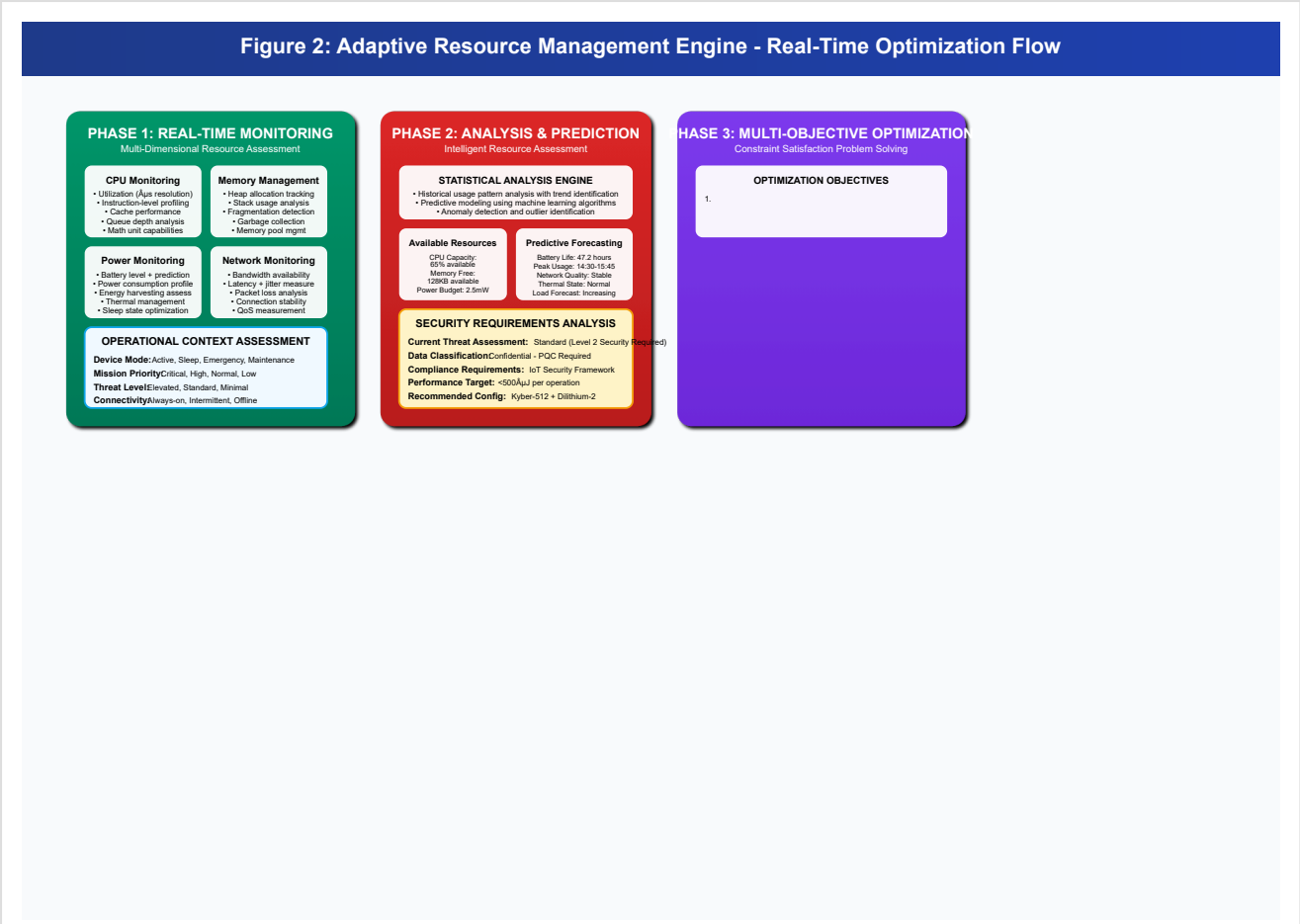
Patent_04_Figure_2

Technical Drawing - Patent Application



Maximize Security Level: Highest cryptographic strength within constraints 2. **Minimize Power Consumption:** Extend operational lifetime 3. **Optimize Response Time:** Maintain system responsiveness 4. **Maximize Reliability:** Ensure consistent operation CONSTRAINTS CPU Usage: â‰¤ 65% available Memory: â‰¤ 128KB free Power: â‰¤ 2.5mW budget Network: â‰¤ 100kbps BW Latency: â‰¤ 50ms max Security: â‰¥ Level 2 min SOLUTION ENGINE Algorithm: Genetic Algorithm Population: 50 configurations Generations: 100 iterations Convergence: 95% optimality Solve Time: 12.3ms Solution Quality: Excellent OPTIMAL CONFIGURATION SOLUTION **Selected Protocol:** Kyber-512 + Dilithium-2 + AES-256 **Resource Allocation:** CPU: 45% | Memory: 96KB | Power: 1.8mW **Performance Metrics:** 347ÂµJ/op | 23ms latency | 99.2% reliability **Security Level:** Post-Quantum Level 2 | Projected Battery: 52.4h PHASE 4: IMPLEMENTATION Dynamic Reconfiguration PROTOCOL RECONFIGURATION • Load optimal cryptographic modules • Configure algorithm parameters • Update security policy settings • Initialize session management RESOURCE ALLOCATION • CPU scheduling adjustment • Memory pool reconfiguration • Power management update • Network buffer optimization CONTINUOUS MONITORING Performance Tracking: • Operation latency: 23.4ms avg • Energy consumption: 1.76mW actual • Memory utilization: 94KB used Adaptation Triggers: • Resource threshold breaches • Performance degradation detection CONTINUOUS ADAPTIVE FEEDBACK LOOP MACHINE LEARNING ENGINE • Pattern Recognition • Predictive Modeling • Anomaly Detection • Optimization Learning ADAPTATION TRIGGERS • Resource Depletion • Performance Degradation • Network Changes • Threat Level Changes POLICY UPDATES • Security