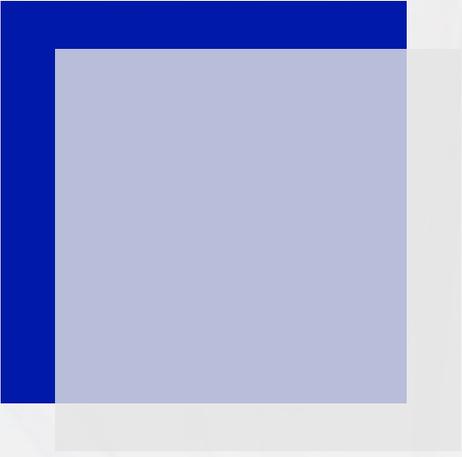


Kaleido Connectivity Vendor Hub H2 2021: Competitive Analysis

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Connectivity Trends & Outlook: Growth

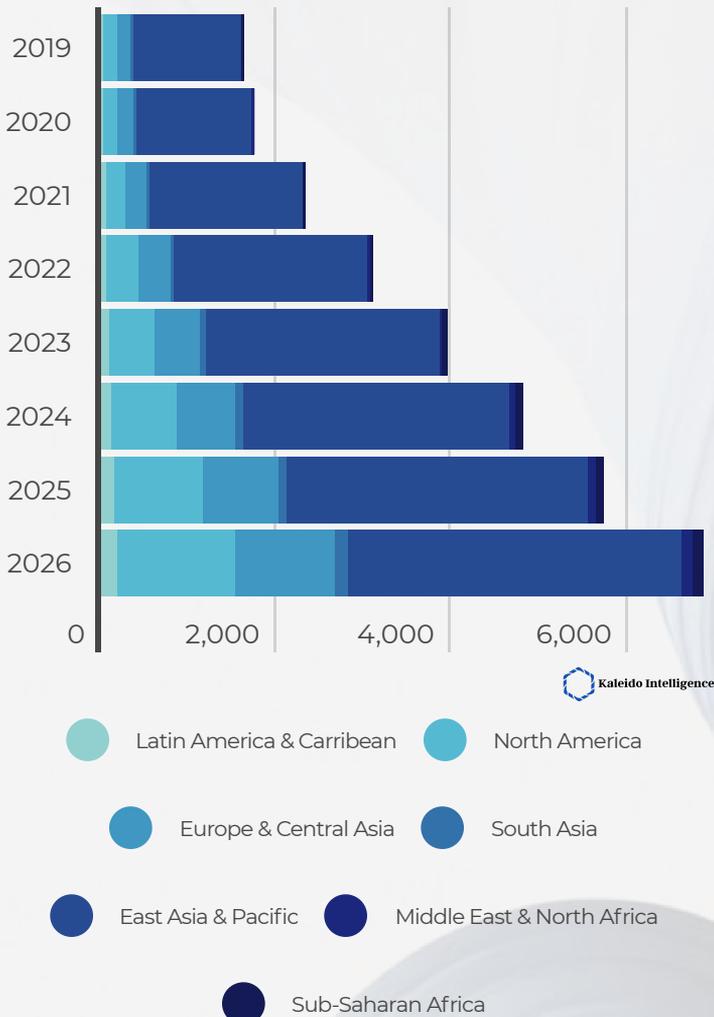
Although cellular connectivity continues to form a relatively small proportion of the overall IoT installed base (approximately 14% in 2020), the technology is expected to see significant growth over the coming 5 years. This growth is fuelled by a combination of factors, including falling hardware costs, innovation in the connectivity space to reduce supply chain complexity, deployment scaling and coverage, the emergence of LPWAN (LTE-M and NB-IoT) standards and, importantly, COVID-19.

While it is certainly true that the pandemic dampened investment prospects during 2020, and the ongoing supply chain and chipset crisis continues to impact the broader market, IoT has helped facilitate many of the remote working, automation and business process transformation efforts that were enforced on many businesses during the height of restrictions imposed by authorities during 2020 and 2021.

