



General Background Information for Telecommunications Development.

England

Introduction.

Cornerstone is the UK's leading mobile infrastructure services company. We acquire, manage, and own over 20,000 sites and are committed to enabling best in class mobile connectivity for over half of all the country's mobile customers. We oversee works on behalf of telecommunications providers and wherever possible aim to:

- Promote shared infrastructure;
- Maximise opportunities to consolidate the number of base stations;
- Significantly reduce the environmental impact of network development.

This document is designed to provide general background information on the development of UK mobile telecommunications networks.

It has been prepared for inclusion with planning applications and supports network development proposals with general information.

Background

Over 30 years ago under the Telecommunications Act 1984, a licence was granted to mobile network operators. The licence was to provide wireless (or mobile) phone services utilising unused radio frequencies adjacent to those transmitted for over 50 years by the television industry.

With the wireless technology being new and the number of potential customers unknown, several tall masts were used to provide basic radio coverage to the main populated areas.

As the way we use our phones and other technologies have changed over the past 30 years, where we locate masts is crucial.

Due to the increased data transfer necessary for the latest telecommunication services, locations of base stations must be where the local demand exists.



Digital networks.



2G

2G digital networks developed in the early 1990s.

This digital technology is also known as GSM (Global System for Mobile Communications), which is the common European operating standard. This technology enabled phones to interconnect to other networks throughout Europe and internationally.



3G

In 2000, the 'Third Generation' mobile telecommunications service was launched, known as 3G or UMTS.

In addition to voice services, this allowed broadband access to the internet for mobile phones and laptop computer data card users.



4G

2013 saw the launch of 4G services on the network.

This technology allows for ultra-fast speeds when browsing the internet, streaming videos or sending emails. It also enables faster downloads.

