AI for Networks :
Use case perspectives

Imen Grida Ben Yahia

Orange Labs Networks

Orange Expert Future networks

orange™

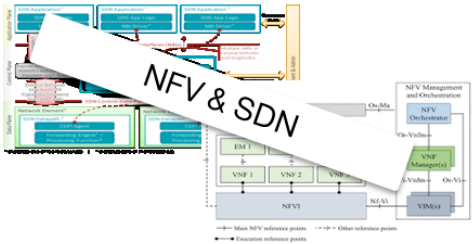
Outline

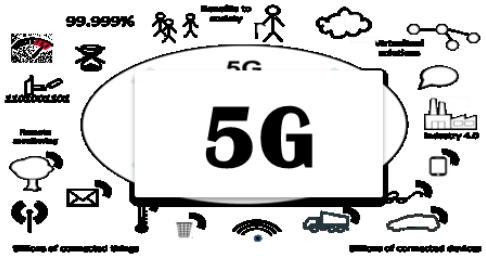
1. ML for Networks
2. ML for Networks in OLN-Orange Labs Networks
3. Use case perspectives in Network
4. Key messages

1 Machine Learning for Networks:
Not an infinite list of operations

SON; Self Organizing Networks
Autonomic Networking
Cognitive Networking

3G 4G





Data description	Deriving statistical characteristics of data
Data segmentation	Grouping of data into homogeneous clusters
Data association	Discovering interesting relations between variables
Data classification	Finding the function linking target categorical variables with input variables
Data regression	Finding the function linking target numerical variables with input variables
Data forecasting	Predicting the value of a target variable for the future
Variation detection	Determining possible drifts in data characteristics
Anomaly detection	Identifying items which do not conform to an expected pattern
Sequential optimi-zation of parameters	Controlling an interactive system or environment

Machine Learning for Networks
Different steps

What happened?	Why did it happen?	What will happen?	How can we make it happen?

Information → Actuations

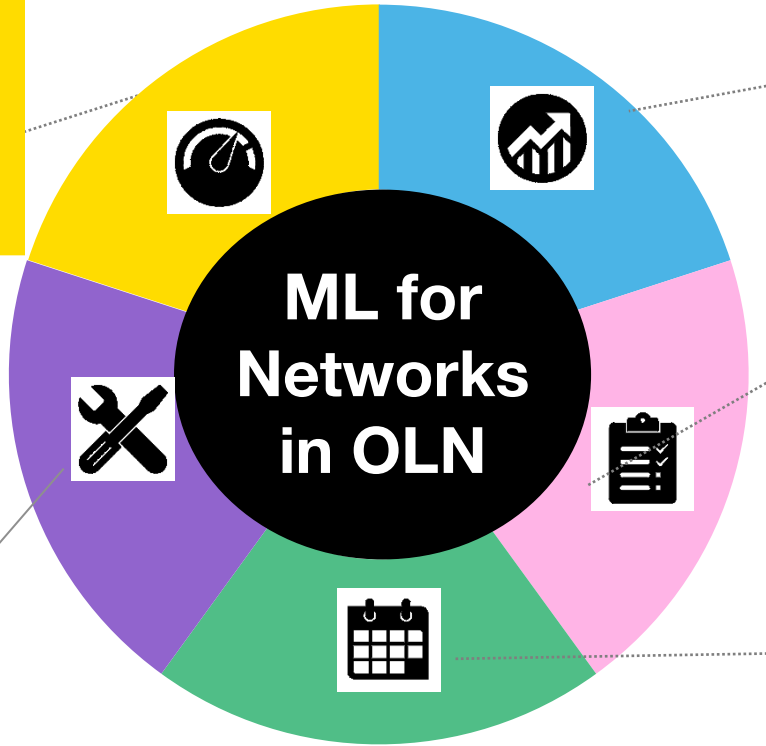
Observe	Understand	Predict	Learn/Act
Estimate the sensitivity of KPIs to parameters	Determine the most impacting parameters	forecast an event in the future	Automated decision support based on acquired knowledge
Analyze correlations between KPIs	Root cause analysis	Model a generalizable relationship between metrics	Online learning: Try (and may fail) to enhance future decisions
Characterize normal behavior ➔ Detect anomalies, trends, context shifts…			

2 Machine Learning in Orange Labs Networks (OLN)

Typology of activities

Variable scope of use cases : E2E, specific network segments covering both infrastructure and service levels

Resilience, Security, QoS and SLA, traffic processing, Incident Mgt. CDN Logs, OSS logs



Software Networks (SDN, NFV based and towards 5G) & Green

ONAP
OPEN NETWORK AUTOMATION PLATFORM
Acumos AI
3GPP
A GLOBAL INITIATIVE
ITU
tmforum

Dedicated Networks (RAN, FTTH, WIFI, etc). E.g; Diagnosis, SON, etc.

