UK 5G Innovation Network

HOW DO YOU IDENTIFY YOUR CONNECTIVITY REQUIREMENTS?

HEALTH & SOCIAL CARE

INTRODUCTION

Few sectors, if any, have been subject to as much sweeping change—and strain—as health and social care. In the wake of the COVID-19 pandemic, employees worked tirelessly on the frontline, saving countless lives and embarking on an impressive accelerated digital transformation.

But despite significant progress, connectivity is still a major problem for the sector and far from the only challenge it faces. Currently, 70% of the NHS budget is used for long-term condition management due to the UK's ageing population and rise in complex comorbidities; in social care, too, demand for services is increasing, and there are significant concerns around recruitment and digital skills.

5G could play an important role in tackling these challenges. Digital technologies can support more people-centric care, a transition from a reactive to a preventative model, and move the delivery of care from clinics to communities. Unlocking the efficiency, resilience and flexibility required to meet the UK's ever-growing health and social care needs.

However, surprising though it might seem for us to say this, 5G is not *always* the answer. It is important to first understand the challenges you want to solve, the specific needs you have, and then determine the most appropriate technology.

This guide has been designed to offer pragmatic, practical guidance to connectivity, helping you to understand how 5G compares to other connectivity solutions and determine if 5G is indeed the answer.

70%

OF THE NHS BUDGET IS USED FOR LONG-TERM CONDITION MANAGEMENT

WHAT ARE YOUR CONNECTIVITY OPTIONS?

1/ Wired connectivity

What is it?

Wired - or fixed - internet connectivity is the most common type of local area network technology and involves a hardwired connection, typically via ethernet cables, to the internet. Long considered a fast, relatively cheap and reliable option for health and social care, it is often seen as the workhorse of connectivity across the sector and is best suited to scenarios where connectivity needs - and workers - are rooted to a fixed location. However, with the promises of new technologies such as augmented reality, the need to access patient information irrespective of location, and increasing pressure to improve operational efficiencies and deliver more people-centric care, it may not always be the best option available, especially for new facilities.

Advantages

- Cost-effective
- When configured and utilised properly, wired networks can provide unparalleled reliability. As soon as the hubs, switches, and cables are installed, you have a reliable network at your disposal; wired connections are also not influenced by other network connections in the vicinity, unlike their wireless counterparts. As a result, it is typically the de-facto option when connectivity is mission-critical i.e. controlling surgical robots
- Administrators can exercise a high level of user access control with relative ease as wired networks are not visible to devices on other networks. Networks can only be accessed via a physical cable connection, meaning fixed connectivity solutions are accepted as offering the greatest security

- Ethernet wires can be isolated and protected in areas with high electromagnetic interference: this is particularly helpful for facilities such as hospitals which contain equipment such as electrosurgery units and short-wave diathermy applicators that are known to produce high levels of electromagnetic interference
- Since a separate ethernet cable is used to connect each of the devices directly to the network, users can't run into common connectivity issues like dead spots

Limitations

- Connectivity is rooted in a set location; this this lack of mobility makes it unsuitable for mobile workers such as district nurses or auxiliary health workers
- A single ethernet cable has a maximum 100-metre length. Although additional hardware, such as a fibre optic cable, can extend the operating distance up to two kilometres, there is a maximum achievable distance before data loss, or data transfer delays, are significant
- Wired networks are difficult to extend without considerable effort and disruption; this is time-consuming and costly, especially in comparison to wireless connectivity solutions
  Connecting industrial equipment to a local network brings the cost and inconvenience associated with running, tracing, and fire-proofing cables and cable trays
- Many new technologies that could transform the provision of care such as mixed reality for medical interventions, are not practical or safely deployable with wired connectivity

2/ Wi-Fi 6

What is it?

Wi-Fi 6 is the next generation of Wi-Fi. Its advanced capabilities include 75% lower latency and four times higher capacity than its predecessor; a much higher theoretical speed of 9.6 Gbps (up from 3.5 Gbps on Wi-Fi 5); and greater flexibility, accommodating many health and social care use case requirements. Wi-Fi 6 also brings additional security with Wi-Fi Protected Access 3 (WPA3) which aims to bolster authentication security and encryption.

