RCR Wireless News
INTELLIGENCE ON ALL THINGS WIRELESS

eSIM for IoT – the new SGP.32 standard

How to navigate the next big shift and avoid deployment pitfalls

By James Blackman, Executive Editor

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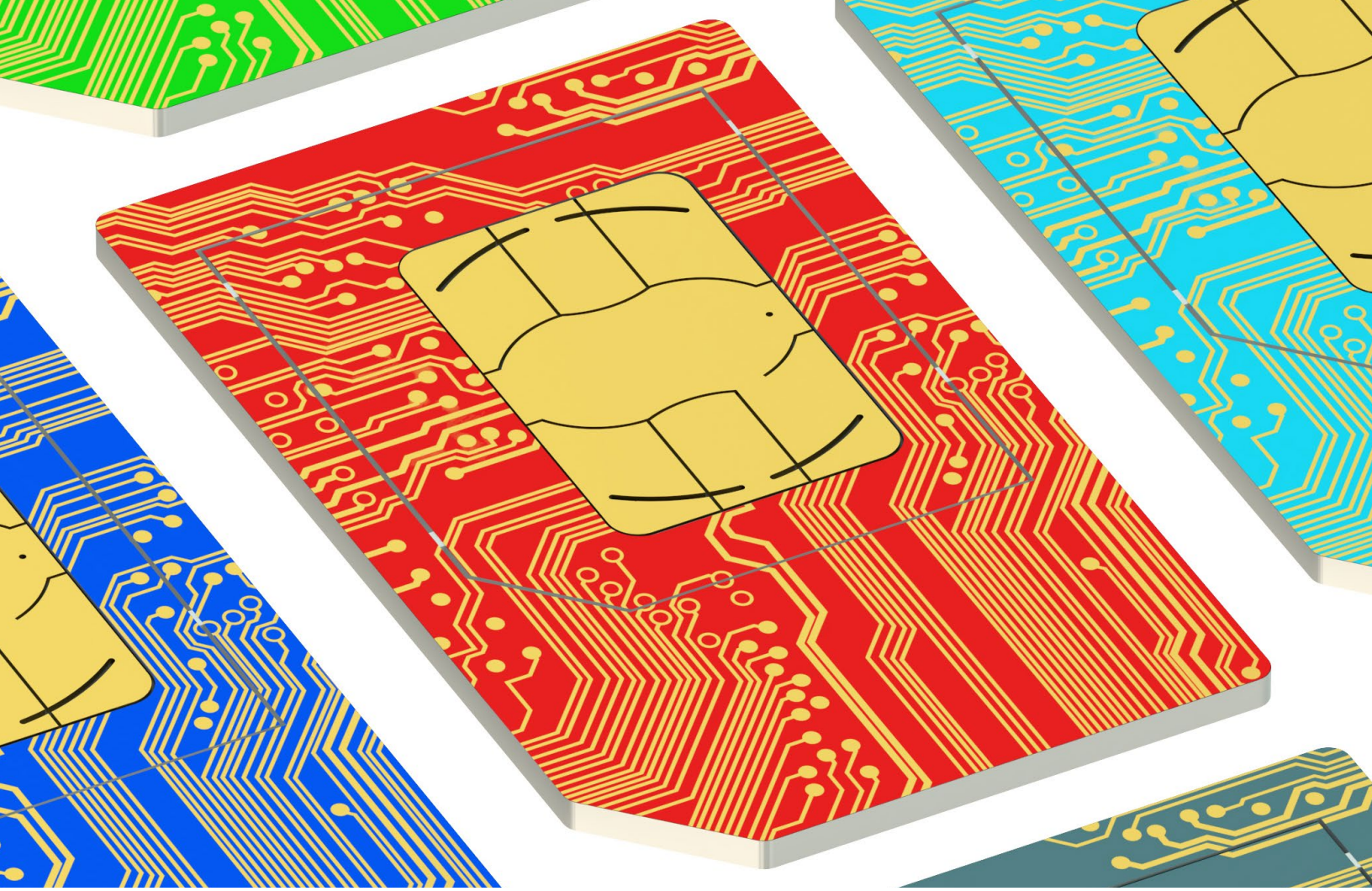

Introduction

In truth, the eSIM revolution never happened in IoT – until now, maybe. The term "eSIM" is often used ambiguously to refer both to embedded solder-on SIMs and to eUICC SIMs. In this article, we are referring specifically to the latter – eUICC SIMs. The technology to embed subscriber identity modules (SIMs) as soldered chips into a device's main circuit board has been around for 15 years already. This drove the creation of the eUICC standards to allow SIMs to be updated after installation and deployment. But developers of cellular-based IoT gadgetry have been forced to provision these in their devices using either hard-coded M2M integrations, defined in the SGP.02 specification, or UI-led consumer activation flows, as set out in SGP.22. In the end, neither have worked very well for IoT – as a mechanism to support globally-available and locally compliant fleet deployments, with assurance and flexibility to last a decade in the field.

But the new SGP.32 specification for remote SIM provisioning (RSP), just now being certified in IoT platforms and devices, seeks to change all of that. It is a clean-slate redesign, and the first to support this zero-touch 'build-once, ship-anywhere' concept. Its key components, as defined in the attendant SGP.31 framework, include a new eSIM IoT Remote Manager (eIM) to oversee SIM profiles in the field and an IoT Profile Assistant (IPA) for secure downloads, updates, and management. As well, it mandates cryptographic authentication and introduces new reset procedures, and allows for delayed / scheduled asynchronous updates, and early RSP provisions for in-factory/field profile enablement.

And it will change everything – says everybody. Here is Carolien Nijhuis, executive vice president of IoT at KPN, on its first SGP.32-based IoT customer contract, way back in February, with UK-based IoT specialist Trackunit. "SGP.32 will revolutionise eSIM connectivity for IoT use cases. [It] eliminates previous eSIM barriers, offering unprecedented flexibility without lock-ins or hefty infrastructure investments, empowering businesses to seamlessly expand their eSIM deployments on a global scale," she says. We'll hear more from Trackunit, momentarily.

And here is Mats Lundquist, chief executive at Telenor Connexion and head of Telenor IoT, talking in April ahead of his firm's SGP.32 debut – "in autumn 2025, as soon as standardized SGP.32 SIMs become commercially available". He says: "[With] SGP.32, we're enabling the move towards a world of seamless, secure, and standardized IoT connectivity, essential for long-term success in the IoT space. This is more than a technology upgrade – it's marking a significant shift in the evolution of global connectivity that will simplify operations for our customers and reduce long-term integration challenges."

But by way of introduction, maybe the most telling remark about the seismic impact this funny new eSIM framework will have on the market is from Vodafone, arguably the biggest name in cellular IoT. Asked directly about it, Erik Kling, president and head of Americas for Vodafone IoT, responds to RCR Wireless that the UK-based carrier group was emboldened 24 months ago to reorganise its entire business because of eSIM, plus other things. He explains: "We spun out Vodafone IoT for several reasons: for scale, for scope, for speed. Because when you look at platform development and global reach, you need further investment. And we did it also because of all the eSIM and iSIM development, which changes the dynamics – for both existing and new customers around the world."

There is a lot in there, in these comments, and in the explanatory preamble; and RCR Wireless hosted a webinar last month (June 2025) with IoT airtime specialist KORE and IoT analyst house Kaleido Intelligence to unpack its meaning, which it has bundled here with fragments of interviews and commentaries with the broader market – into a report that captures some of the hopeful opportunities and familiar problems with it. And it sounds, in the end, like every other IoT tale – said RCR Wireless to Kaleido Intelligence. One of brilliant innovation and difficult progress. "Yes, it kind of is," came the response. Let's get into it.

MATS LUNDQUIST
Chief Executive
Telenor Connexion

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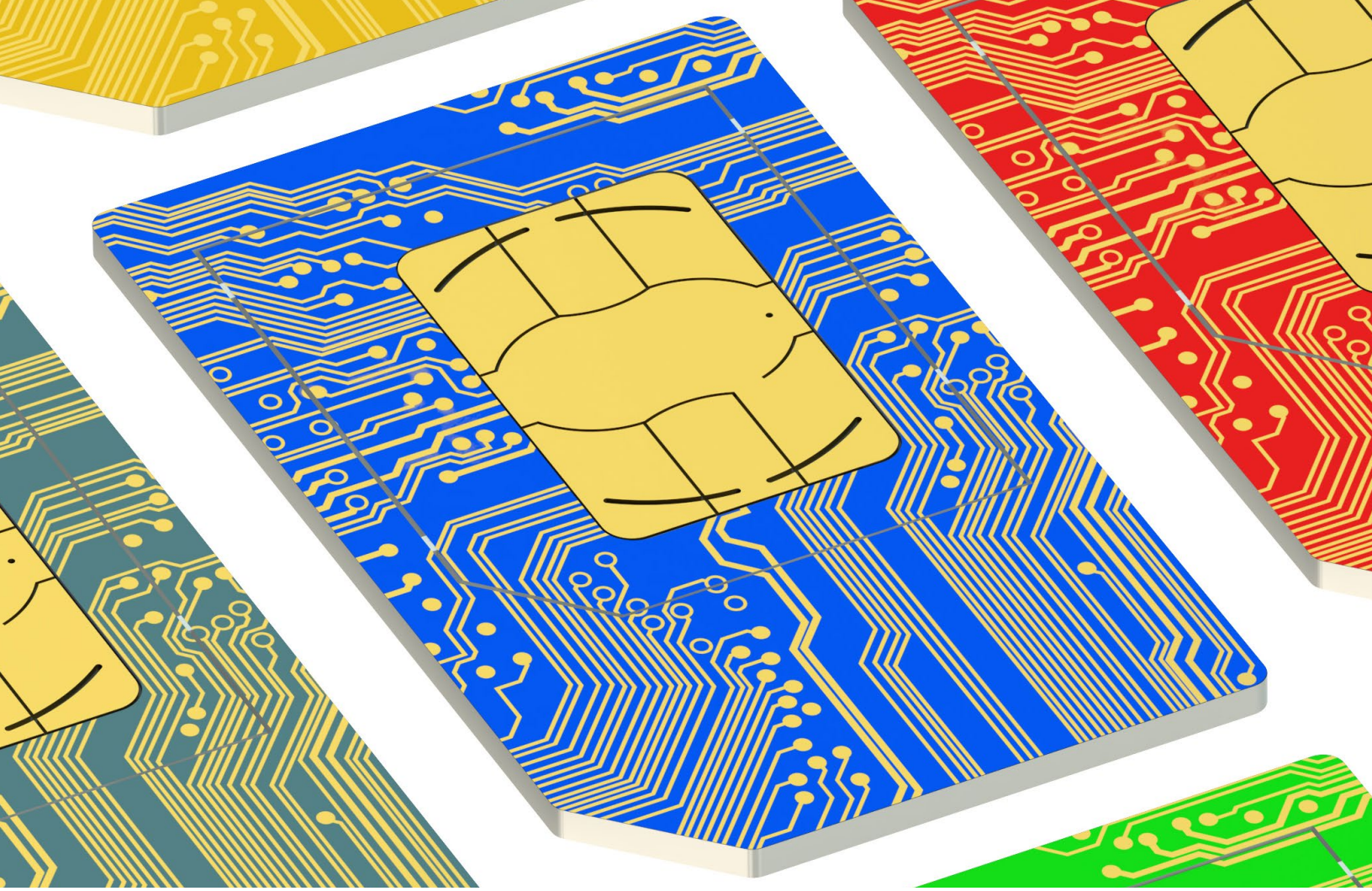


Part 1 – drivers for development

Until now, eSIM adoption for IoT has been slow due to technical and regulatory challenges. SGP.32 promises flexibility, scalability, and compliance, making it the long-awaited enabler for global, headless, low-power IoT deployments.

