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Letters to the editor may be sent to SWEditor@walkerfirst.com

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Editor's Letter

When were we not talking about network modernization, right? I'm fairly certain none of us ever expected to have the network announced "done" - never requiring upgrading, no addition of new technologies, no need for introducing new features. For some time it has been normal to anticipate the need for network modernization, knowing the concept of a modern network was really just a moving target. Perhaps the things we didn't factor into our thinking, however, were how much change would be required, and the pace at which we were required to change.

As we discussed the content of this issue one thing stood front and center: The ICT industry resonates with every facet of our lives. More and more we rely on the transfer of data to navigate our lives. The reliability of that transfer, along with how quickly it occurs and how much we can move, has become more than matters of convenience. With the advent of connected vehicles, manufacturing automation, technology based healthcare, virtualized networks, it can be the difference between life and death. Network modernization is relative to safety, intelligence, security, efficiency, knowledge transfer, health, education, commerce, and more. Sure, a great network allows us to stream latest content and stay connected via social media, but we long ago passed the threshold of our networks providing anything as simple as entertainment and staying connected.

Do not miss reading Ciena's Rick Dodd article on page 32. His predictions about the network in 2017 and beyond are compelling. And if virtualization is something you are considering for your network, ADTRAN's Barry Derrick makes some solid points about its emerging advantages on page 12. As always Prayson Pate from ADVA has done his homework. His article on page 10 explores feedback from your very own peers about operator innovation and its connection to network modernization.

From an industry standpoint, UTC makes a solid case regarding the convergence of IT and OT. What does that mean for the talent pool in your own organization? What are your strategies to overcome the next gap in the talent wars? These are important questions to consider when assessing your network's readiness for newest technologies.

And no conversation about network modernization would be complete without considering the regulatory, legislative and policy components. As a new administration finds its home in DC, all of us stand to be impacted by its decisions and leadership. Already, we've watched a new FCC emerge. What will all these changes mean for network operators, their funding vehicles, competition, M&A activity? The perspectives offered by industry leaders from TIA, INCOMPAS and CCA are the perfect reads as you consider answers.

So, yes, we are talking about network modernization - again. I suspect we all agree this is an ongoing conversation, and we all need to be at the table. We hope you find this issue of Skinny Wire helpful as you consider new ways to make your network more competitive, more relevant, more vital.

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Real Innovation Meets the Access Network

By Greg Whelan
Principal
Greywale Insights

Innovations are much more interesting than inventions. The “laser” is a classic invention and “FedEx” is a classic innovation. Successful innovation disrupts entire industries as we’ve seen with Uber, AirBnB and Amazon to name just a few. The entire global telecommunication industry is at the dawn of a new era of innovation and with all innovations everyone should win except what’s referred to as “laggards”. Who are the laggards going to be in this new era of open communications? You don’t want to be one.

New inventions are announced weekly by technically driven companies all promising the a similar “value proposition” of Open, Low Cost and Agile. I’ve heard the latter term so many times it’s bothersome. Most of these inventions, many neat technical tricks, promise a new network operator nirvana and ability for these heavily regulated companies to compete with the cash-rich, nimble and aggressive “cloud companies” such as Amazon, Google and Facebook. Unfortunately, most of these are “lasers”. One of the more promising “FedEx’s” is CORD or Central Office Re-architected as a Data Center. CORD is the biggest innovation in broadband access since ADSL and has the potential to re-vitalize incumbents and give over-builders like GoogleFiber and Municipalities a substantial CAPEX and OPEX advantage over those network operators holding on to yesterday’s closed, proprietary and expensive architectures. CORD is an Open Linux Foundation Project and is managed by the Open Networking Foundation (ONF) which has recently merged with the CORD founding Open Networking Laboratory (ON.Lab). The new ONF has defined CORD to include a complete hardware and software open source implementations.

CORD was created by network operators, namely AT&T as part of Domain 2.0. In the U.S., Verizon and Comcast have both joined this initiative as has Google/Alphabet (Not GoogleFiber directly). Interesting, first Verizon joined an AT&T spawned initiative and then Comcast joined a telco initiative. CORD has a common core software architecture and supports three use cases: Residential-CORD (R-CORD), Mobile CORD (M-CORD) and Enterprise CORD (E-CORD). I’d

expect a new cable (C) or DOCSIS (D) related CORD in the future. There also a common Analytics CORD (A-CORD) across all use-cases. In theory, a future service provider could have a single backend infrastructure, single set of M&Ps, etc. for fixed and wireless networks and for enterprise and residential services. CORD can’t solve organizational issues or squirrel chews though. For now, think of CORD as a “concept car” as AT&T does. CORD, as the name implies, leverages the ubiquitous virtualized data center architecture comprised of “white box” servers and “bare metal” switches in a “Leaf-Spine” architecture and adds carrier-grade open source software implementations and open APIs. A generic data center architecture is shown in Figure 1, below.

in the CORD rack. The management line cards become embedded in the virtualized software infrastructure including the SDN Controller (ONOS) and the NFV Orchestrator (XOS). The white box servers are a pool of compute resources that can be used for VMs, containers, VNFs, caching, etc. As part of the fundamental architecture initial VNFs include a Virtual Router and a Virtual Subscriber Gateway which eliminated the need for a separate BNG/BRAS and simplifies many CPE operational issues.

There are two primary areas where innovation makes a real impact. The first is doing the same things better and the second is doing new things. CORD does address both in many interesting ways. For the rest of this article, I’m going to

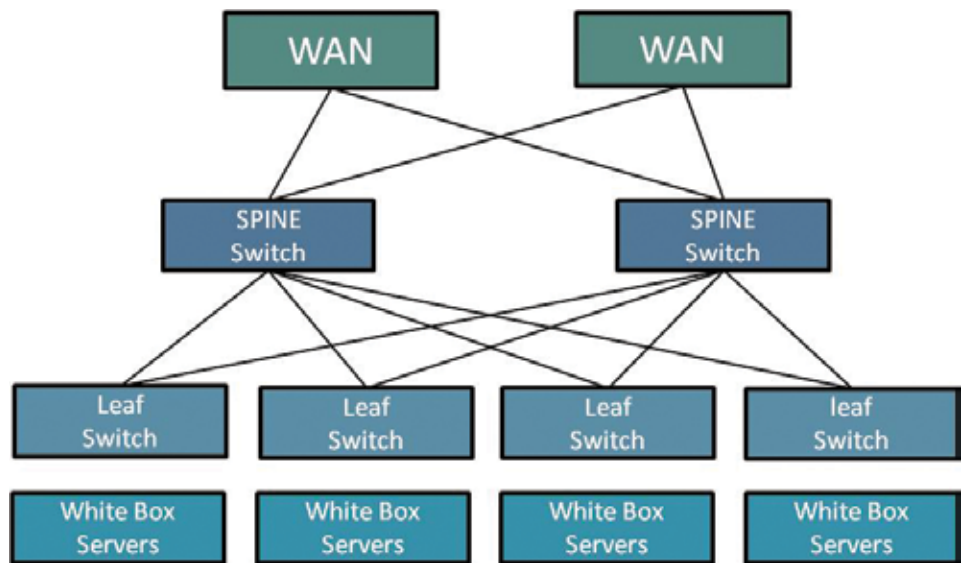


Figure 1 Data Center Architecture
Source: Greywale Insights

CORD re-positions the two WAN ports with one becoming the access network and the other becoming the Metro Network. This is illustrated in Figure 2. Note the switches and servers are “white box” Commercial-Off-The-Shelf (COTS) hardware running open source software. CORD evolves today’s CO and in the process it “disaggregates” a number of today’s fully integrated network elements including the OLT, ROADM, and BNGs. In an OLT case, shown in Figure 3, the chassis itself transforms into the leaf-spine switch fabric and the access and metro I/O blades become 1U I/O shelves

focus on the former and using tactical, yet real life, examples illustrate that I call the “elegant simplicity of the architecture”. The ‘cooler’ examples involved the intersection of virtualization and market dynamics and the access network.

Tactical issue number one, what is the “N+1 problem”, with N being the maximum number of subscribers support in a given chassis and the “1” being the next subscriber(s). With a traditional OLT you’d likely need to buy a new chassis, two access line cards, two metro/WAN line cards and two management cards

and then integrate the new chassis in a rack. With CORD, all you'd need to buy is one 1U access shelf and add it to the CORD rack. This assumes the backend integration in both cases is comparable (Backend integration being everything required to take and order and send the bill).

With CORD your "atomic unit" for adding new subscribers is a 48 port I/O shelf and not a chassis designed for 5000 or more. In a GPON CORD each shelf with a 1:32 split can support 1536 subscribers. It's also expected that each of the 48 ports can be 'software-defined' to be a specific technology. The network operator can then install the requisite SFP and download the appropriate software on port by port basis. In this case, upgrading a port from GPON to XG(s) PON would be swapping out an SFP and downloading new software to the specific port. Everything else remains the same! Thus, one of the business benefits of CORD is the closer alignment of CAPEX with actual subscriber demands.

Tactical Issue Two is supporting two or adding a new access technology. Many fixed network operators must support more than one access technology, GPON and xDSL for example. Others may want to add a new one such as XG(S) PON or NG PON 2. While GPON OLTs today can support new access technologies by simply adding a new line card at some point the existing equipment will need to be upgraded or will lack the capacity or capabilities to support emerging market demands. For illustrative purposes, adding a new access network architecture requires a new system from perhaps a new vendor.

With today's architecture, adding a new access technology would require the network operator to test, qualify and deploy an entire new system. They would then have to create new M&P's and would have a significant backend integration effort. With CORD, the network operator would merely have to qualify a new Access I/O shelf and add it to the existing CORD rack. The backend integration is non-zero but would be substantially less than adding an entire new system. The M&P's would require minor adjustments too. Yet, everything else except the new access I/O shelves, remains the same. The business benefits of this are far ranging and impactful.

These two tactical examples illustrate inherent flexibility of the hardware architecture. The open source software architecture is equally flexible. The reference CORD software implementations include the ONOS SDN Controller and the XOS NFV Orchestrators. Both of these open source initiatives are part of the Linux Foundation and the ONF. Open Flow, Open Stack, Docker Open Daylight, OPNFV and many open source projects are supported as well. All of which bring the value of virtualization and open source to the most challenging part of the network: the access network.

CORD is real innovation and it will disrupt the entire network operator ecosystem. It already has. Here we merely discussed some simple examples of how the CORD concept can improve and simplify network operations. There are many more ways that CORD enables you to 'do things better' by driving efficiencies, automation and slashing OPEX. Equally as interesting and important are the new features CORD enables which will enable network

operations to achieve their goal of being more "cloud-like". CORD is the 'real deal' innovation-wise and network operators of all sizes and shapes should begin to understand how CORD can impact their business. No one wants to be a laggard!



Greg Whelan, Principal at Greywale Insights, has over 20 years of international broadband (telco, cable and wireless) experience. He's a thought leader in merging Service Provider business drivers and leading edge technologies. His research focus is in virtual access networks, Real Open Access Broadband, Gigabit Broadband, fixed-wireless broadband, Community Broadband, and IoT networking. He's a pioneer in the broadband telecommunications area and drove the first global DSL standards and was a co-founder, and Vice President of the Broadband Forum.

Greg has worked in technical marketing roles for large technology firms including Cisco Systems (San Jose, CA) where he led award winning global marketing campaigns in telecommunications and cable markets and Analog Devices (Norwood, MA) where he created and lead their successful entrance into the broadband telecommunication market. He's also spearheaded marketing and products for a number of early stage SP Focused venture-backed start-ups in the Boston area, three of which were acquired by larger tech companies.

He has a BS in Electrical Engineering from Cornell University and an MBA in Innovation from Northeastern University. He has also studied Digital Video over Broadband at the MIT MediaLab.

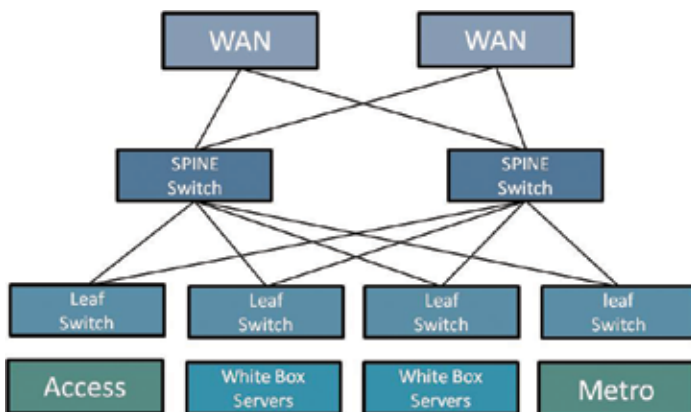


Figure 2 CORD Architecture
Source: Greywale Insights

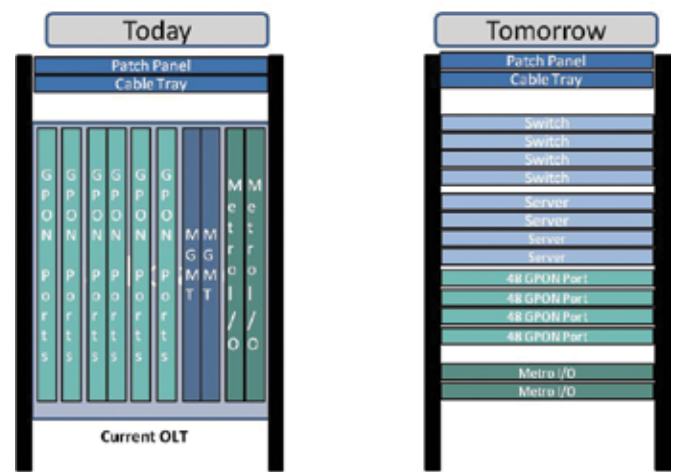


Figure 3 CORD Architecture – OLT Disaggregation
Source: Greywale Insights

Utility Modernization and IT/OT Convergence

By Bob Lockhart
VP of Cybersecurity, Technology and
Research
UTC



Utility Modernization may be a trendy topic but utilities have been modernizing for decades. The first Automatic Meter Reading (AMR) deployments are 20 years old. The first boom in smart metering, with its myriad of telecommunications approaches including neighborhood mesh, powerline telecoms, base stations, and even cellular carriers, is nearly a decade old. But changes continue to arrive at a feverish pace. Newer developments such as synchrophasors and high-speed distribution network monitors promise previously unexpected precision in grid management. Meanwhile, telecoms carriers are retiring legacy technologies that have been utility workhorses, such as SONET.

The commonality of nearly all the advances in grid management is the need for improved telecoms. More data, needed more quickly. Residential solar and wind power generation provides energy inputs directly into a distribution grid, bypassing substations. Unpredictable in timing and intensity, these distributed energy inputs require split-second decision making to keep a distribution grid balanced and within its safe voltage levels. As grids become ever more complex, only automation can react quickly enough to keep things in order. And that automation starts and ends with fast and reliable telecoms.

But things are not straightforward, and utilities as a whole do not appear to have settled on a standard response to the increased telecoms requirements. UTC recently surveyed a number of member utilities on key performance indicators for their OT telecommunications. Some interesting findings:

- Utilities have not standardized on a single organizational placement for the OT telecoms teams. Most commonly we found that OT telecoms were placed either within the IT group, within power system operations, or as a separate operating company.
- Curiously, the OT telecoms team was least likely to charge for its services or to have service level agreements (SLAs) in place when it was within the IT department.
- Outsourcing of OT communications does not appear to have gained any momentum beyond the services traditionally offered by carriers such as mobile voice.
- Only about one third of responding utilities have combined their IT and OT telecoms into a single network.

Utilities do not normally approach tech-

nic issues with such a diversity of solutions. The variance in our members' responses suggests that it could be a while before a standard approach to OT telecoms arrives. If it ever does arrive.

Utility modernization will require lots more collaboration than in the past. The marriage of ICT (information communication and technology) equipment and traditional grid management, with data science as a witness, brings forth overlap between IT and OT heretofore unseen.

