

NETWORK AS A SERVICE: ADDRESSING THE FULL ENTERPRISE OPPORTUNITY



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INTELLIGENT OPERATIONS FOR A 5G WORLD.

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Network as a service: Addressing the full enterprise opportunity

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We hope you enjoy the report and, most importantly, will find ways to use the ideas, concepts and recommendations detailed within. You can send your feedback to the editorial team at TM Forum via editor@tmforum.org

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The big picture

Agility has remained an elusive goal for communications service providers (CSPs), but now revolutions in technology are coalescing in a way that makes it possible for them to transform their businesses. Achieving agility is critical because it helps CSPs cast off pre-conceived notions about what they can and can't be and changes the dynamics of how they compete.

Software control, virtualization, cloud, advanced analytics, microservices and open source software all play a role in helping operators be more responsive to customers and increase revenue. As a result, CSPs, their partners and customers have an opportunity to innovate together on new, game-changing services for businesses, such as network as a service (NaaS).

Competition for enterprise dollars comes not just from giant Internet companies like Facebook, Google and Amazon getting into the infrastructure and services business, but also from new, independent network providers leveraging cloud and virtualization to deliver connectivity services that have long been the domain of CSPs.

The current enterprise market opportunity stems from the unfulfilled demand for business-to-business (B2B) services. Preliminary results from a TM Forum survey that is still underway reveal that nearly half of CSP respondents' companies are deriving less than 10% of their revenue from B2B services today.

The promise of NaaS

CSPs hope to see a significant shift upward in that ratio over the next five years, and many believe delivering NaaS could be key. Simply put, NaaS is a flavor of software as a service that allows CSPs to deliver network services and functionality as a managed cloud offering. This could include hosting virtual firewalls or routers, content delivery, bandwidth on demand, or even an entire network as in the case of mobile virtual network operators.

NaaS can operate in 4G, 5G and fixed networks, delivering cloud-based connectivity, architecture, service and business models. It leverages virtual and physical network functions and software control to offer low-cost entry into network services and support, giving CSPs an opportunity to fill a growing need in the enterprise market for quick access to additional infrastructure and connectivity.

At the same time, NaaS promises to re-establish CSPs as the owners of the important customer relationships in the enterprise market when businesses have turned to hyperscale Internet or platform companies for other cloud services. It can put CSPs back at the top of the value chain.

“ The current enterprise market opportunity stems from the unfulfilled demand for business-to-business services. A TM Forum survey reveals that nearly half of CSPs are deriving less than 10% of their revenue from B2B services today. ”

It's about agility

The enterprise opportunity does not end with infrastructure and connectivity. CSPs are already looking to extend NaaS beyond their own expertise in connectivity services to the enterprise sweet spot: value-added services. With the right NaaS platform they can bundle advanced security, enterprise productivity applications, IT services and even internet of things services with cloud connectivity into digital offerings under a common brand.

“Agility is absolutely critical because we are not sure exactly what the services should be or what features the enterprises want to be able to control. But we can have an ‘art-of-the-possible’ conversation about what the service can be,” says Dr. Lester Thomas, Chief IT Systems Architect at Vodafone.

By thinking this way, CSPs can work with enterprises and other partners to create customized solutions that were impractical prior to the development of software-driven networks. There is, however, much work to do to achieve this.

This report examines the current state of NaaS. Read it to understand:

- How NaaS works and why CSPs are excited about it
- How CSPs like Telus, Vodafone, Telefónica and Telstra are deploying NaaS
- Limitations of the technology
- The potential for CSPs to grow their enterprise business
- How 5G impacts the capabilities of NaaS, for the better
- How CSPs can extend NaaS with value-added services

“ Agility is absolutely critical because we are not sure exactly what the services should be or what features the enterprises want to be able to control. ”

Section 1

What is NaaS and why are CSPs excited about it?

Network as a service (NaaS) is not a new concept. It is an idea whose time has come thanks to the maturity of software-defined networking (SDN), network functions virtualization (NFV), cloud, analytics and soon 5G. For now, though, NaaS should come with two definitions: one describing the service as it is employed today and the other, the service it will evolve into.

Today NaaS assembles networking resources, applications and connectivity services delivered by a communications service provider (CSP) and its partners, independent third-party networking providers or internet platform providers, into a single, turnkey software stack that can be consumed as a service and on demand. NaaS users could be enterprises, virtual operators, internet of things (IoT) partners or internal operating companies.

NaaS services can be deployed with a combination of physical network functions (PNFs), virtual network functions (VNFs)

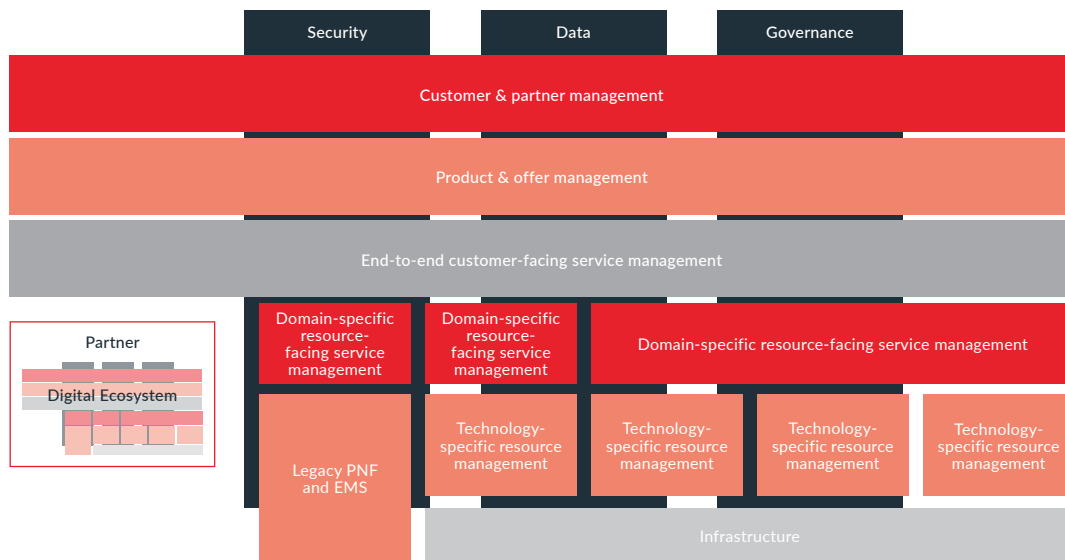
and application services. NaaS offers two ways to deploy cloud connectivity services which can be used separately or together. One is software-defined wide area networking (SD-WAN), which decouples networking hardware from its control mechanisms to simplify the management and operation of a WAN. This service typically is aimed at medium and large enterprises and requires a physical device at the customer's premise. The other is virtual CPE (vCPE), which hosts connectivity functions such as security, WAN optimization and unified communications in the data center with no on-premises device requirements.

