

# NAAS: ENABLING CSPS TO DELIVER ON TRANSFORMATIVE, FLEXIBLE CONSUMPTION OF NETWORK SERVICES

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# NaaS: Enabling CSPs to Deliver on Transformative, Flexible Consumption of Network Services

## Introduction

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In today's IT landscape, enterprise customers are generally accustomed to consuming IT infrastructure through a cloud model. This simplified, consumption-based approach has expedited enterprise transformation and has proven invaluable to many organizations as they look for ways to outsource IT and shift the focus to business goals. As a logical next step, many organizations are expressing interest in ways to consume network connectivity in a similar manner, often called network as a service (NaaS).

In this paper, IDC defines NaaS, discusses how NaaS aligns with enterprise needs, and makes the case for communications service providers (CSPs) as NaaS providers. It also discusses how CSPs can drive revenue and profits from NaaS, and the potential cost savings for the enterprise.

## CSPs Can Leverage NaaS to Grow Their Enterprise Share of Wallet

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NaaS is an emerging concept, driven by enterprise demand to purchase connectivity through simplified, flexible consumption models.

At its basic level, IDC defines NaaS as "a dynamic connectivity service consisting of network infrastructure (hardware and software) and services, consumed via an opex or flexible consumption model, designed to support specific use cases or applications."

NaaS delivers simplicity, whereby hardware, software, and services are bundled into a pay-as-you-grow subscription by spreading costs over time, thereby limiting the financial impact for organizations. Today, a capex-led approach generally requires an enterprise to routinely invest in refreshing network equipment, resulting in time, cost, and production losses. The NaaS business model simplifies network procurement by enabling enterprises to move to a more predictive, opex-led approach. Beyond the business model improvements, a NaaS approach can deliver seamless technology upgrades, which are critical in today's fast-evolving technology landscape.

Moving from a capex- to an opex-centric model reflects the goal of consuming connectivity in the same way that many enterprises already consume cloud services. Inherently, mainstream adoption of cloud services over the past decade is a key driver of NaaS interest. Many enterprises have become comfortable using subscription models to consume cloud services, for example for infrastructure, software, and platform as a service. Cloud services are generally characterized by a key set of features:

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

The NaaS model mirrors this approach, but adds some unique features to the as-a-service value proposition:

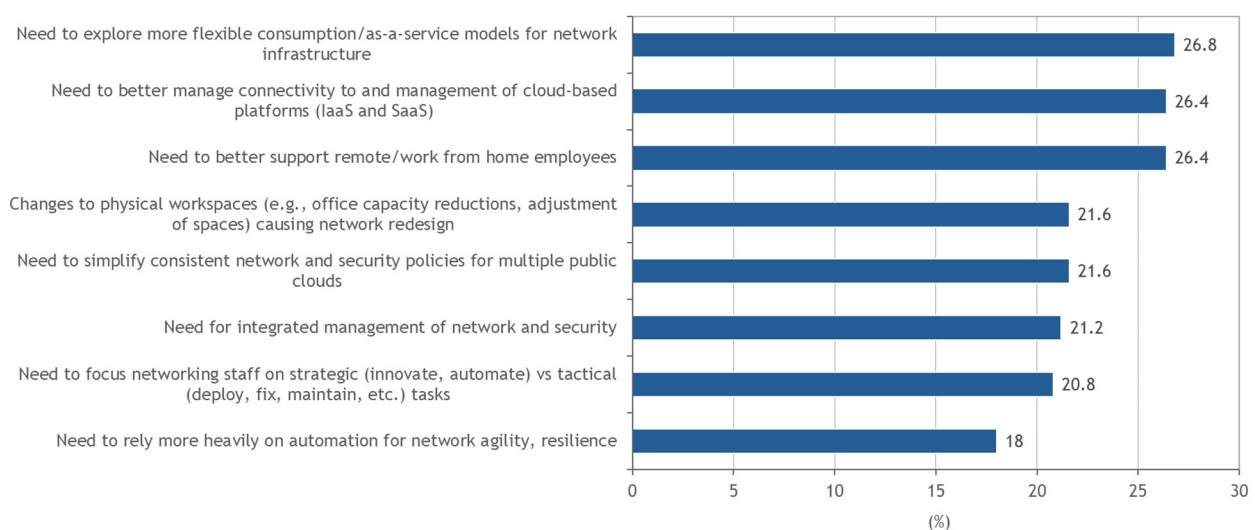
- **Dynamic access to multiple network access solutions (LTE/5G, Wi-Fi 6, SD-WAN, fiber, etc.).** Customers can select between multiple wired and wireless solutions that best fit the needs of their application.
- **Assured, qualified, and ultra-reliable network offerings.** Customers sign a NaaS contract that defines the service-level agreement, including service assurance and pre-tested and high-performing network services (e.g., the CSP provides 5G NaaS).
- **Pre-tested, multivendor network functions to form a solution.** Ability to mix and match from pre-tested vendors to deliver best-of-breed solutions.
- **Zero-trust security enablement.** The ability to embed security in multiple network nodes, ensuring security from not just external entry points, but within the contained network.
- **Multicloud connectivity.** The ability to run distributed applications across public, private, or hybrid clouds from multiple cloud providers.
- **Custom application enablement.** Dedicated network resource, which directly aligns to specific network needs, often enabled by APIs.

