Redefining Network Operations:

The Importance of AI-Driven Predictive Fault Management

How network operators can harness AI and machine learning to enhance performance, reduce costs, and increase network reliability

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Introduction

The telecoms industry is at a tipping point when it comes to fault management.

Modern networks are contending with the ongoing expansion of 5G, and the ever-growing list of low latency use cases it's brought with it. They're grappling with a surge in mission-critical IoT devices, with the number of cellular connections expected to top 4 billion by 2030.[1] And, above all else, they're in an uphill battle to meet subscriber expectations for consistent, reliable service with zero downtime.

It's a tall order. And it doesn't leave a lot of room for when faults or outages take place – which they often do. Ensuring network resiliency and reliability in an environment like this has become more critical than ever before. Yet network operations teams, burdened by heavily manual methods of working out what's happened and how to fix it, aren't being given a fighting chance.

Designed for an era that's long gone, traditional network monitoring systems and the industry's widely accepted stance around post-failure repairs simply don't cut it. On the contrary, they're prolonging outages and contributing to the growing network costs operators face.

The Rising Cost of Network Maintenance

Maintenance and repair costs are estimated to have hit 15-20% of total operational expenditure.[2] The financial impact of an outage can be wide-reaching, too. After AT&T suffered an 11-hour cell network outage in 2024, for example,[3] the fallout caused a 2% drop in the company's stock.[4]

Network faults and outages can't be avoided entirely. Things can and will go wrong. That's Murphy's Law – and nowhere does it apply more readily than to today's highly complex, multi-faceted telco networks. However, an outage doesn't have to grind things to a halt. And resolving it doesn't have to cost as much or take as long as it currently does.

By moving from reactive to proactive, operators can respond faster to network issues when they occur. They can slash the costs of maintenance and repair. And, crucially, they can unlock the foresight needed to predict and prevent issues before they even take place.

This eBook will explain:

- Why the growing complexity of today's telecom landscape has changed the game, and how intelligent automation will help future-proof operations.
- The benefits of embracing AI-driven network fault management and how it can reduce costs, drive operational efficiencies, and enhance network reliability.
- How telcos should think about measuring the impact of AI-driven network fault detection, including the key metrics to focus on and how to calculate expected ROI.

Future-Proofing Network Operations: **The Time for Action Is Now**

Current approaches to fault mitigation are a lot like firefighting

Think of alarm management platforms, which detect and respond to network issues based on pre-defined rules, as a sprinkler system. They'll help to stop smaller incidents, but there's a limit to what they can do. Larger fires will quickly overwhelm the system and require human intervention – i.e., a team of firefighters. Yet, by the time those firefighters arrive on scene the fire will likely have become a huge blaze, causing significant damage and disruption.

The problem with this approach is it's reactive by design. Traditional management platforms take event notifications from network elements and turn them into alarms, so they depend on a recorded network event to trigger any action. In other words, just like the sprinkler system in our firefighting metaphor, nothing happens until there's a deviation from the norm. However, because of this fixed threshold approach, these systems are often overly sensitive. This combination typically results in one of two outcomes: a surge in low-priority alarms, or a fire that's already raging meaning it's too late to take preventative action.

This immediately puts network teams on the back foot. There are often too many alarms to know what to prioritize, with existing workflows requiring huge amounts of manual effort while doing nothing to help meet demand for continuous, uninterrupted network services. If anything, current approaches make things worse as valuable resources end up being focused on the wrong things.

Moving Faster With Intelligent Automation

AI-driven predictive fault management is different. It does away with those purely reactive sprinklers altogether and introduces advanced, intelligent fire detection and suppression.

Rather than waiting for an incident to occur, this approach continuously monitors the network to identify subtle changes in the environment, taking preemptive steps to prevent an outage. If automated remediation can't fix it, the system will flag serious problems in advance (often several days before they'll escalate) so that the network operations team can take action to stop the issue from becoming a major incident.

In this sense, AI-driven predictive fault management represents a fundamental shift. It replaces static rule-based approaches with a smart, predictive model built on intelligent automation to help telcos keep pace with today's complex operating landscape in a cost-effective and scalable way.

