ENI ISG PoC Report: Status of PoC#4 - Predictive Fault Management of E2E Multi-domain Network Slices

1 General

Submission of this ENI ISG PoC Report as a contribution to the ENI ISG does not imply any endorsement by the ENI ISG of the contents of this report, or of any aspect of the PoC activity to which it refers.

2 ENI ISG PoC#4 Status Report

2.1 PoC Project Completion Status

- Overall PoC Project Completion Status:
  Not Completed

The SliceNet integration scenario supporting the proposed use case has suffered consequent delays, compromising the original (as well as the corrected) PoC schedule. As of June, 19th, 2020, the first end to end successful tests of the Use Case are being run, which means that PoC#4 is practically completed and ready to demonstrate. Unfortunatelly this is not possible to do in the scope ENI#14.

2.2 ENI PoC Project Participants

PoC participants are the same of the original PoC proposal. Namely:

- Portugal Telecom (Service Provider)
- The SliceNet Consortium (H2020 Project)

The following entities are active participants of the SliceNet Consortium, and hence of this PoC:

- Eurescom (program Management)
- Altice Labs (Solution Provider)
- University of the West Scotland (University)
- Nextworks, SRL (Solution Provider)
- Ericsson Telecommunicazioni, SpA (Solution Provider)
- IBM (Solution Provider)
- Eurecom (University / Solution Provider)
- Universitat Politècnica de Catalunya (University)
- Redzinc Service, Ltd (Manufacturer / Solution Provider)
- OTE – The Hellenic Telecommunications Organisation (Service Provider)
- Orange Romania / Orange France (Service Provider)
- EFACEC (Manufacturer)
- Dell EMC (Manufacturer)
- Creative Systems Engineering (Solution Provider)
- Cork Institute of Technology (University)

2.3 Confirmation of PoC Event Occurrence

PoC Demonstration(s) to be scheduled

2.4 PoC Goals Status Report

According to the proposal, there are two main goals, separately reported below

Goal#1: Network Slice Fault Prediction: *Demonstrate the use of AI on performance data to be able to accurately predict failure situations on Network Slices and estimate their impact on an E2E multi-domain slice performance*.

This Goal is **partially attained.** *The use of AI on performance data to be able to accurately predict failure situations on Network Slices* has been fully proven and is already available on the PoC. Nevertheless, major changes in the PoC scenario have restricted the PoC to a single administrative domain, hence the *impact on an E2E multi-domain slice performance* will not be assessed by the PoC, only the impact on E2E slice performance in general.

Goal#2: Policy-based Network Slice Management: *Evaluate the use of a policy-based structure for slice composition decisions, as well as the mechanisms for policy definition on that same context.*

This Goal is **fully attained**. The scenario has changed from the composition of slices (building a E2E Slice from partial slices) provided by different Network Service Providers (NSP) to one where the scope is a single NSP, but still there is a policy-based structure taking decisions about slice composition.

2.5 PoC Feedback Received from Third Parties (Optional)

Nothing to report

3 ENI PoC Technical Report (Optional)

3.1 General

The original PoC proposal (Figure 1) was centered on the role of the Digital Services Provider (DSP) role:

- Network Service Providers (NSP) provide Sub-slices
- DSP monitors all Sub-slices behaviour
- DSP predicts Sub-slice failure
- DSP applies its own policies to decide the best failover sub-slice alternative
- DSP triggers Subslice/NSP switching

