QUARTZ - Quantum-Secured Aerial Relay Networks for Terahertz Communications in Disaster Response

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Abstract:

QUARTZ – Quantum-secUred Aerial Relay neTworks for TerahertZ Communications in Disaster Response is a pioneering initiative aimed at transforming the resilience, security, and capacity of emergency communication systems. During large-scale disasters—such as floods, wildfires, and earthquakes—first responders depend on real-time video, sensing, and coordination links. Yet, terrestrial and satellite networks frequently fail due to congestion, infrastructure damage, or cyber threats. QUARTZ proposes a next-generation solution by combining quantum key distribution (QKD), terahertz (THz)

ultra-broadband communications, and AI-driven, energy-autonomous UAV relays into a unified, simulation-based framework for ultra-secure, high-capacity aerial networking.

At its core, QUARTZ integrates QKD-based encryption—specifically the BB84 protocol with decoy states—into UAV-mounted THz relays operating between 0.1–10 THz. These links enable data rates above 10 Gbps and sub-10 ms latency while maintaining quantum-level security against interception, even in a post-quantum computing era. The project will model THz channels using ray-tracing and stochastic geometry to capture the effects of atmospheric absorption, turbulence, and UAV mobility. In parallel, AI-based control systems will optimize trajectory planning, beam alignment, and resource allocation, ensuring sustained network performance under highly dynamic and uncertain disaster conditions.

Image of the project: