

5G and Future Connectivity

An Emerging Framework for Irish Cities and Towns

DISCUSSION DOCUMENT



Acknowledgements and Background to the Report

This report is funded and supported through the Digital Innovation Programme which is administered by the Department of Rural and Community Development. The project was led by the Smart City team based in Dublin City Council in collaboration with leading telecoms experts.

We would also like to acknowledge input, comments, and feedback, from the Department of Rural and Community Development, CONNECT - the Science Foundation Ireland Research Centre for Future Networks and Communications, Sligo County Council, as well as the National Broadband Officer Network.

A number of one-on-one interviews were held with telecoms operators and vendors. Additionally, an online survey was carried out to gather opinions from two main perspectives: telecoms vendors/mobile operators (11 respondents) and broadband officers (representing 21 out of 31 local authorities) from across Ireland.

This report was designed to enable local authorities across Ireland to consider the implications that 5G and future connectivity needs will have on their future planning and development policies. It sets out to achieve the following:

- **To bring together industry and academic experts, and local authority representatives, as well as other public asset-owners to catalogue and address issues related to the deployment of 5G across Irish cities and towns;**
- **To develop a suite of recommendations to support the rollout of 5G across Ireland.**

The impact of Covid-19 has highlighted the importance of current and future connectivity needs, not just in city centres, but also across our suburbs, towns, and rural communities. In a world where remote working is a necessity, we need to future-proof our cities, towns, and communities, to support more flexible working options in a way that protects Ireland's future competitiveness. This discussion paper, and its executive summary, is intended to stimulate debate and discussion from all stakeholders to ensure that Ireland realises its connectivity potential. For more information on the executive summary version of this 5G discussion paper, visit: <https://smartdocklands.ie/5G>

Disclaimer: This document is intended solely for discussion purposes only. All content is based on current knowledge and may change over time.

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Glossary

254 Section License	A licensing mechanism for deployment/installation of equipment or infrastructure that does not have to undergo planning permission. Currently being debated on its role in deployment of next generation wireless equipment.
Allocated spectrum/ Radio frequency ranges	Ranges of allocated frequencies are often referred to by their provisioned use (in this case, cellular spectrum). It is a fixed resource which is in demand by an increasing number of users. The radio spectrum has become increasingly congested in recent decades, and the need to utilise it more effectively is driving modern telecommunications innovations.
Backhaul	Backhaul generally refers to the side of the network that communicates with the global internet; granted access at an internet exchange point or other core network access location.
Core network	A core network signifies the highly functional communication facilities that interconnect the various radio access networks. The core network decides delivery routes to exchange information among various sub-networks, and carries information into the global internet (data centres).
ComReg	Commission for Communications Regulation. ComReg is the telecommunications regulator in Ireland.
Ducting	Also known as the conduit that houses the copper or fibre cables that run through the ground, or overhead.
Electricity Supply Board Networks (ESBn)	ESB Networks finances, builds and maintains the transmission system through which electricity flows from generation stations to bulk supply points near cities and towns across Ireland.
Fibre (Optic) Internet	Fibre optic internet is an internet connection that transfers data fully or partially via fibre optic cables. “Fibre” refers to the thin glass wires inside the larger protective cable. “Optic” refers to the way the data is transferred – light signals.
Internet-of-things (IoT)	The interconnection of everyday objects and devices via the internet, enabling them to send and receive data.
Macrocell	A macrocell is a cell used in cellular networks with the function of providing radio coverage to a large area of mobile network access - which is also known as a ‘larger scale’ radio access network.
Mobile Network Operator (MNO)/Operator	Telecoms operators in Ireland, e.g., Three, Vodafone, Eir, etc.
mmWave	Millimeter wave (mmWave) spectrum is the band of spectrum between 30 GHz and 300 GHz. Wedged between microwave and infrared waves, this spectrum can be used for high-speed wireless communications.
Local/City Asset	Lighting pole / traffic pole / bus shelter / bin / buildings.
Local Authority	The local government city or county council representing services and infrastructure for citizens in the designated area.
Radio access network (RAN)	RANs are radio sites that provide radio access and coordinate the management of resources across radio sites. The RAN transmits its signal to various other wireless endpoints (mobile devices, etc.) and connects them to the core network.
Small Cell	A ‘smaller scale’ radio access network. It comes in many different forms - mostly in the shape of a box less than 0.5m in height, length, and width. Can also be referred to as femtocells, picocells or microcells.
Spectrum	The radio spectrum is the part of the electromagnetic spectrum with frequencies from 30 Hz to 300 GHz. Electromagnetic waves in this frequency range, called radio waves, are widely used in modern technology, particularly in telecommunications.

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5G in Ireland

1.1 What is 5G?

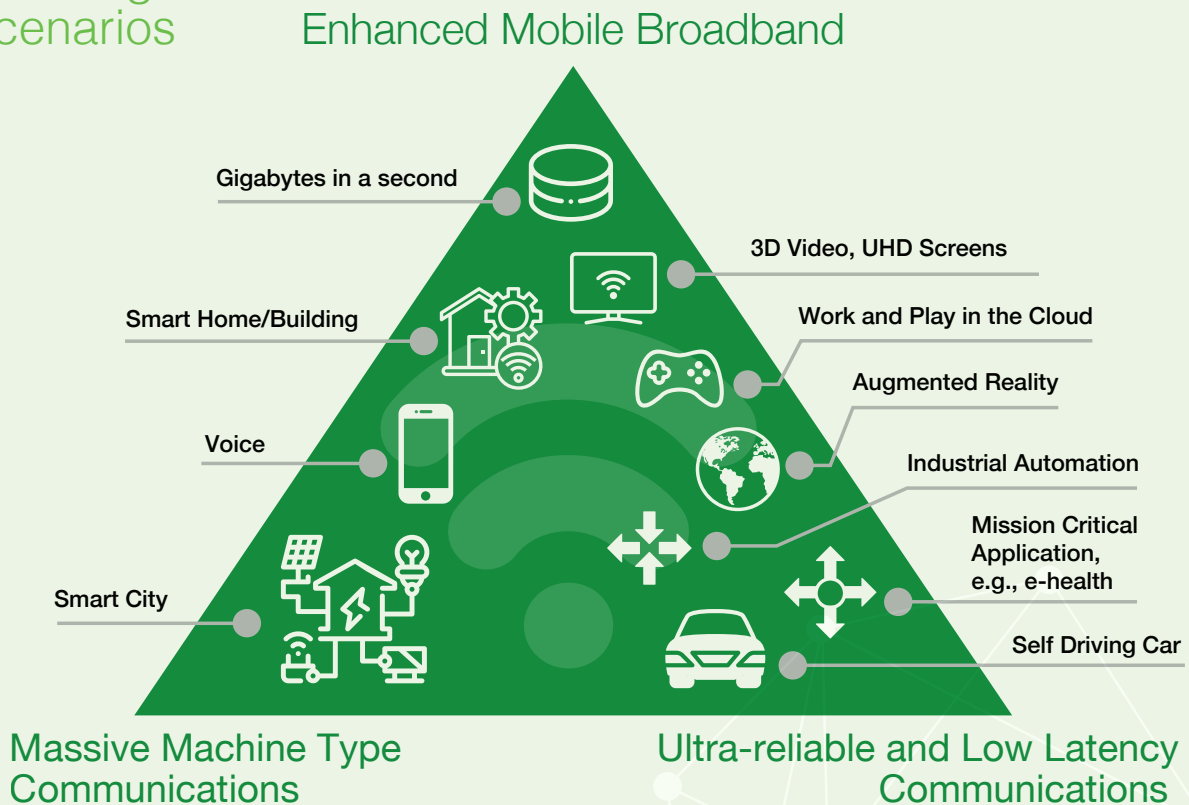
5G stands for “Fifth Generation” Wireless Technology, also known as the next evolution of mobile technology after 4G LTE. 5G will bring faster speeds through lower latency and higher throughput, improved efficiency and reliability, as well as increased capacity to sustain a massive increase in connections between devices and the internet.

It is expected that 5G technology will support new high bandwidth use cases, for example, high-definition video applications (e.g., telepresence, telemedicine and remote surgery) and enable fast-growing, high-volume applications such as smart metering, smart buildings, smart cities and asset tracking – just to name a few.

Another key attribute of 5G will be Ultra-Reliable and Low-Latency Communications (URLLC) for critical services, such as emergency services, autonomous vehicles, healthcare, and industrial automation.

5G will also enable mobile operators to manage the exponential growth in mobile broadband traffic demand, and a massive number of Internet of Things (IoT) connections, in a more cost-effective and efficient manner. These use-cases among others, are summarised in the following diagram:

5G Usage Scenarios



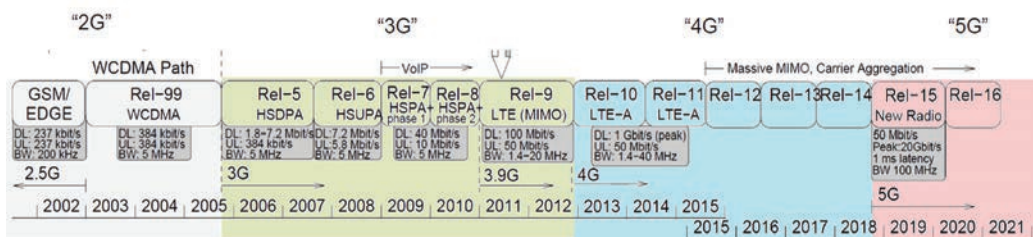
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“While previous generations of mobile networks were purpose-built for delivering communications services such as voice and messaging (e.g., 2G) or mobile broadband (e.g., 4G), 5G will have flexibility and configurability at the heart of its design to enable mobile operators to serve voice, broadband and IoT (Internet of Things) use cases and to support ultra-reliable, low latency connections as well as enhanced mobile broadband and voice. Particularly, new use cases designed to support smart cities, smart agriculture, logistics and public safety agencies will deeply impact every aspect of our lives.”

- GSMA (representative body of the mobile operators), 2019.

1.2 Why is 5G Important?

The world’s economy is at a pivotal point as we see a move towards an increasingly connected society driven by the Internet of Things (IoT), Artificial Intelligence and Big Data. The pace of adoption of these types of technologies will become the basis for long-term national economic growth. The impact of these emerging technologies will be underpinned by the robust connectivity that 5G offers. However, the current reality is that 5G standards are only in their infancy (graphic below).



Demonstrating the evolution from 2G to 5G standards.

Credit: Adapted by David. S. Ricketts, Harvard TECH, from original by Michael Steer.

“Economists estimate the global economic impact of 5G in new goods and services will reach \$12 trillion by 2035 as 5G moves mobile technology from connecting people to people and information, towards connecting people to everything”.¹

5G is not simply an extension of 4G, nor is it merely a faster wireless technology. 5G could make possible the connection and interaction of billions of devices of almost any kind, and collect data from those devices in real-time.

¹ World Economic Forum - <https://www.weforum.org/agenda/2018/01/the-world-is-about-to-become-even-more-interconnected-here-s-how/>

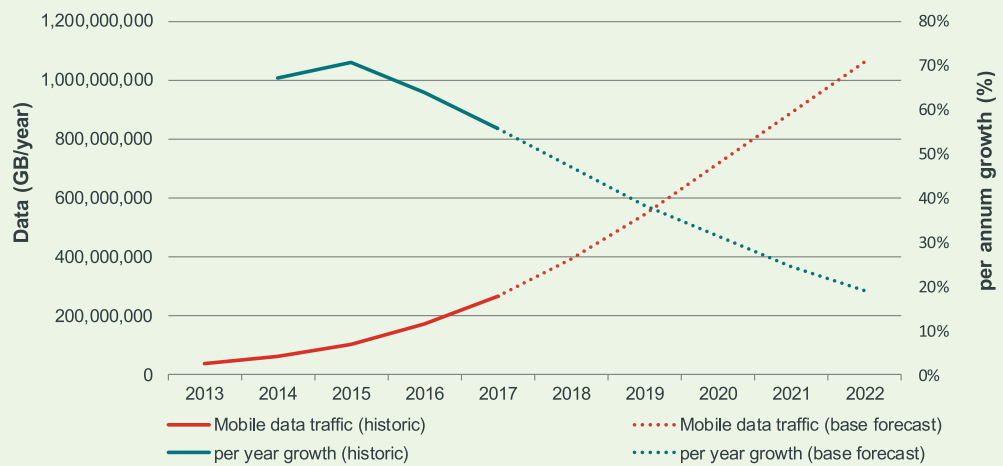
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1.3 Economics of Deployment

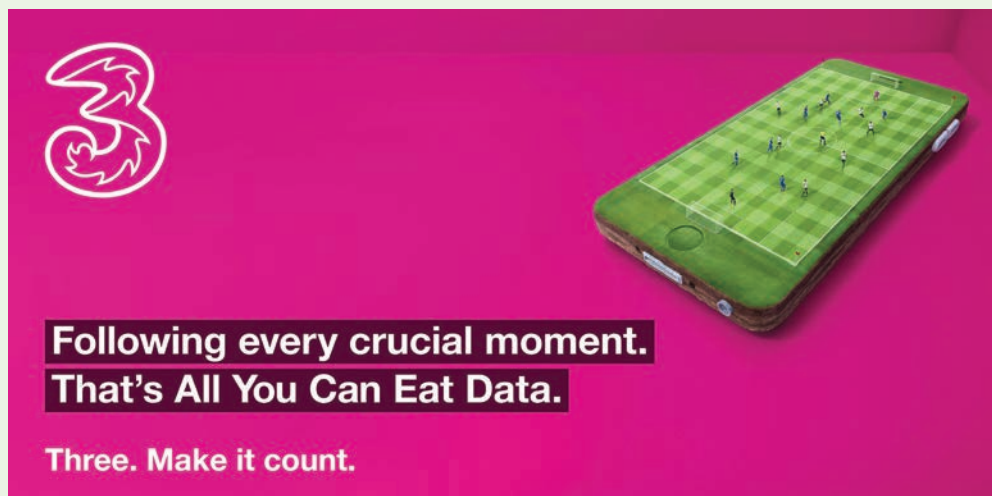
For mobile operators, the current economics and revenue trends are incredibly challenging, and the deployment of 5G is poised to exacerbate this. Insatiable consumer appetite for bandwidth-demanding services such as Netflix and YouTube has prompted mobile customers to seek large and even “unlimited” data allowances.

