Quantum Cryptography

Executive Summary

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Executive Summary: Quantum Cryptography – A Paradigm Shift in Secure Communication

This webinar explored quantum cryptography (QC), a revolutionary approach to secure communication leveraging the principles of quantum mechanics. Unlike traditional cryptography, which relies on computationally complex algorithms vulnerable to advances in computing power (including quantum computers), QC offers *unconditional security* guaranteed by the laws of physics.

QC utilizes the properties of photons, specifically superposition and entanglement, to enable Quantum Key Distribution (QKD). In QKD, two parties (Alice and Bob) establish a secret key, undetectable to eavesdroppers (Eve). Any interception attempt inevitably alters the quantum state, alerting Alice and Bob to the intrusion.

How QKD Works: Alice transmits photons in random states; Bob measures them using a random basis. Public comparison of a subset of measurements reveals any eavesdropping attempts via detectable errors. A sufficiently low error rate allows for a secure key exchange.

Advantages: QC provides unconditional security, unlike classical methods vulnerable to computational breakthroughs.

Challenges: Current limitations include transmission distance constraints due to photon loss in optical fibers. Ongoing research focuses on extending range through quantum repeaters and satellite-based QKD, as well as integrating QKD into existing infrastructure.

Conclusion: Quantum cryptography represents a major advancement in secure communication, offering unprecedented protection for sensitive data. While challenges remain, its potential for truly unbreakable security is undeniable, shaping a future with significantly enhanced information protection.