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Enterprise Cellular IoT Demands & Opportunities: Manufacturing & Industrial

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.

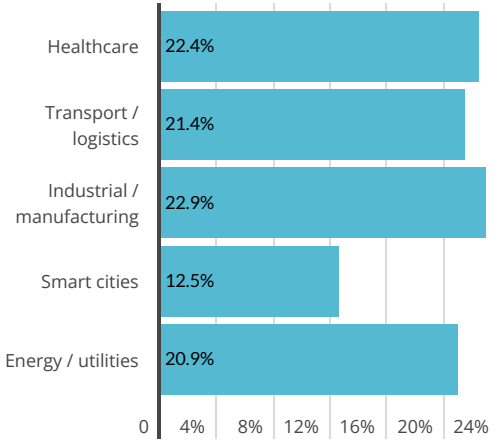
This year's survey has set out to take a deep-dive into where the key pain points in the context of cellular IoT connectivity lie and represents an expansion of the 2022 survey effort. Some 800 enterprises were surveyed during February-April 2023, representing activities in five key IoT industry verticals:

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

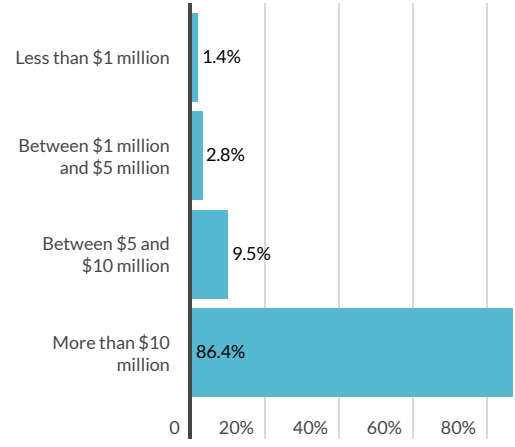
All respondents were all decision-makers at managerial level or higher within their organisation, in addition to having a good knowledge of the cellular IoT ecosystem. In order to understand a broad picture of perceptions, respondents included companies that had adopted cellular connectivity for IoT, 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.

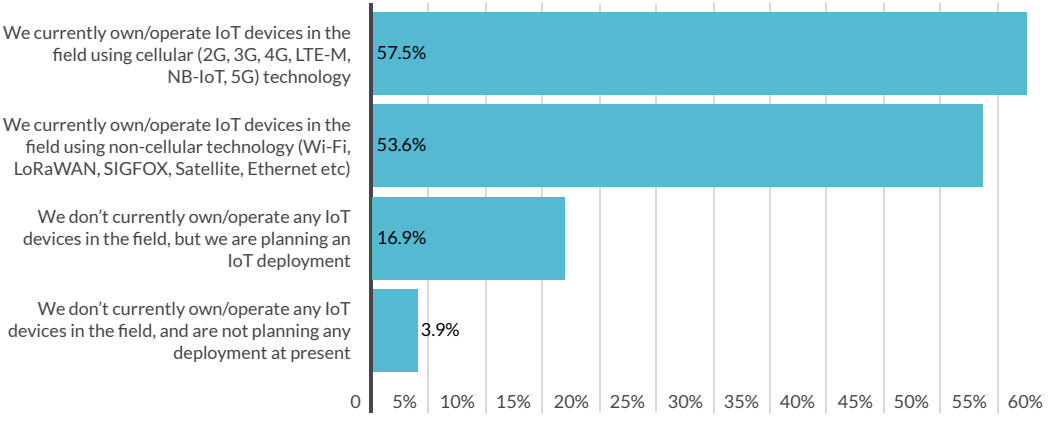
In what market segment does your business unit primarily operate?



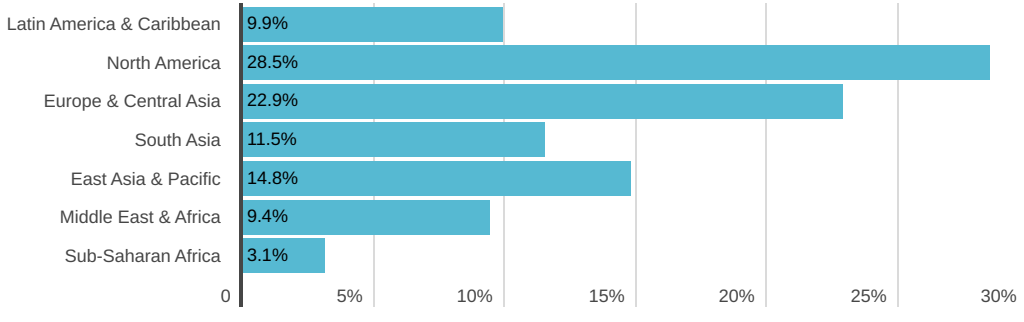
What was your organisation's turnover in 2022?



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:

Manufacturing and Industrial

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State of IoT - Industrial/Manufacturing

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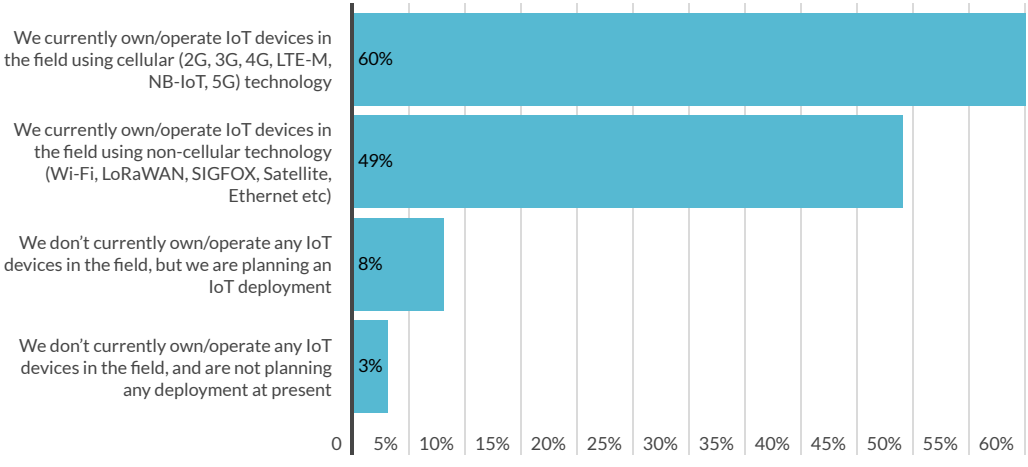
Manufacturing is one of the biggest sectors for the future of cellular IoT, with the smart factory being a prevalent concept in the imagination of the IoT. There is strong current adoption as well; over 96% of respondents reported they either currently have or are planning to have an IoT deployment. However, not all of this is cellular – manufacturing has the highest incidence of non-cellular deployments reported, with 33% of manufacturing industry respondents reporting that they do not have any current cellular IoT deployments. Non-cellular connectivity has a clear role to play, with 49% of respondents reporting they have non-cellular devices in-field and 68% of future adopters considering some form of unlicensed spectrum potentially suitable for their IoT deployments.