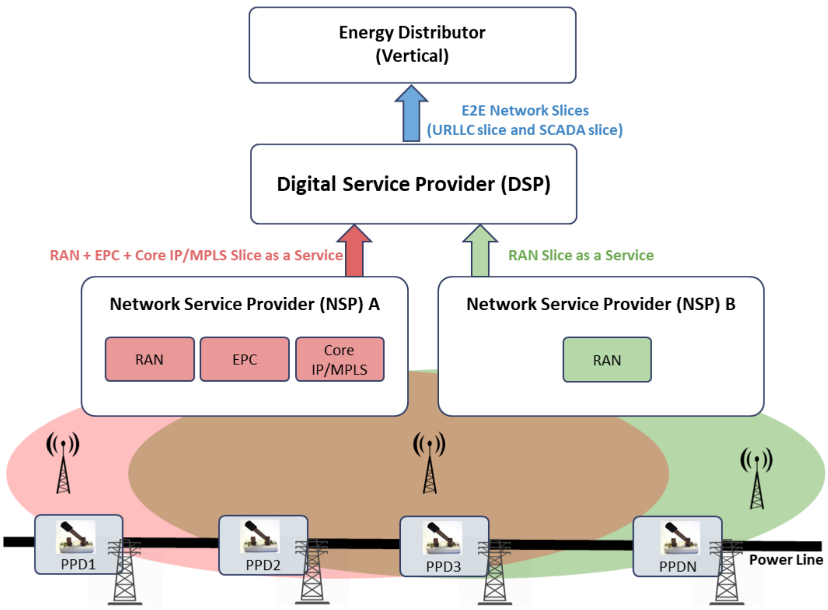

Figure 1 - Original PoC#4 proposal scenario

Several problems and delays have made the above mentioned scenario impossible to demonstrate, and an alternative scenario was set up: a ML-based RAN failure prediction and mitigation at NSP A. In this scenario a Slice fault is avoided internally to NSP A when a RAN potential failure is predicted that would increase latency beyond an acceptable level.
The mitigation action can be an increase in bandwidth or a change in the Network Slice to avoid compromise the required latency, as determined by the policy.
This scenario is fed by real world Alarms, that are for model training as well as to be replayed to and ingested by the Slicenet demo system.

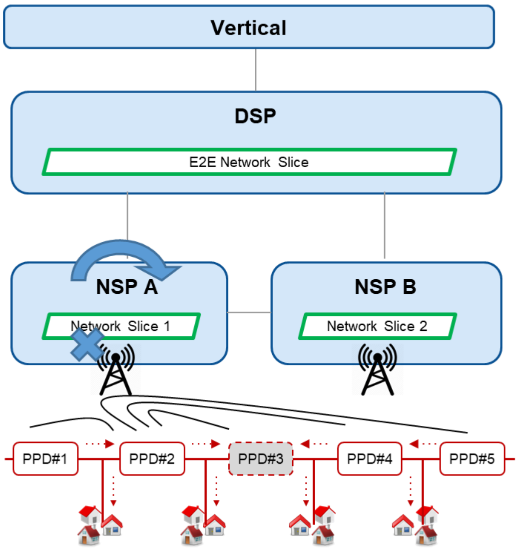

Figure 2 - NSP Slice Fault Prediction Use Case

The next figure and the sequence description below it illustrate in more detail the flow of the Use Case.