There is no doubt that cellular IoT is a complex endeavour, and very much unlike the consumer market for mobile connectivity. Custom device and application requirements, long lead times, regulatory hurdles as well as a lack of interoperable platforms and systems have hampered the growth of the market to a considerable degree. As noted above however, the collective industry has invested heavily in solutions to overcome these challenges:

- **Highly capable connectivity management platforms (CMPs)** have been developed, providing users with the tools to monitor and manage large device fleets. These platforms are now being enhanced further, with some vendors aiming to streamline business process functions via intelligent underlying systems and fully managed services, while others are focused on delivering single-pane-of-glass, single SIM and single invoice connectivity and management services to minimise complexity.
- **The deployment of dedicated, virtualised core network infrastructure is well underway**, further enabling service providers to streamline support operations, reduce downtime and optimise routing to provide superior application performance.
- **The eSIM specification is increasingly supported by service providers, decoupling the SIM card from the serving operator** and reducing instances of lock-in. Meanwhile, the forthcoming standardised iSIM specification will enable OEMs to further reduce costs due to a lower bill-of-materials, while also opening the connectivity space up to a wider set of actors. Several vendors are marrying eSIM technology with IMSI switching capabilities, offering even broader and lower cost localisation capabilities than eSIM profile switching alone.
- **The release of dedicated enterprise spectrum in several countries around world has catalysed the market for private LTE and 5G networks.** Additionally, an increasing number of vendors are supporting network-as-a-service type models, reducing the entry barrier for companies with lower capital.

Connectivity Trends & Outlook: Growth

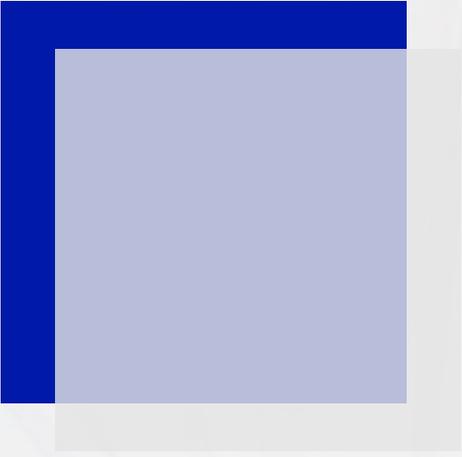


Growth in cellular IoT is supported by a significant expansion in the number of cellular modules shipped. Shipment volumes are forecast to reach over 700 modules annually by the end of 2025. LPWAN; largely through NB-IoT; is expected to account for a significant proportion of shipments by the end of the forecast period, accounting for just under 42% of module shipments in 2025. This will place further demands on connectivity service providers: not only must CMPs cater to this type of technology, but the wider ecosystem must adapt to these low-traffic devices by supporting new business models based on non-traffic models. Billing and Charging Evolution (BCE) is expected to become a factor behind this type of support, driving a move away from traditional TAP-based settlement.

By the end of 2026, Kaleido expects that some 6.8 billion cellular connections will be used to deliver connectivity to IoT devices. This represents a CAGR of 23% between 2019, when connections reached 1.6 billion, and the latter forecast year. China is expected to remain the largest market in the world in terms of connection volume, accounting for just under half of all cellular IoT connections in 2026. Nevertheless, all regions outside of East Asia & Pacific are expected to see average annual growth of over 30% in the connection base between 2019 and 2026.



● Total Cellular IoT Module Shipments (Millions)
● LPWAN Share of Cellular IoT Module Shipments



Connectivity Trends & Outlook: eSIM

Historically, cellular technology has been viewed by many stakeholders as the natural go-to solution for device connectivity. The technology is reliable, now offers remarkable data throughput capabilities, and is perceived as more secure than other technologies using unlicensed spectrum.

The reality is that the ecosystem for mobile connectivity has been built around consumer mobile phones and a traditional retail model, with MNOs owning the primary relationship with the customer through SIM issuance and contract management. This model has worked well in the past, even as the M2M market has grown, with M2M projects typically deployed in cases where sufficient return on investment (ROI) warranted the additional expense and complexity of cellular M2M.

