AI/ML for Telcom: From Reactive to Predictive Network Operations

nagarro

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Executive Summary

Orchestrating intelligent network operations

Over the past decade, Telecom network companies have undergone a massive transformation of technology, change in services offered, and the corresponding business models. Their services must be customer-centric, improve efficiency, and add high-value margins. Moreover, with the rapid growth and the emergence of IoT and 5G, there is enormous pressure on the underlying infrastructure to keep pace with the transition.

Hybrid infrastructure, multi-vendor, and multi-technology open architecture are technological advancements that only add complexities for telecom network companies. With the 24x7 availability expectation, providers have zero leeway for manual errors. Thus, to comply with this stringent Service-Level-Agreement (SLAs) cost-effectively, the transformation from traditional network operations to intelligent automated network operations is the key.

According to a report published by market intelligence firm Tractica, network operations monitoring and management are likely to account for 61% of telecom AI spending in the coming years.

So, how can data sciences be harnessed to orchestrate and automate intelligent network operations?

Read this white paper to explore:

The Why: A number of challenges in traditional network operations

The What: A need for predictive maintenance and the substantial benefits it brings in the day-to-day operations, and

The How: A roadmap to adapt it successfully to fulfill a telco's vision of autonomous and cognitive networks.

01. The Why

1.1 Key Challenges: Putting traditional network operations behind us

A vastly distributed and software-driven network is required to cater the diverse needs of 5G and the next generation of technologies. These distributed networks are hybrid (generally) in nature - a mix of physical and virtual resources. Because they are flexible and adaptable, such networks are best suited for offering a new stream of services to the end consumer. However, with this comes a multitude of challenges in how these networks and services are managed and monitored.

1. Understanding the complete picture: A comprehensive view of the full stack is imperative to control and optimize the SDNs and traditional networks together.

2. Network downtime: End-to-end network visibility, performance issue detection, and root cause analysis have been the key focus areas over the years for network operations teams to minimize network downtime.

3. Manual analysis of overwhelming, massive data: Traditionally, the network management team (see Figure 1: Traditional network maintenance) rely on off-the-shelf monitoring tools and vendor-specific EMS/NMS solutions for troubleshooting any service outages. They develop baselines in relation to historical data, for monitoring "everyday" occurrences.

According to Gartner[1], the average cost of network downtime is around $5,600 per minute (approximately $300,000 per hour)

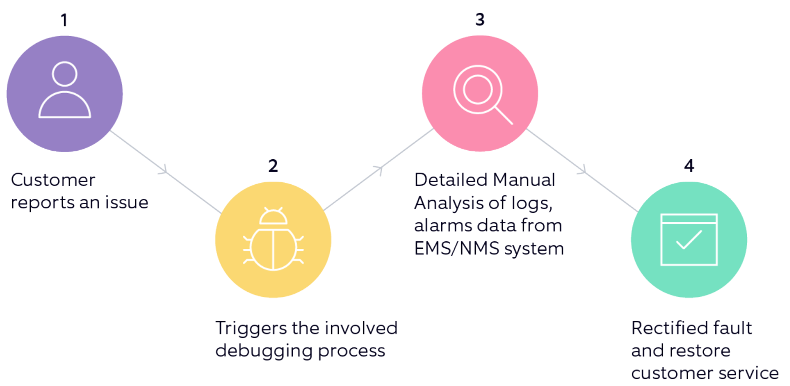

Figure 1: Traditional Network Maintenance

Massive data requires intelligent filtering and co-relational analysis before it brings the required value.

They observe the alarms generated by violations and determine the necessary steps to prevent or mitigate network malfunction. The alarms and events for a mid-sized network are typically in the order of several hundred thousand and hence overwhelming to be analyzed manually in the NOCs.

4. Impact on the user experience and maintenance productivity: Off-the-shelf monitoring tools often give a limited network view. An e2e service view, spanning across the hybrid network elements and infrastructure, constituting a service is missing. Thus, any faults in any of these nodes and layers severely impact the user service experience and the overall network maintenance productivity.

Network operation specialists for these modern networks need intelligent self-learning techniques and tools, and drill down into the network to understand the reasons behind hurdles. With time, these intelligent tools should predict faults before it occurs, based on the underlying symptoms build-up in the system/network. The enormous data generated by these networks, when analyzed along with different context realms like configuration, network topology, cross-relational events, etc., can provide important insights regarding the overall health of the networks.

