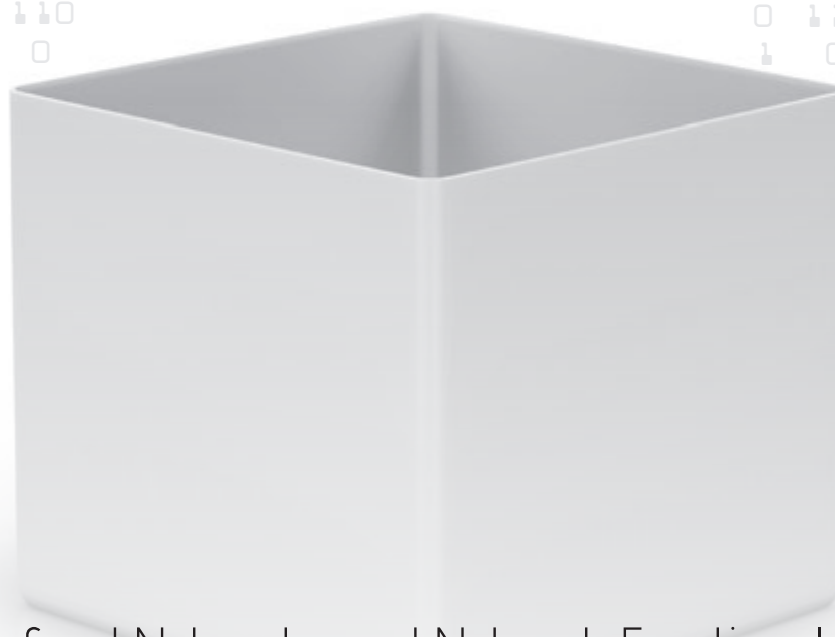


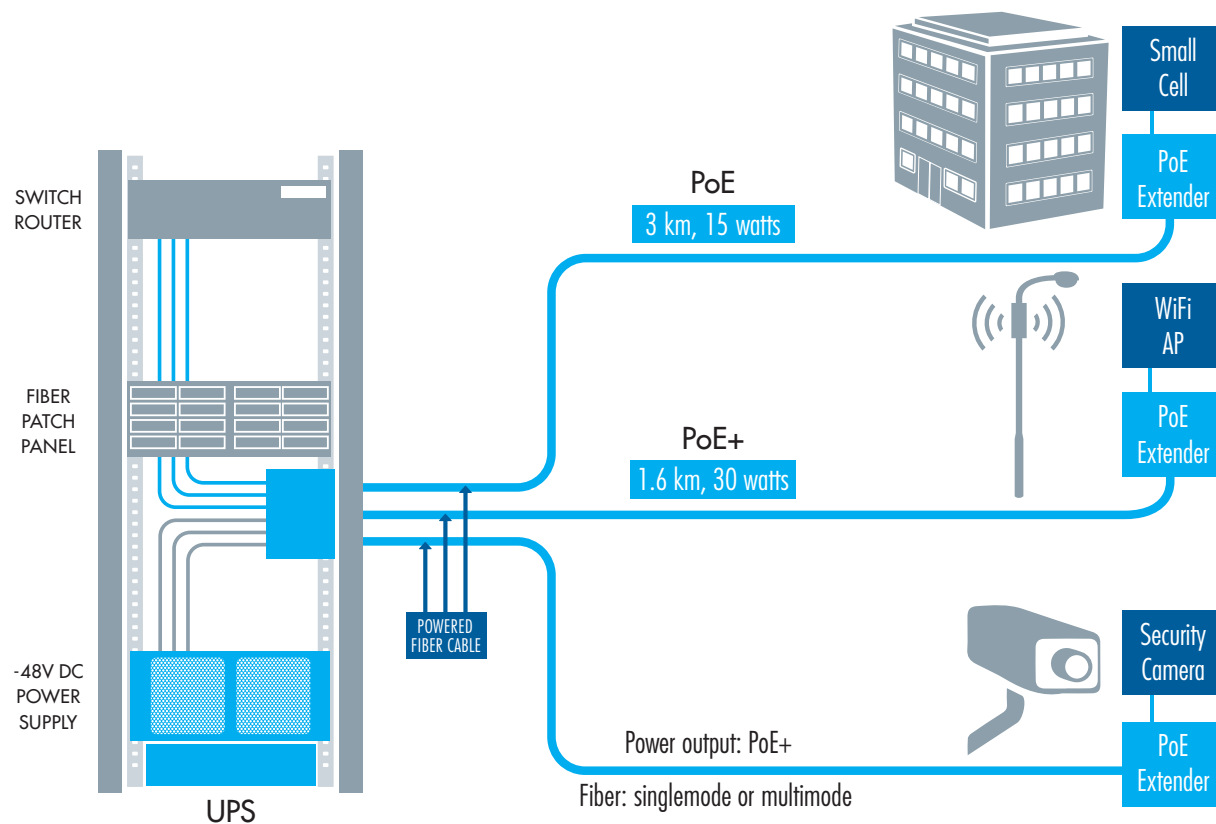
Opening the White Box



How Software Defined Networks and Network Functional Virtualization are changing the way we think about communication, capacity and resources

Powered Fiber Cable System

CommScope's powered fiber cable system provides a complete "rack to device" vision for both powering and communicating with network access devices such as small cells, ONT's, HD Cameras, and WiFi devices.



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- NEC Class II and SELV compliant
- Allows placing devices exactly where they are needed to maximize coverage

YOUR NETWORK
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INSIDE VIEW



I hope everyone's 2016 is off to a great start – it's hard to believe half the year is nearly over already. What's not surprising is how our industry is moving faster than ever before.

What we've noticed with the accelerated pace of change in the industry is how far and wide the initiatives span. Much more than in past years, infrastructure investment initiatives are focused across all segments – wireline, wireless, and enterprise; and in all aspects of the network – Core, Edge, Outside Plant and Premise locations.

The task of managing the materials that support these deployments is significant, not only from the control and project management perspective, but also in the financial burden it places on network providers and contractors. In addition to the vast amount of capital tied up in materials and equipment, the resources needed to provide management, visibility, warehousing and operational support to streamline deployment processes is incredible...and often hidden.

In the pressing efforts to get deployment projects started, the overall project can be greatly affected by lack of a solid plan to manage the full supply chain. That said, it's always gratifying to see how processes can work very well when the appropriate system capabilities are leveraged and processes are clearly defined. Done well, it's a pleasure for everyone. It takes proven experience and a strong commitment from all teams.

Some of the keys to project success are:

- Clear, proven processes
- Defined ownership and accountability
- Proven systems
- Dynamic flow of information
- Strong partnerships

The benefits of sound project management are many. Here are a few:

- Reduced capital (assets and working)
- Reduced operating expenses
- Greater visibility to the supply chain
- Increased speed in deployments
- Higher quality deployments
- Increased customer satisfaction

With the industry investing so heavily the amount of project support needed can be daunting, but with the right approach and partner, great success can be realized.

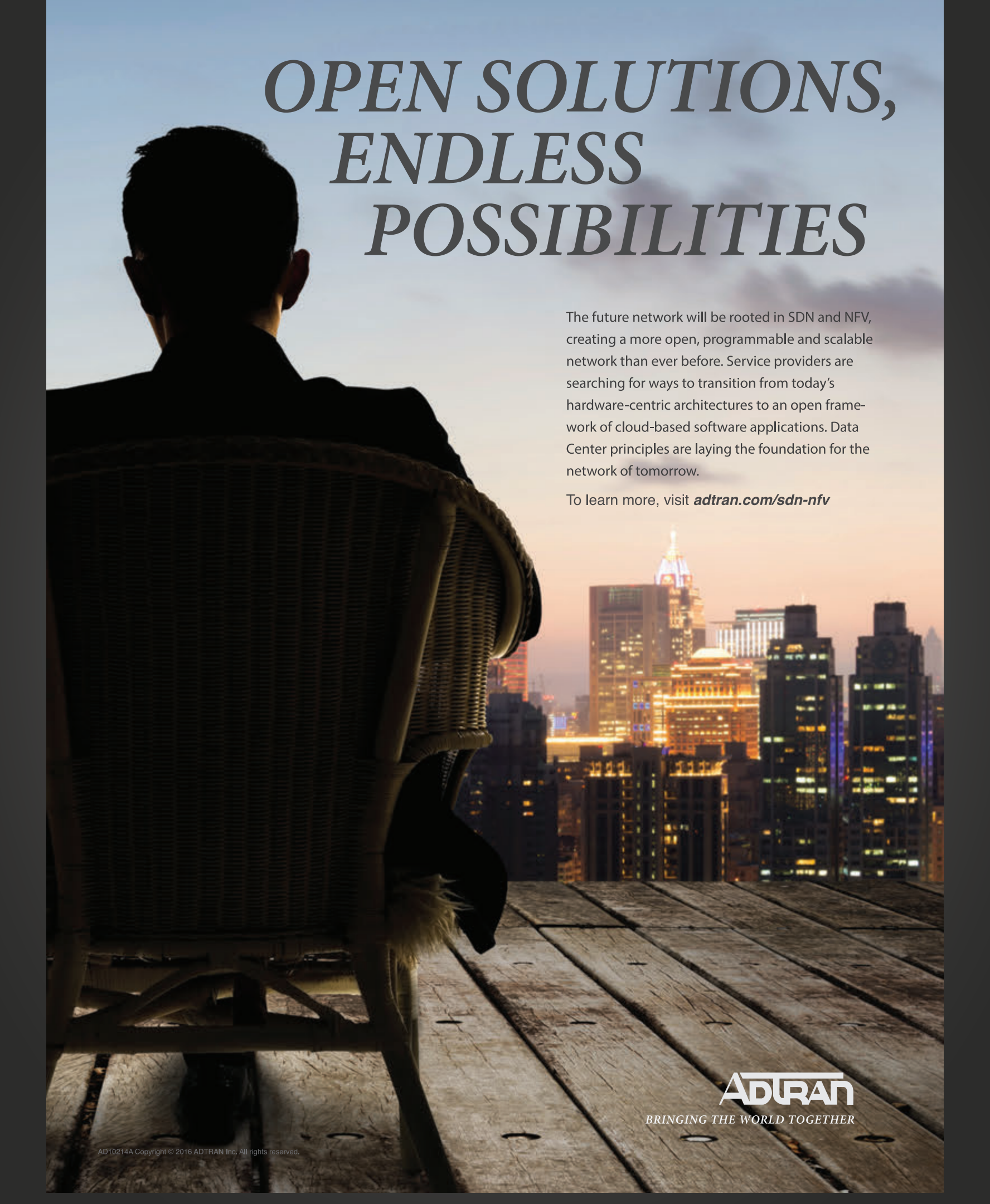
We've built an incredible team at KGP Companies. We work hard every day to meet the pace of the industry, and we're passionate about supporting our customers to ensure their success.

I hope the rest of 2016 is a great one for you! Please let us know what we can do for you.

Sincerely,

Desi O'Grady

Vice President, Broadband Networks
KGP Logistics

A person is seen from behind, sitting in a wicker chair on a rooftop. They are looking out over a city skyline at dusk or dawn. The sky is a mix of blue and orange, and the city lights are visible in the background. The person is wearing a dark jacket. The chair is made of light-colored wicker. The rooftop floor is made of wooden planks.

OPEN SOLUTIONS, ENDLESS POSSIBILITIES

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. Data Center principles are laying the foundation for the network of tomorrow.

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

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BRINGING THE WORLD TOGETHER



Applying Data Center Principles to Next-Gen Broadband Architectures

Kurt Raaflaub, Head of Strategic Solutions Marketing, ADTRAN

Influenced by the network and services scale and agility that data center networks have achieved over the past decade, telecommunications networks are now applying those same architectural principles to transform the way in which broadband networks are being built going forward. The resultant next generation network drastically streamlines service and application innovation to enable new revenue streams offsetting the increased competition from (Over-the-Top) OTT providers and the cost of maintaining annual double-digit LTE, enterprise and broadband traffic growth.

This is not about creating data centers and putting them into telecom central offices and exchanges or broadband vendors building data center solutions. It's about applying the principles that data center networks have employed to create a better broadband network connecting the cloud/data center edge to the subscriber edge. It is about applying the lessons learned – after all, (Software Defined Networks) SDN and (Network Functions Virtualization) NFV principles have been leveraged for years within the data center industry.

When referring to broadband networks for this discussion, we mean advanced fixed network technologies like 10Gps Passive Optical Networks (10G PON), e.g. NG-PON2. And broadband in this context means supporting both Gigabit residential and premium business services delivery as well as mobile backhaul, fronthaul and C-RAN network support.

