RCRWireless News
INTELLIGENCE ON ALL THINGS WIRELESS

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PRIVATE NETWORKS GLOBAL FORUM

KEY FINDINGS REPORT

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INTRODUCTION: MAKING PRIVATE NETWORKS ABOUT THE JOURNEY, AND NOT THE DESTINATION

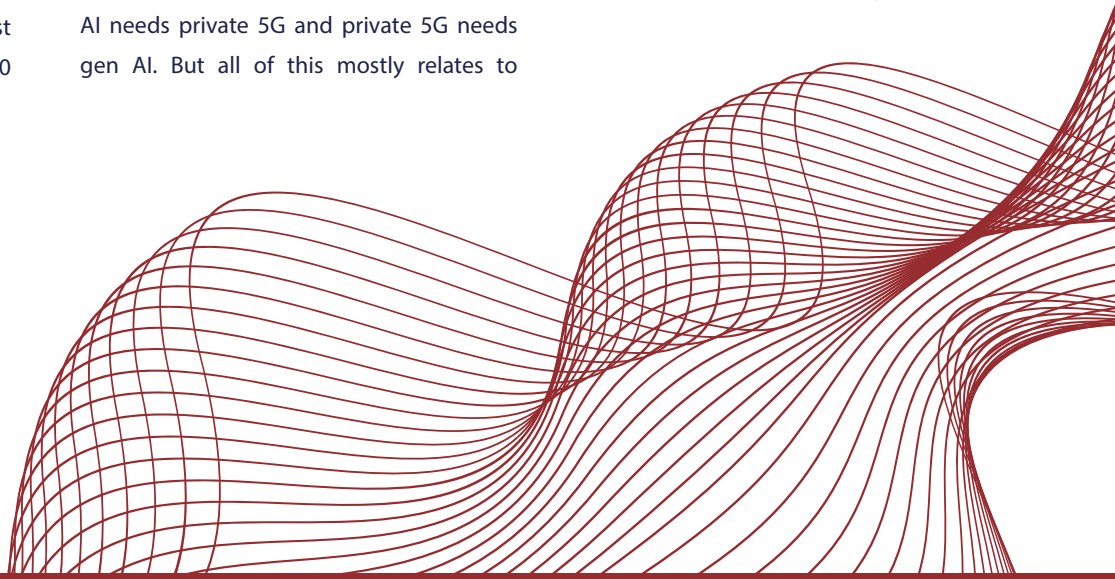
RCR Wireless News recently hosted the Private Networks Global Forum. This is the fifth version of this event — in either its global or European format, and it feels like this technology has come a long way, and also not very far at all. It is a contradictory market, in ways — half the time you hear about how companies are growing business hand-over-fist, and half the time you hear that the market has failed to live up to expectations. But hype is an important aspect of this. Some quick numbers, to start.

The most-quoted stat about private networks, from Nokia five years ago, says the addressable market (TAM) stretches to about 14 million enterprise venues — which captures the epic sweep of the industrial sector, and explains why the market is so excitable. But a recent market review by Analysys Mason — to take just one at random — says only about 4,000 private networks have been deployed. Which is not much at all — just 0.003 percent of that speculative TAM figure.

But it is wrong to look at the market in such a limited way, of course. Every analyst house predicts strong growth over the next few years. The tales from the trenches say what an exciting and powerful technology this is. German industrial giant Siemens, say, which is in no particular hurry with any of this, reckons that 5G will be in every factory, eventually — where critical connectivity is required. Does that mean 10 million factories? No. But it means a good piece of work, and a good piece of business, in lots of them.

Plus, generative AI is coming, of course – on a much steeper hype curve. And we know what they say about that, right — that gen AI needs private 5G and private 5G needs gen AI. But all of this mostly relates to manufacturing — which is the poster-child for industrial revolution, and also the most taciturn in the whole Industry 4:0 brood. It was always going to take longer. And while it kicks the tires on 5G, and waits for a better version of it, the market has been scaling systems and shrinking systems, and selling elsewhere.

Private Networks Global Forum is about private networks everywhere — in mines and ports and warehouses, and in offices and stadiums and hospitals. And in these places, private 5G is going okay. It is early-days, and it is not easy, but who ever said it was going to be easy? This event, and this report about it, considers the hype and glory which has attended the enterprise market's first brushes with private cellular, and seeks to present the reality, both harsh and bright, of the picture they have created.



Our goal with this event was to pair a fabulous agenda with fabulous speakers, featuring enterprise-led case studies and discussions, plus an exclusive gallery of higher-ups from the selling side, talking about network design, network scaling, network testing, network spectrum, and all the industrial AI pyrotechnics you can shake a 5G stick at. The story they tell says that, despite all the impatience that the market goes faster, very real progress is being made — and that there is a ready glut of experience about what to watch-for and how to make it work.

In the end, what this event and this document offers is a shared experience, and shared ideas about ways to go forward. Because, like we all know, private networks — or IoT, or Industry 4.0, or digital change, or whatever — is a team sport and a long game. It's not easy, but nothing worth doing is easy. Equally, the collected stories from Private Networks Global Forum suggest the road is always getting easier, faster, better — and that, even with 0.003 percent of the journey done, industrial revolution is just over the rise.

Finally, to roll the credits…. *RCR Wireless News* would like to thank Druid Software, Future Technologies, iBwave, and Spirent as sponsors of Private Networks Global Forum. Without them, events like this do not happen, and the experience is less shared, and the market is less buzzy. So long as the marketing hype gets commercial focus — through events like this, supported by companies like this — then the ecosystem gets busy and the journey gets productive, and the final destination is not a yardstick to be beaten with.

PRIVATE 5G HYPE VS. HOPE— WHERE ARE WE REALLY?

PETER CAPPIELLO
CEO
Future Technologies

As established in the introduction to this report, private 5G investment has not lived up to forecasts. That said, the technology has matured, enterprises are buying it, and it is delivering net new value. Perhaps the central dilemma here is that, generally speaking, the people selling things tend to want to sell as much as possible as quickly as possible. But in the case of heavy industry, the buyers tend not to build anything in the hopes that the value will gradually emerge. Private 5G-enabled solutions have to deliver from day one. Another wrinkle here for sellers is that selling private 5G is different from selling commodity connectivity; it requires deep familiarity with the needs of the buyer and the ability to eschew business as usual. Buyers need a customized solution so trying to sell everyone some version of the same thing can often lead you to a market reality that's starkly less rosy than a market forecast.

But things are coming along, according to experts convened for the forum. We heard from Future Technologies CEO Peter Cappiello that his firm's private wireless pipeline has grown from about $40 million a year ago to around $185 million today. "It seems to be scaling every week," he said. "We're fairly bullish. We like the reality of it and we feel like we're in the right place at the right time to take advantage of the market conditions."

