

Network Evolution

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THE 5G WAVE COMES ASHORE

Fifth-generation wireless technology promises to transform business as we know it.



EDITOR'S DESK

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THE SUBNET

Durham County Builds Network Automation Into Its DNA



Enterprises are looking toward new ways of doing business with 5G wireless's greater capacity and higher speed.

EDITOR'S DESK | JEAN DERGURAHIAN

The 5G Future Starts Now, if You Prepare

IMAGINE SMART ROADS that can send alerts when it's time to plow snow or repair potholes or an electric grid that knows about and fixes a catastrophic power failure before it happens. Better yet, think about a person remotely receiving life-saving surgery from a doctor miles away who uses computing power and robotics to perform the operation.

In each case, a failure in communication might be disastrous. But with next-generation 5G wireless communication getting closer, faster broadband wireless speeds and increased capacity will deliver information better than it can with today's 4G networks. In this issue of *Network Evolution*, we explore what companies are doing to be [5G-ready](#).

A host of network trials, research and development of 5G devices, standards and specifications development, and government policies for 5G infrastructure buildouts stand between the promise and the reality of 5G technology. This year, carriers like

Verizon and AT&T are expanding 5G tests in cities across the U.S. and globally. Verizon is also showcasing its 5G development during the 2018 Winter Olympics. In addition, organizations are working with telecommunications companies to develop 5G devices and the applications to be used on them. This is the year for enterprises to sit up and take notice.

Also in this issue, network managers share their reasons for choosing [smaller software-defined networking vendors](#) instead of major providers. In addition, one unified communications expert offers his tips for [consolidating UC](#) features and the pros and cons of deploying UC across the enterprise. Finally, in this month's *Subnet*, learn about Durham County, N.C.'s, plan to create a more seamless experience through network automation. ■

JEAN DERGURAHIAN

Features and E-zine Editor, Networking Media Group



5G Wireless

Get Ready for 5G

BY JEAN DERGURAHIAN

→ The promise of broadband wireless for enterprises gets a step closer as 5G trials begin in earnest.

THE FIFTH GENERATION of wireless technology is moving steadily toward the enterprise, as the telecom industry expects the 5G rollout to have a massive economic impact on how business is conducted across the globe. As network operators increase their 5G testing in 2018, and standards organizations continue to hammer out 5G specifications, business customers are getting interested in what's in 5G for them.

Although 5G wireless technology is still in development, network analysts and forward-thinking businesses are banking on the promise of faster wireless network speeds and greater capacity. Telecommunications carriers will continue testing their 5G wireless products and 5G fixed broadband services throughout 2018 and hope to begin

commercial deployments in 2019, with 5G-enabled smartphones and devices available by 2021. Overall, widespread use of commercial [mobile 5G services](#) probably won't arrive until 2025.

Even though it's early in the development process, enterprises can expect 5G to improve productivity and business efficiency with enhanced wireless broadband speed and capabilities, according to Will Townsend, an analyst with Moor Insights & Strategy in Austin, Texas.

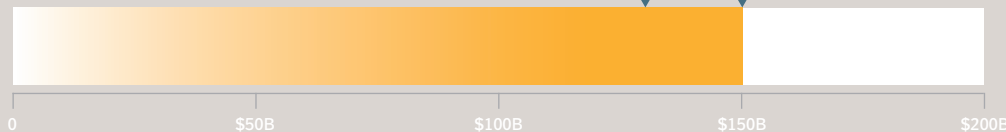
New 5G services for businesses and consumers will roll out in stages, Townsend said. This year,

some telecom providers plan to pilot precommercial 5G fixed wireless consumer broadband services, which use wireless network technology rather than fixed lines.

Currently, telecommunications carriers operate [4G networks](#) that include LTE, LTE-Advanced and Advanced Pro. At peak 4G speeds, mobile devices can exchange data from 100 Mbps up to 1 Gbps. New 5G technology promises peak speeds up to 10 Gbps. That kind of massive improvement in speed over 4G is the key to unlocking the advantages of 5G wireless technology, Townsend said.

Fiber infrastructure investment needed over the next five to seven years for 5G

\$130 B to \$150 B



SOURCE: "COMMUNICATIONS INFRASTRUCTURE UPGRADE: THE NEED FOR DEEP FIBER," DELOITTE, JULY 2017.