“ NaaS assembles networking resources, applications and connectivity services into a single, turnkey software stack that can be consumed as a service and on demand. ”

The NaaS platform acts as a set of service abstractions exposed through application program interfaces (APIs) which hide the underlying network and service complexity. The beauty of NaaS is that it decouples a network service from

the underlying network architecture. The graphic below depicting the **TM Forum Open Digital Architecture (ODA)** shows one way for the management layers to be decoupled.

TM Forum Open Digital Architecture



TM Forum, 2019

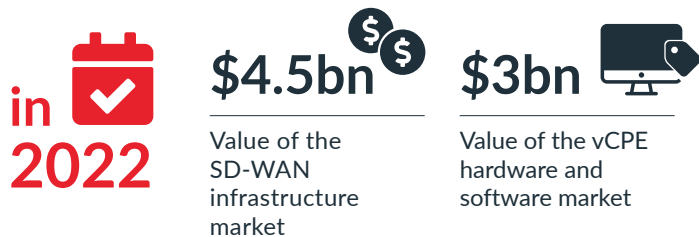
“ The beauty of NaaS is that it decouples a network service from the underlying network architecture.”

NaaS isolates multiple tenants sharing the same infrastructure, which can then be instantiated, operated, cloned, moved or repurposed by the user, as with cloud computing. An important benefit to this abstraction is that it allows CSPs to evolve their network and IT domains independently, in parallel, in order to operate as part of an ecosystem, rather than as intrinsically linked technologies that must be kept in sync through each upgrade or version of their individual components.

The promise of SD-WAN

SD-WAN is already a successful connectivity service with an accelerated growth forecast. In its *SD-WAN Infrastructure Forecast*, IDC projects that the SD-WAN infrastructure market will see a 40.1% compound annual growth rate (CAGR) from 2017 to 2022 to reach a \$4.5 billion market. Likewise, the analyst firm **forecasts** the combined virtual customer premises equipment (vCPE) hardware and software markets to reach \$3 billion by 2022, growing at 44.2% CAGR and 51.2% CAGR respectively.

SD-WAN takes off



TM Forum, 2019 (source for data: IDC)

While healthy, the uptake for SD-WAN has been slower than expected so far, due in part to pricing issues and limitations in offering differentiated services. However, delivering the service through a NaaS platform and business model could increase the pace.

The relationship between NaaS and SD-WAN

SD-WAN presents some performance concerns because even though it can use multi-protocol label switching (MPLS), it often uses the public internet. However, it offers more centralized management and can employ application performance and traffic management policies across the WAN. NaaS takes SD-WAN a step further with the following features:



Faster time to market – Telus, for example, has reported reducing the time between order and delivery for SD-WAN by more than 75% using NaaS; if hardware is in place an order can be turned up in two to three hours (see page 15 for more about Telus' approach).



On-demand services – Like SD-WAN, NaaS allows CSPs to deliver bandwidth on demand, Wi-Fi on demand and Wi-Fi as a service. However, it also offers portal-driven services that enable enterprise customers to manage and visualize all their services and purchase new ones.



A far better pricing model – NaaS allows for network service expansion without capital investment. CBTS, a subsidiary of Cincinnati Bell, **delivered a 55% cost savings** to a Midwest-based auto services company through its NaaS service. One of the primary

advantages in pricing comes from lower-cost cloud access. SD-WAN costs less than traditional MPLS connections because MPLS is point to point and requires more optimization. Also, NaaS enables more options for diverse connectivity and routing, helping users better control costs by selecting lower-priced options when possible by leveraging application-aware traffic management policies.



Ability to support value-added services – perhaps most importantly, NaaS enables CSPs to deliver value-added services such as security and WAN acceleration, and it also helps them extend deeper into the enterprise with software as a service, infrastructure as a service and IoT services. The key to delivering these value-added services and tying them all together through a NaaS platform is network and service orchestration, unified portals and an e-commerce marketplace. In addition, NaaS will continue to support hybrid networks made up of virtual and physical components for some time to come, which means it will continue to support and enhance MPLS, vCPE, SD-WAN and other legacy services.

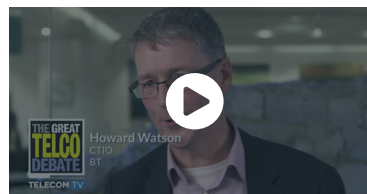
Today CSPs are focusing on NaaS connectivity services such as SD-WAN and vCPE. As they fine tune and automate their connectivity, standardize APIs and succeed in assuring service performance, they can begin delivering more high-value business-to-business (B2B) applications.

Why all the excitement?

Historically there has been an unspoken truth about new

technology capable of motivating CSPs to abandon their comfortable legacy infrastructure: It's never been about enabling great new services nor improving customer experience, though these are often the reasons CSPs give for adopting new technology. Real change has come only with demonstrable evidence that the technology can reduce operating expenses, whether from a reduction in the number of systems or the number of people needed to build, operate and maintain the network.

But with rapidly increasing competition from hyperscale internet providers, reducing costs is no longer enough motivation to embrace new technologies. Luckily for CSPs, the long-term cost savings of transforming to cloud and virtualized architectures has become fairly obvious. Similarly, the profitability of 5G, especially in enterprise markets, is promising enough (see video below) that CSPs can now focus on a new reason for adopting technology: agility.






Watch BT's Howard Watson, former KPN executive Bouke Hoving and Vodafone's Phil Skipper discuss the potential for enterprise 5G






Benefits of increasing agility

By increasing agility, CSPs can focus on delivering customer experience that can be measured and assured. They can also provide the control and self-service capabilities enterprises are demanding. All the CSPs interviewed for this report cited the agility enabled through NaaS as the prime motivator for offering it as a service.

“The hard cash benefits of NaaS are in cost avoidance based on the reuse of components, but the true benefit comes in the more positive effects of building revenue through agility,” says Dr. Lester Thomas, Chief Systems Architect, Vodafone Group.

Agility also enables a more positive, proactive approach to growing business operations, compared to the spirit-sapping practice of forcing engineers to focus on constraining costs by constantly increasing efficiency. The CSPs we interviewed pointed to specific benefits, saying that NaaS helps them:

-  **Provide consistency across all customer channels, which improves the user's experience**
-  **Drastically reduce time to market for large-scale infrastructure and services requirements**
-  **Centralize management of topology, connectivity and services**

-  **Innovate and collaborate to create new services**
-  **Lower the cost of redundancy**
-  **Customize services for multiple verticals and specific markets within verticals**
-  **Match or surpass the flexibility of competitors**
-  **Offer multiple business models**

Together, these attributes can help CSPs better leverage their network assets to deliver connectivity and services wherever needed, for however long. They can deliver NaaS in the access or core network, at the edge, for the enterprise WAN, for public and private Wi-Fi, fixed wireless or in a hosted environment. And all these connectivity services can be enhanced with value-added B2B solutions.

