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The inside track on telecoms operators' technology strategies

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open source powers the network edge

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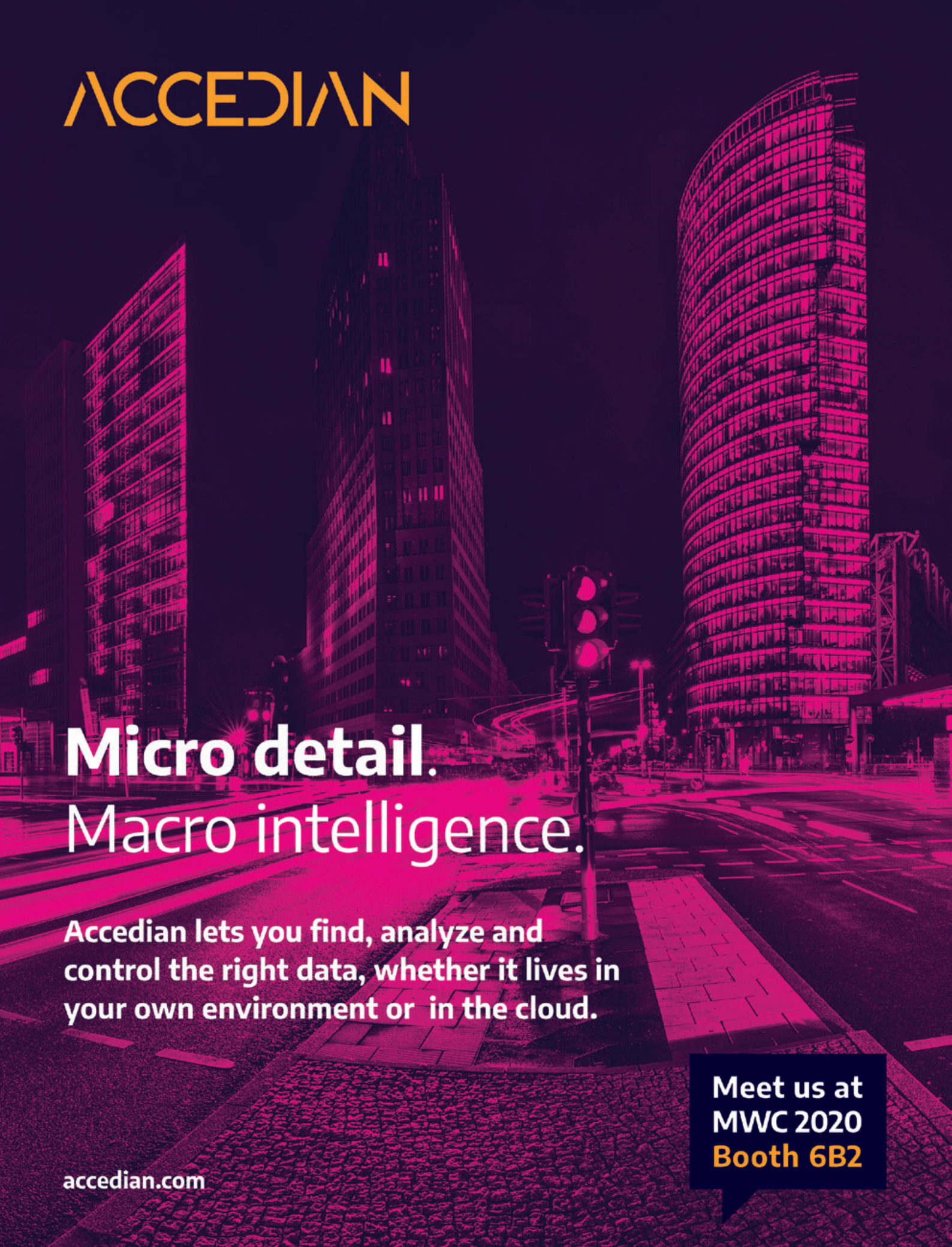
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Welcome

By any measure 2019 has been a landmark year for telecoms infrastructure. It has seen the role of CTO earning far more of the recognition it richly deserves and, most obviously, 5G deployments in the radio access network are underway all over the world, with Europe in the vanguard rather, than as was predicted by many, a regional laggard (see page 42).

5G-enabled network slicing and ultra-low latency are still two to three years away, as we wait for 5G to transform the transport and core networks, but operators are working towards that transformation, with IoT as a key driver – as we explore in this edition of the magazine.

For years, we were dazzled by the iPhone, then smartphones generally and the app ecosystems that evolved around them, but the industry and the world at large weren't much excited by the 'plumbing' that made it all possible. Now 5G and IoT are propelling infrastructure back to centre stage, where it belongs, and this has pushed fibre to the fore, too.

Fibre to the home (FTTH) shot up up the agenda for telcos and governments alike in some of Europe's biggest economies, as the importance of fibre to 5G and the critical role digital infrastructure plays in national economies was finally acknowledged. 4G (by which I mean all varieties of LTE) might have had rather less of the limelight, but nevertheless immense build-outs are ongoing, for example in Germany and the UK, and are essential contributions to the converging connectivity mesh. Nor, as our interview with Gerhard Mack, CTO of Vodafone Deutschland shows, should the longevity and performance of cable networks be underestimated (see page 10).

Two other infrastructure hallmarks of the year are firstly, the prominence of towercos, as operators strive to release the value of their assets which they believe are not accurately reflected in their share price. Secondly, various approaches to RAN-infrastructure sharing, which vary from country to country, as operators endeavour to avoid duplicating cost and infrastructure unnecessarily.

Finally, operators have accelerated the pace of disaggregation across their networks, from the RAN to the core, opening the door to new players, and perhaps trading the disadvantages of vendor lock-in that they have been resisting for years with a serious integration overhead. We will see.

Enjoy the holidays!

Annie Turner, Editor

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In the spotlight: **Benoit Hanssen** CTO, **Wind Tre**

Benoit Hanssen has been the CTO of Wind Tre since 31st December 2016. Previously he was CTO of Vodafone Hutchison Australia and prior to that he headed up the Global Managed Services operation at Ericsson. He speaks five languages fluently.

What is the biggest issue on your mind now?

As Wind and 3 merged, we needed to consolidate the infrastructure, modernise the technology and deliver synergies. All this while ensuring continuity of service for customers. This programme is moving forward successfully. The next challenge is to create opportunities by leveraging our best-in-class network, using technology to benefit our customers.

Which person has most influenced your career?

I am constantly being influenced and inspired by all the people around me. It is through discussion, debate and by observing what others do that I form my own views. And often the people that trigger the best thoughts are not the famous ones, but regular people that battle daily challenges. By having lived and worked in many countries around the world, in very different cultures, I have been influenced by a very diverse set of values, customs, backgrounds and life experiences. I consider this an incredible privilege.

You have been a disruptive force in the Italian market. How will you continue this with 5G?

For Wind Tre, the journey to 5G started as we kicked off the network consolidation. We already knew that 5G would be coming soon, so we considered it in the design for our new network and we now have the advantage that we can upgrade our network to 5G with a software update and only minor on-site works.

What's the biggest obstacle to 5G's success and how will you overcome it?

In my view there are two major challenges. First, there are electromagnetic emissions. This is a technical issue that is particular to Italy. The emissions norms in Italy are stricter than in most other European countries. Consequently today, in most urban areas, the networks are operating at the allowed limit, before considering adding the frequencies that have been specifically allocated for 5G. Technically, these challenges can be overcome by adding and re-engineering antenna sites, but this comes at a cost, and the higher emissions allowed in other countries have not so far been proved to have had any impact on human health.

Then there is the business case for 5G. This technology offers several new capabilities that will enable innovative services, including some that will truly surprise us. So 5G will, for sure, create value for companies and consumers, and open up new opportunities for businesses. However, the question for us telcos is whether we will be able to generate additional value to justify the investments. After the heydays of the late 90s and early 2000s, telcos' revenues have stabilised or slightly declined. Over-the-top companies captured the largest share of the value that mobile internet technology has created, so will it be any different for 5G?

What do you consider your greatest professional achievement?

Wind Tre has nearly completed the network consolidation and modernisation, and we can say that we have a great network. I am now positive that the company is ready to take on the future with confidence.

What do you like to do when you're not working?

Having lived and worked on all continents, and visited more than 65 countries, I have built up a large network of friends with all kinds of backgrounds. When I am not working, I like to visit them, to talk about their lives and their countries – and there are still a lot of places that I haven't visited…

What single recommendation would you make to your peer-group CTOs?

Dare to do things differently and think like an entrepreneur. The role of the CTO is no longer just to implement and operate the technology for the company. It has become much more strategic. As CTOs, we are expected to show and provide guidance for new opportunities, and we need to help our companies become more responsive. Fortunately, and/or unfortunately, there is still a lot of work to do in this space.

Wind Tre, led by Jeffrey Hedberg, describes itself as a major Italian mobile operator and among the main alternative operators in the fixed line market. It is part of the CK Hutchison group, which is Wind Tre's sole shareholder.

Vodafone Deutschland CTO: **2019 has been a landmark year**

In addition to a gruelling auction for 5G spectrum and starting the 5G build-out, Gerhard Mack is responsible for integrating the Liberty Global cable assets that his company acquired this year and doubling the speed at which fibre and 4G are being deployed. However, he still made time to talk to Annie Turner and is clearly someone who takes things in his stride.

That acquisition of Liberty Global's cable company, Unitymedia, in Germany seems like the obvious place to start. It was part of a €18.4 billion deal that also included Vodafone's acquisition of Liberty Global's cable assets in Hungary, the Czech Republic and Romania.

The deal was approved by the European Commission, after an in-depth investigation and certain remedies, in July. Nick Read, CEO, Vodafone Group, said, "With the acquisition of Liberty's assets in Germany and [Central and Eastern Europe], we have completed our transformation into Europe's leading converged operator. Not only have we reshaped our business, becoming the owner of the largest gigabit-capable, next-generation network infrastructure in the region, we are now able to play our part in realising the digital society for millions of customers."

According to the *Financial Times*, the acquisition has shifted Vodafone's centre of gravity away from its home market of the UK to Germany and "cemented the company's position as the main challenger to Europe's incumbent telecoms groups, including Deutsche Telekom."

Of course, completing the deal was only the beginning of the journey. Mack is responsible for enabling and ensuring the operational, and therefore commercial, success of the strategy in Europe's largest economy. What does he think about it? "I'm a cable guy," he says. "I was 'acquired' by Vodafone Deutschland when it bought Kabel Deutschland five years ago.

"As a cable guy, I have always been dreaming of getting all Germany's cable reunified and finally we are there, so I'm super-happy, super-excited. It's a huge push, a huge motivation, and it gives us the energy to get this integration done in a way that we really can get the best parts of both the operating processes and the best teams together, and be much stronger afterwards."

He points out that this integration is only part one of three main areas of effort, but that it is progressing "smoothly and nicely". As Vodafone Deutschland was already experienced in running a successful cable business, Mack says, "There are no borders; we understand the language of cable and what work needs to be done."

Standalone cable success

Vodafone Deutschland's cable business is a success story in its own right, supplying more than 11 million German households with speeds of 1Gbps, using the latest standard for cable DOCSIS 3.1. He states, "There is a fantastic acceptance level and it is really running much better than we expected commercially. There is huge effort going into boosting the cable nodes and segments – we've doubled capacity over where it was last year – driven by our customers' appreciation of what we offer them. By 2022, 25 million households will have gigabit speeds. We have the biggest deployment of DOCSIS 3.1 in Europe and are among the biggest in the world."

Vodafone Deutschland is deploying fibre in places where there is no cable infrastructure to offer fibre to the building (FTTB) and fibre to the home (FTTH), although about 98% of its fixed estate is cable.

Mack accepts that Germany is a laggard in terms of FTTH: when it published its annual report in March 2019, the FTTH Council Europe ranked it 29th out of the 33 European countries with a penetration rate of just 2.3%. He says there are a number of reasons for this and that

looking at fibre deployment in isolation provides a distorted view of the national communications infrastructure.

A primary factor regarding fibre roll-out is that Germany lacks the networks of ducts that are common in countries such as Spain and Portugal, where the population is concentrated in fewer centres. The vast networks of ducts in those countries' cities make it quick and easy to blow in fibre cabling. By contrast, the German population is far more spread out across the country, with a huge number of medium-sized towns and almost no dark fibre.

Therefore, building out FTTH means "a lot of digging, and that is slow and expensive," Mack notes. At the moment some 3 million to 3.5 million homes have full-fibre connectivity out of the total of 40 million, with FTTx also being deployed by Deutsche Telekom, as well as alternative providers, in areas where xDSL is not available and where there is no cable infrastructure.

Future-proof cable

Some competitors and pundits have claimed that cable will not be able to deliver the capacity needed in future. Mack's response is that DOCSIS 4.0 is due for release next year, which will enable speeds of up to 10Gbps, upstream and downstream, on cable infrastructure and, further, the more cable customers Vodafone Deutschland acquires, the deeper it brings fibre into the cable infrastructure, to the nodes where it is split, to provide the capacity where it is needed.

He remarks that this makes more sense than building out fibre and hoping that, once it is in place, people will sign up for it, especially as there is not much uptake of fibre in Germany. Even in areas where the build-out is subsidised and work doesn't begin until 40% of households have signed a contract to take the service once it is available, "You still need decent prices," Mack says. "People still tend to stick with xDSL; there is huge price sensitivity."

Vodafone Deutschland has adopted a strategy of offering gigabit fibre for the same prices as 100Mpbs, say, xDSL in promotional packages for the first year. At the end of the year, customers have the option of returning to lower speeds if they wish, but few make this choice, because once they see the value they don't want to go back.

Mack says behaviour in the German market is changing more widely, though: "Whereas once the amount of capacity customers had didn't

affect how they used it, that is not the case now. We see strong proportionality to internet speeds and once customers have the possibility they become 'addicted' to using it. This is something that is really underestimated; you really get used to it… [but] it is an access technology. You shouldn't care about the technology, but only the services to customers."

