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An AI-Driven Future for Network Operations

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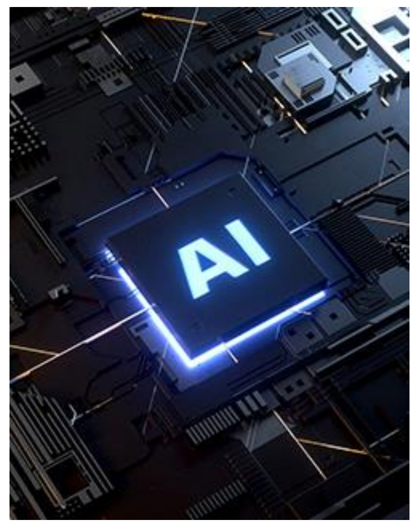

Complexity is costly, but it's a reality in network performance and operations today. To successfully run high-performance 5G services, a mobile network requires an outstanding transport infrastructure, capable of satisfying different services' needs, from capacity and latency to sync and more. The network must run with the highest reliability.

Even this is not enough, though. When the unexpected occurs, a fast, efficient operating response makes the difference between seamless network performance and disruptions that interrupt traffic. This article examines 5G backhaul composition, network complexity, and the transformative potential of artificial intelligence on networks.

The role of microwave radio

Today, according to research by GSMA and ABI, microwave radio technology accounts for over 65 percent of the mobile backhaul connections globally. The use of microwave radio as the preferred backhaul technology is expected to remain in the foreseeable future (forecasted to be over 60 percent in 2027).

On average, a European mobile operator has over 25,000 microwave radio links nationwide, generating over one million event records per day, plus several performance measurement points, generating bulk data that can easily reach one to two billion records annually.

The analysis of such a giant amount of data is a task of titanic proportions—and this is why it is generally done by operators in a reactive manner. Once an event occurs, data is examined for troubleshooting to fix the outage and restore network operations.

Thanks to the use of AI- and ML-empowered applications, raw big data can be analyzed by an artificial neural network (ANN), moving to an automated and reasoned approach to predict network behavior, recognize known network patterns, and intervene before an impairment happens. In the case of an unexpected event, a tempestive reaction can be put in place, avoiding critical escalations and maximizing the network uptime.

An evolution toward a new network management model—SDN, or software-defined networking—has been underway for some time. SDN introduces a software module named domain controller that acts as the network operating system. This software module collects all the data from the network elements and abstracts the interfaces to manage them to higher management levels, allowing applications to easily interact with the network.

The high cost of complexity

In most cases, an operator uses two or three vendors to build the backhaul network, resulting in a multivendor proprietary OSS-based solution. But this comes at a cost.

In the pre-SDN world, each vendor supplied the microwave radio links as well as its own OSS solution to manage, supervise and collect performance data on the equipment, based on a proprietary protocol implementation.

This creates a problematic layer of complexity. In a three-vendor backhaul network scenario, one would find three different OSS with different ways to address equipment, manage alarms and retrieve, store, and access data on performance indicators—leading operators to invest significant CAPEX to reconcile the data across the network.

With the implementation of SDN, we will face a new paradigm. The industry is putting great effort in standardizing the domain controller's southbound (SBI) and northbound interfaces (NBI). This harmonizes how the controller interacts with network elements (SBI) and the way network data are exported and presented in higher-order systems (NBI), allowing easy queries and management of the whole or portions of the network, as needed.

This opens the market for software applications that, through NBI, can interact with the whole network, regardless of the equipment or controller provider. This new paradigm offers operators data analysis and services at a fraction of the time and cost with an accuracy and reliability previously unattainable.

Revolutionizing resolution through AI and ML

Thanks to developments in big data analytics and the availability of scalable computational power, it has become possible to manage, process, and extract information from the billions of records available in each network.

