Essential Guide to Cloud Networking with SD-WAN

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Introduction

We're living in an era of Digital Transformation. The use of digital technologies to transform business is having a dramatic impact across every sector and industry. It is creating competitive advantages, delivering operational efficiencies, and improving user experiences.

Cloud computing is a major catalyst for Digital Transformation. In fact, most companies today have a cloud strategy and are aggressively adopting the Cloud. Their IT organizations are embracing cloud services to host applications that had been running in or would otherwise be deployed in on-premises data centers.

This movement towards cloud services, spurred by executive mandates, is motivated by advantages the Cloud promises. These include increasing business agility by achieving greater elasticity and scalability for application software; speeding the development and deployment of new applications; streamlining costs with a pay-as-you-go model that is better aligned to actual usage; and reducing capital expenditures for equipment and data center facilities.

Use Cases for SD-WAN

SD-WAN can improve Cloud connectivity and enterprise networking when you are:

- ✓ Adopting more cloud-based applications and services
- ✓ Connecting more branch/remote sites directly to the Internet
- ✓ Managing network traffic with performance and security requirements that vary by application, users, and locations
- ✓ Connecting to multiple instances/VPCs in the Cloud
- ✓ Providing temporary VPN connections to the Cloud for DevOps and other purposes
- ✓ Setting up hybrid WAN topologies that connect enterprise sites
- ✓ Improving utilization of redundant/backup WAN circuits

Cloud Success Depends on Networks

Unfortunately, many organizations are unable to fully realize the benefits of cloud computing. The reason? Their networks. This is because cloud application reliability and performance are highly dependent on the network — from end-users to clouds, within clouds, and between clouds.

While compute and storage technologies in most IT organizations have kept pace with the advances in the Cloud, networking is significantly behind.

Major cloud service providers, such as Microsoft Azure and Amazon Web Services, have implemented robust, state-of-the-art networks within their clouds. However, networking outside of clouds remains archaic, brittle and device-centric.

As a result of the cloud shift, there are new demands and greater pressures on traditional networks and their administrators, who have already been suffering from time-consuming and complex network management methods for decades. In today's digital revolution, they can no longer keep up.

New technologies such as SD-WAN are making networks more flexible and programmable. **Software-defined wide area networking** (SD-WAN) greatly simplifies operations and eases the management burden of WANs. It also improves the performance of cloud-connected networks and can work together with WAN optimization, an established network technology, towards this end.

The network must be a strategic asset that emulates the Cloud — elastic, dynamic, and software-defined. This Essential Guide to Cloud Networking with SD-WAN explores how organizations can overcome networking challenges that are holding back their cloud ambitions and take the next steps with SD-WAN to simplify network connectivity to the Cloud.

“The traditional WAN first emerged during the client/server era, when applications resided exclusively in enterprise data centers. As such, the WAN was not architected for the Cloud. This is the reason we have seen the rise of SD-WAN, which responded to the needs of enterprises that are increasingly dependent on the Cloud.”

IDC: Ensuring Network and Application Performance for AWS, Microsoft Azure, and Other Public Cloud Providers
Brad Casemore, August 2017

Download this white paper at riverbed.com/IDC-ensuring-performance

Chapter One:

The Challenges of Cloud-Connected Networks

Fifteen years ago, global IT networks were secure and operationally efficient. Routers were mainstream, and MPLS links connected enterprise sites. But things have changed a lot since then.

Over time, the complexity of networks has steadily increased — even before the arrival of the Cloud. The number of network protocols to support has increased. Likewise, the use of policies governing access control, QoS (quality of service), and routing has grown.

From a physical standpoint, Hybrid WAN, which introduced broadband Internet as a cost-effective (although less reliable) alternative or replacement to MPLS connections between enterprise sites, has added to network complexity. Mobile workers and their devices have added another dimension to networking, driving the needs for expanded remote connectivity and pervasive deployment of wireless LANs.

Now, factor in the impact of Cloud.

The New Network Reality

Complex, Insecure, Unpredictable

Figure 1. The New Network Reality. Most enterprise networks are out-of-date, brittle and device-centric. IT teams are trying to manage global networks with tools designed for the way things were 15-20 years ago. Performance is unpredictable on the Internet and other public networks used to connect enterprises to cloud-based applications.

While major cloud service providers, such as Microsoft Azure and Amazon Web Services, have embraced new networking technologies for use inside their clouds, most enterprise networks are out-of-date, brittle, and device-centric. Overall, the enterprise network of today is an incredibly complex, insecure, and unpredictable environment.

Today's enterprise networks are holding organizations back from fully achieving their cloud ambitions. IT teams are trying to manage global networks with a set of tools designed for the way things were fifteen years ago.

