

A close-up photograph of a hand in a dark suit jacket, with the index finger pointing upwards. The tip of the finger is touching a bright, glowing blue light source, which creates a lens flare effect. The background is a soft, out-of-focus teal color.

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NETWORK

Building better networks for the connected world.

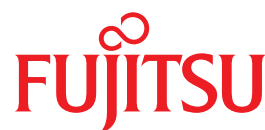


See your Network From a Business Perspective

You've heard the message loud and clear: radical change is happening. The buzzwords are all too familiar: disaggregation; software-defined networking; virtualization; other "disruptive technologies." You need a commonsense business point of view. How will these technologies help you execute your business strategy?

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Editor's Letter

Managing change in our industry is an ongoing challenge regardless of the position we hold or how long we've been in the industry. I recently celebrated my 20th year in telecommunications with Walker and Associates, and the shifts along that journey have been significant. For anyone in the industry longer than that, it must feel like living in a science fiction novel.

My dad worked in the industry nearly all his life, having worked for Western Electric almost 30 years until well after divestiture, followed by a second career with a start-up venture among retirees and their families. His second retirement came only two years ago at age 83. We lost him very suddenly last February, a month before his 85th birthday. Part of my duty now is cleaning out a large building behind his home, filled with electronic relics he accumulated as a young electrical engineer with Western Electric, and more equipment he collected thinking perhaps it held some future value. He kept everything, it seems.

I've carted literally tons of hardware to the recycling yard. I've disposed of boxes of manuals, circuit boards, resistors, transistors, cables, lamps, vacuum tubes, connectors and assorted items about which I have no guesses regarding their purpose. Sorting through all this material, I thought of the shifts in technology my dad experienced in his 60 years of industry experience. The truth is all that "stuff" held incredible value at one time, but the reality is they were all merely bridges to where we find ourselves now.

The hardware market is changing. The methods of maintaining network functionality are evolving. The skillsets of those who perform the important work of network design are shifting. Customer expectations are increasing, our world gets smaller, the needs for greater bandwidth and higher speeds grows at exponential rates. Virtualized and automated solutions are taking our industry to its next logical stage in its evolution process.

In its 2015 report, investment researcher IHS noted the global market for NFV hardware, software and services is set to surge to \$11.6 billion in 2019. A recent report from ACG Research, and sponsored by Affirmed Networks and VMware, found mobile operators would begin saving money on NFV deployments within the first year and realize an investment payback within three years. In addition, the ability to turn up a virtualized network much more quickly (less than 6 months) than with traditional networks (15 months on average) is a sharp contrast. The proverbial writing is on the wall.

This issue of *Skinny Wire* focuses on many aspects of the virtual network, its challenges, its requirements and its value. Walker's partnerships within the manufacturer community are growing to reflect the changes in our industry, and we are taking a leadership role that we believe best serves our customers. Be sure to read Trey Hall's article on page 15.


And, if you're in the market for some truly vintage electronics, let me know! I still have a lot of work to do in my dad's building.

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More than Fast Internet: Network Virtualization and Software Defined Networking Make New Applications Possible

By Timothy Downs
Managing Director
SmartGig Media LLC



Incumbents beware: Municipalities are discovering that the next generation gigabit network enables an explosion of compelling new services and benefits.

Broadband access is not a business for the faint of heart. The access network has thousands of miles of facilities that radiate from head-ends and hubs and terminate in nearly every home and building in the serving area.

It has specialized outside plant electronics deployed in cabinets, underground vaults and mounted to utility poles. Adding to the challenges are onerous federal, state and local regulations that hinder flexibility. Plus, there are real operational challenges, including lightning, floods, backhoe fades and squirrel chews.

Adding to "access network realities" is the cost and complexity incumbents face. They have decades-old access infrastructures and limited CAPEX budgets. Upgrading to gigabit networks is an expensive undertaking. At the same time, people across the country read about Google Fiber and gigabit broadband communities. No one wants to be on the wrong side of the "digital divide", which gigabit cities will make even wider.

All is not lost. Today, incumbents have the opportunity to re-make themselves. According to Aman Segal of Virtual Gateway Labs, "By taking advantage of proven software defined networks as well as virtualization and open source solutions, incumbents can build the right network for the next 20 years." "If they continue the five- to seven-year upgrade cycle many ILECs will get left behind. They will face competition from gigabit community networks that will severely limit their options and perhaps put them out of business."

The founding member of Virtual Gateway Labs and developer of the world's first SDN-capable Virtual Broadband Gateway enabling multi-tenancy for service providers, Sehgal's disruptive business model upends the status quo. "Open access networks will give the people choices for all of their services. Today, some have the choice to switch from a telco triple play to a cable triple play. These are closed access networks. You may have a choice but the choice is between triple play bundles. Switching between providers can be done with the frequency of their contract duration of one or two years," Segal continues. "With open access, consumers have a choice for every service. You would go to a portal and see a menu. You can select a data service (bits/\$) from a number of ISPs. Similarly, you can select a video service from numerous providers and you could select a voice service the same way. The service experience can be described as "Internet-Like" meaning that end users can select and change services instantly. The provisioning is automated so the service is available immediately."

"Why Software is Eating The World" - Marc Andreesson, 2011

"We are at the dawn of a new era: Software Defined Infrastructure . . . a starting point of a very deep revolution that will reshape our global computing infrastructure." That, according to a February, 2016 National Science Foundation Workshop Report. That's a bold statement given the global transformation that has occurred over the past 30 years; a transformation that was driven by computers, smart phones, and communications networks

and has altered every sector of the global economy.

Just as we saw with the Internet revolution, the implications of the transformative shift to network virtualization and a software centric communications network well beyond our ability to predict.

According to Jeff Christensen, President of Entry Point Networks, "By shifting to software-centric networks, innovation will move at the speed of software development rather than at the speed of hardware development. That is a shift from months to hours."

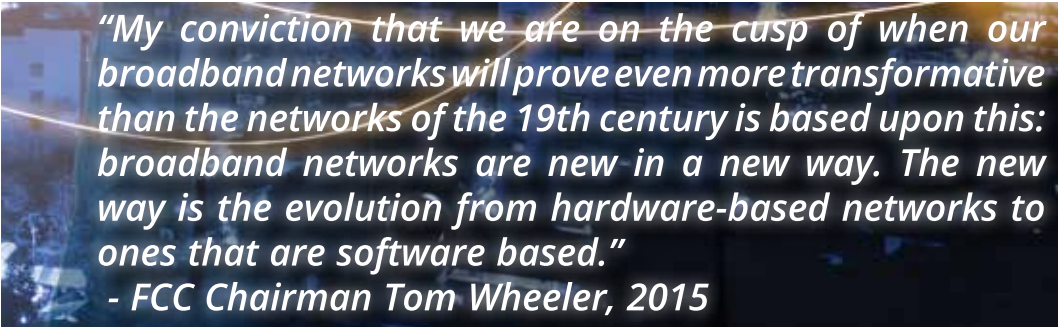
"The impact won't just speed up innovation, software control will also give more flexibility and control to users through automation and easy-to-use interfaces," Christensen continues. "Young children will be able to provision a network slice for a short term need (perhaps to play a game over the network) and then they will dismantle the network when they are done. Historically that kind of provisioning was expensive and required that a network technician come to your house - sometime between 9:00 a.m. and 1:00 p.m."

EntryPoint's vision is that Fiber Optic networks can provide much more value - beyond just delivering fast internet. New technologies including Software Defined Networking, Network Virtualization, and Network Automation make it possible to deliver new applications that make a difference in people's lives in open, secure, cloud-like ecosystems. The same tools that enable automated Open Access also provide a platform for Smart Cities and

the Internet of Things.

"We are quickly reaching a point in many cities across the country where the existing infrastructure is not sufficient for the bandwidth demands. Fiber optic infrastructure provides both bandwidth and speed advantages and the ability for data to travel greater distances. In many situations, fiber may be more expensive to install but will likely prove less expensive to manage over the long run," Christensen says.

If the actual cost to move from 100 Mbps to 1,000 Mbps with fiber optic infrastructure is relatively inexpensive, why do Internet Service Providers and Network Operators treat bandwidth like a scarce resource? Partially because they have a tight grip on yesterday's business models and their current control allows them to keep bandwidth scarce - even in cases where they are upgrading infrastructure to fiber optics.



"My conviction that we are on the cusp of when our broadband networks will prove even more transformative than the networks of the 19th century is based upon this: broadband networks are new in a new way. The new way is the evolution from hardware-based networks to ones that are software based."
- FCC Chairman Tom Wheeler, 2015

EntryPoint and many others are advocating for a dismantling of this model by separating the network infrastructure and network services and then opening up the network. The incumbent operator could continue as an operator or as a service provider but should not exclusively perform both roles. The model that is most favorable for all stakeholders is to have a local municipality install software defined fiber optic infrastructure and manage it as a public utility and then make broadband services available in a cloud ecosystem where the private sector has an opportunity to innovate and compete.

The proposed model is analogous to life before/after the app store on Smart Phones. The app store gave innovators both a technology and business platform from which they could deliver new services. This will lead to evolvable, dynamic networks that foster change.

EntryPoint is focused on Dynamic Open Access. The difference between historical Open Access and Dynamic Open Access

is that we have combined the capabilities of software defined infrastructure, SDN orchestration, network functions virtualization with cloud-like functionality (automation, programmability, virtualization, multi-tenancy, anytime-anywhere access, on-demand self-service, rapid provisioning, easy-to-use interfaces, and management efficiencies) in an open access environment.

The changes will be tangible for every user connected to the network. The results will be real competition for broadband services, a groundswell of innovation in new services, and much more flexibility, control, and utility for users. We can't anticipate the new ideas and solutions that will come from open networks and open API's but we believe the impact will be broad and will drive innovation in telemedicine, smart grid, distance learning, emergency communications, smart homes, entertainment, transportation, private clouds, Internet of Things, and Smart City applications.

In time, software controlled fiber optic networks will be essential to attract new businesses, improve city services, and reduce the costs of running a city. Small cities, which are the most underserved communities in America, will be the first to adopt these technologies. Ironically, for a time, communities with 10,000 residents will have much more powerful networks than large urban centers. As the technologies are validated and innovation accelerates, adoption will move to larger cities. There are many cities that are not even thinking about deploying a fiber optic network today. Three years from now they will start to realize that they run the risk of putting themselves at an economic development disadvantage and they will need to pay attention to this issue to stay vibrant.

Scott Raynovich of SDX Central notes, "The cloud model is only just getting started in communications and it's likely to follow the path that enterprise software has followed. I think this change is coming in telecom. The new buzzwords

in the telecom industry are about provisioning and orchestration. Just like in cloud services, the ideal is that a customer goes online, signs up, and provisions a service how they want it and when they want it."

The 'Softwareization of the Network'

Always on, ubiquitous access has been around for many years. What's new here is the move to high-bandwidth access networks: gigabit networks. While few consumers and small businesses actually need a full gigabit per second speed, the move to gigabit networks eliminates bandwidth as a constraint.

High-bandwidth applications such as Netflix, will run better with more bandwidth. More bandwidth will drive the global innovation engine to create new applications we haven't even thought of. This occurred when we moved from 56 Kbps voice band modems to the few megabits of broadband. The same also occurred when the few meg's jumped to a few 10's of meg.

In addition to the raw speed, gigabit networks also offer very low latency. This too will stimulate applications we haven't thought of yet. Gigabit low-latency networks eliminate distance as a concern. To grasp the implications of this, the distance between a CPE and Memory could be miles apart, not millimeters.

The 'Softwareization of the Network' will mean lower costs for services, choices for all services, new services and better services. Software Defined Infrastructure will greatly simplify the ongoing operations and maintenance of the access network, driving down costs and reducing the burden on rate payers. It will also enable new services and business models.

Timothy Downs is Managing Director of SmartGig Media LLC, producers of 'SmartGigabit Cities' conference series and 'Smart Gigabit Cities.com' information and resource publication. He can be reached via email: tdowns@smartgigmedia.com

Don't Get Burned. Bake Security into Your Virtualized Network

By Franklin Flint
Chief Technology Officer
TIA

The pressure on network operators is building like never before. Data driven demands, the onset of 30 billion connected "things" in four years, the unquenchable consumer demand for over-the-top (OTT) entertainment content, and new developments in augmented and virtual reality are putting extraordinary strains on existing networks. At the same time, network operators must meet changing needs and provide new capabilities to allow customers to set up and operate their own virtual networks and service.

The information and communications technology (ICT) industry is actively working to develop solutions to address demand and advance functionality, and the two current key solutions are network functions virtualization (NFV) and software-defined networking (SDN). But as operators begin to deploy or plan for the implementation of these solutions, one thing has become clear: security is not always the focus of their agenda, since so many other pressing issues still need to be resolved. That said, security is of paramount concern and importance, as a network is only as strong as its weakest link. And, through virtualization, the number of potential links are rising into the billions.

There is no question that, when working in tandem, NFV and SDN are revolutionizing network infrastructure and business models - moving them from being solely proprietary, hardware-specific, fixed models, to being fluid, transmutable, scalable on-demand, virtual models and technologies. The transformation they bring is taking communications infrastructure to the next evolutionary step, strengthening the infrastructure.