“ The hard cash benefits of NaaS are in cost avoidance based on the reuse of components, but the true benefit comes in the more positive effects of building revenue through agility. ”

NaaS will spur B2B growth

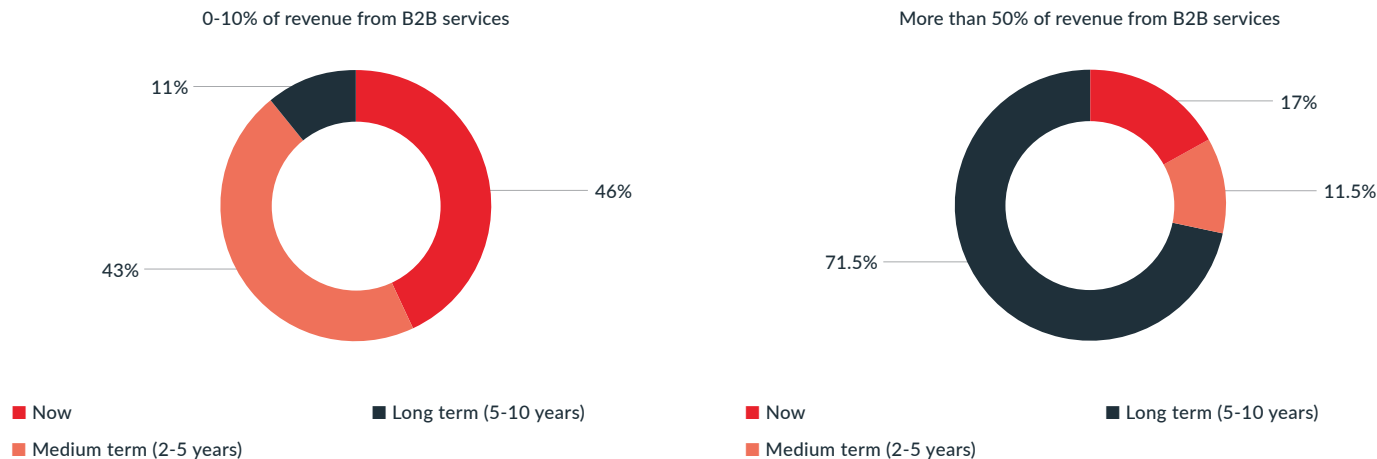
B2B services show great potential for growth, with 46% of CSPs respondents indicating that their companies are deriving less than 10% of revenue B2B services now (see below). NaaS will change this. Indeed, long term more than 70% of CSP respondents expect to generate more than half their revenue from B2B services.

Initially, B2B services delivered via a NaaS platform are primarily connectivity- based, such as SD-WAN, vCPE, and WAN optimization, but as NaaS, 5G, SDN, NFV and cloud

architectures continue to mature, the diversity of value-added services layered on top of NaaS will increase. These include infrastructure as a service (for example, storage, compute and backup); enterprise software as a service, such as productivity applications and IoT or machine-to-machine; and value-added services such as next-generation firewall, quality of service for applications, intrusion detection and prevention; and unified communications as a service.

In the next section, we'll look at some examples of how CSPs are delivering NaaS.

CSP revenue from B2B services



TM Forum, 2019

Section 2

NaaS in action

There are as many ways to deliver network as a service (NaaS) as there are ways to consume it, and CSPs are taking a variety of approaches. This section offers some examples, focusing on how NaaS is increasing agility.

Telus strives for consistency across channels

Canadian CSP Telus was early to market with its NaaS platform in July 2017, launching a software-defined wide area network (SD-WAN) service that customers can manage through a self-service portal. According to CTO Ibrahim Gedeon, Telus was able to deliver its NaaS-based SD-WAN service for 30% less than the cost of the company's existing MPLS service.

Time to market was also greatly reduced. MPLS is notorious for taking a long time to deploy (about 45 to 60 days). Using NaaS, Telus can set up a new branch with connectivity in about 30 minutes.

Improving customer experience

At launch, Telus was targeting mid-market enterprises with fewer than 1,000 employees but since has begun to target larger companies. The larger the enterprise, the more cumbersome and expensive it is to manage daily technology and network operations, according to Dalia Hussein, NaaS Project Lead at Telus, who spoke at Digital Transformation World 2018. So Telus' goal with NaaS was to build a service that was simple and reusable, yet improved flexibility and control and reduced complexity and cost for the customer.

The goal of Telus' transformation is to leverage NaaS to improve customer experience and the operations model while reducing costs. To do this, the company is holding to the following principles:

- Build a digital customer experience which includes a unified, self-service portal
- Deliver touchless product solutions via end-to-end automation
- Provide real-time activation, configuration and reporting
- Use a catalog-driven architecture
- Keep it simple and maintain an agile mindset

Telus NaaS at a glance



Delivering cloud-based SD-WAN



Customers can build and manage their own network through a self-service portal



Prioritizes and routes traffic locally so branch offices can access cloud-based apps directly



Advanced firewall protection



Application traffic management to combat security threats



Backup wireless LTE connection

TM Forum, 2019

Freedom for innovation

Large enterprises want the freedom and flexibility NaaS offers; they want it now, and they want CSPs to work on making it more reliable, hardened and simple, Gedeon says. However, he cautions CSPs to be realistic in setting expectations for enterprise customers. For example, the five-nine's reliability customers have come to expect from telcos can suffer when public internet is introduced as a connectivity option. Gedeon explains:

“People love it until something goes wrong, and something goes wrong with everything.”

But the tradeoff for lower-cost, higher-capacity and more flexible connectivity that can be consumed as a service without much upfront cost is one most enterprises are willing to make. Indeed, one of the most important benefits of NaaS is the freedom the technology gives customers to put the resiliency where they need it and the flexibility to move it around.

In the future, Telus expects 5G to bring NaaS to the fixed wireless market where mobile operators will be able to better support mobile-edge computing (MEC) networks.

“ Large enterprises want the freedom and flexibility NaaS offers; they want it now, and they want CSPs make it reliable, hardened and simple. ”

Vodafone uses NaaS internally first, then aims at verticals

It speaks well of an emerging technology when CSPs apply it to their own businesses first. That's what UK-based Vodafone Group is doing with NaaS. The umbrella organization treats its 25 operating companies as customers by offering NaaS internally, and the operating companies in turn sell NaaS to their enterprise customers.

Vodafone has taken the approach of separating its radio access and fixed access networks from the core, and separating IT and network infrastructure from the services running over them. This lets the company deliver end-to-end services across domains.

