Section 1: World class digital infrastructure

Part 1. Huawei shares the UK Government's vision of building a world-class telecoms infrastructure for the future:

1. Huawei welcomes the consultation on the UK Government's strategic priorities as an effort to ensure a balanced regulatory environment which will "promote commercial investment where possible."

    We understand that the objective of the UK's Future Telecoms Infrastructure Review (FTIR) "to provide the UK with world-class digital connectivity that is gigabit-capable, reliable, secure and widely available across the UK" is a core part of the UK's Industrial Strategy and is important to the country's future competitiveness. Ofcom will play a critical role in the delivery of FTIR.

2. Huawei's commercial strategy is founded on sustained investment

    ▪ Huawei has invested heavily in strategic businesses to innovate and secure technological breakthroughs. Huawei strategically keeps investing around 10% of its annual sales revenue into R&D, totalling in excess of US$ 60 billion over the past ten years. Huawei has invested US$ 20 billion in the 5G area since 2009.

    ▪ Huawei's R&D spend has two components. 20% goes into fundamental research including for example cutting-edge research on 5G algorithms, AI technology, network intelligence, nanomaterials, and other emerging technologies. 80% goes into transforming this knowledge into useable product technology. The magnitude of this investment overall and the specific investment in primary research sets Huawei apart from its rivals.

3. Huawei's contribution to shaping the future network

    ▪ As of 31 December 2018, Huawei has joined over 400 standard organizations, industry alliances and open source communities. Huawei has more than 400 key positions, including board members of 3GPP，IIC，IEEE-SA，BBF，ETSI，TMF，WFA，WWRF，CNCF，and OpenStack. In 2018, Huawei filed over 5,000 standards proposals.

    ▪ As of 31 December 2018, Huawei has 43,371 granted patents in China and 44,434 granted patents outside of China. A total of 87,805 patent applications have been granted. On 5G, Huawei has 2,570 patents.

    ▪ Through constant, heavy investment in R&D, Huawei is able to build to industry standards from the earliest stages of product design and carry out speedy, high-quality product development to enable operators to build networks with the latest technologies.

Part 2. To facilitate the roll-out of a world-class telecoms infrastructure:

4. We fully agree on the strategic priorities outlined in the FTIR, "Making the cost of deploying full fibre networks as low as possible by addressing barriers to deployment". Huawei's simplified network solution is designed to address challenges during the deployment phase and to accelerate 5G network roll-out:

   ▪ Huawei's 5G solutions are designed to help operators to build networks efficiently, reducing CAPEX and OPEX. It features its lowest energy consumption, lightest equipment, minimum reconstruction required. This paves the way for rapid, large-scale rollout of 5G networks.

   ▪ Due to the nature of 5G, we will see site densification even though some of the 4G sites can be reused. By integrating multi-band, multi-mode antennas and other equipment, rationalized sites provide unified access to networks through multiple methods, and also modularize and standardize equipment to reduce total cost of ownership (TCO) and enable fast site deployment and service provisioning.

   ▪ In January 2019, Huawei launched the world's first 7nm 5G "blade" base station core chip, Huawei TIANGANG. This chip has brought a revolutionary improvement to the AAU (Active Antenna Unit). The size of the base station is reduced by 50%, the weight is reduced by 23%, the power consumption is reduced by 21%, and the installation time is reduced by half compared with the standard 4G base station. This effectively solves the challenge of difficult site acquisition and high cost.

5. Huawei fully understands and is willing to support the UK Government's target on rural coverage in the Statement of Strategic Priorities at paragraph (29):

   ▪ Huawei's RuralStar Lite successfully addresses a number of long-standing issues of network development in rural areas where transmission is difficult to reach, infrastructure is costly to build, the power supply is unstable, and deployment requires a long time to complete. It helps the operators to greatly shorten the ROI period.

