

Network automation **USING MACHINE LEARNING AND AI**

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The big picture

For communications service providers (CSPs), creating fully autonomous networks will be a long journey of incrementally automating processes, services, domains and ultimately networks, then securing and managing them with artificial intelligence (AI) and machine learning. Doing this will help operators do more than just compete; it will give them the agility they need to win back enterprise customers, many of whom have turned to digital-native providers for cloud-based services.

CSPs can get started on the road to autonomous networks by making small changes, but these should be part of a bigger, overall plan. Many are already introducing automation in areas of their businesses such as network, IT operations and other business units. Increasingly, however, they need to view automation as an enterprise-wide transformation effort that must be coordinated in order to achieve an end-to-end result.

No choice

There is no disagreement among operators that automation is necessary. The 1 billion IoT devices already connected to mobile networks are too much for management systems to handle, and the number is expected to increase five-fold by 2025, according to the Ericsson Mobility Report. The report also notes that 2.6 billion 5G subscribers will be generating 65% of the world's 160 exabytes of mobile data traffic per month within five years.

It is impossible to provision, activate, monitor and assure devices at such great scale manually. It is also impossible to leverage all the data they produce in ways that can ensure the best user experience – not to mention the daunting challenge of managing the infrastructure and business processes necessary to optimize performance and monetization.

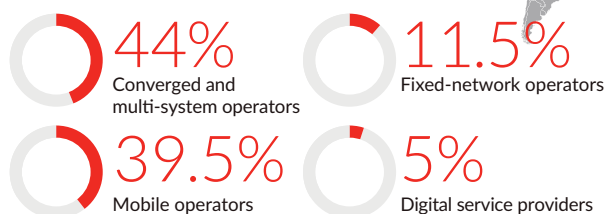
This report assumes that the need and desire to automate telecom networks are givens. The degree to which individual CSPs hope to automate and the path to get there will differ depending on the dynamics of individual markets, available skills, the demands of customers and the complexity of existing network architectures.

Although operators can benefit from incrementally automating existing legacy processes and systems, the autonomous network is not only about evolving the legacy network. It is a revolution that will result in an intelligent, self-managing network that radically transforms how network services are delivered.

Who are the survey respondents?

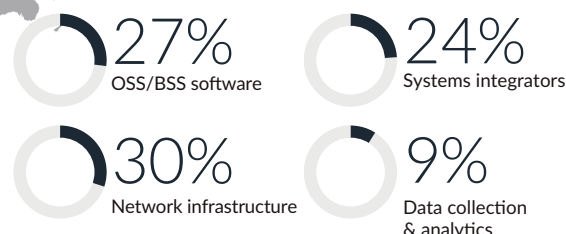
CSPs

44 respondents from companies in every global region



Suppliers

35 respondents



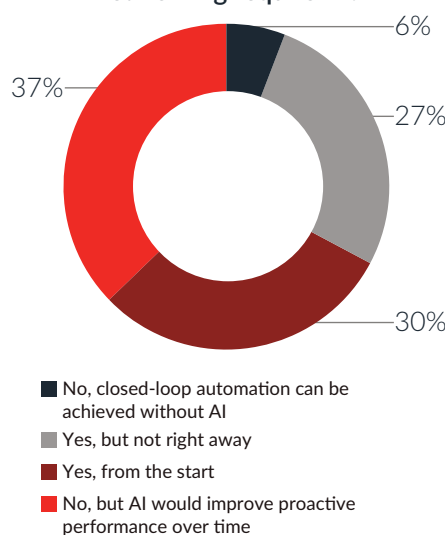
TM Forum, 2019

Research resources

For this report, we conducted a targeted survey of CSP executives and technology leaders involved in digital transformation, operations management and analytics, as well as suppliers and systems integrators supporting them. We received 79 responses, about 55% from CSPs.

The CSPs who participated in the survey hailed from every part of the globe: More than a third were from China and the Asia-Pacific region, while another third were from Europe and/or Russia. The remaining respondents were spread fairly evenly across the Americas, the Middle East and Africa. We also conducted in-depth interviews with additional CSP and supplier executives.

Does closed-loop, autonomous networking require AI?



TM Forum, 2020

Automation & AI

This report focuses on automation *and* AI. According to our survey, CSPs are split over whether AI is required to advance from simple automation to fully autonomous networks, but most believe it will help even if it isn't required. We believe that autonomous networks will, in fact, need AI, and throughout the report we'll explain why.

Automation will be achieved incrementally, but most operators are implementing it in multiple areas of their businesses simultaneously. Some companies are looking to federate these efforts into a single autonomous network initiative, while others are leaving departments and domains (network, IT operations, business) to their own agendas for now. Ultimately, however, it will be important for CSPs to develop a comprehensive, business-wide strategy for autonomous networks.

Where to start?

Each of the following four areas was identified by 10% to 20% of CSPs as a first area of focus for autonomous networking, however, 43% of operators said they are focusing on all four simultaneously:



Self-configuring, self-healing, self-optimizing and self-evolving telecom network infrastructure



Zero-wait, zero-touch, zero-trouble services



The best possible user experience



Full-service lifecycle automation and maximum utilization (from design to creation, fulfillment, assurance and decommissioning)

Interestingly, almost all the CSPs we interviewed for this report said that truly self-evolving infrastructure that relies on AI and requires no human input at all will not happen during their lifetimes, at least not in their networks. One CSP executive said that the last thing he wants is a network that thinks for itself.

Read this report to understand:

- The business drivers for automation and the current state of automation in telecom networks
- The challenges and rewards of implementing automation
- The role of AI in creating autonomous networks
- How to implement automation incrementally
- How autonomous networks can enable innovation
- Why open standards are so important for building autonomous networks, and how industry organizations are beginning to work together to achieve this goal
- Why developing an autonomous network needs to be a centralized, company-wide effort
- Where service providers are successfully applying automation and AI

Section 1

Defining automation and understanding the drivers

The telecom industry is always evolving. Sometimes this means moving from one generation of technology to the next, while other times the change is more foundational, like going from analog to digital or from circuit-switching to internet protocol. The shift to 5G is both, a generational shift in technology and potentially a foundational shift in the way communications service providers (CSPs) do business. Automation can be described as operational shift: It doesn't so much change the fundamental processes of designing, creating, fulfilling, monitoring and managing networks and services as alter how they are implemented in profound and beneficial ways.

As one expert interviewed for this report explains, automation is “a fuzzy word” that’s difficult to define. Is closed-loop automation the same as autonomous networking? Is an automated process governed by policy the same as rules-based automation or simply running scripts? Is AI required for autonomous networks?

Below are some level-setting definitions that are important for understanding the findings and discussions in this report:

 **Network automation** – a recent *MIT Technology Review* report, produced in partnership with Ericsson, defines network automation as “the elimination of repeatable manual tasks and their replacement by programmed tasks automated with the use of software.” Examples include the configuration of servers, scheduling maintenance, and adding or removing services.

Network automation that goes beyond a single server or service to the configuration of several virtualized network functions often requires some orchestration to manage the workflows across the network. A good example of this is Vodafone’s successful test of full automation of its transport connectivity services (see page 16).



Closed loop – Blue Planet, a division of Ciena, offers a good definition of closed loop: “a continuous and repeating cycle of communications between the network infrastructure and software elements, including analytics, policy, and orchestration, to enable self-optimizing capabilities.”



Self-optimizing capabilities – self-optimization takes closed loop a bit further, leveraging closed-loop processes to automatically adjust parameters and configurations to make optimal use of constrained resources such as computing resources, radios, transport and access facilities, and energy.



Autonomous network – fully autonomous networks don’t exist yet, but TM Forum members define them as “providing the service lifecycle on demand with minimal or no human intervention.”

Members are collaborating in the Autonomous Networks Project to develop a common understanding of and consensus about what defines autonomous networks and how to implement them (see page 15). The idea is for autonomous networks to configure, monitor, maintain and repair themselves independently, providing a

fully automated, zero-wait, zero-touch, zero-trouble set of network and ICT services for businesses in many industry verticals and consumers. As noted in the introduction to this report, most CSPs believe that autonomous networks will eventually require artificial intelligence (AI – see below).



AI – the development of computer systems capable of performing tasks that normally require human intelligence. **Machine learning** and **deep learning** are types of AI: With machine learning, computers, systems and machines learn and improve from experience without being explicitly programmed; deep learning takes machine learning further by processing information in layers, where the result or output from one layer becomes input for the next.

CSPs collect huge amounts of network and customer data, the volume and complexity of which is increasing rapidly because of a ballooning number of devices and experience-related data. AI, machine learning and deep learning are becoming necessary to analyze and use this data. **AI in Operations (AIOps)** describes the use of AI technology to automate CSPs’ operations.

Need for skills

CSPs know they need to begin automating greater portions of their networks and accelerate efforts already underway. However, many feel that as network and operations complexity increase, they lack the skills to move forward.

Indeed, a full 82% of CSP survey respondents do not believe they have enough expertise to develop the insights required for automated decision-making and closed-loop operations.

We asked a follow-up question to find out what kinds of tools and/or expertise operators plan to acquire to support automated decision-making. While there is an important place for intelligent network elements in closing the loop within certain domains, CSPs are most concerned about being able to implement end-to-end intelligent network orchestration, which is necessary for automation to work across internal domains as well as across network boundaries (see graphic).

This is important because autonomous network orchestration will be a challenge for software suppliers, just as it is proving to be in network functions virtualization (NFV). Orchestration is not tied to the underlying engines that govern automation within individual domains, which could be rules-based, policy-driven, intelligent devices, machine learning or AI. Autonomous network orchestration must operate at a higher level (think, orchestrator of

Drivers for automation



TM Forum, 2019

orchestrators in NFV) and manage all the domain orchestrators below it.

