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# 5G MONETIZATION FORUM 2023

## KEY FINDINGS

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## Introduction

In the recent 5G Monetization Forum, carriers, vendors, analysts and other stakeholders came together to kick around why 5G hasn't yet been a meaningful contributor to new service revenue, and figure out how it can deliver on the promised influx of profit. While 5G has absolutely enabled new service revenues like fixed wireless access home internet, that's still a B2C play. If the goal is 5G-enabled digital transformation of businesses of all sizes across verticals, the focus needs to be on B2B2X – like many things associated with 5G monetization, that move from B2C to B2B2X is more than an operator can handle by themselves.

Another angle here that requires an operator to look outside the four walls of their business is the needed evolution of people, platforms and processes. To sell (and monetize) advanced 5G services into enterprises, operators need to understand those enterprises' problems. Once you understand the day-to-day difficulties dealt with in an open-pit mine, for instance, you can begin assembling the solution. But the technology is, in this case, perhaps the easy part. New people with new skills are needed to deliver meaningful solutions in a telecoms world that's looking more and more IT-centric and cloud-native by the day. New platforms are needed to manage and offer for sale increasingly complex 5G network-based products. And new processes, involving a healthy bit of artificial intelligence and machine learning, are needed to deliver, guarantee and, on the buyer side, consume, these new types of services.

It's also important to understand that 5G alone isn't going to move the revenue needle. To sell a latency-sensitive service like machine vision, operators also need access to distributed computing infrastructure. To offer a service to the healthcare sector, operators need to work with ISVs and application developers who can leverage the network to address the pain points felt in hospitals around the world. To meet the scale and economic requirements of their own businesses, and their customers' businesses, MNOs need the infrastructure, expertise and workflows developed by the likes of AWS, Google and Microsoft. Again, however 5G monetization happens, it will be a function of an ecosystem-based approach rather than a winner-takes-all showdown.

## Three megatrends shaping 5G monetization efforts

Beyond consumer-facing 5G services like fixed wireless access and step-changes in subscription plans—which are certainly making operators new service revenue—so far 5G monetization has fallen a bit short of the world-changing, trillion(s)-dollar hype around the sweeping digital transformation of industries. Based on a recent discussion on how to create win-win scenarios for operators, their partners and their customers, experts see a path forward where 5G facilitates new applications and business models, but it relies heavily on a strong focus on use case development, the right network beyond the just the RAN, and perhaps a bit more abstractly, a little bit of optimism.

### Going beyond B2C to B2B2X

As mentioned, operators are making new service revenue off of 5G-enabled fixed wireless access serving home broadband. In the U.S., T-Mobile US

*Eugina Jordan*

and Verizon are facing-off in this market. The two-fold goal here is to acquire and bundle new customers, while putting pressure on the cable companies that have traditionally dominated home broadband.

"Fixed wireless access is deeply unsexy and unexciting," Volt Active Data Head of Product Marketing David Rolfe said in response to a question from moderator Eugina Jordan, the Telecom Infra Project's CMO. "Nobody gets in front of 80-foot-wide screens at conferences and gets cheers for shouting about FWA," Rolfe continued. "But around a third of the world are only getting access to proper broadband internet now because of it. And that's a big deal…Don't underestimate the importance of FWA, and also don't underestimate the importance of weird, evolving use cases that nobody ever thought about."

Appledore Research Consulting Analyst Rahul Atri, formerly of Rakuten Mobile, suggested operators ask themselves who the consumers are to understand the how of 5G monetization. "Do we need to explore opportunities beyond B2C, go into B2B2X. And probably the models of engagement would change. The partnership ecosystem.. might change. The way we have to create solutions, it might change."

He continued, giving the example of Airbnb generating revenue from landlords and tenants by providing an intermediary platform. "I think telcos need to reinvent to make the most out of 5G. It might be a platform, it might be services, it might be use cases, but I think more than connectivity. The time is right now for selling use cases…[But] challenges do come with opportunities."

While Rolfe emphasized the importance of simplistic use cases like FWA and left the door open for innovative moonshots, he did acknowledge the reality of 5G monetization today. "I also do empathize with anybody who's investing in 5G and wondering where the revenue's going to come from…Eventually the bandwidth will get used. I've never seen a case where it didn't. It's just what it gets used for – the miraculous use case hasn't sprung into being… but I'm apparently optimist about it. I am hopeful for the future."

**Technology is the easy part; it's about people and use cases**

There's a refrain around 5G for enterprise; it hits notes around hiding technological complexity and selling business outcomes that solve real-world problems. Going another layer into that business/tech dynamic, it's also important to consider the people involved – an enterprise probably isn't going to materially invest in a technology stack that it's un- or underprepared to fully use.

Atri said, "Technology is the easiest thing to solve, gets solved by itself. People are the most complex. They need to be upskilled and look at all these things with a little more broadness. Ultimately every telco, probably every service provider, needs to think about a platform which brings collectiveness and collaboration, so that you don't buy pieces of a solution and then combine them through APIs and say this was transformation and automation."

In the context of 5G monetization, he described the right approach as including the right people, platform and processes with an eye on the flexibility needed to be future-ready. "Wait for the right opportunities. Even go out and say, 'I have a platform which can support you tomorrow.'"

*David Rolfe*

Rolfe touched on 5G monetization efforts that arise when operators are able to offer on-demand network slicing capabilities, and also characterized security as an increasingly important differentiator. Reiterating his point on how unexpected use

cases are making a commercial impact, Rolfe discussed the broadly-applicable deployment of automated guided vehicles being monitored and controlled by 5G-connected cameras.

