COMARCH

RESEARCH REPORT

AI/ML for 5G Network Slicing: Accelerating Network-as-a-Service (NaaS) Strategy

THE FAST MODE

Index

1. Introduction

5G subscriptions are predicted to account for more than half (54%) of all mobile data traffic by 2026, according to Ericsson Mobility Report 2020[1]. Another report from Juniper Research[2], expects close to half (44%) of global operator billed revenue to be from 5G connections.

At the heart of 5G is network slicing, a technology that enables the abstraction of underlying physical resources, to create independent network instances or slices. Each slice becomes a virtual network, configured to meet the requirements of various industry verticals, featuring one or more of following 5G usage classes – Evolved Mobile Broadband (eMBB), Ultra-Reliable Ultra-Low Latency Communications (URLLC) and Massive Machine-Type Communications (mMTC).

Network slicing enables operators to develop and deliver new services, one of which is Network-as-a-Service (NaaS). NaaS greatly enhances operator monetization, as it introduces openness and flexibility that can be leveraged by partners and other operators to create, manage and deliver innovative services to end customers, leveraging the new capabilities brought by 5G.

This research report, which is based on a survey of 100 mobile operators around the globe, assesses network slicing, including the impact of Artificial Intelligence (AI) and Machine Learning (ML) in driving its automation. It evaluates, from an operator viewpoint, the importance of infrastructure virtualization and the adoption of edge computing in driving the implementation of NaaS. It also looks at NaaS deployment models, implementation strategies and its expected contribution to operator businesses.

The survey, which was jointly conducted by Comarch and The Fast Mode, was participated by respondents from five regions - North America, Europe, Middle East, Asia and South America - with the highest number of respondents being European (34.0%) and North American (31.0%) operators, as shown in Figure 1. The survey responses represent views from operators of all sizes, with the majority coming from operators with an organization size of less than 60,000 employees, as per Figure 2.

Findings from the survey are detailed in the next 14 sections.

1) Ericsson - Ericsson Mobility Report 2020
2) Juniper Research - Operator Revenue Strategies: Challenges, Opportunities & Forecasts 2020-2025

Fig. 1 **Breakdown of respondents by region**

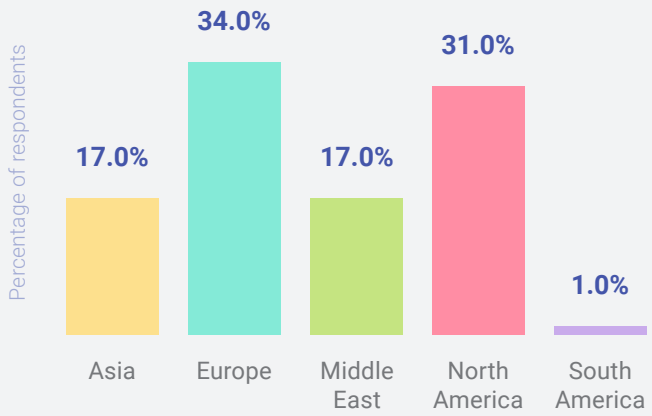
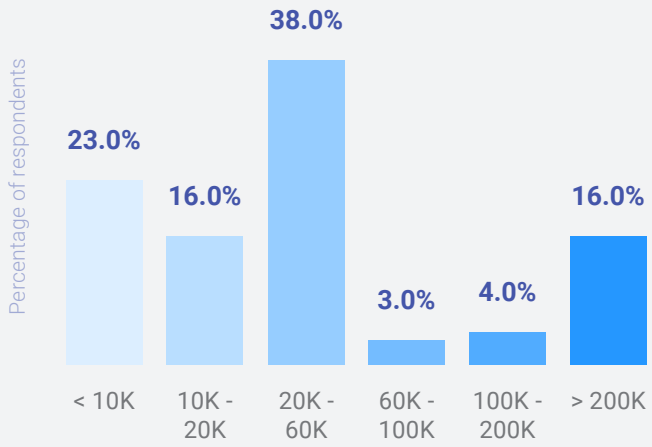


Fig. 2 **Breakdown of respondents by organization size**



2. Network Slicing Application

Clear divergence observed in operators' understanding of network slicing application

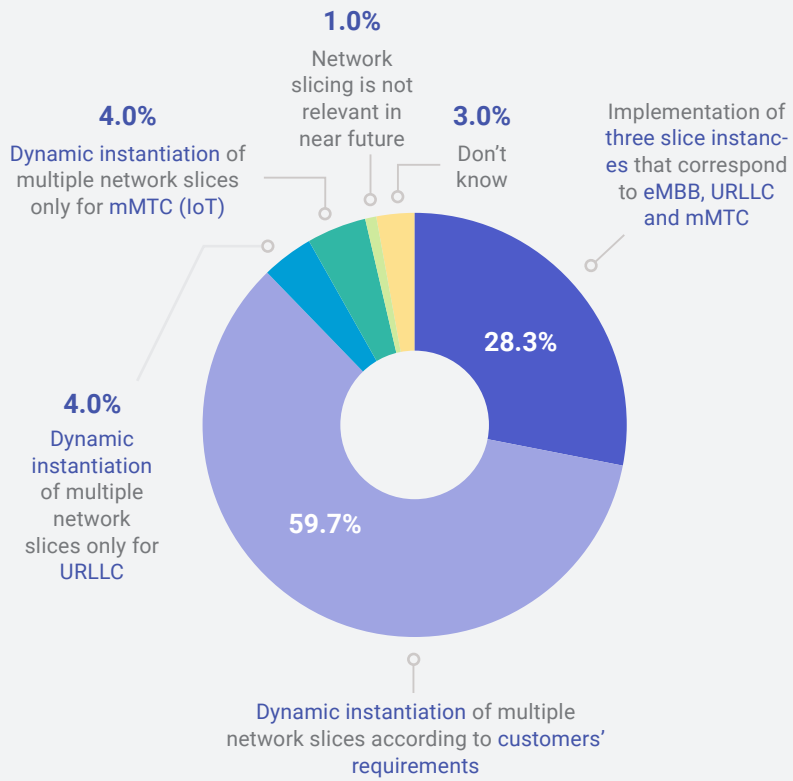
While the idea of network slicing has been widely discussed in various industry literature relating to 5G, there is a clear divergence in terms of what operators understand network slicing to be. The survey shows that 59.7% of the respondents, as depicted in Figure 3, are of the view that network slicing explains primarily, the dynamic instantiation of multiple network slices according to customers' requirements. This translates network slicing into a network management mechanism that allows customers with very different requirements to rent a highly customized, virtualized network tailored to their exact needs, on an on-demand basis.

The idea of network slicing, according to another 28.3% of the respondents, is the implementation of the three slice instances that correspond to 5G service categories, i.e., eMBB, URLLC and mMTC. The specifications for these classes are pre-defined, and align broadly to specific speeds, latency, coverage and connectivity parameters.

Interestingly, 4.0% of the respondents associate network slicing only to URLLC, believing this to be the use case with the highest returns. Similarly, another 4.0% relate network slicing to only mMTC, as the slice-type with substantial returns and with fewer challenges compared to URLLC.

