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CEO, BLACKFOOT COMMUNICATIONS

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"This industry is changing, customer expectations are changing, and cost/revenue assumptions are changing. We want employees and leaders who are always looking to improve, even if something is working just fine."

JASON WILLIAMS, CEO, BLACKFOOT COMMUNICATIONS — PAGE 12

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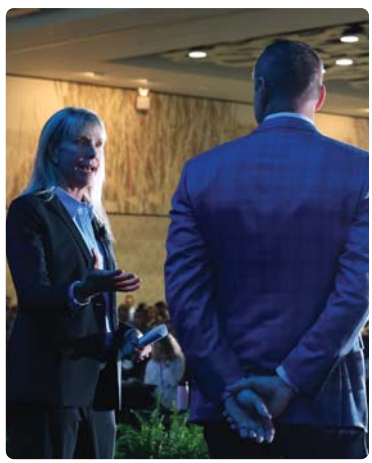

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Ready to Build

LIVING IN HARMONY with the changing of the seasons is the only way a species can thrive. Human beings are not aware of the seasons as deeply as we were in past ages, but we still build our lives around them.

There is a sense of "getting back to work" in September. Not that we ever really get a break from it, but the beginning of fall often feels like the time to put into motion the ambitious plans made during the summer. To reap the harvest. For students, of course, it's a time to think about the possibilities and new experiences waiting for them when school starts.

I think this is a great way to think about the end of summer. We put our hammocks and our boats away, and we remember that part of ourselves that is compelled to move forward. To do, make, build. We see the winter holidays in the distance, and we want to enter them with a feeling of completion, ready to hunker down and reflect when the time comes.

When I was at ISE EXPO last month, a telecom executive told me he felt like people in the industry were feeling happy again. That there was hope and optimism. It's true that 2024 has been a tough year. But there are reasons to believe in a turnaround.

The lingering COVID-era weirdness is finally shifting into a new normal, and not just in inventory management. Consumer and business behavior trends and technological innovations show us what the future may look like: a remote workforce living in smart cities seamlessly connected to multiple devices running AI programs. Throw in autonomous vehicles and drones, too. All of this is dependent on various networks, fixed and mobile, running on telecom infrastructure.

Service providers are ready to start building and expanding these networks. The whole industry is excited to build.

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

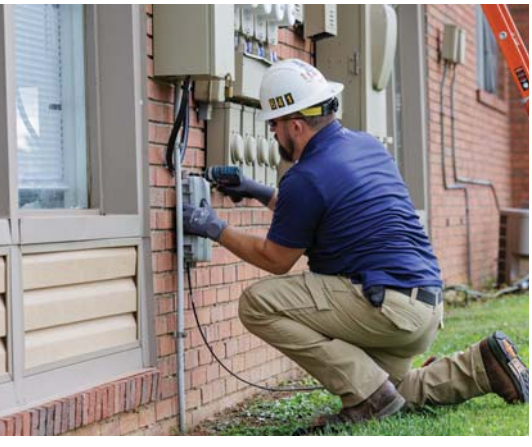
In this issue, you'll get to see what this excitement looks like in our ISE EXPO recaps and photos, including our Network Innovators' Award honorees. And in our feature articles, you'll see what people are working on to get fiber deployed and build out the network of the future.

What 2025 looks like will depend a lot on how we approach these coming months. The end of summer doesn't mean the beginning of toil and grind. It's a time to remember your purpose, your drive, your goals, take a deep breath, and take a new step forward—moving intentionally and smoothly into renewed purpose.

UNLEASHING POTENTIAL:
The BEAD Program's Impact on Broadband Expansion

Jared Spataro, Sales Manager, Communications Market, Oldcastle Infrastructure

The Broadband Equity, Access, and Deployment (BEAD) Program is a landmark $42 billion federal initiative poised to revolutionize internet access across the U.S. With a primary focus on unserved areas—regions lacking internet speeds that meet the FCC's broadband definition—and underserved areas—those with access below 100 Mbps down and 20 Mbps up—this ambitious effort aims to empower all states and U.S. territories to expand internet connectivity, ensuring high-speed internet access for every American. For internet service providers (ISPs) and their support networks, including engineers, technicians, constructors, and vendors, BEAD presents a wealth of opportunities to drive growth and innovation in this dynamic industry.



Fiber to the home brownfield Primex NID enclosure installation in Frankfort, Kentucky.

Key Opportunities for Broadband Operators

Infrastructure Development: The BEAD program's emphasis on infrastructure deployment and enhancement provides fertile ground for projects requiring robust and innovative solutions. Companies involved in this initiative will find numerous opportunities to contribute expertise and technology, playing a vital role in this national effort.

Strategic Partnerships: Each state is required to submit proposals for utilizing BEAD funds, creating ample opportunities for forming strategic partnerships. Service providers can collaborate with state and local governments on project scopes and implementations, ensuring efficient and effective deployments. This collaborative approach helps set expectations and standards for future projects and ensures that local needs are met with the best available options.

Innovation and Standards: BEAD emphasizes the quality of connectivity, with specific requirements regarding labor standards, climate resilience, and equitable access. This focus drives the adoption of innovative technologies that meet these rigorous standards. Providers and builders at the forefront of technological advancements will see increased demand for their solutions, aligning with the program's goals for sustainable and inclusive infrastructure.

Community Enhancement: By connecting community anchors such as libraries, schools, and hospitals, BEAD recognizes broadband's critical role in bolstering community services. Broadband access becomes a vital enabler for better education, healthcare, and public services. This presents strategic business opportunities for service providers capable of delivering reliable connections to these essential institutions.

Fiber installation of Duralite® enclosure along Highway 17 in Richmond Hill, Georgia.

Oldcastle Infrastructure Can Help Get Your Projects Done Right

As states begin to deploy their BEAD-funded projects, there is an immediate call to action for those involved in the broadband industry. Engaging with the program supports business growth and contributes to the broader mission of closing the digital divide. It's an opportunity to install and enhance infrastructure that will power economies and improve lives by making high-speed internet accessible to all.

BEAD is not just an investment in infrastructure; it is an investment in the future of connectivity, promising a more inclusive and connected America. As this program unfolds, the potential for a transformative impact on both the industry and communities across the country is immense.

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THE INTRODUCTION OF SINGLEMODE FIBER 40 years ago was nothing short of monumental. I remember the researchers at Bell Labs who introduced me to fiber optics in the late 1970s telling me that the multimode fiber they were using for early field trials was a poor compromise. Singlemode fiber was coming once some developmental hurdles were overcome; mainly achieving tighter tolerances on the geometry of the fiber and connectors. Corning solved the fiber problems for the first networks in 1983.

The rest is history, but it did not come easy. Early versions of the singlemode AT&T Biconic connectors required grinding to center the fiber core. Early 1310 lasers had a horrific failure rate. But fusion splicers adapted to the new fibers well. Ceramic ferrules for connectors introduced in the mid-80s solved the connection problem. As they say, the rest is history.

Now billions of kilometers of singlemode fiber, mostly made to the ITU G.652 standard, carry the world's communications. Most of us just take singlemode fiber for granted because it's ubiquitous and works like we expect it to.

But sometimes things we take for granted don't stay the same forever. Or something new surfaces to challenge them. Both are true for singlemode fiber.

What's changing in singlemode fiber? I've investigated three new developments recently. Two, multicore fiber and hollow core fiber, are both radical technologies offered to solve special problems. The third is simply technological evolution.

Multicore fiber is just what it says, a standard 125-micron OD glass fiber with two, four, or more singlemode cores arrayed around the circular cladding. The idea is simple; more cores mean more transmission links in a single fiber, a big advantage for cables with a limited number of fibers like submarine cables or in high density applications like data centers where it is being used now (see Figure 1).

The execution is more complex. The preform to make such a fiber is complex and the geometry must be precise to allow splicing with low loss at every core. Make the cores too close together and you get crosstalk. Splicing alignment is more complex, requiring both X-Y movement and rotation to align the cores. How do you make a breakout cable? But development of multicore fiber is progressing, and some is becoming commercially available.

Hollow core fiber is not what you think. I recently read a news article that described optical fiber as a hollow glass tube that transmits light down the hole in the center. That mistake has been made many times since fiber optics began many years ago. The light carrying core of the optical fiber everybody uses today is very pure solid glass, of course, but "hollow glass tube" doesn't describe hollow core fiber either. The actual fiber structure looks like a honeycomb to confine the light properly (see Figure 2).

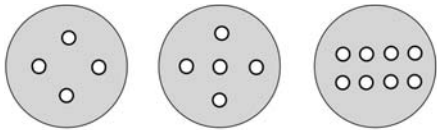

FIGURE 1. *Multicore fiber has several singlemode cores in a 125-micron OD fiber.*

FIGURE 2. *Hollow core fibers use complex structures to get the best performance.*

Hollow core fiber is already being used in specialty applications. What's the appeal of hollow core fiber? Speed. Not the bandwidth version of speed but the "how fast can you get a signal from here to there" speed. The hollow core is filled with air or a vacuum and light travels ~50% faster in air or a vacuum than it does in glass. That makes for a difference of ~1.5 microseconds per kilometer, and that difference in time makes a big difference to some users like high-speed stock traders who want the lowest latency they can get in communication links.

Some hollow core fiber is available now. You can buy it in quantity, and it can be cabled for building networks. If you are a high-speed stock trader, it might be just what you are looking for, but it's not for everybody.

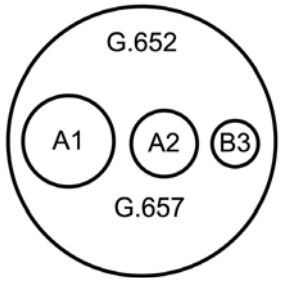

FIGURE 3. *Relative bend diameters for G.652 singlemode fiber and 3 grades of G.657 fiber.*

The third development is one that you are probably benefitting from already. You've probably heard about bend-insensitive (BI) fiber, fiber that can be bent in small diameters or packed densely in microcables or high fiber count cables without incurring high losses due to stress. BI fiber has been around for a while, long enough to get its own ITU designation, G.657 (see Figure 3).

