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5G monetization: Key challenges, opportunities

Deloitte.

By RCR Wireless News staff



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5G market outlook: **Beyond predictions and into real** business applications

5G offers 'a long tail' of services and monetization opportunities

5G is setting the stage for a boom in cellular use cases that extend beyond those in the consumer segment, creating what Stéphane Téral, chief analyst at LightCounting, called "a long tail of services," all of which come with their own potential for monetization. Opening up Arden Media's recent 5G Monetization Forum, Téral shared his perspective on how operators (and partners) should be thinking both near- and long-term about

leveraging network investments to capture new revenues from new and existing markets.

5G's promise of lower latency and higher throughput, for instance, is being used to address enterprise, Industry 4.0 and autonomous vehicle needs, opening up new monetization opportunities for communications service providers (CSPs), as long as they carefully pair technology investments to desired business outcomes.

That's not to say that new revenue opportunities are not waiting to be unlocked in the consumer segment. Particularly in the U.S., operators are standing up fixed wireless access home internet service and going head-to-head with cable companies. There are also emerging device types, cellular-connected PCs and AR/VR products, that could push ratepayers into new plans with more lines. Gaming is also a nascent area for operators with the logic being that mobile gaming is a growing space, and it could certainly benefit from 5G, so there might be an opportunity for a premium-priced gaming tier.

To better explain these two paths to 5G monetization and how they relate, Téral tapped into the Region (R) concept. First published in a 2013 Bell Labs' research paper,



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the concept is an attempt to map the possibilities of the next generation of cellular technologies by determining the boundaries of possible data rates as network users increase. Ultimately, Téral concluded, two forms of 5G monetization are established: direct and indirect.

Region 1: the low-hanging 5G monetization fruit

According to Téral, the industry is currently in Region 1 (R1), and while Region 2 (R2) requires ongoing research to improve spectral efficiencies (and will possibly be reached in 6G), he believes there already exists significant potential for Region 3 (R3) and Region 4 (R4). Considered to be direct monetization, R1 involves enhanced mobile broadband (eMBB).

"[In Region 1], you have the service providers collecting 5G revenues if they do a good job of selling the network and coming up with packages that people are willing to pay for," said Téral, providing specific lifestyle needs such as video streaming, cloud gaming and immersive sports and music events with AR/ VR services as examples of such premium-tier consumer services.

"And then, gradually, you go after the rest of your subscriber base," he continued. "That is the process we are observing. Region 1 is clear cut." And by that, he means it's simple and reflects monetization models of the past.

LightCounting estimates that global 5G revenues were between \$15 and \$20 billion in 2021, with 86% coming from R1 services, driven by strong 5G subscriber uptake in China and Korea, both of which implemented "winning" 5G consumer strategies, according to Téral.

Using supporting materials from Ericsson, Téral laid out these strategies: "Number one, build a network [that] is cost-efficient and scalable. Then you have to look at how to deliver the best smartphone experience. Eventually you expand the 5G [wireless] coverage. Then [...] you go after fixed wireless, as well. Then, beef up the pricing strategy [and finally] you lead with innovative and immersive services."

In South Korea, almost 30% of mobile subscribers — equal to 20.9 million — are on 5G as of the fourth quarter of 2021. That number is even greater in China, reaching 730 million subscribers as of the end of 2021. In the U.S., however, 4G remains the dominant consumer revenue engine because 5G operations in low-band spectrum are not yet producing speeds faster than 4G. "The U.S. [started] 5G on the opposite side of the rest of the world," explained Téral. "They didn't have mid-band. T-Mobile [does] after acquiring Sprint [and that] put T-Mobile in a sweet spot. In fact, it is now the poster child of real 5G, if you wish, in the U.S."

While AT&T does not publish their average revenue per account (ARPA) data, both T-Mobile US and Verizon's ARPA figures are increasing, so Téral expressed confidence that "things are looking up in the U.S.," adding that the deployment of C-band will provide additional revenue opportunities for U.S. operators.

Region 3 and Region 4: 5G as the complex enabler

Region 3, which involves mMTC (Massive Machine-Type Communications), and Region 4, which involves uRRLC (ultra-reliable low-latency communications), are examples of indirect 5G monetization, and Light-Counting estimates that these two regions raked in a combined 5G revenue of between \$2 and \$2.8 billion as of 2021, based on GSA, Ericsson and Nokia data points.

From Téral's perspective, R3 and R4 both represent a "more complex environment characterized by the need for tight cooperation and



Source: Bell Labs' research paper, Five Disruptive Technology Directions for 5G, IEEE Communications Magazine, December 2013

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partnership between various players to solve a specific issue."

In other words, these regions require knowledge of enterprise, industrial and government needs so that an ecosystem of partners can be developed specifically to address those needs.

