LightReading

BIG 5G EVENT CRITICAL INSIGHTS eBOOK

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Jeff Baumgartner is a Senior Editor for Light Reading and is responsible for the day-to-day news coverage and analysis of the cable and video sectors. Baumgartner, who previously had served as Site Editor for Light Reading Cable from 2007-2013, was most recently Senior Content Producer-Technology at Multichannel News, heading up tech coverage for the publication's online and print platforms, and was a regular contributor to Broadcasting & Cable, a sister publication to Multichannel News. Baumgartner was named to the 2018 class of the Cable TV Pioneers.

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Mike is responsible for leading Light Reading's 5G editorial strategy and coverage, including its news analysis, executive interviews, editorial content for live events, on-camera video interviews and more. Based in Denver, Mike comes to Light Reading from FierceMarkets Telecom Group. He was Editor-in-Chief of the publication group for two years, spent five years as the group's Executive Editor and two years as one of its Managing Editors. Prior to his time at FierceMarkets, Dano spent nine years in various editorial roles at RCR Wireless News.

Phil Harvey
US Bureau Chief, **Light Reading**

Phil Harvey has been a writer and editor for more than 20 years covering networking and telecom companies and Internet startups. He was a staff writer for UPSIDE and Red Herring, a contributing editor for D CEO, a managing editor at CRN and he spent more than 12 years as a writer and editor at Light Reading from October 2000 to April 2013. He likes nothing better than wandering the streets with his last-century photographic equipment and canisters of film before heading to the theater for a classic musical.

Iain Morris
International Editor, **Light Reading**

Iain Morris joined Light Reading as News Editor at the start of 2015 -- and we mean, right at the start. His friends and family were still singing Auld Lang Syne as Iain started sourcing New Year's Eve UK mobile network congestion statistics. He is now International Editor, with responsibility for Light Reading's coverage of EMEA and Asia/Pacific (so, most of the world, really...) as well as leading our coverage of the super-hot topic of automation.

Stephen Lawson
Contributing Editor

Stephen Lawson is an award-winning writer and editor with a reputation for telling clear, compelling stories about technology: a 20-year track record of news, analysis, and cutting-edge research coverage in national and international settings.

INTRODUCTION

THE BIG 5G EVENT 2019: PROGRESS & POTENTIAL

There was a lot of ground to cover at the Big 5G Event in Denver, Colorado, on May 6-8, 2019, at the Colorado Convention Center.

The evolution of communications networks to provide the fifth generation of cellular technology is the most significant communications evolution in decades. It's touches every part of the communications networking industry (and beyond) -- impacting investments, R&D plans, corporate cultures and long-term business strategies at companies that have no obvious connection to radio heads, baseband capacity or antenna rays.

It's a giant puzzle, with all the pieces coming together to eventually provide a single network that can support any service, on any device.

To start with consumer mobile broadband services will be supercharged by 5G. Even though consumer broadband is a mature segment, analysts see that the segment could see some growth as abundant upstream and downstream connectivity provides consumers with so many benefits.

"if we think about our experience on, on broadband today, it's really fast, but it's not as mobile," said Sprint's Mishka Dehghan, during in her Big 5 G keynote address. "What we all want and expect from 5G is to have the same great connectivity experience in a much more mobile way so that we can really become, you know, limitless in terms of the experiences that we have... "

Then there are the industrial applications, which are going to be a big focus and significant profit center for the nation's top network operators in the years ahead.

"Where are the service providers are really looking now is to the B2B segments," said Mike Roberts, the Research Director for Ovum's Service Provider Markets group. "That's largely because in a lot of cases, [service providers] haven't really cracked them. So they're going to be using new things like network slicing, like mobile edge computing, to really create these tailored networks and services that they think enterprises are going to like, and are going to be willing to pay for, and [that] is going to really create the business case for 5G for a lot of operators in a lot of markets."

As you'll see in the rest of this curated coverage report, there's plenty of progress that the networks have seen so far as they begin to roll out early, pre-standard 5G services. And, still ahead, there is a lot of potential on the horizon, as network cores are upgraded and the latency and higher throughput speeds promised by 5G start showing up.

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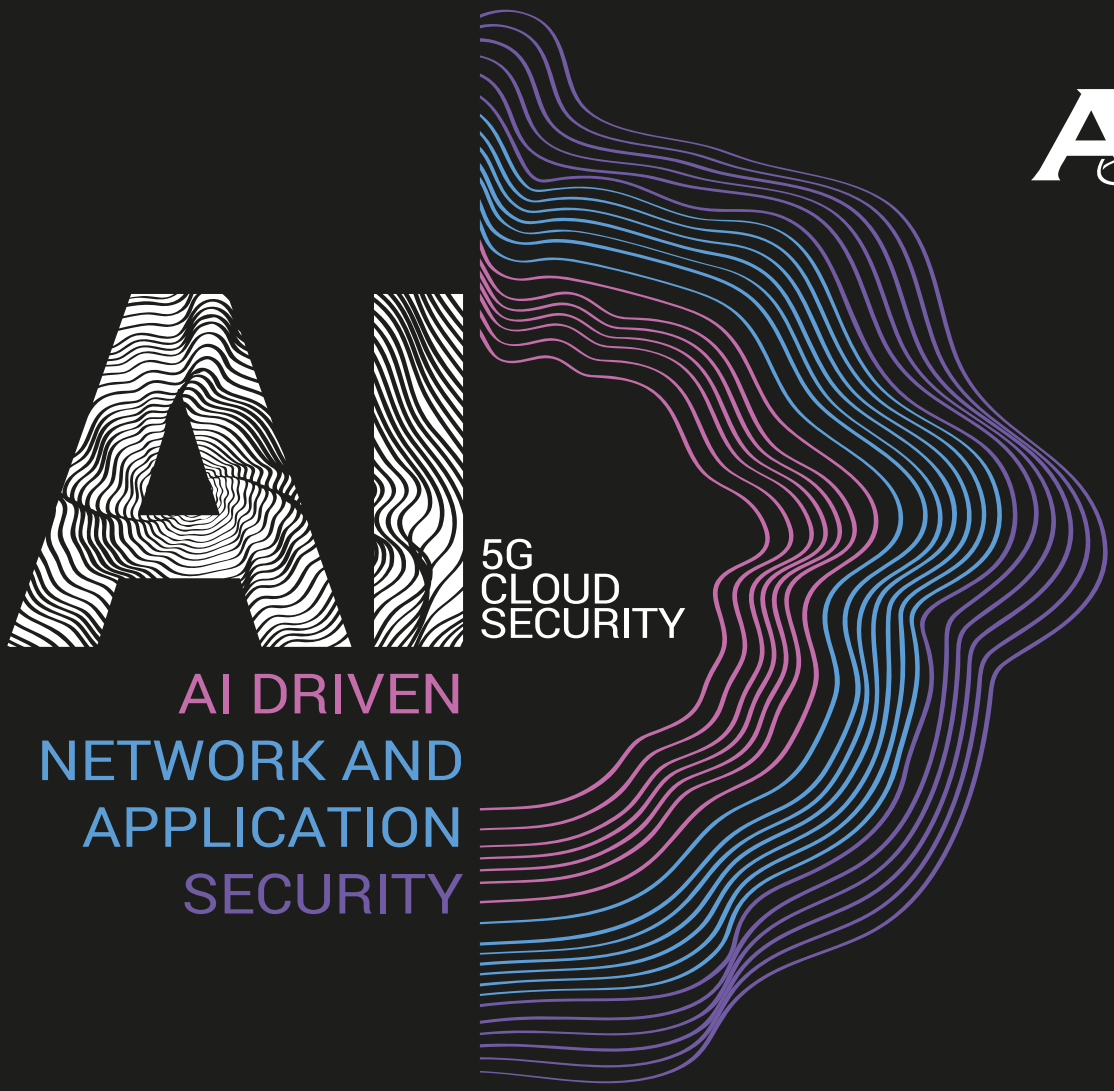

