# ENI(18)000104r1 Reviewed

**Title*:** PoC proposal for Intelligent Network Slice Lifecycle Management

from **Source***: China Telecommunications
Contact: Haining Wang

input for **Committee***: ENI

Contribution **For***:

| | |
|---|---|
| Decision | X |
| Discussion | |
| Information | |

Submission date*: 2018-06-20

Meeting & Allocation: **Rapporteur's call#59: Requirements** -
Relevant WI(s), or deliverable(s):

**Decision/action requested:** Please approve

**ABSTRACT:** *This contribution proposes to start a PoC project on Intelligent Network Slice Lifecycle Management.*

# 1 PoC Project Details

## 1.1 PoC Project

| | |
|---|---|
| PoC Number (assigned by ETSI): | |
| PoC Project Name: | **Intelligent Network Slice Lifecycle Management** |
| PoC Project Host: | **China Telecommunications** |

The PoC will demonstrate network slice lifecycle management stages including operational requirements for specification, creation, analyzing, and modification. The PoC is targeting network management use cases in the operator network. Moreover, it can be applied to verticals and NGMN 5G application use cases (uRLLC, eMBB, mMTC, etc).

The PoC will be used to demonstrate the intent-based service model and the intelligent operations needed for network slice and its services, demonstrating the maturity of ENI architecture in supporting the application of intelligent tools for slice/service-oriented network management and control.

Particularly, the intent-based service model will be demonstrated as the slice tenant interface and the procedure of how to convert the intent-based input to the underlay network realization. The intelligent operations will be demonstrated as the network slice status analysis and network slice modification requests generation.

## 1.2 PoC Team Members

| | Organisation name | ISG ENI participant (yes/no) | Contact (Email) | PoC Point of Contact (*) | Role (**) | PoC Components |
|---|---|---|---|---|---|---|
| 1 | China Telecom | Yes | Haining Wang<br>wanghn.bri@chinatelecom.cn<br><br>Bo Lei<br>leibo.bri@chinatelecom.cn | X | Service Provider | - User Stories / Use Cases Providers and related Business models<br>- AI-Based Predictor<br>- Train the predictor with traffic data, and<br>- infer traffic trends and creates suggested network slice lifecycle management policies accordingly. |
| 2 | Huawei | Yes | Shengming Cai<br>caishengming@huawei.com<br><br>Shucheng Liu<br>liushucheng@huawei.com | | Manufacturer | - User Stories / Use Cases Providers and related Business models<br>- End-to-End Network Slice Manager<br>- Transport Network Slice Manager<br>- Core Network Slice Manager<br>- Intent Convert Intent slice and service definition/description,<br>- Underlay network<br>- User Interface for input and display |
| 3 | CATT | No | Hui Xu<br>xuhui@catt.cn | | Manufacturer | - User Stories / Use Cases Providers and related Business models<br>- Underlay network |
| 4 | DAHO Networks | No | Qian Wang<br>sisy.wq@dahonetworks.com | | Manufacturer | - User Stories / Use Cases Providers and related Business models<br>- Underlay network |
| 5 | Intel | Yes | Kuo Liao<br>kuo.liao@intel.com<br>Jie Dong<br>jie.dong@intel.com | | Manufacturer | - User Stories / Use Cases Providers and related Business models<br>- AI-Based Predictor |
| 6 | China Electric Power Research Institute | No | Delong Yang<br>yangdelong@epri.sgcc.com.cn | | Other | - User Stories / Use Cases Providers and related Business models<br>- Service requirements |

All the PoC Team members listed above declare that the information in this proposal is conformant to their plans at this date and commit to inform ETSI timely in case of changes in the PoC Team, scope or timeline.

## 1.3 PoC Project Scope

### 1.3.1 PoC Goals

The PoC will demonstrate the use case [#3-2 Intelligent network slicing management], addressed by requirements [GR.1, GR.2, SOM.1, NPD.4, NPD.6, NPD.7, NPD.9, DCA.3, DCA.4], and report on the suitability of the ENI Reference Architecture. The detailed goals include:

- PoC Project Goal #1: Demonstrate the use of intent-based interface to translate tenant requirements to network slice configuration and intelligent network slice lifecycle management on demand.
- PoC Project Goal #2: Demonstrate the use of AI to predict the change of traffic pattern and adjust the configuration of network slice in advance.