Internally Vodafone's use of NaaS increases agility and reduces costs enough to make the business case for implementing it, says Dr. Lester Thomas, Chief Systems Architect, Vodafone Group. The company is adopting a platform approach company-wide that uses [TM Forum's Open APIs](#) to expose resource-facing and customer-facing services. The idea is to take a "black box" approach, so that what's inside the platform can be vendor- or operator-specific, which allows for innovation that can set companies apart competitively.

"We're not setting out to standardize what's inside the platform, but open application programming interfaces will make them interoperable platforms," Thomas [explains](#).

NaaS for enterprises

For external customers, Vodafone is using an ecosystem approach to delivering multi-party infrastructure and services. Thomas refers to this as a "[co-creation model](#)", which allows the company and its customers to collaborate on developing services in a test environment where it is safe to experiment. This model is still in the early stages of identifying specific applications with customers.

A lot of Vodafone's experimental work with NaaS has focused on internet of things (IoT) services, which also leverages the IoT platform Vodafone built two years ago. The [strategic partnership](#) Vodafone announced in February 2019 with IoT technology company, Arm, is one example of how Vodafone is collaborating with partners to develop IoT solutions for enterprises.

Other enticing vertical markets are industrial robotics and warehousing, which will require 5G for automation. ([This article](#) does a nice job of explaining why warehousing will require 5G rather than 4G or Wi-Fi.) Vodafone sees this market as ripe for NaaS in the wireless market.

Both these applications are part of Vodafone's future plans for NaaS, and the company remains focused on its internal use and more traditional enterprise connectivity needs right now,

such as SD-WAN and vCPE. In the meantime, Vodafone hopes to push the industry toward two associated initiatives for future NaaS and 5G: a wider acceptance of open source solutions and tools, and a focus on mobile-edge computing, issues that are critical for CSPs, according to Thomas.

For example, Vodafone has been instrumental in the **TM Forum Business Operating System (BOS) initiative**, which aims to create a reference implementation of the **Open Digital Architecture (ODA)**. Initiated by Vodafone and Orange and supported

by Deutsche Telekom, BOS will use Open APIs to create an interoperable, real-world example of a product catalog and order capture service that members can test against. Vodafone and Orange are championing a **Catalyst proof of concept** to demonstrate BOS at **Digital Transformation World** in Nice, France, in May. One area the team is exploring is how to build a reference implementation of a product catalog containing 5G and edge cloud services. Vodafone, together with AT&T, Orange and Telstra, also has sponsored a Catalyst focusing specifically on how to automate network as a service (**see page 20**).

“ Vodafone is using a ‘co-creation model’, which allows the company and its customers to collaborate on developing services. ”

Telefónica Business Solutions embraces NaaS for transformation

Telefónica Business Solutions, which provides connectivity, digital platforms and ICT services to the B2B sector, made a strong commitment to NaaS by making it part of its digital transformation program. Enterprises are driving the change, asking for more flexible connectivity, digital portals and interfaces, and the ability to order and manage services on demand.

To respond quickly, the company opted for a full-stack transformation with Netcracker. The transformation was significant as it brought IT and networks together, encompassing network virtualization to next generation OSS/BSS with the goal of redefining customer experience. From its full stack, the company now offers advanced cloud security services, IP VPNs, bandwidth on demand and many additional enterprise services.

Speaking about Telefónica Business Solutions' NaaS implementation during [a panel discussion at Digital Transformation World 2018](#), Enrique Blanco, CTIO Telefónica Group, said that that one of the key elements of the project has been to improve speed in delivering wholesale business services.

"We can't just think IT; it's also about the network. It means digitizing end to end. The full-stack solution enabled us to deploy new digital offerings in weeks – a remarkable achievement that has been recognized in the industry," he said. "These capabilities validated our decision to use a full-stack approach, as we have been able to exceed the expectations of some of our most important enterprise customers."



Watch the panel discussion featuring Telefónica's Blanco.

Why full stack was key

Telefónica Business Solutions' decision to transform its entire OSS/BSS and network stack was also driven by a desire for cultural change, which the company felt would help it better focus on customers. Moving to a cloud model has changed the way people work by changing their processes and the technology they use. It also has resulted in automation, more agility and significant cost reduction, although Blanco did not specify how much the company is saving.

The second key benefit has been simplicity. With new digital platforms in place, Telefónica Business Solutions has been able to begin retiring legacy systems, which helps simplify data management and business logic, in part by consolidating into a single catalog for all services.

The solution is now operational, but transformation is potentially ongoing as Telefónica Business Solutions now has the option of turning up other capabilities already in place within the stack. Among other milestones along the way, the company was able to deploy its first virtualized NaaS security offering in just three months.

Proving the concepts and setting standards

Australian CSP Telstra is embracing NaaS architecture as part of a **massive network modernization effort** to transform its network and operational and business support systems (OSS/BSS) and processes. The transformation is a collaboration between the company's network and IT teams to build Telstra's 'Networks for the Future' architecture, which is moving away from traditional physical networks supported by silos of OSS/BSS to virtualized, software-defined networks supported and orchestrated by centralized IT.

Telstra was instrumental in creating TM Forum's new **NaaS API Component Suite**, which aims to automate the end-to-end lifecycle of network services. Component suites are highly cohesive sets of TM Forum Open APIs that support end-to-end scenarios or execution flows across resources. TM Forum already provides a **Customer Self-care Component Suite**, which defines the minimum mandatory APIs required to deliver a self-care service to customers.

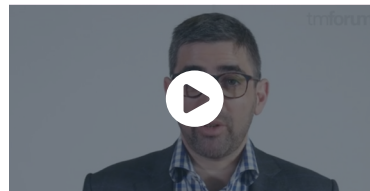
Telstra, Vodafone and other CSPs are hoping to use the NaaS Component Suite to spur conversation among teams and to lead the convergence of Networks & IT. The goal is breaking down the silos that typically exist within telcos, with an overall goal of facilitating an end-to-end customer outcome.

"Today each of the APIs belongs to a different group within IT or Network, and although by investing in standard and open APIs we are reducing our testing, increasing our agility and creating one language, it can still be difficult to break down the silos," explains, Guy Lupo, Network Transformation, Telstra. "The NaaS Component

Suite enables a true solution-oriented, end-to-end conversation, allowing an agile delivery model with one product owner to focus on the customer outcome rather than the different APIs that make it."

Steve Harrop, Principal Integration Architect, Vodafone Group, and Co-leader of TM Forum's Open API Project, notes, "With the NaaS Component Suite, we have focused on the service layer as a result of the NaaS concept spearheaded by Telstra. "This is also of great relevance for Vodafone's work in ONAP and service orchestration, where we have a number of proofs of concept ongoing with vendors and academia."

In 2018, Telstra, Vodafone, AT&T, MEF and Orange championed a TM Forum Catalyst proof of concept called **Automating network as a service**, which leveraged the ODA and Open APIs to expose network capabilities in an open source environment. The team demonstrated products such as Ethernet, SD-WAN and a virtual firewall running in an open source environment could be ordered through a portal and automatically activated across hybrid networks made up of virtualized and physical components. The team's work was key to demonstrating the layers of ODA, from customer management to network resource management, and how the Open APIs can be adapted and used at each layer.