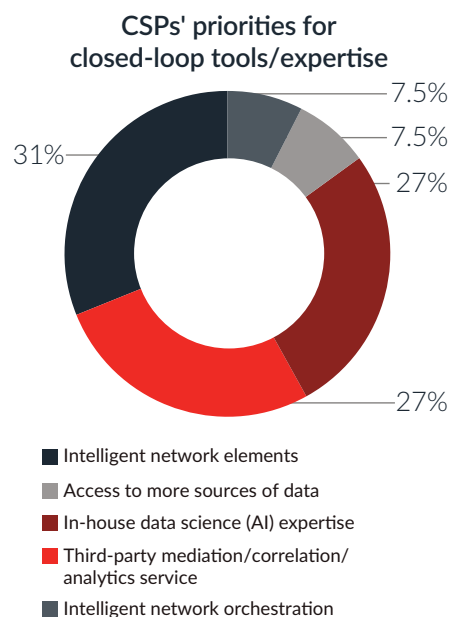
On the upside, CSPs are at least inherently familiar with the concept of orchestration and have internal resources to manage it. Finding talent in data science and analytics will be more difficult and costly.

Why automate?

The need for skills is a new predicament for CSPs that are used to having complete control over their networks, operations and service creation. But disruption caused by bigger, faster, more agile competitors, such as hyperscale cloud providers, is forcing them to transform.

We asked CSPs to rank the top drivers for automation, and faster time to revenue is by far the top priority, with nearly 60% of CSP respondents choosing it as No. 1 (see graphic above). The faster operators can make services commercially available, the sooner they can begin charging for them. This agility and the ability to innovate quickly is a driver for all transformation, not just automation.

CSPs believe automation will drive revenue and reduce costs. Drivers such as faster time to market, supporting real-time services and building out multi-access edge computing (MEC – see panel on page 8) all will increase revenue, while more accurate asset management and staff reduction are obvious ways to reduce costs. Proactive self-healing does both: Revenue results from better uptime, and less staff is required for maintenance.



TM Forum, 2020

Autonomous edge helps CSPs target enterprises

While MEC ranked lowest among the drivers for automation, it is likely to move up the list. Automation at the edge can deliver business value to enterprise customers and help telcos sell autonomous network services to them.

An executive at a European Tier 1 CSP explains that MEC will give telcos an advantage over hyperscale cloud providers that rely on CSP connectivity to reach enterprise customers because telcos can deliver connectivity plus platform-based services.

As Dave Bolan, Senior Mobile Core Analyst, Dell'Oro Group, notes in [an RCR Wireless article](#), the 5G core network is the primary facilitator of MEC:

“Service providers will be able to distribute the user plane function (UPF) to locations that meet users’ need for lower latency. Regional data centers will offer 10-20 ms latency and edge and deep edge data centers will offer latencies of 1 to 10 ms. Combined with network slicing, service providers will be able to custom tailor services for different vertical segments.”

MEC has the potential to reverse the trend of enterprises turning to cloud providers for hosting their apps, especially when it comes to those that have mission-critical, low-latency requirements. CSPs could build an edge-computing platform supported by an autonomous network, upon which they can run not only their own virtual network functions (VNFs), but also customers’ applications.

The idea is that CSPs and their enterprise customers, such as manufacturing companies, could

use the platform to co-create applications that take advantage of 5G and IoT. This is also possible for healthcare, automotive, gaming, media and entertainment, smart city and many other applications.

“

MEC is where CSPs can make a stand,” the Tier 1 CSP executive says. “Creating it is going to give an advantage to the telcos that hyperscalers don’t have and a capability on the edge of the network which cloud providers cannot emulate.”

Telcos have a responsibility to address co-creation, according to the CSP executive. Otherwise, they will be relegated to providing only connectivity.

He adds: “CSPs should not build the edge only for themselves; they should build a generic edge compute platform upon which they can run not only their virtual network functions, but also their customers’ applications.”

He adds that this will require an industry initiative to expose edge-computing assets to developers and others requiring low-latency or highly available connectivity. TM Forum members are exploring this in the [Autonomous Networks Project](#) (see page 15).

NaaS as a driver

Similar to the way edge computing can help CSPs target enterprises, TM Forum members have identified network as a service (NaaS) as an additional driver for autonomous networks. NaaS is a type 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.

Operators interviewed for this report reiterated the long-standing desire of large enterprises and global businesses to be able to access network connectivity services on demand and make changes that automatically reconfigure services to meet their needs. These companies also have been asking for services that automatically adjust to meet the requirements of their service level agreements.

This is a potentially lucrative market. Research firm [Global Market Insights forecasts](#) that the market for on-demand NaaS will reach \$50 billion by 2025, growing rapidly at a compound annual growth rate of 35% between 2019 and 2025.

Co-creating services

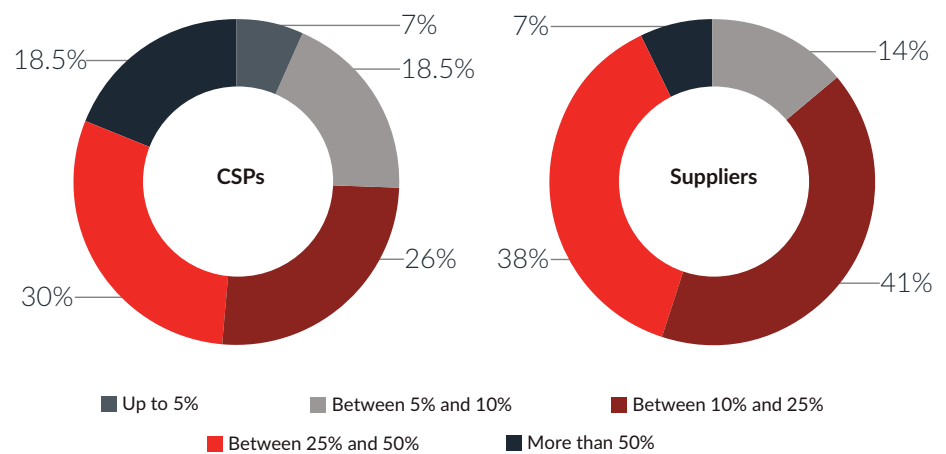
CSPs' willingness to partner with enterprise customers also extends beyond NaaS and edge computing. A full 81% of CSPs surveyed for our 2019 report *5G: Targeting the enterprise* said they are looking for new ways to innovate, experiment and co-create with enterprise customers.

Automation throughout the lifecycle of services is key to making this happen, and it's particularly important in the customer onboarding process. Several TM Forum Catalysts have explored zero-touch partnering. One [award-winning, multi-phased project](#) demonstrated how CSPs can onboard partners instantly without any IT development work using [TM Forum Open APIs](#). The first phase showed how a plug-and-play approach is technically possible using catalog APIs, while a second phase showed how three catalog-driven software products could work together to deliver zero-touch partnering.

Learn more about the Catalyst:



Anticipated efficiency gains from automation



TM Forum, 2020

Increasing efficiency

CSPs are also optimistic about the operational efficiencies they will find through automation. Nearly 20% said they expect to see more than a 50% gain in efficiency (see graphic above). Suppliers are not as optimistic, probably because they are reluctant to promise too much. Only 7% said they expect more than a 50% gain in efficiency.

The earliest and most obvious gains will come from reallocating staff and from network resource management. Automation by its nature reduces the need for manual involvement, but an autonomous network that can fully leverage the promise of virtualization by orchestrating onboarding, configuration and management of VNFs across domains is automation on steroids.

Autonomous networks will significantly reduce the cost of operations by removing the decision-making process for adding a new VNF and automatically verifying that the new configuration aligns with the intended model of the network. Manual processes for troubleshooting the cause of degradation and repairing it are also eliminated ([see panel on page 10](#)).

Where to expect efficiency from automation

A 2019 [report from GSMA](#) shows that nearly 80% of mobile network operators cited reduction in operating expenditure (OpEx) as their top priority for network automation, while [another report from MIT](#) suggests that a reduction of 30% to 50% is possible through automation.

In their *Autonomous networks* white paper ([see page 15](#)), TM Forum members explain that CSPs can expect efficiencies in three areas: operations and maintenance (O&M), energy, and resources.

O&M

Operators can expect savings in three areas of operations based on how proactive they are:

- **Run-to-failure** is the least proactive and requires dispatch of a technician to rectify a problem. Automation allows non-critical repair dispatches to be grouped or assigned by the technician's proximity.
- **Preventive maintenance** monitors the performance of all devices to identify faults and prevent failure. Automation and AI can make this type of maintenance more efficient and accurate.
- **Predictable maintenance** calculates the probability that a device will become faulty, affect service and ultimately fail, then

performs targeted remote maintenance to avoid trouble. Predictable maintenance is expected to reduce the workload required for alarm handling and fault isolation by 90% and predict the failure and degradation of 90% of key components by leveraging AI to learn the characteristics of changes that signal trouble ahead.

Energy

Service loads are modelled using AI in equipment rooms, cell sites and other physical locations to optimize energy consumption for sunlight, temperature and auxiliary facilities such as diesel generators, solar energy devices and batteries. At the equipment layer, dynamic energy distribution is performed based on service loads. If there is no traffic, power consumption is reduced by using various shutdown procedures. An accurate service load prediction model is constructed to balance the traffic on the entire network and achieve optimal energy consumption.

Resources

AI-driven traffic prediction models will be created to schedule network traffic flow determined by actual traffic rather than the physical connections available. This will help operators accurately and precisely predict traffic and help them create an optimal network topology.

radios. We'll discuss the results of the Catalyst project and the Chinese operators' approach to automation more in [Section 3](#).

During a TM Forum [Global Architecture Forum webinar about autonomous networks](#) in November, Orange provided results of an internal study conducted to determine the potential for value creation and efficiency gains from autonomous networks in the areas of operations and maintenance, energy, resource utilization, and applications delivery. The operator expects efficiency gains in several areas as shown in the graphic below.

Autonomous networks value creation & efficiency impact

	Depreciation	21.7%
	Product costs	14.8%
	Employees	13.6%
	Interconnection /circuit leasing	13.4%
	Sales expense	9.9%
	Maintenance	9.5%
	Utilities	5%

TM Forum, 2020 (source: Orange)

AI Ops delivers

Automation is already creating efficiencies for CSPs. China Mobile, for example, has been able to improve throughput across multiple carriers' networks by 14.5% through iterative optimization that enables continuous improvement in its AI-based algorithms. The resulting data has allowed China Mobile to automatically select faster internet speeds for consumers using the same type of device. China Mobile

demonstrated this benefit in the [AI Ops Catalyst proof of concept](#) in May 2019.

