# WHITE PAPER



# NAAS FRAMEWORK FOR CSPs

#### Abstract

Communication Service Providers (CSPs) across the world are looking for avenues to transform their Operations and Network space to drive – agility, flexibility, efficiency, automation, and necessary abstractions within – to accelerate time to market (read – new revenues) for adopting new technologies and delivering new and progressive services. In the recent past, **Network as a Service** (*NaaS*) has been evolving as one such transformational framework for CSPs to achieve these objectives.

While NaaS is evolving, CSPs needs a focused path (vision-goal-architecture-designimplementation) to embrace NaaS ecosystem, and this is where a System Integrator (SI) like Infosys can play a crucial role. Leveraging the technical and functional expertise gathered all along while successfully delivering transformation projects and collaborating not only with CSPs across the globe but also with a host of business partners and suppliers, SI can help CSPs drive their NaaS vision to fruition.

This paper explores NaaS, its drivers and enablers, its industry adoption (by CSPs), its specifications and standards, opportunities for an SI in the NaaS ecosystem addressing CSP's challenges, and what lies ahead with NaaS.



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## Introduction to NaaS

Conventionally, *Network-as-a-Service* aka NaaS was a cloud service model where cloud providers provided networking services, on the lines of storage and compute (as in laaS – Infrastructure as a Service). Access network and cloud connectivity aspects were early takers for NaaS, sort of low hanging fruits. But eventually, NaaS has now been evolving into how network infrastructure is getting consumed by organizations via flexible consumption-based model, which provides flexibility like cloud, easing network operations and speeding up new deployments.

Here network infrastructure, abstractly becoming a service in itself, is a complete package inclusive of hardware, software, licenses, management tools and lifecycle services.

It can cater physical resources as well as logical resources, it can serve across segments – retail, enterprise, wholesale. It can be offered in varied degrees like subscription hardware, managed service or True NaaS.

Typical service offering examples could be Wide Area Network (WAN) connectivity, Data Center connectivity, Security services, Virtual Private Networks (VPNs), Bandwidth on Demand (BoD), Unified Communications as a Service (UCaaS) and others. Industry impact is across healthcare, retail, finance, energy/utilities, manufacturing, public safety & security, and others.

NaaS is transforming the way how networks and networking solutions are dealt with. Obvious factors being flexibility with complete control, easy scalability, low cost.



The network transformation with open, standardized approach, with Software-Defined Networks (SDN) & Network Functions Virtualization (NFV) bringing software-driven programmable control and automation of underlying network and resources.

Like the way 'Agile' has transformed the End to End (E2E) monolithic software development into a modularized one, for analogy, NaaS is the same 'Agile' for Networks and BSS/OSS stacks (Business/Operations Support Systems).

NaaS uses open standard technology and vendor agnostic APIs (Application Programming Interface) to hide network details (abstraction) and expose these to the BSS/OSS systems (internal) & customers (external) as service orchestration.

aS efits	as-a-Service	Flexible consumption based model (as-a-Service), to deliver 'on demand' network services, easing network operations and speeding up new deployments for CSPs' customers (internal/external)
	Catalog building block	Offering flexibility for Innovative product and bundles, as per dynamic business needs, without having significant impact to Network, IT, and Orchestration underneath
	Separation of concerns	Due to NaaS layer abstraction, new release or upgrade in version whether its north or southbound to NaaS API, would just need testing against that API, instead of complete regression
Na Ben	M&A Ease of integration	Ease of integration during Mergers & Acquisitions scenarios/ use cases where CSP need to integrate across the board, it will be easy as it would just need plugging with respective APIs
	Cost reduction	Strealined costs due to optimizaton, Integration tax reduction due to standardization, all leading to tremendous cost savings across
	Complement network upgrade	Network Modernization (SDN/NFV, cloud centric) bringing software-driven programmable control and automation of underlying network & resources and Simple Network Management & Operations

## Industry adoption (CSPs embracing NaaS)

As per MI report, "The NaaS market is expected to grow at a CAGR (compound annual growth rate) of 34.5% over the forecast period (2021-2026)."

As per a recent IDC report, with nearly one-third of the \$45 billion enterprise network market expected to be consumed through a NaaS model by 2025, Communication Service Providers (CSPs) cannot ignore this emerging opportunity.

CSPs have to offer network and value-added services (VAS) in the form of NaaS to enterprise and SMB (Small and Medium Businesses) customers. This will increase sale/ revenue for existing network services portfolio (including enterprise revenue increase) and will also provide opportunity to enter new age product space (like Internet of Things, content services, multi-cloud environment management, etc.).

