THE PROMISE OF SOFTWARE-DEFINED NETWORKS

SDNs offer organizations a flexible solution capable of reimagining the enterprise network.

The IT community is abuzz with discussions about software-defined networks (SDNs) and the potential they have to revolutionize network engineering, both inside the data center and on campus networks. Is software-defined networking just another hyped-up buzzword, or does it truly reflect the next major move forward in the development of enterprise networks?

As with most trends, the reality behind SDN technology is a mixture of truth and hype. Most experts agree that SDNs represent the future of networking. However, it is still early in the adoption curve. Enterprises are figuring out the role that SDNs will play in their enterprise IT strategies over the next five years. The most likely scenario is that many organizations will test SDNs this year and then convert those test networks to production status, most likely within the confines of enterprise data centers.

READ ABOUT

- The characteristics of software-defined networking (SDN)
- Different models of SDN solutions
- Planning now for future SDN adoption

WHAT IS **SOFTWARE-DEFINED NETWORKING?**

Software-defined networking provides network administrators with the ability to simplify networks by abstracting some of the technical implementation details. Specifically, it separates the network control plane, which contains the logic that executes forwarding decisions, from the data plane, which actually moves bits around the network. This separation of functions provides greater flexibility for the engineers and developers who rely on services provided by the network.

By separating these two major functions, specialists in each domain are able to configure their portions of the network in a language that they understand without getting caught up in the details of the other's domain. The network control plane becomes programmable, so application developers can issue requests for network service via an application programming interface (API) without worrying about the underlying hardware. Parallel to an SDN's control plane lies the data plane, the domain of network engineers who ensure the underlying architecture continues to support business requirements.

SDNs are the natural extension of the server virtualization trend and deliver similar benefits that server virtualization brought to the data center. The IT community is now going through the same type of wary acceptance of SDNs that surrounded server virtualization five years ago.

What will this mean for enterprise networking? Many experts believe SDN believes that it will turn the data center on its head. The technology has the potential to be as revolutionary in the data center as server virtualization was.

THERE ARE **THREE IMPORTANT CHARACTERISTICS** THAT DEFINE SDNs:

- They must separate the control plane from the data plane and provide a mechanism (such as OpenFlow) that serves as a transport protocol, facilitating communication between the two planes.
- They abstract network functionality in the same manner that server virtualization has removed hardware details from the hands of system engineers.
- They embrace programmability, providing access to network hardware through APIs.

Data center managers may be in for a parallel experience to server virtualization with SDN. Five years down the road, SDN will likely be deployed everywhere. Some organizations will be completely implemented and some will be in transition, but everyone will be migrating.

WHY SHOULD ENTERPRISES CONSIDER AN SDN?

Today's networks are built on networking principles formulated in the 1970s for use in a different environment than today's networked world. The applications on those networks were simple file servers and databases. Typical data center traffic patterns followed a "north-south" model, where requests came in to servers located in the data center and responses flowed out in the reverse direction.

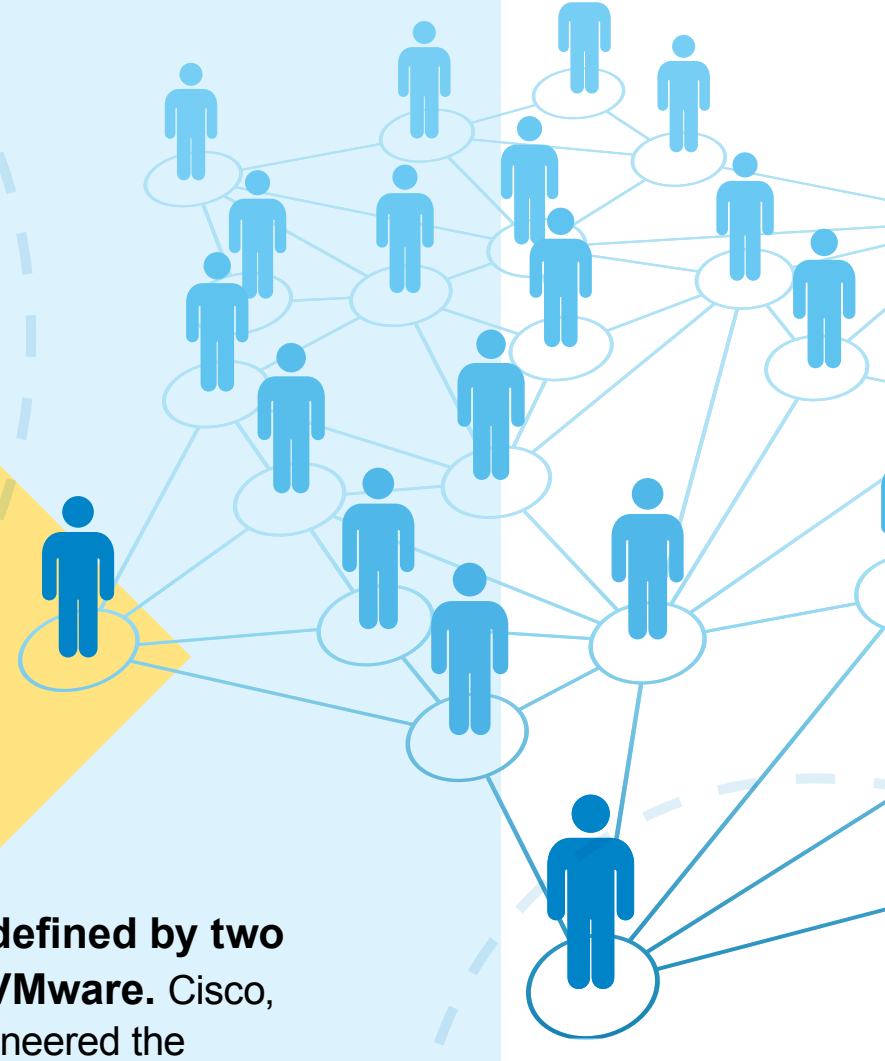
Network design did not anticipate the explosive growth of the Internet or e-commerce. The data centers that once exclusively served internal users now provide web-based services for consumers around the world. Requests still flow into data centers from the outside, and responses still flow back to clients. But the applications producing those responses are now complex multitier applications.

Web servers talk to database servers to create dynamic content in response to user requests. Ordering, marketing and fulfillment systems all have complex integrations designed to automate routine business processes. This evolution creates a whole new "east-west" traffic pattern between servers within the data center.

The appearance of the data center has also changed. Server virtualization replaced cluttered racks with massive virtualization farms that pool computing cycles, memory and storage resources among many virtual servers, increasing flexibility and reducing waste. A virtualization farm may replace hundreds of physical servers and, at the same time, swap out hundreds of physical network connections for a handful of high-speed ports.

In response to these trends, network configurations increased in complexity. Network devices that contained a few dozen lines of code a few decades ago now contain hundreds or even thousands of lines of configuration to support the complex new networking reality.

Contemporary networks simply were not designed to support this. They are designed to provide reliable, consistent bandwidth to static services for long periods of time. SDNs mark a revolutionary redesign of networking from the ground up, with the primary goal of supporting these new demands on the network in an agile, responsive fashion.



EXPLORING THE SDN MARKET

Today's early SDN market is being defined by two major players: Cisco Systems and VMware. Cisco, the long-time networking powerhouse, pioneered the commercialization of IP-based networks and produces much of the equipment that powers these networks today. VMware was the driving force behind the server virtualization boom of the past decade. It should not be surprising, then, that both firms found a natural interest in SDN technology, but approached it from different perspectives.

The Cisco approach most neatly fits the definition of software-defined networking by working directly with networking equipment to provide a programmable control plane that interacts with a separate data plane to move packets around the network. This approach appeals to network engineers, and Cisco is tuned in to that core customer base.

VMware's approach might be better described as network function virtualization (NFV) than software-defined networking. It works entirely within the VMware hypervisor ecosystem, allowing the programmable control of networks that interconnect virtual hosts. It does not interact with the "outside" (non-hypervisor) world and does not directly manipulate the network data plane. Instead, it allows the configuration of virtual networks that exist only in the virtualized environment.

Both of these solutions are still in the early stages of adoption. Few enterprises currently have either SDN model deployed in their production data centers, but that is starting to change. Organizations are beginning the early stages of adoption by purchasing test equipment and building out SDN labs to provide engineers with hands-on experience and the ability to test-drive SDN technology.

Cisco ACI

Cisco's Application Centric Infrastructure (ACI) embraces a declarative model of the SDN that places network intelligence in both the central controller and switches. The controller declares what network functions the switches must perform, and the switches dynamically apply policy to meet those requirements based on traffic flow.

One of the major advantages of ACI is that it is hypervisor-agnostic. The network does not care what type of traffic it carries, and enterprise engineers may connect any type of server to it. There is no problem interconnecting servers virtualized on both VMware and Microsoft Hyper-V right alongside bare-metal servers and networked appliances. Another advantage of ACI is that it supports Layers 4-7 integration, including both physical and virtual appliances.

ACI handles all of this traffic by creating "contracts" between applications. Instead of creating complex network switch configurations, application designers simply specify the parameters of allowed communication. In a traditional three-tier web application, developers would create ACI contracts between end users and the web tier and between the web tier and the database tier.

ACI's ability to be platform-agnostic is achieved by splitting responsibilities between the ACI controller and the network switches. For this to work, the switching equipment must support Cisco ACI. Organizations that have a pure Cisco switching infrastructure will likely benefit from ACI, whereas hybrid environments may have some challenges with this approach.

NSX and ACI **Working Together**

While many enterprises think about the software-defined networking strategy decision as a choice between either Cisco ACI or VMware NSX, it is possible for the two technologies to operate within the same data center. Remember that NSX works only inside the VMware environment. Data centers will continue to need a physical network to carry traffic to and from virtual server farms. They also will continue to host nonvirtualized workloads, such as physical servers and networked appliances.

