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EXTRA INSIGHTS

# NFV: ARE YOU PREPARED?

## OPERATIONS AND PROCUREMENT READINESS

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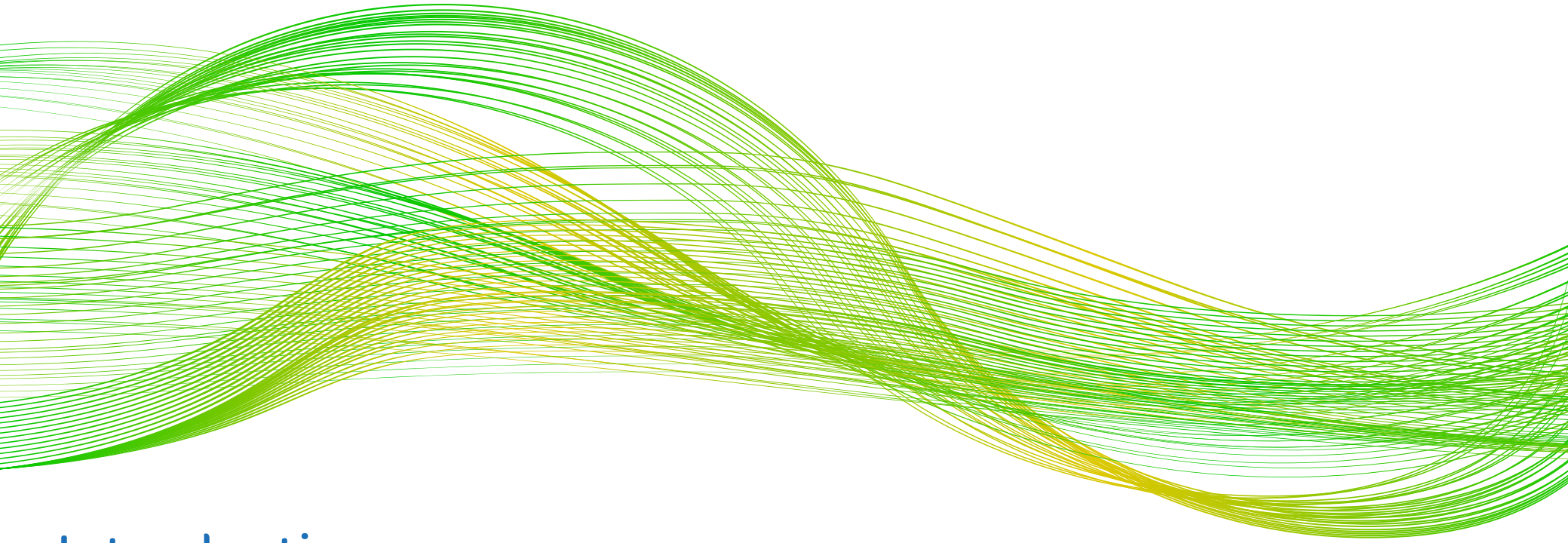

# Introduction

In November 2012 seven of the world's leading communications service providers, all of them TM Forum members, joined forces to form the European Telecommunications Standards Institute's Industry Specification Group for Network Functions Virtualization (ETSI NFV ISG). Encouraged by the success of software-defined networking (SDN) in data centers, these visionary companies – AT&T, BT, Deutsche Telekom, Orange, Telecom Italia, Telefónica and Verizon – began to consider the benefits virtualization could bring to communications networks, namely the ability to:

- leverage commodity computing technology;
- move from deploying physical network appliances to virtualized network functions running on virtual machines in data centers;
- speed the introduction of new services; and
- improve efficiency in deploying, scaling and maintaining virtualized services by leveraging IT's agile development and operations (DevOps) model.

Two short years later, service providers around the world are getting closer to rolling out NFV on a wide scale with help from TM Forum's Zero-touch Orchestration, Operations and Management (ZOOM) program.

## Why is it important to be ready for NFV?

Communications service providers have well-honed approaches to procuring and operating network equipment and appliances – such as edge routers and core switches, and everything in between. But those processes have to be modified to exploit the flexibility and cost-savings inherent in virtualizing these functions.

One thing is certain: Operators are not going to rip out all their existing networking gear and operational support systems in one fell swoop and replace them with software running on servers. It's too expensive and too risky. The migration to NFV will happen over a period of several years, which means service providers will have to manage hybrid environments where current and virtualized network functions and services work together.

> "Operators are not going to rip out all their existing networking gear and operational support systems in one fell swoop."

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### ZOOMing into the future

TM Forum's ZOOM program is advancing a large body of work underpinning four key themes for virtualization, which include: moving away from the traditional service provider operations model to a more agile DevOps model; focusing on end-to-end virtual network and operations management; working on NFV readiness support for procurement and operations; and clarifying how open source technology can be used. Much of the team's work is delivered as part of the Frameworx suite of tools and best practices.

The team has delivered an assessment of how virtualization impacts service level agreements and is working on information, data and policy models; NFV preparedness; Catalyst projects solving real-world implementation issues (see page 10); end-to-end security for NFV; and a set of business and operational support system (BSS/OSS) design principles needed for NFV adoption to become widespread. The team calls this work 'OSS Futures', and it draws heavily on existing TM Forum assets including the Digital Service Reference Architecture, the Software-enabled Services Management Solution and the B2B2X Partnering Accelerator. For more information, please contact Dave Milham via **dmilham@tmforum.org** or Ken Dilbeck, via **kdilbeck@tmforum.org**.