Greater reliance on cloud-based applications has led many organizations to rethink their network designs. The added latency and congestion that typically comes with backhauling cloud traffic from edge (remote/branch) sites through a central point of access has led many IT teams to increase the number of break-out points to the Internet, other public networks, and private networks.

IT generally sets up redundant WAN connections from edge sites to clouds through more than one communication service provider (CSP), sometimes using multiple means of connectivity—Internet, MPLS, and even LTE or cable—to maximize availability.

Setting up a network can be a complex process, as IT often must work with disjointed technologies and existing network equipment from multiple vendors.

Consider the challenge of deploying network devices to an edge location that lacks IT staff. A network specialist typically travels to the site and installs the equipment. This involves physical installation, updating the software (if needed), configuring the devices, and testing the network connections. Many of these tasks must be done using a CLI (command line interface)—an approach that is tedious and error-prone.

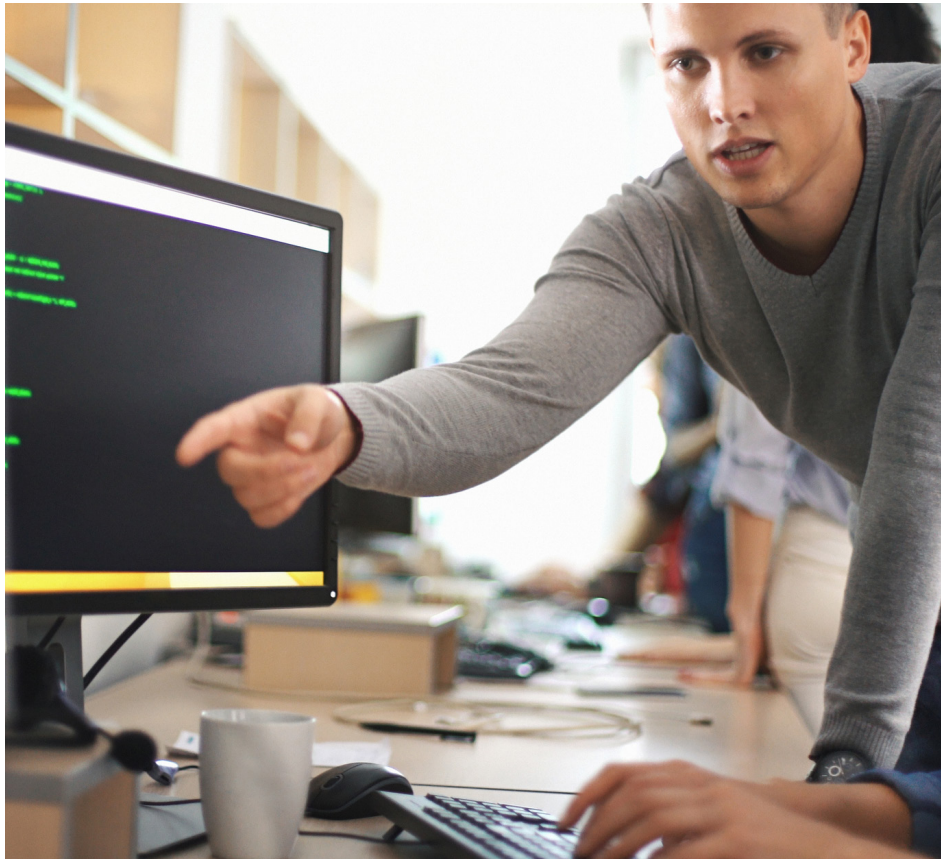
5 Reasons Why IT Organizations Struggle with Cloud Connectivity:

1. Complexity of designing and building networks that connect a large number of sites to public clouds
2. Issues deploying and managing dynamic, cloud-connected networks with traditional methods that are inefficient, slow, and error-prone
3. Meeting needs for both security and performance when deciding where and in how many places to connect to public networks *[See page 21]*
4. Unpredictable performance of the Internet and other public networks which impacts application performance and end-user productivity
5. Difficulty identifying and troubleshooting performance issues due to visibility gaps

Managing by Policy

Then there is the ongoing work of network management, which includes implementing policies that govern security and performance for applications, users, and sites.

For example, if executive management decides that traffic associated with a critical application must be routed across network links meeting a certain standard of security, implementing this policy using traditional methods (via a separate CLI for each network device) would take an administrator hours to complete. Moreover, the risk of an error being made increases with the number of devices. This approach is not consistent with the cloud computing paradigms of automation, elasticity, and efficiency.



