

WiFi tool kit

A guide to deploying WiFi networks for public bodies in Scotland



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0 Glossary of commonly used abbreviations

Abbreviation	Meaning
4G	The fourth generation of cellular networks, capable of delivering high-speed broadband.
5G	The fifth generation of cellular networks, still in its infancy, expected to deliver transformational technological, economic and social benefits.
DCMS	Department for Digital, Culture, Media and Sport – a UK government department responsible for building a digital economy.
ECA	Electronic communications apparatus – electronic equipment designed for use in connection with an ECN.
ECN	Electronic communications network – such as a wireless (WiFi or cellular) or fixed (fibre) broadband network.
IoT	The internet of things – a system of connected devices, sensors and networks.
MNO	Mobile network operator – such as Vodafone, EE, Three and O2.
SCCP	Super-Connected Cities Programme – a DCMS initiative of 2012 designed to improve the availability of digital connectivity across the UK.
WiFi	WiFi refers to a family of wireless network protocols, based on the IEEE 802.11 family of standards, which are commonly used for Internet access.
WiFi 6	WiFi 6 is the next generation of WiFi standards that will deliver significant technical improvements enabling faster speeds and higher capacity for high density environments.
WIG	Wireless Infrastructure Group – a neutral host provider of small-cell infrastructure to MNOs in the UK.

1 Executive summary

Digital connectivity has become a fundamental constituent of any modern economy. The importance of digital connectivity to the Scottish economy is set out in the Scottish Government's digital strategy, 'Realising Scotland's full potential in a digital world'. Not only does digital connectivity enhance productivity, open new market opportunities and reduce operational costs for business, it also enables citizens to achieve a flexible work–life balance, supports remote and distance-learning initiatives, and keeps families and friends connected.

For many years, WiFi has regularly been cited as one of the most important aspects of digital connectivity that consumers cannot live without. WiFi has become essential to our day-to-day living, ranking higher in importance than family and friends, according to public opinion and internet polls. WiFi has also been a consideration in providing low-cost internet access to socially and digitally excluded groups to bridge the so-called 'digital divide'.

Recognising the importance of WiFi to the overall digital-connectivity agenda and the economy, public bodies across the UK launched a number of public WiFi schemes from as early as 2012. These public WiFi schemes were intended to enhance free WiFi provision in public buildings (indoors) or public places (outdoors) in city-centre hot spots such as retail precincts and transport hubs.

However, the success of these public WiFi schemes has been varied. WiFi usage statistics show that the take-up and use of public WiFi in indoor buildings is more popular than in outdoor public spaces.

The variance in take-up and use of indoor and outdoor public WiFi is a reflection of market dynamics. Consumers spend most of their time indoors, where WiFi is likely to be the default way of connecting devices to the internet. In addition, improving cellular coverage across Scottish towns and cities, combined with the declining cost of mobile data and an increase of data allowances in mobile bundles, has made the case for outdoor public WiFi more challenging to maintain on a commercially sustainable basis.

Further, the advent of 5G has resulted in a notable shift, where public bodies are replacing outdoor public WiFi schemes with outdoor small-cell networks. Densified and fibre-connected small cells are expected to form the foundation of future outdoor 5G networks. It is likely that in the near future the 'new norm' will be indoor public WiFi and outdoor 5G networks complementing each other to provide consumers with a seamless connected experience.

A range of commercial models and sourcing options are available to public bodies considering enhancing indoor WiFi or outdoor 5G connectivity. The approach taken by each public body will depend on a number of economic factors, its own unique circumstances and priority outcomes. Due consideration should be given, and advice sought where necessary, to develop an approach that will result in a successful and commercially sustainable outcome.

2 Introduction

Indoor and outdoor public WiFi initiatives first became popular in the UK as part of wider plans to improve the UK's digital connectivity. The Scottish Government undertook activities to enhance WiFi in public buildings across Scotland. This report provides guidance on how future wireless connectivity schemes can be designed by public bodies.

2.1 Background and context

Free public WiFi was popularised by the UK Government's Department for Digital, Culture, Media and Sport (DCMS) in 2012/2013 as part of the broader Super-Connected Cities Programme (SCCP) to improve broadband connectivity across UK cities. The provision of wireless services in city centres was seen at that time as a targeted intervention to accelerate the deployment of high-speed and consistent wireless services.¹

DCMS defined two intervention options to support the deployment of WiFi networks, namely: i) wireless concession contracts for the provision of outdoor WiFi using council street furniture, and ii) provision of indoor WiFi to public buildings such as museums, libraries, etc.

Government grants were awarded to public bodies to subsidise the installation cost of deploying indoor WiFi to public buildings on the basis they could provide evidence of supplier costs.

In 2015, the Scottish Government launched the Public Wireless Programme to provide public bodies with a planning framework and capital grant funding. The funding supported the deployment of WiFi in public places to stimulate greater access to free WiFi in public buildings.² In 2016/17, the programme had awarded public bodies just under GBP1 million in grant funding. As a direct result of this investment, every library in Scotland provided free WiFi. Although these were Scottish Government-funded projects, they were designed, procured and operated by individual public bodies.³

The provision of outdoor WiFi using wireless concession contracts was led entirely by public bodies and they did not receive any government capital-grant support. This was for a variety of reasons, with State aid the most significant. Under a wireless-concession contract, a public body would typically grant an operator the (sometimes exclusive) rights to use public assets, such as a street-

¹ See <https://www.gov.uk/government/publications/super-connected-cities-programme-options-for-wireless-connectivity/super-connected-cities-programme-options-for-wireless-connectivity>

² See <https://www.webarchive.org.uk/wayback/archive/20170401155915/http://www.gov.scot/Topics/Economy/digital/action/WC2020/PWP/PWP-working-paper-1>

³ Scottish Government, 2019. See also <https://www.gov.scot/binaries/content/documents/govscot/publications/foi-eir-release/2019/01/foi-18-03634/documents/foi-18-03634-annex-a/foi-18-03634-annex-a/govscot%3Adocument>. Public bodies that procured outdoor public WiFi with support from Scottish Government grant funding included: Aberdeen City Council, City of Edinburgh Council, Dumfries and Galloway Council, East Ayrshire Council, Falkirk Council, Fife Council, Glasgow City Council, Midlothian Council, North Ayrshire Council, Perth and Kinross Council, Renfrewshire Council, West Lothian Council

light column, to deploy a WiFi network. In return, the public body would receive payments in the form of rental fees and a proportion of WiFi revenues. WiFi concessions are not without their challenges and they have been largely unsuccessful, which is discussed further in Section 4.

The market has evolved since the deployment of free public WiFi schemes and it is no longer possible to consider WiFi in isolation. The advent of new technologies such as WiFi 6, the internet of things (IoT) and 5G, for example, means that public bodies will need to give consideration to a blend of wireless technologies when designing schemes to enhance digital connectivity in the future.

2.2 About this report

Cognisant of the evolving marketplace, this report provides public bodies with a forward-looking, best-practice toolkit. It provides pragmatic guidance on how wireless connectivity schemes can be designed by public bodies from this point forward.