Traditional communication services such as voice calling and SMS once provided healthy revenue streams for mobile operators, however, much of this has been eroded as increasingly cost-conscious mobile consumers exploit free alternatives from over-the-top (OTT) media services such as WhatsApp and Skype.

Base forecast of total mobile data traffic



A report prepared by Frontier Economics on behalf of ComReg.
<https://www.comreg.ie/publication/mobile-data-traffic-forecast-in-ireland/>



Example of the recent data-generous prepay offerings available on the Irish mobile market. Similar offerings exist for other operators such as Vodafone and Eir.

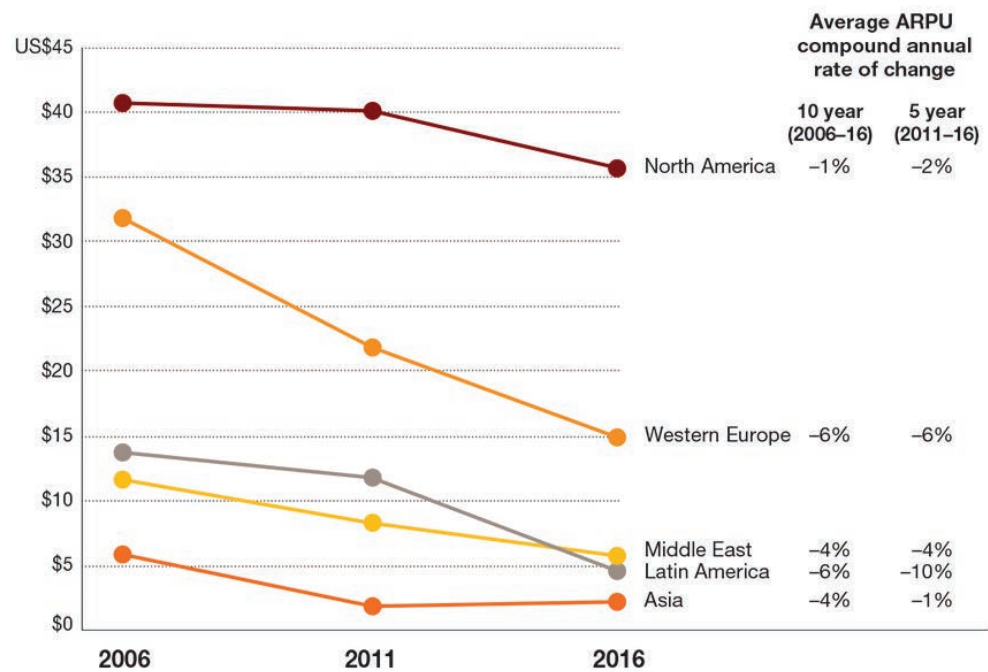
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Notably, OTT media services, including WhatsApp, Telegram and Apple’s iMessage already represent more than 80% of all messaging traffic. Juniper research has forecasted operator voice revenue will decline by 45% by 2024, in the face of an increase of 88% in OTT mobile-voice service use over the next five years.² This is the tip of the iceberg as 5G is expected to open up never-before-seen use cases as mentioned earlier in this report, which will consume massive amounts of data.

In Ireland, quarterly key data reports from ComReg show total mobile operator revenues have been stagnant since 2012³, hovering at around €389m per quarter. In this time, however, expenditure for deploying 4G networks has increased substantially. As a consequence, mobile operators are seeing their profit margins continue to erode.

The value of Europe’s telecoms companies almost halved between 2012 and 2018, from \$234bn to \$133bn, according to Bloomberg data (Financial Times, January 2019). Over the same period, the value of the US sector rose by 71% to \$532bn and Asian telecoms companies have grown in value by 13% to \$561bn⁴.

As demonstrated in the chart below, average revenue per user (ARPU) is declining almost everywhere around the world, with western Europe incurring the most aggressive decline of all regions⁵.



Average revenue per user (ARPU) is falling across the telecoms industry.
 Credit: Strategy & research and analysis.
<https://www.strategyand.pwc.com/gx/en/insights/industry-trends/2017-telecommunications-industry-trends.html>

² Juniper Research, 2020 - <https://www.juniperresearch.com/press/press-releases/operator-voice-revenue-to-drop-45-by-2024>

³ ComReg, Quarterly Key Data Reports - <https://www.comreg.ie/publications/>

⁴ Financial Times, “5G: Can Europe match the US and China on mobile networks?” - <https://www.ft.com/content/650d3bf8-1e32-11e9-b2f7-97e4dbd3580d>

⁵ Strategy & research and analysis, Global ARPU trends - <https://www.strategyand.pwc.com/trend/2017-telecommunications-industry-trends>

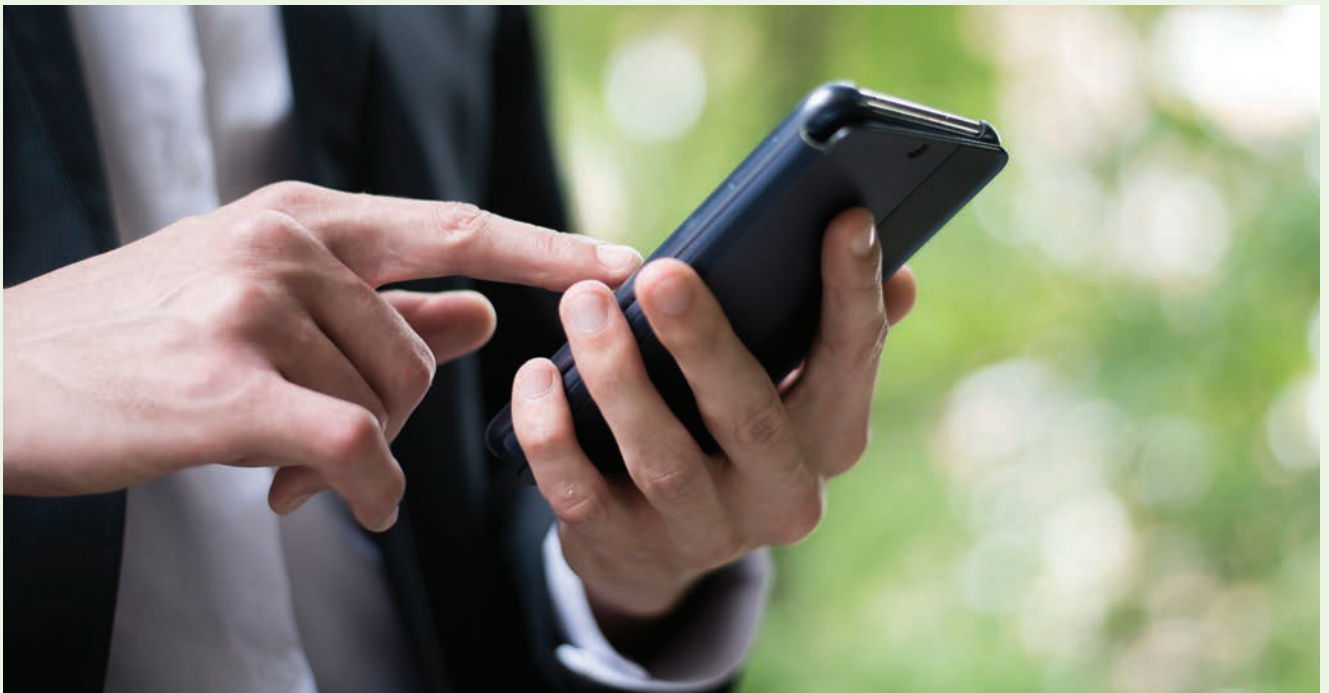
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For the cost-conscious consumer in Ireland who is prepared to shop around, mobile data costs per gigabyte (GB) have dropped 99.2% in the last 5 years!⁶ BT suggests that €1bn has been wiped off the telecoms' market in Ireland in the last seven years and has predicted that the global telecoms market may be set "to lose up to €260bn" from traditional revenue lines in the next ten years.⁷ These challenges will force operators to continue finding ways to reduce costs while searching for new revenue opportunities in order to stay profitable.

In addition, the nature of the mobile industry in Ireland is that investment decisions are also influenced by the operators' parent companies in Hong Kong, France and the UK, i.e., Three, Eir, and Vodafone respectively.

Effectively, this becomes a competition between countries for continued and increasing investment in mobile network infrastructure. Countries in which the business model and return on investment (ROI) makes most sense will be afforded the greatest proportion of investment.

Interviews with Irish operators and vendors suggest they could be faced with a minimum of a ~16% increase in network operations costs needed to meet end-user traffic requirements. In fact, this increase could be as high as 60% according to McKinsey & Company for European operators.⁸ When examined in conjunction with the quarterly report data from ComReg, it is likely that mobile operators will struggle to make the level of investment in 5G networks that is required to deliver pervasive coverage across urban and rural Ireland.



Consumer expectations are increasing when it comes to their data plans, while operator margins are being squeezed.

⁶ Three.ie, Source data for price erosion table

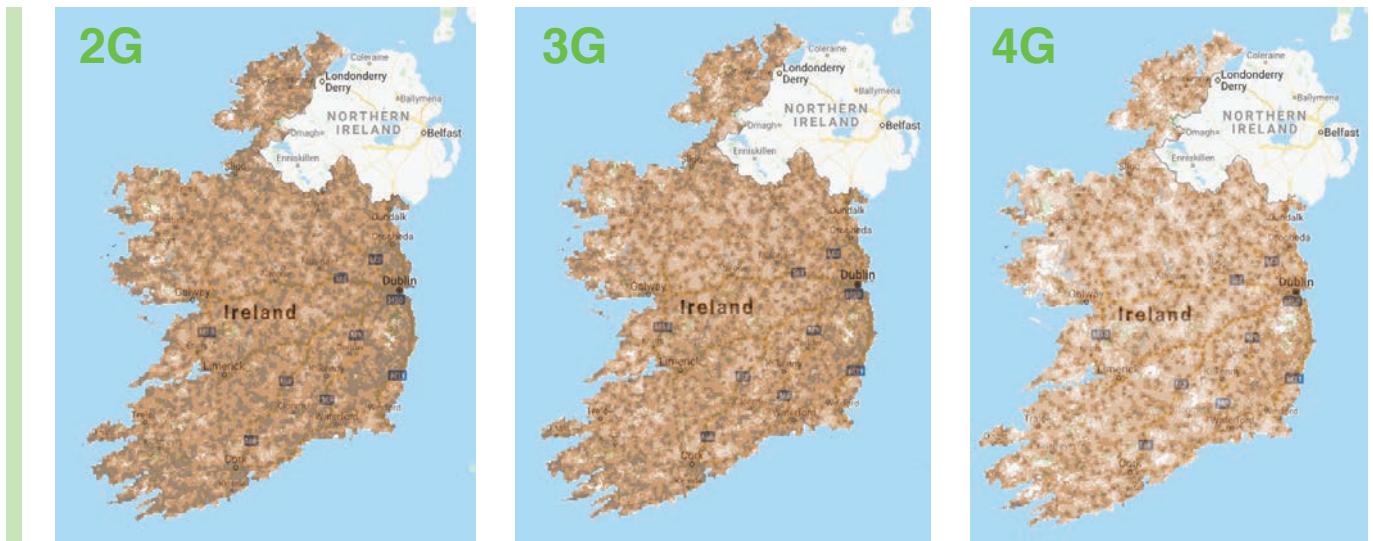
⁷ Irish Examiner, "BT predicts 260Bn drop in telecommunications revenue globally" - <http://www.irishexaminer.com/business/telecoms-industry-to-lose-up-to-260bn-in-the-next-10-years-392500.html>

⁸ McKinsey & Co - <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost>

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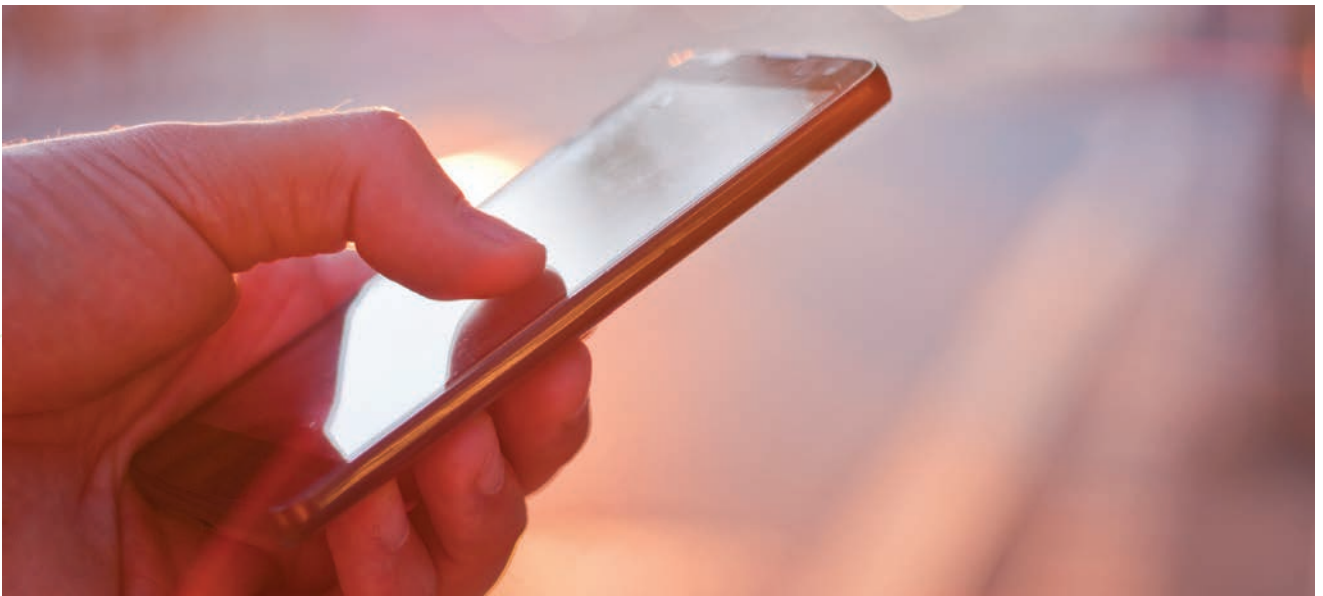
1.4 Coverage Expectations

The latest mobile coverage maps from ComReg demonstrate the challenges of providing pervasive coverage in Ireland (comparing 2G, 3G, 4G coverage levels). The graphic below illustrates the coverage difference between 2G (rollout started circa 1995), 3G (rollout started circa 2002/2003) and 4G (rollout started circa 2011/12) that is typical of the mobile networks in Ireland today. The darker the shade the better the coverage. It illustrates that even though 4G LTE rollouts started at least seven years ago, they are still not nearly as ubiquitous in terms of coverage as 2G and 3G coverage.