There are a number of fundamental data center principles being leveraged to advance these next-generation broadband networks. Disaggregation of network elements and management systems is a significant step, as it removes vertically integrated vendor silos and aids in the transition to open networking architectures. Equally important is the virtualization of applications through NFV principles, which reduces the reliance on purpose-built hardware solutions and increases network agility through software-centric solutions. Lastly, network automation through SDN programming via open APIs reduces service provisioning times, errors, and IT complexity while enabling customer self-service capabilities.

Applying data center principles to broadband networks in turn promotes the economic advantages associated with data center architecture. Chief among those is eliminating the high cost of network overhead by minimizing vendor lock-in through the use of open interfaces and open application program interfaces for true SDN programmability. Likewise, this model assures consumer quality of experience by leveraging highly scalable, pay-as-you-grow data center switching and PON access architectures. And at the same time, it enables the rapid creation of differentiated services by supporting micro-release schedules more aligned with service provider DevOps teams. Bear in mind, this list of advantages is by no means exhaustive; the benefits are numerous.

Service flexibility and velocity remain the predominant reasons why operators are looking toward programmable next generation networks. As noted, while vendor-specific ecosystems force operators to move at the speed of a traditional release schedule, an SDN-controlled network can roll out new services and applications at the speed of now. Within that environment, expect only the most open, programmable and scalable solutions to be able to support the growing customer demand for new user-enabled services while also drastically lowering the total cost per bit delivered. Service providers deploying the most innovative solutions in this model can expect increased profitability by edging out the competition and capitalizing quickly on new revenue-generating opportunities.



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Make Your Mark

David Heard, President of Be Heard Consulting talks changes in the industry, network movement and knowing where we fit in the ecosystem.

ACCESS: What are the biggest changes that you've seen in the industry over time?

HEARD: When I started in this industry, international calls were being metered at \$6.00 a minute, cell phones – the size of a brief case - were just being introduced at \$5,000 apiece and \$8.00 per minute, and it was thought that the penetration rate of cellular communications would tap out at three million subscribers in the U.S. The subscriber experience continues to develop into a more intimate and passionate experience. Subscribers are ultra-mobile, application driven, HD-tuned and even A.D.D. as it pertains to the rest of the world, with running over 45 applications and looking at their mobile devices over 160 times a day. It's now thought that by the year 2020, over 50 billion devices will be connected to the network - a far cry from the expected three million subscribers.

This drives insatiable, and often unpredictable, demand in the network for service providers and those helping them build the infrastructure to carry this precious payload. At the same time, new service platforms like Facebook, Netflix, Hulu, AWS, voice over wifi and Unified Communication Services (UCS) have been introduced, offering services at hyper-scale with new business models. Many of the models are supported through ads, long distance calling is essentially free and consumers are paying for the applications they demand at data rates like utility commodities. Another far cry from \$8.00 a minute airtime.

The traffic payload, service economics, competitive environment and need to be agile in service delivery has driven a need for new architectures that drive more service agility, unbuckle the economics and are more of a mix of application (IT technology) and network (Network Operations) technology, such as Network Functional Virtualization (NFV) and Software Defined Networking (SDN). These technologies change the service delivery model, the way we integrate technologies and mostly, the skillsets our people need in order to successfully introduce, integrate and operate them.



It's now thought that by the year 2020, over 50 billion devices will be connected to the network - a far cry from the expected three million subscribers.





About David W. Heard

David is a proven leader of high-growth public and venture-backed technology companies, driving results in dynamic markets for over two decades. He's an experienced CEO, board member, and consulting advisor. He's known for driving transformational change, particularly at organizations with unrealized opportunity or underperforming assets.

He most recently was president of Network and Service Enablement (NSE) at JDSU (NASDAQ: JDSU), leading the strategy to unleash shareholder value by splitting the firm into two publicly traded companies, Viavi Solutions and Lumentum. In his five years at JDSU, new product revenue increased to over 60 percent, and gross profits by 1,200 basis points. He led a global team of more than 2,500 employees serving 4,300 customers in the areas of big data software, applications performance management, and advanced networking solutions. He also grew JDSU participation in mobility and big data markets, executed five strategic acquisitions, and drove customer satisfaction and employee engagement to record performance—establishing new industry benchmarks.

Prior to JDSU, David held CEO and executive-level positions in the technology industry. He was instrumental in the rollout of HDTV, in taking BigBand Networks public, and leading the growth of mobility and broadband businesses with AT&T and Lucent Technologies. He also led software and policy management with Tekelec, VOIP growth in fixed and mobile communications at Santera Systems, and the successful creation and spin-off of Spatial Networks (sold to Alcatel-Lucent), where he was a founding board member. He was CEO of Somera, a provider of asset management and professional services for the data, telecom, and wireless markets. These assignments included expatriate posts in China, Hong Kong, Singapore, Indonesia, and the United Kingdom with extensive travel to India, Korea, Japan, and Europe.

David holds a MS degree in Management from Stanford University, where he was a Sloan Fellow. He also holds an MBA from the University of Dayton, and a BS in Production and Operations Management from The Ohio State University. He received the Alumni Entrepreneurship Award in 2010 from OSU. He currently sits on the boards of Milestone Sports, Zyvex Performance Materials, KGP Industries and the Telecommunications Industry Association (TIA). He is currently engaged with some of the largest technology, software and systems integration companies providing executive level transformational consulting.

ACCESS: What does SDN and NFV really mean?

HEARD: Software Defined Networking is a way to ensure that a control plane (the intelligence and logic layers) are separated from the physical layer (called the data plane) and can be optimized for service delivery and application performance.

Network Functional Virtualization or NFV, is really the transfer of what used to be carried out in function-fit hardware with purpose-built and proprietary software packaged together, to that of open software, able to interact with commercial-off-the-shelf hardware. You'll often here of a reference to "white boxes" in this regard.



To me, both terms are about a required movement rather than a category or thing. The needs of network economics, service agility and the collision of IT technology and network operations scale has required a new architecture that is open, scalable and capable of meeting the unpredictable volume, mix and service diversity of the future.

The main benefits are expected to be a 50% reduction in operating costs, substation per bit reductions in capital costs and 10x improvements in service agility.

AT&T's bandwidth on-demand is a key example of a service that used to take customers 60-90 days to change, that now, with NFV/SDN can be handled in minutes by the customer themselves, hitting all of the goals of SDN/NFV: dramatically improving operating costs, service agility and offering a service that did not exist before – near real time dynamic network on-demand.



Make Your Mark

ACCESS: What does this mean for KGP, its customer base, its partners?

HEARD: Partnering is the new normal. It's important to understand where each player fits in the ecosystem, as integrated solutions are made by partnering across a number of suppliers, system integrators, solution providers, etc., working together for the delivery of a service. In many cases, some of these partners are likely competitors who must learn the friendly term of co-opetition.

Systems integration is essential. Understanding how a solution across partners works to deliver a service prior to being in the network is not a new concept. This must continue in SDN/NFV solutions, but at warp speeds. While open architectures, applications and white boxes sound like a simple approach, the actual integration of these technologies and development of workflows and procedures must be fine-tuned to enable success. There are over 280 shades of white – the devil is in the details.

KGP and its partner companies have an opportunity to ensure performance, workflows and personnel are aligned for service provider success, with service delivered on time and on budget.

There are over 280 shades of white – the devil is in the details

Creative thinking and new business models in a newfangled ecosystem allows opportunities to align the new supply chain, value chain and human resource pool to meet the pace, skill and efficiency required in this new domain. It's essential to take time to collaborate with your own organization as well as with partners to drive the right solutions that might be outside the box of your traditional mindset.

Taking example from Web 2.0 suppliers, new entrants and ecosystem partners is key. You'll be able to pay them back with your history, knowledge, methods of procedure and day-to-day realities of the intersection of Net Ops and Dev Ops.



ACCESS: Do you have any suggestions based on what you see moving forward for KGP, its partner network and its customer base.

HEARD: Embrace change! I've lived through the transformation of analog to digital, circuit to packet, 2G to 5G, SD to HD (video), service to application, owned infrastructure to cloud. In each of these moves the virtualization gets stronger and the impact grows more profound. We haven't seen anything yet, so prepare your organization, pivot your talent and embrace change. Adeptly managing change will be a required core competency to succeed.

Know who you are and where you fit. It's important to understand where you fit in the value and supply chain and how important that is to the service providers of tomorrow.

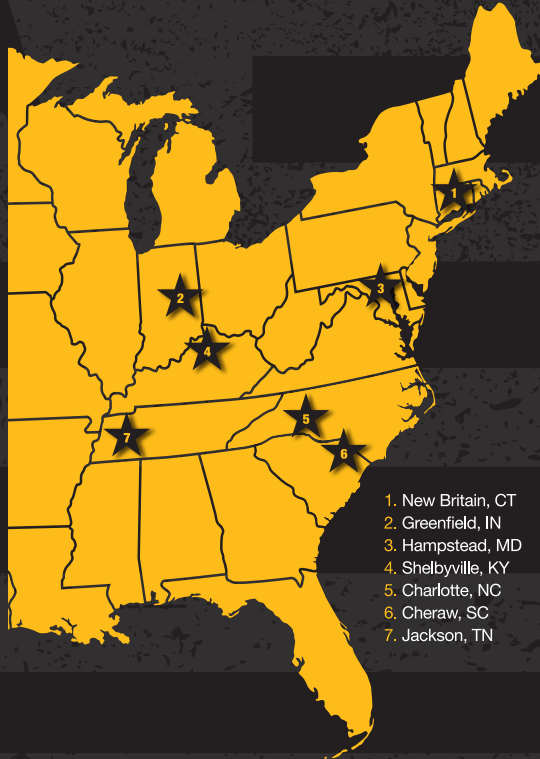
Clear lines of delineation allow for successful partnering and are a reality check for how relevant your strategy is within the continually changing industry. Plotting your strategic course through this transformation, while preserving your core competencies is paramount. There will be many companies that don't cross the chasm. I believe 50% of the existing suppliers in the space will not make it through the next three to five years in their current form.

And finally, make your opportunity. Companies, leaders, people who are driving more intimacy and collaboration with their customer and the value chain/ecosystem, making good decisions and executing quickly will benefit significantly during this period. New technologies and business models always don't go as planned. This opens up gaps, service categories and creates opportunities in the new architecture for a win. Make your mark.



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G.hn – the Backbone of Home Networking

Comtrend Presents

Donna Yasay, President, HomeGrid Forum

Home networks are changing. Ever higher broadband speeds can carry multiple HD video streams into the home, but these then need to be distributed to a variety of devices in a reliable, trouble-free fashion. But it is not just about videos and bandwidth. The vision of Smart Homes and Smart Cities is to have numerous household devices all working together, sharing data, and all on the same network. End users buy a wide range of products, from a Samsung fridge to a Panasonic television and an LG laptop and expect seamless connectivity between them all. However consider what needs to happen behind the scenes to make this a reality - the unsung hero underpinning this connectivity is G.hn.

G.hn solves the home network problem – and it just works!

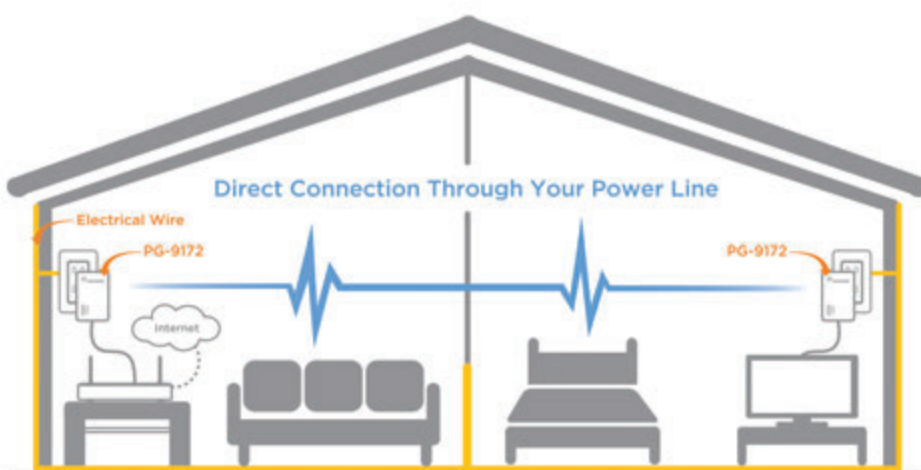
Although many devices are connected wirelessly, wired networks still have a major role to play in the home. This ranges from interconnecting fixed devices by means of an embedded interface over the home's cabling, to providing a robust, high speed backbone for wireless access points so as to greatly improve wireless coverage within the home.

The beauty of G.hn lies in its simplicity. Defined by service providers, for service providers, G.hn is an ITU-T international standard for high speed home networks. Its unique feature is that it can run over any existing home wiring: powerline, coax, phone lines or (POF) plastic optical fiber. G.hn resolves the issues service providers really care about; reliable interoperability between products from different vendors; high, consistent bandwidth at any location in the home; and simultaneous support of video, data, voice, and high speed internet.

