A Guide to Improving
DevOps in the Cloud

October 2019

Introduction

DevOps has become one of the most important differentiators in business today. Organizations that do DevOps well drive innovation, accelerate speed to market, and, potentially, disrupt industries. Those that don't implement DevOpsor, worse, do it poorly—run the risk of lagging behind their competitors.

If you're a DevOps professional, the heightened visibility of your role is not only creating a lot of excitement, but also a set of new challenges and concerns. That's because DevOps is a discipline where success breeds even higher expectations and greater demands.

Welcome to life in the fast lane.

DevOps teams will always be judged on their ability to deliver speed, agility, and reliability. But in today's environment, that's not always enough. DevOps professionals must also focus on broader, organization-wide priorities such as managing costs, improving security, supporting regulatory compliance, and enhancing business continuity.

For DevOps teams, this means:

- Ensuring that applications can run at scale.
- Accelerating development velocity using modern, portable pipeline for software engineering.
- Maintaining reliability through orchestrated deployments and upgrades.
- Overcoming the complexity of using and integrating multiple tools.
- Delivering a single automation platform that combines network infrastructure and security

- Avoiding cloud lock-in and high public cloud costs.
- Building scalable security into all application components from the start.
- Maximizing automation through modern software-defined and cloud-grade infrastructure.
- Leveraging reliable, flexible network infrastructure to support microservice designs.
- Using telemetry, advanced analytics, and machine learning to enable continuous measurement and response.

How do you get there from here? How do you reduce the complexity of configuring and setting up new tools across clouds? How do developers and IT operations work together to ensure you have the reliable network infrastructure you need to do your job? How do you avoid getting lost in the cloud, to the point where costs spiral out of control or performance doesn't meet your needs?

That's where we come in. This guide will help DevOps professionals leverage modern technology solutions maximize the efficiency of both application development and IT operations in a multicloud environment.

We look at ways DevOps teams can retain their speed and agility while meeting enterprise-wide requirements for security, resiliency, simplicity, and cost management. We examine the challenges of running applications at scale. And we look at open software solutions that support cloud-native networking and operations intelligence.

Let's get started.

Chapter 1
Addressing DevOps
Challenges

The practices and principles that encompass DevOps have become so integral to business agility and innovation, in such a short period of time, that it's sometimes hard to believe the term "DevOps" has only been around since 2008. Similarly, the use of containers to virtualize applications has become so ingrained in the DevOps process that it's equally hard to believe that the first Docker release occurred in 2013.

DevOps, as a process and driver of business innovation, has come a long way in a short amount of time—and its business value will only grow as companies embrace digital transformation, the Internet of Things (IoT), big data analytics, and other initiatives.
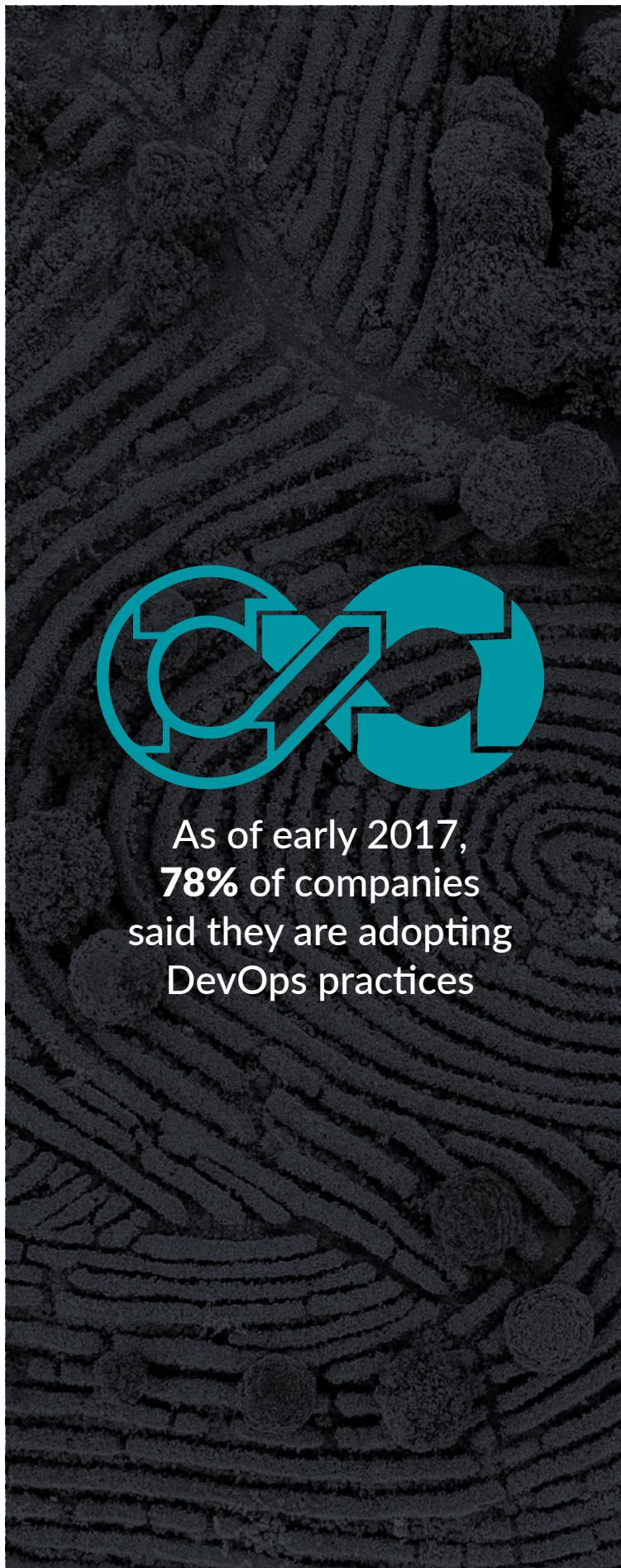
As of early 2017, 78% of companies said they are adopting DevOps practices, up from 74% in 2016, according to the RightScale 2017 State of the Cloud Report. Among enterprise companies, DevOps adoption rose to 84%, up from 81% the prior year, and 30% are adopting DevOps companywide, up from 21% in 2016.[1]