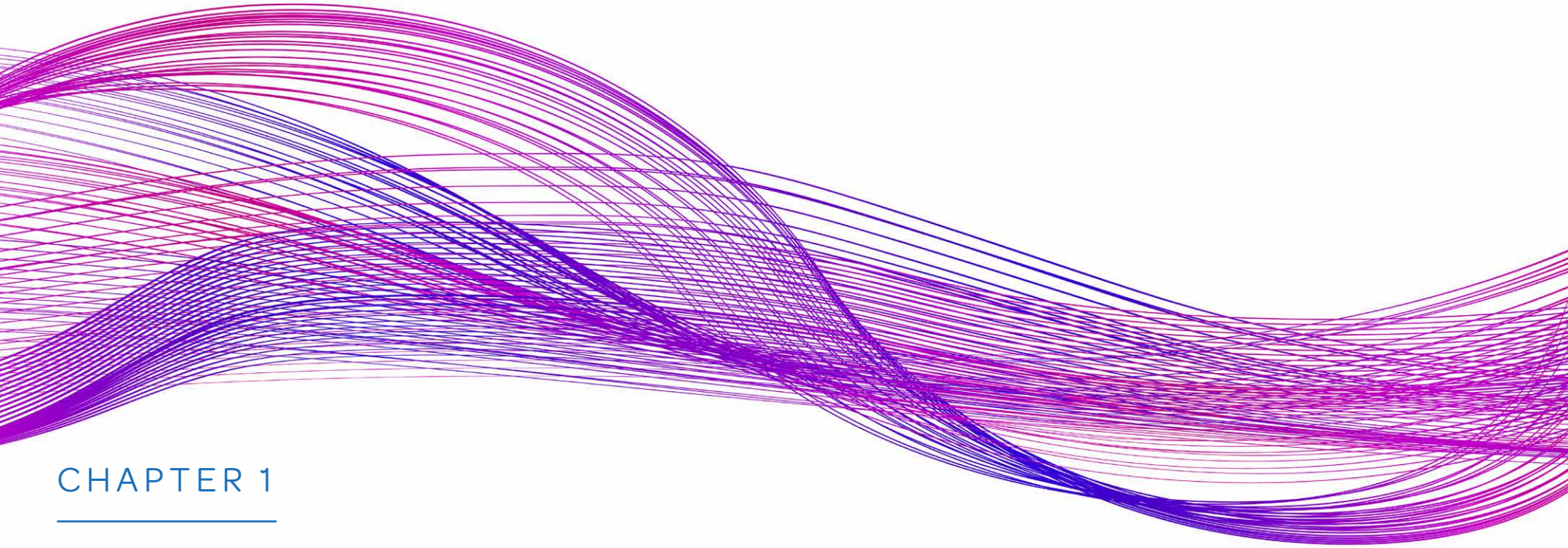
INTRODUCTION

This publication, the first in a series of *Extra Insights* primers, is designed to help executives, like you, assess whether your company is NFV-ready. The information is drawn from more detailed operational readiness documents TM Forum has produced to help executives prepare their companies for network virtualization. Those documents are available to download from the ZOOM website.

If your company is like most others, you are not yet fully prepared for NFV and need some help figuring out how to get ready for wide-scale deployment. This guide will help you answer questions, such as:

- How does virtualization impact network operations? Why is it difficult to deliver services end-to-end in a hybrid environment? And why does NFV necessitate a move toward a DevOps model for network operations?
- How does NFV impact the product lifecycle and how must operational processes evolve? What kinds of new skills, processes and tools are needed for NFV?
- Why do procurement and operations have to change?
- What questions should you ask before purchasing NFV functions and services?
- What questions should you ask about deployment and support of NFV functions and services?
- What should you do next?

> "Service providers will have to manage hybrid environments where current and virtualized network functions and services work together."



CHAPTER 1

# How does virtualization impact network operations?

At first glance, NFV may seem like a panacea because it represents a huge opportunity for service providers to save time and money while simultaneously improving customer experience. But virtualizing networks also means a fundamental change in the way networks are designed, configured and managed. When it comes right down to it, the most important question you can ask yourself is this: Is my company ready for NFV?

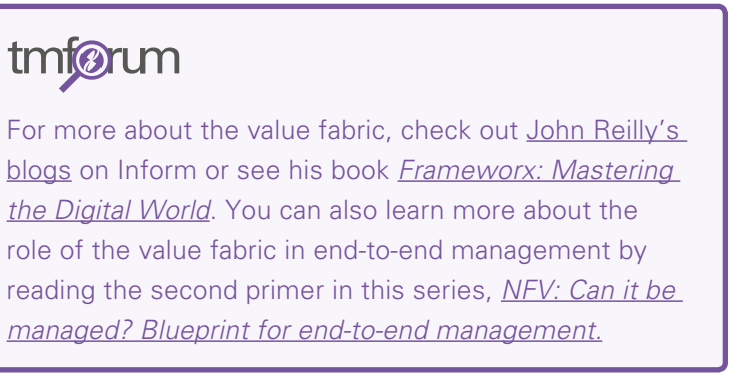
If you are prepared for rollout, you're way ahead of the pack. If you're not, we can help you get there.

Virtualization disrupts current network equipment supply chains and creates new options for procurement by separating the supply of software and computing hardware. It also enables service providers to partner with other companies for access to virtual network functions (VNFs), which shifts the total cost of ownership between capital expenditure (CapEx) and operational expenditure (OpEx).

