Part 4: State of the Art and Beyond

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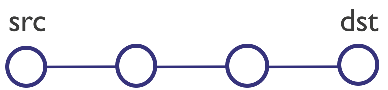
GNNs for wired networks

Predicting delay of large networks



$$delay_{path} = \sum delay_{link}$$

Predicting network performance using GNNs: generalization to larger unseen networks

Publisher: IEEE Cite This PDF

Miquel Farreras ; Paola Soto ; Miguel Camelo ; Lluís Fàbrega ; Pere Vilà **All Authors**

Abstract:
Autonomous Fifth Generation (5G) and Beyond 5G (B5G) networks require modelling tools to predict the impact on the performance when new configurations and features are applied in the network. Modeling modern networks through traditional mathematical analysis can lead to low accuracy, while the execution time and resource usage are high in network simulators. Machine Learning (ML) algorithms, and specifically Graph Neural Networks (GNNs), are suggested as a promising alternative since they can capture complex relationships from graph-like data, predicting properties with high accuracy and low resource requirements. However, they cannot generalize to larger networks, as their prediction accuracy decreases when input data (e.g., network topologies) is significantly different (e.g., larger) than the training data. This paper addresses the GNNs scalability issue by following a step-by-step approach, exploiting networking concepts to improve a baseline model. This work is framed in the 2021 International Telecommunication Union (ITU) and Barcelona Neural Networking Center - Universitat Politècnica de Catalunya (BNN-UPC) challenge. Results show that by following the suggested steps, applied on the RouteNet baseline developed by the BNN-UPC, can lower the Mean Average Percentage Error (MAPE) from 187.28% to 1.838%, improving the generalization significantly over larger graphs. Our approach is more simple than other solutions that participated in the challenge, but obtained similar results.

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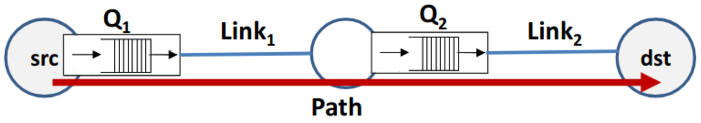

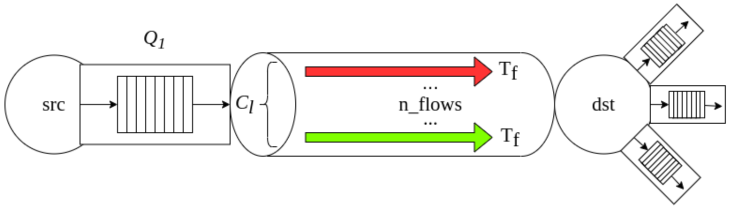

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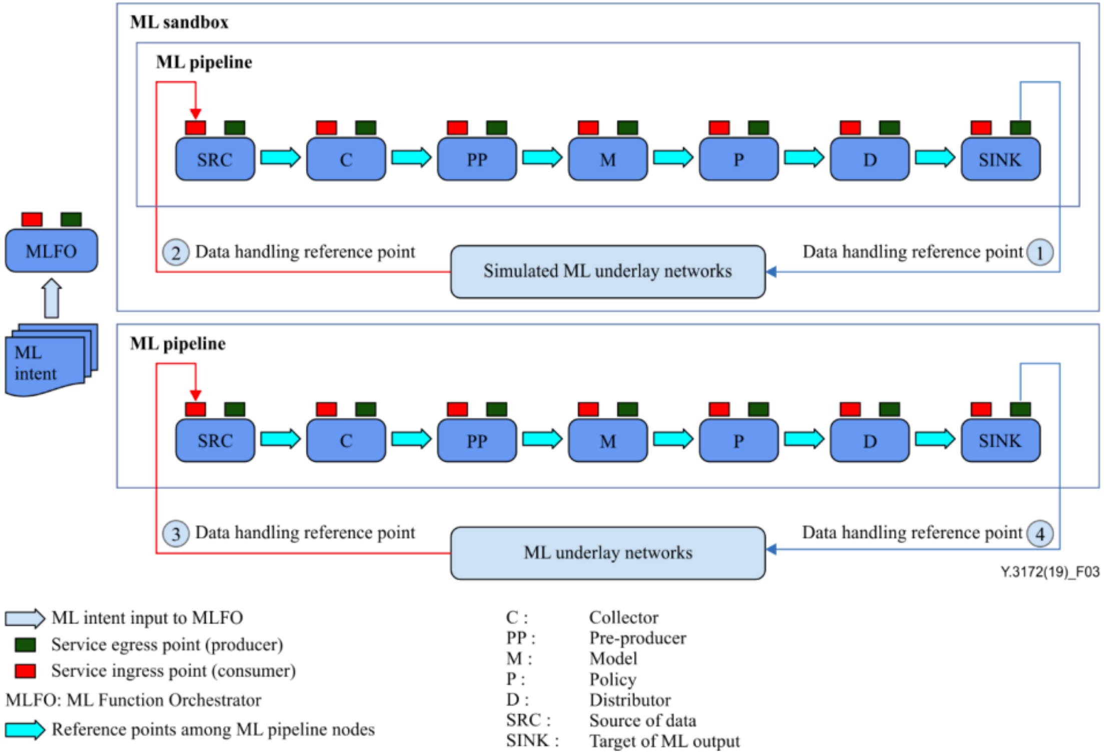
Standarization efforts

