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# IS YOUR IoT CONNECTIVITY MISSING THE MARK?

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**Tech Trends** – your new inside track to the topics that *really* matter.

# Ensure Your IoT Connectivity is Up to Speed

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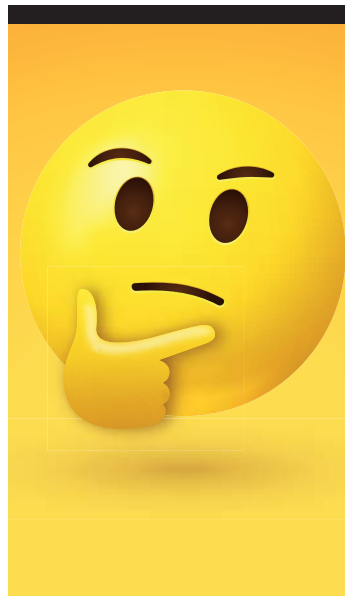Contact Aeris today for connectivity options that match your IoT requirements, as well as your budget.

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# Contents

# IT'S TIME TO TAKE THE GUESSWORK OUT OF IoT CONNECTIVITY SELECTION

Connectivity is everywhere so it should be simple to specify the connections you need for your IoT deployment. However, the decision process remains complicated and fragmented, reflecting the complexity of IoT deployments themselves, writes George Malim.

The IoT connectivity challenge now very much resembles *The Rime of the Ancient Mariner.* It's a case of there being water everywhere but never a drop to drink – or, in this case, connectivity everywhere but not the type your application needs. This is because of the difficulty in finding the sweet spot in the IoT connectivity equation. There are three core elements to this formula: availability, performance and cost to which I'd add a set of nice-to-haves including: simplicity, service, scalability and flexibility.

It's easy to find available connectivity. Simply talk to a satellite provider and they'll sell you coverage that encompasses the entire planet. ▶

IoT Global Network

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# Editor's overview

**George Malim**

**Tech Trends**

It's easy to find cheap connectivity. Speak to low power wide area network (LPWAN) providers or the owners of lower bandwidth cellular networks and they'll sell you connectivity for cents per month per device.

It's easy to find low latency, high capacity connectivity. Sign up with your local 5G provider and access speeds of more than 10 gigabits per second with ultra-low latency, sufficient to support high definition gaming and beyond.

The problem is, you can't get all three attributes at the same time, let alone from the same provider globally.

There are only a few applications today that demand high capacity, minimal pricing and global footprint. For most, the business case either demands low cost and can accept limited capabilities or can sustain higher costs in order to gain the throughput the app requires. In addition, today there are few truly global deployments so covering the major markets is sufficient.

However, we are still only at the dawn of IoT. The massive upswing into the tens of billions of devices has not yet arrived and this will necessitate a global footprint. The large cellular carriers and a number of connectivity providers are moving in this direction but the idea of a global network that is owned and operated by a single entity is unlikely to come to fruition. Instead, carrier groups will collaborate and IoT connectivity specialists will form relationships with a limited number of partners to ensure global connectivity availability for their customers.

## The known-knowns

Enterprises can simplify their connectivity selection by referring to what they already know. If you provide soil monitoring technology, you know you need rural coverage, cheap, easy-to-deploy devices and cost effective access to a network that offers relatively low bandwidth so your devices can report small amounts of data at a fixed regularity. LPWAN offerings are probably the best fit here.

At the other extreme, if you're providing public transport data to a smart city you need, faster speed, continuous, quality-assured connectivity that has good urban capacity. 5G is a good choice here.

## The known-unknowns

If you're launching a new service the things you know you don't know need to be taken into account. These range from the basic such as: Will customers like the service? to the complex such as: Can I get coverage to support the service in Mongolia?

Enterprises recognise that until an app is out in the market, it's hard to estimate how many connections will be required. LTE-M might be cost-effective for a trial involving 3,000 users but, if the app takes off, the numbers might not work for one million users. Narrowband IoT (NB-IoT) might be a better bet.

Equally, a successful global service will need to extend into new markets. An enterprise that has used **Vodafone**, for example, for its traditional enterprise communications needs and uses it for IoT enablement may find everything works well in countries where Vodafone has its own operations. It may also find that in countries where Vodafone has strong partners, the connectivity performs as expected and the cost is sustainable. However, as the service extends into other locations, the original provider may not be able to provide service and the enterprise will have to find and manage new partners.

Making decisions that provide flexibility to address the things you already know is straightforward. It's also relatively simple to select providers in preparation for success of an app and to predict which geographical areas will need coverage first. Many connectivity providers are working across IoT and have experience to draw on from previous deployments and will be able to help with strategies for scaling up or down and extending into new markets.

There is, however, a further layer to consider. What about the unknown-unknowns?

## The unknowns

You can't provision connectivity for a situation you have no awareness of. That's scary but true. Today's app that is ticking over at 10,000 users may take-off or it may be made obsolete by a new innovation. For long-term deployments of more than a couple of years, this is a big issue because it means enterprises are trying to dimension connectivity supply for way into the next technology cycle.

If, for example, you're a car maker, your vehicles will be in use for at least ten years. Equipping them with LTE-M is good for today and 5G is good for the next five years but what will the next apps be. Will they require more capacity than 5G, how will that be retrofitted to vehicles and how will you make money from providing it are all unknowns.

It's abundantly clear that good technical options exist at either end of the spectrum, no pun intended. There are low cost, low capacity solutions that are simple to deploy and are set to offer great geographic coverage. There are expansive, resilient, high capacity options that have probably more limited coverage. In addition, there are mid-market solutions that do most of what you need, most of the time.

That, perhaps, is the goal: to select connectivity that has most of the functionality your app needs, more of the time than alternatives. If you can find a solution that does this for 80% of your customers, you can address the more difficult 20% with alternatives and do so in ways that are scalable and resilient.

No one said this was going to be easy but this issue of **Tech Trends** provides substantial detail on the various options and provides information on how to plan your connectivity, blending different technologies from different providers to give your deployments the connected foundation they need to thrive.

## Huawei demonstrates world-first nuSIM implementation

**Huawei** reports that it has demonstrated a cellular IoT chip connecting to a narrow-band IoT (NB-IoT) network without using a subscriber identification module (SIM) card.

nuSIM is an integrated alternative to existing SIM solutions, optimised for use in IoT networks. The rigorous downsizing of its SIM functionality combined with a straight forward digital provisioning process achieves significant advantages in terms of cost and overall efficiency. The low-footprint implementation allows the SIM functionality to be hosted within the communications chip, thus eliminating the need for an external SIM component.

For the demonstration, Huawei used a **Quectel** BC95-G IoT communication module based on Huawei's Hi2115 highly integrated NB-IoT System on Chip (SoC). Using the dedicated nuSIM loader tool, an encrypted operator profile was downloaded to the security processor inside the chip, then decrypted and installed. The device successfully connected to a live NB-IoT network.

Chris Lowe, SIM technology lead at Huawei UK R&D, commented: "Our Hi2115 NB-IoT chip, designed to minimise system costs for IoT applications, is the market leader. With the integration of nuSIM, we can connect chips to networks without SIM cards, removing another barrier to widespread IoT adoption. We are now moving towards security certification and look forward to continue working with our partners in the nuSIM community."

## 4G roaming traffic doubles for the third year as industry gears up for 5G

**BICS** has reported that 4G roaming traffic doubled in 2019 for the third consecutive year, as subscriber demand for high-capacity borderless connectivity continues to boom. Sourced from the carrier's global network, which connects more than 700 operators and 500 digital service providers and carries over 50% of global data roaming traffic, the findings show an uplift in roaming traffic across all continents, fuelled by increased global travel, adoption of roaming tariffs, travel SIMs, and IoT devices.

Last year also saw momentum build for both national and international 5G; approximately 50 national 5G networks are now live, while BICS pioneered several live 5G roaming services, including a 5G intercontinental roaming service between Europe and Asia. This year, BICS predicts 5G roaming will gain further traction, as service providers progress 5G deployments and launch 5G roaming to support increasing demand from both subscribers and industries requiring high-speed, ultra-low latency 5G data connectivity.

