PRIVATE NETWORKS FORUM GLOBAL

EVENT REVIEW

PNF | chair's intro

Totally overhyped and utterly indispensable – why private 5G networks matter

So much to gain, so much to lose – the private 5G market goes wider than tech riches, writes James Blackman

What to say about the state of the private 5G market – about the state of 'things', if you like, at the top-end of the IoT game? I was asked to speak for five minutes to introduce the latest Private Networks Forum (PNF), put on by Arden Media, publisher of *Enterprise IoT Insights* and *RCR Wireless*. But, again, what to say? And actually, it turns out there is a lot to say. This is a transcription, revision, expansion of the opening address from PNF.

My response is kind of an emotional one – which reflects, I think, that this market is fraught with emotion. Which is what makes it exciting. There is so much in play, and so much up for grabs – and alternately, potentially, so much to lose and to miss out on. This is the case for traditional telecoms players, in particular.

There are lots of stats and forecasts out there; all of them grasping at something. But most of them don't say very much – at least in the way they are presented to the press. The private networks market is really a part of the much bigger corporate IoT market, and the IoT market has never-ever, I don't think, delivered on its forecasts. I mean, 50 million 'things' by 2020? Well, that

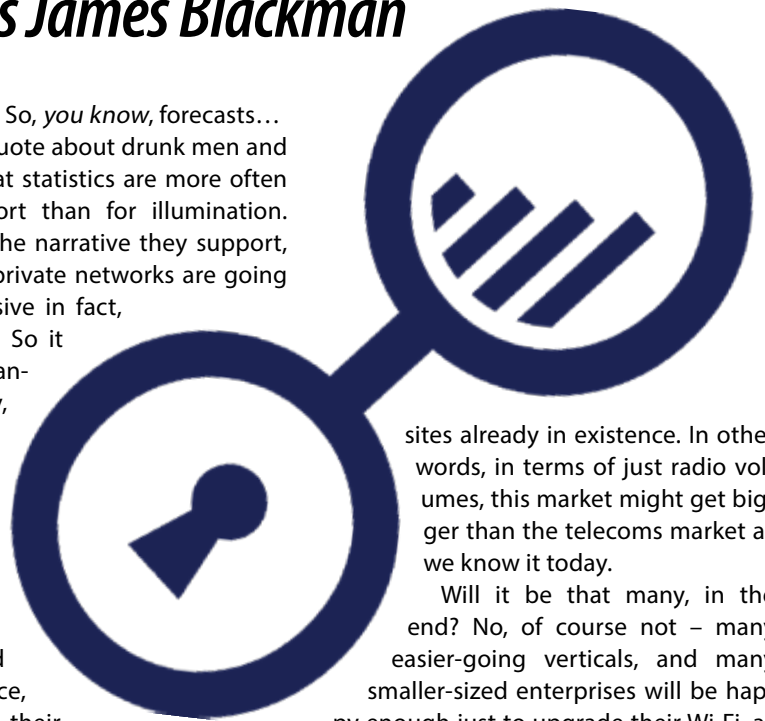came and went. So, *you know*, forecasts…

It is like the quote about drunk men and lampposts – that statistics are more often used for support than for illumination. And we know the narrative they support, anyway – that private networks are going to be big. Massive in fact, in IoT parlance. So it does not add anything to say, here, that private networks will be worth this much by this point. Because the numbers are different, and all over the place, and we know their story very well.

But two stats, maybe three, right or wrong, provide some illumination about this market. The first is Nokia's, from four or five years ago, that there are 15 million-odd venues in the world that might benefit from a private LTE or private 5G network (see page right) – and that this is more than the total number of public cell sites already in existence. In other words, in terms of just radio volumes, this market might get bigger than the telecoms market as we know it today.

Will it be that many, in the end? No, of course not – many easier-going verticals, and many smaller-sized enterprises will be happy enough just to upgrade their Wi-Fi, as Wi-Fi gets better. But if we also accept that private 5G, say, lends itself most exclusively to mission-critical operations, then there are 10 million factories in that count, plus tens of thousands of mines and power plants, plus all kinds of other hard-nosed industrial disciplines.

So if we think just that 5G is made, or will be made eventually, for Industry 4.0, then

you have to think the potential market is substantial – even if it is half of 15 million. Which is big business for anyone, even for those skirting around the edges. And you have to ask: how often does that happen? That one entirely-saturated market gives birth to another one, which is brand new, and comparable in size, and maybe even bigger? Never, I don't think.

Of course, the solution – in terms of features, devices, ecosystem, applications – is not there yet. We know this because there are only about 1,200 private networks in existence. That is what the analysts say. Which is what? A thousandth of Nokia's total addressable market? So this is early days; the dawn of a new era – even if daylight is breaking across the ground.

Another thing to think about is that the cellular market, in terms of public infrastructure today, has taken 20 years to develop. Private networks will move faster – these are not national infrastructure projects by one or two vendors and one or two operators. This is being designed and directed by enterprises, individually, and in conjunction with an ecosystem of telco and non-telco players. When the solution works, the dominos will fall.

There are signs that is starting to happen – new signs of maturity, with cellular integration with IT, in the form of Wi-Fi, and with OT, in the form of all these layer two industrial protocols; and also signs of scale, with serious-minded installs by the likes of Lufthansa Technik, for example, arguably the seminal case study for private cellular, and many others, and single multi-site orders now going in with Airbus, Dow Chemical, and Schneider Electric.

The other big stat, quoted by Federated Wireless, is that private cellular in CBRS – so in the US, alone – will be worth $3 billion

PRIVATE 5G – TAM

(thousands)

Industrial & manufacturing	10,710
Warehouses	3,300
Hopsitals & Labs	263
Water utilities	140
Mining	54
Transport venues & ports	50
Power plants	47.6
Military bases	10
Oil & gas	8

= 14,582,000
Source: Nokia

1,200
– total (roughly estimated) private cellular networks today, a 1,000th of the Nokia TAM, above

$15
– will go on 5G software and services in the US for every $1 that goes on private 5G networks, themselves

Excitable guesswork – Nokia's market-sizing from a few years back says there are around 15 million venues that might, potentially, take a private cellular network (above); as it stands, the analyst community appears to have settled on a run-rate of 1,200 to date (left), which represents the kind of delta one might expect in a brand new market. Worth noting, as well, is this brand new market is the gateway to an even bigger tech supply market, potentially (left).

"But the story is better than that; better than a gigantic new tech supply market. It is about an enterprise user market that might just change the world"

in the next few years. But the value figure, again, is meaningless; the interesting angle is the value-percentage, which says that, for every $1 that goes on 5G in the period, $15 will go on software and services, and whatever edge stuff goes into the mix.

Which tells you that, yes, the private networks market is novel and important, but that it is only the first piece, and only one piece, in the puzzle. It establishes a springboard for digital change, and a much bigger tech-supply story – which will quite possibly recreate and reflect the old telco tale in the rest of the internet market. And the idea of one market giving birth to another is not just about cellular. Because the whole tech world will be reborn out of this.

But the story is better than that; better than a gigantic new tech supply market. It is about an enterprise user market that might just change the world. Private networks have existed forever, but they have opened up to go beyond emergency networks and stuff for rail and the military, and bits and pieces off-shore and on the coast. They have been made different by the liberalisation of spectrum and by new cellular capabilities.

And by the disaggregation of network componentry, and the decentralisation and miniaturisation, separately, of compute, and all kinds of innovation at the edge, and a mad dash to scramble and untangle data in software analytics. But more than anything, the supply-side is so frantic because the demand-side is so desperate, spurred by impatience for industrial renewal and compulsion for environmental change.

So much so that private networks is the big narrative driver at the moment. Suddenly, everyone is writing about it, because everyone is talking about it. Private 5G was the only story in town at MWC in Barcelona a couple of months back; it will be centre stage at Hannover Messe next week. And it matters. This is not self-regarding telco talk about how to optimise big networks to box-shift phones and ser-

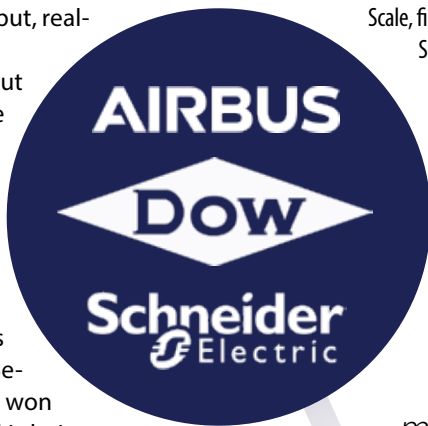vices. That is all related, but, really, who cares?

