

Cookies on GOV.UK

We use some essential cookies to make this website work.

We'd like to set additional cookies to understand how you use GOV.UK, remember your settings and improve government services.

We also use cookies set by other sites to help us deliver content from their services.

[Accept additional cookies](#)

[Reject additional cookies](#)

[View cookies \(/help/cookies\)](/help/cookies)



1. [Home \(https://www.gov.uk/\)](https://www.gov.uk/)
 2. [Business and industry \(https://www.gov.uk/business-and-industry\)](https://www.gov.uk/business-and-industry)
 3. [Media and communications \(https://www.gov.uk/business-and-industry/media-and-communications\)](https://www.gov.uk/business-and-industry/media-and-communications)
 4. [5G Supply Chain Diversification Strategy \(https://www.gov.uk/government/publications/5g-supply-chain-diversification-strategy\)](https://www.gov.uk/government/publications/5g-supply-chain-diversification-strategy)
- [Department for Digital, Culture, Media & Sport \(https://www.gov.uk/government/organisations/department-for-digital-culture-media-sport\)](https://www.gov.uk/government/organisations/department-for-digital-culture-media-sport)

Guidance

5G Supply Chain Diversification Strategy

Updated 7 December 2020

Contents

[Ministerial foreword](#)

[Executive Summary](#)

1. [Introduction](#)
2. [Creating a diverse telecoms supply market](#)
3. [The policy response](#)
4. [Resilience across the supply chain and building UK capability](#)
5. [Conclusions and next steps](#)



© Crown copyright 2020

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gov.uk.

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

This publication is available at <https://www.gov.uk/government/publications/5g-supply-chain-diversification-strategy/5g-supply-chain-diversification-strategy>

Presented to Parliament by the Secretary of State for Digital, Culture, Media and Sport by Command of Her Majesty Laid in Parliament on 30 November 2020

Command Paper Number: 342

Crown Copyright 2020

ISBN 978-1-5286-2283-7

Ministerial foreword



5G has arrived. The next-generation of mobile technology is revolutionising the way we connect, and the government wants the majority of the UK population to be covered by a 5G signal by 2027 so that the entire country can benefit from its social and economic advantages. However, 5G's full potential can only be realised if we have confidence in the security and resilience of the infrastructure that underpins it.

We are taking bold steps to implement one of the toughest telecoms security regimes in the world. A central part of that is combating high-risk vendors, and I have set out an unambiguous timetable for the complete removal of Huawei equipment from our 5G networks no later than 2027.

That decision is the right one, but it also risks leaving us overly reliant on too few suppliers. That is a dilemma faced by countries across the globe - and it is one the government is confronting head-on through the publication of this Strategy.

This 5G Diversification Strategy is a clear and ambitious plan to grow our telecoms supply chain while ensuring it is resilient to future trends and threats. It has three core strands: supporting incumbent suppliers; attracting new suppliers into the UK market; and accelerating the development and deployment of open-interface solutions.

This Strategy sets out a targeted plan to achieve all three so that we are never again dependent on a small number of suppliers. It is backed by an initial £250 million to start work to implement priority measures and build momentum.

As I said, this is a global issue, and this plan also sets out how we will lead a global coalition to find a lasting and sustainable solution to the problem. We are working closely with Five Eyes partners and other friends around the world to deliver that shared goal.

This Strategy also sits alongside the legislation we have introduced that provides the powers that will enable us to control and where necessary exclude the use of high risk vendors from our networks. Together, they lay the foundations for a world-class telecoms security framework, and will ensure that the UK's critical national infrastructure remains safe and secure - both now and in the future.

Rt Hon Oliver Dowden (Secretary of State for Digital, Culture, Media and Sport)

Executive Summary

The UK's telecoms networks underpin our economy, our work and day-to-day lives and have the potential to deliver economic and social benefits for the UK. But these benefits can only be realised if we have confidence in the security and resilience of the infrastructure that they are built upon.

This is why the government undertook a comprehensive review of the supply arrangements for the UK telecoms Critical National Infrastructure (CNI). The 2019 Telecoms Supply Chain Review identified the need to manage and mitigate risks from high risk vendors, introduce a new robust security framework for telecoms, and create a more diverse and competitive supply base for telecoms networks.

We have since taken important decisions to limit and exclude high risk vendors in our telecoms infrastructure and have brought forward legislation to place those decisions on a statutory footing. This strategy sets out targeted and ambitious plans to diversify the global telecoms supply market, focussing on three key areas of activity:

- **Supporting incumbent suppliers** to ensure their resilience and ability to supply the market in the near term, while supporting their transition into the emerging market structure;
- **Attracting new suppliers into the UK market** to build resilience and competition, prioritising deployments that are in line with our longer term vision;
- **Accelerating open-interface solutions and deployment** so that we are not reliant on any single vendor and begin to realise our long term vision for a more open and innovative market.

As part of our approach we will prioritise opportunities to build UK capability in key areas of the supply chain. As we progress this activity we look forward to working with network operators in the UK, telecoms suppliers and international governments to achieve our shared goals of a more competitive and vibrant telecoms supply market.

The value of 5G networks

Significant economic and social value can be gained from the widespread deployment of 5G networks. These networks will deliver faster, more reliable and flexible networks that have the potential to transform key sectors across the economy.

That is why the widespread availability of both 5G and gigabit capable networks is a priority for this government. 5G is already available in over 100 towns and cities across the UK and the next few years will see increased investment in these networks as we deliver against our targets for the majority of the population to have 5G coverage by 2027.

The case for diversification

The Telecoms Supply Chain Review identified that the greatest risk of national dependence in our networks is in the 'access' network. As the characteristics and potential of 5G mean that 5G networks are likely to play a significant role in our critical national infrastructure it is critical that the supply market for these networks is diverse and resilient.

The global telecoms supply market has undergone a sustained period of consolidation due to a range of commercial factors including low profit margins, high R&D costs and high economies of scale. Technical factors that raise the barrier to entry or solidify the position of incumbents have also been a factor.

Following the government's decision to remove Huawei equipment from our future networks, the UK is now reliant on just two mobile access network equipment suppliers - Nokia and Ericsson. This represents an intolerable resilience risk and absent intervention it is unlikely that the market will diversify.

Therefore, it is essential that we create a more diverse and competitive supply base for telecoms networks. A more competitive and diverse supply market will increase quality, innovation and the resilience of our networks.

Our approach

The lack of choice in the supply market for telecoms access equipment is the result of a market failure that is characterised by supplier lock-in and incumbent advantages that limit competition. This market failure calls for a sustained and concerted challenge of the status quo to address the structural, technical and commercial barriers to competition and diversification.

As part of this challenge, a fundamental shift in the structure of the supply market is required, that is underpinned by the principles of openness, competition and diversity.

Our long term vision for the telecoms supply market is one where:

- **network supply chains are disaggregated** providing network operators more choice and flexibility to build their networks;
- **open interfaces that promote interoperability are the default** promoting a 'best-of-breed' approach that bolsters quality, innovation and resilience;
- **the global supply chain for components is distributed** across regions creating resilience and flexibility;
- **standards are set transparently and independently** promoting quality, innovation and security and interoperability;
- **security and resilience is a priority** and key consideration in network design and operation.

Achieving this long term vision depends on removing the barriers that prevent new market entrants from joining the supply chain, investing in R&D to support the accelerated development and deployment of interoperable deployment models, and international collaboration and policy coordination between national governments and industry.