All indications point to those percentages continuing to grow. By 2023, the overall DevOps market is expected to reach $8.8 billion, growing at a compound annual rate of 18%.[2] The application container market is expanding at a 40% compound annual rate, growing from $762 million in 2016 to $2.7 billion in 2020.[3]

1 "RightScale 2017 State of the Cloud Report," RightScale, Feb. 15, 2017
2 "DevOps Market to Reach a Market Size of $8.8 Billion by 2023," KBV Research, Aug. 3, 2017
3 "451 Research: Application Containers Will Be $2.7B Market by 2020," 451 Research, Jan. 10, 2017

As of early 2017, **78%** of companies said they are adopting DevOps practices

Why DevOps, and Why Now?

The reasons fueling the dramatic growth of DevOps are easy to understand.

On one hand, there is the compelling need for businesses to be much more agile in the development and delivery of new business services. Users of digital technologies—whether customers, employees, or partners—expect rapid availability of the services they need, along with mobile access and the highest level of reliability. This is an era in which speed, quality, agility, and continuous innovation are merely the cost of entry.

It is also an era of experimentation. DevOps tools and processes are constantly being refined and enhanced. More tools are available to support relatively recent innovations such as containers and microservices, including Docker, Kubernetes, OpenShift, and Mesos.

They can also leverage multiple open source tools and technologies for other critical aspects of DevOps, such as automation, orchestration, configuration, monitoring, and analytics. These include Ansible, Chef, Jenkins, Spinnaker, Tungsten Fabric, Prometheus, Jaegar, and others.

The growth of DevOps has been affected by the rise of public cloud computing as a reliable and easily available platform. Developers can acquire the programmable infrastructure and services they need with a credit card, helping them bypass the lengthy and complex process of building a private cloud.

However, with private cloud technologies maturing, hybrid cloud a modern reality, and multicloud just around the corner, DevOps teams are now focused on portability. Applications must work in on-premises data centers and multiple public clouds, as well as on edge computing platforms.

In some cases this means that applications will themselves be moved from infrastructure to infrastructure. In an increasing number of cases, however, this means that a single application—one that has been broken out into microservices—has components spread across all of these infrastructures.

In addition to application and/or application component portability, the underlying development methodologies must be portable. Different components may be coded in different languages, use different application frameworks, and so on.

Running on multiple infrastructures, IT teams will have to take the uniqueness of each platform into consideration. Security constructs, APIs, and more will vary from infrastructure to infrastructure. DevOps teams will need to consider both software and network reliability engineering.

As of 2017 **85%** of enterprises are using multiple clouds

DevOps Challenges

The cloud-native application design architectures that have made DevOps so successful are also creating new challenges that must be addressed if DevOps leaders are going to take their methodologies and processes to the next level.

One of these is "shadow IT"—a term that can be either descriptive or pejorative, depending on who is using it. It describes the phenomenon of DevOps teams and lines of business moving to the public cloud on their own, while centralized IT teams are isolated from the process.

As a DevOps team leader or professional, you can't afford to be isolated from other areas of the business. You need to coordinate with centralized IT, particularly as you move from developmental responsibilities to operational responsibilities, and as your applications become successful and need to run at scale.

Whether you're a fan, foe, or neutral observer of shadow IT, there are certain realities that occur when DevOps teams go their own way. One is the emergence of multicloud environments.

As of 2017, 85% of enterprises are using multiple clouds, up from 82% in 2016.[4] Multicloud environments pose particular challenges to DevOps teams and to the centralized IT departments that own organization-wide responsibilities for budgets, security, reliability, availability, and infrastructure.

These challenges typically include:

- Operating at scale: Scale adds complexity.

- Dealing with the complexity of using multiple tools: Each infrastructure has its own tools.

- Cloud cost control: Cloud sprawl and efficient instance selection are ongoing challenges.

- Security gaps in applications and processes: Building security in after the fact never ends well.

- Failure to leverage the benefits of automation: Hands-on management doesn't scale well.

- Building reliable, flexible, scalable network infrastructure: The Ops in DevOps can't be ignored.

- Incorporating telemetry, advanced analytics, and machine learning: Make decisions with data.

- Improving business continuity: Doing all of the above while making it all blow up less often.

Now is the time to address these challenges, given digital transformation is one of the business imperatives of the modern era. In 2016, IDC estimated that by the end of the decade, 50% of Global 2000 companies would see the majority of their businesses depend on their ability to create digitally enhanced products, services, and experiences. By 2019, technologies supporting digital transformation and related initiatives (collectively known as DX) were to account for nearly 75% of all IT spending.[5]

As we approach 2020, IDC now estimates that DX has a $19 trillion USD global economic impact, approximately 20% of global GDP. DevOps teams are at the heart of digital transformation initiatives; their role in propelling business forward, with smarts and innovation, has never been more critical.

Looking ahead, DevOps teams have several key questions to address:

- How do you transform your DevOps challenges into DevOps opportunities?

- Where do you start applying DevOps practices in brownfield environments? (Established businesses with long-standing IT shops have historically been resistant to the types of changes required to evolve towards DevOps.)

- Which technologies are needed to support speed, agility, and reliability—and how can you get them?

- How do you ensure that your applications can run at scale, and integrate across the necessary lines of business?

Ready to find answers to these questions? Read on.

4 "Data to Drive Your Cloud Strategy: Chart Your Cloud Course for 2017," RightScale, Feb. 15, 2017
5 "IDC Sees the Dawn of the DX Economy and the Rise of the Digital-Native Enterprise," IDC, Nov. 1, 2016

Chapter 2
Taking DevOps to the **Next Level**

DevOps is all about delivering speed, agility, and reliability to enable and support business opportunity and innovation. As DevOps practices and methodologies become more widely deployed, the challenges of scale, security, and organization-wide integration become more vital to success.

DevOps teams need to focus on each phase of the application delivery pipeline. Application development must incorporate more than just development; it must include testing, staging, and production operations as well. Accomplishing this requires collecting infrastructure telemetry, including ongoing diagnostics and performance monitoring, and then acting upon that information.

Acting on the data provided by telemetry requires not only the ability to affect the application components themselves, but the underlying infrastructure and the information security apparatus that defends it. DevOps teams need visibility throughout their applications and infrastructure, and multiple points of enforcement for the policies they create to manage it.

The responsibility of DevOps teams doesn't end at any particular stage of an application's lifecycle. DevOps teams must design for, plan for, and manage the operations of both the application code and the infrastructure upon which it runs for the totality of the application's lifecycle.

Because there are so many components involved, multiple teams have to interact and cooperate in order to successfully craft, deploy, and manage cloud-native environments. Developers, IT operations, and individual Line of Business (LOB) units must create cross-functional teams if they are to meet the challenges—and take advantage of the opportunities—that are driving organizations of all sizes to take advantage of cloud native application design.

Modern initiatives such as digital transformation, big data analytics, and the IoT are changing the way IT is done. An end to the old way of doing things means a new approach must be created. Doing this successfully requires all stakeholders to be involved, and this brings us back to the need for collaboration and cooperation among developers, IT operations, and LOBs.

The tools matter.

For example, product management and marketing teams collaborate with DevOps teams to ensure that new applications are reaching the right audiences, whether internal or customer facing. This can involve marketing, customer support, sales, billing, training, and other operational areas. DevOps is not an island, and recognizing that is a key step in ensuring you can take DevOps to the next level in your organization.

While collaboration may be the most difficult challenge for DevOps teams, one cannot simply take a bunch of developers and IT operations nerds, put them in a room, and say "talk amongst yourselves." There are ultimately a number of skills that DevOps teams must develop, because IT touches all aspects of the business, and DevOps teams impact all of IT.

> DevOps is not an island—
> and recognizing that reality is a key step...

No. 1: Reducing Costs

Most DevOps teams lack individuals who are experts in managing costs. They are spending way more than they should on services they may not need, or even use. Unfortunately, waste is a common problem. According to RightScale's 2017 cloud report, IT professionals estimate that 30% of cloud expenditures are wasted.[6]

There are a number of reasons for this. One of the most common is also the most predictable: reversion to the siloed nature of previous roles. It's comforting to have a narrow domain of responsibility; altering both personal habits and business processes to widen the scope of consideration is a challenge that goes against human nature.

Because DevOps teams typically contain IT operations members, a frequently untapped resource for DevOps teams is the traditional central IT team. Central IT is typically more focused on managing cloud costs and are much more aware of where it has pricing leverage based on the organization's overall cloud use and its relationships with cloud providers. They can be much more adept at ensuring you are getting the performance and capacity you need without paying too much.

Traditional centralized IT teams can tell you in detail what you are getting for your money. This will help your DevOps team understand, plan, and optimize its own costs. In addition, they can leverage automation and orchestration capabilities in ways that DevOps teams may not be able to do on their own. Central IT teams often have infrastructure telemetry and points of policy enforcement that nobody else has access to; this can be leveraged to increase efficiency and drive down costs.

6 Ibid. footnotes 1 and 4

No. 2: Scaling Your Architecture

Scale changes everything. Building an application for a proof of concept or pilot project is one thing; building it to handle a massive volume of users and traffic is another. The challenge—and opportunity—is to start fast while simultaneously making decisions and deploying tools and technologies that will let you adjust as the application evolves.
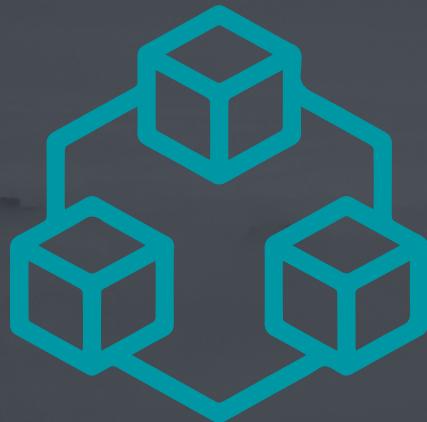
Automation is the key to scale; IT at scale is not possible without automation. Automation can be difficult to build in at the beginning of a project, but it quickly becomes critical. This is why automation tools have become so popular with DevOps teams around the world.

Automation allows for security, reliability, and availability, both of the applications used by the DevOps team and the applications they are developing and deploying. Modern applications are often sprawling affairs, with microservices located on premises, in multiple public clouds, and in edge computing data centers.

