BRIEF DESCRIPTION OF DRAWINGS

Application Number: To Be Assigned
Docket Number: RUTHERFORD-015-PROV
Inventor: Brian James Rutherford
Title: Quantum Side-Channel Defense System for Post-Quantum Cryptographic Implementation Protection within MWRASP Total Defensive Cybersecurity Platform

DRAWINGS SUBMITTED: 12 SHEETS

The following figures illustrate various aspects and embodiments of the quantum side-channel defense system within the MWRASP Total defensive cybersecurity platform:

FIGURE 1 - System Architecture Overview

Sheet 1 of 12

Illustrates the overall system architecture of the quantum side-channel defense system, showing the hierarchical arrangement of sensor layers, AI agent processing layers, decision layers, and response layers within the MWRASP defensive cybersecurity platform. The diagram depicts data flow from distributed sensors through machine learning processing to automated countermeasure deployment. Key components shown include the Quantum

Electromagnetic Emanation Analyzer (100), Distributed Quantum Sensor Network (200), Machine Learning Quantum Leakage Detector (300), and Real-Time Quantum Countermeasure Engine (400).

FIGURE 2 - Quantum Electromagnetic Emanation Analyzer

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Presents a detailed block diagram of the Quantum Electromagnetic Emanation Analyzer, illustrating multiple software-defined radio receivers (201-204), signal processing pipelines (205-208), pattern recognition modules (209-212), and interference mitigation components (213-216). The frequency coverage from 1 MHz to 40 GHz is shown divided across specialized receivers with overlapping coverage zones to ensure complete spectrum monitoring without gaps. AI agent coordination modules (217-220) manage the analysis workflow.

FIGURE 3 - Distributed Quantum Sensor Network Topology

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Depicts the Distributed Quantum Sensor Network topology, showing the spatial arrangement of sensor nodes (301-320), synchronization mechanisms using IEEE 1588 PTP (321), and communication pathways (322-340). The diagram includes SQUID arrays (341-344), single-photon detectors (345-348), temperature sensors (349-352), and acoustic monitoring devices (353-356) in both hierarchical and mesh configurations. Network management AI agents (357-360) coordinate sensor operations.

FIGURE 4 - Machine Learning Quantum Leakage Detector Architecture

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Illustrates the Machine Learning Quantum Leakage Detector architecture implemented by AI agents, showing the hierarchical arrangement of deep learning models. Components include convolutional neural networks for spectrum analysis (401-404), recurrent neural networks for temporal sequences (405-408), gradient boosting ensembles (409-412), and anomaly detection algorithms (413-416). Data preprocessing pipeline (417) and feature extraction modules (418-420) are clearly depicted. AI agent orchestration layer (421-424) manages model coordination.

FIGURE 5 - Real-Time Quantum Countermeasure Engine

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Presents the Real-Time Quantum Countermeasure Engine showing the policy-driven response framework (501), graduated countermeasure deployment system (502-510), and integration with physical security systems (511-515). The diagram illustrates passive monitoring enhancements (516-520), active defensive responses (521-525), and emergency response protocols (526-530). Policy enforcement AI agents (531-535) manage response decisions.

FIGURE 6 - Hardware Security Module Integration

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Depicts Hardware Security Module integration architecture, showing secure communication channels (601-604), firmware extensions (605-608), and crypto-agile frameworks (609-612). The diagram illustrates support for both classical and post-quantum algorithms operating simultaneously, with dedicated monitoring for each algorithm type (613-620). HSM coordination AI agents (621-624) manage the integration.

FIGURE 7 - Multi-Modal Correlation Analysis System

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Illustrates the multi-modal correlation analysis system showing how electromagnetic (701), power (702), timing (703), acoustic (704), photonic (705), and thermal (706) measurements are combined to identify complex attack patterns. Cross-correlation engines (707-712) and machine learning fusion modules (713-718) demonstrate the integration process. Correlation analysis AI agents (719-722) optimize detection algorithms.

FIGURE 8 - Compliance Framework Architecture

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Shows the compliance framework architecture with automated testing modules (801-804), documentation generation systems (805-808), and continuous monitoring components (809-812) for FIPS 140-3, Common Criteria EAL7, and ISO/IEC 19790 compliance. Certification workflows (813-816) and audit trail mechanisms (817-820) are depicted. Compliance monitoring AI agents (821-824) ensure regulatory adherence.

FIGURE 9 - Distributed Processing Architecture

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Depicts the distributed processing architecture showing edge nodes (901-910), regional aggregation centers (911-915), and global threat intelligence platforms (916-920). Load balancing mechanisms (921-925) and elastic scaling systems (926-930) demonstrate system scalability from single HSM to enterprise

deployments. Distributed management AI agents (931-935) coordinate processing resources.

FIGURE 10 - Quantum-Classical Interface Security

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Illustrates the quantum-classical interface security system showing monitoring points for SFQ circuits (1001-1004), qubit control electronics (1005-1008), and measurement readout channels (1009-1012). Isolation barriers (1013-1016) and correlation analysis components (1017-1020) for hybrid quantum-classical systems are depicted. Interface security AI agents (1021-1024) monitor boundary conditions.

FIGURE 11 - Operational Management Dashboard

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Presents the operational management dashboard interface showing real-time threat indicators (1101-1105), system performance metrics (1106-1110), and forensic analysis interfaces (1111-1115). Customizable visualizations (1116-1120) and alert mechanisms (1121-1125) provide comprehensive

situational awareness for security operators. Visualization AI agents (1126-1130) generate intuitive displays.

FIGURE 12 - Quantum Random Number Generation Integration

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Depicts the quantum random number generation integration showing entropy sources (1201-1204), extraction algorithms (1205-1208), health monitoring systems (1209-1212), and secure interfaces for cryptographic key generation (1213-1216). Side-channel protection mechanisms (1217-1220) specifically designed for QRNG systems are illustrated. QRNG management AI agents (1221-1224) ensure entropy quality.

REFERENCE NUMERALS

• 100-199: System Architecture Components

• 200-299: Electromagnetic Analysis Components

• 300-399: Sensor Network Components

• 400-499: Machine Learning Components

• 500-599: Countermeasure Engine Components

• 600-699: HSM Integration Components

• 700-799: Correlation Analysis Components

• 800-899: Compliance Framework Components

• 900-999: Distributed Processing Components

• 1000-1099: Quantum-Classical Interface Components

• 1100-1199: Management Dashboard Components

• 1200-1299: QRNG Integration Components

Note: Drawings should be prepared in accordance with 37 CFR 1.84 requirements:

- Black ink on white paper
- Sufficient quality for reproduction
- Margins: Top and Left (2.5 cm), Right (1.5 cm), Bottom (1.0 cm)
- Sheet size: Either 21.0 cm × 29.7 cm (A4) or 21.6 cm × 27.9 cm (8.5" × 11")
- No color drawings for provisional applications unless specifically required

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