ITU

- Unified architecture that aims at the integration of ML in 5G and beyond networks.
- Given enough accuracy, NDTs can serve as ML sandbox.



Source: ITU-T Rec. Y.3172, "Architectural framework for machine learning in future networks including IMT-2020," 2019.

Standarization efforts
3GPP

- 3GPP contemplates the Network Data Analytics Function (NWDAF).
- This function delivers real-time analytics to support the decisions of the OAM system or other NF.

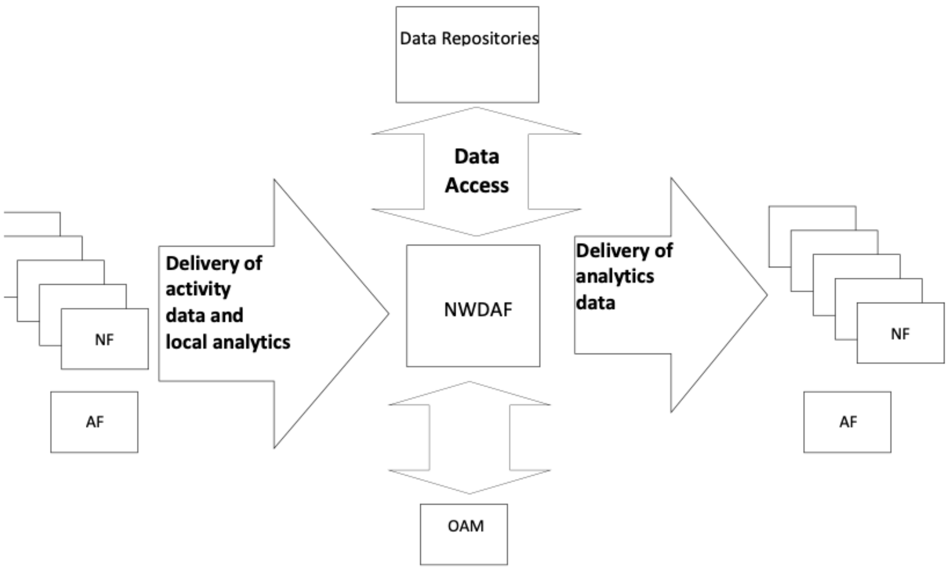


Figure 4.2-1: general framework for 5G network automation

Source: 3GPP TR 23.791 V16.2.0 (2019-06), "Study of Enablers for Network Automation for 5G," 2019.