6. Huawei also fully understands and is willing to support the UK Government's target on high quality mobile coverage in the Statement of Strategic Priorities at paragraph (29):

   ▪ 5G and all fibre networks will boost the innovation in digital transformation of different sectors which will not be possible otherwise.

   ▪ Seamless coverage and high-performance telecommunication infrastructure are crucial for customer's experience and enterprises innovation. VR (Virtual Reality)/AR (Augmented reality) cloud real-time rendering requires speeds of >100 Mbps and <10 ms network latency, intelligent manufacturing requires <1 ms network latency and 99.999% reliability, wireless healthcare requires speeds of 50Mbps, <5 ms network latency and high reliability communication, and HD video services require a capacity density of 2.5Gbps/1000m^2. These technologies impose higher

requirements on the coverage, rate, delay, capacity density, and reliability of the indoor network.

- Huawei has completed series commercial testing and verification of 5G. It has built more than 30 5G experimental sites, and has completed the 5G scale verification and created a series of industry records. Huawei's best test result is a 5G single cell capacity up to 14.58Gbps, 97 times of 4G, single user peak rate 5.2Gbps, with latency less than 1ms.

Part 3. Huawei welcomes and actively participates in the Government's 5G Testbeds and Trials Programme

7. Huawei welcomes government efforts on funding new 5G user-cases through testbeds and trials.

8. In the 5G Trial in Worcestershire, Huawei has collaborated with Bosch UK, Qinetiq, BT, and O2 to demonstrate the Industry 4.0/Remote Manufacturing applications made possible only by 5G. The consortium aims to increase productivity by 1% in the areas of Preventative Maintenance, Use of Robotics and Assisted Maintenance using AR. Huawei's 5G network has enabled the demonstration of the first Connected Factory use case in the Bosch factory. In addition to providing 5G network solutions, Huawei also offers Huawei Academy training to the local university and colleges to help improve the ICT skillset in Worcestershire. The project kicked off on 1 April 2018.

9. Huawei has also been supporting the 5GIC at Surrey University to build their 5G trial network for 5G research.

Part 4. Spectrum Management

10. **Efficient use of spectrum and preventing under-utilisation：**

- We consider that there may be opportunities for release of additional public sector spectrum for commercial use especially in frequencies where 5G deployments are planned in other regions, and where the UK can benefit from global economies of scale in 5G equipment.

11. **Encouraging innovation and investment in 5G：**

- We consider that large scale national 5G networks will create opportunities for digital transformation and innovative services in vertical sectors through new business models with mobile operators. This can be enabled through 5G network slicing technologies developed by 3GPP which allow verticals to avoid the CAPEX and OPEX of dedicated networks and devices.

- This is contingent on the award of individual national licences for the 3.4-3.8 GHz European 5G primary band, and the availability of 80-100 MHz contiguous channels per

mobile operator in this band in order to deliver advanced 5G services in the UK that are competitive with those expected in many countries worldwide.

12. Flexible shared spectrum

▪ We are broadly supportive of shared spectrum models via local licensing for new users and use cases, but only to the extent that they are not at the expense of the availability of sufficient spectrum via individual national licences for the roll out of large scale 5G networks in the UK.

▪ For example, we have proposed that – in light of uncertainties in the spectrum needs of new uses – it is prudent for Ofcom to apply shared local licensing only in a portion of the 3.8-4.2 GHz band, and to consider individual national licensing in the remainder of the band for important uses such as 5G fixed wireless access (FWA).

13. **The 26 GHz band:**

▪ We consider that it would be in the long term interests of the UK for a total of 3 GHz of the 26 GHz band to be made available at the same time, even if this is at the expense of some delay in the availability of parts of the band.

14. **Greater liquidity in the spectrum market:**

▪ We consider that any arrangements for new users to lease spectrum on a local basis from mobile operators should be market-led, and should only apply at locations where such access is agreed by the mobile operator and – importantly – does not result in interference to mobile networks.