PREPARING FOR 5G IN THE ENTERPRISE

For industries like healthcare, financial services, energy and other field-service organizations that require low latency and high throughput, 5G will make a significant impact, Townsend said.

Businesses that have specialized communications requirements, like internet of things applications, self-driving cars and some manufacturing processes, might see benefits from 5G wireless technology before others do, according to Sundeep Rangan, Institute of Electrical and Electronics Engineers

fellow and associate professor at the New York University Tandon School of Engineering. “If 5G can be combined with other teleconferencing technologies, particularly virtual reality and augmented reality, we may see a dramatic improvement in business communication.”

Some enterprises starting to prepare for 5G wireless technology are appointing C-suite leaders and other IT managers to look at the [internet of things](#) and other potential applications that can take advantage of 5G capabilities, Townsend said. Having someone focus on the technology and study 5G right now is the best way to prepare, he added.

One business embracing 5G readiness sooner than others is Odessa Medical Center Health System, based in Odessa, Texas, a 28-facility organization with a staff of more than 2,250. The medical center has 5G on its radar as something for the future, according to IT director Brad Shook. To prepare for 5G wireless technology, the medical center that serves a 17-county

region [upgraded its wireless network](#) in 2016. The medical center saw the need at that time to prepare for 5G, Shook said. When 5G devices are in use, the Odessa network will be able to support them.

Increased bandwidth and speed will help hospital departments like radiology, for example, which sends massive amounts of data to its [picture archiving and communication system](#), Shook added.

One big advantage of 5G is its support for network slicing, where operators can partition a single 5G network into several isolated virtual slices for its enterprise customers, each slice serving a different business service, Townsend said.

Telehealth increasingly is used to [connect physicians to patients](#) in remote locations, for example. Telesurgery requires low-latency, high-speed connections that are available in real time. Eventually, a hospital will be able to use 5G to slice its networks, Townsend said. One slice could manage telesurgery, sending massive amounts of video data to a remote location, for example, while another slice could be supporting more routine work at a nurse's station or a hospital's wireless guest access to ensure its other business segments have separate and secure virtual network slices of their own.

“If 5G can be combined with other teleconferencing technologies, ... we may see a dramatic improvement in business communication.”

—Sundeep Rangan, New York University

OPERATORS ADVANCING ON 5G

Network slicing is only one component of the new [service-based architecture](#) taking shape through 5G standards development, according to the 3rd Generation Partnership Project (3GPP). The 3GPP brings together seven standard development organizations to create specifications for cellular telecommunications network technologies.

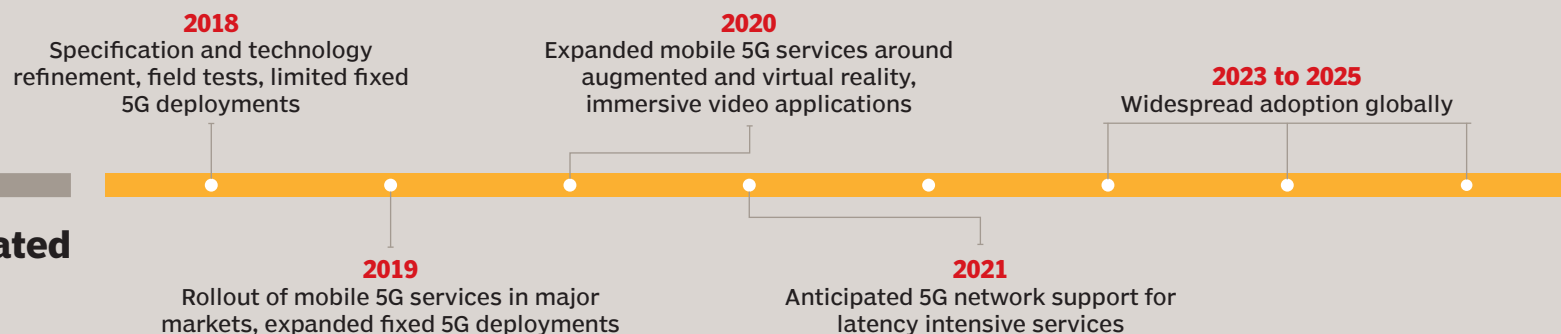
In late 2017, 3GPP announced a new 5G service-based model for network operators. The organization said the model adopts principles like modularity, reusability and self-containment of

network functions and was chosen so deployments will be able to take advantage of the latest virtualization and software technologies. The greater agility from the model will help operators respond more quickly to their business customers' needs, according to the 3GPP.