"In Region 3 and 4, 5G is the enabler," said Téral. "This means it's not necessarily the service provider that is going to collect money for a particular use case; it can be a partnership between a service provider, a systems integrator and a vendor. 5G is being used [...] to solve a problem and [...] this is not a direct 5G monetization item."

In this case, he continued, 5G is simply helping a customer achieve a desired business outcome, such as providing further efficiencies within a factory, and in doing so, the customer deploying 5G is also collecting on the extra revenue. All of this, he said, makes it challenging to parse out who can truly claim additional revenue from 5G services.

The bottom line, Téral concluded, is that there is a long journey ahead for the monetization of 5G, but CSPs can start by tuning up their 5G network to deliver the best experience possible and offering tailored packages to those consumers willing to pay a premium. The next step, R3 and R4 will take more time to establish, particularly because Wi-Fi and LTE are good enough for most current IoT application, and when it comes industrial 4.0, 5G will have to compete with other technology offerings like non-cellular Bluetooth Low Energy (BLE) indoor tracking systems, LPWAN, NB-IoT, LTE-M and non-cellular LoRaWAN.

"We are on a long journey; it has started. That's the good news," he said, adding that by following in the steps of those leading the industry, like South Korea and China, and heeding the roadmap laid out by Ericsson, the industry will "get there" in terms of monetizing 5G across R1, as well as the more complex and elusive R3 and R4.

How can telcos tap into the \$400 billion XaaS opportunity?

Anything as a Service (XaaS) represents a more than \$400 billion market opportunity by 2025 for CSPs, according to Bain & Company. What's more, the company's research suggests that by then, half of telecom enterprise revenue growth will come from XaaS models, assuming they're able to differentiate themselves from hyperscalers.

Bain sees XaaS opportunity for telcos by catering to enterprise and large business-to-business (B2B) segments ready looking for outcome-driven solutions enhanced by the dynamic, scalable framework cloud-native services provide. Bain said telcos that are



Sources: Technavic; Markets and Markets; Bain & Company

Image courtesy of Rakuten Mobile

experiencing early success have identified both broad market categories and promising niches which draw on carriers' core competencies and foundational technology. Operators that narrow focus may increase the chances of success with sufficient investment, they assert.

Examples of where this has proven to be true for Vodafone Americas include growth areas like private 5G, healthcare, manufacturing, and logistics businesses, according to David Joosten, Vodafone Americas regional manager. "I think that's where we see most monetization happening at this point," he said.

Joosten emphasized that the technology is secondary to how it helps the customers. "Our customers are not necessarily looking for products," said Joosten, nor do they want to become subject-matter experts with the tech or telecom they're using. They're trying to solve a problem. "In every offering that is put out to market or how we position ourselves, it has to be oriented around the business outcome," he added.

Deliver outcomes, not tech

The proof of the pudding is in the eating, asserted Arpan Tiwari,



Deloitte TMT managing director. At a time when the economy has pivoted to a consumption model and XaaS is practically everywhere, carriers must deliver solutions which provide tangible benefit to enterprise customers.

"If there is no success that the enterprise is getting, there will be no consumption," he said. "I've seen this shift in thinking vis a vis the operators."

An emerging challenge in finding these new market opportunities is having the institutional knowledge to be able to fluently communicate with customers in increasingly specialized, highly technical market niches, said Tiwari.

Build an ecosystem

"How do you gain the specific industry vertical knowledge?" Tiwari asked. Telcos can't do it alone. Acquiring domain-specific knowledge to address specific XaaS segments requires carriers to think about strategic hires and acquisitions, he said.

Operator success will depend on building partnerships with system integrators and emerging players to help create a viable and sustainable ecosystem for future business growth. That sentiment is shared by both Bain and the panelists. "There is a really big need for ecosystem," said Vodafone's Joosten. Telcos can't possibly create solutions to suit every business need, so it's imperative they draw from outside expertise. "We need to create open platforms," he said.

Test, iterate and see what works

Competing with hyperscalers requires adopting a cloud mindset, Bain said. Testing, deploying and being agile enough to respond to market changes are all essential components of this success. 5G requires a platform that's agile and flexible, said Azita Arvani, GM of Rakuten Symphony America.

"Offering these things as a service to operators allows them to play around and see what works for them, going with much lower investment," said Arvani.

The continuous integration/continuous deployment (CI/CD) lifecycle is at the core of successful cloud-native businesses. Operators must view their platforms through the lens of continuous improvement, said Arvani.

"Lowering the friction with enhancements, throwing innovation in, and being able to try new innovations from different vendors using an open model is really critical," she added.

What is Disruption-as-a-Service? An interview with Azita Arvani, Rakuten Symphony

XaaS - on-demand services running in the cloud - will represent a \$400 billion market opportunity for CSPs by 2025, as established by the aforementioned report by Bain & Company. The firm predicts that by then, half of telecom's revenue growth in enterprise and B2B sales will come from XaaS models - assuming they can differentiate themselves from hyperscalers.

