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# **The Shift To 5G Standalone Core On Cloud**

Insights From A Survey Of CSPs Revealing Benefits,  
Challenges, And Recommendations

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## Executive Summary

Collaboration between communication service providers (CSPs), network equipment vendors, and hyperscalers helps to make network operations and cloud infrastructure more service oriented and its cost base more flexible. As a result, more CSPs are migrating network infrastructure elements into the cloud (private, public, and hybrid). The cloud plays an ever more important role in a network service's lifecycle.

Network equipment vendors work with the hyperscalers to use cloud platforms for radio access network (RAN) and core network functions as well as for operations and business support systems. The shift to 5G standalone core on cloud (see definition on next page) offers a significant change not only in how CSPs go to market but also how they operate their networks to the benefit of their customers — especially enterprises.

In December 2022, Google Cloud, Intel, and Nokia commissioned Forrester Consulting to evaluate the opinions of CSP leaders about 5G standalone (SA) core on cloud. Forrester conducted a global online survey with 171 respondents who are decision-makers at CSPs to explore this topic.

5G SA core on cloud addresses challenges faced by CSPs when delivering new enterprise use cases and offers benefits including increased agility; new network monetization opportunities such as network-as-code; and the opportunity to build a more resilient network. These greatly improve the positioning of CSPs to better serve end customers, particularly large enterprises.

The survey data also highlighted the importance that CSPs place on partnerships and ecosystems, which not only help to overcome technical and business challenges but also enhance and strengthen the benefits described above.



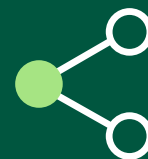
## Definitions

5G standalone core on cloud: The core's network functions based on 3GPP 5G standards — such as mobility management, session management, charging, subscriber data management, policy control, media gateway, signaling, analytics, and slice management — are running on cloud computing architecture that includes private, public, and hybrid cloud infrastructure. The 5G standalone core can be deployed on various types of clouds. Unless specified, the survey's questions refer to any type of cloud (private, public or hybrid):

- **Private cloud (aka on-premises):** CSP owns and operates the cloud infrastructure.
- **Public cloud:** The public cloud provider owns and operates the cloud infrastructure. This includes user and control planes' functions as well as management running on the public cloud.
- **Hybrid cloud:** A mixture of private and public clouds. For instance, user plane functions running at the CSP's edge (on-prem) with control plane functions and management on the public cloud.

## Key Findings

**CSP decision-makers recognize that the most important benefits of 5G SA core on cloud are increased network agility, new business model opportunities, and improved network resilience.** The ability to react quickly to changes in market demand is a key benefit of 5G SA core on cloud thanks to the flexibility it offers. Business models based on network-as-code and network exposure APIs open new monetization opportunities. Increased security, efficiency, and sustainability increase the resilience of communications services.



**CSP decision-makers highlighted three key challenges facing 5G SA core on cloud.** First, the the move from a physical or cloud to a cloud-native architecture is complex. Second, many CSP leadership teams are uncertain about the business case for 5G SA core on cloud because of outside factors such as regulation and customer readiness. Third, the immaturity of cloud-native orchestration tools and some aspects of operations (e.g., fulfilment and assurance) affects adoption.



**Ecosystems and partnerships help CSPs overcome technology and skill challenges and pursue business priorities.** Partnerships with specialists in cloud-native, 5G core, security, change management, and systems integration are important for resolving the complexities of moving to 5G SA core on cloud. By working more closely with customers, application service providers and industry ecosystem groups can bring the right offerings to market faster and boost customer experiences.



## 5G SA Core On Cloud Addresses Key Enterprise Objectives

According to Forrester's 2022 Business Technographics® survey, 5G features support enterprises' fundamental business objectives, namely improving customer experiences, growing revenue, improving their ability to innovate, and accelerating their response to market changes.<sup>1</sup> In surveying CSPs, we found that (see Figure 1):

- **There are many 5G SA core on cloud use cases emerging; however, industrial and utilities are expected to be the leaders.** About a quarter of survey respondents ranked industrial (e.g., robotics and manufacturing line automation) and utility verticals at the top for 5G SA core on cloud use cases, given that features such as high reliability and low latency underpin these industries. However, other verticals are also interesting. There were also some regional differences: across the Americas, respondents saw industrial and utilities applications as the most important use cases; in EMEA, respondents emphasized automotive and augmented reality/virtual reality (AR/VR) opportunities; and in APAC, the region with the most advanced 5G deployments, respondents saw AR/VR and customer service opportunities (such as remote video support) as the most important. For instance, in Hong Kong a carrier is using a 5G-powered AR and drone-assisted field service solution for antenna tower inspections.
- **5G's IoT, high speed, and high reliability capabilities support enterprises.** The survey found that respondents thought the massive and critical internet of things (IoT), extreme mobile broadband speed, and high reliability were the most important 5G SA core on cloud features and functions for CSPs; 34% of respondents considered them critical. Retail organizations benefit from high-density sensors in their outlets, for instance, and high reliability is important in industrial automation and healthcare verticals. Only 25% of respondents consider ultra-low latency a critical feature, although use cases like autonomous vehicles or remote-controlled machines are impossible without it.

