2024 White Paper

The Critical Path to Global Connectivity in the IoT Ecosystem

Why eSIM is the Only Connectivity Choice For High-Data IoT

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Executive Summary

The realm of the Internet of Things (IoT) is expanding at an unprecedented pace, transforming industries and everyday life alike with innovative solutions that enhance efficiency, safety, and connectivity. At the core of this transformation is the evolution of connectivity technologies, among which the Embedded Subscriber Identity Module (eSIM) stands out as a pivotal enabler.

This document provides a comprehensive overview of why eSIM technology is not just an option but the only choice for high-data IoT applications, highlighting its advantages such as scalability, enhanced security, and crucially, its role in ensuring uninterrupted global connectivity. Through a series of case studies from various sectors including smart manufacturing, healthcare, and the automotive industry, the document showcases the tangible benefits and success stories resulting from the adoption of eSIM technology.

Furthermore, it addresses current challenges such as compatibility and regulatory issues while casting a look into the future trends including the integration of 5G and ongoing innovations in eSIM technology. Ultimately, this document aims to underscore the critical path toward a fully connected global IoT ecosystem, facilitated by the adoption and implementation of eSIM technology.

Introduction to eSIM

Embedded SIM, or eSIM, is the natural successor to the physical SIM card, which has been used for many years across consumer mobile handsets and cellular IoT devices.

The technology behind the new form factor is supported and promoted by the mobile industry association GSMA. It offers the same level of security and protection provided by physical cards, but uses an embedded version to house secure elements on devices.

eSIM allows remote provisioning, opening the way for previously impossible levels of flexibility in the management of connectivity for a fleet of devices. This means network providers can be changed without needing to physically swap the card in devices, a major barrier to achieving this in the past.

Previously, changing networks required sending out technicians to the field, far from ideal in terms of time, cost and in some cases this was logistically tough given the location of individual assets.

Being able to quickly update network profiles over the air opens the possibility for OEMs and enterprises to deploy the same hardware in multiple markets and allows a device to move over international borders without having to pay expensive roaming fees.

Why eSIM is the only connectivity choice for high-data IoT

Understanding eSIM technology and the risks associated with global roaming SIMs.

In the expansive landscape of the Internet of Things (IoT) and Machine-to-Machine (M2M) communications, the backbone networks that bind these technologies are the unsung heroes of connectivity. The choice between native core networks and roaming solutions can have a profound impact, not only on the performance and security of IoT devices but also on the bottom line of businesses that rely on these technologies.

TEAL, a front runner in IoT connectivity, is redefining the dialogue with the introduction of native core connectivity for high-data IoT use cases. This article will dissect the intricacies of this vital aspect of IoT and M2M technology, addressing the concerns, and highlighting the benefits that native core connectivity, facilitated by eSIM technology, offers to businesses across industries, including reliability, data security, and competitive advantages.

The Essence of Core Connectivity in IoT and M2M Technology
While the public often associates connectivity with smartphones and consumer devices, the IoT and M2M ecosystem require a robust, reliable, and secure infrastructure to support the high-data and low-latency communication needs of a multitude of mission critical devices. Core networks serve as the lifeline for such technology, enabling the efficient transmission of data across vast cellular networks with the highest standard of security measures in place. Many MVNOs claim to offer high-data IoT connectivity, but the reality is that they are providing roaming solutions which do not provide the required reliability and consistent performance as core network connectivity.

Incorporating the latest advancements, native core networks ensure uncompromising support for IoT devices that demand uninterrupted, fast, and secure connections. The intricate interplay between these networks and the sophisticated IoT architectures guarantees a seamless operation, a significant milestone in streamlining business processes.

Four Fundamentals of eSIM

- **Redundancy:** Eliminate over-reliance on one single provider and its points of failure
- **Availability and Performance:** Delivering low latency, high-throughput anywhere
- **Product Simplification:** No need for multiple versions of device SKU's for markets
- **Control and Flexibility:** Not getting locked into carrier agreements

Roaming vs. Native Connectivity

A Comprehensive Comparison

Examining the contrast between roaming and native core network connectivity brings forward a salient argument for the latter. Essentially, roaming, while useful for many use cases, pales in comparison to the dedicated infrastructure and the subsequent performance enhancement that core network connectivity offers.

Roaming solutions are a popular option, but they often lack the necessary infrastructure to support IoT and M2M devices. Roaming relies on leveraging the network infrastructure of other providers. This can cause issues with connectivity, speed, and security. In contrast, core network connectivity offers access to dedicated MNO infrastructure for these devices, which translates into improved performance.

Some IoT connectivity vendors claim to offer support for high-data use cases, however, the fact that these solutions are using global roaming SIMs, means that they will run into many performance issues such as high-latency, low reliability, and little redundancy.

It's nearly impossible for a roaming solution to stand by a claim that they can consistently provide speeds upwards of 20 mb/s, because latency is the measurement of time to communicate between two computers, and it depends on a lot more than just what any MVNO can provide. The reality is that latency with roaming solutions can be unpredictable.

Why MVNO Solutions Aren't Ideal for High-Data IoT

An MVNO is a network provider that rents airtime (radio network) from the MNOs but adds a virtual data network for the actual throughput. Connections to this network first go through an MNO tower, then an MVNO datacenter.

Many MVNOs claim that they are connectivity platforms, but because they are renting their platform, it means that you're stuck with a static, limited solution and any changes are reliant on a 3rd party.

With Teal's patented and wholly-owned eSIM platform, IoT companies can develop features and functionality without 3rd party reliance, which translates into faster go-to-market capabilities.

An MVNO still operates a virtual network. They still operate datacenters and provide a rough copy of the data architecture of the original MNO network. At first, they look easy to join and may even seem cost effective, but then they fall short when roaming agreements are suddenly blocked or when they experience higher latency due to reduced datacenter capacity.

MVNOs will assert that they offer carrier-switching, but the reality is that they only switch you between towers while datacenters remain the same. In many cases, the identity stays the same as well. Why is this bad for IoT companies? Mainly because MVNOs don't offer redundancy and remain a single point of failure.

IoT devices that are connected onto away networks are not prioritized. This means that in some cases you may experience great performance, but in many other instances, performance will be degraded, and latency will be high. This unreliability in network speeds and availability is not ideal for most mission critical high-data applications such as video surveillance, fleet management (telematics) solutions, autonomous robotics and BVLOS drones.

So, while it might seem like you are getting great global coverage at competitive rates, the reality is that your mission critical devices are put at risk and will likely experience less than advertised performance.

Contrarily, native core connectivity is purpose-built for IoT and M2M devices, ensuring consistent, high-quality service, and response, irrespective of location. The costs associated with core connectivity are also more predictable, given the absence of unexpected roaming charges, which can be detrimental to the financial health of a business. Overall, the return on investment with native core networks stands out due to the performance gains and the ability to maintain better control over connectivity infrastructure.

Diving Deeper into the eSIM Revolution

The introduction of eSIM technology has ushered in a new era for IoT and M2M connectivity, promising unparalleled flexibility and simplified network management.

By adopting eSIM, businesses can circumvent several limitations associated with traditional SIM cards, such as the need for physical swapping, vendor lock-in, and the logistical challenges of managing multiple devices across various carriers.

Some MVNOs claiming to be eSIM platforms are really only offering multi-imsi solutions that don't offer the same freedom and flexibility that true eSIM technology offers.

eSIM empowers devices with the agility to switch seamlessly between networks, with TEAL leading the charge and offering native connectivity onto America's three Tier 1 carriers, along with support for carriers in other countries.

This level of versatility coupled with robust data security infrastructures makes eSIM the definitive choice for businesses that wish to maximize the potential of their IoT and M2M investments.



eSIM: The only connectivity choice for high-data use cases

The Rising Dominance of eSIM

Roaming vs. Core Connectivity – A Comprehensive Comparison
In an age where rapid data transfer is more than a commodity, the way we connect mission critical devices is more important than ever. Among the plethora of connectivity solutions, eSIM has emerged as the preferred choice for industries that rely on high data throughput and low latency for mission critical use cases. In this comprehensive breakdown, we'll explore why eSIM technology is becoming the quintessential link for data-heavy applications such as Beyond Visual Line of Sight (BVLOS) Drone Operations, Autonomous Robot Delivery, and Fleet Management Solutions.

Feature	TEAL eSIM	MVNO "eSIM"	MNO "eSIM"
eSIM Technology Provider	1st Party (TEAL)	3rd Party	3rd Party
Chip Manufacturer	Multi-Vendor	Single-Vendor	Singe-Vendor
Datacenter Provider	Operator	Themselves	Operator
Direct Network Enrollment	Yes	No	No
Roaming Networks	When Necessary	Always	Sometimes
Network Onboarding	Whenever You Need	No	No
Private Networks	Whenever You Need	Not Compatible	Not Compatible
BYOC (Bring Your Own Carrier)	Whenever You Need	No	No

Rising to the Challenge in BVLOS Drone Operations

Drone technology has ascended to the skies and is now heavily relied upon for public safety and military applications. Beyond drone-as-a-first-responder applications, BVLOS drones are integrating into everyday commercial operations and surveillance missions. But as drones move from novelty flights to mission-critical ventures, their connectivity struggles come into sharp focus. Traditional SIM cards offer limited global reach, often tying users to a single network. This can be problematic for drones operating around the world, especially when they are flying missions beyond an eight-mile radius.



The Teal eSIM solution has revolutionized BVLOS drone operations by providing a single, programmable SIM card that tackles the industry's core challenges:

- Global Connectivity Without the Headache: Managing multiple carrier agreements and roaming services has traditionally been an accounting labyrinth. TEAL eSIM simplifies it — one eSIM SKU, give your access to connect onto any network, anywhere in the world.
- Latency and Throughput: For BVLOS drones that require real-time, low-latency data transfer, Teal's eSIM outperforms regular roaming services, ensuring a safer, more responsive unmanned flight experience. How? Because TEAL is the only connectivity solution that can provide native core connectivity onto leading networks worldwide without roaming. The result is higher reliability and better performance.
- Range and Redundancy: Drones that stretch beyond the line of sight can't afford connectivity dead zones. TEAL enable dynamic switching between data networks allowing for redundancy across networks and guaranteeing the coverage and reliability that missions demand.
- Easy Deployment: Traditional SIMs have been a deployment bottleneck. With TEAL, the process is faster and more streamlined, allowing drone operators to get airborne with minimum fuss.

By adopting Teal's eSIM, BVLOS operations have reported massive cost savings and unparalleled deployment efficiency, catapulting the technology to the forefront of this burgeoning industry. Learn more about how leading companies are leveraging TEAL's eSIM capabilities for global BVLOS drone operations in this video:

Navigating the Urban Jungle with Autonomous Robots

Autonomous robots are altering last-mile delivery solutions but are also facing their own set of connectivity intricacies. Encouraging the seamless integration of these robots into our urban landscape requires a connectivity solution that's as versatile as it is robust. On campuses and in cities, robots are traveling in a wide-open environment with a lot of buildings and reflections.

Wi-Fi can't be relied on because it's too short range, and 4G has issues around people and large buildings where there are a lot of dead zones, especially low to the ground where delivery robots operate. There needs to be backups and a flexible solution like TEAL gives autonomous robots the ability to dynamically switch between data networks when needed, over-the-air. Moreover, robots in these urban environments need access to connect onto native core networks to ensure the lowest latency and highest throughput. In short, these robots need to be reliably connected at all times to ensure that deliveries are completed on time and to the right destinations.

Enter TEAL's eSIM technology for Autonomous Robotics. Companies like Starship, pioneers in the field, have found a reliable partner in eSIM technology. True eSIM provides the following benefits:

- Eliminates complexities of working with multiple MNO's
- Has better throughput with lower latency
- Enables programmable access to native core networks
- Provides the ability to switch dynamically between networks

The result is not just a reduction in operational complexity, but a significant enhancement in performance metrics like latency and throughput that are vital in city environments. Check out the video below to find out how TEAL is enabling global robot delivery on a global scale. Although this can work for companies with huge scale, budget, and influence, it is not ideal for most enterprises given the costs and timelines associated with arranging carrier agreements and the requirement to foot the bill for integration projects.

