Serving the Enterprise: The Cellular IoT Connectivity Opportunity

A Kaleido Intelligence Survey Report Sponsored By

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Introduction to the Survey

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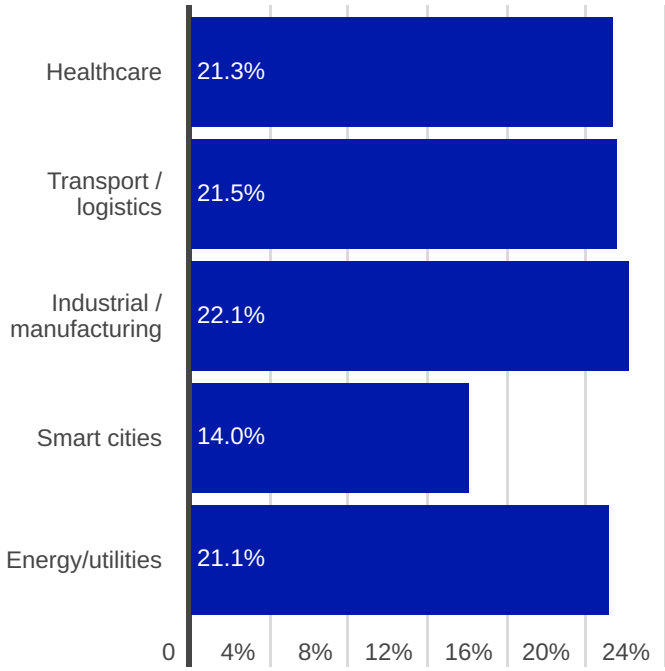
Approximately a decade ago, several large technology firms anticipated that cellular technology would form the natural basis for the majority of IoT connectivity. However, as of 2022, this has not yet happened: there were just over 2 billion cellular IoT connections by the end of 2021, while the broader IoT market ended the year with approximately 12 billion. Thus, cellular connectivity accounts for around 16% of the IoT market by connection volume.

Cellular technology has numerous advantages over other connectivity technologies that helped drive the assumptions made between 2010 and 2012: its inherent flexibility allows it to cater to high- and low-bandwidth requirements, standards have been developed to account for low-power scenarios, while the 5G standard is particularly suited to mission-critical applications that require ultra-low latency response times or Gigabit throughput. The fact that cellular technology is wireless and operates in licenced spectrum, while offering a robust security model, only serves to bolster the business case for using it as part of the IoT connectivity ecosystem.

It is a fact that IoT projects cannot succeed unless the devices are able to properly and securely transmit their data to any software ingestion point for processing. As we shall see, this is easier said than done. Moreover, the success of IoT depends on the capability of the customer to scale connected devices up as projects expand in scope, with this scaling frequently happening on an international scale. Those customers require a relatively high level of efficiency to manage those connected devices, particularly as the cost of engaging with IoT at any sort of scale is not trivial.

With this in mind, Kaleido Intelligence has set out to understand the root of many enterprise pain points in regard to IoT connectivity **through a survey that saw some 759 individual respondents across 5 industry verticals** give their perceptions on the current status quo. Respondents were typically decision-makers within their organisations, with a fair or good knowledge of the IoT connectivity ecosystem, responding on behalf of companies specialising in healthcare, transport and logistics, manufacturing and industrial, smart cities, and the energy and utilities segments.

In what market segment does your business unit primarily operate?



While this study is primarily concerned with cellular IoT connectivity, in order to understand a broad picture of perceptions, respondents included companies that had adopted cellular connectivity for IoT, in addition to those that had not. The differences, as well as the consensuses in perceptions among these groups and industry verticals,

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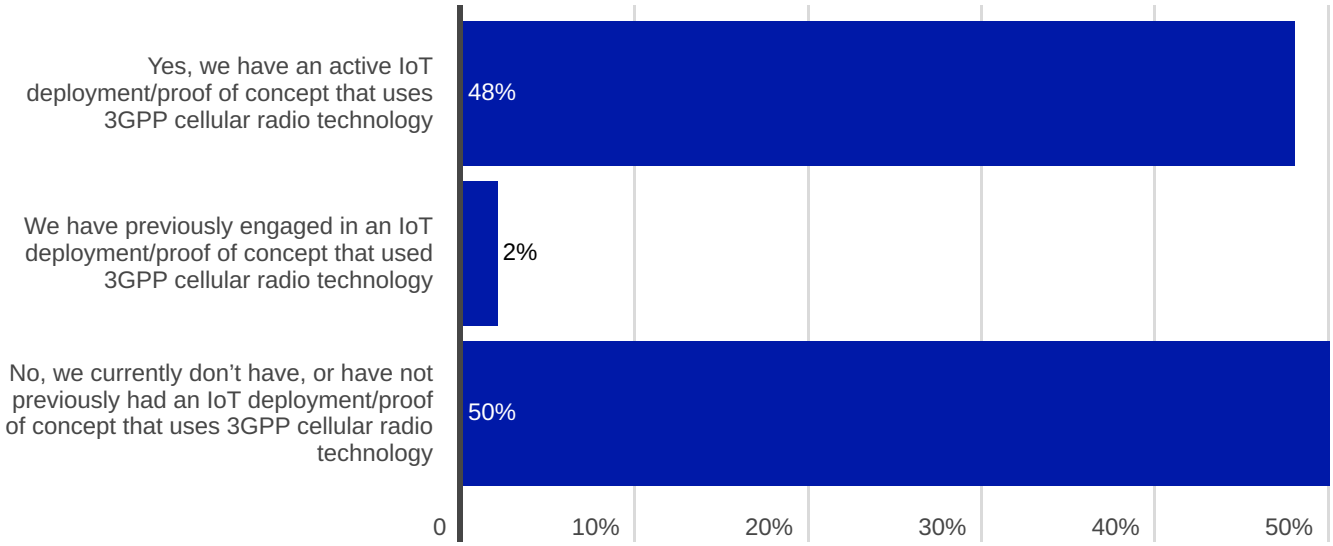
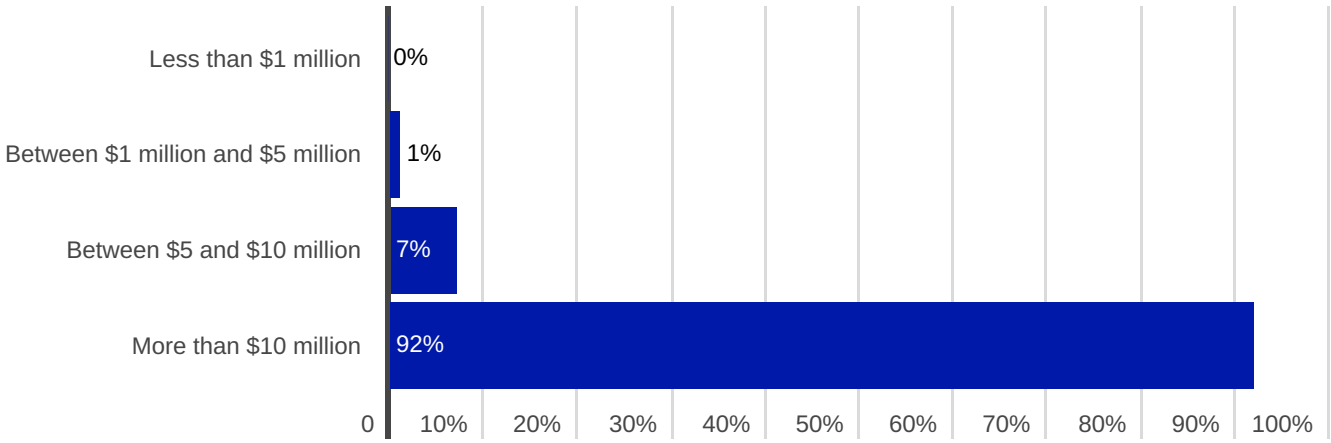
are among the key goals of the study in terms of understanding where the industry can improve and where opportunities to accelerate the adoption of cellular technology for IoT lie.

