NOV/DEC 2023 VOL. 41 | NO. 6

ISE®

ICT SOLUTIONS & EDUCATION

EXECUTIVE INSIGHTS WITH

Chris Sambar

PRESIDENT – AT&T NETWORK

circet USA

Circet USA is a leading provider of network infrastructure services tailored to your specific needs, including the design, engineering, construction, and maintenance of telecommunications networks.

We build the networks communities need to thrive.

Visit us today at www.circetusa.com

"We think the most effective network security is not one or two special techniques but defending in-depth and with layers."

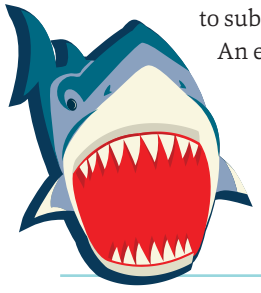
CHRIS SAMBAR, PRESIDENT – AT&T NETWORK— PAGE 10

CONTENTS

NOVEMBER/DECEMBER 2023

CONTENTS

NOVEMBER/DECEMBER 2023



IN EVERY ISSUE

CORRECTION: The Cal Poly article, running in the Sep/Oct issue, is missing a company name within the title. The correct title is "T-Mobile, AWS, Federated Wireless, & Neutral CBRS Host, Launch Cal Poly's 5G Private Network." We apologize for the error.

Continue your professional development with more articles online at www.isemag.com. Check in often for informative and educational online articles.

ISE ICT SOLUTIONS & EDUCATION

VOL. 41 | ISSUE 6

ISE Magazine USPS Permit 1511, ISSN 2470-0517 print, ISSN 2470-0525 online is published 6 times annually, Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec, by Endeavor Business Media, LLC. 1233 Janesville Ave., Fort Atkinson, WI 53538. Periodicals postage paid at Fort Atkinson, WI, and additional mailing offices. **POSTMASTER:** Send address changes to ISE Magazine, PO Box 3257, Northbrook, IL 60065-3257. **SUBSCRIPTIONS:** Publisher reserves the right to reject non-qualified subscriptions. Subscription prices: U.S. $32.00 per year; Canada/Mexico $50.00 per year; All other countries $115.00 per year. All subscriptions are payable in U.S. funds. Customer service can be reached toll-free at 877-382-9187 or at ISE@omeda.com for magazine subscription assistance or questions.

ICT Visionary Q&A

Allen Griser, Chief Commercial Officer, Clearfield

Using our in-cassette splicing within our FDH cabinets, we can do both—lower the cost and increase the speed. We call this our FastPass™ method and using it can double the rate of homes passed compared with legacy methods.

CLEARFIELD

For more information, visit www.SeeClearfield.com.

TOPIC

Partner Superpower

What are two superpowers Clearfield offers their provider partners?

Allen: What drives us is the opportunity to 1) reduce the cost of fiber deployment and 2) to increase the speed of fiber deployment. Using our in-cassette splicing within our fiber distribution hub (FDH) cabinets, we can do both—lower the cost and increase the speed. We call this our FastPass™ method and using it can double the rate of homes passed compared with legacy methods. And with FastPass Connect, we use our superpowers by using our FieldShield pushable fiber utilizing the deploy reels for connecting homes. Studies show a time savings of over 30% for installation technicians connecting the home with fiber.

TOPIC

Your Beef with BEAD

BEAD funding is flowing. What is your greatest concern about BEAD?

Allen: The concept of providing high-speed broadband preferably over fiber optic lines to the remaining unserved and underserved in the country is a great goal. Now it's about execution and when it comes to using the $42.45B of BEAD money to meet that goal, our industry is hamstrung with a hurry up and wait approach. The rules are in place but the industry likely won't see meaningful dollars hitting the street for building fiber networks until late 2024 or early 2025. Our beef is that these rules place too much emphasis on the blanket requirement to build these products in America. Rather than worrying about the percentage of cost for products built in America, we should focus on the parts of the product line that best utilize American know-how and ingenuity.

TOPIC

Change Management and Culture

What have you learned about culture and change management as Clearfield continues to grow?

Allen: Between a tight labor market and the evolving needs of a changing workforce, leaders today need more than just good pay and flexibility to keep and retain strong teams—they need to dedicate time and effort to master the art of listening. Leaders who listen with empathy can respond in a way that matters, making team members more willing to share on a deeper, more authentic level. Listening to everyone also builds a culture of trust. Listening is the foundation for good leadership. It allows us to be more sensitive to employee needs and build better relationships, but it also allows us to weed out problems and solve them faster. Listening leaders create structures that demonstrate their desire to hear everyone's voices and work to ensure everyone understands the value of listening. They model positive listening skills and inspire and empower others to embrace their development, resulting in better decisions at all levels and a more resilient organization.

TOPIC

The Future

What emerging or disruptive broadband technology excites you the most? Why?

Allen: Today, businesses around the world routinely utilize Software as a Service (SaaS) over cloud-based computing that runs over fiber connections to data centers. But a technology ready to improve on that is Edge Computing. Together with a full fiber network, Edge Computing places the processing power of a data center closer to the originator of the data at the edge of the network. Moving this compute power as close to the user as possible creates new demand for fiber-rich active cabinets that can aggregate processors. ■

Writing the Next Chapter

Joe Gillard
EXECUTIVE EDITOR
jgillard@endeavorb2b.com

Follow Joe on LinkedIn for further conversation and insights.
@joe-gillard-336b0771

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

UNCERTAINTY MAY CONTINUE in the telecom world, just like in the rest of the world. But the global need for fast, reliable networks are here to stay. Your roles are crucial, your technology and services improve lives and save lives. But that doesn't mean we aren't faced with the questions of where to spend, where to cut, where growth is actually happening, and where big ideas are falling short of expectations.

This year is almost complete, but 2024 is still unwritten. Many things will be outside of our control in 2024, but our attitude, our mindset, and our decisions are not. We can choose how we react to things, where we focus our efforts, and how we respond to huge opportunities.

I lean on the expertise of all of you every day to keep me informed of what's important to you, so I can make the best possible decisions as editor. And in 2024, we're taking that philosophy to a new level. I'm excited to announce that ISE Magazine and ISE EXPO have launched an editorial advisory board.

The names on this board include **Ashley Travers, Randy Alderton, Kevin Lybrand, John Amundson, Dennis Pappas, Buddy Bayer, and more**. Our goal is to have the board represent our readership, with folks that work broadly across telecom and have different knowledge bases. This will help us ensure that our conference programming and our editorial direction are meeting attendees and readers where they are and providing them with what they truly want and need from an industry show and magazine.

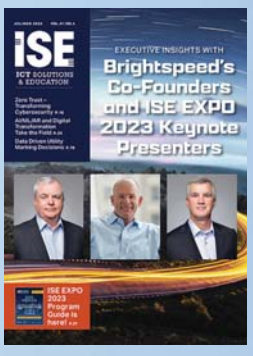
For the industry, as we write the next chapter, we're turning the unwritten pages of history into what will become the rest of the story.

You were faced with this same situation last year. Remember that and think about what you are proud of, what you would have done differently, and how you can apply that wisdom to 2024. Because you want to be looking back, one year from now with the pride of knowing you did the best you could with what you had.

The developments in 2023 have been tremendous. 2024 will no doubt bring even more change. But I don't think there is an industry more suited to mastering the world of change, growth, and evolution than this one.

I look forward to working with the advisory board in 2024. I think their wisdom will be a huge benefit for us and for you. I also want to know what you're up to this coming year, so feel free to send me an email any time.

I hope you enjoy your holidays. Use it as a time to reflect on what's important before we turn the page and start the next chapter.



ISE ICT SOLUTIONS & EDUCATION

SUBSCRIBE

www.isemag.com/magazine

Print

Digital Edition

How Many More Techs Do We Really Need?

JIM HAYES
Web www.jimhayes.com
Email jeh@jimhayes.com

THE FIBER OPTIC ASSOCIATION
Web www.thefoa.org
Facebook FiberOpticAssociation
LinkedIn company/the-fiber-optic-association-inc-foa
Twitter @fiberopticassoc
YouTube user/thefoainc

EVERYBODY, INCLUDING ME, has been talking about the workforce shortage in fiber optics. A couple years ago, a major service provider said it needed 850,000 more telecom techs. Someone mentioned in a recent meeting with government officials at the White House that America needs another 200,000 fiber techs to complete the broadband projects that will be funded by the BEAD program.

Do those numbers make sense? Or is it just wild speculation? Understanding the need for more fiber optic techs requires understanding how many there are now and how fast the work to be done is growing.

Since the industry has been focused on BEAD projects, it also requires knowing just how much work is involved in the broadband networks that will be funded by BEAD. Let's start there.

If you analyze the BEAD data from NTIA, they give the dollar amount available to every state based on their analysis of the percentage of users in each state that were unserved or underserved. At FOA, we analyzed the NTIA data using the latest census numbers and discovered that the number of households included in the NTIA estimates was only approximately 10.3 million households out of the total of 128 million households in the U.S. (You can download our spreadsheet at www.foa.org/images/BEAD_Funding.xlsx.zip.

It was reported by a trade association recently that last year was a banner year for FTTH in America with almost 8 million new subscribers connected on fiber. That's a pretty big number.

So, if the current workforce can connect 8 million users in a year at the same time they are building hundreds of new data centers, long lengths of OSP networks, fiber networks supporting 5G cellular systems, municipal systems, etc., do we need to double or triple the number of available fiber techs in the workforce?

Also, consider that the BEAD money is going to take five years or more to be spent on actual projects. That means we're looking at a ~25-30% increase in FTTH connections each year, not a doubling or tripling of current work like some people are saying.

We do have a problem of workers retiring and needing replacements; that is true for all the trades. I've read estimates that the number of young people entering some of the trades is less than 20%, as many as are retiring, and that's a problem. That's why FOA is trying to get more technical high schools and colleges to teach telecom programs—we need more young people joining our fiber and telecom workforce.

But 200,000 or 850,000 new techs right now? Does that make sense? Or is it just more hype, perhaps hoping to take advantage of the training money set aside in the federal funding for broadband?

Part of the problem is that until recently we didn't really know much about the fiber optic workforce or the overall telecom workforce. The statistics for these jobs have been buried in the U.S. Department of Labor's outdated definitions of the jobs.

The FOA has been working with the U.S. Department of Labor's Bureau of Labor Statistics (BLS) for about 20 years to define the jobs of fiber optic technicians. When first added by the BLS, fiber optic techs were placed in a category of "electrical linemen," a longtime category of other workers who install cables.

This year, in part due to the federal focus on broadband, a BLS analyst told us there was interest in creating a new category. We worked with them for months helping draft new job descriptions, brought in some contacts from the Communications Workers of America (CWA), and suggested adding wireless techs (who were also buried elsewhere in the BLS) to help create a new category for "Telecommunications Technicians."

It all came together nicely. The website is live now. The site offers better job statistics that help put some reality in discussions about how many more fiber techs the U.S. really needs. It also provides a reference for grants applications for those state broadband agencies that are seeking funding for workforce development. (Link to BLS page: www.bls.gov/ooh/installation-maintenance-and-repair/telecommunications-equipment-installers-and-repairers-except-line-installers.htm#tab-1)

"I've read estimates that the number of young people entering some of the trades is less than 20%, as many as are retiring, and that's a problem."

What does the BLS say about the telecom business? They conclude that there are about 300,000 workers in telecom-related jobs in the U.S.; about 112,000 of them are cable installers. Yep, they even include the copper techs with the fiber techs. They also note that median pay is about $60,000. Both those numbers seem about right to FOA, and we congratulate BLS for doing a commendable job on this work.

What can we conclude from this BLS analysis? To begin with, the estimates of the U.S. needing 850,000 or even 200,000 more telecom or fiber techs is greatly exaggerated. For the BEAD program, we might need another 10,000-20,000 techs over the next few years, not much more than FOA-affiliated schools are doing anyway, but where we need them is also important.

Expanding fiber networks into unserved urban areas, small towns, and remote rural areas needs a local workforce. Once these networks are funded, they require installation, of course. But over time, they also need local techs to connect new users, expand networks, repair, and restore damage, etc. The common model of having a contractor bring in a crew, install the fiber, and move on to the next job may not work, especially in rural areas. Restoration, for example, is an immediate need, and local people who know the area and the network are much more effective than those hired from the outside.

That's why the model of Kentucky Wired works so well. (ISE Magazine – Fiber Optic Expert Column, May/June 2023: isemag.com/14292487.) The network of schools FOA helped set up around the state trained more than 1,000 fiber techs who are not only capable installers but also local citizens with a vested interest in their home area. FOA is working with Ohio to create a similar network of schools around the state right now with an interesting twist: Ohio is adding telecom programs at the high school level to help interest young people in joining the trade as well as give them initial training.

So, relax, we can do this. ■

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

EXECUTIVE INSIGHTS WITH Chris Sa

President – AT&T Network

AT&T's "Bridge the Possibility" campaign providing 150+ free laptops to families in need in a small town in Texas.

Photo courtesy of AT&T.

mbar

BY SHARON VOLLMAN

Chris kindly agreed to this interview after a mutual friend introduced us several years ago.* I WAS A BIT INTIMIDATED when I learned his background includes 23 years in the military as a Navy SEAL. (If that level of commitment doesn't signal discipline, I don't know what does.)

