ENI ISG PoC Report
Intelligent Network Slicing Life Cycle Management

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 Report

2.1 PoC Project Completion Status

- Overall PoC Project Completion Status: completed

2.2 ENI PoC Project Participants

- PoC Project Name: Intelligent Network Slicing Life Cycle Management
- Network Operator/Service Provider: China Telecom
  Contact: Haining Wang (wanghn.bri@chinatelecom.cn)
- Manufacturer A: Huawei
  Contact: Shengming Cai (caishengming@huawei.com)

  Shucheng Liu (liushucheng@huawei.com)
- Manufacturer B: Intel
  Contact: Kuo Liao (kuo.liao@intel.com)

  Jie Dong (jie.dong@intel.com)
- Manufacturer C: CATT
  Contact: Hui Xu (xuhui@catt.cn)
- Manufacturer D: DAHO Network
  Contact: Qian Wang (sisy.wq@dahonetworks.com)
- Additional Members: China Electric Power Research Institute
  Contact: Delong Yang (yangdelong@epri.sgcc.com.cn)

2.3 Confirmation of PoC Event Occurrence

ETSI ENI#7 Meeting, Beijing, 19 September, 2018

The PoC was presented in the laboratory of China Telecom Beijing Research Institute with network devices.

Network Intelligence Forum, Beijing, 20 September, 2018

The PoC was presented with network devices during the full event at a dedicated booth.

GNTC 2018, Nanjing, 14-16, November, 2018

The PoC was presented in the form of video record during the full event at a dedicated booth.

ETSI ENI#9 Meeting, 10 April, 2019

The PoC was presented in the form of video record.

2.4 PoC Goals Status Report

- 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.

  The goal has been fully demonstrated. The demonstration includes several transport network slicing use cases for creation and adjustment with intent-based user interface. The user interface simplifies input by offering templates specifying devices' roles and performance requirements for different scenarios. The Transport Network Domain Slice Manager (TNSM) receives slice input, calculate the topology and resources allocated to this slice, and map the result to detailed configuration of devices; it also provides northbound interface to the Intelligence Module for slice monitoring and policy delivery. The underlay network devices support slice features including FlexE sub-interface and VPN+.

- 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.

  The goal has been fully demonstrated. The intelligence module is able to analyse traffic history of a slice, predict traffic trend in the near future, and deliver scale up/down policy for the slice resources to prevent quality of service declining. Policy can be aggressive or conservative to make a tradeoff between resource utilization and quality of service guarantee.

2.5 PoC Feedback Received from Third Parties (Optional)

The SDN Network Intelligence Forum PoC was focused on transport slice creation and adjustment, with high emphasis on the AI applicability in the area of network analyse and control. Most relevant comments that could apply to ENI are:

- **The AI/ML system should consider more possible impact factors from different aspects**. Some promotions and social events will cause unusual traffic statistics. If the AI/ML system is unaware of such events, the upper bound of prediction accuracy may be difficult to achieve a very high value.
- **AI-based decision making model should consider the impact of wrong decision.** If the reserved bandwidth is less than the actual throughput, then traffic congestion will cause longer latency or packet loss, which will have negative impact on user experience. As AI model usually can be correct in all cases, tradeoff is to be made among rewards and potential cost.

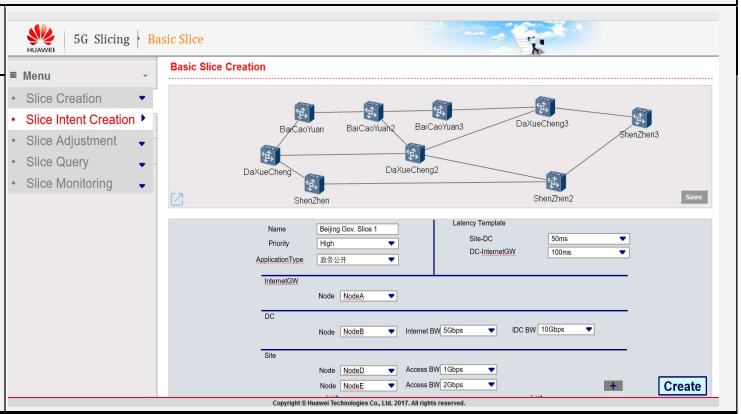
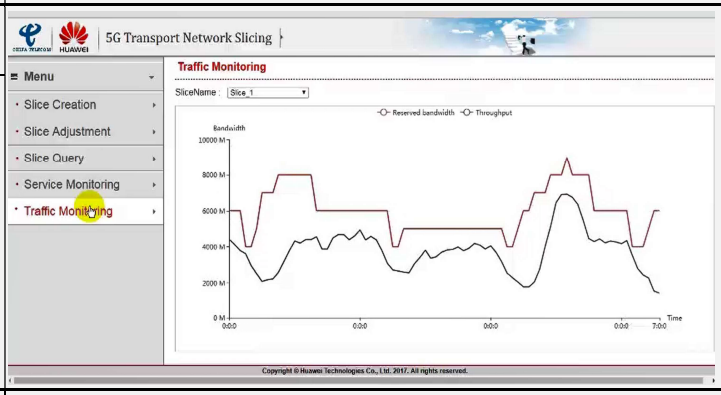
3 ENI PoC Technical Report (Optional)