"The exponential growth in roaming traffic

**Mikaël Schachne**, BICS
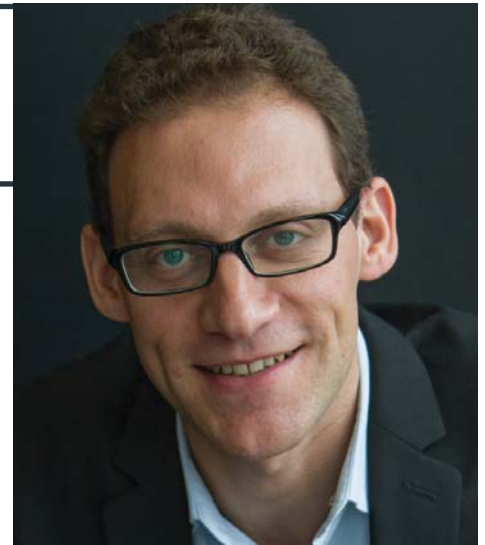
highlights how important international connectivity has become to the subscriber experience," commented Mikaël Schachne, the chief marketing officer and vice president for mobility and IoT business at BICS. "Through the provision of seamless, cross-border 5G connectivity, operators will be able to create new revenue streams and support a wide range of new and innovative use cases in areas such as automotive, gaming, telemedicine and logistics. As carriers launch 5G networks, roaming must be at the heart of their offerings to deliver maximum value for subscribers."

## 5G to cover 65% of world population by end of 2025, says Ericsson Mobility Report

The latest **Ericsson** Mobility Report has projected that 5G will cover up to 65% of the global population by the end of 2025 and handle 45% of global mobile data traffic.

**Fredrik Jejdling**, Ericsson

In 2019, communications service providers in Asia, Australia, Europe, the Middle East and North America switched on their 5G networks. South Korea has already seen big 5G uptake since its April 2019 launch and more than three million subscriptions had been collectively recorded by the country's service providers by the end of September 2019.

China's launch of 5G in late October has also led to an update of the estimated 5G subscriptions for the end of 2019, from 10 million to 13 million.

Fredrik Jejdling, the executive vice president and head of Networks at Ericsson, said: "It is encouraging to see that 5G now has broad support from almost all device makers. In 2020, 5G-compatible devices will enter the volume market, which will scale up 5G adoption. The question is no longer if, but how quickly we can convert use cases into relevant applications for consumers and enterprises. With 4G remaining a strong connectivity enabler in many parts of the world, modernising networks is also key to this technological change we're going through."

Other forecasts from the Report include that the total number of cellular IoT connections is now seen at five billion by the end of 2025. This is an increase from 1.3 billion by the end of 2019 and represents a compound annual growth rate (CAGR) of 25%. NB-IoT and Cat-M technologies are estimated to account for 52% of these cellular IoT connections in 2025.

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## Jerusalem deploys gigabit wireless access for smart city project



**Gigabit wireless access will cover Jerusalem**

**Siklu** has announced that its millimetre wave (mmWave) core and access network equipment have been deployed in an ongoing project for the city of Jerusalem, which is set to become one of the largest municipal networks in the world.

Adopting a cost-effective multi-service approach, Jerusalem's new wireless broadband infrastructure, known as a gigabit wireless access (GWA) network, will provide high-speed internet service in public spaces and municipal buildings and to educational institutions, of which 30 have been connected to date. The network will also connect thousands of security, traffic control and parking management cameras at speeds ranging from hundreds of megabits to 10 gigabits per second.

"Jerusalem is an ancient city filled with historic sites and careful planning is required to avoid harm to antiquities," said Eitan Barzilai, the municipality head of Technological Development. "Therefore, we looked at a wireless network to speed up the process. In addition, our proof of concept studies showed that a private mmWave based system would offer us more available bandwidth at a lower overall cost, as compared to leasing high-speed lines from a public network operator, for example."

## Volkswagen and Aeris announce formation of Ventic connected vehicles joint venture



**Volkswagen Group of America** and **Aeris** have announced the formation of **Ventic LLC**, a joint venture that is the result of a long-term commitment between Volkswagen and Aeris in the development and operations of connected vehicle platform technologies. Ventic is jointly owned, with 51% split to Volkswagen and 49% to Aeris. The company will focus on Volkswagen brand vehicles in North America, starting with the launch of the next generation Car-Net in most model year 2020 vehicles.

Ventic offers a highly customisable approach to Volkswagen's specific requirements. This gives Volkswagen the ability to manage the connected car program on a single platform, while preserving the ability to deploy solutions that differ based on region or vehicle model.

"Volkswagen is committed to connected vehicle technology, as we see a future where all cars are 100 percent connected at all times," said Abdallah Shanti, global CIO for Volkswagen Brand, and member of the board for Ventic LLC. "Our connectivity platform expands beyond remote services and vehicle safety and security. This platform has inherent flexibility which enables new business models through third-party integration and is foundational for V2X communications. Furthermore, this platform will serve our customers with delightful and useful functions, as well as being a gateway to other digital ecosystems."

Raj Kanaya, general manager of Automotive and chief marketing officer at Aeris, and member of the board for Ventic LLC, added: "The connected vehicle is at the centre of the game-changing trends in the industry – autonomous, electric, shared. Through Ventic, we're excited to be on this journey with Volkswagen."

## Nokia signs contract with TIM Brazil to launch IoT offer



**Sanjay Goel**, Nokia

**Nokia** has signed a contract with Italian communications service provider **TIM** to provide Internet of Things (IoT) services to its enterprise customers in Brazil. Using the fully virtualised Nokia Worldwide IoT Network Grid (WING) managed service, TIM and its enterprise customers across industries, such as automotive and agriculture, will be able to capture IoT opportunities faster and more securely.

The Brazilian market is the largest IoT market in Latin America, with widespread adoption of IoT technologies estimated to add US$200bn (€179 billion) to the country's economy by 2025. WING will enable local and multinational companies to benefit from global IoT services. It features a distributed architecture that maintains all user data in-country, such as in Brazil, to remain compliant with data sovereignty and privacy laws.

TIM's enterprise customers will be able to monitor and manage in real-time their devices, ranging from asset tracking and status sensors for logistics industries to the fully connected car with on-board diagnostics and telematics. As part of the deployment, the Nokia IMPACT IoT platform, which simplifies the process of bringing and scaling multiple applications onto a single platform, will provide IoT device management and service capability exposure.

Alexandre Dal Forno, head of Corporate Products and IoT Solutions, TIM Brazil, said: "At TIM Brazil we are seeking to leapfrog the IoT market and see strong growth on our B2B business. We are looking forward to engaging with other global IoT players in order to bring the best possible IoT experience to our customers. Nokia WING will enable us to accelerate our capabilities to support our enterprise customers' IoT needs and tap into the billion dollar IoT market opportunity."

Sanjay Goel, the president of Global Services, Nokia, added: "This deal will empower TIM Brazil to provide its enterprise customers with IoT services to address their growing needs. Additionally, we will work on unlocking new IoT solutions that can be applied in various industries to help enterprises undergo digital transformation."

**IoT Global Network**

**ıl˙tech trends REPORT**

# GET THE RIGHT CONNECTIVITY FOR YOUR NEEDS IN 2020

Connectivity choices for IoT, particularly cellular-related, are changing rapidly with new options now coming to the market, writes Robin Duke-Woolley, the chief executive of Beecham Research. This report reviews these with reference to the European market and taking into particular account views expressed by Mohsen Mohseninia, the vice president of International Market Development for Europe at Aeris Communications, a long-established mobile virtual network operator (MVNO) based in San Jose, California that specialises in IoT connectivity and operates globally. Aeris manages more than 14 million cellular IoT connections, including within the auto sector, transmits over one billion IoT messages per day through its dedicated network and has operational connectivity reach in 190 countries. ▶

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**Robin Duke-Woolley**

CEO

**Beecham Research**

## Is 5G ready for IoT?

5G is very much in the news at present and IoT users may be under the impression this means the technology is imminent for IoT. This is not generally the case though.

At present, mobile network operators (MNOs) are focusing on getting 5G into the mobile market and that raises very different challenges. Essentially, although it is good to know what is happening with 5G and what it can do for IoT users, the timing is not right yet for designing it into new IoT products unless those products will be out in the field for the next ten years. That is the case for the auto industry because of their long product cycles but not typical of IoT devices in general. It is all about the economics versus the benefits and, at present, the cost of 5G modules is high. These costs will decline as production increases and 2022 is most likely to be when 5G becomes a real opportunity for IoT. First implementations are likely to be for applications using fast routers and gateways, where the demand for ever-higher data speeds is strong.

## Is there a Brexit opportunity for IoT?

Border controls are an obvious area for increasing use of IoT. The UK's departure from the European Union (Brexit) has brought into sharp focus the need for real time analysis of border control data in order to minimise trade disruptions.

This centres around freight and transport, including borderless entry to and exit from Ireland and high volumes of movements around Dover-Calais. A number of companies have been approached by the government to see if they can use technology to enable faster movement of goods across borders. Extra delay means longer queues building up quickly and these technologies can assist.