Utility modernization sometimes presented solely as a technology issue. To be sure, there are key technological issues. More recently developed applications such as conservation voltage reduction (CVR) are technically sophisticated and promise to reduce both operational and capital expenses for utilities. However most new applications have heavy communication requirements and, being built upon ICT platforms, many new solutions assume the presence of IP-enabled communications. Thus IT and OT teams must collaborate to ensure a working deployment of new grid technologies.

All that change ripples throughout the utility. New technologies require staff reskilling. Retired telecoms require redeployment of existing applications. And every change brings with it new processes, new job descriptions, sometimes even new people. One fundamental result of utility modernization is IT/OT Convergence.

To briefly define IT/OT Convergence, information technology (IT) is the set of platforms and applications that have operated businesses for decades, enabling systems such as billing, inventory, payroll, and logistics, to name a few. Operations technology (OT) is the set of systems that manages and monitors the power side of a utility – systems that live in substations, control rooms, and at the top of transmission towers. IT and OT systems differ in their approach, the type of technology they employ, and especially in the effect of an outage. Convergence simply means multiple entities approaching a common point.

Therefore, IT/OT Convergence is the concept that ultimately IT and OT as described above will eventually become a single set of systems. That is unrealistic given some of the dramatic differences between the two but it is reasonable to anticipate more overlap of IT and OT than exists today.

IT/OT Convergence may be a misnomer, even if IT and OT will likely overlap more than they do today. Simultaneous external drivers propel IT/OT overlap:

- Migration of OT applications away from discontinued telecoms such as SONET, toward Multiprotocol Label Switching (MPLS) or Carrier Ethernet (CE) telecommunications
- Massive data collection and analytics approaches that are enabled by modern line sensors
- Increasing integration of distributed renewable energy generation into distribution grids
- Increased regulation and green energy mandates
- Threats to utility business models from distributed renewable energy generation
- Increased cyber-attack surfaces due to increased use of ICT
- Poor availability of skilled staff to manage modern networks and data-based approaches

IT/OT Convergence and Network Modernization are often characterized as technical challenges. To be sure, the technologies required are complex, but implementing them may be the easy part. Network modernization frequently requires new forms of collaboration not previously seen in utilities. IT and OT personnel, often with vastly different backgrounds, must collaborate when sometimes they barely speak the same language.

Cultural landmines abound. IT and OT teams typically speak different vernaculars, have different backgrounds, and understand concepts such as security differently from each other. The required collaboration is therefore challenging and sometimes only reluctantly achieved. Key to this, and key to all utility modernization, is executive management support of the required collaboration.

The last bullet point, staff availability, can be a snake in the grass for many utilities. As networks become increasingly complex, utilities may need skills that have been rarely if ever required in the past, such as data scientists and cyber forensics experts. These and other esoteric skills will be key to operating a modernized network. Yet, utilities may be challenged to attract and retain such personnel. For example it is difficult for an electric utility to offer a long-term career path to a data scientist. Meanwhile, those in possession of such in-demand skills are well aware of their worth and will likely be highly sought after.

Without the required collaboration, technology becomes the driver and utility employees the passengers. That does not foretell an enjoyable journey. If utilities want to avoid becoming the passengers in their modernization projects, then some key areas to address are:

- Define all modernization projects in terms of use cases and business results – understand why any given technology is needed and what business benefits it will bring.
- Develop an early understanding of the required changes to job descriptions and business processes. This may require changing some employees' roles, which brings with it a fear of lost employment. Utilities should approach this topic sensitively.
- Plan for cultural disruption and decide early on how this will be handled.
- Write new business and technical processes before the technology is deployed, if possible before it is acquired.
- Continue the traditional practices of supply chain management and technical evaluation of solutions.

Utility modernization is not going to be straightforward for any utility. For those that do not address cultural as well as technical issues, it may become an outright nightmare. The key will be to get ahead of the complexity and think in terms of three essential elements of all solutions: the people, the processes, and the technology.

AUTHOR: Bob Lockhart is Vice-president of Cybersecurity, Technology, and Research at Utilities Technology Council, UTC.



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Network Modernization in the Service Provider Environment

By Erik Muller
Network Architect
Network Utility Force

Networks, like all aspects of operation of any business, evolve over time... and as such they often contain elements deployed at one time which are no longer well-suited to newer requirements. But, prudent and cost-conscious operators find ways to integrate legacy systems with the new, and can maintain multiple generations of deployed infrastructure in parallel. While this model of organic growth is nearly universal within the industry, different operators may take a variety of approaches to manage the complexity and keep their infrastructure up-to-date.

Few operators have the luxury of performing "forklift" upgrades network-wide to standardize their environments - and in the rare cases that doing so might be financially justified, the operational cost, effort, and time required for a global update usually makes it an impractical challenge. So we make do with incremental updates, deploying newer generation equipment in an expansion while leaving the existing systems running. Or we add a new service or product offering, and new customers are turned up on a new platform while existing customers remain on the original systems. Over time as this cycle repeats, a wide and inconsistent range of systems end up in production.

This diversity comes with operational costs. Staff need to be trained on multiple classes of hardware, management systems, and operating procedures. A wider inventory of spare parts needs to be maintained. More devices need to be tested when deploying updates, more documentation needs to be review and kept up to date, and so on. Even in a single-vendor environment, different generations of systems often have differing management applications, supported software versions, and hardware capabilities. All this variety requires time and focus, which results in increased cost of operations - and furthermore adds complexity which results in longer lead times to deploy new features and services.

The good news is that the complexity and burden of supporting legacy systems

and devices can be minimized by taking a mindful approach to updates and new deployments. A variety of approaches can be taken to simplify and modernize a network, using routine operations as a starting point. The key factor in all of these approaches is to treat upgrades, growth, or changes as an opportunity to standardize and update.

Careful planning in advance of deployment can ease the long-term support burden. Once a determination is made that it's time for an infrastructure refresh or addition, a valuable step is to reassess your architecture - as requirements change, the best solutions may also change. While your current solutions may be adequate to the task, there may be other options that provide a better fit today or a cleaner path towards future goals. Walker and our partners can assist with this review, providing a fresh outside perspective. Ensuring that tactical changes fit into a long-term strategy results in a longer service life of newly deployed components, and can minimize the need to retrofit changes down the road as other new requirements arise.

Expansion of footprint or deployment of new products and services are the most obvious drivers of change, but the other end of product life cycle is often overlooked. As manufacturers update their products, older systems are replaced by more capable ones - and today's state-of-the-art device is tomorrow's legacy system. While most vendors offer predictable and well-documented support models, eventually every system will reach a point where support, software updates, and spare parts are no longer available. And, just like cars, houses, or any other product, network infrastructure devices tend to become more failure-prone as they age. Being aware of this, and planning ahead to update aging infrastructure before it becomes a critical issue, allows an operator to minimize disruptions while keeping infrastructure up-to-date. And of course, as technology improves over time, newer equipment can often provide the same functionality in a smaller space with lower demands for power and cooling.

Beyond the hardware level, modernization can encompass a wide range of configuration and management features. For example, identifying legacy or vendor-specific protocols in use, and migrating those portions of the network to a modern, standards-based model can promote consistency within your network, and simplify the integration or transition of suppliers in the future.

Also in many networks, there is a tendency to diverge from standards over time. New equipment is deployed with the latest software, while older systems remain on prior versions; new customers are turned up with new templates while existing customers use older profiles or settings; and other similar updates may not be universally deployed. This tendency towards entropy can be largely overcome with operational discipline or automation, but even in the best-run environments periodic review and audits can identify legacy issues which may be working today but could hinder future changes.

SDN and NFV, while sometimes overhyped, can also be leveraged to good effect to update an existing network. Even if you don't currently need advanced SDN features such as Openflow today, many newer devices support technologies such as NETCONF which can be combined with automation frameworks such as Ansible or Salt to simplify provisioning and management. Investing in tools to simplify management and improve consistency can result in long-term improvements in efficiency of operations.

Maintaining a consistent, modern network can be a challenge in any environment, but doing so can provide operational benefits and cost-savings. Both in equipment and in operations, there are many angles to explore that can drive these benefits. Proactive planning and preparation can be key to ensuring that you're prepared for future needs and requirements, and we at Walker are ready to assist you in this effort.

Network Modernization Means Operator Innovation

By Prayson Pate
CTO, Ensemble Division
ADVA Optical Networking

If you mention network modernization, most people think about updating the infrastructure of the network. I think a bigger and more important set of changes are required in the operators themselves. That's just my opinion, so I thought a sanity check was in order. As a result, I recently did a phone survey of some of my contacts to find out what's on their minds.

Who I Talked to and My Methodology

I asked 10 senior leaders about their views on innovation at their own company and in the industry. Here are the demographics:

- Geography: 7 US, 3 Europe (2 in APAC wanted to participate but we couldn't work out the timing)
- Industry: 9 telco, 1 cable
- Role: 8 technical, 2 sales/marketing
- Level: VP, director, group CTO

I asked a series of open-ended questions, not multiple choice. I also promised that these discussions would be off the record, so you won't see who provided the quotations below, or who they work for. I have found that this approach enables maximum insight into what operators really think. Some of the candid answers were quite surprising.

Do You Have a Plan for Innovation? Does the Team Buy the Plan?

All of my respondents felt their companies had a defined plan for innovation and transformation, and some have stated the plan publicly. Most felt that the goal was understood and accepted by the leadership team across the various disciplines.

Engagement at the lower levels was a mixed bag. While most of the team seemed to understand and embrace the plan for change and innovation, some stated they had seen active resistance from groups like operations or, in one case, the CCIEs (!) who were threatened by the loss of their elite status.

One person said that "we recognize we're on the cusp of a profound shift in technology and market. When we look back in 5 or 10 years we'll say 'wow.'"

What Are the Drivers for Innovation?

I asked my contacts what drivers were being cited to explain or motivate the need for innovation. The following reasons were no surprise:

- New revenue
- Faster turn-up of services and shorter time to revenue
- On-demand services and improved customer experience
- Compete with OTTs

On the other hand, these responses were a bit unusual:

- Move to an open and software-centric platform, i.e. future innovation. (This respondent did say such an open-ended goal complicates investment because of the lack of a clear return on investment.)
- Retirement of old services and infrastructure, e.g. TDM. (All of these operators have to achieve this goal, but only one cited it.)

What Are the Best Opportunities for Revenue Growth?

The following responses were in line with my expectations:

- SD-WAN
- IoT – There is a lot of focus on new revenue from IoT, but one respondent said: "I am personally on the fence about IoT. The revenue per device is miniscule, and IoT complicates scalability."
- Cloud connectivity
- On-demand services – We at ADVA Optical Networking have seen this up close with the success of our partner Masergy.

I was not expecting these responses:

- Location services – This leverages the operator's advantage in physical presence and infrastructure to generate revenue from advertisers based on customer location.
- Open platform for innovation – I personally like this response, but it's hard to get folks to buy into such as forward-looking vision.
- Carrier Ethernet – While a lot of focus is on new technologies, there are still plentiful revenue opportunities in Carrier

Ethernet.

- Network buildout – There's so much talk about content and software that it's easy to forget that telco operators base their business on physical infrastructure.

What Are the Barriers to Innovation?

When involved in an effort like this, I like to say that "nothing is easy," and that certainly holds for this innovation transformation. Here are some of the barriers that were cited:

- Believability of business case – "Are you just trading CapEx for OpEx?"
- IT skills – "This is a tough hiring environment; we are competing for talent with cloud companies." ; "We can and do train staff, but then you have retention issues due to headhunting from other companies."
- Culture – "Everybody has to change but me."; "People don't want to use a common infrastructure, because it leads to a loss of control."
- Funding – Competing projects; "it's difficult to make long term investments in a public company focused on quarterly results."
- Technology – Immature; Adapting from cloud to telco
- Legacy systems and equipment

Over the Top (OTT): Opportunity or Threat?

The impact of OTT was another area that drew divided responses. Some of the operators saw it as an opportunity for partnership in these areas:

- Enterprise services with guaranteed BW and SLA
- Micro BNG/CDN at the edge of the network
- Become an OTT, e.g. AT&T offering DirecTV content
- Network as a Service
- Some of the others saw OTT players as a threat to these offerings:
- Consumer services
- Voice services
- Security services

What New Technologies Are in Play?

I asked my contacts about the status of the following technologies, and whether they are in use now. The responses are in the "Usage" column, but the comments are what's most interesting.

Technology	Usage	Comments
NFV and SDN	√√√√√√√√	"Agile has to get code out the door. Too much PM. Must involve the customer. No scheduled releases."
Agile and DevOps	√√√√√√√√	"Hard to bring a DevOps model up to our standards."
Fail Fast	√√√√	"Kill hobbies." "Never for the network." "How do we move from static six 9s 'never fail' model to fail fast?" "We will do stuff knowing we have to throw it away in 2 years."
Open Source	√√√√√√√√√√	"Can a Linus Torvalds control what goes in?"
SD-WAN	√√√√√√√√	"Everyone is positioning their products as SD-WAN, including vCPE and virtual overlays."

What About Management? Can Today's OSS/BSS Systems Be Used?

The responses were divided on this question. Here are some interesting comments:

- "We have to change them. They don't have open APIs, and operators will need APIs for NNIs. TIRKS is an albatross."
- "We can innovate around or through existing systems. We're going to build an orchestration platform in parallel and connect where needed, e.g. billing. Can't rip and replace – must evolve over time."
- "There are benefits of back office improvements. In the long term, need to replace to address cloud applications."
- "We already had to upgrade and integrate OSS/BSS, and this is largely complete. In 2017, the software focus will be on automating the new feature and products."
- "We are in a merger now, which highlights the difficulty of the existing systems. However, they are effective at scale. We could streamline and do more with fewer people."
- "We can't replace them overnight, and we can't wait. We need a new approach: replacing lower layers with a data-model-driven approach, e.g. with YANG. But it takes time."
- "We can get some benefits from SDN and NFV without an overhaul, but that will only take you so far. We need to replace them in the long run, and we do have an NG OSS vision. However, I've been here 20 years, and there's always been an NG OSS vision."

Virtual CPE: Is It Ready?

I next asked about the readiness of virtual CPE (vCPE) for mass production rollout. Again, the responses were mixed.

On the "no" side:

- "We're not ready! It doesn't fit into what we are doing."
- "Out of my bailiwick now. In the past, we had concerns about number of services required for the business case to work. The technology was fine."
- "The centralized model is hard to gauge due to oversubscription. We don't have enough data to make good rules on what works. If you roll out slowly, you can get the data that you need before you break the service."
- "No. There are issues with scalability of service chaining and the manageability of solutions. Also, issues with scalability when using multiple VMs per tenant, nevertheless, need to get going."
- "Still need to mature the solution. The current implementations would cost more and deliver less than boxes. But there will be a tipping point as costs come down."

On the "yes" side:

- "vCPE is deployable – ready to go now."
- "Ready for mass deployment. We question the ETSI NFV model (VNFs as VMs versus disaggregated) from the standpoint of the financial models."
- "The distributed model works OK."
- "Live trials now. vCPE is reliable now, but there are still issues to solve for scale, e.g. installation. This can be solved within the next 12 months."
- "Yes. We are seeing more choice in vCPE platforms, more VNFs and more virtualization in the core of the network."

In my survey, some operators expressed

concerns about vCPE regarding cost and scale, including automation. We at ADVA Ensemble believe that these issues are solved (or mostly solved), and the situation is getting better. In particular, we have seen innovation in VNF performance and variety, white box cost and performance, OpenStack, MANO, etc. The time is now!

One last point on vCPE: One operator asked me to make the point that vCPE is an application or platform, not a box. Now, I'm asking you to make the same point to your colleagues.

My Takeaways

- It's clear that innovation is proceeding, but there are barriers – both internal and external. Even so, there is recognition that now is the time to start.
- Operators see that new opportunities like cloud, vCPE and SD-WAN are balanced by threats from OTT players.
- NFV/SDN/vCPE technology has progressed and there are some live deployments. However, there are still concerns with cost and scalability.
- Applications like SD-WAN will help drive solutions for the gaps, because they can be tied to services and revenue.
- And possibly most important: operators must work closely with their customers and suppliers to drive innovation solutions!