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MANAGING THE 5G HYPE IS CRITICAL TO CARRIERS

The US telco expects to support a sub-10-millisecond service on its edge platform by the end of this year.

At this early stage of the 5G era, it's critical for mobile carriers to manage the hype around the next-gen platform among both enterprise customers as well as consumers.

The near future of 5G has, of course, plenty to do with engineering, but it's likewise important to prepare customers for what the technology will be capable of early on and to avoid creating "unrealistic expectations," Patrick Riordan, chairman, president and chief strategy officer of Wisconsin-based Nsight (Cellcom), said here Tuesday during a panel discussion focused on the next steps for 5G. "We need to tell the story better on what 5G is."

As labels like "5Ge" enter the marketplace, they can create a "placebo effect" that ends up falling short of what "true 5G" will be capable of, Riordan said.

For its part, Cellcom has been spent the last two years preparing to move from 4G to 5G, he said, noting that purchasing and building fiber is "critical" to that effort, and that for a company like his, which is focused on rural areas, it's also important to "work hand-in-hand' with suppliers on the deployment.

Sprint, meanwhile, is amid an initial 5G rollout that will hit nine markets before the end of the first half of 2019, Mishka Dehghan, vice president of 5G deployment at Sprint, said. She estimated that this early batch of work will enable Sprint to cover about 1,000 square miles with 5G. At this stage, Sprint has some proof-of-concepts announced related to 5G-powered smart city applications. "There is definitely a ton of interest in cities from across the country about what 5G can bring to their communities," Dehghan said.

For Cisco Systems, the next big step on the 5G path is to work with carriers on the deployment of 5G radios with a 4G core. That will follow with the early positioning of a new 5G core architecture and more work on how this core-level migration will be completed, Ian Campbell, CTO service provider mobility and automation at Cisco Systems, said.

5G "is a major re-architecture of the core," he said, citing the move toward network-slicing and installing more compute at the network's edge. Some initial introductions of a 5G core are expected to start next year.

Network virtualization will also be paramount, as it will help to drive costs out of the network and put carriers in a better position to create a profitable 5G business. "There will be no 5G without virtualization," John Baker, SVP of business development at Mavenir, said. He said many carriers he speaks to are still struggling with how to make a 5G business plan work.

He also estimates that the computer industry is some 15 years behind the mobile industry concerning deployment technologies, and that could greatly affect the deployment of effective edge computing architectures needed by 5G. To the computer industry, "everything is 19-inch rack-based," he said, believing that this will open up opportunities for others to rethink and develop processing technologies that are more optimized for the edge.

5G will support faster speeds, but carriers will also need to ensure that their mobile networks can keep up and don't become the bottlenecks. The industry is still data center focused, so more work needs to be done to enable redundancy and harden the edge of the new 5G network, Oded Sagee, senior director of embedded and integrated solutions at Western Digital, said.

Panelists also noted that 5G networks, and the low-latencies and abundant capacities they will support, will be deployed to reach small pockets and target specific early cases early on.

"It can be done one enterprise at a time," Baker said. "It could be as small as a manufacturing plant," Riordan added, reiterating that the industry must avoid the "super hype" building on 5G and the perception that it will suddenly become available everywhere. "It's not going to happen that way."

Jeff Baumgartner
Senior Editor, **Light Reading**

SERVICE PROVIDERS LOOK TO ENTERPRISES FOR 5G ROI

Preparing and educating customers about the true capabilities about 5G can help mobile service providers avoid unrealistic expectations, execs at Light Reading's Big 5G Event insist.

Finding and solving customer challenges that 4G can't address will matter more than sheer performance in making 5G profitable, wireless industry executives said at the Big 5G Event this week in Denver.

"If we are at this conference a few years from now and all 5G is, for consumers, is faster Internet, we will have missed the boat," said Nicki Palmer, Verizon's senior vice president of technology and product development. She spoke on a panel Tuesday morning exploring how to make 5G generate a return on investment.

Verizon will be charging a $10-per-month premium for consumer plans that include 5G, which Palmer called "a low barrier to entry." AT&T has floated the idea of charging for higher speed tiers, a concept that Igor Glubochansky AVP of mobility product management, cited on the panel. But panelists said customized enterprise services offer a greater potential for revenue from 5G. These may include wireless control of robots on factory floors and augmented reality for uses like guiding surgeons and firefighters.

Palmer cited a technology that startup Medivis, which has worked with Verizon, is developing. It would guide doctors in surgery by projecting dynamic 3D visualizations of the patient's organs as the surgery is carried out. This combines the high data rates and low latency of 5G, she said. Another startup, Qwake, has an application to show firefighters where things should be in a smoke-filled building.

5G opens up new opportunities for wireless in industry, AT&T's Glubochansky said. It allows for not just management control of devices but operational control. Enterprises so far have mostly used wired networks to link connected machinery in factories. Indoor 5G will make wireless competitive there through both lower latency and edge computing that can keep the data on-site for the security manufacturers demand, he said.

Some enterprise applications that 5G will make possible are ones that operators haven't even anticipated, said Craig Sparks, CIO of CSpire, a regional US wired and wireless operator.

> “If we are at this conference a few years from now and all 5G is, for consumers, is faster Internet, we will have missed the boat.”

For example, some industries may need an IoT device that sits for years monitoring infrastructure, then detects an event that requires it to deliver data at 10Mbps. The service and orchestration capabilities to make that happen don’t exist today, but they may as 5G reaches its potential. These types of customized applications are a far better opportunity for revenue than the potential to charge consumers for more speed, he said.

Verizon expects 5G revenue to begin this year, become meaningful next year and in 2021 to affect the company’s bottom line, Palmer said. Building out the network and adding more capabilities will take time but should pay off.

“We’re happy with the pace. We’re going to go just as fast as we can,” she said. “The more we solve those pain points... it’ll build on itself.”