Achieving this long term vision, and the diversification it will enable will take time. As we seek to open up the market, we recognise that in the short to medium term a different approach is required in order to ensure resilience. Therefore we will also prioritise activity to support existing suppliers, noting that they play a key role in our critical national infrastructure and have an important role to play in opening up the market. We will seek to attract new suppliers to the UK market in order to start the process of diversification as soon as possible.

Our proposals

Our strategy will pursue a multifaceted approach across three strands of activity which balance building the resilience of our networks in the immediate future, with bold and ambitious interventions to open up and grow the market into the future.

We will support incumbent suppliers by:

1. Encouraging and enabling suppliers to distribute their operational capabilities across the global supply chain, ensuring that they have the flexibility to meet growing demand.
2. Identifying opportunities to diversify component supply chains in order to establish greater resilience against shocks or market disruption.
3. Shaping relevant R&D activity, in line with our long term vision to ensure both suppliers remain at the cutting edge of the telecoms market, lead innovation and enhance competitiveness.
4. Aligning technological roadmaps, in line with long-term market trends such as the increased use of software and network virtualisation, to ensure that as networks evolve both suppliers play a key role in emerging functions.

We will seek to attract new suppliers to the UK market by:

1. Taking forward work to set out a clear roadmap for the long term use and provision of 2G, 3G and 4G network services in the UK - including consideration of options to sunset or streamline provision.
2. Work with Ofcom to identify and address spectrum-related barriers, ensuring efficient use and allocation of spectrum, where this is beneficial to diversification.
3. Developing and introducing appropriate regulatory adjustments regarding performance and resilience requirements, that discourage operators from integrating new suppliers into their networks
4. Considering commercial incentives to mobile network operators to support increased costs of transitioning to and integrating new suppliers into their networks

We will accelerate open-interface solutions and deployment by:

1. Establishing a UK wide R&D ecosystem to accelerate and pull forward the development of interoperable technologies, including a major Open RAN trial in the UK.
2. Establishing a UK National Telecoms Lab that will enable operators and suppliers to match their requirements and specifications to assess the technical performance and security of equipment.
3. Increasing UK presence and influence at standard setting bodies, working with industry and international partners to ensure standards are set in a way that enables market growth and diversification.
4. Conducting a full assessment of how regulatory requirements could be implemented in order to deliver effective diversification outcomes, as part of the long-term delivery of an open, competitive and diverse supply chain.

In order to kickstart the process of diversification and build momentum we are making early progress by establishing a SmartRAN Open Network Interoperability Centre (SONIC) - that will create a platform for existing and emerging suppliers to come together to test and demonstrate interoperable solutions. Alongside this we are launching a trial with the Japanese supplier NEC to test their equipment in the UK market; and funding a range of trials that utilise open-interface technologies as part of the DCMS 5G Testbeds and Trials Programme. These projects will begin to grow the ecosystem for the testing, development and deployment of interoperable technologies in the UK. At the heart of that ecosystem will be the National Telecoms Lab, a state of the art research and development facility that will drive forward security, performance and resilience testing of new suppliers and technologies.

As a first step towards delivering our long-term vision, the government has committed an initial £250 million, to kick off work to deliver our key priorities. The government will continue to explore all further opportunities to accelerate diversification and establish UK expertise and capability within the telecoms supply chain.

The delivery and implementation of the strategy will be guided by the recently established [Telecoms Diversification Taskforce](https://www.gov.uk/government/news/ex-bt-boss-leads-task-force-to-attract-new-vendors-to-uk-telecoms) (<https://www.gov.uk/government/news/ex-bt-boss-leads-task-force-to-attract-new-vendors-to-uk-telecoms>), comprised of experts from industry and academia. The Taskforce will, in the first instance, look at designing and developing targeted measures across the three strands of our strategy and will also consider opportunities to establish UK capability across the wider 5G supply chain.

1. Introduction

1.1 The security and resilience of the UK's telecoms networks is of paramount importance. Telecoms networks are central to the way we live and work, they enable us to do business, keep in touch and access a vast range of services across the digital economy. The government is committed to delivering world class digital infrastructure and has ambitions to become a global leader in 5G.

1.2. 5G networks have the potential to generate significant economic and social benefits across a range of industries and services^[footnote 1]. But these benefits can only be realised if we have confidence in the security and resilience of the infrastructure that they are built upon.

1.3. That is why the government undertook a comprehensive review of the supply arrangements for telecoms infrastructure in the United Kingdom. The Telecoms Supply Chain Review (the Review), published in July 2019, set out the need to:

- **Manage and mitigate the risks from high risk vendors.** The government's decision and details of its approach to manage these risks was announced in January 2020^[footnote 2] - excluding high risk vendors from those parts of the 5G and full fibre networks that are critical to security and from sensitive locations, and limit their presence in the periphery of those networks, capped at 35 per cent. In July 2020 - in response to further US sanctions against Huawei - the government went further by setting a timetable to remove Huawei from 5G networks by the end of 2027.
- **Introduce a new, robust security framework for telecoms.** The new arrangements will raise the height of the security bar and set out tough new standards for telecoms operators to meet in the design and operation of their networks.
- **Create a more diverse and competitive supply base for telecoms networks.** This will be critical to drive higher quality, innovation and to reduce the risk of national dependency on individual suppliers, and in particular high risk vendors.

1.4. The Telecommunications (Security) Bill will create a strengthened set of security duties and requirements on telecoms operators alongside enhanced powers for Ofcom, to underpin the security framework, and provide powers to the Secretary of State to place the decisions around high risks vendors on a statutory footing.

1.5. Since the Review, the government has also taken forward work to develop a targeted and holistic approach to diversifying the telecoms supply market.

1.6. This 5G diversification strategy sets out an ambitious long term plan for how we will achieve a sustainable, competitive and diverse telecoms supply chain. It sets out where the government will remove barriers to diversification, invest in emerging telecoms technologies, and work with like-minded countries to achieve our shared goals.

1.7. While the environment is challenging, this is also a moment to seize. The successful implementation of this strategy will not only safeguard the future of our 5G networks; it will also provide an opportunity for the UK to show global leadership in rebalancing a critical supply chain and to shape the roadmap for the deployment of future generations of telecoms networks. We will also, in the near future, set out plans to address the lack of diversity in fixed access networks and consider the diversity and innovation in the wider telecoms supply chain, including new areas of capability, in order to ensure the security and resilience of our networks.

1.8. This strategy has been developed in parallel with other key government programmes including the Industrial and Digital Strategies and the Integrated Review and is consistent with the government's broader levelling-up, R&D and investment, and security and resilience priorities. We also hope that this strategy, and other key programmes, may provide future guidance for sectors dealing with similar risks to their critical infrastructure.

2. Creating a diverse telecoms supply market

2.1. The Telecoms Supply Chain Review concluded that the risk of national dependence on a small number of suppliers is most pronounced in the mobile and fixed access networks. In mobile networks this is known as the 'Radio Access Network (RAN) and provides the radio functions of the mobile network by transmitting signals between mobile handsets and the core parts of mobile networks.

2.2. This strategy is focused on the 5G - rather than legacy - mobile access network** where the risk of market consolidation is most pronounced^[footnote 3]. The measures set out here seek to accelerate diversification within the mobile access network supply chain where new technology provides an opportunity for diversification.