The other related area is applications using cameras for freight, which is sharply in focus now following recent tragedies with people smuggling and closed containers. But that is not just cameras. This is about collecting data from transit assets and being able to apply machine learning and artificial intelligence (AI) to pick up things for inspection. There will be a major drive as the government is putting increasing pressure on freight companies to make sure they have done their homework well. All of this means more broadband is required, all of it 4G not 5G.

## How does NB-IoT compare with LTE-M for deployment?

Narrowband IoT (NB-IoT) has been in prospect for a while, but with later market entry than LTE-M. NB-IoT represents the first cellular-based technology that is aimed at static or semi-static assets rather than mobile ones and that means it is essentially lower cost than those alternatives focused on mobile assets. Battery life is also expected to be longer. As a result, there is some pent-up demand for NB-IoT. One of the main drawbacks of the technology is use for international solutions. At present, ▶

implementing NB-IoT in different countries requires different variants – it is not a case yet of one device, many markets. There are even different variants of NB-IoT within countries, with different operators using different infrastructure providers. That means it may not be possible to easily move an NB-IoT device from one network to another within the same country, for example in the UK where LTE-M is not planned to be available.

The Aeris view is that NB-IoT is now late and that it may well become the solution that never takes off in the way that everyone was expecting. Time has moved on and the technology was not out there early enough. Major customers are now looking at LTE-M, because it provides better solutions for global deployment, rather than just locally. Many customers are thinking that NB-IoT has very good properties like good battery and low cost but they cannot deploy it globally. LTE-M is a natural evolution for many network operators of their current LTE deployments, and availability of modules for LTE-M vs NB-IoT at the moment is driving many to say they will deal with NB-IoT when it is ready, but in the meantime proceed with LTE-M. In general, LTE-M does give them a significant amount of the benefits that they would likely get with NB IoT, although not all. Power saving on LTE is quite similar. However, the ability of NB-IoT to fire and forget – user datagram protocol (UDP) vs transmission control protocol (TCP) – provides additional saving as most LTE-M applications tend to be TCP based.

LTE-M is designed for roaming, with NB-IoT originally designed for fixed assets. Version 2 of NB-IoT is looking to address that mobility issue but there is no particular timescale for that.

From a module perspective, it means that in some markets there will be LTE-M, in others NB-IoT. Both are essentially evolutions from 2G and 2G will be around in Europe for some time. As a result, some module suppliers are now catering for NB-IoT, LTE-M and 2G in one device, on the basis that devices can be switched over from 2G to either NB-IoT or LTE-M when those technologies become available locally. In effect, this provides IoT users with the ability to deploy globally with one module – one stock keeping unit (SKU) that is future-proof. This avoids the need for multiple SKUs for multiple regions and multiple networks, which is potentially a major saving of supply chain cost.

### When will LTE-M take off in the IoT market?
LTE-M is already standardised and network implementations are underway. So when will LTE-M take over from 2G/3G?

The Aeris view is that in Europe we are already seeing network operators announcing a switch-off of 3G. For example in Norway and Switzerland, sunsetting of 3G is now planned for 2021. This is not the case for 2G though. For 2G there are a lot of long-term contracts – in particular government-run contracts – that are dependent on 2G availability and network operators cannot easily extricate themselves from those. So last year at Mobile World Congress the CEOs of Vodafone, T-Mobile and Orange all hinted at keeping the 2G networks up and running until 2025. There are no consumer handset technologies that will rely on these 2G networks, so in reality the 2G networks are becoming essentially IoT networks. The operators do not have to spend any money for additional capacity because most customers are looking at newer technologies.

That is in Europe. Looking then at Africa, the spending power of individuals (consumers) is not high, so low cost 2G mobiles are still around and will continue to be used in African communities. 2G will be in Africa for a long time to come, as it will in some parts of South East Asia and in some parts of Latin America. 3G is likely to go, but 2G will be around for a while. On the ▶

other hand, it is likely that network operators will start to switch spectrum more aggressively so there is unlikely to be further 2G expansion in coverage.

That means attention will focus more on LTE-M and NB-IoT over the next few years and from 2021 it will most likely be the main area of interest for IoT users. Large LTE-M device deployments are then most likely to start happening during 2022 and 2023.

In comparing hardware costs, LTE-M is expected to be significantly lower than 2G, with NB-IoT being lower cost than LTE-M.

## Other technologies – Wi-Fi and satellite use for IoT

Beecham Research's own research has shown that Wi-Fi use for industrial applications is currently very high for on-site use but is challenged in large sites with many access points and particularly where there is a need for outdoor use and for use with mobile assets. The use of LTE for private networks in both licensed and unlicensed spectrum is then becoming of greater interest. The opportunity to use LTE as part of a longer evolution towards 5G in private networks – which would utilise network slicing – is a likely future trend.

In the meantime, the overlap between Wi-Fi and cellular is being utilised by Aeris. One of the key

**Figure 1: Total Cellular IoT - Installed Base (m)**
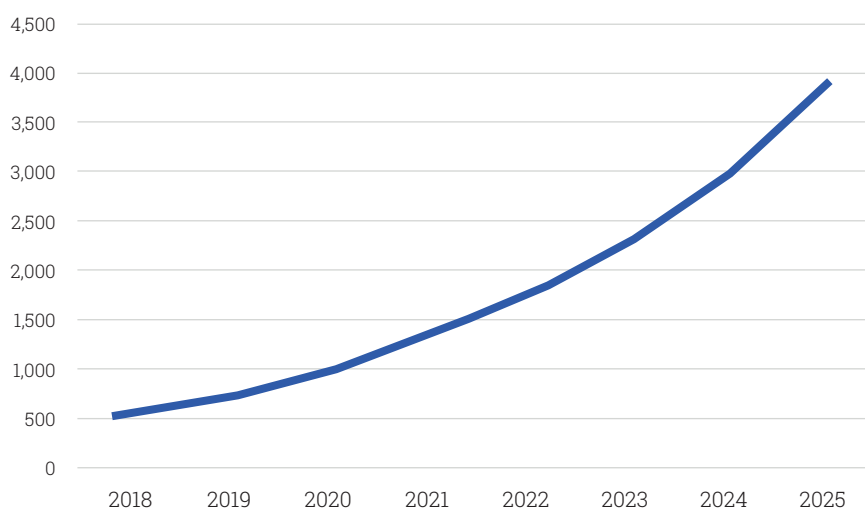


Source: Beecham Research 2020

issues with Wi-Fi is the security management of access, which is that customers or providers regularly change the service set identifier (SSID), user name, password, and those are the handicaps of using a Wi-Fi based solution. Aeris is combining cellular with Wi-Fi, so that through its platform and SIM it can remotely update the SSID, user names and passwords to make sure the Wi-Fi route is working. This is envisaged to be in residential premises, for smart home type applications, where the best method would be to use the Wi-Fi that is currently available, but have the ability to manage the credentials using cellular. As such this is a light use of Wi-Fi as opposed to an industrial use.

Another area that Aeris is now offering is satellite. Which is receiving attention at present partly because of new, low cost constellations being planned. Satellite has a role to play for niche IoT applications, as does combining satellite and cellular together as a dual mode – using cellular when you can for lower cost and satellite when cellular is not available. ▶

### What is the opportunity for high bandwidth cellular?

**Figure 1** shows projected total cellular IoT connections worldwide to 2025. Within this there are three key elements – high bandwidth (4G, 5G); legacy (2G, 3G); and low bandwidth (LTE-M, NB-IoT). As outlined above, 2G/3G growth is expected to flatten quickly during the period whereas 4G/5G will grow quickly and NB-IoT/LTE-M will also grow quickly as indicated above. Beecham Research projections are for continued overall connections growth of more than 30% per annum. This indicates the growing opportunity for 4G/5G as IoT applications become more sophisticated, requiring more data from more individual sensors and other sources to provide a better overall service.

Of growing interest in this area at present is use of 4G (LTE). This has opened up new possibilities for innovative companies to obtain data coupled with machine learning and AI. This is streaming data that provides for real-time (or near real-time) decision making. That means transporting huge amounts of data in almost real time and processing that data very quickly. That includes applications like facial recognition, vehicle recognition and number plate recognition among many others.

At the same time, processing data at the edge versus in the cloud has matured significantly. In future there will be more of a mix of the two and where the processing is carried out will depend on the economics and requirements of the particular application. The growing trend is to put more focus on what can be done at the edge before it is passed to the cloud for further processing. While that reduces the amount of connectivity for each application, it is also tending to enable more new applications that then require new connectivity.

### Aeris Fusion Platform

Fusion is about building intelligent applications on top of the networks that help Aeris customers to aggregate and enhance the data that they get at the edge, together with additional sources of data that Aeris can provide that can then go to the cloud for further processing.