The organization plans to deliver more 5G specifications in June 2018.

In addition to the standards work, Verizon will continue testing 5G networks, expanding to 11 major metropolitan areas this year, and plans to demonstrate the capabilities of 5G wireless technology at

5G's Estimated Timeline



SOURCES: 3GPP, DELOITTE, GARTNER, MOOR INSIGHTS & STRATEGY, FARPOINT GROUP, TELECOMMUNICATIONS INDUSTRY REPORTS

the 2018 Winter Olympics in Pyeongchang, South Korea.

For its part, AT&T has expanded its 5G fixed wireless tests to include Magnolia, a home and lifestyle brand at its shopping location called the Silos in Waco, Texas. AT&T is testing [millimeter wave](#) spectrum to distribute connections throughout the location via Wi-Fi. It will also test 5G radio and antenna prototypes and is using AT&T FlexWare, its [network functions virtualization](#) product, as the router for the 5G network. AT&T said it hopes faster wireless speeds will benefit employees who use mobile point-of-sale devices and wireless devices to manage back-office operations, in addition to consumer shoppers.

Many trials have to be completed before network

operators make 5G services commercially available. In addition to pilot projects and standards development, federal and state access regulations and local permitting have to be established that allow telecommunications companies to install more fiber. [Additional fiber](#) is needed to meet the data demands that will come with 5G,

according to Tom Nolle, president of CIMI Corp., a consulting firm specializing in telecommunications and data communications.

The need to install fiber closer to the consumer's location, where connections could be completed by 5G wireless connections, explains why new capacity is required, Deloitte wrote in its July 2017 communications infrastructure upgrade report.

For now, telecommunications carriers and operators are bearing the brunt of 5G investment. Eventually, businesses will have to consider spending on fiber upgrades and other physical equipment to upgrade to 5G. But IT managers aren't yet making strategic commitments to 5G products or services they can't even buy yet, Nolle said. "It's too far out."

FUTURE OF 5G

Users' [capacity for data consumption](#) is at the heart of the 5G issue.

With mobile devices being used to access more data, 5G could have the greatest impact in the enterprise data center, according to Craig Mathias, principal with Farpoint Group, a wireless and mobile advisory firm in Ashland, Mass., adding that 5G

181%

**compound annual growth rate
in internet traffic through 2020**

SOURCE: "COMMUNICATIONS INFRASTRUCTURE UPGRADE:
THE NEED FOR DEEP FIBER," DELOITTE, JULY 2017

wireless broadband services will be able to handle a variety of traffic demands and applications. Still, the ramp up of 5G adoption probably won't start until 2023, he added. Because organizations have different time frames and strategies, 5G implementation isn't one-size-fits-all.

Eventually, organizations will have to contend with the data demand from 5G-equipped devices, which will put a strain on data centers. But higher wireless capacity will lead to far fewer bottlenecks

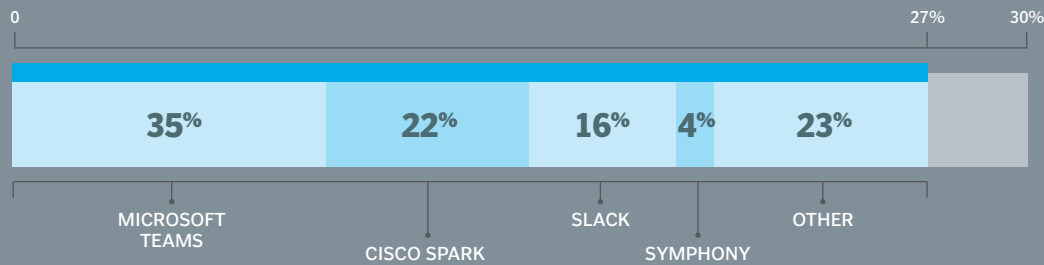
from more demands on the data center, he said.