Prayson Pate is ADVA Optical Networking's chief technology officer for the Ensemble division and is an evangelist for network functions virtualization (NFV). He speaks at industry events and writes posts and articles to inform, educate and entertain, mostly about NFV with plenty of innovation for good measure. These include The Real CTOs of NFV series.

Prayson received a master's degree in electrical and computer engineering from North Carolina State University and a bachelor's degree in electrical engineering from Duke University. Prayson has contributed to standards bodies such as the MEF and IETF. He is a named inventor on nine patents.

Software Holds the Promise of Tomorrow's Telecom

By Brenda Boehm

Chief Strategy Officer and Executive Vice President of Technology and Products
Telecommunications Industry Association (TIA)



The Promise

The promise of tomorrow's telecommunications networks is to have an agile, dynamic, efficient and secure connectivity to everything...everywhere. Service providers, and IT leaders, have been dreaming of the day when they can put a secure, new connection to a new location without wading through numerous inefficient internal system changes that take months to complete, require the time, and expense of personnel on site with truck rolls, and then have to repeat the process if they want any alternations. We all want a network that can provide us high-speed connectivity if we are in our cars, home, office, or even at our favorite coffee shop, or restaurant.

Many of us await the option with great anticipation of being able to ride in our driverless car so we may be more productive with our time. Or arriving to a home that is "ready" by sensing we are close and preparing our interior lights, adjusts the temperature, and possibly even have our first course of dinner waiting. We can go on and on about how our lives will become more efficient for living with tomorrow's network promise.

Transforming Telecommunications for the Promise

For this promise to become a reality, the telecommunications industry will have to completely change the way it thinks about its business and service offerings, and builds and operates networks. Information & Communication Technology (ICT) companies must drive their next generation networks with designs based upon new frameworks, collaborative standards and encourage interoperable innovative solutions. The progressive network equipment providers are leveraging the new technologies and completely changing their new service portfolios to offer the components that the service providers, evolving enterprises, and smart consumers expect. This is an evolution in telecommunications, from the architecture, to the infrastructure network components, all the way to the end point devices.

First Step in Delivering the Promise - New Data Centers

The center of these changes, the "brains" of the new networks, is the data centers. Over the last 50 years, since Intel's co-founder, Gordon Moore, correctly predicted that computing power will double every two years, the processing capability has provided a foundation to manage and build upon information. This continued exponential capability of the CPUs has been essential for data center technology developments; however, the ability to harness the computing by virtualizing computing cycles and data servers is what has dramatically changed the game with information technology with software led infrastructure (SLI). Today, mega-data centers are located across the globe to be geographically redundant, energy efficient, and built around the dynamic capacity and flexibility of the new virtualized technologies.

Extending the Data Centers to the Networks

IT and Telecommunication architects have converged to bring the virtualized capabilities that we are experiencing in the data centers throughout the new telecommunications network functions. The new networks utilize software defined architectures (often known as software defined networks (SDN) that place the centralized control planes in these high capacity data centers so that can be directly communicate with the virtualized network functions (VNF). This is the foundation for the modernization of tomorrow's networks that will create a highly efficient and agile network because it is centrally managed and programmatically configures every network component.

This network functions virtualization (NFV) architecture is being utilized in the central, infrastructure functions for telecommunication networks and for the edge supporting virtualized customer premise locations. By implementing this new network architecture, the network can be programed at every point to enable flexibility, efficiencies, and higher customer satisfaction as has never been possible before.

Connecting to Everything

As the new software defined network is in place, it creates the necessary infrastructure for connecting to the Internet of Things (IoT). The networks from the past had end points that were the phones. That evolved to the smart phones where we could utilize our devices to do more than just transmit our voices, but also data. Now we will connect together billions of sensors, based upon micro-electromechanical systems (MEMS) technology that will be embedded in everything we can imagine. MEMS technologies, or sensors, are continuing to improve by becoming smaller, more power efficient, less expensive, and, hopefully, more secure. IoT virtualized management platforms control these sensors through application process interfaces (APIs) directed at vertically focused market segments. Some large vertical markets such as: industrial internet, automotive, healthcare, energy, smart buildings, and smart homes are working across their industries to deliver innovative solutions.

Bringing these individual markets together into system wide connected solutions enable government officials, service providers, suppliers as innovation leaders to build smart campuses, communities, and cities. Every company is now becoming a technology company, establishing new divisions of digital marketing, analytics, energy management, finding other business opportunities to utilize the market advantages that can be realized by leveraging these new connected-thing touch points.

Complexities in Managing the New Networks

New networks cannot be managed without new Operational Support Systems (OSS) processes and tools to manage the new ecosystem. The ability to design a network so that there is a plan for programmatic management of all the network devices is essential. Creating this capability will not only create a way to operate the network through the standard process steps of: orchestration, assurance, optimization, and maintenance. It is also critical for the next generation networks to be secure. This capability will enable the expansion or contraction of a network instance

as capacity requirements evolve, and also protect and shut down an instance if it is compromised. Introducing new automated processes and frameworks can leverage such things as Autonomic Network Management (ANM) that will simplify network management and control, build in efficiencies, and minimize the impact on operations with all these new network capabilities. It will be critical that part of our next generation modernization will continue to evolve and improve so that the promise of the new networks can be realized.

As with all changes, the plans can only be realized if the operating workforce can support it. Establishing the necessary skills for the organizational management teams necessary to design, operate, maintain, and protect the network is the biggest challenge for the ICTs.

Summary

The new telecommunications networks will change the way we work and live. It has the potential to solve many of our world's shortages, and bring a better, easier, life for its citizens. However, change as significant as this is not easy. It will take continued innovation, collaboration, and fortitude to deliver on this promise.



About the Telecommunications Industry Association (TIA)

TIA's mission is to advance global connectivity and accelerate business growth by convening the entire supply chain of communications - more than 250 companies including the service providers, manufacturers and suppliers, software developers, distributors and integrators, consultants and educators-- that build and support the communications and information networks of today and tomorrow. TIA is also accredited by the American National Standards Institute (ANSI).

About Brenda Boehm

Brenda Boehm, Chief Strategy Officer, is responsible for the overall strategic direction and provides the technology and product leadership for the Telecommunications Industry Association (TIA). Brenda's deep industry expertise is based upon her successful leadership roles at both the executive and board levels with various innovation-focused technology companies from entrepreneurial start-ups; Starent Networks, Tango Networks, and Cyphre to Fortune 100 leaders; Cisco, Nortel, Alcatel-Lucent and Nokia. This uniquely broad set of experiences and skills have equipped her with the insight to create a market vision that recognizes industry disruption, an ability to harness change for innovation, develop global market reach and ensure the most successful operational best practices.

Most recently Brenda's focus has been on developing company infrastructure and operational transformation; driving virtualized, dynamic, secure networks that can connect to everything, everywhere. She recognizes that this new architecture and operational transformation will bring further efficiencies, agility and an ability to truly manage the new Internet of Things.

Brenda Boehm holds a Masters of Science (MS) from SMU's School of Engineering in Telecommunications and a Bachelors (BA) in Computer Information Systems (CIS) from the University of Louisiana. She also attended Stanford's prestigious Graduate School of Business Executive Program, recently completed the Advanced Computer Security Certification Program.

The Business Services Opportunity: Maximizing the Capabilities of Emerging Networks

By Barry Derrick
Strategic Solutions Marketing Manager
ADTRAN

Broadband service providers, both telco and cable-based, are striving to offer their business customers emerging high-bandwidth, low-latency services that will help them differentiate themselves in today's marketplace. To maximize the opportunities ahead, service providers will need to evolve their networks to embrace service agility, flexibility and scalability.

In-demand cloud-based services require symmetrical ultra-high-speed broadband networks that can respond to customers' changing needs and requirements, preferably in real-time.

Upgrading broadband networks for symmetrical gigabit capabilities ensures service providers can competently deliver the enterprise applications required to remain competitive. More importantly, ultra-broadband network connectivity allows service providers to maximize growing revenue and profitability opportunities presented by serving the SMB

and enterprise business segments. The landscape is indeed changing, and competitive Gigabit offers targeting the business sector are on the rise.

Software Driven Programmable Networks

Unlike legacy networks, which are comprised of hardware and software dedicated to specific functionality and over-subscription, just in case demand grows beyond engineering forecasts, emerging network infrastructure and its components are software-driven and programmable. Both capabilities work in tandem to enable operators to meet their customers' changing demands in minutes, hours or days, rather than the weeks, months or years legacy networks historically took.

For example, emerging networks take the focus off of hardware and place it on software by employing software-defined networking (SDN) and network functions virtualization (NFV) technolo-



gies. Both enable network hardware to serve more than the one specific purpose for which a system or its components were created. Together, SDN and NFV and programmable hardware also unleash unprecedented scale by setting all networking resources free to be used or optimized wherever they are needed most. In emerging networks, the functionality of network resources is driven by demand instead of predetermined roles or "guess-timated" forecasts.

Emerging networks' agility, speed, scale, and flexibility enable new levels of collaboration between, customers, service providers, and developers, creating a promising future. Together they can design, develop and deploy apps, services and virtual controls that legacy networks are incapable of supporting. For example, just as the smartphone introduces apps and services that made land line phones look inert, emerging networks are now supporting apps, services and features that most businesses will be unable to imagine living without for years to come.

Building Solutions, Not Problems

Businesses have always wanted simple solutions to their complex needs. Historically, service providers have had to initiate complex solutions involving byzantine hardware-software combinations that were expensive and confusing. One promise of software driven, Gigabit enabled networks is their flexibility and agility, which enables custom solutions for business customer requirements.

Smart service providers migrating to programmable networks can tailor services to meet their customers' needs in record time, adjust those services to

Key components businesses value when shifting to cloud:

High-performance, secure, reliable solutions that guarantee safe transfer of data to and from the cloud.

Enterprise-wide support for employees who are working at home or from remote locations.

Business continuity ensured by multiple back-up options designed to optimize business connectivity uptime.

meet specific requirements on demand, or create brand new services as new trends and needs dictate. Broadband service providers can now collaborate more closely with their business customers and meet their varying requirements, improving their revenue and profitability prospects as a result. Networks can now conform to customer requirements, reversing the legacy of the opposite, which historically all too often meant customers had to conform to a service provider's network environment.

This new approach enables both service providers and their customers to grow and prosper together. Business customers can now rely on their service providers to manage their IT and business application infrastructure, freeing them up to better focus on their own end customers. They can now use technology as an asset to better achieve their mission, without the hassle and burden of having to devote significant resources to manage it. In this regard, service providers now become trusted technology partners, not just vendors offering complicated and costly services.

“In emerging networks, the functionality of network resources is driven by demand instead of predetermined roles or ‘guess-timated’ forecasts.”

Seize the Moment

The potential of the emerging software-driven programmable broadband access network is already upon us and it's limitless in its opportunity. However, success is by no means guaranteed. Indeed, service providers will need to seize the moment. Enterprise and business ser-

vices are a lucrative market segment, attracting wide-ranging competitors. The capabilities of advanced networks includes inviting non-traditional competitors to pursue these opportunities. Competitors now include companies like Microsoft, Google, Amazon, and many more, who leverage the power of IP enabled networks to offer many of the applications discussed in this paper.

Whether service providers are defending their own market, or expanding into others, the need to leverage the capabilities of software-driven programmable broadband access networks is now critical. There is too much opportunity at stake. The good news is these capabilities exist and are available today. Enterprise and business customers are looking for technology partners to help them leverage their own business opportunities. Service providers now have the tools to seize that opportunity.

Walker and Associates Expands NC Warehouse Capabilities

By Randy Turner
Director, Marketing Communications
Walker and Associates

In order to better support new fiber cable stocking initiatives, Walker and Associates recently completed construction of an outdoor fiber cable yard at its warehouse facility, located in Winston-Salem, NC. This new resource, dedicated to stocking large fiber reels, enables Walker to support fiber cable demands from its customers. In addition to stocking the cable, Walker's investment in equipment to cut cable to customer-specified orders, provides expanded opportunities to meet the growing demand for fiber cable.

Walker currently stocks bulk cable from manufacturers such as CommScope and Corning, in addition to the fiber equipment necessary for FTtx projects, central office redesigns and more. This expansion solidifies Walker's goal of providing a single source for customer needs. Through their engineering services, Walker assists customers with network design. Their expansive range of logistics services provides customers with worry-free



supply chain management. Additional services include managed services such as monitoring, remote support, Network Operations Center (NOC) services, Security Operations Center (SOC) services, and more.

Fiber cutting, re-spooling and maintaining and inventory of bulk fiber cable is positioning Walker to support customer needs in even greater capacities. While fiber availability shortages continue to challenge US carriers, Walker is uniquely poised to provide not only the fiber cable, but also the associated equipment and services that matter to anyone involved in designing, building and maintaining growing networks.

Learn more about Walker's extensive network services at <http://walkerfirst.com/managed-services/>

Competition Builds the Future

By Chip Pickering
CEO
INCOMPAS

There is a new sheriff in town. As with all changes in administrations, the arrival of President Donald Trump in the nation's capital signals change. And change brings both questions and opportunity.

Today, the broadband industry stands at the edge of a great frontier. The need to deploy faster, more affordable broadband infrastructure is essential to job growth, innovation, education and international competitiveness. That's the opportunity.

But massive consolidation in an industry filled with mega mergers has left consumers and business customers with even less choice and higher prices. Anti-competitive practices that artificially inflate prices and delay new technology are barriers to deployment—mountain ranges blocking the railroad to tomorrow.

“For every \$5 billion invested in broadband infrastructure, 250,000 jobs are created, and with every percentage point increase in new broadband distribution, employment expands by 300,000.”

In the 21 years since the landmark bi-partisan Telecommunications Act of 1996, we have seen new companies explode and reshape the marketplace with new investments and innovation. With competition policy that promoted access, interconnection and deployment, we have seen innovators bring us Ethernet, the cloud, and the possibility of a 5G future.

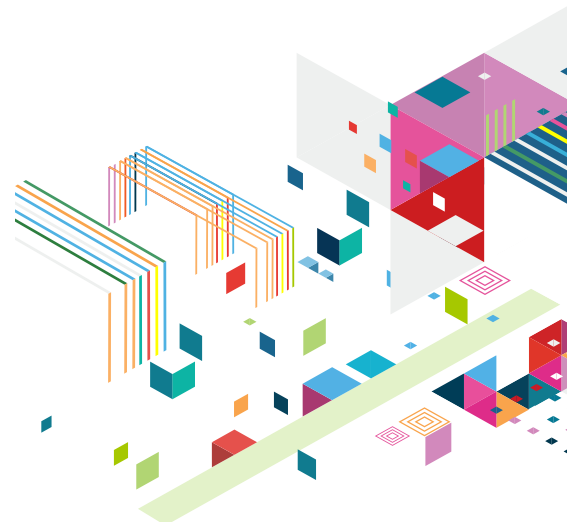
The new FCC, under the direction of Chairman Ajit Pai, has launched a Broadband Deployment Advisory Committee. INCOMPAS, the internet and competitive networks association, applauds this move. Our members are on the front lines of building the future. We provide middle-mile infrastructure, residential and enterprise fiber, and wireless networks across the nation.

We also represent internet companies, streamers and data centers rounding out an end-to-end internet ecosystem that consumers and business customers depend on for binge watching, tweeting and sharing.

INCOMPAS believes competition remains the silver bullet of broadband policy. And here are three recommendations we have given to the new administration to help keep broadband shooting straight to the future.

First: Lower the barriers to deployment.

Adding a third competitive broadband network to a residential community has powerful results. Just look to cities like Austin, Detroit, or Kansas City. Not only have speeds doubled, but we have seen prices for higher speed networks reduced by more than half! And the biggest fringe benefit of the new network?