Progressing 5G

Another big landmark for Germany this year was the 5G spectrum auction, which was drawn out over many weeks, had an unprecedented number of rounds of bids and turned out to be even more expensive than feared for the operators, which between them paid €6.4 billion.

Mack said the spectrum auction was the first one he's ever been involved with and that it was one of the most painful episodes of his career. He also remarked wryly that at the end of it, all parties were in almost exactly the same position as they'd been in two weeks after the bidding started, except for collectively spending €6 billion more.

He is proud that Vodafone was the first to launch 5G services in Germany, but believes it is different from other European markets in that consumers are generally conservative and slow to try out new technologies. The operator has deployed Massive MIMO in Berlin and other cities, and has used 5G to provide fixed wireless access in some rural areas that were not served by any other broadband infrastructure.

On the other hand, Mack says, "Industry is much more aggressive and ready try out new things, and of course we have experience in providing services to that customer base." Crucially, it is mostly looking to monetise 5G by helping this customer based digitalise, which is often referred to as Industrie 4.0.

Vodafone Deutschland is involved in about 150 pilots across different sectors, including smart cities, with each one requiring infrastructure with different parameters for different purposes. However, Mack does not seem unduly concerned that some large industrial groups have been allowed to apply for spectrum by the regulator, so that they can build their own private networks.

He notes that one of the biggest motivations for these large enterprises is the belief that they will save money, but he thinks they have massively underestimated the difficulty involved in building and running a network, and the complexity of 5G in particular – plus this regulatory policy has meant operators lost out on some spectrum, which is a scarce resource.

Also, scale is important in a number of ways. The capital costs of building the network are dwarfed by the total cost of ownership across its lifecycle, and this is far more economically viable at scale. At the time of writing, the German industrial group Bosch had just announced it has been awarded spectrum to build its own networks at some locations.

Mack comments, "This is fine for one factory, but a group such as Bosch has hundreds of them, as well as offices and other locations. You

need scale, you need availability 24/7 and reliability at 99.99," which is business as usual for a telco. Also, an operator can provide a secure hybrid private-public network that looks after issues of data privacy and more, and there is less risk involved in being part of a much bigger, telco-standard operation.

5G's attributes and opportunities

Mack says, "We love 5G because it brings us all sorts of potential applications due to its low latency," but is not fixated on autonomous vehicles and network slicing. Besides providing 5G to connect people, industries, machines, cars and even drones, one of the biggest opportunities Vodafone Deutschland sees is around sports – and soccer is a very big deal in Germany.

The operator is running a pilot with the Deutscher Fussball-Bund (DFL – the German Football Association) and the Bundesliga (German Premier League) club VfL Wolfsburg, so that spectators at the football ground can use their smartphones to access augmented reality content in real time. This could be information about a particular player displayed on screen while they have the ball or different angles of a penalty shot – the possibilities are endless. Mack says, "This shows that 5G is also a huge game-changer for things you couldn't have imagined just a couple of years ago – we will be launching the service commercially right across the Germany premier league."

4G is still happening

4G/LTE might grab the headlines less than 5G, but it is a critical part of national infrastructure. Mack says that for mobile as well as fibre, "We have shifted gear and doubled the speed of rollout." He acknowledges that in the case of LTE there are certain coverage obligations, but emphasises this is only one driver, adding, "There is huge coverage and capacity demand."

Vodafone Deutschland completed 1,300 LTE site deployments in the first 100 days of 2019, adding 720 new LTE stations nationwide in the last quarter and installing an additional 700 antennas at existing sites. This connected more than 400,000 Germans to the LTE network for the first time. It also improved the speed and capacity for a further 3 million people.

The operator states that by September this year it had coverage of 95% of the country: the goal is to bring a new LTE antenna online every three hours by the end of the year. In 2019, more than 5,500 construction projects have been finished in order to get rid of dead spots and increase LTE's capacity and surfing speeds on the Vodafone network.

Currently, Vodafone reaches more than 80 million Germans with its LTE network, which equates to about 95.8% of the population, and Vodafone technicians have closed LTE dead spots on a total area of 12,000 square kilometres.

It seems that if 2019 was a landmark year for Vodafone Deutschland, 2020 is going to prove pretty special too.

Red Hat: Open Innovation and 5G empower industries at the Network Edge with Hybrid Cloud

2019 saw a glut of 5G launches globally, with operators targeting consumers with the ultrafast speeds next-generation technology promises. 4G transformed how we use mobile devices and powered the smartphone boom that started in the latter end of the 3G era. While 5G promises to build upon that success, Red Hat maintains it is the enterprise sector where the possibilities of high speed and low latency at the edge of the network will drive use cases that we are only just beginning to contemplate. Smart cities, autonomous vehicles, smart energy, intelligent financial services are a few examples of how 5G have the potential to change the way society operates in the same way LTE changed what consumers could do with their phones.

What unites this disparate group of use cases is the sheer volume of data they will generate and the complexity of processing it. In their search for efficiencies and desire for new applications, companies will want to process these huge amounts of data at very low latencies. Edge computing promises to satisfy those demands.

Darrell Jordan-Smith is vice president for Vertical Industries and Global Accounts at Red Hat and says 5G, coupled with edge computing, will enable these applications and efficiencies at an unprecedented level. The company has broadened its verticalised business approach from telecommunications and financial services, which generate a large amount of the company's revenue, to areas spanning automotive, energy, healthcare, manufacturing and retail.

The new use cases in each industry reveal the transformative nature of 5G. The energy sector will be able to use 5G to change how it operates, make itself more efficient, and bring new solutions to consumers. Jordan-Smith explains: "Take oil fields as an example, it's about how you connect sensors to predict a leak or even a faulty machine. When

pumping the oil out of the ground, a machine that isn't working could be costing a business tens of thousands of dollars per hour".

Preventative maintenance extends to other areas including the mining sector, where the massive trucks transferring materials from a mine could block roadways if they break down. 5G and edge computing will offer faster communication speeds, enabling companies to have real-time data not only to check vehicles are not being overloaded but also to inform them of how their fleets are performing. Elsewhere, wellbores can stretch to thousands of feet below ground level. Edge computing brings computation and data processing much closer to where it is needed, enabling significantly improved response times.

Predictive maintenance will also be critical to the manufacturers of the future, with edge computing processing data transmitted from the assembly line or elsewhere on the factory floor in real time. 5G and edge computing will underpin further innovations in Industry 4.0 as factories take increasing advantage of automation, whether its connected logistics, assembly and/or product handling. Edge computing coupled with AI/ML can proactively discover and solve problems before they occur. Jordan-Smith says: "In Europe today, for example, corporations and factories in particular, are starting to buy 5G technologies and provide fibre links into the core network in order to provide access to low latency, high speed wireless capabilities."

Automotive is another exciting area, with vehicles evolving towards a data centre on four wheels, building upon the self-driving and self-parking capabilities the likes of Tesla offer today. Ambulances will also be transformed by 5G and edge computing, with remote diagnoses through in-vehicle scans and real-time video helping paramedics provide a greater level of treatment while a patient is on their way to hospital and administering optimal treatment upon arrival - saving valuable minutes and costs.

Gaming is emerging as a popular edge use case, reducing latency and ensuring satisfaction levels for participants. Various forms of AI have been in use in games for decades - for example, "virtual adversaries generated by the game itself are powered by AI, and provide a superior gaming experience for human participants."

Edge computing also contributes to security, by reducing the need for data to travel across the network to various cloud providers and data center resources. "As a result, more is accomplished close to the device and user, which reduces the overall attack vector."

Within airports, edge computing will further transform security. Facial recognition software is already in place in many airports, speeding up the security process more than fingerprint systems. But Jordan-Smith says with consumer opt-ins, airport operators could take advantage of a lot more passenger data. He says: "[Within a security context] you can look at detailed facial features in 3D, such as which direction the eyes are looking, or the unique gait and stride of an individual. You could provide enhanced services outside of that capability." An example of this could be wider airport logistics, with 5G providing real-time tracking of every vehicle operating across an airport, delivering fuel and labour efficiencies.

"But in order to do that, the compute and storage of that information has to be super-low latency, almost real time. A lot of that compute will have to happen in the actual building itself and only the necessary information will be transported back to the main data centre at very high speeds where a database may interrogate a particular facial feature."

Transforming security even extends to the military. In May 2019, Red Hat announced it was working with Lockheed Martin to deploy its agile

and adaptive open source architecture so the jet manufacturer could deploy new capabilities to its F22 jets much faster.

Jordan-Smith says: "The 'warplane' could download applications using Red Hat OpenShift in real time to run them in the aircraft, mirroring a certain set of circumstances the jet is experiencing in the battlefield. It can determine if certain threats are imminent within a specific battlefield environment providing the pilot with realtime mission critical options and directing the attention accordingly."

He adds: "In very many different industries the edge will have a considerable impact on how people and businesses will interact with the network. We're putting intelligence closer to the edge of the network and we're providing services with very low latencies at the edge of the network in order to facilitate those capabilities and those interactions."

Red Hat is already preparing for the opportunities these verticals will bring by building what it calls "verticalized selling units", specialising in a market that has the greatest opportunity. For example, its automotive unit in Europe has expanded into North America. Europe also boasts a manufacturing and energy selling unit, while North America has established ones for healthcare and retail. Red Hat's ability to talk the language of a customer means it can quickly establish their pain points and discuss how the edge can transform their businesses in different ways.

Edge of tomorrow

In October 2019, graphics chip manufacturer NVIDIA announced it was using Red Hat OpenShift Container Platform, an enterprise Kubernetes platform that manages multi-cloud and hybrid cloud deployments, on its EGX edge computing platform. Red Hat OpenShift plays a crucial role in NVIDIA's Aerial 5G software developer kit, enabling the likes of artificial intelligence and machine learning, smart cities and smart factories through managing and automating the chip manufacturer's 5G radio access network.

Jordan-Smith says: "[NVIDIA's] developers as well as their clients can write applications that run on NVIDIA microprocessing technology. These field-programmable gate arrays and GPUs are being sold to car manufacturers, retail companies as well as oil and gas companies.

"You can easily see how OpenShift can be used by NVIDIA as the main platform that brings an operating system to the microprocessing technology but also the tools to develop some of those applications that will run at the edge of the network."

Red Hat is now part of IBM after its $34 billion acquisition was completed in July 2019. Jordan-Smith identifies the edge as Red Hat's focus, armed with the additional clout of IBM and giving it greater resources to further target verticals He says: "We're going to invest our energy and resources into defining the edge opportunity at Red Hat. And we [IBM and Red Hat] are making some significant investments in this area because the edge really is the hybrid cloud environment that companies are gravitating towards".

"In terms of hyperscale, a lot of the hyperscalers are driving to the edge of the network as is IBM. This is going to be a big area for the company and you will see thought leadership on this topic at Mobile World Congress in Barcelona [in 2020]."

Additionally, Red Hat is seeking to drive continued network transformation by enabling operators to target customers of their own with 5G solutions. Red Hat OpenShift Container Platform will play a critical role in handling 5G workloads at the edge. Jordan-Smith says: "5G's underlying architecture is all built on containers. It neatly fits into our OpenShift technology and all the work and innovation we are doing around that. Open source communities are engaging and embracing our contributions that make low latency use cases a reality."

The hybrid journey

By offering hybrid cloud at the network edge, Red Hat aims to merge its telco and enterprise opportunities, not only driving success at the service providers who will deploy and run these open clouds, but also the companies who will ultimately build and use the applications.

The telco and enterprise industries are at the start of what Red Hat's Jordan-Smith describes as a five-step journey. The first step is evolving network architecture using Network Functions Virtualisation (NFV) towards the Kubernetes open source platform that automates container operations. Red Hat is one of the largest deployers of the cloud computing platform OpenStack for telcos, with more than 150 NFV deployments globally. Jordan-Smith says: "This puts us in a great position to start positioning containers with existing customers as we evolve the NFV journey to Kubernetes."

However, Jordan-Smith stresses that Red Hat OpenShift Container Platform isn't just Kubernetes; it offers a full developer environment, allowing enterprises to transform their methods of application development. This is Phase Two; enabling companies to do continuous integration and continuous delivery (CI/CD) and DevOps. Jordan-Smith explains: "A lot of the conversations with telcos, banks and other enterprises is actually helping them shift from a traditional waterfall developer environment to an agile developer environment using OpenShift capabilities and reshaping and remodelling existing applications to become cloud-native. Red Hat wants to provide the best possible developer experience that can be deployed over a microservices environment that is able to run not just in a multi-cloud but a hybrid cloud."

The third phase is where intelligence can be provided at the edge of the network, by developing AI, the Internet of Things and integration platforms. Jordan-Smith says this is an evolution of the Tesla use case described above, where a car is effectively a datacenter on wheels with the ability to self-drive and self-park. As artificial intelligence evolves, these features will only become richer and not just within vehicles. Improving customer experience and providing a whole new dimension to product differentiation for the automobile industry.

Jordan-Smith describes Phase Four, deploying automated operations with integrated AI, as a huge opportunity. He says: "Managing all of the networking and all of the routing capabilities is going to take place across a massive network with the number of connected devices in the billions. You can certainly see the huge growth potential with sensors and the AI and telemetry data that will be connected "

The final stage of this journey is supporting intelligent edge services, delivering different use cases for different verticals. Bringing the discussion back to one of Red Hat's core businesses, Jordan-Smith says banking is an example of where 5G could identify and deliver consumer opportunities in future. For example, instead of sending a threatening letter to a bank customer who does not pay their mortgage on time, a bank could use analytics to tailor a conversation with that customer, creating an opportunity to sell a new, more relevant product and developing a higher level of customer satisfaction which in turn delivers more revenue to the bank.

This focus on innovative new use cases across a wide range of diverse verticals is a pivot away from Red Hat's historic identity as a horizontal platform player. Jordan-Smith says the company is best placed to take advantage of the appetite for open source. He says: "From a market perspective we are pushing at a set of open doors in an area where there are high levels of innovation and where there is a high level of interest and intrigue in terms of what is possible And that really ignites what the market calls the fourth industrial revolution.