When purchasing networked products for entertainment and the smart home, consumers expect them to connect, straight out of the box, with no need for expert knowledge or configuration. G.hn is the embodiment of 'plug and play'; not only is it easy to self-install, but it includes both QoS and in-built security. On top of this, G.hn can be remotely configured and managed using the Broadband Forum's management system (TR-069) so in the unlikely event of a problem, their service provider can diagnose and dynamically re-configure the devices remotely. This can all be done without entering the customer's home, installing any new wires or worrying about service limitations or conflicts with existing equipment.

Smart Home applications involve a wide variety of simple devices. The need for a reliable plug and play operation is even greater here, and brings new challenges with regard to the security and privacy of communications. Applications range from energy management to home improvements and security, and even wearable devices.

With its ability to extend existing wireless networks in any home, G.hn is an obvious choice for service providers to deliver emerging and converged future services and applications, such as Ultra-HD and home automation, while continuing to support existing services.



The hub of entertainment

Smart TVs are now starting to come with an embedded G.hn powerline interface as standard. This allows the TV to automatically connect over the home's powerlines – eliminating the need for new cables and providing instant Internet access on the TV. There are other devices which can benefit from this type of technology, including Blu-ray players and stereo systems.

The possibilities are endless for delivering extensive in-home information services, including assisted living, education, healthcare, shopping, games and entertainment.

Seamless access to home automation

With the 'plug and play' ease which G.hn provides, home automation has never been simpler. While many home automation devices are simple, battery powered, wireless connected devices, G.hn can provide the IP communication backbone which allows these smart home Internet of Things devices to speak to the cloud and allow for reliable remote home control. Fixed devices which are home powered can also benefit from an embedded G.hn powerline interface, opening up new possibilities in the areas of energy management, lighting control and security systems.



G.hn can also act as the wired backbone to connect a home server to many devices, ranging from a high performance PC (via G.hn to an Ethernet adapter) to multiple laptops or tablets via a G.hn to WiFi extender.

Legacy systems

Some operators have expressed concerns about G.hn interfering with legacy powerline systems. While there is an installed base of such systems, this is quite small when compared to the number of homes that will need high speed networking in the future. Further, as G.hn is not just limited to powerline, there is always the possibility of using one of the other G.hn wire types to sidestep this issue.

The home network of the future will be a hybrid. Wi-Fi is the connectivity of choice for all portable devices. However there are several, large fixed device types in the home (ranging from TVs to white goods) which would benefit from being networked, but there is no advantage in this being done wirelessly. Indeed, not having such devices on the wireless network means there is greater capacity for those which really need it. As mentioned above, multiple wireless access points will become increasingly common to improve wireless coverage and performance. These will need a robust, high performance backbone which G.hn provides.

A secure network

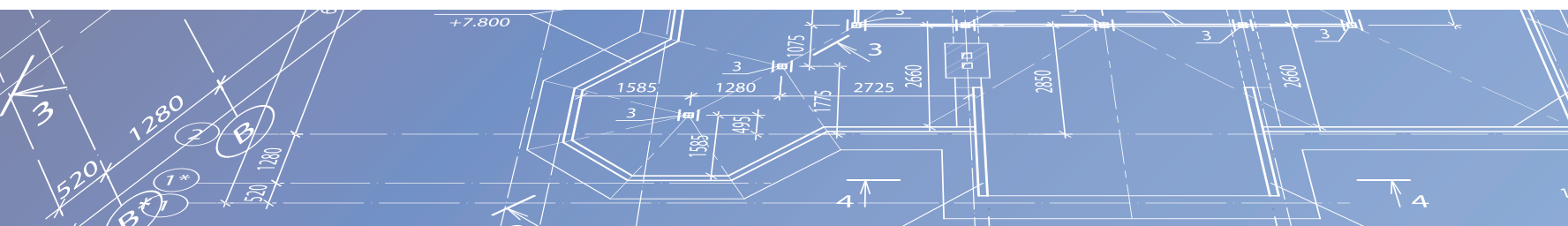
In a truly connected world, security is more critical than ever. It is not only data and equipment that need to be protected against hacking and theft, this now extends to content, personal information and credentials. Wireless has made great strides to enhance its security, but wireless signals can always be intercepted and the end-user may well, knowingly or unknowingly, disable their wireless security. G.hn is inherently secure, it can even utilize different encryption keys for each link in the network. While the user should take care to setup their wireless network securely, once traffic enters the G.hn domain, they do not have to worry about this part of the network.

G.hn, the backbone of the home

One of the main roles of G.hn will be to extend Wi-Fi coverage and performance throughout the home, a true hybrid network. However it will also play an increasing role in interconnecting large, fixed devices which have no need of wireless, and providing a different sort of backbone to interconnect disparate Smart Home technologies. It will also play a role in Smart Homes and Smart Cities. G.hn started out in the service provider domain, and many of its features benefit from that heritage. However it is now moving into the retail space, and end users will start to realize what a valuable and easy to use networking technology it really is.



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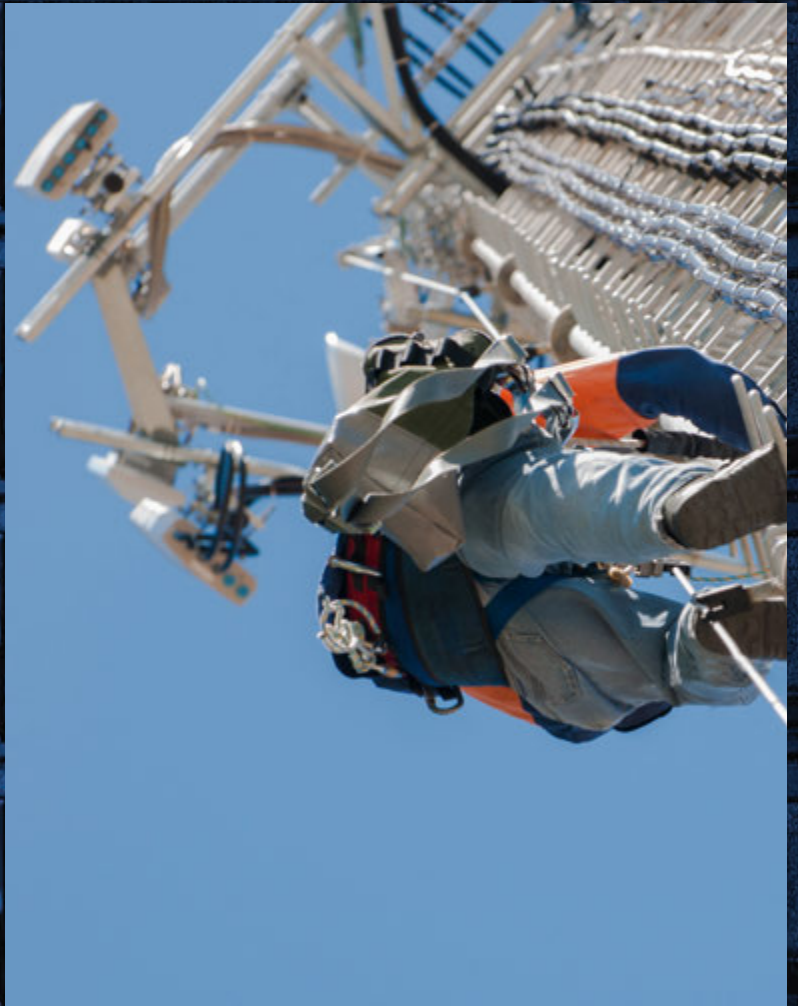
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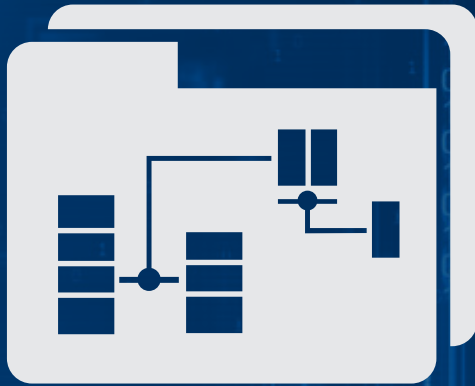
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DRIVING TRANSFORMATION SD FV

Authored in part by
Paul Schultz - Vice President Sales, SDN/NFV
BlueStream

Defining and building networks that are versatile, agile, scalable and cost effective has become a primary focus for telecommunication service providers. With an influx of competition stemming from non-traditional markets, Service Providers are finding they must shift their strategy toward a software and digital architecture. The migration will provide significant cost relief while improving speed to market timelines.

Network function virtualization (NFV) and software defined networking (SDN) solutions are transforming the industry. Current roadblocks include legacy proprietary solutions for both hardware and software, the desire to safeguard and control existing infrastructure, and the ability to effectively and efficiently adapt and integrate the new network. Questions Service Providers are asking include:

- What initiatives to invest in that will offer relief to the current network, provide momentum toward the shift to NFV, yet still remain cost effective?
- How can challenges to the transition be identified and overcome?
- Who is the competition, and what is their progress?

With estimates predicting data usage in the United States topping 45 billion gigabytes by the year 2018, Service Providers are counting on NFV and SDN as a significant resource for driving and generating new revenue. With an end goal of reduction of both OpEx and CapEX, transitioning to a new architecture requires focusing talent on the new technology. This may require organizational changes, new skill sets, and augmenting current technical resources, all of which may increase OpEx costs short term.

In the midst of the transition, the Service Provider cannot lose sight of the customer. End user appetites are changing so rapidly in today's market that Service Providers work closely with the consumer, developer and suppliers to transform the network into a software and digital architecture. To reap the revenue benefits, Service Providers need to develop and introduce a simplified methodology to ensure relevancy, profitability, and customer satisfaction.

PROGRESSION OF CONVERSION

The Network of Today

Prior telecommunication usage called for static, redundant and proprietary platforms. Network reliability, availability and security have been top priority for Service Providers when considering new options. Planning and implementation has been slow and methodical so as to ensure risk avoidance. Standardization of hardware, interfaces, and protocols guaranteed design and development of new services was a slow and costly process.

Increased Customer Appetite

Consumer migration toward smart devices over the past few years continues to strain wireless networks, with estimated capacity consumption almost 50 times greater than basic handsets. With smart devices comes an explosion of application development and usage, causing an even greater demand increase on the network infrastructure.

Legacy Infrastructure and Cost

Transitioning to a new architecture requires focusing talent on the new technology. During this evolution, service providers must also allocate resources on maintaining legacy assets, ensuring they are running optimally through the end of their lifecycle. The days of service providers buying dedicated hardware, software, and licensing to support specific applications are over. Proprietary legacy hardware will be replaced with off the shelf products. Service providers will no longer invest in stand-alone platforms that have a finite shelf life. A virtualized network addresses inefficient use of bandwidth, limited visibility in the network layer, load balancing restraints and lack of control over congestion. It also allows for higher efficiency, better ability to provide a secure network, flexibility and dynamic scalability.

CHALLENGES

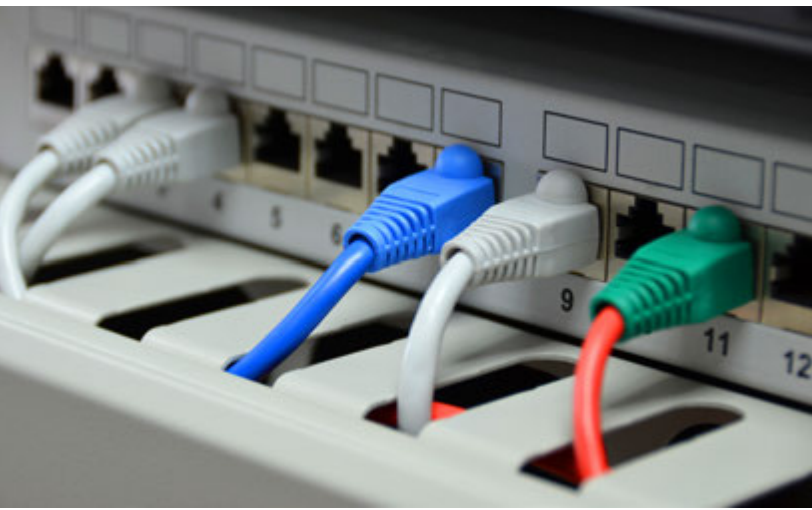
Along with the multitude of benefits Service Providers will reap by transitioning to a virtualized network are a substantial number of roadblocks that will need to be overcome. Service Providers recognize challenges will exist in transitioning to new business models, the need for additional skills sets, and the potential cultural changes that may come with such momentous alterations in business processes and procedures.