Streamlining Fleet Management Operations

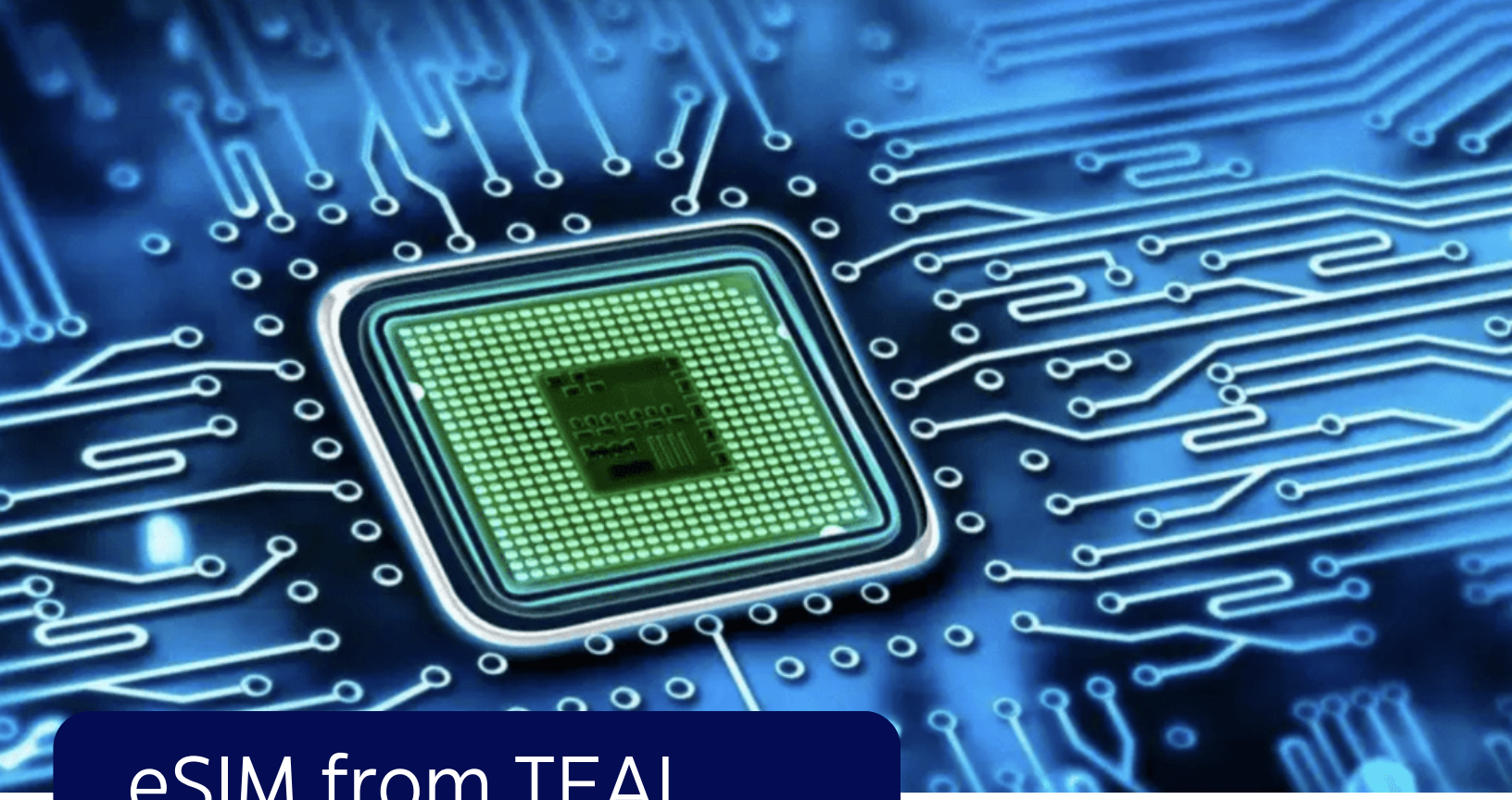
Fleet management and telematics are synonymous with the need for constant, high-volume data exchange. TEALs eSIM technology has found its sweet spot in revolutionizing how fleet operators manage their assets on a global scale, freeing them from the shackles of single-carrier alternatives and the false promises of roaming solutions.

- Real-Time Data Demands: The need for vehicles to communicate critical information in real time is paramount. TEAL's eSIM technology ensures that telematics solutions are always connected to the best networks available, without the latency and throughput hiccups of traditional roaming services.
- Multi-Network Flexibility: To cope with the geographic diversity of fleet operations, Teal's eSIM allows dynamic switching between different networks, ensuring a seamless and uninterrupted data flow.
- Native Core Connectivity: Teal's eSIM is the only connectivity solution that can provide native core connectivity onto America's three tier-1 carrier as well as providing core connectivity onto networks in Canada, Mexico and the EU.

The convenience of a single eSIM SKU granting multiple network access (especially native core networks access) has simplified fleet connectivity management, reducing operational complexities and cutting down on costs significantly.