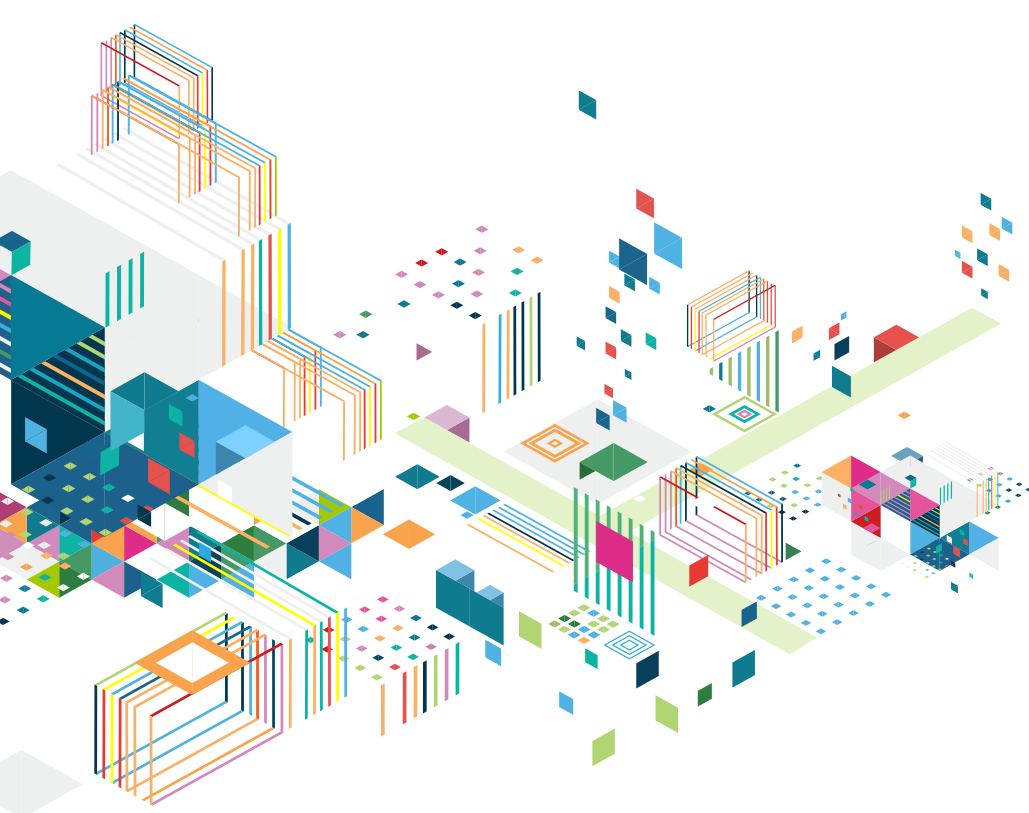
Tech companies and start-ups are flocking to America's competitive fiber cities and towns. A competitor in Detroit deployed one of the fastest gigabit networks in the nation, and soon after Amazon and Microsoft announced plans to open offices there.

So how can we bring more competition to more towns?

Reforming rights-of-way and pole attachment rules is a critical first step. Federal, state and local regulatory agencies are tasked with facilitating access to rights-of-way infrastructure like poles, conduit and other infrastructure. Further action in this area is needed to enable competitive broadband deployment.

The current process for allowing a new, competitive builder access to poles is a disaster. Being blocked by large incumbents' lawsuits is bad enough, but the molasses-like speed delays are killing smaller, new entrants. With multiple attachers that need to move their facilities on each pole to make room for competitors, delays stack up as new entrants often have to wait for each provider to complete their work. This leaves competitors and the customers they serve in a state of limbo.

One-touch make-ready policies where a contractor approved by the pole owner could do make-ready work on one climb not only makes sense, it is consistent with the goals and law of federal telecommunications policy. It speeds the planning process for communities, com-



panies, and broadband customers alike.

Second, bring competition to the condo

Competitive service options are also being denied to customers at apartment buildings, condo complexes, and retirement homes around the nation. Large internet service providers and landlords have entered into exclusive deals, sometimes with hefty kickbacks, to trap residents into one choice for internet and cable service. Monopoly tactics include exclusive marketing and advertising arrangements that prohibit providers from highlighting competitively-priced alternatives in building common areas, on their websites, and in welcome to the building materials.

Locking up apartment customers, and locking out competition harms both broadband deployment and video choice. As we have seen, consumers prefer to purchase internet and TV together in a bundled product. When offered together, competitive adoption increases by 24 percent.

The FCC should listen to the locals. Across the nation, city councils and county commissions are passing local ordinances to attract new network competition and help free residents in large apartment buildings from monopoly control, giving them access to more choices and better customer service.

So let's free these apartment building customers from monopoly control. Because getting the keys to the condo

should also be the key to more competition and lower cable prices.

Third, bridge the last mile and transition to the future for businesses and wireless backhaul.

For decades, the last-mile of broadband—the connection from the street to the doorstep, has been the bottleneck that has strangled competition and kept prices high.

Just last year, after decades of delay, the FCC released the analysis of the most comprehensive data collection in Commission history for broadband service used by businesses and wireless companies. It showed undeniable market power abuse at the last mile—where large incumbents are continuing to gauge business customers with sky-high prices for services.

It's time once and for all to stop living in the Epi-Pen world of broadband, and let competition set the prices—not monopoly control. The FCC can ensure a robust wholesale marketplace; one that provides access to encourage more money is spent on deployment infrastructure and less wasted on monopoly rents.

On the wired side, we know buildings with more connections to competition are more far more desirable locations for businesses in the real estate market. But this necessary reform would also help storefront small businesses, schools, hospitals and libraries save money as well.

On the wireless side, reform is critical to the 5G future. Recently a Telecom Advisory Services study found “high backhaul costs reduce competitive wireless carrier service quality, increase industry consolidation and exacerbate the digital divide.” That is why 3 of the 4 leading wireless service providers favor wholesale access and last mile reform.

Speeding the technology transition to new networks is a business customer's dream, and a job-creating engine. Recently, a bi-partisan letter from 48 U.S. Senators called for more broadband for every American living in urban centers and rural towns. They said: “For every \$5 billion invested in broadband infrastructure, 250,000 jobs are created, and with every percentage point increase in new broadband distribution, employment expands by 300,000.”

No one ever said building the future would be easy. But without innovators, dreamers and disruptors, America will fail to reach the broadband Promised Land. Let's make sure our infrastructure plans are based on competition, not protectionist policies for monopolies. Let's set the future free.

**

Chip Pickering is the CEO of INCOMPAS, and a former Member of Congress from Mississippi.

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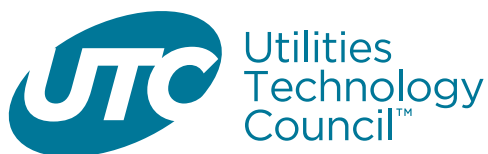
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Clearing a Path to Network Modernization

Kevin Driscoll
Vice President, North American Carrier Sales
Fujitsu

Network operators and service providers of every stripe are facing a challenging time of increased competition, pressure to economize, demand for better service quality and above all, uncertainty. These are the main factors motivating what the industry collectively terms “network modernization.” But “network modernization” encompasses a range of projects and initiatives and there are no shrink-wrapped solutions. The key to success is a clear understanding of your own business context and a commitment to applying this understanding as you make key decisions about what the business goals are—and what needs to change in order to achieve those goals.

Since the communications network industry is a diverse mix of businesses rather than a homogeneous group, the theme of modernization covers similarly diverse business drivers and possible outcomes. What works for a national Tier 1 carrier may not be relevant to a local utility cooperative or small independent telco.

Solving the Right Problems

Every operator needs to take a methodical three-phase approach to modernization: discovery, analysis/planning, and finally migration. The first two phases help ensure you are solving the right problems. They also minimize the risk and disruption of the actual migration and ensure that both bill of materials and project plan/timeline are complete and accurate. This kind of introspective approach ensures a tailor-made solution and helps target modernization efforts where they are most needed and where the greatest business benefits can be realized.

While it's important to be prepared for seemingly glamorous technological advancements such as virtualization and software-defined networking, for many network operators much more down-to-earth considerations have to come first. New technology alone is not a justification for modernization. The primary driver for network modernization in the wireless world is the need to reclaim space and power to house their next-generation services. Many of them need to clear out legacy equipment in order to avoid constructing new facili-

ties, or renovate power plant to realize energy-efficiency benefits. In the wireline services, many service providers are grappling with cumbersome old equipment that may have been discontinued and become more costly than it's worth, both in terms of maintenance and regular operation. They may also be faced with outdated buildings not designed to modern safety or energy efficiency standards. In general, despite the situational variation among operators, it's accepted wisdom that old equipment and facilities generate less revenue per square foot than modern platforms. Reducing the amount of rack and cabinet space occupied by network equipment is one of the most easily proven benefits of modernization.

Reclaim, Replace, Revitalize

Digital Cross Connect (DCS), Synchronous Optical Networking (SONET) and Time-Division Multiplexing (TDM) are three of the technologies currently targeted for modernization, each for similar overall reasons. One or more of these technologies is currently employed in most facilities throughout the country, so it is in these areas where most modernization activity is taking place. Many operators can benefit by replacing these legacy technologies with up-to-date methods such as Ethernet, delivered over space-efficient and flexible multiservice platforms.

Recently, as wireless service providers moved from TDM to IP to increase capacity and reduce cost, they freed up a large number of TDM ports that now sit idle in wireless central offices—consuming floor space, straining HVAC plant, and using excessive power without delivering maximum value. These infrastructure resources could instead be used to house next-generation networks that cost vastly less to run and maintain—and deliver much-needed bandwidth increases at greatly reduced cost. TDM was designed for landline deployment where reliability was paramount. In comparison with IP networks that are dynamic in nature, TDM is an inefficient approach to networking despite its high reliability. With IP, you can share a single pipe for multiple things for multiple customers, whereas with TDM dedicated connections are required. Driving more efficient

use of bandwidth and greater flexibility is thus a predominant driver for replacing TDM with new technology.

In terms of DCS, a large number of these systems are still in operation in North America. DCS systems can be challenging to replace because they are embedded at the center of the transport network and extensively interconnected with network elements and ancillary equipment. These systems may be beset by inefficiencies in terms of power and service density, as well as ongoing reduction in the availability of qualified staff to operate and service them. They also impose burdensome and costly complexity on the network. Replacing DCS with smaller, newer equipment reclaims power and space and clears the way forward for network evolution that will support customer demands.

Take a Ground-Up Approach

Overall the first order of business for network modernization should be a ground-up, evolutionary approach that focuses first on “cleaning house” by decommissioning or repurposing old gear to optimize the network's performance and cost-effectiveness. A properly conducted discovery phase often unearths “pockets” of unused equipment or circuits suitable for reclamation and able to continue delivering revenue.

Floor space reclamation; power demand reduction; more efficient HVAC; denser bandwidth and capacity; better reliability and lower maintenance costs; and operational simplification are all key areas where investment can quickly yield long-term gains. Network modernization should also be undertaken with an eye to reducing operational burdens on staff, enabling them to focus their expertise on delivering more services to more customers rather than fighting fires; even auditing and updating old databases, records and documentation can have a dramatic positive effect on operations. Additionally, prioritizing these practical concerns helps to set the stage for eventual migration to leading-edge SDN/NFV technology.



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Considerations When Incorporating DC Power in Pole or Wall Mount Enclosures

By Jeff Patrick
Product Development Manager
Newmar

Backup power is a critical element in the reliability of any network. Configuring a system that will survive in the intended application requires close attention to detail. Large systems/ central office applications typically utilize well engineered / integrated DC systems with a goal of providing five 9's reliability (99.999%) Remote sites and wall/ pole mounted enclosures are in similar need of high reliability but lack the space and budgets of Tier 1 systems. However, with good engineering practices and component selection, high reliability and economical DC power can be achieved in these smaller, often hostile environment applications.

There are critical issues which must be considered in configuring an enclosure power system. Number one is temperature which is a known killer of power electronic circuits and the batteries they maintain under constant charge. Watertight enclosures provide little or no ventilation thus components must be rated for high temperature, and operate without fans as they provide no benefit. Properly designed DC UPS are a good choice for these applications as they typically operate to 70 deg C and rely only on convection cooling, having no moving parts, and utilize high efficiency circuitry minimizing heat generation.

Batteries are the heart of the system and must be charged at the proper voltage under varying seasonal temperatures. A good DC UPS offers temperature compensated output , reducing voltage in high temperatures to avoid overcharge , and increasing voltage to batteries in low temperatures to prevent undercharge. In addition the DC UPS should be programmable for use with various types of battery chemistry: lead, AGM, Gel, Ni-cad, etc.

Status monitoring adds to reliability in performance as problems can often be

detected before total shut down occurs. Form C contacts are effective and simple monitoring and typically activate on AC fail, running on back up, battery fail, and bad battery conditions. Monitors which data log and communicate status via Ethernet can also be incorporated as a separate component.

Din rail mounting method is ideal for securing components in enclosures where devices quickly and securely click on to the rail and have front terminals which provide easy access for AC input, load and battery wiring.



Din Rail Mount DC UPS Simplifies DC Power Integration in Enclosures

Integrators are best served by utilizing DC systems that are designed for enclosure applications rather than trying to cobble together an interconnected assembly of various components and then going through the often painful proving out process. Din Rail mount DC UPS are now available in units that incorporate all essential functions in one convection cooled device: battery charger, power supply, low voltage disconnect, temperature compensation, battery health monitor and alarm contacts. Typically units are available in 12, 24, 48 volt output in power levels from 100- 500 watts, which cover the majority of enclosure power requirements.

Virginia Broadband Crisis Averted: HB 2108 Amended

Version 3 moves toward Senate floor stripped of all language that once threatened Virginia's Local and Municipal Broadband Authorities

Richmond, VA (February 13, 2017) – The Virginia Wireless Services Authority Act; Rates and Charges, or House Bill 2108, (formerly the Virginia Broadband Deployment Act) has been amended by the Virginia Senate Commerce and Labor Committee and, in its latest form, no longer poses a threat to Municipal Broadband Authorities across the Commonwealth.

Last Tuesday, just prior to a floor vote in the VA House of Delegates, Delegate Kathy Byron (R-Lynchburg) announced her intention to remove the still hotly contended FOIA Exemption clause “Exemptions Notwithstanding” from the latest version of HB 2108 when, and if, it made it to the Senate committee for review. Today, before the Senate Labor and Commerce Committee, Byron made good on that promise by offering an amendment to the bill, which was subsequently accepted by the committee.

“With the removal the FOIA Exemption clause this afternoon, HB 2108 no longer poses a threat to local and municipal

broadband authorities. Instead it merely reasserts the very same laws and procedures in the Code of Virginia to which we all already operate and gladly adhere and abide,” Frank Smith, President and CEO of the Roanoke Valley Broadband Authority said.

The Roanoke Valley Broadband Authority and allies across the state, and across the country, had vehemently opposed previous versions of HB 2108 which contained several clauses designed to limit the ability of local governments to serve their constituents and protect the long term economic viability of their communities.

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Improving the Customer Experience

By Randy Turner
Director, Marketing Communications
Walker and Associates

Rarely is it a good idea to put ourselves in the customer's shoes! I know that may seem counterintuitive, but it is absolutely true. Why would we imagine that we can experience the same thing as our customers? This thinking nearly always leads to assumptions that result in customer failures. If we want to really shape the best customer experiences, we have to acknowledge first that the customer experience belongs to them, not us. Focusing externally rather than internally is the best first step.

Early in my sales career I was taught "You are not your market." As I explored that concept, I began to realize that if I limited my sales approaches to only what would satisfy me, I would rarely meet customer needs in my sales presentations. I would either close too early, assume on needs rather than ask good questions, overlook important decision makers, believe that price mattered most, and make other costly mistakes. Learning from the customer – the market – allowed me to realize greater sales success and stronger customer relationships.

As an example, Walker and Associates recently completed its annual Customer Satisfaction Survey. Participation levels were the highest in years, and we received very specific and valuable feedback. Reviewing customer comments helped us gain a better picture of the customer experience from the customer's perspective. I was particularly interested in what they had to say about our website, communication, and processes. What they expressed provided us important data about what shapes their customer experience. As we collect that kind of information, we can then understand how effectively we are meeting customer requirements through the people, policies, procedures, processes and partnerships we have in place.