"This is why I made my comment about being optimistic," he said. "We did not foresee that one of the big things we'd be hearing about… was a use where CCTV is driving robots which can't see around a factory floor…Nobody here anticipated that. And that's my point—that these things are emergent…Normally, you know, you laugh at people who say, 'Well, if you built, they will come,' but this may well be a case where we built it and they started to come."

So what does this degree of (relatively) rapid technological and business change mean from an operator's perspective? Looking at the road ahead, Telenor Vice President and Head of Asia Strategy Danny Han Seng Foong segmented CSPs into three buckets:

1. "They are actually more of a lean-operating telco…Operators are clearly taking a network 5G leadership position or fixed/mobile convergence approach in this. It's a traditional approach on data monetization but, I think, in certain sectors and also the ecosystems of certain countries, it makes sense."
2. From lean telco to digital telco; "this is where they position with partners in the local scene, on a regional level working with them to offer services beyond connectivity."
3. After being a digital telco, the move is to a platform play. "This is a little bit more bigger, and I've seen some fo the bigger telcos, for example in India Reliance Jio, is taking this position…You do see that being reflected in terms of not just monetization but also valuation in terms of some of these digital assets they bring to the table."

*David Rolfe*

**5G is just one part of the equation**

Back to the refrain about solving business problems and simplifying telco solutions for enterprises without telco expertise, back to thinking about use cases and understanding that 5G is one part of larger technology set that needs to be developed and managed by people, and back to this idea of telco reinvention – not selling connectivity but selling a platform for innovation.

"I think the crus of the matter is it's not the whole

*Rahul Atri*

or it's not the SIM card or a connectivity play anymore," Atri said. "It's about the use cases… Telcos are obviously onto the path of creating platforms, but obviously they cannot create all the things they need. [They need] partners."

Another important vector of 5G monetization that also intersects the goal of enterprise digital transformation is private 4G and 5G networks. Foong cited figures showing a concentration of private 4G/5G in the China, Germany, the U.K. and U.S., the first of which has tight cohesion between operators, industries and government, and the last three of which have dedicated spectrum for enterprise use.

In terms of vertical adoption, Foong called out traction in manufacturing, transport, mining, utilities and the public sector. "What strikes me when I look at this is how the ecosystem… took the leap in deciding what were the use cases and the use cases were very practical, simple…Use cases that actually helped them to solve the problems they were trying to fix…That is a good example of monetization."

Rolfe gave the example of a video-based, cellular-enabled system for pedestrian/vehicular traffic monitoring and management that also needs AI/ML—used "in a non-magical way"— and localized computing resources for rapid decision making.

*Danny Han Seng Foong*

"When you say edge, it's not just a computer in a building…We had that in that '70s. The distinction is here data has been gathered and the first level of analysis is done at the edge…a very simple way to actually establish what's going on and then that information gets sent up to some kind of controlling function, some intelligence, which figures out what you want to at an execution level.

He gave another example of a broken dishwasher. The manufacturer can remotely look at the machine and potentially determine the problem, and provide a fix, without sending an expensive repairman out to someone's house. In the case of a recall, that could also be managed centrally based on data generated by the distributed machines. This, Rolfe said, is something that benefits manufacturers by saving time and money, and can also be positioned as a benefit to the consumer. "This is genuinely new stuff which nobody thought up until they saw it and then did the classic black swan thing and said, 'Ah, well, that's obvious. We should have know that all along.' And so again, nobody, when we create all this wonderful technology out at the edge, we didn't see it and it's coming."

## How will 5G Standalone open up new monetization opportunities?

**The shift to 5G Standalone — and enterprise service delivery — requires cross-domain network resource management and an OSS/BSS re-alignment**

The 5G that's available out in the world today largely follows a 5G Non-Standalone architecture meaning new radios and spectrum were added to existing core infrastructure. What you may have heard called "real 5G" refers to a 5G Standalone mode of operation wherein a shiny, new cloud-native core facilitates the delivery of the advanced enterprise-facing services that, based on industry consensus, will spur long-term operator monetization efforts.

But along with that move to 5G Standalone, operators need to think strategically about cross-domain network management and orchestration that allows the investment into a service-based architecture to be translated into enterprise-facing SLAs that can be dynamically configured and delivered, according to Ravi Sinha, vice president of technology and solution development for Reliance Jio.

Sinha, who also sits in chairmanship positions within the O-RAN Alliance and Small Cells Forum, discussed how this evolution in network architecture and management, as well as how O-RAN principles and AI fit into the mix. In an interview with Hardin & Associates President Lauriston Hardin, Sinha talked through challenges operators will face in the near-term as they transition to 5G Standalone, but also longer-term as 5G Advanced, coming with 3GPP Release 18, and eventually 6G begin to influence how cellular networks are architected.

With 5G Standalone, Sinha said a service-based architecture lets an operator use and re-use the same infrastructure "based on the different kinds of use cases" which can range from automated guided vehicles and robotic control to fleet management and, at a higher-level, more real-time data analysis. "Those things need a very separate approach where the different slices of the network…[are] well-aligned with the service provider maintaining the SLA in terms of jitter, in terms of delay, in terms of throughput, in terms of quality of experience, everything end to end. And that's also on the fly. Those things will not be supported by Non-Standalone… One day, the major chunk of business will be coming from the enterprise."

*Ravi Sinha*

**The OSS/BSS of it all**

With this transition to 5G Standalone and bespoke SLAs for enterprises, operators also face a transition in how networks are operated and monitored, and how billing systems track and charge consumption. Sinha described this emerging paradigm shift: "There are humongous areas of changes coming because of a new generation of services coming around." The interactions between RAN, transport, core, and service management and orchestration functions "are very much focused toward AI/ML-driven data collection, data analysis and data model training, and how those things can be pushed across domains…Ultimately it's all going toward your OSS/BSS."

