Autonomous Network Slice Management for 5G Vertical Services

POC#9

PoC in a nutshell

- **Ambition**
  - Empower the creation of 5G Vertical Service with ENI principles
  - Apply AI/ML to Vertical Service Management and Network Slice Management functions

- **Technical goals**
  - Identify characteristics and profiles of 5G network slices in an automatic manner to meet the requirements of vertical services
    - **Exp. impact/outcome: Intent based interface**
  - Manage composition, sharing and actions for automated lifecycle of 5G network slices through AI/ML
    - **Exp. impact/outcome: ENI procedures and interfaces**

Members

Role	Organization	R&D track of origin for PoC		
		5G EVE	5GROWTH	5G-TOURS
Operator	TIM	✓	✓	✓
Manufacturer	WINGS ICT SOLUTIONS	✓		✓
Manufacturer	SAMSUNG			✓
Other	uc3m | Universidad Carlos III de Madrid	✓	✓	✓
Other	NEXTWORKS ENGINEERING FORWARD	✓	✓	

PoC Goals

DEFINED BY THE ENI FRAMEWORK

Detailed Goals

- **Use case #2-8: Automatic service and resource design framework for cloud services**
  - Extend the concepts of this use case from cloud services to 5G services, deployed across radio and transport, edge and cloud domains
  - Additional modeling items for descriptors:
    - network connectivity requirements in terms of virtual links capacity
    - QoS characteristics at the transport network level
    - service profiles expected at the radio access segment
  - Highly context-dependent:
    - action change depending on the network status

- **Use case #3-2: Intelligent network slice management**
  - Automation of the management of 5G network slices associated with multiple, concurrent Vertical Services
  - Meet service-level requirements, while optimizing the usage of the underlying 5G infrastructure, jointly considering access, core, edge, cloud resources
  - Design and implement algorithms that will be fed and assisted by the ENI system, based on short-term and long-term profiles

PoC Assessment

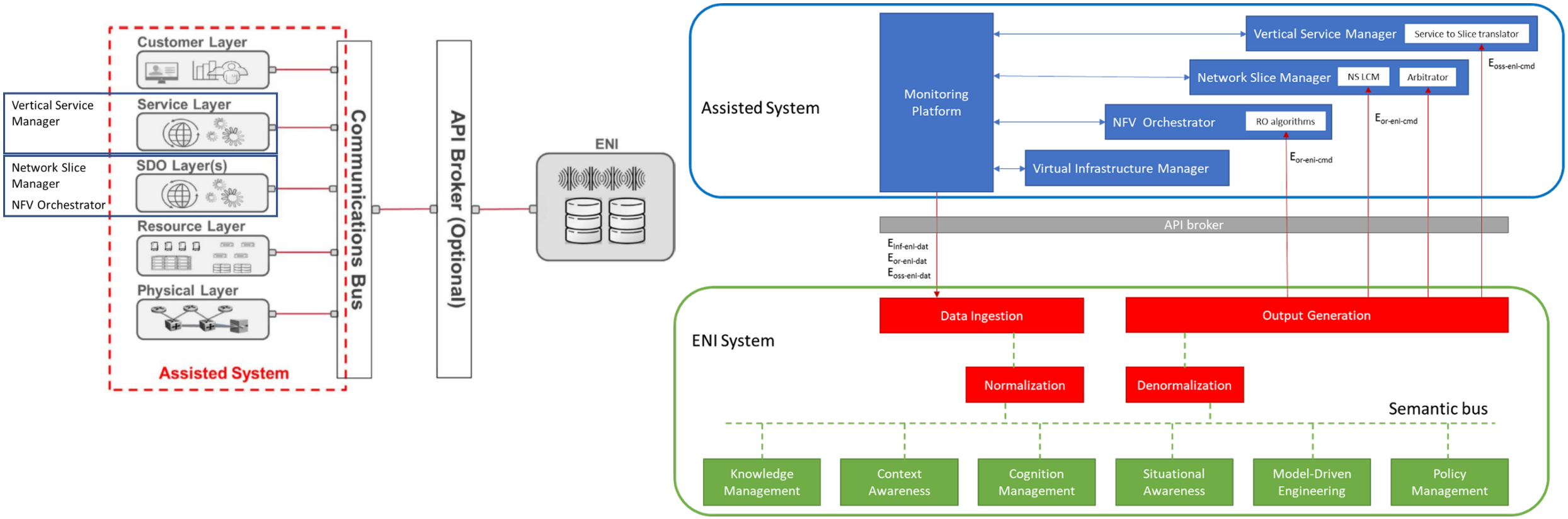
- Major functionalities of the ETSI ENI system to be validated:
  - **Ingestion and normalization** of multi-source, heterogeneous input data, related to service demands, service application performance, physical and virtual infrastructure utilization and NFV orchestration
  - **Processing of input data** to build a cross-domain knowledge about the trends of service demands, resource utilization, application and infrastructure performances and about how these elements are correlated
  - **Decision-making procedures**, generated through the Policy Management functional block
  - Assessment of the system through the **Performance Diagnostics** component which will be part of the Situational awareness module