3.1 General

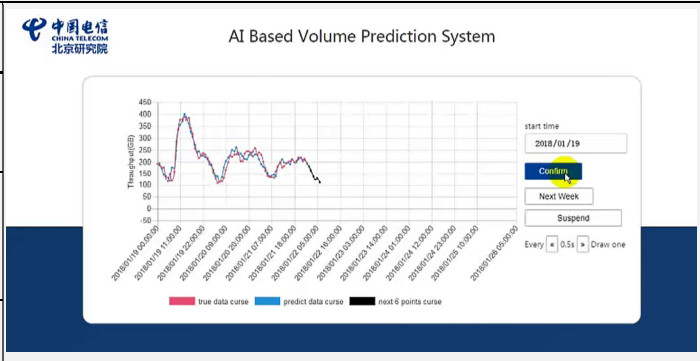
The PoC was organized over two different scenarios

1. Intent-based intelligent slice management (PoC goal #1)
2. Traffic prediction and slice adjustment with AI (PoC goal #2)

Scenario 1: 1. Intent-based intelligent slice management

Scenario:	Intent-based intelligent slice management
Motivation:	Provide functionalities required by intelligent slice management, and simplify input for portal interface
Sequence:	
1. Select high priority slice and an intent-based template, select node roles and SLA parameters, request for slice creation.	
2. The TNSM converts the intent-based request into detailed request with unified format. During the conversion, parameters will be supplemented according to the build-in relationship between the selected template and the unified format of slice creation requirement	
3. TNSM calculate the optimal result, and creates a slice in the underlay network.	
4. The slice topology and resources can be displayed once successfully created.	
5. Create services in the slice to enable E2E service provisioning. 6. Monitor real time traffic QoS in the Dashboard	
7. Receive scale up/down policy for bandwidth resources of the slice. 8. Monitor the real time traffic throughput and reserved bandwidth in the Dashboard	
Results:	TNSM accepts slice creation and adjustment policies, and applies them to related slice.

Scenario 2: Traffic prediction and slice adjustment with AI

Scenario:	Traffic prediction and slice adjustment with AI
Motivation:	Verify the feasibility of AI in network traffic prediction and decision making.
Sequence:	
1. Collect historical network traffic data	
2. The data is stored and processed by feature engineering techniques.	
3. A supervised learning model (LSTM) is trained to predict traffic trends from the stored data.	
4. Deploy the trained model, receive real time traffic statistics from TNSM, inference future traffic trend, determine scale up/down policy and deliver the policy to TNSM	
5. Display time series data for real traffic statistics and predicted traffic statistics	
Results:	The AI module can predict network traffic with a high accuracy, and the policy delivered to TNSM can satisfy real time bandwidth requirement

3.2 PoC Contribution to ENI ISG

Table 1

Contribution	WG/EG	Work Item (WI)	Comments
ENI(18)000186 Requirements from PoC project#1		RGS/ENI-007 (GS ENI 002) Requirements	*Two new requirements are identified for resilience and reliability. Two new requirements are identified for data collection and analysis.*
ENI(18)000187 Add description to intelligent network slicing management from PoC project#1		RGS/ENI-008 (GS ENI 001) Use cases	*Modifications are identified regarding intelligent network slice management use case (#3-2).* Extend the use case context to more services. Add some description of triggering conditions and operational flow of actions.

3.3 Gaps identified in ENI standardization

Table 2

Gap Identified	Forum (ENI ISG, Other)	Affected WG/EG	WI/Document Ref	Gap details and Status
Model deployment and update Interface	ENI		DGS/ENI-005 (GS ENI 005) Architecture	AI will be applied in multiple use cases of network administration and operation. It is desirable to have a unified interface for AI model integration in all cases. The AI model of this PoC is manually deployed and updated.
Data collection and normalization	ENI, BBF		DGS/ENI-005 (GS ENI 005) Architecture	Large scale and real time data collection requires support from network devices. Collected data should be normalized and centralized managed together for better sharing. This PoC can collect end-to-end traffic statistics every 3 seconds.
Interface between network controller and intelligence module	ENI		DGS/ENI-005 (GS ENI 005) Architecture	Interaction between intelligence module and network controller is required for data analysis, inference and result delivery. The PoC implements data collection and policy deliver via TCP with json format. This help decouple AI module and TNSM.

3.4 PoC Suggested Action Items

It is suggested that ENI continues to work on standardization of gaps described in Section 3.3.

3.5 Additional messages to ENI

None in addition to the matters discussed above.

3.6 Additional messages to Network Operators and Service Providers?

None.