
ENHANCING EFFICIENCY IN TELCO CLOUD WITH EXPLAINABLE NETWORK BASED MACHINE LEARNING (XNML™)

Telco clouds are transforming today's connectivity and mobility services to an experience driven set of services that position Mobile Network Operators (MNO) to address new digital demands from consumers and capture new revenue stream. MNOs are making large investments to upgrade their network infrastructure to deliver these enhanced 4G and 5G services while facing stiff competition within the industry and from Over-the-Top (OTT) players. In this environment, Artificial Intelligence (AI) and Machine Learning (ML) technologies offer MNOs disruptive opportunities to improve operational efficiencies, deploy automation and deliver superior customer experiences.

The logo for ALBEADO features the word "ALBEADO" in a white, uppercase, sans-serif font. The text is centered within a black rectangular background. A thin blue horizontal line is positioned above the letter "A" and another thin blue horizontal line is positioned below the letter "O".

ALBEADO

EXECUTIVE SUMMARY

Mobile Network Operators (MNO) are expected to spend more than \$300B by 2025 to upgrade their infrastructure to roll out 5G services.¹ This includes data center investments in Multi-access Edge Computing (MEC) datacenters that delivers low-latency applications and increases network capacity to meet the expected surge in dynamic demand for computing and network resources. Operational efficiencies are at the center of 5G technology and vendor decisions by MNO. ABI Research² forecasts that MNOs will invest \$14B in AI technology by 2022 primarily to deliver these operational efficiencies.

MNOs are increasingly deploying Network Function Virtualization (NFV) technologies across hybrid clouds (Telco Cloud) to deliver 5G services. NFV increases availability of network performance data with high granularity across the Network Function Virtualization Infrastructure (NFVi) stack in real time. This accessible granular data creates tremendous opportunity for AI/ML algorithms to leverage Data Collection, Analytics and Events (DCAE) output to learn the network behavior, correlate events, telemetry data, logs and alarms across the entire network, from Transport to Packet Core to Applications. Albeado's eXplainable Network based Machine Learning (XNML) technology can deliver operational efficiency improvements to Telco clouds and be the driving force for core applications such as automatic fault resolution, proactive maintenance, automated machine learnt root cause analysis (RCA), intelligent network slicing management and dynamic demand prediction of network resources.

This paper discusses Telco cloud challenges and provides an overview of how Albeado's proprietary XNML technology based AI/ML solutions can tackle them today at the junction of cloud technology, NFV and Software Defined Networks (SDN).

TELCO CLOUD CHALLENGE

Telco clouds today deliver resources to support various network functions, provide a high capacity & responsive packet core and deliver low latency applications to support new consumer experiences. To deliver low-latency applications (<1ms) with high availability in a distributed Multi-access Edge Computing (MEC) architecture requires a continuous demand-supply balance across various tiers. Compute, Storage and Network resources need to be allocated at various tiers of the distributed cloud for optimal performance at every point in the aggregate demand curve. As demand dynamically changes, a continuous rebalance of resources is needed to maintain customer experience within desired threshold and defined cost & resource boundaries. Rebalance needs to be orchestrated and controlled by dynamic demand learnt by the analytical framework and predicted ahead of time, to account for provisioning delays and to deliver service mix desired by the customers. Telco clouds inherently will have multiple vendors with different software and hardware systems, management tools, disparate databases of performance data and complex OSS/BSS applications and interfaces governing the service delivery lifecycle. Predicting the right balance of resources to meet dynamic demand at any given point of time is an enormous challenge with direct implications to subscriber churn and profitability.

While traffic and content demand patterns continue to evolve and are prone to rapid changes, mobile networks are faced with a continuous stream of events, performance data, alarms, logs that require increasing amount of attention from network operations teams. Network operation teams are further challenged by multiple network management systems across their legacy and next-gen vendor map.

1. [Moor Insights and Strategy](#)
2. [ABI Research: Artificial Intelligence in Telecom Networks](#)

Many tools are being implemented to improve the signal-to-noise ratio of this stream of network events. However, the workload of network operations teams continue to increase to intervene either manually or by activating scripted solutions to take corrective actions.

Connecting the power of AI and Machine Learning (AI/ML) solutions to unlock the automation and efficiency benefits today require tremendous, and often open-ended, investments in data science teams. To understand the network data and train algorithms to predict future outcomes, data science teams employ a variety of open-source and proprietary algorithms. However, the lack of explanation behind such “black box” predictions prevents understanding of data and logic (the “why”) of the predictions thereby inhibiting adoption of AI/ML solutions in network operations. Albeado’s XNML based AI/ML solution can play a pivotal role in solving such issues by inferring and learning from the interconnected contexts of events and historical data by calculating their influence and weightages in driving the demand variance, resource orchestration and network performance. Our solutions can help network engineering and operations teams by providing the needed analysis rationale and explanation to increase understanding of prediction logic and build their trust to accelerate AI/ML adoption.

To address these challenges faced by MNOs and vendors, European Telecommunication Standards Institute (ETSI) has recently released a [report](#) that provides guidance on use cases that AI/ML technology can help with automating complex human-dependent decision-making processes and meeting service level agreements (SLA) in the changing context of new services. Albeado’s PRISM™ solutions can address many of these ETSI use cases and the following sections describe how PRISM™ can help enterprises achieve the efficiency benefits.

TECHNOLOGY OVERVIEW

PRISM™ AI/ML system analyzes data from disparate sources - both within the network and from external sources - to infer the interconnected contexts in which the observed data was generated as a multi-partite network of interacting elements (also known as *Interactome™*). Albeado’s XNML algorithms apply combined analysis of topological features and network metrics along with attribute vectors to infer hidden connections and their importance to compute total influences of connected events, elements and observed data. XNML’s signature boost in accuracy with explainability is achieved by reasoning about influence of direct & indirect interactions among elements which are few “hops” away and uncovering hidden associations and grouping from the inferred contextual interactome.

Recognizing that most Telco network events are driven by customer demand and issues, that are influenced by the complex interaction of events and actions, PRISM’s philosophy begins with the understanding that network data emanates from these interactions between events and actions from network of networks (akin to system of systems) representing the physical networks as well as business information connectivity. Data (e.g. MME Session Logs) is generated from interactions and activities in multiple interconnected domains (e.g. Transport and EPC) within the networks from IMS, EPC & Transport layers of the physical network and the NFVi stack delivering various virtual network functions. Additionally, external factors such as transit commuter data, sports or social events, weather events or disasters, macro and micro seasonality play a role in customer demanding specific services and experiences from Mobile networks.

By augmenting internal and external data sets with network and attribute features of the multi-partite computational multi graph (*Interactome*), PRISM™ combines AI/ML reasoning and learning over the network features and elements of attribute vector space at the vertices and edges of the graph which are interconnected via a complex setting of graph structures and topological properties.