But it's also opening it up new vulnerabilities. The incredible opportunity presented by these solutions will be severely limited, and possibly even lost, if operators aren't thinking about security from the very start. To address rising security risks and concerns, the Telecommunications Industry Association (TIA) has formed the NFV Security Working Group, which is analyzing the issues and developing approaches to resolve them. The resulting solutions will be shared with the ICT

industry. The Working Group benefits from the combined thought leadership of the organization's member companies and associated carriers, including Verizon, AT&T, Comcast, Red Hat, ADTRAN, Intel, and Dell.

Having met in June 2016 at TIA's annual Network of the Future Conference, NFV Security Working Group members discussed the top priorities for their companies and what they believe the industry needs.

Securing NFV and SDN Systems Themselves

Among the most pressing concerns that were discussed by the Working Group is how to ensure that network software deployments are themselves secure. Given the increased sophistication of attacks on carrier, government and enterprise private networks, software vulnerabilities are particularly challenging.

Host operating systems, hypervisors, cloud platforms, and management tools, as well as virtual machines and docker containers hosting Virtual Network Functions (VNFs), must all be secured. Switches, modems and other links, both physical and virtual, also present points of network vulnerability. In addition, routine aspects such as common administration interfaces and logging mechanisms; system authorizations; and credential systems with legacy protocols present obvious challenges, particularly if multiple vendors are both competing and collaborating together.

The Cost of Securing a Network - or Not

Integration of NFV and SDN in existing networks is complicated and labor consuming in its own right. The challenge becomes even more daunting when operators must consider complexities such as multi-tenancy, and adding a layer of security to which all participating parties need to agree, or the need to deploy quality assurance certifications requiring Public Key Infrastructure (PKI). These issues demand increased requirements of skills and commitment of com-

pany resources, and many companies are attempting to avoid making such investments. It's time for all operators to accept that inaction is not an option - after all, vulnerability in one point of the network can compromise whole systems.

Labor Skills and Training

While the benefits of SDN and NFV are gaining global recognition, there is still a need to educate companies on the latest network virtualization technologies and on the inherent vulnerabilities. A broad industry understanding of where vulnerabilities exist will inform a concerted effort to fill the gaps in knowledge and lead to the development of innovative solutions.

NFV Working Group members specifically noted the difficulty in finding qualified engineers with the skills and knowledge to effectively manage NFV and SDN network deployments, along with the security issues. Carriers and their solutions providers are implementing training programs to address the dearth of market ready engineers, but more needs to be done.

Standardization and Guidelines Will Drive Adoption

Implementation of NFV and SDN is an industry-wide initiative in which a wide range of companies are coming together to address the needs and opportunity. Of course, not all companies can apply the same resources, and standardization will be important for easing deployments with lower capital and operational expenditures.

Work is quickly proceeding in this area, including addressing application programming interface (API) standardization among vendors. This has become a particular point of frustration, and the lack of standards in this area is making the orchestration layer more complex than it needs to be. Also, virtual network function (VNF) orchestration interfaces can benefit from standards development. As standards development proceeds, guidelines can provide first steps toward unity of deployments, with noted areas of focus being host operating system hardening procedures and consistent scal-

able architecture.

Building New Solutions and Business Models

In these exciting times of building new technologies and solving issues faced by a broad spectrum of companies in the ICT industry, there is an unprecedented opportunity afforded to companies to utilize NFV and SDN to creatively resolve security issues. Security can be built directly into NFV and SDN systems, putting a solution in place at the beginning to avoid more serious problems in the future.

The IT industry has dealt with security issues for decades, and many of the solutions from the data center world are applicable, with or without adjustment, to meet the needs and goals of carriers. Where needed, the development of new solutions not already available from the IT market offers opportunities for both startups and established companies to innovate and build businesses that support these activities. Companies are developing new service business models to match the needs of the many new products and services being deployed.

The next 12-18 months will be a remarkable period for NFV and SDN. The indus-

try will see several NFV and SDN networks deployed and fully functional, and these trailblazing efforts will produce best practices and important lessons. They'll allow new technologies to be vetted, lead to educational programs, and help the industry better understand what it takes to secure a virtualized network. TIA is committed to being at the center of this effort - serving as a catalyst for industry collaboration and information sharing. Working through the NFV Security Working Group, TIA will dive more deeply into the needs identified and continue producing educational content.

Franklin Flint is the Chief Technology Officer of The Telecommunications Industry Association (TIA). TIA represents the manufacturers and suppliers of global communications networks through standards development, policy and advocacy, business opportunities, market intelligence, and networking. To learn more about the TIA NFV/SDN Security Working Group, which will hold a workshop on December 7th in Silicon Valley, contact Germaine Palangdao at gpalangdao@tiaonline.org. To learn more and attend TIA events visit TIAonline.org; to view TIA's collection of NFV/SDN expert interviews on video, visit TIANow.org.



The Telecommunications Industry Association (TIA) (TIAonline.org) is a non-profit trade association representing the manufacturers, OEMs and vendors who supply products and services to telecommunications carriers. TIA provides standards, policy advocacy, market intelligence and other services to its members. TIA publishes an annual market intelligence report, and technology and market analysis white papers. It holds a number of events including its annual conference TIA 2016 (TIA2016.org), workshops, webinars, seminars, standards meetings and more. Its video news service is TIA NOW (TIANow.org).

Using Virtualization to Reduce the Business Risks of Launching New Services

By David Nogueer Bau
Senior Manager Service Provider Marketing
Juniper Networks

Launching a new service by the telecommunication industry is not an easy task: it requires a lot of research and planning in order to make sure the huge investment is safe. Profits come from taking business risks, but in front of a huge investment, corporations prefer to take calculated risks. The dependency of telecom services to heavy network investments, limits the amount of innovation they bring in the portfolio, specifically when compared with the Over-the-top OTT providers.

Those Telecom Providers looking to reduce their investment risk while continuing to innovate in new services, should introduce the following technologies in their processes:

- Virtualization in x86 compute platforms to reduce the dependency on dedicated infrastructure
- Build a common platform for innovation
- Automated network analysis and

optimization

- Automate the service provisioning with NFV MANO
- DevOps to accelerate the development of new services
- Transforming the Service Provider Organization

The new culture helps Service Providers to innovate faster over a common platform and reduce the upfront costs in launching a new service.

Where do we start?

A good place to start experimenting using the new techniques for service-creation is in areas of real potential revenue growth with high uncertainty.

Many service providers see the potential of the ICT services market for enterprises. The traditional approach requires sophisticated CPEs but the scope of services is too limited, expensive and inflexible. With infrastructure virtualization, carriers could build a modular platform

with lots of options to the market. A customer can personalize services through a self-service portal with 'instant' activation.

After working with some customers, we have identified some key advantages:

- Building an Open platform reduces the vendor lock-in risks.
- Each new service will be based in VM instances with no hardware dependencies.
- Rapid time-to-market with simplified integration.

It is true that the price/performance ratio for some services is better in physical infrastructure than virtual. Virtualization mitigates the risk by allowing carriers to experiment with new services, and if they are successful in the market, they can be transferred to a more scalable physical infrastructure.

What NFV and vCPE Will Bring to Service Providers

By Timothy Brown
Director, Virtualization and Security
Network Utility Force

Service providers often have to do more with less. Beyond basic bandwidth and limited business services as voice, small to medium service providers often struggle with how to deploy new services and capture more revenue from their customers, and want to continue to see performance from their existing investments as long as possible.

Over the past several years, academia and research teams at major carriers and OEMs have been developing solutions designed to make the most of a bad situation: the commoditization of hardware and bandwidth. These solutions center around making hardware programmable, manageable at scale, and in some cases using generic off the shelf hardware that we'd normally see in desktops and servers repurposed for networking needs.

You've probably heard the terms SDN, NFV, and vCPE, and wondered what they mean and what they mean for your business. Is it all hype? I hope in this article to help you cut through the marketing messages to get to the reality of where the market is heading.

Software Defined Networks (SDN) are a collection of approaches designed to change the way we think about networks. Despite the fact that network engineers often use protocols that are "dynamic" to route around failure and error, and employ methods designed to classify and act on traffic in real time, networks tend to be statically configured. SDN is designed to give operators new tools to make the network more responsive to the customer and to the provider.

An often-cited example is firewall provisioning, a process that takes a great deal of time in implementing the change and managing the change process and business assurance once a change is created. What if my customer could try out a new firewall whenever they wanted, or send a copy of their production traffic to a firewall that has the new rules defined?

Another example from our own experience is a need for a VPN that doesn't require additional hardware. A large manufacturing company has resources

that span several ILECs and traditional service providers, as well as the cloud. These sites might have different kinds of CPE and connectivity. With SDN, these resources can all be tied together and integrated into a single holistic network, and changes to that network can be interpreted to each type of CPE and connectivity.

Provisioning time is often a very slow operational process in many operators. SDN makes the promise of a much more automated, streamlined, less error prone process. Orchestration solutions can be used to make the changes on many devices at once. This can help mitigate human error from manual provisioning and allow much quicker response to a failed device or network segment.

SDN means many things to many people, of course. There are many other use cases that I haven't described here. What I'd like to do next is talk to you about NFV and vCPE, and how products that are currently shipping can make your life easier and increase stickiness for your customers.

Virtual CPE represents a compelling set of use cases for providers. If you're one of the many service providers who has wished that you could put a PBX or session border controller on site with your customer, sold them a cheap firewall, or helped them diagnose elements deeper inside their network, vCPE offers you options to put these features as close to the customer as possible: at your ONT or NID.

Today's devices support a general purpose compute capability inside the ONT or NID, allowing us to deploy virtual machines that contain a virtual firewall, router, SBC, intrusion detection device, you name it. These features are being deployed today in products from the likes of Adtran and Adva/Overture. The virtual machines are provided by major OEMs including Juniper, Cisco, F5, Fortinet, and Palo Alto, and the fact that we can now deploy them anywhere we have a server, ONT, or NID totally changes our landscape.

Another compelling case for virtual CPE

allows us to move around the CPE itself. Rather than having to roll a truck to premise, there are several options now for pulling the most involved CPE functions closer to the data center or central office.

The hardware versions of these devices are typically a larger cost than most smaller service providers can afford and justify in an investment cycle without drumming up significant demand. The software versions now available offer a very attractive set of deployment possibilities to service providers, allowing us to deploy them on a per-customer basis at much lower cost. The performance is suitable for this use case even in large enterprises. If you're selling colocation or managed services, now that offering can add security, VPN, advanced routing, and other features and keep you competitive.

Why do all this? A few reasons. In the next couple of years, 5G wireless and millimeter wave technologies for the last mile are going to put an enormous set of pressures on service providers and usher in a new era of competition. While some of us may even be a part of that wave, the closer relationship we have with our customers by offering them more services and capturing more revenue from them will help keep service providers relevant. Other technologies being deployed today, such as Openstack and OpenFlow, will help us come up with new service offerings at a very low cost and build our own clouds. It's an exciting and challenging time for the next wave of investment, and Walker is ready to help.



The Industry's NFV Powerhouse

Leverage Pure-Play Virtualization



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A Division of ADVA Optical Networking

www.advaoptical.com

Leveraging Existing Networks for Virtualized Services

By Prayson Pate
CTO, Ensemble Division
ADVA Optical Networking

Service providers want to use network functions virtualization (NFV) to improve the cost and dynamism of their services. However, they must figure out a way to apply NFV without re-inventing their network, processes and OSS/BSS infrastructure. The good news is that goal is now achievable. Service providers can leverage existing infrastructure to offer virtualized services to their current customers.

Before going into the details of how service providers can incrementally apply NFV, let's step back and look at what NFV is and how it can be applied.

NFV: The Basics

The original intent of NFV is to replace closed appliances (e.g. routers, firewalls, etc.) with software virtual network functions (VNFs) that can be hosted anywhere in the network on any open hardware, as shown in the following diagram. By moving to NFV, service providers can take advantage of low-cost servers as well as independent innovation on the software side. Even so, simple replacement of appliances does not provide all the benefits that are available from the cloud.

The Goal: Cloudy NFV

Ideally operators would gain the benefits of the cloud when they move to NFV. Those benefits include:

- Hosted centrally. There are two main models for NFV: centrally hosted, and located in the access network at the customer site or cell tower. Both are valid and are needed for different applications. The central hosting model is preferred by many because it is more cloud-like and provides better economies of scale and resource pooling.
- Available on demand with variable billing. Static and flat services are passé. End users want dynamic and scalable services with an option to pay based on the time and amount of usage.
- Integrated with network. Over-the-top services are popular but they lack the service level agreements (SLAs) that are available with

services delivered natively on the network. Operators need to integrate new technologies such as NFV with their existing networks to enable SLAs.

- Integrated with OSS/BSS. The OSS/BSS is the heart of an operator's business. Any new technology needs to be integrated at some level to enable dynamic services and accurate billing.
- Pay-as-you-grow model. An ideal technology has costs that start low and grow only as new revenue is generated.

Some Obstacles

As described above, truly cloudy NFV offers tremendous advantages to operators. So, why aren't they moving faster to deploy it? Some questions remain:

- Integrated with network. NFV is fundamentally different than today's network equipment. How can operators gracefully insert VNFs into existing services?
- Integrated with OSS/BSS. Operators and their suppliers shudder at the time and effort required to integrate new technologies into existing OSS/BSS systems. How can that effort be minimized and contained?
- Hosted centrally. Hosting VNFs centrally has many benefits, but how do we connect them to existing services?

