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Enterprise Cellular IoT Demands & Opportunities: Energy & Utilities

A Kaleido Intelligence Survey Report

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Introduction to the Survey

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Introduction

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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.

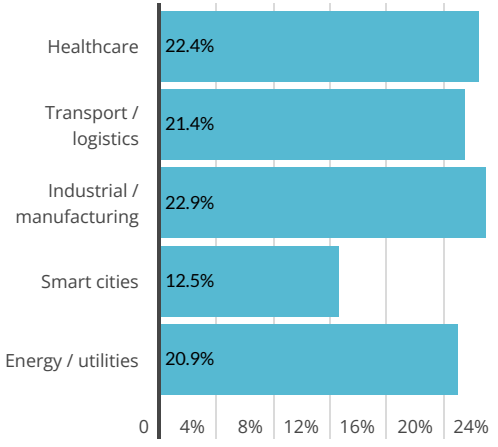
This year's survey has set out to take a deep-dive into where the key pain points in the context of cellular IoT connectivity lie and represents an expansion of the 2022 survey effort. Some 800 enterprises were surveyed during February-April 2023, representing activities in five key IoT industry verticals:

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

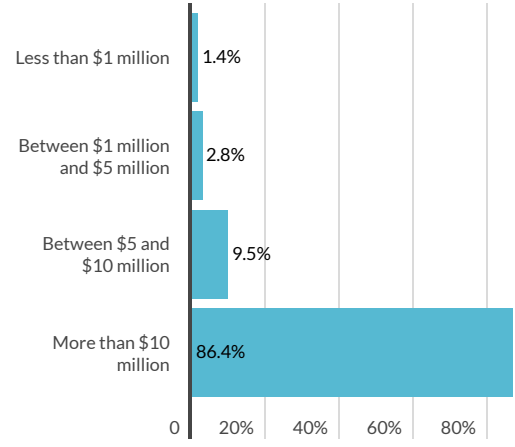
All respondents were all decision-makers at managerial level or higher within their organisation, in addition to having a good knowledge of the cellular IoT ecosystem. In order to understand a broad picture of perceptions, respondents included companies that had adopted cellular connectivity for IoT,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

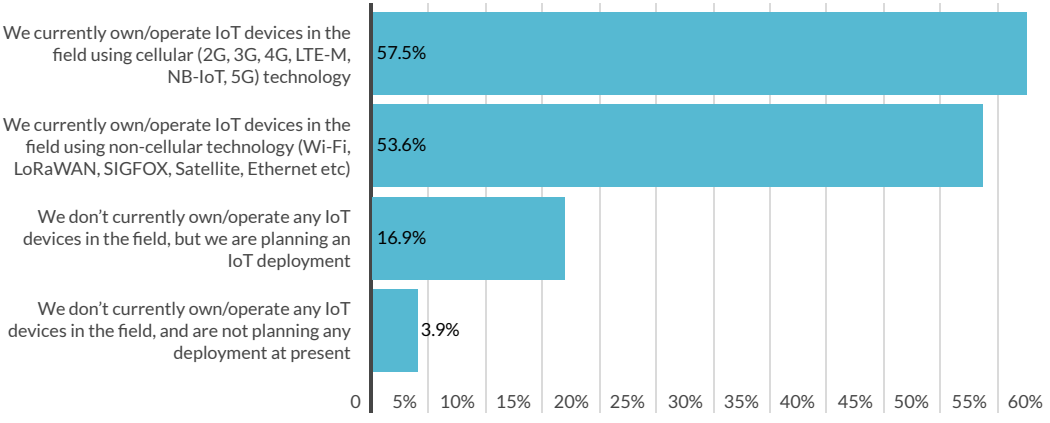
In what market segment does your business unit primarily operate?



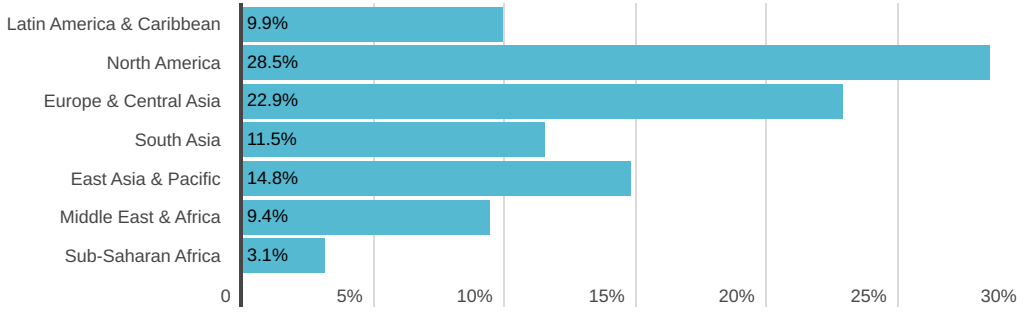
What was your organisation's turnover in 2022?



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



Where is your business unit based?



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Survey Themes

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The survey analysis allows us to identify several themes among the respondent base, which will be examined in the following sections.

Complexity

Costs, time-to-market, commercial and regulatory barriers, in addition to enterprise understanding of IoT requirements and goals all play a role in the success of IoT projects. Service providers must position themselves as both problem solvers as well as experts in the field here in order to help enterprise customers launch and maintain successful IoT deployments.

Sophistication

Enterprises are becoming increasingly aware of IoT risks, while simultaneously becoming more demanding in what they expect from connectivity providers. This means that service providers must become more sophisticated in how they approach the market.

Roaming

IoT devices provisioned with cellular connectivity often operate across several countries worldwide. Inevitably, this means that roaming, the technical and commercial arrangement that allows cellular devices to access networks in visited countries, is required. Coverage, costs, performance and support are of fundamental concern to enterprises here.

eSIM

eSIM enables a paradigm shift in how cellular connectivity can be provisioned and managed. Its reprogrammability over-the-air makes it a highly flexible solution to achieve various goals, and is increasingly considered a must-have for cellular IoT connectivity.