"I've been saying to my board… 'tomorrow, tomorrow,' for the last few years now," Ste Ashton of NexGworx, said. And finally, he sees interest expanding from huge global enterprises to small — and medium-sized firms as well as with governments. "I think we're ready for that wave to come," he said. He then made an important distinction between selling private 5G to support one use case and stacking up multiple use cases to help buyers "justify that return on investment…I do believe we're actually on the cusp of that wave at the moment."


(Image courtesy of 123.RF)

Druid Software Senior Manager of Business Development David O'Byrne acknowledged that revenue isn't matching up with forecasts, but "reality is always less shiny than the magic spreadsheet." However, "Things are definitely peaking, and the amount of business we're doing is definitely growing." As far as why there hasn't been an explosion in private 5G adoption by manufacturers, for instance, O'Byrne rightly noted that delivering a solution is "ecosystem-dependent" in that it requires alignment across core and radio networks as well as chipsets and devices. "We're not building Lego here," he said. "There is a time lag once the standard is completed to bring all of this into chipset design, into end-user devices, into radios."

Big picture, he said, it would appear the private 5G ecosystem is "coming out of our difficult teenage years and starting to grow up into a real, serious industry." Success "depends on the vertical, it depends on the ecosystem you need to deliver the thing."

iBwave Market Development Director Jalal Berrahou noted regional growth in the U.S., U.K, Germany, France and Japan, as well as stand out verticals like oil and gas, energy and mining. The commonality, he said, "is all of these, they have really valid use cases" that speak to safety, security, reliability and other business-critical characteristics private 5G can deliver. But once you get out of major global industries in advanced economies, and once these types of potential buyers see the breadth of available solutions, there's "hesitancy. They probably have a harder time justifying the ROI and the value." As to the number of technology options, Berrahou said he's "waiting for consolidation" in the private 5G vendor market. With consolidation, "it becomes easier to pick a solution and really prove the value of the investment…Once we get to that point, I think it's going to become mainstream."

JALAL BERRAHOU
Market Development Director
iBwave

DAVID O'BYRNE
Business Development,
Senior Manager
Druid Software

STE ASHTON
Managing Director,
NexGworx

O'Byrne dug into the killer app vs. apps conversation, distilling his pitch to private 5G as a justified investment if it solves a recurring problem that costs a business time and money. Giving the example of autonomous guided vehicles (AGVs), he said, "If you have Wi-Fi-driven AGVs that are breaking down…your infrastructure is not fit for purpose. Then, when you have [private 5G] in, you can start to think about how do you amortize the costs, what are all the benefits this is bringing us? Then at that point you can think about moving everything…to digital…It's really about changing the context away from what's the killer app for this. You need the private network because something you're doing today is not working, and that's why you need to invest in new infrastructure."

Berrahou, analoging the trouble with selling a one-size-fits-all product into a market that requires tailoring with the work RF engineers have to do in the private network space, said they have to become consultants and think about the technical and business sides of the equation. Cappiello agreed that the in for private 5G is around "common sense use cases you can make a decision on today."

"It's just a different mindset," O'Byrne concluded. "You need to be business-focused to really understand this." Of potential private 5G buyers, "You have to meet them where they are."

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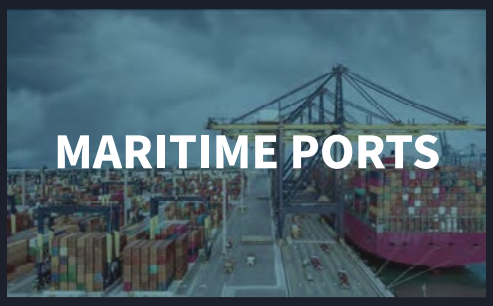

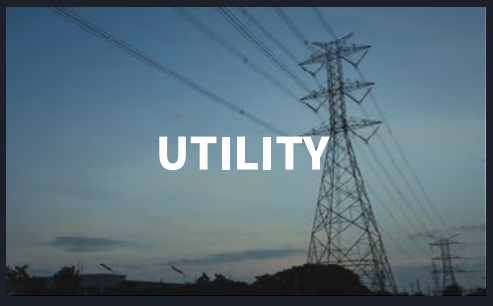

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(Image courtesy of Verizon)

THE 5G FUTURE IS NOW; THE 6G-ONE CAN WAIT — SAYS VERIZON

ARVIN SINGH
Head of Global 5G Solutions Engineering,
Verizon

Five private 5G learnings; what is old is new again

Arvin Singh, head of global 5G solutions engineering at Verizon, and part of the US carrier's global go-to-market team for private 5G, was recently in conversation with Bruno Tomas, chief technology officer at the Wireless Broadband Alliance (WBA), ostensibly to talk about the concept of neutral host networks as the "killer app" for private 5G; in the end, the conversation was more wide-ranging, touching here and there on the neutral host model, but jumping around the role of cellular within enterprises in a more expansive fashion. Here is a summary of the big points.

1. Private cellular is age old and brand new

Make no mistake: private cellular is like a new technology, with all the optimism that brings – and more, just because it is more special. Yes, said Singh at Private Networks Global Forum, enterprise-geared cellular has been around for donkeys' years. "We have been in the private networks game for a decade and a half," he said, making reference to distributed antenna (DAS) and license assisted (LAA) and aggregated (LWA) systems for enterprise setups. But spectrum liberalization in a number of global markets has changed the dynamic, and allowed enterprises to rent their own airwaves, and service providers of various sorts to sell services in almost any market they want.

This is "what's unique and different now", said Singh. But, perhaps unsurprisingly, given the sensitivity for traditional operators about spectrum ownership, the reference to spectrum was short, or else skewed behind the parallel narrative about how cellular technology itself has changed – with both development of the 5G standard, but also, notably, with smaller and simpler core network and radio access (RAN) systems. "We are in a different place… as an industry; the technology has modernized rapidly," remarked Singh.

"[With] the miniaturization of radios and core network equipment – we are able to bring private dedicated on-prem indoor / outdoor networks that are designed and purpose built to serve specific business use cases and problems. Industries… are positioned to benefit from this type of network experience that is tailor-made for their use cases."

2. Neutral host builds the business case

The impact of smaller and simpler LTE/5G systems is not just about their manageability, of course; it is about cost, as it always is – and as it must be for new technology to gain credibility in watchful industrial markets. When presented as a fully-managed service solution (as sold by Verizon's enterprise team), private cellular might even appear like a light-touch investment, suggested Singh. "Think about the IT burden it lifts from IT staff, and the ease-of-deployment [because of] reduced wiring [compared to fixed Ethernet or higher-volume Wi-Fi installations]," he said.

More than this, however, the emerging neutral-host model, where new LTE/5G systems are operated with both carrier-agnostic channels for general work comms and private-dedicated channels for critical work comms, means the investment case is exploded and secured by multiple departments and enterprises. Singh said: "Neutral host networks [are] going to be a key driving force [for] private 5G adoption, and [will] enable the next wave of use cases… I see tremendous benefits from a capex / opex standpoint… [Because] [private 5G] is an IT funded network."

He continued: "[Whereas] you get into neutral-host… [and it] is a network for anybody and everybody – for the facilities [and] real estate department, and for OT partners and other business units to collaborate on [funding for] this next-gen network.