What is your organisation's current status in regard to IoT? (All Respondents)



It should be noted, however, that there is a significant number of deployments where cellular and non-cellular connectivity coexist – **34% of cellular IoT users report using non-cellular connectivity as well**. Connectivity providers need to be ready to support multiple technologies within their management platforms in this industry, particularly as **72% of cellular non-adopters use non-cellular connectivity for their IoT needs**. Cellular gateways transporting data from non-cellular endpoints will be a core feature of these forms of networks in future. The bandwidth constraints inherent in most non-cellular technologies also mean that many of the features of new cellular technologies, particularly 5G-based networks, are not necessarily required by manufacturing customers, despite high levels of interest in the technology.

In addition, supporting smaller companies may also be a good way to grow the market, as relatively few of these

companies are currently deploying cellular IoT. While 65% of manufacturers with more than 500 employees report they have a current cellular IoT deployment, only 38% with under 500 employees do so. However, this is likely due to the inaccessibility of the IoT to small businesses in general, as non-cellular IoT adoption shows similar numbers.

Much of this opportunity will fall to MVNOs; they remain the most popular type of company to engage for cellular IoT, with **67% of current adopters using an MVNO, and 62% of future adopters having approached them.** However, MNOs appear to be positioning themselves as strong contenders as well, with **31% of future adopters reporting they have selected an MNO as an IoT connectivity provider**, while no future users noting confirmed MVNO selection. It should be noted that, even where an MNO is selected, being able to offer services on an independent basis is still valued; being an independent partner is a capability that manufacturers ranked number 4 in their assessment of connectivity provider capabilities, and so being able to offer not merely the operator's own connectivity but the best connectivity available is vital. MNOs need to become like MVNOs if they are to provide a strong product offering in the IoT market.

Penetration of Non-Cellular Technology use for IoT (Cellular IoT Adopters)

34%

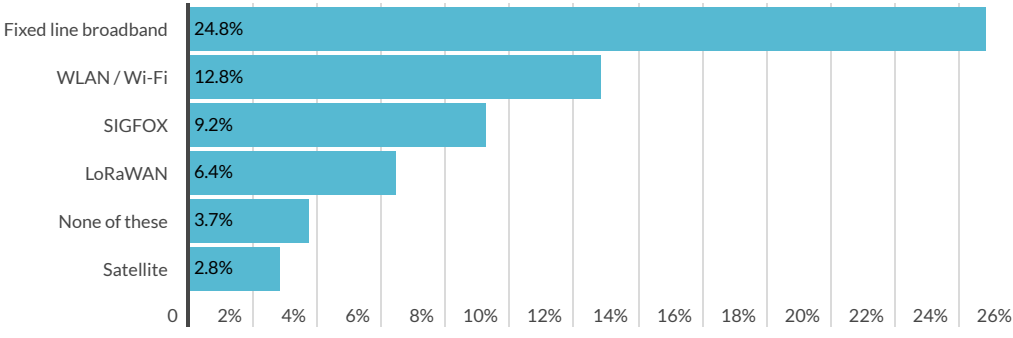
Non-cellular technology use for IoT (Cellular IoT Non-Adopters)

72%

How important is a carrier agnostic, independent partner? (All Respondents)

Rank 4

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



Complexity - Industrial/Manufacturing

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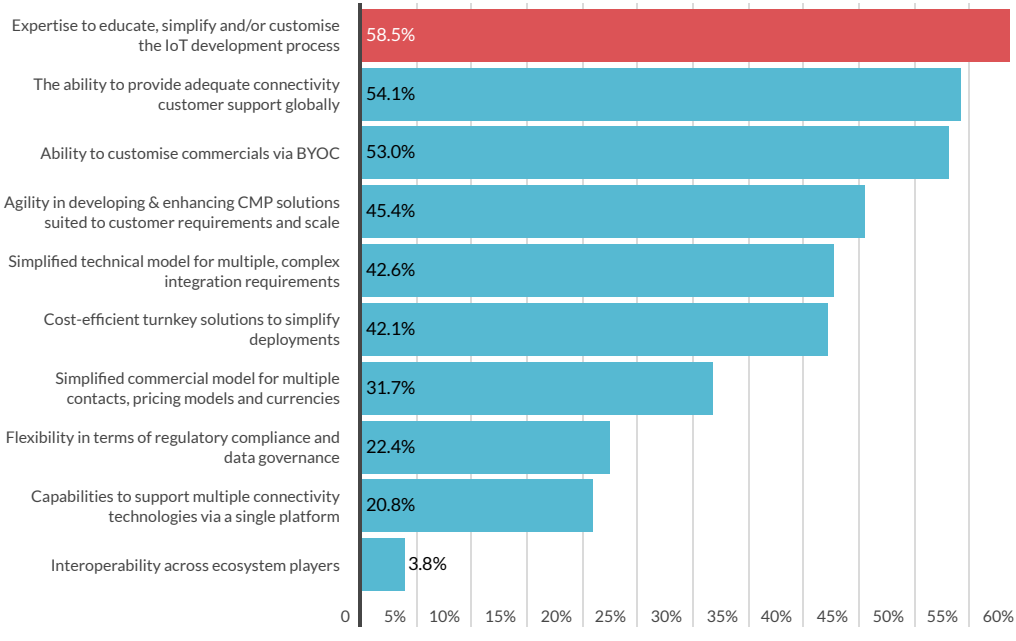
The complexity of the IoT is seen as one of the biggest barriers to both overall adoption and scaling up; the combinations of different radio technologies, protocols and systems can produce an array of potential problems for equipment designers and other manufacturers. With **59% of manufacturers putting support for new technologies in their top 3 factors that influence their choice of connectivity provider,** being able to offer a variety of connectivity options while keeping things simple is a key competence for connectivity providers. This is particularly important when it comes to hardware; hardware design is given as the number 1 obstacle to scaling up IoT deployments. **82% of respondents consider hardware design services a very important capability for a connectivity provider to have, and 61% of all respondents ranked device and hardware experience as the top factor they looked for in a connectivity partner's capabilities,** alongside consulting services for device design as the third highest concern. However, this may be difficult to convince end users of; **58% of respondents reported that they believed that expertise to simplify and customise the IoT development process was lacking in the current ecosystem.** Connectivity providers need to be able to provide hardware-related services to end users if they are to be of the greatest value to end-users, and put those services in easy-to-understand terms for end users to be satisfied.