FOA was recently working with one of our technical advisors, Joe Botha of Triple Play Fiber Optics in South Africa, to answer a technical question from an installer. Joe has done studies on the ability to fusion splice various types of fibers and had some recent data which he shared with us.

When examining the data which included many OTDR traces taken in both directions, Joe and I both noticed that it has become more difficult to distinguish splices made between conventional G.652 and G.657 fiber. That made us wonder, has there been changes to the singlemode fiber formula to make these two fibers more compatible?

"Most of us just take singlemode fiber for granted because it's ubiquitous and works like we expect it to."

I decided to contact a couple of fiber manufacturers to find out. Here is what they said:

Corning: *The industry is moving towards a G.657. A specification in fiber, because the industry is moving towards smaller denser cables in the network and the bend resilience is a requirement for the cable design.*

OFS: *The simple answer is most SMF is moving to G.657.A1. OFS' AllWave+ and Corning's Ultra fiber—which are among the most deployed fibers in America right now—are both examples of this trend.*

Both told us that the design of BI fiber has evolved to have a mode field diameter (MFD) more like regular singlemode fiber, so the splicing compatibility is excellent and the OTDR testing issues (gainers and losers) greatly reduced.

So singlemode fiber is moving to being mostly BI fiber, exactly what happened with 50/125 laser optimized fibers a decade ago. You get a better, more resilient fiber and with the new fiber compatibility is not an issue. But you might check with the cable manufacturer if you are not sure what fiber is being used in the cable you are purchasing or installing. ■

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

AI Networking: Training the Unruly Child

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Personal Experience

Thirty years ago, I founded an AI-based software company. AI was described as "knowledge-based systems" back in those days. From a basis of sales knowledge and experiential data, I programmed the software to make recommendations to improve sales. It measured and forecast performance, adapting as the sales of individuals and the company progressed.

Critically, how I made it intelligent was my applying sales experience, judgement and adaptation to results achieved that was programmed into the software. The complexity of today's evolving networks and massive increase in compute power plus cybersecurity threats make it a whole different world. Artificial Intelligence has been around for a while—using data and adapting to change are not new.

The application of AI to networking and security is what had me write this article since today's complexity and opportunities for network as a service, network management, data curation and cybersecurity **make the exploration a necessity**. It seems like an exploration at this point because although there are attractions—cost savings and responsiveness to changing conditions—there are significant unresolved issues that the article raises yet still it looks optimistically at the potential possibilities.

Challenges

The main challenge for GenAI is the distracting and misleading use of the word "Intelligence." Yes, it already has outstanding characteristics, bringing plain language explanations of learned concepts, coding and surprising graphics capabilities. It's much more than the knowledge-based systems referred to earlier. **However, it does not meet our definition of intelligence by any of the obvious criteria.**

Also, it currently does not accurately adapt to new information. Here's an actual example. My wife asked Copilot how to do something on her Galaxy phone. Copilot claimed it knew about the latest software loaded on her phone—but the instructions it gave were incorrect. When asked why, its many apologies included "I have certain limitations and potential weaknesses in how I adapt to new information."

Imagine if applying GenAI to a critical part of your network infrastructure, data curation, service performance or transaction security and the results were incorrect. You would be putting your organization at great risk. You may have already experienced something similar.

Can GenAI apply judgement or innovative thought in the context of our business goals? How can it deal with the unacknowledged emotional aspects of every decision we make? We shall see! Suddenly, it doesn't sound so intelligent.

This article is not intended to be a Luddite rant, since I do think that this is an exciting journey for all of us. However, before we get to the positive aspects, there's still the issue of cybersecurity threats penetrating the large language models (LLMs). I.e., how do you know if the data you are basing your decisions on is inaccurate or deliberately misleading? For instance, if a threat actor deliberately distorts data about an asset's authentication or privilege, then your network and organization is now toast.

Always Look on the Bright Side of Life

Since we just started the AI Networking journey, let's assume that these challenges will get sorted out quickly, making AI smarter and safer. Protection against the abuse of LLMs is already under way. So, what are the most promising candidates to simplify and handle network complexity and are they cost-justified? **How can we apply some actual, albeit flawed human intelligence and expertise to train this unruly GenAI child?**

AI for Network as a Service (NaaS)

Since my article in the May/June issue, **NaaS** has made rapid progress. At the core is the need for services to be on-demand, available from multiple providers without lock-in, in multiple locations, accessing workloads in multiple clouds with varying performance requirements.

The advantage to any service providers or systems integrators who could offer such a service is huge, since it meets all the enterprise requirements. An

Adaptive GenAI system—one that constantly retrains as data changes—may be the only viable, scalable approach. Such a system could gather and update the information accessed either via APIs or a portal.

Managed service providers would be served well too, getting access to the services offered on behalf of their users. The race is on to develop this approach as it addresses the most challenging aspect of NaaS.

The use of **AI Networking to the Orchestration/Automation of NOC/SOC** (Network and Security Operations is one of the projects of the Open Networking User Group Collaborative (ONUG.net), where I participate. An interesting part or this work[1] covers the choices of how to train LLMs or SLMs (industry/context specific Small Language Models) using publicly available services, GenAI augmented tools or custom solutions developed in-house.

The enterprises' big challenge is to organize large amounts of disparate legacy data in order to train the models.

Other Promising Areas

- **Policy as code:** Using GenAI to bring Zero Trust principals to automate access, identity, authentication, privilege control, policy enforcement and continual monitoring.
- In ONUG's **Cloud Secure Notification Framework** project, GenAI could oversee and report on large quantities of different network data/monitoring/networking incident reports involving cloud-based workloads.

There are many more. Some suggest immediate actions and others are currently under investigation. Speaking of which, the publication of this article is timed to alert readers to ONUG's Fall event where industry luminaries give the very latest on their work and their perspectives on the state-of-the-art of AI Networking. If it's anything like the ONUG Spring event, you do not want to miss it. Check it out at ONUG.net.

Conclusion

Despite all the challenges, I am confident that our ingenuity will overcome the cautions at the beginning of this article. Some say the AI bubble will burst. If it does, then it will mean we didn't make the most of the opportunities to create a better world of networking and far beyond. This story, including updates and insights from the ONUG event, is expanded at cybyr.com/ai. ■

REFERENCE

1. https://onug.net/onug-collaborative-blog/evaluating-different-approaches-for-adopting-generative-ai-in-network-and-security-operations/

Mark Fishburn is CEO of cybyr.com and a provider of strategic network, cybersecurity, and marketing services.

EXECUTIVE INSIGHTS WITH Jason Williams

CEO, Blackfoot Communications

BY SHARON VOLLMAN

From the moment I soaked in Jason's responses to our questions, I wanted to invite him to dinner. He's as open as a CEO gets. He shares what he doesn't know and admits that Blackfoot needs to catch up on some important things like fiber-to-the-premises (FTTP) deployments and network automation.

Perhaps it's because he's grateful that Blackfoot's board took a chance on him eight years ago when they welcomed a literature student turned lawyer into the C-Suite. Perhaps it's because he lives in Western Montana—a beautiful but challenging place to deliver high-speed broadband to the underserved.

Whatever it is, we'll ask other leaders to have what Jason's having. Read on to learn what we see in Jason and why you might also want to ask him over for dinner.

Happy 70th to Blackfoot Communications!

Blackfoot Communications serves more than 30 rural communities throughout its nearly 9,000-square-mile service territory in Western Montana and Eastern Idaho. The company celebrated the cooperative's 70th year in business at its annual meeting in April. In addition to being one of the largest rural broadband providers in Montana and Idaho, Blackfoot also provides advanced networking and connectivity solutions to enterprise-level customers throughout the Rocky Mountain West.

As part of a multiple-year fiber build, Blackfoot connected nearly 1,800 locations to FTTP-based

broadband in 2023 and plans to cut over more than 1,000 more locations to fiber-based broadband in 2024. Since 2017, Blackfoot has had 35% of its rural customers converted to FTTP.

ISE: Share two network-related learnings your team collected during the early days of this build that have been game changers in improving your deployments moving forward.

Jason Williams: First, we should have started years before we did. We were relatively late to the FTTP game as we were focused on aggressively building out our CLEC business over the last decade. With portions of our copper network approaching 50 years old, we spend huge amounts in OpEx to keep our DSL network up and running. It's no secret that FTTP is much more efficient for broadband than copper. We're seeing that in the areas we've already built out.

Second, plan to build more than you can at any one time. Early on, we ran into permitting problems for a few of our service areas. Since we had completed outside plant engineering for other areas, we were able to pivot quickly so as not to miss out on Montana and Idaho's short construction season.

TOPIC: Rural Broadband

ISE: What's your greatest joy and challenge related to ensuring your community's residents can live a big life in a small community?

Williams: I'm biased, but I live in the most beautiful place in the world—Western Montana.

Photo taken at award-winning Missoula Public Library in Montana. Boardroom named for Blackfoot's large donation.

The beauty can be deceiving, though, because making a living out here can be challenging. Whether it's hundreds of inches of snow in the winter or devastating wildfires in the summer, nature is in the driver's seat, making it challenging to deliver service in some of our areas. But our board is committed to getting FTTP-based broadband to as many rural customers as possible, ensuring that those living, working and going to school in our rural communities have access to the world.

TOPIC: Telecom Network Evolution

ISE: McKinsey's report[1] shared, "Organizations have more than ever to gain from technological advances—and more to lose from falling behind." This resonates equally with telecom companies as it does with customers. How does Blackfoot Communications plan to move toward intelligent networks and AI in network operations?

Williams: We have a company-wide initiative to give all our employees some baseline level of AI training. We're also set to deploy AI across some applications many of our employees use every day to get them familiar with these tools and experience how they can help.

Finding ways to automate our network has been and will continue to be a priority. We must find ways to automate and streamline as we grow our customer base.