1. A tangled e-sim proposition

Until now, for 15 years, eSIM adoption has been mostly limited to IoT deployments in the automotive and utilities sectors due to complex integrations and high deployment costs. Previous eSIM setups were expensive and restrictive. The SGP.02 specification, published in 2014 for old-style M2M deployments, was a breakthrough in its day. But the work to integrate new carriers required expensive interoperability work ("often six figures"), limiting flexibility and locking customers into their initial hardware/airtime pairings. Meanwhile, the SGP.22 specification, from 2016, is great for consumer smartphones and wearables with user interfaces, but a non-starter for headless IoT.

Scott Lemon, senior director for market engagement and innovation at KORE, explains the difference: "SGP.02 is the driver, but there is a tie-in with it – a link to the carrier you get it from, which decreases the flexibility. SGP.22 broke those ties, and introduced the SM-DP+ server to pull profiles onto the SIM. That has been powerful for consumer eSIM devices, but it requires you to call APIs in the LPA – by scanning a QR code or running an app. And that's the problem for headless IoT devices, right there. SGP.22 affords great functionality and flexibility, just not for IoT." Some quick definitions, here, as we go (further explained in the box, see 'anatomy of an eSIM solution', page 13).

To start, and in order: the subscription-manager data-preparation server (plus; SM-DP+), introduced in SGP.22, is a server-side system that encrypts, stores, and downloads eSIM operator/subscription profiles for over-the-air (OTA) delivery to eSIM-enabled devices. It authenticates and communicates with devices using a local profile assistant (LPA), resident on the device itself. The LPA software manages comms between the device's eSIM chip (eUICC) and the SM-DP+ server, and works as the interface and controller to discover, download, install, and manage airtime profiles. But as Lemon explains, IoT devices are stripped of features to make them power efficient, and also cheap.

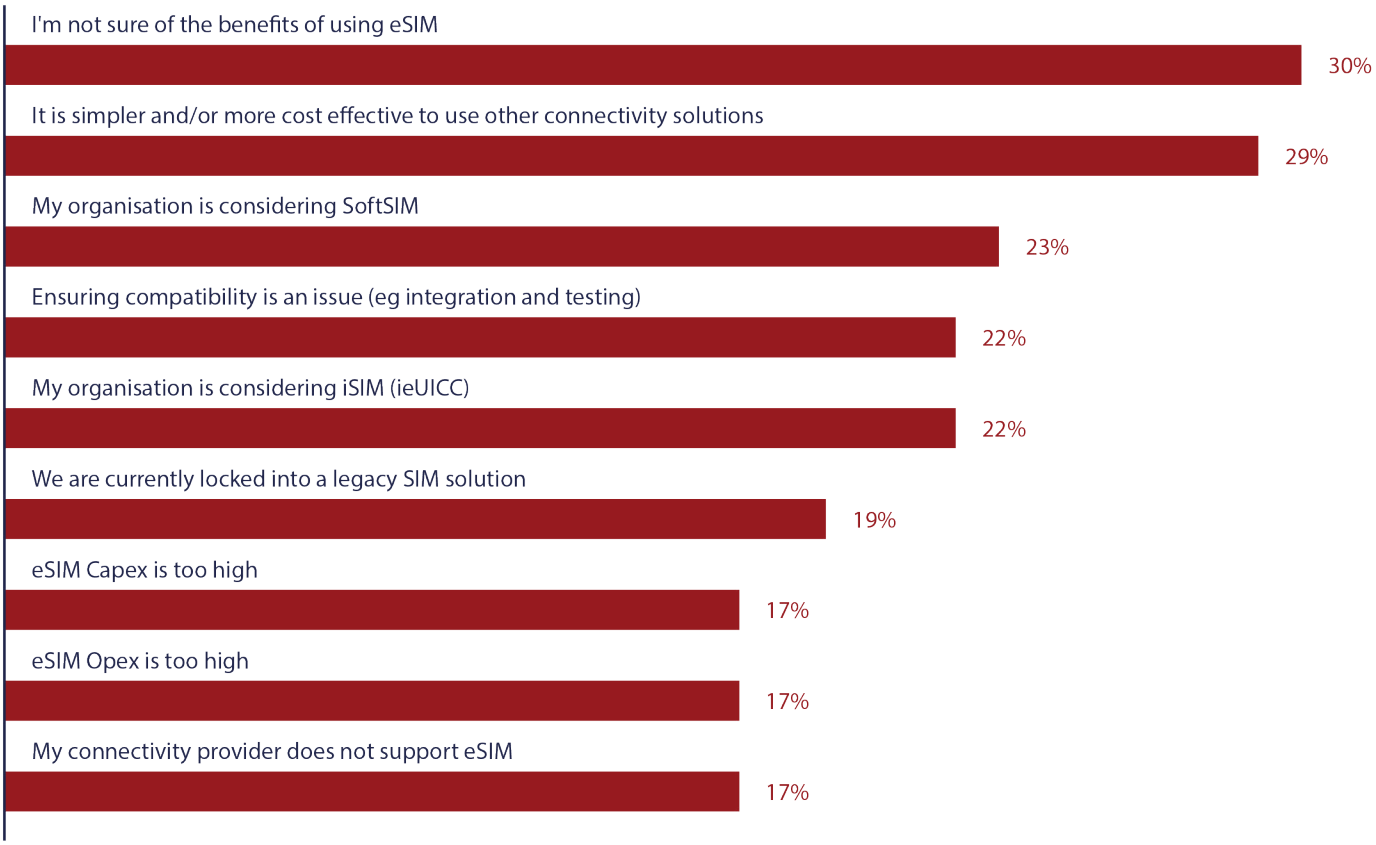
Which means they do not tend to support LPA interfaces to manually trigger airtime switches via application programming interfaces (APIs). In other words, they are 'headless' – on the grounds large IoT fleets need to be remotely controlled in cloud systems. Until now, big operations – enterprise clients and service providers, serious about IoT – have been required to build proprietary consoles to 'talk' remotely to the LPA software in SGP.22-based IoT devices. The head-banging

STEFFEN SORRELL
Chief of Research
Kaleido Intelligence

"The cost, the lack of support, the technical challenges – these things mean that only automotive and utilities have really deployed eSIM... There [just] hasn't been a great choice on the market to deploy IoT devices."

eSIM Non-Adopters:

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



Source: Kaleido Intelligence

SCOTT LEMON
Senior Director for Market Engagement and Innovation
KORE

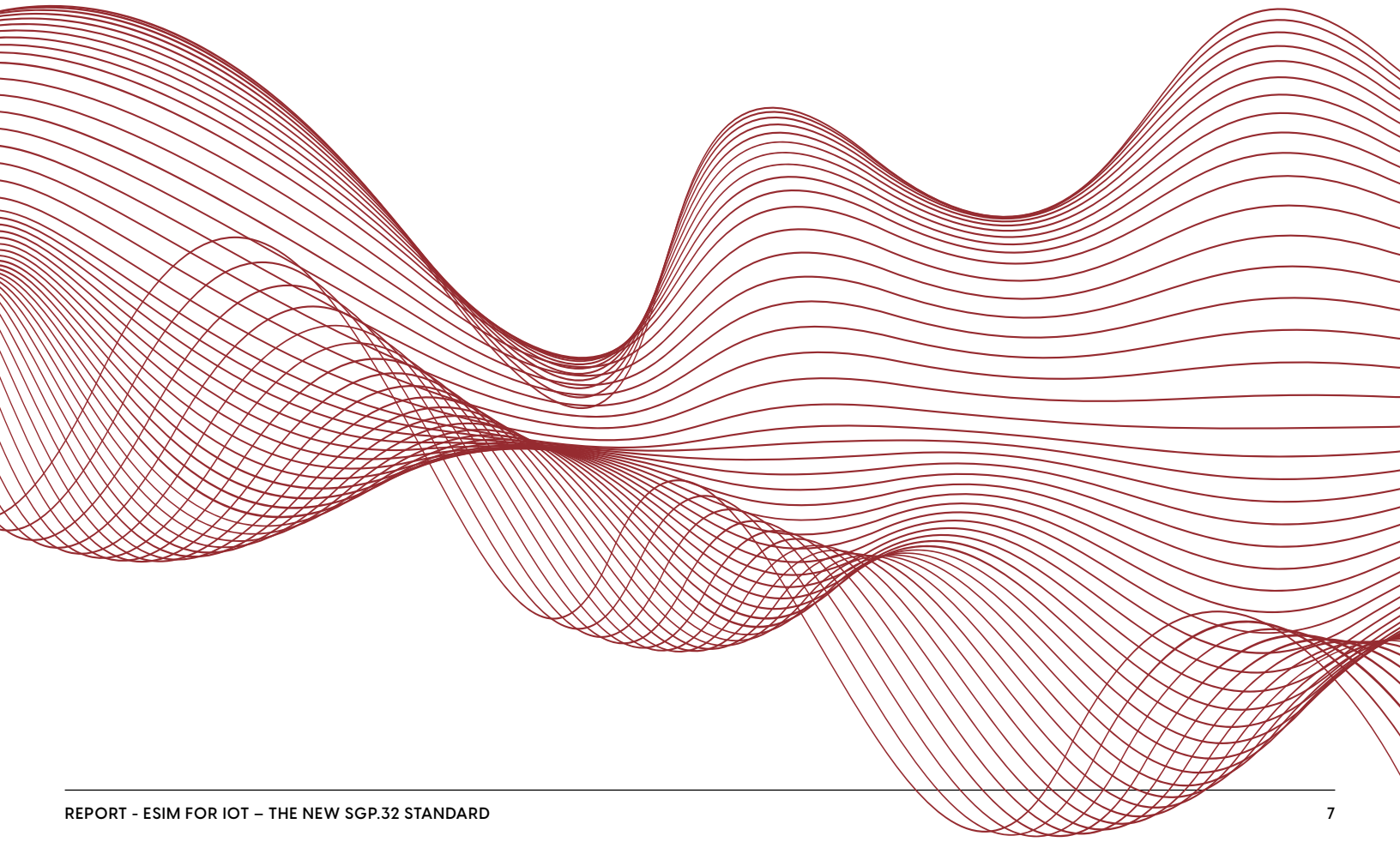
"We are beyond excited about SGP.32 and what it brings. Because it is the best of both worlds. We get the same flexibility as SGP.22, but with a standardized interface for the eIM to remotely manage the SIM and the profiles."

inflexibility of the carrier-led SGP.02 standard for M2M means the UI/UX-led SGP.22 mechanism for consumer gadgetry is being reworked as the default OTA system for IoT devices.

As such, proper eSIM support for cellular IoT is hard to find. Indeed, analyst house Kaleido Intelligence calculates there are only around ("over") 300 deployments of SGP.02 'platform instances' out there – from the remote SIM provisioning providers like G+D, Idemia, Kigen, Thales, and so on, developing the certified backend solutions for eSIM lifecycle management and provisioning. "SGP.02 is really poorly supported," remarks Steffen Sorrell, chief of research at the firm. Whereas there are over a thousand SGP.22 deployments. "It is a 70/30 ratio, in favour of consumer type eSIM platforms," he says. It means only the biggest and oldest M2M sectors have pursued SGP.02.

