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Welcome

Changes

I'm a big David Bowie fan so thought it best to highlight changes both across the mobile industry and within the magazine you are holding as we move into 2018. The eagle-eyed among you will have spotted a new look and new kinds of features such The Wireless World, our look at the key telecom developments around the globe.

We still aim to provide the best technology analysis and news about the telecoms industry, but what do you think of the changes we've made? Email me at graeme.neill@mobileeurope.co.uk. David Bowie puns are optional.

Change doesn't just relate to this magazine. Our Q4 issue looks at the Internet of Things, a subject a few of you may have heard of. In addition to the challenges over security, a look at how LoRa and NB-IoT are being deployed in commercial contexts, plus an in-depth analysis of how (or indeed if) Sigfox can hold off its fast-growing rivals, we hear about whether operators are doing enough to change their businesses to adapt to the opportunities afforded by this next generation technology.

Change also dominates my exploration of virtualisation in 2017. All too often each of us attend conferences where we are assured "technology [x] is just months away from the mainstream", when the truth is light years away, yet it appears virtualisation is making in-roads into many operators' strategies. It's not all plain-sailing: Deutsche Telekom's Deputy CTO tells me that it's a challenge to shift operators away from the model of there being "a clear throat to choke". As ever, internal change is as much of a challenge as technological shifts.

Our CTO interview section has been expanded to include a new In The Spotlight feature, with DNA CTO Tommy Olenius as our inaugural interview. Finland is a fascinating market with absolutely huge data consumption and deployment challenges. DNA is just one of several operators across the country having to overcome those obstacles.

Our feature interview, with TIM CTO Giovanni Ferigo, got swiftly sidetracked into a conversation about football and motorcycles, rather than immediately getting to grips with the telecoms industry. We also managed to explore that too, with TIM, and Italy in general, becoming one of Europe's key innovation testbeds during the past 12 months.

Christmas may only be days away but we already have our minds set on 2018. You should have received our pre-Mobile World Congress survey as we seek to get the industry's opinion on the subjects that really matter. We will publish the findings in our Q1 issue, ahead of a week of excitement in Barcelona in February.

Enjoy the issue,
Graeme Neill

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TIM CTO: putting Italy at the forefront of 5G innovation

Giovanni Ferigo enthuses about the potential of emerging technology – so long as you can get him off the subjects of football and motorcycles. TIM's running man CTO talks to **Graeme Neill**

Not to let you into any trade secrets but my interview with Giovanni Ferigo, Head of Technology at TIM, quickly bucks the trend of my usual CTO profiling methods. Normally once the fat of a telco's technology strategy is sufficiently chewed, I turn to the executive's own life to get a sense of who they are when not neck deep in LTE, 5G or whatever else his or her in-tray holds. This leads to conversations about the attractiveness of Tyrolean cuisine, as in the case of Swisscom's Elmar Grasser last issue, or a detour into the world of Harry Potter, which happened with Proximus's Geert Standaert earlier this year.

However, it takes all of five minutes for Ferigo to infectiously start talking football and motorcycles, two of his loves. Hailing from Udinese, he's been a lifelong fan of the north-east Italian city's football club, the second oldest in the country and one that boasted legends such as Zico and Dino Zoff. Less auspiciously, the son of former Libyan dictator Muammar Gaddafi also made the team, albeit for one 10 minute substitute appearance during an end of season dead rubber.

Ferigo also enthuses about a visit to September's Misano MotoGP race in San Marino, coincidentally sponsored by TIM. He says: "It's incredible to me, to feel the emotion of the competition." He jokes that his addiction to motorcycle racing is something his wife has come to accept, albeit grudgingly. He says: "It's a compromise of marriage, I suppose. I accept that I have to visit a lot of shops and she is ok with motorcycle tours."

Another passion is running. "I like to run eight to 10 kilometres of running each day," he explains. "I live in a green area and it helps me to arrive in the office with a free mind and go about my day in the right way." This clear-headedness is required as the operator is buffeted by rows over its ownership and the role, nefarious or no, of majority shareholder Vivendi.

Flavio Cattaneo left his role as TIM CEO this summer after reportedly falling out with Vivendi and he was replaced with a one-time executive from the French company. In between, Italy's regulator ruled that Vivendi had de facto control over the telco, something strongly denied by the mediaco. TIM confirmed in September that it would go to court to challenge the ruling.

How is this boardroom politicking affecting the role of the technology team? Ferigo says: "At the moment, my responsibility is to upgrade the network in terms of best infrastructure and best services to our customers. I cannot comment on this issue because for me, it's business as usual." I try again as it surely must have an impact. "The plan of LTE, 5G, the network, I am managing as usual," he replies, declining to comment further.

Ferigo describes his approach to technology as trying to "combine the right [balance] of innovation and concrete things". He says: "My view of the CTO is getting the right mix of concrete facts to have the best platform for the best services but to push at the same time innovation and always look for new things to insert into this platform... Innovation driven by business."

Which brings us neatly to 5G. While TIM has plenty of interests outside of home, with a substantial business in Brazil, the operator has been at the forefront of making its home market one of the European pioneers in 5G development. A demo day on November showcased the technology's potential in powering artificial intelligence, robotics and virtual reality. The cities of Bari and Matera will host trials of pre-standard 5G in the middle of next year, with TIM working with Swisscom subsidiary Fastweb, Ericsson and Huawei on the research.

Bari will host trials on how connectivity can improve security and logistics in the city's shipping port. At Matera, connectivity's role within tourism will be explored ahead of the city's tenure as 2019 European Capital of Culture.

"In the first phase we will experiment sharing of network infrastructure and

Maximum coverage: Ferigo's wide-ranging tech strategy has caught the eye with ambitious 5G plans

platforms," Ferigo says. "In the late phase, based on the availability of the standards and technical solutions, we will test scenarios with [TIM and Fastweb] sharing parts of the spectrum allocated for the 5G trial. Possible use cases could be, for example, spectrum allocation based on daily traffic profiles and forecasts, special events etc.

"This would give us important feedback on the maturity of spectrum sharing techniques and evaluate their adoption in case the spectrum allocation policy will require it."

Other use cases that excite Ferigo are cloud robotics and drones, the latter using the mobile network to send high quality images and video and handle the likes of security. He says operators could potentially use machine learning so the drone can autonomously respond to unpredictable situations.

The cost of intelligent networking

Ferigo also wants to bring this automated intelligence into TIM's own network. The operator is currently trialling bots and how they can deal with customer service issues. He says: "The customer will interact with a bot that will recognise him, his necessities, his profile and our vision is it will be able to try and solve his problem automatically."

Its own virtualisation plans are well underway (and outlined in more details in pages 28) and Ferigo is also looking to use more intelligent networks to anticipate and deal with problems before they occur. He says: "[With] algorithms we can not only be reactive in terms of things that happen but also be able to run predictive scenarios that mean we can upgrade the network and avoid some problems."

He says defining efficiencies not only across quality of service but delivering quality of capex is something that has "very, very interesting potential" for TIM. He describes these technologies as central to its network transformation. But while there is near consensus that change is essential, talk of automation and its effects on jobs is something that troubles industries the world over. How concerned is Ferigo about how this change would affect staff at TIM?

> "My view of the CTO is innovation driven by business

"The network transformation that is necessary will cause a transformation in skills," he says. "At the moment we work in silos, between the designer, the developer, the engineer. With this new kind of architecture, the same person will have all of those skills.

"We have to improve and provide a lot of new skills. I would be afraid for the "old" professions but I am sure the people will be able to transform themselves. There are a lot of new opportunities.

"There are a lot of other things that right now we are not managing. For example, data analytics or within virtualisation, there is the need for storage engineering, capacity engineering, [or] teams needed for orchestrators, hypervisors.

"I don't think the number of vacancies will improve but there is a huge quantity of people that will help the business, not just technical people but technical businesspeople."

He says it is the duty for operator HR teams to put plans in place to upskill staff today, but rightly notes this is also a problem for vendors.

Ferigo is not just focused on the era of 5G; across Italy work is underway on the 4.5G technologies that will bridge the current generation with the next. He describes NB-IoT in particular as a "paradigm shift" for the industry in terms of the doors it can open.

TIM switched on a NB-IoT network covering 5,000 municipalities in October, with LTE-M following next year according to customer demand. Ferigo rattles off the use cases that he says the operator is already getting asked for, from smart parking, connected cars and insurance to the luxury industry using sensors that guarantee the originality of their products. He adds: "Let me give you a simpatico example - connected bicycles. You can organise your trip in the city depending on where the smog isn't. This is a concrete and simple example."

Another area is one very important to Italians and gourmands all over the globe: food. He says the technology could be useful to identify the origins of that all-important cheese, wine and oil: "It can be used in smart agriculture to monitor crops, herds and flocks, to check for example the health status of livestock, their position, their productivity level.

"But it can also be used to monitor the whole supply chain, which is particularly important for those goods that need particular care in terms of time to be delivered...exposure to heat or sun radiation and so on.

"Dairy products are a good example for sure, but also meat or other delicate production: there are already companies that provide this kind of solution for luxury wine for example."

Roaring ahead: TIM's Ferigo has been one of the country's leaders in 5G trials

While the ARPU is low per sensor, Ferigo says the Internet of Things affords operators "millions of possibilities" and places it at the centre of 4.5G, a term that has also been used by operators to span gigabit LTE, virtualisation and other kinds of tech. More importantly for Ferigo, it allows operators to get to grips today with technologies that will be widespread tomorrow. He says: "I always say the 4.5G network is one that permits you to connect objects and not just humans... the applications are not so dependent on latency but with 5G, the business cases will be more latency-intensive. It's the right bridge to understand in a concrete way how 5G will enable different kinds of services."

Here and now

This bridge to 5G comes in addition to ongoing work in improving the performance of its LTE network, a now seemingly forgotten part of a CTO's role. TIM is aiming for 98 percent population coverage outdoors by the end of the year and Ferigo says work is ongoing to fill the gaps of indoor coverage, which lags behind.

Small cells will be deployed for special areas such as stadiums, shopping centres, hospitals and transport hubs, "areas critical for strong concentration of traffic and coverage issues", he says.

Some 2,000 small cells will also be deployed outside next year as TIM turns its attention to geographical coverage, especially in areas where macro coverage proves too difficult. These will centre on some of Italy's historic centres or areas limited by architectural or electromagnetic constraints.

Ferigo says the challenge for making this deployment is ensuring the small cell network is fully coordinated with the macrocell layer, ideally through a cloud-RAN that can enable both LTE-Advanced and manage interference. He says small cells' role within 5G, in addition to virtualised architecture, means this will also be a longer term focus.

He is expecting 3G will be used to fuel its LTE network. The short-term plan is to refarm TIM's 2.1GHz holding for LTE and keep 900MHz for 3G voice. He notes the company will need to overcome challenges related to those customers that have 3G-only handsets and to MVNO agreements that offer 3G-only connectivity. In the longer term, its customer service department can help migrate TIM's base onto VoLTE, freeing up 900MHz completely. With fresh spectrum coming in forthcoming auctions, Ferigo is unconcerned about supply. The operator is also tapping into licence assisted access technology that uses unlicensed spectrum, with plans to roll it out to 10 major cities across Italy, but Ferigo notes there are only a few compatible handsets.

Whether it's LAA, small cells, the IoT or 5G, it is clear that the TIM CTO is one of many European enthusiasts about the promise of emerging technology. But amid all his talk of what technology can bring to Italian society, surely there's one particular use case that excites him. How excited is he about the prospect of a truly connected motorcycle? "This is my dream," he replies, laughing.

In the Spotlight:

DNA CTO, **Tommy Olenius**

On Finns' thirst for data and managing the customer experience

What is the biggest issue you are currently thinking about?
Network scalability, as DNA has the highest mobile data volumes per subscriber in the world (14.3GB per month in Q1 2017, according to figures from Tefficient).

What's the most important thing you have learned professionally?
A solid, secure and future proof network foundation is the basis for any successful service development, and in the end provides a good customer experience.

What first attracted you to telecoms?
The first portable mobile phones and the start of automatic mobile communication in the Nordics with NMT (Nordic Mobile Telephone).

Who has been the most influential person on your career?
During my 30 years in the business, there have been numerous colleagues and mentors advising, helping and showing the direction, often in difficult disruptive market situations.

DNA is currently rolling out gigabit LTE. What is the deployment strategy?
Optimised investment based on estimated and monitored customer experience and return on investment are the key drivers in a fast growing network development. The gigabit benefit is still mainly in capacity add-on, as terminals of category 16-18, are still quite rare.

How can you encourage consumers to trade-up to compatible devices with the technology when most of today's smart devices can handle data intensive use cases?
The more advanced terminals mean a more efficient usage of the network resources and are therefore favourable. However, there has to be a service demand among the customers, before large scale trade-up will take place. The main drivers leading the 4G trade-up today are social media, high quality video capabilities and IP TV services. Higher terminal volumes again brings the prices down, which further escalates the trade-up.