These results correspond to the growth and lifecycle stages of URLLC and mMTC applications. URLLC applications such as autonomous driving, industrial control and smart grid are still being trialed and tested, with an expected huge growth potential. On the contrary, mMTC use cases comprise verticals which are at the mature stage of a product lifecycle, with stable revenues and well-developed applications - for example environmental, marine and logistics monitoring - where a large number of low-power and low-cost devices and sensors are already in use. These applications are relatively more established, and hence, register fewer challenges compared to URLLC.

Fig. 3 **Operators' idea of network slicing application**



3. Network Slicing Challenges

Vertical translations, distributed and multi-domain cloud-based networks key challenge areas for network slicing

Network slicing is essentially the first step towards the implementation of NaaS. Network slicing is a network architecture that enables the underlying physical network infrastructure to be partitioned into isolated, virtualized, logical networks, allowing operators to offer their partners and customers, network instances that are highly configurable, customizable and scalable.

Providing virtual networks suited for a wide range of verticals and customer needs however, requires continuous reallocation of resources within a slice, and between slices, and involves intelligent orchestration of RAN, transport and core slices, on an end-to-end basis. To enable this, it is important that key processes involved in network slicing are automated, via either comprehensive policies/rules or AI/ML-based algorithms. This survey assessed some of the key challenges faced by operators in driving network slicing automation by analysing the most common complexities in its implementation.

More than a quarter of the respondents surveyed (26.3%) admit that they face difficulties in automatic (AI/ML-based) translation of the vertical needs (intents) into network engineering requirements, as shown in Figure 4-a. This is particularly apparent among smaller operators and stems from the overall lack of understanding of non-telco verticals. While operators are apt at building networks and delivering connectivity services, they have limited expertise in areas such as healthcare, logistics, manufacturing and public safety. Operators are hence constrained in their ability to predefine network requirements and SLAs by vertical needs, let alone automate this task based on AI and ML.

Fig. 4-a **Operators' biggest challenge in the implementation of network slicing**

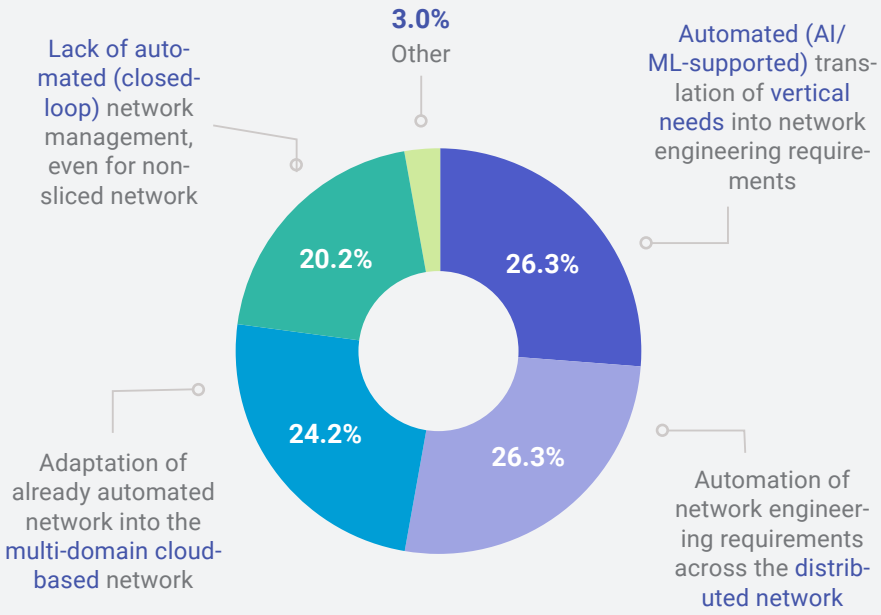
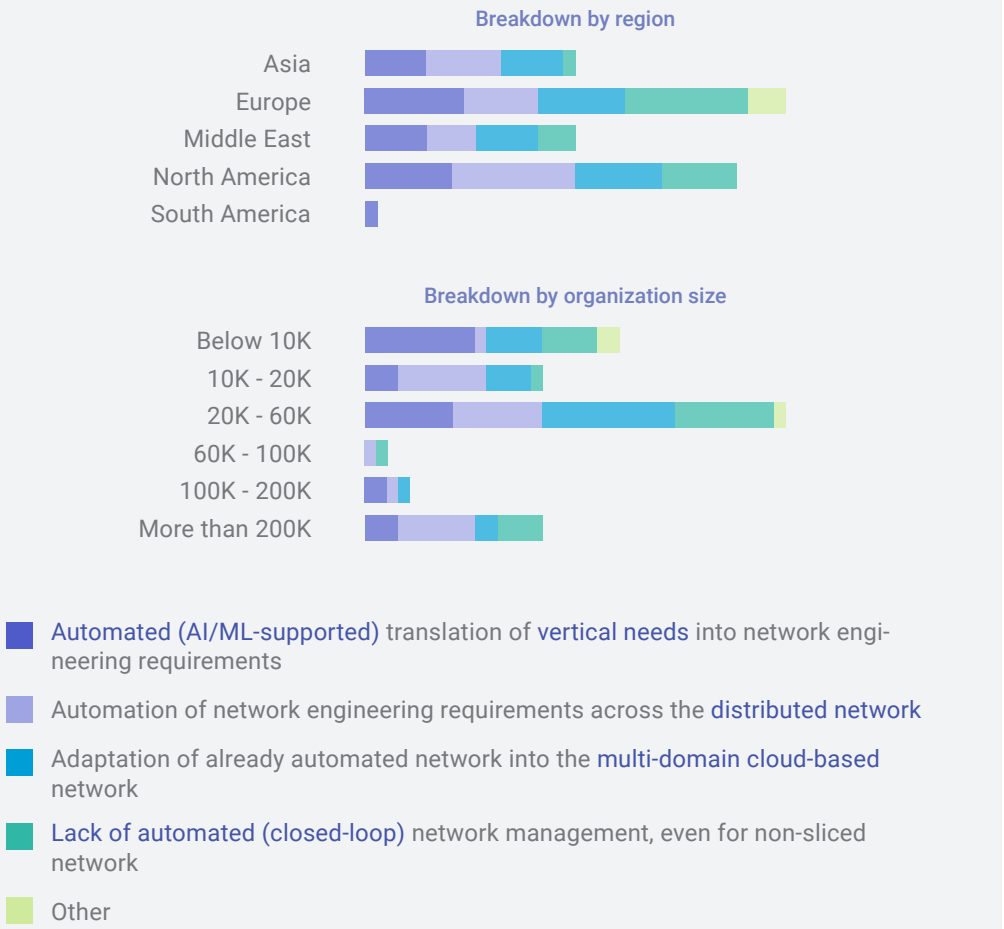


Fig. 4-b **Operators' biggest challenge in the implementation of network slicing**