The application of policy across all of these infrastructures is a considerable challenge, underscoring the importance of management applications. Juniper Contrail provides an extensive solution to these tough challenges, and does it across multicloud infrastructures.
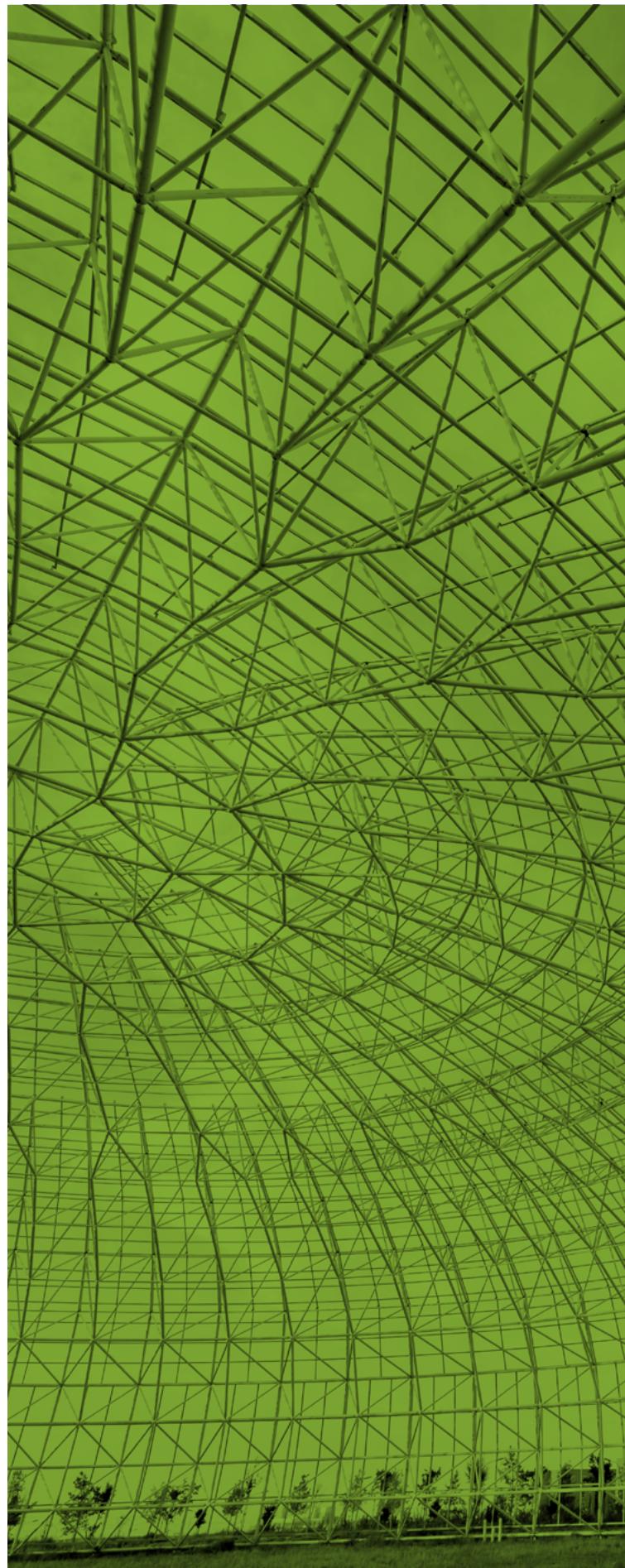
Contrail provides NetOps and SecOps teams control and visibility, while its plug-in to Kubernetes keeps security and networking simple for DevOps teams. Contrail fosters cooperation with central IT because it's the same tool they already use to manage networks, including those in the data center, IaaS stacks, and edge computing hub and spoke architectures.

No. 3: Reducing Complexity

Reducing complexity is a common goal for IT practitioners, regardless of title. Tools that reduce complexity—or which at least promise to—are popular and quickly adopted. Unfortunately, many of these seemingly promising paths to simplicity are traps.

Serverless (and similar) technologies are frequently discussed as such. Serverless can accelerate initial development of an application's features; however, this can ultimately be a self-defeating effort. The services that underpin and enable technologies like serverless are vendor-proprietary, and the lack of portability often creates new challenges as applications scale across geographies, and—inevitably—across multiple cloud providers. This leads us to opportunity Number 4, which is…
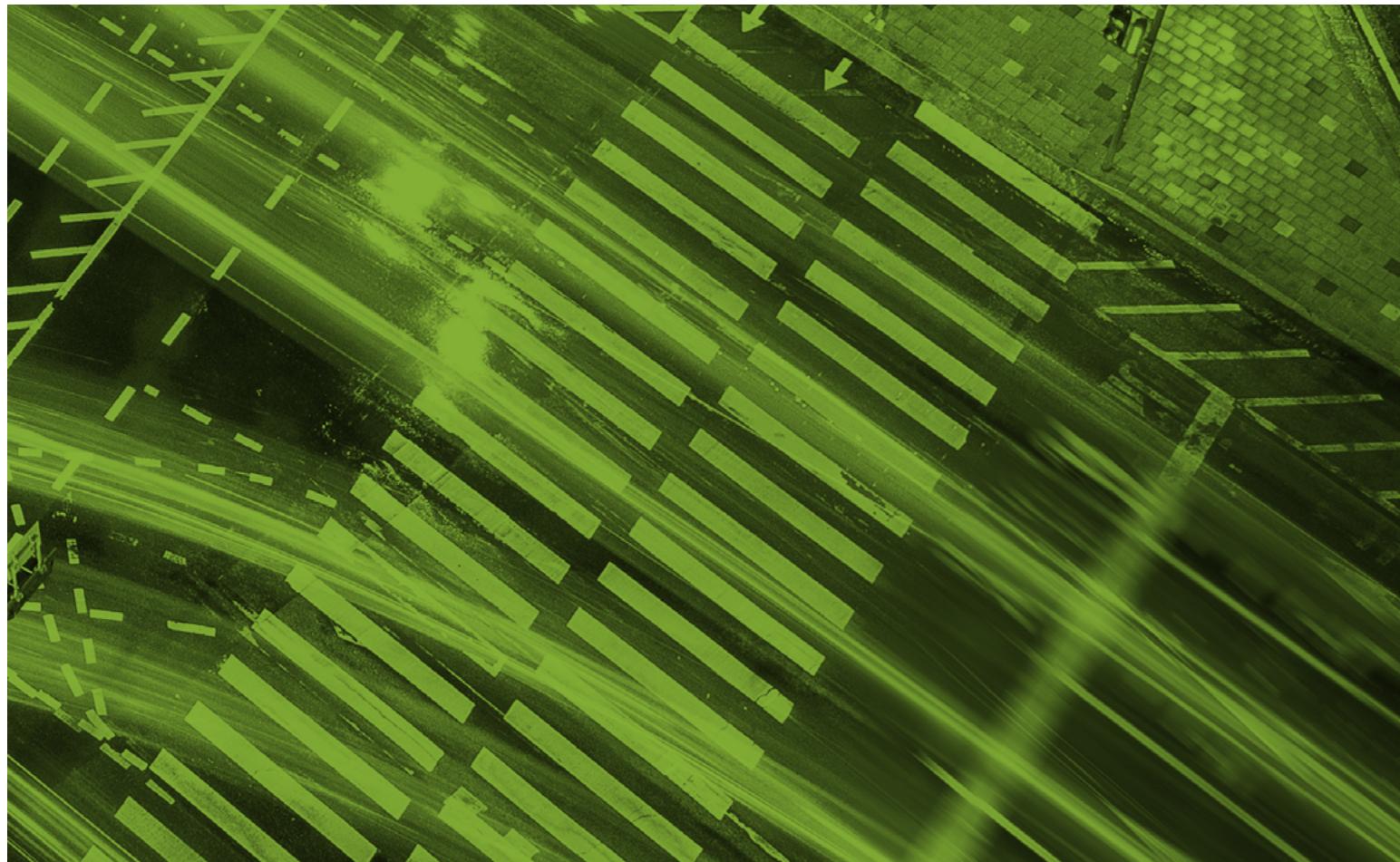
No. 4: Avoiding Vendor Lock-In

One of the aspects of public cloud that is most attractive to DevOps teams is the wide variety of available services. But as you start using more and more services from a single vendor, you may find that you can't port the application or move it away from the cloud provider's proprietary APIs.

There are ways to avoid vendor lock-in. One is to work closely with the centralized IT team to identify tools that can be used commonly across the entire organization, so the tools you are using are compatible with those being used by other DevOps teams or individual lines of business. This also gives IT a way to standardize on a common tool set, which will simplify life in the future.

Another important way to avoid vendor lock-in is to start with managed open source solutions and work only with software and infrastructure providers that support open-source solutions. That way, the APIs don't change regardless of which cloud you are using or whether it is private or public.

Most organizations usually require openness, but not necessarily open source. The use of open protocols, open standards, and the availability of multicloud management tools allow for the creation of applications that work on multiple infrastructures, even if the local implementation of certain services varies slightly.
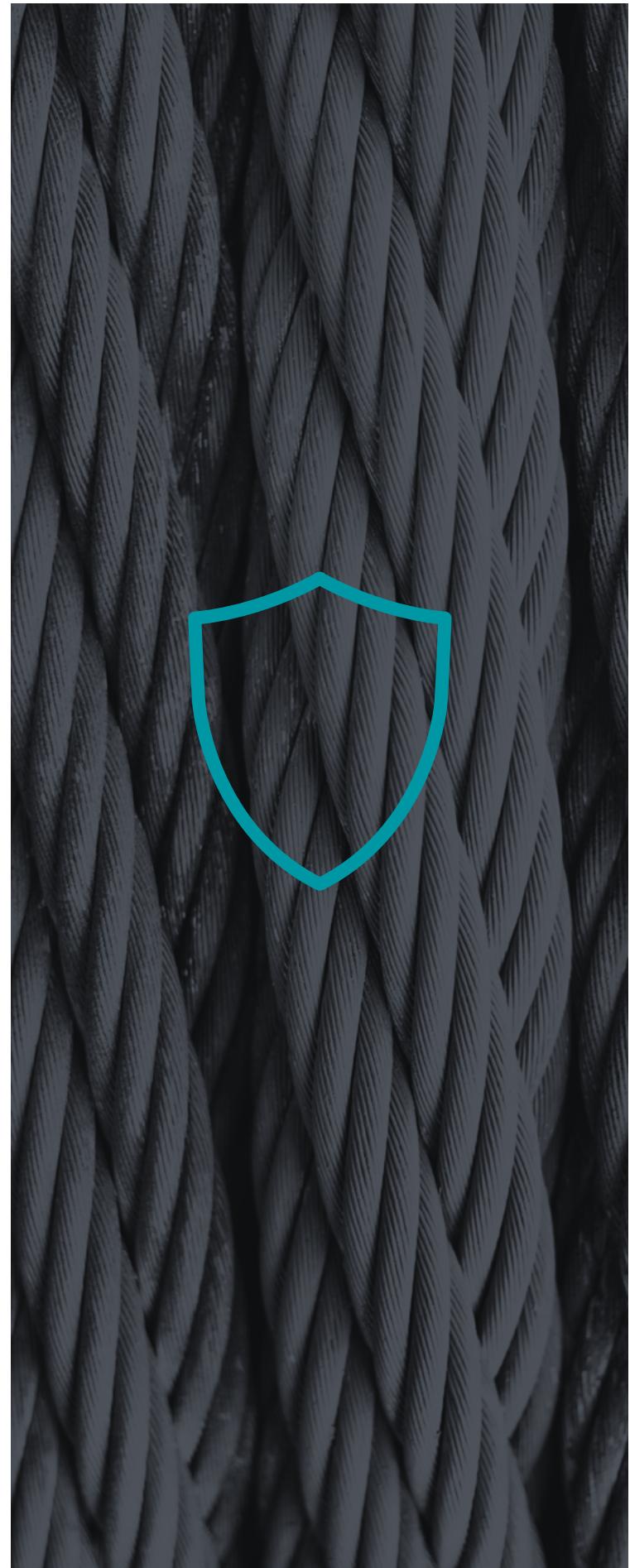
No. 5: Improving Security