China Mobile and China Telecom also reduced energy consumption by 10% during the Catalyst. The reduction was achieved by automatically switching users to lower bands of the spectrum in low-traffic situations and turning off higher bands until needed. Turning off the higher bands not only saves on energy costs, but allows operators to cover a wider area with fewer active

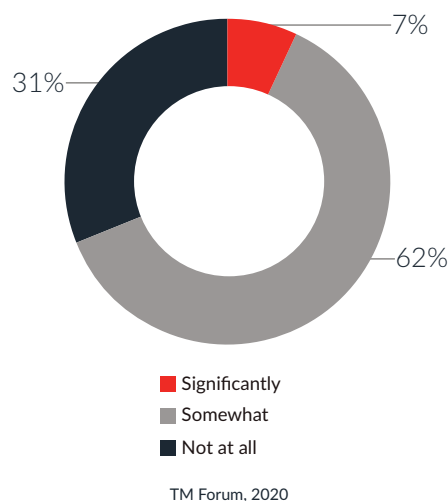
Watch the Global Architecture Forum webinar on demand:

The ripple effect

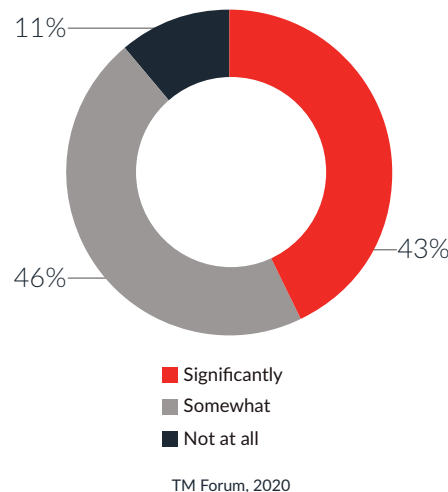
Efficiency and cost savings are important benefits of automation but not as important as driving new revenue. Automation's real promise lies with 5G.

The inability so far to implement closed-loop operational processes has had a negative impact on the rollout of Standalone 5G and the introduction of new services (see graphics). The impact on rollout is moderate, and the primary reasons for the delay are lack of available hardware and CSPs' decisions to allow time for the 5G ecosystem to mature.

How is lack of automation affecting deployment of Standalone 5G?



How is lack of automation impacting CSPs' ability to deliver differentiated, real-time services?



However, the impact on introducing new services is a bigger problem, with 43% of CSP respondents saying that lack of automation impacts their ability to deliver differentiated, real-time services.

Take slicing, for example. Technically, CSPs have been able to create network slices in 4G networks, but they can't create and deliver them automatically across network domains, so they can't really offer slicing as a service. Automation is also important for operators to be able to quickly develop and test potential services.

CSPs also need automation to combine network elements for higher-level services (for example, linking a firewall with an access service to create a secure access service). Higher-level services as well as multi-party services created and delivered through ecosystems of partners can't be delivered or managed manually. They require cross-domain, closed-loop automation.

In the next section we'll look at why automation will be a step-by-step process for CSPs.

Section 2

The evolutionary path to automation

Most communications service providers (CSPs) have introduced some automation into their networks and operational processes. However, automation has seldom, if ever, been the primary driver of any formal, overarching transformation plan. Even as the need becomes urgent, most efforts to automate processes are one-off projects that are not part of an integrated plan. This needs to change, and operator should embrace a multi-level, evolutionary path toward autonomous networks.

In their [white paper](#) (see page 15), members of TM Forum's Autonomous Networks Project lay out six levels of automation, ranging from manual operations and maintenance to fully autonomous networks. The idea is to help CSPs assess their current level of maturity and illustrate how they can progress step by step, with each level building on the capabilities outlined in the previous.

Defining what happens at each level makes the concept less nebulous and helps operators understand when to take the next step. It is unclear whether the highest level of autonomy will be attainable or necessary for all companies.

Six levels of autonomous networks



LEVEL 5 Fully autonomous network

The system possesses closed-loop automation capabilities across multiple services, multiple domains (including partners' domains) and the entire lifecycle

LEVEL 4 Highly autonomous network

In a more complicated, cross-domain environment, the system enables decision-making based on predictive analysis or active closed-loop management of service-driven and customer experience-driven networks

LEVEL 3 Conditional autonomous network

The system senses real-time environmental changes and in certain network domains will optimize and adjust itself to the external environment in order to enable intent-based, closed-loop management

LEVEL 2 Partial autonomous network

The system enables closed-loop operations and maintenance for specific units based on AI modelling under certain external environments

LEVEL 1 Assisted operations and maintenance

The system executes a specific, repetitive subtask based on pre-configuration in order to increase execution efficiency

LEVEL 0 Manual operations and maintenance

The system delivers assisted monitoring capabilities, but all dynamic tasks must be executed manually

TM Forum, 2020

Getting started

In our survey, we provided descriptions of the six levels of automation and asked operators where they are with implementation. The graphic opposite shows that just over half of CSPs feel they are operating at Level 1, meaning they use repetitive subtasks and pre-configured actions but not AI-based analytics and intelligent decisioning. The other half believe they will get there within two years.

When to implement AI?

CSPs are already using AI-driven tools for some processes. Our 2019 report *Future OSS: Towards an open digital architecture* found that nearly half of CSP respondents are using AI to measure customer experience, and within two years, 85% said they will be.

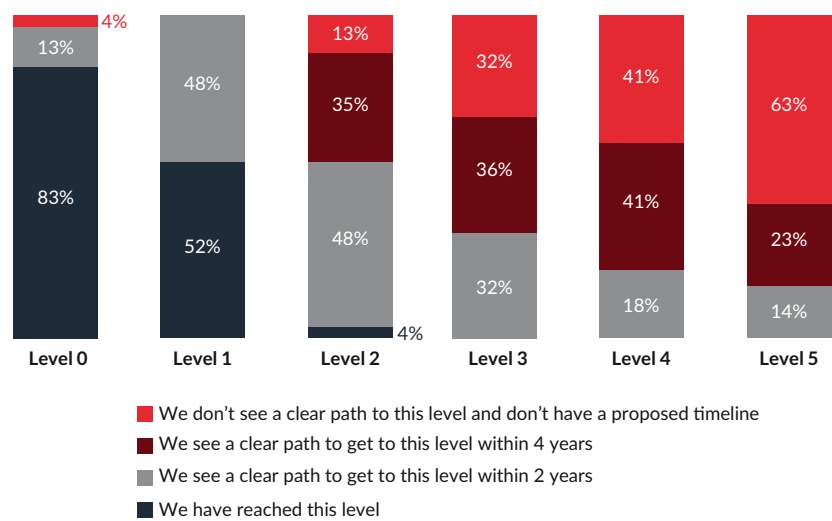
They are also using AI and machine learning to assist network planners and engineers. AT&T, for example, is using machine learning to create a virtual world that describes its outside plant environment (poles, buildings, building materials, foliage, etc.) to determine where to place cell sites without requiring a site visit. The company also applies AI to field maintenance by using deep-learning models to analyze video feeds from drones, which are used to inspect the antennas.

However, these are mostly targeted big data analytics applications, which can only be described as early-stage AI. It is not until Level 3 that AI becomes a necessity in order to sense environmental changes and make decisions based on the intended model of the network.

“The decision-level support is not implemented in an autonomous way, and it does not feel like there is ‘AI inside,’” explains the director of operations transformation at a Tier 1 European operator. “Level 3 would be the beginning of that.”

Until AI is ready to take its place at the center of automated network and service management, a clear path to achieving the upper levels of the

CSPs' progress implementing automation



TM Forum, 2020

autonomous network is hard to envision. Nearly a third of CSP respondents said they don't see one to Level 3, let alone to Level 6.

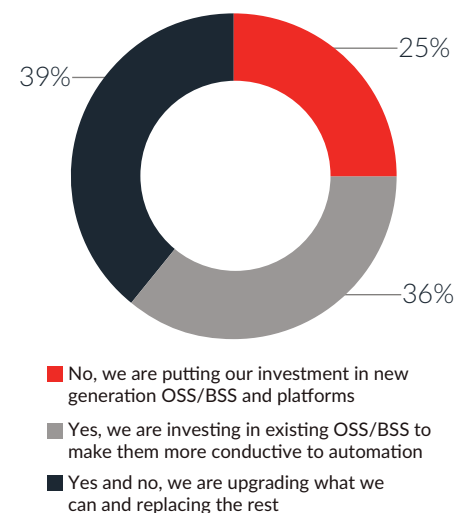
TM Forum's AI in Operations (AIOps) collaboration team is developing ways to use AI in automation processes. One effort underway, which we'll look at more closely in Section 4, addresses uncertainties about how to apply and control AI by implementing checklists, not unlike airline safety checklists (see page 22).

Leaving OSS/BSS behind?

As the industry progresses through several simultaneous transformations, including cloud, virtualization, microservices and autonomous networks, the shortcomings of legacy operational and business support systems (OSS/BSS) become evident. However, most CSPs are not ready to completely abandon these systems because they have made significant investments in them.

Only 25% of CSP respondents said they are halting investment in legacy support systems. In fact, more than a third are investing in them so that they can be incorporated into autonomous networks (by adding machine learning or disaggregating individual functions into microservices, for example.)

Are CSPs trying to automate legacy OSS/BSS?



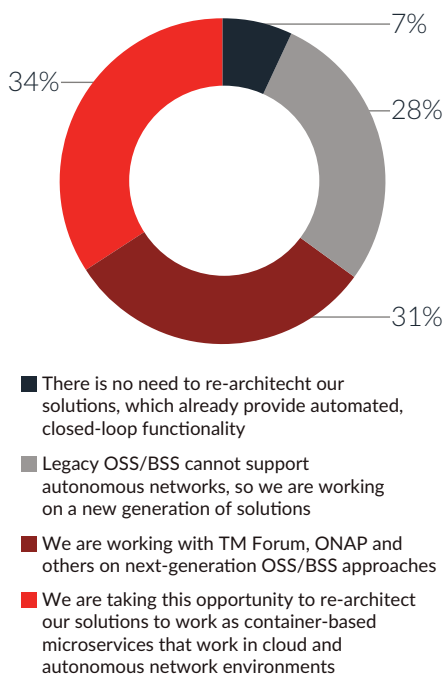
TM Forum, 2020

What about suppliers?

The overall OSS/BSS market is forecast to grow to more than \$50 billion by 2024, about the time CSPs are getting their autonomous networks built. [Analysys Mason projects](#) that CSPs' spending on network automation and orchestration software will grow at a compound annual growth rate of 12.9% through 2022.