Public bodies should be aware of the importance of digital connectivity in improving the social and economic wellbeing of their citizens, workers and visitors to the region. Modern economies can attract inward investment, create jobs and generate positive economic impact through the provision of enhanced digital connectivity. Digital connectivity enhances productivity, opens new market opportunities and reduced operational costs for business. Enhanced digital connectivity enables citizens to achieve a flexible work–life balance, supports remote and distance-learning initiatives, and keeps families and friends connected.

The remainder of this report is structured as follows:

- Section 3 – describes the benefits of public WiFi schemes, drawing upon digital town case studies
- Section 4 – explains some of the challenges of deploying public WiFi schemes
- Section 5 – gives an overview of additional factors that need to be taken into consideration
- Section 6 – summarises best practice delivery models for future wireless schemes
- Section 7 – concludes the findings of this report.

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3 The role of public WiFi

There are a number of benefits to public WiFi schemes, as it can be more inclusive than mobile connectivity, and can provide socially and digitally excluded groups with internet access at a low cost. Public WiFi schemes can also support public body transformation from ‘offline to online’, while benefiting from analytics to help decision-making and improve planning decisions.

3.1 Advantages of public WiFi networks

Public WiFi networks can offer a number of advantages over mobile connectivity. Free public WiFi can be a more ‘inclusive’ method of connecting to the internet, as users are not tied into expensive mobile contracts.

The inclusive nature of free public WiFi schemes is further exemplified in areas where mobile operators have varying degrees of coverage. Consumers tied into contracts with mobile operators with good levels of coverage will have an advantage over a consumer contracted to a mobile operator with poor coverage. This disparity in coverage can leave many at a disadvantage. Free public WiFi networks can allow consumers to connect to the internet, regardless of mobile provider.⁴

Public WiFi can also be more advantageous where indoor mobile coverage is poor. In scenarios where indoor cellular coverage is limited, public WiFi networks can be a cheaper alternative to providing enhanced indoor mobile connectivity, which requires often-expensive, small-cell networks to be deployed indoors.⁵ Further, there is no guarantee that all mobile operators will be able to justify the investment required to enhance indoor connectivity, as this is dependent on demand, among other factors. Thus, enhanced indoor mobile connectivity may only benefit the subscribers of mobile operators that are willing to invest, leaving other subscribers disadvantaged.

Public WiFi networks may in fact be used by mobile operators to extend their indoor coverage without investing in indoor small cells. Indoor public WiFi networks can be used by mobile operators to keep subscribers connected to their mobile networks through ‘cellular over WiFi’ or WiFi calling. Using public WiFi to ‘offload’ mobile connectivity allows text messages or voice calls to be made as though still connected to a mobile provider, therefore keeping subscribers online. All four UK mobile operators offer a cellular-over-WiFi capability.

3.2 Bridging the digital divide

Free public WiFi networks can support social inclusion initiatives.

⁴ Public WiFi in the context of this report refers to public-body-provided WiFi in public buildings and open spaces.

⁵ Indoor small-cell networks are often deployed on behalf of mobile operators by a neutral host provider. The shared nature of the platform can reduce the total cost of ownership, which can improve the case to extend indoor coverage.

According to the UK telecoms regulator Ofcom, the elderly, C2DE socioeconomic groups and the disabled are least likely to have access to the internet.⁶ Although commonly cited reasons for this are to do with a lack of relevant content and a lack of digital skills, affordability is also a significant factor contributing to the digital divide.

The elderly, C2DE and the disabled groups are least likely to be able to afford a broadband connection at home. In addition, they are unlikely to be able to afford mobile contracts with meaningful data allowances. Internet access provided through public WiFi networks is typically provided free of charge. As a result, these disadvantaged groups can receive the many benefits of being online that are available to large swathes of the population. These benefits include getting access to online shopping, discounts, health advice, job opportunities and education.

The bodies responsible for public WiFi initiatives in Renfrewshire, Hamilton, Inverness, Highland Towns and Moray have cited digital inclusion as an important factor when considering their public WiFi schemes.⁷

3.3 Enabling the shift to ‘online’

Enhanced availability of internet access is crucial to implementing a successful digital transformation. The provision of free WiFi in public places enables disadvantaged groups without internet access at home to participate and interact with public bodies online.

WiFi in public spaces can support digital transformation initiatives to ‘online’, particularly as many public bodies are moving to a ‘digital first’ delivery model.

Digital transformation is vital to enable public bodies to discover more effective and efficient ways of working, to improve the services they offer, and the means by which citizens can communicate and interact with them.

In late 2015, Scottish public bodies joined forces to drive forward digital transformation and established The Digital Office, which has set up a programme of support to councils in their vision to be digital businesses by 2020.⁸ The digital-first delivery model is where services are delivered digitally from more expensive channels, such as face-to-face or phone-based, to less expensive ‘online’ delivery models, such as self-service through online platforms and social media channels.

Digital transformation can also help public bodies to connect with citizens in an age of austerity. It is widely recognised that the shift to online will deliver significant benefits and cost reductions for public bodies, while giving citizens a range of means to interact with them at any time, day or night. The shift to digital can make it easier for citizens in remote regions to access services online, where

⁶ “Access and inclusion report”, Ofcom, 2018. C2DE refers to skilled working class, working class, and non workers (e.g. pensioners, casual and low grade workers and unemployed) based on the National Readership Survey demographic classification,

⁷ “Digital towns, pilot programme”, Scottish Towns Partnership, March 2018 and “Scotland’s towns, digital guidance”, Scottish Government and Scottish Towns Partnership, March 2017

⁸ “Digital progress”, Audit Scotland, December 2019

historically they may have needed to travel long distances to access public services. Further, having the ability to fine-tune services and to deliver them where they are needed most is becoming increasingly important. Connecting with citizens over social media, for example, gives public bodies the opportunity to respond in real time, collecting ideas that are expressed spontaneously at a low cost.

3.4 WiFi analytics

Public bodies can use public WiFi data analytics to improve public spaces and support decision-making.

Analytics allow public bodies to monitor the location of consumer devices – even when they are not connected to the public WiFi network – in a museum, for example, to understand visitor behaviour, which can in turn be used to improve the visitor experience.⁹ The data gathered can help museums to understand footfall by time of day, the length of time visitors queued to get in, the flow of people from one exhibit to the next and the time spent by visitors at certain exhibits. With this data, museums can improve the flow of visitors, offer ‘off-peak’ incentives to reduce busy periods, remove any bottlenecks and reposition exhibits to optimise the visitor experience.

Analytic tools have been built into public WiFi schemes in Auchterarder, Milngavie and Renfrewshire; however, the extent to which the tools are being used proactively to optimise public spaces is uncertain.¹⁰

The use of personal data gathered through the provision of public WiFi networks can be considered controversial. Organisations collecting personal data must give clear and comprehensive information for individuals to make them aware of any data gathered, and must avoid excessive and unnecessary data collection. However, where information is gathered in line with best practices, public WiFi has an incredibly unique advantage over mobile networks, which often charge for analytics.