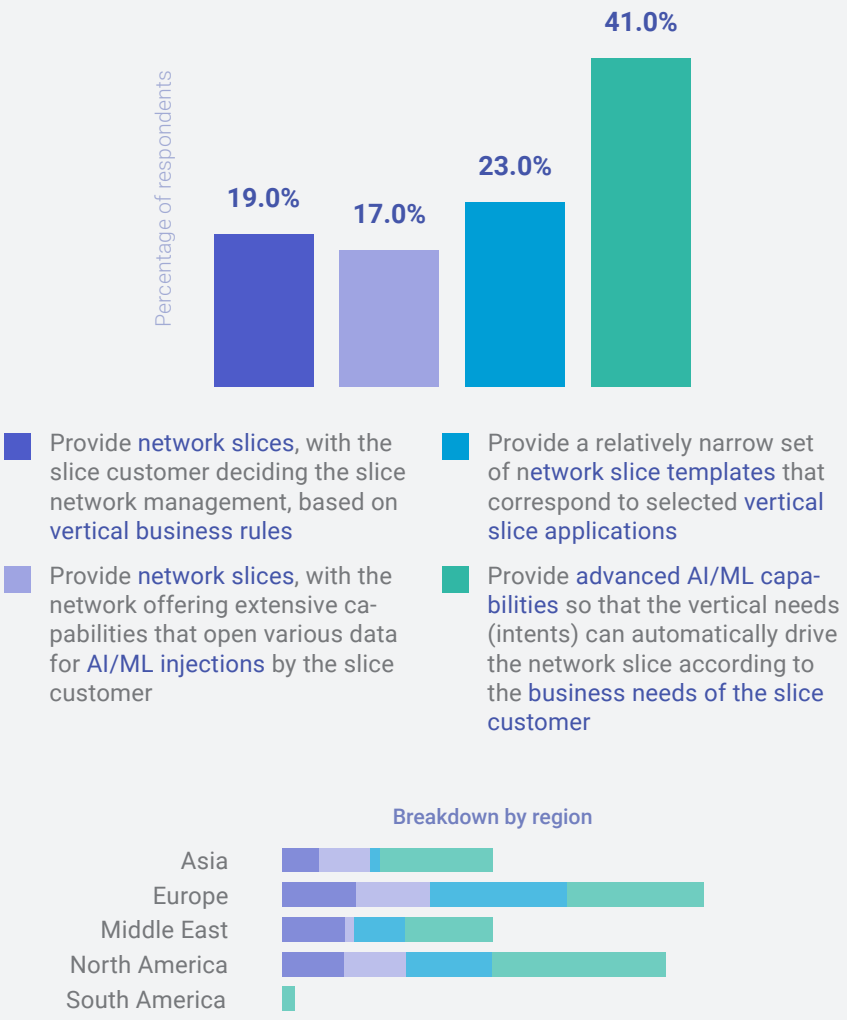
A further 26.3% of the operators surveyed acknowledge a bigger challenge in the automation of network engineering requirements across the distributed network, given the different systems governing the RAN, core and transport networks, and the lack of centralized orchestration across these domains.

Another 24.2% of respondents agree that they are struggling to adapt an already automated (closed-loop) network into the multi-domain cloud-based network. While operators may have at least one automated network management system, these systems are focused on a single domain. Integration of these systems is critical for different automated systems to communicate with each other. However, such integration is limited by the lack of tools needed to coordinate edge, close-edge, and core domains.

The survey responses also point to a lack of automated (closed-loop) network management altogether, even in non-sliced networks, across 20.2% of the operators surveyed, with this observation more noticeable in the European region.

Automated translation of vertical needs, which is the most prevalent challenge across operators in the implementation of network slicing, appears to be more apparent among smaller operators (below 10K employees), with a share of 43.5%.

Fig. 5 **Operators' approach towards providing network slices for verticals**



4. Vertical Slicing Models

Automated AI/ML-based translation the most preferred approach

In the implementation of network slicing, slices are created based on vertical requirements. Each vertical is broadly defined by a combination of 5G service categories (eMBB, URLLC and mMTC). A smart city vertical, for example, uses mMTC as the primary service category and eMBB and URLLC as the supplementary categories. These slices are customized further according to, among others, security, redundancy and lifecycle configurations, to create responsive, service-aware networks. There are various approaches to creating the required slices, and this survey looks at some of the most prevalent methodologies deployed.

As depicted in Figure 5, 41.0% of the operators surveyed say that they prefer to provide advanced AI/ML capabilities so that the vertical needs (intents) can automatically drive the network slice according to the business needs of the slice customer. Under this approach, each customer is availed, automatically and intelligently, via AI/ML, a network that is highly customized to their needs and that auto-configures its requirements, without the need for human intervention.

While the above represents the ideal scenario for network slicing, most operators take an in-between approach. About a quarter (23.0%) of the operators opt for the more practical approach of providing a relatively narrow set of network slice templates that correspond to selected vertical slice applications. This approach is more prevalent among European respondents, with 32.4% of the operators from the region selecting this approach.

On the contrary, 19.0% of the operators surveyed choose to provide the network slices themselves, but will allow the slice customer to decide the slice network management, based on vertical business rules. Another 17.0% of the operators desire to provide the same, but with more flexibility, by offering extensive capabilities that open various data for AI/ML injections by the slice customer.

5. Challenges for Network Slicing Automation

E2E coordination the most challenging domain; RAN the second most challenging

When it comes to network slicing automation, each network domain features different complexities and challenges. Respondents of this survey were asked to identify two domains that pose the biggest challenge, from a list of four domains – RAN, core, transport or end-to-end (E2E).

The majority of the operators surveyed (80 respondents), as illustrated in Figure 6, identify E2E coordination, which involves coordination between all these domains in a distributed network concept with separate edge, aggregation and core data centers, as one of the most challenging domains for the implementation of network slicing automation. This finding can be explained by the current network architecture where equipment across different data centres such as the edge, aggregation and core have a wide range of dissimilarities. The network topology is often complex and in some circumstances, is hidden or unmanaged from the operator's perspective. More often, these equipment are maintained by different departments or teams across the operator. This renders coordination between those domains complicated and difficult, which in turn makes the identification of usage and performance patterns difficult, and subsequently, automation of network slicing, a complex task.

A standalone domain that is most challenging for slicing automation is the RAN, which was selected by 31 respondents. The RAN comprises various parameters, which require constant tuning and optimization based on the available resources, operators' experience and domain expertise. Whether automation is rule-based or driven by AI/ML, the RAN is constrained by spectrum scarcity which results in more complex resource allocation issues between not just the service classes, but application-based, intra-class allocations. This is exacerbated by frequent fine tuning of RAN parameters, in response to coverage, signal strength and quality of service issues. Where these fine tuning is controlled by slice owners, it impacts the RAN's global performance, and has the potential of impairing the services delivered to other customers.

The core and transport domains were selected by less than a quarter of the operators surveyed, at 21 and 17 respondents, respectively.