Also providing easy to understand unlimited data pricing, combined with good network performance, makes it easier for consumers to trade-up.

What is your biggest professional achievement?
Together with a small and highly skilled organisation of real professionals, planning and implementing DNA's 4G mobile network strategy. As part of the strategy implementation a huge effort was put in to make mobile broadband customer experience measurable and visual.

The created customer experience management view helped both customer care, network operations and network planning to maintain and improve network quality and customer experience, despite the explosive data volume growth.

All network organisation resources, from core network and backbone to the transmission access and radio base stations, work in extreme cooperation to build an end to end network experience never seen before.

What's the biggest challenge facing the telecoms industry?
Finding new areas of growth as competition from global players is getting tougher. New technology provides capacity, flexibility and opportunities, but is it possible to get a bigger share of the customer's wallet?

What's the biggest opportunity facing the mobile industry?
New technologies like 5G, the Internet of Things, artificial intelligence, virtual reality, fixed-wireless access are opening up new business opportunities. Commercialisation and right timing are crucial.

What one recommendation would you make to your fellow CTOs?
Large investment in nationwide 4G coverage and capacity will pay off and improve return on investment only when the built capacity is put to maximal usage. Fixed priced, unlimited data makes an attractive package to all customers, when any services can be used without broadband restrictions and limitations.

NetNumber: NFV takes signalling control from arcane pursuit to strategic imperative

Doug Ranalli, NetNumber Founder and CSO

The appeal of NetNumber's neat technical solution for the inherent complexity and inflexibility of core network operations is undeniable. "We build one signalling-control platform, which supports 20 mission critical signalling functions," says Doug Ranalli, the company's Founder and Chief Strategy Officer.

"That is completely disruptive. It is as dramatic as having one iPhone with 20 apps, compared with carrying 20 iPhones for 20 apps. No one would do that. It's ludicrous. But that's exactly been the history of signalling control."

The company's Centralised Signalling and Routing Control (CSRC) solution, TITAN, is catching the attention of communications providers of every type. "We get insight into every part of this industry," says Ranalli, pointing to its work with providers of mobile, fixed, cable, MVNO and OTT services, as well as those between the lines offering IP exchange interconnect.

"It gives us insight into every aspect of signalling control," he says. The US-based firm promises to "simplify, scale and secure" these organisations' signalling control networks, which manage such functions as subscriber profiles, policy servers and access control servers, and also track access and activity.

The world's largest telecom technology vendors – Ericsson, Huawei, Nokia and Oracle – have their own signalling control solutions, and are NetNumber's direct competitors. NetNumber is keeping such company because of the disruptiveness of its proposition, and its burgeoning reputation. "It is no mistake we broke into this market and achieved direct relationships with many of the biggest operators on the planet."

For the traditional players, signalling control is a sideshow to the main event. By contrast, NetNumber is interested in nothing else; it is the only vendor in the market majoring in the subject.

It has developed its proposition over 16 years, going ever deeper to help communications providers transition from legacy technologies to IP networks, whilst also handling a spiralling signalling load from new devices and services.

"For us, signalling control is everything," says Ranalli. "Those guys aren't in every service provider segment for signalling control. We have competition in each, but we're the only one playing in all of them. Our competitors just don't have the breadth of offering."

Their offers are not as elegant, either. As per the iPhone analogy, NetNumber proposes to swap out multiple signalling control functions for its TITAN platform, which defines customers' application and control in software. "Our competitors want to deliver 20 different platforms, and have the customer integrate, manage and scale them all. That model is inflexible and expensive," he says.

Presently, most operators support three signalling control networks (SS7, LTE, IMS), deployed to underpin the traditional 2G and 3G services they cannot yet turn off, the all-IP packet-switched LTE services they have just built, and the new IMS architectural framework that will carry forward their digital services. "It makes it a very complicated picture," says Ranalli.

Most run three networks, three technologies, and three standards. As a result, they are required to manage over 20 different standardised functions in the signalling control plane. The NetNumber Founder says: "You have a new function, you buy a new platform; you now have to integrate that platform, train your team, monitor, upgrade, scale, and plan roadmaps. It is a huge burden, with every piece of technology you put in your network. We have broken that cycle. You put one piece of technology in (TITAN), and activate 20 functions."

The disruptiveness of its vision has enabled it to break into the market; the elegance of its proposition has allowed it to steal business from better-established brands. "Our competitors cannot match this architectural advantage, so they cannot squeeze us out," he says.

Circulatory system

Signalling control authenticates every user, activates every service, and tracks every policy and activity. "It's probably like the circulatory system – it's your blood flow, your arteries, your veins," says Ranalli. Decisions might be taken in the OSS/BSS, but the signalling control function has to be engaged for the message to get through and the action to play out.

"Your brain decides you want to run, and you run a race as a result. But it's the circulatory system that makes it possible, pumping blood to your muscles." He adds: "It is critical to everything operators do. And that's what makes it great space for us. It's arcane – it's really complicated and there aren't that many people who understand it."

Times are changing, however. NetNumber is getting noticed. It now serves (publicity-shy) tier-one brands in every region of the world, alongside many operators. It has also been spotted on the industry awards circuit of late, having been recognised for the most robust IMS security solution at the IMS World Conference in May, and the best new security solution at the SDN NFV World Congress in October.

"The reason is that NFV and SDN are becoming real. We have been talking about it for years, and people have been testing it for years. But those two trends are now very real – if they didn't exist, no one would be talking about signalling control because it is standardised, and it works," explains Ranalli.

But the trend for network virtualisation – and its promise of greater efficiency and productivity, giving rise to a new era of innovation in telecoms networking – means every function is up for renewal. "They have no choice. They are absolutely, positively going to re-implement their signalling control," says Ranalli.

"Everyone accepts, now, that's absolutely true," he adds. Indeed, the company's warning – that virtualising the familiar chaos of signalling control in software would be an appalling mistake, and that it has a more elegant solution of its own – is now well understood.

The move towards virtualised networks presents a golden opportunity for them to totally discard, the old encumbrance of legacy functions. But it is essential operators do not make the tragic mistake, he says, of virtualising the old complexity in software. "Our message is, 'don't do that; don't translate that physical chaos into virtual chaos'. NFV is the perfect opportunity for a carrier to re-envision how they think of signalling control. Don't virtualise 20 things. Virtualise just one thing: your signalling platform. Scale it and distribute it once, not 20 times," he says.

> "Our competitors cannot match this architectural advantage, so they cannot squeeze us out

"It makes no sense. You will not achieve the scale you want, nor the price point you want, if you do it the same way you're doing it today. That's why we're seeing more attention. The transition to a software network has become visceral to our customers. They are starting to see it; they are starting to say, 'hold on, I am actually going to do this; I need to pay attention.'"

Network Function Virtualisation promises new flexibility and innovation. "NFV is the real gift, here," says Ranalli. Operators can redefine their network architecture, and reinvent their market position. "That's important because virtualising infrastructure increases cost. After all, operators already have infrastructure in place, so they better get some benefit if they are going to rebuild it."

Having ploughed its own furrow for more than a decade, the operator community is interested in NetNumber's crop. Its proposition is attracting meaningful glances. "They see now that we provide a way to a greatly simplified world, which leads to faster innovation." Innovation is the crux of it all, of course. Operators cannot launch new services without adjusting aspects of their signalling control.

Change is hard when it affects up to 20 different protocol-specific functions, he says. "Just imagine: the marketing team has a bright idea for a new service, presents it to the engineering team, and gets told it will take adjustments to four separate platforms in the signalling control network. 'It will take a year and a half to align the roadmaps, and longer to upgrade everything.'"

The current model for signalling control is expensive to operate and slow to evolve. Inspiration can be hard to come by, and harder to make real in network operations. The moment has gone as soon as the idea arrives, or at least as soon as the engineering team is consulted. "They just turn and say, 'it's going to cost a lot of money and a lot of time, so you better make sure it's a $1 billion opportunity; otherwise it's not worth it.'"

For service providers, innovation effectively starts with changes to the signalling core. A multi-platform signalling set-up kills progress, declares Ranalli. "Service providers constantly complain that OTT

> "We get insight into every part of this industry

companies steal their revenue. Here's why: OTT companies don't build their networks with 20 standalone platforms like that, nor just generally this level of complexity."

He continues: "Decades ago, the service-provider community decided it would benefit them to have a standardised architecture with standardised interfaces between all the functions so they could choose best of breed functionality for every one of these well-defined functions. That turns out not to be a winner when you compete with OTT providers." By contrast, OTT providers are not hobbled by legacy hardware or standardised architecture. "They build solutions in the most efficient way they can," says Ranalli. "It is entirely proprietary to them. In order to win, service providers need to find ways to leverage the benefits of a standardised architecture without suffering the loss of flexibility that comes from working within a rigid structure. We can help."

NetNumber is offering a software-based control platform to launch a new era of innovation in telecoms, by swapping out, one piece at a time, the standardised hardware that has so far held them back in the digital era. "You have to evolve; you can't just do a flash cut to a new model," explains Ranalli.

"We are trying to figure out how customers can keep the benefits of this standardised model, but evolve to a much more flexible, lower cost software driven implementation. So we're taking those 20 physical platforms, keeping all the interfaces, and converting them all into software functions that run on one platform."

Strategic imperative

Virtualisation is not just a casual trend; it is a strategic imperative for operators, which must reconfigure their infrastructure to support billions of additional devices and connections within the Internet of Things. The point is the design of today's complex signalling control infrastructure, conceived in hardware in every telecoms network on the planet, is based on the assumption that subscribers will pay $50 per month for services, and are, mostly, human. As a concept for telecoms design, it is no longer valid; the IoT will usher in massive machine-based connectivity, and a new industrial revolution. The forecasts are staggering: Gartner makes a conservative guess at 20.4 billion IoT devices by 2020, up from 8.4 billion today. Cisco reckons the total market will be worth $1.9 trillion by 2025, equivalent to US GDP.

"Most subscribers will be machines in the next decade, and not people streaming Netflix on smartphones," says Ranalli. "Ask a bunch of engineers to build a signalling control network for 100 million humans paying $50 per month and they might just come up with what we already have. Ask them to build for billions of devices, each paying a dollar a month, and they will come up with a completely different architecture."

The rise of low-power wide-area networking technologies – notably, unlicensed cellular technologies like Sigfox and LoRa, as well as licensed cellular variants like NB-IoT and LTE-M – have provided the IoT ecosystem with a backbone. They have also made it easier for enterprises and institutions to get into network provision themselves a trend expected to rise with the introduction of shared spectrum.

With its software-based control solution for core networks, NetNumber finds itself in demand among enterprises at the vanguard of this new trend in private network rollout. It has been involved in deployment of a private network for a mining operation in Australia, with several thousand staff and a significant base of automated machinery that requires a highly reliable LTE network.

"It's in the middle of Australia; there is no macro network," explains Ranalli. The local service provider implemented the solution and brought NetNumber in as an OEM provider, offering private LTE network infrastructure based on its IMS portfolio of signalling applications, part of its TITAN platform.

"It is an opportunity that we never saw coming, actually, " says Ranalli, noting the interest, particularly, from defence operations and public safety services, alongside heavy industry. "We are seeing a significant number of enterprise customers wanting to deploy their own mobile networks. And it just turns out we are a perfect fit for that because we collapse those 20 functions into one virtual machine. We fit this private network model perfectly."

The alternative is 20 virtual machines, demanding more significant investment, a bigger infrastructure footprint, and more complex management. Ultimately, current architecture for signalling control will not scale for next generation of wireless technologies. It is just too costly, and too complicated. Opportunity knocks, and NetNumber is delivering the message.

"This is a lucky time for the operators. What they have today isn't going to meet their needs in an IoT world. But the migration to software is coming along, and the chance to re-envision signalling control is right in front of them."

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Where next for the IoT pioneer amid market challenges?

Cellular IoT makes in-roads but can operators adapt to new opportunities?

The past 12 months have seen new kinds of technology and use cases emerge in the Internet of Things. Alex Sword polls industry analysts to see how well operators are taking advantage

What have been the biggest developments in European operator IoT strategies over the last 12 months?

Julian Watson, Senior Principal Analyst of IoT Connectivity Research at IHS Markit: The key one has been the deployment of networks that are optimised for massive IoT opportunities: NB-IoT and LTE-M. This gives MNOs a way of migrating legacy M2M customers to new networks as 2G gets switched off gradually.

Adarsh Krishnan, Senior Analyst at ABI Research: Telcos' IoT strategy for the B2B market in the region can be categorised by the following: providing connectivity infrastructure services only, providing this with IoT application enablement platform services for vertical markets and providing both of these with IoT devices through OEM partnerships.

