**Advanced
Wireless
Networks**

**Active
demand
stakeholder
study**

*November
2024*

Firetail
Strategy for social progress

matrix.

**Northern Ireland
Science Industry Panel**

Foreword

The Matrix Advanced Wireless Networks (AWN) Report set a visionary foundation for understanding the transformative role of advanced wireless networks in Northern Ireland. This follow-up study, the Matrix Demand Stakeholder Study, builds on the initial report's findings by providing an in-depth analysis of demand drivers, stakeholder needs, and opportunities to foster innovation across diverse sectors. As Northern Ireland's economy advances, the demand for robust connectivity—encompassing everything from 5G and 6G to broader advanced connectivity solutions—has only grown more critical.

The Matrix Demand Stakeholder Study not only maps the active stakeholders shaping Northern Ireland's connectivity landscape but also identifies the dynamic forces driving demand across industries, including manufacturing, health, and creative technologies. With these insights, this report highlights how demand-responsive strategies can better align Northern Ireland's infrastructure development with the expectations of a digital future, where connectivity enables a sustainable, inclusive, and competitive economy.

This study is a timely response to the evolving needs of our region and stands as a strategic guide to harnessing advanced wireless technologies to fuel Northern Ireland's continued growth and innovation.

I am confident that its findings will inspire collaborative efforts across sectors, positioning Northern Ireland at the forefront of advanced connectivity and innovation.

Patrcia O'Hagan
Deputy Chair, Matrix

Contents

1. Project Introduction

1.1. Project background

In early 2023, Matrix commissioned Firetail to conduct a strategic foresight study into the future of advanced wireless networks in Northern Ireland (NI). The report [1] highlighted the critical importance of connectivity as an enabler to innovation, economy, inclusion, climate, and society.

One of the report's recommendations was to identify and map the key demand drivers and stakeholders for advanced connectivity across NI, to help provide an evidence base for telecoms policy in NI, both now, and into the future.

This project was commissioned to deliver against this recommendation.

This report also coincides with the launch of the new NI Economic Mission, with its key objectives to increase the proportion of working age people in good jobs, promote regional balance, raise productivity, and reduce carbon emissions.

The role of advanced connectivity in helping NI achieve these objectives is explored throughout this report.

1.2. Project aims

This project was commissioned to deliver against three aims:

Map demand-side stakeholders who are actively looking to explore and adopt advanced connectivity across NI.

Explore the current and future drivers of demand for advanced connectivity across NI economy and society.

Develop practical and actionable recommendations to help inform the NI Mobile Action Plan and NI Barrier Busting Taskforce for how to reflect and respond to demand drivers.

1.3. Scope

For this project, the agreed scope goes beyond advanced mobile telecommunications networks, and encompasses the broader range of advanced wired and wireless connectivity technologies.

The scope covers all areas of the NI economy, and builds on the sectoral breakdown used in the initial study. These sectors used are advanced manufacturing, engineering, and construction; agri-food; digital, ICT, and creative industries; energy and utilities; financial services; health and social care; and public services.

It is also recognised that advanced connectivity has a close link with advanced computing and that this is an area which will also grow in importance, especially with the acceleration of AI. Advanced computing demand is beyond the scope of this study.

1.4. Definitions

Advanced connectivity

All wireless and wired connectivity technologies that enable new services and applications that can have a transformative impact on the economy, environment, or society of Northern Ireland.

This includes, but is not limited to, technologies such as 5G-Advanced and 6G mobile telecommunications, Wi-Fi 7 and 8, Fibre-optic broadband, Li-Fi, and non-terrestrial networks. All these technologies will be suitable for different sectors and use cases, based on their needs and requirements, with some delivered via public networks and other via private networks.

Active demand-side stakeholder

The state, market and civil participants that consume, or have a stake in, advanced connectivity consumption, and who are likely to be actively looking to test and leverage advanced connectivity technologies.

1. Project Introduction

1.5. Timeframes

The timeframe in focus for this project is up to 2035. The projected evolutions[1] for some of the key advanced connectivity technologies are captured in Figure 1 below.
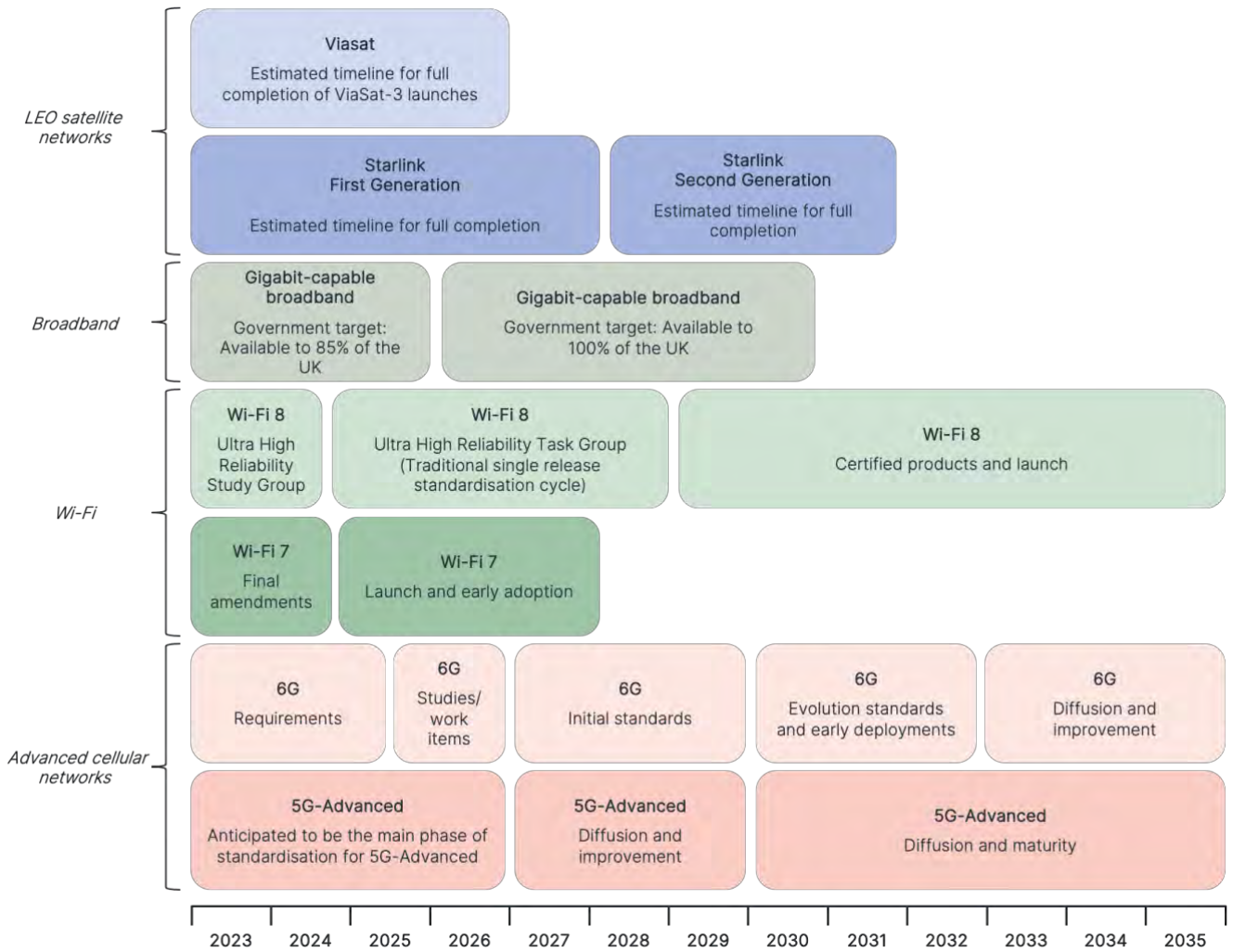

Figure 1: Projected evolutions of some key advanced connectivity technologies

---

[1] These timelines are indicative and based on multiple sources available at the time of collection.

