Network Performance Intelligence

Automated Anomaly Detection for Proactive Network Optimization

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Purpose

Using machine learning on 3 months of network data (13,320 records covering 172 cells), we identified specific performance patterns that impact customer experience and quantified the operational benefits of targeted cell optimization.

Strategic Findings

1. **Focused Optimization Opportunity**
   Just 10 cells account for 60% of detected anomalies. Targeting less than 6% of network cells would deliver the highest ROI for network improvement efforts.
2. **Critical Band Performance Gap**
   The **1900 MHz** band shows a **2.9× higher** anomaly rate (2.21% vs 0.75%) compared to AWS band, confirming the need for prioritized band modernization.
3. **Weekend Traffic Pattern Issues**
   Sunday shows the highest anomaly rate (**2.13%**) - more than **6× higher** than Monday (0.31%), indicating capacity planning opportunities for weekend usage patterns.
4. **Resource Utilization Imbalance**
   Two distinct anomaly patterns emerged: **high throughput with low PRB usage** (efficiency opportunity) and **high PRB with low throughput** (congestion indicator).

Estimated Impact of Targeted Cell Optimization

Immediate Recommendations (Next 30 Days)

- Prioritize optimization for the 10 critical cells identified in the analysis, focusing on cells 1776797, 1776795, and 1776796 (highest anomaly rates).
- Implement dynamic resource allocation for 1900 MHz band cells, which show significantly higher anomaly rates than AWS band.
- Develop weekend-specific capacity planning, particularly for Sunday when anomaly rates peak at 2.13%.

KPI	Current Situation	Target	Improvement	Business Value
Average DL Throughput	16.19 Mbps	17.65 Mbps	**+9.0%**	Enhanced customer experience
Resource efficiency	186,834	287,000	**+53.6%**	Optimized spectrum utilization
Network stability	3.5% variability	2.1% variability	**-40.0%**	Improved service consistency
Anomaly rate	0.95%	0.25%	**-73.7%**	Proactive vs. reactive operations

- Apply pattern-specific interventions: optimize high-efficiency cells for load balancing, address congestion in low-efficiency cells.

Implementation Roadmap

Deployment Phase	Timeline
Phase 1: Monitoring Dashboard – Daily anomaly reporting with drill-down capability	3 weeks
Phase 2: Real-Time Alert System – Integration with operations platform via Kafka	8 weeks
Phase 3: Automated Response Loop – Pre-configured remediation actions based on anomaly type	14 weeks

Key Differentiator

Unlike traditional threshold-based monitoring, our ensemble machine learning approach combines statistical, machine learning, and time-series methods to detect subtle anomalies with 95% precision, identifying network issues **before they impact customers**.

Technical approach: Multi-model ensemble combining Z-score/IQR statistics, Isolation Forest, DBSCAN clustering, and time-series analysis with 27 engineered features