Why this matters

Mobile operators recognize that 5G could transform industries, and they see that potential as key to their own evolution from providers of consumer mobile broadband to partners in creating customized services to enterprises. While 3G brought simple services like mobile e-mail, and 4G made mobile video possible, 5G ultimately could change businesses and industries more than the consumer experience. It must do that in order to pay back the massive investments being made in the technology.

Stephen Lawson
special to **Light Reading**

VERIZON EYES 80%+ LATENCY REDUCTION ON EDGE PLATFORM

The US telco expects to support a sub-10-millisecond service on its edge platform by the end of this year.

Verizon has recorded latency of just 10 milliseconds during trials of its edge computing platform in New York City as it targets a commercial launch of services by the end of this year.

Latency denotes the time for a data signal to make the round-trip journey from a user device to the Internet and then back again, and it has become a hot topic for service providers launching or planning to introduce 5G networks.

The next-generation network technology promises a much shorter signaling delay than is possible on today's 4G systems. Operators such as Verizon hope this reduction will lead to new service opportunities in areas such as virtual-reality gaming and self-driving cars. Verizon is now confident it will be able to cut latency by at least 80% through investment in 5G technology and the rollout of new "edge" architecture, according to data shared with attendees at Light Reading's Big 5G Event in Denver this morning.

"Improved edge architecture will be a true architectural driver of change," said Nicki Palmer, Verizon's senior vice president of technology and product development, during a keynote presentation at the event. "On the wireless network today, the lowest latency available is about 50 to 60 milliseconds to gather information and come back. With 5G, latency will ultimately be less than 10 milliseconds."

The "edge" is a hazy term that refers to parts of the network in closer proximity to end-user devices. By installing IT and network-processing resources in data centers at the network edge, instead of in the centralized facilities where they are normally found, operators could shorten the journey for a data signal and reduce latency.

Verizon is currently investing in its own multi-access edge computing (MEC) platform and aiming to have some commercial services on this infrastructure by late 2019.

"We have architecture up and running in New York City and we are seeing sub-10-millisecond latency right there as we continue to test," said Palmer. "We will have services available on our MEC platform by the end of the year and we will deliver on that promise."

Such low latency may be critical in a future world of driverless cars, where the signaling delay on a 4G network could lead to accidents, but Verizon has said little about the types of service that could become available this year.

Verizon's Nicki Palmer expects a huge reduction in latency from investment in 5G and the edge.

It has been collaborating with business customers at various innovation centers as it tries to unearth the low-latency applications that could fuel revenue growth in future. The operator has also opened some incubation labs where its staff can work side by side with entrepreneurs and technology start-ups.

In one case, it is working on capturing and processing holographic images in real time before distributing these over the wireless network. "You will need 5G for that," said Palmer.

Earlier this year, Verizon said it would give up to $1 million to any business that comes up with an idea it can turn into a commercial service.

But the investments that would be required for a nationwide sub-10-millisecond offering could be staggering, while demand and willingness to pay for that service currently remain unclear.

Verizon plans to invest between $17 billion and $18 billion in capital expenditure this year, about the same amount it spent in 2018, as it builds out a 5G network based on millimeter wave spectrum.

Much of that investment, however, will go toward bolstering mobile services for smartphone customers and on "5G home," a residential broadband offering that uses 5G as an alternative to the fixed line.
"We will launch [5G] in 30 markets this year and are well on the way to that," said Palmer. "5G home expands in the second half of 2019 as more home devices and equipment become available."

During a panel session later in the day, Palmer said she was expecting "meaningful" 5G revenues at Verizon in 2020, citing the 5G home service as a big potential driver of sales growth.

The offer would allow Verizon to extend its broadband business outside what Palmer called the "original colonies" on the east coast of the US, where fixed-line technology is more readily available. "We don't really compete outside that area so this is new for us and we get to be the disruptor," she said.

Iain Morris
International Editor, **Light Reading**

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A 5G SECURITY Q&A WITH TERRY YOUNG, DIRECTOR 5G MARKETING, A10 NETWORKS

Do mobile operators need to reconsider their network security strategies as they plan for, and launch, 5G services?

Yes, a great deal has been discussed about IoT devices, how poorly they are protected and the potential for infection, botnet attacks, etc. While this is also true, I think there are some more fundamental business reasons why operators need to reconsider their network security strategies.

First, the cybercrime economy has grown to reach $1.5 trillion in profits in 2018 alone[1]. Cybercrime is hugely lucrative, operates like a professional business and uses automation and machine learning to perfect its techniques and platforms. Compare this to the $1.3T[2] in 5G-enabled revenue (not profit) projected by Ericsson for the entire 5G ecosystem. If cybercrime was viewed as a competitor to mobile network operators (MNOs), they would be at a significant disadvantage. The growing number of cybercriminal activities and tools means that operators can't compete with outdated approaches.

Secondly, 5G services require a level of performance and security that operators have not previously had to offer to their enterprise customers. Many of the new applications are life-impacting, such as public safety or telemedicine.

With DDoS attacks, for example, operators can no longer ignore the impact to their downstream subscribers. A 1Gbit/s DDoS attack passing through the mobile network may be a blip on the MNO radar, but has a devastating impact on small, critical data centers for public safety. Most DDoS attacks are not the large, volumetric attacks that make the headlines, and given the growing number of amateur cybercriminals buying DDoS-as-a-service from the cybercriminal platforms, the volume and sophistication of DDoS attacks on selective services will only increase. To compete effectively for that $1.3T in opportunity, operators will have to decide how much to step into the role of offering security as part of their service package.

Are there significant differences between securing a 4G and a 5G network?

In both 4G and 5G non-standalone (NSA), network security must keep up or outpace the rising threats and the protection expectation of subscribers and enterprises while still providing the capacity, performance and latency expected of the mobile network. With a common 4G core, all the network interfaces will still need protection. In practical terms, this may mean adding firewall functions at interfaces and for protocols not previously protected, such as roaming, radio access network (RAN) and Diameter, or upgrading/replacing existing systems with those that provide automated security and the required level of performance.

If mobile edge computing (MEC) is part of the topology, then security functions must also be highly distributed and centrally managed. This is a much different operations model than what is currently used with a centralized evolved packet core (EPC) and limited interfaces. In 5G, the user and control plane are separated, which will require some changes in what is needed and where. I think the biggest challenges are operational – how to integrate security into the larger business objectives of the operator – to increase scalability, reduce latency and increase efficiency. Security platforms that offer highly sophisticated malware analysis, for example, are not practical for mobile operators if they don't also provide the scale and efficiency needed.

The widescale introduction of 5G services is expected to herald an increase in data and signaling traffic volumes. Should these trends be considered by operators as security challenges?

The increase in signaling traffic is definitely a security challenge. The huge volume of IoT devices and new smartphone applications will put a much greater load on the network, increasing the potential for signaling storms, for example. Not all such storms are caused by malicious events – they can be caused by local outages. When there are huge volumes of IoT devices, the simultaneous reconnection requests can cause further outages, much as they did with smartphone apps in early 4G networks.

Network slicing is much talked about as a benefit to operators of 5G. Will the introduction of network slicing result in unique or new cybersecurity challenges for mobile operators and/or their customers?

Combined with network function virtualization (NFV) and software-defined networking (SDN), network slicing is one of the key mechanisms that will enable mobile operators to offer security and other capabilities tailored to each vertical application and capture revenue from these diverse use cases, without losing the economies of scale of common infrastructure. A network slice is a collection of logical network functions that support the requirements for diverse use cases. Network slicing isolates each use case or service from one another, so that the services can be independently deployed, managed securely and delivered in a robust way. This will allow operators to secure individual slices to the level required or isolate them from the rest of the network in the event of an attack.

Network slicing provides an opportunity to strengthen the security of the network and of individual slices. It also poses additional threats, as cybercriminals can now target more specific use cases.

What is A10 Networks doing to help mobile operators secure their networks and services as they shift into 5G mode?

A10 Networks provides highly scalable security solutions for 5G network scenarios. Its robust firewall and DDoS detection and mitigation technologies can be deployed in physical, virtual, bare metal, and container form factors to suit individual network topologies, including 4G, 5G-NSA, MEC and 5G standalone (SA). The A10 Networks Thunder® Convergent Firewall (CFW) provides exceptionally high firewall connection rates, throughput and concurrent sessions for the most demanding 5G use case.

The A10 Networks Thunder Threat Protection System (TPS) is an automated multi-vector DDoS protection solution that ensures availability of business services at any scale or type of network. Combined with deep packet inspection (DPI), carrier-grade network address translation (CGNAT), intelligent traffic steering and analytics, the A10 Networks 5G security portfolio provides the highest flexibility, scalability and protection for mobile operators as they evolve their networks to support 5G.

1 https://www.thesslstore.com/blog/2018-cybercrime-statistics/
2 *Source: Ericsson. The 5G business potential. Second Edition*

https://www.a10networks.com/5G

T-MOBILE'S EWALDSSON: 5G SPECTRUM – THE MORE BANDS THE BETTER

A broad range of spectrum bands is critical to helping T-Mobile deliver on a good 5G experience, and millimeter wave takes another knock.

Having a broad range of frequencies across low, middle and high bands will be a critical differentiator for T-Mobile US as it rolls out 5G.

Ulf Ewaldsson, T-Mobile's senior vice president of technology transformation, made spectrum the focus of a talk on Tuesday at the Big 5G Event in Denver. The combination of low-band and mid-band spectrum for coverage, with millimeter-wave frequencies for additional capacity in densely populated areas, is key to delivering a good customer experience, he said.

Summarizing T-Mobile's position in an interview following the session, Ewaldsson said the carrier is well positioned in each area of spectrum to deliver a full-service 5G network.

T-Mobile has yet to name a launch date for commercial 5G, and Ewaldsson declined to break that news. The company is waiting for two things before a rollout is possible: Device availability and stable millimeter-wave networks, he said. He cited true mobility, rather than signals in a limited number of spots, as is an important part of 5G service.

Ewaldsson said he was surprised to see other operators introduce services in millimeter-wave bands. AT&T launched 5G late last year for businesses in parts of 12 cities, and Verizon has introduced mobile 5G in parts of Chicago and Minneapolis. Verizon is on track to expand that offering to at least 30 cities by the end of this year, said Nicki Palmer, senior vice president of technology and product development, earlier Tuesday.

The biggest technical challenge to deploying millimeter-wave 5G has been vendor software, Ewaldsson said.

The company is poised to start rolling out 5G on its low-band 600MHz network, which reaches more than 3,500 communities with LTE. That whole network is software-upgradable to 5G, he said. It has also deployed 28GHz 5G gear that's currently in testing and holds licenses in the 39GHz band for future use.

T-Mobile's mid-band strategy depends largely on its proposed merger with Sprint, which regulators are still reviewing. The company hopes to use Sprint's 2.5GHz spectrum, though it already has some mid-band spectrum in the 1900MHz and AWS bands, currently being used for a combination of 2G, 3G and 4G services.

Why this matters

As the third-largest US mobile operator, T-Mobile is a key competitor to AT&T and Verizon. Its effort to combine spectrum in a broad range of bands highlights the importance of spectrum diversity to make 5G realize its potential. Mid-band spectrum, which offers a combination of coverage and high speed, is a critical need in the US, which hasn't made as much of it available as China and other governments. A successful T-Mobile-Sprint merger, which is increasingly in doubt, could give the combined company a powerful position from which to compete with the traditional industry leaders in the next generation of mobile.

Stephen Lawson
special to **Light Reading**

CENTURYLINK CTO: EDGE COMPUTE & FIBER WILL SUPERCHARGE 5G

Ample fiber infrastructure and edge computing resources will play a key role in getting 5G services ready to go, says CenturyLink CTO Andrew Dugan.