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



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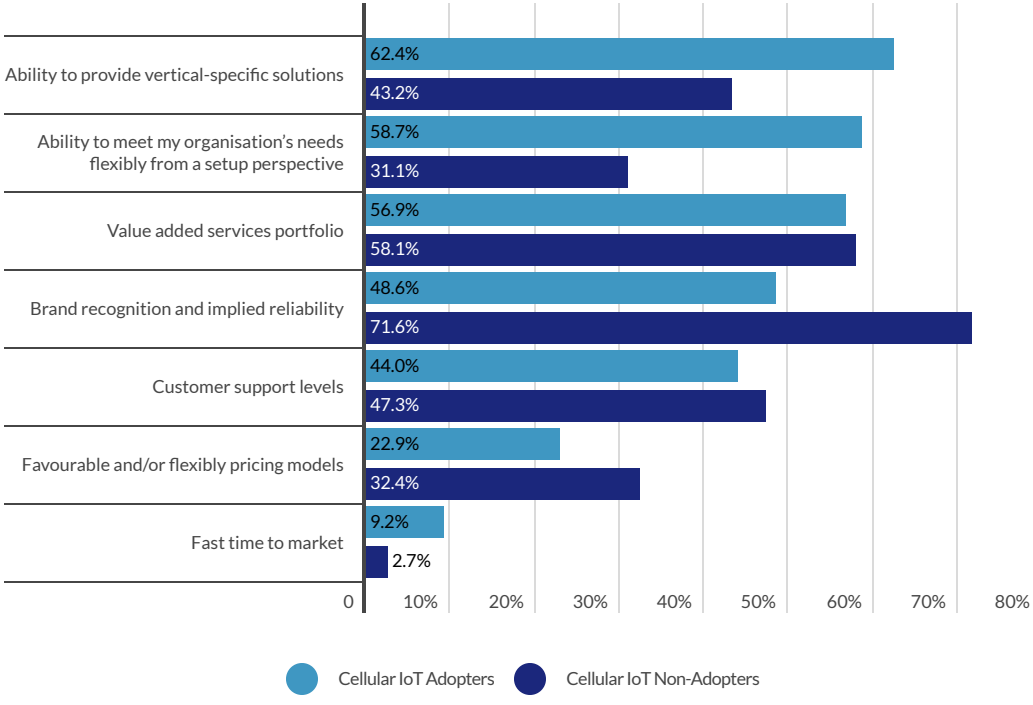
However, this cannot be generalised knowledge and offering generalised solutions. While **41% of manufacturers consider 'plug-and-play' hardware bundles to be very important,** few respondents reported fast time-to-market as an influence on their choice of connectivity provider. Instead, **being able to offer flexible and customised solutions is the key competence, rather than simplification, with 80% of respondents placing consulting services in their top 5 features they look for in a connectivity partner's capabilities.** This needs to sit alongside vertical-specific knowledge to be most helpful to customers; **62% of manufacturers currently using cellular IoT report vertical-specific solutions as a key non-technical influence on their choice of connectivity provider, and 43% of future adopters said the same.** In addition, only slightly fewer reported that flexibility of setup was important. These are ultimately two sides of the same coin, pointing to a need for customised and adjustable solutions at all stages of connectivity management.

This desire for flexible and tailored solutions may explain respondents' sales channel preferences. Only 12% of cellular IoT adopters expect VAS to be delivered through a digital marketplace, with the vast majority expecting direct sales channels. This mode allows dialogue about network performance and related concerns to be discussed more openly, tying into a demand for thorough customer service; **44% of cellular IoT users and 47% of non-users state that customer support levels are one of their main non-technical influences in choosing a connectivity provider, even if a fully globalised 'follow-the-sun' customer service is not a requirement for many.**

