FAST & EASY ON-SITE TERMINATIONS

The Lynx2 Splice-On Connector is a fully integrative splice-on fiber optic connector enabling quick, easy, and reliable field terminations without shorts, excess slack, and logistic delays.

Ease of use, elimination of hand polishing and index matching gels, consistent results, reliability, and unprecedented accuracy in connectivity make the Lynx2 the best choice in fiber termination.

Here's a few reasons why so many networks trust Sumitomo Electric's Lynx2 Splice-On Connectors:

- 30+ Years Offering Fusion Splicers & Connectivity
- First-to-market for Splice-On Connectors in United States
- Sales Support and Repair located in the United States
- Free Certification on Equipment and Splice-On Connectors
- Machine Replacement during Repairs/Upgrades
- Extended Warranties Offered

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ISE
ICT SOLUTIONS & EDUCATION
APRIL 2021









2021 ICT Visionaries

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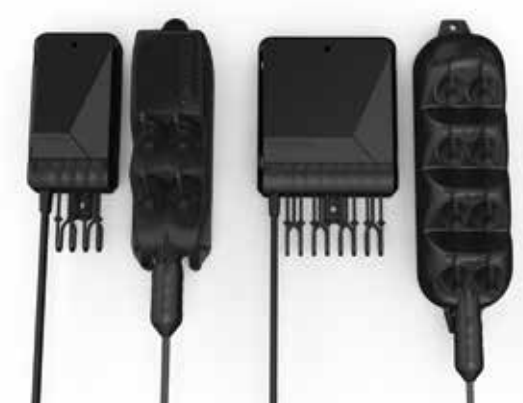

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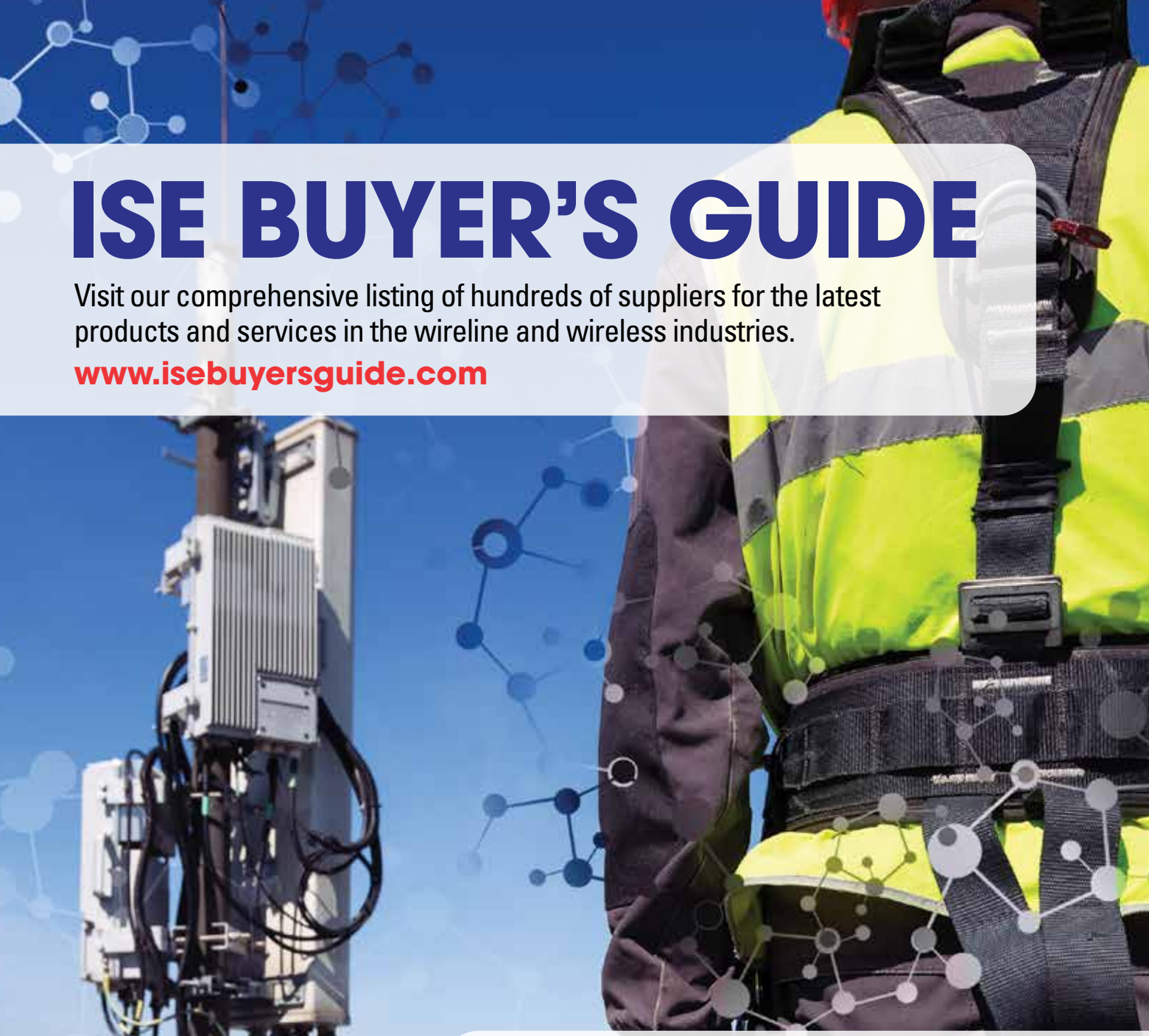

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5G Security Vulnerabilities

By Alex Thornhill

An Accenture study finds 2,600 businesses worry about 5G security.

What Did You SASE?

SASE, which refers to the combination of SD-WAN and security, will be an all-important enterprise networking technology in 2021, especially as businesses operate in a distributed, or hybrid manner, with employees working from a variety of locations.

As a result, the SASE Market is expected to grow at a 116% compound annual growth rate over the next 5 years.

Source: https://www.delloro.com

WIRELINE & WIRELESS NETWORK PRIORITIES

COLUMNISTS

IN EVERY ISSUE

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EDITOR'S NOTE
by Sharon Vollman

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Follow Sharon on Twitter and LinkedIn for further conversation and insights.

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

THE SKILLS GAP IS REAL????

According to a recent survey by EY, 59% of companies believe there's an industry-wide shortage of the type of skills that would help accelerate their digital transformation efforts.

We agree. That's why we bring you perspectives from leaders who are charged with empowering their teams. It's also why this is a perfect time to proudly introduce our 2021 ICT Visionaries.

- Kelly Thengvall, Assistant Vice President – Customer Care, AT&T
- Kevin Morgan, Chief Marketing Officer, Clearfield
- Jason Atwater, Director of Network Operations, CTC
- Tammy Perry, Director of Service Delivery, Horizon
- Dave Cooper, VP, Edge Compute, CDN & Vyvx, Lumen
- Mattias Fridström, Chief Evangelist, Telia Carrier
- Faisal Vishram, Senior Technology Architect, Global Solutions, TELUS
- Shari Griffin, Director, Global Network Operations and Assurance (GNO&A) Program Management Office, Verizon
- Dr. Sameh Yamany, Chief Technology Officer, VIAVI Solutions

These 9 leaders weigh in on all kinds of questions related to the interdependence of network transformation and employee empowerment in the April, July, and October issues. Will they have all the answers? Of course not.

Still, you and your team could snag a nugget of wisdom from those who really get what you do. Or you could ask **your** team members to weigh in on some of the questions we pose to the Visionaries.

Whatever you do, don't waste the opportunity to DO something to bridge the skills gap of your own team. And if you need a trusted partner to create a custom educational program for them, just shoot me a note. (We've kind of done that kind of thing once or twice before.)

ISE Custom Educational Partners

AT&T LUMEN verizon windstream

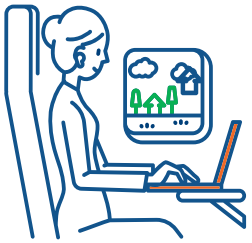
Source: https://www.ey.com/en_us/consulting/six-habits-of-digital-transformation-leaders

Sharon

Sharon Vollman, Editorial Director

FUN FACTOIDS

April showers bring factoid flowers.
(Or something like that, right?)



83% Say No, No, No...

Remote work is becoming the new normal in the wake of the COVID-19 pandemic, according to 83% of global IT decision-makers.

They don't see employees returning to physical offices anytime soon: 3 in 4 global IT decision-makers say the transition to remote work will either continue for years or become permanent.

Source: http://www.lumen.com. Statistics are from the report **Global Trend Report: How the 4th Industrial Revolution is Changing IT, Business and the World.**

20 to 25 Times Faster? Really?

The great acceleration in the use of technology, digitization, and new forms of working, will likely be sustained. A recent McKinsey report shared that many executives said they moved 20 to 25 times faster than they thought possible on things like building supply-chain redundancies, improving data security, and increasing the use of advanced technologies in operations.

https://www.mckinsey.com/featured-insights/leadership/the-next-normal-arrives-trends-that-will-define-2021-and-beyond?cid=other-eml-alt-mip-mck&hdpid=b422b741-024f-4d56-96df-2d4f-05ce9a5f&hctky=12322243&hlkid=2aba1c3f08c-14f45a109c3cbfaf599b9#

A.I. at the Edge

5G is a composition of several network layers that leverage technology with varied maturity levels, such as:

- Open RAN
- Network Slicing
- Cloud-edges
- Cloud Infrastructure (private, public, and hybrid)

With respect to cloud-edges, the broader Artificial Intelligence (A.I.) industry is witnessing a migration of A.I. to the edge.

$2.6
US BILLION IN 2020

$10.7
US BILLION IN 2025

For example, the edge A.I. training and inference market for chipset sales is expected to grow at a CAGR of 35%.

Source: http://www.abirresearch.com

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COPPER EXPERT
by Don McCarty

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Don McCarty is the Copper Expert columnist for ISE magazine, discussing the issues around provisioning, testing, and maintaining copper for all services from POTs to IPTV. Don is also President of and the Lead Trainer for McCarty Products, a technical training and products company training field technicians, cable maintenance, installation repair, and Central Office technicians and managers.

THE CHANGING ROLE OF THE FIELD TECHNICIAN IN THE BANDWIDTH BUSINESS

When I started in the telephone business in 1965, the field technician's jobs were fragmented. Technician's responsibilities today are even more fragmented. Let's take a trip from then until now.

THAT WAS THEN

On a new installation it is the responsibility of the dispatch center to program the originating equipment (OE), and to provide wiring information to the central office technician and the installer as to which OE is wired to which horizontal mainframe and to which vertical the feeder cable appears.

- The CO frame technician runs jumper wire from the horizontal main frame to the vertical main frame, and wires the CO equipment to the feeder cable pair.
- The frame technician draws dial tone at the vertical, and dials the automatic number identification to verify that the correct service is on the right cable pair.
- The installer found dial tone on the feeder cable (F1) at the cross box, verify the telephone number, and wire the feeder cable pair to the distribution cable pair (F2).
- The installer then goes to the customer's workout terminal or pedestal, finds dial tone, verifies the telephone number, and terminates the customer's drop to the cable pair.
- The installer then installs the network interface, finds dial tone and then pulls in the inside wire, installs the jacks, and then installs the telephones.

When dial tone is present on all phones, the installer dials the quiet line termination and listens. If it sounds good, the technician closes out the install, and moves on to the next install.

If there is any trouble with the initial installation or any existing service, an installation repair technician is dispatched. The installation repair technician is responsible for phones, jacks, inside wire, the service drop, and the distribution cable pair.

- If the problem is on the cable pair, the technician proves the fault into the feeder plant or into the distribution plant.
- If the fault is in the feeder plant, then it is turned over to the cable repair technician.
- If the fault is proved into the distribution plant, then the field technician checks all multiple terminals or pedestals that the cable appeared in. Any terminating faults are repaired, and any cable troubles such as wet cable splices, sheath damage, and circuit design problems, are turned over to the cable maintenance technician.

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THE BIG CHANGE

With deregulation, the outside workforce decreases, and the technician's tasks increases threefold.

- The installer is eliminated, and the installer repair technician takes over initial installations and any repairs.
- The central offices are unmanned.
- The CO technicians are assigned to other departments within the company.
- On a new install, the time-sensitive installer repair technician first goes into the CO, does all of the wirework and all of the paperwork, then goes to the field and finishes the install. Also, any faults found on the cable pair must be identified, found, and fixed.
- Faults on the feeder cable are the responsibility of the cable repair technician.
- Terminating faults on the distribution cable pair are the responsibility of the installation repair technician. Rather than finding a terminating fault in an associated terminal or pedestal that could take hours to find and fix, the technician moves the service to another good distribution pair at the cross box and the customer's work-out terminal.

This is also the time when FAX machines, caller-ID, answering machines, modems, and burglar alarms, started showing up. This was literally the beginning of bandwidth usage around 300 baud for FAX machines. Baud rates that were maybe 6 to 10 bits increased quickly, jumping from 14.4Kbps-28.8Kbps to 33.6Kbps-56Kbs on substandard cable pairs.

Then DSL hit the market, service went from ADSL to VDSL to VDSL to IPTV and other bandwidth services in a heartbeat. As bandwidth increases, distance from the CO or the remote becomes a problem. End users scream "more bandwidth", and field technicians yell "We don't guarantee bandwidth on copper cable pairs where you live. If you want more bandwidth, then move closer to town".

There were cable faults that affected both bandwidth service and plain old telephone service (POTS) circuits, such as caller-ID and answering machines. Field technicians use transmission test sets when the cable pair tested OK, but circuit design faults cause complaints of no dial tone, no dial tone at times, bell rings, can't answer, can't hear, etc. They measure loop or line current, station ground, circuit loss, circuit, and power influence.

Initially, any failed transmission test is turned over to the ICEP engineer, but with more end-user equipment coming online it forces the field technician to find and fix circuit design faults, making their job more fragmented.

All circuits are affected by unwanted AC voltage on the cable pairs. Field technicians are ill-equipped to find and repair those noise mitigation faults. They are turned over to a quality Inductive Coordination and Electrical Protection (ICEP) engineer, and there are not nearly enough of them. That still holds true today.

If you need noise mitigation help, especially with unwanted AC voltage, you are better off using a contractor who is equipped and has the ability to find and fix those faults. My noise mitigation guru, Russ Gundrum, is one of them. You can contact him at russgundrum@telecomproblemsolvers.com.

As you can see, the role of the field technician in the bandwidth business is constantly changing. Fiber is rapidly replacing copper for bandwidth. Some field technicians move to the fiber arena; some technicians maintain both the fiber arena and the copper arena. **They all need new tools, training, and support.** ■

Signing off

My hat is off to today's technicians. They are masters in their trade with complex tasks and with complex equipment that requires significant training. Unfortunately, many of them are handed a box, and told to go online and review the manual. But with no extra time or funds allotted to education, it's a learn-as-you-go while also under pressure to complete a certain number of jobs in a given day. No wonder cut-to-clear is a commonly used technique. If you have comments or thoughts or questions, even if you are struggling while in the field with a problem, call me! 831.818.3930 or email dmccarty@mccartyinc.com.