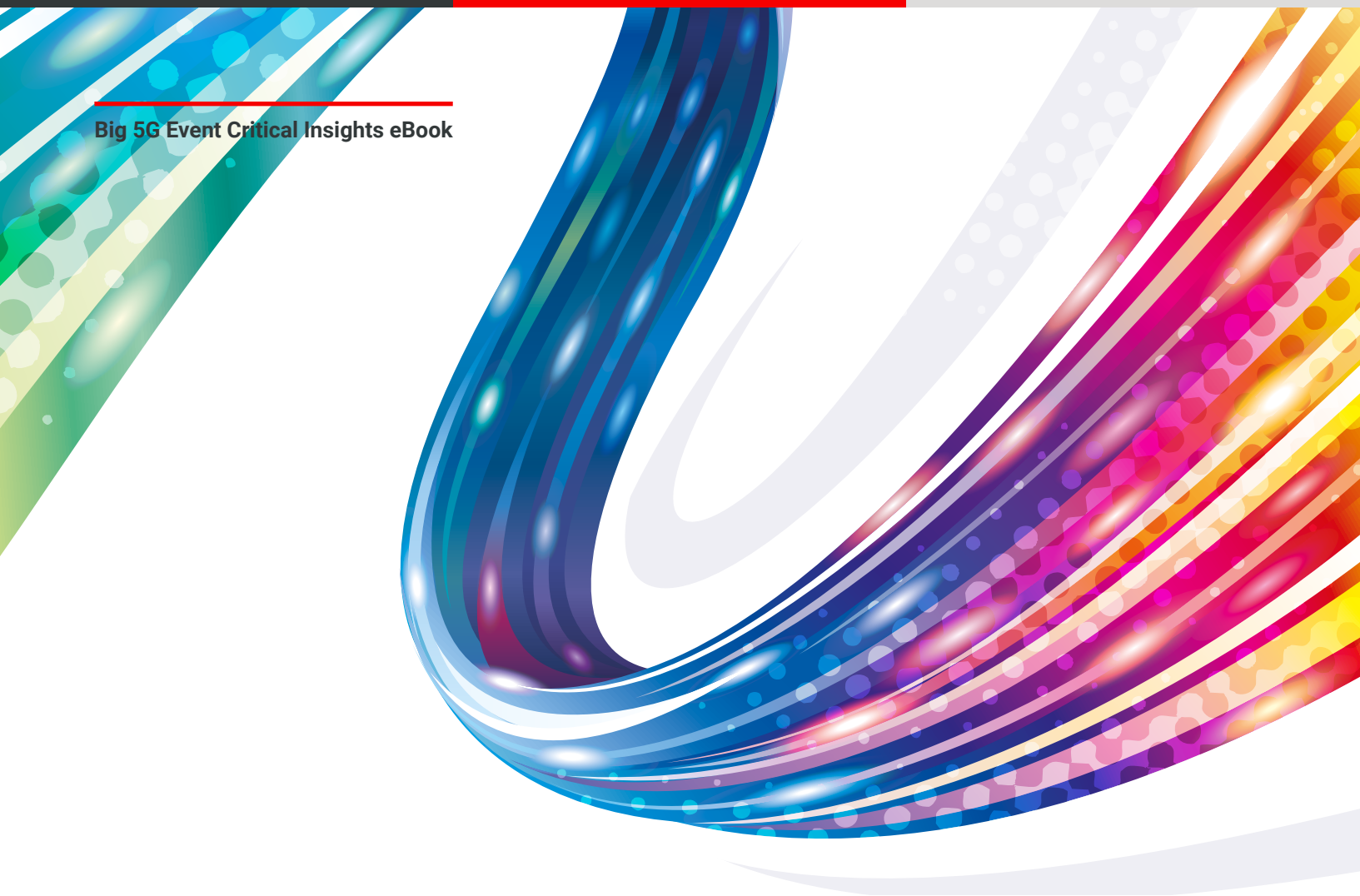
As 5G applications emerge, providing wired infrastructure to support mobile services will go far beyond just offering fiber, regional network operator CenturyLink says.

CenturyLink is already working with wireless operators that want to set up mobile edge computing, CTO Andrew Dugan said in an on-stage conversation at the Big 5G Event in Denver on Tuesday.

CenturyLink is a global provider of enterprise and residential broadband with an extensive fiber network. In addition to supporting 5G operators with fiber available for both macro and small cells, it has 3,500 sites with space and power where mobile carriers can deploy edge computing, Dugan said. That resource comes from the company's legacy as a telecommunications carrier, with facilities like a downtown Denver central office where ten floors were once filled with switches. Now, much of that space is free for customers' equipment, though it has needed retrofitting to meet growing power demands.

Mobile operators are part of the planned customer base for new fiber buildouts in Boulder, Colo., and other upcoming cities, he said. And with 5G, the market is not just growing but spreading out. "There's a lot of 5G suppliers that sort of come out of the woodwork once you start to say you're interested," Dugan said.

"Fiber network providers like CenturyLink and Zayo will help to make reliable, low-latency and quickly deployed 5G services possible."



The company's Programmable Services Backbone for edge computing is deployed in tens of locations across the US, Dugan said. Customers are presenting deeper requirements for specialized services, such as video monitoring at retail stores for checkout, security or foot-traffic analytics. Robotics control in factories is another new application.

Companies looking for those kinds of services are asking for network latency of 10ms or less. End users in those companies would like 5ms, but that's not necessarily practical yet, Dugan said.

Software-defined networking and dynamic computing capacity now allows CenturyLink to help customers build and connect applications on demand within minutes, he said. Customers can choose anything from pure space and power in a facility to a fully managed service.

CenturyLink is also a 5G operator itself, though on a small scale. In the US, it's deploying fixed wireless access in some rural areas using elements of 5G. Dugan cautioned the audience that 5G is still radio, and sometimes it gives far different speeds to customers in the same area. "I think we just need to be realistic about what the technology can do," he said.

Why this matters

5G networks to serve advanced applications in transportation, industry and other fields will need more than strong RANs. Speed and latency requirements will demand a much more advanced back end than 4G networks in use today. Ample fiber infrastructure and edge computing resources will play key roles here, and third parties will provide those pieces in many cases. Fiber network providers like CenturyLink and Zayo will help to make reliable, low-latency and quickly deployed 5G services possible.

Stephen Lawson
special to **Light Reading**

TELUS CTO: 5G IS LETTING US DOWN

Ibrahim Gedeon of Canada's Telus says there needs to be less focus on speed and more attention paid to real transformation.

The telecom industry has been crowing about 5G as the most transformational G ever. And yet what did operators do when it finally turned up? Use it to provide faster mobile connections and broadband services.

That's the frank assessment of Ibrahim Gedeon, the amusingly outspoken chief technology officer of Canada's Telus, and he's not at all happy about it. "We just spend more money and don't make more money," he said during a keynote presentation at this morning's Big 5G Event in Denver. "5G is letting us down."

Gedeon clearly isn't a fan of some of the more advanced "use cases" that are typically associated with 5G, either. "Can you please raise your hand if you would like to be one of the first people in the world to have a surgeon operate on you using a reliable network?" he joked. He seems equally unconvinced by talk of 5G-powered autonomous cars. Everyone appears to be doing their own thing, he said, perhaps alluding to some of the recent battles involving carmakers and telecom players over the technologies that will ultimately be used.

So what does Gedeon recommend? In a nutshell, he thinks there should be less focus on the radio side and more on how 5G will affect other parts of the telco network, and specifically the "edge" -- a promised land of opportunity for telcos that has been somewhat overlooked.

At least, it has been overlooked in some critical ways, according to Gedeon. While operators such as Verizon, in the US, and Deutsche Telekom, in Germany, are busy talking about their edge plans and trialing new services, the industry has yet to address some critical edge-related issues. Above all, if the edge means deploying the telco cloud and IT resources at customer premises, such as a sports stadium, then where is what Gedeon calls the "demark?" What does the customer actually own?

Ibrahim Gedeon, the chief technology officer of Canada's Telus, is not happy.

"We just spend more money and don't make more money, 5G is letting us down."

"We need to think of the demark. We need to think about APIs and gateways... Everyone talks about cloudifying, but everyone is busy doing EMBB [enhanced mobile broadband] and autonomous vehicles," said Gedeon. His other objective is to cut out some of the complexity in telco networks and operations by integrating the edge with the metro network, consolidating planning teams and ditching technologies that are driving up costs. "It is stupid to have two planning teams. Why is a wireline planning design acquisition team different from a wireless planning design acquisition team?" he said.