Firetail © Matrix Demand-side Stakeholder Study

2. Demand drivers

2.1. Section introduction

To help understand demand for advanced connectivity, this section outlines a set of drivers which are likely to shape demand.

These drivers are assessed to be relevant now and also assessed as highly likely to be the drivers which will continue to shape demand in the foreseeable future. Additionally, these drivers are assessed to be relevant across all sectors.

2.2. Methodology

To identify drivers, a literature review was conducted of over 60 reports, research papers, industry white papers, government strategies, and other supporting data.

This produced a list of 128 individual demand drivers which were then sorted and analysed to arrive at 5 thematic demand drivers. These are summarised below in Table 1.

These drivers were then tested with the project steering group and with a wide range of stakeholders from across NI industry, public sector, and academia.

Thematic demand driver 1: **Connection density and network capacity**	The capacity of networks to efficiently and effectively support a large number and high density of connected devices and bandwidth-intensive activities.
Thematic demand driver 2: **Integration and interoperability**	The ability to make seamless use of different connectivity technologies across devices, spaces, and places, as well as the integration of connectivity technologies with existing digital and physical infrastructure and services.
Thematic demand driver 3: **Quality, reliability, and security**	The demand for connectivity to deliver quality of service across an increasingly diverse set of specialised and specific requirements, and to do so with high reliability and security.
Thematic demand driver 4: **Environment and sustainability**	The construction of energy-efficient connectivity infrastructures, and potential of advanced connectivity to enable downstream sustainability efforts across sectors.
Thematic demand driver 5: **Inclusive and equitable coverage and access**	The provision of regionally balanced and inclusive connectivity solutions that can bridge the digital divide, enable remote work, education, healthcare, and support industrial growth beyond major urban centres.

Table 1: Thematic demand drivers

2. Demand drivers

2.3. Thematic demand driver 1:

Connection density and network capacity

2.3.1. Demand drivers within this theme

Increasing volume and density of connected devices

Between 2017 and 2021, "mobile data traffic has increased at an average of 40% year on year" and is expected to continue growing [2]. The growth in wireless network connection numbers is now primarily driven by IoT devices, rather than mobile handsets [3]. In a survey of NI businesses conducted as part of this study, 'more simultaneous connections' came out as one of the most important features of advanced connectivity for respondents.

IoT devices are fostering the development of smarter environments across industrial, public, and domestic settings [3]. This expansion extends the demand for connectivity beyond traditional consumer entertainment and internet applications, with integrated ecosystems of machine-to-machine connections being the key in IoT applications. For example, smart city traffic management systems that integrate data from cars, traffic lights, road sensors, and buildings.

Each IoT device and application will make a different demand on the network, depending on factors such as the level and direction of data flows, tolerances relating to latency and security requirements, and frequency of data sharing requirements. Managing these different, and often competing demands, within the context of exponential growth in the number of connections, will become a hallmark for the efficient use of advanced network connectivity.

There is also demand for high capacity of networks in locations with a high density of people, such as mass event venues and transit hubs (e.g. Casement Park and Weavers Cross) [4]. The performance of existing public mobile networks can be impacted by network congestion, for example in places with high concurrent demand or at times of peak demand.

Bandwidth-intensive streaming applications

High-capacity streaming and gaming applications add to the demands on current networks. Streaming necessitates robust connectivity to handle vast amounts of data efficiently. The proliferation of streaming content is a significant driver of connectivity demand, and it is forecast that video traffic will account for 80% of all mobile data traffic by 2028 [3].

Streaming is also diversifying beyond audio and video content. Cloud gaming, cloud-based productivity tools, and virtual collaboration platforms all require robust connectivity. Mobile gaming demand continues to be a driver of mobile traffic growth [3], and is a factor that is likely to drive future mobile traffic growth [5].

The runaway success of visitor attractions, such as London's ABBA Voyage, is set to inspire the development of a new generation of deeply immersive city tourism experiences. These will use highly connected, specialist production facilities, incorporating volumetric capture, holographic projection, XR and advanced streaming capabilities to showcase and connect the world-leading strengths of Northern Ireland's burgeoning Creative Technology sector.

As advanced wireless network capabilities develop, opportunities exist for the creative industries to benefit from high quality streaming and data sharing direct from filming locations, allowing for enhanced creation, collaboration, and production.

Augmented Reality devices like the Apple Vision Pro promise to overlay digital information onto the real world. As AR becomes more pervasive, the need for high bandwidth, low latency connectivity will increase [5].

> There is a new standard of speed connectivity that sets the floor. Beyond that, the focus needs to be on ensuring low latency and matching the different technologies to the appropriate use cases.

2. Demand drivers

Connected industry and smart cities

With the number of connected IoT devices growing exponentially, the capacity and density of networks are crucial for managing digital twins and implementing predictive maintenance, enhancing operational efficiency real-time monitoring, and productivity. Initiatives like the Smart Manufacturing Data Hub at the University of Ulster have begun showcasing the transformative power of real-time monitoring, data visualisation and data analytics, prompting a growing recognition of their benefits amongst businesses in the sector. This will lead to an increase in demand for cloud storage solutions and high capacity, high density connectivity solutions to address connectivity challenges and unlock the full potential of IoT technologies.

The density and capacity of networks are vital for smart city initiatives. Connectivity supports traffic management and monitoring systems, as well as machine-to-machine communications, optimising urban mobility and infrastructure.

> We are now at the point where you have got pretty much commercialised technology that can put a chip in any piece of packaging you want to talk about. That doesn't need a gigabit broadband connection, that needs density. We're going to see an explosion of connected devices but at a low bandwidth level.

Integration and interoperability

2.4.1. Demand drivers within this theme

Seamless connectivity experience for consumers

End-users are generally less concerned about the specific technologies they use; instead, their focus lies on the quality, reliability, and consistency of the service they receive. As a result, the integration of various connectivity technologies into one seamless ecosystem is increasingly expected by end-users.

Indoor environments often present specific challenges [5], as the wireless signal wavelengths that can deliver high bandwidths have poorer propagation characteristics. This means they are more greatly impacted by obstacles such as buildings and walls, making it difficult to deliver mobile wireless connectivity to indoor environments. This often means that MNOs will use lower frequency spectrum to deliver this 'outside-in' coverage, however there is insufficient capacity within this spectrum to meet anticipated future demand [5]. Many public places and spaces also offer Wi-Fi for indoor connectivity. However, many public Wi-Fi solutions still rely on individual login pages and captive portals, impacting the end-user experience.