The functional components of OSS/BSS will continue to evolve and grow, and be enhanced by new capabilities including AI and automation, but they likely will be deployed as microservices or as-a-service software in a cloud. Indeed, only 7% of supplier respondents said there is no need to re-architect solutions to support autonomous networks, and most of these companies probably are providers of cloud-based systems with no legacy systems to worry about.

Suppliers' approaches to automating legacy OSS/BSS



TM Forum, 2020

Almost a third of respondents said that legacy systems cannot support autonomous networks. The reason it's so difficult to transform them is because they are ingrained, or intertwined, with the processes they were built to support and the practices put in place by the departments that execute these processes.

Start to finish, OSS/BSS feed into and use output from each other to deliver services and support customers. They were built for accuracy, not flexibility, and they were built for a business model that is changing quickly. Bringing these systems into an environment that requires agility above all else has proved difficult, though not impossible. TM Forum's Open Digital Framework can help operators and suppliers develop an evolutionary strategy for reimagining OSS/BSS (see [page 15](#) and [page 29](#)).

It is also a challenge for suppliers to know which emerging technologies they should focus on:

- Should they optimize systems to run under a network functions virtualization (NFV) orchestrator?
- Should they optimize for cloud?
- How can they build in more intelligence and automation?
- Should they risk their competitive advantage and differentiation by disaggregating systems into microservices – and how do they charge for that?

Lastly, legacy OSS/BSS were built to last and cannot all be reconfigured to work in a DevOps environment where they undergo continuous change in order to support new services and new business models. We examined the fast-changing CSP-supplier relationship in depth in our report [*Time to kill the RFP? Reinventing IT procurement for the 2020s.*](#)

Read the report to learn more:



In the next section, we'll look at the progress some leading CSPs have made toward autonomous networks.

Helping CSPs implement and monetize autonomous networks

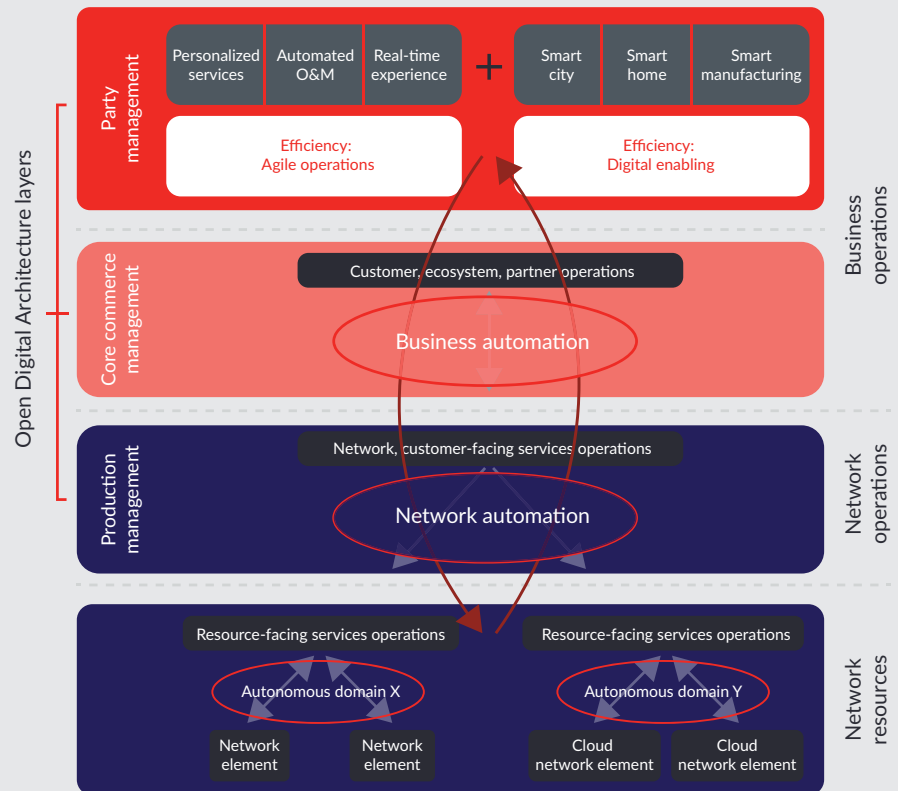
TM Forum's Open Digital Framework, which members are developing through collaborative efforts such as the [Open Digital Architecture](#), [Open API](#) and [Autonomous Networks](#) projects, can help CSPs create an evolutionary path toward cloud-native, software-defined, autonomous networks and operations. By taking it step by step, operators and their suppliers can realize a return on investment in legacy systems, while at the same time benefitting from new technology.

The Open Digital Architecture is fundamentally designed as a component-based architecture, with the business services of a component exposed as a set of Open APIs. The APIs can be, and typically are, further decomposed into a set of services and microservices. The advantage of using microservices is that they can be managed on scalable infrastructure using [Agile DevOps](#) practices.

The Autonomous Networks Project has grown out of work on the Open Digital Architecture. The group got started in May 2019 when BT, China Mobile, Orange and Telstra joined with suppliers Ericsson and Huawei Technologies to coauthor a white paper called [Autonomous Networks: Empowering Digital Transformation For The Telecoms Industry](#). The team, which now includes 7 CSPs and 16 suppliers, is now working on a reference architecture and best practices for self-healing, self-optimizing, self-scaling networks. At the same time, they are looking at how CSPs and their partners can monetize autonomous network services and what the role is for edge-computing (see [page 8](#)).

The white paper, a second version of which will be published soon, describes six levels of autonomous network capabilities, as illustrated at the beginning of this section. In short, fully autonomous networks will use

Layers and closed loops of autonomous networks

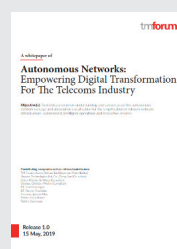


TM Forum, 2020

automation, AI, policy and closed control loops to provision, manage and assure services end to end across an ecosystem of partners.

TM Forum's Autonomous Networks Project is collaborating with standards bodies and open source communities to test many of the concepts through [TM Forum's Catalyst Program](#). The riddle everyone wants to solve is how self-healing and self-optimization will happen in networks.

Read the white paper:



“

“We are looking for patterns so that we don't have to solve the problem for every specific case,” explains George Glass, VP of Architecture & APIs, TM Forum. “It's very important that we be able to describe the patterns in terms of business outcome, because what the customer needs is an autonomous network service.”

If you're interested in joining TM Forum's Autonomous Networks Project, or would like to learn more about the Catalyst proofs of concept, please [contact Glass directly](#).

Section 3

CSPs take steps toward autonomous networks

Most communications service providers (CSPs) have begun automating at least some processes, but they will reap the biggest rewards when they make it part of a strategic plan. This section looks at how leading operators are applying automation and explores some of the market opportunities that come with it.

Early in March, Vodafone Group [published details](#) about a live trial in Italy conducted last fall that demonstrates how a template for automation can be applied to replicate implementation of automated configuration across its multiple national networks (Vodafone has mobile operations in 24 countries and provides fixed broadband in 19 markets). The trial also showed the level of automation possible today.

Vodafone claims to be the first operator to successfully test full automation of transport connectivity services. The work is part of the [Digital Vodafone transformation program](#) launched two years ago to simplify and automate network and IT systems, with an overarching goal of giving customers more control over their services.

Vodafone's template

In a multi-location testing environment in Italy, Vodafone engineers successfully integrated the orchestration of network traffic with software-defined networking (SDN). The resulting template not only provides for consistent implementation of automation across networks, it does so using a single architecture for the orchestration of all the operator's transport networks.

Vodafone successfully enabled:

 **Catalog-driven, intent-based service provisioning**, which automated the design and management of mobile connectivity services traffic between its 4G and 5G radio access and core networks.

 **Use of open application programming interfaces (APIs) between network and business systems** – Vodafone used [TM Forum Open APIs](#), carrying MEF-defined payloads on the northbound interface, and mapping to IETF APIs southbound to control live traffic (northbound interfaces allow network components to communicate with higher-level components, such as business systems, while southbound interfaces allow network components to communicate with lower-level components such as a virtual network function).

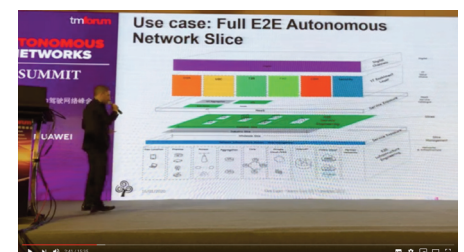
 **Creation of a platform** to abstract and expose complex network capabilities to Vodafone's business and consumer customers.

"The trial brings Vodafone a step closer to allowing business customers to increase the amount of bandwidth in their networks or connect to a new office or worksite on demand," says George Glass, TM Forum's VP of Architecture & APIs.

"The effort also demonstrates the network-as-a-service (NaaS) approach, and it plays into the autonomous networks story over time as it enables the transport network to be configured automatically as opposed to manually," he adds.

TM Forum's Open API Project team is working on API component suites to address specific business challenges such as [management of NaaS](#) and IoT device management. Using the NaaS component suite, for example, operators can create catalogs of "exposed" network services, which they can mix and match to build offers for customers.

Watch this video for an interesting presentation from NaaS evangelist Guy Lupo at a recent TM Forum workshop on autonomous networks:



China looks to AI

As noted in [Section 1](#), CSPs in China are already leveraging artificial intelligence (AI) as they move toward autonomous networks. China Mobile, China Unicom and China Telecom are each nominated for a [TM Forum Excellence Award](#) in the Autonomous Networks & the Edge category.

The GSMA published a [report in October](#) on several use cases in the Chinese market, many of which the operators also have been exploring as part of the [TM Forum Catalyst Program](#) (for example, an intelligent planning robot, root-cause analysis of wireless alarms, intelligent transport network slice management and intelligent service identification).

In January, TM Forum held an autonomous networks summit in Beijing in which China Mobile, China Unicom and China Telecom participated. During the workshop, members of TM Forum's Autonomous Networks Project, GSMA members, representatives from the China Academy of Information and Communications Technology (CAICT), and China's Artificial Intelligence Industry Development Alliance (AIIA) collaborated on requirements and best practices for autonomous networks.

