

INTELLIGENS CONSULTING REPORT TO

THE UK WIRELESS INTERNET SERVICE PROVIDERS
ASSOCIATION (UKWISPA)

ON

THE ROLE OF WIRELESS NETWORKS IN ENHANCING DIGITAL
CONNECTIVITY IN THE UK

IQBAL SINGH BEDI

GORDON WELSH

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The background of the slide is a dark, abstract composition. It features a dense field of small, bright blue and purple particles, some of which are arranged into distinct, curved, comet-like trails that sweep across the lower right portion of the frame. The overall color palette is dominated by deep blues and vibrant purples, creating a high-tech, digital atmosphere.

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1 Executive Summary

This report presents a compelling economic case for wireless technology to support the delivery of the Government's 2030 gigabit ambition: one that can deliver over GBP 4 billion of economic impact to the UK as well as advancing the benefits of digital infrastructure.

Gigabit Britain has become a defining aspiration for the UK's technological progress. The nation's quest for ultra-fast, reliable, and ubiquitous broadband access has led to considerable advancements in the deployment of full fibre infrastructure within the Government's pursuit of Project Gigabit to roll out gigabit broadband across the UK by 2030. However, the role of wireless networks in complementing and enhancing the mostly fibre driven gigabit ambition has been under exploited.

This report has been commissioned by the UK Wireless Internet Service Providers Association (UKWISPA) to review the case for greater use of wireless networks in the realisation of a gigabit enabled Britain. Both now, and in the future, in their capacity to upgrade broadband connectivity across the UK sooner rather than later, wireless networks can extend benefit more widely, all while delivering significant public value for money, even savings.

The argument for employing wireless technology in urban settings contradicts the prevailing notion that fibre being readily accessible in such areas precludes other solutions. This report illustrates specific scenarios where wireless technology proves considerably more cost-effective than deploying fibre networks. This enables a swift and cost-effective network rollout, providing high-speed broadband benefits to consumers sooner. Additionally, this approach mitigates the risks associated with fibre deployment by allowing transitioning to such fibre networks once market demand and conditions become favourable.

In rural and hard-to-reach areas which are less conducive to fibre investment the case for wireless solutions is very clear. Wireless networks can extend into hard-to-reach areas quickly, cost effectively and can scale in line with demand, delivering almost instantaneous connectivity benefits. The versatility of wireless technologies makes them exceptionally well-suited for providing connectivity to rural and remote areas, bringing forward the desired social impact and economic growth.

In addition to connecting urban and rural customer sooner and at lower cost, wireless ISPs (WISPs) can design bespoke solutions for customers providing the most appropriate connectivity method ensuring users receive value for their money. WISPs tailor solutions and technologies to meet the specific needs of users. Wireless solutions can also reduce environmental disruption by avoiding street works and trenching.

Sceptics of wireless technology assert that wireless is not gigabit capable and that it has no long-term future. This report reveals that lower-speed broadband options seem more popular with consumers than gigabit; however, there is recognition among WISPs that gigabit is essential to meet the potential future demand. WISPs are confident in wireless technology innovation to meet these future broadband speed demands. Indeed, there is an alternative view that proposes there is greater merit to prioritise enhanced in-home WiFi experience to users before delivering gigabit capability to the premise.

The economic analysis shown in Figure 1 highlights how wireless can deliver policy objectives more quickly and more cheaply, potentially saving taxpayers GBP 1 billion, while helping consumers benefit by over GBP 3 billion by advancing high speed broadband services to rural areas. Wireless can also make an important contribution to ensuring equality and preserving communities. In doing all this, the opportunity exists for the UK to become an exemplar for the global wireless industry, building on its historic research strengths to drive high value exports, supporting industry and jobs.

Figure 1 – Summary table of quantifiable economic impacts

Wireless Contribution	Impact	Policy Implication
Advancement of service to rural areas	Advance gigabit services to 1.8 million homes by an average of 3 years. Benefit > GBP 3 billion.	Accelerated planning, noting potential to remove and redeploy infrastructure as fibre emerges.
Extending benefit to remote areas	Reduce costs to hard-to-reach premises and provide consumers with choice and savings over competitors such as satellite. Total savings GBP 29 million a year	Ensure technology neutrality in Project Gigabit – so that FWA is competing fairly.
Working with fibre to deliver gigabit service	Saving public purse GBP 1 billion in future phases of Project Gigabit.	Prioritise value for money in Project Gigabit, by using wireless deployments to build markets and de-risk investment.
Promoting competition	Giving consumers a choice will lead to better tariffs and better services, benefiting consumers by GBP 337 million a year.	Consider fostering a competitive environment that allows for such potential cost savings, ultimately benefiting the end-users.

This report presents five recommendations for policy makers (Figure 2). Policymakers must recognise the significant role of wireless technologies as part of the technology mix needed to support the Government to deliver its gigabit ambition. Streamlined procedures and regulatory processes that accommodate smaller wireless operators are essential to ensure equitable access. The vision of ubiquitous gigabit connectivity can only be achieved when wireless, in conjunction with other technologies, plays a central role in strategic planning and policy design. The preferred policy will always be a blend not a choice.

Figure 2 – Implications for policy makers

Policy Area	Key Policy Implications
1. Balancing needs with cost-effectiveness and value	- Ensure future interventions consider wireless as part of the technology mix. - Prioritise value for money by using wireless deployments to build markets de-risking fibre investment.
2. Advancement of service to rural areas	- Encourage rapid deployment of wireless technologies for faster connectivity in remote and underserved areas. - Recognise the agility of wireless infrastructure, allowing swift deployment and flexible redeployment as fibre infrastructure becomes available.
3. Encourage competition	- Encourage competition for improved tariffs and services by fostering a competitive environment. - Prevent market dominance supporting startups and new market entrants.
4. Streamline processes and support small WISPs	- Streamline procurement processes and interventions to reduce administrative and cash flow burdens on smaller WISPs. - Address challenges in selling to the public sector that favour larger national companies, making processes more accessible to smaller WISPs.
5. Streamline regulatory process and access to spectrum	- Ensure fair spectrum allocation for wireless broadband and other applications, considering dedicated spectrum channels for ISPs. - Streamline regulatory processes, licensing, and spectrum auctions to improve access to spectrum resources for smaller WISPs.

In conclusion, this report presents a compelling case for wireless technology to be integrated into the advancement of the UK's digital infrastructure and digital economy. With industry confidence in its ability to innovate and meet evolving needs, wireless is a crucial contributor to the broadband ecosystem and the gigabit vision alongside fibre networks.

2 Glossary

Term	Definition
Altnet	Alternative network providers that typically build and operate full fibre networks.
CPE	Customer premises equipment kept at the customer's physical location such as a router.
CPPP	Cost per premises passed is cost of building a fibre network to serve residential or business premises divided by the number of premises served.
FTTP	Fibre to the premises is a generic term for a broadband network architecture using optical fibre to provide the local loop used for last mile telecommunications.
FWA	Fixed wireless access is a type of wireless technology that enables fixed broadband access using radio frequencies instead of cables.
LEO	Low earth orbit satellite systems orbit the earth at low altitudes and move with respect to the earth meaning
LiFi	Light fidelity is a bidirectional wireless system that transmits data using light.
ngFWA	Next generation fixed wireless access is new category of wireless technology designed specifically to deliver fibre-class throughput and latency.
NLOS	Non line of sight is where there is no visual line of sight between a wireless transmitting and receiving antenna.
ODU	Outdoor unit is part of the wireless network that works together with an indoor unit to provide multiple types of service interfaces.
PIA	Passive infrastructure access is an Openreach product that allows other communication service providers to access poles and ducts on a wholesale basis.
UKWISPA	The UK Wireless Internet Service Providers Association is the official trade body recognised by UK authorities.
WISP	Wireless internet service providers that typically operate and own wireless networks to serve customers with broadband services

3 Introduction

Background

Gigabit Britain has become a defining aspiration for the UK's technological progress. The nation's quest for ultra-fast, reliable, and ubiquitous broadband access has led to considerable advancements in the deployment of full fibre infrastructure and driven the Government's pursuit of Project Gigabit to roll out gigabit broadband across the UK by 2030.¹ The Government envisions a future where ultra-high-speed internet connectivity empowers businesses, individuals, and communities, driving economic growth, creating jobs, and fostering innovation. And that this future is for all; everyone, everywhere.

However, in the pursuit of a gigabit enabled Britain, an essential aspect that merits further exploration is the role of wireless networks in complementing and enhancing the mostly fibre driven infrastructure.

This report has been commissioned by the UK Wireless Internet Service Providers Association (UKWISPA) – an officially recognised trade body – to clarify the role wireless networks can and currently play in the realisation of a gigabit enabled Britain now and, in the future, and its capacity to upgrade broadband connectivity across the UK.

It is vital to note that this report does not seek to diminish the importance of fibre networks. In fact, it is recognised that the substantial investments from both private investors and the Government in fibre infrastructure are crucial for bolstering the UK economy. However, it's important to emphasise that this report seeks to highlight the equally vital role of wireless networks in Britain's gigabit aspirations. Wireless technology serves as a complementary and synergistic counterpart to fibre networks as part of the gigabit technology ecosystem, collectively contributing to the realisation of the nation's gigabit goals. It is a partner, not a rival, to fibre, this is clearly evident in the rise of 'hybrid' operators, who offer both technologies, on the basis of whatever is best for their customers.

This report aims to illustrate the additional social and economic advantages that wireless networks can offer within the gigabit landscape. Wireless networks have the potential to connect underserved locations to high-speed broadband well before 2030, especially in challenging-to-reach areas, all while maintaining cost-efficiency compared to fibre solutions. Furthermore, wireless technologies come with environmental benefits, making them a sustainable choice.