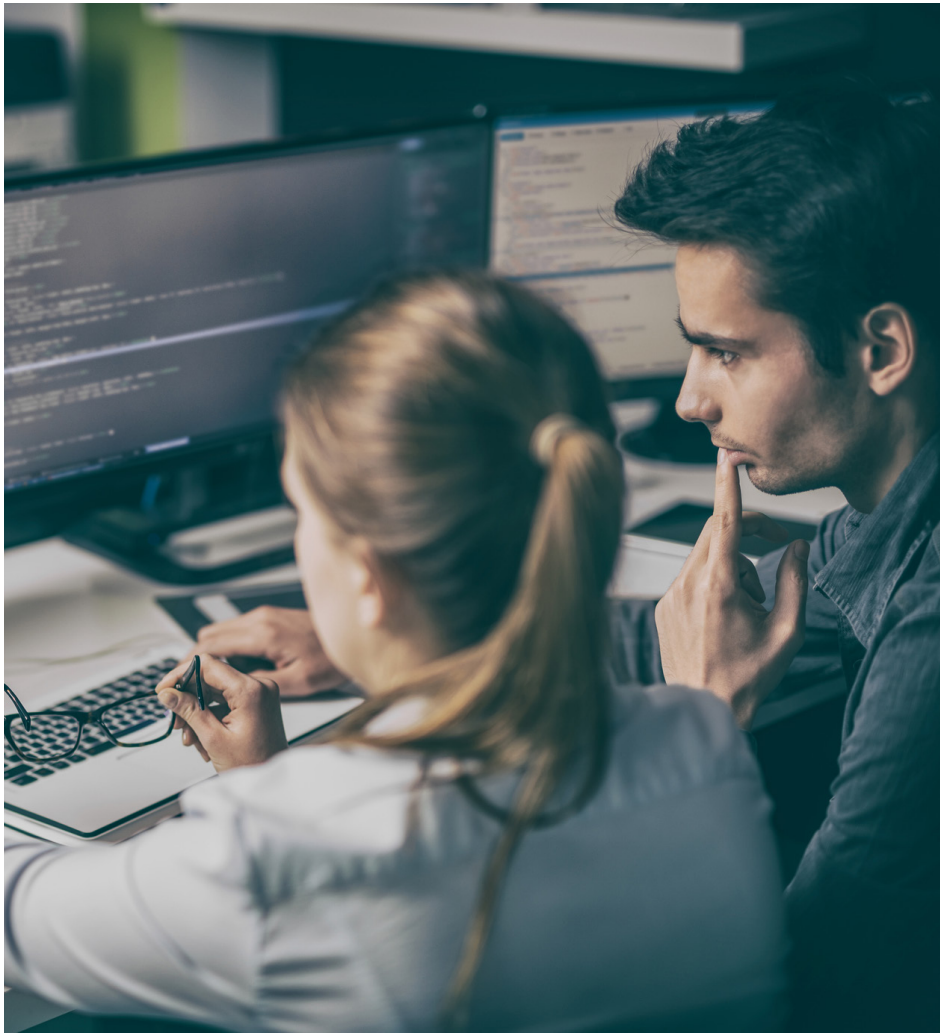
Assuring Application Performance

The next challenge for IT teams is performance assurance and visibility. The loss of control over the application stack and servers in conjunction with the dependency on public networks to connect end users with application services means unpredictable performance. In particular, congestion on the last mile of a public network can ruin what would otherwise be good application performance. Unfortunately, the SLAs of cloud service providers stop at the edge of the Cloud.

Guaranteeing performance requires end-to-end visibility. However, many IT teams use a collection of "siloed" monitoring tools for devices, networks, applications, and infrastructure with uncorrelated data and separate interfaces. This leaves visibility gaps that can make it difficult to identify performance issues and troubleshoot their causes.

The combination of outdated network management practices, incomplete monitoring tools, and unpredictable Internet connections to public clouds can leave IT teams overwhelmed.

Changes are needed for most enterprises to catch up with the demands of Cloud. In the next chapter, we'll discuss how organizations can simplify network connectivity and overcome the complexity of cloud-connected networks by turning to SD-WAN.



Future of Networking Global Survey 2017

A Riverbed-commissioned study, which surveyed 1,000 IT decision makers from around the globe at companies with $500 million+ in revenue, explores the impact on legacy networks and roles that next-generation networks and SD-WAN play in helping companies adapt to transformational changes in their industry.

97% say their legacy network infrastructure will have difficulty keeping pace with changing demands of cloud and hybrid networks.

91% agree that their organization's cloud strategy will only reach its full potential with a next-generation network to support it.

98% agree, and 49% strongly, that in the next two years SD-WAN will be critical to next-generation networks and helping to manage cloud and hybrid networks.

Download the full report here at riverbed.com/future-of-networking

Chapter Two:

How to Simplify Network Connectivity

As IT organizations strive to be more agile and responsive to changing business needs, the Cloud has become central for many in achieving this goal. Fully embracing cloud computing, however, requires a fundamental rethinking of enterprise networking.