FAST & EASY ON-SITE TERMINATIONS

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- Extended Warranties Offered

SUMITOMO ELECTRIC LIGHTWAVE

SumitomoElectricLightwave.com

Introducing Our 2021 ICT Visionaries

By Sharon Vollman

Meet our 2021 ICT Visionaries from AT&T, Clearfield, CTC, Horizon, Lumen, Telia Carrier, TELUS, Verizon, and VIAVI Solutions. These thought leaders will weigh in on all kinds of topics facing our industry in the April, July and October issues.

A few weeks ago, ISE sent to these 9 Visionaries 8 questions, asking them to select 3 to answer. Read on for their insights.

TOPIC: THE INTELLIGENT EDGE

Deloitte predicts the global market for the Intelligent Edge will expand to $12 billion in 2021, continuing a CAGR of around 35%. Telecom providers deploying the intelligent edge for 5G networks, and hyper-scale cloud providers optimizing their infrastructure and service offerings will drive this increase.

Share your thoughts about this and why telecom providers must leverage the Intelligent Edge for success in the future.

The Intelligent Edge is the combination of advanced connectivity, compact processing power, and artificial intelligence (A.I.), located near devices that use and generate data.

(Source: https://www2.deloitte.com/content/dam/insights/articles/US93838_TMT_Predictions_2021/DI_2021-TMT-predictions.pdfhttps://www2.deloitte.com/content/dam/insights/articles/US93838_TMT_Predictions_2021/DI_2021-TMT-predictions.pdf)

TOPIC: FIBER

The fiber optic market is expected to grow at a 10% CAGR from 2019 to 2024. The major growth drivers for this market are increasing demand for the Internet and growing use of wireless systems.

What are your company's objectives related to this area in 2021? Share some tactical innovations you plan to use or are using that other providers could employ.

(Source: https://www.businesswire.com/news/home/20201214005458/en/Global-Fiber-Optics-Market-Report-2021-Trends-Forecast-and-Competitive-Analysis-2013-2024---ResearchAndMarkets.com)

TOPIC: 5G HEALTH PERCEPTIONS

While extensive scientific evidence proves that mobile phone technologies have no adverse health impacts -- not just for 5G but also earlier generations -- 10% and 20% of adults in many advanced economies will mistakenly equate 5G with possible harm to their health.

What can/should our industry do about this perception?

(Source: www.deloitte.com/us/tmtcenter)

TOPIC: CLIMATE GOALS

Verizon and Vodafone are aiming for net-zero emissions by 2040, and Telefónica has committed to net-zero in its top 4 operating markets by 2030. To get there, Verizon and Vodafone are targeting 50% reductions in electricity usage by 2025, and Telefónica a 70% reduction by 2030.

What are some new network-related tools and tactics providers can employ to meet their climate goals?

(Source: https://res-www.zte.com.cn/mediares/zte/Files/PDF/white_book/202011241046.pdf)

TOPIC: SD-WAN

After experiencing slower growth in 2020 caused by the COVID-19 pandemic, worldwide sales of SD-WAN technologies are forecasted to grow at a compounded annual growth rate of 24% over the next 5 years. The market is expected to surpass $4 billion in 2025.

What does this mean in terms of network changes for service providers?

(Source: https://www.delloro.com/news/sd-wan-market-growth-will-accelerate-in-2021/)

TOPIC: PLANNING, DESIGNING, AND OPERATIONS IMPROVEMENTS

During every stage of the 5G deployment journey, telecom providers are dealing with 5G's increased complexity: more network nodes to install and maintain, more parameters to adjust, and more services to design and operate. This poses new challenges -- from network planning to service operations.

What are the challenges your company faces, and what are some creative network solutions/processes to address them?

TOPIC: WIRELESS CAPEX SPENDING

The Wall Street analysts at Deutsche Bank Research say they expect wireless carriers -- including T-Mobile, Verizon, and Dish Network -- to collectively spend $35 billion on capital expenditures in 2021, a figure they said will rise by 6% to $37 billion by 2022.

Do you think this is a reasonable forecast? Why or why not? How does this impact your company?

TOPIC: VIRTUAL HEALTH CARE

The telecom industry has a large role to play in making virtual health care as widely available as possible. Although 90% of adult Americans and 73% of Americans over the age of 65 are connected to the Internet, both numbers should be higher in order to make universal access to video visits possible. This speaks to an ongoing problem of those who are underserved/unserved by high-speed broadband connectivity.

What are some solutions to resolve this problem sooner rather than later?

Kelly Thengvall

Assistant Vice President – Customer Care, AT&T

TOPIC: FIBER

Fiber is foundational to our network today and tomorrow. It's the backbone that powers our mobility network and is critical to creating a 5G network with dense coverage and enhanced capabilities. With Fiber, we serve customers via in-home fiber Internet, business fiber Internet, as well as wireless customers via mobile network backhaul. We continue to innovate what we do with AT&T Fiber. In 2021, we have a new AT&T Wi-Fi Gateway, that is tri-band and Wi-Fi 6 enabled. This new Gateway is available for select AT&T Fiber customers and is capable of providing Wi-Fi coverage that is faster and even more reliable when all devices are using Wi-Fi 6. It can also support more devices on the home Wi-Fi network and is prepared to support multi-gig speeds in the future.

TOPIC: PLANNING, DESIGNING, AND OPERATIONS IMPROVEMENTS

We're deploying two types of 5G – Sub-6 and millimeter wave (mmWave). We've achieved nationwide Sub-6 5G coverage and deployed mmWave 5G in strategic, urban areas and venues with high-traffic areas where customers can benefit from ultra-fast speeds and the high capacity of mmWave 5G. With our FirstNet deployment, we've often used a one-touch deployment process, where we bundle and deploy several technologies simultaneously. Over the years, we've developed a strategic set of vendor relationships and use their capabilities to adjust our builds as needed. We also have wireline and wireless operation leads who work with jurisdictions around the country, local leaders and communities for our network build programs. After decades of deploying wireless networks, we're still constantly looking for ways to enhance our processes and develop more automation tools as we deploy new technologies, such as 5G.

TOPIC: WIRELESS CAPEX SPENDING

Wall Street analysts at Deutsche Bank Research have said the last time industry CapEx grew this fast was in 2013, amidst broader LTE rollouts. I believe this growth is largely attributed to exciting investments around 5G and over time, it's expected to deliver new capabilities for customers such as increased bandwidth, faster speeds and less buffering online -- from streaming entertainment, to playing games, to connecting with others. At AT&T, we invested more than $135 billion in our wireless and wireline networks between 2015 and 2019, including capital investments and acquisition of wireless spectrum and operations. Over this same period, we invested more in the United States than any other public company and we plan to continue investing in the network for our customers.

Kelly Thengvall, Assistant Vice President (AVP) of Customer Care, AT&T Consumer, leads a passionate team of over 3,000 people dedicated to improving customer experiences through back-office functions supporting Legacy Customer Care and Order Completion Management. Her ability to collaborate across the business helps the team resolve root cause customer pain points through technology, automation and process enhancements.

Since her role as an AT&T Service Representative, Kelly has dedicated herself to empathizing with customers and made meaningful contributions by simplifying operations and processes so customers are served more efficiently.

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Kevin Morgan

Chief Marketing Officer
Clearfield

CLEARFIELD

TOPIC: CLIMATE GOALS

Carriers are now taking the initiative to migrate their networks to greener architectures. These include Passive Optical Networks (PONs), collapsed networks and automated provisioning. PONs do not require powered electronics in the field, which not only reduces energy consumption, but also real estate, cooling, and maintenance costs. Clearfield® contributes to this effort by using FiberDeep® technology on our connectors that limit insertion loss to 0.2dB or less -- half the value of typical connectors on the market. FiberDeep helps optical signals travel further but use less power.

TOPIC: FIBER

The best advice I can give is make it fast, get it passed, and make it last. As an example, we doubled the number of customer turn-ups in a neighborhood fiber build by dramatically speeding up installations using Clearfield plug-and-play products. Pulling only a single cable through duct from terminal to terminal, and using FieldShield® 12-fiber pushable MPOs to cascade YOURx™-Terminals, resulted in only 6 splice points -- with 5 workers in 6 hours for 100 single family units. That's making it fast. To get it passed takes funding. The initial steps taken by the FCC to fund $9.2B to the Rural Digital Opportunity Fund (RDOF) Phase 1 broadband deployments to 5.2 million unserved and underserved locations are encouraging. Finally, as the number of fiber deployments grows, so does the need for skilled technicians who've received proper training. The limited pool of existing certified technicians and the steep learning curve for future technicians can't keep up with the demand. Plug-and-play solutions that provide quick and reliable installation of state-of-the-art fiber optic networks help shorten the learning curve and future-proof your network.

TOPIC: THE INTELLIGENT EDGE

In order to implement multi-access edge compute (MEC), you need 3 things: a secure location (both logically and physically), a reliable power source, and lots of fiber. Clearfield sees an expanded role for high-density fiber active cabinets in this scenario. While active electronic equipment cabinets are not new for carriers, satisfying the high-count fiber requirement in tight spaces for MEC will rely on fiber management experts like Clearfield. Our FiberFlex and FAC cabinet portfolios are GR-487 compliant to accommodate extreme operating environments in the outside plant -- a critical success factor for edge compute.

Kevin leads the marketing efforts for Clearfield as Chief Marketing Officer and joined the company in 2016 leveraging his extensive experience in advanced communications technology, fiber optic systems, and business product marketing. Prior to joining Clearfield, he spent two decades serving in various senior marketing positions at ADTRAN. Before that, he spent a decade at telephone operating company BellSouth, now a part of AT&T, where he worked as the lead broadband product evaluations resource in the Science & Technology department. Morgan also served in various leadership positions at the Fiber Broadband Association, and is currently Vice Chair of the Board of Directors for 2021.

@kevinmorgan520 @kevinmorgan1

For more information, please email kmorgan@seeclearfield.com.

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StreetSmart 288 Pre-Assigned Outdoor FDH Cabinet

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Jason Atwater

Director of Network Operations
CTC

TOPIC: THE INTELLIGENT EDGE

In 2020 CTC experienced the largest increase in Internet usage in our cooperative's history. Regardless of a global pandemic, our members continue to find new opportunities to utilize the service: whether it's virtual reality, IoT, telemedicine, remote work, distance learning, or business expansion. The increased demand puts a strain on networks and "instant performance" is increasingly expected from our members. Providers have an opportunity to utilize the intelligent edge to deliver extraordinary member experiences while simplifying network elements, reducing expenses, streamlining efficiencies, and improving reliability. Along with our partners, our goal is to use the Intelligent Edge to solve our members problems *before* they know they have a problem.

TOPIC: FIBER

Over the last 16 years CTC has deployed a 100% fiber-to-the-premises (FTTP) network to over 30,000 homes and businesses in Minnesota, providing our membership with the fastest, most reliable network available today. For the past 5 years CTC has also partnered with electric cooperatives, municipalities, and tribal government, to develop technology solutions and deploy FTTP services to their members. During 2021 we will continue to focus on helping our partners while growing and expanding our own fiber network.

I think there are innovative opportunities for existing networks, especially as it pertains to multi-dwelling units. Over the last 10 years we've refined the installation process for multi-tenant spaces and have found that fiber to each individual living space is a viable option -- one that could provide additional business growth. Gone are the days of using existing four conducter wire to provide DSL speeds. FTTU may be the new FTTP.

https://www.goctc.com/services/internet/fiber-optics/, https://www.goctc.com/partner/

TOPIC: VIRTUAL HEALTH CARE

This question is at the forefront of leader's minds across the country but first we need a clear understanding of who is actually served, underserved, and unserved. Today's data is not a clear respresentation of our communities. Until this problem is resolved at the federal level we will continue to have large swaths of rural America that will be ineligible for funding and lack a viable Internet option. Couple that with an aging rural population whose need for virtual health care services is increasing and finding a solution becomes even more critical. We are starting to move in the right direction but I'm afraid time will be the enemy of this process.

Jason Atwater holds the position of Director of Network Operations at CTC, a telecommunications cooperative based in Brainerd, Minnesota. He has 24 years of industry experience that includes 22 years with CTC in an operational and executive management role. Atwater graduated from Inver Hills College with a Telecommunications Degree, and from Dakota County Technical School with a Telecommunications Diploma. He has extensive knowledge and experience in network operations management, network planning, and partner relations -- all with a member-centric vision. Previous positions with CTC include Operations Manager and Product Manager.

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CTC

Tammy Perry

Director of Service Delivery, Horizon

TOPIC: SD-WAN

SD-WAN might be the trendy new solution, but it does not come without its own set of challenges for providers to solve. At the end of the day it won't replace the carrier network. Service providers will still design, engineer, build, and splice networks much like they do today. And customers will still buy Ethernet services as they are today. No matter how intelligent the SD-WAN is, it simply cannot replace underlying network quality and bandwidth capability.

TOPIC: FIBER

The easy answer here isn't very innovative: we'll build more fiber. Certainly COVID-19 pandemic remote working requirements haven't hurt the prospective take rates for a FTTH deployment. It also goes without saying that no one wants a smaller pipe. Once you've acclimated to working with a higher bandwidth, it's pretty difficult to adapt to slower speeds, so the increasing demands are no real surprise. Horizon has been, and will continue to be, a fiber optic broadband provider well into the future. Our mission, and the mission of many like us, is to deploy more fiber to more places continually. As needs increase, we will be there to meet the demand.

TOPIC: WIRELESS CAPEX SPENDING

If I had the kind of crystal ball to know if this was reasonable, I would be playing the lottery! Unfortunately I don't and I need to rely on industry analysts for guidance! It's no shock that the world is demanding more bandwidth, more reliable connectivity, and in more places. The ongoing pandemic has actually increased the demand because of the changing behaviors or working or learning remotely and telehealth needs. To meet that demand, the wireless carriers will need to continue to accelerate their investment in both radio and fiber infrastructure. Otherwise, they will fall victim to their competition's marketing! As a fiber optic broadband service provider, when these carriers need to expand their fronthaul and backhaul networks, Horizon will be there to meet that increasing demand.

Tammy Perry is a driven, obstacle-removing, change leader with a demonstrated history of turning chaos into trackable order. In her current role as the Director of Service Delivery at Horizon, she has proven inventive and motivational leadership to help drive employee and team performance to accomplish the unexpected. A dauntless, caffeinated, ENTJ, Tammy loves working outside her comfort zone and helping others to do the same. Outside of office hours she enjoys travel, camping, and entertaining family and friends.

@tammy-perry-b9a62a8

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Dave Cooper

VP, Edge Compute, CDN & Vyvx, Lumen

LUMEN®

TOPIC: THE INTELLIGENT EDGE

The Intelligent Edge opens the door to new and innovative applications that can take advantage of lower latency and performance by locating compute and storage much closer to a human or machine. This allows that human or machine to interact in enhanced or more efficient ways that may not have been possible in a more centralized cloud or datacenter. This Intelligent Edge opportunity distributes the demand for network and compute capabilities closer to the human or machine, requiring telecom providers to integrate and automate those capabilities within their metropolitan networks to provide the digital experience expected by their customers. The opportunity of the Intelligent Edge means that the coupling of network and compute will play a centralized role in a telecom providers value proposition.