Build on Today's MPLS VPNs

Fortunately, there is a way forward. We can use existing layer 3 VPNs as a basis for NFV. Service providers have deployed layer 3 VPNs everywhere, built on fast and reliable MPLS backbones, as shown in Illustration A below.

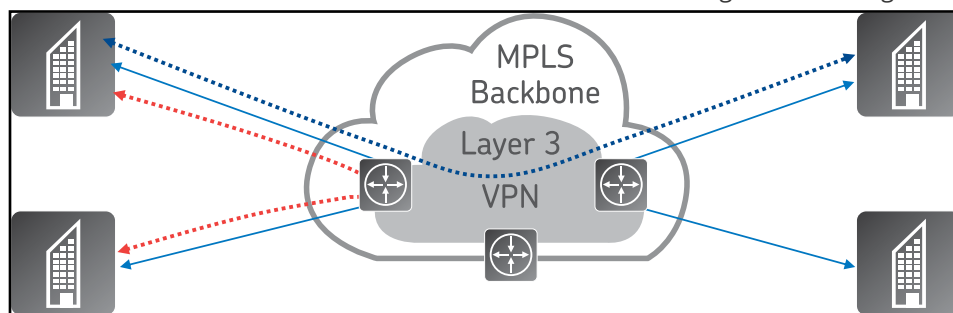


Illustration A

Layer 3 VPNs are built using customer edge (CE) routers at the customer site, and provider edge (PE) routers in the operator network. Together, they allow customers to have private networks with high bandwidth and assured quality of service.

... and Add NFV in the Cloud
It's possible to build small clusters of servers in the provider network and use them to host VNFs, as shown in Illustration B.

The question is: How do you dynamically connect a new VNF with an existing layer 3 VPN?

Solution: Use BGP

The answer is to use an existing technology: the exterior border gateway protocol (eBGP). eBGP is the standard way that today's MPLS networks propagate topology information. We can use eBGP to inject a VNF into an existing service.

Here are the steps that are shown in Illustration C.

1. Customer makes request at portal. They choose from a menu of incremental services such as gateway router, security service, VPN gateway, traffic analysis, etc.
2. OSS generates service order for orchestrator. This is the single point of integration, where the OSS/BSS sends an XML service order over a RESTful interface to the orchestrator.
3. Orchestrator instantiates VNFs via OpenStack. The orchestrator uses the standard features of OpenStack to create and initiate the constituent VNFs.
4. Orchestrator signals eBGP engine.

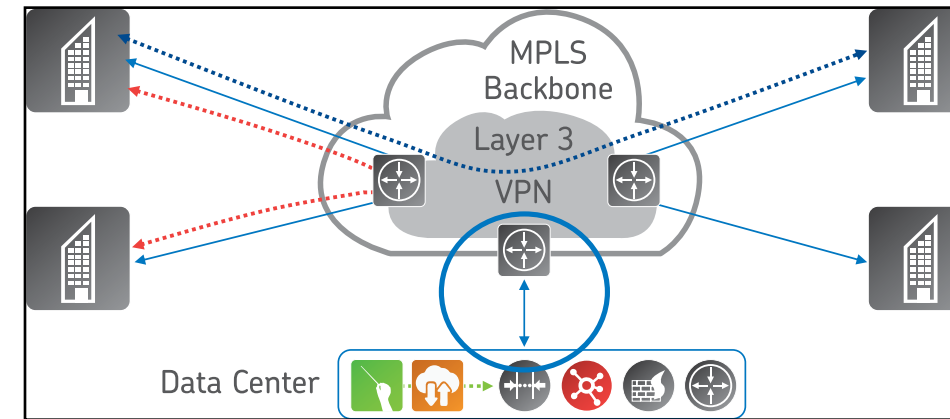


Illustration B

5. eBGP engine signals route insertion. The eBGP engine now has the needed information to create eBGP messages and send them to the PE router.
6. VPN traffic redirected to VNF(s).

Once the PE router receives the eBGP message, it redirects traffic to the relevant port. The VNFs are inserted and the virtual service is live!

Benefits of Using Existing Infrastructure

The approach described here has many benefits, including:

- Layer NFV on top of existing infrastructure and OSS systems.
- No change to existing CEs, PEs or L3 VPNs.

- Offer customers dynamic incremental virtualized services.
- Centralized NFV offers lowest TCO.
- Very distributed and scalable approach - Each VNF hosting server need only support a single customer VPN.
- Starting cost at each point of instantiation is very low - a single server.
- Required integration to OSS/BSS is limited to sending the service order to the orchestrator.
- We Can Get Started Today!

By augmenting existing MPLS VPNs, service providers can get started on NFV and at the same time offer dynamic new services to their existing customers. It's a win-win situation!

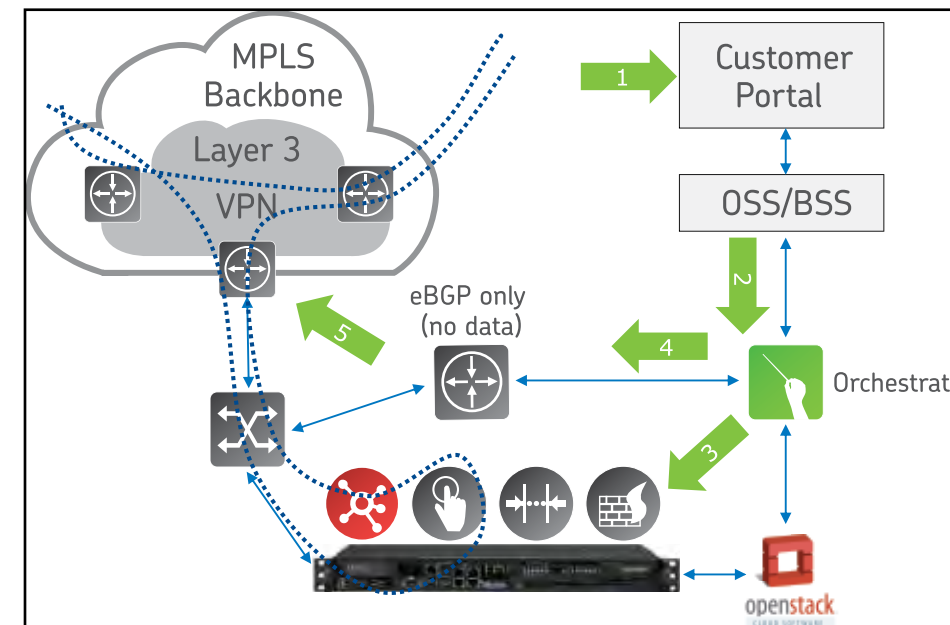


Illustration C



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.

The DevOps Revolution: The “Jig is Up” for Legacy Telco Software Vendors

By Dr. Recep Ozdag
Senior Director Blue Planet
Ciena

The “jig is up” -- kind of an odd expression isn't it. For our non-English readers throughout the globe, it's an expression that means that a scheme or plot has been discovered or ended.

With that back-drop, we're sorry to announce that the jig-is-up for legacy telco software vendors and their software professional services strategy. What do we mean? Well, in most cases, telecom software is based on the premise that you sell the customer a closed platform for a specific purpose, and then reap the rewards of perpetual software updates and support services. A good example is OSS systems, where the only way to modify, change, or adapt that piece of software is to contact the vendor, engage in a software professional services engagement, and pay millions of dollars in fees to evolve the software.

This has been a cash cow for legacy software vendors and an incredible bane to service agility and innovative operations for network operators for decades.

But this model is unsustainable. Why? On-demand applications, cloud, content distribution, 5G, the Internet-of-Things, are all drastically changing how networks need to operate. The age of static networks and static software are over. Competing and surviving in the on-demand age requires real-time DevOps agility.

DevOps in a Software-defined World

In order to maintain a sustainable advantage in the web-scale and on-demand economy, network operators are learning how to innovate and react faster to competitive threats. An important tool in transforming their business is SDN and network virtualization software technologies designed to orchestrate, automate, standardize and expedite service creation and delivery across multi-vendor networks both physical and virtual.

But this new set of open and programmable software tools are useless without a new agile method of software development. That's where DevOps comes in.

What is DevOps?

DevOps describes the value of collaboration between IT development resources and operations staff throughout all stages of the software development lifecycle for creating and operating a service. This is different from the past where hard lines were drawn between the responsibilities of IT and operations.

In the new, on-demand, software defined world, network operators become more agile and are able to manage their physical and virtualized networks, their devices and the services they offer -- in near real-time. They want to go from concept to revenue very quickly. And this is enabled not just by the software tools they choose, but their ability to use a DevOps methodology to maximize the value of that software.



DevOps reduces the time it takes to go from concept to revenue

Network operators can't get this business agility from their legacy OSS/BSS vendors or solutions, which require significant professional services involvement, often times resulting in extremely costly and very lengthy engagements even for the simplest of changes.

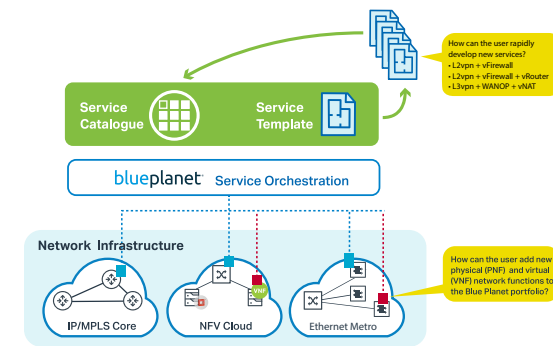
This is one of the reasons many operators are turning to next generation SDN and NFV orchestration platforms like [Blue Planet](#). Blue Planet breaks the silos that are slowing down operations but also brings an open and programmable (DevOps enabled) service orchestrator to the world.

CSPs need to easily change the infrastructure and services for agile business services

Introducing the DevOps Toolkit for Blue Planet

To unleash the full programmability of Blue Planet, today we are introducing our DevOps Toolkit. Our new DevOps

Toolkit promises to bring business agility in the form of automation, quick service delivery and full programmability -- freeing network operators from the crippling monolithic systems, costly professional services and lock-in of traditional vendors.



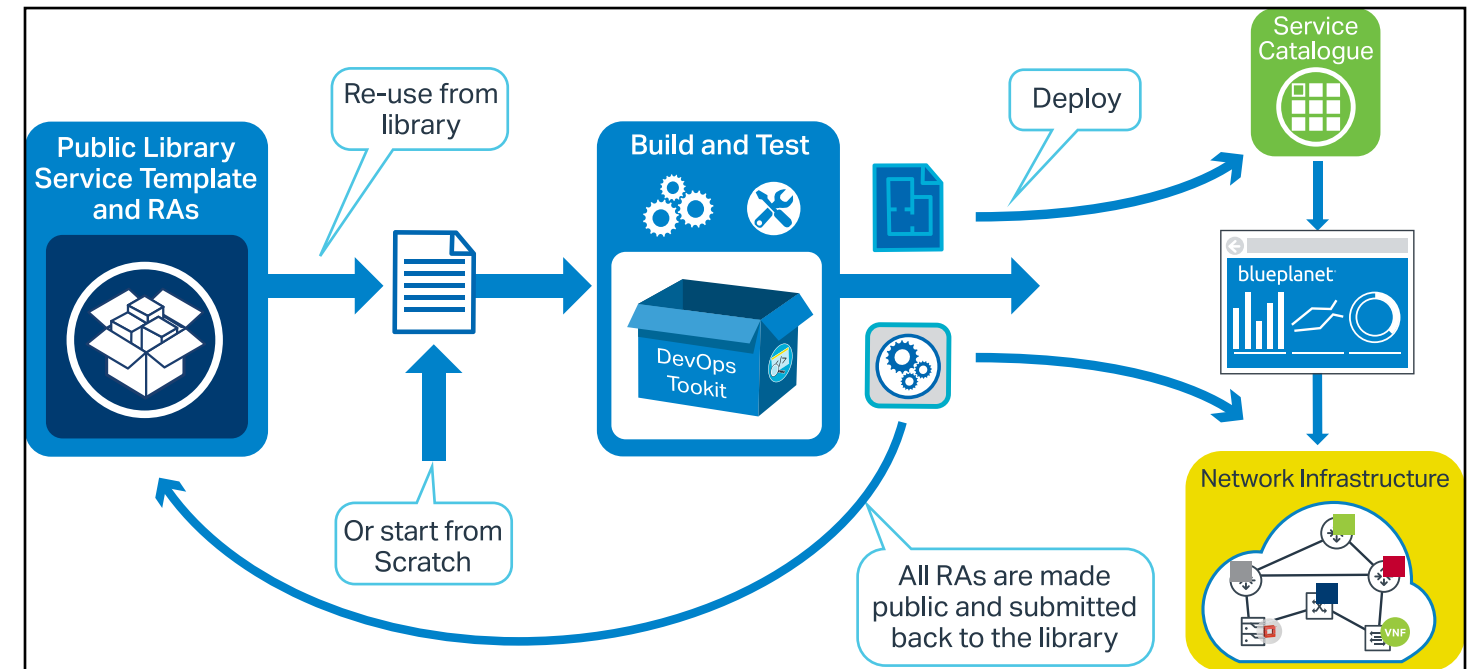
The DevOps Kit brings the much needed business agility to CSP infrastructure

The Blue Planet DevOps Toolkit provides a platform to create, modify, test and validate service templates so that CSPs can quickly offer differentiated, revenue generating services as well as create and modify resource adapters that allow them to control any physical or virtual device.