For example, Aeris is focusing on machine learning and AI. An example is for a fleet management company, where machine learning is applied to learning places. The network data shows a particular pattern of the assets that are in transit where there could be places of interest. This is viewed directly from the network not from the GPS the devices have. Aeris is already offering this to a number of customers in Europe as one of the micro-services available as part of Fusion.

A further micro-service is about location-aware over-the-air (OTA) upgrades. In future, Aeris believes that OTA will become ever more critical to operations so they have developed a service specifically to manage that. In the world of LTE-M, for example, they see problems that customers previously have not experienced when using 2G that they will experience when it comes to LTE-M. Chief among those is congestion on the channels at the cell sites, where there are only a limited number of channels ▶

**Aeris Fusion IoT Network**



**Aeris Connectivity Options**

**Aeris Core Network and Value-Adds**
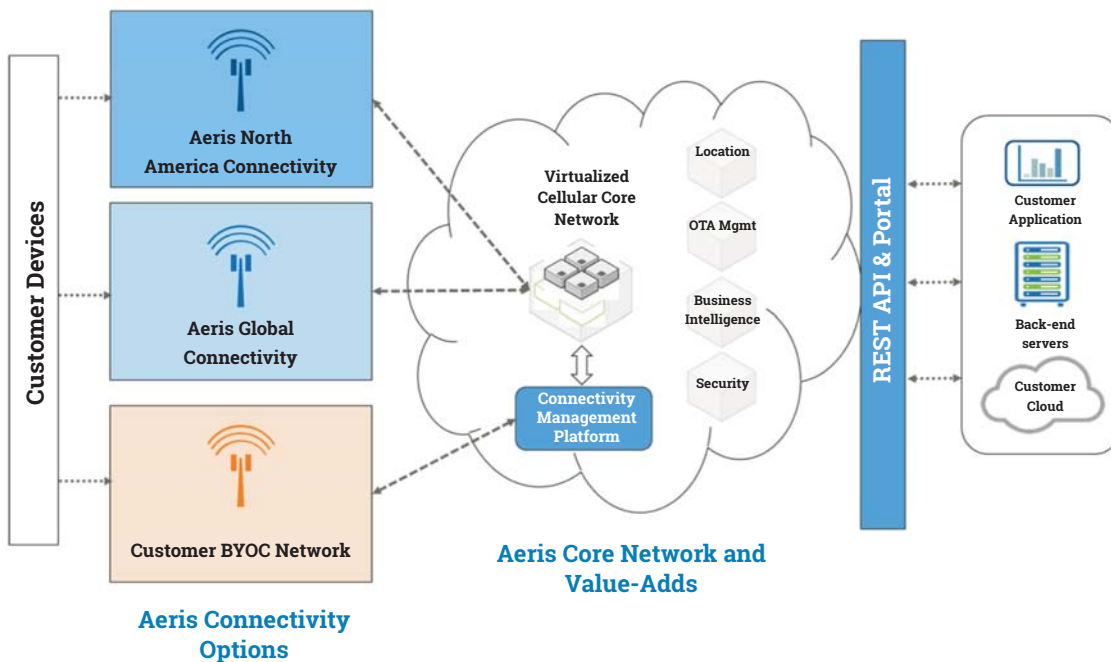
available to communicate to the devices. If you have a large number of devices – say 5,000 – that are communicating through a single cell site, then an OTA update to those devices will most likely fail.

Aeris has built a micro-service that allows their customers to sequence their OTAs rather than broadcast them. OTAs can then be scheduled into groups of devices as sequential activities, rather than all-at-once. This significantly improves the success rate of OTAs and, as a result, decreases the cost of the overall OTA activity. This will be particularly significant in the future because considerably more data will be downloaded in future as OTA updates – from network profiles, to application updates and security updates. Any time a customer needs to update their end point devices, the end point firmware itself, the configuration of the radio module

for a new security update, or the need to change the behaviour of a device regarding the amount of data collected or where it needs to go to. Even adding a new capability to it. All of that will require an OTA. Particularly with the high volumes of low data rate LTE-M and NB-IoT connections envisaged, OTA will become a central activity to operations far exceeding what is used today, and IoT users need to take into account the implications of that.

That is the nature of the Aeris Fusion network. It is to add intelligence – a set of micro-services to help customers reduce their costs, improve their service quality and take advantage of the new technologies. It brings intelligence to the application layer.

Fusion is an intelligent, purpose-built network for IoT that enables innovation on top of cellular networks to add real business value to enhance intelligence, security and also information. It is a network that enables customers to apply machine learning, to do artificial intelligence, and data processing on top of that network and enables innovation through micro-services. ▪

# IoT ORGANISATIONS FACE UP TO THE CHALLENGE OF CONNECTIVITY CHOICE

Mohsen Mohseninia is the vice president of market development Europe at Aeris, the provider of IoT services that include the Aeris Fusion IoT Network and Mobility Suite, which span from connectivity up to vertical solutions for things that move. Here, he tells George Malim how organisations can demystify the growing array of connectivity technologies and select those best suited for their deployments, not just for today but taking into account future needs, innovation and business models.

**George Malim: Do you think the somewhat bewildering choice of connection technologies impedes organisations' abilities to select the most appropriate connectivity for their deployments?**

**Mohsen Mohseninia:** It's very hard for organisations to make the right choice but, as long as they completely understand the business model upfront, what geographies they deploy in and how long the device needs to be active in the market, they can go through the different types of technology and, ultimately, come to a decision.

However, what's often unforeseen is the change in circumstances, where a customer's business requirement may change because of market circumstances. The question then becomes whether the choices they've made can support the needed changes in their environment, that's the $6 million question. If they have done their homework and spoken to consulting firms that are much closer to connectivity technology, they then can make the right decision.

This is not an easy decision for organisations to make today because they can't really change their mind next year and adapt their solutions very quickly. There are long-term cost implications to this and that's a significant challenge.

**GM: How do you see the prospects of narrowband IoT (NB-IoT)?**

**MM:** I think NB-IoT is a great thing for certain types of applications. It's not the right technology for all solutions, but there are specific types of deployments that NB-IoT is right for. These typically are solutions that are going to be in the field for a very long time and are powered by batteries. A business case might be reliant on a battery being operational for five, ten or 15 years and, if it doesn't last that long, costly replacement, involving truck rolls, will be required.

The right connection technology is only part of the equation. The price point for having the devices or modules and technology at the edge also is a critical factor. With NB-IoT, the customer devices that are coming out are cheap compared to 2G and other cellular options and that's a catalyst for new IoT-based solutions to emerge into the market.

It's not just about being the right technology for the right IoT solution, NB-IoT will enable yet-to-be-created solutions and expedite development and deployment of these. Having said that, NB-IoT is not there yet. There has been lots of talk, but it's not ubiquitous and ▶

there still is much to be done in order to get NB-IoT to the level of 2G.

**GM: Is talk of 5G a red herring given that it's not available in most markets and many IoT applications simply don't need the high speed and low latency it offers?**

**MM:** Well, LTE-M and NB-IoT are 5G-supported technologies, so already we have 5G available in the form of these technologies. However, the sexy features of 5G – the high speed, low latency and massive capacity – are all, in the first instance, consumer-related features and capabilities.

One thing that drives IoT is the cost of deploying a solution. Factors, such as the cost of modules, will be fundamental to the success or failure of deployments – the lower the cost, the more viable the service.

With 5G, we're not at the price where native 5G modules need to be. Three years from now, as people talk about 6G, 5G will be the technology that is selected, but it's not ready now.

**GM: Do you think the connectivity supply side is doing a good job or are too many of the same old providers still pushing the same old technologies?**

**MM:** I think the supply side, on the whole, is doing a great job. However, there are cases where, because of the competitive pressure on the supply side, some suppliers tend to mislead customers in terms of the technology that would best suit their purpose. I say that because I have seen this in the field when I speak to customers and they have been using technology that was not right. They've been advised by some suppliers to choose what is ultimately not the right technology for them and their business case.