2.3. Consideration of the need for diversity in other elements of the mobile network, and the impact of increasing reliance on software and virtualisation of networks is set out in Chapter 4.

2.4. It should be noted that market consolidation is also an issue within the supply chain for fixed access networks. As announced in July 2020, DCMS is conducting a technical consultation which will inform our approach to accelerating diversification within fixed networks^[footnote 4]. We will set out our plans to diversify the fixed access supply market following the consultation.

The mobile access supply market today

2.5. The global RAN market (through 2G, 3G and 4G) is dominated by Nokia, Ericsson and Huawei who have a combined global market share of over 80%^[footnote 5]. Beyond these dominant suppliers, ZTE (11%) and Samsung (5%) are the next largest suppliers^[footnote 6]. Other alternative suppliers include NEC and Fujitsu and a number of smaller emerging challenger vendors such as Mavenir and Parallel Wireless - although these alternative suppliers do not currently offer products across the full range of RAN equipment.

2.6. Many of the network deployment approaches adopted in the UK are commonplace across the global market. However, the UK accounts for about 2% of suppliers' global mobile revenues and therefore will not drive significant change in the market independently. [\[footnote 7\]](#)

2.7. In the UK, mobile network operators typically adopt a two vendor strategy, where two suppliers are selected to provide mobile access network equipment across the network in order to maintain network resilience [\[footnote 8\]](#). Typically, one vendor is responsible for supplying equipment to the lion's share of the network [\[footnote 9\]](#). This approach is preferred by operators as it minimises compatibility risks, streamlines procurement and maintenance operations, and allows for quicker upgrades.

2.8. Today the major suppliers to the UK's four mobile network operators (Vodafone, EE, O2 and Three UK) for their 2G, 3G and 4G networks are Ericsson, Huawei, and Nokia [\[footnote 10\]](#).

2.9. Following the government's July 2020 decision to remove Huawei from the 5G network, without further action, our expectation is that the 5G market will consolidate further to just two suppliers - Ericsson and Nokia (the incumbents).

2.10. This level of consolidation is significant for the prospects of diversification in 5G networks as early 5G deployment will be based on a 'non-standalone' (NSA) architecture. NSA deployments require compatibility with existing 4G equipment and have been the basis of the first phase of public 5G deployments in the UK. Therefore without measures that support interoperability that would enable greater diversity, UK operators will be reliant on Nokia and Ericsson for their 5G deployment.

2.11. While both Nokia and Ericsson are well established and leading telecoms equipment suppliers, this represents a significant resilience and competition risk, and risks national dependency compromising our ability to deliver secure, world class digital infrastructure across the country. The government will explore opportunities to bring new suppliers into the market to replace the outgoing Huawei footprint.

Reasons for a lack of diversity in the market

2.12. A number of factors have contributed to the long term consolidation in the market for network equipment and services. These are wide-ranging and sit on both supply and demand sides of the global market and have exacerbated market consolidation over an extended period of time. The following factors were identified in DCMS' market research and engagement which included both existing and prospective suppliers.

- **Economies of scale benefit the dominant suppliers** who have larger product development and production capacity. This enables suppliers to produce equipment at lower average cost. The size of the market they serve further enables suppliers to employ aggressive sales and pricing practices in order to maintain high volumes of demand, which in turn reduce costs.
- **Operators' preference for established, reliable, scale and stable suppliers** makes it difficult for operators to commit to new and emerging suppliers (and technologies) who by definition will have smaller operations as they enter the market. In return, new market entrants find it challenging to grow without the large scale opportunities that are needed in order to offset the high initial cost of market entry and ongoing R&D costs
- **Intense price competition in the market and low profit margins discourage entry and expansion.** This is partially driven by a range of sub-factors including operator procurement strategies that sustain high concentration in the RAN equipment market, low operator profit margins which have been further pressured by the delivery of high value services from networks operators to 'over-the-top-players' and strict regulatory frameworks
- **High levels of R&D investment required to compete** in the RAN equipment market. This acts as a barrier to entry for prospective vendors that are unable to access the capital and resources required for such investment. In the UK, bespoke operator requirements create a further challenge for suppliers and additional R&D customisation costs in order to access the relatively small market.
- **High cost and burden of switching suppliers** drives operators to reprocur with incumbent suppliers and suppresses opportunities for new market entrants. This extends to the increased operational costs associated with the integration and maintenance of equipment from multiple suppliers.
- **Concentration of Standard Essential Patents (SEPs) and Intellectual Property portfolios** amongst market leading suppliers that limit new market entrants from accessing licenses - on the same terms as incumbents - that are crucial to the development of telecoms equipment and push up R&D costs and requirements
- **Different spectrum allocations** in harmonised spectrum bands across the world (caused, typically, by the need to accommodate incumbent users) require suppliers to tailor equipment to meet the needs of different markets, driving up costs and inefficiencies.
- **Lack of interoperability promotes incumbent 'lock-in'** as deployment and performance of new generation network equipment typically depends on the use of a single supplier across each generation of network technology (2G, 3G, 4G and 5G) providing an advantage to incumbent suppliers. This is exacerbated by operators requiring the provision of legacy generation equipment and features that are only provided by the incumbent suppliers.
- **Track record and established relationships with operators reinforce incumbent suppliers' market positions.** This can be characterised as operator risk aversion, as they are less willing to purchase from new, less known vendors with less mature products. Furthermore, operators have sought to transfer costs and risks associated with network outages or poor performance to suppliers - these costs can only be borne by the incumbent suppliers who have significant revenues.
- **National policies, including direct subsidies, that support certain suppliers** and give them a competitive advantage outside of their home markets, including in the UK
- **Outsourcing strategies of operators**, resulting in a reduction of in-house capability and an increasing reliance on the procurement of end-to-end services, which can only be offered by incumbent suppliers

2.13. Looking beyond the RAN supply chain, there are a number of factors and trends in the broader telecoms market that may drive consolidation and hamper opportunities for diversification:

- **Incumbent suppliers exercise significant influence over standards setting bodies** enabling existing suppliers to set the technological roadmap in line with their own R&D priorities and product development^[footnote 11]. This disadvantages smaller suppliers or new market entrants who do not have the same influence, exacerbates lock-in and maintains the status quo. As telecoms increasingly underpins more digital services, this represents an increasing risk across the digital economy.
- **Mobile operator revenues are under pressure as the market reaches saturation** whilst the costs of deploying and operating networks increases. Operators are likely to respond to these pressures by looking to reduce their costs or minimise risk, reducing appetite for investment in new suppliers and in turn reducing profitability for potential market entrants.
- **Significant capital investment is required to build 5G networks** as operators will need to invest in fibre backhaul, additional spectrum and upgrading and densifying their networks. These investments will need to be weighed up against the potential but uncertain commercial opportunity that 5G networks offer. Again this encourages risk averse investment strategies.

2.14. Taken together these factors create a set of structures and commercial incentives in the market that do not encourage diversification. We assess that, left unchallenged, these factors will lead to further entrenchment of the status quo and further market consolidation creating an intolerable security and resilience risk. That is why the government has decided to intervene and take steps to support increased diversification within the market, by creating the environment for a more diverse, competitive and innovative supply market that builds competition and resilience.