"For Industry 4.0, Red Hat is right at the centre and well positioned to be able to facilitate a lot of that innovation with an extensive ecosystem and considerable developer capabilities, all built and based on open source principles."

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IoT
Insight report

20 Annual readership survey
The results showed that Industry 4.0 is your biggest priority, overtaking last year's top choice, smart cities. Operators' views on a number of issues differed from those of other respondents, too

28 IoT in Industry 4.0
A look at this hot sector and how operators are addressing it in their determination to move up the value chain

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As vehicles move towards being a service and part of an ecosystem, we look at the tensions between different parties and factors that will influence the balance of power

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A quick guide to developments in familiar technologies such as NB-IoT, LoRAWAN and Wi-Fi plus some emerging challengers

38 Smart cities
As ever, operators eye smart cities as a great opportunity, so what's holding up progress?

Survey finds industrial IoT is top of mind for operators

This autumn we carried out our annual survey on IoT and found some big shifts in priorities since last year. The biggest single change was the rise of industrial IoT, somewhat to the cost of smart cities, and we also found our operator and non-operator respondents had considerably different views and priorities in a number of key areas.

We had 105 respondents, 39% of whom were from network operators (all numbers are rounded) and 23% were from equipment vendors, while 38% chose the 'other' category, which included analysts, consultants, systems integrators, regulators, water managers and public sector executives, including people working in the healthcare sector.

We began by asking respondents to list what they see as the three biggest opportunities for IoT. Although the same three sectors came top in responses from the operators and the non-operators, the order and degree of emphasis varied sharply.

For the non-operators, smart cities were top at 63%, with Industry 4.0 at 44%, followed by with connected cars at 41%. The operators chose Industry 4.0 and eHealth as joint top opportunities at 51%, followed by smart cities scoring 46% – almost 20% less than the non-operators – and connected and automated vehicles at 44%. Answers in the 'other' category included agriculture, smart grid, water management and private networks for smaller as well as large companies – see below.

A comparison with last year's thinking by all respondents reveals a shift: at the end of 2018 smart cities were a clear winner with a score of 79% and smart factories had only 33% of the vote, in sixth place. Two reasons that industrial IoT has shot up operators' agendas are 5G deployments began in 2019 and private networks have proliferated (see article on page 28).

Biggest challenges for operators

Next we asked respondents to tell us what they think the single biggest challenge operators are facing in IoT now. Both operators (32%) and non-operators (30%) identified business models as being the greatest hurdle. In last year's survey, too, business models took the top slot, followed at a distance by cybersecurity, which seems to indicate an overall lack of progress – or perhaps confidence – on both fronts.

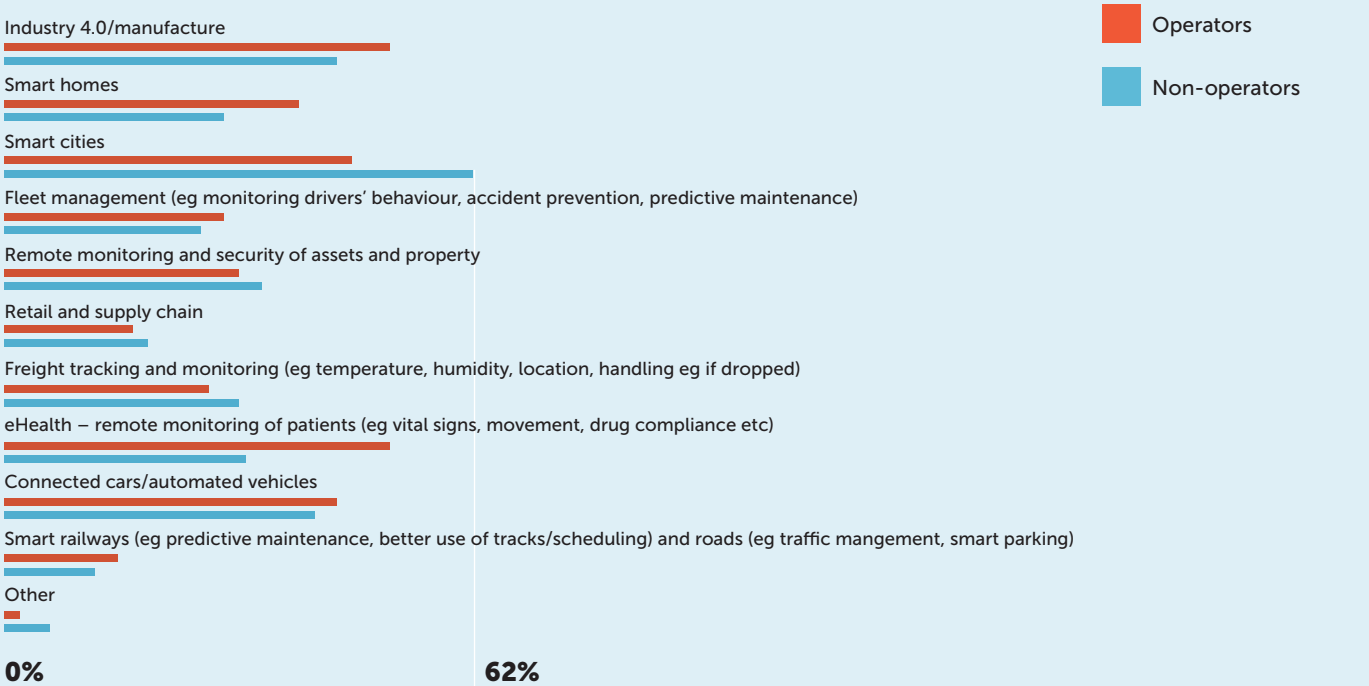
However, this year the operator-only responses put cybersecurity in a tied fourth place with lack of company strategy (both 12%), hence it seems the operators are more confident in their ability to secure IoT than the overall market is. As one respondent noted, "Customer perception of security risk" is also a concern in itself, in the same way that people's fear of crime is often disproportionate

> "Two reasons industrial IoT has shot up operators' agendas is 5G deployments began in 2019 and private networks have proliferated

Biggest security risks

We probed a bit deeper, asking what is the biggest security risk for IoT? Operator and non-operator respondents chose the same top three, but the order and emphasis was, again, markedly different. The non-operators'

Which specific use cases do you see as most important?



biggest concern was the failure to implement security by design (that is as an inherent component) with 31%, while for operators, this was a distant third at 20%, way behind there being too many potential attack vectors as IoT proliferates (32%) and the lack of cooperation in the IoT ecosystem (27%). In other words, they have faith in the security of what they control directly.

The non-operators put the failure to implement security by design as their second biggest worry (28%) and the lack of cooperation in the IoT ecosystem as a distant third with 11%.

LoRaWAN in the middle

Which IoT communications technology will be the most prominent at the end of 2019 in Europe was next. Non-operators put LoRaWAN in second place (27%), above LTE-M with 23%, but greatly lagging NB-IoT at 41%.

Not surprisingly perhaps, and as a reflection of the cellular technologies they deal with, operators put NB-IoT top with 56%, more than double the next nearest, LTE-M with 27%, with LoRaWAN down at 15% and Sigfox a very distant fourth at 2%.

LTE-M's time is coming

We asked which IoT technology would dominate in Europe by the end of 2025. The operators reckon it will be LTE-M (44%), followed by NB-IoT with 37% and LoRaWAN at 12%. Hence the biggest change they foresee here is LTE-M overtaking NB-IoT.

> **"Clearly the operators still see [LoRaWAN] as having a significant presence in what will be a very much bigger market**

While LoRaWAN has lost 3% of its market share from answers to our survey in 2018, clearly the operators still see the technology as having a significant presence in what will be a very much bigger market. IoT Analytics reckons there are 8 billion connected devices as 2019 draws to a close, which it predicts will rise to 13.5 billion by 2020 and 21.5 billion by 2025.

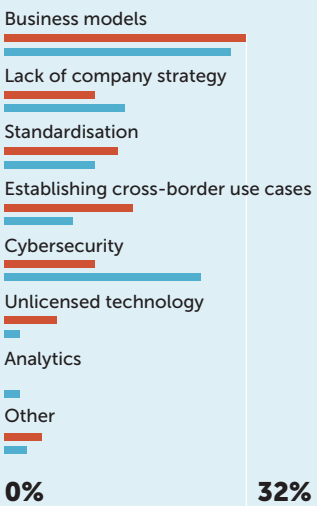
The non-operators view of the IoT world in 2025 is the NB-IoT will still be top dog with 45%, followed by LTE-M at 25% and LoRaWAN at 17%.

Other responses included that 5G will lead by 2025, 6G will be a force to be reckoned with by then and that IoT-connected satellites will have made their presence felt. We think that the unique attributes of 5G – the powerful combination of network slicing and ultra-low latency – will only be needed by certain sectors, such as autonomous vehicles (and most of them are likely to be in industry, such as in factories and mines), connected cars (where safer driving technology will have a growing presence, such as detecting when a driver is distracted), gaming (which could be a big money spinner for operators) and sports coverage (which will change beyond recognition in the next decade).

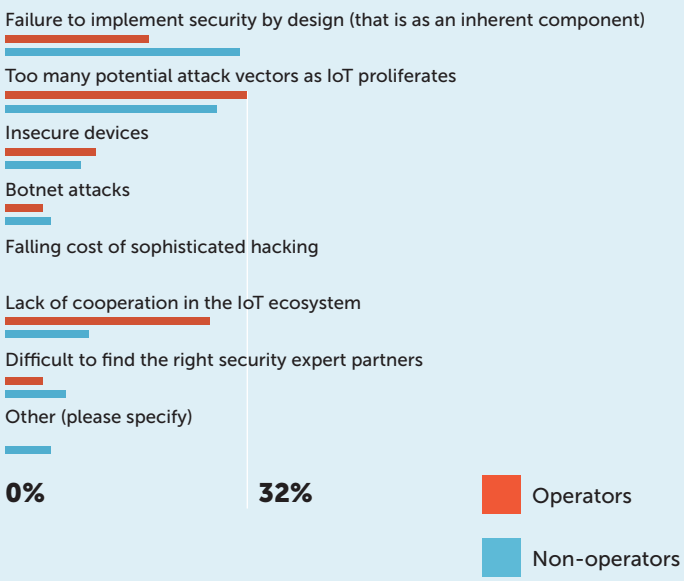
Is IoT a priority?

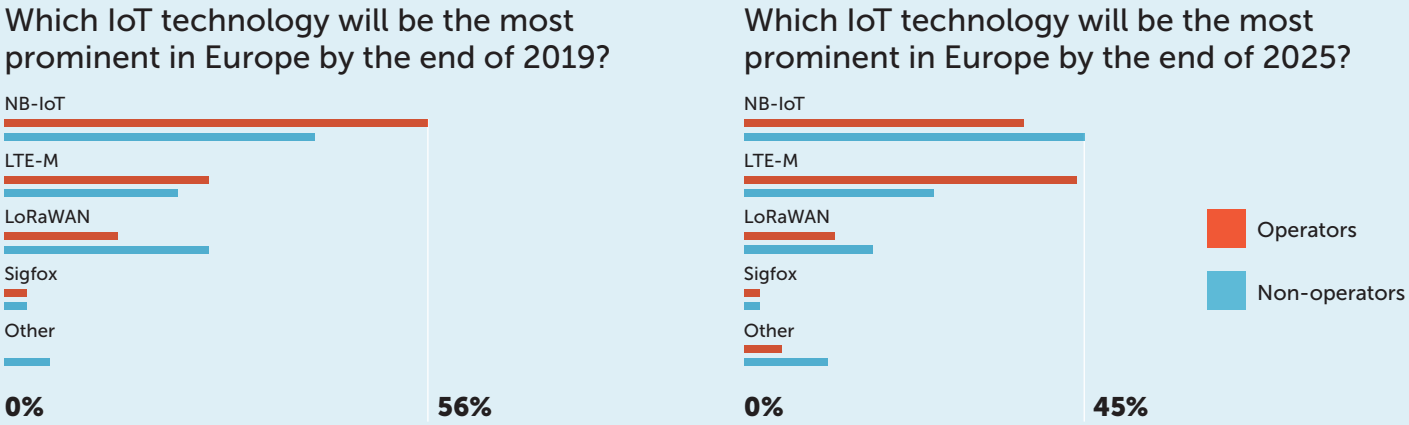
Four-fifths or 80% of operators said IoT is either essential or important to their company, while for non-operators this was 68%. In both

What is the single biggest challenge facing operators in IoT today?



What is the biggest security risk in IoT?





cases, most said it was 'important' rather than 'critical'. Eight per cent of the non-operators said that IoT was not a focus at all.

Biggest impact in 2020?

We asked which technology would have the biggest impact on IoT next year? Just over half (52%) of the non-operators said 5G, which dropped to 39% for the operators, perhaps reflecting those at the sharp end being more realistic in terms of rollout, waiting for standards to be finalised, pending spectrum auctions and other challenges. Also, as mentioned above, 5G is not needed for the deployment of IoT in many sectors to progress.

For the non-operators, data analytics was a distant second with 14%, as it was for the operators with 17%. Cloud and eSIM tied for third place for operators and the non-operators.

The biggest difference was that 7% of operators believe blockchain would have the biggest impact next year, while only 1.5% of the others think so.

Overhyped, least impact

Like last year, blockchain topped the listings for the technology that is most overhyped and will have the least impact with 42% across all respondents. While it was down from 47% last year, the business case for its use in IoT is clearly not there yet, although many operators are running pilots, including Swisscom, which is working with Deutsche Börse on the settlement of securities transactions.

Lorenzo Solazzo, Technology Analyst at GlobalData, commented, "The implementation of blockchain will support telcos' digital services transformation to a more competitive, agile and customer-centric service provider. Key areas in which blockchain can help telcos transform include roaming fraud management, wholesale fees settlement, mobile money payments and IoT management."

