Intelligence in Action: AI-Driven Networks

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Introduction

Modern networks have evolved from static infrastructures into dynamic, intelligent, and adaptive systems. 5G and Beyond 5G networks need to handle large volumes of data, support a wide variety of applications, and ensure high reliability and low latency. However, increased data flow can degrade network performance, and usage spikes may compromise service quality.

To address these challenges, our work introduces a scalable and modular MLOps pipeline that integrates ML and automation directly into the 5G Core architecture. This approach enhances network optimization, improves decision-making, and ensures resilient performance even in high-demand conditions.

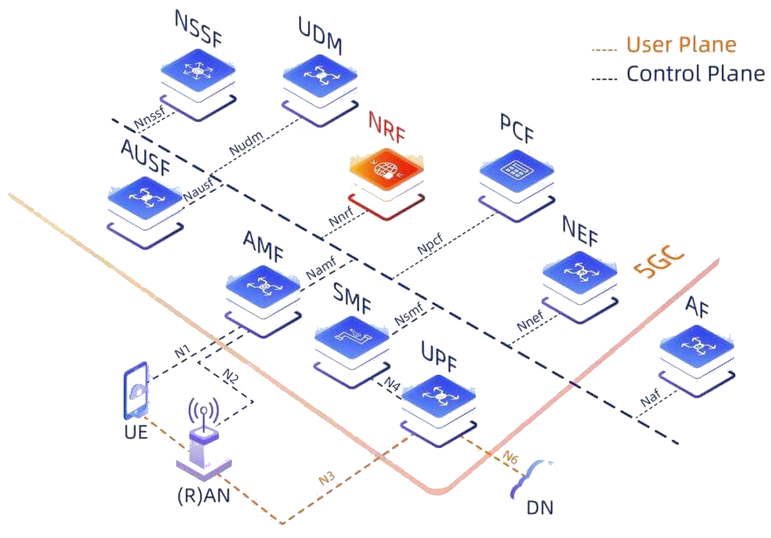

Fig 1 - 5G Core Network Functions

Objectives

- Collect and expose network data according to 5G standardized APIs;
- Extract useful network metrics and features from the data collected;
- Train and test various types of ML models while evaluating their performance;
- Dynamically choose and deploy the best model;
- Retrieve our model's inferences from live network data;

Implementation

5G core integration components:

- Data Receiver - receive 5G network data;
- Data relay - expose network metrics and model inferences;
- ML APIs - enable network operators to train models, monitor their behavior, and assess performance metrics.

Main MLOps pipeline components:

- Data Processor - processes data for ML Training;
- ML Training - dynamic training and testing of ML models with network data, and deployment;
- ML Inference - Deployed inferences on network data.