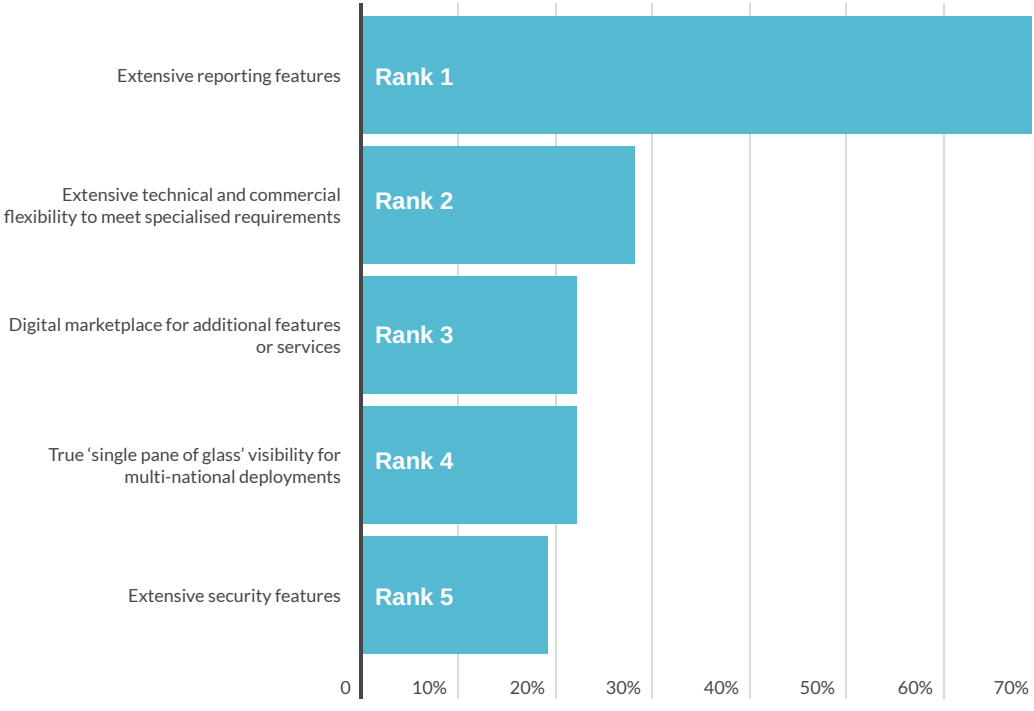
What are the main non-technical/commercial influences impacting your organisation's choice in choosing a cellular IoT connectivity provider? (All Respondents)



In addition, the need for international coverage often requires multiple providers, a particular pain point for the industry. Indeed, **64% of all respondents believe that the connectivity ecosystem not having a single model for international deployment to be the biggest challenge for first-time adopters. This lack of a consistent model has led 71% of current cellular IoT users to report using more than one connectivity provider.** As with results from last year's survey, dealing with multiple providers is seen as the biggest challenge to scaling IoT deployments. It is, however, one that is well understood by the manufacturing industry; those who actually engage multiple providers do not believe it is much more or less of a challenge than those who rely on a single connectivity provider, meaning that expectations are realistic in this respect.

The simplification that can be offered by connectivity providers is instead best offered through its platform once the devices are up and running. **Extensive reporting is the top product feature manufacturers look for in their IoT solutions, and 56% of respondents put 'single pane of glass' visibility in their top 5, with it being the highest-scoring rank 4 factor.**

What are the top 5 factors that you look for/would look for in an IoT connectivity partner's product?
(All Respondents)



Sophistication - Industrial/Manufacturing

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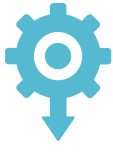
With connectivity rapidly becoming a necessity in many ways, offering services in addition to connectivity is the main point of difference between providers in the current market. **More than half of both adopters and non-adopters consider VAS a major non-technical influence on their choice of connectivity provider. At the same time, only 2% of respondents consider an end-to-end solution one of the top 5 things they look for from a connectivity provider's product.** Striking a balance between full service and a narrowly-focused set of connectivity capabilities is key to appealing to customers while not overloading them with unnecessary features. Being able to step alongside existing processes is a vital capability here, with the ease of integration into existing processes being the second most important factor for IoT connectivity overall for respondents generally.

Importance of ease of integration into existing products & processes (Cellular IoT Adopters)



Rank 2

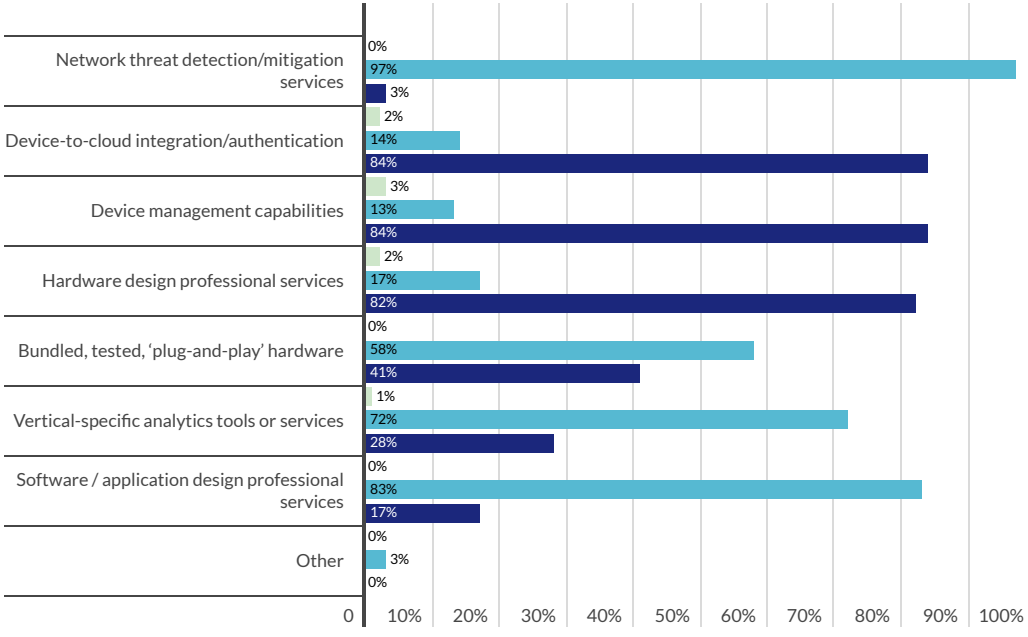
Importance of ease of integration into existing products & processes (Cellular IoT Non-Adopters)

Rank 4

The primary VAS desired by current users are all focused on devices, with over 80% of current cellular IoT users considering device-related VAS very important. This underscores the complexity that IoT hardware management brings, and the necessity of offering assistance with that. Even with the emphasis on vertical-specific customisations noted above, tailored analytics software takes a back seat to device services. However, these need to remain distinct and flexible – only 41% of current adopters consider plug-and-play hardware to be very important, and consolidated hardware bundles only reaches the rank 5 in a partner's desired capabilities, with only 44% of all respondents putting it in the top 5 things they look for in a partner's capabilities. It is clear that device services are necessary, but they should not appear standardised to any great degree if they are to appeal to most users.