Sorrell says: "The cost, the lack of support, the technical challenges – these things mean that only automotive and utilities have really deployed eSIM." Interestingly, Kaleido Intelligence has polled enterprises and manufacturers in the IoT market and found that almost two in five (37 percent) of eSIM adopters reckon mobile operators only support one eSIM profile specification. "Which profile is that? It is the consumer one, invariably. Whereas maybe they want M2M (IoT) support. It just means there hasn't been a great choice on the market to deploy IoT devices." The alternative, to custom-engineer SGP.22 solutions, is hardly ideal – and not at all feasible for smaller operatives.

"It is a lot of work to build those protocols and platforms," says Lemon. Queue this long GSMA project to develop the SGP.31 framework and SGP.32 specification as a properly-flexible eSIM mechanic for IoT. Lemon adds: "We are beyond excited about SGP.32 and what it brings. Because it is the best of both worlds. We get the same flexibility as SGP.22, but with a standardized interface for the eIM to remotely manage the SIM and the profiles." Another acronymical aside (see page 23, also): the eIM (eSIM IoT Remote Manager) is the new cloud-based software which communicates with the IPA (IoT Profile Assistant) that is on the device. This replaces the LPA in SGP.22 by taking over the device-side logic to manage eSIM profiles, placing it in the network/server instead.



2. A complex regulatory scene

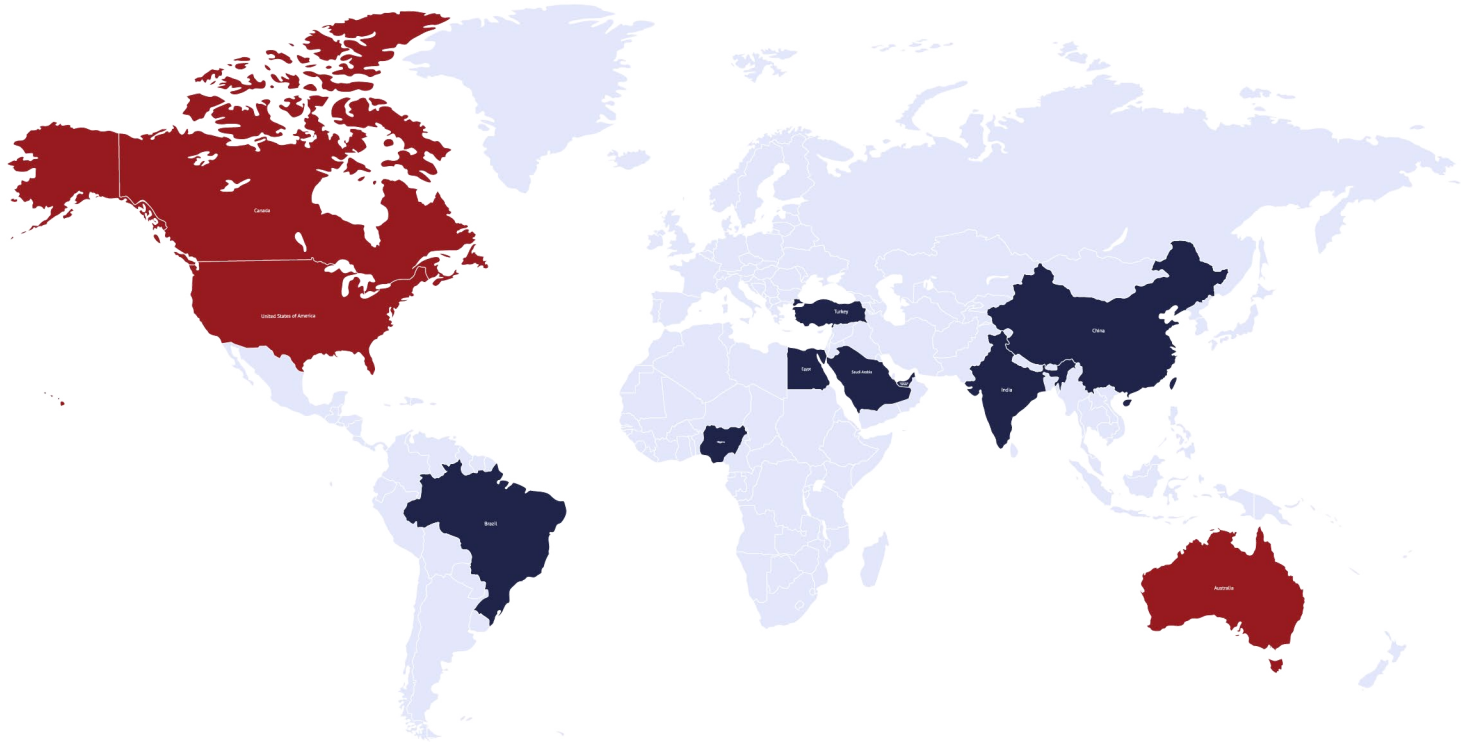
All of which reveals the essential keys to this crucial innovation: the same SGP.22-style SM-DP+ server to pull carrier profiles, and a new SGP.32-era eIM controller to manage them remotely. But while this potted history discusses eSIM fixes for the IoT sector, it does not explain the broader context – which makes machine-type connectivity awkward without a programmable eSIM, and headless IoT connectivity nigh-on impossible without the SGP.32 variant. Because the IoT market has grown unwieldy as demand scales and splinters.

A key driver for the SGP.32 architecture, and for eSIM in the first place, is changing regulation about data roaming and localisation.

Suddenly, the requirement to switch between airtime providers is not just an expensive one, traditionally achievable only by big M2M providers (connecting cars and meters) with the means to engineer SGP.02 integrations or SGP.22 workarounds, but also a legal one – for every IoT maker. Permanent roaming restrictions are playing havoc with IoT fleets. Roaming cut-offs of 90-180 days mean traditional roaming SIMs, marketed as global solutions, do not work – which is part of the whole eSIM-RSP rationale. Sorrell says: "More countries are restricting how devices roam onto their networks. If you want to support global IoT, you need to localize. And you can't do that with a roaming SIM."

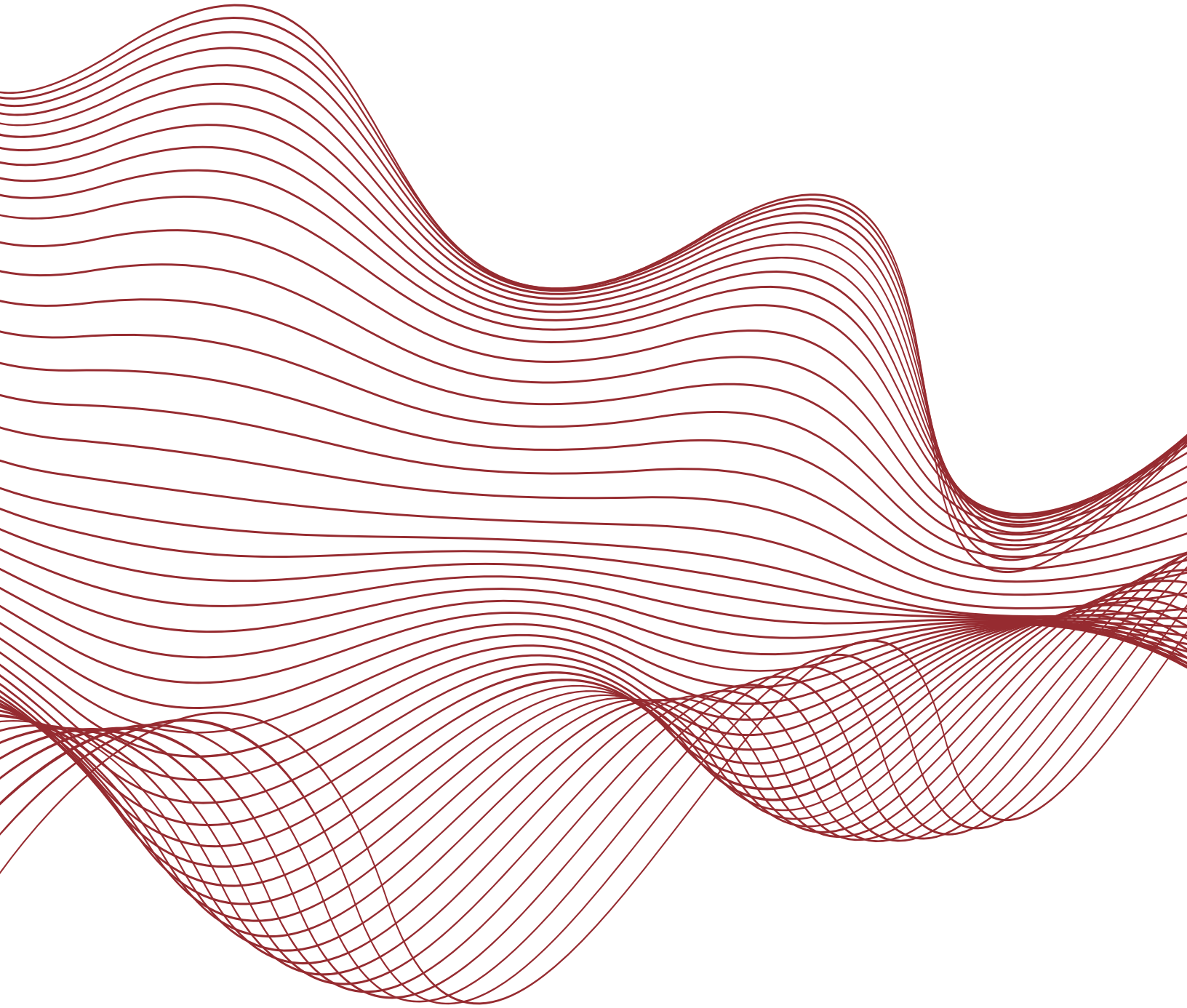
The list of countries with limitations is long. Certain countries have formalised such rules for IoT with restrictions on 'permanent roaming', whether as de

Major Countries Where Permanent Roaming is Restricted



jure bans (Brazil, Turkey, Nigeria) or de facto ones (China, Egypt, India, Saudi Arabia, Singapore, UAE). Elsewhere, mobile operators impose restrictions on permanent roaming with much the same result (as in Australia, Canada, US). At the same time, developing data sovereignty laws – around where data is captured, processed, stored – have also driven the case for flexible SIM mechanics. Which is about geopolitical control, of course – about data as a strategic asset, an economic driver, a security concern, and a citizen right.

Regulation is real or pending: the EU's GDPR privacy rules and Gaia-X sovereign cloud initiative; China's cybersecurity and data security laws; India's proposed Personal Data Protection Bill. The net result for the IoT sector? The clunky old roaming model – global SIMs in local deployments – is broken. It means appropriate eSIM mechanics are more urgent than ever. But as discussed, the tangled eSIM proposition is a bust for multiplying IoT cases. Until now; until this SGP.32 variant arrives in the second half of 2025. Which explains why such hopes are pinned on it. Because SGP.32 is the solution – as a replacement for SGP.02 and a complement for SGP.22.



3. A critical business case

There is another shift in the market, besides; the SGP.32 facility is critical, now, because IoT is a line-item in standard corporate strategy. The old hype has subsided – without fanfare, without much comment – and IoT-based sensing technologies, increasingly allied with AI-style sense-making technologies, are a crucial component for enterprises to bring new dynamism, intelligence, and efficiency to assets and operations. To the point that enterprise demand for IoT solutions is accelerating upwards and outwards – in terms of the volume and variety of use cases. This brings complexity, and also more acute requirements in terms of performance and security.

Sorrell explains: "On the customer side, we're seeing more sophistication. More applications now require better performance than roaming can offer. Home-routed roaming creates this kind of tromboning of data, where it goes from the device to the home network, and back again to the device. And latency is high; it is not great. Meanwhile, the IoT market is maturing and IoT is becoming more important, and so companies want risk-management to know their deployments are viable in the field for a good 10 years or more. And you can't really do any of that with a physical SIM – so eSIM comes into play again because it is programmable."