Private LTE/5G

Private cellular networks offer enterprises significant enhancements over traditional communications solutions, and suffer from few technical compromises. The ecosystem is complex, however, and a significant level of expertise is required to aid in choosing an appropriate deployment.

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IoT Connectivity Challenges & Opportunities:

Energy and Utilities

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State of IoT - Energy/Utilities

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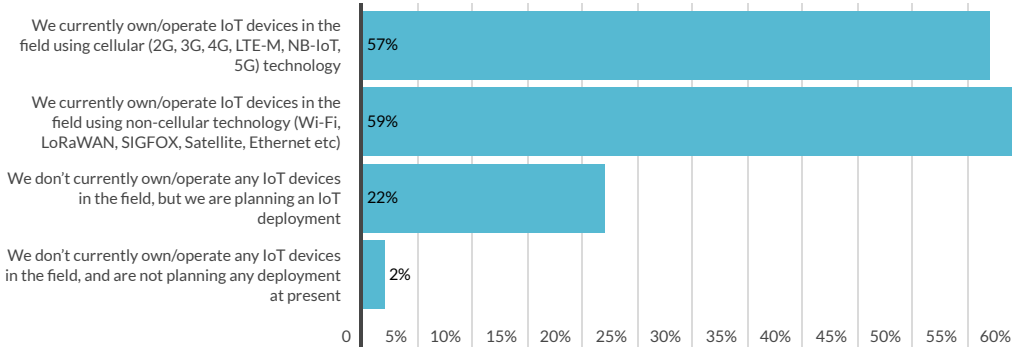
In last year's survey, some **48% of the survey respondent base reported that they had a cellular IoT deployment in the field; this proportion has now increased to 57% of respondents.** Naturally, this does not indicate an absolute percentage increase in adoption on account of the refreshed cohort, but it does serve to indicate that cellular technology is increasingly important in the energy and utilities segment.

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

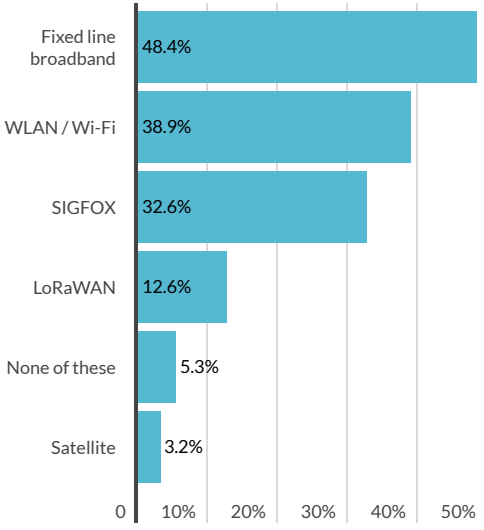


Does your organisation plan to adopt IoT over the next 12-24 months? (Cellular IoT Non-Adopters)

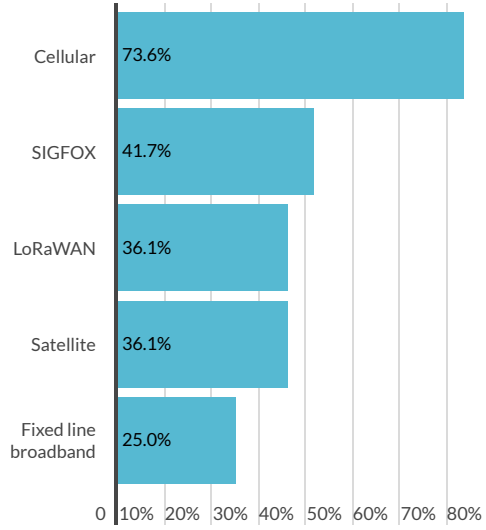
72%

It should be noted that 72% of cellular IoT non-adopters reported that they intend to deploy IoT connectivity over the next 2 years: cellular's importance is further underlined through cellular IoT non-adopters, with 74% of respondents stating that they view the technology as most viable for wide-area connectivity within their segment, although it should be noted that alternative LPWAN technologies such as LoRaWAN and SIGFOX combined to reach a proportion of 78% of respondents. Interestingly, satellite is viewed as a potential radio access technology by 36% of cellular IoT non-adopters, which reflects the current renewed interest in satellite communications following the development of the Non-Terrestrial Networks (NTN) support framework within the 3GPP's Release 17 for 5G. In contrast, only 3% of existing cellular IoT adopters reported that they have leveraged satellite communications.

Apart from cellular technology, are you deploying IoT using devices with other communications technologies? (Cellular IoT Adopters)



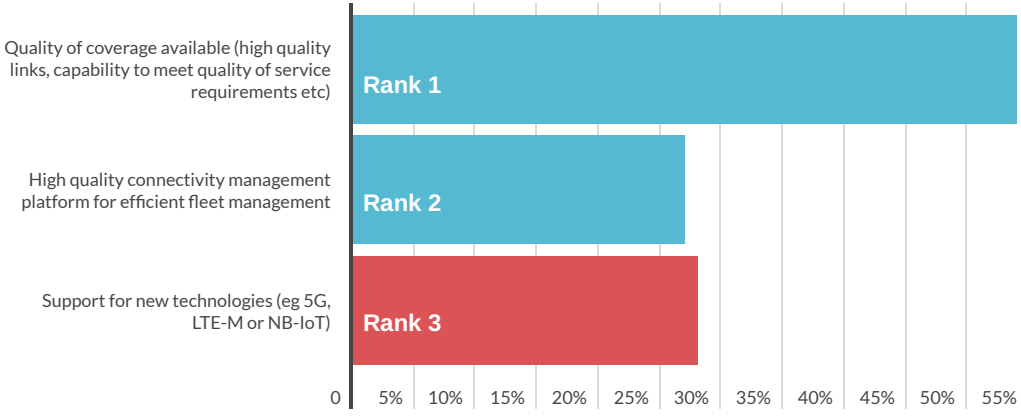
Which technology(ies) for wide-area connectivity do you view as most viable for IoT deployments? (Cellular IoT Non-Adopters)