PoC Technical Details

PoC Overview

- **Goal:** Design, develop and validate an ENI-assisted system for the intelligent management of network slices in support of vertical services operating over 5G network infrastructures
- **Software components**
  - A reference implementation of the ENI System, compliant with the architecture defined in ETSI GS ENI 005
    - ingestion and normalization of input data
    - knowledge management and processing
    - policy management
  - A multi-layer ENI-assisted system, implemented as an extended NFV MANO platform, for the management of vertical services and network slices in 5G network infrastructures.
- The offered services will use eMBB and URLLC network slice types

PoC Architecture



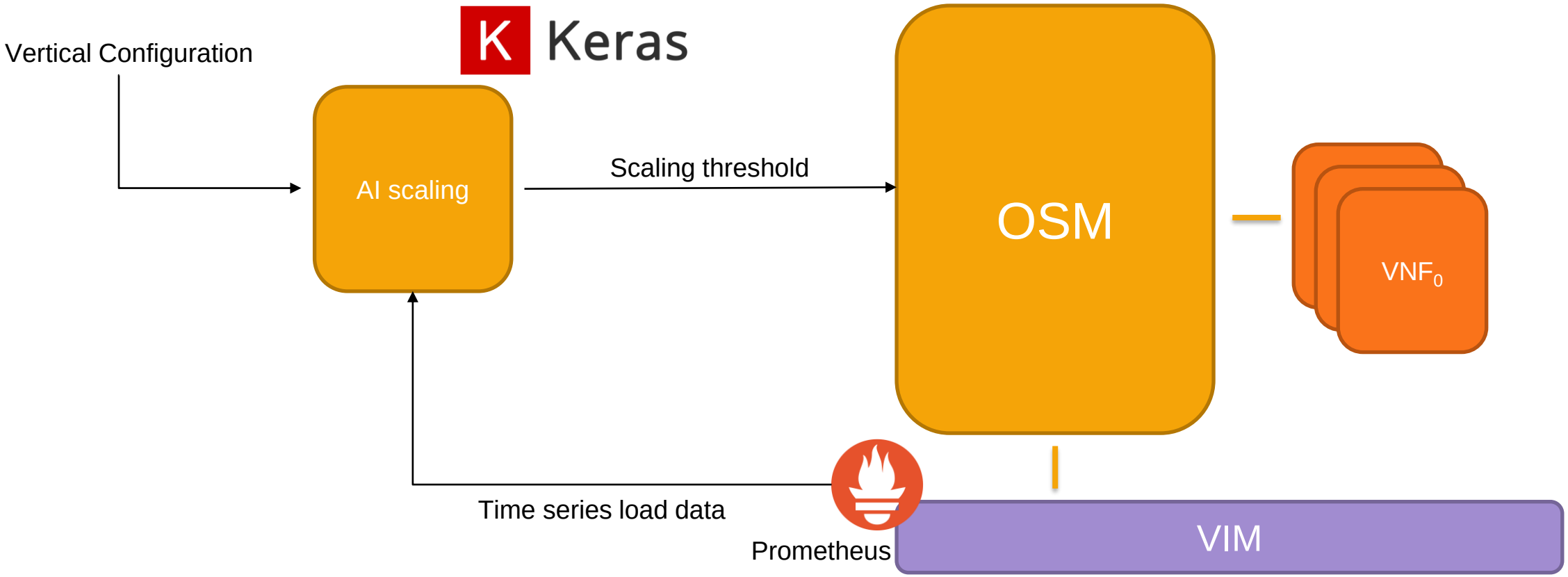
Validated through the usage of a vertical use case: enhanced visit to a Museum or itinerant orchestra

PoC Success Criteria

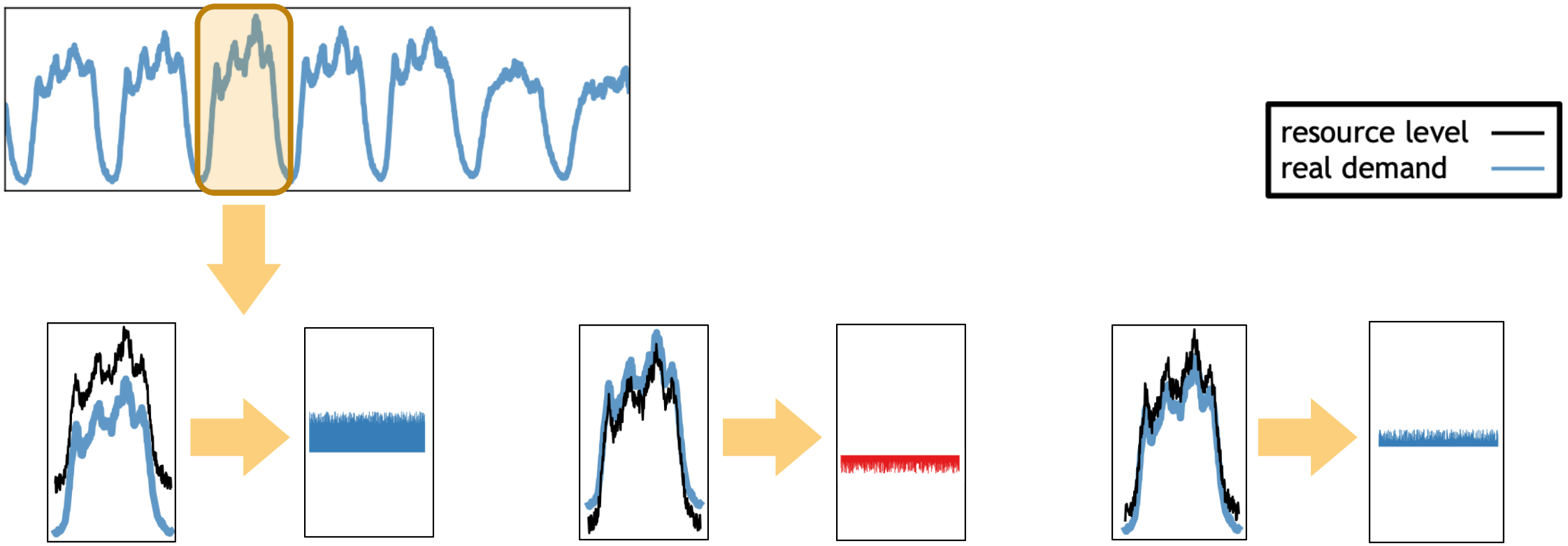
Goal to be verified	KPI	Stand-alone mode	ENI-assisted mode
Translation between intent-based Vertical Service definition and resource-based descriptor of the end-to-end 5G network slice	Service performance (see note 1)	Translation based on static rules preconfigured by the system administrator	Translation rules dynamically modified through policies injected by the ENI system, according to historical data about relationships between network slice characteristics and service performance
Enhanced strategies for sharing and composition of network slices.	Utilization of the 5G infrastructure. Total amount of resources used by the global set of network slices, for radio, transport, edge and core computing resources. Service performance (see note 1).	Static rules for network slice composition and sharing, applied at the provisioning time only and based on the current resource utilization and the currently active network slices.	Slice composition and sharing rules are dynamically modified through policies injected by the ENI system, according to short-term and long-term predictions for future service demands.
Automation of scaling and migration procedures for self-re-optimization of the global set of network slices.	Utilization of the 5G infrastructure. Total amount of resources used by the global set of network slices, for radio, transport, edge and core computing resources. Service performance (see note 1).	Feature not supported. Network slices are scaled manually or automatically, based on the real-time performance of single services following a threshold-based mechanism.	Suggested commands for network slice re-optimization are triggered from the ENI system, according to cross-layer and cross-domain monitoring data feeding a decisions process related to the entire set of network slices.
Note 1: Service performance will be measured through application-based KPIs, to be defined for each of the services adopted in the PoC.			