While the cloud consumption model has garnered mainstream recognition, the network industry has lagged in its efforts to deliver similar offerings. However, with significant interest in simplified consumption in both the networking and the broader IT space, IDC expects NaaS to grow and become an established CSP model going forward.

IDC recently asked enterprises to identify their top network-related priorities in 2021. As Figure 1 shows, flexible consumption was the top choice, followed by a focus on cloud, agility, and security.

FIGURE 1

What Are the Top Priorities for Your Organization's Networking Strategy for 2021?



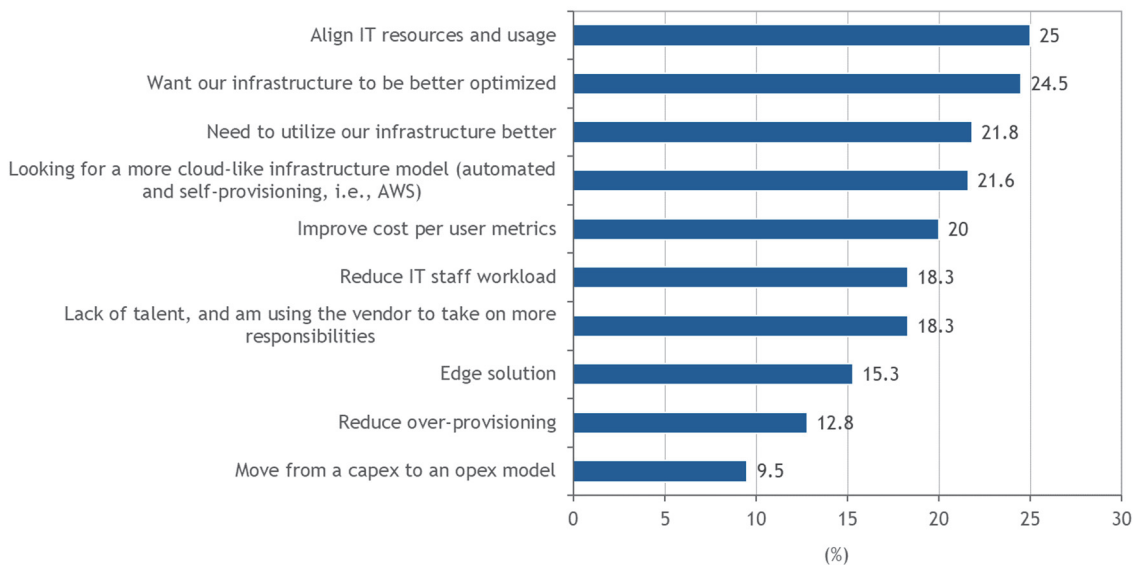
Source: *Enterprise Networking: Emergence of the New Normal Survey*, IDC, December 2020, U.S. n = 250

## NaaS: How CSPs Can Address Customers' Technology and Business Challenges

While NaaS is a new way to deliver network services, its success lies in its ability to address specific enterprise challenges. IDC's recent consumption-based infrastructure market survey provides insight into the challenges that enterprises expect consumption-based IT models to solve.

FIGURE 2

### What Challenges Are You Trying to Solve with a Consumption-Based Approach?



Source: *Consumption-Based Infrastructure Market Trends Survey*, IDC, September 2020 (base = 600)

Moving to a consumption-based model is expected to address a range of both business and technical challenges. Specific to NaaS, CSPs need to understand what enterprise customers expect to achieve from moving to a NaaS consumption model.