For example, a service provider can use the virtualized infrastructure of another service provider to deliver services to end customers. This is a mutually beneficial arrangement for a value fabric of partners: Service providers that don't operate in a specific region get a fast and cost-effective means of expanding their reach, while service providers that do own the network resources can make money selling excess capacity, which is available on demand and can be scaled up or down as needed.

In this new environment, operational methods must be flexible enough to manage virtualized and hybrid networks. Network functions look a lot more like applications running on virtual machines, which requires skills and processes more in line with IT's agile DevOps methods than traditional network operations practices. In addition, services provided to end customers must be managed end to end across network clouds operated by different partners, many of whom will also be managing hybrid networks made up of current and virtualized components.

Virtualization impacts the entire lifecycle of sourcing, or procuring, network functions and services, which means you have to re-evaluate traditional processes for purchasing equipment from a single supplier. Inside a service provider organization, procurement executives are usually responsible to the finance department for ensuring that the enterprise's assets are well spent, that the total cost of ownership is assessed and that risk is managed. As NFV also impacts the balance between CapEx and OpEx, those executives are in the perfect position to lead the analysis of the total impact on operations.




"Virtualization impacts the entire lifecycle of sourcing, network functions and services."

## Why is it difficult to deliver services end to end in a hybrid environment?

It's hard enough to provide reliable services to end customers when you own the entire network and it comprises only elements, functions and processes that have been vetted over the course of decades. With NFV, everything about the network and how it operates changes – and it's no longer a network you control exclusively.

To deliver services end to end in a hybrid, multi-partner network of networks, you need a migration plan that uses best practices to ensure you are able to maintain service levels without degrading customer experience. TM Forum's ZOOM team is working on information, data and policy models to help you accomplish this. Again, for a more detailed look at end-to-end management of hybrid and virtualized networks, see the second primer in this series, *NFV: Can it be managed?*

## Why does NFV necessitate a move toward a DevOps model for network operations?

In IT environments, including the data center, DevOps emphasizes communication, collaboration, and integration between software developers and IT operations staff. DevOps also focuses heavily on agile work methodology and automation.

The goal of DevOps in networking is to facilitate close collaboration between application development teams, operations staff and network engineers and to increase automation in the network and back office. This approach is in stark contrast to the traditional network operations model, which finds most of these groups working separately in silos, primarily using manual processes.

While it's easy to imagine how the network of the future will be managed using DevOps processes, the challenge in the short term is operating a hybrid of current and virtualized environments concurrently, while somehow managing to sustain or improve the reliability that customers have come to expect.

It won't be easy – especially in a fundamentally different environment where some users will be humans, used to 'five nines reliability', and others appliances in the Internet of Things. The third primer in this series, *NFV: What does it take to be agile? DevOps transformation framework for the digital ecosystem*, covers the move toward a DevOps model for network operations in greater detail. In addition, the ZOOM team's *OSS/BSS futures overview* identifies areas where DevOps practices must be enhanced to manage NFV-specific needs.

CHAPTER 2

# How does NFV impact the product lifecycle and how must operational processes evolve?

Virtualization impacts the entire lifecycle of a service from concept and design to ordering and fulfillment to management, billing and retirement. Most back-office systems are not up to the task of managing hybrid or virtualized environments because they operate in silos. They are often manual, inefficient and expensive to operate and maintain. Put another way, today's back-office systems can only support a static relationship between physical and virtual resources, in contrast with the virtual world where things will be much more fluid, shifting in response to circumstances and associated policies.

As a first step on the NFV journey, existing support systems must be consolidated and adapted. Many companies have already started down this path, undertaking massive operational transformations as AT&T is doing using TM Forum's Frameworx suite of standards-based tools and best practices. So far, the company has saved $159 million with its new Service Realization Excellence platform, which now serves as the foundation for its software-defined network of the future.

## It's an evolutionary process

As NFV matures, technologies will evolve and suppliers will improve their implementations. That means the backward compatibility of newer versions and interoperability must be addressed. Many evolutionary steps will be necessary, all of which will involve hybrid network operations to some degree.

> "It's impossible to obtain large, lasting benefits without a dynamic information model and metamodel."
>
> C-level Executive, Tier 1 Service Provider

A new architecture for business and operational support systems (BSS/OSS) is required, and this likely will be virtualized as well. Management interoperability is needed at both the technology and operational levels, which means that open application program interfaces (APIs) connecting support and network management systems are crucial. Service providers agree this requires a new information model and a metamodel for APIs to support agile integration of support systems.

Several TM Forum Catalyst projects have been working on metamodels for APIs and other important issues that must be resolved before NFV can be deployed on a widespread basis. The ZOOM team is incorporating lessons learned into Frameworx. More information about enhancements to the Information Framework is available on the ZOOM website.

For example, two of the projects have focused specifically on agile service fulfillment. One showed how a buyer can bundle a collection of services sourced from different suppliers and deliver them seamlessly to a customer in a business-to-business or business-to-business-to-consumer arrangement, while the other delivered a metamodel for event-driven management and operations.

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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.

The Forum also does a significant amount of work around application program interfaces. For more information check out the API Zone.

## New skills, processes and tools are required

Historically, network operations have not been known for their flexibility. Just the opposite is true, in fact: Traditional network engineering and management is a rigid, siloed and largely inflexible process. That must change with virtualization as automation becomes essential. Communications service providers must move toward agile service provisioning and operations, especially in light of the need to ensure service quality and security end to end.