TOPIC: SD-WAN

SD-WAN and the integration of Security and Policy control provides Enterprises the ability to maintain consistent and readily adaptable overlay topologies that abstract the underlying network infrastructures. This allows Enterprises to mix and match network access, core network, cloud and datacenter options based on their requirements without significant implications to their software-based topologies. For service provider networks, this means their networks must be equally flexible in their ability to be provisioned and adapted. Common-place Enterprise hub-and-spoke MPLS VPN topologies, without high-degrees of network automation and customer control, become impediments to SD-WAN deployments. The service provider must evolve these private MPLS VPN networks to be as flexible as any-to-any networks, like the Internet, so as to remain a viable option to Enterprise network infrastructures.

TOPIC: FIBER

Lumen continues an over-3-year-long program for overpulling its North America long-haul networks, placing low-loss SMF-28 fiber-optics into our expansive duct system to support the needs of Enterprises and hyperscalers. We've completed network wide builds and, in many cases, overpulling a second time over the same routes. Lumen is also investing extensively in its metropolitan networks, supporting 5G builds requiring dense fiber optic cable counts (1000+) for the expected growth in support for those programs. We believe Lumen is well positioned to satisfy the needs of Enterprises and hyperscalers with its extensive right-of-way and duct capacity, utilizing next-generation fiber optics and construction methods to meet the hyper-growth needs of our customers.

Dave has overall responsibility and general management of Lumen's Edge Compute Program. Additionally, Dave has responsibility for Lumen's Content Delivery Network and Vyvx architecture, engineering and software development. Previously, Dave served as CenturyLink's VP Global Network Architecture overseeing all network technology deployed across the company's global network.

Dave has 24 years of experience in designing, building and maintaining large-scale network and data-center architectures. He has spent the last decade leading network and software teams in progressing network automation and orchestration at scale. He has contributed to the development of numerous protocols and technologies including MPLS, Traffic-Engineering, Ethernet Pseuedowires and has numerous patents and patents pending in the areas of IP, Optical and Voice networks.

Mattias Fridström

Chief Evangelist
Telia Carrier

TOPIC: SD-WAN

SD-WAN technologies are forecasted to grow with a compounded annual growth rate of 24% over the next 5 years, which will have quite an impact on Service Providers. The massive growth of online traffic during the COVID-19 pandemic has clearly shown that the public Internet is robust enough to take loads of traffic -- and is an ideal underlay for all sorts of traffic, including an increased amount of Enterprise traffic that currently most likely sits under some sort of VPN or MPLS-based contract. The flexibility of the public Internet fits perfect with the way most Enterprises wants to run their network traffic. MPLS will still be there as a good solution for the smaller portion of traffic you want highly secure. If you're also moving storage, applications, and workload, to the cloud then you have a future-proof solution to build on. All of this will have a major impact on how Service Providers need to serve their Enterprise customers.

TOPIC: FIBER

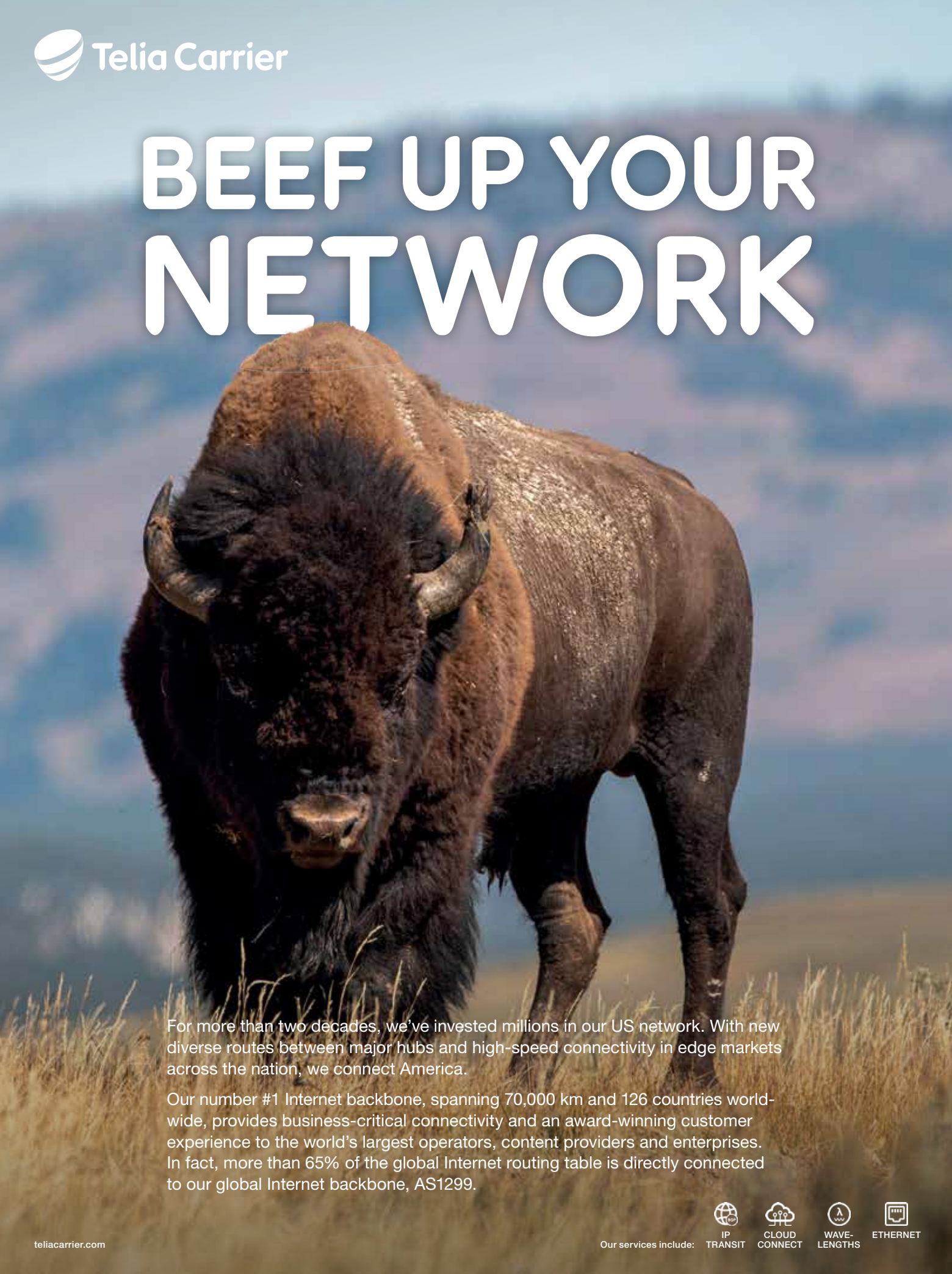
With a massive increase in traffic due to the COVID-19 pandemic, and adding 5G on top of this, it is clear that Service Providers will need more capacity and more diversity. More of this simply means more of fiber. New technologies within IPoDWDM solutions with 400G ZR implementations in dense metropolitan areas increase the need for fiber even further. While fiber in more dense areas are being built, the real issue is more in the long-distance areas across the US where the lack of fiber will become an issue in the coming years. Lack of ongoing building projects combined with the high cost of construction risks limiting the traffic growth -- an area of concern that needs to be solved.

TOPIC: THE INTELLIGENT EDGE

As a Carrier we will not build ourselves all the way to the very edge as that is more for others to build. We will still focus on picking up the traffic to bring it long-distance if needed. The main question for us is: who will actually build the real edge? Current domestic Service Providers (mobile or fixed), Local State/Regional Service Providers, hyperscalers, equipment manufacturers, or even completely new companies still not heard of? I would assume all categories mentioned have a great interest in building the edge, and this will have a huge impact on the telecom landscape.

With over 20 years in the telecommunications industry, Mattias Fridström can be considered a veteran -- but his enthusiasm hasn't faded. Mattias combines expert knowledge with anecdotes from behind the scenes and deep insight into the networked economy. Mattias holds an MSc in Electrical Engineering from the University of Wollongong, Australia. Since joining Telia in 1996, he has worked in a number of senior roles within Telia Carrier, most recently as CTO. Since July 2016 he is Telia Carrier's Chief Evangelist.

@MFridstrom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For more than two decades, we've invested millions in our US network. With new diverse routes between major hubs and high-speed connectivity in edge markets across the nation, we connect America.
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Faisal Vishram

Senior Technology Architect, Global Solutions, TELUS

TOPIC: THE INTELLIGENT EDGE

The Intelligent Edge allows telecom providers to use a perceived weakness as a key strength. Each point of presence in a community is now a strength, from a Central Office right down to an underground vault, these facilities allow for Edge computing very close to our customers. In the past, some of these facilities were viewed mostly as operational overhead. With the drive to the Intelligent Edge, our facilities create an opportunity to collaborate with hyperscalers. IoT in particular is one such area. Limited on-board computing combined with low latency requirements is a natural fit for Intelligent Edge computing over a more traditional centralized cloud solution. Telecom providers must leverage their existing assets in communities to bring the Intelligent Edge to our customers.

TOPIC: FIBER

For TELUS, building our fiber network is a generational investment. We're building as fast as possible and we have aggressive targets for connecting customers to our network. Our speed and scale have been facilitated by several key IT system enhancements during the build, one such investment has been in our network inventory systems. Using our TELUS Network Automation product, all of our teams have a consistent and accurate view of our network as it is being planned, designed, built, used, and enhanced. Before we had access to this geospatial software, these processes were siloed with manual handoffs. Do not underestimate the role systems have in unlocking the value in network investment.

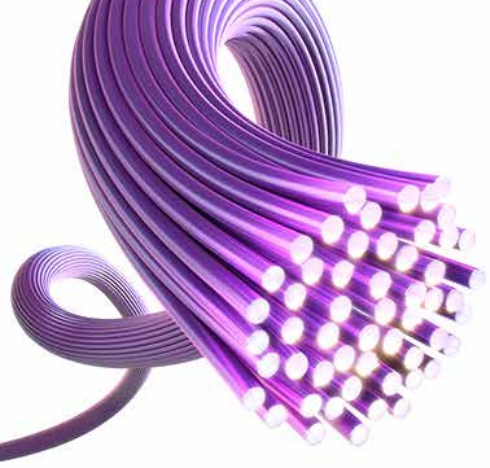
TOPIC: PLANNING, DESIGNING, AND OPERATIONS IMPROVEMENTS

5G has been an opportunity for TELUS to better integrate our wireless and wireline design teams. With our systems, roadmap and strategic investments in our TELUS Network Automation software, our RF design teams are able to plan sites collaboratively with our fibre design teams. Our proposed 5G sites are immediately visible to our fibre designers, and in some cases our system can automatically plan for fibre to feed a site. By removing that part of the complexity in our 5G design cycle, we can focus on bringing the benefits of 5G to our customers.

Faisal Vishram is a Senior Technology Architect in TELUS Global Solutions, supporting the Geospatial Information Systems (GIS) portfolio and other strategic roadmaps. As a Professional Engineer, he has 18 years of experience in end-to-end solutions design with expertise in Location Analytics, Enterprise Architecture, Digital Transformation, and Business Intelligence. He enjoys solving complex business problems, with a keen interest in new and evolving technologies.

@faisal-vishram-8b4b7b41/

Contact Vishram at Faisal.vishram@telus.com.



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[1] As ranked by OpenSignal - Global Mobile Network Experience Awards 2020

Shari Griffin

Director, Global Network Operations and Assurance (GNO&A) Program Management Office, Verizon

verizon

TOPIC: THE INTELLIGENT EDGE

We now have Verizon 5G Ultra Wideband service in parts of 67 cities where customers see download speeds up to 4Gbps. But it's SO much more than peak speeds -- our 5G will be able to support up to 1 million connected devices per square kilometer -- eventually handling 10 to 100x more connected devices per square kilometer than 4G. This will allow cities to tap into the power of 5G for things like smart streetlights, remote security monitoring, intelligent transit, and smart parking solutions.

We're building our 5G Ultra Wideband network to support breakthrough technologies for our customers. But we're not just building the network, we're supporting the entire ecosystem.

Verizon was first in the world to offer 5G network edge computing with AWS Wavelength -- providing key developer partners the ability to create, test, and deploy applications that require ultra-low latency at the edge of our 5G network. We now have 10 cities live for developers with AWS Wavelength at Verizon's 5G Edge. And we're not done yet. Verizon has committed to launching 5G Edge in 10 more cities by the end of 2021.

TOPIC: PLANNING, DESIGNING, AND OPERATIONS IMPROVEMENTS

The health and safety of our employees and customers was paramount. We implemented safety protocols that were in line with federal and state guidelines. For frontline workers who served our customers it meant rethinking the way we operate. We quickly implemented touchless retail as well as hands-free, virtual, and no-contact methods for our Fios techs.

From the start of the COVID-19 pandemic, we reiterated our commitment to our 5G network, and we raised our CapEx guidance soon after the pandemic began in part to support this. As we continued forward with our 5G build out, we couldn't achieve that goal without the support of forward-looking policymakers at the local, state, and federal levels who understand the need for policies that promote 5G while preserving the pivotal role of localities in managing public rights-of-way.

TOPIC: VIRTUAL HEALTH CARE

I believe that this answer is simple: provide affordable broadband and free tutorials on how to use the capabilities. Once the broadband challenge is cared for, we could volunteer our time and share knowledge on how to use broadband for things such as telehealth, remote learning, and just keeping in touch with loved ones.

The COVID-19 pandemic has continued to reveal the inequities that exist for the underserved and the unserved such as senior citizens. Verizon is committed to creating a digitally inclusive and equitable society through its Citizens Verizon Initiatives.

Shari Griffin is the Director of the Global Network Operations and Assurance (GNO&A) Program Management Office. She is responsible for operationalizing Strategic Initiatives, such as 5G Home and Business Internet Installations, Intelligent Edge Network, MEC, and Satellite Backhaul, by identifying, developing and deploying efficient and sustainable processes and strategies for the GNO&A field teams. Shari joined Bell Atlantic in 1999 as an IOF Engineer. Shari holds a BS in Electrical Engineering from Binghamton University and an MS in Telecommunications Management from Stevens Institute of Technology.

in @shari-g-1854413

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Genia Wilbourn
Senior Vice President,
Verizon Global Network
Operations & Assurance

Dr. Sameh Yamany

Chief Technology Officer, VIAVI Solutions

VIAVI Solutions

TOPIC: THE INTELLIGENT EDGE

5G, next-generation telecom, and hyperscale networks, are essential elements enabling The AI Era Revolution, which is about connected things enabling new verticals and full automation via machine learning and artificial intelligence. 5G is designed and architected to enable this revolution, in particular use cases requiring Ultra-Reliable Low Latency Communications -- think connected cars.

Essential intelligence to react and enable new real-time services will move to the network edge, hence Intelligent Edge, which can be leveraged by telecom providers to offer cloud computing capabilities in close proximity to end users. Computing resources then can be used to process user data close to its source, rather than distant, centralized data-processing warehouses that form the traditional cloud environment. When data is processed near its source, the transmission latency can be reduced, as can the volume of data that must be hauled across the transport network to the cloud -- resulting in satisfied customers and optimized networks.

TOPIC: PLANNING, DESIGNING, AND OPERATIONS IMPROVEMENTS

Critical to 5G delivery is programmability that allows dynamic resource assignment to corresponding tasks at any point in time and across the end-to-end network. To deliver both the incremental capabilities of 5G network programmability -- compared to legacy networks -- and to enable relevant cost savings, operators need the ability to disconnect peak and average utilization in terms of service delivery cost. They will be challenged to deliver service at peak utilization with the desired QoS. As usage scales down to a much lower level, the correlating resources assigned must scale back to align costs with traffic.