The shift to 5G Standalone is predicated on the shift to a cloud-native core, but there are other factors that feed up to the need for OSS/BSS evolution—network disaggregation, currently focused on the RAN and part of the larger story around Open RAN principles and open interface specifications defined by the O-RAN Alliance, adds complexity by adding vendors. Just as the RAN is historically a proprietary monolith provided by a single vendor, the same is often true of OSS/BSS systems.

Speaking last year at the Telco Cloud Forum, MATRIXX CTO Mark Price tied together the future of slicing networks to support niche services and the outlook for operations and billing platforms. "I don't think we would be reinvent our networks or the business systems around them if it wasn't for the fact that the business models themselves are changing." Networks are typically optimized for broad application market segments like voice calling or video streaming, not the specific needs of one manufacturer using one type of industrial robot. "Networks are optimized for throughput," Price said, adding that "the business systems are optimized to suit that."

Back to how all this relates to monetization, Sinha said, "It is important for scale and price efficiency that the same network…can be leveraged in many ways…[As] an operator, I can have my connectivity slice going to a bank, many going to the public domain, but the same slice can be re-aligned for a specific need."

**Open RAN, the edge and getting to real time**

Open RAN, while still maturing, is prompting operators to distribute radio infrastructure and capabilities in a new way wherein centralized, distributed and radio units can be located in ways that create cost and operational efficiencies while opening up the opportunity for new types of service delivery and network optimization. This comes as there's also ramping investment in moving compute functionality out of centralized data centers and to more lightweight, distributed computing nodes; this facilitates latency-sensitive services where data needs to be ingested, analyzed and turned into action more quickly than backhauling it to a remote cloud would allow.

These two trends create an opportunity to think holistically about new network architectures and layer in decision-making compute power for the RAN (and for services) at the network

edge. Sinha sees the edge as a platform for network functions and for exposing those functions, and others, to application providers. "Anything in terms of connectivity is going up to the telco layer as well as the telco edge layer and the device layer," he said.

But Open RAN is not without its challenges (and critics), and has been deployed at scale primarily in greenfield network builds by 1&1, Dish and Rakuten Mobile. That said, major multinational operators have committed to significant future investment in Open RAN systems. In terms of headwinds, Sinha called out management of multi-vendor systems in the RAN, and aligning those multi-vendor systems with other multi-vendor systems at the edge, and in the transport and core domains. "We have not reached to a level where we can have plug and play and pick and choose," he said. "Most of those challenges will be solved…then we can achieve very much closer to the traditional kind of solutions in telcos."

Big picture, he said Open RAN will continue to mature and will be aided by the proliferation of Open Test and Integration Center labs and the O-RAN Alliance's certification of compliance program. "I'm hopeful that 2023 and '24 will be the time when you see hundreds of thousands of not only the macro side of it, but I'm hopeful that the pico[cell]s and enterprise solutions can also become compliant to Open RAN."

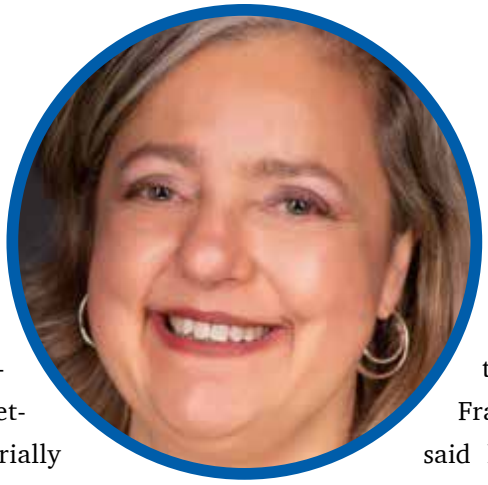

## Can sustainable 5G networks lead to 5G monetization?

**There are early signs of sustainability as a 5G value proposition, but can saving money through reducing power consumption be construed as 5G monetization?**

If you look at major global corporations, you'll like notice an increasing emphasis on reducing power consumption, achieving net-zero carbon emissions, and all around making business greener. The telecommunications sector is no different with many major operators committing to substantial reductions in carbon emissions both directly and indirectly. With the ongoing deployment and evolution of 5G, coupled with rising energy costs and green initiatives, sustainability is top of mind for operators. But how do the parallel goals of reducing power consumption and 5G monetization fit together?

Senza Fili Founder and Principal Monica Paolini framed up the issue. "You might find it odd we're talking about saving power in terms of monetization, but the two go really hand-in-hand because power saving is also going to get us more efficiency, not only in the power consumption but in the way operators spend money."

More on the nascent direct link between network sustainability and 5G monetization later, but there's some semantic parsing that's potentially worthwhile. Generally speaking, monetization would mean leveraging an asset, in this case a 5G network,



*Monica Paolini*

to create net new revenue. However, when the cost of operating an asset, again, a 5G network, can be materially reduced, the asset operator realizes an opex reduction. So not monetization in the literal sense but certainly there's a potential synergy between sustainability as a vector of operating cost reduction while generating new revenue against the macro backdrop of a move from shareholder to stakeholder capitalism.

Based on the operator-led work being aggregated within the Next Generation Mobile Networks Alliance, CEO Anita Döhler reflected on the big picture. When "talking about sustainability and talking about energy efficiency, collaboration is key," she said. "I think it's an industry effort and therefore, of course, it is extremely valuable to have our members working on those topics…Every operator is currently working on [their] own strategies and implement[ing their] own measures to reduce the energy consumption. It is not only…a general sustainability topic, but in the current economic times it's clearly also an economic necessity to work on those areas."

Bottomline, Döhler said, NGMN and other industry consortia help with "best practice sharing. And here I think that that's the value of collaboration. We work in a pre-competitive environment."