3.5 Economic benefits

The economic value of WiFi (globally) is expected to grow to almost USD3.5 trillion by 2023.¹¹

One report suggests that free public WiFi is advantageous to the tourism industry as it can increase footfall and the length of time that visitors spend at attractions. This could result in an increase in

⁹ Anonymous data can be collected from WiFi enabled devices. These WiFi devices send out signals searching for WiFi networks. WiFi analytics captures these search requests and can report on it.

¹⁰ “Scotland’s towns, digital guidance”, Scottish Government and Scottish Towns Partnership, March 2017

¹¹ “The economic value of WiFi”, WiFi Alliance, 2018

expenditure at cafes and shops at site attractions.¹² Tourists may also be more inclined to visit WiFi-enabled public spaces and spend more money in such facilities to benefit from free internet access.¹³

Cities such as Aberdeen City Council and Stornoway have cited social and economic benefits as a reason to justify their outdoor public WiFi initiatives.¹⁴

Other studies suggest that public WiFi interventions should be limited to situations where there is an uncompetitive market and to provide temporary affordable internet access, a viewpoint that is reinforced by another academic study on public WiFi.^{15, 16}

3.6 WiFi case studies

In 2017, the Scottish Government published a study illustrating how organisations in different towns across Scotland use digital technologies and platforms as part of wider social or economic plans or strategies.¹⁷ The study demonstrated the variety of approaches being taken in different towns, as well as the range of different actors deploying digital technology in ways that can support regeneration, community engagement, tourism and economic growth.

The study found that not all towns invested in digital infrastructure such as free public WiFi schemes. Perth, Clarkston, Elgin, St Andrews and Fort William, for example, invested in apps, websites and a social media presence to promote local business and to support marketing.

Other town centres such as Auchterarder and Milngavie did invest in free public WiFi, as well as apps, websites and social media. Anecdotal evidence shows that many residents are unaware of Milngavie's free public WiFi offering.¹⁸ Those that are aware of the WiFi service experienced connectivity issues. It is understood that the Milngavie town-centre WiFi will not be renewed.¹⁹

A further study undertaken in 2018 showcases outdoor public WiFi initiatives across 21 other Scottish towns and cities.²⁰ The study highlights the most common outcomes sought by town-centre public WiFi schemes were to:

¹² <https://pinacisolutions.com/blog/2016/5-ways-that-social-wifi-is-benefitting-retail-outlets>

¹³ Visitors from EU countries already benefit from free mobile-roaming deals. Tourists from non-EU countries or those without mobile-roaming deals are most likely to benefit.

¹⁴ "Digital towns, pilot programme", Scottish Towns Partnership, March 2018 and "Scotland's towns, digital guidance", Scottish Government and Scottish Towns Partnership, March 2017

¹⁵ "Economics of Public WiFi", RMIT University, 2014

¹⁶ "An overview of different business models for public WiFi and their implications on indirect revenue", Ghent University, 2017

¹⁷ Scotland's Towns, Digital guidance, Scottish Government, March 2017. The towns featured are Perth, Clarkston, Elgin, Auchterarder, Milngavie, St Andrews, Fort William, Renfrewshire, and Glasgow.

¹⁸ Based on a poll undertaken on 10 August 2020 with members of 'Bearsden and Milngavie' Facebook group. The sample may not be statistically representative and may exclude tourists and socially excluded groups.

¹⁹ Source: 802 Works

²⁰ Digital towns pilot programme, Scottish Towns and Partnerships, March 2018. Towns included: Aberdeen City, Dumfries, Hamilton, Inverness and Highland towns, Grantown, Moray and Stornoway.

- deliver social and economic benefits
- support digital-inclusion initiatives
- regenerate town centres
- boost tourism.

Some of the larger cities and towns across Scotland undertook their own initiatives to enhance digital connectivity through WiFi:

- In 2014, in advance of the Commonwealth Games, Glasgow City Council awarded a wireless concession contract with exclusivity to BT. BT provided free public WiFi across busy city-centre locations and to 31 Glasgow Life venues, including museums and libraries. Usage data shows that the demand for outdoor public WiFi consumption is limited, while demand for indoor public WiFi is still healthy. In 2018, the council established a programme of works as part of its digital strategy to attract investment in 5G.²¹
- In 2016, Edinburgh City Council signed a ten-year concession contract with InTechnology to deliver free indoor and outdoor WiFi coverage across the city centre and public buildings such as the Scottish National Gallery, Edinburgh Castle and the National Museum of Scotland, and to targeted hotspots such as Calton Hill, Dean Gardens, the Meadows, and Haymarket and Waverly stations. Edinburgh's unique position as the second-busiest city for tourism outside London may make it a 'special case' that bucks the trend for public WiFi when compared with other Scottish towns and cities.²²
- In 2017, Renfrewshire Council awarded a contract to Boston Networks for the design and delivery of a WiFi platform. The WiFi platform was to serve the towns of Paisley, Johnstone and Renfrew, and public buildings such as leisure centres, care homes, museums and libraries. The initiative was designed to support major outdoor and indoor events in and around Paisley. Recent analysis suggests that most WiFi bandwidth is consumed indoors. Renfrewshire Council is now considering the future of its outdoor public WiFi strategy among IoT and 5G initiatives.²³
- In 2017, Aberdeen Council awarded a wireless concession contract to neutral-host provider Wireless Infrastructure Group (WIG). The concession was designed to target significant long-term investment in fibre-connected, small-cell infrastructure to enable enhanced 4G, 5G and other wireless services, rather than just focusing on WiFi alone. This was the first such 5G enabled rollout in the UK, which was initially provided as enhanced cellular connectivity (in partnership with Telefonica O2) in city-centre locations such as the railway station, the University of Aberdeen and Pittodrie stadium.²⁴

²¹ https://www.publiccontractsscotland.gov.uk/search/show/search_view.aspx?ID=DEC339013

²² <http://www.edinburghfreewifi.com/>

²³ https://www.publiccontractsscotland.gov.uk/search/show/search_view.aspx?ID=MAR276004

²⁴ WIG and Aberdeen City Region Deal, 2018

4 An evolving market

While indoor public WiFi is popular and is likely to remain so, there are many challenges associated with outdoor public WiFi deployments. Consequently, in preparation for 5G, there is a notable shift to deploying outdoor small-cell networks that are expected to gradually replace outdoor WiFi.

4.1 The challenges of outdoor WiFi

The case for outdoor public WiFi is challenging; it is generally limited to areas with the highest footfall for commercial reasons, resulting in only a few outdoor areas that benefit from the scheme. There are a number of reasons for this as explained below.

Public bodies deploying outdoor public WiFi through a wireless concession scheme typically demanded high fees for their assets and a high proportion of revenue share in return for exclusive rights. However, WiFi is difficult to monetise, which made outdoor WiFi concessions commercially challenging to implement as a result. Outdoor public initiatives across London, including one in Westminster and an initiative led by Camden Council and other London boroughs, were unsuccessful and resulted in extremely limited rollouts. In Scotland, cities such as Glasgow, Aberdeen and Dundee have shelved plans for outdoor public WiFi concessions.^{25, 26}

There is also an expectation among consumers that WiFi should be free of charge and therefore it is immensely challenging to convince consumers to pay for it. Using advertising to generate income to subsidise the investment made by concessionaires is still an unproven business model and has had, at best, extremely limited – if any – success.