> There will be 20 million people coming through Weavers Cross every year. Every single person will want to be connected automatically. We won't be able to rely solely on 4G for that, and people won't want to log into a Wi-Fi network to stay connected.

Integration and interoperability of connectivity technologies across systems and supply chains

The growth in machine-to-machine connections for connected industry and the need for these to work within an integrated connectivity ecosystem, within and across public and private connectivity networks, is another key demand driver.

The growing use of connected and autonomous mobility technology and greater industrial automation are anticipated to unlock significant growth and efficiency gains in the manufacturing and logistics sector [2]. These applications require advanced connectivity solutions which can deliver an integrated, resilient, and robust system [2].

Integration of connectivity technologies for network coverage

The increasing digitisation of the economy and public services, coupled with expectations of connectivity as a utility, will continue to drive demand for universal and ubiquitous coverage. To achieve this, a mix of connectivity technologies will be required.

One example of this is in how to achieve remote and rural wireless coverage through a mix of terrestrial and non-terrestrial networks, and how to integrate these connectivity technologies into a coherent connectivity ecosystem.

Another example is achieving robust and reliable indoor coverage, which is again likely to require integration across a mix of connectivity solutions to deliver reliable and equitable coverage.

2. Demand drivers

Integration of advanced connectivity with existing physical and digital infrastructure

One significant barrier to the adoption of advanced connectivity by businesses is compatibility issues with existing software, data systems, and hardware devices. These compatibility challenges can result in substantial changeover costs, which can discourage businesses and public sector organisations from embracing new connectivity solutions [6]. Respondents to our survey noted the need to invest in new, compatible devices as one of the reasons why businesses are not adopting advanced connectivity in their operations.

The need to integrate sensors and connected devices is another key aspect of this driver. This is especially so for applications such as predictive maintenance or connected mobility, where sensors need to be integrated with existing physical infrastructure. As well as integration with physical infrastructure, the need to integrate with existing digital and data infrastructure is critical, helping to provide accurate, timely, and coherent data to support effective and efficient decision-making.

> From a port perspective, we have much more reliable information now regarding crane usage. Which is probably one of the best examples because there's a lot of sensorisation now around predictive maintenance.

Interoperability of connectivity across borders

Interoperability between networks is crucial for seamless cross-border movement and trade. Individuals, businesses, and their goods increasingly necessitate consistent and stable connectivity when transitioning between countries. Stakeholders report that crossing borders can result in significant connectivity disruptions, a concern that will become increasingly relevant with the expansion of connected and autonomous transport solutions and increasing use of advanced connectivity for supply chain management and optimisation.

> Regarding an all-Ireland context, cellular needs to work seamlessly as far as possible. We tested it – currently calls drop out when you cross the border, and you have to dial back in.

2. Demand drivers

Quality, reliability, and security

2.5.1. Demand drivers within this theme

Demand for specific and specialist network characteristics

Many of the emerging use cases for advanced connectivity have specific and specialist requirements from networks. For example, a network that can deliver ultra-low latency, ultra-reliable connectivity for mission-critical systems requires different characteristics to one that can provide mass, public connectivity for consumers. As advanced connectivity technologies mature, the ability to offer flexibility, fine-tuning, and tailored services to different user needs will be essential.

As advanced connectivity grows to support an increasing diversity of users and uses, smart network management is vital to ensuring that multiple, competing network demands can be met. The capability to distinguish between applications that are high bandwidth, low latency, and mission critical, such as critical health monitoring, and applications that are comparatively low bandwidth, such as smart parking or lighting sensors, is essential to ensuring the efficient allocation of overall network resources.

In industrial applications, there is a growing need for connectivity to intelligent devices that offer ultra reliable and low-latency connections. Businesses aim to increase efficiency of operations through automation, and health and safety by removing workers from the immediate vicinity of heavy goods movements. The enablers to this include precise positioning capabilities to enable ubiquitous and real-time information collection and sharing, and automated control and feedback of machines. Businesses at Belfast Harbour have indicated a desire to improve worker health and safety, and speed of operations through automation. To address this, the harbour has conducted trials of autonomous hoppers to automate certain goods movements throughout the harbour.

> "There is a very clear demand driver from the Belfast Harbour tenants to say, "what we would like is the ultimate flexibility".

More connected devices, more safety critical systems

The proliferation of connected devices has led to an exponential increase in safety-critical systems that rely on network connectivity. As more devices, such as autonomous vehicles, medical implants, and industrial control systems, become interconnected, their reliability becomes paramount. Ensuring robust security and dependable network performance is essential to prevent catastrophic failures and safeguard lives and critical infrastructure.

The advanced manufacturing sector heavily relies on the quality, reliability, and security of networks to enable remote operation, real-time monitoring, and automation. These network features are essential for ensuring uninterrupted production processes, as well as for predictive maintenance of machinery.

In sectors like civil aviation and emergency services, the reliability and security of connectivity are paramount. The Civil Aviation Authority, for instance, is scrutinising the reliability of 5G for drone operations. Additionally, emergency services require reliable access to building floor plans while on the move to an emergency site, highlighting the critical importance of dependable connectivity.

High-quality, reliable, and secure networks are mission-critical for the operation of modern energy systems and grids. Ensuring the integrity and security of data and communication is essential for maintaining operational stability and resilience in the face of evolving challenges and threats.

> At the moment, someone has to be on the hopper for 8 hours a day, managing that process, and there's dangers associated with that, with all the moving vehicles. But if they could use the improved connectivity from 5G to manage that from a safer location in an office, you don't only improve the health and safety element, but you can potentially open it up to a 24 hour operation as well. But that needs to be a real-time connection with no lag time.

2. Demand drivers

Supply chain optimisation and resilience

The increased use of technology and data in supply chain management is expected to drive increased efficiency, reliability, resilience, and sustainability [2]. Advanced connectivity has a critical role to play in this [7] [8], helping optimise supply chain management through data collection, sharing, monitoring; as well as enabling greater automation. This requires reliable and secure connectivity to ensure supply chains remain resilient.

2. Demand drivers

2.6. Thematic demand driver 4:

Environment and sustainability

2.6.1. Demand drivers within this theme

Enhanced sustainability and increased energy efficiency within business and industry.

The drive for sustainability within business and industry stems from a dual aim: to curtail costs and minimise environmental footprints. Embracing advanced connectivity networks plays a pivotal role in this endeavour, facilitating the transition to more sustainable practices across various sectors [9].

With the adoption of IoT technologies, manufacturers are increasingly equipped to track and monitor both direct and indirect carbon emissions. Leveraging advanced wireless solutions becomes essential in this pursuit. These technologies provide manufacturers with real-time insights into energy consumption patterns, enabling them to identify optimisation opportunities. Moreover, IoT facilitates waste reduction by enabling remote monitoring and control of factors like temperature, crucial for goods in transit, including perishable items like fresh and frozen produce. The ability to validate the origin of goods within supply chains is also becoming imperative. Advanced connectivity supports blockchain technologies and non-fungible tokens, offering transparent evidence of materials' origins and enabling efficient smart contracting.