As per ITU-T Y.3512, NaaS implementation covers three categories –

- NaaS Applications (Virtual Network Functions i.e., VNFs offering) This includes any network function for either fixed or mobile or both core and access as well as for control and forwarding planes network elements. NaaS application ex. are virtual router, vCDN (virtual content delivery network), vFW (virtual firewall), vEPC (virtualized evolved packet core), etc.
- NaaS Platforms Programmable environment for network functionalities for customers to deploy, manage and run customer-created or customer-acquired network applications like router, firewall, load balancer.
- NaaS Connectivity Infrastructure capabilities type of service where NaaS customer can provision and use networking connectivity resources. This includes for ex. flexible & extended VPN, BoD, etc.

Furthermore, NaaS provides much needed avenue for CSPs to revolutionize their network (enters SDN/NFV) and decouple network from BSS/OSS stack.

CSPs need to automate their lifecycle management for network services and need to simplify their service operations, resulting into time-to-market efficiency.

CSPs should envision majority of their services (if not all) through NaaS framework enabling agile networks delivering assured services orchestrated across network domains between virtual & physical service end points.





#### Competition

Non-infrastructure operators and Webscale companies are also jumping into the NaaS bandwagon and competing with CSPs, emphasizing the point that orchestration and automation would be the key differentiators.

Examples are the likes of Cisco, Dell & HP providing NaaS solutions, and on the other hand we have AWS Cloud WAN and AWS Wavelength (5G service); Azure virtual WAN; and GCP Network Connectivity Centre.

#### **Deterrents or challenges CSPs face**

- CSPs lacks digital 'self service' capabilities and VNF marketplace capabilities, compared to competition
- CSPs are wary of network outages and cyberattacks and hence not exposing their networks externally
- Enterprises tries to do it themselves rather than opting CSP
- Enterprises prefer Cloud Service Providers over CSPs for their XaaS (Anything-as-a-service) needs

NaaS is a significant transformation and can provide CSPs a larger ROI (Return on investment).

Continuing with today's course of action will not deliver on the agility the CSPs need to have, to compete with hyperscalers, or support the developers, or the 5G application market opportunities coming about.

Even to support the scale that would be required, CSPs cannot do by hand and would need automation.

## What does NaaS offer to Enterprise customers?

- From NaaS consumer point of view, network essentially reduces to be just another utility like water and electricity.
   SMBs or Enterprises are typical external NaaS consumers, having obvious advantage of -
  - ✓ no network CapEx (capital expenditure) and
  - fixed, reduced, limited network OpEx (operational expenditure)
- Convenience, flexibility, agility, and scalability which such an as-a-service offering provides (read consumption-based approach) is unparalleled.
- Enterprises are relieved from burden of hybrid network design, setup, operations, and management, and hence can rather focus on dynamic business needs offering new capabilities and values. No surprise here that the easy point-and-click nature of the NaaS proposition is so striking.
- NaaS will enable the as-a-service network requirement of the 'Industry 4.0' driver technologies like 4G/5G, Cloud computing, IoT (Internet of Things), AI/ML, SASE (Secure Access Service Edge), MEC (Multi access Edge Computing).

## Are Enterprise customers ready for NaaS?

Are enterprises prepared to adopt as-a-service model for telecom and communication services? Do they foresee the additional benefits of network security, network performance, cost savings beyond the obvious NaaS narrative?

As per the Feb '2021 Nokia and Pulse survey on enterprise demand –

- almost half of the 100 odd enterprises surveyed, plan to adopt NaaS for business benefits
- nearly half voiced that their IT, Engineering and Operations practices would benefit from NaaS
- of the ones who plan to adopt NaaS, indicated that Network Security and BoD are most tempting features

Although unproven and unconvincing business benefits and aspects like availability, compliance, security, privacy, standardization, compatibility, service assurance, SLAs, and price uncertainty are found to be barriers for NaaS implementation, CSPs can address them through marketing, education, and ROI tools. CSPs can demonstrate improved security with NaaS as a compelling reason to adopt.

## What CSPs should focus on, for NaaS adoption?

- Offer a range of choices of programmable functions including VNFs, service chaining and bundling
- Agnostic Network with abstraction
- Process simplification (automated life cycle management including service fulfilment, orchestration, assurance, and operations) for improved customer experience
- Service Assurance and SLAs with 24 x 7 customer service
- Omnichannel Digital Experience (DX Digital delivery strategy)
- Open APIs to enable multi-partner scenarios, zero touch interactions and open digital ecosystems
- Offer a sandbox environment (testing environment)
- Appropriate metering and measurement
- Competitive pricing



#### Covid-19 pandemic and NaaS

Covid-19 accelerated network performance optimization, cloud adoption, and automation. It even made CSPs reevaluate their network infrastructure and shorten their planning cycles with regards to network capacity and volume-based orchestration challenges. NaaS helps to achieve exact the same and even much more, on the similar lines.