Today, Chris is responsible for deploying ~70% of AT&T's capital dollars, including global responsibility for architecture, planning, engineering, and constructing its wireless, fiber, and core network infrastructure build programs. He also oversees AT&T's 24/7 global operations team.

With his impressive background and current title, it's easy to view Chris as untouchable. Instead, the opposite is the case. As you learn he and his wife are foster parents, you see a multi-dimensional side of this leader. He believes in meeting people where they are, offering compassion, and leading with high expectations.

That's as down-to-earth as it gets.

TOPIC: Change Management and Culture

ISE: What have you learned about culture and change management that helps your teams succeed with you as their leader?

Chris Sambar: Culture: Be honest with people instead of sticking to the silly talking points that gloss over the real issues. People are smart and see right through the corporate speak.

Change: Clearly define success and help clear obstacles for your teams so your people can get there. People who consistently demonstrate that they don't want to change need to find a workplace that doesn't require change.

TOPIC: Risks

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

Sambar: I spoke up often and expressed my opinion even when I knew it was unpopular. I was told early in my career that I needed to do a better job of not rocking the boat and towing the company line. I ignored that advice.

TOPIC: Leadership Style

ISE: Please share ONE word that encapsulates your leadership style. And ONE word that describes you as a person.

Sambar: Disciplined.

TOPIC: Inspiration

ISE: In large organizations, there can be a tendency for the "institution" to dampen the "inspiration." How do you keep this from happening on your team?

Sambar: Reward ideas whether they are acted upon or not because that encourages more ideas. Work hard to get the front line to generate and push the ideas upwards because the front line knows how to win.

TOPIC: Personality Trait

ISE: What's an essential personality trait someone needs to succeed in a company like AT&T?

Sambar: Integrity.

TOPIC: 5G Private Networks

ISE: The U.S. Private 5G Network market is projected to grow 53% from 2022 to 2030, with customers demanding ultra-reliable, low-latency connectivity for their future bandwidth-sensitive applications. Broadband network providers are just one of the players in this market. What network-oriented upgrades must occur to ensure AT&T secures its share of this lucrative market?[1]

Sambar: Private 5G networks are built to address the business customer's need for highly reliable, low latency connectivity. Operators play a significant role in delivering these requirements by enabling private 5G networks with licensed spectrum and developing processes that enable roaming onto public networks. Without both, we believe

that businesses will not be able to meet their resiliency and performance requirements fully.

Additionally, standalone 5G technology will make an even more significant impact on private networks. 5G SA uses a dedicated 5G core to unlock capabilities like faster upload speeds, ultra-low latency, ultra-high reliability, and increased service differentiation. As a company, we've recently made significant progress enabling AT&T's standalone 5G. Many of the newest mobile devices are ready for 5G standalone, and we continue to move thousands of customers daily. And in the not-too-distant future, 5G-connected cars will ride on AT&T's standalone 5G.

TOPIC: MEC

ISE: The growing demand for low-latency applications, data-intensive services, and real-time analytics will drive the deployment of edge computing infrastructure. The U.S. Multi-Access Edge Compute Market is expected to increase 44% from 2023-2030, even though it didn't take off in 2023 as hoped.[2] Talk about AT&T's roadmap for this area.

Sambar: As business transforms, the optimal placement of workloads isn't just in the cloud. In an environment with 100s or 1,000s of sensors at a site, it is often ideal to process that data locally rather than hogging up precious bandwidth by sending all the data to an off-site cloud. There are many examples where the workload may need to be hosted closer to the end-user or the device to meet user experience or privacy requirements. MEC represents a distributed infrastructure that brings computing and storage closer to these devices, and it is a crucial enabler to next-generation use cases.

> "We think the most effective network security is not one or two special techniques but defending in-depth and with layers."

AT&T focuses on rearchitecting the transport between the end devices and the compute to enable direct routing and low latency. To prepare for this evolution of data-intensive services, we are architecting our network by defining rules that route data based on the optimal needs of the application and not just the efficiency of our network. This creates lower latency for applications that are necessary to support next-generation application performance.

One example of how AT&T's roadmap is already addressing a need is our private cellular network portfolio. These solutions deliver private 5G on premises and provide localization of cellular data for eligible devices. The ability to move data from a device over the on-site 5G network and directly to the customer LAN creates the opportunity for the lowest latency over cellular. We also maintain partnerships with the cloud providers. If necessary, their cloud stack can be deployed with our 5G network creating an end-to-end solution meeting the customers' low-latency needs. None of this would be possible without the AT&T software-defined network capabilities and virtualized network functions that enable these innovations.

We're also working to stand up the ability to provide true deterministic routing on our macro network to a **regional** cloud instance—we call these localized 5G network capabilities "edge zones." And we're excited because these edge zones are powered by regional 5G standalone network cores, which will open a range of new capabilities that aren't possible with 4G. Simply put, we'll be a foundational building block for tomorrow's inventors/startups.

TOPIC: Network Automation

ISE: What is AT&T doing to automate their networks to streamline network operations, reduce human errors, improve efficiency, and enable self-configuring and self-healing networks?

Sambar: Three years ago, we started the Network Simplification and Transformation journey to build and operate our network better, faster, and cheaper than anyone else. Using AI, machine learning (ML), and automation, our scientists and engineers are building on a legacy of innovations to tackle some of the most challenging network problems.

Labs AI-enabled automation innovations ensure that we optimally and efficiently operate our network and services. Our AI innovations use ML and predictive analytics to optimize customer experience, learn how to auto-heal the network quickly and effectively, optimally configure very complex network environments, and ensure that we can, in near real-time, get network capacity to where our customers need it. Our AI-based automation innovations also ensure that we efficiently use our resources—for example, reducing our energy consumption and carbon footprint through ML-optimized cell site sleeping.

TOPIC: Network Security AND Cybersecurity

ISE: Share the two most effective network security approaches and technologies (like SASE or others) AT&T is adopting to secure its network(s).

Sambar: Security starts in the network. We have more than 1,000 security-related patents and have been a security technology leader for over a century. As the owner and operator of the largest network in North America, we're constantly monitoring the security of our network 24/7 using AI, algorithms, automation, and shared alerts from other security experts.

We're currently building more security capabilities into our core network and edges. These security services will be "built-in" to our connectivity products, creating

AT&T's Network Disaster Recovery (NDR) team staging to prepare for a hurricane in Ft. Myers, Florida (2022).
Photo courtesy of AT&T.

a new network-embedded security category for small and medium-sized business customers.

The most effective network security is not one or two special techniques but defending in-depth and with layers. Basics are still the key: identity and access management, threat analytics, network monitoring, vulnerability management, and software security. What's new and helpful is correlating, automating, and orchestrating those basics.

TOPIC: FWA

ISE: AT&T recently shared it is expanding its "Internet Air" FWA offering to 16 new locations.[3] Share any network-related challenges for this rollout and the solutions your team is employing to secure a chunk of this market.

Sambar: That's correct! AT&T Internet Air is our new fixed wireless home Internet service. In other words, it's home Wi-Fi delivered over our reliable wireless network. Customers can easily self-install AT&T Internet Air in five steps and be up and running in less than 15 minutes.

There are challenges in every environment. We spent time identifying customer pain points, like legacy Internet options. We created a solution by utilizing available network capacity in less densely populated areas while still providing a strong connection. We've already successfully rolled out AT&T Internet Air to existing copper-based customers. As we begin to scale, we are hyper-focused on selecting locations with enough wireless coverage and capacity to deliver a tremendous in-home experience and maintain a top-notch wireless service for our existing mobile users.

TOPIC: AI and the Network

ISE: The AI Network Intelligence market is forecasted to grow 40% by 2029. By 2035, it could improve construction profitability by 71%.[4] Many providers use AI to tame network complexity, reduce OPEX, and improve network performance management. Share how AT&T is using AI now and how AI will be used across the network by 2029-ish.

Sambar: Today, AI is embedded across AT&T. Customer service is one major area that's seen many advantages thanks to AI. Behind the scenes, AI optimizes the daily routes our field technicians take in their trucks to serve more customers and handle more repairs with less fuel consumption. AI helps us recognize and block fraud in the network in near real-time to greatly reduce the number of spam calls our customers receive.

We also recently built and launched our generative AI tool for our employees to use—we call it Ask AT&T. It's an intuitive, conversational platform that you can interact with by asking simple questions. While our initial use case was for software developers to use it to write and refine code, we're seeing opportunities across every part of our business. Today, more than 30,000 AT&T employees have access to Ask AT&T. Our goal is to put this tool in the hands of as many AT&T employees as possible!

TOPIC: Network Restoration Successes

ISE: Talk about how network installation and restoration processes will change with robotics, AI, and ML in the next five years.

Sambar: At AT&T, we believe "connecting changes everything," and to achieve this, we utilize our best human resources and equip them with tools like AI to connect people to greater possibilities. Our Wireless Engineering Organization uses AI in many forms to improve network efficiency and customer experience. As AI technology evolves and our wireless network gets more complex, AI will play an essential role in our network.

Various automation apps help us manage our wireless network, from creating and optimizing neighbor lists to optimization of parameters. We employ ML techniques to detect and triage network issues, identify the benefits of new software features, automatically optimize the network in the event of natural disasters or outages to improve customer experience, and many other optimization efforts. We're embedding AI into everyday practices and work processes, building on efficiencies and work optimization.

We helped transform our teams to become more analytical and operational through a "digital twin" that brings a new level of intelligence to the core of everything our teams do. We think of AI-powered operations, where analytics, algorithms, and LLMs will serve as co-pilots to help our teams make better and faster strategic decisions. We use our digital twin to mine processes and understand where the opportunities are. Still, before all, we leverage our human closed-loop feedback—talking to frontline employees and getting their input on whether the changes make sense and add value for our customers. We want AI to drive better business outcomes, not simply introduce new technologies.

When installing new networks, we can now design and engineer prints in days (vs. weeks) by digitally sending the designs to our field engineers to walk the plant and make any changes on the spot. We can automatically recalculate the design and submit the purchase order, significantly reducing cycle times and waste from errors. As AI evolves, we foresee leveraging satellite imagery as an example to reduce the design cycles further.

We're also giving public safety agencies a level of support during emergencies and planned events far beyond anything they've ever seen—this includes maintaining the strategically staged FirstNet fleet of 150+ dedicated land-based and airborne portable assets, including drones and amphibious vehicles.

TOPIC: AI and Sustainability Efforts

ISE: Some say AI will help reduce energy consumption by 30%–40% because it will better predict the network's traffic capacity requirements and adjust energy usage more smartly and sustainably. Share how AT&T Network plans to leverage AI to help become better environmental stewards.

Sambar: In addition to helping build the network, AI aids in optimizing and securing our network so you can feel safe exchanging information and data. This enables business customers to run solutions that can increase efficiency and help reduce emissions. And for these solutions to work, connectivity needs to be reliable and widely available, which is why we're using AI to plan our network better and ensure reliability.

We also enable select cell site capacity to sleep under low loads to conserve energy. We have done this by using ML algorithms that we created to optimize sleeping without impairing customer experience. Cell site sleeping is deployed across our U.S. mobility network, and in 2022, it saved the equivalent annual power use of 13,500 average homes. Using ML and analytics, we can quickly identify inefficient cell sites that consume high amounts of energy and send dispatch repair teams to these sites to maintain energy efficiency. We work with engineering teams to identify and decommission older, less efficient network equipment. For instance, we look at alternative network architectures to enable us to streamline capacity needs and decommission more equipment to reduce energy and save on operations costs.

> **"At AT&T, we believe 'connecting changes everything,' and to achieve this, we utilize our best human resources and equip them with tools like AI to connect people to greater possibilities."**

Even though traffic on our network has skyrocketed, our network electricity bill has roughly stayed the same. Our solutions to improve energy efficiency and reduce power consumption include using advanced analytics and SON capabilities to turn down parts of the unused wireless network at night while maintaining customer experience. We purchase low-energy consumption radios and continue to virtualize network functions, which helps simplify and speed up

> "We're committed to connecting more Americans to reliable, high-speed broadband Internet in several ways, including expanding and upgrading our network, and we believe combining public-sector funding and private-sector investment is the most cost-effective way to do so."

deployment, minimize unused network capacity, and reduce energy and real estate expenses. Additionally, we collaborate with industry partners, equipment vendors, and other stakeholders to help drive the adoption of energy-efficient practices across the telecommunications sector.

TOPIC: The Future

ISE: What emerging or disruptive broadband technology excites you the most? Why?

Sambar: For all wireless carriers, it's impossible to cover every square inch of America with any single technology. Space-based direct-to-mobile technology excites me because it's designed to provide customers with connectivity by complementing and integrating with our existing mobile network.

For years, we've been working with satellite companies to help test and develop innovative, out-of-this-world solutions for remote and challenging geographic locations, including collaborating with AST SpaceMobile.

We've helped AST SpaceMobile achieve some excellent milestones over the past few months, including the world's first space-based direct voice and video call[5] between unmodified every day 4G LTE smartphones. We also recently provided AT&T spectrum for the first-ever 5G connection[6] for voice and data between an everyday smartphone.

In the future, we hope these collaborations will help supplement connectivity for customers in rural or off-grid locations to keep public safety connected after disasters or during emergencies. The sky is the limit on complementary connectivity delivered from satellite cellular broadband.

TOPIC: Fiber Timelines

ISE: What are the best ways to quickly deploy fiber to the underserved and unserved while reducing costs simultaneously?

