The Institution of Engineering and Technology

Allaying health concerns regarding 5G and exposure to radio waves

An IET guide for local planning authorities regarding 5G masts and small cells

theiet.org/5g-health

Introduction

The UK has an ambitious programme[2] to become a world leader in 5G; the fifth generation of mobile technology. The aim of this document is to give local planners a better understanding of what 5G is – and isn't – as this affects both future coverage and concerns that have been expressed about exposure to radio waves. The document is intended to be a brief overview and references for further reading are provided at the bottom of each page.

What is 5G?

5G is the next transformational technology that will provide the underlying wireless infrastructure to cope with relentless rise in data consumption and support many new applications[3]. This includes everything from connected cars and virtual and augmented reality through to the foundations for emerging smart city and Internet of Things (IoT) technologies.

Features of 5G

Faster download speeds
It's expected that 5G will provide speeds of between 1GBps and 10GBps; much faster than today's 4G networks. This would mean a full HD movie could be downloaded in 10 seconds, as opposed to 10 minutes today.

Lower latency
5G has been designed to have significantly lower latency, meaning very little lag, or buffering. This could enable mobile applications that simply aren't possible today, such as multiplayer gaming, factory automation and other tasks that demand quick responses.

Greater capacity
5G will also have vastly greater capacity, allowing networks to better cope with not only the rapidly increasing data demands of customers today, but also the growth of high-demand applications being planned in the future.

[2] Department for Culture Media & Sport "*Next Generation Mobile Technologies: A 5G strategy for the UK*" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf

[3] Ofcom "*Enabling 5G in the UK*" https://www.ofcom.org.uk/__data/assets/pdf_file/0022/111883/enabling-5g-uk.pdf

Key observations

1. Operators will continue to design and build sites to be rigorously compliant with the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The commission's guidelines cover all frequencies used for 5G.

2. The use of small 5G base stations in towns and cities will reduce exposure of radio waves to individual smartphone users.

3. The most widely deployed 5G spectrum band in public places will be 3.6GHz.

4. A new generation of 5G antenna called massive MIMO will not be 'massive'.

5. A good 5G fibre based local broadband infrastructure will be important to local communities over the coming decades.[1]

[1] Future Telecommunications Infrastructure Review, DCMS, 23 July 2018 see https://www.gov.uk/government/publications/future-telecoms-infrastructure-review

EMF exposure guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)

Mobile operators in the UK design and build their masts, rooftop antennas and other installations to be compliant with exposure guidelines developed by the ICNIRP[4].

These guidelines are prepared following a comprehensive assessment of all the peer-reviewed scientific literature, including thermal and non-thermal effects. The guidelines are based on evaluations of biological effects that have been established to have health consequences. The World Health Organisation (WHO) recommends that countries adopt the ICNIRP guidelines[5].

As part of the process for obtaining planning consent for new 5G sites and upgrades, each operator will continue to confirm compliance with ICNIRP guidelines[6].

Exposure levels due to 5G small cell networks

Small cells, also known as micro-cells or pico-cells, are smaller antenna systems designed to work over a very short range, such as a hundred metres. They can be deployed in high usage urban areas, in conjunction with large cells on normal masts, to ease network congestion[7]. Some people have expressed a concern that a large number of 5G cells may increase a person's exposure to radio waves.

However, the particular feature of cellular radio is that every time a new base station or cell is added, the distance the signal has to travel is shorter. Therefore, under the laws of physics, the power needed is reduced, leading to a decline in the smartphone power level required to connect to a base station. For many people, their smartphone will be by far the nearest source of radio wave energy to their bodies. As a result, more 5G cells will lead to a reduction in the overall radio wave signal strength an individual smartphone user is exposed to[8].

4 See https://www.icnirp.org/en/frequencies/high-frequency/index.html
5 World Health Organisation Standards and Guidelines https://www.who.int/peh-emf/standards/en/
6 See https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/mobile-wireless-broadband/exposure-electro-magnetic-fields
7 See https://www.smallcellforum.org/what-is-a-small-cell/
8 "*Public exposure to radiofrequency electromagnetic fields in everyday microenvironments: An updated systematic review for Europe*" September 2019 https://www.sciencedirect.com/science/article/pii/S0013935119303068 and "*Impact of 5G technology on human exposure*" Dr. Fryderyk Lewicki ITU-T SG5, Chairman of WP1 Orange Polska, Poland Expert Meeting: Electromagnetic Field Level and 5G Roll-out November 2017 https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Events/2017/EMF/Fryderyk.pdf

The most widely used 5G band in the UK will be 3.6GHz

The UK and Europe will use three bands for 5G[9]. These are termed the 5G pioneer bands and each has a different purpose.

700MHz

This band is to secure pervasive national coverage. It's likely to be deployed from the traditional tall mobile phone masts.

3.6GHz (3.4-3.8GHz)

The 3.6GHz band sits between the current WiFi bands at 2.4GHz and 5GHz that are already widely deployed in smartphones, homes and offices. 3.6GHz is the 'sweet spot' for achieving the best capacity over the largest areas for the lowest cost, and has wide international support. The mass deployment of small low power base stations in towns and cities will most likely use this band as the cost of covering wider areas is much lower than at 26GHz[10].

26GHz

Sometimes referred to as millimetre or mmWave, 26GHz will be used to provide very high capacity in the limited number of locations of exceptionally high traffic density and applications, such as industry 4.0 (very advanced manufacturing). It will also be used in the relatively few locations where the 3.4-3.8GHz band maxes out. Total coverage by mobile operators at this frequency could be as small as 3% of the UK land area[11].

The 5G massive MIMO antenna

The name given to a new kind of 5G antenna – Massive MIMO (multiple input, multiple output) – has provoked some unnecessary concerns.