I don't think this has been done deliberately but because they fail to understand or the supply side doesn't have full grasp of the customer's success criteria for their deployment. ▶

"
**I think NB-IoT is a great thing for certain types of applications. It's not the right technology for all solutions, but there are specific types of deployments that NB-IoT is right for**
"
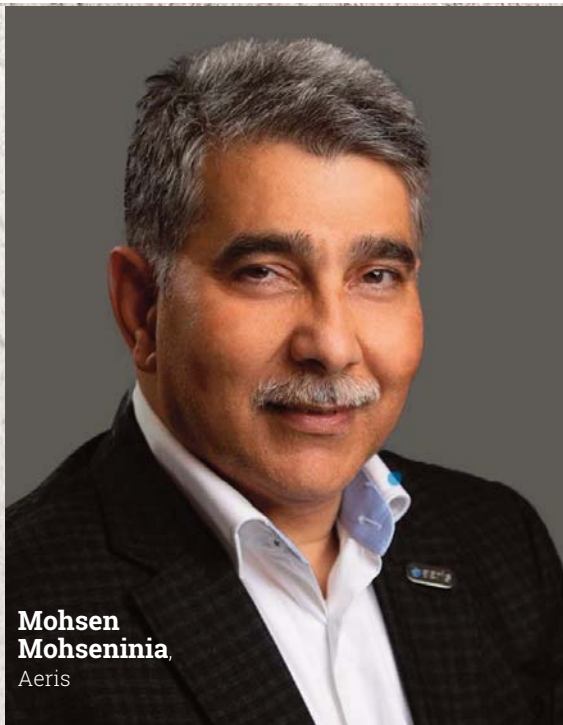
**Mohsen
Mohseninia**,
Aeris

The saying goes that you can fish better in muddy water, so some muddy the water to suit their own purposes.

**GM: With 2G sun-setting, is the starting point now LTE-M because it does most of what organisations want more of the time than the other options?**

**MM:** It all depends on geographies. In North America, LTE-M has become the *de facto* replacement for what was done on 2G networks. **Verizon** and **AT&T** are both pushing LTE-M, while **T-Mobile** is pushing NB-IoT. More and more, we see the availability of LTE-M networks around the world so customers see LTE-M as the next technology for their solution moving forward.

There is a ramp-up going on with LTE-M but hardly any customer is looking to LTE-M-only modules. Specifically, if they have global deployments, they are looking at technology that allows some risk mitigation and simplifies their supply chain with the possibility of fall back to 2G, or with LTE-M the possibility of fall back to 2G or others. These types of approach are being sought after outside of the United States.

**GM: What are the common mistakes that organisations make when selecting IoT connectivity and how can these be avoided?**

**MM:** The general mistake that they make is to consider IoT as a commodity and, therefore, focus on price per megabyte. In reality, although the connectivity itself is a commodity, the delivery of the service is not a commodity. This differs from one organisation to another where different features and benefits are required.

Our focus, therefore, is to look at total cost of the connectivity over the length of the project. We assess how we could optimise that with our tools, capabilities and service level agreements so the customer gets low total cost of ownership and the assurance they need for better quality service. Service assurance also ensures

the total cost of ownership is reduced. While we provide highly competitive prices, others can undercut us. But down the line, customers will see how a lack of assurance affects performance.

**GM: Where does Aeris fit in here? Which technologies do you prefer and how to do you add value beyond the connectivity?**

**MM:** The Aeris Fusion IoT Network is the latest addition to our technology and is designed to add value by offering intelligent services on top of our core network, such as connectivity-aware over-the-air (OTA) upgrades. We have proven through lab and field testing that many customers will suffer a significant amount of failures with their OTA upgrades if they continue to perform these in the standard way for 2G connections when they migrate to LTE-M devices, purely because of the nature of available capacity and channels.

We've developed value-added services to reduce OTA upgrade failures and, thereby, have reduced the cost of re-trying and failing upgrades. On top of this, we've improved services by making sure security patches are updated with few failures.

We are building intelligence on top of the network and that involves a lot more security and more intelligence in terms of the way devices work in the future.

Achieving cost reduction and accelerating time to market improves operational efficiency, which is what every customer wants. Of course, there is no silver bullet but there are a number of things we do to make better outcomes happen for customers.

Support is a key area that will come under even greater pressure as volumes of IoT devices increase. A lot of people think that if they have a problem, they call up and we fix it, but we think of support more broadly. It's better if you don't have to call, so we are proactively checking the network before customers, and if we find the problem before them, and if there is anything they need to address the issue, we have the tools so they can roll out that fix in a scalable and automated way.

To this end, we're continuously exploring and looking to add partners to enhance our cloud-based offerings, tools and support.

We have been in the IoT connectivity business for a long time and we have a lot of experience with customers—from small units to two million units. We have learnt a lot in those deployments and we have taken these learnings to inform our direction for the Aeris Fusion IoT Network launch.

**GM: How is Aeris different from the competition?**

**MM:** With our Fusion IoT Network, we have created a step change in efficiency. We now can have deep control of the device and we can act on the insights in ▶

real time. What we have seen in others in the market is that the insights are not actionable or they are coming too late. We have done a lot of work here and we have a lot of interesting capabilities.

The second area where we're different is in network and carrier flexibility. As I detailed earlier, there now are a lot of wireless technologies, including LTE-M, NB-IoT and 5G, but older technologies are still there. At the same time, customers want to move from regional deployments to global deployments, so a single technology carrier doesn't really work anymore. With the Fusion IoT Network, we are providing global flexibility in deployments. This is in marked contrast to force-fitting enterprises to a single technology.

Finally, this really is about the blurring of the lines between the IoT layer and the connectivity later. Historically, these have been strictly siloed and a lot of information between these layers has been isolated. With the Fusion IoT Network, we are doing things to improve security and application performance. The application is aware of the status of the device, whether it is on the network, whether it is roaming or not, or simply unavailable. In other solutions, that is not available and we think that is a big differentiator for us.

**GM: What's next for Aeris?**

**MM:** We have never been in a better position from a technical infrastructure perspective. We now have the baseline for new functionality and will be harnessing the benefits of artificial intelligence and machine learning to empower our customers further. We'll be increasing carrier portability to support our customers, many of which manufacture in one region while selling in many others.

As the market scales up, the focus will move away from per megabyte price to total cost of ownership and the value in flexibility, management and control that IoT connectivity specialists can deliver. ▮▮

> **We now have the baseline for new functionality and will be harnessing the benefits of artificial intelligence and machine learning to empower our customers further**

www.aeris.com

# WE NEED TO TALK ABOUT IoT CONNECTIVITY

**Connectivity is a subject of concern among those engaging in the Internet of Things (IoT) and the situation is only getting more complex as new options come to market and the volumes of devices to connect increase, writes Nick Booth.**

The problem with IoT connectivity is that demand is stretching the suppliers. Before we even get to 5G, the network providers have got their own version of network slicing to do within their own operations, with decisions to be made about how they divide up their time, energy and budgets. Network providers need to decide which connectivity technologies they should buy, in order to build the right supply. Which begs the question: what do these enterprises intend on doing and how?

At the moment, one of the significant choices is between two cellular technologies, narrowband IoT (NB-IoT) and LTE-M. That's NB as in narrow band and low power, versus LTE-M as in 4G networks. Which is better suited to cater to demand depends on what enterprises actually ask for.

The **GSMA** says three billion more devices will be connected by 2025. That will triple by 2030, according to data from network provider **BICS**, which also reports that demand for data roaming nearly doubled in 2018.

Demand has been shaped by governmental stimulus. One fifth of smart city connections have been encouraged by the EU's Smart Grids Task Force for smart energy. Operators like **Orange**, **Deutsche Telekom** and **Vodafone** -

which have built NB-IoT networks - did so because connections into big vertical markets fit the NB-IoT use case of generally transmitting small amounts of data infrequently.

The operators have seen that connectivity is the lowest common denominator and the big profits are in what they offer over the top of these connections. Which is why Vodafone's M2M strategy is about cloud services, not connections. Deutsche Telekom and Orange have opened IoT labs to develop application-specific IoT prototypes in order to maximise the value of the connections they supply.

Few of the IoT apps need much power for their devices, but they do need to be both on and connected for long periods of time. Think smart meters in homes, sensors in smart cities and farming applications.

## How will NB-IoT provide greater choice and meet demand better

In this context NB-IoT is the kindest technology to batteries and devices can stay on for a decade. Since it meets 5G standards it is guaranteed longevity. "It's here to stay and a safe choice for long-term IoT projects," says Mikaël Schachne, the chief marketing officer and vice president of Mobility and IoT at BICS. NB-IoT doesn't just need staying power, it needs to be easy to install in the initial stages and available globally, which it isn't yet.

Connections in the hardware in a smart factory must stay on all the time so the devices and sensors must work anywhere the hardware is used. Users must activate and connect the hardware by turning on the device - so the whole process has to be painless and easy. ▶

**tech trends**

That gets hard if each branch in each country has to buy a local SIM card and manually insert it into the hardware. This complicates the already challenging integration with local IoT platforms and commercial agreements with local mobile operators. The complexity is multiplied with each country in which the hardware was deployed.

"Native global connectivity is required and this is only possible with roaming," says Schachne.

IoT can only fulfil its potential if the new devices can have low power and no borders.