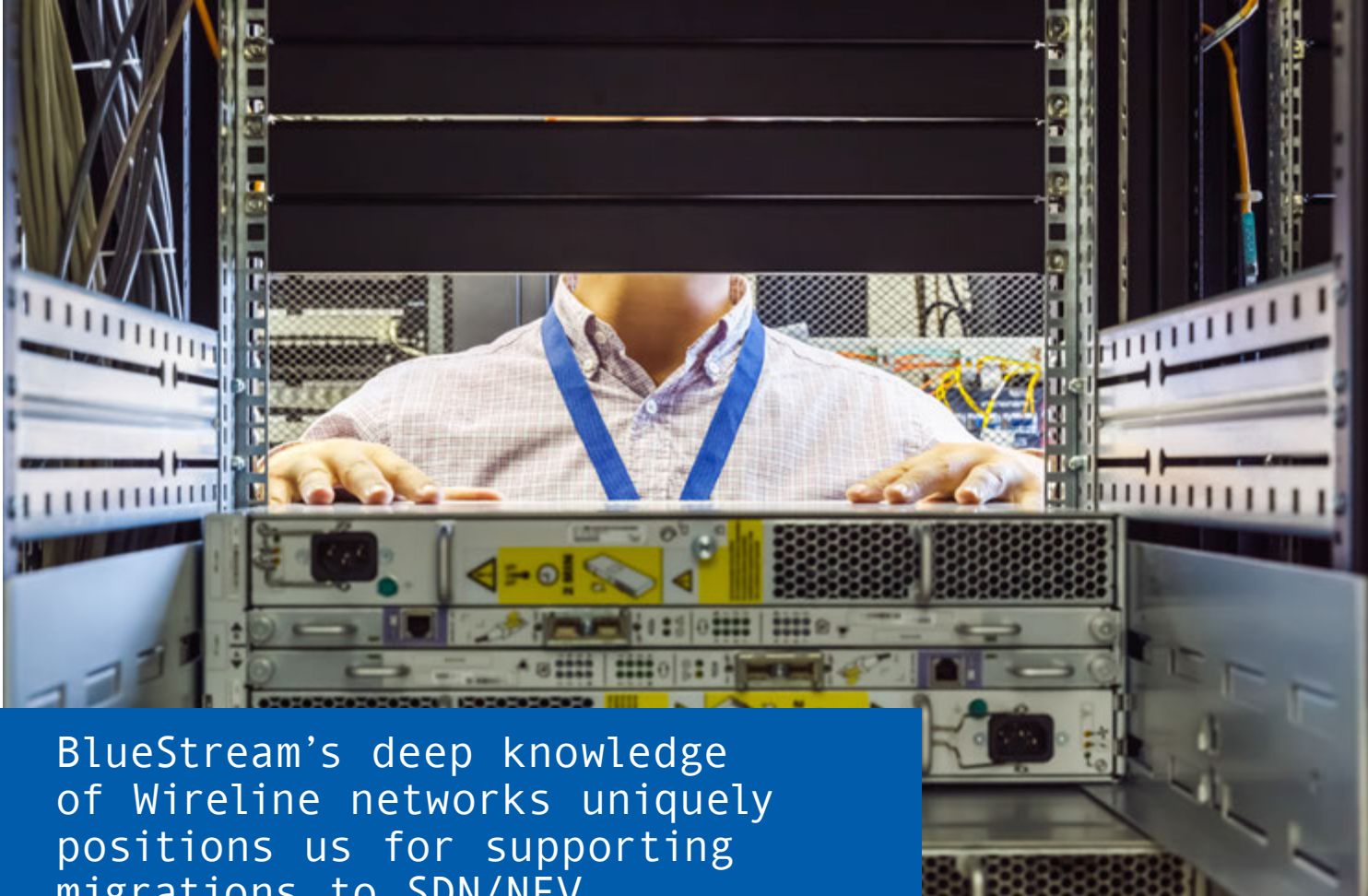
KGP Logistics and BlueStream are partnering with leading OEMs to deploy SDN solutions.

Due to the infancy of SDN/NFV in the telecommunications industry, hardware and software platforms continue to be developed; a shift requires a complete overhaul of products and services.

- Service Providers need hardware that can virtualize numerous applications.
- While Service Providers are partnering with vendors to explore hardware and software options and test new products, there is a lack of mature end-to-end solutions.
- There is a need to develop processes and procedures to standardize and replicate installation and integration of the new hardware with no impact to the existing network.

In addition to these technical challenges, existing back office solutions may require some form of renovation or modernization to support the forward growth of the network. Integrating existing network management systems with NFV/SDN elements will be a key function in the end-to-end service orchestration.



A person wearing a blue lanyard and a light-colored button-down shirt stands in a server room. Their hands are resting on a server rack. The rack is filled with various network equipment, including switches and routers. The background shows more server racks and network cables.

BlueStream's deep knowledge of Wireline networks uniquely positions us for supporting migrations to SDN/NFV.

Culture Shock

Development and integration of cross functional teams will take the place of the traditional segmented work structure. Communication and collaboration will be vital in migrating to and maintaining a virtualized network infrastructure.

By encouraging and utilizing the pooled strengths of cohesive cross-functional teams, Service Providers may gain the benefits of innovative, agile, and flexible solutions. Removing traditional barriers improves communication and responsiveness, providing the ability to assess solution viability more quickly and cost effectively.

A fresh approach regarding leadership roles may also be critical in the culture transition from a slow-to-evolve, stagnant legacy network to the fast paced, ground-breaking culture that comes with the transition to a virtualized network. Merging, transitioning, and shifting traditional roles will assist in organizational agility.

Evolution of Business Models and Partnerships

A fresh approach to hardware and software purchasing and configuration is necessary for a successful progression to NFV/SDN. Equipment and software manufacturers are preparing for the transition, with new business models emerging that should be vetted for successful integration into the Service Provider's business plan. Included in this transition are several models Service Providers may encounter, including:

- Stand-alone hardware platforms that allow for any software applications
- Focus transitioning from hardware/equipment to software/services
- Shifts in pricing structures, tending toward the pay-per-use models

Transitioning business models and product offers will take time, and may require several reconfigurations as the partnerships and products develop.





People Resources and Knowledge Base

Service providers will need to develop processes and procedures to standardize and replicate installation and integration of the new hardware with no impact to the existing network. In legacy networks, Service Providers have historically relied on a few key vendors as subject matter experts. With the transition to NFV, the Service Providers will need to retain internal resources with the skill sets that allow them to work efficiently on multiple platforms manufactured by multiple supplies.

CONCLUSION

Transitioning to a new generation of technology redefines the network and requires new methodologies. Due to the ever evolving customer needs and desires, Service Providers need to embrace this dramatic evolution. SDN and NFV have the potential to bring new approaches to traditional purchasing models for both hardware and software. Network virtualization integration allows Service Providers to move into the next generation with more flexible, innovative, and cost effective business and customer solutions.

KGP Logistics and BlueStream are well down the path of expanding from a traditional Wireline / Wireless partner into a full service SDN integrator to assist and support Service Providers with their transitions. By partnering with Service Providers to explore hardware and software options and test new products, BlueStream is positioned to as a trusted and valued resource for network transitions. Many challenges have been identified that need to be overcome by Service Providers to ensure both customer satisfaction and revenue streams are not negatively impacted. BlueStream has been actively looking for solutions to these roadblocks.

BlueStream offers single source, end-to-end communications infrastructure & network technology services that bridges the gap between legacy networks and next generation SDN networks. In addition, they boast a service line up that is unmatched in the industry that includes supply chain management, inventory management, transportation and integrated solutions. Service Providers will have confidence in partnering with BlueStream.



BlueStream is an active member of Telecom Infra Project (TIP) and the Open Compute Project (OCP) Community



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White Paper

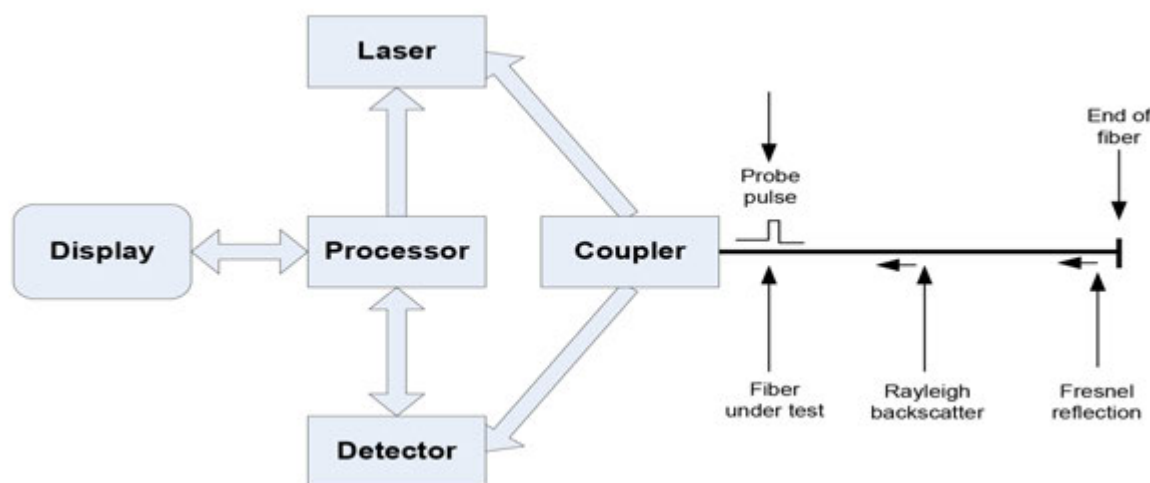
Troubleshooting Fiber Installations using the 930XC OTDR

Introduction

The 930XC OTDR is used to find the length and or the location of loss events of a fiber optic cable or link. This is necessary during the installation/fiber qualification processes and also during troubleshooting tasks. This application note will provide the reader with details concerning typical measurements of optical fibers for passive optical networks (PON) and point-to-point (P2P) networks.

How an OTDR Works

The **optical time-domain reflectometer** (OTDR) is an instrument that uses the inherent backscattering properties of an optical fiber to detect faults and categorize its condition. The OTDR sends high power pulses of laser light down the fiber and captures the light that is reflected back (much like a radar system). Correlation is determined between the reflected information and physical locations along the fiber by measuring the timing and power levels of the return pulses. The instrument will display a “trace” that shows the optical power versus the distance. Attenuation of the fiber is displayed as the slope of the trace. Interruptions such as splices, connectors, bends, breaks or flaws in the fiber appear as transitions or “events” that represent their nature and location.



Troubleshooting using the OTDR

The 930XC OTDR can be used to find the location(s) of fiber damage, while in use or after installation. Fiber is usually found cut or compromised due to a third party rerouting the fiber. Properly documented installations record the installed fiber length, and if there is a reflection before the value, location of the fiber damage are likely identified.



Troubleshooting Fiber Installations using the 930XC OTDR

When fiber is cut the resulting reflection is very high and easy to identify. This is typically the location of the cut fiber for a P2P network since there are no splitters or alternate paths for the light to travel. Other reflections could be possible “ghosts” which will be covered later in this application note.

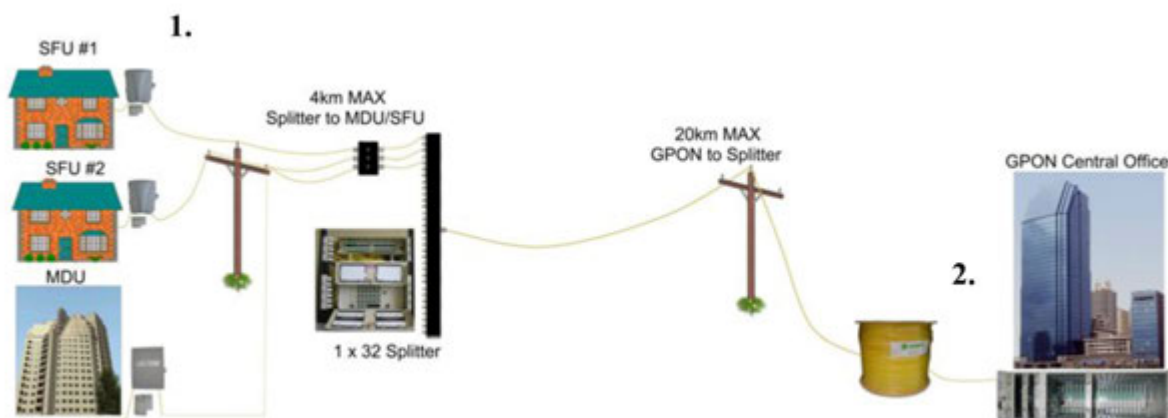
If a technician is troubleshooting a PON system there could be many reflections from an **optical network terminal (ONT)**. This can occur if the measurements are being made from the input of a splitter. Frequently, technicians will not measure from the active splitter because they would have to disconnect the service from all subscribers connected to that splitter. Instead, the technician will often test from the ONT to identify where the fiber is damaged. If the PON is live, the technician should use a 930XC-30F at 1625nm. This allows the technician to measure the fiber cable without disrupting the other subscribers on the network.