However, the traditional MNO business model has not been able to address the modern mobile ecosystem, where cellular connected machines and mobile devices often demand high-quality connectivity in visited mobile networks. In this case, consumers have often been either forced to pay high prices for roaming data, SMS and voice services, or rely on local Wi-Fi services, with silent roamers representing a high proportion of mobile subscribers travelling in foreign countries. On the M2M side, those looking to connect devices in several countries around the world have had to negotiate multiple contracts with connectivity providers, leading to increased management costs as well as overheads in production and deployment.

The eSIM (eUICC) has laid out the path for future mobile connectivity across both consumer and M2M sectors. Even MNOs with the most wide-ranging networks and roaming agreements are unable to provide optimal connectivity and pricing for all use cases that cellular technology is now designed for. This is especially apparent in the M2M sector, where data throughput, pricing, National Regulatory Authority (NRA) regulations, and Quality of Service (QoS) requirements can vary dramatically, depending on the type of deployment and country of operation.

eUICC is, of course, simply a standardisation of programmable SIM technology that has existed for years. The crucial difference, and the reason why eUICC is called 'future proof,' lies in the fact that non-eUICC programmable SIMs rely on proprietary technology to facilitate provisioning and device management. There is no doubt that these solutions have worked well in the past. However, the fact that customers have effectively been locked in with a connectivity service provider offers little difference to the traditional MNO SIM distribution and management model. In both cases, switching to a new provider offering more favourable management rates or higher levels of service means high costs incurred for the customer.

With the emergence of the eUICC specification, control of the SIM card distributor is lost due to the ability to download and provision new operator profiles and access credentials over the air (OTA). This concept has created massive disruption to the historical SIM card value chain: unsurprisingly, incumbent MNOs have been slow to support the eUICC specification.

Connectivity

Trends & Outlook:

eSIM

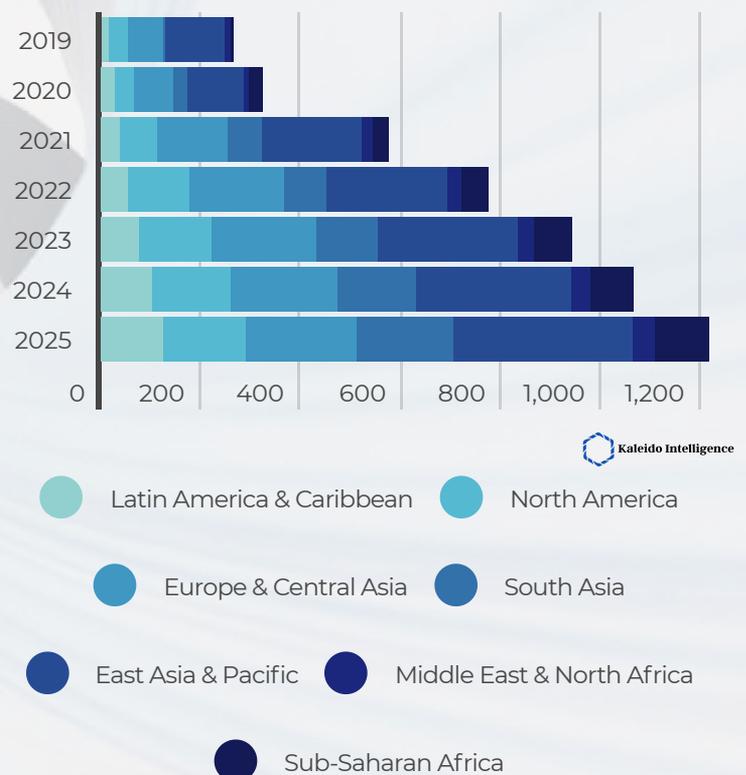
This disruption is compounded in the consumer space, where mobile subscribers could be changing operator profiles multiple times per year depending on their movements and requirements. This means that additional complexity is added to existing Operations Support Systems/Billing Support Systems (OSS/BSS) alongside new challenges in terms of Key Performance Indicator (KPI) reporting and tracking.