There will be other challenges for NB-IoT though. Mobile operators have to install new core network elements in order to accommodate NB-IoT, which means roaming coverage has to be redeployed and tested with each roaming partner. Is it worth the effort for them? Devices that use network resource but generate very little data usage might not fit into their model of return on investment (ROI). The operator is entitled to say show me the money.

## How will LTE-M give greater choice and meet needs?

LTE-M has fewer mobile operators running it but since it's natively everywhere that 4G roams it has wider global coverage than NB-IoT. Therefore, the opportunities for world connectivity with LTE-M are greater.

In a time of security vigilance, LTE-M is a safe bet if your hardware needs firmware updates because, by comparison, the NB-IoT downlink speed is too limited. LTE-M also supports real-time communication, though will only support devices with a battery life of a few years.

If your ambition is to roll out services domestically, right now, the choice must be LTE-M.

The NB-IoT roaming footprint will grow but it'll take some time to be truly global. NB-IoT supports long battery life with devices remaining connected for up to ten years, which is great for things like smart meters, but less ideal for real-time communications, says Schachne.

One of the impediments of the roll out of IoT is the lack of common standards, especially when it comes to the best network technology to use, says Nicolas Hauswald, the chief executive of communications specialist **Etelm**.

The choice over NB-IoT or LTE depends on the type of sensors and devices that are gathering information.

"If you've got sensors transmitting low bandwidth data from remote locations then NB-IoT is a good option," says Hauswald, "but when devices run from cars, drones and machines then LTE-M is more effective for these mobile assets."

Then there is the difference in how NB-IoT and LTE-M networks typically operate. NB-IoT networks are usually delivered by telecoms operators who provide access to the network to their customers. On the other hand, LTE-M can be run as a private network, with the business running it taking responsibility for its creation and management.

It gets more complicated though. These two technologies aren't the only game in town, say the analysts.

"While cellular low power wide area (LPWA) connections such as NB-IoT and LTE-M will make up the largest portion of M2M connections in Europe in 2023, operators face increased competition from non-cellular technologies such as SigFox and LoRa," says Ryan Harbison, a research analyst at **ABI Research**. "By putting everything together and delivering an end product, rather than just the technology, any supplier can tempt buyers to choose them."

# WHY DOES IoT NEED 5G?

With a global IoT market of 4.8 billion endpoints by the end of 2019, according to Gartner, clearly not all IoT applications need 5G. It will, however, enable some that are either not possible or pragmatic now, and transform the scale and scope of many that are, Annie Turner finds.

John Vickery, a principal technology partner in the Enterprise CIO unit at **BT**, says it makes sense not just to look at why IoT needs 5G, but to consider that a major use of 5G will be IoT, which will help to fund the investment in 5G. "There are a lot of ways at the moment to do IoT without 5G, but as an explosion of scale happens in IoT, the amount of data flowing over the 5G network will increase dramatically," he says, adding that 5G will have the capacity to carry it economically.

"Ultimately, it's about the combination of the two, and what they will do for businesses and consumers," he explains, pointing out that all the additional data "leads to deeper insights and better interventions and actions, and our customers can take better strategic decisions."

He acknowledges that although the telecoms industry has this ambition to bring 5G and IoT together, it has yet to work out exactly how the combination will bring about the desired outcomes, but states: "We are beginning to see the green shoots of some uses cases."

Bengt Nordström, the chief executive at consultancy **Northstream**, part of Accenture, comments: "5G is needed for mission-critical IoT where applications require super low latency and ultra-high reliability with cases like remote surgery, discrete automation, such as motion control, and the use of drones."

"Another IoT use case that might need 5G is massive IoT where there are millions of connected devices per kilometre," he adds. "For instance, consumers now have more and more devices that are connected, smart cities and autonomous cars are becoming a reality, and even stadia are connected."

Autonomous vehicles aside, Vickery says other applications that need low latency communications and could greatly contribute to the greater safety of workforces include remote manoeuvring of massive cranes, which can be done from the ground. Automated vehicles – from drones to heavy plant machinery and trucks – could also improve safety in dangerous environments such as mines, agriculture and shipping.

He agrees that not only can 5G help shift vast amounts of data, affordably which is a key consideration, see **Figure 1**, in real-time, but that edge processing and storage, which are facilitated by 5G's network architecture, could be used in certain applications. Here an application is isolated at the edge to reduce congestion on the network – for example, avoiding sending high definition streams across a network – or where localisation and data sovereignty are important, such as within a manufacturing plant. Vickery says: "5G is encrypted end-to-end – by nature – and LTE and 5G have some of the most robust security embedded".

Nordström adds: "Narrowband IoT (NB-IoT), a technology built on 4G, is evolving to address the need to ensure so many simultaneous devices and connections work seamlessly at the same time, and it might be considered as part of the 5G tech family. This 5G service would likely be deployed as part of the operator's macro network."

This notion of 5G being a network of networks rather than a single, ubiquitous infrastructure is key, and in particular, as well as interoperability with 4G, it relies heavily on fibre networks – in all wireless technologies, the trick is to keep the airborne leg of the journey as short as possible and get the data onto a physical, wired network.

Mikael Sandberg the chairman of **VXFIBER**, stresses: "You can't add fibre to 5G network but [you can] add 5G to fibre, and in almost all conversations we have – we are talking to 30 UK cities now – that is either not understood or ignored, but 5G starts underground with fibre." ▶

**John Vickery**,
BT

**Bengt Nordström**,
Northstream
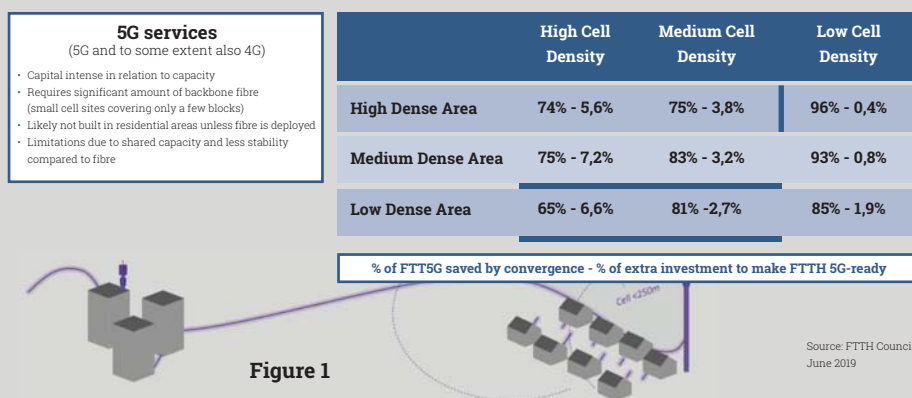
**Tom Winstanley**,
NTT Data

VXFIBER works with local councils that have smart city ambitions to help them identify what they want to achieve and look at how fibre will help them and their community, as well as understand what assets they have and how they could be harnessed. Sandberg adds, "Part of that is to look at how councils will prepare for 5G".

He continues, "5G and IoT are high on these councils' agendas, but to make it possible they need fibre as much as 5G. Often their understanding of IoT through 5G is vague. People paint pictures of use cases but the stark reality is that cities need to consider the basic infrastructure they need to make it possible."

Sandberg gives the English town of Oxford as example of where fibre, 5G and IoT will provide a solution to what has proved an intractable problem with many repercussions: it is one of the most congested cities in the UK. In three years' time, the council is to launch a self-driven park-and-ride service through electric vehicles – and the fibre infrastructure supporting 5G to provide real-time data is essential.

He explains a dedicated fibre passive optical network is not good enough for these purposes, as even a dedicated line can split the signal at the base station among users and applications that require super low latency and ultra-high reliability cannot run on an unknown input. This is why

trailblazer Stockholm has a dedicated fibre end point every 50m in the city centre, with fewer in less dense urban areas at 250m apart.

Tom Winstanley, the vice president for New Ventures and Innovation, **NTT Data** UK agrees that 5G will not be enough to support IoT without full-fibre infrastructure but is already foreseeing that. "Even 5G will not be able to achieve ubiquitously connected society because you can't build enough data centres and network points to build the society we envision," he says.

At the end of last year, NTT announced a research agenda for photonic wireless networks and recently DoCoMo, another

unit of NTT, published a white paper on 6G. As Winstanley says, with IoT you need at least a ten-year research horizon to meet the future demands and potential of smart cities and other possible innovations, as fostered by the NTT Data global Open Innovation Contest. Recent entries include autonomy as a service, composed of vehicles, drones and robots as proposed by unmanned.life, and Iotic Twins, which are not a 3D model or visualisation of an asset, but a through-life, semantically defined virtualisation of an asset.

It seems like whatever the generation of communications technology, IoT applications will evolve to exploit its speed and other attributes.

