



SliceNet Webinar

Cognitive, Slice-Level QoE Management

WEBINAR HOST: KENNETH NAGIN, IBM HAIFA RESEARCH LAB

DATE: 17 MARCH 2020

TIME: 11:00 CET

slicenet.eu



Introduction

□ Terminology

- Cognition (Artificial Intelligence, Machine Learning, Big Data)
- Quality of Service (QoS)
- Quality of Experience (QoE)
- Vertical (network slice user)
- Network Service Provider (NSP)
- Digital Service Provider (DSP)
- Plug & Play (P&P) Plugin

□ Goals

- Cognitive Driven Problem Determination (Predict problem before QoE degrades)
- Cognitive Driven Remedial Actuation (Automate network optimization)
- Vertical in the loop

Webinar Agenda

□ Agenda

- Purpose/Objectives (Why is Cognition required for Slice QoE Management?)
- Requirements and challenges (Why is it hard?)
- Technical approaches for design and prototyping (What are the basic building blocks?)
- Technical achievements (What did we actually do?)
- Industry Vertical applications/contributions (How does it apply to the real world?)
- Summary of innovations (rap-up and time for more questions)

Why use cognition for slice QoE management?

- ❑ Many workloads, dynamic traffic patterns
 - Must constantly **adapt, anticipate**
- ❑ Multiple data sources, multiple owners, multiple semantics, multi-layering, multi-domain
 - Must **combine sources, interpret, predict outcomes**
- ❑ E2E Quality of Experience (QoE) per slice
 - Must derive QoE from Quality of Service (QoS)
- ❑ Explosion of possible per slice states and possible configuration
 - Must **scale**

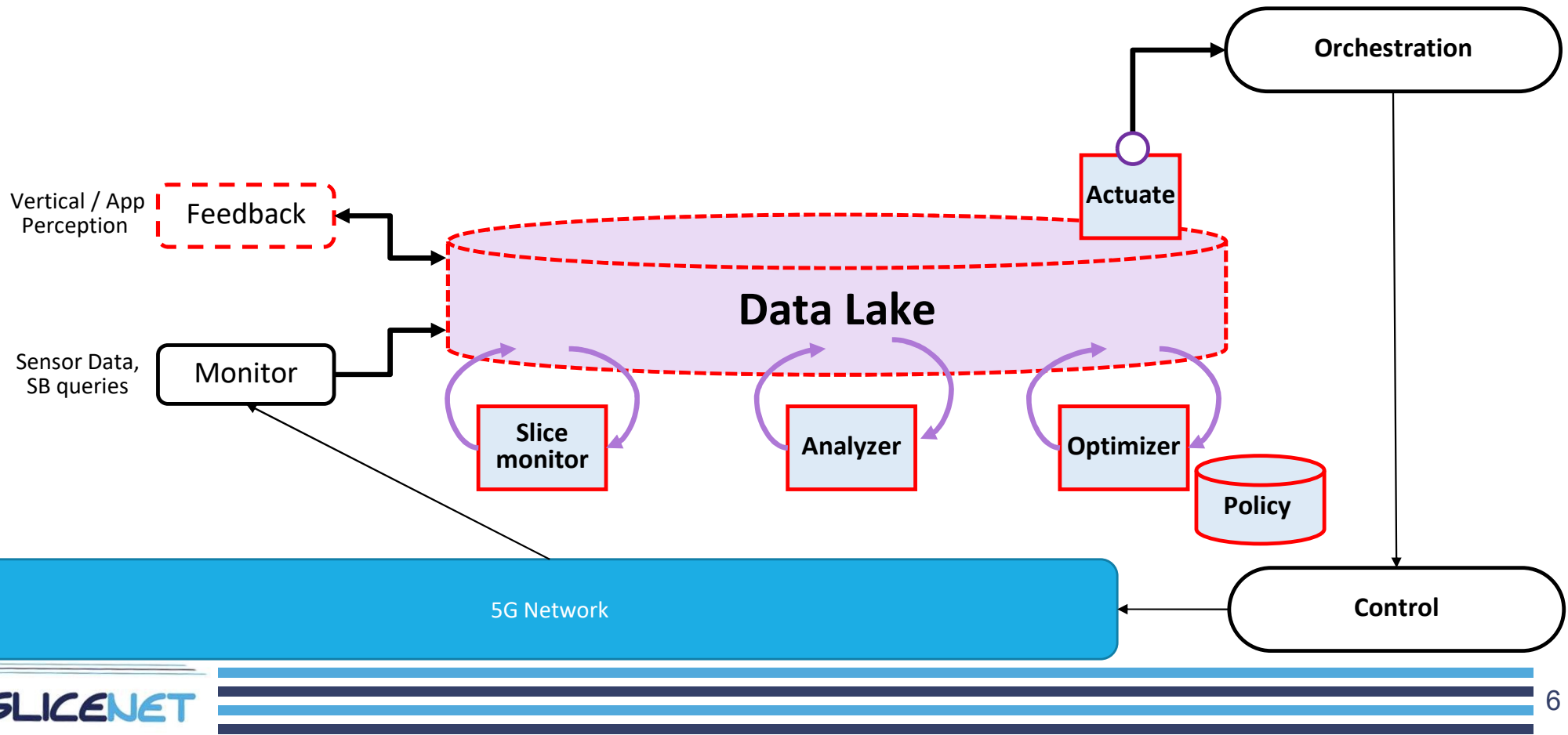
Traditional problem determination, e.g. thresholding, not adequate.