Since the 930XC OTDR is using an out-of-band wavelength at 1625nm, and the 930XC is equipped with a filter that only passes 1625nm and blocks all PON wavelengths, the OTDR will not be affected. The PON will also not be affected by the 1625nm wavelength, and network communication will continue functioning for the other subscribers. If the technician knows there is no network traffic, testing can be done with a 930XC-20C at either 1310nm or 1550nm from any point in the circuit.

The technician can also use the **visual fault locator (VFL)** that is integrated into the 930XC. The fiber connector is inserted into the VFL port of the 930XC and the technician can visually identify/locate a possible loss location whether it is a faulty splice or a cut/broken/pinched fiber.

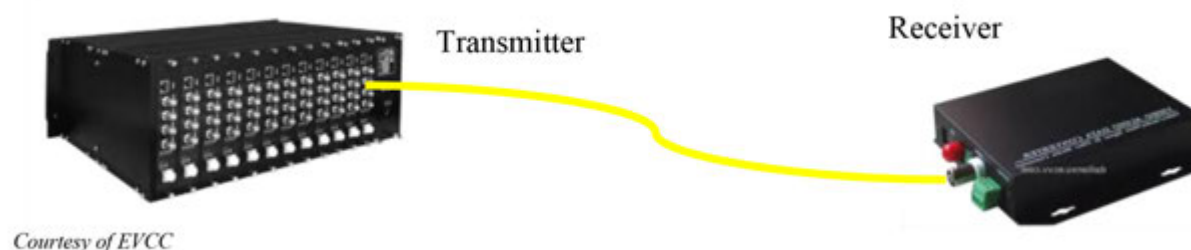
The 930XC OTDR also has an integrated stabilized laser source and optical power meter. These can be used to measure the insertion loss of a fiber link or fiber component. One 930XC OTDR is designated as the source and the other 930XC OTDR is the power meter. Individual Greenlee Mini fiberTOOLS™ sources or power meters can be used in tandem with the 930XC power meter and sources.

Typical PON Configuration



- 1) The technician will likely see the patch panel, splitter, and/or any fault that may be present when probing from the ONT.
- 2) The technician will see up to 32 ONT's after the splitter when probing from the CO and/or any fault that may be present.

Typical Point-to-Point Configuration



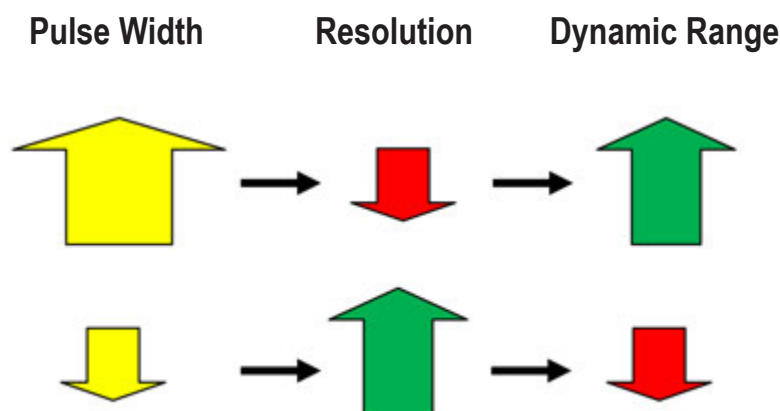
In a point-to-point (P2P) configuration the entire length of the fiber will be measured.

Key OTDR Settings

The technician can use the 930XC OTDR in automatic mode. This is a single button operation and allows amateur technicians to troubleshoot and probe fiber networks. The 930XC OTDR will automatically select the appropriate distance range and pulse width at the beginning of the measurement. The 930XC OTDR can also be used in manual mode. This allows the technician to fine-tune the OTDR settings for optimal performance as described below.

The “range” setting needs to be set so that approximately two-thirds of the screen is backscatter signal from the fiber, and the remaining one-third is noise baseline after the last event.

Adjusting the pulse width is a situation where the technician needs to weigh the tradeoffs between resolution and dynamic range. A wider pulse width will allow the OTDR to see further and through higher loss devices, but at the expense of signal resolution. A narrower pulse width will have better resolution, but not be able to measure as far of distance or through higher loss devices. A good starting point is to use the default pulse width provided by the OTDR range setting. Increasing the pulse width will increase the deadzones. The **event deadzone** is the ability of the OTDR to resolve between two reflective (Fresnel) events. The **attenuation deadzone** is the ability of the OTDR to measure a backscatter event (bad splice) after a reflective event. If the pulse width is too large, then two or more events will merge into what looks like one event. Increasing the pulse width increases the dynamic range of the OTDR, which means that there is more optical power injected into the fiber under test and allows the probe pulse to travel longer distances and through higher loss devices.



Continued on page 30



PREFORMED LINE PRODUCTS

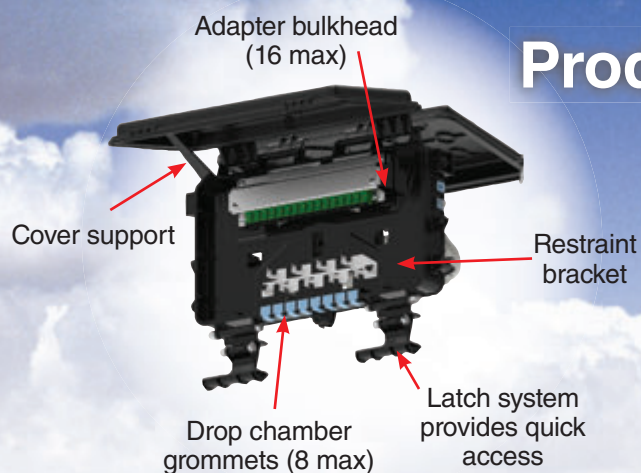
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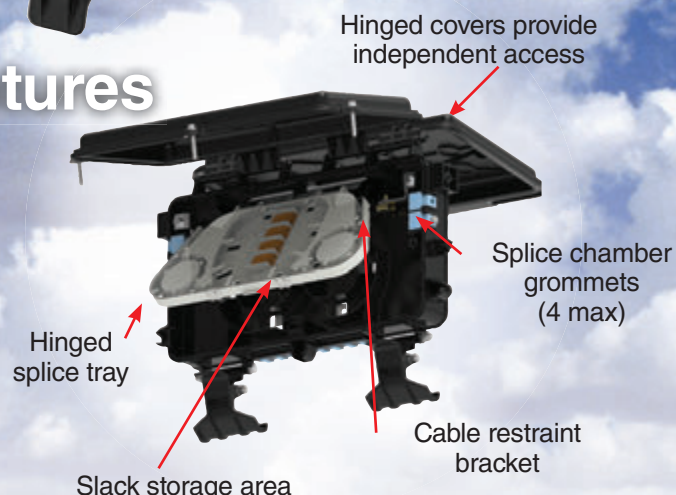
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“Rural telecom operators like Chickasaw play a critical role bridging the digital gap in vast areas of the United States. They are committed to bringing value to their communities and are a perfect customer to Viavi. Another great example of collaboration between the Viavi team and a Velocity partner that will allow us to replicate this win across this space.”

- Sergio Bea, Vice President Worldwide Channels

Repair time goals drive new fiber testing business to Viavi

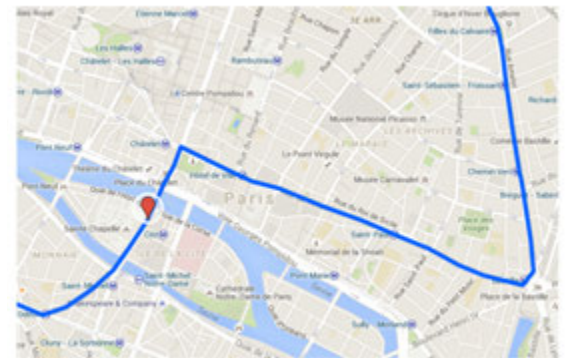
Customer Challenge

Chickasaw Telephone Company holds the honor of being a Viavi customer with one of the most interesting start-up stories – their company was created because of two mules (read the history on the next page). Another interesting fact about Chickasaw is that they are a small operator that plays a big and vital role in Oklahoma’s telecommunications infrastructure. However, Chickasaw Telephone realized it was critical to reduce meantime-to-repair (MTTR) fiber issues throughout their widespread fiber network in order to expand their network footprint and shrink customer churn.

Viavi Solution

Chickasaw considered several options before deciding on the SmartOTU solution. Our Viavi and partner account teams helped Chickasaw to realize that:

- Implementing Viavi’s SmartOTU standalone fiber testing is a perfect solution to quickly solve physical fiber issues that arise and therefore be able to provide better customer service.
- SmartOTU specifically addresses meantime-to-repair issues by proactively monitoring the fiber and eliminating erroneous dispatches.
- The increased efficiency results in significant operational cost savings.
- With the ability to grow into ONMSi, SmartOTU provides a roadmap to scale as their fiber network continues to expand.



Fiber fault location displayed with Google Maps

Viavi Deal Value

This is the second largest SmartOTU implementation in the United States. This deal also gives us a new key reference account and a strong use-case for winning future opportunities.

How We Won

Understand Our Customers: To meet Chickasaw’s needs, a custom solution was needed but they had strict budget constraints. Our industry expertise was key to understanding their needs and proposing the right technology and product.

Collaborate to Win: Our deployment and Premier Viavi Velocity partner, KGP Logistics, was instrumental in closing the deal. The KGP team provided valuable insight about the customer as well as using their existing relationships to promote Viavi’s solution. It took both of us to address budget concerns while enabling Chickasaw to monitor critical network elements and provide excellent service to their customers. CES introduced Viavi into the Chickasaw account and helped manage the client-partner relationship.

Chickasaw Telephone Company History

What do two mules have to do with telecommunications?

Plenty, if you're one of the Chickasaw companies. Back in 1909, Chickasaw Telephone Company was created because of two mules. You see, there was a farmer who bought a couple of mules from a Mr. John W. Gauntt on credit against his next year's crop. But the crop failed and the poor farmer couldn't pay John, so he set out to return those mules.

Now, this put John in a bind because he had no use for a pair of mules that had been worked for a year. So John and the farmer sat down and worked out a deal. John didn't need the mules back because he had acquired more mules in the past year and he asked the farmer what else he had to cover the note.

After a few suggestions John said, "Is that all?"

The farmer said, "Well, I have the Lone Grove Telephone Company with thirty-five telephones. If you want it you can have that."

John said, "I'll take it."

Thus under new ownership the company began to grow. In 1937, John advised his son Royce Gauntt that, "You're the last of 12 children; the others have gone from home and you now can have the telephone company since no one else wanted it."

Royce went to college and then joined the Navy in 1942. During his 27 years with the Navy, members of his family assisted in running the company with Royce calling home once a week to check on operations.

In 1956, while still on active duty, he secured an REA Loan. Plans were being made to continue expansion beyond Lone Grove, and the trade territory was located almost entirely in the Chickasaw Indian Nation thus was born the Chickasaw Telephone Company.

In 1962, Chickasaw Telephone moved their business office from Lone Grove to Ardmore after they had expanded into seven more operating areas.

In 1975 they acquired the Sulphur area and moved the business office there on July 1.

Chickasaw Holding Company, which was formed in 1990 includes 14 separate companies.

From its modest beginning with two mules in 1909, Chickasaw has grown to become an industry leader in telecommunications. Repair time goals drive new fiber testing business to Viavi.



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- Compatible with APC/UPC/SPC/PC connectors
- Jack module insert will snap into keystone style faceplates and housings
- Ceramic sleeve



PT-KJKSC-85

KGP Logistics Item #	Part #	Description
0000419425	PT-KJKSC-85	Snap-In SC Single-Mode Fiber Module in White. Compatible with APC/UPC/SPC/PC connectors. Jack Module Insert Will Snap Into Keystone Style Faceplates And Housings. Ceramic Sleeve.

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The Advantage of PREMIER

PREMIER formed in 1983 with a mission to help our parent company, United Telephone (now CenturyLink), establish a reliable new source for critical supply items at a more competitive cost while maintaining the quality and dependability that carriers demand to meet their 99.999 reliability standards. To this day PREMIER continues to supply essential carrier-grade products to telecom, MSO, data center, wireless, utility and OEM markets.