There is a sense that RSP capabilities will see independent providers (MVNOs mostly) switch fleets of IoT devices between carrier (MNO) networks in pursuit of the clearest signal, sharpest pricing, smartest access; that, somehow, it will bring total dynamism to IoT provision to max out price and performance, and to drive up churn. But this is wrong, actually. While technically possible, the idea of on-the-fly switching is not widely supported. As Sorrell says, the big draw for enterprises – essentially, disinterested in technology unless it doesn't work – is that new eSIM mechanics brings choice, and therefore resilience. We will return to this topic, when we get into the pitfalls.

Certainly, that's the story from Trackunit, which has just signed with KPN to take SGP.32 eSIMs for tracking devices deployed in the construction industry. Daniel Conradsen, head of engineering at the firm, comments: "We can [now] equip every device with a single eSIM setup at the manufacturing stage, making sure they work out of the box regardless of where in the world they surface. They must work now, tomorrow, and five years from now. The SGP.32 platform is essential in ensuring the longevity of our solution, in the sense that it allows our customers to be flexible and scale across borders, complying with roaming restrictions without disruptions… [It] is a game changer."

DANIEL CONRADSEN
Head of Engineering
Trackunit

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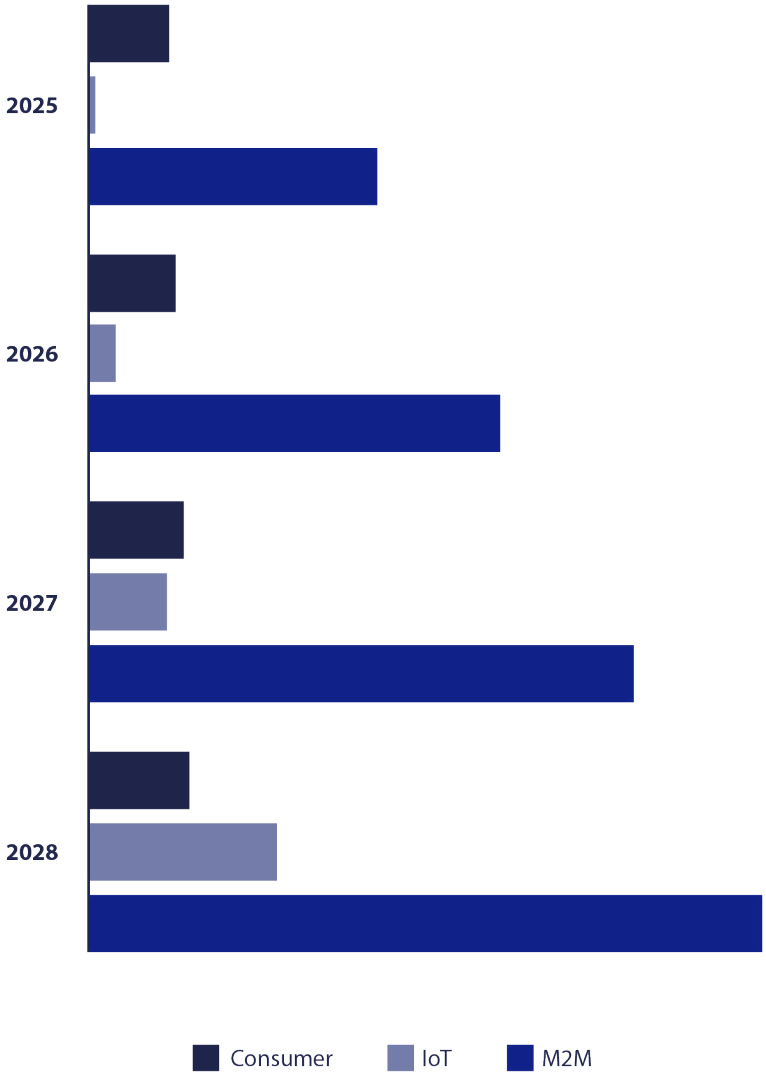
Note, Conradsen touches on an important auxiliary aspect of SGP.32, to be formalised in SGP.42 in 2026, around in-factory provisioning, which is covered on page 23. But he addresses the other points, as well – about roaming restrictions and data localisation, and just keeping the lights on. SIM specialist Kigen says the same. "The biggest shock for everyone in IoT is when critical connectivity fails," comments Loic Bonvarlet, senior vice president for ecosystem and marketing at the firm, which sees SGP.32 as its chance to establish itself in the big leagues, alongside the likes of G+D and Thales, with influence and scale from the SGP.02/22 era.

But we should pause, briefly, to consider the schedule for SGP.32-specified eSIMs to arrive in the IoT market; because everything is brand new. Indeed, early deployments are expected from now, through the second half of 2025, as platforms and devices are certified. Lemon explains: "The market is still early. We are offering SGP.02 and .22, and we have .32 in test right now. But 2026 is when it will really take off. And there will come a point, quite soon, where, if I were an IoT developer, I don't know that I would consider any alternative. It just makes too much sense – for the flexibility it gives to manage the lifecycle, without truck rolls or device swaps."

Kaleido Intelligence says the same: testing and certification through late-2025, broader adoption through 2026, and a tipping point some time in 2027/28, when over 50 percent of new IoT connections will use an eSIM – whether via an M2M (SGP.02), consumer (SGP.22), or new IoT (SGP.32) profile type. "Clearly the driver will be SGP.32," says Sorrell. "By 2028,

Global eSIM Deployment to 2028



Source: Kaleido Intelligence

IoT profiles will be roughly on par with M2M profiles in terms of new profiles issued." Worth noting: M2M-SGP.02 eSIMs still have a 'long tail' ("several years") of growth, even as customers switch to SGP.32, because automotive and utility customers are locked into purchase decisions years ahead of deployment, he explains.

But the growth figures tell the story, perhaps; Kaleido Intelligence forecasts compound annual growth (CAGR) of nine percent for consumer SGP.22 eSIMs in the period to 2028 (80.2 million to 102 million), 33 percent for M2M SGP.02 eSIMs (295.3 million to 693.5 million), and 240 percent for IoT SGP.32 eSIMs (4.9 million, today, to 192.8 million). Of course, whatever-percentage growth of not-very-much is still not-very-much, potentially. But these numbers say the installed base

of SGP.32 eSIMs will go from next-to-nothing to twice the consumer eSIM base in just a few years, and to about a third of the M2M base. And by 2030, practically every non-consumer machine/thing will use SGP.32.

Sorrell zooms out: "Today, we are at the certification stage – testing for interoperability. So all the hardware, the OS, the platforms and so on are currently being validated. The first proper deployments will come at the end of this year. We will see more rapid growth for the eSIM IoT-spec by the end of 2028, coming up to about 200 million profiles in that period." In the meantime, there is work to do, and pitfalls to swerve. And so we should give those proper attention.

	M2M / SGP.o2	Consumer SGP.22	IoT SGP.32
2025	295.3M	80.2M	4.9M
2028	693.5M	103M	192.8M
CAGR	33%	9%	240%

Source: Kaleido Intelligence

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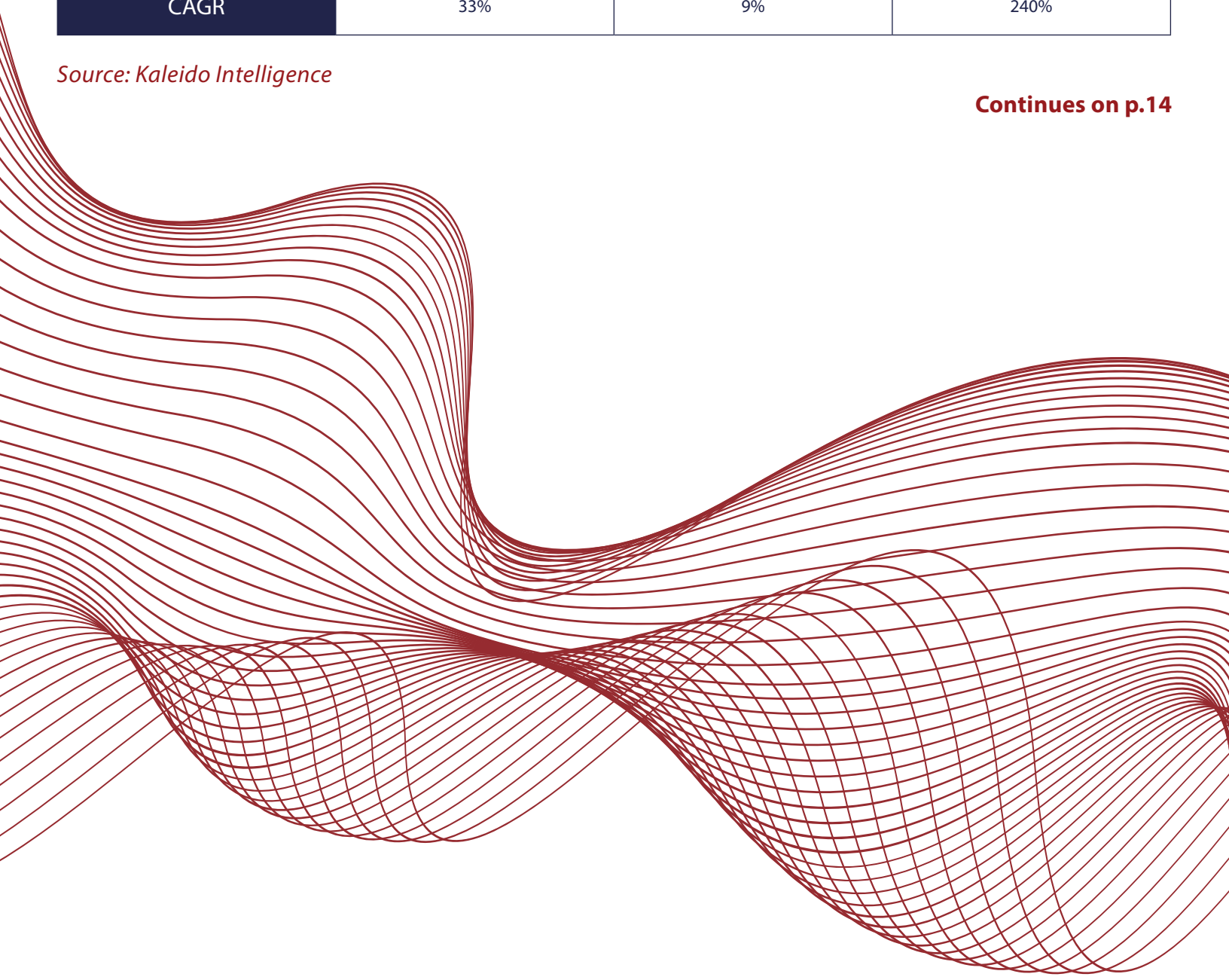
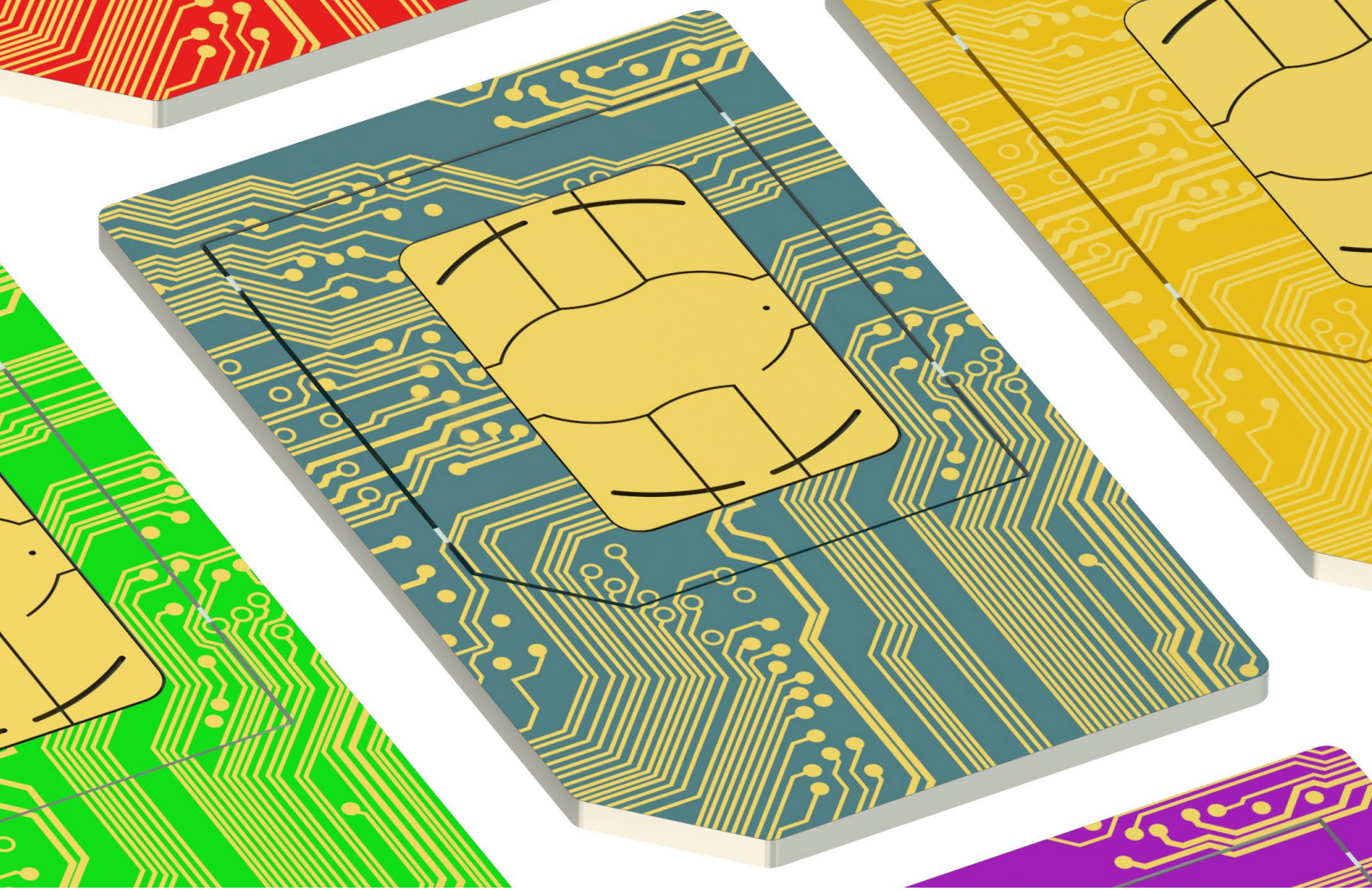