Cognition Required

Challenges

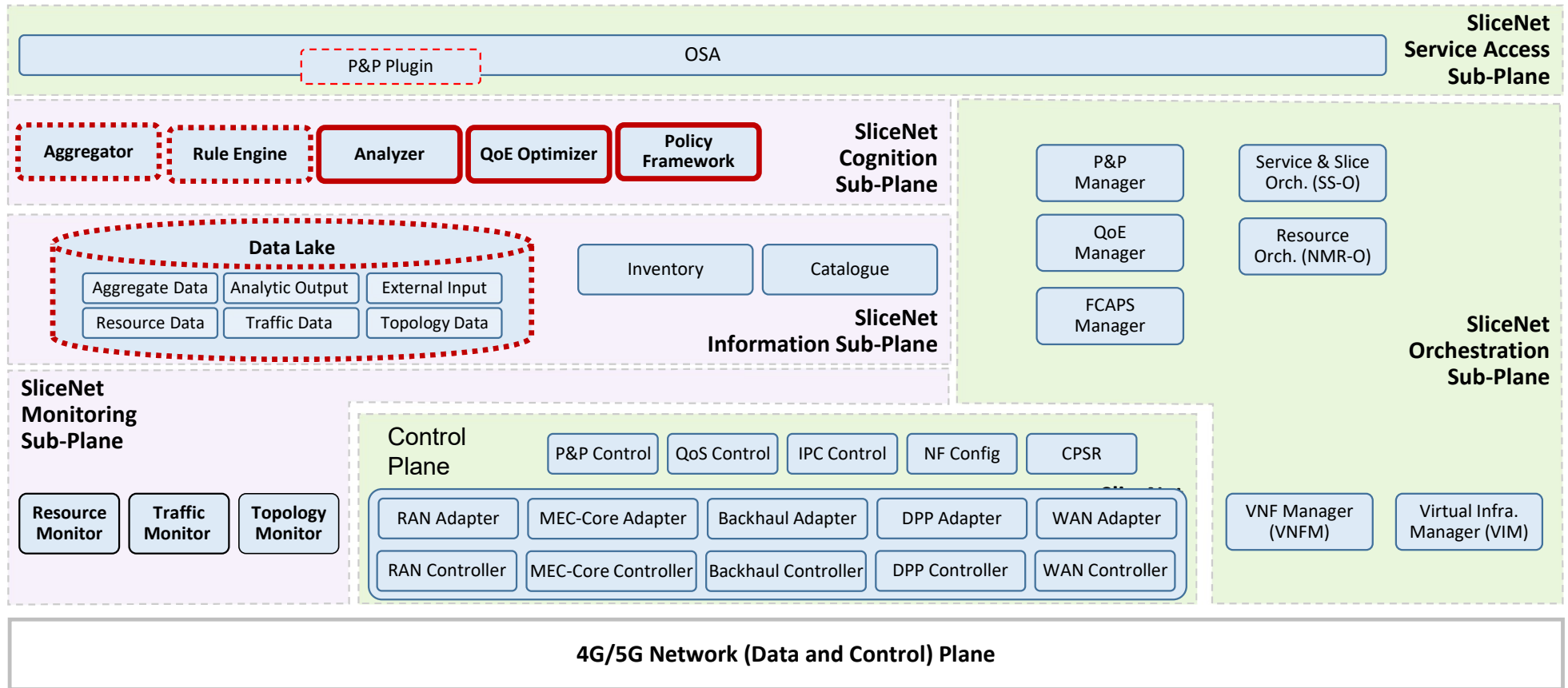
- ❑ Combine Cognition with “traditional” network operations management
 - Event-action, policies
- ❑ Many machine learning methods
 - Allow easy integration of new analytics
- ❑ Big Data management
 - Many sources and Many components using data
- ❑ Harmonize under single architecture
 - ❑ Allow mix-and-match of different tools, orchestrate cognition across layers and domains
 - ❑ One paradigm for both NSP and DSP
- ❑ Quality of Service (QoS) vs Quality of Experience (QoE)
 - Network level QoS KPIs do not reflect E2E QoE
 - Must **estimate** and **predict** actual QoE

