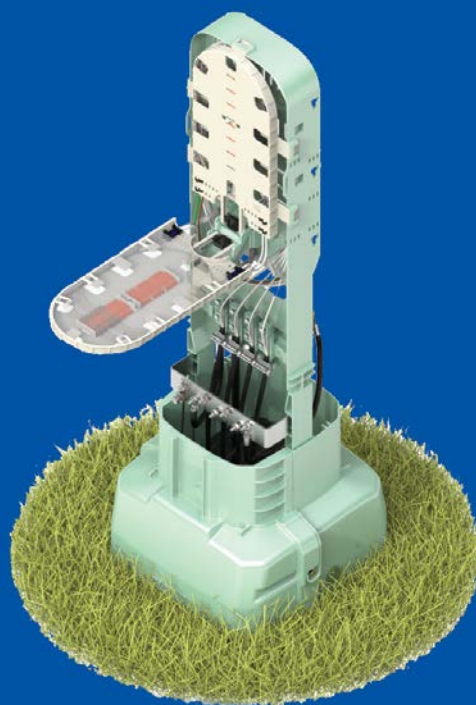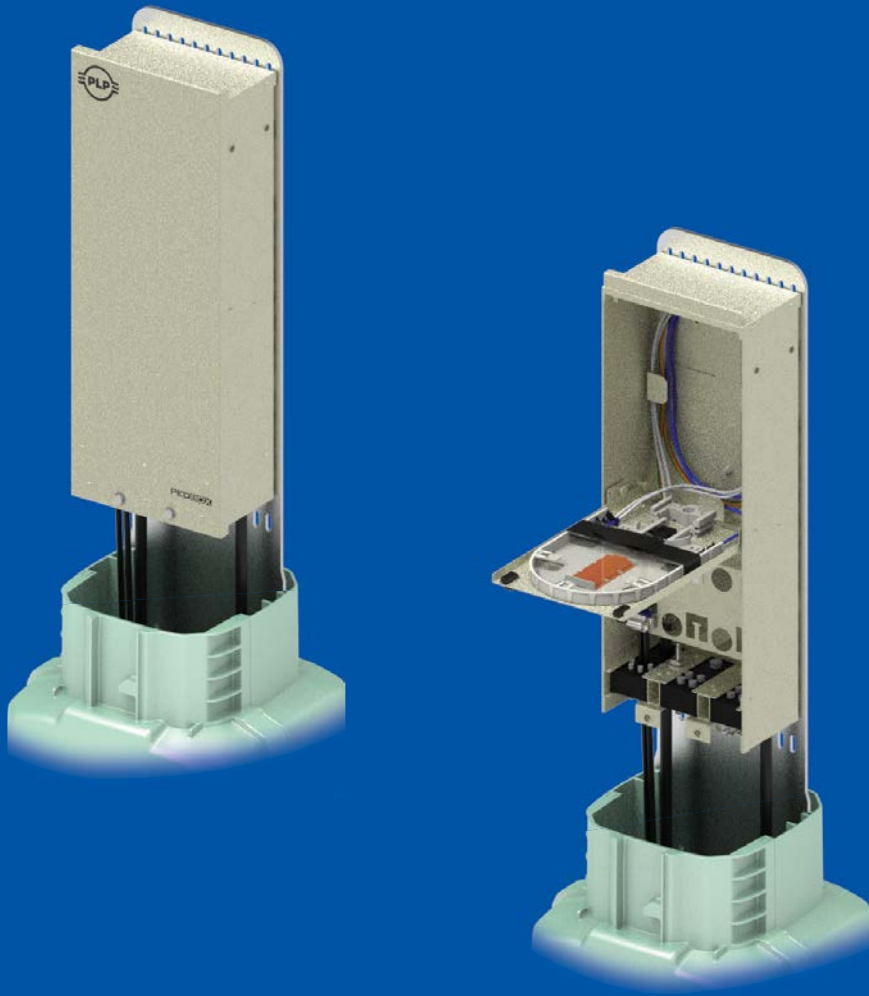# ISE

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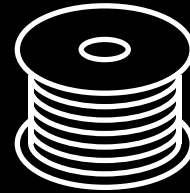
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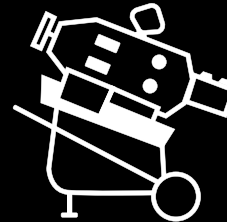
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Lightning in a Bottle

BENJAMIN FRANKLIN'S EXPERIMENTS with electricity, which involved a Leyden jar, have given us the expression "lightning in a bottle." 270 years later, we are again harnessing impulses through glass, but for billions of us across the nations of Earth to send love to our family or conduct business and governance at the highest level imaginable.

Of course, the expression "capture lightning in a bottle" also means, to quote author Candace Osmond, "to do something nearly impossible … seizing the extraordinary … achieving great success against all odds."

Few industries ask as much from their workforce as this one does. You're asked to materialize an ethereal data network connected at the speed of thought, and to do it yesterday. To meet both the needs of the many *and* the needs of the few.

But look around you. You've *already* done what no one ever could have foreseen. The lightning is in the bottle.

Nevertheless, when I got to meet some of you at ISE EXPO, I didn't encounter a lot of abstract, lofty sentiments. I saw people who pragmatically address the problem right in front of them, and then move on to the next one.

The powerful keynote presentations and the plethora of educational sessions made it abundantly clear to me that the only way forward is to continue taking it one step at a time. Carl Jung famously wrote, "if you always do the next thing that needs to be done, you will go most safely and sure-footedly along the path…"

ISE Magazine and isemag.com are here to connect, inspire, and educate you, so that the endless impossible demands become manageable challenges that cause growth on the global scale as well as the personal.

As the new Executive Editor here at ISE Magazine, I look forward to working with and learning from Editor-in-Chief Sharon Vollman, Publisher Janice Oliva, and many others who have made this magazine, and ISE EXPO, educational

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Visit www.isemag.com/contribute for more information on submitting an article to ISE Magazine in print, digital, and online.

forces in the industry. It's an honor to support this legacy.

In this issue, you'll see some of those who have captured lightning in a bottle, as we present the Honorees of our inaugural Network Innovators' Awards and recap the ISE EXPO Awards breakfast.

In our cover story, you'll find an in-depth conversation with Julie Slattery, Senior Vice President, Core Engineering & Operations, Verizon.

We'll also explore BEAD, workforce opportunities, hybrid connectivity, and a lot more.

I hope you all had a great summer, and I can't wait to see where this industry leads the world in the months and years to come.

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Fiber vs Wireless – Are You Kidding?

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WHEN I WAS IN HIGH SCHOOL in a suburb of Nashville, Tennessee, I remember a discussion in math class about politicians in our state who had tried once to pass a law making the mathematical constant pi (π) equal to an even number, 3, which we all thought hilarious. Later in life, I heard the same story ascribed also to the states of Indiana, Oklahoma, Kansas, and Ohio.

You probably remember from high school geometry that pi is the ratio of the circumference of a circle to its diameter, about 3-1/7 or 3.14. It is also an irrational number; no matter how many digits beyond the usual abbreviation of 3.14 you calculate, it's never exact.[1]

Trying to force pi to be 3 would not last long. In the era that the law was supposedly proposed, it would have been a problem for people making wagon wheels and gears for machinery, for instance. Legislating mathematical constants in a state legislature can give us all a chuckle.

But sometimes, these attempts at legislation can be more than just humorous. For example, one state senator called the Internet, "just a bunch of tubes". Other state legislators in Ohio recently attached a provision to the state budget bill, HB 23, which would limit future state broadband funding to fiber optic projects only. Whose lobbyist came up with this crazy idea? What politicians agreed to it? Having a state law allowing only fiber optics, effectively banning broadband funding for wireless, would probably shut down most broadband projects.

Since the allocation of the $43 billion in broadband funding has been announced, it seems a lot of people are taking leave of their senses.

There is no single solution to broadband any more than there is any single solution for telecommunications. Copper, fiber and wireless—all with their many variations—are needed to create a telecom network. How it's done keeps changing as technology evolves.

