Written evidence submitted by Starion UK Ltd

4. How resilient are the UK public and private sectors likely to be in the event of major disruption?

Introduction

Starion UK Ltd, is part of the Starion Group. We are working with the European Space Agency (ESA) and partners in the UK, Europe and Canada on the use of satellite-based quantum key distribution to secure communications across optical fibre networks over transcontinental distances.

This evidence is provide based on our experience and knowledge of this domain and offers a view of technologies that have the potential to augment or increase the resilience of communications using undersea cables.

Background

Undersea cables are a critical infrastructure supporting telecommunications applications including internet traffic, financial transactions, secure communications and many others. As a fixed asset, they are vulnerable to interference both on the ocean floor and at landfall. Due to the distances involved, optical fibre cables are reliant on repeaters along their length, themselves dependent on power supplied from the shore. The repeaters also inhibit the sharing of quantum-based security keys over long distances (so-called quantum key distribution (QKD), potentially limiting resilience of these links to quantum computer-based attacks in the future.

In this evidence, we propose that, in addition to enhancing the physical protection of the cables and their supporting infrastructure (the subject of other questions), satellite-based technologies can provide a backstop should there be major outages and a resilient means to provide secure end-to-end QKD over transoceanic or intercontinental distances. These technologies are in development and will start to become commercially available in the next 5-10 years.

Optical Satellite Links

Optical satellite data link technology is starting to show that very high data rates can be achieved (10-100 Terra bits per second are theoretically possible). These are order of magnitude more than radio-frequency technology (typically 1-10 Gbps with Ka- or Ku-band). Optical satellite data link technology uses optical ground stations (telescopes) to be located at sites around the world (also ultimately connected to a fibre network) not only to benefit from cloud-free skies but also to provide geographic diversity.

UK companies and universities are actively developing this technology not only for ground-space links but also for inter-satellite links needed to support a constellation, small enough to be hosted on CubeSats and small, low-cost spacecraft. These include Archangel Lightworks, Spire, Durham University. In Europe Airbus, TESAT and Mynaric are developing technologies and systems as are several US companies.

Optical satellite links may not replace optical fibre for all long-distance communications but can provide a backstop and additional diversity of routes should critical point-to-point cables be damaged. Once the technologies are perfected, a constellation of such satellites (feasible in the next 10-15 years) could provide a viable alternative to fibre cables for some critical uses.

Quantum Key Distribution

Quantum key distribution addresses the generation and secure distribution of symmetric encryption keys. BT's Quantum Safe Metro Network is an example where this technology is being used in the UK to support secure connectivity between financial institutions. However, while the keys can be exchanged over optical fibres over shorter distances (less than 100-150 Km), longer distances require a so-called trusted node to act as a repeater, which can be expensive and, with current technology, is infeasible for transoceanic or transcontinental distances.

Satellite QKD involves the exchange of quantum generated keys using satellites to overcome the distance limitations for fibre optics. Keys are shared between two locations via satellite using optical ground stations, using quantum secured optical data links. The keys are generated using a quantum random number generator onboard the satellites or, in some schemes, on the ground. The aim is to transfer a store of fresh keys that can be used over a certain period for communication between two parties, meaning only intermittent exchanges are needed.

The UK is one of the leaders in this technology with several technology demonstrator satellites due to be launched in 2025 and 2026, including VOLT (Craft Prospect), Spectre (joint UK Singapore initiative – RAL Space and SpeQtral. Singapore) and SPOQC (the Quantum Communications Hub). Other UK companies such as BT, Archangel Lightworks, Toshiba Europe, Starion, NPL and Honeywell are working of different parts of the ecosystem.

Satellite QKD, especially when combined with Post Quantum Cryptograph (PQC), can provide an enhanced level of resilience for long-distance fibre-optic based communications and should be part of the considerations in increasing the protection of the undersea cables that carry the bulk of the intercontinental data traffic.

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