NFV: WHAT DOES IT TAKE TO BE AGILE?

TRANSFORMING OPERATIONS FOR THE DIGITAL ECOSYSTEM
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Introduction

Communications service providers know they need to be more agile in order to compete, and network functions virtualization (NFV) and software-defined networking (SDN) offer them a way to change underlying infrastructure to make rapid service development and delivery possible. But operating and managing large networks of virtualized network functions (VNFs) while continuing to operate physical networks for some services is going to be challenging to say the least.

In recent years, IT operations teams have turned to DevOps practices to increase agility and reduce the time it takes to develop and deploy new applications. Wikipedia defines DevOps as “a concept dealing with, among other things: software development, operations, and services. It emphasizes communication, collaboration, and integration between software developers and information technology (IT) operations personnel. DevOps is a response to the interdependence of software development and IT operations. It aims to help an organization rapidly produce software products and services.” Since the term can be interpreted in many ways, to avoid confusion this Extra Insights publication accepts this definition.

As the name implies, DevOps is a combination of development and operations: The applications development team continuously writes small incremental pieces of code that are continuously tested on an architecture that reflects the production architecture. As IT organizations have had so much success with this model, many executives are now looking at how to apply lessons learned to network operations (NetOps).

How to transform NetOps

In this primer TM Forum sets a clear vision for what the digital world requires to operate networks made up of a combination of current and virtualized infrastructure. Specifically, the Zero-touch Orchestration Operations and Management (ZOOM) project (see page 4) outlines how to transform from the current NetOps model to an enhanced one that drastically reduces the time and resources it takes to introduce new services, and improves a service provider’s ability to compete in the digital world.
The goal of TM Forum’s ZOOM project is to create a Digital Operations Center of the Future – a living blueprint for a new generation of service provider support systems capable of delivering true business agility.

Through a top-down, end-to-end operational approach, ZOOM complements ongoing work within other standards and collaboration groups including open source communities, to advance orchestration and management of virtualized and hybrid networks.

The project is backed by the world’s largest service providers, including AT&T, China Mobile, Cox Communications, Deutsche Telekom, KDDI, Microsoft, Optus, Portugal Telecom, Sprint, Telecom Italia, STC, Tata Communications, Telekom Srbija, Telefónica, Telenor, TeliaSonera, Verizon and Vodafone. Together with participating suppliers, they are working to address business and technical aspects of NFV, ranging from planning to building and operating software-defined networks.

Key focus areas for the ZOOM project are:

- **establishing requirements for the vision** – focusing on the strategic issues around NFV/SDN adoption, which include procuring, orchestrating and managing virtualized network functions across multi-partner, hybrid networks;
- **planning the transformation** – designing and building the Digital Operations Center of the future;
- **increasing agility** – applying methodologies like DevOps to network operations, product lifecycle management and digital workforce management; and
- **developing the foundation** – continuing to build solid technical foundations including development of information, data and metamodels for end-to-end management.

As part of the Agile Business and IT strategic program, the ZOOM project draws heavily on existing TM Forum assets including the Frameworx suite of tools and best practices. It also draws from the Open Digital program relying on the Digital Services Reference Architecture, Digital Services Toolkit and B2B2X Partnering Step-by-Step Guide.

Many TM Forum Catalyst proof-of-concept projects contribute to this work. So far the ZOOM team has conducted 19 Catalysts. Notably, several of them have shown how closed-loop policy management and big data analytics are needed to handle the scale and complexity of NFV hybrid networks and why automated dynamic, catalog-driven APIs are needed for B2B2X and internal integration. In addition, a Catalyst conducted in conjunction with the MEF delivered a practical implementation of end-to-end management using the Frameworx information model for virtualization.

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NetOps/DevOps tooling can give a wider audience what is needed. This isn’t access to APIs. It’s access to their infrastructure; it’s access to their data – the data that is currently hidden in every fabric and device out there.”

Jason Edelman, Founder Network to Code as quoted in his blog

We will answer the following questions about moving toward a DevOps model for NetOps:

1. Why is agility an imperative for network operations?
2. What are the lessons learned from IT operations?
3. How can your company adopt DevOps methodology for NetOps?
4. What is the organizational impact of adopting a DevOps approach?
5. What should you do next?