Different systems, different controls – the anatomy of an eSIM solution

The three eSIM profile types – SGP.02, SGP.22, and SGP.32 – define eSIM models for M2M, consumer, and IoT devices, and they differ in terms of their controls, provisioning methods, device capabilities, and management components. Here is

Feature / Component	SGP.02 (M2M)	SGP.22 (consumer)	SGP.32 (IoT)
Standard finalised	2014	2016	2023
Devices / Applications	Connected cars, smart meters, industrial routers	Smartphones, tablets, laptops, wearables	Constrained IoT trackers, wearables, sensors, meters (next-gen)
Ownership control	Mobile network operator (MNO)	End user / device owner	Enterprise / IoT service provider / OEM
Provisioning model	Network-side push (MNO-controlled)	Device-side pull (user-initiated)	Network-side push (user / provider initiated)
Management system	SM-DP (Subscription Manager – Data Preparation) and SM-SR (Subscription Manager – Secure Routing)	Local Profile Assistant (LPA) and SM-DP+	eIM (eSIM IoT Remote Manager) and SM-DP+
Protocol complexity	High (HTTPS, SOAP, TLS)	Moderate (HTTPS, REST)	Low (CoAP over HTTPS)
Interoperability complexity	High – SM-SR adds integration burden	Medium – LPA and SM-DP+ interface well	Low – streamlined model, no SM-SR or LPA required



Part 2 – pitfalls to deployment

Even though SGP.32 simplifies eSIM deployment for IoT, pitfalls remain: poor education, rushed reuse, hidden lock-in, and power shifts. Success depends on understanding, testing, and ensuring flexibility in provider agreements and orchestration.

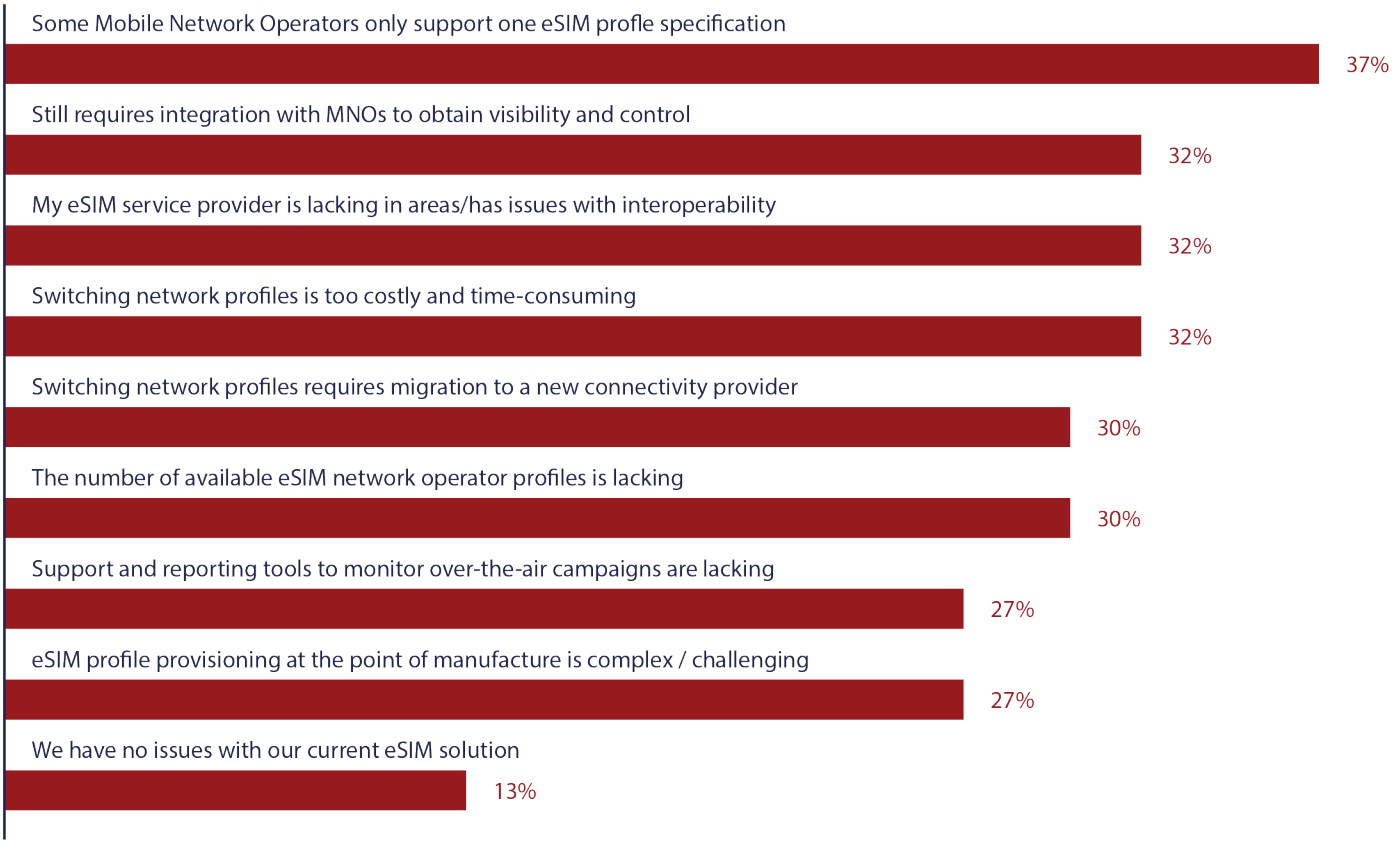
1. Complexity and education

So what are these deployment pitfalls, and how can they be avoided? The first thing to note, which the preamble above tees-up, is just how complicated the eSIM landscape is. Which is strange, of course – that something built to hide complexity appears to create complexity. But it is a familiar trait in new technology, too, especially where it is developed to solve a mix of regulatory, technological, and commercial pressures in an already-fragmented market. The first pitfall, then, is ignorance; the first solution is just to understand. Kaleido Intelligence's survey of eSIM non-adopters is revealing; 30 percent simply don't get it – they are 'not sure of the benefits', they admit.

Besides, they appear to be either uninterested, or else resigned to alternatives. About the same proportion (29 percent) say it is 'simpler' or cheaper to use other solutions. About one in five (22 percent) say 'compatibility' is an issue; about one in six (17 percent) say perceived cap/op-ex costs are too high. It paints a picture, at least, that

eSIM Adopters:

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



the advantages and practicalities are not well communicated. Sorrell says: "It shows a lack of education – that a notable proportion are either not sure of the benefits, or think other solutions are more cost effective. There's a lot of education to go to understand cellular connectivity on the whole, as well as eSIM."

The minutiae of managing eSIM technology is gnarly, too. Quizzed as part of the same poll, existing eSIM adopters, with experience in the field, protest about issues with visibility and control, interoperability, cost and time (32 percent, on each count), and just with general support (as referenced above). In fact, only 13 percent report 'no issues' at all with their eSIM solutions. All of which confirms that RSP processes with current SGP.02/22 workarounds are not up to scratch. "When you switch providers, you have to integrate new CMPs (connectivity management platforms), different contracts, and different SLAs. Those pain points are certainly there today – and possibly tomorrow as well."

He adds: "Even when network switching [is supported], it is challenging to execute that switch in a reliable and expected manner." On paper, at least, the SGP.32 architecture promises to remove these management issues – in practical ways, by preserving the server-side SM-DP+ 'pull' mechanism and replacing the device-side LPA software manager in SGP.22. But actually, they still exist; just a step removed, up the stack, transposed from rigid architecture to commercial policy. Airtime contracts, carrier integrations, management platforms, service guarantees – these are the components for IoT devices to go anywhere in the world. They have not vanished, and they have to be managed.

We will discuss; but the first thing, in this new IoT takeaway joint, is just to know what's on the menu. "I love that slide," says Lemon of the Kaleido Intelligence survey results. "We run into the same thing with the non-adopters. Customers ask about eSIM, and don't even understand there are three SGP variants. And all the pitfalls are linked to the choices they make." He explains how certain KORE customers are "porting" open-source LPA code bases into their IoT products or using mobile device management (MDM) systems on smartphones to remotely manage profiles onto SGP.22 SIMs in their IoT fleets. It is clever, but it is not ideal, and not an option for very many.

He reflects: "You have to understand the diversity of these solutions. Because it's all over the map, and it requires money and effort. But the eIM in SGP.32 really changes things into a standardized RSP process." Nevertheless, it still has to be explained, in context; suppliers have a responsibility to educate, and customers have a responsibility to understand. Sorrell says: "We are in an industry that loves silly acronyms – like SGP.32. Which makes it hard, in a sense, to reach the end customer." He tells a story about how a session on SGP.32 certification at Embedded World, the big annual IoT event in Germany, in March was attended by precisely… two people, including himself.