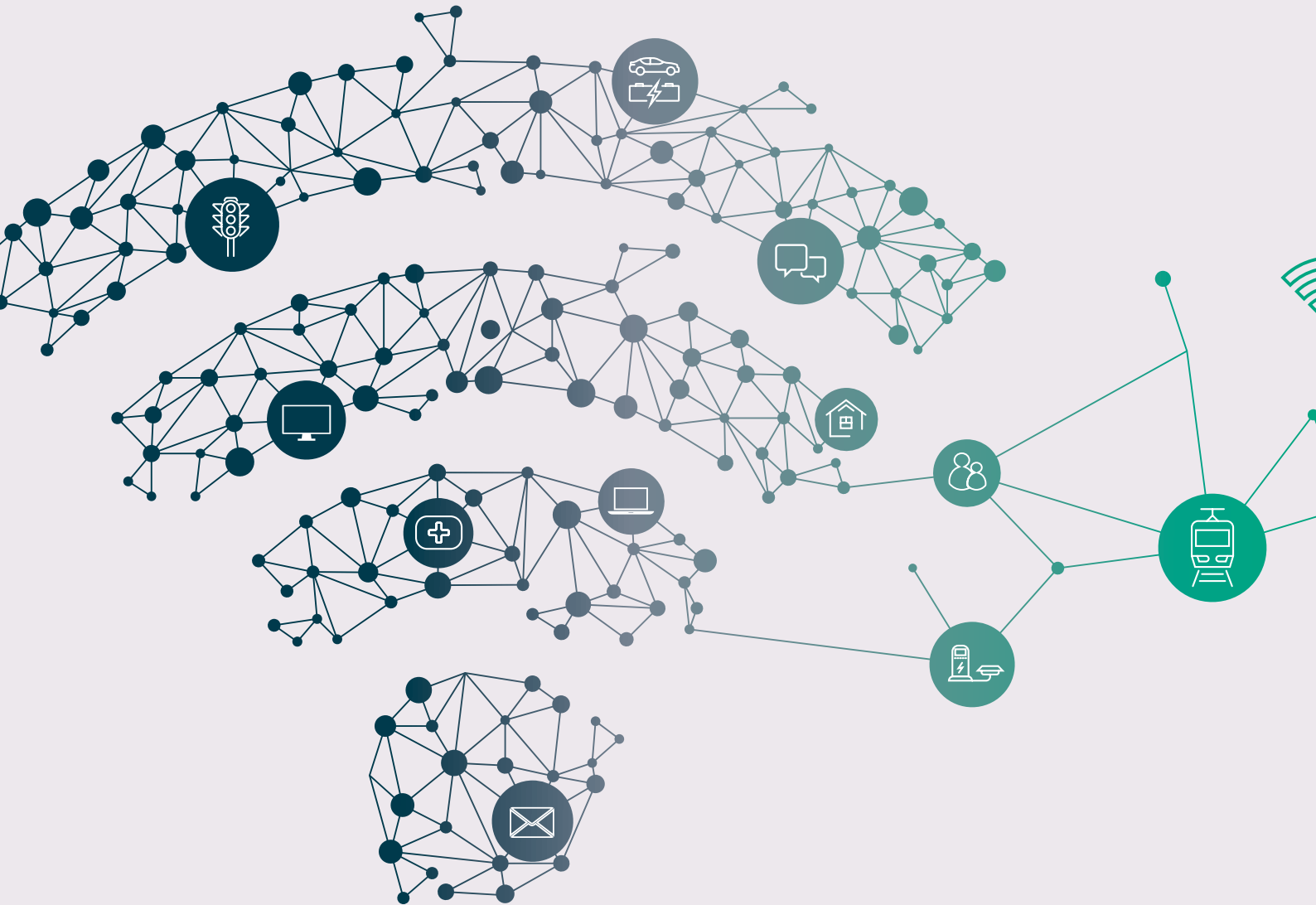


5G

2019 saw the introduction of 5G services, with the Government's ambition for the UK to become a world leader in this technology.

5G Connectivity will ensure that everyone benefits from early advantages of its potential and that the UK creates a world-leading digital economy that works for all.

What is 5G?



5G is the new generation of wireless technology that will deliver reliable and faster networks of the future, changing how we understand wireless connectivity.

The technology will see us all move from something we experience through personal devices to an integrated infrastructure across buildings, transport and utilities. The new technology will provide enormous benefits for citizens, businesses and urban regions alike.

5G will also offer a new level of underlying connectivity to transform services and create new digital ecosystems.



The benefits of 5G.

The economic benefit

- Businesses offering online services can extend their products to a broader audience
- Local areas and businesses can benefit from tourists and visitors as hotels, attractions, and restaurants can be booked online from anywhere in the world
- Business owners and services like doctors can provide a faster and more cost effective service by offering both online appointments and ordering
- Digital connectivity facilitates economic growth, something which the Government is keen to progress and promote

The social benefit

- Mobile communications can help people to stay in touch wherever and whenever, which can help improve social wellbeing
- Contacting emergency services is easier, especially in remote areas
- Using a mobile wherever you go can provide better personal security
- Having access to social networking sites and applications can keep people entertained with their lifestyles and interests
- Mobile connectivity helps promote smarter and productive ways of working. For example, working from home can help minimise commuting which can provide better work and home life balance
- Access to personal information 24/7, e.g. bank accounts, can offer efficiency and convenience

5G is the next generation of mobile connectivity, providing us with a new level of experience. It will offer immense opportunities, given the faster and more reliable connectivity that it will provide.

We will experience new technologies that will help us become more efficient and save costs as an individual or business.

What can we expect from 5G?

- Driverless vehicles – this will give drivers autonomy to do other things while driving
- Advanced healthcare facilities – performing surgeries remotely will be made possible, along with freeing up more GP time through better online facilities
- Enhanced Virtual and Augmented reality (AR) – used in gaming and entertainment already, with 5G, live interactions will be taken to the next level
- Greater Internet of Things (IoT) transformation – with better connected devices, the IoT will enable us to control devices more independently
- Cutting-edge agricultural operations – operating farming machinery and tools remotely will promote smart agriculture, saving time and increasing productivity for farmers

We need to continue to work together to enable the opportunities that mobile technology brings to all of us.



Planning policies.

Planning policy guidance on telecommunications

The revised National Planning Policy Framework (NPPF), published on 20th July 2021, supports high-quality communications infrastructure and recognises it as a strategic priority.