Further, the customer onboarding experience when joining outdoor public WiFi has in many cases been clunky, requiring often unnecessary personal data to be provided. Only a handful of organisations, e.g. Renfrewshire Council, used a single ‘tick box’ as a means of authenticating users, thus streamlining the onboarding process.

For the above reasons, contracts for outdoor public WiFi have not been renewed by many public bodies after the initial contract term expired.

4.2 The shift to outdoor small cells

The use of outdoor public WiFi is expected to reduce, given the declining cost of mobile services and increase in mobile data allowances (see Figure 1 and Figure 2).

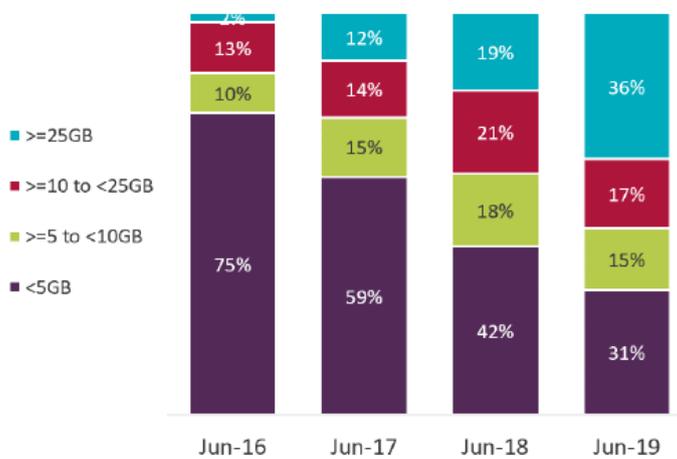
²⁵ Sources: Intelligens Consulting FOI requests and “Local authorities, WiFi and the SCCP”, Point Topic, 2013

²⁶ It should be noted that these outdoor WiFi concessions are provided at zero cost to the council. Under the concession model, lower utilisation sites are less likely to be of interest to mobile operators.

Figure 1 – Average monthly price of mobile services excluding handset. Source: Pricing trends, Ofcom, 2020



Figure 2 – Mobile data allowance trends. Source: Pricing trends, Ofcom, 2020



Rather than using outdoor WiFi, consumers (who are able to) tend to use their own mobile data bundles when outdoors. An increase in free data bundles and intensified competition among mobile operators has led to an increase in mobile data usage.²⁷

Given the expected decline in outdoor WiFi usage, the challenges associated with monetising outdoor WiFi and the advent of 5G, the mobile industry and public bodies are turning their attention to densified small-cell networks in preparation for 5G, rather than outdoor public WiFi.

As previously mentioned, the cities of Glasgow and Aberdeen have put in or are putting in place initiatives for the deployment of outdoor small-cell networks rather than WiFi. Further market players, such as WIG, Cellnex, BAI Communications and Ontix, among others, are proposing the use of neutral-host networks to make the deployment of small cells less costly for mobile operators. The city of Edinburgh continues to provide free outdoor public WiFi, although this mainly serves the significant influx of visitors during its summer and winter festivals.

²⁷ 70% of mobile tariffs include over 5GB of mobile data. Only 10% of mobile data consumers use more than 5GB per month. Source: Pricing trends for communications services in the UK, Ofcom, 2020

4.3 Digital divide

Outdoor public WiFi is less of a consideration for public bodies when considering the digital divide. Public bodies and social housing landlords such as the Wheatley Group have experimented with a number of approaches to provide connectivity to the most socially disadvantaged groups, but a public WiFi approach was not proven to be an effective means of bridging the digital divide.²⁸

As a result, many public bodies and social landlords leading on digital-inclusion initiatives have settled on market-driven delivery methods that are commercially sustainable as a means to provide connectivity to disadvantaged groups, described below:

- **Delivery method 1 – wayleave agreement.** Where a public body enters into a partnership to sign non-exclusive wayleave agreements with fibre operators to provide connectivity to social housing stock. This approach is used by Renfrewshire Council, Wheatley Group, Aberdeen City Council and Southwark Council among a host of other public bodies with providers such as Openreach, Virgin Media, CityFibre, CFL and Hyperoptic.²⁹
- **Delivery method 2 – bespoke affordable broadband.** This approach delivers a dedicated internet connection to social-housing blocks. However, the proposition requires buy-in from social housing providers to offer the service and collect rental fees on behalf of the internet service provider. This approach is still relatively untested and in its infancy.

In addition, the Connecting Scotland initiative aims to connect up to 9,000 people on low incomes by distributing SIM cards and devices to digitally excluded and low-income groups.³⁰

4.4 The case for indoor public WiFi

Despite the decline in demand for outdoor public WiFi, indoor public WiFi continues to be popular. It is largely accepted that consumers tend to use WiFi at fixed ‘indoor’ locations such as offices, transport hubs, homes, etc. This reflects the fact that consumers spend most of their time indoors, where WiFi is likely to be the default way of connecting devices to the internet.

Public body usage statistics reinforce this view, with circa 80% of public WiFi usage coming from indoor public buildings such as leisure centres, children’s homes and town halls, etc. These effects may be amplified by the fact that indoor cellular coverage is often limited; therefore, consumers tend to connect to indoor public WiFi networks if and when they are available.

²⁸ <http://www.scottishpolicynow.co.uk/article/connecting-the-unconnected>

²⁹ <https://www.cityfibre.com/news/scottish-housing-associations-team-cityfibre-bring-full-fibre-broadband-tenants/>,
<https://www.southwark.gov.uk/housing/housing-getting-involved/better-broadband-for-southwark?chapter=2>,
<https://www.scotlandis.com/blog/commsworld-wins-multi-million-pound-deal-to-transform-renfrewshire-councils-digital-infrastructure-in-partnership-with-cityfibre/>
<https://www.hyperoptic.com/social-value/>

³⁰ Connecting Scotland is a Scottish Government initiative being managed by the Scottish Council for Voluntary Organisations.

