White Paper

FUJITSU

Ignite 5G Network Analytics with Machine Learning & Artificial Intelligence

Network data is a rich source of insights that can be used to make highly informed and impactful business decisions that not only improve the customer experience, but also assist with new product development. However, as more and more 5G services come online, the demands of consuming, processing, and taking action with that data have outpaced traditional databases and now require sophisticated data visualization tools and applications. Time-series databases and Artificial Intelligence/ Machine Learning (AI/ML) are needed to build, train, and interpret network models capable of understanding and emulating human experiences at machine scale.

Why do network operators need analytics powered by AI/ML?

Over time, while network models and automated recovery reduce the number of catastrophic events, no human being can perform the kind of atomized and granular network monitoring that complex 5G ecosystems create. Providers need AI/ML so they can focus their time and energy on efficiencies, directional items, and customer experience while the AI system manages typical operational tasks with a neural network brain.

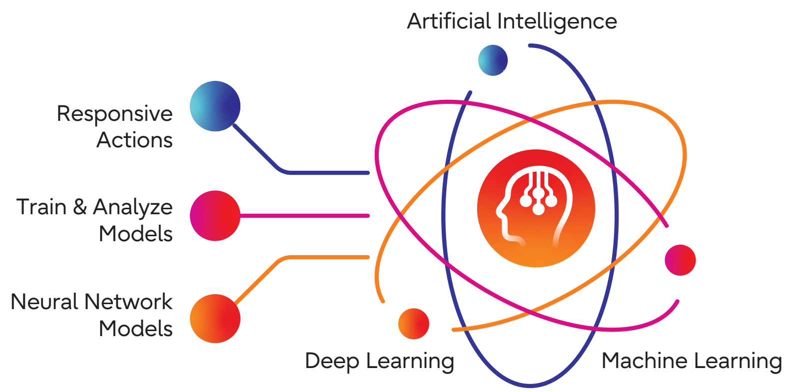

Figure 1: Network operators need AI/ML

Monetizing network data with multivendor, multilayer analysis

To monetize network data and create business value, providers need AI/ML solutions that facilitate management of the entire data pipeline of the multilayer, multivendor network. That management encompasses ingestion, data processing, clustering, model training, and automation for 5G RAN, edge and mobile core, as well as optical transport and the MPLS network. This comprehensive form of network data analytics yields much more sophisticated insights into pricing and consumer segmentation as it relates to network usage, enabling dynamic, on-demand capabilities such as:

- Partitioning and prioritizing traffic
- Optimizing throughput and transmission speeds
- Managing high-traffic users and their impact on other customers' service quality
- Handoff capabilities between networks
- Managing low- and high-density geographies differently
- Pricing structures based on different types of traffic

Beyond building customer loyalty through improved service quality, new use cases make it possible to monetize network data and create business value by aligning network value directly to revenue. This can be a crucial differentiator for new B2B and B2C service offerings.

Building the business case for AI/ML

To get started with AI/ML in a provider network, keep the business case simple. Learn to look for problems and then use that knowledge to solve future problems faster and more economically. And it's easier than you might think. Here are four real-world examples of how a network operator can harness AI/ML to manage their network.

Predictive network planning

With AI/ML tools, the right network expansion in the right place with the right equipment can deliver higher ROI. Predictive network planning allows providers to reduce downtime and increase revenue by pinpointing exactly where network congestion and bottlenecks occur, and then automatically allocating new resources, either with idle capacity or with new equipment recommendations that match the need. Providers and operators can drive revenue growth by optimizing their capex budgets for customer experience and new service delivery, rather than relying on business-blind metrics like capacity and reach.

Consistent problem solving

Solutions to complex network problems should not depend on the experience of the person who catches the ticket. That makes improving the consistency of problem-solving a significant goal of every Network Operations Center (NOC.) For example, on the back end of network events, like an outage or planned maintenance, effective machine learning and artificial intelligence tools can provide NOCs with consistent measurements and automated responses that returns the network to steady-state convergence.

Adaptive network solutions

5G networks are constantly evolving, and NOCs need adaptive problem-solving approaches that include fast and accurate root cause identification and remediation. But when a problem occurs, it's impossible to sift through network events, alarms, and obscure behaviors without advanced tools. Machine learning can automatically identify and sort relevant performance data, classify it appropriately, and pinpoint systemic issues and causes quickly. Using "fuzzy logic," AI returns possible solutions and pre-implementation predictive modeling and testing for all potential matches. Operations staff can use those testing outputs to choose the best solution for the specific problem at hand, and then AI tools can re-provision the network automatically.

Fewer executive escalations

Solving network problems consistently and faster, with well-documented and automated solutions, will inevitably reduce the number of escalations the NOC must negotiate between customers and executives. With adaptive network solutions powered by AI/ML, NOC staff and administrators will spend less time firefighting and explaining themselves, and more time creating greater efficiencies, planning, and optimizing the network.