3. 5G is complementary, but also better

The above-point about private cellular being special is not just because it is smaller, simpler, and cheaper than it once was, of course; it is because it is just plain better, too. That is, if better means higher-performing – for higher-performance applications; and if the comparison is with other wireless technologies. Either way, this is the conclusion from Singh. Pressed by Bruno Tomàs at the WBA, chairing the session, about how 5G will slot in with legacy enterprise connectivity technologies, he responded: "The [5G] value proposition is far more interesting."

Actually, that is not entirely fair; Singh provided a right-on and round-about justification for both enterprise customers and technology vendors to use an arsenal of technologies to arm a fleet of applications, before a righteous proclamation about 5G as the big gun in the ranks. It went like this: "Look, there are a variety of network modalities… and… tremendous proof points… [for] industrial-grade deployments in logistics, oil and gas, energy, manufacturing – [whether for] replacing or augmenting Wi-Fi networks."

"IoT can be advanced and scaled greatly on private networks. We've come into scenarios where manufacturing facilities are using ground robotics like AGV or AMRs, and there are Wi-Fi dead spots and handoff issues… [and] congestion… This notion of a secure connected 5G fabric that gives high speed, low-latency, predictable performance – and the ability to assign quality-of-service to different applications and profiles – makes [5G] super interesting, and the value proposition far more interesting than the previous modalities of connectivity, frankly."

4. The private 5G future is now—the 6G one can wait

The other thing – which has undermined the hype, but also makes the hype tangible – is that 5G is a developing technology. Singh reflected: "5G packs tremendous promise. A lot of it is yet to be realized. Over 315 operators globally have deployed commercial 5G networks, and a lot of the progress in the macro network, going from NSA to SA architecture, or enabling slicing [and] URLLC, can carry over to private network infrastructure." He cited nearer-term opportunities with reduced capability (RedCap) 5G for lower-power industrial IoT, as well.

These developing network capabilities also shore-up the business case for private 5G, he said. "We are not saying [5G] is a replacement network [for Wi-Fi]. Quite frankly, [they are] very complementary. But it really depends on the use case, and not just the immediate use case but the longer term ones – the future vision, and horizon-three applications that [an enterprise wants to enable]. That [kind of thinking] should really prescribe the flavor of the network investment one should make," said Singh. The implication is that 5G is the safer long-term bet.

Asked by Tomàs, as well, about even longer-term development, with 6G starting to loom larger in the telco consciousness, he provided some kind of perspective – that 5G is a real commercial proposition, close enough and young enough to support industrial transformation, and that 6G is a potent standards exercise, which will not feature properly in commercial discussion for another decade. "Tech progression takes herculean effort… and a lot of the lessons of 5G and 5G Advanced will shape the 6G future," he said.

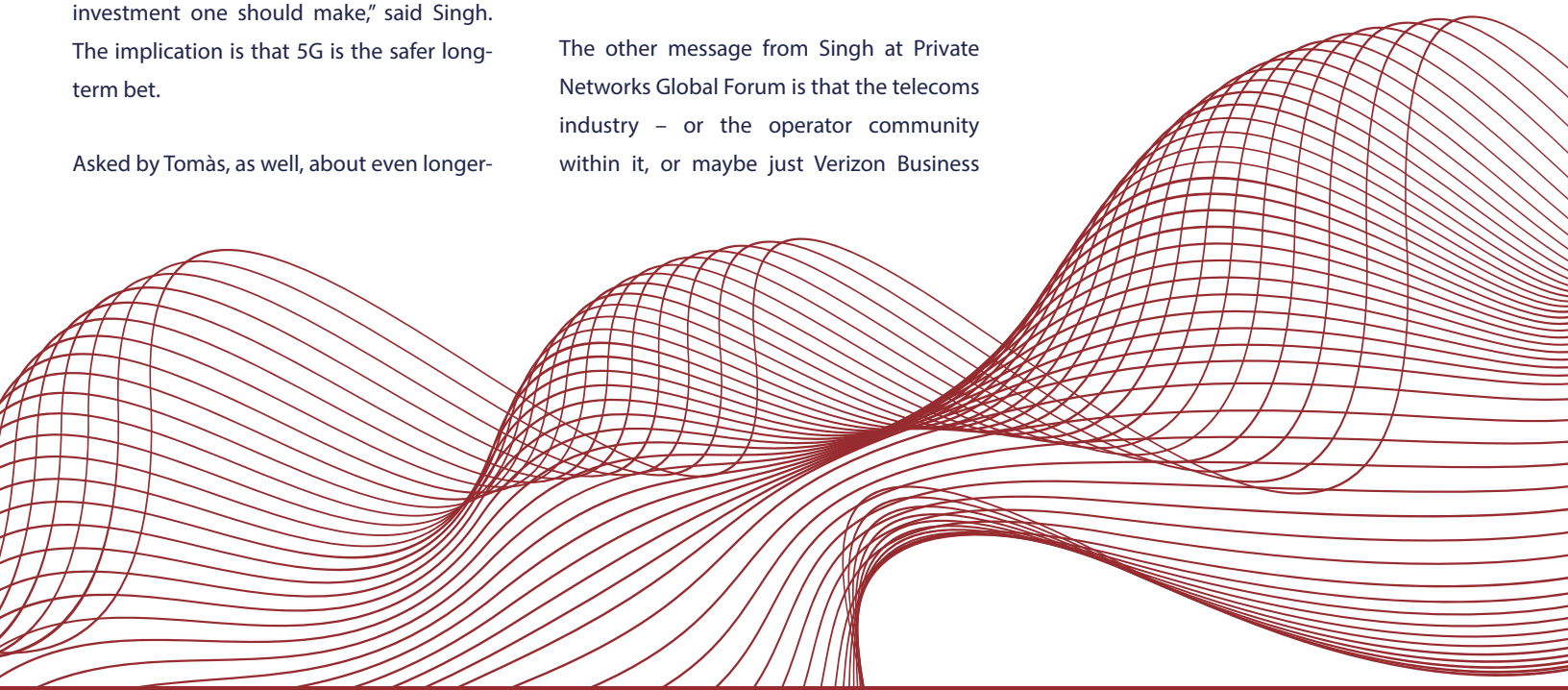
"But these technologies [are] 10 years in the making, on paper – to ratify the standards, [schedule] capabilities, that sort of thing. And once [they are deployed] at scale, it [still] takes time – and the network lives for three or four decades… 6G is a post-2030 type of experience, and it won't be designed for anything and everything. Private [5G] is a promising opportunity [now] to take networks in places where operators did not typically build public infrastructure – so that makes it a more of an interesting proposition."

5. Experience is building—and experience is everything

The other message from Singh at Private Networks Global Forum is that the telecoms industry – or the operator community within it, or maybe just Verizon Business – has learned a lot, and fast, about how to design, sell, build, and manage private cellular networks for enterprises. "We have learned a ton, quite frankly, in the four years of doing this – from proof-of-concept, to proof-of-value, [to] commercial deployment. We have tons of proof points that give confidence that this is real, that it works and solves problems, and that customers can realize their ROI fairly quickly."