Although the name would imply something large in scale, in reality the antenna elements of a massive MIMO system are actually tiny. An antenna helps direct the radio energy along a specific path, known as beam forming, rather than spraying it in all directions.

For the past 20 years mobile operators have typically used three or four sectored antennae, so as not to waste radio energy in directions where it's not needed. The 5G massive MIMO antenna makes the transmission more efficient, with the equivalent of 40 sectors, each delivering the same power to a user standing at the edge of coverage but wasting less energy to achieve this[12].

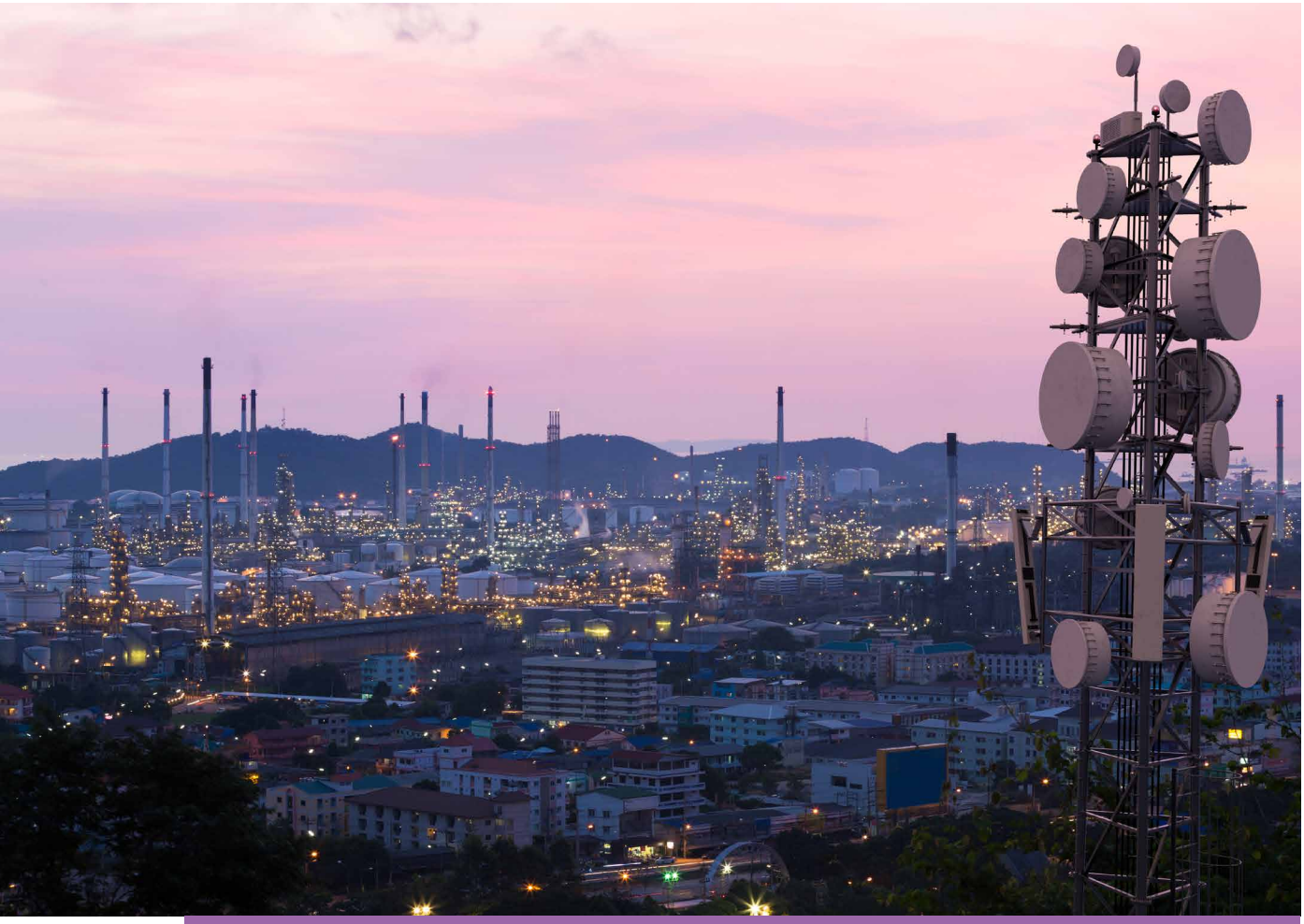
[9] European Commission Radio Spectrum Policy Group's "*Strategic Roadmap towards 5G in Europe*" https://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf and IET "*5G Networks for Policy Makers*" report https://www.theiet.org/media/1166/5g-report.pdf

[10] Ofcom "*Enabling 5G in the UK*" March 2018 paragraph 1.13 https://www.ofcom.org.uk/__data/assets/pdf_file/0022/111883/enabling-5g-uk.pdf

[11] techUK "*UK SPF publish principles for the release of 26 GHz 5G pioneer band*" https://www.techuk.org/insights/reports/item/15915-uk-spf-publish-principles-for-the-release-of-26-ghz-5g-pioneer-band

[12] IEEE Spectrum "*5G Bytes: Massive MIMO Explained*" https://spectrum.ieee.org/video/telecom/wireless/5g-bytes-massive-mimo-explained

Conclusion



This document has aimed to set out the reality around concerns regarding radio wave exposure, mobile coverage and 5G.

Small 5G base stations in our towns and cities will allow improved network coverage. They will reduce radio wave exposure to individual smartphone users and improve local 5G capacity for all manner of useful bandwidth-hungry applications. And a good 5G fibre base local broadband infrastructure will be important to local communities over the coming decades in view of the ever-increasing amounts of data being consumed by the general public.