Juniper Research suggests that using blockchain and IoT tracking technology to track food from farms to grocery store shelves will 'revolutionize' the food industry, reducing retailers' costs by streamlining supply chains and simplifying regulatory compliance, which could reduce food fraud by $131 billion in five years.

> "So blockchain isn't going away, it's just in that nadir between overexcitement and pragmatic solutions. Most technologies go through this trough

IBM recently conducted a survey among IT industry professionals to find out how promising they find blockchain technology for IoT: one interesting finding was that blockchain could be used to adjust the level of control over the device – strengthening it in the face of increased risk, such as hacking, to defend the data exchange system. IBM has also just patented a blockchain solution to prevent anonymous theft of packages by hacked drones.

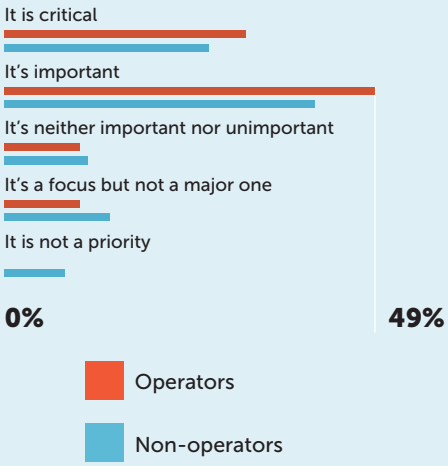
So blockchain isn't going away, it's just in that nadir between overexcitement and pragmatic solutions. Most technologies go through this trough, when we're all bored with talking about something and want mainstream action. We never seem to learn that the time lag is almost always greater than we bargained for initially.

5G and IoT – short term

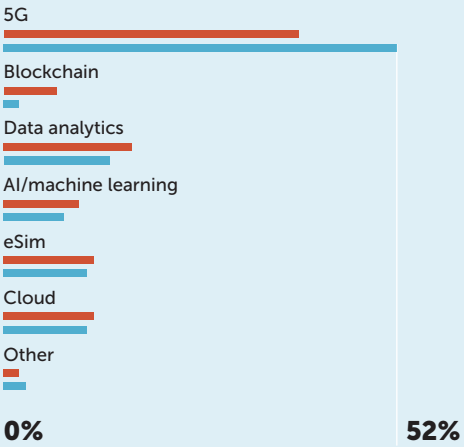
The biggest difference in answers between the two groups when we asked what 5G will bring to IoT by the end of next year was that 29% of operators thought it would give them greater ability to target enterprises, putting it in a close fifth place after low latency for specific applications at 34% and network slicing at 32%, with new use cases and new operator business models tied for first place (39%).

On the other hand, non-operators were less convinced regarding operators being better able to target enterprises, placing it in joint last place with new operator business models at 19%. Like their operator counterparts, non-operators put new use cases in first place but tied with network slicing.

How much of a priority is IoT to the future of your company?



Which technology will have the most impact on IoT within the coming year?



The high ranking of network slicing by both groups is somewhat surprising, given that 5G-powered network slicing is unlikely to hit the mainstream before 2023 according to analysts, vendors and operators we have spoken to recently.

5G and IoT – mid term

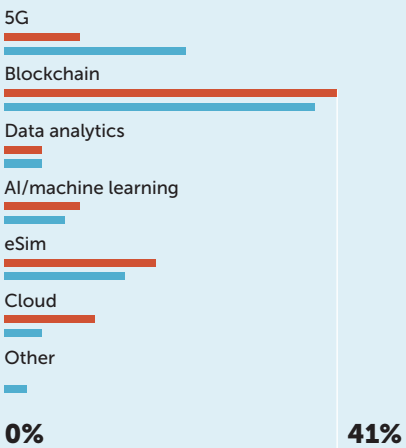
The non-operators were more optimistic about new business models for operators by 2025, putting it in first place (41%) when asked what 5G will bring to operators by then, although operators having greater ability to target enterprises still languished second to last, only beating the response that 5G's role in IoT is overhyped (11%) – very close to the 10% of operators thought that 5G's role in IoT would be overhyped in 2025.

At 46%, the operators promoted low latency for specific models to the top slot for what 5G will bring to IoT by 2025, with new business models close behind (44%).

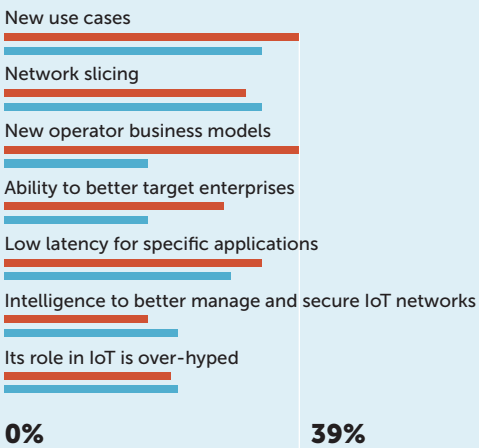
Which vendor?

We asked which vendor is most impressive in the IoT market. Huawei came top in both, but with the biggest lead among operators. The greatest discrepancy in perceptions was over ARM, with operators putting it last, albeit joint last with Gemalto, with 5%, while it came second for the non-operators with 22%. This is probably because operators buy products and solutions from vendors, not components to build them: chip maker ARM claims its processor designs are in more than 150 billion chips, from sensors to supercomputers and it works in an ecosystem of more than 1,000 technology partners.

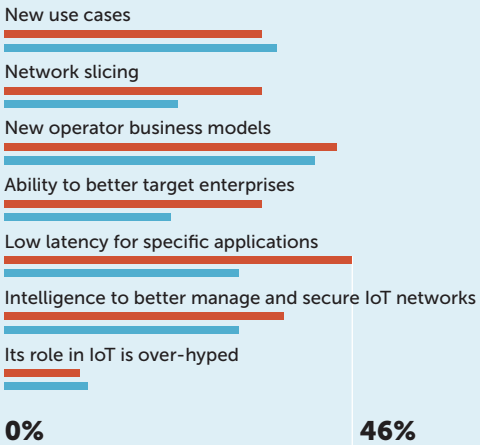
Which technology will have the least impact on IoT/is over-hyped?



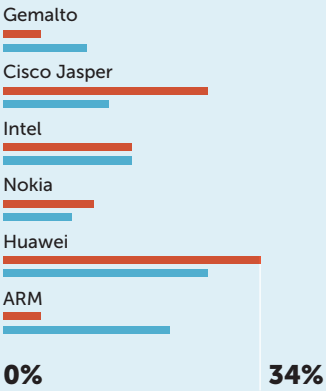
What will 5G bring to IoT by the end of 2020?



What will 5G bring to IoT by the end of 2025?



Which vendor is most impressive in IoT?



The fact that operators put Cisco Jasper in second place (27%), whereas it had the third lowest placing (14%) among the non-operators is also likely to be down to the respondents' situation in the supply and deployment chain, and similarly the results for Gemalto.

Which European operator leads?

Among operators, Vodafone was chosen by 46%, light years ahead of Deutsche Telekom in second place with 20% of the vote. The results were similar among the non-operators, although DT gained more votes with (30%).

Vodafone has the advantages of first mover, but the IoT market is still in its infancy in terms of both scope and scale, so wide open.

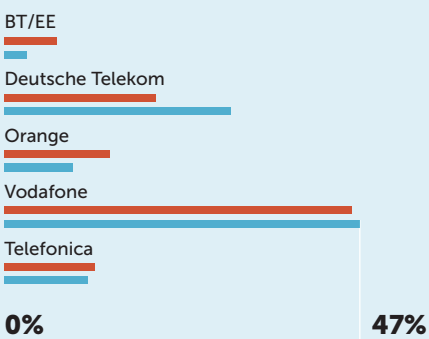
What should the operator's role be?

Among the non-operators, 47% said provider of connectivity, with end-to-end solutions provider at 39%. The operators see things very differently, though, reversing the order to put end-to-end solutions provider top of the tree with 71% and 20% saying connectivity. This tells you everything you need to know about the operators' ambitions and how others see them.

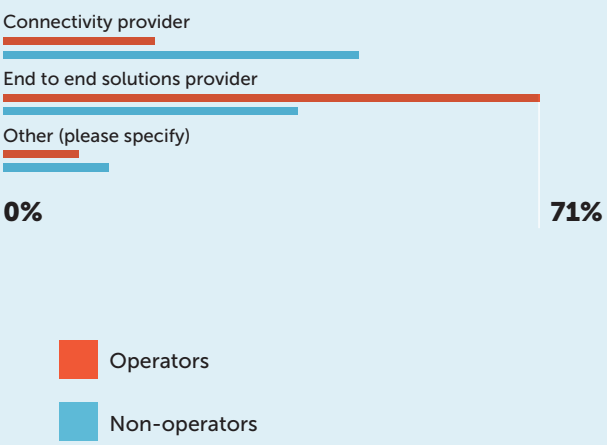
In addition to the very many challenges operators face with IoT and the coming era of 5G, how they are perceived could prove to be among the most serious. As one respondent said, "It should be end-to-end, but they don't have the DNA."

On the other hand, many respondents made additional comments suggesting that the path to success lies with platform-based models, and being effective and easy to work with as part of ecosystems, along with services integration.

Which European operator is leading in IoT?



What should the operators' role in IoT be?



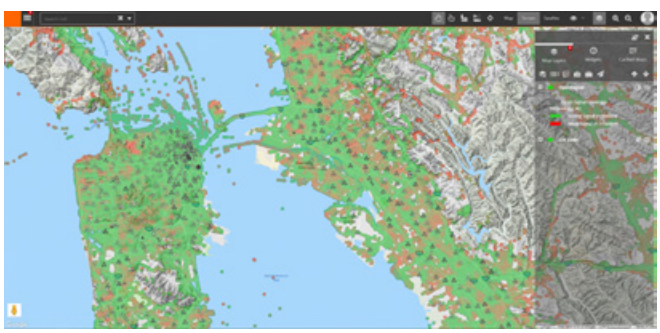
3 tips for delivering a step change in 5G NR rollouts

As 5G gradually takes hold throughout the industry, service providers are increasingly exploring how to leverage key enabling technologies – such as vRAN, SDN, NFV, IoT, AI/ML, MEC, network slicing, blockchain and quantum cryptography – to realize its full business value.

Indeed, while the core 5G network architecture is set to continue its evolution in the coming years based on some of these technologies, the immediate challenge and choke point facing service providers is more fundamental, albeit perhaps more mundane: how to deploy 5G New Radio (NR) and the related infrastructure quickly, with high quality and as cost-effectively as possible.

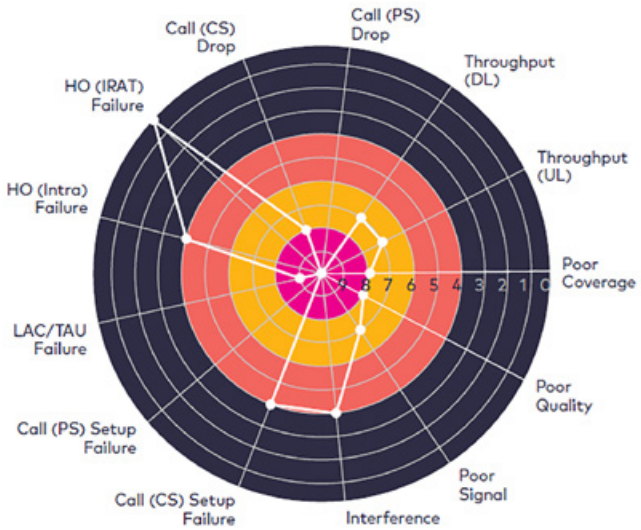
With 4 to 5 million radio access network (RAN) sites across the world today, service providers need to update many of these in the coming years with 5G capabilities. A significant number of new sites, in many cases small cells, will be deployed as part of delivering higher 5G speeds using mmWave. Additionally, new service models that leverage 5G capabilities, such as CBRS/shared spectrum and private networks, will drive additional demands for broader RAN footprints. Finally, with 5G accelerating the move to multi-vendor, modular and open technology RAN networks, there will be increased complexity in planning, design, integration, commissioning, acceptance, verification and optimization.

Since the scope of the 5G NR rollout challenge is massive, traditional approaches will be far too slow to be up to the task. Moreover, the scalability of these approaches is severely limited and overall, they're simply not economically viable.



To meet the market windows and timelines for 5G service launches, service providers globally will therefore need to rethink the approaches they take to rolling out their networks, while ensuring that the organizations and suppliers performing these tasks have the expertise, processes and tools to operationalize new RAN sites twice as fast as before, at a lower cost and more efficiently. Three main capabilities form the basis for being able to drive this level of step change in RAN deployment, duration and efficiency.

The first area of required expertise is the breadth of cross-equipment-vendor/technology skills and best practices necessary to support high-quality deployment, commissioning and optimization of heterogenous RAN infrastructure. This will be increasingly important given the coexistence of multiple technologies and the need to support parallel networks during a time of transition. Discrepancy management for automatic detection and mitigation of issues across multiple vendor



technologies will be required, and solutions that enable rule creation and template management for multiple carriers, bands, hardware configurations, layer management and different network topologies will be required to ensure timely and high-quality deployments.

The second critical capability is having the right analytics tools and processes to ensure accurate, data-driven decision-making for network planning, design and optimization. A holistic solution approach that utilizes customer geo-located data, network KPIs and other related metrics minimizes operating and capital expenditure, will improve network performance and provide an enhanced customer experience. These solutions address challenges around the co-existence of 5G NR and LTE, along with the introduction of active antenna systems, which in turn introduce beam forming and beam steering to significantly increase network capacity, while ensuring a seamless network experience.

Big data analytics and visualization capabilities that simplify the viewing of multiple complex data sets can significantly enhance the efficiency and effectiveness of 5G RAN deployment and operations activities. Flexible web platforms allow operators to consolidate data sources and tool outputs into a single, efficient source of data visualization and drilldown, with configuration, KPIs, sales data, retail, events and demographics, as well as operator custom data in a single map and dashboard view.