Bain contends that the early leaders in the telco market who are finding success with the "as a Service" model have gone cloud-native. They're adopting the agile operational characteristics of cloud service providers, and they're open to exploring partnerships and acquisitions to build that expertise.

XaaS has already proven to be a disruptive influence in the public cloud services market. Studies show Anything as a Service is a key growth driver of public cloud spend now and in the future. Finding success in the XaaS market starts with a disruptive mindset, contends Azita Arvani, the North America-based general manager of Rakuten Symphony.

Rakuten describes Symphony as telecom reimagined for the



"The first principle for us is about the mindset. We need to continually disrupt ourselves." *Azita Arvani, Rakuten Symphony*

hyperscale era. Rakuten's core competency is as a cloud company, not as a telecom, Arvani readily admits, and that's precisely why they were able to disrupt the market. Arvani, who recently took part in RCR Wireless News' 5G Monetization Forum, said Rakuten is the first and still the only end-to-end cloud-based telco in Japan, and the only one to have deployed Open RAN at scale.

Rakuten has brought Disruption as a Service to the telco market by reimagining the network itself as a service. As part of their larger-reaching mobile strategy, the next step is to scale it globally.

Upcoming Events



PRIVATE NETW@RKS GLOBAL FORUM

May 24th 2022, 9AM Eastern / 2PM UK Free Virtual Event

The New World of Private Networks: Exploring the Backbone of Digital Transformation

Private networks are powering innovation across all sectors, allowing businesses to unlock exponential growth. Enterprises are under constant pressure to improve product quality, boost efficiency, stay competitive, enhance safety, security and sustainability, all whilst remaining profitable.

This day-long event will consider the various different private network deployment models, the developing market for licensed and unlicensed 'vertical' spectrum, the investment case for enterprises to scope new private-network installs, the question of infrastructure design and management, and the key use cases that these new private networks will engender – among a host of other topics.

www.privatenetworksforum.com



June 7th, 2022 9:30AM UK / 10:30 CET Free Virtual Event The First Dedicated Open RAN Event for Europe Free to Attend Virtual Summit

With a specific focus on European market development, at this event we will examine the evolving vendor ecosystem, investment and Open RAN deployments made by European carriers to date. We will discuss the latest on network economics, commercial deployments, security, interoperability standards and design specifications, and the continuing debate regarding interoperability and parity of performance.

www.openranforumeu.com

Explore all upcoming events at <u>RCRWireless.com/events</u>

Disruption is easier from the outside

"The first principle for us is about the mindset. We need to continually disrupt ourselves, we need to disrupt the industry, the technology we're working on, we can't get comfortable with just one big innovation and try to get the last drop of value out of that," Arvani said.

Disruptive transformation in telecom for Rakuten centers on what Arvania describes as four strategic innovation pillars: Disaggregated Radio Access Network (RAN), unified cloud, massive automation, and platform organization.

Disaggregating the RAN and aligning the cloud infrastructure requires a shift in operational mentality from purpose-built software and hardware to virtualized software running on commodity IT hardware.

"That brings the cost down and brings a lot more flexibility and elasticity to the system," she explained.

An efficiently designed and unified cloud service is essential to coordinate all network elements, said Arvani.

"It enables better resiliency, higher availability, it provides higher elasticity," she said. "You can do oneclick deploys, upgrades, one-click scales and backups. This instantaneity is the key. "It allows you to continuously upgrade the products that you have at the cloud's speed, not the traditional slow model of development," she said.

Massive automation yields productivity gains

Disruption as a Service requires nimble operations. Network automation can essentially be thought of as cloud infrastructure's atomic-level activity. Network automation is the process that governs the operation of the cloud from its data center core out to the very farthest edge. It's what enables the cloud to work at scale.

"Massive automation is big for us as well," said Arvani. "It's made our operations staff 20X more productive, and we aspire to be a Level 4 Autonomous Network."

That's one step below the <u>TM Forum's</u> fully autonomous ideal, where "the system enables, in a more complicated cross-domain environment, analyze and make decisions based on predictive or active closed-loop management of service and customer experience-driven networks."

That disruption extends to looking to create market opportunities amidst the disruption. Arvani points to Symware, Rakuten's RAN as a service offering.

"Now we're disrupting an area we

never thought could be a service – RAN and a Service," she said.

For another example, Arvani notes that Rakuten's Symworld brings app store-level ease of use and deployment to telco network management.

"Innovation culture is really the engine powering that Disruption as a Service," said Arvani.

How is E2E orchestration key to fulfilling the promise of 5G? An interview with Alla Goldner of Amdocs



Operators are facing challenges along multiple vectors with the complementary yet distinct transitions to Standalone 5G, disaggregated network systems, and cloud-native operations. At the same time, there are multiple vectors of opportunity to leverage network investments



into new service revenue streams. A key piece of aligning the reality of 5G with the hype it has generated is E2E orchestration of both the network and of services, according to Alla Goldner, director of technology, strategy and standardization with Amdocs.