As for the technologies that do not meet Gedeon's approval, CPRI and E-CPRI are at the top of the list. These already have a bad rap in parts of the industry as semi-proprietary technologies used to support the "fronthaul" connections between radios and baseband processors. They are also an obstacle to simplicity, as far as Gedeon is concerned. "We need by design to think of a single metro. We have got to find a way to kill CPRI and E-CPRI because they will be the death of us. They will keep coming up with unique requirements for wireless networks that will deny us the right to put things on the same fiber-optic grid," he said.

Gedeon's remarks about the edge come just one day after his company announced a partnership with MobiledgeX, a software company owned by Deutsche Telekom (but managed separately) that is developing a middleware platform for third-party applications to run on an operator's edge computing assets.

The Canadian operator has said it will pilot MobiledgeX technology at "key locations" near the edge of its fixed and mobile access networks. That is a boost for the small company, which Deutsche Telekom is positioning as a global standard for middleware in edge computing.

"The idea is just to expose the edge cloud to developer communities in the form of APIs," said Alex Choi, Deutsche Telekom's senior vice president of technology, during a conversation with Light Reading earlier this year. MobiledgeX is also in trials with South Korea's SK Telecom, where Choi was the chief technology officer before he left to join Deutsche Telekom in 2017.

Iain Morris
International Editor, **Light Reading**

NEW 5G NETWORK SECURITY THREATS Q&A WITH YASIR LIAQATULLAH, VP OF PRODUCT, A10 NETWORKS

Yasir Liaqatullah, VP of Product at A10 Networks joins Phil Harvey, Light Reading US Bureau Chief to discuss the new 5G network security threats facing operators and mobile service providers.

DATA CENTER FIRMS, MOBILE OPERATORS POUR COLD WATER ON EDGE COMPUTING

Edge computing, particularly in the 5G world, faces a series of serious obstacles, according to several in the mobile network and data center industries.

The topic of edge computing has generated a significant amount of hype, and many in the space do agree it could play a key role in the ultimate development of 5G technology. But some top players in the mobile networking and data center industries are voicing serious concerns about edge computing in the near and even the medium term.

"Spend enough time in the telecom and technology industries and it becomes clear that the hype of many new technologies usually precedes the reality by 5-10 years. We believe that is the case with micro edge data centers," wrote Raul Martynek, the CEO of data center provider DataBank, in a lengthy post on LinkedIn. Some speakers here at the Big 5G Event echoed that sentiment.

Jim Poole, VP of ecosystem business development at data center giant Equinix, said that mobile operators would need to completely revise their network designs away from voice services to get edge computing to work in a 5G world. "This whole thing needs to be changed, rearchitected," he said. "5G is an extraordinarily daunting change."

Poole likened the process to "turning around an aircraft carrier, in the mud."

And even Ibrahim Gedeon, CTO of Canadian mobile operator Telus, warned that there's a serious chance that the edge computing space could get bogged down in the telecom industry's standards process. "It took us forever just to come up with ORAN," he said of the wireless industry's work to separate vendors' various network components from each other, a goal many refer to as "open RAN." He said ORAN efforts would be great "if it was 1985."

Edge computing proponents argue that the mostly centralized nature of the Internet today won't support the snappy, real-time services that 5G providers hope to offer, like autonomous vehicles and streaming virtual reality. Such services require almost immediate connections between computing services and users, and an edge computing design would enable that instant connection by physically locating data centers geographically next to the users that need them. Such a design -- dispersed computing instead of consolidated in one location -- potentially could eliminate the tens or even hundreds of milliseconds it takes for a user's request to travel across a network to a computer that can answer it.

At least, that's the idea.

DataBank's Martynek argued that, at least so far, there's very little need for hundreds or thousands of mini computing locations spread out all over the country. Specifically, he noted that there are already several data centers physically located in most major metro markets in the US. For example, in Los Angeles, there are already two or three computing facilities that potential customers could use, he said.

But Martynek adds that a growing number of regional data centers can handle most edge computing needs today. For example, he said DataBank currently operates a data center in Minneapolis, which is roughly a thousand miles away from the nation's three main data center hubs: Ashburn, Va.; Dallas; and Santa Clara, Calif. He said that one data center in Minneapolis essentially eliminates the need to build additional micro data centers in that city. "The incremental improvement from going from one data center location to 5 micro data center locations only improves your round trip latency by less than 1-2ms," he wrote.

As a result, he argued, "deploying in tens-hundreds-thousands of micro-data centers would only improve latency by 1ms or less, and in some cases introduce latency depending on where the peering occurs." Those comments essentially represent a dig at the likes of EdgeMicro and Vapor IO that are hoping to build out mini data centers in dozens of cities across the US.

Similarly, Equinix's Poole noted that edge computing is already available in a basic form today, considering that Equinix operates roughly 200 data centers around the world. And that raises the question of whether additional computing locations are really needed to support edge computing use cases like remote surgery or cloud gaming. "The classical mobile edge is a solution looking for a problem in some respects," Telus's Gedeon acknowledged.

However, most speakers agreed that, eventually, 5G would help spark more demand for edge computing services. "Does 5G need edge computing? I'd say the answer is yes. Does edge computing need 5G? The answer is no." Equinix's Poole said.

"I think edge computing is one of the two or three things that make 5G different," Gedeon said.

But Equinix's Poole argued that wireless networks need to essentially be redesigned in order to fully take advantage of the edge computing opportunity. Instead of routing all traffic through a handful of on-ramps, mobile operators will need to instead create ways for applications to immediately access local mobile users -- and to interoperate. For example, an autonomous driving system in Denver must be able to immediately route its traffic to 5G users in the city rather than through an operator's central routing location in Dallas -- and that system must also work regardless of whether the system uses AT&T or Verizon.

"This is real stuff. It has to happen. It can't not happen," said Poole, arguing that such complexity is akin to getting multiple technologies and companies to "dance on the head of a pin."

And Telus's Gedeon noted that, so far, there is no consensus about how 5G operators should design their networks to account for these kinds of edge computing use cases. "There is no fundamental way of rolling out the network," he said. "I fear we will all do our siloed things."

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SPRINT EYES IOT USES AS 5G LAUNCH APPROACHES

Ahead of its 5G launch, Sprint's Mishka Dehghan discussed the carrier's Curiosity IoT platform and highlights smart city applications that will take advantage of 5G's technical capabilities.

Roughly five years ago, the global wireless industry touted 5G as something that we wouldn't see until around 2020. And then everyone got 5G fever. As a result, wireless engineers -- spurred on by the whips of their paycheck signatories -- finalized a barebones version of the 5G standard in 2017 so that operators like SK Telecom and AT&T could get to market more than a year ahead of that initial schedule.

But now, here in the middle of 2019, today's 5G networks in the US don't inspire much confidence.

Verizon, for its part, was so desperate for 5G that it created its own 5G standard, 5GTF, so it could launch fixed wireless services to a handful of customers last year. Much of that equipment is going to be replaced with 3GPP-compliant equipment when Verizon restarts its fixed wireless buildout later this year.