Watch this video
to learn more
about the Catalyst

Section 3

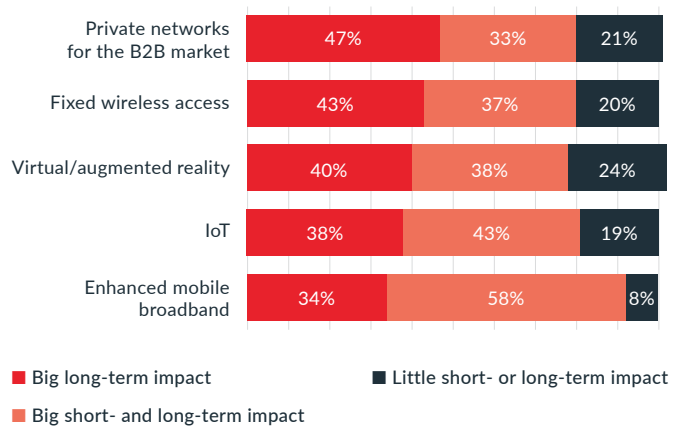
What does the future hold for NaaS?

While communications service providers (CSPs) have high hopes for network as a service (NaaS), prognosticating about their ability to be successful in delivering it to enterprises may be premature because it's closely linked to 5G deployment, which is only in its infancy.

Preliminary results of a TM Forum survey still underway show that operators expect private networks for the B2B market (potentially delivered through NaaS) to be important 5G offerings in the short and long term. Only enhanced mobile broadband is expected to be more impactful.

Operators also expect to see demand for 5G IoT, and it is one of the services most often identified by CSPs as one that can be delivered through NaaS business models, particularly through collaboration directly with enterprises and third-party application developers.

Impact of 5G services on CSPs' businesses

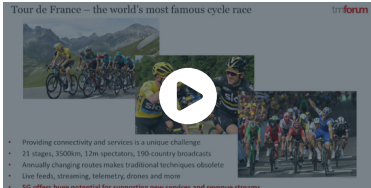


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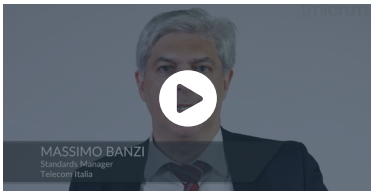
Catalysts for 5G

TM Forum has conducted several **Catalyst proofs of concept** looking at how to deliver 5G services as part of a digital ecosystem that includes vendors and customers as partners. In one pair of linked projects demonstrated at Digital Transformation World 2018, TM Forum members used the Tour de France bicycle race as an example to show how 5G network slices could be dynamically set up and torn down to meet the various (and changing) needs of broadcasters, race organizers and fans.

The **5G intelligent service operations** project, which **won an award** for outstanding communications, concentrated on service delivery, the practicalities of working with slices and how to build attractive service propositions, while the **5G intelligent service planning and optimization** project showed how to plan 5G networks and automate optimization.



Watch the teams discuss their Catalyst projects to learn more



Standards are needed

Although NaaS has been deployed commercially (see Section 2), there is a long road ahead of tightening standards, testing models and automating operations. Says Dave Milham, TM Forum’s Chief Architect, Service Provider Engagement:

“Despite all the effort and progress on open standards, much work remains. Management systems are rarely standard.”

CSPs and their suppliers must address several pressing issues:

- **Standards development for APIs and data models** – APIs are the most essential component of NaaS and any other next-generation network. Standard, open APIs permit the sharing of data between systems without the complex integration and high costs that CSPs have been saddled with for decades. TM Forum, MEF, ONAP and other organizations are coming together to define and test standards for NaaS (see page 20) but it’s early days.

- **Interworking among multi-vendor systems** – large CSPs like AT&T, Orange, Telstra, Telefónica and Vodafone all have included open source software to some degree in their NaaS solutions. Whether this is to prove a point to vendors about being more open and interoperable or because they truly believe open source is the future isn’t completely clear. For now, most CSPs will need to partner with suppliers to deliver NaaS, so work must be done to improve interworking not only among vendors’ network functions, but also between CSPs’ network functions and those of their enterprise customers.
- **Proofs of concept** – although NaaS is technically beyond the proof-of-concept stage for connectivity and into commercial deployment, CSPs will need to demonstrate the ability of NaaS-supported, value-added services to solve the problems of specific vertical markets, and do so with an expedited time-to-market and a lower-than-normal price point. Operators also will have to prove they can provide, measure and meet service level agreements with this new architecture.
- **Automating operations processes** – CSPs cannot invite their large enterprise customers into what can sometimes be an ugly fulfillment process simply by giving them a portal. The underlying processes must work from the point of the customer request through to the service activation and billing without complexity. Given that NaaS operates across several network domains, this automation is ongoing. Only full automation will allow CSPs to realize all the promises of NaaS.
- **5G network slicing activation, assurance and monetization** – as a key feature of 5G, network slicing is getting the full attention it deserves, but not necessarily from the standpoint of assurance, management and orchestration. With perhaps tens of thousands of network slices running simultaneously across network domains, the operations and business processes must be fully automated.

Currently service classes are assigned and mapped onto network slices manually, which simply will not scale.

■ **Incorporating concepts from intent-based networking**

– intent-based management of SD-WAN and NaaS takes the need for automation to a new level. It also raises the stakes for real-time performance data and assurance, as NaaS offerings must continually adjust to meet the intended service quality. Gartner **forecasts** that by 2020 more than 1,000 large enterprises will be running intent-based networks.

- **VNF licensing and partnership management** – providing an on-demand usage model for hybrid network services that are reliant on virtual and physical network functions (VNFs and PNFs) from multiple vendors requires that complex business and licensing agreements be pre-determined in

NaaS. Ongoing partnership management and reconciliation also are necessary, and in order for NaaS to scale, all VNFs must use the same mechanisms and protocols for licensing, calculating usage and sharing usage data. This requires standard licensing management systems.

The better a NaaS platform addresses these issues, the better prepared the CSP will be to reach the next level and begin offering a wide variety of value-added services to enterprises. NaaS is only as agile, or dynamic, as the applications running over it. Applications need to know what resources they need, when they need them, and they must communicate this information to network. NaaS will have visibility into performance and resource availability, but it still has to know the application's intent.