As the business cases for 5G evolve, enterprises will find new ways to take advantage of 5G wireless technology. Eventually, if telecommunications carriers can achieve true 5G ubiquity, 5G could someday replace Wi-Fi all together, Townsend said.

In the meantime, enterprises can consider increased fiber and 5G device investments and prepare for staged rollouts of fixed 5G wireless services, followed by mobile cellular services. ■

Data Mine

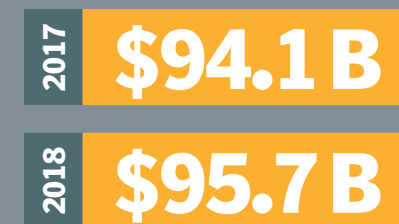
Team Collaboration Apps



Nemertes polled 700 companies and found 27% use or plan to use team collaboration applications. Here is the breakdown of which apps are used.

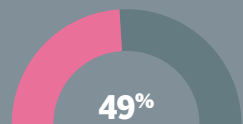
SOURCE: NEMERTES RESEARCH, 2017

Federal Spending on IT Increases

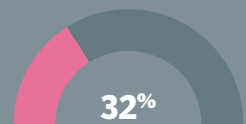


SOURCE: BUDGET OF THE U.S. GOVERNMENT, FISCAL YEAR 2018, MAY 8, 2017. TOTAL INCLUDES BOTH DEPARTMENT OF DEFENSE AND NON-DEFENSE SPENDING.

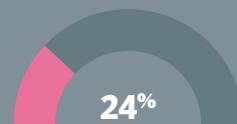
Enterprises Buy SD-WAN for These Top Five Reasons



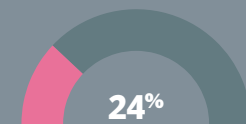
Improve bandwidth utilization (dynamic WAN aggregation)



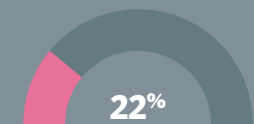
Increase WAN agility



Improve network security



Speed up WAN provisioning



Improve real-time voice and video performance

SOURCE: SD-WAN SURVEY, TECHTARGET, DECEMBER 2017. N=106. RESPONDENTS COULD CHOOSE THREE FACTORS.

SDN

When It Comes to SDN, Size Might Not Matter

BY STEVE ZURIER

→ Some enterprises find savings with smaller players rather than the market leaders.

WHEN IT COMES to software-defined networking, there's VMware's NSX, there's Cisco's Application Centric Infrastructure and then there's everything else.

Included in "everything else" is a number of SDN providers that enterprises continue to find attractive. As organizations [consider their SDN options](#), they should look into what those smaller vendors have to offer.

The benefits of using the bigger SDN providers are that they are focused on security and features like automated configuration and policy management that can scale across large enterprise networks. But the smaller players can also offer cost savings and flexibility that appeal to small and mid-size businesses, according to network professionals.

To prove the point, the need for greater agility drove U2 Cloud LLC, an IT company that provides

desktop as a service to government, financial services and commercial clients, to consider different options for building its network infrastructure, according to Pete Valentine, executive vice president for the company, based in Green Cove Springs, Fla.

U2 Cloud already uses a VMware environment, Valentine said, but when the company began looking at SDN providers four years ago, VMware's NSX network overlay product wasn't yet mainstream. Instead of going with VMware automatically, the company's primary choices were Cumulus Networks or [Big Switch Networks Inc.](#)

Big Switch won because U2 Cloud liked the way its operating system could be integrated into its VMware environment, Valentine said.

"We like that we can use an engineer [trained on VMware] to run this system," Valentine said. Big Switch's software enables U2 Cloud to create its own policy and security settings and gives the company more visibility into the network to see the logs and know where each packet has gone, he added.

Cost was also a big motivator. Valentine said a traditional proprietary switch with the vendor OS running on it costs around \$40,000, but U2 can buy a [white box switch](#) for \$6,000. The white box

approach also provides flexibility in terms of how much microsegmentation his smaller organization really needs.

"I don't need to put that ramped-up security with only 10 to 15 users," Valentine said.

