



Kaleido Intelligence

Enterprise Cellular IoT Demands & Opportunities

A Kaleido Intelligence
Survey Report

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Introduction to the Survey



Over the past decade or more, considerable interest has risen around the concept of IoT and what it might mean for businesses and end-users impacted by the digitisation strategies applied using IoT technologies. In turn, a plethora of IoT survey reports have been published that typically cover a broad range of topics. In 2022, Kaleido Intelligence recognised the need for a more focused understanding of specific areas of IoT implementation and, as a result, undertook one of the largest survey fieldwork efforts of its kind, examining enterprise perceptions around cellular IoT connectivity in detail.

Despite the fact that much of the revenue and user experience is impacted by the applications and services that are applied in the context of IoT, connectivity remains the bedrock for any deployment. Therefore, it is imperative that the ecosystem serving IoT customers understands where challenges exist, where improvements could be made, and how customers perceive the IoT ecosystem in the context of connectivity. As we shall see later in this report, cellular technology is well-understood as an important enabler of IoT connectivity, albeit with several challenges associated with it.

The end of 2022 saw some 2.5 billion cellular connections deployed globally for IoT programmes, with connections having increased by 26% over 2021. In contrast, the end of 2020 saw only a 12% increased in connection volume, and as a result, it is evident that the overall ecosystem for cellular IoT connectivity is on the path to recovery following the pandemic. Nevertheless, this strong growth highlights that meeting the challenge of 'scaling up': supporting higher volumes of

connections from a technical, service and commercial standpoint is ever more critical for service providers if the ecosystem is to be sustainable. Meanwhile, the introduction of new radio technologies, such as 5G, support for converged cellular-satellite communications systems and private cellular networks, in addition to a vast ecosystem of connectivity service providers, hardware vendors and differentiated regulatory and commercial requirements has meant that cellular IoT is more complex than ever for enterprises to navigate.

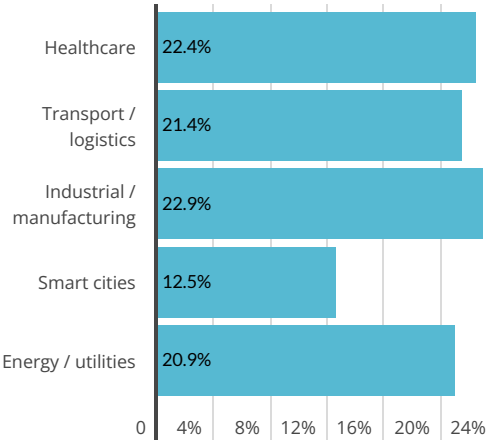
This year's survey has set out to take a deep-dive into where the key pain points in the context of cellular IoT connectivity lie and represents an expansion of the 2022 survey effort. Some 800 enterprises were surveyed during February-April 2023, representing activities in five key IoT industry verticals:

- Transportation & Logistics
- Industrial & Manufacturing
- Healthcare
- Energy & Utilities
- Smart Cities

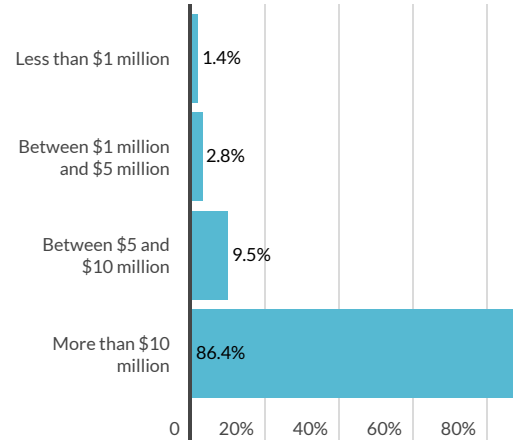
All respondents were all decision-makers at managerial level or higher within their organisation, in addition to having a good knowledge of the cellular IoT ecosystem. In order to understand a broad picture of perceptions, respondents included companies that had adopted cellular connectivity for IoT, in addition to those that had not. The differences, as well as the and consensus in perceptions among these groups and industry verticals, 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.