During the summit, China Mobile delivered a presentation on self-driving mining trucks in [opencast mines](#) that helped autonomous trucks operate at 30 miles per hour (because they didn't have to worry about driver safety) rather than 5 miles per hour when driven by humans. The company has been working to automate several processes simultaneously, including self-healing networks, optimization of radio access nodes, resource management, fulfillment, customer self-service and wants to improve customer experience overall and hopes to have these areas fully automated in two to three years.

China Unicom noted that it plans to publish a whitepaper soon on autonomous network capabilities, and the company has established a testbed for evaluating them.

Following are details about the benefits operators in China are realizing from AI and automation:

China Mobile

■ **Alarm aggregation** – China Mobile was experiencing 600,000 packet transport alarms daily, so the company began looking for new ways to troubleshoot issues in its core network. The company implemented an incident-centric approach to alarm management that flagged the primary cause of the alarms rather than all related alerts by using an AI-driven aggregation solution. The result was compression of alarms by up to 99%.

■ **Resource utilization in 5G radio frequency (RF) propagation** – the telco improved 5G resource utilization by automating Massive MIMO optimization. Massive MIMO uses scenario-specific settings for parameters that determine network coverage. These parameters are difficult to set for optimal coverage using current analytics capabilities, but AI-based performance predictions can learn to identify the optimal configuration and enable automatic intelligent optimization. Using AI, RF utilization improved by 6% and aggregate traffic for the MIMO cell increased by 14.2%.

■ **Energy efficiency** – During the [AIOps Catalyst proof of concept](#), China Mobile reduced energy consumption by 10%. In addition, the company is preventing approximately 2 million kilograms of carbon dioxide emissions from entering the atmosphere annually by switching mobile users to lower spectrum bands at low traffic periods and turning off unused high bands until needed.

■ **Throughput optimization** – China Mobile worked with China Unicom and China Telecom to conduct multi-carrier tests of performance optimization. The carriers achieved throughput improvement of 14.5% by automatically selecting faster internet speeds for consumers with the same hardware.

China Unicom

■ **Throughput optimization** – Like China Mobile, China Unicom leveraged AI to improve cell throughput by repetitively feeding new intelligence back into the AI engine to teach it to model the best configuration for optimal network performance. The operator was able to increase throughput by 15%. Next, the company plans to automate configuration changes from either the AI engine or autonomous network orchestrator.

■ **VoLTE (voice over LTE) packet loss** – China Unicom applied AI-based mobile radio parameter optimization to decrease VoLTE packet loss rate by 5%. In this case, a machine learning algorithm was used to establish the correlation between the user's experience of a VoLTE service and network performance indicators. This allowed China Unicom to set radio parameters optimally. The company also was able to reduce the time it takes to isolate faults to just one minute.

■ **5G RAN self-healing** – Using RAN self-healing and autonomous optimization, the telco was able to decrease the workload on network maintenance by 30%.

China Telecom

- **Energy efficiency** – China Telecom achieved 10% reduction in energy usage by intelligently shutting down unnecessary cells, frequency bands and chipsets.
- **Anomaly detection** – the telco used AI-based anomaly-detection algorithms to get early warning for core network signaling storms, achieving 71% accuracy. Signaling storms, which are similar to denial of service attacks in IP networks, overload the network with signaling traffic and decrease experience quality.

Centralizing automation

To achieve the highest levels of automation, CSPs must coordinate all the disparate efforts across their companies. Orange Group, which has operations in 29 countries, began centralizing its automation strategy after realizing that teams working in disparate parts of the organization on individual automation projects were either duplicating efforts or taking different paths toward automation.

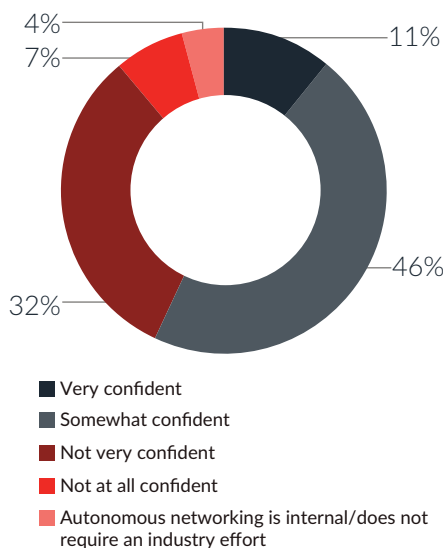
Projects such as developing predictive analysis, reducing restoration time and supporting smart city initiatives needed central oversight, so the company established a single team to lead the company's vision for the future, which includes autonomous networks. An Orange Group spokesman involved in the coordination effort said that all teams now have a better understanding of what the company is trying to achieve. More insight into the company's vision and research efforts can be found on its [Hello Future webpage](#).

Collaboration is needed

End-to-end automation requires coordination between CSPs, and between standards-development organizations (SDOs) and open source groups. In fact, one chief architect working in operations for a Tier 1 CSP in Europe, goes so far as to say that automation will not happen without collaboration.

"Standards bodies are like gentlemen's clubs," he says. "They need to evolve to be more like communities. People are trying to do the right thing, but everyone is doing their own thing. It is starting to change but needs to become more like a community quickly."

CSPs' confidence in industry's ability to develop a reference architecture for autonomous networks

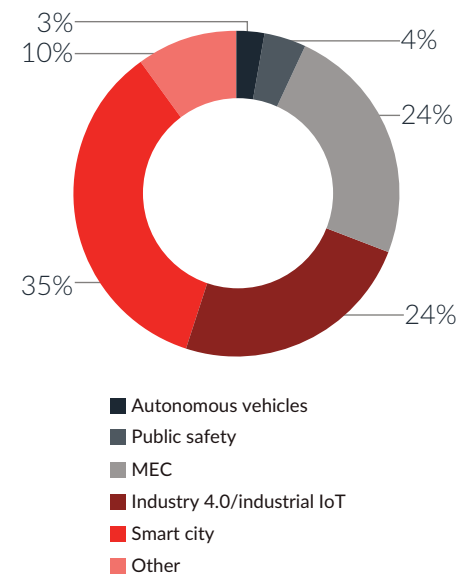


Most of the CSPs we surveyed believe the industry will meet the challenge, but the percentage saying they are not very or at all confident is disturbingly high at 39%. It's unclear whether this pessimism stems from a true or perceived lack of progress. In either case, operators can change the trajectory by getting involved in collaborative efforts around automation and AI.

Market opportunities

As noted in [Section 1](#), two of the top three drivers for autonomous networks are faster time to revenue and support for real-time services. We asked survey respondents which verticals can benefit most from autonomous networks (see below). The kinds of capabilities operators expect to offer to these markets as a result of automation include zero-touch and self-controlled networks and a better overall experience through increased speed, convenience, accuracy and performance.

Best market opportunity for autonomous networks



Among the choices we offered, smart cities and Industry 4.0, or industrial IoT, will rely on ultra-low latency connectivity as well as automated routing, optimization and real-time analytics. Since many new services will be delivered as part of a digital ecosystem of partners, automation will need to be end-to-end across all parties' domains.

Smart cities

Amit Nisenbaum, CEO of Tactile Mobility, a company that provides an analytics platform for autonomous vehicles and smart cities, [notes in a blog for Scientific American](#) that “the urgency of the many challenges facing city environments underscores the importance of smart cities continuing to fuel growth, innovation and cultural dynamism amid this wave of continued urbanization. To do so, they’ll need to harness data analytics, smart infrastructure, sensing technologies and innovation networks to improve civic services, manage day-to-day operations and make cities attractive destinations for capital.”

Here again, Orange is setting an example. Orange Egypt [has been selected](#) to build and operate a data center and cloud computing platform for Egypt’s new capital city, New Cairo. Orange Egypt will provide the main infrastructure to help the city provide various services in conjunction with IoT solutions, cloud computing and AI.

Orange Group is also sponsoring an upcoming Catalyst proof of concept on smart cities, with a special focus on how to implement critical networks in a city environment that includes IoT, security and automation at scale.

Watch this video to learn more about the Catalyst:



Industry 4.0

The manufacturing vertical will be one of the biggest drivers of 5G revenue, offering CSPs a huge opportunity for return on investment. Ericsson [predicts](#) that 5G services for manufacturing will be a \$113 billion market in 2026, representing potential revenue growth of 7% over current service revenue forecasts.

Similarly, Capgemini’s Digital Transformation Institute [forecasts](#) that smart factories could add \$500 billion to \$1.5 trillion in value to the global economy in five years. The consultancy finds that 76% of manufacturers either have an ongoing smart factory initiative or are developing one, yet only 14% are satisfied with their level of smart factory success.

This represents an opportunity for CSPs because manufacturing companies will require specialized services that rely on automation. Manufacturers are willing to pay a premium for enhanced 5G connectivity. For example, 71% of companies said they will pay more for 10 or 100 times faster wireless connectivity, according to a 2019 [Capgemini Research report](#).

Speed is the most obvious attribute 5G and network automation can offer, but CSPs are collaborating with manufacturers to identify other requirements. For example, AT&T recently joined MxD (Manufacturing times Digital), a US-based association for manufacturers formerly known as the Digital Manufacturing and Design Innovation Institute. The telco plans to install 5G mmWave and edge computing technology at the MxD facility in Chicago in order to collaborate with manufacturing companies and demonstrate capabilities.

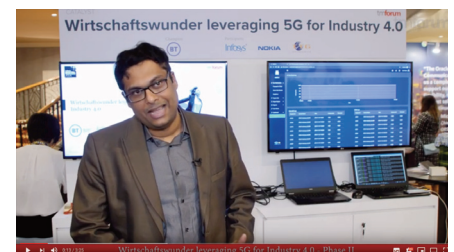
In our recent report [5G future: Targeting the enterprise](#), Tony Papke, Director of Business Development, MxD, said of the AT&T relationship,

“If you look at some of these legacy factories, they are not going to rip up their factories to put in a bunch of Ethernet cable, so having a high-bandwidth, low-latency system – especially with network slicing which can be customized for different use cases – says there is a lot of good potential here.”

As noted in [Section 1](#), MEC will be key in Industry 4.0 applications for data security, minimized processing requirements, low latency and speed. For example, [the Institute of Electrical and Electronics Engineers explains](#) that computing performance in manufacturing machinery is limited in order to focus on precision. The data generated by the machinery needs to be offloaded to the network for processing and storage. MEC can handle this processing without transporting all that data to the core and introducing delay. MEC can also be used to manage security for these machines.