Part 5. Making the most out of the synergies between 5G FWA and Fibre

15. Huawei fully agrees with the statement in the Statement of Strategic Priorities the "Fixed fibre networks and 5G are complementary technologies..." Huawei also firmly believes that a smart combination of FTTH and 5G FWA will benefit UK citizens in many ways.

16. Huawei shares the general industry view in favour of the allocation of wide contiguous blocks of spectrum (e.g. 80-100MHz per operator at 3.4-3.8 GHz). Another possibility is to provide subsidies to help cover the costs of FWA consumer premises equipment (CPE) as has already implemented in some other European countries. In France, a new funding scheme called "Cohésion Numérique des Territoires" was created with a budget of €100 million devoted to providing CPE subsidies of €150/household (for which 4G FWA is eligible) in well identified underserved areas which would not benefit from 8Mbps fixed broadband services by 2020.

Section 3: Secure and resilient telecoms infrastructure

Part 1: Context

17. Huawei is pleased that the UK Government considers it important for Ofcom to play an enhanced role in helping deliver telecoms networks that are secure and resilient. The UK's oversight regime for Huawei is arguably the toughest and most rigorous in the world. Huawei welcomes Ofcom's enhanced regulatory role and we believe that Ofcom has the potential to help further develop the UK's technical capabilities in this area, alongside its current role promoting healthy competition, strong investment, and consumer protection.

18. However, this is still insufficient if we want to achieve the key cyber security and network resilience goals that the UK Government has set. Taking remedial measures after vulnerabilities are identified has weaknesses in costs, efficiency, and risk controls. As the UK Government implements its strategic priorities for Ofcom in respect of cybersecurity, Huawei believes that in addition to testing, importance should be attached to *ex-ante* setting and implementation of cybersecurity standards, including standards on the confidentiality of communications and data, network and service integrity, and network availability.

19. Standards can help clarify the business case for operators as they design and run networks. To measure the risks related to security and resilience, the Government must be clear about the standards that align with the expectations of industry players, and take the lead in developing a systematic risk evaluation system to identify and prioritize different types of risks. The Government must also develop clear standards agreed by all parties, and provide guidance for operators and vendors on how to manage cyber security based on unified baselines and regulations. This will ensure that the cyber security methodologies of the Government can be consistently applied across the industry

20. In the 5G era, communication technology will evolve faster than ever before. During this process, regional or fragmented security standards and certification processes will not only drive up costs across the global industry, but also lead to technology silos that will impede innovation. We believe international collaboration on globally unified security standards is beneficial to fair competition. Such collaboration is also an efficient way to address the global challenge of cyber security.

Part 2: principles for good management of cyber threat

21. As Ofcom enhances its role in helping to manage the cybersecurity threats that the UK faces, the Statement of Strategic Priorities sets out three specific areas of focus for Ofcom. One of the suggestions is for a cyber penetration testing programme. The TBEST plan is not only about making UK telecom networks more secure and resilient, it's also an important part of establishing uniform, objective security standards and certification paths. Huawei agrees that TBEST can help drive improvements in cybersecurity, and agrees that

Ofcom, DCMS and NCSC should work with operators to carry this out. Huawei stands ready to help support this work as needed.

22. The other two areas of focus are to:

    ▪ Ensure appropriate risk understanding, ownership, and mitigation by communications service and network providers.

    ▪ Strengthen stakeholder engagement with providers and suppliers, including on sector wide cyber security and supply chain arrangements.

23. Huawei welcomes both priorities. Huawei also has specific suggestions for how Ofcom's role could develop in relation to these points. While it will be for Ofcom as an independent regulator to decide, in consultation with industry, how best to discharge these functions once DCMS has issued the final Statement of Strategic Priorities, Huawei would like to take the opportunity to set out its views on the best way of making this role work in practice.

24. Huawei believes the following principles should be considered:

    ▪ There should be a level playing field – the best way to promote strong competition and security is for the Government to ensure objectives are clear and that there is a level playing field for meeting them.