- **The benefits of 5G SA core on cloud impact enterprises both directly and indirectly (see Figure 2).** Boosting CSP brands, improving customer experiences, and driving product and service differentiation are important benefits that 5G supports. Indirect 5G benefits for CSP customers include the capability to be more responsive (37% of respondents considered this critical), more resilient (32% considered this critical), and more innovative (26% considered this critical), as well as accelerating the move to digital business (32% considered this critical).

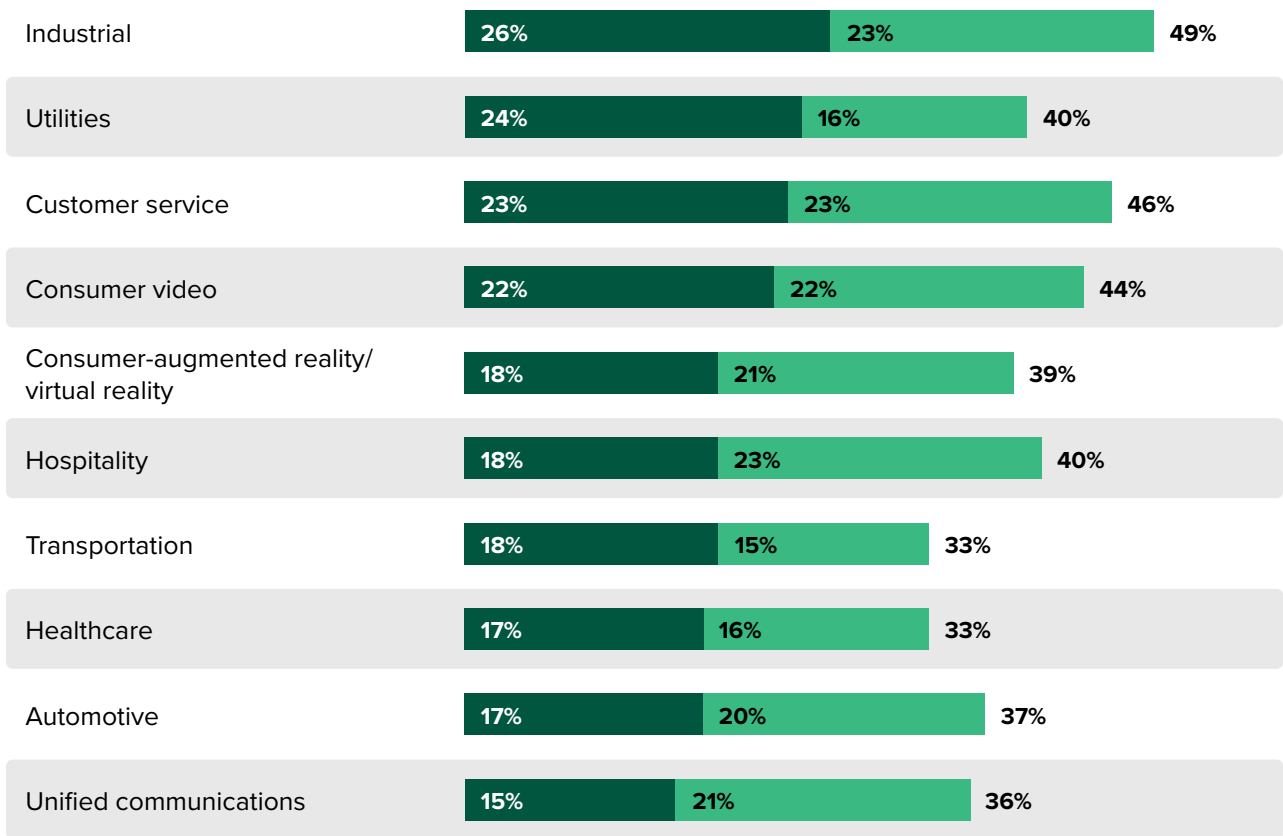
**Figure 1**

**“What are/do you expect will be the key use cases that 5G standalone core on cloud enables?”**

(Showing ranked top five)