Beyond cost reduction and waste minimisation, these technologies aid in regulatory compliance and contribute to broader Net Zero initiatives. This becomes particularly pertinent in the context of envisioned "factories of the future," with innovation hubs and research centres within the sector placing a significant emphasis on sustainability and regulatory adherence.

Smart Grid

As a consequence of the shift towards greater electrification of mobility and other services, the grid itself will need to become far 'smarter'. Advanced connectivity will be essential to enable a distributed, two-way grid that can effectively balance microgeneration, advanced battery storage, and overall grid performance. Within this context, the smart grid opens new possibilities for deregulation, localised energy markets, and trading within and between communities.

Reduced energy consumption of networks

Data transmission networks and data centres are estimated to account for 1 – 1.5% of total energy use globally and 1% of all energy-related greenhouse gas emissions [10].

Sustainability and energy efficiency of networks are central elements that are guiding the design of 5G-Advanced [11] and 6G [9]. The move to 5G networks, and other technical and operational improvements being delivered by network operators, are already delivering significant energy efficiency gains, even with the growth in data traffic [12].

This also applies to the increasing using of sensors and advanced connectivity capabilities to build smart connectivity infrastructure, which is able to monitor demand, performance, and resilience of telecoms networks.

Environmental monitoring and tracking

The demand for monitoring and tracking environmental data to shape decisions is also experiencing rapid growth. Advanced connectivity technologies can play a crucial role in facilitating large-scale data collection and monitoring across various environmental parameters such as air and water quality, soil health, ecosystem vitality, and land use.

This is critical to help support public and private sector stakeholders in managing their environmental impact. Environmental monitoring and tracking can also play a crucial role in helping to track the impacts of climate change, through providing more real-time and reliable data about environmental conditions. Providing real-time data to citizens and communities has the potential to help accelerate sustainable behaviour change, for example, by reinforcing the positive impacts of sustainable travel choices, and switching energy consumption patterns to help deflect peak grid demands.

2. Demand drivers

2.7. Thematic demand driver 5:

Inclusive and equitable coverage and access

2.7.1. Demand drivers within this theme

Access to public services

Inclusive and equitable access to connectivity plays a vital role in preventing a digital divide and enabling opportunities for remote work, education, healthcare, and economic development outside of urban population centres.

The transition of public services to online platforms is essential for improving access to services for rural communities. In the healthcare sector, connected solutions can offer significant benefits by reducing the need for travel or transfers to appointments, especially for patients with mobility issues and those in vulnerable situations. These solutions can also help reduce unnecessary hospital admissions, aid in medical diagnosis, and provide rapid access to information to assist welfare in care homes and hospices. The West Midlands 5G testbed demonstrated many of these use cases [13].

Access to economic opportunities

Improving rural connectivity has the potential to significantly boost the UK economy. A Virgin Media / O2 study suggests that enhancing rural connectivity could increase the UK economy by £65.1 billion and raise employment by 6.8% [14]. Furthermore, their survey of 1,096 rural business owners found that about 17% in UK rural manufacturing businesses would make greater use of technologies like remote stock checking, inventory management, and fleet management, if their connectivity allowed for it [14].

The growth of the digital economy has also led to the emergence of businesses that operate entirely on digital infrastructure, making a stable and reliable connection not just desirable, but essential for these businesses.

The increasing digitisation of the economy, further accelerated by the advent of revolutionary technologies such as AI, will further increase the importance of inclusive and equitable access to connectivity technology in order to help mitigate the risk of an increased digital divide in the economy and society.

2. Demand drivers

Connectivity as a utility

Connectivity is increasingly seen as an essential service, comparable to utilities such as water or energy. In the future, it is almost certain that connectivity will be viewed as an essential service like heating, water, and electricity. Access will need to be universal, to ensure citizens have access to critical services such as banking, education, health, and welfare as those systems and services become increasingly reliant on online connectivity.

Often, the last 20% of coverage can be as difficult and expensive as the first 80%, which can make it a challenging commercial proposition for MNOs [4], and as such may require others (such as community cooperatives or national governments) to step in and subsidise/seed the investment. Recent examples of this approach are the Shared Rural Network and Project Stratum, which have the specific aim of reaching the remaining hard-to-reach rural properties and places that are currently underserved.

This is also critical with the coming switch-off of the Public-Switched Telephone Network (PSTN), 2G, 3G, and Terrestrial TV. In 2023, Ofcom estimated that 5.5m UK mobile users still relied on older 2G/3G devices [15]. As well as this, a range of other devices (such as smart meters) also rely on 2G/3G connections. Whilst plans, policies, and expectations have been set for the transition, including supporting customers to transition to newer generation connectivity, these legacy transitions will be a critical factor in shaping demand for connectivity in coming years.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.1. Belfast Region City Deal

3.1.1. Regional characteristics

The Belfast Region City Deal (BRCD) covers six local authorities with a total population of over 1.1 million people. It is also home to two universities, Queen's University Belfast (QUB) and the University of Ulster (UU) [16]. The region contributes around £30 billion in GVA, which represents almost two-thirds of NI's economic output [16]. Approximately 40% of businesses and 63% of jobs in NI are in the BRCD region. Whilst much of the region's population is located in Belfast and other urban areas, there are still significant rural populations across the region's other borough councils [16].

3.1.2. Example active demand-side stakeholders

From our desk research, stakeholder interviews, and responses to our survey to NI businesses, we have synthesised a list of **233** organisations within this region. Of these, **170** are headquartered in NI. The types of organisations break down as follows:

184 businesses.

23 hubs.

10 City Deal projects.

7 research centres.

7 government bodies.

2 academic institutions in this region.

3.1.3. Prominent sectors and clusters

Advanced manufacturing, engineering, and construction

The sector contributes over £1.5 billion to the regional economy and has particular expertise in aerospace engineering [17].

QUB and UU both house innovative research centres in various manufacturing fields, including the Advanced Manufacturing Innovation Centre at Queen's.

Digital, ICT, and creative industries

"Digital industries contribute 5.4 per cent GVA to the region's economy; the 2nd highest proportion in the UK." [18].

The Titanic Studios was the main studio and post-production facility for all series of Game of Thrones.

34 businesses including 28 headquartered within NI.

5 hubs: Arts Council NI, BT Ireland Innovation Centre, Casement Park, Catalyst, and Pixel Mill.

4 City Deal projects: Augment the City, The Global Innovation Institute, Shed 1.0, and Studio Ulster.

2 research centres: Centre for Secure Information Technologies and the Innovation and Knowledge Centre.

1 government body: BBC Northern Ireland.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

Financial services

Belfast is home to a particularly strong FinTech cluster, with the highest concentration of FinTech employment in the UK [19].

Financial and professional services account for almost 9% of jobs in Belfast city and contribute to nearly 19% of the city's GVA [20].

