

DETI Case Study:
**EC1.4 Secure Inter-Site
Connectivity Pilot**

Quantum Key Distribution (QKD) for Secure Inter-Site Connectivity

Successful Trial of Remote Monitoring for Manufacturing

The UK's first industrial quantum secure network, created by the DETI partnership, **BT** and **Toshiba Europe Ltd**, has successfully shared live data for remote manufacturing using Quantum Key Distribution (QKD), over a 2 month trial period. This is the first time the capability has been demonstrated using "off the shelf" components and marks the first milestone in DETI's quantum programme exploring the practical application of this technology.

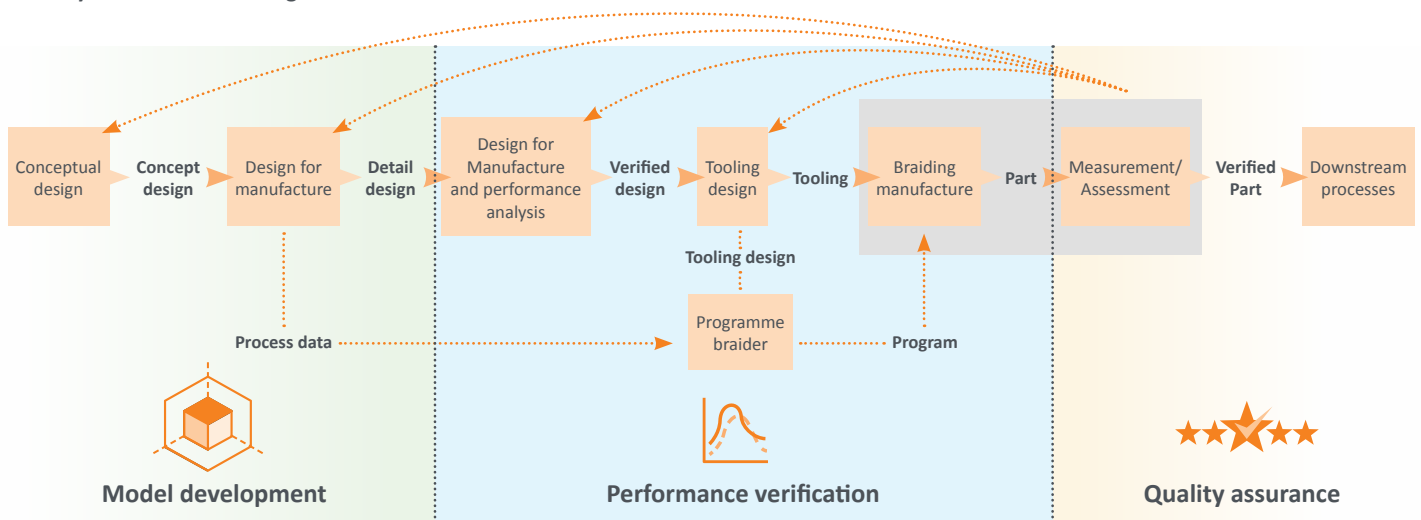
This first step of the Secure Inter-Site Connectivity (EC1.4) work programme focuses on the application of secure connectivity in the digitalisation of manufacturing and is one of three key areas in the transformation of engineering. The digitalisation of design, and also the supply chain are two further aspects which are planned in the programme to enable the modernisation of the entire product lifecycle and process.

Quantum to unlock the value from manufacturing data shared inter-site

The shift to fully integrated digital using data from multiple sources – while keeping it secure – is a key enabler to delivering smart factories. The DETI programme tests the 'real world' readiness of novel digital technologies by taking them out of the lab and putting them to work on the factory floor.

For this project, the team partnered with BT and Toshiba to install a quantum secure network between the **National Composites Centre (NCC)** and the **Centre for Modelling & Simulation (CFMS)**, near Bristol, using BT Openreach's "standard" fibre optic infrastructure. Over the trial period the team then tested this QKD enabled link, sharing production data for measurement and assessment from the NCCs Overbraider with the design team at CFMS [Figure 1].