This particular market vertical represents a diverse set of use cases ranging from smart metering, smart grid monitoring and automation, in addition to infrastructure monitoring and automation use cases, often in remote locations around the world. It is thus understandable to see a high proportion of respondents favour satellite for potential future applications, given the current state of NTN support in addition to in-orbit satellite capacity, while the lean towards LPWAN technologies, whether licenced or unlicensed, speak to many existing use cases, namely low-bandwidth monitoring and telemetry deployments.

Current industry support for LPWAN technologies such as LTE-M and NB-IoT remains in development, particularly from a wholesale and international perspective. The low throughput and battery-powered nature of these devices make them largely unsuited to eSIM OTA campaigns, where OTA downloading of a new operator profile can have a significant impact on battery life. Thus, roaming is a critical tool to support such devices. As such, it is not surprising to see that, among cellular IoT adopters, support for new radio technologies, including NB-IoT and LTE-M, was reported as a top three priority in terms of CSP choice for cellular connectivity.

What are the top 3 technical factors that influenced your organisation in choosing a cellular IoT connectivity provider? (Cellular IoT Adopters)



Complexity – Energy/Utilities

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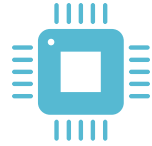
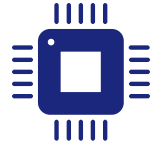
Vertical analysis reveals that challenges and complexity associated with hardware for cellular IoT represent a top pain point, and enterprises within the energy and utilities vertical are no exception. Here, 51% of cellular IoT adopters ranked this as their top challenge in the ability to scale operations up, compared to 60% of cellular IoT non-adopters. Linking this to earlier analysis regarding the types of RATs likely to be used for deployments, it is certainly understandable why this might be the case: international support in terms of coverage for technologies such as NB-IoT and LTE-M is inconsistent to say the least. In most cases, this requires acquiring hardware capable of supporting at least both radio types. Meanwhile, support for low power modes such as PSM (Power-Save Mode) and eDRX (Extended Discontinuous Reception) is not a given even when a network supports either LTE-M or NB-IoT, which creates new challenges at the application design level.

Top IoT scaling challenge: hardware complexity (Cellular IoT Adopters)



51%

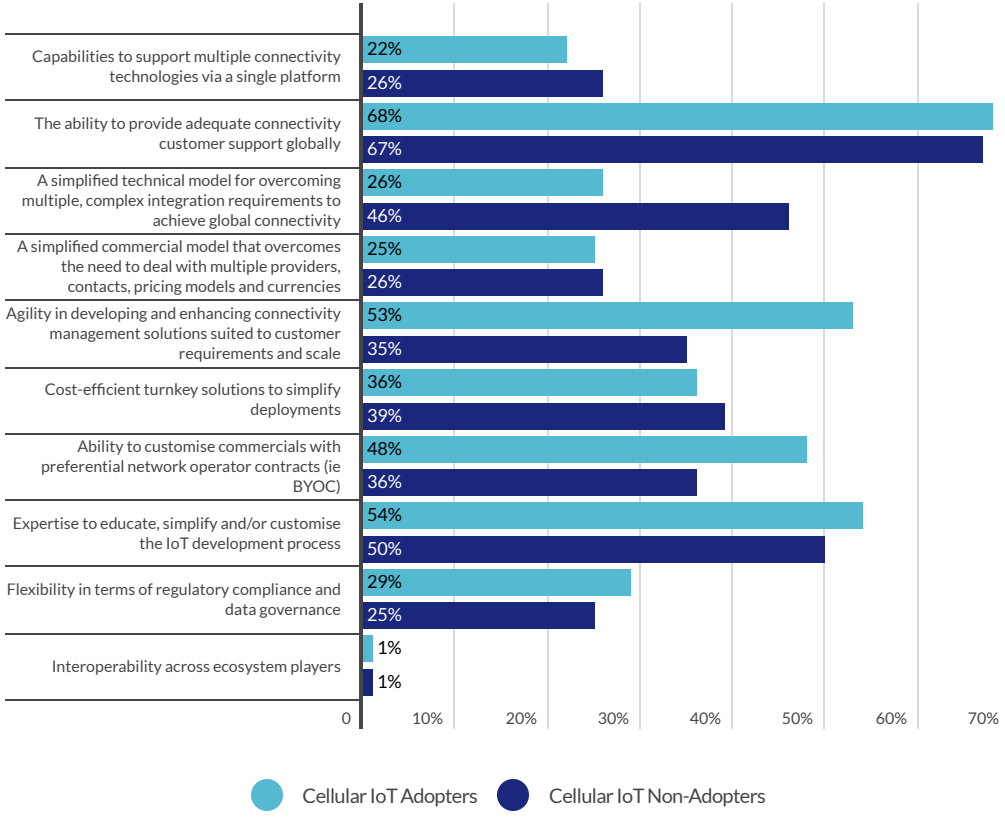
Top IoT scaling challenge: hardware complexity (Cellular IoT Non-Adopters)