Covid-19 is not the only driver for change, as CSPs are always up for network modernization, network optimization, network management simplification and network security enhancement.

#### SDN/NFV as NaaS enablers

As CSPs are embracing SDN/NFV to build network infrastructure, they are on the path to virtualize majority of network components. Virtualization provides the ability to share, market, sell any networking platform.

*This network digitalization* and *virtualization* is the biggest enabler as far as NaaS is concerned, making subscription-based services, improved security, simplified network management and improved network visibility a possibility. As a parallel, BSS/OSS stack is also transformed/evolved to incorporate and manage virtual assets.

#### NaaS and 5G

Programmability of Cloud along with SDN/NFV technology, enables 5G operators to create a flexible, standards-based, high value service at much lower cost, which can be deployed at a fraction of time comparatively.

Operators have started leveraging open-source cloud native private 5G platforms to build own private 5G NaaS offering, thereby providing cloud-based platforms offering innovative, open, carrier-grade Private LTE and 5G that is purpose-built for enterprises.

As per the Nokia survey, 91% CSPs agreed offering NaaS is critical to the successful delivery of enterprise 5G service.



### NaaS Specifications & Standards

Instead of proprietary APIs for NaaS implementation, CSPs need to move to open standard APIs for the obvious reasons of reduced time, complexity, cost, and increased efficiency.

MEF's LSO (Metro Ethernet Forum - Lifecycle Service Orchestration) provides specs and reference architecture that enables standardized end-to-end orchestration and automation for service across one or multiple network domains even across multiple provider networks.

TM Forum has a suite of REST-full Open APIs that enable standardsbased interoperability for management of complex digital services. TMF 909 NaaS API Component Suite (API Standards) covers the operations required to be exposed to provide the functionality required by Operational Domains interworking with BSS/OSS applications and/or other domains from same service provider or from 3rd parties.

Basically, it's the API control plane contract between BSS/OSS (IT systems) and Operational Domains, also between operational domains to operational domains.

This includes the framework & common header information for exposed services.

The API set supports the control plane for services, but not delivery of service.

Set of Operational Domains are exposing and managing 'Network' Services (NaaS) and includes all services offered from a service provider (SP) including connectivity, media services, end points, etc.

A single Operational Domain supports set of functions & capabilities responsible for the complete lifecycle of services & resources within its domain, that includes exposure of services supported by SLAs, interfacing via standard TMF APIs with the BSS/OSS systems and other peer operational domains.

The 'NaaS API component suite' comprises APIs classified into below lifecycle areas:

- P2O Prospect to Order
- O2A Order to Activate
- T2R Trouble to Resolve
- U2C Usage to Payment (i.e., Usage to Cash)

All the aspects of Service Catalog, Inventory, Activation, Configuration, Ordering, Qualification, Tests, Problems, Quality and Consumption are covered.

Other key TM Forum reference asset is the IG1224 NaaS Service Management which describes the use of TM Forum ODA assets (Open Digital Architecture) (such as Open APIs, API Data Model and service payload) to expose & manage the lifecycle of the domain capabilities (network technologies, media, applications, etc.) as services i.e. NaaS.

These guidelines describe best practices for – which approach to take in different circumstances and develop a framework solution across systems, processes, data, and people utilizing standards, and policies, while putting compliance mechanisms and measures in place. It also explores NaaS' relationship with Autonomous Networks (AN) including E2E Network Service Orchestration and Closed Loop Automation.

## System Integrator (SI) as a catalyst

CSPs find enormous value in Time to market (T2M). This brings focus on timings for network service order fulfillment and activation to be in minutes and not weeks. Network performance and quality must meet the demands for both users and applications (dynamic and always-on).

While choosing a NaaS SI partner, CSPs should certainly consider the one which fits to be a strategic partner to achieve CSP's NaaS oriented business objectives, a trusted partner that understands CSP's business, architecture, and infrastructure.

SI should look at NaaS engagements with a view that it offers a sweet opportunity to drive innovation in network



technology, and operational efficiency through automation and centralized orchestration.

SI should be able to showcase and drive end to end NaaS lifecycles right from setting up the network through NFV to the customized offering to enterprises and other customers on demand basis, navigating them in their transformation journeys.

Third party NaaS vendors provides completely virtualized NaaS offering built on top of the infrastructure of public cloud. SI can help CSP evaluate between the options of do-it-yourself (DIY) NaaS offering or partnering with third party NaaS vendors. Determining factors are must haves, nice to haves, compatibility, future adaptation, elasticity, costing, etc.

