FIGURE 4: IoT Swarm Intelligence Network Architecture

30% • Auto-recovery <5s • Scalability 10K+ nodes • Energy <10μJ per operation

Node A1
Sensor
2KB RAM

Node A2
Actuator
4KB RAM

Node B1
Gateway
32KB RAM

Node B2
Smart Sensor
8KB RAM

Coordination

Management

Local Coordinator
16KB RAM

Local Coordinator
16KB RAM

Distributed Swarm Brain Coordination Center

Collective Intelligence: Network Management:
• Multi-agent coordination • Topology optimization
• Emergent behavior patterns • Resource allocation
• Adaptive decision making • Load balancing

Swarm Communication

Network Mesh

Intelligence Distribution

Distributed Decision Engine

Consensus Algorithm:
• Byzantine fault tolerance
• Quantum-safe voting

Decision Exchange

Swarm Threat Intelligence

Collective Defense:
• Pattern sharing
• Coordinated response

Local Coordinator
16KB RAM

Local Coordinator
16KB RAM

Node C1
Monitor
4KB RAM

Node C2
Controller
8KB RAM

Node D1
Relay
2KB RAM

Node D2
Edge Node
32KB RAM

Network Resilience and Self-Healing Mechanisms

Fault Detection:	Auto-Recovery:	Adaptive Behavior:	Metrics:
• Node health monitoring	• Route recalculation	• Topology optimization	• Recovery: <5s
• Communication failures	• Load redistribution	• Resource reallocation	• Availability: 99.9%
• Performance degradation	• Backup activation	• Security adaptation	• Fault tolerance: 30%
• Byzantine behavior	• Network reformation	• Performance tuning	• Self-healing: 95%

Quantum-Safe Swarm Consensus Protocol

Consensus Steps:	Performance:
1. Proposal broadcast	• Consensus time: <100ms
2. Local validation	• Message overhead: <5%
3. Cryptographic voting	• Energy cost: <10μJ/vote
4. Result aggregation	• Scalability: 10K+ nodes