SD-WAN simplifies cloud connectivity. The rise of software-defined networking (SD-WAN in particular) has introduced revolutionary changes. Now, IT organizations can design, deploy, and manage complicated networks with much greater speed and efficiency.

What makes this possible? SD-WAN offers the ability to:

- Manage many network devices from a single, central console with an intuitive, graphical user interface, rather than separate CLI management interfaces for every network device.
- Automate simple tasks and orchestrate the complicated workflows needed to deploy cloud-connected networks.

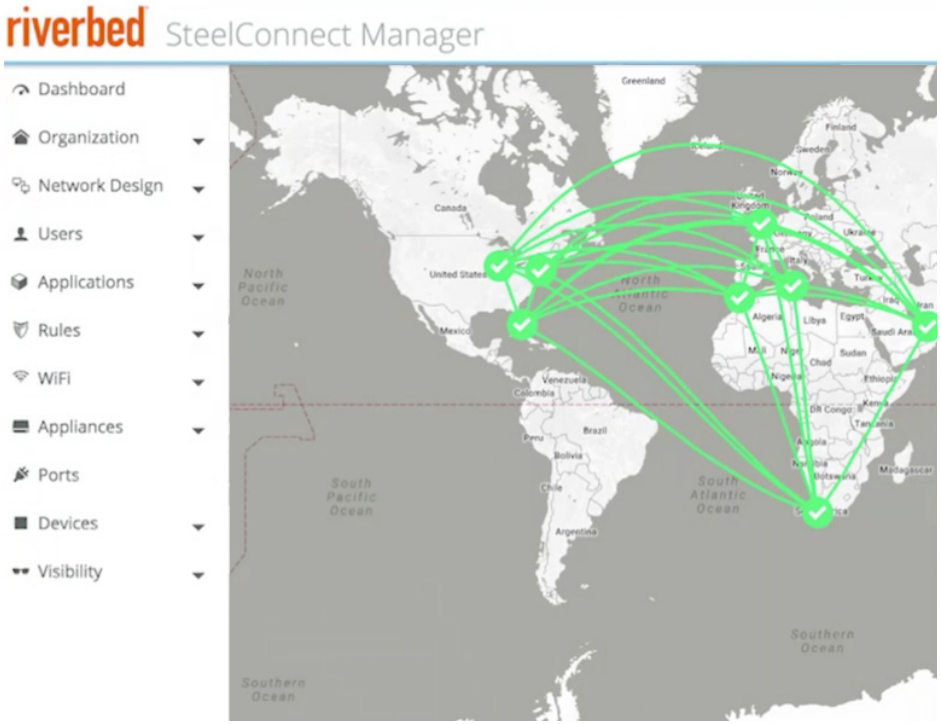


Figure 2. SD-WAN is managed from a single, central console with an intuitive, graphical user interface instead of separate CLI interfaces for every network device. This screen provides a quick look at the operational status of all WAN connections between sites.

Zero-touch Deployment

Let's revisit the scenario of setting up cloud connectivity at an edge location lacking in IT staff. This required the network specialist to travel to the site to install the equipment, update the software (if needed), configure the devices, and test the network connection—mostly using tedious command line interfaces.

The same task can be accomplished with SD-WAN using zero-touch deployment. Instead of traveling to the site, an administrator designs the network node from a central management console using a graphical interface. An SD-WAN appliance is then shipped to the edge location where a person with minimal IT skills simply unpacks the appliance, attaches network cables, and turns on the power.

After discovery and identification, a secure connection is made between the appliance and the SD-WAN controller, which proceeds to update the software (if needed), configure the appliance, apply default policies, conduct remote tests, and bring it online. A secure, full-mesh network can be established with links to other SD-WAN-enabled enterprise sites and to designated public cloud service providers in a matter of minutes. This is all done with automation and orchestration – there is no need for a network specialist to take any action. His or her work was completed in the design phase.

High Flexibility

What's more, SD-WAN can be implemented in various ways, including with physical appliances (fully integrated hardware and software in a "box") or as software running on a virtual machine (VM) on commodity hardware. Likewise, SD-WAN can be implemented in Clouds, such as AWS or Microsoft Azure, with one or more instances of the SD-WAN software running on cloud infrastructure.

Cloud-based SD-WAN gateways can be used not only to steer traffic between a public cloud and application users in the enterprise but also to manage traffic between public clouds and across hybrid clouds. This is significant because application architectures are increasingly distributed across multiple data centers.

More than this, however, is required to make a quantum leap in productivity of network administrators and to bring about a substantive increase in business agility.

"The ability to enable a new connection so quickly, instead of the weeks or months it took in the past, is really important for the success of our SaaS offerings."