Fig. 6 **Network domains that pose the biggest challenge for network slicing automation**

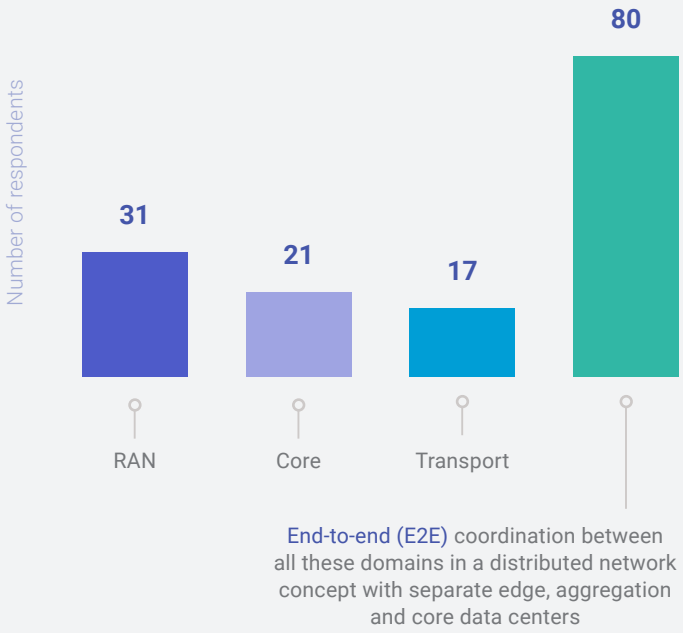
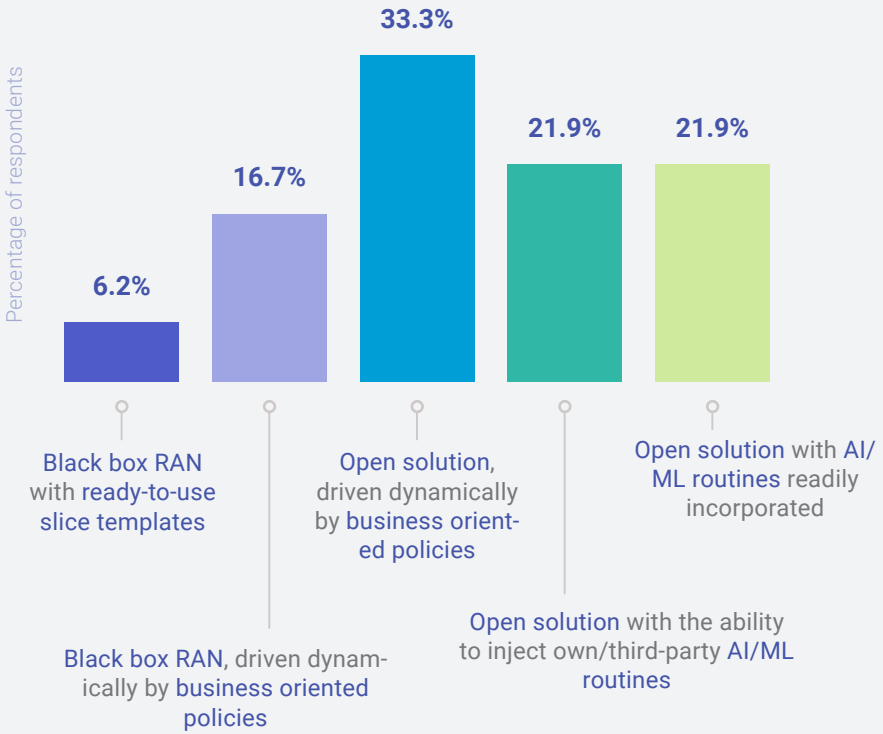


Fig. 7 Operator preference on RAN slicing capability



6. RAN Slicing Capabilities

More than three-quarters of respondents prefer an open solution for RAN slicing

Given the complexities of RAN slicing, operators were asked to identify the slicing capabilities required in this network domain. Based on the survey results, a third of the respondents (33.3%) prefer an open solution, driven dynamically by business-oriented policies. Another 21.9% prefer an open solution with the ability to inject AI/ML routines provided by different vendors and/or built in-house, while a further 21.9% would like an open solution with AI/ML routines readily incorporated, with a high degree of customization provided on the algorithms.

The responses, as summarized in Figure 7, demonstrate the general preference among operators for open solutions for RAN slicing, compared to traditional, black box, single-vendor solutions. This finding aligns to the industry-wide shift towards interoperability, and solutions which are vendor-agnostic. Open solutions deliver tremendous enhancements over single-vendor deployments, from ease of integration between different systems and vendors, reduction in integration costs and complexities, and circumvention of vendor lock-ins.

Black box RAN solutions, on the other hand, are chosen by 22.9% of the operators surveyed with close to three quarters of them preferring a solution that is dynamically driven by business oriented policies as compared to those that come with ready-to-use slice templates.

A notable trend in RAN network slicing is the strong preference among Asian operators for open solutions without pre-built AI/ML routines, which offer the flexibility of introducing in-house routines or routines sourced from third-parties. European and North American operators, on the contrary, incline towards the use of pre-built AI/ML routines that come with algorithm-level customization which enables to them to impute internal network and business policies in the provisioning of RAN slices.

7. Role of E2E Orchestration

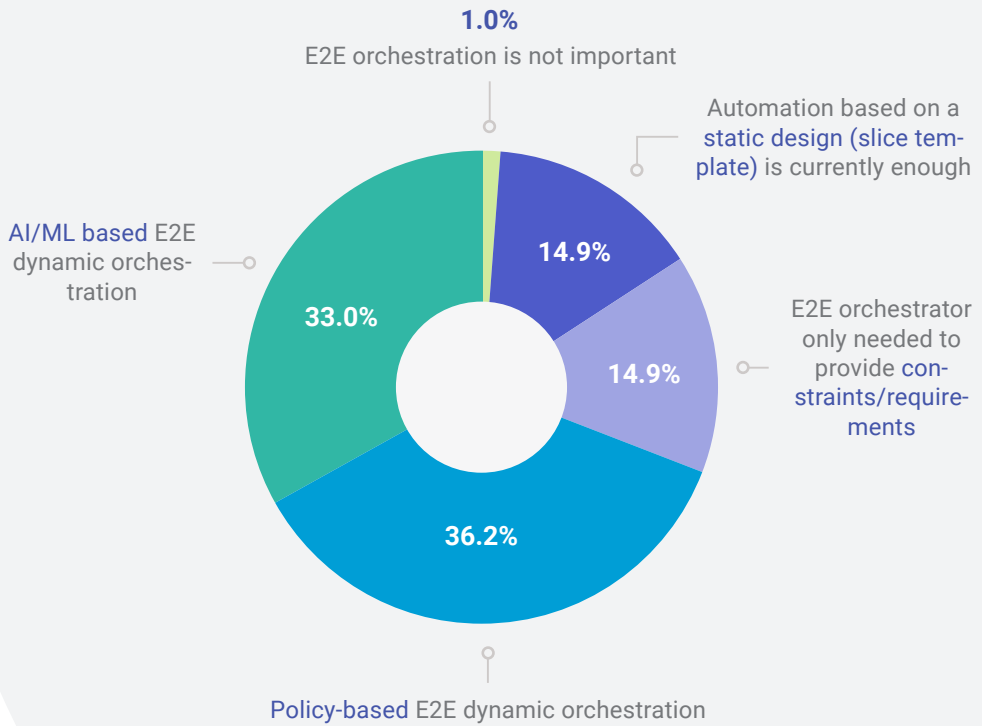
65% of operators expect dynamic orchestration that is able to deliver cross-domain reallocation of resources

Creation of virtual networks using network slicing requires orchestration of network functions and applications across all network domains, enhanced rapidly across operator networks by the widespread adoption of software-defined networking (SDN). Orchestration grants 5G networks the level of programmability required to instantiate, manage and retire network slices, instantaneously, intelligently and reliably, on an end-to-end basis.

