



## **Submission to the National Infrastructure Commission for its inquiry into 5G from Mobile UK**

### **About Mobile UK**

Mobile UK is the trade association that represents the UK's mobile network operators: EE, Telefonica UK (O2), Three and Vodafone.

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## 1. Introduction: What is the case for 5G?

The mobile industry across the world is currently investing heavily in **4G**. In the UK, operators are spending £2-2.5 billion per annum in new network deployment, adding to geographical coverage and capacity, to meet increasing demand from customers, particularly for data. 4G is providing significantly increased download speeds, giving a truly mobile broadband experience. It is expected that 4G technology will be with us for many years. Nevertheless, there already much interest in 5G, which will deliver even higher download speeds and lower latency (i.e. quicker response times).

First, this is part of the natural mobile cycle, where work on the standardisation and spectrum allocation starts on the next generation just as the prior generation comes to market scale.

Secondly, the increased capability of 4G is revealing a considerable latent demand for mobile data, both in terms of more volume, increased speeds and lower latency (reaction time – very important for some sensory applications). This pattern of capability revealing latent demand is very typical in the mobile industry and it is expected to continue with 5G, as more and more subscribers use smartphones (currently 67%) and ‘machine to machine’ (Internet of things) applications are deployed.

The economic and social impact is expected to be considerable. For example, the tables below set out the results of a study carried out by Real Wireless on behalf of the European Commission (published in May 2016.) The study focused on four vertical markets (automotive, healthcare, transport and utilities) and four environments (smart cities, non-urban areas, smart homes and workplaces) to investigate the potential impact of 5G in the EU. In particular, 5G is expected to generate indicative benefits of €95.9 bn per annum in the four selected verticals by 2025 and benefits of €50.6 bn in the four environments by 2025. 63 per cent of these benefits will arise for business and 37 per cent will be provided for consumers and society.

<b>Economic &amp; Social benefits for 5G in the EU: Net annual benefits from 4 selected environments</b>					
<b>Environment benefits</b>	<b>Smart City (€ bn)</b>	<b>Non-Urban (€ bn)</b>	<b>Smart Home (€ bn)</b>	<b>Workplace (€ bn)</b>	<b>Total (€ bn)</b>
Economic	Reduced traffic congestion	Enhanced access to broadband	Reduced cost of domestic burglary	Supply chain integration and economies of scale and scope	21.42
Social	Reduced road accidents	Online purchase savings	Reduced healthcare costs	Accident reduction	12.40
Environment	Reduced congestion emissions	Reduced congestion emissions	Decrease in energy consumption	Reduced waste production	16.77
Total	8.12	10.54	1.33	30.60	50.59

**Source: Real Wireless, 05/'16**

<b>Economic &amp; Social benefits for 5G in the EU: Net annual benefits in 2025 from 4 selected vertical markets</b>					
<b>Vertical benefits</b>	<b>Automotive (€ bn)</b>	<b>Healthcare (€ bn)</b>	<b>Transport (€ bn)</b>	<b>Utilities (€ bn)</b>	<b>Total (€ bn)</b>
Strategic	Real time telematics data	Preventative care	Real-time telematics data	Peak demand smoothing via smart meters	32.77
Operational	Supply chain integration and economies of scale and scope	Wearables and increased operational efficiency	Increased loads and operational efficiency	Operational efficiency from smart meters	11.85
Consumer	Infotainment	Reduced healthcare	Delivery tracking	Decrease in energy consumption	24.11
Third party	Telematics data	Health data and reduced drug testing costs	Telematics data	Data sharing for energy as a service	27.17
<b>Total</b>	<b>75.60</b>	<b>5.53</b>	<b>8.30</b>	<b>6.47</b>	<b>95.90</b>

**Source: Real Wireless, May 2016**

### *Connected things*

From the tables above, it is clear that, in addition to a significant increase in data consumption by people, it is expected that there will be very strong growth in machine to machine applications. Currently, only about 6 million ‘things’ are connected in the UK – mostly remote measurement or tracking devices. With the imminent arrival of ‘smart meters’ in homes, this number will increase rapidly in the next few years.