And, as a sales pitch of sorts, he warned finally that experience counts in the private-enterprise- networks market, and that enterprises should choose carefully. "Now, with open spectrum ecosystems, there are a lot of players [in this] business. [Enterprises] really want to do [their] tech due-diligence to make sure [they] are partnering with the right providers that can deploy a network that has the ability to scale; which has a future roadmap that can be enhanced with software upgrades, rather than requiring a major forklift."

Verizon is that type of partner, of course – the message went.



(Image courtesy of 123.RF)

IT'S ALL ABOUT SPEED'—GEORGIA-PACIFIC ON LEARNING AND REASONING LOOPS AT THE INDUSTRIAL EDGE

Like virtually every other large global enterprise, paper product manufacturer and distributor Georgia-Pacific is working to leverage generative artificial intelligence (gen AI) for workforce productivity gains. While the current focus is "all about speed these days," according to Vice President of Innovation Michael Carroll, the underlying problem dates back to the 2000s when manufacturing productivity increases began to slow then plateau as skilled workers began exiting the workforce en masse which was met with a scramble to replace institutional memory with technology.

At the time, Carroll said, "You could start to feel this difficulty in being able to sustain productivity…which made automation appear." But this led to an overcorrection that ultimately saw frontline workers distracted by an overload of information and analytics that were meant to augment human knowledge. The cumulative effect of these distractions, this "generational susceptibility" to distractions, was the opposite of the intent—instead of workers using technology, instead of knowledge, to become more productive, the opposite happened. Then COVID-19 hit further compounding the problem around knowledge loss and generational susceptibility.

Carroll said that at its core, gen AI is a technology that lets people interact with other technologies; it makes knowledge that exists in silos within a company something that can be harvested and used for decision making. It's all about communicating contextualized information to a worker when and where it's needed.

He referenced the Purdue Model, a reference enterprise architecture that follows a six-level hierarchical model. To recap:

- Level 0 is the physical process, including sensors, actuators and other devices on the factory floor.
- Level 1 refers to basic control—things like programmable logic controllers and remote terminals that directly manage physical processes.
- Level 2 is all about monitoring and supervising process control systems; this is your first level of data aggregation and attendant visualization.
- Level 3 is the manufacturing operations systems that handles the overall operation of the manufacturing process, including scheduling, batch management and quality control.
- Level 4 gets into business planning and logistics wherein manufacturing operations are integrating with the manufacturer's larger business.
- Level 5 is the enterprise network and covers everything from corporate IT and finance to human resources and company-wide applications.

Right now, Carroll said, humans serve as the intermediaries between those levels and create something of a "learning loop" that informs decision making. "Now what we're really trying to get at is how do I build artificial intelligence that converts that human learning loop…to a digital learning loop that is agent based?" This future state would create transparency between these layers in terms of understanding the fundamental inputs into thought and reasoning processes that result in the larger output of intelligent decision making. "Everything is explainable all the way back through your generative AI model which is taught by your employees."

Carroll continued: "In this agent world, you have to be able to deliver to the employee what do you need to know, what do you need to do with it, and when do you need to do it?...You have to be good at the ability to deliver content to the individual relative to what their persona says they're trying

MICHAEL CARROLL,
Vice President, Innovation,
Georgia Pacific

to achieve…The disappointing part is that today you have to build this world yourself. There are no applications that allow you to go do this. Hopefully in the future there will be a platform that agents can live in."

While acknowledging all of the point solutions he sees vendors putting into the market, Carroll said, "The issue is the orchestration of your problems and getting those delivered contextually and prioritized to the frontline when they need to get there…You have to become your own orchestrator of context."


(Image courtesy of 123.RF)

THREE KEY PRIVATE NETWORK CASE STUDIES

5G in operating rooms and healthcare environments

In a comprehensive discussion between Mathieu Lagrange, vice president of research and development at Obvios, and Alain Garcia Vazquez, surgeon and senior research officer at the Institute of Image-Guided Surgery (IHU) in Strasbourg, shed light on the integration of 5G and artificial intelligence technologies into the operating room (OR) environment.

During the conversation, Lagrange brought technical expertise to the table, particularly focusing on the main challenges of deploying 5G networks in healthcare environments. He outlined the challenges encountered, such as indoor equipment synchronization, device compatibility, and the maturity of the 5G ecosystem. Meanwhile, Garcia Vazquez provided valuable insights from a surgical perspective, emphasizing the importance of data-driven decision-making and real-time insights enabled by 5G technology.

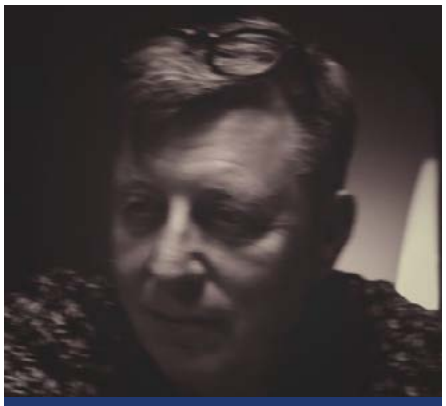
"For us, it was really interesting to better understand how to handle this massive amount of data currently generated in the OR. For us, 5G raises up as a solution that can transmit this massive amount of data. And later, in the OR, what is really interesting is to have these kinds of inputs and insights in real time," said Garcia Vazquez.

The discussion delved into why 5G was chosen over alternatives like 4G or Wi-Fi. Lagrange highlighted the superior capacity, lower latency and better reliability of 5G, making it an ideal choice for the demanding requirements of surgical environments. He explained the efficiency of 5G spectrum usage and its flexibility in handling radio resources compared to 4G and Wi-Fi. Garcia Vazquez expanded on this, highlighting the advantages of wireless deployment in the OR, including the avoidance of cable installation, ease of retrofitting and seamless data integration from multiple sources.

Lagrange illustrated a 5G deployment scenario in the OR, emphasizing a software-defined network architecture with centralized control and edge data planes. This approach allows for greater flexibility and scalability while ensuring efficient resource allocation and management. Garcia Vazquez also addressed concerns about patient safety in case of service disruptions, emphasizing the importance of backup plans and the reliance on surgical expertise to navigate certain unexpected circumstances.

In conclusion, both speakers underscored the significance of team collaboration, patient privacy, and safety when adopting new technologies in healthcare settings. They expressed optimism about testing use cases in both France and Germany, highlighting the primary focus on enhancing patient care and safety through the seamless integration of cutting-edge technologies in the OR.