● Rank 1

● Rank 2



Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services

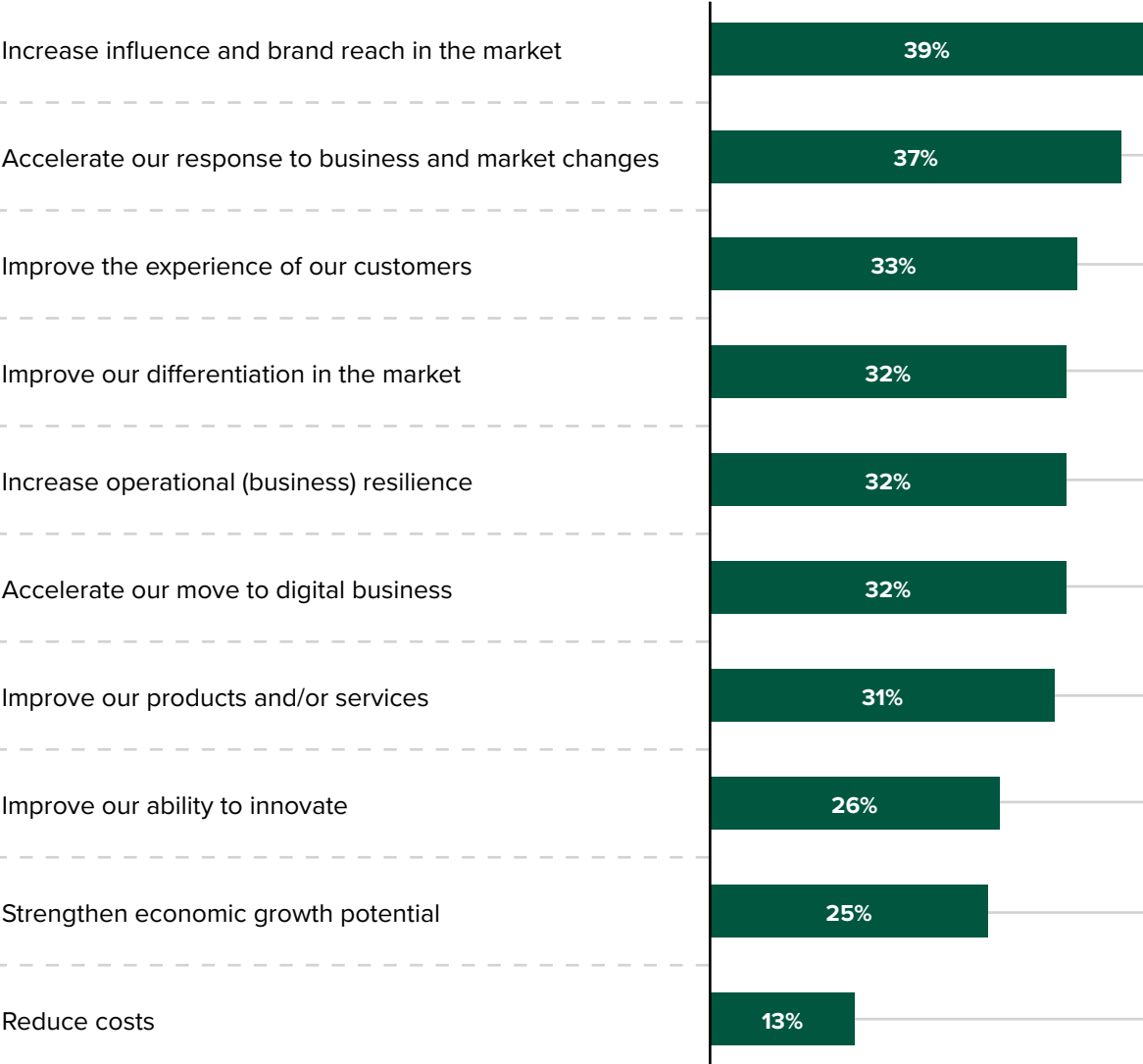
Note: Total percentages may not equal separate values due to rounding.

Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022

**Figure 2**

**“How important is/will your organization’s 5G standalone core on cloud implementation be in achieving the following business objectives?”**

(Showing “Critical” responses)



Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services  
Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022



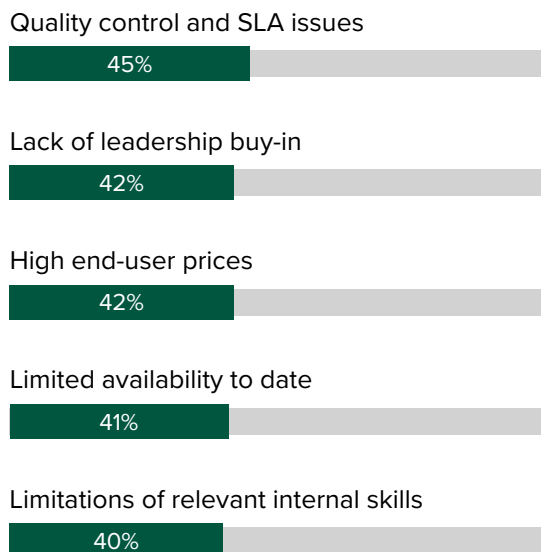
## High Complexity, Maturity Gaps, And A Lack Of Leadership Buy-In Are Top Identified Challenges

While CSPs recognize that 5G SA core on cloud offers many opportunities to enable their organizations to better serve enterprise customers, there are also a number of important inhibitors, both from a technical and business perspective (see Figure 3). High complexity, some maturity gaps, and a lack of leadership buy-in are three key challenges the research identified. The shift to 5G SA core on cloud is more than just a move to a new generation of mobile radio; it also incorporates moving to a cloud-native, service-based architecture and implementing new capabilities, such as network slicing. That not only adds technical complexity but also introduces the need for new go-to-market approaches. Internally focused technical operations need to align with customer-facing teams to successfully bring new services and experiences to customers. Ecosystems play a critically important role in CSPs' go-to-market activities to help address these challenges (see next section).

