

# How government can drive 5G innovation

The UK is establishing itself as a global leader in developing, trialling, and implementing 5G solutions. This UK lead can provide tremendous support for the government's goals to raise productivity and growth, and to develop and implement a modern Industrial Strategy. However, unless we take action now to maintain and build on this leadership, our potential competitive advantage may be quickly eroded by a series of infrastructure and policy barriers.

In this short paper we set out four vital strategic actions for the government to take **now**.

First, government should recognise the value of public street furniture as a key strategic infrastructure asset. Street furniture offers a unique opportunity to rollout a 5G network at scale – if a coordinated approach to leveraging these assets at national scale is developed.

Second, there should be a focus on ensuring efficient usage of all digital infrastructure. Across the UK, for instance, a strong fibre network is already in existence. However, it is owned by a complex range of organisations working in silos. Fibre sharing should be prioritised, and regulated if necessary, in order to deliver a functioning pan-UK network.

Third, government should pursue a more nuanced approach to spectrum policy. The lease and sub-lease of the operators' spectrum to non-operators is important and requires clearer and more permissible regulation. This would allow a wide range of organisations to explore use-cases – building expertise, delivering innovation, and de-risking network investments for operators.

Finally, there needs to be a national approach to building skills in 5G. The unprecedented nature of 5G technology demands a shift in skills and expertise. Only by building the technology leaders of the future will the UK remain a global leader in 5G.

The above recommendations are founded on, and drawn from, King's work in delivering 5G in a real-world UK setting. This work has highlighted what is and is not working in the 5G ecosystem. These recommendations must be prioritised in order to deliver innovative and sustainable developments in 5G, and to maintain the UK's global leadership.

## Introduction

5G is the communications technology that will drive many major solutions in the coming decades. However, more needs to be done to ensure that the benefits of 5G can be realised in the UK from a business and service point of view. As international investments in 5G technology continue apace, this is a critical moment for the UK to solidify its position as a leader in 5G. King's has significant and practical understanding of real-world deployments of 5G technologies. This experience has encouraged King's to make the following four recommendations to government, in order for the UK to leverage the potential of 5G.

### 1. Better utilise public street furniture for 5G network deployment

King's work on 5G has confirmed the importance of public street furniture as a key infrastructure asset. This is particularly the case with urban deployments, demonstrated by King's partnership with the City of London, but also has particular relevance in wider settings.

5G demands radically different network infrastructure. Depending on connectivity and use-case requirements, this may include a significant increase in base-stations, line-of-sight connections, and large-scale area coverage. In particular, accessing electricity and backhaul (including for fibre and millimetre-wave deployments) can be costly, complex, and time-intensive. For example, a recent King's deployment took seven months of negotiations, planning, and discussion to install three base-stations – despite these buildings being owned by the university.

Across the UK, street furniture offers enormous potential to enable many 5G network deployments and use-cases. There are over five million street-lamps in the UK, and thousands of other structures that are suitable for siting of network equipment. Street furniture enables coverage of 5G at the largest scale, and should be recognised as a key strategic asset that brings 5G to the entire population of the country.

However, efforts to utilise street furniture to enable strategic 5G network deployment cannot wait. Its potential in rolling out 5G technology must be explored now. Currently, 5G development and implementation is occurring in siloes. These projects are led by a range of organisations – but with few wider partnerships, and a limited focus on scaling up pilot projects or identifying opportunities for larger-scale network deployments. Street furniture is a foundation that can tie them all together. Ignoring or marginalising this unique infrastructural asset will impair delivery of effective UK 5G coverage.

With this in mind, King's makes the following recommendations:

- **Create a holistic policy framework for accessing public street furniture nationally:** currently, operators and other 5G stakeholders must negotiate a complex and unclear world of local authorities, public and private landowners, and other gatekeepers to access street furniture. Government must make it as simple as possible for operators to deploy 5G infrastructure in an economically-viable way. Street furniture could be managed similarly to how radio spectrum is offered at national scale today: the key requirements are that it is a national framework and that it creates a clear process for all stakeholders.
- **Street furniture policy should be 'owned' by the Infrastructure and Projects Authority (IPA):** the IPA recognises the value of 5G connectivity, and the importance of a joined-up approach to infrastructure strategy. Providing the IPA with policy ownership relating to public street furniture would prevent protracted and confusing discussions in deploying 5G infrastructure. It would ensure that local authorities and other street furniture owners are fairly compensated, that the role of street furniture is recognised, and enable operators to roll out 5G at (national) scale.

We welcome the steps the government has taken thus far in creating the Barrier Busting Task Force and the formation of the Local Connectivity Group, both of which aim to address barriers to deployment and improve access to public sector infrastructure, with evidence gathered through the recent Future Telecoms Infrastructure Review.<sup>1</sup>

## 2. Prioritise efficient usage of public and private digital infrastructure

The UK benefits from an extensive network of digital infrastructure. This includes connectivity provided by telephone companies, Internet service providers, private infrastructure companies, and public institutions – including Network Rail, local authorities, and the NHS. This is particularly the case with fibre, a key foundation for 5G fronthaul, backhaul and core network

connectivity. For instance, Network Rail manages 16,000km of fibre across the UK.