BT sponsored a recent TM Forum Catalyst project called [Wirtschaftswunder leveraging 5G for Industry 4.0](#) demonstrating network management to support Industry 4.0 applications. The team showcased a blueprint for closed-loop automation using real-time network monitoring and the provision of additional 5G network slices via dynamic orchestration.

Watch this video to learn more about the project:



In the next section, we’ll look more closely at the role AI plays in autonomous networks.

Section 4

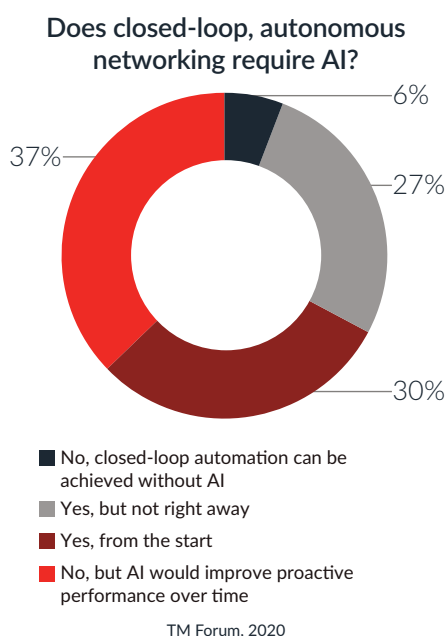
The role for AI in autonomous networks

Artificial intelligence (AI) is not required for automation, but it will be necessary to develop the fully self-healing, self-optimizing, self-scaling networks needed to deliver advanced services. To scale their operations, communications service providers (CSPs) must apply machine learning and deep learning in conjunction with closed-loop automation.

Machine learning and deep learning work by “studying” the algorithms and mathematical models computer systems use to build and refine performance of tasks, without specific coding for those changes. By using AI, CSPs can reduce and potentially eliminate the manual effort required to generate the rules needed for automation.

As noted in the introduction to this report, CSP respondents to our survey are divided about whether AI is required to advance from simple automation to fully autonomous networks (see graphic again, opposite). We suspect the split is due in part to how we worded the question: Does closed-loop, autonomous networking require the application of AI?

Respondents who focused on “closed-loop” in the description probably answered that AI is not necessary, because it is not for simple closed-loop processes in a single domain. However, AI will be necessary to improve automated decision-making and go beyond the limited purposes of single-domain, closed-loop automation to include partners’ domains

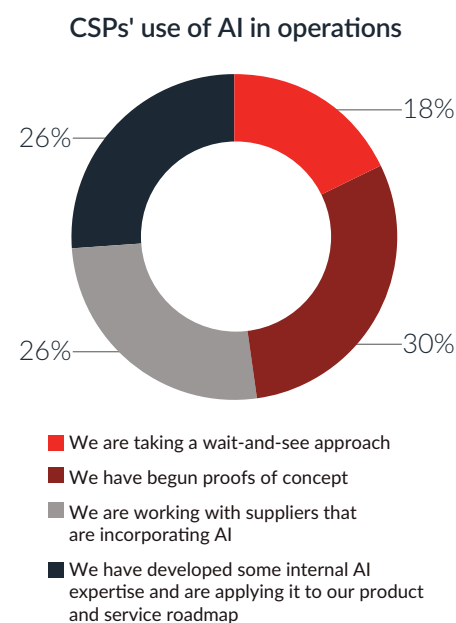


Not ready

It is just as clear, however, that current AI technology is not yet capable of advancing automation in the way CSPs envision. AI systems must be taught how to identify anomalies, and that takes time. It is one thing to learn the usage behavior of a consumer, but it is quite another to learn the radio frequency performance characteristics of a multi-vendor, multi-standard radio network. More CSPs and suppliers need to start teaching AI systems now to advance autonomous networks.

“If you need to learn the behavior of something, you need AI, and I’m not sure the moment has arrived,” says the head of standardization at a Tier 1 European CSP. “Every time people think we are far enough in AI, we realize we are not.”

We asked CSPs about their use of AI in operations (AIOps), and, again, their responses were almost evenly split among the choices we provided, with about a quarter saying they have developed internal AI expertise and a similar percentage looking to suppliers for AI technology.



Inside knowledge

It likely will not be enough for CSPs to partner with analytics firms, because so much institutional knowledge resides with internal operations teams and engineers. CSPs will need to hire employees with AI expertise and train them with institutional knowledge so that the experts understand what they're trying to uncover.

When CSPs talk about hiring internal AI expertise, they typically are talking about data scientists. But they also may want to consider adding other types of expertise. In a 2019 report, *The Harvard Business Review* predicted that AI will add \$13 trillion to the global economy over the next decade. More importantly, the report gave good advice to all types of companies struggling with adopting and getting the most out of AI, encouraging them to identify “analytics translators”.

“[Translators] bridge the data engineers and scientists from the technical realm with the people from the business realm – marketing, supply chain, manufacturing, risk personnel, and so on,” the report states, adding that their role is to ensure that AI applications address business needs and can be easily adopted.

The report estimates that only 8% of firms engage in core practices that support widespread adoption of AI and suggests that most deployments thus far have been ad hoc or applied to a single business process.

Benefits of AI

Many CSPs say they are already reaping the benefits of AI applications developed both internally and by suppliers or systems integrators. A full 91% of CSP respondents said this is having a moderate or significant impact on improving customer experience (see graphic below).

Customer experience is one of the first areas where CSPs have applied AI, and many of the improvements come from using chatbots for customer care. Operators also use AI to analyze customers' behavior.

For more about the use of AI in customer experience, read this report:



Improving capacity optimization ranked No. 2 in our survey (tied with analyzing service performance). This is likely because optimizing capacity provides a quick return on investment by lowering capital expenditure (CapEx). Analyzing service performance will also have a financial impact but its more immediate impact is on improving quality of experience for customers.

Nearly two thirds of CSPs said AI is having only a slight impact or no impact at all on reliability. This is perhaps

because network reliability is already at “five nines” in most carriers' networks, and it is not possible to test end-to-end reliability of closed-loop automation across domains until automation becomes widespread.

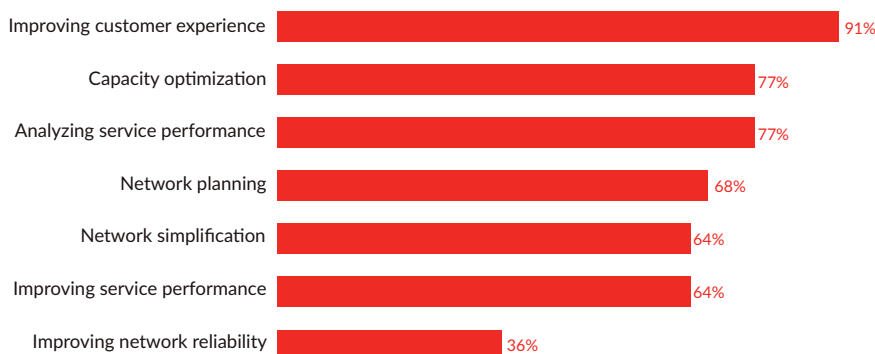
Overcoming barriers

Despite some early wins, implementing AI is not easy for CSPs. When we asked operators about the challenges, inconsistent, fragmented data topped the list, with 61% of CSP respondents citing it as the primary challenge.

Ranking the AIOps challenges



Where will AI have the most impact?

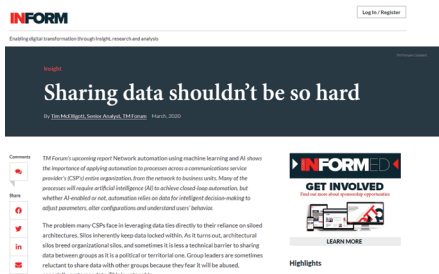


TM Forum, 2020

TM Forum, 2020

Without a comprehensive, company-wide approach to collecting and storing data, inconsistent and fragmented data will continue to be a problem for CSPs that are dealing with huge volumes of structured and unstructured data, data from multiple vendors' network elements and data from myriad end devices. Big data analytics helps, but CSPs need to implement corporate initiatives for not only managing data but also sharing it.

For more about the difficulties of sharing data, see this article on *TM Forum Inform*:



Explainability, or accounting for the decisions made by AI systems, is another problem inherent to the technology, and it affects all types of companies. This *Forbes* article does a good job of explaining the issues: "This inability to understand how AI does what it does also stops it from being deployed in areas such as law, healthcare and within enterprises that handle sensitive customer data."

Lack of explainability also factors into the No. 8 challenge, which is fear that automation will limit control. TM Forum members are addressing these and many other challenges in the [AI & Data Analytics Project](#). For example, CSPs and suppliers have collaborated to identify many AI use cases, a majority of them focusing on AIOps and automation.

Exploring AIOps

As noted in previous sections, China Mobile, China Telecom and China Unicom are already realizing benefits as a result of their participation in [an ongoing TM Forum Catalyst proof of concept focusing on AIOps](#). They sponsored the first phase of the project and [have been joined in two subsequent phases](#) by KDDI Research, PCCW/Hong Kong Telecommunications (HKT), Smart Communications and Telefonica Deutschland. TIM also championed the second phase of the project.

The Catalyst team, which plans to demonstrate the third phase of the project at [Digital Transformation World](#) later this year, has been exploring many use cases to increase efficiency and improve customer experience by optimizing IT processes and operations. Their work has been so useful that it has resulted in a new AIOps workstream within the AI collaboration project.

Watch this video to learn more about the current phase of the AIOps Catalyst:



AI at scale

The new workstream aims to help CSPs implement AI safely and in a way that instills confidence among users. Team members are developing a new AI Open API Component Suite to identify which operations can be governed by implementing AI at scale. The suite covers the management of model contracts, which provide a way to document and enforce the dependencies and constraints that must be observed for an AI system to function correctly. An important part of this is identifying which actions should take place when any of the dependencies or constraints in the model contract are no longer satisfied.

The team also is addressing some uncertainties around how to [apply and control AI](#). Because it would be impossible (and impractical) to develop a massive number of prescriptive processes covering every possible AI use case, the team is developing checklists to establish best practices and standards.