The cost of deploying indoor public WiFi networks can average at GBP1,500 per access point and can range from between GBP500 to GBP3,000 per access point. The difference in costs is down to a number of factors such as competition, the level of service provided and the solution used (e.g. backhaul, management platform, etc.). Operational costs are likely to be around 10% to 25% of the total capital cost of the WiFi solution.³¹

³¹ Source: Intelligens Consulting, 2020 based on historical data and competitive quotes

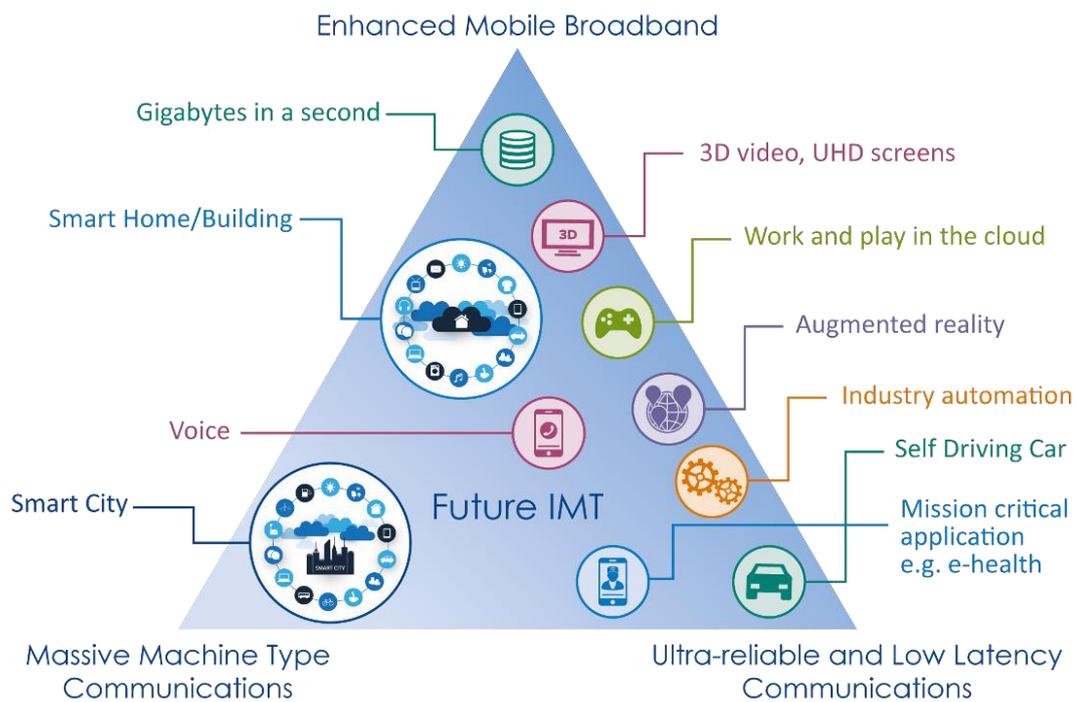
5 Other considerations

WiFi rollouts should not be considered in isolation and need to be cognisant of other technologies such as 5G, WiFi 6 and OpenRoaming standards. It is likely that, over time, indoor public WiFi and outdoor 5G networks will soon complement each other. The rollout of IoT networks will also limit WiFi’s usefulness in Scotland’s ‘smart cities’ future.

5.1 5G

5G is the next generation of cellular technologies, promising multigigabit download speeds, ultra-reliable, low-latency communications, and support for connected machine-to-machine communications, the IoT and smart cities (see Figure 3).

Figure 3 – 5G usage scenarios. Source: ITU-R IMT-2020 Vision Recommendation, 2017



As mentioned previously, the mobile industry and public bodies are turning their attention to densified small-cell networks and enabling investment in enhanced 4G- and 5G-ready networks to improve outdoor coverage.

5G is likely to have a significant economic impact. The European Commission (EC) estimates the total cost of 5G deployment across the 28 Member States will be EUR56 billion, resulting in benefits of

EUR113.1 billion per annum arising from the introduction of 5G capabilities and creating 2.3 million jobs.³²

However, the rollout of 5G is in its infancy, i.e. there is not yet enough demand to justify the investment needed in 5G networks. It is estimated that the cost of investing in 5G (through small-cell densification) across one square mile of a medium-density city is around GBP5 million.³³

Currently, this means that the mobile network operators (MNOs) are – where commercially feasible to do so – deploying 5G radio access networks across their macro sites, working alongside their existing 4G networks, which provide the control interface. In the medium term (2025 onwards), it is expected that mobile operators will invest in ‘standalone’ 5G networks, with the deployment of densely packed small cells using a neutral-host infrastructure.

Neutral hosts reduce infrastructure costs, while offering a pro-competitive solution to infrastructure sharing. Neutral-host providers lower the economic threshold for rolling out small cells, lessening the total cost of ownership and anticipating future sharing by other wireless operators.

In the meantime, public bodies can and should embark on:

- **supply-side interventions**, such as barrier busting (as implemented by Glasgow City Council) to attract investment in 5G small cells.³⁴
- **demand stimulation**, to develop ‘5G-centric’ use cases that will stimulate demand and enhance the commercial case for 5G investment. Examples of potential use cases for consideration include: 5G connected ambulances, 5G social care, 5G telecare, etc.³⁵

5.2 WiFi 6

WiFi 6 is the next evolution of WiFi standards, promising higher speeds, reduced latency and better support for applications such as IoT.

The proliferation of OpenRoaming standards is likely to mean that indoor public WiFi and outdoor 5G networks will soon complement each other. OpenRoaming allows devices to connect to and authenticate approved WiFi networks automatically, without needing to log in or register more than once.³⁶

OpenRoaming authenticates mobile devices using SIM credentials, therefore extending 5G network coverage by using indoor WiFi networks seamlessly (see Figure 4).

³² ‘Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe’, EC, 2016

³³ https://www.itu.int/en/ITU-D/Documents/ITU_5G_REPORT-2018.pdf

³⁴ <https://www.glasgow.gov.uk/CHttpHandler.ashx?id=43572&p=0>

³⁵ <https://www.gov.uk/government/collections/5g-testbeds-and-trials-programme>

³⁶ OpenRoaming is a multi-vendor initiative to provide a better bridge between mobile and Wi-Fi networks.

Figure 4 – Complementary role of 5G and WiFi 6 interworking facilitated by OpenRoaming. Source: Cisco, 2020



5.3 Smart cities

In recent years, ‘smart city’ initiatives have started to gather pace and rollouts have commenced. IoT Scotland for example, is an initiative supported by the Scottish Government in partnership with Boston Networks. The initiative will deploy a Scotland-wide sensor network, allowing public- and private-sector companies to use smart-sensor technology applications without the need for cellular or WiFi networks.³⁷

Existing WiFi infrastructure could be repurposed to serve smart-city applications. Street cabinets used to deploy existing outdoor public WiFi networks can serve a dual purpose. Subject to access rights, size and space availability, these street cabinets could be used to co-locate other technologies to enable IoT fibre, or even electric-vehicle charging points.

Virgin Media’s ‘park and charge’ initiative, for example, plans to deploy some 1,200 electric-vehicle charging points across the UK, along with a resilient, low-latency electronic communications network (ECN) required to support the charging network. The network may also be used to provide wireless services and IoT applications such as parking management, pollution monitoring and data-offload from vehicles.³⁸ It should be pointed out that this specific initiative involves building new infrastructure, rather than repurposing existing WiFi street cabinets.

³⁷ <https://www.iot-scotland.net/>

³⁸ <https://www.libertyglobal.com/electric-car-charging-consortium-unveiled/>

6 Best-practice delivery models

There are a number of delivery options available to public bodies to designing WiFi and small-cell schemes. Consideration needs to be given to the availability of funding, public-sector assets, consumer demand, timing, the complexity of the requirement, the implications of State aid and the Electronic Communications Code when designing such schemes.

6.1 Indoor public WiFi delivery models

Indoor WiFi remains reasonably popular and therefore it is reasonable to suggest that its provision is likely to remain a consideration for public bodies going forward. There are three main commercial delivery models to provide indoor WiFi, as describe in Figure 5.