Advantages

- Provides greater flexibility and agility: no cables means connectivity can move around facilities with workers - boosting efficiency and productivity
- Operates on an unlicensed spectrum, making it available to all
- Ubiquitous existing Wi-Fi solutions make for an easy upgrade path
- Deployment is often easy and requires limited technical competence (users can establish one or a few access points themselves) - although this may not be true for more complex use case requirements and configurations
- Today, Wi-Fi 6 equipment is typically less expensive than its 5G counterpart (but may not necessarily have the same ecosystem of apps around it)
- Mainstream enterprise wireless solutions currently outperform 5G in terms of device ecosystem, network cost and ease of deployment

Limitations

- Wi-Fi is still mostly a “best-effort” system; its reliability and availability cannot be guaranteed making it unsuitable for anything mission-critical or related to patient safety i.e. remote care monitoring of vulnerable individuals
- While Wi-Fi 6 brings improvements for multiple users, services with a higher number of uses will start to degrade more quickly than cellular connectivity
- Not well suited to use cases that require outdoor coverage.
- Wi-Fi 6 devices require a Wi-Fi 6 compliant access point to get the full speed, latency, and capacity improvements, meaning some replacement of kit is required to get the full functionality
- With wireless networks, one network is visible to the other which can affect the performance of your connection: since Wi-Fi operates on an unlicensed spectrum the possibility of interference is higher, which can result in slower speeds, higher latency, frequent disconnects and sometimes an inability to connect to a Wi-Fi signal at all
- Hospitals contain some types of equipment, such as electrosurgery units and short-wave diathermy applicators that are known to produce high levels of electromagnetic interference that can impact Wi-Fi. Similarly, Wi-Fi itself can cause interference that can be problematic in hospital settings with ECG and EEG known to be particularly sensitive to electromagnetic disturbances
- Generally, wireless networks are less secure than wired networks since the communication signals are transmitted through the air. While Wi-Fi 6 offers significant security improvements, it still only offers security and assurance on the network side, making it a less secure option than wired or cellular

3/ Cellular: 5G

What is it?

5G is the fifth-generation technology standard for cellular networks, operating on a licensed spectrum, either shared or dedicated. The network can provide 50x more speed, 10x less latency, and 1,000x more capacity than 4G/LTE—enabling it to connect to more devices and transmit more data than ever before, delivering fast connectivity and significantly enhanced user experiences. Significantly for mission critical applications, for instance where loss of connectivity could impact patient safety, 5G offers high availability at 99.999%. 5G can be deployed through public networks (that anyone can use), private networks (dedicated spectrum that only your organisation can use over which you have total control) or hybrid networks (where a mobile network operator provides a slice of its own network exclusively for an organisation to use).

Critically, 5G networks eliminate many of the bottlenecks associated with applying 4G. This makes it a far more suitable solution for implementing solutions such as remote care monitoring of individuals in the community, at scale.

Advantages

- Suitable for flexible, agile set-ups: no cables mean connectivity can move around with workers - boosting efficiency and ensuring that everyone from health workers to paramedics can always be connected
- Unlike Wi-Fi, 5G networks operate on a licensed spectrum, with the option to secure dedicated spectrum, offering greater reliability and minimising chances of interference
- 5G is able to pick up in areas where Wi-Fi 6 can't reach – for example, when IoT devices move outside of an indoor space, a sensor can still connect via 5G, creating flexibility for workers and augmenting a large, campus-wide environment, such as a hospital
- 5G is better able to support use cases with ultra-low latency requirements
- Better suited to mission-critical use cases than Wi-Fi due to greater flexibility in the physical level for cellular to configure performance and make intelligent trade-offs to maintain quality of service. Multiple base stations but offer even greater assurance - although this comes at additional cost
- Advanced security compared to previous cellular generations, giving extra confidence to health and social care providers. Cellular offers an element of certification on the network and device side, offering additional assurance compared to Wi-Fi
- Private networks - available with 5G and 4G - offer greater control and flexibility, including the ability to configure the network to your exact requirements i.e. focus on uplink which might be relevant for uploading large files such as MRI scans
- Operating expenses are typically lower than Wi-Fi according to research from Ericsson
- 5G networks may use as much as 90% less energy per bit of data transferred compared to 4G networks. This significantly reduces energy expenses, contributing to a reduction in operating costs

90%

5G NETWORKS MAY USE AS MUCH AS 90% LESS ENERGY PER BIT OF DATA TRANSFERRED COMPARED TO 4G NETWORKS.

