

Written Evidence Submitted by Digital Catapult, follow up evidence (UKT0037)

Digital Catapult and our work in 5G

Digital Catapult is pleased to respond to the request by the Science and Technology Committee to provide further written evidence on the UK Telecommunications Infrastructure and domestic capability following the oral evidence given by Dr Dritan Kaleshi, Head of Technology - 5G at Digital Catapult, on 22nd July 2020. This document provides our written response to a number of the Committee's questions presented below, focusing on the UK domestic research, development and innovation capability and potential to develop telecoms supply chains with international partners. It also explores what is needed to strengthen the UK's emerging leadership in adopting advanced technology infrastructure solutions across the country and the role that Digital Catapult can play in this new landscape.

Digital Catapult is the UK's leading advanced digital technology innovation centre. We are part publicly funded through Innovate UK and act as an impartial, commercially-neutral technology organisation focusing on technology transfer and early adoption. Our mission is to drive early adoption of advanced digital technologies, making UK businesses more competitive and productive. We have been working in 5G and advanced networks since the Digital Catapult creation in 2014. We made a strategic decision at that time to build deep technical expertise in the area of future digital infrastructure, including 5G. This is necessary to help digital innovators to work with and adopt complex infrastructure systems for the benefit of their businesses, industry sectors and the broader economy, as well as enabling new innovative companies to become part of the UK telecommunications ecosystem. We also focus on adoption of other transformational advanced digital technologies, both in their own right and in their combination with 5G. This includes; the internet of things (IoT); artificial intelligence (AI); immersive technologies (VR/AR) and Distributed ledger technologies (such as blockchain).

Over the past six years, Digital Catapult has established a strong technical and innovation capability in 5G for the UK. We designed, developed and operate one of the most advanced end-to-end 5G testbeds in the country in both London and Brighton, utilising a diverse set of suppliers in our technology stack. We also provide open access to these 5G testbeds for UK companies, enabling them to deliver technically-underpinned 5G-centered innovation programmes and undertake applied R&D projects with strategic partners. We are also building two more 5G testbeds in the Midlands as part of the 5prinG Application Accelerator project, part of the West Midlands 5G Programme led by the West Midlands Combined Authority and funded by DCMS 5G Testbeds and Trials. Digital Catapult helps to accelerate 5G innovation and adoption, working with the UK Government, the regulator, and across the UK ecosystem of 5G supply and demand. This includes engagement and collaboration with academic leaders, a high growth advanced technology startup & scaleup community, traditional sectors of the economy and companies of all sizes.

Summary

We make three broad observations about the telecoms industry which are relevant to the inquiry's principal questions:

- 1. Fixed and mobile telecommunications is a mature industry** - looking to expand its reach beyond consumer and business voice and data services where revenues are relatively flat, into new services in enterprise and wider industrial settings where there are large revenue growth opportunities.
- 2. Softwarisation and virtualisation, two unstoppable trends in telecommunications, are introducing a major disruption opportunity in the telecommunications supply chain.** This is enabling new players to rapidly enter the supply chain leveraging off-the-shelf hardware without requiring huge initial investments. This is currently exemplified in the OpenRAN initiative in the radio access network part of the mobile technology system, and is more advanced in the development of the network core software, traditionally “the brain” of a mobile network system.
- 3. There is a real market need for reliable and secure mobile communications in the enterprise as well as national infrastructure, with a corresponding need for a diverse and resilient supply chain.** For this reason the Committee should note that it is not only the national telecommunication providers that should be considered when thinking about supply chain resilience and security, but also the growing and evolving market of enterprise and industry communication service providers small and large, including the cloud service providers.

Whilst the near term challenge is clearly to seek diverse suitable suppliers for the UK infrastructure, work must be initiated now on both mid and long term strategies to secure the longer term development of a resilient telecommunications infrastructure. Some important considerations in this direction are:

- **Sustainable international collaboration:** The UK should build sustained collaborations with international partners, not just in the immediate/near term but also in the long term. This will allow the UK to develop capabilities that can respond to the potential re-consolidation of supply chains in the market.
- **Creating resilience across the telecommunications supply chain:** The UK should take action to foster capabilities and seed opportunities for existing companies and new entrants to the market, including UK companies and accelerating them to become part of the UK's telecommunications supply chain. With both international and domestic elements to the supply chain, the UK will build better resilience and security through diversification and shared capabilities.