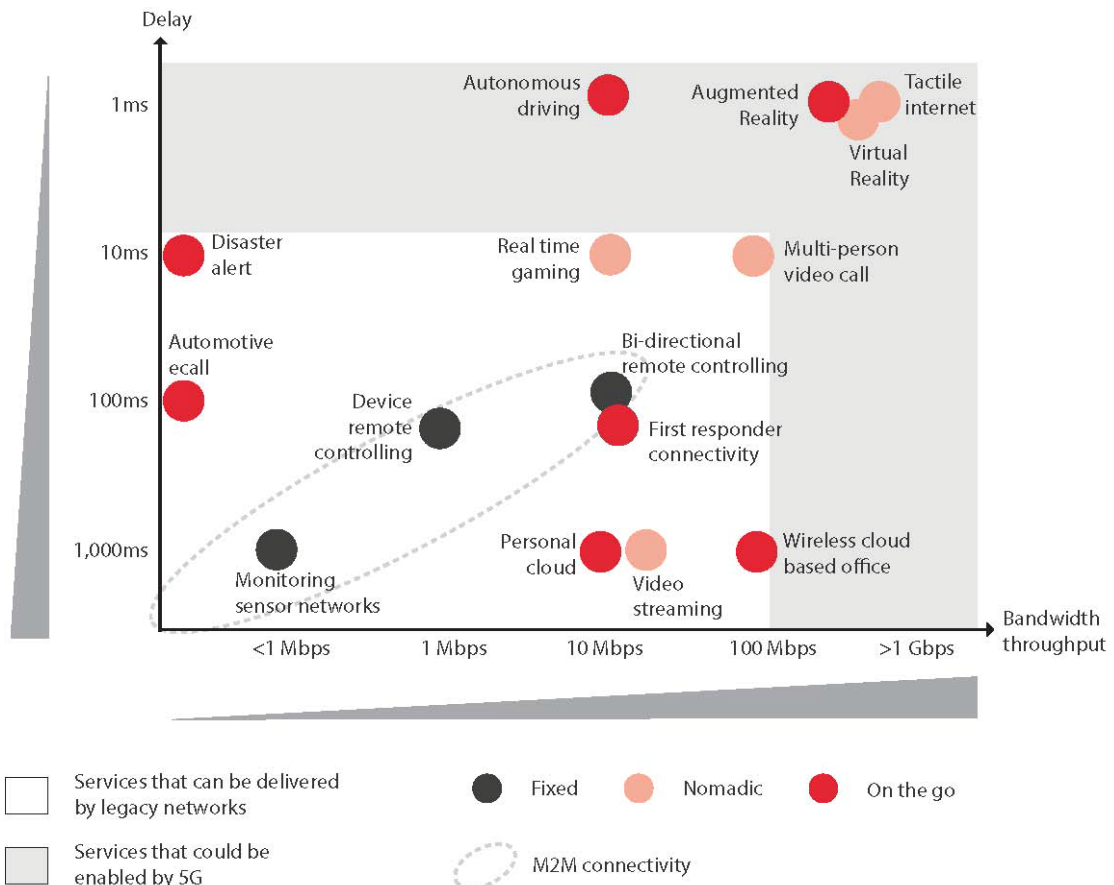
In addition to smart meters, many other applications will be developed, driven mainly by the need to make modern urban environments healthy and convenient places in which to live by, for example, delivering:

- Efficient use of energy (minimise power generation and transmission)
- Low levels of pollution and traffic congestion, good public transport
- High levels of recycling and waste management
- Increased citizen engagement

**5G** will play an important part in delivering such benefits, where networks will collect and/or transmit data (through sensors and other mobile connections), often in real time. Good use of mobile and other technologies is fundamental to a city’s or a region’s competitive advantage. Likewise, in the countryside, mobile networks will be needed to sustain local communities and

businesses, make farming more competitive in global markets, support tourism and many other applications.

Figure 1: Diagram of potential 5G use cases



Source: GSMA

It is too early in the technology development cycle to say which of the applications in Figure 1 will be widely adopted and which will not. The history of the industry is that the networks provide the platform, using 'best efforts' insight into which capabilities will be useful. It is not until customers apply their ingenuity that the full extent of demand becomes apparent.

## 2. What will 5G look like?

The spectrum allocations for 5G are not yet settled through the process of international negotiation. Broadly, 5G will operate in some UHF bands, in the range of 700MHz to 6GHz (similar to mobile services today) and, in addition, in the 'millimetre wave' bands, around 30GHz and above.

It is at these extremely high frequencies that 5G will achieve very high bandwidths (it has been suggested up to 1,000 times 4G) and low latency over a short range.

In urban areas it can be expected that 5G will be deployed on existing macro cells to enable mobile operators to match their network capacity with the increase in growth of mobile broadband, and will be complemented by small cells operating in the extremely high frequencies supporting new services and the most demanding traffic densities. Small cells will use base stations and antennas that will be much smaller in appearance, located on buildings, lamp posts and other street furniture.

In less populated areas, there will also be demand for 5G services, not least because some applications may rely on having a mobile connection at all times. This will present similar challenges to previous generations, where it is economically unviable to deploy mobile networks. While spectrum licence conditions for 4G and other competitive factors will mean that there is very extensive 4G coverage by 2020 and that this will provide a good base on which to overlay 5G, the micro cell architecture (short range) needed for some applications could continue to present challenges for viable deployment.