Separately, Verizon in February launched mobile 5G services on the 3GPP standard in two markets across a handful of sites, with coverage that earned decidedly middling reviews. Likely as a result, Verizon has backtracked a bit on its plan to charge 5G customers an extra $10 per month to access the service.

But at least Verizon has been upfront about its early 5G efforts. AT&T boasted it was "first" to 5G with a launch of the service in a dozen markets at the end of last year. That "launch" is pretty much anything but, considering AT&T is offering the laughable pricing plan of $70 per month for 15GB of data and isn't actually selling the service to regular customers. Instead, AT&T's 5G network, now "available" in 19 markets, can only be used by "select" customers who are probably either employed by AT&T or are related to those who are.

AT&T, understanding its somewhat precarious position in these early days of 5G, also decided to throw the marketing equivalent of a smoke grenade at the problem by changing the LTE icon on a bunch of its phones to one that said "5G E."

Beyond such shenanigans, there's also evidence of the 5G rush job in the network core. Today's 5G operators are generally using the "non standalone" (NSA) version of 5G. This version of 5G runs off a 4G core and therefore it doesn't support fancy services like advanced network slicing. Verizon has said it hopes to move to a shiny new 5G core within the next year or two, though Ibrahim Gedeon, CTO at Canadian operator Telus, worried that his decision to embrace NSA really means that he's going to be stuck milking a 4G core for another decade.

And what of the other fancy features of 5G, like massive IoT and ultra low latency? Specifications for those technologies are scheduled for availability in -- wait for it -- 2020, when the 3GPP's Release 16 isscheduled to be finished.

"We believe the current investment opportunity associated with 5G is limited and unlikely to drive meaningful incremental upside for companies involved considering the mature state of the smartphone market," wrote the analysts at Wall Street research firm Cowen in a recent note to investors.

But congratulations are in order

All that said, bringing 5G into the real world in 2019 has given us important insights into two key areas: The 5G NR transmission standard and millimeter-wave spectrum.

The 5G NR transmission standard is the actual wireless part of the whole thing: It's the invisible magic that moves data through the air from a phone to a receiver, like a cell tower. 5G NR works, and it works pretty well. Meaning, it's at least twice as fast as LTE, with much lower latency. That's not revolutionary by itself, but it's a big piece of the puzzle. Did I mention it works?

The other big lesson we've learned this year is that millimeter-wave spectrum can be used for mobile, commercial services. This is important because, up until recently, it was considered mostly "junk" spectrum that was only good for applications such as backhaul. Adding a millimeter-wave option to today's wireless networks is like adding electric scooter options in downtown Denver: They help you get around quickly and easily in urban areas, but they're not much good in the suburbs.

But 5G NR and millimeter wave are just two elements in a much broader 5G story. The Cowen analysts describe "true" 5G as a network that couples NR transmissions across all kinds of devices and spectrum bands leveraging everything from edge computing to network slicing.

"Today's marketing hype around mobile 5G is tied to speed and the promise that devices (primarily phones) will be faster than the previous generation and ignores the two other 5G key performance indicators including latency and connected devices," the Cowen analysts wrote. "True 5G will require a significant investment in the network core, edge computing, and a small cell/ fiber network as 'true' 5G will further blur the delineation between wireless and wireline. True 5G will usher in new applications/use cases similar to how 4G helped to create Lyft."

This kind of "true 5G" is probably five to ten years away, considering it will be contingent on operators and others figuring out solutions to some seriously complex obstacles. But it's nonetheless possible. And potentially it's a big deal.

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5G WAS RUSHED TO MARKET – IT SHOWS

The global wireless industry rushed a barebones version of the 5G standard out the door so it could get to market more quickly. Today's 5G certainly reflects that haste.

Sprint played up future smart city and enterprise applications in its 5G development pipeline on Wednesday as both its initial commercial 5G launch and the fate of a critical merger with T-Mobile US loomed.

The fourth-largest US mobile operator plans to kick off a 5G service aimed at highly mobile users this month in New York, Los Angeles, Chicago and Dallas, said Mishka Dehghan, vice president of 5G development at Sprint Business. But the full benefits of 5G will only emerge over time, Dehghan said in her keynote speech Wednesday at the Big 5G Event in Denver.

She highlighted a few uses under development now. Sprint's Curiosity IoT platform, introduced last September, will power some of these applications, including smart city technologies being developed at testbeds in Greenville, N.C., and Peachtree Corners, Ga.

At the Georgia site, Sprint has deployed an urban transportation system that uses micropositioning -- a technology that uses the cellular network to do accurate, real-time location tracking of objects. Sprint has said micropositioning can provide location details of an object down to the inch, compared to GPS's 5 to 10 meter disparity. This, plus high-definition mapping, would allow autonomous vehicles to position and locate themselves, pedestrians and objects in the road to safely navigate city streets.

Dehghan also played up medical uses of 5G, though she became the second speaker here on Wednesday to downplay 5G remote surgery, once a commonly promoted application. "We could be talking about the benefits of remote surgery, but let's face it: Remote surgery is not going to happen in a meaningful way for another few years," she said. Earlier Wednesday at the Big 5G Show, Telus CTO Ibrahim Gedeon jokingly asked how many in the audience would volunteer to be operated on via 5G.

A more useful medical application in the short term will be remote consultations with a doctor made possible by 5G's high throughput and low latency, Dehghan said. Many patients who have to wait weeks to see a doctor in person now go to the emergency room instead, she said. Being able to set up a video call quickly could cut down on those visits, she said.

However, Sprint's 5G vision partly depends on the success of its proposed merger with T-Mobile, still awaiting federal approval. Last month, the Department of Justice reportedly warned the companies that the deal is unlikely to be approved in its current form.

On Tuesday, Sprint reported a net decline of 189,000 postpaid phone subscribers and a net loss of $2.2 billion for its most recent quarter.

Why this matters

Mobile operators are banking heavily on new kinds of enterprise services to make 5G more than a faster version of today's consumer mobile services, which are highly competitive and relatively price-sensitive. Specialized services that take advantage of new 5G features could help carriers differentiate themselves and attract lucrative enterprise contracts -- while also opening up new capabilities for their business customers.

Stephen Lawson
special to **Light Reading**.

5G POTENTIAL IS ALL IN THE TIMING

The move to 5G will also disrupt carriers' timing systems as 5G's timing and clock synchronization requirements are much more strict.

As 5G networks start to go live, mobile operators are working on one technology that's less sexy than connected cars or gigabit-speed video but could cause a lot of headaches if it doesn't work.

The issue is timing: Most carriers in North America rely on GPS to tell their cell sites what time it is. That works for timing and clock synchronization in 4G, but 5G networks have much more strict requirements, and getting out of sync could cause a site to go down.

The problem is one of the biggest worries for carriers implementing 5G transport networks, said Heavy Reading analyst Sterling Perrin, who led a panel on the topic at the Big 5G Event in Denver this week. In a Heavy Reading survey last month sponsored by four equipment vendors, 45% of respondents said network synchronization was of high importance.

