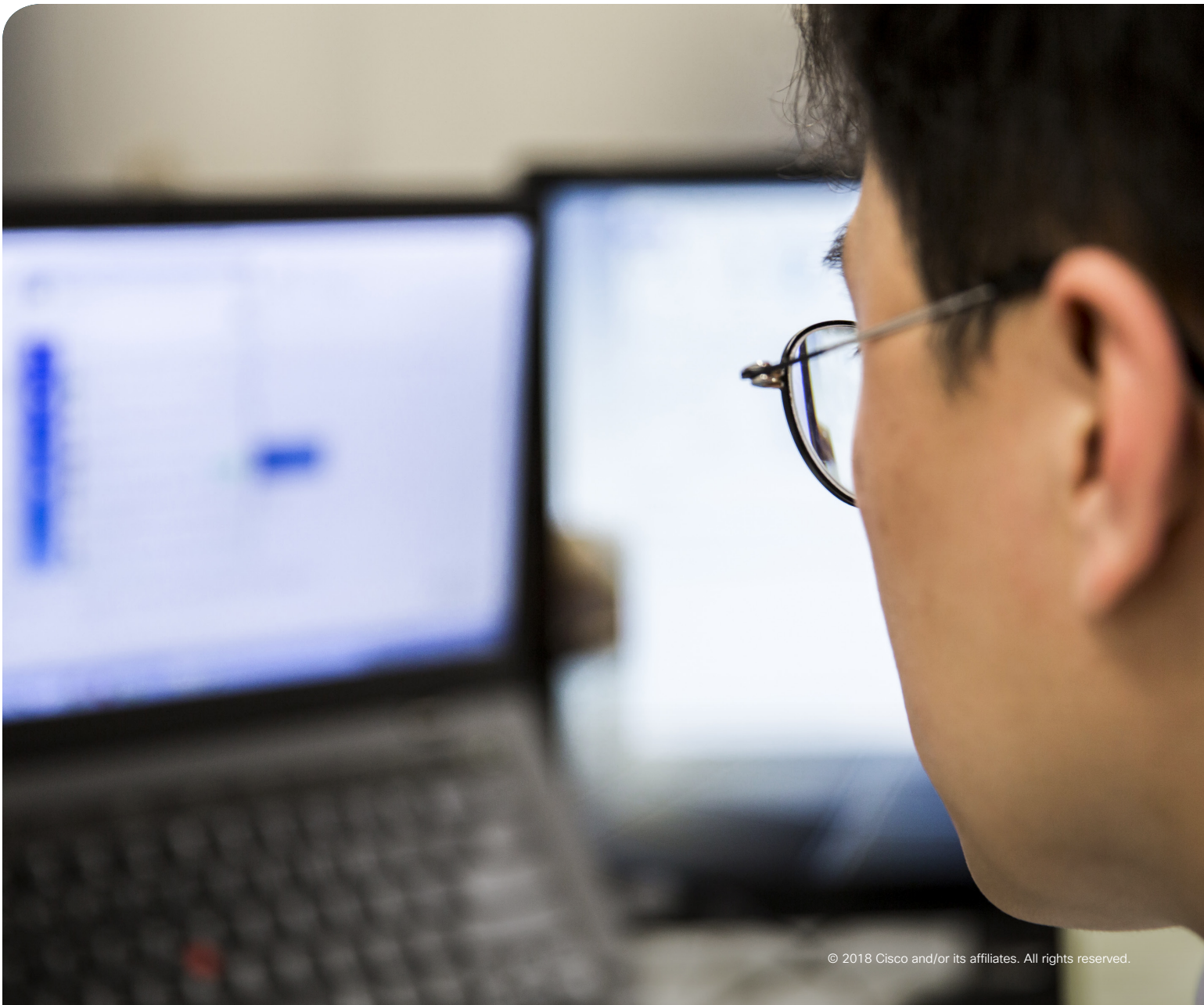
White paper
**Cisco Public**

# Software-Defined Access: A Primer



Legacy networks need to evolve in order to address today's network needs. They must be flexible, while providing a consistent experience for users anywhere on the network—without compromising security.