For telcos, this is about how to engage with the outside world. For enterprises, it is about how to rebuild the global economy – to make it better, richer, fairer, greener. And for market watchers, it is just a hell of a show. Because fortunes will be won and lost while the world is being remade. At the same time, what is clear is that private networks – scratch that; the whole industrial edge-play – is a team game, just like the low-power end of IoT has always said.

It will not work at scale without open minds and, mostly, open technologies. It won't work, just yet, by selling boxes into IT departments in enterprises – because the technician or operator in charge of the OT engine room will scratch his/her head, and say: '*What (TF)* am I supposed to do with that?' If that happens, then the whole supply-side, caught up in its own mythology, will have failed. Like someone (Appledore) said, this requires some kind of a Copernican moment.

The tech industry, and telecoms market in particular, must understand it is not at the centre of the universe. 5G is not the star-turn; it is a dutiful planet (to rob another line), bounded to the enterprise, and buffeted along with a bunch of other technological space junk. And – irony, and double irony – if we believe that technology, properly directed, will save the world, then all these enterprise-suns will be strung-together to make the earth the galactic centre, after all.

The point is only, and simply, that 5G is a good platform for long-sighted digital change, and a useful marketing tool to spread the word. But it is not the solution. It is not the thing to start with. And it will come to pass, when it is well-proven and easy-to-sell, and when its deployment fits the bill, that it is a gateway technology for

Scale, finally – Airbus, Dow Chemical, and Schneider Electric have all said they are rolling out private LTE and 5G networks to multiple industrial sites in multiple countries, suggesting the market has attanined some new maturity.

"It requires some kind of a Copernican moment [where] telecoms understands it is not at the centre of the universe. 5G is not the star-turn; it is a dutiful planet, bounded to the enterprise, and buffeted along with a bunch of other technological space junk. And – irony, and double irony – if we believe that technology, properly directed, will save the world, then all these enterprise-suns will be strung-together to make the earth the galactic centre, after all."

a bigger fix – and maybe even 'just another app on the edge', as the hyperscalers would have it.

The industry is in the 'build' phase, right now. Which feels like a brave new world, being mapped venue by venue and campus by campus through a deliberate and careful design phase – which requires suppliers and enterprises to knock heads in co-creation, and to navigate tangles with national spectrum, legacy equipment, a lack of devices, and an ecosystem that is not firing yet. These are the tasks that the captains of industry must tackle.
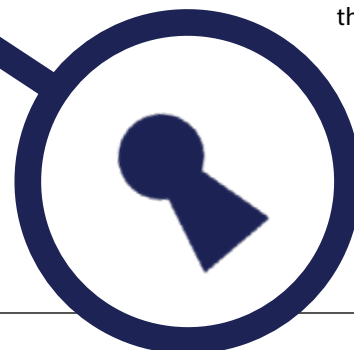
But Industry 4.0, whatever that is, is not about mega brands like BMW and Bosch. It is about the SME market, which comprises the engine room of the global supply chain. The question is how these enterprises get a handle on it.

And as 5G becomes a menu item in the bigger edge buffet, the opportunity for suppliers will be in the 'run' phase – and the intrigue will be how that is carved up between telcos, integrators, industrialists, hyperscalers, and enterprises.

The opportunity for enterprises will be to see where else this new combination of connectivity, computing, and analytics – or 5G, IoT, and AI, to reduce it to clickbait brands and acronyms – can take them. To go back to the purpose of writing this piece, what is striking about events like the PNF is what an astonishing job has already been done to understand and resolve all of these challenges – by standards people, technologists, enterprises.

They have done it together and apart, and they have come together in such forums to present their experiences, and share their learnings. It sounds corny, but it is the most important part of this story. And the surest sign that the smartest people are combining to make the best chance of digital, industrial, societal, global change etc.

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The Next Chapter of Open Ran

Free Digital Forum, September 20th, 2022

This third edition of the Open RAN global forum will take the discussion to the next level. Years have passed and Open RAN is still evolving. The many lab, field tests and collaborations have led 2022 to be the cornerstone of a new Open RAN deployment era. However, much needs to be consolidated and many questions and barriers remain: integration costs, slow deployment, immaturity of the technology to name a few.

Early Confirmed Speakers

Bhartendu Chaurasia
Head of TIP Technology,
Europe & Middle East
Telecom Infra Project

David Debrecht
VP Wireless Technologies
CableLabs

Patrick Lopez
Global VP Product
Management - 5G NEC
NEC

Diane Rinaldo
Executive Director
Open RAN Policy Coalition

Rex Chen
Director of Business Development
LitePoint

Free Virtual Forum, September 20th, 2022
www.openranforum.com

PNF | panel session

Critical and complementary – setting the record straight on 5G and Wi-Fi

Experts say private 5G and Wi-Fi 6/7 are not, and never will be, mutually exclusive, writes James Blackman

Time to set the record straight on cellular 5G and Wi-Fi 6/7, a panel of Industry 4.0 luminaries suggested at Private Networks Forum (PNF) a couple of weeks back; these technologies are not, and never will be, mutually exclusive, it implied. They will not be competitor-technologies, ever, and should not be pitched as such. Their futures are separate and together, they said; geared for different ends, even if they are in close company in the same venues.

And yet this idea that private 5G will replace Wi-Fi, or that Wi-Fi 7 will replace 5G, will not go away. Which is why Arden Media put on the session at PNF in the first place, and why the commentary from it is worth hearing again. "None of that will happen; neither will replace the other. They are complementary; they will coexist," responded Rahul Patel, senior vice president and general manager for connectivity, cloud and networking at Qualcomm Technologies.

The question was about their overlap in Industry 4.0. Patel explained: "5G is an upgrade on cellular that brings robustness in a different way, and brings bandwidth

and latency to new heights. And Wi-Fi 7 does the same in unlicensed spectrum, by bringing in tremendous robustness and latency, as well as enhancing bandwidth. They are very complementary. One is a [local-area] LAN technology, and one is largely a [wide-area] WAN technology."

But why the confusion? The simple answer is that these generation-

> "The [project] is not to avoid Wi-Fi; there is demand for Wi-Fi in all the use cases. [But]... the demand is for connectivity everywhere – for every worker and every asset in manufacturing."
>
> **Patrick Castagnino, Connectivity Business & Strategy Innovation, Digital Aviation, Airbus**

> "5G brings robustness, bandwidth and latency to new heights. And Wi-Fi 7 does the same in unlicensed spectrum. They are very complementary. One is a LAN tech, and one is a WAN tech."
>
> **Rahul Patel, Senior Vice President & General Manager, Connectivity, Cloud & Networking, Qualcomm**

al upgrades both bring giant leaps in performance, which precipitate new Industry 4.0 dynamics. We know the 3GPP-developed 5G NR standard quite well, especially as it is introduced (often via LTE) by private enterprises in private and shared spectrum. Wi-Fi is written about less (here), just because it is familiar already, and its Industry 4.0 credentials are less spectacular.

This is a fair assessment, borne out in the PNF session; the task to animate business/

mission-critical operations, at the higher-end of the Industry 4.0 chain, will be a mostly-5G affair, the panel concluded. But Wi-Fi, ever-more capable, will provide crucial support besides. "[You find] use cases where 5G, for mission critical needs, is going extremely well, and Wi-Fi, [for] less mission critical [needs], is complementary," said Patel.
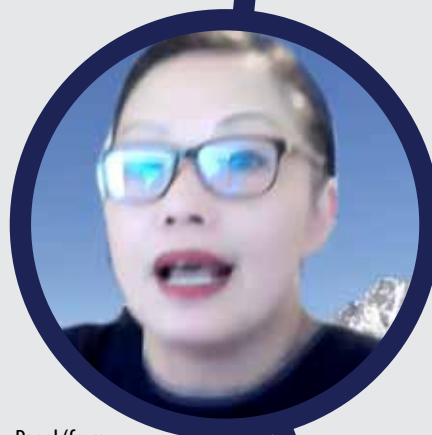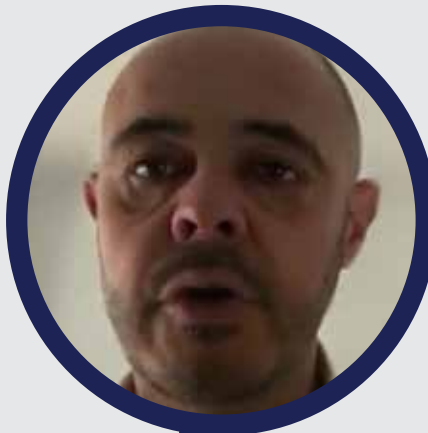
Airbus is putting this into practice. The company set up as a private MVNO in France seven years ago in order to run post-flight data offloads and predictive aircraft maintenance over LTE (4G); its adventures in cellular expanded into its manufacturing business five years ago – and into private LTE, initially, on the grounds it could not find a single operator to replicate service across its multiple production sites. in France, Spain, Germany, and the UK.
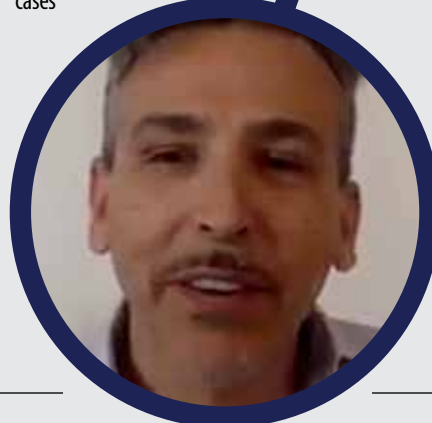
MARKET DYNAMICS

In the end, with liberalisation of radio spectrum and optimisation/miniaturisation of network systems, Airbus was able to engage with cellular on its own terms, with a roadmap eventually to private-industrial 5G; it is the same story that is being multiplied across Industry 4.0 sectors. But Patrick Castagnino, in charge of connectivity and strategy innovation for digital aviation for the company, makes clear its interest in cellular is not at the expense of Wi-Fi.

