PRESS RELEASE

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Singapore and UK collaborate on S$18m project to develop quantum-secured communications networks

Early demonstration of new quantum technologies deployed in space, through the latest collaboration between the UK and Singapore governments, could lead to more secure online activity for consumers in everything from financial transactions to online conversations.

A SG-UK Collaboration to Secure our Networks from Space

2 The S$18 million initiative between the Singapore and UK governments will build and deploy a satellite quantum key distribution (QKD) test bed. Under the collaboration, Singapore and UK will co-develop a “QKD Qubesat”, a satellite based on the CubeSat standard that will use a pioneering QKD technology from Singapore to test the secure distribution of cryptographic keys over globe-spanning distances. The satellite is expected to be operational in late 2021.

3 Satellite-based QKD is emerging as an unbreakable encryption technology, far more secure than existing encryption techniques. If successful, this new joint quantum technology satellite mission will open access to a global market estimated to be worth up to S$20 billion over the next decade. It builds on both countries’ efforts to grow the space and quantum technologies sectors to venture into the emerging QKD market.

4 In Singapore, work will be led by the Centre for Quantum Technologies (CQT) at the National University of Singapore (NUS), which will contribute its expertise in the building of rugged and compact QKD instruments suitable for deployment in space. In the UK, work will be led by the Science and Technology Facilities Council’s (STFC’s) RAL Space, which will contribute its expertise in innovative space technology and optical links needed for beaming QKD signals.

Quantum Encryption for Secure Communications

5 Existing systems to facilitate the secure electronic transfer of information are becoming increasingly vulnerable. The public key algorithms that handle the secret keys to lock and unlock encryption will be easily broken as quantum computers come into use. These systems currently underpin the security of 99% of the world’s data communications from mobile banking and payment systems to smart home devices.

6 Satellite-based Quantum Key Distribution is a fundamental enabler of the next generation of secure communication networks. QKD provides an alternative that can be seamlessly integrated onto the network systems we already use. It is resistant to all known computational attacks, including from future quantum computers. A space-based QKD system will ensure security over national and international distances, at a lower cost to the alternative, ground-based fibre infrastructure for quantum-secured
communications. By ensuring the secure distribution of cryptographic keys over globe-spanning distances, this space-based technology delivers ultra-secure, long-range communications capability at a level that cannot be achieved with ground-based fibre infrastructure.

7 On this new collaboration with the UK, Mr George Loh, Director, Programmes at the National Research Foundation (NRF) in Singapore said: “Singapore has developed deep research capabilities in quantum technologies through our past investments in the Centre for Quantum Technologies. Singapore and UK share the same outlook to leverage research & innovation to develop capabilities and derive benefits for our respective countries. This collaboration with UK is significant for both countries, in bringing together our experts to demonstrate satellite-based QKD communication capability. Singapore will also bring in local companies to develop and commercialise products and services in the QKD market, as well as other forms of space and quantum technologies.”

8 Dr Artur Ekert, Director of CQT said: “Having access to quantum-secured communication is a smart step for cybersecurity. We already have trials over fibre for secure communication within Singapore, building on CQT’s decade of development of this quantum technology. Reaching into space with our UK partner is a strategic move towards global data security.”

9 Dr Chris Mutlow, Director of STFC RAL Space said: “As the UK’s national laboratory for innovative space technology development, this is exactly the kind of mission we are here for. Alongside our international partners, we will provide a vehicle for technology readiness-raising and rapid space qualification of quantum technologies. This mission puts the UK ahead of our competitors in quantum communications. It will enable the space sector to tap into new manufacturing and export opportunities that will help the UK achieve its ambition of capturing a 10% share of the estimated £40 billion global space market by 2030.”