Graphic showcasing the density of mobile coverage from 2G to 4G LTE across the country - ComReg, 2019.

There are questions as to how 5G deployments will play out in Ireland as the technology is more challenging to deploy in high levels of concentration, especially in the mid and high-band spectrums needed for 5G and grossly increased data demands.⁹



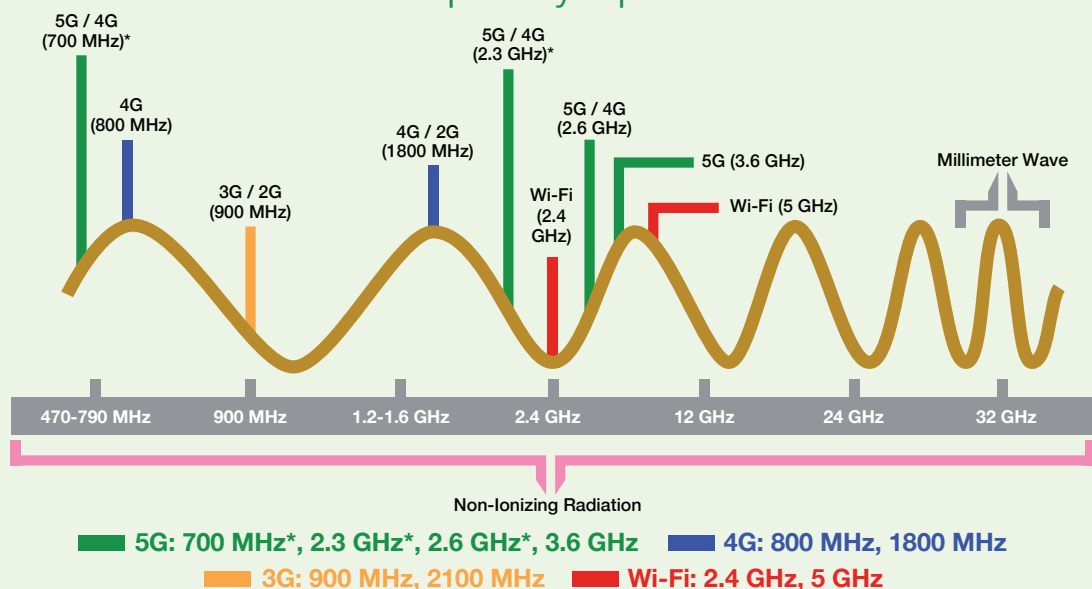
⁹ ComReg - <https://coveragemap.comreg.ie/map>

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1.5 Spectrum Explained

In Ireland, the first wave of 5G networks has been supported by spectrum in the 3.6 GHz frequency (mid) band. This spectrum was awarded in an auction process by ComReg in 2017, with the winning bidders including Imagine, Airspan (Parent company of Dense Air), Vodafone, Three and Eir.

Radio Frequency Spectrum in Ireland



*Frequency Bands proposed by ComReg for inclusion in a Multi-Band Award Process.

Each of the three mobile operators has committed to launching a commercial 5G network in the 3.6 GHz frequency (mid) band by 2020. Vodafone and Eir have already done so in key hotspots across Irish cities and towns¹⁰. A further auction of spectrum is expected to take place this year,¹¹ in which ComReg is proposing to release low-band spectrum (700 MHz, 2.3GHz, and 2.6GHz), the type that can propagate over longer distances.

The delivery of pervasive connectivity with 5G will take time. Rollouts of previous mobile network generations did not face the same challenges. For example, to achieve the top 5G headline multigigabit speeds in all locations, many more radios and antennas will need to be deployed in higher densities. Another major driver for increased densities is spectrum reuse - which is maximising (e.g., higher data rates, more users) existing spectrum licenses.

Beyond the deployment of more sites, multigigabit speeds will require significantly more spectrum to operate effectively. These demands may trigger a transition towards currently unused high-band spectrum in the mmWave range, for extremely high-capacity mobile networks in dense environments. The European Commission has identified the 26 GHz frequency band as the medium in which to pursue gigabit-class 5G across its member states, with a harmonisation strategy in place.

¹⁰ Vodafone / Eir - <https://n.vodafone.ie/network/5g.html> / <https://www.eir.ie/5G/>

¹¹ ComReg, "Proposed Multi Band Spectrum Award Including the 700 MHz, 2.1 GHz, 2.3 GHz and 2.6 GHz Bands" -

<https://www.comreg.ie/publication/proposed-multi-band-spectrum-award-including-the-700-mhz-2-1-ghz-2-3-ghz-and-2-6-ghz-bands/>

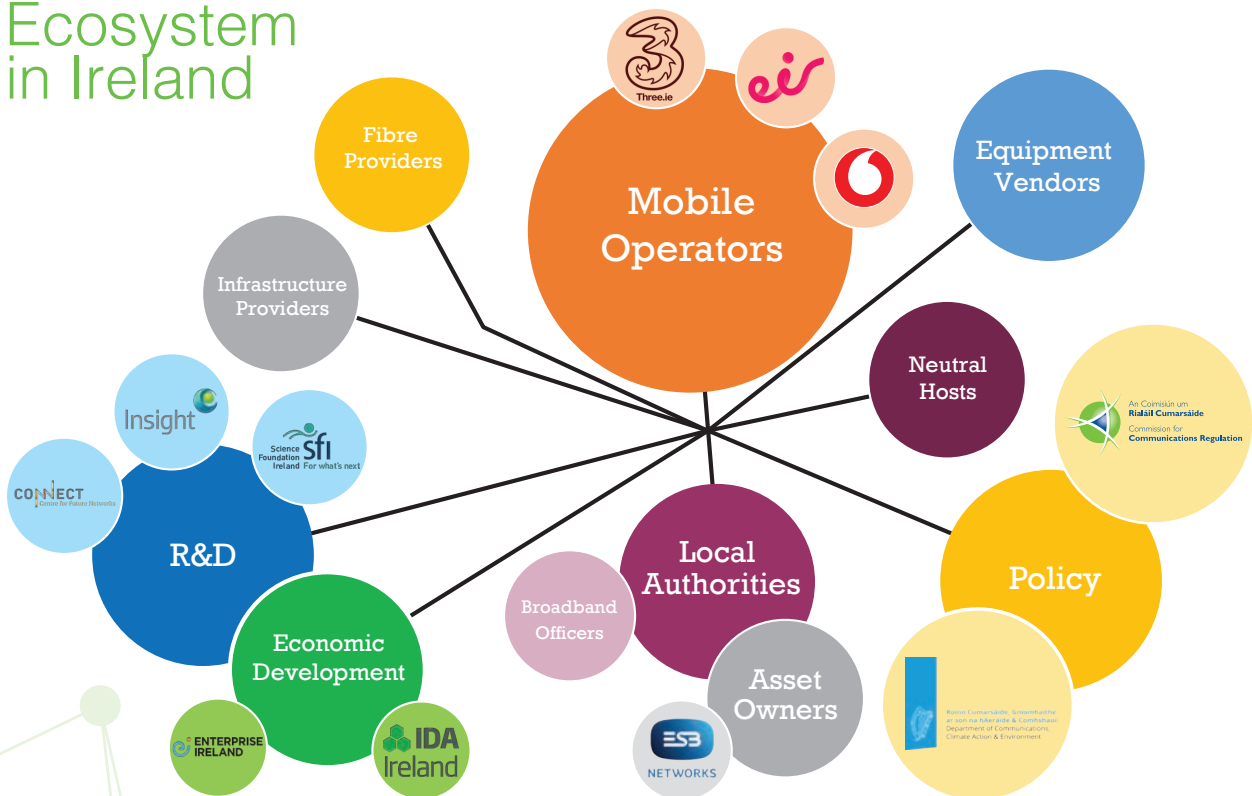
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In Ireland, the 26 GHz frequency band is currently licensed for point-to-point links, enabling microwave backhaul from base stations where there is no fixed connectivity available. It is expected that ComReg will allocate spectrum within the 26 GHz frequency band for 5G over the coming years, but only when the demand for capacity cannot be met by existing 5G bands.

1.6 Ireland's Key Stakeholders

There are a number of key stakeholders influencing the 5G agenda in Ireland, such as state bodies like the Commission for Communications Regulation (ComReg), the Department of Communications, Climate Action & Environment (DCCAE), Electricity Supply Board Networks (ESBn), and local authorities, as well as private sector actors such as mobile operators, vendors and asset owners. If Ireland is to deliver world class 5G services, it will require a joined up approach as well as streamlined regulatory and policy responses. We have detailed some of these in the recommended actions section of this document.

The 5G Ecosystem in Ireland



Ecosystem map detailing a selection of the key stakeholders with a role in realising 5G in Ireland.

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1.7 Current Status in Ireland

In general, however, the availability of handsets, modems and equipment to support 5G is limited at the moment, leading to a high cost of entry. However, barriers associated with the adoption of 5G will dissipate rapidly as telecoms vendors and chipmakers compete with one another to launch 5G-capable products and solutions. There are a small number of 5G mobile consumer plans currently available, albeit only functioning in limited locations due to coverage of existing macrocells. Strong market demand of 5G will, in turn, provide an incentive for mobile operators to pursue a more widespread commercial rollout.



Examples of some of the first commercially available handsets. (left to right) Xiaomi Mi Mix 3 5G, Samsung Galaxy S10 5G, Huawei Mate 20x (5G).

To better stimulate future market demand, there needs to be a structured programme of pilot deployments that will help to develop our understanding of how this network will be deployed and what the value of their use cases could be. These pilot deployments should also support the delivery of the physical infrastructure that underpins 5G with an emphasis on the quality of design of the physical streetscape both over and underground. For example, in Dublin, Dense Air Ireland (a subsidiary of major telecom equipment provider Airspan) has built a pilot 5G Neutral Host deployment in the Docklands, in conjunction with Dublin City Council's smart city initiative, Smart Docklands, and the CONNECT Research Centre. Other comparative testbeds by Dense Air Ireland include pockets deployed across County Laois, done in collaboration with Laois County Council.

If Ireland wants to position itself as a global leader and be at the forefront of technological innovation, it is essential that we embrace 5G as it scales out over the coming years.

02 Role of Local Authorities

A survey produced for this report demonstrates that 90% of local authority respondents see 5G and the IoT as either critical or very important for the social and economic development of their locality. Incidentally, local authorities, by virtue of their sheer operational influence and ownership of multiple assets in key locations, will play an instrumental role in Ireland's path to 5G. Collaboration and engagement between local authorities and stakeholders such as mobile operators will be critically important. In particular, ease of access to local authority assets will be key to enable pervasive 5G connectivity.

The maturing of 4G networks and their life cycle means mobile operators are beginning to exhaust traditional spaces for macrocells on rooftops and high ground within cities and towns. Combined with this, the exhaustion of antenna space on existing macrocell sites and the necessity to place antennae closer to end-users (ground-level) is forcing mobile operators to seek new ways to densify their networks in cities and towns.

Local authority assets, such as street furniture, have typically been under-utilised for the purpose of supporting mobile network infrastructure. With 5G, in order to achieve indoor and outdoor coverage, there is a necessity to leverage as many of these local authority assets as physically possible.



Examples of under-utilised street furniture that could support mobile network infrastructure.

Importantly, the requirement to access local authority assets for delivery of 5G in cities and towns is a golden opportunity for local authorities to wield more influence in proposed future mobile network infrastructure upgrades, putting the interests of citizens at the heart of the deployment process and in turn reducing the risks of digital exclusion.

02



Credit: MIT Technology Review.

The current situation which deals with ad-hoc requests to access finite local authority assets is not scalable when considering the vast number of small cells required for pervasive 5G connectivity. Local authorities are in prime position to create a more structured model facilitating access to assets in a manner that is open and transparent for operators, as well as for users, and citizens in general. Local authorities, thus, have a responsibility to ensure equal access to their assets considering their strategic importance.

The existence of connectivity blackspots within a town or city can be attributed to the reality that mobile operators have limited resources, and will only deploy infrastructure where it makes commercial sense to do so. By identifying the specific areas within a town or city that lack access to competent mobile connectivity, local authorities can prioritise rapid access to their assets there and incentivise mobile operators to install 5G infrastructure, thus mitigating the digital divide.

Collaboration and mutual benefit between local authorities and mobile operators will also be required to mitigate disruption such as road closures during installation works. A particular concern will be the increased requirement to bring fibre optic cables to the equipment, which may require a significant amount of enabling works and road openings.

02

2.1 What Happens if Local Authorities do Nothing?

An apathetic stance towards the deployment of 5G in cities and towns will prove significant in multiple ways.

The reality is that if there is a lack of collaboration and coordination between the relevant stakeholders in a process as intricate as the deployment of 5G, the result will be a streetscape full of clutter (picture below), and a network that fails to achieve its full potential, where pockets of citizens will be left disadvantaged with only some neighbourhoods and central business districts being 5G-enabled.