Intuition. It's a core part of what makes us human.

What if the network could intuitively configure itself based on the intent of its users? What if the network could learn to adapt itself to defend against threats?

Digital transformation is forcing enterprises to search for new ways to enable digital capabilities, deliver IT services, and manage assets.

We're moving toward a very different world. We need a very different network to get us there.

An explosion of devices being connected to the network brings connectivity and security challenges. As a result, these new digital requirements need a fundamentally different approach.

Legacy networks must evolve in order to address today's network needs. They must be flexible, while providing a consistent experience for users anywhere on the network—without compromising security.

These business needs have led to programmable networks, also known as software-defined networking (SDN). Programmable networks can be set up or updated on demand without changing hardware. They are faster and cheaper for organizations to build and manage.

## Software-defined access: changing the game

Until now, there has been a missing piece in the programmable networking puzzle—the user access portion. Cisco Software-Defined Access (SD-Access) is here to complete the picture. SD-Access is a central part of the Cisco Digital Network Architecture (DNA) solution.

SD-Access represents an exponential and fundamental shift in how we design, build, and manage networks, enabling enterprise customers to reduce operating expenditures (OpEx) and risk.

At the same time, it helps create an agile infrastructure that delivers consistent policies and services over wired, wireless, and hybrid networks.

By automating day-to-day tasks such as configuration, provisioning, and troubleshooting, SD-Access reduces the time it takes to adapt the network, improves issue resolution, and reduces the impact of security breaches.

This results in significantly simpler operations and lower costs.

Here, we offer an overview of SD-Access in its broader context as part of intent-based networking, along with the following focus areas:

- A brief overview of traditional IP network technology
- The rise of programmability and the trends making it popular
- What SD-Access is, and how it relates to network programmability

Traditional IP networks have been hard to build, costly to maintain or update, and not very transparent. What's going on inside of them has been tough and time-consuming to figure out.

- Why SD-Access helps organizations attain business benefits, and its strategic implications
- The new skills you need to manage and operate SD-Access systems with new protocols
- How we are helping you update your networking skills with SD-Access training

## The IP network crunch

Over the years, administrators have grappled with traditional IP networks as they emerged with the arrival of the commercial Internet.

You know these networks.

Routers. Firewalls. Switches. Servers. End nodes. Network interface cards. They use cable, fiber, or wireless transmitters.

Making all of these work smoothly together can be a herculean task, which has traditionally been done by hand. Adding any kind of new hardware to a traditional IP network manually can take months or even years, depending on the size and scope of the changes.

Traditional IP networks have been hard to build, costly to maintain or update, and not very transparent. What's going on inside of them has been tough and time-consuming to figure out. Troubleshooting them is an ordeal. Rather than a resource for business innovation and growth, these networks have been a financial drain on organizations.

The industry, of course, has been well aware of all of the issues with traditional IP networks. These problems became much more serious with the advent of mobility and the cloud. But the Internet of Things (IoT), which connects all manner of machines, sensors, and other devices, has forced the issue. Traditional IP networks are simply no match for the demands of billions of attached machines and sensors on top of billions of attached mobile access devices and cloud computing.

Something has to change.

## The rise of network programmability

The change is network programmability. This technology has a history that began in the mid-1990s, just as the commercial Internet was taking off.[1] The Internet's success and huge surges in traffic soon began to overwhelm IP networks.

The appeal of network programmability is obvious. It enables dynamic updates of software services on demand, without worrying about any of the hardware.

1. ACM Queue, "The Road to SDN: An Intellectual History of Programmable Networks," December 2013.

Core-to-edge programmability enables network automation. And that is the foundation of intent-based networking. An automated network can monitor traffic conditions and make changes when and where they are needed.

