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5G STANDALONE:

What does cloud-native mean for operators?

By Peter Cohen

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5G Standalone (SA) is driving fundamental change for network operators to think and operate cloud-native. The underlying technology demands it and can't work without it. But it's more than just putting network functions in the cloud and expecting them to work.

Cloud-native technology and operations requires cloud-native thinking on the part of Communication Service Providers (CSPs), and a complete rethink of the innumerable business and operational functions and frameworks which enable CSPs to serve their customers.

First, let's understand what "cloud-native" means, and why it's important. Cloud-native describes the technology and, just as importantly, the business processes, that enable companies to operate with the scale and speed they need to stay competitive. Underpinning that is an increasingly distributed infrastructure of network automation platforms, tools and services to make it happen.

5G represents, for the telecom industry, the ultimate embrace of cloud-native technology and principles. That starts at the nucleus of a 5G SA network. The 5G core's service-based architecture provides a cloud-native foundation for operators to deploy new services and scale them as needed. It's the same functional design that's enabled hyperscalers to build public clouds to serve the globe. It's the domain of modular microservices, snippets of code that perform specific, individual functions, rather than monolithic code, or virtualized network functions whose hypervisor management can impose performance overhead. Microservices are endlessly reusable and able to be activated, deactivated and scaled in moments instead of weeks or months. Network automation tools and services need to be employed to enable the end-to-end transformation of the carrier's network needed to make 5G SA possible. Going cloud-native, and deploying 5G SA, enables operators to bring new services to market faster and adapt to changing network demands faster too.

5G deployments continue apace globally: Omdia says that 1.3 billion users will be connected this year alone, with 4.8 billion expected on 5G by the end of 2026. But for most users, their initial experience with 5G is through a Non-Standalone (NSA) connection: Faster radios attached to an Evolved Packet Core (EPC), the heart of 4G LTE service. 5G SA is still very much the exception, rather than the rule.

Omdia has identified 20 operators in 16 countries or territories which have launched public 5G SA networks. An additional five operators have deployed 5G SA technology but not yet launched services or have only soft-launched them, another 25 or so have announced 5G SA pilots for public networks and 22 more are reportedly involved in evaluations, tests and trials.

Globally, mobile operators face numerous headwinds when it comes to 5G SA deployments. The myriad technical challenges involved in deploying a Standalone network start with the 5G core itself, which demands a radically different approach than the EPC, whose virtual and physical network functions have developed in a siloed environment. Building the business and networking infrastructure to monetize 5G will be an ongoing challenge for telcos for years to come.

"2021 was the year when 5G standalone (SA) networks became tangible, with 15 commercial launches by year-end. In 2022 and 2023, these and upcoming 5G SA launches need to

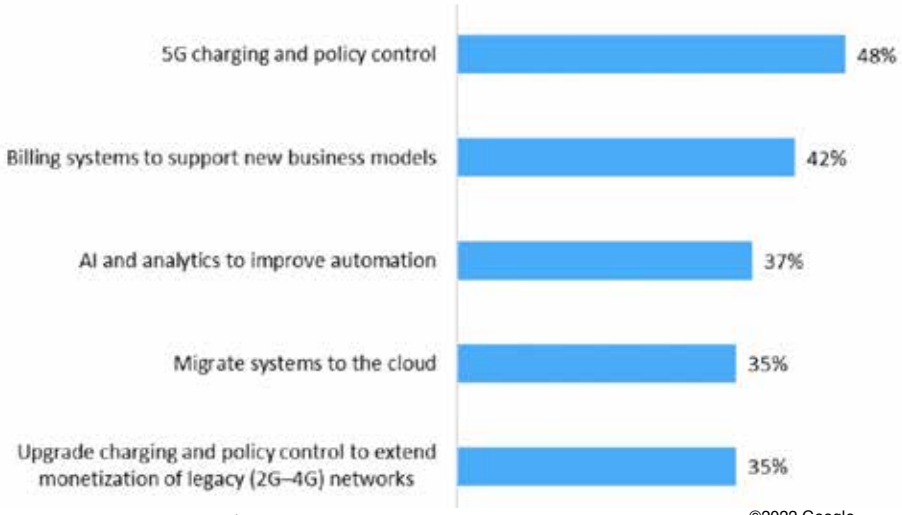
become monetizable," said Omdia.

The first link in the chain leading to 5G Standalone is the development and deployment of converged charging systems that support a broader array of chargeable services that can be used beyond just telecom, said Omdia. CSPs polled by the research firm overwhelmingly indicated getting charging and billing systems up to snuff as top investment priorities to drive monetization, not only for 5G SA but for other services.

Omdia's research points to the many fundamental technical, operational, and business changes that need to happen for 5G SA to be deployed and work at scale at many CSPs around the world.

Telco BSS Priorities

What are your top investment priorities to improve monetization over the next 18 months? (Select 3.)



Source: Omidia OSS/BSS Evoluton Survey - 2022

What's the status of 5G SA?

As of January 2022, the Global mobile Suppliers Association (GSA) reported that 99 operators in 50 countries worldwide are investing in public 5G SA networks in the form of trials, planned or actual deployments and that 20 operators in 16 countries/ territories had launched public 5G SA networks, including China Mobile, Vodafone UK and Germany, SoftBank, T-Mobile US, SingTel, STC, Rogers, RAIN and DirecTV.

An additional five operators had deployed 5G SA technology but have not yet launched services or have only soft-launched them, another 25 or so had announced 5G SA pilots for public networks and 22 more were reportedly involved in evaluations,tests and/or trials.