Operators also must meet a range of challenging, potentially contradictory, use cases on the same network with extraordinarily diverse characteristics in terms of data rates, latency, reliability, and number of connected devices. Autonomic monitoring, self-regulation, and intelligent adaptability -- all are potential solutions, with artificial intelligence and machine learning as their cornerstones.

TOPIC: FIBER

Fiber technologies that enable 5G introduce a number of new challenges and testing considerations as they are layered into legacy networks. (See www.viavisolutions.com/en-us/5g) Finding the right expertise, management solutions, and tools is key to successfully scale evolving fiber networks. In 2021, VIAVI will work closely with industry leaders to enhance our portfolio of automated test solutions that help:

- Service providers launch, maintain, and monetize, networks with ease.
- Contractors close out jobs and settle payment quickly.
- NEMs achieve acceptance the first time.

Dr. Sameh Yamany leads technology vision and is responsible for applied research programs, industry thought leadership, and advanced technology incubations at VIAVI. He previously held executive roles at Trendium and Techtronix. Dr. Yamany holds a Doctorate in computer science and engineering, a Master of Science, and a Bachelor of Science in systems and biomedical engineering. He has authored patents and contributed to numerous scientific journals, conference and industry-related publications, and book chapters on 5G, artificial intelligence, telecommunications, systems, and biomedical engineering.

@yamany

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CTC

CTC is a technology advisor and full-service telecommunications cooperative based in Brainerd, Minn. Formed in 1952, CTC has grown into a complete communications provider offering high-speed Internet, digital television, phone, and IT services to businesses and residents throughout central and northern Minnesota.

As an advisor, CTC also partners with electric cooperatives, municipalities, and communities throughout the nation to bring in-demand services to rural homes and businesses. By assisting with system infrastructure, offering technical expertise, or securing funding for broadband, CTC helps organizations and entire towns build and maintain state-of-the-art fiber and wireless networks. Follow CTC on Twitter @twitter.com/ConnectCTC. You can also follow CTC on Facebook, LinkedIn, and Instagram.

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HORIZON

Horizon is a facilities-based, fiber optic broadband service provider based in Ohio, with expanding services across the Midwest. We provide high-quality connectivity solutions for small to large enterprise and wholesale carrier customers, where high-reliability and high availability are critical.

Horizon owns and operates over 4,500 route miles of fiber along with over-the-top services that are backed by local leadership, sales, customer care, and network operations. We offer robust and extensive connectivity solutions such as high-speed Ethernet, DIA and cloud-based Hosted Voice, along with dark fiber and wavelength services and connectivity into data centers across the Midwest.

With a drive for innovation and growth, Horizon has built up a state-of-the-art fiber infrastructure, all while maintaining the long-standing reputation for putting customer service first with unmatched responsiveness and care. At Horizon, we make business personal. Follow Horizon on Facebook, LinkedIn, and Twitter.

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LUMEN

Lumen is guided by our belief that humanity is at its best when technology advances the way we live and work. With approximately 450,000 route fiber miles and serving customers in more than 60 countries, we deliver the fastest, most secure platform for applications and data to help businesses, government and communities deliver amazing experiences.

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Our mission is to provide exceptional network infrastructure and services -- empowering individuals, businesses and societies to execute their most critical activities. By working closely with our customers, we make big ideas happen at the speed of fiber. Follow Telia Carrier on LinkedIn and Twitter @teliacarrier.

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VERIZON

Verizon Communications Inc. was formed on June 30, 2000 and is celebrating its 21st year as one of the world's leading providers of technology, communications, information and entertainment products and services. Headquartered in New York City and with a presence around the world, Verizon generated revenues of $128.3 billion in 2020. The company offers voice, data and video services and solutions on its award winning networks and platforms, delivering on customers' demand for mobility, reliable network connectivity, security and control.

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VIAVI SOLUTIONS

VIAVI Solutions is a global provider of network test, monitoring and assurance solutions for communications service providers, enterprises, network equipment manufacturers, government, and avionics. We help customers harness the power of instruments, automation, intelligence and virtualization to Command the network.

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Mega TITAN (above)
NEO Indoor UPS (right)

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If you pose this question to any plant manager or field technician, both ease of installation and product quality generally tends to be near the top of their list. Why? They are busy.

It is imperative to finish the job quickly and move on to the next, without having to return for any follow-up repairs.

Cutting down the duration of time technicians spend on site and reducing the amount of future truck rolls is a measurable goal for any telco operation. The implementation of quality, longer life UPS equipment that is both easy to install and improves network resiliency are all viable ways to achieve that goal.

During the design and build phase, the network designers should consider the overall long-term costs once the system is deployed. When reviewing costs, it is tempting to eliminate UPS units from the network design or choose a cheap one.

However, this will inevitably lead to increased truck rolls and time on site. Making the "cheap" solution turn into the "cost a fortune" solution in the long run.

In past years, a 30-minute disruption in service may have been acceptable. But in today's world, making compromises on the equipment powering your network has the potential of affecting your customer's livelihood. Thus, the utilization of reliable, easy to install back-up power equipment to the residence or business is equally important.

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AUTONOMOUS NETWORKS ON STEROIDS

Why Industry 4.0 Can't Survive Without Them

By Liliane Offredo-Zreik

Network automation is not new, but the level of automation (full automation) is now possible in the telecom infrastructure and is a major enabler of Industry 4.0.

Sure, digital transformation has been a major trend across most industries over the past few years. Companies and organizations of all sizes and across many industries have initiated major moves toward automation, the adoption of data as driver for processes and business models, the use of distributed computing, IoT, and other technologies. At the same time, they have started rethinking their organizations to align them around a digitally enabled infrastructure.

Despite their best efforts, the response has been uneven and for the most part suboptimal, because the tools that these businesses have are inadequate. For example, operators have increased capacity in the Last Mile by sending technicians to add physical network components, and often had to supplement these systems with additional hardware racks in their central operating locations. Although this met the short-term need, it is expensive and totally nonelastic. If utilization decreases in the future, the added capacity will be underused, resulting in stranded capital.

Companies in all industries need much better digitally enabled business models and are now rushing to define and implement those business models at an astonishing rate. A recent survey by the World Economic Forum found that 80% of companies intend to digitize their processes; a study by the *Economist* highlights the type of technologies firms will be implementing. (See Figure 1.)

The rate of transformation is also unprecedented. A recent study by McKinsey, for example, showed that "increasing the use of advanced technologies in business decision-making" takes 25.4 days, compared to the 635 days it takes in normal times.(2)

CSPs have been delivering the technologies and associated services to enable the transformation to digitization.(2)

- Scalable cloud infrastructures
- Edge compute resources
- IoT
- Blockchain
- Automated networks
- Real-time visibility

However, to realize the full promise of Industry 4.0, a communication infrastructure must provide the underlying framework for these technologies; this framework is Autonomous Networks.

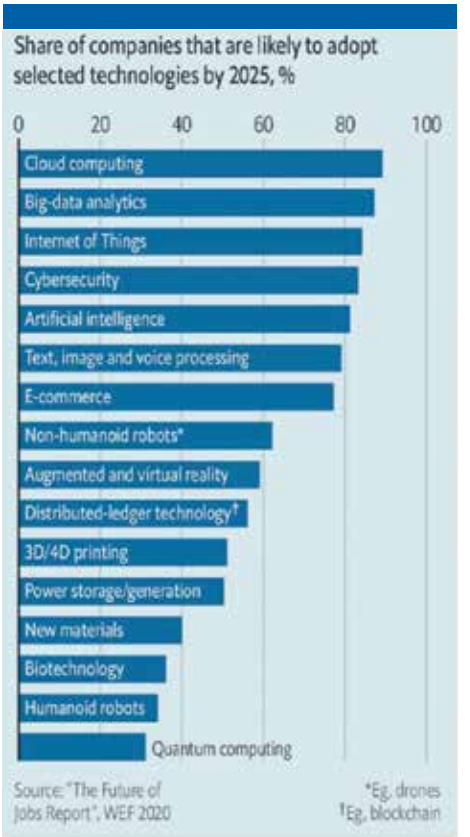

Figure 1. Adoption of Digital Technologies (1)

What's Needed

As they accelerate their digital transformation, companies in all industries will demand new services and capabilities from their suppliers and vendors. At the forefront are the service providers that deliver the underlying connectivity, hosting, and compute infrastructures, that will provide the underlying infrastructure inherent to the digital firm. Cloud and edge computing, the secure and fast transport and processing of big data, IoT enablement, the delivery of Virtual Reality and Augmented Reality capabilities, cybersecurity, blockchain, and others, are some of the capabilities the service providers need to deliver at scale, with high reliability, velocity, elasticity, and flexibility, in the near future. (See Figure 2.)

Delivering these capabilities and others will not be possible with manual, siloed infrastructure. Although

it is true that CSPs have started implementing software-based infrastructures, and many have introduced automation capabilities across their networks and operating environments, the scale and complexity of what Industry 4.0 will require far exceeds the capabilities of most, if not all, CSPs today. (See Figure 3.) A new framework is required: this framework relies on pervasive intelligence and automation; it demands a communication and an operating infrastructure that is a fully automated network that is self-healing, self-managing, and fully reliable.

Network automation is not a new concept, and most operators have already implemented some level of automation in their networks and operating environments. However, the level of automation currently in place is inadequate for the requirements of the market going forward. It is increasingly obvious that the market needs a much more comprehensive and pervasive level of automation in network infrastructure powered by intelligence implementation. The new level of automation must handle closed-loops as well as the capability to support full-cycle automation, enabled by AI This level is referred to as *Autonomous Networks (AN)*.

ANs are becoming an essential goal for every CSP, and will be table stakes for success in a fast-transforming market as they become the bedrock of digital industries. Today, operators are in a better position to move toward AN:

- Market forces are making AN essential, and the pace of change is creating business opportunities for CSPs to grow revenue by offering end-to-end services across verticals.

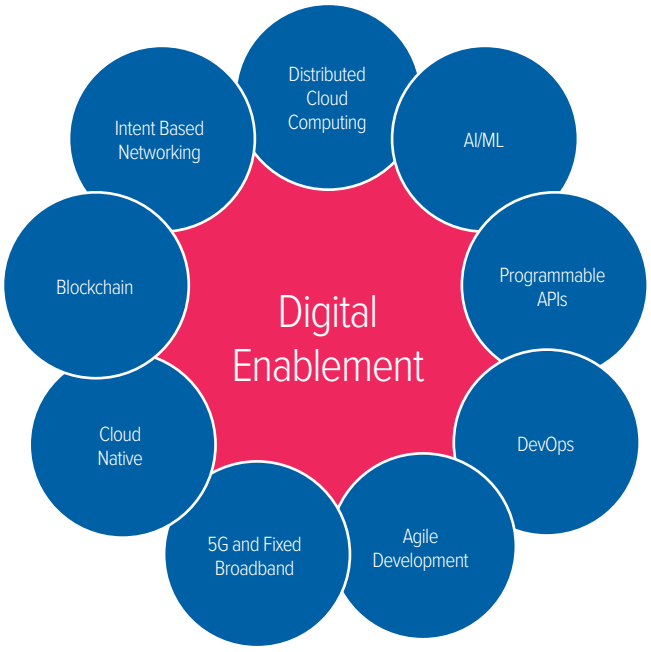

Figure 2. CSP Digital Enablement

- Many of the impediments to achieve AN are being mitigated by advances in technology.(3)

Although each vertical has its own ecosystems, operating goals and KPIs, applications, and customer needs, an underpinning requirement is the gathering and storage of data, the reliable movement of that data, high speeds over a versatile communication infrastructure, and the ability to dynamically adapt to changes in the business environment.

Achieving the promise of Industry 4.0 requires a complete transformation of the enterprise toward a digital operating model where employees design and oversee a software-automated, algorithm-driven digital organization that actually delivers the goods.(4) At the heart of this enterprise is an AI factory that provides the underlying capability for data gathering, analytics, and decision-making. This organization is modular or composable; it requires a new communication infrastructure that enables modularity, flexibility, scalability, and velocity.

ACG Research has recently defined the concept of *Intelligent Composable Fabric,* which contains operations, information, and communications technology modules that flexibly compose the intelligent digital operations platform of an enterprise.(5) (See Figure 4.) This fabric requires a communication infrastructure that is zero wait, zero touch, and zero trouble (Zero X). Such an infrastructure can be delivered only by autonomous networks.

Although there are multiple levels of automation, the truly digital enterprise is realized only at the maximum level of automation or full automation where the system possesses closed-loop automation capabilities across multiple services, multiple domains, and the entire life cycle. Only in this case can Zero X be realized.

At the heart of autonomous networks are autonomous domains that form the basis for closed-loop automation. They expose

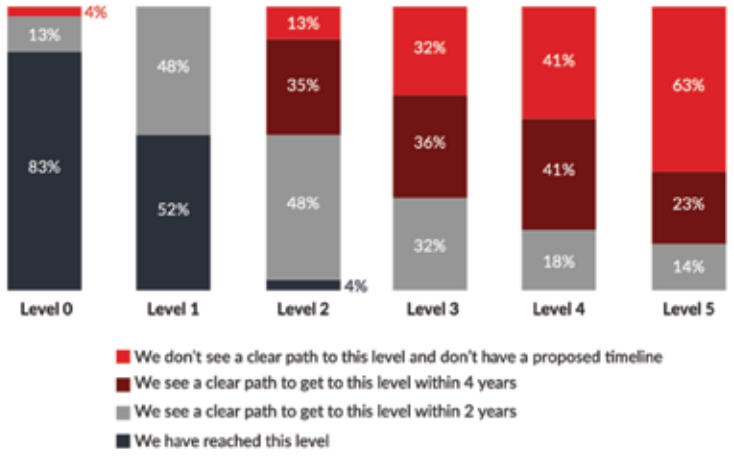

Figure 3. CSPs' Progress on Automation (Source: TM Forum 2020)

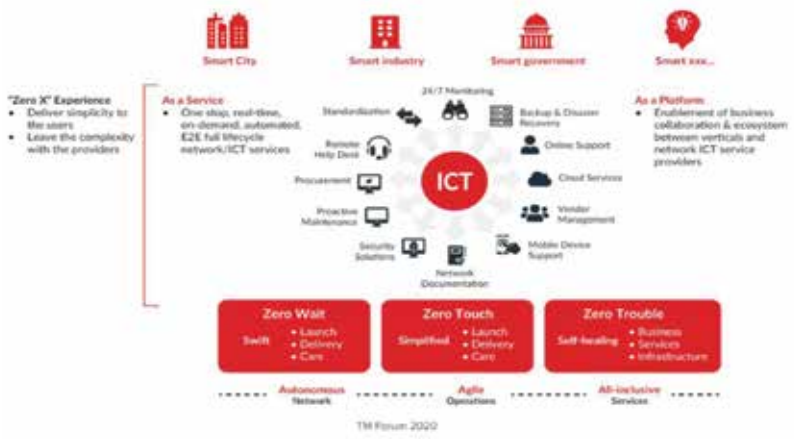

Figure 4. Vision of Autonomous Networks (Source: TM Forum, 2020)

network capabilities that can be used by the enterprise without exposing the complexity, enabling the enterprise to define business rules and to use the capabilities as needed and when needed by the business on a modular level. These capabilities are self-assuring, providing maximum reliability to the business.