Cognitive driven problem determination, prediction and remedial actuation

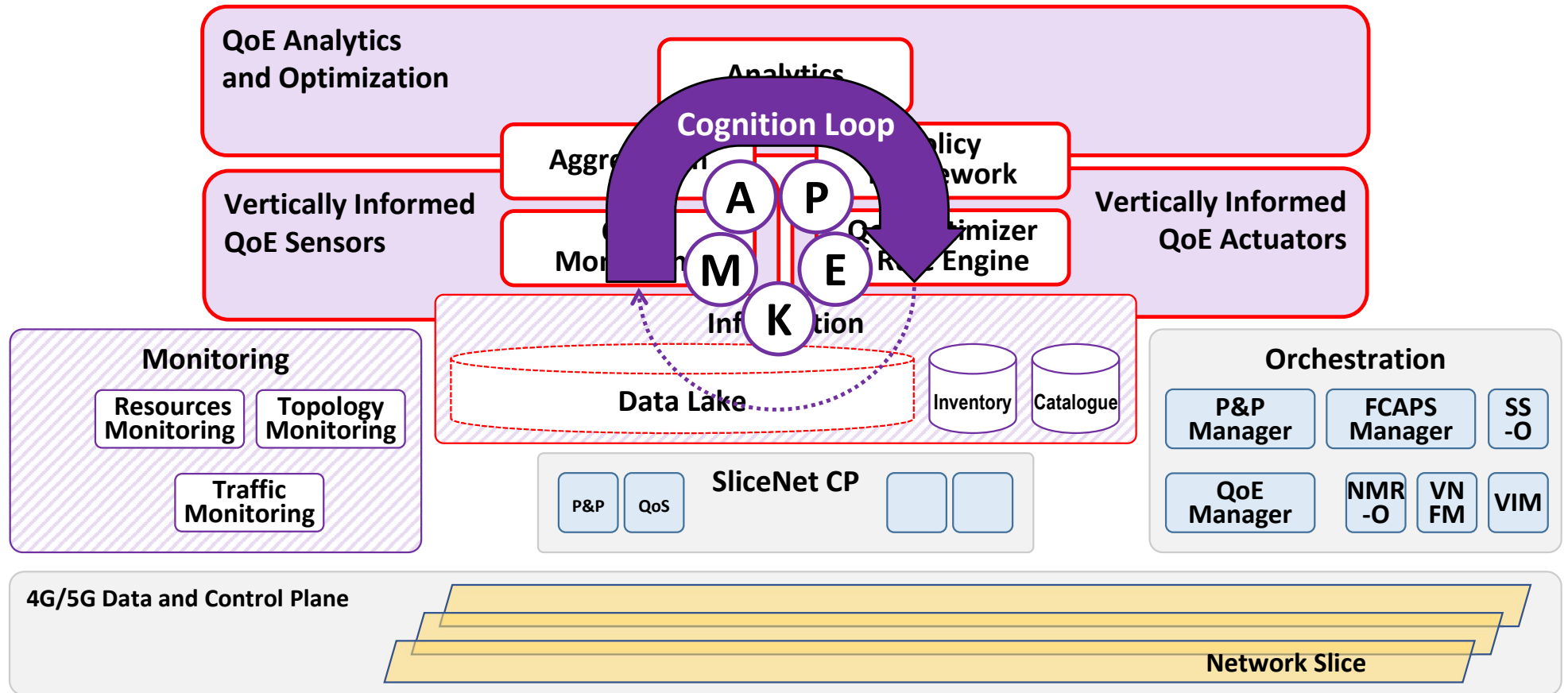