Although eSIM chips and services have been commercialised for several years, traction thus far has been relatively limited:

- eSIM for consumer and M2M device are composed of separate specifications. This creates a level of friction in the market which the majority of our interviewees believe will be eliminated as specifications are converged. Kaleido understands that work is underway to develop a specification to address IoT use cases in a more streamlined manner within the GSMA's Working Groups.
- Alongside an additional hardware cost to support eSIM, operational costs are also increased in the form of subscription management platforms. This reinforces the need to demonstrate return on investment (ROI).
- The nature of the eSIM specification architecture can create challenges when switching operator profiles is desired. The transfer must be agreed to by all parties, while integration to enable the transfer of service from one eSIM platform to another is often required, and is rarely simple.

- eSIM for LPWAN devices also come with technical challenges that lowers the potential for the much sought-after 'single SKU' concept.

Challenges notwithstanding, the eSIM market has seen healthy growth over the last 3 years, averaging between 30-35%. Year-over-Year (YoY) shipment increases. In the consumer sphere, eSIM support for iPhone has been fundamental in catalysing market support for consumer eSIM. On the M2M side, eSIM is now viewed as a future-proof solution to long-term IoT deployments, while costs have fallen to the point where it is now considered as a preferred option for many customers. According to Kaleido, this will translate into a market of over 1.2 billion annual eSIM shipments in 2025, up from 264 million in 2019.

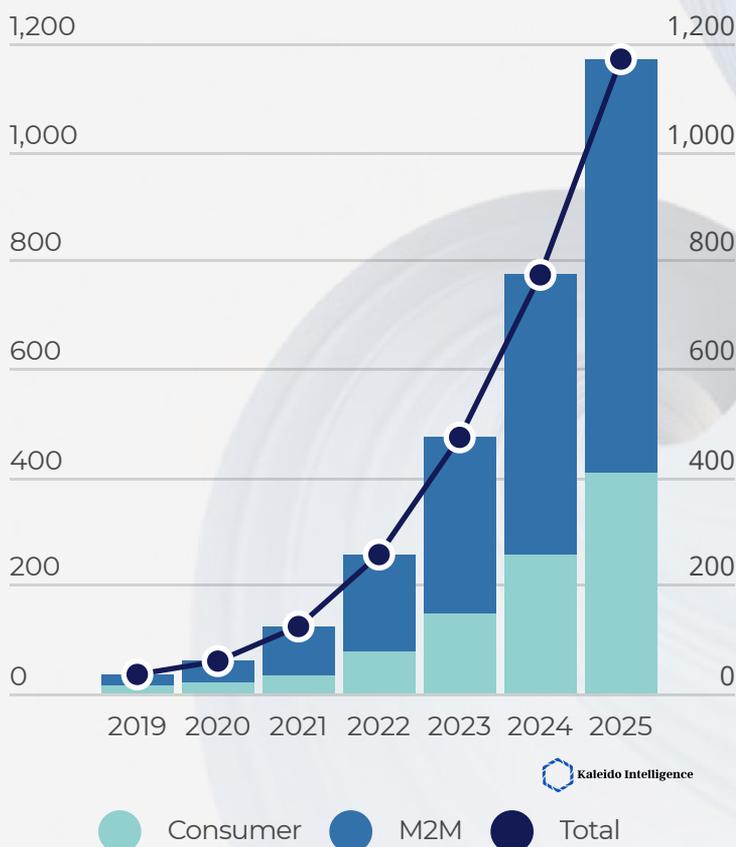


Connectivity Trends & Outlook: eSIM

It is recognised that some overlap exists in the IoT world between traditional M2M devices and consumer devices. Examples of consumer devices classified as IoT include smartwatches, laptops and tablets, as well as other devices that offer a consumer-facing user interface. Naturally, these use a consumer Remote SIM Provisioning (RSP) profile for eSIM Subscription Management.

Meanwhile, it is envisaged that some M2M devices will begin using a more streamlined RSP specification to simplify profile management and reduce the integration time and costs that presently make the M2M RSP specification challenging to navigate.