When asked to share their expectations of end-to-end orchestration (E2E orchestration), the majority (69.2%) of respondents expect dynamic orchestration, resulting in cross-domain re-allocation of network functions and applications between edge, aggregation and core data centers. Of these, 36.2% opt for policy-based dynamic orchestration while the remaining 33.0% choose AI/ML-based orchestration, as shown in Figure 8. Dynamic orchestration avails operators the means to more efficiently allocate network resources between domains, optimize capacity and reduce redundancies, and synchronize network administration, on a network-wide basis.

Not all operators however, see the need for dynamic orchestration to be implemented network-wide. According to the survey, 14.9% of operators agree that E2E orchestration is only needed to provide the constraints/requirements based on E2E service policies, decomposed statically, as there is already dynamic automation within domains. In fact, another 14.9% of respondents think that automation based on a static design, or slice template, is currently adequate, which renders E2E orchestration unnecessary, while one other respondent argues that E2E orchestration is not important as traditional E2E Business Process Management (BPM)-based processes can support network slicing instantiation.

Fig. 8 **Operators' expectation on E2E orchestration**



8. Adoption of Infrastructure Virtualization

52% of operators have already virtualized their infrastructure; another 42% will do so in the next 5 years

A key enabler for dynamic orchestration of network domains is the introduction of virtual infrastructure, which replaces traditional hardware with virtual machines for a software-based deployment of network functions.

The survey assessed each operator in terms of their readiness to embrace network virtualization as a crucial step towards 5G network slicing. Based on the survey findings, more than half (52.0%) of the operators surveyed already have virtual infrastructure in place, as shown in Figure 9. This indicates the widespread adoption of network functions virtualization (NFV), a trend driven by the need for faster deployments of network functions and applications, increased scalability, lower costs and improved responsiveness across operator networks.

The trend towards NFV is expected to accelerate over the years to come. Among operators currently without any virtual infrastructure in place, 87.5% intend to introduce it in the next 5 years, with 50.0% of these operators intending to have it in place within the next one year.

Interestingly, 76.5% of European operators with future plans to introduce virtualization are targeting deployments only over the next five years. This contrasts with their North American and Asian counterparts where the bulk of planned virtualization deployments are expected to take place in the next one year (69.2% and 100.0% respectively). These findings indicate a correlation between the size of the respondent organization and network virtualization initiatives. Survey respondents from Europe are mostly from smaller operators; limited infrastructure budgets and lower economies-of-scale therefore drive fewer near-term deployments for this region.

Only 6.0% of all the operators surveyed have no plans to introduce virtual infrastructure.

Fig. 9 **Operators' infrastructure virtualization plans**

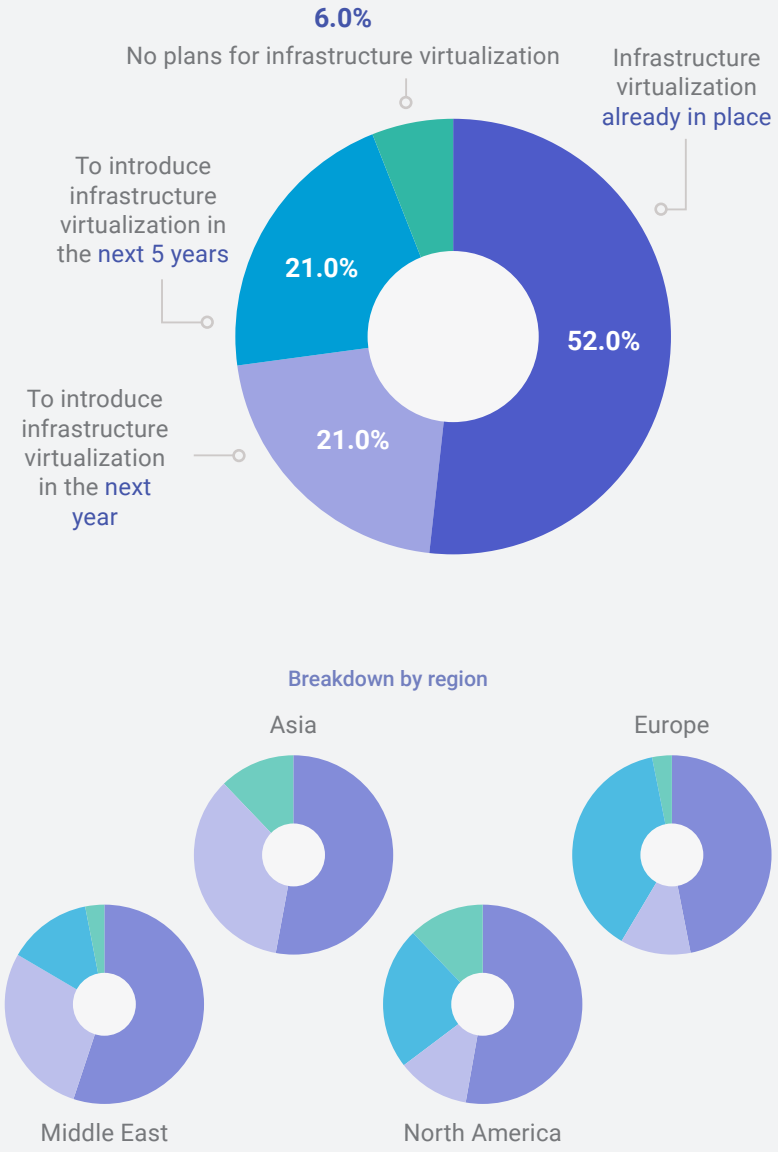
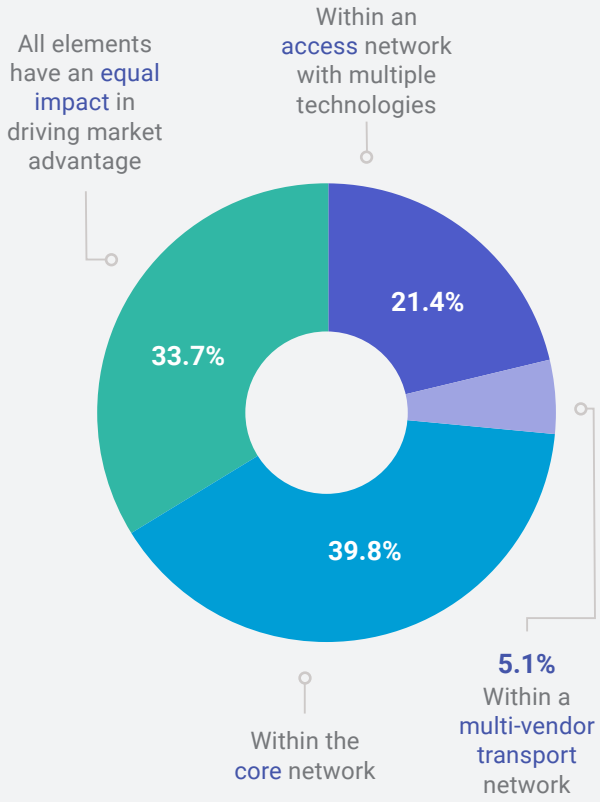


Fig. 10 **Infrastructure elements in which the introduction of virtualization is of key importance**



9. Domain-level Virtualization for RAN, Transport and Core

Core network to reap the most benefits from infrastructure virtualization

Infrastructure virtualization, while being an important precursor to the implementation of network slicing, can be deployed end-to-end or in parts of the network.