King's has worked closely with a range of partners, who have provided their own network assets as a foundation for 5G use-cases and wider partnerships. In addition, King's has developed a thin technology layer, in the form of software, which can control different connectivity assets. This allows management of fibre belonging to different organisations, as well as joining up all forms of cellular, Wi-Fi, and Cloud connectivity. It has been proven as a cost-efficient approach in enabling shared infrastructure provision on a bottom-up basis. However, more can be done – including through more effective regulation.

King's work has confirmed that a significant amount of network development and rollout is led by individual organisations, and not partnerships. This is not conducive to enabling the catalytic potential of 5G for all parts of the UK. Instead, fibre and other digital infrastructure must be shared on an as-needed basis. The transformational potential of 5G can only be realised by considering the bigger picture – moving beyond simple asset ownership and immediate costs, and focusing on the value of the wider network and its social, economic, and wider multipliers.

In short, the UK has an existing fibre network that could drive 5G deployments at the biggest scale. However, this network is not being used at maximum economic and operational benefit. Effective, sustainable, and efficient rollout of 5G demands a new approach to infrastructure sharing. In order to enable this, King's makes the following recommendations:

- **Fibre sharing should be prioritised, and regulated if necessary:** government should encourage fibre sharing among public institutions – including Network Rail, and Transport for London – private operators (such as BT, Sky, and Virgin Media), and government bodies (notably the Janet network). This may require a stocktake of current fibre assets, developing a mandate to join up fibre provision for national benefit, implementing ultra-secure multi-tenancy, and supporting further refinements (including upgrading existing routers with software-defined technology). Building a network to drive 5G rollout across the UK demands joined-up policy and actions.
- **Fibre deployment should be at the heart of all public and private construction projects:** construction – including housing, highway development and maintenance, and a wide range of public and private works – touches every part of the UK. Fibre co-deployment should be a priority in all construction projects, to ensure that a future-proof network can be built in an efficient way.

### 3. Ensure spectrum regulation fosters innovation

Spectrum is a key asset for 5G connectivity – these airwaves are a crucial component of 5G networks and use-cases. However, spectrum policy needs to become more nuanced. It should move beyond a focus on one-time profit maximisation – highlighted by government’s focus on auctioning spectrum at a scale affordable to only the largest operator – and instead should foster a culture of innovation.

Government should consider the considerable benefits of a phased or sub-leased approach to spectrum sales, and a long-term view of spectrum as an asset. This is particularly important in enabling more effective rollout of 5G technology. There needs to be a legal and policy framework in place to allow enterprises such as manufacturing sites, shopping malls, cultural institutions, and wider private sector organisations to build their own networks for their own clients – in conjunction with traditional operators. These networks will enable quick coverage and capacity provisioning in areas out of business interest to operators.

Such network innovation has been demonstrated by King’s work on 5G. King’s has a range of spectrum test licenses and, because of these, has been able to develop, test, and deploy the first attempts at 5G in the UK. This has attracted significant interest and attention from operators, who – with a few exceptions – are unable to commit considerable resource to exploring an unknown technology proposition. King’s work has generated huge multipliers for operators, vendors, and a wide range of stakeholders. It has significantly increased the sector’s understanding of the intricacies of 5G, and accelerated the exploration and development of 5G business cases and use-cases.

There is a particular urgency associated with this area. Operators remain uncertain of the business case of 5G. They are likely to focus on serving the main outdoor areas with 5G coverage, but remain hesitant to commit to delivering wider connectivity. Therefore, to ensure that complete coverage is not delayed, as was the case with 4G technology, 5G spectrum rollout should be ‘crowdsourced’. Government ought to provide a role and opportunity for organisations to explore the potential offered by 5G, beyond the usual operators. This wider approach to spectrum would also de-risk further spectrum investments on the part of operators. King’s therefore recommends that a:

- **Framework for alternative spectrum licensing models is enabled:** this would allow access to spectrum by new types of users and service providers, such as wholesale infrastructure service providers. Such models might include leasing and subleasing over given locations and time-horizons, light licensing based on a first come, first served basis, or Dynamic Spectrum Access, which permits access to spectrum

on an opportunistic basis, subject to the licensee always having agreed priority access. Organisations making use of that 5G spectrum would not become mobile or virtual network operators. Instead, they would have the opportunity to explore and demonstrate important network deployments, which would not often be prioritised by operators due to uncertain returns on investment. This framework must have a strong economic and legal definition, should ring-fence the business of operators and the creativity of enterprises, and safeguard the interests of all clients and customers.