As AI becomes the run time of the digital enterprise of the future, the firm will be rearchitected to leverage the power of data, networks, and AI. This is possible only when the underlying network infrastructure delivers the resiliency, scalability, and automation, that is enabled by autonomous networks.

The Promise Realized

The COVID-19 pandemic ushered a digital acceleration on an unprecedented scale and scope. Although some of the changes were short-term-focused, meant to blunt the impact of the pandemic, the crisis has caused leaders in every industry to rethink their business models, with digital enablement front and center to their strategies.

Digital enablement is the foundation of this transformation, and this foundation has to be powered by a network that is autonomous, ultra-fast, extremely reliable, flexible, and highly scalable. That autonomous network is the only route to achieve this transformation because it enables the diversity, agility, dynamic scalability, and security requirements, of Industry 4.0.

Now is the time for the autonomous network, which is not simply the next thing -- it is essential to enabling the world to deal with shocks, to deliver the dynamism that will be needed in every industry going forward.

The business conditions are ripe, but the technology has also evolved to a point where this premise is now possible and, indeed, realizable. Innovative CSP vendors are already introducing AN solutions, and CSPs are beginning to draw plans with their vendors and partners to evolve their technology and business models to make autonomous networks a market reality. ■

References and Notes available on www.isemag.com.

This article is adapted from an ACG Research white paper; it can be found at https://acgcc.com/reports/autonomous-networks-power-industry-40/.

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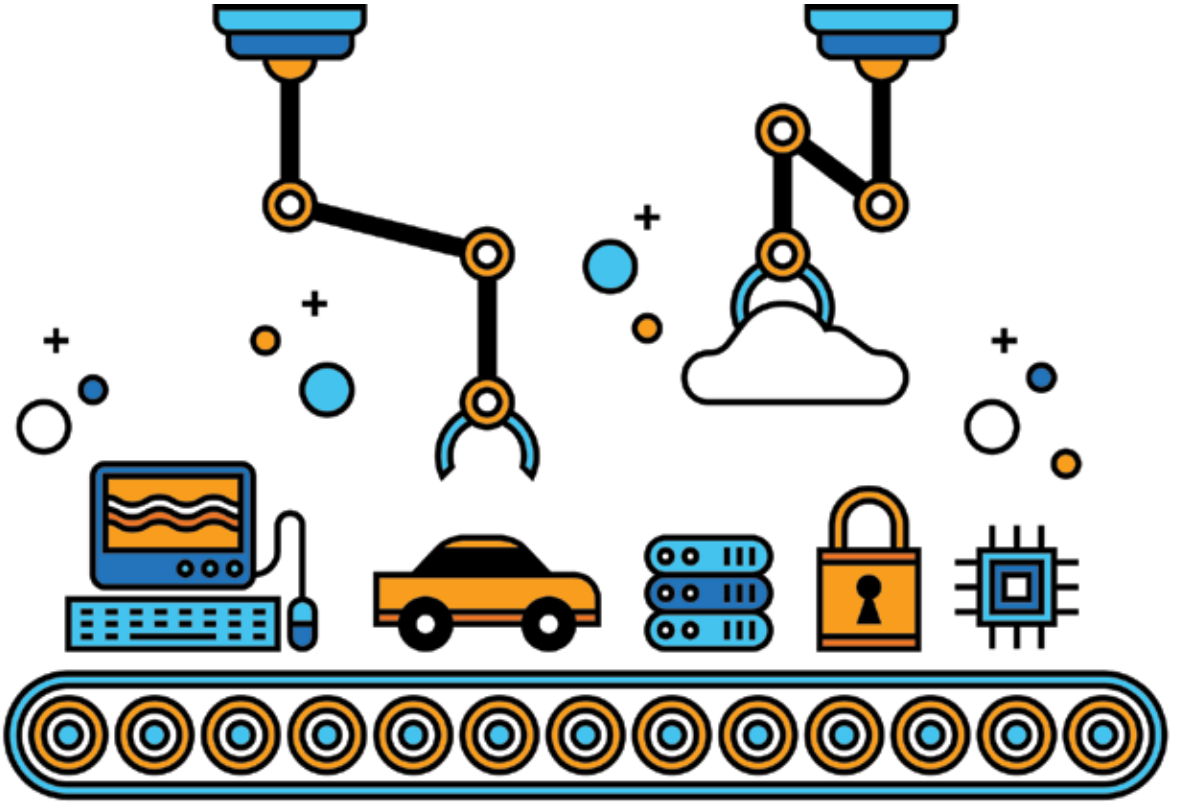
LIVING ON THE BLEEDING EDGE

IT Leaders Share Their Pain Points

By Shaun Andrews

Data is the currency of the 4th Industrial Revolution, just as steam, electricity, and silicon chips, were for the prior industrial revolutions. This requirement means service providers need to walk a mile in their customers' shoes and respond to their needs with concrete infrastructure changes.

Toward that end, a recent report, *Global Trend Report: How the 4th Industrial Revolution is Changing IT, Business and the World,* explored global IT decision-makers pain points on behalf of Lumen. The data showed that **91% of IT decision-makers surveyed in the US** believe a business' ability to quickly acquire, analyze, and act, on data is a key factor in determining if they will be technology leaders in the future.



While these leaders know that next-generation applications are vital to business success, they also believe their current infrastructures aren't ready to harness the power of the 4th Industrial Revolution. **Nearly 3 in 4** say current IT infrastructures are not prepared to support coming increases in users, data volumes, and application performance requirements.

Interestingly, while many spent the last several years moving to the cloud, most global IT decision-makers agree that the cloud is not sufficient; **4 in 5** say that a centralized cloud model cannot support their workload demands. Why? Because their applications require high-bandwidth and ultra-low-latency network performance, and there is a need to move critical applications, workloads, and data, closer to where they are processed.

"There's the relationship between the edge and 5G. While many people think of 5G when they think of "the edge," nearly 3 in 4 global IT decision-makers agree that 5G needs edge compute more than edge compute needs 5G."

What does that mean in terms of network infrastructure evolution for network providers? Fiber. In fact, **9 in 10 global C-suite leaders** believe that fiber infrastructure is essential to connect to a distributed cloud network.

What's more, they want to bring their applications and data closer with edge compute because the applications require high bandwidth to support massive volumes of data together with ultra-low latency to support near real-time response to market challenges and opportunities. In a distributed environment, edge compute brings critical applications and data closer to where they are processed. The vast majority of global IT decision-makers say that edge compute is vital to their future. In fact, **more than 90%** anticipate implementing edge compute services to keep pace with the expansion of the Internet of Things (IoT) in the coming years.

These factors make edge compute seem like an obvious choice for many workloads. So why are many enterprise IT infrastructures still focused so heavily on-premises and/or in a centralized cloud? Market availability appears to be the only thing holding edge compute back: **90%** of global IT decision-makers say they would move their organization's applications from on-premises to edge compute if it was available today.

Then, there's the relationship between the edge and 5G. While many people think of 5G when they think of "the edge," nearly **3 in 4** global IT decision-makers agree that 5G needs edge compute more than edge compute needs 5G.

Edge compute is the secret weapon enabling 5G according to **82%** of global IT decision-makers. They say 5G needs edge compute to deliver the performance and experience necessary for their business to succeed.

However, not all global IT decision-makers are excited about 5G. **Nearly 30% of global** IT decision-makers and 33% of US IT decision-makers say they are skeptical about their company using 5G networks.

Security and Edge Compute

When combined with the increasing complexities of business IT environments using emerging applications and technologies, traditional perimeter-based security approaches have become obso-

"60% of global IT leaders require a latency of <10ms for their apps."

lete. **81**% of global IT decision-makers and **85**% in the US say perimeter-based security is no longer sufficient for their business.

This can be daunting, especially when you're preparing for the 4th Industrial Revolution: **68**% **of C-suite leaders globally** say that's what keeps them up at night.

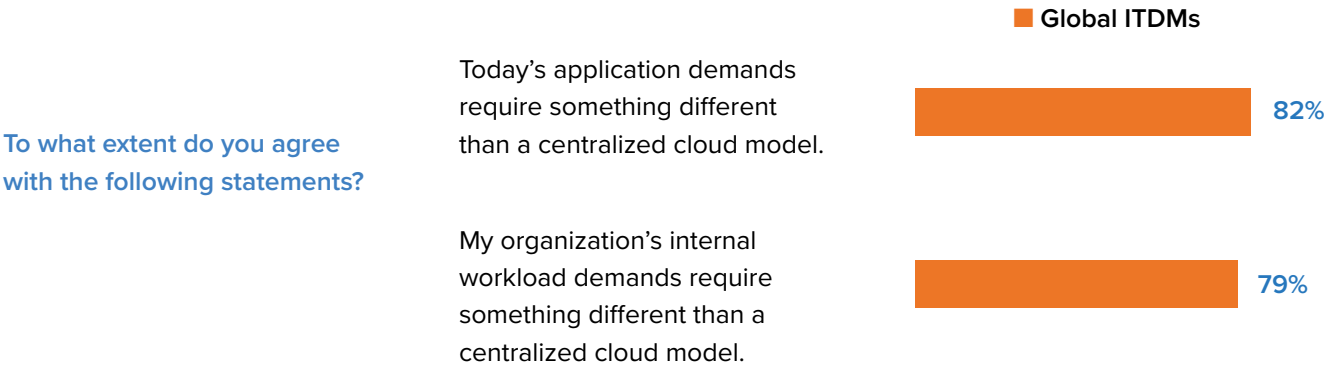
In addition, global IT decision-makers expect data security and connectivity will become more critical as a result of the current global pandemic: **3 in 5** say security will become much more important in the wake of COVID-19, and **more than half** say that about data connectivity, as well.

That's why network orchestration is so important. It ties applications together with other applications, with the data being moved and with the compute, storage, and network infrastructure underneath. Orchestration technology is evolving rapidly to use APIs to connect applications and data with network services. Software-defined networking (SDN) enables the orchestration layer to issue calls to the network, turning up new connections on the fly to wherever data needs to go, and then turning the connection back down again once that data gets there. That helps save money, makes the process work more efficiently, and enables greater flexibility.

The goal of the network is to connect to the needs of applications and workloads without manual intervention. And not surprisingly, **9 in 10** global IT decision-makers say that the seamless integration of applications and their network is a top priority.

All of these facts support one very clear point: **Edge Compute is no longer an option -- it is a necessity for businesses to thrive in the 4th Industrial Revolution.** That translates into one critical finding for network service providers in the future: **only those who transform their networks to meet their customers' needs will secure their loyalty and their future business.** ■

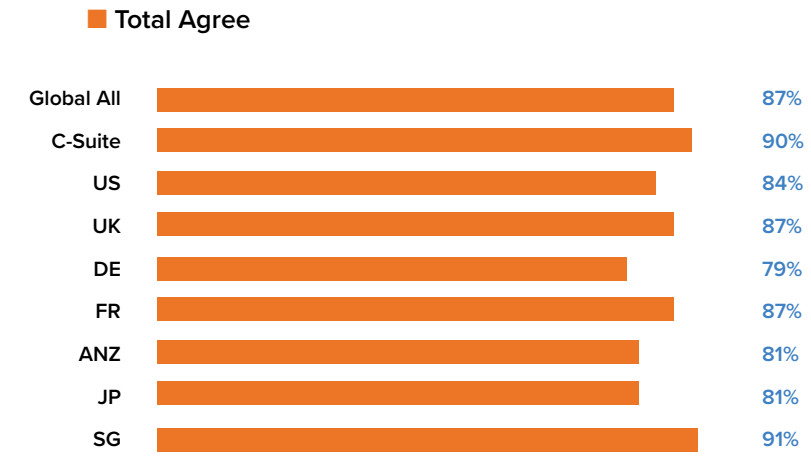
4 in 5 global ITDMs say that a centralized cloud model cannot support their current workload or application demands.



9 in 10 global IT C-Suite say fiber infrastructure is essential to connect to a distributed cloud network.

To what extent do you agree or disagree with the following statement?

Fiber infrastructure is essential to connect to a distributed cloud network.



References and Notes

This article is adapted from the Lumen white paper Global Trend Report: How the 4th Industrial Revolution is Changing IT, Business and the World. This report is based on a Quadrant Strategies online quantitative survey with 2,464 Senior IT Decision-Makers and C-suite executives from large and midsize organizations in the US, UK, Germany, France, Australia, Argentina, Colombia, Brazil, Singapore. and Japan. To download this white paper, visit https://assets.centurylink.com/is/content/centurylink/global-trend-report-4th-industrial-revolution-4IR.

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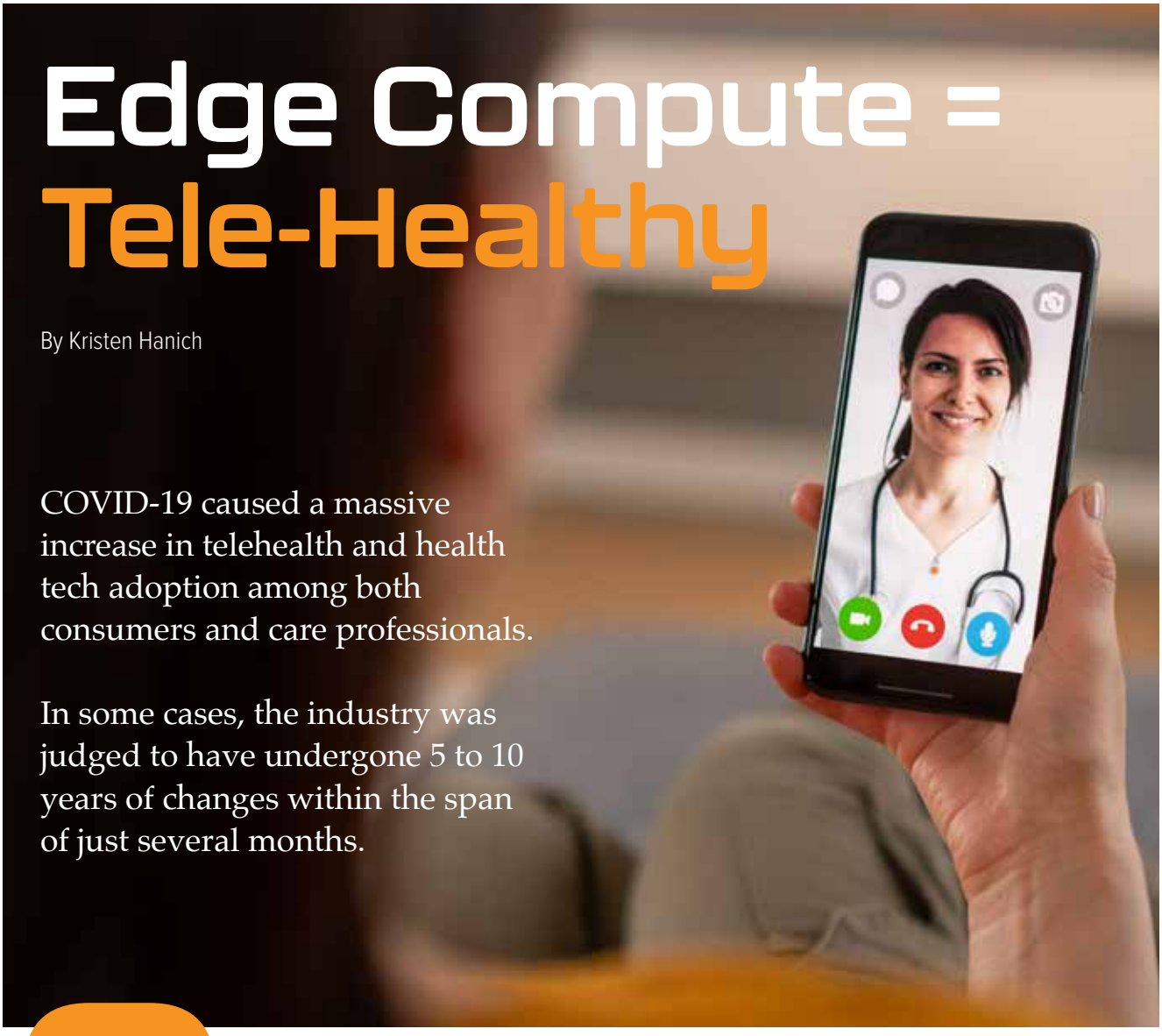
Edge Compute = Tele-Healthy

By Kristen Hanich



COVID-19 caused a massive increase in telehealth and health tech adoption among both consumers and care professionals.

