



Software- Defined Networking



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New Choices

An IT pro today must keep one eye on ROI, but the prize is elsewhere—the ability to deliver IT services fast enough to support modern applications that help business find and serve customers.

IT faces mounting pressure to reduce CAPEX and OPEX. They operate on legacy in-house networks strained by mounting usage demands and growing complexity while also sorting out the best path to modernizing. Meanwhile, inflexible physical networks mean every new request takes longer and longer to fulfill.

And new requests keep coming. Mergers and acquisitions create head-on collisions between competing networks, and it's the IT professional's job to build bridges. The use of streaming video, social media, virtual reality and games, and line of business applications and databases is expanding rapidly, a growing burden for private and public cloud implementations. More and more employees are working remotely in increasingly complex situations. Amidst this, employees everywhere are taking personal devices to work and taking work devices home, and they just want things to work securely, and they want it right now.

This crush of complexity and demand is increasing pressure on corporate networks, so much so they must bend or break. For many, bending means turning to software-defined networking, which allows organizations to rise above typical in-house networking roadblocks.

If you're considering SDN, you're not alone. IT decision makers are increasingly looking at it as a way to solve networking woes—29 percent of those surveyed by TechTarget at the end of 2014 said network virtualization would be one of their key initiatives for 2015, and 16 percent of those surveyed specifically said SDN was a key implementation target that same year¹.

¹ 2015 Purchase Intentions Survey, TechTarget, December 2014, [SDN and Virtualization Top the List: 2015 Networking Priorities](#)

Taking Stock of Software-Defined Networking

Software-defined networking helps organizations support growth and change. It helps IT provision new applications faster, optimize for high quality connectivity and stability for priority tasks, and support multiple tenants with conflicting IP addresses while allowing for varying levels of isolation.

With software-defined networking, control of the network moves from hardware to software, which reduces operational rigidity and enables new levels of efficiency, flexibility, and scale.

Organizations that have made the move are using software to make networks pooled, automated resources that support isolated tenants and virtual machines and help them seamlessly integrate across datacenter boundaries and into the cloud. Software can also help them extend the capabilities of existing network investments, dramatically decrease solution times, and gain new, unprecedented flexibility.

Benefit	Legacy physical network	Modern virtualized network (Software-defined network)
Agility	<input type="checkbox"/> Diversity and manual provisioning.	<input checked="" type="checkbox"/> Automated provisioning, integrated process.
Efficiency	<input type="checkbox"/> Complex hardware and lack of automated operations.	<input checked="" type="checkbox"/> Simplify requirements, optimized design, and unified infrastructure.
Availability	<input type="checkbox"/> Siloed infrastructure and operations.	<input checked="" type="checkbox"/> Resilient, automated monitoring and remediation, low human involvement.

Table 1: Traditional versus modern networking. Modern workloads require more flexible networking environments than available with traditional, rigid, physical networking infrastructures. Software-defined networking helps make your network a pooled, automated resource that can be controlled more easily.

Today, customers using hyperscale public clouds such as Microsoft Azure already reap the benefits of software-defined-networking. When an Azure customer logs into his Microsoft Azure portal, he deploys a few of his virtual machines and an application or two. Everything works. There's no concern about whether the configuration is consistent across his entire infrastructure or how the network will scale as application usage increases.

Meanwhile, customers using Windows Server 2012 R2 and System Center 2012 R2 today can benefit from the Microsoft SDN solution in their own datacenter, building on their existing network hardware.

And in the near future, they are in a position to benefit from more capabilities when Windows Server 2016 is released next year.

IT decision makers are taking notice.

“The ability to virtualize network traffic without reengineering our base physical network infrastructure is huge,” says Alan Bourassa, chief information officer at EmpireCLS Worldwide Chauffeured Services.

Echoing Bourassa, Neil Merton, Innovations and IT Development Manager at Outsourcery, is focused on isolating his network traffic by partner.

“We are excited about the Hyper-V Network Virtualization feature in Windows Server 2012 because it will help us isolate network traffic from different partners and their respective customers without using VLANs, and we can move virtual machines as needed within our virtual infrastructure while preserving their IP addresses,” says Merton.