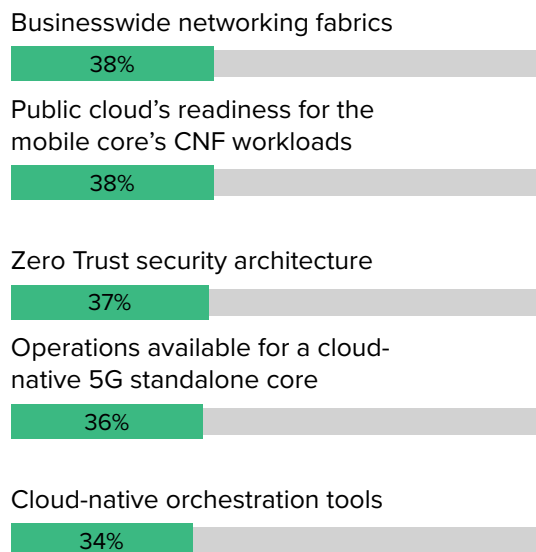
- **The shift to 5G SA core on cloud is a complex challenge.** For many CSPs, 5G will coexist with 4G for years. Therefore, a big technical inhibitor is the multiyear migration from legacy network operations to automated 5G core networks. Survey respondents (39%) highlighted that the implementation and management of multiple businesswide networking fabrics is a large inhibitor. This refers to the successful combination of network components and interweaving multiple layers of network hardware, software, and services to interconnect users, data, and applications throughout the entire business. The survey also highlighted respondents' related concerns, such as skills gaps and the need for zero trust architecture.

Figure 3

“To what extent do/will the following non-technical areas inhibit the growth of your organization’s 5G standalone core on cloud service adoption?”



“To what extent do/will the following technical areas inhibit the growth of your organization’s 5G standalone core on cloud service adoption?”



Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services

Note: Top 5 “Large inhibitor” responses shown for both questions

Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022

- **Leadership buy-in at CSPs is lacking.** Backing from senior executives is crucial to turn 5G into a success, given the lengthy return-on-investment cycles for most 5G initiatives. Hence, forty-two percent of respondents considered the lack of support and buy-in from their top management a large inhibitor. The leaders in our survey were more concerned about a lack of 5G strategy and clarity about the path to monetization of 5G than those from other departments (including technology/network and product-related roles) (see Figure 4). This also relates to other inhibitors such as the availability and affordability of 5G devices and services, regulatory issues (particularly for tier-one CSPs), and, more generally, customer readiness. In the survey, respondents in leadership roles also emphasized concerns about quality control and adherence to service-level agreements (SLAs). These are important nontechnical inhibitors overall since they require a detailed understanding of sector-specific processes, regulations, and other business factors.

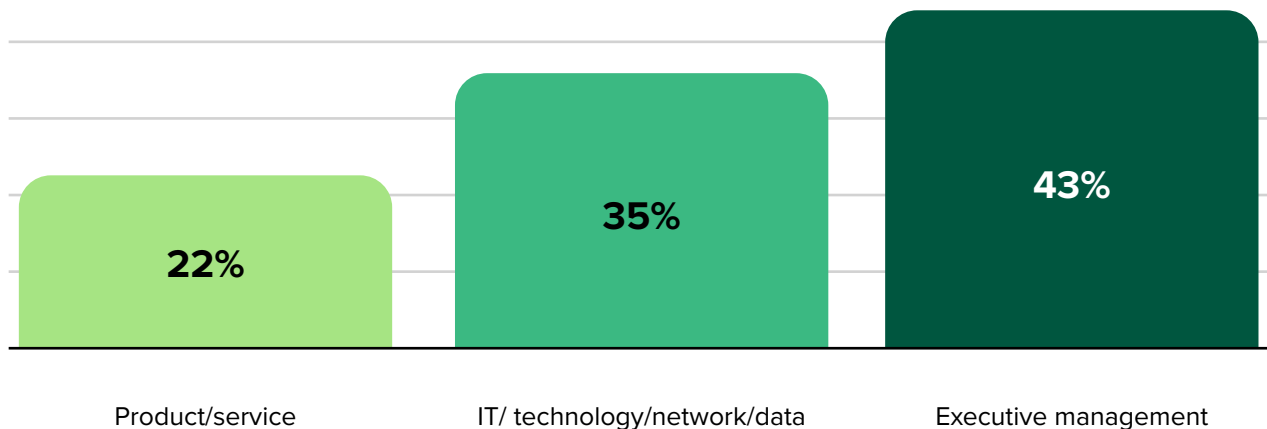
- **Lack of technical and market readiness.** The third key challenge is a lack of 5G technical and market readiness coupled with immature 5G use cases. This not only relates to concerns regarding market or customer readiness but also technical areas that many CSPs believe are not yet sufficiently mature. These are:
  - Public cloud readiness for mobile core cloud-native network functions (CNFs); 38% of respondents rated this as a large technical inhibitor.
  - General operational readiness, such as fulfilment, assurance and orchestration is a large inhibitor; 36% rated this as a large inhibitor.
  - Cloud-native orchestration tools; 34% rated their immaturity as a large inhibitor.

It is concerning that CSPs consider their ecosystem immaturity, including the breadth and depth of their partnerships, as the least critical nontechnical inhibitor. CSPs that underestimate the importance of strong 5G ecosystem partnerships risk losing out to competitors outside their peer group that are increasingly aiming to exploit the growth potential they offer.