At PNF, he said: "The digital transformation is not to avoid Wi-Fi; there is demand for Wi-Fi in all the use cases we have today in manufacturing. [But we wanted] to find a new way of connectivity. So 4G was the first one in PoC, and now we are moving to 5G… Today, in terms of use cases, the demand is for connectivity everywhere – for every worker and every asset in manufacturing." The point is cellular WAN reaches the parts that Wi-Fi LAN does not.

He explained: "Why cellular? Because the performance of Wi-Fi is not enough to perform certain manufacturing tasks. Because we cannot [even] receive Wi-Fi properly within an aircraft during the manufacturing process – only 4G/5G delivers coverage for workers inside an aircraft. So that was

Panel (from top) – Castagnino from Airbus, Chan from Intel, Patel from Qualcomm, and Quintana from Telefonica agree that Wi-Fi 6/7 will coexist with private 5G in the enterprise market, with the latter delivering connectivity for higher-end Industry 4.0 cases

the demand: full roaming and connectivity everywhere, for every worker on the campus."

But the previous assessment, about 5G for mission-critical comms and Wi-Fi for general-purpose support, is unfair as well, at the same time. Castagnino, it might be noted, is comparing past and present cellular and Wi-Fi versions, even if his point stands about wireless WAN-versus-LAN inside complex manufacturing plants. At the same time, Wi-Fi 7, coming some time after 2024, builds significantly on Wi-Fi 6 and 6E, only just starting to be available.

Wi-Fi 7 will offer a number of gains; mostly significantly, higher throughput. Also referred to as Wi-Fi Extremely High Throughput, the key metric, on paper, is it will deliver 30 Gbps speeds; about three times faster than Wi-Fi 6. It also proposes wider transmission (at 320 MHz; double of Wi-Fi 6), higher modulation (to 4096-QAM, optionally; four-times Wi-Fi 6 levels), plus broader band/channel aggregation, greater spectrum efficiency, and less signal interference.

It should also support applications that need absolute determinism, higher reliability, and dynamic service (QoS). Which pitches it against incoming 5G versions, from Release 16 onwards, featuring the same industrial magic that is supposed to deliver total control of high-end Industry 4.0. The real comparison, then, should be between Wi-Fi 7 and Release 18-level 5G, similarly scheduled for the medium-near term (after 2024), rather than the short-near term.

SIMILAR, DIFFERENT

For now, both technologies exist effectively as half-baked technologies so far as Industry 4.0 goes. Which is not to say they are not useful, even crucial, for progressive enterprises looking to catch a sail on the rising swell and wild wind of industrial change and digital revolution. But they are different, the panel maintained, despite parallel development paths. And the reasons are plain, however far along they go. Because of coverage, mainly.

Back to Castagnino, responding to a question during the PNF panel session about whether the limitations of Wi-Fi will be addressed by future versions, or whether certain Industry 4.0 use cases will be forever out of reach of it, only serveable in the end by 5G. "Continuity of service will be addressed by cellular, not by Wi-Fi – by which I mean the roaming capacity of the technology. For Airbus, Wi-Fi is a coexistent technology; it is not one against the other."

He continued: "But [you need cellular] to provide maximum coverage… We can cover a small area with Wi-Fi with specific performance. But we cannot cover a hangar with one Wi-Fi access point; we cannot cover all the sites and all the campus with it. So it is extremely [valuable] for us to be able to install one 5G mast for full indoor and outdoor coverage, versus multiple WI-Fi access points. That is the main reason: coverage and performance."

Indeed, the idea that Industry 4.0 will wait on 5G-proper (Releases 17-plus), or Wi-Fi 7 potentially, is not right, said Guillermo Quintana, in charge of business development for private networks and multinationals at Telefonica's global solutions business. He rejects the idea that private 5G is a two-speed market, between lightweight 'carpeted' verticals making use of consumer-style eMBB functions and hard-floored industry holding out for URLLC.

"We have seen demand for private networks in manufacturing, of course, and in logistics, utilities, ports, mining – with use cases that are way ahead of what we would expect from a simple step-by-step approach. In mining, for example, these autonomous haulage systems, these big self-driving trucks, pulling on average 400 tons in each load, provide lots of data to control centres by sending daily updates related to predictive maintenance and self driving."

He continued: "The data needs to be very precise; these are business-critical, close to mission-critical, use cases we are supporting. So we have simple network setups with very simple use cases, and also very demanding use cases." But back to the dif-

ferences; it might be suggested, as well, that their network operation, alternatively, in licensed (and, importantly, privately-licensed) and unlicensed spectrum is another major point of difference.

FOUNDATION LAYER

Even if there is technical development to make 4G/5G function in unlicensed bands, pristine new 6 GHz spectrum coming available for Wi-Fi 6E, and new technical and regulatory work to make Wi-Fi spectrum management more prescriptive in unlicensed bands, these differences matter, for now – as the foundational Industry 4.0 networking layer goes in.

Back again, as well, to the idea that 5G is better for mission-critical comms; this is unfair, also, perhaps, because it does not consider the criticality of Wi-Fi as a support act. This seemed to be implicit in the PNF commentary. Patel's run-down of dual-mode cases referenced a couple of key crossovers: Wi-Fi for offloading data from 5G infrastructure, and, more prosaically, for fixed wireless access (FWA) for SMEs in remote climes, where fibre will never reach.

"Both will exist in industrial applications. The [privatisation] and industrialisation of networks, [means] 5G will

coexist with Wi-Fi in many situations. They will exist, and be very complementary," he restated. But there are obstacles, most clearly for the cellular market, which – unlike the straighter path for the enterprise Wi-Fi ecosystem – is negotiating a complete about-turn in terms of network systems, user requirements, and sales channels.

Caroline Chan, vice president and general manager for Intel's 5G infrastructure division and network platform group, said the conundrum for telcos goes way beyond spectrum (fragmented), devices (scarce), or service (undefined).

She said: "This is a business problem to solve. I grew up in the telco business, and the telco business always chases the problem as a tech issue – solving radio coverage, and squeezing spectrum. Those things will

"We have seen demand for private [LTE] networks in manufacturing, logistics, utilities, ports, mining – with use cases that are way ahead of what we would expect."

Guillermo Quintana,
Business Development for
Multinationals and Private Networks,
Telefonica Global
Solutions

be addressed."

She explained: "But we are going into manufacturing and agriculture to solve business problems. It is about the end result. So the ecosystem is more complex. It is not just [about solving a] telco issue – it is telco, plus operations, plus IT, plus OT… Spectrum and devices are problems that need to be solved, but the number one thing is to enlarge the ecosystem to cover the needs of our verticals for 5G to thrive."

Flight of the navigator – the Airbus quest to build and run a multi-market 5G network

Airbus will replicate its French and German 5G setups in Spain and the UK; here is its story, as retold by James Blackman

European aviation and aerospace firm Airbus effectively headlined the latest Private Networks Forum (PNF), hosted by RCR Wireless and Enterprise IoT Insights, in May, as the premier (the first, at least) enterprise on the schedule.

Fresh from a panel with Intel, Qualcomm, and Telefónica, which explained the new industrial scissor movement to tailor enterprises with new layers of 5G and Wi-Fi, the company was back to present its own fittings.

Patrick Castagnino, in charge of connectivity and strategy innovation for digital aviation at Airbus, explained the different applications, making clear Wi-Fi remains strategically important for aviation services, but that dedicated 4G and 5G bring new possibilities.

He said: "Wi-Fi is not powerful enough or performant enough. Only cellular works inside the aircraft; [only cellular] connects everywhere, and any worker – across multiple manufacturing campuses."