Sambar: We're committed to connecting more Americans to reliable, high-speed broadband Internet in several ways, including expanding and upgrading our network, and we believe combining public-sector funding and private-sector investment is the most cost-effective way to do so.

Government funds like the American Rescue Plan (ARP) and Broadband, Equity, Access, and Deployment (BEAD) program create opportunities for public-private partnerships to build fiber in unserved and underserved areas. The federal Affordable Connectivity Program is lowering the Internet price for eligible households, which also helps close the digital divide.

So far, these federal dollars, in partnership with our own private investments, are helping to expand the reach of AT&T Fiber to more than 130,000 customer locations. The customer locations now served are thanks to the speed and momentum of these broadband projects, which represent a whole new world of economic, educational, and social opportunity for those who need it the most. With industry experience building, maintaining, and repairing networks and local stakeholders' knowledge and support, we can deliver on the goal of helping to bridge the digital divide for more Americans.

*Thank you, Trevor Putrah and KGPCo, for kindly allowing me to facilitate your keynote with Chris at the KGP Pinnacle Conference 2022. ■

REFERENCES AND NOTES

1. Grandview Research, https://www.grandviewresearch.com/industry-analysis/private-5g-network-market
2. Grandview Research, https://www.grandviewresearch.com/industry-analysis/multi-access-edge-computing-market
3. CNET, https://www.cnet.com/tech/mobile/at-t-expands-5g-home-internet-with-new-internet-air-offering-in-16-markets/
4. Valuates Reports, https://reports.valuates.com/market-reports/QYRE-Auto-7L853/global-ai-in-telecommunication
5. Business Wire, https://www.businesswire.com/news/home/20230425005532/en/AST-SpaceMobile-Makes-History-in-Cellular-Connectivity-Completing-the-First-Ever-Space-Based-Voice-Call-Using-Everyday-Unmodified-Smartphones
6. Business Wire, https://www.businesswire.com/news/home/20230919031637/en/AST-SpaceMobile-Achieves-Space-Based-5G-Cellular-Broadband-Connectivity-From-Everyday-Smartphones-Another-Historic-World-First/

Chris Sambar, President, AT&T Network, is responsible for AT&T's next generation wireless & wireline network planning, investment, AT&T's long-term technical initiatives, infrastructure & cloud, tower strategy & roaming, engineering, construction & operations for consumer, business, and government customers.

Chris joined AT&T as part of the Leadership Development Program in 2002. Since then, Chris has held positions in Network Operations, Business Solutions, Consumer Television, Retail & Wireless, Human Resources, Corporate Strategy and most recently, AT&T FirstNet.

He holds an MBA from the University of Southern California and a Bachelor of Science degree from The United States Naval Academy. Following graduation from the Naval Academy, he served 7 years on active duty and 16 years in the reserves with multiple deployments throughout Europe, the Middle East and one tour of duty during the Iraq war in 2005 and 2006. He is married with 4 children and enjoys spending as much of his free time as possible with his family. For more on AT&T, visit www.att.com. Follow them on Twitter @ATT, @ATTNEWS, and @ATTBusiness. Also on LinkedIn: www.linkedin.com/company/att/ and Facebook: www.facebook.com/ATT.

Eyes on the Stars, Feet on the Ground

apirak thiptaluck / iStock / Getty Images Plus

Network evolution and transformation cannot solely rely on innovation. It will require pragmatism and common sense.

BY MARC DUROCHER

I've been fortunate to lead successful network evolution and network transformation efforts. However, I have also seen many projects fail due to their scope becoming too bold and ambitious with innovation, losing sight of the core problem they aimed to solve. The root cause of these project failures invariably traces back to a lack of pragmatism and common sense demonstrated early in the ideation process. The allure of radically reshaping our practices can be tempting, but it's not always necessary or financially best for businesses.

In my current role, I oversee multiple support groups within Verizon's Wireline Network Operations organization, focusing on installation and maintenance, construction, and 5G fixed wireless pro setup teams within ILEC. Embracing innovation and leveraging new technology is integral to my responsibilities. But what does this truly mean? Doesn't everyone strive to leverage innovation and technology? It's imperative to underscore that a significant part of my role is solving practical problems. This requires a more balanced approach.

I must admit that I occasionally find myself rolling my eyes when I encounter terms like "evolution," "transformation," and "innovation." These words are frequently overused, to the point where they lose their genuine significance.

Innovation can indeed be intricate and costly, but it doesn't have to be. When a reader dog-ears the corner of a book page before bedtime, that simple innovative act enhances the book's usability, making it easier to resume reading. I recall a visit to an elderly customer's home while a technician was completing a video service installation. She greeted me at the door with remote controls attached to her bathrobe using Velcro strips. The customer had innovated a solution to prevent misplacing her remotes. Humans are innately innovative, and there are numerous examples of everyday practical innovations.

Mauro Porcini, Chief Design Officer at PepsiCo, once shared his perspective on the human aspect of innovation, stating, "The problem is, dreaming is not enough. If you just live in the comfort zone of dreaming, nothing happens. Unicorns know how to balance the ability to dream with the ability to make things happen, with pragmatism, with the ability to make compromises and trade-offs, and with the understanding that those compromises and trade-offs are not something negative; they're just a step toward the dream."[1]

> **"I must admit that I occasionally find myself rolling my eyes when I encounter terms like 'evolution,' 'transformation,' and 'innovation.' These words are frequently overused, to the point where they lose their genuine significance."**

It's easy to become entirely immersed in the excitement and intricacies of innovation. Dreaming about the potential applications of new technology is simple, but translating those dreams into meaningful outcomes is far more challenging. For instance, a few years ago, analysts predicted significant growth in enterprise usage of Virtual Reality (VR). While there has been growth in training applications, enthusiasm waned due to substantial cost and scalability hurdles. VR failed to fully

realize many of the exciting use cases initially envisioned. In retrospect, this exemplifies how a good idea can get lost in the pursuit of innovation, losing touch with practicality.

My team has collaborated with several companies on AR/VR projects, working with some of the brightest minds. In one early VR use case, we aimed to provide prospective employees with a sense of the job they were applying for. We wanted to reduce dropouts from our training programs due to unexpected fears like heights or confined spaces. We created VR experiences, partnering with vendors to design impressive fully synthetic environments such as entering a manhole in downtown Manhattan or climbing a pole on the side of a busy road. However, despite the innovation and technology invested, these experiences couldn't match the impact of live video from a camera on a technician's hardhat, a simple, practical solution that saved substantial production costs while delivering superior results.

Similarly, when winning rural broadband bids, we need to maintain a pragmatic approach to network evolution as well. We've been working diligently with cross-functional teams and vendor partners to develop new products and strategies for expanding fiber optic networks. However, it's essential for me to remain grounded with a pragmatic approach. We must challenge ourselves with common-sense questions. In some rural environments, adhering to conventional fiber deployment practices leads to overbuilding and wastage.

Network evolution and transformation projects often entail more intricate technical challenges than marking a page in a book or finding a lost remote control. Nevertheless, employing the same common-sense approach to complex issues enables teams to swiftly identify solutions and streamline troubleshooting. Some projects present solutions so complex and costly that they become nearly unattainable. Pragmatism guides our focus towards achievable solutions over theoretical ones that could exhaust resources and time unnecessarily. ■

REFERENCES AND NOTES

1. The Committed Innovator: The power of design, https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-committed-innovator-the-power-of-design

Marc Durocher is a Director at Verizon. For more information, email jr.marc.j.durocher@verizon.com or visit linkedin.com/in/marc-durocher-jr.

WHERE WE ARE AND WHERE WE'RE

[L to R] Kevin Morgan, Chief Marketing Officer, Clearfield; Denise Manka, Director – Business Development, Future Infrastructure; Randall René, Director Industry Solutions – Telecommunications & Cable, Esri

Highlights from ISE EXPO 2023 Executive Roundtable

BY JANICE OLIVA

Each year at ISE EXPO, I get to sit down with some of telecom's brightest thought leaders and strategists and discuss where we are and where we're headed in the industry. This year, ISE EXPO 2023's roundtable included executives from Clearfield, Esri, and Future Infrastructure.

The questions and conversations yielded astute observations and wisdom regarding the state of the industry, what still needs to be solved in 2024, and how we can overcome the challenges. It's the kind of valuable insight that comes from experience, high-level leadership, and unique knowledge. I'm glad to be able to now

share with you their thoughts on the supply chain, the workforce, AI, cybersecurity, BEAD, permitting, sustainability, and much more.

Topic: Solutions Required

ISE: Share two network-related issues the industry must solve in 2024 that it was unable to remedy in 2023.

Kevin Morgan, Clearfield: Supply chain issues continued to hamper the broadband industry in the first half of 2023 but rather than supply shortages, we experienced excess supply. Hindsight is 20/20 and we now see that the excess inventory was a natural by-product of over-ordering enabled by panic buying after the pandemic. The refrain among buyers sounded like they wanted to make sure they were in the front of the line once the supply shortages abated. However, the bounce back caught buyers off guard and spilled over to excess inventory. We all must be smarter about this in 2024 and beyond.

Lack of skilled labor continues to constrain an otherwise booming industry on the doorstep of historic fiber optic deployment. The limited resource of skilled labor in such a booming market puts the onus on the supplier community to come up with innovative solutions that reduce the need for skilled labor and concentrates on dependable, consistent fiber deployment using state-of-the-art plug and play methods.

Randall René, Esri: The first issue on the forefront of my mind ties to the need for organizations to have comprehensive understanding before acting. Now, more than ever, the critical need for creating a centralized and accurate source of truth for the organization is profound. Creating a comprehensive source of truth not only includes all network mapping, but also includes breaking down walls and connecting siloed datasets contained in legacy OSS and BSS platforms. Through connection to these platforms, organizations can establish a source of truth for all resources teams need for strategic and tactical decision-making. For instance, companies can provide real-time analysis for decision-making, deploy easy-to-use collaborative resources, and communicate accurate and timely information, throughout the organization and with external entities.

The next major issue I see throughout the global telecom industry is the need to transform workflows from reactive to proactive. For example, traditionally, organizations find out about new build properties only months before the first occupancy date. This often leads to unbudgeted capital or expense, negative customer experience, supply chain issues, and unnecessary stress on employees. However, today it is entirely possible to see where homes and businesses will be built years before an organization ever receives a joint-trench notification or address information from a state or local government. In this one example, leveraging GIS and Data organizations can create automated processes designed to provide early warning to the entire organization, allowing for proper planning, forecasting, and engagement.

Denise Manka, Future Infrastructure: With the growing demand for data-intensive applications and the increasing number of connected devices, networks will need to handle larger volumes of data traffic. In 2024, the ICT industry may face the challenge of scaling network infrastructure to meet this ever-increasing demand efficiently. This includes expanding network capacity, improving bandwidth availability, and optimizing network performance to avoid bottlenecks and maintain reliable connectivity.

Cybersecurity threats continue to evolve, and network security remains a critical concern. In 2024, the ICT industry will likely need to focus on developing enhanced network security measures to combat sophisticated cyberattacks, data breaches, and network

intrusions. This may involve implementing advanced encryption protocols, strengthening authentication mechanisms, and adopting proactive threat prevention strategies like AI-driven anomaly detection and network behavior analysis.

Topic: Passion

ISE: Share one problem/challenge you are passionate about solving for the ICT Industry.

Morgan, Clearfield: Now, more than ever, the industry needs to put its foot on the gas pedal and go fast. That's why I'm passionate about speeding up fiber deployments. For example, Clearfield's FastPass™ methods using in-cassette splicing demonstrate the ability to pass twice as many homes with fiber than older legacy methods. Passing twice as many homes in the same amount of time means the service provider gets twice as many work orders completed in a day. That translates to real ROI for the service provider. At Clearfield, we wake up every day thinking about how we can help our customers remove the barriers to fiber deployment. We do this because we have the vision to enable the lifestyle that better broadband provides. No community should be left behind when it comes to fiber services.

René, Esri: One area I'm passionate about is providing understanding before acting. In telecom, this comes from providing a single source of truth for the organization and comes from unifying OSS and BSS resources. Over the past 20 years, I've come to know that the quality of tools and resources our teams leverage in pursuit of daily activities directly impacts successful and timely task completion and affects the satisfaction of both employees and customers. This is because the quality of decisions team members make through organizations are based on the information available at hand. I have heard many times, "I want to eliminate swivel-sharing" or "the process is too cumbersome," and "we shouldn't have to create this report manually." When we dig into these statements to learn what drives them, we see they are a symptom of the bigger problem associated with legacy OSS and BSS workflows. These systems are far too often siloed in nature, require standalone interfaces and reports, and numerous other time-consuming and costly workflow requirements.

Manka, Future Infrastructure: Ethical use of Artificial Intelligence (AI) and automation. AI and automation technologies are advancing rapidly, raising concerns about their ethical implications. Issues such as bias in

algorithms, job displacement, and the impact of AI on society require careful consideration. Someone passionate about ethics in technology may work on developing frameworks for responsible AI, promoting transparency and accountability in algorithmic decision-making, or advocating for ethical guidelines in the field. While I may not be able to—most likely cannot—solve this by myself, I am passionate about it and feel that this makes connectivity even more important for all, because without the technology connection, our future leaders stand no chance of competing with AI, and they most certainly would be in a lesser opportunity than those who are connected and in a constant learning environment!

Topic: Your Beef with BEAD

ISE: BEAD funding is flowing. What is your greatest concern about BEAD? What's a solution to that concern?