A marketplace and extensive security features are other VAS that respondents find most useful. The ability to select features as necessary from a marketplace again underlines the notion that OEMs want choice in their connectivity packages, but do not necessarily want or need an all-encompassing single product. It is also worth noting that only 12% of respondents expect to be sold VAS through such an interface. Keeping direct sales channels open, as a way to provide a sought-after high level of customer service, is a must-have for connectivity providers, whether or not they can build compelling marketplace experiences.

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



Product digital marketplace importance (All Respondents)

Rank 3

Product security features importance (All Respondents)

Rank 5

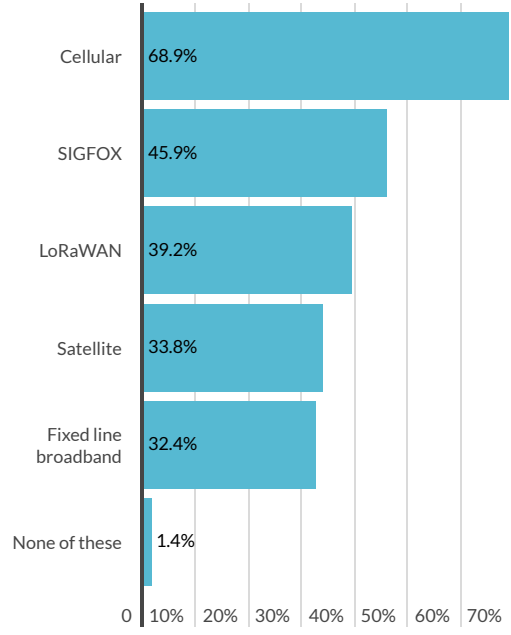
Comprehensive reporting is also required, as the #1 thing that manufacturers look for in a connectivity product, which will require granular details on connections' status, data usage, location and other features. However, it should be noted that single-pane-of-glass visibility is not the goal here, with only 9% of respondents reporting that as a top 5 factor they look for in a connectivity partner's capabilities. Having the information available is clearly important, but having everything in a single platform is not an expectation for manufacturers, potentially a symptom of expecting to work with many connectivity providers. Service providers also need to be ready to handle multiple RATs in their systems; all future cellular IoT adopters also see at least one form of non-cellular RAT as viable for their use cases, and so connectivity providers need to be willing and able to integrate non-cellular technologies into their CMPs so that these multi-RAT needs can be met. This is not particularly marketable, however, as very few respondents highlighted RAT interoperability in things they would look for in a

partner's product, so while there is little in the way of marketable benefits from such a move, it can be used to extend influence within a customer's operations to enable a smoother experience, which will enhance stickiness overall.

Connectivity providers would also benefit from making the range of cellular technologies they support more prominent, as well. There is a clear desire for a variety of different cellular technologies, with **59% of adopters ranking the support for technologies like 5G or cellular LPWAN in their top 3 technical factors influencing their decision of connectivity provider.** Such services would also give connectivity providers a wider range of ways in which to upsell clients and apply that tailored experience that is so valued in this industry.

The manufacturing sector also shows a strong preference for connectivity providers with sector-relevant expertise. As noted above, custom solutions tailored to customers' requirements are very much in demand, and although domain expertise does not make it onto manufacturers' radar for an overt capability, the preference for vertical-specific solutions heavily implies it. In addition, 58% of respondents believe that expertise to simplify and customise the IoT development process is lacking in the ecosystem. This could make for a strong differentiator from the competition if properly conveyed.

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



Roaming - Industrial/Manufacturing

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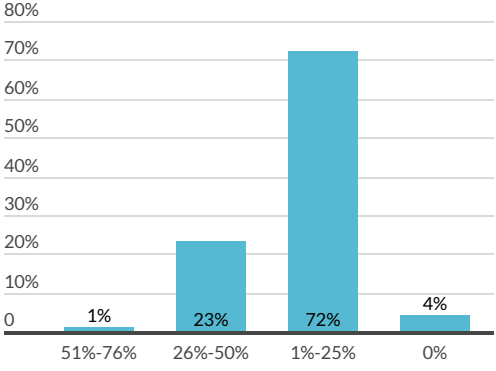
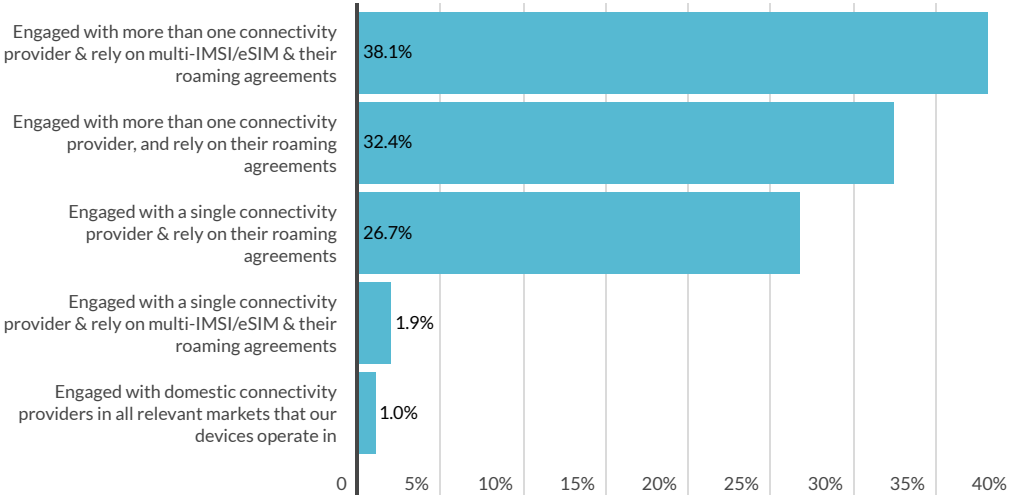
Roaming is a necessary part of the IoT ecosystem, and the manufacturing sector is no different; over 96% of respondents in this industry have an international connectivity requirement, and **59% of respondents rely purely on roaming agreements to cover this. This will not go away in future – 83% of future adopters report that they are planning an international distribution of their devices.**