GARY HILL
Chief Operating Officer
Future Technologies



WILLEM BLOM
Senior Advisor
Royal Schiphol Group

MATHIEU LAGRANGE
Vice President, Research and Development
Obvios

ALAIN GARCIA VAZQUEZ
Senior Research Officer
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(Image courtesy of 123.RF)

Seaports and airports embrace 5G private networks

Elsewhere in the world of private networks, Koen Mioulet, co-founder and board member at EUWENA, and Willem Blom, senior advisor at Royal Schiphol Group, delved into the intricate world of main ports and private wireless networks. Mioulet kicked off the discussion by introducing the European Users of Wireless Enterprise Networks Association (EUWENA), emphasizing its role in accelerating the enterprise wireless market, particularly in regions like Europe where spectrum fragmentation poses significant challenges. The executive also underscored the importance of main ports, such as seaports and airports, as major users of private wireless networks.

Blom, representing Amsterdam Airport Schiphol, provided insights into the group's ongoing efforts to deploy private 5G networks. He outlined the airport's ambitious goals, including optimizing operations and achieving autonomous airport operations by 2030. Blom detailed the steps taken by Schiphol, from obtaining spectrum permits to conducting tenders for private 5G installations.

Throughout the session, the speakers addressed various challenges and considerations in the deployment of private wireless networks, including spectrum harmonization, device availability, and collaboration among stakeholders. Both speakers emphasized the need for standardization and innovation to overcome these challenges and drive the adoption of private wireless networks in critical infrastructure like main ports and airports.

5G and edge computing implementations

Looking across verticals, Pete Cappiello, CEO of Future Technologies and Gary Hill, the company's COO, also provided an in-depth overview of Future Technologies's expertise in private cellular networks.

Cappiello emphasized Future Technologies' extensive experience in the field, highlighting its approach of integrating private 5G networks as an additional component to existing infrastructure.

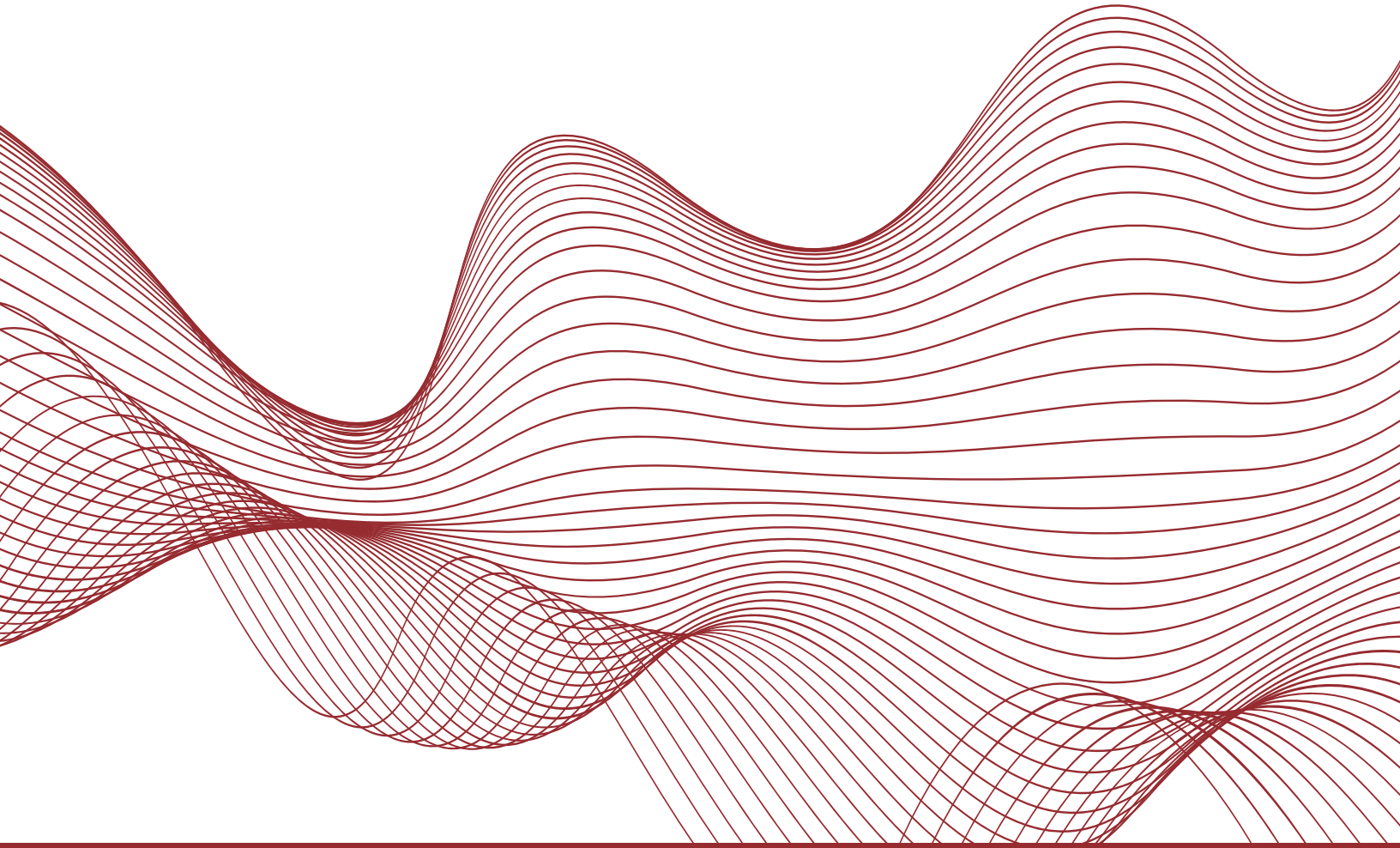
Meanwhile, Hill guided the audience through a virtual tour of the company's living lab, which showcased the practical implementation of private 5G and edge computing technologies. The living lab demonstrated a holistic approach to network integration, incorporating private cellular 5G, Wi-Fi 6, microwave, and LoRaWAN to address diverse enterprise requirements.

Several real-world applications were showcased during the tour, highlighting the efficacy of private cellular networks. These applications included remote expert systems for remote troubleshooting, computer vision for object detection and people counting and autonomous mobile robots controlled over a private 5G network.

Hill also indicated a shift in the market towards greater adoption of private cellular networks. He noted a transition from proof of concepts to production implementation, with enterprises across various sectors embracing private networks for their reliability and coverage advantages.

"We are definitely seeing maturity in the market, in terms of uptake of private cellular 4G and 5G. Three or four years ago, most of our work was a lot of proof-of-concepts with larger corporations trying the technology out. I would say the last 18 months, we've really seen a bigger shift in production implementation. I think we're seeing it going from enterprises testing the technology to now deploying it. I'd say we're probably still early in that cycle," said Hill.

Key drivers of adoption discussed during the session included the need for enhanced remote worker connectivity and the growing demand for mobile robotics solutions. Hill stressed the importance of seamless integration with existing enterprise networks, emphasizing the need for efficient testing and deployment processes.



(Image courtesy of EDF)

EDF BOOSTS PRIVATE LTE AT FRENCH NUCLEAR POWER PLANTS WITH ERICSSON, THALES

Electricity company EDF has accelerated its private LTE rollout at nuclear power plants in France with Ericsson and Thales. The firm, which originally scheduled two-to-four networks per year when the project was announced in 2021, said that it has so far deployed nine private LTE networks, and has a new target of six per year. It wants 21 private LTE networks at 21 nuclear sites, to connect workers and machines at 57 power stations.