Within paragraph 114 it states that:

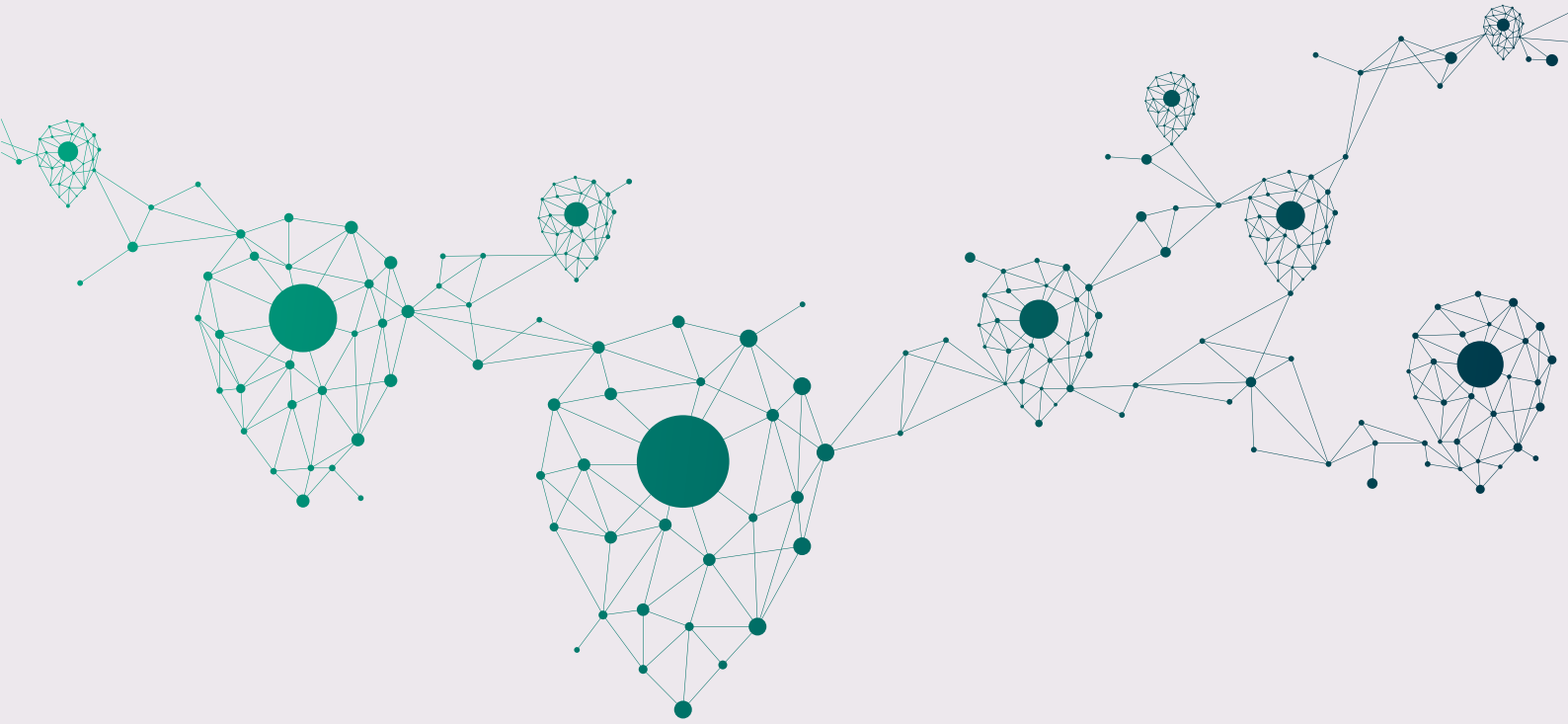
“Advanced, high-quality and reliable communications infrastructure is essential for economic growth and social well-being. Planning policies and decisions should support the expansion of electronic communications networks, including next-generation mobile technology (such as 5G) and full-fibre broadband connections.”

The NPPF goes on to state within Paragraph 118 that:

“Local planning authorities must determine applications on planning grounds only. They should not seek to prevent competition between different operators, question the need for an electronic communications system, or set health safeguards different from the International Commission guidelines for public exposure.”



Site/mast sharing.



Cornerstone actively encourages and supports site-sharing for both commercial and environmental reasons.

All operators are required to explore site-sharing opportunities under the terms of their licences.

Cornerstone has implemented many measures to identify and maximise site-sharing opportunities.



Consultation & legal case.

Consultation

Cornerstone is committed to carrying out appropriate consultations with Local Planning Authorities, stakeholders and the public. The Code of Practice for Wireless Network Development in England (March 2022) gives guidance on the factors that operators should consider when determining what consultation is required, as each development is different. These factors are equally applicable for Local Planning Authorities who carry out their own consultation once the application has been submitted.

Legal case

The following legal case may be helpful:

Harrogate case November 2004

The Court of Appeal gave a judgement that Government Planning Guidance in PPG8 (now replaced by the NPPF) is perfectly clear in relation to compliance with the Health and Safety standards for mobile phone base stations. The Court of Appeal and the High Court both upheld Government policy in response to a planning inspector's decision that departed from that policy and failed to give adequate reasons for doing so.