More specifically for operations, our approach is continuous learning and adaptation, focusing on network automation tools/software and improved data collection/analysis. Network security is a pillar underlying all efforts toward improving network operations and utilizing AI. We are evaluating a new network monitoring platform and event manager so we have more predictive intelligence around potential issues and can get to root causes faster than we do today.

> "More specifically for operations, our AI approach is continuous learning and adaptation, focusing on network automation tools/software and improved data collection/analysis. Network security is a pillar underlying all efforts toward improving network operations and utilizing AI."

A chat with Beau Bailey, Director of Finance.

Blackfoot Cooperative Trustee team.

TOPIC: FWA and FTTP

ISE: Share your perspective about the interplay between these two technologies when working to deliver gigabit speeds to serve hard-to-reach customers.

Williams: We own and operate a FWA network using both licensed and unlicensed spectrum. While FWA has a lower cost of entry into a market, you need to keep a close eye on the ongoing OpEx of those networks. Few subscribers are out here, so you have limited revenue growth but ongoing tower rents and labor increases. In addition, radios need to be replaced every 5 to 10 years.

That said, there are some locations where FTTP costs simply too much to justify the build. Our goal is to work with both established and emerging RF vendors to continue to find the most reliable, highest-speed, and lowest-cost FWA solution for those areas where fiber is too expensive.

TOPIC: Telecom Trends

ISE: How do you see emerging technologies such as 5G, IoT, and edge computing shaping the telecom landscape across rural America in the coming years?

Williams: For better or worse, sparsely populated states like Montana have a long way to go before emerging technologies become common. About 35% of our residential subscribers still purchase POTS services from us because they have no reliable mobile wireless offering. As Montana's Senator Tester says, "Some of us out here don't even have 3G, let alone 5G."

Regardless, Blackfoot is well-poised to facilitate the deployment of these technologies with its extensive fiber network, which is growing daily.

TOPIC: Permitting and Easements

ISE: There's been much debate in DC about permitting and other approval processes that can result in significant deployment delays and cost increases. What would help solve these challenges?

Williams: We ran into permitting problems early in our FTTP deployment and continue to run into permitting issues today. On the federal side, we have supported the idea of a "shot clock," meaning,

for example, that if we submit a complete permit application to a federal agency, the permit will be deemed granted within 45 or 60 days if that agency doesn't act on it. Another option would be to require a streamlined permitting process for areas that have already been disturbed—i.e., areas where we have an existing network and we're just reinforcing what we already have.

Railroad crossing permits are also an ongoing issue. A few years ago, we had modest success negotiating with the Montana-based division of a larger national railroad to establish some processes and timeframes. That helped a little, but it was voluntary, and whenever there are personnel changes at the railroads, it seems like we start over again.

TOPIC: Operational Realities

ISE: ICT industry analysts and observers often focus on CapEx budgets. But the reality is that OpEx can make or break the bottom line. The key to controlling OpEx is cost-efficiently improving network life cycle management for complex fiber and legacy networks. How is Blackfoot Communications reducing its OpEx?

Williams: Our strategy is implementing tools and processes that enable our employees to do more. We're also using better network monitoring and management systems to be more proactive when dealing with issues in the field, like bad fibers or splices, failing optics, network interfaces and capacity planning. Getting ahead of these issues will allow us to reduce the number of reactionary responses we have, which often come with higher costs due to timing and urgency.

One initiative we currently have underway is a partnership with FNT Software to deploy their FNT Command/GeoMaps applications across the network. The platform supports easy-to-read DLRs and circuit records, providing physical and logical circuit tracking, primary and alternate circuit paths, and traceroute capabilities. These features, combined with site-specific information such as address details, notes, and photos, will significantly improve network management efficiency and data accuracy, both in the field and in the network operations center.

TOPIC: Edge Compute

ISE: The growing demand for low-latency applications, data-intensive services, and real-time analytics will drive the deployment of edge computing infrastructure. Talk about the network changes required for this.

Williams: As we design our network, we always identify critical routes (not just for us but for third parties too) and install additional ducts. In the future, we can use that additional duct for additional capacity or different types of fiber that may emerge for lower latency or increased lit speeds. We're also looking at more

CFO Stacy Mueller, COO Joe Fanguy, and Williams in a leadership meeting.

Strategy session with Lori Parker, Director of Accounting/Controller.

ways to connect Montana and Idaho to larger metro areas in the Western United States. This will enable high-speed access between the larger data centers down to the smaller edge systems delivering finished services to customers.

TOPIC: Network Security

ISE: Talk about your network security strategy with Fortinet. Can a vendor partner in this critical area care about your network equally as much as you do? What are the concrete ways you will ensure it does?

Williams: Innovation is vital in partnering with vendors on network security. Fortinet's approach to a security fabric enabling automated protection, detection, and response along with consolidated visibility across both Fortinet solutions is key to understanding accountability when it comes to keeping the Blackfoot network safe and our customers' networks. We have worked with many network and security vendors over the last 15 years. Even though Blackfoot is a smaller ISP, Fortinet has been more interactive and involved with us than any other vendor. They ask for our feedback and transparently communicate what's happening with their products. This has made for a very good partnership.

TOPIC: Legacy Systems and Interoperability

ISE: Talk about the ongoing challenge BSPs face in making legacy systems interoperable with newer, more effective solutions. What can be done to help them with this?

Williams: We've been updating our systems and processes for more than a decade. While we've had some success, we still have a long way to go. Fundamentally, legacy systems integration and interoperability boils down to corporate culture. Blackfoot spent the first 50 years of its existence as a heavily regulated telephone company. Now, we are a largely unregulated broadband provider, but that legacy mindset can still be the "tail wagging the dog."

This business is not that complicated, and we are our own worst enemies for overcomplicating things. Lately, we've been looking at and using some low-cost, off-the-shelf applications that did not germinate within the telecom industry. They are super simple to use and are highly effective. I see us continuing to move more in that direction.

TOPIC: 5G

ISE: Share Blackfoot's role in deploying fiber for 5G.

Williams: We work closely with all the national mobile wireless providers, providing fiber backhaul to hundreds of tower locations across Montana, Wyoming and Idaho. Because of our vast, empty spaces and sparse population, we must get creative when it comes to latency and redundancy. Blackfoot's network engineers, who I would put up against the best in the industry, have developed some pretty creative solutions to ensure our infrastructure can support 5G deployments.

Trustee and Key Leadership meeting.

TOPIC: Corporate Culture

ISE: As a cooperative, Blackfoot is deeply committed to the communities it serves. You show this commitment by providing high-quality broadband and contributing to many community organizations and events, non-profit activities, and education. What are some of the projects Blackfoot is most proud of?

Williams: Pearl Jam's bassist, Jeff Ament, lives in Missoula. He runs a non-profit that builds skate parks in small, rural towns across Montana. Blackfoot has contributed to several of these projects across our cooperative service territory. Whenever I drive by one of these parks, it is packed with kids. They've become a central place for social interactions in many of our rural communities.

Beyond that, we have a high employee engagement in volunteer work—up to 40% of our employees routinely participate in our Ambassador Program. These folks drive Blackfoot trucks in parades and celebrations, show up at county fairs and rodeos, and volunteer for community beautification days and projects. Our employees genuinely want to make these communities better places to live.

TOPIC: Paying It Forward

ISE: Share three things you recommend to other leaders who want to follow your path.

Williams: First, trust your subject matter experts but with a dose of healthy skepticism.

Second, this industry requires you to take the long-term view. While there needs to be short-term results, you should always maintain sight of your longer-term vision.

Third, if it's important, say it more than once. I joke with my employees sometimes that they think I may be going senile because I keep saying the same things over and over. But if it's important to me and the organization, I'd rather them hear it more than once than not at all or listen to it but forget about it.

TOPIC: Risks

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

Williams: Accepting the job as CEO of Blackfoot. I studied literature in college and went to law school. I have no formal technical or business training. My board took a chance on me, and now, eight years later, I'm humbled to continue to lead such an amazing organization.

TOPIC: The Secret Sauce

ISE: What's an essential personality trait someone needs to succeed in a company like Blackfoot Communications?

Williams: Be someone who never settles for just "good enough." This industry is changing, customer expectations are changing, and cost/revenue assumptions are changing. We want employees and leaders who are always looking to improve, even if something is working just fine.

TOPIC: Dissent

ISE: What is one thing almost everyone disagrees with you about?

Williams: That the Seattle Mariners are the greatest team in MLB history! ■

> "We ran into permitting problems early in our FTTP deployment and continue to run into permitting issues today. On the federal side, we have supported the idea of a 'shot clock,' meaning, for example, that if we submit a complete permit application to a federal agency, the permit will be deemed granted within 45 or 60 days if that agency doesn't act on it."

REFERENCE

1. McKinsey, https: //www.mckinsey.com/featured-insights/2023-year-in-review?cid=other-eml-alt-mip-mck&hlkid=14eff70c261f4f9789091ca1b07c385b&hctky=12322243&hdpid=6ff46fa4-eb3b-4d6d-bbbd-b847a5dd3f02#outcompeting-with-technology

Jason B. Williams is CEO of Blackfoot Communications, a regional broadband and technology solutions provider headquartered in Missoula, Montana. As a cooperative, Blackfoot is deeply committed to the communities it serves. Mr. Williams reports to a nine-member, cooperative Board of Trustees that represent more than 15,000 members/owners located in rural western Montana. To learn more, visit www.blackfoot.com. Follow them on LinkedIn: linkedin.com/company/goblackfoot, Facebook: facebook.com/GoBlackfoot, and X @GoBlackfoot.

ISE EXPO

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SVP, CORE ENGINEERING & OPERATIONS, VERIZON

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THE 2024 ISE Network Innovators' Awards

Meet the Honorees of the Network Innovators' Awards in this ceremony recap with photos, judges' comments, and more.