The company has been impressed by its work with Ericsson and Thales, and the coverage and performance achieved by its new private LTE setups, and has resolved to go faster with the project in France. EDF (Électricité de France) said it had another private LTE deployment at an offshore wind farm, and a brand new private LTE pilot, with scope for a private 5G upgrade, at a thermal / gas power generation plant, as well.

Vincent Audebert, handling 5G and IoT in EDF Lab, the firm's R&D department, said: "It is the first time in my 30-years at EDF that a telecoms project has finished ahead of deadline. Because there is such interest in this project, [and] EDF has decided to accelerate the deployment. So we are going to gain two years on our schedule – [and move to a schedule of] six networks… per year. We already have nine networks – out of 21 sites with 57 reactors. [The plan is] we will have 21 [private] networks."

VINCENT AUDEBERT
5G, IoT and Telecom Expert
EDF Lab

EDF's LTE rollout, which started in 2021 at the Blayais power plant in southwest France, goes under the name CONNECT, and is considered the biggest deployment of its kind in the nuclear power sector. At Private Networks Global Forum. Audebert said EDF will install private LTE at other wind farms and thermal power plants in France, as well. "We plan to extend it to other… plants," he said. EDF has eight power plants in the UK, also.

The company has a 10-year licence for 20 MHz of spectrum in the 2.6 GHz TDD band (band #38, 2570-2620 MHz) at its sites in France, as offered to metropolitan businesses by regulator ARCEP; it also has a deal with the French Ministry of Interior for two three-megahertz tranches of 700 MHz spectrum, officially prescribed for public protection and disaster relief (PPDR). "With that we're able to cope with our jobs that we need to do on a day-to-day basis in the nuclear power plant," said Audebert.

To an extent, upgrade-rollout of private 5G hinges on ARCEP making available spectrum at 3.9-4.0 GHz to enterprises in France. The R&D team at EDF Lab holds an experimental licence to develop 5G use cases in the 3.9-4.0 GHz band; Audebert said the R&D team is working with Ericsson, Thales, and France-based IoT chipmaker Sequans to develop new LTE and 5G applications ("drones, video, AR; anything like this"). "The output of the project will be delivered within two years," he said.

He noted EDF's interest in the 450 MHz band as well, which is subject to a parallel work stream within ARCEP.

Specifically, Audebert said EDF's private LTE networks are being managed and maintained by the company itself. He commented: "[Ericsson and Thales] provide us with a solution that is able to be provisioned, and then it's built by EDF. Even if the integration is done by our partners, it is very important for us to… manage what's on our site." He noted the challenge to find skilled staff, however.

"What I would say is [most] complex is to find skilled people. Because [for a nuclear plant] it's not your usual domain of expertise. But we have [found] people… to be sure that we are able to work with [cellular[by ourselves. So EDF is doing the day-to-day work [so] everything runs smoothly – for… functions, security. We count on Ericsson and Thales for support… but we are really driving the system."

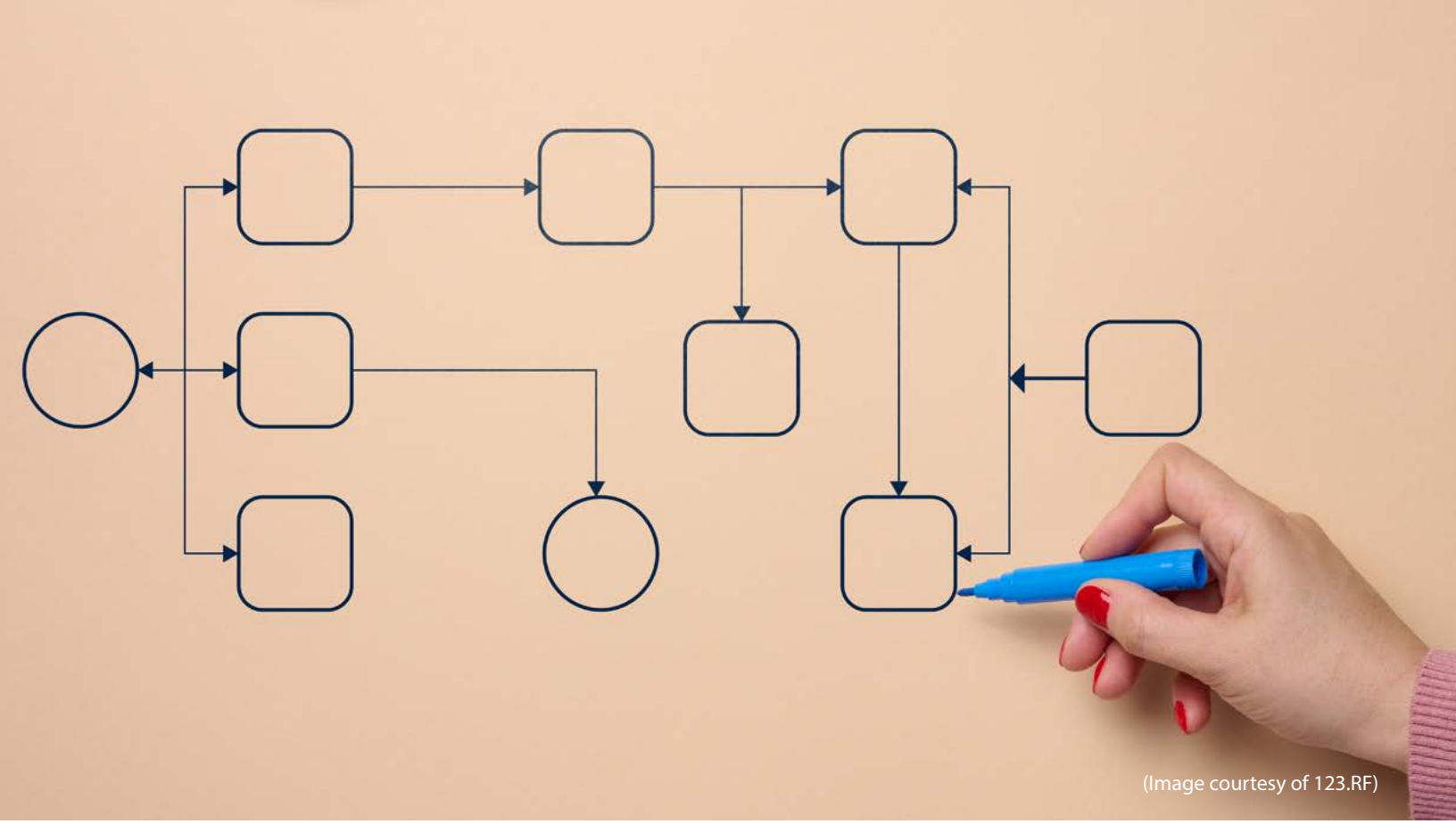
The other takeaway from the discussion is that EDF is focused primarily on LTE because of spectrum availability, but also because it delivers for its purposes, currently, which are generally focused on reliable and extensive coverage for straight worker connectivity. "The first thing, and it may be basic, is we need voice communication," said Audebert.