Bardsey case January 2005

The Court of Appeal confirmed that the permitted development regime for mobile phone base stations is compliant with the Human Rights Act. This was a case in which a local planning authority failed to comply with its obligations to act within the 56 day period provided under the permitted development regulations.



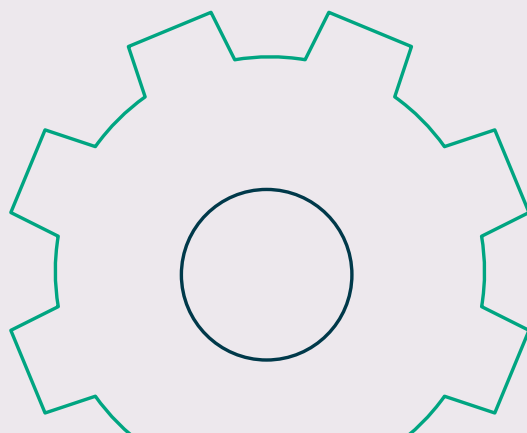
Further information.

We trust that this document answers your main queries regarding our planned installation.

The enclosed site-specific details will identify any alternative discounted options and reasons why they were rejected and how the proposed site complies with national and local planning policies.

The Local Government Ombudsman's Special Report on Telecommunication Masts gives some positive recommendations and advice to Local Planning Authorities in determining prior approval applications.

The **Digital Connectivity Portal** provides guidance for local authorities and network providers on improving connectivity across the UK. Produced by DCMS, it promotes closer co-operation between network providers and local authorities, and offers guidance on effective policies and processes to facilitate deployment of digital networks.



For further information or to contact Cornerstone,
please visit **www.cornerstone.network**

or write to us at:

Hive 2, 1530 Arlington Business Park, Theale,
Berkshire, RG7 4SA.



HEALTH AND MOBILE PHONE BASE STATIONS

We recognise that the growth in mobile communication has led, in some cases, to public concern about perceived health effects of mobile technology, in particular about siting masts close to local communities. Quite naturally, the public seeks reassurance that masts are not in any way harmful or dangerous.

We are committed to providing the latest independent peer-reviewed research findings, information, advice and guidance from national and international agencies on radiofrequency (RF) electromagnetic fields.

Cornerstone ensure that our radio base stations are designed and built so that the public are not exposed to radio frequency fields above the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). In fact, radio base stations operate at low power and emit levels of radiofrequency fields many times lower than the ICNIRP general public guidelines.

RESEARCH REVIEWS

The World Health Organisation notes that "In the area of biological effects and medical applications of non-ionizing radiation approximately 25,000 articles have been published over the past 30 years. Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals: (<http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html>).

The scientific community have collated, summarised and assessed these publications into research reviews. The most influential in the UK being the Mobile Phones and Health Report (also known as the Stewart Report). These research reviews are used by Governments to develop policy on exposure to radiofrequency signals.

The Stewart Report concluded that the balance of evidence did not suggest that exposures to radio frequency fields below international guidelines could cause adverse health effects. One of the recommendations of the Stewart report was a research programme to address uncertainties regarding mobile phone base stations and health. This programme was called the Mobile Telecommunications and Health Research (MTHR) Programme. The final report from this programme was published in February 2014. The report noted that the research conducted found no evidence of adverse health effects from the radio waves produced by mobile phones or their base stations.

Since the Stewart Report, over 30 further reviews have been carried out, carefully considering many hundreds of pieces of research. Most have made similar recommendations and have come to comparable conclusions: that research should continue to address any gaps in the knowledge and that overall, the possibility of adverse health effects from mobile communications remains unproven.

In April 2012 the Health Protection Agency's independent Advisory Group on Non-ionising Radiation (AGNIR) published a report entitled "Health Effects from Radiofrequency

Electromagnetic Fields". This report concluded that there is no convincing evidence that mobile phone technologies cause adverse effects on human health.

The World Health Organisation (WHO) noted that "A large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use" WHO factsheet 193: Electromagnetic fields and public health: mobile telephones, 2014.