The final competence is around infusing software-driven automation into as many aspects as possible of the 5G rollout lifecycle. It starts with ensuring use of software tools for end-to-end project orchestration for planning, building and modernizing the network. Then, multi-organization tracking systems enable operators to ensure graded visibility across the team (technicians, engineers, managers, executives); eliminate unnecessary paperwork (e.g. spreadsheets, email stops); provide timely notifications and reminders to avoid missing SLA obligations; and have guided processes that lead to error-free execution of deployment steps. These systems streamline the planning and project management process by combining automated technical design with dynamic project plan generation using reusable building blocks.

Some companies such as Amdocs, have already acquired such skills and know-how, proving themselves in the market by delivering vastly improved and superior results in RAN deployment activities. For example, they've been devising innovative ways to leverage numerous automation tools during the integration and commissioning phases to speed up the deployment process and eliminate the need for multiple specialist field technicians to be on-site. They have also created mobile and web-based applications that enable trained personnel to rapidly validate the site, verify performance, conduct pre-/post-checks and ensure that a new carrier or technology is seamlessly integrated into the network, alarm free. Meanwhile, automated reports enable service providers to turn on new sites faster by using go/no-go dashboards for validation and to check whether there are any KPIs gating the launch of one or more sites.

The transition to 5G is challenging service providers to simplify and accelerate network deployments, which demands a new approach for RAN infrastructure buildout. Service providers need to adopt cross-equipment-vendor/technology, analytics-driven, and automated solutions for planning, design, integration, acceptance and optimization in order to ensure their 5G deployments are fast, efficient and scalable.

For information about Amdocs portfolio of solutions and services to help you accelerate your rollout of 5G, download Amdocs 5G FAST catalog.

Or contact Parag Shah at open5G@amdocs.com.

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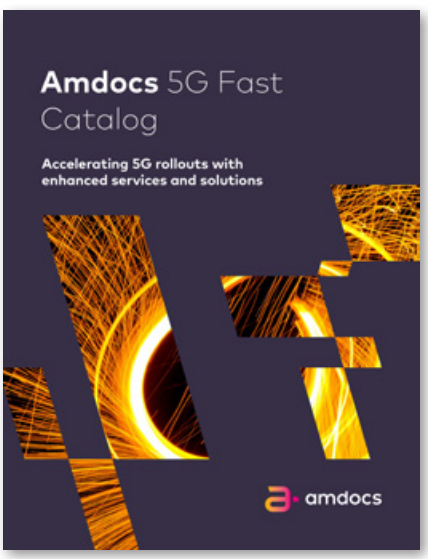


amdocs

A crucial year for Industry 4.0 in Europe kickstarts a new era

Industry 4.0 – or if you prefer, smart factories or Industrial IoT (IIoT) – came out as the most important IoT sector for network operators in our IoT survey this year (see page 20), overtaking smart cities. According to BIS Research, Europe is likely to have led the global IIoT market in 2019 and is expected to maintain its dominance until the end of the company's forecast period, 2024.

Of the world's ten smartest factories, identified by the World Economic Forum in September 2018, five are in Europe, four in China and one in the US. Europe's apparent lead is particularly encouraging given that Capgemini's Digital Transformation Institute predicts that smart factories could add as much as $1.5 trillion to the overall output of the industrial sector in the next five years.

BIS estimates the global Industrial IoT market was worth $75.60 billion in 2019 and it predicts it will have a compound annual growth rate of 8.67% between 2019 and 2024, driven by the high demand for IIoT applications in smart industries; the use of cloud computing for large-scale IIoT solutions; lower sensor costs; and innovative sensor technology.

Moving up the value chain

GlobalData notes that European operators are shifting towards services, software and devices to ramp up their IoT portfolio and ascend the IoT value chain to remain competitive and find new revenues.

"Growth [of all IoT] in the region is driven primarily by the software and services segment while connectivity revenues will remain relatively low over 2018-2023, making up circa 11% of the IoT service revenue opportunity," said Sergej Gavrilov, Telecoms Market Data and Intelligence Analyst at GlobalData.

Given that operators are banking on the enterprise sector as one of their main strategic sources of growth by moving up the value chain, this is good news.

Gavrilov continued, "To drive IoT revenues,

telcos in Europe have been expanding their enterprise portfolio by offering more end-to-end solutions by striking new partnerships or expanding existing ones." For instance, Deutsche Telekom expanded its partnership with SAP in 2018 to include IoT solutions for real-time logistics.

The power of platforms

Operators are also moving from B2B models to B2B2X, where X could be other businesses, local, regional or national government departments and agencies, or consumers. Here a good illustration is the Russian operator MTS, which, in 2017, launched an IoT platform with open APIs that is sufficiently flexible to accommodate various IoT technologies and approaches.

AT&T, Orange, Vodafone, Deutsche Telekom, Verizon and Telefónica, among others, have built their own platforms and all kinds of experimentation is going on with the big three 'As' for IIoT – analytics, artificial intelligence and automation. An interesting indication of things to come is Deutsche Telekom's memorandum of understanding (MoU) for a partnership between its T-Labs division and UK start-up Fetch.AI.

Their plan is to research, build and deploy what they call "autonomous economic agents" on the Fetch.AI test network to investigate how such agents can be built into IoT devices. This is to provide the devices with the authority and autonomy to be self-organising without needing human intervention. T-Labs and Fetch.AI said they want to remove "the roadblocks [to] a seamless machine-to-machine [M2M] economy".

Extending footprints

Gavrilov said, "Going further, telcos could consider offering one-stop-shop IoT solutions on a national or global scale, as well as being proactive in identifying and building new use cases for industry verticals."

In fact, there's plenty of evidence this is underway already. In June, AT&T, KPN, Orange and Swisscom activated LTE-M roaming across North America and Europe to enable low-power IoT devices to operate efficiently on multiple networks in those territories. Carolien Nijhuis, Director IoT at KPN, explained, "Roaming with LTE-M has been one of the most requested features by our customers in the market."

Then in October, Vodafone Business and América Móvil announced a partnership designed to make it easier for customers to connect IoT devices globally, and Vodafone has a similar partnership with China Mobile.

Not waiting for 5G

Vendors, too, are increasingly relying on ecosystems to address the IIoT market. For example, Nokia has teamed up with Telefónica, Microsoft for cloud, Komatsu for industrial support and EY and DXC for systems integration.

Houman Modarres, Marketing Leader – Webscale and Hyperscale Enterprises at Nokia, said, "Seventy per cent of enterprises are now investing in industrial IoT [according to PwC] – that's way up from last year. The big problem was that there are two groups within these enterprises. There's the operational technology groups and the classic information technology groups and they were siloed. Recent numbers [from 451 Research] show almost half [49%] are working much closer together."

At a briefing in Paris in early December, Ramon Fernandez, Deputy Chief Executive Officer and Chief Financial Officer at Orange, pointed out that the 5G enterprise market will be many times bigger than the consumer market, unlike the generations of mobile that have gone before, although clearly serious progress is being made without it.

The rise of private networks

This includes the rapid rise of private LTE networks, the market for which Global Market Insights reckons will be worth more than $19 billion by 2026. Nokia alone has built 120 of them in the last year.

Modarres commented, "Asset-intensive industries are really the second wave of digital transformation and you don't need 5G for many of those applications. We are addressing them today. We're doubling down on our investment, because we're seeing an increasing number of these applications across a range of industries."

However, how the private networks market, for IIoT and elsewhere, will unfold remains to be seen. Opinions are sharply divided in terms of cost, their deployment and the role – or not – of operators.

For example, speaking at the *Private Networks in a 5G World* event in London in December, Johan Krebbers, IT CTO and VP, TaCIT Architecture at Shell, described building a private network as "the last resort" largely on the grounds of cost.

Others, such as Bosch in Germany, plan to build their own 5G network, with one of its motivations being to reduce costs.

Security and scale

Keeping data on the premises is another reason given for private networks, but a counter argument is that operators' networks are highly secure, more so than enterprise IT, plus a private segment of a public network benefits from economies of scale, security, ongoing innovation and much else.

2019 has been a year when edge computing has been hugely hyped, but some question how many ultra-low latency applications are there to merit the change in architecture? It seems for the moment at least there is a logical argument for why industry needs it rather than a proven business case. Also, would a network slice be more pragmatic solution than a mini core network on site?

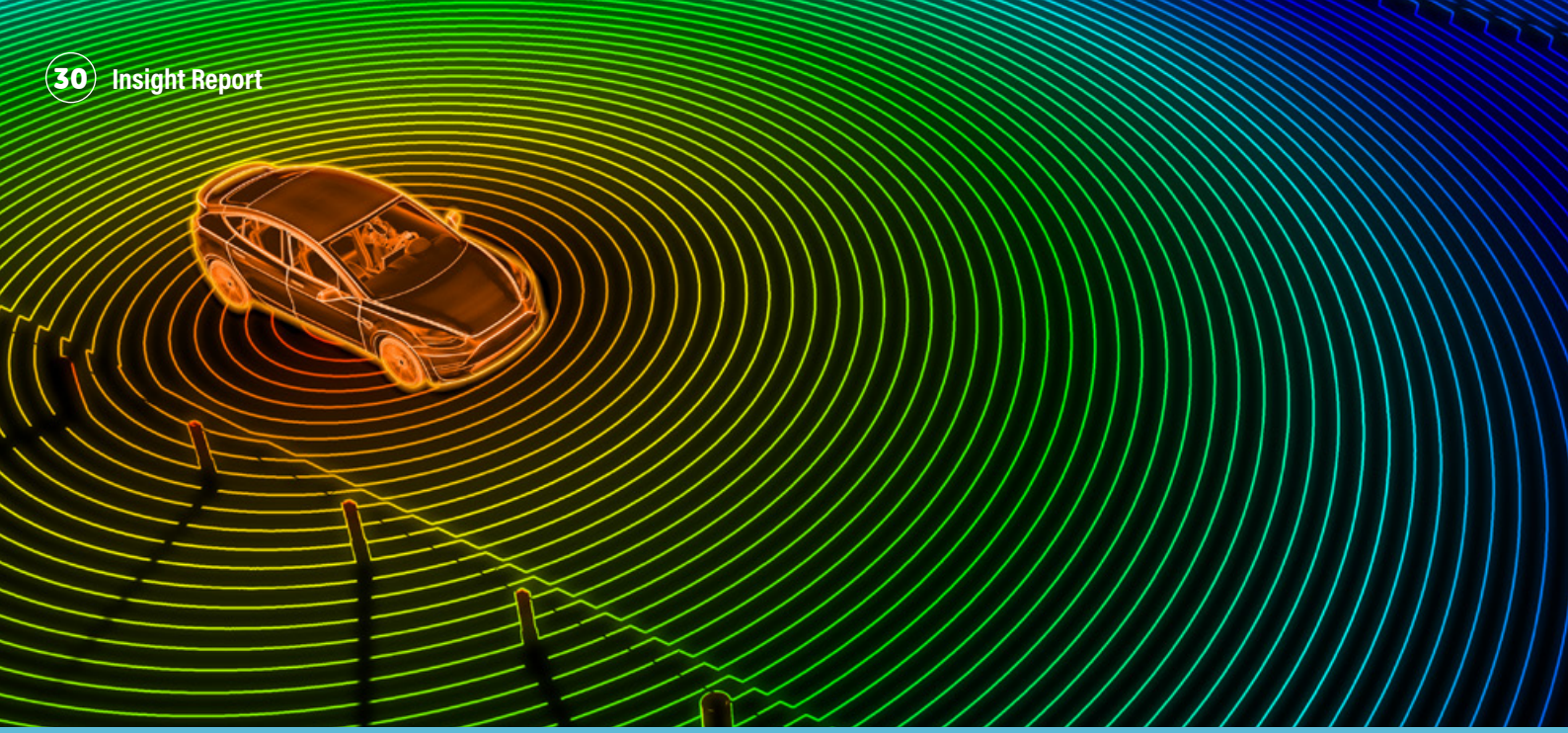
In addition to cost, as Gerhard Mack spells on in his interview (page 12), a great deal of knowhow is required, although it is expected that this will change, such as with the use of some hardware on site combined with cloud.

As with connected cars, operators are likely to face fierce competition from, as well as partnering with, systems integrators as most lack the IT integration skills that will be necessary. However, some operators anticipated this and have taken steps to address the situation: for instance, the role of IT integration in business to business services was highlighted in Orange's new five-year strategy in early December, with IoT as one of its main targets.

Fernandez pointed out that in 2014 IT business accounted for 25% of Orange Business Services' revenues. Now it is close to 40% and will be 55% by 2023.

There is no doubt that as the scope of IIoT is so wide and different enterprises have different needs and priorities, there is not going to be a uniform approach but we are likely to see this market grow rapidly in the coming months.

Modarres concluded, "We're as excited about 5G as anyone else, but we're taking the pragmatic and necessary position of taking our partners and customers from what they have now to what comes next. We believe those who invest in this technology and do their initial use cases will be in a much better position to leverage the new 5G applications and build on top than otherwise."



Connected cars – watch out for the bumps

Connected cars are a great example of the importance of ecosystems as no single party can provide all the components, but one of an ecosystem's critical attributes is that it is interoperable. This underpins another crucial characteristic – that it can be easily scaled. However, with so many vested interests and parties who are accustomed to being in charge of their own destiny, the journey to connected and autonomous cars is never going to be smooth ride.

The 5G Automotive Association (5GAA) was set up in September 2016 by eight founding members: Audi, BMW Group, Daimler, Ericsson, Huawei, Intel, Nokia and Qualcomm. At the time of writing, membership had increased to 133 organisations.

5GAA's CTO, Maxime Flament, explained that its goal is to bring together two industries that formerly had little contact – telecoms and automotive – and in terms of standardisation, the creation of the association was timely. He said, "For the first time in the 4G/5G standardisation process there was some clear activity to address vertical sectors' needs, including automotive."

The first phase of the cellular vehicle to everything (C-V2X) standard was finalised by 3GPP in June 2017. It's based on LTE technology, but is designed to be fully compatible with 5G when it is available and to protect investments in C-V2X infrastructure in the meantime.