When I first started using the Internet in the late 1980s, I used dial-up phone lines at the office and the home. When we needed more bandwidth at the office, we had a T1 line on 50-year-old copper twisted pair wires. In February of 1997, I got one of the first cable modems on our home CATV coax, after helping run early field trials in my kids' school system. When Verizon came to FOA for help in 2006 for starting FiOS, FTTH finally took off.

My first cell phone was a brick, evolved into a flip phone, that was just for voice calls and eventually some texting. When the iPhone came out in 2007, we could finally access the Internet from a mobile device and since then it's been nonstop wireless bandwidth growth. By 1999, data traffic had exceeded voice traffic and since then has grown astronomically.

Today, wherever you are, you expect broadband. At home or in the office, most people have a landline Internet connection, with many businesses and homes now connected on fiber. Cellular service providers are also offering 5G home connections, touting the high-speed capability of 5G. Odds are that most of your devices connect wirelessly, mostly using Wi-Fi indoors and cellular outdoors.

In rural areas, it's not uncommon to have fiber running along roads and line-of-sight Wi-Fi connecting homes. Along many of the same roads are cellular antennas connected on fiber. This is all a way of providing broadband—fixed and mobile—to more people.

Even in cities, line-of-sight Wi-Fi can be used where installing fiber is difficult or to provide a solution until fiber can be installed. It is often used as a solution for connecting buildings from roof-to-roof to prevent having to install expensive private fiber optic circuits.

Cellular and Wi-Fi are not even the only wireless solutions. Satellites are also an option. At one point, when we were living on a farm in a rural town in California, we had DSL, cable modem, satellite, and cellular Internet connections. We needed reliability, so we had all of them to ensure we had 100% coverage. It also allowed us to compare the services.

The fastest, most reliable service on the farm was VIASAT satellite. The downside was it had usage limits, so it was not good for streaming video, but it was always available and fast when the others were slow and often unreliable—like during the rainy season! VIASAT is a very large satellite in a geostationary orbit, like TV satellites. The latest versions are the first "terabit" satellites, offering high bandwidth capabilities to rural areas.

The other types of satellites that have been in the news are low earth satellites like the Starlink satellites from SpaceX. These small satellites whiz by overhead requiring connections that pass from one satellite to another to provide coverage. Some of these new satellites can connect to regular cell phones also.

Of course, satellites depend on fiber optic ground networks. The connection to the satellite from the ground is wireless, but then they must also be connected into ground-based networks to access the world's telecom networks and the Internet. VIASAT has a network of around 100 ground stations to connect their satellites. Starlink probably needs many more to cover their fast-moving satellites.

What's common about all these wireless options? All wireless systems are wireless only from the customer device to the antenna, then they are connected into the telecom network on fiber.

We all agree that fiber-to-the-home (FTTH) provides the highest broadband bandwidth but building a FTTH network often cost more and takes longer to build. Wireless networks can often be deployed quicker and provide service immediately, even if it is just an interim solution as FTTH gets built. And maybe it's good enough for a long-term solution.

The point that needs to be made to legislators (and lobbyists and maybe broadband officials) is that "one size does not fit all". A functional broadband system should have both fiber and wireless available. And most of the time they can share a fiber backbone in an open access system. ∎

REFERENCES AND NOTES

1. To 39 decimal places, pi=3.14159265358979 32384626433832795028884197. The value has been calculated to trillions of digits!

Jim Hayes is a VDV writer, educator, and President of The Fiber Optic Association.

Julie

Slattery

Senior Vice President, Core Engineering & Operations, Verizon

BY SHARON VOLLMAN

Leaders are guides. They set and achieve challenging goals. They take decisive action in less-than-ideal situations. They are students of their respective fields.

They allow themselves to be human and are authentic about walking a mile in their teams' collective shoes.

But the truly effective leader is more. To borrow a great description of a leader from a leader, I like what John Quincy Adams said, "If your actions inspire others to dream more, learn more, do more and become more, you are a leader."

With that, I invite you to learn from Julie.

TOPIC: 5G Network Evolution for First Responders

Verizon conducted a survey of nearly 2,000 first responders from across the nation and close to 80% identified 5G as a priority for their agency. First responders expect they will be using drones, augmented and virtual reality training applications and connected vehicles daily within the next five years, if not sooner. The daily use of drones is expected to rise by over 30% in the next four years alone.[1]

ISE: What is required by network engineering teams to meet the needs of our first responders?

Julie Slattery: Verizon's network teams prepare 365 days a year to ensure our network is built for reliability and resiliency. This starts with how we engineer and design the network—including redundant paths and backup power.

Network engineering teams are tasked with hardening network assets all year, so when an emergency happens, we are prepared to support first responders on the ground and to keep customers connected when it matters the most. This requires operational discipline in activities like exercising our generators, pre-staging fuel deliveries, and deploying additional mobile assets to provide temporary service when necessary.

We also maintain a specialized group of Verizon network engineers called MERIT[2]—Major Emergency Response Incident Team—to be deployed when necessary to protect Verizon's network assets and facilities during natural disasters or hazardous materials incidents.

Our Verizon Frontline Crisis Response Team provides on-demand, emergency assistance to government agencies, first responders, frontline workers, and

Julie and team checking out the upgraded network at the Asbury Park, NJ, boardwalk.

Figure 1. Tethered drone at Punta Rassa providing cellular coverage for Sanibel Island.

communities—to help maintain mission-critical communications when they're needed most. We have more than 200 certified drone pilots, and one-of-a-kind solutions developed with and for first responders (e.g. THOR[3], MUTT[4], THOR's Hammer[5]). And Verizon Frontline delivers the most reliable 5G network for first responders in more cities today while continuing to help agencies build for the future.

TOPIC: Network Security

ISE: Share the network security approaches—like SASE (Secure Access Service Edge) or others—Verizon is adopting to help with this.

Slattery: Security is built into Verizon's networks by design. We embed controls and services directly into our network such as DDoS Protections. Further, we have become one of the first Tier 1 telecom providers to be accepted as a participant of Mutually Agreed Norms for Routing Security (MANRS)[6], which is a global initiative to help reduce the most common routing threats. We are also seeing an uptick in private 5G sales whereby we are replacing customer Wi-Fi solutions due to performance and better security. We also have a significant investment in Managed Security Services and Professional Security Services.

We work directly with our customers to risk assess their environments and develop solutions that meet their needs from our ThingSpace platform for IoT security, to SASE solution to support their Zero Trust Architecture goals and address more people working remotely. We also recently launched our Threat Protection services for our Fixed Wireless Access product.

TOPIC: Network Automation

ISE: What is Verizon doing to automate their networks to streamline network operations, reduce human errors, improve efficiency? Talk about your network automation successes and how it will impact field teams.

Slattery: Network reliability is the single most important thing we can offer to our customers. We are monitoring the network 24/7/365 and perform audits for overall health of the network to ensure our customers have a superior network experience and to fix any potential problems before they impact the customer. Alarms and big data telemetry provide self-healing and optimization across the network (RAN, transport, and core) using data intelligence to reset equipment or run commands to restore an outage. We're also able to see configuration deviations from original install/activation time setup due to various triggers—such as change management activities performed by a dispatch technician—and we're able to identify and restore those to original condition and avoid outages.

Verizon has a culture of accountability and awareness to minimize preventable incidents and human errors. We have ongoing learning and development campaigns that educate engineers on new technology and operational activities, ensuring they evaluate the impacts before any changes are deployed.

We also have great partnerships across the business with network teams, systems and process teams, and AI teams working together with common goals of driving efficiencies, automation and using predictive analytics to improve reliability. As we virtualize network functions it enables us to increase efficiency, productivity, and agility. Automation of network functions is a key part of the strategy to keep up with growing demands. This enables our field teams to keep pace with increased volumes and workloads, while driving increased efficiency as the network grows.

TOPIC: Network Restoration Successes

ISE: Talk about how network installation and restoration processes will change with robotics and when we can expect to see those changes.

Slattery: Robotics are being used today. They are an active part of our network installation and restoration efforts. It's

proven to be faster and safer, especially during moments when restoration efforts are needed. During natural disasters or emergencies, we've been able to leverage robotics for both mini cell tower service and to assess damage in hard to access locations. This makes for a faster recovery and shorter outages for our customers.

