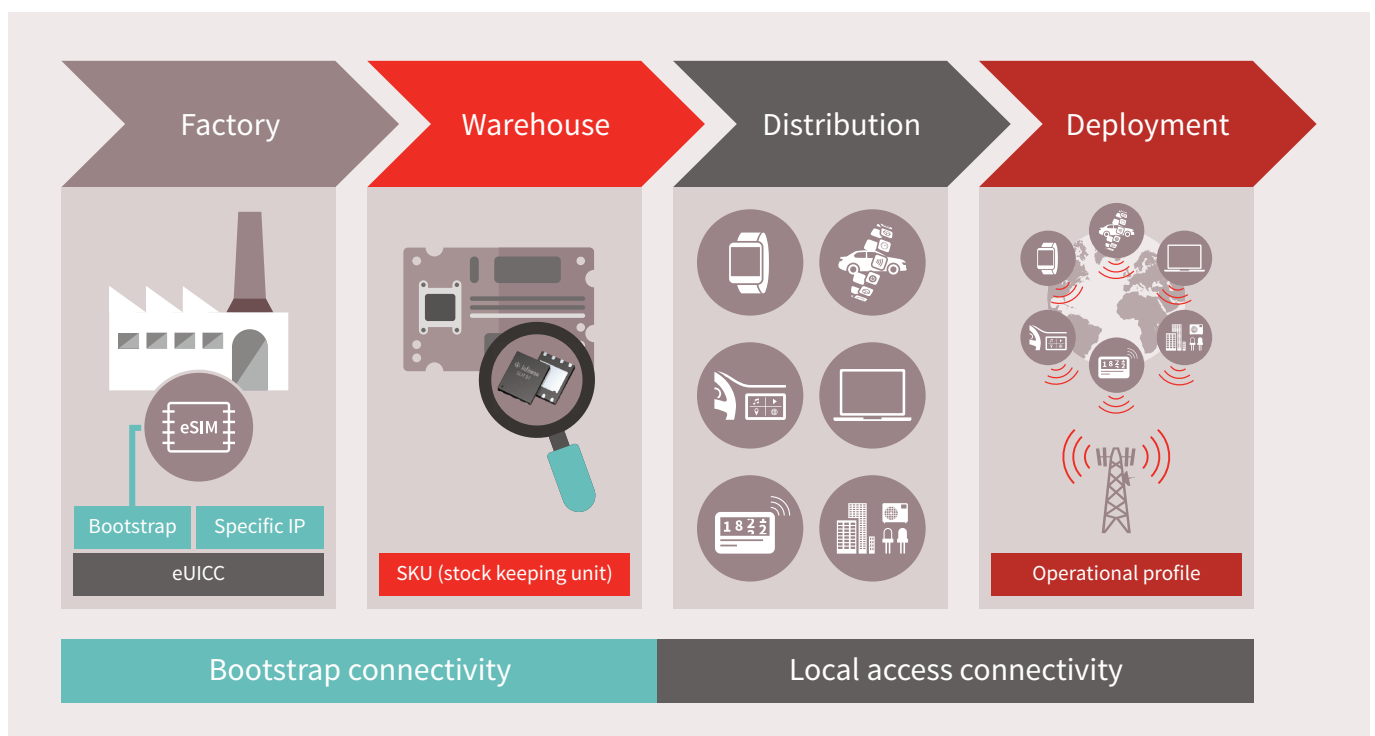
Although Embedded SIM is a standardised technology, a number of issues associated with deployment remain - not least of which is convincing MNOs to implement solutions based on the specifications.

Around a decade of development lies behind today's Embedded SIM standards. This creates a challenge for MNOs who may be unconvinced by the benefits offered for their own business, let alone for enterprise customers operating across diverse vertical markets.

Expertise in managing Embedded SIM may be lacking. While traditional SIMs have typically been configured for a specific terminal, be it a mobile phone or IoT device, MNOs may need to update their systems to enable them to handle a broad range of devices regardless of form factor, to deliver the equivalent level of security and authenticated access to mobile networks provided by traditional SIMs.