**Figure 4**

**“To what extent do/will the following nontechnical areas inhibit the growth of your organization’s 5G standalone core on cloud service adoption?”**

(Showing “Large inhibitor” responses for “Lack of clear strategy” by department)



Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services

Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022

## Strong Ecosystems Address Challenges And Deliver Key Benefits To CSPs

Despite the risk of responding leaders overestimating the strength of their organizations' 5G ecosystems, the survey highlighted that they were aware of the importance their CSPs place on partnerships and ecosystems. These are important both for addressing technical complexities for improvements in network resilience and designing new 5G use cases and monetization opportunities. The most important steps to overcome 5G challenges are partnerships with: 1) network vendors and cloud providers on the technical side; 2) customers, application developers, and specialist industry ecosystem groups on the business side; and 3) professional services organizations to help with change management (see Figure 5).

5G ecosystems are also important in pursuing three key benefits from both a technical and business aspect:

- **5G SA core on cloud helps boost CSP agility.**

The increased operational flexibility of the network infrastructure and higher responsiveness on the customer side are key objectives that CSPs are looking to achieve from their 5G SA core on cloud investments.

- **Network & operational perspective:** Efficient network management is critical for controlling operating costs. Therefore, the most important technical drivers behind CSPs' 5G SA core on cloud investments focus on network flexibility, cloud, and a distributed architecture. For those responding CSP leaders with organizations planning to implement 5G SA core on cloud in the next 12 months, 38% ranked faster deployment as the most important. CSPs can have more flexibility in deploying and operating their networks through 5G SA core on cloud, and they can scale up or down as demand requires without incurring disproportionate costs. A flexible architecture also enables them to optimize service delivery and traffic costs by



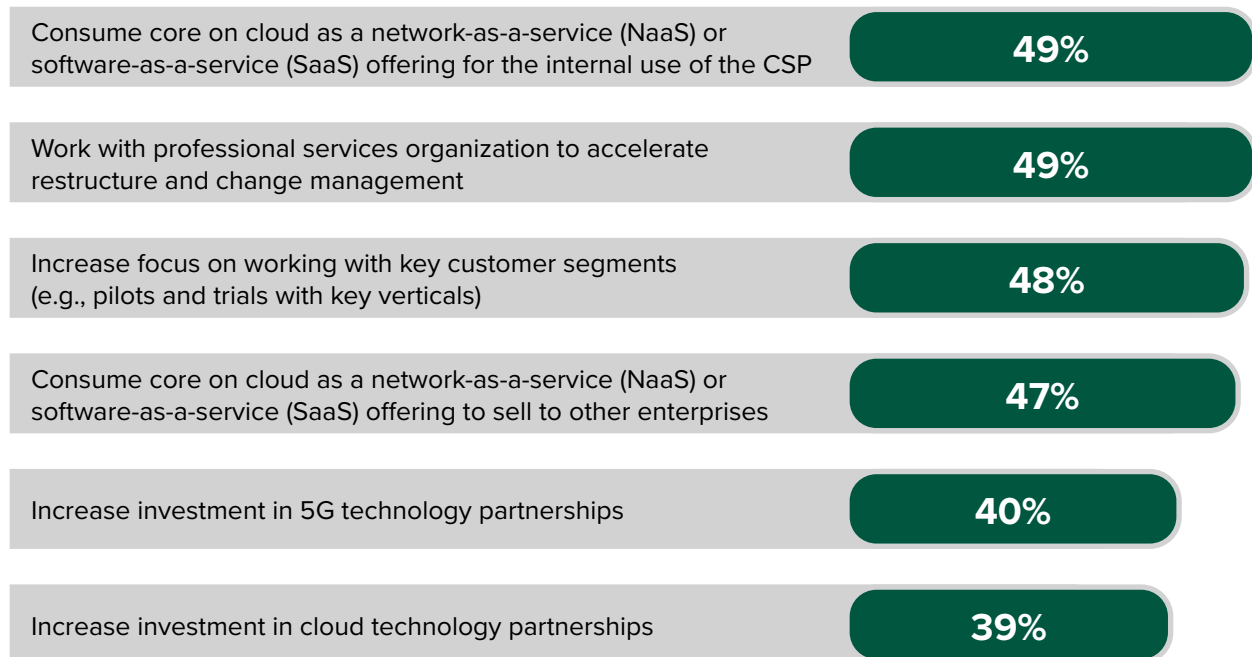
5G SA core on cloud is expected to boost CSP agility from both a customer responsiveness and operational flexibility perspective.

balancing public and private cloud infrastructure. Strong partnerships with cloud providers and network vendors in particular help fill skills and technical gaps, transfer knowledge, and reduce complexities regarding network deployment and operations.

- Customer perspective:** Customer expectations are changing at an ever faster rate. Therefore, the ability to respond to market changes and develop new offerings quickly is a key objective for CSPs (37% of respondents considered this a critical objective). Given that there are multiple potential use cases and new revenue opportunities that 5G SA core on cloud enables, it will be critical that CSPs are able to innovate and launch offerings as customer demand emerges. Partnerships with key customers, applications service providers, independent software vendors, and industry-specific ecosystems further improve the agility of CSPs.