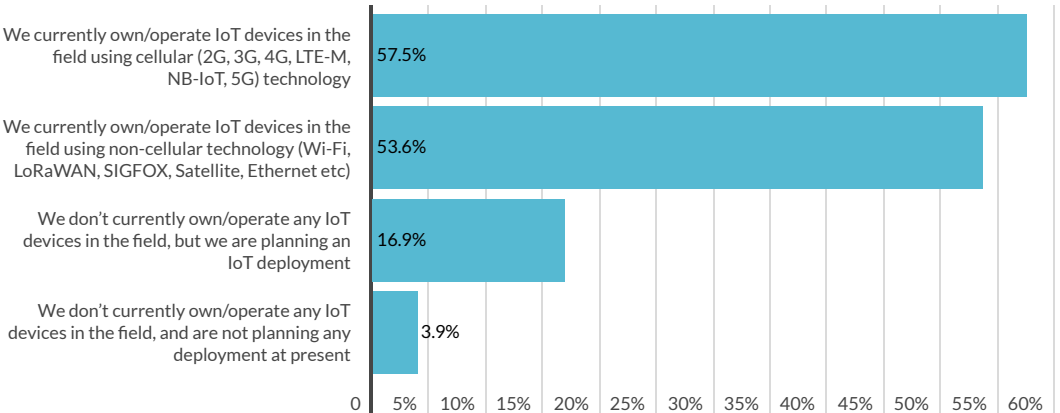
In what market segment does your business unit primarily operate?



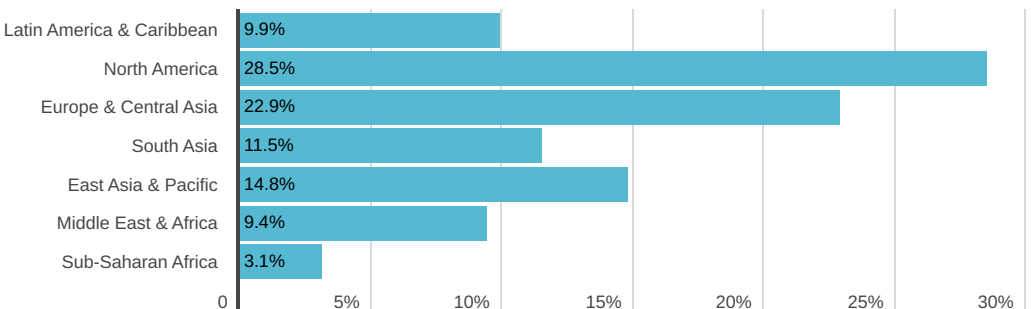
What was your organisation's turnover in 2022?



What is your organisation's current status in regard to IoT?



Where is your business unit based?

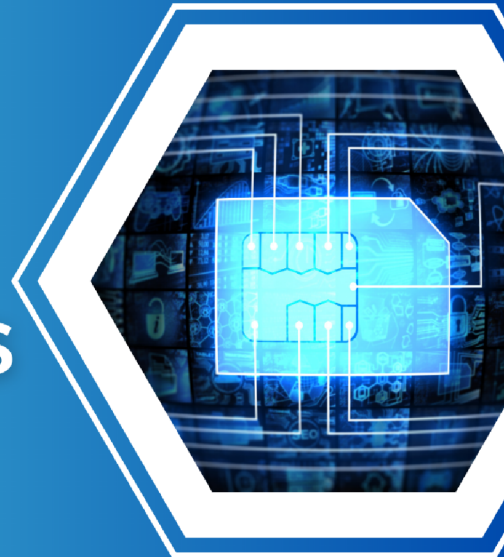




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eSIM Connectivity Challenges & Opportunities:

Adoption, Key Drivers and Barriers



eSIM Adoption, Key Drivers & Barriers

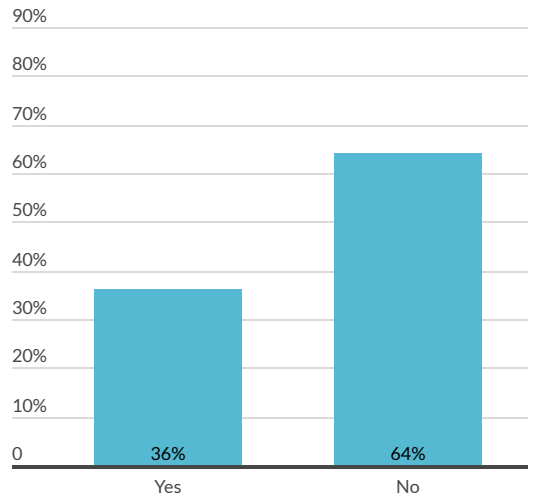
Although a standardised specification for eSIM has been in existence for close to a decade, the technology has been relatively slow to gain traction in the IoT world. In part, this is due to the complexity associated with the specification originally designed for IoT devices, dubbed SGP.02, or the 'M2M' specification. While the vision behind eSIM has played on the potential to switch operator profiles OTA, technical, commercial and legal barriers have largely prevented this practice from taking place. In essence, the majority of eSIM-enabled cellular IoT devices have remained in 'insurance mode' where leveraging the Remote SIM Provisioning (RSP) infrastructure necessary to execute profile swaps is only anticipated to be used in instances where regulations or considerable commercial restrictions make it necessary. Therefore, eSIM deployments have largely been considered a mechanism to avoid the long-term risk associated with IoT connectivity. Meanwhile, the additional expense associated with eSIM hardware and digital profiles has meant that, in an industry vertical context, automotive was the main customer for eSIM.