Let me say that in a different way: Blue Planet already provides WAN automation as well as NFV orchestration across multiple vendors and domains. This helps CSPs enhance their connectivity services with strategic managed service offerings such as virtual router or virtual firewall services.

With the DevOps kit, a CSP can now easily and quickly customize this service by adding other virtual functions or other vendors, thereby, significantly improving their competitive advantage because they can now more quickly adapt to changing business requirements. Not to mention, with the DevOps kit, they can do so without being slowed by costly and lengthy professional services engagements.

Creating an industry standard platform



to deliver value added services

A Community to Develop, Share and Profit

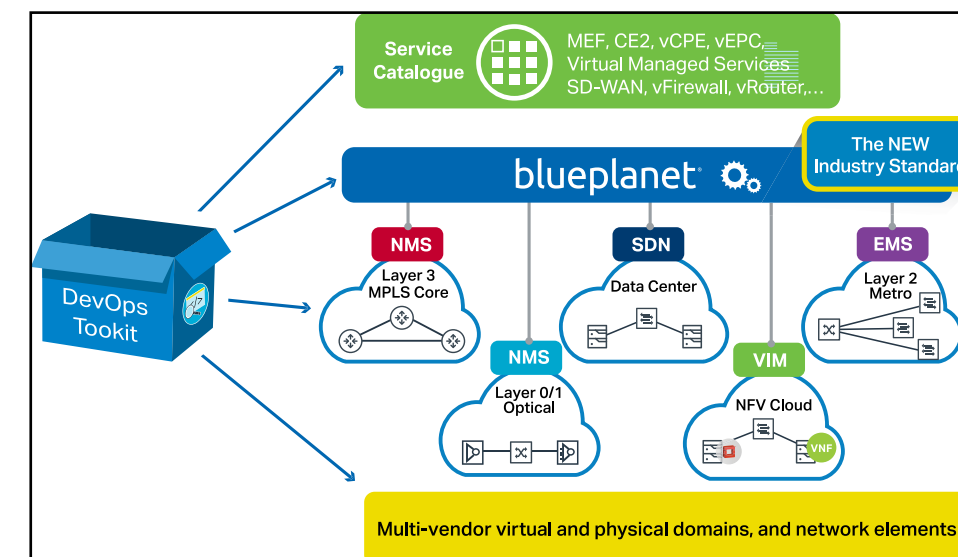
But wait... there's more; as part of the DevOps Tool Kit, we are also announcing an open developer and community portal to bring your ideas to life, share experiences and get support. Customers, users and partners can collaborate, share service templates, troubleshoot and quickly find a solution that will help kickstart their foray into SDN and NFV.

The Blue Planet DevOps Kit work flow

Users can start creating new service templates and resource adapters to talk to new devices in their network or access

and reuse those created by other users. Just as with other open communities, developers submit their work back to the public library. The power of the developer community is sure to turn this platform to the ultimate service orchestration platform, catapulting CSPs to take full advantage of the value that is offered by SDN and NFV.

Dr. Recep Ozdag (@DrOzdog) is senior director in Ciena's Blue Planet division, and is a regular speaker at industry events on the topic of SDN/NFV.



“To be competitive in the digital economy, service providers need to dedicate more budget and resources to service innovation.”

Rhonda Holloway is Head of Product Marketing for the Fujitsu Network Communications Software Business Unit. With over 20 years in high-tech marketing and technical writing, Rhonda has worked with multiple on premise and cloud enterprise systems management solutions including network software, supply chain management, enterprise resource planning, customer relationship management, performance management, and database management in the original cloud—the mainframe. Rhonda is a member of the global marketing leadership team and a key strategist for our software portfolio.

Prior to joining Fujitsu, Rhonda led multiple teams where she managed narrative branding and the customer journey. In addition to her professional roles, Rhonda is a third-generation beekeeper, a computer security enthusiast, and an intense advocate for using technology and equipment to help those with neuromuscular diseases. If you are interested in how one non-profit is guiding this mission, please visit <http://www.teamgleason.org/>.

Virtualization and the New Business as Usual

By Rhonda Holloway
Product Marketing Manager
Software Business Unit
Fujitsu Network Communications, Inc.

Mobile broadband will account for almost 70% of global connections by 2020, while new services will increase data traffic tenfold by 2019.[1] At this rate, most of the world will soon be mobile. The “cloud” has become synonymous with mobility, and is matching customers with new services more and more. More customers are coming, and more services are coming. More, more, more.

To drive this digital revolution, service providers must adopt a new ‘business as usual’ mentality. Unlike the static operating models of the past, a new dynamic network is emerging, but it’s not about the network at all. It’s about the applications that deliver services to subscribers and consumers wherever they are, however they want them. That requires intelligence, extreme flexibility, modularity, and scalability. It means innovative, differentiated services and the kind of customer experiences that create relationships so tight, so integrated, that highly personalized services can be delivered on-demand and billed “automagically.”

To be competitive in the digital economy, service providers need to dedicate more budget and resources to service innovation. Yet today, the lion’s share of any budget is dedicated to the network itself because of the necessities of multilayer, multivendor designs. The network as we know it must be rearchitected: disaggregated, flattened, and virtualized. Applying standard IT virtualization technologies to the service provider network allows network administrators to shed the expense and constraints of single-purpose, hardware-based appliances, and create a unified network fabric that delivers new services to market faster, more profitably.

Rolling out new services over traditional hardware-based network infrastructure used to take months or even years for service providers to achieve. Many time-consuming steps had to be taken: service design, integration, testing and provisioning. Virtualization address-

es these wide-ranging use cases and more.

Software-defined networking, in combination with network functions virtualization, creates a single resource to manage and traverse an abstracted and unified fabric so that application developers and network operators don’t have to worry about network connections; the intelligent network does that for them. Imagine seamlessly connecting applications and delivering new services, automatically, at the will of the end user. Virtualization delivers this new business as usual: best-of-breed components that are intelligent, optimized end-to-end, fully utilized, and much less expensive. Budget previously dedicated to network infrastructure can now be freed up to support new applications and services for whole new categories of customers.

Enterprise customers and communications service providers will get better tools, on-demand provisioning, and tight integration between the carrier network, enterprise network, and cloud builders. Business customers will get on-demand services and always-on mobile connectivity. Some customers will get bundled services; others only high-bandwidth mobile connectivity. Service providers will be able to accommodate diverse use cases like these and differentiate their service offerings beyond bandwidth, SLAs and price points.

Welcome to the new business as usual.

Taking the Next Step in Innovation

By Trey Hall
VP, Marketing
Walker and Associates

Software networking technologies are breaking paradigms, creating opportunities, and causing a lot of sleepless nights for network operators and equipment providers alike. As we meet the challenges of today’s telecommunications industry the only constant is accelerating change. It’s a fun debate to rank software networking’s impact on our industry alongside some of the historical moments such as the 1984 divestiture, the World Wide Web, the dot.com bubble burst, and so forth and regardless of where we rank it -- it’s clear that software networking technologies are driving changes to our industry today. The concepts of network automation and function virtualization carry promises of service agility, optimized network utilization, elimination of vendor lock-in, and reduced capital expense. This treasure trove of benefits has captured the attention of our industry, but only a small portion of service providers have made meaningful progress toward achieving these results.

The adoption rate so far is no mystery to most who are familiar with the state of software networking offerings today. The technology was not ready. But today in 2016 we are realizing the potential of SDN. Commercial suppliers’ offerings are maturing, standards bodies are developing, open source communities are creating carrier-grade platforms and building blocks, and the integrators and value-added channels are reformulating what value add means in this new world.

The elephant in the room that most equipment manufacturers would never want to directly address is that this open technology is eroding traditional forms of leverage incumbent equipment manufacturers held over network operators. Open source projects are eroding traditional areas of value-add. The industry is moving and paradigms are shattering. Change is here, and just in time. Our industry has always realized that these evolutions are necessary. Network bandwidth and agility requirements aren’t slowing down - they are accelerating. To keep up with market demands our networks need to evolve and adapt. With this realization comes some peace about our industry’s future. This technology isn’t going to put us all out of business. It’s going to serve as the platform to

fuel the next big surge of networking advancements. And yes, it will cause us all to evolve, too. Network operations organizations will continue to adopt technology and develop new operational skills. Equipment providers will focus on new forms of added value. Agile development cycles will speed innovation. Open source communities and standards bodies will provide platforms and basic building blocks that fulfill the promise of interoperable networks.

Walker and Associates is no exception to this trend of change. As a value added distributor, Walker has a rare combination of supplier partner breadth and technical depth which has presented the opportunity to solve a significant problem facing our customers: interoperability. Walker has always had a consultative approach to supporting our customers with complex multi-branded solutions in areas such as core routing, optical transport, access networks, and CPE. To support our customers Walker is creating a software networking lab environment that will test, integrate, deploy and maintain virtualized and automated versions of the same hardware versions of networks we sell and support today.

As Walker builds the capability of this lab we are working with our OEM partners to test and package turn-key solutions for specific use cases. But the really exciting aspect of our lab is that we working with our customers to design, test, and deploy solutions that are custom-tailored for each customer’s network. We believe that Walker’s software networking lab can fill a specific need in our current markets. That need is interoperability testing and solution integration. Performing this work once on behalf of over a thousand network operators with whom we do business today just makes common sense. The hardware integration function is not new to Walker, nor are the many valued partners that trust Walker to represent their solutions. Most of the ingredients were in our lap when we started. As we take this journey together we welcome you to contact us to learn more about how we can work together to achieve those benefits that network automation and function virtualization promise.

“This technology isn’t going to put us all out of business. It’s going to serve as the platform to fuel the next big surge of networking advancements.”

Open Access Fiber Network Launches in Virginia

By Jennifer Eaddy
RVBA Communications
Roanoke Valley Broadband Authority

When area business leaders started asking questions about the future economic health of the region, they probably didn't realize the wheels they set in motion. Not quite five years later, the Roanoke Valley Broadband Authority is operating as an open-access, multi-municipality utility across the region. While communities across the country have had to find their own way to cross the digital divide, smaller cities like Roanoke often have the hardest time. In the Roanoke Valley, local business owners were asking for faster, more affordable Internet access but found that without the population density of a larger city nor the federal subsidies available to more rural areas they had to do something unprecedented to ensure continued economic health and stability in Southwest Virginia.

On April 26th, more than 150 area business owners, government officials and community leaders gathered around a podium to see Kevin Boggess, Chairman of the Roanoke Valley Broadband Authority, announce the official launch of the new Roanoke Valley Broadband Authority, a multi-community collaboration designed to increase enterprise access to fiber optic Internet transport service, and help the region attract and retain 21st century businesses.

"A lot of hard work from people throughout our community and the surrounding

regions made the Roanoke Valley Fiber Network a reality," explained Frank Smith, President & CEO of the Roanoke Valley Broadband Authority. "From the officials in the Cities of Salem and Roanoke and the counties of Roanoke and Botetourt, to the business owners who saw a problem and connected to resolve it, to the many economic development research teams and vendor partners who rallied along the way to making this vision a reality, it has been quite the collaboration."

In retrospect, the project began when local business leaders and local government officials with a hunch decided to investigate the issue of high-speed, enterprise quality Internet transport options in the region. They jointly funded independent research to better understand how affordable, secure, high speed and high capacity Internet affects economic prospects, and how the region compared to similar communities across the nation.

Design Nine, a broadband and telecom planning, design, and project management firm out of nearby Blacksburg, Virginia was selected to review the region's current telecommunications systems. They were asked to survey the degree of interest residents and businesses have in broadband services, and to identify what investments will be needed if a decision was made to

improve telecommunications infrastructure to accelerate economic development and enhance job and educational opportunities in the Roanoke Valley.

The results were alarming.

The study revealed that while the world is increasingly relying on online communications, services and retail, demand is only expected to increase... exponentially. Further, many other regions, some very close by, were well ahead of the Roanoke Valley in their plans to acquire 21st century broadband infrastructure. Specifically, the study found that the region:

Lacked Distribution - competitive providers could only afford to build distribution and provide fiber access to the larger customers in the area, leaving wide portions of the Valley limited options for broadband services and virtually no competition

Lacked redundancy - The competitive fiber that existed did not provide a coherent, fully redundant core fiber ring, which is essential for many businesses that might want to relocate to the region. Lacked diversity - Existing providers were relying too heavily on fiber cable exiting the region along Interstate 81.

Did not take advantage of regional effi-

ciencies - by ignoring political boundaries, a collaborative network could take advantage of efficiencies that can't be achieved by an independent provider or just one or two local governments.

Faced significant competition - from an economic development perspective the region was facing significant competition both within Virginia and across the country. Businesses looking to relocate could find cheaper, faster, higher quality and more abundant Internet transport options elsewhere. And the highly skilled, high paying jobs most communities wanted to attract were attached to businesses that had high technology expectations.

Next Steps

After reviewing the report, a decision was taken to form a task force to determine what next steps could and should be taken to address the issues revealed. After 9 months of evaluation and further study the taskforce, made up of both public officials and private citizens, recommended the formation of a regional Broadband Authority whose mission would be to increase affordable access to broadband technologies.

Legal and support staff of the four municipalities (Roanoke County, Botetourt County, City of Roanoke and City of Salem) worked together with the Roanoke Valley-Alleghany Regional Commission throughout 2013 to form the Roanoke Valley Broadband Authority under the provisions of the Virginia Wireless Service Authorities Act, Chapter 54.1 of Title 15.2 of the code of Virginia.