Based on the responses summarized in Figure 10, the highest benefit for infrastructure virtualization is seen in the core network, as agreed by 39.8% of the operators surveyed. This can be explained by the concentration of network functions in the core, where traditional appliances such as the DRA, PCRF, SBC, IMS and MME are being replaced by their virtualized equivalents – the vDRA, vPCRF, vSBC, vIMS and vMME. The deployment of these virtualized network functions (VNFs) is spurred partly by advanced virtualization techniques, including intelligent orchestration and flexible service chaining, which enable operators to speed up the orchestration of these NVFs based on their traffic management policies.

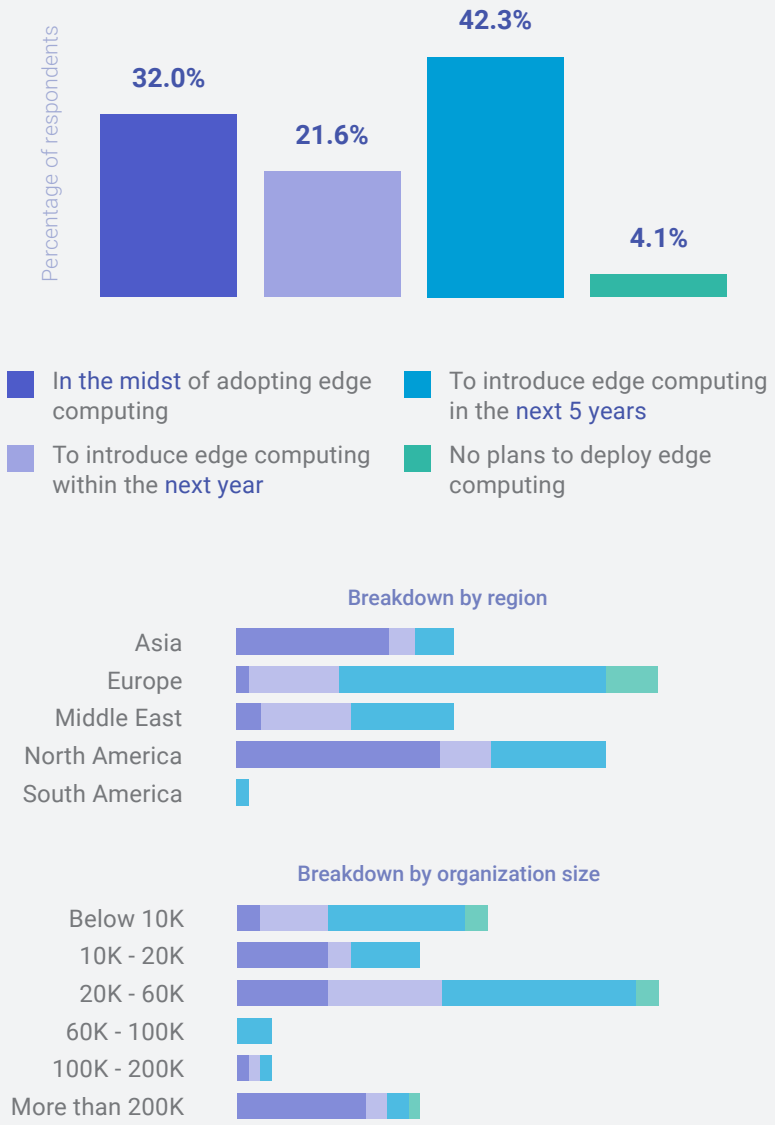
An emerging trend in the core network is the deployment of cloud-native network functions (CNFs), deployed as microservices in containers. While CNFs do not require infrastructure-level virtualization, they are expected to significantly enhance the instantiation of network slices, and further promote network responsiveness. CNFs are expected to be deployed alongside VNFs.

Apart from the core network, the access network with multiple technologies was selected by 21.4% of the respondents as the next most important element for virtualization, driven by benefits such as improved network availability, reliability and efficient apportionment of network functions and resources between 5G service classes.

Another 5.1% of respondents named the transport network.

Despite the availability of modular deployment options for network virtualization, 33.7% of the operators surveyed feel that it is difficult to identify any critical element given that they all have an equal impact in driving market advantage. Overall, survey respondents unanimously agree that virtualization, whether deployed end-to-end or in parts of the network, does confer a market advantage.

Fig. 11 Adoption of edge computing among operators



10. Adoption of Edge Computing

More than 95% of operators will have deployed edge computing within the next 5 years; a third have already done so

Supporting 5G service classes such as URLLC which demands ultra-low latencies, requires computing, storage and networking capabilities to be shifted to the edge, for processing that is closer to the user. Edge computing is a pre-requisite for NaaS, to enable the provisioning of slices across verticals such as smart stadium live broadcasting and autonomous driving, which comprise mainly of URLLC-type applications requiring extremely low latencies (e.g.,1 ms) and very high reliability.

The survey assessed the adoption of edge computing among the respondents and found 32.0% of them having already implemented it. A significant portion (42.3%) intend to introduce it in the next five years, while 21.6% are introducing it within the next year. Only 4.1% of the operators have no plans for edge computing.

As anticipated, the survey finds very large operators to be ahead of their smaller counterparts in the adoption of edge computing, spurred in large part, by higher traffic volumes and the potential in the uptake of URLLC services among their larger enterprise customer base.

In terms of region, the inclusion of Rakuten in the survey drove up the overall edge computing adoption rate for Asian operators to 70.6%, given the operator's leadership in 5G, cloud and virtualization. The Rakuten Communications Platform (RCP), in particular, has accelerated the development of cloud-native, virtualized 5G networks for the region.

For Europe however, the disproportionate number of smaller operators has resulted in the overall adoption rate for edge computing skewing towards a lower than average rate of 3.0%.

11. Impact of IT-Telco Convergence on Telco Operating Models

Close to 60% of operators choose to grow in-house IT capabilities

SDN, NFV and edge computing involve IT expertise, from scaling up computing and storage capacities, to securing VNF/CNF stacks from cyber-attacks and managing them throughout their lifecycles. The move towards a software-based network has essentially blurred the borders between telco and IT domains, and with it, brought the need for stronger IT capabilities within operator organizations.