Vodafone UK Head of Infrastructure and Energy Francesca Serravalle said her organization is "really trying to be very holistic in our approach, in the way we plan, we build and we deliver the network so that we can deliver a network that is green by design." This includes developing a demand-driven network topology, a more distributed network architecture, and using virtualization and automation tools; another key aspect is decommissioning legacy infrastructure and redundant network sites. The goal, she said, is to "evolve the network towards distributed and energy-centric infrastructure…There is a strong focus on energy and delivering green infrastructure."

**Hardware modernization and automation make networks more sustainable, but how do you measure that?**

Ericsson has really leaned into its own decarbonization, delivering more sustainable 5G solutions to their customers, and facilitating 5G monetization in a manner that also helps end users drive decarbonization in their own businesses. It's a complex calculus but the numbers are clear. According to recent Ericsson research, the ICT sector is growing but maintaining a fairly stable carbon footprint representing around 1.4% of total global emissions. With a switch to renewables, the ICT sector could reduce its own energy consumption by 80%.

And, by delivering technology-enabled solutions to other vertical sectors, ICT investments can help reduce carbon emissions by 15% for end users. To tie that all together, more than 200 5G communications service providers (CSPs) connect around 1 billion users; those same CSPs can expect mobile network traffic to double every two years. So as networks expand and data consumption goes up, how do you know if your investments in sustainable 5G are working?

Döhler suggested operators start with the low-hanging fruit. Because the radio access network (RAN) accounts for some 70% of an operator's power consumption, that's a great place to start. Modern radios, and other pieces of network kit, can be loaded up with software-based intelligence that an ingest network telemetry and scale available capacity (and attendant power draw) to demand in a dynamic manner. And that's just one example.

*Anita Döhler*

*Francesca Seravalle*

Serravalle listed out what Vodafone UK is doing: optimizing the network, powering down legacy infrastructure, closing redundant sites, and otherwise "trying to really drive the acceleration of rationalization program and virtualization program all together. I think that will drive a lot of energy efficiency." She reiterated taking a holistic approach to sustainability.

So how's this all measured; how can the ICT industry know that it is (or is not) delivering on those potential reduction targets referenced in the Ericsson research. At a high level, Döhler said the most rational measure would be energy consumption based on data volume. But like most things 5G, it's not quite that simple because the industry lacks a unified metering architecture and standardized KPIs that would allow a like-for-like analysis of corporate sustainability reporting.

She also teed up perhaps the most important consideration in a world where networks have to become more sustainable, operators have to pursue 5G monetization, and the former cannot come at the expense of the latter.

**Driving sustainability without compromising quality of service**

"We strongly believe that we need also to link quality of service (QoS)" to sustainability, Döhler said. "There is a question of would consumers, for instance, be OK with trade-offs in network quality if this lead to network energy efficiency and therefore to lowering footprint? Probably not…I think that's a hard trade-off for operators… What we want to achieve is to deliver the same service with less energy consumption."

How does Vodafone UK consider that potential trade-off? "We will not do it," Serravalle said of potentially swapping QoS for energy savings. "We are becoming more and more customer-centric in everything we do, even on the way we build our network…We don't want to have any impacts to the customer experience."

She continued: "We are expanding the network, the traffic is growing, we're serving more customers, we have new, more demanding services, but we have decoupled. We manage to keep flat our energy consumption with the list of initiatives that I was mentioning before… You really need to be laser focused on the program and the project you want to deliver. And most of those initiatives are also very capex intensive."

**Can sustainability directly lead to 5G monetization?**

A few summary observations: In order to save money on energy, operators have to invest in modern hardware and software solutions, so spend money to save money. With the right approach and solutions, this can be done in a way that doesn't compromise QoS and keeps up with the trend line around increasing data consumption. What about direct 5G monetization?

As referenced, essentially all major global corporations have some sort of sustainability program, many of which span their own operations as well as their vendors' operations. 5G can enable power-saving efficiencies when adopted in the logistics sector, for instance, by optimizing fleet routing and streamlining O&M activities. Apply that framework to all industries, and operators have an opportunity for 5G monetization by building sustainability into the larger value proposition.

There's even a potential opportunity in the consumer sector. In Germany, Vodafone is running a campaign with the tagline, "Switch to Giga Green." This is just one aspect of the operator's sustainability strategy which also includes climate-neutral retail locations, circular economy activities, network modernization, and switching energy mix to more renewables. From the marketing copy, "On the way to a green future, you can accompany Vodafone again this year and follow many steps to see how #SwitchToGigaGreen succeeds." Back to that shift from shareholder to stakeholder capitalism – if consumers who support sustainability are willing to vote with their wallets, then investment in sustainable 5G networks can itself be a vector of 5G monetization.


## 5G monetization opportunities 'tightly tied' to service assurance

**The three (not so) easy pieces of 5G service assurance—orchestration, the edge, and end-to-end visibility**

Here's a hypothetical: A manufacturing enterprise has looked at its options for gaining production efficiencies and opted to use various video analytics backed by private 5G. A partner is engaged, radios are secured, and an on-prem core with additional overhead for mobile edge computing is put in place. Because of end-to-end, dynamic service assurance solutions, everything works as it should; the solution provider(s) make money, the end user gains efficiencies and potentially opens up new revenue streams.

In the hypothetical, an access control system uses cameras to identify authorized entrants, quality assurance happens as video is fed into an ML-equipped analytics platform, and AGVs are effectively "driven" by a software system ingesting video feeds. And all of that will continue to work as it should so long as end-to-end system latency stays below 25 milliseconds (a number I made up for expediency). But spikes in latency above that threshold mean people queue at entrances, defective items get through QA, and AGVs bump into one another. In this scenario, whoever sold the system has agreed to meet that latency SLA (again, based on robust service assurance processes) in exchange for money; not meeting the latency SLA means regular chargebacks or the risk of losing the account.