“ Only full automation will allow CSPs to realize all the promise of NaaS. ”

Section 4

Make it happen – Strategies for implementing NaaS

Before considering which steps to take with NaaS, in what order, communications service providers (CSPs) would do well to act like a millennial and consider their relationship status first. In other words, CSPs should not wait for all the complexities of delivering value-added NaaS services to be resolved before actively identifying potential partners and building deeper relationships within the enterprise community. Here are some steps they should take:



Partner with customers and suppliers

With enterprise customers CSPs will find common interest in creating solutions and solving problems. Co-developing applications and services goes a long way toward forming long-lasting, reciprocal relationships. Software vendors have discovered the reality of not being able to solve every problem by themselves and are embracing cooperative partnerships and ecosystems. CSPs should do likewise with their enterprise customers. At the same time, operators should create partnerships with suppliers. In some cases, it might make sense for CSPs to go with a hosted NaaS solution to get to market quickly, as Telefónica has done (see Section 2).

and business support systems (OSS/BSS) that allow CSPs and their enterprise customers to take full advantage of the flexibility, programmability and user control that is possible with NaaS. Look for re-imagined OSS/BSS and management and orchestration solutions that increase automation, leverage near real-time analytics and service assurance, and can equitably enforce service level agreements.



Think about differentiated services

Connectivity services are hard to differentiate beyond some guaranteed level of service. Enterprises want to monitor and generate reports for network performance and usage, and control their services through a unified, self-service portal. CSPs should begin thinking about the next step for NaaS, which is connecting to a digital marketplace that offers value-added services on top of connectivity.



Re-imagine OSS/BSS

Much of NaaS is about infrastructure and connectivity, but these hold little value without agile operational



Embrace abstraction and Open APIs

With NaaS CSPs have an opportunity to move to intent-based management, which abstracts the complexity of the network at a high level and then uses a customer's intent along with assurance, analytics and policy to manage it through open, standards-based APIs, such as **TM Forum's Open APIs**. This delivers the agility CSPs are striving for with digital transformation by enabling flexible interaction between systems in different domains.



Figure out how to monetize NaaS

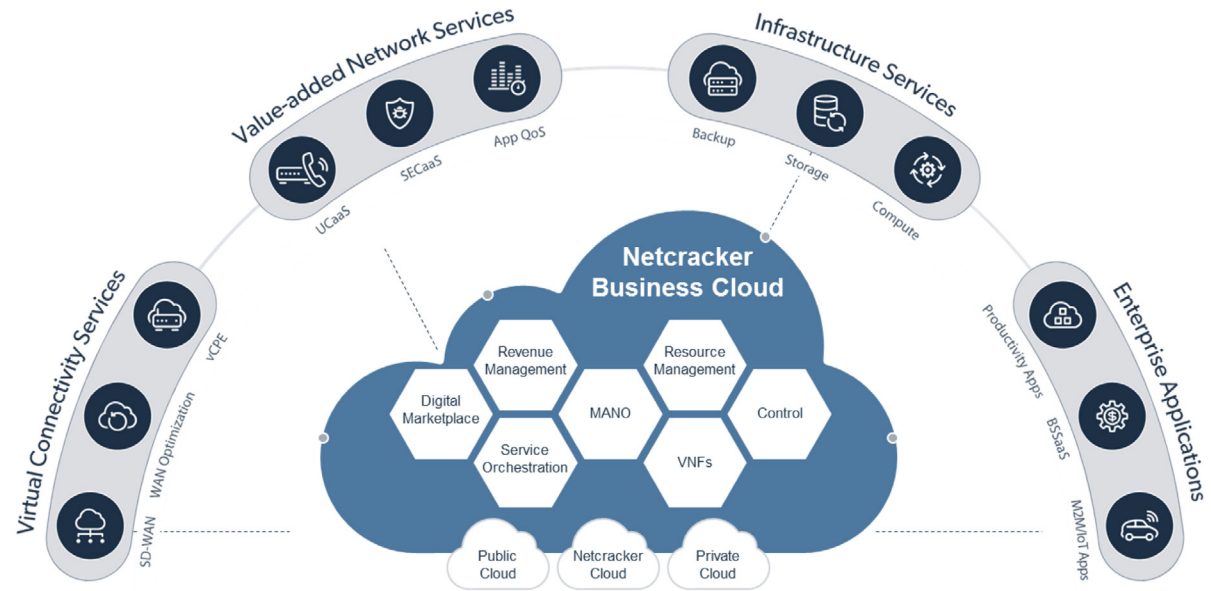
Multi-party services are difficult to monetize in a way that allows all parties to share in the revenue, and virtualization and 'as-a-service' business models only complicate the process. CSPs should look for a partnership management platform that can support real-time charging, multi-party compensation and license management for virtual network functions. They also should ask vendors about their roadmaps for new charging strategies such as blockchain.

Netcracker Business Cloud: A Game-Changing B2B Service Enablement Platform

While the demand for Network as a Service (NaaS) is clear, many service providers are struggling with the pace of technology and organizational change that is required to meet the demanding needs of the digital enterprise. Agility is the goal and has been the focal point of this research paper, and yet there are very few service providers that are truly benefiting from the substantial increase in new business that NaaS promises. Enterprises, however, are not holding back. They have already moved a significant portion of their applications and services to the cloud in order to benefit from increased productivity, improved economics and a faster response to their market needs. They are becoming digital enterprises with high expectations for on-demand, secure and easy-to-access services that enable a sense of empowerment to drive business success.

Netcracker Business Cloud can help service providers realize the full potential of the B2B market with a complete full-stack NaaS platform focused on helping them build and commercialize cloud service offerings for innovative, digital enterprises. By augmenting existing SD-WAN deployments or launching new NaaS services, operators can create real value from their cloud connectivity offers, expanding deeper into the B2B value chain and maximizing agility through automation.

Netcracker Business Cloud brings together the entire SDN/NFV/IT stack—from VNFs to control, orchestration, BSS, OSS, marketplace and self-service portals—and makes it available to service providers



from any cloud environment: public, private or hybrid. The platform is based on a modular cloud-native stack with a microservices architecture that is open and fully standards-based. Its focus is to reduce time-to-market, simplify operations and scale multivendor applications.

Netcracker Business Cloud can help service providers get more value from the B2B market in the following four ways.

- 1. Reduce time-to-market** with a strong ecosystem of pre-integrated partners and B2B cloud services ready to go.

Netcracker has incorporated the leading SD-WAN and value-added services (VAS) vendors into its Business Cloud offering. This means **service providers can get started with SD-WAN and security offerings 70% faster**, as the hefty pre-integration work and creation and testing of VNF descriptors have all been completed. In addition, Netcracker’s solution can orchestrate across multiple SD-WAN and VAS vendors using TM Forum and MEF Open APIs. It incorporates unified license management capabilities, enabling operators to offer their enterprise customers a choice of services based on market demands.

Netcracker Business Cloud: A Game-Changing B2B Service Enablement Platform

Netcracker Business Cloud uses both network and service orchestration functions to automate the full service lifecycle management from onboarding to instantiating, scaling, healing, upgrading and terminating services. By incorporating TOSCA and YANG models, Netcracker can enable enhanced agility within NaaS offerings.

