Unlocking the Benefits of Artificial Intelligence and Machine Learning

Automation, artificial intelligence and machine learning will have a profound impact on future operations because they will be used at every level of a fixed broadband network to make faster, better and more predictable decisions.

By Filip De Greve / *Nokia*

Network complexity is one of the biggest problems broadband network operators face today. In addition to multiple access technologies and traffic types in the broadband network, there are a few root causes of this complexity: explosive growth in devices, nodes and bandwidth. None of those factors are going away anytime soon, so complexity needs to be managed because it can't be eliminated.

Technologists have come up with several solutions. Software-defined networking and virtualization enable IT-like programmability that can automate many network processes. Automation speeds things up, increases accuracy and cuts through the complexity in a way that humans can't – reducing waste and increasing productivity. As network elements are redefined through programmable software and cloud evolutions, new use cases drive the need for a more IT-like approach with better efficiency, agility and DevOps capabilities.

Artificial intelligence (AI) and machine learning (ML) play an extremely important role in automation, but are they a cure-all? Let's find out.

AI/ML CHALLENGES, OPPORTUNITIES

Given the mass amount of available data and massive computing power, one would think programming effective AI/ML tools would be simple; however, they are fickle and notoriously difficult to get right. The evergreen phrase "garbage in, garbage out" rings true here as any AI/ML algorithm can only be as good as the quality of the data that goes into it. In fact, data is the most valuable component of any AI system.

Data must be ultra-precise, not just in its integrity but also in format (e.g., config, logs, alarms, counters, etc.). It also needs to be centralized, to avoid an incomplete view; consistent, which means quickly collecting real-time and historical data; and always-on, so data is available in the cloud when it's needed. It should also be standardized, so different data sets can be directly compared for ML algorithms, and open, so data can be processed by third-party models. Finally, data needs to be secure to comply with regulations, such as Advanced Information Management (AIM) and General Data Protection Regulation (GDPR).

So, what is network irregularity? Once network data is available, operators need to ensure it's robust by checking for irregularities and patterns. The basic concept of real-time anomaly detection is to compare live collected data with a benchmark or range known to correspond to a normal, healthy condition. In the simplest form, the expected range is manually defined by a person with the required domain expertise. These key performance indicators (KPI) are set once and updated very infrequently.

To scale this method, one can use automatic fingerprinting to set the expected range right

after a new broadband service has been deployed. Though this method is robust and powerful, it is limited. Parameters are influenced by temperature or network traffic, which exhibit cyclical patterns that make detection of a real anomaly complicated.

This is where AI/ML excels. Using well-established techniques, such as rolling mean and standard deviation with auto-regressive (ARIMA) algorithms, it is possible to dissociate a seasonal repetitive pattern and a fundamental trend from the background noise, allowing a more accurate prediction of the expected range and making anomaly detection faster and more accurate. Typical use cases include degradation of optical signal power, network traffic peaks, abnormal/unfair user data consumption, board temperatures, and central processing unit and random access memory usage.

In AI/ML, domain expertise is essential in analyzing service, device and network data to predict customer issues and prescribe the best actions.

CLOSED-LOOP AUTOMATION

Detecting anomalies is not the end of the matter, however. If anomalies have the potential to cause service degradation, the root cause must be identified and remedied. Closed-loop automation helps resolve issues faster.

This also has different levels of algorithmic complexity. In simpler cases, in which the repair action is directly derived from the detected anomaly or root cause, a simple rule engine can be used (an "if-this-then-do-that" type of automation). Multiple rules can be combined to address slightly more complex problems – assuming the rules are "humanly manageable" as they must be manually configured and maintained by qualified people.

However, for complex problems, deriving an optimal set of rules manually is not always obvious. Here again, AI/ML comes to the rescue. Reinforcement learning is typically a technique that can automatically identify the best configuration changes to apply to the network to maximize a certain objective, such as network stability, performance and fair sharing.

Getting data input right also requires domain knowledge – the detailed understanding of the real-world environment in which AI/ML algorithms operate. This crucial skill was once considered a nice-to-have. After all, AI/ML has been able to complete a range of detailed asks without a human expert, from superhuman performance to determining the best in-game Pokémon characters.

But the real world often comes with a lot of ambiguity, and data comes with a lot of noise, so views have now changed dramatically. Whether it's diagnosing breast cancer, saving elephants, or learning from gender bias issues, domain knowledge is what differentiates an underperforming, even damaging AI solution, from a best-in-class creator of value.

Domain expertise is essential in analyzing service, device and network data to predict customer issues and prescribe the best actions. The AI/ML algorithms replace time-consuming investigations and recognize impairments more quickly than technicians, who have been working in the field for many years, and with a tremendous increase in accuracy and very low false-positive rates.

Automation and AI/ML will have a profound impact on future operations because they can and will be used at every level of a fixed broadband network to make faster, better and more predictable decisions. Productivity increases benefit a steadily rising number of network tasks – especially thanks to the exponentially increasing amount of data available to train the algorithms on which AI/ML depends.

The reliable capture, transmission, storage and processing of all these data sets is therefore essential. So is the ability to have a highly scalable infrastructure for streaming and collecting the vast data sets and making them available to operations support systems and other applications via open application programming interfaces.

In short, the benefits of AI/ML are unquestionable; all one needs is the right approach to unlock them. ❖

Filip De Greve is product marketing director for the Fixed Networks division at Nokia.