Objectives and scope

The primary objective of this report is to provide a comprehensive and unbiased analysis of the role of wireless networks in the context of building a gigabit enabled Britain. The report presents evidence and insights from primary research that showcase the unique benefits of wireless technology and its capacity to accelerate digital transformation across urban and rural landscapes alongside fibre networks.

To achieve this objective, the report explores five fundamental aspects:

1. The role of wireless networks in urban settings, encompassing case studies that demonstrate the operator, investor, and societal advantages of wireless connectivity. We investigate the cost-effectiveness of wireless solutions compared to fibre, focusing on deployment times, resilience, and reduced disruption to existing infrastructure.
2. The potential for wireless networks to revolutionise connectivity in poorly served rural areas. Through a selection of case studies, we emphasise the operator, investor, and

¹ **Source:** House of Commons Library, Gigabit broadband in the UK, July 2023.

economic benefits of high-speed wireless connectivity, while evaluating its cost-effectiveness and faster deployment times compared to traditional fibre solutions.

3. The necessity for gigabit speeds and the implications of wireless technology in meeting this demand. We assess take-up rates, affordability, and the impact of gigabit wireless services on consumer download speeds, all while forecasting usage needs and end-user experiences.
4. The future of wireless networks. We provide commentary on the future of wireless technology and innovation to improve the performance capability and network economics of wireless technologies.
5. The contribution of wireless technology to the UK economy by accelerating the planning and deployment of high-speed and gigabit broadband networks, reducing coverage not-spots while delivering social benefits and enhanced social inclusion levelling up unserved regions and populations with the rest of the UK.

Methodology

The study combines secondary research with primary research and consultations undertaken with UKWISPA members. A series of semi-structured consultations were held with a selection of UKWISPA members that offer wireless-only and hybrid fibre-wireless broadband to customers in urban and rural areas, see Figure 3.

Figure 3 – List of UKWISPA members that participated in consultations. Source: Intelligens Consulting, 2023.

Company	Technology	Geographical Focus	Target Customer
XPON Wireless	Wireless	Urban and Rural	Residential and Business
GigaAir	Hybrid fibre-wireless	Urban	Residential and Business
Clearline	Hybrid fibre-wireless	Rural	Residential
Rapier Systems	Hybrid fibre-wireless	Rural	Residential
Bink	Hybrid fibre-wireless	Urban and Rural	Residential and Business

In addition to the consultations, a questionnaire/survey was issued to UKWISPA members to explore and gather feedback on the importance of gigabit speeds and to ascertain their views on the future of wireless networks. Eight responses were received, see Figure 4.

Figure 4 – Make-up Of UKWISPA members that participated in survey. Source: Intelligens Consulting, 2023.

Business Focus	Geographical Focus	Target Customer	Size
CPE deployment specialists	Urban, rural and Suburban	Internet Service Providers	Small (up to 1,000 connected customers)
Wireless	Rural and suburban	Residential	Small (up to 1,000 connected customers)
Hybrid fibre-wireless	Urban	Business	Small (up to 1,000 connected customers)
Wireless	Rural	Residential	Small (up to 1,000 connected customers)
Hybrid fibre-wireless	Rural, Urban and Suburban	Business, Residential	Small (up to 1,000 connected customers)
Hybrid fibre-wireless	Rural areas	Business, Residential	Large (>10,000 connected customers)

Wireless	Rural and Urban	Business, Residential	Small (up to 1,000 connected customers)
Wireless	Rural	Residential	Medium (up to 10,000 connected customers)

The report recognises that the response rates are not statistically definitive, nonetheless they do provide real insights into other challenges WISPs face day competing in a dynamic market.

Report structure

The remainder of this report is structured as follows:

- Section 4 explores the role of wireless technology in supporting urban rollouts.
- Section 5 explores the advantages of wireless solutions in supporting rural rollouts.
- Section 6 explores the case for gigabit broadband and whether the end goal should be high speed rather than gigabit.
- Section 7 explores the future of wireless networks and if they have an evolutionary pathway.
- Section 8 demonstrates the social and economic benefits of accommodating wireless broadband solutions in the Government's gigabit ambition.
- Section 9 draws out the implications of this report's findings for policymakers.
- Section 10 provides our concluding thoughts.

4 The case for wireless in urban settings

This section demonstrates the case for using wireless technology in urban settings. Although the deployment of wireless in urban settings may seem inconsistent with the common understanding that fibre is widely available in urban areas, this section shows that this is not always the case and that there are unique instances where using wireless technology can be cost-effective enabling low cost customer acquisition and de-risks the eventual transition to fibre networks.

Wireless helps to overcome urban connectivity gaps

The telecoms press and media has written extensively on the pace of build (and overbuild) by alternative fibre network (altnet) operators in the UK, particularly in urban areas.

Intelligens Consulting's research shows that the top 10 altnet fibre operators are constructing networks at a rate of 279,000 premises per month. To support this construction pace, the top 10 altnets have committed to investing over GBP 12 billion. The fibre altnet landscape is mainly dominated by a few large operators primarily focusing on fibre network expansion in larger rural settlements, urban towns and city centres. This concentration has raised concerns about potential overbuilding, leading to duplicated efforts, increased costs, and potential inefficiencies in network deployment and maintenance.

However, despite concerns of overbuild in urban areas, many premises in city centres and urban areas still lack access to affordable high-speed broadband. GigaAir operates in Glasgow city centre and serves central locations such as George Square. Their research (which is based on Scottish Government data) shows that businesses in George Square are typically experiencing slow internet speeds. In their experience, small businesses, including restaurants and pubs, often find fibre-based solutions cost-prohibitive or unavailable, resulting in substandard connectivity.

According to GigaAir they deliver cost-effective wireless connectivity to these underserved premises. Leveraging wireless technology enables GigaAir to expand its network swiftly and efficiently without extensive fixed infrastructure. The wireless network is established on building rooftops, providing multi-Gigabit speeds to covered properties.

GigaAir employ hybrid fibre-wireless solutions and highlight their adaptability in selecting the appropriate technology for each situation. GigaAir emphasises their technology neutrality, choosing between fibre and wireless based on contextual factors such as area characteristics, customer requirements, and demand feasibility.

Bink similarly emphasises that while fibre is readily available in urban centres, there are specific scenarios where wireless technology proves more cost-effective and operationally efficient than deploying fibre. This approach stems from practical considerations. Erecting a pole and deploying wireless equipment on the side of a property proves far more economical and straightforward for Bink. This approach grants them access to hundreds of properties within line of sight. They emphasise the importance of deployment speed, which favours wireless technology. Rapidly setting up wireless infrastructure, including poles and nodes, requires less investment and time compared to fibre trenching. As a result, wireless technology has become their primary focus.

GigaAir and Bink demonstrate that despite the rollout of fibre in urban areas many premises are left unserved, enabling them to serve premises with high-speed affordable broadband using a hybrid fibre-wireless approach. Using wireless technology, the focus can shift from costly and time-consuming fibre deployments to connecting customers swiftly, creating real-time demand-driven responses to customer needs.

Wireless technology to grab market share and de-risk fibre investments

Wireless solutions can also offer practical and cost-effective strategy enabling a seamless transition to a fibre network when market demand and conditions are conducive.

GigaAir's implementation of this approach showcases its adaptability in delivering efficient and high-speed internet solutions. By swiftly expanding its network using wireless technology, GigaAir avoids the complexities of dealing with extensive underground infrastructure. For instance, GigaAir successfully introduced wireless connectivity to a business park near Glasgow, with plans to eventually transition to fibre based on evolving market demand and conditions.

This strategic approach empowers GigaAir to swiftly capture market share without substantial investments in fixed infrastructure. GigaAir emphasises that the accelerated setup time of wireless networks compared to their fibre counterpart allows for swifter customer acquisition, enabling rapid revenue generation and early cash flow—distinct business case advantages over the relatively protracted process of fibre installation.

Bink also emphasises the crucial advantages of wireless networks, particularly their flexibility and rapid adaptability. In contrast to fibre installations, which can involve considerable initial expenses, regulatory hurdles, and possible delays tied to passive infrastructure, wireless networks can be established promptly. This agility empowers Bink to promptly address real-time demands and adapt to market dynamics.

Bink further employs wireless as a tactical market entry tool in urban settings. The approach involves quickly establishing a customer base through wireless technology and subsequently determining the feasibility of deploying fibre based on market success and demand. Essentially, this approach leverages wireless technology as a "land grab" mechanism, enabling Bink to swiftly onboard customers and assess market viability. By doing so, Bink can effectively gauge the market potential, understand customer preferences, and build a loyal customer base. If an area demonstrates widespread customer demand, a fibre rollout to the customer base can be initiated.

Wireless solutions can thus be used to de-risk fibre investments by connecting customers cost-effectively and capturing market share rapidly, enabling a shift to fibre once the demand and investment case for fibre has been proven.

A very low cost per premises passed

Wireless networks offer a cost-effective edge over fibre-based solutions as they do not necessitate significant investments in underground assets, or customer premises equipment (CPE) until successful customer connections are successfully established. This aspect is explored further in Exhibit 1 using a case study supplied by Bink. However, it should be noted that this case study does not include the customer connection costs which is explored in an example provided by Rapier Systems.

Exhibit 1 - Cost efficiency of deploying wireless networks

Bink illustrates the cost efficiency of wireless deployments based on a real figures employed in a fictional deployment.

- Scenario: Bink's Wireless Deployment
- Initial Investment: Approximately GBP 20,000
- Initial Investment Includes: Mast, Power Setup, Backhaul Radio, AP Radios
- Coverage: Up to 180 Customers
- Extended Coverage: Over 1,000 Properties within Line of Sight
- Cost Per Premises Passed (CPPP): GBP 20

Source: Bink, September 2023

Fibre deployments typically incur much higher CPPPs, often reaching GBP 300 – GBP 400 per premises passed in urban areas, and significantly higher in rural areas. This is because deploying fibre networks requires a higher upfront investment in infrastructure that is front loaded, pre-customer connection.