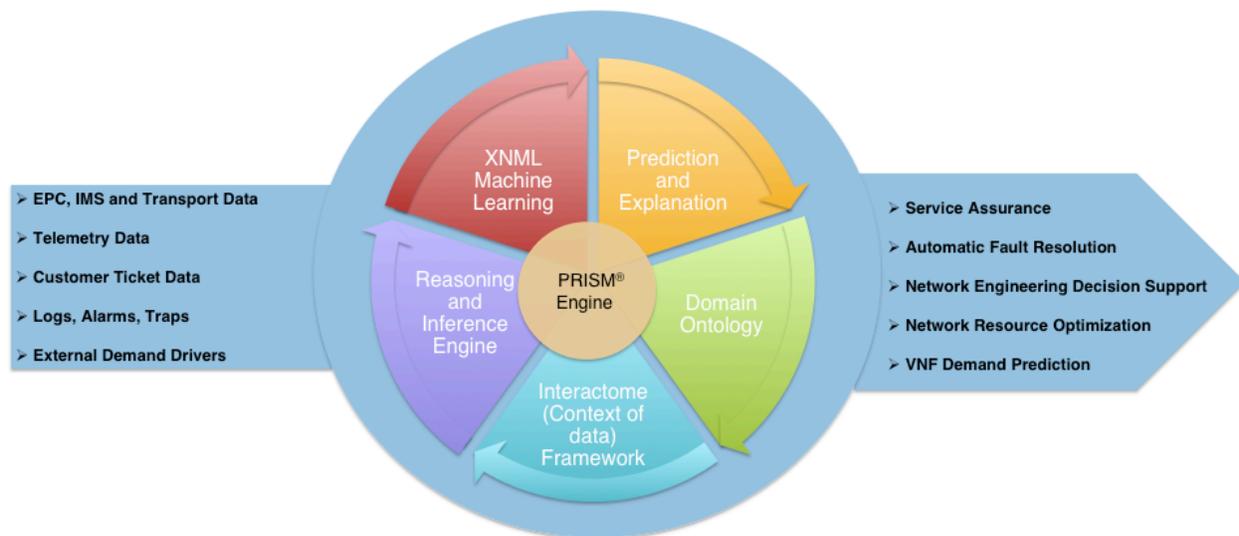


Fig 1. PRISM™ modeling and prediction

Hidden predictors from an interactome are calculated from multimodal feature analysis using an ensemble of analytical, modeling and reasoning techniques. PRISM™ generates predictive features in multiple stages using proprietary XNML based unsupervised and supervised machine-learning techniques to achieve high accuracy with explainability for analysis and predictions. Fig. 1 gives an overview of the core functional modules making up PRISM™.

PRISM TELCO CLOUD SOLUTION

PRISM™ Telco cloud solutions can offer among other functions, Service Assurance capabilities such as Automatic Fault Resolution and Proactive Maintenance. Additionally they can offer various Network Resource Optimization capabilities that are integrated in your Network Operations systems and workflows. PRISM™ XNML algorithms will analyze logs, alarms, network events, configurations etc. from your network in addition to data sets from external sources to both boost the accuracy of predictions. PRISM™ then will find explanations behind the predictions to establish the trust that is currently not delivered by “black box” AI/ML solutions. Fig. 2 gives an overview of the complexities of Telco cloud KPIs across multi-layer networks and how XNML can process the DACE output data to infer the network contexts and deliver the learning and predictions.

Service Assurance of Telco clouds is critical to the overall customer experience and is a strategic differentiator for MNOs. Automatic Fault Resolution can correlate network faults with symptoms learnt from the performance data, alarms, logs and other telemetry data, infer the issues from such learnt symptoms and connect them to documented method of procedures (MOP) that can be activated automatically by SDN controllers and automation orchestration engines to reduce mean time to resolve (MTTR). For example, suboptimal network configurations frequently lead to service disruption or degradation. PRISM™ XNML™ based automatic fault analysis can pin-point, from all the runtime KPI and historical data in the context of operations knowledge base, how to activate automatic or engineer mediated automation scripts.

Network Resource Optimization is a significant differentiator to deliver service quality and profitability to MNOs. VNF Demand Prediction tackles NFVi resource optimization challenges by predicting VNF resource

consumption in advance of significant demand changes and volatility and recommends how to optimally scale-up and scale-out your multi-vendor VNFs across the MEC.