Deploying Embedded SIM can also necessitate a rethink of MNO business models, for example in markets where MNOs subsidise devices locked to their network.

Another factor to consider is the impact Embedded SIM may have on module manufacturers. As the industry moves away from a model where SIMs are produced for specific MNOs, the manufacturing business model will also change: it is not unreasonable to expect some consolidation in the sector as a result.



New production / distribution flow for born connected devices

Born connected

There are numerous challenges associated with deploying and using Embedded SIM, despite the clear advantages it offers over the traditional SIM-based approach. Fortunately, leading companies are working on solutions to these challenges, in a bid to enable the true potential of Embedded SIM for MNOs and enterprises alike.

One such approach is being offered by Infineon and Tata Communications. The companies have joined forces to offer a solution that delivers seamless cellular IoT connectivity from the device design phase, through service rollout, to future-proof global operations.

The approach aims to marry the key benefits of Embedded SIM with a set of supporting

technologies to address the key pain-points associated with deploying at scale. It combines Embedded SIM with connectivity to offer customers the ability to deploy cellular IoT enabled devices without encountering the restricting factors that have impeded adoption. This joint solution can be applied to a broad range of devices, addressing connectivity challenges associated with automated subscription and device provisioning; authentication; and device-specific deployments.

The goal of removing complexities is to enable customers to focus on the benefits cellular IoT connectivity has to offer, rather than spending time and money working to resolve compatibility issues, or having to make tough choices at the design stage.

Deployment benefits

Offering a pre-integrated approach to connectivity has the potential to enable equipment manufacturers to deliver products capable of worldwide use, rather than needing to deliver specific versions for specific markets. This offers obvious economies of scale, and cuts costs through simplified product management, with a need for fewer versions of products (stock keeping units, or SKUs).

With the ability to deploy globally, manufacturers can deliver modules for multiple devices regardless of form factor or end-use, opening up the full range of vertical market opportunities, in the knowledge that integration of cellular IoT will not be the major challenge.

The availability of a pre-integrated set of best-of-breed technologies means a significant

portion of the heavy lifting for cellular IoT adoption is taken out of the equation, enabling manufacturers to quickly adopt the technology and reap the rewards. When combined with flexible service assurance, this pre-integrated approach holds the potential to improve time-to-market for customers, while also keeping research and development costs under control.

And in an alternative chain involving hardware manufacturers, Embedded SIM vendors, integrators and connectivity providers, each party is looking to make a profit on their slice of the deal as well as other components built into their solution, meaning multiple levels of margin stacking and ultimately inflated prices. This additional cost is taken out by an integrated offering, delivering a significant benefit for customers looking to embrace cellular based IoT.

Interoperability assured

A pre-integrated solution also tackles complexity around interoperability, for example challenges associated with using multiple Embedded SIM suppliers and hardware module vendors.

Tata Communications MOVE™ - eSIM Hub is designed to address this complexity, bringing benefits such as network independence and SIM inter-operability, alongside reduced cost and complexity, operational excellence and future proofing. It allows businesses to focus on their core strengths, without the need to take on issues such as device connectivity and the management of Embedded SIM interoperability.

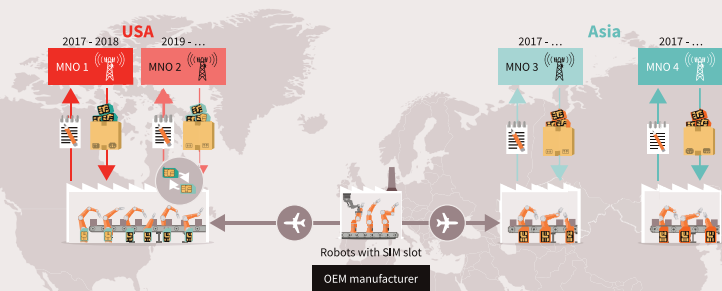
Tata Communications MOVE™ - eSIM Hub offers interoperability across multiple SIM vendors, using a seamless API abstraction layer to allow

access to the major GSMA-certified Embedded SIM providers.