Craig Bruce, Scientific Software Developer, OpenEye

Automated Policy-based Management

It is essential to have automated management that implements intent-based (business-aligned) policies with speed and consistency. Take, for example, executive management deciding that traffic associated with a particular group or application must be routed across network links that meet a certain standard of security.

This directive can be implemented quickly by a network administrator using the policy engine of an SD-WAN controller. A new rule will be downloaded to all SD-WAN devices. Then, when packets entering the device are inspected and identified as being associated with the critical application, they will be forwarded onto a network path meeting the security requirement.

Business-aligned policies can also be implemented to give certain applications, users, or groups better network performance. For example, latency-sensitive traffic of unified communications, such as Skype, WebEx, etc., can be routed onto the fastest available path. Conversely, the traffic of storage backup from personal computers to the Cloud can be given a lower performance priority.

With SD-WAN, IT organizations can accomplish more, faster, and have greater agility and responsiveness to the changing needs of the business.

In the next chapter, we'll explore how SD-WAN can improve network and application performance.

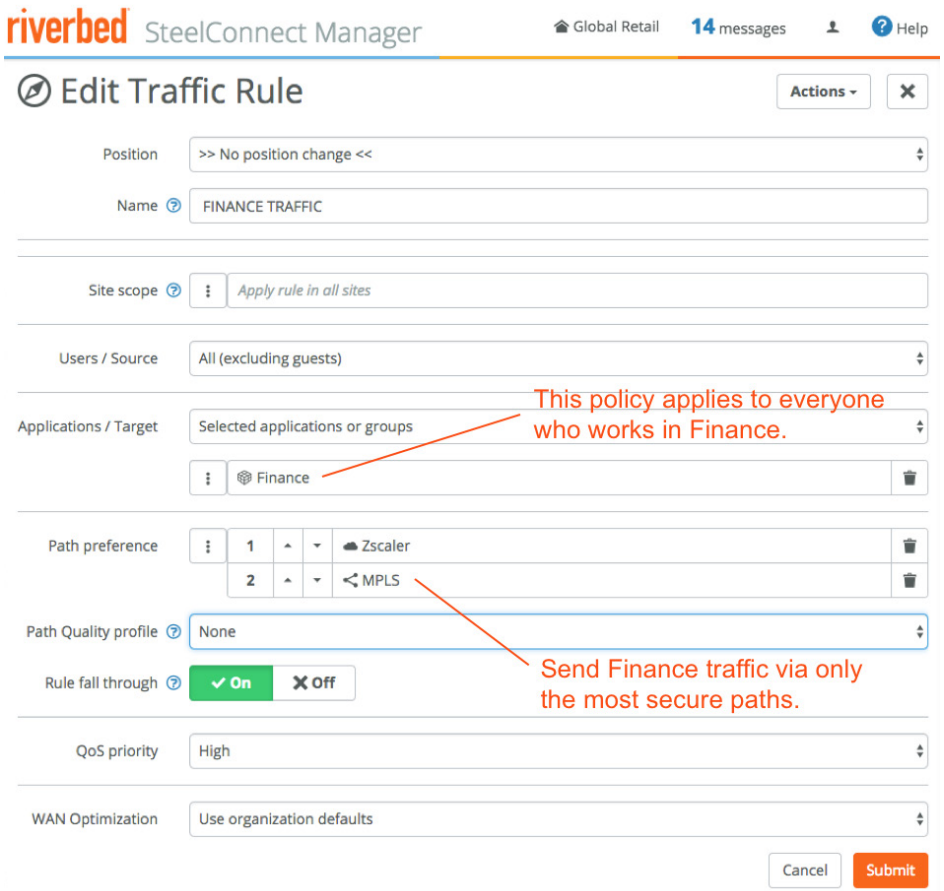


Figure 3. Intent-based policies aligned with business needs are easily implemented as SD-WAN traffic rules that govern security and performance for applications, user groups, and locations.

SimplePay: Building Agile Networks with SD-WAN

When Australian start-up SimplePay decided to take its payment processing service global, the first priority was to replace its existing networking infrastructure with one that would deliver the security and reliability the company needed to scale its agile business.

SimplePay decided to partner with Riverbed and Amazon Web Services (AWS) to quickly rollout a global application and network infrastructure. Riverbed® SteelConnect™ for AWS, an SD-WAN solution that automates cloud connectivity for hybrid cloud environments, enabled SimplePay to deliver its service to new sites quickly, securely, and cost-efficiently, paving the way for future growth.

> "We now have the ability to very quickly build and deploy a global network in a matter of hours, which would have taken months of planning and deployment before."

Rob Gillan, CTO, SimplePay

Watch the Video
at **riverbed.com/simplepay-video**

Chapter Three:

Methods of Improving Performance

Poor application performance directly impacts the business — from end-user productivity all the way to customer experience and a company's brand perception.