- **Balancing commercial and public interest:** The UK should take a multi-activity approach to balancing commercial and public interests, with careful coordination between key public and private stakeholders both domestically and internationally. Several initiatives have emerged to this effect in the UK, but they remain fragmented. The coordination of these initiatives into a cohesive strategy will help the UK to diversify its supply chain for UK telecommunications infrastructure and build upon existing capabilities that can enable domestic companies to enter the market faster with benefits across both supply and demand.
- **Supporting up-to-date technical understanding of technology development:** In a context of rapid market and technological change over the next decade, supporting public bodies such as government departments, regulator and others to be technically timely and well-informed will enable constructive decision making and interventions. This could include, for example, a faster understanding of technology readiness, barriers and challenges to a competitive and diverse supply chain, and the range of technology / exploitation roadmaps that are developed in the UK and internationally.
- **Develop both public and private UK telecoms testing capabilities:** The UK could take a proactive role in the testing of interoperability for telecommunication systems, thus allowing all parts of the value chain to understand the state of development and readiness of the telecoms technologies for integration. A public-funded open network interoperability testing capability in the UK would be a logical early step alongside industry initiatives, to support immediate engagement with international standardisation, inform public stakeholders (including the regulator and the government), and facilitate emergence of mobile communication suppliers from the UK ecosystem.
- **Utilising existing investments into deeper R&D and innovation:** Leveraging existing R&D capacity (people and facilities) across the UK, some of which have been mobilised in the UK since 2016, and bring together the technology sector, academia, regulators and technical innovation centres with known capabilities to explore collaborative approaches to accelerate technology development that can address the supply chain diversification challenge.

Introduction

Virtualised software operating on general processing and compute is a major industry trend, having started 10-15 years ago in IT, data centres and cloud are now reaching network and telecommunications infrastructure through initiatives such as OpenRAN, OpenBNG, white-box networking, CORD and M-CORD, etc. The full picture will take some time to emerge, and the UK needs to take the necessary right steps for this to happen in parallel with the nearer term national mobile infrastructure replacement that will happen until 2027.

International free market forces have led to the current mobile technology supply chain in the UK. Private industry activities alone may not guarantee a supply chain that meets national strategic interests. For example, interoperability of products is still a major challenge due to vendor option implementation choices, even with strong existing specifications and standards such as those from 3GPP. Testing for standards implementation is paramount in cases where diversified technology chains need to be put together across multiple existing and new vendors (like OpenRAN) to influence standardisation and development of working solutions. Open and truly disaggregated standards and interfaces give the opportunity for UK companies to start developing solutions much faster with software-centric development timescales, forgoing the 10+ years of specialised hardware R&D. It will accelerate the time scales in which new players can emerge both internationally and from the UK, and we are seeing signs of this with OpenRAN.

To maximise the opportunity of diversification it is essential to work in a coordinated way in the R&D space across public and private organisations, the regulator and academia. It is necessary to strengthen the industrial R&D capabilities in the UK whilst supporting the existing strong academic R&D capabilities in the telecommunications sector in the UK. This can take several forms, for example not only by setting up national capability infrastructure for research, development and innovation (R&D&I) to deliver a defined set of objectives but also setting up corresponding collaborative tools, platforms and governance structures to address it as a nationally coordinated activity. The goal would be to provide some coherence and direction to ensure alignment with national strategic objectives in future digital infrastructure developments..

A resilient UK telecoms infrastructure, on which our critical new industrial digital infrastructure will be based, will require an improved international supply chain with trusted partners in the near term. In the mid-to-long term it would be advantageous to foster as far as possible a UK domestic capability that will be part of that supply chain. Furthermore, as telecommunications and digital services infrastructure become increasingly consolidated offerings over the near to mid term, it is advisable to follow a participative telecommunications development approach which also incorporates exploitation and adoption in UK of industry and future digital solutions which depend on having advanced digital infrastructure capabilities. If this is well managed there are clear benefits here both in

terms of the security and resilience of UK digital infrastructure, but also for the UK industrial strategy ambitions.

Evidence Response

Q1. What led to the current lack of market competition among telecommunications equipment suppliers and the absence of a domestic supplier in the UK?

Whilst there is still price competition in the telecommunications vendor market, there are several factors that have led to the current consolidation of the network equipment vendors over the past 20 years, with the numbers dwindling to the handful of suppliers existing today globally.

One of the key challenges has been the increased cost required to do the necessary R&D in telecommunications in specific timeframes (approximately over 10 years), and putting this upfront cost in the frame of the market share globally - with the most profitable market being Europe and North America regions. It is significant to note the shift in R&D investment over the past 15 years, away from operators and into the vendors. This is in tandem with the operators focusing primarily in R&D for new services and applications in competition with other over-the-top service providers for video, entertainment, banking, communications etc., or in very selected areas related to network system management, operation and fundamental security. This shift is accompanied by a long standing decrease in public and private industrial R&D funding in telecommunications in the UK over the past 15 years or so.