In some cases, the industry was judged to have undergone 5 to 10 years of changes within the span of just several months.

Connectivity is necessary in order to gather data from devices both in patients' homes and in healthcare settings. However, it is not enough to simply receive the data -- the value of data lies in its interpretation and use. Thankfully, network evolutions in computing and connectivity are driving new developments in the health IoT space. The key is to unlock the value of health device data via the use of edge computing, machine learning, and health flexible IoT platforms.

Health Technology on the Rise

- **A Parks Associates consumer survey captured a nearly three-fold increase in remote visits with a healthcare practitioner.** These consumers reported positive experiences and high levels of satisfaction. Interestingly, consumers ages 65 and older had higher satisfaction than younger people.
- **What's more, many connected health device owners are particularly interested in sharing data from their connected health devices with telehealth services.** Currently, 64% of connected health device owners report that services that allow them to share device data are "appealing" (rating 5-7 on a 7-point scale), vs. 43% of non-owners.
- **Consumers also report high intentions to purchase connected health products.** As of May 2020, 29% of heads of US broad-

band households were very likely to purchase at least 1 type of connected health product in the next 12 months, with 25% interested in medical devices and 17% interested in wearables.

On the care professional side; telehealth vendors, telehealth specialists, and care providers saw huge utilization boosts during the beginning of the COVID-19 crisis. Two examples below illustrate this compelling trend:

- **Amwell, a leading telehealth platform,** reported a 1,000% increase in virtual visits due to COVID-19, with even higher increases in certain locations.
- **Northwell Health, a NYC-based hospital system,** reported a 900% increase in its ambulatory telehealth visits within just the first six weeks of the COVID-19 crisis in New York.

A Flawed Model -- and an Emerging Solution

Although many virtual platforms offer greater operational efficiencies than in-person visits and in certain circumstances result in improved patient outcomes, many virtual care solutions also have substantive weaknesses that make them unsuitable as a core means of seeking or providing care. Some solutions are remote visit only and lack the means to gather important vital sign and clinical testing data. This significantly limits the use cases of telehealth -- limiting the ability to use virtual solutions for tracking chronic conditions, for monitoring those patients who are at an elevated risk of complications due to a disease state, those who are pre- or post-surgery, and others who may benefit from tracking data.

The solution to this problem is to layer in remote patient monitoring platforms in order to collect vital sign and biometric data from connected health devices. However, while these platforms exist and are highly in demand by care professionals, many existing programs have not yet been scaled to the same extent as remote visit solutions. A number additionally suffer from user experience flaws, causing user error and frustration with regards to pairing devices and taking accurate measurements.

High levels of consumer demand for connected health devices point to a growing interest in health data and actionable insights among consumers as well. Consumers want to be able to access this data and share it with their care providers. This stands to substantially boost the remote patient monitoring model.

Edge Computing: A Healthy Option

The COVID-19 pandemic has accelerated change and evolution in the healthcare industry. It has taught us that there is a need for health IoT for both in-patient and outpatient settings, and also among consumers. Next-gen approaches to health IoT should collect health data, integrate with robust platforms and services, and provide intelligent feedback and interpretation in order to support clinical decision-making.

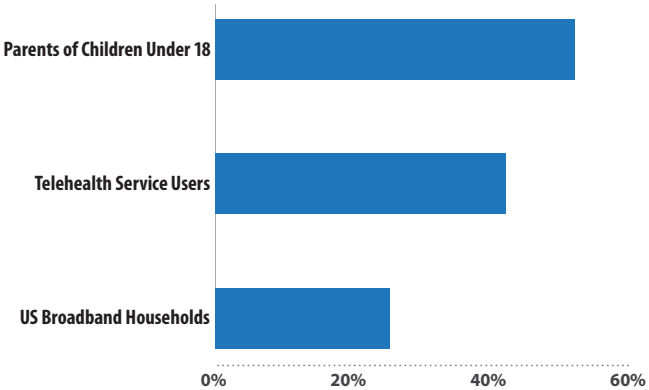
New approaches to edge computing -- called the "agile edge" -- make the most of software-defined computing models, offering increased performance and reliability as compared to traditional on-premise or even cloud computing, incorporating flexible device firmware capable of being updated with new functionality and security enhancements, and allowing connected health devices to holistically work together in various scalable solutions. This promises to unlock the value of health data, as well as substantially boost care outcomes and lower care provider fatigue.

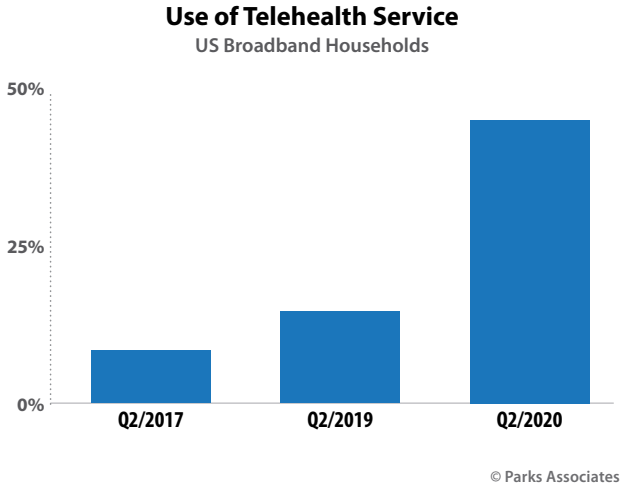
Three examples illustrate the use cases for edge computing, machine learning, and Artificial Intelligence (AI) in health IoT.

1. Smart Alarm/Dashboards for Monitoring

Edge computing is capable of combining and interpreting data from multiple devices locally, leading to greater speed and intelligence. One use-case example is that of smart alarms for in-patient monitoring. Using edge computing, a smarter alarm system can be created, combining data from different monitors (e.g., verifying patient heart rate across both monitors before sounding an alarm).

High Intent to Purchase Connected Medical Products





This allows the system to avoid the false alarms that fatigue healthcare workers.

2. Comparing Trajectory of COVID-19 Patient to Others in At-Home Setting

AI can be used to help monitor COVID-19 patients in the comfort and safety of their own homes. Devices in the home send data to remote monitoring platforms, allowing physicians to track the health of their patients. AI, paired with a rich dataset, allows physicians to identify patient trajectories and to compare a patient's trends to others with similar trajectories. This has been used to save the lives of patients with COVID-19, identifying when patients -- who may otherwise feel well enough to not realize they need help -- are at risk of death and require hospitalization. This type of functionality may also be applied to the field of chronic disease monitoring as well as post-surgical recovery, among others.

3. Virtual Assistants for In-Home Care

By combining edge computing and AI, intelligent whole-home solutions may be enabled for remote patient monitoring or even eldercare. Sensor suites monitoring daily activities such as taking medication, or health metrics such as blood sugar, temperature, weight, pulse oxygen, lung capacity, and blood pressure, may be combined with smart displays featuring virtual assistants.

- **The virtual assistant may encourage patients or seniors to follow through** on medications, monitor their vital signs, perform rehabilitation exercises or mental health routines, or conduct video consultations with their care providers.
- **The addition of depth cameras allow the solution** to postural stability and gait, evaluating if seniors are at risk of falls.

Edge computing allows healthcare organizations to improve their internal operations and to better diagnose and support their patients. These solutions support various types of in-home monitoring and diagnostic devices, applications, and platforms, across a single common platform that solves many of the headaches of earlier technology.

Agile edge computing brings the power of cloud-native development home, enabled by advances in computing and connectivity, building scalable platforms that can both extend and augment provider capabilities -- now and in the future. ■

References and Notes available on www.isemag.com.

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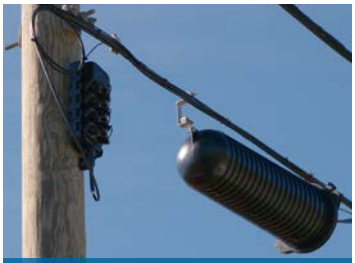

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GETTING TO THE NEXT G

By Chris Pearson

As the ICT industry evolves from 5G to Next G, there are many exciting use cases on the horizon. (See Figure 4-4.) While each is subject to change as the industry and consumers' future needs are better understood, the possibilities are impressive. Just a few of them include:

1. Holographic Communications

Holography is a method of producing a 3D image of a physical object by recording, on a light-sensitive medium (e.g., photographic plate), the pattern of interference formed by a split laser beam where one of the beam paths interacts with the 3D object in question. The resulting interference pattern contains the complete optical amplitude (intensity), phase (depth) and wavelength (color) information that characterize a visual representation of any 3D object formed by the human brain. When the interference pattern is illuminated either with a laser or with ordinary light, the optical amplitude and phase information of the original object is regenerated, and the human brain perceives a realistic 3D picture of the original object.

Studies based on human perception of 2D images and conventional 3D videos that use binocular parallax technology to create 3D effect and holograms reveal that a holographic display comes closest to satisfying all visual cues for human visual observation of any 3D object. In other words, for humans, true holograms are the best substitutes for natural sight.

In the next decade, network advancements are expected to enable fully immersive user experiences

Figure 4-4. Provided by Ericsson from 6G Symposium, October 2020. Used with Permission.

virtually. A key component of the immersive nature of user experience is the transmission of 3D holographic images from one/multiple sources to one/multiple endpoints in an interactive manner. There are a variety of user-device-oriented technologies, such as the adoption of lenslet light-field 3D through the naked-eye, or AR/VR via head-mounted display (HMD) devices. However, fully immersive, and interactive 3D holographic imaging/streaming, will be a challenge even for future networks.

2. Tactile/Haptic Communications

The Tactile Internet can be considered as the next evolution of the Internet of Things (IoT). The Tactile Internet encompasses human-to-machine and machine-to-machine interaction, enabling a variety of real-time interactive and control systems applicable to industrial, societal, and business use cases. It adds a new dimension to human-to-machine interaction by enabling transmission of human touch and haptic sensations. This enables humans and machines to interact with their environment, while on the move and within a certain physical range over which communication takes place.

Robotic surgery is one example of the Tactile Internet. At one end is the human system interface, which is a master console where the surgeon gets a real-time audio-visual-haptic feed of the patient and operating room. Additional data feeds such as patient diagnostics and reactions are provided in real time. The visual feed is provided using real-time holographic streaming technology (mentioned above) with adjustments based on whether the surgeon is wearing a head-mounted display device or interacting with a hologram. As the surgeon proceeds with the operation the haptic-enabled robots (Human System Interface) at the patient-end mimics the surgeon's actions with high reliability, fidelity, and minimum latency. Real-time feedback (audio/visual/haptic/patient diagnostic) from the patient side is transmitted back to the surgeon throughout the surgery process.

The Tactile Internet use cases generally comprise real-time interactions that require the network to have very low end-to-end latency and guaranteed high bandwidth support. True interactive control in the Tactile Internet requires stringent synchronization between various data feeds. These network requirements will be explored in a later section.

3. Ubiquitous Services (Land, Air, Space, Sea)

This use case provides seamless service coverage nearly everywhere: all terrestrial, marine, air, and space-based locations. A seamlessly integrated connectivity framework consisting of land, sea, air, and space-based nodes would be a significant step forward compared to today's fragmented scenario.

A simple but powerful example is the ability to extend real-time emergency visibility and response to every remote corner of the world that until now were entirely cut-off from current emergency response infrastructure.

4. Medical/Health Vertical

A transformative healthcare experience in the 21st Century will need the confluence of multiple innovations spanning across all aspects of the healthcare industry. In addition, for telemedicine, especially for remote telesurgery performed by either human and/or robots, the underlying data transport must satisfy stringent and demanding requirements for reliability, fault tolerance, bandwidth, latency, jitter, and embedded AI. While 5G could meet some of these requirements, Next G is expected to be the first communication infrastructure capable of handling full spectrum healthcare needs of the 21st Century.

5. Government / National Security

Mobile networks are also becoming part of a critical national security strategy where governments see a need for advanced communication technologies and ubiquitous connectivity to operate with speed, precision, and efficiency.

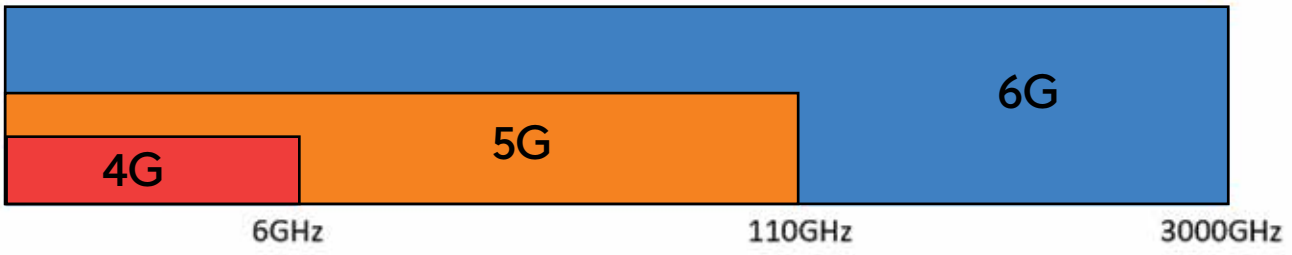

Figure 5-2. Spectrum Usage by Wireless Cellular Generation

National security requirements for future networks call for ubiquitous high-speed connectivity for moving massive amounts of data in dense networks and for low-latency communications to enable new generations of unmanned and autonomous systems, both in the air and on the ground.

Effective and survivable future networks must operate in contested environments with constant threats and counter with new capabilities. Spectrum-sensing systems will classify signals to detect denial-of-service attacks, and self-organizing radio access networks will dynamically use the spectrum to continue operations unimpeded. Future networks must counter attacks on data traffic, and control elements with national security-specific enhancements not found in commercial networks today, including robust network protocols and air interfaces with low-probability of intercept and detection.

Technology Enablers

The key is HOW to evolve the networks to meet the high-performance network needs of these use cases. Thankfully, many technology enablers exist today, and new ones are being developed to help fulfill the vision of Next G and beyond. Four (4) of these are briefly described below:

1. Artificial Intelligence (A.I.) at the Network Edge

As AI turns out to be an important resource to enable more powerful services across several use case categories, the necessity of AI at the edge of the network is becoming clearer.

