Politecnico di Torino
Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering
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Integration of Machine Learning and Network Virtualization for the Orchestration of Distributed Edge Infrastructures

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1. Introduction

Recent advances in network virtualization, machine learning, and artificial intelligence have made data-driven techniques attractive to handle the increasing complexity and scale of today's network infrastructures, especially to automate network orchestration. In particular, valuable progress has been made on edge network management using learning techniques and even developing new ways of making the user interact with the network through intents – *i.e.*, Intent-Based Networks (IBN). Integrating these technologies would be a further added value for network automation, but it is still challenging in several ways, as data is not always available or obtainable, and even when it is, retraining machine learning models is slow and expensive.

2. Goals

This research aims to propose network management solutions using artificial intelligence and machine learning for inference and with limited cost and training opportunities to deploy a scalable and efficient network automation framework in combination with data-plane programming languages and intent-based networks (IBN).

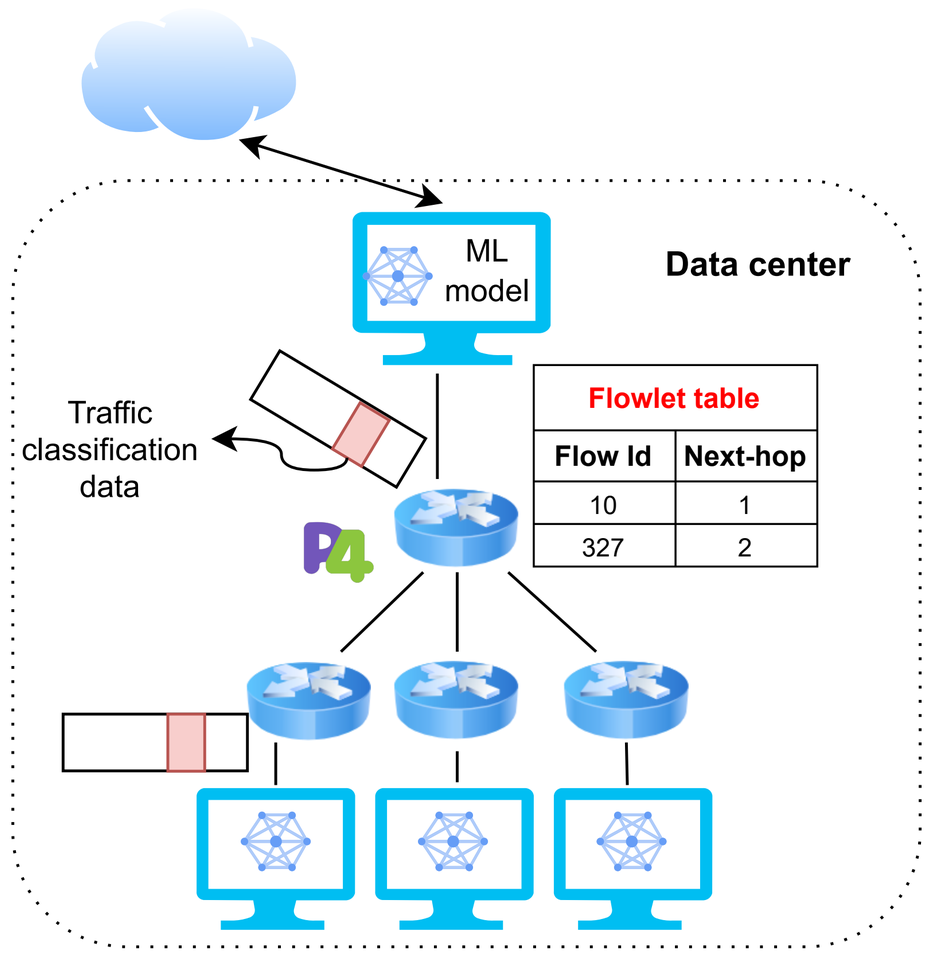
3. Methods

The research aim is achieved through:

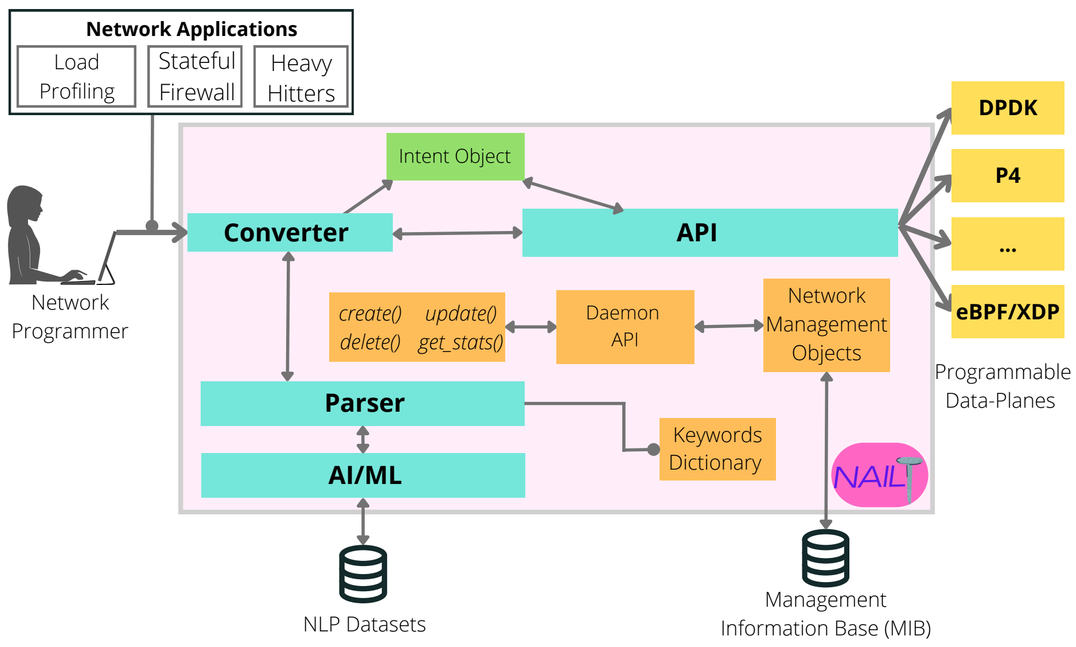
- Analyze and compare different ML methods to study the condition of the traffic on the network [1];
- Implement Software-Defined Networking (SDN) and Network Function Virtualization (NFV) approaches to manipulate the traffic according to the network status [2];
- Integrate decision logic directly on switches using data-plane programming languages, *i.e.,* P4 and OpenFlow;
- Allow even less-experienced users to customize the network using intents [3].

4. Results

- Deployment of a load profiler solution with host-switch cooperation, according to the network status and the sending packet's dimension.



- Implementation of a network management architecture that allows network programmers to customize their networks with the use of intents.



5. References

1. Angi, Antonino; Sacco, Alessio; Esposito, Flavio; Marchetto, Guido; Clemm, Alexander. "Howdah: Load Profiling via In-Band Flow Classification and P4" International Conference on Network and Service Management (CNSM) 2022
2. Angi, Antonino; Sacco, Alessio; Esposito, Flavio; Marchetto, Guido; Clemm, Alexander. "Load Profiling via In-Band Flow Classification and P4 With Howdah" IEEE TRANSACTIONS ON NETWORK AND SERVICE MANAGEMENT (TNSM) 2023
3. Angi, Antonino; Sacco, Alessio; Esposito, Flavio; Marchetto, Guido; Clemm, Alexander. "NAIL: A Network Management Architecture for Deploying Intent into Programmable Switches" submitted (minor revision) to IEEE Communication Magazine (ComMag) 2023