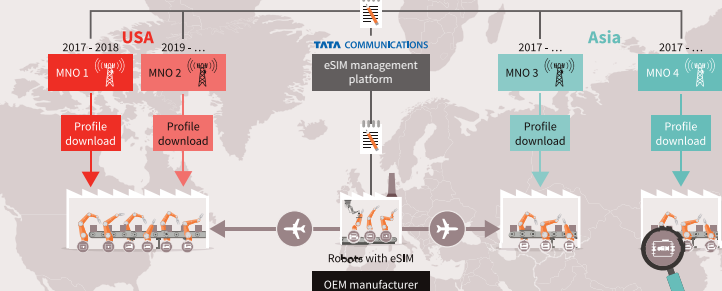
The Hub also provides a connection to Tata Communications MOVE™ - IoT Connect platform, delivering seamless integration of devices in the field with connectivity providers, and to the back-end platforms enterprises use to manage and analyse data.

This approach is designed to address what can be a real burden for companies looking to adopt cellular based IoT connectivity, particularly those that do not have easy access to the right resources. Indeed, for many of the key beneficiaries, the requisite skills are simply not available in-house.

Classic SIM approach



eSIM approach



eSIMs overcome the limitations of conventional SIMs, which include the need for maintenance, the risk of theft, interoperability issues and ongoing integration effort. With eSIMs, OEMs enjoy a wide range of benefits, particularly with the option of a single point of contact for multiple carrier contracts through the services of an eSIM management platform provider.

Best-of-breed cellular

Crucially, Infineon and Tata Communications have also set out to address the core connectivity challenges associated with global deployment of products supporting cellular IoT.

For cellular connectivity, customers will be able to choose from multiple MNO in each market, enabling them to access the optimum services instead of being limited by commercial agreements. This also means support for local or roaming connectivity, enabling compliance with relevant regulatory restrictions around permanent roaming.

Existing MNO agreements can also be supported, for enterprises and manufacturers who already have deals in place and deployments in the market.

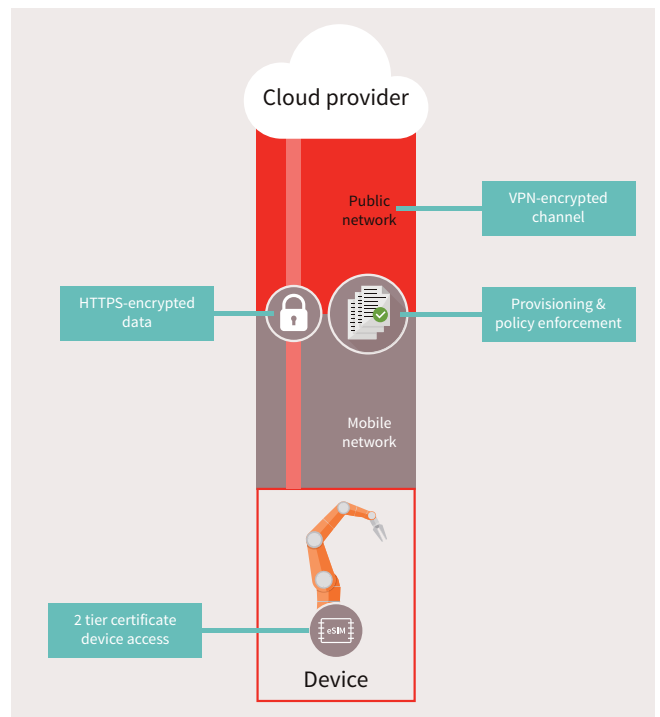
The solution provides access to a globally available IP backbone network, which can offer secured connectivity to public, private and hybrid cloud environments. This opens the possibility of ensuring seamless data transfer from network edge to applications in the cloud.

The Infineon and Tata Communications solution lets customers access a globally consistent service capability, delivered over a virtual global network.

Service solution

The combined Infineon and Tata Communications solution provides enterprises with a pervasive connectivity option, delivering seamless coverage across 200 countries and territories with a single agreement. Achieving this kind of reach by doing deals directly with potentially hundreds of individual MNOs would be time consuming and complex, and comes without the other benefits delivered by the integrated solution.