Over the past few years, the situation has begun changing. Industries beyond automotive have begun realising the long-term value of eSIM, while the mobile industry has carried out work on developing a new specification (SGP.32 - dubbed the 'IoT' specification) that is more aligned with the relatively simple RSP architecture in use for consumer smartphones and other mobile-enabled devices.

In the context of the survey, some **36% of cellular IoT adopters reported that they use eSIM as part of their IoT connectivity deployment,**

which highlights that the technology has yet to become pervasive across the IoT ecosystem.

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

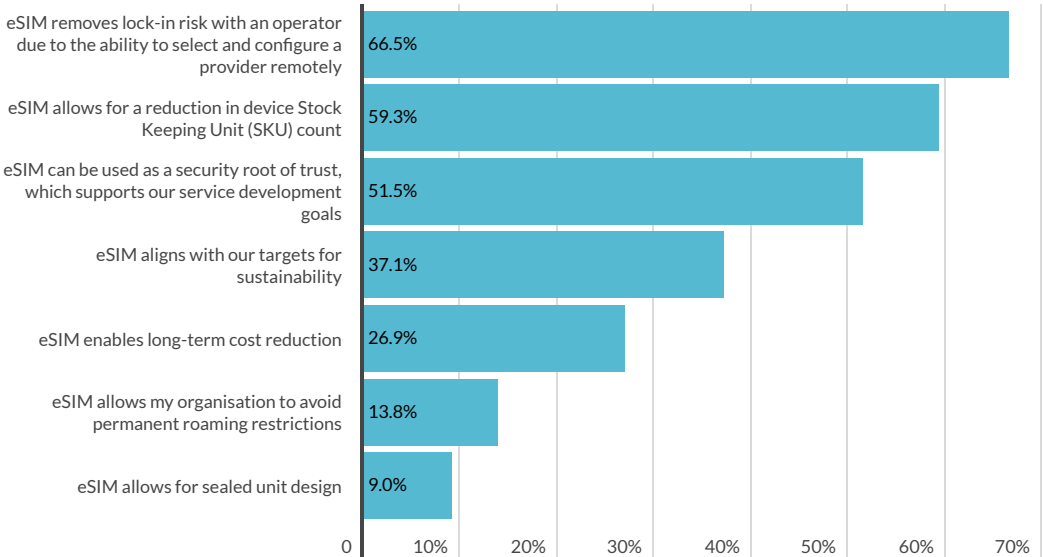


The primary reason behind choosing eSIM is, not unexpectedly, the ability to mitigate risks associated with being locked in with a single operator, and was cited by 66% of those who have adopted eSIM.

Importantly, it is apparent that this is not the only reason for choosing eSIM, with 57% of respondents claiming their decision was based on the ability to reduce the number of device Stock-Keeping Units (SKUs) on the production line. Here, it is pertinent to note that without the capability to optimise device connectivity OTA, different device configurations with different SIM cards targeting varied countries or regions are often produced at the point of manufacture.

Naturally, this increases complexity and costs; despite the additional costs involved with an initial eSIM deployment, avoiding this complexity at the production line can be highly beneficial to IoT customers. Meanwhile **51% reported that eSIM can be leveraged as a root of trust**, which is important in a security context. By leveraging industry frameworks such as IoT SAFE, eSIMs can be used to guarantee device identity, as well as ensure that data integrity between the device and connected third-party services has not been compromised.