John Delaney, Associate Vice President, European Mobility at IDC: The biggest developments have included the development of specific vertical expertise and solutions, development of IoT platforms and attempts to expand from connectivity into higher-value parts of the IoT value chain.

Joe Madden, Principal Analyst at Mobile Experts: A few European operators have already decided to push forward with LTE-M, taking advantage of the existing LTE network with quick software upgrades. Others such as Deutsche Telekom have chosen NB-IoT as another 3GPP variation for IoT.

Rob Bamforth, Principal Analyst at Quocirca: Many seemed to go down the IoT platform route, which is fine. However, as many have discovered, IoT deployments need much more than a base platform plus a network – there is a whole bunch of participants in the IoT ecosystem and things need pulling together. That's what has made initiatives such as Orange's 'Live Booster' programme interesting - there seems to be an understanding that the ecosystem needs a catalyst.

What technological leaps have been made in the same period?

Watson, IHS Markit: In June 2016, NB-IoT and LTE-M were standardised by 3GPP. Since then, the ecosystem of chipsets and modules have both developed greatly. There has also been accelerated commercial deployments following pilots. At the last count, there were 18 commercial NB-IoT, five LTE-M commercial networks in operation and another 60 NB-IoT and 21 LTE-M networks either being planned or in trial.

Delaney, IDC: The significant ones have been the standardisation of low-power, wide-area connectivity for 4G networks and devices.

Madden, Mobile Experts: LTE-M is a technology leap in a way, because as a new standard it enables a significant drop in power consumption. This allows for battery life that's measured in years, not days.

Which European operator IoT projects stand out?

Watson, IHS Markit: There have been some interesting operator initiatives, mostly focused on operators creating compelling IoT solutions for vertical markets. For instance, Deutsche Telekom has developed its own smart home offering, Qivicon, which powers its smart home offerings in its own markets. It has also licensed it as a white-label platform to other operators such as KPN.

Another interesting move has been Vodafone's launch of its visual security solution Vodafone Digital Buildings. Vodafone has developed not only the connectivity, but also the module, analytics platform and control centre that make up this solution. Through its acquisition of Cobra Automotive, Vodafone already has a strong position in the connected car market. Vodafone Digital Buildings represents an effort by Vodafone to "move up the stack" in another vertical.

Delaney, IDC: Vodafone's NB-IoT rollout stands out – it is already live in six markets.

Madden, Mobile Experts: It's still early and honestly the European IoT projects so far have been much smaller than the deployment in China and the USA. We expect European projects to lag behind the rest of the world in terms of scale for the next few years.

What is the biggest obstacle to operators taking a key role in the IoT ecosystem?

Watson, IHS Markit: The biggest challenge is operators' traditional focus on connectivity. Delivering connectivity that is reliable, with wide and deep outdoor and indoor coverage, is complex in itself. Reliable, secure connectivity must underpin every IoT application. The challenge for operators is to generate revenue from beyond connectivity, such as through platforms and managed services.

Krishnan, ABI Research: There are challenges from adopting technology innovation, lack of innovative business models and disruptions in existing business.

Delaney, IDC: The biggest is the lack of a "native" brand and capability in big IT services projects, especially regarding deep expertise in specific verticals.

Madden, Mobile Experts: Operators are not good at customising solutions for individual enterprises, so their ability to sell to an industrial

company can be limited. Their main obstacle is organisational and cultural, not technology.

Bamforth, Quocirca: They sit at the wrong end of the value chain. Earlier waves of mobile such as BlackBerry, smartphones, handhelds and tablets are all about the app. IoT takes it up a level – it's all about mobilising a business process, not just an app. The network risks being viewed as a bit-pipe, but it could be the nervous system.

How do telco approaches and attitudes in Europe differ from counterparts in other regions?
Watson, IHS Markit: The approaches operators take will be largely shaped by regional conditions and dynamics. For instance, in the USA, consumers are used to paying significant sums for mobile connectivity. This makes it somewhat easier to upsell them with additional connected car services. In Europe, where ARPU is much lower, upselling is more challenging. Operators in Europe and elsewhere are increasingly seeking to shift away from offering products to solutions that address tangible challenges their customers face such as the performance of remote assets, energy wastage and leaking pipes.

Madden, Mobile Experts: The Chinese operators are extremely aggressive and have strong support from the VC community and other investors in China. European operators do not have the same level of enthusiasm from the financial world, so European players must somehow make the investments themselves to penetrate new business areas.

What can operators do now to prepare their networks for the deluge of new devices?
Krishnan, ABI Research: LTE-M and NB-IoT are two cellular standards that are specifically ratified to address this scenario. Although network deployment has been somewhat slow, rollouts are starting to gather pace with large operators such as Vodafone, Deutsche Telekom, Orange, and Telefónica taking the lead in Europe.

Watson, IHS Markit: Continuous testing of their networks for security. Working very closely with chipset, module, device makers and other partners to ensure that security is embedded into each element of an IoT solution.

Delaney, IDC: They can implement LPWA to reduce the power consumption and reduce per-device signalling traffic for IoT devices.

Madden, Mobile Experts: There's no danger of an NB-IoT network being overloaded with devices anytime soon. Mobile operators can keep it simple: implement LTE-M or NB-IoT and work on growth for the next five years.

What is the biggest emerging IoT opportunity for operators?
Watson, IHS Markit: There are many opportunities, such as connected car, smart meters, healthcare, security, digital signage and others. The largest, in terms of the potential number of connections is asset tracking and management, which encompasses a very broad range of use cases. An application is cold chain monitoring: using connectivity to monitor the condition of perishables in transit.

Krishnan, ABI Research: Smart metering implementations by water utilities are the most prominent emerging IoT opportunity for operators. This is followed by asset tracking and telematics.

Delaney, IDC: The biggest sector in 2016 was manufacturing. We forecast consumer to be the biggest in 2021.

Madden, Mobile Experts: The fragmentation of IoT is extreme, and we're tracking 75 different ways that people can connect IoT devices. We expect that fragmentation to be reduced over the next 10 years as some formats wither and die… and others merge. Mobile operators will be focused on three technologies: LTE-M, NB-IoT, and LoRa. Other variations will not survive in the operator-led business model.

Bamforth, Quocirca: I think the pragmatic IoT applications that deliver tangible returns, for example energy monitoring and preventative maintenance, will be where they should get success.

In the next 12 months, do you expect operators to converge or fragment in their choice of IoT standards, including unlicensed technologies such as Sigfox?
Watson, IHS Markit: Because Sigfox retains a monopoly on service provision in each country (often through a single partner), we do not expect MNOs to deploy Sigfox to any great extent. However, we do expect to see more operators enter into partnerships with Sigfox.

Krishnan, ABI Research: In the next 12 months, operators will converge on their choice of cellular IoT standards with some operators launching both NB-IoT and LTE-M. That said, non-cellular technologies such as Sigfox, LoRaWAN will continue to flourish in some vertical applications that don't require the high QoS that is possible with licensed technologies.

Delaney, IDC: No, I expect to see a gradual shift away from unlicensed-spectrum solutions in favour of cellular connectivity.

Bamforth, Quocirca: I expect them to converge - they need to all be multi-bearer wireless carriers, but IoT demands universal coverage, including cross border.

IoT devices continue to leave networks vulnerable

As the IoT deployments accelerate, the opportunity for hackers to gain access to critical systems and private data keeps pace. Can operators keep up? James Blackman reports

In 2015 Symantec established a honeypot to track attempted hacks of IoT devices and quickly made clear they are increasingly common targets for cyber-criminals. Attacks on its honeypot almost doubled from January to December 2016, rising from an average of 4.6 attacks from unique IP addresses per hour to just over 8.8.

At peak activity, when the Mirai botnet was expanding rapidly at the end of last summer, attacks were taking place every two minutes. "Whenever new technologies take hold and start to proliferate, the hackers and attackers are never far behind," remarks Robert Arandjelovic, EMEA Director of Product Marketing for Symantec.

Right now, the challenge of security is tougher than ever. The massive scale of IoT deployments on telecoms networks expands the attack surface ever further, as each new node lights up. "There is a huge potential for data to be lost, malicious modification or prevention of functionality, and enslavement in botnets, as the number of potentially weak or open entry points that can be exploited increases," says Les Anderson, Chief Security Officer at BT.

Deployments are racing ahead. Gartner reckons 20.4 billion connected 'things' will be in use by 2020, up from 8.4 billion in 2017. Cisco says the market's value will outrun US GDP by 2025, reaching $19 trillion. The risk factor is keeping pace. HP finds 70 percent of consumer IoT devices use unencrypted network services, and AT&T calculates just half of enterprises are running IoT security assessments.

Come together: Success in securing networks hinges on cooperation

The threat is also magnified by the complexity of the technologies in play. "The fundamental problem is this cacophony of different protocols – there's no single device and no single standard the industry agrees upon," says Jaya Baloo, Chief Information Security officer at KPN. "Everything is jumbled together… without much thought for interoperability or harmonisation."

Security by obscurity does not provide an answer. The response must evolve with the threat landscape. "Additional complexity just makes it more difficult for that evolution to take place," says Baloo. "The real challenge is to establish a simple architecture, which is standardised and transparent, and up-to-date. That is the name of the game – not hiding behind some obscure, complex, difficult-to-understand nonsense."

> "Vendors are either not aware of the risks, or prefer not to accept them

Technology stack

Of course, the entire IoT stack must be protected – from inception, through upgrade and replacement. Vulnerabilities can be exploited in any "technical layer", observes Pedro Pablo Pérez, Vice President of Security at Telefónica.

Leading operators are taking an "end-to-end" approach, informed by hard-won lessons in IT security, supported by sophisticated cyber-security centres that they have built in response. Their standard mechanisms and techniques include firewalls with application-layer visibility and controls, whitelisting, intrusion detection, data loss prevention, and vulnerability and malware scanning.

But commentators all make the same point – that the industry has to pull together to be effective. "There is no silver bullet for this," remarks Arandjelovic at Symantec. "This is a fragile ecosystem, which requires everyone to play its part in the dilemma if any type of real security is to take place," says Baloo at KPN.

Deeper collaboration is required between mobile network operators, cloud service

providers, silicon providers, device manufacturers and third-party software providers. "Successful IoT deployments require multi-layered, end-to-end security that ranges from baked-in security requirements up front to the ongoing management and protection of sensitive machine-generated data," says Seshu Madhavapeddy, VP of Product Management at Qualcomm.

But collaboration only works if all parties are committed. As it stands, each layer in the technology stack is not equally vulnerable and each section of the technology industry is not equally culpable. "The level of maturity is not the same for each component," explains Olivier Ondet, VP of IoT and Analytics at Orange Business Services.

"Network security is in pretty good shape. We are used to managing the security of our networks – of solving problems before they arise. That doesn't mean there aren't challenges – you can never say never – but the ecosystem is well structured, and accustomed to managing security."

3GPP has a well-oiled programme for the standardisation of licensed cellular technologies, including newer low-power wide-area alternatives like LTE-M and NB-IoT, and emerging 5G protocols. Equally, a strong ecosystem has grown up around LoRaWAN, with a steady contribution towards tighter cyber-security from industry protagonists.

The cloud ecosystem is mature, too, says Ondet, and accustomed to security challenges from traditional IT. "The challenge around the data management is fairly well determined too, in terms of securing the platform and hosting in the cloud. That is working reasonably well. Standards are in place, and there is a way to do that. We are already used to securing IT systems in this way," adds Ondet.

Weakest link

By contrast, and despite operators' considerable efforts and increasing sophistication, the endpoints themselves are riddled with failings. IoT devices represent the weakest link, and the root cause of all known IoT cyber-attacks to date. Their inherent security vulnerabilities are putting strain on the other functions in the stack, and undermining the technology's broader reputation.

"If you don't have security you don't have trust, and if you don't have trust you don't have an ecosystem that develops and progresses," says Ondet. "It is really important devices are secured. If they are going to hold secrets, then they have to have the facility to bury or hide them. As it is, device makers today are mostly focused on making sure the usage is great, and not on the basic security stuff."

Ideally, IoT devices should have an immutable identity to ensure a secure channel. Bootstrapping that on the device and securely storing keys and certificates is essential, observes Pérez. The trouble is the market's growth has hinged on low-cost, low maintenance connectivity, which often precludes basic security on devices. "Because devices are constrained in battery and computing power, not all security measures can be deployed," says Telefónica's Pérez.

> "Security is built into hardly any IoT devices. There is very little security by design

Among a number of failings which have exposed networks to attacks, the most significant is the persistent absence of automatic firmware updates. "There is very often no update process, and, where there is, the updates can often be hijacked as they are not protected by cryptography," remarks Symantec's Arandjelovic.

