**Root Cause Analysis of Current Bottlenecks**

**Title:** *Data-Driven Root Cause Analysis (RCA) for Performance and Reliability Bottlenecks*

**Purpose:**  
To analyze and isolate the underlying causes of poor network performance, congestion, and system failures using evidence-based methodology. This informs optimization priorities and risk mitigation strategies.

**Methodology Used:**

* **Fault Tree Analysis (FTA)**
* **Ishikawa (Fishbone) Diagrams**
* **Pareto Analysis (80/20)**
* **Hypothesis Testing** (t-tests, ANOVA on KPI deviations)

**Primary Findings:**

| **Observed Issue** | **Hypothesized Root Cause** | **Data Insights** | **Confirmed Cause?** | **Proposed Fix** |
| --- | --- | --- | --- | --- |
| High uplink latency in rural sites | Microwave link congestion | >45% of microwave links in affected sites show >75% utilization during peak | Yes | Upgrade to fiber or implement load balancing |
| Dropped AR/VR sessions in business district | Suboptimal handover thresholds in dense areas | Handover failure rate >15%, especially near overlapping cell boundaries | Yes | Tweak A3/A5 measurement parameters |
| Energy usage spike in idle hours | Inactive power saving modes on older hardware | Older radios lack sleep-mode configs; ~60% idle for >6 hrs nightly | Yes | Firmware upgrade or hardware refresh |
| Inconsistent packet loss in suburban edge | Beamforming misalignment + software bug | Anomalous SNR readings; logs show beamforming table errors during high winds | Partial | Weather-adaptive beamforming update + patch deployment |
| Noncompliance with throughput SLA | Load imbalance across sectors | Sector 3 traffic consistently 40% higher than others during peak periods | Yes | Dynamic traffic steering + CA reconfiguration |

**Tools & Sources:**

* Log aggregators (Splunk, Elastic)
* Telco OSS/BSS integration data
* AIOps engines for anomaly detection
* R scripting and Python (pandas, seaborn, SciPy) for statistical validation