"This all together into the same picture actually brings you the critical technology enablement from one side and, from the other side, a demand for those new on-demand services," Goldner said in an interview. "Orchestration, design, inventory and assurance are really four key elements of the E2E orchestration solution."

The North Star here—encompassing the shift to 5G Standalone, the flexibility that comes with multi-vendor network systems, and increasingly automated cloud-native operations-is the ability to spin up a network slice. This cross-domain virtual partition of a network would provide the user with exacting service parameters on-demand while enabling the operator to make the most efficient use of network, spectral and other resources; and (ideally) it would all happen automatically. But, as Goldner notes, standing up a slice that spans the core, transport, RAN and edge domains is a challenge.

"By now," she said, "everyone realizes that there is no single killer application. The key of 5G is actually in combining those applications" and delivering them on-demand. "Building such a slice across a different domain or supporting several applications at the time by allocating those slices is definitely a technological challenge and quite complex and quite advanced network management capabilities are required here."

As operators work towards network slicing and attendant capabilities, Goldner reiterated that there's no single orchestration solution that manages everything, rather it's a layered approach. "The highest layer would be service orchestration which supports super complex service decomposition into the network, translating parameters of the service into network parameters."

She likened this layer of orchestration as providing an overview of domain-level orchestrators for the core, transport, RAN and edge. The highest layer "gets and correlates information from those domains, and manages those domains in a closed loop. That layer has the most complexity...and also that layer basically is the layer responsible for instantiating, for establishing, the slices."

With a service orchestrator talking to domain orchestrators, the next need is for unified design of slices according to service



Image courtesy of Amdocs

demands "which works E2E by getting into different domains and design parameters within those domains," Goldner said. Next is inventory "which is close to a real-time single source of truth that covers both network and service parameters and sees everything which is happening to the network in real time." Last "but not least" is running service assurance which itself also has a layered architecture. Assembling these layers in a hierarchical, logical way allows operators to conduct E2E orchestration of network slices and the services traversing those slices.

In addition to the E2E orchestration piece, another best practice is to develop what are essentially network slice templates modeled on service parameters and necessary network functions that may be shared or dedicated to specific network slices. Further, Goldner noted that operators need to be aware of complexities that come along with integrating telecom networks with centralized and distributed, and public, private, and/or hybrid cloud infrastructure.

With regard to multi-cloud operations and management, "There is actually a big technological challenge of how you combine those clouds, how you manage dynamically the service, and deciding finally how you instantiate those network network functions and then those slices.

As Standalone 5G footprint grows, Vodafone advances network slicing capabilities

As it continues to leverage investments in Standalone 5G, Vodafone today announced a successful lab trial, conducted with Ericsson, of automated creation of a network slice tuned to support virtual reality in a retail environment. According to Vodafone, it took 30 minutes "from placing an order to creation of the network slice to carry live network traffic;" the operator reported the slice "guaranteed" 260 Mbps download speed, 16.5 Mbps upload speed, and 12.4 milliseconds of latency.

This builds on nearly a year of Standalone 5G activity for Vodafone. With network slicing, the company is talking the ability for customization based on service requirements with use cases in the areas of remote working, mobile and cloud gaming, autonomous vehicles, and remote assistance.

Vodafone U.K. Chief Network Officer Andrea Dona said in a statement, "Network slicing is an incredibly valuable step forward. By segmenting our network, and customizing different slices for different requirements, we can bring to life new ideas that would be impossible otherwise. When we configure our network to empower new services, industries like gaming, entertainment and healthcare can enter a new era. What might seem like science fiction is one step closer thanks to network slicing."

For this trial, Ericsson lent its containerized Standalone 5G core and automated orchestration solution.

In June last year Vodafone U.K. launched a commercial Standalone 5G pilot in London, Manchester and Cardiff, with the goal of testing new features, including network slicing. In this case, Vodafone carved out a virtual network for Coventry University to use for VR-based distance learning. Ericsson was also the key vendor here.

Rather than viewing network slicing as a point solution, Dona said it "complements our investments in multi-access edge computing capabilities, the internet of things, mobile private networks and Open RAN."

Beyond its Standalone 5G activity in the U.K., Vodafone is also active in its German and Spanish markets. In April 2021, Vodafone Germany upgraded 1,000 3.5 GHz sites to connect to its Standalone 5G core. Vendors included Ericsson, Nokia, Qualcomm and OPPO. In July 2021, Vodafone Spain tapped Ericsson for its pre-commercial Standalone 5G core deployment. Julia Velasco, Vodafone Spain's network director, called the pilot launch "a critical step towards delivering the full potential of 5G service," adding that Ericsson's solution will address those applications that require "the fastest connectivity, highest data rates and lowest latency."