### Enterprise Business Benefits

- **Simplify strategic planning:** simplify business planning cycles by building continuity into operations
- **Move from capex to opex:** move from a lumpy capex to a more flexible opex consumption model
- **Reduce costs:** redeploy staff to business-enabling tasks, as opposed to IT- or network-related tasks, to improve cost structures
- **Improve top-line revenue:** ability to dynamically provision network resources to deliver optimized services to end customers

### Enterprise Technology Benefits

- **Quicker network upgrades:** accelerate network refresh cycles and expedite access to the latest network offerings (e.g., private LTE/5G)
- **Improved application performance:** match application needs to network resources



- **Network utilization:** map network resources directly to business requirements, particularly if operations need to scale up or down
- **Simplification:** simplify network deployment and management cycles by enabling network consumption packaged as an end-to-end solution (e.g., hardware, software, services)
- **Embedded security:** embedding security throughout the network and IT stack is becoming "table stakes" to prevent intrusion from logical entry points but also from middleman attacks internally

While the benefits of moving to a consumption-based approach for enterprises are clear, delivering NaaS will require high-level of commitment, expertise, and resources from suppliers. CSPs should be viewed as logical NaaS providers, based on their incumbency in providing managed connectivity offerings.

## Multiple NaaS Models Emerge, with CSPs Well Positioned to Capitalize

With NaaS in its early days, the broader network industry is still evaluating optimal delivery models. While enterprise network vendors are exploring ways to simplify network consumption through NaaS, CSPs are also exploring their role in the NaaS market, leveraging their incumbency in managed services and their established regional, national, and/or multinational footprints. It is useful to examine how these approaches differ in terms of meeting customer needs.

TABLE 1  
Current NaaS Models

Model	Key Characteristics
CSP-enabled NaaS	<ul style="list-style-type: none"> <li>• Evolution from basic managed connectivity to NaaS which incorporates multiple feature sets on-demand to supplement connectivity (analytics, security, etc.)</li> <li>• Shift to a marketplace-led approach where customers can pick and choose multivendor solutions to achieve best-of-breed solutioning</li> <li>• Easier access to latest network upgrades (e.g., 5G network slicing)</li> <li>• Easier access to partner solutions for bundle options (e.g., edge cloud with connectivity)</li> <li>• Over time, evolution to a platform model, whereby advanced NaaS features (e.g., orchestration and network APIs) are procured through a customer portal to ease purchase</li> </ul>
Enterprise NaaS	<ul style="list-style-type: none"> <li>• Inclusive model whereby vendor hardware, software, and services are bundled into a single subscription payment and delivered as a service</li> <li>• Uses cloud-based management platforms to control and manage enterprise infrastructure, which could enable enterprises to dynamically add or remove network software features via a centralized dashboard</li> <li>• Delivered directly from a vendor to the end customer or through channel partners</li> <li>• Vendor may manage solution or third party could manage on behalf of the vendor</li> </ul>

Source: IDC, 2021

While both models are gradually being introduced, IDC expects CSPs to have a strategic role in the NaaS space for several reasons:

- NaaS inherently considers a multivendor approach, where CSPs can act as a neutral broker for connectivity services, providing multiple options to an enterprise.
- CSPs have a legacy position in managed services and SLA delivery.

- CSPs are well versed in providing connectivity for enterprise customers on a local, regional, or even global scale.
- CSPs, particularly those adopting 5G, can offer new features (such as network APIs) based on forthcoming standards efforts.

## Market Readiness: Introducing NaaS to Customers

Due to the complexity inherent to any NaaS offering, CSPs should evaluate best practices on how to onboard customers. Day 1 NaaS offerings can prioritize specific feature sets, such as SDN and security, related to ongoing enterprise initiatives.

TABLE 2  
Present-Day NaaS Solution Matrix

Category	NaaS Feature	Use Cases to Be Solved
Connectivity	SD-WAN	<ul style="list-style-type: none"> <li>Managing network traffic with performance and security requirements that vary by applications, users, and locations</li> <li>Establishing one-to-many connections of cloud apps to branch/remote offices</li> </ul>
Connectivity	Public and private 4G/LTE and 5G services	<ul style="list-style-type: none"> <li>Connecting cellular IoT devices, embedded devices, and other endpoints to either a public or private mobile network</li> </ul>
Connectivity	Unified communications	Mobile access to deliver seamlessly integrated voice, messaging, collaboration, and video applications
Connectivity	AI/ML and orchestration	Analytics, operations, and dynamic network resource management
Connectivity	Security services	Continuous monitoring and management of intrusion detection systems and firewalls enhanced by routine patch management and security upgrades
Applications	Application enablement services	Customized network resource management based on where the app resides and where the data needs to go
Applications	Edge network enablement	Demand to host or deliver applications from an edge (public or private) environment
Customer experience	Unified customer portal	Demand for self-service experience and ability to control

Source: IDC, 2021

While these technologies have traditionally been delivered as point solutions, NaaS envisions seamless integration based on specific customer needs. In that light, NaaS should not be looked at as a simple mash-up of point products, but as a set of on-demand features already integrated as a solution.