T-Mobile US wins pride of place as the first carrier globally to activate a 5G SA network, which they first did in August 2020. Dish activated its own greenfield 5G SA network earlier this year. Despite those efforts, it's Chinese telcos that have been the biggest champions of 5G SA, according to LitePoint's Director of Business Development Rex Chen.

"China is pretty gung-ho about Standalone, not so much in North America."

Rex Chen, LitePoint Director for 5G Business Development

"China is pretty gung-ho about Standalone, not so much in North America," he explained. "In the U.S., you have 300 million plus people, and other than a few big cities, we all live kind of far from one another. In China, you have more population and a really high density of people, and if you're covering those big cities, you're covering not just a massive part of the population, but also those who can afford 5G smartphones, so if you're China Mobile or China Unicom, if you deploy 5G cellular in Beijing, you can easily get to 10, 20, 30 million people," said Chen.

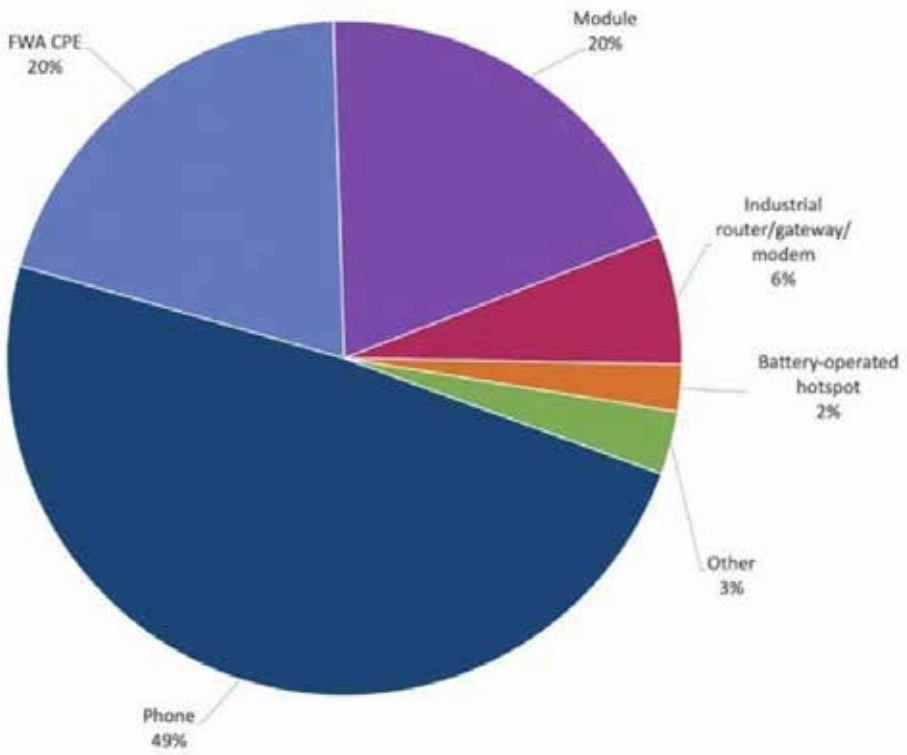
China's success and T-Mobile's US dominance notwithstanding, many experts have been underwhelmed by 5G SA's deployment globally, even in regions like the United States which have seen widespread 5G NSA deployment to start.

What's the holdup outside of China? Chen says the U.S. has fewer megacities with the sort of population density that makes a Beijing-style 5G SA deployment possible. What's more, existing carriers have a lot of balls in the air at once, starting with the billions they've invested in spectrum. To that end, carriers are densifying their networks and turning up C-Band spectrum to prepare for the transition to 5G SA.

"I thought that by now, SA would be more widely adopted," said EXFO's Group Manager of 5G Transport and RF Sebastien Prieur. "We are barely starting to see it in terms of operators turning it on. Verizon and AT&T are focusing much more on building out the edge."

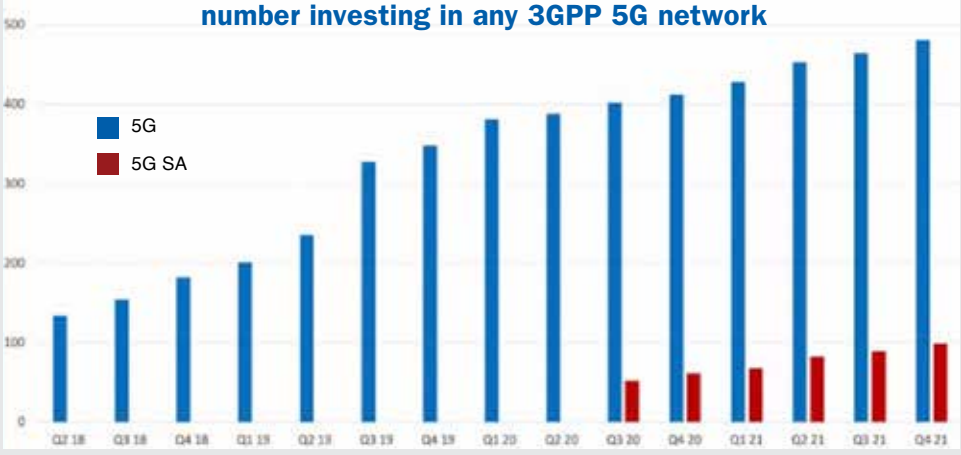
Prieur thinks that once U.S. carriers sort out C-Band tuning and cell densification, 5G SA transitions will happen in force. It's inevitable. After all, without 5G SA, carriers won't be able to iterate, find new business opportunities and scale them. What's more, 5G SA is essential to the full range of 5G features which telcos need to drive Industry 4.0 innovation. 5G SA underpins the ability for operators to offer network slicing, the massive device density, ultra reliable low latency communication and other key features they need to monetize the huge investments they have made, and continue to make, in developing 5G to its full operational potential.