### 1.3.2 PoC Topics

PoC Topics identified in this clause need to be taken for the PoC Topic List identified by ISG ENI and publicly available. PoC Teams addressing these topics commit to submit the expected contributions in a timely manner.

| PoC Topic Code | PoC Topic Description | Related WI | Expected Contribution(s) | Target Date |
|---|---|---|---|---|
| Service Orchestration and Management -> Intelligent network slicing management | Intelligent Network Slice Management | ENI 005, ENI 007, ENI 008 | 1. Architecture for intelligent network slice lifecycle management<br>2. Intent northbound interface (NBI) for E2E network slice<br>3. The feasibility of network traffic prediction using artificial intelligence<br>4. Others, e.g. on use case #3-2, or requirements GR.1 / GR.2 / SOM.1 / NPD.4 / NPD.6 / NPD.7 / NPD.9 / DCA.3 / DCA.4. | 31/12/2018 |

## 1.4 PoC Project Milestones

| PoC Milestone | Milestone description | Target Date | Additional Info |
|---|---|---|---|
| P.S | PoC Project Submission | 11/05/2018 | |
| P.TP.1 | PoC user story | 30/06/2018 | High level description of E2E Network Slice, 5G end-to-end Slice and 5G IoT applications (Smart Insurance) slices deployments User Story |
| P.TP.2 | PoC Test Plan 1 | 31/07/2018 | Transport Network Slice Manager (TNSM) module and intelligence module joint test and deployment |
| P.TP.3 | PoC Test Plan 2 | 31/09/2018 | TNSM module, Core Network Slice Manager (CNSM) module and intelligence module joint test and deployment |
| P.P.1 | PoC Presentation | 31/10/2018 | Publish Joint White Paper by all the stakeholders |
| P.D1 | PoC Demo 1 | 1-31/09/2018 | Webinar demo at China Telecom Beijing Research Institute forum, Partner's premises |
| P.D2 | PoC Demo 2 | 1-31/09/2018 | Webinar demo at ETSI ENI#07 meeting place |
| P.D3 | PoC Demo 3 | 1-31/11/2018 | Webinar demo at China Telecom exhibition hall, Partner's premises |

| | | | |
|---|---|---|---|
| P.C1 | PoC Committed Contribution 1 | 31/12/2018 | Demonstration of the integration of ENI intelligent service deployment in a network slicing context. |
| P.C2 | PoC Committed Contribution 2 | 31/12/2018 | Intent NBI Demonstration in the network slicing scenario |
| P.C3 | PoC Committed Contribution 3 | 31/12/2018 | Network traffic prediction Demonstration in the network slicing scenario |
| P.C4 | PoC Committed Contribution 4 | 31/12/2018 | PoC-Demos Feedback report |
| P.R | PoC Report Project End | 31/03/2019 | PoC-Project-End Feedback |
| P.E | PoC Project End | 31/03/2019 | |
| PE.1 | PoC Final report presented to ISG ENI for information | 31/03/2019 | presented to ISG ENI for information |

## 1.5 Additional Details

Three Demos are currently planned but the detailed dates are to be confirmed. In addition, there may be more Demos if the PoC team finds appropriate occasions.

# 2 PoC Technical Details

## 2.1 PoC Overview

Network slicing is considered to be one of the most important innovation in in the telecommunications sector. From the business point of view, it is supposed to provide network agility, flexibility, scalability and elasticity to meet diverse needs of verticals, and offer configurable warranties in terms of Quality of Service (QoS) or Quality of Experience (QoE). A significant number of new markets will be open to support more demanding use cases such as smart grid and vehicle-to-everything (V2X).

From the technical point of view, network management of network slicing is not only required to satisfy differentiated SLAs and isolation requirements for various services, (e.g. during the creation stage), it also required to provide high efficiency in terms of real-time monitoring, analysis, and self-optimization. For the former requirement, when network slice is open to a large amount of small and middle enterprises with limited network technology level, an easy-to-use interaction interface is necessary. For the latter requirement, the network management system must be able to close the loop of network control under a more dynamic and complex network environment. These requirements cannot be properly achieved in current network management system.

To this end, architecture and key technologies innovations are critical for network slicing operations. The new technical challenges on network management turns AI as a competitive option for handling different types of complex network slicing scenarios, especially in which deterministic results cannot be easily derived from analysis or control.

The plan is to use this PoC to demonstrate the feasibility of several and different demanding requirements of network slicing management with intelligent and intent approaches. This PoC consists of the realization of 2 scenarios that will be phased in time.