SDN PROVIDERS THINK INSIDE THE WHITE BOX

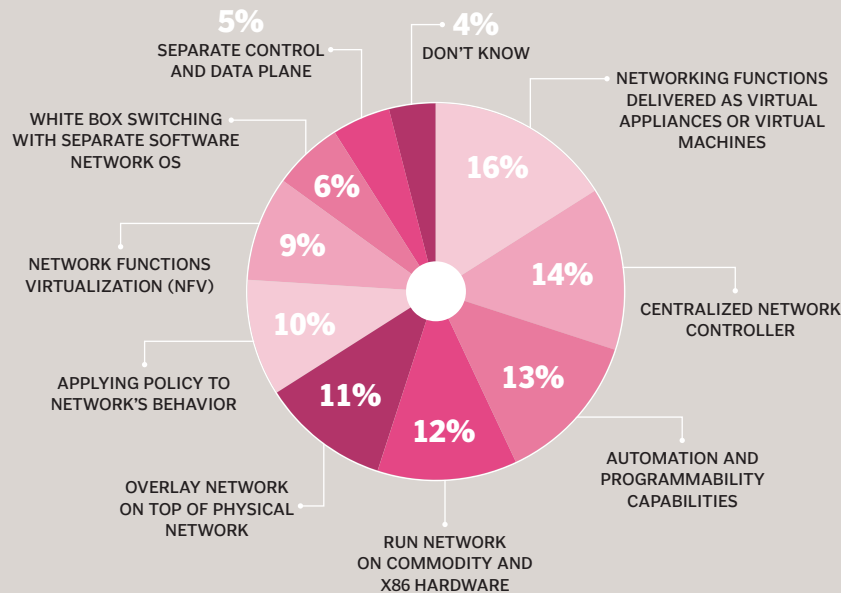
Developing flexible protocols and software that lets network managers mix and match traditional switches from any vendor was the original goal of SDN, according to Dan Conde, an Enterprise Strategy Group analyst.

As various elements of SDN hit the market over the last several years, many businesses found that running an open, separate operating system from SDN providers, like Cumulus Networks—which works by replacing proprietary switch interfaces from large, legacy switch vendors with common Linux interfaces—and Big Switch Networks on commodity white box switches, offered flexibility and cost savings. For network managers who still wanted to purchase a networking product from a single vendor, [Arista Networks](#) took a different SDN approach, providing both commodity-style switches

based on so-called merchant silicon chips and proprietary network software.

Networking customers have started to [respond to these new trends](#), pointing out that many

How Enterprises Define SDN



SOURCE: 2017 NETWORK MODERNIZATION TRENDS, ESG RESEARCH, JULY 2017. N=300

networking devices and software from Cisco and the other incumbents now run on commercial off-the-shelf chips, including [x86 chips](#) and other merchant silicon, as opposed to more expensive, custom, proprietary chips.

That said, enterprises are conservative and have been largely unwilling to try a white box switch and install a disaggregated network OS on it, primarily because they don't know who to call, the hardware or software company, if something breaks down, Conde said.

So while firms like Cumulus and Big Switch have blazed the trail with separated operating systems and switches, their business model isn't mainstream in the enterprise yet, largely because networking customers still prefer to purchase a networking switch and hardware from a single vendor, Conde said.

"The tricky part is that white box switching is more than x86—you need to put on a network processor, so you can't just convert a plain server into a network device," Conde added. "That's why white box switches include a CPU and some network processing power based on Broadcom processor chips."

Vendors like Arista have successfully integrated

merchant network processors and software into one box, Conde said. Over time, traditional network vendors have also adopted merchant silicon, like Cisco did in its Nexus 9000 series switches.

STREAMLINED OPERATIONS

The allure of white box switching to modernize its network led SaaS company [LogicMonitor Inc.](#) to look at Cumulus Networks' SDN product. The company, based in Santa Barbara, Calif., developed a SaaS application to monitor enterprise IT and needed a network infrastructure that could be as fast and agile as the applications it delivered to customers.

In the past LogicMonitor ran multiple network devices, each with its own operating system, feature set, and licenses, LogicMonitor network engineer Andrew Martin said. Managing the different devices was time-consuming and expensive. Having one OS through Cumulus streamlined its operations.

"If we need to spin up 20 racks in a hurry to meet demand, we didn't want to have to deal with four separate vendors, each one with a different license, possible bugs and configuration disparities," Martin said. "With Cumulus, we now have one operating

system and don't have to worry about four or five different configurations."