**Figure 5**

**“To overcome challenges with 5G standalone core on cloud, what steps does your organization plan to take to ramp up quality cloud network offerings?”**



Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services

Note: Showing top 6 responses

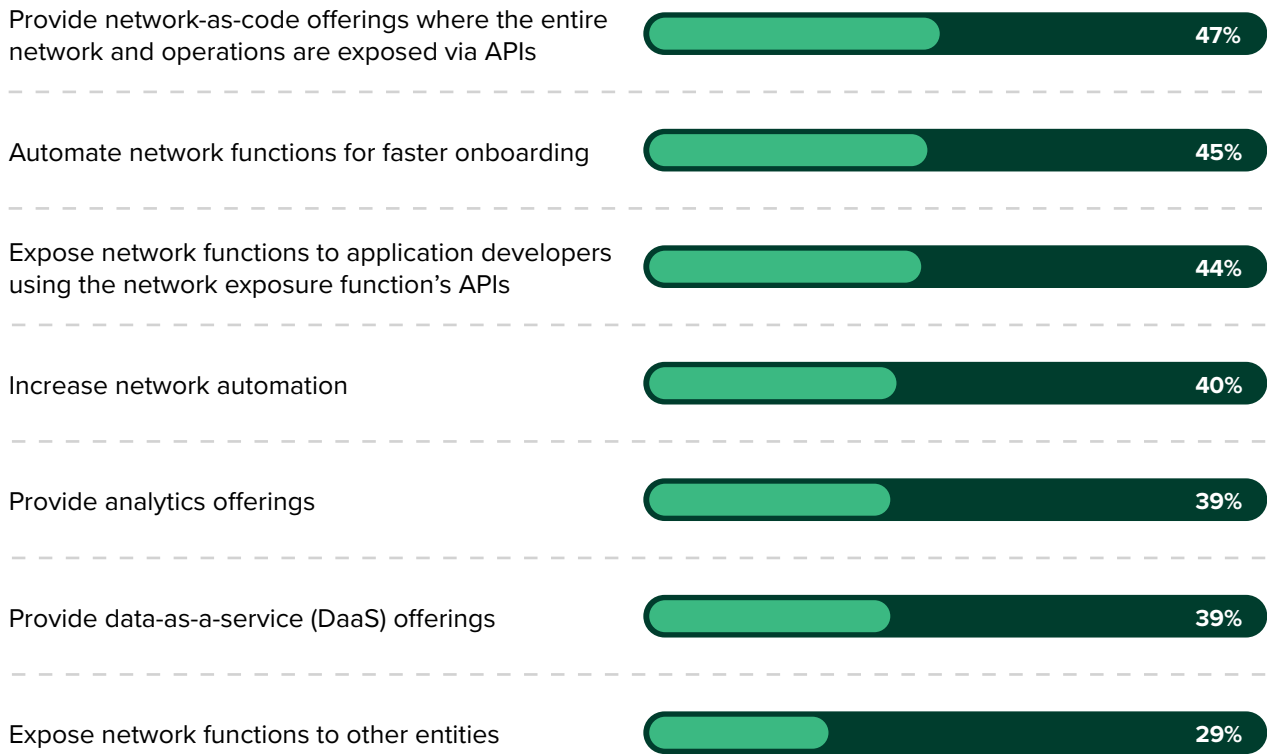
Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022



- **Partnerships drive new 5G monetization opportunities.** The survey found that there are a number of ways respondents' CSPs are planning to monetize their 5G SA core on cloud investments. This includes not only new go-to-market approaches via partnerships but also the ability to onboard customers and partners faster and more easily (see Figure 6). There are both customer-facing and technical aspects to this:
  - On the customer-facing side, new business models, such as providing network-as-code offerings (47% of survey respondents) and exposing network functions via application programming interfaces (APIs) (44% of survey respondents), are expected to be attractive new ways to monetize 5G SA core on cloud investments. Novel value propositions are based on software-as-a-service (SaaS) providers aligning their APIs with CSPs that can then market the SaaS offerings to customers. Similarly, revenue sharing or charging by volume of data are other ways for CSPs to monetize 5G-based services via partners without having to directly manage the customer relationship. Moreover, 45% of survey respondents are monetizing or plan to monetize by automating network functions for faster onboarding.
  - On the technical side, 5G's network slicing capabilities enable organizations to develop and tailor offerings according to different customer needs, such as guaranteed bandwidth or access rights to digital content. Sixty percent of respondents' CSPs that plan to implement network slicing will provide standardized plans and options, such as dedicated bandwidth provisioned for specific user groups. The provisioning of SLAs for certain users is also expected to be popular. Moreover, automated and self-service onboarding services enable customers to procure and deploy 5G services faster and with less friction. Partners, such as systems integrators and professional services organizations, are important partners for CSPs to help implement 5G.

Figure 6

**“How does your organization monetize/plan to monetize beyond deploying 5G standalone core or 5G applications on cloud?”**

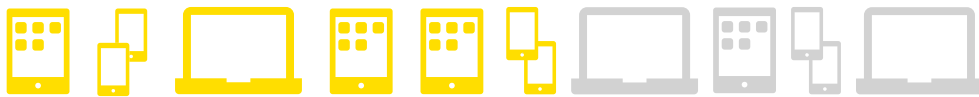


Base: 171 telecom or CSP decision-makers and influencers from tier-one or tier-two CSPs in America, EMEA, and APAC currently interested in, using, or planning to adopt 5G services

Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022

**61%**

of respondents believe that greater network efficiency/security is the most important internal benefit for CSPs from investing in 5G SA core on cloud