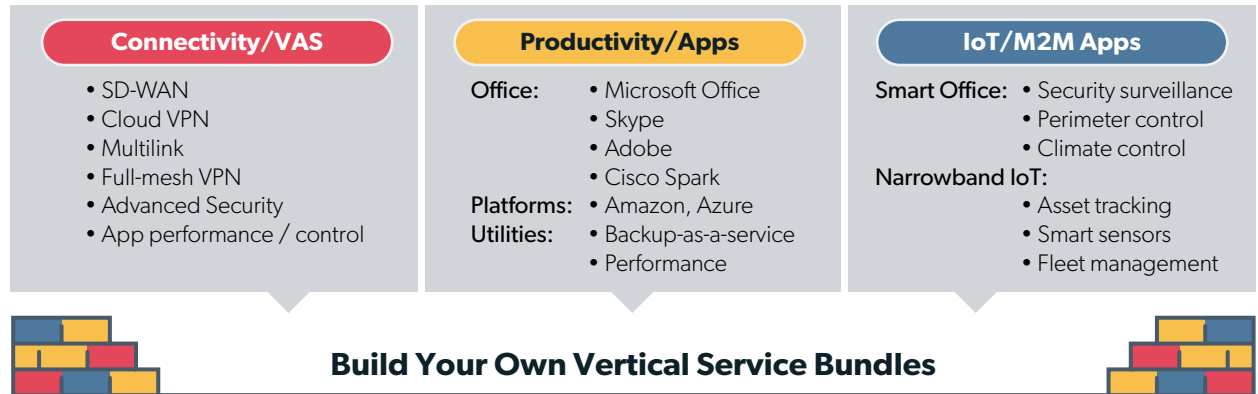
2. Address and monetize bigger service opportunities

by bundling cloud connectivity with enterprise applications.

Netcracker Business Cloud extends beyond the connectivity market with a vast partner ecosystem across many domains including SaaS, IaaS and IoT. **Service providers can expand their addressable B2B market by 40% with high margin services**, becoming a single interface for an enterprise’s application needs with a unified digital experience.

Below is a sample of ready-to-go services that have been pre-validated with myriad partners. These services that can be bundled to create customized offerings that target specific markets, including small business, large enterprise or more specialized vertical markets. Service providers and enterprises can even add their own in-house applications into the service bundle.

The solution leverages open-source technologies, open APIs and service design automation capabilities for fast partner onboarding, helping operators to build



upon their own portfolio of cloud services. Partners can be suppliers, resellers and distributors. Service offerings are made available in a unified product catalog together with the VNF services. Using Netcracker’s Revenue Management solution, service providers can support flexible business models and automate financial settlements between all parties.

3. Deliver a differentiated digital user experience

by giving enterprises control and visualization capabilities from a single GUI.

Netcracker helps service providers offer a new digital experience to their enterprise customers by automating the end-to-end lead-to-cash process and delivering personalized customer journeys. Enterprise customers get full control of their services and a unified experience with the help of two portals—a

self-service portal and a digital marketplace.

Netcracker’s intuitive Self-Service portal provides a single user interface to manage different types of VNF and SD-WAN services from multiple vendors. The portal gives customers more control as well as the ability to define network topology and monitor service performance using analytics-driven visual dashboards.

Netcracker’s Digital Marketplace provides a full e-commerce, catalog-driven shopping experience with configuration, pricing and quotation (CPQ) capabilities for all types of VNF, XaaS and IoT services. The catalog provides unified storage and configuration of cloud product offers, prices and licenses. It allows potential and signed customers to select and configure offerings with just a couple of clicks.

Netcracker Business Cloud: A Game-Changing B2B Service Enablement Platform

4. Leverage flexible deployment models, including hosted/managed cloud services and multicloud strategies.

Netcracker Business Cloud is built on a cloud-native platform with a microservices-based architecture. Operators can choose the parts they need with simplified BSS/OSS integration and full flexibility to interwork with third-party software using open APIs.

For some service providers, however, building and launching virtualized and cloud services that involve complex transformation projects are time-consuming and costly. Operators often need to undergo lengthy vendor selections; get their cloud platforms ready; become familiar with new technology; and test, validate and integrate the solutions with existing BSS/OSS infrastructure. And this cannot be achieved

without reskilling the workforce, changing business processes and making significant upfront investments.

For service providers that need to enter the B2B cloud market faster, Netcracker Business Cloud provides an alternative to building and running their own cloud by delivering the entire SDN/NFV/IT stack as a hosted service. Netcracker can host and run the operator's services in Netcracker's data centers, or in a multicloud environment using the operator's own data centers and public clouds.

This accelerated launch plan means operators can **launch innovative new services, such as SD-WAN with security, in as little as eight weeks.** Given that it typically takes 18 months to deploy and launch an SD-WAN service, Netcracker Business Cloud presents a game-changing alternative for many operators.

Netcracker helps its customers further by providing a portfolio of professional services that can help overcome the commercial, operational and organizational challenges faced during go-to-market (GTM) initiatives. Leveraging its rich experience and deep knowledge in the telecom domain, Netcracker provides a GTM framework that covers all key commercial and operational pillars, including consulting on market offers as well as assistance with sales training, creation of marketing and sales collaterals and execution of customer trials.

Our game-changing approach to the NaaS market with Netcracker Business Cloud helps service providers better compete in the digital economy and provides an important foundation for new 5G services.

“ By augmenting existing SD-WAN deployments or launching new NaaS services, operators can create real value from their cloud connectivity offers, expanding deeper into the B2B value chain and maximizing agility through automation. ”

TM Forum toolkit for digital transformation

Agile & Virtualized

TM Forum Digital Maturity Model

The DMM is a 'living' maturity model and set of metrics to help companies measure their true digital maturity. Members can access a guidebook as well as an Excel spreadsheet containing the actual model. It is also available as an iOS app.

Agile OSS/BSS Toolkit

This toolkit includes a complete blueprint for a platform for managing a multi-vendor hybrid/NFV infrastructure, which includes open APIs, information models, best practices and deployment guides.

Open Digital Architecture

Developed collaboratively by the world's largest telecom operators and their partners, the ODA provides a common operations and IT management 'blueprint'. It combines proven cloud-computing best practices with TM Forum's work on zero-touch orchestration operations and management; digital ecosystem management; data analytics; AI and Open APIs.

Open & Partner Effectively

Open APIs

TM Forum offers more than 50 APIs to manage services end to end and throughout their lifecycle in a multipartner environment.

Digital Trust Challenges and Opportunities Standard

This technical report outlines the key concepts of digital trust and identifies the top seven digital trust challenges.

Monetizing the Internet of Everything Guide

This information guide describes a standardized approach and a monetization template for new, innovative services.