This is revolutionary. Previously, due to the complexity of the task, the KPI information database was analyzed only after an impairment occurred. If this analysis caused loss of traffic, the interruption was related to propagation issues or network-related problems. In those cases, investigation activity aimed to understand the root cause and put in place corrective actions. This was a reactive process, taking place after the event occurred, under pressure and with hard time constraints. It pushed for broad non-cost-effective corrections.

The introduction of AI into the process is transformative. Using AI, the big-data database can be proactively analyzed to identify and highlight any network issues and present them in an aggregated format so that the operations team can plan maintenance in advance, based on priority.

The AI algorithms identify multiple network issues, including those with minimal effects that have not yet triggered any network alarm. This insight is brought to the attention of the expert network engineer, who can proactively assess the identified network elements and network portion. As a result, the issue can be corrected before it escalates, without any time pressure, leading to a targeted and cost-effective response.

Moreover, the AI algorithm can be retrained periodically to learn how the network has changed or has been expanded, improving its ability to recognize new network scenarios, and increasing its added value. Furthermore, with the introduction of reinforced learning, the AI algorithm can autonomously discover and learn new ways to autonomously solve upcoming network issues, ensuring its status is continuously up to date.

A deeper dive into the AI/ML process

There are substantial benefits to using an AI application with machine learning algorithms. To unlock them, designing and training the artificial neural network is key—and even more so is the quality of the big data on which the application is trained. Missing data, disorganized formatting, and uneven reading will yield incoherent results.

Consequently, data mining and data preparation are fundamental steps. Today in a multivendor installed base environment, organizing data is an onerous function, aseach vendor reads, saves, and presents data in its own proprietary formatting. Tomorrow, with the adoption of SDN-standard models, all collected data will already be presented in a homogeneous format with reliable quality across any vendor solution.

Once data is available, clustering takes place. The algorithm assigns the observed data patterns to one of the possible clusters, each associated to a possible network behavior. At this stage, in which data gets labelled and classified, the design intervention of a microwave subject matter expert becomes paramount to ensure the network training isn't biased, compromising any future result.

Furthermore, data can be gathered externally to the network and correlated with the mined performance data to create a deeper understanding of the network behavior, especially if we consider the propagation aspects. In the same way, some network data can be offered externally to fulfill other applications outside the telco world.

Case study: live network deployment

Let's bring these benefits to life with two different applications. One targets a repetitive process that is tedious to carry out but has critical impact. The other is impossible to carry out manually. Both applications are aiming to simplify operational activities and speed up time of intervention, resulting in significant cost savings.

The first application targets software upgrades for network elements. This is usually carried out manually during off-peak time with a rigid sequential process. An application can map the entire network topology, optimize the software download policy, plan the activity, and execute it autonomously, reducing the upgrade activity time fivefold. Furthermore, the application can include in its planning any operator-specific constraints or policy guideline. The estimated benefit to an operator with 25,000 links—the average number of microwave radios in a European operator, as mentioned earlier—is cost savings of over €1 million annually.

The second application matches the traffic requirements with the available physical resources, monitoring the network traffic in real time and optimizing hardware resources accordingly. When the network is running at an off-peak time, for example overnight, traffic needs are much less compared to the daytime peak time or even day-average needs. In this scenario, the application can switch off the extra capacity when it isn't needed, with relative power consumption and CO_2 savings. In this scenario, the estimated cost savings from higher energy efficiency amounts to €100,000 annually for every 5,000 nodes.

An AI-driven future

SDN and AI-driven applications will change the future of network management, especially at the operational level. There will be a gradual shift toward proactive and preventive management of the network, as the AI application will relentlessly monitor the network performance. This change will offer mobile operators the means to see through the mist of big data, turning it into an asset to be capitalized on to ensure the network is operating at his best.

The relationship between network engineer and supervision tools will become even more important as AI will be capable of bringing to light a series of activities, upgrades, and maintenance. These will need to be validated, planned, and executed to maximize network uptime and flawless service delivery. Furthermore, knowing where and in what to invest will improve the spending lifecycle and increase ROI.