For example, last year we deployed drones during the recovery efforts after Hurricane Ian. When the bridge connecting Sanibel Island to the mainland collapsed and wireless service needed restoration, Verizon launched a tethered drone outfitted with a cellular node (a flying cell site) that provided cellular coverage from the air to support search and rescue teams and first responders on the ground. (See Figure 1.) The drone provided coverage for an approximate 5–7-mile radius and could fly for up to 1,000 hours. When first responders and customers are limited and unable to get access to critical information and help, the temporary coverage a drone provides can significantly help the situation.

TOPIC: AI

ISE: How is Verizon using AI across the network?

Slattery: We use AI for force models to predict growth and capacity needs to ensure that we have the right resources in the right places, we use AI for predictive analytics and

Verizon works with local public safety officials after Hurricane Ian.

insights into network trends so we can proactively address issues before they occur, and we use AI to understand customer insights so we can better respond to their needs.

Among some notable use cases, Verizon used our own AI platform[7] to help build our 5G network.[8] The AI models, designed by in-house data scientists, factor in multiple variables that can alter the strength of 5G signals, the position of the transmitter, as well as other nearby transmitters.

Recently, we announced we are also using artificial intelligence and machine learning to analyze over 10 million 811 dig requests annually to identify which requests pose the greatest risks for accidental fiber damage. A Machine Learning algorithm generates a score each day using the probability of a specific fiber cable at a specific location on that day being damaged due to construction/excavation activity. At any given day, there are 50-100K such locations in the US, and each of them is given a risk score (1-100). From there we can help deploy interventions to prevent accidental cuts for the projects deemed most high risk.

TOPIC: Network Upgrade and Customer Transparency

ISE: Verizon has been talking about their biggest network upgrade ever; can you expand on this and what it means for customers?

Slattery: Verizon is upgrading its network around the country to make sure our customers continue to have the excellent experience they've come to expect from Verizon. This has meant multi-year redesigns of our network architecture deploying the C-Band[9] spectrum we acquired in 2021. Network upgrades include deploying new cell sites to extend coverage and capacity in local communities, adding more capacity on fiber optic cables to move more data through the network and adding bandwidth to the cellular network to accommodate new services like wireless Internet service for homes and businesses. In the spirit of transparency, we're proactively notifying customers about upgrades in their area.

TOPIC: Personality Trait

ISE: What are some of the most important personality traits someone needs to succeed as a leader?

Slattery: For me, two traits that I value the most are listening and humility. I find these are often underrated. We cannot successfully lead teams by doing all the talking and telling them what to do. We need to listen, to understand how things are really working, to understand challenges, to hear ideas, to empower our teams and learn how we can best support them. The second trait I value most is humility. Leading is about building the strongest teams we can and achieving a greater good. The best leaders—to build the strongest teams—need to be confident enough to surround themselves with people who are better and stronger than them in many

Julie with Verizon drone pilots.

ways. They don't need to be the smartest people in the room, and they don't have huge egos. They bring people together, recognize and value strengths, and create an environment that enables each team member to utilize those strengths to their maximum potential to contribute to the team achieving their goals.

TOPIC: Leadership Style

ISE: Please share ONE leadership principle that encapsulates your leadership style.

Slattery: There is no one right way to lead. It's important to lead with authenticity—true to who you are, comfortable and confident in your approach, which may be different than others. If I had to pick one quote that is my guiding principle in leadership, it is "True leaders don't create followers. They create more leaders".

I believe deeply and spend a lot of time developing and investing in leaders at every level with the goal of leaving an impact with stronger leaders for our business. I learn as much as I offer and so I develop myself through this process as well. I do this through offering and creating opportunities to stretch skill sets in new areas, through sponsoring, advocating and mentoring talent across the business, through helping others see their own strengths and new areas they can add value, through constructive feedback on areas of opportunity, and through sharing my own experiences—the good, the bad, and the ugly—in the hopes that others will connect and relate to those experiences.

TOPIC: Risks

ISE: What's the biggest professional risk you've taken?

Slattery: My career has been built by taking a series of risks repeatedly. That is, to leave a role I was comfortable and performing well in to take on new assignments in new areas where I had to learn whole new spaces. I have lost count of the number of roles I have had over my 26 years at Verizon. Some

moves were promotions, many were lateral moves. Each time I have changed roles I have done so deliberately to expand my knowledge of the business. Many times, this meant leaving teams where I knew I was highly rated and developing subject matter expertise to take on assignments in unknown territory. Over the years, this has provided me with a breadth of experience and relationships that continue to be extremely valuable to me. I always encourage employees to not stay in any one role too long. There is no right length of time, as I'm often asked, but you need to be aware if you are continuing to learn and grow. When you are ready to make a move, look to spaces that are a far enough leap to push your limits and broaden your exposure to different parts of the business.

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ABOUT JULIE SLATTERY

Julie Slattery is SVP of Verizon's Core Engineering & Operations team. In this role, she leads a team of nearly 7,000 network engineers and technicians who build and operate the most reliable, highest performing and secure networks for Verizon's customers, including deployment of the 5G core. Her team is also responsible for Verizon's business continuity program, ensuring that Verizon can serve customers and keep them connected when it matters most. Throughout her tenure at Verizon, Julie has held a variety of leadership positions of increasing responsibility across engineering, operations, and customer experience. She has led large, global organizations serving Verizon's wholesale, multinational enterprise, and consumer customers. She holds a master's degree in technology management from Stevens Institute of Technology and a bachelor's degree from Wake Forest University. Follow her on LinkedIn: www.linkedin.com/in/julie-slattery-balsamo-86b86a43/. For more on Verizon, visit www.verizon.com. Follow them on Twitter @Verizon, LinkedIn: www.linkedin.com/company/verizon/ and Facebook: www.facebook.com/verizon.

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Cheri Beranek, President & CEO, Clearfield

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+ TOPIC
Operational Realities

ICT industry analysts and observers often focus on CAPEX budgets. But the reality is that OPEX can make or break the bottom line. The key to controlling OPEX is improving network life cycle management for complex fiber, and legacy networks in a cost-efficient manner. How is Clearfield ensuring network service providers can reduce their OPEX?

Cheri: Clearfield designs products that reduce the complexity of installing and maintaining fiber networks. Fiber technicians installing the final connection to the home get measured not only on first dispatch resolution (quality) but also on the time it takes to complete the order (speed). In the past, meeting these key metrics relied solely on the skill of the technician. However, Clearfield innovations like the SeeChange® terminal and hardened connector system allow less skilled techs to meet these operational objectives using a 100% plug-and-play approach with minimal technical training.

+ TOPIC
Edge Compute

The growing demand for low-latency applications, data-intensive services, and real-time analytics will drive the deployment of edge computing infrastructure. How will Clearfield help BSPs in this area?

Cheri: Moving the processing functions of a data center further out to the edge of the network makes technical sense to reduce latency but it requires three things—a secure location (both logically and physically), sufficient power, and an abundance of fiber. The active cabinet portfolio from Clearfield satisfies all three and is uniquely designed with a fiber first approach in the outside plant environment with the ability to host compute resources directly in the cabinet serving as an aggregation point of multiple fiber feeds. These active cabinets are engineered to scale up in size to meet the needs within any locale—eliminating the need for brick-and-mortar buildings and huts. This allows BSPs to place the compute resources where they are needed the most—closest to the origin of the traffic source.

+ TOPIC
Fiber Field Realities

Time, talent, and cost are the enemies of BSPs as they work to deploy fiber deeper in the last mile. What are the best ways to help them defeat those enemies?