In the interim, hybrid operations imply that some steps will be needed to ensure that existing management does not impede service agility. Approaches to the new skills and processes needed to support agility could include:

> "People need to feel comfortable with an interactive and agile development approach. It may require several times to get things right, risk-taking and doing things in a much more collaborative fashion."
>
> **Jenny Huang**, ZOOM Project Co-chair and Lead of OSS/BSS Standards Strategy Group, AT&T

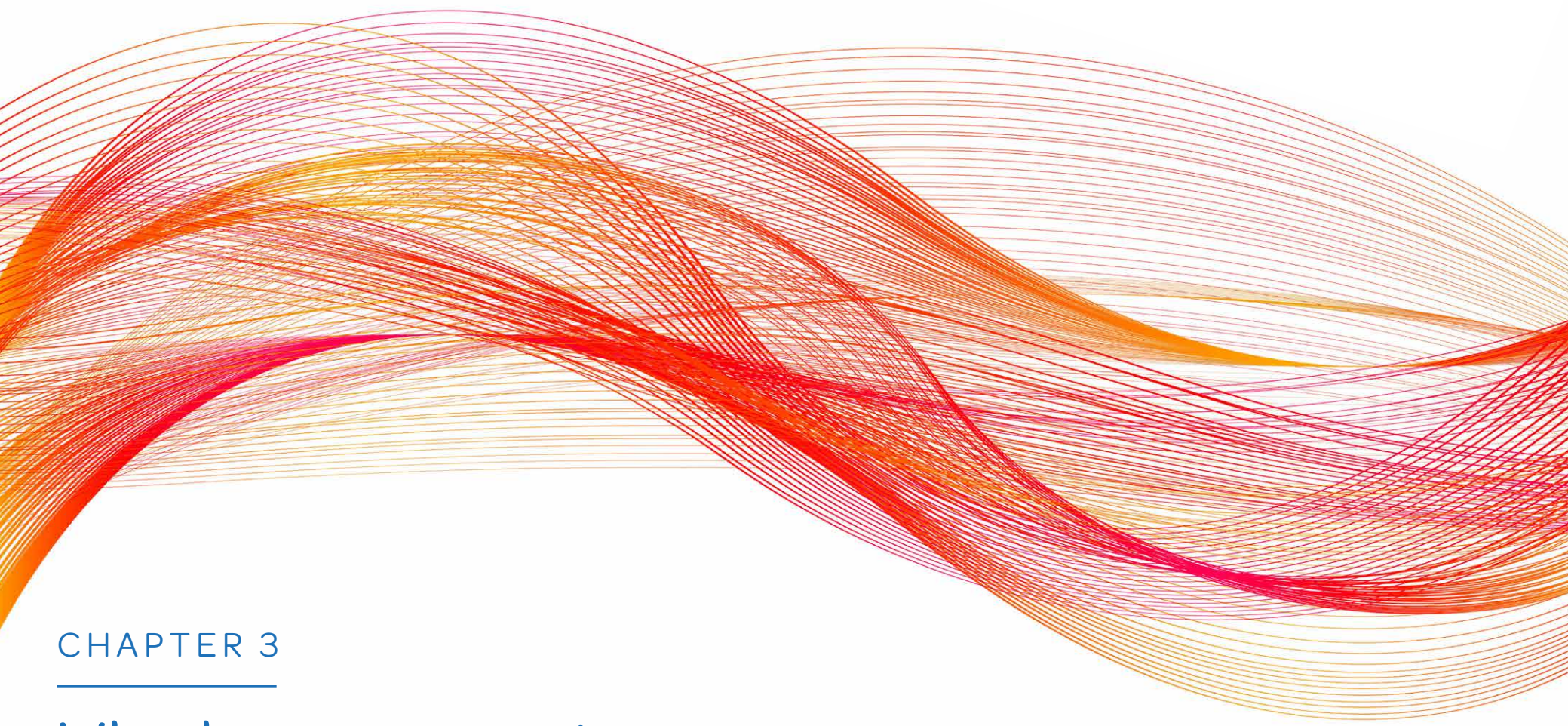
- adoption and enhancement of DevOps methods for service development and operations;
- integration of OSS/BSS and IT management systems;
- integration of existing and virtualized service operations to use common, virtualized IT infrastructure; and
- focusing operations around specific skill sets.

Service providers also need to focus on hiring people with both network operations and DevOps management skills. Unfortunately they are not easy to find, and in many cases, operators will have to train them.

Again, for more a more detailed discussion about the transition to DevOps-based, agile network operations, see *NFV: What does it take to be agile?*

New monitoring tools also will be needed in a virtualized or hybrid environment where ensuring quality of service end to end is critical, so that customer experience is maintained or enhanced, not degraded. We'll discuss the necessary tools in more detail in Chapter 5.

Now that we've given you an overview of the challenges and requirements for implementing NFV, we can move on to some specific questions you may be asking about NFV.