Charles Thompson, vice president of product management with Spirent, laid it out. "One of the interesting things that we look at, at Spirent, especially from the service assurance perspective, is what does it take to successfully monetize 5G? And what we've seen and what we've been hearing consistently from all the partners that we work with is that the monetization opportunities and the revenue will be tightly tied to these strict SLAs."

Traditional approaches to service assurance, Thompson said, are further complicated by the parallel developments of cloud-native networking and Open RAN along with 5G. Cloud and disaggregation, respectively, introduce more velocity and more vendors into a total solution. Doing this in the real world, he said, means, "It's

actually being rolled out, iterated and deployed in daily increments in many instances. You've got so much coordination between these different pieces and parts. There's a lot that can go wrong in a 5G environment."

**Service assurance that pays**

So how can an operator work with its partners and customers to scope out, instantiate and continuously uphold business-critical SLAs? Thompson identified three key areas.

First, orchestration and validation—operators have to understand "where you've not delivered the services as anticipated…and as monetized, so that you don't have SLA violations, so that you're not doing chargebacks, and so that your customers continue to see your environment as leading edge."

Second, and in recognition that delivering a latency-sensitive application may require a push of processing power out to the edge, operators need to understand the shift from centralized, comparatively static environments to a more dynamic, distributed approach. "It's constantly changing, constantly evolving, workloads shift literally dozens of times a day."

Third, Thompson said, "We at Spirent firmly believe that 5G requires what we call an end-to-end visibility approach. If we look at the assurance market historically, what we see is a very segmented type of a view where organizations had a bit of visibility in perhaps their backhaul, a bit of visibility in their fronthaul, a bit of visibility in their fixed wireless environments and so on, but nothing that brought the full picture together. Worse yet was the fact that much of that was static. It didn't evolve with the pace of the infrastructure.

*Charles Thompson*

"Service assurance is a critical component of making sure that organizations have a successful 5G deployment and that when they're trying to monetize their services, they're doing so successfully and within customers expectations."

**For 5G, there's "no single path to revenue"**

In the larger context of 5G monetization, Spirent looked at the trends across its 2,600 5G-related engagements; the company said that it had more than 800 new 5G-related engagements during 2022 to help inform the report. Those customers are mostly CSPs, but also network equipment and device manufacturers as well as hyperscalers and others.

5G revenues have thus far been relatively hard to come by, the report notes, but Fixed Wireless Access is a bright spot and the company is keeping an eye on how video-rich experiences from gaming to live broadcast and remote monitoring, as well as private networks, will develop into new revenue-sources—if operators and their vendor and testing partners can nail down consistency in 5G services, which will probably come with end-to-end (Standalone) 5G.

One of the prevailing themes that the company is observing, it said, is that "there is no single path to revenue that most service providers will follow. Instead, providers will pursue a variety of new 5G service offers aimed at incremental growth combined with targeted efficiency programs."

**Final thoughts on 5G service assurance**

Bottomline, Thompson said, 5G use cases will be dynamic and will continuously evolve given the cloud-native architecture. No amount of lab testing will translate into real world service assurance perfection. "Much of the learnings will happen in the real world. If providers don't embrace a more active, more dynamic approach to assurance, their visibility and their ability to deal with issues as they arise is going to be extremely hampered. And as we all know, you only get one first impression with your customers to really establish yourself as a differentiated vendor in the 5G environment."


## How can operators monetize MEC?—'Selling shovels instead of digging for gold'

One promise of 5G is unlocking latency-sensitive use cases, things ranging form immersive gaming experiences without jitter that takes a player out of the moment to computer vision systems deployed for access control, quality assurance, and other applications relevant to numerous verticals industries. But delivering on low-double-digit latencies is a job for more than just the 5G New Radio air interface; it also requires a distribution of computational resources out of centralized data centers to closer to where data is created. In the push to monetize mobile edge computing (MEC)—something that hasn't really happened to a meaningful degree if you listen to quarterly reporting from most major global operators—how do you keep your eye on the ball?

Where MEC fits into the sweep of making new money off of 5G investments was front and center during the 5G Monetization Forum. Volt Active Data Head of Product Marketing David Rolfe painted a picture of a future state wherein devices of all types are becoming intelligent and cloud-connected. In this environment, "There has to be some kind of orchestration effort or coordination effort going on somewhere," he said. "And from the CSP's perspective, this is another business. This is theirs to lose. Because if they don't [capitalize], somebody else will. And they have the ability and the know-how, the capability to make an effort in this space. And they should."

Vodafone Americas' David Joosten, noting that operators already have spectrum in hand and networks deployed, but in the context of MEC at scale, it's going to take an ecosystem approach. "If we want to scale, if we want to be flexible, we need to make sure that we offer this technology, or that we partner with other people or other partners in a flexible way to make it accessible to everybody, to make sure that the entire ecosystem is able to benefit. In my view, 5G or MEC…the potential is actually seismic."

In terms of what that looks like in-market, we've seen operators partner with major hyperscalers for a number of reasons, chief among them access to existing distributed computing infrastructure and access to existing enterprise relationships. Some operators partner with the big three cloud providers—AWS, Google Cloud and Microsoft Azure—and provide dedicated on-prem, shared near-prem and consumption-based, public cloud-hosted options. The overarching notion is to meet your customer where they are, and give them the ability to pick and choose in a way that fits with existing organizational buying patterns and IT know-how.