As the enterprise itself evolves, NaaS can evolve to support more advanced features, such as application enablement in tandem with private LTE/5G networks, for example. CSPs should look at NaaS as a way to on-ramp customers, and by cross-selling more features that can be enabled by the full NaaS solution set over time.

From a customer view, most organizations will look to NaaS as a means to simplify payment structures and to establish a predictive cost model. As such, NaaS offerings are best served through a subscription-based approach, which can be customized in several ways based on specific use cases, features needed, usage patterns, and duration. Today's models often take a

tiered approach, where base networking is layered on with advanced feature sets, such as analytics. Adding features can alter the subscription price, but offering step-wise adoption better aligns with the varying stages most organizations are in as they transform.

For reference, IDC estimates the worldwide enterprise network infrastructure market spend at \$31 billion in 2020, growing to approximately \$45 billion by 2025. By 2025, IDC expects nearly a third, or around \$15 billion, will be consumed through a NaaS model. Those CSPs that can tap into the demand for NaaS are therefore more likely to outperform peers across the business services space.

## CSPs as NaaS Providers

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### *Defining the NaaS Value Proposition*

NaaS is a shift in how CSPs do business. At the retail level, it changes the 100-year-old sales model for selling network connectivity services, sometimes with the customer premises equipment (CPE) needed to enable such services, into a flexible means that empowers customers to choose the network offerings they want for a specific workflow, application, coverage geography, or end-to-end business solution. In the future, NaaS offerings will be enhanced with additional capabilities such as network operational insight, traffic control functions, routing definitions, device location information, and service quality levels designed to bring increased customer value.

At the wholesale level, NaaS opens the traditional network services opportunity window to others that are not network infrastructure operators. Non-traditional services organizations, through a wholesale connectivity agreement with one or more CSPs, can be a virtual services provider (VSP) — the second generation of what the market knows as mobile virtual network operators (MVNOs). This group, empowered by ecosystems of partners from any industry, combined with CSP network connectivity, is a new force for meeting customer needs by going beyond the resale of traditional connectivity services to include advanced business solutions with low latency connectivity combined with compute and storage capabilities at the network edge, to connected business solutions with embedded Internet of Things (IoT) devices.

Regardless of who provides NaaS-based services — a CSP or virtual services provider — customers expect to have a self-service portal for ordering services, monitoring service quality, and paying for service utilization. The operational insights customers often care about, which are usually tied to infrastructure complexity, are addressed by analytics and open API-based systems integrations designed to emphasize connectivity alignment with business outcomes.

### *What it Takes to Implement NaaS Now*

Like so many parts of the digital world, NaaS is designed to improve business outcomes and the customer experience. Regardless of systems architecture or existing processes, the objectives for streamlining service operations to achieve these results in a dynamic services world remain the same:

- **Satisfying new requirements.** Satisfying new NaaS business and operational requirements, without launching into an elaborate systems/process update initiative, requires CSPs to engage in orchestrated change. This is change that keeps the scope of transformational actions manageable within acceptable limits, that is reached through collaboration with trusted partners showing a track record of successful outcomes within budget and schedule constraints.
- **Providing a frictionless environment to engage with solution partners.** For VSPs engaging in a NaaS business strategy, the new requirements mean providing a frictionless environment to engage with solution partners including interaction with CSPs for wholesale network connectivity and B2C solution delivery.
- **Workflow digitalization.** Digitalizing CSP workflows across siloed systems, data, and processes to accommodate business change means moving at market speed (a few hours) rather than allocating weeks for traditional methods tied to new functionality cross-checking, updating, and multilevel systems testing.
- **Understanding the customer.** Expanding from a partial view to a full view of CSP retail and wholesale customers means integrating across internal product and data silos, including network data repositories, to create an end-to-end view of customer challenges and behaviors. For VSPs, a full view of customer data means using existing insight from CSP systems to minimize time to market and then expanding with the types of tools that can combine this data with other insights using minimal work effort.
- **Process updates.** Redefining existing processes means making them simpler, more responsive, more efficient, flexible, and fully automated to rapidly accommodate change or business redirection in market real time (in hours and not days, weeks, or months).
- **New business models.** Enabling new business models with a many-to-one and one-to-many delivery strategy means taking advantage of the compounding effects of simultaneous revenue streams working collectively to deliver new business options such as selling solutions and not just connectivity or selling data insight rather than just transport capacity.