What proportion of your organisation's cellular IoT device fleet requires international or multi-regional connectivity? (Cellular IoT Adopters)



As a result, roaming is high on respondents' priorities, with both present and future cellular IoT adopters considering it the #3 challenge to IoT scalability. This is of particular concern to future users; 72% of these respondents see the absence of a simple international deployment model as a challenge for first-time cellular IoT users, and more manufacturing respondents placed roaming restrictions in their top 3 challenges for IoT scalability than any other vertical surveyed. There is likely a commercial as well as operational concern here, with 98% of manufacturers reporting to be connected device OEMs, and an inability to secure stable roaming agreements for these devices will restrict the markets they can be sold in.

How will your organisation address its international connectivity requirement? (Cellular IoT Non-Adopters)



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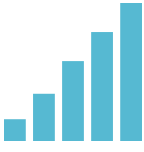
However, the ability to actually have full international coverage is less important to manufacturers; even while 66% claimed safety from roaming restrictions as the most important factor for connectivity overall, no manufacturing respondents placed robust international coverage overall in this spot, instead ranking it the third most important factor for IoT connectivity, with similar levels of concern from adopters and non-adopters. It is worth noting however that manufacturing respondents are more concerned about this than any other vertical, with 28% of respondents placing it at number 3. It is also a feature that will be looked for in a potential business partner, with 17% rating coverage in countries with regulatory or commercial restrictions as the joint second factor they would look for in a connectivity provider's capabilities, with 72% putting it in their top 5 factors overall.

Importance of assurance of protection against commercial & regulatory restrictions (All Respondents)

Rank 1

Robust international coverage as a key consideration for connectivity (All Respondents)



Rank 3

Manufacturers seem keen to solve this is conventional ways, through roaming agreements with 59% of respondents solving their international connectivity needs via these arrangements. Change is coming in the form of eSIMs and multi-IMSI options being used by 40% of current users, and **40% of users considering OTA network optimisation the number 2 technical factor that influenced them in choosing an IoT connectivity provider.** However, this is most likely to be in an effort to optimse connectivity to provide a high quality of service (the top factor) rather than necessarily to solve international roaming issues specifically. This means that those manufacturers looking for the best possible connectivity will engage in a degree of network switching, even within a single nation. These forms of advanced switching will also coexist with roaming agreements, with very few respondents seeking to manage relationships directly with domestic connectivity suppliers.

Roaming agreements do need to sit alongside other partners and arrangements, however, and be seen to be simple to integrate in this way. Over half of respondents report that they see an ability to incorporate preferential data rates and BYOC arrangements is lacking in the current cellular IoT ecosystem. There is also a perception that international deployments need a simpler model, with 64% of respondents saying this was lacking in the current ecosystem. There are high expectations for what should be possible with international connectivity and roaming, with respondents wanting BYOC options, simple deployments and increasing demands for technologies such as eSIM to simplify and optimise connectivity. This means that flexibility is needed at the connectivity profiles level, regardless of what SIM technologies are used, and the ability to provision roaming and local profiles to customer specifications will be a key competence in the coming years.

eSIM - Industrial/Manufacturing

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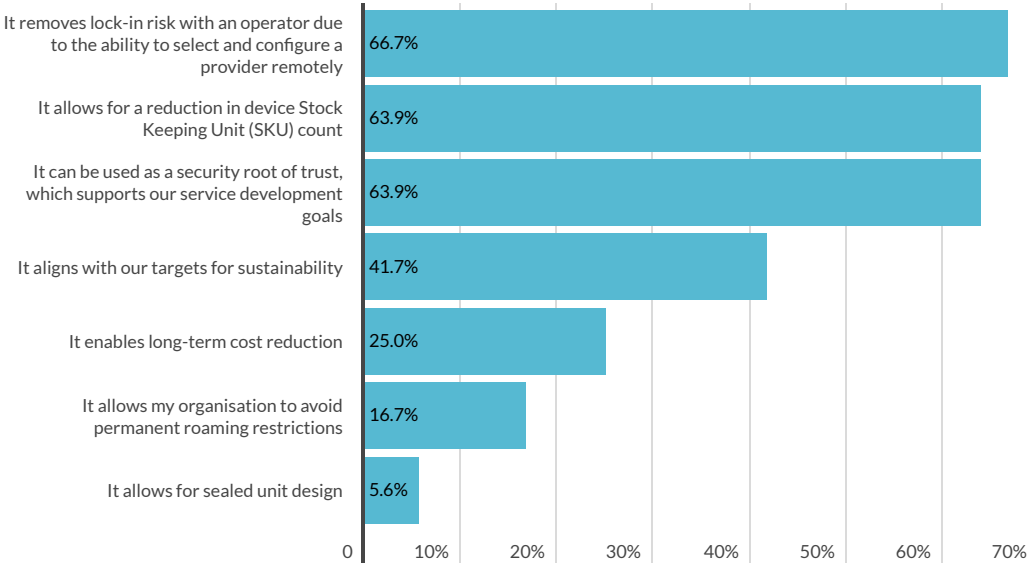
33% of current cellular IoT users report that they use eUICC as part of their deployment. eSIMs appeal on multiple levels, with the average adopter reporting more than 2 reasons for using the technology. The most popular of these is that they remove operator-in risk (67%), reduce SKU count (64%), and the desire to use eSIM as a root of trust (64%). Interestingly, only 17% of eSIM users report that they are using the technology to mitigate permanent roaming restrictions, despite clear concerns about that being present (see the previous roaming section).