In 2019 Public Health England (PHE) noted that "Exposure to radio waves is not new and health-related research has been conducted on this topic over several decades. In particular, a large amount of new scientific evidence has emerged since the year 2000 through dedicated national and international research programmes"

<https://www.gov.uk/government/publications/5g-technologies-radio-waves-and-health/5g-technologies-radio-waves-and-health>

ICNIRP GUIDELINES

The radiofrequency public exposure limits for EMF fields were developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) <http://www.icnirp.org> following evaluation of all the peer-reviewed scientific literature, including thermal and non-thermal effects. ICNIRP is a non-governmental organisation formally recognised by WHO. Established biological and health effects have been used as the basis for the ICNIRP exposure restrictions. These guidelines have been adopted for use in the European Union and the UK.

In 2017 ICNIRP reaffirmed that their safety guidelines provide protection against all known health effects of radiofrequency signals.

COMPLIANCE WITH INTERNATIONAL EXPOSURE GUIDELINES

All Cornerstone installations are designed and constructed in compliance with the precautionary ICNIRP public exposure guidelines as adopted in EU Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz). These guidelines have been set following a thorough review of the science and take into consideration both thermal and non-thermal effects. They protect all members of the public 24 hours a day. In addition, precautionary measures have been taken into account when setting relevant guideline limits for the public (i.e. in the UK a safety factor of 50 times is applied to the public exposure guideline).

When measured, field strengths are many times lower than the precautionary ICNIRP general public guidelines.

An ICNIRP certificate is provided with every planning application and this verifies that the mobile phone base station, when operational, will meet the precautionary ICNIRP guidelines. We also provide further documentation to clarify that the ICNIRP certificate addresses emissions from all mobile phone network operators' equipment at the proposed site.

Further Information:

World Health Organisation EMF Project

<http://www.who.int/peh-emf/en/>

International Commission on Non-Ionizing Radiation Protection (ICNIRP)

<http://www.icnirp.org/>

Public Health England (formally HPA)

<https://www.gov.uk/government/collections/electromagnetic-fields>

Or contact:

Community, Cornerstone

The Hive 2, 1530 Arlington Business Park, Theale, Berks, RG7 4SA

Email: community@cornerstone.network

5G Masts & Health

5G is a generation leap in mobile technology with multiple benefits. However, with new technology, it is understandable that people wish to seek reassurance as to its safety and how it works.

This guide provides an explanation of 5G and the equipment behind it, including the antennae and the masts, to ensure that there is no cause for concern in regard to health.

5G & Radio Waves

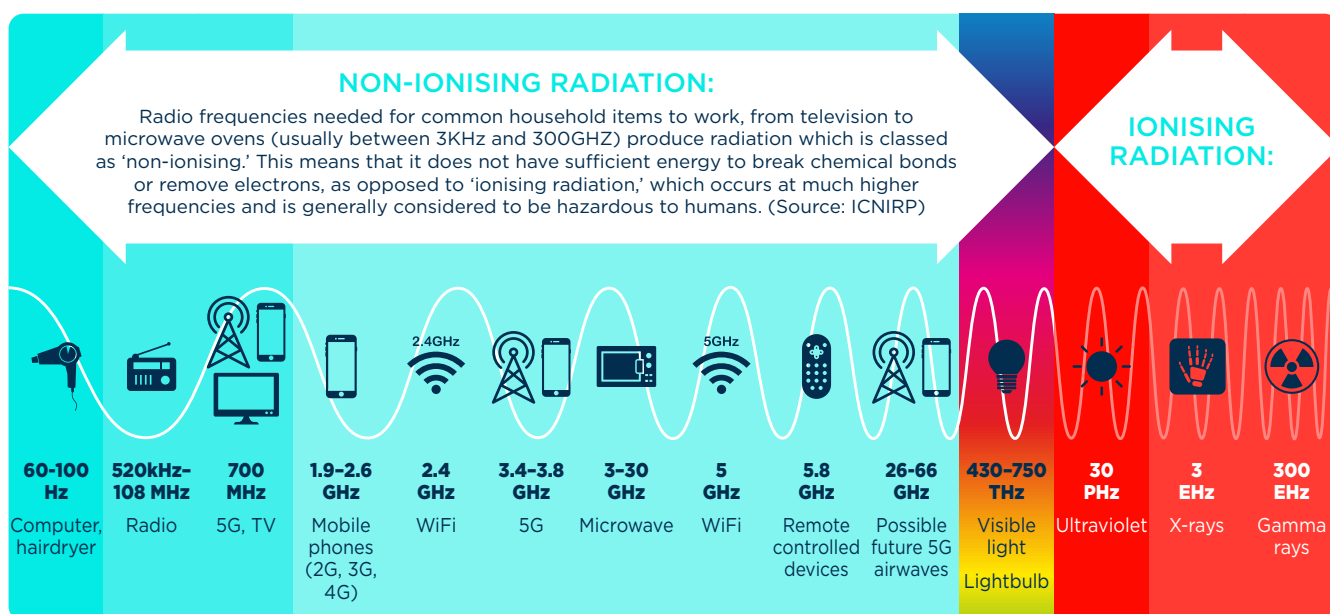
5G is broadcast using radio waves, which are a type of radiation in what is commonly referred to as the 'electromagnetic spectrum.' Sometimes the word 'radiation' scares people, because it is an invisible thing and something many people do not understand, or easily confuse with 'radioactivity.'