Faced with unpredictable performance of the Internet and other public networks, and inconsistency of application performance across users and geographies, organizations are turning to SD-WAN for performance assurance across their cloud-connected networks.

SD-WAN can improve application performance in the following ways:

1.

SD-WAN can identify network traffic by application, user, or the source/destination and treat it differently.

An administrator can use the SD-WAN policy engine to create a set of rules so SD-WAN devices will use an appropriate network path for each application. This opens the door to using broadband Internet more effectively in conjunction with traditional MPLS links.

For example, SD-WAN can steer the packets of critical applications down paths with adequate bandwidth and minimal latency. On the other hand, policies can also be set so lower priority traffic of Internet browsing and file backups is always sent across the most cost-effective connections, where performance may be less reliable.

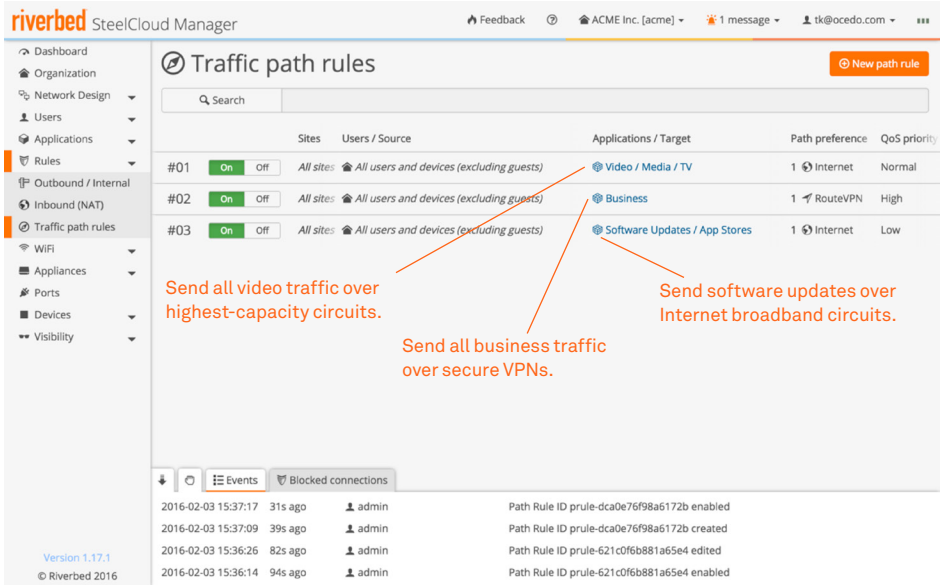


Figure 4. Business-aligned policies can be defined to govern the performance of applications, users, and locations. New policies and changes are automatically translated into operating rules that are instantly downloaded to all SD-WAN devices.

2.

SD-WAN steers traffic around last-mile congestion on connections to the Cloud.

SD-WAN monitors the health of each network link using metrics that include latency, packet jitter and dropped packets. These metrics get worse when there is congestion or another problem on a WAN connection. SD-WAN can be set up to recognize this and steer traffic that would have gone onto a congested link down an alternate, healthier path.

3.

WAN optimization (or WAN acceleration) and SD-WAN can be used together.

SD-WAN can steer network traffic around congested links to improve performance. However, it cannot help if all of the available paths are bad. WAN optimization can improve performance across congested links and high-latency connections.

Using a combination of methods including deduplication and compression, WAN optimization can dramatically reduce the number of packets sent across a WAN connection, which decreases bandwidth requirements. Similarly, WAN optimization can mitigate the effects of latency by streamlining inefficient protocols when the application server and the client are separated by long distances.

While SD-WAN and WAN optimization improve performance, the next step is to assure performance. In the next chapter, we'll share how IT can close visibility gaps with monitoring tools and provide end-to-end visibility needed to proactively identify and troubleshoot performance issues.

Use Cases for WAN Optimization

You can improve network and application performance with WAN optimization when:

- ✓ Latency is high due to long distances between end users and application servers
- ✓ Bandwidth is constrained because of limited capacity and/or traffic congestion
- ✓ "Chatty" protocols (e.g., SMB, MAPI) slow data transmission

WAN optimization is particularly effective with applications such as email, collaboration software, and cloud-based storage that move lots of files across the network.

Security and Performance:

Do you need to sacrifice one for the other?

Connections to the Internet and other public networks are points of vulnerability in enterprise networks. Often, organizations backhaul network traffic between edge (remote/branch office) sites and public clouds through a central location where comprehensive security software is in place. However, a long network path increases latency and may cause slow application response times.