BY JOE GILLARD

The 2024 Network Innovators' Awards have wrapped up and this year we had 23 honorees. This is our second year, so the big increase is a hopeful sign for the future of the Awards.

The following pages are packed with innovations. These awards are open to not just new gadgets, but also software and systems that move the industry forward.

I hope that as you look over these marvels, you'll feel inspired by their work. Because I believe that all of us are capable of extraordinary work and brilliant innovations, no matter what part of the industry we work in.

ISE's Executive Editor, Joe Gillard, announces the honorees.

ISE NETWORK INNOVATORS' AWARDS

BRONZE

cOS™ Broadband Platform

The cOS™ Broadband Platform from Harmonic is a Bronze Honoree.

"Harmonic's cOS Broadband Platform is the driving force behind DOCOMO PACIFIC swiftly rolling out fiber-to-the-premises broadband service in just five weeks, an unparalleled, groundbreaking milestone. Faced with the aftermath of weather-related outages, the leading Guam-based telecom provider prioritized restoring connectivity for over 10,000 residents across Guam and the Northern Mariana Islands. Harmonic's cOS, coupled with the Wharf DAAS/CRE switch and Fin optical line terminals, facilitated rapid deployment in a disaggregated access architecture, enhancing network simplification, flexibility, and cost efficiency."

Harmonic receives bronze award.

FROM THE JUDGES: "Interesting platform that should help with broadband deployment."

Zyxel EE6601-00

The Zyxel EE6601-00 from Zyxel Communications is a Bronze Honoree.

"The Zyxel EE6601 Tri-Band Wireless BE19000 10G Ethernet VoIP Gateway with SFP+ is built to simplify service providers' and subscribers' lives both from a hardware and maintenance perspective.

The technology supports Wi-Fi 7 standards, allowing service providers to future-proof their premium, lag-free streaming Wi-Fi services. It offers multiple WAN options with a 10GbE WAN pot, three 1GbE LAN ports, and a built-in SFP+ cage, enabling flexible XGS-PON/GPON (P2M) or Gigabit active fiber (P2P) configuration to meet bandwidth-intensive needs and simplifying deployment in existing copper or fiber network infrastructure."

FROM THE JUDGES: "Definitely a solid product."

RXT-6800 Advanced 800G Multi-Service Test Module

The RXT-6800 Advanced 800G Multi-Service Test Module from VeEX is a Bronze Honoree.

"The RXT-6800 builds on the RXT family of high-speed modules, specifically the evolution from the RXT-6402 400G test set, to 800G. RXT is the industry's most flexible, compact, and future-proof handheld test solution for Core, Metro, Data Center, Access, and R&D lab applications. The RXT-6800 expands the RXT family's applications and flexibility to 800G multi-service testing. Equipped with a single port 800G and dual port 400G, along with dual port interfaces for 200G/100G/50G/40G/25G/10G/1G, it supports 800G QSFPDD, QSFP112 transceivers, QSFPDD 400G, and other common transceiver form factors, AOCs and DACs."

FROM THE JUDGES: "Innovative product, the user interface seems very intuitive."

VeEx, Inc. receives four awards—one gold, two silver and one bronze.

Joe leads a toast with this year's honorees.

Superior Essex's New Website

Superior Essex Communications' new website is a Bronze Honoree.

"The culmination of this innovative endeavor has fundamentally redefined how customers interact with their brand. The website is now a dynamic gateway, facilitating meaningful engagement between their brand and customers. The BABA/BEAD landing page is designed as a user-centric platform that prioritizes ease of navigation, ensuring a smooth journey for users from first click to final transaction."

FROM THE JUDGES: "The website has a nice look and feel to it. It's clearly a crucial milestone in how their clients engage with them."

Versatile Splice Closure for Rural Broadband

The Versatile Splice Closure for Rural Broadband from Prysmian is a Bronze Honoree.

"There are many good closures on the market today. However, BEAD projects are creating new requirements for closures. By definition, these projects weren't financially feasible in the past,

Superior Essex Communications receives bronze award.

due to lower densities and different deployment conditions. So, it's no surprise that existing closures are not optimized for this market. The Eagle closure addresses emerging requirements for Rural Broadband…"

> **FROM THE JUDGES:** "Flexible usage, made in America, and at a good price point. Fits the needs for Rural Broadband builds and BEAD projects."

The Telecom Operating System

The Telecom Operating System from Lightyear is a Bronze Honoree.

"Lightyear's Procurement software digitizes and automates telecom procurement from RFP through implementation for one site or hundreds—all backed by the industry's most robust dataset. Enterprises and BSPs can utilize Lightyear Procurement to create digital telecom RFPs, receive pre-validated best-price quotes, sign contracts, digitally track and manage installations, and manage procurement across an enterprise team digitally. When managing telecom procurement in this manner, enterprises and BSPs can cut hundreds of tedious hours from circuit procurement while ensuring services are always purchased at the best possible price."

> **FROM THE JUDGES:** "This is the first time I've run across a system like this—nicely done."

Prysmian receives bronze award.

ISE NETWORK INNOVATORS' AWARDS

SILVER

144-1728F Compact Armored Central Core IBR Outdoor OFC

The 144-1728F Compact Armored Central Core IBR Outdoor OFC from HFCL Limited is a Silver Honoree.

"The Compact Armored Central Core Intermittently Bonded Ribbon (IBR) cable family utilizes a revolutionary, patent-pending design that eliminates the need for an inner tube or jacket, significantly enhancing the efficiency and cost-effectiveness of network deployments. An innovative hybrid fiberglass/steel protective sheath provides the toughness demanded from an armored cable, while allowing much smaller bend radii than competing armored cables."

> FROM THE JUDGES: "An intelligent redesign of traditional armored cable, this design is innovative. It appears to save some time with workability per the time study findings which always brings benefit to the business. Most notably is its reduced bend radius requirements and environmental footprint from a manufacturing material perspective."

VETRO, Inc. receives silver award.

VETRO Mobile

VETRO Mobile from VETRO is a Silver Honoree.

"VETRO Mobile is the mobile companion app for VETRO FiberMap—a best-in-class fiber management platform for Broadband Service Providers. Now BSP's can take their network map with them into the field and make edits and sync changes instantly. VETRO Mobile is purpose-built to transform network field operations, enhance productivity, and streamline how BSP's handle their network data. It bridges the gap between the office and the job site and enhances design walkouts by consolidating diverse field data into a real-time and visually managed pipeline."

> FROM THE JUDGES: "This is terrific and a big step in the right direction."

HFCL Limited receives silver award.

RXT-4113+ xWDM OTDR Test Module

The RXT-4113+ xWDM OTDR Test Module from VeEX is a Silver Honoree.

"The RXT-4113+ xWDM OTDR module is designed to operate with the VeEX RXT-1200 multi-service, modular test platform. With the evolution of communication network architectures, OTDRs have also had to evolve to meet the diverse test and measurement needs of modern fiber optic networks. Historically, customers would buy different types of OTDRs depending

on the network type they had to evaluate. To support multiple network types, another OTDR had to be installed or swapped.

The RXT-4113+ xWDM OTDR module can be configured to offer test support for various fiber optic networks and requirements. Contractors prefer to carry a single OTDR with built-in launch fiber to verify correct channel routing and provision network testing."

> FROM THE JUDGES: "I liked the all-in-one approach to minimize the number of different tests sets that techs would need to carry. Robust software feature set and rugged hardware."

FX120 PON Analyzer & Multi-Gig Service QoE Test Set

The FX120 PON Analyzer & Multi-Gig Service QoE Test Set from VeEX is a Silver Honoree.

"The VeEX Next Gen FX120 PON Analyzer and Multi-Gigabit Service QoE test set allows technicians to validate and maintain PON network and service layer testing with the use of one device. As an all-in-one PON analyzer, one touch of a button allows you to switch between PON networks such as GPON, XG(S)-PON, EPON, 10G EPON, and RF video to analyze and determine the root of your problems."

> FROM THE JUDGES: "All-in-one meter for complete testing is a great feature. Easy to use with clear menus."

Fiber Driver

The Fiber Driver from Jameson Tools is a Silver Honoree.

"The Jameson Fiber Driver is an ergonomic, efficient, and cost-effective tool designed for installing final drop cables into ducts. It offers a stress-free cable installation method that minimizes cable buckling. With the use of a standard power drill (battery or corded) it will push fiber optics cable into conduit quickly and efficiently. Because it uses a power tool, it requires very little effort from the operator, which reduces fatigue, plus it allows for the job to be completed more quickly. This allows service providers to complete more jobs in the same amount of time."

> FROM THE JUDGES: "The fiber driver provides a very mobile solution for placement of the common flat drop into a conduit up to 1". The design feature of working with a cordless drill is very beneficial and delivers a product requiring no training and, from the information provided, greatly reduces the effort and time that would traditionally be needed to pull in a drop via the manual method."

Jameson Tools receives silver award.

Comprehensive Broadband Availability & Data Mapping

Comprehensive Broadband Availability & Data Mapping from Esri is a Silver Honoree.

"Esri, Inc.'s ArcGIS® solutions provide comprehensive tools for broadband and data mapping, significantly aiding customers in achieving their strategic objectives, optimizing operational expenditures, and creating new avenues for revenue generation. The product addresses the pressing need for accurate broadband mapping, which is crucial for informing investment decisions aimed at connecting underserved communities."

> **FROM THE JUDGES:** "This is the most comprehensive mapping tool for BB availability and data. Its capabilities are of great value to those who need this service."

Esri receives silver award.

REVOLink3 - 3-in-One Drop Cable Solution

The REVOLink3 - 3-in-One Drop Cable Solution from Emtelle is a Silver Honoree.

"Emtelle's REVOLink3 cable represents a revolutionary shift in FTTH installations, offering BSPs unparalleled flexibility, efficiency, and cost-effectiveness. By harnessing this innovative solution, BSPs can overcome traditional barriers and deliver high-quality broadband connectivity to even the most remote areas, unlocking new opportunities for growth and expansion in emerging markets."