Lessons have not been learned, it seems. The most common security flaws in cheap IoT devices, as published on the Open Web Application Security Project, are familiar from IT already. Alongside the absence of update mechanisms, they often lack authentication tools, access controls, and data encryption. Worse, default admin passwords are common, frequently hardcoded and unchangeable.

"History repeats itself with IoT," remarks Dominique Brack, Senior Security Consultant at Swisscom. "Security is built into hardly any IoT devices. There is very little security by design. If there is any security at all, then it is bolted on in most cases. The products are trimmed down to be cheap and easy to use, but not with security or even privacy in mind."

New technologies are emerging. Lightweight cryptography, a coded algorithm to shore up simplistic IoT devices, is helpful, notes Arandjelovic, but only applicable in certain use cases. "For some applications, speed and low latency is more important than small code and low memory usage," he says. Pérez points to the success of elliptic curve cryptography certificates, as a compliment to traditional RSA and DSA algorithms.

Collaborative prevention

But security-by-design is a largely failed concept in IoT, or among IoT device manufacturers anyway. Brack compares attempts to bolt security onto IoT devices after they have left the factory to retrofitting an old car with airbags or an anti-lock braking system. "It's a nearly impossible task," he says.

What are manufacturers doing about it? "Not much," says Michela Menting, Digital Security Research Director at ABI Research. "There are pockets of effort, notably in sectors where security impacts functional safety, such as transport. But the efforts are poor, even in critical sectors like healthcare and utilities. Vendors are either not aware of the risks, or prefer not to accept them due to cost and time to market constraints."

Indeed, there is something rotten in the mad commercial rush. Baloo suggests device makers are more worried about time-to-market than time-to-hack. "It's about priorities," she says. "If they considered the time-to-hack, we might actually see an evolution in security."

The conversation returns to collaborative threat management, and the fact device makers are failing to hold up their end of the bargain. "As an operator, our job is to make sure connected devices on long-range networks have security by default. We have hacked the heck out of our network, and we have tested the devices on it – which means we don't just place blind trust in our vendors, we test their products as well. We do that as a buyer and a reseller," explains Baloo.

"What is shocking is the manufacturers – the software and hardware vendors – don't take the same accountability when they deliver services or products to us. That is something that needs to be remedied. They should be accountable for the weaknesses in their products."

The consensus is that until IoT device makers put security first, hackers will find an ever-expanding variety of attack vectors to gain access to networks, systems and data.

NB-IoT answers Vodafone Ireland's call

The Irish operator is using IoT technology to protect against flooding. Michelle Donegan reports

Vodafone is determined to turn Ireland into a "smart nation" with the launch of the country's first NB-IoT network in August this year. The operator envisions helping people and businesses to live smarter and work more efficiently via the connectivity of millions of low-power devices.

The operator recently partnered with Dublin City Council (DCC) to provide NB-IoT connectivity for the Docklands Smart District programme, which brings together technology companies, research organisations and other agencies to develop smart city solutions for this part of Ireland's capital.

It is part of the broader Smart Dublin initiative started by four local authorities and aimed at using new technology and big data to improve life in the areas of mobility, environment, energy, waste and emergency management. Vodafone and DCC also launched a €50,000 innovation fund to support start-ups testing smart city services on the new network.

One of the first applications to be tested is for flood monitoring and response and was developed by Irish company Voguetek. The council is working with the two telcos to develop low-cost sensors that detect gully blockages and alert the city council before they can cause a flood. The technology could be applicable for other urban and rural scenarios.

"Irish consumers will see a huge variety of products, services and applications enabled by NB-IoT, from gas meters to smoke alarms and car parks," says Anne O'Leary, CEO of Vodafone Ireland. "Waste infrastructure will have the potential to 'phone home' when full, reducing cost and improving city cleanliness, as an example. Also, parking bays can be fitted with sensors, providing drivers with information about where the quickest parking is available and reducing traffic congestion."

Vodafone believes applications enabled by NB-IoT will touch many different industries from agriculture to energy. For example, IoT apps can help farmers track livestock, monitor animal health or keep tabs on soil conditions to improve crop yields.

NB-IoT technology is suited to scenarios that require reliable connectivity for sensors that cannot be easily accessed for repairs or battery replacements, such as underground or deep inside buildings, and that transmit small amounts of data.

According to Vodafone's fifth annual IoT Barometer 2017/18 report, the proportion of companies using IoT has increased from 12 percent in 2013 to 29 percent in 2017, with transport and logistics industries and the retail sector showing the most growth since 2016.

But as 28 percent of respondents said they are considering low-power wide area network (LPWAN) technologies, new connectivity options like NB-IoT could drive the next wave of growth. "Vodafone wants to provide the strongest LPWAN alternative to Irish customers and launched NB-IoT to act as the catalyst for companies to consider connecting things that would not have been viable with existing technologies," says O'Leary. "NB-IoT offers long battery life, lower cost, extended coverage into buildings and underground locations as well as operating in licensed spectrum, meaning solid reliability and security for users."

The operator also stressed the significant advantage of NB-IoT operating in licensed spectrum is "guarantee of service," compared to alternatives that use unlicensed spectrum.

When Vodafone started rolling out the network in 2016, the main implementation challenges were related to having an embryonic ecosystem and dealing with a new technology, according to Phil Skipper, Head of IoT Business Development at Vodafone Group. "Since then, Vodafone Ireland has gained a lot of valuable expertise that can now be transferred to our customers," he said.

But one of the benefits of NB-IoT is quick time-to-market, he added. "In Ireland, only a software upgrade was needed [to 4G base stations]."

Looking ahead, Vodafone Ireland says it plans to expand the network geographically in response to customer demand. "The growing ecosystem around NB-IoT as an industry standard is driving customer take-up and the exploration of new business cases," said Skipper.

But the biggest challenge is moving to scale, he added. "We have seen for the first time in our IoT Barometer that scale projects have doubled in the last 12 months. Supporting successful large-scale deployments will go a long way to realise the return of investment that comes from IoT projects," said Skipper.

How "smart art" reaped LoRa benefits for Proximus

Proximus was one of the first operators to jump with LoRa tech. Michelle Donegan looks at how it is paying off and how connected paintings became just one surprising use case

Masterpiece: Proximus used LoRa to connect valuable paintings in its own building

Like many mobile operators, Proximus delivered M2M services via 2G and 3G networks for years. But when customers started asking for low-power, long-range solutions back in 2014, the Belgian operator knew its cellular networks could not meet the technical requirements for such use cases. So Proximus bet big on LoRa technology and it hasn't looked back.

In 2015, it was one of the first operators to deploy LoRa, the low-power wide area network technology that uses unlicensed spectrum to connect IoT sensors, and became a founding member of the LoRa Alliance. It now operates a nationwide LoRa network and delivers IoT services to a variety of businesses. While being an early adopter of a new technology was challenging, Proximus says the learning experience was worth it to gain a first-mover advantage.

The operator had evaluated NB-IoT and Sigfox, but the former "just wasn't there yet" for commercial deployment, according to Vincent Hebbelynck, Head of Tech Incubation and Corporate Venturing at Proximus. As for the latter, Sigfox had limited bandwidth and an inflexible business model that did not give operators enough control over the network. Proximus preferred LoRa because it was based on openness and was attracting a growing ecosystem.

It initially rolled out the IoT network in Belgium's 10 largest cities, including airports and harbours. "It was important to give ourselves high visibility as the LoRa operator of choice," says Hebbelynck. Because LoRa uses unlicensed spectrum, Proximus knew they could have competition not just from other operators but also private companies.

As one of the first to deploy the new technology, the operator encountered many unexpected issues. For example, there were sometimes power incompatibilities with devices. And even though Proximus reused much of its existing infrastructure, including base station masts, backhaul transport and power, there were challenges with obtaining permits to add new hardware. Some devices were also not designed to emit the right level of power.

The biggest lesson learned from the rollout is that "the ecosystem is much more important than the technology," says Hebbelynck.

> "The ecosystem is much more important than the technology

"You may have great technology, but if you don't have all the players around it, you will not make it."

Many of the early challenges Proximus faced were resolved thanks to support from partners in the LoRa Alliance that were experiencing similar hiccups. "Being an early adopter has a cost – maybe we underestimated that – but it has been an advantage to be a first mover," says Hebbelynck. "In Belgium, we're considered to be the more advanced with regards to our competition in IoT."

Proximus also reaffirmed the value of its mobile networking expertise to IoT. "Many players in LoRa think they don't need an operator because it's in an unlicensed band," says Hebbelynck. "But anything linked to radio is complex. It's not that any city or organisation can just evolve and operate a network. They quickly realise that it can be done by professionals in a better, more cost-efficient way."

Proximus targets numerous use cases, including smart buildings, smart retail for food supply chains, transport logistics and smart parking. One use case came to the operator out of the blue. Proximus has an art collection and the pieces of art need to be monitored so that they are stored or displayed at the right temperature and humidity. It used LoRa to monitor its own collection and realised there was a market for "smart art" and smart insurance.

The next step is to offer more than IoT connectivity and provide complete solutions that meet business needs for enterprise customers. For example, the operator developed an IoT management platform called MyThings that provides a dashboard to give customers the ability to view and analyse the data coming from the sensors. The platform can be further integrated with other business applications via APIs. The operator is working with partners to develop services that sit above the network, sometimes taking a systems integrator role to manage the customer relationships.

In addition to new services, Proximus also plans to deploy NB-IoT at some point for specific use cases and in response to customer requests. But Hebbelynck said the operator is in no hurry. "There is no one technology that fits all IoT use cases," he said. "To support a very broad spectrum of use cases, I have to invest in several technologies."

Can Sigfox hold its ground against LoRa and cellular IoT?

IoT pioneer Sigfox is facing assaults from various cellular fronts but its CSO and co-founder is confident the technology can fight off the challenges. Alex Sword reports

Having opened up shop in 2009, when the Internet of Things was a niche concept, the Chief Strategy Officer and co-founder of Sigfox Christophe Fourtet is confident that its technology will be able to hold its own amid external competition from the operator big beasts and rumours of internal strife.

With a background in cellular having worked at Motorola in the 1990s, Fourtet founded Sigfox alongside CEO Ludovic Le Moan in an effort to create a highly efficient radio for applications that require little data to be transmitted and at low power.

The technology transmits at rates of a millionth of 1MBps, via a 100Hz wide channel in unlicensed spectrum bands that differ across regions. The use of this free spectrum dramatically reduces the investment required compared to operator methods.

Adarsh Krishnan, Senior Analyst at ABI Research, says: "Sigfox aims to be the cheapest and most power-efficient connectivity technology to make it feasible to embed connectivity to most physical objects."

Since the company was founded, the wider IoT market has moved quickly towards a more mature and indeed heavily hyped ecosystem. Instead of customers in the early days wanting "everything to be connected all the time", they are now looking at the return on investment they can make on "much simpler applications with a much more simplistic way of connecting". Fourtet says: "People are understanding there are lots of constraints – they have to integrate the constraints within the technology and their business model."

It is here that he feels Sigfox comes in. The technology aims to capture one of three segments which Fourtet believes make up the future of the IoT market. One is the mass market solution for personal use, which will be the evolved forms of the Wi-Fi and Bluetooth flavours of connectivity used today. Another is cellular-based such as NB-IoT or LTE-M. The third, which Fourtet calls the "abandoned device" segment, is the sweet spot for Sigfox.

He says: "You are spreading [these devices] over the field and you no longer want to care about them for five to 10 years. In 10 years you probably lose it, it has done its duty and that is it. With this approach we are sure there is a huge market."

In this sense, Fourtet says, while usage of cellular technology has been fairly monolithic, focusing on telephony and data, IoT connectivity needs to address a "huge variety" of different situations. This varies from getting information once a month to exchanging video. He adds: "One technology cannot answer that."

At the low-cost end, the company has demonstrated at its conference in September how a Sigfox module could be attached to an envelope, sending out a message when it is opened.

Common uses of the technology today include smart utility or smart agriculture solutions. For example, Water-Link, based in Antwerp, Belgium, is using the technology to

connect 205,000 smart water meters in the city.

Telefónica, which invested in Sigfox in 2015, signed the company up in February to provide the LPWA component of its managed connectivity platform, with the logistics and asset tracking industries in mind.

"Sigfox offers Telefónica the possibility to reach the ultra low-cost segment of IoT solutions," says Andrés Escribano, IoT Global Connectivity Business Director at the operator.

Sigfox hounded

But like its counterparts, Telefónica also has plans to roll out the cellular-based LTE-M and NB-IoT across its markets. How much are these technologies a threat to Sigfox? Fourtet appears untroubled by projections from ABI Research that cellular module costs will continue to decrease to reach $5 and $3.50 for GSM/GPRS and NB-IoT respectively by 2026, a risk to Sigfox's low-cost USP.