The reduction of lock-in risk shows through the usage patterns of the technology, where more than 95% of eSIM and multi-IMSI users engage more than one connectivity provider. Despite this, there is still an array of problems with eSIM deployment, with the average manufacturing respondent claiming more than three problems with the technology.

Chief among these remains the fact that OTA campaign tools are limited, although a similar number of respondents report that the number of available

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



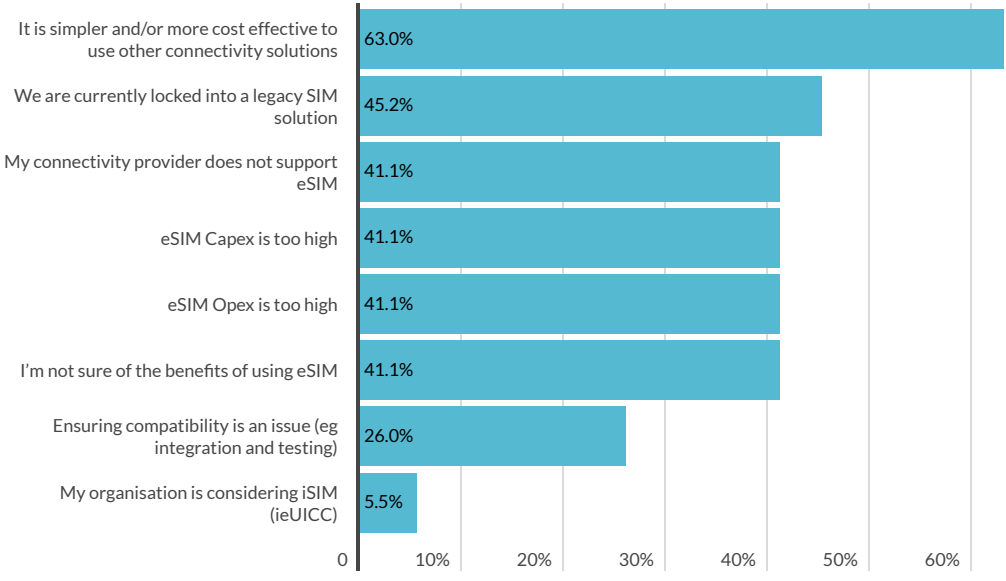
profiles is lacking. This latter problem should begin to be resolved with the forthcoming SGP.32 specification and the more flexible and changeable nature of profiles under the new specification. However, this will not begin to have an impact until Q4 2023 at the earliest, given the time required for devices to be made in line with the new specification.

The ability to offer eSIM will also make a connectivity provider more flexible and appealing, with 26% of current IoT adopters considering OTA network optimisation the number 2 technical feature they look for in an IoT connectivity provider, an area where eSIMs are very capable. As 41% of non-users claim a reason for their non-use to be that their providers do not offer

eSIM, there is a large potential market for eSIM capabilities, although existing multi-IMSI technologies and other network steering options may be desired as well.

Despite this, more work needs to be done to make eSIMs more appealing overall, particularly concerning their value proposition. 63% of non-users consider it to be simpler or more cost-effective to utilise other connectivity solutions, and 77% of non-users believe that either the Capex or Opex of eSIM is too high.

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



Private LTE/5G - Industrial/Manufacturing

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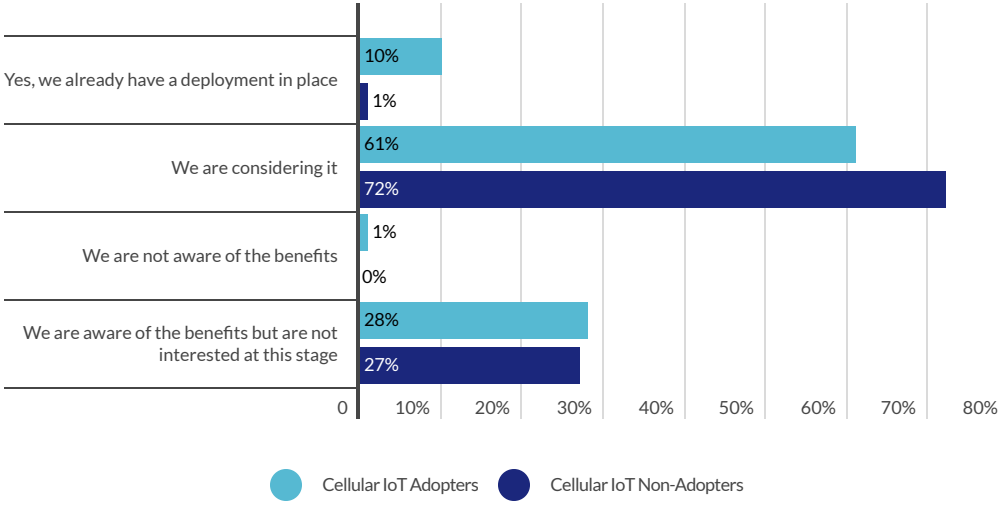
Private cellular networks are a hot topic at the moment, although there is limited deployment on the ground, with manufacturer network numbers worldwide numbering close to 1,000 rather than millions. Our survey bears this out, with 66% of all respondents considering private networks but only 7% reporting they have deployments in place.