**What MEC use cases are operators attracted to?**

*David Rolfe*

While the figurative heat around 5G as an enabler of massive IoT has cooled from its early days, there are some break-out use cases which, rather than

being hyper-tailored to a particular vertical, are more broadly applicable. Volt Active Data's Rolfe called out autonomous guided vehicles steered by software using video feeds from cameras, and "vision-based use cases…to control traffic around schools, for instance."

"What these things have in common is too much data at the edge to plausibly move elsewhere, or for security or sensitivity reasons you don't want to move it elsewhere," he said. "And there is also a requirement to coordinate or orchestrate it at some level. So they are not talking about individual components acting as individuals. You are talking about somebody turning the enterprise into a team. And from the CSP's perspective, the opportunity is for managing this stuff. Because as time goes on, these environments will get more and more complicated."

Rolfe continued: "There's probably a significant market need for orchestration management and general device herding at the edge. And the advantage of going for that space is one, it's something the CSPs have a broad familiarity with. And two, it's probably a safer bet. You are selling shovels instead of digging for gold…Because a lot of these edge use cases are … They go from speculative, to surreal, to downright ludicrous in some cases, and so we're seeing a shakeout as we are in the market generally. But if I were a VC right now, I'd be putting my money in managing the edge, not necessarily trying to place my bets on the right place on the roulette wheel for a specific use case. But the general pattern is collectivizing behavior and absorbing lots of data, but managing the data behavior collectively somewhere else."

Joosten picked up on this idea of operator as manager of MEC applications delivered by multiple parties. To deliver on meaningful use cases, he said, "You need to work with the complete ecosystem to drive a successful deployment."

*David Joosten*

**MEC takes an ecosystem**

As noted earlier, this ecosystem-forward approach often involves a major hyperscaler. Joosten cited Vodafone's tie-up with AWS to use the cloud giant's Wavelength solution. "We can set that up in a stadium within minutes just by connecting the technology through 4G, 5G, [and] using Wavelength's greater let's say reliability and lower latency than the public internet…It's just one of the examples that a hyper scaler, plus network, plus 5G, really puts an application that benefits from that technology. And with that you can really create quite amazing business cases."

Vodafone Americas, which also partners with Microsoft Azure for the cloud piece of the MEC puzzle, has also combined the technologies into applications that, again, are applicable to multiple types of business. Things

*Tim Plfugradt*

like mixed reality and drone-based detection.

Ecosystem development, Joosten said, is "critical…in this space. I think it's important to build enabling technologies and what we call here at the intersection between let's say 5G, edge, hyperscaler clouds…The key challenge I think is more around the complexity of the implementation. If you can demonstrate simplicity, it's much easier to sell. So often I would say by levering preexisting relationships with system providers as well as hyperscalers it makes it much easier for customers."

**Advanced services require an evolution of billing**

Imagine a world where these private, public and hybrid MEC nodes are interworked with private, public or hybrid 5G networks, app developers have developed, and enterprises have bought in. It's a multi-party solution creating meaningful new business value. If the operator, as Joosten suggested, serves as the manager, how can they extend the implementation simplicity all the way through into billing? And how does BSS need to evolve in the context of consumption-based pricing with network and cloud components delivering better than best-effort connectivity?

Gotranverse Vice President of Customer Solutions Tim Pflugradt picks up the story. "The current legacy systems have a very static product catalog that allows you to charge one price or two prices for a specific thing." That's not really going to work as the IoT is connected to 5G and MEC. "So by having a billing system, monetization system, that has a less static and more flexible product catalog and pricing rules that can be changed on the fly and have more intent-driven pricing than contract-driven pricing, I think that's where we're seeing a whole lot of challenges in the billing side of it."

This idea of intent-driven pricing can be a differentiator for operators, he said. It gives operators the ability to be transparent. In a hypothetical example, "Every one of those devices is functioning differently, has different latency expectations, resolution expectations, things like that."

Tying that back into the need for an ecosystem approach to monetizing MEC, Pflugradt said CSPs need to "sign up various different partners to provide those end services to the end customer, and then be able to monetize that end customer for those end services, but also compute a revenue share for the partner. So the partner is incentivized to grow the market, to add more devices, add more functionality, add more stuff, but to drive also new customers to the CSP."

**Technological vs. business evolution—Three key considerations for MEC monetization**

First, and from the perspective on operator, new applications can be delivered with the combination of 5G and MEC, but that requires alignment between the network, the user, likely a hyperscaler, an app developer, potentially an integrator, and maybe even more parties. Second, because it requires an ecosystem approach to deliver on the technology, there's going to need to be some business case evolution to see revenue shared between the parties and to allow a more cloud-like, flexible consumption model for the user. And third, look at any market projections and you'll see multi-access edge computing, including with 5G as the access part, are set to grow at double-digit CAGR, north of 30%, through the end of the decade.

So who's making money off of MEC? Because right now it doesn't seem to have made a splash on too many operator quarterly reporting calls.

*RCR Wireless News* put that question to Volt Active Data's David Rolfe, head of product marketing. "In terms of actually paying the monthly bills? There's not a huge amount of stuff out there, to be honest. But there's a lot of stuff in the pipeline, and we keep getting onto calls for people who are discussing things which aren't hypothetical, aren't science fiction…So it's real."

Tim Pflugradt, vice president of

customer solutions at Gotransverse, gave the example of a TM Forum Catalyst project the billing specialist participated in alongside Salesforce, MATRIXX Software and Mirakl. In this case, the operators offered a marketplace for 5G-enabled drone manufacturers to sell their connected drones to construction companies. He described: "The construction company would pay a very small monthly fee for the access to the marketplace. When the drone user wanted to use the drone for construction inspection, it was totally intent-based."