THIS SIGNIFICANTLY REDUCES ENERGY EXPENSES, CONTRIBUTING TO A REDUCTION IN OPERATING COSTS

Source: Nokia, December 2020

Limitations

- Comparatively high deployment costs, although an increasing portfolio of solutions should provide lower entry points
- Can be complex to install: organisations may also need to invest in new skills to manage private 5G networks, pushing up the cost of running
- Although improving, 5G has limited device availability, especially in certain spectrum bands
- Indoor coverage can be patchy with cellular, especially in buildings with reinforced walls or older buildings with thick walls. This may mean that to secure robust indoor coverage, organisations have to look at other vendors beyond mobile network operators and public / hybrid networks to secure connectivity
- While 5G offers improved security and reliability compared to previous cellular generations and Wi-Fi, fixed connectivity still offers greater assurance on both measures
- Unless you invest in a 5G stand-alone network - which comes with greater cost and complexity - you won't be able to access the full benefits that 5G offers

Identifying Your Connectivity Requirements

While understanding the advantages and limitations of each connectivity solution can help to guide your thinking, it is important to be led by the business challenge rather than start from the assumption that you need a certain technology.

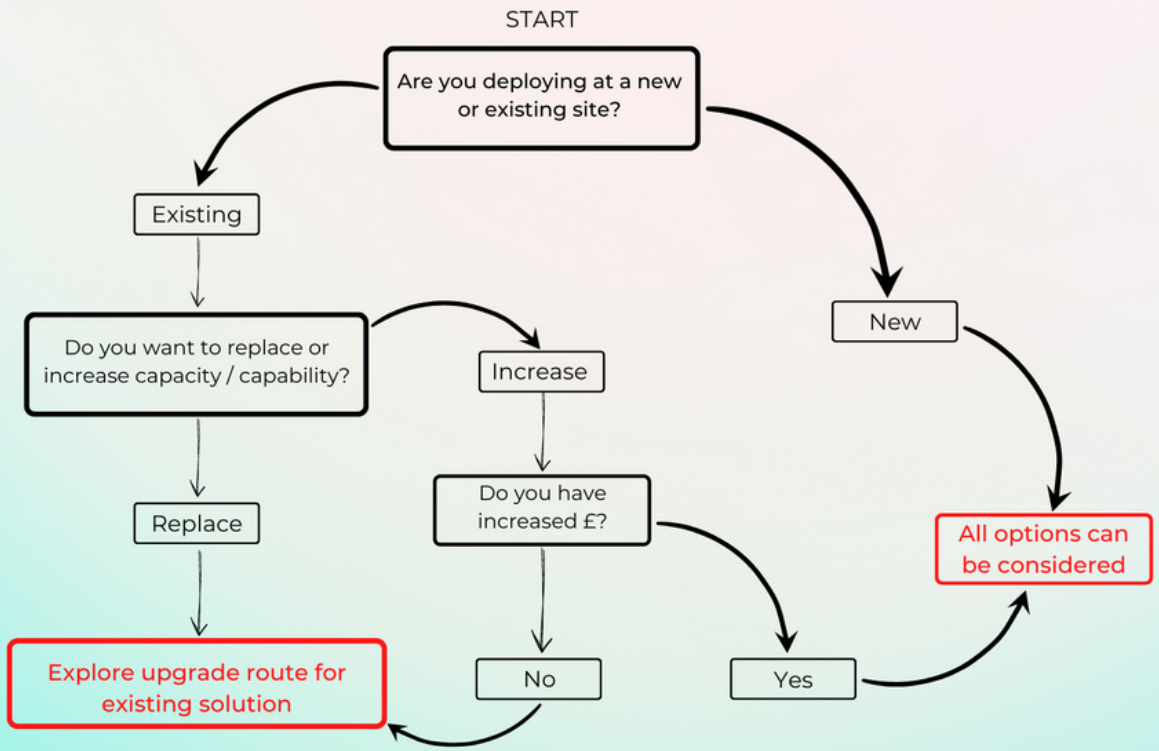
For most organisations and trusts, identifying your needs and requirements is a highly nuanced process and the UK5G Supplier Directory can direct you to Systems Integrators and Consultants who can guide you through this process. Similarly, NHS Digital's Wireless Centre of Excellence can provide guidance.

We have outlined here a decision tree to help you understand the sorts of things you will need to consider.

This is not all encompassing - there are other factors that come into play, like whether you need public or private connectivity and what appetite you have for securing spectrum - but this has been designed to kick-start your thinking, enabling you to have meaningful and informed discussions with suppliers.

