جامعة
حمد بن خليفة
HAMAD BIN KHALIFA
UNIVERSITY
عضو في مؤسسة قطر
Member of Qatar Foundation

HBKU Thematic Research Grant 3rd Cycle– Project Highlight

Project Title: Optimal AI and Quantum Secured Wireless–Optical Communication Design for Smart Cities in Qatar

Theme: *Quantum Communications & AI & Sustainability*

Prof. Khalid Qaraqe

Executive Summary (limit to 200 words)

This project aims to develop an AI- and quantum-secured communication framework tailored for Qatar's smart cities. By integrating wireless sensor networks (WSN), optical backbones, and quantum key distribution (QKD), it ensures secure, efficient, and resilient communication under Gulf climatic conditions such as heat, dust, and high solar radiation.

The proposed architecture combines Quantum-Inspired AI (QAI) algorithms for optimal routing and scheduling with climate-aware QKD protocols over fiber, free-space, and wireless links. These will be consolidated within a city-scale Digital Twin of Doha, capable of simulating environmental and network scenarios to produce deployment-ready policy maps.

The project outcomes include patentable designs in quantum-secured wireless–optical architectures, AI-QAI optimization toolkits, validated QKD frameworks, and a Digital Twin–based planning platform that supports Qatar's Vision 2030 for sustainable and secure urban development.

Ultimately, this initiative strengthens HBKU's leadership in AI, quantum communication, and sustainability research, fostering impactful collaboration between CSE and QEERI, and positioning Qatar as a pioneer in next-generation smart city communication systems.

Expected Outcome (limit to 100 words)

- **QAI-driven optimization toolkit** enhancing wireless sensor network performance under Qatar's climatic conditions, enabling improved routing, scheduling, and network resilience.
- **Design and prototype evaluation framework** for wireless and optical quantum key distribution (QKD) links, focusing on secure and efficient communication across smart city layers.
- **Digital Twin simulation platform** for evaluating environmental and operational scenarios, generating district-level **policy maps** that guide network design, adaptive protocol selection, and resource allocation for future smart city deployments.

Collaborating HBKU and industry entities:

- **College of Science and Engineering (CSE), HBKU** – Lead Entity
- **Qatar Environment and Energy Research Institute (QEERI), HBKU**
- **Professionals for Smart Technology (PST), Jordan**
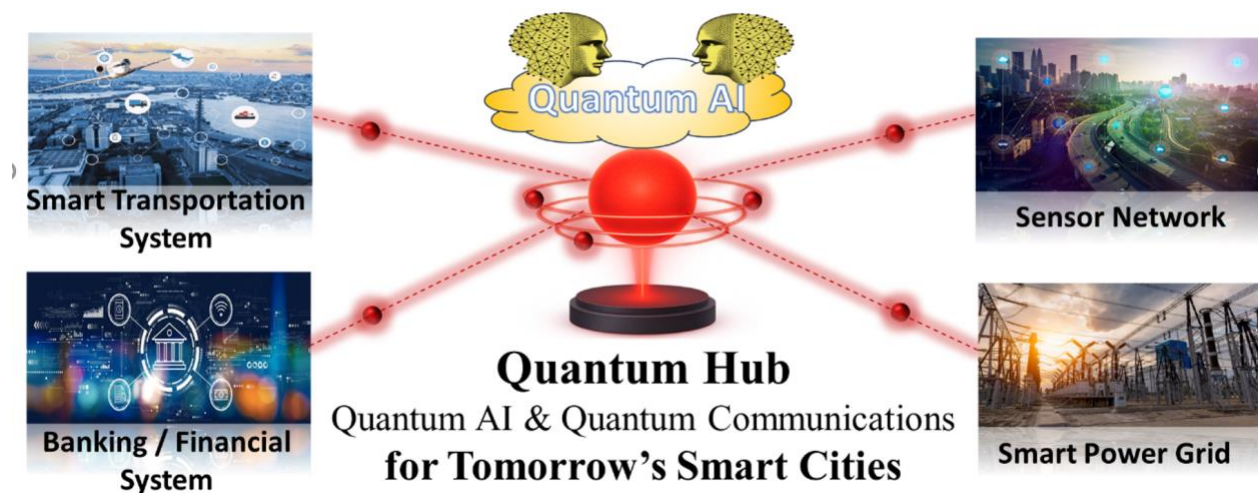
Conceptual overview of the proposed Quantum AI–secured communication framework linking key national sectors including energy, transport, and smart city infrastructure.