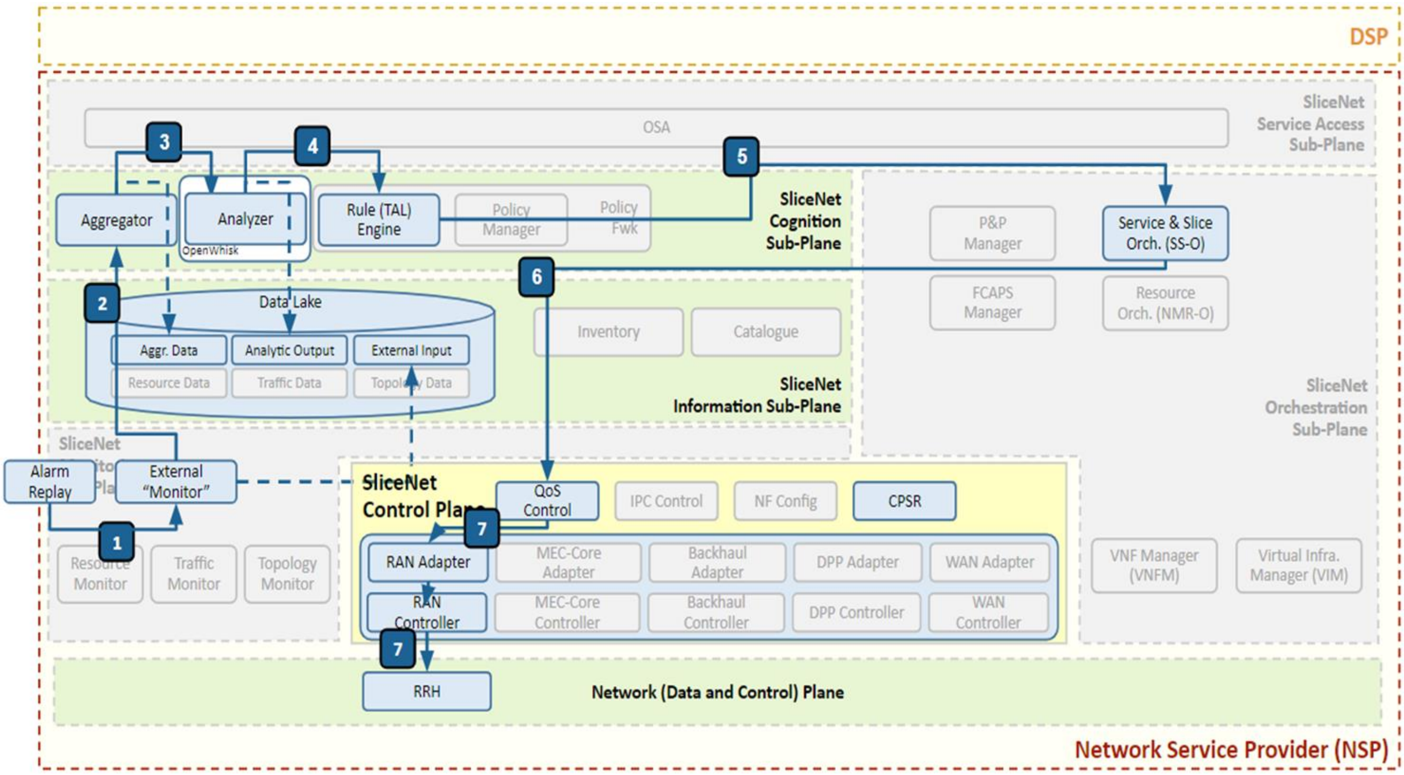

Figure 3 - NSP Slice Fault Prediction Flow

1. Alarms data is replayed and ingested by the Slicenet System;
2. Data is aggregated and persisted;
3. The **Analyzer,** which is running the Alarms Prediction ML model, runs the model, producing alarms insights/predictions
4. A **Rule Engine** consumes a prediction event, checks the NSP policies conditions and verifies that the slice available bandwidth is too low. It decides to increase the NS bandwidth to avoid/mitigate the fault
5. The action plan decided by the **Rule Engine** is delivered to the **Service and Slice Orchestrator** for enforcement.
6. the **Service and Slice Orchestrator** interacts with the **QoS Control** subsystem
7. **QoS Control** identifies the appropriate network segment (RAN) adapter to address and interacts with the **RAN Controller**, which translates the generic bandwidth increase information request to RAN specific parameters.
8. Finally, the **RAN Controller** modifies the NS bandwidth by interacting with the OAI **Remote Radio Head (RRH)**

3.2 PoC Contribution to ENI ISG

Table 1

Contribution	WG/EG	Work Item (WI)	Comments
Implementation of various aspects of identified Use Cases		ETSI GS ENI 001 (UC)	Intelligent Network Slicing Managemnt; Network Fault Identification and Prediction; Assurance of Service Requirements
The Fulfillment of several identified requirements was demonstrated		ETSI GS ENI 002 (Req)	Service Orchestration and Management; Network Optimization; Resilience and Reliability; Data Collection and Analysis; Policy Management; Data Learning
Implementation of aspects of ENI Reference architecture		ETSI GS ENI 005 (Arch)	A policy based Intelligent loop is demonstrated

3.3 Gaps identified in ENI standardization

Table B.2

Gap Identified	Forum (ENI ISG, Other)	Affected WG/EG	WI/Document Ref	Gap details and Status

3.4 PoC Suggested Action Items

- Schedule a Demo of the PoC according to ENI availability and member interest.
- Produce a Final Report

3.5 Additional messages to ENI

Feedback to ENI will be produced in a Final Report

3.6 Additional messages to Network Operators and Service Providers?

Feedback will be produced in a Final Report

References

[1] RGS/ENI-008 (GS ENI 001), "Experiential Networked Intelligence (ENI); ENI use cases", v2.0.8 (early draft), S
[2] RGS/ENI-007 (GS ENI 002), "Experiential Networked Intelligence (ENI); ENI requirements", v2.0.4 (early draft).
[3] DGS/ENI-005 (GS ENI 005), "Experiential Networked Intelligence (ENI); System Architecture", v0.0.22 (early draft).