Established in 2020, The FinTech Corridor works to leverage NI's unique position as a gateway to both EU and UK markets. The cluster enables collaboration between organisations of all sizes between Belfast and Dublin [21].

64 businesses including 26 headquartered within NI.

2 hubs: The FinTech Corridor and FinTech NI.

1 government body: FinTech Envoy for Northern Ireland.

Health and social care

There are over 250 organisations in this sector in Belfast, employing over 18,000 people [22].

Two of the region's City Deals are in the health sector, as well as several leading research centres at QUB and UU.

25 businesses including 23 headquartered within NI.

3 research centres: Centre for Cancer Research, Connected Health Innovation Centre, and the Precision Medicine Centre of Excellence.

2 City Deal projects: Centre for Digital Health Care Technology and the Institute for Research Excellence in Advanced Clinical Healthcare (iREACH Healthcare).

2 hubs: European Connected Health Alliance and the Health Innovation Research Alliance Northern Ireland.

1 government body: Digital Health & Care Northern Ireland.

3.1.4. Stakeholder insights

[Northern Ireland regions] are not as attractive for investment as other places, because of the size, so we believe there's a market failure there and that the market is not going to deliver the ambitions that we have.

We always talk about the remote businesses, that's why you have the Belfast Region City Deal rather than just Belfast. The problem is for the pockets of businesses in County Down, County Antrim etc.

We still have 4G not-spots and we know of areas of the city where businesses etc. complain that they don't have the connectivity that they would hope to.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.1.5. Advanced connectivity demand case studies

The Advanced Manufacturing Innovation Centre (AMIC)

One of the region's City Deals, the £100 million AMIC at QUB aims to catalyse innovation in manufacturing in NI by providing a testbed for NI SMEs to access the latest manufacturing technologies. At the interface of industry and academia, businesses will be able to use the state-of-the-art Factory of the Future facility to test Industry 4.0 smart automation and receive guidance from professional engineers. The Centre aims to contribute more than £1 billion to the local economy by 2050 and to have created 1,500 permanent jobs.

Belfast Harbour

The second largest port on the island of Ireland, 90% of all goods that enter Northern Ireland come through the harbour. A proof-of-concept 5G private network was launched in one area of the harbour, that generated over 40 use cases in its first 18 months. These networks enabled use cases include autonomous vehicles, crane sensorisation, drones, 5G cameras, and digital twins.

The Titanic Quarter is also situated on the Belfast Harbour Estate and is home to over 100 businesses from across finance, digital media, and manufacturing. A 5G public network is also provided to cover the 20,000 people who live, work, or visit every day, with the biggest attraction being Titanic Belfast which opened in 2012 and attracted 7.5 million visitors within 11 years.

Weavers Cross

Set to open in 2025, the flagship regeneration of Weavers Cross will combine the new Belfast Grand Central Station, with mixed-use commercial, residential, and retail space. The station will be the largest integrated transport facility on the island of Ireland, with an expected annual footfall of 20 million passenger journeys per year. Advanced wireless networks will be needed to ensure the passengers' connection as they move around the hub.

Casement Park Stadium

The proposed redevelopment of Casement Park stadium in West Belfast will see the new stadium open in time to host five matches at Euro 2028. The renovated stadium will be the largest venue in Northern Ireland with a capacity of 34,500. Owned by the Gaelic Athletics Association, the venue will be used for other sports and events after the tournament has finished.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.2. Derry and Strabane City Deal

3.2.1. Regional characteristics

The Derry City and Strabane District Council area serves just under a fifth of NI's population and has a slightly younger age profile than for NI as a whole. Almost 35% of the region is under the age of 25 (compared to 32% in NI) [23].

The region's population is mostly urban (71%), with the council area representing the fourth largest city on the island of Ireland, but with a significant rural share as well [24].

3.2.2. Example active demand-side stakeholders

From our desk research, stakeholder interviews, and responses to our survey to NI businesses, we have synthesised a list of **92** organisations within this region. Of these, **69** are headquartered in NI.

The types of organisations break down as follows:

78 businesses.

5 hubs.

5 City Deal projects.

3 research centres.

1 academic institution.

3.2.3. Prominent sectors and clusters

Advanced manufacturing, engineering, and construction

Accounting for 42% of employment in the region, it is the largest sector in the region [25].

Derry has a strong manufacturing and engineering heritage and is home to global brands such as DuPont, Nelipak, Seagate Technology, Vertiv, and Terex Ecotec.

9 businesses including 4 headquartered within NI.

2 hubs: Smart Manufacturing Data Hub and Smart Nano NI consortium.

1 City Deal project: Centre for Industrial Digitalisation, Robotics and Automation.

Digital, ICT, and creative industries

Derry is one of the most vibrant digital clusters on the island of Ireland. It is home to major global brands such as Fujitsu, Kainos, and Allstate.

The non-profit organisation Catalyst expanded to open The Innovation Centre in Derry in 2014. The centre is focused on fostering innovation and entrepreneurship and is home to dozens of small and medium enterprises, particularly in this sector.

49 businesses including 36 headquartered with NI.

1 City Deal project: Cognitive Analytics Research Laboratory.

1 hub: Catalyst.

1 research centre: Intelligent Systems Research Centre.

Life and health sciences

Derry is home to two major research centres, the NI Centre for Stratified Medicine at the University of Ulster, and the Clinical Translational Research & Innovation Centre (C-TRIC). Both centres have expertise in personalised medicine, pharmacogenomics and health care analytics.

In addition to research centres, there are also over 30 businesses in the sector in Derry City and Strabane [26].

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

Tourism

Derry is the only walled city on the island and is the second most popular visitor attraction in NI, attracting 577,000 visitors per year [27].

Tourism employs approximately 9% of the region's eligible workforce [28].

There were two other sites in the region in the top ten attractions in NI. Guildhall attracts 321,000 visitors per year, which ranks at number six, whilst the Centre for Contemporary Art Derry~Londonderry is ninth with 241,000 [27].

3.2.4. Stakeholder insights

Derry is a good example where they have that triple helix approach and they've got that advanced connectivity element... They're looking at an innovation hub linked to the university, and a pathway for spinouts coming out of it. They also want to run challenge funds, inviting people to put forward IoT pilot projects and are encouraging local start-ups to get involved.

In order to stimulate uptake, we have to really engage with local businesses to demonstrate the benefits of advanced connectivity, and it's important to have good use cases.

Derry has an established and growing Business, Finance, and Professional Services sector, with expertise across many related fields... Technology is playing an increasingly important role in financial and professional services.

A huge problem for the local business community is a lack of funds. I think there needs to be dedicated funding to support businesses.

3.2.5. Advanced connectivity demand case studies

Smart Derry Strabane

This smart city seeks to harness the benefits of advanced connectivity, digital transformation, and the green transition to deliver growth and well-being across the economy, environment, and society. It aims to make Derry and Strabane 'smarter' by using data and emerging technologies to build a more efficient and liveable environment, support resource management, and help the region to achieve its climate goals and growth ambitions. The project has a number of thematic areas including Digital Enabling Infrastructure, Digital Innovation Hub, Challenge Funds, IoT and Smart Energy pilots.