The basic function of a switch is to enable networked devices to talk to each other efficiently, Martin said. By [running Cumulus](#) over white box switches, LogicMonitor saves significant money on switching and licensing costs. The company also reduced labor costs because it can cross-train its engineers to operate the Cumulus operating system.

"Another big benefit is that Cumulus is built over Linux, so our engineers can do automated configurations and policy management with tools like Puppet and Ansible," Martin said. LogicMonitor can utilize its existing staff to help get tasks done because utilizing tools like Ansible eliminates the need to train employees on vendor-specific configuration interfaces, he added.

The software-based networking options offered by Cisco, VMware and other vendors to improve network efficiency are enough to keep enterprises interested in being part of the evolution of SDN. Where the larger players can offer advanced security and features, the cost and flexibility offered by smaller SDN providers continue to be attractive alternatives for organizations. ■

Pulse Check

2018 Predictions

Networking Trends to Watch

Edge computing

The power of data processing is strongest when it's close to the source. This digital transformation will lead enterprises to take a decentralized approach to their infrastructure.

Intent-based networking (IBN)

By 2020, more than 1,000 large enterprises, up from 50 in 2017, will use IBN to design high-performing, automated networks.

Hybrid infrastructure management

Data centers are giving way to a mix of on-premises, colocated, hosted, and public and private cloud infrastructure all focused on driving business services and outcomes faster and more efficiently.

SOURCE: "TOP 10 TECHNOLOGY TRENDS IMPACTING INFRASTRUCTURE & OPERATIONS FOR 2018," GARTNER, DECEMBER 2017.

40%

of IT staff, **by 2021**, will be generalists, holding multiple roles, most of which will be business- rather than technology-related.

SOURCE: "TOP PREDICTIONS FOR IT ORGANIZATIONS AND USERS IN 2018 AND BEYOND," GARTNER, OCTOBER 2017.



Cybersecurity

Percentage of organizations interested in security as a service

SOURCE: ESG RESEARCH, DECEMBER 2017.



EXPERT TIPS | UC TOOLS | JON ARNOLD

Tricks of the Trade: Streamlined Enterprise Collaboration

Check out these best practices for consolidating enterprise collaboration tools.

BEFORE TOOLS FOR enterprise collaboration were mainstream, employees largely used stand-alone applications like telephony, email, messaging and chat applications, and video and audio conferencing. That was the norm in the absence of a single collaborative environment. While there were natural inefficiencies in cost and workflows, employees were reasonably productive, and they were not clamoring for more efficient collaboration tools.

But the ongoing availability of [new communications tools and features](#)—many of which are free—offers end users multiple options to choose from, which can lead to overlapping features. If anything, this is making collaboration more challenging.

With so much duplication among communications tools, IT needs a plan, especially if companies want to deploy unified communications (UC) to improve collaboration across the enterprise.

HOW TO CONSOLIDATE AND COLLABORATE

The [value proposition for UC](#) has always been difficult to articulate, mainly because it doesn't solve a specific problem or replace a tool already in use. Employees already use multiple tools for enterprise collaboration. So the starting point for UC is to consolidate them into a unified environment and provide a more effective way to use those applications.

Furthermore, UC can be the impetus for end users to stop using multiple versions of one communications tool—chat programs, for example—and use only the version that integrates seamlessly with all the other UC applications. This integration is really the foundation of UC's value proposition, so understanding the rationale is essential when building a business case. If your organization is analyzing a UC strategy, check out the following benefits and challenges of moving to an integrated system.

**PROS****Common interface**

Smoother workflows come with everyone using the same tools with a common interface.

Cost-efficient

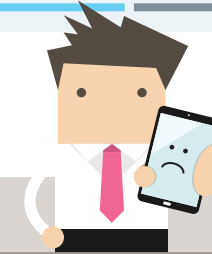
Consolidated tools features are easier and more cost-efficient for IT to manage.

Easier management

Consolidation provides streamlined app management, security and OS compatibility.

Consistent experience

Consistent user experience better supports remote workers.

**CONS****Complexity**

Complex UC platforms reduce employee use, drive workarounds.

ROI vs. total cost of ownership

Hard-dollar savings rarely support UC business case; it's difficult to prove app consolidation savings.