The pressure on DevOps teams to be fast usually translates into security being treated as an afterthought—something built into an application during the development cycle, rather than being incorporated from the start. One of the ways to significantly improve security protections is to leverage modern tools and processes to facilitate what is commonly referred to as a "shift left."

A shift left moves security and other infrastructure considerations to an earlier point in the development timeline. Shifting left means that instrumentation, telemetry, monitoring, security, and infrastructure automation must be part of coding, architecture, and pre-production systems.

By collaborating earlier with security professionals and leveraging tools that facilitate security automation, DevOps teams can avoid security problems that do not usually appear until the application has entered the production and deployment cycles.

No. 6: Leveraging Modern Infrastructure

Beyond the clear role of networking between multiple clouds, NetDevOps—or cloud-native networking—has the potential to be a breakthrough technology for microservices architectures. In a microservices architecture, applications are broken down into a number of small (micro) services.

These services must communicate in order to function. This both dramatically increases the number of workloads communicating on the network as well as the importance of the network, including inter-network connectivity. The network plays a role in service discovery, service/API gateways, service advertising with DNS, service resilience (i.e., circuit breaking), service scale-out and scale-in, and load balancing.

Beyond microservices, any state replication, backup, or analytics over an API, a volume, or a disk also rides on the network. In parallel with the shift left, DevOps teams can also benefit by leveraging software-defined secure network infrastructure built on cloud-grade networking principles.

Cloud-grade networking principles are designed to make networks less capital-intensive, more automated, and better suited for innovation, both on and within the network. Network reliability is an important consideration when collaborating with IT teams.

With the growing reliance on multicloud, containers, and microservices, DevOps teams can be crippled by networks that can't deliver the performance, bandwidth, reliability, and availability needed to be fast and agile with respect to application development and deployment.

No. 7:
Using Advanced Intelligence

DevOps teams have an opportunity to work in close collaboration with cloud architects to ensure they are leveraging advanced, modern software for real-time intelligence into operations and performance—which they can, in turn, translate into faster and better development, deployment, and management.

By using telemetry, advanced analytics, and machine learning in real time across all aspects of shared infrastructure, DevOps teams can associate resource consumption with containers and virtual machines. This enables teams to control and visualize how infrastructure resources are used by workloads in order to plan for and provide the capacity needed for smooth application performance.

Juniper Networks Contrail Insights is an example of a currently available solution that leverages big data analytics and machine learning to give DevOps teams the information they need to automate cloud operations. Contrail Insights offers DevOps teams real-time visibility and predictive analytics, which they can use to drive real-time orchestration and optimization capabilities.

Chapter 3
Choosing DevOps **Technologies** and **Partners**

In every major advancement of IT processes and technologies helps tremendously if the key players are willing participants and drivers of change. For DevOps professionals, it is important to recognize the benefits that can be achieved by leveraging hybrid cloud resources and working in close alignment with IT teams and lines of business.

The benefits described in Chapter 2 are all very achievable:

- Lower costs

- Ability to scale applications

- Reduced complexity

- Flexibility to choose multiple cloud providers

- Improved security

- Modern infrastructure Advanced intelligence

To achieve these benefits, it is important to deploy modern, open solutions and work with vendors that are focused on providing DevOps teams with the technologies and environments they need to get to the next level.

Key areas to focus on include:

- Innovative tools to maximize cloud elasticity and programmability.

- Support for open solutions, standardization, and consolidation.

- Consideration of security and networking earlier in the timeline.

- Simplification through automation, analytics, and machine learning.

Work with an Innovative Technology Partner

Juniper Networks is a leading innovator when it comes to enabling and empowering DevOps teams to be more successful in today's complicated multicloud environment, extending its long history of building reliable, secure, and high-performance networking infrastructure for the globe's most demanding networks and clouds.

As the foundational platform for DevOps processes shifts to multicloud environments, Juniper has articulated a vision that cuts across the company's product line and includes solutions that unify policy for automation with seamless integration across a wide variety of tools, such as Kubernetes, OpenShift, OpenStack, Mesos, Tungsten Fabric, and others. This allowsDevOps teams to unify tools across disparate environments, supporting simplicity and scale. Instead of dealing with the complexity of using multiple tools, operators can leverage a single tool that supports unified and harmonized policies.

In addition, Juniper supports open-source solutions and is a pioneer in network reliability and software-defined networking. This allows them to deliver the underlying infrastructure and cloud-native architecture DevOps teams need to ensure security, performance, speed, and agility when building and scaling applications. Juniper's cloud-grade solutions include:

Contrail Networking: Contrail Networking is an open software-defined automation solution that spans the boundaries and use cases of most physical infrastructure, orchestration systems, DevOps tooling, virtualization runtimes, and operating systems. It unifies policy for network automation with seamless integrations for systems such as Kubernetes, OpenShift, Mesos, OpenStack, VMware, a variety of popular DevOps tools such as Helm and Ansible, and a variety of Linux operating systems. Contrail Networking enables DevOps teams to migrate applications and IT resources to hybrid cloud environments without the need to rip and replace existing physical infrastructure. Based on proven open networking standards, open APIs, and the Tungsten Fabric open source project, Contrail Networking can orchestrate virtualized automated networking for demanding, elastic, multicloud environments.