For many use case categories, whether they support millions of low bandwidth devices on a massive IoT network, or networks with high bandwidth devices such as video cameras, enormous data sets will be created at the edge of networks. Reducing the need to transport these data sets to a central location requires intelligent processing at the edge. AI can be used to extract useful patterns and events out of a sea of raw data. For example, smart farming applications can spot dry patches or insect infestations, while a video surveillance system can pinpoint areas with suspicious looking activity.

2. A.I./ML in the RAN

AI/ML concepts and technology can be expected to have major impact on RAN systems evolution. Due to better level of performance and reduced complexity, they have the potential to replace some of the model-based Layer 1 and Layer 2 algorithms such as channel estimation, preamble detection, equalization, and user scheduling. AI/ML will be applied extensively in deployment optimization on the road towards zero human touch network optimization -- for example, for configuring an optimal subset of beams with which to illuminate the coverage area, taking cell traffic patterns into account.

However, Next G systems can be envisioned to employ AI/ML in a more fundamental way -- namely AI as a foundation for air interface design and optimization. Next G communication framework will be designed in such a way as to allow learning in the field to make some design choices. Through extensive training, a single deep-learning network at the transmitter and one at the receiver learn to pick the best design. This will enable optimization of the air interface characteristics based on the choice of spectrum, environment, hardware deployed and target requirements.

3. Fully Service-Based: Cloud Native Networking and RAN-Core Convergence

In the 5G era, the transition to a cloud-native and microservice-based architecture is a key change. Cloud-native technologies empower service providers and vendors to build and operate scalable applications in dynamic cloud environments. A microservice provides a dedicated business function and is an integral part of a service-oriented architec-

ture with published APIs and options for discovery.

Beyond 5G networks are likely to be extreme-edge or edge centric and data flow-based across the network. Network functions and other workloads would be dynamically scheduled in a hierarchy of data centers across the network topology. The criteria used to arrange the functions and workloads would be based on the combination of available resources, connectivity needs, latency requirements, energy consumption targets, etc., and would use AI and ML-based multi-object optimization algorithms to optimally balance the criteria.

One of the most important dimensions of cloud-native architectures is how they are delivered and orchestrated: the transition to the DevOps paradigm will assure an agile framework for continuous delivery and integration for large scale digital production environments.

Research into the design options of the Next G offers the opportunity to make the network simpler and more flexible. Latency, security, resilience, and energy efficiency can be used as criteria to optimize functional placement. Separation of user plane and control plane, virtualization and cloud native implementation of the core have facilitated the greatly increased level of flexibility.

4. mmWave and THz Radio Technologies

Academia and industry are driving research into existing mmWave as well as greenfield and unexplored THz spectrum to meet world-wide demand for mobile communications and applications. At these new frequencies lie an opportunity for a tenfold increase in the amount of spectrum available today.

There is also a great opportunity for semi-autonomous Next G sub-networks with special attributes of performance, where at least the most critical services in the subnetwork will continue uninterrupted despite poor or no connectivity to the wider network.

Multiple path connectivity employing infrastructure and opportunistic device-to-device connections will be required for the ultra-reliability, potentially leading to fully meshed and truly cell-less architectures. The integration of such sub-networks into Next G architectural paradigm will ensure high data rates, extreme low latency, reliability, and resilience, while security and resilience features will be enforced to the lowest level of devices in the sub-network. Next G service execution can dynamically be split between execution in the edge cloud or in the device that is part of the sub-network.

The capabilities of this extended spectrum goes beyond today's 5G capabilities, and enables even more new Next G use cases. The immense bandwidth available in the mmWave and THz regions add orders of magnitude higher data rates for terabit/sec mobile communications and backhaul systems. (See Figure 5-2.)

But getting into this greenfield spectrum requires many beyond-leading-edge capabilities that make Next G radio technology uniquely distinct from earlier generations. The challenges span the mmWave/THz air interface and the transport and processing of signals at terabit/sec speeds.

While basic research is under way for the future of 5G and beyond, the R&D community today is squaring up to tackle the technical challenges to evolve 5G mmWave, sub-THz, and densified networks.

What's Needed Now

Clearly, there is much work to be done to get from 5G today to the Next G. From a leadership standpoint, 5G Americas feels that North American wireless cellular and ICT companies should take the initiative instead of allowing other countries, regions, and organizations, to take the lead.

Our organization believes, in particular, North American technology companies, can do more to actively commit resources to push this work, and to lead and participate in these global organizations in order to support them and continue to drive an innovative vision. 5G Americas believes there may always be situations when companies may not agree. However, having common goals and visions will be helpful to ensure the viability of next-generation wireless networking. ■

This article is adapted from the white paper Mobile Communications Beyond 2020: The Evolution Towards the Next G by 5G Americas. The complete white paper, citations, and sources, can be found in this link: https://www.5gamericas.org/mobile-communications-beyond-2020-the-evolution-of-5g-towards-next-g/

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Choosing the Right Tools for Your FWA Toolbox

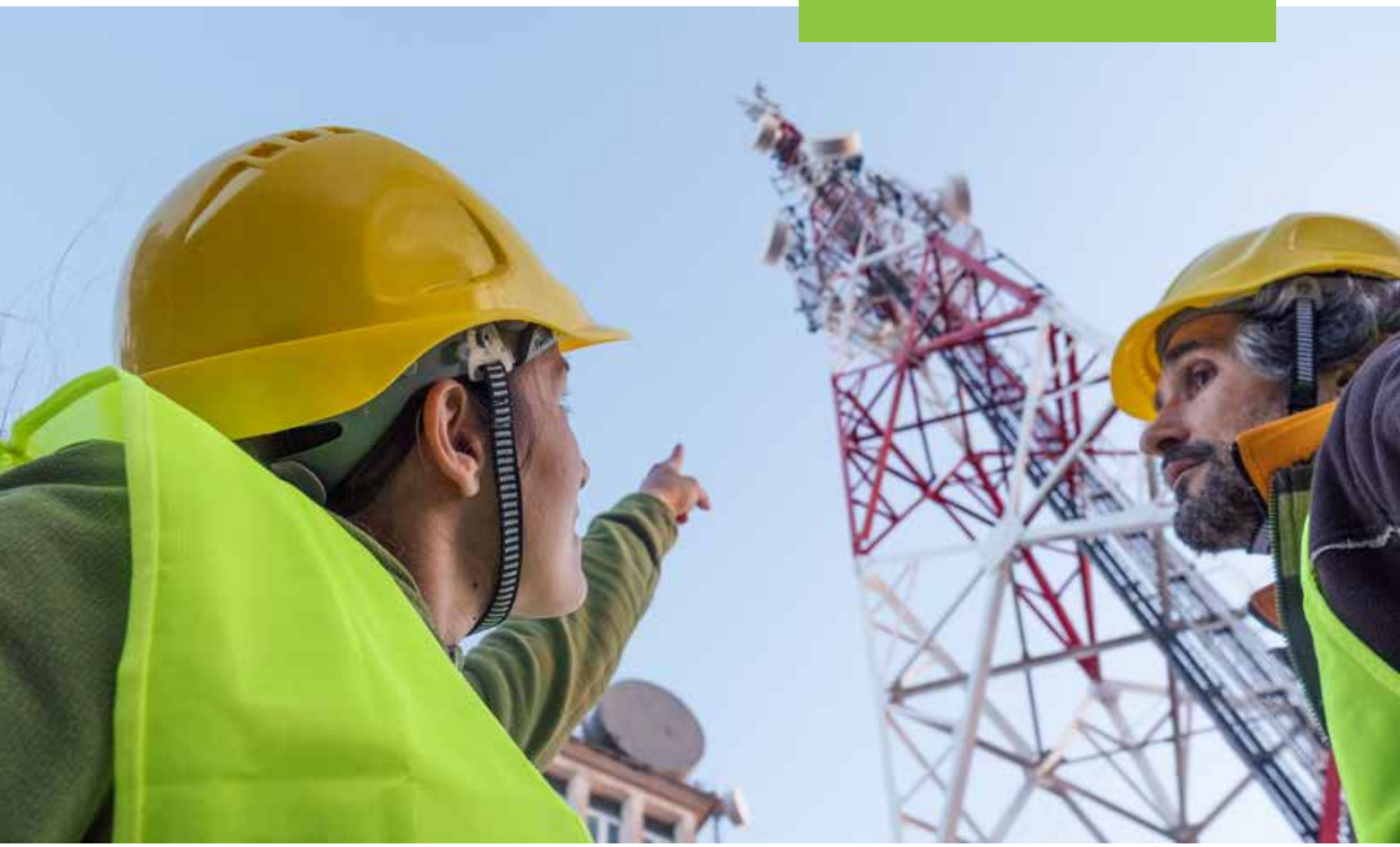
By Paul Wright

Enterprise network traffic is expected to increase by 6 times the volume of global broadband Internet access traffic by the end of 2030. This means it is imperative that operators deliver connectivity capable of handling this forecasted growth, especially under the current circumstances relating to the COVID-19 outbreak.

Competitive telcos and Wireless Internet Service Providers (WISPs) must help their customers meet their needs while scaling their network in a cost-efficient manner.

This is why it's critical that operators examine the design differences between microwave point-to-multipoint (PMP) and Point-to-Point (PTP) technologies. In most cases both

Evaluating Microwave PMP and PTP Technologies for Your Specific Application



PMP and PTP are complementary, and often work with each other within different parts of the same network. (See Figure 1.)

The fundamental use case for PMP architectures is to create a series of links between a hub site and a set of remote sites, whether these be in urban or rural areas. With the hub equipment and radio frequency channels being shared equally by the remote sites and the hub, the costs of both the spectrum and hub equipment are amortized across all links.

As PMP is available at a range of frequencies across both licensed and unlicensed spectrum, it is important operators make the correct choice when choosing the network equipment they will be deploying. As a result, many operators providing high quality corporate and residential broadband access services will prefer to use licensed spectrum, because such networks generate higher revenue, and are often sold with a specified or guaranteed throughput and availability with Service Level Agreements.

With unlicensed spectrum, there is a risk of uncontrolled interference occurring without any warning or recourse. This reduces the network's availability, and means it is usually not suitable for corporate and critical availability access or high-performance networks.

Licensed spectrum is far more suitable, as it eliminates any possible interference through the careful and regulated allocation of channels. This produces a true carrier-grade service where high performance is guaranteed, along with reliability, which brings reduced customer churn.

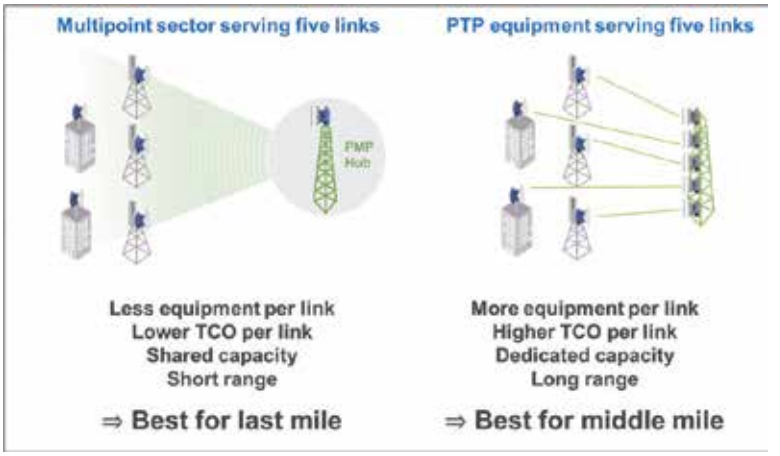


Figure 1.

The next decision operators face is whether low or high frequencies are best-suited to the kind of service they want to offer.

- Lower Radio Frequency (RF) (below 6GHz) is considered advantageous for its propagation properties, whereby the radio energy penetrates buildings and at the same time avoids obstacles. This is ideal for operators running networks such as Wi-Fi, 2G and 3G.
- However, the spectrum below 6Ghz is highly fragmented, which makes it complex for regulators to aggregate large blocks of this spectrum for lease. In turn, this can mean it is not particularly economic.
- Large parts of this spectrum are already owned by existing MNOs as they utilize it for their traditional mobile network operations.
- On the other hand, microwave frequencies between 6GHz and 60GHz are readily accessible, since these frequencies are less useful for mobile access, making them well-suited for fixed wireless access for residential and enterprise connectivity.

Now that 3GPP standards have been rolled out globally, a number of bands have been identified and harmonized for 5G applications. The initial mmWave bands, between 24.5GHz to 29.5GHz, and 37GHz to 44GHz, are now being made available in various locations, and are already seeing operators seizing the opportunity.

PMP provides spectrum owners with a great way of maximizing the revenue from their assets, whilst guaranteeing customers the high speed and capacity they have come to expect.

These networks can be rapidly deployed and expanded because all operators need to know the area in which their existing and targeted new customers are located.

- It takes just 1 day to commission a PMP 4-sector hub covering up to a 10km radius.
- From that point on, it is possible to rapidly add 1 radio per customer without any need to revisit the hub site.
- Operators can also target campaigns in the area, knowing they can deliver service within just days of signing a service contract.

This technology amortizes the costs of equipment and spectrum rental over multiple links through Statistical Multiplexing Gain, where Radio Frequency (RF) spectrum needs can be reduced by a factor greater than 2. As a result, the initial expenditure of deploying PMP can be a less costly investment than the more traditional PTP solutions.

It is also possible to dynamically adapt the PMP system to support both long range at a reduced capacity or availability, and high capacity at short range by adapting the modulation order of each individual link. This makes it suitable for a wide range of use cases when it comes to backhaul for enterprise and residential services.

With PMP, network designers need to predict in advance where customers will be located, and how heavy demand is to plan the coverage of hub sectors. Sometimes, they must take a pragmatic approach and take a best guess on providing blanket coverage, which can lead to sectors not having any customers in them, and over time leads to a waste of infrastructure spending. A worst-case example of this is when designers stick rigidly to deploying 360-degree coverage, resulting in areas pointing directly towards hills or the sea, where there is never any chance of customers coming online.

As PMP hubs aggregate traffic from many sites in the coverage area, the backhaul capacity of these hub sites quickly increases.

- A new PMP hub site could start by providing services to just 10 customers.
- What can then happen, with PMP being so easy to add, is

customer sites can quickly double or even triple in a very short time, placing a higher load on the backhaul.

- Network designers must then carefully consider this factor and plan the backhaul solution for each hub well in advance, for example deciding that some hubs may need to migrate the backhaul from a PTP microwave to a fibre.

Finally, as the appetite for PMP becomes greater, with the ease of adding coverage and the cost benefits, new hubs and sectors can be added in a such way that growth becomes organic.

- As with all things left to grow organically, planning shortcuts are often made to save time, and, if left unchecked, these networks can become far less efficient.
- For instance, issues with interference between adjacent hubs can occur.
- To avoid this, PMP networks need to be intelligent enough to adapt, and, secondly, PMP planning tools must be able to integrate with a network's management system.
- This allows for the quick detection of issues, and offers rapid solutions to correct and continuously optimise the network.

Gone are the days of deploying a PMP network and leaving it alone to grow unchecked. The best PMP solutions are those that provide feedback, ensuring the best possible customer service experience.