End-user adoption

Employees need to see a clear benefit to collaboration app or they won't embrace it.

Collaboration Tool Consolidation

The pros and cons of consolidating collaboration tools

BEST CONSOLIDATION PRACTICES

Your initial objective will be to consolidate the use of stand-alone applications into a common platform, and, from there, the benefits should emerge quickly. By providing a better collaboration experience, end users will have less reason to keep using multiple forms of the same application, thus streamlining both their desktops and network demands. Consider these high-level strategies when consolidating collaboration applications:

- Ensure the tools for enterprise collaboration are easy to use. Without that, established employee patterns will be hard to change, and, most likely, staff will keep using the same mix of multiple applications that aren't integrated. Test different vendor platforms with a cross-section of employees before purchasing.
- IT should drive the move away from consumer-grade applications because lower-quality features

and potential security risks could be detrimental to the enterprise.

- Messaging to employees should focus on the idea that they will have better collaboration results when everyone is using the same set of applications and only one form of each. To reinforce this, vendors should be able to provide case studies from successful UC deployments.
- Identify employees to champion the use of UC across the organization. One driver that should resonate with employees is the flexibility of UC, especially for customizing the applications. Once the user experience has been customized, employees will have less reason to use other variations of each application.
- [Gamification](#) represents a different approach that may be well-received. With a bit of creativity, employees might find this to be an intuitive way to adopt the UC model, track success metrics for working more efficiently and perhaps even earn rewards for streamlining the use of multiple applications. For the IT department, this could provide

some cool cachet to show it speaks the business language.

VENDOR FLEXIBILITY

Perhaps the best validation of this consolidation trend comes from the enterprise collaboration vendors, and how they're adapting to changing market conditions. Vendors have shifted their value proposition focus away from cost savings, which was always dubious, to the ability of UC to impact business outcomes. They have learned that strategic business value is a better selling point with management than everyday cost reduction. When deployed properly, UC can really deliver.

With that in mind, vendors have diversified their offerings to address various scenarios for businesses. In more static settings where telephony and email are the dominant applications, conventional UC products tend to work best. In more digital-friendly environments, however, especially mobile ones, conventional tools for enterprise collaboration have been jettisoned in favor of messaging and video-centric applications. Both types of offerings operate on the same principle of unifying

applications into a common environment, but the mix will be different for each.

This is an important strategy for vendors to differentiate, as they know that tools for enterprise collaboration don't fit a one-size-fits-all model.

Not only do they need to provide the right offering for each customer, but they want employees to use their applications to the fullest extent possible so customers have less reason to use similar offerings from their competitors. ■



- [Seth Price](#)
- [Senior Network Engineer](#)
- [Durham County, N.C.](#)

THE SUBNET | Q&A | JEAN DERGURAHIAN

Durham County Builds Network Automation Into Its DNA

HOW DO FOUR engineers become network management rock stars? According to Seth Price, the senior network engineer for Durham County, N.C., the road to fame means removing complexity, increasing network automation and shifting management to a single controller to enable an efficient and seamless network experience for users. That's the goal as he redesigns the county's network.

Durham County government includes 2,000 employees who use the network to provide support services for more than 280,000 residents. A little more than two years ago, Price was tasked with re-designing the network from scratch. He used [Cisco's Application Centric Infrastructure](#), the vendor's version of [software-defined networking](#), to rebuild the county's core data center network, and he is now at work to extend the ACI fabric, using Cisco [DNA Center](#) management software, to county offices and

facilities that include a library and a security operations center.

When he's not busy creating new network configuration tactics, Price is outside as much as possible, balancing work and life with exercise, golf or new adventures like deep-sea fishing. We caught up with Price to hear more about Durham County's ACI project, Cisco DNA Center and his thoughts on where the networking profession is headed.

Editor's note: *This interview was edited for length and clarity.*

[How did your ACI project get started?](#)

We were at the point where [the data center network] was due for a lifecycle replacement, and I was given the opportunity to say, 'OK, starting from this point forward, how do we want to redesign and carry Durham County into the future?'

So I selected the Cisco software-defined ACI product and designed and implemented it for the Durham County data center. It's been in production for about a year and a half now. We've continued to build upon that to make the management of the network at Durham County much more efficient, including automation and a central point of orchestration.