Optimisation techniques for ressources planning, allocation and network function placement etc.

2 Machine Learning in Networks

Typology of Data

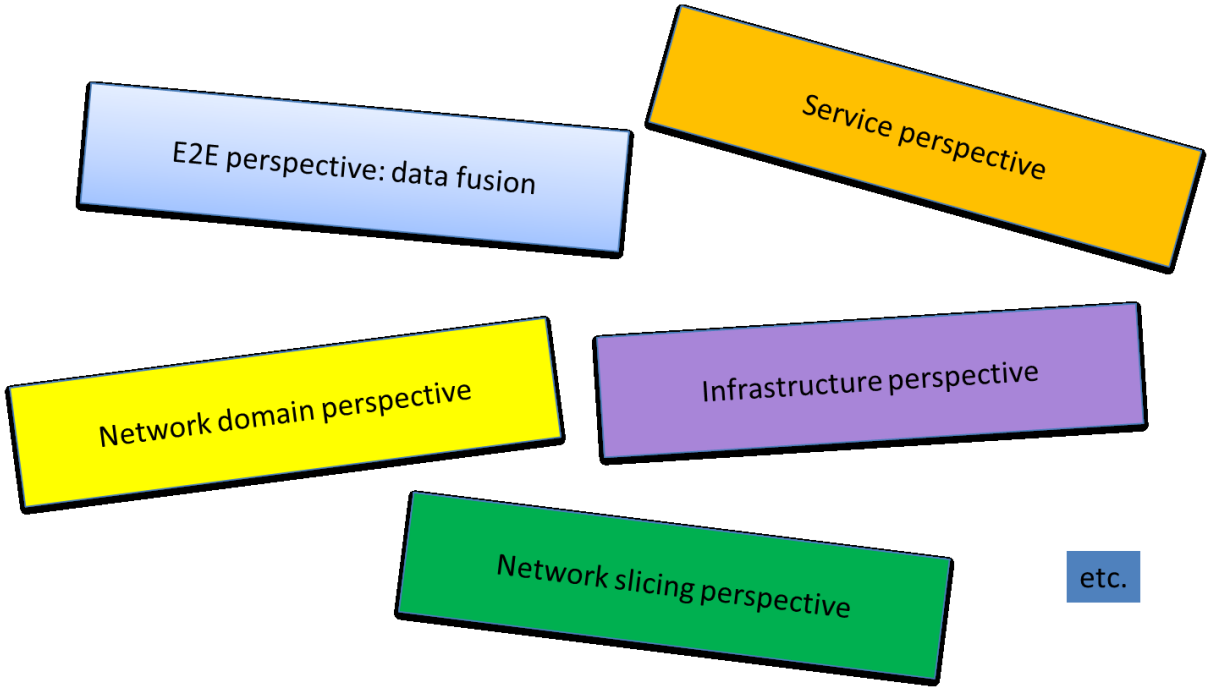
Various types & format

- Probes, Monitoring agents, Surveys, etc
- Data from RAN, Fixed access, Wi-Fi, Core Networks, Network topology, CDN logs, OSS logs, QoS/QoE metrics, Alarms, trouble tickets, etc.
- Service parameters, SLA, Network configuration files
- Social Networks, Weather Forecast
- VNFs: e.g. vIMS, vEPC,
  Slicing: data from PoCs on Smart Grid, eHealth, etc.

- Numerical Data
- Categorical Data
- Timeseries Data
- Text
- Code (config. Files)

3 Use case perspectives in Network

1. **Problem framing is even more important in Machine Learning for Networks**
2. **Usecases are generally covering or belonging to different perspectives**