Announced 5G devices with stated 5G SA support, by form factor



Prieur's 5G SA prognosis has proven prescient: In June, a GSA executive summary updated the worldwide 5G SA deployment numbers: 108 operators were investing in 5G SA efforts at the time of the updated report, with 28 operators having deployed or launched a 5G SA network.

Number of operators investing in 5G SA for public networks versus number investing in any 3GPP 5G network



Source: GSA

Carrier 5G SA investments have increased sharply since the end of 2020.

Building a network is crucial, but so is having the equipment to take advantage of the network. 5G SA networks, of course, need 5G SA-compatible end user equipment. That's very much a work in progress too: GSA in January reported 663 announced devices with claimed support for 5G SA, up 138% from 278 at the end 2020. Of these devices, 461 are commercially available. 5G SA devices accounted for 35.6% of 5G devices in Dec 2019, 49.7% in Dec 2020 and 54.6% in Dec 2021.

When broken down by form factor, phones accounted for just over half (50.3%) of announced 5G devices with standalone support, with fixed wireless access consumer premises equipment (FWA CPE) and modules tying for second place, each accounting for 20% of devices.

To understand the current state of play and what remains to be done, this report gathers comments and analysis from stakeholders throughout the 5G SA ecosystem who understand what the change to cloud-native means for operators, and how to make the most of the opportunity.

Aligning operations and business systems with 5G SA

Scaling up to the cloud

5G SA requires a fundamentally different approach to managing operational support systems (OSS) and business support systems (BSS) which help carriers efficiently and reliably manage subscriber services. OSS and BSS systems sit in the center of the telco network, siloed. That needs to change with 5G SA.

It's ironic that CSPs are undergoing the same digital transformation efforts as many other industries and public sectors, as entire economies are moving to the cloud. Cloud-native operations promise CSPs cost efficiency, scalability, agility and — hopefully — new monetization strategies. But there is both a business culture shock and tech debt that need to be paid when it comes to upgrading OSS and BSS services to handle 5G SA. Going cloud-native requires a different set of skills. In some respects, it's an evolutionary step forward. But as with many things associated with 5G, it's also a fundamental rethink in terms of how the business operates — not just today, but how it needs to be built to operate for the future.

"IT and the telco world are now merging together."

Andrew Keene, Volt Active Data Senior Director of Product Management

What is cloud-native service assurance?

Ericsson identifies five principles that should guide CSPs as they journey towards cloud-native service assurance operations. Paraphrasing:

- **Choices.** Cloud-native apps should be infrastructure-independent, to align with new cloud technologies as necessary
- **Decomposition.** Comprising modular and reusable software components
- **Resiliency.** Responding to problems without service interruption
- **State optimization.** Separation of app logic and data
- **Orchestration and automation.** Emphasizing zero-touch networking principles
- **Openness,** or the ability for software apps and components to be modular and easily replaceable as necessary

The challenges abound: CSPs need to get the balance right by creating environments that allow Virtual Network Functions (VNFs) and Cloud Native Functions (CNFs) to be aligned and operating perfectly, even while functioning on an increasingly distributed hybrid cloud network.

"It's a journey when you think about it. Most of the vendors in this space are traditional bare-metal vendors," said Mark Hiseman, director of service assurance strategy and platforms at EXFO. The move to virtual network functions (VNFs) and now to the cloud has required an evolutionary different mindset, he added.

"There's a massive amount of inertia in the telco industry, which in general has been the last to step into the cloud, from an operational perspective. They're the last man

standing, right? They are really concerned about losing control," he said.

BSS and OSS functions have traditionally been tightly integrated, proprietary efforts. Virtualization may have pushed those efforts forward, but they're not sufficient to meet the growing need for automation, the desire for optimal performance and the ever-pressing need to lower operating costs.

"Pre-cloud-native, even VNFs took a long time to deploy. It's a manual process. Typically, to deploy a function could take months or weeks," said Volt Active Data's Senior Director of Product Management Andrew Keene. Automation tools for cloud-native functions can do the same in minutes or moments, he added.

"IT and the telco world are now merging together. Now we've been talking about this for twenty years, right? About the fact that eventually IT and network worlds would come together. The cloud is the catalyst for that," he said.

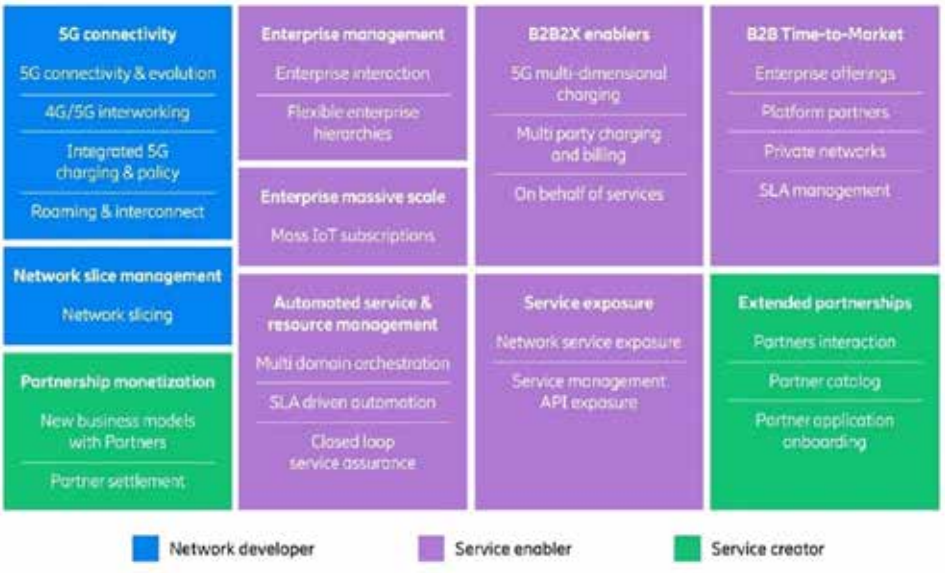


Image courtesy of Ericsson.