In response to our survey, we received the strongest level of interest in improved services available on Walkerfirst.com than ever before. In response, we have

already taken steps to improve the search functionality of our website. As a result, we deployed "smart machine" technology in our search capabilities, which now draws data from ten different criteria for potential matches from our database of part numbers, descriptions, web content and more. These improvements offer quicker responses, more intuitive results, reduced need for customers to know complete part numbers and more. Based on survey responses, we've hit a homerun that matters to the customer. In our research, we've noted that this is also a distinguishing feature when comparing our website to our competitors. If customers are looking for a user-friendly web experience, customized with their transaction data (and we know they are because they told us), Walkerfirst.com delivers.

Sure, we can build all kinds of things, offer new products and services, alter processes, add procedures, introduce change, and do it all under the banner of "improvement." But, as mentioned earlier, we are not our market. If it doesn't matter to the customer, it doesn't matter. Shaping the customer experience is all about knowing our customers through observing, listening, collecting and analyzing data, and then responding. As providers of customer service, we are always focused on how to shape customer experiences in ways that truly resonate with them.

What do we mean by "customer experience?" It is really the entire journey a customer takes when doing business or attempting to do business with a company. It is the result of processes, some carefully chosen and others simply the result of habit, that influence customer behavior and choices going forward. For example, the customer experience when requesting a quote is influenced by how quickly they receive an acknowledgment and the quote itself, how professional the quote looks, how complete it is, how accurate it is, and how well the company follows up. If it becomes the

responsibility of the customer to remind of action items, point out an oversight, or if they feel de-prioritized in some way, that becomes their experience. They will then carry that impression into the next opportunity, choosing either to engage with the same company or look elsewhere.

One of the keys to shaping in positive ways the customer experience is identifying the moments that truly matter to a customer. The best way to really understand this is to know how your customers are judged as being successful in their roles. Are they evaluated on quote response time? On-time deliveries? How well they manage projects? Is price the only thing that really matters to them (the answer to that question is nearly always no, by the way)? Think of all the things that truly matter to your customer, and use that list as a starting point to match ways you can set them up for success by how you manage your own work. Improved management of customer expectations will always produce more solid results, stronger customer relationships and fewer surprises.

Pay attention to the customer experience, but never assume you completely understand it. Generally speaking, it is a moving target. Walker takes steps on an ongoing basis to solicit customer feedback, analyze it, and consider ways to improve in areas that will likely offer greater levels of customer satisfaction. Seth Godin, perhaps, said it best: "The best measurement of customer support is whether, after the interaction, the customer would recommend you to a friend." Walker's customers indicated during our most recent survey that nearly 92% of them would recommend our company to a friend or colleague. That would appear a good indication we are on the right path to improving customer experiences. It's a journey we've enjoyed nearly 50 years!



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Walker and Associates Announces West Coast Warehouse

By Randy Turner
Director, Marketing Communications
Walker and Associates



Walker and Associates has announced plans to partner with a 3PL company that will provide Walker with a west coast warehouse in Reno, NV. This move strategically supports specific customer and Walker warehousing programs for 13 Pacific Coast states, including Hawaii, Alaska, Washington, Oregon, Idaho, Montana, Wyoming, Utah, Nevada, California, Arizona, New Mexico, and Colorado.

Hal Sveum, General Manager and VP of Operations at Walker, stated "This

is a great step for Walker in being able to market improved customer support capabilities." The new facility's objectives are to provide stronger support to targeted customers, offer improved availability to meet customer delivery requirements, and reduce transportation costs.

This is Walker's first remote warehouse facility in over a decade, and is opening in direct response to customer demand for improved availability of Walker's products and services. A recent customer

satisfaction survey revealed significant interest among customers for a warehousing facility in the Pacific Coast area. Walker's solid reputation for logistics services has earned them respect as a trusted business partner among US carriers. This new announcement further indicates the company's ability to deliver on its commitments to meet customer requirements.

Viavi Recognizes Walker and Associates as Star Team Award Recipient

By Randy Turner
Director, Marketing Communications
Walker and Associates



Left to Right: Todd Mathes, OEM Development Manager with Walker; Tom Kane, VP/Sales with Walker; Erin Hallett with Viavi; Trey Hall, VP/Marketing with Walker; and Paula Sullivan with Viavi

Viavi Solutions is proud to have presented Walker and Associates, Inc. with the Viavi Star Team Award for FY16. This annual award recognizes members of the Viavi Velocity Partner Program for superior sales performance, business growth, and customer support.

"I'm delighted to recognize Walker & Associates, Inc. with the FY16 Viavi Star Team Award", said Sergio Bea, Viavi Vice President of Global Enterprise and Channels. "As a result of outstanding performance during FY16, Walker and Associates, Inc. is one of Viavi's top partners globally. We are thrilled to have such high-caliber partners as Walker and Associates, Inc. participating in the Viavi Velocity Partner Program. Together, we deliver powerful and innovative solutions that help network operators and enterprises address their toughest network, application, and service-performance challenges."

Walker is a Premier Solution Partners with Viavi, which shows a higher level of commitment and focus to Viavi product lines. Premier Solution Partners can help customers select the right products and provide very technical product advice. Walker can also help address basic product usage questions and has proficiency in managing in-warranty and out-of-warranty equipment returns for Viavi repair.

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Keeping Your Options Open: How Ciena Brings Choice Back to Your Network



Network operators need more options and freedom to adapt and grow their networks. What they need is choice – not only with the equipment they deploy, but choices around the architectures, services, and operational paradigm that the products support. Kent Jordan details the work Ciena has been doing to bring choice and options back to the optical network.

As cloud computing, the Internet of Things, and high-bandwidth video services put more and more pressure on today's networks, network operators need more options and freedom to adapt and grow their networks. Equipment decisions are made with the intention to future-proof and scale, but as demands and customer requirements rapidly change, it can be difficult to adapt. In fact, you may feel constrained by your network as you try to offer new services or scale to higher capacities. Instead of costly work-arounds, operations and management teams want more alternatives for deploying, operating, and automating the network. However, you may feel like you've exercised all your options, but your network is still moving down a path in the wrong direction.

What you need is choice – not only with the equipment you deploy, but choices around the architectures, services, and operational paradigm that the products support. At Ciena, we understand your pain, and we've been working hard to bring choice and options back to the network. Here are three areas of choice that provide new opportunities for optical networking:

1. Services choice

Whether your network is predominantly packet or carries a mix of different services, Ciena's packet/optical solutions are built to carry any service across the network – from wavelength services to OTN and packet.

With a wide variety of transponder and muxponder options available today, high-capacity wavelength services have never been easier to deploy. Add in OTN switching, and multi-service traffic can be flexibly mapped and packed into wavelengths for transmission. Services such as Fiber Channel or Video can be mapped more efficiently into OTN by using ODUflex containers rather than dedicating a full ODU1 (2.5G) or ODU2 (10G) per service. Even sub-rate Ethernet can be mapped into ODUflex payloads, enabling the option to rate limit the bandwidth on 10GE, 40GE, or 100GE clients.

Plus, with packet switching built-in, Layer 2 Carrier Ethernet services can be rolled-out to grow and enhance your service offering. Ciena provides options for scalability up to 1Tbps per slot, ensuring you've got room to grow, even in the largest networks. If you're worried about a challenging migration to change your current service mix to a more packet-centric set of services, Ciena's packet/optical solutions make the transition from one service type to another a painless process. One single solution can handle a full mix of services and functions with less equipment, enabling more choice and options for you.

Furthermore, Ciena's recently announced WaveLogic Ai coherent chipset enables single-carrier line rates from 100G to 400G in 50G increments, and it extends optical reach farther than ever before – with single carrier 100G wavelengths capable of traversing 7,000km without requiring regeneration. This provides a wider choice to match capacity requirements to the appropriate distance (from short-reach metro to ultra-long haul or subsea) for any application or service.

2. Architecture choice

Just like services have evolved to offer a wide variety of choices, network architectures are also evolving. Depending on your operational model, software development expertise, and willingness to perform systems integration, there are different options in how networking technologies can be consumed and deployed. You can deploy an open line system with multiple vendor alien wavelengths. Some open line systems can even provide for the decoupling of the modern technology from the photonic line and photonic control, allowing you choice in coherent technology and enabling the ability to carry multiple 100 Gbps+ transponder solutions across the same photonic line.

There is no single "right" architectural approach – whether you prefer a fully integrated solution, desire some level of disaggregation to pick and choose the best-of-breed transceivers, or want a fully disaggregated system where you can choose the individual building blocks and integrate them together, Ciena has you covered with solutions that allow you to pick the option that best fits your network and operational model.

3. Management and operational choice

Similar to what's happening on the hardware side, openness is being extended into the software components that are used to operate and manage the network. Open APIs can be used to craft new applications and scripts for operations and automation. Of course, the associated hardware must make useful information available to the API. Ciena is designing its next generation networking solutions with these requirements in mind.

For example, Ciena's WaveLogic Ai coherent technology provides access to an unprecedented level of real-time optical networking performance data. Advanced analytics can be performed on this data to help predict your network's health or to optimally match each wavelength's reach requirement with the highest line rate that can be achieved at that distance. Open APIs can also be used to communicate with modern multi-vendor network tools. Tremendous amounts of data can be provided through the open APIs, giving options and opportunities for building more automated and profitable networks.

The bottom line is that choice means opportunity. The network should not constrain you from adding new advanced service models or building new applications for management and automation. Ciena is building equipment that brings choice back to the network, and opens new opportunities for network analytics, trending, and on-demand services.

New Political Priorities; But Same Challenges to Bring Mobile Broadband to Rural America Remain

By: Steven K. Berry
President & CEO
CCA

Just a few short weeks into 2017 and so much has already happened. The Republican-controlled 115th Congress hit the ground running in early January, and shortly thereafter the Trump Administration moved into the White House, setting the stage for Washington policymaking for the next few years.

There are new decision makers and a new Chair at the Federal Communications Commission (Commission), and the focus on bringing high-speed mobile broadband should not be lost as new priorities emerge in DC. Many challenges for competitive carriers, especially those serving rural and regional areas, remain the same, and we must build upon CCA's progress to reform the Universal Service Fund (USF), and preserve and expand mobile broadband in rural America.

Representing nearly 100 competitive carriers serving rural, regional and nationwide areas of the country, Competitive Carriers Association (CCA) is committed to ensuring a competitive wireless industry – no matter which political party sits in the White House or controls the House or Senate. While technology advances every day, the unfortunate fact-of-the-matter is that many rural and hard-to-reach areas of the United States remain unserved or underserved.

In today's mobile-dependent world, the thought of not being connected is inconceivable for many. And, the lack of connectivity is an economic detriment to everyone, especially in the vast area of "fly-over states." Consumers with little or no access are missing the economic, education, health, public safety and social benefits that mobile broadband services bring and these consumers face a serious risk of being left behind in this mobile revolution as technologies continue to move forward at a blisteringly fast pace. To prevent unconnected citizens, policymakers must make it a priority to promote the deployment of mobile broadband in these remote and rural areas, something the USF was designed to do.



Fortunately, Congress is already taking steps in the right direction. On the first day of the 115th Congress, Senate Committee on Commerce, Science, and Transportation Chairman John Thune (R-SD) and Ranking Member Bill Nelson (D-FL) reintroduced the Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless (MOBILE NOW) Act. This bi-partisan legislation seeks to boost the development of next-generation 5G mobile broadband by ensuring more spectrum is made available for commercial use and streamlining network deployment regulations. The bill also recognizes the importance of deploying wireless broadband services in rural areas. Senators Thune and Nelson should be commended for their work, and fellow policymakers should follow their lead to ensure the bill ends up on the President's desk for signature.

While the MOBILE NOW Act is certainly an important step toward addressing current deployment and infrastructure challenges, there are several other policy priorities that will help accelerate deployment of mobile broadband. When the 600 MHz incentive auction comes to its conclusion, policymakers must ensure that carriers can put this critically important low-band spectrum to use as expedi-

tiously as possible and, just as important, a safe repack. Low-band spectrum's unique propagation characteristics allow for superior coverage, especially in rural America, and carriers must promptly have access to this spectrum to upgrade their networks and satisfy consumer demand.

CCA has been involved and worked with Congress and the Commission on the incentive auction from the very start, and it is of the utmost importance that the new Administration maintains the congressionally-based 39-month timeframe to relocate 600 MHz spectrum upon the auction's conclusion. Many rural areas desperately need access to mobile broadband services and should not have to wait any longer than necessary.

New policymakers also should look to millimeter wave (mmW) spectrum bands, implementing sharing mechanisms and increasing unlicensed spectrum resources as a means for deploying next generation networks. As with the incentive auction, mmW spectrum bands provide additional opportunities for carriers to densify their networks. More competitive carriers acquiring more spectrum means greater competition, a healthier mobile marketplace and better services for consumers. Certainly, a win-win-win scenario for everyone.

Competitive carriers are ready and willing to deploy the latest network technology, but the right policies must be in place to achieve this important goal. CCA encourages both new and returning policymakers to visit these unserved and underserved areas to see first-hand not only the work that still needs to be done but also the wonderful opportunities that high-speed mobile broadband will bring to these communities. And to see the success stories from CCA members serving these rural areas. CCA members are some of the most innovative companies in the industry and want to best serve their customers. Washington policymakers have the opportunity to create a framework to promote innovation and growth in the mobile market and more broadly throughout America; let's continue our collaborative work together to ensure all consumers can take advantage of this digital revolution so rural and remote areas are not left behind.



The Competitive Carriers Association

About CCA

Headquartered in Washington, DC, CCA advocates on behalf of our members' interests and works to educate policymakers on the key issues that impact our members' ability to compete, survive, and thrive. Currently these issues include access to spectrum, access to devices access to networks, universal service fund (USF) reform, Next-Generation 911 (NG911) solutions, among others.

Advocating before the Federal Communications Commission (FCC), the White House and Congress, CCA works to ensure that our members' voices and views are heard not only by policymakers but also by the media, third parties and throughout the entire wireless industry.

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Power Plants: Rack Mount Systems with Batteries

DC-DC

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24 and 48 VDC Input; 12, 24, 48 VDC Output,
8 - 55 amps

Configurations: Rack Mount

DC-AC

Voltage/Power Range:

24, 48 or 125 VDC Input;
120/240 VAC Output, 800 - 1600 Watts

DC Power Distribution

Voltage/Power Range:

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Type: Circuit Breaker, Fuse, Automatic Re-Boot

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Recognizing Excellence

Walker's 2016 Sales and Marketing Performance Recognized by Manufacturer Community

By Randy Turner
Director, Marketing Communications
Walker and Associates

Following another year of growth and new business opportunities, members of the industry's manufacturer community came together during the Walker and Associates Annual Meeting to recognize sales and marketing leaders. Presenters included some of the most recognized company names in the industry, underscoring the wealth of manufacturer relationships Walker offers its customers. An often repeated sentiment was an appreciation for the hard work, commitment, and determination demonstrated by Walker and its sales and marketing teams in solving customer problems, presenting value at each opportunity, and exceeding expectations among equipment manufacturers.

In addition to individual awards, Walker was recognized by ADTRAN as their Top Service Provider Distributor in 2016,

marking the company's 14th consecutive year achieving this status. The partnership between ADTRAN and Walker spans nearly two decades, representing solid commitments to carriers throughout the US market. Walker's status as ADTRAN's largest service provider distributor provides customers enormous value, including selection, availability, pricing, service and customer support.

Later in the evening, Walker presented awards to manufacturers in recognition of their partnerships with the company. Taking time to pay tribute to the innovation, support and loyalty among manufacturer partners, Trey Hall, VP of Marketing commented, "Tonight as we reflect on our success in 2016 and look ahead to 2017 with excitement, we are proud to share our celebration with each of our manufacturer partners. As a value-added distributor, Walker and Associates is fueled by the innovation, collaboration, and support of our suppliers. As we wrap Walker services, support, and solutions around our manufacturers' offerings the value that we collectively deliver to our customers is something we should all take great pride in."