Morgan, Clearfield: Federal government programs routinely require transparency and long timelines. As of July 2023, significant portions of BEAD funding are not yet flowing. That's my biggest concern. We have no reason to believe that the BEAD funding and significant flow won't happen, but it takes a long time. The eligible entities are the States and Territories. They are literally and figuratively "all over the map" when it comes to their readiness. Even the most prepared states do not even expect to begin the service provider selection process until August 2024. So, there's really no way any business will be coming into the market until 2025. Of course, BEAD is a reimbursement model so, a provider could opt to purchase whatever they want at any time. But that seems unlikely.

René, Esri: Providers throughout the nation are doing what they can to obtain BEAD funding and leverage broadband services to those who need it. One primary question is whether organizations have a sense of the long-term needs and impact of expanded networks. For instance, throughout the world, organizations and governments are working to operate more sustainably and efficiently, while being fiscally responsible and purposeful in their capital investments and overall expenses. With these expanded networks comes a variety of carbon footprint increases with elongated drive times, increase to direct and indirect supply chains, increased power usage, and more. Additionally, with the increased drive times for employees and customers alike, the need for real-time operations metrics as well as advanced analytics for strategic planning, are necessary.

Ultimately, this is a geospatial problem and can be solved with GIS. One example I can share would be drive time analysis associated with rural new build. Having the ability to create an automated high-level design and BOM, then complete a drive time analysis against current fulfillment offices and retail store locations, provides the critical insight and understanding leaders need for strategic and tactical decision-making. With the capability to understand true needs, organizations are best prepared to bid on build areas and understand what it will take to deliver long-term quality of service and experience to consumers while also knowing operational costs and environmental impact.

Manka, Future Infrastructure: I have a few concerns but nothing that can't be solved with meticulous planning and oversight by the many experts we have in our industry and at the federal wheel:

One major concern is ensuring that the funding is distributed fairly across different regions and communities. There may be concerns about prioritizing underserved or rural areas to bridge the digital divide and provide equal opportunities for all.

Questions may arise regarding how the funds will be managed and whether there will be proper oversight to ensure that the money is being used as intended. Transparency in the selection process, project implementation, and reporting of outcomes is crucial to maintain trust and prevent misuse of funds.

While it's important to deploy broadband quickly, concerns may arise regarding the quality and reliability of the infrastructure. Ensuring that the deployment is done with

high-quality equipment and technologies is essential to provide reliable and fast Internet access.

Sustainable funding models and strategies are necessary to ensure that the benefits of broadband deployment are long-lasting. Concerns may include how ongoing maintenance and operational costs will be covered beyond the initial funding period.

Topic: Permitting

ISE: Industry leaders have urged Congress to quickly streamline broadband permitting processes. They argue that inconsistent processes, delays, pole attachment, and environmental regulations could slow fiber deployments being funded by BEAD. Share your thoughts about this.

Morgan, Clearfield: Permitting is a partnership between the governmental body and the installer. In this instance, communication is the key. Well-staked rights-of-way along with thorough complete drawings tell the story. The burden is on the service provider to show the plan, stick to the plan, and communicate any changes. Permitting should not be viewed as a revenue source but rather as an investment in the future. The governmental agency cannot be shortsighted when it comes to the long-term benefits of a high-speed broadband network. The permitting process needs to clearly inform the service provider up front on how they should leave the job site during and after construction. Safety requirements must be identified and maintained. Ultimately, the service provider should leave the job site better than they found it. If that happens, everyone wins—the governmental agency, the service provider, and the local residents.

René, Esri: There are a wide variety of roadblocks and hurdles organizations face while working to build out networks. Whether it's aerial or underground, urban or rural, every location has a variety of entities involved, process requirements, information needs, environmental limitations, and much more that service providers must address in order to connect people to what's important in their lives. Unfortunately, these factors drive costs upward, customer experience downward, and create frustrating work environments for team members trying to get the job done.

In my role, I see how easy the permitting process could be. I am privy to processes involving permitting entities leveraging GIS working within digital workflows sharing information in real-time with service providers who also leverage GIS. Through leveraging the power of location and GIS, both groups share information seamlessly and in a secure and real-time environment. Additionally, the permitting agency has no paperwork to contend with, they can see all permitting in their region in one view, and they can request more information, approve/deny, or create a collaborative build area when multiple companies wish to build in the same location. The most important part is this all happens with a few clicks.

Manka, Future Infrastructure: Streamlining the broadband permitting process is a topic of interest and importance for many in the telecom industry. The current process and environmental regulations can indeed cause delays in the implementation of broadband projects, resulting in slower deployment and potentially hindering access to high-speed Internet for various communities.

The telecom industry leaders advocating for the streamlining of the permitting process argue that it would help expedite the deployment of broadband infrastructure, reduce administrative burdens, and ultimately enhance connectivity for underserved areas. They believe by simplifying the regulatory procedures, projects can move forward more efficiently and effectively.

However, it's crucial to balance these efforts with environmental considerations and safeguards. Environmental regulations are in place to protect natural resources and ensure responsible infrastructure development. Streamlining the process shouldn't come at the expense of compromising environmental standards or disregarding potential impacts. ■

Janice Oliva is VP, Group Publisher, Lighting & Digital Infrastructure for Endeavor Business Media. She oversees sales, editorial, circulation and production of ISE Magazine, ISE EXPO, and both websites. Contact Janice at joliva@endeavorb2b.com.

For more on these executives, visit isemag.com/14300079.

ISE ICT SOLUTIONS & EDUCATION

2024 BUYER'S GUIDE

BE THE RESOURCE BUYERS NEED

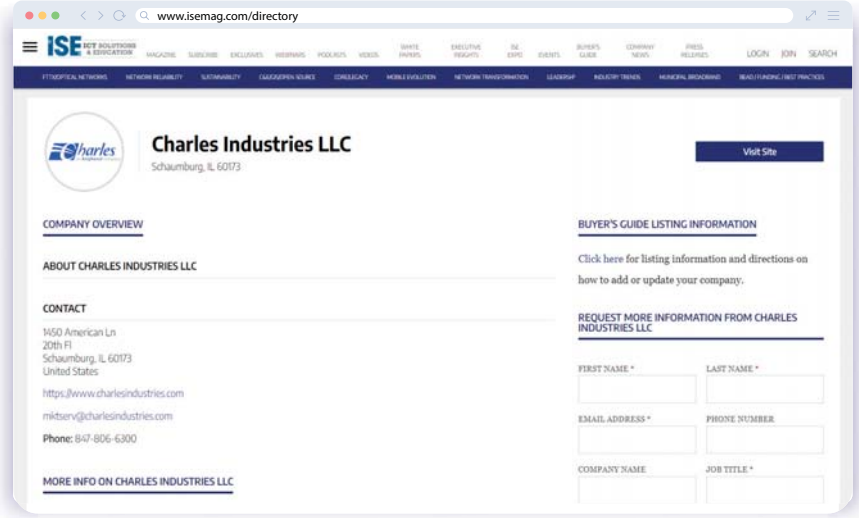
The ISE Buyer's Guide is the leading ICT product and service resource and is published annually in the January/February issue and year-round online.

16,000

print, digital, and web readers looking for effective and cost-efficient solutions to their network pain points.

Promote your product in the ISE Buyer's Guide (print/online) by completing the online submission.

Ad Close: 12/15/23



SCAN HERE

Contact Robin Queenan Today

847.804.4975 | rqueenan@endeavorb2b.com

CRITICAL INFRASTRUCTURE, CRITICAL DECISIONS

An in-depth look at network evolution choices, operational networks, and overall security in critical infrastructures.

BY MARK FISHBURN

When you examine the definitions of Critical Infrastructures[1] covered by the U.S. Government's Cybersecurity Infrastructure and Security Agency (CISA), you see the mind-bending breadth of its scope. What distinguishes the categories defined is the impact on wide areas of the population or on specific communities, *"... should any of these infrastructures be incapacitated or destroyed."*

This article examines how evolving and related networking, security and business models create challenges and decisions for specific critical infrastructures. Instead of attempting to boil this ocean we address three important areas common to implementors and operators. They are:

- Network ecosystem evolution – Network as a Service.
- Operational network business and security challenges.
- Security – the basics that are still constantly ignored leading to high profile incidents.

The Context: Distinguishing Critical Infrastructures

Looking at CISA's list (See Figure 1), you will see why it's beyond this article's scope to go into detail of any of the 16 sectors or 70+ interrelated subsectors served more than 80% by non-government organizations.

We have split the list into two groups. The first being where the effect is immediate and rapid response is most critical. The second group has less immediate impact but is also critical.

All are costly undertakings but what distinguishes the first group is that disablement is so much more impactful than even business cost. Making such infrastructures resilient to incapacitation encompasses architectural choices, holistic approaches, threat avoidance, prevention, and automated recovery. Some areas such as "smart cities" pharma companies are not covered but are also critical. The Dallas municipality cyberattack impacting the whole community comes to mind. Those relying on IoT/IIoT devices requiring physical device security are especially vulnerable and open to human error.

Caution is required when looking at approaches based on thinking that predates Cloud proliferation,

CISA-Defined Sectors	Sub-Sectors Where Very Fast Response Is Required to Protect Life Include
Communications	Undersea, satellite & terrestrial, dedicated & Internet networks. 5G, fiber, microwave & copper, access networks, Wi-Fi
Dams	Management, water retention, control, and energy conversion systems, etc.
Defense	Location infrastructure systems, communications systems
Emergency services	Law enforcement, fire, rescue, emergency medical services
Energy	Electrical generation, grid systems, oil refineries, pipelines, natural gas, wind, solar
Financial services	Financial management, money storage, transfers
Information technology	IT systems, data center, Cloud, edge, applications software, networks
Nuclear sector	Active, test reactors, medical products & waste management
Transportation systems	Aircraft, traffic control, airports, highways & traffic management, road delivery & hazardous material transport; rail passenger, freight networks, stations
CISA-Defined Sectors	**Sub-Sectors Where Measured Response Is Required**
Chemical	Basic, specialty, agricultural, consumer products
Commercial facilities	Entertainment, lodging, malls, outdoor events
Critical manufacturing	Machinery, electrical & transportation equipment
Food and agriculture	Farming, food distribution, retail stores
Government facilities	Federal, state, local government education, law offices
Healthcare, public health	Hospitals, epidemic prevention & treatment, etc.
Water and wastewater	Capture, purification, storage, distribution of water & wastewater

FIGURE 1.

modern IoT systems, distributed workforces, connected supply chains, current network infrastructures, COVID-19 and state-sponsored cyberattacks.

Critical Decisions: Business Needs for Network as a Service

Changes driven by focus on their mission-critical applications are required by enterprises. They no longer have the resources or time to build handcrafted, complex networks. These requirements include:

- On-demand, services purchased via portals, consumption-based billing without lock-in.
- Seamless access to multi-Cloud workloads and apps located anywhere.
- Agnostic to infrastructure technologies and providers, performance, and security sensitive.
- Business aware to cope with M&A, policy shifts and migration.
- Integrity of real-time operational networks that serve its customers.

2024 will decide how critical infrastructure organizations will reshape their networks based on how Cloud/Service Providers and Supplier/Integrators respond to these needs.

Enter the new **Network as a Service**. Services offered will vary to match the capabilities and end user organizational requirements, resources, and capabilities. New forms of Managed Services, Infrastructure as a Service and Platform as a Service will help end users feel secure in delegating to their various partners. It will be essential to always look beyond the marketing jargon to verify that functions offered actually meet your needs without having to pay for service functions that you do not want.

What will the likely next phase of the network look like?

This shift is shown in Figure 2 but all the providers and integrators will market their own version reflecting their positioning. The important thing is the shift that began with data center centric to Cloud and network ecosystem is beginning its journey to a new Network as a Service model. This will be inherently more secure than the everything-to-everything connectivity with almost unlimited attack surfaces.

Marrying Business and Network Requirements

These changes will shape how applications and networks are architected and managed, shielding enterprises from the implementations. Three important decisions to be addressed are:

- Will new architectures meet the business drivers with system integrity and save OpEx cost?
- Can this architecture avoid insecure connection to IoT devices via Internet, Cloud-based or other servers beyond the operational networks?
- Companies such as Cisco, Splunk, Zscaler, and Verizon will play important roles here, but inspection of the actual functions offered will be important.