At-a-glance view of enterprise 5G capabilities needed across CSP's OSS, BSS, and core network.

Readying OSS and BSS for the cloud

From Hiseman's perspective, having cloud-native service assurance is about using the data that's already there in smarter and more efficient ways. In his particular example, he mentioned the need to physically probe networks to assess service levels.

"What does it mean on the OSS side? You have to think about how we've always done this," Hiseman said.

"In theory, we've had that technology from the RAN back in the 4G days. As soon as they put traceport on, you just needed someone to process the data. You no longer needed that probe tapped in the network," he said.

"When that first came out, the reaction was 'A RAN element can't possibly have the data that we get from a probe,' and lo and behold, it did. Same noise we're getting at the 5G SA Core level is, 'What you're going to get is events, and events aren't rich enough to troubleshoot problems,'" added Hiseman.

Turns out event data isn't the problem, he said. Instead, it's an issue of scale - how to manage the data you do need from the data you don't. The standard mode in OSS has been to capture as much data as possible. That simply won't scale as operators pivot to cloud-native.

"The problem is you have many layers: The physical machine level layer — what's the machine doing, how much CPU and RAM is being used, disk I/O. Then you have a

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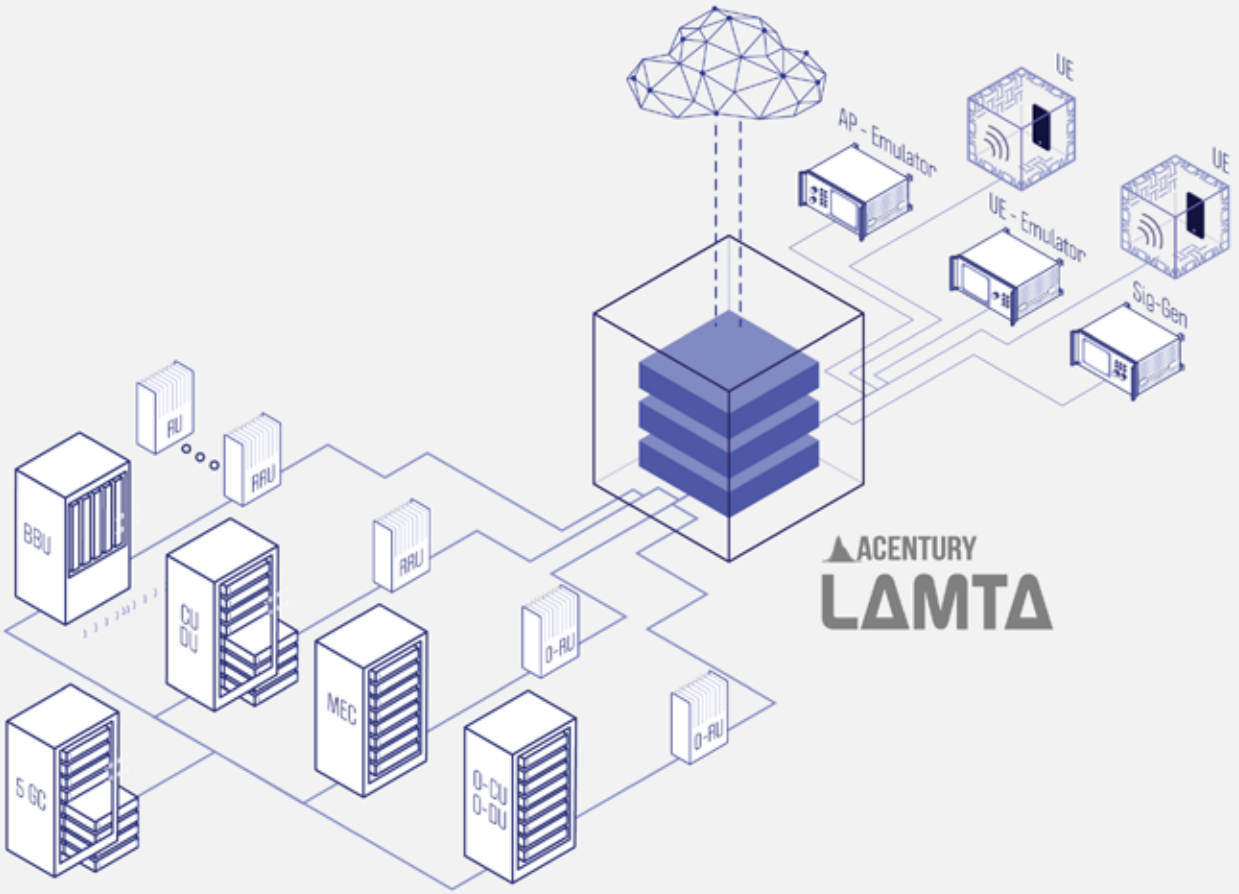

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"Telcos waste too much time looking for the actual problem."
Mark Hiseman, EXFO Director of Service Assurance Strategy & Platforms

Kubernetes layer running. Then you've got network functions running, and then you have users on top of all of it," he said. "So how on earth do you assure the entire stack?"