Cisco DNA uses a hybrid of centralized and distributed control planes. In the Cisco model of network programmability, the control plane is split from the data plane. The former decides how to handle network traffic, and the latter forwards traffic according to decisions that the control plane makes.

In addition, Cisco network programmability unites the control plane, so that a lone software control program handles multiple data-plane elements. Using an application programming interface (API), the programmable control plane directly controls the network's data-plane elements, that is, those routers, switches, and other middleboxes.

Access networks are where people—employees, partners, customers, consumers—hook into the core network itself. When they want to take advantage of cloud services, stream videos, or even just send a text message, people do so through access networks. The same goes for devices, machines, and sensors.

Hardware known as customer premises equipment (CPE) makes network access possible. Network operators would likely not want to pay for replacing existing CPE with next-generation models.

That is precisely why SD-Access is such a critical breakthrough. This software makes all of the Internet programmable, from the core right to the edge, without regard to the underlying hardware.

The gains of core-to-edge network programmability are substantial. It permits services to be connected end to end. This makes it much easier, faster, and cheaper to set up and launch new services across the network. The task is done by programming the software across the network rather than replacing hardware or using firmware or software patches, hoping it will all work smoothly together.

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Core-to-edge programmability also slashes the budget needed to operate a network. The less the network costs and the more automated it becomes, the more likely it is to be an organization's asset.

## SD-Access and Cisco DNA

SD-Access certainly offers big-picture benefits for networking and your business. But how will SD-Access affect the network on a day-to-day basis?

What, exactly, is SD-Access? SD-Access is a central part of the Cisco Digital Network Architecture. It represents an exponential and fundamental shift in how we design, build, and manage networks, enabling enterprise customers to reduce operating expenditures (OpEx) and risk while creating an agile infrastructure that delivers consistent policies and services over wired, wireless, and hybrid networks.

SD-Access is the foundation of Cisco DNA. It enables network access in minutes for any user or device to any application, without compromise.

SD-Access provides policy-based automation from the edge of the network to the cloud. It offers secure segmentation for users and things enabled through a single network fabric. This approach dramatically simplifies and scales operations while providing complete visibility and delivering new services quickly.

On the whole, Cisco DNA goes beyond the ecosystem of network technologies that make up SDN and focuses on bringing these technologies together into a holistic architecture to achieve business outcomes. Cisco DNA is a way to make network services relevant and easy to use in an enterprise architecture journey to digital transformation. It is an architectural suite that includes ready-to-use applications as well as easily consumed APIs. Cisco is committed to helping our customers successfully evolve to SDN while maximizing their investment protection.

SD-Access is the foundation of Cisco DNA. It enables network access in minutes for any user or device to any application, without compromise. With SD-Access the established policies automatically follow the user across all network domains.

As previously stated, by automating day-to-day tasks such as configuration, provisioning, and troubleshooting, SD-Access reduces the time it takes to adapt the network, improves issue resolution, and reduces the impact of security breaches. This results in significantly simpler operations and lower costs.

Automation and simplicity result in increased productivity, which enables IT staff to innovate early and be an industry leader in transforming to a digital enterprise, increasing operational effectiveness.

Manual network access in the era of mobility and IoT is a challenge. Users and devices or machines log onto the network remotely and change all the time. There is no way to track or keep up with these fluctuations when access is granted by hand. It is now simply far too complex for human beings without the help of automation to figure user or device credentials and maintain a constant policy across the network. Not to mention keep the network secure.

Indeed, remote access handled manually is a huge network security problem. Virtual private networks were devised in the 1990s as a safe way to add users remotely. But they are no longer enough to secure today's networks against the vulnerabilities of third-party apps or the pitfalls of connecting devices or machines that turn out to be compromised. In addition, tracking VLANs, access control lists, and IP addresses for every single new user or device to ensure policy and security compliance can be next to impossible.