Radiation is simply the release of energy, just like the light from the sun or heat from our bodies. Most radiation is considered harmless, or in scientific terms, non-ionising when used within guidelines. It is part of our everyday lives, without us even realising it. Radio waves are used by your TV, radio and remote control.

5G uses a specific frequency of radio waves, just like 4G and before that 3G. The exposure to these radio waves is very low and crucially, many times lower than public safety guidelines dictate.

All frequencies that are currently and will in future be used for 5G fall within the part of the electromagnetic spectrum that includes radiation which is classed as non-ionising. This means that these radio waves do not carry enough energy to directly damage cells. This is different from 'ionising' radiation, which is generally considered to be hazardous to humans and includes gamma (nuclear) radiation as well as x-rays, which occur at the higher frequency end of the electromagnetic spectrum.

- Ofcom



5G Masts & Health

Research into the safety of 5G and mobile phone signals

Research into the safety of radio waves has been conducted for more than 80 years, across the UK and around the world. The strong consensus of scientific opinion and public health agencies, such as the World Health Organisation (WHO), is that no dangers to health have been established from exposure to the low-level radio signals used for mobile communications, including 5G, when used within guidelines.

Strict safety guidelines

All mobile operators must ensure that their radio base stations (also known as masts) are designed and built so that the public are not exposed to radiofrequency fields above the strict safety guidelines which govern and limit public exposure to electromagnetic fields. In fact, base stations operate at low levels, emitting levels of radio waves many times lower than the guidelines.

The International Commission on Non-Ionising Radiation Protection (ICNIRP) is the universally recognised non-governmental organisation that governs the safety levels of electromagnetic field or radio wave exposure and is accepted by the World Health Organisation (WHO). The guidelines, updated in 2020, monitor frequencies up to 300GHz, anything below this threshold is considered to not cause adverse health effects and is therefore safe for the public. 5G radio waves fall well within this category, operating at 700MHz and between 3.4GHz 3.6GHz.

Testing of 5G masts

In fact, the UK's telecoms regulator Ofcom carried out tests at 5G-enabled mobile masts across the country. The highest emission levels (e.g. radiation) recorded at mobile phone masts were consistently well within the strict safety guidelines that monitor radiation levels.

Further Information

As the world depends more and more on mobile connectivity and we are consuming more data, existing networks are becoming congested. 5G has the capacity to handle this and future demand, as it will offer much faster data and upload speeds, allow more devices to access the mobile internet at the same time, and significantly reduce the amount of time it takes to send information from one point to another.

The rollout of 5G is not just about the benefits to each individual mobile phone user but the wider societal benefits of providing connectivity to all, such as the emergency services, local businesses and the provision of council services; the capability of 5G can transform, and ultimately help save lives.

For more information on 5G and health, and to learn about the wider benefits of 5G visit www.mobileuk.org.uk/5G-and-health

For further information from external sources regarding 5G and health, the following links may be helpful:

World Health Organization (WHO) - Radiation: 5G mobile networks and health: <https://www.who.int/news-room/q-a-detail/radiation-5g-mobile-networks-and-health>

BBC - Does 5G pose health risks?: <https://www.bbc.co.uk/news/world-europe-48616174>

Which? - Is 5G safe?: <https://www.which.co.uk/news/2020/06/is-5g-safe-everything-you-need-to-know-on-the-5g-powered-future/>

BBC Click - Testing the Safety of 5G: <https://www.youtube.com/watch?v=k2t1dUCyEOI&feature=youtu.be>

Cancer Research UK - Do mobile phones cause cancer?: <https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/cancer-myths/do-mobile-phones-cause-cancer>

A hand holding a smartphone, with a bokeh background of colorful lights. The image is framed by a large white semi-circle on the left and top.