Public bodies should undertake an extensive market consultation and options-appraisal exercise to determine the most suitable commercial deployment model, taking the following factors into consideration:

- the availability of funding
- council priority outcomes for social/digital inclusion
- internal resources available to manage WiFi
- level of WiFi coverage required
- anchor procurements
- market interest to support added-value initiatives.

Figure 5 – Potential delivery models for the deployment of indoor public WiFi

Commercial model	Description	Advantages	Disadvantages
1. Outsource	Where the provision and management of an indoor public WiFi solution is outsourced to a third party. This is similar to the arrangement that Renfrewshire Council has with Boston Networks	<ul style="list-style-type: none"> Likely to result in a carrier grade solution Frees up public body IT resource from day-to-day management Fully managed service and SLA 	<ul style="list-style-type: none"> Requires initial capital grant to fund installation of WiFi Requires ongoing operation operational budget to support management and maintenance costs
2. Insource	Where the provision and management of an indoor public WiFi solution is undertaken by the public body	<ul style="list-style-type: none"> Likely to see lower capital and operational cost implications Additions, moves and changes to sites can be implemented relatively quickly and at low cost 	<ul style="list-style-type: none"> Resource-intensive as public body has to oversee all day-to-day management activities Will not benefit from carrier grade solution Will need to use existing council internet

			connectivity, which may cause traffic issues
3. Anchor tenancy	Where a third party provides free public WiFi as part of an added value to an anchor service procured by the council	Opens up potential for the third party to offer free public WiFi as an added-value service at zero cost to the council	To date, the anchor tenancy model has only been proven in the context of delivering full fibre connectivity.

6.2 Outdoor small-cell delivery models

Given the decline in outdoor WiFi usage and the challenges associated with monetising outdoor WiFi, it is expected that densified 4G (followed by 5G) small-cell networks will prevail as the means of providing outdoor connectivity. There are three main delivery models to provide outdoor wireless small cells, as describe in Figure 6.

Public bodies should undertake an extensive market consultation and options-appraisal exercise to determine the most suitable commercial deployment model, taking the following factors into consideration:

- market appetite to invest in the region
- the development of discrete 5G use cases to stimulate demand
- the availability of internal resources to implement barrier-busting initiatives and the creation of an asset register
- the availability of funding.

Figure 6 – Potential delivery models for the deployment of outdoor small cells

Commercial model	Description	Advantages	Disadvantages
1. Wireless concession	A third party is awarded rights to public body assets in return for investment in digital infrastructure, and provision in fixed and/or wireless services. Typically common with wireless deployments, but has been used with fibre deployments	Can deliver a wireless network at zero cost to the council Has been tried and tested in Aberdeen and in other prominent UK cities	Market is wary of concession model due to previous link with failed WiFi concessions Mobile operators are insisting on demand and supply initiatives to increase revenues and decrease costs of deploying small-cell networks Where it is not possible to stimulate demand or reduce costs, mobile operators may look for capital subsidy to

			<p>improve the investment case</p> <p>Rollout may be limited to areas of high footfall only and large, dense cities first</p> <p>Navigating the Electronic Communications Code requires professional advice (see Section 0)</p>
2. Barrier busting	The public body agrees to simplify operational and planning processes to allow mobile operators to deploy digital infrastructure quickly, reducing overheads and costs	Barrier busting will attract market interest and signal to the market that the public body is ready for engagement	This initiative alone is unlikely to deliver investment in small cells and <u>may</u> need to be combined with a wireless concession, demand stimulation initiative and capital subsidy
3. Demand stimulation	Public body develops discrete 5G use cases that depend on 5G's unique capabilities in order to stimulate demand, take up and usage	Early market discussions held by Intelligens Consulting suggest anchor use cases that drive demand (and early cashflow) that <u>may</u> enhance the investment case for deploying small cells	This initiative alone is unlikely to deliver investment in small cells and <u>may</u> need to be combined with a wireless concession, barrier busting initiatives and capital subsidy

6.3 Procurement approach

Tender exercises should be undertaken in accordance with the appropriate legislation and specialist advice should be sought to determine the most appropriate sourcing strategy. The legislation applicable to procurement is as follows:

- The Procurement Reform (Scotland) Act 2014, which has been implemented and establishes the national legislative framework for sustainable public procurement.
- The Procurement (Scotland) Regulations 2016, which have been implemented to provide the rules for lower-value contracts. These rules are comparable with the equivalent rules for EU-regulated contracts.
- Public Contracts (Scotland) Regulations 2015 – applies to SPCB contracts whose value is equal to or above the EC Procurement Threshold.

The complexity of service or goods being sourced will determine the procurement route, as specified in Figure 7. Public bodies should undertake an appraisal of each option to determine the most suitable route to market, taking the following factors into consideration.

- timing constraints
- availability of resources to support the procurement exercise
- access to professional advice to support the procurement exercise
- certainty of the requirements
- complexity of the solution
- the level of competition.

Figure 7 – Procurement options. Source: Intelligens Consulting, 2020

Procurement route	Circumstances dictating use of the procedure
Open/restricted	Can conclude procurements within three months Standard or readily available solutions will meet the contract requirements The contract requires no additional design or the use of innovative solutions The contract can be awarded without prior negotiation because of the limited complexity of the technical, commercial, legal or financial components of the contract and/or the risks attached to them The technical specification can be established with sufficient detail
Competitive dialogue and competitive dialogue with negotiation	Standard or readily available solutions will not meet the contract requirements The contract requires additional design or the use of innovative solutions The contract cannot be awarded without prior negotiation because of the complexity of the technical, commercial, legal or financial components of the contract and/or the risks attached to them The technical specification cannot be established with sufficient detail at the start of the procurement process
Negotiated procedure without prior publication	No suitable tenders have been submitted in response to an open procedure or a restricted procedure Services can be supplied only by a particular economic operator The situation is one of extreme urgency brought about by events unforeseeable by the contracting authority
Scottish and UK government frameworks	Suppliers have already been through a pre-qualification exercise Can be conducted in a shorter time than an OJEU procurement Fully compliant with the 2015 Public Contracts Regulations and the 2014 EU Public Procurement Directive Limited contract periods, usually no more than seven years

Figure 8, Figure 9 and Figure 10 provide a summary of the process for the open, competitive dialogue and negotiated procedures.