    ▪ Understanding of roles and responsibilities – The Government, industry organisations, and companies must work together to build end-to-end network-wide security. All actors in the market have a role to play – operators, suppliers, the UK Government and Ofcom as the independent regulator each have a role in responding to the challenge of cybersecurity.

    ▪ Effective competition is critical to the market – strong competition creates the right incentives for innovation and is the best way to deliver high quality products to market at the best value.

    ▪ The UK should be able to embrace the latest technology – in line with the UK's Industrial Strategy the review should set the stage for the adoption of the best technology available to ensure the UK has world class infrastructure.

Part 3. Creating better incentives through standards

25. As part of its steer to 'ensure appropriate risk understanding, ownership and mitigation', the Government should ask Ofcom to
    (a) develop clear standards agreed by all parties, and
    (b) provide guidance for operators and vendors on how to manage cyber security based on unified baselines and regulations.
This would improve alignment of incentives across the market and naturally complement enhanced penetration testing and remediation of issues in deployed equipment.

26. By taking both these steps, the potential for misalignment between the Government and operators and between operators and vendors can be limited, and variable results will be reduced. With a clear regulatory bar to aim at, and in a highly competitive market, operators will increase investment in cybersecurity.

27. The telecommunications industry relies on heavy investment. To promote investment, industry needs efficient processes for the design of security features into equipment. Design should be based on tangible standards that enable risk control implementation from the source or front end and preventive defence rather than post-event remediation. This will help the industry to build better telecoms infrastructure from the outset and reduce the cost of strong cybersecurity in the long run.

28. We believe that the introduction of standards for cybersecurity in telecoms networks will take time and a concerted effort from all players to get right. Ofcom will need to conduct detailed consultation with industry and carefully consider the best framework for a standards-led approach. However, Huawei thinks that standards offer a great many advantages, and are also the most practical way of delivering improvements in cybersecurity, alongside enhanced testing.

29. Huawei would like to suggest the following points for your consideration to demonstrate that standards could work in practice:

    - Enhancing regulation by defining standards and requirements for security and resilience at different network layers (such as access, core and IT systems) is potentially an effective approach for Ofcom to take. Ofcom should define network resilience management – including the creation of resilience standards for different network layers – as one of their strategic priorities for telecom regulation over the next five years.

    - Common criteria (CC) certifications can be used at different levels to meet the security requirements of critical telecom infrastructure in different scenarios. For example, CC EAL4 includes the scope of automated configuration management as well as stringent penetration testing, which are aligned with the strategic telecom priorities of the UK Government.

    - Gradually refining the TBEST testing plan by referring to industry practices in standardization. Ofcom should further build the capabilities and channels in threat intelligence discovery through intelligence-led vulnerability penetration tests. Ofcom should also consider how T-BEST could be expanded to provide a holistic framework that allows for the identification of all potential vulnerabilities. For example, T-BEST should take different factors in operator network into consideration, such as different network layers, suppliers, equipment, and age, thus ensuring the widest possible view of security. Therefore, on sample selection, Ofcom should select appropriate samples from different network layers including core network, transport network, and access network, and select network elements from different operators and suppliers to ensure diverse and representative testing.

- Huawei calls for closer collaboration between the UK Government and the industry, operators, vendors and standards bodies in terms of security standards and evaluation schemes. This is vital to improve security across the entire value chain and help build trust through verification.

Part 4: Next steps on Section 3

30. DCMS could include in the Statement of Strategic Priorities a suggestion that Ofcom consider a range of approaches to ensuring appropriate risk understanding, ownership and mitigation, including guidance and standards.

31. Ofcom should consult carefully with the industry (both operators and vendors) as it enhances its role in cybersecurity, and we encourage Ofcom to consider seriously the role that standards could play in its approach.

32. Huawei will fully engage with Ofcom as it deepens its work around cybersecurity including in the telecoms supply chain.

33. Huawei would be pleased to discuss further any elements of this response with DCMS and Ofcom.