Whereas a PTP link comes with perceived certainties, such as the dimensioned data capacity being 100% available, and that no more than 1 site will compete for a share of that traffic load.

- It is this perception that has led operators to err on the side of caution, and to connect high-value, top-priority customers using PTP, since there is no possibility that the customer will demand more than the link is provisioned for.
- The downside of this is that many PTP networks become over-dimensioned, and most of the time the full link capacity is not fully utilised.
- This results in spare capacity not being passed on to other customers, capping revenue.

When designing PTP links, a lack of line of sight may mean that reaching a particular site needs several relays installing to avoid an obstruction.

- As a result, more radios require more planning, installation work, potential points of failure, maintenance activity, and a higher cost to deploy.
- If a new building goes up, then the PTP network designer must react and change the network.

In contrast, PMP allows for far more flexibility, since a customer in a blanket coverage area can generally be served by multiple hubs, meaning the site is more likely to achieve a line of site to other sectors in the coverage zone. This flexibility allows for fewer links to be deployed to overcome line-of-site issues, and requires far less engineering activity.

Looking Ahead

Due to the global pandemic, networks are experiencing unprecedented levels of traffic with home working and learning. As the COVID-19 pandemic continues to affect our daily lives, this is likely to result in even higher bandwidth demand in the future. With so many businesses reliant on communications to stay profitable and active, operators wanting long-term success must plan ahead.

At the same time, strong industry competition means telcos and WISPs need access to solutions that can be deployed quickly, are affordable, and offer high scalability, to allow for future growth.

To deliver high-quality connectivity with no interruptions, it is critical that WISPs and telcos carefully examine when to use PMP and/or PTP. The electromagnetic spectrum is a finite resource, and needs to be used as efficiently as possible to ensure that all demand for traffic is met.

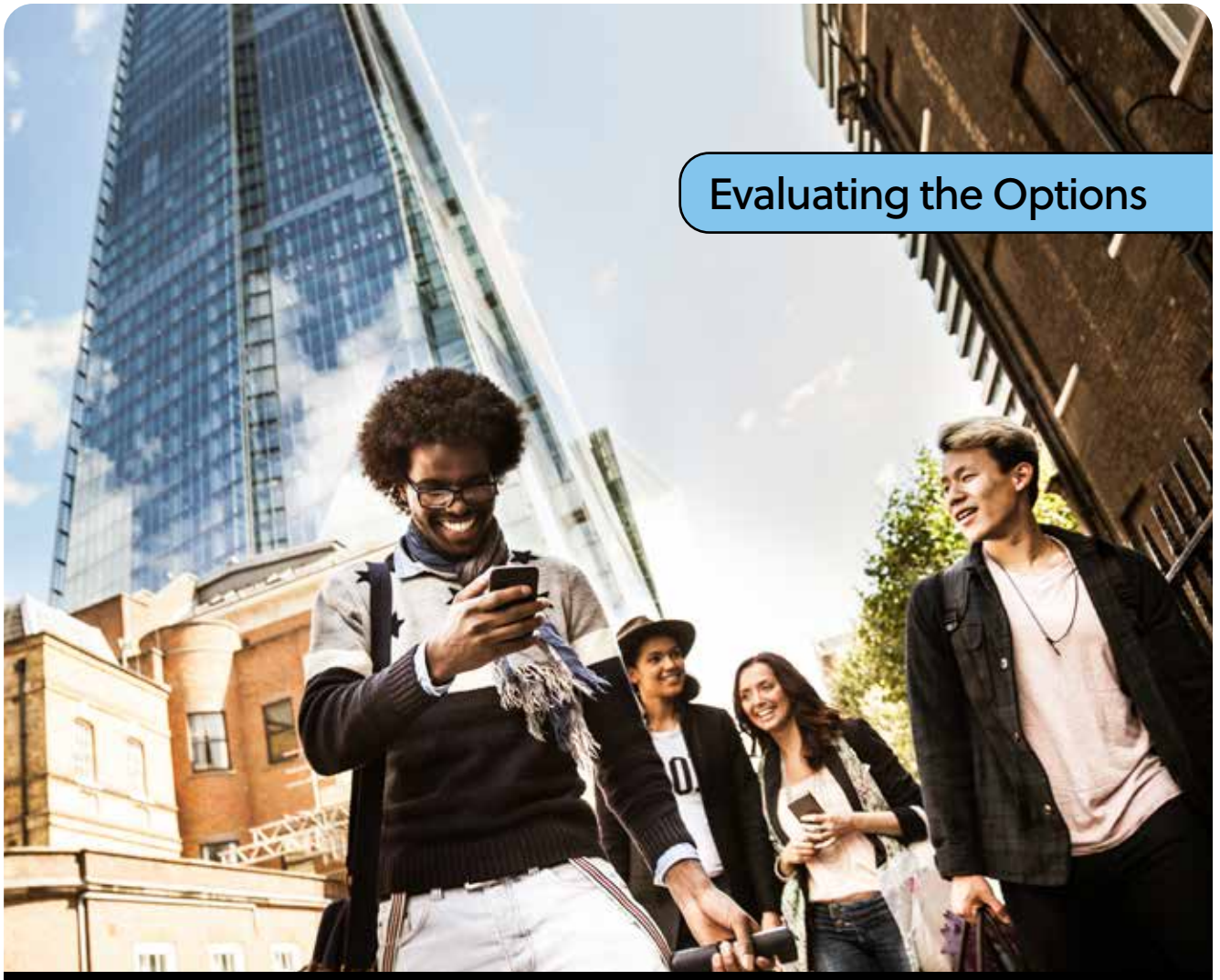
With the provision of enterprise services, operators should not underestimate the power of PMP. Its ability to deliver high capacity, dynamic range, and its easy deployment, makes this technology a great choice for providing high-quality reliable connectivity.

Telcos and WISPs can also optimize their network rollouts by providing coverage where the largest and fastest uptake in customers can be captured. Meaning their network can be up and running quickly, resulting in reduced costs and maximized revenue.

At a time when networks are facing increasing pressure and growing uncertainty due to the COVID-19 pandemic, it is critical that WISPs and telcos have a variety of tools in their network toolbox. Cambridge Broadband Networks Group can help service providers find the right solutions for their Middle and Last Mile deployments that meet their needs for the future. ■

Reference and Notes: https://www.computerweekly.com/news/450421966/Equinix-expands-its-Europe-an-datacentre-footprint-with-AM4-opening-in-Amsterdam

Paul Wright is VP Sales and Customer Operations at Cambridge Broadband Networks Group (CBNG). He has more than 25 years of experience in deploying point to multipoint and broadband satellite systems. For more information, please email enquiries@cbnl.com or visit https://www.cbnl.com/. You can also follow us on Twitter @CBNGTeam.



Evaluating the Options

Improving Campus and Skyscraper Cellular Coverage

By Taylor M. Underwood

For any cellular amplification system installation, the cabling is a major factor influencing the signal strength and improvements in cellular coverage inside a building. There are primarily 3 categories of cable used in systems that amplify indoor cellular signal: coax, category twisted pair, and fiber. Each has its own purpose and each needs to be used strategically for an efficient design that provides a facility with optimum amplification at the best cost.

Coax Cable

For in-building cellular amplification systems, coax cables transmit analog signal between a signal source, such as a donor antenna on the roof of the building, and the headend of the system. It can also be used to transmit the signal from the radios to the antennas that distribute the signal to building occupants. One strategic way to do this is by placing redistribution equipment (equipment that converts the analog signal to a digital form) nearby to minimize the negative effects of coax for stronger transmission.

While coax cables are an essential element in most in-building cellular amplification systems, they do have drawbacks.

- **Power is lost over these cables on all runs** due to simple physics, but the loss drastically increases over longer runs. For example, over 100 feet half the power or more may be lost.
- **Also, twice as much power is lost when transmitting at higher frequencies than in the lower frequencies,** so a system designer must take into consideration the frequency bands that will be amplified. High bands (1700-5000 MHz) may lose 3-6dB (50%-75%) per 100 linear feet. Low bands (600-800 MHz) might lose 1.5-2dB per 100 linear feet.
- **The amount of power that reaches the antenna directly impacts** the coverage footprint and the user experience.

Headend of the School. 3 Network Units: 1 for each building, and 2 coverage units feeding service.

(Pictured with Taylor Underwood)

Of the 3 types of cables used, coax is the most challenging to install. If connectors are installed poorly or if there are breaks in the cable, there can be passive intermodulation which is a phenomenon where multiple frequencies mix together resulting in spurious harmonics, interference, and unintended leakage of power and signal.

While sweep tests should be done on all cable installations to ensure that specifications and standards are met, the tests for coax cable are the most complex and time-consuming.

- **Because coax transmits analog signals, there are more characteristics to test,** such as different frequency ranges for the standards required by each of the carrier's bands. The test might pass at lower bands but can fail on a high band. Field technicians would then need to troubleshoot to find the root cause of the failure. This may require reinstalling and/or cleaning connectors multiple times due to simple things like oils from the installer's hands left on the connectors, slight condensation, or miniscule metal shavings or dirt and dust from when the cable was cut and prepped.
- **Coax cables are also thick and harder to install when tight radiuses are required,** so crimping can become an issue which results in a test fail.

The average price of half inch coax is $1.50-$2.00 per foot. Each connector costs $25-$50 to replace. A coaxial sweep analyzer costs $10-$20K or more. (Based on pricing quotes from major vendors Anixter and/or Anritsu.)

Outdoor Donor Antennas

Category Cable

Category 6 twisted pair cable can be used to transmit signal from the headend of the system to the remote radios and antennas. There are many advantages to using Category versus Coax cable.

- **Category cable is all digital so there is no signal degradation** up to 300 linear feet or 600 feet with a cable extender.
- **Unlike coax, it is simple and foolproof to put a network connector on the end of category cable;** the installer simply needs to ensure that the 8 wires are in the correct positions before crimping.
- **It is also thinner cable with a smaller bend radius** so it can be installed in tight areas.
- **Simple and quick tests are done to make sure the cable conforms to standards for data rate** over the length using an inexpensive Fluke meter or similar device. If the test fails, the installer can usually just snip off a connector and replace it, taking only a couple of minutes.
- **Care must be taken when bundling category cable runs** as this can cause too much noise from other cables in the bundle and can cause errors in the digital system.

The average price for Category 6 cable is $.50-$.60 per foot. Each connector costs $.50 to replace. A Fluke meter for testing costs $500 to $750. (Based on pricing quotes from major vendors Anixter and/or Anritsu.)

Fiber

- **Similar to Category 6 twisted pair cable, fiber is all-digital but it doesn't have the same distance limitations.** With single mode fiber, runs cans transmit anywhere from a few hundred feet upwards of 25 miles depending on the amplifiers from the headend to the remote radios/antennas inside the building -- without needing any additional repeaters or hardware transceivers.
- **Also, there are different ways fiber can be modulated for greater signal capacity than category cable,** so capacity and radio frequency (RF) propagation planning should be done as part of an in-building system design to determine the optimum cabling to install.
- **Inside fiber cables, the signal is transmitted over pristine glass that is very sensitive.** It requires minimal back reflection which can cause the light to go in the wrong direction.
- **It also requires correct polarizations, which is the angle the light is reflecting throughout the cable.** If the light is not bouncing at the right angles, then there can be lost signal.
- **These factors make the installation more delicate** as harsh bends and improper connector surfaces need to be avoided.
- **Splicing the connectors on the ends** also requires specific expertise and more expensive equipment, such as a fusion splicer that "welds" glass together without significant imperfections.
- **Since fiber cables are tiny,** dust particles can cause unwanted loss as well.

Fiber used for in-building distributed antenna systems (DAS) normally costs $2.00-$8.00+ per linear foot. (Based on pricing quotes from major vendors Anixter and/or Anritsu.)

Alternative Solution

Due to the technical limitations on the length of category and coax cable runs, larger facilities looking to improve cellular reception for occupants, IoT, or cellular devices have historically deployed expensive DAS with long fiber runs throughout the buildings.

However, traditional DAS solutions are not always financially viable for most facilities under a million square feet. This is due to the high upfront cost of equipment and cabling, extensive length of installation time and contract negotiations with carriers, and extra operating expenses due to the heat, electrical, and air conditioning loads.

M S Benbow & Associates (MSB) has found a more cost-effective solution, using all 3 types of cabling, for providing cellular amplification in multi-building complexes, skyscrapers, and other larger facilities.

One application example illustrates the point well. Using Cel-Fi QUATRA, an active DAS hybrid from Nextivity, MSB amplified cellular signal throughout a 3-building, new construction, K-6 school with 236,000 square feet of indoor space. The entire system, including installation, cost the school about the same as it would have cost for only a headend of a traditional DAS.

The system is fully digital and uses both category and coax cable to deliver up to 100dB gain simultaneously on multiple carrier networks. A recent Fiber HUB addition to the hybrid allows fiber runs to transmit signal in multi-building and larger facilities from the headend of the system to the remote units at distances of up to 1.25 miles.

The hybrid solution can be deployed with an off-air donor signal or connected to a small cell to create a distributed small cell network called a *Supercell*. When deployed off-air, donor antennas are generally placed on the roof of a facility, one for each carrier. Coax is run from the donor antennas to the system headend. From the headend, category cable is run up to a maximum of 656 horizontal or vertical feet (with signal extenders) to the remote units inside the facility that distribute the signal to occupants. The Fiber HUB and fiber runs are used when longer runs are needed.

We found the Fiber HUB fit into the infrastructure like traditional DAS but without being traditional DAS. The Fiber HUB enabled the company to provide cell service to multiple and larger buildings, all while cutting down on the infrastructure costs.

Interestingly, the entire school was constructed as a LEED-certified building, so it was a giant Faraday cage with no cellular signal coming in or out. Outside there was a fairly decent signal, but inside all the materials were RF-blocking, resulting in no signal.

- The headend of the hybrid was placed in the 2-story main building.
- 4 antennas were put on the roof of the main building, 1 for each carrier, with coax cable run to the headend to provide the signal source for delivering cellular coverage to the entire school campus.
- 6 strands of single mode fiber were run 700 feet from the headend to Fiber HUBs in the other 2 buildings.
- The fiber was cut and spliced at key points, so it went back and forth between the buildings, providing full redundancy with a couple of backups and an alternate route if needed.
- Cat 6A cable was run from the headend in the main building and the Fiber HUBs in the 2 external buildings to the 6 remote units positioned inside each of the 3 buildings.

It took 2 of our engineers about a week to get everything turned up and checked out, including the cables, antennas, and sweep testing. It took an hour to commission the system. The system can monitor itself for any type of interference that is introduced into the system, and it has an online portal and apps for remote performance monitoring, which is important to us in providing maintenance and ensuring that standards promised are met. ■

Taylor M. Underwood, P.E., MSB Senior Telecommunications Engineer, M S Benbow & Associates, has 10 years of experience with Cellular network design, optimization, and operations support. Taylor spent most of his career working at AT&T in their mobility division, deploying the 700 MHz, AWS, PCS, and WCS LTE overlay. He is also experienced in 5G mmWave, designing Macro and CRAN 5G NR, and the deployment of DAS in both small and large public venues. For more information, please email TUnderwood@msbenbow.com or visit https://www.msbenbow.com/. Follow M S Benbow on Linkedin: https://www.linkedin.com/company/msbenbow/.

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