Standarization efforts

ETSI

ENI

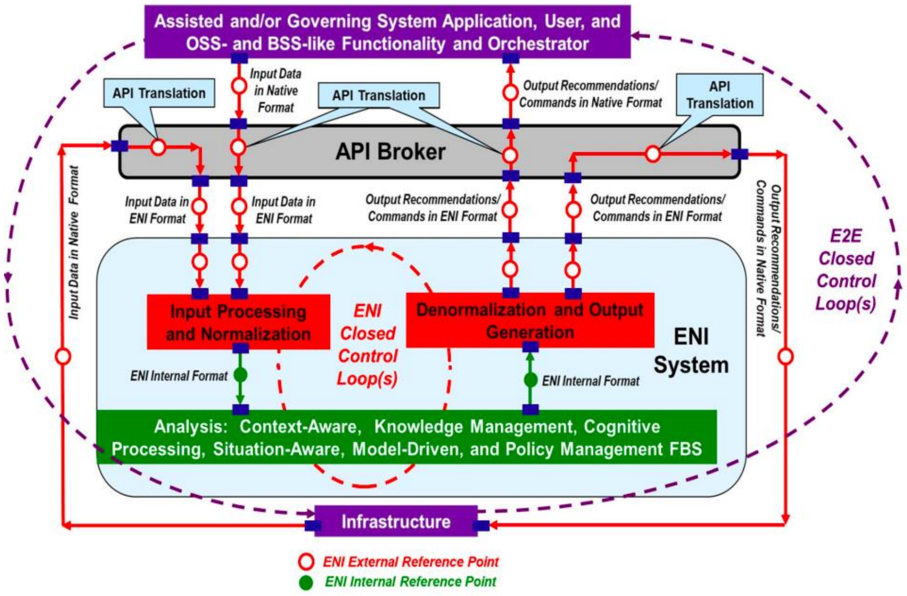


Figure 4-5: High-Level Functional Architecture of ENI When an API Broker Is Used

Source: https://www.etsi.org/deliver/etsi_gs/ENI/001_099/005/02.01.01_60/gs_ENI005v020101p.pdf

ZSM

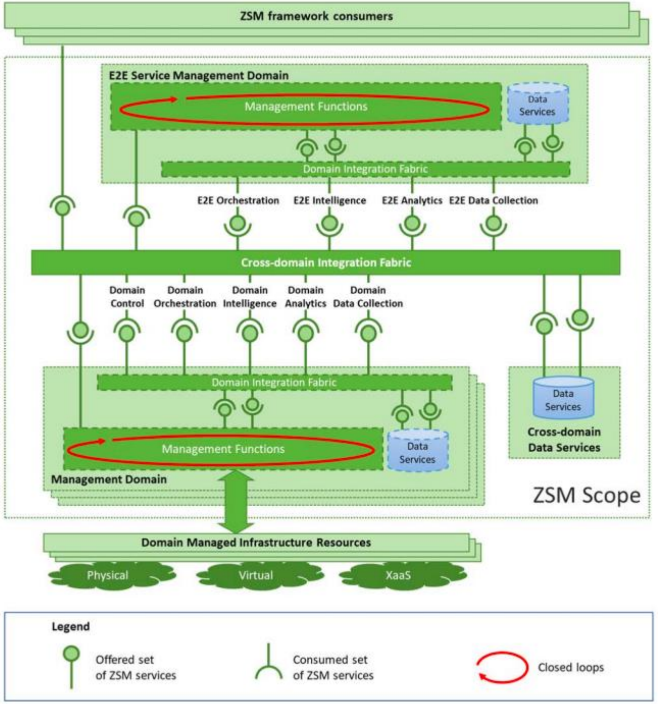
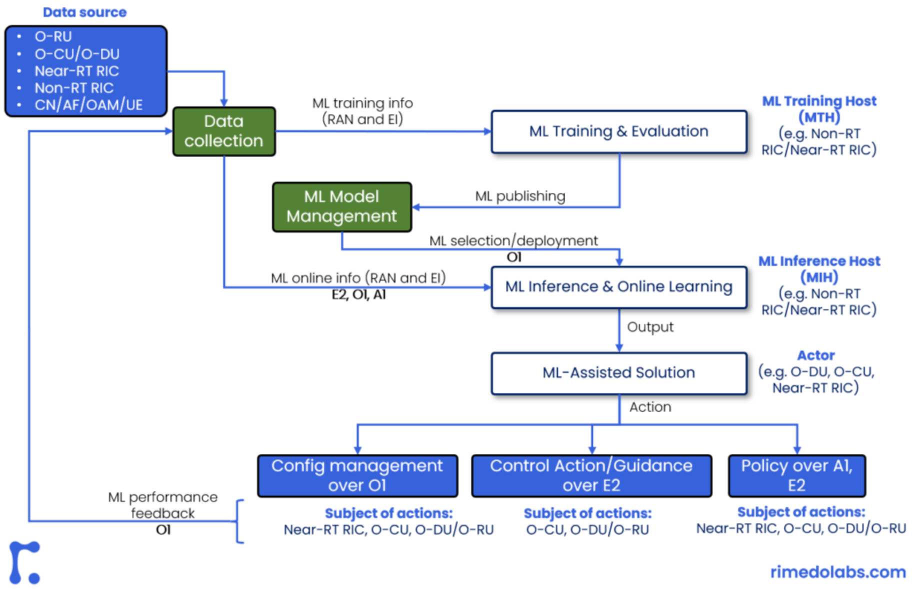
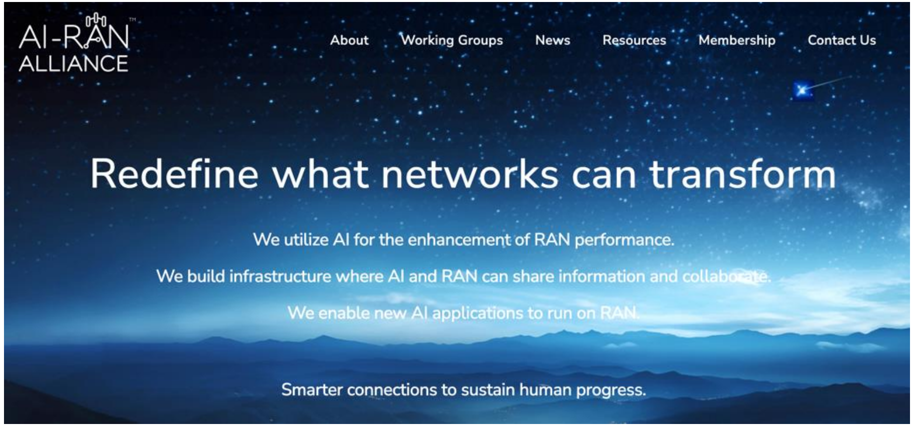