Smart Nano NI 5G Testbed (led by Digital Catapult)

In September 2023, the Smart Nano NI consortium, launched the largest 5G testbed in NI, to further the development of smart manufacturing and education in the region. The smart education site is in the Northwest Regional College's Springtown Campus, whilst the smart manufacturing site is at Seagate's manufacturing facility. The testbed will provide students and industry with access to explore new use cases of the 5G private network, as well as other connectivity technologies such as Narrowband-Internet of Things (NB-IoT).

Smart Manufacturing Data Hub

Initiatives like the Smart Manufacturing Data Hub at the University of Ulster support small and medium-sized manufacturers to boost their productivity and competitiveness, through better utilisation of their data. The hub provides expert guidance and helps demonstrate the benefits of advanced connectivity technologies such as virtual reality.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.4. Mid South West Region Growth Deal

3.4.1. Regional characteristics

The Mid South West (MSW) Region Growth Deal covers 50% of NI's landmass, including many of the more isolated areas. Many of the unreachable premises identified within Project Stratum are located in MSW [4].

The region provides 224,000 jobs and is home to approximately a quarter of NI's population [29].

MSW provides a significant contribution to the NI economy, accounting for 34% of NI exports, and generating £10bn of gross value added (GVA) per year [29].

3.4.2. Example active demand-side stakeholders

From our desk research, stakeholder interviews, and responses to our survey to NI businesses, we have synthesised a list of **66** organisations within this region. Of these, **54** are headquartered in NI.

The types of organisations break down as follows:

57 businesses.

6 Growth Deal projects.

1 hub.

1 research centre.

1 academic institution.

3.4.3. Prominent sectors and clusters

Advanced manufacturing, engineering, and construction

There is 70% more employment in this sector in the MSW region compared to the UK average [30].

The sector accounts for more than 42% of NI's manufacturing employment and 40% of NI's manufacturing GVA [29].

MSW has a very strong presence in the following manufacturing sub-sectors: basic metals, fabricated metal products, electronic and optical products, machinery and equipment, motor vehicles, trailers and semi-trailers, and other transport equipment.

32 businesses including 29 headquartered within NI.

4 Growth Deal projects: CAFRE NI Robotics, Automation, Packaging Innovation Centre, Construction Innovation Centre of Excellence, Desertcreat Green Innovation Industrial Park, and The Learning Factory.

1 hub: Manufacturing NI.

Agri-food

The MSW region accounts for a third of all NI's agri-food firms, employing approximately 11,500 people [30].

It is also home to three major hubs: the Agri-Food and Biosciences Institute (AFBI) in Loughgall, as well as the College of Agriculture, Food & Rural Enterprise (CAFRE) campuses in Loughry and Enniskillen.

13 businesses including 9 headquartered within NI

1 Growth Deal project: Agri Bio Innovation Centre

1 research centre: Food Technology Centre

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

Tourism

The MSW region is renowned for having a wealth of natural beauty, world class attractions, and some of the best tourist accommodation in NI.

Linen Mill Studios is the home of the Game of Thrones Studio Tour, which has created 200 jobs in the local area. With an estimated 600,000 visitors a year, it could generate as much as £400 million in tourism revenue by 2030 [31].

The Loughs and Lakes of Lough Erne in County Fermanagh are a recreational and tourism resource and strongly differentiates the region from other destinations in Ireland and NI [4]. The Sperrin Mountains are one of the largest upland areas on the island and are designated as an Area of Outstanding Natural Beauty (AONB).

3.4.4. Stakeholder insights

Strengthening MSW's digital and physical connectivity will advance north/south and east/west cross border interactions and global transactions. The region needs greater access to regional, national, and global linkages (roads, railways, ports, and airports).

It's hard to drive innovation when you don't have the basic enabling connectivity in the first instance.

Where I used to work in the Craigavon area, there's a number of factories there and it seems a very obvious cluster that would benefit from connectivity.

[MSW] has some of the most forward-thinking and entrepreneurial companies in the UK ... our region contributes more than Belfast to NI exports.

3.4.5. Advanced connectivity demand case studies[2]

Agri Bio Innovation Centre

The project aims to create a regional centre to provide an innovation bridge across the agri supply chain. The centre will support agri-tech, food-tech, and climate-tech innovators by providing them with space, knowledge, and connections.

CAFRE NI Robotics, Automation, Packaging, and Innovation Centre (RAPIC)

The RAPIC will incorporate a regional centre of the Advanced Manufacturing and Innovation Centre (AMIC), a £100mn project led by Queen's University Belfast under the Belfast Region City Deal. CAFRE NI RAPIC will provide the food manufacturing industry with fully functional and customised robotics, automation, and packaging solutions in order to improve the industry's productivity, sustainability, and resilience through optimising yield, minimising food waste, increasing food safety and reducing operational costs.

Carn Seagoe Charlestown Green Innovation

A collaborative project between ABC Borough Council and local businesses within the Carn, Seagoe, and Charlestown areas. The project aims to reduce consumption, greenhouse gas emissions and drive innovation in the green energy sector.

Desertcreat Green Innovation Industrial Park

The Desertcreat Green Innovation Park will provide the platform for businesses to trailblaze in the development of low-carbon technologies, products, and infrastructure, which will ultimately contribute to increasing industry competitiveness and contribute to NI's Green Growth targets.

---

[2] Information for this section was drawn from documentation provided by the Mid South West Growth Deals team.

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.5. Causeway Coast and Glens Growth Deal [3]
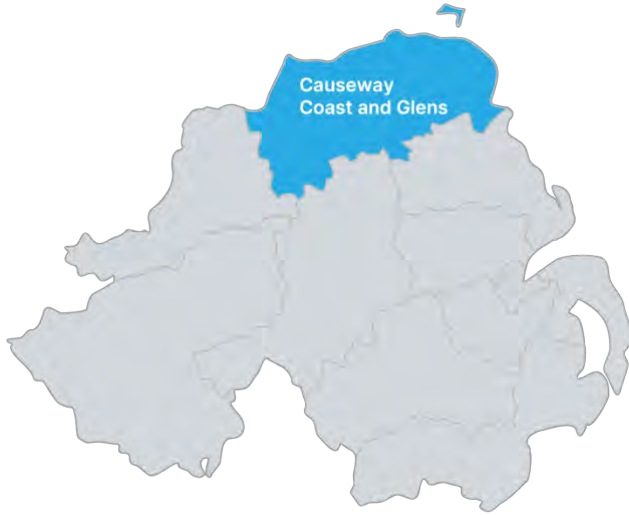
3.5.1. Regional characteristics

Causeway Coast and Glens' permanent population is just 140,000, but the region attracts over 1 million visitors per year [32]. The region is home to over 6,000 businesses, which provide 53,000 jobs [33]. 98% of these businesses are either micro (less than 10 employees) or small (less than 50), and only 0.2% of businesses employ over 250 people [34].

Causeway Coast and Glens is "primarily a rural Council area which presents several challenges including access to key transport links, educational underachievement, poor broadband connectivity, and access to healthcare" [34].