Cheri: Flexibility, a willingness to adopt new methods of fiber deployment, and training are the keys to success for BSPs deploying fiber. For example, the FastPass™ method from Clearfield utilizes in-cassette splicing within the fiber distribution hub (FDH) cabinet instead of using the legacy method of a splice case collocated with this FDH. The simple adjustment of moving the splicing function from the splice case in the vault into the cassette that is housed in the FDH cabinet saves enough installation time to double the number of cabinets placed in a given time period and meet or exceed BSP "Homes Passed" goals. BSPs can also benefit from Clearfield College training curriculum designed to educate students about fiber technology and allow them to obtain certifications on how to install fiber products. ∎

The 2023 ISE Network Innovators' Awards

At ISE EXPO 2023, Innovators' Award Honorees Were Celebrated for Their Outstanding Achievements

BY JOE GILLARD

TOP RIGHT: ISE Magazine Publisher Janice Oliva meeting with Honorees at the Awards breakfast at ISE EXPO. **CENTER RIGHT:** John Fitz (left) and Patrick Jacobi (right), Prysmian Group. **CENTER LEFT:** Guillaume Lavallée, EXFO (left) and ISE Editor-in-Chief Sharon Vollman (right). **BOTTOM RIGHT:** ISE Magazine Editor-in-Chief Sharon Vollman presenting the Awards at ISE EXPO.

In the world of telecommunications, innovation is the unseen force that powers the ever-growing global human network. Every small step, and every giant leap—from the first morse code message sent, to the finely tuned wireless and fiber optic symphony pulsing, emanating, and sparking all around us today—comes from the minds of those able to harness that force and wield it to move humanity forward.

To honor these telecom wizards walking among us, we've launched our inaugural ISE Network Innovators' Awards program. Each honoree has done something remarkable. Their novel ways of thinking, brilliant ingenuity, and dedication to solving problems have resulted in innovations that could take the industry to a higher level of speed, safety, and efficiency.

These innovations could have far-reaching impacts. They could be the catalyst for new directions in technology, techniques, and workforce management. By recognizing these innovators, we acknowledge their gifts to the world and hope those of you reading this will be inspired by their story and go on to change the world with your own innovations.

Categories

The diverse set of categories of the ISE Network Innovators' Awards program ensure that we compare apples to apples, and that no one realm of innovation is favored over another. Telecom ingenuity extends broadly across the industry and their applications serve many important functions.

The categories are:
- FTTx/Optical Networks
- Network Reliability & Maintenance/Testing/ Security/Damage Prevention/Safety
- Construction Digitization/Intelligent & Autonomous Networks
- Construction & Engineering/BEAD & Middle Mile Network Prep/GIS/ Edge Networks/Cost-Containment
- Network Systems & Architecture

FTTX/OPTICAL NETWORKS

Clearfield

Clearfield is a Silver Honoree with its SeeChange® Access Terminal and Hardened Connector System.

The SeeChange® Access Terminal and Hardened Connector System helps realize revenues quicker by simplifying numerous aspects of fiber installation including upfront planning and engineering along with a craft-friendly 100% plug and play approach.

From the judges: "This product brings plug and play into the FTTx world and will certainly make it easier for inexperienced fiber techs to install ... it may also shorten fiber outage times by doing quick plug and play replacements rather than spending time splicing."

"Investment in innovation is a founding principle at Clearfield. SeeChange® is just another example of a game-changing solution that helps our customers quickly and economically build fiber broadband networks." **- Paul Kmit, Technology Manager, Clearfield, Inc.**

Corning Optical Communications

Corning Optical Communications is a Platinum Honoree with its Evolv® Solution with Pushlok™ Technology.

Corning's Evolv® Terminals and drops support FTTP and 5G deployments in today's space-constrained environments with improved aesthetics and one-handed drop installation.

From the judges: "This product truly is transformational. Not only are the cost savings, space savings, and time savings impressive. If you can really reduce the time it takes to get local government approvals, you really have reduced the key barriers to deploy."

Corning is also a Gold Honoree with its MiniXtend® Cable with Flow Ribbon Technology.

The MiniXtend® Cable features Flow Ribbon Technology combining the flexibility of loose tube cables with the speed of ribbon splicing to help reduce installation time and cost.

From the judges: "Innovations in fiber continue to improve the installation and maintenance costs as well as improve the ease of fitting into duct and bending around corners. This product does all of that and more but with ribbonized fiber. Very impressive product!"

Emtelle

Emtelle is a Bronze Award Honoree with its QWKlink Pre-Connectorized Solution for All Telecom Operators.

Representatives from the winning companies joined ISE staff to celebrate brilliant industry innovations at the Awards breakfast at ISE EXPO.

The QWKlink drop cable allows for fiber connectors of specific types—whether SC or LC APC ferrule. It is small enough to store any excess cable in a two-inch square box and eliminates the need for fiber splicing.

From the judges: "Pre-connectorizing is the way of the future … This product allows you to pre-connectorize at one or both ends, this is a differentiator. The fact that this is done in a controlled environment drives up the quality of the actual splice."

Prysmian Group

Prysmian Group is a Silver Honoree with its SiroccoHD Microduct Cable.

This Microduct high fiber density cable helps reduce material usage, space requirements, transport and storage costs, and the size/cost of installation equipment.

From the judges: "The reduction in size with the SiroccoHD cable is impressive and ahead of most competitors. This is a great value in 'CO2 equivalent' reduction from both, the cable jacket and tube reduction itself and the duct size reduction the cable will be installed in."

Kristine Collins (left), Robin Queenan (center), and Sharon Vollman from ISE Magazine preparing to present the Network Innovators' Awards at ISE EXPO.

NETWORK RELIABILITY & MAINTENANCE/TESTING/SECURITY/DAMAGE PREVENTION/SAFETY

EXFO

EXFO is a Gold, Silver, and Bronze Honoree with its SmarTips, PXM/LXM, and D-Series OTDRs, respectively.

The company's SmarTips fiber inspection scope adjusts to the type of connector under test, prevents threshold selection mistakes, and makes fiber inspection easier than ever.

From the judges: "This tool is a real time and mover saver. Being able to change tips with just a 1/4 turn click saves the techs the time it takes to swap out tips or change tools. Love the fact you don't need the longer more expensive tips. Another great feature is the automated threshold settings."

EXFO's PXM/LXM Optical Loss Test Set MPO Certifier helps control OPEX by significantly reducing test time for single and multimode fibers.

From the judges: "The test speed is an excellent differentiation vs other products in the market and provides clear labor cost savings for installers—if it is 10 seconds faster than the next best device it saves ~1 hour test time on a 3456f in a data center, on each end! The device functionality in a compact form factor together with excellent learning and documentation tools are an added plus."

The D-Series OTDRs help increase operational efficiency and covers testing needs for access, PON, FTTx, metro, and last-mile environments.

From the judges: "The swap-out connector feature sets this test gear apart from its competition. This will prevent techs from making mistakes often made by swapping out the wrong connector type."

Anritsu

Anritsu is a Silver Honoree with its Network Master™ Pro MT1040A.

The Network Master™ Pro MT1040A transport tester is a single-instrument solution that supports 10G to 400G Ethernet installation and maintenance (I&M). It is the world's smallest class portable 400G analyzer and has a full range of built-in test functions to help lighten mobile operators' workloads.

From the judges: "This is a market leading instrument. The broad capabilities across network protocols and speeds seems unmatched and the compact form factor is an additional benefit."

CONSTRUCTION DIGITIZATION/INTELLIGENT & AUTONOMOUS NETWORKS

3-GIS

3-GIS as a Bronze Honoree with their CAD network management solution.

3-GIS's CAD network management solution optimizes workflow and helps expedite time to revenue by helping customers know where their fiber network assets are located and how they interact.

From the judges: "Fiber network planning and managing are crucial for a successful FTTH build. Reducing the cost with a modern tool that is GIS based is clear."

IQGeo

The Gold Honoree in this category is IQGeo's Network Manager Telecom.

IQGeo's geospatial software solution provides an intelligent digital twin of fiber operators' physical network assets to support their unique and complex network architectures.

From the judges: "Promising product that could be beneficial to many BSPs looking for a software partner versus building in-house. Love the single-platform approach."

CONSTRUCTION & ENGINEERING/BEAD & MIDDLE MILE NETWORK PREP/GIS/EDGE NETWORKS/COST-CONTAINMENT

VETRO

In this category, VETRO is our Bronze Honoree.

VETRO's FiberMap® is a comprehensive cloud-based platform that creates a collaborative environment to effectively plan, design, construct, and manage fiber networks, allowing them to capitalize on new business opportunities.