Figure 6.2-1: ZSM framework reference architecture

Source: https://www.etsi.org/deliver/etsi_gs/ZSM/001_099/002/01.01.01_60/gs_ZSM002v010101p.pdf

O-RAN and AI RAN Alliance

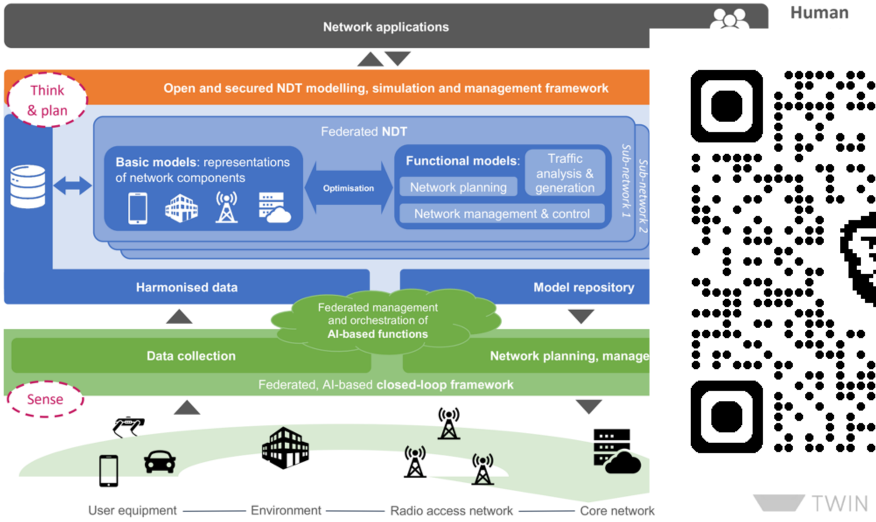


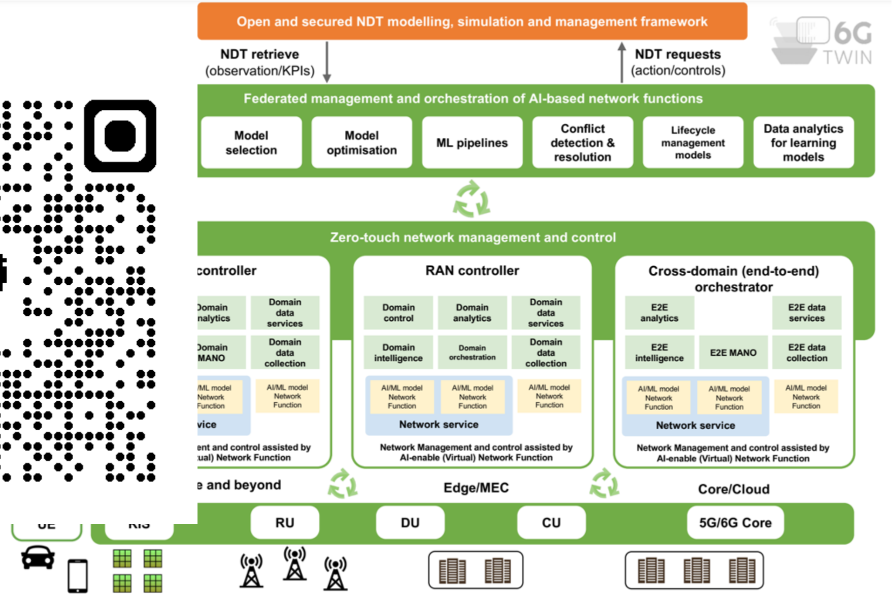


Source: https://rimedolabs.com/blog/ml-framework-in-o-ran/

Research

6G-TWIN and other related projects.





Questions?

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