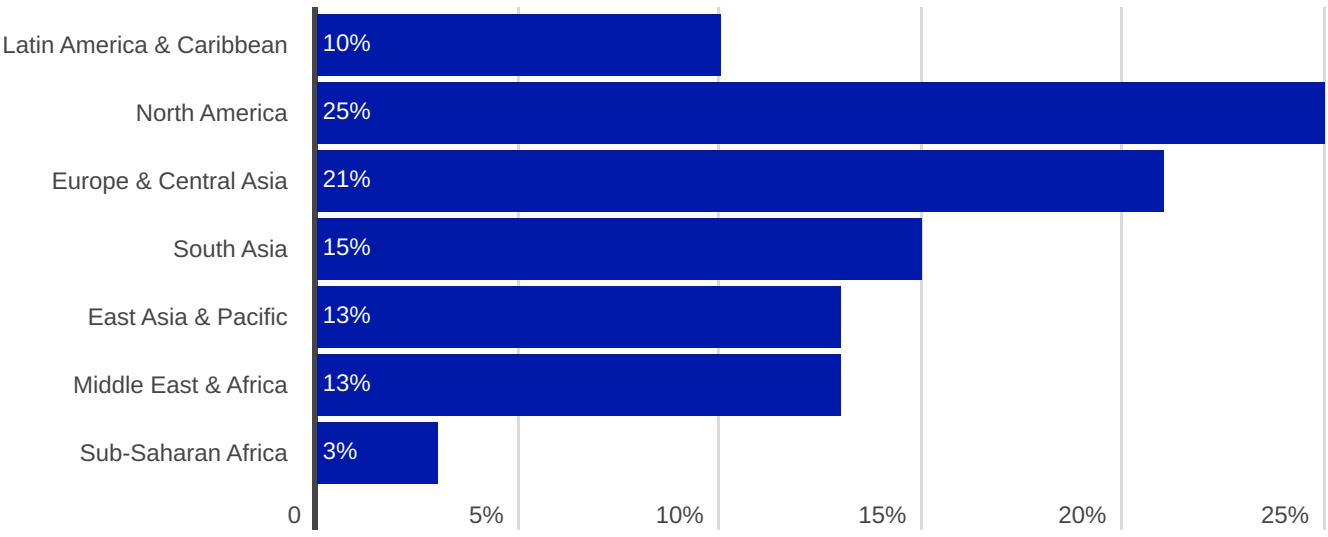
Does your business unit currently have an IoT deployment or proof-of-concept underway that uses 3GPP cellular radio technology (2G/3G/LTE/5G)?



What was your organisation's turnover in 2021?



Where is your business unit based?



IoT Connectivity Challenges & Opportunities

eSIMs

Complexity

Roaming

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eSIM

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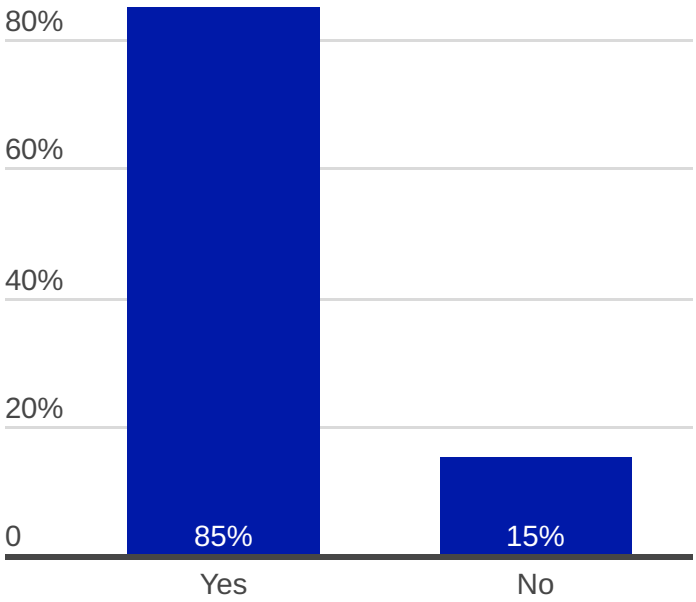
The GSMA's publication of the first interoperable embedded SIM (eSIM) specification in 2016 set the stage for a transformation in how cellular IoT connectivity can be provisioned. eSIM essentially decouples ownership of the SIM card and connectivity from the operator and the enterprise customer in the sense that eSIMs are capable of storing digital operator profiles that are remotely updatable over-the-air (OTA). In simple terms, this means that a single chip can be used as a proxy for any number of SIM cards without the need to physically swap between them, as was traditionally the case. Despite the name suggesting eSIM is only applicable to embedded (soldered) SIM cards, the remote management software architecture can actually be used for eSIMs in any form factor, as long as the SIM card carries an appropriate OS and is linked to a certified Remote SIM Provisioning (RSP) management platform; this makes eSIM a potentially useful tool across any number of IoT use cases and applications.

The business case behind eSIM use for IoT, when eSIM is maximised to its full potential, is overwhelming. The capability to update operator profiles OTA can enable enterprise customers, for example, to avoid the significant costs involved in having to physically swap SIM cards in instances where the commercial relationship with the original connectivity provider breaks down or where regulatory action may prohibit permanent roaming mid-lifecycle. The industry has already observed cases where enterprise customers were told that their devices would no longer be able to access the mobile network due to one of these reasons.