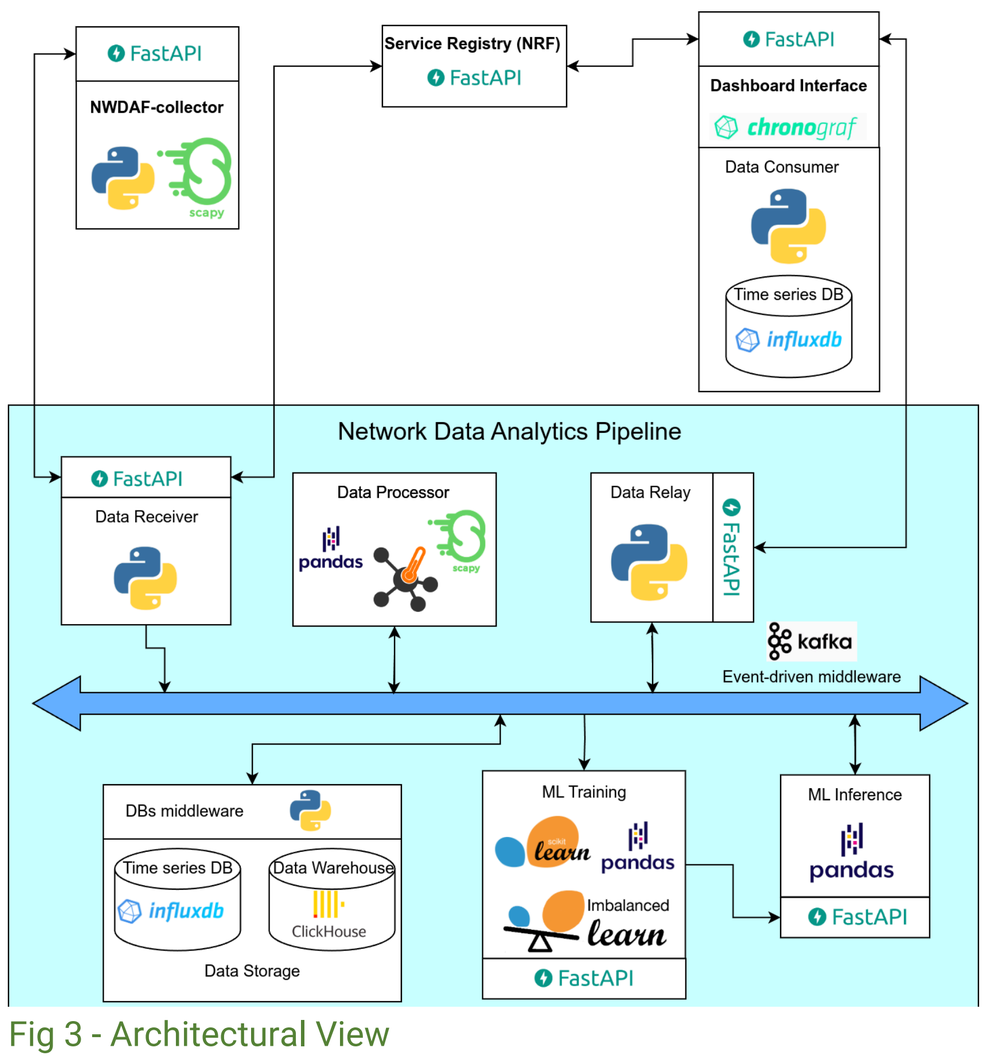

Fig 3 - Architectural View

Validation

To validate our solution, we developed a MLOps pipeline foccusing on attack detection, a critical function for maintaining optimal network performance and security.

When an attack is detected, our pipeline communicates with other Network Functions to ensure that the right measures are applied in order to guarantee consistent quality of service across all network.

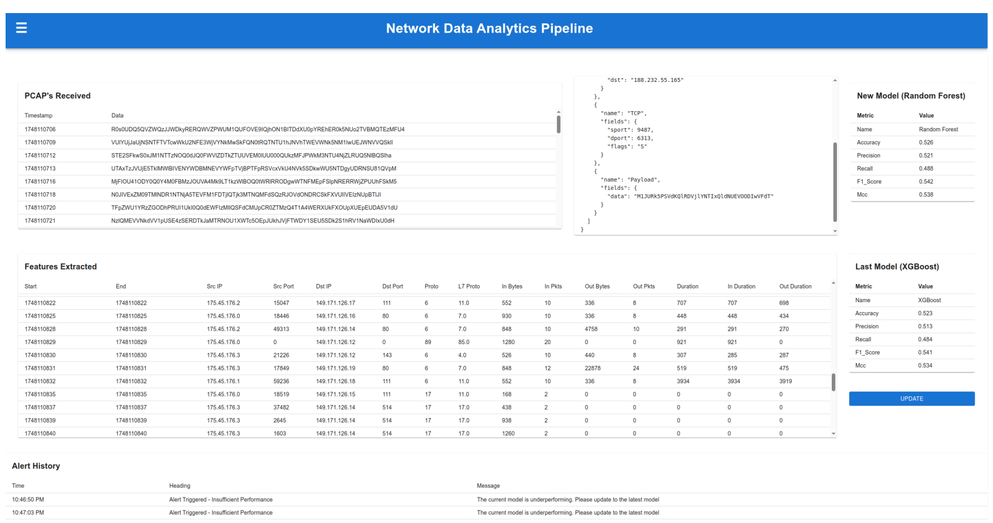

Fig 2 - Network Operator Dashboard

Attack	network_processed_data.count
Backdoor	3.00
Benign	124201.00
DoS	44.00
Exploits	476.00

Fig 4 - Inference Results on Network Data