Aspect	Traditional Approach	AI-Driven Approach
Fault Detection	Reactive detection after failures occur	Proactive anomaly detection and predictive analysis
Fault Recovery	Manual troubleshooting and resolution	Automated fault resolution with self-healing networks
Data Analysis	Manual, rule-based monitoring	Real-time, dynamic data-driven analysis with machine learning
Scalability	Low. Reliant on human operators and static rules	High. Able to continuously learn and scale with network demands
Operational Complexity	Complex, and requiring large IT/ networks teams	Simplified operations through intelligent automation
Response Time	Delayed due to manual intervention	Real-time via automated systems
Root Cause Analysis (RCA)	Manual and time-consuming	AI-driven automated RCA with pattern recognition
Tech Integration	Limited adaptability to new technologies	Seamless integration with IoT, 5G, edge computing, and cloud
Downtime Impact	Higher service disruptions due to delayed fault response	Minimal downtime with predictive issue resolution
Customer Experience	Prone to service disruptions and user dissatisfaction	Enhanced reliability and seamless service delivery
Cost Efficiency	High operational costs due to manual labor	Cost savings from reduced downtime and automated processes

Enhancing Network Autonomy Through AI-Driven Predictive Fault Management

As telcos embrace AI-driven predictive fault management, they'll progress from manual and reactive fault resolution to a more autonomous network management approach. In turn, this will support the move from Level 1 or Level 2 autonomy (assisted/reactive) to Level 3 (predictive and preventive) where network issues are proactively detected and mitigated before they escalate.

This shift significantly enhances operational resilience; minimizing service disruptions, reducing heavily manual workloads for network operations teams, and lowering operational costs. And, since AI-driven root cause analysis improves Mean Time to Repair (MTTR), this further reduces downtime and enhances service continuity.

Looking ahead, the next step toward Level 4 autonomy (self-healing networks) requires AI-driven closed-loop automation integrated with network orchestration, paving the way for zero-touch network operations.

Autonomy Level	Description	Before AI-Driven Predictive Fault Management	After AI-Driven Predictive Fault Management
Level 0 (Manual Operations)	No automation; network entirely managed by humans	✗ Full manual monitoring and fault resolution	✓ Moves away from manual processes
Level 1 (Assisted Operations)	Basic rule-based automation for alarms and threshold-based alerts	✓ CSPs typically start here, relying on reactive fault management	✓ Predictive analytics reduces reactive interventions
Level 2 (Partial Autonomy – Reactive)	AI-assisted incident detection with limited automation	✓ Some CSPs are at this level, with automated alerts but manual issue resolution	✓ Moves CSPs beyond just reactive alerts to predictive maintenance
Level 3 (Conditional Autonomy – Predictive and Preventive)	AI-driven predictive fault detection and automated remediation	✗ Most CSPs are not here yet	✓ AI-driven predictive analytics and automation drive CSPs toward this level
Level 4 (High Autonomy – Self-Healing and Adaptive)	AI autonomously detects, fixes, and optimizes without human intervention	✗ Rarely achieved today	Future goal—requires AI-driven closed-loop automation
Level 5 (Full Autonomy – Autonomous Networks)	Fully self-sustaining network with zero human intervention	✗ Not achievable yet	✗ Not applicable—requires AI maturity beyond current capabilities

Unlocking Value From Network Data With AI

Key to this approach is leveraging operational data from across the network, together with historical performance and contextual inputs. Combined, this is what makes it possible to predict issues before they have a chance to become expensive, time consuming, and reputation-damaging disruptions.

AI-driven predictive fault management platforms make it easy to collect, structure, and analyze network information in real time, removing data silos to create a unified data layer that is paired with an advanced machine learning model. Everything from bandwidth usage to power and temperature fluctuations for physical assets are used to identify patterns and trends that can signal potential faults before they escalate.

Establishing this data foundation sits at the very heart of shifting fault identification and recovery from reactive to proactive. Beyond the immediate benefits, introducing AI and machine learning to network management has several knock-on effects that can enhance business performance overall:

- **Bottom-line growth:** Intelligent automation that capitalizes on the transformative power of AI is expected to unlock $9 billion in operating profits for telcos from less frequent and shorter network outages.[5]
- **Minimizing human error:** A significant contributor to network disruption, human error is thought to play a role in nearly 40% of major outages.[6] AI-driven platforms help to mitigate this risk, ensuring a more consistent and accurate response to network issues.
- **Proactive customer support:** AI capabilities make it easier to predict common customer issues based on network data and actionable insights, allowing telcos to deliver real-time support and notifications to subscribers before they even realize there's a problem.

The Benefits of AI-Driven Predictive Fault Management

Let’s take a closer look at the three main benefits of adopting AI-driven predictive fault management and the impact of this technology on network operations.

Cost Reduction

Unplanned network outages result in both direct and indirect costs for telcos. There’s the immediate financial outlay of repairing the issue, which can often result in expensive truck rolls, then the financial impact of lost revenue and a spike in customer care calls.