Remote activation and configuration of devices over-the-air enables a more automated, secured approach to provisioning. This offers benefits both when bringing large numbers of devices online, for example in a smart metering deployment, or when devices have been deployed across broad geographic areas, for example in telematics and fleet management applications. The solution also delivers comprehensive connectivity management from



Provisioning of eSIM with Tata Communications

design through manufacture and deployment, to offer full visibility and control of IoT devices.

But it is not just in this “last mile” connectivity that the benefits are to be found. Devices are connected to applications in the cloud using Tata Communications’ secure, globally deployed IP infrastructure. Cloud connectivity includes access to private cloud or major public cloud data centres – seamlessly and securely. Device-to-Cloud traffic crosses a global private network isolated from the public internet.

This high level of control and flexibility is a key benefit of the integrated Infineon/Tata Communications solution when compared with standard MNO agreements, enabling enterprises to truly tap the potential of Embedded SIM and cellular IoT, while avoiding the trade-offs which have made current deployments complicated and cumbersome.

Hardware features

The hardware element of the reference design builds on Infineon’s proven credentials in providing secured platforms for industrial applications. It uses Infineon’s certified Embedded SIM hardware alongside an Embedded SIM application that conforms to GSMA specifications to deliver an easy implementation path for cellular IoT connectivity.

Infineon has played a key role in the cellular market, supplying SIM chips for more than twenty years – and pioneering the first deployments of Embedded SIMs in the automotive sector more than ten years ago. Today, Infineon delivers a flexible portfolio of Embedded SIM products and personalisation services for consumer, industrial and automotive environments.

The integrated solution enables manufacturers to use the same hardware in products regardless of application or market, enabling them to more easily manage inventory and benefit from economies of scale. By delivering cost savings and reduced bill of materials, this makes cellular IoT connectivity a more attractive proposition, particularly for cost-sensitive segments.

Infineon’s Embedded SIMs are available in different quality grades and form factors, to meet specific deployment requirements. A classic, removable SIM form factor enables existing products to be upgraded, while a solderable MFF2 package is ideal for harsh environmental conditions. Products can operate in temperature ranges from -40 degrees to 105 degrees.

This means the hardware is suitable for a wide range of use cases, again removing a potential barrier for the adoption of Embedded SIM-based cellular IoT connectivity at scale.

And as hardware plays an important role in delivering end-to-end security, Infineon’s Common Criteria EAL5+ certified Embedded SIM hardware is exceeding today’s industry security requirements. This adds an additional level of tamper-resistance including physical attacks, meaning that data can be protected as it is transferred from the device to the cloud – which is especially important for devices that remain in the field for a long period of time.

Cost factors

A critical challenge faced by cellular IoT and Embedded SIM-based implementations is cost. The price of adopting Embedded SIM can add significantly to the bill of materials for an M2M device, particularly when compared with other unlicensed low power wide area (LP-WAN) connectivity alternatives.

Infineon and Tata Communications' approach simplifies the path to market, delivering a simplified proposition that takes cost out of the chain at every stage.

Instead of needing to either buy or build multiple units from multiple vendors to cover multiple regions, the combination of Infineon's hardware with Tata Communications' service enablement stack significantly reduces the number of solutions needed – potentially down to a single, global SKU. This delivers benefits in terms of inventory management and enables benefits through economies of scale, while maintaining maximum flexibility.

Another key factor affecting cost is the challenge of managing multiple MNO relationships. Each implementation means an IT system to manage and pay for, a different commercial contract based on volume, and the need to manage devices across the relevant operators. This requires outsourcing or

resourcing to manage, while still resulting in separate contracts and invoices without the ability to gain an aggregated overview at any one point in time.

And this has a real impact on costs: one customer with four operator relationships cited figures of €500,000 more than anticipated in a single month. Because MNOs have no technical means to communicate with each other for a single shared customer, the customer was not always connected to the optimal provider for a given region and volume was split across operators.

Tata Communications' connectivity proposition aggregates multiple MNOs, with its core intelligence ensuring that the best partner is selected – across both its own pre-selected MNO partners and any a customer also chooses to bring. By aggregating multiple MNOs, the core intelligence also offers a single control point across all devices deployed, instead of having silos of devices and operators.