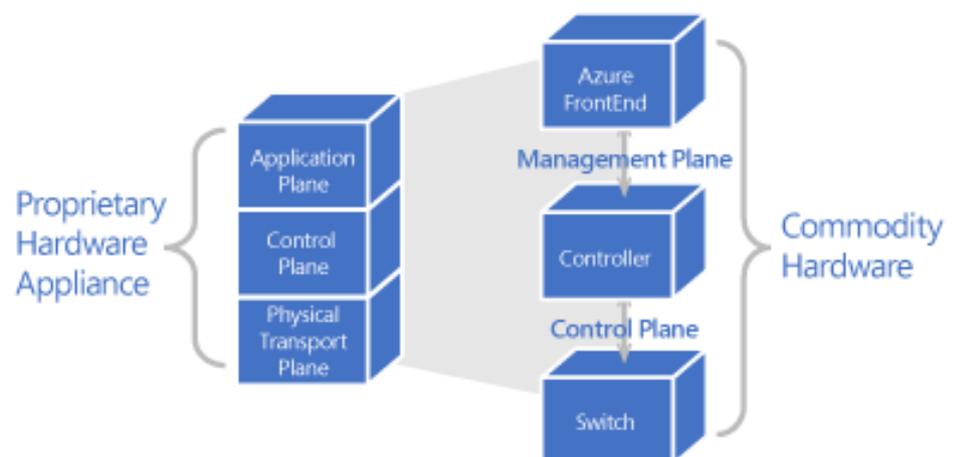


Figure 1: How software-defined networking works. Software helps you abstract the physical networking resources from the physical transport plane. The control plane enables software to centrally control the resources and the management plane helps provision and operate the control plane layer. The physical transport plane integrates with the underlying physical hardware via standard APIs—deep integration supports existing hardware investments and end-to-end troubleshooting.

The configuration changes that Bourassa and Merton are talking about occur automatically, without requiring user interaction. Software-defined networking insulates operators from the

complexities of the underlying physical infrastructure, resulting in workload portability and fine grained control. In the software-defined datacenter, bonds between the application and underlying hardware—we're talking about the switches, routers, and other hardware that you already have—are decoupled.

Think of SDN as a layer of software that works with any hardware you might have. Aligned with the Open Daylight protocol, and focused on interoperability and openness, using the Microsoft SDN solution to abstract your existing physical hardware means you aren't forced to invest in new hardware—you just keep using what you have. And the Microsoft SDN solution comes included with Windows Server 2012 R2, so there is no need for you to purchase a separate SDN solution.

Support for Open Standards

Microsoft supports key standards in its software-defined networking solution.

Open vSwitch, supported in the upcoming release of Windows Server 2016, is an open-source software switch designed to be used as a vSwitch (virtual switch) in virtualized server environments. A vSwitch forwards traffic between different virtual machines (VMs) on the same physical host and also forwards traffic between VMs and the physical network. Open vSwitch is open to programmatic extension and control using OpenFlow and the OVSDB (Open vSwitch Database) management protocol. The Open vSwitch project includes open-source OVSDB client and server implementations.

The Open Management Infrastructure (OMI) helps simplify multi-vendor device management for inclusion in the overall Microsoft SDN solution architecture. OMI is a portable, small footprint, high-performance Common Information Model (CIM) Object Manager. Using OMI and System Center 2012 R2 Virtual Machine Manager, you can rapidly and programmatically configure devices, such as Cisco Nexus 3000 and Arista Networks top-of-rack (TOR) switches.

Here's a real-world scenario to help you piece together how this works.

Imagine Jim, an IT pro manager at Contoso Company. Jim's team struggles to keep up with growing demands on the company's network. Employees, impatient to make their apps available, are doing so without the blessing of IT, creating potential security problems.

Jim knows that the Microsoft SDN solution could help the team be more responsive and agile, and even better, his company already

uses Windows Server 2012 R2. Jim decides to test the SDN solution in the lab, using it to abstract a portion of the company's datacenter.

What he finds is that the network becomes faster and more flexible. His team can respond to requests faster. After digging in a bit more, he finds his team's costs go down because they don't have to buy proprietary hardware. Additionally, he finds that the team can use SDN to provide security at a more granular level—he can set up security policies at every tier in his application to determine exactly which traffic flows between the layers of his application and between his virtual machines and the containers within them.