To put this publication into context, let’s consider an important ‘user story’:

As a leader in the CTO/CIO organization accountable for transforming my company so that it can take advantage of virtualization, I need to move to an operations approach that supports a dramatically more agile service lifecycle, one that lowers capital and operating expenses and supports continuous service innovation and delivery.

To do this, I need to understand how operations must change so that I can manage hybrid environments.
Virtualization of compute, storage and network resources has many significant benefits for communications service providers: It lowers capital and operating costs and helps them develop new services more quickly; provides just-in-time capacity to meet dynamic changes in user demand for services; and delivers a higher-quality experience for the end customer.

In a traditional environment, implementing services such as network optimization or security is cumbersome because it requires acquiring network appliances and cabling them together in the correct order. Since each appliance has its own unique interface, configuration is a time-consuming, error-prone task.

As we explain in the Extra Insights primer NFV: Can it be managed? The blueprint for end-to-end management, the deployment of VNFs improves this process greatly. For example, it is now possible to dynamically create optimization or security as a virtual function that can be moved around from server to server and rapidly decommissioned when it’s no longer needed.
Adoption of virtual network functions has a dramatic impact on end-to-end management and requires many changes.

Time for change

The adoption of VNFs has a dramatic impact on end-to-end management and requires many changes. (For more information about the changes, see ZOOM’s OSS/BSS futures: Preparing the future mode of operation information guide.) The new tools, models, procedures and culture adopted by the NetOps team must be able to respond. For example:

- End-to-end management systems must be re-architected to support dynamic creation and decommissioning of network functions in accordance with a set of highly granular policies designed to ensure quality of experience for the end customer.
- The fact that VNFs can be dynamically created and moved makes it difficult to identify where a VNF is running.
- In contrast to being negotiated and included in business agreements for network services, service level agreements (SLAs) are likely to be negotiated on the fly as VNFs are chained together or as configurations are modified. (For more about this see ZOOM’s NFV Procurement Survival Kit, which is explained in more detail on page 11.)
- Topology changes, which occur infrequently in a traditional environment, occur frequently in a virtualized environment.
- Setting quality of service goes from being a laborious, one-time manual process to a dynamic process that is repeated as needed.
- The focus on fault management is replaced by a focus on network and application performance.
- In a traditional environment, end-to-end management has to be performed across technology domains. In the emerging environment, end-to-end management happens across technology domains that span both current and virtualized infrastructures and in some instances multiple service providers’ domains.

In the next chapters, we’ll provide guidance on how DevOps processes can help service providers address many of these necessary changes.
One of the problems in traditional software development is how to address the conflicting goals of rapidly deploying new capabilities versus maintaining a highly stable, error-free environment. IT operations teams that have successfully adopted DevOps methodology have managed to overcome this obstacle.

When asked in a recent InformationWeek survey to indicate the level of improvement in application development speed that they had either already gained or expected to gain as a result of adopting DevOps, 41 percent of respondents indicated ‘significant improvement’ and 42 percent noted ‘some improvement’.

To apply DevOps to network operations, it’s important to understand the principles used in a successful DevOps software development environment:

- **Collaboration** – a key aspect of DevOps requires creating a culture of collaboration among all the groups that have a stake in the delivery of new software.

- **Continuous integration and delivery** – software changes are added to a large base of code immediately after development so that new capabilities can be continuously delivered to the entire chain of users for testing and monitoring in production-style environments. The goal is to generate rapid feedback so that defects can be identified and corrected as soon as possible.

- **Continuous testing and monitoring** – testing is performed continuously at all stages of the release process, and not just by the quality assurance team. Developers perform testing and provide test data and procedures that can be used by all collaborating groups.
DevOps requires creating a culture of collaboration among all stakeholders.

The operations group is also typically involved in testing and monitoring. This team can add value by specifying load patterns to make test environments more realistic, and they can monitor continuously to identify service issues and resolve them in near real time. Note that the same set of tools that monitor the production environment can also be used in development to identify potential performance issues.