He claims those modules are inherently more expensive because of the complexity required in the hardware to connect. All that a Sigfox device needs to send a signal is a transmitter, he says. The cognitive infrastructure of the network compensates for the signal's lack of accuracy in frequency and modulation.

By comparison, due to greater complexity, more hardware is required to connect to a cellular network even to transmit small pieces of information, claims Fourtet. For example, cellular modules need mixers to modulate the signals, which Sigfox units do not.

However, while Fourtet does not rule out the 3GPP operators eventually trying to aim for similar cognitive network techniques to Sigfox, he says it will take time.

If the price of physical elements goes down, Sigfox elements will also get cheaper, but from a lower starting point. Certainly at present, Krishnan of ABI says, cellular IoT modules are still above the $10 mark while non-cellular are below $5.

What about competition closer to home, within the "abandoned device" segment itself? Here the most likely rival is LoRaWAN, a communication protocol and system architecture which uses a modulation technique called LoRa, the technology's more commonly used name. "LoRa is a splendid technology but not for making a WAN within the [unlicensed] band," says Fourtet.

However, he does accept that the technology is better than Sigfox at establishing a long-range communication between two relatively simple objects. LoRa provides a symmetric link between two radio units whereas for Sigfox connectivity is from the endpoint to the base station.

In addition, while Sigfox modules may be slightly cheaper, both the endpoint and base station of LoRa are relatively inexpensive, as the same radio can be used for a receiver on the base station and the end point.

LoRa is also considered more "open" and varied. Unlike Sigfox, members of the LoRa Alliance, spanning 47 operators, can steer its development by submitting deliverables for specifications and participating in working committees.

However, Fourtet says the technology is incapable of achieving the same network capacity as Sigfox due to a higher error rate for messages, a claim supported by simulations run by University of Antwerp academic Maarten Weyn. Fourtet claims that a gateway can support only 100 devices per base station, around 100 times less than Sigfox.

Geoff Mulligan, Chairman of the LoRa Alliance, tells Mobile Europe the group has not released a formal response to the capacity question. However, he claims members have achieved better performances in tests than were indicated by research such as Weyn's. He also questions the models used in the simulations themselves, saying they do not take account of how real networks are deployed.

> "Sigfox offers can reach the ultra low-cost segment of the IoT

Regardless, there is certainly strong support for LoRa and in Sigfox's home market of France, both Orange and Bouygues Telecom are using LoRa. Arnaud Vamparys, VP Radio Access Networks and Microwaves at Orange, says the company has been achieving good progress. He says: "We have national coverage, good indoor coverage and more than 100 business customers on the LoRa network."

Orange is launching the technology alongside LTE-M, with the operator expecting to cover "almost all use cases" between the two technologies. While Vamparys would not rule out future use of Sigfox, he says Orange prefers to opt for open rather than proprietary technologies. He says he can think of no examples of a proprietary technology being able to succeed "to the same degree".

The same sentiment comes from Bouygues Telecom's IoT division Objenious, founded in 2016, which now operates 4,300 LoRa gateways in France and is trialling LTE-M.

Stephane Allaire, President of Objenious, also cites the openness of LoRa as an advantage. He adds: "Even if it was the same technology, the open one would be better. The success comes from the number of people using it."

However, Neal Forse, CEO of WND UK, which operates a Sigfox network in the UK, argues the open versus closed debate is a "red herring". He says most businesses simply want cost-effective connectivity and the proprietary nature of the technology "really doesn't enter the decision-making process".

So what is the technology's future? Escribano of Telefónica says the operator considers Sigfox a long-term technology, because no direct alternative exists under the GSMA standards "today or in the medium-term". Krishnan of ABI Research also thinks it will continue to play "a significant role in IoT".

In a sense then, the survival of Sigfox specifically may be more of a business question than a technology one. Reports have recently surfaced of financial difficulties and prominent employees exiting. A Sigfox spokesperson said in an emailed statement that "contrary to any rumours", the company was in a "strong financial situation" and "on track" to hit its financial and connection targets, albeit ones that the company does not disclose. The company plans to announce launches of the technology in up to six more countries before the end of the year.

Krishnan of ABI says reports of all not being well at Sigfox should not be ignored. Deputy CEO Xavier Drilhon left the company in March and Kirshnan thinks the departure of senior executives is a concern. However, he also believes the company has shown "positive signs" of shifting its focus from building out networks to creating a device ecosystem, which should shore up its revenue streams in the future.

It may not be connecting the most glamorous applications of the IoT, but if CSO Fourtet is right, Sigfox has the unique capabilities needed to hold onto its chosen niche even as cellular technologies increasingly muscle into the space.

Kerlink: Seizing the IoT Opportunity Requires Mastering Network Essentials

The Internet of Things presents a historic opportunity for mobile network operators, *writes Yannick Delibie, Kerlink's co-founder and CTIO, and CEO of Kerlink Inc*. But capitalising on it has its own unique challenges, in part because the IoT's structure, scale and requirements are unprecedented in telecommunication, or even the wider internet.

Enabling tens of billions of devices to talk to the cloud, and managing those untold gigabytes of data so businesses, farms, cities and government agencies can put all that information to work, introduces unique efficiencies, service improvements and connections between network operators and end-users.

We are beginning to see and hear about the variety of exciting use cases the IoT is enabling. Users of Kerlink-powered networks worldwide are reporting unprecedented opportunities to collect and use data for fleet management, asset tracking, meter reading, smart-city applications, crop monitoring and maintenance, and smart health.

But behind these stories are the less exciting but essential components of cost-effective connectivity, such as scalable and reliable networks and automated, powerful monitoring and management tools, as well as the challenge of selecting a network platform and provider.

Network operators continuously seek partners and solutions that differentiate their connectivity services, streamline their global performance, generate new revenue streams and improve customer experience. The challenge MNOs must overcome early on is choosing a partner that provides those essentials, that ensures that the seamless addition of a new, dedicated IoT network alongside an existing broadband network reduces time-to-market, enables rapid service monetisation and controls overall project return on investment.

Equally important, but less-often mentioned, are four crucial features that can ensure the operator will implement and operate low-power, wide-area connectivity that competitors may lack. These essential features are high service reliability, security access and management, backhaul management and device management.

Kerlink leverages its experience with tier-one operators around the world to show MNOs, as well as MVNOs and cable operators, how to quickly capitalise on IoT opportunities. We have helped operators quickly and successfully design, launch, manage and monetise dedicated LoRaWAN™ networks that not only allow billions of devices to phone home through the cloud, but also include enhanced services such as geolocation and remote device management. We began offering remote connectivity well before the IoT became the next big thing.

A brief history and the four essential services for telcos

Kerlink's success story, which is still in its early chapters, is a case study of engineering excellence combined with entrepreneurial vision. Founded in 2004, the company anticipated a future market for communication solutions dedicated to devices, and foresaw the role that RF communication technologies and their associated support platforms could play in fleet management, freight tracking and telemetry. It soon added solutions for wirelessly connecting gas-and-water meters and enabling remote metering. All these new low-bandwidth SIM-less M2M solutions significantly expanded the communication capability of objects, compared to traditional SIM-based technologies.

A co-founder and board member of the LoRa® Alliance, Kerlink specialises in end-to-end IoT network solutions for LoRaWAN™'s Low Power Wide Area technology and its cost-effective, energy-efficient and long-distance connectivity. The company designed the world's first commercially available product range of outdoor carrier-grade LoRaWAN™ gateways for IoT dedicated networks. Kerlink's success, including its rapid international expansion, has been an engine of growth for the implementation of LoRaWAN™, and for worldwide IoT adoption.

Leveraging this expertise and successful deployments with tier-one telcos in Europe, south Asia, South America and New Zealand, Kerlink ensures operators, as a trusted network vendor, that their LoRaWAN™ networks deliver the following four essential services, which are often overlooked.

High service reliability

A carrier-grade network requires high service reliability to ensure Service-Level Agreements (SLAs) for critical vertical applications like smart metering. These types of vertical applications and related devices have long lifetimes, in some cases more than 15 years.

The underlying network should have several components. The first is carrier-grade base stations with very high (e.g., more than 20-year) SLAs associated with mean-time-between-failures. The second is software versioning functionality to provide security alerts, manage maintenance programs, seamlessly handle network corrective measures and adapt to performance improvement over time. Finally, continuous validation to ensure hardware and software sustainability and scalability over time.

The benefits are fivefold. Operators can offer SLAs and quality of service guarantees to customers, they can guarantee network sustainability, monitor and optimise service performance, provision network services instantly and efficiently, and rapidly and easily scale IoT networks and services to speed monetisation

Security Access and Management

Operators must maximise the security of the IoT network to guarantee its performance, to maintain end-customer data privacy and to avoid fraud or unauthorised use of the infrastructure. To maximise the security of an IoT network, network architecture should include key

Yannick Delibie, Kerlink's co-founder and CTIO, and CEO of Kerlink Inc

and certificate management (including radio side keys, wireless WAN/backhauling access and encryption), secure boot functionality (including high-level authentication procedures) and secure storage (including physical protection of security assets).

This architecture needs to also offer software/hardware isolation using unique security signatures, integrity-checked firmware and hardware/software pairing to prevent unauthorised software updates. Another recommendation is to have a systematic way to avoid local access to the network by instituting highly secured maintenance procedures, factory-burned architecture, independent from the base station manufacturer, and finally trusted third-party support allowing network roaming.

The benefits for operators is the ability to ensure a carrier-grade, secure network architecture and appropriate management layers for enterprise customers, offer secure end-to-end key management processes for OEMs, equipment/device manufacturers and mobile operators, in which each player in the value chain manages its own secure key, as well as isolate the flow of date for certain critical applications.

Backhaul Management

While radio networks are commonly able to provide "best effort" quality of service, operators that can propose higher network guarantees are likely to exceed market expectations for introduction and sales of new services. A high network guarantee can be a key differentiator for new IoT applications and connected assets.

In order to provide enhanced network quality associated with backhaul management, operators should implement target Service Level Objectives (SLOs) by deploying appropriate tools to manage core performance and rapidly take action to optimise backhaul. They should also install highly secured tunnels to offer transparent and market-grade standard interfaces for application integration with very high management of latency and round-trip delay to ensure the best feasible performance.

Additionally, operators should distribute high levels of connectivity by managing all backhaul sessions available, including public land mobile networks (PLMN), private local-area networks, open public infrastructure, cloud-oriented architecture, on-premises networks and hybrid networks. Finally, operators need procedures to optimise the global cost of wireless wide-area network transfers, especially for PLMNs by using compression technology and transfer of essential data.

By doing so they can ensure high service reliability, anywhere and anytime, increase global SLAs by raising SLOs related to the radio network and targeting critical applications, and improve network performance with real-time infrastructure monitoring, troubleshooting and optimisation.

Device Management (Base Station Control)

Operators must ensure their carrier-grade network is monitored to maintain an enhanced quality of service. They should proactively address all maintenance that requires detailed technical intervention. Without a very high level of infrastructure compatibility, successful network monitoring and management are very difficult. Equally important, operators must monitor, test, diagnose and repair all software, hardware and radio network problems remotely.

In order to manage a network of this quality, operators should create a unique, secure and seamless firmware update procedure, including signed and integrity-checked firmware, provide protection against "man-in-the-middle" attacks, maintain local software profiles with operator parameters to ensure full service continuity, and check equipment integrity, hardware identity and software identity to guarantee complete control of the infrastructure.

They also need to provide highly secured remote access with authentication and encryption, as well as enable real-time monitoring of critical key performance indicators, including access, resources, radio usage, backhaul data overages, hardware/software failure, installation defaults and local technology repairs with dedicated procedural plans for remediation.

Again, the benefits are manifold. Operators can avoid all software failures for the network and have back-up plans in place, they can remotely diagnose and resolve service issues, and automate monitoring processes and reduce response time. Other advantages include determining asset/network state in real-time and running relevant optimisations, accelerating time to market and scalability, and reducing global maintenance costs through bulk and batch operational updates.

Kerlink: at the heart of LoRa®

Strategically positioned at the centre of the LoRa® ecosystem, Kerlink crystalises a strong network of partners around its IoT network solutions to both unlock the creativity for designing connected devices and trigger development of innovative applications that can improve the lives of people worldwide.

It is growing its business by establishing partnerships with MNOs and other major clients, and expanding into new markets. It established a subsidiary in Singapore to support its expansion in Asia Pacific in early 2016, launched a U.S. subsidiary in January 2017 and established an office in India in September 2017 where it partners with Tata Communications to deploy the world's largest LoRaWAN™ network.