60%

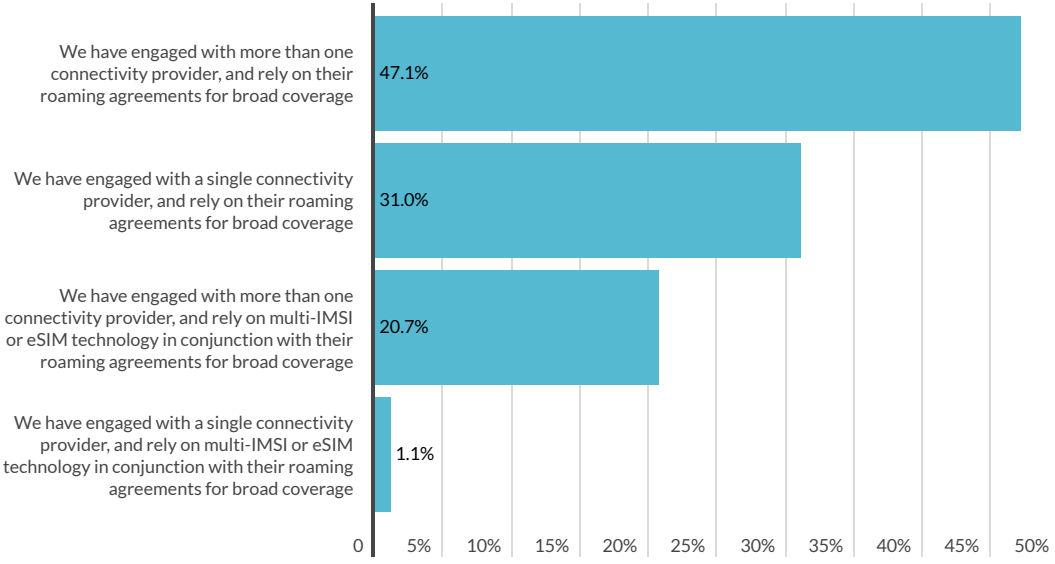
According to survey respondents, these challenges are compounded by a lack of ecosystem professional services and expertise to help them in design choices such as hardware and associated software. 54% of cellular IoT adopters and 50% of cellular IoT non-adopters perceive that expertise to educate, simplify or customise the IoT development process is lacking in the industry.

What do you perceive as lacking in the present IoT connectivity ecosystem? (All Respondents)



Further pain points continue with how customers approach the market to meet their coverage requirements. **68% of the cellular IoT adopter respondent base reported that they have contracted with more than one connectivity provider to meet international connectivity needs**, which underlines a key pain point that runs throughout the cellular industry today: global connectivity advertised by many CSPs is not truly global, owing to gaps in coverage footprints, ability to adhere to specific regulations within certain countries, or an inability to achieve competitive access rates in all markets that customers require.

How has your organisation addressed its international cellular IoT connectivity requirement? (Cellular IoT Adopters)



The ecosystem does not support a simple model for rolling out devices internationally (Cellular IoT Non-Adopters)

60%

This sentiment is reflected when examining perceptions from the cellular IoT non-adopter cohort: 60% of respondents believe that the lack of a simple model for rolling out devices internationally represents a major challenge in entering the cellular IoT connectivity ecosystem.

One possible avenue to overcoming the issue of engaging with multiple providers for connectivity can be found through an emerging concept, dubbed 'Bring Your Own Connectivity' (BYOC). In this scenario, enterprise customers can retain commercial connectivity contracts with favoured partners, and integrate them into a preferred CSP's CMP solution. This allows the enterprise customer to leverage both the connectivity relationships that the CSP is able to offer, in addition to existing contractual relationships formed by the enterprise. BYOC remains at a relatively nascent stage of development and is inherently challenging to execute: not only must connections be migrated from one CMP to another (a long and often arduous process), but all parties involved must also agree to the migration. The result is typically an expensive process.

Notably, respondents also stated a desire for simplification where connectivity and back-end systems are concerned. In this context, cellular IoT adopters and cellular IoT non-adopters ranked the ability to simplify the integration of solutions into existing products and processes as a top 3 and top 2 priority, respectively.

How important is ease of integration into existing products processes? (Cellular IoT Adopters)

How important is ease of integration into existing products processes? (Cellular IoT Non-Adopters)

These results underline the need for CSPs to look beyond their role as simply a connectivity provider and focus on delivering more fleshed-out solutions. As we saw in the overall survey results, the ability to authenticate and provision devices with cloud services is viewed as highly important, and this type of offering goes some way in simplifying integrations processes. Meanwhile, the desire stated for professional services and expertise highlights that enterprise customers would like to see CSPs as more of a 'one-stop-shop' for many of their requirements, and this is likely related to the fact that conversations with CSPs typically now take place much earlier in the IoT development process than was the case some years ago. Indeed, the points raised in this section highlight how enterprises are now more demanding in terms of their expectations from service providers and their portfolios, which leads us to the following section.