Organizations with existing VMware and Cisco infrastructures may consider a data center strategy that embraces both technologies simultaneously. VMware NSX can provide network function virtualization and security isolation within the hypervisor, while Cisco ACI can carry traffic over the physical network, treating NSX as just another application requiring ACI contracts. ACI then serves as the glue that binds everything together, allowing enterprises to harness the benefits of both solutions.

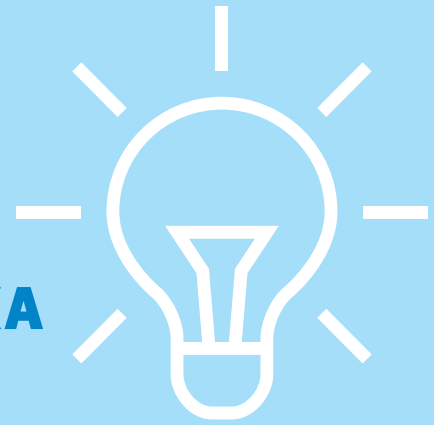
VMware NSX

VMware's NSX embraces an imperative model of the SDN that pushes explicit instructions from the controller down to the devices implementing the policy, a different approach then Cisco's ACI, which has the controller declare requirements but then allows the devices to implement those policies however they see fit.

NSX is not reliant on any underlying network infrastructure. The enterprise can be using Cisco or Juniper switches or a mixture of equipment from multiple vendors. NSX functions by building network virtualization completely within the confines of VMware virtualization environments. When the NSX controller pushes instructions to a machine, it reaches directly into the hypervisor and creates virtual tunnel endpoints (VTEPs) between virtual machines.

NSX also provides additional functionality beyond just routing and switching. It allows administrators to specify requirements for firewalls and load balancing between virtual machines. This capability allows the implementation of microsegmentation, separating virtual machines from each other within the same hypervisor.

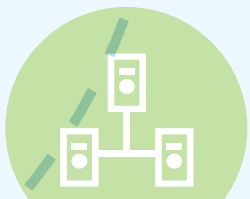
As mentioned earlier, NSX can run on top of networking equipment from any manufacturer, but it cannot support non-VMware hypervisors. Enterprises can use NSX within their VMware implementations, but it cannot interconnect workloads supported by other hypervisors or physical servers and appliances.



THE EUREKA MOMENT

Rita Younger, CDW's national practice lead for software-defined networking, recently shared her views on SDN technology with a roomful of networking professionals in Texas. During her presentation, she noticed an older gentleman in the back of the room who sat with his arms crossed and appeared skeptical of the need to learn a completely new technology toward the end of a long career in traditional networking. "He was skeptical from the beginning, which I completely expected," said Younger. "Why should he learn something that's totally different from anything we've ever done before?"

As Younger's presentation continued, the man started asking questions and became more interested in the technology. When she demonstrated SDN technology and showed attendees the interface, he paid rapt attention and asked several questions about the details of the interface and how it would work in practice. At the end of the workshop, this gentleman approached Younger and said, "It's about time! What took us so long to finally figure out how we should be managing networks?"



SDN AND THE ENTERPRISE

Most networking experts agree that SDNs represent the future of data center networking technology and mark a revolutionary change in the way enterprises think about networking. Now is the time to begin planning for SDNs and to take steps to get ahead of this emerging trend.

How can organizations prepare themselves for the emergence of SDNs? Younger believes that it begins with making strategic purchasing decisions. “It’s extremely important that our customers know about SDNs, because the hardware they purchase today will be in place for five years, maybe more. We have to make sure that the hardware and architectural decisions that we make today will support our SDN solutions in the future.”

To effectively make these decisions, enterprises should have a long-term roadmap that describes their SDN end state. By doing so, they can align today’s purchasing decisions to be compatible with future SDN technology. For example, organizations that intend to adopt the Cisco ACI model will want to make sure that switching equipment purchased for data center use supports SDN technology.

They may wish to purchase Cisco Nexus 9000 equipment that can run Cisco’s NX-OS today, and then support an upgrade to ACI licensing when the enterprise moves to software-defined networking. Similarly, organizations that intend to adopt VMware NSX will want to choose hypervisors that support that strategy.

One of the first steps toward SDN adoption is familiarizing engineering staff with the SDN platform chosen by the organization. Building an SDN test environment today allows engineers to gain experience and experiment with SDN configurations before deploying them in the data center. If the enterprise purchases test equipment that is sized to meet enterprise demand, the test equipment can be rolled directly into production after a successful testing period.

CONCLUSION

Software-defined networking is the next revolution in network technology, and it will cause dramatic rethinking of the entire network function. IT workers face a steep learning curve as they explore the opportunities offered by this technology. As with any major transition, approaching this learning curve in a gradual fashion will produce the best results.

To get ahead of the trend, enterprises should begin deploying SDN technology on a small scale now. IT leaders should provide training opportunities for network engineers and allow them to build out test environments with an eye toward shifting them into production use over the next couple of years. Taking these steps today will allow organizations to quickly harness the power of software-defined networking and deliver value to their business. ■

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