Kaleido forecasts that some 1.1 billion IoT eSIM profiles will be active in 2025, up from 32.6 million in 2019, representing a CAGR of 82% during the evaluation period. Due to long deployment and testing lifecycles for M2M devices, roughly 38% of the IoT market saw consumer RSP used in 2019, although this will drop to 29% by 2022, driven by increasing automotive, logistics, asset tracking and energy use cases. This proportion will begin to rise again for the reasons given above and will see 410 million consumer RSP profiles active in contrast to 760 million using the M2M RSP specification in 2025.



Leading Connectivity Service Providers & Competitive Analysis



Kaleido Intelligence

Cisco's Connectivity Management Platform (CMP), Cisco IoT Control Center, is comprehensive in terms of features, while the company's heavy focus towards optimisation of certain business processes through automation has delivered proven results.

Cisco is the market leader in CMP solutions, with leading features including automaton, reporting, connectivity management and device management capabilities.

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Kaleido Intelligence | October 2021



Cisco Scored the
#1 Vendor for
Connectivity Management Platform
by Kaleido Intelligence

Kaleido Champion:
Connectivity Management Platform



Kaleido Intelligence

Cisco's eSIM Connectivity offering, Cisco eSIM Flex, delivers a highly impressive solution that offers cloud abstraction and multi-vendor component interoperability to considerably reduce time-to-market when switching operators.

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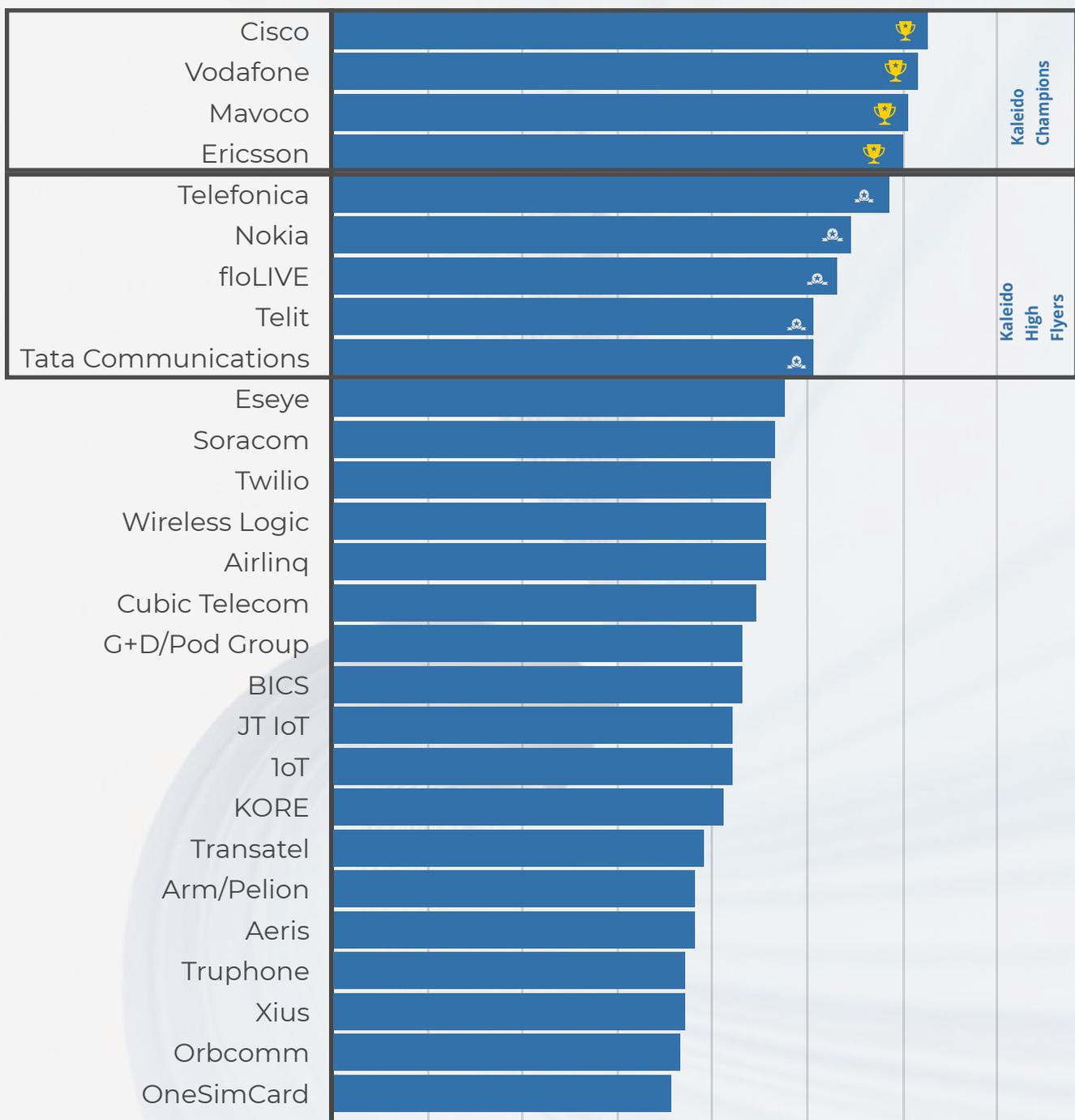