Vodafone is further working on Standalone 5G in the Czech Republic, Hungary, Ireland, Portugal and Romania.

The real complexity in network slicing lies in multi-domain—core, transport, RAN and edge—orchestration and management of both the network and service or services. For this part, Vodafone is using VMware's Telco Cloud Platform to manage its Standalone 5G networks with plans to ultimately use the platform across its footprint.

Commenting on the deal in November last year, Vodafone said the telco cloud stack lets it "securely design, build, test and deploy next generation functions 40% more quickly and for half the price."

Standardizing on VMware's Telco Cloud Platform helps Vodafone scale services to meet burgeoning demand, according to CTO Johan Wibergh. "Having launched the first 5G standalone network in Europe, we are now putting all that power into a single cloud-based platform to simplify operations and rapidly respond to customer's needs across Europe and Africa. It starts with 5G at the core, but the possibilities are limitless."

Is mmWave the key to consumer 5G success?

It's about finding the hot zone for mmWave in consumer 5G, and building the ecosystem.

The massive bandwidth contained within 5G millimeter wave (mmWave) spectrum holds tremendous promise to unlock new services. Finding the right deployment strategy has proven to be



"This market needs more alliances." Maryam Rofougaran, Movandi

challenging for some CSPs who face coverage and propagation issues using the tech.

The devil is in the details, or so the saying goes. Finding the right deployment strategy is also the secret to unlocking mmWave's promise.

"There's huge bandwidth in this spectrum, and that's required for the real promise of 5G," said <u>Movandi</u> CEO and Co-founder Maryam Rofougaran.

From Irvine, CA-based Movandi's position as a full-stack mmWave solutions provider, getting 5G mmWave to work as a solution to provide fixed wireless access isn't about technical challenges. And it certainly isn't about developing a market; she pointed to statistics showing large tracts of the U.S. population without high-speed access, either because they're too remote for companies to bother or in urban areas burdened with aging communications infrastructure. It's about aligning a supply chain that answers customer requirements.

"So far the challenge has been that the devices have not been available, or if they were available, they were too expensive," said Rofougaran.

There's a considerable market opportunity: Rofougaran points to Research & Markets data that says the fixed wireless access market will grow from \$823 million in 2021 to \$3.3 billion by 2026.

Making the mmWave case for carriers

Making the business case for telcos to deploy 5G was the recent focus of <u>research conducted by Bell Labs</u> <u>Consulting</u>. Finding the revenue potential for mmWave involves deploying the technology strategically, according to Stephen Rose, Executive Partner, Bell Labs Consulting.

"We could see that most operators...would be able to achieve an 8 percent growth in their top line. That's massive," said Rose. "That would be a hard statistic to sniff at."

Bell Labs identified what it terms as "hot zones" for mmWave deployments: indoor shopping malls, stadiums, train stations in urban areas,



outdoor hotspots and more.

"The business viability of mmWave is sensitive to certain factors like subscriber density, the size of the hot zone and the penetration of mmWave devices," he said.

Hot zones are high-density locations identified by operators, Rose explained. They're places where the operator perceives a business opportunity based on demand. Finding the right mix is key, he said.

Bell Labs said that a range of 1,000 to 3,000 subscribers per hot zone is the Goldilocks zone for U.K. 5G mmWave deployments. Go too high, you run the risk of reducing your total addressable market, Bell Labs tells CSPs. Go too low, and you won't have a viable business to build.

Building the mmWave ecosystem

Qualcomm and Movandi's recently-announced partnership hopes to move CSPs in the right direction by providing a more economical way to deploy mmWave in those hot zones identified by Bell Labs. Qualcomm and Movandi are combining the capabilities of mmWave small cells powered by Qualcomm FSM 5G RAN Platforms and Movandi-powered 5G smart repeaters. Their goal is to lower the cost of mmWave deployment costs for carriers.

"This market needs more



alliances," Rofougaran said.

The new partnership may prove once and for all that mmWave's well-documented challenges are, in the right hands, opportunities.

Rofougaran said that mmWave can even ensure better network security because the frequencies won't penetrate too much beyond the walls of an enterprise or business.

"The penetration issue, the lineof-sight issue, these could actually be advantages in some cases because you can actually control the signal better," she said.

What is the impact of the semiconductors supply chain on the 5G agenda?

Supply-chain constraints are disproportionately impacting the non-advanced chipset market, signaling a particular challenge for 5G

Global supply-chain constraints, driven mostly by the COVID-19 pandemic, are continuing to impact nearly every industry, even as much of the world is returning to pre-pandemic life. In the telecoms market, this issue has been exacerbated by global sanctions enacted against the Chinese vendor Huawei

Company	2021 shipments (in millions)	2021 market share	2020 shipments (in millions)	2020 market share	Year- over-year change	
Samsung	272.0	20.1%	256.6	20.0%	6.0%	
Apple	235.7	17.4%	203.4	15.9%	15.9%	
Xiaomi	191.0	14.1%	147.8	11.5%	29.3%	۲.
Орро	133.5	9.9%	111.2	8.7%	20.1%	f ID(
vivo	128.3	9.5%	111.7	8.7%	14.8%	tesur
Others	394.3	29.1%	450.5	35.2%	-12.5%	2007
Total	1,354.8	100%	1,281.2	100%	5.7%	ata.

and by an increase in consumer and business demand for connectivity infrastructure and solutions.

