Objectives
❖ Demonstrate how post-quantum cryptography invalidates Blockchain technology.
❖ Incorporate quantum-safe cryptography into Blockchain.
❖ Produce a roadmap for quantum-safe Blockchain.

Challenges
❖ Architectural limitations within Blockchain
➢ Quantum-safe key sizes exceed the block size limits
➢ There is no mechanism for increasing size limits to fit larger keys
   ▪ Sending keys in multiple blocks will cause a segregation of the transactions from the information in their block, in essence creating the same limitations as failed segWit attempts
❖ Resource requirements
➢ There is not a fully-vetted, functional internet protocol layer that can handle larger block sizes to include quantum sized keys plus increasing block sizes
❖ Scaling requirements
➢ Making either smaller or more transactions is at a monetary loss
❖ Social ramifications
➢ Gaining consensus from the Bitcoin community to change the underlying blockchain architecture has, historically, not been accepted by the entire community
➢ The only way to make an impact in blockchain tech that allows for PQC is by gaining >50% consensus

Background
❖ Blockchain Overview
A blockchain is a permanent, digital transactions ledger of inputs and outputs that allows solely for solvent transactions between parties without the need of a bank or other third party. In place of the trust granted to banks, the blockchain architecture relies on peer to peer networks, complex math problems that chain together, and cleverly coded processes to verify all transactions are solvent.

Our Results
❖ A demonstration of how quantum computers break the current blockchain.
   ➢ Simulated quantum computer and blockchain
   ➢ Working quantum code at small scale
❖ Potential Solution 1: Rely on Merkle Roots
   ➢ Using a one-time, quantum-safe hashing algorithm, will have smaller key sizes
   ▪ Caveat: The user takes responsibility for changing keys every transaction
❖ Potential Solution 2: Rely on Quantum-Safe Hardware
   ➢ Store the local Blockchain node on quantum-safe hardware, providing an external firewall
   ▪ Caveat: Quantum-safe hardware is not yet publicly accessible
   ○ Making the hardware relies on the NIST Quantum-Safe algorithm selection process and updates to internet protocols

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