From the judges: "This product is a dream for those that manage/engineer fiber networks. Its accessibility helps with engineers working out in the field. The tracking mechanism is helpful in understanding why people made different changes to the network. It certainly creates time savings for both the people engineering the network and for those monitoring and doing fiber restoration on a network."

It's a time to celebrate success as Editor-in-Chief Sharon Vollman raises a toast to the Honorees.

NETWORK SYSTEMS & ARCHITECTURE

Amphenol Network Solutions

In Network Systems & Architecture, Amphenol Network Solutions is our Bronze Honoree.

Amphenol's LiNC™ Panel is an innovative approach to managing multi-fiber networks. It is a rapid deployment and high-density panel with integrated trunk spools, meaning that it can pay out fiber cable as needed, and it has up to four 12f/24f MPO breakout modules integrated, reaching a density of 48 SC or 96 LC breakout ports.

From the judges: "Density and ease of fiber access are the key metrics for panels in data centers/central offices and this product provides competitive attributes." ∎

Joe Gillard is Executive Editor at ISE Magazine and a contributing writer.

Ask the Expert

Not all fiber closures are created equal;
what to look for to protect your network investment

Spurred by a wave of government spending, it seems fiber cables are being installed pretty much everywhere, from downtowns to suburbia to some of the most rural outposts in this country. It's important to protect that valuable investment, and sometimes it's the little things — like the quality of the fiber closures being deployed — that play a big role in the performance of the network and the ease of repair once the initial deployment is wrapped up. PLP has been manufacturing and selling closures for nearly half a century. We talked with Matthew Becker, PLP's senior market manager, North America Communications, who offers his perspective on why closures are important in the network and why some are better than others.

MATT BECKER
Sr. Market Manager,
North America
Communications

Q: Why is a fiber closure's role in the network so important?

A: A fiber closure can be positioned in many places in the outside plant environment: manholes, handholes, direct buried, aerially, and anywhere from the head end — including a central office or data center — through the middle mile and last mile to the exterior of a customer's premises. Wherever they are, they are critical for the protection of the fibers and the connections you're making. You have to keep out water, dust, mud, our friend the squirrel, insects, and anything else you might encounter in the outside plant. Time is money, so anytime a fiber splicer has to waste time thawing out a frozen closure, dispersing water, or cleaning out unwanted debris, it adds more cost to your bottom line and potentially more downtime on your network.

Q: Why is it so important to address this issue now?

A: So much federal funding is coming into the U.S. broadband industry right now. There is all the new federal BEAD funding — $42.5 billion in total — as well as CAF, RDOF, ARPA, and many other federal- or state-funded programs that continue to drive broadband deployment. On top of that, there is a lot of private capital flowing in as well. The extended lead times for products that we saw over the past 18 to 24 months, along with this influx of capital, have attracted many foreign designs and products. OSP engineers, consultants, fiber splicers, contractors, and their companies now must decide what products are best suited for their networks.

Q: So you're saying that not all fiber closures are created equal?

A: There are some key differences, and one of the most important is how rigorously the closures are designed and tested. Key stakeholders should make sure they look for closures that have been tested against the GR-771-CORE standard. The GR-771-CORE is the Generic Requirements for Fiber Optic Splice Closures. PLP and other manufacturers contributed to the testing criteria of the GR-771-CORE standard. It provides criteria for analyzing fiber optic splice closures used in a variety of OSP environments and applications, covering functional designs, mechanical and environmental requirements, and performance tests. It addresses design, packaging and identification; features and functions; and performance requirements and objectives, tying in all of the technical criteria you would want to see in a fiber splice closure. It's the gold standard when it comes to evaluating closures. Some of the foreign equipment we're seeing come in has been tested to international standards, but those may not be as rigorous or all-encompassing as GR-771-CORE.

Q: How would these tests be different?

A: As one example concerning water tightness and penetration under GR-771-CORE, testing a closure is subjected to the equivalent water pressure of a 20-foot depth for seven days, and then it is examined to see if any water has penetrated the closure. Compare that to IP-68 testing, where the test requires putting the closure just one meter deep for 30 minutes. That's a massive difference in product performance. GR-771-CORE also involves a number of concurrent tests that fully evaluate the product and simulate the real-world environments it will operate in.

Q: What are the downsides of a fiber closure failure?

A: Network disruptions are costly. If a closure that's below grade has taken on water and frozen, it could mean broken fibers and an outage for a lot of customers. There is the immediate expense of the truck roll to get a fiber splicer out to do repairs, and then there is the fallout from less-than-thrilled customers.

Q: Is closure cost an issue in most deployments?

A: In large rollouts, it can be a consideration. The thing to remember is that savings can quickly vanish if non-quality or non-vetted products are deployed without regard for the testing or company behind the product. A rip-and-replace due to a non-functional or non-conforming product doubles the cost for the product and for the labor involved.

Q: Beyond the closure itself, what else is important in a buying decision?

A: Training and field support are too often overlooked when it comes to buying from a particular vendor. Most U.S. companies ensure field forces are trained properly in using their product. No matter the closure, if installation instructions are not followed or the field forces are not trained properly, it cannot perform adequately. Field support and high-quality customer service are typically also included in purchases.

Q: Any other advice you can offer to companies looking for fiber closures?

A: As an industry we need to keep in mind we're investing billions of dollars worth of infrastructure and we want these networks to operate reliably for 20 to 30 years. Selecting quality, thoroughly tested products is critical. ◼

Take Care of Your Rural Drop Network

And It Will Take Care of You

BY MARK BOXER

While the drop network is the shortest part of the network, it poses the most decision points for the typical network operator.

Working from the trunk network toward the house, there are multiple decisions to be made regarding the network architecture and components. This article will explore each section of the network, including the drop terminal, drop cabling, and the network in the home. These components are all interconnected, and the network should be examined as a whole, since decisions made for one part of the network may influence other parts of the network.

Section 1: Drop Terminal

An important decision is how to manage the drops at the terminal in the rural network. There are two main decision points.

The first decision point is whether to use a mid-span access closure/terminal or a pre-stubbed terminal, as shown in the pictures within this article.

A mid-span access procedure is the way drops have been done for decades. At the closure location, a short length of cable is stripped down to the buffer tubes. The fibers to be spliced are accessed and spliced to drops or pigtails, and the rest of the fibers are recoiled within the closure.

An alternative to this architecture is to pre-stub a terminal with a cable which is then spliced at a central closure location.

There are several factors that can help drive this decision. Many larger carriers with partitioned workforces often choose to use tethered terminals. They may have a "construction" crew that splices the terminals in place, and the "installation" crew then installs the final drop to the home.

However, many rural workforces don't have the same level of segmentation, so that division of labor may not hold as much sway with the rural carrier.

Also, many rural areas may have some distance between homes, which means the tethered cables will need to be installed for quite some distance. Tethered terminals can make sense in more densely populated areas.

From a cost standpoint, labor rates for different operations can influence the decision process. If the cost of running the additional tethered length is small relative to the cost of

splicing a closure, tethered lengths can make sense. However, in those instances where drop cable installation labor is pricey, it can be much more advantageous to install more closures and have shorter drop lengths.

A rough summary table is below.

Factor	Tethered Terminals	Mid-Span Closures
Labor segmentation	Often seen with larger carriers	Often seen with smaller carriers
Population density	Often seen with denser networks	Often seen with more rural networks
Number of closures or terminals	Typically, fewer	Typically, more
Drops per device	More	Less
Drop length	Longer	Shorter

The various types of closures and terminals can also be viewed as tools in a toolbox, and it may make sense to have tethered terminals in parts of the network and mid-span closures in other parts of the network. This approach is like the approach that is sometimes seen with splitter architecture, where centralized splits may be used in some parts of the network, where distributed splits are used in other areas.

The second decision point is whether to pre-connectorize or to splice/terminate in the field. For connectors, we believe that non-proprietary connectors provide sourcing flexibility to service providers by not locking them into a proprietary connector type. This will likely be a very important point over the next years, as we enter a time of unprecedented network building in rural areas across the country. There are many credible terminal options from different manufacturers using standard SC connectors that should be considered.