Technical approach for design and prototyping

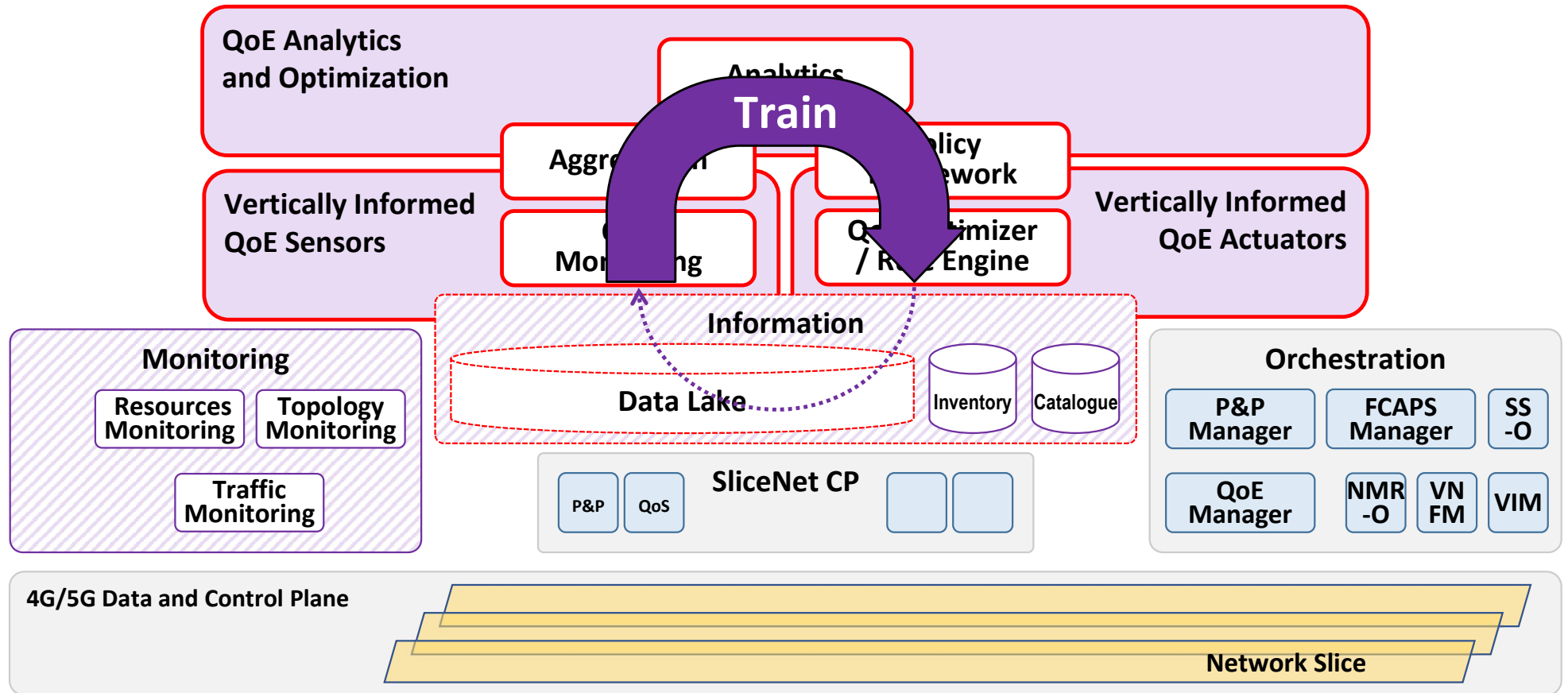
SliceNet Architecture



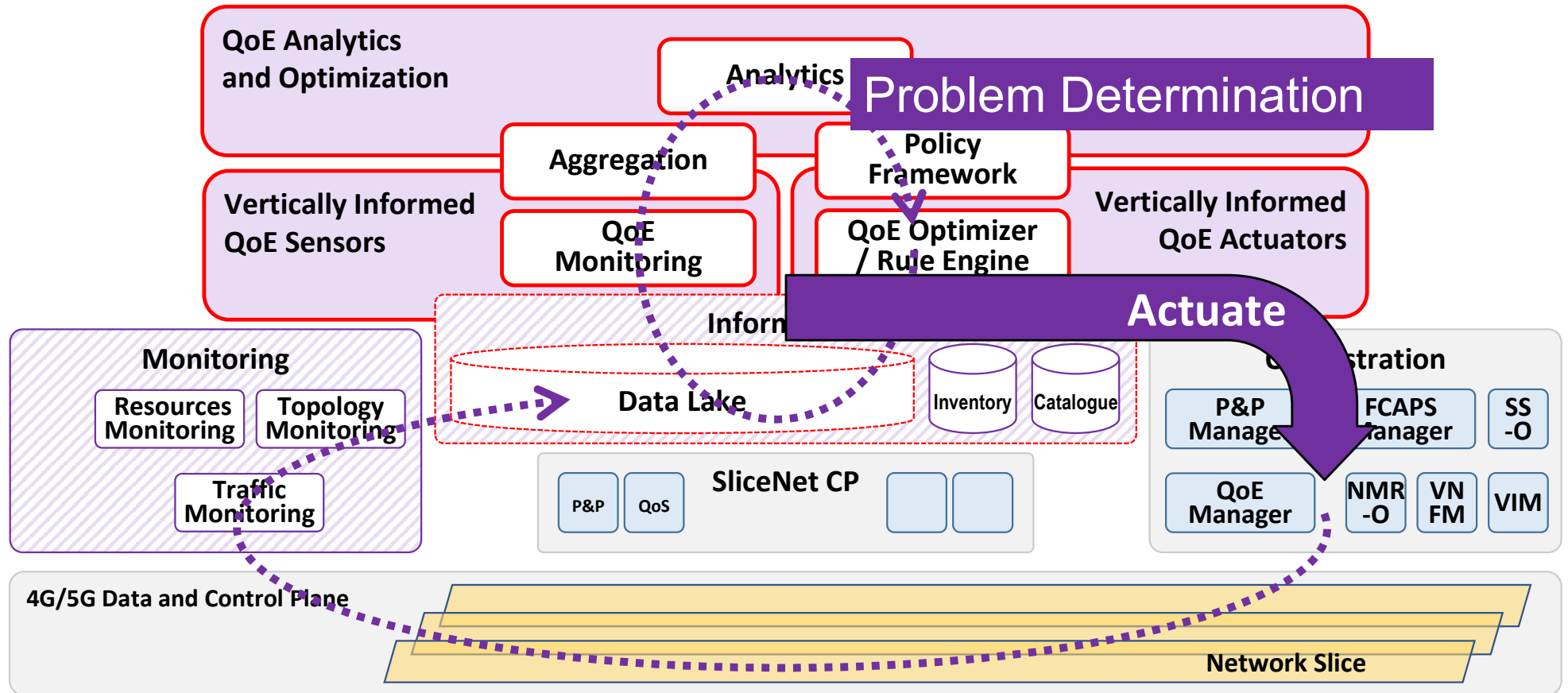