Sophistication - Energy/Utilities

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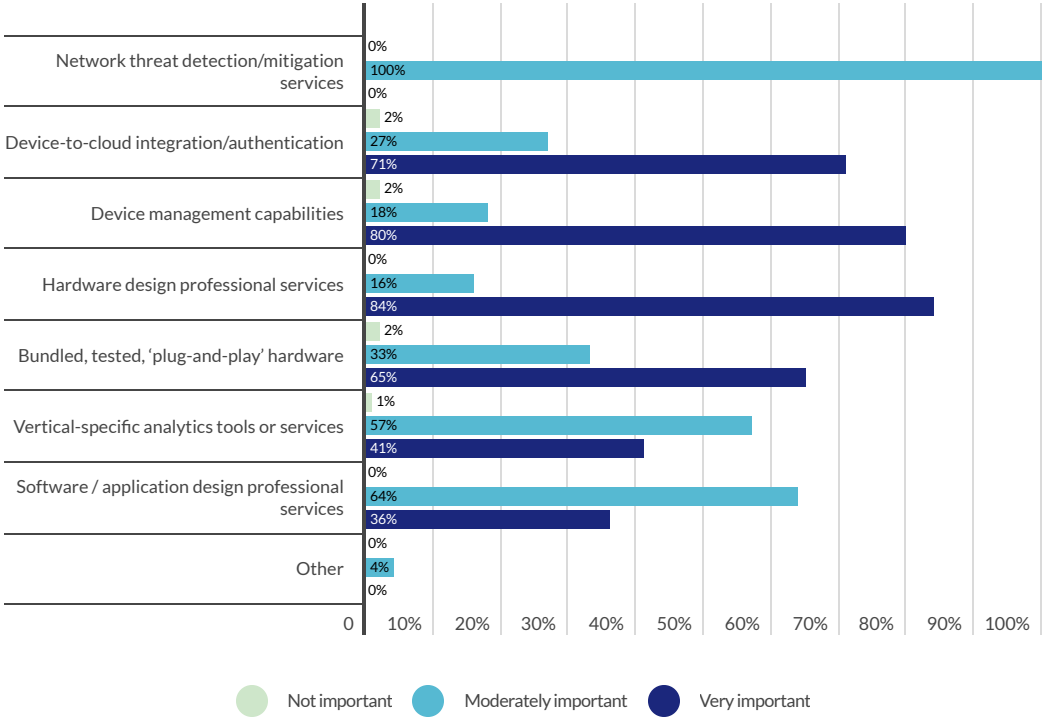
VAS is evidently an important factor in theenergy and utilities enterprise customer selection process in the context of their CSP. While device-to-cloud authentication is viewed as very important by 71% of cellular IoT adopters, compared to a survey average of 75%, device management capabilities were also reported as very important by 80% of the respondents. In the present market, relatively few CSPs offer device management capabilities in conjunction with connectivity management services, with the majority of providers that do provide a combined offering falling into the MNO or module OEM and connectivity service provider segments.

Beyond connectivity, what are the most important value-added services you expect your cellular IoT connectivity service provider to offer? (Cellular IoT Adopters)



Similar results were observed in 2022's survey regarding device management capabilities, and these indicate an increasingly demanding enterprise customer base within this vertical. It is certainly the case that devices, particularly in smart metering use cases, can be in the field for 15 years or more, and thus must ensure that firmware can consistently be updated in order to mitigate security risks. The capability to provide security services as VAS was viewed as moderately important by the entire cellular IoT adopter respondent base, while the capability to offer extensive security features was ranked as a top 3 and top 2 priority by cellular IoT adopters and non-adopters, respectively, when asked which CSP product capabilities were top priorities.

How important are extensive security features as part of a CSP partner's product? (Cellular IoT Adopters)

Rank 3

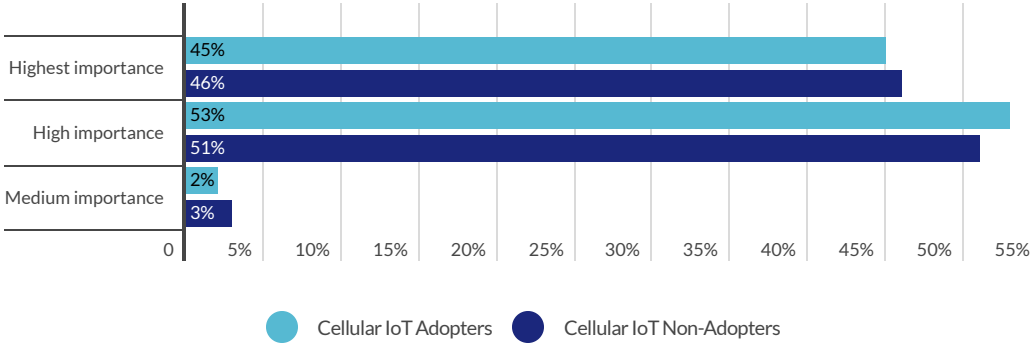
How important is ease of integration into existing products processes? (Cellular IoT Non-Adopters)

Rank 2

Security is notably important within this particular vertical, given the fact that critical infrastructure is often involved, such as in the supply of electricity and water. CSPs must evidently position themselves to enable customers to not only keep devices updated throughout their lifecycle in order to mitigate risks but also consider offering solutions beyond the typical private APN and VPN offering found across the ecosystem. In many instances, MNOs offer managed security services, although this does not provide the customer with visibility over devices' risk profile; as such, there is a potential avenue for MVNO players to develop offerings to help customers understand traffic flows, identify risky behaviour and perform root cause analysis and mitigation.

A further point of consideration is the fact that enterprise cellular IoT adopters evidently place a high emphasis on CSP business practices: 45% of respondents, higher than any other vertical, placed a very high importance on CSPs' adherence to ESG frameworks. This is not an unexpected result, given the growing trend for businesses to adopt environmentally sustainable approaches to business; even in the case of fossil fuel industries, considerable pressure has led some companies to become more environmentally sustainable and incorporate ESG frameworks into operations and reporting.

How important is that your connectivity partner actively adheres to sustainable (Environmental, Social and Governance) frameworks? (All Respondents)



Further evidence of growing enterprise sophistication is the demand for more flexible approaches to billing, which becomes important when one considers the types of connectivity technologies involved in deployments. Earlier, we observed a strong preference towards LPWAN-based technologies, which do not consume large volumes of data. Additionally, deployments for use cases such as smart meters normally involve several hundred thousand, if not millions of devices. In this case, the ability to offer pooled pricing plans, where a large pool of data is allocated to a group of devices, is critical in maximising efficiency for the customer. Meanwhile, Kaleido has observed over the past 2 years that some CSPs are beginning to move away from data-based billing and billing instead based on 'non-telecom' metrics, such as the number of messages transmitted per day, or the number of sensor readings made per day. Pure data-based billing is still highly prevalent in the industry, but the fact that cellular IoT adopters and non-adopters ranked billing flexibility as top 5 and top 4 in terms of IoT connectivity importance highlights a growing demand for new approaches to how the market is set up.