For CSPs, the mantra for improving digital operations pushes usage and behavior data toward internal work teams and processes. With the proper definition and strategy, such data is harnessed — as insight — to improve the productivity of internal care agents and network operations personnel, ultimately enabling a positive customer experience delivered by an omni-channel model (service portal, chat, retail store, mobile app, or phone). For VSPs, delivering continuous customer value is critical to winning customer loyalty.

### *NaaS Operations and Monetization Systems/Process Challenge*

Current processes have served the communications industry well for over a century. Many installed systems are automated sections of those processes, with improvements added along the way. Some systems have now been in operation for more than four decades. The installed systems and process environment is designed to address mostly B2C sales and customer management of network connectivity services. Adding partner interactions via B2B and B2B2X

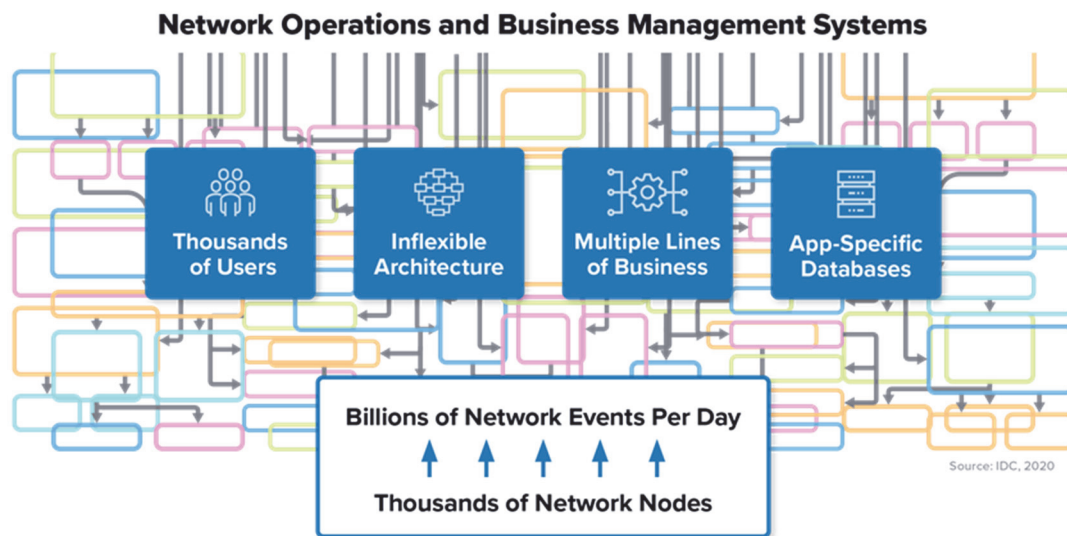


solution scenarios, which are part of any NaaS business strategy, requires change on multiple levels.

Enabling NaaS with the point and click simplicity that customers expect requires enhancements in how back-office operations support systems (OSS) and business support systems (BSS) work together. For example, recognizing that change was needed, many CSPs launched large transformation projects over the past decade aimed at improving their OSS BSS environment. However, little positive yield has come from the time and resources spent to date by CSPs globally. So, why is OSS BSS and business process change so difficult?

In moving to a NaaS business model, the challenge for all CSPs, as shown in Figure 3, is tight system-to-system integration, an inflexible architecture, multiple application wrapped silo databases, and numerous duplicated systems tied to specific technology or business unit definitions. The required change to both systems and processes is painfully slow as this architecture is optimized for long-term support of static B2C consumer service offerings and the network nodes delivering such services. These systems and processes were not designed to meet the real-time flexibility requirements that a NaaS business strategy depends on for CSP commercial success.

FIGURE 3  
Network Operations and Monetization Systems/Process Architecture



Source: IDC, 2021

Though the architecture challenges are significant, some CSPs in certain geographic regions have successfully transformed their operations and monetization environment so that NaaS is fast becoming a business success for them. Key questions for consideration:

- How did these organizations make the transition?
- Did they do it all at once or did they engage in some type of transitional approach to resolve this seemingly insurmountable business challenge?

- Most importantly, what was the level of effort needed to get to a state of rapid configuration change, elastic connectivity, and customer self-serve flexibility?

### *Successfully Launching NaaS Today*

How can NaaS become a successful business strategy for CSPs globally?