With wireless networks, the converse is true. While the upfront costs to pass premises is low, the cost of connecting wireless customers according to Rapier can range from GBP 500 to GBP 700 per customer. A greater cost is incurred upon connection with wireless rather than with fibre.

Another example is provided by GigaAir in which the CPPP is more than 50 times less than that of a typical urban fibre deployment, see Exhibit 2

Exhibit 2 - GigaAir's cost-effective city centre coverage

GigaAir illustrates the low CPOPP achievable with its wireless deployment in Glasgow

- Investment: Approximately GBP 350,000
- Coverage: Roughly 50,000 Premises in Glasgow City Centre
- Cost Per Premises Passed (CPPP): GBP 7

Source: GigaAir, September 2023

Wireless networks are more cost-effective compared to fibre-based solutions as they defer the brunt of the costs until a customer is connected which can de-risk customer acquisition.

An alternative investor profile

GigaAir's emphasis on wireless networks naturally shapes its investor profile, distinguishing it from the long-term infrastructure funds that finance most fibre operators. The majority of the company's investments stem from local entrepreneurs who share a belief in GigaAir's mission and potential. While infrastructure funds can offer significant financial backing, they might prioritise standardised strategies and financial returns over the unique needs and opportunities of specific communities. The benefits of being entrepreneur-backed align more closely with the dynamic and community-focused nature of the WISP industry.

Bink further highlights the benefits of financing wireless deployments through simple leasing or financing arrangements. Bink elaborates that wireless infrastructure offers a distinct advantage to adjust or relocate equipment in response to changing demand or competitive landscapes, a flexibility that is not possible with below ground fibre networks. The contrasting fixed cost of fibre versus the adaptable nature of wireless highlights the unique strengths of wireless networks in a dynamic market.

When probed about the Bink's investability, the company emphasised its focus on building value through sales revenue, cash flow, and customer acquisition, with less emphasis on the infrastructure itself. While this approach has merit, Bink highlights an important

consideration from an investor standpoint: that wireless networks may not hold the same level of inherent value as a network that includes a physical fibre infrastructure. In terms of investor interest and potential exit strategies, having a physical fibre infrastructure can enhance the overall value of the business, in effect transforming it to a 'utility' whose dependable income is highly valued.

Wireless operators tend not to attract the same type of investors as fibre altnets. The less rigid financing arrangements can enable WISPs to be more entrepreneurial and flexible. However, WISP exit valuations will focus on customer connections rather than the investment made in assets as tends to be the case with fibre altnets.

Wireless overcoming landowner resistance

Wireless deployments can reduce the physical environmental impact compared to traditional fibre installation, as wireless equipment is either placed on masts or on rooftops, negating the need for street works to deploy ducts or fibre cable. The case study in Exhibit 3 describes a specific case where an industrial estate landowner was preventing fibre installations and where a wireless solution was proposed to minimise environment disruption.

Exhibit 3 – Wireless overcoming landowner resistance



- Scenario: A business park landowner hesitated to permit traditional fibre infrastructure installation due to concerns about disruption, land use, and costs, hindering high-speed broadband deployment.
- GigaAir's Solution: Leveraging wireless technology as a less invasive and infrastructure-friendly alternative, GigaAir provided reliable connectivity without significant development, addressing landowner concerns.
- Key Takeaway: Wireless solutions excel in scenarios where traditional fibre installations face obstacles.

Source: GigaAir, September 2023.

As this case study shows, wireless solutions can be used to overcome environmental impact concerns and minimise disruption due to street works.

5 Enhancing connectivity in poorly served rural areas

This section delves into the potential of deploying wireless connectivity solutions to underserved rural communities. It does this by exploring examples of wireless networks extending into hard-to-reach areas cost effectively and scaling up infrastructure investment in line with demand and swiftly, delivering almost instantaneous connectivity benefits for rural residents and businesses.

Extending reach beyond traditional infrastructure

Rural areas often feature challenging terrains that hinder the deployment of traditional broadband infrastructure. Ofcom data shows that while there has been an increase in gigabit-capable coverage in both urban and rural areas, there has been a greater increase in urban areas which continue to have superior access to full fibre due to some providers focussing their roll-out in these areas.²

Wireless technologies circumvent geographical barriers by transmitting signals over the airwaves. A significant and well-known advantage of wireless technology that is exploited by WISPs is that it has the unique advantage of being able to cover vast expanses or rural areas without the need for extensive physical infrastructure deployment. This flexibility enables connectivity providers to navigate hills, valleys, and other obstacles, ensuring that even the most remote regions can access high-speed internet.

Unlike traditional fibre networks that may require laying cables within existing ducts, or where those ducts are unusable may require operators to lay new ducts, wireless networks can be established relatively quickly and efficiently, reaching remote areas, where digging trenches and installing cables might not be economically viable.

Bink highlighted the significant advantage of wireless technology in addressing the limitations of fibre deployment in areas with challenging terrain. They emphasised that wireless networks offer a practical solution to overcome geographical barriers that often hinder the installation of fibre networks. By opting for wireless connectivity (utilising 5GHz and 60GHz spectrum bands enabling balanced approach to achieve coverage range and capacity) Bink can provide high-speed broadband to locations that would otherwise be difficult or costly to reach with traditional fibre installations.

5G's FWA (fixed wireless access) capabilities are being exploited by Quickline to provide high-quality connectivity to rural areas. 5G can deliver fast speeds and low latency, making it suitable for a wide range of applications. Consequently, 5G FWA enables Quickline to offer substantial network performance even at lower speed levels, making it a cost-effective alternative to fibre for many use cases.

XPON Wireless caters to areas that have been overlooked by larger fibre providers, preferring to deploy wireless networks in reaching remote and rural areas. However, they did stress the importance of both fibre and wireless technologies working in tandem to provide rural broadband solutions, as they address different connectivity challenges.

The versatility of wireless technologies and their adaptability to various scenarios makes them exceptionally well-suited for providing connectivity to rural and remote areas. This is especially relevant in cases where deploying traditional Fibre to the Premises (FTTP) infrastructure can incur substantial costs.

Flexibility and incremental network expansion

Wireless networks offer scalability that matches the pace of community growth. In rural settings it is more cost effective to deploy a wireless solution within a defined coverage areas and with a low upfront cost compared to laying an extensive fibre network. The

² **Source** Ofcom, Connected Nations Report, 2022.

flexibility of wireless technology allows operators to invest in network expansion incrementally, ensuring that the network connectivity investment evolves with demand – the so-called ‘pay-as-you-grow’ model.

Wireless networks also tend to require fewer physical infrastructure components compared to traditional fibre networks. This streamlined infrastructure results in simplified deployment processes and faster expansion, allowing for easier scalability. As a consequence of this infrastructure and construction costs wireless deployments they often offer a cost-effective solution for extending connectivity to underserved or remote regions.

Bink emphasises the financial flexibility inherent in wireless deployments, highlighting the ability to lease or finance physical radio equipment. This approach offers a tangible and adaptable asset in contrast to buried fibre, which could potentially go unused. Bink elaborates that another advantage lies in the ease of relocating or repurposing wireless equipment in response to shifting demands or heightened competition. This adaptability provides a strategic edge in dynamic scenarios, ensuring resources can be effectively reallocated to maximise value.

Wireless networks provide a cost-effective and scalable solution for rural areas avoiding the need for extensive upfront fibre infrastructure.

Rapid deployment and community impact

The ability of wireless networks to be deployed swiftly, leads to almost immediate connectivity benefits for rural residents and businesses. This agility empowers communities by enabling faster access to online education, telehealth services, e-commerce opportunities, and more, ultimately fostering economic growth.

The speed of deployment is a significant factor favouring wireless technology; according to Bink setting up wireless infrastructure, such as poles and nodes, is quicker and requires less investment compared to extensive fibre trenching, thus allowing them to respond to real-time demands and changes in the market.

There are financial advantages of deploying wireless networks quickly too. Quickline state that their wireless networks allow them to get people connected quickly, generating revenue from customer subscriptions sooner than traditional fibre deployments would allow. This accelerated revenue stream has a significant and positive impact on the company's cash flow.

Connecting customers quickly without the need for extensive infrastructure investment enables WISPs to connect individuals, farms and small villages in a matter of days where traditional providers might take several years to establish coverage. By deploying 5G nodes and ODU (OutDoor Unit) equipment, XPON Wireless can connect a handful of users within a day.

In specific situations, customers are willing to pay additional fees to connect to a wireless provider. Some premises in areas designated for government intervention, such as the Scottish Government's R-100 program, may experience long delays in getting connected, with some waiting until as late as 2028. In response to this delay, customers have approached providers like Rapier Systems to obtain a connection sooner, and they are willing to pay the associated extra costs.

Wireless networks provide a cost-effective and scalable solution for rural areas enabling them to grow according to demand thus avoiding the need for upfront infrastructure investment. The low upfront investment in infrastructure means they can be deployed swiftly and lead to almost immediate connectivity benefits.

Solutions tailored to user needs

In rural areas, the diverse connectivity needs of different users are paramount. Wireless technology enables connectivity providers to offer customisable solutions, adapting

bandwidth and speed offerings to suit user needs. This customisation ensures that rural communities receive connectivity solutions tailored to their requirements.

Rather than simply pushing for high speeds, Quickline for example, aim to provide the most appropriate connectivity for each user's needs, ensuring that customers receive best value for their money.