He went on: "You can add [mission-critical and video] on PTT… [and also] share pictures… which is important [for remote access to] expertise… [The success of these applications] is why the project has been sped up. There is such interest to… digitalize [worker processes] with applications on smartphones… In a nuclear power plant, you don't have a public network so it is very important to have… very, very reliable [connectivity] that can reach all parts of the power plant."

Current R&D work at EDF is focused on "more applications on 4G", he explained – as per the collaboration with Ericsson, Thales, and Sequans. There was less said about network performance, except to note that EDF has its own private on-site and local edge data centres, which dictate latency of applications, and even less on service level agreements ("confidential"). But Audebert opened proceedings with a note about EDF's need for closer collaboration with public network operators as well.

He said: "I know we are in a private networks event, but as a big utility it is important for us to be able to work with operator networks as well… Which is why we're pushing a lot working with 3GPP to have better coordination between the distribution system operators for the grid and mobile network operators for the telecoms."

He summed up: "It was difficult to [make] this choice… – to say, okay, we're going to move to this new [critical communications] technology. It was a very innovative move by EDF… [and] it changed the way the processes are done in nuclear power plants. So it was very important… And it showed [how it was possible for] an industrial company to build a private network. Nobody else was building private networks; now you have multiple offers, a lot of companies… It is nice to see that we were at the forefront."



(Image courtesy of 123.RF)

THREE RECOMMENDATIONS FOR A PRIVATE NETWORK TESTING STRATEGY

Enterprises report that one of their top reasons for considering and implementing private networks is in pursuit of better network reliability.

But how do you achieve the expected level of private network reliability? Rich McNally, senior director of mobile service strategy at Spirent Communications, discussed Spirent's point of view on the topic at Private Networks Global Forum event, in light of its extensive engagements in the testing and assurance of private network deployments.

According to McNally, there are three key aspects to network testing for private networks.

1. Measure what matters.

"The first thing, and in my mind, perhaps the most important, is really to focus on what matters to the end user—to measure what matters," McNally said. "When all is said and done, even if your network and the individual components, even if they conform to different specifications, pass different standards tests—what really matters is, does it deliver what my customer needs?" That means answering questions such as, is coverage strong in areas where it is needed? Does the network have the capacity to meet the performance and quality of experience requirements for the use cases that the customer wants to be supported? And what is the impact to performance and user experience as the network becomes loaded to the expected level? Answering those questions helps direct design and optimization, McNally said.

RICH MCNALLY
Senior Director of Mobile Service Strategy
Spirent Communications

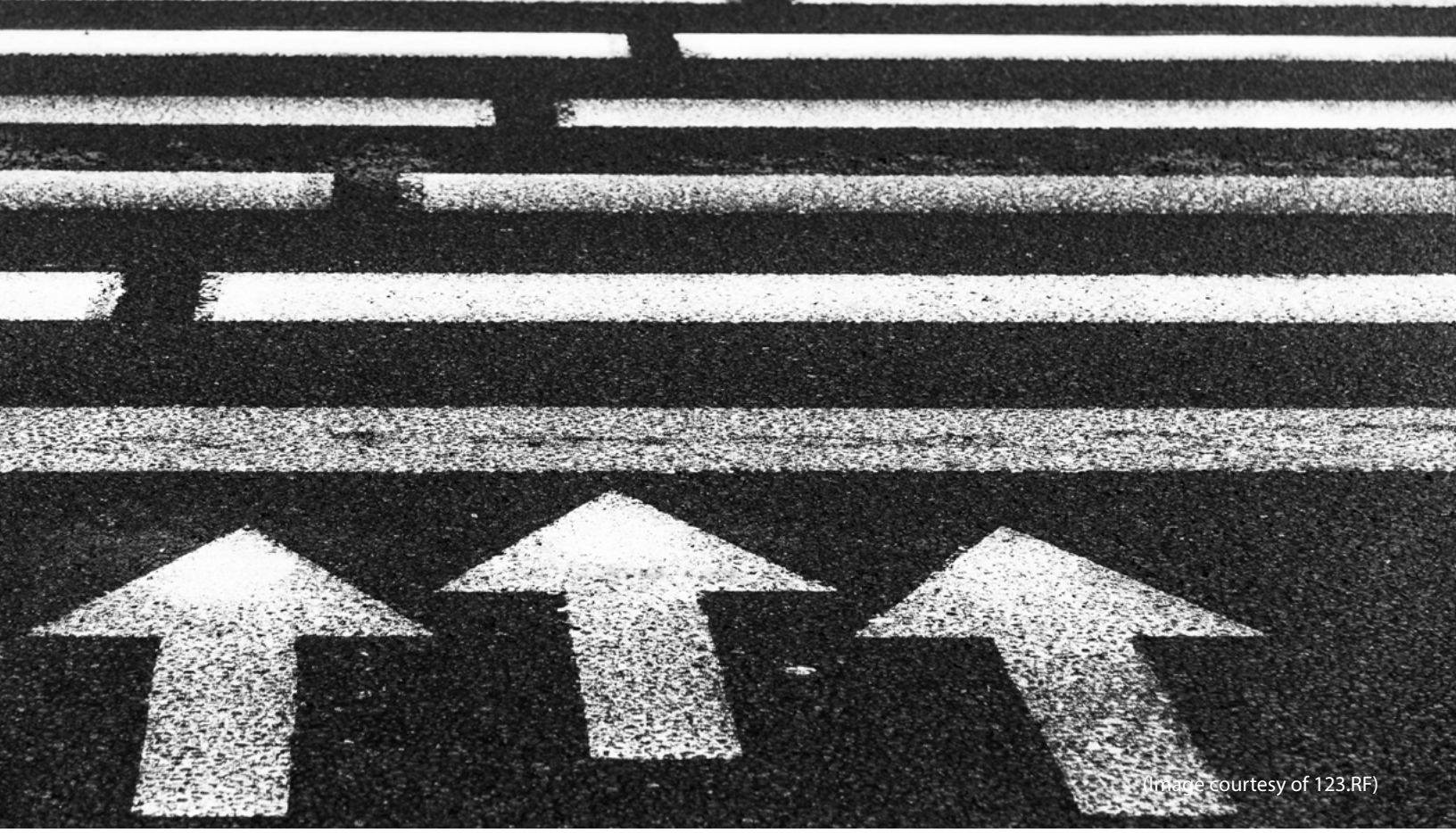
2. Adopt a lifecycle testing strategy.

Private network validation and assurance can't be viewed as a single event, a one-and-done task to be checked off as part of deployment. Successful private network customers "adopt more of a lifecycle strategy," McNally said, starting with lab work in the design and build phase to make sure, especially in a multi-vendor deployment, that the RAN and core equipment and software conform to standards and work well together, and that the private network's functions, coverage, use of spectrum, performance and quality of experience is tested thoroughly before it is rolled out to its user base.