As device volumes in the field grow in number, the cost avoidance capability that eSIM offers becomes significant, often running into millions of dollars of saved expenses.

The fact that **85% of cellular IoT adopters have chosen eSIM as part of their deployment** is thus not surprising.

Have you decided to use eSIM (eUICC) as part of your IoT deployment? (Cellular IoT adopter responses)

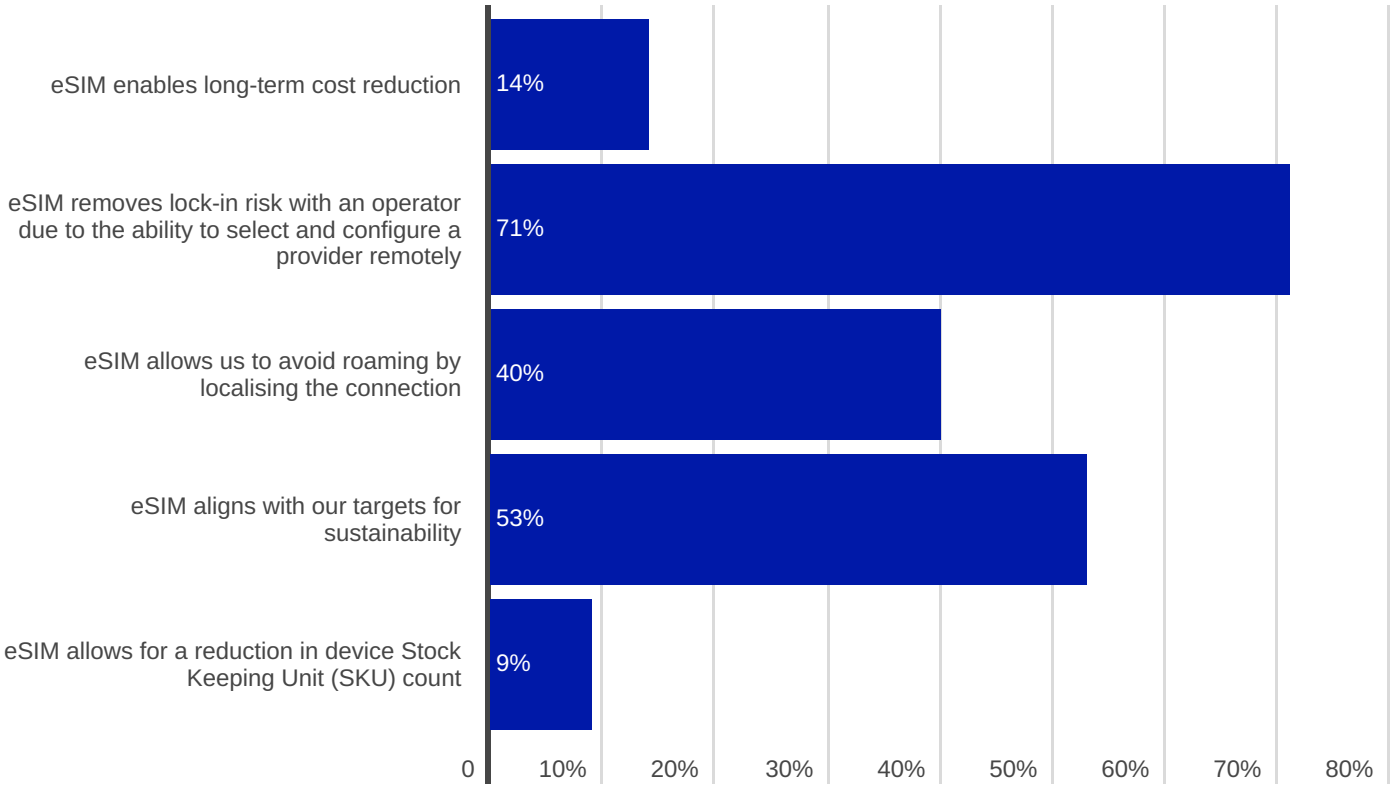


Today's M2M eSIM specification for IoT products incorporates a highly complex and challenging technical architecture, which often introduces legal, business process, and technical hurdles for those wishing to switch operator profiles OTA. The result of this is that IoT eSIMs are predominantly used for insurance purposes; switching operator profiles only in unavoidable situations; rather than using the technology as a means to regularly optimise costs and performance.

Nevertheless, the long-term project viability that eSIM offers means that **71% of eSIM adopters see it as an important tool to avoid the lock-in risks associated with legacy SIM deployments.**

An often-overlooked advantage associated with eSIM is the fact that a single component can potentially replace multiple SIM cards. Not only is this important from a long-term cost perspective, as we have seen earlier, but also from an environmental perspective. As more profiles are associated with and used with an eSIM, the savings in terms of energy use and materials consumption becomes exponentially greater. As sustainability and environmental protection is now increasingly at the top of countries' and organisations' strategic goals, the benefits that eSIM can offer in this context are becoming increasingly important. Here, **53% of eSIM adopters stated that the technology's environmental sustainability was an important factor behind their decision to use eSIM.**

What factors made you choose eSIM (eUICC)? (Cellular IoT adopter responses)



Although eSIM offers great potential in many areas, the ecosystem has not yet fully matured to the point that other connectivity solutions have become irrelevant. The technical architecture of the M2M eSIM specification creates several barriers that can raise costs and complexity when OTA changes to the operator profile are required. Meanwhile, each OTA operation executed via the RSP platform incurs a charge in order for RSP providers to achieve a return on investment in the eSIM software support environment. As such, it was important to understand why some respondents are not using eSIM, and what sort of challenges are experienced by those using it, in order to identify opportunities to increase adoption and maximise eSIM potential.