Find out how TEAL is helping Safe Fleet a leading telematics provider achieve its goal to help its customers reduce preventable accidents across their fleets.

Safe Fleet product lines include advanced technology, mobile video surveillance, fleet management and advanced collision avoidance systems. Connected by TEAL, these products form an integrated platform to help predict and prevent accidents, create better drivers, smarter vehicles and safer fleets. Check out the case study here: eSIM For Safe Fleet



eSIM from TEAL

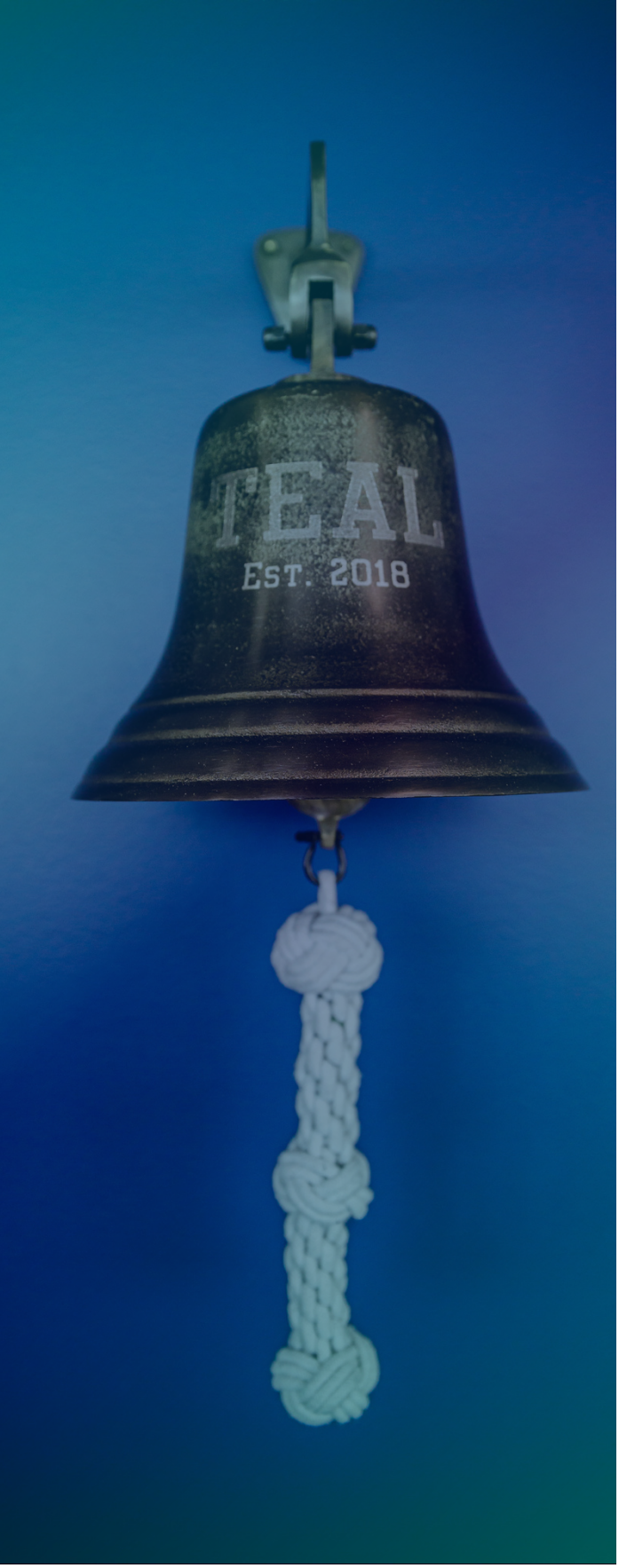
“True” eSIM

There are a limited number of “true” eSIM solutions in the market that are ready for global enterprise deployments and full eSIM optionality at scale.

TEAL, for example, has its own eSIM platform, runs its own source code, and is not reliant on third parties for integration with the ability to preconfigure with a range of carriers.

The system uses a crowdsourcing model, creating a network-as-an-app style system. If a carrier profile is requested that is not already integrated into the Teal system, they can integrate it into its platform for free on behalf of the IoT enterprise. This is because “true” eSIM platforms like Teal are serious about growing a collaborative 800+ carrier eSIM technology platform.