Ciena was recognized with the greatest year-over-year dollar growth award for 2016 and Corning was noted as finishing second place in this award category. These partners are congratulated for the people and processes they put in place to support Walker and its customer base. Their attention on training, shared resources and solid leadership contribute to their successful work with Walker's sales and marketing teams.

Walker also presented its annual Hank Ford Award to Kara Swanson, Corning's channel manager for Walker. The Hank Ford Memorial Award is presented each year to recognize an individual who rises to the highest level of performance in support of product and event marketing, as well as their focus on best of breed channel marketing strategies. Kara has worked with Walker several years, and has been instrumental in partnered successes within the marketplace. Congratulations Kara!

The awards event was sponsored collectively by ADTRAN, ADVA Optical Networking, Brocade, Ciena, CommScope, Corning, Emerson Network Power (now Vertiv), Fujitsu, Juniper Networks, SmartRG, and Telect.



Corning's Kara Swanson receives the Hank Ford Memorial Award from Trey Hall, honoring her for exemplary work in her channel management responsibilities with Walker and Associates.

In addition to awards presented by manufacturer partners, Walker recognized associates in sales and marketing for their performance during 2016. The President's Citation Award was presented to OEM Development Managers who reached 100% of their annual plan, and sales associates were recognized for their leadership in sales and profit goals attainment.

Wayne Williams, President of Telect, acknowledged the 30th anniversary of its business relationship with Walker, presenting Mark Walker with a commemorative gift. His tribute to the long term partnership between Walker and Telect acknowledged commitments to customers that resulted in stronger relationships through the years.

The evening concluded with comments from Chrystie Walker-Brown, company CEO, and Mark Walker, company president. They expressed appreciation for strong partnerships with manufacturers, commitment by associates, and acknowledgement of a strong team of collaboration and innovation between Walker and its healthy list of manufacturer partners. A challenge was issued to rise to challenges and opportunities ahead in 2017, always keeping an eye on presenting value to shared customers.



Trey Hall, Walker VP of Marketing, Left, and Mark Walker, President of Walker and Associates, Right, receive Ciena's Award from Bob Meier, recognizing Walker for Largest Revenue Growth Partner in North America.

Leveraging SDN for Network Security

By Pete Moyer
Principal Solutions Architect
Brocade

SDN continues to generate and receive quite a bit of industry buzz. While the early years of the SDN hype cycle was often interpreted as a 'solution looking for a problem', the industry is now transforming to real and relevant use cases for SDN. While there are a bunch of various use cases that SDN could help solve, network security continues to be at the top of mind for most IT executives and network engineers.

More specifically within the network security arena, Distributed Denial of Service (DDoS) attacks continue to wreak havoc on service provider and enterprise networks. In some cases, a DDoS attack not only takes out the intended victim, but a network service or user application, but very large DDoS attacks can affect all network services and application availability by congesting the links inside the network, including the links between the local network and the upstream service provider. This short article will focus on that particular problem and will show how SDN helps to automatically mitigate those very large DDoS attacks.

There are multiple parts that are needed to create a workable DDoS mitigation solution. From a very high level, this problem space can be deconstructed into two primary components; detection and mitigation.

DDoS Detection

There are various methods available to detect a DDoS attack, however most of them rely on some sort of traffic sampling or traffic monitoring capability. The network engineers must have visibility into the traffic flows traversing the network and must have some sort of "baseline" network capacity model that provides them the comfort level that the network is operating normally. In particular, the critical links in the network must be monitored. sFlow is one of several packet sampling technologies that can provide the network traffic visibility needed to baseline the network and to detect a DDoS attack. sFlow is documented in Informational IETF RFC 3176.

Once sFlow is enabled on the network switches and routers, the collector that receives the sFlow samples stores this flow information and using analytics,

provides a first level of visibility into the different traffic flows traversing the network. There are open source and commercial applications that can provide this functionality. Machine learning algorithms could be leveraged here for very advanced analytics functionality. An additional feature is the ability to create profiles of various traffic flows in the network so that when one or more of those flows exhibits abnormally high traffic rates, a flow specific alert should be automatically sent to the network operations staff notifying them that something might be amiss.

DDoS Mitigation

Similar to the plethora of options available for DDoS detection, there are many mechanisms available to provide the DDoS mitigation functionality. OpenFlow is one such technology that can be leveraged to provide the mitigation component, and this was highlighted in a previous article on SDN Use Cases. This is shown in the following diagram.

As shown in Figure 1, below, the DDoS application receives sFlow packet sam-

ples from the network devices. Once a DDoS attack is detected, the application can automatically mitigate the attack at the local border router. This is the ingress point into the network and this effectively mitigates the attack. In this example, OpenFlow is being used as the mitigation technology.

While this solution does mitigate the DDoS attack at the ingress point of the network, the high volumetric attack traffic can still congest the critical link between the local network and the upstream service provider. There have been documented DDoS attacks that have resulted in a cumulative attack capacity in the 100's of Gbit/s!

A more common solution for DDoS mitigation involves leveraging BGP FlowSpec (BGP-FS). BGP-FS is documented in IETF RFC 5575. The beauty of using BGP-FS for DDoS mitigation is that it leverages the extensibility of BGP; which is the inter-domain routing protocol that has already been widely deployed for several decades. As shown in Figure 1, BGP is used between the local network and the upstream transit network to advertise

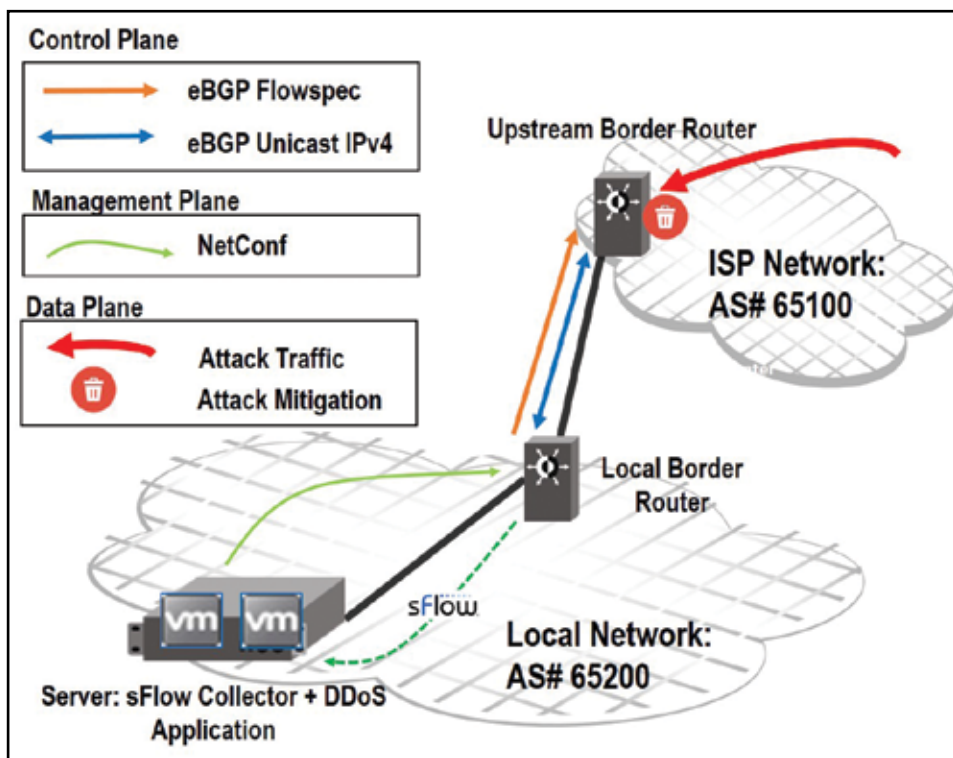


Figure 1: SDN-based DDoS Mitigation with OpenFlow

IPv4 Unicast routing information. BGP-FS extends BGP to support additional Network Layer Reachability Information (NLRI) that is used to distribute traffic flow filters. In other words, BGP-FS is used to advertise Access Control Lists (ACLs) and these ACLs provide the mitigation mechanism.

There are a few new protocols that warrant explaining in Figure 2. In this example, the detection mechanism remains the same; that being, sFlow is still used. However, instead of using OpenFlow to mitigate the attack at the ingress point of the local network, BGP-FS is used. Furthermore, BGP-FS is run between the local border router and the upstream border router.

In addition, the management plane is introduced as a key component of this solution. The DDoS application can use NetConf to program the local border router to advertise BGP-FS rules to the upstream router. NetConf is documented in IETF RFC 6241. As with all the other protocols used in this solution, it is an industry standard protocol.

The primary resulting benefit of this solution over the previous one shown in Figure 1 is that the DDoS mitigation actions are taken at the upstream border router. BGP-FS advertises the necessary ACL rules that are then implemented on that router to mitigate the DDoS attack. This prevents the critical transit link between the local network and the upstream service provider from becoming congested by the DDoS attack. This SDN-based solution leverages multiple components and technologies to provide a fully automated, closed-loop DDoS mitigation solution.

One other interesting thing that is shown in Figure 2, is that the BGP-FS peering

session is shown as being separate from the normal IPv4 Unicast routing peering session. This is really a deployment consideration, as the routers could be configured to carry IPv4 Unicast NLRI plus BGP-FS NLRI in the same peering session. There are pros and cons to combining the IPv4 Unicast + BGP-FS NLRI in the same peering session; however, it may be prudent to have the BGP-FS NLRI in its own dedicated peering session for operational reasons. It is an accepted best practice to have IPv4 Unicast and IPv6 Unicast routing information in separate BGP peering sessions. This is to eliminate any 'fate-sharing' that might arise due to having both types of routing information carried in the same BGP peering session. If they are kept in two separate sessions, the BGP-FS peering session can be modi-

fied or taken down for operational reasons with no impact to the IPv4 Unicast peering session.

So, there you have it. In summary, this article discusses how SDN can be leveraged to provide a fully automated DDoS mitigation solution as a key component within your overall network security umbrella. Multiple protocols and technologies are included in this type of solution and all of these are industry standard protocols. BGP-FS provides a powerful mitigation capability with the additional benefit of being able to be deployed between cooperating networks (eg. inter-domain). BGP-FS provides a very granular mitigation action, in addition to having the ability to rate-limit or redirect DDoS traffic if so desired.

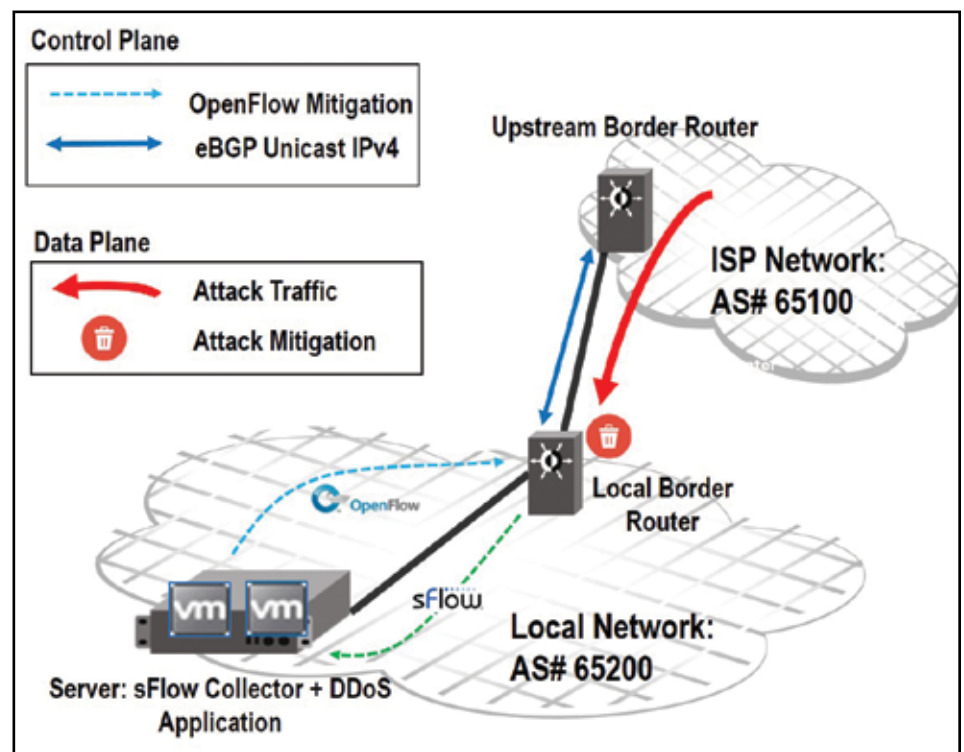


Figure 2: SDN-based DDoS Mitigation with BGP FlowSpec

The Network in 2017: Four Predictions

By Rick Dodd
SVP of Open Architecture
Ciena

This article was originally published in VMBlog



“... the network needs to be smarter and more autonomous.”

2016 saw the network take major advances toward a software-defined future, with SDN and NFV being the acronyms on everyone's tongues. 2017 is about taking the next steps in the long-going synthesis of networks and computing. Here are four things we see happening, or beginning to happen, with the network in the next year.

Network orchestration will fuse with the "orchestration of things"

The last ten years were about the fusing of computing and networking, and the next ten will be about the symbiotic relationship of the network and "things."

I don't just mean that you'll be able to attach your light bulbs and thermostat to the internet; that's all very 2010. Instead I mean that, increasingly, physical things will interact with a more dynamic network to the benefit of both, and this will be implemented very much like the network orchestration we're beginning to see today. In a way, this is an easy prediction, thanks to a proof of concept demo at Cable-Tec Expo which showed an orchestration of a simple network along with some software-controlled toys—a drone, a BB-8 droid. The point was that a network orchestrator can control anything with an API. From there it's a small leap to imagine controlling more economically significant things—power systems, sensor arrays, industrial and medical equipment, etc. It will be exciting to see some creative minds figure out new and interesting uses of IoT, especially as it blends into the network.

Virtualization will force a rethink on basic networking concepts

In recent years, the definition of "machines" has lost its long-held aspect of physicality as virtual machines have made us rethink how we talk about computing infrastructure. We expect 2017 and onward to see more and more aspects of networking being virtualized. In optical networks, even something as basic as the concept of a "wavelength" isn't immune from being affected by this

“The last ten years were about the fusing of computing and networking, and the next ten will be about the symbiotic relationship of the network and ‘things.’ ”

trend. In 2017, those of us in the networking space will have the opportunity to reimagine the building blocks of an optical network, and move beyond limitations that cease to exist in a virtualized environment.

Another concept that is looking more and more like a reality due to virtualization is the notion of network slicing. Slicing refers to segmenting a wireless network so that different portions of that network can be tied only to certain applications, and thus allow for different parameters and priorities to determine service quality. Imagine a large, self-driving truck next to you on the highway-the possibility is not far off, autonomous driving proponents say. That truck needs a stable internet connection in order to have the most up-to-the-millisecond knowledge of its surroundings, traffic and weather conditions in order to make driving decisions with the least chance of an accident. Thus, you probably want the truck to have a higher-priority, lower latency network experience than your iPhone as it updates your Minecraft app in the background. By slicing the network, that priority can be assured.

R&E networks will seed the development of open-source network tools

Ever since organizations saw what the open-source model did for the Linux operating system (which is celebrating its 25-year anniversary this year), efforts have been made to create open-source tools in other areas. For networks, those efforts have started gaining momentum in recent years. One example is ONOS (Open Network Operating System), the open-source SDN platform for service provider networks.

Those familiar with open-source communities will also recognize that research and education (R&E) networks generally play a big role in their development. In fact, if you want to see the future of openness, look at what R&E organizations are already doing. The research community is naturally open and built to foster greater collaboration, driving more innovation. The R&E community was also ahead of the curve when publishing the

first OpenFlow paper in 2008, which kicked off the conversation around SDN. The spirit of collaboration is also making for some unexpected but fruitful partnerships, such as the work that took place this year between Ciena and the U.S. Department of Energy; specifically, the DOE's Energy Sciences Network (ESnet), which helped to improve design cycle times for future high-speed optical networking components.