3.5.2. Example active demand-side stakeholders

From our desk research, stakeholder interviews, and responses to our survey to NI businesses, we have synthesised a list of **23** organisations within this region. Of these, **18** are headquartered in NI.

The types of organisations break down as follows:

19 businesses.

2 government bodies.

2 research centres.

3.5.3. Prominent sectors and clusters

Agri-food

As of 2023, over a third (34%) of Causeway Coast & Glens businesses are in the agri-food sector [33].

In 2023, the agri-food sector contributed over half (53.7%, £640m) of the regions sales [33].

Advanced manufacturing, engineering, and construction

As of 2023, Advanced manufacturing and engineering (22%) and construction (24%) combine to account for almost half of the region's employment [33].

In 2023, Advanced manufacturing and engineering contributed 18.9% (£226m) of sales in the region, and construction contributed 18.3% (£218m) [33].

Tourism

Giant's Causeway is one of the most recognisable landmarks in the UK, and is the third largest visitor attraction in NI, attracting 422,000 visitors in 2022 and with a pre-pandemic peak of 1,039,000 visitors in 2018 [27].

3.5.4. Stakeholder insights

In April 2024, the Causeway Coast and Glens Growth Deal had its Head of Terms signed. This Head of Terms outlines nine project proposals across the Borough. These nine projects fall under three pillars of activity: digital and innovation, tourism and regeneration, and infrastructure [34].

---

[3] Information for this section was taken from the Causeway Coast and Glens Region Growth Deal Head of Terms, April 2024. [34]

3. Active demand-side stakeholders

Example stakeholders, projects, case studies, and clusters are not intended to be a comprehensive or complete overview. Instead, they are provided to demonstrate the range and diversity of activity across NI regions, and to summarise the insights shared by stakeholders from across NI industry, business, and academia in support of this study.

3.5.5. Advanced connectivity demand case studies

Centre for Food and Drug Discovery, Ulster University Coleraine

The Centre for Food and Drug Discovery "will be a Northern Ireland-based consortium... providing a single-site, preclinical hub for the biopharmaceutical and food industry delivering capability, capacity, and expertise at all key stages of the discovery pipeline... With state of the art equipment, the centre will enable industry, academia, healthcare providers and regulators to work collaboratively" [34].

Atlantic Link Enterprise Campus

The Atlantic Link Enterprise Campus was established in 2017, offering digital companies a campus with "distinct competitive advantage in terms of infrastructure, connectivity, lifestyle, and labour force" [35]. As of 2023, the campus had one tenant, Prescient Data Centres, who had invested £20 million into the site [36]. One of the nine projects in the Causeway Coast and Glens Growth Deal Head of Terms, signed in April 2024, is to establish a Business Innovation and Incubation Hub at Atlantic Link [34].

4. Recommendations

4.1. Introduction

The recommendations in this study build on those included in the first phase report [1], which all remain relevant and valid against the findings of this follow-on phase. As such, these recommendations are not repeated in this report but instead these recommendations look to complement and add further detail.

The recommendations from this phase, focus on how NI stakeholders across government can best:

> Create the right environment for demand-side stakeholders to develop, grow, and accelerate demand.

> Raise awareness, interest, and enthusiasm with potential demand-side stakeholders.

> Provide capital, capacity, or capability to help initiate and encourage demand.

These recommendations seek to unlock the potential of advanced connectivity across NI, enabling the achievement of the objectives outlined in the NI Economy Minister's new economic vision: to create good jobs, promote regional balance, raise productivity, and reduce carbon emissions.

4.2. Recommendation theme 1

Unlocking the opportunity

Recommendation 1:

DfE to develop a Northern Ireland Digital Connectivity Strategy.

This phase has further reinforced the need for an NI Digital Connectivity Strategy, as recommended in the previous AWN report [1]. This strategy should recognise and reflect the different demand realities across regions and sectors of NI. It should recognise the role of connectivity as a utility, and the increasing importance of universality of connection with the growing digitisation of the economy, society, and public services. This strategy should also consider drivers of investment, including demand aggregation and the potential investment opportunities that will be opened by Terrestrial TV, 2G/3G, and PSTN transition.

Recommendation 2:

DfE to actively monitor available funding streams for advanced connectivity innovation and investment.

This should also consider the balance of capital resource availability for investment versus operational resource available for sustainment. This is especially important where trials, testbeds, and demonstrators are being built for advanced connectivity.

Recommendation 3:

NI Barrier-Busting Taskforce (NIBBT) Communications Workstream to use its business engagement to collect demand-side blockers.

This should build on the ongoing work with digital champions, business engagement, and NIBTT x-NICS representation. This should also build on the NIBBT's existing activity to unblock supply-side barriers around planning and usage of publicly owned assets. As well as its business engagement, input should also be gathered from the public sector, academia, and citizens.

4. Recommendations

4.3. Recommendation theme 2

Engaging and educating

Recommendation 4:

NIBBT Communications Workstream to ensure that NICS and NI Executive leaders are equipped with 'real-world' case studies of the benefits of advanced connectivity.

These case studies should anchor the benefits of advanced connectivity in meaningful outcomes for NI society, citizens, and businesses, as well as supporting demand aggregation.

Recommendation 5:

NIBBT to explore the attractiveness, feasibility, and viability of NI establishing a platform for collaboration, learning, and sharing on advanced connectivity.

This should build on the existing NIBBT Communications Workstream and their work looking into developing showcases. Whilst it is recognised that this is beyond the agreed Terms of Reference for NIBBT to create or own such a platform, the diverse membership of NIBBT means this is a good forum to explore this idea further. This should focus on helping inform engage and educate businesses about the real-world business benefits of advanced connectivity. It should also build on successful initiatives such as Ulster University's business engagement and the successful model of business engagement delivered at Belfast Harbour.

4.4. Recommendation theme 3

Scalability and sustainability

Recommendation 6:

City Deals teams to explore developing an advanced connectivity 'ecosystem'.

This ecosystem should be broader than a testbed or trial, to instead look at demonstrating the impact of advanced connectivity at scale within a sector (e.g., in health, manufacturing, transport) and show region-level impact (including across both urban and rural geographies). This ecosystem is defined at the outcome-level rather than the use-case level, with learnings generated and captured across the City Deals teams. This may not necessarily require new activity, as there are a number of existing and planned projects from across city and growth deals in NI which may be able to help demonstrate this ecosystem-level benefit of advanced connectivity.

Recommendation 7:

NI Executive and local government stakeholders to ensure advanced connectivity initiatives involve co-design with business and citizen demand-side stakeholders.

Stakeholders engaged through this study reflected the importance of ensuring that demand-side end users are involved from the earliest stages of conception and design. This should include looking across all aspects of capability, to ensure that new technologies are supported with the skills, knowledge, and supporting infrastructure to deliver scalable and sustainable benefit for citizens and businesses.

References

[1] Matrix, "Matrix Advanced Wireless Networks Report," [Online]. Available: https://matrixni.org/wp-content/uploads/2023/11/Matrix-Advanced-wireless-networks-Report.pdf.

[2] DSIT, UK Government, "UK Wireless Infrastructure Strategy," [Online]. Available: https://www.gov.uk/government/publications/uk-wireless-infrastructure-strategy/uk-wireless-infrastructure-strategy.