**5G will complement fibre and create business opportunities for fibre owners**

**5G services**
(5G and to some extent also 4G)
- Capital intense in relation to capacity
- Requires significant amount of backbone fibre (small cell sites covering only a few blocks)
- Likely not built in residential areas unless fibre is deployed
- Limitations due to shared capacity and less stability compared to fibre

| | High Cell Density | Medium Cell Density | Low Cell Density |
|---|---|---|---|
| **High Dense Area** | 74% - 5,6% | 75% - 3,8% | 96% - 0,4% |
| **Medium Dense Area** | 75% - 7,2% | 83% - 3,2% | 93% - 0,8% |
| **Low Dense Area** | 65% - 6,6% | 81% -2,7% | 85% - 1,9% |

**% of FTT5G saved by convergence - % of extra investment to make FTTH 5G-ready**



**Figure 1**

Cell <250m

Source: FTTH Council June 2019

# Aeris Fusion IoT Network + LTE-M

LTE-M is poised to dominate the Internet of Things (IoT) for years to come, replacing GSM and CDMA protocols. One reason is the cost — to date, cellular technologies have not been optimised for IoT deployments, leading to higher hardware and operational costs.

LTE-M is a bi-directional, standards-based protocol within the same spectrum as LTE. It provides carrier-grade security, long battery life, and low-cost modules. Another strength is that LTE-M does not need a new infrastructure as it can piggyback on existing LTE networks. As such, a carrier can update software on its network to enable LTE-M, with savings that can be passed directly to the customer.

LTE-M is a much simpler technology than standard LTE and it offers unique capabilities that significantly extend battery life. For most IoT devices, operating in a low throughput LTE-M environment is not an issue as they are only sending small amounts of data on an intermittent schedule. However, there can be issues when sending large amounts of data (for example, an OTA firmware update) while bandwidth constrained.

The resulting network congestion can lead to high failure rates, thereby prolonging the time-to-update as well as increasing costs. With the Fusion IoT Network connectivity-aware APIs, these issues can be avoided, ensuring that the update campaign is conducted efficiently and quickly, with complete information about the underlying network status.

LTE-M is today's standard, meeting security and power conservation levels suited for deployments in multiple business sectors. With low-cost modules, extended battery life, better signal penetration, and the ability to use existing infrastructure, LTE-M has the potential to improve all IoT business models.

### Launching New IoT Programmes
Get to market faster using the best connectivity network for your needs. Investing and planning a large-scale project can be daunting as enterprises have high expectations for their IoT business. That's why it's vital to make smart investment choices about infrastructure now, in advance, to ensure future viability and success.

Aeris connectivity solutions are designed from the ground up exclusively for the rigours of IoT, not retrofitted from an existing consumer system. Aeris provides a single portal for managing every device — one login for billing, support, APIs, VPN, and more. And everything is backed by our top-rated customer support teams dedicated to your success.

### Transitioning to New Technologies
Gain optimal efficiencies and new functionality with the latest IoT networks, such as LTE-M. Whether you are dealing with a technology sunset, wanting to lower hardware and battery costs, or just trying to reduce overall operating costs, the Aeris Fusion IoT Network provides the pathway to higher functionality with greater cost savings. It is a dynamic and flexible connectivity solution that adapts to a rapidly changing environment. And it comes with the highest level of support in the industry.

> **Whether you're new to IoT or a veteran of the industry, Aeris can help you get connected.**

### Replacing 2G/3G Technologies
There are many reasons companies switch technologies: Sunsetting of older technologies, controlling costs, or simply improving your IoT deployment. Businesses will need to look past the protocols and technologies of today and deploy a solution that's future-proof — dynamic, flexible, and adaptable. Adopt next-gen connectivity technologies (LTE, LTE-M, NB-IoT) to improve cost and functionality of any IoT business model. That's the Aeris Fusion IoT Network.

### Improving Your IoT Deployment
With the Aeris Fusion IoT Network, you stay ahead of the competition with industry-leading, cost-effective, and flexible cellular IoT solutions. Expanding to new coverage areas is made simple by managing multiple networks through Fusion's unified dashboard. All in all, customers save 60% in connectivity costs, reduce over-the-air (OTA) update charges by 50%, and achieve 30% faster problem resolution.

With the Distribution Channel Package, customers simplify a complex, business-critical function by creating an organised and secure environment for managing IoT solutions. The delegated billing and reporting capabilities result in a reduction of operational costs for OEMs. The Aeris Fusion IoT Network lets you do all this and more. ▶

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## Data and Device Security

Any device that is connected to the internet is at risk of being hijacked. That's the standard assumption. Businesses deploying IoT solutions are responsible for protecting data and devices, as well as any corporate proprietary data. In the context of IoT, privacy and security protocols need to ensure that access is limited only to appropriate and authorised personnel. To that end, the Aeris Fusion IoT Network provides in-depth data and device security, including:

### ConnectionLock™

ConnectionLock prevents access to unauthorised endpoints or IP addresses, creating an additional layer of security for IoT devices. If the SIM card is stolen from the device, Aeris ConnectionLock ensures that the SIM card can connect to no other IP address or URL.
- Connect, send, receive only to/from preselected IP addresses or endpoints.
- ConnectionLock acts as an additional firewall within the Aeris Fusion IoT Network.
- Aeris SIM cards cannot connect to other devices, thereby reducing security risks.
- Our solution is implemented at the network level, without added complexity or work for the customer.

### Connectivity-Aware OTA APIs

Over-the-air (OTA) updates can be deployed to thousands of IoT devices at once rather than requiring each device in the field to be manually modified. OTA updates eliminate the need to send technicians into the field, save owners time and money, and make IoT deployments vastly more scalable.

The ability to make changes to many devices remotely is important, especially for operators of large-scale IoT deployments where updating devices manually would be a nearly impossible
- Up to 50% reduction in time-to-completion for OTA campaigns.
- Up to 50% reduction in OTA failure rates and data costs.
- Scale for large deployments with ease.
- Significantly reduce manual operations.

## Visibility and Control

The Aeris Fusion IoT Network provides robust IoT lifecycle management, bound together with heightened customer support. Device traffic management provides customers with the ability to analyse performance and cost drivers and, when combined with alerts management, allows for a wide range of pre-defined or option-driven system alerts and reports, thereby ensuring optimum performance. Additional Aeris Fusion IoT Network functionalities include:

### AerPort / APIs

The Aeris AerPort™ dashboard provides a single portal for managing global deployments, including end-to-end device lifecycle management, billing status, connectivity analytics, and access to customer support. Aeris also offers a rich set of REST APIs, enabling easy integration into other management frameworks.

### IoT Analytics

By identifying devices with connectivity issues, analysing usage activity, and focusing on outliers or devices behaving abnormally, you can reduce equipment outages and downtime, resulting in decreased business expenditures. The Fusion IoT Network Analytics capabilities find insights, issues, and potential security vulnerabilities before you do.

### IoT Billing

The Fusion IoT Network's robust billing functionality enables a high level of flexibility in enabling new business models, including delegated billing to distribution partners and diverse rollover and pooling policies.

Whether you're new to IoT or a veteran of the industry, Aeris can help you get connected.

**Visit www.aeris.com or follow us on Twitter @AerisM2M to learn how we can inspire you to create new business models and to participate in the revolution of the Internet of Things.**

# CAN WE COMMUNICATE PRIVATELY?

Wi-Fi currently remains the most prevalent wireless technology in enterprise networks, but private 4G LTE cellular technology, and soon 5G, can be much more reliable and cost-effective when it comes to various industrial use cases around IoT, writes Antony Savvas.

Problems around Wi-Fi can include susceptibility to spectrum noise and also interference from steel walls, for instance. In addition, Wi-Fi can be cost prohibitive when it is called upon to provide coverage for large geographic areas, because of the large number of Wi-Fi access points needed.

## The alternative

Though cellular wireless is often thought of as a carrier service, factories, offices, public sector organisations, farms, fleets and other locations can instead benefit from deploying private mobile cellular technology. This alternative can complement or even replace Wi-Fi for applications that support IoT devices – often deployed over large areas – and which generate large amounts of data.

A private cellular network consists of cell sites and core network servers supporting dedicated connectivity for an organisation's specific requirements - independent of the cellular networks of mass service providers accessed by the public.

Companies can customise such networks for mission-critical applications and they can optimise the network for low latency to support service level agreements (SLAs). And this is without interference and contention from using congested public wireless spectrum.

Professor Dimitra Simeonidou, **IEEE** fellow and professor of high performance networks at the **University of Bristol** in the UK, says: "Organisations are increasingly building their own bespoke, private cellular networks. While Wi-Fi was always the go-to for enterprises, due to its ease of installation and deployment, those companies have since become so reliant on internet-connected devices that their Wi-Fi networks are now experiencing limited reach and capacity."