During a panel discussion at RCR Wireless News' 5G Monetization Forum, Keith Mallinson, founder of WiseHarbor, and Neil Shah, vice president and co-founder of CounterPoint Research, spoke more specifically about where the constraint is being felt within the telecoms industry and how it's impacting the 5G agenda.

"Supply hasn't completely disappeared," Mallinson pointed out, commenting that many smartphones are still readily available. "The top five smartphone OEMs actually all increased their market shares and their sales volumes significantly year-over-year in 2021 ... partly because they had better supply-chain arrangements with more component inventory and longer-term supply contracts and others." IDC data supports this claim, showing that the overall smartphone market experienced a 5.7% increase in 2021 shipments despite a "sluggish" final quarter of the year that saw a 3.2% decline.

Mallinson went on to say, however, that these OEMs have indicated that while they have an adequate supply of advanced nodes, they are being hit by a shortage of legacy nodes, which signals a particular challenge for 5G.

"With 5G, everyone is looking for those killer applications beyond smartphones and those are IoT, robotics, AR and VR [and] FWA," said Shah, explaining that these use cases don't require advanced smartphone chipsets, and therefore, are subject to the very supply-chain constraint outlined by Mallinson. "This situation will remain for at least another year," Shah predicted. Routers and other Customer Premise(s) Equipment (CPEs) are also being impacted because they too require low-end chipsets. Wi-Fi, for example, is facing high constraints, Shah said.

Even further, Shah expressed that when it comes to 5G monetization, Fixed Wireless Access (FWA) would have been "a clear application" if only there was no pandemic. "We would have seen more FWA roll out ... everywhere globally, but that was not the case because of the CPU supply constraint and again, the biggest CPU vendor is Huawei, so they could not get chipsets [out] ... and the transition for someone like Vodafone or European operators moving from Huawei-based CPE to [another vendor] took almost 16 to 18 months."

"[The pandemic] has caused so many disruptions to the sort of balance and the continuity that there were in various supply chains. Because of the structure of the chip industry with large-cap investments required and fixed capacity, it's much more difficult for things to adjust," commented Mallinson. "You've got the auto manufactures, for example, who reduced their production and reduced their orders initially, and now things are snapping back in the opposite direction. For the folks who haven't gotten themselves well-lined up, they're going to continue to face some problems."



Verizon executives field questions from financial analysts at a March investor event.

Verizon building a 21st century infrastructure to support five vectors of growth

As discussions among operators turn to monetizing massive investments in 5G networks, Verizon in March held an investor event that laid out in detail how it sees its network creating new service revenue in the near term. Key drivers of revenue growth identified by executives include fixed wireless access home and business internet, premium and value 5G mobility, mobile edge computing (MEC) and other B2B solutions like IoT and private networks. And those are opportunities that will scale as Verizon expands C-Band 5G coverage to 175 million people by year-end.

Detailing the revenue side, Verizon estimates service and other revenue growth of 3% this year, "at least" 3% in 2023, and 4% in 2024 and following. CFO Matt Ellis also put this in the context of capital intensity dipping below 12% in 2024 when the initial C-Band build is complete which equates to higher free cash flow.

CEO Hans Vestberg said Verizon has spent the past few years redefining itself resulting in a much larger addressable market than it has had in the past. "I hope you get the feeling for the things and actions we're taking...how we've redefined Verizon, putting the Verizon intelligent edge network as a base, putting the network-as-a-service on top of it, then having the five vectors of growth which leads to the financial commitments."

With regard to 5G-backed FWA, Verizon said it plans to cover 50 million households and 14 million businesses and have 4 million to 5 million FWA subscribers by the end of 2025. The long goal is becoming a nationwide broadband provider and making FWA the second largest contributor to revenue growth behind mobility.

In terms of near-term monetization, Verizon sees fixed wireless



"We aspire to lead the industry and become the first nationwide broadband provider through fiber, 4G and 5G fixed wireless access."

Rima Qureshi, Chief Strategy Officer, Verizon



access being its second biggest line of business behind mobility.

"With this new alternative to traditional broadband, we intend to disrupt an existing market," Chief Strategy Officer Rima Qureshi said. "On the consumer side, our wireless customer base offers a significant opportunity to bundle our offerings with home broadband and extend average customer lifespan with simple and flexible plans."