## 3. How can the National Infrastructure Commission (NIC) contribute?

The NIC can make an important contribution to the development of 5G in the UK, particularly with the extension of coverage and the stimulation of the public sector as a buyer. (In Figure 2, below, Red signifies greater contribution, yellow, less so).

Figure 2: summary of activity leading up to 5G

Activity	NIC Input
Standardisation	Yellow
Spectrum	Orange
Research	Orange
Coverage	Green
Public sector as a buyer	Green

### a) Standardisation process

5G standards are presently under discussion at 3GPP<sup>1</sup>. 3GPP have announced their planned timetable for produce the first official release of 5G specifications<sup>2</sup>. Mobile UK would not expect

<sup>1</sup> <http://www.3gpp.org/about-3gpp/about-3gpp>

the NIC to be involved in detailed way with the standardisation process. It should be sufficient to have visibility of how the UK Government is contributing and that what they are saying is consistent with the nation's long term infrastructure needs and the EU's ambition that 5G networks will start to be deployed by 2020.

## **b) Spectrum**

Spectrum allocations have to be agreed on an international basis. This work is underway through the offices of the World Radio Conference. The UK, through Ofcom, contributes.

Once 5G bands are agreed, it will then be necessary for the Government (with the assistance of Ofcom) to proceed with schemes to clear the relevant bands in a timely manner and to re-allocate them in a fair and open process, designed to maintain competition.

This did not happen with 4G, where the UK auction was late, relative to our international competitors, which potentially left UK business and consumers at a disadvantage.

Since 2000, the mobile operators have paid around £25 billion in radio spectrum fees. While Mobile UK recognises that [well designed] auctions are the fairest way of allocating spectrum, there needs to be continuing vigilance to ensure that this method, as is required under the Wireless Telegraphy Act, is used exclusively to allocate spectrum to those that are going to make the best use of it, and not to maximise funds for HM Treasury. Annual Licence Fees must also be kept under review, so that they are used for their strict purpose – efficient use of spectrum, not maximising funds for the Treasury.

This is a role that the NIC can play, as all these matters have a direct impact on operators' ability to invest in infrastructure.

There can be little doubt that, while the £25 billion 'negative subsidy' has benefited other parts of the economy, it has not helped mobile coverage. £150 million was given by the Government for the Mobile Infrastructure Project ('MIP'), to cover 'not spots' but much of this was not used, as the contracted party was not able to roll out sites as quickly as the Government had hoped. Mobile UK believes, nevertheless, that lessons can be learned from MIP and that there will be future opportunities for targeted subsidies or co-investment schemes to improve coverage (see 'coverage' below), where it is justified by broader economic and societal gains.

## **c) Research**

While the UK does not have a 'national carrier' handset manufacturer such as Samsung or Apple, or for network infrastructure such as Ericsson or Huawei, it is very strong in many other aspects of mobile – such as networks, chip-making, network software and

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<sup>2</sup> <http://www.ispreview.co.uk/index.php/2016/06/3gpp-agrees-timetable-first-official-5g-mobile-specifications.html>

applications. Research test beds have been established in the UK (e.g. 5GIC at the University of Surrey.)

The NIC can ensure, through its recommendations and encouragement, that the UK's research centres are well supported, so that the UK can be a global centre of excellence for the advanced application of mobile technology. The 'centre of excellence' approach is demonstrably effective at creating a virtuous circle for attracting talent and venture capital to boost innovation and a skilled workforce for the UK.

#### **d) Coverage**

For the foreseeable future, mobile operators will need to continue to invest in new geographical coverage, capacity and network capability (for example putting 'intelligence' closer to the edge of the network improves the user's experience of many applications). Business customers, consumers and 'things' will demand it.

#### *Planning law and Electronic Communications Code*

While the respective governments of the UK's nations are currently updating planning legislation for communications network (and other facilities), this is unlikely to be a 'once and for all' exercise. Over the years people have become more tolerant of the visual impact of mobile infrastructure, as their need for a mobile connection has become more pressing. This trend is likely to continue (and, with much mobile infrastructure being far smaller, less contentious).

Currently the UK builds smaller (thus more expensive) infrastructure than all other European nations. This could only harm 5G deployment. While current reforms start to address this, NIC must make sure that the planning laws are regularly reviewed, so that there is maximum freedom for small cell deployment, enabling operators to meet the needs of citizens for mobile coverage, in line with their expectations and consistent with operators' responsibilities for compliance<sup>1</sup> and the environment.

The UK Government is also reforming the Electronic Communications Code through the Digital Economy Bill. By changing the basis of valuation for the mast sites, the policy objective is to make it more viable to deploy network infrastructure, particularly in rural areas. In parallel with this reform, interested stakeholders (principally site providers and mobile operators), led by Ofcom, are creating Codes of Practice that are intended to provide a framework for site provision whereby the commercial process of coming to agreement, and of maintaining an agreement, can take place simply, quickly, and straightforwardly, against a backdrop of a clear set of expectations on both parties. The NIC can add considerable value by making sure that the impact of the ECC and associated codes are effective in meeting the Government's objective of wider and deeper mobile coverage.