OSS and BSS vendors can no longer just focus on their own data, he said.

"Now we're saying that's not good enough. You need to be able to take data from elements, Kubernetes, your own active network tests, your own data, maybe your competitor's data, and correlate all of this stuff. And be able to do it in real time, and do it quickly," he added.

"We're noticing that operators need to go on that data strategy journey," he said. Moving the data and processing of that data to the edge is the strategy some are now employing to mitigate the worst of big data processing and cloud bills.

In the cloud, "data has a cost," said Hiseman, and this requires vendors and operators to be mindful about what's important to collect versus what isn't.

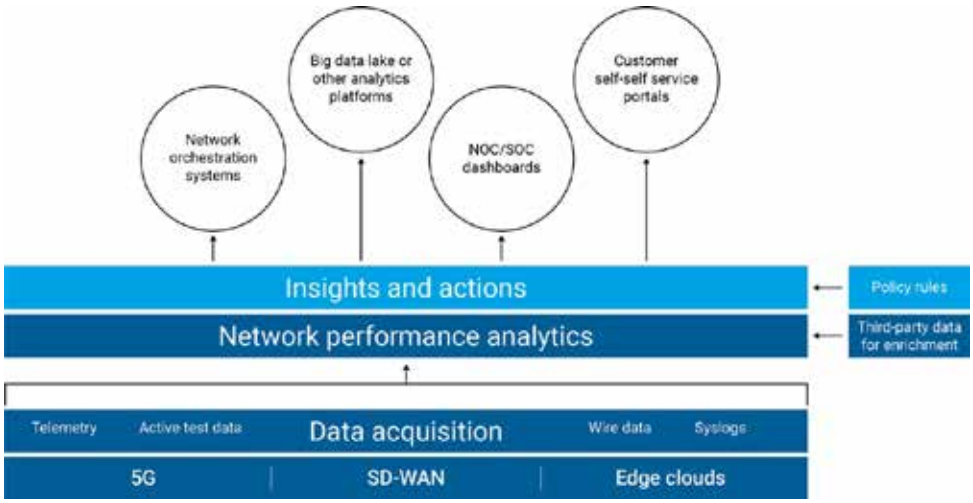
"Imagine a RAN detail record has 400 fields. Do you need all 400 to build a KPI? No. You need five, maybe 10. Only when the KPI is a problem do you need more fields," Hiseman added.

So it's not about collecting all the data, then sorting it out reactively to find anomalies. The new model best suited to going cloud-native is only to look for the data you need to solve the problem and focusing there.

Finding the single version of the network truth

Adaptive assurance is the solution that EXFO emphasizes in this environment. Service assurance systems based on big data collection will be increasingly unwieldy or simply not scalable to the cloud. Big data can fill data lakes much faster than the time it takes to extract meaningful, actionable small data from it.

"Process at the edge, store what you need," Hiseman said. But more importantly, as carriers face increasingly distributed and complex network topologies, they need what Wiseman calls "a single version of



A 5G service assurance model.

Image courtesy of EXFO.

the network truth... being able to pinpoint problems is something we're seeing telcos focus more on. Because what they're finding is that telcos waste too much time looking for the actual problem."

"One of the problems the telcos have is that the business model hasn't been as favorable as they thought, because hyperscalers charge them for everything — data storage, transmission, regional replication. So if you can make sense of the data before you send it off, you can save yourself a lot of costs," said Volt Active's Keene.

Standalone 5G use cases and monetization strategies heavily leverage technology that fundamentally alter carrier relationships with their customers. Legacy OSS and BSS systems are optimized for a model where the carrier provides connectivity. But that's on its head with 5G SA, as the use of private networks, network slicing, massive IoT deployments and other innovations will create myriad Service-Level Agreements (SLAs) by which vendors have to abide. CSPs need to design service assurance systems from the ground up to manage the scale and flexibility of the cloud.

Standalone 5G demands a cloud-native test environment

Verizon's Vice President of Network and Field Operations Dean Brauer said that CSPs must consider 5G testing as its own unique operational challenge.

"We have to be able to measure and monitor the network very well, real-time, at a scale that we haven't seen before," Brauer said.

Testing products in simulation before actual field deployment remains as relevant and important today as it was 20 years ago, but the stakes have risen as the networks themselves have grown more complex. So, what's new to say for 5G SA, when it comes to testing? A lot, it turns out, according to David Woodcock. He heads product strategy for Canadian RF engineering firm Acentury. Acentury makes RF lab management and automation platforms for network operators.

Woodcock says that 5G SA puts mobile networks much closer to IT. The number and types of network nodes are increasing exponentially, which puts more pressure on operators to test and deploy efficiently.

"5G SA is easier in that the block diagram is a lot simpler, but when you get there it's a very different

place than you are now," said Woodcock. Obviously, greenfield 5G SA deployments are the exception, not the rule. And carriers must support their existing networks for years to come.

Scaling testing to meet a more dynamic operating environment

Woodcock outlined some of the challenges that operators must grasp within a cloud-native network environment.

"The nature of the infrastructure is far more dynamic. The architecture can change even based on service type. As the operator scales VNFs and CNFs up and down in their network, those changes need to be validated," he said.