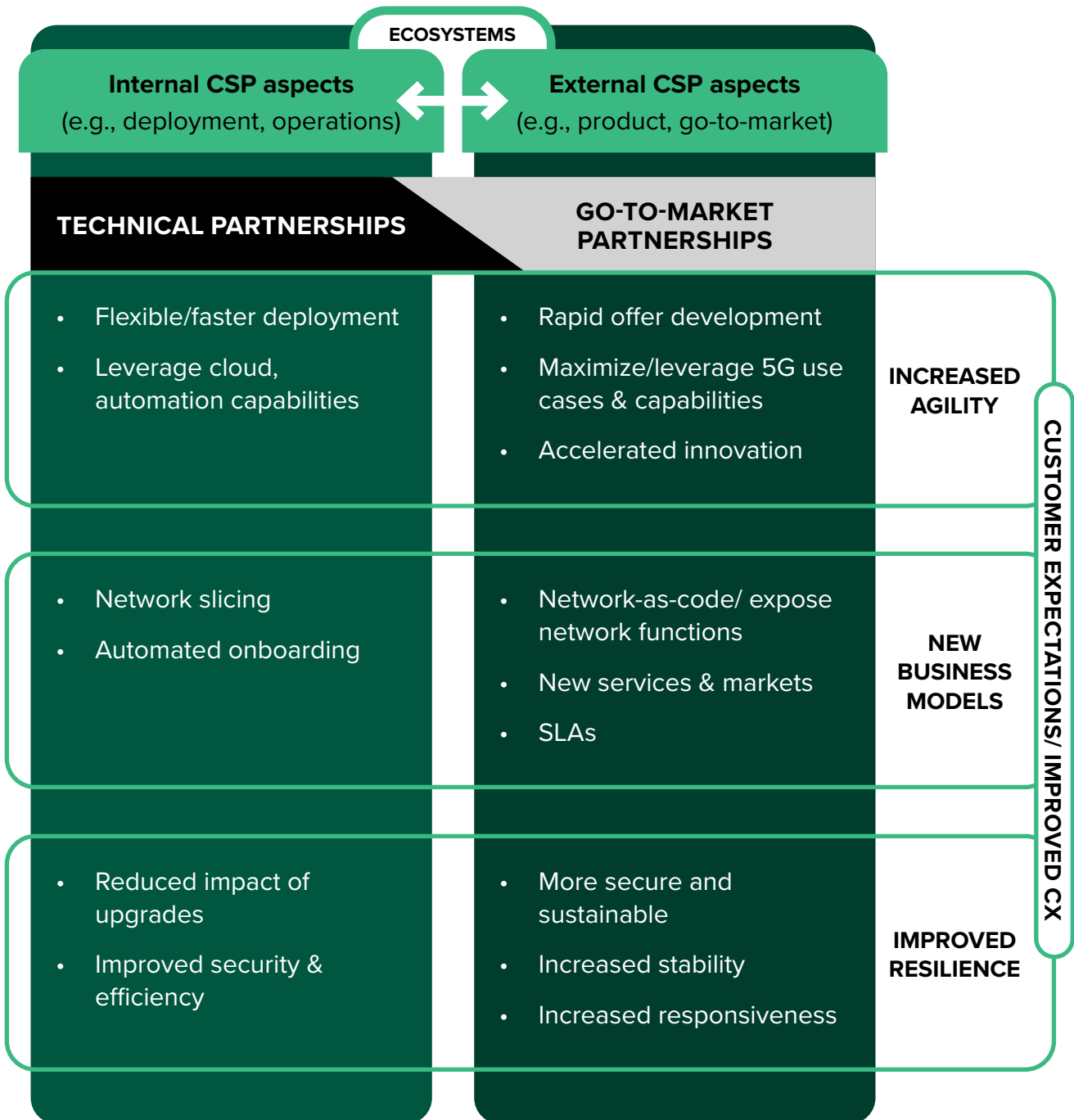


- **Networks based on 5G SA core on cloud will be more resilient.** The third key 5G SA core on cloud benefit area relates to networks becoming more secure, efficient, stable, and environmentally sustainable. This aligns with growing customer expectations around better mobile network performance and environmental footprint reduction. There are different aspects to improved network resilience:
  - Greater network efficiency and security are the most important internal benefits for CSPs from 5G SA core on cloud, according to 61% of respondents. This includes capabilities such as closed-loop issue resolution, better utilization, and optimized traffic. When asked which vendor types are best positioned to provide 5G SA core on cloud offerings, security vendors were noticeably the second most popular choice, with 45% of respondents choosing this option. This underlines enterprises' growing awareness that the potential attack surface for cyber criminals increases as connected solutions — like IoT or extended reality — spread.
  - The 5G SA core on cloud network is more stable because upgrades and changes can be managed with less disruption to network performance. When an organization launches new network functions and features, they can be pushed out similar to software updates in a cloud context. This makes it easier for the CSP to operate and upgrade network infrastructure while keeping the impact on customers, including downtimes, minimal.
  - 5G is designed with higher energy efficiency in mind. Although mixed-legacy 5G infrastructure can be less energy efficient, 5G standalone operations allow CSPs to transport greater data volumes with lower energy consumption. Hence, as 5G networks evolve, they will contribute to sustainability initiatives. With networks better able to scale up and down, there is also an additional potential positive sustainability effect because a cloud architecture uses infrastructure more efficiently.