Sector Focus - Transport & Logistics

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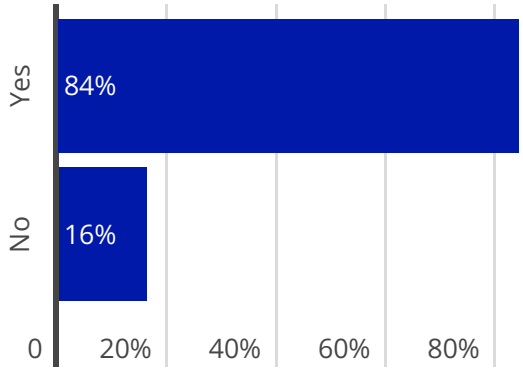
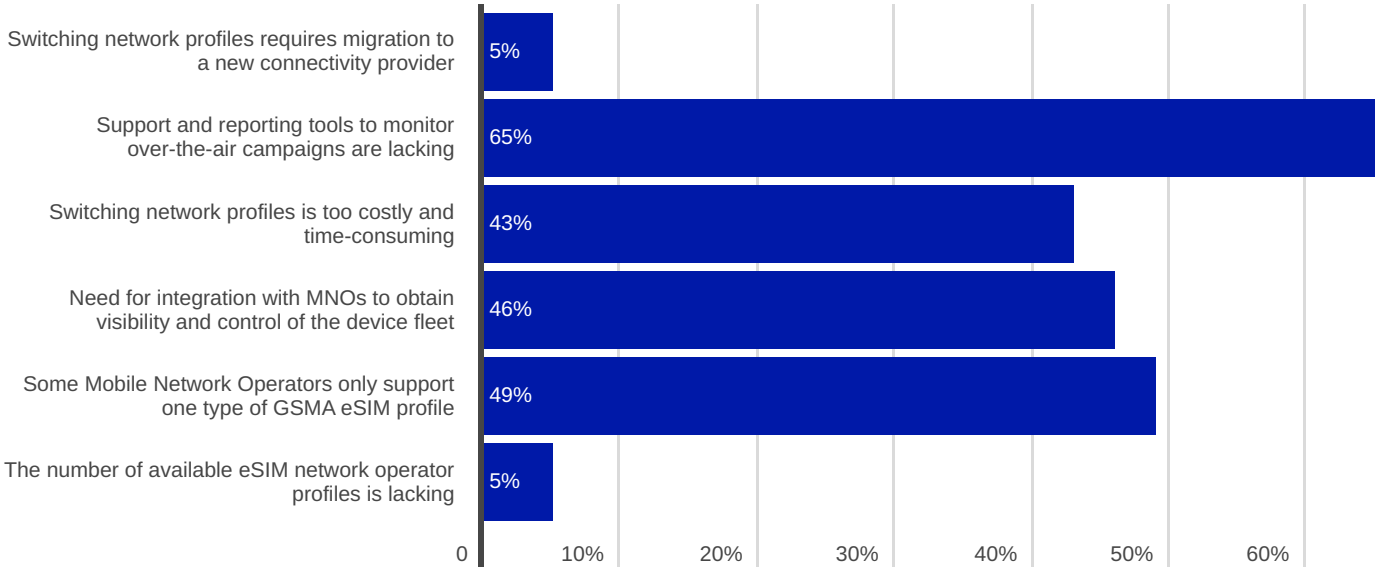
With the automotive segment in part responsible for the development of the original interoperable eSIM specification, it is not surprising to see that **84% of cellular IoT adopters stated that they are using the technology for their IoT deployments.**

Have you decided to use eSIM (eUICC) as part of your IoT deployment? (Cellular IoT adopter responses)



The ability to offer a consistent customer service experience across global deployments is a fundamental aspect of automotive OEM success, with eSIM offering a technical solution to enable that and de-risk long-term IoT deployments. Furthermore, emergency calling (eCall) regulations; particularly in the EU; have led to the de facto use of eSIM in an attempt to ensure that, in the event of a traffic accident, the vehicle can connect to emergency services to report the incident no matter if it is in the original connectivity partner's coverage footprint or not. Nevertheless, this vertical was notable in the fact that **43% of eSIM adopters stated that network operator profile switching was too costly and time-consuming** and refers here to the technically and commercially complex M2M specification in common use for transportation applications. It is often an enormous challenge to ensure that eSIM profiles are downloaded and activated away from the original network profile at scale, and is one of the reasons why network profile switching has rarely been observed in this vertical. This presents a clear opportunity for IoT MVNOs that have extensively tested their eSIM connectivity solution and capabilities, but also have secured partnerships with a broad number of MNOs to use their digital profiles.

What are your main issues with your current eSIM (eUICC) solution? (Cellular IoT adopter responses)



In addition to the above, transport and logistics enterprises were significantly concerned with the type of eSIM profiles available at their disposal. Presently, eSIM profiles conform to one of two specifications: one developed for M2M applications, with another for consumer-orientated applications. With many connected services, such as infotainment and navigation, in the transportation segment delivered via the vehicle's head unit in addition to services that monitor and report on metrics related to the vehicle or asset itself in the headless domain (ie without any user interface), relatively high demand for a mixture of eSIM profile types has arisen in this segment in order to cater for the diversity of applications in use. However, the survey results highlight that **49% of transportation and logistics customers have observed a lack of compatibility on the part of the connectivity provider with both profile types**, which has the net result of the customer being forced to seek disparate connectivity relationships with partners in order to service applications in their fleet that require a mix of eSIM profile types.

With the latest IoT eSIM specification likely to be delivered as an extension of the existing consumer eSIM specification, with support for remote management of IoT eSIM requirements, the ecosystem is on the way to resolving some of the issues described above. Nevertheless, development of the specification is not expected to be completed until the end of this year, while commercial rollouts and support are only likely to gather traction several months beyond that. Additionally, the transportation segment is infamous for long lead times in product development, meaning that demand for 'legacy' consumer and M2M eSIM profile types is likely to continue for at least 2 years. It is thus important for CSPs to take this into consideration in the context of their future eSIM support strategy, and may present an opportunity for innovative IoT connectivity service providers to capture market share from MNOs, which may be more risk-averse to eSIM in general in the first instance, while also reluctant to cater to specific market niches.

49% of cellular IoT adopters observed a lack of support for both consumer & M2M eSIM profile types

Complexity

It is apparent from the results that perceptions of complexity where cellular IoT connectivity is concerned continue to plague the industry. When non-cellular IoT adopters were asked to rank the top 5 challenges of cellular IoT, they overwhelmingly reported that hardware design poses the most significant challenge to any potential undertaking, with 84% of respondents choosing this element as their number one challenge.