The TM Forum's Frameworx and Open Digital Architecture (ODA) initiatives are a gathering place for CSPs and their suppliers to update business processes tied to the ordering, provisioning, activation, assurance, and monetization of connectivity services. This work has also produced numerous open APIs that are now available to CSPs with their systems integration partners and their operations and monetization solution suppliers to avoid the type of systems/process inflexibility shown in Figure 3.

While a flexible systems architecture has been limited to a few CSPs to date, real business improvement by these companies cannot go unnoticed. For example, adjusting to changing market conditions shortly after the global pandemic forced businesses and consumers into a full at-home lockdown in early 2020:

- One major network operator transitioned most of its care organization to a work-from-home (WFH) environment within 48 hours. Two weeks later, it said 93% of its care workforce was doing business within a WFH configuration. The company also said it has no plans to revert to its pre-pandemic environment.
- A major broadband operator launched a digital assistant application for use by outside technicians to interact with customers requiring service repairs, which was completed in less than 72 hours and included training 10,000 technicians on how to use the application.

Why is leaping to digital operations more practical for some organizations and not so for others? How soon will CSPs be ready for the new revenue opportunities coming through partnerships and wholesale service agreements such as the nascent VSP market for NaaS offerings? Establishing a digitalized business environment is essential to enable the agility needed to adapt to business change, especially for CSPs that see the long-term value in delivering business outcomes rather than just network connectivity for customers.

## ROI Considerations

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### *For the Enterprise*

Switching from a traditional model to a NaaS commercial model is set to produce cost savings for enterprises and additional revenues for CSPs. Let's consider the hypothetical case of an enterprise that is getting a bundle of Ethernet switches, routers, WLAN equipment, firewalls and network management software, WAN connectivity, and maintenance services all provided by a CSP. In a traditional model, the enterprise would invest capex in equipment and software at the outset (i.e., in year 1) and would also likely make a midcycle refresh (i.e., in year 5). In years 1 and 5, the enterprise would have additional expenditure for consulting and integration services to define the right approach and architecture to achieve its digitization targets. During the life cycle

of the contract, network and security maintenance services would deliver regular software updates, network and security visibility, fix and repair, and preemptive failure detection.

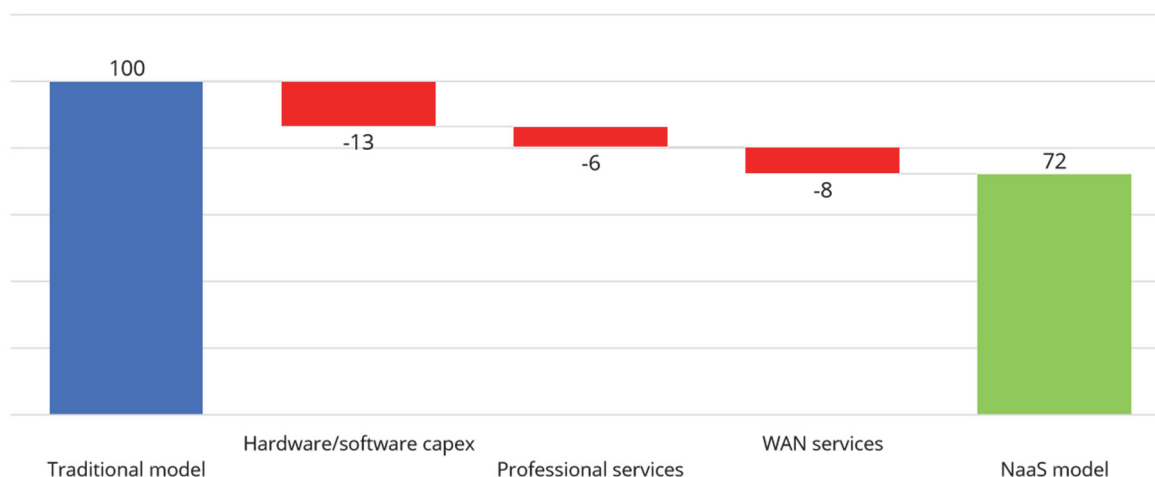
In a NaaS model, the enterprise will move to an opex model for all network hardware, software, and services. As equipment and software will be delivered in a bundle in a predictable long-term contract, it is likely to be offered at a lower cost than for the standalone components. The enterprise will also save further network infrastructure costs by using a pay-as-you-grow contract, thereby removing infrastructure and WAN connectivity overprovisioning and eliminating expenses for technology refreshes.