PREMIER operates as an OEM as well as a strategic sourcing company. We have developed a strong network of supply partners, both internationally and domestically. We seek out and negotiate better cost alternatives for the essential 'day-to-day' carrier-grade commodity products – products like cable assemblies and cords, alkaline batteries, weatherproofing, outside plant grounding, drop wire hardware, wire and cable, structured cabling, supplies like cable ties, marking paint, decals, tags and signs and more. While it may seem easy to search the internet to locate an offshore source for less expensive products, it's not so easy to manage these suppliers, their quality, delivery and production schedules, as well as maintain knowledge of the specifications and standards inherent with the telecom/datacom industry. That's the value you get working with the PREMIER team.

We have been successful for over 30 years because we relieve supplier "pains" and drive solutions. We do not allow an environment where performance issues, customer complaints and unnecessary truck rolls result in higher overall costs. In today's economic environment with increased local competition, customer churn and shrinking demand for legacy service, we understand cost savings is a critical element for service providers. PREMIER can deliver savings to drive a bigger impact than ever for your business.

Through the changing marketplace and dynamic sourcing landscape of recent years PREMIER has faced more competition from newer startups. And while there are ways to achieve lower-priced products – using lower cost raw materials and cutting corners on Quality Assurance practices – PREMIER remains committed to product quality, performance and dependability. Our focus is to provide cost savings, not being the cheapest products out there.

PREMIER is a wholly owned subsidiary of KGP Logistics, part of KGP Companies. Quality has always been a guiding force in PREMIER and in 2004, we were the first in our organization to become ISO 9001 and TL9000 certified.

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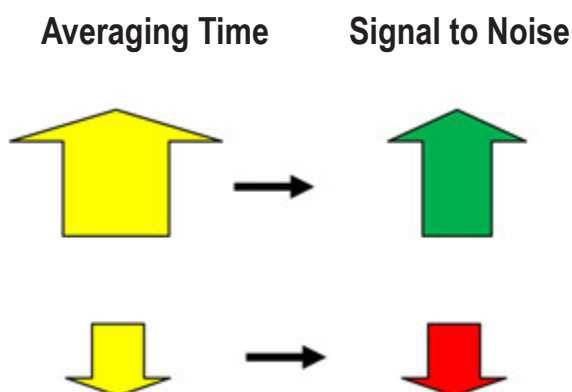




Continued From page 23 - Troubleshooting Fiber Installations using the 930XC OTDR

A wider pulse width decreases the resolution, but increases the dynamic range and will allow the OTDR to measure longer distances. A shorter pulse width increases the resolution, but decreases the dynamic range but the OTDR will only be able to measure shorter distances.

A longer averaging time will improve the signal to noise ratio which will allow the technician to see a more detailed trace with more clearly defined events.

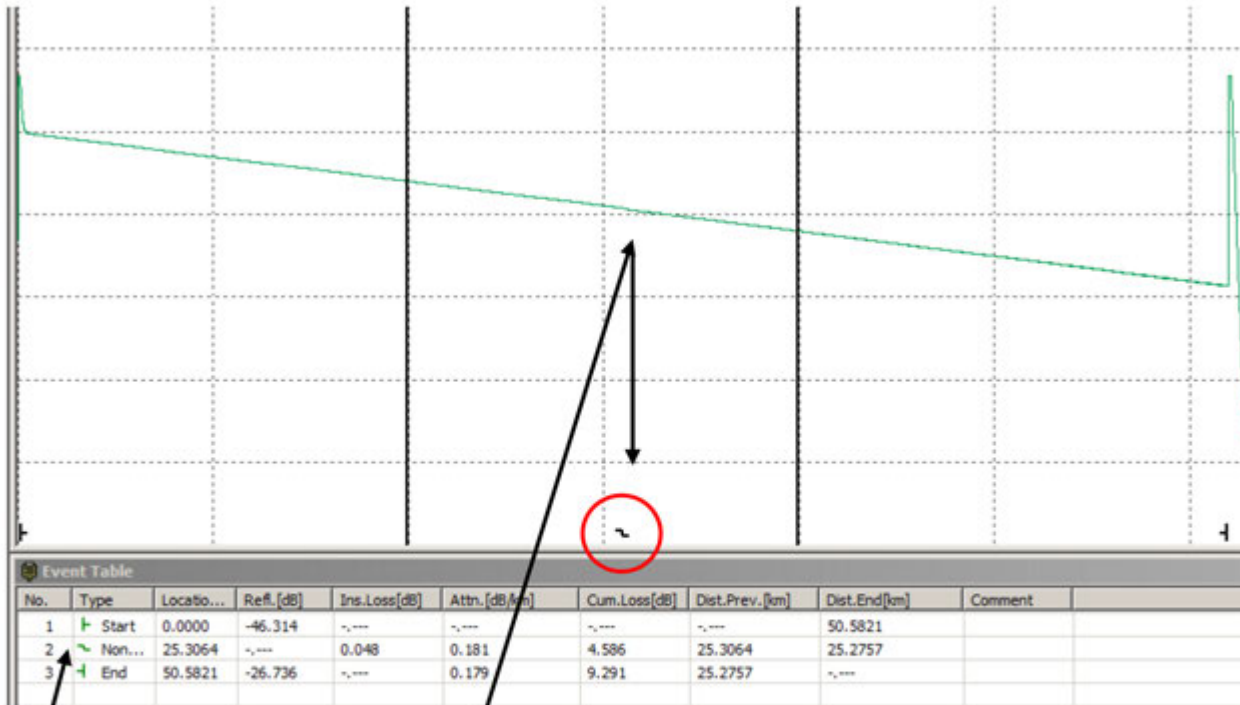


Other Causes of Fiber Losses

If fiber is rerouted after installation it may be subjected to macrobends caused by the fiber being moved and subsequently bent. Tie wraps that are overly tight can also cause macrobends. Dirty or damaged connectors and poor splices can cause losses in a fiber link. These types of losses are harder to detect and require the fine-tuning of the 930XC OTDR settings to attain optimum performance.

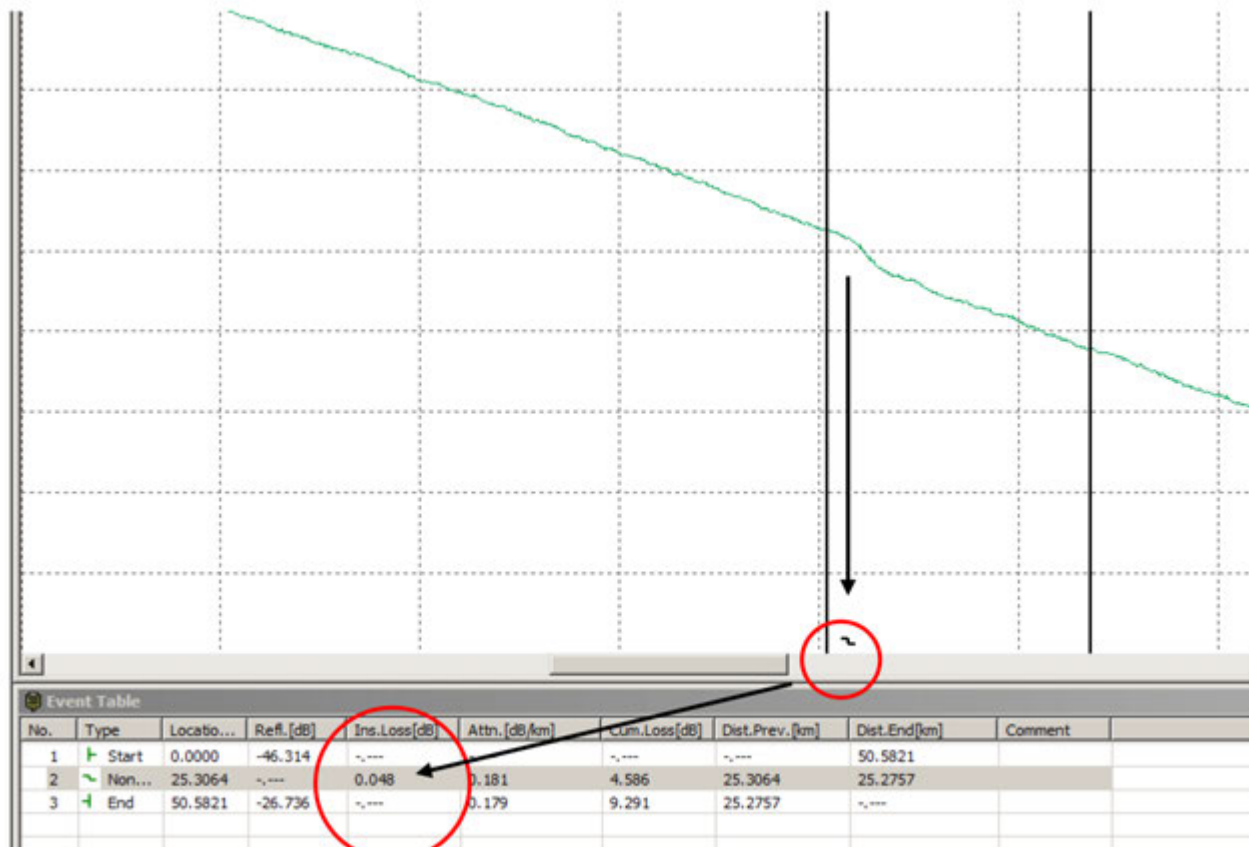
Troubleshooting Macrobends, Bad Connectors and poor splices

Small events such as macrobends, bad connectors, and poor splices can sometimes be hard to measure and characterize. The 930XC OTDR is capable of finding these events since it has a high dynamic range of up to 38dB (930XC-30). The high dynamic range of the OTDR is attained by the sensitivity of the detector and the algorithms that interpret the data. Some of these events can be less than 0.1dB. With events this small the technician needs to be able to set the range, pulse, width, and averaging parameters for maximum performance.