### 4. Establish a national approach to building skills in 5G

5G is an unprecedented shift in technology development, deployment, and usage. However, the skills to leverage the benefits offered by 5G are currently in short supply. In addition, 5G technology is likely to be commoditised ahead of skills. This issue has been recently highlighted by other technological developments – such as Artificial Intelligence, Big Data, and the Internet of Things – where significant effort has been expended to ensure that skills ‘catch up’ with the demands of the above sectors. Building a strong and sustainable foundation of suitable 5G skills is central to supporting, growing, and driving innovation across the 5G ecosystem. This will be particularly the case when 5G is fully operational, but should be prioritised now in order to identify the skills and knowledge that will be required to drive and maintain UK leadership in 5G. Skills should be institutionalised, and expertise should be fostered – and not solely bought in or imported.

King’s has focused on building skills and expertise across the UK. This has included developing curriculums, running webinars and delivering other forms of learning, and highlighting the knowledge that will be needed for academic, public, and private organisations to leverage the exciting potential of the technology. 5G will only succeed if its role, attributes, and intricacies are understood across the UK.

The UK is starting from a very strong position. In recent years, the UK has developed an enviable reputation as a leader in software development – a key asset when considering that much of 5G development will be software-led. Similarly, the UK has led the way in identifying the benefits and requirements of new and exciting technologies, demonstrated by the country’s global leadership in Artificial Intelligence. King’s therefore recommends that:

- **5G software skills should be at the heart of university Computer Science and Engineering curriculums:** 5G development and deployment requires a wide range of new skills, and demands innovative ways of exploring current and future connectivity projects. Therefore, universities and higher education institutions should identify the skills required



– whether in network security, architecture design, or wider technology development – and build future-proof curriculums that develop the next-generation of 5G talent.

- **A national 5G innovation and acceleration platform is launched:** building on the success of the 5G Hub – which brought together King’s and partner universities – there is a need for a longer-term platform that identifies and prioritises the skills and structures needed for 5G. This platform could be hosted by a university or similar, or be a virtual entity. However, it must be long-term, and should have strong links with industry, government, and academia.

## Conclusion

The UK has a unique opportunity. Through government leadership and investment in initiatives such as the 5G Testbeds and Trials Programme, the initial foundations of 5G are being built across the UK. However, delivering 5G – and its transformational benefits – to all areas of the UK demands a holistic approach to the technology, from skills to infrastructure provision.

This work must be done now. The UK is currently a global leader in 5G, however in such a fast-moving landscape this advantage could be lost quickly. Beyond this, aspects of the above recommendations will have some setup time, and all demand a cross-government response.

These are radical recommendations, but they are not made lightly. Each recommendation is directly linked to the experience of King’s in developing and implementing 5G in a real-world setting. King’s considers them to be crucial steps to take in order for the UK to maintain its leadership in 5G, and to deliver the benefits of 5G to citizens in all parts of the UK.

In 2017, King’s College London – in partnership with the University of Surrey and the University of Bristol – was funded by the Department for Digital, Culture, Media, and Sport to develop, test, and demonstrate 5G technology. As part of this work, deployments in culture, health, entertainment, and other sectors are being developed by King’s College London and partners. The 5G Testbed project is based in the Department of Informatics, at King’s College London.

## About the team

**Professor Mischa Dohler** is full Professor in Wireless Communications at King’s College London, driving cross-disciplinary research and innovation in technology, sciences and arts. He is a Fellow of the IEEE, the Royal Academy of Engineering, the Royal Society of Arts (RSA); and a Distinguished Member of Harvard Square Leaders Excellence. He is a serial entrepreneur; composer & pianist with 5 albums on Spotify/iTunes; and fluent in 6 languages. He acts as policy advisor on issues related to digital, skills and education. He has had ample coverage by national and international press and media.

**Dr Maria Lema Rosas** is currently the technical project manager for the 5G UK Testbeds and Trials project as well as the lead Researcher for the Ericsson-sponsored 5G Tactile Internet project at the Centre for Telecommunications Research, King’s College London. Maria has been heavily involved in the definition architecture and use cases for 5G, working together with various industry verticals and other telecom players to identify the main requirements and challenges to successfully bring 5G to market.

**Professor Mark Kleinman** is Professor of Public Policy and Director of Analysis at the King’s Policy Institute. He has been a government adviser at the No. 10 Strategy Unit, a civil servant at the Office of the Deputy Prime Minister, and a policy director for all three London Mayors, including leading policy work on the economy and business, smart cities and technology. The Policy Institute at King’s addresses complex policy and practice challenges with rigorous research, academic expertise and analysis focused on improving outcomes.

**The 5G work at King’s would not be possible without the dedication and world-leading expertise of the entire team:** Dr. Oliver Holland, Dr. Vasilis Friderikos, Dr. Nishanth Sastry, Dr. Mohammad Shikh-Bahaei, Dr. Toktam Mahmoodi, Dr. Ali Hossaini, Dr. Fragkiskos Sardis, Anthony Tsiopoulos, James Arias, Dr. Luis Sequeira, Idelkys Quintana, Ali Azam, Ran Rana, Maria Veneva, Chien Chin-Yun, Aravindh Raman, Lisa Desai, and Calum Handforth

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