WISPs emphasise the importance of tailoring solutions and technology to meet the specific needs of users. Providing a one-size-fits-all approach is rarely the most effective strategy, especially in diverse environments in which they operate. It is essential for WISPs to understand the unique requirements of rural settings and deploy the appropriate technology accordingly. For example, Bink believes in offering a reliable and quality service and acknowledges that trying to serve users too far away from its core coverage can lead to complications and headaches for both the provider and users. Instead of stretching the network to its limits, they strategically place additional masts to cover those users who are situated further from the core network. This approach aims to strike a balance between providing efficient connectivity and ensures that users receive the connectivity speeds and capabilities they require but also optimises the use of resources.

The case study in *Exhibit 4* showcases how XPON Wireless was able to provide a personalised wireless solution to a farm set within in a rural area, enabling them to engage in commercial activities such as a gin factory and a coffee shop. The case study also illustrates how wireless technology can revitalise and streamline rural businesses.

Exhibit 4 - Bawdon Lodge Farm's Connectivity Transformation



Bawdon Lodge Farm, nestled in the heart of Leicestershire's Charnwood Forest, is a thriving National Forest site and arable farm with a unique blend of offerings. Established in 2012, it initially focused on outdoor weddings, events, and the retailing of Burleigh's Gin, distilled on-site. In 2021, the farm expanded its horizons with the opening of a gift and coffee shop. The future holds exciting plans, including artisan shopping fairs, outdoor concerts, theatre performances, afternoon teas with live local music, creative workshops for adults, and engaging activities for children.

Despite its remote location and diverse tourism offerings, reliable high-speed broadband connectivity became a critical necessity for Bawdon Lodge Farm. The challenging geographical terrain surrounding the farm made deploying traditional fibre networks impractical.

In response, XPON Wireless proposed an innovative solution centred around wireless technology. This approach effectively addressed the farm's connectivity needs while circumventing the limitations of wired infrastructure. Bawdon Lodge Farm now leverages XPON Wireless' connectivity for various purposes, including monitoring and managing farming operations, day-to-day business activities such as marketing and administration, and remote equipment management.

Source: XPON Wireless, September, 2023

Environmental sustainability

WISPs are committed to both efficient network operations and environmental sustainability. They emphasise the reduced environmental disruption associated with wireless network deployment compared to traditional digging for fibre. Quickline strive to minimise disruption by utilising existing Physical Infrastructure Access (PIA) and avoiding extensive digging where there are deploying fibre. Quickline also takes an energy-conscious approach to design the network architecture by minimising the equipment needed at each site by employing cloud networks and by implementing energy-efficient solutions like battery backups and power management.

6 The case for gigabit speeds and wireless technology

This section explores the current and future demand for gigabit through analysis of the survey and consultation responses. Although lower-speed broadband options seem more popular than gigabit, there is recognition among some WISPs that gigabit will ultimately be essential to meet the potential future demand. In the meantime, a reliable in-home WiFi and high-speed broadband experience is more important to customers than raw speed to the premise.

Lower-speed broadband packages are more popular

Ofcom's latest home broadband performance report estimates the mean download speed (across all technology connections) to be 139 Mbit/s with a median download speed of 69Mbit/s.³ In the UAE (which has the highest global rank) the median download speed is 206 Mbit/s.^{4,5} It is worth noting that the UAE has the highest global fibre penetration rate of any country in excess of 50% compared to the UK which has a fibre penetration rate of 11%. Even with such high fibre adoption, the UAE is far from achieving the gigabit speed threshold.

This could, of course, be due to various factors, including pricing, where consumers may prioritise lower costs over extremely high speeds, but clearly the existing speeds already meet most of their current needs. It indicates that while gigabit speeds are seen as a desirable goal, currently they may not be an immediate necessity.

It is common for many users to focus on gigabit speeds. According to Quickline, many customers discussions start with an excessive focus on gigabit speeds, despite the fact that many users may not fully utilise such high speeds, and this can lead to users paying for more than they need. The reality is that a significant number of devices, including older laptops, smartphones, and smart home devices, do not require gigabit speeds for their regular functionality. This indicates that the actual speed needs of users may be considerably lower than what is commonly perceived by those at the forefront of technology.

This is a sentiment reflected in the survey findings. The response to Question 5 (Figure 5), indicated that despite offering gigabit speed products, the 50 Mbit/s product speed tier is the most popular choice among WISP customers, while noting some WISPs did indicate gigabit as the most popular product. This suggests that there is a notable preference among customers for a broadband speed tier that falls significantly below gigabit speeds. While the prevailing argument often emphasises the demand for gigabit connectivity, the survey results suggest customers are currently content with and favouring lower-speed broadband packages, such as the 50 Mbit/s tier. No respondent indicated that they receive significant requests for speeds higher than gigabit, which confirms the view that 'gigabit' is a 'round number' rather than a demand based specification sought in the market.

The response to Question 6 (Figure 6) also indicates that most WISPs do not consider gigabit speeds as essential for driving current customer satisfaction and loyalty. This suggests that, at present, WISP customers do not prioritise gigabit speeds as a critical factor in their choice of broadband service. This is echoed by Rapier, which said that despite having a gigabit package available they have not yet been asked to provide a gigabit broadband connection to rural residential customers.

³ **Source:** Ofcom, Home Broadband Performance Report, September 2023.

⁴ **Source:** Ookla, Speedtest Global Index, July 2023.

⁵ **Source:** FTTH Council, FTTH/B Global Ranking 2023.

Despite the results suggesting lower-speed options are more popular, there are of course strategic and forward-looking reasons for continued investment in fibre infrastructure to meet the potential future demand. However, in areas where the cost of fibre infrastructure is prohibitive or deployment is challenging, wireless solutions are demonstrably a viable consideration. This approach acknowledges the importance of preparing for future connectivity needs while also addressing the immediate need for accessible high speed broadband services in underserved or rural areas. Broadband delayed is broadband denied.

Figure 5 – Response to Question 5. Popularity Of Broadband Product By Speed. Source: UKWISPA Members Survey, September 2023.

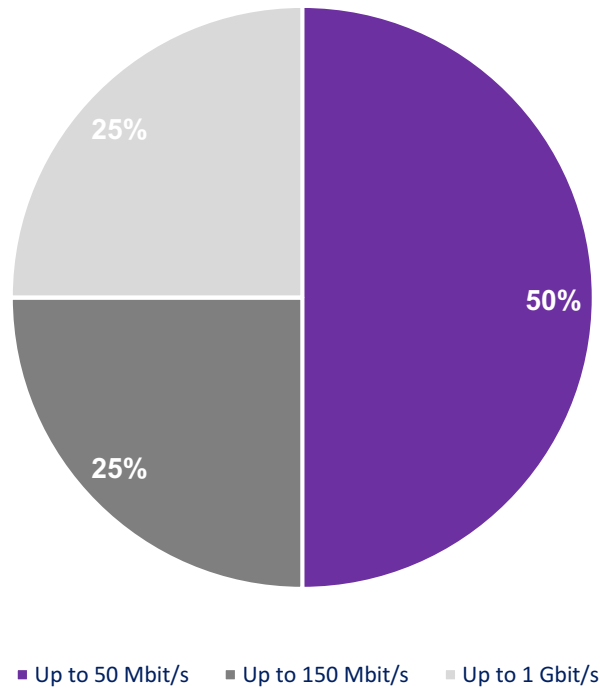
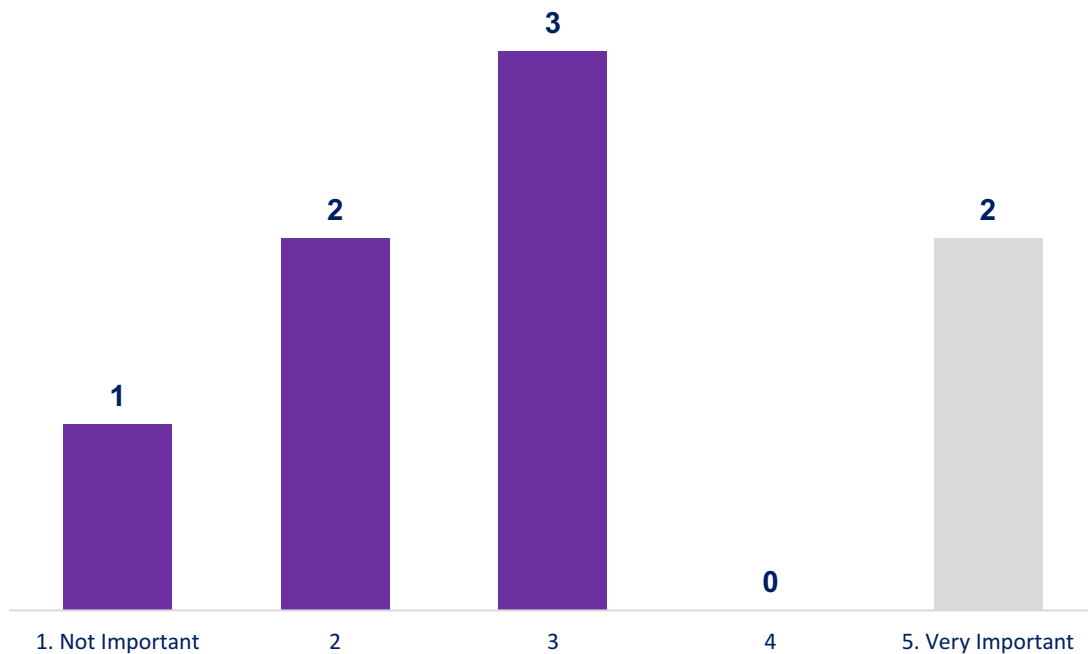


Figure 6 – Response to Question 6. Importance Of Gigabit To Driving Customer Satisfaction And Loyalty By No. Respondents. Source: UKWISPA Members Survey, September 2023.