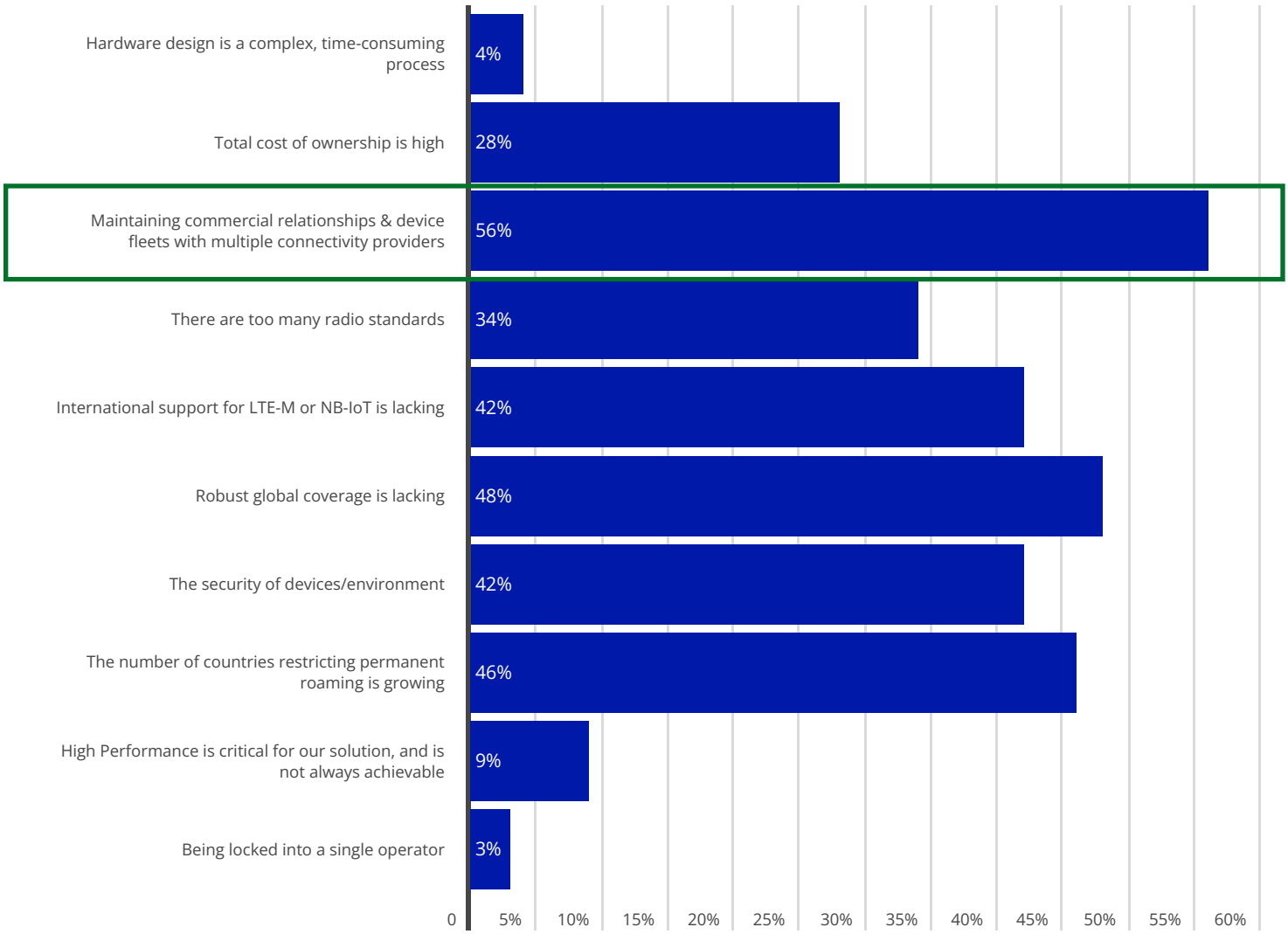
Hardware design ranked as a leading challenge by 84% cellular IoT non-adopters

Unlike the consumer smartphone industry, the IoT industry is not built around plug-and-play concepts. This means that customers are rarely able to procure off-the-shelf products with the expectation that they will meet their business requirements, much less be optimised for the project in question. Building hardware from the ground up is an arduous, costly process that, if it is built from the base components up, requires that radio hardware is certified for all the regions in which it operates. This can often result in very high costs that leave little margin for profit unless extremely high deployment volumes are expected. Cellular modules can solve this issue to an extent, in that chipsets are pre-certified for various regions and countries, while support can be offered by the module OEM for configuration and technical issues. Nevertheless, many companies are not familiar with 3GPP radio technologies in terms of the standards available on the market, in addition to the protocols in use. Without third-party expertise to guide them on their journey, selection, configuration and testing hardware solutions for cellular IoT can become a painful process.

Once an IoT project is underway, it frequently becomes an international endeavour, with products manufactured in one country and then shipped and operated in another, or even many others. This is simply the nature of global supply chains and global customer channels today. Once again, the lack of a plug-and-play model comes into play here: while large MNOs are capable of offering a broad international footprint for cellular connectivity, this footprint is often limited in terms of the number of available roaming partner networks in any given country, while costs for roaming can vary considerably; particularly when devices operate outside of the ‘core’ footprint. In some instances, the supporting MNO will be unable, either due to regulatory or commercial reasons, to offer connectivity in certain countries for devices that roam in foreign networks for long periods of time (usually over 90 days; this is known as permanent roaming). The result of this is that enterprise customers must often establish several contracts with connectivity suppliers in various markets in an effort to optimise costs, performance and support for their IoT devices. In addition to having to manage several connectivity contracts, devices must typically be managed across a number of different Connectivity Management Platforms (CMPs), making it difficult to achieve a holistic view of the device fleet and to consolidate data in an effective manner.

When examining the same theme from the viewpoint of cellular IoT adopters, the situation becomes slightly different. **Interestingly, hardware design complexity no longer factors as one of the main challenges associated with cellular IoT, with only 4% of respondents seeing this as a key factor.** This suggests that hardware design for cellular IoT is a challenge that can be overcome with experience: and underlines the need for service providers to offer hardware consulting services for customers, with a heavy focus on education and guidance for newcomers to cellular IoT. Nevertheless, **a significant proportion of cellular IoT adopter respondents still consider the issue of multiple contractual relationships with connectivity suppliers to be a critical issue, with 56% of the respondent base believing this to be the case.** This is a rather interesting statistic, considering the state of cellular IoT connectivity today. Indeed, while MNOs continue to dominate the number of cellular IoT connections under management today, with 1.8 billion connections at the end of 2021, IoT MVNOs now account for 11% of the market, registering 233 million connections in the same year. Historically, IoT MVNOs have focused on differentiation points such as customer service and flexibility, and as part of this have offered large, global multi-network footprints capable of being managed from a single portal or API interface. This undoubtedly highlights that while there are options on the market to alleviate some of the concerns enterprises have over complex multi-national deployments, efforts to market these differentiation points must be doubled down upon.