> "Wi-Fi is not powerful enough. Only cellular works inside the aircraft; [only cellular] connects everywhere, any worker."
>
> **Patrick Castagnino, Connectivity Business, Digital Aviation, Airbus**

Downlink comparison – in a 150 square-metre hangar, populated at any time with up to 10 aeroplanes, 4G posts a steady 55-66 Mbps at all test points, while Wi-Fi vacillates between 1 Mbps and 12 Mbps (see below)

LOCATION (interior / exterior)	P4G (DL / Mbps)	WI-FI
Rear wheel (ext.)	66	12
Rear cargo hold (int.)	59.5	9
Central cargo hold (int.)	55.5	1
Central aisle (int.)	60	6
Electrical room (int.)	63	12

It was a carry-over from the previous session, which said the same, but worked as an essential start-point for the Airbus tale, too – just because the path to digital transformation for Airbus, like for others in the aviation game, vaults beyond existing networking infrastructure.

"We started with a proof-of-concept [in Toulouse] four years ago with 4G, for multiple reasons – firstly to combine Wi-Fi and cellular," said Castagnino.

The motivation to test out cellular was to raise security and performance in its connectivity estate, he said – "compared to Wi-Fi". It was not, he made clear, just for the sake of it.

"It depends on the use case. We use Wi-Fi in static mode and 4G/5G in other use cases – when we need full connectivity and roaming across the site… [But] with a static environment or machine, Wi-Fi is [already]l very well adapted, [and] we are deploying Wi-Fi 6 [as well]."

OPTIMAL NETWORK
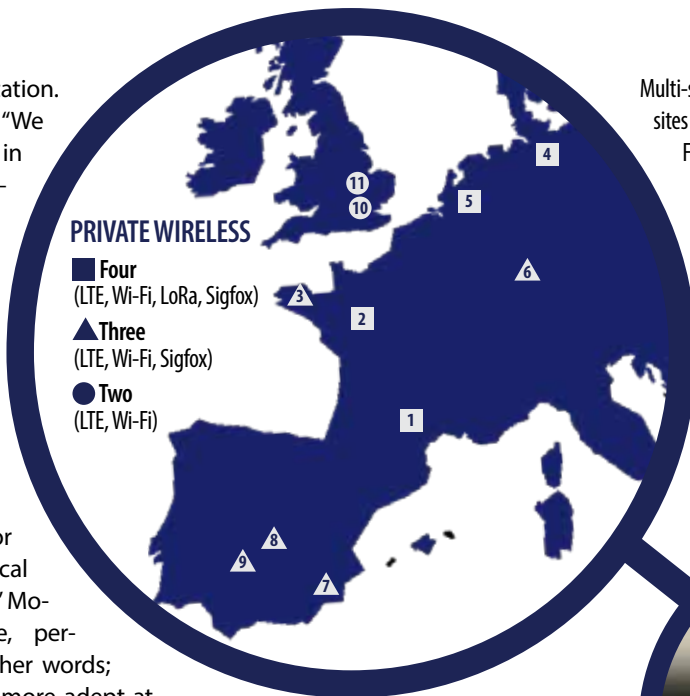The quotes are taken from across

the PNF presentation.

He went on: "We are using them in combination – the best tech for our needs, [every time]. 4G/5G [ensures] continuity of service [when roaming between access points]… [and is] key for mission critical comms, as well." Mobility, coverage, performance, in other words; with Wi-Fi ever more adept at serving familiar point solutions, in factories and airports, other indoor enterprise venues.

A slide late on (see image) compared downlink rates for private 4G and Wi-Fi in a 150 square-metre hangar, populated at any time with up to 10 aeroplanes; it said 4G is steady at 55-66 Mbps in and around the aircraft – going from outside, under the wheel, into the cargo hold and control room – while Wi-Fi vacillates between 1 Mbps and 12 Mbps, tops. "Private 4G is much better than Wi-Fi," he said, pointing to Wi-Fi bounce in metal rooms and vehicles.

The presentation ran through key use cases for the airline industry, as Airbus has propped them up over the past few years on Ericsson networking gear across multiple sites (seven) in both Toulouse (4G, going to 5G NSA) and Hamburg (5G NSA), in France and Germany, and is to replicate in Spain and the UK "in the next months". Castagnino said his company's private 5G pursuits are predicated on the fact these markets are difficult to rationalise with public network infrastructure.

"The main challenge [is] regulation and spectrum," he said. It is a problem for private network deployments too, just because, in the case of France and Germany, where Airbus has focused its initial efforts, local regulators have made spectrum available at 2.6

PRIVATE WIRELESS

■ **Four**
(LTE, Wi-Fi, LoRa, Sigfox)

▲ **Three**
(LTE, Wi-Fi, Sigfox)

● **Two**
(LTE, Wi-Fi)

GHz (Band 38) and 3.7 GHz (Band 43), respectively. The workaround has been to develop a dual core, managed centrally in France. "It was a big challenge to harmonise our core network," he explained.

But the result is the right one, he added. "That's how we will manage the full European campus."

The reference, here, is to centralised management of multiple sites across Europe, including the forthcoming rollouts. SA upgrades will follow the geographic expansion; the upgrade path is less urgent, he noted, because 4G works very well. "Why [are we still using] still 4G? Because 4G is fully adapted to 95 percent of our needs," he reasoned.

NORTH STAR

Airbus' decision to go it alone, separately from traditional telco operators, is down to security, which remains the north star for dig-

Multi-site – Airbus sites in Germany, France, Spain and the UK take some combo of LTE/5G, Wi-Fi, and Sigfox and/or LoRaWAN

ital change in just about every Industry 4.0 scenario.

"The data has to be stored on our campus without external connectivity. That is one of the main reasons for selecting private networks." The only data flowing out of is network data, for network control; all the industrial data remains locked into the edge networks.

But back to the use cases, which are the things on Castagnino's mind, actually. Private cellular is being used already in Toulouse and Hamburg for site surveillance, flight-to-ground data offloads ("95 percent of the volume"), quality inspections, automated guided vehicles (AGVs), collaborative robotics, digital twins "the shop floor with digital mockup", private mobile radio (PMR), and asset tracking ("Supply Chain 4.0", including via international roam-

> "Why [are we still using] still 4G? Because 4G is fully adapted to 95 percent of our needs."
>
> *Patrick Castagnino, Connectivity Business, Digital Aviation, Airbus*

ing).

Airbus is running the whole gamut of Industry 4.0 cases, then, mostly on 4G for now. "Connectivity is everywhere in the aviation domain," noted Castagnino.

How should enterprises choose spectrum for private networks?

New spectrum options and technology present enterprises with private network challenges and opportunities, writes Peter Cohen

The choice of what spectrum to use is key to the success of a 5G private network, and not all spectrum choices are equal. Choosing the spectrum that fits your needs is paramount for enterprise digital transformation, but there are attendant tradeoffs. The questions around private network spectrum remain top of mind for many enterprise executives beginning or undergoing digital transformation. And the top-line message from an assembled collection of spectrum stakeholders was, to put it simply, coexistence.

With vast institutional experience in Wi-Fi, some enterprises look at it as a one-size-fits-all approach to solving every wireless connectivity problem. Traditional Wi-Fi certainly has trouble with that burden, but the standard is moving forward just as 3GPP standards do, noted Richard Bernhardt, national spectrum advisor for the Wireless Internet Service Providers Association (WISPA). "Use the tool that makes the most sense"

"There is no one or the other necessity," said Bernhardt, speaking at Arden Media's Private Networks Global Forum panel entitled "A spectrum of spectrum: understanding your options."

"They're compatible," he noted. "When you underestimate the value and use of Wi-Fi, you run into problems. You use the tool that makes the most sense in the right application."

"It will depend on the application," said Sam Darwish, 5G sales manager of test and measurement specialist Viavi Solutions. Simply put, he suggested that different use cases demand deployment scenarios. Asimakis Kokkos, who heads Technology Ecosystems at Nokia Enterprise Solutions and also serves as the Technical Specification Group Chair for MulteFire Alliance (MFA), noted that businesses are led by outcome-driven decisions, not technology. The goal   for enterprise private network should achieve the business outcome using whatever technology is optimally suited. "That's where 5G is going to play the role here, to bridge the gap," he said.

> "There is no one-or-the-other. They're compatible. When you underestimate the value [of spectrum], and use Wi-Fi, you [can] run into problems. Use the [tech] that makes the most sense."
>
> *Richard Bernhardt,*
> *National Spectrum Advisor,*
> *WISPA*

TOWER OF BABEL

Global enterprises have an additional challenge, asserted Darwish: "When we've got so many different implementations…you've got unlicensed spectrum, you have different technology at different parts of the spectrum in different countries." Enterprises with global footprints will find bespoke solutions designed for one region

may fail regulatory or technical muster in remote locations. Off the shelf and out of the box solutions will enable some companies at smaller scale to deploy solutions, said Darwish. But navigating those myriad spectrum challenges, he continued, will be best handled by system integrators and other experts.