The standard supports two complementary transmission nodes:

- short-range communications between vehicles, between vehicles and infrastructure, and between vehicles and other road users, such as cyclists and pedestrians. In this mode, and somewhat confusingly given the name, C-V2X works independently of the cellular networks. In the longer term, it could support automatic actions, such as braking.
- network communications, in which C-V2X employs the conventional mobile network to enable a vehicle to receive information about road conditions and traffic in the area.

Political interference

However, that standard looked like it would be undermined earlier this year when Europe's Transport Commissioner, Violeta Bulc, tried to bulldoze Wi-Fi through as a kind of interim legal standard for connected cars by arguing that Wi-Fi was readily available and would help reduce the 25,000 deaths that happen annually on the continent's roads.

Wi-Fi (more specifically 802.11p) was also the option preferred by some big car manufacturers, including Volkswagen and Renault, as well as chip-maker NXP, Autotalks (which specialises in connected vehicle tech) and intelligent transport solutions provider, Kapsch TrafficCom.

However, other vehicle makers (like Audi, BMW, Daimler, Ford and Groupe PSA) and technology companies such as Ericsson, Huawei, Intel, Qualcomm and Samsung

strongly opposed her proposal. Operators, such as Vodafone and Deutsche Telekom, were also against it individually and through trade organisations, including the GMSA, the European Telecommunications Network Operators' Association (ETNO) and 5GAA.

Opponents of the proposed Act argued that a technology-agnostic approach would enable the evolution to 5G when the time is right and, in the meantime, allow the use of 4G/LTE for connected vehicles. They said if Wi-Fi was mandated, coverage could be poor and patchy, and Europe would risk falling further behind the rest of the world in deploying connected/automated vehicles and their economic, environmental and safety benefits. They also pointed out that the US had rejected this solution in favour of C-V2X. In the event, the legislation was thrown out by the EU member states in July.

Commercial complications

However, the US abandoning 802.11p as a solution for connected and ultimately autonomous cars, for which the 5.9GHz spectrum had been earmarked, could have negative consequences. The American regulator, the Federal Communications Commission (FCC), has recently looked again at this spectrum and wants to give part of it over to Wi-Fi.

Flament commented, "For us [spectrum allocation] is fine at the moment because you can still do the basic safety with LTE on that small band, but if we look at longer term, we are shooting ourselves in the foot and we need to reserve it for future applications."

He is also concerned that where spectrum is severely limited the short-range portion could be turned into a commercial service, with only those who can afford to pay being able to use it, rather than everyone having access to it on an unlicensed band for the common good of safe roads and efficient traffic.

This is particularly pertinent considering that the 5GAA is not only focused on private vehicles, but also trucks, buses and ambulances having access to this connectivity. These are usually fleet vehicles and are not yet represented directly in the 5GAA, but, said Flament, "Through the vehicle manufacturers we talk about them and their needs. The fleets tend to have years of experience in terms of connectivity, but usually they don't rely on a single standard, whereas C-V2X offers is a standard that fits many different purposes."

Car crash?

As readers understand only too well, most of Europe's network providers are under pressure – they have heavy debts yet need to invest massively in 5G, and fibre and 4G roll-out, while developing new business and operational models. But the car makers are under pressure, too. Perhaps surprisingly, according to Flament the pressure to embed 4G/5G technologies in their vehicles is mainly being driven by consumer demand, not regulation, at the same time that the automotive sector is also being put to the test at the moment in terms of how it offers its products.

He explained that what was a standalone, physical product is being turned into a service, saying, "We see there are four trends relevant here. The first is the sharing economy that is not [about] owning a vehicle, but accessing a service. The second one is electrification, which simplifies the car so it can be built more easily and requires much less maintenance. Then there is connectivity, and that's the core of our contribution, but it cannot be separated from the other trends, and the last one is the automation."

> "We can provide a variety of mobile network-level information into the data lake and analytics capabilities Microsoft has

Platform-based solutions

This transition begs some big questions for network operators and car makers alike about the balance of power and their roles in the emerging ecosystems as intermediaries and alliances are formed to handle the complexity, using platform-based business and operational models.

For example, in November, Tata Communications announced it intended to combine its IoT connectivity and network intelligence capabilities for connected cars —MOVE — with those of the Microsoft Connected Vehicle Platform. Tim Sherwood, VP of Business Development, Mobility and IoT Solutions at Tata Communications, explained, "The integration between our MOVE platform and the connected vehicle could streamline a lot of the operations and maintenance, because our control of the cellular eSIM subscription in the car itself can be managed through a common interface.

He added, "Our collaboration is working towards how do we do a level of integration between our two solutions to provide enhanced value to the car makers and potentially some other players in the ecosystem.

For example, "We can provide a variety of mobile network-level information into the data lake and analytics capabilities that Microsoft has… to enhance the business intelligence and learning capabilities that the car makers gets."

As the point of all IoT implementations is the actionable intelligence that can be derived from data, whichever party controls, processes and owns that intelligence is in very powerful position, and even more so in future as more sophisticated analytics and artificial intelligence are applied.

No doubt there will many different models regarding ownership and control of the data within different arrangements between different groups of partners.

Integration matters

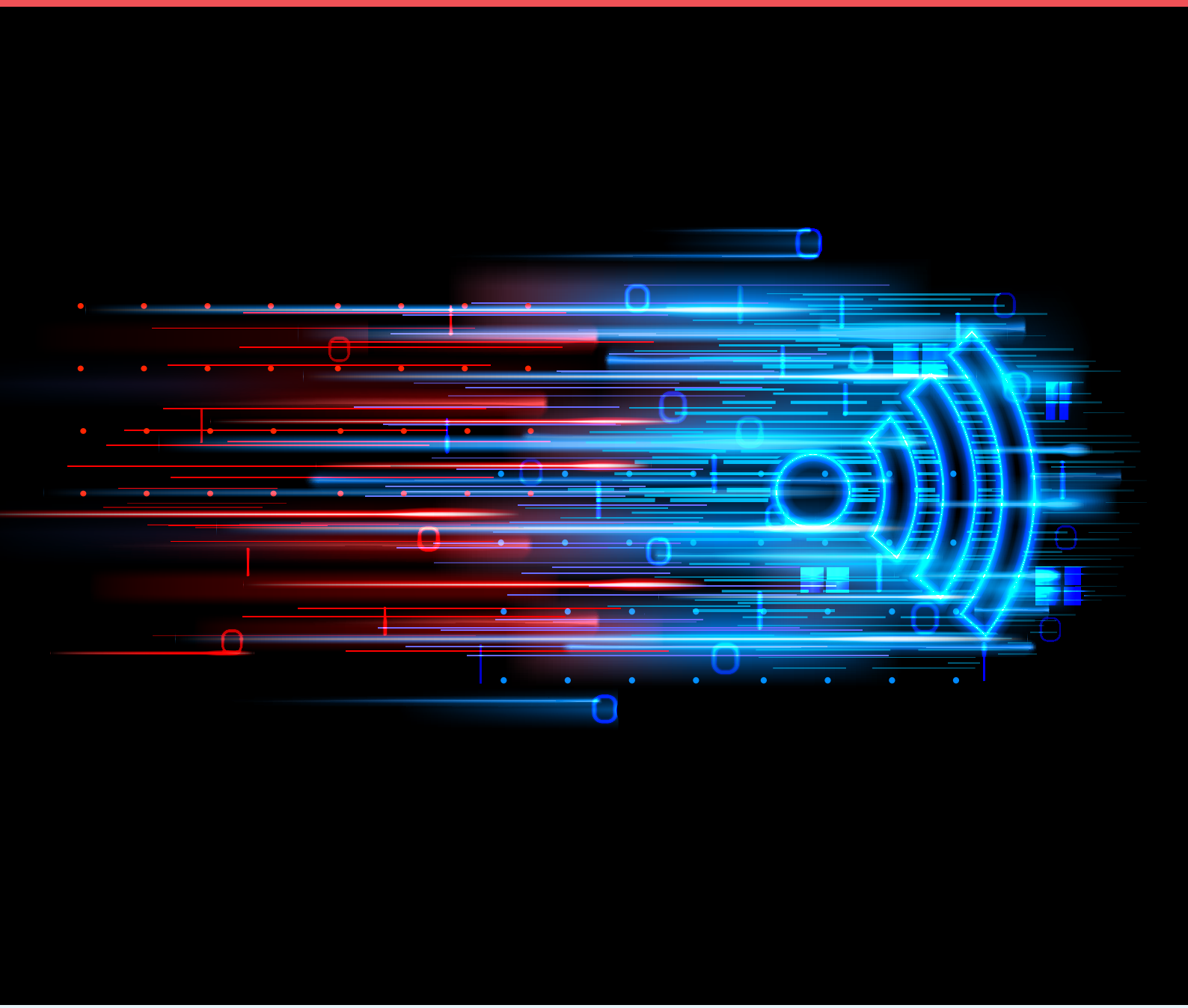
From the communications providers' point of view too there are both opportunities and causes for concern. As more of the car makers are focused on autonomous vehicles, electrification, shared mobility and greater personalisation, having that connectivity from the vehicle back to the cloud-based application is critical.

In this instance, Sherwood stated, "We provide that across the globe, working with hundreds of mobile operators, not only to aggregate supply, but to apply a level of intelligence to connectivity management to use the best available supply to meet the car makers' regulatory, cost and performance requirements."

Clearly the aggregator is higher up the value chain than those who simply provide connectivity. The role of aggregator is open to operators too, but few are qualified to do it and they will face stiff competition.

Bearing the weight: the technologies that carry IoT

The success of IoT in every sphere depends on the communications that enable it. Here we take a quick look at some of the latest developments in established technologies, such as LoRaWAN, NB-IoT, Sigfox and Wi-Fi, and highlight some new ones that could have a big impact on the market, such as Chirp, Li-Fi, OpenRoaming and Sidewalk.



Cellular IoT technologies (LTE, NB-IoT)

According to the *Ericsson Mobility Report*, published in November 2019, Massive IoT technologies, that is narrowband IoT (NB-IoT) and LTE Cat-M, are projected to account for 52% of all cellular IoT connections in 2025. At the moment, 2G and 3G still enable most IoT applications, but during 2019 the number of Massive IoT connections is thought to have tripled to almost 100 million by year end.

Massive IoT is mostly for wide-area use cases, connecting huge numbers of simple, cheap devices that have a long battery life and relatively low throughput. NB-IoT and Cat-M technologies complement each other; hence almost 25% of the 114 cellular IoT service providers have launched both.

Broadband IoT mainly includes wide-area use cases that need higher throughput, lower latency and larger data volumes than Massive IoT can support. LTE is already supporting many use cases in this segment (see graph below), but by the end of 2025, 28% of cellular IoT connections will be broadband IoT, according to Ericsson, with 4G connecting the majority.

Critical IoT includes both wide-area and local-area use cases that require extremely low latency and ultra-high reliability. The first modules supporting Critical IoT use cases are expected to be deployed in 2020. Only a small fraction of total cellular IoT connections will be Critical IoT in 2025.

Chirp

James Nesfield, CEO of Chirp, says, "We are very focused on being a kind of *de facto* standard, transport-layer technology along the lines of Li-Fi, Bluetooth, Wi-Fi and even things like QR codes and 4G, 5G."

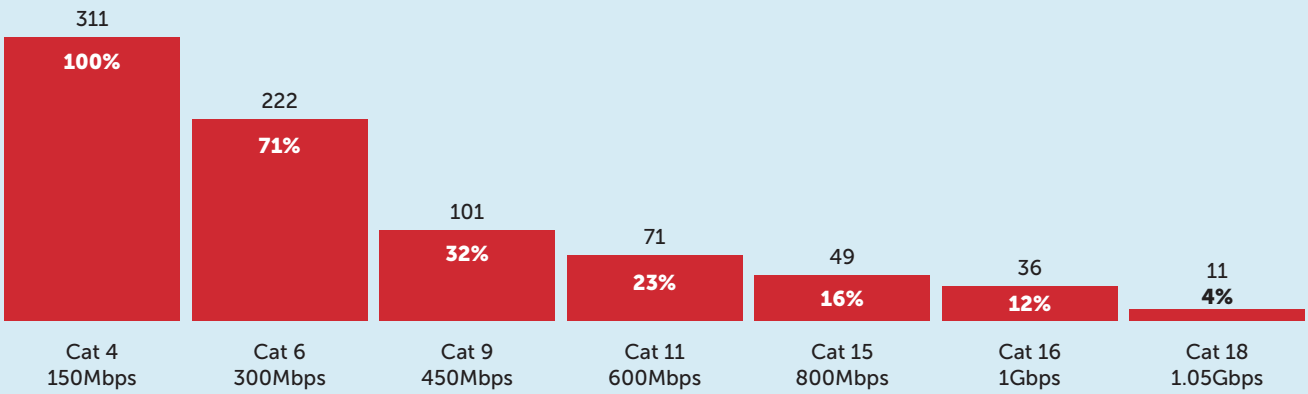
His company moves data by modulating low level, near ultrasound soundwaves, broadcasting them through the air, then demodulating them at the receiver. Chirp mostly uses frequency shift keying, whereby digital information is transmitted through discrete frequency changes of the carrier signal. Nesfield says the encoding process is straightforward and synthesizer-like, whereas the decoding is much harder, because it has to distinguish the signal from noise and distortion to decode it.

This is where the firm's IP and other "smarts" are, Nesfield explains, adding, "We make sure that our algorithms are robust enough to work with any off-the-shelf loudspeaker or microphone." Unlike the electromagnetic spectrum, the sound spectrum isn't licensed, which gives Chirp an advantage over radio frequency technologies in some environments, such as airplanes, where airplane mode turns off the radios on devices.

The business model is to license the technology to larger organisations. In India, a bus service, Shuttle, replaced QR codes with Chirp because the service needs people to board and alight quickly, and QR codes proved hard to use in the dark. Energy company EDF has used Chirp technology in a nuclear plant, where radio transmissions are prohibited for regulatory and safety reasons, and the Californian toy company, Roblox, is an example of the technology being used at huge scale.

