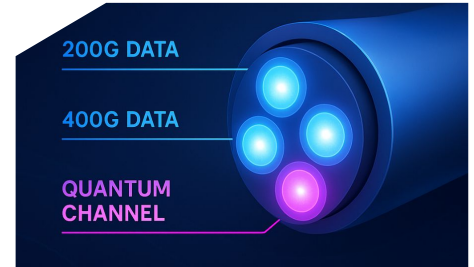


## Introduction

As digital communication systems scale to multi-terabit to petabits capacities, securing data has become critical in the face of emerging quantum computing threats. Quantum Key Distribution (QKD) is emerging as a future-proof solution to data security in the post-quantum era. However, integrating QKD with high-speed data networks poses challenges related to noise, isolation, and scalability.



Quantum communication typically requires dedicated fibre to ensure the integrity of quantum signals. However, deploying separate fibre for quantum and classical data transmission increases network complexity, cost, and physical infrastructure demands, limiting scalability. STL and C-DOT addressed this challenge using Multiverse Fibre, STL's Multicore Fibre (MCF), which integrates multiple isolated cores within a single optical fiber. In this breakthrough demonstration, STL, in collaboration with C-DOT, successfully enabled QKD transmission coexisting with 200G/400G classical data over a MCF link over 100+ km, establishing a new benchmark in the hybrid optical network innovation. The experiment showcases one of a leap toward hybrid secure and scalable space efficient quantum-classical network infrastructure.

## Objectives

### Validation of Secured Optical Network

Enabled high-speed, tamper-proof quantum key generation over 100+ km MCF.

### Bridging Quantum & Classical Worlds with MCF

Achieved simultaneous QKD and 200G/400G classical data transmission on spatially separated cores.

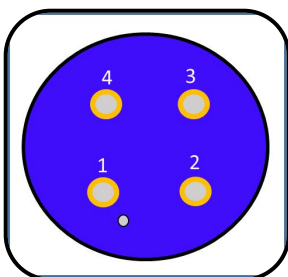
### Future Proof Optical Network Security

Demonstrated practical feasibility for national secure communication goals under C-DOT/DoT initiatives.

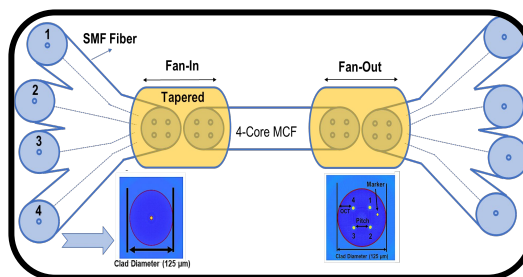
## STL Developed Solution and differentiators

The state-of-art solution demonstrates STL's strength in fiber design, system-level engineering, and rapid industrialization of next generation cutting-edge technologies through its Multiverse Fibre.

- **Low-crosstalk MCF Fiber:** STL-developed MCF with optimized trench-assisted core design for reduced cross-talk.
- **MCF FIFO Assemblies:** Co-developed MCF FIFO with external partner collaboration for interfacing with single core fiber for connectivity between MCF and legacy systems.
- **Indigenous Technology Demonstration:** Demonstrated QKD and high speed classical data together with one core reserved for QKD, remaining core used for parallel 200G/400G data transmission.
- **Secure Network Validation:** Jointly tested and validated by STL and C-DOT in real-world environments for QKD transmission over Multicore Fiber (MCF) alongside co-existing 200G/400G classical data



TA-MCF



MCF FIFO Assemblies



QKD Demonstration

# The Strategic Advantages of Collaborating with C-DOT

**Innovation Acceleration through Joint Expertise:** First-of-its-kind demonstration of coexisting QKD and 400G classical channels over 100 km multicore fiber—pushing the boundaries of secure, high-capacity communication.

**Technology Leadership in Quantum-Classical Integration:** First-of-its-kind demonstration of coexisting QKD and 400G classical channels over 100+ km multicore fiber—pushing the boundaries of secure, high-capacity communication.

**Indigenous Capability Building:** Boosts India's self-reliance in quantum-secure fiber solutions, supporting Atmanirbhar Bharat and trusted telecom initiatives.

**National Security Alignment:** Joint initiative supports India's secure communication objectives under DoT's national mission for quantum and high-speed data networks.

**Scalability for Next-Gen Networks:** Establishes a scalable architecture ready for rollout across metro and long-haul secure communication networks.

## Overcoming Key Challenges

- **Intercore cross-talk:** Quantum signals are extremely sensitive to noise, however STL's low-crosstalk MCF design ensured  $< -45$  dB isolation.
- **Low IL Fan-out:** Power budget is a critical factor in quantum-secure networks; therefore, low-insertion-loss fanouts enables long-distance quantum communication alongside classical data over MCF.

## Strategic Impact

**"This initiative is a key milestone for India's telecom ecosystem. It clearly establishes the feasibility of integrated quantum-classical networks over next-generation optical fibers."**— Dr. Rajkumar Upadhyay, CEO, C-DOT.

**"By integrating QKD with our indigenously developed MCF, we've demonstrated how optical innovation can drive secure communication. This collaboration showcases the power of public-private partnerships in advancing India's quantum ambitions."**— Rahul Puri, CEO, Optical Networking Business, STL.

## Conclusion

The C-DOT-STL collaboration exemplifies a transformational approach to secure communication, blending QKD innovation with multicore fiber scalability. As India builds toward a digitally sovereign future, this pioneering use case establishes a robust foundation for national quantum-secured networks—resilient, efficient, and future-ready.

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