SI can help CSPs in collaborating with VNF vendors, OEM suppliers (Original Equipment Manufacturer), hyperscale cloud providers, technology/ software vendors, and also by implementing features to be at par with third party NaaS providers, to deliver measurable objectives –

- E2E NaaS feature set of self-service portals, VNF marketplace capabilities, and automated orchestration of network services
- Incorporating open, vendor-agnostic, programmable, crossdomain orchestrators into NaaS ecosystem to simplify VNF management
- Proactive monitoring and management capabilities
- Solution and partner/supplier ecosystem
- Collaboration on designs and configurations with industry experts and customers
- High skilled SMEs (Subject Matter Experts) as professional services



Below are key challenges CSPs face, and corresponding Infosys value proposition as an SI -

CSP Challenge Areas	Problem Statement	Infosys Value Proposition as an SI
NaaS Vision and execution	Often CSPs lack the internal cultural change and alignment, required for NaaS vision and execution	SI to partner with CSP to define and execute the focused path (vision-goal-architecture- design-implementation) to embrace NaaS ecosystem (which includes solution and partner ecosystem), so that CSPs focus better on innovation and differentiation. This involves knowing which all partners CSPs will need, to drive the enabling architecture, to realise full potential of NaaS.
NaaS Specifications and Standards	Compliance to NaaS specifications and standards	SI to create transformation guidelines driving CSP's implementation of TMF assets like TMF 909 NaaS API Component Suite, IG 1224 & IG1228 ODA flow with NaaS, to do things NaaS way than traditional. Approach would include mapping of API flows, data modeling and specs with API requirements and use cases, based on API principles and best practices.
Enterprise Sales and onboarding	Dealing with E2E life cycle for <i>n</i> number of Enterprise customers	SI to partner with CSP for offering services to enterprise customers, right from sales, design, onboarding, etc. helping them in cost, infra-automation, user experience, etc.
Enterprise customers' engagement with hyperscalers	Cloud hyperscalers have limited VNF expertise and cross domain orchestration and multiple vendor management capabilities. They also lack professional services.	With SI having their channel parterships with cloud hyperscalers, SI can help CSP navigate through monetizable opportunities for their enterprise customers, by bundling NaaS delivery platform with scaled consultation for migrating and consulting services which enterprise customers values.
CSP Portal for their customers CSP Portals lack self service channels required for a true NaaS 'on demand' experience for enterprise customers.		SI to enable NaaS sales engagement for CSP via self-service omni-channels enabling business customers with a digital marketplace with pre-integrated VNFs and application partners, which are crucial to sales acceleration of new 5G business solutions/services.
VNF Onboarding & Integration	CSPs have been slow to move on NaaS services, to add VNF services to networks. VNF vendors are aware of direct selling problems of scaled reach and sales in the enterprise world.	To address VNF onboarding issues, SI to incorporate programmable, open and cross- domain vendor-agnostic orchestrators into CSP's NaaS ecosystem to automate the lifecycle management for network services and simplify the operations. VNF vendors face competition from hyperscalers and DIY enterprises and hence are inclined to go with CSPs, as they see value in developing joint go-to-market strategies with CSPs, reason being sales engagements and enterprises themselves relying on CSPs for orchestration platform and service management.

## Infosys Credential – Case study 1

While working with large CSPs across geographies, Infosys had identified challenges they face around the complex IT spaghetti.

If any of the seemingly major change is introduced, for example – a new prodcut or a bundle, or a new custom offering, or a new network type, or any system or process transformation; there are impacts across E2E landscape.

Changes would be required to the complex IT spaghetti and would require cross functional teams across multiple units to dedicatedly invest resources to deliver the change. This would take endless time, exorbitant costs and would have to be repeated for every such change, howsoever small or big.

Infosys has partnered with various CSPs as SI, to design and implement their NaaS Abstraction Layer using TMF APIs (NaaS TMF 909 API Suite) and Service Catalog model, to address the challenges, achieve a level of 'zero-touch' automation, enabling a standardized way of publishing & consuming networkexposed services. NaaS Abstraction Layer is basically a common point where network services are exposed, controlled, and managed. It addresses the problem of complex and inconsistent exposure of network services, eventually impacting the cost and time to market for network services and offerings, thereby enabling consistency and allowing the rapid discovery & usages of network services.

NaaS Abstraction Layer provides common set of generic service attributes agnostic to the service implementation technology used. This leads to less 'feature' testing time owing to network decoupling.