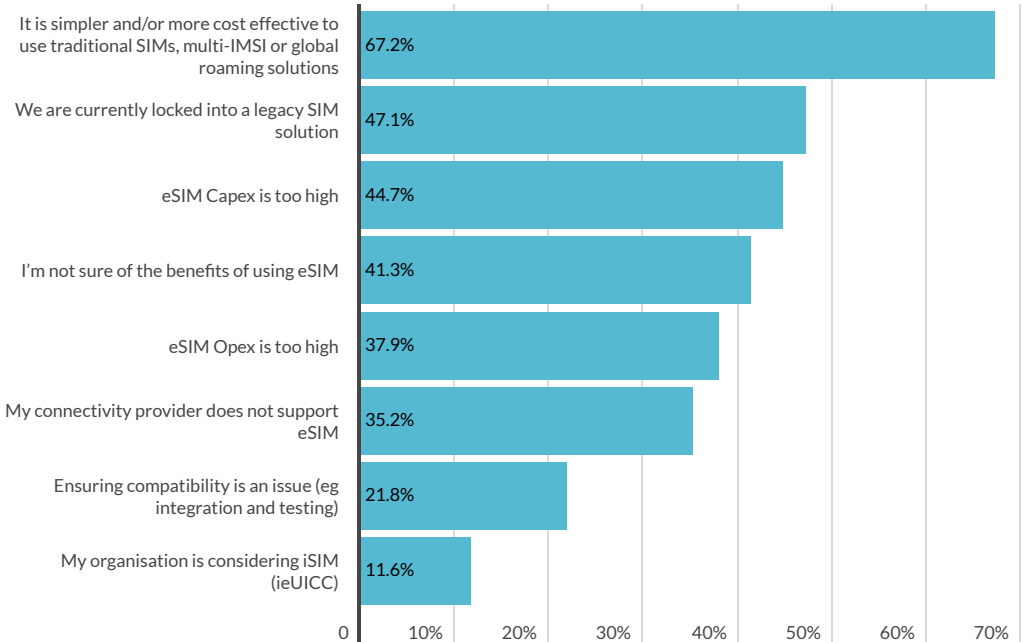
What factors made you choose eSIM (eUICC)? (Cellular IoT Adopters)



The 64% of cellular IoT adopters who stated they had not used eSIM for connectivity were questioned on their reasons for not adopting the technology. Given the imminent emergence of the IoT specification during summer 2023, the results provide an interesting juxtaposition, given that this development is almost certainly not broadly understood by the majority of enterprises. 67% of respondents reported that they felt it is simpler or more cost-effective to use solutions such as traditional roaming SIMs, multi-IMSI SIMs or global roaming solutions. While this might be the case where the use of the M2M specification is concerned (if one ignores the high costs involved with remediating and regulatory or commercial issues

encountered with international connectivity), the new IoT specification has been developed with reduced complexity in mind, and will thus make OTA profile switching a less painful process for customers.

Why have you chosen not to use eSIM (eUICC)? (Cellular IoT Adopters)



Nevertheless, challenges related to eSIM costs, whether Capex-related (45% of respondents) or Opex-related (38% of respondents), remain significant points of concern. The physical cost of eSIM will always be higher than legacy UICC cards (removable or embedded non-eSIM cards) due to the additional memory utilised for storing more than one operator profile on the card itself. The prevalence of iSIM (a SOC-integrated form factor of eSIM) will certainly reduce this cost, although iSIM is not anticipated to gather industry traction until around 2025. Meanwhile, other costs associated with eSIM, such as digital operator profiles, set-up fees and fees associated with OTA operations are dependent on both economies of scale being reached from a service provider perspective in addition to widespread recognition of the benefits of eSIM and associated action taken to encourage its use among

the broader MNO community which, in many cases, will only play a role at the wholesale level where providing profiles is concerned.



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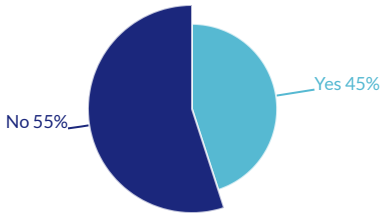
eSIMs in the Transport & Logistics Industry



eSIMs in the Transport & Logistics Industry

eSIMs are an increasingly common solution to many of the problems of international connectivity, and the logistics industry has enthusiastically adopted them. **45% of transport and logistics respondents with a current cellular IoT deployment reported they use eSIM**, the most highly adopted vertical of all the survey.