What do you perceive to be the main challenges where cellular IoT connectivity is concerned? (Cellular IoT adopter responses)



Sector Focus - Transport & Logistics

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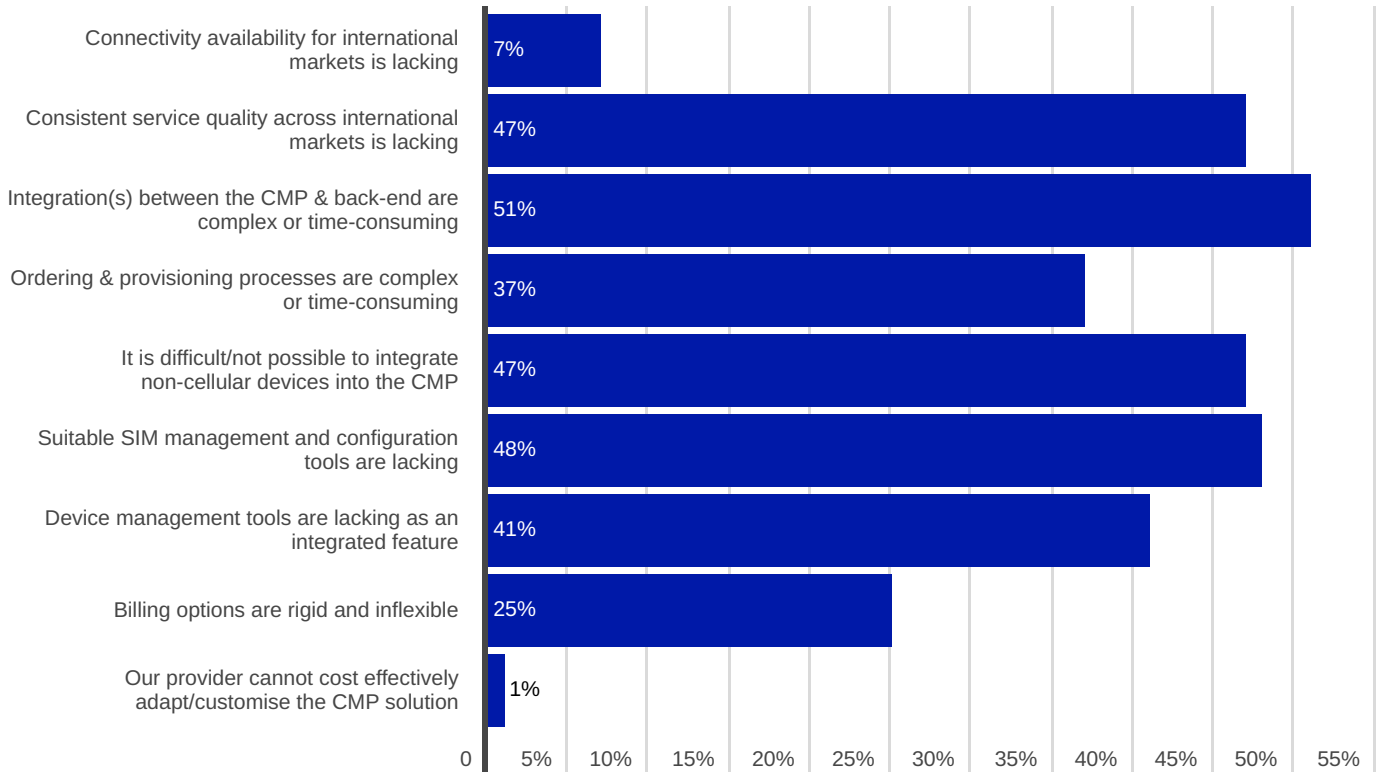
For the transportation and logistics industry, being able to offer a consistent experience is paramount. This is especially true for automotive applications, where OEMs have a strong desire to harmonise vehicle features and services no matter where the vehicle is sold. This desire is highlighted by the fact that **72% of cellular IoT non-adopters stated that the need for CSPs to have an extensive network of mobile operator partners for their connectivity footprint was their top priority in terms of a CSP's capabilities, while 56% of the same respondent base reported that the ability to provide extensive customer support was the number two priority in the context of a connectivity partner's product.** Being able to cater to these requirements will result in a high level of uptime while additionally minimising the number of disparate relationships required for customers have to deliver their products worldwide. As we have seen earlier, this is a critical factor across the enterprise landscape as a means of reducing complexity for global IoT solutions.

Extensive MNO partnerships are a #1 priority for 72% cellular IoT non-adopters

Extensive customer support is a #2 priority for 56% cellular IoT non-adopters

What are your biggest issues with your current cellular IoT connectivity solution? (Cellular IoT adopter responses)



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Nevertheless, there is evidently a perception that the issues described above have not yet been solved. **51% of cellular IoT adopters in this vertical stated that maintaining multiple connectivity relationships with providers continues to be a significant challenge, while 51% of the same respondent base reported that integrations between the connectivity platform and back-end software are complex or time-consuming**.

Undoubtedly, the majority of these challenges could be solved in instances where a single provider is capable of delivering a highly robust global footprint alongside a substantial number of integrations with connectivity partners' core network architectures. Minimising the pain points: contractual relationships in addition to the amount of time required to integrate CMPs with back-end software is clearly highly valued by customers within this vertical.

Further opportunities for reducing complexity lie within the relationship between device, and device connectivity. **47% of cellular IoT non-adopters stated that it is important for a connectivity provider to offer a consolidated hardware and connectivity offering, while 41% of cellular IoT adopters reported that suitable device management tools as a feature integrated with the connectivity solution were lacking**. This speaks to the need to more closely intertwine device and connectivity management, with the latter offering capabilities such as device software and firmware updates, and non-SIM monitoring capabilities. The fact is that in the transportation space, the ability to launch new products and services OTA has largely been lacking from the industry, with this capability only having emerged in recent years. The ability for connectivity service providers to bundle this type of offering alongside the connectivity service would once again allow the enterprise customer to reduce the number of support touchpoints required to develop their IoT solution, and offer a point of differentiation. In addition to this, the ability to bring hardware expertise to the table alongside connectivity is an important factor, given the testing involved when launching an IoT product, and the inevitable in-field support requirements involved when deploying at scale.

47% cellular IoT non-adopters rank hardware & connectivity bundles as #2 priority

41% cellular IoT adopters wish to see device management tools integrated into the connectivity management solution

Roaming

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IoT roaming continues to form the basis for cellular IoT connectivity on an international scale. Here, devices that are provisioned with connectivity in one country and then operate in another are allowed to connect to visited mobile networks by virtue of a series of inter-operator agreements and technical processes that facilitate communications and data exchange between the 'home' and the 'visited' operator. Historically, this was achieved using the same agreements and routes as consumer cellular devices, although increasingly, dedicated agreements are being set up at the wholesale level to accommodate the enormous differences in behaviour and data consumption between consumer mobile handsets, which frequently make use of high-bandwidth video, messaging and voice services and connected machines, which vary from simple telemetry and sensing devices to advanced robotics and remotely operated unmanned vehicles that require exceptional Quality-of-Service (QoS) performance.