AI/ML technologies every operator should know

Insights and remediation related to slowdowns, degradations, and failures in network elements inevitably cascade into major usability problems at customer endpoints, setting off alarm storms. As a result, modern applications running on those endpoints are highly dependent on extreme real-time visibility into usage, the network and its connections, supporting compute elements, and storage.

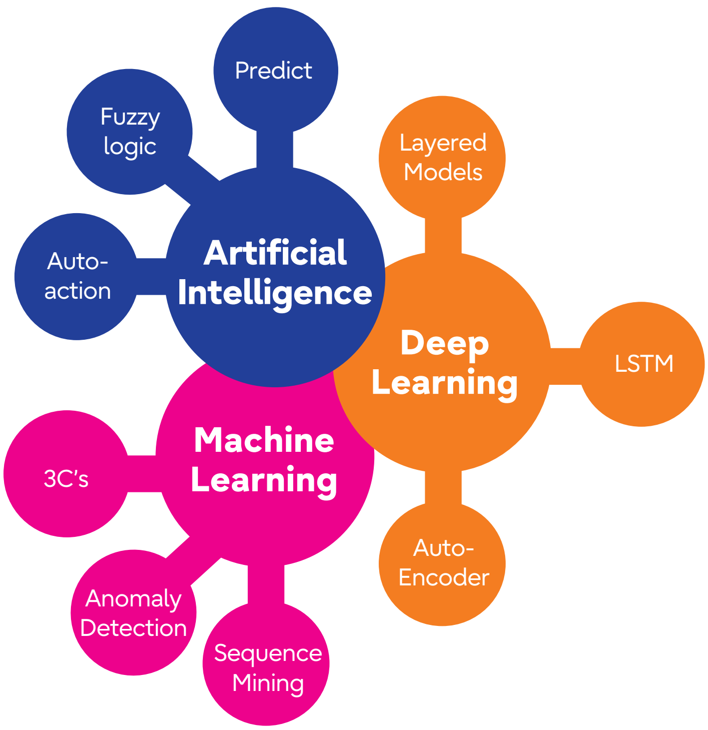

Figure 2: AI/ML techniques

AI/ML techniques track these network measurements and events and analyze changes, trends, seasonality, cycles, and fluctuations. While m ML isolates issues, AI correlates the data, draws conclusions, and triggers network automation to deliver a closed-loop system that fixes root causes before severely impacting the end-user experience.

Here are a few tools and techniques to know:

- ML uses Anomaly detection, a type of outlier analysis, to identify data points, events, or observations that vary significantly from a global data set. Operations staff uses anomaly detection to recognize a critical incident or to surface opportunities for new service development.
- Auto-encoder is a deep-learning neural network system that compresses data and then reconstructs that same data with minimal errors.
- Correlation is the basis of statistical modeling that shows the degrees to which two variables change in coordination with one another.
- Classification references predefined categories the system uses to sort data into specific categories.
- Clustering is a collection of data points gathered together because of certain similarities.
- Long short term memory (LSTM) is a recurrent neural network model with memory blocks that provide context for the system's information. ML algorithms use that context to understand data and help inform the next steps.
- Principal Component Analysis (PCA) is an ML technique that reduces data dimensionality and increases interpretability while minimizing information loss.
- Time-series prediction uses any data source, including streaming data, to forecast future behavior.
- Sequence mining is a technique that examines sequences of data groups and identifies statistically relevant patterns.

These AI/ML techniques completely upend loosely documented "if-then-else-do-this" fixes. Using multidimensional observations from the network itself, transformative analytics and network automation deliver carefully orchestrated sequences of remediation that provide adaptive network management solutions.

As networks evolve, behaviors fluctuate, and interdependencies between data and behaviors fluctuate correspondingly. Only AI/ML tools that leverage these techniques can close the gaps that would otherwise take a person hours or days to sort through.

Putting AI/ML techniques to work in the communications network

Today, providers and their NOCs are most likely monitoring network behaviors with manual thresholds. When an event crosses a threshold, the system sends a notification, and the person who receives that notification may or may not take corrective action- again, manually. But it doesn't have to work that way.