Symbol for a non-reflective event

Fusion splice found

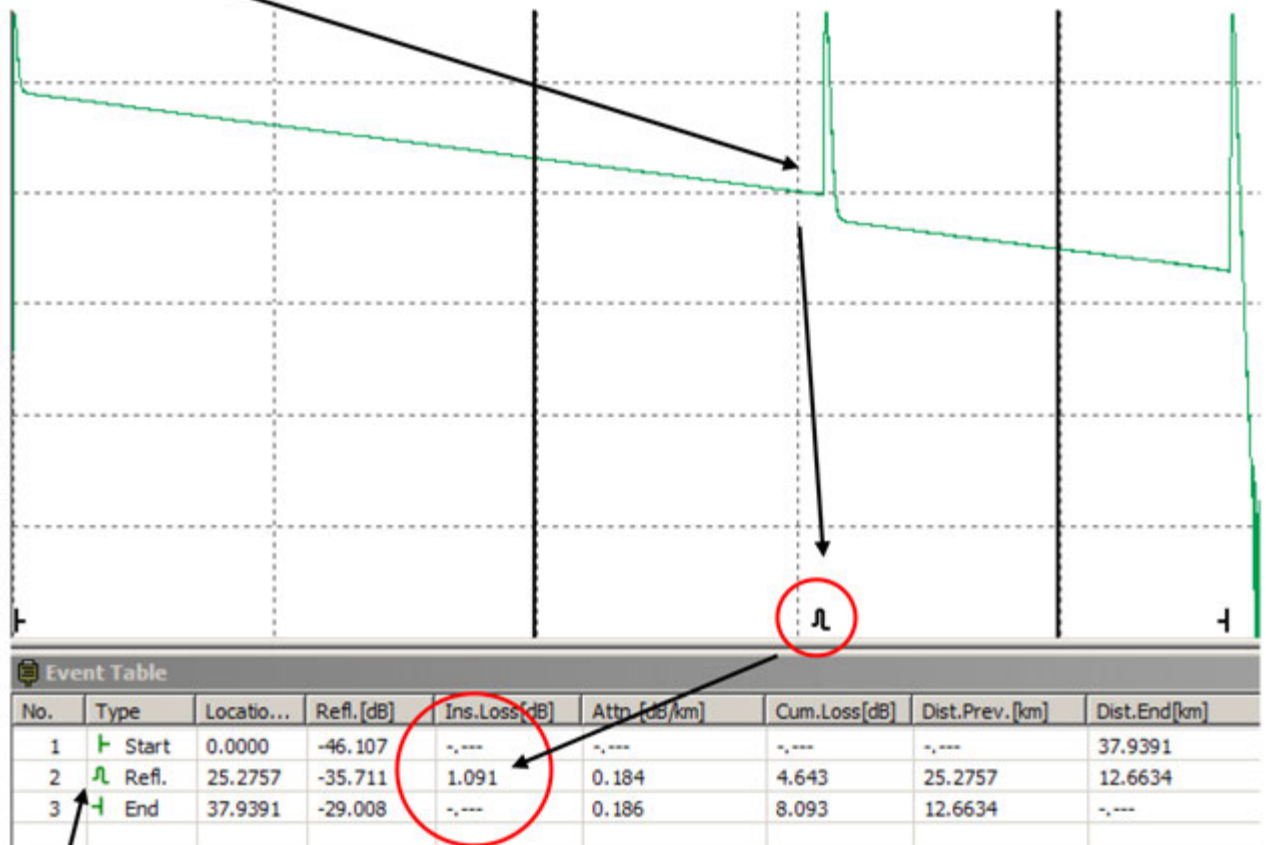


The 0.048dB fusion splice loss can be seen after zooming in on the splice



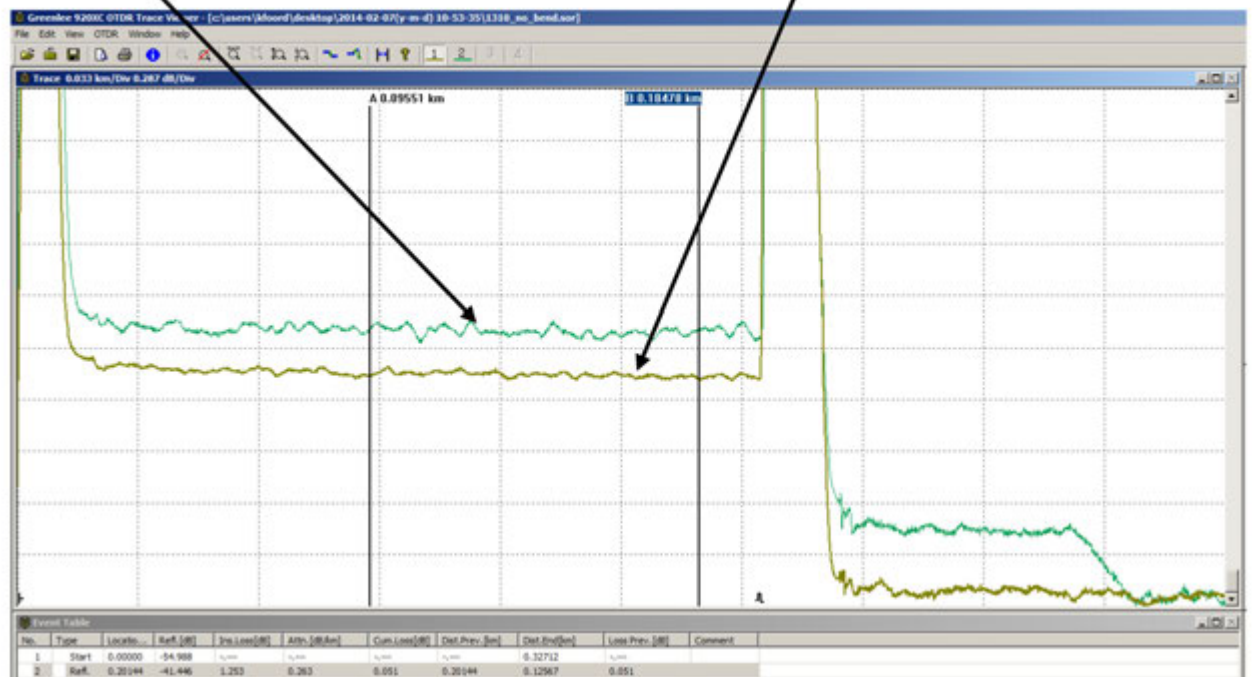


Example of a bad connector with a 1.091dB insertion loss and a reflective component of -35dB:



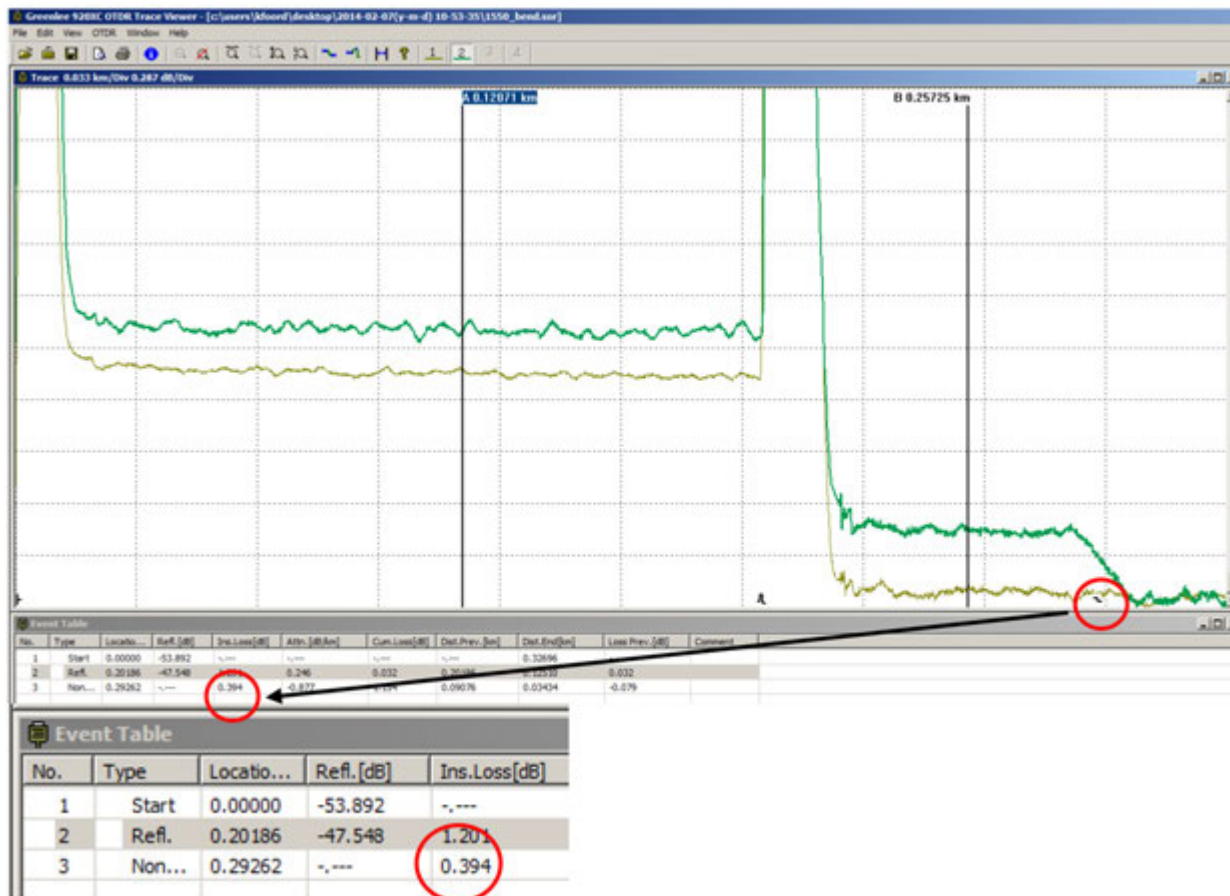
Symbol for a reflective event

Example of a macrobend event that has virtually no loss at 1310nm, but a significant loss at 1550nm:



Fiber link measured at 1310nm, and only two events annotated at 1310nm.

Note: The 1310nm trace is shifted down for easier viewing.



Fiber link measured at 1550nm. Note that three events are annotated at 1550nm.

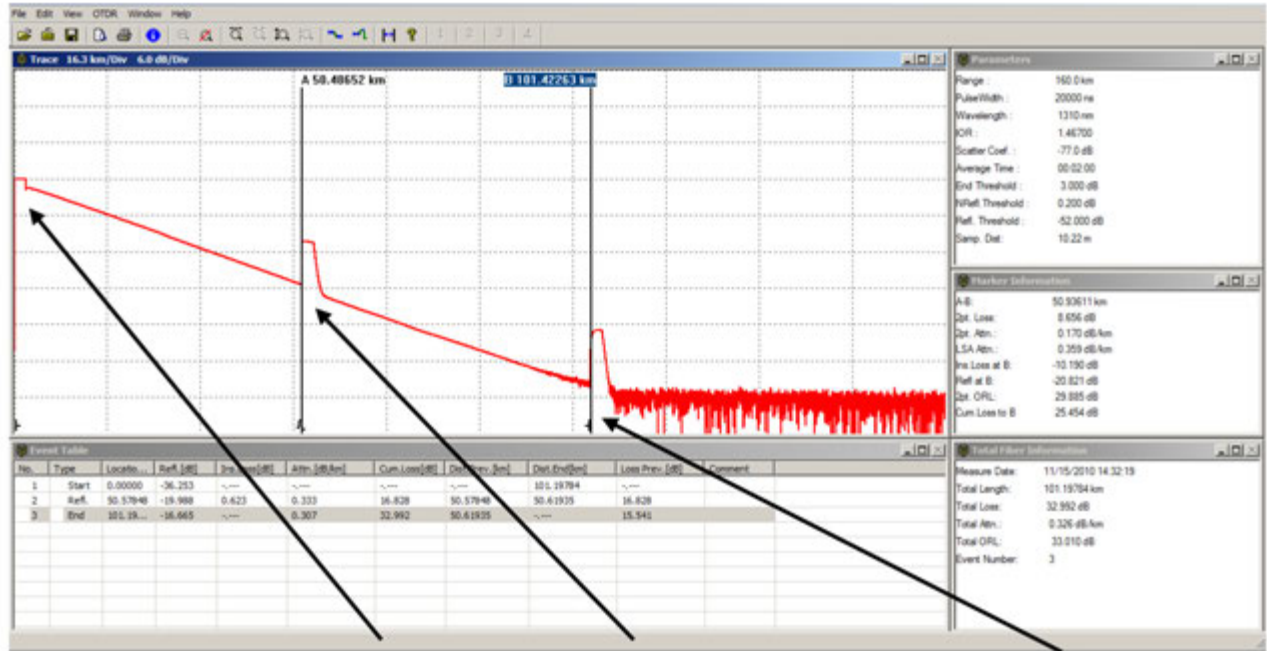
This is a typical example of a tie wrap causing a loss at 1550nm of 0.39dB, but very little loss at 1310nm. Macro-bends are more problematic at 1550nm due to the minimum bend radius of the fiber being exceeded.

Trace Viewer for Analysis and Documentation

The 930XC trace viewer software allows the technician to upload the saved files from the 930XC to a personal computer for trace evaluation. Compliance reports can also be generated using the standardized GR-196 SOR file system. All pertinent data including a time stamp and measurement conditions are recorded. Compliance reports can be exported as a PDF copy.

Event analysis is sometimes problematic and false events can be annotated with some events being missed. It is suggested that the technician uses the default analysis settings. The event threshold settings can be adjusted to make the annotation more or less sensitive. However, if the thresholds are set too low then random noise might be interpreted as an event.





Trace viewer showing the bulkhead, an event at 50km and the end of the fiber at 101km.

Event Table

No.	Type	Locatio...	Ref. [dB]	Ins. Loss [dB]	Attn. [dB/km]	Cum. Loss [dB]	Dist. Prev. [km]	Dist. End [km]	Loss Prev. [dB]	Comment
1	Start	0.00000	-36.253	-	-	-	-	101.19784	-	
2	Ref.	50.57848	-19.988	0.623	0.333	16.828	50.57848	50.61935	16.828	
3	End	101.19...	-16.665	-	0.307	32.992	50.61935	-	15.541	

The Event table clearly shows all events measured.

Parameters

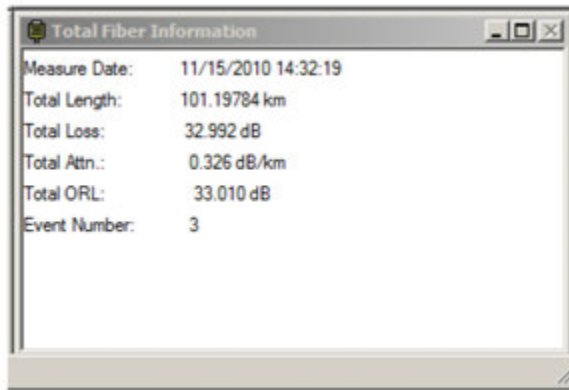
Range :	160.0 km
Pulse Width :	20000 ns
Wavelength :	1310 nm
IOR :	1.46700
Scatter Coef. :	-77.0 dB
Average Time :	00:02:00
End Threshold :	3.000 dB
NRrefl. Threshold :	0.200 dB
Ref. Threshold :	-52.000 dB
Smpl. Dist :	10.22 m

The Parameters Table shows all of the OTDR settings for the particular measurement.