In the end, Jim's team decides that it will use the Microsoft architecture and deployment guides within Windows 2012 R2 and System Center 2012 R2 to build a new software-defined network and infrastructure for his company. He also knows that, by investing in Microsoft's current SDN solution, his company will be well positioned to move later to Windows Server 2016.

Use cases to get you started

While SDN increases organizational efficiency and ability, it also supports new ways of doing business. Here are four real world scenarios made possible with SDN.

Use case #1: Connect branch offices

Providing employees at branch offices with network access and necessary redundancy is challenging when you have to build unique and complex VLAN environments on unique physical networks. The VLANs that allow you to support offices in multiple locations must be designed, configured and maintained properly to function. Any misconfiguration, and you have lost full or partial network connectivity.

When you use software-defined networking to virtualize your network, you eliminate the need to use VLANs to manage your branch office networks. Instead, you layer software on top of your existing network structure. It doesn't matter that your network infrastructure varies from site to site because your software connects and unifies the network technology, allowing you to choose how and when your branch offices talk to each other. This minimizes the need to add additional layers of network management, and reduces complexity and the opportunity for errors.

Use case #2: Protect your network from the inside out

Many of us use firewalls to protect the edge of our networks from external attacks. Firewalls, however, can't help you if a security breach comes from inside your network.

This is where SDN can help. If you virtualize your network, you can isolate and protect from the inside. The benefits are many, including the ability to create internal firewalls and harden to various levels depending on how much security you need.

In some cases you may want to extend or amplify your credential requirement process to restrict access to high security networks. In this situation, you require all machines that access a network to adhere to an enhanced security policy set to your specifications. Your ability to modify the network path means you decide how integration with other networks or devices will work. And best of all, you can do this all the way down to the router level.

SDN lets you examine and reroute your network in small, manageable chunks, allowing you to isolate and quickly tackle the root of the problem. This capability can help manage security and performance, since it allows you analyze slices of traffic and specific parts of your network. The ability to adjust your environment rapidly is crucial when you have a security issue.

Use case #3: Create a virtual environment to test patches

For many organizations, patching operating systems is an ongoing challenge in the face of large updates. Shutting down networks to test the impact of the patches is disruptive. SDN can help. You can use it to create a virtualized environment that looks and behaves exactly like your production network and safely test updates. You can test, take a snapshot of what it will look like after the updates, and roll back configurations as desired if something isn't working.

Use case #4: Segment user access

SDN can help you serve groups of people who need different levels of isolation. Let's say you are trying to set up an online training application for multiple classes of students. Each group requires its own set of machines with unique domain services, a SQL Server middle tier that stores information for the students, and a front end web application that keeps track of scores and progress. Assume that all three services offered by the larger training app require internet access.

Traditionally, you might segment the network into individual virtual local area networks and configure a router to manage the traffic—a costly and time-consuming approach. By using SDN, you simplify this scenario by configuring a virtual machine network and by assigning Network Address Translation (NAT) rules to allow incoming traffic while also making sure each group of students remains isolated.

Solution in Plain Sight

The same IT professionals trying to figure out how to modernize their networks and tackle scenarios like those listed above may not realize that there is a solution right in front of them, one that they already own and are paying for if they are Windows Server 2012 R2 customers.

End-to-end ecosystem

Microsoft offers an end-to-end ecosystem that many customers are already using: Windows Server (which is the datacenter leader), Hyper-V (the Microsoft virtualization platform), and System Center (the Microsoft management layer).

Once customers have built a solid datacenter foundation using Windows Server and System Center, they can add Microsoft Azure Pack to deliver service portals and automation efficiencies similar to what's available on Microsoft Azure. Azure Pack, which enables organizations to be the masters of their own private datacenters, offers customers a glimpse of what's coming with Windows Server 2016 with its emphasis on Azure-consistent technology.

Microsoft Operations Management Suite (OMS), announced recently at Microsoft Ignite conference, will help unleash enhanced management scenarios within System Center faster. As System Center continues to drive faster time to value, OMS extends its capability to deliver a full hybrid management experience across any datacenter or cloud.

OMS is simple to set up, it's always up to date, and it connects to both your on-premises datacenters and cloud environments. With System Center and OMS, you get a single, powerful, integrated portal and instant access to critical information to help you collect, analyze, and search millions of records across all your workloads and servers – no matter where they are.