Ecosystems are important for delivering increased agility, supporting new business models, and improving network resilience and sustainability from both internal and external perspectives (see Figure 7).

**Figure 7**

**Ecosystems Bind Technical And Business Aspects To Better Address Customer Expectations And Improve CX**



Source: A commissioned study conducted by Forrester Consulting on behalf of Google Cloud, Intel and Nokia, December 2022

## Key Recommendations

The shift to 5G SA core on cloud provides compelling upsides but is not without transformational challenges. First, multivendor and legacy environments invariably raise interoperability issues, affecting quality of service and service-level agreements. Hence, virtualization providers are helping minimize integration complexities. Second, in light of the cloudification of network infrastructure, a new generation of CSPs is emerging in the form of cloud-native network providers. Third, CSPs are more carefully evaluating their decisions regarding how many and which applications to move into the cloud in light of growing inflation. Against these transformational challenges, Forrester's in-depth survey of CSP leaders about 5G SA core on cloud yielded several important recommendations:

**Network agility, new business model opportunities, and improved network resilience are strategic objectives for CSPs.**

Hence, accelerate your 5G SA core on cloud deployment and rollout to improve your agility and better serve the key enterprise market segment and address customers' business priorities. The closer relationships between CSPs, network equipment vendors, and hyperscalers will accelerate the network cloudification trend. That means that CSPs need to prepare for a faster pace of partner management activities.

**The move from a physical or cloud to a cloud-native architecture is complex and multifaceted.**

The leading CSPs pursue a comprehensive 5G SA core on cloud strategy, aligning application and process design, agile/GitOps ways of working, network orchestration, operations, and technology architecture design. CSPs must focus on translating the benefits of 5G network functions into positive business outcomes. CSPs need to be able to explain how network features can help boost business objectives and outcomes for their enterprise customers.



**Ecosystems and partnerships help to overcome CSPs' 5G SA core on cloud technology and skill challenges and pursue business priorities.**

Therefore, embrace a global ecosystem of vendors, including application, cloud, and network providers, to innovate and create compelling 5G services. For instance, GSMA Open Gateway, launched at Mobile World Congress 2023, is a framework of common network APIs designed to provide universal access to operator networks for developers. The goal is to help developers and cloud providers enhance and deploy services more quickly across CSP networks. Another example is intent-driven automation, which enables faster onboarding of network functions on cloud infrastructure. These kinds of initiatives should help CSPs address challenges and compete more effectively with non-CSP competitors in the future.

**CSPs need to urgently transform towards a more agile, experimental, and collaborative culture and operating model.**

CSP leadership teams are often uncertain about the business case of 5G SA core on cloud because of outside factors like customer demand and regulation. Leading CSP executives embrace 5G SA core on cloud to ensure that CSP innovation remains relevant. They also regularly review and adjust their innovation-related practices by boosting their human-centric design capabilities throughout their organizations.

**Most CSPs face skill gaps to fully exploit all opportunities that 5G SA core on cloud empowers.**

Hence, CSPs need to increase their focus on building stronger sector-specific ecosystems. Ecosystem partnerships help improve innovation capabilities, better address specific use cases, and obtain access to relevant skills for designing, rolling out, and operating next-generation dynamic network architecture and customer experiences.

## Appendix A: Methodology

In this study, Forrester conducted an online survey of 171 telecommunications and communications service provider decision-makers at organizations across the Americas, EMEA, and APAC to evaluate 5G SA core on cloud. Survey participants included decision-makers at manager level or above. Questions provided to the participants asked about objectives, drivers, and inhibitors surrounding their organization’s 5G SA core on cloud investment or expected investments. Respondents were offered a small incentive as a thank you for time spent on the survey. The study began in November 2022 and was completed in December 2022.

## Appendix B: Demographics

REGIONAL BREAKDOWN	
Americas	33%
APAC	33%
EMEA	34%

COMPANY TIER BREAKDOWN	
Tier one	50%
Tier two	50%

INDUSTRY BREAKDOWN	
Telecommunications services	70%
Communication service providers	30%

RESPONDENT LEVEL	
C-level executive	18%
Vice president	22%
Director	36%
Manager	34%

RESPONDENT DEPARTMENT	
Product/service	22%
IT/technology/network:	29%
Data and analytics	32%
Executive	18%

Note: Percentages may not total 100 because of rounding.

## Appendix C: Supplemental Material

### RELATED FORRESTER RESEARCH

- “Achieve Personalization’s Promise In Retail With 5G Plus AR/VR,” Forrester Research, Inc., July 5, 2022.
- “China Is Leading Global 5G Innovation,” Forrester Research, Inc., August 2, 2021.
- “Research Overview: 5G Technology, Products, And Services,” Forrester Research, Inc., February 22, 2021.
- “5G Makes Its Rounds In Healthcare — Virtual Care And Security Are Top Use Cases,” Forrester Research, Inc., July 14, 2021.
- “Zero Trust Primer For 5G Security Use Cases,” Forrester Research, Inc., May 1, 2020.

## Appendix D: Endnotes

<sup>1</sup> Source: Priorities 2022, Business Technographics® Survey, Forrester Research, Inc., February 2022.



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