By identifying network issues before they escalate, AI-driven predictive fault management transforms a heavily manual, labor-intensive process into a highly automated one, supporting the shift from reactive to proactive.

As a result, network operations teams can take preventative measures long before expensive on-site intervention is needed, slashing the frequency of truck rolls and introducing a more efficient, cost-effective approach to issue resolution.

Transformational Impact for Cost Reduction

By significantly reducing the time spent on issue investigation and problem solving, AI and machine learning can help prevent unnecessary truck roll dispatches. Advanced AI-driven fault management platforms can also automate the resolution of common issues, further minimizing operational costs.

Operational Efficiency

Traditional monitoring tools generate a huge volume of alarm logs that need to be waded through to assess and triage faults. This requires significant manual effort for network operations teams who are often overwhelmed by the sheer volume of information, resulting in large chunks of time being spent dealing with what turn out to be low-priority issues.

Critical faults then slip through the cracks, only getting spotted when it's already too late. This leads to unnecessary service disruptions, increased downtime, and more reactive work.

By continuously monitoring the network, and using advanced analytics to suppress noisy alarms and correlate patterns with historical insights, AI-driven predictive fault management makes it possible to prioritize issues that are likely to escalate into serious outages. This overhauls the fault detection and resolution process, flagging problems ahead of time and giving network operations teams deep insights into the nature of the fault, the root cause, and where it's taken place – together with practical remediation steps.

Transformational Impact for Operational Efficiency

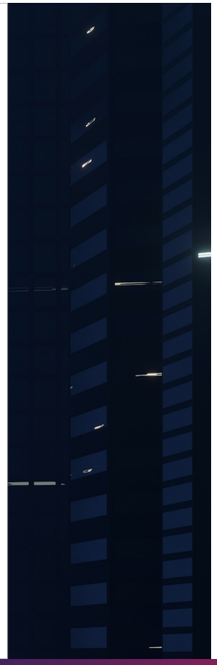
Automating routine tasks and reducing the load on network operations teams allows resources to be allocated more effectively. Having practical remediation steps to follow can also mitigate any technical skill limitations with operations personnel, supporting faster issue resolution and a more streamlined approach to network management.

Network Reliability

As subscriber expectations grow, identifying and resolving issues before they degrade service or impact the customer experience has become increasingly challenging – especially as the arrival of new technologies and other factors that are increasing network complexity have resulted in more frequent maintenance.

Balancing the need for proactive maintenance with minimizing overall service disruption is, therefore, a significant operational hurdle to overcome.

AI-driven predictive fault management can help forecast disruptions from both unplanned outages and planned maintenance. Having an end-to-end view into service impact makes it easier to assess the overall health of the network. And, by understanding how maintenance activity will affect performance and uptime, operations teams can better plan and schedule work across the RAN and core network to minimize customer impact.



Transformational Impact for Network Reliability

Prioritizing maintenance activity based on real-time risk analysis and potential impact helps sidestep potential disruptions, reducing unnecessary downtime. The result is improved network reliability, enabling telcos to keep up with ever-increasing subscriber demands.

Measuring the ROI of AI-Driven Predictive Fault Management

Introducing the power of AI to network operations can bring rapid, sustained return on investment. A good approach for working out its impact is to focus on Key Performance Indicators (KPIs) across the three main benefits this technology delivers.

Using these KPIs will help you calculate how investing in AI-driven predictive fault management will influence the bottom line while also enhancing overall network performance.

Cost Reduction

AI-driven predictive fault management brings both direct and indirect savings. When assessing ROI in this regard, start by focusing on cost savings that can be directly quantified:

- **Cost of truck rolls:** Review historical data to calculate the average cost of a truck roll and how many take place per year. Expect around a 25% reduction with predictive fault management.
- **Downtime cost per outage:** Account for the average number of minutes per outage and the average cost per hour of downtime. By reducing the volume of outages and the time needed to resolve them, AI can cut this by upwards of 40%.
- **Budget impact to support:** Take the number of subscribers your network serves, the average number of core outages per year, the percentage of those likely to call in after an outage, and the average cost of a care call. Minimizing the frequency and severity of network failures with AI will translate into a 30-35% lower budget impact in this regard.