The organization, officially established in December 2013, was chartered to move the project from vision to production under the leadership of 5 board members representing the four municipalities and one citizen at large.

The RVBA was charged with a number of specific initiatives, including:

- Developing a master plan for construction and operation of a high-speed, redundant regional network "ring" to reach schools, industrial parks, large employers and other economic centers,
- Developing cooperative agreements for localities with technical specifications and commercial terms for operating the network and exchanging data across municipal boundaries
- Developing dig once requirements for construction projects, including

the placement of open-access conduit for fiber optic cable

- Communicating broadband related activity to the public

The newly formed Roanoke Valley Broadband issued RFPs for long-term and adaptable "telecommunications equipment suppliers to furnish, install and test a complete set of packet optical network electronics with turnkey services & support."

Walker and Associates in partnership with Ciena technology was hired to deliver the metropolitan network featuring five environmentally conditioned Points of Presence (POPs) connecting 47 initial miles of backbone fiber. The project was to be configured in 5 redundant rings with access to all the critical business centers across the valley.

Having specified the use of Ciena Network Electronics, Walker and Associates began the tasks of installing, testing and turning up all equipment. They documented all network performance metrics and provided a complete inventory of assets as well as trained RVBA employees and designates on the network operating system.

Throughout the installation, the RVBA and the Walker team encountered unique challenges. Tight spaces allotted in the urban and historic areas of downtown Roanoke left very little room for machinery and large incisions in the ground, so innovative solutions like four channel vertical micro-duct conduit and micro-trenching were deployed to provide less invasive and disruptive methods of laying fiber-optic cable.

The four path micro-duct was used for small slot cuts and the standard four path conduit was used elsewhere.. Each path holds 144 strands of fiber optic cable and has the ability to carry 88 channels of data traffic on each fiber. Initially, RVBA is using just one of the four available conduits and plans to leverage the additional paths to expand capacity as the network grows. Each channel is designed to transfer up to 400 gigabits per second (terabit-level) speeds. and each channel on a fiber can carry up to 200 Gbps.

After just nine months of construction, the system went live and the RVBA turned up their first customer, the local Blue Ridge Public Broadcasting Station. "Roanoke Valley Broadband has given us access to 21st Century fiber infrastructure at a reasonable cost which is

critically important to Blue Ridge PBS," James Baum, President and CEO said. "In this day and age, we need this as much as we need streets, bridges and almost any other service or facility. With the new broadband network, it's now possible for us to expand the station's programming and move control of its technical operations to cloud computing saving staff time and the station money." Shortly after Blue Ridge PBS celebrated the system launch, the Western Virginia Water Authority also transitioned to the new network..

"For the first time in my years in IT, a fiber construction engagement happened on time and as promised" David Carter, Chief Technology Officer of Advanced Logic Industries said.

Now, with a full pipeline of prospective new customers, the RVBA's network is connecting businesses, schools, libraries and government offices to the rest of the world via multiple regional access points. This top-tier system and world-class equipment provides security compliant with U.S. Department of Defense regulations and for a cost lower than was previously available in the area. Now more local businesses than ever before have a choice in who provides their Internet service, how much they can procure, and what methods they can leverage to get it into their worksites.

The RVBA currently offers three connection types to businesses across the Roanoke Valley: Dark Fiber, Transport Service and Internet Service scalable up to 200 Gb/s speeds. The RVBA offers open access to the fiber network for all businesses, and looks forward to serving last mile providers that may choose to leverage the network.

"The RVBA Fiber network has created an open and competitive market of Internet service in the Roanoke Valley. Citizens can now reap the benefits of increased competition with trust that our region has the capacity to serve them as their needs evolve," Roanoke City Manager Chris Morrill said.

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Orchestrating Success in a Changing World

By Gina Williams
Strategic Solutions Marketing Manager
ADTRAN

Telecommunications is rapidly changing. Gigabit bandwidth to the home and business, the rapid adoption of OTT video, the Internet of Things, and SDN/NFV are transforming the way operators do business. Software-driven, API-centric architectures will increasingly dominate the services delivery infrastructure, and a superior customer experience remains among the highest priorities for the successful service provider. Orchestration solutions enable the software-driven networks of the future by combining technology with domain knowledge to deliver on the promises of CAPEX and OPEX savings along with a superior customer experience.

Orchestration and Automation

Service providers are very familiar with automation in terms of flow through provisioning, software updates, alarm management and network monitoring. These existing systems suffer from a number of challenges, including proprietary interfaces that are expensive to modify, interoperability issues with other ecosystem components and difficulty adapting to new technologies, services, or processes. Effective orchestration combines structural business and operational components with these independent automated tasks to establish an end-to-end workflow - a higher order automation more closely aligned to the business operation.

Today's Challenges for Service Providers
Operators face a range of ongoing hurdles in service activation and maintenance. Given the manpower intensive nature of today's swivel chair, manual operations, there's always a chance for human error. Add to that the typically lengthy installation times and service delivery intervals, tightly coupled systems that are not easily modified, and all the associated troubleshooting across the operation. Lastly, there remains significant investment needed for training and required visibility associated with effective customer service.

The Value of ADTRAN Orchestration

Orchestration can not only reduce or eliminate the operator difficulties mentioned but also save OPEX and CAPEX while potentially establishing new revenue streams. As noted in Figure 1, orchestration provides instantaneous

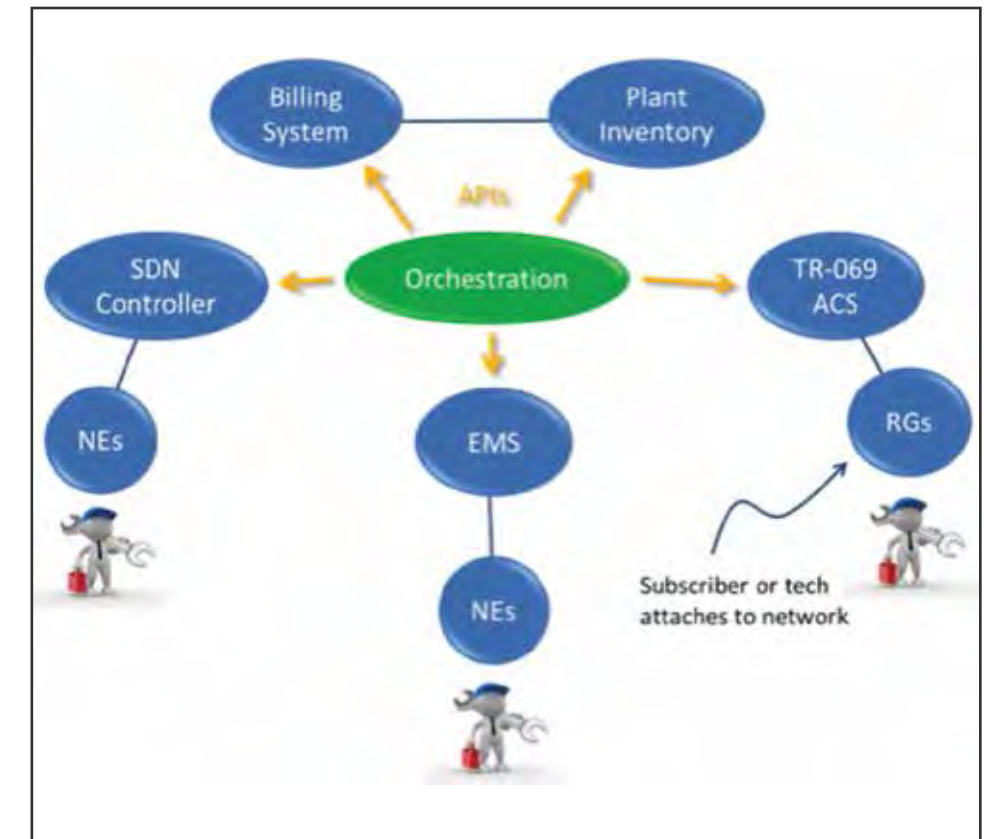


Figure 1: Orchestration and instantaneous service activation for homes and businesses

service activation for homes and businesses, allowing customers to attach to the network and choose their services independently, eliminating the time and coordination required of traditional approaches. Service and inventory accuracy is also assured in activation automation because the network reports how it is provisioned to the OSS and BSS systems.

ADTRAN orchestration and service activation automation offer tremendous value, empowering the operator's value proposition and impressing its customers. Service providers can realize faster time to revenue, substantial back office OPEX savings and OPEX savings at the home or business. Establishment of an "open" automation environment, one that is vendor agnostic and supportive of technology substitution, also greatly reduces or eliminates pre-provisioning tasks. Operators implementing orchestration solutions will see a vast reduction in required network engineers and staff to activate customers while also benefiting from faster installation using

non-technical contractor labor. ADTRAN orchestration solutions represent the next step in the evolution of broadband ecosystems, enabling service providers with greater opportunities for success in emerging programmable and cloud driven telecommunication networks.



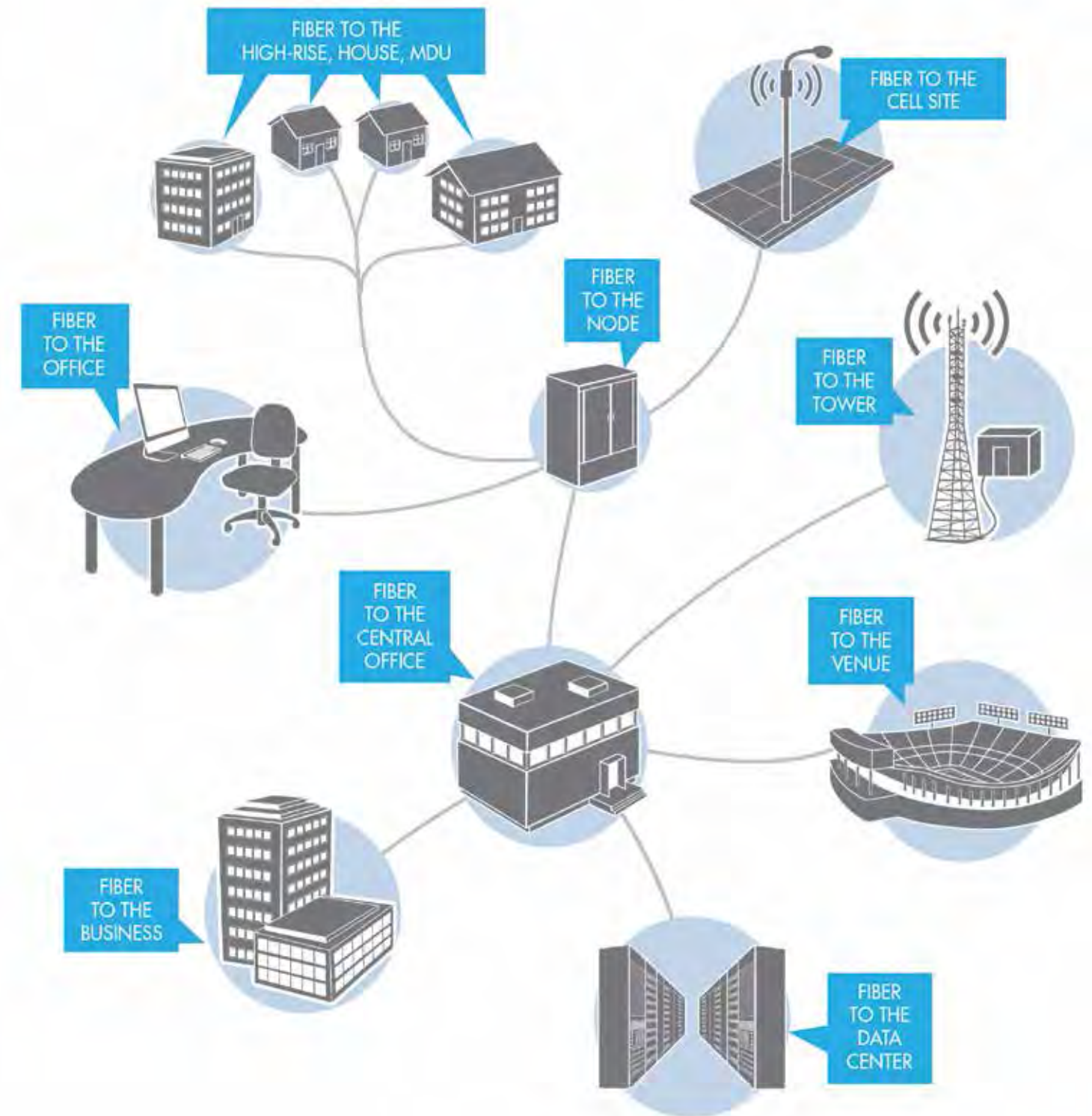
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HOW?

- By changing from a star to a daisy-chain topology for connecting service terminals, and consolidating functionality into the service terminal.
- By using hardened service terminals with hardened multi-fiber connectors, this architecture combines the advantages of a daisy-chain topology with plug-and-play connectivity.



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Available
(Contact Factory)



Site Power Monitoring

Virtualization: The Key to Personalized Service Creation and Delivery

By Virtualization Team
Juniper Networks

As consumers, we relish the ability to get what we want, when we want it. Retailers, manufacturers, and providers of all stripes understand this. They realize the key to a customer's heart—and loyalty—lies in their ability to adapt mass market products for individuals. Compute power and manufacturing advances now make it possible to create this "mass market of one," or at least of thousands.