- **Automation** – all stages of software delivery are highly dependent on automated tools. Automation is essential because it enhances agility and provides the productivity required to support the continuous nature of integration, delivery, testing and monitoring of many small incremental changes to the code base.
Automated management interfaces – software-defined environments (SDEs) are an emerging core capability of DevOps that allow organizations to manage the scale and speed with which environments need to be provisioned and configured to enable continuous delivery. SDEs use technologies such as automated management interfaces in the form of application program interfaces (APIs) that define entire systems made up of multiple components. These interfaces are based on information models that define the characteristics, behaviors, configurations, roles, relationships, workloads and workload policies for all the entities that comprise the system.

In the IT world, applying DevOps principles has delivered big benefits. It provides enhanced customer experience for service differentiation, which is maximized by incorporating customer feedback as an important aspect of the DevOps continuous monitoring function. Organizations also enjoy increased capacity for innovation because they can leverage emerging technologies, such as cloud computing, mobile applications, big data and social media. Finally, they realize faster time to value because they have adopted the methodology, tools and culture required to minimize the time between conception and delivery.

TM Forum does a significant amount of work around APIs. For more information check out the API Zone. We’ll discuss information models more in the next chapter, but you can find additional information in the Extra Insights primer NFV: Can it be managed? and in ZOOM’s Why information models are needed for agile operations information guide.
Current network service development and operations are based largely on manual and/or static techniques, such as those required to configure quality of service parameters on switches and routers. However, the transition to virtualized network infrastructure and network services based on VNFs creates a more flexible environment similar to DevOps-based IT operations.

In a virtualized environment, network services are created by linking together, or chaining, VNFs that may have been sourced from a variety of suppliers. One of the primary goals of NFV is to streamline the integration of these VNFs. For example, a service provider may purchase network optimization functionality from one supplier and security from another.

For more about VNF procurement, see this article on Inform and this set of information guides about ZOOM’s NFV Procurement Survival Kit. The survival kit, which is based on service providers’ operational experiences, addresses: procurement patterns (for example whether the service provider wants to develop, buy or rent components); catalog federation (including development of a Yellow Pages-style directory for virtual components); and supplier, operator, infrastructure and sustainability maturity models.
Our experience on this journey to date has been that the small, self-directed teams required in a DevOps world require an amalgamation of skills spanning everything from IT security to database design and application architecture, plus everything in between. While each individual on the team has a particular strength (say, application design and coding), each one also needs to have working knowledge in other areas (maybe UX or network design).”

Eric Reed, CTO, GE Capital as quoted in InformationWeek

Continuous integration and testing

The use of DevOps in IT operations has taught us that continuous integration and testing is required and that these processes must be automated. To achieve automation, an information model is required to develop the necessary management interfaces. Again, for a more detailed discussion, see ZOOM’s Why information models are needed for agile operations information guide.

An information model is a way of describing a wide range of entities, such as network functions (for example, firewall or routing functions), customers and product information. The description includes the characteristics and properties of each of the entities and their relationships with others. A data model is a specific representation of an information model.

For example, a data model may describe the exact schema used to represent customer information in a database or to exchange customer information across an interface between two or more OSSs. ZOOM has produced a technical report analyzing the YANG data model in relation to the TM Forum’s Information model. The report is available to TM Forum members.

When models are implemented correctly, it’s possible to precisely combine information from multiple suppliers and multiple technologies to automate service operations and create consistent end-to-end views. Very often this doesn’t happen, however, which leads to the need for labor-intensive OSS integration. This is a major reason why existing OSS/BSS solutions are inflexible and expensive.
How to ensure interoperability?

In order to implement a DevOps-like continuous development model, service providers must determine how they will ensure interoperability. Standards traditionally have been defined by creating a detailed set of requirements and a single, specific implementation with supporting test tools. This assumes that all the requirements are known at the outset, which is rarely the case.

Using core common information models that incorporate best practices is a more flexible way of ensuring interoperability. TM Forum’s Information Framework, which is part of the Frameworx suite of standards-based tools and best practices, is an example. The ZOOM team is working to enhance this model for virtualized and hybrid networks by incorporating lessons learned from several Catalyst proof-of-concept projects.

The TM Forum Information Framework enhancements to support ZOOM technical report, which is available to members, describes the enhancements and defines four concepts fundamental to modeling NFV-based systems (VirtualResource, NetworkFunction, NetworkService and Graph) as well as two general-purpose concepts (Catalog and Event) that have been used in Catalyst demonstrations.