The checklists act much like an airline pilot's checklist, which allows the pilot to validate actions taken by the plane's automated systems. The team is creating checklists for procurement, pre-development, post development, deployment and eventually a system's end of life. The idea is to support practitioners in deploying AI safely at scale by providing lightweight and practical prompts and guidance to ensure that critical processes aren't forgotten at any stage and to increase the quality of AI management and governance.

In the next section, we offer a set of recommendations to help CSPs to get started on the path to autonomous networks.

Section 5

Make it happen – Strategies for maximizing automation & AI

The six levels of autonomous networks defined by TM Forum members are important for several reasons. Foremost, they remove the fuzziness around the concept itself. This is particularly important as artificial intelligence (AI) increasingly is applied in conjunction with automation. The levels also help communications service providers (CSPs) set an evolutionary path toward autonomous networks. Following are steps operators can take now to embrace automation and AI across the business.



Get started

There is plenty of low-hanging fruit when it comes to automation. Automating some processes in network, IT operations and business domains will not only save time and money, but also reduce errors and improve customer experience, long before truly autonomous networks are possible. Each domain has unique opportunities for automation, and CSPs should focus on the ones that can help prove the concept and provide a quick return on investment.

A full 82% of CSP respondents said they don't feel they have the expertise necessary to implement automated decisioning, so acquiring it is a good place to start. Most respondents identified expertise in intelligent network orchestration as a top priority, but it may be better to start with building an understanding of how to apply data to specific processes first, such as RAN optimization or automated energy conservation.

Six levels of autonomous networks



LEVEL 5 Fully autonomous network

The system possesses closed-loop automation capabilities across multiple services, multiple domains (including partners' domains) and the entire lifecycle

LEVEL 4 Highly autonomous network

In a more complicated, cross-domain environment, the system enables decision-making based on predictive analysis or active closed-loop management of service-driven and customer experience-driven networks

LEVEL 3 Conditional autonomous network

The system senses real-time environmental changes and in certain network domains will optimize and adjust itself to the external environment in order to enable intent-based, closed-loop management

LEVEL 2 Partial autonomous network

The system enables closed-loop operations and maintenance for specific units based on AI modelling under certain external environments

LEVEL 1 Assisted operations and maintenance

The system executes a specific, repetitive subtask based on pre-configuration in order to increase execution efficiency

LEVEL 0 Manual operations and maintenance

The system delivers assisted monitoring capabilities, but all dynamic tasks must be executed manually

TM Forum, 2020



Understand the steps

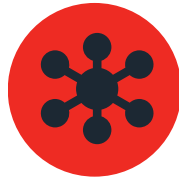
In all automation projects, operators should be clear about which level they plan to achieve. Teams should treat automation as they would a discussion of physical, network or session layers in the [seven-layer OSI model](#). This way everyone understands the scope of the project – for example, whether single or multi-domain capabilities are required or whether a system is expected to be reactive or proactive.



Teach systems

AI modelling, iterative teaching and optimization of intelligent systems will become increasingly important. While there is much industry discussion about reducing vendor lock-in, there is as much talk about CSPs and suppliers evolving toward more collaborative partnerships. Teaching systems how CSPs want their networks and services modeled is a place where CSPs and software and hardware suppliers can work together to ensure all teams are driving toward the same result.

CSPs may not know about teaching systems and AI experts likely don't know much about telecom operations. The output of iterative training will be the model operators use to inform the AI tools how the desired network should look and act. Operators should not wait until Level 3 to start teaching and optimizing systems, and they should begin experimenting with AI at lower levels. This will also provide opportunity to involve traditional operations personnel in new ways of networking in a non-critical environment.



Centralize projects

It is critical for CSPs to centralize management of their efforts to automate and apply AI. They should appoint an executive to oversee a coordinated, company-wide initiative for building a cross-domain autonomous network. As processes in individual network, operations and business domains are automated, teams should create loose couplings between the domains, especially those that may be affected by an automated change occurring in another. For example, order management can have a cascading effect on inventory, or a self-healing instruction to remove a system from service may affect network planning. Once the linkages between automated domains are identified, they can become part of an end-to-end closed loop network.



Collaborate

Advancing a vision for autonomous networks is a lot like advancing a worldview or political agenda: Operators must make their voices heard and demonstrate the changes they want to see. Most of the CSPs we survey and interview consistently explain that they want better collaboration, integration and cooperation between standards bodies and other industry initiatives, as well as between CSPs themselves and with suppliers. There are many collaborative projects focusing on autonomous networks, AI, virtualization and cloud where operators can participate. If you're interested in joining TM Forum's Autonomous Networks Project, please contact [George Glass](#), VP of Architecture & APIs.



Have no fear

Dong Sun, Chief Business Strategist at Futurewei Technologies, and a leader in TM Forum's Autonomous Networks collaboration team, says this about the concerns network operators have about losing control with the introduction of AI-based orchestration of their networks:

“

Everyone knows the systems are very sophisticated, but we set the rules. There is no way AI can control the knowledge or replace a human being.”

That's not to say that all concerns about automation and AI are unfounded. CSPs must figure out how to make AI accountable and explainable in order to ensure security and privacy. “We are worried about the incapability of AI, not the capability,” Sun explains. “We fear the systems are too dumb, not too smart.”

TM Forum members are taking concrete steps to help CSPs manage the use of AI across the business. If you would like to join TM Forum's AI & Data Analytics project, please contact [Aaron Boasman-Patel](#), VP of AI & Customer Experience.

Additional features & resources

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Intraway Symphonica: Accelerating new service launches with cloud-native automation

Mexico's izzi Telecom is pursuing an aggressive growth and expansion strategy. The Communications Service Provider (CSP) delivers high speed Internet, digital television, and voice services to consumers and businesses in Mexico.

izzi's acquisition strategy entails overcoming challenges with heterogeneous networks and operations environments. It also has opportunities to reduce costs by simplifying its multi-vendor environment and reducing its need to engage legacy suppliers to modify BSS systems and process flows when launching new services. As izzi moves forward, it seeks vendor-agnostic, cloud-native solutions, like Intraway's Symphonica codeless automation, orchestration and service activation engine to gain efficiencies and accelerate growth.

Expanding in New Markets

izzi aimed to offer new, premium GPON-based voice and high-speed data services in Monterrey. It had to do so rapidly to seize its market opportunity; its business case required a launch in no more than 6 months. The growing CSP didn't intend to limit itself to Monterrey either; after a successful launch there,

the company wanted to expand its new services nationwide, which meant finding a cloud-native solution that could span its territories.

izzi sought to accelerate its time to market for new services with a solution that would enable any roll out, in any city, to be done remotely and in a highly automated way. The voice and high-speed data provider engaged [Intraway](#) for its Symphonica codeless cloud service orchestration solution, a cloud-native platform that runs out of Amazon Web Services (AWS).

The Power of Intraway's Symphonica

Symphonica delivers a state-of-the-art technology stack, running out of AWS in a Kubernetes-based environment that enables containerized instances to be deployed dynamically. Leveraging event-oriented architecture built on Apache Kafka, Symphonica is highly available and scalable with all components running in active/active mode. It supports asynchronous order

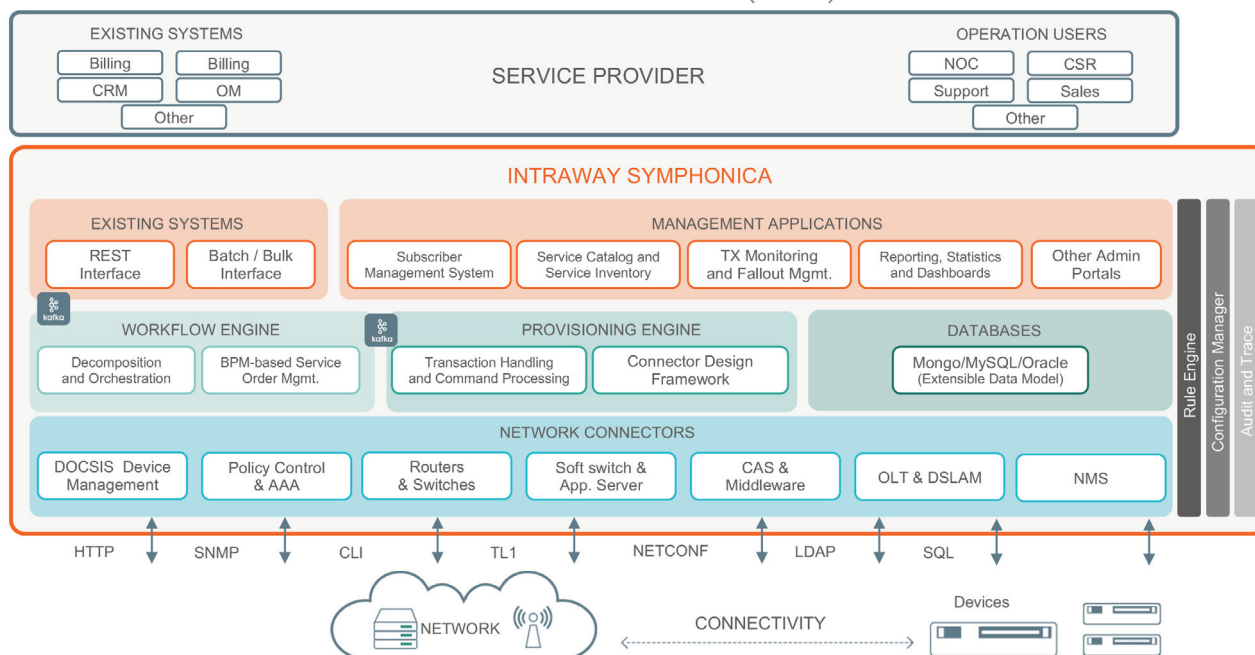
Intraway Delivers Stunning Results:

- Just 3 months to launch HSD and Voice over GPON
- 1 day to deliver initial solution components
- 1 month to add newly acquired FTTH assets
- 1 week to solve OLT multi-session challenge
- Reduced NMS/EMS footprint

processing to guarantee highly efficient resource utilization. Its flexible, cloud-based implementation infrastructure can be deployed in minutes. It supports geographical distribution among its device connectors, greatly reducing latency while enabling load-balancing in each region. Symphonica was developed using state-of-the-art languages like Java with a Spring Boot stack and reuses open components from Netflix like Zuul, Eureka, Ribbon and Hystrix.

