



## Quantum United

Photonic Encryption and Interconnect for  
Quantum Computing

### Application Area

**Sector:**

**Area:**

**Industry:**

**Market:**

### Partnership Opportunities

This is a startup and license opportunity.

- Cooperative Agreement
- License
- Tech Assistance
- Start-up

### Technology Readiness Level 2

### IP Information

US Patent and Copyright Pending

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### Overview

Network hardware and software must be updated now for the upcoming quantum computer boom due to the vulnerabilities of traditional encryption methods to quantum attacks such as harvest-now-decrypt-later. The current encryption methods were developed after the classical computer and the internet were invented. Even then, the evolution of the encryption algorithms had seen several iterations and patches. While the quantum-safe algorithm for classical networks is being standardized for the yet-to-be-seen quantum computers, physical data encryption through quantum hardware could provide security and peace of mind. However, today's solutions for the quantum-classical hybrid network infrastructure are costly and complex, preventing the hardware deployment to the market.

LANL's Quantum United is a portable quantum hardware module that emits a stream of single photons at telecom wavelengths, operates at ambient to cryogenic temperature, has material compatibility with photonic integrated circuits on silicon chips for scalability, and has rad-hard packaging for reliability. This innovation is particularly relevant for research and development and testbed communities focused on pioneering new techniques for distributing quantum keys or entanglement via photons as a countermeasure to these growing security threats. Further, they also enable photonic interconnect to network multiple quantum computers.

### Advantages

- Existing telecom fiber-optics compatibility
- Scalable and economical manufacturing through fab compatibility
- Faster on-demand encoded photon covering tens of kilometers scale distance at room temperature (for quantum key distribution)
- High fidelity and data rate with indistinguishable photons at cryogenic temperature (for entanglement distribution)
- Fiber-coupled chip-scale plug & play package for heterogeneous integration (for quantum computing)

## Technology Description

Quantum information science in the 21st century has the potential to revolutionize computing, communication, and sensing. A promising pathway to realize this opportunity is utilizing the evolved fields of nano-engineering, photonics, and digitization. Quantum light source is a critical part of such platforms. Despite decades of research, the challenge remains in creating an ideal single photon source that can match the key requirements for cost-effective real-world deployment, such as (1) light emission in the existing telecom wavelengths for fiber-optics compatibility (2) operation near room temperature for quantum key distribution delivering high data rate and operation at cryogenic temperatures for high fidelity indistinguishable photons, and (3) material compatibility with scalable fab manufacturing. LANL's Quantum United technology utilizes a nanoscale platform in a chip-scale package, delivering on-demand high-purity and indistinguishable single-photon states directly in the telecom band operable at ambient to cryogenic temperature conditions.

## Market Applications

Due to vulnerabilities of traditional encryption methods to quantum computing attacks, the need for secured communication methods is escalating in sectors such as banking, finance, defense, and critical utilities. The Quantum Key Distribution (QKD) market is a niche market that will expand if the benefits of quantum-classical hybrid network hardware outweigh their cost and complexity. The market encompasses the development, production, and deployment of QKD systems, including hardware (like quantum source detectors) and software (for key management and distribution protocols). LANL's Quantum United will address the overall quantum information science market sector, such as communication (quantum encryption), computing (interlinking quantum computers using photons), and sensing (quantum detectors). Quantum United could be a stand-alone product or the basis of a platform for many applications in multiple sectors.

## Next Steps

Proof-of-concept for the technology has been demonstrated. A fiber-coupled chip-scale prototype controllable by electrical and optical means is under development.