Cisco

Kaleido High Flyer:
eSIM Connectivity

Leading Connectivity Service Providers: Connectivity Management Platforms

The following chart shows Kaleido's assessment of leading cellular IoT CMP providers, based on extensive primary research. For a full understanding of its methodology and approach, see page 10.



Leading Connectivity Service Providers: Cisco

Kaleido Champion Score



CMP: 12.4/15

Kaleido High Flyer Score



eSIM Connectivity: 10.2/15

Outside of China, Cisco enjoys the status of having the largest fleet of cellular IoT connections under management in the world, at 180 million connections.

Within the context of this research, Cisco's IoT Control Center (CMP) and eSIM Flex solution were analysed. Its CMP has its roots in the Jasper Technologies platform, with Jasper being acquired by Cisco in 2016 in a deal worth over \$1.4 billion. The platform has continued as an important CMP for MNO customers, with AT&T providing a notable example.

Cisco enjoys a particularly strong position in the automotive sector, although recently the platform has seen significant growth in connected energy meters. As a result of its automotive strength, the company is likely to take a leading role in early 5G IoT deployments, with 5G SA connected vehicle launches having occurred during 2021, with network slicing support for vehicle use cases planned towards the end of this year.

Not unexpectedly, the company's CMP is among the most fully-featured of all of the platforms analysed. Reporting and diagnostics within the CMP are robust and provide both enterprise-friendly as well as complex metrics for analysis, although the graphical Spotlight diagnostics tool may be less intuitive than a filtered list.

Cisco has a particular strength in having developed solutions to automate business processes on behalf of the customer, with machine learning able to be applied to SIM fleets to suggest service plan optimisations. The company reports customers have achieved 10-15% cost savings by using this tool. In addition to this, the company is developing and improving zero-touch deployment and device configuration tools alongside powerful anomaly and rogue device detection tools. Combined, these services offer a compelling offering for customers looking to reduce management complexity across large device fleets.

Overall, in terms of self-service capabilities and underlying intelligent logic, Cisco's CMP is unmatched in the market. The platform would benefit from a simplified business model; presently, many of the more advanced features are not available to customers without certain upgraded account types, while additional add-ons may have to be purchased even after upgrading an account.

Meanwhile, Cisco has developed an eSIM enablement service, dubbed eSIM Flex. This offers a vendor-agnostic solution to eSIM profile switching, supported by Cisco's SM-SR and SM-DP, and is deployed as-a-service in the cloud.