Symphonica High Level Architecture

Business Process Framework (eTOM) 14.0



In short, Symphonica is a true, vendor-agnostic, cloud-native solution designed to support rapid growth and change; to meet aggressive time to market demands; and to provide massive cost advantages over traditional and incumbent technologies.

Intraway takes a partnering and trusted advisor approach to every customer engagement. Not only is Symphonica a cutting-edge solution, but Intraway takes responsibility for its delivery; for educating customers on how to maximize its use; and partners with its customers to overcome the unique technical and operational challenges inherent to every operator's IT and network environment.

Implementation

Together Intraway and izzi needed to solve several operational challenges. Integration with two existing systems from different vendors, resulting from previous acquisitions, had to be conducted rapidly as did integration with izzi's legacy BSS. During

implementation, izzi's IT team was eager to complete northbound BSS integration first. But the GPON engineering team was focused on integrating resource-facing services. Intraway was able to address both needs simultaneously, conducting northbound integration while building southbound connectors to deliver an end-to-end solution.

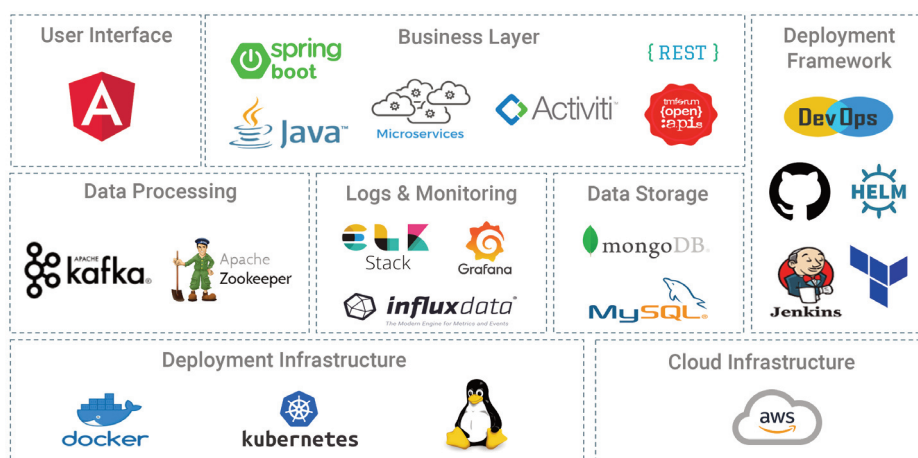
This approach was possible with Symphonica because it enables new NMS and Network Elements to be added in minutes through its design studio. The design studio simplifies the configuration of the southbound connectors through multiple protocols. Symphonica's codeless approach enables its users to create their own workflows using a business process management (BPM) workflow machine. This replaces traditional programming done with an editor and manually typed syntax with a drag and drop interface that provides loops, conditionals and protocol libraries like HTTP, SSH, Netconf and more.

The northbound integration to izzi's legacy systems was another important

challenge to take on. Intraway utilized the TM Forum Application Framework (TAM) to facilitate discussions that helped to adapt legacy functionality to the new solution approach and to define components and entities. This ensured the usage of a common language to define each component's scope, domain and integration.

Symphonica's microservices are also based on functions aligned with TM Forum Open API TMF641 for Service Ordering. The separation of functions allows Intraway to create containers, deployed in Kubernetes, that enable a continuous deployment approach. For northbound integration with izzi, TM Forum Open APIs were used for service ordering, service inventory, and service catalog. Sharing these API specifications with izzi's IT team prior to implementation accelerated the integration process. Migrating legacy services was also made easier by using the TM Forum Information Framework, which provided business entity definitions for service inventory to simplify the migration process and avoid duplication.

Symphonica is Open, Scalable, Standard



Results

The program's results were stunning. High speed data were launched in the third month. Initial components were deployed and configured in the cloud in just one day, with all APIs, modules, and functionalities ready for use in less than 24 hours. Once connectivity was established, connector testing took only 8 hours, including tests executed from Symphonica to different network elements. With connectivity between Symphonica and the fiber service platform in place, the first activation actions were executed in one day, using lab equipment.

While this program was underway, izzi also acquired another FTTH provider. Integration of its assets required only a month by reusing the integration and artifacts already in place. It was also possible to add a new NMS to existing provisioning flows in just three weeks, rather than the three months that would have been required with legacy approaches. izzi's OLT Network Management system faced a challenge with multi-session handling, which Intraway solved in one week, rather than 2 months required with the legacy system. Intraway also eliminated izzi's dependence on third parties for modifying BSS interfaces

with every product launch. By providing an independent means of modifying process flows, with API-based abstraction and its codeless approach, Intraway was further able to reduce cost and accelerate time to market for new services for izzi.

Looking Ahead

As more operators pursue 5G, IoT and other next-generation service strategies, their major growth opportunities will arise from the solutions they can provide over new, high performance networks. In a multi-vendor, multi-network, ecosystem-driven service environment, many disparate vendors will bring their own tools for activation and provisioning. The danger CSPs face is recreating the silos and heterogeneous environments they are transforming to eliminate today. Intraway's vendor-agnostic and cloud-native approach, powered with Symphonica, enables CSPs to escape vendor lock-in, avoid recreating silos, accelerate time to market and gain massive efficiencies. These factors will set a CSP apart from competitors as it expands into new markets and service offerings.

For more information, you can visit Intraway's website at www.intraway.com

About Intraway and Symphonica

Intraway Corporation, founded in 2003, has over 40 million subscribers successfully served in more than 20 countries over three continents. Intraway is a Select Technology Partner in the Amazon Web Services (AWS) Partner Network.

Its Symphonica platform is a cloud-native, codeless automation, orchestration, and service activation engine designed following the five pillars of the AWS Well-Architected Framework — operational excellence, security, reliability, performance efficiency, and cost optimization. It is designed to allow CSPs to automate service lifecycle management without investing in time-consuming and budget-heavy projects.

Symphonica accelerates deployment for GPON, 5G small cells and Remote Phy, with multiple, ready use cases and deployment scenarios.

Symphonica, based on microservices and Open APIs, is aligned with TM Forum and MEF standards. It is deployed on containers managed by Kubernetes which allows the platform to scale vertically and horizontally. Symphonica cloud is the closest CSPs will get to plug and play automation. Operators can simplify traditional onboarding and launch services in accelerated time frames, as Mexico's izzi Telecom has experienced.

TM Forum Open Digital Framework

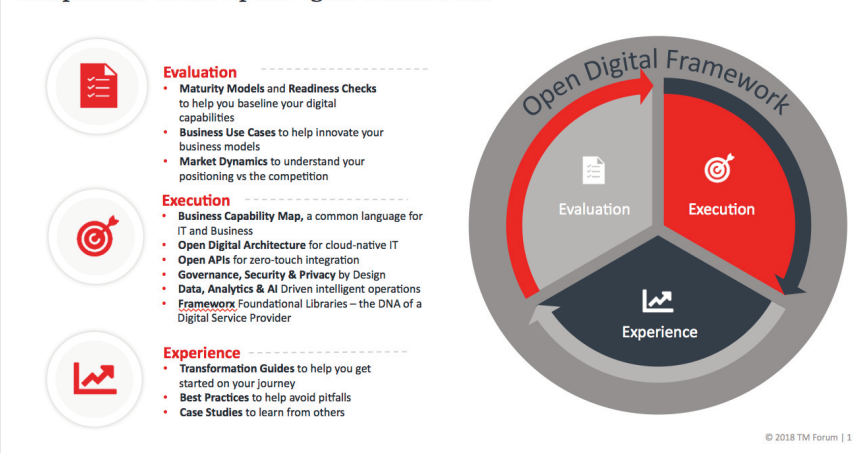
Delivering the tools to go from concept to cash in just 18 days

The [TM Forum Open Digital Framework](#) is an interactive, continuously evolving collection of tools, knowledge and standards that give communications service providers (CSPs) an end-to-end migration path from legacy systems to modular, cloud-native IT components. Simply put, it is a blueprint for service providers to deliver intelligent operations fit for the 5G era.

New online Digital Knowledge Centers will be available soon for TM Forum members to explore. The Open Digital Framework is being developed through the [TM Forum Collaboration Program](#) and [Catalyst Program](#), and builds on the success of the Forum's established [Open APIs](#) and the [Frameworkx](#) suite of standards. Specifically, it includes:

- **Open Digital Architecture (ODA)** – an enterprise architecture blueprint, common language and key design principles for modular, cloud-based, open digital platforms that can be orchestrated using AI
- **Open APIs** – 50+ standardized REST-based APIs to facilitate zero-touch integration and zero-touch partnering
- **Data & AI standards** – an industry-agreed data model, together with standards

Components of the Open Digital Framework



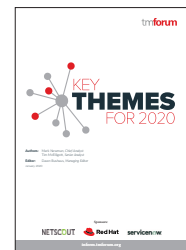
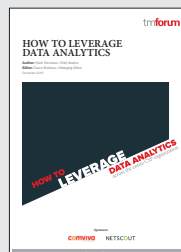
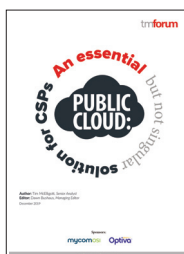
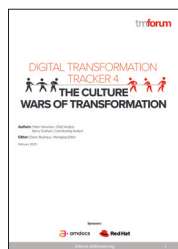
maximizing the potential of AI to enhance customer experience and increase operational efficiency

- **Reference implementations** – a framework for assembling and validating ODA components in the Forum's [Open Digital Lab](#), fostering the creation of a services marketplace
- **Practical guidance** – guides and videos showing how the Open Digital Framework can be used to transform the core business and enable new business growth
- **Foundational libraries** – normalized models providing a common language for business processes and information that simplifies and de-risks transformation projects

The goal of the Open Digital Framework is to help service providers increase agility and drastically reduce the development cycle for products and services from 18 months to 18 days. Much of the collaborative work that is part of the framework is already available, but it helps to organize it and make it more accessible. The framework is a work in progress and will improve through crowdsourcing.

If you would like to learn more about the project or how to get involved in the TM Forum Collaboration Community, please contact [Andy Tiller](#).

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