There is another alternative solution for drop cable management. Where previous networks may have either lashed or tie-wrapped drops to a strand, a new device known as Sherpa can be used to attach drop cables either to a trunk cable or to a strand. This device can be used with a wide variety of cables, and can significantly simplify drop management, especially in those situations where drop cables are mandated to have no

Figure 1. Sherpa device connecting drop cables to strand.

Figure 2. Typical flat and round fiber drop cables.

Figure 3. Round drop cable transitioning to 900-micron InvisiLight® cord inside the home.

more than a certain amount of separation from a host strand or cable. Figure 1 shows this device in action.

Section 2: Drop Cabling

Either flat or drop cables can be used in aerial or underground networks, and there are a wide variety of cables for different applications. Figure 2 shows different types of drop cables.

A relatively new option on the market is an EZ Bend drop cable that can be run outside and stripped to reveal a 900-micron InvisiLight ultra-bend insensitive cord inside. This option has the potential to eliminate the network interface device (NID) on the side of the house, saving both cost and optical loss. Figure 3 illustrates how this is done.

Section 3: In the Home

The network at the home has changed dramatically since the initial days of FTTH. Networks built prior to 2010 had the ONT almost always installed outside. Especially with the advent of wireless streaming video services, ONTs are now mainly installed indoors with wireless distribution inside the home.

A sometimes overlooked point, for the best location for wireless distribution, is often to place the ONT and wireless device at the center of the home. Ultra-bend insensitive fibers can enable these installations to occur quickly and virtually invisible inside the home, significantly enhancing the user experience.

These same fibers can also be used as network extenders, either enabling repositioning of the ONT, or with media converters and SFPs in a kit, enabling fiber service to be extended throughout the home.

While wireless network extenders are very well known, they're often expensive and may or may not work. Extending the fiber network using in-home fiber can be a less expensive and higher performance choice, and may also reduce truck rolls caused by poor wireless performance.

Although the drop and in-home network only makes up the final short length of the overall network, the decisions made in this portion of the network can affect the cost, reliability, speed of deployment and ultimately the end user experience with your network. There are many tools that can be used to build the last portion of the access network. Here, we've described three considerations to use when you're choosing the right tools for your toolkit. Use them well! ■

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Crunch Time FOR BEAD

Five Principles to Guide Us

BY JONATHAN SPALTER

I n 2021, the nation committed to an extraordinary investment in fully and finally connecting every American home and business to high-speed Internet. The Infrastructure Investment and Jobs Act set in motion a timeline to achieve this ambitious goal by 2030.

We have now reached a critical phase of this work. The National Telecommunications and Information Administration is managing the $42.5 billion set aside for deployment and announced in June how these funds will be allocated among the states. Now, state broadband offices are in the make-or-break role of translating federal resources into specific projects. They are currently determining the criteria by which they will vet applicants and ultimately make their selections.

In other words, it's crunch time for the work we all do together—state and federal policymakers, broadband providers, and all stakeholders—in converting the lofty goals set forth in the Broadband Equity, Access, and Deployment (BEAD) program into connected reality throughout the country.

These five principles should guide our future work together.

PRINCIPLE 1: Focus on Unserved and Underserved Locations

The Federal Communications Commission's new national broadband map[1] offers a granular view of where we need to fill deployment gaps. Through the BEAD challenge process, states have until the end of the year to weigh in on whether a location is unserved or underserved and therefore eligible for BEAD funding. Providers will have the same opportunity. In addition to delivering a more precise view of the work before us, this challenge process helps "de-dupe" the list of eligible locations—accounting for projects already underway and funded through other state or federal programs as well as projects advancing through the private investment of broadband providers. This attention to detail will help prevent the loss of funds to duplicative overbuilds, so every dollar can contribute to universal connectivity.

PRINCIPLE 2: Prioritize Experience

State leaders should insist on partnering with providers who have a proven track record of success. In their selection and vetting process, state officials should ask: does the applicant have

the experience, resources, technical know-how and round-the-clock capacity to ensure these networks are built, maintained, repaired, and secured for the long haul? No one understands better than network engineers that true, lasting universal connectivity is hardly a "set it and forget it" endeavor. The networks that BEAD monies fund must be sustainable in the long term.

PRINCIPLE 3: Encourage Holistic, Scaled Builds

States should select proposals that cover the widest swath of underserved and unserved locations possible. Underserved areas (defined as those without access to 100/20 Mbps service) should be tackled alongside unserved areas (those without access to 25/3 Mbps service). Past programs favored narrow builds to unserved areas due primarily to budget constraints.

Carrying that approach over to BEAD forfeits the program's game-changing advantage—its sheer size and scale. Tackling unserved and underserved locations separately would require multiple truck rolls, repetitive or duplicative fiber and backhaul deployment, and other added effort—driving up costs and delaying connectivity.

PRINCIPLE 4: Set Communities Up for Success

Each state should ensure rights-of-way and permitting processes are as streamlined as possible. This includes coordination with other branches of government and easement holders like railroads. Indiana, for example, is pre-certifying communities as "broadband ready"[2]—taking steps to reduce regulatory barriers, so they can hit the ground running once connectivity projects are approved.

PRINCIPLE 5: Embrace Public-Private Partnerships

The challenges associated with rural broadband connectivity require an enduring and constructive commitment across the public and private sectors. We should take the opportunity presented by BEAD to shore up the foundation of our work together. Throughout the country, we see strong and mounting evidence of successful public-private partnerships, which allow each party to play to their respective strengths in pursuit of a shared connectivity objective. Among the many examples, Ritter Communications worked with the city of Stuttgart, Arkansas, to upgrade that community of roughly 8,000 people to an all-fiber network. In New England, Consolidated Communications is bringing fiber to 1.6 million homes and businesses by 2025. Both companies have been committed members of their communities for more than a century. Working constructively with state and local partners, they are demonstrating the drive and experience that defines our industry.

These partnerships work, and we're seeing them replicated by innovative broadband providers and their community partners across the country. In sharp contrast, we've all witnessed the long and unfortunate history of municipalities attempting to build and manage their own networks. Partnerships where broadband providers and local officials each play to their strengths and experience consistently get the job done right, delivering lasting, reliable connectivity.

We Can Get the Big Things Done

As this work proceeds, USTelecom stands as a national resource[3] and partner to state broadband offices and all stakeholders who share our determination to finish and sustain the work of connecting everyone to modern, high-speed broadband.

It's true, the BEAD program represents a "once in a generation opportunity". But it's also important that we put this commitment in context. Our nation is walking the talk on its core values by putting up $42.5 billion in funding to connect the nation. Our industry—broadband providers—invest roughly $86 billion[4] each year to do the same. Together, these resources can be transformative for our country.

BEAD represents our opportunity to collectively demonstrate that we can get the big things done. We do so for the long term by working together to get the details right today. ∎

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Meet Them WHERE THEY ARE

Historic Fiber Deployments Demand Workforce Change

BY MATT FISHER

Consulting firm RVA's[1] recently released "2023-2024 North American Fiber Broadband Report: FTTH and 5G Review and Forecast" shared there could be 100 million+ fiber passings in the United States over the next ten years or so. This is in addition to the estimated 68 million homes already passed with FTTH in the US alone (63 Million unique homes excluding homes passed twice or more).

This effort demands a talented engineering and operational workforce. Unfortunately, the telecom industry faces a significant talent bottleneck, because older, more experienced workers are retiring or moving to new roles. Finding new workers who possess the talent, skills, and knowledge required to support the fiber rollout is becoming increasingly difficult.

Executives in the industry are not unaware of this challenge. According to a global survey by McKinsey,[2] 90% of tech executives and managers report skill gaps in their organization, or anticipate them to arise in the next five years. Furthermore, a recent study by Veriforce[3] highlights that 86% of telecom company executives identified a lack of skilled workers as the primary challenge facing the industry.

Additional factors have further complicated the task of maintaining a skilled workforce—regardless of age. Industry perception is one. Educational upskilling is another. Not because there aren't professional development options out there, but because they may be misaligned with industry needs, and the teaching methods don't resonate with younger engineers who need upskilling.

