Predictive Network Intelligence & Self-Healing

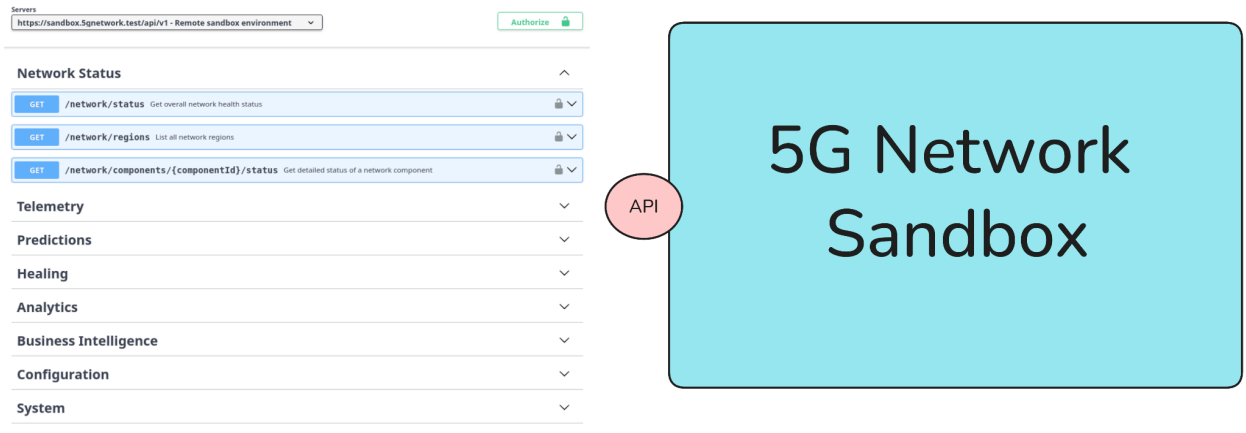
The Scenario

You've been recruited to solve one of the telecommunications industry's most expensive problems: network downtime. A major telco provider loses millions of dollars every hour when their network experiences outages, and their current reactive approach to network management is no longer sustainable. Customer expectations for 99.99% uptime, combined with increasingly complex network topologies, have pushed traditional monitoring and response systems beyond their limits.

Your mission is to build an AI-powered predictive intelligence platform that doesn't just monitor the network—it anticipates problems before they occur and automatically orchestrates healing actions. Think of it as creating a digital network physician that can diagnose early symptoms, predict when and where failures might happen, and perform surgery on the network before customers even notice there was a problem.

The platform needs to process massive streams of network telemetry data, identify subtle patterns that indicate impending failures, and coordinate complex multi-step remediation workflows across diverse network infrastructure.

The Network Sandbox



You'll work with a simulated telco network environment that generates realistic telemetry data and responds to various management operations:

Network Infrastructure Components:

- **Radio Access Network (RAN)**: 5G base stations with varying load patterns
- **Core Network**: Packet switching nodes, authentication servers, user plane functions
- **Edge Computing Nodes**: Distributed processing resources
- **Transport Network**: Fiber links, routers, and switching infrastructure
- **Customer Devices**: Mobile handsets, IoT sensors, enterprise equipment

Available Data Streams:

- Real-time performance metrics (throughput, latency, packet loss, CPU utilization)
- Historical trend data spanning months of operations
- Environmental factors (weather, temperature, power grid status)
- Customer experience indicators (call drop rates, data session quality)
- Network configuration changes and maintenance schedules
- Traffic pattern analytics and usage forecasts

Management Capabilities:

- Load balancing and traffic rerouting
- Resource scaling (compute, bandwidth, power)
- Predictive maintenance scheduling
- Emergency response coordination
- Customer communication and SLA management
- Configuration rollbacks and failover procedures

The sandbox simulates realistic failure patterns: gradual degradation that leads to cascading failures, sudden equipment faults, capacity exhaustion, and complex multi-component interactions that create emergent problems.

- **API Documentation**: [Network Intelligence Sandbox API]
- **Historical Dataset**: Assume you have 6 months of network performance data for training and analysis. It is not required to generate any in this challenge.

The Challenge

Task

Design and implement an intelligent predictive platform that can analyze network telemetry in real-time, predict potential failures before they impact customers, and autonomously orchestrate healing actions. Your system should operate at multiple time horizons: detecting immediate threats (seconds to minutes), anticipating near-term issues (hours to days), and planning for long-term capacity needs (weeks to months).