### 2.1.1 Scenario 1 – Automatic Creation of E2E Network Slice Instance

This scenario demonstrates the creation of network slices with specific QoS performance, including bandwidth, latency, and reliability. Network slice tenant (e.g., smart grid administrator) issues an intent-based processing request and QoS request to the E2E Network Slice Manager (E2E-NSM). For the transport network segment, where multiple service scenarios with different QoS performance combinations are possible (including but not limited to isolation, reliability, bandwidth, latency and loss rate), multiple underlay network slicing technologies must be taken into account when calculation, mapping and verification of the (new) slicing request is performed by the TNSM. The tenant is completely unaware of how the underlay network realizes its QoS requirements.

During the creation stage, the significance of intent or AI technology lies in the simplification of tenant's parameters input. In order to accomplish that, the network management system must know what the tenant wants for bandwidth allocation, i.e. some tenants may want dedicated bandwidth, while some others may want to reduce cost by partially share bandwidth with other slices. In such cases, where the tenant is not supposed to directly guide the network

management system how to do E2E resource allocation, an intent-based input as well as the convert procedure is needed.

### 2.1.2 Scenario 2 – Dynamic Network Slice Modification

This scenario focuses on the runtime stage and demonstrates the dynamic modifications of existing network slice instance based on the prediction of the traffic pattern and the corresponding modification suggestion. This is accomplished by an AI-based prediction functionality, while the modification actions are implemented by TNSM and by the CNSM. This includes the capability to scale up/down a core network slice instance and adjust the transport network slice configuration in advance, based on the prediction of reduction/growth of the traffic.

In this PoC implementation, a trigger to scale up/down target VNFs is sent from the prediction functionality of the Intelligence module to the CNSM, with a new suggested deployment flavour. Then the CSNM performs internal scale up/down of the involved VNFs. Related scale up/down requests for the transport network are also generated by the prediction functionality and sent to TNSM to adjust the transport network slice correspondingly.

In the transport network, a good AI functionality provides network analysis or management expertise for a particular field. In an agile network slice management system, real-time and reliable analysis results are needed for performing a sustained and more accurate decision on network slice management. The use of big data and AI technologies offers a more general and efficient method for network traffic prediction. It adaptively and recursively learns the traffic patterns for different periods of time and infers a prediction result by taking both regular events and network traffic fluctuation into consideration. With that more accurate prediction result, TNSM can change network slice services routing, expand or reduce the network slice resources and topology accordingly, increasing the network resource utilization as well as the automation level of network management system.

## 2.2 PoC Architecture

The following diagram outlines the architecture framework of this PoC. Both core network slicing and transport network slicing, which are part of the system under test, are included in the picture for simulating the service processing and the corresponding network transmission. As above indicated for the first scenario, the E2E-NSM delivers service processing requests to meet the service requirements together with specific QoS parameters to TNSM.
Meanwhile, network monitoring, analyzing and optimizing are implemented for the complete network slice lifecycle management.

