TATA CONSULTANCY SERVICES

Building on belief

Journey to the 'Concept of Zero': AI and ML-Driven Programmable Network Operations

Abstract

With advancements in technology, networks are becoming increasingly complex and diverse. The growing endorsement of network abstraction technologies such as software defined network (SDN), software-defined wide area network (SD-WAN) and network functions virtualization (NFV) offers a challenge to both understand as well as effectively manage the network stack.

The ‘concept of zero' approach is a growing trend among telcos, implying zero human-led latency, zero vendor lock-in, zero limitation on the capacity, and zero defects. It aims to develop a software-based network by leveraging SDN technologies that deliver centralized control, programmability, virtualization and a high level of automation combined with artificial intelligence (AI) and machine learning (ML). These are the guiding principles behind the ‘concept of zero'. Leveraging AI-ML, telcos can process and analyze huge volumes of data to extract actionable insights that help enhance customer experience, improve ease of operations of complex networks, and increase revenue through new products and services.

Network evolution for new end-user services

The introduction of new network technologies like 5G will give rise to data-centric networks with edge computing capabilities, which will in turn drive new end-user services. End to end softwarization will transform legacy networks into programmable autonomous networks, backed by AI-ML based operations.

Autonomous networks enable telcos to provide network-as-a-service. This approach ensures high degree of flexibility, reconfiguration and enhanced functionalities through software updation, resulting in improved end-user experience and reduced opex.

Cognitive network operations are crucial in tackling the complexity of managing virtualized networks across radio access networks (edge computing, virtual RAN, open RAN), core (cloud native, enterprise SD-WAN), transport (SDN), and next-gen OSS.

The big leap from automation to autonomous networking

Autonomous networks have been enabling digital transformation across organizations. An autonomous network represents a powerful paradigm shift that runs with minimal to no human intervention and can configure, monitor and maintain itself independently, leveraging a variety of new-age, disruptive technologies. Autonomous networks use artificial intelligence and cloud technologies to become self-provisioning, self-diagnosing and self-correcting.

However, there are several challenges that programmable networks face in transitioning from automated to autonomous networking. These include use cases for the networks that have been using new technologies such as multi-tenancy and network slicing. Today's networks add a level of complexity as they change dynamically, and the ability to maintain an accurate view of the state of the network in real time is a challenge. In addition, knowing how to manage changing topologies and assess how they impact management actions (i.e. effective actions) in autonomous networks is critical. As networks are expected to become more on-demand and therefore highly specialized in a given context, the operator may not necessarily benefit from a large amount of historic data as it may be too specific.

The challenge is in deploying cognitive network management and its orchestration across multiple heterogeneous networks, all of which have their own peculiarities and requirements in multi-vendor and multi-technology network landscapes. This includes radio and access networks, core and aggregation, edge networks, edge and computing clouds, and satellite networks.

Driving home the zero concept through AI-ML

AI and ML based operations can provide complete network programmability using a fully customizable, agile and programmable automation capability. It communicates through standard interfaces such as REST API. This approach supports geo-redundancy, hierarchical deployments and integration with multi-vendor programmable switches. It also supports deployment on containers and traditional virtual machines (VM). Programmable switches can be deployed on bare metal, cloud or original equipment manufacturer (OEM) devices.

The approach also enables end-to-end cross domain correlation to deliver autonomous decision making- complex decisions based on the detection of a large number of hidden or hierarchical influencers and self-healing zero touch operations.

The 'zero concept' approach targets the development of software-based network by leveraging SDN technologies that deliver centralized control, programmability, virtualization and an extreme level of automation combined with AI-ML concepts. These are the guiding principles behind the 'zero concept', an in-demand trend from telcos and other enterprises. Broadly, it means zero human-led latency, zero vendor lock-in, zero limitation on the capacity, and zero defects.

This journey toward the 'concept of zero' is aligned to the network infrastructure demand that needs to closely work with network functions virtualization infrastructure (NFVI) and NFV orchestrator (NFVO) integration requirements and the maturity in the SDN technology and its market adoption.

The 'concept of zero' approach has its origins in the traditional legacy networks, which involves the three stages of transformation – automated to adaptive to the final leg of the transformative journey, autonomous.

Figure 1: Stages in the Journey Toward the Concept of Zero

- Automated

  The ability of the network to adapt to changing business requirements depends on the extent of automation in operations and the implementation of network changes. Currently, telcos have dedicated teams to manually schedule the device back-up jobs, change policies on a multitude of devices, perform provisioning with command-line interfaces (CLIs), and spend hours in troubleshooting and restoration.

  The philosophy behind automation is to introduce a basic level of programmability, centralized control and virtualization. This is the first step toward transitioning to autonomous networks.

- Adaptive

  Beyond automation, enterprises are now able to re-think their network operations with advanced analytics to achieve their long-desired goal of being adaptive. For this, networks need to be aware of the applications, transactions, and alternatives available for resolution along with the required actions.

  Data center interconnect demands are changing rapidly with cloud computing, virtualization and growth in traffic. Utilization of the resources spread across various data centers can be drastically improved by pooling and sharing. Bandwidth-on-demand increases network agility, leading to building business responsive networks.

- Autonomous

  An autonomous network requires zero to minimal human intervention. It brings in intelligence from ‘closed-loop network telemetry’ and provides the business context. Artificial intelligence and machine learning techniques are employed in order to make the network self-driving and self-healing.

  SDN attributes (drive, differentiate, digitize, migrate and intelligent branch network cloud) are aligned to the network journey from traditional to automation to adaptive to autonomous, the end goal of which is the ‘concept of zero’. Adding to this transformation is technology maturity.

  As part of the 'concept of zero' transformation, service assurance is centered on collecting, correlating, and resolving events in an automated, predictable, machine-first approach to address the following aspects:

  - Maximize customer experience through proactive identification and resolution of issues
  - Minimize operational expenditure by maximizing automation
  - Strive toward unmanned/lights out NOC through big data analytics, machine learning and robotic process automation (RPA)
  - Minimize customer service expenses through automation-driven approach with proactive notifications
  - Enable insights across different types of monitoring information with single touch collection of all monitoring information (events, performance metrics, traffic information, customer behavior) through unified data ingestion platform
  - Leverage non-traditional inputs such as social media feeds, weather information and events such as sports

Navigating the future of telecom with AI

AI technologies have the potential to completely transform the telecom sector, the most distinct applications being the classification of traffic, anomaly detection and network optimization. In addition to these applications, AI helps in autonomous decision making, self-optimization, self-learning and self-healing.

With the growing endorsement of network abstraction technologies such as 5G, edge computing, SD-WAN and NFV, improved network visibility and effective network management can be achieved with AI-ML based programmable network operations. This will facilitate autonomous decision making toward future-proof and self-heal network operations.

Enhancing the telecom industry with AI could lead to various new revenue streams. The AI-ML based programmable network operations have the ability to address multi-vendor complexity to achieve end-to-end automation across domains. Not only will this improve customer experience with a single pane of view for the wireless, wireline and enterprise networks, but it will also allow for opex optimization.

About the authors

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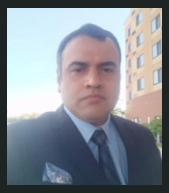

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