Reliable in-home connectivity is more important than gigabit speeds

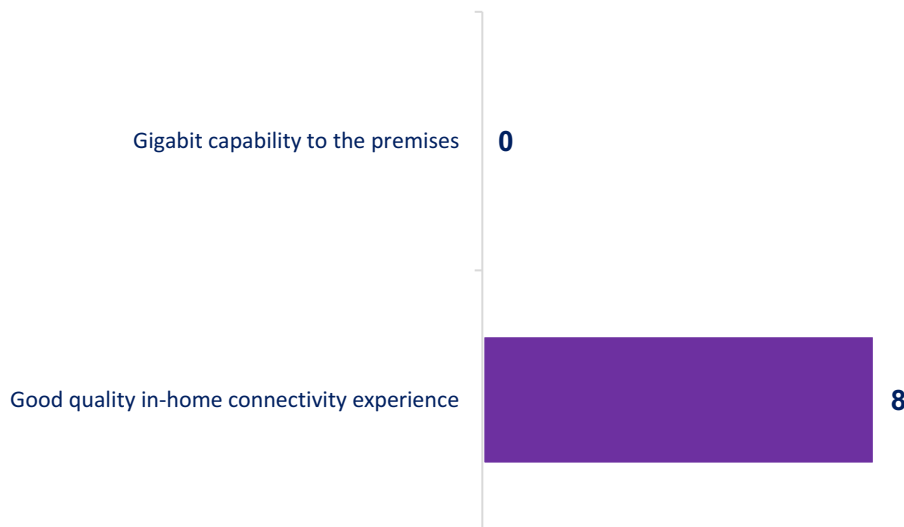
According to the survey consumers are placing a greater value on good quality reliable in-home WiFi connectivity than on having gigabit capability to the premises. The response to Question 8 shows that all WISPs (including those offering hybrid fibre-wireless solutions) believe that consumers currently place greater value on a good quality, reliable in-home connectivity experience rather than having gigabit capability pass their premises. This suggests that, for the time being, consumers may prioritise a consistent and reliable connection within their homes over ultra-high-speed or gigabit broadband speeds.

Even hybrid fibre-wireless WISP GigaAir emphasised that in their experience, reliability is more important to customers than raw speed and highlights that wireless can be as reliable as fibre if designed and deployed correctly.

This underscores the customer-centric nature of WISPs, often serving smaller customer numbers, allowing them to provide more personalised and tailored solutions which can include a strong focus on providing reliable in-home WiFi to ensure a high-quality user experience to meet the specific needs of their customers.

The feedback from WISPs also indicates that there is a misconception among some customers who believe that higher speeds will automatically enhance their in-home WiFi experience. This highlights the need for consumer education on the relationship between speeds and WiFi performance.

Figure 7 – Response to question 8. Good quality reliable in-home connectivity (WiFi) versus gigabit capability to the premise by percentage of respondents. Source: UKWISPA members survey, September 2023.



Gigabit speeds are crucial for future business growth

Despite WISPs suggesting that gigabit broadband speeds are not essential to their customers today, half of the WISPs emphasised the critical role of gigabit speeds in their future business growth plans. The response to Question 7 (Figure 8) shows that 50% of the respondents – a mix of hybrid and wireless operators, and rural and urban operators – believe that gigabit speeds are very important to their future business growth. This perspective highlights a significant shift in future expectations among some within the industry. However, the other half of the respondents do not believe that gigabit is very important to their future growth and so this shift in expectation is not universal.

The shift towards higher speeds is something that Bink has witnessed. According to Bink, there is demand for high-speed broadband in rural areas, with customers willing to pay for higher-speed plans. Customers' preferences are diverse, with uptake on higher-speed packages often surpassing expectations.

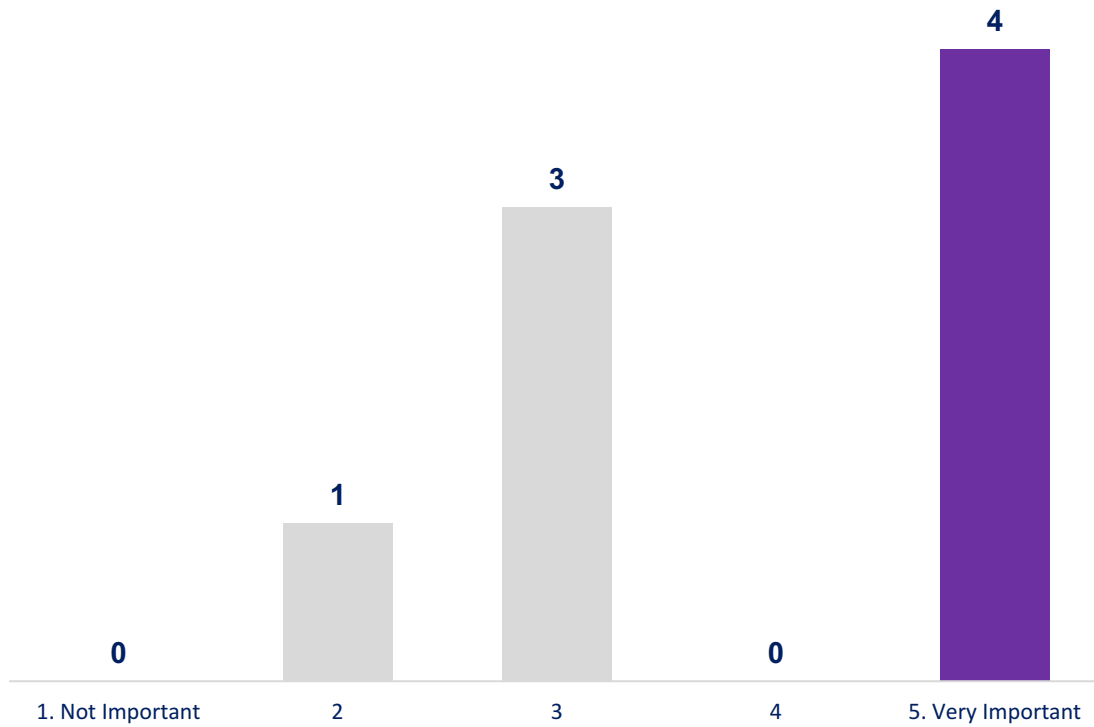
There is a growing awareness that higher gigabit capable speeds will become more necessary in the future. According to GigaAir, not everyone currently needs Gigabit speeds, however there is a growing awareness within the business that it will become more necessary in the future. GigaAir likens this to the demand for electric cars, where people know they'll have to transition eventually.

Overall, the feedback highlights that the significance of gigabit speeds is not universally acknowledged. It suggests that there is a range of strategic viewpoints regarding the role of gigabit speeds in their future growth plans. Some operators perceive gigabit speeds as a critical factor for success and expansion, while others may have alternative strategies or may prioritise different aspects of their service offerings.

When asked about what is driving the demand for gigabit, WISPs cited several key factors including competition from alternative fibre network operators (altnets), while others cited the Government's policy around gigabit influencing fibre network deployments where wireless would work.

Figure 8 – Response to Question 7. Role of Gigabit in Future Business Growth By No. Respondents.

Source: UKWISPA Members Survey, September 2023.



Those operators that are positioning themselves to harness gigabit technologies to meet future bandwidth demands have alternatives to fibre, as discussed in Section 7.

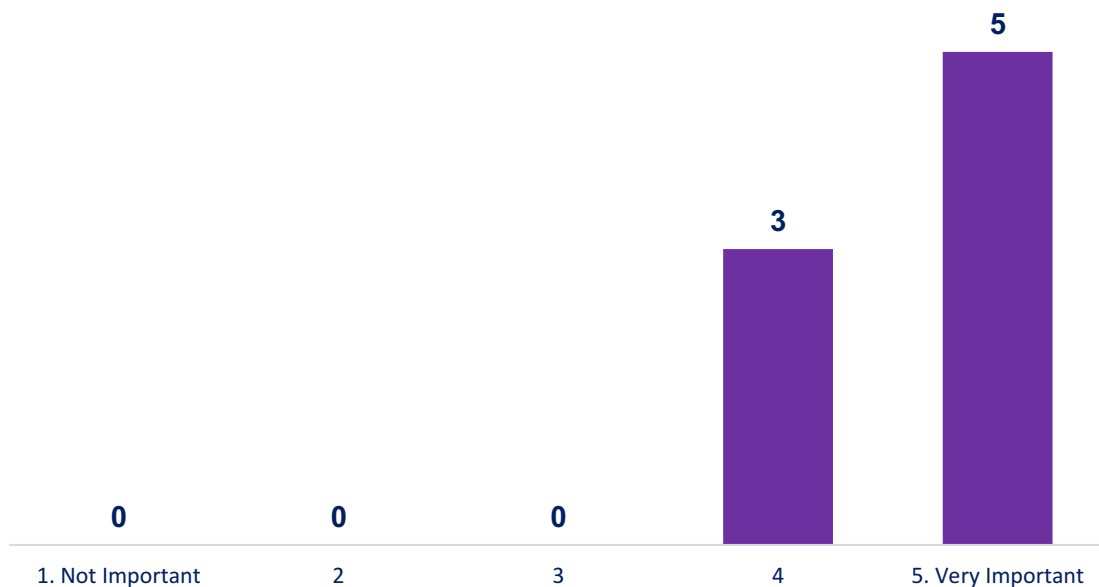
7 Future-proof and evolving wireless technology

Sceptics of wireless technology have often proposed that wireless is not gigabit capable and that it has no long-term future or evolutionary pathway. Through analysis of the survey responses and secondary research this section investigates the future of wireless technology and reveals that the industry has high levels of confidence in wireless technology innovation and investment to meet current and future needs. It recommends policymakers recognise the vital role wireless technologies can play in the broadband ecosystem and gigabit vision.