Marker Information

A-B:	68.50064 km
Opt. Loss:	22.188 dB
Opt. Attn.:	0.324 dB/km
LSA Attn.:	0.346 dB/km
Ins. Loss at A:	-11.111 dB
Ref. at A:	-44.879 dB
Opt. ORL:	28.918 dB
Cum. Loss to A:	32.991 dB

The Marker Information details all measurements with respect to the current marker location.



The "Total Fiber Information Table" summarizes the entire fiber link including a time stamp.

Summary

- The 930XC OTDR can be used to locate catastrophic events such as a cut fiber or to find subtle loss events like macrobends and bad connectors.
- The trace viewer allows the technician to document and produce professional reports of installed fiber links and for use during later troubleshooting.
- The user can locate faults using the 930XC OTDR in the fully automatic mode with only minimum training. With experience the technician can become proficient at troubleshooting difficult faults.
- As the technician gains more confidence with the 930XC OTDR, they will learn the basic principle of pulse width versus resolution and dynamic range.





ADTRAN

Item No.	Vendor No.	Description
0000367745	1287701G1	TA 351, 2ND GEN
0000360629	1287702G1	TA 352, 2ND GEN
0000386904	1287702G3	TA 352H, 2ND GEN
0000434502	1287781F1	TA424RG 2POTS+4GE RG ONT

AFL

Item No.	Vendor No.	Description
0000432295	FM002711-BE	XFM-1U-B: Xpress Fiber Management 1U Patch Panel,Black, Empty
8800000469	FM002712-BE	XFM-2U-B: Xpress Fiber Management 2U Patch Panel,Black, Empty
Contact KGP Logistics	FM000691-B	XFM MPO Optical Cassette 24F LC UPC Single Mode
Contact KGP Logistics	FM000692-B	XFM MPO Optical Cassette 24F LC 50 µm LOMMF
0000432345	FUSEMPO-TL-KT	FUSECONNECT MPO TOOL KIT
0000408219	S015671	Fujikura 70R Fusion Splicer Kit w/CT-30,BTR-09,DC-18
0000397667	S015591	Fujikura 70S Fusion Splicer Kit w/ CT30A,

CommScope

Item No.	Vendor No.	Description
0000427343	L4A-DMDM-10-P-SGW	10' Din Male-Din Male LDF4 SureGuard Jumper - PIM Rated
0000387380	L4A-DMDM-8-P	8' Din Male-Din Male LDF4 SureFlex Jumper - PIM Rated
0000417117	158EZN	1-5/8" N-Female Connector
0000413371	SSH-114	1-1/4" Stackable Snap In Hangers
0000417361	SSHAK-3812	3/8" Stackable Snap In Hangers
0000408373	FT-TB	Black Silicone Weatherproofing Tape
0000417387	UGBKIT-0412-T	1/4"x4"x12" Tinned Copper Ground Bar With Universal Hardware
0000416817	SBNH-1D6565A	Quad Port Antenna 698-896/1710-2180MHZ
0000391093	SF-SU12-B	12'-6" Sector Frame - Purchase Antenna Pipes Separately
0000417405	SF-QV12-B	12'-6" QV Folding Sector Frame - Purchase Antenna Pipes Separately
0000433108	VSR-TS-B	Stabilizer Kit For QV Folding Sector Frame
0000391081	MC-PA12L-B	12' Monopole Co-Location Platform For 30-30" Monopole - Purchase Pipes Separately
0000409907	WB-K210-B	24" x 10' 2 Post Direct Burial Waveguide Bridge Kit
0000387437	SM-U2080	Universal Saddle Mount
0000387452	XP-2020	Crossover Plate For 2-3/8" Pipe
0000387411	MT-651-96	2-3/8" x 96" HDG Antenna Pipe
0000368963	CMA-DM60-CPUSEi	MIMO DAS Antenna 698-960/1710-2700 Mhz
0000369031	T-2-DM	2 Watt DIN Male Termination

Comtrend

Item No.	Vendor No.	Description
0000462058	Nexuslink 3120	VDSL2 Bonded Gateway, Quantenna 11ac (Dual Band, 2050Mbps), High Power (400mW), 5-Port Gigabit Switch, TR-069
0000464899	Nexuslink 3240	VDSL2 Bonded Gateway with VOIP, Quantenna 11ac (Dual Band, 2050Mbps), High Power (400mW), 5-Port Gigabit Switch, TR-069
0000465703	WR-6895	Telco Wireless Router, Quantenna 11ac (Dual Band, 2050Mbps), High Power (400mW), 5-Port Gigabit Switch, TR-069
8800000049	PG-9172	G.hn Powerline Ethernet Adapter – 1200Mbps, 1 Gigabit Port, Single Unit, HomeGrid Certified, TR-069
0000466865	PG-9172-KIT	Package of two G.hn Powerline Ethernet Adapter – 1200Mbps, 1 Gigabit Port, HomeGrid Certified, TR-069
0000462060	PG-9171n	G.hn Over Powerline Adapter - 1200Mbps, with Wireless 802.11n (300Mbps), TR-069
0000462061	PG-9172PoE	G.hn over Powerline Adapter - 1200Mbps, with PoE, TR-069
0000462062	GCA-6000-KIT	G.hn Ethernet over Coax Gigabit Adapter Kit (2 Adapters) – 1200 Mbps, TR-069
Contact KGP Logistics	GCA 6000 single	G.hn Ethernet over Coax Gigabit Single Adapter – 1200 Mbps, TR-069. You can buy these in a kit of 2 of in singles

Greenlee

Item No.	Vendor No.	Description
Contact KGP Logistics	930XC-30F-APC-SC	OTDR, SM TRIPLE FILT,13/15/16, OPM,SLS,A
Contact KGP Logistics	930XC-30P-APC-SC	OTDR, SM TRIPLE PON,13/14/15, OPM,SLS,AP
0000386165	TV220	Tdr Cable Scout Tv220
0000405502	TV90US	Cablesout TV90 TDR
5522040816	77HP-G/6A	High Pwr Tracer W/6A Clips UPC#08688
0000432782	910FS-KIT2	KIT, FUSION SPLICER, CONTRACTOR (910FS)
0000424281	FI-100 KIT	Fiber Identifier Kit, 250 Um, 900um, 2.0 Mm And 3.0 Mm Adapters

Preformed Line Products

Item No.	Vendor No.	Description
Contact KGP Logistics	COYATC	Fiber Optic Dual Chamber Aerial Termination Closure to Support Drop Distribution Networks
Contact KGP Logistics	COYDTC2	Fiber Optic Drop Termination Closure Above and Below grade applications to Support Drop Distribution Networks 2 Grommets
Contact KGP Logistics	COYDTC4	Fiber Optic Drop Termination Closure Above and Below grade applications to Support Drop Distribution Networks 4 Grommets
Contact KGP Logistics	COYDTC6	Fiber Optic Drop Termination Closure Above and Below grade applications to Support Drop Distribution Networks 6 Grommets
Contact KGP Logistics	COYDTC8	Fiber Optic Drop Termination Closure Above and Below grade applications to Support Drop Distribution Networks 8 Grommets

PREMIER

Item No.	Vendor No.	Description
0000419425	PT-KJKSC-85	Snap-In SC Single-Mode Fiber Module in White Compatible with APC/UPC/SPC/PC connectors. Jack Module Insert Will Snap Into Keystone Style Faceplates and Housings Ceramic Sleeve.
0000439505	CA-38F / 30382	Heavy Duty Post Hole Digger

Schneider Electric (APC)

Item No.	Vendor No.	Description
0000354106	SMT1500RM2U	APC Smart-UPS, 1000 Watts / 1500 VA,Input 120V / Output 120V, Interface Port SmartSlot, USB, Rack Height 2 U

DeWALT - Stanley Black & Decker

Item No.	Vendor No.	Description
0000285497	DC725KA	Cordless 18V Compact Hammer Drill/Driver UPC 028877590233
0000109736	DC9096	Battery Pack 18 Volt XRP Battery Compatible with Entire Line Of Dewalt 18 Volt Cordless Tools
0000196886	DCD970KL	Hammerdrill/Drill/Driver Heavy-Duty Cordless 18 Volt 1/2 Inch Self-Tightening Chuck 3 Speed Include One Hour Charger (2) 18V NANO Phosphate Lithium Battery Packs
0000233263	DC9180	18 Volt XRP Li-Ion Battery w/ NANO Technology Heavy Duty UPC 885911007801

Viavi -

Item No.	Vendor No.	Description
Contact KGP Logistics		



Contact your KGP Logistics representative for more information about these products and the many other solutions available through KGP Logistics.

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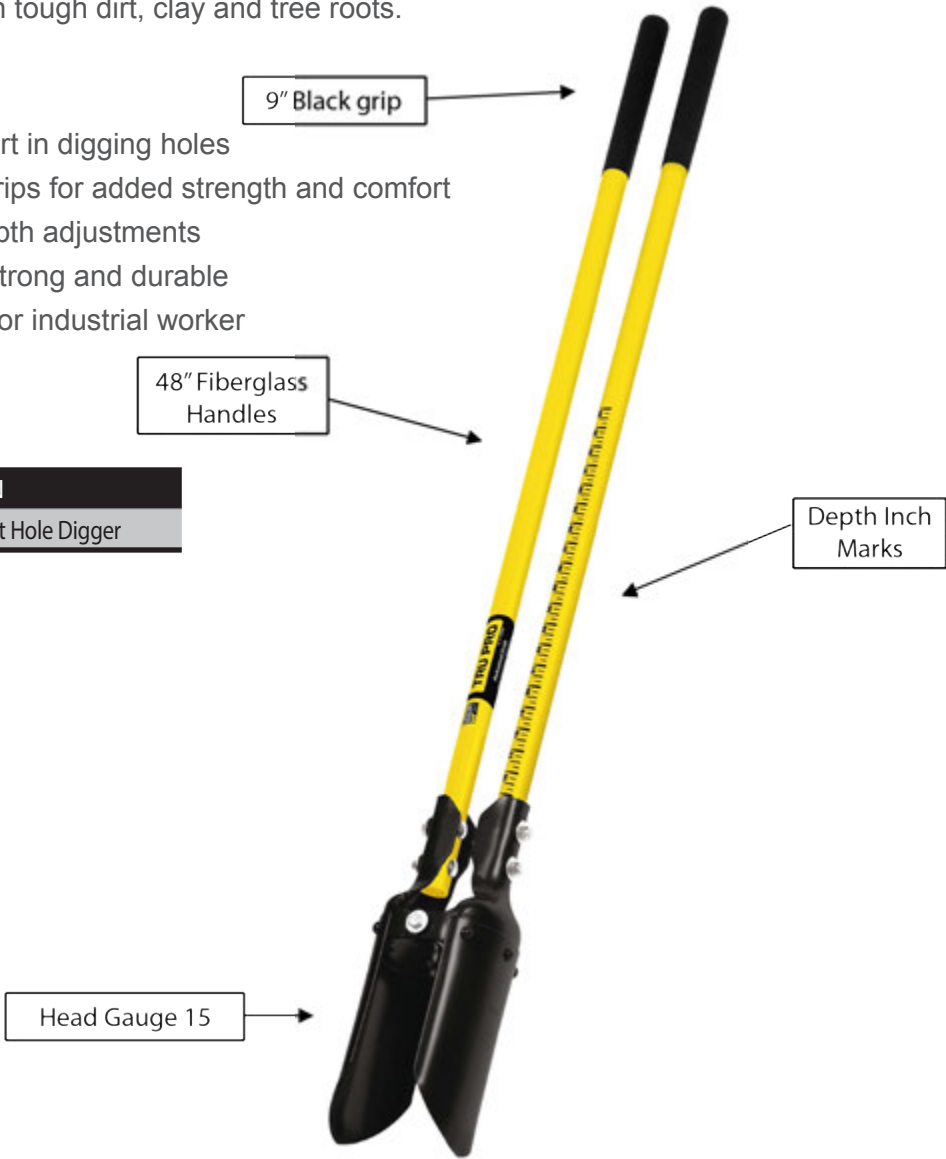
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- » Side Measurements make for easy depth adjustments
- » 15 Gauge tempered steel blades are strong and durable
- » Perfect for the professional contractor or industrial worker

ITEM ID	PART#	DESCRIPTION
0000439505	CA-38F / 30382	Heavy Duty Post Hole Digger



For more information, visit www.dependonPREMIER.com or call 1.800.755.1950.





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66031-8000

Upcoming Events

ACCESS



CTIA Super Mobility
September 7-9, 2016
Las Vegas, NV



BICSI Fall Conference
September 11-15, 2016
San Antonio, TX



ISE Expo
September 20-22, 2016
San Antonio, TX



SCTE Cable-Tec Expo
September 26-29
Philadelphia, PA



For a complete list of upcoming events visit www.kgplogistics.com/events.html

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