Our long-term vision for a diverse supply market

2.15. It is clear that the current telecoms supply market is not fit for purpose from a security and resilience point of view. As our economy and day-to-day lives are increasingly underpinned by digital services, it is essential that the infrastructure that the digital economy is built on is served by a dynamic and vibrant supply market.

2.16. The government's view is that there is a strong requirement for policy interventions to address the market failure in the supply market and to take action to stimulate market growth. Additionally we believe that a healthy supply market will lead to greater quality and innovation.

2.17. This requires a shift in the supply market from the current status quo that is characterised by supplier lock-in and incumbent advantages to a more competitive market that is underpinned by the principles of openness, competition and diversity.

Our long-term vision for the mobile supply market

- network supply chains are disaggregated, including within the access network, breaking down the consolidated supply chains in today's market and providing network operators more choice and flexibility to build their networks
- open interfaces that promote interoperability are the default rather than proprietary systems that promote incumbent supplier lock-in, promoting a 'best-of-breed' approach that bolsters quality, innovation and resilience
- the global supply chain for components is distributed across regions rather than concentrated in specific regions or countries, creating natural resilience and flexibility
- standards are set transparently and independently balancing industry and consumer interests with internationally agreed priorities - promoting quality, innovation and security and interoperability
- security and resilience is a priority and key consideration in network design and operation

2.18. Central to our long term vision are the steps we have taken to manage the risk that high risk vendors could present to our networks. In January 2020 the government set out that high risk vendors should be excluded from the core of the network, excluded from sensitive sites, and restricted to up to 35% of the access network subject to an NCSC approved mitigation strategy. In parallel, the NCSC published advice on the use of high risk vendors in the UK's telecoms network.

2.19. The Telecommunications (Security) Bill introduces the long term framework and necessary powers to allow us to manage and control the risks from high risk vendors in the future, whilst also seeking to raise the overall security bar through the new telecoms security framework. As we seek to diversify the market, it is vital we have the necessary powers and levers to incentivise, and where necessary, enforce good security.

2.20. In advance of the legislation, we have also confirmed that both Huawei and ZTE are considered to be high risk. In response to US sanctions, we have had to go further in the case of Huawei. We have advised UK operators that they should stop procuring Huawei equipment affected by the US sanctions by 31 December 2020 and remove Huawei 5G equipment from the network by the end of 2027 at the absolute latest. We welcome the early steps operators have taken to follow this guidance, in advance of the powers coming into force to allow us to put this position on a clear statutory footing.

2.21. As a result of these decisions, the UK Radio Access Network market will become increasingly reliant on just two suppliers - Nokia and Ericsson. This national dependence on just two suppliers represents a serious risk to the resilience of our critical national infrastructure. To that end, this strategy is a vital part of our plan to deliver more resilient telecoms networks as quickly as possible. By shifting the market to adopt the practices set out above, our aim is to foster competition and growth and to increase choice from a handful of suppliers to many more. The successful implementation of this strategy will see new and diverse suppliers enter the market in the coming years, as the footprint of high risk suppliers is reduced.

Requirements for success

2.22. As set out in the previous chapter, the factors that have led the market to consolidate are wide ranging and entrenched in the way the supply market operates today. Therefore, successfully challenging the status quo will require a concentrated, targeted and sustained effort. Successfully achieving our vision will depend on:

- **A willingness to work with incumbent suppliers but challenge their market power**, noting that they play a key role in our networks and influence technological roadmaps, but enjoy clear market dominance. Measures will need to be taken to address barriers to entry such as aggressive commercial practices, closed interfaces and control over standards setting bodies.
- **The removal of technical barriers that prevent operators from adopting multi-vendor strategies** and from integrating new suppliers into their supply chain. This could involve addressing regulatory and/or performance requirements that lead operators to maintain legacy networks or addressing spectrum related barriers where they exist and raise the barrier to entry for new suppliers.
- **The accelerated development and deployment of next generation technologies that enable interoperable and open-interface solutions**, supported by enabling global standards, allowing operators to utilise equipment from multiple suppliers in their network. This will challenge incumbent supplier lock-in and promote choice and flexibility for operators.
- **Investment in research and development to support new and emerging suppliers**, recognising that the radio access network market is dynamic and reliant on significant research and development costs.
- **Incentivising network operators to diversify**, recognising that in the current market, radio access equipment accounts for the majority of mobile operators' network equipment costs. While a more diverse supply market should lead to greater price competition, operators are likely to require encouragement to integrate equipment from new suppliers into their networks ahead of the natural refresh cycle. Operators will also need to be confident that new suppliers conform in practice to the aforementioned open, interoperable standards and that any initial concerns around performance, reliability and efficiency are addressed.
- **International collaboration and policy coordination between national governments** to drive long term and sustainable change in the supply market. The UK makes up less than 2% of the global supply market so international partnership is critical in creating scale and opportunity for new and emerging market entrants to establish themselves in the market.

The importance of interoperability

2.23. In recent years, increased network interoperability has become an important topic within the telecoms industry, particularly with the introduction of 5G networks and their broader range of potential applications. Interoperability is a critical requirement for successful diversification of telecoms networks and will counter vendor lock-in by reducing the risk and cost associated with adding new suppliers' equipment to networks.

2.24. Interoperability is also now a consideration when looking at the telecoms market from a network design, regulatory or consumer perspective. Indeed from a consumer point of view, interoperability is often the default with mobile handsets working seamlessly across infrastructure providers and as barriers to switching are increasingly reduced. This same approach, if applied to infrastructure deployment, could rapidly accelerate diversification.

2.25. The consideration in this strategy is solely focused on network design and the technical application and implementation of interoperability. Here interoperability can be generally understood as the ability of two or more networks, systems, devices, applications or components to communicate and deliver competitive performance. Within the access network this refers to the interworking of services over multi-vendor inter-connections where equipment from different suppliers can be integrated into one network.

2.26. While the emergence of software defined network and virtualised network functions and disaggregated supply chains - brought about by 5G - have increased the demand and potential for interoperable solutions, interoperability is not a new concept within the telecoms supply market. However, previous attempts to define, standardise and implement interoperability have been hindered due to technical complexity and a lack of willingness on behalf of suppliers as they seek to protect their commercial interests. This has resulted in the use of proprietary specifications that have exacerbated supplier lock-in.

2.27. Interoperability could therefore enable market diversification by giving operators confidence to diversify their supply chains and utilise equipment from multiple suppliers. However, this will require reassurance that the equipment will integrate seamlessly with little risk to performance, efficiency and the end user experience.

2.28. Greater interoperability will also free operators from vendor lock-in. Increased compartmentalisation of the network could also enable new and emerging market entrants to interface with incumbent suppliers and differentiate themselves by offering new and specialised services.

2.29. Together this will offer network operators greater flexibility and choice to select the best equipment available from different suppliers based on performance and prices, driving up quality, innovation and resilience. At the same time, suppliers will be able to design and develop equipment with the confidence that their equipment can be integrated across networks, without the need to create tailored or proprietary solutions.

What do we mean by interoperability in the mobile access market?

- The use of open interfaces as the default - starting with equipment suppliers sharing any proprietary specifications for existing interfaces, for example their eCPRI specification. In the longer term this would involve defining a set of open interfaces between the different components of the RAN architecture and elements of network management interfaces.
- Development and adoption of comprehensive standards that specify and incorporate the full range of requirements, architecture and protocols needed to ensure interoperability.
- Fair and transparent licensing of Intellectual Property, meaning that suppliers - whether established or new market entrants - all operate on a level playing field when it comes to accessing equipment specifications.