Leading Connectivity Service Providers: Cisco

Kaleido Champion Score



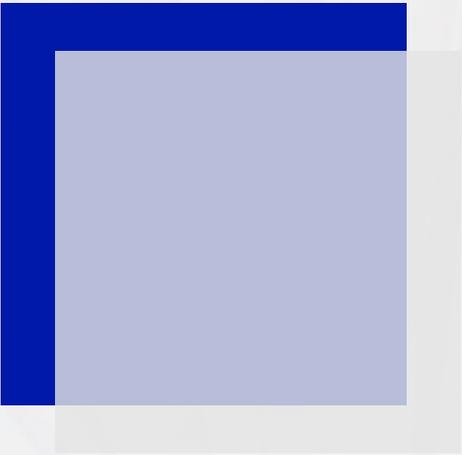
CMP: 12.4/15

Kaleido High Flyer Score



eSIM Connectivity: 10.2/15

The solution is able to both integrate with Control Center as well as other third-party platforms, with SIM profile OTA management executed either via the GUI or through APIs. The company reports that timescales for carrier switching using this solution can be reduced to around 6 weeks, much lower than the months often experienced across the industry.



Leading Connectivity Service Providers: Scoring Methodology

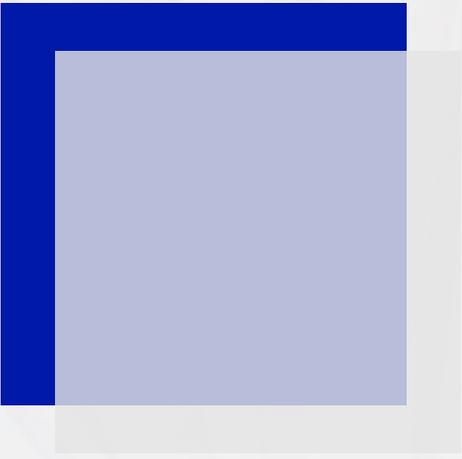
Kaleido's approach towards competitive analysis enables all connectivity service providers to showcase their strengths on an equal playing field and enable customers to choose a provider based on their strengths and innovation as opposed to existing popularity.

Therefore, our approach focused on categorising vendors, examining their strengths and weaknesses, identifying their unique product features, market positioning, problem-solving capabilities, technological innovation, and finally, how the vendor is positioned to meet customer needs and requirements. We conducted the following process to achieve this:

- We conducted in-depth interviews with service providers across the connectivity landscape, collecting information through detailed questionnaires, product demos when available as well as through telephone briefings. Through these interviews, we established how the companies are positioned in terms of customers and deployments, service offerings, market presence and key strengths and weaknesses.
- This enabled all service providers to showcase their strengths and be appropriately assessed by the expert team at Kaleido. Kaleido's impartial approach alongside feedback from vendors enabled us to provide accurate scores.
- Further to vendor interviews, Kaleido conducted interviews with MNOs, MVNOs, OEMs and hardware component suppliers from across the globe to determine customer needs and requirements. This enabled us to match up vendor strengths with real needs as perceived by connectivity service providers, especially from a technical perspective.

CMP scoring is based on an evaluation of 53 variables organised across 13 subcategories, which in turn are organised into Core Features, Extended Features and Technology & Innovation. Scoring weights are applied to each variable, which translates into a total score out of 15 for each subcategory. The combined scores across each subcategory are then normalised to derive a total Kaleido score out of 15.

- Core Features are features considered by Kaleido to be an essential part of any CMP. These allow customers to monitor, search and sort the SIM fleet and perform analysis in addition to applying configurations (such as provisioning SIMs) OTA.
- Extended Features are those where more advanced capabilities are supported by the platform. These concern the optimisation of SIM management workflows and alerting, facilitating troubleshooting, fleet optimisation, and more advanced OTA functionality.
- Technology & Innovation is primarily focused on the platform's underlying technology to support global deployments, improve system performance, and support a comprehensive range of IoT use cases and business models.



About Kaleido Intelligence



Kaleido Intelligence

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

Kaleido is the only research company addressing mobile roaming in its entirety, covering industry leading market intelligence and publications on Wholesale Roaming, IoT Roaming, 5G Roaming, IPX and Analytics & Fraud in Roaming. Research is led by expert analysts, each with significant experience delivering insights that matter.

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