Emtelle receives silver award.

FROM THE JUDGES: "Simple, flexible drop installation tool should help reduce time and cost of getting that last part of the network in place. Love the use of the drill to provide the power! Well done."

CyberPower CP1500PFCRM2U PFC Sinewave Short-Depth UPS System

The CyberPower CP1500PFCRM2U PFC Sinewave Short-Depth UPS System from CyberPower Systems is a Silver Honoree.

"The CyberPower CP1500PFCRM2U PFC Sinewave Short-Depth UPS System provides battery power backup, surge protection, and EMI/RFI noise filtering for security systems, audio/visual equipment, networking, storage devices, telecommunications, and sensitive electronics requiring an active PFC power source. Its shorter-depth (10.5") allows it to fit easily into wall-mount racks, while allowing for more accessible cable management. The user-friendly, multifunction color LCD Control Panel quickly displays UPS status."

FROM THE JUDGES: "Nice straightforward product that could have a home in huts, CEVs, etc. Great form factor for mounting in limited space installations."

ISE NETWORK INNOVATORS' AWARDS

GOLD

RFTS-400 Remote Fiber Test System (RFTS)

The RFTS-400 Remote Fiber Test System (RFTS) from VeEX is a Gold Honoree.

"The RFTS-400 is the newest addition to VeEX's monitoring solutions. Used as a standalone fiber monitoring probe or as part of VeEX VeSion, a centralized, multi-probe monitoring system for fiber, RF-CATV or Ethernet networks, the RFTS-400 supports dark fiber monitoring, in-service monitoring, PON construction and monitoring, infrastructure monitoring, and security monitoring applications. The RFTS-400 can be operated via its built-in serverless monitoring system, designed to offer similar user experiences whether it's operated in standalone mode or as part of a large-scale VeSion Remote Fiber Test System (RFTS)."

FROM THE JUDGES: "This design is well thought out and provides an array of configuration options for limited space applications. Its expansion ability provides a great opportunity for monitor dense fiber networks in urban settings from a single optical control module."

Fiber IQ™

Fiber IQ™ from VCTI is a Gold Honoree.

"Fiber IQ™, powered by two additional VCTI products, Pole IQ™ and Geology IQ™, enables service providers to significantly improve the efficiency of their capital investments to expand and/or upgrade broadband networks."

FROM THE JUDGES: "This product will certainly lessen the time it takes to engineer certain parts of the network and will take the guess work out of the assumptions that need to be made by engineers."

VCTI receives gold award.

Precision Optical Technologies receives gold award.

Genesee™ Dispersion Compensation ASIC

The Genesee™ Dispersion Compensation ASIC from Precision Optical Technologies is a Gold Honoree.

"Precision's Advanced Engineering Group (AEG) designed and manufactured the Dispersion Compensation ASIC (application-specific integrated circuit) called Genesee, using patent-pending technology to address the impact of data quality in DWDM networks as distance increases. While today's 10G DWDM transceivers can facilitate transmission distances of up to 80km, available 25G DWDM optical transceiver solutions fall short, limiting network operators to 10-15km distances unless specialized equipment is employed for longer links."

> FROM THE JUDGES: "This product clearly hits the mark on the need to achieve greater data ranges. What sets it apart from the competition and makes it even more valuable, is that it is non-invasive! Many times, when we're upgrading the network, we need to change out fiber or other components and/or network elements. That's not the case here. This allows you to do more with your existing infrastructure."

Monolith Underground Enclosure

The Monolith Underground Enclosure from NewBasis, LLC is a Gold Honoree.

"The new patented Monolith® underground enclosure (US Patent #11,931,930) is the market's strongest and most durable.

Combines fiber-reinforced polymer with polymer concrete to create a smooth one-piece enclosure (Monolith®) that exceeds T22 load testing. It also incorporates a tapered design (a first for polymer enclosures) that will allow installers more interior volume and can be stacked, which will allow for a smaller shipping footprint."

> FROM THE JUDGES: "The vault/manhole enclosure provides benefits for installers and logistics with an innovative design and material approach. These products are typically (and literally) overlooked but can make a big difference in first installed and maintenance cost. So glad there is still innovation in this area."

Fujitsu Network Communications receives gold award.

1FINITY™ T900 Series Transponder

The 1FINITY™ T900 Series Transponder from Fujitsu is a Gold Honoree.

"The Fujitsu 1FINITY™ T900 Series Transponder delivers extreme performance, automation and sustainability for regional, metro and long-haul networks … The next-generation T900 Series Transponder features terabit speeds on a single wavelength, sustainable liquid cooling and greater capacity for seamless scaling. Moreover, the T900 Series Transponder is included in the 1FINITY Ultra Optical System platform that also enables AI/ML automation to optimize end-to-end service delivery. This hyper-reliable optical transport platform provides the ideal balance of cost, reach and capacity with simplified operation."

> **FROM THE JUDGES:** "Fujitsu's latest transponder innovation is another great step in performance. It brings new speed and reliability through better cooling."

Corning Optical Communications receives gold award.

Evolv® Single-Fiber Pushlok™ Adapter

The Evolv® Single-Fiber Pushlok™ Adapter from Corning is a Gold Honoree.

"Corning's One Fiber (1F) Pushlok™ Adapter reduces complexity and time to deploy a network by giving operators more options to connect a customer location. The 1F Pushlok Adapter leverages Corning's Pushlok Technology, allowing for direct connection between two Pushlok connectors. This versatility enables the extension of any Pushlok drop or assembly with another."

> **FROM THE JUDGES:** "This adapter is brilliant! The ability to quickly connect a customer saves time and money and improves customer satisfaction. The clicking sound is good affirmation that you have a solid connection."

NewBasis, LLC receives gold award.

ISE NETWORK INNOVATORS' AWARDS

PLATINUM

LOC-DROP® Fiber Drop Repair Solution

The LOC-DROP® Fiber Drop Repair Solution from Enginuity is a Platinum Honoree.

"The LOC-DROP® Fiber Drop Repair Solution was developed based on the ISP's need to reduce the cost to repair a subscriber outage caused by a severed fiber drop cable. With the explosion in FTTH subscriptions, the challenge the service provider faces each day is reducing the restoration cost to repair a damaged fiber drop cable. Due to fiber's low-loss characteristics, some service providers have increased the length of the typical subscriber drop cable from 50-300 ft to 1,000-2,000 ft. This long cable length, along with obstacles such as driveways, roadways, sidewalks, patios, etc, adds up to significant restoration cost if replacing the entire drop was the only solution. The LOC-DROP contains several design innovations to support the wide range of drop repair field conditions..."

> **FROM THE JUDGES:** "Great idea and execution. An innovative product that will reduce repair time for fiber cuts. The product can be used in a direct buried or aerial application."

Enginuity Communications receives platinum award.

The 2024 honorees.

Evolv® Solution With Multifiber Pushlok™ Technology

The Evolv® Solution With Multifiber Pushlok™ Technology from Corning is a Platinum Honoree.

"Corning's new Multifiber Pushlok™ technology and its pre-connectorized FTTx solution evolves outside plant hardened connectivity solutions to unlock increased network deployment speeds, ease-of-use, and sustainability. With the broadband industry at a critical juncture and a historic level of government funding available, Multifiber Pushlok helps network operators overcome increased challenges such as cost constraints, labor shortages, and challenging build timelines to connect the unconnected."

> **FROM THE JUDGES:** "Love the attention to increasing installation efficiency. Any labor and material savings that providers can gain are great. This has the potential to speed deployment up quite a bit. The ability to use smaller duct sizes will be beneficial as well. Nicely done."

Corning Optical Communications receives platinum award.

Fujikura 45S Cladding Alignment Fusion Splicer

The Fujikura 45S Cladding Alignment Fusion Splicer from AFL is a Platinum Honoree.

"The 45S cladding alignment fusion splicer is changing the way people splice fiber in small to mid-fiber count applications. This Fujikura splicer debuts a landmark improvement to the fusion splicing process with the ability to prepare and load both fibers simultaneously. After preparation, the 45S patented sheath clamps enable the loading of both fibers simultaneously into the splicer with one fiber in each hand. The user can press down on the sheath clamp base to close it while positioning the fiber in the v-grooves. This enables one-handed operation and saves operational costs."

> FROM THE JUDGES: "The Fujikura 45S Cladding Alignment Fusion Splicer is the epitome of technology adapting and evolving to meet the technician more than halfway, greatly reducing the time and skill required in the fusion splicing process. ■

ISE EXPO 2024 RECAP:
What a Great Show

What a year for ISE EXPO, a telecom show like no other.

BY JOE GILLARD

ISE EXPO 2024 in Dallas was a huge success.

There was a 10% increase in attendance this year, and telecom professionals from all 50 states and 28 countries were at the show.

We also had a completely sold-out exhibition floor and offered 45 sessions with a total of 77 speakers.

If you were there, then you probably felt the genuinely good vibes all around. The warm, Dallas sun was shining on the telecom industry that week, as friendly faces felt the optimism of an industry that's seeing rays of sunlight peeking in on an industry that's been recalibrating and evolving.

Frontier's Scott Mispagel led a keynote that reinforced the fundamental importance of building out the fiber network with an entire technological revolution depending on it. A new age that's only beginning.

Janice Oliva led an executive session that addressed what's top of mind for telecom executives in this exciting new era of AI and grant-funded rural broadband initiatives.

Speaking of BEAD, I was delighted to lead the "Building to BEAD" session that featured our very own research in the form of a BEAD readiness survey. The three panelists that joined me had keen insights on how folks responded, and what it means for the whole industry.

Education sessions were well attended and topics included:

- Supply chain management
- Artificial intelligence
- BABA guidelines
- Public/private partnerships
- Smart cities
- Construction and engineering for the future
- Middle mile trends
- The customer journey
- And so, so much more...

PHOTOS: Endeavor Business Media

Keynote speaker Scott Mispagel, Frontier Communications

ISE Network Innovators' Awards Ceremony.