For more information, visit www.kerlink.com, email contact@kerlink.com or follow us on Twitter @kerlink_news

Simplicity through complexity: the rewards of virtualisation are clear but getting there is another story

Maze of intrigue: the journey to true virtualisation

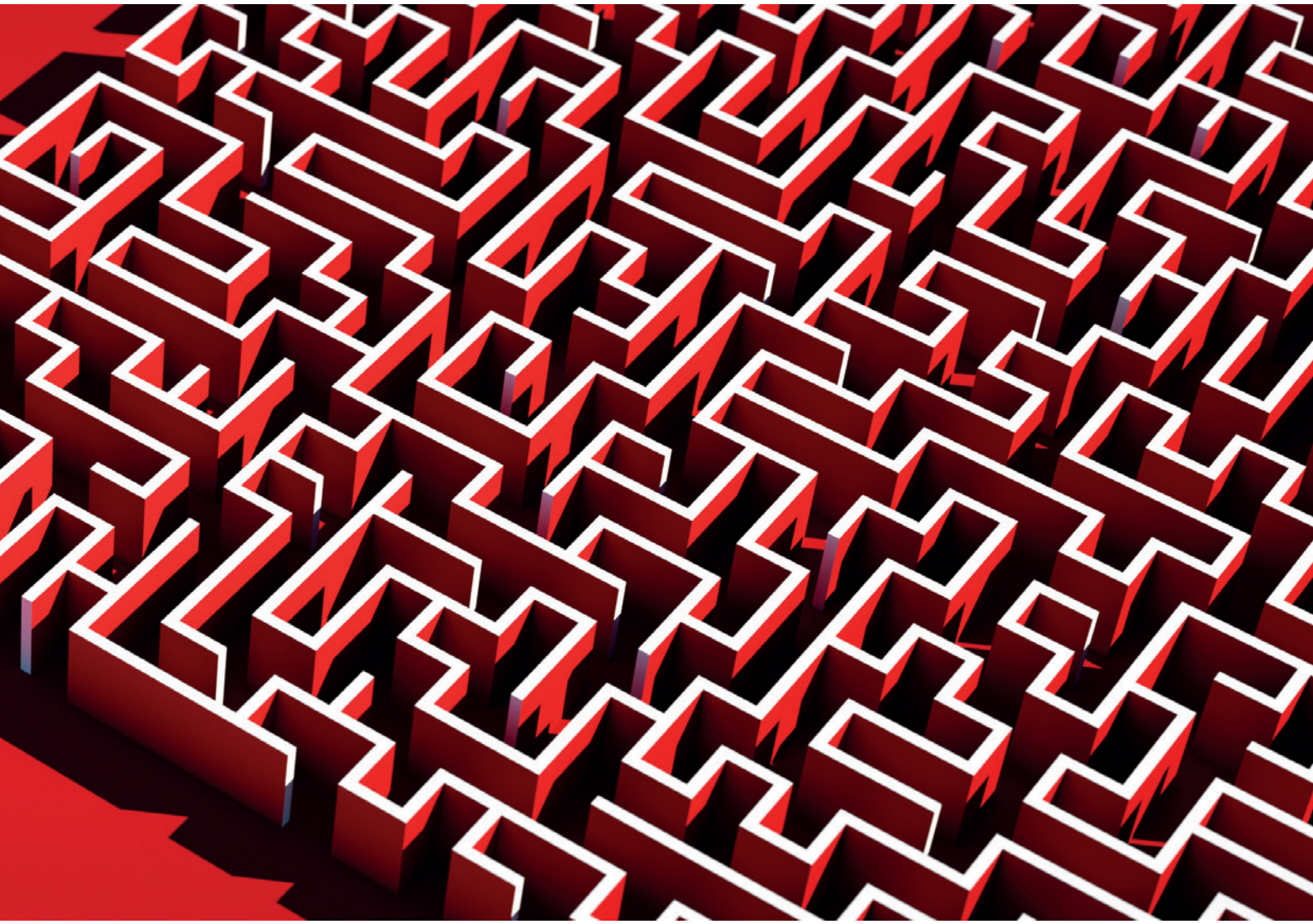
Progress is being made in virtualisation projects across Europe but are operators changing fast enough to truly take advantage? **Graeme Neill** reports

For all its promise of simplicity, sifting through the progress of virtualisation among operators is akin to an Ancient Greek trying to work out where he left the piece of thread that will get him out of this damned labyrinth. While there is no minotaur to contend with, undergoing the change that telcos are unanimously convinced must happen remains a complex, long-term project, rather than hurriedly following a pre-defined path.

The goal is cloud-native networks, where operators tap into multi-vendor ecosystems to deliver services through an automated, scalable and dynamic network at the quality subscribers expect. It is a world away from the traditional siloed vendor boxes but knowing you have to get to the labyrinth's exit is one thing; seeing the sun for the first time in an age is another.

However, daylight is starting to emerge. This year's SDN World Congress saw operators discuss concrete progress on virtualisation projects, whether it was Vodafone's OCEAN or Telefónica's UNICA, to name two of the most high profile. While the various virtualisation projects are by no means finished, or even started in earnest in some cases, operators were able to talk about tangible learning and achievements during the past year, rather than issue the bland "we are on the cusp of success" chat that can plague other technology.

Whether it's using virtual network functions from different vendors, or going down the collaborative route through partnerships such as the fast-growing open source Open Network Automation Platform, the technology is making more headway.



To give just one of countless examples, TIM is two years into its virtualisation journey, extolling the technology's benefits of delivering a "fast and scalable" fully programmable network, and automatically delivering network slices to meet specific use cases.

It's aiming to deliver a geographically distributed telco cloud infrastructure, with centralised "inner NFV" sites for service and control layer functions and distributed edge micro-sites for delivering high volume and/or low latency constraints.

To date, four sites have been deployed with 25 virtual network functions, including unspecified value-added services. Further sites will follow in 2018 with services such as virtual IMS, EPC and VoLTE.

Paolo Fasano, TIM's Network Automation Manager, says the operator is also working on a virtualised RAN, centralising the baseband and putting in a standard and homogeneous hardware environment that is in line with the rest of the NFV architecture that is being deployed.

As simple as that? "Very simple!" he laughs. "The process is at the very beginning but we have been working with a few technologies that are enabling this move.

> "In our books, a 5G network is a virtualised network

"But it's still in the initial phase of evaluating visibility, planning, distribution of the sites and so on. It's something we foresee over the next two years will be a big activity for us."

Transform and roll out

But virtualisation typifies the wider challenge facing the telecoms industry; how to change sufficiently to build for the future. The concept is valid – operators are excited about the chance to offer fit-for-purpose services that can be scaled up and rolled out efficiently and automatically as required – but change is not just a technological challenge.

Sue Rudd, Director Service Provider Analysis at Strategy Analytics, is critical of telcos. She says: "Human beings are much harder to change than technologies and complex organisations are even harder. To fully benefit from the digital transformation that virtualisation brings will take not only new IT skills and a shift to a new level of abstraction that is alien to many telecoms providers, but a cultural change and a shift in the organisation's reward systems."

Arash Ashouriha, SVP Group Technology Architecture & Innovation and Deputy CTO at Deutsche Telekom, is vocal about the need for cultural change, admitting his company is only midway through this. He says: "The challenge is threefold. One is that everything you do, you do in parallel to the existing operations. It's always difficult to mobilise an entire organisation to do this next to their day jobs. No-one was sitting around just waiting for this to come. You have to dedicate and assign resources full-time on this transformation."

The second is shifting away from the "five nines" model of near-perfect network operations tested to death to accepting that things will go wrong but the rewards are greater. Orange's Head of R&D Team Eric LeBeau demonstrates the challenge to change this way of thinking when he is asked why it is keeping its own virtualisation efforts outside of its home market. Although he notes virtualisation efforts will happen in France in earnest "very soon", he adds: "[We want] to be sure there will be no surprises. We have to be careful. At a core network level, if your VNF fails it may impact all customers."

Rudd agrees with Deutsche Telekom's Ashouriha on what is needed: "In network operations, KPIs may still be set to reward minimal failures and avoid the risk of system outages. But NFV requires real faith in unseen stochastic processes that can no longer be monitored by human beings in real time. So there is a perceived loss of control over the core job functions."

Ashouriha says the third challenge is the reinvention of the traditional vendor/operator model where, if things go wrong, "there is a clear throat to choke". He adds: "In the new world, where we have much more control and those ingredients have been put together more like a menu of food, you are the one putting all of this together. You need to take on a completely different role that a lot of people are not used to. It's easy to pay money and have someone to take blame when things go wrong."

The new model requires a sense of partnership and a clear definition of what the goals are and who is responsible for what. Ashouriha adds: "It needs to be a full partnership. We win, we lose."

> "You need to take on a completely different role that a lot of people are not used to

Perhaps unsurprisingly, vendors also politely express frustration that while the technological challenges are being increasingly solved, it's cultural shifts that are the problem. Timo Jokiaho, Head of Telco Technology Office, EMEA, at Red Hat says: "We're finding from conversations with customers that to get the full benefit of NFV, they have much to do. For example, large-scale training of their workforce on how to handle a virtual network environment.

"Some CSPs are already making changes but many are yet to address this. Change often needs to start with procurement processes, because procuring this SDN/NFV thing is different from procuring hardware boxes. And that is no mean feat."

Light at the end of the tunnel

Vendors say change will very much dominate the years ahead, with DevOps, the method of cross-functional, continuous delivery where projects never really end, very much the buzzword of the recent SDN World Congress. While it might be the latest phrase to be imported from Silicon Valley, Caroline Chappell, Principal Analyst at Analysys Mason, says there is merit following through with action, so long as operators are prepared to change accordingly. She says: "There are operators where 80 percent of their network operations staff are now software engineers. The industry is still experimenting with what DevOps means in a telco sense, though. The developers are the vendors; operators operate vendor software. So DevOps principles and ways of working need to adapt to the telco environment."

While Chappell describes the virtualisation progress of the industry as a whole as a "mixed bag", with some ploughing ahead, some standing still, and some regressing, overall she says there are signs of encouragement. Rather than a big bang, operators have been steadily building up their projects. She adds: "There is more understanding of and experimentation with cloud native VNFs and steady development of orchestration, so the market is gradually moving out of the early virtualisation phase of NFV, where software was simply forklifted out of proprietary hardware onto virtualised x86-based boxes."

Adam MacHale, Senior Director, Service Provider Architectures for Cisco Service Provider EMEA, says 5G's imminent arrival also focuses operators' attention on new kinds of networks. He says: "Ultimately, operators want to create services for any customer on a single converged infrastructure, automated and virtualised, to adapt to users' needs. Virtualisation and automation are critical to operators who want to achieve sustainable growth from 5G." Simple, as Fasano put it above.

Chappell adds: "We see the pace of NFV picking up – there are a number of functions now reaching end of life which will be replaced by virtualised versions. 5G will give virtualisation another boost – in our books, a 5G network is a virtualised network.

"There are still big challenges to overcome but many operators are realising that they can't sit around waiting for them to be resolved – the fear of being left behind if they do nothing is growing."

Something no-one wants, unless they want to feel the breath of a minotaur on the back of their neck.

I can do that Dave – telcos launch new generation of digital assistants

Mobile operators are flooding the market with Siri alternatives. Can they make an impact in an already crowded space dominated by the likes of Amazon, Apple and Google? **Kate O'Flaherty** reports

The battle of the digital assistants is ramping up as firms try to grab a slice of a market that already includes Google, Amazon, Apple and Microsoft. According to IHS Markit, the artificial intelligence (AI) enabled assistants space is on track to exceed four billion consumer devices by the end of 2017, growing to seven billion by 2020.

But it is a diverse market and split between products that focus on entertainment and the smart home, and those offering customer support. Digital assistants' capabilities also range from intelligent voice-activated services like Siri, or text-based and limited customer service bots.

Nascent services from mobile operators fit into both descriptions – those that appear to directly compete with Siri, and the assistants intended to provide customer support, reduce costs and integrate services.

One of the first operators to launch a digital assistant was Deutsche Telekom, which introduced its Tinka chatbot for customer service queries around three years ago. The company is now poised to enter the smart home with its intelligent, voice-based Magenta assistant. Other operator offerings include Telefónica's voice enabled AI Aura platform, due in 2018, and Orange's Djingo assistant, which can integrate with services in the home.

Jack Kent, Research Director, Technology, Media and Telecomunications at IHS Markit, says: "Everyone might be launching an assistant platform or service, but their purposes will be different. For example, the aim could be to sell consumer electronics, or to support a retail business."

His master's voice: Google has brought search to the home

Smart speaker services include Apple's Siri on its soon-to-launch HomePod, Amazon's Alexa, Google's Assistant, and Microsoft's Cortana. This is an increasingly crowded area and a market that is far from mature. IHS Markit says Amazon has an early lead through its Echo speaker and Alexa assistant, due to "an impressive range of skills, and device and developer partners". However, unlike Apple and Google, Amazon does not have its own mobile platform.