Partly as a result of fragmented network access, organizations are struggling against cyber attackers.[2] Only 45 percent are sure they can uncover the scope of an event and fix the damage. In 2014, 64 percent of security professionals surveyed said their security was up to date and being constantly upgraded. But just a year later, that percentage dipped to 59.

2. Cisco, "2016 Annual Security Report."

SD-Access helps make network management easier. Issues and network updates are faster and smoother, without compromising on security. Overall productivity rises in the organization.

SD-Access enables organizations to set up automated access and security policies that cover all users, devices, and machines across the network. This allows users and applications to be segmented in an automated, policy-driven way. That one benefit alone will save you endless hours of boring repetitive tasks while bolstering network security.

## Strategic implications of SD-Access

But where SD-Access truly changes the game is its strategic implications. It is the missing link of programmability that will transform the entire network into an intelligent system. Plus, the system continues to evolve, becoming smarter and more responsive.

This intelligent system can understand the world it is connecting. It can catch and respond much faster to both threats and opportunities. It is based on new silicon and hardware design that supports high-speed analytics. This intelligent automated system is transparent from end to end and designed to deliver business benefits, like provisioning resources more efficiently, consolidating network management with automation, and delivering new services more quickly.

More advantages of this system include:

- **Applied intelligence.** Harness the vast network and connected device information for understanding that yields new markets or business models.
- **Threat perception.** Uncover previously invisible threats better and faster to keep sensitive data and users safe. The intelligent system turns the network into a sensor.
- **Time back to IT.** By automating mundane tasks like adding users, what used to need days of work now takes hours at most.

Unique to Cisco, SD-Access is part of a slate of products designed to deliver intent-based networking through an intelligent system. Traditional networking focuses on per-device management, which takes time and creates many complexities. This approach is prone to human errors. SD-Access uses a modern controller architecture to drive business intent into the orchestration and operation of network elements.

Other products include Cisco's Digital Network Architecture Center. This DNA hub manages the entire network from a single place. Its technology turns the network into a sensor. And Catalyst 9K switches take care of advanced persistent threats and make it possible to detect attacks even amid encrypted traffic.

To sum up, SD-Access helps make network management easier. Issues and network updates are faster and smoother, without compromising on security. Overall productivity rises in the organization. That's because employees can focus on gaining business intelligence from network data instead of a network that is constraining their analytics applications.

Become familiar with how virtualization works; this is key to grasping network programmability because hardware is no longer the only focus in networking.

## Network programmability needs new skills

The network is moving away from a manual, time-intensive, and static approach. It is shifting to one that foresees needs, understands intent, and constantly learns from the data that surrounds an organization.

This means you, as current or future IT and networking professionals, have to evolve as well.

Your first step is a mindset shift. Stop thinking of the network as hardware. Start viewing it in the form of functional software items removed from hardware.

This is a big change, but an important one, as networks become programmable from the core to the edge.

The second step is adding and honing specific talents and skills. No one is born knowing how to build and operate intuitive networks. You can acquire this expertise through work experience augmented by study and the right certifications.

You must also see beyond the network itself. You need to comprehend how the network fits into the rest of the organization. How it supports and advances the organization's growth strategies and goals. The business case for the network, in other words. IT and networking professionals like you must develop a talent for business awareness and acumen.

You are no longer isolated in your cubicle, typing into a command line interface. The intuitive network is integral to organizational strategy, as are those who build and run it.

There are skills that IT and networking professionals like you can add to your roster to keep up with network programmability. You should become familiar with open source switch controllers and how to program them with some basic programming skills. You also should know how to handle application and orchestration systems that are connected through APIs.

In addition, become familiar with how virtualization works; this is key to grasping network programmability because hardware is no longer the only focus in networking. Those who become familiar are able to use tools like SD-Access to help drive operational efficiency.

## Evolved training and certifications

With SD-Access leading the way to intent-based networking, we see a huge opportunity. This means that we are evolving our training and certifications and adding new courses.