"So there is a gap. People are building connected devices and don't think about how the connectivity is implemented. That is where a lot of education needs to happen."

SCOTT LEMON
Senior Director for Market Engagement and Innovation
KORE

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2. Reuse and readiness

One of the best aspects of the SGP.32 specification is it is designed to work with existing SGP.22 consumer RSP infrastructure. For developers and operators, this reuse offers a significant operational and economic advantage. The "thousands" of SGP.22 instances already deployed globally can be repurposed to support IoT devices under the SGP.32 framework, drastically reducing the time, cost, and complexity associated with onboarding a new standard. This backward compatibility is not just about maintaining older infrastructure – it expands the ecosystem. By building on the SGP.22 foundation, SGP.32 brings broader availability of platforms and tools, enhancing flexibility and choice.

Bonvarlet at Kigen explains: "An MNO with an SGP.22 SMDP+ server for smartphones can use the exact same consumer RSP infrastructure to provide a profile for IoT. So there is no incremental cost; they just have to agree on the data plan associated with the profile. So an MNO that was not playing in IoT at all can now serve the whole IoT market. I mean, there is work for it to understand the market, and how to sell to an OEM to build a fleet, and so on – but on the technical side, there is not much to do. We are currently certifying our OS against both standards at the same time – so the same OS can be used in consumer or IoT mode, or even in a kind of hybrid mode."

The pitfall – or elephant trap, even – is that developers persist with fudged SGP.22 implementations of IoT solutions, and miss the chance to get them right in the first place. The new SGP.32 protocols have been designed to be simpler and more open for onboarding, making it easier to support a wider variety of devices with fewer integration issues. Specifically, it introduces an IoT profile download protocol (IPDP) for lightweight profile delivery, eliminating the need for a device-side LPA interface, and relies on RESTful APIs for easier backend integration. The result is a more accessible and scalable IoT setup – if developers take the time to adopt it properly.

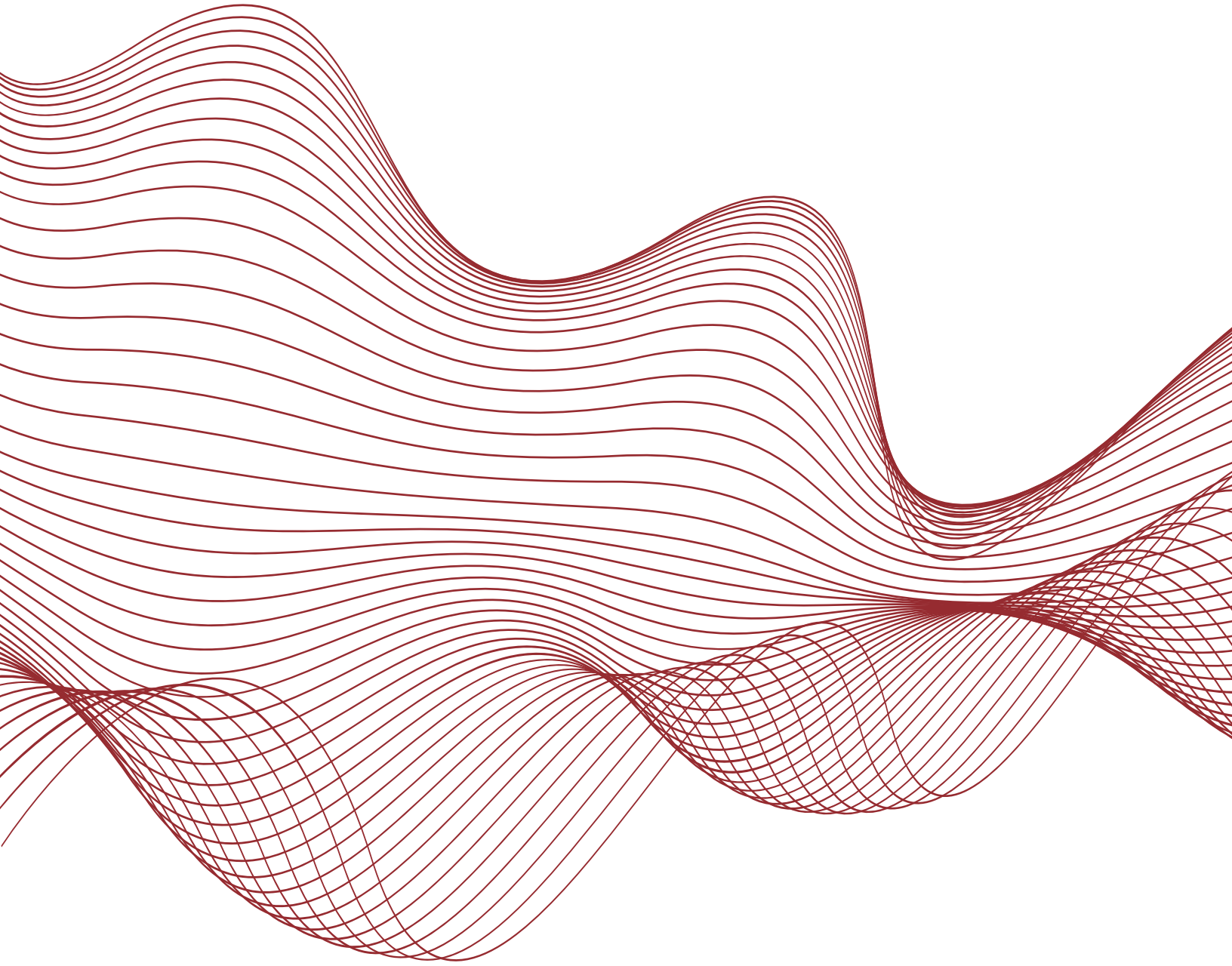
But while the infrastructure is geared for reuse, developers cannot just assume any eSIM device will be compatible. The good news is that almost all of them are a natural fit. The interface between the eSIM and the modem has not changed from legacy SIM designs – which means, in principle, that any device that can house a SIM card can adopt an eSIM, and, by extension, can also support SGP.32. Switching eSIM profiles is dynamic – akin to physically removing a SIM and inserting a new one. "The modem interprets the change as a loss and reappearance of the SIM," says Lemon. But there are challenges in the software layer – specifically with the device firmware.

LOIC BONVARLET
Senior Vice President for Ecosystem and Marketing
Kigen

"An MNO that was not playing in IoT at all can now serve the whole IoT market. I mean, there is work for it to understand the market, and how to sell to an OEM to build a fleet, and so on – but on the technical side, there is not much to do."

SGP.32 introduces more dynamic behaviour around profile management, particularly when switching profiles. The profile shift has ripple effects. For instance, firmware must be able to handle connectivity transitions, which may require configuring a different access point name (APN) or adjusting max transmission unit (MTU) sizes to suit the parameters of the new profile. These are not guaranteed to be handled automatically, especially in more constrained IoT devices where minimal firmware is tightly coupled to specific connectivity rules. "There are pitfalls there," says Lemon. "These are things we are testing now."

Developers should be vigilant, he says – to "accommodate some of these things that might happen with SGP.32". The point is that, while it brings powerful new capabilities for remote provisioning and lifecycle management, it also introduces hidden complexities. It is not just about ticking a compatibility check-box in a hardware manual, in other words. Developers must test for profile-switching behaviour, understand how their firmware responds to new network configurations, and ensure compatibility with varying profile parameters – or partner with providers that have run the checks already, and know the form. That is the urgent message from KORE.



3. Flexibility traps

The whole promise with SGP.32 is about flexibility, of course – specifically, the ability to provision and manage eSIMs remotely, across massive fleets of IoT devices, over many years. At the heart of this promise is this server-side eIM system, as discussed, which replaces the old SM-SR (subscription manager for secure routing) routing system from SGP.02, takes over profile management on the eUICC chip itself, coordinates with the SGP.02-made SM-DP+ profile storage and delivery software, and works as the primary orchestration and control layer. But while it has been ostensibly designed to reduce lock-in, the risk remains, potentially, depending on how eIMs are controlled.

Indeed, the eSIM concept of freedom remains something of an illusion. "I feel pretty strongly about this," says Lemon, answering a question during the webinar about whether it makes a difference to host the eIM with an MNO or a third-party provider, such as an eSIM provider or a KORE-style MVNO. "I don't know that the selection of one versus the other is going to prevent lock-in. Because either could lock you in," he says. The point is that the SGP.32 standard provides support for multiple eIMs on a single eSIM, which means, in theory, developers and enterprises can move between eIM providers without ripping and replacing hardware – which promises genuine flexibility.

But it also limits flexibility, potentially, because it provides the ability to remove eIMs, as well as to add them – and to also "throttle" their provisioning in a management console. In other words, the freedom only holds if eIM providers, whether operators or others, implement the standard as intended. Lemon explains: "This is important for people to understand. If you are going to partner with an MNO, you have to make sure they provide the facility to move to another eIM, or add another eIM. The same with any third party. The standard was designed to avoid lock-in. But if your provider refuses to allow another eIM to be connected, then you're stuck – and with that vendor forever."

So the pitfall is not embedded in the standard, itself, but manufactured in its execution. Again, it falls to the customer to perceive it. Lemon goes on: "Developers and enterprises really need to be talking to the service providers about their eIM, and what their remote capability is going to provide – to stick with or move to an eIM. Because all these different SGP.32 capabilities could be throttled." But maybe the problem, real enough, is overstated, as well. The idea of lock-in is based, mostly, on a fear of churn. But this is not the consumer market; in the end, IoT fleet management, even when it is remote-controlled and flexible, is a headache. Enterprises don't want to switch just for the sake of it.