Of all the market offerings, Siri already has the largest reach through iPhones and iPads, Thomas Husson, Principal Analyst at Forrester says. According to Apple, it is available on 400 million devices, while Microsoft claims its Cortana assistant is being used by 148 million people. Amazon's offering pales in comparison: by the end of 2017, Forrester forecasts Amazon will sell 22 million Echo devices.

Meanwhile, with around 10 million users to date, Samsung's Bixby was created as an intelligent interface to help consumers get the best out of their devices, says Kyle Brown, Head of Technology, Content and Launch Management at Samsung Electronics. "Bixby can access Samsung's functions and features through voice, touch or text – which is unique in the market."

One of the principles of Bixby is, "the phone

Home comforts: Amazon is one of many companies looking to make digital assistants central to the home

learns you", says Brown. He explains: "You can put multiple commands into one: for example, if you say, 'I'm going to bed', it can put an alarm on, reduce blue light, and switch the lights out."

Operator assistants

For the most part, operator's digital assistants have different aims from those offered by the likes of Apple, Google and Amazon. They are more likely to work in partnership with these solutions, rather than go into direct competition with them.

However, outside of Europe, Korean firm SK Telecom's smart speaker Nugu has a similar aim to Apple's Siri. Nugu, which launched in 2017, has so far sold more than 150,000 units in the country. "Nugu is Korean language-based and uses a deep learning and natural language processing engine developed by the operator in-house," says Bengt Nordström, CEO at Northstream. "It's also available as a maps and navigation smartphone app."

Orange's Djingo, meanwhile, supports its wider ecosystem of services. According to Kent: "Orange has smart home, TV and mobile and...this can be a way for an operator to integrate across services."

Djingo is part of a wider project around an AI platform, says Luc Bretones, EVP Technocentre, Orange. As part of this, the operator is working in partnership with Deutsche Telekom on elements including the natural language recognition engine. It is with this in mind that Deutsche Telekom and Orange have merged APIs for the smart home, Bretones adds.

Orange's assistant is based on the technology Apple uses for Siri, and was developed by US company Nuance. Currently, the assistant can be accessed through a smartphone app but Bretones says Orange also wants the solution to work through a microphone in a remote control. "This will allow us to access Djingo in the living room through the TV remote and the smart speaker," he explains.

Among its aims, the operator wants to develop a platform open enough to accept third party services across verticals such as retail and music, says Bretones. "We know that 80 percent of requests through a smart speaker or AI are getting information or ordering something simple.

"Our priority is to improve the Orange experience for our own services including TV, radio, and music, and in the smart home, we want to connect the services to Djingo."

Bretones says partnering with the likes of Apple and Amazon "is possible" but Orange's focus is on getting third party speaker manufacturers on board to integrate Djingo onto their own devices.

In an increasingly competitive market, many operators' assistants are also helping to improve customer service – at least initially. For example, Deutsche Telekom's Tinka is currently a chatbot sitting on the T-Mobile Austria Website.

Paul Stuefer, Head of Digital Business, T-Mobile Austria, says the operator is looking into how it can optimise the service experience for customers and ensure 24/7 support. "We also want to reduce pressure on service agents – pushing customers to Tinka and getting more complex questions to a human assistant."

> "Eighty percent of requests through AI are getting information

Stuefer says Tinka is over-performing on the operator's estimates in terms of how many questions can be asked. "We have 60,000 users per month and over 120,000 questions being asked," he says, adding that growth accelerated at the start of this year with 15-20,000 new customers per month using the service.

Although Tinka is not able to speak yet, Stuefer says the firm is looking into the ability to build back-end solutions to 'talk' to the assistant and receive an answer via the Amazon Echo speaker.

Meanwhile, Telefónica's Aura, developed in partnership with Microsoft, has the ability to answer subscribers' questions about its products and services. But the assistant also offers entertainment recommendations and is also compatible with the Echo.

In parallel, Vodafone launched its own service Tobi in April, powered by a combination of IBM Watson and LivePerson. Tobi, a virtual customer services' agent, can handle a range of customer queries including device troubleshooting and order tracking.

Beyond the consumer

Outside the operator market, other telecoms firms are launching virtual assistants too. Amdocs has introduced a digital assistant called the Smartbot in partnership with Microsoft, which it offers to the telecoms industry.

Doron Youngerwood, Product Manager, Big Data and Artificial Intelligence, says the solution is capable of "sentiment analysis", meaning it can understand the customer's question in a detailed way. "It tracks the emotional tone of your voice; it can see if you are angry or sad. It can personalise the response – as every telco wants to reduce customer churn. If someone is angry for example, it might offer a 50 percent discount instead of 20 percent."

Mika, Nokia's digital assistant, is slightly different from other offerings. It is aimed at its 20,000 engineers troubleshooting issues on operator networks. "It's a multi-purpose intuitive knowledge assistant," says Andrew Burrell, Head of Marketing for Ultra Broadband and Analytics Services, Nokia. He says a customer has labelled the service, which targets telecoms engineers, "Siri for geeks".

Nokia is also hoping to eventually offer it as a service to operators. In addition, the firm is carrying out proof of concepts with Mika and linking it with mixed reality using a Microsoft Hololens.

The market is growing rapidly, but there are issues to be resolved, especially around the huge amounts of data being used. IHS Markit's Kent says a key challenge for providers is balancing privacy concerns with the need to capture enough data to ensure a compelling experience.

Orange says it is "very cautious" to respect the customer when using data to personalise its services, while T-Mobile says it is protecting data in line with the incoming EU update to general data protection regulation.

It is also important that mobile operators find their place in an area already dominated by well-established software giants such as Apple and Google. Forrester's Husson says in order to succeed, operators must find the right balance by not competing with digital platforms, but perhaps partnering.

But once these issues are overcome, operators can capitalise on their massive customer bases to sell more services. Husson says: "If you look at Orange in the smart home already, you could see there is a planet of services they can launch around digital entertainment," he says. "But it increases the need for massive investment."

News spotlight

Cellular to beat LPWA in agriculture IoT deployments, says Berg

Cellular technology will cement its leadership over LPWA connectivity in agricultural IoT deployments over the next four years, but will continue to lag behind traditional industry methods of connectivity, new figures claim.

According to predictions by Berg Insight, the number of wireless connections in farming will grow at a compound annual growth rate (CAGR) of 10 percent from 17 million in 2016 to reach 27.4 million in 2021. Berg said the agriculture market was currently "greatly underpenetrated" by wireless IoT solutions.

Many of the new connections will be made over cellular, which will grow from 0.8 million connections at the end of 2016, 4.7 percent of the total, to reach 3.1 million in 2021, around 11 percent of the total.

This represents a CAGR of 30.2 percent, with Berg citing machine telematics and remote monitoring via in-field sensor systems as key applications for cellular.

While growth in LPWA technologies such as NB-IoT, LTE-M, Sigfox and LoRa will outpace growth in cellular with a CAGR of 141 percent, they will still only account for 0.5 million connections or two percent of the total by 2021, growing from a figure in the thousands at the end of 2016.

At the same time, shipments of in-field sensor systems and remote control units will grow from 107,000 in 2016 at a CAGR of 43.5 percent to reach 653,000 units in 2021.

The majority of connections will continue to be powered by 802.15.4-based standards, which currently hold an 85 percent share. The category includes protocols such as Zigbee, Snap and Wireless Heart, with the former used in a cow monitoring solution offered by Delaval.

Fredrik Stalbrand, IoT Analyst at Berg Insight, said: "Leading providers are now investing in technical platforms capable of supporting integration with third-party hardware and software solutions as agricultural equipment is becoming part of broader systems."

The last 12 months have seen operators trialling cellular technology for farming projects, including Telia using NB-IoT in Norway.

MegaFon, Rostelecom moot shared 5G infrastructure

MegaFon and Rostelecom could share 5G network infrastructure as part of plans to jointly develop a 5G network, the Russian operators have announced.

The partnership will reduce the costs of rolling out next generation network technology, the telcos said. A working group will develop optimal scenarios for rolling out 5G across Russia by using the 3.4-3.6GHz and 26GHz bands. They said they wanted to devote "special attention" to identifying where spectrum could be freed up and devoted to 5G.

If the two companies agree to share network infrastructure, they will set up a joint venture to handle the project.

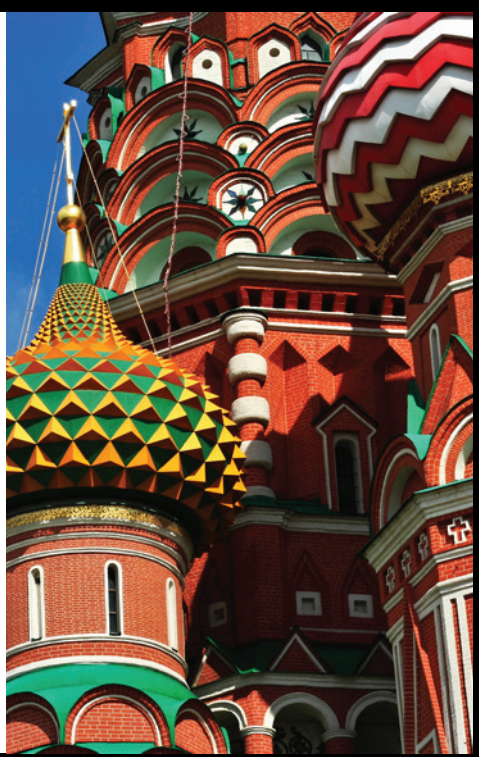
MegaFon CEO Sergey Soldatenkov said: "In the current market conditions, the most logical and cost efficient option for deployment of the new standard is cooperation between several players.

"We are already working together successfully with Rostelecom as part of the working group on Information Infrastructure under the government programme for Digital Economy and we see huge potential for further cooperation.

"I am confident that, through joint efforts, 5G can become the foundation for technological development in a number of sectors of the digital economy."

In June, MegaFon hit speeds of 35GBps in a 5G demonstration with Huawei. It is also planning to deploy 5G test zones ahead of next year's World Cup.

Rostelecom announced in November that it is planning to launch a 5G trial at Russia's State Hermitage Museum in St Petersburg in 2018.



Magyar Telekom advances NB-IoT plans with Hungary launch

Magyar Telekom is tempting enterprises to the Internet of Things by launching a new NB-IoT network in Budapest.

Working with vendor Ericsson, the Deutsche Telekom opco has upgraded its LTE network across the whole of capital Budapest to support the low energy connectivity.

Magyar did not specify when the network will be rolled out to other parts of the country but said it was seeking partnerships to tap into the technology. Enterprise division T-Systems Hungary plans to use the service to offer connectivity to businesses for smart solutions.

The establishment of the network is part of Deutsche Telekom's broader roll-out of NB-IoT. In November, the operator revealed it had introduced the technology to 300 locations across its home market of Germany. It said more than 150 companies are trialling the technology.

The operator finished rolling out the technology in the Netherlands in May and is also bringing the technology to Greece, Poland, Austria, Slovakia and Croatia.

Ericsson to launch 5G testbed in Belgium in 2018

Ericsson has set up the first 5G campus in Belgium as it aims to speed up digitalisation across the country and wider Europe.

The 5G Life Campus, which will be located at the Corda Campus technology park in Hasselt, will launch in the first quarter of 2018.

It will offer a testbed for a variety of unspecified industry players to develop new applications of the technology years ahead of its launch.

Raf Degens, Director of Corda Campus, said: "Corda Campus is a high technology campus, where more than 200 innovative companies work on new products and services every day. With Ericsson, this 5G Life Campus will provide industries a way to prepare for the future and grow faster."

Saskia Van Uffelen, Country Manager of Ericsson Belgium and Luxembourg, added: "Ericsson and Corda Campus will engage Belgian enterprises to be key players in the development of 5G, helping to speed up industrial digitalisation in the country and Europe."

In November Ericsson predicted there would be one billion 5G connections by 2023.

ERICSSON

Vodafone Romania connects oil and gas equipment with NB-IoT

Vodafone has conducted Romania's first national trial of NB-IoT, working with oil and gas provider OMV Petrom to connect wells without access to GSM coverage or fixed line internet.

The tests were carried out in labs and the field. The two companies sent information to OMV's centralised data centre through Vodafone's commercial NB-IoT network.

OMV Petrom is the largest oil and gas group across south-east Europe and generates around 64 million barrels of oil per year. Peter Zeilinger, OMV Petrom Board Member, said the company started to automate and digitalise its oil fields in 2009.

He said: "We managed to implement automation technologies at 4,200 wells, out of a total of approximately 8,100 active wells. However, for wells located in isolated areas, with no GSM coverage, data communication is a challenge."

According to Zeilinger, by 2020 over 70 percent of the company's wells will be automated and able to be monitored remotely.