PoC Status

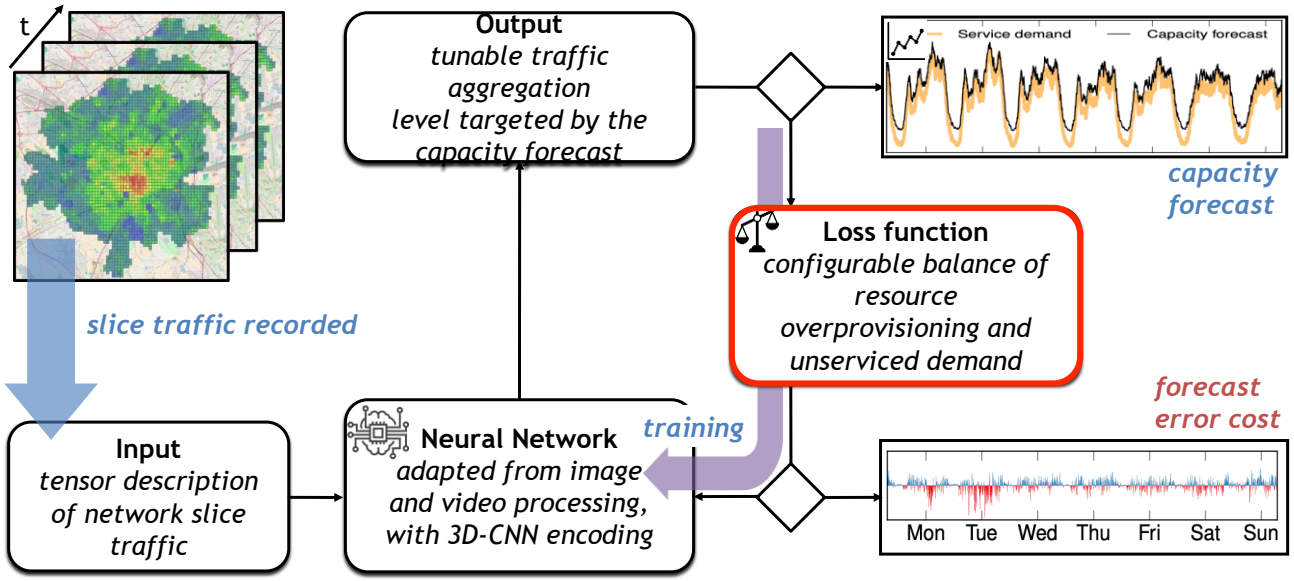
Implementation status



Proactive Resource orchestration



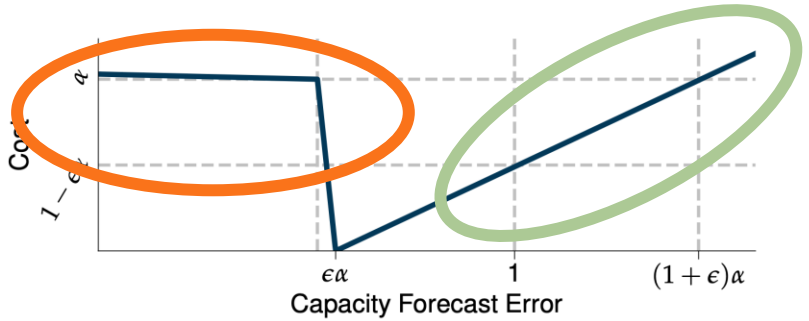
Cognitive vertical service management using deep learning