High levels of confidence in wireless

It is important that the wireless industry has high levels of confidence in the relevance of wireless technologies to invest, innovate, and provide reliable services, ultimately benefiting both the service providers and consumers. The response to Question 10 (Figure 9) indicates there is a high level of confidence in the relevance of current wireless technologies to meet future bandwidth demands in their target markets. This suggests that hybrid and wireless providers believe their existing wireless infrastructure is well-suited to accommodate the evolving needs for higher bandwidth and improved connectivity to customers in the areas they serve enabling them to invest with confidence.

Figure 9 Response to question 10. Relevance of current wireless technologies in meeting future bandwidth demands by no. respondents. Source: UKWISPA members survey, September 2023.



One of the challenges commonly associated with wireless networks is that they can encounter limitations related to line-of-sight requirements and distance restrictions. Consequently, signal strength and signal quality can be affected by obstacles (such as buildings, mountains or dense vegetation) or when users are located far from the network. In turn, these restrictions can limit access to wireless networks, or the speed of service operators can offer. The strategic placement of masts and use of point-to-point links can overcome line-of-sight or distance restrictions. Bink is confident that wireless technology is evolving to address long-distance connectivity and non-line-of-sight scenarios and therefore remains supportive of wireless technology.

From a user perspective, there can be resistance from customers who lack confidence in the performance of wireless networks. To overcome that, GigaAir offer free connectivity for

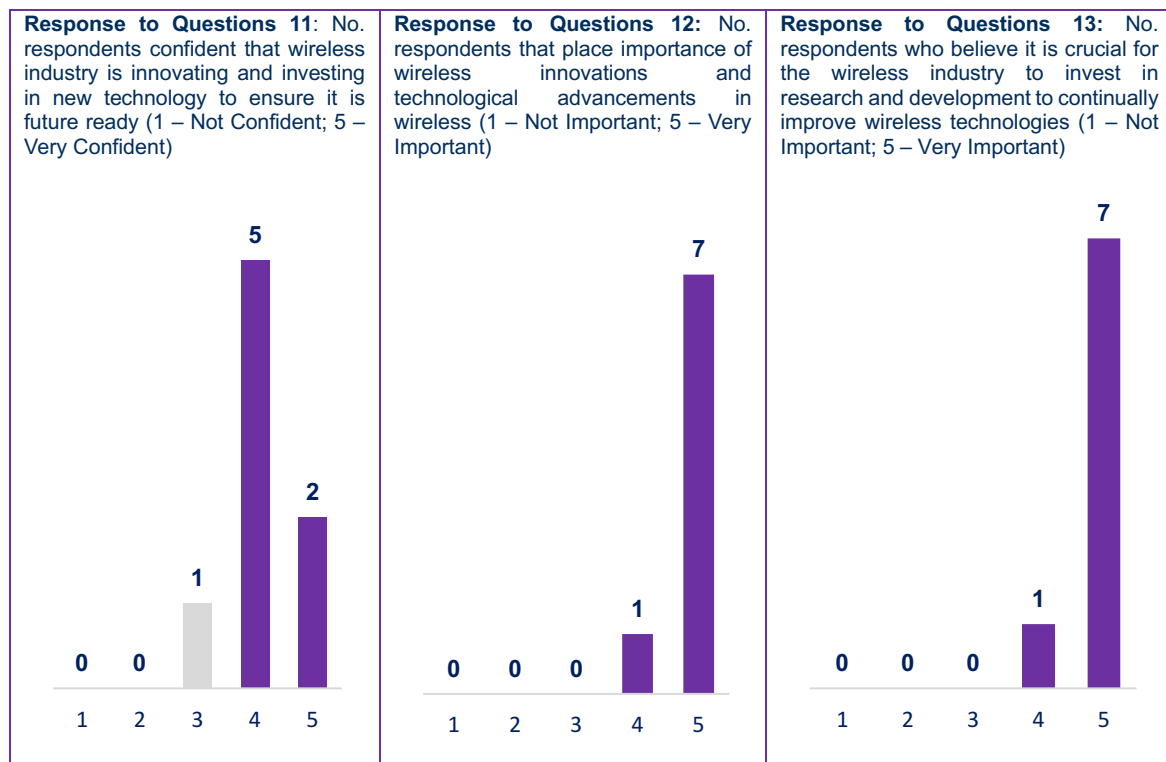
testing and showcasing its reliability to end users, thereby building confidence in the technology.

These findings collectively demonstrate the wireless industry has high levels of confidence in the relevance of wireless technologies positioning it as a key technology option as part of the broadband connectivity mix.

Confidence in wireless technology innovation and investment

A high level of importance is attached by operators to innovation and investment ensuring new technology is future ready and will incorporate technological advancements. This sentiment is reflected in the response to Questions 11, 12 and 13 which indicate a high level of confidence that the wireless industry is innovating and investing in new technology.

Figure 10 Response to questions 11, 12 and 13 by no. respondents. Source: UKWISPA members survey, September 2023.



Tarana Wireless is an excellent example of recent innovations in wireless technology that challenge misconceptions and offer gigabit speeds with non-line-of-sight capabilities as highlighted in Exhibit 4.

Exhibit 5 – Tarana Wireless: Fibre Class Wireless Broadband

Introduction: Tarana Wireless is at the forefront of cutting-edge next generation fixed wireless access (ngFWA) technology, revolutionising the delivery of fixed broadband services. Their groundbreaking G1 (gigabit) platform, which benefited from over USD 400 million in research funding, was commercially launched in late 2021. This innovative technology is currently empowering over 210 active operator networks spanning 19 countries, providing high-speed wireless broadband to communities that were previously left underserved.

Technology: Tarana's ngFWA technology is a game-changer. It thrives in both near- and non-line-of-sight (nLoS and NLoS) scenarios, even in high-interference, unlicensed spectrum environments. This adaptability makes wireless technology an adaptable and potent solution, capable of meeting the connectivity needs of diverse urban and rural areas.

Connecting Communities: With Tarana's G1 product, delivering "hundreds of megabits per customer" becomes a reality. It covers ranges of 3km to 5km in non-line-of-sight scenarios and exceeds 10 km in line-of-sight deployments. But that's not all – a forthcoming G2 model will take this a step further, delivering "gigabit rates on a per-user basis," even in challenging non-line-of-sight situations.

Source: Tarana Wireless, 2023.

The development of gigabit-capable wireless technology for NLoS conditions represents a significant step toward a more connected, high-speed future. WhiteHaul, an early-stage Edinburgh University company, has developed unique hardware and software technology to develop wireless solutions that can offer gigabit speeds over long distances in NLOS conditions.⁶

Other innovations include the use of LiFi which has shown promise in achieving 100 Gbit/s using incoherent light using intensity modulation⁷. Other research is ongoing to explore cost-effective, power-efficient, high-performance millimetre wavelength (mmWave) transceiver for use in future 6G fixed wireless access cases.⁸ Another research programme is ongoing to advance the use of mmWave to provide high-capacity internet connectivity, offering speeds of up to 45 Gbit/s.⁹

In addition, analysts note that the wireless gigabit market is in currently in the early stages of development and is showing promising growth prospects as demand for high-speed wireless continues to rise.¹⁰

These innovations align with the broader trend of wireless technology playing a crucial role as part of the technology mix to support the next generation of connectivity solutions.

In recent decades wireless has consistently evolved, providing better solutions, to a scale that was perhaps unimaginable to early pioneers. There is no sign that this dynamism is slowing, never mind stopping.

⁶ **Source:** WhiteHaul & University of Edinburgh, 2023.

⁷ **Source:** University of Strathclyde, 2020.

⁸ **Source:** University of Sheffield, 2021.

⁹ **Source:** Lancaster University, 2019.

¹⁰ **Source:** Future Market Insights, Wireless Gigabit Market, 2023.

8 Exploring the economic benefits

This section sets out a fresh perspective to identifying, and, where feasible, quantifying the economic advantages from wireless technology. This task presents a unique challenge due to the diverse range of factors that impact the influence of wireless, including foundational technology, government policies, consumer attitudes, the competitiveness of fibre, innovation, and, significantly, its scale.

The chosen methodology for gauging the economic impact of wireless begins by constructing a framework rooted in the fundamental characteristics of wireless networks. These aspects are well established, intimately tied to the fundamental principles governing wireless propagation. This approach forms a sturdy foundation for assessing various impacts and estimating their extent. These key characteristics of wireless are:

- Very low capital costs per km² served.
- With the cost to reach premises largely independent of distance.
- Capable of rapid deployment and avoidance of most wayleave / landowner barriers.
- Very low environmental impact in provision.
- Can be readily re-deployed if needs or demand profile changes.
- Higher connection costs per premise than fibre.
- High level of UK expertise, an important sector and one with growing export potential.

These characteristics then shape how wireless network providers fits into a competitive telecoms market, like that of the UK. It is, for example, widely accepted that wireless technology has a role in reaching remote areas, where the cost of fibre, which rises linearly with distance, would be prohibitive. This analysis extends and broadens that thinking to examine how other attributes of wireless solutions can generate real benefits to customers, communities, policy makers, the public purse and industry.

These attributes are considered in turn, though in practice there is a degree of interdependency.

Advancing benefit: GBP 3 billion gain from rapid wireless deployment

The capability for rapid deployment of wireless networks allows it to bring high speed connectivity to many areas much earlier than with current Project Gigabit plans (to reach all but the very remotest areas by 2030).

Wireless network providers can, if adequately resourced, target and provide service to these areas quickly, advancing, typically by a few years, the date at which those remote communities will access the myriad benefits of fast, reliable and affordable connectivity.

