Juan Carlos Hernández Hernández

Personal Data

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Work Experience

09/2021 - Present	PhD Student in the Department of Telematics Engineering, Universidad Carlos III de Madrid (uc3m)
09/2018 - 09/2019	Teaching/Research Internships in the Department of Telecommunications and Electronics Engineering , Universidad de Pinar del Río

Education

PhD in Telematics Engineering, 2021-2025 (summer)
University Carlos III of Madrid, Spain
Thesis: *"Design and scheduling of Time-Division Multiplexed QKD networks."*
Brief description: This work focuses on designing cost-effective and scalable Quantum Key Distribution (QKD) networks to guarantee the security of current optical network architectures in the post-quantum era. It addresses critical challenges such as optimal routing, resource allocation, and scheduling of quantum resources. This work overcomes the challenge of integrating QKD networks with existing classical infrastructure, enabling seamless hybrid systems and enhancing network efficiency by minimizing resource consumption and maximizing performance.

Master Degree in Telecommunications Engineering, 2019-2021
University of Alicante, Spain
Final Project: *"Programmatic reconstruction of transmission network topologies."*
Brief description: This project focused on developing an application that reconstructs the physical topology of transmission networks from device configurations. The tool enables multivendor network monitoring using automation libraries such as Napalm and Ansible as abstraction layers, providing a unified solution regardless of the underlying equipment technology.

Degree in Telecommunications and Electronics Engineering, 2013-2018
University Carlos III of Madrid, Spain
Final Project: *"Real-time information system for public transportation system."*
Brief description: GPS, RFID, QR codes, mobile data networks, and a private cloud to track the location, status, and other variables of the public transportation system. The system provides real-time updates to users and optimizes routes, schedules, and vehicle availability. Additionally, it incorporates a distributed network of information displays powered by a Raspberry Pi to deliver updates to the passengers.

Publications

- **Under review:** "On Offline Scheduling for Time-Division Multiplexing QKD Networks" (journal as first author), "Enhancing the Reliability of Multipath QKD over Multi-band Systems", "ALLEGRO SDN control plane to support next-generation services in optical communication networks."

- **Juan Carlos Hernandez-Hernandez**, David Larrabeiti, Maria Calderon, Ignacio Soto. *Off-Line Allocation and Scheduling in Switched Trusted-Relay QKD Networks* **Accepted: ONDM Pisa 2025**.

- **Juan Carlos Hernandez-Hernandez**, David Larrabeiti, Maria Calderon, Ignacio Soto, Bruno Cimoli, Hui Liu, and Idelfonso Tafur Monroy. *Designing Optimal Quantum Key Distribution Networks based on Time-Division Multiplexing of QKD transceivers: qTDM-QKDN* **Journal** Future Generation Computer Systems, Volume 164, 2025, ISSN 0167-739X.

- Rivas-Moscoso, JM and Melgar, A and Poti, Luca and Krilakis, K and Velasco, Luis and Bahrani, S and Moreolo, M Svaluto and Monroy, I Tafur and Nguyen, P and Ruiz, **Hernandez-Hernandez, Juan Carlos**

and others. *A Security Plane Architecture for Ultra-Low-Energy, High-Capacity Optical Transport Networks* **Conference Paper** in 2024 International Conference on Quantum Communications, Networking, and Computing (QCNC).

- Dibaj, M Reza and Mehdizadeh, Pouya and Beyranvand, Hamzeh and Zefreh, Mahdi Ranjbar and **Hernandez-Hernandez, Juan Carlos** and Fernández-Palacios, Juan Pedro and Larrabeiti, David and Hernández, José Alberto and Arpanaei, Farhad. *Cost-Optimized Quantum Communication Networks: The Crucial Role of Trusted Node Placement in Multi-Band and Multi-Fiber Realms* **Conference Paper** in 2024 12th Iran Workshop on Communication and Information Theory (IWCIT).

- M Reza Dibaj, Pouya Mehdizadeh, M Sadegh Ghasrizadeh, Hamzeh Beyranvand, **Juan Carlos Hernandez-Hernandez**, José Alberto Hernández, David Larrabeiti, Farhad Arpanaei. *From strings to streams: A multi-period analysis of QKD over eons, showcasing multi-band vs. multi-fiber solutions* **Conference Paper** in 2023 33rd International Telecommunication Networks and Applications Conference.