Configurable with user parameters

Fixed penalty for SLA

Proportional cost for overprovisioning

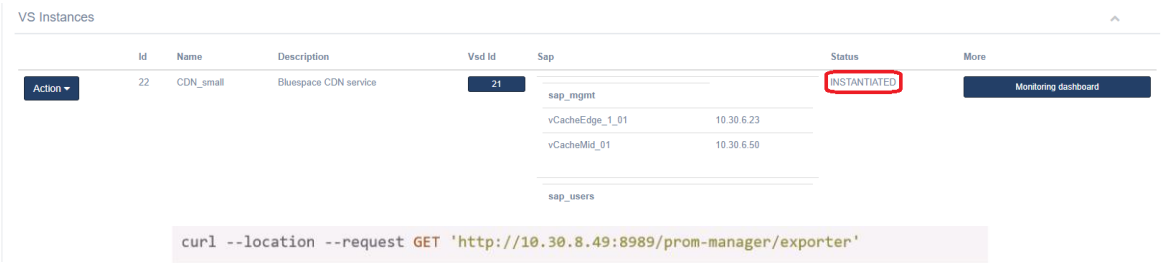


Implementation status

- Currently we are in the implementation pase
- Through an API interface we can onboard and gather a number of metrics from the onboarded VNF
- Currently we are using a CDN VNF, for getting training data

```
curl -b seb_cookie.txt --location --request POST \
'http://10.30.8.49:8082/vs/catalogue/vsdescriptor' \
--header 'Content-Type: application/json' \
--data-raw '{
    "vsd":{
        "name":"VSD_TEST_SMALL",
        "version":"0.2",
        "vsBlueprintId":"9",
        "sst":"EMBB",
        "managementType":"PROVIDER_MANAGED",
        "qosParameters":{
            "users":"50"
        }
    },
    "tenantId":"nextworks",
    "isPublic":true

}
```




```
curl --location --request GET 'http://10.30.8.49:8989/prom-manager/exporter'
```

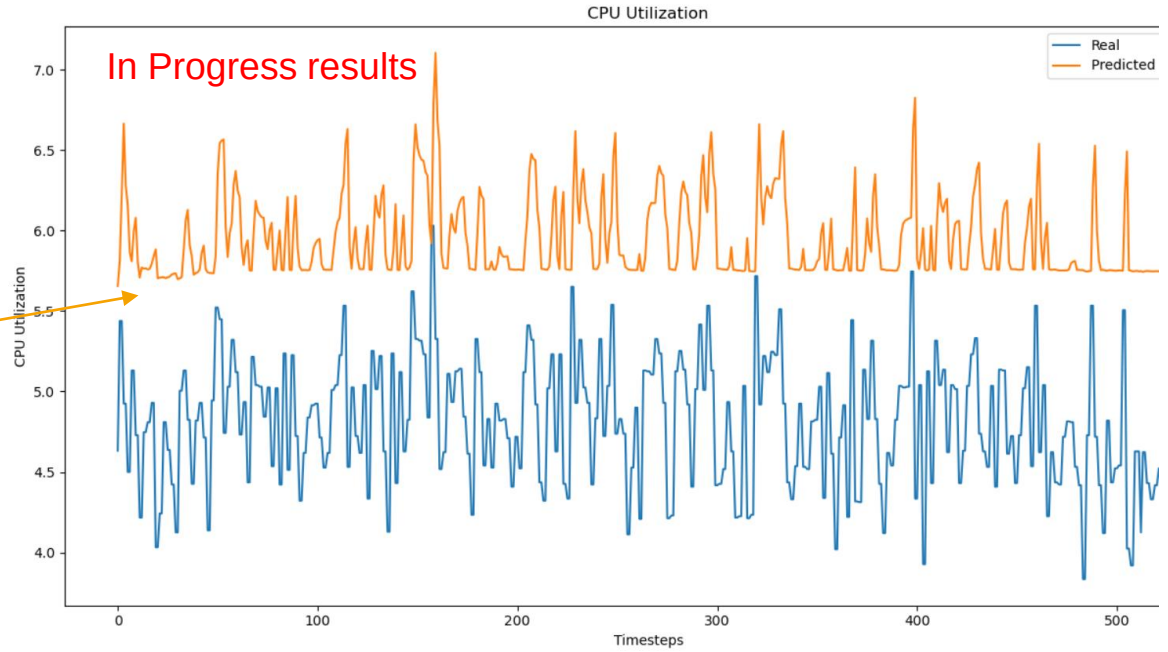
o

```
{
    "exporter": [
        {
            "exporterId": "307b934d-de55-4b87-bda1-6d755a14961e", #job id
            "name": "TELEGRAF_EXPORTER403_vCacheEdge_1_01",
            "endpoint": [
                {
                    "address": "10.30.6.44",                    #instance ip
                    "port": 9273
                }
            ],
            "collectionPeriod": 1,
            "nsId": "384",
            "vnfdId": "vCacheEdge_1_01"
        }
    ]
}
```

Load forecasting for VNF scaling

- We are performing fine tuning of the Deep Neural Network to provide the best forecasting

- Guard level configurable by the vertical



Questions?