"I see the opportunity for vendors to offer this as a service rather than an out-of-the-box solution," he said, adding that this is especially true for companies running critical production applications.Bernhardt predicts the rise of a class of businesses focused on offering custom solutions for enterprise customers.

"I think it's the opening of a whole new industry. It allows for some great customizations and localizations we weren't seeing before. You can make networks work in specific regions, you can have them for specific applications and uses, and I think the managed service portion of this is ripe for that," he said.

"IoT, SCADA [Supervisory Control and Data Acquisition], agriculture, there are vertical markets all over the place that are just waiting to have some of this come in," he added.

Another practical consideration for Sam Darwish is the use of unlicensed devices that can wreak havoc on private networks.

"You're never certain of what's actually in that spectrum because people have amplifiers, inverters, lots of different electronics everywhere across the whole globe, and we never know where they'll resonate. You need to make sure that spectrum is clear, that it's safe, make sure that it's no interference that is going to cause a problem," he said.

CASE FOR HARMONIZATION

With so much variation in the spectrum, Prakash Sangam, Tantra Analyst founder, expressed concern about spectrum fragmentation across different regions. Spectrum harmonization is the solution, but he wondered about implementation. "We need to keep our options open, but getting everybody to agree on the same spectrum for industry would be very helpful… If you look at 3GPP,

they have a lot of options for combining spectrum together, they're all there. I think it needs some courage and effort to try to identify this, and maybe regulators can play role here, if they can harmonize between different countries," said MFA's Kokkos.

Christian Regnier, chairman, PRIVINNET/EUWENA (European Users of Wireless Enterprise Network Association), noted that there is no EU accordance for spectrum

> "You're never certain what's in there – because people have amplifiers, inverters, electronics. You need to be sure interference won't cause a problem."
>
> ***Sam Darwish,***
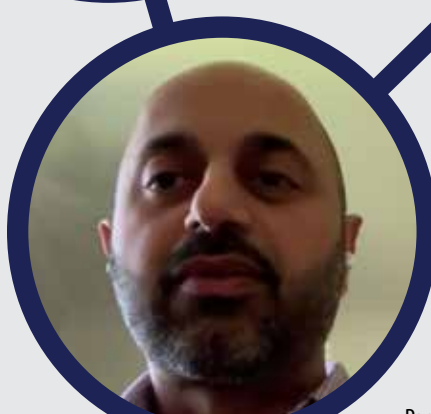> ***5G Sales Manager,***
> ***Viavi Solutions***

harmonization. Germany, France, and the UK have disparate spectrum and usage rules for private networks, he explained.

"In some countries, you don't have any spectrum for private networks," he said. The absence of European Union member country harmonization around spectrum use is the problem EUWENA is focused on, he added, to enable private network use to drive Industry 4.0 transformation.

Technical innovations for private networks have emerged that enable more efficient spectrum usage and easier multi-spectrum coexistence, noted Bernhardt, who reframed a consistent theme from the other speakers: that this is very much still a work in progress.

"If we can at least take things and go low middle and high, the low bands, the midbands and the millimeter waves and so forth, and then figure out how to use these tools that we're beginning to develop, then harmonization between countries and different uses will allow a lot more options and much more robust systems," Bernhardt said.

Panel (from top) – Bernhardt from WISPA, Kokkos from Nokia and MFA, Darwish from Viavi Solutions, and Regnier from EUWENA

How robot tractors and a private network came together at a vineyard

These were the seeds of success for a precision agriculture use case at one smart vineyard, writes Kelly Hill

Three technology partners, one private network and robot tractors: At a U.S. smart vineyard, these were the seeds of success for a precision agriculture use case.

Intel, Federated Wireless and Blue White Robotics discussed the partnership and the particulars during a session of the recent Private Networks Forum. When it comes to private cellular working for industry verticals, says Caroline Chan, VP and GM of the 5G infrastructure division's network platform group for Intel, "It's not just a terminology change, it's actually a mindset, a skill set and a solution-mix change as well."

She continues: "If you look at Industry 4.0, a lot of the transformation is taking place because people are looking from automation to autonomy," she added. "It's not just about automating the workflow, it's about taking the data to be able to analyze and use it to drive automation in … the factory floor."

Cellular private networks, she added, also will have to co-exist with technologies already in use, whether that is Wi-Fi or wired Ethernet. "It's not about one replacing the other," Chan said. "This is not a technology conversation, it's about solving business problems. We are not here to make the TCO

worse, we are here to improve efficiency and the TCO."

She said that supply chain constraints, scarcity of food in some places, labor shortages, increased focus on sustainability are driving the interest in decision-making autonomy that is pushing verticals to adopt cellular.

In the case of the vineyard, it was a location with zero connectivity, explained Blue White Robotics founder and CEO Ben Alfi.

AFTER-MARKET
Blue White, based in Israel, has put together an after-market robotic system that can be installed on any tractor, and operate with any permanent crop, he said, along with a soft-

> "It's a mindset, skill-set and solution-mix change... It's not just about automating the workflow [but] about analyzing data to drive automation on the factory floor."
>
> *Caroline Chan, VP and GM, 5G Infrastructure Division, Network Platform Group Intel*

ware platform that enables control of a fleet of robot tractors equipped with sensors, cameras and more that can generate real-time data from the fields.

The private network solved the problem of bring able to operate the vehicles remotely, collect and transmit the data, Alfi said — and the partners worked together quickly, he added, going from ideation to capability in less than half a year.

Federated Wireless set up a 5G-capable

CBRS private network that has a radius of nearly 2 miles at the site, according to Chris Swan, chief commercial officer of Federated, with Intel equipment in support.

The key step was defining the use case, Swan said, and the partners had to consider what IoT devices were being connected (tractors, cameras, hand-held devices) as well as how they had to communicate out to other places, including the farm's back-office area, where there were edge compute resources, and what had to be processed in the cloud. Other considerations included what that applications were, the goals of the project, return on investment and total cost of ownership. "These are all important factors in trying to get this right, and the most important element at the beginning, is defining that use case down to that level," he said.
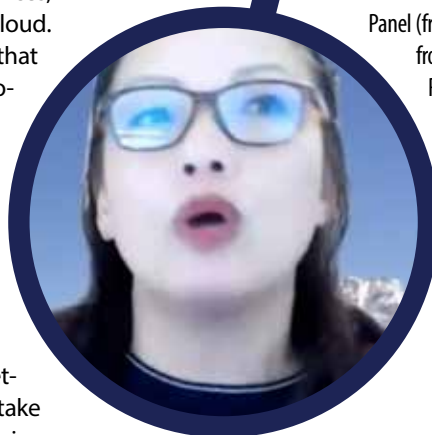
NETWORK INSTALL

In terms of actually deploying the network, he went on, Federated had to take time to understand the topology of the vineyard and what the radio frequency design should take into account to get the right coverage and performance, as well as look at other local use of RF and potential objects that could block RF signals in order to plan optimal placement for the radios.

Security, privacy, internet backhaul and monitoring and management also can come into play, he said, but in the case of networks-as-a-service, the end customer gets to hand many of those off to Federated.

The three partners came together through Intel's 5G Open Innovation Lab, and this use case illustrates how in private networks, "the ecosystem building becomes ever more important than before," Chain said.

Intel, she added, "can't just say, 'Here's a reference design.' We need to come in with much more than that", including different types of AI and enabling software and equipment, as well as being the "trusted advisor" that brings partners together. "I really think this blueprint can be repeated in other verticals and in other partnerships as well," Chan adds.

Alfi says that Blue White has provided customers with set-ups that include anywhere from 20 vehicles, plus 50 IoT devices and another 40 implements, to more than 600 vehicles. Farming operations often have large revenues but very low margins, he says, so up-front investment needs to be low and the after-market robot kit has "reduced a lot of the entry problems."

Customers, he added, want "a one-stop shop

Panel (from top) – Alfi from Blue White Robotics, Chan from Intel, and Swan from Federated Wireless

that gives the whole solution" rather than piecing things together themselves. Swan notes that a private cellular network, once deployed, also offers scalability for many additional devices to be added and controlled through the same system, and, as their tech partners continue to innovate, farmers can add potentially add even more new technology at better cost-points over time.

TOTAL COST

In terms of TCO, Swan said, one of the factors in the U.S., at least, that takes cost out of the overall equation is the availability of CBRS. General Authorized Access (GAA) use of the spectrum doesn't require a spectrum license or leasing, although such arrangements could be made depending on the enterprise's preference. That's a big factor in return on investment, he says.