This survey evaluated how the convergence between telco and IT domains is impacting respondent operating models, in terms of IT infrastructure, tools and expertise. As illustrated in Figure 12, the majority of respondents (59.2%) opt to grow their own internal teams with competencies in both domains. This aligns to the need to deliver service differentiation, an objective that can only be achieved via capabilities developed natively in an operator-specific environment, and that are matched closely with its existing network systems and services.

Another 19.4% of respondents however, prefer the alternative. They choose to partner with hyper-scalers – the likes of Google, Amazon, and Microsoft – and combine their key strengths to develop their services. There are already major inroads made by hyperscalers into the telco industry. Google Cloud for example, enables operators to bring their services to the network edge leveraging its Anthos platform, a cloud-native infrastructure for operators and enterprises.

Apart from these, 12.2% of respondents are looking for partners for new tasks, who can independently influence the shape of the business. These third-party vendors will bring on board capabilities tailored for specific verticals, and launch new services by combining their IT and domain expertise with the operator's existing network strengths.

The remainder 9.2% of respondents feel that suitable toolsets are sufficient in meeting the required IT needs. They expect these toolsets to equip their internal teams on their existing tasks, enabling them to maximise existing IT and networking capabilities.

Fig. 12 **Impact of telco-IT convergence on operator operating models**

12. NaaS Solution Models

Hybrid solutions, which balance integration and openness, the most preferred deployment model for NaaS

Implementing NaaS requires operators to decide on a NaaS platform that can provide the following key functionalities - network management, resource orchestration, network integration, network monitoring and service assurance. An ideal NaaS platform will be self-optimizing, will incorporate cloud-native approaches and provide the full range of features supporting end-to-end network automation.

This survey assessed the 5 most common approaches to developing NaaS, and found that almost half of the operators surveyed (47.0%) are in favour of a hybrid solution, which combines the merits of both best-of-suite and best-of-breed. The hybrid approach grants operators an internally highly integrated solution, yet makes allowance for partners' and customers' own systems with its openness.

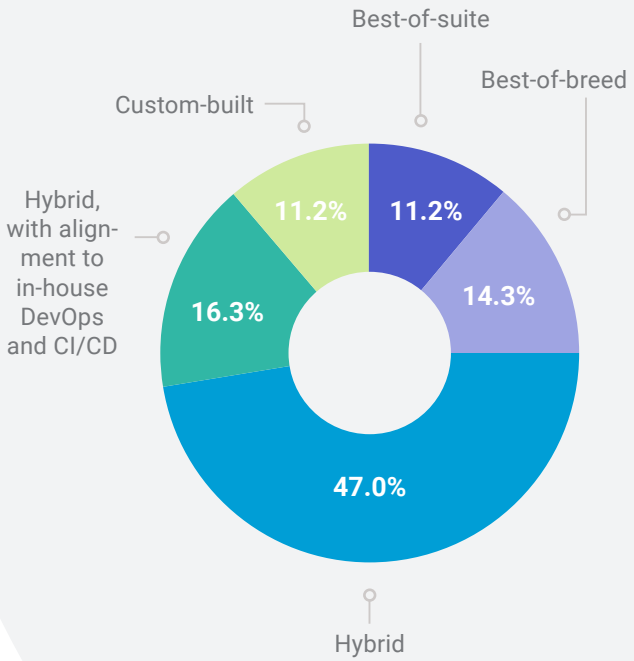
The hybrid approach is preferred by a further 16.3% of respondents, as shown in Figure 13, but these operators require the offering to be aligned with in-house DevOps programs & CI/CD processes. This approach provides operators a high degree of flexibility derived from in-house customization and avoids the integration complexities typical of best-of-breed solutions.

Best-of-breed solutions on the other hand, are chosen by 14.3% of the operators surveyed, indicating a somewhat moderate preference for independent selection of suppliers and the flexibility in module upgrades and replacement. This approach as discussed, involves time-consuming integration.

Best-of-suite solutions, which are essentially pre-integrated solutions, are typically anchored by a single vendor. This option was chosen by 11.2% of the respondents, driven by a more consistent user experience, a high scale of integration and the potential for quick interdisciplinary changes without the need for labor-intensive coordination of many suppliers. This approach however sees a lower take-up rate due to its inflexibility, module redundancies and a lack of sufficient features on its supplementary modules.

Another 11.2% of the operators prefer a custom-built solution. Custom-built solutions are closely tailored to operator needs, but may result in more integration complexities between different organization units, partners and customers.

Fig. 13 **Preferred solution model for NaaS**



13. NaaS Monetization Partnerships

mMTC-powered IoT verticals represent NaaS' biggest monetization opportunities

NaaS provides various private and public entities a ready access to network resources and services, which in turn enables them to develop and deliver new and innovative services for their end users. This survey evaluated five categories of partners whom operators can partner with, to drive NaaS monetization.

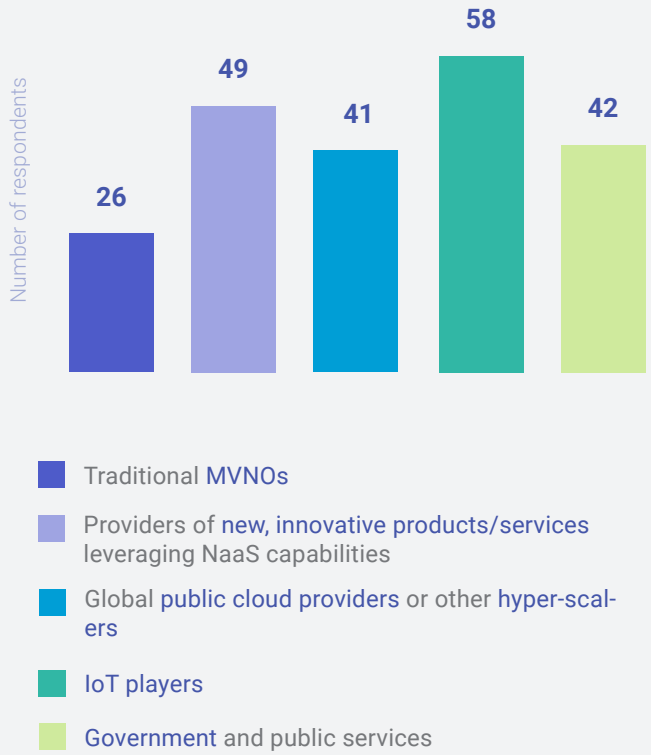
IoT players across verticals such as automotive, healthcare and industry 4.0, were selected by 58 operators, indicating huge monetization opportunities from mMTC-type connectivity. IoT is expected to grow to reach 24 billion connections by 2025[1], and IoT service providers are rapidly enhancing their monitoring, analytics and cloud offerings to support enterprises and end-users across their IoT services.

Providers of new, innovative products and services leveraging NaaS make up the second biggest category for monetization partnerships, chosen by 49 respondents. These are products and services that are born from the availability of 5G NaaS, and an example of these is a subscription-based service for verticals dealing with bandwidth-heavy, ultra-low latency 5G applications.

Government and public services are the third most favored category, selected by 42 respondents as main partners for monetization, indicating the potential demand for connectivity across essential and strategic services. Global public cloud providers or other hyper-scalers come in the fourth place with 41 operators selecting them as potential monetization partners, to deliver, for example, premium cloud and connectivity bundles to enterprise customers.