10 The Singapore and UK teams will work with academic and industry partners to help support future development of commercial products and services. In Singapore, S-Fifteen Pte. Ltd., a company spun out from CQT, aims to provide QKD hardware and other quantum-safe solutions. CQT already collaborates with telecommunications companies, such as Singtel, to bring QKD communication technologies to market. RAL Space will be working closely with the UK telecommunications and service sector, including BT and Arqit Ltd., to prepare for the inclusion of quantum communication into mobile and static applications. RAL Space is collaborating with the UK’s National Quantum Technology Programme to develop space applications of quantum technologies.
The Centre for Quantum Technologies (CQT) is a national Research Centre of Excellence in Singapore. It brings together physicists, computer scientists and engineers to do basic research on quantum physics and to build devices based on quantum phenomena. Experts in this new discipline of quantum technologies are applying their discoveries in computing, communications and sensing.

The Centre was established in December 2007 with support from Singapore’s National Research Foundation and Ministry of Education. CQT is hosted by NUS and has staff at Nanyang Technological University and Singapore University of Technology and Design. www.quantumlah.org

Science and Technology Facilities Council’s (STFC) RAL Space is an integral part of the Science and Technology Facilities Council’s (STFC) Rutherford Appleton Laboratory (RAL). RAL Space carries out an exciting range of world-class space research and technology development. It has had significant involvement in over 210 space missions and is at the forefront of UK space research.

RAL Space has established a Quantum Space Laboratory to help UK academics and industry prepare quantum technologies for use in space applications. www.ralspace.stfc.ac.uk @RAL_Space_STFC

The Singapore National Research Foundation (NRF) is a department within the Prime Minister’s Office. The NRF sets the national direction for research, innovation and enterprise (RIE) in Singapore. It seeks to invest in science, technology and engineering, build up the technological capacity of our companies, encourage innovation by industry to exploit new opportunities that drive economic growth, and facilitate public-private partnerships to address national challenges.

Under RIE2020, NRF is committed to create greater value in Singapore from our investment in research, innovation and enterprise through 1) closer integration of research thrusts, 2) stronger dynamic towards the best teams and ideas, 3) sharper focus on value creation, and 4) better optimised RIE manpower. For more information, visit www.nrf.gov.sg/RIE2020
About Quantum Entanglement Technology

The task in a satellite QKD mission is to send quantum signals at the single photon level between an orbiting platform and a ground receiver. The joint SG-UK initiative will work towards employing quantum entanglement to establish the secret key between satellite and ground. One unique advantage of entanglement is that by testing the quality of quantum correlations, it can be shown that no third-party has access to the transmitted signals. This is a capability not available to other types of random number generators (even if these are based on other quantum properties).

QKD Qubesat, together with supporting ground station receivers in Singapore and the UK, will demonstrate quantum entanglement-based encryption to secure communications from space. The satellite will perform QKD between two ground stations, one in the UK and the other in Singapore. It will create a shared key by sending quantum-entangled signals to the ground stations. The entanglement will synchronise the two parties’ keys. It will also reveal any attempts to hack the transmission, making sure the parties never risk their data by using a compromised key.

In June 2016, CQT reported the first operation in space of a correlated photon source, which was launched on a Cubesat built by NUS. The joint collaboration with the UK will review and upgrade both hardware and software segments from previous research and development efforts for the final satellite QKD mission. CQT will partner local companies to design and establish a ground station in Singapore to receive keys from the satellite.
Photos

[Caption] Andy Vick, Head of Disruptive Space Technologies at the UK’s RAL Space with Associate Professor Alexander Ling from the Singapore’s Centre for Quantum Technologies meet in Singapore to discuss quantum encryption from space. Photo: CQT

[Caption] Researchers at the Centre for Quantum Technologies in Singapore have expertise in building rugged and compact QKD instruments for spaceflight. Photo: CQT
Quantum key distribution creates encryption keys using signals sent at the single-photon level. This device uses lasers and crystals to create the type of signals required for entanglement-based QKD. Photo: CQT

Engineers at STFC RAL Space have heritage in novel space technology and small satellite development and testing. Photo: STFC RAL Space
[Caption] The task in a satellite QKD mission is to send quantum signals at the single photon level between an orbiting platform and a ground receiver. Photo: STFC RAL Space