The network of the future will be self-driving

At Ciena, we have talked a great deal about the fact that the network needs to be smarter and more autonomous. Intelligent and programmable functions are key in making the network better able to respond to the unpredictable demands that are a symptom of a world of cloud computing and high-bandwidth services like high-definition streaming video, machine-to-machine connections, and IoT, to name a few. And the network needs to be able to react quickly - faster than a human being can respond manually. The computing world has seen massive benefit from machine learning and artificial intelligence work, and there's every reason to believe the same will be true in networking. Networking devices will be more generous in providing instrumentation and data, and we'll see more systems taking advantage of that information to make good networking decisions. Of course we humans will keep the all important role of setting policy and rules by which the network makes decisions, and if we do this right we'll have more time to optimize those policies as the network itself takes on the busy work of driving.

Onward and Outward

In 2017, the network will continue its steady growth in strategic importance as it broadens the reach of its impact to include "things," new aspects of virtualization, and fleshes out concepts like slicing. Expect to see major steps taken toward open-source network tools, fueled by collaborations that are inspiring developers all over the world, as well as more flexibility in the new year as networks become smarter, more interconnected, and more robust.

The Value of Immediacy in Service Delivery

By
Juniper Networks

Service providers that own networks are facing intense pressures in today's market. As the cloud—along with the information-oriented and connected world—has evolved, customer expectations have grown more immediate. Value measured against time is a decisive metric (Figure 1), and savvy service providers are using SDN and Network Functions Virtualization (NFV) to fundamentally change the economics of their business.

Over-the-top (OTT) players, as well as more nimble service providers, are leading the way with new cloud and virtualization technologies. These technologies allow them to rapidly roll out new services and capabilities almost instantaneously to address anticipated—or in some cases, unanticipated—customer needs. If the new service doesn't take off, these providers can “fail fast,” rapidly scaling down and redeploying assets without missing a beat. Conversely, if the new service is a success, they can “scale fast” to quickly capture maximum value. As a result, “value” is migrating toward rapid innovation, while conventional network connectivity is increasingly becoming a commodity. Service providers must adapt to this new mindset.

While quickly harnessing these capabilities to capitalize on innovative ideas is the future, successfully implementing them is another story. Service providers are burdened by costly planning and development cycles that don't match the pace of today's escalating requirements.

Most service and network infrastructures are designed and deployed in a rigid, manual, step-change fashion that can take from 12 to 18 months to roll out, requires large upfront investments, and is difficult to modify midcourse or after completion.

The Challenges Service Providers Face

These trends have created an innovation gap between customer expectations and what network providers can realistically deliver. Many application vendors have eagerly filled this void, ironically by using existing service provider networks for connectivity to deploy their services.

There are a few systemic reasons behind this innovation gap (Figure 2). First, lega-

cy environments are based on complex manual workflows, limiting speed and increasing cost. Second, a fixed physical infrastructure that requires stringent testing and time-consuming modifications further contributes to higher costs and lengthy deployments. Finally, service providers have limited network intelligence and visibility, precluding them from using analytics for innovation.

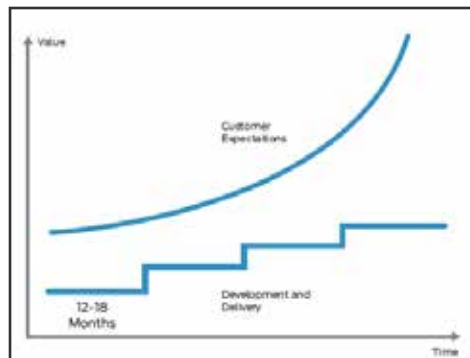


Figure 1: Customer expectations vs. development and delivery

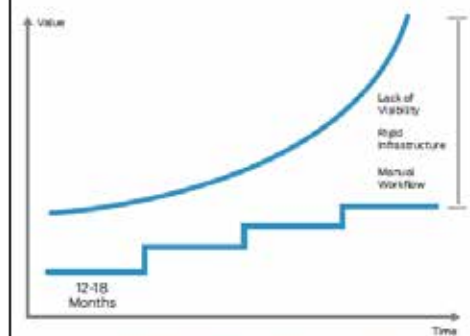


Figure 2: Attributes that create the innovation gap

For service providers that remain mired in this old approach, the gap will only widen; they will be further marginalized and, as pricing pressures intensify, their already dwindling profits will continue to erode. At the same time, they must continue to invest in connectivity to deliver existing services or risk getting blamed for poor customer experience. It is truly a quandary.

A New Approach

Network providers need to take a different approach. The current network investment cycle is slow, with investments made in advance of demand; the new network model, on the other hand,

is responsive to demand and keeps its options open. In order to advance with agility in today's market, network providers need to adopt a carrier-grade, open network platform—one that accelerates delivery cycles and reduces operational and upfront expenses while minimizing risk.

This evolution requires software-driven workflow automation that strengthens and streamlines service delivery. Such an approach requires a mix of physical and virtual infrastructure that optimizes investments while dynamically changing the network to meet service needs.

Virtualization enables variable cost business models, which means lower upfront costs and lower risk. While dedicated boxes can offer better performance and higher potential margins, they also come at a premium; the higher fixed-cost model means higher risk—especially when demand is uncertain and customer needs are dynamic. Smart providers follow a simple rule of thumb: virtual for flexibility and options; physical for efficient scalability.

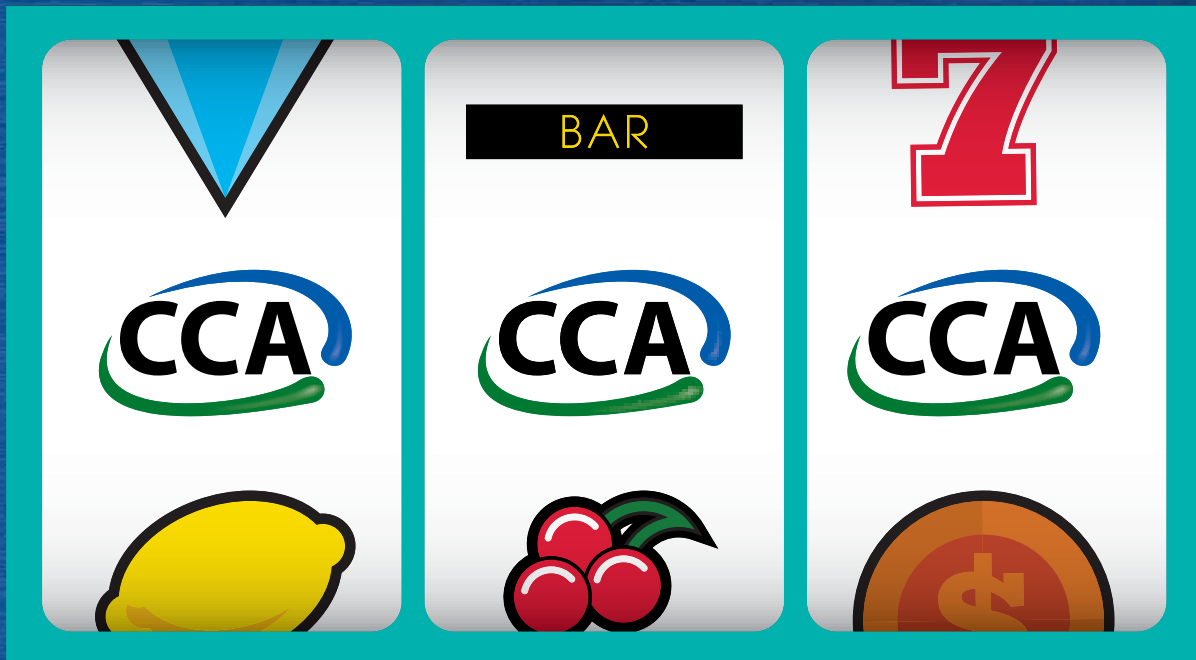
Closing the Gap to Create Value for Your Network

As networks become more automated and programmable for innovation, service providers can take advantage of these capabilities and the agility they afford for adapting to changes in the market. It's a unique opportunity to elevate the game and close the customer expectations gap.

Closing this innovation gap is why network providers trust Juniper Networks to help them navigate the journey toward SDN and NFV. Visit www.juniper.net/go/nfv to learn more.

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Connect America Fund: Challenges and Opportunities

By Paul Shreve/Randy Turner
Director of Technology/Director of Marketing Communications
Walker and Associates



Infrastructure Investment. It's not just a catch phrase; it is an imperative to keeping America competitive. Now, in 2017, the FCC is in the final stages of rolling out the newest Connect America Fund (CAF) initiatives.

CAF has been a long and deliberate process. For the last 20 years, the U.S. has endeavored to ensure its residents are connected to essential telecommunications. We saw the roots of the investment take place in The Telecommunications Act of 1996, which states that "advanced services" should be accessible to all Americans.

The goals of Universal Service, as mandated by the 1996 Act, were to:

- Promote the availability of quality services at just, reasonable and affordable rates for all consumers
- Increase nationwide access to advanced telecommunications services
- Advance the availability of such services to all consumers, including those in low income, rural, insular, and high cost areas at rates that are reasonably comparable to those charged in urban areas
- Increase access to telecommunications and advanced services in schools, libraries and rural

health care facilities

- Provide equitable and non-discriminatory contributions from all providers of telecommunications services to the fund supporting universal service programs

Enter the E-Rate Program

One of the initial investments was education with the E-Rate program, which provides subsidies for Internet access and general telecommunications services to schools and libraries. The subsidies typically pay 20% to 90% of costs based on need, with rural and low-income schools receiving the greatest subsidy. USAC has more than \$37.3 billion in E-Rate funding commitments and \$26.8 billion in E-Rate funding disbursements issued to schools and libraries nationwide through the E-Rate from 1998 to 2013.

Rural Health Care

The rural health care program provides subsidies to health care providers for telehealth and telemedicine services, typically by a combination of video-conferencing infrastructure and high speed Internet access. These capabilities enable doctors and patients in rural hospitals to access specialists in distant cities at affordable rates. The Rural Health Care Support Mechanism allows rural health care providers to pay rates for telecom-

munications services similar to those of their urban counterparts, making telehealth services affordable. More than \$417 million has been allocated for the construction of 62 statewide or regional broadband telehealth networks in 42 states and three U.S. territories under the Rural Health Care Pilot Program. In 2013, the rural health care program paid out \$159 million.

Historically, the pace of investment in the US has not kept pace with other nations. Following a 2008 release of broadband statistics by the Organization for Economic Co-operation and Development (OECD) which suggested that the U.S. may be lagging in broadband, Congress passed the American Recovery and Reinvestment Act of 2009 (ARRA) requiring that the FCC draft a National Broadband Plan. The plan's goal was to ensure hard-to-serve areas and demographics were reached by communications technologies including mobility, broadband and emergency services.

To further advance the merits of the National Broadband Plan, a research study was conducted in 2011 by the NTIA (National Telecommunications and Information Administration) This study demonstrated an "Increased economic output of as much as \$21 billion annually. . .".

Birth of CAF

On April 21, 2010, the US FCC launched a notice of inquiry (NOI) and notice of proposed rulemaking (NPRM) for what it called the "once-in-a-generation transformation" of the Universal Service Fund (USF).

According to the National Broadband Plan, the FCC planned to make 4 megabits per second download speeds and 1 Mbit/s upload speed available to all Americans by 2020.[31] To support this, two funds were to be created: the Connect America Fund (CAF) and the Mobility Fund. The CAF will replace high cost programs in the USF but will only provide funds to areas where there is no private operator willing to provide broadband service for a lack of profitability. The Mobility Fund will mainly focus on

the wireless Internet access.

There were three stages in the plan. The first stage goal was to set up the overall policymaking apparatus. In this stage, the Universal Service Fund transformed from telephone service support to broadband service support. The Connect America Fund and the Mobility Fund were created in this first stage. In the second stage, which was scheduled for 2012–2016, these two new funds were required to distribute the funds they collected. Broadband services were taxed to support the funds. In the third stage, scheduled in 2017–2020, the USF is scheduled to be discontinued.

In February 2011, the FCC adopted an NPRM and Further Notice of Proposed Rulemaking (FNPRM) to ask for comments on reforming the Universal Service Fund and the Commission's intercarrier compensation (ICC). Following a series of workshops that same year, agreements for the new initiatives began taking place. The main theme was related to the implementation of a Phase I of the Connect America Fund (CAF), including the costs and capabilities of broadband technologies and the use of the funds in Phase I of the CAF.

On October 27, 2011, the FCC adopted its "Connect America Fund & Intercarrier Compensation Reform Order" which established a \$4.5 billion Connect America Fund to expand broadband access to seven million unserved rural Americans, replacing the Universal Service Fund's high-cost support and explicitly endorsing broadband as a universal service. The Connect America Fund also included \$500 million for mobile broadband, of which \$100 million is set aside for mobile broadband on tribal lands.

On November 9, 2011, the Connect-to-Compete program was announced. Businesses and non-profit groups were called on to work together to provide broadband access for low-income people in the United States. Thirty-Five million households, about one-third of the total, many of them poor, do not have basic broadband service.

What's Next?

Going forward the E-Rate Program and the Rural Health Care Program have been folded into the CAF funding program to allow for better coordination and competitive bidding of small local telecommunication providers.

The Goals of Connect America Fund are rooted in the 1996 Telecommunications Act and are stated as:

- Preserve and Advance Voice Services
- Ensure Availability of Voice and Broadband to Home, Businesses and Community Anchor Institutions
- Ensure Universal Availability of Mobile Voice and Broadband where Americans Live, Work or Travel
- Ensure Reasonably Comparable Rates for Broadband and Voice Services
- Minimize Universal Service Contribution on Consumers and Businesses

A lot has happened since the original 2011 CAF Order was issued. Our world is literally moving at Internet speeds and those speeds are getting exponentially faster. So much so that the FCC has redefined broadband as 25Mbps/3Mbps - 6x faster download speeds than the CAF Phase I broadband buildout requirements.

In August 2015, all price cap telecommunications carriers made public their decisions to accept or decline Connect America Fund Phase II subsidies from the Federal Communications Commission. Over the next six years, \$9 billion will fund the upgrade of networks to over 4 million homes and business locations across the United States.

Connect America Fund Phase II commitments represent the largest single federal effort to expand broadband infrastructure in history. Targeted areas were identified by using data gathered through Connected Nation's State Broadband Initiative in states where it has had active State Broadband Initiatives. Over the next six years, companies such as AT&T, CenturyLink, Consolidated Communications, Cincinnati Bell, FairPoint, Frontier, and Windstream will

be required to build out fixed voice and broadband networks offering speeds of 10 Mbps download/1 Mbps upload to designated locations in these identified areas, using approximately \$1.5 billion in annual subsidies. Of the total subsidies offered, carriers only declined a total of \$175 million annually.

As 2017 begins we are witnessing the disbursement of the CAF funds through A-CAM and the Rate-of-Return funding vehicles addressing some of the hardest to reach communities.

Proven Strategies

Walker and Associates has a proven track record of partnering with carriers who have received funding for network upgrades via CAF, RUS, BTOP, BIP and more. Numbers of networks are now serving targeted populations as a result of these programs, and Walker worked alongside engineers, project managers, investors and installation teams to deliver expertise throughout the process.

Now with new initiatives well underway, Walker is excited and looking forward to partnering with carriers to help build the networks that will provide advanced services to the underserved communities the CAF Programs target. With nearly 50 years of experience in building and expanding US Telecommunication networks, Walker and Associates will be a fundamental core partner assisting carriers as they implement the CAF goals and meet commitment requirements imposed by the FCC. Our experienced extended logistics services team and CAMP Program will be fundamental in ensuring service rollouts timetables are met. Our EFi&T team is ready to fit; test and burn in cabinets and configurations, and our installation teams are prepared to field these solutions during all phases of CAF deployment. We are ReadyNOW CAF.