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

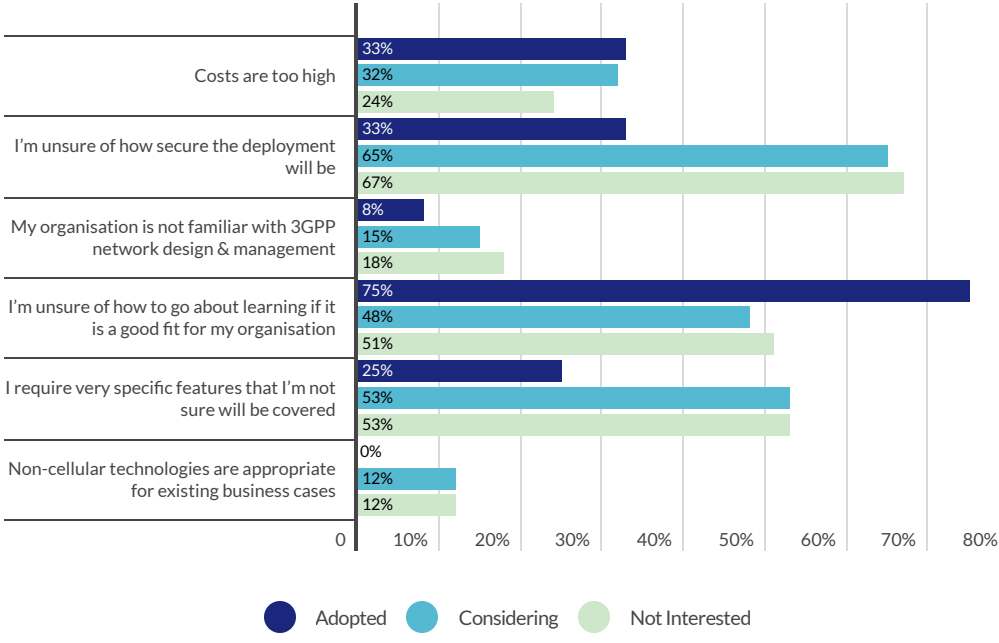


Awareness of the benefits of private networks is high, with the average respondent listing more than 2 benefits of the technology, even among those who have no interest in using private networks, and only 11% of users considering that non-cellular technologies are appropriate for them. However, the main stumbling block appears to be perceived security, with 65% of respondents considering private networks reported security as a concern. This is markedly lower among adopters, where 33% report it as a concern. Overcoming these obstacles may take some time, particularly as private network architectures increasingly tend towards cloud-based networks. With much network data often being competitively sensitive for manufacturers, work needs to be done by connectivity providers to illustrate how private networks enhance security, potentially by enforcing a strict boundary between the management and data planes in any architecture discussions and builds.

There also needs to be more work done to make private networks more obviously cost-effective. 30% of respondents reported that the cost of private networks was too high, including 33% of adopters. When paired with the fact that 75% of adopters in manufacturing are also unsure how to go about checking whether private networks are a good fit for their organisation, it

is clear that producing a quantified value proposition is key to both retaining customers and placating concerns of potential buyers.

What are your main concerns over a potential Private LTE/5G deployment? (All Respondents)



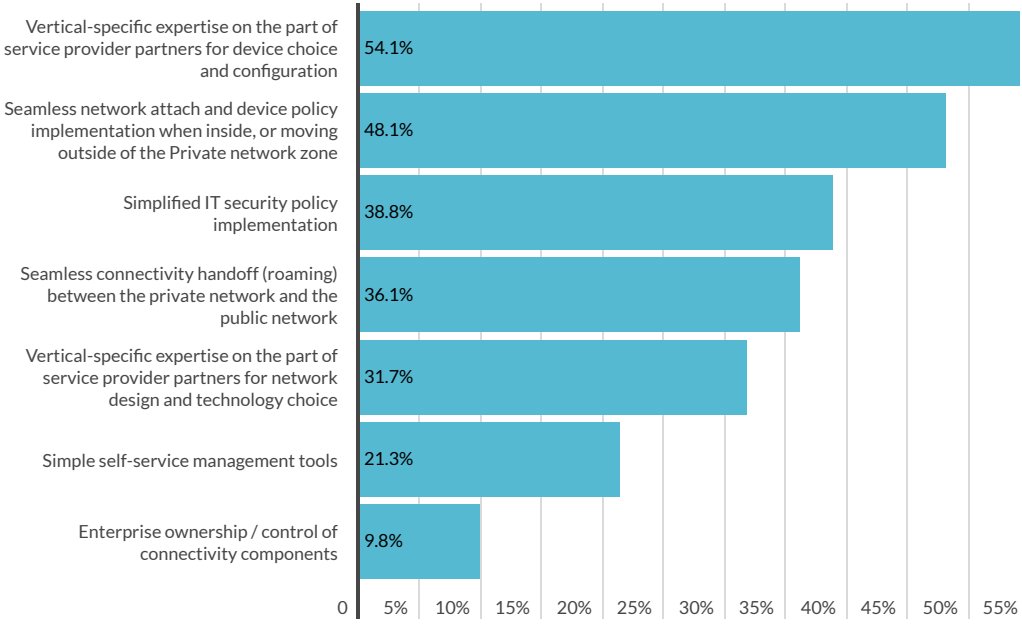
Note that this cannot be done by making the network security seem worth the cost; less than 5% of these respondents are concerned about both the security and cost of private networks. This means that it is not a case of "is it secure enough for the cost" but instead separate questions about private network security and their potential to achieve ROI.

The first steps towards this can be taken by providing manufacturing-focused designs and devices. Over half of respondents consider vertical-specific expertise in device choice and configuration to be an important factor for private networks. This is less vital for overall network design, with only 32% of respondents claiming this as important. However, these are of similar importance for current adopters, with 50% or overseeing both kinds of vertical-specific expertise as important.

Seamless network attach is also a key area for many, particularly those considering private networks, where 50% of respondents consider it important. While we have not seen much demand for private-public network roaming to date, emerging use cases may support use cases for seamless network attach, particularly as multi-campus network deployments become more common.

There is a clear indication that managed services are preferred for manufacturing private networks – self-service tools and enterprise ownership of connectivity components are the two lowest-scoring factors for private networks, indicating that manufacturers are happy to have MSPs play a large role in private network management. In line with results from last year's survey, this is even more pronounced among current adopters, none of whom consider enterprise ownership important, and only 8% want self-service tools.

What are the most important factors for consideration where Private LTE/5G is concerned? (All Respondents)



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Afterword

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About the authors

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