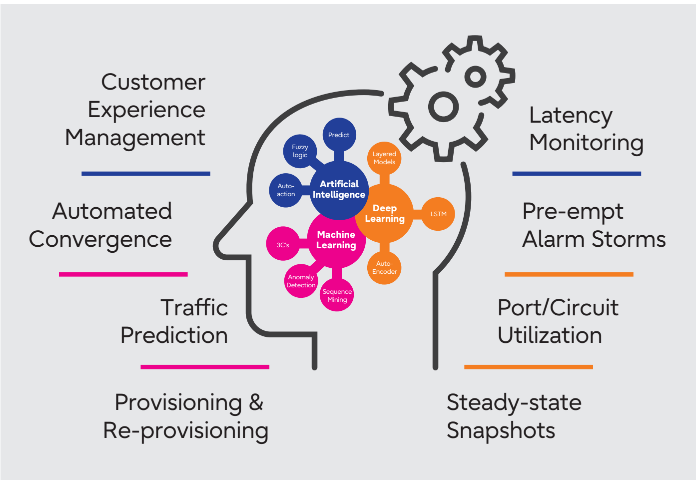

Figure 3: AI/ML in the provider network

Streaming data analysis and model training

Using techniques like LSTM and the mathematical models that make up time-series prediction, AI/ML analyzes all the information a network, its equipment, and its endpoints create. This can include offline data and/or streaming data from a network that is in service.

The system uses the information to forecast behaviors and enforce policies for handling service disruption. AI/ML tools also use the information to build and maintain multidimensional neural network models. Maintaining network models includes model training, which is critical to minimizing loss of function within a prediction range that could impact the accuracy of the forecast.

For example, circuit and port utilization predictions and forecasts can be made using streaming data analysis and online/offline model training. Latency-sensitive applications that traverse network paths can combine predictions and forecasts with latency monitoring. This combination can proactively identify path fluctuations in longer routes that might impact the application's service. Once identified, operations staff might choose to provision a new circuit, re-provision an existing circuit with fewer fluctuations, and even assess applications that appear unnecessarily sensitive.

Time-series prediction and closed-loop actions

Closed-loop actions based on time-series predictions can provide better management solutions than traditional, reactive fixes. An example is span-loss prediction. Using time-series prediction, the system can project when span loss will hit a preconfigured threshold in the future. Then, the system can be preprogrammed to reprovision the circuit before performance is impacted.

Post-event health checks

Post maintenance event health checks also benefit from AI/ML. Before maintenance events, the logical layers of a healthy network are converged optimally in a steady state. Using multidimensional modeling, AI/ML tools develop a snapshot of the network. That includes log data, PM data, and alarm patterns. After the maintenance event is performed, staff can compare the new network state to the steady-state model. If the network does not re-converge, the snapshot uses anomaly detection and correlation techniques to help identify discrepancies and missed configurations that can be addressed immediately. Multidimensional modeling might also be used before and after snapshots, surfacing missed configurations before a maintenance event is performed.

Monitoring rising alarm storms

Significant alarms for catastrophic events can go unnoticed in a sea of meaningless data. Or worse, network conditions create an alarm storm with no obvious indications of where to start solving the problem. Sorting through all the relevant data to find the root cause might take days and maybe a bit of luck. AI/ML surfaces those events identifies their root cause more quickly, and provides consistent and accurate resolutions within hours.

Recognizing disruptive network behaviors before they cause major problems

An added benefit to solving alarm storms using AI/ML tools is that, post-event, providers know what caused the event, understand what behaviors contributed to that event, and can tag those behaviors for future reference and pre-emptive remediation. A disk overrun, equipment failure, or signal loss can be tagged with potential resolution suggestions for future events.

Managing the budget for growth rather than remediating problems

AI/ML tools help create network planning recommendations that generate more efficiencies and budgeting insights. Accurate network inventory, progression, and growth forecasts can be used maximize shelf utilization before new investments are made, and help ensure assets are added in the right places.

AI/ML with Virtuora® AX

Virtuora AX delivers explainable AI for sophisticated data sets, with tools that operations, planning, engineering, and services teams can leverage to improve service and network quality of experience. Combine any or all of the Virtuora AX Network Intelligence toolset and Virtuora AX MicroApplications to deliver specific automated network control and management across domains, layers, and systems.

Virtuora AX is a collection of cloud-native microapplications that uses actionable and automated network intelligence to extend traditional network monitoring. It includes:

- Application-building infrastructure capabilities for DevOps
- Network Intelligence tools
- Network models
- Learning engines
- A library of Virtuora AX microapplications for network operations

The Virtuora AX leverages cloud-native architecture that scales to fit data consumption and operation needs, and runs in public or private clouds. Virtuora AX is a member of Fujitsu's Virtuora cloud family of products. The Virtuora cloud family unifies orchestration, control, and management of the multilayer, multivendor network stack, unwinding complexity and enabling powerful functionality.

Virtuora cloud products are part of the Fujitsu hybrid CT/IT infrastructure, expanding the reach, productivity, and value of the communications network within the enterprise. With Virtuora cloud, anyone can build a network around offerings and services powered by software.

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Configuration requirements for certain uses are described in the product documentation. Features and specifications subject to change without notice.