- Regular conformance and performance testing to ensure integration and security and to feed back to the interface and standards specifications.

2.30. Establishing interoperability as the default will require the buy-in and engagement of industry (suppliers and network operators), transparent and collaborative standards setting and the establishment of R&D and testing facilities to provide assurance and feedback from representative or 'live' networks.

2.31. Within industry there is a recognition of the importance and value of interoperability. This has led to a range of initiatives and the development of technical applications of interoperability, such as Open RAN. The government is committed to supporting these and other emerging deployment methods where they align with our aim to open up the market to increased competition, innovation and diversity.

Open RAN

Open RAN introduces an open standard for developing Radio Access Network technology, meaning that all suppliers could develop interoperable products and components. It enables operators to deploy equipment from multiple suppliers in the same configuration - utilising software and virtual solutions - allowing them to choose the best equipment suppliers for a particular component of the RAN to suit their particular deployment requirements or needs.

Open RAN can be expected to have a number of positive impacts on the market barriers currently affecting supply chain diversity, including for example:

- Reduced switching costs and future proofing by enabling operators to more easily switch between and integrate new suppliers, due to the open interface basis of the solution. As a result operators could save on capital expenditure as they could add suppliers without incurring the costs associated with replacing or refreshing legacy equipment when looking to integrate a new supplier.
- Enabling disaggregation of both the hardware and software in the access network, allowing operators to pick and choose from a range of suppliers. This will also serve to enhance opportunities for and competitiveness of new market entrants who offer specialist or innovative services.
- Scalable and agile deployment as a result of the critical role software will play at the centre of the network, offering operators the ability to roll out more timely updates and adjust capacity and coverage outcomes as required.

While Open RAN promises to unlock the supplier lock-in across today's market, there are challenges that will need to be overcome including the need to manage the introduction of additional 'touch points' across the network architecture from a security and resilience perspective and new challenges in system integration. The technology is also relatively nascent and requires further research and development to ensure that it is able to match the performance, efficiency and robustness of traditional network architecture. Rakuten Mobile has recently launched the world's first Open RAN by default network in Japan and aim to prove its strengths.

3. The policy response

Government's role in supporting diversification

3.1. The government is committed to increasing diversity within the telecoms supply chain. On the basis of the market factors and barriers set out above, our assessment is that, absent government intervention, the market is unlikely to diversify of its own accord. Whilst the government welcomes the emergence of new deployment methods based on open-interface standards - such as Open RAN - and their potential to stimulate market growth, we consider it unlikely that these initiatives will meaningfully open up the market in the short to medium term without additional intervention and investment.

3.2. Our assessment is that the factors that have led to the current status quo of a consolidated market with high barriers to entry are likely to persist. It is also possible that the current market mechanisms will undermine and disrupt the industry-led efforts to open up and grow the supply market.

3.3. Set against our long-term vision for a growing, vibrant and diverse telecoms access market - this represents a market failure. This market failure calls for a sustained and concerted challenge of the status quo to address the structural, technical and commercial barriers to competition and diversification. Therefore it is essential that the government intervenes and utilises all of the tools at its disposal to open up the market and rebalance the supply chain.

3.4. In doing so, the government will seek to work closely with industry - both suppliers and operators - to ensure that interventions support existing initiatives, technological roadmaps and with consideration of broader trends in the market.

Taking a balanced approach

3.5. As we seek to open up the market and deliver against our long term vision, we recognise that in the short to medium term a different approach is required in order to ensure resilience. Following the decisions on the use of high risk vendors, the supply market in the UK will be dependent on Nokia and Ericsson for the foreseeable future. The removal of one of our suppliers - albeit a high risk vendor - leaves us in a position where there is heightened risk to the resilience of our networks and so the government recognises the

need to take a balanced approach in order to maintain the resilience of our networks. This risk will need to be managed - working within the existing market structure - by ensuring that incumbent vendors can continue to supply our networks and by seeking to attract new vendors in order to build resilience.

3.6. However, it is possible that by supporting incumbents within the existing market structure there is a risk that this could undermine our longer term aim of opening up the market and accelerating market diversification. The government is clear that supporting incumbents must not come at the expense of achieving our longer term goals. Therefore we will work closely with incumbent suppliers and potential new entrants to ensure that where we work together in the near term this is done with our long term vision in mind. We will seek to embed approaches that will help achieve our long term vision for the sector in a way that recognises the considerable investment that existing suppliers have made in advancing and rolling out network infrastructure. This will involve seeking commitments from the incumbents to open up interfaces that will enable interoperability and ensuring that new market entrants utilise deployment methods that demonstrate the effectiveness of interoperable solutions.

Supporting incumbents, attracting new suppliers and opening up the market

3.7. Our strategic approach is therefore based around three strands of activity:

- **Supporting incumbent suppliers** to ensure their resilience and ability to supply the market in the near term, while supporting their transition into the emerging market structure
- **Attracting new suppliers into the UK market** to build resilience and competition, prioritising deployments that are in line with our longer term vision
- **Accelerating open-interface solutions and deployment** so that we are not reliant on any single vendor and begin to realise our long term vision for a more open and innovative market

Measures the government will take to deliver the strategy

Supporting incumbent suppliers

3.8. As set out above, the effect of the decisions we have taken means that in the near term the UK market will become reliant on Nokia and Ericsson, the two incumbent suppliers. These suppliers play a significant role in building and maintaining of critical digital national infrastructure which underpins our economy.

3.9. We recognise that both these suppliers have established a leading position in the market as a result of their investment in R&D and by successfully building relationships with operators. This investment in 5G and emerging telecoms technologies will continue to be vital and both suppliers will continue to have a leading role to play in leading and enabling innovation in the market.

3.10. The government will therefore take appropriate steps to ensure the long-term resilience and robustness of both suppliers' supply chains by:

- encouraging and enabling suppliers to distribute their operational capabilities across the global supply chain, ensuring that they have the flexibility to meet growing demand
- identifying opportunities to diversify component supply chains in order to establish greater resilience against shocks or market disruption
- shaping relevant R&D activity, in line with our long term vision to ensure both suppliers remain at the cutting edge of the telecoms market, lead innovation and enhance competitiveness
- aligning technological roadmaps, in line with long-term market trends such as the increased use of software and network virtualisation, to ensure that as networks evolve both suppliers play a key role in emerging functions.

3.11. These measures will ensure that incumbent suppliers continue to play a central role in our digital infrastructure supply chains, today and well into the future - and this activity will need to be delivered in concert with international partners, noting the key role Nokia and Ericsson play in markets across the world.

Attracting new suppliers

3.12. In order to start the process of diversification as soon as possible, the government is seeking to attract new suppliers into the UK market. The government recognises that this will require a twin track approach: removing barriers for suppliers where they exist, while also incentivising operators to take up and integrate new suppliers. The government will therefore:

- take forward work to set out a clear roadmap for the long term use and provision of 2G, 3G and 4G network services in the UK - including consideration of options to sunset or streamline provision^[footnote 12]
- work with Ofcom to identify and address spectrum-related barriers, ensuring efficient use and allocation of spectrum, where this is beneficial to diversification^[footnote 13]
- develop and introduce appropriate regulatory adjustments regarding performance and resilience requirements, that discourage operators from integrating new suppliers into their networks
- consider commercial incentives for mobile network operators to help offset increased costs of transitioning to and integrating new suppliers into their networks

3.13. These are significant commitments to work with suppliers and network operators to find solutions to long standing structural barriers to diversification. The government will work closely with the independent regulator, Ofcom, to ensure that solutions are fit for purpose and are supported by an appropriate regulatory framework.