CHAPTER 3

# Why do procurement and operations have to change?

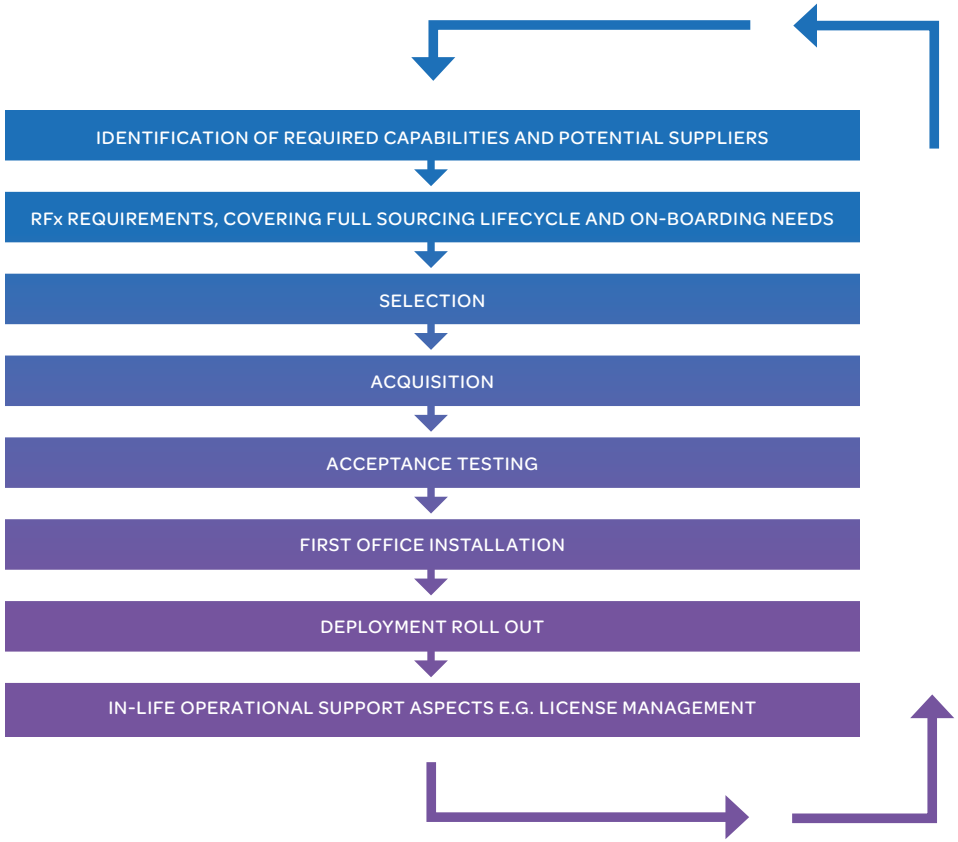
Purchasing traditional networking equipment and services is a process that has been enhanced with best practices and tested over several decades. Service providers first issue a request for information or proposal (RFx), which provides details about the equipment they're looking to purchase, and then potential suppliers respond by submitting their proposals. The service provider evaluates the proposals and may require testing of the proposed products.

The image opposite outlines all of the steps, which are well-defined through best-practice models that organizations like TM Forum have been working on for years.

This well-honed procurement process does have a major drawback: As it is executed today, it's extraordinarily time-consuming. Traditionally, it has taken service providers about 18 months to roll out a new service from concept to cash. Also, the time-honored procurement cycle typically assumes ownership, rather than other means of sourcing the functionality required like using another service provider's network, which has its own drawbacks. For example, using a partner's network or services involves covering the whole lifecycle, just as procurement does, but with less control, which is the trade-off for more flexibility. Whichever route is taken, long cycles are not acceptable. Customers today are demanding new services instantly, which means service providers must automate the process.

**It is important to note, however, that automating the procurement process does not mean abandoning it. A well-articulated process is still necessary to ensure that you know what you're buying and your supplier ensures you get what you want.**

## SOURCING LIFECYCLE




*Source: TM Forum 2014*

## A new way to play the game

Virtualization enables new ways of doing business with suppliers. Unlike buying a physical network appliance, virtualized functions allow the buyer to source the complete solution in separate parts from different suppliers: the virtualized functions, the virtual machine platform, the orchestration of virtualized functions, the systems integration and the maintenance support.

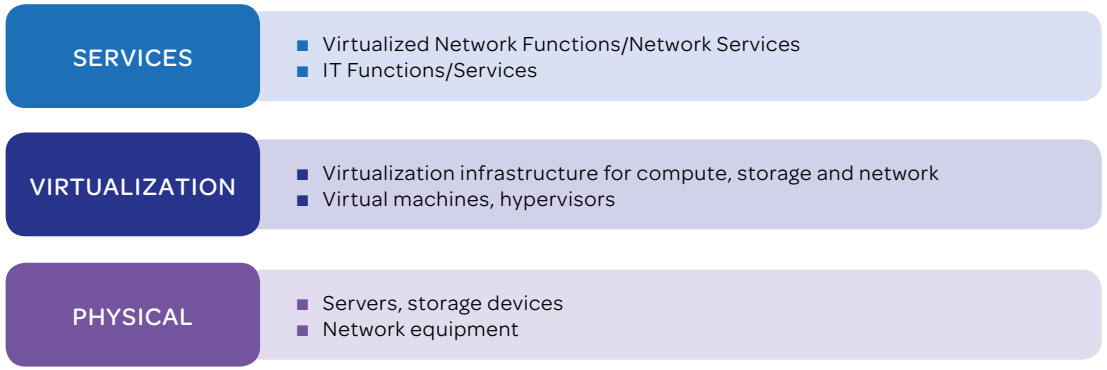
This sourcing flexibility will require additional effort from your technical department to manage the relationships and overall business integration. Virtualization also encourages a diversity of suppliers, from traditional partners for integration with existing networks to niche players and open source platforms.