TM Forum Catalysts are short-term, collaborative projects led by our members that create solutions for addressing today’s most pressing operational and systems challenges. For more about the Catalysts mentioned here, see the Extra Insights primer NFV: Can it be managed? You can also find additional articles and videos by searching the word ‘Catalyst’ on our site.
The Frameworx Information model helps ensure interoperability

One series of Catalysts has shown how a buyer can bundle a collection of services, including NFV and legacy services sourced from different suppliers, and deliver them seamlessly to a customer in a business-to-business or business-to-business-to-consumer arrangement.

Building on three previous Catalysts, the Dynamic APIs for the Connected Carrier Catalyst, which was demonstrated at TM Forum Live! 2015 in June and won for the most significant contribution to Frameworx, showed how to create dynamic integration interfaces for both inter- and intra-operator service bundling that supports zero-touch provisioning.

The Catalyst demonstrated an end-to-end solution in a multi-vendor, multi-technology, multi-domain environment, showing how the dynamic APIs were able to mediate connections between diverse systems – in this case a B2B broker and orchestrator configured in DGIT Telflow, an ordering system supplied by Comverse, orchestration provided by EnterpriseWeb and monitoring provided by Qosmos.

The Catalyst has contributed key assets for Frameworx to support agile DevOps-style automated interfaces including:

- an event-driven management model;
- Information Framework contributions on metamodel extensions supporting dynamically defined management APIs; and B2B2X interfaces along with a set of guidelines and examples.

Watch the co-leaders of the project, Greg Tilton, Chairman and CEO, DGIT, and Dave Duggal, Co-founder and Managing Director, EnterpriseWeb, explain more in this video.
Ensuring quality end to end

All of the basic DevOps principles discussed in Chapter 2 are applicable in a NetOps setting. However, DevOps is generally applied to discrete services that are frequently delivered over the Internet on a best-effort basis. Communications service providers, on the other hand, need to be able to ensure quality of service and guarantee service level agreements (SLAs) end to end – often across multiple partners’ networks.

Another Catalyst demonstrated at TM Forum Live! 2014 called Orchestrating SDN and NFV while enforcing an SLA over a WAN highlighted some of the limitations of applying DevOps to network operations. The Catalyst used a DevOps ‘service mesh’ and use cases provided by the Open Data Center Alliance to demonstrate SLA management in a cloud environment.

The Catalyst showed the difficulty of ensuring compatibility between VNFs. When VNFs are chained together for an end-to-end service, strong interdependencies between them are created. For example, if a service provider updates an optimization VNF, it needs to ensure that it is fully compatible with other VNFs, such as those used for security. As a result, much stronger version control and compatibility testing is needed than would be typical in an enterprise application.

The Catalyst continued at Digital Disruption and TM Forum Live! 2015 with Microsoft and AT&T championing it in the hopes that they can learn how to eliminate the necessary upfront planning now required to ensure SLAs in a multi-cloud environment. For more about the Catalyst, see the Extra Insights primer NFV: Can it be managed? and this article on Inform.

For additional information about VNF procurement, see the set of information guides that make up ZOOM’s Procurement Survival Kit, referenced on page 11.
Developing the right skills

In order for service providers to realize the value of virtual and hybrid networks, operations staff must develop additional skill sets and adopt more agile operational and organizational models and processes. Managing virtual network functions running on virtual machines requires skills and processes similar to IT’s best practices for data center operations – for example, automatically spinning up a VM when utilization crosses a pre-set threshold.

To maximize the benefits of policy-driven automation in network operations, service providers must be able to dramatically reduce the amount of time it takes to develop and introduce new network services supported by a range of VNFs from a variety of suppliers. As the adoption of virtualization progresses, end-to-end management systems and other OSS/BSS capabilities will have to evolve rapidly to keep up.

“At a technical level, successful DevOps requires an architecture and operations model that supports not only continuous development and deployment internally, but also seamless interactions across the ecosystem of developers, operations staff and network engineers.”