KPI/Metric	Explanation and Impact
Reduction in Call Volume (%)	The percentage decrease in customer care call volumes due to proactive AI-driven fault management.
Fault Incidents per Month	The number of incidents occurring monthly. AI-driven prediction reduces fault volume.
Average Cost per Field Visit	Total cost for dispatching technicians to cell sites. Lower fault volume reduces average cost
Resource Utilization Rate	NOC and field engineer productivity impacted by fault handling. Optimized usage reduces costs
Downtime Duration (Hours)	Total duration of network unavailability due to faults. A key driver of SLA penalties
SLA Penalties	Financial penalties due to SLA breaches (either downtime or performance degradation)

Operational Efficiency

Moving from reactive to proactive fault management transforms the day-to-day functioning of network operations, boosting productivity. To assess this, consider the metrics that will help to show how core workflows can be optimized:

- **Faults per month:** Analyze your alarm logs to identify the average number of fault incidents that network teams need to review per month. With AI-driven automated remediation, this figure will be slashed by a third. Alarms will also be categorized and prioritized based on their severity, allowing for better resource allocation and further driving efficiencies.
- **Mean Time to Detect (MTTD):** Track the average time it takes to identify faults across the RAN and core network. AI can significantly reduce this figure by upwards of 75% – not only flagging issues faster to enable quicker response times but also identifying problems in advance before they can escalate, further minimizing delays.
- **Mean Time to Repair (MTTR):** Measure the average time it takes to resolve network faults once they've been identified. Again, automated remediation and predictive insights enable issues to be addressed before they become problems that result in an outage, minimizing downtime and enhancing overall network service continuity.

KPI/Metric	Explanation and Impact
Mean Time to Detect (MTTD)	The time taken to identify network faults. Lower MTTD improves overall fault resolution speed
Mean Time to Repair (MTTR)	The time taken to resolve faults after detection. A shorter MTTR indicates a more responsive network
Fault Rate (Incidents per Month)	Frequency of faults occurring in the network. High fault rates suggest inefficiencies in network health
Alarm Noise Rate (%)	The ratio of false alarms to total alarms. Higher noise rates waste resources on non-issues
Manual Intervention Frequency	The number of times human intervention is required for fault detection and resolution
Operational Automation Level (%)	The percentage of operations managed automatically by AI systems or workflows

Network Reliability

Network reliability is the area where AI-driven predictive fault management can have the biggest long-term impact. Several of the metrics already covered under cost reduction and operational efficiency play into overall network reliability, but you can also laser in on the following:

- **Outages caused by planned work:** Monitor the volume and frequency of outages caused by scheduled maintenance and upgrades. Look at this across the RAN and core network, which means considering the number of outages per tower you have each year as well as the number of core outages. Then, poll your historical maintenance logs to calculate the percentage of outages that came from scheduled maintenance or upgrades. AI can help minimize these disruptions by forecasting and mitigating issues ahead of time, reducing the likelihood of unexpected service disruptions.
- **Downtime caused by planned work:** Measure total downtime from planned maintenance across the RAN and core network. By leveraging AI to gain actionable insight into potential disruptions, you can expect to see around a 20% reduction in downtime from this activity.
- **Network uptime:** Record the increase in the overall uptime of your network. By acting before issues disrupt service, you can keep things running smoothly and bring uptime even closer to 100%, enhancing subscriber experience and network resiliency.

KPI/Metric	Explanation and Impact
Network Uptime (%)	Percentage of time the network is operational. A lower uptime negatively impacts reliability
Mean Time Between Failures (MTBF)	The average time between two consecutive network failures. Longer MTBF indicates higher reliability
Packet Loss (%)	The percentage of packets lost during data transmission. Lower rates signify better reliability
Network Latency (ms)	Delay in data transmission across the network. Higher latency impacts reliability for time-sensitive applications

Simplify Your ROI Calculations

Calculating return on investment can be complex. If you're looking for a faster way to estimate the ROI of moving to AI-driven predictive fault management, try our easy-to-use ROI calculator.

The tool is designed to save you time and effort, providing results in just 60 seconds based on your custom inputs (or you can use the preset options for an indicative view). Once the calculations are complete, you'll get a personalized report that outlines the financial and operational benefits of implementing AI into your network management strategy.

Scan the QR code **(or click here)** to get your personalized impact report:

CONCLUSION

As telecom networks grow in complexity and subscriber expectations continue to rise, being able to predict and prevent network issues before they take place is more important than ever. Especially in a world where downtime and network failure are no longer just inconvenient – they're costly in more ways than one.

Taking an AI-driven approach will minimize downtime, faults, and inefficiencies, playing an important role in future-proofing network operations. Having the right partner can enable this in a way that also accelerates your journey towards fully autonomous networks, unlocking digital performance and delivering measurable results.

Looking for our ROI assessment tool?

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