To the billing piece, MEC nodes would be queried to determine bandwidth demand and what that means for other customers, then make a pricing determination that was pushed back out to the drone operator. With approval, the operator "would get permission and then it would run. And then, at the end of all that, the CSP charged the drone operator for the slice, and then also paid the third-party settlement or royalty to the partners for driving that usage to the CSP."

From the CSP perspective, David Joosten of Vodafone Americas, speaking of the global parent, noted activity in around 30 countries involving MEC, but MEC as part of a mobile private network solution to support things like smart factories. Given activity levels, he said, "I sometimes wonder if we are capturing enough of them as an operator. For sure not. Joosten also highlighted traction in the healthcare space and using drones for a variety of purposes, including logistics applications.

"I think there is really a lot of use cases at this point out there," he said. "I think the one thing that I don't see enough of, maybe, is really new business ideas…I think that's the stuff that I miss a little bit at the moment…Because we are a bit early in that phase still, we need to work on that. But, yeah, [mobile private networks] I think is front and center of everything…I think that it's a bright future. Not on every aspect, but let's keep working on that."

**For MEC, there is no easy button**

To reduce that down, the technology can and does work, the use cases make sense, but there's room for improvement in determining the clear business models needed for 5G-enabled MEC applications to deliver on market expectations. If it doesn't sound easy, it's because it isn't.

As Dell Technologies Senior Director of Global Solutions Co-creation Services Douglas Lieberman told *RCR Wireless News* late last year, "There's not an easy button…The math comes down to shared risk and capex vs. opex and who's responsible for maintaining it and running it. The reason why anyone moves to a cloud model is beyond just that it's cheaper. You're buying a risk model. Ultimately they make sure it's running and they do software updates and patch updates. On my books, I can pay opex, not capex. It also enables, from an enterprise perspective, elasticity. We all know…there's a financial model somewhere that accounts for elasticity."

He continued: "I truly believe that MEC is something that will evolve to provide value for the telcos. The takeaway is, there's no easy button. We're not going to walk out tomorrow and it's just gonna be there. That ecosystem is going to be critical. That is going to be as much of a battle as the technology is."

## Private 5G: Build-to-requirement vs. build-to-scale

**BT outlines its approach to the private 5G market**


*Image courtesy of BT*

Private 5G networks are widely viewed as the next big revenue driver for operators as enterprises increasingly understand the value of 5G-enabled solutions. Within BT, these capabilities reside in the Division X part of the organization which was designed to facilitate the transition from telco to techco and, as Division X Head of 5G and IoT Stephane Remy explained, "to scale up and commercialize the development of unique customer solutions to incorporate components such as private networks, IoT, edge compute, etc…"

Remy said the central thesis is to deliver "outcome-based solutions…The way we're looking at this is really enabling those customers to accelerate their digital transformation in a very complex world, a very demanding world."

One of the open questions in the private 5G space, particularly from an operator perspective, is how to organizationally develop vertical-specific expertise so a salesperson can credibly approach a manufacturing enterprise, for instance, and pair the right technology with actual business problems. Remy said Division X has vertical experts who follow particular projects throughout their lifecycle. "You have to be focused on the business outcomes that private 5G can enable," he said. Developing in-house expertise while interfacing with customers and third-party experts "allows us to get a really deep understanding of the business problem."

And, in keeping with the emphasis on technology as a solution for a business problem rather than technology for the sake of technology, Remy said BT focuses on delivering proof of value, not just proof of concept.

**Design to requirement vs. design to scale**

In terms of private 5G value propositions, Remy said BT has two categories: design to requirement and design to scale which come with distinct sales and delivery channels. With regard to design to requirement, "We usually work with early adopter customers and leverage our vertical capabilities…It's tailored to customer requirements and usually involves professional services. That calls also for specific skills and expertise to address the high complexity of a non-standard service element that this very proposition calls for."

He continued: "Design to scale is a fully vertically agnostic proposition that's really focusing on connectivity and usually includes managed services. They both depend on the individual network requirements."

*Stephane Remy*

One example of design to requirement (and also exemplary of how a design to requirement private 5G deployment informs the development of a design to scale private 5G solution) is the work BT did with Ericsson at Belfast Harbour in Northern Ireland. Following a pilot phase, BT delivered a private 5G network across the 2,000-acre site to drive worker safety, security, operational efficiency and a host of other applications that draw on 5G and attendant technologies. Belfast Harbour handles more than 1.75 million people, half a million freight vehicles and 24 million tons of cargo.

"Our success criteria was around latency mainly," Remy said. He also noted that demonstrating proof of value at Belfast Harbour around key private 5G-enabled applications allows BT to replicate that success with other customers in other industries. "It is really making sure that technically and commercially it really works for the customer, and making sure we have the right technical and commercial models in place so we can do that and scale… just lift and shift what we have. The ability to take a proof of value from one customer to another, and show them in a repeatable way that it's very easy to drive benefits."