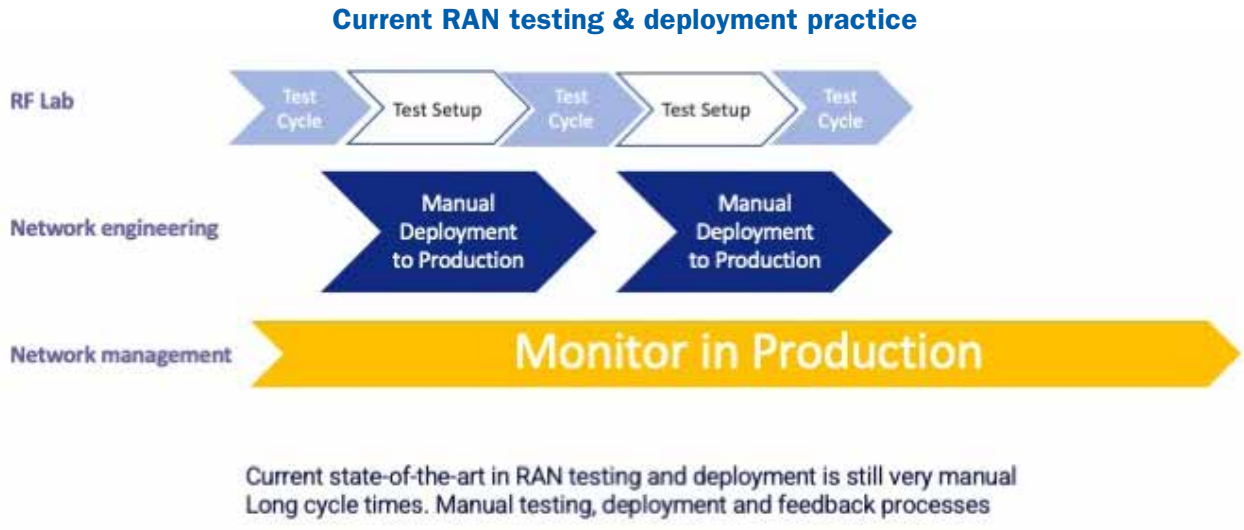
That technical debt, and the addition of a highly dynamic 5G SA environment, imposes a huge burden for operators when it comes to testing.

"It's a geometric amount of more work to have multiple networks operating simultaneously. It's a challenge from a commercial perspective because you can't offer all the same services to your subscribers, so that's revenue-limiting. And it's just technically a lot more work because the more things you have, the more scenarios you have to test," Woodcock said.

"Modern data networks are incredibly complex; global network operators spend a great deal of time and money to make sure they meet their customers' expectations," he said.

Radio Access Network (RAN) testing today is still a very manual process, said Woodcock. Whether it's a routine update to base station firmware or something more significant, like troubleshooting for dropped calls, "each test is generally independent and done to validate a set of changes to a given configuration," he said.

This manual process can take hours or days, he said. "In fact, we've seen situations where it takes longer to set up a test and tear it down than it does to perform the testing



Current RAN testing practices are still too manual, claims Acentury.

Image courtesy of Acentury

itself," he said.

Once changes are approved, the changes move to deployment. While operators may use automation tools to help speed the process along, Woodcock emphasized that it's mostly a manual process, which can increase in complexity and time to deploy depending on the nature of the change and the requirements for testing.

There's a place for emulation, but use your network to test your network

Woodcock ultimately encourages end-to-end testing in real-world production environments. "There's always a place for emulation," he said. "But focus on end-to-end testing as much as possible. Use your network to test your network," he said. "Use your actual radios to actual describer devices under test, in the middle is an RF switch matrix that mimics real-world MIMO and carrier aggregation, simulates handovers, et cetera."

Acentury's Mirror Lab is its solution for bringing network testing to where it needs to exist for today and tomorrow's 5G deployments. While the concept of "digital twins" has picked up speed in recent months, Woodcock is careful to differentiate Acentury's Mirror Lab from a digital twin. It's a lab recreation of actual network conditions, powered by test automation and orchestration, which enables operators to handle a lot more complexity and variation than they can with manual or patchwork automated processes.

First of all, the Mirror Lab equipment must reflect the same equipment the network operator uses in deployment, he said, straight up to end user equipment operating in Faraday cages to simulate real-world conditions and challenges.

In addition to an RF re-creation of the network's actual operating environment, The Mirror Lab comprises an orchestration and management system, test automation at scale and deployment automation software and tools. It's these features and functionality that Acentury believes can make the difference for network operators looking for testing agility in a standalone 5G environment.

"Our orchestration system talks to the RAN, talks to the device, any emulation equipment. We orchestrate the tests and automate the tests. We collect all that information and analyze it," he said. Using open Application Programming Interfaces (APIs) helps to make it possible to deploy and manage at scale.

Carriers are grappling with the same workforce challenges as the rest of the technology industry. Using advanced network automation like what drives the Mirror Lab is ultimately about working smarter, not harder, and getting results.

"Anecdotally, one of my favorite customer quotes is, 'I love this system: I just did 45 handover tests while drinking my tea.' It frees up the smart people in the organization to do other things, to be innovative and think about solving bigger problems than running a test script," said Woodcock.

Of course, operators need to be mindful of what all this testing is for. The proof of the pudding is in the eating, as the old saying goes.

Customers ultimately will vote with their wallets, said Woodcock. Regardless of what the operator has to test in the lab, "the end user is the ultimate tester," said Woodcock. "It's their perception of the service, on delivery, that matters."

Bringing network automation up to snuff for 5G SA

Kubernetes is the lynchpin to make network automation work at scale

Acentury's Woodcock makes the point that adapting testing to a 5G SA environment will require operators to deploy extensive network automation; without it, there is just too much ground to cover. But zero-touch network automation needs to be employed at every level of the 5G stack in order for any SA services to work as envisioned. 5G SA will bring considerable benefits to customers, but it also increases the complexity of the network itself. Network automation is essential to managing this new complexity.