For private networks, Verizon announced this week it was building out a system for <u>BlackRock's</u> <u>headquarters</u> at Hudson Yards in New York City. The deal with Black-Rock, the largest asset management firm on the planet, marks what Verizon Business called the first "commercial implementation" of its OnSite 5G private network product.

The private network uses an LTE core and Corning radios. Coverage is focused on the facility's trading floor, conference and meeting areas, and auditorium. According to Verizon, BlackRock is targeting applications around training, AR, VR, security, edge compute and "emerging data-centric technologies that require high bandwidth and low latency."

BlackRock COO Rob Goldstein said the private network investment is part of a "vision...to create a world-class, tech-centric experience for our people and our clients...As we usher in a new world of work, the vibrant and dynamic environment that we are looking to create will give our people the best opportunities to succeed and better serve our clients."

Alongside private networks, other B2B solutions like private MEC and IoT will contribute to new revenue growth, according to Verizon. "We are scaling and growing private networks which serve as the gateway to private edge compute capabilities and solutions," CFO Matt Ellis told investors. "We're in a great position to drive the market."

As emboldened by the C-Band deployment, the combo of a multi-purpose network, edge compute infrastructure, and new services like FWA and private networks, represents a "21st century infrastructure," according to Verizon EVP and Business Group CEO Tami Erwin.

Erwin explained that enterprise customers are investing in digitization to be more responsive while reducing cost and improving customer experience. To address the wide set of enterprise needs and align technology with desired business outcomes, Erwin said Verizon has made changes to how sales people are trained as well as tying compensation and quotas to customer outcomes.

This pivot to consultative enterprise sales in pursuit of 5G monetization "has moved us from being a business that focuses on transactions to really being a partner that enables a different kind of solution outcome for our customers," Erwin said.

How to understand, map and mitigate 5G cybersecurity risks: An interview with Ande Hazard, AT&T

'A business' most valuable assets are data, data and more data'

Delivering enterprise-level digital transformation is proving to be a key 5G monetization strategy for operators. This approach, however, comes with a host of cybersecurity implications around things like data privacy and anomaly detection. At the *RCR Wireless News* 5G Monetization Forum, AT&T's Vice President of Manufacturing Solutions Ande Hazard discussed these, and other, cybersecurity considerations in depth.

Can you start by sharing your experience working in the manufacturing sector at AT&T in terms of the conversation you have with a potential customer? What kind of questions or concerns do they articulate to you around 5G security?

As we talk about this transition into 5G, there's many security considerations that they're still trying to sort out, especially as we look at the expansion of connected devices. It's really clear that the theme of protecting the data regardless of where it's stored or the communication channel that it travels, it's one of the biggest concerns that we hear that our customers are trying to tackle.

Data privacy and managing the security of the data that's accessed by the mobile end points is also top of mind for all of our customers, so there's a lot of effort around securing the data at rest, in motion and then being responsive to all the data privacy requirements. And as we look at data in this new 5G-enabled world it's all about protecting one of the most valuable assets for businesses and for our customers, which is data and data and more data.

If we could take a look at 5G NR from the standard perspective, as this went through the 3 GPP process and became finalized, there is enhanced security that's just baked into 5G. But if I was an enterprise buyer, that's kind of an opaque statement. What else do you see operators as needed to do to help their business customers understand that these 5G-enabled processes are safe and resilient?

I think you made a great point as far as sort of the legacy cellular



Ande Hazard, Vice President of Manufacturing Solutions, AT&T

environment. As we look at 5G, solution buyers are embedding security into the net arch. 5G network operators are also building security into their networks. For example, to your point [about] 3 GPP, those standards are part of the focus that we look at as operators and as providers. When you look at 5g, this new era of security with encryption on the IMSI to protect that network data traffic over the 5G radio networks is also an important sec element. There are so many improvements from 3G and 4G LTE, where security in those cases was more of an overlay versus embedded into the network and those standards.

But there's still work to be done

to protect the data. I think that we look at it as what was equivalent to the early public cloud adoption, right? There's a shared security responsibility model that we see with 5G. Enterprises shift many of those network functions to the carriers, which ultimately brings a higher enterprise grade security level, similar to what we saw with the cloud shift. There is a responsibility of the network providers and the cloud infrastructure to comply with all of the regulatory standards to provide continuous monitoring of the data on that network. But there is also the responsibility of the enterprises to provide the security on their own devices and their endpoints.

We see things like identity access management, data protection suites that are needed to complement the physical security of the on-premise equipment, especially when we look at things like multi-access edge computing—MEC—so it's a hybrid of the carrier grade, and what's embedded in the network, and what has to happen at the physical endpoints.

You mentioned endpoints and maybe we can stick with this man example when we think about 5G in that type of environment, a lot of it has to do with connecting physical assets



like machinery robotics, cameras, other types of sensors, so new endpoints that are dii from the endpoints where accustomed too, like me holding a phone. So, what do carriers and their customers need to do in terms of adapting a set of cybersecurity best practices that kind of lend itself to this new IoT world?