Following a completely free market approach to telecommunication infrastructure development and deployment has been accompanied with few and far public interventions to align the market operation with public national strategic interests. One good example of this intervention is the proactive approach to manage security of operations of telecommunications infrastructure since mid 2000, through the establishment of a testing and certification facility in the UK. Another good example of a useful intervention is the DCMS 5G Testbeds and Trials Programme (2017, £200M), which has created an active 5G ecosystem in the UK focusing primarily on technology adoption. This can be used as a model to go forward to address the current challenge of resilience and diversification, building more depth in technology exploration and development through nationally coordinated government initiatives.

Q2: What are the major barriers to entry into the UK telecommunications market and how these could be overcome?

Some of the major barriers to entry are:

- The de-facto consolidation of the market players (in particular among vendors, but not exclusively), and their hold on the market. This position is maintained through very significant and sustained investment in R&D (primarily from equipment vendors) and service innovation (operators). Most of the R&D investment from them is done outside the UK.
- The decline in telecommunications industrial R&D investment in the UK in the past 15 years in particular, both public and private. The notable difference, publicly, is the DCMS 5G Testbeds and Trials intervention in 2017 (£200M), focusing on supporting testing and trialling of adoption of 5G and other relevant telecommunications technologies in the UK.
- The size of the UK market and the global market supply chain is not conducive to scaling up of specific companies in the telecommunications sector without significant support in the early stages of the development in national strategic priority areas. In other words, a completely free-market approach to fostering major technology developments without government interventions in the early stages of the commercialisation of the technology (TRL3-6) is more challenging in mature/commoditised and/or small-sized home markets like the UK for telecommunications.

On the positive side, the UK has been historically a leader in wireless communications research. It still has very strong (in several cases world-leading) capabilities in aspects of networking and mobile communications academic research, which have allowed the current jump in UK-wide 5G ecosystem engagement to be delivered in the past decade, also with the support of the DCMS 5G Testbeds and Trials Programme since 2017. There is a strong academia-industry collaboration in the UK, despite the decline in industrial R&D investment, leveraging specific academic and industry research skills in radio, network and computing areas. Furthermore, the UK is recognised to have specific strengths in system integration, cybersecurity, networking and entrepreneurship that allow a vibrant innovation ecosystem to emerge.

In a mid to long-term strategy (5-10 years) it is both necessary as well as possible for the UK to build specific capability in the telecommunications supply chain, but in partnership with international partners and fostering a UK-participative disaggregated supply chain. However, this needs to start immediately with pragmatic and practical steps alongside a coherent and concerted strategy. For example, one such step will be to quickly engage with the global standardisation activities through interoperability testing, whilst building the R&D capability to feed into the details of the standards in due course. This will require building a national capability for testing integration and interoperability of developing solutions in parallel with the input into standardisation processes.

Q3: The feasibility of the Government supporting the establishment and growth of a UK-based vendor of 5G equipment?

It is critical for the UK to contribute to and participate proactively in the development of standards and technologies that will go in its digital infrastructure. This can be achieved only if there is relevant technology development, through R&D, in the UK. Furthermore, the UK should move beyond a customer-only role of merely testing and ensuring security

compliance of the equipment deployed in the UK. A better position would see the UK government encouraging a competitive international global market through fostering international standardisation and interoperability whilst also participating as suppliers of technology blocks in it. In other words, the UK should seek to be part of the telecommunication supply chain - not immediately as a single scaled-up player, but as part of a group of suppliers.

The softwarisation of the telecommunication industry is affecting the way technical specifications and standardisation processes are carried out, with potential for disruption of the status-quo (exemplified by initiatives like the OpenRAN). This could allow competition and evolution in the supply chain, for example enabling smaller players to enter the market rapidly and grow in partnership with one-another. It could enable faster pull through from our strong academic capabilities in this space into UK companies and partnerships, and also in a context of international collaboration with trusted partners. This medium-term activity requires strong focus on technology transfer from our academic strength into industrial exploitation - an area where the UK has traditionally sought to do more. In the near term it is important to establish national capabilities in testing for interoperability and integration of new solutions in telecommunication systems (starting with OpenRAN, but allowing for the evolution of the solution space in the future). This will also foster and accelerate a broadening of the supply chain and act as a means to influence the adoption of standards whilst they are being developed, and can also be used to foster mid-TRL development of the UK grown capabilities in this space.