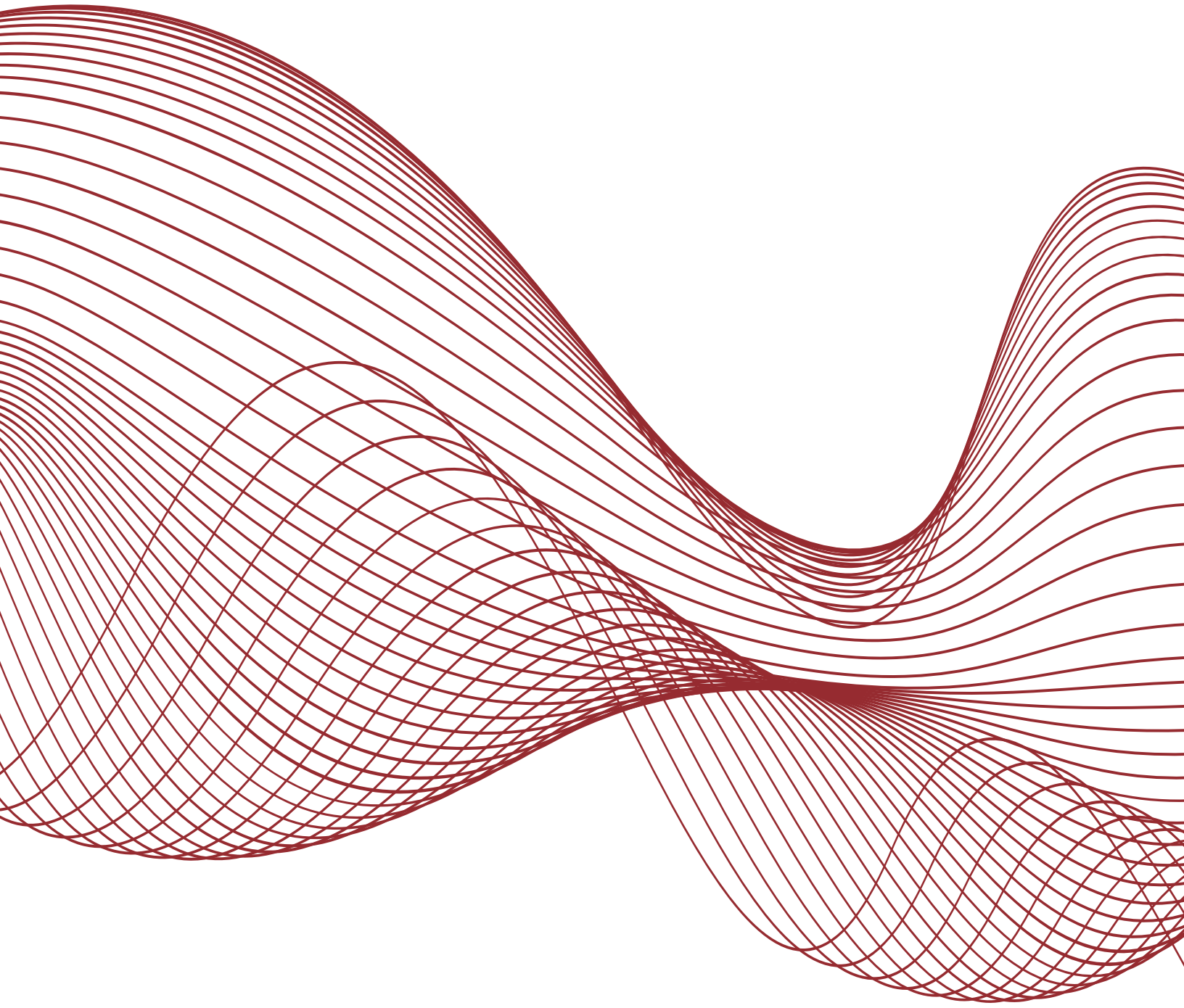
As discussed, they do not even really want to know about the connectivity

STEFFEN SORRELL
Chief of Research
Kaleido Intelligence

"There will be some concerns among some operators about how the eIM is assigned. But there are already players on the market who are providing flexibility to switch. So market forces will dictate, ultimately. As long as customers are doing their due diligence, the old walled gardens will come down."

technology or the bearer network, unless it is to solve a problem. Which is the message that comes out of every tech-led digital-change consultancy – like it is a revelation. Enterprises don't care about the tech so long as it works. Which is the secret sauce, here: the real value with these new eSIM capabilities is around risk mitigation, rather than opportunistic churn for better signal or price. It is about insurance against long-term risk – in case the signal or signal provider fails or changes over a 10–15 year lifecycle. "That is the most powerful aspect of eSIM," explains Sorrell.

"Because if you run into trouble, whether it's with regulation or pricing, or you have an argument with your provider, then you can contract with someone else. But enterprises won't just switch networks willy-nilly. Because you get into a situation where one part of your fleet is connected to one platform and another part is connected to another… and it gets [messy and expensive]. There will be some concerns among some operators about how the eIM is assigned. But there are already players on the market who are providing flexibility to switch. So market forces will dictate, ultimately. As long as customers are doing their due diligence, the old walled gardens will come down."



4. Power dynamics

Which, in itself, changes the cellular IoT market dynamics. Whether or not enterprises jump about between airtime carriers, power and control shifts away from traditional MNOs with these user-directed RSP mechanics. Transforma Insights suggest operators are "increasingly cautious about granting network access, particularly for eSIMs". Which reads like they are paranoid about churn. But it is probably saying the same as Kaleido Intelligence. "They want stronger guarantees on device security, certification, and network resource utilisation," it writes – as if the worry is that wayward MVNO partners will drive up churn figures for reasons beyond their control.

But the power shift works for MVNOs. It gives them a chance to get closer to their MNO sponsors – as IoT enablers. In some cases, they are turning the old MVNO model on its head, so MNOs are piggybacking on their infrastructure instead – which is cloud-based, nimble, and global; plugged-in northbound (airtime roaming, network APIs) and southbound (SIM provisioning, vendor platforms), and able to handle billing and management between both. "On the one hand, the data resale play is less attractive for MVNOs. On the other hand, MNOs realize they can't go it alone, and are starting to use MVNOs to extend coverage and manage devices," says Sorrell.

He goes on: "Together with the new eSIM spec, that creates an interesting scenario. Because .02 was all about SM-SR swaps, where both parties had to agree to a swap – and of course everyone drags their feet, and the process takes months and is sometimes unreliable. This is what SGP.32 solves – in that it makes it a customer decision to switch networks, assuming they haven't been locked in. But it is not going to be like, 'Oh, it is Thursday, I want to switch to network B'. It is going to be like, 'Yeah, there's a real reason to switch, and I have this new tool to do so without spending several months and several thousands of dollars."

It is interesting, here, to hear from Vodafone. Is SGP.32 something Vodafone embraces wholeheartedly, or does the dynamic shift in a way that makes it uncomfortable? Kling responds: "We embrace it. You have no choice but to embrace it. It is a natural evolution, which makes IoT easier and better for customers. And Vodafone is all about the standards, of course; we are working on the frontline with all standards.… We should be ready with SGP.32 by the end of this year. We are working in the background; we aren't just waiting until it's commercially ready. We have the infrastructure and the ecosystem partners to be ready in time. We will follow the needs of the customers."

Right; and what is the impact for Vodafone with regards to delivering a service that stops churn? Or is this new

ERIK KLING
President and Head of Americas
Vodafone IoT

"You have no choice but to embrace it. It is a natural evolution, which makes IoT easier and better for customers.... We should be ready with SGP.32 by the end of this year. We are working in the background... We have the infrastructure and the ecosystem partners to be ready in time."

dynamic overplayed? "It is always about the balance, right? Especially in this industry, which is always dealing with change – with 2G, 3G, 4G, 5G, now 6G, and all the different flavours of IoT; and with the global diversity in all of that, where 2G and 3G are gone in the US, say, and where it is different in Europe or Asia. And for customers, it's like, 'Ugh, what do I do?' What product strategy makes sense around the world? And so it is good to have a partner that knows the roadmap and has the vision, the contacts, the network access. Which can provide a consultancy service."

He adds: "Automotive is the driver, followed by healthcare. We have adapted to all these technology and network changes early. Which is why we don't see much danger that customers will suddenly say, 'Hey, I can get a better deal over here'. Because that is not the value proposition. When you go with Vodafone, you have the largest partner in the IoT world, and we are hyper-scaling connectivity for critical IoT services – from container tracking to healthcare applications." As an aside, it is strange that Vodafone is noisier in its marketing about its pioneering iSIM work with Kigen, Murata, and Sony Semiconductor, based on pre-commercial standards, than it is about the humble eSIM.

But Kling's comments are valuable. Meanwhile, Transforma Insights argues that the shifting power-play might position MVNOs in a new 'orchestrator' role to bridge eIM-based RSP and full-stack roaming and billing. Which could also be an analyst house looking to coin new terminology, of course; but the idea is well received. Bonvarlet at Kigen responds: "If someone can integrate and manage all the activation and optimization – with logins from this provider and that provider, and APIs to manage airtime plans – in a single pane-of-glass platform, then the user has a full view of their eSIM lifecycle, across their fleet." He points to 'orchestrator' offers from SIMETRIC and IoTM, notably.

His colleague, Bee Hayes-Thakore, in charge of marketing at Kigen, adds: "A lot of times things were possible for OEMs if they were so large they controlled their value chain – if you are Apple or Samsung, say. But IoT is in the hands of operatives at a service desk, who want to solve problems and manage costs, but have different expertise. All of this is about taking away that burden – of having to be a telco specialist just to have devices in-field that do the job they were put there for. In the end, the connectivity is just a utility, which has to be managed – but like it's across many buildings in many places, all with different utilities. Which is why this orchestration layer is essential."

But roles and responsibilities are changing, anyway; the SGP.32 standard just accelerates the shift. "Yes, MVNOs will orchestrate eSIMs, but only as part of this wider shift," says Sorrell. "Some are taking a more indirect role, but MNOs are still doing the selling, onboarding, and management. The orchestrator idea has developed over a few years – as an overlay to manage eSIM fleets across different CMPs. And that single pane-of-glass is important because more choice means more players, and more players means more platforms. But there aren't any commercial SGP.32 devices in the market yet, and adoption will take a couple years. It is only then that it becomes really important."

Lemon says: "I agree – that automation on top of the eIM will be key. Think about a device on a truck in South America, attaching to a local profile to navigate roaming restrictions in Brazil, and switching to a roaming profile as it heads north, and then to a carrier profile to get carrier-grade capabilities in the US. All of that should be transparent and rule-based, and orchestrated in an automated fashion. SGP.32 allows for that. That is the vision – to analyse, adapt, switch profiles to be on the best networks. But you need an appropriate portfolio of profiles in the first place, and a transparent way to manage them as well."

Continues on p.25

In-factory provisioning – putting eSIM at the heart of IoT production

New and future eSIM standards enable in-factory provisioning, giving OEMs control, reducing SKUs and costs, and avoiding post-deployment complexity – encouraging ownership of SIM decisions earlier in production.

A key part of the SGP.32 gambit is to also provide a foundation for in-factory profile provisioning (iFPP), to be formally defined in SGP.41 and specified in SGP.42 some time in late 2025/early 2026. The SGP.41 framework is deliberately loose, to make current experiments commercial endeavours. As it describes, iFPP will see original equipment manufacturers (OEMs) load SIM profiles onto IoT devices during their production – instead of wasting battery power, and risking the customer experience, to locate and download them in the field.

More than this, it affords a way to reduce SKU complexity, and associated management costs, which multiply in post-deployment when field variants connect to different airtime connections. Kigen, closely involved in the GSMA standardisation process, has commercial trials in Asia that use an eIM agent to decouple provisioning from live connectivity, and support local activation even in air-gapped or offline venues. "[The OEM] can manufacture a completely generic and vanilla device with the eSIM embedded in it… and test it out… in under two minutes"