3.14. The government looks forward to working with potential new suppliers to ensure the UK market is a welcome and dynamic one for them to operate in. We have engaged extensively with a range of suppliers including established and leading technology brands such as Samsung, Fujitsu and NEC who share a keen interest in growing their global footprint in the telecoms supply chain. We have also established relationships with new and emerging suppliers, such as Parallel Wireless and Mavenir, who are driving forward the development and deployment of interoperable solutions.

3.15. As we continue to develop and build these important strategic relationships the government is keen to ensure that entry into commercial networks sits alongside a broader operational presence in the UK. This includes the scaling up of skills, capabilities and R&D, and a commitment to work together to deliver our long term vision to open up the market.

3.16. Early progress in this space is demonstrated by our commitment to work with NEC - one of the leading suppliers of Open RAN equipment - to implement and demonstrate the performance of a 'neutral host' Open RAN solution across a range of deployment environments. This project builds on NEC's recent strategic investments to establish both a Global Open RAN Centre of Excellence and 5G Radio R&D Centre in the UK.

NEC - NeutrORAN Trial

NEC has the ambition to work closely with the UK government to help realise its supply chain diversification objectives in a secure and cost-effective way. The NEC NeutrORAN project will showcase the latest innovations in the Radio Access Network space.

It will test and demonstrate a 'neutral host solution' and the role of a new service provider in the ecosystem whose role is to deploy and operate the solution. NEC see the planned architecture as having potential for global scale and applications beyond the UK. The project will seek to reduce costs and enhance efficiencies to empower rural communities and businesses by removing the digital divides that still exist in the UK and the rest of the world.

This project will see live 5G Open RAN within the UK in 2021, testing solutions to deploy 5G networks in the most cost effective, innovative and secure way. This project is backed by a UK government investment of £1.6m and forms part of the 5G Testbeds and Trials Programme. The £200m Programme has to date launched over 25 projects to accelerate the deployment of 5G networks in the UK and will now continue with a focus on attracting new suppliers into the UK market.

Accelerating open-interface solutions and deployment

3.17. The government is clear that it has an important role to play in making open-interface solutions and deployment the standard across the global supply chain. We recognise that in order to achieve our vision of a more open, competitive and diverse market there is a need to take a multi-faceted approach that includes considerable investment and a willingness to address long standing structural barriers, at a global level. This will require a wide ranging and ambitious programme of work that includes the following elements.

3.18. **Establishing a UK wide R&D ecosystem to accelerate and pull forward the development of interoperable technologies.** Projects within the ecosystem will fund trials and testbeds that will create a dynamic and vibrant proving ground in the UK for operators and suppliers to test and demonstrate the performance and capabilities of interoperable solutions across a range of environments, use cases and applications. This ecosystem will span the development of physical hardware and equipment, the development of software and virtualised solutions, and testing and integration of solutions into 'live' networks. Specifically this ecosystem will include:

- Lab based R&D focused on finding scalable solutions to incorporating interoperable interfaces
- 'Plugfests' bringing together operators and suppliers to test and demonstrate equipment in representative networks and that inform final technical specifications
- Open RAN trials across a cluster of locations including rural districts, suburban and dense urban sites, to test and prove the performance of Open RAN networks
- Funding to support the growth and emergence of vendor-neutral hardware and software-defined solutions, based in the UK
- Testbeds and trials that test and demonstrate the effectiveness of open interface deployment models for new 5G capabilities, applications and use cases. These will also include the testing and development of complementary technologies such as AI, Cloud and other forms of network virtualisation.

3.19. To add to this ecosystem the government is funding a new facility - the SmartRAN Open Network Interoperability Centre (SONIC) - that will create a platform for existing and emerging suppliers to come together to test and demonstrate interoperable solutions. The SONIC project will be led by the Digital Catapult and Ofcom - who will provide technical insight and expertise and help shape the overall ecosystem design and broader activity such as the government's approach to influencing telecoms standards.

SmartRAN Open Network Interoperability Centre (SONIC)

The SmartRAN Open Network Interoperability Centre (SONIC) is a joint programme between the Digital Catapult and Ofcom for testing interoperability and integration of open networking solutions, starting with Open RAN.

SONIC will demonstrate and foster an open disaggregated network ecosystem in the UK, of large and small suppliers along with the telecoms industry, helping to develop a supply chain with multiple suppliers for each element in the technology stack. In addition it will enable UK players to maximise their part in the new supply chain as part of an international effort.

This will enable Government, Ofcom and the Digital Catapult to build a better understanding of technology readiness and maturity and challenges of Open RAN, to inform technology roadmaps and strategies.

SONIC will be live and operational from May 2021, and will evolve over time to create a foundation for broader national testbed and laboratory initiatives.

Specifically the Centre will:

- Provide innovative companies with a neutral environment to come together to test and demonstrate solutions
- Facilitate interoperability testing with organisations involved in standards development and similar - e.g. ETSI, ORAN Alliance, Telecoms Infra Project (TIP)
- Support and link small and large companies to collaborate in a rapidly technology changing landscape
- Operate at a pre-commercial stage at technology readiness levels 5-7

3.20. Establishing a UK National Telecoms Lab at the heart of that ecosystem. The Lab will serve as a hub for telecoms R&D activity across the UK and deliver a wide range of benefits that will derisk, enable and accelerate diversification through new market entrants and interoperable deployment methods. It will create a unique testing environment for operators and suppliers to match their requirements and specifications to assess the technical performance and security of equipment in representative networks - this could be particularly beneficial for new and emerging suppliers, offering them a unique opportunity to demonstrate their viability. This facility will also play a major role in setting best practice for open-interface network deployment and deliver an uplift in telecoms skills and specialism in the UK.

National Telecoms Lab

The National Telecoms Lab builds on the outcomes of the 2019 Telecoms Supply Chain Review that recommended the creation of a new capability.

The Lab will independently test network equipment security, resilience and performance under various conditions - providing access to representative, operational examples of the UK's critical next-generation telecommunications networks. The lab will be a bookable, accessible research facility, allowing teams from academia, SMEs, critical industries and government to research, test and learn about security on the UK's existing and future networks.

Specifically the Lab will:

- provide a place to undertake security research into telecommunications security; enabling operators, vendors, government, academia and other entities to overcome security challenges
- create a secure operating environment to manage commercial and National Security sensitivities
- enable vendors and operators to understand and test how their technology can meet the government's telecoms security framework technically, potentially reducing their costs of doing so
- support supply chain diversification by providing new vendors with access to environments where they can demonstrate interoperability and security capabilities
- allow for end-to-end security research to be conducted against networks that are representative of real world UK deployments with research being targeted to the reality of network deployments seen in the UK today
- provide security scrutiny over a broad range of telecoms technologies including legacy, current and future systems that are likely to be used in our fixed and mobile infrastructure
- support the development of skills in telecommunications and telecommunications security in particular creating a national cadre of valuable and experienced resource

The National Telecoms Lab will be one of the first capabilities of its kind anywhere in the world and will be operational in 2022.

