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The Race to 5G and Full Fibre:

How Telecoms, Media and Entertainment Leaders are Reshaping the Future

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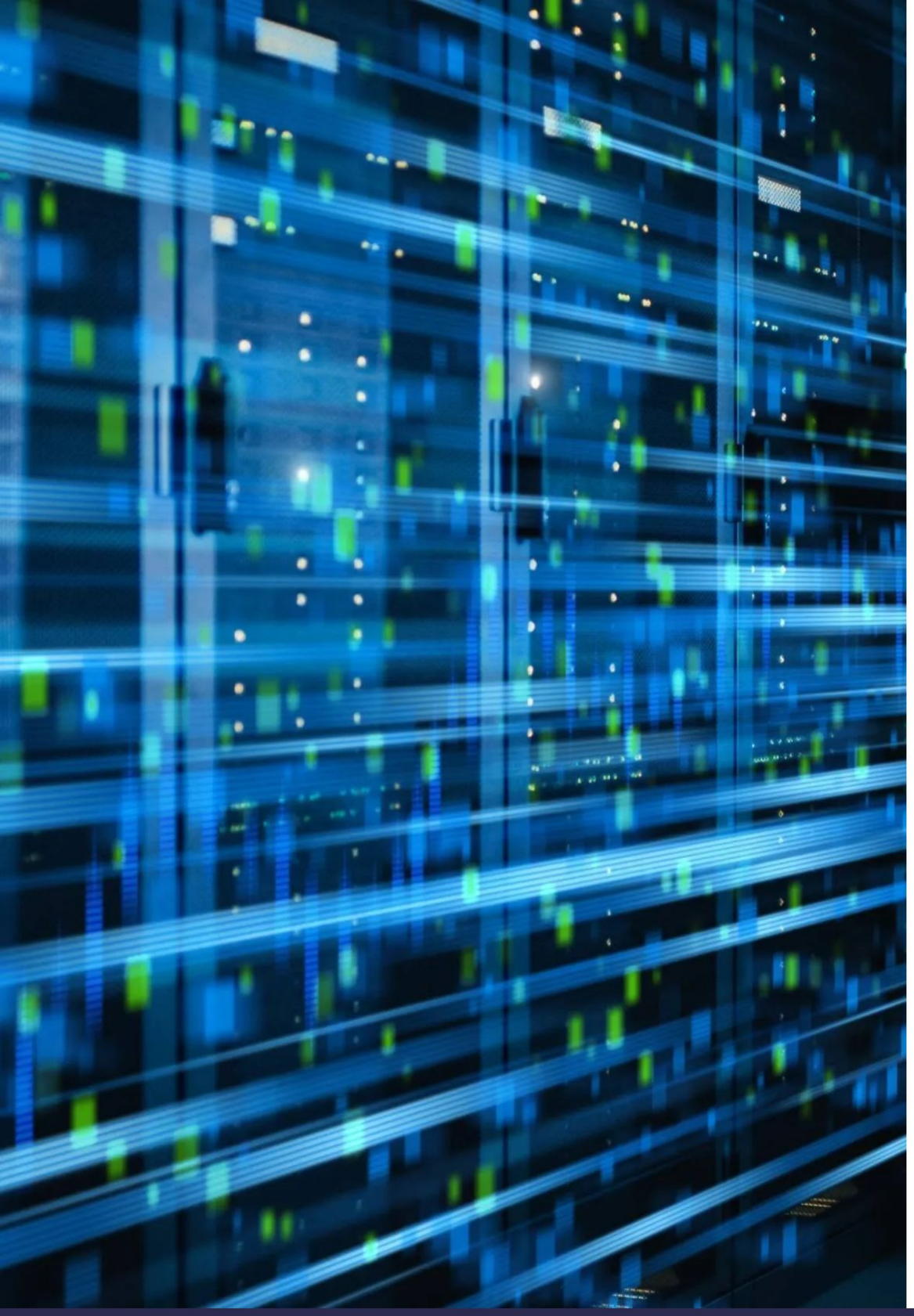

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Executive Summary

The future of a connected Britain rests on the widespread availability of 5G and Full Fibre to homes and businesses.

Advances in Artificial Intelligence, Machine Learning, Autonomous Driving, Smart Cities, and the Internet of Things, will only be realised by building resilient networks; those able to offer faster speeds, greater bandwidth, and low latency.

Alongside this, the UK Government's levelling-up agenda cannot succeed if 5G and Full Fibre aren't quickly connected within more regional and rural areas, to match the high-speed offerings already in place in so many bigger urban towns and cities.

However, for the network operators and vendors, this is a complicated journey to navigate. The race towards 5G and Full Fibre is a marathon, not a sprint, and there are many hurdles to leap over, as well as plenty of obstacles in the way of success.

In this eBook, sponsored by Esri UK, we will examine the opportunities and challenges offered by both communication technologies, and explore how the infrastructure to support this is being installed above and below ground.

As part of that, Techpros.io has taken the pulse of the telecommunications industry, speaking to many experts working in this space, from the big players to the alt-nets. The views that follow demonstrate the power of change on the horizon.

For its part, Esri brings its experience to this e-book of working with telcos and alt-nets across the UK, and globally. As the global market leader in Geographic Information System (GIS) software and Location Intelligence, it delivers solutions ranging from a digital twin of the network to OSS/BSS integration, as well as network planning. Esri UK clients include BT, Openreach, Vodafone, and EE.

As you read through the following pages, you will learn and understand:

- The challenges and obstacles to rolling out 5G and Full Fibre
- The benefits that 5G and Full Fibre will bring to our everyday lives
- How all industries will be transformed by these new technologies
- How the networks, operators, and vendors conduct future-planning
- The technology involved in identifying the right sites for installations
- The barriers to getting cable in the ground and cells on masts
- Where the telecommunications industry is heading next

We hope you enjoy this eBook, and trust it will inspire discussion and action among your own C-suite.

Next: Introduction

A successful telecoms transition is critical for society and the economy

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Introduction

A successful telecoms transition is critical for society and the economy

We now live in a hyper-connected world, where digital technology and real-time data form the backbone of our daily existence.

Globally, everything from our cars to our washing machines ‘speak’ to the smartphones in our pockets, while the planes we travel on - and the machinery used to make our favourite products - constantly feed information on their productivity and progress back to computers and cloud-based servers.

However, if innovation is to continue at pace and adoption is to grow exponentially, consumers and businesses will require greater levels of telecommunication speeds and bandwidth. Lower latency will also be demanded if we are to exchange digital information faster and across shorter distances.

Underpinning this societal transformation will be the ongoing rollouts of 5G and Full Fibre happening across the UK; these are designed to ensure homes and work premises get access to all the benefits such gigafast connections can offer.