## New spectrum

She adds: "With private cellular, enterprises can build their own network infrastructures that are independent of service providers. And UK communications regulator **Ofcom**, for instance, recently opened up a part of the 5G spectrum that enables businesses to use spectrum that does not belong to a service provider. A private mobile network can better support IoT enterprises in terms of capacity and performance."

Simeonidou says private cellular networks are especially effective for companies with factories, warehouses and industrial plants. This is not least because private mobile can support large amounts of data and low latency applications.

Looking at a manufacturing company where the factory floor has deployed automation and robotics, and is operating over a Wi-Fi network, Simeonidou says: "While that company may have dense Wi-Fi and good connectivity, it cannot support a very fast and precise response – both of which are becoming critical to manufacturing processes. With a private 5G network the company can support low latency applications and high location accuracy, meaning it can do much more than it could with a Wi-Fi network." ▶

## Slice and dice

In addition, with private cellular firms can slice and dice their network for different operations. A manufacturing plant will have lots of sensors that monitor the performance of its different manufacturing processes. With private cellular, the plant can slice its network, assigning part of its network to monitor and process data while allocating another part to support separate services, therefore developing a network that supports two or more independent operations over the same service.

Until recently, there was no opportunity to do this, because plants didn't have access to their own private cellular spectrum to be able to create bespoke services specific to the manufacturing sector they were in.

## Ecosystem

Ken Hosac, the vice president of IoT strategy and business development at technology distributor **Cradlepoint**, is confident about the market opportunities. He says: "Firms have a variety of use cases that benefit from having private wireless networks across a large area. Enterprise-deployed private LTE networks will become a big reality in 2020."

"US comms regulator FCC recently approved a swath of shared spectrum that was commercially launched last fall," adds Hosac. "A variety of companies, including us, have formed a broad ecosystem of interoperable private LTE solutions that enables those commercial deployments."

Chris Bataillard, group chairman and chief executive of **WND UK**, which is part of an ecosystem that sells services around the Sigfox low-power wide area network (LPWAN) technology, says: "Private cellular networks are essentially a capacity and coverage extension of the public networks. But many cellular operators do not have ready solutions for customers to extend coverage on their premises. This is mainly due to their fear of damaging the performance of their public networks if the extensions are using the same spectrum."

"Unlicensed bands, like citizens broadcast radio service (CBRS) for instance, have opened the possibility to create private networks without the need to use scarce licensed bands," he explains. "Wi-Fi was never designed to provide wide area coverage nor was it designed to perform hand-off. LTE and 5G was designed specifically with this in mind, plus network security and centralised authentication is the norm."

Bataillard adds: "In IoT, the coverage aspect is even more important, as devices are often deep inside a building and cannot move to communicate, so private coverage extensions for many applications will become mandatory."

Despite Bataillard's scepticism, there are some traditional cellular service providers in the new market. Chris Allen, mobile private networks lead at **Vodafone Business**, says: "As more advanced manufacturing technology is adopted, new systems will collect and analyse data in real-time, creating deeper business intelligence and allowing for more autonomous functionality in production.

"5G mobile private networks are secure, scalable and able to guarantee very specific performance requirements," he adds. "Paired with mobile edge computing (MEC) where autonomous decision making can be near instantaneous, private cellular can form the backbone of an Industry 4.0 factory."

And other players are carving out niches for themselves in this evolving market. **Aeris**, for example, recently announced it had partnered with cloud infrastructure provider **Google** to support its Aeris Fusion IoT Network, an intelligent global solution for connecting IoT devices across 2G, 3G, LTE, LTE-M and narrowband IoT (NB-IoT).

The integration with the Google Cloud Platform (GCP) will focus on advancing IoT cellular connectivity, "delivering significant steps forward in security, operational efficiency and customer choice and flexibility", the partners said.

**Dimitra Simeonidou**,
University of Bristol

**Chris Allen**,
Vodafone

# WHO SHOULD YOU BUY YO

With companies in various sectors looking to benefit from the advantages offered by mobile private networks (MPNs), they should plan their buying strategies for these services carefully. Different requirements mean a new approach may be needed from simply buying connectivity from their traditional telecoms provider, writes Antony Savvas.

Mikaël Schachne, the chief marketing officer and vice president of mobility and IoT business at **BICS**, says: "We're all aware of the growing array of benefits that the Internet of Things brings to operators, enterprises, end-users and society as a whole, including productivity gains, the widening of access to essential services, the chance to reduce energy consumption and waste and the maximisation of assets. However, what's also key in this emerging ecosystem is the new opportunity it will unlock for players outside of the traditional telecoms space – enterprises themselves have the chance not only to be users of IoT services, but to become core components of the IoT value chain."

## Opportunity

James Gray, the director of technology consulting firm **Graystone Strategy**, adds: "Telcos too are presented with a new opportunity – to move from simply being providers of IoT connectivity, to offering managed services to enterprise users which do not have the experience or industry knowledge to take full control of their IoT proposition."

For telecoms providers, this includes experience and knowledge of the roaming market, as devices often require seamless, borderless, always-on connectivity wherever they are located. Providers of connectivity will therefore have to ensure that they can provide roaming services as a complete package, making it

as easy and cost-effective as possible for all ecosystem players to capitalise on the global Internet of Things.

It's not only connectivity which will be for sale either, with business analytics and intelligence services becoming a vital part of the global IoT ecosystem. These will allow users to optimise network performance; ensure the delivery of appropriate, relevant, profitable services; and to gain more insight into customers to help reduce churn.

## Cost factors

Chris Bataillard, the group chairman and CEO of **WND UK**, which provides a sensor network to various industries based on the Sigfox low-power wide area network (LPWAN) technology, says: "What is revolutionary in IoT is not the bandwidth per device, it's the sheer number of devices that could be connected to generate valuable data. But as the total data per device is very low the total cost per device – hardware, power and connectivity – must also be low. All data has value and the objective is to collect the data from each device for less than the value of that data. This therefore requires both a technology and a network that is extremely low cost and uses low power."

For Gray, traditional providers have an advantage. "Commercially, established operators often have the ability to offer the best deals ▶

# UR CONNECTIVITY FROM?

on IoT connectivity," he says. "After all, they own all the value chain and benefit from network economics. For solutions like mobile private networks they have the experience and the spectrum capacity to deliver a bespoke solution for very large deployments. But when it comes to more moderate scale solutions, there are a range of IoT specialists who may be able to deliver bespoke solutions quicker and more efficiently."

## Specialists

That's because they manage some of their own IT systems and this tends to allow them to be more dynamic, says Gray. There is also a good chance they won't be tied to one operator so they can offer multiple networks and hence more resilient solutions. And, as they are smaller, they are often more open to developing bespoke solutions, he adds, and still have access to the roaming footprint and quality networks of the host operators that they work with.

"Ultimately, I'd say it depends on the individual use case, degree of integration required into the network and the question of whether the connectivity cost is the most important element of the value proposition — in many cases it's not," he explains. "Businesses and consumers are buying into more

premium services where the connectivity layer is simply an enabler. Considering this will help establish how best you build the service to attract customers and grow, and therefore which partners are better suited to your strategy."

Catherine Gull, head of business development for mobile private networks at **Three**, says there are key things for customers to consider when choosing an MPN provider for efficient and reliable communications.

## Buying factors

She says providers must have available spectrum that has the ability to run on separate infrastructure from their public networks. The network has to be a bespoke ring-fenced end-to-end managed service for the enterprise.

Customers also need to take an ongoing proactive risk-managed approach, she adds, not an issue resolution approach to simply mitigate issues as they appear. Having clear service level agreements (SLAs) and the monitoring of the private network by a bespoke team at the service provider is crucial to this.

"This stuff isn't easy so proven experience on private networks is extremely

important. Just because the provider manages a large macro network it doesn't mean they are skilled in private networks. There is a reason why Three runs entirely separate teams with very specific skill sets in this market," says Gull.

Three already delivers an MPN at Heathrow Airport's Terminal 5 and at the key port of Felixstowe in the UK.

A number of technology suppliers are already addressing the dual required needs from customers around often demanding applications and the delivery of reliable connectivity from various service providers. These include **Aeris**, which last year launched its Fusion IoT Network, a 5G-ready solution that supports LTE-M, NB-IoT, LTE and 2G/3G.

Historically, IoT connectivity solutions have been inflexible and rigid, creating lock-in to certain networks and technologies, along with barriers to updating systems. As IoT deployments can last for ten years or more, this model is no longer tenable as the pace of change has increased with new regulations and frequent wireless technology transitions. The Fusion IoT Network turns the legacy model upside down, says Aeris, breaking up the application and connectivity silos that can exist in IoT deployments.

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