Imagine accessing thousands of network configurations in an “app store” when you can just select the one that fits your solution and you’ll then be directly connected to it, eliminating roaming completely.



Why Partner With TEAL?

TEAL offers a comprehensive solution to OEMs and enterprises looking to embrace the full flexibility and benefits of eSIM for their devices and organizations.

Its patented, GSMA certified eSIM platform has been built from the ground up and can offer all of the advantages and flexibility brought by this new technology.

Among its many benefits, Teal offers more competitive pricing than the likes of MVNOs as it is directly enrolling into the carrier network. Additionally, it's not reliant on a single network operator with limitations on selling off a specific carrier's rate card.

Businesses using their own platform can gain greater control of connectivity and are able to dynamically switch between providers if pricing or coverage changes.

This offers greater redundancy, ensures IoT devices are always connected and, ultimately, provides a much better rate for overseas connectivity.

TEAL gives customers access to a wide range of MNOs through direct connections without having to flow through a third-party data center, unlike with an MVNO.

Using its solution means there are no more concerns about network sunsets and outages given the ability to dynamically move connectivity to an alternative service provider.

This flexibility is one of TEAL's unique selling propositions.

For example, TEAL is the only eSIM provider in the United States with first-party partnerships offering off-the-shelf native connectivity on the AT&T, Verizon and T-Mobile networks.

It has a wide range of networks pre-integrated into its platform but includes the ability to bring your own as new requirements arise.

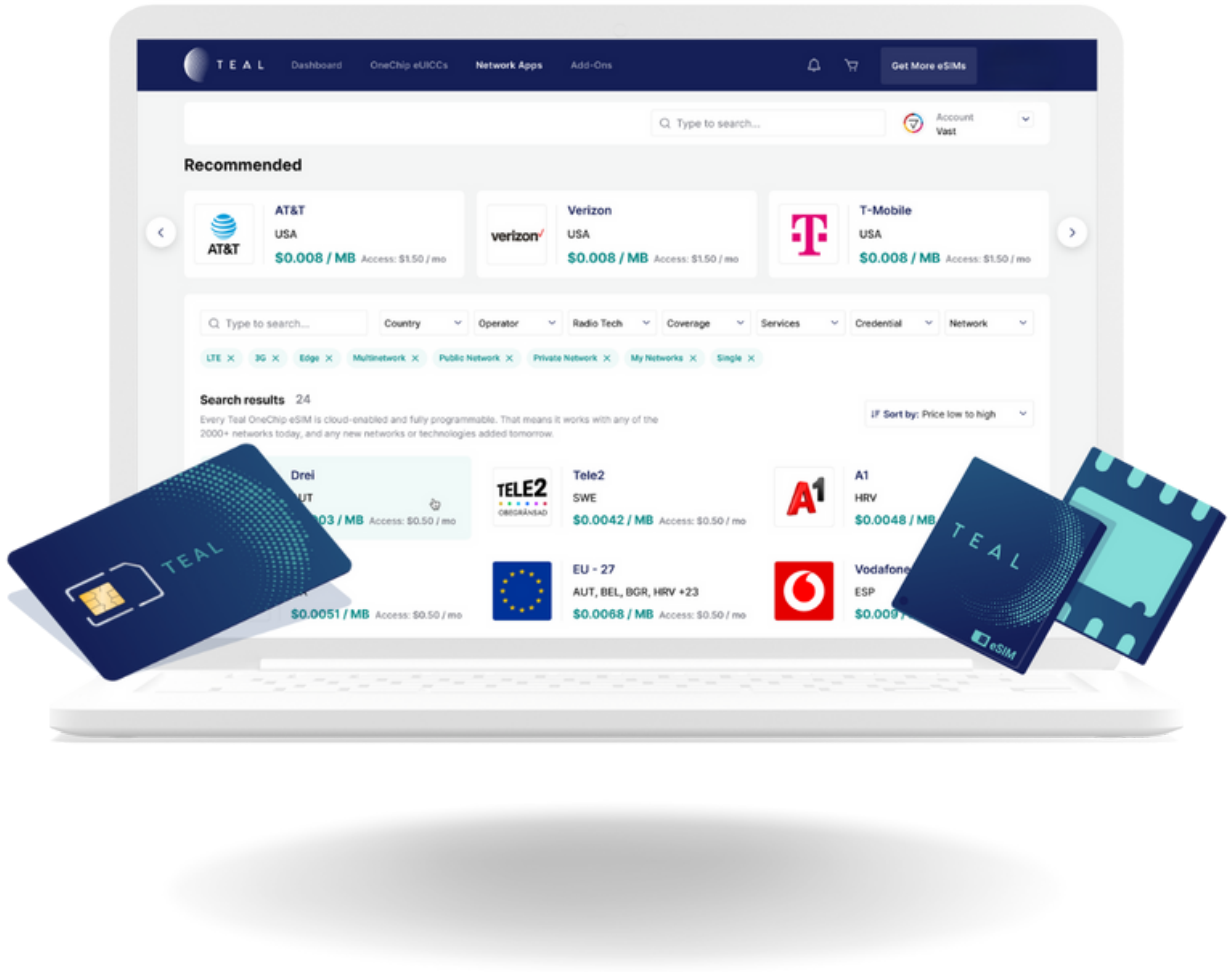
While many MVNOs claim to offer programable or automatic carrier switching, they are often just relying on outsourced eSIM technology and roaming capabilities within their own mobile core, which are often more expensive and have lower redundancy.