Roaming – Energy/Utilities

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International connectivity and roaming continue as a key theme in the energy and utilities segment. Although risks associated with permanent roaming were ranked as the top 4 and top 3 challenges in scaling up operations by cellular IoT adopters and non-adopters, respectively, the same respondents agreed that ensuring deployments are free from regulatory and commercial restrictions is the number one priority for IoT connectivity.

Permanent roaming causes scaling issues (Cellular IoT Adopters)

Rank 4

16%

Permanent roaming causes scaling issues (Cellular IoT Non-Adopters)

Rank 3

21%

CSPs must safeguard against commercial & regulatory restrictions (All Respondents)

Rank 1

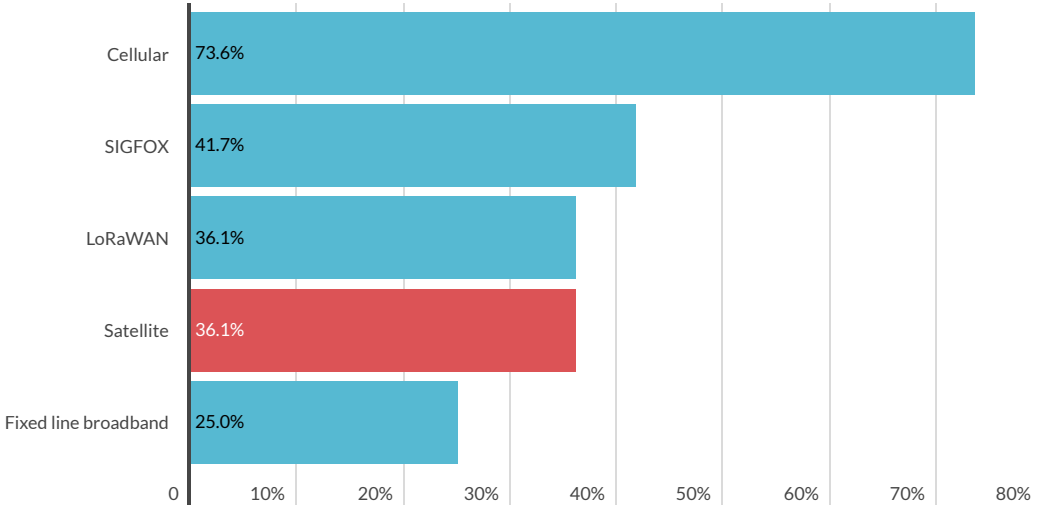
52%

Risks related to roaming are particularly evident in this vertical, given the fact that devices are often in the field for longer than a decade, and the need to replace SIM cards across what might be hundreds of thousands, or even millions of devices would be considered a catastrophe in terms of the viability of any IoT initiative. It is thus imperative that CSPs delivering connectivity solutions to customers within this vertical can offer long-term guarantees to customers in the context of ensuring that connectivity uptime can be maintained throughout the lifecycle of the devices in question. This is easier said than done, given the length of typical wholesale roaming agreements in place for IoT connectivity and likely means that technical solutions must be delivered to provide the relevant assurances. Indeed, these will be observed and examined in more detail as we analyse the use of eSIM in this vertical.

Notably, coverage is an important factor within this vertical, likely due to the fact that many deployments will involve devices either located in remote areas, such as is the case in mining or smart grid applications, or devices potentially located underground, as might be the case in smart metering scenarios. Here, 54% of cellular IoT adopters ranked quality of coverage as their top technical factor behind choosing a cellular IoT CSP, and indicates a need for CSPs to establish multiple connectivity partnerships to fill coverage gaps that might occur if reliance is placed on connectivity through a single MNO incumbent. Indeed, the idea of quality of coverage becomes even more important when considering the fact that LPWAN connectivity is often demanded in this segment: while operators may well claim to have coverage for LTE-M or NB-IoT within a specific country, this by no means indicates that blanket coverage is offered alongside traditional LTE. In some instances, LPWAN coverage is limited to a select number of cities, which in turn

does not match the requirements of enterprises that might require coverage in remote locations. It is here that one can infer that establishing satellite connectivity partnerships may well be beneficial for the industry as a means of bridging that connectivity gap: 36% of cellular IoT non-adopters reported that they would consider the technology as viable for any future IoT deployment

Which technology(ies) for wide-area connectivity do you view as most viable for IoT deployments? (Cellular IoT Non-Adopters)



eSIM - Energy/Utilities

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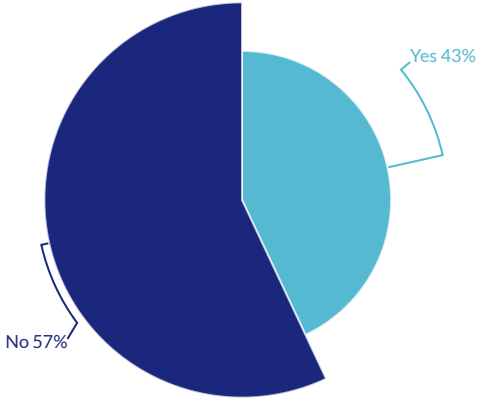
The energy and utilities sector demonstrated the second highest adoption level of eSIM across the 5 verticals analysed here, second only to transportation and logistics. Here, 43% of cellular IoT adopters reported that they have included eSIM in their deployment, compared with a survey average of 36%.

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



As outlined earlier, many deployments in this vertical involve connectivity requirements that span a decade or more. This presents issues, not only from a security perspective but also from the perspective of long-term connectivity assurance.