[3] GSMA, "Mobile Economy Europe 2023," [Online]. Available: https://www.gsma.com/mobileeconomy/wp-content/uploads/2023/11/GSMA-Mobile-Economy-Europe-2023.pdf.

[4] Stakeholder, Interviewee, *Stakeholder interview.* [Interview].

[5] Ofcom, "Meeting future demand for mobile data," [Online]. Available: https://www.ofcom.org.uk/__data/assets/pdf_file/0017/232082/mobile-spectrum-demand-discussion-paper.pdf.

[6] 5GTT, "Interim Evaluation Report 2023," [Online]. Available: https://assets.publishing.service.gov.uk/media/64d2248ea4045e0011a84bf1/5gtt_interim_evaluation_2023.pdf.

[7] UKTIN, "5G in the Supply Chain," [Online]. Available: https://uktin.net/how-to-deploy-5G/manufacturing/supply-chain.

[8] UKTIN, "5G in Transport and Logistics," [Online]. Available: https://uktin.net/how-to-deploy-5G/transport.

[9] International Telecommunications Union, "Framework and overall objectives of the future development of IMT for 2030 and beyond," [Online]. Available: https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2160-0-202311-I%21%21PDF-E.pdf.

[10] IEA, [Online]. Available: https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks.

[11] 3GPP, "Rel-18 status," [Online]. Available: https://www.3gpp.org/technologies/ran1-rel18.

[12] GSMA, "State of the Industry on Climate Action," [Online]. Available: https://www.gsma.com/betterfuture/wp-content/uploads/2023/02/Mobile-Net-Zero-%E2%80%93-State-of-the-Industry-on-Climate-Action-2023.pdf.

[13] WM5G, "Health and care," [Online]. Available: https://www.wm5g.org.uk/health-and-care/.

[14] Virgin Media O2, "Great Rural Revival Report," [Online]. Available: https://news.virginmediao2.co.uk/wp-content/uploads/2023/07/VMO2-Great-Rural-Revival-Report.pdf.

[15] Ofcom, "2G and 3G switch-off," [Online]. Available: https://www.ofcom.org.uk/__data/assets/pdf_file/0025/252592/3G-and-2G-switch-off.pdf.

[16] Belfast Region City Deal, "Annual Report 2022," [Online]. Available: https://belfastregioncitydeal.co.uk/assets/files/BRCD-Annual-Report-2022-23-27.09.23-Final.pdf.

[17] Belfast City, "Key Sectors, Advanced Engineering and Manufacturing," [Online]. Available: https://www.belfastcity.gov.uk/investinbelfast/key-sectors/advanced-engineering-and-manufacturing.

[18] Belfast City, "Key Sectors, Creative and Digital," [Online]. Available: https://www.belfastcity.gov.uk/investinbelfast/key-sectors/creative-and-digital.

[19] Invest NI, "Financial Services," [Online]. Available: https://www.investni.com/international-business/our-sectors/financial-services.

[20] Belfast Telegraph, "Output of financial and professional services in Northern Ireland," [Online]. Available: https://www.belfasttelegraph.co.uk/business/northern-ireland/output-of-financial-and-professional-services-in-northern-ireland-up-68-in-last-decade/a196206005.html.

[21] FinTech Corridor, "What we do," [Online]. Available: https://thefintechcorridor.com/what-we-do/.

[22] Belfast City, "Life and Health Sciences," [Online]. Available: https://www.belfastcity.gov.uk/investinbelfast/key-sectors/life-and-health-sciences.

[23] Grow Derry Strabane, "Population," [Online]. Available: https://growderrystrabane.com/performance-monitoring/dcsdc-statistics/population/.

References

[24] Derry Strabane, "Growth Strategy," [Online]. Available: https://www.derrystrabane.com/getmedia/a78e5d05-79fd-4e1a-bed3-0514719721f9/EVB-3-Population,-Growth-Strategy-2.pdf.

[25] Invest NI, "Derry and Strabane," [Online]. Available: https://www.investni.com/sites/default/files/2023-01/investni-performance-council-area-derry-and-strabane.pdf.

[26] Invest Derry and Strabane, "Life and Health Sciences," [Online]. Available: https://investderrystrabane.com/lhs/.

[27] NISRA, "2022 NI Visitor Attraction Survey," [Online]. Available: https://www.nisra.gov.uk/publications/2022-northern-ireland-visitor-attraction-survey-publications.

[28] NISRA, "Tourism Stats Alternative Data sources 2021".

[29] MSW, "MSW Socio Economic Profile March 2024".

[30] Mid South West Region, "Regional Economic Strategy," [Online]. Available: https://midsouthwestregion.org/wp-content/uploads/2020/09/PDF-Regional-Economic-Strategy-Document-4SEPT20.pdf.

[31] White Rock Finance, "Linen mill studios avails of 3.5m funding for game of thrones studio tour," [Online]. Available: https://whiterockfinance.co.uk/linen-mill-studios-avails-of-3-5m-funding-for-the-game-of-thrones-studio-tour/.

[32] Invest Causeway, "Invest Causeway," [Online]. Available: https://www.investcauseway.com/.

[33] Invest NI, "Causeway Coast and Glens Council Area Performance 2023," March 2024. [Online]. Available: https://www.investni.com/sites/default/files/2023-01/investni-performance-council-area-causeway-coast-and-glens.pdf.

[34] UK Government, "Causeway Coast and Glens Growth Deal Head of Terms," April 2024. [Online]. Available: https://assets.publishing.service.gov.uk/media/66292a9c3b0122a378a7e6fe/CCG_Heads_of_Terms.pdf.

[35] Atlantic Link Enterprise Campus, "https://atlanticlinkcampus.com/campus/," [Online].

[36] Belfast Telegraph, "Causeway council's push to find more firms for NI's only enterprise zone," [Online]. Available: https://www.belfasttelegraph.co.uk/business/northern-ireland/causeway-councils-push-to-find-more-firms-for-nis-only-enterprise-zone/a250647357.html.

[37] NI Department for the Economy, "NI Mobile Action Plan implementation progress," [Online]. Available: https://www.economy-ni.gov.uk/articles/map-ni-implementation-progress.

[38] Causeway Coast and Glens, "Growth Deal," [Online]. Available: https://www.causewaycoastandglens.gov.uk/work/strategic-projects/growth-deal.

[39] Wikipedia, "Ulster University at Coleraine," [Online]. Available: https://en.wikipedia.org/wiki/Ulster_University_at_Coleraine.

[40] Belfast Telegraph, "Causeway council's push to find more firms for NI's only enterprise zone," [Online]. Available: https://www.belfasttelegraph.co.uk/business/northern-ireland/causeway-councils-push-to-find-more-firms-for-nis-only-enterprise-zone/a250647357.html.

[41] Belfast Telegraph, "Enterprise zone status in NI town has 'expired' after a decade," [Online]. Available: https://www.belfasttelegraph.co.uk/business/northern-ireland/enterprise-zone-status-in-ni-town-has-expired-after-a-decade/a746012713.html.

matrix.