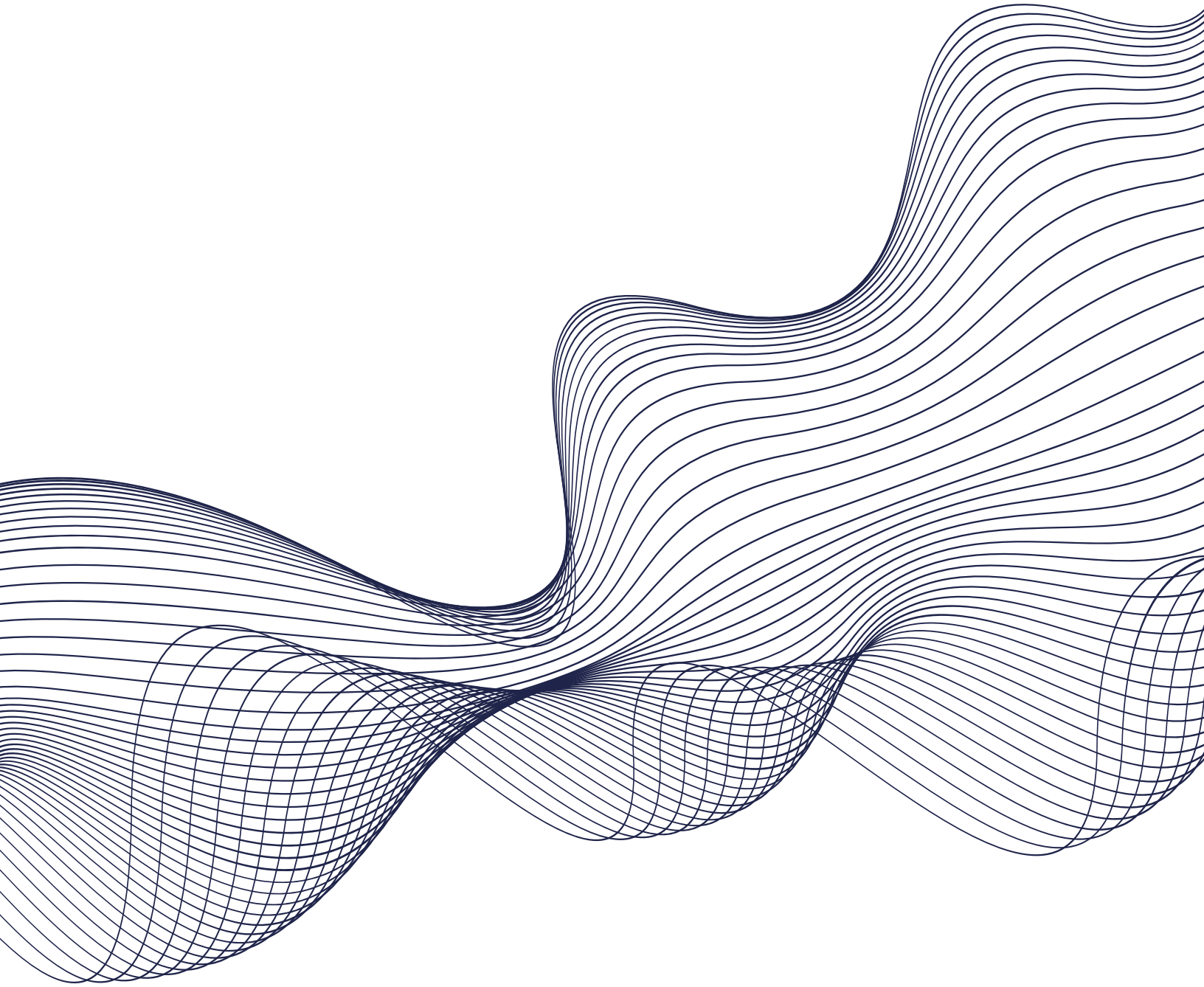
So says Loic Bonvarlet, senior vice president for ecosystem and marketing at Kigen. He says: "The new thing with SGP.32 is that the eIM becomes this agent that securely takes a download package and roots it down to your device or factory line." On paper, it solves a major bottleneck for OEMs in the low-power cellular IoT space. He presents a cautionary tale of sorts about OEMs skipping through standard production without an eye on longer-term gains – which chimes with the message in the rest of this report about education, due diligence, and investing for the future.

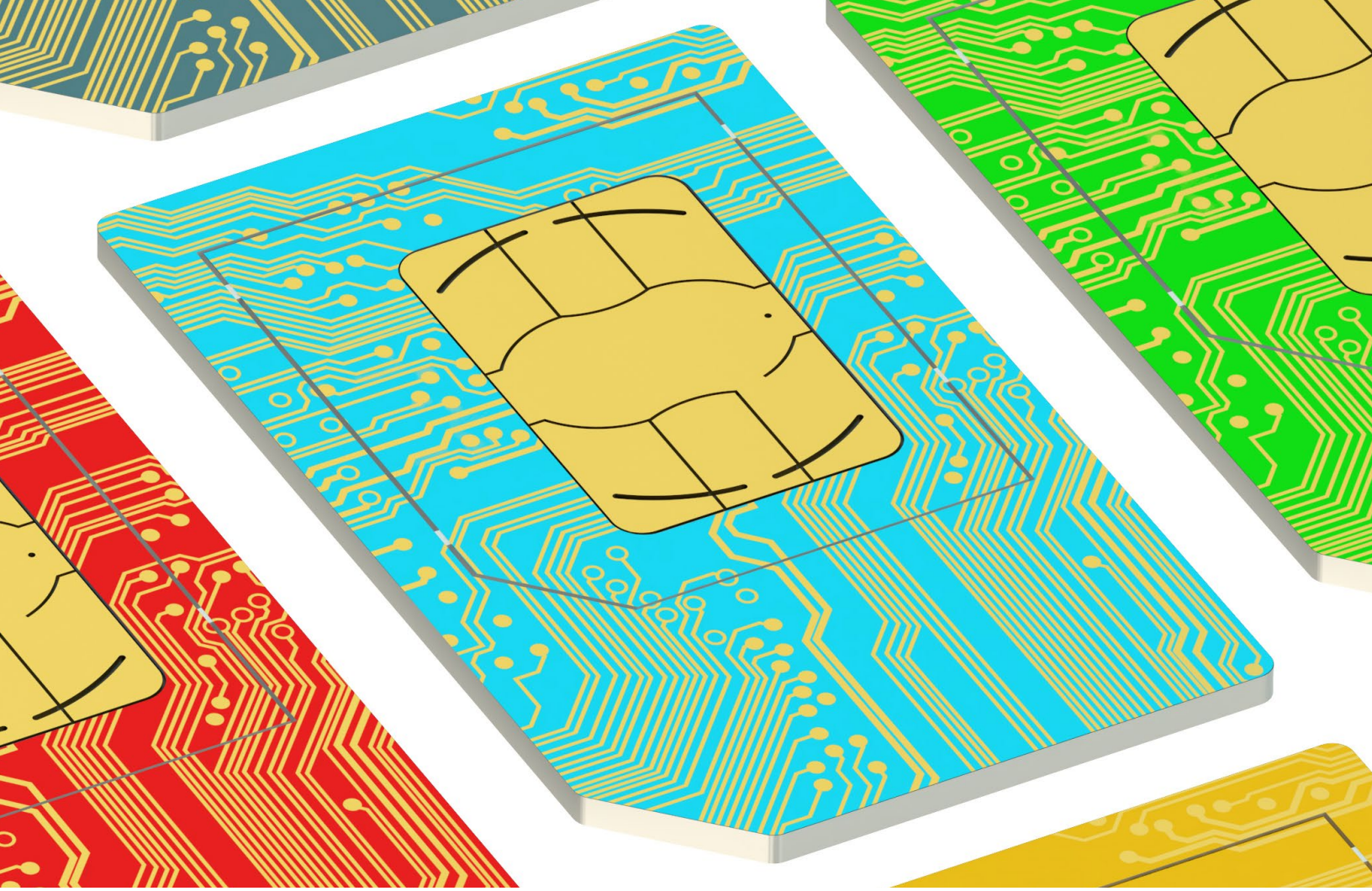
LOIC BONVARLET
Senior Vice President for Ecosystem and Marketing
Kigen

"Whatever you can do in the factory means more control and less cost. Too often, OEMs think they can choose a module, antenna, connectivity, and that's it – like the SIM is somebody else's job. 'Not my problem'. But the wrong [SIM] choice in production means a higher TCO downstream."

"Whatever you can do in the factory means more control and less cost. Too often, OEMs think they can choose a module, antenna, connectivity, and that's it – like the SIM is somebody else's job. 'Not my problem'. But the wrong [SIM] choice in production means a higher TCO downstream," he says. The iFPP mechanic brings greater control by shifting connectivity decisions upstream, into the manufacturing phase. Instead of relying on post-deployment profile downloads and SIM swaps, reliant on bootstrap profiles, a neutral eSIM can be provisioned as a SKU before it ships.

For industries where device lifetime, battery efficiency, and regulatory compliance are critical, it starts to look like a game-changer. This idea that the "SIM is someone else's job" is important. With all this new flexibility, OEMs are being encouraged to take ownership of SIM provisioning upfront, rather than treating it as a telco responsibility. Fragmentation, complexity, and ROI remain big hurdles for IoT makers, even in the new eSIM era. Switching providers still involves new contracts, SLAs, and platforms – making multi-provider deployments complex and costly.





Conclusion

In the end, this is the crux – and the advice to developers and enterprises: do your due diligence, before deploying SGP.32 based eSIM solutions; or worse, before missing the SGP.32 boat entirely and setting a new fleet of IoT devices adrift in dodgy craft on choppy tides. Ask hard questions of your service providers. What is your portfolio of profiles? Do you support remote eIM switching? How much control will I have? How transparent, and how seamless? Show me the proof; let me see it in test and in action. "The thing is to talk to lots of vendors," says Lemon. "Ask questions, compare answers. Go into it in a smart way – because IoT investments pay off in the future as well."

Because, as discussed, the SGP.32 standard offers a leap forward in flexibility and neutrality – if it is implemented with care, and if enterprises and developers know the pitfalls. KORE makes its own case about its carrier profiles, as well as its business profile; Lemon reels through the highlights: 20 million connections; 3,600 customers; 45 carrier integrations; roaming in 190 countries; support for all eSIM standards; SGP.32 solutions in test, and coming soon. He says: "A good portfolio of profiles is essential to all of this – to have the freedom, in the end, to deal with roaming regulation and data localisation, via local carriers, and even profiles from other vendors."

Sorrell at Kaleido Intelligence says IoT developers should see SGP.32 devices in action – "rather than just on paper". He remarks: "Interoperability of all the different components, especially in a multi-vendor sourcing scenario, is very, very important. Because we are at a really early stage in the market, and, yes, the basic components might be tested and compliant, and might appear interoperable, but there are other

elements that might not work in tandem. So bear that in mind." More than this, the message is to add it up and suck it up; entry costs are higher with eSIM, invariably, and hard money-metrics are scarce. "An eSIM is always going to be more costly than a standard SIM solution."

Lemon says IoT module makers are being aggressive with SGP.32 hardware pricing, but acknowledges as well that the total cost of ownership will likely stack up with integrations, airtime, and management licences. Sorrell says: "Price parity will never be reached. So the entry will always be more challenging from a financial perspective. There will be a segment of the market that is very, very cost sensitive, which won't go with eSIM – because it's just too much buy-in. So they may look at soft SIM solutions, instead. But that will be a very small segment." In the end, as per his firm's forecasts, the whole machine-based comms market will go with SGP.32.

But it has to approach it, even if costs inch upwards in comparison with old SGP.02/22 solutions, with a clear sense of the benefits, including financial ones, that will come with an open and flexible RSP tool over the lifetime of an IoT fleet. "There is work for companies to explain and understand that a little extra cost can save a lot more if it comes down to it," he says. Kigen agrees, and reverts to the original point (pitfall), as explained above. There is an 'education gap', which is holding back adoption. Potential users, holding the keys to 'massive IoT' in new markets, do not see the whole picture. The biggest challenge is mindset, says Bonvarlet.

"The fundamental mistake in IoT [is to] save on the bill-of-materials at the risk of incurring downstream costs. So many IoT initiatives launch and so many fail. The business case only works when devices are in the field for a long time." It ties in with the message about in-factory provisioning (iFPP), a part of the SGP.32 specification, to be formalised in SGP.41 and specified in SGP.42 some time in late 2025/early 2026 (see page 23) – that early design choices, even at the production stage with SGP.32, have long-term business impacts. Device makers, like developers and enterprises, must take responsibility for the SIM make-up, as well.

Be deliberate, from factory to field – the message goes. Invest in technology that will last a lifetime – from SIM to network to application, to business-result and financial-return.

SCOTT LEMON
Senior Director for Market Engagement and Innovation
KORE

"You have to understand the diversity of these solutions. Because it's all over the map, and it requires money and effort. But the eIM in SGP.32 really changes things into a standardized RSP process."

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