Valeriu Nistor, Director Enterprise Business Unit, Vodafone Romania, said: "This is an absolute premiere for Romania, both for the telecommunications market and for other industries relevant for the national economy, such as oil and gas, which will find tremendous benefits in using this technology. More efficient costs, permanent and real-time monitoring and control of the activity in full security, and a lower impact on the environment are only several of these benefits for businesses.

"With the help of NB-IoT, we will be able to connect millions of devices with very small requirements regarding costs and power consumption."

The Wireless World

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ARMENIA

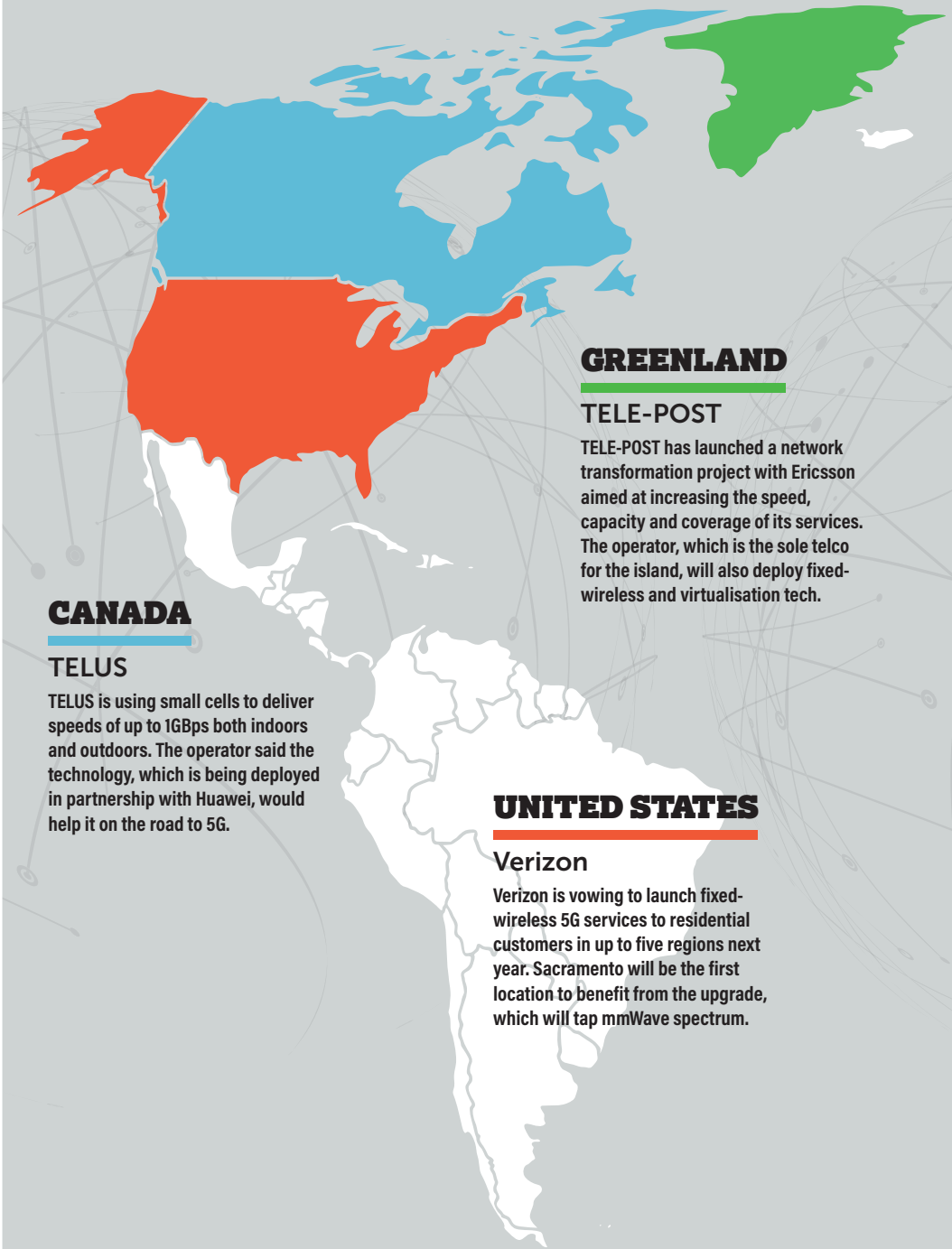
Ucom

Ucom has launched a commercial voice over LTE service, a first for the country. The former Orange opco is in the midst of a widespread network improvement project across fixed and mobile. Network testing company Ookla recently said the operator provided the country's fastest mobile network.

PUERTO RICO

AT&T and T-Mobile US

AT&T and T-Mobile US have teamed up with Project Loon, Google's experimental mobile system using hot-air balloons, to deliver connectivity to areas devastated by October's Hurricane Maria.



GREENLAND

TELE-POST

TELE-POST has launched a network transformation project with Ericsson aimed at increasing the speed, capacity and coverage of its services. The operator, which is the sole telco for the island, will also deploy fixed-wireless and virtualisation tech.

CANADA

TELUS

TELUS is using small cells to deliver speeds of up to 1GBps both indoors and outdoors. The operator said the technology, which is being deployed in partnership with Huawei, would help it on the road to 5G.

UNITED STATES

Verizon

Verizon is vowing to launch fixed-wireless 5G services to residential customers in up to five regions next year. Sacramento will be the first location to benefit from the upgrade, which will tap mmWave spectrum.

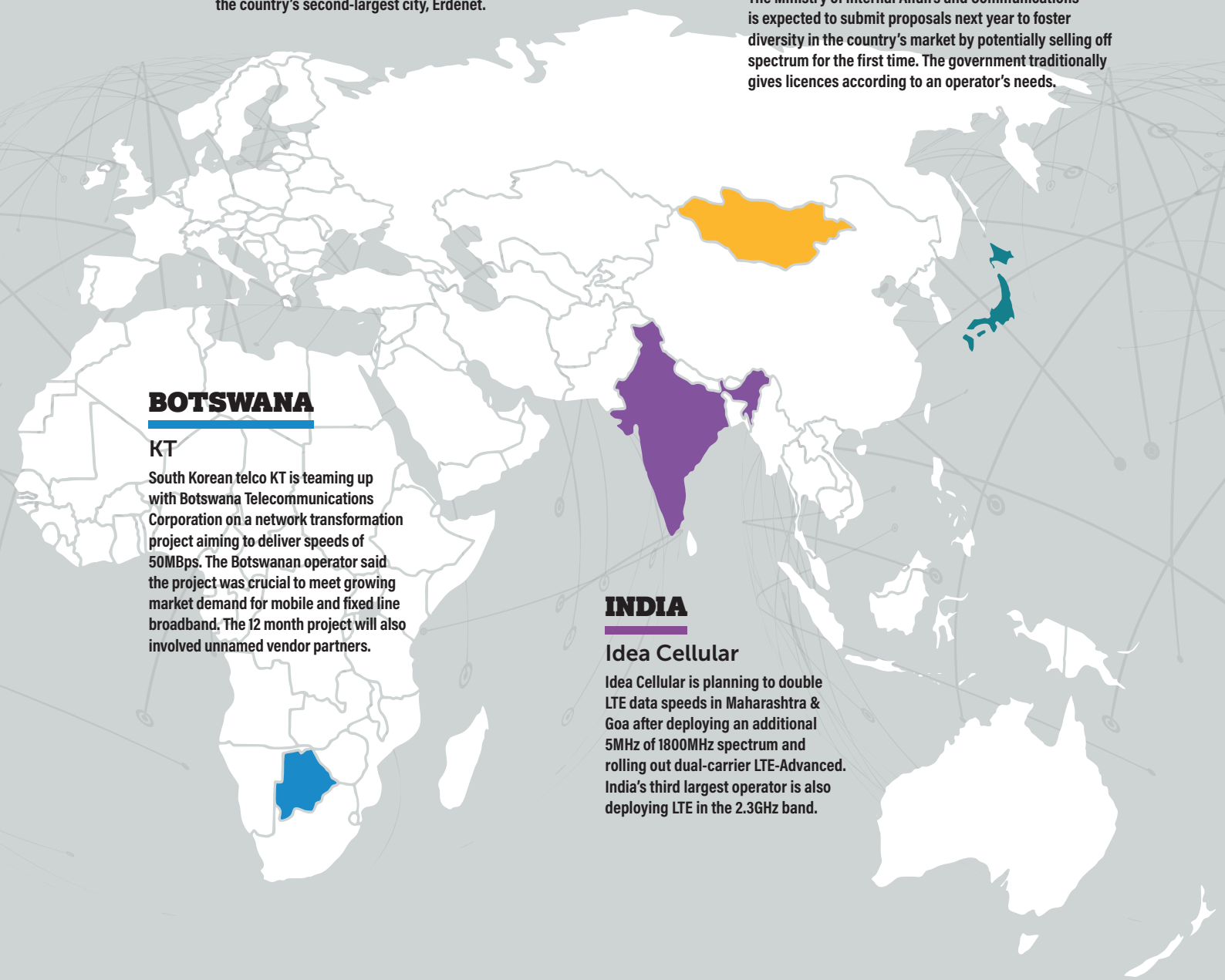
MONGOLIA

Mobicom

MobiCom has launched its first carrier aggregation network, bringing speeds of 225MBps to customers with compatible handsets. The network is available in Mongolian capital Ulaanbaatar and the country's second-largest city, Erdenet.

JAPAN

The Japanese government is looking beyond the country's traditional telco players by opening up the forthcoming 5G spectrum allocation to new companies. The Ministry of Internal Affairs and Communications is expected to submit proposals next year to foster diversity in the country's market by potentially selling off spectrum for the first time. The government traditionally gives licences according to an operator's needs.



BOTSWANA

KT

South Korean telco KT is teaming up with Botswana Telecommunications Corporation on a network transformation project aiming to deliver speeds of 50MBps. The Botswanan operator said the project was crucial to meet growing market demand for mobile and fixed line broadband. The 12 month project will also involved unnamed vendor partners.

INDIA

Idea Cellular

Idea Cellular is planning to double LTE data speeds in Maharashtra & Goa after deploying an additional 5MHz of 1800MHz spectrum and rolling out dual-carrier LTE-Advanced. India's third largest operator is also deploying LTE in the 2.3GHz band.

The Final Say

Remy Cricco, Chairman of SIMalliance

In the first of a regular feature with industry figures, Cricco discusses IoT and security

You became Chairman of the SIMalliance in September. What have been the first things in your in-tray?

As the IoT and M2M ecosystem continues to grow at a rapid rate, myriad security and logistical challenges are emerging. Explaining how these challenges can be addressed, whether it be through a UICC, embedded UICC (eUICC, also known as eSIM) or embedded secure element (eSE), is a key priority for SIMalliance and the wider SE industry.

In parallel, SIMalliance will continue to define and assess differing security requirements within 5G and advocate that use case appropriate security is built into 5G standards from the very outset.

We are also exploring emerging integrated SE solutions, which could potentially bring value to the ecosystem.

What security challenges does the increase in IoT deployments create and what can the industry do to tackle them?

The lack of IoT security is well documented. When correctly developed, implemented and distributed, eUICC solutions are uniquely positioned to deliver the advanced security required by IoT and M2M deployments.

This is because the eUICC is built on the most widely distributed and secure application delivery platform in the world, UICC, which is certifiable and specified by the GSMA. This means it retains all the security benefits of the UICC and the various SE form factors. This is coupled with the significant advantages associated with over-the-air remote provisioning and management, which offers the potential to provide security not only now, but also in the future.

In parallel, the security of cellular networks has been proven over decades. A particular feature of their success has been device and network authentication, which ensures that only authorised devices are connected.

What are the primary challenges facing the SIM industry in the new year?

Many new growth opportunities are emerging within the UICC, eUICC and embedded secure element markets, thanks to the increasing need for security in a world that is ever more connected.

However, as the industry evolves, new challenges emerge. The existing core competencies of the SE industry mean it is best placed to address the many new security and logistical issues associated with IoT and M2M deployments. For example, secure element vendors already have the established infrastructure, processes and relationships required to successfully manage the lifecycle of deployed UICCs/eUICCs.

SE vendors also have the most extensive and proven experience in providing secure operating systems for UICC/eUICC, secure subscription and data management services, remote provisioning capabilities and a comprehensive understanding of MNO requirements.

Western Europe is facing a slowdown in SIM shipments as it reaches saturation. Where should vendors seek growth in this market?

Western Europe remains a significant SIM market in terms of volumes, with 420 million units shipped in 2016. High levels of smartphone penetration and subscriber acquisition have kept shipments stable in recent years, although growth was impacted in 2016 by MNO consolidation.

Europe is a technically advanced region, and with myriad IoT and M2M use cases emerging, there is limitless growth potential for eUICCs and eSEs because there is no saturation limit. me

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