Figure 8 – Summary process for open procedure. Source: Intelligens Consulting, 2020

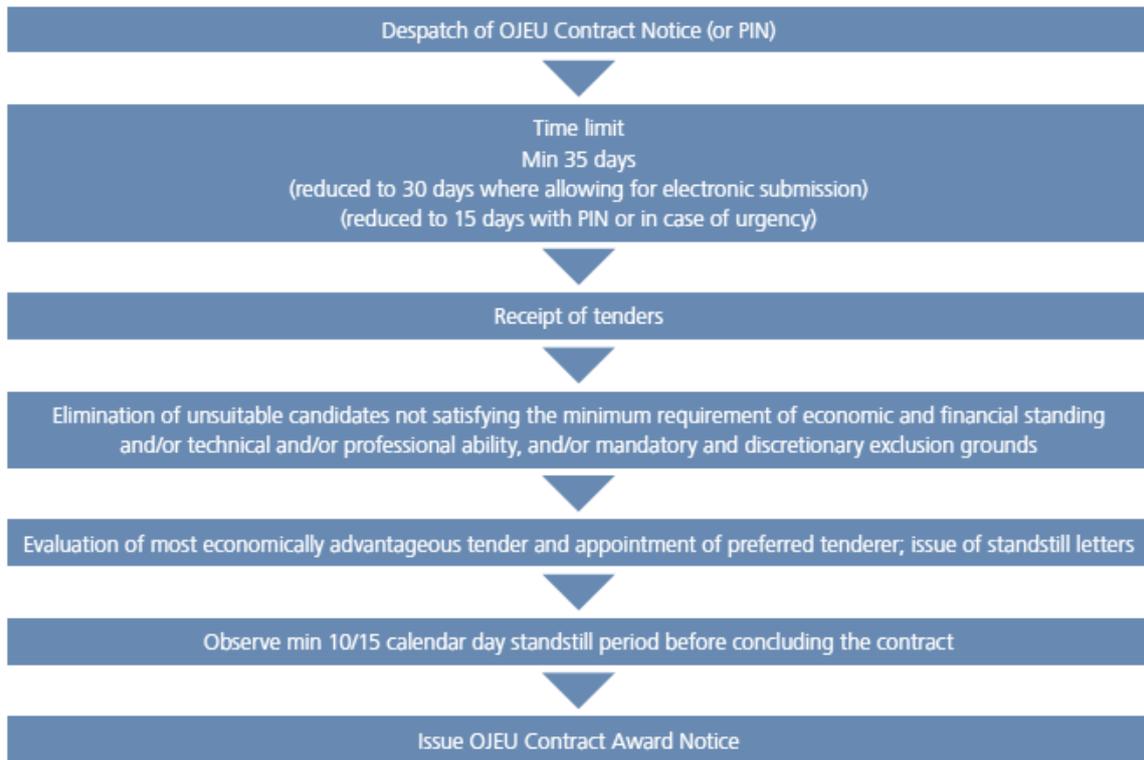
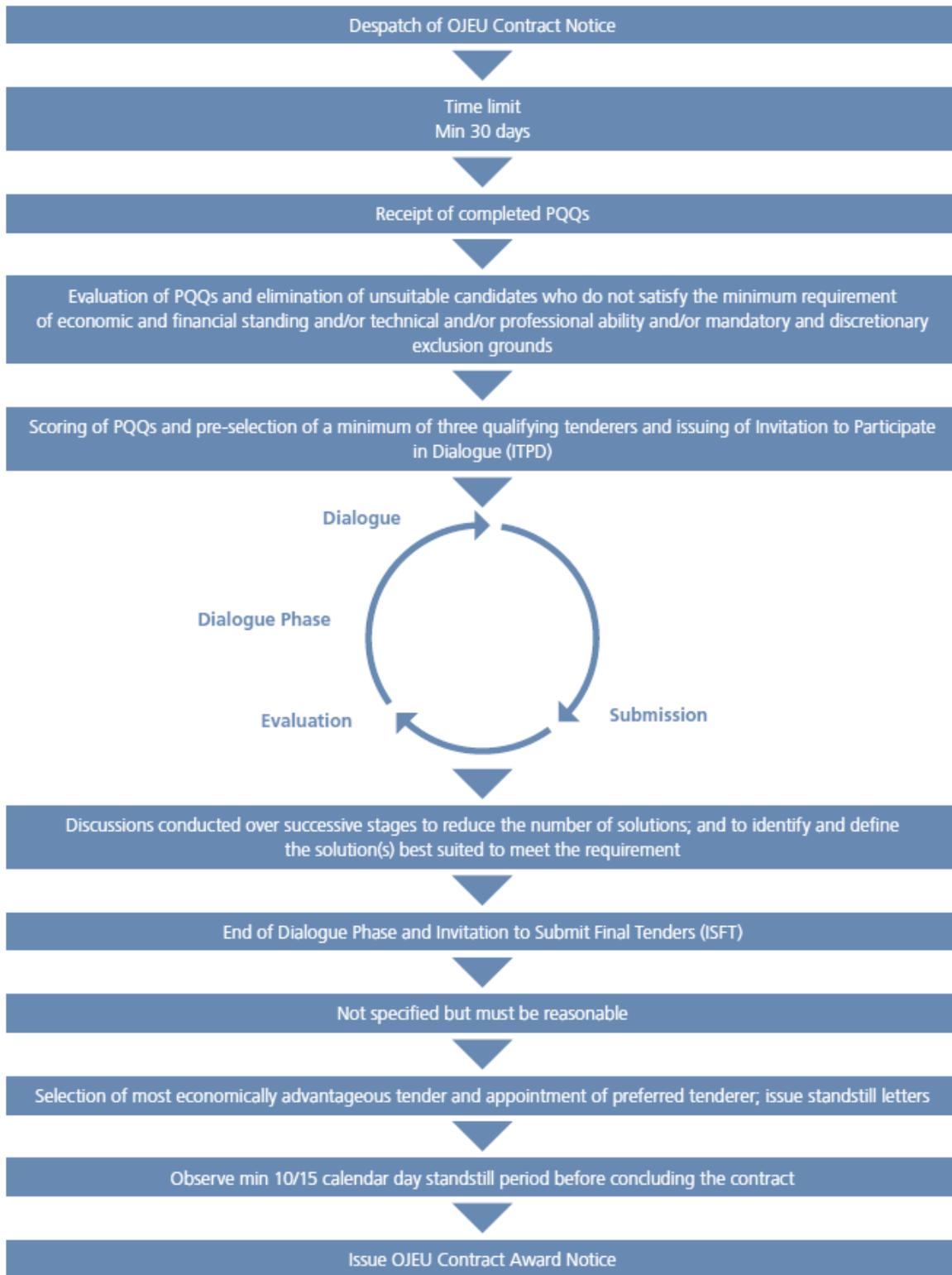


Figure 9 – Summary process for competitive procedure with negotiation. Source: Intelligens Consulting, 2020