Credit: Shutterstock/kriang phromphim.

Visual pollution created by mobile network infrastructure, including antennae, is an unwanted development in cities and towns. Without engagement between mobile operators and local authorities, visual pollution at ground level is poised to become a more profound issue with 5G because of its densification requirements. Local authorities will need to explore some of the emerging installation solutions and deployment models which help to minimise visual pollution and consider, in conjunction with mobile operators, whether such solutions may have an adverse impact on end-user network performance.

From the perspective of digital inclusivity, it is difficult to imagine how local authorities can address the digital divide across different regions within cities and towns without actively engaging with mobile operators to incentivise commercial investment in underserved areas.

02

The biggest risk is that 5G and small cell technology are only deployed in affluent areas of towns and cities. Given the commercial challenges faced by Ireland's mobile operators and the technical hurdles of achieving widespread connectivity densification of the site grid, a passive local authority approach will hinder the pervasiveness to which high-capacity 5G networks can be deployed in Irish cities and towns.

By playing a central role in facilitating equal access to local authority assets, local authorities can help to ensure that 5G develops in ways that benefit all sections of society and works to address the digital divide.

Additionally, a significant increase of urban disruption (picture below) will have to be expected if each mobile operator is allowed to pursue its own deployment plans. For example, 'opening the roads' multiple times for each deployment will prove a detriment to transportation needs of the community.

In order to carefully manage urban disruption such as road openings, local authorities will need to work closely with mobile operators during the deployment phase of 5G in cities and towns, minimising the impact on traffic flow and the mobility of citizens.



An example of Urban Disruption caused by trenching. Credit: WPLN/Tony Gonzalez.

03 Deployment Architectures

Mobile network coverage in Ireland is predominantly provided by high-power macrocells on high grounds and rooftops, supplemented with a relatively small number of distributed antenna systems (DAS) that enhance localised coverage and capacity at specific high traffic hotspots, such as shopping centres, concert venues and sports stadiums.

“The traditional model of mobile network deployments has been delivered with minimal engagement from local authorities, as the focus was on building mobile towers and securing vantage sites on buildings across the country”

- Survey Respondent

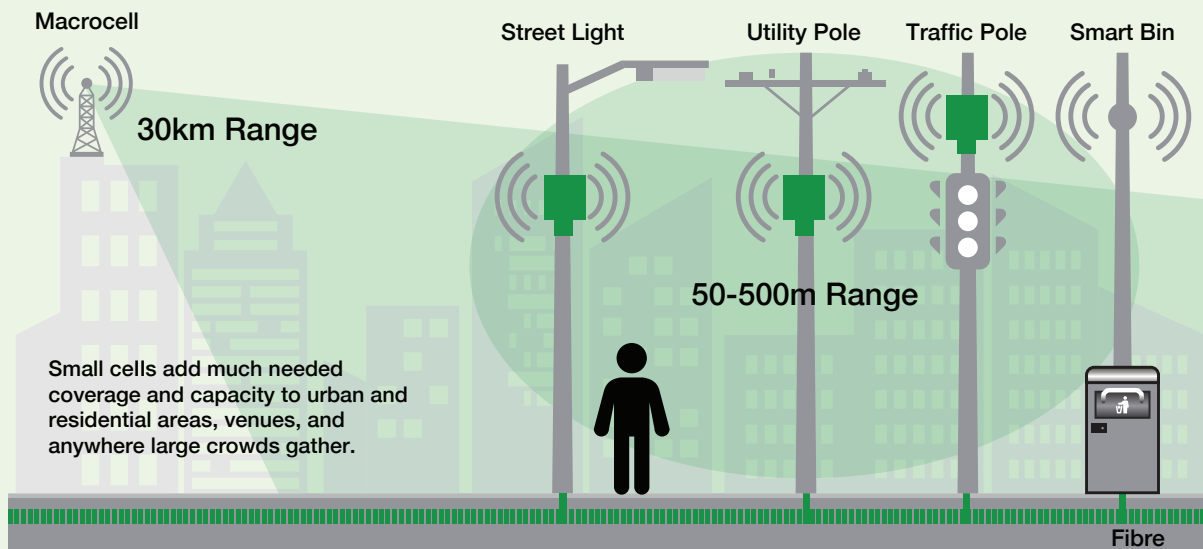
However, a paradigm shift is on the verge of transforming mobile network architecture from something that is universally dependent on macrocells, to a high level of site densification (ranging from more than 200 cells per square km for hyper-dense deployments and less than 20 cells per square km for low-density deployments). A dense site grid is especially needed in dense urban areas, seeing the need for low latency, predictable throughput, and support for a massive number of connected devices. Small cells will typically complement the macro network in such an instance, to enhance coverage, add targeted capacity, and support new service experiences.

“In the future, local authorities, street asset owners, and building owners, will play a key role in the rollout of 5G - this will require new ways of working if we are to realise the opportunity”.

- Survey Respondent

For context, a small cell is a radio access point with low radio frequency (RF) power output, footprint and range. There is very little difference between many Wi-Fi access point installations and small cell installations. Even the larger cellular small cell installations are typically very visually discreet and unobtrusive.

What Are Small Cell Deployments?



Small Cells will complement the existing macrocell, ensuring pervasive 5G coverage.

Small cells enable a versatile deployment strategy, with the potential to be installed indoors and outdoors, in licensed and unlicensed spectrum. A combination of factors, including power output and the frequency band, will impact the range of a small cell, which can vary from fifty metres to a kilometre. Small cells will be required to enhance indoor mobile network coverage, where more than 80% of data traffic is generated. Given the propagation characteristics of mid and high-band spectrum, mobile operators will not be able to provide competent indoor signal quality with the existing macro site grid. There will be an increasing need for flexible solutions to address coverage inside buildings.



Examples of indoor (left) and outdoor (right) small cell solutions. Credit: Smart Docklands.

03

Small cells will aid site grid densification efforts and enhance network performance both indoors and outdoors by lessening the strain on the outdoor macrocell network. The installation of small cells will typically require height, power, and a resilient backhaul solution, usually through a fibre optics connection. These would help to enable improved capacity and coverage. There are a number of key challenges that will need to be addressed, however, in order to deploy 5G effectively. These are covered in the following subsections.

“Key priorities for the rollout of 5G for local authorities will include: ensuring equitable and fair access to assets for operators, minimizing road openings and associated disruptions, shared use of assets, minimizing clutter, reducing CapEx costs and also delivering a digitally inclusive city”

- Survey Respondent

3.1 Physical Challenges

A key challenge to deployment includes access to assets. Common assets that can be used include existing roofs and sides of buildings, as well as street furniture that currently provide other services to the city and citizens (e.g., street lighting, traffic lights, CCTV poles, bus shelters, etc.). In fact, the demand for sites and densification has increased to such an extent that novel solutions are starting to appear, such as newly created smart manhole and smart bin variations that extend coverage in the area.

Having said that, street lighting and traffic light columns could still be some of the most important assets to enable the delivery of 5G in Irish cities and towns. These assets can be considered particularly suitable candidates since they are located at street-side, and sit at least 5 metres above street level with existing access to power. In some cases, there is even existing ducting available to connect further fibre optic cabling. However, there are still challenges to overcome.

At present, Ireland’s street lighting infrastructure is composed of a very wide range of metal and wooden columns, exhibiting varying designs and age. Many of the existing street asset poles lack the required ducting space for fibre optics wiring to be fit through. Due to their design and age, compromise to their structural foundation (pictured below) becomes an issue when attempting to mount additional equipment. This is especially apparent with ‘legacy’ infrastructure. It is important to note that a significant number of poles are in this category, especially if they fall under the ‘era-aesthetic’ category e.g., Georgian, Victorian etc.

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Importantly, ownership of these columns is split between the Electricity Supply Board Networks (ESBn) and the respective local authorities. As a result, if cities and towns in Ireland aspire to open their street lighting assets to the installation of mobile network equipment, there will need to be a methodical process of identifying which particular columns can be considered applicable and also a mechanism to manage risk and liability. This methodical process should also assess the Health and Safety implications of mobile network equipment on electrical supply, traffic, and street lighting assets. In particular, attention needs to be afforded to ensure that the structural integrity of poles is not compromised if deciding to drill holes for either mounting IoT devices, small cells or for passing fibre and power cables.



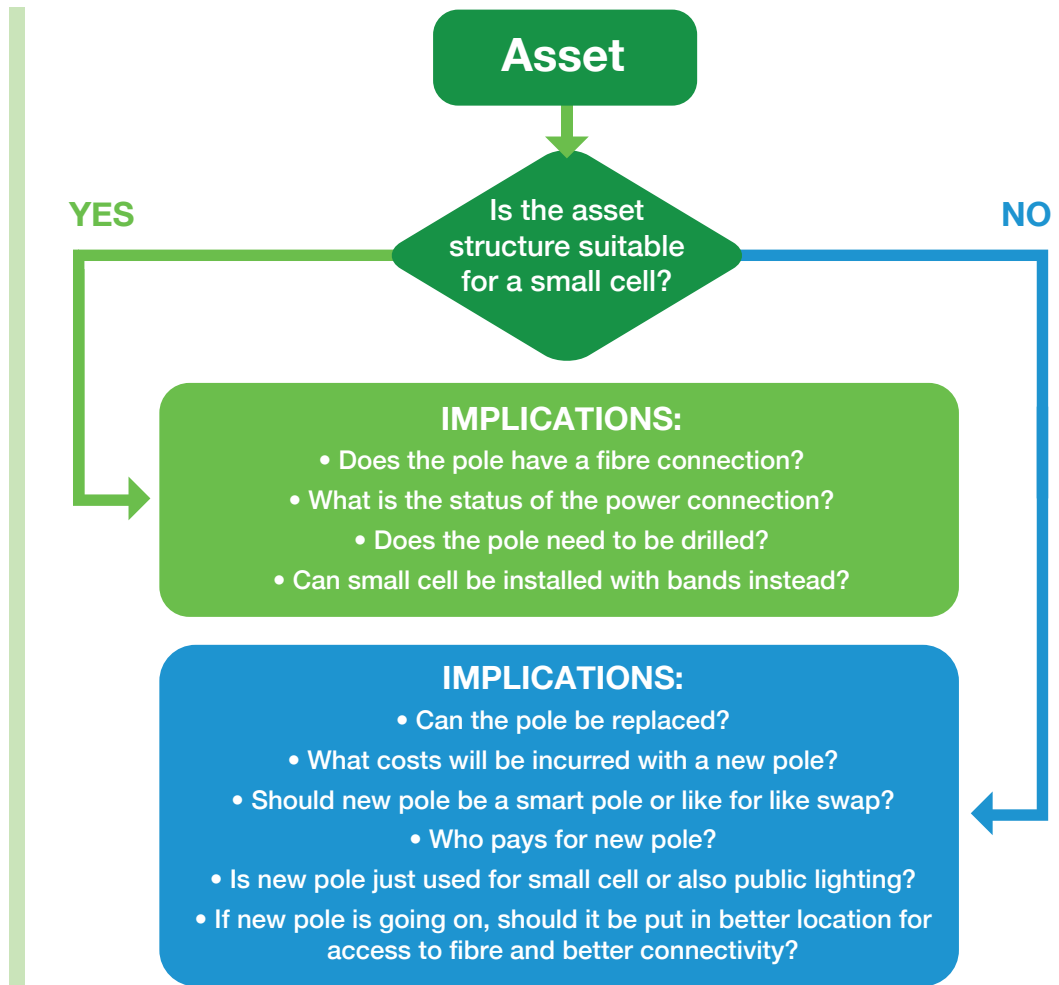
Example of compromised infrastructure

In addition, guaranteeing access to the asset in a manner that is both streamlined and straightforward will be of critical importance to future-proof the physical maintenance of the asset and attached equipment. This necessitates the establishment of appropriate and robust Service Level Agreements (SLAs) that ensure the longevity of operations.

When combined, the challenges associated with identifying suitable local assets and facilitating both the deployment and maintenance of the assets and hosted mobile network equipment highlights the importance of developing pilot trials. This will allow better understanding of these physical access issues and help to refine Service Level Agreements (SLAs) in a way that serves to mitigate risk for all parties.

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Example: Deploying A Small Cell - Challenges with Assets (Pole/Bus Shelter/Building)



Example of deployed small cell.

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3.2 Fibre Challenges

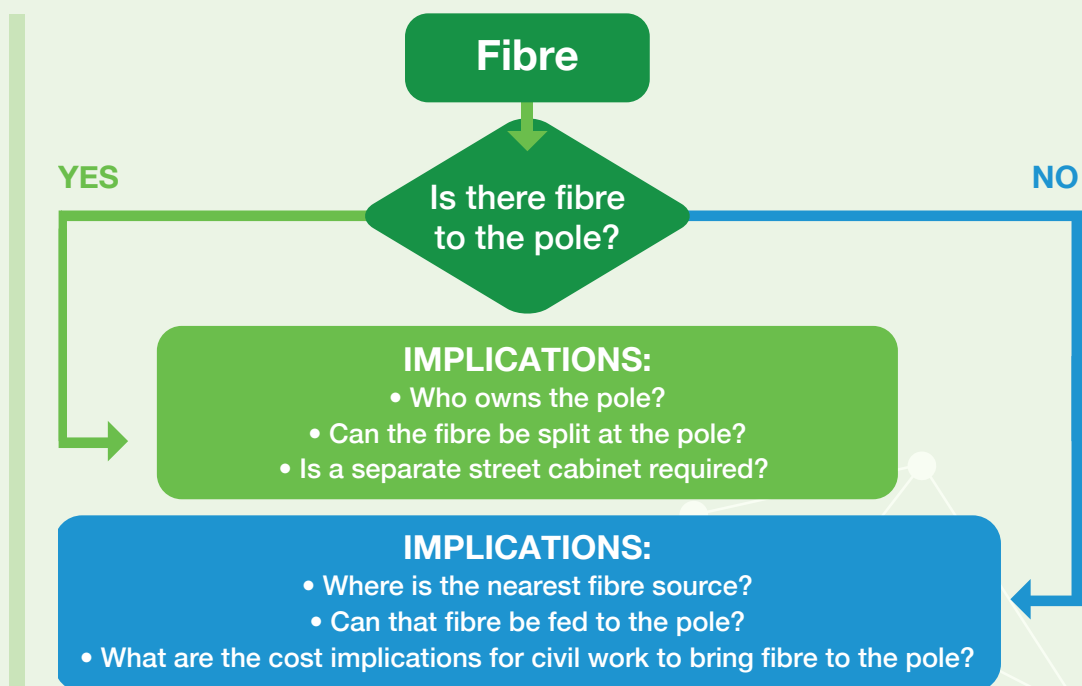
Fibre is an increasingly critical component of connectivity, and given the unprecedented capacity demands that will be placed on 5G networks, its utilisation as a method of future-proof backhaul will continue to grow in importance.