Want your name on a bottle of Coca Cola? Done. Print a custom message on M&Ms? No problem. Not only is this level of personalization now possible, but a recent study by business consulting firm Bain & Company found that consumers are willing to pay up to 20% more for these customized products.¹

For service providers, the next great battleground for service personalization is in networking. Whether delivering business connectivity (IP VPNs) or consumer connectivity (mobile, cable, DSL), network providers have a massive - and unique - opportunity to transform how people use their product.

Some forward-thinking providers are already harvesting this information to deliver a better product: bandwidth on demand, which adapts automatically to usage; subscriber portals to give users more control at their fingertips; and segmenting and zero-rating traffic to introduce new applications.

A number of issues, however, are preventing full customization, full control, and full adaptability of the network from becoming a reality. Networking professionals often describe their infrastructure as complex or inflexible. As a result, the majority of their energy and resources are spent managing and running the existing network, just keeping everything operational.

Intelligent Automation and Scalability

By adding intelligence to the network, and abstracting the network through software control as well as programmatic interfaces, we at Juniper believe that network providers can begin adding value to the customer experience by creating

unique and differentiated products and services.

Automation is a key component of transforming the network. Done properly, automation overcomes many of the inherent complexities of managing network resources. Abstraction and virtualization change boxes into platforms for connectivity. And back-end systems must be automated in order to give customers control and provide a service portal for accessing and managing their own resources.

With an automated and scalable network, providers can turn their attention to service creation. A combination of deep understanding of traffic patterns and usage, analytics and policy, and an agile, programmable network gives providers the tools they need to truly personalize the network experience.

Change customer expectations
Imagine a small business managing their connectivity. Through a portal, the IT manager can order a new service or add bandwidth to existing services.

With an intelligent, automated network, a service provider can detect a potential security threat and notify the IT manager before there is a problem.

Networks can offer free trials of new applications to drive loyalty and increase spending—for instance, free firewall service for 30 days with the purchase of a new site.

With deep data insight, the network provider's sales and marketing teams can craft new plans designed to meet the needs of their customers. Partnering with Software-as-a-Service (SaaS) or Platform-as-a-Service (PaaS) providers offers one-stop-shopping for all of the IT manager's needs.

For service providers with mobile access, it's possible to combine policies across devices and access networks. Employees at their desks, accessing services via Wi-Fi and laptops, can be correlated to smartphones over LTE to provide consistent



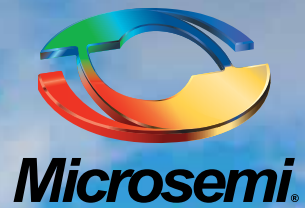
access to cloud or data services with a common security and policy framework.

Virtualization: Creating New Customer Value

Intelligent networking is not new, and combining intelligence with analytics provides a deeper insight into utilization. However, the lynchpin for service creation is network virtualization. New technologies such as NFV and SDN enable a programmatic approach to automation and scale. Changes to the network can happen in seconds and minutes, rather than days and weeks.

This is a network that knows how to create value.

"... network providers have a massive - and unique - opportunity to transform how people use their product."



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In A Virtual Network World, Policy Matters

By: Steven K. Berry
President & CEO
CCA

Today's consumers depend on reliable mobile broadband services not only to connect socially, but also for critical health, educational, public safety, and economic needs. While there is no question that everything is moving towards virtualized networks to keep up with ever-increasing consumer demand, we must keep in mind that sound physical infrastructure and backhaul services must be in place before network virtualization can be achieved.

Wireless carriers desperately want to give consumers what they want and need, which will soon include access to "5G" capabilities. Moving to the next generation of technology means significant network upgrades and densification, and as carriers continue to buildout 4G and start to move to 5G, it is more important than ever to have sound, consistent infrastructure policies in place to ensure carriers can achieve this important goal.

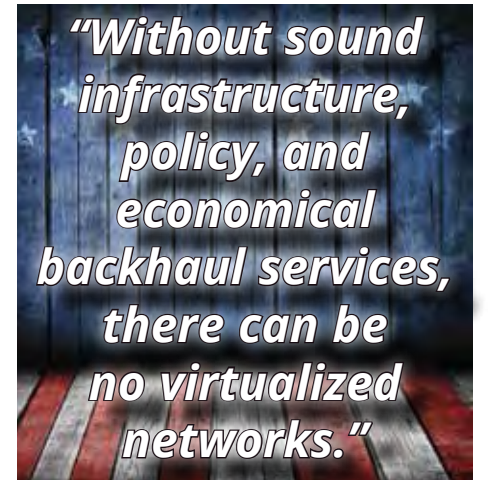
Competitive Carriers Association (CCA) members are ready to provide their customers, including those in unserved and underserved areas, with access to the most robust wireless services, yet many competitive carriers have experienced challenges or delays when attempting to deploy, upgrade, provision, or expand their networks. Regarding infrastructure policy, CCA members have encountered lost or missing tower siting applications, unreasonable delays without a determination for approval or denial, inconsistent or undisclosed rules across agencies or even within the same agency, and redundant reviews causing unnecessary delays. Additionally, some carriers' initial tower site locations have been rejected, only to have them be determined months, or even years, later as the most reasonable location for that tower facility. With such a frustrating list of challenges, it is easy to see why carriers may not make progress on network deployments and upgrades. Policymakers must take action to help speed deployment by harmonizing and streamlining infrastructure processes.

CCA has been supportive of Federal Communications Commission (FCC or Commission) and congressional efforts to solve infrastructure challenges and continues to encourage policymakers to move forward to find solutions.

Implementing shot clocks for applications on federal lands, standardizing and simplifying the application process, establishing a responsive point of contact, and streamlining historical and environmental reviews are a few steps that can be taken to ease broadband deployment challenges and bring consumers the access they need and desire. Ensuring sound infrastructure deployment policies is one of CCA's highest advocacy priorities, and CCA continues to take these messages to Congress, the FCC and the White House at every opportunity.

In addition to addressing tower siting challenges, policymakers also must focus on ensuring carriers have access to backhaul – another important component of establishing sound physical connections. In recent months, the FCC proposed modernizing and reforming the business data services (BDS) market, also known as the special access market. Competitive carriers depend on BDS for backhaul, and the demand for backhaul has only increased as consumers' demand for mobile data has surged. To meet consumers' calls for more, carriers are prepping to densify their networks in order to move to 5G technology. For the benefit of all consumers, including those in rural areas, competitive carriers must have access to business data services on reasonable terms and conditions. For far too long, incumbent local exchange carriers (LECs) have been able to charge exorbitant rates, taking advantage of other carriers that have no choice but to purchase business data services from the incumbent LECs, often their biggest competition in their market, to achieve connectivity. Incumbent LECs should not be permitted to continue this anticompetitive practice which greatly harms the marketplace and, more importantly, consumers who will continue to pay unnecessarily high rates, if not cured. Policymakers must not underestimate the importance of ensuring competitive carriers have access to necessary backhaul resources. With 5G deployments right around the corner, now is the time to act on this long-standing BDS proceeding.

In this day and age when consumer demand for mobile broadband services is at an all-time high and growing, both



policymakers and industry participants must look at every opportunity to ease strain on networks and provide consumers with the connectivity they need and deserve. With virtualized networks already a reality or on the horizon for many carriers, it is absolutely essential to establish sound infrastructure policies and reasonable access to backhaul resources first. We must have robust connectivity in place to implement virtualized networks and get to the next generation of technologies that consumers so desperately want.



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.

NETWORK ORCHESTRATION SIMPLIFIED

The future network will be rooted in SDN and NFV, creating a more open, programmable and scalable network than ever before. Service providers are searching for ways to transition from today's hardware-centric architectures to an open framework of cloud-based software applications. ADTRAN has not only embraced this transition, but is at the forefront of this movement.

To learn more, visit adtran.com/sdn-nfv

Fiber Indexing: A Cost-Optimized Approach to FTTH Networks

The Economics of Fiber

Over a decade has passed since the first FTTH network deployments, yet the cost of building a network remains the primary obstacle to ubiquitous fiber connectivity for every household. Consumers can buy bigger TV screens with more pixels, smarter smartphones, lighter and more powerful laptops - with prices falling year after year. Fiber optic networks have not followed the same cost trajectory: from 2005 to 2015, the cost per home passed dropped from \$1,021 to just under \$700 [1]. Why does Moore's Law apply to transistor density and disk storage capacity, but not to FTTH?

Building an outside plant fiber network is a labor intensive undertaking. Construction, civil works engineering, obtaining permits and right-of-ways account for roughly two-thirds (67%) of the total cost, while the equipment accounts for one-third. While GPON and fiber equipment costs have indeed fallen, skilled labor rates have risen. Any attempt to take costs out of the network needs to look closely at reducing labor costs.

Fiber Indexing: Simplifying The FTTH Network Architecture

Fiber indexing has the potential to reduce construction and civil works costs in the distribution network by 70% - and in the process, significantly reduce deployment times and speed up time-to-market. Table 1 compares Fiber Indexing with today's typical deployment model in a suburban network (see figure 1). One key savings lies in the length of cable needed, made possible by changing the network topology and consolidating the functions of multiple network elements into the service terminal.

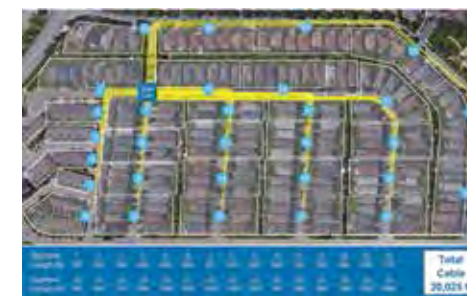


Figure 1A: Typical fiber distribution network today for a hub serving 240 homes. Individual cables are laid from the hub to each terminal (blue circles) in a star topology. Each terminal services up to 8 homes

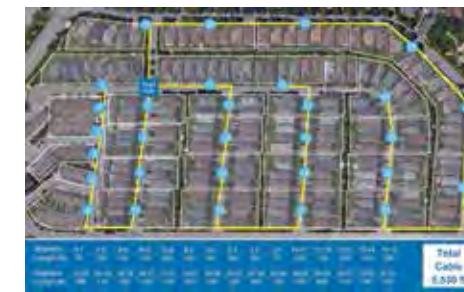


Figure 1B: Fiber Indexing uses a linear daisy-chain topology, with terminals that perform multiple functions

How Indexing Works

Fiber indexing is a novel approach that uses connectorized cables and terminals, and allows installers to use a cookie-cutter approach to build out the network. The exact same components are "daisy-chained" together, limiting the need for custom cable assemblies or splicing. The basic building block, which is repeated throughout the service area, includes a terminal, with a built-in splitter, hardened 12-fiber inputs and outputs, and 8 hardened drops to the homes.

The indexing begins with a 12-fiber cable entering the first terminal. In the terminal, fiber 1 is routed to a splitter for servicing local customers and the remaining fibers are "indexed" or moved up as they exit the terminal to connect to the next terminal. Indexing means that the second fiber entering the terminal will exit as the first fiber to enter the next terminal, and so on in a daisy-chained fashion.

The terminal uses Rapid Fiber cable spool technology to eliminate the need to store excess fiber. This technology allows any amount of fiber cable to be pulled from the spool back to the previous terminal without the need to cut specific lengths. All the remaining cable is simply left on the spool, allowing fast and easy daisy-chaining of the indexing terminals.

Traditional cascaded architectures require different terminals with different fiber lengths that require complex planning, whereas fiber indexing uses a single configuration throughout the network.

There are several variations of this architecture, so it meets the requirements of many deployment scenarios. By using

the same components over and over throughout the network, along with less overall fiber, the network can be installed faster and with lower overall installation costs.

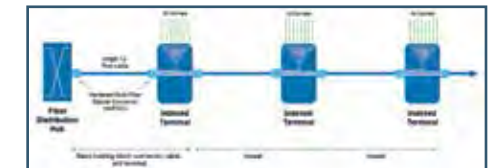


Figure 5: Fiber Indexing architecture (daisy-chained)

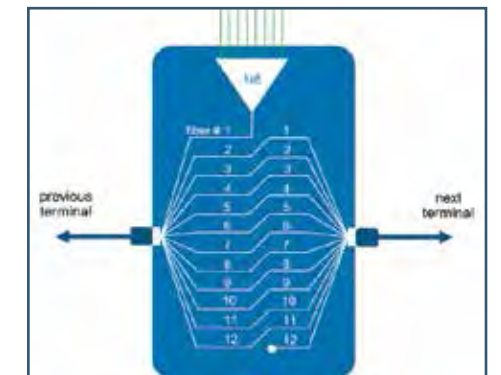


Figure 6: Fiber Indexing terminals all have the same configuration, which speeds up installation

Conclusion

CommScope has comprehensive and in-depth experience in designing, implementing, and maintaining fiber and FTTH networks around the world. The FTTH Architecture Series is a complete set of white papers that explore the key issues and decision criteria for building best-in-class FTTH networks. For more information, please visit www.commscope.com.

