SecureRouteX: Generative and Trust-Aware AI-SDN Routing Architecture for Intelligent and Underwater IoT Networks
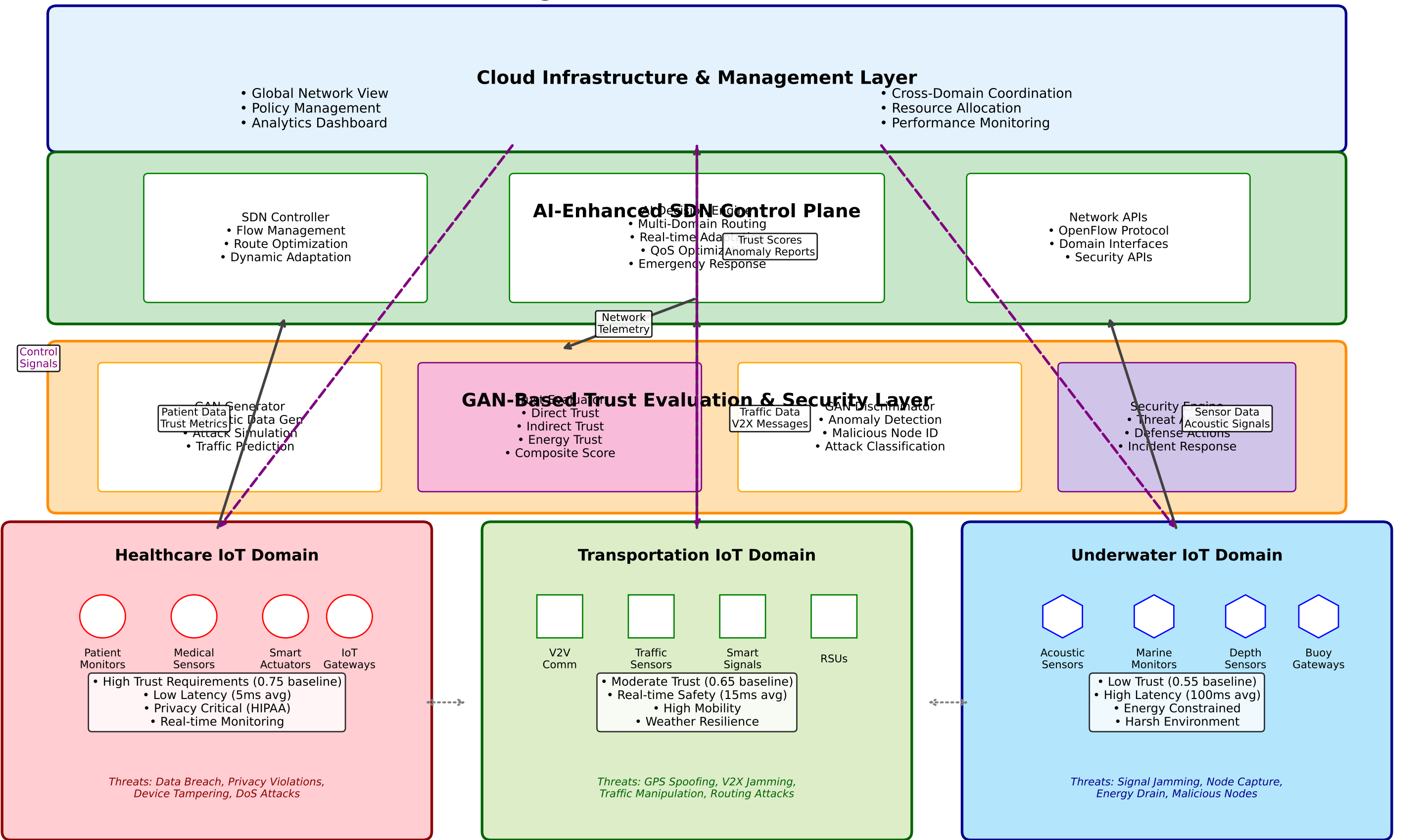
Cloud Infrastructure & Management Layer

- Global Network View
- Policy Management
- Analytics Dashboard

- Cross-Domain Coordination
- Resource Allocation
- Performance Monitoring

AI-Enhanced SDN Control Plane

SDN Controller
- Flow Management
- Route Optimization
- Dynamic Adaptation

AI Decision Engine
- Multi-Domain Routing
- Real-time Adaptation
- QoS Optimization
- Emergency Response

Network APIs
- OpenFlow Protocol
- Domain Interfaces
- Security APIs

Trust Scores
Anomaly Reports

Network Telemetry

Control Signals

GAN-Based Trust Evaluation & Security Layer

GAN Generator
- Synthetic Data Gen
- Attack Simulation
- Traffic Prediction

Trust Evaluator
- Direct Trust
- Indirect Trust
- Energy Trust
- Composite Score

GAN Discriminator
- Anomaly Detection
- Malicious Node ID
- Attack Classification

Security Engine
- Threat Analysis
- Defense Actions
- Incident Response

Patient Data
Trust Metrics

Traffic Data
V2X Messages

Sensor Data
Acoustic Signals

Healthcare IoT Domain

Patient Monitors | Medical Sensors | Smart Actuators | IoT Gateways

- High Trust Requirements (0.75 baseline)
- Low Latency (5ms avg)
- Privacy Critical (HIPAA)
- Real-time Monitoring

Threats: Data Breach, Privacy Violations, Device Tampering, DoS Attacks

Transportation IoT Domain

V2V Comm | Traffic Sensors | Smart Signals | RSUs

- Moderate Trust (0.65 baseline)
- Real-time Safety (15ms avg)
- High Mobility
- Weather Resilience

Threats: GPS Spoofing, V2X Jamming, Traffic Manipulation, Routing Attacks

Underwater IoT Domain

Acoustic Sensors | Marine Monitors | Depth Sensors | Buoy Gateways

- Low Trust (0.55 baseline)
- High Latency (100ms avg)
- Energy Constrained
- Harsh Environment

Threats: Signal Jamming, Node Capture, Energy Drain, Malicious Nodes

Cross-Domain Trust Sharing & Coordination

Trust Baselines:
Healthcare: 0.75 | Transport: 0.65 | Underwater: 0.55
Attack Types: DDoS, Malicious Node, Energy Drain, Routing
Performance: 99.6% AUC | Privacy: ε-DP (ε=1.0)

Key Features & Innovations

- GAN-Enhanced Trust Evaluation: Synthetic attack generation and real-time anomaly detection across domains
- Multi-Domain Routing: Unified framework supporting healthcare, transportation, and underwater IoT networks
- Dynamic SDN Control: AI-driven routing adaptation based on trust scores, QoS requirements, and security threats
- Cross-Domain Intelligence: Trust sharing and coordinated defense across heterogeneous IoT environments
- Energy-Aware Optimization: Trust-energy trade-off optimization for resource-constrained underwater deployments