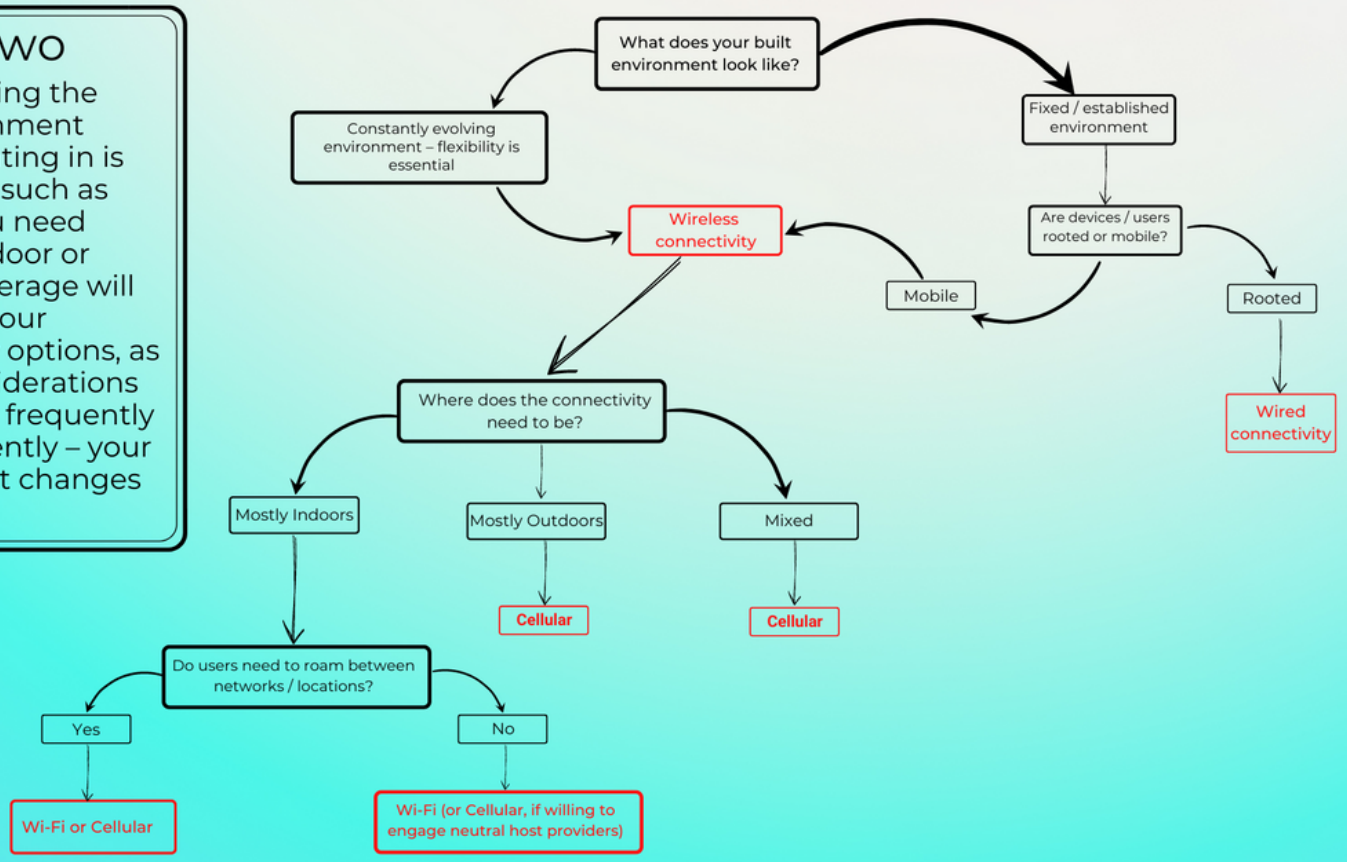
Stage One

First, it's important to identify your starting position. Are you building a brand new facility? If so, all options are on the table, but if you're looking at an existing site then you'll need to consider the appetite to upgrade and further invest in your connectivity.