Critical Decisions: Critical Infrastructure Operational Integrity

Some more practical considerations:

- As National Transport Safety Board chair Jennifer Homendy said earlier this year of the Ohio rail incident: *there is no such thing as accidents and it was 100% preventable.* Was this a system

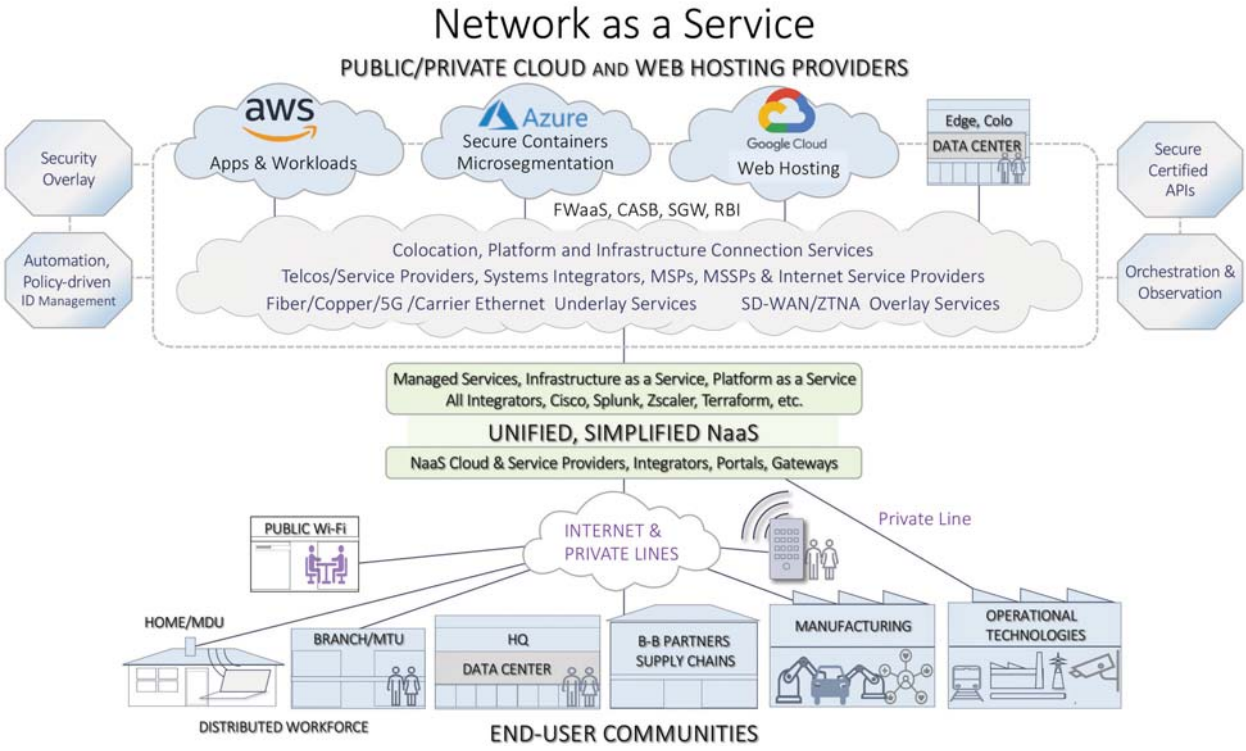


FIGURE 2.

and networking failure? Having a trackside generated alarms-only based system not an alert and alarm threshold system with no single point of network failure was a recipe for the disaster that happened. I would hope that after-the-fact other ideas were explored. Fiber optic networks are expanding, yet the pace of implementation is too slow and the prospect of $60k to $80k per mile fiber installation is daunting. Without commercial viability, critical infrastructure systems cannot function, no matter how severe the impact of their incapacitation.

- To address both concerns, adoption of the latest hybrid fiber-copper infrastructure in airport, Smart City, and rail network infrastructures is growing. Fiber/copper can now transmit at fiber speeds, can be instantaneously available as copper is often already in place, provide failover with fiber installations, and provide power for remote monitoring devices. This was addressed in the context of expanding broadband network reach with Actelis in the ISE Magazine article published a year ago.[2] This important trend is of great benefit throughout critical infrastructures.

Cybersecurity Evolution

The migration to Cloud and hybrid models is a two-edge sword, creating new attack surfaces and Internet connectivity. The days of defending the data center as the principal concern of cybersecurity are long gone. Applying the Zero Trust principles of "Never Trust, Always Verify" in the network, for software suppliers and in the organization is a necessity. Thanks to CISA and the SEC, this has become a corporate imperative. Physical or virtual separation between Information and Operation Technology networks is a big step in the development and protection of your critical infrastructure.

Last but not least, Network as a Service has the potential to reduce the attack surface by harmonizing identity management and authentication. Importantly, it will also lessen the expertise and security work and cost for enterprises—a big advantage. However, it will never remove their overall responsibility to properly delegate to suppliers.

Critical Decisions: Cybersecurity Best Practices

Almost every breach or ransomware attack can be traced back to lack of board oversight, accountability, and lack of understanding of holistic cybersecurity. That applies to security software companies too! In fact, if IT-based defense is the only defense, it ends in tears. The recent high profile MGM Resorts incident likely had multiple weak links but began with lack of board imperative and expertise and yes, hotels and casinos are in the Commercial Facilities category.

Basic Critical Actions to Reduce Risk

Ensure that all these are covered, strengthening weak links, and dramatically reducing risks.

- A holistic cybersecurity approach for whole organization, contractors and beyond. Have the board implement a security policy and step-by-step strategy to strengthen each weak link.
- Curate all critical assets and test resilience. Encrypt all data, network configurations and customer info. Test air-gapped backups in case live data is rendered inoperable or

> "The migration to Cloud and hybrid models is a two-edge sword, creating new attack surfaces and Internet connectivity. The days of defending the data center as the principal concern of cybersecurity are long gone."

re-encrypted. Employ micro-segmentation to separate and protect data. Automate all software updates.

- Access is via multifactor authentication using passkeys not usernames/passwords, verified with identity management and with no access from non-company devices.
- Insider threat, social engineering strategies, training and least privilege access must be in place.
- Installed phishing, malware, elevation of privilege, lateral movement prevention is in place.
- Adopt Zero Trust principles of Identity and Authentication, access control, least privilege, automated monitoring including blocking of non-typical user behavior.
- Be cybersecurity threat aware, map out avoidance and prevention tasks, automate everywhere.
- Know that all software (especially security software) is not trusted but verified using our Verified Delegation Methodology (see references online).[3]
- Continually assess your security posture, measure progress, take new actions.
- Comply with new SEC rules, with clear documentation demonstrating your security policy is thorough and implemented.

See my "Security as a Service" page for many more details.[4]

Complement These with Critical Infrastructure Security Specifics

- Use Zero Trust techniques to create trusted routes. Use packet fragmentation over multiple physical paths, limiting access to users and software that has insufficient privilege or fails identity and authorization checks to access remote devices.
- Microsoft's 2023 Security Report[5] found 71% of IoT devices are vulnerable, 46% can't be patched, and 21% use obsolete operating systems. I.e., total physical or virtual separation of Operational Networks from the Internet is essential.
- The ability to intercept video, traffic sensors are seen in movies but video recordings can also be disabled by techniques that bury malware in H264 encoded video files.
- ASCON lightweight cryptography for IoT devices was selected by the U.S. Government earlier this year. Look for early deployment of implementations now becoming available. These will supersede the need to use layer 2 encryption protocols such as the IEEE's MACsec which has had limited uptake.

Final Thoughts

We have addressed a monster topic, with the intention of providing guidance on three critical areas: network evolution choices, operational networks, and overall security.

We hope you found it valuable—even if just one or two weak links are strengthened—as you take the next steps in your network and cybersecurity journey to prevent incapacitation of your critical infrastructure network. ■

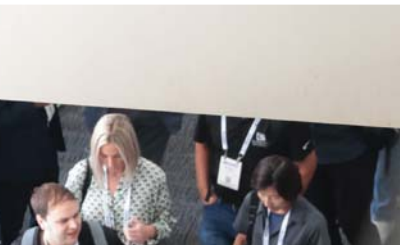
REFERENCES AND NOTES

1. CISA, https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors
2. ISE Magazine, https://isemag.com/14284341
3. Topic References, https://isemag.com/14300293
4. Security as a Service, https://cybyr.com/services/
5. Microsoft, https://www.microsoft.com/en-us/security/security-insider/microsoft-digital-defense-report-2023 (10/23)

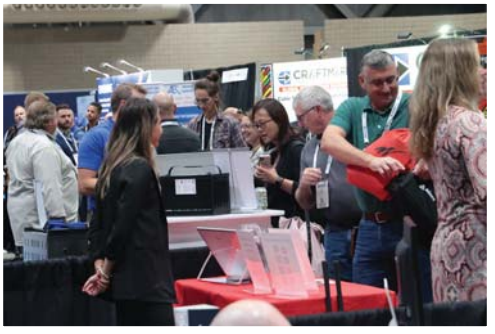
Mark Fishburn has five decades of experience in software, networking, and security, and author of the Holistic Cybersecurity book: Hey Who Left The Back Door Open? For more information, or to give feedback, email mark@cybyr.com or follow him on LinkedIn: linkedin.com/in/markfishburn/.

ISE EXPO

ICT SOLUTIONS & EDUCATION



Attendees were eager to meet the 200+ vendors and to see, touch, and learn about the various products on the ISE EXPO Exhibit Floor.



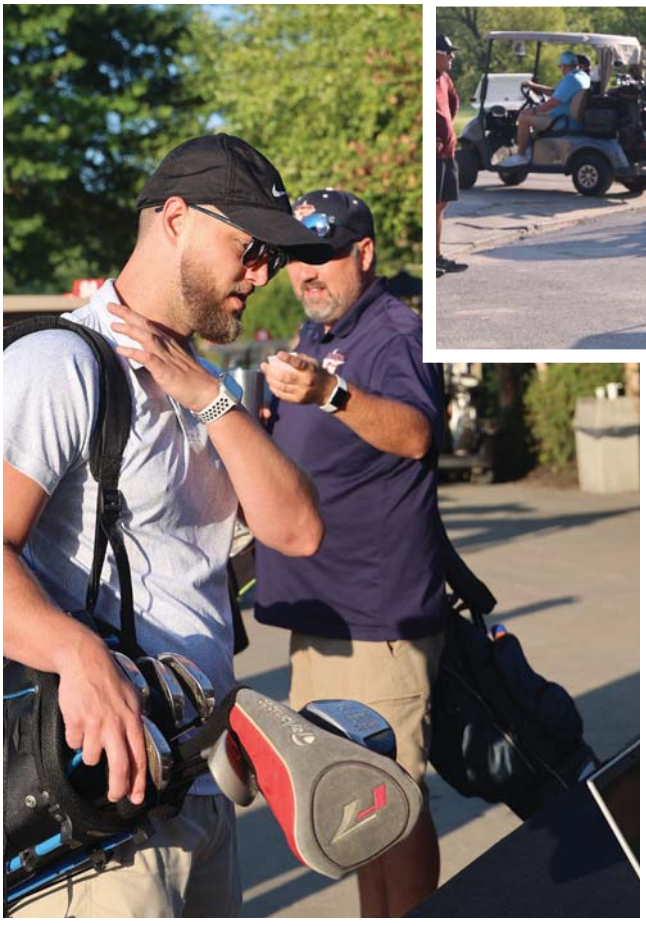
Attendees received hands-on equipment training and more during the two-day Hands-on Fiber Training, powered by SCTE.

A good time was had by all at the first annual ISE Network Innovators' Awards Ceremony. 2023 honorees include Clearfield, Corning, Emtelle, Prysmian Group, EXFO, 3-GIS, IQGeo, Amphenol Network Solutions, Anritsu, and VETRO.

Brightspeed's executive leadership team inspires attendees with their Opening Keynote presentation. (L-R) Chris Creager, Advisor and Board Member, Tom Maguire, CEO, and Bob Mudge, Executive Chair, Brightspeed Board of Directors. Moderated by Sharon Vollman, Editor-in-Chief, ISE Magazine.

With 40 seminars to choose from, attendees gained up-to-date telecom knowledge and the opportunity to earn BICSI Continuing Education Credits (CECs).

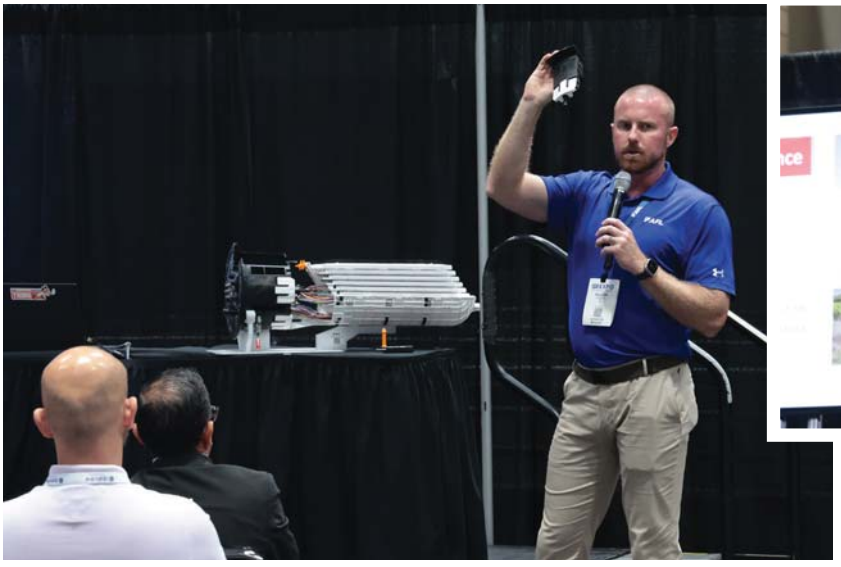
The second annual Women in Telecom (WIT) Panel Discussion was well attended—standing room only. Attendees were eager for insights from these leading female executives (L-R): Janice Oliva, Endeavor Business Media, Kim Hartwell, Corning, Katy Greenfield, Telstra, Sherry Hessenthaler, Brightspeed, and Emily McGinn, Windstream.



The second annual golf tournament, held at Drumm Farm Golf Course, provided a perfect way to tee off ISE EXPO week.

EXFO displaying their three Network Innovators' Awards at their booth on the exhibit floor.