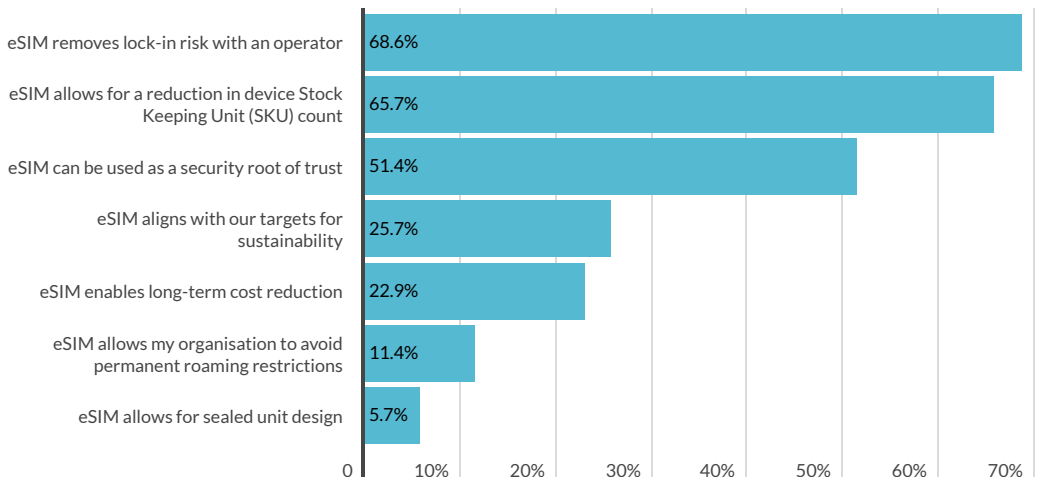
Have you decided to use eSIM (eUICC) as part of your IoT deployment? (Cellular IoT Adopters)



The main driving force for this is to **avoid operator lock-in**, with **69% of users reporting this as the reason for their usage**. A **reduction in SKU count is close behind at 66%**. These measures are intended both as a security policy and as a way to simplify international deployments, which it seems to be doing; non-eSIM users are significantly more likely to rank the complexity of managing multiple providers higher than those who use eSIM.

However, this reduction in complexity is unlikely to be related directly to roaming, with **only 11% of users reporting they use it to avoid permanent roaming restrictions**. It is likely to be used to provide a handful of global connectivity profiles that can then be switched to local profiles as required, rather than local profiles being a consistent use pattern wherever devices are located. In the context of logistics, this is also more cost-effective, as international mobile assets may need to change profiles several times if they are aiming for local usage, whereas a single international profile will require less switching, lowering both management time and profile costs.

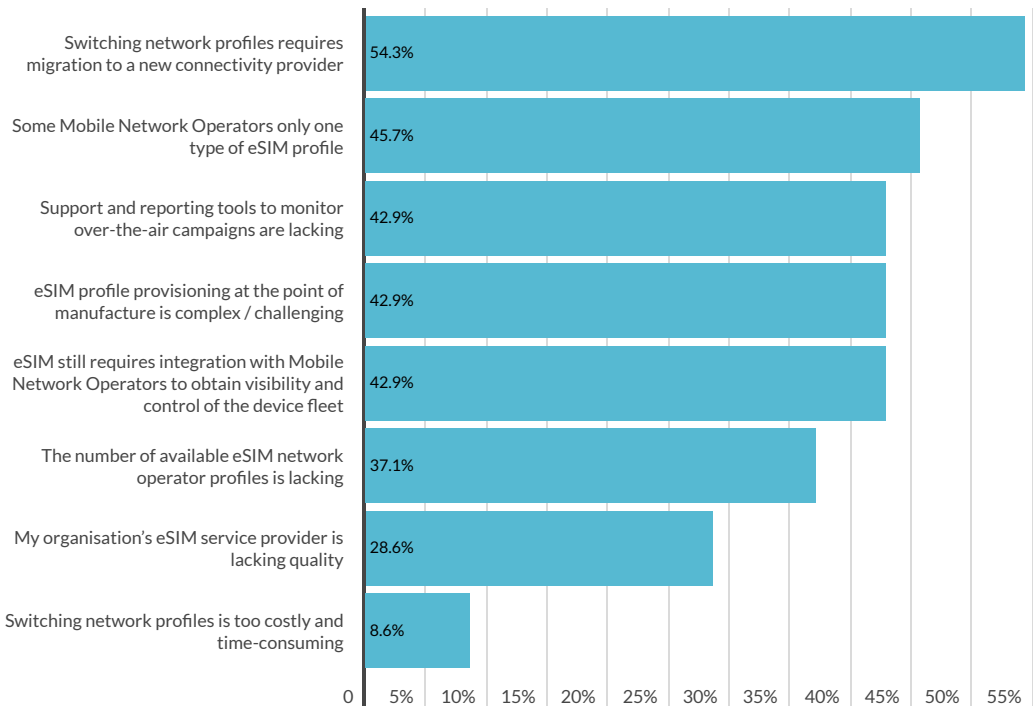
What factors made you choose eSIM (eUICC)? (Cellular IoT Adopters)