Virtualizing networks with shared hardware

Introduced in Windows Server 2012, [HNV](#) (Hyper-V Network Virtualization) enables virtualization of customer networks on top of a shared physical network infrastructure. With minimal changes necessary on your physical network fabric, HNV gives you the agility to deploy and migrate your tenant workloads anywhere across your three clouds: the

service provider cloud, the private cloud, or the Microsoft Azure public cloud. HNV is a fundamental building block of the Microsoft

software-defined networking solution, and is fully integrated into the SDN stack.

Also unveiled at Ignite, Microsoft's forthcoming Network Controller included in Windows Server 2016 will push HNV policies down to a Host Agent running on each host using Open vSwitch Database Management Protocol (OVSDB) as the SouthBound Interface (SBI). The Host Agent stores this policy using a customization of the [VTEP schema](#) and programs complex flow rules into a performant flow engine in the Hyper-V switch.

The flow engine inside the Hyper-V switch is the same as the one in Microsoft Azure, which has been proven at hyperscale in the Microsoft Azure public cloud. Additionally, the entire SDN stack up through the Network Controller, Network Resource Provider (details coming soon) and Microsoft Azure Pack tenant portal is consistent with Microsoft Azure, thus reinforcing the consistency and the power of the Microsoft Azure public cloud to enterprise and service provider customers.

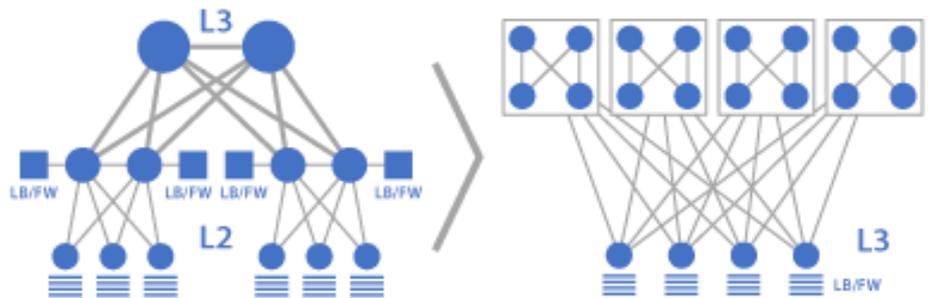


Figure 2: Traditional versus software-defined networking. Traditional networks are built on large L2 domains, hardware-based services, and a simple tree design. Modern networks, on the other hand, are L3 at all layers, with software services and a Clos-based multistage switching architecture design to maximize agility.

Microsoft SDN-related partner ecosystem

Microsoft has fostered an ecosystem for networking solutions that builds on its open, extensible and standards-based view of networking. The key way it does that in Windows Server 2012 R2 is through an extensible switch in Hyper-V that offers additional security and manageability capabilities through solutions available through partners like these:

- NEC
- Cisco
- 5NINE
- inMon

Looking ahead, with Windows Server 2016, Microsoft is extending the company's current extensible switch interoperability to an organization's entire network.

Making it easier, making it simpler

Microsoft aims to use its services and solutions to make it easier for IT managers to run their infrastructures. These IT leaders are becoming more agile so that they can effectively respond to the needs of their developers and a rapidly changing business climate. They recognize the careful balance between moving at speed while still providing the level of stability and discipline their companies depend on. The Microsoft SDN solution is an ideal solution for many companies looking to modernize and stay current because it delivers the same experience and interoperability expected in a public cloud. Ultimately, it enables organizations to support hybrid clouds, which bring together the agility of public cloud and the control of on-premises systems.

Networking Across all Environments

IT pros who download Windows Server 2016, now available in [Technical Preview](#), will find that a steady cadence of improvements to Windows Server are making it easier and easier for them to move to a more dynamic, manageable, cost-effective, and adaptable architecture.

[Microsoft Azure Stack](#), introduced at the Ignite conference, extends the agile Microsoft Azure public cloud model of application development, deployment, and management to enterprise datacenters—enabling IT pros to have the best of both worlds. Azure Stack delivers IaaS and PaaS services to datacenters so customers can blend enterprise applications such as SQL Server, SharePoint, and Exchange with modern distributed applications and services while maintaining centralized oversight.

Using Azure Resource Manager (released in preview at the end of April), customers get consistent application deployments every time, whether provisioned to Azure in the public cloud or in soon-to-be-available Microsoft Azure Stack in a datacenter environment. This approach is unique in the industry and gives developers the flexibility to create applications once and then decide where to deploy them later—all with role-based access control to meet compliance needs.