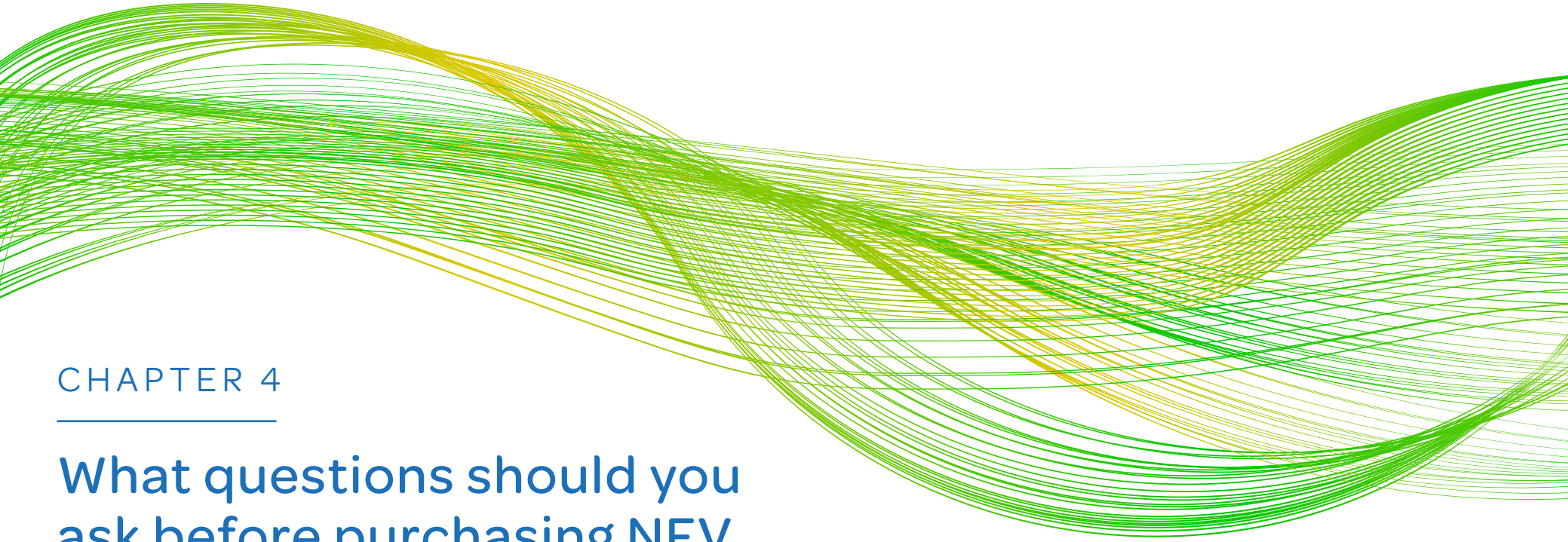
The introduction of virtualized services and functions will require your operations team to be organized in such a way that it can address three levels of management: the network function/service layer, the virtualization layer and the physical resources layer – as shown below.

While today's operations organizations are familiar with managing the first and third layers, the virtualization layer introduces many new challenges and necessitates the move toward an enhanced DevOps model. For more on this see *NFV: What does it take to be agile?*

Now that we've explained why the procurement and operations processes have to change, let's look at how the procurement and operations teams within your company will be affected by the move to NFV.

### ADDING A NEW MANAGEMENT LAYER





CHAPTER 4

# What questions should you ask before purchasing NFV functions and services?

When considering how to purchase virtualized network functions and services, it helps to consider some relevant 'user story' examples from within your company. Let's look at it from the point of view of a network planner first, since they are charged with the task of building the services the marketing team has promised to the end customer.

***As a network planner I need*** *to be able to identify potential suppliers of virtualized network functions and services that meet my planning requirements.*

***To do this I need*** *a way to classify detailed network functionality so that it can be included in an RFx issued by my procurement department. I need a standard way of describing procurable virtualized network functions and ideally a library of them, along with their suppliers, which is agreed by the entire network operator community. I also need to specify the management processes and the RFx requirements for virtualized network functions' management interfaces.*

Today there isn't an agreed-upon definition of what a virtualized network function constitutes, and that makes it difficult to purchase one. The ZOOM team is working with ETSI on the definitions and on tools and best practices to help suppliers and service providers communicate about VNF capabilities. These best practices must cover everything from network planning and procurement through to application development and operations management, and TM Forum is working to package them as part of its ZOOM deliverables – see page 4.

Once network planners are satisfied that they can help their procurement departments issue an RFx for virtualized network functions or services, procurement executives can go to work figuring out which suppliers' products or services will best suit their needs.

***As a procurement executive I need*** *to be sure there is a reasonably competitive supply of the required network services and functions that my networking colleagues need.*

***To do this I need*** *to be able to search in a simple, business-oriented way for potential suppliers and be able to compare their offerings.*