Note

1. Data from Verizon FIOS Briefing Session, September 27, 2006 and news reports.

SDN Use Cases for OpenFlow

By Pete Moyer
Principal Solutions Architect
Brocade

The OpenFlow control protocol emerged 6+ years ago from the networking research and academia community; most importantly from Stanford University. The goal of OpenFlow was somewhat simple at the time; to provide a common, standardized and open control protocol that would facilitate the separation of the control plane from the data plane in networking devices, such as switches and routers.

The general thinking at that time was that this separation would accomplish several things; one being that the data plane of networking devices would become very simple since the control plane functionality is removed from the device and moved to an external higher layer device. This external device is now generally called a SDN controller. If the networking device only needs to support the primitives of a single control protocol, the hardware of this device should become greatly simplified. All other control protocols would reside in software only, in the SDN controller. This in effect centralizes the control plane of the network into a logically centralized SDN controller. It is important to note that this does not create a single point of failure, as the SDN controller is actually a cluster of servers.

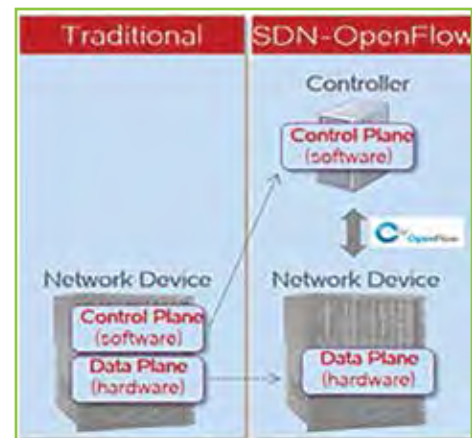


Figure 1: Separation of Control Plane from Data Plane

The networking industry has converged on the OpenFlow v1.3 specification; and this is what is currently deployed in the market place. However, the specification for OpenFlow is now at v1.5+. The Open Networking Foundation (ONF) is the standards body that controls the OpenFlow

protocol specifications. It is expected that v1.6 will be published sometime in 2016.

There continues to be many use cases that are possible with the innovative functionality that is provided by OpenFlow. And use cases matter! Some of these use cases are deployed and well known, such as the Google SDN Inter-DC backbone, while many other use cases are either not well known or not yet deployed.

There appears to be some uncertainty within the networking industry about when OpenFlow will become widely deployed. It's a fair question to ask since the technology has now been available for ~6 years and there are only a limited number of publicly referenceable OpenFlow deployments. However, I believe some of this uncertainty, or misconception, stems from the blending and blurring of the OpenFlow-enabled use cases.

I would like to classify OpenFlow-enabled use cases into two general categories: a network transport category and a network service category. These two categories are quite distinct from one another and they solve completely different problems.

Using OpenFlow to Build Network Transport

The original intent of OpenFlow, as many in the industry continue to perceive, was to provide network transport; in other words, create the connectivity in the network infrastructure. Basically, deploy a network of simple OpenFlow switches that provides the network connectivity between the end hosts, similar to how IP or MPLS routers operate today. The key difference in this paradigm is that the control plane intelligence and associated protocols are not embedded into the network devices themselves, as they are with IP or MPLS routers; this functionality resides in the external SDN controller. This SDN controller is assumed to be logically centralized to avoid a single point of failure. An application on the controller determines how to construct the network and informs the controller of this; the controller then uses OpenFlow to program the network paths into the OpenFlow switches. The result of this operation is that OpenFlow

actually builds the forwarding tables in each device.

Using OpenFlow to Provide Network (Value Added) Services

There are many other innovative use cases that are enabled by OpenFlow. Some of these use cases solve specific networking or operational problems, while other use cases provide value-added services. Using OpenFlow to provide a value-added service is quite distinct from using OpenFlow to build network transport infrastructure.

There is rapidly increasing industry traction and practical deployments of using OpenFlow for providing value-added services than there is for using OpenFlow to actually build the network transport. OpenFlow solves real network and operational problems and there are many relevant use cases to demonstrate this.

Before describing the high-level architecture of these types of use cases, here is a list of some of the more popular use cases that are being deployed.

- Volumetric Traffic Management for DDoS Mitigation
- Elephant Flow Management
- Edge Based Policy for QoS Enforcement
- Flow-based Mirroring

Those are just a few of the use cases that OpenFlow provides. A key point to emphasize in these types of network services deployments is that OpenFlow is used in the network alongside the traditional control and management plane protocols. In the network transport category, OpenFlow is used in the network infrastructure but the other control protocols are embedded into the SDN controller and no longer run in the network devices themselves. In the network services category, OpenFlow is added to the network devices as an additional control protocol; the other control and management protocols continue to run in the network devices as they similarly do with traditional IP and MPLS networks. This is an evolutionary approach to deploying OpenFlow; in other words, OpenFlow can be deployed incrementally. This is a key advantage when using OpenFlow in these types of use cases.

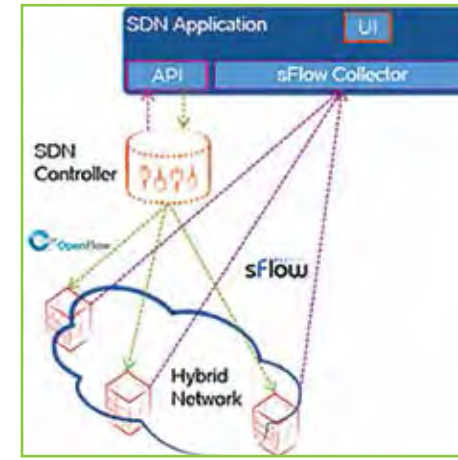


Figure 2: SDN/OpenFlow Network Services Use Case Architecture

Some of these use cases require that sFlow or some other packet sampling mechanism is deployed to provide the requisite network flow visibility. The SDN application in these use cases often requires real-time network flow visibility in order to determine when to take an

action. Once a sFlow sampled traffic flow matches the criteria that is defined in the SDN application policy, then the specified OpenFlow action is taken. This action is taken by sending OpenFlow rules into the hybrid routers. A hybrid router is often the term used to identify routers that support traditional networking protocols plus OpenFlow.

As an example, assume an operator wants to enforce QoS policies on its edge ingress ports. This use case would use OpenFlow to "meter" (eg. rate-limit) flows on the ingress edge interfaces while also possibly modifying the IP DSCP bits of those flows.

Another example would be that upon an sFlow match of a DDoS policy, the OpenFlow action that is programmed into the router is a simple "discard" action for that flow. This provides an L3/L4 volumetric DDoS attack mitigation service.

Another example use case is for per-flow mirroring. For example, an operator may desire to mirror a specific application

flow to an analytics device for further inspection. This solution will use a "mirror" action to copy the flow from the router to an offline device while not interrupting the normal forwarding of the flow through the router.

These are just a few example use cases where OpenFlow-based SDN is used to provide a real value-added service. These solutions solve real operational problems; they are not theoretical nor academic use cases. Again, use cases matter! In summary, this brief article describes some innovative SDN use cases for OpenFlow. As described briefly here, OpenFlow solves real operational problems and these types of solutions are deployed today. As OpenFlow continues to evolve over time, many additional use cases will emerge that leverage the unique capabilities that OpenFlow provides.

Timing Matters

By Paul Skoog
Senior Product Manager
Microsemi

"Free" time from the internet for our corporate networks: it doesn't get any better, right? Well, not so fast. Truly secure, accurate and reliable time synchronization comes from time servers under your control and inside your network. Certainly we can appreciate synchronizing our trusted and highly protected corporate networks to easy to find, publically available, NTP server IP addresses. But perhaps you didn't know that these "free" NTP servers are also among the most common Distributed Denial of Service (DDoS) targets on the internet. Factor in possible accuracy and reliability issues and suddenly the high price of "free" time is clear.

It's no surprise internet NTP servers are so vulnerable. NTP is User Datagram Protocol (UDP), easy to spoof for a reflection attack, and has a one of the highest bandwidth amplification factors of any protocol, making it a favorite target for DDoS attacks.

So it's worth pausing to consider how

important accurate and reliable time is on your network. If log file accuracy doesn't come instantly to mind, it should, as well as multiple other vital roles that accurate time plays in network and business operations.

Synchronizing to time servers on the internet is a risky practice, comparable to trying to convince someone of the benefit of robust passwords. You often need to experience the downside to appreciate proactively getting in front of a very troublesome problem, in this case, the wrong time.

Wrong time from internet time servers can occur in two ways; one is a time server that provides the wrong time, which is not uncommon and sometimes deliberate. The other is no access to the correct time, in which case the wrong time results from your own server clocks naturally drifting at different rates and times. Making matters worse, the virtual clocks in today's cloud infrastructure are particularly susceptible to falling behind

in time if there are no frequent updates to the correct time.

The solution to all of these timing woes is simple: bring the NTP time server inside your firewall, under your control, with monitoring in case of any unexpected change in activity.

Today's modern enterprise time server has many security aspects that harden both access to the time, as well as the management interfaces. These modern time servers have migrated timekeeping to more hardware-based operations, eliminating many of the software vulnerabilities and providing incredible time stamp accuracy.

Ultimately, it's time server reliability that really matters and is often taken for granted. We expect network time services to be accurate, readily available and flag us when things may be amiss. And then, we want to forget we own them. So ask yourself, is "free" time for your network really worth the risk?

Navigating the Mid-Career Crisis

By Brenda Abdilla
Founder, CEO
Management Momentum



Okay, so maybe it is not a crisis...but it's no picnic, either. On one hand, you feel you should be grateful for your income, the hard-earned respect you've gained in your field, and a job that many people would feel extremely lucky to have; on the other hand, the meaning has gone out of it for you (or was never there), and success has taken its toll. The thought of another ten or twenty years sounds pretty awful.

Welcome to the Mid-Career Crisis.

MINDSET BEFORE ACTION

My all-time favorite quote is by Swiss psychiatrist Carl Jung: "Until you make the unconscious conscious, it will direct your life and you will call it fate." If you are in a career funk, you have some mental work to do before you put yourself out there—especially if you want to make a great choice and not give up most of your income (see The 5 forbidden actions sidebar). At first it might feel like you have no choices except for in the extreme sense which is to either quit your job or stay unhappily where you are. You don't want to be unhappy at work, but your mind is telling you to "gut it out." Meanwhile, your heart is telling you that you deserve to find happiness and meaning in your career, and that you can have a life of more than just work, sleep and an annual vacation.

It's important to understand that our current business culture worships action. The message we all receive is that if you want to change something, then spring into action and make the change happen. That thinking can be a mistake for a person in a high-level career; making an impulsive leap without first looking can increase the chances of having to do it all over again in a year or two. As uncomfortable as it may sometimes be to delay action, it is critical to a positive, long lasting outcome. Plus, the world is more complicated than it was when you started your career. There are complexities in the market and in your own career history that deserve some thought and reflection and later on, research. Grab a legal pad and prepare to do some writing as you take the following steps:

Make a list of what you really want at this age and stage.

This exercise is easier said than done because of our own negative mental

chatter, or what prolific author Dr. Gay Hendricks calls "back talk." Let's say the first thing on the list is: To wake up feeling excited about my work. Great! Commendable. But the back talk in our head says, "You still have kids in school. You can't afford to screw this up." The strategy for dealing with the voice in our heads is to just continue anyway - in spite of the voice. List at least 10 things you WANT in your life and work. Imagine that by some twist of fate you are able to have the exact life and work you want. And don't forget to include how much income you want. Taking a pay cut is not a requirement for increased career satisfaction.

Settle into this unsettled phase of life.

The sooner you settle into this phase of uncertainty, the sooner you will have clarity and direction. Mary LoVerde, author of the book *The Invitation: When You're Ready to Take Your Next Step*, encourages her readers to "embrace ambiguity" as part of the process of creating a new life. Ambiguity is painful. We don't want to be unsettled. But leaning into it and accepting that it is temporary will be most helpful.

Deal with your baggage.

Yes, you have career-related baggage, and yes, it shows. Your baggage could have come from a wide range of circumstances such as a layoff, a missed promotion, a 10-year stint of near constant mergers and acquisitions, or a new boss who is (fill in the blank: crazy, neu-

The 5 Forbidden Actions

These actions are forbidden because they can actually work strongly against you until you have done the mindset work (getting your head on straight) which should be led by what you want particularly at this age and stage of life. As tempting as it is to do exactly these five things—you will be in a stronger place once you deal with your head trash and figure out what you really want.

- 1 Quitting your job abruptly
- 2 Sending out your resume
- 3 Trolling the internet to "see what's out there"
- 4 Talking to recruiters
- 5 Activating your network

rotic, evil, lazy, incompetent, political, self-serving, narcissistic, overwhelmed, racist, or sexist). During my six years as a recruiter, my job was to uncover this hidden element in candidates. I called it "professional trauma" and it's real. It will follow you to your interviews and your next step in life unless you deal with it. Give yourself the gift of some time with a coach, therapist, counselor or spiritual advisor to work through your professional grievances.

Assess your situation.

Once you have done the mental work, you will be capable of a more accurate perspective in assessing your individual situation. To see how far off you really are from your "I want" list, go back to the first assignment and give it a rating on a scale from 1-10, where 1 equates to your life is a total disaster, and 10 equates to all your dreams have come true. Where are you currently? Draw it out on a piece of paper and then answer these questions: What's working about your current circumstance? What are you most proud of (list at least five things for every 20 years of career)? Finally, what attitude or thought process (not action) do you need in order to close that gap between where you are and where you want to be?

Don't throw away your past.