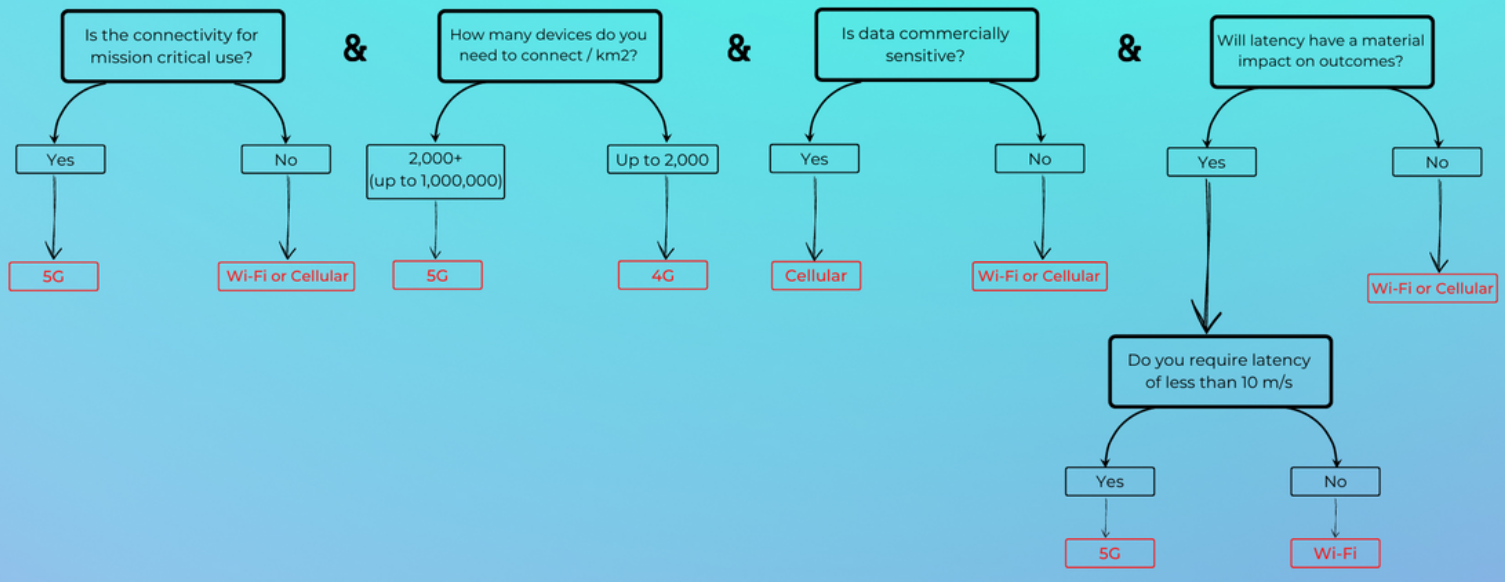
Stage Two

Understanding the built environment you're operating in is key. Factors such as whether you need primarily indoor or outdoor coverage will determine your connectivity options, as well as considerations around how frequently – or infrequently – your environment changes and evolves.



Stage Three

When assessing wireless connectivity, there are a number of factors that can influence the possible solutions available. Consideration of these factors is not necessarily linear, and the relative importance of these factors will vary across organisations. Unlike stages one and two therefore, the factors here should be reviewed in parallel.



Exploring use cases

Hopefully by now you have a better understanding of the key connectivity solutions available and the sorts of questions you should be asking to define your needs.

Of course, there is no such thing as the perfect connectivity option for a particular use case, it really does depend on a combination of factors that will be personal to each organisation, authority or trust, including the solutions you already have in place; the skills you have internally; the broader set of use cases you want to deploy; your appetite to innovate; and of course, available budget.

Looking across your organisation as a whole, it's likely that a blend of connectivity solutions will be most appropriate and 5G and Wi-Fi should be considered complementary rather than competitive.

Below however, is a list of some key health and social care use cases and a guide as to which connectivity solutions could deliver those use cases. This should provide a useful starting point for your own considerations and discussions.

Use Case	Wired	Wi-Fi 6	4G	5G
Loneliness & social isolation solutions i.e. haptic hug	X - fixed solutions only such as Push to Talk	X - apps, Push to Talk	X - apps, Push to Talk	X - apps, Push to Talk plus solutions like Haptic Hug
Remote monitoring of individuals in their home and / or care home		X	X - small scale / limited data points that do not require real-time monitoring	X
Connected ambulance			X - suitable for communicating with hospitals while in the field but limited real-time capabilities and transfer of large files	X - far better suited for low latency requirements and transfer of large files or ultra high definition video feeds
Telemedicine	X - but only when in a fixed location	X - ultra high definition video and real-time transfer of data. Lacks the reliability and security of wired or cellular.	X - offers greater flexibility around location. Civic private networks can also ensure coverage for patients. Limited in terms of real-time transfer /ultra high definition video and capacity.	X - offers greatest flexibility around location. Civic private networks can also ensure coverage for patients. Suitable for real-time transfer of data and ultra high definition video.
Transferring large files	X - but only from fixed location	X - although there may be a reluctance to share sensitive data	X - only suitable if timeliness of transfer is not a key requirement	X - most relevant when transferring from mobile / outdoor locations e.g. ambulances. Private networks also offer the ability to optimise network for uplink
Drones				X
Augmented Reality / Virtual Reality		X		X
Automation of analysis with Artificial Intelligence and Machine Learning	X	X		X
Monitoring of assets in a small defined space i.e. GP surgery		X	X - will support a limited density of devices and may encounter issues with indoor coverage	X - may encounter issues with indoor coverage
Monitoring of assets in a large space i.e. hospital campus		X	X - will support a limited density of devices and may encounter issues with indoor coverage	X - offers a greater range of coverage including the ability to extend outside, but may encounter issues with indoor coverage