02. The What

2.1 Defining a cognitive operations approach powered by AI/ML

Telcos worldwide are taking measures to move from the traditional reactive network maintenance to a more proactive, predictive, and cognitive mode of operations. Data Analytics and Data Sciences (AI&ML) have been at the center of these initiatives. Machine learning is an application of artificial intelligence (AI) that allows systems the ability to learn and improve automatically from experience without being explicitly programmed. These techniques have evolved over the years from Descriptive (what has happened) to Diagnostic (why did it happen) to Predictive (what could happen) to Prescriptive (what action could be taken).

The upcoming evolution is towards Cognitive Analytics that explores the advancements in high-performance computing by combining advanced Artificial Intelligence and Machine Learning techniques with data analytics. The vision of cognitive networks is to create a self-aware, self-maintaining, and self-healing network.

Data sciences can help in evolving network operations in several ways, making them more efficient and autonomous. Fault isolation, anomaly detection, and event co-relation to future fault prediction - are popular use cases many telcos are exploring.

According to a research based on conversations with executives at 132 mobile operators around the world, 53% of carriers expect to be using AI in their networks by 2020.

An embedded large-scale computing ability enables analysis of all available network data to create a central repository of events. The intelligent self-learning algorithm continuously carries out predictive analytics on data aggregated automatically from different systems for proactive troubleshooting, thus paving the way for automating hierarchical, complex decision-making and implementation of the same in real-time. Human intervention is limited to jobs that demand absolute dependencies such as physical connectivity and workflow policy governance. This can significantly improve in the MTTR (Mean Time To Recover) and MTBF (Mean Time Between Failures) and hence reduce the OPEX.

Modern machine learning techniques bring percentages into play, unlike traditional methods that concentrate solely on the concrete values of baseline parameters to establish anomalies. This adds to the strength of the anomalies detected. With AI-based probability algorithms, the system can search for likely causes of the anomaly, select the most appropriate solution, and act on it. So, the original anomaly event can be determined by allowing the system to work back from potentially multiple symptoms.

And this applies to individual anomalies and common violations grouped, which is essential from the machine learning perspective because it means the system can learn what action to take in every situation.

03. The How

3.1 The three-phased execution approach

'Cognitive operations backed by AI and ML is the future of network operations' is no longer an argument. However, the approach and transformation must be gradual and phased. In this section, let's cover what possible journey path (see Figure 2) Telcos can follow for a successful transformation.

PHASE 1: LEARN

- A preparatory phase where Telcos usually focus on their self-discovery, their challenges, key systems and data sources, priorities, etc.
- Collecting the data that will be the foundation of the AI/ML algorithms implemented and deployed in the later phases.
- The data sources can be both structured and unstructured. It is processed and vetted to generate valuable insights effectively.
- Careful observation and recording of any real-time incidents, failures, and outages.
- Records created for a period can be used as data for supervised learning.
- The data analysis platform that collects all this data, filters and cleanses it can be put together to integrate these pipelines.

More details of this platform are in the following section The Network Analysis Platform – the foundation of intelligent operations.

PHASE 2: ADVISE

- A focus on data analysis and modeling for the challenges identified in the Learn Phase.
- An analysis is done using big data tools and platform, which are integral part of the Network Analysis platform, and the models created are trained based on the captured data.

- The training approach (supervised, unsupervised, or reinforcement learning) depends on the data sets available.
- Eventually, the models deployed start detecting the known faults and build data for remediation actions.
- Anomaly detection, event/fault co-relation are some of the valued outputs we can derive from this phase.

PHASE 3: AUTOMATE

- The models mature using the self-correcting (feedback) techniques, and the monitoring & maintenance becomes autonomous.
- The system can isolate the known faults and identify similar faults.
- It also becomes capable of applying the recommended corrective changes in an automated fashion.

Figure 2: Phased Adoption of AI/ML for Telcos

04. Getting started

4.1 Network Analysis Platform, the foundation of intelligent operations

The machine learning algorithms are based on data produced by the networks. This data must be comprehensive and of the highest quality because that will be the critical deciding factor for the AI/ML algorithms applied to a given problem. Supervised and unsupervised learning methods differ in the way they are used. The supervised learning models require a well-labeled historical dataset and are most suited for predictive analytics. The unsupervised learning techniques are applied in the absence of this labelled data.

In both scenarios, the data generated is raw and needs processing and filtering to be fed to the machine learning models to create meaningful outputs. The volume of data generated is exhaustive and necessitates a big data-powered platform to ingest, filter/cleanse, process, and feed this data to the machine learning algorithms.