### *Coverage in special situations*

The NIC has a strong role to play in ensuring that all new infrastructure projects, such as roads, railways and tunnels make proper provision for mobile coverage.

Retro-fitting mobile coverage after the fact can be much more expensive (even uneconomic) than building it in as part of the project. The Channel Tunnel is an example of where coverage was only installed many years later, at far greater cost.

Railways, with their deep cuttings are particularly difficult to cover with a mobile connection. The construction of HS2 and other advanced lines should incorporate radio planning as part of the project build.

These arguments apply not only to the radio coverage but also to other elements that go to building a mobile network, such as access to backhaul and power.

As discussed above, the NIC should consider recommending that, where the business case for installing mobile cannot be made by any one party, but there is clearly a use case (and a positive externality), Government money (in a good use of spectrum auction receipts) could be used to make the business case for funding or partially funding network roll-out.

#### **e) The Public Sector as a buyer**

The public sector – central government, local government, the health service, Highways Agency etc. etc. all have a pressing need to make productivity gains, to deliver services without reducing quality and for less cost. One the most effective ways of doing this will be to make better use of technology, particularly mobile technology. There are many examples of good practice in the public sector but many of them are isolated and not rolled out sufficiently broadly<sup>3</sup>.

The NIC has a potentially very positive role to play in encouraging the public sector to make use of the communications infrastructure at its disposal. This tends to deliver exponential benefits, where projects are done at scale, experience and knowledge is spread more widely and unit costs are reduced. The public sector investing in new applications also gives operators added confidence to invest in new capacity and coverage.

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<sup>3</sup> [http://www.local.gov.uk/productivity/-/journal\\_content/56/10180/6357119/ARTICLE](http://www.local.gov.uk/productivity/-/journal_content/56/10180/6357119/ARTICLE): Transforming local services through digital



#### 4. Conclusion

Over the last three decades, mobile communications has continually demonstrated its ability to grow, to evolve and to surprise, from telephony and text messaging to fast internet and the mobile Internet of Things.

None of this has happened by accident. It has taken vision and effort on the part of investors and entrepreneurs, business providers, governments and regulators, and civil society itself – often working in collaboration and partnership - to create the ingredients for success: open, secure standards, co-ordinated radio spectrum, and a viable regulatory and legal framework.

Mobile network operators have played a central role in this by continually investing in the network infrastructure and value added services, as well as subscriber acquisition.

World-leading mobile infrastructure has become a source of competitive advantage for nations. As populations become more urban based, those cities that offer the best environment ('smart', low carbon etc.), underpinned by high speed mobile networks, will attract a talented workforce and create a virtuous circle of improvement - a new industrial revolution.

Likewise, in the countryside, mobile networks will sustain communities and support rural industries, such as farming and tourism, in increasingly competitive global markets.

Given the platform, consumers and businesses have shown extraordinary ingenuity in harnessing mobile to be more creative and productive, to offer new services and to improve lives.

Mobile UK has identified actions where NIC can make a direct or indirect contribution:

- Encouraging the Government and Ofcom to release spectrum for 5G in a timely manner
- Advocating a legal and regulatory framework that attracts investment and makes network roll-out more economically viable, in a world where there is strong competition for capital and talent
- Ensuring that all major infrastructure projects, such as tunnels, rails and roads, make provision for mobile communications, including access to backhaul and power
- Promoting research, particularly into applications, and far wider adoption of mobile technologies and processes by the public sector

World class mobile networks are a source of national competitive advantage. It will remain extremely important that, as a nation, we can attract investors to locate businesses in the UK by offering leading communications infrastructure, including mobile. With its very strong operator base, the UK is already a leading provider of 4G services. With the support and the actions of the wider stakeholder group, including the NIC, this can be carried forward into 5G, underpinning success in the mobile sector, and to the benefit of the UK as a whole.

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<sup>i</sup> *Health & Safety*

The industry has always recognised its responsibility to maintain public confidence with regard to any potential health effects from electro-magnetic fields.

Research into the safety of radio signals, which has been conducted for more than 50 years, has led to the establishment of human exposure standards including safety factors that provide protection against all established health risks.

The strong consensus of expert groups and public health agencies, such as the World Health Organisation, is that no health risks have been established from exposure to the low-level radio signals used for mobile communications.

The WHO and the [International Telecommunication Union \(ITU\)](#) recommend that governments adopt the radio-frequency exposure limits developed by the [International Commission on Non-Ionizing Radiation Protection \(ICNIRP\)](#).

In the UK, the Government has adopted the exposure limits developed by ICNIRP and mobile network operators operate within these guidelines.