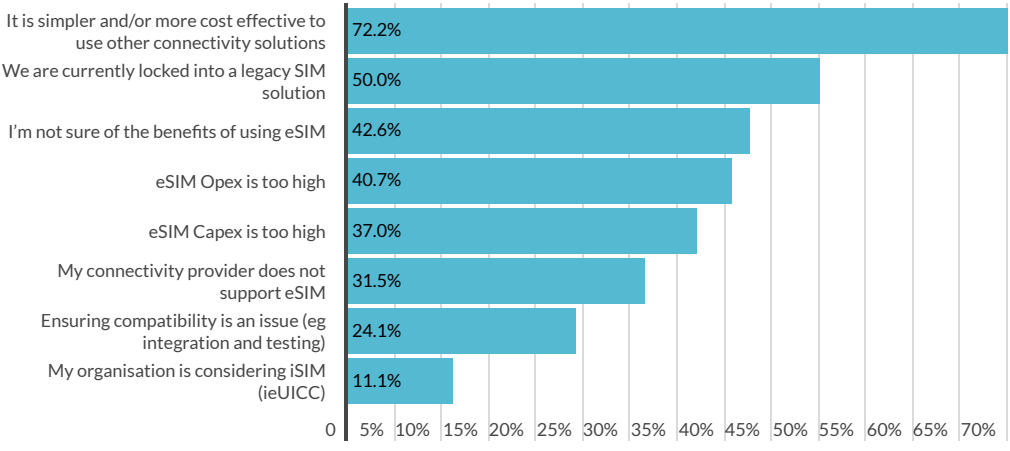
Leveraging the capabilities of eSIM within the energy and utilities vertical is presently problematic in cases where LPWAN connectivity is used. In the first instance, eSIM profiles typically consistent of several hundred kilobytes, which may present issues for LPWAN devices designed to utilise low bandwidth. Additionally, NB-IoT devices utilising the M2M eSIM specification typically cannot be reached by SMS (the mechanism with which an OTA campaign is initiated), requiring a custom solution. Meanwhile, devices may have inconsistent sleep times, depending if they make use of PSM or eDRX, which in turn means that they may be difficult to reach when an OTA campaign is executed. In this instance, careful monitoring of the campaign will be required to understand the success rate of any commands issued to change operator profile OTA. According to cellular IoT adopters, **39% of the respondent base reported that support and reporting tools to monitor such campaigns are lacking in the industry**: it is certainly the case that, due to the complexity of OTA operations, these are often conducted via the 'back office' of the CSP in order to minimise error rates and potentially costly mistakes in configuration. Nevertheless, it is evident that more transparency regarding campaign activity is desired.

Support and reporting tools to monitor over-the-air campaigns are lacking from eSIM Connectivity Solutions (Cellular IoT Adopters)

39%

Importantly, more pressing challenges are perceived in the form of profile availability for eSIMs, with **54% of respondents reporting a lack of available profiles.** This ties closely in with the concern over regulatory and commercial restrictions that may arise over time in roaming scenarios, given the lack of a suitable commercial arrangement will necessitate the use of a local profile, or even the full migration of connections onto an alternative provider. For the time being, the majority of local profiles available on the market are delivered as a result of regulatory restrictions in place, such as in Turkey, Brazil etc. Kaleido is aware of activity by operators, particularly in North America as well as the Middle East to maximise the wholesale potential of eSIM by initiating strategies to open up their profiles to MVNO players, although this development by no means indicates a free-for-all on the market. Nevertheless, profile availability is likely to increase over the coming years, particularly following the commercial launch of IoT specification RSP architecture.

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



A large majority of those who have not adopted eSIM reported that this is due to the fact that **it is simpler or more cost-effective to use alternative SIM solutions, with 72% of the respondent base reporting as such.** This strong perception certainly highlights an ongoing belief that entry into the eSIM ecosystem results in complexity, and undoubtedly the existence of the M2M specification has had a hand in developing this perception among those who have a reasonable technical understanding of eSIM.

Nevertheless, it is potentially encouraging, from a service provider perspective at least, to see that **43% of those who have not adopted eSIM are not sure of the benefits** of eSIM technology. Studies have been produced that highlight the advantages of eSIM over 'legacy' SIM solutions, both from a practical perspective as well as from a cost standpoint, when physical SIM swaps are required into the long term. It is evident, however, that greater education is required, and greater emphasis is applied to the total cost of ownership for eSIM versus alternative solutions, particularly for deployments that involve many thousands of devices or devices in remote areas.

Private LTE/5G - Energy/Utilities

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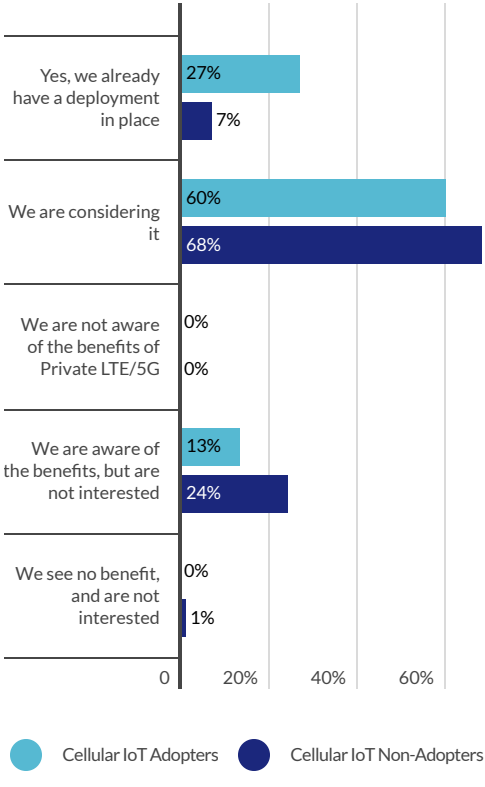
Private cellular networks can be viewed as a particularly attractive solution for enterprises within this vertical, on account of the range of use cases requiring connectivity in remote locations, in addition to the high-security requirements for connected critical infrastructure. In the case of energy and utilities enterprises, private network solutions may often require connectivity across multiple sites across a given country, leading to a network architecture that makes use of public RAN infrastructure alongside private core network infrastructure. Naturally, private RAN infrastructure will be required for locations where no public RAN coverage is available, which may mean additional complexity for deployments.