The end-goal of network automation is to deploy truly "zero touch" services that are autonomous — capable of scaling up and down to meet any need, but also capable of repairing themselves when they fail and continuously optimizing to achieve best results.

Ericsson describes the challenges facing operators today: "The majority of CSPs have complex, multi-technology networks that will need to co-exist with the future 5G networks. Many CSPs desire openness and need non-proprietary automation solutions for multivendor networks that will also support the new and exciting capabilities of 5G with assured performance."

Kubernetes has emerged as the lynchpin to help carriers and enterprise customers manage 5G services within a containerized framework. Kubernetes' strength is in eliminating manual processes used to deploy and scale containerized applications, helping to easily and more efficiently manage clusters of host systems operating cloud-native microservice apps.

Kubernetes running a bare-metal environment — that is, a single-tenant server, optimized for specific performance, security and reliability — is the best choice for deploying 5G cloud-native applications, according to Henrik

Bäckström and Rakesh Bohra of Ericsson. Why bare metal? Keep it simple and fast.

"With a Kubernetes over bare-metal infrastructure, without the virtualization layer, service providers get a simplified architecture common for central, edge, and private network deployments providing substantial CAPEX and OPEX benefits," the two offered in a blog posted to Ericsson's site earlier this year extolling Kubernetes as a cloud-native solution for telecom.

Image courtesy of Ericsson

Kubernetes over bare metal extracts maximum performance when single tenancy is an option.

Project Nephio emerges for cloud-native network automation specifically for telcos

The Linux Foundation and Google Cloud, along with an increasing number of CSPs, are putting considerable weight behind Project Nephio to help manage network automation using cloud-native principles while providing carrier-grade service. The open-source effort uses Kubernetes, also developed by Google.

Nephio takes the concept further, unifying automation control planes which are entirely abstracted from infrastructure. This will help make multivendor 5G cloud deployment and management easier and more performant, through intent automation and automation templates, according to the Linux Foundation.

"Building, managing and deploying scalable 5G networks across multiple edge locations is complex. The Telco industry needs true cloud-native automation to be faster, simpler, and easier, while achieving agility and optimization in cloud-based deployments," said the Linux Foundation in a statement at the time of the announcement.

The Nephio project attracted initial interest from a host of companies including CSPs and telco equipment and software makers after being announced in April, with dozens more joining the chorus a few months later. More than 50 companies are supporting the project, including big guns like Verizon, Vodafone and Deutsche Telekom.

Kubernetes' suitability for telco is also a focus of the Cloud Native Computing Foundation (CNCF), a subsidiary of the Linux Foundation. KubeCon and Cloud NativeCon Europe 2022 took place in Valencia, Spain, in May. There, the CNCF announced efforts to improve the usability of Kubernetes service mesh systems for telco and a new certification program to help telcos assess the suitability of Network Equipment Providers (NEPs), which purport to offer cloud-native solutions.

The new Kubernetes-related project is called Envoy Gateway. Envoy Gateway's goal is to make Envoy, the open-source edge and service proxy, easier to use. Envoy helps wrangle load balancing and other networking complexities specific to cloud app microservice management. Envoy enables cloud developers and network operators to more easily observe and tune overall

cloud app performance.

Envoy Gateway adds a simplified deployment model and API layer aimed at lighter use cases. The new effort also merges two existing CNCF API projects: Contour and Emissary, into a common core.

"Exposing a simplified set of APIs, and implementing the Kubernetes Gateway API, Envoy Gateway makes it easier to extend Envoy. Developers will now have a cost-free, unfettered way to provide external access to their work in progress. At the same time, Envoy Gateway will not replace API management features currently found in commercial products," said the group.

Nephio, Envoy and Envoy Gateway are three examples of where open source development is working to meet telecom on telecom's own home turf. The good news is that they're being encouraged and supported throughout the ecosystem, from the largest multinational telecommunications firms to the smallest startups. It may be happening in fits and starts, but telecom is slowly opening its doors to the same sort of open, agile innovation that's enabled hyperscalers to lap the telcos with new product offerings.

Bringing network operations cloud-native

DevOps and CI/CD for 5G SA

5G SA is very much a double-edged sword when it comes to network operations. Experts see 5G SA as, in some ways, simplifying from an operational perspective. But the addition of 5G SA to existing network topologies and infrastructures comes with challenges, workforce challenges that require broad culture changes within organizations.

"From a performance perspective, and an operational perspective, you get some simplification in how you can operate your network," said Dean Brauer, VP of network and field operations for Verizon, during a discussion at RCR Wireless News' Test & Measurement Forum event earlier this year.

"But the complication comes in because as you introduce 5G, we're not just introducing a new frequency band… and with Standalone, you can start to slice your network," he said.

This adds up to huge challenges, especially for Tier 1 CSPs like Verizon. The key through it is largely through better automation tools, according to Sinan Akkaya, director of RAN Engineering at AT&T. Akkaya, speaking at RCR's Telco Cloud Forum earlier this year, cautioned that the days of "hundreds of engineers working behind the curtain" are long gone, and that

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"The real advantage here is the close collaboration between development and operations."
David Woodcock, Acentury VP International Sales & Distribution

especially as carriers approach 5G SA, they need to employ network automation tools to help operational functions more than ever.

5G SA gives CSPs the ability to test, deploy and scale new services at hyperscaler velocity, but the cloud-native design presents operational challenges. That's why so much of the discussion about going cloud-native ultimately circles back to the critical importance of the agile process that dominates cloud culture: DevOps.