Jenny Huang, ZOOM project co-chair and Lead of OSS/BSS Standards Strategy Group, AT&T
It’s not going to be easy

Other challenges in the NetOps world that need to be addressed by a new hybrid DevOps model include:

- Since the vast majority of environments will be hardware- and software-based for the foreseeable future, NetOps methodology must accommodate services that depend on network functions running on dedicated hardware platforms as well as VNFs.
- Virtualized services will often be created by integrating services from multiple suppliers. This will require NetOps and DevOps methodologies and best practices to support concurrent, synchronized development and integration across the domains of multiple partners using dynamic APIs.
- NetOps will need to support dynamic and automated management of service performance and SLAs, which can be achieved through closed-loop policy management.

- Again, in contrast to what happens when delivering an application over the Internet, NFV services are often mission-critical. This creates a need for high levels of resilience and rapid fallback capabilities to restore services.
- Virtualized services will cover a wide range of network functions and technologies. As a result, consistent frameworks and interfaces are needed across suppliers’ solutions to minimize or eliminate the need for manual intervention of any sort when incorporating VNFs into a network service.
- Due to the large number of network functions and technologies, and the dependencies between them to support network topology, creating NetOps test environments that accurately simulate production environments is much more difficult to do than in a DevOps environment.

NFV services are often mission-critical, so they need to be resilient.
The ZOOM project has created a vision for NFV based on the ability to flexibly integrate a wide variety of suppliers’ solutions covering multiple technologies. Several other standards-development organizations (SDOs), collaboration groups and open source groups are tackling the challenges as well, but inevitably the work is diverging, which means that multi-technology integration is becoming more complicated. It is clear that some umbrella organization needs to drive the multi-technology, converged management agenda.

The Forum is well positioned to help in this effort. ZOOM’s OSS/BSS futures overview information guide leverages best practices and experience from many Catalyst demonstrations featuring collaboration between the Forum and groups such as the 3rd Generation Partnership Project, Alliance for Telecommunications Industry Solutions, European Telecommunications Standards Institute, Internet Engineering Task Force, Metro Ethernet Forum, Next Generation Mobile Network Alliance and Open Networking Foundation.

In addition, the Forum’s Digital Services Reference Architecture (DSRA) proposes a simple set of modeling principles and API patterns, which if widely adopted would alleviate the current integration challenge and lay the foundation for automated APIs that can be integrated by configuration rather than coding to support DevOps for network operations. Such a capability is an essential pre-requisite for achieving automated development and integration, and without widespread adoption of these principles, solutions will be unable to support the necessary levels of automation to deliver on the promise of NFV.

It is clear that an umbrella organization needs to drive the multi-technology, multi-provider converged management agenda.
What is the organizational impact of adopting DevOps methodology?

The greatest organizational challenge in applying DevOps methodology lies in fostering effective collaboration across all the groups involved in bringing network services to market, including standards-development organizations. There are a number of possible approaches to creating a culture of closer collaboration. One that has been used successfully within IT DevOps is merging some or all of the application developers with some or all of the operations organization to create a single, multi-functional team with a set of performance incentives and metrics that align closely with the overall business objectives of the organization – for example, reduced time to deployment for new applications.

An alternative approach is to leave the basic organizational structure in place and focus on replacing conflicting objectives and incentives with a common set of metrics, such as for measuring the quality of applications. In either case, collaboration is greatly enhanced by a common set of automated tools that span organizational and/or technological boundaries. With both types of organizational structure, new processes must be developed to support the DevOps practices of continuous integration, delivery, testing, monitoring and feedback, and adoption of catalog-driven zero-touch implementation and orchestration lays the foundation for a DevOps approach.
Wherever new practices are based on well-defined and automated processes, business objectives for agile development of innovative, high-quality services can be met more efficiently through much shorter product lifecycles.

Change is underway

In a recent survey, 33 communications service provider executives were asked about the impact NFV will have on the organization of their companies over the next two years. More than 44 percent indicated it would have either a ‘significant’ or ‘very significant’ impact.

“How will NFV impact organizations overall?

“… In the forward-looking CTO group where we’re looking at technology down the road, we can’t make decisions or requirements in a vacuum – we have to be able to have everybody’s review of it. We need to eliminate silos between organizations. We have included the IT group in our proof of concepts and in writing framework documents for deployment, and we also have the network team involved in helping review test plans. We’re getting input from everyone on RFIs, and we’re learning how to work together across the borders.”