The real question then is how can operators accelerate fiber deployments with these headwinds?

The key is to attract and retain and engage two groups of talented professionals:

- Experienced current employees who can be upskilled to meet providers' engineering requirements.
- Younger digital natives who are motivated and excited by the latest technological advances.

Understanding Digital Natives

Let's explore ways to do this. McKinsey's study on "The Next Telco Battleground"[4] shares that the network engineering talent of operators needs to move beyond specializing in radio capabilities. With virtualization becoming prevalent, differentiation will rely on a broader range of tech skills and capabilities.

Operators and recruiters can and should seize this opportunity by empowering the digital natives they may already have on their teams.

Remember, digital natives are those professionals who grew up with digital tools and technologies, since they were born after 1980. Vantage Circle[5] does a good job sharing several key characteristics of digital natives:

- They are effortlessly comfortable with technology. They use multiple platforms to problem-solve and make decisions.
- They require immediate feedback for almost everything they do. Think about their social media habits; they seek high numbers of likes for posts.
- They value flexibility. They believe remote work and flexible hours allow them to be most productive.
- They demand cultural cohesion. They will only work for companies that value the same things they do. LinkedIn's research found 86% of these professionals will take a reduction in pay to work in a company that acts on the same values as their own.
- They want consistent positive feedback. If they feel their efforts are not appreciated, they will move on.

Leveraging their strengths and upskilling this talented cohort may be one strategy to solve the workforce challenges the telecom industry faces. The characteristics mentioned above share why companies should speak to digital natives' strengths by meeting them where they are—using technologies like interactive virtual training, gamification, and more. Then, take it one step further by upgrading the internal software used to manage their networks to be the "mother tongue" of those engineers who are digital natives.

Motivating Existing Employees

While a focus on new talent is crucial, operators must also remember to leverage the strengths of existing employees. The successful rollout of fiber relies on buy-in from all employees, ensuring everyone sees the value in new technology being implemented and feels actively involved in achieving business goals.

Operators should take existing employees' wealth of experience into account during the evaluation, selection, and implementation stages. By actively participating, workers witness the tangible benefits of digital transformation firsthand. This leads to a virtuous feedback loop, where employees recognize how meaningful their changes are and feel even more compelled to support digital transformations.

Existing employees are the backbone of company culture. Ensuring they are involved in the digital transformation process creates a culture of innovation and collaboration. By keeping your current employees top-of-mind, operators are more likely to build an efficient, productive, and motivated workforce made up of highly experienced and knowledgeable workers.

Meet Employees Where They Are

Remember, digital evolution may feel daunting to employees, particularly those of older generations. There is a risk of leaving workers feeling disenfranchised as a new generation of employees with more compatible skill sets is introduced to handle new technology. Broadband operators must take the steps to clarify the benefits of modern technology and provide assurance that implementation of more tech-focused technologies is not intended to replace employees but rather to enhance their working lives.

Digital natives and existing older employees benefit when technology meshes with their value system. Operators should highlight how technology democratizes access to vital information, equipping workers with the necessary tools to complete jobs to the best of their abilities.

Involving the entire workforce is imperative in the swift and smooth rollout of fiber technology. Operators can achieve this by providing up-to-date operational technology that capitalizes on the competencies of both digital natives AND existing employees.

Both groups deserve to continue professional development that helps advance network evolution. Consider upskilling in digital twin technology, virtualization, edge computing and other future imperatives that will meet your end-users and employees' needs. ◼

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Is Hybrid Connectivity Enough?

The Future Requires Heterogeneous Networks that Optimize Reliability

BY TRISTAN WOOD

With advancements in technology, and that which carries data across our ether, hybrid connectivity has become increasingly popular to optimizing communications. Promising a seamless integration of multiple network technologies, it aims to provide enhanced reliability, flexibility, and performance. However, upon closer examination, what many believe to be hybrid connectivity, isn't truly hybrid.

First, we need to think differently and take a close look at the "classic networking approach," and how failover, whilst offering a degree of resilience and redundancy, isn't truly hybrid. Despite its apparent benefits, hybrid does not truly embody the essence of hybrid connectivity. Failover refers to the ability of a system to switch to a backup connection when the primary connection fails. While failover mechanisms do indeed provide a level of redundancy, they do not fundamentally transform the nature of the connectivity architecture. Consequently, the degree of resilience is inherently constrained.

In a truly hybrid—or heterogeneous—network, multiple network technologies seamlessly work together, actively sharing the load and resources, combining, and binding together a variety of bearers from cellular and LTE to satellite and Wi-Fi into a single "pipe". In this way, it can deliver a faster and, more importantly, more reliable service.

In fact, a truly hybrid platform should go a stage further than that, accommodating and configuring itself for a range of other variables, depending upon each bearer's performance and other environmental conditions affecting it at any one moment in time to optimize performance and reduce costs—but I'll touch on that later.

When optimized in this way, a hybrid system can work through degradation and failure to ensure that single TCP connections are maintained and accelerated, regardless of the availability and performance of the underlying networks. This ability to optimize connectivity, even in the most challenging conditions, will deliver a truly consistent and uninterrupted user experience. In critical operations, where connectivity can be the difference between life and death, hybrid and resilience take on a whole new meaning.

Failover, on the other hand, relies primarily on a backup connection to take over in case of an outage, without actively utilizing the strengths and capabilities of both primary and secondary connections simultaneously. It is the concept of failover, I would suggest, which challenges the traditional orthodoxy of what hybrid connectivity really means.

Redundancy Is Not Optional

The need to be able to "connect" within any given environment—regardless of whether terrestrial infrastructure is available or has been compromised—is now more significant than ever. Live streaming of video, the transfer of data and voice calls are crucial within countless sectors.

Defense will always require multiple ways to communicate with fallback options. Emergency services need real-time access to ongoing incidents—whether that be drone video

footage above a forest fire in a remote or rural area—where cellular infrastructure isn't an option. The ambulance service is reliant on good connectivity to access patient data or the services of a clinician while on the move or at curb side. Telehealth triage will not work without hybrid connectivity and the robust bonding of all and any available networks.

Likewise, the marine industry meanwhile is utilizing the power of hybrid connectivity as yachts and commercial vessels navigate the seas, and even utilities require machine-to-machine (M2M) and IoT capability to control and monitor operations on windfarms, oil rigs and installations that are traditionally "out of reach".

With the relay of live video no longer the preserve of news organizations, but a mainstay of multiple sectors and consumers, the biggest challenges are no longer around relaying footage from A to B, but with the network and available bandwidth. Now, the key to delivering the highest quality video is bonding available networks to increase bandwidth, seamlessly correcting errors and optimizing the link.

Even the cars we drive and the appliances we use daily are harnessing variations of satellite, Wi-Fi, and cellular communications, and with low Earth orbit (LEO) satellites becoming increasingly accessible, the applications and opportunities are endless.

Factors such as latency, packet loss, and network congestion can hinder the integration of networks, resulting in suboptimal user experiences. As a result, the envisioned performance improvements of hybrid connectivity become overshadowed by the complexities and compromises it introduces in the classic approach—hence a need to think differently.

Security and Compliance vs Cost and QoS

Integrating different network technologies from diverse sources introduces additional security challenges and consideration across various network endpoints and connection points. The lack of a unified security framework can result in vulnerabilities and inconsistencies that make the overall network infrastructure more susceptible to cyber threats. Moreover, ensuring compliance with industry regulations and data protection standards becomes increasingly challenging in a fragmented network environment which incorporates public networks and the Internet.

When it comes to being efficient with cost-management, a key consideration is that with true hybrid, heterogeneous connectivity, different parameters can be configured to allow for cost efficiencies to be made. For example, with the transmission of voice calls, parameters can be set to allow for the most cost-effective bearer to be used if it's good enough—i.e., cellular can take preference over satellite if it's "stable enough," thus reducing the costs of always using satellite.