## How to build a machine-to-machine internet at the edge

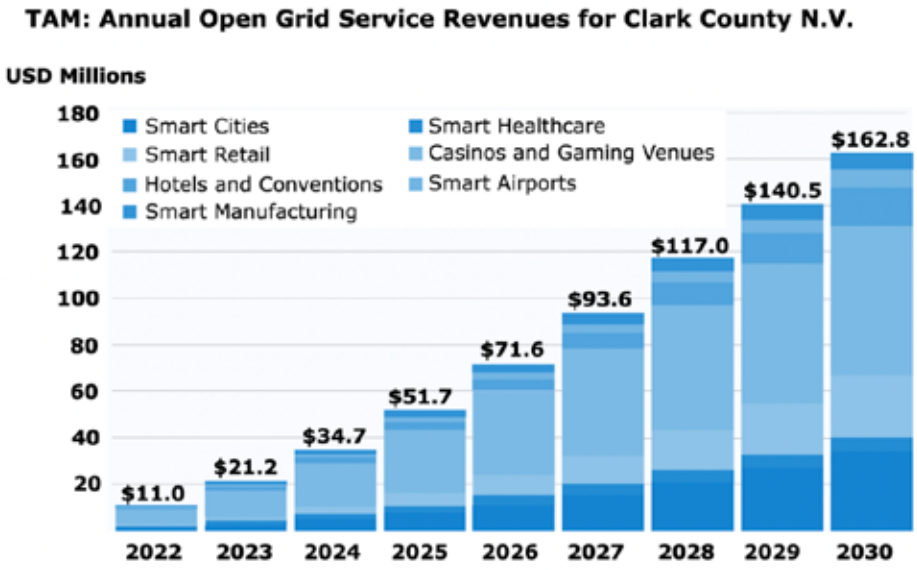
**Vapor IO/Open Grid Alliance on leveraging edge compute to digitally transform Las Vegas**

Internet of Things (IoT) devices using cellular networks reached 2.7 billion connections in 2021, according to the November 2022 Ericsson Mobility Report, and by 2028 that figure is projected to increase to 5.5 billion. As the vision of IoT comes to life (albeit potentially slower than expected in the early days of 5G), "The internet we built is not the internet we're going to need," according to Matt Trifiro, CMO of edge specialist Vapor IO and co-chair of the Open Grid Alliance. This is the basic premise Open Grid Alliance members have taken, and Trifiro explained what that means.

"We built an internet that was primarily humans talking to machines oor humans consuming content that came from machines. And now we're moving into a world where most of the traffic on the internet is going to be machines talking to machines. And machines operate in microseconds and nanoseconds and milliseconds, and humans operate in ones of seconds and tens of seconds and minutes. And so there's an entirely different infrastructure that's required to deliver on these, this next generation of capabilities."

Tactically what this means, Trifiro said, is that infrastructure from real estate to

fiber to data centers to software to radios need to change too. Trifiro used the city of Las Vegas, a very tech-forward locale with strong city-level guidance, as an example. Trifiro explained that Vapor IO used Las Vegas as a "showcase" city where the company first built "layer zero…So we put down data centers, we take fiber, we light the fiber, we then put a software-defined network on top of it, but that's like this under-structure. All of these other services need to layer on top of that, and there'll be other people that do what we do, but we were the first."




The point here is that building out and leveraging the edge is a multi-party play. Beyond the technology piece, he also called out the "complexity of the business models because usually these vendors have a lot of different technologies and they all want to make money. The enterprise just wants to buy it, but wants a single SKU, and they want to buy it as a service." He divided the market into three broad buckets: wired and wireless private networks, "near-premises" compute nodes to handle latency-sensitive use cases, and as a service applications like video inference for public safety, building security, smart retail, and others.

### Monetizing edge infrastructure

So when the infrastructure and service layers are in place, what's the route to monetization in this multi-party scenario? Trifiro noted the complexity of that answer but, in the context of private companies delivering infrastructure to catalyzing public and private user onboarding, he said, "By bringing new infrastructure into a region, particularly an infrastructure that is largely paid for by private companies, but might be catalyzed by public partnerships, you can create economic impact that goes way beyond just Vapor IO making money because it attracts new businesses to that area because now they've got services that they can't get anywhere else."

Open Grid Alliance conducted an extensive assessment around TAM in Las Vegas for the types of services delineated above, and sees long-term upside. Trifiro said the group has replicated that study in 12 other cities suggesting that the Las Vegas model scales. But in terms of the video-centric and other end user applications that would benefit from the Open Grid Alliance approach, what's the generally timeline in terms of ROI and new revenue generation?

First off, Trifiro said the economics for consumer-facing applications aren't in place. And in the case of something like enterprise use of augmented and virtual reality, "I don't know of a single enterprise that's adopted…at scale. It's going to happen…but it's not something that has happened." Back to the apps that ride on top of videos, "If they're being deployed faster than they can be analyzed — and what I mean by that is the human solution of guards sitting in a room or looking at cameras — that's just not scalable anymore."

But, big picture, it comes back to latency-sensitive applications that enterprises will ultimately want to run near-premises; in this case, the Open RAN architecture of splitting

*Matthew Trifiro*

functionality between centralized and distributed units plays into market trends. He called out the popular 7.2 functional split on the fronthaul interface between a distributed unit and radio unit. Trifiro said a target latency of 100 microseconds does two things in this context. "You can deliver workloads off-premises that appear for all intents and purposes being on-premise. In a 7.2. Split, the only thing you have to have on the other side [of the distributed unit] is the radio. And the radio is relatively inexpensive…You can deliver a private 5G experience into a warehouse, a 7-Eleven, a Starbucks, a Target, just by hanging the radios and connecting to the internal network."

So this architectural approach opens up the three buckets outlined earlier, all using shared infrastructure and all scalable based on demand. "If every company has to go build what looks like a data center in order to have private 5G, you're going to have a much lower addressable market. But if you can pull a lot of that capability back to the infrastructure, then you've got a much larger addressable market. So that 100 microseconds was very, very important for us…So it's a very different model than the internet today where maybe we'll have a good Zoom call, maybe we won't, depending on whatever is going on."

**When it comes to edge, "We cannot solve this alone"**

Final thoughts on building, taking to market, running and monetizing a flexible, edge-centric approach to connectivity and services? "It's complicated… It involves charging and billing and all kinds of things, but all the members are motivated. That's the point of the organization is everybody got together and said, 'We cannot solve this alone. We have to solve this together.'"

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