Network Analysis Platform: A layered perspective

A Network Analysis Platform that intakes and collects data from relevant data sources is a logical priority. Figure 3 captures a layered view of such a platform.

THE DATA LAYER

- The bottom-most layer represents the data layer with diverse sources like network devices, monitoring tools, ticketing tools, etc. The network elements spanning the service chain, including access, core, backhaul, and transport, generate massive data in the form of syslogs, SNMP alerts, and PM/FM counters.
- Network traffic intercepted between the different network elements by protocol analyzer tools (e.g., Wireshark) can also be a good data source as it offers a vendor-agnostic approach. The tools used for connection and service monitoring can provide additional data processed and aggregated in KPIs.
- The OSS/BSS and other service platforms also generate data used in analytics-based decision-making. These systems are further strengthened by contextual data from inventory, topology mapping, configuration data, and ticketing systems.

THE PROCESSING LAYER

- The middle layer represents the network analysis platform capable of processing high-volume data for insights. It provides an ecosystem where the machine learning models can be developed and deployed later on in the end-to-end pipeline.

- The data generated from the data layer is ingested and stored in data lakes provided by frameworks like Hadoop, Elastic Search, etc. These tools offer a distributed, scalable, and high-performance processing environment needed for data-driven algorithms.

- For real-time or batch data processing requirements such as data cleaning, complex event processing on incoming log events, processing ML models, etc., over high-volume data ingested at high-velocity services like Spark may be utilized. It leverages the methodology of distributed computing to meet the required performance SLAs.

- The deployed machine learning algorithms depend on the use case and the outcome desired. For instance, anomaly detection is the process of identifying unexpected items or events in datasets that differ from the norm. In contrast to standard classification tasks, anomaly detection is often applied on unlabeled data, considering the internal structure of the dataset alone. Another example could be the event and alarm co-relation using ML techniques such as clustering.

THE VISUALIZATION LAYER

- The uppermost layer is responsible for visualizing the insights and dashboards to the end-user and push notifications to the network administrators via emails and other channels.

- These visualizations can range from simple dashboards plotting anomalies, future faults built using tools like Kibana, Grafana, and more.

- Frameworks like Kibana enable raw data querying interface over Elasticsearch with extensive visualizations. However, these can also be depicted on a customized portal using BI tools.