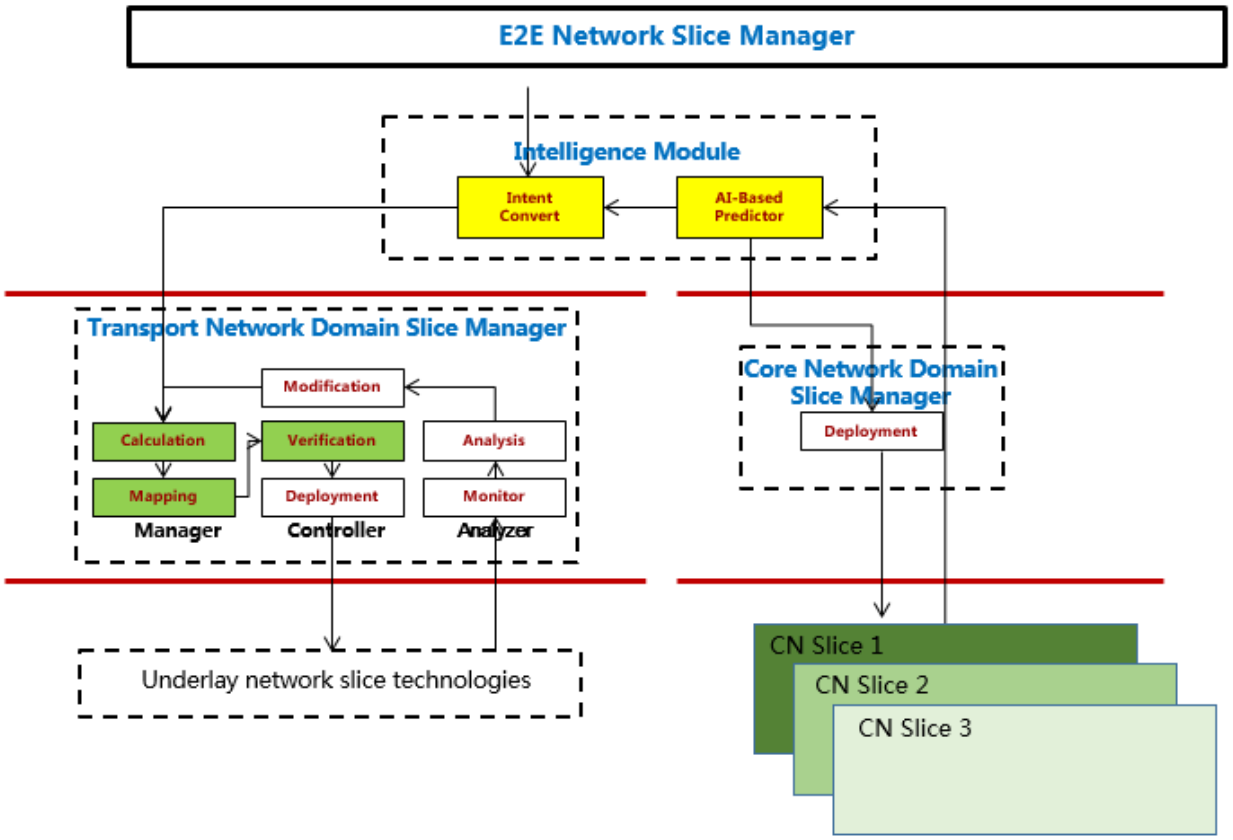


**Figure 1: PoC Architecture**

For the second scenario, in order to make a better decision, an AI-based predictor is deployed for generating new scale up/down and the corresponding suggested configuration. Once the scale up/down re-configuration is accepted by the CNSM, the predictor will notify the TNSM with an intent-based network slice creation/modification request sent within the Intelligence module.

The intent convert functionality translates those intent-based network slice creation/modification requests, coming either from the E2E-NSM or from the AI-based predictor, into a detailed network slice creation/modification request and delivers it to TNSM. By taking the network status into consideration, TNSM provides underlay network ~~modules~~ components configurations to satisfy the network slice requests. A number of data plane and control plane technologies are to be deployed in the transport network in order to achieve the requested specific transmission QoS performance.

Next subsections report with deeper detail the working procedures that must run in order to fulfil scenario 1 and 2 above described. Subsection 2.2.1 is applicable to both scenarios, while subsection 2.2.2 is applicable only to scenario 2.

### 2.2.1 Translation from Tenant Requirement to Network Slice Configuration

Dedicated QoS supported by TN network slicing is an important E2E feature that requires the cooperation among data plane, control plane and management plane. Data plane and control plane provide the feasibility of dedicated QoS in the bottom layer, while management plane provides the operations to optimally manage a network slicing by determining the components slicing capability selection, parameters configuration, network slice topology, etc.

The objective of introducing an intent-based interface is to make network slice easy-to-use. After receiving an intent-based request for creating/modifying a network slice, TNSM analyzes existing requests, configurations, as well as network conditions to send a detailed technical request as an output to the underlying network. As the mapping from an intent-based request to this detailed technical request may not be unique, a previous use of an intelligent converter takes place as it provides a better plan by learning from previous context when using AI. Within the TNSM, the calculation functionality further estimates a network slicing creation/modification and configuration according to the detailed technical request and network resource inventory. The Network resource inventory is data that is available within the

TNSM. Because the calculation functionality is designed to be independent of the underlay network deployment, a mapping functionality is introduced within the TNSM to map the suggestion to particular network components configurations. After passing verification, configurations are delivered to underlying network components that become active.

### 2.2.2 Prediction of Service Pattern and E2E Management Cooperation

By learning from data, the AI based predictor functionality can analyze the service pattern and marked service trend prediction for dynamically scaling up/down an E2E network slice. The dynamic modification requirements related to e.g. computation or resources handling, are delivered to CNSM and TNSM. E2E-NSM collects slice status from CNSM and TNSM, and then notifies the slice tenant.

## 2.3 PoC Success Criteria

All goals are met when the described functionality is proved to be available.