Q4: How the UK can work with international partners (such as the 'Five Eyes' countries) to build a domestic capacity?

The mobile communications industry is global, and the world has benefited from the way that global standards have been set, fostering scale of supply from end user devices to the core of the networking system. The development of the specifications and standards for mobile communications has been an international effort, and it would be beneficial for all if that continues to be so.

UK organisations have worked within European Telecommunications Standards Institute (ETSI) and 3GPP, contributing to specific parts of the specifications and standards. These contributions are proportional to the level of R&D undertaken in the country.

Looking forward towards a more open and disaggregated supply chain across the key network components (Radio Access Network, mobile core software, and management and operations software) it seems clear that it is expected, from a resilience perspective, that the system is supplied in a multi-vendor chain for the different segments mentioned, and not in a largely end-to-end single provider situation like today.

What needs to be avoided is a repeat of the situation we have today, emerging through consolidation of new vendors in the future. If it can be built, an end-game whereby several partners in the world collaborate to build a co-dependent supply chain for their telecommunication infrastructure would be the best possible outcome to avoid the UK being a purely technology adopter country for our critical digital infrastructure.

There are international R&D collaborations with different countries, but those are not focused on a single area with commonly agreed objectives, like resilience in telecommunications supply chain. A shared and coordinated innovation programme with “5 Eyes” partners, and others could help address this.

Q6: In what timeframe should the Government look to build domestic capacity and remove all “high risk” vendors?

Building domestic capacity in the UK will take time, and if the UK government wishes to build capacity it must take action immediately to kickstart the creation and fostering an ecosystem of supply now. This should be a concerted national and international activity.

Telecoms is being transformed from specialist hardware to software operating on more general purpose compute platforms. This offers an opportunity to develop domestic supply more quickly, but still looking at mid-to-long term (7-10 years) for scale up capacity. It is possible to foster development of specific technology blocks more quickly if targeting smaller network deployments (such as private mobile networks/non-public networks) and focusing on developing system integration and network management capabilities.

Open, interoperable, softwarised telecoms approaches will enable a disaggregated supply chain with more vendors, and more competition. If the UK Government wishes to build domestic capacity it should actively support the development and uptake of an open, interoperable and standards-based approach. Equally, internationally adopted standards and a disaggregated supply approach to telecoms software will encourage international competition and will lead to additional international vendors to enter the UK market.

This approach can be pursued with international partners such as the “5 eyes” countries and others, and will be useful in creating adoption of global and competitive standards in the industry in a fully diversified and, ideally, mutually co-dependent supply chain. Common approaches can mean softwarised telecoms systems can be operated on secure cloud compute platforms, whether on sovereign capabilities or on cloud platforms from trusted partners.

Q7: What support would be required to make best use of telecoms R&D expertise in the UK, and to support market diversification and lower barriers to entry for new infrastructure suppliers?

The UK is internationally recognised as having strong expertise in specific areas of networks and telecommunications R&D. Considering the discussions in the previous questions and in the introduction, some of the key things that are needed to support market diversification and lower barriers for entry whilst leveraging UK telecoms R&D expertise in the UK are:

1. Continue to support targeted collaborative R&D activities in academia, both in terms of fundamental research (which is strong) and national interconnectivity infrastructure activities. The state of academic research in 2016 and their continuing

engagement since then has acted as a positive springboard for the current state of 5G adoption in the UK - it requires sustained public funding to continue to be so.

2. Devise mechanisms and interventions for growing telecommunications industry R&D in the UK, looking to build the strength gradually through a mid-to-long term strategy. This will require supporting existing industrial R&D centres, incentivisation of inward investment from established international technology players, and supporting the development of small and medium sized companies that provide highly specialised components to the telecommunications industry supply chain. This includes small cell and core network software companies that have the expertise to move to open initiatives, such as OpenRAN and/or similar approaches on the network side.
3. Support strategic telecommunication R&D activities through an interconnected set of national capability centres that build on existing investments and expertise (testbeds, laboratories and technical innovation centres). These can leverage existing R&D expertise in the UK and build the necessary critical mass to directly and identifiably address specific diverse supply chain challenges like cybersecurity testing and interoperability testing of new technology offers, and support collaborative working of mid-Technology Readiness Level companies in ways that feed usefully in international standards and their implementation practice.
4. Support directly and strengthen the technical innovation activities that enable the UK's ecosystem of technology companies working with low TRL solutions for network technologies (including those that spin out of areas where the UK has academic research strengths) to scale to the level required for joining the telecoms supply chain, both in national scale and private enterprise networks.

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