By shifting to a NaaS model, the enterprise will avoid a substantial part of the professional services expenses. While the initial NaaS consulting and integration costs may be at the same level as in a traditional model, NaaS can enable significant savings after the initial deployment. With centralized monitoring dashboards, self-service portals, and frequent optimization and improvement enabled by automation, enterprises will drive the service and will benefit from cost savings in the previously mentioned maintenance services.

What does this mean in practice for the enterprise? IDC estimates that in this hypothetical case in which an enterprise spends an indexed 100 in a traditional model over five years, the NaaS model would lead to savings of around 27%. The main contributor would be hardware and software (47% of savings), followed by WAN connectivity (30%) and professional services (23%).

FIGURE 4

#### Enterprise Cost Comparisons Over a Five-Year Period: NaaS vs Traditional Models



Source: IDC, 2021

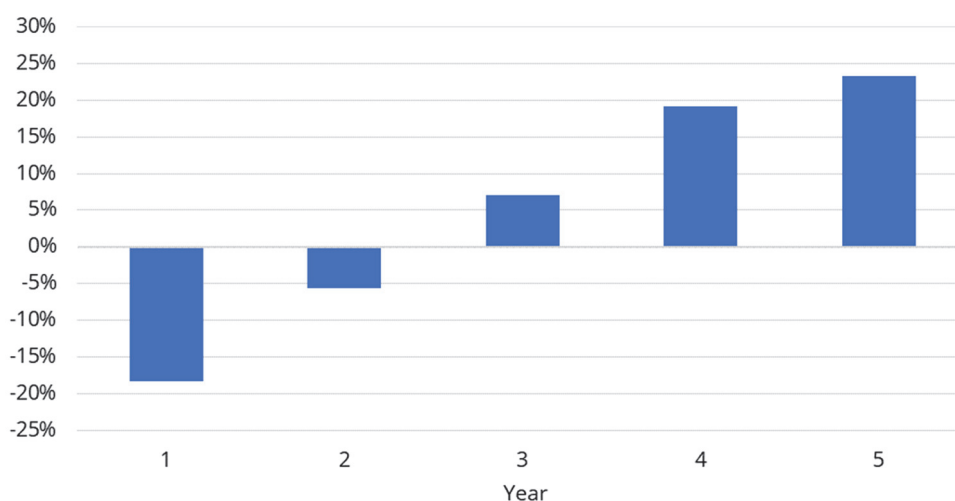
#### For the CSP

Let's continue with the hypothetical case of a CSP that delivers a bundle of Ethernet switches, routers, WLAN equipment, firewalls, and network management software, as well as WAN connectivity. The enterprise NaaS costs assessed in the previous section will represent the revenues of the CSP. To determine the ROI and the NaaS business case for the CSP, it is critical to analyze how NaaS offerings transform the nature of many different costs in CSP operations.

- **Network and software equipment acquisition costs:** In a traditional model, typical hardware and software commissions applied by equipment vendors to channel partners are around 5%. Applying this regular commission in the NaaS bundle outlined above would reduce CSP margins. Therefore, leading hardware and software vendors are exploring stronger incentives and compensation models to stimulate NaaS models. This means that commissions will be at least two times higher than regular commissions in traditional models and that they will increase with the adoption rate of the NaaS model.
- **Commercial costs:** In NaaS models, IDC assumes that total acquisition costs are at the same level. Indeed, selling NaaS bundles is likely to require a less commercial effort but CSPs need to incentivize sales teams to stimulate the NaaS model. As the relationships with NaaS users become more digital with increased customer stickiness, commercial costs during the contract life cycle will substantially decrease.
- **IT systems costs:** In traditional models, CSPs have already invested in self-care portals and network and service orchestration. The NaaS model will require incremental investments in a unified customer portal and billing, which are key attributes of NaaS offerings. But incremental investments will decrease with the rise of NaaS users benefiting from economies of scale. Additionally, CSPs will use "pay as you grow" in their IT systems, which helps to minimize upfront costs.
- **Internal IT costs:** As outlined in the NaaS operations and monetization systems/process challenge section, IT organizations require significant changes and investments to break silos. However, after the transition, services delivered to end users will become more automated and efficient with improved profitability.

Assuming the NaaS model represents a third of enterprise network infrastructure consumption in year 5, CSPs will reach breakeven in year 3 (see Figure 5). During the first two years, costs are higher than revenues due to the incremental investments in IT systems, additional IT internal costs, and commercial expenses. In year 5, the margin rate exceeds 23%.