"Even if you've got a bit of a standard model on your design, the components that are being used—both core and RAN—every network is going to have its own characteristics, quirks, its going to have its own critical use cases that you're going to want to pay attention to in the real world," McNally said.

3. Stay on top of assurance during ongoing operations.

Networks change, and having active assurance such as virtual agents that can run tests, will help identify impacts of loading changes, usage changes, component failures or other patterns changes over time, McNally said. "It's really to expect the unexpected, and be ready for things you don't see coming," he said.



(Image courtesy of 123.RF)

'THE ONLY PATH FORWARD'—SPECTRUM SHARING IN THE US AND UK

Balancing spectrum incumbents with new users and mitigating signal interference are increasingly challenging

All around the world, CSPs are looking for access to more spectrum. In many cases, governments are responding; however, things like balancing incumbents with new users and mitigating signal interference are making the process of giving everyone the access they need challenging. As a result, sharing has become a significant component to government spectrum strategy. During a panel at the Private Networks Global Forum, panelists provided more insight into how the U.S. and the U.K. are facilitating spectrum sharing.

"Sharing is the only path forward," claimed Joe Kochan, the CEO and executive director at National Spectrum Consortium in the U.S. He noted that spectrum wasn't always the hot commodity it is today: "You started where anyone could use anything, and licenses were handed out for free," he said, adding that now, there is a growing need to relocate certain users to make room for others, and that further, with models like CBRS, more U.S. users are sharing or adjacent – both of which require strategies to deal with the "technical ramifications."

The U.S. government released the Biden Administration's National Spectrum Strategy (NSS), a National Telecommunications and Information Administration (NTIA)-led plan that focuses on 7.1 GHz to 8.4 GHz. It acknowledges that dynamic spectrum sharing is "key" to meet the growing demands of advanced systems such as 5G and 6G broadband networks, private wireless networks and autonomous vehicles.

Also on the panel was Derek Khlopin, who is deputy associate administrator in NTIA's Office of Spectrum Management, which is an agency of United States Department of Commerce. He shared that while repurposing and reallocating spectrum has worked in the past, such opportunities are "very few and far between these days" and is, in fact, only going to become harder to do. "So obviously, a natural solution is to find a way to share spectrum more. This can be the most granular dynamic spectrum sharing to more of these you take a band and carve it up different ways or you do a geographic exclusion. What we are trying to do … is to find ways to advance that sharing," he said.

The U.S. currently has CBRS, a 150 MHz segment of the 3.5 GHz band established in 2015 that is part of the FCC's three-tiered system for sharing the spectrum between federal and non-federal users. According to Kochan, it's working. "Folks were able to come up with a framework, design new technology — SAS and its related technologies — onto the band to make it possible, prototype, test and deploy that

DEREK KHLOPIN
Deputy Associate Administrator for Spectrum Planning and Policy,
NTIA Office of Spectrum Management

JOE KOCHAN
CEO and Executive Director
National Spectrum Consortium

technology and now put it out there for commercial use in such a way that CBRS has an active market, and in some ways underpinning the private network activity here in the U.S.," he stated.

The U.K. government established the Shared Access Licence (SAL) framework in 2019, and as of March 2023, issued more than 1600 licenses across the four shared bands (3.8-4.2 GHz; 1781.7-1785 MHz paired with 1876.7-1880 MHz; 2390-2400 MHz, and the lower 26 GHz indoors). Ofcom's Principal of Spectrum Policy Richard Moore told event attendees that many of these licenses are for fixed wireless access, others are being used to connect factories ports and mining facilities.

Moore called the 3.8-4.2 GHz band the "anchor band" for the overall spectrum-sharing strategy, commenting: "One of the advantages of being in that band … is

RICHARD MOORE
Principal, Spectrum Policy
Ofcom

that it's adjacent to the band we've made available for 5G … so we've seen the equipment ecosystem start to bleed up," he said, adding that Ofcom now expects to see a lot more take-up within this band. "[Spectrum sharing] solutions require a level of collaboration, whether that's developing the technology to start with or when you deploy," Moore concluded.

(Image courtesy of 123.RF)

HOW TO ENSURE FLEXIBILITY AND CONTROL WHEN SCALING PRIVATE 5G

Private 5G networks are beginning to deliver "real business value," says AWS exec

Even as private 5G deployments are taking off around the world, from China to Europe, scaling across and managing multiple services and locations remains a challenge. At the Private Networks Global Forum, panelists discussed how their companies ensure flexibility, visibility and control across and between different services and networks for their enterprise customers, as well as the private network use cases they see gaining the most traction.

But first, what does scaling up mean in the context of private networks? According to Vodafone's Global Senior Product Manager Elizabeth Rumsey, the carrier — which has deployed more than 100 private networks globally — views scalability as "the opportunity to deploy different private networks … to different sites" and "across different geographies." Doing so, she continued, enables the customer to take learnings across these different networks and have the same visibility and control as they may have with a fixed wide-area network. "Even if the different networks have different requirements," she added.

For customers looking to scale private networks across different services and locations, Airbus Defense and Space provides what the company's Head of Research and Standardization Amina Boubendir called a "catalogue-driven approach" to network management. This approach allows customers to shop around, for solutions that deliver what each service or network slice may require depending on KPIs. "[This approach] promotes the flexibility that we can have in dealing with different clients… the solution would be transparent for them," she said. "The scale of private network would vary but the approach that we choose for the management… can still be the same."

Chis McKenna, the global head of business development for private 5G at Amazon Web Service, provided a real-world example of this catalog-driven approach, commenting that AWS is often asked if it offers a private 5G neutral host solution. The answer, he continued, is no, but they have partners that do. "We have onboarded them in AWS and our customers are able to choose them and even procure them from AWS… our goal is to make it as easy as possible to consume them," he said.

McKenna also commented that the way enterprise networks are being deployed is changing as these deployments are beginning to deliver "real business value."

AMINA BOUBENDIR
Head of Research and Standardization
Airbus Defense and Space

"More often than not, the point of the deployment is less about the network itself and more about the value it brings," he shared. "All the industries are moving at a different pace, but private wireless sits across a massively broad set of industry. Where we're really seeing the scale coming in is a few horizontal use cases that sit across every vertical. Something like compute division use cases, for example, are just as equally valid in healthcare as they are in sports as they are in security, mining." Other growing areas of interest include augmented reality, robotics, all of which cut across many industry verticals, he said.

And as these types of applications continue to become more ubiquitous, so too will the need for the lower latency, better security and higher reliability and control

ELIZABETH RUMSEY
Global Senior Product Manager–Mobile Private Networks,
Vodafone

CHRIS MCKENNA
Global Head of business Development–**Private 5G**
Amazon Web Services

that private 5G networks can provide. "We identify the need of a private network as part of the transformation rather than it just being about the network itself," McKenna said.

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