And they are certainly needed as the Ofcom Communications Market Report 2021 demonstrates. It found fixed and mobile customers continue to use more data, with the average monthly data consumption per fixed broadband connection being 429GB per month in 2020 (36% higher than in 2019), while the average monthly data used per mobile data connection was 4.5GB (up 27%).

We also know that 5G and Full Fibre technologies will enable the future; they will ensure Artificial Intelligence, the Internet of Things, Machine Learning, Autonomous Driving, and Smart Cities, can enhance how people live their lives and carry out their jobs - thanks to the maximum speeds possible.

For example, 5G could be 100x faster than 4G, and 5G’s low latency is another major positive too. Full Fibre also brings its own huge improvements in broadband reliability, bandwidth, and speed, being up to 1,000 times faster.

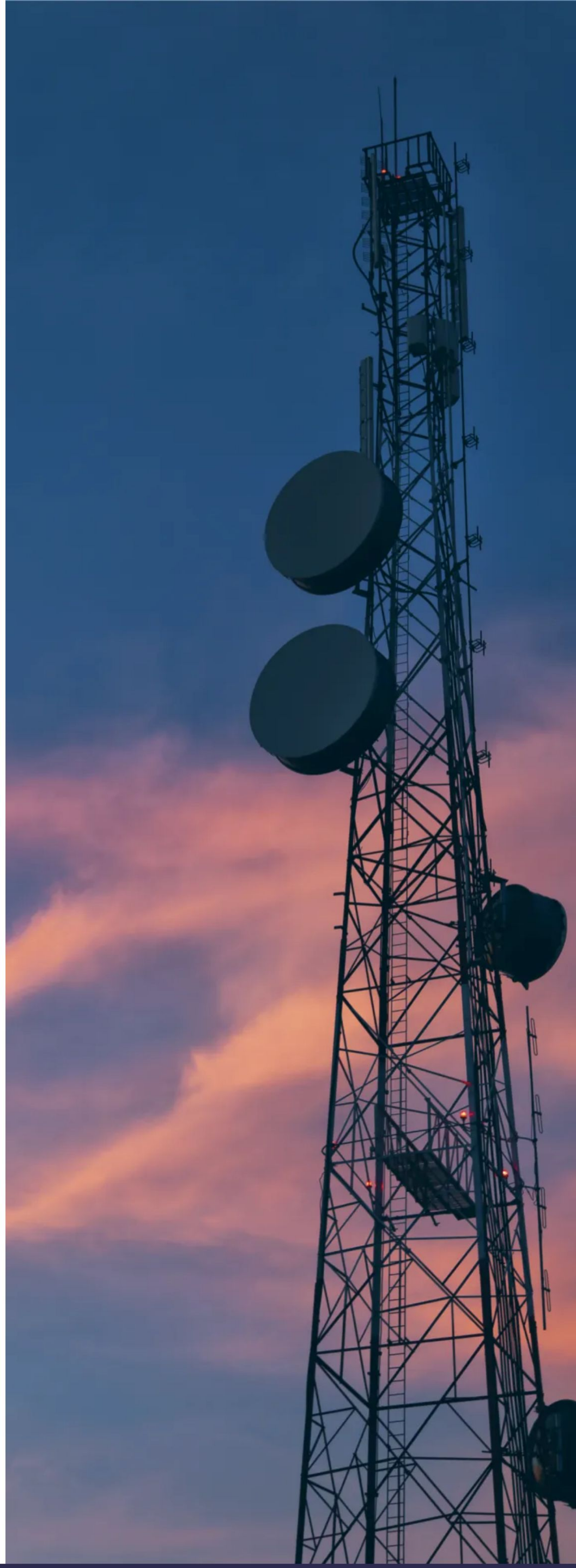
For the UK Government, these enabling connections lay at the heart of its plans to level-up the country, and represent a massive opportunity for increased employment, entrepreneurial innovation, greater business productivity, and supercharging post-pandemic remote working.

New homecare and healthcare applications will also benefit, and sustainability will be boosted too, including via lower energy usage vs existing copper and cable.

However, the deployment of 5G and Full Fibre infrastructure is a complicated jigsaw to get right - and a puzzle that might not ever be fully finished. There is a massive and complicated ecosystem of operators, vendors, and suppliers to navigate.

It is big business too. The same Ofcom Communications Market Report 2021 found telecoms revenues make a £31.5bn contribution to the UK economy. Retail fixed and retail mobile services generated £14.0bn and £12.5bn in revenue respectively in 2020, with the remaining £5.1bn coming from wholesale services.

So, as the race hots up to deploy this infrastructure as quickly as possible, this eBook will go on to explore what actions are being taken right now, as well as examine the challenges ahead. It will also highlight the opportunities a successful telecoms transition will deliver to the future of our society, and the economy.



Next: Chapter 01

The hurdles ahead for this “infrastructure of the 21st century”

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1 Chapter One

The hurdles ahead for this “infrastructure of the 21st century”

For those companies running in the race towards 5G and Full Fibre, there are many challenges and obstacles; it is a marathon, not a sprint.

However, the implications of the rollout cannot be underestimated. Kevin Murphy, MD at Openreach, describes it as creating “a completely immersive connectivity environment across the UK”.

And Nokia’s Chief Technology Officer for Northwest Europe, Alessandro Bovone, suggests this will be the first time since telecommunications were invented that “fixed and mobile are having a major upgrade and major shift at the same time”.

Reaching that milestone though isn’t easy, and it’s a journey that won’t ever actually end. What started for 5G with the spectrum auctions in 2018, will inevitably give way to 6G eventually. We will also say goodbye to 3G when it is switched off in the UK in 2033.

Until then, delivering the 5G and Full Fibre to replace it is a massive - and expensive - undertaking for networks and operators, not least ensuring that rural communities are as well-served as those living in urban districts.

This will be the first time since telecommunications were invented that “fixed and mobile are having a major upgrade and major shift at the same time”.

Alessandro Bovone | Chief Technology Officer, Nokia Northwest Europe

There are considerable hurdles to leap and hoops to jump through, including Government regulation, match-funding, and investment, as well as neighbourhood fears and concerns. The role of landlords with objections against infrastructure being sited on their land or properties is also a factor, as are the obligations of local and regional councils with planning permissions.

The sheer scale of competition in the telecoms industry is also hugely complicated, with incumbent network operators now being challenged by the smaller and nimbler alt-nets. But all must co-exist if we are to ensure Full Fibre cables get into the ground, and 5G masts and sensors are installed on structures to strengthen indoor and outdoor mobile coverage.