Closing Keynote Tech Talk presenters shared their network evolution wisdom. The executives are (L-R) John Amundson, Director of Planning & Implementation, TDS Telecom, Charlie Cano, CEO, Etex Telephone Cooperative, Brian Bond, Chief Operations Support & Innovation, Brightspeed, and Ashley Travers, former Director of Network Engineering, Verizon.



(L-R) William Miller, AFL, and Derrick Reish, Laser Tech, showcasing innovative products in the Demo Zone.

Attendees and vendors continue conversations during the Networking Happy Hour on the exhibit floor.

Big, Vast, and Complicated:

IoT, Cybersecurity, and the Global Supply Chain

Industry standards and systems reduce risk in the deep complexities of global supply chains.

BY MIKE REGAN

The scope of the Internet of Things (IoT) is expanding across network infrastructures, with millions of connected devices deployed in all kinds of environments for a wide range of business, industrial, and consumer use cases across all sectors. A new Worldwide Internet of Things Spending Guide released by International Data Corporation (IDC) estimates that investments in IoT will surpass $1 trillion in 2026.

As service providers and network operators expand broadband connectivity to homes, businesses, and cities nationwide, they support this ever-expanding IoT ecosystem and ensure the reliable transmission of substantial amounts of diverse and often critical IoT data. The proliferation of IoT also provides an opportunity for them to expand their offerings and reap new revenue streams.

Despite the significant benefits of IoT, widespread adoption demands that service providers and network operators ensure a high level of security—especially given the rise in frequency and sophistication of cyberattacks and the vulnerability of IoT devices. These efforts must start with securing the global supply chain and aligning with emerging global government and industry initiatives through straightforward, technology-agnostic baseline requirements.

IoT Brings New Opportunities for Service Providers

IoT is everywhere and continues to expand with more connected systems, devices, and sensors from an ever-increasing number of suppliers across commercial, industrial, and consumer sectors. As emerging technologies like artificial intelligence (AI) and machine learning (ML) mature, more IoT devices that produce substantial data will be deployed.

In the consumer market, smart home IoT devices are becoming popular. According to Fortune Business Insights, the global smart home market is projected to grow from $93.98 billion in 2023 to $338.28 billion by 2030, with an estimated 94 million U.S. households using smart home devices in the next four years. These devices include smart doorbell cams, thermostats, locks, detectors, outlets, lights, and appliances—to name a few. A study from Parks Associates found that 71% of U.S. broadband households also own connected entertainment devices, such as smart TVs, virtual reality headsets, and gaming consoles.

The growth of consumer IoT opens many opportunities for service providers and network operators to expand their offerings—everything from installation, setup, and technical support to data management and gateways for device connectivity.

Smart cities increasingly leverage IoT for applications related to public safety, energy management, smart lighting, smart traffic and parking, electrical vehicle charging, waste handling, air pollution monitoring, crowd monitoring, and more. Many service providers are unlocking new revenue streams by rolling out IoT solutions for municipalities. Nokia, AT&T, Verizon, and others have launched IoT smart city platforms for connecting, integrating, and orchestrating smart city operations.

IoT is also entering critical infrastructure sectors, including healthcare, manufacturing, transportation, telecommunications, finance, energy, water and wastewater, agriculture, and defense. Many of these applications fall under the government's definition of critical infrastructure, including connected IoT sensors and control devices used in critical pipelines. Critical infrastructure

> **"The global smart home market is projected to grow from $93.98 billion in 2023 to $338.28 billion by 2030."**

operation is increasingly contracted to service providers and network operators that can effectively aggregate data assets at the edge and enable transmission to cloud-based platforms.

Healthcare is one critical sector experiencing rapid IoT adoption that relies heavily on broadband connectivity. With increased healthcare costs and the growing shortage of physicians, healthcare providers are turning to remote telehealth experiences using connected cameras, speakers, and IoT devices for health monitoring and prevention of chronic conditions. These include connected stethoscopes, insulin pumps, and consumer wearables such as pulse oximeters, heart monitors, and blood pressure monitors, making medical care increasingly possible from patient homes.

Cybersecurity Is the Greatest Concern

While ever-increasing IoT applications deliver significant benefits across all sectors and provide opportunities for service providers and network operators to enhance their offerings, cybercrime is expanding along with technology, global unrest, rising geopolitical tensions, and economic uncertainty.

IoT devices have become a key target due to their vulnerability. They are typically customized for specific functions with limited computational ability, which can inhibit ensuring adequate security measures. Vendors in the competitive IoT market also rely heavily on open-source software to keep prices down and improve speed to market. Highly distributed and ubiquitous open-source software is also often co-created and available for anyone to access and modify, increasing the potential for poorly written or undermanaged code that cybercriminals can easily exploit.

Consumer IoT devices add another layer of vulnerability due to a lack of consumer awareness, insecure home networks, weak passwords, and outdated software. According to a 2023 report by Check Point Research, high-risk vulnerabilities in IoT-related code bases jumped 130% over the past five years, and the first two months of 2023 saw a 41% increase in attacks targeting IoT devices compared to 2022.

Securing IoT devices against attacks that target critical infrastructure is paramount. If not properly secured, IoT devices in critical infrastructure risk unauthorized access that can wipe out services, damage the economy, and threaten public safety. One example is the 2021 breach where a computer hacker gained access to a Florida city water system and tried to pump in a dangerous amount of a chemical. Another is the famous ransomware attack that halted all pipeline operations of the Colonial Pipeline Company that carries fuel to the Southeastern U.S., causing significant gasoline price increases.

Cloud-based solutions that support IoT are also becoming a target. These solutions increasingly leverage open-source code to enable integration across diverse workloads, handle storage of large data sets, and provide broad access via public-facing applications. According to a 2023 Thales Global Cloud Security Study, cloud exploitation cases grew by 95% in 2022. While emerging technologies like AI/ML are helping cloud providers identify anomalies to detect malicious activity, cybercriminals also leverage these technologies to scan for vulnerabilities, automate malware, crack passwords, analyze stolen data, and formulate content used in social engineering attacks.

New Regulations Help Address the Issue

Recent global government and industry initiatives aim to address IoT security, several of which directly impact service providers and network operators. The 2020 U.S. IoT Cybersecurity Improvement Act sets minimum security standards for IoT devices used by the federal government and prohibits agencies from procuring or using IoT devices considered "non-compliant" with standards developed by the National Institute of Standards and Technology (NIST). In September 2022, the Office of Management and Budget (OMB) issued Memorandum M-22-18, requiring federal agencies to comply with NIST guidance. In partnership with national security and counterintelligence agencies, the U.S. Cybersecurity and Infrastructure Security Agency (CISA) also released the Enduring Security Framework that provides guidelines for software vendors on implementing secure development processes. As a result of these efforts, federal government stakeholders and partners must attest that they have an acceptable cybersecurity and supply chain risk management (C/SCRM) plan in place. That includes all eligible entities and sub-grantees of the Broadband Equity, Access, and Deployment (BEAD) Program.

In 2021, Executive Order (EO) 14028 directed NIST to initiate pilot programs to educate the public and identify IoT cybersecurity criteria for consumer labeling. NISTIR 8425, Profile of

the IoT Core Baseline for Consumer IoT Products, is the foundation for the U.S. Cyber Trust Mark program that supports this labeling requirement and is expected to be up and running in 2024. The program applies a distinct mark to consumer devices that meet established cybersecurity criteria, including smart home appliances and devices, entertainment devices, wearables, and more. Several manufacturers and retailers have announced their commitment to the program, including Amazon, Best Buy, Google, LG, Logitech, and Samsung.

Critical infrastructure and sectors vital to the economy and national security must also comply with the NIST Framework for Improving Critical Infrastructure Cybersecurity. Federal law requires anyone operating in critical infrastructure sectors—including service providers—to report any cybersecurity incidents or ransomware per the Cyber Incident Reporting for Critical Infrastructure Act (CIRCIA) of 2022. Several other regulations and standards cover cybersecurity for specific sectors, such as the Consolidated Appropriations Act of 2023, which requires FDA-approved connected medical devices to meet certain cybersecurity requirements.

Securing the Global Supply Chain is Vital

While global government and industry initiatives boost defenses in the public sector, many regulations focus on a specific industry or technology or only address apparent vulnerabilities. However, IoT systems and devices comprise hardware and software components and subcomponents from thousands of suppliers and locations worldwide across a vast, complex supply chain serving the private sector. Even reputable vendors may not be aware of vulnerabilities deep within open-source code and other subcomponents, especially if a device functions as expected.

"The first two months of 2023 saw a 41% increase in attacks targeting IoT devices compared to 2022."

Service providers must ensure that *all* components comprising their networks and IoT solutions are secure—from switches and routers to customer gateways and the IoT devices they connect. That means verifying that all equipment and device vendors have prioritized security across hardware and software development life cycles, including components and subcomponents such as open-source software.

A Supply Chain Industry Standard

To address these concerns, the SCS 9001™ Supply Chain Security Management System from the Telecommunications Industry Association (TIA) provides the level of detail and required processes needed to address cybersecurity deep within the supply chain. It's a straightforward, technology-agnostic means to verify that networks and their supporting hardware and software components and subcomponents meet critical security benchmarks to mitigate the risk of cybersecurity attacks. It provides operational process criteria to ensure vendor corporate policies and procedures inherently deliver secure products and services. The recent SCS 9001 Release 2.0 is updated and expanded to ensure alignment with the latest global government policies and industry initiatives, while providing a simple, unified architecture with baseline requirements that apply to any technology, including emerging IoT and cloud-based applications.

While no single standard is sufficient for securing all components and applications, specifying vendor compliance to SCS 9001 allows network operators, service providers, system integrators, manufacturers, buyers, suppliers, and consumers to gain trust and confidence that network equipment, systems, devices, and sensors have been assessed for risk—providing a secure foundation for unlocking new business opportunities in IoT. ■

Mike Regan is VP Business Performance at Telecommunications Industry Association (TIA). For more information, email supplychainsecurity@tiaonline.org or visit www.tiaonline.org. You can also follow TIA on Twitter @TIAOnline andLinkedIn: linkedin.com/company/tia-telecommunications-industry-association-/.

A Monumental Year for RURAL BROADBAND

Shirley Bloomfield, CEO of NTCA–The Rural Broadband Association, looks at progress made in 2023.

BY SHIRLEY BLOOMFIELD

2023 has been a monumental year for broadband. From the ReConnect program overseen by the U.S. Department of Agriculture (USDA), to the American Rescue Plan Act (ARPA) funds being distributed by the U.S. Treasury through the states—and from the Federal Communications Commission's (FCC) universal service fund programs, to new programs launched by the National Telecommunications and Information Administration (NTIA)—there has never been a year like 2023 when it comes to finding ways to reach the millions of Americans still longing for better broadband access.

Of course, the biggest deployment program is still to come, with NTIA and the states ramping up to distribute tens of billions of dollars through the Broadband Equity, Access, and Deployment (BEAD) program with the goal of ensuring that every unserved American has broadband access by 2030.

But before we get to the promise of BEAD—and the work still needed to make that work—let's look back at the programs that are already working because we can see the substantial progress made and draw some lessons for what comes next.

In 2023, for example, the USDA has given out more than $1.5 billion in funding through ReConnect, with more than

▲ Gamers compete at the 2023 GigaZone Gaming Championship hosted by Paul Bunyan Communications in Bemidji, Minnesota.

$800 million flowing to small, community-based broadband providers in NTCA's membership to deploy future-proof broadband networks in deeply rural areas. This program—along with the ARPA-funded state grant programs—has been highly successful in years past in prompting construction of cutting-edge networks that will meet the needs of consumers today and tomorrow, and we have high hopes for the funds awarded in 2023 as well.

Meanwhile, NTIA and each state have been working at a fast and furious pace over the course of this year to implement the $42.5 billion BEAD program. At the end of June, President Biden announced the amount each state will receive from the BEAD program, and I am grateful to have been in the room for the historic announcement. The buzz in the security line getting into the event itself was electric as folks lined up early in uncharacteristic Washington, D.C. style.

Throughout the late summer and into the fall, state broadband offices have been working diligently to develop their Initial BEAD Proposals, which are due by the end of the year. To help these offices and stakeholders of all kinds as they race toward this finish line, NTCA worked with the Fiber Broadband Association to release the third iteration of our Broadband Infrastructure Playbook this fall.[1] Over the course of these releases, this tool has aimed to provide easy-to-follow guidance and recommendations on successful implementation of a BEAD-funded grant program. As the state broadband offices complete this work over the next few months, NTIA will then have to review and approve these plans, meaning that BEAD funding may not flow until the first half of 2024 in even the most early acting states and not until later next year or into 2025 in others.

As we get closer to the launch of the historic BEAD program, this is a good opportunity to highlight the lessons we learned from how broadband grant programs have worked in 2023 and years past.

For example, even something as simple as the timing of program implementation can be critical, in that if a grant is awarded in the late fall or during the winter, in many states this means construction won't start for months while the ground is frozen. Add to that the time it takes to apply for and receive permits from federal, state, local, and tribal governments and entities, and it could be a significant challenge to complete construction within the ambitious four-year deadlines of the BEAD program. So, timing—and streamlining processes where possible to help with timing—needs to be a critical piece of any state plan for BEAD.

Another important lesson to draw from earlier initiatives like ReConnect and some of the FCC's universal service fund (USF) programs is "getting it right the first time." Too often, we've aimed just "to get something to everyone," with the result being deployment of broadband networks that quickly appear outdated and require reinvestment soon thereafter.