MAPE-K cognitive management loop



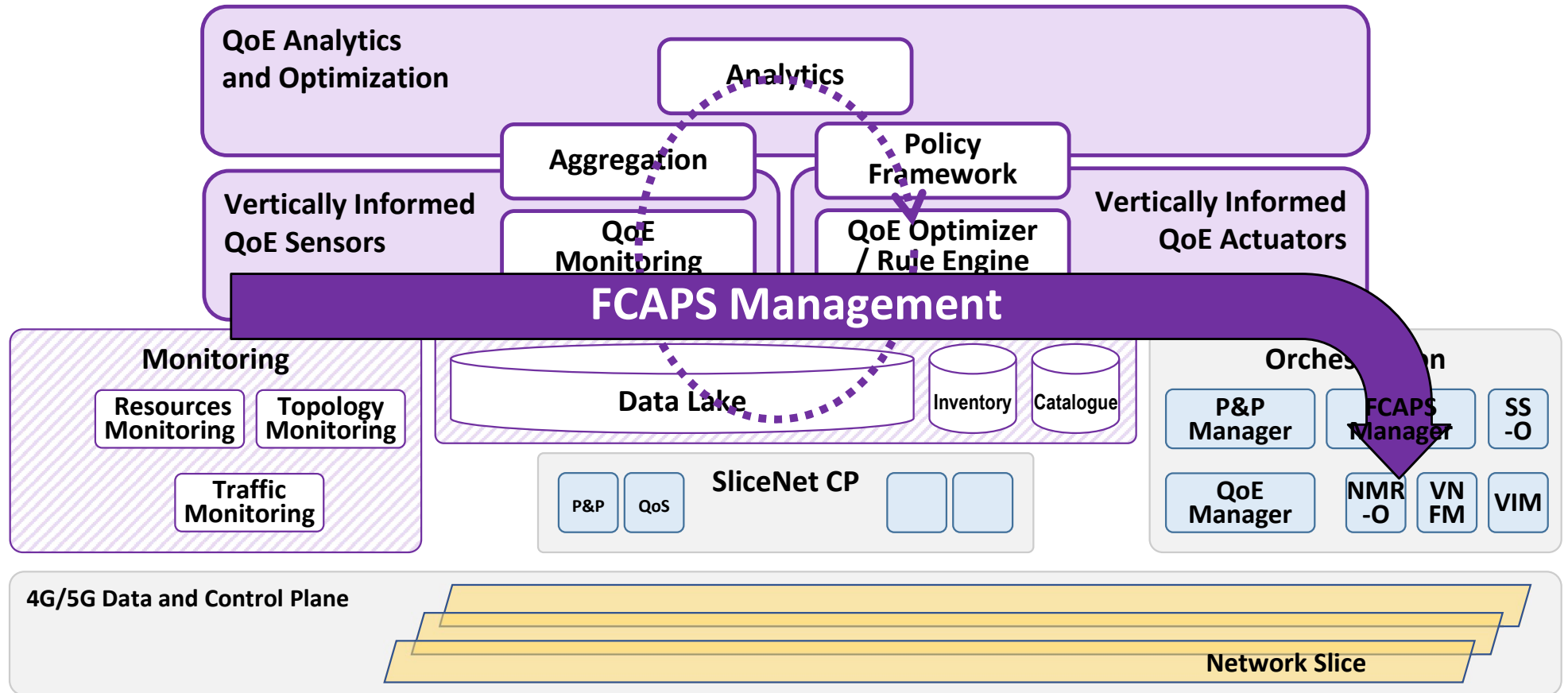
Learn/train: generate knowledge (as policy)