3 Use case perspectives in Network

e2e perspective: data fusion

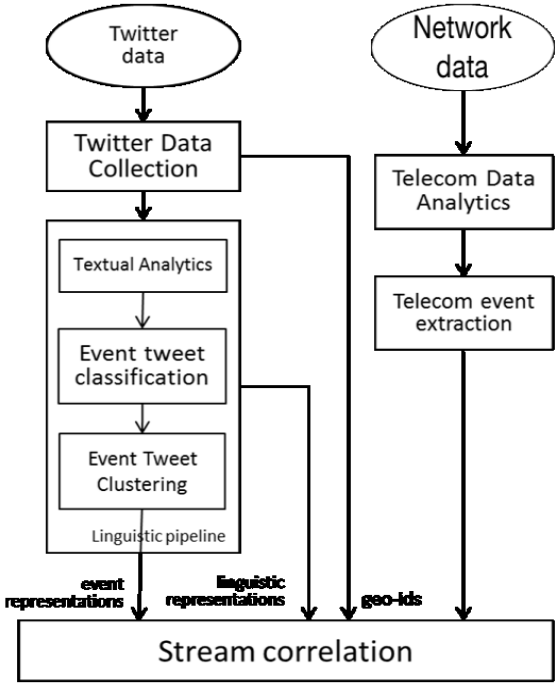
Problem . Predict demand patterns and anomalies (peaks, mobility, user typology) : Enriching telecom internal data with external evidence. E.g. Use **Social Media** data (Twitter, Foursquare,..) to **predict** large **gatherings of people** that might drastically **affect traffic demand**

Network data

Social Networks data

Weather Forecast data

Points of Interest data



Solution.

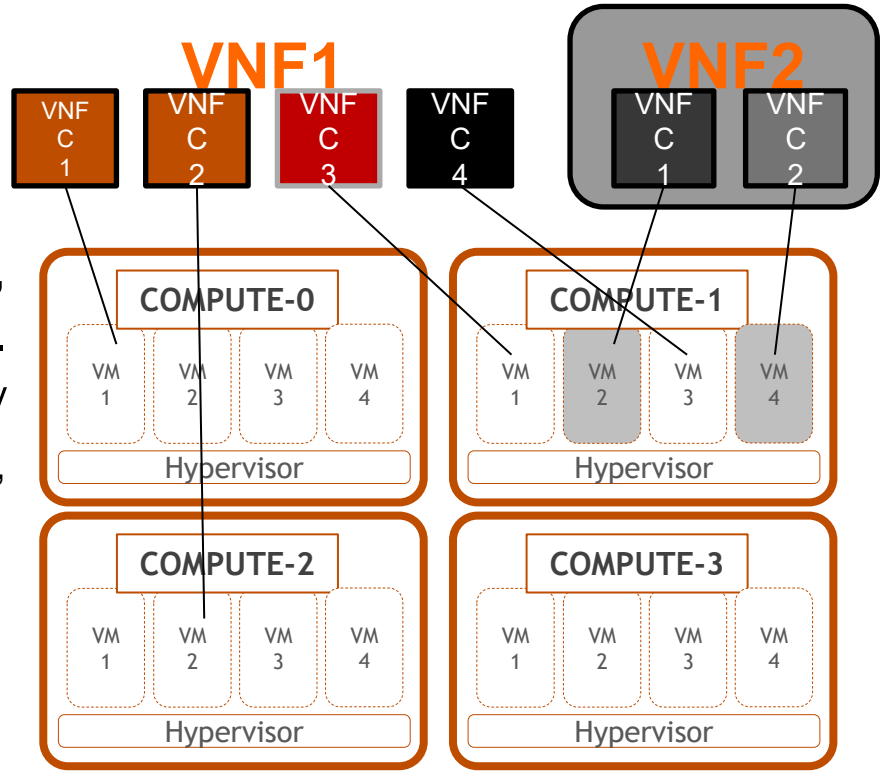
- Crawl Twitter data,
- Analyze Twitter data,
- Define twitter events,
- investigate algorithms for event extraction,
- Analyze Telecom data data,
- identify consumption anomalies (peaks)
- Correlation analysis

Ref. Spatio-temporal clustering approach for detecting functional regions in cities

3 Use case perspectives in Network

Virtual infrastructure perspective

Problem. **Noisy Neighbor**: 2 or more VNFs, deployed on same cloud infrastructure. This may cause "noise" to one another by "hogging" resources (including CPU, Memory, Storage, Networking).