Built on the same core technology and services as Microsoft Azure, Azure Stack will package Microsoft investments in automated and software-defined infrastructure from its public cloud datacenters and deliver them to customers for a more flexible and secure datacenter environment. For example, Azure Stack will include a scalable and flexible software-defined Network Controller and Storage Spaces Direct with automated sync and failover. Shielded VMs and Guarded Hosts will bring “zero-trust” software-defined security to private clouds so customers can securely segment organizations and workloads and centrally control and monitor access and administration rights. Furthermore, Azure Stack will simplify the complex process of deploying private and hosted clouds based on Microsoft’s experience building the Microsoft [Cloud Platform System](#), a converged infrastructure solution.

The best way for customers to think about Azure Stack is as an expansion of the investments they have already made in System Center 2012 R2 and Microsoft Azure Pack—they won’t have to replace what they will already have, they will be improving and expanding it.

Customers can preview Azure Stack starting this summer.

Organizations can also use Microsoft [Azure ExpressRoute](#), which enables dedicated, private, high-throughput network connectivity between Azure datacenters and on-premises IT environments. It provides connections with faster speeds, lower latencies, and higher security than typical Internet connections. ExpressRoute is also a robust option for transferring large data sets for high performance computing applications or for moving large virtual machines between an Azure dev/test environment and on-premises production environments.

And looking ahead, Microsoft is anticipating what customers will need beyond Windows Server 2016.

[Nano Server](#), in preview from Microsoft, is a build-it-before-you-need-it operating system designed to run born-in-the-cloud applications and containers. As customers adopt modern applications and next-generation cloud technologies, they will need a cloud-optimized OS that delivers speed, agility and lower resource consumption.

Charting the Path Forward

The push to innovate is accelerating. The demand on IT shops to provision applications continues to grow. Networks are aging, and becoming more brittle. Investing in new hardware is growing more expensive. Add it up, and it's evident that virtualizing your networks is the path forward. As proven with compute, the flexibility and scalability you gain with virtualization makes SDN a clear next step.

Give software-defined networking a try, and if you do, try the Microsoft offering on for size. Here is a summary of the reasons why:

- **Familiar face:** You know Microsoft well—you're likely already using one or more of the Microsoft related services (Windows Server, System Center, Microsoft Azure), and if you know one, you know them all as they are all designed to work together as one system.
- **Price is right:** If you're a Windows Server customer, the cost is free—unlike VMware, the Microsoft SDN solution comes without extra charges.
- **Put through its paces:** Microsoft uses its own technology to manage some of the world's largest services (Azure, Bing, MSN, and others), so it is well tested.
- **Compatibility:** Microsoft enables compatibility with other systems and is friendly to open standards.

If you own Windows Server 2012 R2, you own the Microsoft SDN solution. That said, the fastest way to see SDN in action is through Microsoft Azure—if you don't have an account, try it out with this [free one-month trial with a \\$200 in-service credit](#).

Keep an eye out for Windows Server 16 Technical Preview 3. It will give you a chance to test-drive the updated Microsoft SDN offering with a Network Controller and other new services such as a Software Load Balancer. Early versions of Windows Server 2016 are available to preview now and updates are being rolled out all the time.

Resources

Want to find out more about Microsoft software-defined networking? Here are some resources worth reviewing.

[Windows Server 2012 Networking Training](#)

Introduction to networking features and capabilities that help reduce networking complexity while reducing costs and simplifying management tasks.

[Windows Server 2012 R2 Networking Training—Advanced Software Defined Networking](#)

Learn more about what's new in the networking industry and how System Center 2012 R2 can help manage Windows Server 2012 R2.

[Software-Defined Networking with Windows Server 2012 R2 and System Center 2012 R2](#)

Learn about self-service provisioning, simplifying network management, and increasing security with fully isolated environments.

[Windows Server 2012 Hyper-V Network Virtualization Survival Guide](#)

Use this package of resources to get up to speed on software-defined networking.

[What's new in Windows Server Technical Preview](#)

Download the Windows Server Technical Preview.

[Microsoft Platform and Vision Strategy for Networking Overview \(Microsoft Ignite Conference\)](#)

Watch this video and download slides to learn more.