The public benefit of

mobile connectivity.

The evolution of mobile connectivity.

The demand for faster and improved mobile connectivity continues to grow. Most of us rely on having mobile phones and devices 24/7, which provides us with many benefits.

Since the launch of 2G in 1991, the mobile generation is firmly established. Not only has it provided a way to communicate with each other and exchange information, but it has given individuals and businesses an innovative platform to do much more. Over the years, we have seen 3G and 4G, and now we have been introduced to 5G. The differences between the generations have provided us with higher speed, better connection, and many more advanced features on our mobiles. Now with 5G, we can expect to experience an even more extensive range of telecommunication services.



1G

Mobile
voice only



2G

Calls
and texts



3G

Data
services



4G

High-speed
internet access



5G

Faster connection,
enhanced data services



Connecting you to what matters.

Access to a reliable mobile network has become a necessity for many of us. Some of the key benefits it provides us with are:

- Connecting with family, friends, and colleagues at any time around the world
- Giving the ability to manage our personal information 24/7
- Keeping us always entertained and informed with the latest news
- Creating more productive and cost efficiencies for businesses

The economic benefit

- Businesses offering online services can extend their products to a broader audience
- Local areas and businesses can benefit from tourists and visitors as hotels, attractions, and restaurants can be booked online from anywhere in the world
- Business owners and services like doctors can provide a faster and more cost-effective service by offering both online appointments and ordering
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What can we expect from 5G?

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These are just some highlights of how the public benefits from mobile phones and what 5G will offer. But what's also essential is reliable mobile coverage and connectivity. Without this, we are at risk of not being able to use our phones or maximise it's potential if we experience poor coverage or no signal.

What do we need to enable mobile connectivity in the UK?

To maintain and improve mobile connectivity, it is crucial to recognise that this is only possible with the continuous deployment of mobile infrastructure throughout the UK. Mobile infrastructure (or masts as you might know them) can be placed on rooftops, greenfield sites, and street-works.

As the UK's leading mobile infrastructure services company, Cornerstone works with landowners, institutions, and public authorities to place mobile equipment on sites to enable telecom operators to deliver mobile services to the public.

With more advanced technology now available, placing mobile infrastructure has become even more necessary. To achieve this is a collaborative effort between telecoms, the legal & property industry, and landowners, and requires everyone to work together.

Recognising this, the Government introduced an updated version of the Electronic Communications Code (ECC) in December 2017, to help support the roll-out of mobile infrastructure. Ofcom also issued an ECC Code of Practice to help guide operators and landlords with site dealings and negotiations. Since the introduction of the new ECC, many landlords have been agreeing leases using the Code principles. This has helped operators and landlords, guiding them through the process and ultimately playing a key role in enabling mobile connectivity.

Working together

The future for digital connectivity in the UK lies in many of our hands. The telecom operators are constantly developing new technologies to provide better mobile services to the public in rural and urban areas. However, landlords play a crucial part in building the network too, allowing mobile infrastructure to be placed on their site. Without infrastructure, providing a mobile network to the public isn't possible, which would affect all of us as individuals and businesses.

We need to continue to work together to enable the opportunities that mobile technology brings to all of us.



Proud to be delivering sites for the
future of UK mobile connectivity.



Hive 2, 1530 Arlington Business Park
Theale, Berkshire, RG7 4SA
www.cornerstone.network

RADIO PLANNING AND PROPAGATION (V.4 November 2019)

An introduction to how radio networks are planned and the limitations associated with the technology

When planning cellular telecommunications networks engineers use specialist software to predict, with a high degree of confidence, the behaviour of cellular transmissions. This then enables the operator to calculate how many cell sites are needed to provide the level of coverage and capacity required by their customers.

Radio signals at the frequencies used for cellular radio propagate in a manner that is broadly similar to light. Generally anything that casts a shadow to light will attenuate radio waves. The strength of radio signals detected at a receiving device naturally reduces the further away it is from the transmitter. In general, the attenuation (or decay) in signal power is affected by a number of variables. The main factors are:

- signal frequency (attenuation increases with frequency),
- distance (from the transmitter),
- terrain (such as hills),
- clutter (such as buildings, foliage, vehicles, and water) and
- atmospheric conditions (such as rain).

A reduction in the strength of the radio signal increases the likelihood of dropped calls and reduced data rates for internet browsing, for example.