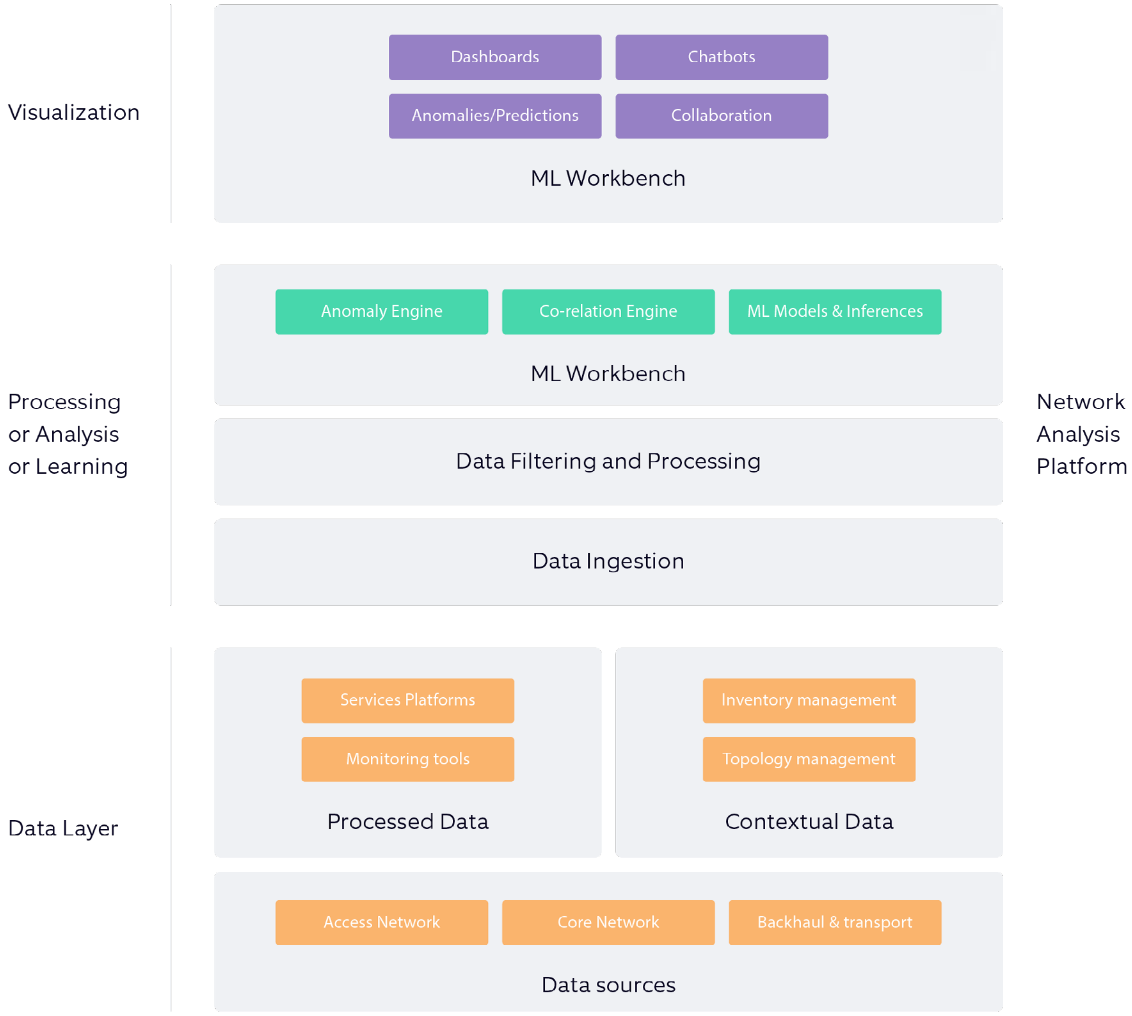

Figure 3: Network Analysis Platform

05. Conclusion

5.1 AI/ML is not a quick fix but a tool to promote continuous improvement.

The application of AI in the telecom field is still in its infancy. The years ahead will be crucial for the transformation of intelligent network operations. With the gradual maturity of AI and ML techniques, we can truly revolutionize the current manual governance model to a self-driven autonomous system. Leveraging AI/ML should continue to remain a focus area for the network operations teams in Telcos to benefit in several ways:

- **A predictive view of alarms and performance enables shift-left maintenance operations when required.**
- **A singular view of the network with co-related alarms can reduce the monitoring and troubleshooting effort substantially.**

Some business benefits such as:

- Reduced network maintenance time and its associated lost operational hours.
- Optimized OPEX cost by minimizing the cost of spares and managing the unplanned outages better.
- Improved service/network availability boosts customer satisfaction and reduces churn.

Therefore, creating a definitive and tailored roadmap with phased milestones is the key to defining the success path.

AI/ML needs to be viewed not as a quick fix for all the network shortcomings but as a tool to be embedded in the daily network operations workflow. These technologies should be considered part of an ongoing process of continuous improvement, keeping costs under control, and ensuring sustainable growth.

Glossary

Acronym	Description
AI	Artificial Intelligence
BSS	Business Support Systems
EMS	Element Management System
FM	Fault Management
IoT	Internet of Things
KPI	Key Performance Indicators
ML	Machine Learning
MTBF	Mean Time Between Failures
MTTR	Mean Time to Recover
NMS	Network Management System
NOC	Network Operations Center
OPEX	Operational Expenditure
OSS	Operations Support Systems
PM	Performance Management
RCA	Root Cause Analysis
SDN	Software Defined Networking
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol

References

1. https://blogs.gartner.com/andrew-lerner/2014/07/16/the-cost-of-downtime/

2. AI Enables Network Intelligence - ZTE AI White Paper

3. Service Monitoring and Alarm Correlation - Whitepaper

4. Network Transformation, ETSI Whitepaper #32

5. ETSI GS ENI 005, V1.1.1 (09/2019): “Experiential Networked Intelligence (ENI); System Architecture”, https://www.etsi.org/deliver/etsi_gs/ENI/001_099/005/01.01.01_60/gs_ENI005v010101p.pdf

6. Tractica, Telecommunications Industry Investment in Artificial Intelligence Software, Hardware, and Services Will Reach $36.7 Billion Annually by 2025 (April 2018), accessed October 9, 2018.

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Ashima has 16 years of communication software development experience, specializing in different cellular and VoIP technologies. She has worked on building multiple carrier-grade network nodes including LTE-EPC and IMS core servers. She is currently, leading multiple technology projects in Edge computing, IoT, AI/ML for global telecom clients.

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