Tech Talk presentations from (left to right) David Curran, Frontier, Todd Zeiler, AT&T, and Diana Scudder, Verizon.

Executive Panel Discussion with (left to right) Kirk Smith, Randall René, Charles Harlow, Paul Sulisz, Kevin Czaicki, and Kevin Morgan.

ISE EXPO – a Symposium for the Future of the Network

With a panacea of opportunities to learn, network, make deals, and find out what's really on the minds of your customers, ISE EXPO is a unique, annual opportunity to really dig into issues such as workforce challenges and what AI can actually do for BSPs and their vendors.

With everyone in one place to talk comfortably and candidly about these things, maybe over lunch or a cocktail, opportunities and solutions suddenly appear, like magic. And we take this inspiration home with us and we start solving the future of the network with renewed focus and enthusiasm.

For example, our Women in Telecom panel gives women an opportunity to talk openly about telecom leadership with and for each other, bouncing ideas off and creating conversations that move the industry and its leadership to new heights with new perspectives.

Third annual golf tournament.

Let me extend my warm gratitude to all of you attendees that made this show such a joy, and for bringing your perspectives to the industry.

We could not have done it without you.

Women in Telecom Panel (left to right): Janice Oliva, Katie Curtis, Jennifer Prather, Nancy White, and Alexandria Martinez.

New Orleans in 2025

Mark your calendars for July 29th next year, because we're going to be in New Orleans! I hope to see you there. New Orleans is a fun city, and we couldn't be more excited to set up ISE EXPO in the Big Easy.

I look forward to seeing you there! ■

Solving the Transformation Puzzle

Why AI is just one piece of network evolution.

BY MATTIAS FRIDSTRÖM

Network evolution is unpredictable, but we can approximate its future by examining the past and present. Telecom has had a wild ride from its humble beginnings rooted in legacy protocols.

While some networking technologies have been phased out, dense wavelength-division multiplexing (DWDM), Ethernet, and others have stood the test of time. The industry then experienced the rise of cloud services amid hyperscaler growth, challenging how operators build their networks.

Now, artificial intelligence (AI) will transform networks and network operations again, but it may only be one piece of the bigger puzzle. So, where do networks go from here? Let's explore networking's early development to contextualize its evolution amid these emerging applications.

From Gas Station Bathrooms to Global Infrastructure

Early networking infrastructure was placed in unconventional locations, with some network operators' amplifier sites even placed in gas station bathrooms to save both cost and installation time. While this seems strange, these sites can function optimally for years. As connectivity expands globally, operators will continue to choose creative infrastructure locations according to companies' business needs.

Various legacy protocols dominated the early networking landscape, including X.25 and frame relay. As an early packet-switched networking protocol, X.25 was designed to maximize the reliability of communications but was plagued by inefficient error checking and correction mechanisms.

Frame relay replaced X.25 as a high-performance wide area network (WAN) protocol designed to maximize cost efficiency while reducing the complexities of error correction. However, scalability was frame relay's Achilles heel, with its fixed-size virtual circuits hindering the management of varying traffic loads.

Multiprotocol Label Switching (MPLS) emerged as a dynamic alternative, offering improved flexibility and performance as networks and internet traffic scaled up in the late 1990s. Throughout these changes, network operators worked to maximize efficiency, cost savings, scalability, capacity and more.

No matter how the network evolves to accommodate AI's requirements, operators will integrate new technologies or leverage innovations in existing technologies to enhance these same networking qualities that have proved vital since the internet's early days.

Tomorrow's Puzzle Pieces: Where Networks May Head Next

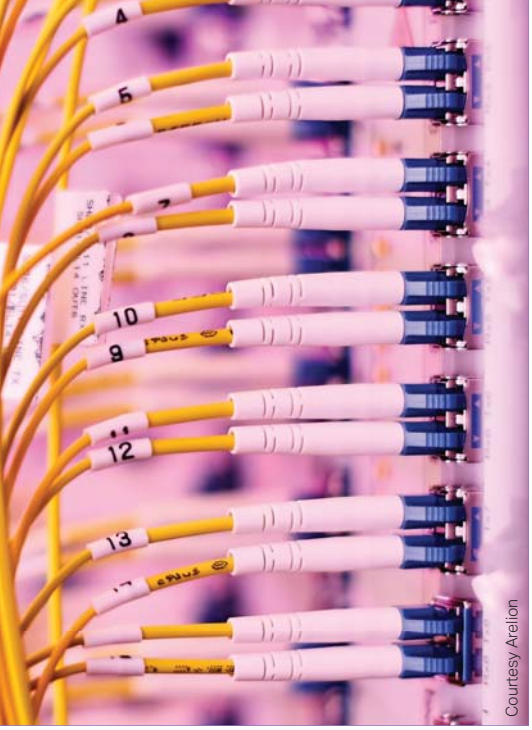
AI AND OPTICAL INNOVATION: A SYMBIOTIC DYNAMIC

AI has captured the technology industry's imagination and wallet, and networking is no exception. AI will catalyze a two-pronged transformation, where operators will build their networks to maximize automation, high-capacity bandwidth, cost savings, speed and reliability to serve AI's enormous data processing and transfer needs. But telecommunications providers will also integrate AI applications internally to streamline customer experiences and minimize manual intervention through self-service capabilities.

Since AI relies on massive amounts of high-quality data, telecom operators must collapse their internal data siloes to create a unified source of truth. Despite its transformative power, AI is only as good as the data you feed it.

Optical networking innovation is crucial in supporting AI's massive data requirements. DWDM, which first increased fiber network bandwidth in the 1990s, remains vital as bandwidth demands increase due to the growth of internet traffic and AI applications.

However, service providers are increasingly integrating IPoDWDM (IP over



Courtesy Arelion

DWDM) in long-haul and metro segments, allowing them to remove the transport (or DWDM) layer between routers to substantially reduce the long-term operational costs of IP-based networks.

Open optical networking will also prove critical for network evolution in the era of AI, allowing network operators to integrate 400G ZR and ZR+ coherent pluggable optics through open line systems to significantly increase capacity. This development is a game changer, particularly with Shannon's limit (the maximum physical limit for how much traffic can pass through a fiber) already here.

Open line systems with an expanded L-Band option allow operators to double the capacity of a single fiber pair and overcome these physical limitations. We may also see further developments in higher baud rates, new modulation formats and even frequency bands outside of the C and L-Bands. While fiber's physical limitations remain, network requirements will heighten due to AI's demands, so optical innovation is an essential part of the network's continued evolution.

FORGING EFFICIENT AND SUSTAINABLE NETWORKS THROUGH AUTOMATION

Sustainability is a relatively new goal in telecommunications. Historically, traffic throughput and CapEx costs were the industry's focus, with sustainability being an afterthought, if it was even considered. In comparison, network automation is not novel, but its prohibitive costs and operational complexities were previously difficult to justify.

With the advent of AI, networks must be better, faster, and simpler. As a result, operators are leveraging advanced analytics to enhance network automation and efficiency, helping them improve sustainability by reducing power consumption. These tools have helped operators overcome automation's previous limitations, empowering them with agile operations through real-time data insights.

Automation enables internet carriers to facilitate proactive network management through predictive analytics, ensuring the reliable low-latency connectivity enterprises need for real-time AI functionality.

Automation also enhances network scalability, keeping operators adaptable to AI applications' resource requirements by automatically scaling capacity up or down according to real-time demands. Automation's dynamic resource allocation and predictive maintenance capabilities also help operators mitigate AI's massive energy consumption, enabling them to minimize energy waste resulting from low-demand periods or malfunctioning equipment.

DREAM A LITTLE DREAM: QUANTUM COMPUTING AND FIXED WIRELESS ACCESS

Telecommunications has always turned ambitious dreams into reality through technological innovation. Quantum computing could revolutionize the industry, potentially fitting the entire internet on a piece of equipment as small as a sugar cube.

While we likely won't see real-world integration for at least 10 years, quantum networking will progress as network demands rise and space and power become more precious. Quantum networking innovations may include enormous traffic capacities, specialized fiber types, further integration of quantum key distribution and other developments.

While quantum key distribution is already enhancing network security and efficiency, operators will realize quantum networking's true potential when they can transport quantum traffic over long distances to serve global enterprises' networking needs.

The digital divide has improved since the internet's early days, but operators still have plenty of work left to enable equitable access to global connectivity. Fixed wireless access (FWA) will likely grow in the coming years, offering the most cost-effective connectivity option for underserved communities across the globe.

Equitable Internet access is a more attainable dream than quantum networking and other lofty technologies, but it requires substantial investment. Still, that investment is lower than the cost of fiber buildouts, making FWA an appealing option to bridge the digital divide and realize the dream of a fully interconnected world.

Putting the Pieces Together to Enable Evolution

When considering connectivity's rapid progress over the past 30 years, network evolution is impossible to predict. While change is certain, the underlying drivers of network evolution will likely remain constant.

Whether enabling widespread AI integration or improving network automation, operators will continue to enhance high-capacity bandwidth, reliability, cost efficiency, scalability, reach and other familiar qualities.

These are the underlying pieces of the overall puzzle comprising connectivity's future. One thing is guaranteed, no matter how the network evolves over the next few decades, it will be a wild ride. ■

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Mesh Networking: The Bridge Across the Digital Divide

How to solve the dilemma of connecting rural America.

BY TODD RIGBY

High-speed connectivity is no longer a luxury but a necessity. Without it, people are at a disadvantage. The phrase "digital divide" refers to the inequality of access to high-speed broadband service in rural areas compared to urban areas.