Over the years, the industry has seen an increasing level of concern over the impact of IoT roaming. Traditional roaming agreements were built around the predictability of short-term roaming service usage for tourism or business travel which, as a general rule, results in roaming service provision for a period of fewer than 90 days. The case for IoT roaming is quite different. Not only are data consumption patterns highly variable depending on the deployment type in question, but IoT is almost always a long-term endeavour, with devices in the field for many years. Inevitably, this means that many roaming IoT devices are operating in the visited network for periods well over the 90-day threshold commonly seen in the handset space.

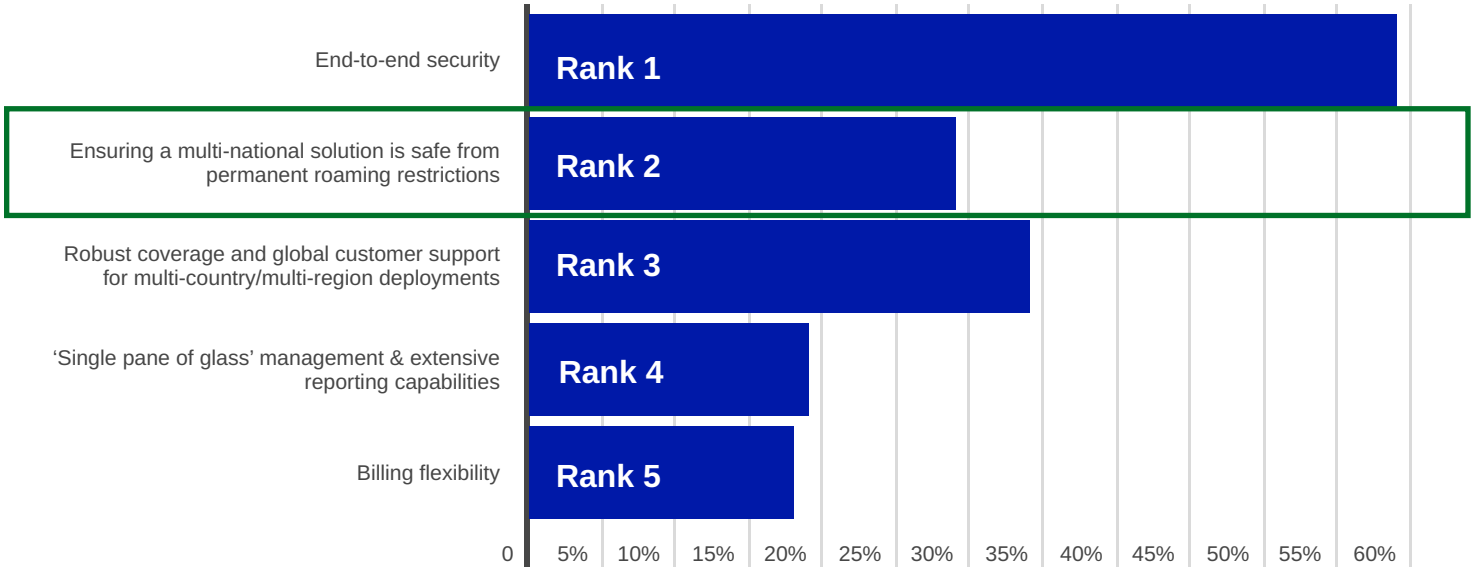
This so-called 'permanent roaming' has given rise to perceived issues, such as:

- There is a common perception that, given the high growth in cellular IoT devices, the volume of connections operating in a 'foreign' country may lead to network capacity and performance issues.
- IoT devices frequently consume low levels of data traffic while still consuming a high level of signalling resources. This can create challenges with traditional roaming business models based on traffic consumption and negatively impact the bottom line.
- MNOs have invariably focused on serving their domestic footprint over international enterprise needs. They are thus likely to view the permanent use of foreign SIMs as a threat to their domestic business.
- Regulators in some countries do not take a favourable view towards cross-border data transit for IoT devices. In these cases, permanent roaming clearly presents issues.

The net result is that National Regulatory Authorities (NRAs), as well as MNOs, are, in some instances, taking an increasingly hostile view towards permanent roaming. In several countries, such as Brazil, China, Turkey and Singapore, permanent roaming is prohibited by the regulator. Meanwhile, in countries such as Canada, the US, and Australia, MNOs have actively taken a commercially hostile approach to permanent roaming, limiting the ability of service providers to support permanent roaming.

This issue is clearly of considerable concern for enterprise customers: **after end-to-end security, the ability to ensure that a cellular IoT deployment is safe from permanent roaming restrictions was ranked as a top priority by cellular adopter respondents, who clearly see this as a potential barrier towards expanding the scope of the IoT deployments internationally.**

What are the top 5 factors that you look for in an IoT connectivity partner's product? (Cellular IoT adopter responses)



Permanent roaming is equally viewed as a key challenge among non-cellular IoT adopters, with the growing number of countries prohibiting or limiting permanent roaming ranking as the 4th top challenge related to cellular IoT.

Permanent roaming restrictions key for 21% non-cellular IoT adopters

The fact that permanent roaming may be difficult from a commercial or regulatory perspective does not mean that it is impossible for connectivity service providers to support devices in those countries or regions. Indeed, some Connectivity Service Providers (CSPs) have sufficient market power to enable them to reach commercial agreements with other operators around the globe to ensure that devices may roam permanently on their networks. Additionally, there are technical solutions available on the market in the form of eSIM or multi-IMSI SIM cards whereby local operator profiles, International Mobile Subscriber Identity (IMSI) translation, or donated local IMSI ranges can avoid the registration of a foreign IMSI on a network and thus avoid roaming on a technical basis. Today, it is certainly the case that an innovative CSP will apply at least one of these methods alongside traditional roaming capabilities to ensure that regulatory or commercial restrictions can be avoided. As we shall examine in a later section, eSIM is now increasingly deployed as a means to guarantee the longevity of device connectivity availability and is often supplemented alongside some form of multi-IMSI implementation to deliver an optimal customer experience from a cost or performance perspective.

What is the Impact of No Connectivity?