Example Interactions

Network Engineer: "The financial district has a major conference tomorrow with 50,000 attendees. Make sure we're prepared." **Your Platform**: [Analyzes historical event patterns, predicts traffic spikes, pre-positions resources, adjusts capacity thresholds, sets up proactive monitoring for the area, and provides confidence intervals for service levels, creates reports and orchestrates the different actions]

Operations Manager: "We're seeing some unusual patterns in the northwest region. What's happening and what should we do about it?" **Your Platform**: [Correlates multiple data sources, identifies subtle anomalies indicating potential fiber damage, traces root cause to construction activity, predicts impact timeline, automatically reroutes traffic, schedules preventive maintenance, and provides business impact assessment]

Executive: "Give me a 72-hour predictive health assessment with business risk analysis." **Your Platform**: [Performs comprehensive network-wide analysis, identifies top risk scenarios with probability assessments, estimates potential revenue impact, recommends proactive investments, and provides actionable executive summary with confidence metrics]

System Alert: "Anomaly detected: Base station cluster showing 15% degradation in signal quality." **Your Platform**: [Automatically investigates surrounding infrastructure, identifies weather-related interference pattern, predicts 6-hour timeline to service impact, initiates load balancing to adjacent towers, schedules weather-resistant configuration deployment, and monitors effectiveness]

What We're Looking For

We evaluate submissions across four key dimensions that demonstrate different aspects of your engineering and AI expertise:

- **Predictive Analytics & Architecture**: Show us your approach to time series analysis, anomaly detection, and failure prediction. How do you handle multiple data sources, feature engineering, model training/retraining, and prediction confidence? We want to see sophisticated use of ML and GenAI techniques that are actually appropriate for network operations.
- **Real-time Processing & Orchestration**: Demonstrate your system design for handling high-velocity telemetry streams, making time-critical decisions, and coordinating complex healing workflows using Agents. How do you balance speed vs accuracy? How do you handle partial failures in your healing actions? Show us production-ready streaming architectures.
- **Business Logic & Risk Management**: Network operations isn't just about technical metrics—it's about business impact. How does your system prioritize different failure scenarios? How do you include that in the Agentic system
- **Adaptive Intelligence & Continuous Learning**: Networks are constantly evolving. How does your system adapt to new failure patterns, seasonal changes, and network

expansion? How do you validate predictions against actual outcomes and improve over time? We want to see systems that get smarter through experience.

Deliverables

1. The Predictive Intelligence Platform

A functional system design and architecture demonstrating:

- Real-time anomaly detection and root cause analysis
- Autonomous healing orchestration with confidence-based decision making
- Business impact assessment and SLA management
- Adaptive learning from prediction accuracy and network changes

2. Technical Architecture Document

Comprehensive explanation of your approach including:

- Data processing pipeline and feature engineering strategy
- ML model architecture and training methodology
- Real-time decision engine and action orchestration
- State management across distributed network components
- Monitoring and validation of prediction accuracy
- Scalability and reliability considerations for production deployment

3. Presentation

A brief presentation (live or recorded) where you:

- Walk through your solution's architecture
- Demonstrate key capabilities
- Discuss interesting challenges you encountered and (optional) some error handling
- Explain trade-offs and design decisions

Evaluation Philosophy

We're not looking for a perfect solution - we're looking for thoughtful engineering and creative problem-solving. We value:

- **Pragmatism**: Does your solution work reliably for common scenarios?
- **Innovation**: Have you found creative ways to solve problems?
- **Engineering Judgment**: Did you make sensible trade-offs given the time constraint?
- **AI/ML Sophistication**: How effectively do you leverage AI capabilities?
- **User Experience**: Is your agent actually helpful and easy to work with?

The Creative Space

This challenge intentionally leaves room for interpretation and creativity. You might consider:

- What would make this agent truly useful in a real operations center?
- How can AI techniques make network management more intuitive?
- What kinds of proactive capabilities would add value?
- How can the agent learn and improve over time?

There's no single correct approach. Some candidates might focus on sophisticated NLP, others on robust state machines, and others on innovative planning algorithms. Show us your strengths and your unique perspective on the problem.

Time Expectation

This challenge is designed to be completed in less than one working day (approximately 6 hours). We understand this is a constrained timeframe - focus on demonstrating your capabilities rather than building a production system. We're more interested in seeing how you think and solve problems than in receiving a completely polished product.