Indeed, there is likely to be a pervasive hesitancy from end users around profile switching; **54% of eSIM users reported that changing profile meant changing provider, negating the biggest benefit to using the technology to a large extent.** More profile flexibility is needed in general as well, with **46% of eSIM users reporting that there is limited support for the whole range of eSIM profile types.** With logistics covering a wide variety of device types, eSIM providers need to make a broader range of profile types available to match the needs of their end users.

These profiles also may not be delivering what end users need, with 43% noting that they cannot get full visibility without more integrations with local MNOs. This also makes switching MNOs challenging, as there will be a reluctance to change MNOs without guarantees of that fuller integration. Making sure that the profiles offered are full-featured should be a priority for eSIM providers.

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

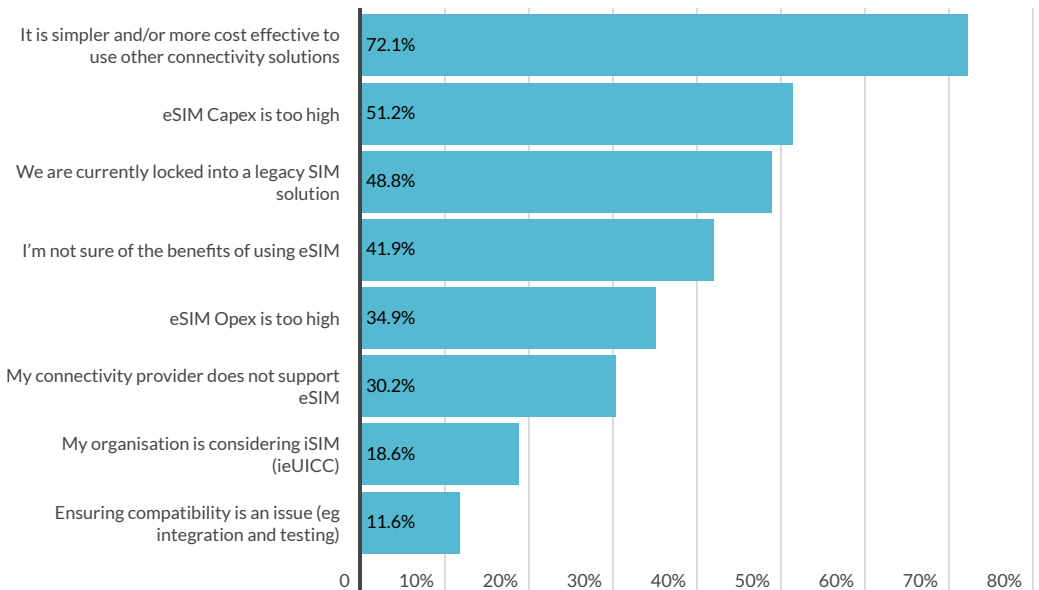


eSIMs' operational complexity is putting off potential users – **72% of non-users report that they believe other connectivity solutions are simpler.** However, even with the perception of complexity reduced it is unlikely to increase adoption by much. On average, non-users are reporting more than 3 reasons they do not want to use eSIM, and almost half are locked into a legacy SIM solution, and, therefore, unlikely to move unless the switch to eSIM happens as part of a broader hardware refresh.

iSIM can potentially help with some of these issues, although not all. Most particularly, the note that eSIM Capex is high can potentially be reduced by using iSIM over eSIM; with a reduced bill of materials, the expenditure on connectivity can potentially be reduced to more acceptable levels. More broadly, it should be emphasised that there is still a lot of uncertainty in the market about eSIMs, with 42% of non-users reporting that they are not sure of the benefits of using eSIM. Working with enterprises to clarify where it can be useful would be a good start

towards increasing their adoption, particularly for those who are committed to legacy solutions – establishing a relationship before the need to replace devices would give connectivity providers time to make the benefits of eSIM clearer to potential users.