Contrail Insights: Leveraging big data analytics, telemetry, and machine learning, Contrail Insights delivers real-time and historic monitoring, performance visibility, and dynamic optimization features to improve cloud orchestration, security, accounting, and planning for users.

With Contrail Insights, DevOps teams can leverage "self-driving" and intelligent cloud infrastructure with automated operations for real-time visibility, predictive analytics, and real-time orchestration and optimization capabilities. Contrail Insights manages containers, virtual machines, and virtualized network functions (VNFs) to support multitenant, dynamic, and constantly evolving multicloud infrastructure.
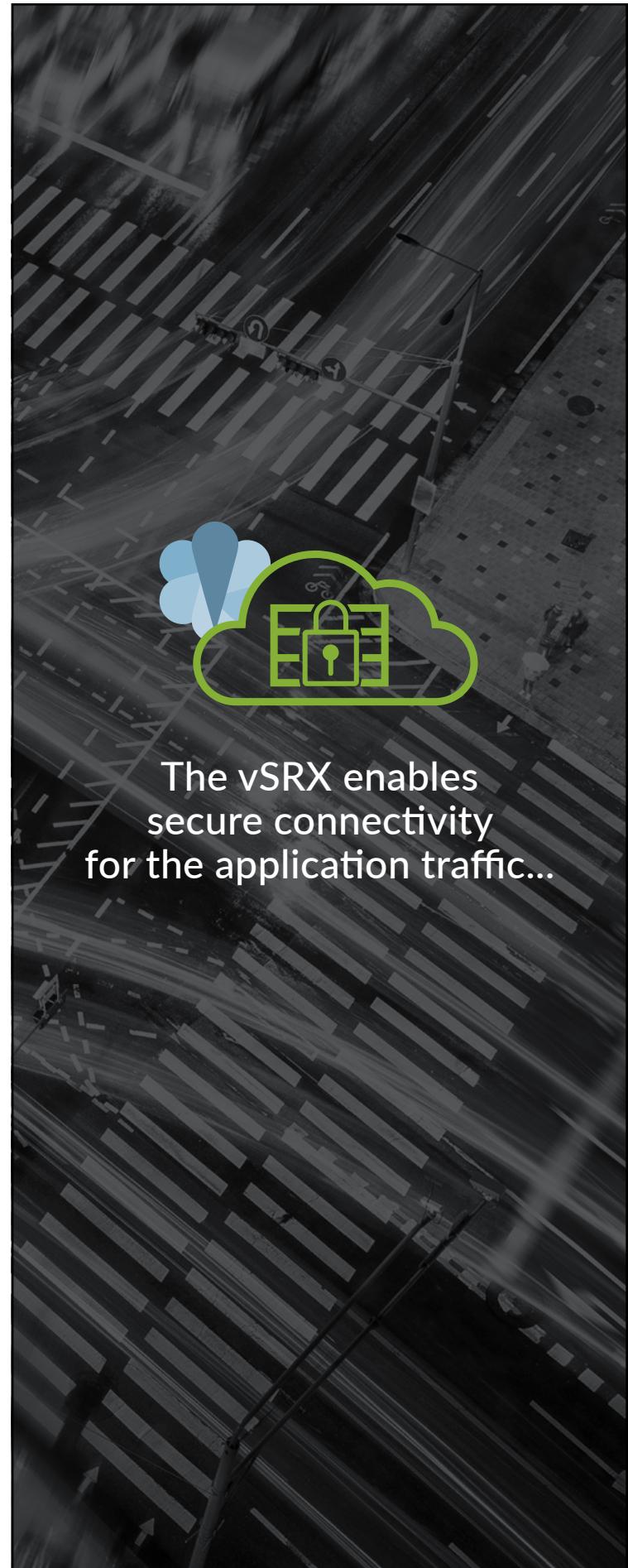
With Contrail Insights, DevOps teams can leverage "self-driving" and intelligent cloud infrastructure...

Juniper Connected Security: Juniper Connected Security is defence in depth achieved through the interconnection of multiple technologies from multiple vendors working together to create a whole that is vastly more capable than the sum of its parts. No single vendor can possibly produce all the technologies necessary to defend all networks, nor would a singular approach to information security adequately defend all networks. Juniper Connected Security helps organizations navigate the heterogeneity of modern networks through a focus on open standards, open protocols, and API accessibility.

vSRX Virtual Firewall: The Juniper Networks vSRX delivers a complete virtual firewall solution, including advanced security, robust networking, and its own automated VM lifecycle management, enabling firewall protection in highly dynamic cloud environments. The vSRX virtual firewall secures multitenant hybrid cloud environments and is available in public cloud marketplaces, including those of Amazon Web Services, Microsoft Azure, Google Compute Platform, and IBM cloud.

cSRX Containerized Firewall: The Juniper Networks cSRX is the industry's first enterprise-class containerized firewall. Orchestrated by Contrail, the cSRX delivers a rich feature set in a very small footprint and instantiates in seconds. The cSRX is extremely useful in a kubernetes environment, it can be inserted, using Contrail, directly into the data path–adding enhanced protection from lateral threats.

vMX Virtual Router: In the multicloud world, DevOps teams need highly agile, scalable, and automated cloud-grade networks to support speed, collaboration, and quality assurance. The Juniper Networks vMX virtual router increases agility by enabling users to quickly implement and scale services by spinning up new routing instances on demand, and by supporting non-disruptive service introductions in parallel with current services. This eliminates the risk, complexity, and delays typically associated with reconfiguring and requalifying existing infrastructure for new services.