Some **27% and 7% of cellular IoT adopters and non-adopters reported that they have a private LTE or 5G solution in place**, with adoption among the former cohort considerably higher than the survey average of 13%. Meanwhile, it is notable that a sizeable proportion of the respondent base, **60% of cellular IoT adopters and 67% of non-adopters, reported that they are considering a future private LTE or 5G deployment.**

Does your business unit have an interest in Private LTE/5G to enhance business operations? (All Respondents)

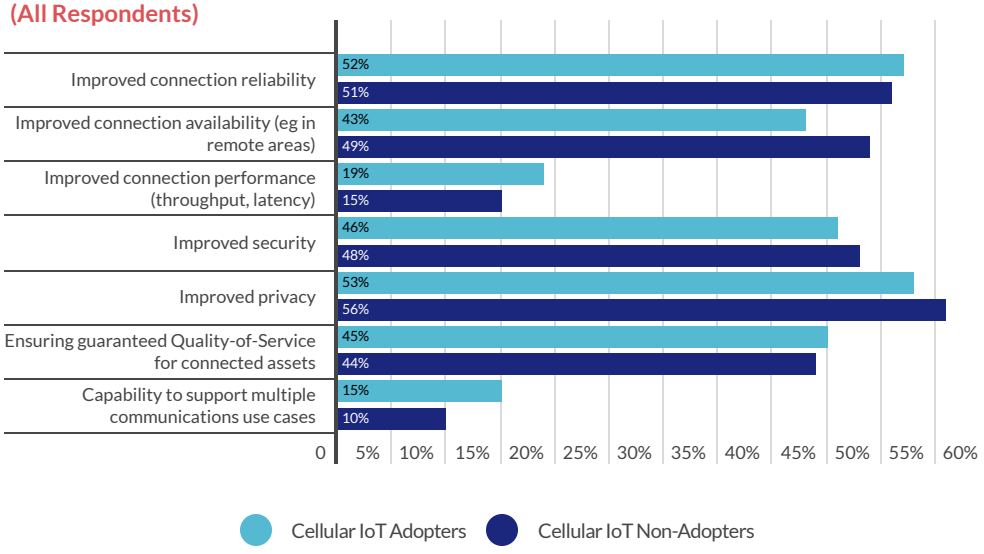


Improved privacy and connection reliability were cited as key factors behind the consideration of private cellular networks as an organisational benefit, according to 53% and 52% of cellular IoT adopters and non-adopters, respectively. As noted earlier, deployments often involve the communication of potentially sensitive data, while the nature of the industry means that assurance of connectivity uptime is critical to operations. Interestingly, **throughput and latency improvements resulting from private network deployments were not seen as a critical benefit, with only 19% of cellular IoT adopters and 15% of cellular IoT non-adopters citing this as key.**

Once again, this highlights the likely nature of devices involved in potential deployments, where sensing and intermittent status reporting are the most demanded use cases, as opposed to high throughput, real-time applications. Nevertheless, it is important to note that this capability may well be of interest to certain enterprises within this particular vertical: for example, mining operations may wish to deploy private LTE or 5G

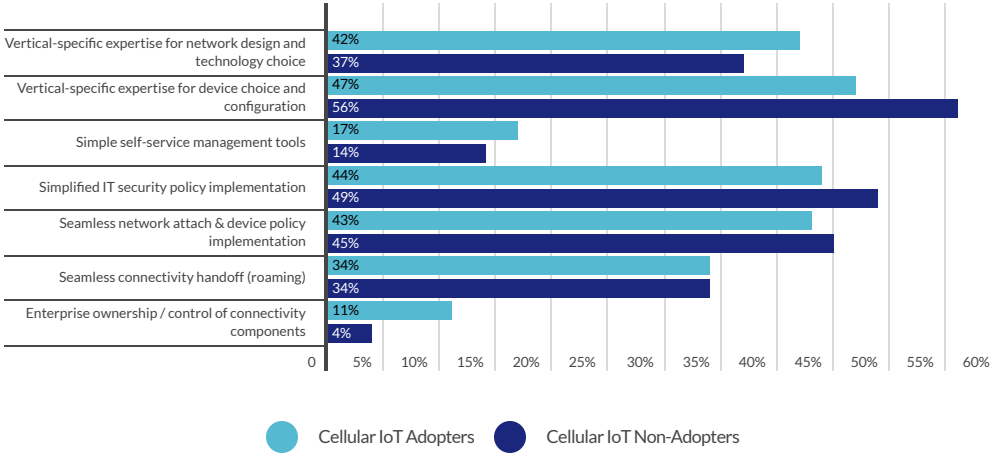
while leveraging the technology in conjunction with automated guided vehicles.

What do you perceive to be the main benefits of a Private LTE/5G solution? (All Respondents)



Several factors come to light as important where enterprises consider private LTE or 5G deployments. In line with broader survey results, **expertise in device design and configuration is a key requirement, according to 47% of cellular IoT adopters and 56% of non-adopters.** However, it is interesting to observe that **42% of cellular IoT adopters additionally reported a need for expertise in network design,** which likely speaks to the more distributed nature of private LTE or 5G requirements in this vertical – whereas in some other verticals, deployments will be restricted to campus-type deployments. Meanwhile, other factors, such as IT security policy implementation in addition to seamless network attach between private and public networks, indicate that a high level of service provider specialism will be required to cater to enterprise needs where private LTE and 5G is concerned.

What do you perceive to be the main benefits of a Private LTE/5G solution? (All Respondents)



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Afterword

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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.

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Publication Date: May 2023
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