But Swan adds that he often sees companies that want to "solve everything all at once. I think that's overshooting. … What I'm seeing people that are really successful do is, they pick a simple, very valuable use case … that saves money and returns ROI on the people side. Pick that use case and get started. Don't try to cover everything all at once. … Once you define the total solution … you kind of weave it back in to a supplier that will work with [you], or an ecosystem, a team that comes together who will partner on that ROI, that outcome, not just sell you a network connection. That's the last thing people need," he says.

"They really need someone who's going to be responsible. In this case, Intel, Blue White and Federated Wireless, all came together to make that happen."

> "Pick a simple, valuable use case… that saves money. Pick that use case and get started. Don't try to cover everything all at once."
>
> *Chris Swan,*
> *Chief Commercial Officer,*
> *Federated Wireless*

Upcoming Digital Forums

Open RAN
GLOBAL FORUM

September 20th
9AM-4PM EST
Virtual Event

The Next Chapter of Open Ran

This third edition of the Open RAN global forum will take the discussion to the next level. Years have passed and Open RAN is still evolving. The many lab, field tests and collaborations have led 2022 to be the cornerstone of a new Open RAN deployment era. However, much needs to be consolidated and many questions and barriers remain: integration costs, slow deployment, immaturity of the technology to name a few.

www.openranforum.com

PRIVATE NETWORKS EUROPEAN FORUM

October 4th
9AM UK / 10AM CET
Virtual Event

Europe's Dedicated Private Networks Virtual Forum

With a specific focus on European market activity, this event will connect key stakeholders to discuss - are private networks the key to driving enterprises into the Industry 4.0 era? We will examine the latest private network deployments, European spectrum liberalization and management, and which deployers are dominating this market. We will evaluate the technical and financial considerations of roll outs and the benefits which private networks can bring to enterprises.

www.privatenetworksforumeu.com

5G Manufacturing Forum

November 1st
9AM-4PM EST
Virtual Event

Leveraging 5G Connectivity for Smart Manufacturing

The manufacturing industry is one of the key enterprise verticals tipped to truly reap the benefits which 5G connectivity can bring. The low latency, high reliability, and increased speed offered by 5G is critical to support emerging technologies and applications in the smart manufacturing space. At this event we seek to discuss the how Industry 4.0 can leverage 5G to improve industrial processes, create cost and operational efficiencies to build smart, digital manufacturing businesses.

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PNF | panel session

How can businesses get what they want from private cellular? Three factors in play

A private 5G network is "only one piece of the puzzle," and not the whole solution, writes Kelly Hill

The enabling ecosystem for LTE private cellular networks has matured significantly, but there's still quite a ways to go when it comes to private 5G. And the network, as one participant put it, "is only one piece of the puzzle."

Spectrum availability, end-user device availability and overall flexibility also play in to whether cellular networks can accomplish the operational and financial objectives that enterprises are considering.

In a Private Networks Forum session, Stephane Daeuble, head of marketing for enterprise solutions at Nokia, said that the company has seen the state of the ecosystem improve significantly since it began deploying private networks in 2011.

"Now, we have a lot of ecosystem players in pretty much al the segments we address," he said, with a range of companies having validated LTE tech, providing planning tools and a solid variety of devices. 5G, however, is not yet as developed, particularly when it comes to integration of specific industrial features.

In some sense, private networks are both demonstrably providing real-world benefits, but also still finding their footing. Among the development factors discussed

by the session participants, three emerged as key considerations – starting with establishment of a baseline network framework that can be customized for vertical-specific needs is essential.

BASELINE NETWORK

Rasmus Hellberg, senior director of product management for Qualcomm Technologies described it this way: "You need a baseline — that we think is multi-vendor — that you can customize and program so you can set up certain use cases,"

> "Companies are doing customization because their requirements aren't being met by what is out there today"
>
> **Jacob Reeb, Vice President of Wireless and Digital Services, Cambridge Consultants**

> "You need a baseline – which we think is multi-vendor – that you can program and customize to set up certain use cases"
>
> **Rasmus Hellberg, Senior Director, Product Management, Qualcomm Technologies**

he explained.

"But then, to really scale this and then meet the customer demand, you need to work from this network baseline, to work with specific system or challenges … for that vertical, then tweak the RAN and add the use cases and the programming for these use cases." That, he added, is where Open RAN implementations may become particularly useful.

"Let's be frank, I think a lot of these companies that are actually looking at building on these ecosystems and doing customization are doing so because they do have those unique requirements that aren't being met by what is currently out there today," said Cambridge Consultants VP of Wireless and Digital Services Jacob Reeb.

"I think that drives part of it. The other part is that organizations want to own their own data, their own destiny, and potentially see a revenue opportunity. There's a lot at stake for companies to look at this."

Daeuble pointed to the importance of experience in putting together basic networks that are then customized, offering the example of mining. Once you've done 10 or 20 mines, he said "you realize you will always need the same ecosystem players"—and that they're different for open-pit mines versus deep mines.

Nokia, he went on to say, has put together "segment blueprints" for various verticals so that rather than customizing 15-20% of the solution, it's only 2-3% that needs to be tweaked for a particular customers' needs.

POTENTIAL HICCUP

As well, end-user devices are a potential hiccup, the panel concluded. The Murray City School District has been operating a CBRS network for several years, including launching a Fixed Wireless Access service to provide connectivity during the course of the global Covid-19 pandemic. Jason Eyre, technology department coordinator for the district, said that the network core and radios worked well together, but devices have been a stumbling block. "What we are finding is that the end-user devices, if you don't find a vendor that's completely open and unlocked with their chipsets, that you'll find devices that you might buy somewhere and expect them to work, and they   don't," he said. "And I think that's where the industry is getting

Panel (from top) – Daeuble from Nokia, Reeb from Cambridge Consultants, Hellberg from Qualcomm Technologies, and Jason Eyre from Murray City Schools District

better, and we've definitely seen improvements over the past three years — but I think that's a place where the industry can do better."

OWNERSHIP COST

Figuring out Total Cost of Ownership, is also crucial, the panel concluded. It's still a tricky thing to do an apples-to-apples comparison between Wi-Fi and cellular, for businesses to figure out which one they should go with for their specific needs.

Daeuble said that Nokia has some basic planning tools (with simple versions available online) that can help with estimates of a rough number of cells based on which frequency is being used—and that generally, looking at a TCO over 5-7 years, cellular has a comparable cost to Wi-Fi such that "the cost is no longer a barrier."

It's one thing to build a network, Reeb pointed out, and another one to fully understand the end nodes and their relationship to and impact on the operations of that network: How things fluctuate over time and how that affects design, capacity and ability to scale over time.

One of the observations that Cambridge Consultants has made over time, he said, is that "a lot of organizations get themselves in trouble because they make a really large assumption at the very beginning of what they're going to do which isn't based on what is the best option, but as far as what is the lowest-cost option that we can do."

He recommends that companies looking into private wireless engage experts not only for design but for advisory services to understand the technology choices available to them.

"Really, what this comes down to, is that when you're doing this—and it's the same across any industry—you're looking at trying to either build efficiencies or you're trying to build a new revenue stream. If you keep that in mind and build it up from there, that's where you can end up helping … your organization grow."

PNF | panel session

'Digitalization is not a destination' – why tech change matters

The strategy for digital transformation is far more important than the specific technology, writes Catherine Sbeglia

During a session at the recent Private Networks Forum, panelists put aside all those technical buzzwords related to digitalization and digital transformation – you know the ones: artificial intelligence, machine learning, automation, connectivity etc – and instead addressed the *why* of the matter, a question that attempts to bridge the gap between strategy, technology and the workforce.

For Siemens Digitalisation and Sustainability Lead Joan Mulvihill, the strategy and the reasons behind an organization's particular digital transformation are far more important than the specific technology being used to facilitate the transformation.

"Digitalization is not a destination," she said. "No one is going to get any prizes for being the most digitalized version of an organization that is selling a product or service that people don't want anymore," she said.

To get at the why then, Mulvihill continued, organizations must first ask themselves what their market will look like several years from now and what needs to be done to ensure they remain relevant in that future market.

TECH, MEET STRATEGY
The why involves understanding, first and foremost, that technology can remove, replace or improve several operations, processes and systems within an organization.

According to Conrad Leiva, the VP of ecosystem and workforce education at CESMII-Smart Manufacturing Institute, there has been a lot of early digitalization success around increasing internal productivity and cost efficiency, as well as the reduction of energy, particularly for industries that produce things like cement and chemicals and food products, as these all require energy-hungry equipment.

"We've also seen now, when you start looking more strategically, benefits like speed, agility, [the] ability to change your product mix quickly [and] to create stronger partnerships and innovate," he said.

He added that there has been a notable move away from "the period of early adopters" and that we are "crossing the chasm" with a lot of enterprise-level technology. "We are seeing [organizations] looking at technology as part of their strategic plan," he said.