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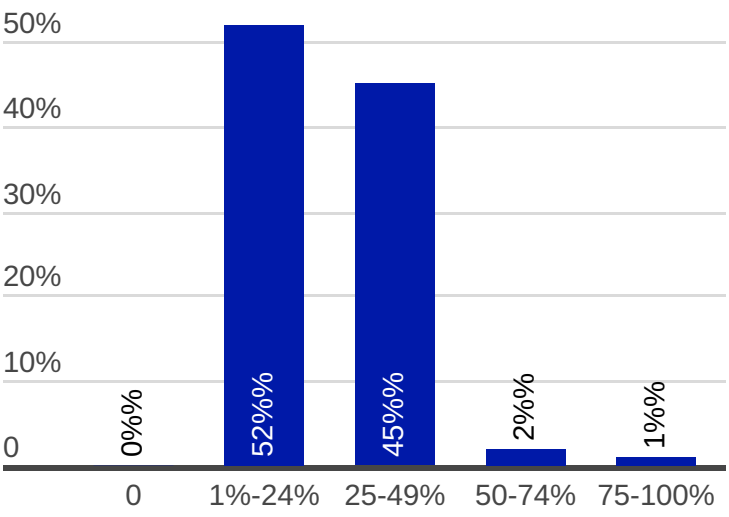
The IoT as a whole can bring a wide range of benefits including overall cost savings as noted above, Emphasising the possibilities for what can happen without connectivity is also a key point for IoT ecosystem players, particularly for bringing in new customers. Most benefits will be felt at the stage of IoT deployment from scratch, rather than refinements in the process, simply because of what connectivity can bring. This is particularly vital for the logistics and transportation industry, where connectivity can prevent the irrevocable loss of valuable goods or vehicles.

Most benefits will be felt at the stage of IoT deployment from scratch, rather than refinements in the process, simply because of what connectivity can bring. This is particularly vital for the logistics and transportation industry, where connectivity can prevent the irrevocable loss of valuable goods or vehicles.

To what extent would you perceive your IoT deployment to have been successful in terms of reaching your business objectives? (Cellular IoT adopter responses)



Despite these obvious benefits, very few respondents consider their deployments to be more than 50% successful in achieving their business objectives. This may be because the places that many are seeking their connectivity from are not providing solutions that alleviate that connectivity first and foremost - 37% of respondents looking to begin IoT deployments reported they would secure connectivity from an MNO rather than a specialist IoT MVNO.

37% of future cellular IoT adopters reported that they would seek connectivity from a general MNO.

Without that expertise in the IoT, much of the complexity of deployment will remain part of the perception customers have of the space. Our survey has clearly shown that handling the complexity of IoT deployments, particularly international deployments that require roaming agreements in many cases, is something that IoT users are keen to see solved.

If positioned correctly, eSIMs, which many customers are already using, can be leveraged to solve these problems. This is particularly key tool for the logistics industry, where connections, as well as deployments, are likely to cross borders. eSIM technology can be used to maintain connections across large connectivity fleets, even where roaming is not possible or not desirable.

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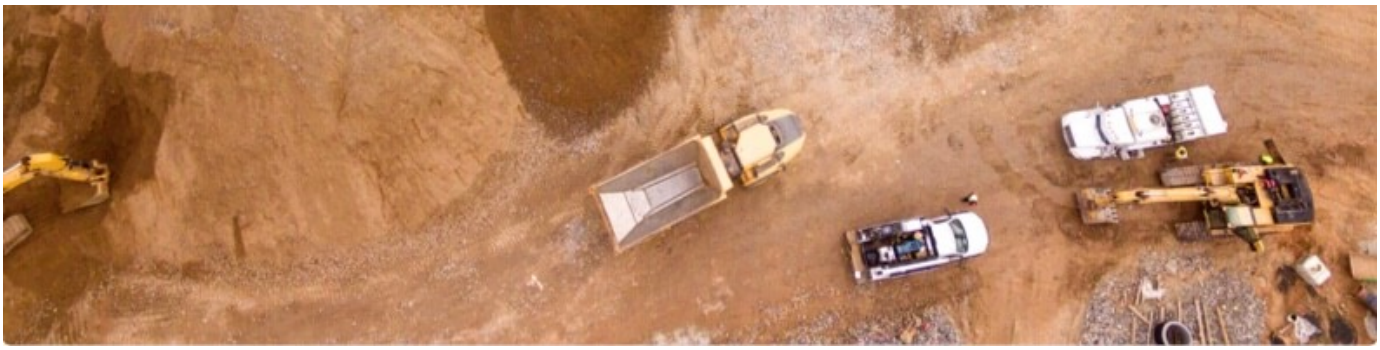
Truphone connects MachineMax's entire fleet in moments



MACHINEMAX

"With the support of Truphone, we are confident we can continue our rapid global expansion whilst providing seamless global connectivity."

Amit Rai, CEO, MachineMax

The company produces sensors designed specifically for off-highway heavy equipment—tractors, dumper trucks, excavators, diggers of any brand and any model—and ships them globally. Its customers use the sensors to track their machines and receive efficiency, productivity and fuel-cost insights to help them maximise profitability and reduce emissions.

But while MachineMax could offer revolutionary wireless telematics to its customers, it didn't have a way to simplify connectivity for their vehicle fleets.

That was, until it partnered with Truphone.

How eSIM has changed the Machine Max offer

Truphone's commitment to eSIM (embedded SIM) technology has given MachineMax a huge competitive advantage, and its customers a simple solution for getting their off-highway vehicles connected.

By implementing Truphone's state-of-the-art eSIM technology in its devices—and thanks to Truphone's network which supports 2G, 3G, 4G and CAT-M1/LTE-M networks worldwide—MachineMax is now able to offer connectivity straight out of the box, wherever in the world the device is deployed.

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What's more, every eSIM profile in customers' fleets can now be updated and connected remotely and at scale from the Truphone for Things platform. Users have the ability to deploy and manage connectivity for thousands of devices via a simple-yet-powerful interface, at their fingertips.

MachineMax's connected-device offer provides the company's customers with complete confidence that their fleet of devices can be tracked, 24/7, no matter the site size or manufacturer.

But it also provides MachineMax's CEO, Amit Rai, with belief. "With the support of Truphone, we are confident we can continue our rapid global expansion whilst providing seamless global connectivity."

A one-stop shop for IoT connectivity

Truphone for Things joins together previously fragmented elements of the Internet of Things (IoT) ecosystem to provide a **'one-stop shop' for IoT connectivity.**

The company's global mobile network is leveraged to connect devices anywhere—via a range of low-and high-power networks—and full control is provided via an easy-to-use management platform.

So it's little wonder new partnerships such as the one with MachineMax are forming continually as manufacturers seek to unlock the potential of the Internet of Things for their customers.

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Afterword

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This survey report would not be possible without the support of its sponsors. Kaleido wishes to thank the sponsors of this study, who, along with Kaleido and IoT Now, are supporting our vision of enabling business decisions across the enterprise sector through inspiring, educational and accessible insights.

Kaleido Intelligence is a specialist consulting and market research firm with a proven track record delivering telecom research at the highest level. Kaleido provides insightful business analysis, market projections, recommendations and growth strategies for global mobile operators, telecom vendors and IoT service providers.

Kaleido covers industry-leading market intelligence and publications on IoT Roaming, eSIM, Connectivity Management Platforms, Private Cellular Networks and Mobile Telecoms Fraud & Security. Research is led by expert analysts, each with significant experience delivering insights that matter.

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