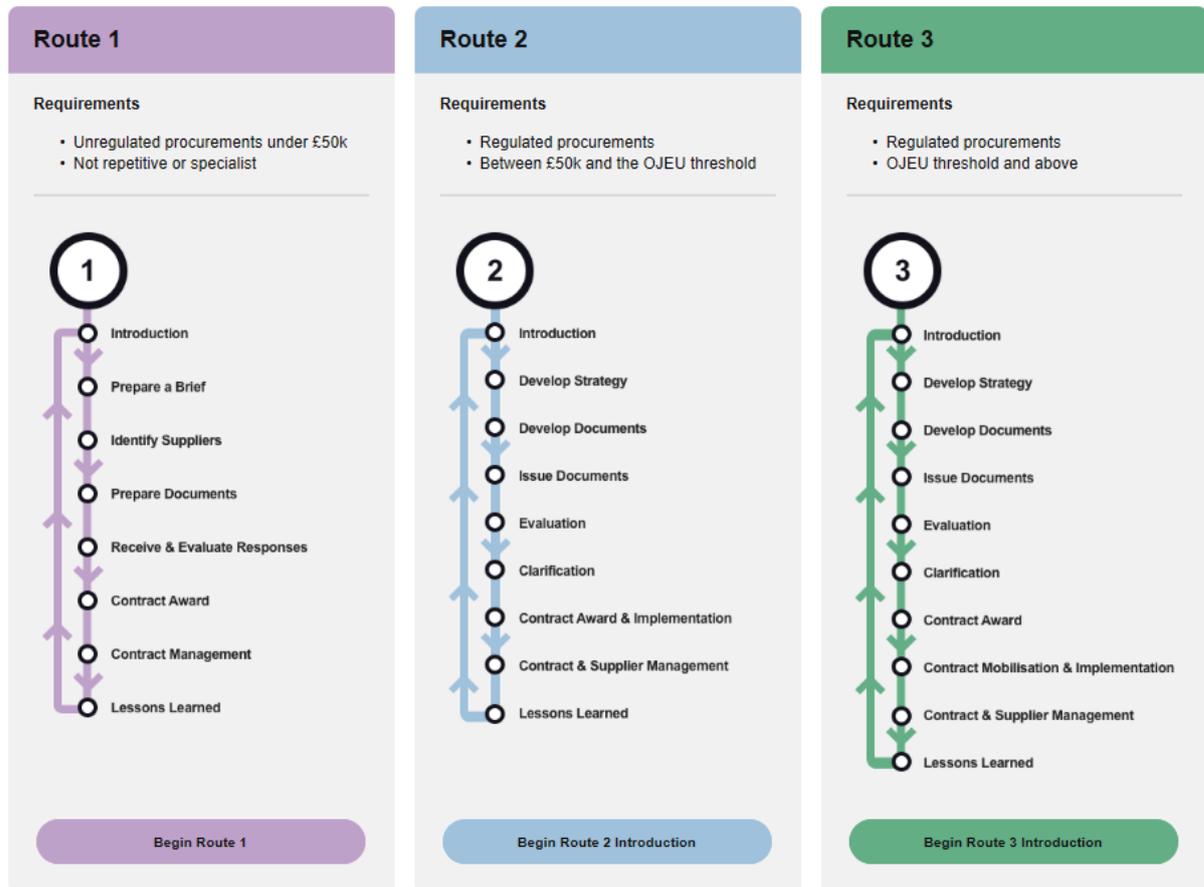


Figure 10 – Summary process for competitive dialogue procedure. Source: Intelligens Consulting, 2020



The Scottish Government provides further broad guidance on the procurement routes available to public bodies procuring goods and services by procurement value, see Figure 11.³⁹

Figure 11 – The procurement journey. Source: Scottish Government, 2020



6.4 Electronic Communications Code

The Electronic Communications Code came into force on 28 December 2017, following the enactment of the Digital Economy Act 2017

The Code sets out the rights and obligations to be included in agreements between landowners and telecoms operators in respect of the installation and operation of telecoms masts. The Code applies in full to all telecoms agreements completed after 28 December 2017. There are two critical aspects to note that affect public bodies:

1. The Code states that the rent paid by telecoms operators will be based on market value, which means that telecoms operators can no longer be forced to pay disproportionately high rents for using third-party assets and councils will no longer be able to command high rents for renting out assets such as rooftops or streetlights.

³⁹ See also <https://www.procurementjourney.scot/>

2. The Code gives operators the right to install electronic communications apparatus on, under or over any land regardless of any commercial agreements already in place; however, that right does not apply to apparatus designed or adapted for use in connection with the provision of an ECN, such as ducts.

The implication is that the award to a mobile operator by a public body of exclusive rights to its assets for the deployment of a wireless network (as is quite often the requirement from mobile operators) may result in a legal challenge. Professional advice is recommended to provide guidance on a pragmatic course of action.

6.5 State aid

Current State-aid rules mandate that the deployment of broadband networks where using State aid (in benefit or in kind) should only target market failures and minimise negative effects on competition.⁴⁰

Public intervention should be targeted to limit the risk of crowding out private investments, of altering commercial investment incentives and ultimately of distorting competition.

The wireless concession model ensures that this method of public intervention in broadband networks is compatible with State aid, as long as the process to secure a wireless provider follows an open, transparent and competitive sourcing process.

Providing public subsidy to support the provision of indoor public WiFi is not deemed to interfere with the market and is therefore considered a non-aid measure.

The following considerations should be taken into account when sourcing service providers:

- All procurement of works, equipment, goods and services shall be based on value for money and suitable skills and experience.
- A fair and transparent documented decision-making process is undertaken.
- Tender exercises are in accordance with the appropriate regulations.
- Any single enterprise does not receive aid in excess of the *de minimis* threshold (currently EUR200,000) over a three-year rolling period.

At the time of publishing this report the UK has left the EU; therefore, the application of State aid to broadband networks may be subject to change. Professional advice is recommended to provide up-to-date guidance on State aid.

⁴⁰ The EC published 'EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks' (2013/C 25/01).

7 Conclusion

The recent coronavirus pandemic has illustrated how dependent society has become on digital connectivity to connect with work colleagues, to socialise with friends and family, to shop online and to educate young people.

In the past, public bodies have invested in indoor and outdoor public WiFi schemes, as part of wider initiatives to improve broadband availability and to drive digital-transformation initiatives. Indoor public WiFi schemes in particular have enabled the most socially excluded and vulnerable members of society to access the internet, allowing them to partake in the many benefits it provides, and this should continue.

There are many other reasons for indoor public WiFi schemes to continue. For example, mobile coverage can be limited in an indoor setting and it can be expensive to improve indoor mobile coverage. There is also good evidence to suggest that most users consume WiFi at a fixed or indoor location, as opposed to when they are outdoors, meaning demand for indoor WiFi is high.

Although the case for indoor public WiFi is relatively well-defined, the case for outdoor public WiFi is less certain and public bodies must establish the need for outdoor public WiFi depending upon their own unique circumstances. With the advent of 5G consumers will expect seamless connectivity regardless of location or technology they are connected to, thus we are likely to see indoor WiFi complement outdoor 5G (or existing 4G deployments where 5G has not yet been provisioned). Further, public WiFi concessions schemes (bar some exceptional circumstances) are coming to an end in favour of supporting 4G/5G small cell deployments. Public bodies must therefore determine for themselves whether there is a strategic case to support outdoor public WiFi schemes.

Public bodies must also embrace a new way of working to facilitate the transition to seamless connectivity and to maximise economic benefits for their region. IT departments and economic teams will need to collaborate more closely than ever to ensure ICT procurements align with economic outcomes to generate added value and social benefits for the communities they serve.

A range of delivery commercial models should be considered by public bodies as part of a larger sourcing strategy and options appraisal. Carefully designed procurements employing innovative commercial models can deliver on their priority outcomes with minimal public-sector investment, to drive value and to create social and economic impact.