With hundreds of millions of users, Roblox has just surpassed Minecraft as the most popular online gaming platform. For the mobile version of some games, Chirp allows younger players to connect with each other, because, similar to Apple's Airdrop, devices nearby can be 'discovered' and connect if the owners give permission. Nesfield says, "In that instance Chirp works completely offline, but we can still provide a really good and safe experience for that demographic."

What is the rough population in the country(s) you operate in, or total if you work in a group capacity?



Source: Ericsson and GSA (Oct 2019)

[1] The coverage area for the three categories may overlap in some areas but the calculated numbers refer to the combined coverage area predicted
[2] The figures refer to coverge of each technology. The ability to utilize the technology is subject to factors such as access to devices and subsciptions

LoRaWAN

IHT has predicted that LoRaWAN and cellular IoT (see previous page) will take more than 80% of the low power, wide area network (LPWAN) market in the next five years (also see Sigfox, below). LoRAWAN technology is developed by the LoRa Alliance, and runs on unlicensed spectrum. Crudely put, when compared with cellular IoT, LoRaWAN and Sigfox lead on power performance and cost, whereas NB-IoT leads on latency, security and throughput.

However, it is important to note that the differences between them (and other IoT technologies) are beyond the technical, and include commercial and deployment models, and architectures. Proponents claim LoRaWAN is supported by a bigger ecosystem than NB-IoT – which is something SigFox (see below) is working hard to strengthen. The point is that they fulfil different use cases.

In January 2019 the Alliance announced it had 100 networks in operation around the world, and that it intended to expand its certification and testing activities to smooth deployment and ensure interoperability.

At that juncture the Alliance focused primarily on four vertical markets – agriculture, industry, smart buildings and smart homes – but it has since embarked on initiatives to address other verticals, too. For example, utilities are an obvious market, with applications ranging from metering, to smart grid, electric vehicle charging, renewable energy, distributed energy generation and more.

In April the Alliance signed a liaison agreement with the Device Language Message Specification User Association (DLMS UA), which encourages utilities and meter manufacturers to develop and support a standard for smart meter data exchange. The aim is to define a new DLMS communication profile for LPWAN technologies, including LoRaWAN.

Richard Stamvik, Head of Ecosystem Business Development at Multitech, which develops and manufactures data communications equipment for the industrial IoT and is a member of the LoRa Alliance, predicts that water management will rise up the Alliance's agenda (see page 38).

Speaking to *Smart Energy International* at *European Utility Week* in late November, he also singled out track & trace for logistics as another big opportunity and noted, "The [LoRaWAN] technology is ironed out, the ecosystem built out. The next phase is the product and business use cases that demonstrate the return on investment and show how deploying LoRA devices can be profitable."

Li-Fi

This technology uses light waves to transmit data, which offers advantages for industry and IoT by providing communications in areas where certain radio frequencies perform poorly or wireless communication is not allowed due to safety regulations.

Signify (formerly Philips Lighting) recently introduced a Li-Fi system, branded Trulifi, that can be installed in Philips luminaires. Instead of radio signals, it uses the lighting infrastructure to provide a reliable and secure high-speed broadband connection at up to 250Mbps.

Vodafone Deutschland and Signify are collaborating to develop applications and solutions for secure, reliable, two-way wireless communications for IoT, among other things. At the *IEEE 5G Summit* in Dresden in October, the two showed the benefits of combining Li-Fi and 5G, so customers gain more benefits from their wired Gigabit connections.

In addition, fault-tolerant systems and services are better equipped to withstand network outages: the two communication technologies work independently of each other to provide redundancy where required.

Other possible applications are for vehicle-to-vehicle (V2V) and cellular vehicle to environment (C-V2X), the direct communication between vehicles and the environment to improve road safety and efficiency (see article on page 30).

The collaboration aims to develop applications and solutions for secure, reliable, two-way wireless communications at speeds beyond wireless technologies like Wi-Fi and Bluetooth, both over wireless and light waves. Other Li-Fi companies include Firefly Li-Fi, LIFX, Lumefficient, Oledcomm, PureLiFi, Velmenni and Vincc.

OpenRoaming

Cisco is leading what it calls the OpenRoaming Federation, announced at MWC2019, to promote combining mobile roaming with Wi-Fi 6, which allows devices to connect automatically to Wi-Fi and seamlessly roam from one hotspot to another without the need for logging in.

This is not a new idea as the Wireless Broadband Alliance's WISPr 2.0 and the Wi-Fi Alliance's Hotspot 2.0, known as Passpoint, are both supposed to tackle this issue. In addition, some operators jointly enable roaming between different Wi-Fi network platforms, but the user often has to pay a subscription.

Cisco and CloudNet began live trials of the OpenRoaming technology on the Scottish island of Orkney as part of the government-backed *5G RuralFirst* project. The first commercial trial started on 30 October in London with the Canary Wharf Group.

Supporters say OpenRoaming offers dramatically faster speeds, improved capacity, lower latency and longer battery life. OpenRoaming is an extension of the Passpoint technology that Boingo, Cisco and others demonstrated in February at MWC2019.

Cisco envisages the technology being incorporated in door bells, TVs and household appliances, as well as newer smartphones that have Wi-Fi 6 inbuilt.

Sidewalk

At its annual event in Seattle, in September, Amazon announced it will be launching Sidewalk, a new low-bandwidth, long-distance wireless protocol to connect IoT devices such as trackers, sensors, lightbulbs and so on.

The low-power, wide-area network (LPWAN) will use 900MHz-spectrum. It can securely send data to devices up to a mile away and supports features such as secure over-the-air (OTA) updates.

Amazon argues that Bluetooth and Wi-Fi don't have enough range, while 5G takes too much power and is too complex for some applications. "That leaves a middle ground for devices that are looking for low-cost, low-power, low bandwidth connection where battery life needs to be measured in years, not days," says Dave Limp, Senior Vice President of Devices for Amazon, who expects developers will build all kinds of useful, low-cost products for the Sidewalk network, from garden weather stations and water sensors to connected mail boxes.

Amazon is testing the protocol in Los Angeles, and sent Sidewalk-enabled devices to 700 employees of its subsidiary, Ring. It says that within three weeks the network covered the LA Basin. "We learned that, with just a few access points, very broad coverage becomes available," says Limp.

Amazon plans to build a reference design, which will be available in 2020, called Ring Fetch – a dog tracker that will use Sidewalk and send an alert when your dog leaves a certain area.

Sigfox

Sigfox operates its own IoT solution as a service provider and its global rollout is ongoing through partnerships with various network operators. This is different to LoRa Alliance's approach, which is about providing interoperable technology for others to implement.

At Sigfox's annual event in Singapore, in November, the French company's CEO and co-founder, Ludovic Le Moan, said it expects to have connected 16 million devices to its network by the end of this year. The company believes that increasing this to 1 billion by 2023 is an attainable goal if connectivity is at extremely low cost; hence it has developed a $0.20 reference design and is looking at ways to harvest energy to power remote devices, to reduce battery replacement.

From Singapore, the company announced that it has formed a partnership, PinPoint, with the global network Amadeus, to provide asset tracking to the travel industry. It is launching a private network service to allow Sigfox's customers to choose between a private service and a global service, depending on their economic and industrial constraints. Also, it is to strengthen its Atlas geolocation services to improve asset tracking.

Wi-Fi 6

This isn't a turbo-charged version of Wi-Fi as we know it, it's an upgrade designed to ensure that Wi-Fi doesn't collapse in a few years' time as the capacity demands on it increase. Scott Petty, CTO, Vodafone UK, recently pointed out that while the average household in Western Europe currently has 10 devices consuming Wi-Fi, this is expected to rise to 50 in the next decade.

Wi-Fi 6's theoretical top speed is 9.6Gbps, compared to Wi-Fi 5's 3.5Gbps, but the standard includes technologies that enable that greater capacity to be split across a whole range of network devices.

The typical download speed in the US in 72Mbps – or less than 1% of Wi-Fi 6's theoretical fastest rate – so Wi-Fi 6 enables routers to communicate with more devices simultaneously and to send data to multiple devices in the same broadcast, and allows the connected devices to have scheduled checks with the router to maintain strong connections as more devices are added.

The technologies used include MU-MIMO (multi-user, multiple input, multiple output). This is already deployed in routers and devices, but Wi-Fi 6 upgrades it for use with multiple devices simultaneously, rather than broadcasting to one device, then the next and so on. At the moment MU-MIMO allows routers to communicate with four devices at once, whereas Wi-Fi 6 allows for up to eight. OFDMA (orthogonal frequency division multiple access) also allows one transmission to deliver data to multiple devices at once.

This next generation Wi-Fi is built into hardware and is not a software upgrade, so its introduction will be gradual, as people buy new games consoles, laptops and phones, but to benefit from Wi-Fi 6 they also need a router that supports it.

Other advantages of Wi-Fi 6 include much better security, as it uses a protocol known as WPA3 (Wi-Fi Protected Access 3), which makes it tougher for hackers to break passwords by having endless numbers of attempts, and it also renders some data less useful to criminals, even if they do manage to access it. WPA3 is present on some current devices, but it must be included in Wi-Fi 6 devices to receive certification from the Wi-Fi Alliance.

The certification programme was launched in September. Happily, the Alliance has abandoned its highly confusing naming schema, so 802.11ac was renamed Wi-Fi 5 in 2018 and all subsequent generations will just take the next number.

Smart cities are still in their infancy with everything to play for

Mobile Europe & European Communications **ran a survey over the summer to find out how operators are addressing the smart city opportunity, which is seen as one of the biggest growth markets for IoT (see page 20). Yet almost half – 47% – of our respondents said that although they are interested in smart cities, they do not have many live projects. What's holding them back?**

We had 72 respondents to our annual survey, with 54% from converged network operators, 26% from mobile, 10% from fixed, 4% from data centre and cloud operators, with 4% describing themselves as 'other', including a satellite service provider and three telcos (rounding means the figures don't add to 100% throughout this article).

More than half, 54%, worked for network operators serving a population of more than 30 million, with 28% serving a population of fewer than 5 million (see chart below). They came from multi-country groups, as well as from countries including Armenia, Bosnia and Herzegovina, a number of European autonomous or semi-autonomous island territories, Finland, Germany, Indonesia, Israel, Latvia, the Netherlands, Norway, Oman, Spain, Turkey, the UK and Ukraine.

Almost 14% said that smart cities are central to their business strategy and growth, with a third describing smart cities as being quite important to it. Although 47% of respondents were not participating in many smart city activities, they did say they are interested in the opportunity. Just under 6% said they have no focus on smart cities.

Does size matter?

We investigated whether size had a role here. Of those serving populations of more than 30 million, 16% said smart cities are central to their strategy, while 44% described cities as being quite important – 60% in total – and a further 32% said they are interested but not yet very active.

At the other end of the scale, in our second biggest category of respondents, the operators serving fewer than 5 million people, only 7% said smart cities are central to their business and growth strategies, and a further 7% are quite interested. The huge majority (79%), though, said they are interested, but not very active. So it does seem that size is a factor when it comes to turning interest into implementation.

Will a decade make a difference?

When we asked operators if they thought this will be different in ten years' time, the number who thought that smart cities would be central to their business strategy and growth by 2029 doubled to 28%, while 57% thought smart cities will have become quite important to their business strategy and growth by then, making a combined total of 85%. A further 12% thought that they will have 'a few' smart city projects on the go in a decade's time, but 4% still thought they will have no focus on the sector at all.

What are you offering now?

Next, we asked what services our respondents are already providing to smart cities and, not surprisingly, just over 86% said connectivity, with 51% saying they are providing digital services and applications, such as smart street lighting, digital kiosks for citizens, parking and traffic monitoring. Just over some 39% currently provide security services and 37% act as lead partners and/or master systems integrators within an ecosystem of specialist partners providing services to cities. About 29% act as consultants to cities and 18% provide digital identity services.

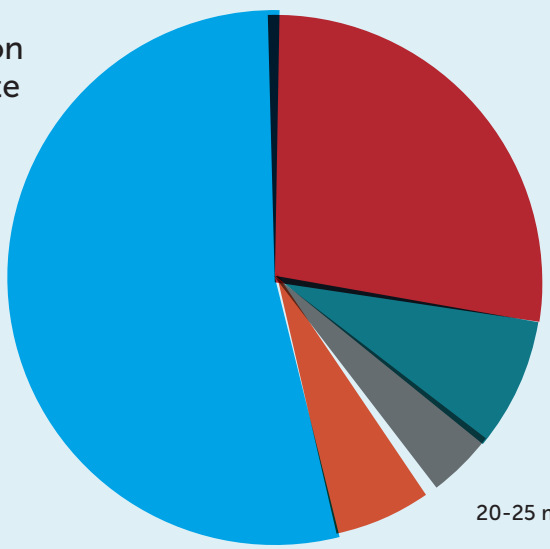
Future opportunities

We asked them what they thought the main opportunity within smart cities would be over the next five to ten years and it was encouraging to see that connectivity slipped from that overwhelming lead in services provided at the present time to just over a quarter, behind providing digital services and applications (31%) and acting as lead partners and/or master systems integrators within an ecosystem (29%). Curiously, both consultancy (4%) and security services (2%) appear to plummet down the agenda.

This could be because consultancy is key to the new and early stages of markets, and in five to ten years it will have been replaced by implementation. Regarding security, an optimistic take on it falling so far down the agenda would be that everything will be secure by design; that is security measures will be intrinsic to all parts of infrastructure, rather a separate issue.

We asked respondents to outline some of the projects they've been involved in. In addition to the ones mentioned above, others included smart patrols, mapping cities' infrastructure using 3D printing and cloud, parking, monitoring and managing water purity, waste management, involvement in creating a national data structure, deploying IoT platforms and identifying business models.

What is the rough population in the country(s) you operate in, or total if you work in a group capacity?