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STREAM 1

Transforming Wireless and Connectivity Infrastructure

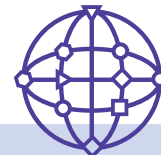
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- ▶ 5G, 4G and XG
- ▶ DAS and Small Cells
- ▶ Backhaul
- ▶ Data Centers
- ▶ Towers and Antennas
- ▶ Fiber and Cabling
- ▶ Integrating Legacy and New



STREAM 2

Virtualized Networks and Software

- ▶ Network Functions Virtualization (NFV)
- ▶ Software Defined Networks (SDN)
- ▶ SD-WANs
- ▶ Open Source
- ▶ Cloud



STREAM 3

Connecting the Internet of Things

- ▶ Smart Communities
- ▶ Connected Vehicles, Transportation and Infrastructure
- ▶ Artificial Intelligence, Autonomous Intelligence
- ▶ Streaming Media Ecosystem and Infrastructure

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How to Connect to a Network with 100GE

By Viavi

Most network backbones are currently based on 100Gbps transmission with some metro backbones even using 200Gbps. Thus, connectivity between devices such as routers, switches, and transport equipment commonly requires the use of 100 Gigabit Ethernet client ports. As 100GigE deployments started around 2012, pluggable client optics were very expensive largely because of technological complexity. In fact, client ports at 100GigE do require multiple lanes/lasers and photodetectors as this has proven to be the most efficient way to standardize local client connectivity.

The path to lower costs lies largely in higher volumes, which is happening, and in using the right type of optics based on distance requirements. Basically, shorter distances allow for lower cost pluggable optics. As a result, there has recently been a proliferation of 100GigE client interface types to closely match connectivity requirements. Table 1 provides a breakdown of reach and interface types for 100GigE.

From a telecom standpoint, LR4 (100GBASE-LR4) is by far the most mature and commonly available interface; the up to 10 km reach meets most applications. The costs for associated optics which

now typically use the QSFP28 form factor have steadily been decreasing; however, there are additional possibilities especially for shorter connections driven largely by data center requirements. The nomenclature for interface names starting with '100GBASE' reflects an IEEE-based standard; this is supplemented by additional interface types originating from industry groups called MSA (Multi-Source Agreements) or alliances. The ER4 interface uses the same wavelengths as LR4 but for up to 40km. There exist a few variants generically called ER4-lite to reach 20 to 25 km.

RS-FEC refers to Reed Solomon Forward Error Correction; it is a digital algorithm which provides automatic error correction for many of the newer interface types. RS-FEC adds redundancy to the bit stream to help detect and correct errors that occur during transmission. Interface types using RS-FEC include CWDM4/CLR4, PSM4, SWDM4, and SR4 which either use of SMF (Singlemode Fiber) or MMF (Multimode Fiber). There are 2 methods for information bundling which are wavelength multiplexing or the use of ribbon fibers terminated using MPO connectors, sometimes also called MTP which is a registered trademark of MPO compliant connectors. Most interface

names end with digit '4' which means 4 x 25 Gbps over the transmission medium. The SR10 interface by opposition uses 10 x 10 Gbits/s over a wider ribbon cable; this interface type is set to be replaced over time by other interface types such as SR4.

Viavi's brand new product, the 5800-100G, provides all-in-one testing including dual-port connectivity at 100GE/OTU4. Technicians can test a multitude of applications covering metro, backbone, and datacenter interconnectivity. Despite its very small size, the 5800-100G can test from DS1 to OTU4 including CPRI, Fiber Channel, PDH, SONET/SDH, OTN, and Ethernet. Further, the 5800 platform provides expandability to support OTDR modules, fiber inspection with auto-focus, and advanced timing capabilities with the Timing Expansion Module. The 5800-100G is a complete solution to support the needs of the modern field technician.

Interface	Maximum Reach	Medium	Implementation	Wavelength Range	Connector Type	RS-FEC
100GBASE-ER4	40 km	SMF	4 λ / dir	1310 nm	Duplex LC	No
ER4-Lite variants	~25km	SMF	4 λ / dir	1310 nm	Duplex LC	Possible
100GBASE-LR4	10 km	SMF	4 λ / dir	1310 nm	Duplex LC	No
CWDM4 MSA	2 km	SMF	4 λ / dir	1310 nm	Duplex LC	Yes
CLR4 Alliance	2 km	SMF	4 λ / dir	1310 nm	Duplex LC	Optional
PSM4 MSA	500 m	SMF	4 fibers / dir	1310 nm	MPO-12 SMF	Yes
SWDM4 Alliance	~100 m	MMF	4 λ / dir	850 nm	Duplex LC	Yes
100GBASE-SR4	70 m 100 m	OM3 MMF OM4 MMF	4 fibers / dir	850 nm	MPO-12 MMF	Yes
100GBASE-SR10	100 m 125 m	OM3 MMF OM4 MMF	10 fibers / dir	850 nm	MPO-24 MMF	No

Table 1 100GigE Interface Types

In the Spotlight

By Randy Turner
Director, Marketing Communications
Walker and Associates



Bill Rinehardt has joined Walker and Associates as a Field Systems Engineer. Bill brings more than 20 years of telecommunications industry experience from past Sales and Sales

Engineering positions with several OEMs. Bill's past includes many years with Fujitsu Network Communications, primarily in Sales Engineering roles but most recently in a Sales Manager responsibility. Bill also has experience working with BTI Systems and ADVA Optical Networking.

He holds CCNA, MEF-CECP 1.0/2.0 and Fujitsu WDM certifications, and has a proven background in Sales, Product Management, Engineering and Field Service. Bill offers extensive hands-on experience in multimillion-dollar industrial projects. His in-depth knowledge of C/DWDM, ROADM, SONET/SDH and Ethernet networks provides his new customer base at Walker a solid resource as they consider new network solutions.

Bill Rinehardt can be reached by email at bill.rinehardt@walkerfirst.com, or by phone at 336-731-5354.



Chris Walker recently passed exams necessary to earn his official certification as a Project Manager Professional by the Project Management Institute. The PMP is the gold standard of project management certification, and is recognized as the standard for validating competency to perform in the role of a project manager, leading and directing projects and teams.

This new professional certification will serve Chris and Walker customers well in his work as Government Development Manager. He can be reached by email at chris.walker@walkerfirst.com, or by phone at 336-731-5476.



Sam Bruce has joined Walker and Associates as a Regional Account Manager in the New England states. He is a respected and highly trusted seasoned professional in the

telecommunications industry, with over 25 years of proven experience in business management, and enterprise sales. Sam has been a consistent top performer in both individual and team environments.

Sam comes to Walker following his 16-year tenure in most recent position with TE Connectivity, working as a Territory Account Executive. His customers have come to know him for his charismatic and tenacious outside-the-box thinking and problem solving skills. He is a veteran team leader focused on strong relationships and customer solutions, and is a trusted advisor with a focused expertise in providing solutions that lower day-2 management costs, power consumption, and overall operating expenditures, fostering a more competitive value to core carrier services.

Sam resides in Allenstown, NH. He can be reached by email at sam.bruce@walkerfirst.com, or by phone at 336-731-5434.



Tyson Philyaw was recently recognized by Juniper Networks as a Marketing Challenger. He has been part of the marketing team at Walker and Associates for eleven years, and manages the

Juniper Networks account., Tyson offers great experience and tips for his peer marketers, especially Juniper partners. He is a solid performer, and continually seeks new opportunities to expand his extensive skill sets. Congratulations, Tyson, for this professional recognition from Juniper Networks!





Richard (Rich) Ferrante recently accepted the position of Federal Sales Channel Manager with Walker and Associates. Rich has been in Telecommunications since 1987 and supports DOD and Civilian customers with COTS IT solutions from Walker. He has worked in numerous technical and sales roles working with TDM, voice and data systems, DSL, Optical, Timing and Infrastructure. He has worked with many CLECS and ILECS in CONUS and worked through product approvals with Verizon and Comcast.

His new role establishes him as a sales leader for Walker's Federal sales group, which is focused on a broad range of the federal government, including DoD and civilian customers. The new structure provides additional support by which Walker intends to grow its business through contracts such as SEWP V, C2 and GSA,

Rich can be reached by email at richard.ferrante@walkerfirst.com, or by phone at 410-991-6029. He is based out of Crownsville, MD.



Tal Strolight has returned to Walker and Associates as a Strategic Account Manager, following a brief career change in 2016. Tal is a proven sales performer, recognized by manufacturers and peers alike for exceptional results.

Throughout his career, Tal has assumed roles in sales, engineering, marketing, strategic planning and product management, working for leading telecommunications industry companies such as ADTRAN, Calix, Lucent, Nortel and Symmetricom.

Tal can be reached by email at tal.strolight@walkerfirst.com, or by phone at 336-731-5423.



Dale Gerdts has joined Walker and Associates as a Federal Strategic Account Manager. Prior to joining the Walker team Dale led a business unit in AECOM where his portfolio of cybersecurity and information technology contracts included agencies such as the U.S. Air Force, Department of Homeland Security, Department of State, Securities and Exchange Commission, and the Federal Trade Commission.

Dale's responsibilities included P&L, business development, partner relationships, and the business units strategic vision. Dale held other roles within AECOM over the course of his 13 years with AECOM.

Additionally, Dale spent 21 years in the Air Force and has accumulated over 31 years' experience in the cybersecurity/information technology industry. He is a visionary, goal-oriented, and seasoned executive with demonstrated experience planning, developing, as well as utilization of emerging technologies influencing more than \$100 million in sales during his time with AECOM.

Dale has an MBA, BS in Computer Information Systems Management and is certified as a Information System Security Professional (CISSP). He can be reached by email at dale.gerdts@walkerfirst.com, or by phone at 703-244-6034.



Dale has an MBA, BS in Computer Information Systems Management and is certified as a Information System Security Professional (CISSP). He can be reached by email at dale.gerdts@walkerfirst.com, or by phone at 703-244-6034.



Ed Ullrich has joined Walker and Associates as its Technical OEM Development Manager and will be managing Ciena and Viavi partner relations. In addition, he will manage Walker Services as a product providing ODEV functions for this growing segment of Walker's business.

Ed has a long, distinguished work history at industry-leading companies such as ADVA, Fujitsu, Alcatel, Tellabs, and Accedian. Having spent years in sales, sales management, and business development functions, Ed brings significant technical depth to Walker and will leverage his knowledge to execute the technical marketing functions for success in these areas.

Ed may be reached by email at ed.ullrich@walkerfirst.com, or by phone at 336.731.5483.

UPCOMING EVENTS

As an active member of multiple state, regional and national industry associations, Walker and Associates is strategically engaged with organizations supporting telecommunications markets. We demonstrate our commitment through event sponsorships, exhibiting at conferences and expos, and directory advertising.

Look for us at the events listed here, and refer to the Upcoming Events section of our website, www.walkerfirst.com, for additional details.

We look forward to seeing you at these events!

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FEBRUARY	
* UTC Region 8, 9, 10 Utility Telecom Forum	Reno, NV
* UTC Region 7 Spring Meeting	San Antonio, TX
GTA Vendor Showcase	Macon, GA
Telecom Training & Safety Conference	Bismarck, ND
SDTA Spring Technology Training	Pierre, SD
AFCEA West 2017	San Diego, CA
FISPA Live	Nashville, TN
MARCH	
* UTC Region 3 Spring Meeting	Chattanooga, TN
ICA Annual Meeting & Expo	Des Moines, IA
* ITA Showcase Northwest	Portland, OR
SCTBA Annual Convention	Charleston, SC
MTA Annual Convention	Minneapolis, MN
APRIL	
* Texas Communications Expo, Inc.	Belton, TX
TANE Spring Symposium	South Portland, ME
* CalCom Showcase & Tech Expo	Sacramento, CA
OTA Outside Plant Seminar	Newport, OR
TechNet Fort Bragg	Fort Bragg, NC
MAY	
NDTA TOC Conference & Showcase	Fargo, ND
ANMTA Spring Conference	Mescalero, NM
KTA Annual Meeting	Lexington, KY
* UTC Telecom & Technology	Charlotte, NC
Broadband Communities Summit	Dallas, TX
JUNE	
OTA/ATA Summer Conference	Tulsa, OK
OTA-WITA Joint Annual Meeting	Stevenson, WA
TTA Annual Meeting	Franklin, TN
ITA Annual Convention	Osage Beach, MO
* Fiber Network Alliance Conference	Buford, GA
MTIA Summer Conference	Branson, MO
* TIA Jam	Dallas, TX
FTTH Connect	Orlando, FL
AFCEA Defensive Cyber Operations	Baltimore, MD

* - Indicates Walker and Associates is an event sponsor

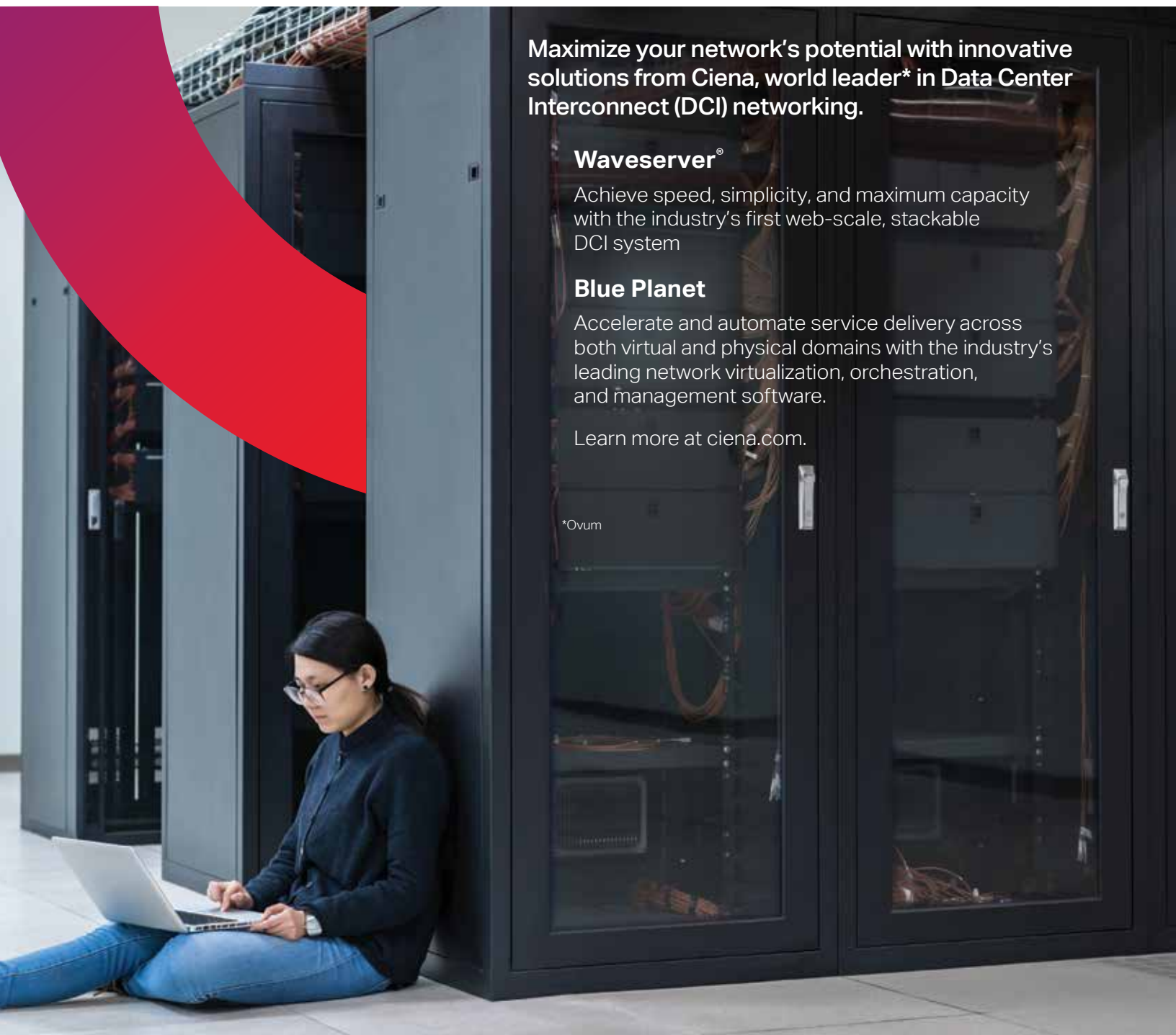
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