- **Juan Carlos Hernandez-Hernandez**, David Larrabeiti, Maria Calderon, Ignacio Soto, Bruno Cimoli, Hui Liu, and Idelfonso Tafur Monroy. *Toward Optimal Orchestration of Time-shared QKD Infrastructure* **Poster** in European Conference in Optical Communications (ECOC), October 2023.

- **Juan Carlos Hernandez-Hernandez**, David Larrabeiti, Maria Calderon, Ignacio Soto, Bruno Cimoli, Hui Liu, and Idelfonso Tafur Monroy. *Quantum key distribution resource sharing schemes for metropolitan area networks*. **Poster** in 26th International Conference on Optical Network Design and Modelling (ONDM), May 2022.

- Pedro Juan Roig, Julio Jornet, Adolfo Albaladeio, and **Juan Carlos Hernandez-Hernandez**. *Remote surveillance system in isolation for covid-19*. The International Conference on Electrical, Communication, and Computer Engineering (ICECCE) will be held in 2021. IEEE, June 2021.

Teaching Experience

Internet of Things (2021-2025): Design and implement IoT sensor networks for data collection and visualization. Develop security strategies for IoT devices.

Software-Defined Networking (2022-2024): Create and simulate an SDN architecture using tools such as Mininet or ONOS. Implementation of custom traffic-routing policies using OpenFlow.

Access Network and Shared Media (2024): Network protocols. Simulate collision management in shared media networks (e.g., Ethernet, Wi-Fi)—strategies for avoiding loops, Spanning Tree Protocol, and Rapid Spanning Tree Protocol.

Thesis Supervision

Master's Thesis:
-"Securing IoT Networks with Quantum-Resistant Protocols: Deployment Strategies and Practical Implementations." (ongoing)
Brief description: This study focuses on addressing the security challenges faced by IoT networks in the context of quantum computing. It explores the use of post-quantum cryptographic protocols and evaluates their performance and practicality in constrained/embedded devices, aiming to identify effective deployment and implementation strategies using the current technology.

Bachelor's Thesis:
-"Air 360°: Comprehensive Air Quality Monitoring Using the Internet of Things and Mixed Reality." (ongoing)
Brief description: LoRa was used to prototype a network of sensors to collect real-time data on various air quality parameters such as pollutant levels, temperature, and humidity across different locations. The data are visualized through Mixed Reality (MR), which combines augmented reality (AR) and virtual reality (VR) to create an immersive experience available in an application for Meta Quest3 glasses.

Technical Experience

Server Administrator, Adscom Group (uc3m), 2021-present
Responsible for managing and maintaining the group's high-performance computing servers. Installing and configuring software tools for simulations, data processing, and network research. Replacing and upgrading hardware components (e.g., hard drives, RAM, and network interfaces). Managing virtual machines for different research projects. Provided user support, account management, and troubleshooting for researchers.

International Mobility

Research stay (three months) in the Electro-Optical Communication group at the Department of Electrical Engineering, Eindhoven University of Technology (TUe), Eindhoven, The Netherlands, focusing on characterizing and modeling QKD systems.

Achievements and Awards

- Quantum Delta Netherlands Visitors Program Grant for the stay at TUe.

- Competitive Official Research Scholarship FPI (Formación de Personal Investigador) of the Spanish Ministry of Science and Innovation.

- Competitive grant from Banco Santander for master's studies "X Convocatoria Banco Santander-UA'.

Certifications and Skills

- Introduction to Quantum Computing with Qiskit - Recap of fundamentals, simulators and visualization tools, implementation of Deutsch-Jozsa and Grover's algorithms (issued by IBM URL-4260E8EFECC8).

- Quantum Machine Learning - Building basic and advanced models, implementing algorithms with Python and Qiskit, exploring challenges and future prospects (issued by IBM URL-6A6828C3B546).

- Skills: Networking, Network Protocols, Python, C++, MATLAB, Qiskit, Cirq, Pennylane, Java, IoT, embedded devices, mathematical network modeling, Optimization, Software-Defining Networks, Machine Learning, Quantum Computing/Optimization, Quantum Machine Learning.