However, the current level of fibre density in existing urban and rural networks is insufficient to support 5G, and that's why local authorities should work to facilitate the deployment of fibre in parallel to the deployment of 5G. Both of the networks serve to complement each other.

When utilising fibre, there are many practical considerations associated with the connection to street assets and small cells. The exploitation of existing council ducts or subducts for fibre will be important to minimise deployment costs and urban disruption. Where existing ducting is unavailable, access to dark fibre at economical rates will need to be considered.

The practical challenge of running fibre up poles and attaching it to street furniture is a barrier to deployment, adversely impacting costs. As stated in previous sections of the report, mobile operators are not likely to adopt deployment strategies that need excessive investment and, thus, cost-effective access to backhauling will be key. Other options floated include satellite-based solutions among others, but all face the same concerns of keeping rollouts as cost-effective as possible. Hence, easy access to both dark fibre and ducting could prove instrumental in enabling pervasive 5G at a more reasonable economic cost, and steps must be taken to ensure this accessibility.

Example: Deploying A Small Cell - Challenges with Fibre



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3.3 Power Challenges

The operation of mobile network equipment on existing local assets introduces considerable challenges in the realm of power given the nature of unmetered power supply in Ireland. Left unaddressed, this issue will stifle future large scale deployments of 5G.

Throughout Ireland, the majority of street lighting infrastructure utilises an unmetered power supply source, regardless of whether it is owned by the respective local authority or ESBn. For context, unmetered supply is where power consumption is estimated based on the predicted power consumption of lighting equipment that is limited to a maximum of a 2kW load on the circuit.

In the case of street lights, power consumption is typically based on a dusk to dawn tariff and, importantly, only allows for a single connection to power the light, and singly-owned equipment associated with the functioning of that light.

“We need to move quickly to resolve the unmetered power supply issue with ESBn. Local authorities require more efficient ways to attach low power equipment (such as small cells and IoT devices) to existing unmetered powered assets”

- Survey Respondent

The current scenario of unmetered power supply puts Ireland at a disadvantage compared with other EU countries and, in particular, the UK, where there are existing arrangements to allow for virtual metering (e.g., being able to estimate or measure the consumption of electricity in the ‘back-end’ or ‘away from the meter’ on its software layer without using a physical meter). For example, under the Elexon system in the UK, there are 2,865 approved devices that can be attached to an unmetered power supply - this includes validated equipment such as CCTV cameras, Wi-Fi access points and small cells¹³.

Based on the results of the industry survey for this report, there were multiple examples highlighted where the combined time and cost of applying for new power connections (to deploy small cells, IoT equipment, etc.) renders it almost impossible to justify deployments at scale across Irish cities and towns. We will need to ensure that multiple devices/add-ons onto the poles (e.g., CCTV, WiFi, Small Cells, etc.) can be powered and accounted for through existing power connections. The challenge associated with power extends beyond unmetered supply, however, and also includes physical accessibility issues with regards to the installation of mini-pillars in an already congested street environment.

¹³ Elexon - <https://www.elexon.co.uk/operations-settlement/unmetered-supplies/>

03

Access to power on public assets is a complex challenge that hinges on two main aspects:

1. **Are the assets owned by ESBn or the respective local authority?**
2. **Is the power connection found on ESBn assets or on the customer's side (for example, Dublin City Council)?**

Detailed below are the three most likely scenarios for local assets that are considered to be suitable to support the installation of mobile network equipment. In each case, there are barriers to deployment and challenges that need to be overcome before these assets can be leveraged. These revolve around three main aspects, where asset IDs (known as TMRPNs) are unique and cannot be shared, billing from a 3rd party is not permitted, and installations carried out by a 3rd party may also not be permitted.

These are elaborated as follows (explanations on following page):

Power Connection Ownership

		ESB CONNECTION	Local Authority CONNECTION (Customer Side)
Asset Ownership	Local Authority Owned Asset	Option B	Option A (Majority of connections in Dublin city centre)
	ESB Owned Asset	Option C (Majority of connections in rural settings)	N/A

Option A: Local Authority Asset + Customer Side Connection

Challenges to overcome:

- Local authorities cannot install third-party equipment on local authority assets (which have access to power) and cannot act as a distributor or supplier of electricity to a third party (this is due to regulatory requirements).
- There is currently no method of splitting the energy bill for two different assets on one connection.
- It is currently not possible to have two asset IDs (TMPRNs) attributed to one connection. So an example would be attaching a local authority WiFi access point to a local authority lighting pole - each requiring their own TMPRN.

Option B: Local Authority Asset + ESB Connection

Challenges to overcome:

- It is currently not possible to have two asset IDs (TMPRNs) attributed to one connection.
- It is currently unclear who should apply for a TMPRN in this scenario - is it the local authority or a third party?
- In the event that a third party applies for TMPRN/new connection(s), there is a requirement that they must install the equipment, which may not be feasible operations/permit-wise.

Option C: ESB Asset + ESB Connection

Challenges to overcome:

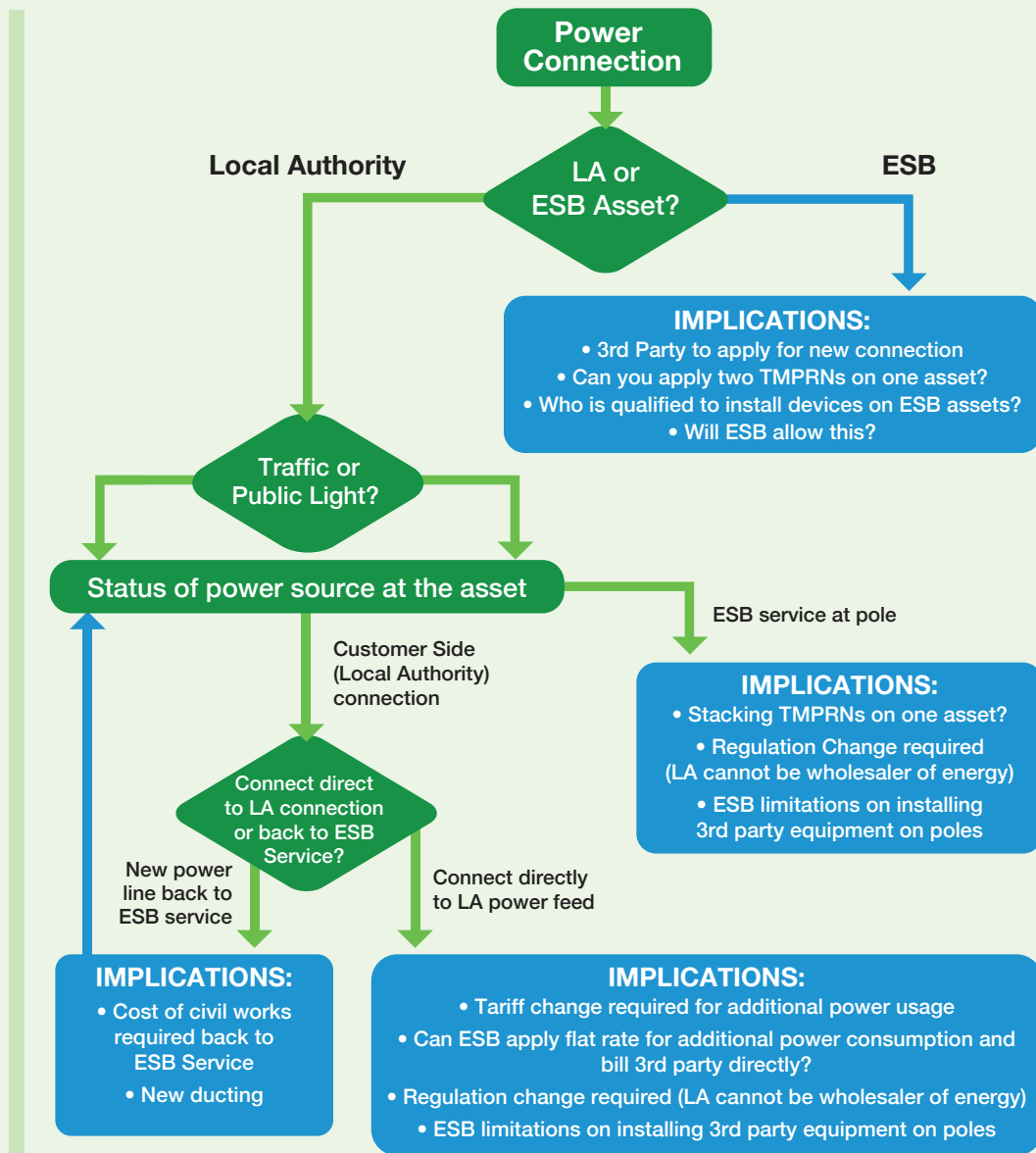
- It is currently not possible to install third-party equipment on ESBn assets (ESBn Guidelines).
- It is currently not possible to attribute two TMPRNs on one ESBn asset.
- In the event that a third party applies for TMPRN (ESB unique asset ID)/new connections, there is a requirement that they must install the equipment.
- ESBn may not permit this.
- There are a limited number of companies with the certification to work on ESBn assets due to stringent safety measures.

In order to address these concerns, Dublin City Council is working with ESBn through the Mobile Phone and Broadband Taskforce (a task force established by the Department of Communications, Climate Action and Environment and the Department of Rural and Community Development).

There is a commitment by ESBn to lead action “No. 20 - liaise with local authorities to consider the issues governing the use of public lighting infrastructure for siting small cell technologies”. The proposed output of this, a policy document for local authorities to address the above issues, is due this year (2020).

03

Example: Deploying A Small Cell - Challenges with Power:



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3.4 Planning Challenges

There is currently a lack of consistency across local authorities on how telecommunications equipment is treated as part of the planning process, even when exemptions are allowed. Planning and Development (Amendment) (No. 3) Regulations 2018¹⁴ clearly states the exemption of 'small cell antenna', which means anything that:

- (a) operates on a point to multi-point or area basis in connection with an electronic communications service,**
- (b) including any power supply unit or casing but excluding any mounting, fixing, bracket or other support structure—**
 - (i) does not, in any two-dimensional measurement, have a surface area exceeding 0.5 square metres, and**
 - (ii) does not have a volume exceeding 0.05 cubic metres, and**
- (c) subject to paragraphs (a) and (b), includes a femtocell antenna, a picocell antenna, a metrocell antenna, a microcell antenna, and any similar type antenna.**

The exemption also states that only two small cells are allowed for each asset.

The interpretation of these vary for each local authority, however, where some insist that small cells would fall under section 254 licensing requirements¹⁵ as a result of the exemption. Section 254 licenses allow for the erection of installations that do not fall under other planning permission requirements, such as (a) a vending machine, (b) a town or landscape map for indicating directions or places, (c) a hoarding, fence or scaffold, (d) an advertisement structure, (e) a cable, wire or pipeline, (f) a telephone kiosk or pedestal, or (g) any other appliance, apparatus or structure, which may be prescribed as requiring a licence under this section.

The Section 254 process has guidelines that assist with the process of supporting deployment of telecommunications. However, this only covers individual applications with set fees and a process in place for each application (see on following page the workflow for Dublin City Council's application process):

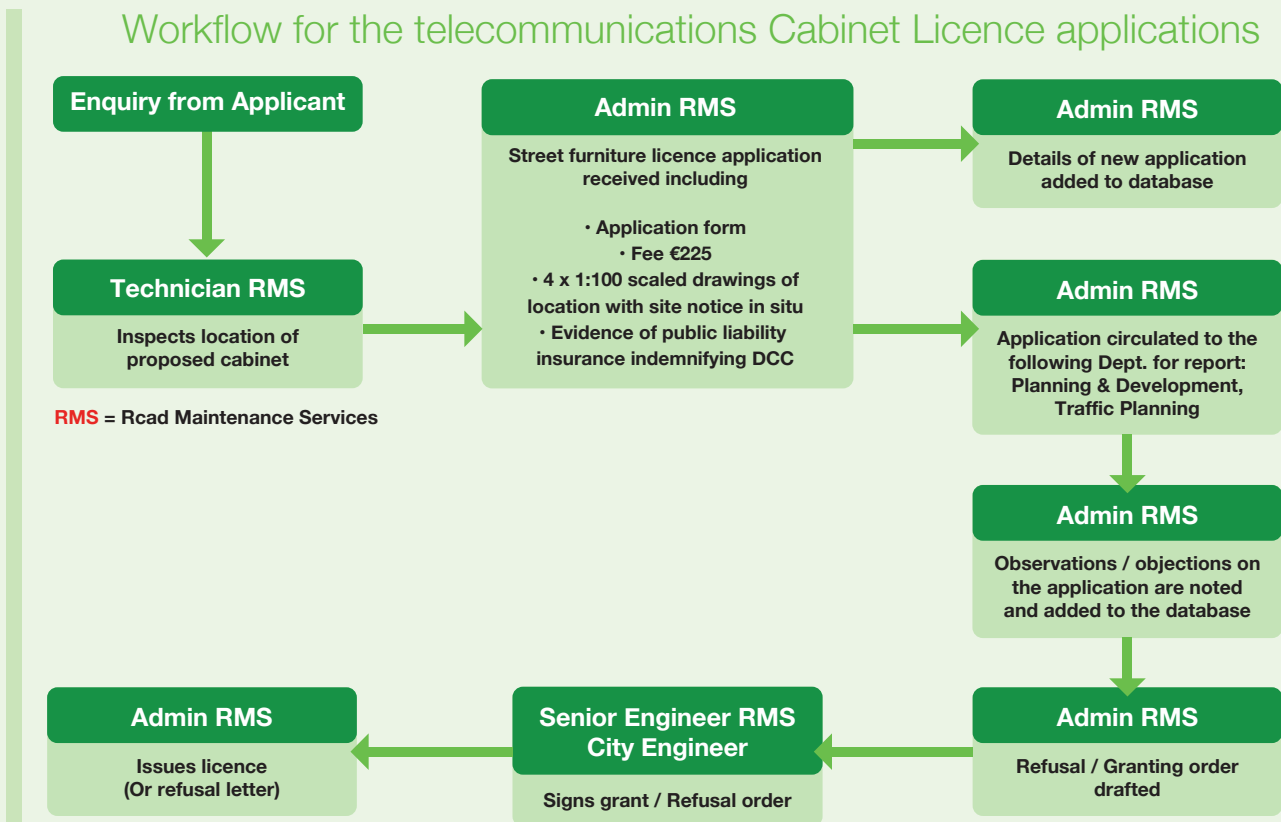
¹⁴ Irish Statute Book - <http://www.irishstatutebook.ie/eli/2018/si/31/made/en/print>