The vSRX enables secure connectivity for the application traffic...
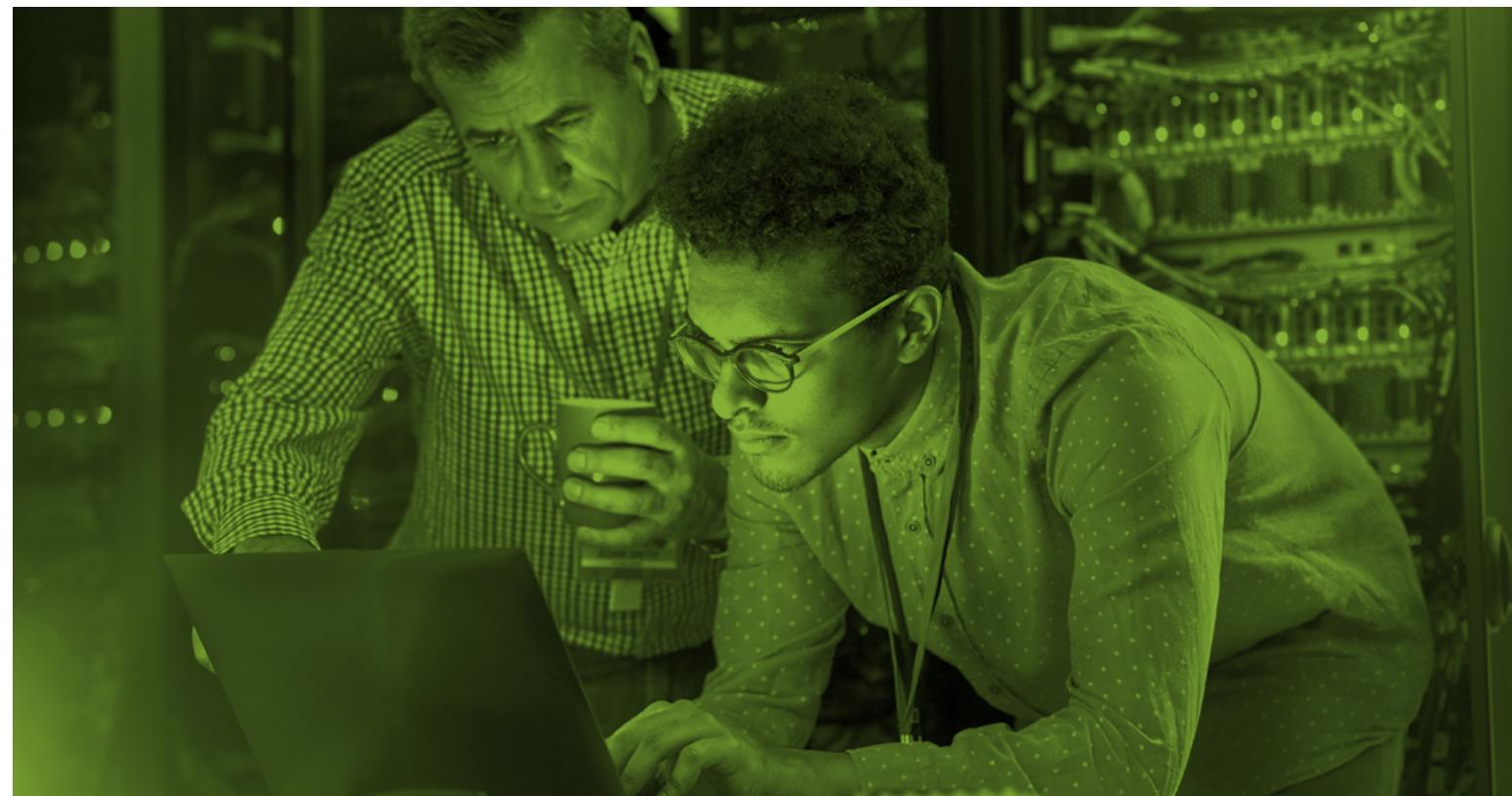
Chapter 4
Conclusion

DevOps has become a critical set of practices, policies, and technologies that organizations are using to empower digital transformation, speed to market, and business innovation. The growing role of DevOps is placing more pressure on individuals and teams to ensure that they are focused on broader organizational imperatives such as security, cost control, and enterprise-wide business-technology alignment.

Today's cloud environments provide the framework to address these issues, but it is critical for DevOps teams to work closely with the larger IT organization and individual lines of business. As a DevOps team member, you must strive to ensure that your applications can scale and are not locked into proprietary architectures and limited options. By choosing the right solutions and partners, DevOps teams can embrace open, scale-out, software-defined hybrid cloud architectures that maximize automation and orchestration to support speed, agility, and reliability.

Juniper Networks has emerged as a leader and innovator in delivering solutions that support, and empower DevOps teams. With leading solutions such as Contrail Networking, Contrail Insights, vSRX and cSRX virtual and containerized firewalls, and vMX virtual routers, Juniper Networks is providing the tools and technologies DevOps teams and professionals need to reach the next level on their journey.

Juniper is pleased to sponsor this e-book in collaboration with TechTarget. We hope you have found it valuable and useful. For more information on how to improve DevOps in the multicloud/hybrid cloud era, please visit Juniper Networks.

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