What were some of the challenges you faced migrating to the software-defined environment?

First of all, it was so new. So many people had heard the acronym, maybe read some stories about what software-defined networking was, but they were having a hard time grasping how to manage a network in that environment.

We've done things the same way for 30-some years with the way that we manage data centers and networks, in general. What [ACI] brought to the table was a brand-new way of doing things. Not only were some of the networking components vastly different, but the terminology was too.

One of the biggest challenges was educating myself and those around me not only on how we were going to implement this, but how it was going to

make Durham County better. We have different teams here that are kind of siloed off. I think for the migration, one of the biggest challenges was just getting everybody on board.

What does it mean to be 'application-centric'?

In the network world, we've just cared about, 'OK, can this network talk to this network? What ports need to be open? How do we secure it?' But as far as having visibility into the applications running on the network, it's always been very limited without additional software services. With an application-centric model, we're able to take a step back and not worry so much about network requirements, but worry about application requirements. That is a big change from a network engineer perspective.

On top of that fabric, we're able to group our endpoints and our servers into application needs rather than network needs. We've always been very specific on routing within the network. Now we're able to group services, servers and applications together in a way that makes sense where we don't really care about what network they're associated with, what [virtual LAN] they're associated with. Then the great thing is that we can monitor that application's

health from within the [main console in ACI](#).

Cisco has been trying to build its use case for ACI for the last year or so. What makes it work for you?

I find whenever I talk to any other engineers, any other peers [about ACI], there still seems to be a lot of fear. It goes back to, 'Well, we've always done things the same way. We know how to get into an [Secure Socket Shell] session or a console session on a switch. We know how to program them. We know the language well. We can script things against them to kind of automate things.' It's very predictable and comfortable.

This kind of blows that up. A lot of people don't really even start looking at ACI unless they have a lifecycle replacement. My recommendation is: Gather the knowledge. This is the future. This is where everything is going. This is where Cisco, in general, and other vendors are putting all of their resources into development, in this technology.

So how do you see the ACI project shaping the network serving county offices?

Cisco's intent-based networking all revolves around its DNA Center. It's taking that same type of model

in the data center and now bringing it out to the enterprise. The Cisco DNA Center is going to be the software-defined controller for the enterprise network.

We have 50 sites with a bunch of switches and a bunch of routers, and different pieces of gear out there, wireless controllers all over the place. When we have issues or requests, more often they're not in the data center. So DNA Center is going to be that central point of automation and orchestration for the county.

The Cisco DNA Center has hooks directly into ACI. What I'm going to be able to do is—from a user's laptop, desktop, whatever they may be using, once they connect into the network, they'll have a policy associated for them. Their user ID and the device they're connecting with will carry through the enterprise and into the data center. Not only that, but I'll be able to manage all of the network elements, all the network devices from a single point of orchestration, rather than from device to device, site by site. The other thing that Cisco DNA Center allows us to do is have a single point where we can upgrade all of our devices in the network with a couple clicks.

DNA Center gives us a more holistic view of the enterprise network, rather than thinking of a bunch of switches and a bunch of routers and a bunch of sites. It offers a big advantage for an organization like Durham County because we don't have a huge staff.

This whole automated process is going to make us look like rock stars, to be honest with you.

How did you first get into networking?

At the beginning of my junior year of high school my guidance counselor told me he had an opportunity for a co-op program. It actually was a job with the state of Michigan as a computer technician. In my junior year, I would go to school for three hours, then I would go to the program, and I would work the rest of the day. I would get paid, but I'd also get graded. I kept that position through college as well. I spent a lot of my time working with the network

administrators and engineers, and I quickly moved into roles of being able to assist on network configuration engineering and troubleshooting.

I've heard a lot of schools, including my old school, dropped their co-op programs. I was very disappointed, because it was really the start of my career having the opportunity to do something like that.

What are you doing when you're not thinking about networking?

It's important to have outlets—as an engineer or anyone, really, who works in any type of stressful job, to have an outlet where you can disconnect. I just got back from a deep-sea fishing trip with a bunch of buddies off the Outer Banks of North Carolina. We caught a bunch of tuna, so that was a lot of fun. I enjoy anything that gets me outside and where I can be active. ■

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