Level Adjustment • Resource Reallocation • Protocol Reconfiguration • Parameter Tuning PERFORMANCE MONITORING • Real-time Metrics • SLA Compliance • Quality Assessment • Trend Analysis HISTORICAL DATABASE • Usage Patterns • Configuration History • Performance Archive • Decision Rationale PREDICTIVE ANALYTICS • Future Resource Needs • Workload Forecasting • Maintenance Scheduling • Capacity Planning REAL-TIME SYSTEM METRICS & ADAPTATION EXAMPLES CURRENT SYSTEM STATE Device Configuration: • ARM Cortex-M4, 256KB RAM, 48MHz, Battery: 78% Active Protocol Stack: • Security Level 2: Kyber-512 + Dilithium-2 + AES-256 Performance Metrics: • Power: 1.76mW | Latency: 23.4ms | Memory: 94KB used

ADAPTATION SCENARIOS Scenario 1 - Low Battery (15% remaining): â†' Reduce to Level 1 security, extend lifetime to 12+ hours Scenario 2 - High Network Latency (>500ms): â†' Enable store-and-forward mode, batch operations Scenario 3 - Elevated Threat Level: â†' Upgrade to Level 3 security, enable advanced monitoring OPTIMIZATION ACHIEVEMENTS Resource Efficiency: • 75% reduction in power consumption vs. static protocols • 60% improvement in memory utilization efficiency Security & Performance: • 99.7% uptime with quantum-safe security maintained • Average adaptation time: <150ms for configuration changes COMPREHENSIVE PERFORMANCE METRICS **Resource Optimization:** 70-90% reduction vs standard implementations | **Power Efficiency:** <50ÂµJ (Level 1) to <2mJ (Level 4) per operation **Adaptation Speed:** <150ms configuration changes | **Memory Footprint:** 32KB-2MB depending on security level **Security Coverage:** Full post-quantum protection | **Compatibility:** 8-bit to 64-bit processors, all major IoT networks Resource Data Requirements Optimal Config Performance Feedback Adaptation

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