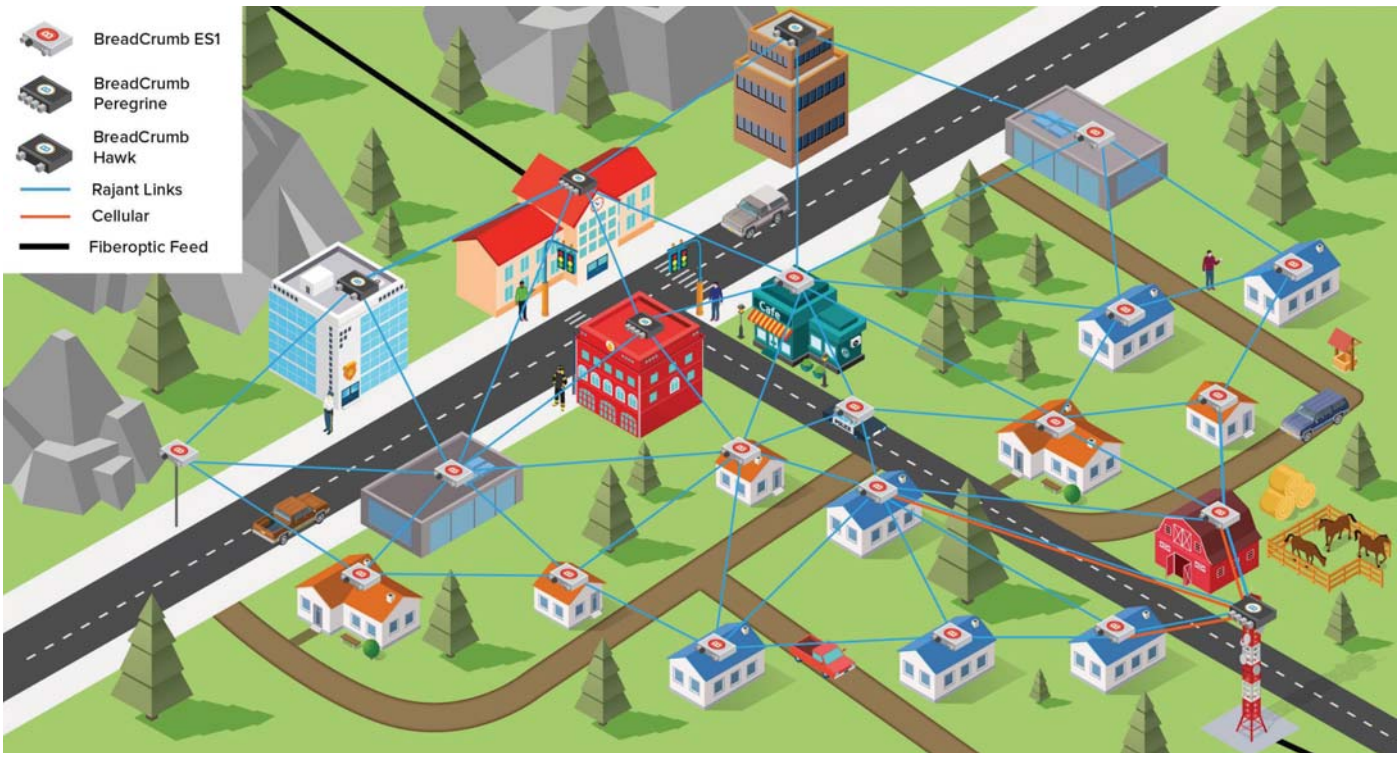
The reason for the digital divide is simple mathematics. Rural areas have considerably lower building density. Fewer houses and commercial buildings mean fewer potential paying customers. On top of that, if potential customers are spread out, the cost of installing fiber optic or coax cable is much higher per structure compared to densely populated cities due to the empty land between service hook-ups.

The challenge of overcoming the digital divide is still getting worse. Many people in the United States do not have electric utility services in their homes because of their remote location. If people do not have utility service, they do not have power poles along their street, which means internet infrastructure must be buried, which is more costly than stringing fiber or coax between existing power poles.

If internet service providers (ISPs) must spend more money to install communications infrastructure in rural areas, and there are far fewer potential customers to collect service fees from, the potential to recover the cost of installing broadband is less. Telephone utilities, cable companies, fiber optic companies, and ISPs must make spending decisions based on the cost versus revenue equation.

Governments worldwide have recognized this issue and, in some cases, have invested millions in providing network infrastructure in low-income and rural areas to ensure no one gets left behind. Every time a wired or wireless telephone bill in the United States is paid, a contribution is made to the Universal Service Fund. This fund makes low-cost loans available to carriers to motivate them to deploy communications services to rural America. Unfortunately, many people still find themselves disconnected from the digital divide.

A 2021 Study[1] by BroadbandNow Research confirmed more than 42 million Americans do not have broadband access. While this number is much greater than FCC figures, the study also pointed out that the FCC relies on self-reporting data by ISPs instead of any type of actual survey.



Rajant Corporation

Perhaps the most challenging part of connecting rural customers is the "last mile." The "last mile" is the final part of the network that connects homes and buildings to the extensive backhaul of the network.

This responsibility is often passed to wireless providers to cover the often isolated and robust "last mile." Many people think satellite connectivity is the only solution for wireless broadband in rural areas. And while the top satellite providers can reach impressive speeds, it is not cost-effective for everyone residing in a rural area to pay the expensive monthly rates. What is needed is a cost-effective wireless broadband solution that can provide sufficient connectivity and bandwidth.

Essential Services for Rural Communities

The COVID-19 pandemic highlighted the crucial role that high-speed internet access plays in each person's life. When face-to-face contact was actively discouraged, schools and offices shut down; people needed broadband to work from home, access health care services, order food or prescriptions, and education. In the United States, 97% of the country's land mass is rural, with 19.3% of the population[2] inhabiting it. This means that around 60 million people are geographically disadvantaged when it comes to broadband connectivity.

Many factors make internet access even more vital, especially for rural towns and their residents. Rural residents are more likely to be older, which makes them more susceptible to health issues. A poor connection can be an issue for health providers who may struggle to reach their patients directly. Health providers also rely on internet connectivity for remote patient monitoring and online appointments.

Until March 2020, Mountain Comprehensive Health Corporation, based in Kentucky and one of the largest rural community health centers in the United States, fielded 1,500 telehealth calls. From March 2020 through September that number skyrocketed to 156,000,[3] demonstrating broadband's critical role in healthcare access for people in rural areas.

Another example is the Navajo Nation, located in the four-corner area of the Southwestern region of the United States. The Navajo Reservation is home to the Navajo, Hopi, and Piute bands of Native Americans. The school district that serves the Navajo Reservation has the highest number of missed school days in the United States.

> "No utility telephone service, cell service, or broadband internet service. What do they do in an emergency? At best, they get in their car and drive to the nearest town with the needed services."

Over 60% of people on the Reservation live on paved roads. Most of the streets in the Southwest are susceptible to washout due to the high content of sand in the earth. Every time it rains, the roads are impassable, and the school buses cannot pick up children.

A missed school day is no big deal for students on the fortunate side of

the digital divide. They can access school-issued laptops, attend a web meeting with their teacher, and have class at home. However, students living on the Navajo Reservation miss so many school days that it is impossible to schedule enough makeup days. This vicious cycle repeats year after year.

Broadband services are also crucial for other public-sector organizations and for businesses. Businesses in rural areas need internet connectivity to process credit card transactions. With improved internet access, they have a much better chance to grow, equating to more jobs and higher household incomes.

Fast rural internet is also essential for many aspects of the modern workplace, such as streaming, downloading, and participating in video calls. For municipal use cases, such as emergency services, limited bandwidth or sporadic connectivity can mean the difference between life and death.

I will give you an example. I live in a suburb of a good-sized city. I do not have a utility telephone service to my house by choice. Everyone in my household has cell phones. Even though cell service is not excellent, we have a gigabit fiber connection feeding our home Wi-Fi.

This allows me to work from home, my daughter to take college classes at home, and all of us to shop, make phone and video calls, and stream entertainment. If my fiber service goes down, I can walk onto my front porch to make a cell call. However, millions in rural America may have none of these options. No utility telephone service, cell service, or broadband internet service. What do they do in an emergency? At best, they get in their car and drive to the nearest town with the needed services. Working from home or attending school at home is not an option. The unfortunate side of the digital divide is not a convenient place to live.

Considering Both Fixed and Wireless Options

The "last mile" is one of the network's most expensive and complicated parts to build and operate. Rural areas are isolated and remote, making cable deployment costly. Existing infrastructure in rural areas is often outdated, meaning the rollout of new technologies, such as fiber, is much slower. Customers generally have fewer service options and slower internet speeds. While a fiber optic service is fast and reliable, getting fiber to every door in rural areas is expensive.

Several wireless technologies are also available, such as 4G/5G LTE service. Cellular infrastructure is expensive. When cellular carriers build out their network in urban areas, they can afford a higher density of towers, which provides more capacity and faster data rates. However, building in rural areas is all about providing minimal coverage to most people. Some people are invariably missed, while others live in topographically challenged places that are inaccessible with minimal infrastructure.

> **"Many people think satellite connectivity is the only solution for wireless broadband in rural areas. And while the top satellite providers can reach impressive speeds, it is not cost-effective for everyone residing in a rural area to pay the expensive monthly rates."**

Satellite's wide availability and broadband speeds of up to 250 Mbps present another option for customers living in rural areas. However, as mentioned earlier, satellite is an excellent option if you can afford the cost of the equipment and the high monthly service costs. My suburban internet costs nothing for installation and equipment, and I pay less than half of what a satellite customer would pay, and I get 4x the data rate.

It's essential to remember rural areas have lower median incomes when compared to urban areas (23% rural-urban gap).[4] In addition to paying a higher price for service, rural home workers could also experience high latency due to the distance the satellite signal has to travel. This is particularly problematic when video conferencing. Weather can also interfere with service.

Supporting Rural Communities With Reliable and Robust Connectivity

As societies and lifestyles evolve in this age of technological interconnectivity, it is important that broadband networks can also move with them. A mesh network can do precisely that. It can enable a seamless and quick deployment for ISPs that is robust enough to navigate the most challenging rural terrains.

Mesh networks such as Rajant Kinetic Mesh can deliver broadband speeds of over 200Mbps[5] to multiple municipal buildings, exceeding the Federal Broadband, Equity, Access & Deployment Program (BEAD) requirements of 100 Mbps for underserved communities and 25 Mbps for unserved communities.

Rajant's mesh network is made up of wireless nodes called BreadCrumbs. These can be deployed on buildings, poles, or any physical structure to extend coverage of existing network infrastructure, including fiber, satellite, and LTE technologies. They only require power, which can be provided by existing utility services or solar. Unlike wireless point-to-point or microwave, which transport signals from point A to point B, BreadCrumbs can transport signals from point A to point B and provide usable signals in between. BreadCrumbs mesh and provide reliable, longer-range Wi-Fi compared to a traditional access point.

BreadCrumb nodes extend broadband over the "last mile" to schools, government buildings, and even homes. In essence, mesh networking can provide "Smart City" enablement of Internet of Things (IoT) devices such as traffic lights, surveillance video, public Wi-Fi,

and public safety equipment. In addition, anyone with a commercial off-the-shelf client device, like laptops, tablets, and smartphones—can connect to the Kinetic Mesh network.

Mesh networks are resilient to physical and RF interference. The mesh nodes create a self-healing network by forming multiple redundant connections and then using them to relay information and data to ensure no single point of failure. This means that data can keep moving even if a single node is damaged or lost, enabling anywhere connectivity. The ability to leverage multiple paths and frequencies also provides high capacity to guarantee the performance of bandwidth-intensive applications.

Mesh Networking: Moving With the Digital World

The rollout of broadband has ramped up in rural areas worldwide over the last few years thanks to an increasing focus by governments and ISPs on the "digital divide." The global percentage of individuals using the internet in rural areas (46%) was 1.8 times lower[6] than in urban areas (82%) in 2022—decreasing from a 2.3 ratio difference in 2019.

As digitalization and technologies evolve and become more advanced, broadband networks must move with full mobility to expand and enhance connectivity. Wireless mesh networks can ensure that 24/7/365 high-speed internet is provided to every corner of the world and connect the underserved and unconnected.

Rajant is committed to assisting communities and service providers with creative solutions for rural broadband initiatives. You can contact Rajant to learn more about Kinetic Mesh. ■

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AD INDEX

GIS Dashboards 101

Simplifying Fiber Construction

BY JAMES KING

Winning the FTTH race comes down to finding fiber construction efficiencies that accelerate your time to market. However, designing, constructing, and managing a fiber optic network is demanding.

Challenges include coordinating with key stakeholders, navigating regulatory requirements, meeting funding requirements, and finding ways to reduce fiber construction costs. Deploying a fiber broadband network with geospatial services and GIS dashboards provides construction efficiencies at every project stage, from planning and design to managing network operations, including compliance requirements for grant funding like BEAD.

GIS in Fiber Construction

Geographic information system (GIS) offers deep insights by integrating location-based data with descriptive information. You'll be able to pinpoint infrastructure such as water pipes to visualize your fiber construction project clearly before any crews are on site.

Given the demands of funding programs like BEAD, resource allocation is even more essential for project success. GIS dashboards offer effective project management solutions with advanced data visualization tools that combine location-based information with performance data for real-time project tracking.

They can also facilitate compliance management for grant funding and permitting by helping project managers track permit statuses, funding requirements, and their respective deadlines. Broadband networks and contractors who use GIS dashboards will gain a competitive advantage for getting to market faster.

Finding Efficiencies During Fiber Construction

Challenges such as labor shortages, material delays, and resource deployment can hinder fiber network construction. Access to reliable, real-time field data is crucial for meeting milestones and addressing these obstacles. Users can use GIS dashboards to manage the construction process accurately and in real-time.

GIS dashboards facilitate:

- Efficient labor management and oversight
- Streamlined workflow delegation
- Comprehensive project reporting

By integrating field maps with GIS dashboards, project managers can log real-time fiber footage and mark completed fiber sections for expedited invoicing and timely project reporting that can accelerate the as-built process. The potential return on investment of incorporating GIS in the construction process is significant, particularly in an environment that prioritizes speed and efficient labor management.

Designing and Planning Stage

Using GIS to design and plan your fiber construction sets your project up for success from the start. A customized map gives you a detailed understanding of your service area, allowing you to build your network efficiently.

GIS helps you choose both a high-level design (HLD) for your network that captures your overall network architecture and a low-level design (LLD) that gives you nitty gritty technical specifications for managing your fiber construction project like splicing diagrams that show fiber routes and splitter locations. Using GIS as both a design

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tool and asset management platform, broadband businesses can efficiently geo-locate and track changes across your network builds.

Millennium GIS Dashboards for Fiber Construction and Network Management

Reliable field data is your construction lifeline to meeting key milestones, and GIS dashboards are the ultimate fiber construction tracking tool through all phases of project engineering and implementation. Millennium Engineering[1] can set up industry-specific GIS dashboards for your build, including engineering tracking, bill of materials (BOM) tracing, permit tracking, construction tracking, and fiber splicing management.

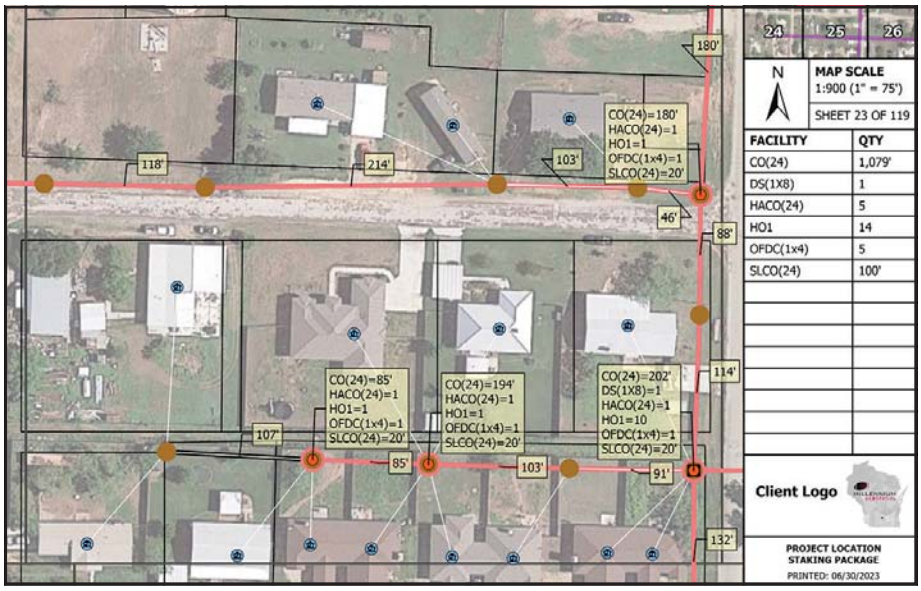
Not only are dashboards user-friendly they're also highly customizable to your fiber construction needs. Pulling layers of paper trails, databases, and index stats together gives you a big picture look at your business in one snapshot. These dashboards are also compatible with Esri's ArcGIS Field Maps app, which works on smartphones or tablets. This app gives you the power to connect your back-office people with real-time updates from your field crew, allowing you to find construction efficiencies that save money and get you to market faster.

Splicing Management Dashboard

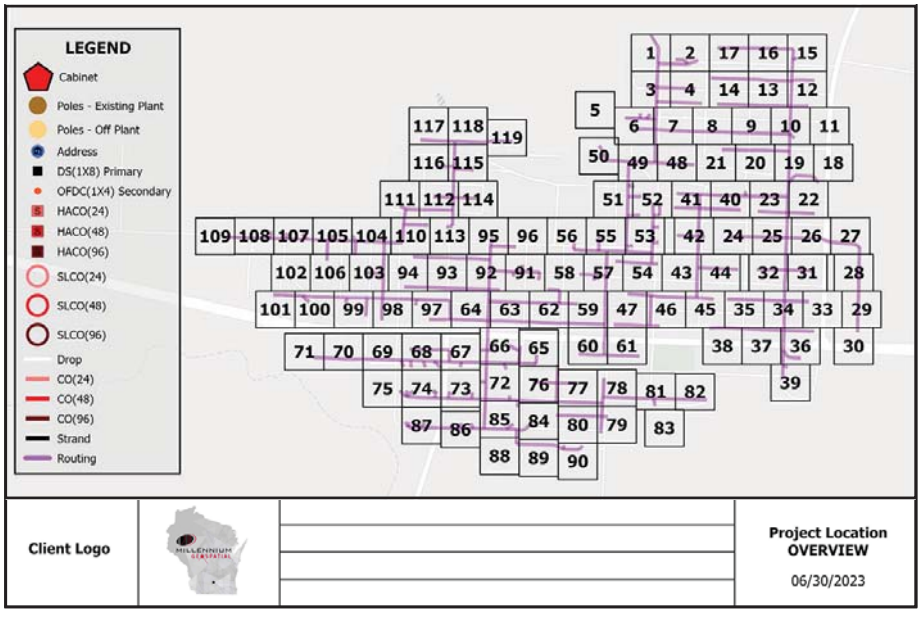
Stay in control of your splicing operations with this dashboard, which gives you live insights into the location and quantity of your network splices. Knowing the required splicing materials can help secure cost-effective bulk purchases from your suppliers.

Construction Tracking Dashboard

Monitor construction progress in real time and assess whether you're on track to achieve your ROI milestones. Immediate updates inform you about any geological obstacles your team encounters, allowing you to address issues promptly and prevent delays.



Distributed Staking Sheet Millennium



Distributed Overview Millennium

LLD/BOM Dashboard

Anticipate the materials and labor needed for your fiber construction project and identify potential shortages before they happen. As construction progresses, your material staking units update in real time, enabling you to provide a bill of materials to your distributors for quick quoting.

Millennium Engineering is an Esri Business Partner who has earned the Esri Release Ready Specialty, committing to a fully certified technical staff. This partnership allows Millennium Engineering to offer software and training services. ■

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