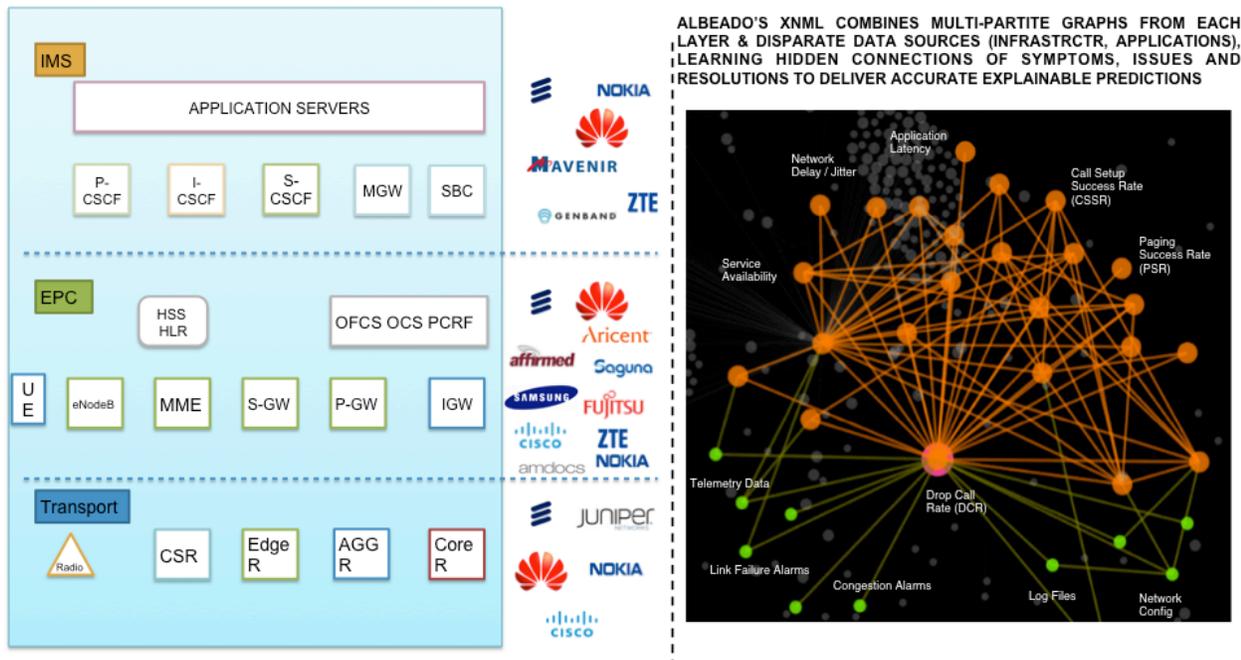


Fig 2. Multi-vendor Telco Cloud XNML Network

Customer experience (CX) KPIs are learnt over XNML features and historical network, application and virtual infrastructure configurations and behavior patterns to identify actionable pathways to improve CX. For example, adding more VMs to deliver VoLTE to services that serve certain geographies based on specific customer mobility predictions and QoS predictions for Drop Call Rate (DCR) and other CX KPIs. Additionally, external data sources such as commuter movement, weather, major sports, social and even natural disaster events may be used, along with historic demand data to boost prediction accuracy. MNOs compete with OTT applications such as Skype and FaceTime with their VoLTE services by providing Telco-grade services with end-to-end management of QoS across IMS, EPC and Transport layers of the network. PRISM™ VNF Demand Prediction application can provide tremendous insights and predictive inputs to compete effectively OTT players.

Network Engineering Decision Support offers network design teams assistance in network capacity expansion, spectrum efficiency planning and network-slicing resource allocation projects. PRISM™ AI system can provide decision support based on machine learning insights and network behavior models that impact key design parameters across all layers of the Telco cloud and the underlying Transport network.

PRISM™ Telco Cloud Solutions will be fine-tuned to your specific network implementation to offer the best in class Artificial Intelligence & Machine Learning capabilities to your Network Engineering and Operation teams.

Please contact us at info@albeado.com for more information.

About Albeado

Albeado builds cool AI/ML solutions for Enterprise Data Centers, Mobile Network Operators and Manufacturing applications. Our foundational AI/ML inventions and Data Science work have been awarded numerous competitive grants and innovation research awards.

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