Assuming Project Gigabit meets its target of 85% coverage by end 2025, there will be 15% unserved at this point. As the target is a milestone rather than an endpoint it is prudent to assume that roll-out will continue beyond 2025, though the speed of roll-out will decline as the more commercially attractive and easy to reach areas will have been served by then.

The approach here assumes that by 2025, about 10% of the UK will not have good internet access. Introducing wireless networks in an area that would have had to wait until 2030 for internet service, would speed up the provision by about 5 years. On average, it might help speed up internet access by around 3 years.

The impact of this depends on the assumed value of fast connectivity and the level of take-up. Our research shows that consumers will typically pay around GBP 35 per month (for a service offering 100Mbit/s). That helpfully provides a guide as to the minimum consumers value it. Some, like those working from home or relying a lot on the internet due to a disability, will find it much more valuable, perhaps averaging at around GBP 50 a month.

Based on similar cases in the past (Superfast provision), it is reasonable to assume 60% of premises could take a connection.

Combining these assumptions suggests that 60% of the 3 million relevant premises (being the 10% of the UK total expected to see no firm date for connection by 2025) could see benefit, of around GBP 1,800 each, in total over the three years before fibre arrives. This is a total benefit, to consumers, of GBP 3.24 billion.

Extending benefit: GBP 29 million saved for the very hard to reach

The preceding section was concerned with those areas where wireless providers can act to advance provision for those who will ultimately be able to access fibre. Arguably even more important are those who will never be reached by fibre networks due to its cost.

The UK Government indicated in 2022 that around 100,000 premises are deemed to be 'Very Hard to Reach' and will likely remain unserved by fibre.¹¹ A separate report from National Infrastructure Commission, which provides the UK Government with impartial, expert advice on major long-term infrastructure challenges, reported that the distance between premises and local distribution points in any technical architecture can be anything from typically 10 metres for dense urban areas (classified as geotypes 6) to 1km for sparse rural locations (geotype 1).¹² The NIC report suggests a wide range of costs in bringing fibre and noted the development of new techniques such as micro-trenching which cut costs by 40%, but still finds GBP 30 per metre to be realistic. For a property one km from a local distribution point to be passed by fibre will then cost GBP 30,000. These costs are so high as to be purely hypothetical as no Government could justify a policy of fibre to every premise.

This section takes a different approach than the advancement case, which relied on what people are willing to pay. For people in very remote areas, when they do have a choice, it's usually between a wireless provider and Low Earth Satellite (LEO) provision like Starlink and OneWeb.

Recently (July 2023), Starlink reduced its tariffs from GBP 89 to GBP 75 per month, offering unlimited usage, fast latency times (20-40ms), and downloads of around 50-200 Mbit/s with uploads of approximately 10-20 Mbit/s. Our research indicates that this is about GBP 40 more per month than the average WISP tariff for a comparable level of service. Therefore, wireless providers can save each connected customer approximately GBP 480 per year compared to a LEO alternative like Starlink.

Assuming a prudent eventual take-up of 60%, (our research shows take-up rates of greater than 60% can be achieved in hard-to-reach rural areas) this represents a minimum of 60,000 connections. Users save around GBP 480 a year each, so this is a minimum annual cash saving in aggregate of GBP 28.8 million.

De risking fibre: Delivering GBP 1 billion in public savings

Wireless can 'pave the way' for fibre. By signing up customers and proving demand, wireless can improve the business case for eventual fibre deployment, which reduces the level of public subsidy required through de-risking fibre builds.

The experience of wireless to date is that it can provide a very effective 'bridgehead', bringing connectivity to an area and building a subscriber base that might then be migrated to a fibre network. For many hybrid (fibre and wireless) ISPs this 'flip to fibre' approach is

¹¹ **Source:** Consultation outcome Improving broadband for Very Hard to Reach Premises. DCMS, May 2022.

¹² Digital Communications Infrastructure: Cost Analysis report (for NIC) by Prism and Tactis, 2017.

central to their business model and is something that has been discussed both in this report and at length in the past.¹³

However, it is feasible and demonstrated among our case studies, that creating a strong wireless presence in areas lacking connectivity profoundly impacts the broader market and consequently the necessity for subsidies. Wireless solutions can serve as proof of demand, attracting customers from the start and reducing uncertainty while accelerating revenues. This improved business outlook for fibre makes it more appealing and less reliant on subsidies. Essentially, this early investment in wireless has the potential to save public funds while expediting connections. We investigate this more closely below.

The most recent set of Project Gigabit contracts are expected to pass up to 218,000 rural homes and businesses across Norfolk, Suffolk and Hampshire.¹⁴ This will entail GBP 318 million of UK government funding which has been awarded to a fibre operator, which in turn will invest a further GBP 170 million giving a total spend of GBP 488 million. This equates to an average spend per premise passed of GBP 2,240 and subsidy at 65.2%, or GBP 1,460 per premise. This level of subsidy is required as the successful operator could only justify contributing GBP 780 for each passed premise.¹⁵ This figure reflects the potential revenue from future tariffs from connected customers, but also uncertainty over take-up and delay before any income is received. A high rate of return on the investment will also be demanded to reflect these challenges.

On the other hand, wireless provision can deliver more value, attract customers early, providing demand and deliver immediate cash flow. It can be argued that, starting with a wireless intervention covering most premises in this area (especially those easily visible from a few masts) would have been significantly cheaper – approximately 100 times less based on case studies presented earlier – therefore negating the need for significant public subsidy. It can also be said that a wireless connected premise has greater value than a typical premise in an unserved area.

To determine the potential saving to the public purse we can make a series of assumptions about how providing wireless might attract customers and what value that customer base might add to the intervention area. This will illustrate how much Project Gigabit subsidies could then be cut by.

First, we estimate the value of an existing (wireless) customer to be around GBP 1,680.¹⁶ This is GBP 900 more than the GBP 780 calculated above and represents the additional value created to the network provider due to deploying wireless.

Given that a 'wireless first' approach would only operate for a few years we would expect take-up to be a little lower, at 40%. If 40% of the premises in the above intervention example had taken up the early wireless service, this would have resulted on 87,000 customers. With each customer subscription bringing a value to the network provider of GBP 900, the aggregate increase across this customer base would have been around GBP 80 million. This would have boosted the business case and hence cut the required level of public subsidy by an equivalent amount. In this example the saving to the taxpayer is roughly a quarter. The saving will rise with harder to reach areas.

On this basis the potential saving to the public purse from frontloading wireless across the remaining phases of Project Gigabit is then of the order of GBP 1 billion.

¹³ **Source:** Intelligens Consulting Article: 'Flipping Fibre', March 2021.

¹⁴ **Source:** Project Gigabit Progress Update, DSIT, September 2023.

¹⁵ The GBP 780 is calculated by subtracting the subsidy (GBP 1,460) from the estimated costs (GBP 2,240). As the subsidy is required to be the minimum necessary it follows that the GBP 780 is the most that the successful bidder could pay.

¹⁶ Assumes the net income (on a wholesale basis) is GBP 200 a year, that a 15-year time horizon is taken, with no residual value, and an internal rate of return of 10% is required.

Promoting competition: delivering GBP 337 million in public savings

Wireless provision can promote competition, delivering savings to customers and encouraging high levels of service. Ofcom state the current number of UK consumers taking a broadband connection at 28.1 million¹⁷. If the presence, or even threat, of a wireless ISP prompted a reduction of a token GBP 1 in the typical monthly tariff, this would be worth GBP 28.1 million a month, or GBP 337 million a year in savings to consumers.

Bridging the digital divide: Tackling inequality and tackling social decline

Delivering high-speed broadband to individuals who wouldn't otherwise have access is the core policy objective of Project Gigabit. However, the policy is currently outlined in broad geographic terms, using postcodes, rather than being directed at disadvantaged individuals or groups in society. Consequently, Project Gigabit delivery covers specific areas, within which there exists a significant spectrum of income and wealth levels.

Using the previous intervention example as a benchmark, public subsidy amounts to approximately GBP 1,460 per premise. A significant portion of this subsidy goes towards households that are relatively well-off and can comfortably afford the connection and subscription. It's important to highlight too that certain studies have indicated that a typical household gains financially from being connected, as the direct costs are outweighed by savings on online purchases, travel, insurance, and other expenses. These savings tend to increase with higher household incomes. Consequently, directly subsidising rural residents to access fibre can act to exacerbate inequality within the intervention area. The less advantaged, who cannot afford it, derive no benefit, while those with higher incomes reap the advantages of connectivity, including direct financial savings. This situation is notably regressive.

In contrast, wireless solutions, especially those that extend beyond areas likely to receive fibre soon, can promote equality. The rapid and extensive coverage that wireless solutions offer is evidently valuable for individuals who would otherwise be excluded. Specifically, it benefits rural residents who lack the financial means to opt for alternatives like LEO satellite provision. By reducing connectivity costs, more people can access and enjoy its advantages.

There's also an equality concern at the community level, with implications for public spending. Areas with poor connectivity, often termed 'connectivity deserts', tend to deter families with young children from settling there. This results in a decline of social resources like nurseries, schools, and healthcare facilities, triggering a cycle of decline as these services dwindle. Consequently, these essential services must be provided in other areas, incurring significant costs. However, by providing robust connectivity, social capital can be preserved or even strengthened. This can actively attract individuals to move to the area, boost enrolment in local schools, and optimise social infrastructure. The potential benefits of this could be substantial.

Business benefits

The UK has a long history of innovation in wireless, from the days of Marconi to cutting edge research in the UK's university academic and research network. Supporting the wireless sector maintains jobs in the UK, can help diversify the supply chain, but also opens considerable opportunity for the export of high value product and services, from commercialising IP to offering professional service and selling telecoms equipment and devices.