Using intelligence and aggregation capabilities particular to Tata Communications, OEMs can benefit from gains in operation efficiency and cost control, while still having access to the widest coverage, optimal cost and service assurance.

Security benefits

It is impossible to overestimate the importance of security in the IoT and M2M application marketplace. Indeed, GSMA Intelligence identified securing IoT as “one of the biggest challenges the industry faces,” with the potential to stifle growth if left unaddressed.

Infineon and Tata Communications approach is to blend standards-based security – for example complying with relevant GSMA requirements – with implementation-specific approaches. This brings together all of the ingredients of IoT security, from device to application, via local and global networks and cloud platforms.

This runs from 2-Tier Certificate Control at the device level through to VPN-encrypted channels and HTTPS-encrypted data when crossing public networks, delivering a secured network from edge to cloud (and back) without the need for additional integration work or customised security solutions for each hardware and connectivity option.

This combined with a “zero-trust” silicon-to-cloud hardware-based security feature (creating generic and customer device specific route-of-trust certificates), delivers a complete answer to the current security challenges of IoT deployments.

There are also benefits in the security proposition from a cost perspective. When working with multiple MNOs, cloud providers and/or SIM vendors, OEMs end up paying for basic or advanced security from each partner on the list, increasing costs across the board.

By working with Infineon and Tata Communications, the integrated and aggregated management of security elements means reduced capital and operating expenditure, while still providing access to a full suite of security components.

Key Takeaways

- IoT connectivity is growing fast, supported by a complex ecosystem, with more than 25 billion IoT connections expected by 2025
- Embedded SIM technology offers flexibility to enterprises that want to adopt cellular IoT, enabling flexibility in the selection of MNOs
- Hardware and connectivity vendor interoperability challenges at local service provisioning stage stand in the way of cellular IoT adoption at scale, preventing enterprises from reaping the rewards from cellular based IoT
- Infineon and Tata Communications have partnered to deliver an integrated Embedded SIM solution addressing the key pain points of interoperability, technical support, cost, connectivity and global scale - enabling businesses to focus on the benefits of cellular IoT
- The solution delivers benefits, aggregating and delivering a streamlined service for improved flexibility for cellular IoT devices both at manufacture and in the field as well as reduced cost and complexity for enterprises
- A single interface is provided, through which to manage existing and future deployed devices and equipment
- Security is a core feature of the solution, with multi-layered security and encryption. Security is further enhanced through the combination of security mechanisms from silicon to cloud and back. The joint solution is also fully compliant with GSMA industry standards



Infineon Technologies AG is a world leader in semiconductor solutions that make life easier, safer and greener. Infineon designs, develops, manufactures and markets a broad range of semiconductors and system solutions focused on automotive electronics, industrial electronics, communication and information technologies, and hardware-based security.

Infineon is the leading provider of security solutions. Securing electronic devices and infrastructures is a number one priority in today's digital and connected world. Addressing this need is one of Infineon's key competencies. Infineon offers tailored and ready-to-use security solutions serving a wide range of applications from smart cards to IoT.

Outstanding security expertise and technology innovation based on almost 30 years of experience, system competence and the broadest security solution portfolio focused on customer needs is what makes Infineon the preferred partner in this area.

For more information visit:
www.infineon.com/security

TATA COMMUNICATIONS

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The company's customers represent 300 of the Fortune 500 whose digital transformation journeys are enabled by its portfolio of integrated, globally managed services that deliver local customer experiences. Through its network, cloud, mobility, Internet of Things (IoT), collaboration and security services, Tata Communications carries around 30% of the world's internet routes and connects businesses to 60% of the world's cloud giants and 4 out of 5 mobile subscribers.

The company's capabilities are underpinned by its global network. It is the world's largest wholly owned subsea fibre backbone and a Tier-1 IP network with connectivity to more than 240 countries and territories.

Tata Communications Limited is listed on the Bombay Stock Exchange and the National Stock Exchange of India and is present in over 200 countries and territories around the world.

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