- BSS/OSS layer abstracted through TMF APIs.
- API gateway used to achieve multi domain orchestration, also allowing to expose capabilities to not only to internal IT, but also to third parties, trusted developers, partners, enterprises, and others.
- NaaS adaptors implemented based on microservices architecture for the underlying domain orchestrators, again interfacing through TMF APIs.



## Infosys Credential – Case study 2

While working for a large US based CSP, Infosys integrated the E2E lifecycle automation of Carrier Ethernet services (MEF E-Line Point-to-Point service example below), orchestrating across partner service provider (SP) over diverse network technology domains shaping up the automated modular ecosystem for the multi-site multi-domain connectivity product.

By integrating MEF LSO (Cantata, Sonata, Legato) with TMF Open APIs, while conforming to MEF Service Definitions, E2E NaaS automation was achieved by partnering and integrating with Ciena and ONAP (Open Network Automation Platform) Domain Orchestration for operational network domains. This enhanced the customer experience and upgraded the operational efficiency, including the smooth inter-carrier service delivery.

EVC (Ethernet Virtual Circuit) order connecting on-net customer site with off-net customer site, as a managed service offering, with a virtual CPE and virtual Firewall provisioned at the site, is the example depicted in below diagram.

- Domain Orchestration from Ciena provides the on-net leg
- Partner SP provides the off-net leg
- ONAP provides the vCPE and vFirewall VNF services





#### **Infosys Solution Offerings**

Below are some of the key Infosys Solution Offerings which CSPs can leverage to drive their NaaS vision to fruition –

#### Infosys Virtual Network Infra Platform

- Infosys Virtual Network Platform is an integrated solution that comes with a variety of tools, automation and templates for complete lifecycle management of VNFs and Container Network Functions.
- The platform enables the CSPs and enterprises to accelerate the dis-aggregation and virtualization of network functions leveraging cloud-native open-source components.

#### **Infosys Network Function Automation**

- Infosys Network Function Automation is an automation framework with inbuilt intelligence for seamless VNF onboarding and lifecycle management.
- Infosys Network Function Automation enables CSPs to provide a standard-based approach that automates the VNF onboarding process and minimizes its complexity.

#### Infosys Next Generation OSS (NGOSS)

- NGOSS offers a modern, highly agile, modular, and scalable OSS framework for CSPs to expedite the business needs of today's agile, cost-conscious and competitive telecom environment.
- Infosys OSS digitization process follows the principles of TMF ODA, open APIs and ZOOM. When complemented by adoption of open source technologies, this framework empowers CSPs to transform their legacy OSS to NextGen OSS.

#### **Infosys Smart Network Assurance**

- Infosys Smart Network Assurance (ISNA) is a NextGen Al/MLbased closed loop assurance solution that has the capability to predict through ML, self-heal through automation and manage networks through insights.
- ISNA provides predictive automated maintenance of networks, thereby enabling customer-centric & analytics-driven digital network operation centers. It helps CSPs achieve high availability of network services & OpEx improvements supporting use cases on latest of SDN, 5G and IoT..



## Conclusion

Against its popular belief that NaaS is just another channel or stack of 'operations + network' to sell new age communication services, and that of NaaS is just a way for CSPs to offer services dynamically, it's much more than that.

It's fundamentally more of a transformational framework which leverages multiple facets like modularity, abstraction, open APIs, standardization, orchestration, and automation enabling true digital transformation resulting in customizable possibilities where network services can be configured and adapted.

Many of the Research and Market Intelligence firms have reported shift for enterprises, away from capex and licenses model to *as-aservice* and subscription model. This is what the future holds for NaaS. As we see cloud adoption accelerating, network virtualization will also be picking up.

NaaS objective must be core to any of the CSP's transformation and revolutionization goals, as well as product offering portfolio. The

success which laaS and PaaS providers had will be replicated by CSPs by offering NaaS. Enterprises will be digitally ordering network infrastructure components from a curated menu, as per their business needs, and get them delivered and managed in hours.

Situation now have evolved in such a way that enterprises are now ahead of the curve and are ready to consume NaaS (read new revenue), but CSPs seems to be lagging in terms of NaaS readiness, offering and strategy for digital delivery. CSPs should partner with **System Integrators** to accelerate and accomplish their NaaS objectives.

NaaS is not an all or nothing proposition, NaaS adoption is a journey unique to each CSP where they need to work with trusted partners to achieve NaaS specific goals, while ascertaining their role. It's certainly not the end but means towards future revenue growth.

For the propagation of NaaS to be a 'win-win' for all, partnership amongst CSP, OEMs, VNF & Cloud vendors, and SI will be the key.

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