Even now there's a debate in Congress over whether to change the ReConnect standards to expect improved performance or to ratchet them downward so that certain kinds of providers have a better chance of winning. In the end, if we learned anything from prior broadband programs, it should be that the customer comes first—and program rules should be designed in a way that gives those customers robust and reliable broadband rather than access to a network that in just a few years' time falls far short again.

Yet another lesson to draw from 2023 and recent years is that the work of connecting communities is not finished simply because a network has been built. To the contrary, the work is just beginning once the network is completed. If one puts the customer first again, it's clear that customers don't just need networks—they need services. And this is where the FCC's universal service initiatives are critical, recognizing the difficulty of sustaining rural networks and keeping rates for services affordable in sparsely populated areas.

Even as the new grant programs offer great promise, they are just a step toward universal service rather than final achievement of that goal. The FCC has taken significant steps in recent years to refocus its essential USF programs on this mission of sustainability of networks and services, and while creating many of these new grant programs, Congress also explicitly directed the FCC to neither abandon nor neglect the more comprehensive mission of universal service. Even as aspects of these long-running USF programs face challenges now in courts—more than 25 years after their creation—we hope that the interest of Congress in supporting this universal service mission will remain strong and resolute.

Turning from the programs that helped in 2023 (or are poised to begin next year) to promote and sustain better broadband access, we also took a series of steps within NTCA over the course

NineStar Connect, Greenfield, Indiana, employees deploying fiber.

of this year to help small rural broadband providers prepare for these opportunities. For example, NTCA collaborated with Corning to secure a dedicated supply of fiber for small broadband providers to help with the flood of upcoming network buildouts. In addition, we were pleased to join several major manufacturers this year as they announced increased domestic production of critical broadband equipment. Our hope is that these kinds of measures will help NTCA members and others like them be ready to hit the ground running with the supplies needed to build broadband as funds are awarded.

And of course, you can't have a network if you don't have the workforce to build it. Like other sectors, the broadband industry faces a shortage of skilled workers. That is why NTCA partnered with Northwood Technical College in Rice Lake, Wisconsin, to provide NTCA members with online access to Northwood's Broadband Academy courses and "Digital Badging" program,[2] which provides employees with professional development opportunities and provides companies with a pipeline of skilled workers. Even if you are not an NTCA member, continued learning opportunities and certifications can help ensure your knowledge and skills are up to date in an industry that is constantly changing and evolving.

Hill Country Internet and Phone Service (HCTC), Ingram, Texas, linemen installing fiber.

In addition to ensuring the current workforce has the technical skills and certifications necessary, we believe it is never too early to engage with the next generation. NTCA members have been particularly focused on this area, with members hosting internship programs and job fairs, working with their schools to develop a STEM curriculum, and even supporting esports and robotics teams and hosting tournaments to engage with students who may be interested in engineering or other technical jobs down the line.

While many of these students are too young to play a significant role over the next few years, a focus on "growing our own" can bring them into the fold down the line. To that end, the Foundation for Rural Service, the philanthropic arm of NTCA, published a "Guide to Careers in Rural Telecommunications"[3] to highlight the types of job opportunities available within local rural telecommunications companies.

And NTCA's Smart Communities program teamed up with the National Rural Education Association to create the Broadband Opportunities and Leadership Development (BOLD) K-12 Career Awareness Toolkit,[4] which provides guidance and best practices for locally operated communications providers and educators to create more awareness of broadband careers among K-12 students. Both educational resources are available for free online.

A final item worth highlighting is how cybersecurity has become an increasing focus over the past year, with BEAD and other broadband funding programs now requiring recipients to have cybersecurity and supply chain risk management plans in place. To help NTCA members in becoming more aware of these issues and obtaining greater information on mitigating such risks, we operate CyberShare: The Small Broadband Provider ISAC and offer a sector-specific guide to help companies enhance their cyber posture and resiliency.

It's clear there is no shortage of issues as we continue the work of closing the digital divide. But, at the same time, the future of broadband is as bright as it ever has been, and NTCA stands ready to help small broadband providers navigate these issues and deliver the best possible broadband for the benefit of rural America. ■

REFERENCES AND NOTES

1. Broadband Infrastructure Playbook, https://www.ntca.org/opportunity/broadband-infrastructure-playbook
2. Northwood Technical College, https://www.northwoodtech.edu/continuing-education-and-training/professional-development/broadband-academy
3. Foundation for Rural Service, https://www.frs.org/programs/educational-materials/guidetocareers
4. BOLD Toolkit, https://www.ntca.org/sites/default/files/documents/2023-04/SRCBOLDToolkit_0.pdf

Shirley Bloomfield is Chief Executive Officer of NTCA–The Rural Broadband Association. For more information, visit www.ntca.org. Follow Shirley and NTCA, respectively, on Twitter @sbloomfield15 and @NTCAconnect. Follow NTCA on Facebook: facebook.com/NTCARuralTelecom/ and LinkedIn: linkedin.com/company/ntca/.

MAXIMIZING POTENTIAL BENEATH OUR FEET:

The New Edge of Dark Fiber Investment

How increased demand for data infrastructure nationwide is straining market capacity and fueling a "new" edge.

BY SCOTT BERGS

By now, we all understand that data has become the driving force behind innovation. No matter the industry, location, customer, or provider, companies are using data to improve efficiency, fuel growth, and discover new opportunities. Over the past decade, we've seen a significant surge in data-intensive applications that have put a strain on our networks. Because of this, the once-efficient infrastructure is now struggling to handle the data demand. Businesses and individuals are facing frustrating delays and connectivity issues.

As we look ahead, it's also clear that in addition to managing and adapting to yesterday's growing data consumption, we must also prepare for the continued growth fueled by emerging trends such as AI and machine learning. According to IDC's forecast, new data creation is projected to grow at a compound annual growth rate (CAGR) of 23%, resulting in approximately 175ZB of data creation by 2025. This clear indication highlights the need for creative solutions that address the needs of a new era.

Preparing for Tomorrow's Data Demands

Amidst the explosive surge in data consumption, a phenomenon known as the

"edge" in data infrastructure emerged. Traditionally, we've envisioned the "edge" in geographical terms, picturing the need to expand and move further from major metros to establish data centers closer to users.

Fueled by AI, data analytics, remote work, and big data overall, the demand for data continues to skyrocket, and the concept of the "edge" has taken on new meaning. It might once again be time to challenge our conventional understanding of the edge because the edge is no longer about distance and reaching further out; it's about capacity and maximizing the potential right beneath our feet—within our urban centers and data hubs.

As data demands grow, and supply is pushed to its limits, businesses are confronted with a critical decision: how to prepare for the data demands of tomorrow. This decision isn't just another operational consideration; it is a long-term strategy move, much like purchasing an insurance policy. Instead of safeguarding against unforeseen disasters, however, this insurance policy ensures that organizations are prepared for the ever-expanding data landscape. The urgency of this decision comes into sharp focus when we consider the current supply-demand dynamics surrounding dark fiber and conduit. And maybe, nowhere else on the planet is this more evident than in Data Center Alley.

Data Center Alley's Infrastructure Advantage

Northern Virginia's position as a global powerhouse in data structure infrastructure is no secret, and has been highlighted, once again, in Cushman & Wakefield's 2023 Global Data Center Market Comparison. This extensive annual study covers 63 global markets and over 1,600 data centers and offers a comprehensive analysis covering 13 distinct categories, including fiber connectivity, market size, and cloud availability. Northern Virginia has been a recurring front-runner in the study and retained its top spot again this year. With its substantial market size, boasting over 2,600 megawatts of commissioned power, and impressively low vacancy rates of below 1%, Northern Virginia reaffirms its status as a global leader in data center infrastructure.

Infrastructure Strategy for Tomorrow's Demands

Virginia's ascent as a data center powerhouse was driven by early and extensive investments in fiber optics. The state's appeal was initially tied to its proximity to Washington, D.C., and the subsequent arrival of the Metropolitan Area Exchange, East, which attracted firms and spurred fiber network growth. This strategic groundwork reduced latency, making it an attractive hub for data centers. Virginia further incentivized the industry with sales tax exemptions and leveraged its skilled workforce, low energy costs, and streamlined development processes.

Continued infrastructure investments, such as subsea cables like MAREA and BRUSA connecting Virginia to Europe and South America, further bolstered its status. Today, Northern Virginia's data center market surpasses the combined size of the next five largest U.S. markets. The industry's significance to the global economy is underscored by claims that around 70% of the world's Internet traffic traverses Data Center Alley each day.

It's clear Data Center Alley holds a crucial role as one of the world's vital data hubs, and it's important to maximize its potential to ensure it remains indispensable to businesses in the future. This isn't just about pushing the boundaries of expansion; it's also about strengthening the core right beneath our feet. How can we achieve this? By planning for the ever-growing data demands of today and tomorrow, which could mean securing a surplus of dark fiber and conduit infrastructure.

By proactively making these investments, businesses can position themselves to meet the escalating data needs of today and tomorrow. This strategic approach not only supports their growth but also reinforces their resilience in the face of evolving digital challenges. It's about future-proofing operations and preparing for the data-driven world that lies ahead.

Future-Proofing: Dark Fiber Rising

Forward-thinking carriers, data centers, cloud providers, and enterprises recognize the need to strategize for the future by bolstering their fiber capacity in high-demand regions such as Data Center Alley. And one way of staying ahead of the curve lies in acquiring dark fiber and conduit now, essentially securing an insurance policy against tomorrow's inevitable surge in data requirements. This foresight-driven approach involves obtaining unused, unlit fiber optic cables that are strategically positioned within conduits for future activation.

To address densifying data demands, many organizations are turning to high-count dark fiber solutions. The appeal of high-count dark fiber lies in its capacity to accommodate an extensive volume of data traffic, making it an ideal choice

"It might once again be time to challenge our conventional understanding of the edge because the edge is no longer about distance and reaching further out; it's about capacity and maximizing the potential right beneath our feet—within our urban centers and data hubs."

for long-term scalability. By seizing the opportunity to acquire these assets now, organizations position themselves for a smoother and more cost-effective transition when they eventually decide to "light up" this dark fiber, bringing it into active service.

Additionally, the acquisition of dark fiber and conduit infrastructure not only future-proofs operations but also enhances overall network resilience and flexibility. As the world becomes increasingly reliant on data-intensive applications, cloud computing, and emerging technologies like IoT and 5G, having the necessary fiber infrastructure in place ensures organizations can adapt swiftly and efficiently to meet evolving connectivity demands.

Choosing the Right Infrastructure Provider

Equally important to location is having the right infrastructure provider. A specialized dark fiber provider familiar with the region offers unique advantages. They possess invaluable insights into the latest advancements in network infrastructure. These newer networks are essential due to their lower likelihood of technical problems, faster speeds, and overall reliability. They not only strengthen your current operations but also ensure that your network is ready to meet future demands.

A strategically located, high-capacity, purpose-built network, such as DF&I's newly constructed, all-underground Express Connect® dark fiber and conduit system, offers several benefits. It facilitates access and on-net interconnection to the precise locations, data centers, clouds, and carriers your business requires. It also equips your company with the scalability necessary for future growth.

Data Infrastructure as a Strategic Investment

In an evolving digital landscape, businesses must approach their data infrastructure strategy with the same level of precision they use when selecting an insurance policy. It's not just about resource allocation; it's a strategic decision aimed at securing a competitive edge.