Resourcing and supply chain management are critical to the success of the business. Openreach’s Murphy suggests this is the biggest challenge when he says: “Demand across the industry is going to pick up in the next two years when everybody is trying to build and provide provision at the same time. That’s why having a strong recruitment, training and contracting strategy integrated with continuous process and system innovation keeps downward pressure on unit costs."

Elsewhere, “capital investment” is the major hurdle with 5G rollouts according to Keri Gilder, CEO of Colt Technology Services. “The amount of capital that has gone into the spectrum vs the actual rollout of the 5G infrastructure itself is very different from region to region,” she explains. “Here in Europe, the spectrum was so expensive that there was little capital to actually deploy the physical infrastructure of the 5G network and we are still struggling with some of that.”

Hitting deadlines and targets also becomes a major factor. For instance, in the UK the Government is aiming to deliver nationwide gigabit-broadband to a minimum of 85% of premises by 2025. The networks are also aiming to have widespread 5G coverage by the end of this decade.

What isn’t in doubt, however, are the benefits of both technologies. Gabriel Yepes, Head of Networks for Gigaclear, describes 5G and Full Fibre as “complementary to the solution of bringing broadband and connectivity to everybody. They don’t necessarily negate each other,” he also suggests.

And according to PWC’s Powering Your Tomorrow global report, the rollout of 5G technology will drive a business, skills, and service change worth £43bn to UK GDP by 2030 - suggesting it "puts a new lens on advancing productivity and rethinking entire business models for the future".

For Juan Francisco Redondo, Senior Manager in Three UK’s Strategy and Architecture Team, a healthy competitive landscape, along with economic and political stability, is a fundamental requirement to incentivise 5G and Full Fibre investments. “This is the infrastructure of the 21st century,” he says, and a “key enabler” for the next generation of apps, content and ‘magic’ to be born and flourish under a thriving ecosystem of technology and business partnerships.

This is the infrastructure of the 21st century and a "key enabler" for the next generation of apps, content and ‘magic’ to be born and flourish under a thriving ecosystem of technology and business partnerships.

Juan Francisco Redondo | Head of RAN Strategy and Architecture at Three UK - Hutchison 3G

Next: Chapter 02

Achieving operational efficiencies and breaking down barriers

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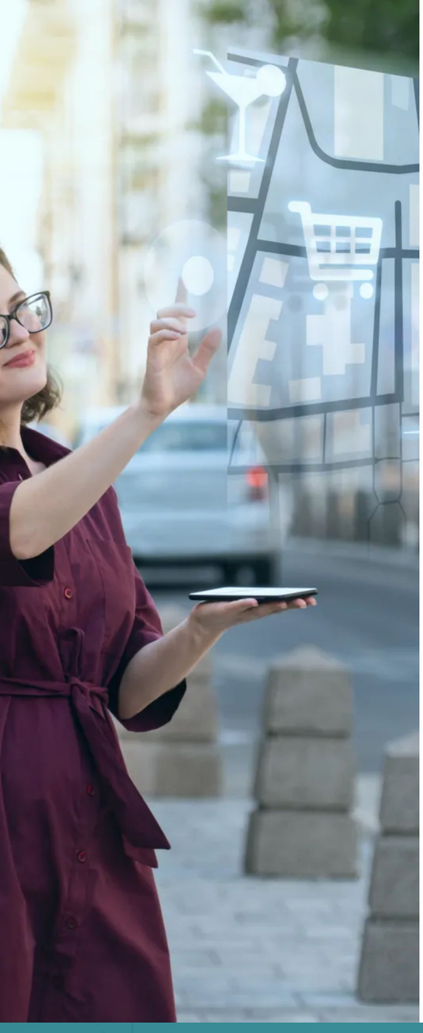

2 Chapter Two

Achieving operational efficiencies and breaking down barriers

The rapid deployment of telecoms infrastructure dominates C-suite decision-making within the telecoms industry, and elsewhere across all industries.

Speed-to-market of 5G signals alongside Full Fibre in the ground creates a competitive advantage for the networks and vendors - and drives customer acquisition and growth for the providers.

Colt's Gilder suggests that the power of 5G and Full Fibre means "the line between consumer and enterprise is starting to blur". "You'll start to see the access infrastructure becoming ubiquitous," she says.

For the consumer, this offers many positive outcomes, from access to remote healthcare monitoring to becoming part of online gaming communities. In the future, it will also allow people to play a full and active part in the metaverse.

Another critical function will be the unlocking of the potential of the Internet of Things and Augmented Reality, as well as real-time data. This will be critical to the progress of so many companies.

Additionally, 5G's enabling of widespread remote operations—such as remote fixes and working away from the office—will also transform workplaces and cultures.

Gilder adds: "I believe data and analytics will take the lead on business decision making. Regardless of what your operating model is—whether it's smart manufacturing or finance and banking—you're going to have an environment that is more data-driven, more AI-driven."

To achieve all of this, and hasten the arrival of smarter digital cities, many conversations must first happen in boardrooms, with lots of difficult decisions to take in partnership between networks, providers, and vendors.

Openreach MD, Kevin Murphy says: "We've done a lot of work with infrastructure companies across the UK around smart buildings and smart infrastructure. There's a lot of thinking going on now around sensors being built into infrastructure so everything will talk to everything; this is all enabled by high-speed connectivity."

However, this will throw up several issues, such as cost responsibility for building and maintenance. Establishing the right IT systems, architecture, and infrastructure becomes a joint responsibility to achieve.

Big choices remain on the siting of Full Fibre cabling. Who owns the land and what permissions are needed are chief concerns, along with knowing what environmental obstacles might prevent 5G's signal propagation. For example, transmission cabling might be required to connect 5G cells, rather than them daisy-chaining wirelessly, if the likes of trees and buildings are in the way.

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>
> **Kevin Murphy | Managing Director, Fibre and Network Delivery at Openreach**

For rural community rollouts, an early understanding of what sort of terrain you are working with is also top of the list of requirements.

Gigaclear's Gabriel Yepes says: "Planning is a major problem for us, plus permission studies and regulation with local authorities. It makes it challenging sometimes to dig up roads and motorways, for example."

"Obviously we want a nice and beautiful countryside not cluttered with equipment, but at the same time, we need the equipment to provide these services."

In some areas, overbuilding will need to take place to prepare these services for future housing and commercial properties. However, this takes much oversight of local plans and potential planning applications, and disruption of works to nearby communities must also be factored in.

Some of this could be solved by using 5G 'fix wireless access'. Deloitte's TMT Predictions 2022 highlight how 5G is giving fixed wireless access (FWA) a popularity boost versus wired broadband, and this could potentially help to bridge some of the digital divide.

It is this technology that leads Three UK's Juan Francisco Redondo to admit "we can't expect to continuously dig stuff or build new towers or a new master." He references "the power of landlords" in the upgrading of infrastructure and says the whole ecosystem must understand "the nature of the beast to contribute or facilitate."