In my experience, the best, most gratifying career changes somehow utilize or re-use your history and valued experi-

ence. A combination of burnout and stress plus Hollywood movies can cause us to have fantasies of extreme change (e.g., the powerful trial attorney gives it all up to open a flower shop and then finds the love of her life; or the burned-out couple moves to the jungle to do monkey research and then lives happily ever after). But extreme change is not always necessary. The healthier you become mentally, the more resourceful you will become in your thinking about yourself and your future.

One example is a client who was so unhappy in his high-level career that he was actually getting physically sick. His doctor told him he needed to reduce his stress or he could suffer dire consequences. Something clicked in his head and he agreed to make some small changes that had a big impact. He began to take his un-used vacation time and proposed to his boss that he work from home two days a week—and to his shock, his boss easily said yes. He stopped responding to every email he was cc'd on and simply stopped attending meetings that were not directly necessary for his role. No one seemed to notice. He also allowed himself to explore all kinds of career change in the process. He considered going to law school, writing a book, becoming a speaker. He also took up fly-fishing - a lifelong wish - and spent more time puttering. To my utter surprise, he stayed at his current company and has even been

promoted. He is a different person. Years later he is still happy and amazed at how unhappy he had to become before making some basic but life-changing tweaks.

There are at least five solid options for change where you could be happier and more satisfied, and live a life of more meaning - *without an extreme or impulsive leap*. The key is to find your five.

Give it time.

Give yourself six months to a year to explore and consider ideas and options. It's a process. Your key guidepost in all of this is what you WANT. From that want list you can explore myriad options such as having your own company, buying a franchise, consulting, developing your thought leadership, working in the same industry but a different company or culture, going back to school or gaining some additional certifications (e.g., Project Management Certification), or putting together a plan for a big promotion. Yes, it will feel like a roller coaster at times, but all you can do is hang on and enjoy the ride. You have earned some time for reflection and deep consideration.

"You don't have to swing hard to hit a home run. If you got the timing, it'll go." Yogi Berra

Walker and Associates Awarded Multi-year U.S. Navy Equipment Supply Contract

By Randy Turner
Director, Marketing Communications
Walker and Associates

Walker and Associates, an Information Communications Technology (ICT) supplier, headquartered in Welcome, NC, has been awarded a multiyear equipment contract. The U.S. Navy has awarded 21 companies positions on a potential five-year, \$750 million contract to provide command-and-control systems and related support services to the Department of the Navy.

The Space and Naval Warfare Systems Center Atlantic in Charleston, South Carolina, awarded the indefinite-delivery/indefinite-quantity contract through a competitive procurement process. The multiple-award, firm-fixed-price contract contains a base term of one year and four option years and covers the

provision of imagery and video systems, intercom equipment, intelligence support tools as well as tactical workstations, processors and displays, among other C2 equipment.

Walker's VP of Government, RBOC and International sales Jane Brightwell, states "Walker and Associates is delighted to be chosen as part of SPAWAR Atlantic's C2 Multiple Acquisition Contract (MAC) award. We have enjoyed a successful history of specialty contracts and look forward to expanding our relationship to meet SPAWAR's continuing mission. Our broad product selection, range of manufacturer relationships, and carrier grade distribution services will enable Walker to be a valuable partner in SPAWAR's

procurement process." The work to be performed provides for the procurement of commercial-off-the-shelf, Command and Control (C2) equipment and related support services primarily for the Department of the Navy; although nominal support of other Department of Defense and civilian federal agencies will be accomplished as the mission allows. C2 equipment consists of items such as video systems, imagery systems, global positioning system equipment, intelligence support systems, intercom systems, tactical displays, tactical processors, tactical workstations, etc. Work will be worldwide, and is expected to be completed by June 2017. If all options are exercised, work could continue until June 2021.

Testing and Monitoring in a Virtualized Network

By Christian Illmer
Marketing Director of Virtual Test Solutions
Viavi

Introduction

SDN (Software Defined Networks) and NFV (Network Function Virtualization) are about to change the way operators and service providers will be offering network services. Moving away from a hardware-centric proprietary network infrastructure towards a standardize, SW based model that is built on standard x86 compute platforms, will revolutionize the way networks will be designed, implemented and operated.

But as they deploy NFV, service providers are facing a new set of challenges in assuring, monitoring, managing and testing virtual services. It becomes clear that not only the core networking functions itself will be virtualized – testing, monitoring and service assurance will have to be virtualized as well. Those traditional assurance solutions and processes must transition from a static, slow and reactive model to a much more dynamic approach allowing for proactive monitoring, real-time intelligence and analytics. This has to be tightly coupled with orchestration and policy systems. In addition multiple services and applications including Ethernet/IP, video and mobile have to be addressed.

Benefits of NFV for Network Testing & Monitoring

Reaction time
NFV, by its definition, dictates a migration from rather static service offerings and deployment models to a dynamic environment in which services can be provisioned by a mouse click and immediately activated.

Applying the same NFV techniques to network test and service assurance enables network operators to test on demand or as integrated part of the service roll-out. Instead of waiting to dispatch a technician with specialized equipment, automated service activation or network performance and troubleshooting tests are automatically executed once required.

Migration to Software-Based Agents

Migration to software-based agents is key to achieving goals of speed and scale in NFV networks as discussed above. As physical network functions get virtualized as software it is the obvious choice to vir-



Figure 1: Potential setup or virtual test and PM functions

tualize test and performance monitoring as well. Software agents running on the same compute platform provide visibility and can be deployed on demand or as part of complex service chains.

Compatibility of software-based agents with field instruments, microprobes and other existing physical network elements and devices is critical for operators that need to span both their virtual and legacy physical networks. Legacy technology will not disappear for some years and, therefore, assurance solutions and processes must deliver an approach supporting both virtualized and non-virtualized environments, enabling a transition from today's networks to future software-defined, orchestrated virtual networks. Such hybrid networks are expected to be the norm for nearly all network operators for the foreseeable future.

Cost

Historically monitoring and network test systems required their own proprietary HW platform. Those platforms were custom built and did not really scale well with network traffic growth. Software-based agents and new data collection methodologies enable operators to re-use compute platforms which they are deploying anyhow to host virtual network functions. No additional hardware is required and testing scales-out as the network grows. This also allows operators to dramatically increase the number of network test points – giving them dramatically increased network visibility at an acceptable cost

Openness

Openness is central to NFV (and SDN) as network operators look to integrate network equipment from multiple suppliers and coordinate and deliver services across multiple layers of the OSI stack. Open architecture and interface support is critical to testing and monitoring of NFV networks as well. The IETF is standard-

izing virtual test and PM in broadband networks as part of the LMAP-Standard (RFC 7594). Open interfaces at multiple levels allow network operators to integrate assurance-solution components into various systems, and open APIs are required at the collection, mediation and reporting layers, among others.

Conclusions

There is no question that SDN and NFV will radically transform how telecom networks are built and operated and how communications services are delivered. By leveraging high-volume standard servers and IT virtualization NFV enables use of a single physical platform for different applications. As NFV moves from lab to real field trials the spotlight will increasingly be on how to actually monitor and test those new virtual applications.

Applying the advantages of SDN/NFV to the area of test, monitoring and service assurance will provide the following benefits:

- integration of test and service assurance methods into the service definition allows for automated testing once a new service is deployed
- dynamic or static deployment of SW based virtual test and PM agents/ virtual taps enable
 - > elimination of costly service technician dispatches
 - > immediate and fast troubleshooting from a central location
 - > reduction of costly test and monitoring tools
 - > measurement of network and application performance
 - > migration from re-active to proactive network assurance
 - > building a self-healing network infrastructure
- comprehensive data analytics tools leveraging the virtual test and monitoring data enable sophisticated new service and revenue models

Virtual test, diagnostic and service assurance functions will be necessary and critical capabilities. These capabilities enable dynamic assurance and troubleshooting functions spanning both virtualized and non-virtualized networks

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In the Spotlight

By Randy Turner
Director, Marketing Communications
Walker and Associates



Paul Shreve has joined Walker and Associates as the Director of Technology. Prior to joining Walker and Associates Paul's 30+ year career in technology spanned the Internet revolution. His career includes seventeen years at Cisco Systems beginning in 1994 as a technical consultant for Europe, Middle East and Africa. There he was responsible for designing, certifying and implementing network solutions for large enterprise customers including financial institutions and telecommunication companies. During the last half of his career he was the Industry Solutions Manager for US and European defense agencies as well as Eurocontrol Air Traffic Control Architectures in EMEA. Before joining Cisco he spent nine years with Advanced Computer Communications (ACC) in Santa Barbara, California. As Principle Systems Engineer he managed projects ranging from Ethernet, IP and IBM gateways, to satellite communications. At ACC Systems he was also Director of Marketing for corporate communications.

Paul is also a member of the University of Texas Engineering Advisory Board since 2000.

Primarily, Paul will guide Walker's technology strategy through:

- Partner portfolio management
- Qualification of potential partners
- Digestion of current partners' evolving offerings into product positioning strategies
- Identification of strategic gaps in current portfolio
- Construction of solution packages for top applications
- Building of sales enablement tools focused on top technologies, applications, and markets
- Maintenance of technical demand trends from sales, customers, and partners

Paul may be contacted by phone at 336.731.5330, or by email at paul.shreve@walkerfirst.com.



Bob Wright has joined Walker and Associates, working as sales agent on the company's Federal team, managing Colorado and other named territories. A key area of his focus will be the Colorado Springs/Denver area which some say is the DC of the West in concentration of DOD and Federal agencies.

Bob is retired Air Force Colonel with years of Telecommunications and IT experience. Most recently he was Commander, Space Innovation & Development Center (Colorado Springs, CO) 2007 - 2010. Other active duty assignments were Vice Commander, 14AF and Joint Space Operations Center, LOMPOC, CA 2005-2007, and Space, Missile and Terrestrial Communications Manager, Space & Missile Systems Center, Pentagon, HQ USCENTCOM, Saudi Arabia, HQ AF Space Command, HQ STRATCOM, Vandenberg AFB, Manager 1981-2005. After retiring in 2010, Bob was Senior Vice President & General Manager for Integral Systems, Inc and Kratos Deense & Security Solutions, Colorado Springs.

He is a graduate of the United States Air Force Academy with a Bachelor of Science degree. Masters of Science from University of Southern California. Graduate DoD Executive Leadership Development Program, George Washington University Telecommunications Classes as well as other distinguished academic accomplishments. Currently Bob serves as the President of the Rocky Mountain AFCEA Chapter, Chairman of the Board, American Heart Association, Southern Colorado Division, Board Member, Peterson AFB Air & Space Museum Foundations.

He, his wife and two daughters live in Colorado Springs. He may be reached by phone at 719-216-4530, or by email at bob.wright@walkerfirst.com



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Fear of NFV Failing

By Prayson Pate
CTO, Ensemble Division
ADVA Optical Networking

With network functions virtualization (NFV), service providers gain new revenue opportunities with dynamic service delivery. NFV also provides cost savings through automation and openness, and it delivers unprecedented agility and flexibility. No other new technology today promises such positive concrete change for network operators.

So why are most providers still waiting at starting line, afraid to deploy network virtualization?

It's the fear of failing. Telecom service providers are conditioned to innovate only as a major generational jump every several years. Up to now, change required massive upfront investments of time and money (usually paid to one supplier) and operators were right to move with extreme caution.

NFV decouples software from hardware and that changes everything for service providers. They can now purchase interoperable system components, both hardware and software, from multiple suppliers. NFV brings new pay-as-we-go pricing models that create partnering-for-growth relationships with multiple suppliers. This puts the service provider in supreme control of the partnerships, a reversal from the past when the supplier was sometimes in a position to call the

shots. Network innovation can now be an ongoing and opportunistic process.

It's frustrating that all of these potential benefits are still not enough to start broad NFV deployment. Let's look at a couple NFV pioneers who are showing the industry how NFV gets done.

Masergy CTO, Tim Naramore, says his global managed services company is growing fast by solving customer problems better. Masergy's pure-play NFV-fueled Managed Network f(n) is doing just that by allowing customers to tap into a virtual store for immediate access to the services they want, when they want them. Customers love this dynamic service offering, and they love working with Masergy.

Being small and agile can make innovation easier but massive scale doesn't hinder AT&T's NFV efforts.

AT&T's chief technology officer Krish Prabhu says his team is adopting NFV out of necessity. Network traffic at AT&T is exploding, driven by demand from mobility, smartphones and video. Network virtualization is necessary to support massive traffic growth and maintain service quality for subscribers.

Prabhu says the key for large organiza-

tions like AT&T is to bite off pieces that can be virtualized in a manageable way.

In his words, "We looked at our entire network, which has over 200 network functions implemented as physical network functions. We can't change all of them in a flash cut. We don't need to. We look at areas that are facing tremendous traffic growth. Then we look at where the step to virtualization is fairly simple and then look at different parts of the network. When we sequence all that, it's a bite-size problem."

How is bite-size NFV transformation working for super-size AT&T?

"Our assumptions are proving right based on the part of the network that we've now gone to scale with NFV. We are increasing automation to address OpEx. When we bring on the next 10 million or 20 million subscribers, it's going to be much easier. When you actually go past the tipping point, you start seeing the real value of NFV."

So it seems that for Masergy and AT&T alike any original fear of NFV failing has long since been replaced by excitement for how successful NFV is proving to be. While bringing on new subscribers 10 million at a time, no less. The NFV transformation is well underway!

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