Alternatively, to shorten the network path and improve performance, IT can enable connections from edge sites to public clouds with Internet breakouts. This presents IT with what seems to be a trade-off between performance, security and operational costs — choose either weaker security or an investment in deploying and managing robust security at each point of Internet access.

SD-WAN can help IT organizations balance the needs for performance and security at edge locations:

- Many SD-WAN appliances come with a perimeter firewall which, combined with VPN, will provide adequate security for many needs.
- SD-WAN devices can identify network traffic by source/destination, application, and users. Traffic is then routed according to centrally-defined security policies.
- Connections with trusted SaaS providers that use encrypted transmission can go directly across the Internet.
- Traffic to/from untrusted websites can be steered through a central Internet access point with stronger security.
- Confidential network traffic going to/from public clouds can also be routed through a highly secure, central access point.
- Alternatively, external network traffic that is confidential or going to/from untrusted sites can be sent through a cloud-based security service (e.g., Zscaler).

Chapter Four:

Monitoring to Assure Performance

What happens between the end user and the application server? Or with an application that is running in the Cloud? For many IT teams, it's a mystery. But IT organizations remain accountable for application performance and responsible for identifying and troubleshooting performance issues. IT can no longer rely on "siloed" monitoring tools that leave visibility gaps and create uncertainty.

IT needs monitoring tools that provide end-to-end visibility — from users, across the network, and into the Cloud — to assure application performance.

This can be realized with digital experience management tools that are seamlessly integrated to remove blind spots

1. End-user experience monitoring (**EUEM**)
2. Application performance management (**APM**)
3. Network performance management (**NPM**)
4. Infrastructure management (**IM**)

"69% of decision makers lay the blame equally on their legacy networking infrastructure and a general lack of visibility when asked what is likely to prevent their cloud strategy from reaching its full potential."

Future of Global Networking Survey 2017

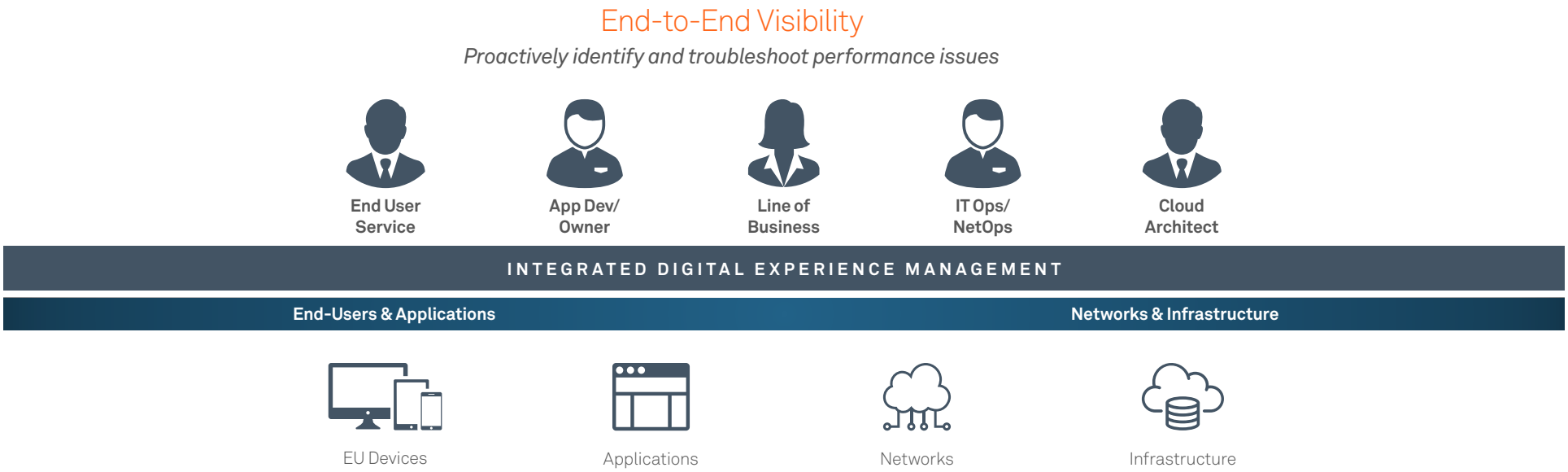


Figure 5. End-to-End Visibility. IT teams need integrated monitoring tools so they can proactively identify and troubleshoot performance issues.

EUEM uses a software agent running on the end-user device to monitor every process and record how long it takes from a user click to the resulting display update. IT can set thresholds for acceptable response times and get an alert when the service objective is not being met.

APM uses software instrumentation to directly monitor the performance of an application. It can spotlight a problem in the code or with the application server.

NPM gives IT the ability to monitor network health and analyze data to identify network performance issues and their causes.