Traditional MVNOs will continue being their main monetization partners, according to 26 of the operators surveyed.

Fig. 14 **Operators' main partners in the monetization of NaaS**



1) GSMA Intelligence - IoT Connections Forecast: the Impact of Covid-19

14. Key Drivers for NaaS Implementation Strategy

Zero-touch provisioning and real-time management identified as the biggest drivers

NaaS implementation strategy is dependent on a number of drivers, each with a different impact on its effectiveness. Based on the survey responses, delivery of a new zero-touch solution enabled by end-to-end automation ranks highest as a key driver. 62 operators are in favor of implementing this, marking a gradual, yet steady shift towards fully automated networks.

As shown in Figure 15, the next biggest driver is the availability of real-time activation, configuration and monitoring which is required by 57 operators. Having better control and a deeper visibility into the network essentially allows their customers to better manage their verticals and the allocated resources.

Following the above two factors is the enhancement of digital customer experience which includes building a unified, self-service portal. This feature was chosen by almost half of the respondents, or 48 operators, indicating an increasing emphasis on the ease of access, configuration and control of networks on the customer end.

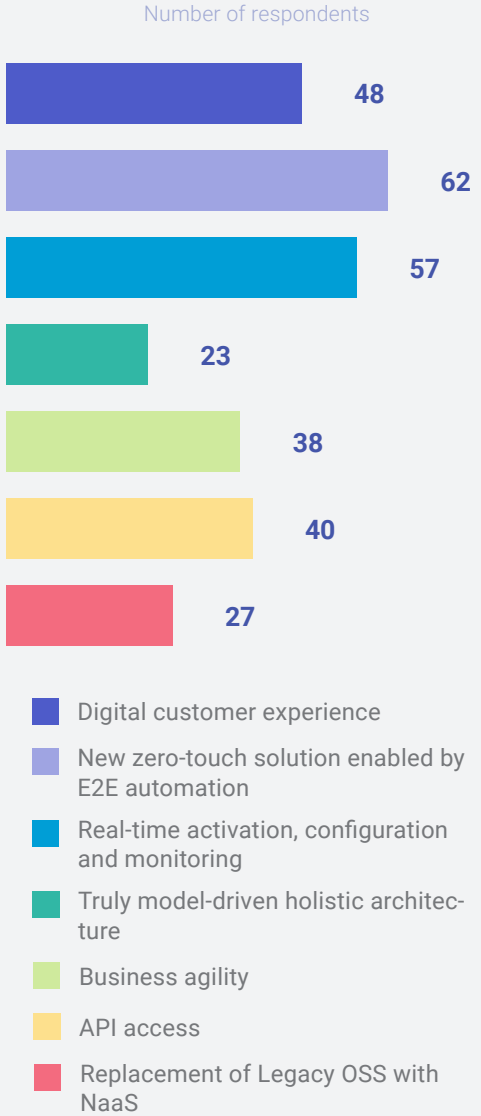
Providing various verticals the exposure to the operator's API layer enables new partnerships as well as new business and monetization models. This, according to 40 operators, is also a key driver in NaaS implementation. APIs ensure seamless and secure access to required resources, and spur the creation of new services across various verticals.

Increasing business agility is another contributing factor, identified by 38 operators. Service providers must be able to rapidly launch, sell and innovate their products and services, leveraging a model-driven architecture combined with standardized APIs.

In addition, 27 respondents see the need to replace legacy Operation Support System (OSS) with NaaS as part of its implementation strategy.

Another 23 respondents agree that a truly model-driven holistic architecture is key. This involves extended configuration and creation of new entities, such as Customer Facing Services, product specifications and offerings, which are readily registered and executable by existing system functions.

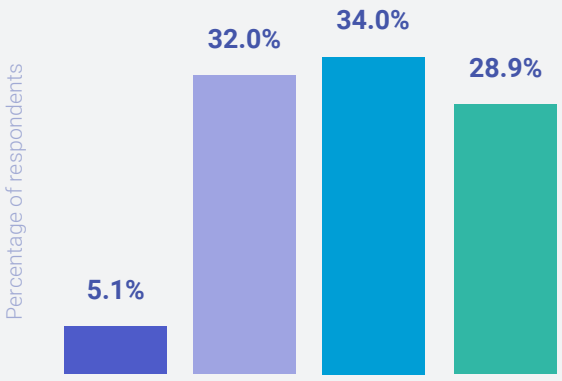
Fig. 15 **Key drivers in operator NaaS implementation strategy**



15. Impact of NaaS on Operator Growth and Monetization

Close to 95% of operators expect NaaS to have a major impact in driving operator revenues

Fig. 16 **Impact of NaaS on operator growth and monetization**



The implementation of NaaS, as part of operator 5G offerings, is expected to drive operator business in many ways. 94.9% of the operators surveyed believe NaaS will have a major impact on business growth and monetization.

Of these, 28.9% believe that it will be a real game changer and will completely change the way operators cooperate with their B2B partners. NaaS allows operators to onboard new services rapidly, and offer these on a digital catalog, available via a friendly, easy-to-access user interface. Business partners are able to browse, click and create customized networks by configuring the parameters provided, or through API calls, in a process that is fully automated.

Another 34.0% of the operators surveyed feel equally enthusiastic about NaaS, with the expectation that it will have a great influence on how they manage internally and resell their network resources. Via NaaS, operators are able to optimize network resources through the reallocation of network capabilities between verticals that maximize returns, and by converting excess capacity into new product offerings.

NaaS will have a positive impact, according to another 32.0% of respondents, who see it opening new possibilities, including new partnerships. Enterprises, hyperscalers and virtual operators can now create flexible, virtual networks in collaboration with operators, enabling them to enhance their product suites with 5G-powered connectivity.

Only 5.1% of operators do not expect a major impact from the implementation of NaaS, and see it just as another way of managing the network.

16. Conclusion

The introduction of network slicing revolutionizes mobile operators' value proposition by enabling a high degree of service differentiation, customization and innovation across what used to be a highly commoditized service. NaaS builds on this proposition, introducing the next level of openness, which allows operators to forge partnerships with existing and new players, and greatly enhance their monetization potential.

The findings of this report point to the need for dynamic automation in network slicing and E2E orchestration between network domains. Network slicing readiness among operators is evident from the widespread adoption of infrastructure virtualization, and the increasing edge computing deployments. The need for extended IT capabilities to support networks that are becoming increasingly software-driven, sees most operators opting to develop these capabilities in-house, to maintain service differentiation and a competitive edge in the market place.

More interestingly, this report finds a strong preference among operators, towards an open solution for NaaS, with some degree of pre-integration between its core modules.

This report also notes operators' strong outlook for IoT-based verticals, and emerging 5G-based services. To drive their NaaS offerings across these opportunities, the majority of operators see the need for automation-enabled, zero-touch solutions that accord real-time control and visibility for partners.

Most notably, almost all operators expect NaaS to significantly drive operators' business growth and monetization. This in turn shapes the demand for a NaaS platform that is able to translate infrastructure investments in 5G into new and exciting revenue streams for operators and their partners.

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