Ref. Using Machine Learning to Detect Noisy Neighbors in 5G Networks

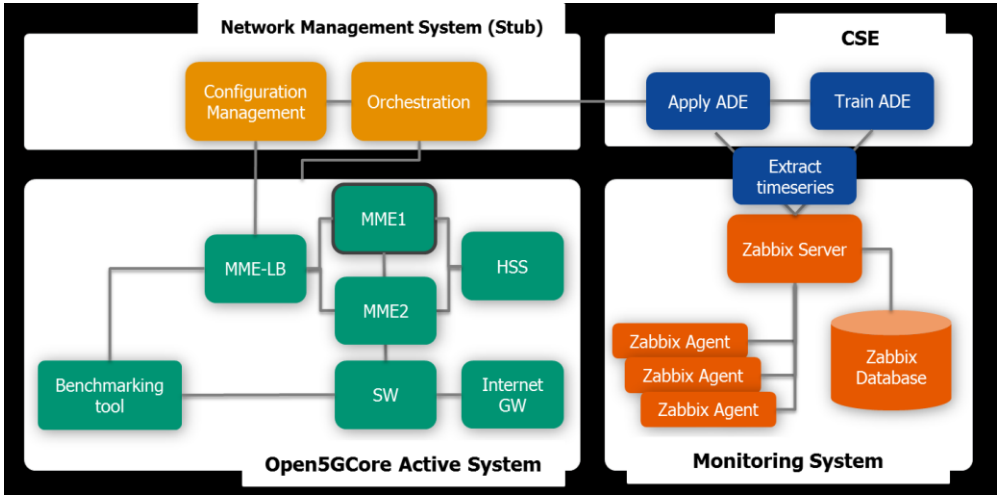
3 Use case perspectives in Network

Dedicated Network perspective

Fraunhofer FOKUS

Problem. **Anomaly detection for vEPC**

1/ Anomaly is detected
2/ A notification is sent to orchestration
3/ The orchestrator will indicate to the MME LB to forward all the requests to the hot standby MME
4/ MME having the abnormal behaviour is rebooted by the orchestration functionality.



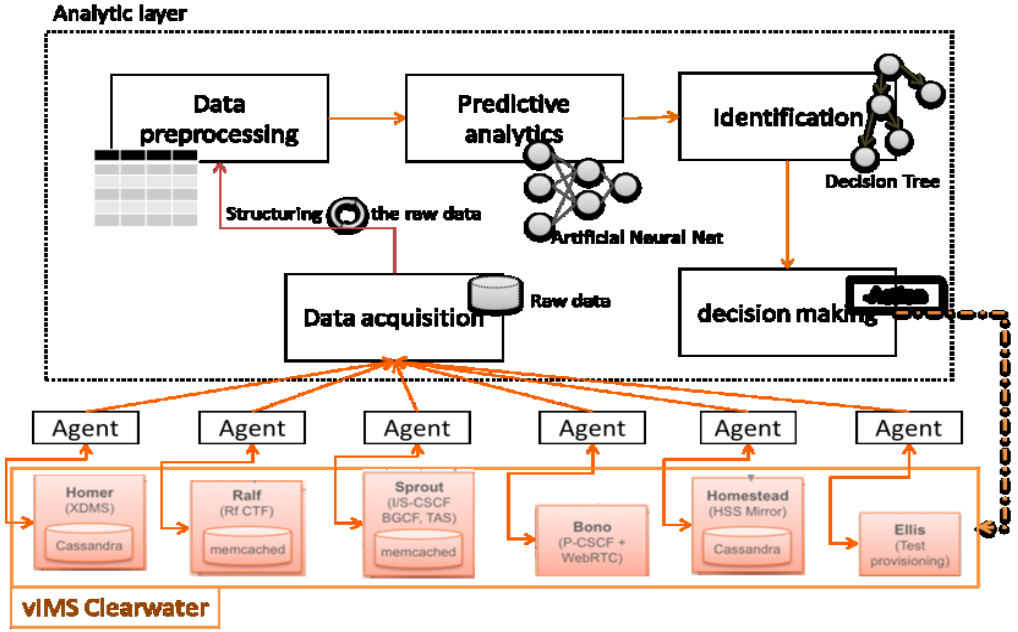
Ref. Practical Performance Degradation Mitigation Solution Using Anomaly Detection for Carrier-Grade Software Networks

3 Use case perspectives in Network

Service perspective

Problem. **Guarantee Service Level Objectives** (SLO). e.g. of SLOs

- Service availability
- Service Response time
- Latency
- ….



Ref. AI for SLA Management in Programmable Networks

- ✓ **Availability and Quality of data : a must have**
- ✓ **Problem framing is important: the use case perspective help to select the data to use**
- ✓ **E2E approach towards Network Intelligence: how to build a common E2E approach while taking into account the different perspectives**

Thank You!