IM is a broad category. In this context, IM is used to capture infrastructure information, detect performance and configuration issues, map application network paths, and troubleshoot infrastructure problems.

Using a combination of these monitoring tools, IT can blend and correlate analysis from all domains to provide role-specific insights. When everyone is looking at one management console with data combined from multiple sources, this can dramatically speed up troubleshooting efforts.

With proactive detection, IT can troubleshoot and fix performance issues before they affect end-user productivity. This leap in visibility can go a long way to restoring a sense of control to IT teams responsible for cloud-based applications.

In the final chapter, we'll offer recommendations on how to begin your journey to better cloud networking with SD-WAN.

Chapter Five:

Starting the SD-WAN Journey

It's time for a new approach to networking. Enterprise networks need to catch up to the tremendous advances in cloud computing, and IT organizations need the technologies and tools to simplify network connectivity, improve performance, and provide end-to-end visibility.

SD-WAN is simplifying connectivity to the cloud, speeding the traffic of critical applications, and giving network administrators the ability to manage policies instead of devices. Monitoring tools that provide end-to-end visibility give IT the ability to proactively manage cloud application performance. Having more control over cloud-connected networks, IT can respond with speed and agility to changing business needs.

Is your organization ready to move to SD-WAN for cloud-connect networking? Here are some steps you can take to move forward.

1. Learn what IDC says about Ensuring Network and Application Performance for Cloud at **riverbed.com/IDC-ensuring-performance.**
2. Watch an informative technical demonstration of SD-WAN capabilities at **riverbed.com/SCM-demo.**
3. Estimate how much you can save by using SD-WAN at **riverbed.com/SDWAN-ROI-calculator.**

Try Riverbed SteelConnect for Free

SteelConnect is a complete SD-WAN solution for securely connecting users and businesses to the applications they need, wherever they reside — on a remote LAN, in a data center, or in the cloud.

Start Your Free Trial of SteelConnect Today!

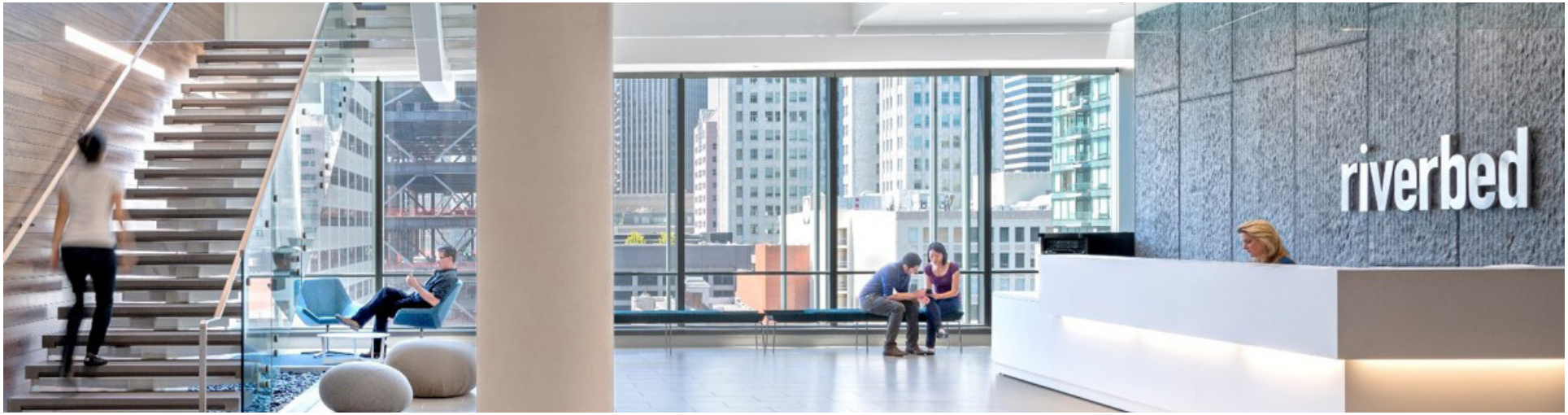
FREE TRIAL

riverbed.com/SDWAN-free-trial

"Our company deployed Riverbed's SD-WAN solution SteelConnect across 50 new offices in just four weeks, and we anticipate saving $1 million annually."

Elizabeth Harper, CIO, GHD

About Riverbed



Riverbed enables organizations to modernize their networks and applications with industry-leading SD-WAN, application acceleration, and visibility solutions. Riverbed's platform allows enterprises to transform application and cloud performance into a competitive advantage by maximizing employee productivity and leveraging IT to create new forms of operational agility. At more than $1 billion in annual revenue, Riverbed's 29,000+ customers include 97% of the *Fortune* 100 and 98% of the *Forbes* Global 100. Learn more at **riverbed.com.**