Securing and using data from multiple sources is a key enabler to unlocking value



[Figure 1]

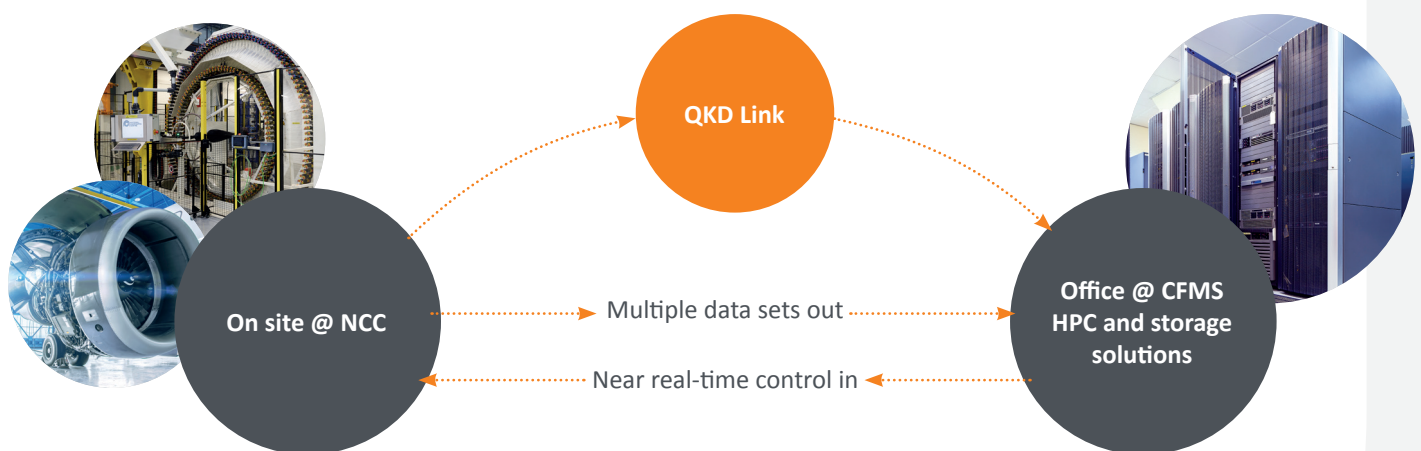
The Quantum Challenge for Manufacturing

The processing power of quantum computing, when it comes onstream will challenge the security of today's encryption technologies. This has serious implications for design and manufacturing sectors including aerospace, defence, automotive and maritime, which rely on ultra-secure data transmission. QKD has been identified as one of the solutions to secure communications (when paired with quantum-safe cryptography mechanisms¹), but its suitability for real-world manufacturing applications has been largely untested.

¹Quantum Security Technologies White Paper, National Cyber Security Centre, 24 March 2020

UK's first industrial trial of a quantum-secure network

The 2-month trial routed data between the NCC and CFMS sites across a dedicated 7km long connection: a QKD enabled encryption tunnel, between two Edge firewalls. [Figure 2]. The application was the remote operation of the NCC's composites Overbraider machine – a highly complex device that weaves strands of carbon fibre from 288 separate spools to create precision hollow composite components, such as aircraft engine blades.



[Figure 2]

In the trial, the team shared production data and quality-critical measurements using Toshiba's QKD Multiplexed System to transmit encryption 'keys'. This can distribute thousands of cryptographic keys per second, making it possible for both the data and the quantum keys to be transmitted using the same fibre, eliminating the need for costly dedicated infrastructure [Figure 3].

For the quantum enabled link, the team used BT OpenReach Optical Filter Connect product, with two fibres from each of the buildings connected to a BT exchange, this means that not only Quantum but also Ethernet communications was provided (ADVA) so that the team was adding QKD security on top of, rather than replacing, any existing security measures.

The network also benefits from Toshiba's Active Stabilisation technology within the QKD which automatically compensates for any changes in the ambient conditions like temperature and stress, which allows the system to work continuously and stably.

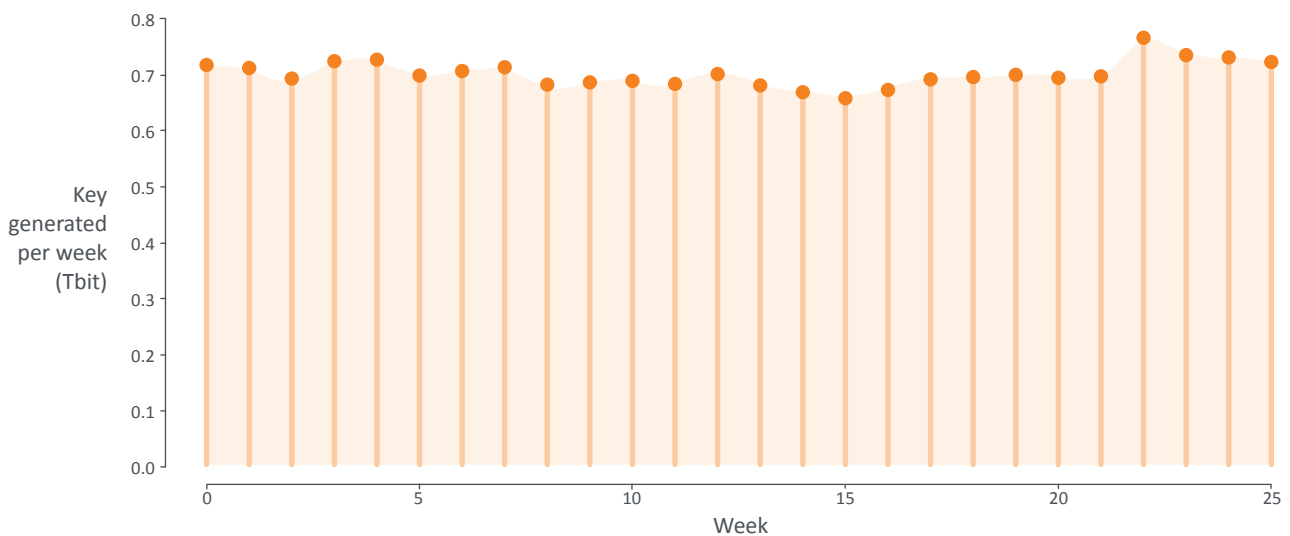
The QKD enabled connection was presented effectively as a point-to-point ethernet connection, making it simple to integrate into existing infrastructure for both traditional and modern networks. Data from the Overbraider cell traverses the NCC operations network, and is routed across the QKD enabled link via the NCC edge firewall. Once the data arrives at the CFMS edge firewall it is routed through the CFMS network before being stored and analysed within the Data Warehouse application hosted within CFMS Openstack private cloud system.

The CFMS ethernet network is a designed for purpose high-performance network, built on Open-Networking technologies and can deliver up to 400Gbps of bandwidth to each rack within the research datacentre. The use of Open Networking and Openstack allow for the CFMS infrastructure to be rapidly and repeatably reconfigured for each project using 'infrastructure-as-code' principles.

Significant milestone achieved of seamless, reliable and secure connectivity

Over the course of the Overbraider trial, the QKD system generated on average between 0.7 and 0.8 terabit (Tbit) of secure keys each week, with the link operational for six months.

Secure key material generated by QKD over 7km NCC-CFMS Link



[Figure 3]

Next Steps

The DETI team and partners, working with the High Value Manufacturing Catapult, will now look to extend the scope of the trial and integrate QKD into the 5G-Encode test bed, incorporating more of the technologies on-site at the NCC linking the applications even closer to the machinery and IoT devices deployed in UK factories.

Project Partners

The quantum link was established between the NCC and CFMS as part of the DETI test beds funded by the West of England Combined Authority (WECA), using the quantum solution installed by BT and Toshiba supported by UKRI's AQuaSeC project.



TOSHIBA

Contact us

Organisations interested in learning more about the quantum programme or accessing the 5G-ENCODE and DETI test beds can email deti@nccuk.com.