

## MLOps and zero-touch predictive closed loops for network slice performance optimization

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The proposed demo is a joint effort from Nextworks and Orange Romania, which showcases a zero-touch network and service management solution, capable to deploy virtualized closed loop functions, integrated with an MLOps framework for training and deployment of ML models in support of prediction of network slice performance degradation. The demo targets the AI-enabled and automated operation of vertical services and network slices through zero-touch closed loops, with deployment of services for regular Internet access (eMBB) and prioritized traffic (URLLC). The goal is to validate the zero-touch deployment of virtualized closed loop functions, integrated with an MLOps framework for training and deployment of ML models in support of ML-enabled analytics for prediction of network slice performance degradation (ANFIS model), and ML-enabled decision for network slice congestion identification (random forest classifier). The proposed demo integrates smart network and services solutions developed in the Horizon Europe SNS project ADROIT6G (<https://adroit6g.eu/>).

The demo setup, shown in the figure, is deployed in the Orange Romania 5G Lab in Bucharest, which implements a full 5G Standalone (SA) infrastructure, comprising 5G RAN and 5G Core aligned with 3GPP Rel.16, integrated with Edge Computing capabilities and advanced SDN and IPFABRIC elements in the associated Datacentre. The testbed is equipped with network and services monitoring capabilities, through functions for data collection of a variety of metrics, benefitting by different open software tools used for monitoring (Prometheus and Grafana) and data presenting through dashboards.

The scenario includes two vertical services to be operated with full automation through AI/ML services. First, a regular eMBB service for internet access automatically deployed through a network and service management stack, with best effort network slice profile and no closed loops associated (i.e., no possibility to automatically optimize or adapt the service and slice). Second, a priority service for object detection at the edge is automatically provisioned through the ADROIT6G M&O, with a URLLC network slice profile (with QoS guarantees in terms of bandwidth and latency), a containerized object detection kubernetes application automatically deployed, and an AI-enabled closed loop (with four virtualized functions for monitoring, analysis, decision and execution) integrated with the Orange Romania testbed monitoring system, two ML models automatically trained and deployed through an MLOps framework. At runtime, in case of network congestion, the regular eMBB service performance is going to be degraded as no closed loop is available, while the priority service is automatically reconfigured by the AI-enabled closed loop through a network load prediction process.

In terms of software components, several building blocks are integrated in the Orange Romania testbed. For what concerns the network and service management framework (upper part of the figure), the service orchestration and closed-loop governance components from Nextworks are deployed and integrated in the testbed, together with a resource orchestrator for the automated deployment of applications into the Orange Romania 5G Lab virtualized infrastructure. The monitoring platform collects the required network slice metrics from the Orange Romania monitoring system to make it available to the closed loop functions. For the MLOps framework, an AI/ML pipeline manager leveraging on the Prefect tool is overarched by a custom orchestrator, and it is integrated with an AI/ML catalogue based on MLFlow and an ML model storage based on minIO.

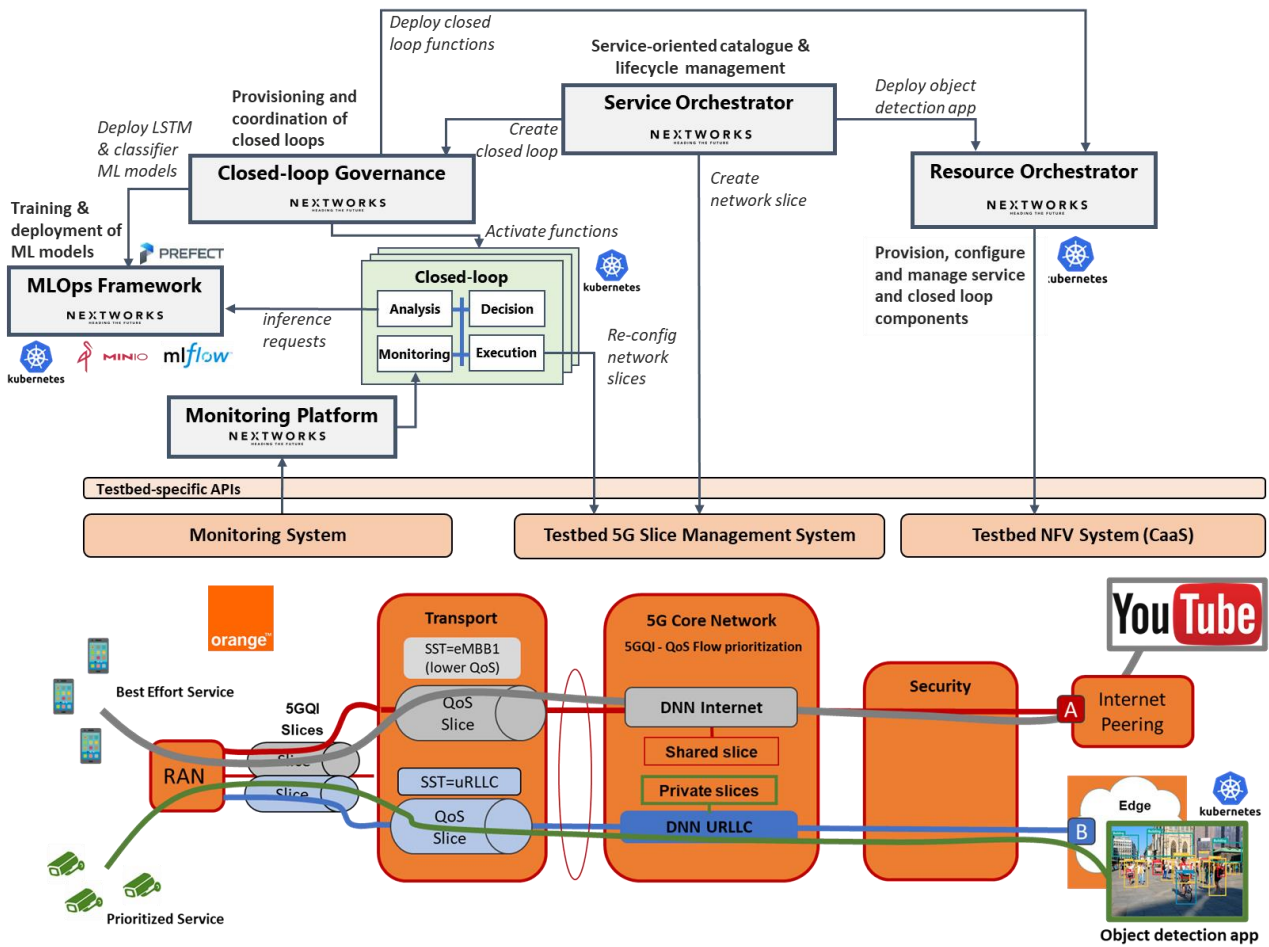


Figure: Demo setup and scenario.