Teal has strong credentials with its customers and within the IoT industry.

It was the first US-based company to have its M2M eUICC platform accredited by the GSMA's security accreditation scheme, some you can be reassured your deployment is in safe hands.

With Teal, a true eSIM experience can be achieved, transforming industrial IoT deployments with mobility and true flexibility.

It has already had a significant impact for a range of customers across a whole host of sectors, many of which can be read about on the Teal website: www.tealcom.io/case-studies.



Case Studies

Visit: tealcom.io/case-studies

Starship Technologies

Starship is the world's leading robot delivery service on college campuses and cities, using Teal to connect its autonomous robots.

Teal brought simplicity to Starship's operational pain points by providing a single SIM SKU that offers access to multiple native MNO IoT Packet Cores.

The performance of Teal's native core profile has lower latency with better throughput than the business-grade SIMs they were using, which accessed MNO retail networks.

STARSHIP

Volatus Aerospace

Volatus Aerospace is major player in the commercial drone and UAV technology sector, providing integrated solutions for global clients in the civil, government and defense markets.

Teal provides Volatus with a single eSIM SKU which gives them the ability to connect drones directly to networks around the world.

By avoiding expensive roaming charges, Volatus is able to provide its customers with a low latency, high throughput, and highly redundant solution.

VOLATUS AEROSPACE

Machfu Industrial

Machfu's industrial IoT solutions are designed to improve performance within Industry 4.0. Machfu operates in more than 20 countries and required its equipment to be carrier agnostic.

Teal is currently connecting its equipment globally with affordable pricing and the ability to connect over the air, with Machfu's customers able to take advantage of pay-as-you-go pricing or volume pricing for those committing.

MACHFU

Safe Fleet

Safe Fleet has unified an unrivaled portfolio of best-of-breed smart solutions for fleets of every type. Safe Fleet's main mission is to ensure that drivers, passengers, first responders, in-the-field workers, & pedestrians arrive home safely.

With Teal's eSIM, Safe Fleet is now carrier agnostic as has the flexibility to choose which carrier credentials best support their business needs. They don't have to be concerned with pairing an MNO with the correct modem to support that specific carrier. They can deploy the Teal eSIM which will support the carrier LTE bands that their modems support.

SAFE FLEET
Driving Safety Forward™

Skyway

Skyway is leading the efforts in building the most secure automated airspace authorization cloud service for the aviation industry. With TEAL, Skyway can connect onto any network worldwide.

Teal puts Skyway in control by giving them the ultimate flexibility to switch between carrier networks at the click of a button, which translates into ultimate redundancy.

Having access to the best networks for any flight path will ensure that Skyway's comprehensive suite of solutions is available within the UTM operations at all times.

skyway

Stargent

Stargent is a value-added distributor specializing in cellular, RFID, IoT, and broadband solutions for enterprise and industrial clients.

Stargent needed reliable robust networks for enterprise customers who are deploying connectivity solutions to deliver mission-critical data, requires highly secure solutions in order to operate efficiently and safely.

With one eSIM from TEAL, Stargent's customers can connect onto any network worldwide.

STARGENT
UNIVERSAL CONNECTIVITY

Contact us today to find out how eSIM from TEAL can help your business!

Email us at: info@tealcom.io
Visit us online at: Teal.io