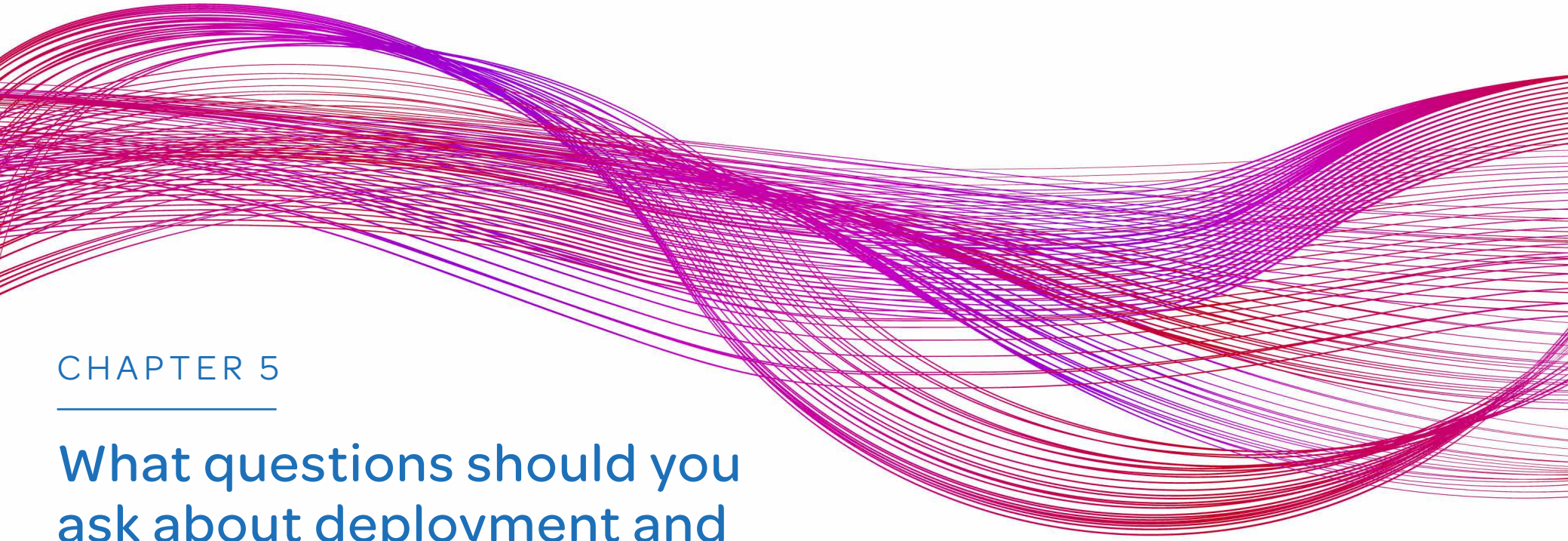
Procurement executives are faced with some simple, yet challenging questions:

- When I buy a virtualized network function, what do I get?
- How do I test it for acceptance?
- When should I pay for it?

Again, there are no complete answers to these questions yet, but the ZOOM team is working to create the standardized RFx templates needed to make the procurement and selection process easier for both buyer and seller. These RFx templates are necessary to:

- make supplier-standard responses possible, which reduces cost and time needed for RFx analysis;
- help automate the on-boarding process, which is necessary in virtualized environments; and
- support federated identity and security management, and management of service level agreements in end-to-end networks.

In the next chapter we consider another very important user story: that of the operations executive.



CHAPTER 5

# What questions should you ask about deployment and support of NFV functions and services?

***As an operations executive, I need*** *to figure out how to implement and manage virtualized network functions and services, and how much it will cost to operate them on an ongoing basis.*

***To do this, I need*** *to know what the supplier is providing and how it will be licensed and managed.*

Operating and managing virtualized functions and services is a task that will involve many parts of your organization, and weakness in any one area will affect customer experience. This means that further optimization of operational processes are inevitable.

Operations executives should ask the following questions of suppliers:

- When a virtual network function is delivered, what am I really getting and how do I implement it?
- Which management tools does it support?
- How will I manage it automatically within my IT and network operations?
- How will support be coordinated between suppliers?

Most suppliers cannot yet answer all these questions. That's why some of them are packaging NFV functions in more than one way. For example, some suppliers are offering to install virtualized network functions on the service provider's servers in a data center or network operations center, or alternatively they will deliver the functions bundled with a server. These two approaches have different implications for operations and deployment.

> "The assessment of total cost of ownership and total operational impact when implementing NFV is very crucial in order to consider long term-profitability, which is based on the promise of new revenues and significant reduction of operating costs. It should not be a roadblock to starting the first steps of the transformation."
>
> **Roberto Kung**, Senior Vice President Network Operation and Performance, Orange

## Figuring out the costs

Being able to answer the questions on page 17 is key if you want to be able to establish where operational costs lie. For example, you will have to know how licensing is going to be tackled in a virtualized environment.

Service providers will want to scale virtualized network functions up and down rapidly – that agility is one of the primary reasons for moving to a virtualized environment. This means the licensing scheme in the RFx must be able to support change and requires a tracking system so that costs can be determined. As the costs are variable, there must also be an auditing mechanism in place to manage them.

Change management and the costs that arise from supplier updates to procured VNF packages will have to be addressed, too. All suppliers will develop a view of the direction that their product should take. Inevitably over time, the suppliers' road maps and the service providers' business directions will diverge. You will need RFx requirements to address visibility of the road map and a method to manage change.

## The right tools for the job

In a virtualized or hybrid environment, ensuring quality of service end to end is critical so that customer experience is maintained or enhanced, not degraded. That means new monitoring tools are needed so that you can:

- trace and audit end-to-end security policies;
- monitor performance across organizations (from business-to-business or business-to-business-to-consumer, for example);
- manage policies set for service performance;
- localize and resolve service problems;
- monitor and manage capacity; and
- track usage of virtual services against licence conditions.

## Other operational considerations

Virtualized environments will rely on a significant amount of open source software, which means that service providers and their suppliers will have to agree how to support it. Clear, standardized APIs will be critical for this. Operating virtualized environments also means you will need support from many different hardware, virtualization and orchestration suppliers. The boundaries and relationships with all these suppliers must be clearly defined and maintained.