Network Architect, Tier 1 Service Provider
Some of the answers from service provider respondents when asked to indicate the type of organizational changes that have already occurred or that they expect to occur include:

- The operations group is likely to be restructured;
- The company’s technical experts have been consolidated into a single group;
- The company has set up a subsidiary and is in the process of moving IT employees to that subsidiary; and
- The organization’s OSS/BSSs need to be revamped.

Survey respondents were also asked how much of an impact they think NFV will have on the nature of their jobs over the next two years. Nearly 60 percent said it would have either a ‘significant’ or ‘very significant’ impact.

Some of the answers from service provider respondents when asked to indicate the type of changes that have already occurred or that they expect to occur to their jobs include:

- The product development lifecycle will change;
- The job will require new skills in general and more knowledge of software in particular;
- There will likely be a new, unknown set of customer demands;
- Product development needs to be able to provide tools to manage and monitor the environment; and
- There will be new business models and new product offerings that must be supported.

### HOW WILL NFV IMPACT JOBS?

Source: Ashton, Metzler & Associates
Addressing the challenges

The network operations team’s use and enhancement of DevOps practices and automated processes will impact the activities and organizational structure of the entire service-delivery chain. For example, changing the focus of service-development activities from code generation to VNF chaining via configuration will require major structural changes for existing development groups. In addition, many network organizations are adopting the DevOps practice of removing middle line managers in favor of setting up self-organizing teams with end-to-end responsibility for a specific feature.

Another serious organizational challenge is the need to support the rollout of network services that partially depend on VNFs hosted by partners. This requires organizations to be able to integrate and synchronize NetOps processes across the boundaries between administrative domains. For this to be feasible, new standards and best practices will be needed to share responsibilities and exchange data between the automated systems of multiple partners. ZOOM’s Procurement Survival Kit helps service providers understand when it makes sense to make, buy or rent VNFs.

Since current DevOps practices do not address enterprise development synchronization, there clearly is a need for best practices and standards for the exchange of product and service definitions, lifecycle state and other development and operations metadata. The Forum’s work on the Digital Services Reference Architecture, the Digital Services Toolkit and the B2B2X Partnering Step-by-Step Guide provide a starting point for addressing these challenges, and potential solutions using these best practices have been demonstrated in the Catalysts discussed in Chapter 3.

The ZOOM team is incorporating the lessons learned from the Catalysts in the next iterations of Frameworx, which will help service providers make a successful transition to DevOps-based network operations.

Best practices will be needed to share responsibilities between automated systems of multiple partners.
What should you do next?

We hope this primer has helped you understand the opportunities and challenges associated with adopting a modified DevOps approach to network operations. The benefits of adopting such an approach are compelling: lower costs and increased agility, including the considerable ability to implement new services in days rather than weeks or months. Unfortunately, the challenges are considerable and include extending information models, adopting new tools, implementing new operational and organizational models, and in some instances, changing a company’s culture.

TM Forum’s ZOOM team has done a lot of work already, creating best practices and experiences, crafting blueprints for operational models, extending the information model, modifying the DSRA and demonstrating practical solutions through the Catalyst program.

A lot of hard work remains, but in the end it will be worth the effort, because it will help you reduce costs and serve your customers better and more quickly, with the kinds of services they are demanding.

The next steps to take include learning more and getting involved. To discover more about NFV readiness and the necessary changes to end-to-end management, check out our other NFV primers. You can also find more detailed information about DevOps and more information about ZOOM on the ZOOM homepage of our website.

Finally, get involved! Don’t be content to wait for virtualization technology to mature – join the ZOOM team and make your voice heard as we set the course for the future of networking by developing the tools and best practices required to make network virtualization a success.
Agile Network DevOps brings out the value of Cloud Based Networking

Communications Service Providers (CSPs) need to embrace the world of network on cloud to enable new ways to radically reduce costs and rapidly create and deploy new services.