Customer Centricity

Customer Experience Implementation Suite

This set of tools consists of a guidebook, hundreds of metrics, a maturity model, lifecycle model, ROI model and more than 54 implementation use cases.

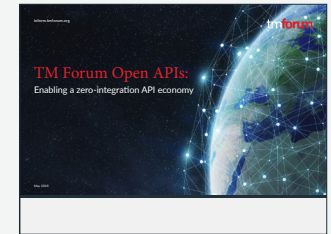
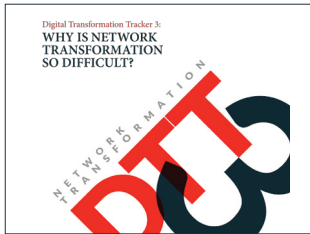
Big Data Analytics Solution Suite

This set of tools includes a big data reference model, a guidebook containing more than 65 use cases and 1700+ pre-defined metrics.

360 Degree View of a Customer

This guidebook offers a 360-degree view of a customer and explains how to put customers at the center of considerations and actions.

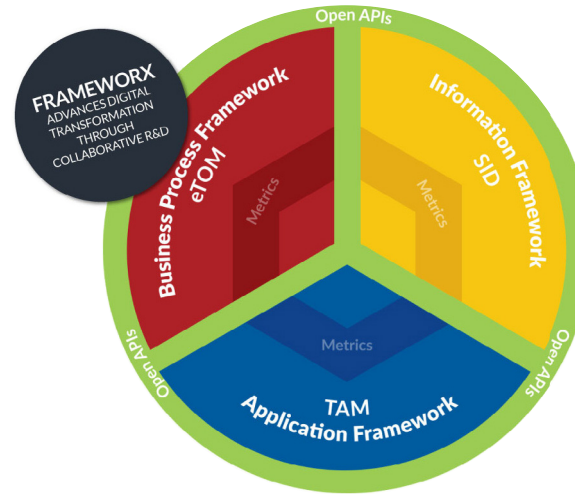
TM Forum research reports



TM Forum Framework

TM Forum Framework is a suite of best practices and standards that, when adopted, enable a service-oriented, highly automated and efficient approach to business operations. Framework provides hundreds of standardized business metrics that allow for benchmarking, as well as a suite of interfaces and APIs that enable integration across systems and platforms. Framework also includes adoption of best practices to help companies implement and use the standards and ensure ongoing conformance.

Framework has been widely adopted and proven to significantly improve agility in IT and operations, resulting in increased margins, lower costs and optimal customer experience. Framework is created and evolved by TM Forum members who participate in the Forum's Collaboration Community.



8 things Framework can do for you:

1. Reduce transformation risk by delivering a proven blueprint for agile, efficient business operations
2. Innovate and reduce time-to-market with streamlined end-to-end service management
3. Create, deliver and manage enterprise-grade services across a multi-partner ecosystem
4. Improve customer experience and retention using proven processes, metrics and maturity models

5. Optimize business processes to deliver highly efficient, automated operations
6. Reduce integration costs and risk through standardized interfaces and a common information model
7. Gain independence and confidence in your procurement choices through conformance certification and procurement guides
8. Gain clarity by providing a common, industry-standard language

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Business Process Framework (eTOM)

The Business Process Framework (eTOM) is a comprehensive, industry-agreed, multi-layered view of the key business processes required to run an efficient, effective and agile digital enterprise.

6 things you can do with the Business Process Framework:

1. Create a common language for use across departments, systems, external partners and suppliers, reducing cost and risk of system implementation, integration and procurement
2. Adopt a standard structure, terminology and classification scheme for business processes to simplify internal operations and maximize opportunities to partner within and across industries
3. Apply disciplined and consistent business process development enterprise-wide, allowing for cross-organizational re-use
4. Understand, design, develop and manage IT applications in terms of business process requirements so applications will better meet business needs
5. Create consistent and high-quality end-to-end process flows, eliminating gaps and duplications
6. Identify opportunities for cost and performance improvement through re-use of existing processes and systems

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Information Framework (SID)

The Information Framework (SID) provides standard definitions for all the information that flows through the enterprise and between service providers and their business partners.

5 things you can do with Information Framework:

1. Reduce integration costs by adopting standards-based models and using them in applications and interfaces
2. Save hundreds of design hours by starting with a mature framework and 1,500 entities developed and vetted by subject matter experts
3. Speed time to market by using well-understood integration interfaces, eliminating the need for data translation between systems
4. Avoid wasting precious development time on debates with your team, partners or vendors by adopting a widely proven, industry accepted, rich and extensible information model
5. Mandate conformance to the Information Framework and save time and money during vendor evaluation and procurement

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Application Framework (TAM)

The Application Framework (TAM) provides a common language and means of identification for buyers and suppliers across all software application areas.

5 things you can do with the Application Framework:

1. Streamline procurement by using common definitions and language to specify and evaluate solutions
2. Document and then rationalize your application inventory during transformation projects or mergers and acquisitions

3. Integrate faster and with lower costs by defining and clearly communicating the functions provided within each application
4. Reduce custom development costs with modular, standard application requirements
5. Increase automation and efficiency with standard, deployable components

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Open APIs

TM Forum's 50+ REST-based Open APIs have been developed collaboratively by communications service providers (CSPs), government organizations and their partners. When used internally, the Open APIs help companies transform their IT, increase operational agility and improve customer centricity. Externally they enable end-to-end seamless connectivity, interoperability and portability across complex digital ecosystems.

To date, 45 of the world's leading CSPs and technology suppliers have signed the Open API Manifesto publicly demonstrating their endorsement of TM Forum's Open APIs. CSPs that adopt the Open APIs can position them as a preferred requirement in their IT requests for proposal, and technology partners can commit to using the Open APIs in relevant product applications. Together they can unlock many growth opportunities, including

dramatically improving business and IT agility, reducing the cost and complexity of operations, and reducing integration cost, risk and time for the entire supply chain.

The Open APIs are often tested, improved and extended through TM Forum's Catalyst Program. Catalysts are proof-of-concept projects that bring together companies large and small to create innovative solutions to common challenges, demonstrating how solutions can be achieved by leveraging key TM Forum best practices and standards. Catalyst teams work on the projects for four to six months before demonstrating them at TM Forum's flagship events.

[Access the Open APIs](#)
[Learn more](#)

Best practices

TM Forum members have collaborated to produce an extensive library of standards, best practices, guidebooks, technical reports and much more covering the most important topics for companies operating in the digital economy.

We have arranged these resources into toolkits by topic. Click on the link below to access the full toolkits and download* all the available resources.

**Downloads are available to employees of TM Forum member companies. Interested in joining as a member? [Click here](#)*

[Access the toolkits](#)

Meet the R&M team



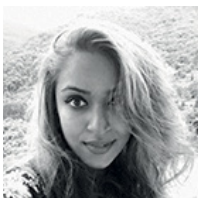
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