¹⁵ Irish Statute Book - <http://www.irishstatutebook.ie/eli/2000/act/30/section/254/enacted/en/html>

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Dublin City Council Section 254 License Application Process:

Workflow for the telecommunications Cabinet Licence applications



However, the interpretation among local authorities on this also differs. Some assume they should only be for installations that require roadworks, others consider any infrastructure that touches the ground to be included, and there are others who consider it as a ‘catch all’ mechanism for anything considered an exempted development, such as small cells, or that has a ‘newly defined use’ even if installed on existing infrastructure. There needs to be consistency on planning requirements of small cell deployment across the different local authorities involved.

Importantly, there needs to be consideration on how to treat multiple applications of small cells, and their integration into existing street furniture assets such as bus stops, as mentioned earlier. This development should allow a streamlined process for bulk planning requests for deployment of small cells and other next generation wireless equipment. This should align with the current transposition of the European Electronic Communications Code on opening up access to support small cell rollout currently known as ‘Light deployment regime for small-area wireless access points’¹⁶. In essence, the regulation will pave the way for small cells to be deployed in big numbers without restrictive administrative barriers. While this is a welcome development, consideration needs to be given to balancing telecom needs and economic, environmental, as well as planning guidelines the local authorities. Consultation has been done by the European Commission, and is now undergoing review to determine the necessary characteristics for small cells to be exempted from individual permits across the EU.

¹⁶ <https://ec.europa.eu/digital-single-market/en/news/public-consultation-light-deployment-regime-small-area-wireless-access-points>

04 Deployment Models

There are a number of options available to local authorities to support 5G deployments. There are variations which include the following:

- 1) Macrocell Upgrade:** Macrocell upgrading and continuing on an ad-hoc basis responding to requests individually. Although this is not a small cell deployment model per-say, this is the predominant deployment model for 5G currently.
- 2) Neutral Host:** Take a Neutral Host approach where one vendor manages local authority assets enabling operators to share the same physical equipment and a radio access network. There are a number of variations on this model depending on ownership of spectrum.
- 3) Shared Infrastructure:** Promote the shared infrastructure model where access to local authority assets is made open to multiple MNOs, where either a singly selected vendor, or each MNO's vendor, manages the deployment of physical equipment onto the local authority asset without discrimination.
- 4) Exclusive Concession:** Advertise a concession which would allow an operator to gain exclusive access to local authority assets.

It is important to acknowledge there are no industry-agreed definitions on the different deployment models where much crossover is found, including many 'hybrid' models. For the purposes of this document we have attempted to simplify this into four separate deployment models.

4.1 Macrocell Upgrade

The current 5G deployment model for the mobile network operators in Ireland is to upgrade their current macrocell locations. This is the case with the rollout of 5G by Vodafone and Eir to date. This involves the replacement of current macrosite equipment with 5G-ready equipment. The feedback from operators is that this type of upgrade will likely suffice for their short-term 5G network requirements (2-5 years). On a positive note this provides a window of opportunity for local authorities to engage stakeholders to ensure better collective outcomes. However, there is also a strong view that this will not address the long-term challenge of network densification as covered earlier in the report. And hence, alternative models are required to support pervasive 5G coverage on a more equitable basis.

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4.2 Neutral Host

There is a lot of discussion emerging on the concept of a ‘Neutral Host’ network that could help accelerate 5G deployment and make it more economical to scale. It involves the deployment of a single, physical small cell that can then be shared by multiple operators, particularly in a dense urban setting. It should be highlighted that there are many flavours of Neutral Host; however, for the purposes of this paper we see Neutral Host as meaning the local authority working with one facilitating entity who manages only one physical small cell on a city asset. Based on this understanding, the two main approaches are:

- **Passive Neutral Host a.k.a Multiple Operator Antennas in one Small Cell**

This involves a one-piece enclosure deployed with multiple operator equipment found inside. This means the only thing the operators are sharing is the small cell and not the radio spectrum. This can be utilised by a single small cell and supporting multiple MNO frequency bands.

This may require the design and deployment of new tailored smart poles and multi-operator cabinets – so there is an opportunity to align with street lighting upgrades across local authorities.

- **Active Neutral Host a.k.a Spectrum-based sharing**

This is where the provider has its own local radio resources (shared or dedicated) and network (access to spectrum) to host others as ‘tenants’. This means the sharing happens on a core network level rather than at a small cell street level.

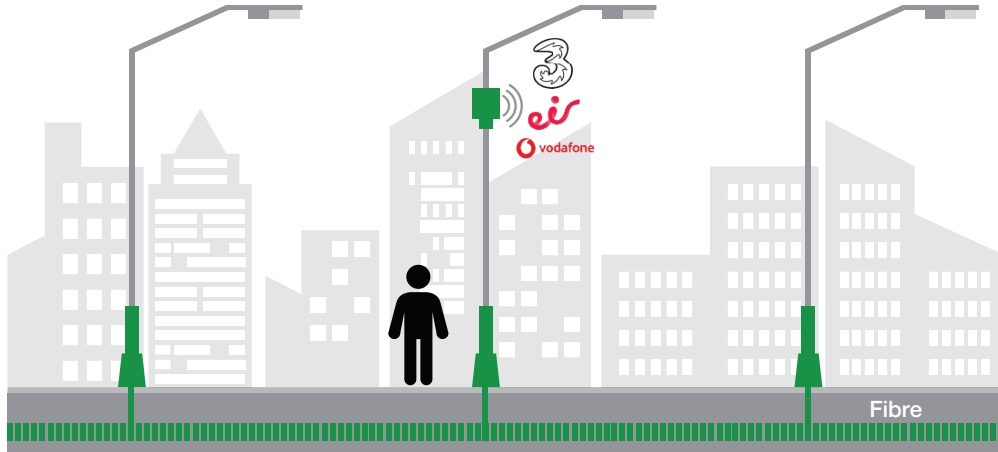
There is a very strong case to be made for the deployment of a single physical enclosure that can be shared across operators. This elimination of equipment duplication puts mobile operators in a position to achieve a higher degree of network density in cities and towns, while significantly driving down the costs associated with attaining such a level of densification. For mobile operators, sharing makes commercial sense. They are familiar with network sharing arrangements for their macrocell networks, but the cost savings potential for network sharing is even greater with small cells and 5G. For example, the cost of small cell deployment can be dramatically reduced if three MNOs share the same city asset, power and backhaul, as well as the small cell itself in a ‘neutral host’ capacity.

Neutral Host is an attractive model from a local authority perspective as well, where the duplication of small cell installations and, hence, planning applications from multiple mobile operators is minimised. There is also the issue of limited available assets to install mobile equipment in high footfall areas in cities and towns. More equipment also brings risk of significant ‘visual pollution’ as seen in the graphic on the following page.

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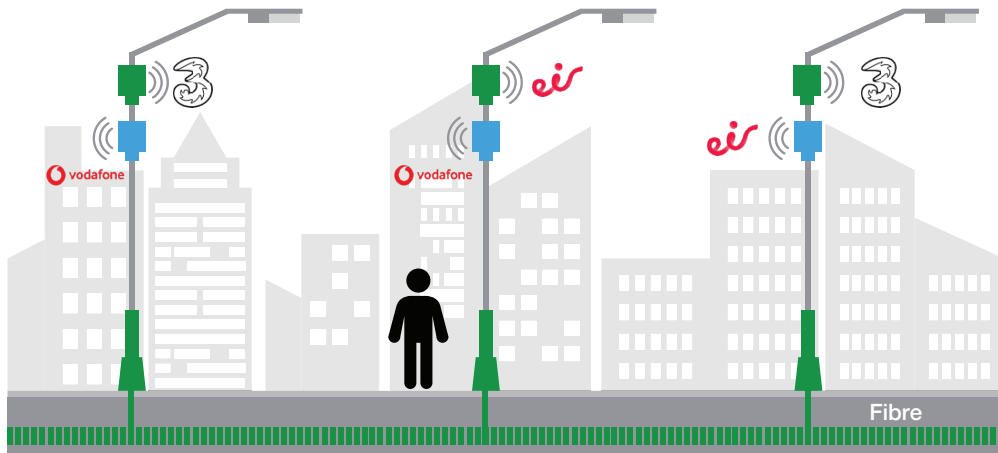
Small Cell Deployment Models

1. Neutral Host



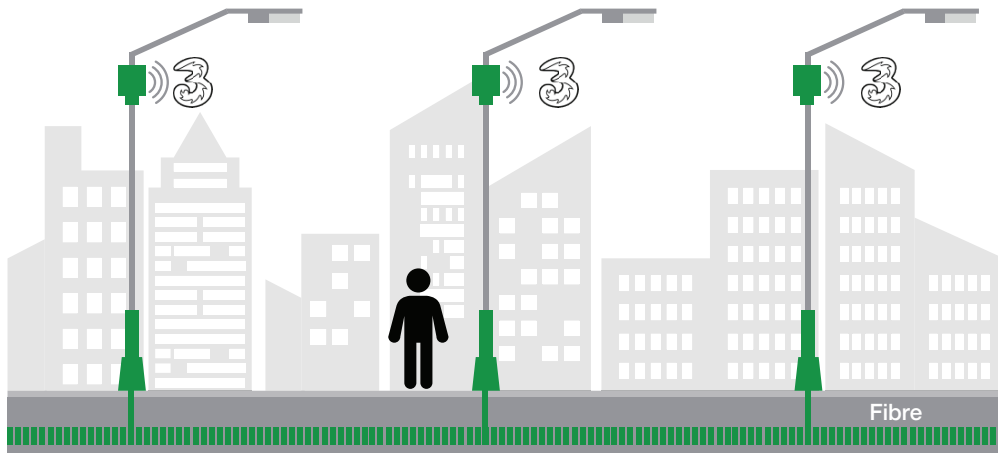
Neutral Host involves a single physical device deployed on city assets that can be shared by multiple operators (as opposed to multiple installations of such equipment).

2. Shared Infrastructure



Example above where multiple MNOs deploy their own equipment on shared city assets such as traffic or street lighting poles.

3. Exclusive Concession



This gives exclusive rights to one MNO, which makes it difficult for other MNOs to gain access.

Logo and city assets for illustrative purposes only. Other scenarios may apply.

04

A Neutral Host shared model could be an ideal solution to enable widespread 5G deployment. Based on our survey for this report, four out of five operator respondents indicated they would be “very interested” in a Neutral Host model by Dublin City Council, with the fifth being “neutral”. The survey results underline the increasing importance of providing a cost-effective 5G network with sufficient capacity and capabilities, where neutral hosting may hold the key. The idea being that it brings reduced infrastructure and maintenance costs. However, the Neutral Host model also comes with additional technical risks for operators that will require a lot more upskilling across the wider telecoms sector.

A holistic approach to deploying a Neutral Host network within Irish cities and towns would be for respective local authorities to engage with a third-party operator through the development of a public/private partnership (3P) to help fund, operate and maintain the network for ‘open access’ among operators. More specifically, a feasible 3P may require the creation of a ‘Special Purpose Vehicle’ (SPV) in order not to contravene EU State Aid Rules, which prohibit any actions that may be perceived as favouring one vendor over another.

Collaboration with a third-party operator would enable local authorities to explore an opportunity to generate new revenue streams from the Neutral Host network. In particular, consideration should be given to the potential for revenue sharing between the facilitating local authority and the Neutral Host provider.

4.3 Shared Infrastructure

Similar to our definition of Neutral Host, to simplify the discussion, we categorise sharing infrastructure as one city asset hosting multiple small cells. It is important to note in this scenario the local authority may work with one facilitating entity who deals with multiple operators and installs multiple small cells. Alternatively, the local authority may work with multiple entities, each installing their own small cells. The significant difference between this and the Neutral Host model is that multiple small cells may be deployed on one city asset. Hence, the shared infrastructure model promotes collaboration and coordination between public and private bodies for mutual benefit.

From the perspective of market competition, the inherent neutrality of access ensures there is no discrimination against any involved party and also promotes continued maintenance and upgrading of the network. The downside to this is more street clutter, which is less aesthetically pleasing, and may also lead to multiple service level agreements depending on how the local authority decides to manage the procurement process.

The other challenge, as mentioned earlier, was only having two small cells allowed on a single asset under existing planning exemptions. This model will most likely require the deployment of tailored poles to facilitate the loads and wiring requirements of multiple small cells.

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4.4 Exclusive Concession

In the exclusive concession model, a period of exclusivity is granted by the local authority to a single concessionaire in order to incentivise investment in connectivity. In return for the granting of exclusivity, the concessionaire pays an upfront fee and, oftentimes, shares a portion of its revenues with the local authority.