Clutter

Any physical object obstructing the propagation of radio signals causes a reduction in the signal strength reaching a customer's device. A common term for these objects is 'clutter'. The more obvious examples are buildings and geographical terrain such as hills and trees.

Buildings cause a varying amount of signal reduction depending on their height, construction, thickness of walls, number of windows etc. Glass causes a lower reduction in signal than brick/concrete walls.

Customers will inadvertently be aware of this by finding that sometimes they need to go near windows, a higher floor of a building or even outside in order to achieve a stronger signal for their mobile devices.

Generally, the higher the signal frequency the more it will be impacted by clutter.

Tree Clutter

The effects of trees on signal degradation can be significant. Signal absorption and shadowing effects vary according to vegetation and density, and are caused by the main tree trunk, branches, and leaves.

Cell sites located in or near trees will have signals significantly reduced. As a result, a number of extra sites may need to be built locally in order to counter-effect this.

Signal variation throughout the seasons is also a practical concern. Leaves on trees in the spring and summer can cause shadowing and reduce radio voice quality and increase the number of dropped calls.

As a result, the bottom of an antenna should a) be above the top level of the trees, b) allow greater height due to the antenna downtilt at build or for future requirements and c) allow some room for future growth of the trees.

When a cell site utilises point-to-point microwave dishes to communicate with other cell sites in the network any obstruction between these dishes will result in failed line of sight communications. As a result, dishes need to be placed above the top level of the trees.

Propagation Models

In essence these are mathematical formulae used to characterise radio wave propagation, in order to determine the signal strength at a receiving device.

Coverage Planning Tools

Radio planning engineers plan cellular networks using highly sophisticated computer programs that incorporate propagation models. Armed with data on cell site location, cell site configuration, maps, terrain etc. they are used to *predict* areas of coverage deficiency (so called 'coverage holes'), new site requirements and configurations.

Network Changes

Over time the topography and clutter in an area may change. For example, building developments, housing and tree growth can all change. As the signals received from local phone masts can degrade, as they are dependent on these factors. These reasons along with increased usage of mobile devices, customer complaints, network consolidation (mast sharing) and new technologies (5G) require a re-evaluation of a network operator's telecommunications infrastructure.

Mast sharing can result in some masts no longer being needed. As a result, they are decommissioned and physically removed. Mast sharing will however sometimes result in the need for a taller more substantial structure.

Technical surveys undertaken for reasons above may highlight that antenna height increases are required – this is more likely for sites with low antenna heights around 15m AGL, particularly street furniture sites. More details on these reasons below.

While thus far this document is generic to mobile telephony masts it should be noted that each mast has to be dealt with on a case-by-case basis.

Site Height increases

There are a number of reasons why an operator may request a height increase on existing structures. The main ones are described below.

Maintaining existing coverage

The antennas inside, for example, street furniture sites are generally of 2 physical build designs – 'Single Stack' and 'Dual Stack'. The former describes when the set of antennas are all at the same height. The latter describes a site with 2 sets of antennas one above the other.

The 'Dual Stack' is by far the preferred option. This is due to a number of factors including greater flexibility & control for different technologies and providing optimum service performance to customers.

Site upgrades such as network consolidation between Vodafone and Telefonica and/ or new 5G technologies facilitate a Single Stack structure being upgraded to a Dual Stack structure. In a straight swap scenario at equal height the new lower aperture antennas would be lower than they were originally - resulting in significantly reduced coverage. To ensure existing coverage is maintained the whole structure needs to be increased in height.

Clutter changes

A more extreme example is when the local clutter or tree lines have changed, or are such that the mobile signals are blocked, resulting in lower quality calls and downloads for mobile device users. To provide sufficient services to customers height increases on existing masts or additional new masts are required. The former is the preferred option in many cases.

5G Technologies

5G New Radio technologies operate in higher frequency bands than older technologies. Since it operates at higher frequencies where attenuation of the radio signal is naturally higher, and the effects of clutter are greater it will normally require a higher structure to achieve the same coverage footprint. Furthermore, unlike traditional technologies 5G uses adaptive beamforming technologies to increase capacity and data speeds to the user. For effective beamforming the antenna will normally need to be mounted higher than conventional antennas. These factors drive a require for an increase in antenna height in 5G

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

The addition of new technologies and mast sharing affects ICNIRP compliance, one of the health and safety requirements for a cell site, a higher minimum mast height is required in some cases.