> "No one is going to get any prizes for being the most digitalized version of an organization that is selling a product people don't want anymore,"
>
> **Joan Mulvihill,
> Digitalisation and
> Sustainability Lead,
> Siemens**

Because digitalization fosters a better environment for innovation, it can result in significant market disruption and differentiation, particularly if an organization has room to grow.

For instance, longtime IBM manufacturing industry group leader and Intel Manufacturing IoT Council leader Mary Bunzel described watching smaller companies scale throughout her time with IBM and Intel as the result of digitalization.

Specifically, Bunzel shared how she encountered several organizations that "incubate[d] a core capability within their organization, automate[d] it for disruption and then [broke] that company off as an independent service."

In other words, these companies "productized" a core capability and turned it into an entirely new revenue stream.

Bunzel also shared that it's "absolutely key" to strategically align technology deployments to the direction that the enterprise is going to ensure that you have support from leadership, as well as unified corporate messaging to pass along to the workforce.

Otherwise, technology and the improvements it brings will not become part of the organization's DNA, which Bunzel said is the ultimate mark of a true and successful digital transformation.
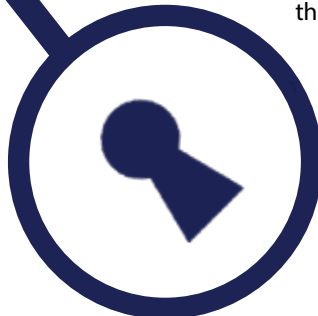
NOT SELF-DRIVING

"The technology is interesting … and a vehicle that will get you there, but it's not a self-driving vehicle. It needs people in the organization to go on that journey," commented Mulvihill. "It's all about the people… and finding the technology that [allows] people to grow sustainable careers."

Building from Mulvihill's self-driving, or not-so-self-driving concept, Leiva noted the importance of workforce education. "The workforce … need[s] to keep up with all the technology changes and know all the options that are available and how practical they have become, he said.

Panel (from top) – Mulvihill from Siemens, Leiva from CESMII-Smart Manufacturing Institute, and Bunzel from International Academy of Automation Engineering

For its part in this, CESMII has established regional innovation centers aimed at provided this much needed education. "We can demonstrate the technology and bring manufacturers to see first-hand a lot of that integrated technology in person because for a lot of manufacturers, seeing is believing," Leiva continued.

Both Leiva and Bunzel stressed the need to ensure that the criticality of new technology and digitalization is understood within the entirety of an enterprise, from top to bottom.

"The why of these investments… needs to be understood by the whole company and by the workforce," Leiva said, claiming that a culture that doesn't put this at the center of its vision statement cannot truly embrace digital and higher levels of collaboration and innovation.

Earlier on in the conversation, Mulvihill commented that it's incredibly easy for companies and their workers to "get lost in the maze of technology," but later argued that adding technology into an organization can actually improve that organization's the human element if done right.

"The more technology we put into organizations, the more human those organizations will become," she said.

"If we automate everything that's automatable, then the only thing left for humans to do is that which is truly human, and the only thing that is truly human is our intention, our purpose, our creativity, our ability to make decisions that are beyond the data.

"There will always be a role for people in organizations, but there will not always be a role people who do not what to engage with technology at all."

> "[Companies that] incubate[d] a core capability... then [brokeit] off as an independent service."
>
> **Mary Bunzel,
> Executive Director,
> International Academy of
> Automation
> Engineering**

PNF | panel session

How is security foundational for private 5G networks?

Private 5G networks change the security landscape by converging siloed cellular, IoT and enterprise security, writes Peter Cohen

Frank Satterwhite, founder and principle of cybersecurity firm 1600 Cyber, sees private 5G as the convergence point for technologies that have evolved separately over time. "Cellular, IOT, and enterprise security were almost in entirely separate buckets," he said. "Today's there's a convergence at 5G. This presents more problems – more attack surfaces," he explained.

"5G is a critical component of this transformation," he said. But the number of devices being deployed daily grows as billions worldwide come online, making the scope of work to protect enterprises from potential threats almost staggering in its scope.

For Nancy Wang, general manager of data protection and governance for Amazon Web Services, it's about having actionable security intelligence to understand how to respond, when presented with attacks. Wang believes a foundational approach is essential for businesses to protect themselves as they deploy private 5G.

For Dave Mor, CEO at private cellular security firm OneLayer, it's more straightforward. "Private 5G is just another enterprise network that you own," he said. It comes with the same attendant benefits, challenges, and responsibilities as any other corporate network, and a few unique ones that demand mindfulness from his clients.

The three security experts recently traded observations and general recommendations for best practices during Arden Media's Private Networks Global Forum.

FOUNDATIONAL APPROACH

"When we think about securing customer's data as they're being processed or generated at the edge, we know IoT devices are subject to a lot of attacks. If we are serious about evangelizing 5G and fast connectivity and all the goodness that comes from being super-connected, we also need to think about our protection strategy about setting safety perimeters and guardrails of how data is processed, accessed, and secured at the edge," said Wang.

As a public hyperscaler, Amazon Web Services' clientele includes Fortune 500 companies and other businesses that operate in tightly regulated environments. So device and data security is more than a bolt-on, said Wang, it's the start of . the conversation.

This starts with a foundational approach to network security using tools like SSL and basic encryption as building blocks.

"The first step to having a holistic security approach is around asset visibility," said Wang. The problem with onboarding 5G at scale is the magnitude of those devices, she added. "With this proliferation of devices joining your networks, what used to work will no longer will. You need a platform-aligned approach for 5G security"

Wang said it's important for organizations to implement a policy engine with the framework to understand what's operating in the environment. "What do you want to do with your data, and how do you want to secure it," she asked. "Which actors can do what to what data, and what actions are you going to allow and deny? That becomes a foundation of

> "The first step to holistic security is asset visibility. With [so] many devices joining your network... you need a platform approach for 5G device security"
>
> **Nancy Wang,**
> **General Manager, Data Protection and Governance, AWS**

your security playbook," she said.

"Data is no longer traveling as far, it's being processed at the edge," said Satterwhite. This requires a more targeted and tactical approach to security to make sure data stays safe. Securing the perimeter and managing this data presents a new set of problems and opportunities, he added.

There are security threads to tie together when devices operate on both IT and cellular networks, said Mor. "First, the architecture is different. The devices communicate with the cellular core in a much more centric approach. Secondly, the identifiers of the device are different," he said. An enterprise network will use Internet Protocol (IP) and Machine Address Code (MAC) addresses to identify individual devices, while cellular networks rely on International Mobile Subscriber Identity (IMSI) identifiers, he noted. Such issues need to be mitigated in order for devices and data to stay visible and secure.

Mor notes that enterprise security deployment and needs may vary on the endpoint connection. Sophisticated devices, such as computers used by home workers connecting remotely to enterprise networks, are capable of more autonomy. "But in most of the critical networks, the IoT devices are less sophisticated," he explained. That drives a need for network-driven security that doesn't depend on on-device functionality.

Wang and Mor both agree that at a basic level, enterprise security must provide effective device and service visibility, and context-based segmentation in order to offer protection. "You need to identify the device, wherever it is connected. And once you have that, you can build all the security solutions on top of that," said Mor.

CONTEXT IS EVERYTHING

Securing IoT data in a 5G pipeline requires a more holistic understanding than a simple gated approach to authentication, said Mor. Context-driven security using network automation tools like Zero Trust Network Access provide a solution.

"We are not protecting IoT devices

with cellular protocols. We are protecting IoT devices with security tools. And that's in my perspective the main gap that we are seeing in the private cellular domain," said Mor.

"It's harder to identify the devices with this shift in the architecture, and if you can't identify the devices that affects your ability to authenticate and then understand what context they need to connect," agreed Satterwhite.

Zero Trust Networking requires more than

Panel (from top) – Mor from One Layer, Satterwhite from 1600 Cyber, and Wang from Amazon Web Services
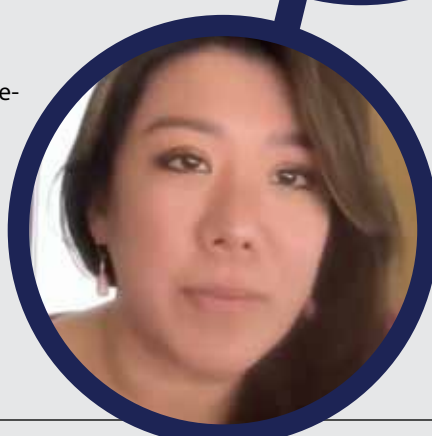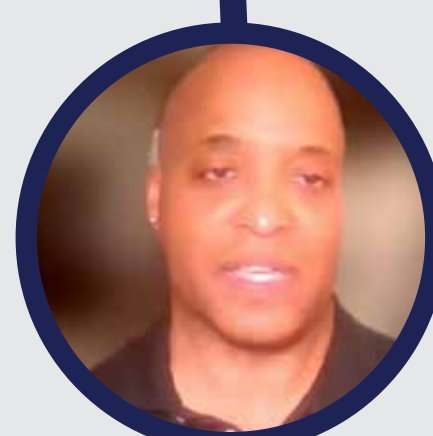
simple authentication. The entire approach to security is predicated on a contextual understanding of how the device operates and what its user needs, exposing only that functionality for that instance. This helps to reduce potential threat surfaces. "If you are talking about a zero trust approach, the authentication is only the first layer. Then you need to authorize, you need to understand the context of the device, its destination and behavior," said Mor.