3.21. Building influence and capability in telecoms standards to shape the long term technical framework for the telecoms supply market. The specifications for equipment in the telecoms supply chain is dependent on standards set in global standards setting bodies. These bodies, and the standards they agree, play a critical role in determining the barriers to entry for new suppliers and establishing principles such as open interfaces and interoperability. Identifying and shaping priority telecoms standards in a more democratised and transparent way - so that bodies consider a range of stakeholder needs, and support diversification, innovation and open implementations - will therefore be critical to the long term success of our strategy.

3.22. Analysis and experience shows a number of areas where the UK government could, and should, act decisively in order to ensure standards are developed and set in a way that aligns with our long term vision:

- **Ensuring representation** - while large domestic players such as BT and Vodafone are present and active in standards bodies, overall industry and government presence from the UK and our international partners has diminished and is outweighed by industry and governments from other countries. To secure our interests, we will increase our presence at standard setting bodies and ensure there are voices to speak for them;

● **Boosting participation** - success or failure in standards bodies is determined by the level of input and activity by members. The UK government, Ofcom, industry and academia will therefore increase participation and take a leading role in submitting new proposals and seeking leadership of key working groups to ensure they are more open to our interests;

● **Industrial cooperation** - most technical standards are necessarily developed for commercial purposes, but a strong relationship between government, industry and academia can be effective in delivering results. The UK has had success in providing expert, government input to industry-led discussions on aspects of telecoms security - such as Secure By Design principles - to ensure the right outcomes. We will replicate this approach in order to ensure our representation and participation is as effective as possible;

● **Strategic coordination** - telecoms security and resilience is a strategic priority across government, a range of sectors and for our international allies. In order to increase reach, impact and efficiency we will adopt a multilateral and holistic approach to deliver against our shared goals. Our approach here will be led by working across industry, the regulator, agencies and the national standards body to develop a national strategic framework for long term standards engagement.

3.23. We will also work with standards and industry bodies, intellectual property licensors and licensees and others to optimise the licensing regime for telecoms standards to enable modularisation of networks. This will help to remove barriers to entry for new market entrants by ensuring fair and equal access to intellectual property and licenses - while appropriately rewarding those who have genuinely innovated.

3.24. This work is part of the government's wider strategic interest in digital standards and work to ensure standards are developed in order to support growth and innovation in the digital economy and to mitigate risks to our national security.

Building a global coalition

3.25. The market failure in the telecoms equipment market is a global challenge and we will need to work at a global level if we are to achieve our ambitions. The UK market represents less than 2% of suppliers' global mobile revenues^[footnote 14] and so the UK market alone cannot drive or sustain meaningful change across the supply chain. However, the UK is well placed to lead international efforts to address the global market failure. The Telecoms Supply Chain Review, and subsequent evidence-based decisions - on the use of high risk vendors and the introduction of a new, robust security framework for telecoms - are world leading approaches to assess and assure security and resilience across telecoms networks. In addition, this diversification strategy has been informed by engagement with suppliers across the world who have noted the strategic value and importance of the UK market.

3.26. International partnership and collaboration will be fundamental to the success of this strategy across all three strands of activity. Countries and markets across the globe are recognising the importance of secure digital infrastructure and their increasing reliance on a smaller pool of suppliers. Telecoms supply chains are part of a global system of suppliers, networks operators, and international bodies; typically suppliers develop equipment and capability to support regions rather than individual markets.

3.27. The international context within which our cooperation on telecoms takes place is increasingly complex, and in places, contested. However, we believe that the long term vision set out in this strategy and its key principles - of openness, competition and diversity - are firmly in the interests of all states that want to ensure a fair, secure and resilient global telecoms supply market.

3.28. If we are to achieve a better functioning supply market the international community needs to send a clear and collective signal that will enable and support industry to work with governments to make strategic investment decisions that will drive increased investment in R&D, a commitment to adopt interoperable solutions and to build resilience in supply chains. This will involve working with a wide range of international partners, including markets with advanced technology and manufacturing bases, those with the ability to drive change in the market through scale and emerging markets with potential for rapid growth.

3.29. Our diplomatic networks are mobilised behind these efforts and will continue to work to build a unified approach and deliver coordinated international action with partners that will open up the global market. We will also make full use of our extensive trade network to build on our strong relationships with suppliers and technology providers to establish commercial partnerships with UK industry and attract investment into the UK's innovative telecoms sector.

3.30. In doing so we will take full consideration of the specific requirements and market characteristics of strategically significant regions and markets across the world. In particular we must build consensus and strategic alignment around the need to ensure telecoms standards are set in a way that facilitates competition and interoperability, shared and efficient investment in R&D initiatives that pull forward technology cycles and a shared commitment to secure and protect key supply chains.

3.31. We have already engaged with a broad range of partners and will continue to work with all those with an interest in creating a healthier and more competitive telecoms supply market. We will work bilaterally and in international groups and fora, including the Five Eyes and G7, to build support for the principles set out above and align behind shared initiatives to grow and open up the global market.

4. Resilience across the supply chain and building UK capability

4.1. The measures we have taken with regard to high risk vendors and the ambitious approach set out here, to create a more open, innovative and diverse supply chain for access equipment will deliver the security and resilience of the most sensitive parts of our networks.

4.2. However, the government is alive to the fact that 5G and gigabit capable networks create new security and resilience challenges - greater surface for attacks, new range of services including in critical sectors, new and untested technological approaches - all in an increasingly hostile threat environment.

4.3. Therefore while this strategy focuses primarily on the RAN element of the mobile supply chain - where the need for diversification is most urgent - we will maintain a broader long term view of where security and resilience risks could emerge such as the core and transport network elements.

4.4. We will also consider expected and emerging technological developments. As telecoms networks evolve and trend toward the increased use of software and virtualisation they will increasingly depend on emerging technologies including Artificial Intelligence and Cloud services. These will be integrated into the network, playing key functions such as managing distributed network architecture as a single entity and, in the longer term, replacing hardware functionality itself.

4.5. While software-based and virtualised networks may carry greater potential for risks to emerge within the supply chain, they also offer the opportunity to increase diversity and interoperability by enabling generic hardware to be used to support a wide range of functions, lowering barriers to entry for new hardware suppliers.

4.6. These shifts and trends will also place a spotlight on the need to ensure the security and resilience of the infrastructure on which these data-intensive technologies rely. As set out in the National Data Strategy, the government has a responsibility to ensure that data and its supporting infrastructure is secure and resilient in the face of established, new and emerging risks, protecting the economy as it grows. We will determine the scale and nature of risks, and whether the current arrangements for managing risks are sufficient.

4.7. This will inform the development of specific measures - including investment in R&D and considerations of telecoms standards - that respond to and support technological development across the network, keeping security and resilience of the network at the heart of our approach.

4.8. These technological developments also represent an opportunity for the UK to grow presence and influence within the supply chain itself. The UK is widely recognised for its leadership in R&D, innovation and the excellence of our scientific institutions and is also widely recognised for its leadership in shaping international consensus standards – one of the underpinning threads of this strategy

4.9. Therefore the UK is well placed to play a leading role in developing and establishing novel and new solutions, such as within systems integration and to build and lead an international coalition to tackle some of the key barriers to diversification identified here [\[footnote 15\]](#).