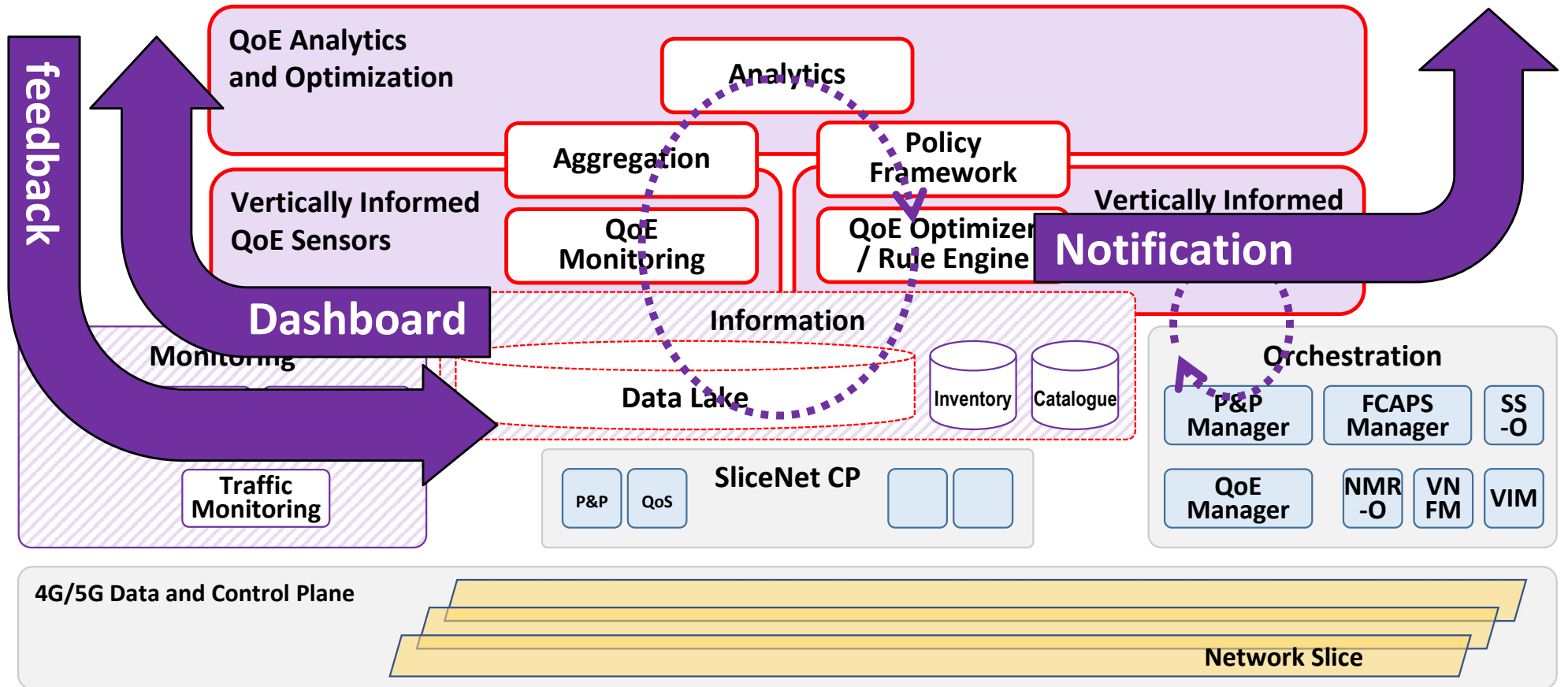
Cognitive Driven Remedial Actuation



FCAPS management: short loop



Vertical In the Loop (Plug & Play Plugin)



Three Use Cases

Use Case	ML Model	Model Type	Remedial Actuation	Quality of Experience (QoE)
Smart Grid	Predict RAN degradation and RAN failures from alarm data	Neural Network	<ul style="list-style-type: none"> • Modify slice network parameters (bandwidth), • Failover to new RAN 	Power grid under constant observation and control.
Smart City	Detect performance degradation due to Noisy Neighbours	Random Forest	<ul style="list-style-type: none"> • Bandwidth • VNF scaling (VM Scaling), • VNF migration (VM Migration) 	All signals from light sensors received as usual. No lose of control of lights.
eHealth	Anomaly Detection: <ul style="list-style-type: none"> • Data from ambulance mobile plug-in • Observe network behavior for the last 5 minutes in order to forecast the signal strength degradation within the future 5 minutes. 	Random Forest	<ul style="list-style-type: none"> • Traffic Re-direction within same NSP • Hand-Over to another NSP 	No degradation in video stream noticed by health workers.

Prototyping

❖ Delivered SW components prototypes and interfaces available at SliceNet Git:

- ✓ QoE REST Client: <https://gitlab.com/slicenet/qoe-rest-client>
- ✓ QoE Plugin: <https://gitlab.com/slicenet/qoe-plugin>
- ✓ QoE Optimizer: <https://gitlab.com/slicenet/qoe-optimizer>
- ✓ Policy Manager: <https://github.com/onap/policy-engine> ,
Docker: nexus3.onap.org:10001/onap/policy-pe
- ✓ RAN NS Prediction Model:
<https://gitlab.slicenet.oteresearch.gr/jose-nuno-sousa/cog-demo>

Innovations

- ❑ Cognitive-driven state analysis and problem determination
 - Multiple ML Model Support
 - One paradigm for both NSP and DSP
- ❑ Cognitive-driven remedial actuation
 - Cognitive-driven triggers
 - Cognitive-driven policy framework
 - Actuators de-coupled from triggers (reusable)
- ❑ Cognitive-Driven & Traditional Network Management Integration
- ❑ Slice aware, vertical in the loop
 - Plug & Play Plugins
 - Vertically-informed Quality of Experience (QoE) sensors
- ❑ Data Lake
 - Data Sharing
 - ❑ Between monitors and Cognitive Sub-Plain
 - ❑ Between NSP and DSP
 - Component Decoupling

Further Information

Website: <https://slicenet.eu/>

Email: contact@slicenet.eu

Further information: <https://slicenet.eu/publications/>

SliceNet Open source contributions:
<https://slicenet.eu/software-contributions/>

Questions ?