Software-defined networks and network functions virtualization (SDN/NFV) enables the world of the network on a cloud foundation to harness the power of the cloud for networking. Much of the focus today is around enabling the functions of the network and the connection of those functions using cloud capabilities. However, if a service provider moves to cloud based networking to deliver current services, but maintains the current silos of technology, methods, and organization of service design & development, they will find the “time to value” of cloud based networking to be incremental at best versus the needed radical cost and revenue improvement required by their business. Cloud based networking is all about enabling the function, real-time operations, and agile network development/operations (DevOps). It also enables multiple dimensions of value: driving the current network to take advantage of the cloud; leveraging innovation to rapidly bring new services to market; and enabling the innovators to drive growth.

**Consider this:** A marketing department of a service provider is defining a new campaign to encourage the use of its data services. They want to provide a “Free Traffic Tuesday” for videos posted to websites as an incentive for their data customers to increase usage of 4G LTE from 3G. Users would be able to upload their videos on Tuesday for free, but on Wednesday, the cost and usage of data on LTE would return to normal at the time when users will now want to view and share the videos that were uploaded the day before. Offering this free service on a Tuesday allows users to benefit from this service without impacting their data usage. The service provider, on the other hand, can demonstrate how a superior service experience can be delivered on the LTE environment while not impacting the user’s payment plan. As the marketing
The networking department shares this campaign idea with other organizations across the company, they quickly realize that execution will cause a significant spike in network traffic on Tuesdays that will require increased capacity and network optimization. The networking department and associated network orchestration teams put a plan in place to scale traffic and network elements as needed, and proceed to scale up a test of the various scenarios that might be encountered within their cloud based network testing environment. Since the network elements involved are virtual functions, the teams collaborate to rapidly enable new services, test these new services for traffic scaling, and confirm traffic loading requirements needed to ensure optimized service delivery and then return the resources used to the cloud pool upon verification. Rather than taking weeks or months to enable a new marketing program with existing services, the teams are now able to do this in a matter of hours/days instead!

Cloud enables a new level of agility of the network not seen before. With the ability to quickly create capabilities and scale up and down on demand, cloud allows for the combination and recombination of IT applications or functions to create services rapidly in new ways with unprecedented agility. Cloud based networking harnesses the power of innovation that IT has found in the cloud and extends it to the network. The cornerstone of the value for this level of innovation and agility lies in capturing the methods used for innovation in the cloud, adapting them to the network, and driving the innovation into the marketplace for true revenue growth.

Agile network service lifecycle management enables network service development from concept to reality

The cloud enables agility – the cloud enables innovation – the cloud enables an environment where ideas can be developed, quickly moved to operational status, and tightly integrated across the DevOps function. As a result, network planning, engineering and operations now need to capitalize on these cloud benefits of agility, innovation and integration by embracing the new world of Agile Network DevOps. Agile Network DevOps drives development and operations to rapidly maintain the multiple combinations of software now enabling network services. It also opens up the ability to innovate new services by mixing and
matching the network and IT applications in new ways that deliver speed to value not seen before to meet new market demands. The benefits that cloud brings alone – and the network brings alone – are powerful…but when combining them together, you now realize the true promise that cloud based networking has to offer!

So, how do we move to a world of Agile Network DevOps? This transition requires thinking and planning across three key areas:

1. technology
2. processes, and
3. people

Cloud technology not only allows network functions to be implemented and scaled in a new way, but also enables the ability to create development, automated test and automated deployment to operational environments rapidly with a common set of tools and resources that reduce cost by positioning them to be reused and shared across various services. Tools and updated processes are needed to automate and enable this new world.

Change is good!
The culture and skills of today’s network planning and engineering will need to be infused with a level of agile development skills. Changing from 18-month development cycles to 18-day ones requires incremental, iterative and collaborative experimental thinking that moves in a common, longer term vision that starts first with the end experience. Agile behavior and techniques can be used to develop new services. Tools can be engaged for onboarding and maintaining levels of software for network services. However, Agile Network DevOps teams also need to collaboratively combine skills from network, IT, marketing and operations to enable this type of thinking and behavior. Agile is more than a change in technology, tools or terminology -- it is a change in thinking.