4.10. We will also explore all opportunities to establish homegrown capability and grow the telecoms base within the wider UK tech industry by investing in big-bet R&D initiatives that could transform the telecoms market - and contribute towards the government's ambitious commitment to increase public spending in R&D by £22 billion by the end of this Parliament. While the government recognises that diversification is a significant challenge it represents an even greater opportunity that we are determined to seize - for growth, productivity and in order to secure our position as a global leader in science and technology.

4.11. As part of establishing a holistic UK R&D ecosystem we will seek to support the incubation and scale-up of homegrown suppliers building on the foundations that exist across our universities and in regional advanced technology hubs. This work will be closely linked to the government's broader growth and productivity agenda that will be set out in the Industrial Strategy.

4.12. Key to this will be the alignment across the existing R&D ecosystem in the UK - building on DCMS' £200m 5G Testbeds and Trials Programme, aligning with existing projects and initiatives led by industry and the Catapults Networks and streamlining R&D activity across the range of investment vehicles including Innovate UK, UK Research and Innovation (UKRI) and the Engineering and Physical Sciences Research Council (EPSRC)

The need for systems integration within telecoms networks is likely to be driven by an increasing need to integrate cloud and other virtual activities undertaken by operators and suppliers. This has created a need for telecom system integration expertise to seamlessly integrate network, IT infrastructure and advanced cloud solutions.

5. Conclusions and next steps

5.1. This diversification strategy sets out a clear and ambitious plan to address the market failure in the telecoms access supply market. Through it we will take forward a range of measures to address barriers to entry, boost investment in R&D and lead and establish a global coalition to deliver sustainable and lasting change.

5.2. Diversification of the telecoms supply chain represents a significant challenge, it is one we stand ready to face head on. The approach set out here will drive competition and innovation throughout the supply market and will unlock opportunities for new deployment models and many more suppliers to enter the market. In the UK we will set the standard by promoting the benefits and adoption of open and interoperable networks - underpinned by world class security and resilience requirements. By working in partnership with a wide range of international partners we will ensure the long term vision set out here - for open, flexible and diverse networks - becomes the default in markets across the globe.

5.3. While many of the interventions set out here will ultimately seek to reduce costs by promotion choice, competition and innovation the government has an important role to play in stimulating and invigorating market growth here in the UK. The UK is determined to be a leader in telecoms diversification and we will consider all options to ensure we enable the emergence of an open and diversified supplier market - and seize opportunities for the UK to establish itself as a key player in the market.

5.4. The government recognises the need to move at pace and to ensure the process of diversification gathers momentum as quickly as possible and will commit an initial investment of up to £250m, to drive early progress. In particular we will take forward the following specific measures as a priority:

- **Establishing the National Telecoms Lab** to test security, resilience and performance of our networks and interoperable deployment solutions
- **Launching a major Open RAN trial in the UK** to speed up the development of OpenRAN and laying foundations for roll out in UK networks

- **Committing to remove key barriers to diversification**, in particular: - working with Ofcom to identify and address spectrum-related barriers, ensuring efficient use and allocation of spectrum, where this is beneficial to diversification; - setting out a roadmap for the sunseting of legacy networks - easing the pathway for new suppliers
- **Increasing UK presence and influence at standard setting bodies**, working with UK standards bodies, UK networks operators and industry and international partners to ensure standards are set in a way that enables market growth and diversification
- **Conducting a full assessment** of how regulatory requirements - supported by standards - could be implemented in order to deliver effective diversification outcomes, as part of the long-term delivery of an open, competitive and diverse supply chain.
- **Leading a global coalition** to take collective action to open up the market and establish a competitive and sustainable supply chain.

5.5. This next phase of work will be guided by the recently established Telecoms Diversification Taskforce, comprised of experts from industry and academia. The Taskforce will, in the first instance, look at designing and developing targeted measures across the three strands of our strategy in order to ensure effective, accelerated and sustainable diversification. In the longer term the taskforce will also consider opportunities to build UK capability.

Telecoms Diversification Taskforce

- Lord Ian Livingston of Parkhead (chair)
- Rosalind Singleton, Chair of UK5G Advisory Board
- Clive Selley, CEO, Openreach
- Scott Petty, CTO, Vodafone UK
- David Rogers, CEO, Copper Horse
- Professor Rahim Tafazolli, Head of Institute of Communication Systems, University of Surrey
- Professor Dimitra Simeonidou, Professor of High Performance Networks, University of Bristol
- Scott Steedman, Director of Standards, British Standards Institution

Dr Ian Levy, Technical Director of NCSC and Professor Simon Saunders, Director of Emerging & Online Technology at Ofcom will also be available to the task force to provide technical advice.

5.6. The Taskforce will present its recommendations early in the new year and the government will regularly report on progress to achieve the goals set out in this strategy. Alongside this the government looks forward to engaging with international governments and industry in the UK and across the world as we develop and implement the measures set out here.

5.7. All together, we believe these measures will deliver lasting and meaningful change in the 5G supply chain and pave the way for a vibrant, innovative and dynamic market. One where competition and innovation bring forward new deployment models based on open interfaces and interoperable standards; where networks are flexible, built on a best of breed approach and made up of an array of suppliers; and where security standards are adopted by all operators and suppliers to ensure the robustness and resilience of our networks.

1. The Impact of 5G: Creating New Value across Industries and Society, World Economic Forum and PWC - January 2020
2. This took into account the impact of the addition of Huawei to the US Entity List in May 2019
3. Legacy networks can be defined as earlier generations of mobile network technology (2G, 3G, 4G) and copper fixed broadband networks. The Telecoms Supply Chain Review Report (July 2019) highlighted that the speed scale and processing power of 5G will enable a wide range of new services, including the greater dependency of wider critical national infrastructure sectors on those services.
4. Aside from Huawei and other high risk vendors there is currently only one appropriate scale vendor for full fibre equipment (Nokia). The technical consultation commenced in September 2020 and will build understanding of supply chain alternatives and help to ensure there are no unnecessary delays to our gigabit ambitions and prevent significant resilience risks. The conclusions are expected in the winter.
5. Global mobile base station market share 2019-2020, Trendforce (August 2020)
6. ZTE is a high risk vendor and should not be used in UK networks
7. DCMS estimate
8. Equipment from the two different suppliers is typically deployed in different geographical areas as operators tend to pursue a 'single RAN' strategy in regions
9. In some cases this extends across markets as part of an international procurement strategy as operators seek scale in order to achieve efficiencies across a region

10. Samsung also has a presence within the 4G layer in Three UK's mobile network
 11. Some of these organisations are industry-led, such as ETSI or 3GPP; others like the International Telecommunications Union are run at nation-state level.
 12. Legacy networks are also maintained in order to maintain provisions for older mobile devices and for a range of commercial functions and services - the ongoing provision of these services will need to be considered as part of our approach.
 13. We note that Ofcom has exercised its powers and included additional measures in the upcoming auction of 3.6-3.8 GHz bands to facilitate trading between operators who have expressed an interest to trade;
 14. Telecoms Supply Chain Review, 2019
 15. The need for systems integration within telecoms networks is likely to be driven by an increasing need to integrate cloud and other virtual activities undertaken by operators and suppliers. This has created a need for telecom system integration expertise to seamlessly integrate network, IT infrastructure and advanced cloud solutions.
-

OGI

All content is available under the [Open Government Licence v3.0](#), except where otherwise stated

© [Crown copyright](#)