He adds: "We want 5G technology and the deployment of new antennas, fibre, and the systems that are needed to support them, to happen swiftly. That's not necessarily the case, but the benefits we will get from these new technologies are incentivising everybody to try to overcome the challenges. That's good news!"

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>
> **Juan Francisco Redondo | Head of RAN Strategy and Architecture at Three UK - Hutchison 3G**

Next: Chapter 03

How location intelligence will enable the speed to succeed

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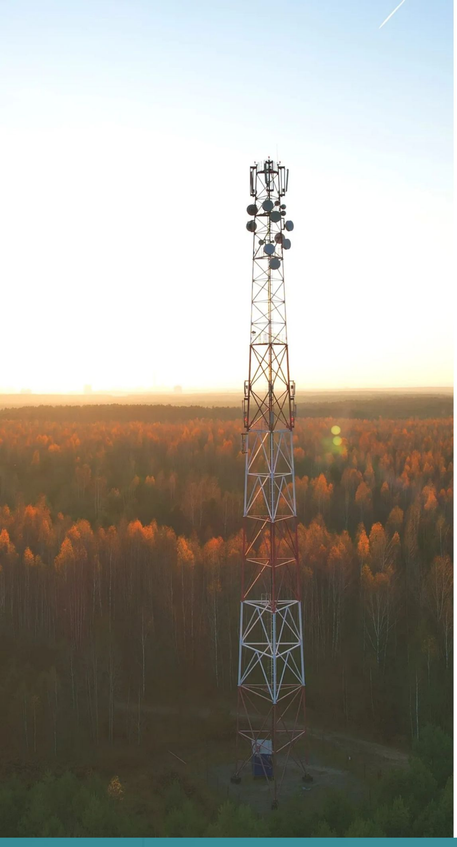

3 Chapter Three

How location intelligence will enable the speed to succeed

The race to 5G and Full Fibre is not being run in a straight line; it's not even being run along a flat surface. The rollout of both technologies requires complex investigation, planning, and inspections of all kinds of terrain before cables can be laid or masts erected.

Initial investment in this stage of the process is critical and costly, but too often reliant on many field visits and much human-led data mining. It is time-consuming to unearth the required information and regulatory details about proposed or potential sites.

However, technology is now making this process simpler and easier. A Geographic Information System (GIS)—like those offered by Esri—can create, manage, analyse, and map all types of data; for instance, location data (where things are) and descriptive information (what things are like there).

This in-depth oversight from afar—and from the start—is crucial to a successful rollout and can speed up the process. It can also remotely identify issues that crop up, reducing the frequency and cost of site visits.

Such systems are also instrumental post-rollout, helping engineers to find faults and get fixes done fast. Openreach's Kevin Murphy says: "We have invested a lot in our GIS systems, the ability for our engineers to visualise the network in real-time, almost like a digital twin."

"We've used a lot of computer power to interpret the network, the ability to use AI to understand how these connections are made, what's right and wrong, and to give more intelligence to the engineer," he adds.

Better planning of network infrastructure through GIS can prioritise profitability, ROI, and community need, assisting with a better understanding of the environment, the target market, and competitors.

> We have invested a lot in our GIS systems, the ability for our engineers to visualise the network in real-time, almost like a digital twin. We've used a lot of computer power to interpret the network, the ability to use AI to understand how these connections are made, what's right and wrong, and to give more intelligence to the engineer
>
> **Kevin Murphy | Managing Director, Fibre and Network Delivery at Openreach**

Bringing together so many different data streams can offer a competitive advantage, especially when knowing who owns which pieces of land or which buildings. Identifying the right structures to mount on, having sight of the obstructions in the way, and what the flood risks are, remain key to this too.

Three UK's Juan Francisco Redondo explains: "More and more we can do network planning work remotely, as well as managing what we do when on field visits, both proactively and reactively."

Gigaclear's Gabriel Yepes also speaks highly of the critical dataflow from telemetry tools, especially for on-going monitoring and maintenance of networks. It reduces the number of people the company must deploy to sites, cabinets, and underground cabling to investigate in-person.

AI and Machine Learning have a major and growing role here too. Yepes says: "We need less people to run and maintain the network. All the datasets can now be combined into our analytics platform so we can send out specific people with the right skill set. We are more intelligent on how we deploy."

To achieve this, the company takes advantage of Augmented Reality (AR) technology, using Microsoft's HoloLens which allows a technician on-site to show the problem to someone elsewhere who may have greater technical skills.

At Openreach, GIS reduces the amount of paper and emails needing to be read manually. "It is a real gamechanger," says Murphy, "because for the networks that were built over the past 100 years—the manholes, telegraph poles, etc.—things haven't always been recorded properly and things have changed."

He adds: "To be able to see it all visually, a digital twin representation in your hand, and be able to modify that instantaneously, has fundamentally changed things for our engineers who do provisioning. We've pushed a lot of power into the engineers' hands."

> AI and Machine Learning have a major and growing role here too. We need less people to run and maintain the network. All the datasets can now be combined into our analytics platform so we can send out specific people with the right skill set. We are more intelligent on how we deploy.
>
> **Gabriel Yepes | Head of Networks**

Next: Conclusion

A geo-spatial approach is key to achieving 5G and Full Fibre goals

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Conclusion

A geo-spatial approach is key to achieving 5G and Full Fibre goals

For many network operators and vendors, this push towards 5G and Full Fibre is not about winning the race, it's about staying competitive—and in it.

The rise of the alt-nets is forcing bigger players to think and act more cleverly, and if a connected Britain is to compete on the world stage, there might be a need to work more closely together to deliver on this aim.

Openreach's Kevin Murphy suggests: "There's a lot of communications providers, everybody is looking for a foothold in the market."

One of the new telecom operators is **CityFibre**, and **Alex Blowers, Director of Regulatory Affairs** at the company says its aspiration is to build at least eight million connections to premises across the UK by 2025. "We see ourselves as the kind of emerging challenger to BT and Virgin Media, a sort of third player in that ecosystem to particularly build in parts of the country that have been left behind and neglected."

CityFibre is one of a growing number of these nimbler players. **David Payne, Technology Strategy Manager at Virgin Media**, explains how not so long ago, there were only a "very small handful of main players offering connectivity"; this has exploded in the UK in the last three to five years.

He says: "You've got your traditional infrastructure owners like us, Openreach, and so on, and then the likes of CityFibre, a new player in that space. The difference they bring is they're doing a wholesale-only model. That's challenging the lower income brands like ourselves to think about our offerings."