This also applies to the handling of Quality of Service (QoS), to ensure the performance of critical applications where there's limited network capacity, rapid variations in bandwidth and latency across each network. While security and compliance remain a network engineer's priority in many organizations, it should never be compromised by cost. In a true hybrid ecosystem, this compromise need never be a concern because factors such as priority, efficiency, and cost have formed part of the underlying design and mirrored in the configuration settings.

> " The lack of a unified security framework can result in vulnerabilities and inconsistencies that make the overall network infrastructure more susceptible to cyber threats.

Why does all this matter?

The adage says that if you do what you've always done, you'll get what you always got. But that's not the case in networking. If you do what you've always done in a networking environment—where the explosion of tech, amount of data being transferred, and the sheer weight of traffic vying for space on our heavily congested networks—you will in fact get less than you always got.

So, we need to think differently. Many hybrid systems are not the least bit hybrid, they simply provide a backup where the switchover is often measured in minutes. While this might be adequate for some, it doesn't meet the evolving requirements of industries that rely upon always-on, fail-safe connectivity, as cited earlier.

To achieve full hybrid connectivity, and as part of a European Space Agency (EAS) contract, we at Livewire Digital developed RazorLink, an industry-first Software Defined Networking (SDN) solution that can seamlessly and dynamically bond any number of bearers, from satellite, cellular, Point to Point radio, Wi-Fi, and terrestrial services in line with user-defined objectives and prevailing conditions. This is true hybrid, a WAN which is capable of efficiently combining high latency VSAT with low latency cellular, and any range of other bearers in between to create an aggregate service with optimized configurable bandwidth. We believe failover is not an ideal option in our data-hungry world. ∎

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Cal Poly Innovation Lab in Partnership with AWS, Federated Wireless, and T-Mobile. (Courtesy of Cal Poly)

T-Mobile, AWS, & Neutral CBRS Host **Launch Cal Poly's 5G Private Network**

BY WILLIAM J. BRITTON

"Introducing a 5G private network to Cal Poly meets three important needs: improving campus operations, enhancing core IT services, and connecting faculty and students in collaboration with faculty and partners."— Jeffrey D. Armstrong, President, Cal Poly

The challenge facing California Polytechnic State University (Cal Poly), an institution known for its Learn by Doing philosophy, was an immediate need to enhance its connectivity. Cal Poly sought a network solution that would optimize safety, communication, and research potential for its student and staff community. T-Mobile, a key partner in the endeavor, had to ensure its customers enjoyed the best experience possible, particularly in areas traditionally hard to reach for cell signals.

The answer to those pain points lay in collaboration. The key was using a wireless communication hub that integrated AWS Snowball Edge and AWS Snowcone services to support a multi-use private wireless network. Neutral hosting of the Citizens Broadband Radio Service (CBRS) band has emerged as a robust solution to address connectivity requirements, opening doors for academic innovation and seamless communication.

This convergent 4G and 5G technology utilized the CBRS band, a public-access, shared-spectrum model. Unlike legacy neutral host technologies requiring differing configurations for

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Cal Poly Radio Hill.
(Courtesy of Cal Poly)

each Mobile Network Operator (MNO), the Neutral Host 2.0™1 used an open, shared solution, thus eliminating the need for complex MNO-specific configurations.

The deployment of this solution started in remote hiking areas and the William and Linda Frost Center for Research and Innovation at Cal Poly. The private wireless network supported both private connectivity services provided by the university, and connectivity for T-Mobile subscribers, demonstrating an effective model of public-private network interoperability.

Enhanced connectivity and safety across the campus were achieved by leveraging the 4G neutral host over CBRS, thereby boosting the coverage experience in places like the Frost building and outdoor areas on remote hiking trails. The system's capabilities ensured students could make 911 calls in case of emergency, even from the most remote corners of the campus. Unmetered broadband streaming provided students the ability to securely stream class videos and other content over the private wireless network via self-provisioned mobile devices with an embedded subscriber identity module (eSIM).

High-speed, ultra-low-latency 5G connectivity opened new vistas for advanced research supporting next-gen use cases such as 3D image capture and augmented reality to manage the progress of site construction projects.

According to Sameer Vuyyuru, Director and Head of Worldwide Telecommunications Business Development at AWS, "Many buildings, such as those that are built with metal or concrete, or are LEED-certified, leverage building materials that can block cell signals inside the building. Signals can also be blocked by geographical landscapes, which impacts coverage and creates dead zones. A neutral host solution runs along with the private network on AWS edge compute, while a CBRS Spectrum Access System runs on AWS, providing an innovative, versatile, scalable, and low-CAPEX approach for building owners, campuses, and facilities to work with wireless providers to enhance coverage."

The combined efforts of Cal Poly, T-Mobile, AWS, and the neutral host partner, serve as a practical blueprint for addressing complex business challenges and exemplify the power that shared spectrum and an open ecosystem model can bring to higher education and private enterprise.

The Cal Poly project embraces shared spectrum, shared radio networks, and a standards-based interoperable ecosystem. This open ecosystem breaks down vendor silos, bridging the gap between public and private wireless. The framework significantly reduces cost barriers typically associated with vendor-specific models. The blend of technologies equips clients with superior private wireless capabilities and public cellular connectivity in previously unconnected indoor and

outdoor areas. This is done by leveraging CBRS to efficiently power a single radio network that can be simultaneously used by multiple MNOs. This is a major departure from the more expensive, legacy Distributed Antenna System (DAS) neutral host systems which needed separate radios to support different licensed spectrums for each MNO.

Mark McDiarmid, SVP, Technology Innovation and Industry Partnerships at T-Mobile, shares, "At T-Mobile, we want to make sure all our customers—both business and consumer—have the best experience possible. To help Cal Poly enhance coverage, we were able to use neutral host capability to quickly layer T-Mobile service onto Cal Poly's existing private wireless network, providing our subscribers with an optimal, game-changing network experience on campus."

This open ecosystem approach promotes the breakdown of vendor silos by merging the best 5G solution components based on customers' use-case needs. This strategy effectively negates the restrictions of vendor lock-in so customers can use their private wireless network to provide public cellular access as needed.

Cal Poly's unique 5G Innovation Lab sits at the heart of the ongoing development of new capabilities using this robust new network. A joint venture of Cal Poly, T-Mobile, AWS, and Federated Wireless, "The Innovation Lab and its partners are demonstrating ways to remove longstanding hurdles in technology adoption and enabling people at Cal Poly in shaping the future," noted Mike Bonewitz, Principal Solutions Architect at AWS.

The resulting converged network brings to life the vision of Cal Poly's CIO and Vice President for IT services, Bill Britton. Britton explained, "The wireless communications world is on the edge of exciting and beneficial advancements, and the innovative capabilities around private 5G, Wi-Fi 6E, and commercial 4G/5G are expansive.

> **Unmetered broadband streaming provided students the ability to securely stream class videos and other content over the private wireless network via self-provisioned mobile devices with an embedded subscriber identity module (eSIM).**

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Through our partnership with experts in the 5G space, the Cal Poly 5G Innovation Lab will answer questions about reducing wireless access points, providing wireless coverage in hard-to-reach areas, keeping secure transactions on a private network, designing, and operating digital twins, and improving remote search and rescue as just a few of the examples to be explored." ∎

REFERENCES AND NOTES

1. Neutral Host 2.0™, https://www.federatedwireless.com/products/neutral-host/?utm_source=publication&utm_medium=referral&utm_campaign=neutral-host-ISE

William J. "Bill" Britton is the Vice President of Information Technology and Chief Information Officer (CIO) at Cal Poly, and Director of the California Cybersecurity Institute. For more information, email hollyh@connectmarketing.com or visit Neutral Host 2.0™.[1] Follow Bill on LinkedIn: www.linkedin.com/in/wbritton/. Follow Cal Poly on Twitter @CalPoly and LinkedIn: www.linkedin.com/company/cal-poly-state-university/. Follow Federated Wireless on Twitter @FedWireless and LinkedIn: www.linkedin.com/company/federated-wireless/. Follow AWS on Twitter @awscloud and Linkedin: https://www.linkedin.com/company/amazon-web-services/. Follow T-Mobile on Twitter @TMobile and LinkedIn: www.linkedin.com/company/t-mobile/.

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