We look at it in three areas. The first would be around Machine Learning [ML], Artificial Intelligence [AI], advanced analytics. This explosion of IoT devices on 5G ultimately expands the attack surface, so security design really has to incorporate automation to ensure you can apply those security policies dynamically and get it at the scale of what we're seeing with the network. Utilize AI and ML, other analytic capabilities to improve rapid detection and response of these new threats because their networks are becoming more complex and the number of devices connecting to these networks grows, so you have to be very nimble in that approach.

Second would be around software-defined networks [SDN] with security. As you need more connected devices added to the manufacturing ecosystem, attackers have a great opportunity to exploit those vulnerabilities and grab that very valuable data. Software-defined networking is a security enabler with the increase of applications developed, SND allows embedding that security into the design and architecture of the network. This improves the opportunity to put policy enhancements and anomaly detection and mitigation. It also allows applications to block malicious activity on the network and enforce policies across the security services.

Then the third would be virtual network functions [VNF]. Virtualization is an excellent opportunity to implement across a big, distributed network very quickly and because of this, enterprises can spin up security components like firewalls and push policies to many devices very efficiently. We also see virtual security controls to allow technologies to prevent attackers' lateral movements. You can apply micro perimeters to protect applications, and then utilize SDNs for mitigating threats. As a follow up: There is a lot of discussion around the role of strong ecosystems in terms of operators successfully selling 5G into verticals. From a security standpoint, whether that's the deployment of the network, the operation of it, or even the governance of who controls which bits, does that make things more complicated than just if it was AT&T selling an entire turn-key solution versus when you involve all of these other stakeholders?

Absolutely and as you navigate all of those players in the ecosystem, you have to be conscientious of how to plan it from an architecture perspective, a security perspective, and I think one of the practices that we see is the role of a consultant element to help to have a roadmap. If you dive deep into this quickly without a structure around it, it can have a lot of pieces that can actually give you more vulnerability from a security perspective.

If we could get back to this point around monetization of 5G, maybe you can take us through some of the use cases that AT&T is opening up for customers by bringing 5G networks to manufacturing businesses.

In manufacturing, we are seeing vision systems [...] around quality control and employee safety. We are seeing autonomous-guided vehicles



[...] and then also data intelligence from predictive maintenance of the factory equipment. I'd even give you a very specific reference. We did a publish use case with Ford Motor Company back in the fourth quarter of 2021 and it's a great example of bringing that all together. They have their electric vehicle production in Michigan that's going to produce the Ford F-150 Lighting pickup. We are leveraging 5G and MEC in that facility. Some of the use cases that they are going to tap into around the ultra-fast speed and low latency and this massive connectivity on the factory floor, they will be able to leverage the vision systems, the equipment status, material supply chain, automated robotics and even faster wireless vehicle updates, just to name a few use cases.

When we think of a vision system for quality control that seems pretty straightforward in terms of delivering an improved business outcome almost immediately but from your experience, is the time to value as fast as it seems like it would be when you implement these systems?

We're seeing that from our customers [...] that agility that you see from it and the consistency, and you take the human element out of it so you're in this automated environment that allows for very quick analytics, very quick decision making, and it has actually produced improvements on the supply chain, on the factory floor and on the production line.

The manufacturing industry has been automated for a very long time, but if you can do smart automation, if you can actually accelerate that decision making and leverage more connectivity, [...] I do think it's accelerating that go-tomarket capability.

Do you feel like the 5g deployments AT&T has in place with enterprise customers are delivering the type of value that you could characterize as monetization?

The customer's we speak with daily are looking to find the right use cases that we talked about right, be able to identify that to an ROI and then they're going to invest in multi elements of 5G...that entire layer of this capability, that's an investment that our customers are making and they're seeing the results of it as far as a go-to-market strength and brand. Then they're able to shift where they put that investment. Maybe they can dial back on other investments that are no longer needed at the scale that they had because you can be more optimal with 5G.

Any final thoughts?

I would take security as an embedded piece - it's not an afterthought, it's not an overlay. Security considerations in the cloud environment, in the 5G environment, in the physical assets [...] we look at the ability to wrap that into the embedded decision making road map, that's the most important thing.

Conclusion

Based on the discussions at 5G Monetization Forum, there's a clear path to that "long tail" of 5G service revenues laid out by Light-Counting's Téral. But whether it's mmWave 5G, fixed wireless access for home and business broadband, mobile edge computing or private networks, success requires focused ecosystem development. There's an opportunity for a rising tide to lift all boats here but, again, operators, vendors, vertical specialists and enterprise themselves will need clear channels of communication to align on technology designed to address a business problem. This collaborative ecosystem play may require new models for engagement, governance, go-to-market, and more, that challenge the status quo. Back to Téral for the last word: "We are on a long journey; it has started. That's the good news." (((•))

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