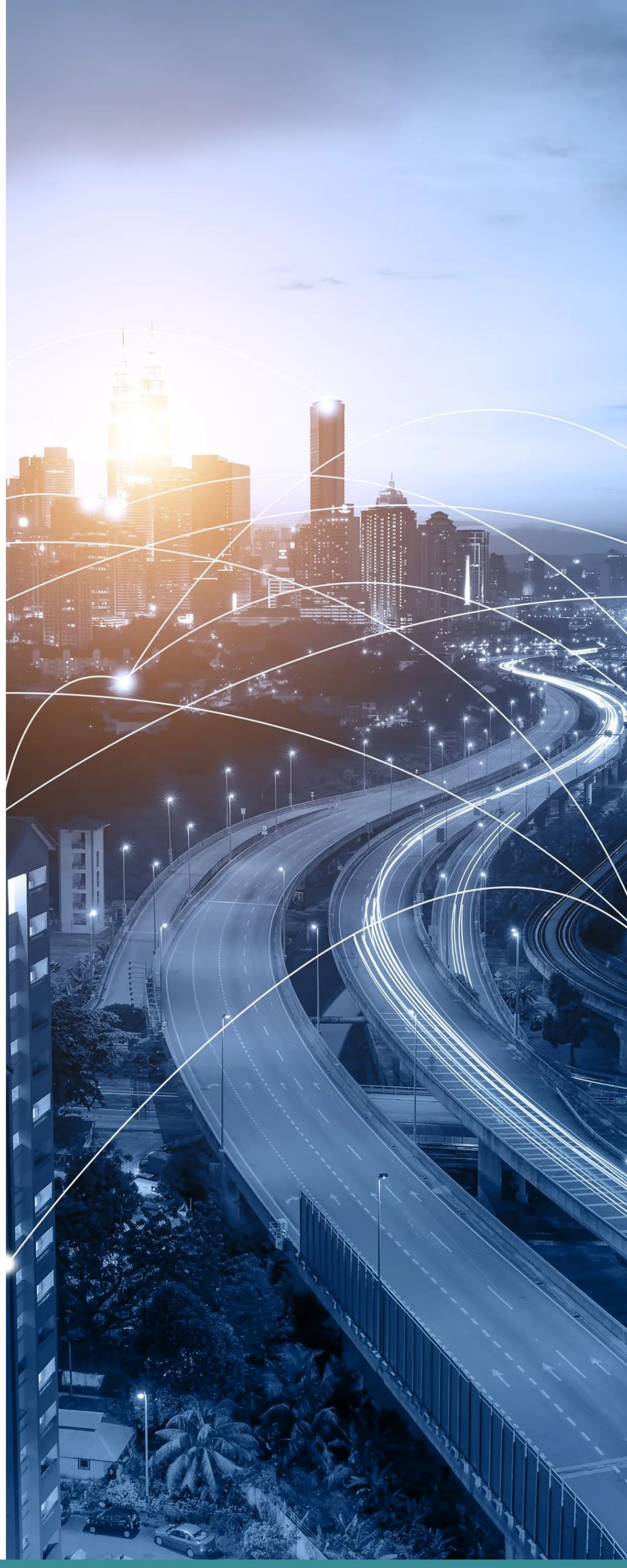
"Can we offer wholesale packages of connectivity, be it 5G or fixed fibre, the gigabit speed stuff, as well as the traditional business to customer offerings?"

Payne believes all this competition will eventually lead to greater differentiation around additional layers of offerings, from customer service to driving customer value as well as the numbers of sensors and environmental monitoring devices each company can invest in and install to drive smarter cities.

There is no doubt that the UK telecommunications industry over the next few years will be at the forefront of country-wide transformation. The competition to roll out 5G and Full Fibre though is fierce and many experts remark how we might see much merging and consolidation, as a more common standard comes to the fore.

In the meantime, the telecoms market has a geographical challenge and operators need to automate and optimise performance to allow speed-to-market to secure new territories before their rivals.

Investing in a geo-spatial approach across the enterprise (not just the planning team) will reduce the total cost of deployment and increase the value of the business by having a digital footprint of the network. Interesting times are ahead!



Richard Stevenson
Telecoms Commercial Lead at Esri UK

For more information regarding Esri UK's products and services, please contact **Richard Stevenson** via email at **rstevenson@esriuk.com**

Next: Further thoughts

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Further Thoughts

Since the late 90s, the trend has been to "move the brain to the center" and "the eyes and hands to the field." However, as companies merge, they'll need a "strong hand at the center" to avoid the danger of limited integration and poor customer experience.

Kevin Murphy
Managing Director, Fibre and Network Delivery, Openreach

One of the by-products of digital transformation and agile, which I think is the more powerful thing to value, is not the cost or speed to market; it's the fact that the organisation transforms from being a delivery organisation to an ideas organisation.

Ash Roots
CDO, BT

For us all to truly benefit from what 5G can enable, such as driverless cars, the infrastructure has to be in place across the whole country, not just in parts.

Shawn Nolan
Head of Technical Operations - BDUK

As we continue to roll out 5G and Full Fibre, we are, literally and preverbally, paving the way for the next generation of apps, content, and 'magic' to be born and flourish.

Juan Francisco Redondo
Head of RAN Strategy and Architecture,
Three UK - Hutchison 3G

Every interaction on a mobile phone or laptop provides telemetry data back to the network, which presents the problem of dealing with massive amounts of data. As technology improves, we can process this information more easily in back-end systems, which can sift through these vast data sets.

Gabriel Yepes
Head of Networks

The business case, investment, and technology required for 5G and full fibre rollout is already in place; however, we are dependent on competent field services to deploy this technology on the ground. There is a considerable gap between the demand and supply of the qualified resource.

Milan Parmar
Head of Service Management, Ericsson

5G is currently just an extension of existing consumer mobile services; there isn't any penetration within enterprise businesses. It looks very nice on the road map, but there is still a long way to go and a market to be explored.

Jose Revuelta
IT Solutions Architect, BT

Smart factories make up about 10% of the overall factories across the world with various levels of digital maturity. 5G has enormous potential to transform factories in many areas, from automotive to other manufacturing industries and high-tech manufacturing with robotics, AI and industrial automation.

Soundar Rajan Kannan
Head - ORAN and Edge Cloud solutions and Engineering, Nokia

In the long run, before we get to 6G, we will see private mobile wireless become as easy to set up as our wifi at home.

Rashdan Rashid
Digital Transformation Director

You've got to understand the data you need and the value it will add. Otherwise, you'll spend more money analysing data rather than gaining its actual value.

Hitesh Parekh
Senior Program Manager, Nokia

First and foremost, the physical infrastructure must be in place to unleash the unparalleled power of 5G and full fibre.

Umar Sattar
System Introduction Manager

To gain the full benefit of full fibre and 5G, acquiring and setting up sites is of primary importance now and for the foreseeable future.