The portmanteau combines developer and operations. DevOps emphasizes an interconnected and continuous process of software development, deployment, monitoring, testing and improvement. Practitioners refer to the concept of Continuous Integration/Continuous Deployment, or CI/CD.

Stakeholders across the 5G SA spectrum see DevOps and the CI/CD process as essential. The telecom industry faces enormous workforce challenges in the race to deploy 5G SA, and they aren't going away. That tight labor market is under increasing pressure as billions of dollars flood into the telecom marketplace globally to aid public sector digital transformation efforts, rural infrastructure initiatives and more.

Network operators, system integrators and subcontractors are competing heatedly for a limited workforce, while also seeking to keep deployment costs down. More is being asked of site technicians: not just experience with RF testing, but also the ability to test fiber and validate services as well.

Sandeep Sharma, VP and global head of Tech Mahindra's 5G/RAN/ORAN portfolio, noted during RCR's Test and Measurement Forum that telco workforce challenges extend well beyond site deployment. With the increase in virtualization and cloud as well as the emerging role of edge computing in 5G, that changes the set of software skills and familiarity that is needed across the telco industry, Sharma said.

While the move to 5G SA provides some end-to-end simplification for network management, it doesn't solve everything—Sharma pointed out that if you look at telco network based on their end-users, the type of 5G devices available, which bands they support, and 5G device penetration still represent issues.Another event-related quote, please cite when the remarks were made

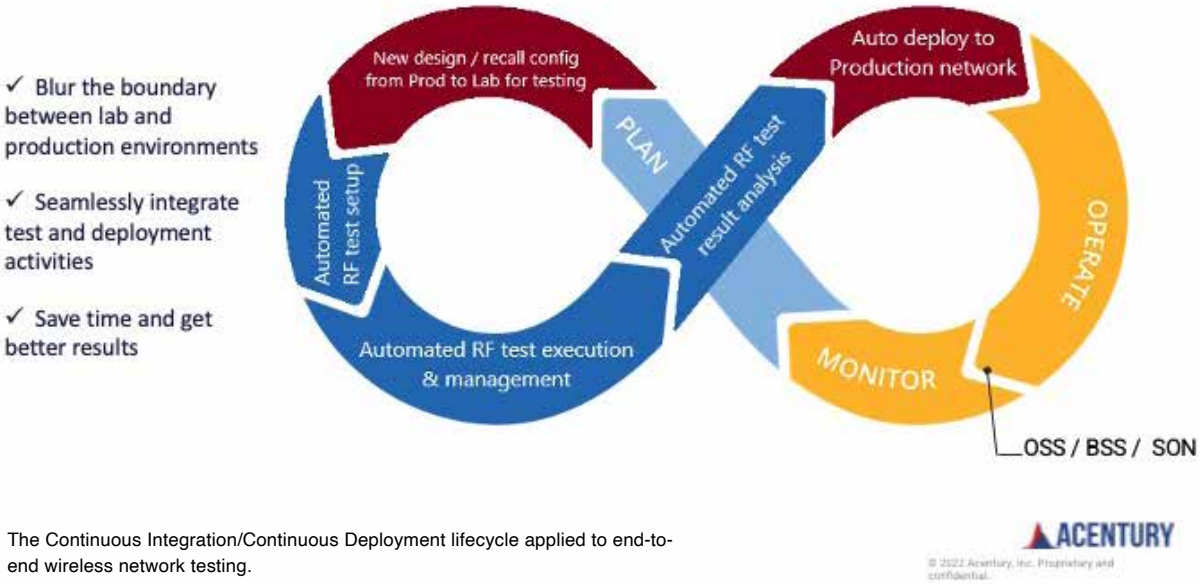
'It's harder to screw up'

The continuity that underpins the DevOps process is highly dependent on, and integrated with, network automation. Acentury's David Woodcock provided some context.

"CI/CD bridges the gap between development and operation activities by using automation throughout the building, testing and deployment processes," Woodcock said.

"CI/CD compiles the incremental

CI/CD applied to the end-to-end wireless network



The Continuous Integration/Continuous Deployment lifecycle applied to end-to-end wireless network testing.

Image courtesy of Acentury

changes made by developers, then links and packages them into deliverables. Automated tests verify the functionality, and automated deployment services deliver them to the end user," he explained.

The goal, ultimately, is to increase productivity, hasten app development cycles, and to iron out code issues earlier in the development process, before the app is ever deployed.

Acentury's "Mirror Lab" concept seeks to re-create live network conditions as realistically as possible, but network automation is the engine that enables everything else to work. The Mirror Lab relies heavily on orchestration and automation pieces, which take the repetition and drudgery out of testing and speed it along. Network automation isn't the only key to getting DevOps to help telcos work at scale, however.

"The practice really encompasses the entire app lifecycle," said Woodcock. And when employed effectively, Woodcock said the payoff for organizations that embrace DevOps and CI/CD is dramatically improved overall productivity, and shorter time to market. Shorter cycle times between releases helps to snag defects in code much faster. But there's a more practical benefit for the entire team, said Woodcock.

"The real advantage here is the close collaboration between development and operations. When people work together, it's harder to screw up," said Woodcock.

Conclusion: Skating to where the puck will be

5G SA efforts are very much about aligning business, technology and processes in the service of what 5G will be, not what it is today. That requires an ongoing evolutionary process in which every element of the business needs to go cloud-native to achieve success.

NHL star Wayne Gretzky's famous quote about skating to where the puck will be, not where it has been, has been a favorite touchstone for generations of business leaders and growth hackers. It's a popular quote because it's apt. And it's certainly apt here: 5G SA success is very much a function of being able to look to the future, plan, anticipate and execute effectively in that service.

Acentury

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