Finally, operations teams will be responsible for ensuring services end to end in virtualized and hybrid environments. You still have to provide service level agreements to your customers, and you must be able to pinpoint the root cause of any problems and take quick action to fix them. For more about the specific challenges associated with guaranteeing services end to end, see *NFV: Can it be managed?*

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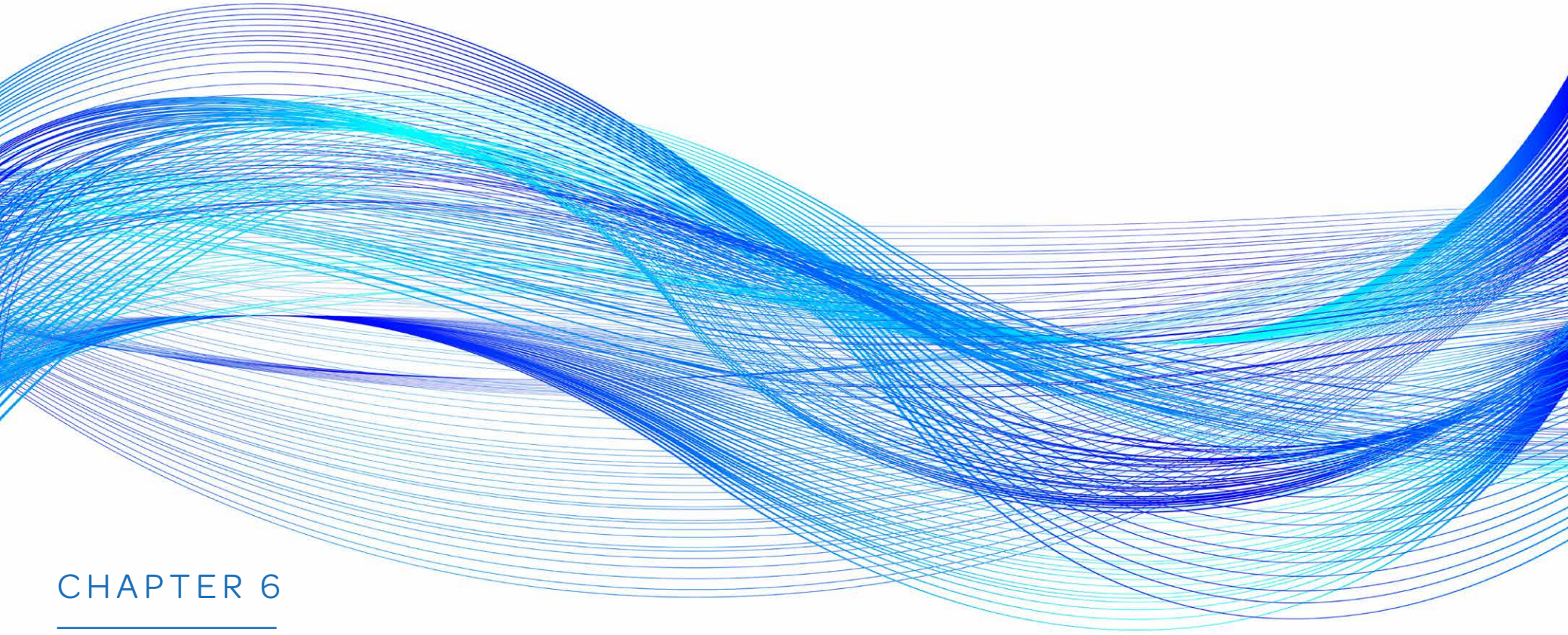
### A WORD ABOUT PACKAGING

It is clear there is a need for a description or model of the relationships between procurement packaging, software packaging and deployment packaging of virtual network functions and services. The ZOOM team is working on a best practice proposal for packaging that is designed to provide a high-level overview and definitions of the specific terms used in ETSI's management and operations documents. Since ETSI's current focus is on network engineering and not procurement or operations, the team has interpreted some of the terms in its *NFV readiness: Packaging virtualized network services for procurement and operations* document.

To get involved with the ZOOM team's important work on packaging, please contact Dave Milham via **dmilham@tmforum.org**.



CHAPTER 6

# What should you do next?

We hope this primer has helped you understand what your company needs to do to become NFV-ready. Unfortunately, there is no quick fix and a lot of hard work must still be accomplished. In the end, however, it will be worth the effort, because it will help you deliver service agility, reduce costs and serve your customers better and more quickly, with the kinds of services they are demanding.

> "There is no quick fix and a lot of hard work must still be accomplished. In the end, however, virtualization will be worth the effort, because it will improve agility and reduce costs."

To prepare for deploying NFV on a widespread basis, you must first understand the benefits and challenges of moving to a virtualized environment. The benefits are clear: It can reduce time to market for new services while also lowering operational costs.

The challenges aren't as easy to articulate, and they are numerous. The biggest issues to tackle are:

- charting a migration path, because no large network operator is going to rip out everything and start over;
- addressing the organizational changes required to adopt a DevOps approach to networking; and
- figuring out how to make sure you understand what you're buying when you are ready to purchase products.

The next steps to take include learning more and getting involved. To learn more about the end-to-end management challenge and the move toward DevOps for networking, check out the second and third eBooks in this series. You can find them here. You can also find more detailed information about becoming NFV-ready here.

Finally, get involved! Don't wait for virtualization technology to mature; instead, join the ZOOM team and make your voice heard. We're setting the course for the future of networking by developing the tools and best practices required to make network virtualization a success.

If you would like to join the ZOOM team, please contact Dave Milham via dmilham@tmforum.org or Ken Dilbeck via kdilbeck@tmforum.org.

"To prepare for deploying NFV on a widespread basis, you must first understand the benefits and challenges of moving to a virtualized environment."

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