Chris Jefferies
Acquisition Senior Manager, Vodafone

5G will be integral to the gigabit society but you can't have 5G independent of full fibre - as our world becomes more wireless it also becomes more wired. This provides a critical foundation for the digital infrastructure of tomorrow.

Keri Gilder
CEO, Colt Technology Services

Network availability to provide high capacity and low latency will be beneficial to monitoring and making reasonably quick decisions on how your assets are being managed.

Malcolm Corbett
CEO, INCA

Edge computing would be an enabler for the more efficient processing of 5G data, and this separation of infrastructure, with more intelligence moving out towards the cell sites leads to a network that is less centralised.

Chris Taylor
Project Manager, Virgin Media O2

Delivery of M&E is fundamentally changing with the 5G & full fibre rollout. The consumer will be one of the key winners in this, enabling them to consume anywhere, anytime, without experiencing old issues.

Alex Blowers
Head of Regulatory Affairs, CityFibre

The home will be the battleground in terms of experience with full-fibre as an access technology. As is rolls out in parallel with IoT, device proliferation around the home is scaled up. You might have 50+ devices, one of which could create issues that have nothing to do with the access technology.

Peter Wilson
Principal Technology Partner, BT

We must look at the pandemic's impact on people's general perception of data and how we use it. For example, there was much concern around the vaccine track-and-trace app and being asked to check in or have their movements monitored. The public is apprehensive now, not realizing this has been the case for several years through social media, when we attend events, take pictures with friends, then tag the location when we post the content.

David Payne
IT Innovation Architect

With 5G private networks, we'll be capable of doing things that were not manageable before, facilitating robot connection and connectivity that will allow the industry to speed up production and operate more efficiently and with fewer errors.

Alessandro Bovone
CTO North & West Europe, Nokia

Next: Find out more

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Esri is the global market leader in geographic information system (GIS) software, location intelligence and mapping, helping customers unlock the full potential of data to improve operational and business results. Founded in 1969, Esri software is deployed in more than 350,000 organisations including 90 of the Fortune 100 companies.

Esri UK offers GIS solutions to a wide range of markets in both the public and private sectors. Customers include EE, BT, Openreach and Vodafone.

To explore how location intelligence is key to solving the challenges discussed in this eBook, please contact us by email at **sales@esriuk.com**, by calling us on 01296 745599, or by visiting our dedicated UK telco industry webpage at **esriuk.com/telecoms**.

FIRESIDE CHAT

The Race to 5G and Full Fibre: How Telecoms, Media & Entertainment Leaders are Reshaping the Future

We hosted a Fireside chat on the subject with 3 guests: **Shawn Nolan** (BDUK), **Letizia Guadalupi** (Viberoptix) and **Alessandro Bovone** (Nokia).

These collaborative 90 min sessions (exclusive to your business) are moderated by TechPros.io. They help teams align on a common vision relating to the chosen subject, build momentum, push forward an agenda, and provide inputs to a business case for change.

Watch the video

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FIRESIDE CHAT

The Race to 5G and Full Fibre

How Telecoms, Media & Entertainment Leaders are Reshaping the Future

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FIRESIDE CHAT
TechPros: Thought Leadership series

The future of a connected Britain rests on the widespread availability of 5G and Full Fibre to homes and businesses.

However, for the network operators and vendors, this is a complex undertaking to navigate. The race towards 5G and Full Fibre is not just about rolling out the latest technology as fast as possible, as well as plenty of obstacles in the way of success.

To complement the eBook, sponsored by Esri UK, TechPros.io invited 3 industry leaders for a fireside chat.

Thank you to Shawn Nolan (Ofcom), Letizia Guadagni (Vitesyntis) and Alessandro Bovone (Nokia) and again to Esri UK for sponsoring this chat.

Jermaine Edwards
Podcast Host, TechPros.io

Shawn Nolan
Head of Technical Operations - BDUK

Letizia Guadalupi
Design Director, Vitesyntis

Alessandro Bovone
CTO North & West Europe, Nokia

Jermaine Edwards: Welcome again to the Esri podcast, hosted by Techpros.io. This is the conversation around the race for 5G and full fibre, so how telecoms, media, entertainment leaders are reshaping the future.

I'm going to start with this really big statement which comes out of the upcoming ebook on this topic, and one of those statements was this:

The future of connected Britain rests on the widespread availability of 5G and full fibre to homes and businesses.

That's quite a big statement and obviously the government manifesto currently has a commitment to getting a minimum of 85% of premises nationwide with gigabite broadband by 2025, so a lot of really ambitious targets.

First question to you: what do you see as some of the major challenges to rapid deployment of fibre, particularly in the areas of things like partnership or access to technology or tools, or even knowing where to deploy fibre to maximise return on investment? Any thoughts around that to kick the conversation starting with you Shawn?

Shawn Nolan: Yes, so that government commitment of the year 2025, that's the team that I sit on, actually trying to hit those targets. It's quite poignant, we have that quite often, every day, to try to hit those targets. I think, from a high level in my experience, probably less on the technical stuff and then the data science stuff that we're doing around where to deploy fibre to, I think the first one then has around that, but the biggest challenges that I've seen so far, working with multiple altnets across the UK is very much that the market is actually very against their plans to roll out.

We see a lot of altnets springing up all over the place, I think there's currently around about 40 altnets trying to deliver fibre, and they're in various states of investment, various states of design, and what I see at the moment is that it seems to be a lot easier to get funding than it is to get access to overcome the technical capabilities. Where that could be, you know, getting the right civils, contractors and the right skills to actually deploy that network once it's been designed, advertised to the investment body, whoever the investors are or which indeed they say every month to the board. So that's my biggest one, is that there seems to be, at least, a lot of cases and a little bit of a mismatch between the ambitious targets without necessarily having that technical or civils capability to deliver those targets. So, I think that's probably where I see the biggest challenge, getting the investors want to know that there's a really good return of investment, but at the same time, I see that there's more people in that kind of business here, and less people in the technical delivery twilight, people that can deliver and the other technical people who actually deliver something besides a flashy PowerPoint. So it kind of sounds like a cynical take on it a little bit, but with my experience having sat on, I look for what's broken and not necessarily what's fixed. It's more or less an investigative mindset that I have, and I think that's where I see the biggest issues, capabilities, so that's kind of my initial thoughts.

Jermaine Edwards: Clearly you've got an array of varying different kinds of things that may come into play into wireless capabilities, which may not necessarily be there against those deadlines. We'll continue to hear from Letizia, what your thoughts are around that, considering your position and the business as well.