For starters, we are always adding to our list of digital skills training. Data analytics, network programmability, cybersecurity, IoT, cloud, and business skills courses are now available. These topics are now also required parts

It's true that this huge digital change mandates equally big shifts in your skills as a current or future IT or networking professional. But you are not alone in your professional journey. Cisco has your back.

of training for CCNA, CCNP, and CCIE certification or recertification. These changes help keep skills relevant for emerging new technologies—like SD-Access.

### Deploying Cisco SD-Access (ENSDA)

In fact, the latest addition to our digital skills training is Deploying Cisco SD-Access (ENSDA). This course lasts two days and includes labs. Participants study the value of Cisco SD-Access. They review selected use cases for SD-Access and how to structure SD-Access. This new training also covers capabilities that relate to policy-based automation, simplified provisioning, and network assurance.

### Digital Network Architecture Implementation Essentials (DNAIE)

Our five-day Digital Network Architecture Implementation Essentials (DNAIE) boot camp delivers primarily lab-based training that focuses on core DNA technologies. It includes APIC 2.0 updates plus analytics training for the Network Data Platform and best practices for rolling out SD-Access.

### Network Programmability Design and Implementation Certification

For network engineers, we offer the Cisco Network Programmability Design and Implementation Specialist certification. This course teaches crucial network programmability skills and prepares candidates for the 300-550 NPDESI exam. It is offered as an instructor-led training workshop via Cisco Learning Partners. It also is available as self-paced interactive training with videos, integrated labs, and assessments.

### Programming for Network Engineers (PRNE)

Programming for Network Engineers (PRNE) is self-paced training for network engineers like you who want to use programming right away to simplify or automate your tasks. It covers the basics of Python programming in the context of functions relevant to network engineers. PRNE is recommended before taking the Cisco Network Programmability Design and Implementation certification course.

## Looking ahead

SD-Access is the result of a years-long effort by Cisco to fundamentally transform networking.

Today, it's enabling an endlessly flexible architecture that empowers innovation across the business.

So, what is in it for you? More than you might imagine.

It's true that this huge digital change mandates equally big shifts in your skills as a current or future IT or networking professional.

But you are not alone in your professional journey. Cisco has your back.

If you act now to update your skills and expand your talents, you are in the driver's seat. CIOs across the board identify lack of skills as their No. 1 barrier to success.

We offer IT and networking professionals across multiple disciplines superior skills development to make your digital transformation a resounding success.

Entire IT teams can collectively expand their skills and fully leverage the power of next-generation technologies. Cisco's training and certifications help you, as an IT or networking professional, become a better strategic business partner in your respective organization. That is great for your career today and in the future.

If you act now to update your skills and expand your talents, you are in the driver's seat. CIOs across the board identify lack of skills as their No. 1 barrier to success.[3] Organizations will require specially trained network engineers to design and deploy the automation and orchestration features in this new era of networking.

That's why SD-Access and other programmable networking skills are in hot demand. In fact, programming and application development were at the top of the most in-demand IT skills for 2017.[4]

Digitization cannot move forward without IT/networking professionals like you who have these skills. You will be even more in demand as millions of apps and billions of users connect with each other in the IoT. Expanded skillsets offer you the potential to be better, faster, and more promotable.

Having high-demand skills is certainly a distinct career advantage. But that's just the start of how SD-Access, as part of programmable, automated, and intent-based networks, will affect your job. It will free you to take on new challenges, like analytics and virtualization. It will help you drive your organization to operational efficiencies while setting up a competitive edge in the digitized world.

Programmable networking will indeed rock your professional world. It will expand your role and make you far more of an integral part of the team that organizations need to thrive. There's just one question remaining. Are you ready to step up and meet this challenge with the right skills?

Join us. To learn more, visit the Network Automation, Analytics, and Virtualization page on the Cisco Learning Network.

3. Gartner CIO Agenda Report, 2017.
4. InfoWorld, "10 Hottest Tech Skills for 2017," December 2016.