FIGURE 5  
CSP Yearly Margin Rate in a NaaS Model



Source: IDC, 2021

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## Conclusion

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NaaS is set to redefine how enterprises consume connectivity and networking. NaaS rests on several established cloud services features such as rapid elasticity, measured service, broad network access, resource pooling, and on-demand self-service. But it also brings unique attributes such as dynamic access to multiple access technologies, assured and ultra-reliable network offerings, multicloud connectivity, zero-trust security enablement, and prepackaged multivendor network services. NaaS will help enterprises to operate more efficiently and flexibly while enabling a strong alignment with their DX objectives.

The network industry is still evaluating optimal NaaS delivery models. While network vendors are exploring ways to simplify network consumption through NaaS, CSPs are also exploring their role in the NaaS market, leveraging their incumbency in managed services as well as their established regional, national, and/or multinational footprints. As a result, IDC expects both enterprise NaaS and CSP-enabled NaaS models to co-exist. For CSPs, NaaS is an opportunity for differentiation with bundles of connectivity, hardware, software, and value-added services tailored to enterprise needs and specific business outcomes. With a NaaS offer, the enterprise can take greater advantage of opex consumption models to better spread investment costs. CSPs should look at NaaS as a way to on-ramp customers, and by cross-selling more features that can be enabled by the full NaaS solution set over time.

NaaS is a shift in how CSPs do business. By being flexible they can empower customers to choose the network offerings they want for a specific workflow, application, or end-to-end business solution. Going forward, NaaS offerings will be enhanced with additional capabilities such as network operational insight, traffic control functions, routing definitions, device location information, and service quality levels designed to bring increased customer value.

Enabling NaaS with the point and click simplicity that customers expect requires enhancements in how back-office operations support (OSS) and business support systems (BSS) work together. The first NaaS offerings will require incremental costs in OSS and BSS, but as NaaS will become a platform-based business, many CSPs will need to address the challenges of tight system-to-system integration, an inflexible architecture, and numerous duplicated systems tied to specific technology or business unit definitions. Though architecture challenges are significant, leading North American CSPs are successfully transforming their operations and monetization environment so that NaaS is fast becoming a business success for them.

While NaaS propositions remain nascent, IDC expects them to deliver tangible financial ROI benefits to both enterprises and CSPs. IDC modeling of enterprise networking infrastructure, security WAN connectivity, and services bundles suggests that an enterprise switching to a NaaS model can benefit from a lower and smoother cost outlay of up to 27% over five years. IDC also estimates that CSPs' positive ROI comes from providing a larger bundle of services offered in a more predictable long-term contract with more healthy commissions. CSPs will minimize incremental back-office investments by using pay-as-you-grow models.



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## About the Analysts

### [Bruno Teyton](#), Research Director, EMEA Telecommunications and Networking



Bruno Teyton is based in Paris and works in IDC's Telco 2025 research program. He covers telco investment and opex strategies, with a focus on fixed networks (VDSL, Gfast, GPON, etc.). He also covers SDN/NFV, SD-WAN deployments, security in telco strategies, edge computing, mobile backhauling, IoT, and network life-cycle services. Before joining IDC in 2007, he led the B2B practice at IDATE, where he managed consulting projects covering fixed telephony and data services, wireless services, network infrastructure, satellite services, and broadband network projects granted by local authorities. He also contributed to several EC projects.

### [Karl Whitelock](#), Research Vice President, Communications Service Provider Operations and Monetization



Karl Whitelock provides strategic insight and global perspectives concerning the operations and monetization functions such as rating and charging, policy management, partner management, subscriber data management, customer service assurance, and network operations. His breadth and depth of coverage provides a holistic operations and monetization perspective relative to hybrid (virtual and physical) networks, customer experience evolution, and enterprise partner ecosystems. He also brings several years of insight into multipartner (B2B2X) business models, ecosystem management, and cloud-based solution architecture. In his current role, he is responsible for market share and forecast reports in addition to global strategic insights.

### [Patrick Filkins](#), Senior Research Analyst, IoT and Mobile Network Infrastructure



Patrick Filkins covers edge IoT infrastructure and is responsible for market and technology trends, forecasts, and competitive analysis related to the IoT network edge, gateways, and protocol strategies (such as 5G/WiFi), including the LPWAN domain (NB-IoT, LTE-M, LoRaWAN, SigFox). He also focuses on mobile infrastructure, fixed-mobile convergence, and the emerging 5G ecosystem worldwide, which includes SDN/NFV and telco cloud architectures, as well as how enterprises leverage cellular technology, including LTE/5G routers for backhaul, private LTE/5G, CBRS (unlicensed spectrum), and licensed spectrum allocation. While contributing to ongoing forecast and market share updates, he also contributes to custom projects for IDC's consulting practice.

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