Partnering with specialized providers with extensive experience in building high-capacity dark fiber networks ensures a robust, scalable, and future-ready data infrastructure. So, as your business navigates the digital terrain, remember that investing in data infrastructure is more than a strategic move; it's an investment in a future where data is the currency of success. The time to act is now, as those who secure their fiber assets today will be well prepared to meet the data demands of tomorrow. ■

United States Postal Service
Statement of Ownership, Management, and Circulation **(Requester Publications Only)**

1. Publication Title: ISE (ICT Solutions & Education)
2. Publication Number: 1511
3. Filing Date: 09/22/2023
4. Issue of Frequency: Bi-Monthly
5. Number of Issues Published Annually: 6
6. Annual Subscription Price:
7. Complete Mailing Address of Known Office of Publication (Not Printer): Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI 53538 — Contact Person: Laura Moulton, Telephone: 941/259-0859
8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not Printer): Endeavor Business Media, LLC,30 Burton Hills Blvd., Ste. 185., Nashville, TN 37215
9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor - Publisher: Janice Oliva, 30 Burton Hills Blvd., Ste. 185., Nashville, TN 37215; Editor: Sharon Vollman, Editor-in-Chief, 30 Burton Hills Blvd., Ste. 185., Nashville, TN 37215; Managing Editor: Joe Gillard, Executive Editor, 30 Burton Hills Blvd., Ste. 185., Nashville, TN 37215
10. Owner - Full name and complete mailing address: Endeavor Media Holdings I, LLC, 905 Tower Place, Nashville, TN 37204; Endeavor Media Holdings II, LLC, 905 Tower Place, Nashville, TN 37204;Resolute Capital partners Fund IV, LP, 20 Burton Hills Blvd, Suite 430, Nashville, TN 37215;RCP Endeavor, Inc, 20 Burton Hills Blvd, Suite 430, ,Nashville, TN 37215;Northcreek Mezzanine Fund II, LP,312 Walnut Street, Suite 2310,Cincinnati, OH 45202;Invegarry Holdings, LP,44235 Hillsboro Pike,Nashville, TN 37215;Everside Fund II, LP,155 East 44th St, Suite 2101 - 10 Grand Central,New York, NY 10017Everside Endeavor F1 Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017;Everside Endeavor International Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017;Everside Founders Fund, LP, 155 East 44th St, Suite 2101 - 10 Grand Central, ,New York, NY 10017;Suncap Endeavor Blocker, LLC,155 East 44th St, Suite 2101 - 10 Grand Central,New York, NY 10017;
11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities: None
12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one)
    The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes: N/A
13. Publication Title: ISE (ICT Solutions & Education)
14. Issue Date for Circulation Data: 09/01/2023

15. Extent and Nature of Circulation	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies (Net press run)	15,059	14,944
b. Legitimate Paid and/or Requested Distribution (By Mail and Outside the Mail)		
(1) Outside County Paid/Requested Mail Subscriptions stated on PS Form 3541. (Include direct written request from recipient, telemarketing and Internet requests from recipient, paid subscriptions including nominal rate subscriptions, employer requests, advertiser's proof copies, and exchange copies.)	8,369	10,003
(2) In-County Paid/Requested Mail Subscriptions stated on PS Form 3541. (Include direct written request from recipient, telemarketing and Internet requests from recipient, paid subscriptions including nominal rate subscriptions, employer requests, advertiser's proof copies, and exchange copies.)	0	0
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid or Requested Distribution Outside USPS®	0	0
(4) Requested Copies Distributed by Other Mail Classes Through the USPS (e.g. First-Class Mail®)	0	0
c. Total Paid and/or Requested Distribution (Sum of 15b (1), (2), (3), and (4))	8,369	10,003
d. Nonrequested Distribution (By Mail and Outside the Mail)		
(1) Outside County Nonrequested Copies Stated on PS Form 3541 (include Sample copies, Requests Over 3 years old, Requests induced by a Premium, Bulk Sales and Requests including Association Requests, Names obtained from Business Directories, Lists, and other sources)	6,050	4,509
(2) In-County Nonrequested Copies Stated on PS Form 3541 (include Sample copies, Requests Over 3 years old, Requests induced by a Premium, Bulk Sales and Requests including Association Requests, Names obtained from Business Directories, Lists, and other sources)	0	0
(3) Nonrequested Copies Distributed Through the USPS by Other Classes of Mail (e.g. First-Class Mail, Nonrequestor Copies mailed in excess of 10% Limit mailed at Standard Mail® or Package Services Rates)	0	0
(4) Nonrequested Copies Distributed Outside the Mail (Include Pickup Stands, Trade Shows, Showrooms and Other Sources)	0	0
e. Total Nonrequested Distribution (Sum of 15d (1), (2), (3), and (4))	6,050	4,509
f. Total Distribution (Sum of 15c and 15e)	14,419	14,512
g. Copies not Distributed	0	0
h. Total (Sum of 15f and g)	14,419	14,512
i. Percent Paid and/or Requested Circulation (15c divided by 15f times 100)	58.04%	68.93%
16 Electronic Copy Circulation		
a. Requested and Paid Electronic Copies	682	723
b. Total Requested and Paid Print Copies (Line 15c)+ Requested/Paid Electronic Copies (Line 16a)	9,051	10,726
c. Total Requested Copy Distribution(Line 15f) + Requested/Paid Electronic Copies (Line 16a)	15,102	15,235
d. Percent Paid and/or Requested Circulation (Both Print & Electronic Copies) (16b divided by 16c x 100)	59.94%	70.40%

17. [x] I certify that 50% of all my distribution copies (electronic and print) are legitimate requests or paid copies:
    Publication of Statement of Ownership for a Requester Publication is required and will be printed in the Nov/Dec 2023 issue of this publication.

18 Date

Laura Moulton, Audience Development Manager — 9/22/23

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

PS Form 3526-R, July 2014

Scott Bergs is the Chief Executive Officer of DF&I. For more information, visit DF&I at darkfiberinfra.com/express-connect/. Follow DF&I and Scott, respectively, on LinkedIn: linkedin.com/company/df-i/ and linkedin.com/in/scott-bergs-8a40a75/.

A "Low-Fiber" Diet for Sharks

Setting the record straight on shark attacks.

BY GEOFF BENNETT

Some actors are just born to play villains. Who can forget the late, and sadly missed, Alan Rickman and his portrayal of Hans Gruber in *Die Hard*, or the Sheriff of Nottingham in *Robin Hood: Prince of Thieves* (Christmas is cancelled!)?

In the world of marine biology, the ultimate villain has to be the shark—a beast so psychotic that it must keep moving at all times or it will die. But are sharks as dangerous as movies and TV would have us believe—at least when it comes to subsea cable damage?

Despite their appearance in films such as *Jaws*, *Jaws 2*, *Jaws 3-D*, and so on, not to mention *The Meg* franchise, most sharks are completely harmless—especially when it comes to their undeserved reputation for damaging submarine cables.

45288558 © Geraktv | Dreamstime.com

Like any good urban myth, there is a smattering of truth at play...the magnetic fields emitted by underwater cables of all types attract those "evil" sharks, potentially causing them to bite into cables and creating a world of problems for the service providers who are sending vital traffic over them.

What Can Cause a Subsea Cable Outage?

Submarine cable outages, while not exactly common, are not exactly rare either. According to reports by the International Cable Protection Committee (ICPC), there are between 100 and 200 incidents of damage to cables around the world each year, but on average only four of those involve deep water sections of the cable—which would be the most expensive and time-consuming to repair. All the others occur in shallow water—but how many of them are caused by sharks?

Figure 1 shows a breakdown of cable faults for all types of submarine cable from 1901 to 2020. As you can see, well over two-thirds of cable outages are man-made in some way. There's a big "unknown" category, and I'll talk more about that later, because maybe it's sharks and we just can't be sure, right?

Confirmed fish bites represent around 0.1% of incidents between 1901 and 2020.

Given this span of time, let's go back to that theory of magnetic attraction. In the telegraphic cable era between 1901 and 1957, at least 28 cables were damaged by fish bites attributed mainly to sharks, as determined from teeth found embedded in cable sheathings, as well as other fish such as barracuda.

Between 1959 and 2006, 11 cable repairs were recorded as being caused by fish bites. This period covers the deployment of coaxial submarine cables, which would still generate magnetic fields, as well as the early fiber optic cables that were deployed in the 1980s.

Given the change to optical fiber, do we think these cables generate magnetic fields? In fact, they do because long-distance fiber optic cables will include repeater modules every 60 to 100 km along the cable, and these repeaters have to be electrically powered. The cables include a conductor layer that carries a very high DC voltage to power the amplifiers, and even though it's DC, the operation of the repeater as it works to amplify a set of modulated data signals will cause the magnetic field to "wobble," which might well attract various types of fish.

Do Sharks Attack Fiber Optic Cables?

To cut to the chase—yes. But only because of a design fault in the earliest repeatered cables that has subsequently been fixed. The first subsea repeatered fiber optic system, AT&T's SL Undersea Lightwave System, was deployed in 1985 on the OPTICAN-1 route between Gran Canaria and Tenerife, and it used a lightweight, 21-mm cable type with no armoring.

This cable failed on four occasions because of shark attacks in water depths of up to 1,900 m, and at this time, OPTICAN-1 accounted for <0.5% of global submarine cable faults. Dozens of shark teeth were recovered from the failed

sections of cable, and so the cause of failure was pretty conclusive—those pesky sharks!

You might be picturing the shark from *Jaws* literally biting through the cable, but that's not what happens. The shark doesn't need to actually cut through the fiber—the dental penetration just needs to be enough to slice into the polyethylene insulator layer and cause the power conductor to short out to the sea. This is called a shunt failure and is the most common failure mode in subsea cables historically—although the root cause of the insulator damage is most likely to be anchors and nets rather than sharks.

The investigators noticed that there was an older coaxial cable, SAT-1, that followed the same route as OPTICAN-1. SAT-1 had been in service for 17 years without a single fish-related failure. So why was OPTICAN-1 attracting shark bites and not SAT-1? It couldn't just be that SAT-1 was a coaxial cable because, between 1956 and 2006, there were 11 fish-related cable attacks, and seven of them were on other coaxial cables.

What did SAT-1 have that other cables did not? The answer seemed to be that SAT-1 included a metal tape layer just under the insulator, and while this was too thin to function as armor protection, it did seem to be functioning as a Faraday cage to prevent electromagnetic fields leaving the cable. Now that the cause of fish attacks in repeatered fiber cable had been identified, the design of subsequent cables was changed to include a shield layer.

Since 2006 there have been no recorded fish-related attacks on submarine fiber optic cables.

Cables Are Vulnerable to Humans, Not Sharks!

While sharks—and let us not forget other ninja fish like barracudas—are off the hook (sorry) we still have that issue of 100 to 200 cable failures per year. What causes them and what can we do about them?

Subsea cables are marked on maritime maps and are protected under international treaties that forbid fishing and anchoring within a certain distance of the cable. Ideally, they are routed to avoid regions of seismic activity, although this is not always possible in highly active areas such as the seas off Portugal or pretty much all of Southeast Asia. In shallow waters, where they are most vulnerable to anchors and fishing nets, they are fabricated with massive steel armor, and, where possible, are buried several meters under the seabed using special plows.

Neighborhood Watch

There have been several attempts to implement monitoring technologies that are deployed on the ends of the cable. One of the most sensitive is distributed acoustic sensing (DAS), which is also used in terrestrial networks and can be combined with a rapid response team to identify unexpected construction work that might threaten a cable and to get to the right place to stop it.

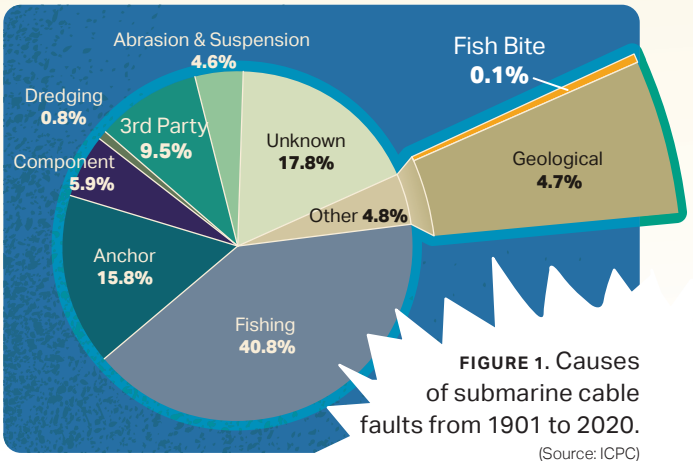


FIGURE 1. Causes of submarine cable faults from 1901 to 2020.
(Source: ICPC)

A similar approach, subsea cables could detect anchors or fishing nets, and given the fact that all these vessels should have radar transponders to identify them, appropriate action could be taken. But DAS only works on the first 100 km or so of the cable and requires dedicated fiber, which is expensive in a long-distance cable.

More recently, a technique pioneered by Infinera, based on interferometric optical time-domain refractometry, which is being developed as a seismic detector for existing subsea cables, may be able to deliver the kind of sensitivity that could give a warning—but this requires real-world validation.

It's clear that sharks biting into subsea cables is a thing of the distant past, with zero shark-related incidents since cable designs were improved in 2006. Cables are certainly vulnerable to human activity, though, and there are parts of the world's oceans where cable routes are getting quite congested.

Ultimately, operators themselves are reducing the worst of the problems by sharing capacity on their cables with other operators in a quid pro quo resilience approach. So, if one cable experiences a fault, traffic can be rerouted over an alternative route. This is not always possible, as we saw with the Tonga incident several months ago, which was caused by a subsea earthquake and made worse because there is only one cable into that island nation. Moreover, resilience must be built into submarine line-terminating equipment and extended to terrestrial backhaul networks, and this capability varies by vendor. ■

Geoff Bennett is the Director of Solutions & Technology for Infinera. For more information, visit infinera.com. Follow them on Twitter at @Infinera, LinkedIn: linkedin.com/company/infinera/ and Facebook: facebook.com/Infinera/.

ISE EXPO

ICT SOLUTIONS & EDUCATION

August 20-22, 2024
Kay Bailey Hutchison Convention Center
Dallas, Texas

EMPOWERING COMMUNITIES THROUGH DIGITAL INFRASTRUCTURE SOLUTIONS

FIXED · MOBILE · CLOUD

KEYNOTE SPEAKER:

SCOTT MISPAGEL

SVP, National Engineering and Operations,
Frontier Communications

iseexpo.com

Owned and Produced by: ENDEAVOR BUSINESS MEDIA

Presented by: ISE ICT SOLUTIONS & EDUCATION

Enabling the Lifestyle that

Better Broadband Provides

SeeChange: Accelerating Homes Connected

The game changing SeeChange® Access Terminal and precisely designed hardened connectors speed the final connection through:

- Simplifying inventory complexity
- Speeding your installation
- **Cutting network design time**

Utilizing SeeChange MPO and SC/APC pre-connectorized and hardened connectors, our drop and express approach is straightforward to understand and easy to engineer and design. Clearfield® innovations make designing 100% plug-and-play fiber networks faster than ever before - helping you achieve your fiber connection goals. Ask Clearfield to show you how.

CLEARFIELD

Technologies that speed your fiber broadband buildout.

Learn how to simplify your deployments at **SeeClearfield.com** or call 800-422-2537