Concession models have been adopted by a number of local authorities in the past to enhance connectivity, with the primary source of attraction being an ability to work with one, rather than multiple entities in the design, deployment and maintenance processes. This simplicity enables local authorities to be more agile and to free up some of their resources.

An exclusive concession limits access to one operator on the city asset. An example of this is between Telefonica and The City of London where exclusive access was given to over 200 city assets, leading to a monopoly in that area. The prospective concessionaire is attracted by the opportunity to deploy and operate their network exclusively, coming at the cost of an upfront fee made payable to the local authority and, usually, a share of ongoing revenues.

Despite the relative simplicity of the concession model, it can present a number of challenges for local authorities, particularly in the realm of ensuring there is sustainable market competition. During the period of exclusivity, a concession contract may stifle investment from third-party network providers in the provision of connectivity infrastructure.

In terms of the opportunity to generate revenue from concession contracts, it is important to understand that previous experiences have not always met the expectations of local authorities or, indeed, the concessionaire. For example, prominent MNOs in the UK such as BT have said that current concession models would force other mobile operators who wish to access the same physical infrastructure to pay a wholesale charge to the concessionaire. They also have the ability to make things 'difficult' for competitors who want access, charging large fees, or preventing access outright. This was corroborated in London, where thirteen boroughs said they had concession agreements with infrastructure providers such as Arqiva, but had significantly increased operator costs. This can be countered if policies are in place to force exclusive holders to 'sell' access to other MNOs/ vendors, which ironically defeats the purpose of a concession in the first place.



Operators in London have begun to understand that the exclusive concession model may in fact, bring increased cost to all operators in the long run.

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4.5 Evaluation of Deployment Models

In order to evaluate the best type of model for a local authority to support future 5G deployments and best in class connectivity, this section considers some of the key principles. These factors were identified through the industry and local authority consultations and surveys. They include the following:

Equal access of assets

The chosen model needs to ensure equal access to operators. It should allow flexible access to assets - there should not be exclusivity arrangements or a 'first-come, first-served' approach to prevent 'asset hoarding'.

Deliver future connectivity needs

The economics of small cells require a coordinated and streamlined approach for deployments. It is clear from the current market evaluation that a small cell densification model will not happen unless there are steps taken to simplify the process of installation and reduce the cost of deployments. There also needs to be reasonable access given for ongoing maintenance.

Bridge the digital divide

The experience of telecom deployments to date has been market-led, leaving some areas behind in our cities and towns. Local authorities have a remit to ensure that the rollout of 5G can be delivered in a way that does not increase the digital divide, where benefits are shared across their local authority area.

Reduce visual pollution and road openings

This is a key consideration for a local authority and the choice of deployment model will strongly influence the outcome. The deployment of small cells needs to consider existing heritage and aesthetic policies and ensure that the equipment blends in with existing assets as much as feasible. There is also a need to minimise the amount of road openings associated with deploying fibre and power to small cell sites.

Revenue opportunity

There is a real opportunity for local authorities to play a key role in the future connectivity needs of their cities and towns. Depending on the approach chosen there will likely be an initial capital outlay cost to map, audit and bundle local authority assets. The longer term revenue benefit can be used to re-invest in city initiatives that include social inclusion and infrastructure developments.

Ownership retention by local authority

The model chosen must consider whether the asset will continue to be owned by the local authority and the pros and cons of such an approach. This is an important consideration as the local authority could potentially be locked out from future opportunities on their own assets.

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The following table summarises each deployment model based on the above evaluation metrics:

	Shared Infrastructure	Neutral Host	Exclusive Concession	MNO Macrocell Upgrade
Equal access of assets	Shared Infrastructure models enable MNOs to access LA assets and passive infrastructure on an open-access basis through the medium of a cooperative.	Neutral Host models enable MNOs to access LA assets and active infrastructure on an open-access basis through the medium of a wholesale provider.	Exclusive concession models may enable MNOs to access the concessionaire's network on an open-access basis, but this is dependent on the contract.	Macrocells do not enable open-access to passive or active infrastructure.
Deliver future connectivity needs	Shared Infrastructure models can reduce total cost by distributing installations amongst MNOs. However, the duplication of active equipment is unfavourable.	Neutral Host models can deliver major cost synergies by preventing the duplication of active infrastructure across MNOs.	Exclusive concession models may place a large cost burden on the concessionaire when there is an inability to share costs amongst multiple parties.	Macrocells are expensive when there is an absence of network sharing. However, they offer a very large coverage footprint, but lack penetration at higher frequencies.
Bridge the digital divide	Shared Infrastructure models enable social inclusion in the enhancement of connectivity by balancing public and private sector power.	Neutral Host models enable social inclusion when MNOs share active equipment equally and contribute to the expansion of the network.	Exclusive concession models may result in deployment inactivity during the period of exclusivity and deter deployment by third-parties.	Macrocells are only commercially viable to deploy in a limited number of locations because of their high cost. This may hinder social inclusion of areas.
Reduce visual pollution and road openings	Shared Infrastructure models can contribute to visual pollution and disruption because each MNO needs to deploy its own antenna on the asset.	Neutral Host models minimise visual pollution and urban disruption because MNOs share active infrastructure.	Exclusive concession models can contribute to visual pollution when the concessionaire offers passive infrastructure sharing to MNOs.	Macrocells are a major source of visual pollution in urban environments, and densification will only exacerbate this.
Revenue opportunity	Shared Infrastructure models enable LAs and public sector bodies to monetise access to their assets with a simple fee.	Neutral Host models may enable revenue sharing between LAs and the third-party wholesale operator, but this hinges on take-up by multiple MNOs.	Exclusive concession models are dependent on revenue sharing between LAs and the concessionaire. High costs and small - scale deployments hinder the potential for revenue generation.	Macrocells located on LA assets may offer a recurring revenue stream for LAs, with MNOs and/or wholesale infrastructure providers paying a site rental fee.
Ownership retention by local authority	Shared Infrastructure models enable LAs to retain their assets.	Neutral Host models enable LAs to retain their assets, whether the operator is the LA or a third party.	Exclusive concession models may enable LAs to retain their assets, but a period of exclusivity can sterilise the asset.	Macrocells are usually located on private property, with MNOs paying a site rental fee.

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4.6 Small Cell Deployment Business Models

While there are a few operational models to deploy small cells, there are also several different business models being developed to facilitate the deployment of small cells in a fair and equitable manner. The most popular models currently known are:

- **Special Purpose Vehicle (SPV) or Join Venture (JV)** - The local authority creates a legal entity with a small cell provider, usually a Neutral Host provider, and this entity manages the operational rollout of small cells. Typically the local authority's contribution to this model is their assets and in some cases they may provide additional funding.
- **Concession Model** - The local authority will consult the market and choose one third-party entity, either small cell provider or MNO, to grant access to their assets. This is often done on an exclusive basis, reducing the level of competition in cities.
- **Lease Agreements** - This model, used in San Jose, where the local authority grants multiple MNOs access to individual assets on a lease basis.

In general, the business model varies on the current conditions in the city. For example, whether the city owns the lighting, traffic, assets, fibre, or ducting. Or does it want to manage the deployment or outsource to a third party? More innovative models will emerge that will benefit local authorities, MNOs, small cell operators and all involved in the deployment of telecoms equipment. As the technology is relatively new, the year 2020 will be the first year cities engage the market on a wide-scale and we may see cities creating models for entities to manage all wired and wireless telecoms on their behalf.



Access to city assets will be critical to small cell deployments. And the commercial models behind accessing these will be key.

04

4.7 Additional Small Cell Deployment Considerations

Additional considerations were identified through industry interviews and surveys on the different small cell deployment approaches, and how they may impact the speed of network densification. This includes:

Complementary to MNO Macrocell upgrade

Any small cell deployment will complement the current rollout of 5G Macrocell sites.

Volume of Installations

The projections of sites required particularly in dense city environments will see initial demand kicking in by 2022. The numbers required to service Dublin city, for example, will require a model that considers mass deployments.

Expenditure for MNOs

The current costs of small cells, as well as paperwork, regulation and policies, mean that innovative business modelling is required.

Can deliver Required Site Density

The site density required will only be possible through a flexible model and approach - with a fundamental requirement that local authorities set up a structure and process to enable this.

Potential for Operator Collaboration

This goes without saying - sharing of physical assets is the starting point. The big question is whether this can be extended to sharing radio network assets through virtualisation.

Access to LA Infrastructure

This is a prerequisite to ensure future connectivity needs for Irish cities and towns. While local authorities play a key role there is also a role for other state bodies such as ESBn to consider appropriate models as set out in this paper. There is also an opportunity to align with infrastructure investment to future-proof connectivity needs. For example, deployment of smart poles as part of street lighting tenders, laying of ducting in new housing and roads investments, etc.

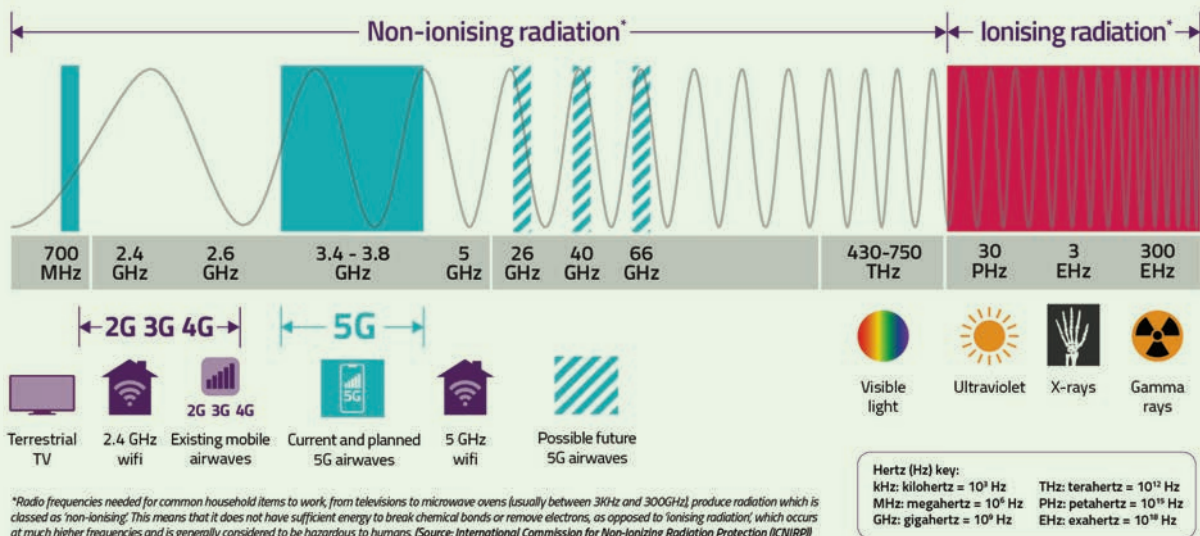
05 Health & 5G

For any report on 5G, it is important to address concerns that are being raised on possible health impacts. The World Health Organisation has stated:

“there is no scientific evidence to support any adverse health effects to individuals exposed below the international exposure levels set for members of the public.”¹⁷

In particular, the strict and safe exposure limits for electromagnetic fields recommended on an EU level through 1999/519/EC on the exposure of the general public to electromagnetic fields apply for all frequency bands currently envisaged for 5G. In Ireland, ComReg is the statutory body responsible for ensuring mobile operators do not exceed the emissions levels established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ComReg conducts a “Programme of Measurement of Non-Ionizing Radiation Emissions” across a sample number of licensed macrocells on an annual basis to assess compliance with the emission level thresholds defined by the ICNIRP.

The Electromagnetic Spectrum



Credit: Ofcom

These emission level thresholds are set to prevent radio frequency (RF) exposure from reaching a level that is known to produce adverse health effects, with an additional reduction factor to take care of scientific uncertainties pertaining to the determination of the threshold. The ICNIRP has stated the following:

“A large number of studies have been undertaken on both acute and long-term effects from HF [100 KHz - 300 GHz] exposure typical of base stations. Research at these levels of exposure has provided no conclusive evidence of any related adverse health effects”¹⁸

- International Commission on Non-Ionizing Radiation Protection (ICNIRP).

¹⁷ WHO - <https://www.who.int/peh-emf/about/WhatIsEMF/en/index4.html>

¹⁸ ICNIRP - <https://www.icnirp.org/en/applications/wi-fi/index.html>

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All local authorities across Ireland have been liaising closely with the Environmental Protection Agency (EPA) through their statutory advisory role in assessing health risks associated with 5G technologies. This must continue, together with guidance and alignment on a national level.

Further information regarding the role of ComReg in monitoring non-ionising radiation levels in Ireland can be found below.