Cell sites need to be on synchronized clocks to avoid interference among signals on the same frequencies. The T-1 lines that once served as backhaul for cell sites had built-in timing, but when carriers switched to Ethernet, that went away. Now, in North America, timing usually comes from GPS units on top of cell towers, using the atomic clocks of the GPS satellite network.

Several big changes coming with 5G are forcing carriers to rethink this approach, Perrin said. First, most North American 4G networks use frequency-division duplex (FDD) spectrum, but 5G networks are based on time-division duplex (TDD), which requires tighter synchronization. On top of that, the virtualized radio networks coming with 5G have their own strict timing requirements, with tolerances as low as sub-microsecond.

And in the dense 5G small-cell networks coming to cities, GPS units would be expensive to deploy and prone to coverage problems in urban canyons.

It's not enough to rely on GPS anymore, said Kevin Boyle, a customer solutions sales manager for Ericsson North America. If a 5G site loses its timing, the carrier will have less than an hour to fix it before the site shuts itself down to prevent interference with neighboring cells, he said.

"GPS today has been great, but if you get somebody with a jammer, or you get a GPS unit failure, you're going to have a problem with actually keeping your cell sites up," Boyle said. GPS jamming devices are illegal but can be found for less than $100 online, he said.
To prevent this, he recommends operators build in a backup for GPS. Ethernet now has timing mechanisms that allow for timing via the transport network, and carriers can distribute clocks around their infrastructure to keep cell sites synchronized, Boyle said.

For synchronization in its fledgling 5G network, Verizon is using GPS units at cRAN (centralized RAN) hubs that serve multiple cell sites as well as border clocks within the network. After using these redundant systems to ensure synchronization works, it hopes to move to a solely network-based solution in the future, said Glenn Wellbrock, Verizon's director of optical transport network architecture, design and planning.

Why this matters
As operators introduce 5G elements into their networks, reliability will be essential for getting customers to trust 5G services. Consumers will want to see predictable performance before paying a 5G premium, and enterprises will demand it before committing to the advanced services that the technology was built for. How mobile operators carry out the transition to 5G in their infrastructure, including implementing systems such as cRAN and new approaches to timing and synchronization, will be critical to making the new mobile applications they envision into commercial realities.

Stephen Lawson
special to **Light Reading**.

WHERE IS THE 5G EDGE? TOMORROW'S APPS DEPEND ON THE ANSWER

To build the edge computing capabilities that 5G applications need, carriers need to find out where more processing is needed – and that's not terribly clear at the moment.

If a 5G network's edge can be distributed, where should it be? That issue came up several times at this week's Big 5G Event in Denver as vendors and operators discussed how to turn advanced 5G applications into reality.

In addition to being designed for RAN latency of less than 1ms, 5G will allow for virtualization and distribution of the systems behind the RAN, including baseband units remote from radio head and computing moved away from centralized clouds. Exactly where those elements should reside will depend on distance and cost, and no yet one knows where the edge should be, Heavy Reading analyst Sterling Perrin said. There may even be more than one.

The original concept for mobile edge computing (MEC) was to place servers for application processing in a macro cell site, which would also put them close to small cells. But in the past year, carriers have balked at the cost of that approach, Perrin said. Now they are looking at placing it in their central offices (COs), which would mean deploying to just a fraction of the number of sites. And there are other options, including processing at the customer site and partnering with operators of local data centers.

Depending on how many low-latency services carriers can sell, any or all of those options might pay for themselves -- but the operators don't yet know what services will take off. "You have to spend a lot of money to make a bet, and it's too early to make a bet right now," Perrin said.

It's not even clear what all the options are for where to locate the edge, Perrin said. This could be the next question for the industry to tackle. "I think the menu is going to be more clear in a year," he said.

Infrastructure providers such as Zayo Group stand to gain a lot by hosting edge infrastructure in their facilities. On Wednesday, Zayo agreed to a $14.3 billion buyout by two investment firms. The company owns 12.2 million miles of dark fiber in North America, the UK, France and Ireland, and offers managed services.

Mobile operators need to decide where to place the 5G edge as they adapt to demanding new applications such as connected autonomous cars, said Brian Daniels, Zayo's senior vice president, strategic networks, Z5G. He spoke at the event on Tuesday.

MEC all the way out at macro sites is more than just a monetary challenge, Daniels said. Most existing cell sites aren't equipped to host what is essentially a small data center, because they lack features such as redundant power.

Further complicating the problem of where to put the edge is distance, which affects latency even if the link between the elements is fiber, he said. Applications that work downtown might not work in surrounding areas or suburbs without edge infrastructure closer to the site.

Applications will drive service providers' choices about where to locate the edge, but it's not clear which ones, Daniels said. "Nobody has a concrete idea of what's going to put the dollars around this," he said.

AT&T plans to use several edge computing approaches to cut what is roughly a 100-millisecond roundtrip latency between customers and a central cloud, said Jeff Shafer, associate vice president of edge solutions and portfolio transformation.

Computing in the metro network, with no need to send data to the central cloud, can cut the roundtrip latency to 20ms, he said. Moving data processing all the way out to the customer edge, in servers owned by the customer, carrier, or local data center company, can slash that to 10ms or less, Shafer said.

For a test of drone-tracking technology from Israeli startup Vorpal, AT&T has set up servers at the network edge to do real-time processing of data coming from Vorpal sensors.

The passive sensors, connected to the mobile network, use the drone's radio signals to track them. From the mobile network, that data goes to the servers at the edge of the network. This provides the latency required for real-time tracking while not requiring server rollouts to the test site. Servers can be deployed and scaled more quickly at the network edge, Shafer said.

Why this matters

For 5G networks to deliver the digital transformation that enterprises have been told to expect, changes need to take place across transport networks and computing infrastructure as well as on the RAN. Large commercial deployments of advanced applications may have to wait until the range of choices for how to make those changes is broken down. That effort will require cooperation among wireless operators, service providers, vendors and potential customers.

Stephen Lawson
special to **Light Reading**.

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Securing the Future of a Smart World – Opportunities & Challenges in a 5G Connected Economy. Business Performance Innovation (BPI) Network in partnership with A10 Networks, conducted a global survey of communications service providers to understand industry intentions, priorities and concerns about 5G. The study includes a survey of 145 IT and business leaders at communications service providers globally.

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Service providers must defend mobile network infrastructure, applications and subscribers against malicious online threats and multi-vector attacks, while maintaining always-on network availability and the best possible subscriber experience

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Mobile networks are evolving quickly to 5G–and so are the vulnerabilities. Cyber criminals have increased their capabilities and the network complexity itself is no longer a barrier to attackers. This white paper describes the escalating threat landscape for mobile operators and outlines a strategy for securing the mobile core using a comprehensive security stack.

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