The Many Dimensions of Agile Network DevOps.
In addition to driving DevOps in an agile manner across technology, process, and people, Agile Network DevOps occurs across multiple dimensions with the network. The primary dimension is being able to implement a set of network functions and connectivity as a network
service. Onboarding virtual network functions, developing the network services, testing those services, scaling up resources and then returning them to a common pool after the testing is done as the service is deployed into the network is all part of enabling this network service with Agile Network DevOps. The flexible infrastructure of the cloud enables the ability to rapidly onboard, assemble and test virtual functions and forwarding graphs. The realization of a network with a new speed not seen in the past creates a world of CapEx and OpEx benefits and changes how network services are built and brought to life.

In addition, today’s new networks enable a second dimension of innovation with new types of network services that can combine network functions with IT functions. The combination of a network function with a web service can provide new avenues and points of innovation to enable things like new mobile store experiences, enhanced stadium experiences, or improved enterprise operations. The ability to enable a new network service, test the service of network and IT functions as they scale and expand together and then move that service to operations also opens a new ability for innovation in the network with services not seen before.

For the Catalyst ZOOM project at TMForum Live 2015, called “React First, Resolve Next”, IBM and its partners show the ability to enable the management and orchestration of services resultant from the DevOps processes by bringing together the network, IT, service and user experience to drive orchestration and scaling in addition to what would normally be available through VNF lifecycle management.

From the start, a key component of the vision for NFV has been around enabling new innovation and revenue streams, with a focus on rapid enablement for less cost. But where does this new innovation in the network come from? For today’s service provider, new network services are developed internally over long periods of time with the need for market assessments. In the world of the cloud and mobile, going beyond a base set of functions and services provided, the real innovation has come from outside the mobile industry through innovators that are able to rapidly take the ideas from the business and personal worlds that they live in and combine/recombine them with the capabilities of the mobile smartphone.
In the world of cloud-based networking, the many possibilities of innovation needed to drive growth need to come from that similar group who can take the possibilities of this new network and map them to the areas of life beyond the common carrier view to grow value. What is needed is a way to expose this world of innovation in cloud-based networking to the world of innovators.

This opens up the final dimension of Agile Network DevOps – the dimension of enabling the services as network API’s or services that can be rapidly combined with innovation by a wide group of innovators. Opening up these network services in this way also opens up new ways for the network to be used. Being able to expose network services while also enabling DevOps, is the final dimension of Agile Network DevOps. At TM Forum Live 2015, network services and API’s were provided for use within a “hackathon” for IoT (Internet of Things) in smarter cities. Innovators used API’s from TM Forum and from network equipment providers (NECs) that were provided in a tooling environment, called IBM BluemixTM. This environment allowed for rapid innovation, testing, and operations, and in essence was this final dimension of Agile Network DevOps. Innovators were able to quickly understand and bring to life a real-world perspective for using these services with a novel approach. “Connected Car” API’s from Ericsson were used to work with robotic vehicles and TMF Product Catalog API’s were used for enabling restaurant menus. Although these applications were not the original intent for the API’s, leveraging innovation brought new uses together to enable IoT use cases. In a similar manner, network API’s may also be adapted/adopted to drive greater growth and use of network services.

One of the most interesting aspects of the “hackathon” was around how innovators who weren’t normally network service creators were now able to use the network services and API’s to drive new areas of innovation rapidly. It was the intersection of ideas that drove the innovation and opened up new areas of growth. In a short amount of time, they were able to drive this final dimension of Agile Network DevOps around driving network usage growth.

Agile Network DevOps enables the value of cloud-based networking to go from an idea to real value for a service provider. Agile Network DevOps when implemented in
a multi-dimensional manner allows a service provider to move not just from concept to production, but into the reality of enabling innovation that can drive real growth.

In the changing telecom landscape, CSPs are planning to virtualize the network and collapse network and IT operations silos into a single set of standard data center/cloud processes and infrastructure. These changes are needed to deliver the agility required for rapid development and roll-out of new services with real-time expansion and contraction of network function capacity when and where it is needed.

The whole is greater than the sum of its parts.
An agile DevOps environment is just one critical part of the emerging world of cloud based networking needed for service providers to truly attain innovation, transformation and cost advantage.

IBM offers a broad set of capabilities required to enable a CSP’s journey to open, multi-vendor cloud based networking.

For more information:
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- [Cloud Based Networking infographic](http://www.ibm-serviceengage.com/products)
- [OSS for Cloud Based Networking whitepaper](http://www.ibm-serviceengage.com/products)
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