Partnerships are tricky

Just under 16% of respondents said that their experience of working in partnership with cities has been successful, but 63% described their city collaborations as 'somewhat successful', while 10% classified them as unsuccessful. To shed more light on their answers, we asked the operators to name the two main challenges of working with city partners.

It turns out that the two biggest obstacles, both of which were cited by 41% of respondents, are a lack of clarity around business value and return on investment for IoT deployments, and finding the right business models. These are obviously closely linked. The next most common answer, at 31%, was funding difficulties in cities. Then we had another tie, with city projects' lifecycles and the difficulties of getting in front of the right people within cities in order to strike a deal both scoring 18%.

City procurement processes were recognised as an issue by 14% of respondents. Two others that tied at 10% concerned cultural differences in how things are done, and a lack of support and strategy from leaders within operators and/or cities.

Procurement progresses?

We wondered whether procurement processes within cities are changing as the smart movement gathers momentum. More than half the respondents (55%) said yes, the rest said no. When we asked for reasons for their answers, on the downside these included: too much focus on individual projects or a piecemeal approach instead of the bigger transformation; difficulties with timelines for projects, legal restrictions; and national requests for proposal rules.

On the upside, some cities are testing innovations, built around new procurement processes, rather than issuing traditional requests for quotations.

Takeaways

Finally, we asked our respondents what useful takeaways they have gained from their smart city activities so far. The replies including the critical importance of working with cities' top managers, building IoT platforms, and collaborating on R&D-based smart community projects that were part sponsored by city authorities.

Water: the next big splash

In our research for this IoT edition of the magazine, water management broke the surface a number of times as an area of growing importance. However, according to John Lillistone, Director – Water at Arqiva, while water and waste water management are undoubtedly essential aspects of smart cities, "Actually, the bigger picture is that water is an increasingly vital resource and there are increasing challenges in terms of supply."

He noted the environmental, social and economic havoc being wreaked by droughts in parts of Australia and the US, while parts of the UK, East Africa and Venice have experienced serious flooding in the last few weeks. Hence stewarding water supply to ensure it is where it is needed is a big challenge, along with addressing water pollution produced by agriculture and other industries.

Yet for something that is fundamental to every living thing, data about water supply and distribution seems to be relatively scarce. Lillistone said, "We had one large British commercial customer who told us we gave them more data in the first day of operation [monitoring water usage] than they had had in the previous four years."

In the UK, water meters are primarily used to detect leakage and are "much less about informing and encouraging the behaviours of end users – that will come later – than the immediate challenge, which is to identify and prevent leaks," added Lillistone. Every day in the UK, the equivalent of thousands of Olympic swimming pools of water is lost, about 15% of which occurs on the consumers' premises through constantly dripping or running taps due to worn washers, and – perhaps somewhat surprisingly – the constant topping up of leaky fish ponds.

In countries where monetary value is attached to water, such as some of the Nordics, far greater care is taken over water consumption – the average daily use per person is only 80 litres, compared with 140 litres per day in the UK.

Lillistone pointed out, though, that once customers who are profligate in their use of water are identified and advised about how much wasting water costs them each month (rather than the quantity wasted), 90% of the leaks are resolved within 72 hours.

For now, though, the big problem for water companies in many places is a lack of information. For example, while smart electricity meters have received huge government backing and promotion, water meters have not received the same support and fewer than half of UK homes currently have a water meter and it only has to be read every two years.

Richard Stamvik, Head of Ecosystem Business Development at Multitech, which develops and manufactures data communications equipment for the industrial IoT, recently said that there are 6 million smart water meters sold every year in Europe, the Middle East and Africa, with 50,000 utility companies in Europe alone. Some 200 million water meters are deployed in total, which means there is a huge replacement market.

As this magazine was put to bed, the Swiss company Guterman announced what it described as "the world's first water leak detecting noise logger", based on NB-IoT, for the permanent monitoring of water distribution mains. It has been used in successful trials in Australia, France and the UK, and hit the market just in time for the first ever *World Water Loss Day* on 4 December.

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Global

Ericsson

Ericsson's latest *Mobility Report* predicts that by 2025 5G subscriptions will top 2.6 billion, cover up to 65% of the world's population and handle 45% of global mobile data traffic. It also expects smartphone users to consume a global average of 24GB per month by the same year, up from 7.2GB now, as video usage increases and new services become available. It estimates the total number of cellular IoT connections will be 5 billion by the end of 2025, up from 1.3 billion at the end of 2019.

Nokia

In late November, Nokia announced it had built 120 private networks around the world, including 32 for public sector organisations and smart cities. ABI Research reckons the private wireless market will be worth $16.3 billion by 2025. In May 2019, Nokia's CTO, Marcus Weldon, said that the private network market could eventually equate to as many as 14 million base stations. That is twice as many as are deployed now by the world's commercial wireless network operators. At the time the comment was made, Nokia had deployed 30 private networks.

United States

T-Mobile

John Legere is to step down as CEO of T-Mobile at the end of April 2020. It is uncertain whether T-Mobile's $26.5 billion acquisition of Sprint will be completed by then: the 'merger' was to be the crowning glory of his highly successful turnaround of the operator which began in 2012. The acquisition is opposed by a number of states' attorney-generals, who fear the merger will ultimately result in less competition and higher prices.

Russia

iHome and ER-Telecom

Russia's second-largest broadband provider by subscribers, ER-Telecom, is to acquire iHome, which launched in 2000 and specialises in services for other carriers and enterprises. iHome will retain operational independence after the acquisition, which is thought to be worth around RUB1.5 billion (€21.23 million). iHome's backbone network covers more than 30 cities in the Russian Federation, with traffic connection points in eight other European countries.

South Africa

MTN

Ericsson is to supply MTN South Africa with 5G products and solutions from its RAN, transport and core portfolios, with rollout expected to start in 2020. As part of its transformation strategy, MTN is upgrading its core network to support 3GPP-compliant 5G Non-Standalone (NSA) architecture. Commercial 5G services are planned between 2020 and 2022, including enhanced mobile broadband, fixed wireless access and IoT.

Japan

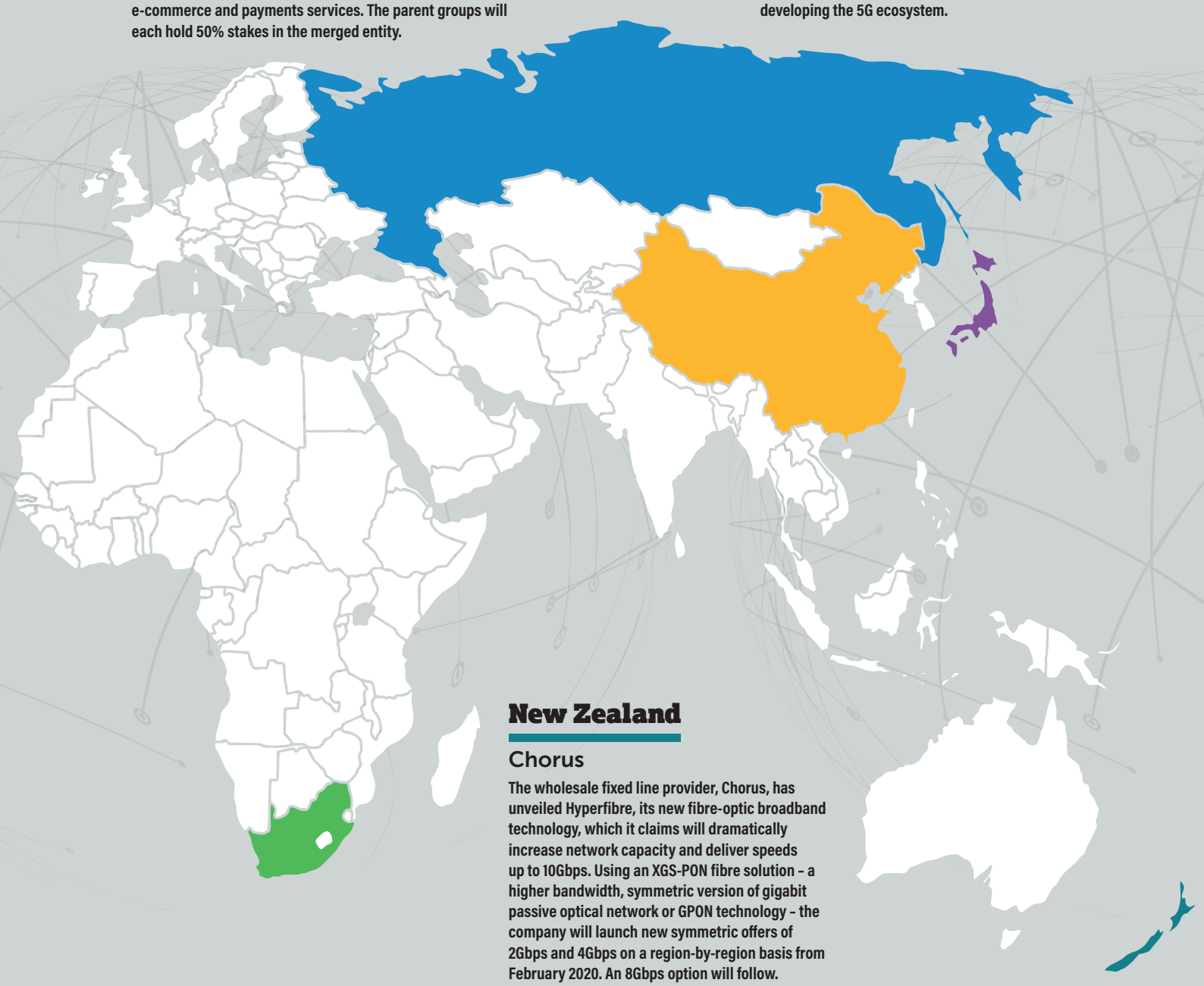
Yahoo! Japan and Line

Yahoo! Japan, which is controlled by SoftBank, has agreed to merge with messaging app operator Line Corp, owned by the South Korean internet firm Naver. The plan is to create a $30 billion (€27.1 billion) entity, which will form the largest mobile platform in Japan, and expand the Japanese conglomerate's e-commerce and payments services. The parent groups will each hold 50% stakes in the merged entity.

China

China Mobile

The world's largest mobile provider by subscribers, China Mobile, said it expects to sign up 70 million 5G subscribers and sell 100 million 5G devices in 2020, according to a report in *China Daily*. The company launched commercial 5G services in October and plans to invest CNY20 billion (€2.575 billion) next year in developing the 5G ecosystem.



New Zealand

Chorus

The wholesale fixed line provider, Chorus, has unveiled Hyperfibre, its new fibre-optic broadband technology, which it claims will dramatically increase network capacity and deliver speeds up to 10Gbps. Using an XGS-PON fibre solution – a higher bandwidth, symmetric version of gigabit passive optical network or GPON technology – the company will launch new symmetric offers of 2Gbps and 4Gbps on a region-by-region basis from February 2020. An 8Gbps option will follow.

2019 saw a strong start to the 5G marathon

It is just over a year since the world's first commercial 5G service went live, so this feels like as good a time as any to take stock and assess progress over the past 12 months, says Kester Mann, Director, Consumer and Connectivity, with CCS Insight.

By late November 2019, CCS Insight counted 49 commercial 5G networks in 25 separate markets, an achievement that would have been hard to foresee this time last year. And, while most of these fledgling networks are still confined to select parts of major cities, the industry has made great strides.

What's encouraged me most is the strong progress by players across the ecosystem: infrastructure suppliers, chipset providers, mobile operators and device manufacturers. Unlike in previous generations, the industry appears to be moving not just quickly, but together.

European spurt

One trend that has taken many by surprise is the strong progress of 5G in Europe. During the build-up to the first launches, much was made of the region trailing the US and developed Asian markets, yet Europe now accounts for almost half of all 5G network launches.

In fact, some markets one would not normally associate with being at the forefront of mobile technology have been fast out of the blocks with 5G. Who would have thought that people would be using 5G in Romania, Latvia and Hungary before Japan, for example?

Meanwhile, in the UK, all four network operators have already gone live, a feat possibly matched only by the US. If we cast our minds back to 4G, the UK was the 53rd nation to launch, behind countries including Guam, Azerbaijan and Kiribati!

Of course, launching a 5G network is one thing. Getting consumers to understand how 5G can help them and – crucially – convince them to pay for it, is something completely different.

Consumer research

CCS Insight's recent consumer research revealed strong awareness and encouraging interest in 5G, although it was less clear to what extent people are prepared to upgrade their device or switch provider to receive it more quickly.

In the UK, 95% of people we spoke to indicted they had heard of 5G. This is a very positive story that reflects strong marketing campaigns, notably by EE and Vodafone. Indeed, awareness in the UK was higher than the US, despite the high-profile battle to be first that played out between Verizon and AT&T.

We also identified a small but distinct group of people interested in services such as virtual reality and gaming on a 5G network. The low latency and higher throughput of 5G can significantly enhance these applications. In fact, gaming is emerging as one of the first consumer use cases beyond straightforward enhanced connectivity and it has played an important part in the early 5G service offerings of some operators, such as Deutsche Telekom, Vodafone and EE.

Perhaps inevitably, we also unearthed several clear challenges to 5G adoption. Notably, about 30% of people in the UK told us they don't need 5G right now. This finding suggests that better communication of the technology's leading benefits, alongside more innovative service bundles and new applications, may be necessary to stimulate early consumer demand.

Too expensive?

Cost was also cited as a significant hurdle which 5G must overcome. This is understandable considering the steep price of early supporting devices, some of which cost over €1,000. However, 5G smartphone prices should move rapidly down the price curve over the next six to 12 months, as new models targeting a broader demographic hit the shelves. This could be the real lever to kick-start demand.

In the long run, CCS Insight expects 5G take-up to broadly mirror that of 4G. On a global basis, we see total connections passing 3 billion in 2025, including about 400 million in Western Europe. Of course, it's great to see the industry making such encouraging progress, but we're still only a few tentative miles into this marathon 5G journey.

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