Letizia Guadalupi: Based on my experience, I'm more into data, and I think those numbers, set up by the current mentor or vender, the race for the fibre increases the competition, we see where there's more need of ownership, there's more competitors, then you have service priorities, so you need to understand from a data point of view, where is the best investment to go. Is it in the city? Is it in the need to to ask for permits, or to pay for charges or fees on the roads. Then you have the fibre planning route perspective and you need to choose the right architecture, maybe, based on what is on the ground, which is based on how many aggregates there are in homes. So this kind of planning needs to be done very carefully, and I think that's where I see the, I'm not sure if I'm right, but the businesses is rely on the most advanced tools and especially to be sure that people are not scared about this, but they will embrace the new tools available, and develop within the tool, and stay up to date with technologies. That's my opinion.

Jermaine Edwards: That's interesting, clearly it's a complicated journey to understanding all of the data points that you've got to look at, there's a lot of a marathon, as we work through competitively but also collaboratively in terms of how that works out across different businesses. Alessandro, from Nokia's perspective, how do you view this as you look at the business case for return on investment, or the way in which you might serve your clients as well?

Alessandro Bovone: It's a very interesting discussion because I can see all of the challenges that I've seen in the past, and I've been in the industry for 25 years. When I look back 5-4 years ago, the main issue was to find investment, and to find these kind of opportunities. Now they are there, the investment is coming from many investors who want to put money in the fibre, and I think the challenge now is that everybody got a good idea where to go and we see a diversification, where all these altnets, they've been acquired by incumbents, they've been sold, but at the same time, I think the two main things that I've heard, the delivery, yes it's a very challenging situation for many of them.

It's a challenge today also because the workforce, perhaps, is not fully trained and is not there to support this massive amount of deployment that we have all in one go. And maybe the problem comes from the past, we don't invest in the fibre in the last 10 years in the UK, because a lot of the companies rely on people from abroad to come and work in the UK and so on. That means that as an impact, of course you've got high demand, less level of availability of the workforce.

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Jermaine Edwards: This is interesting, so considering the array of challenges that you've all shared; delivery and execution, workforce, as you've mentioned Alessandro, the appetite for 5G, and I think that's the one that's driving the high demand, low available talent, maybe come into the fact that you're planning technology deployment. What would you say today, is the biggest challenge directly to be able to support, provide and deliver on the ambitions that we have, and what are you doing as an organisation to perhaps mitigate some of those risks or take advantage of the full fibre development? I'll go back to you Letizia on this one.

Letizia Guadalupi: I think it's about communication, coordination and integration between people, that's like between the altnets and the incumbents. So, that's what we need, when we run a business, we want to have communication between people, that's the first key point there, we want to go up at a hardware level, so we would like to have a unique platform to work on, to plan, to design and to deploy, so that we can have a unified way of communicating data and reports and everything that is produced in the same platform, and a unified process for the quality checking of the job. This will save time, reduce the manual areas, miscommunication and, obviously, increase the quality of the job and the productivity. I think the challenge here is to overcome the miscommunication within a company between people and data.

Jermaine Edwards: Thank you for that. Shawn, would you agree with those particular points or recognise them? What would you add to that?

> There's a huge amount of value in being able to have a more robust business process and to be able to automate that.

Shawn Nolan: Yeah absolutely, I 100% agree with that. So, two points from a high level view, I would say that business process which links into the communication across the individual departments, whether it's on a task level or a program level, I think a company really has the advantage, or the edge if they really understand that side of things and have a really robust process in there. I think, as I've seen in the stream, design the full end-to-end delivery on this.

I've seen a lot of companies, I've been in companies where they haven't understood the value set of things and it's been such a fabricated item through that chain, whether it's the deployment of either a particular street or a village and the actual fibre connectivity. So, I think that's probably the biggest one, is being able to come with an exceptions process, so if this doesn't happen then do that.

There's a huge amount of value in being able to have a very robust business process and to be able to automate that.

Jermaine Edwards: Extremely pertinent, particularly that transformation element of digital and how that's being deployed, particularly in younger companies, but also in those more established companies as well. Shawn, I'll go back to you regarding the best practices of how to go and reach those goals. I'm curious to hear more about that in a second, but Alessandro, what would you add to that in terms of a new challenge, or ways in which you mitigate your own risk, in the sense of?

Alessandro Bovone: Yeah I totally agree with what has been said and I hear everything, but I think that we need to be fast. We need to be fast, to speed up everything. You want to do the things right in the first attempt so that means you really need to have automation, again the kind of capability for anomaly detection, and is something that also we are supporting most of our customers to develop these capability tools. It's right, normally they are the youngest.

They mostly have this skill set and it's good because in the past we have a new generation coming along. We have been always told that telecommunications is a dying industry, but actually it's not because we have always had the injection of new ideas. The other point is that sometimes I see companies that are a bit stuck in delivery, the same things over and over because they think it's still the right thing to do, although sometimes a more agile approach is needed, to take a bit of a risk, to change a bit of the architect, or change something that is not working and to create a huge success. I've seen that change some of the mindset of some people in the last couple of years, and I think that definitely it is this kind of willingness to try and have this kind of possibility to have a portfolio of architectural changes that you can choose and you can pick. Maybe in some of these kinds of situations, there is a lot more that is possible to do, to push boundaries. The investment is there, so I don't think that any of the companies we are talking are too short of money to invest in these kinds of capabilities.

Jermaine Edwards: This is interesting. So clearly 5G and full-fibre infrastructure is a complicated jigsaw to get right. Massively complicated ecosystems, operators, vendors, suppliers to navigate and so forth. So, considering those things that you've identified there, what role is currently being played by technologies playing, being able to support? We talked about automation and things like this, but what role is currently being played by technologies that you're seeing, these kinds of enablement tools out there, would you say people should be adopting or thinking about much more readily inside their businesses? We will come to you Letizia first.

Letizia Guadalupi: I can give an example from my past experience. So if I can name two initiatives, we used mapping form for a long time, basic GIS software, and we were using it to design the network. And it was a very challenging, it was towards GIS, which meant we were able to work on it in real time. There was a 50% increase in performance and that's just because we changed the tool without changing the process, we were able to automate the process. Then we used the model builder inside it. Very easy. User friendly and I personally think this should be a standard for all the companies to have this tool.

So that's my experience, obviously there's a lot there that you can do. The software is very powerful and it's full of potential. However, You can do analysis, design, and mapping obviously, dashboard, share with other people so it's really something I would recommend to everyone to have.

> We decided to migrate towards QGIS, which meant we were able to save half of the time. There was a 50% increase in performance and that's just because we changed the tool without changing the process

Jermaine Edwards: That's high commendation, so I'm curious to hear, Shawn, what do you see in terms of current and emerging technologies, things that you may say, is enabling your business today or things you might recommend?