<https://www.comreg.ie/industry/radio-spectrum/site-viewer/non-ionising-radiation-information/>

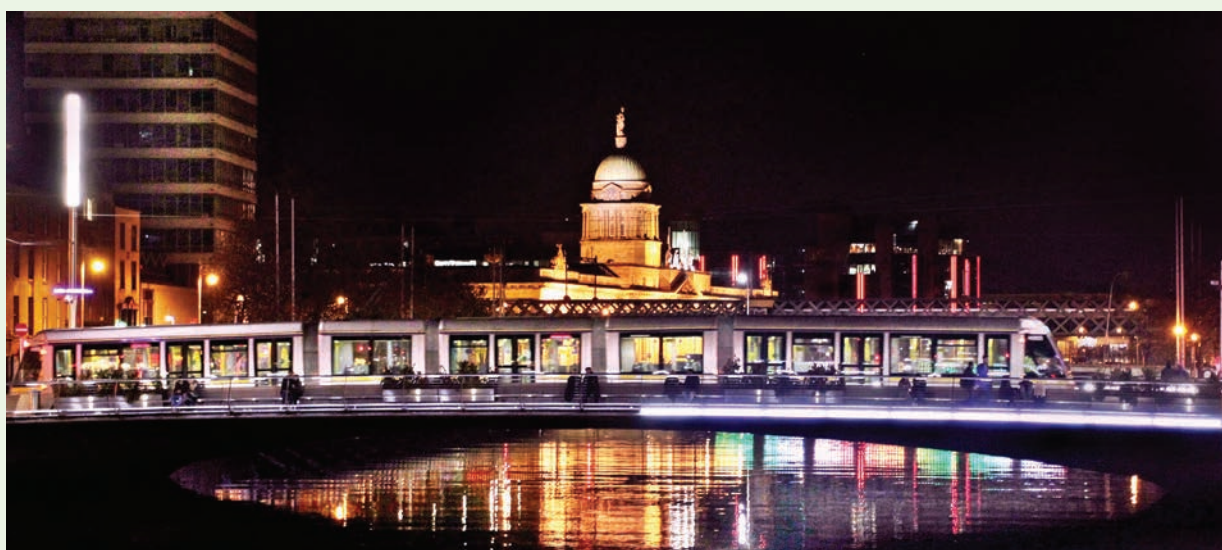


06 Recommended Actions

On the back of this whitepaper, we have a better understanding of the opportunity that 5G offers our cities and towns across Ireland. However it is clear that there is a much bigger role envisaged for local authorities in how these networks get deployed with likely future demands on accessing assets such as poles, ducting, traffic assets, buildings and street furniture.

Designers of future streetscapes must ensure that consideration for connectivity is made. This will require a change of working within local authorities to facilitate this in a way that can support the delivery of world class connectivity infrastructure in our cities and towns.

Local authorities also have a responsibility to ensure equal access to their assets considering their strategic importance, rather than reward a first come, first served, or highest bidder exclusive approach, to small cell deployments. Also, for mobile operators there is a risk that local authority assets become 'filled' or sanitised in that the first operator gaining access will block other operators from using these assets.



The report also reviewed the pros and cons of the different deployment models available for deploying 5G and how we can better use local assets to make this a reality. The initial evidence is continuing to mount in support of more 'open' access models that are both operationally, and financially, feasible.

Local authorities will have to take the next steps of exploring models such as the 'Neutral Host', together with private sector entities through market engagement conversations.

We propose four broad areas of actions to be taken in order to lay the groundwork for pervasive 5G rollout across Ireland. They include a review of international class best practices, better alignment across national and local stakeholders and a more detailed review of the most appropriate deployment & business models.

Action

1

Review International Best Practice

The challenges faced by Irish cities and towns are not unique. Hence, lessons can be learned from the models being explored by other cities such as San Jose in the US, Helsinki in Finland, and Amsterdam in the Netherlands. Dublin City Council recently hosted an international 5G accelerator with Harvard TECH, which brought together over 20 cities to share experiences and best practices in 5G. Presentations and information from this event can be found in the following hyperlink: <https://smartdocklands.ie/5G>

We should continue to build upon international best practice and share and learn from international city networks such as Harvard TECH City Innovators Forum.

Action

2

Better National Alignment

At a national level, there is a requirement to align on objectives and goals in order to successfully deploy pervasive 5G connectivity across Irish cities and towns:

2.1 Creating a working group and forum for Ireland's 5G ambitions

A working group should be established to include national and local stakeholders to agree a 5-10 year roadmap overseeing this rollout. It should include local authorities, the Department of Rural and Community Development, the Department of Business, Enterprise and Innovation (DBEI), the Department of Communications, Climate Action and Environment (DCCAE), Commission for Communications Regulation (ComReg), Environmental Protection Agency (EPA), Electricity Supply Board Networks (ESBn), Irish Business and Employers Confederation (IBEC), as well as Science Foundation Ireland (SFI), and their research centres such as CONNECT, the Science Foundation Ireland Research Centre for Future Networks and Communications.

In addition, we should create a forum where local authorities can discuss 'future connectivity proofing' of projects with their funding bodies (National Transport Authority, various Government Departments, etc.). This will ensure that additional capital costs for future-proofing infrastructure can be included in budget allocations when determining longer-term investment opportunities.

2.2 Enhancing alignment with national R&D centres to support future 5G applications

This should focus on supporting emerging application areas and testbeds in mobility, connected health, emergency response, safety and other emerging applications. The development of dedicated physical testbeds should be facilitated to support this national R&D agenda, of which stakeholders will be able to congregate, discuss, and test hypotheses. Key stakeholders should include actors such as Science Foundation Ireland (SFI), its research centre CONNECT, the Irish Development Agency (IDA), and Enterprise Ireland (EI).

2.3 Continue to monitor safety concerns of 5G

National government, together with local authorities, must continue to monitor the latest scientific guidance from the World Health Organisation (WHO) and Environmental Protection Agency (EPA) on 5G health concerns. There also needs to be more consistency in communication across government bodies, local authorities, vendors and mobile operators in regards to these concerns.

2.4 Address unmetered power issue with ESBn

The challenge of accessing power in an affordable manner is a make or break issue for future deployment of 5G. There must be continuous communication with ESBn via the Mobile Phone and Broadband Taskforce to resolve unmetered power issues for the installation of small cells on unmetered supply. A review of ESBn's policy document must be undertaken by all other actors, in order to fully understand the suggested approaches to address the power issue. This should avoid the requirement for additional infrastructure installations such as mini pillars, which would add further street clutter and additional costs that could make small cell deployments commercially unfeasible.

Action

3

Better Local Alignment

Local authorities will play an instrumental role in Ireland's path to 5G. Collaboration and engagement between local authorities and stakeholders such as mobile operators will be essential to allow for a sustainable rollout:

3.1 Establish a centralised point of contact for connectivity requests in each local authority

A single point of contact is required within each local authority in order to engage with mobile network operators and mobile infrastructure providers. This will likely necessitate a permanent role in each local authority to coordinate this activity. For example, having a dedicated broadband officer or digital officer.

3.2 Develop a 'single view' of local authority assets and condition of assets

All ducting, fibre, street furniture, streetlights, buildings, traffic, and other assets owned by local authorities should be compiled into a database and asset map that includes an assessment of suitability/condition for use in 5G deployments. To ensure that a complete and accurate database of these assets is recorded and mapped, a common standard for mapping and recording assets should be agreed with industry. This should help to ensure uniformity of records across the country but also help to maximise the possible take up by telecoms of these assets.

3.3 Develop policies on rules of engagement for third parties accessing local authority assets

Local authorities must agree protocols around access to their assets, ensuring all involved parties have clearly defined roles and processes to follow. Any Service Level Agreements need to take into account safety considerations, city operational priorities and insurance risks.

3.4 Develop streamlined interpretation and issuing of section 254 licences for delivery of new mobile sites or equipment installs such as small cells

This should have clearer definition and indication across local authorities. This alignment should be done in collaboration with the Department of Housing, Planning, and Local Government to develop a set of draft guidelines.

3.5 Develop streamlined processes to allow for bulk planning requests for deployment of small cells and other next generation wireless equipment

This should align with the current transposition of the European Electronic Communications Code on opening up access to support small cell rollout currently titled as 'Light deployment regime for small-area wireless access points'.

3.6 Develop reasonable pricing and access of local authority assets

The development of standard rate-cards should be explored to ensure consistency on pricing and scalability across local authorities and priority locations in high density areas in urban centres.

Action**4****Assess Deployment Models**

As mentioned in this discussion paper, the pathways for asset-sharing should be thoroughly assessed, including the preferred model(s) and options.

4.1 Local authorities and mobile operators must agree key principles that underpin enhanced sharing of assets for mobile and connectivity purposes

These principles should include:

- Minimise road openings and associated disruption
- Open access to local authority assets on equal terms to all operators where appropriate to support densification plans
- Minimise visual pollution and clutter (reducing duplication of installations where possible)
- Ensuring that the interests of citizens and communities are put at the centre of this process by minimising digital divide and social exclusion risks

4.2 To further explore the deployment models in particular 'Neutral Host' model

Based on an evaluation of the various deployment options for rollout of 5G, the 'Neutral Host' model has emerged as an attractive future deployment model for local authorities across Ireland. This model would enable better sharing of local authority assets in a way that addresses the key principles of small cell and 5G deployment as set out above.

It is proposed that Dublin City Council will lead a market engagement exercise in Q2 2020 to review the opportunity of Neutral Host and shared infrastructure deployment models to support 5G rollouts.

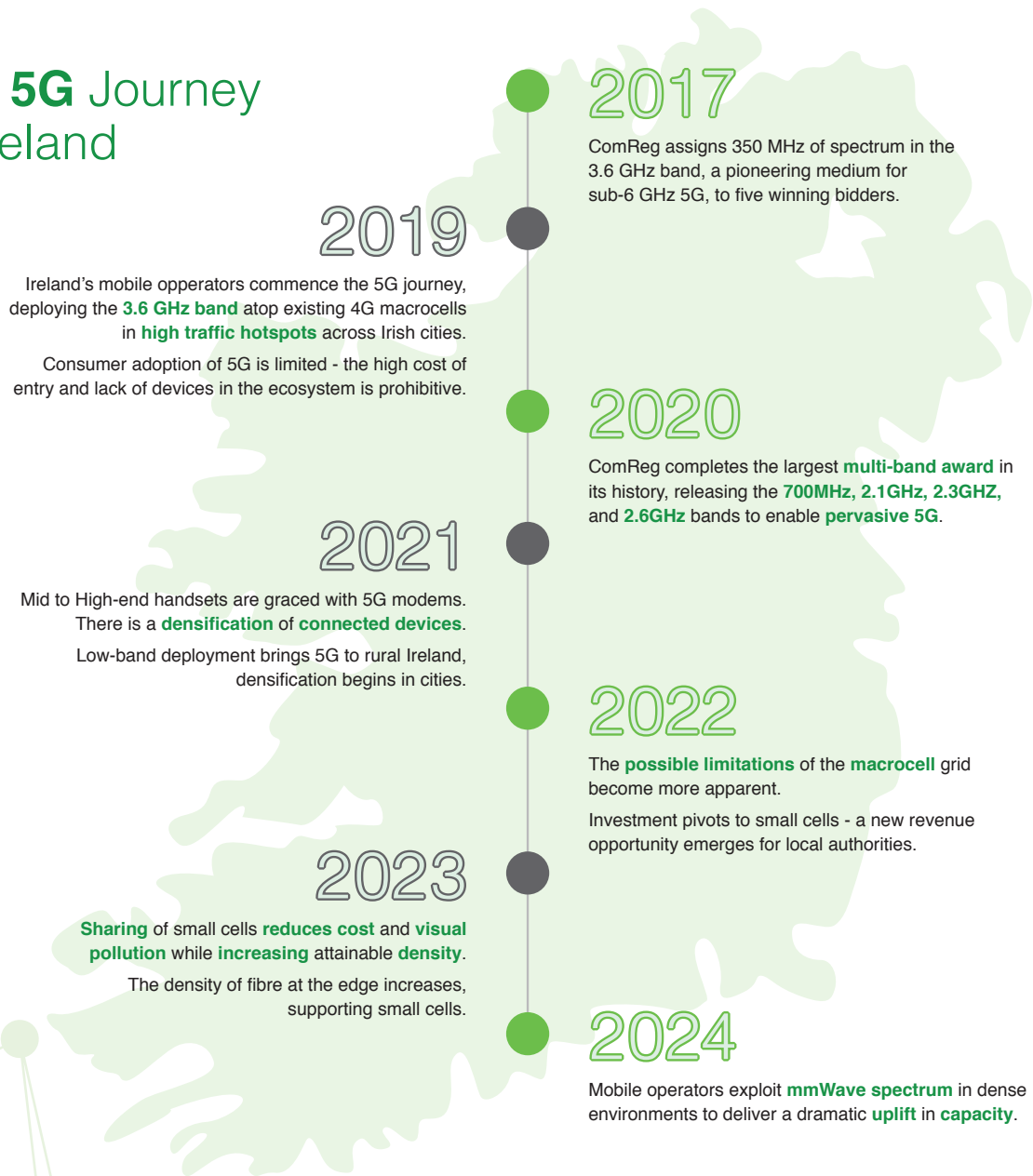
Action

5

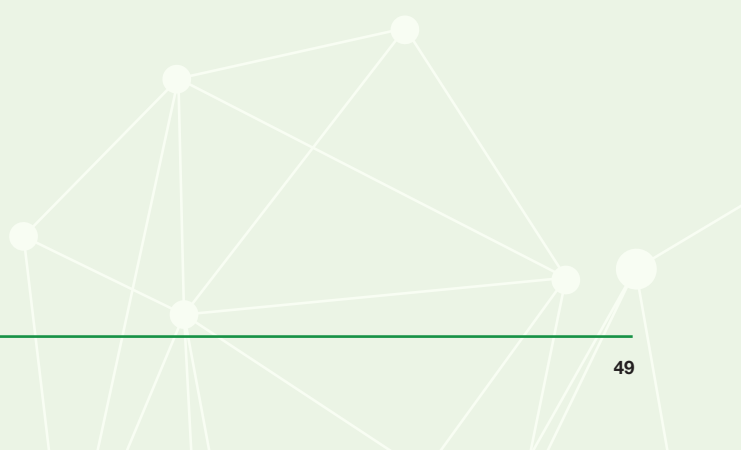
Development Of A 5-year Roadmap For Ireland

This roadmap is open to discussion and consultation with all stakeholders to better guide Ireland's 5G connectivity vision. It is clear from our engagement with stakeholders that it will be a number of years before Irish cities realise the benefits of 5G at scale. The pace of this uptake will be dependent on the recommendations prescribed in this discussion paper, and moving in tandem with fast-growing developments in this space.

The 5G Journey in Ireland



If Ireland wants to continue being a leader in technology and innovation, fast tracking the suggested actions in this report should be made a priority. Our future competitiveness depends on it.



5G and Future Connectivity

An Emerging
Framework
for Irish Cities
and Towns



An Roinn Forbartha
Tuaithe agus Pobail
Department of Rural and
Community Development



Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council



Sligo County Council
Comhairle Chontae Shligigh