¹⁷ **Source:** Ofcom Research, Q1 2023.

Environmental impacts

There are obvious benefits from using wireless over trenching or otherwise taking fibre to a premise. This is not however amenable to measurement as it depends on the technology used, and the carbon policy of the installer, for example use of renewable energy, waste policy and so forth.

Figure 11 – Summary table of quantifiable economic impacts

Wireless Contribution	Impact	Policy Implication
Advancement of service to rural areas	Advance gigabit services to 1.8 million homes by an average of 3 years Benefit > GBP 3 billion	Accelerated planning, noting potential to remove and redeploy infrastructure as fibre emerges
Extending benefit to remote areas	Reduce costs to hard-to-reach premises and provide consumers with choice and savings over competitors such as satellite Total savings GBP 29 million a year	Ensure technology neutrality in Project Gigabit – so that FWA competing fairly
Working with fibre to deliver gigabit service	Saving public purse GBP 1 billion in future phases of Project Gigabit	Prioritise value for money in Project Gigabit, by using wireless deployments to build markets and de-risk investment
Promoting competition	Giving consumers a choice will lead to better tariffs and better services, benefiting consumers by GBP 337 million a year	Consider fostering a competitive environment that allows for such potential cost savings, ultimately benefiting the end-users

9 Implications for policy makers

This section explores the implications of this report's findings for policymakers. It highlights the need for policy makers to ensure interventions consider wireless as part of the ecosystem and gigabit ambition. It advocates for streamlined procedures that ease the administrative burden of procurements for smaller WISPs. In addition, this section emphasises the importance of engaging with smaller WISPs to streamline regulatory processes and provide greater spectrum resources.

Balancing needs with cost-effectiveness and value

Government intervention programs have influenced the decisions and strategies of WISPs and their technology decisions. Consultations with WISPs noted some notable behaviours being influenced by government interventions and policy. Consultation feedback noted concerns that government intervention programmes may inadvertently favour fibre deployments, potentially sidelining wireless technologies. This has led to some frustration within the industry that wireless is wrongly seen as an inferior option and that wireless capabilities, in particular the way they can dovetail with fibre, are not fully understood within the sphere of policy makers.

As a direct consequence of government policy, Quickline has designed and built fibre networks where a wireless solution could be built faster and at lower cost. This has direct implications for public value.

In contrast, Bink points out that the Welsh Government's approach involves engaging smaller companies and considering solutions beyond just fibre. The Welsh Government's Superfast Cymru programme has delivered fibre and wireless connectivity to unserved premises by offering up to GBP 800 grant to cover eligible costs including wireless mobile and satellite equipment for a superfast (30Mbit/s) broadband package.¹⁸

Policy makers should seek to balance the need for improved connectivity with cost-effectiveness and long-term sustainability fostering an environment where wireless broadband innovation is encouraged and supported in addition to fibre and cellular technology maintaining technology neutrality.

Policy makers should also prioritise value for money in Project Gigabit, by using wireless deployments to build markets and de-risk investment.

Advancement of service to rural areas

Wireless solutions offer a pathway to accelerate the provision of high-speed connectivity to remote and underserved areas much earlier than the current Project Gigabit plans, which aim to reach these areas by 2030. Policy makers should encourage the rapid deployment of wireless technologies so these areas can benefit from fast, reliable, and affordable connectivity several years earlier than initially anticipated.

Policymakers should also recognise the agility of wireless infrastructure, which can be deployed swiftly and, as fibre infrastructure becomes available, potentially removed and redeployed. This flexibility ensures that the evolving technology landscape can be leveraged optimally, making it a valuable asset in the pursuit of comprehensive and timely broadband coverage for all communities, including those in remote or challenging-to-reach locations.

Encourage competition

It is commonly perceived that overbuilding networks is inefficient. However, in this context, it can be argued that if overbuilding does not result from public subsidies, it can deliver

¹⁸ Source: Welsh Government, 2023.

significant benefits to consumers. Encouraging competition provides consumers with choices, which can lead to improved tariffs and services. Policy makers should consider fostering a competitive environment that allows for potential cost savings, ultimately benefiting end-users.

Policy makers can employ a range of strategies to cultivate a competitive environment such as preventing market dominance, directing subsidies to rural and underserved areas, and supporting startups and new market entrants, and new technologies, for example.

Streamline processes and support small WISPs to overcome challenges

Although government procurements and programs can provide opportunities for WISPs to expand their networks and serve underserved areas, these processes can be challenging for smaller businesses due to their complexity and resource limitations. Some of the smaller WISPs interviewed highlighted the challenges of tendering for public contracts, which can often be difficult to navigate with restrictive qualification criteria and are not aligned with the needs of smaller providers.

A common challenge in selling to the public sector can be where procurement practices tend to favour larger national companies. Bink and GigaAir both mentioned the administrative burden of procurement can be counterproductive and challenging for smaller providers.

The conversation with GigaAir also points out frustrations with the administrative processes associated with claiming vouchers. XPON Wireless also mentioned challenges with claiming vouchers with securing funding and managing cash flow.

These challenges can lead to WISPs losing out on public sector contracts, which can lead to financial resources flowing out of the local economy. There's a widely held belief that if local businesses were provided with opportunities, they could effectively participate in portions of public sector contracts, thereby contributing to and enhancing the local economy, while building local capacity.

Addressing these challenges will require the Government to streamline procurement processes and interventions to reduce the administrative and cash flow burden they can place on WISPs, and ensure procurements are accessible to smaller industry operators.

Streamline regulatory process and access to spectrum

The discussions highlighted the complex landscape of spectrum challenges and the need for innovative solutions, regulatory reforms, and increased access to spectrum resources to meet the growing demand for wireless connectivity.

WISPs touched on the importance of fair spectrum allocation for different use cases, including wireless broadband and other applications. It's suggested that having dedicated spectrum channels for ISPs could help mitigate interference issues. Bink noted that clear spectrum is crucial to avoid congestion, especially in densely populated areas.

Participants highlighted the increasing demand for spectrum in urban areas due to the proliferation of wireless devices and data-intensive applications. Spectrum challenges are also particularly pronounced in rural areas where more spectrum is needed to provide high-speed connectivity to underserved and remote regions.

Regulatory processes and hurdles, such as licensing and spectrum auctions, were seen as obstacles for smaller WISPs to access spectrum. These challenges were noted to limit the growth potential of WISPs.

The need for spectrum to support 5G deployment and the future evolution of wireless technologies was highlighted emphasising that adequate spectrum resources are crucial for realising the full potential of 5G and beyond.

Interestingly, spectrum challenges were also seen as an opportunity for innovation. Participants mentioned technologies like TV White Spaces and dynamic spectrum sharing as potential solutions to address spectrum scarcity.

Policy makers should also play a role to dispel misinformation around switching providers. Rapiere Systems refers to a situation where potential customers have been told that they would lose their email address if they left their current provider.

Ofcom should proactively engage with smaller wireless operators, streamline regulatory processes, and explore innovative approaches to ensure equitable access to spectrum resources to foster the growth of wireless connectivity.

Foster an innovative technology ecosystem

Policymakers should also recognise that alternative wireless technologies play vital roles in the technology ecosystem. The Government should build on the UK academic research to promote research and development in broadband wireless technologies and support the commercialisation of such technologies. This will ensure that the UK wireless sector remains innovative resulting in high growth companies that create jobs and economic opportunities in the UK but can also de-risk the UK's telecoms supply chain in line with currently policy aims.

10 Conclusion

This report provides an overview into role of wireless technology within the broadband landscape, offering a nuanced perspective on its potential to support the Government's deliver its gigabit ambition. It demonstrates that wireless networks, typically associated with rural and remote areas, have a broader use and can also significantly impact connectivity strategies in urban settings.

In urban areas, where fibre infrastructure seems to dominate, this study reveals circumstances where wireless technology emerges as a cost-effective alternative. By postponing major investment costs until customers are connected, wireless solutions can mitigate financial risks and offer a strategic advantage for broadband providers, connecting customer more quickly improving cash flow.

Furthermore, the report explores the distinct financial dynamics within the wireless operator industry. This fosters an environment of adaptability and flexibility, with a focus on driving the number of customer connections.

In rural areas, this report illustrates how wireless technology can extend cost-effective coverage and scale infrastructure in alignment with demand. The 'pay-as-you-grow' approach eliminates the need for substantial upfront investments in fibre infrastructure, facilitating rapid connectivity improvements for rural communities.

Lower than gigabit-speed broadband options seem prevalent among WISPs, suggesting demand for full gigabit is suppressed. However, the report highlights the importance of acknowledging the future demand of gigabit connectivity. Preparing for this eventuality, especially in areas where deploying fibre is challenging, positions gigabit capable wireless solutions as a viable alternative.

The economic analysis highlights how wireless can deliver policy objectives more quickly and more cheaply, potentially saving taxpayers GBP 1 billion, while helping consumers benefit by over GBP 3 billion. It can make an important contribution to ensuring equality and preserving communities. In doing all this, the opportunity exists for the UK to become an exemplar for the global wireless industry, building on its historic research strengths to drive high value exports, supporting industry and jobs.

In conclusion, this report resents a compelling case for wireless technology to be considered in collaboration with fibre networks. With industry confidence in its ability to innovate and meet evolving needs, wireless is a crucial contributor to the broadband ecosystem and the gigabit vision alongside fibre networks.

The implications are clear: policymakers must recognise the significant role of wireless technologies as part of the technology mix and to support the Government to deliver its gigabit ambition. Streamlined procedures and regulatory processes that accommodate smaller wireless operators are essential to ensure equitable access. The vision of ubiquitous gigabit connectivity can only be achieved when wireless, in conjunction with other technologies, plays a central role in strategic planning and policy design.