Shawn Nolan: Yeah just from a broad industry point of view, and I think there's a lot of things that I've seen, I've been in the industry for 20 years, I've seen a lot of cold conversations, being able to see what's under the ground with some sort of 3D glasses, which would help for things like maintenance and support and being able to like locate breaks a lot more quickly and being able to have things like service restoration and turnaround times a lot quicker. But I suppose, on probably a less shiny thing, some of these projects, for example, what farmers have been doing. They have a project called Project Reach at the moment, it's a 1 billion pound project to connect the last remaining premises in the UK, and I've been to a few of the trials. So as anyone knows, if you're on the phone a lot, and you go to sleep, because you can't do any emails on there, I certainly can't ever, I was on a train from Leeds yesterday to Manchester the other day, and there's literally no point, you might as well just stare out the window and think about life or something like that.

So I think a lot of the rail companies are starting to get aware of things like this, and I've been to a few trials, and I've been to a few, I've been to Manchester to open up their tracks, masts and poles, especially on big sites to actually allow this connectivity. I think wider industry and the wider, large CAP companies are starting to see that they need to change that line of thinking and being able to actually have that value add towards the rest of the UK and towards the fibre market, which does back on to other human technologies like mobile connecting. There's a lot of stuff like rest computing that's a bolt on, you can say that's a bolt on, but I think that's going to be a big thing in the next generation, but yeah, I'm not really sure. I'm still without getting a signal, even in my phone and 5G is starting to be rolled out but it is 5G standard, or it is you know the 4G fallback method, which pretty much as most of 5G these days.

And other emerging technologies, do we look into things beyond 5G? Things like Elon Musk's program of Starlink, and developing satellite down to very hard reach areas, and how viable technology is. So that's more future technology and, obviously, I'm not the right person to ask on that, but I'm interested in it, I'm not sure, but I'd have been to Scotland or some parts of Wales on the Brecon Beacons, you'll know that the connectivity up there is not great, so you might be looking forward to getting access through Starlink satellites. And then obviously the other stuff Letizia is saying about being able to assist the large data and processing of that data, I think it's quite a big challenge, I'm not able to find anomalous data and trends in that large data, sets before any normal human could find it and being able to capitalise on that data before anybody else, before the competitor.

Jermaine Edwards: Thank you, lots of powerful points here. In the last few minutes together Alessandro I'd like to get your poignant points on any new developments that you're seeing, any new technologies that you're seeing, any kind of technology development are you actually most excited about using in the future, any particular innovations that you're seeing actually hey, this is what we're working on and we're willing to share, so I'll be coming to you on that as well.

But Alessandro, last points from you specifically on any particular technologies and then perhaps any things that you're excited about using or seeing in the future.

Alessandro Bovone: There's a lot of technology today being used to solve problems, I think that's something very important. The biggest challenge that is really powerful, in particular in delivery mode but it's all the aspects that we have discussed before. In the future, a lot of technology is emerging that will help in many aspects, and not just only the delivery and so on, but the optimisation of the other things that we haven't discussed here but everything needed also to be optimised and to be careful. So we need to also to ensure that in the future we can continuously improve what we have deployed, that is not just only a single deployment and then it's done, but it's a living thing. So I think that artificial AI, AI and so on, a lot of numbers, but the point is technology is moving into an environment where the network will become a network of sensing and where the fibre deployment that we see today would become the backbone of these new infrastructure. Everything that is wave, call 5G, 7G, call as you like, will be able to sense the world around us. So I think that this is the point that we will continuously check on stuff, we'll be able to absorb all this information in different media, different devices, different capabilities. It is why one other important aspect of all this discussion about automation and AI, from 5G, is that in the future, devices will be a bit more simple. In the sense of the processing capacity, today in devices, is quite powerful, but we don't see this curve going up because what we see is more and more capacity building the network to elaborate the data, instead of in hardware.

At this point you have the capability to have, for example, a device with longer battery life, with more capacity to connect with other devices because one or the other software ways to mantle years before something is delivered or deployed. Kind of what we experience today with the likes of Android or Microsoft that push out updates all the time, and we'll have the same kind of capability embedded in this new infrastructure of the network that we are building, and the direction of sensing is really the fact that I'm excited for.

Jermaine Edwards: Excellent, Letizia, any last things for you, anything you're excited about? Technology to develop more innovation you'd like to see in the future?

Letizia Guadalupi: Yes, and I want to go back to the concept that Alessandro just said about optimisation of everything. That's why I said in the beginning, we would prefer to have a unique platform where all the data can be visible to the whole company, so that we can have a unified way of working and optimising what we and I'm actually excited about a new tool that is available now. It is called the utility network tool. Its on the GIS system, where you can overlay different kinds of information on the ground. If you're also able to have the same platform to create your own network there, you can then have a global vision of everything. Everything that is existing and everything that is planned. So I'm excited about it. Let yet so that's why I'm really excited about this. So let's see if we can integrate everything on the same platform, we will not have miscommunication transferring files from software to another, making mistakes. Transformations will be automated, you will work on the same geographic system at any time, and you can use different sources of data on the same platform, so that's where I want to go, and I would recommend this.

Jermaine Edwards: Excellent, thank you Letizia. Any last words from you Shawn? Anything in particular that you're most excited to see?

Shawn Nolan: I'm quite a big geek, I really am. I try not to let Sir I would say Internet of Things, but that's kind of how we've been using it if I buy another Alexa, my wife will kill me. Anyway, I'll probably say things around VR and AR really, really excite me. I'm not sure if I'm going to be the right person to ask on that commercial front, but things I said before, as core delivery and medical and learning, there's a lot of things, the good connectivity to those everyday tools. As Alessandro was saying before, the fibre will become like a utility and everywhere the airport, we'll much like your gas, water or electricity, just kind of there. And all these fun technologies, connecting technologies, overlay technologies, they're there for the end user sees every day. So, the two things I'm kind of looking forward to are the VR and AR, and I'm a big, I'm a bit of a geek, I'm a big fan of machine learning, Python programming, and I'm also learning about machine learning and teaching myself from books as well. There's quite a lot of interesting machine learning, I suppose, an application you can insert into the AR and VR world as well. Once your brain starts thinking of the possibilities, you kind of wish somebody had already done it for you, but, no I'm just trying to learn myself in a very slow way, but yeah that's it for me.

Jermaine Edwards: Excellent, and I do appreciate it. Clearly some exciting innovations, lots of prospects, but some real challenges to overcome as well in order to really maximise and benefit from all the things you're talking about.

So I do want to thank everybody for being on the podcast, thank you for your experience, for your experience, for your thoughts. Shawn, Alessandro, Letizia, it's been really cool to hear your contributions, so wishing you success obviously in the race to 5G. Thank you again for contributing.

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