Setting up a zero-trust perimeter around mission-critical workloads is important, Wang said, but so is understanding what is mission-critical and where it is. "Where are your dev secrets, and where are your crown jewels," she asked. That context changes between public and private networks, the experts agree. Regardless of the medium, device visibility and a contextual understanding is essential. The device's visibility must maintain consistency.

Public networks also affect threat exposure, Mor noted. It's a lot of work to go after devices on public networks, usually with limited gain. The cost value proposition for bad actors changes dramatically if they're able to penetrate a private network – it can be the difference between a highly automated production line dependent on a 5G workflow either running at capacity, or not at all.

For Wang, it's about a "defense in depth" approach: Adding multiple layers of security controls to create a more secure operating environment. Constant monitoring, zero trust perimeters – at the end of the day, it's all about reducing potential threat exposure to the barest possible minimum while preserving the speed, latency, and reliability needed to work at the speed of enterprise.

Wang notes the increasing interplay between between regulatory agencies and enterprises as an important consideration. As an example, she mentioned a client in Mexico who, due to local regulations, must duplicate any data maintained in a public cloud in a private cloud kept entirely offline. "We're seeing more of these business continuity controls that are coming out from regulatory bodies that are shaping how businesses see the security of their data," she said.

PNF | case study

How to deliver sustainable growth with a 'made-to-order' factory

Siemens has transformed a UK production site into a sustainable, make-to-order factory, writes Catherine Sbeglia

Building upon its lean heritage and by avoiding the mistake of digitalizing and automating wasteful or inefficient processes, Siemens transformed its factory in Congleton, U.K. into a sustainable, make-to-order factory, where customer orders are automatically obtained and pushed through to the factory floor for manufacturing.

At the Private Networks Forum, two Siemens executives detailed how the company used advanced tools like digital twins and automation to achieve this notable step change in productivity.

As Sarah Black-Smith, Siemens general manager of motion control and head of factory operation, explained early in the discussion, the company prioritized running lean and efficiently as far back as 2008 when the financial crisis hit, a priority that lasted until about 2011. In 2020, she continued, the new focus became getting close to customers so as to deliver a product more aligned with what they wanted. This, she said, was to address the flat growth it was experiencing at the Congleton factory.

The answer here, she continued, was found in advanced manufacturing tools like robotics, 3D printing and automation. "Things we

weren't really engaged with," she acknowledged, "that was really a step change in productivity for us."

FIVE STEPS TO DIGITAL

Diving deeper, Carl German, strategic lead of innovation in products and processes at Siemens Digital Industries, shared the five steps of digitalization that the company coined several years ago: Product design (machine concept), production planning (machine engineering), production engineering (machine commissioning), production execution (machine operation) and services (machine services).

Using the case study of automating the process of producing and packaging a particular product at the Congleton facility, which required the design and production of a new machine, German stated that the goal was to apply "simulation models and processes wherever we [could]."

German then walked through the previously outlined digitalization steps to this journey, beginning with the digital twin concept for the product design step, saying that modeling a new machine virtually allows for more efficient collaboration. "There is no better way to facilitate [collaboration] then

using digital tools and digital modeling," he claimed, adding that digital twins also reduce risk and cost associated with new machine designs because "it's all about learning and failing in the virtually world. If you're learning and failing in the physical world, that's costing you time and money."

PRODUCTION PLANNING

Next, was the production planning, where German said the company used "more rich digitalization tools to simulate the factory" to better "understand the efficiency, utilization and capacity" of it. "This is really important because you can scenario test in a safe place and not make changes to your physical production flow and find out that there is something actually not quite right," he added.

The third step — the realization of production automation — is where the true engineering of the process comes in. Here, Siemens used kinematic modeling of the actual solution, which is a mathematical description and representation of an asset's workspace, positional capabilities and constraints.

"Again, what you can get from this is a real sense of the capabilities and the constrains and the potential problems of the solution in a virtual world, so then you can articu-

late that and make changes, so when you commit to the physical worked, you are very confident that what you are going to implement will be fit for purpose," said German.

The final two steps of digitalization outlined in the presentation are really where the 'make to order' concept begins to emerge.

For the product execution stage, which refers to the software platform that runs the factory, Siemens' redeployed its legacy system to make it a "highly connected ecosystem." He continued that in the new system takes customer orders as they come in, and then, using definitions from the production engineering and R&D departments, pulls the necessary information related to factory scheduling.

RECIPE WRITING

From there, a recipe is created, which is automatically pushed down to the factory floor where the necessary assets are mobilized to manufacture the ordered product, again automatically.

"The idea is that each [assembly] bench articulates exactly what needs to be done for that particular product order for that particular assembly bench," German added. "It's real-time. There is no plan B; if the network slows down, production slows down so part of our approach to this system was [asking] how can we be resilient [and] make sure that the networks… are able to support the flow of the prod-

ucts." Finally, comes service. "Data is the driving force behind everything," stated German. "Data isn't new… but the appreciation of data, the systems and the intelligence we can apply to data has made a difference… We viewed our core manufacturing process in this instance in terms of core assets, core processes and infrastructure, so it's about how do we use data to maximize the value of these particular domains."

Part of that, he continued, involves deploying cloud-based systems, as well as industrial edge-based systems.

"What we are now doing is understanding the role of high speed, low latency edge within our manufacturing processes where you need to have very quick, analytical feedback on the capability of processes or decision-making capabilities.
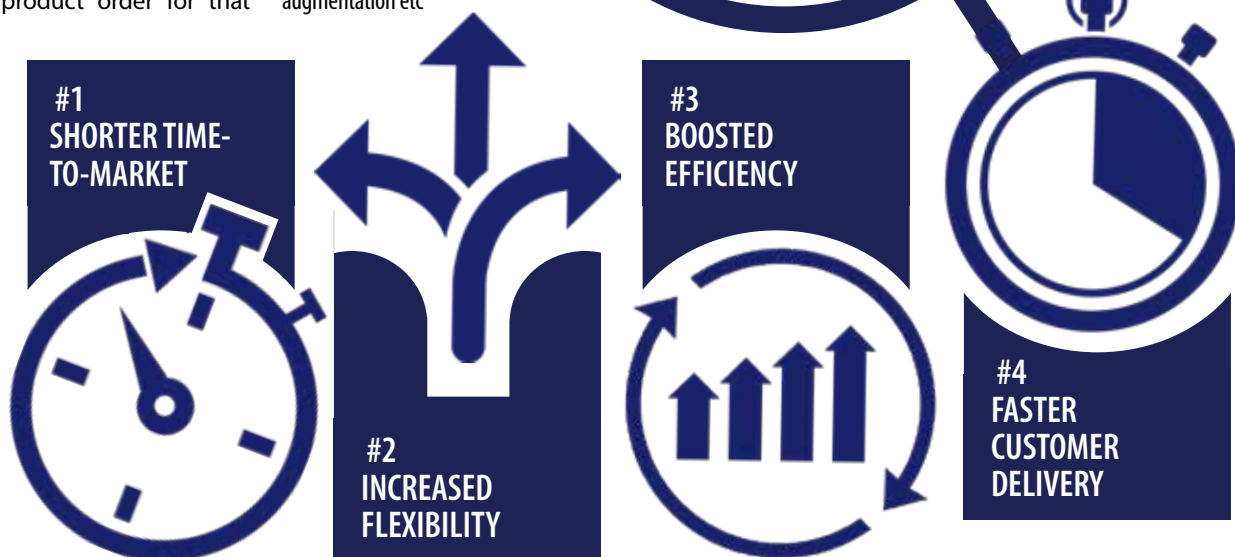
Beyond the steps outlined in Siemens' digitalization strategy, Black-Smith also made it clear that the workforce at the Congleton factory was another key element of the company's forward-facing strategy, commenting, "It's all about people. Without bringing our people and developing our culture, we're not going to be able to deliver any of the good things for Siemens and for our customers."

Siemens panel – Black-Smith and German presented four steps to factory digitalisation (below), variously covering IoT apps for automation, supply chain automation, predictive maintenance, worker augmentation etc

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Carl German,
Strategic Lead for Innovation in Products and Processes, Siemens Digital Industries

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