Why have you chosen not to use eSIM (eUICC)? (Cellular IoT Adopters)





eSIM and iSIM enabled vehicle tracking and retrieval

Rethinking what smart vehicles are



Smart e-bike fleets and logistics tracking with smart trucking solutions are redefining urban mobility by addressing transportation challenges in major cities. These innovative approaches tackle congestion, emissions, air quality and the lack of city transit options. Research shows the sustainability benefits clearly:

if the share for e-bike riding rises to 11%, we could see a 7% decrease in CO2 emissions from the urban transport sector by 2030 – potentially accounting for over 50% of urban trips in the US and 70% in cities like London.

Behind the scenes, smart-vehicle solutions are complex. Interoperability is crucial as it facilitates collaboration among various stakeholders, including government and city councils, product manufacturers, and platform developers. Vehicle operators need a reliable, long-lasting solution to locate and retrieve lost devices or re-distribute them to places of greater usage.

Their success lies in the simplicity they present to users, who will only change their behaviors if the services offered are significantly more convenient and reliable. Those who sign up for e-bikes give away sensitive data, including billing information and other involuntary analytics, such as location and individual vehicle information.



Challenge:

Our customer is a pioneer in developing tracking and analytic solutions for managing and servicing large fleets of smart-mobility urban transportation. Our customer requires a unified customer experience that adheres to the regulatory, security, and safeguarding standards of over fifty cities spanning multiple regions. To meet these requirements, it was necessary to simplify the manufacture of a low-power and compact cellular IoT-enabled device.

This has resulted in a device that can be customized to cater to specific local requirements and associated carrier profiles. Its capabilities include offering location and retrieval functionality, reporting of lost assets, and collecting utilization statistics to drive adoption.



Solution:

Kigen's integrated SIM (iSIM) and embedded SIM (eSIM OS) combined with our strong partnerships within the module and chipset ecosystem provided a route to simplifying secure manufacture and late-stage personalization eliminating the need for multiple product development routes and inventory management.

Kigen is proud to contribute to the industries' collaborations around

eSIM specifications within GSMA working groups. We understand the requirements of businesses who need to embrace eSIM and iSIM today and those looking to deploy their devices to leverage the latest IoT-centric functions and features as detailed in the new IoT Remote SIM Provisioning (RSP) technical specification, SGP.32.

Kigen offers a flexible portfolio of eSIM operating system (OS) designs, which cover the full range of RSP specifications and can be employed to enable products to integrate with the matching RSP ecosystem. Furthermore, to meet the needs of citizen data security, it was essential that these edge devices were treated with robust security protocols - implementing chip-to-cloud security with GSMA's IoT SAFE security scheme. This approach offers additional assurances on ease of data cloud integration and interoperability.



Result:

By simplifying the manufacture of cellular-connected smart-mobility vehicles to offer location tracking, pattern tracking and more usability features in a compact, low power and ready-to-connect out-of-the-box solution, vehicle companies now have a solution that can scale seamlessly. To ensure that the early benefits of greening our cities are realized, operators of fleets and city councils can take advantage of well-established security frameworks ensuring data of the city, it's consumers and all IoT that serves them is cost-effective, secure and tamper-proof.

A blue and black kick scooter is shown against a dark background. Three yellow dots are placed along the stem of the scooter, each with a corresponding text label: "Robust authenticated ID" at the top, "Smart data" in the middle, and "Compact size" at the bottom. The Kigen logo is visible in the bottom left corner of the image area.

iSIM in micro-mobility fleet operations

- From root of trust to new use cases
- Tamper-proof and provisioned flexibly, extending service life
- Expand your markets with connectivity of your choice

Wider applicability:

Kigen's iSIM OS and solutions are built with high-growth markets of Massive IoT, such that enterprises can leverage strong security even at the most constrained size, power, and cost envelopes. Through greater integration of components, longer battery life and tamper-proof protection can allow safeguarding IP and innovation for manufacturers. Kigen's iSIM OS enables edge devices in consumer lifestyle products, mobile medical healthcare and point-of-sale devices. This along with standards-based security schemes such as IoT SAFE is a perfect combination to support the market's growth and strengthen the social contract with users.



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Afterword



About the authors



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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