

---

# PoC Report

## 1 PoC Project Details

### 1.1 PoC Project Review

PoC Number:	4
PoC Project Name:	Autonomous network slice management
PoC Project Host:	DOCOMO Communications Lab., NTT Corp., NTT Communications, Corp., NTT DOCOMO, INC.
Short Description:	This PoC demonstrates the use-case of the autonomous network slice management. The use-case is based on ZSM framework reference architecture and implemented with the ZSM standards and NTT products. The PoC will demonstrate management services (defined in ZSM 002), network slice management (defined in ZSM 003) and cross-domain orchestration (defined in ZSM 008) on E2E service management domain and TN, CN, DN management domain.
PoC Project Status : <i>(Ongoing/Completed)</i>	Completed

## 1.2 PoC Team Members Review

	Organisation name	ISG ZSM participant (yes/no)	Contact (Email)	PoC Point of Contact (*)	Role (**)	PoC Components
1	DOCOMO Communications Lab.	yes	Wenjing Chen <a href="mailto:wenjing.chen.bv@nttdocomo.com">wenjing.chen.bv@nttdocomo.com</a>  Shinsaku Akiyama <a href="mailto:akiyamashi@nttdocomo.com">akiyamashi@nttdocomo.com</a>	X	Research center	In charge of the study and implement to integrate all these products with the PoC scenarios and standard specification.
2	NTT Corp.	yes	Aki Fukuda <a href="mailto:aki.fukuda.cd@hco.ntt.co.jp">aki.fukuda.cd@hco.ntt.co.jp</a>  Shiku Hirai <a href="mailto:shiku.hirai.uk@hco.ntt.co.jp">shiku.hirai.uk@hco.ntt.co.jp</a>  Sho Kanemaru <a href="mailto:sho.kanemaru.pw@hco.ntt.co.jp">sho.kanemaru.pw@hco.ntt.co.jp</a>  Yoshiki Aoki <a href="mailto:yoshiki.aoki.ev@hco.ntt.co.jp">yoshiki.aoki.ev@hco.ntt.co.jp</a>  Hiroki Baba <a href="mailto:hiroki.baba.zp@hco.ntt.co.jp">hiroki.baba.zp@hco.ntt.co.jp</a>		Research center	Take over the "Multi-layer Transport Provisioning Engine", "HANMOC", "ACPE", "APIO", SLG and router.
3	NTT Communications, Corp.	no	Shoji Hashimoto <a href="mailto:shoji.hashimoto@ntt.com">shoji.hashimoto@ntt.com</a>  Senri Hiraba <a href="mailto:s.hirabaru@ntt.com">s.hirabaru@ntt.com</a>  Haruki Takahashi <a href="mailto:haruki.takahashi@ntt.com">haruki.takahashi@ntt.com</a>		Network operator	Take over the "Qmonus" as a PaaS for the implementation of E2ES MD.
4	NTT DOCOMO, INC.	no	Taisuke Omoto <a href="mailto:omoto@nttdocomo.com">omoto@nttdocomo.com</a>  Shinichi Isobe <a href="mailto:isobes@nttdocomo.com">isobes@nttdocomo.com</a>		Network operator	In charge of the study and implement to integrate all these products with the PoC scenarios and standard specification.
(*) Identify the PoC Point of Contact with an X. (**) The Role will be network operator/service provider, infrastructure provider, application provider or other.						

All the PoC Team members listed above declare that the information in this report is conformant to their activities during the PoC Project.

## 1.3 PoC Project Scope Review

### 1.3.1 PoC Topics

Report the status of all the PoC Topics and Expected Contributions anticipated in the PoC Proposal

PoC Topic Code	PoC Topic Description	Related WI	Submitted Contribution link	Date	Status (*)
Cross-domain user-driven E2E services	Demonstration of the cross-domain orchestration and automation between the E2ES MD and the TN, CN, DN MD	ZSM002, ZSM003 and ZSM008		Final May 2022	Completed
(*) Planned, On-going, Completed, delayed (new target date), Abandoned					

### 1.3.2 Other topics in scope

Report the status of all the additional PoC Topics and Contributions anticipated in the PoC Proposal.

PoC Topic Code	PoC Topic Description	Related WI	Submitted Contribution link	Date	Status (*)
(*) Planned, On-going, Completed, delayed (new target date), Abandoned					

## 1.4 PoC Project Milestones Review

PoC Milestone	Milestone description	Target Date	Additional Info	Completion Date
P.S	PoC Project Start	Jan 2022	Presented to ZSM members during ZSM#18-e and e-mail approved.	Mar. 3 <sup>rd</sup> 2022
P.D1	PoC Demo 1	Mar 2022	Network slice instance creation based on ZSM002 ZSM framework with ZSM003 network slicing process and ZSM008 management service between E2ES MD and MD.	Mar. 7 <sup>th</sup> 2022
P.D2	PoC Demo 2	Mar 2022	Network slice instance deletion based on ZSM002 ZSM framework with ZSM003 network slicing process and ZSM008 management service between E2ES MD and MD.	Mar. 7 <sup>th</sup> 2022
P.C1	PoC Expected Contribution 1	Mar 2022	Contribution on the lessons from Demo 1 and Demo 2 (PoC_x_Interim_Report.doc)	During the ZSM-Interim#11e.
P.D3	PoC Demo 3	Apr 2022	Closed-loop automation due to the FM/PM notification related to ZSM002, ZSM003 and ZSM008.	May. 22 <sup>nd</sup> 2022
P.R	PoC Report	May 2022	Contribution on the lessons from Demo 3 is included in the final report.	During the ZSM#19.
P.E	PoC Project End	May 2022		

---

## 2 Additional information

An Interim report and a final report are presented at ZSM's meetings (ZSM-Interim#11e and ZSM#19).

A PoC presentation including demonstrations is presented at ETSI ZSM forum "Insight from ZSM PoC demonstrations" during Lay123 Reunion on 26<sup>th</sup> April 2022.

<https://congress.layer123.com/event/f6bbdefe-7441-4e9c-bcb8-9ae25cf1877b/websitePage:2baa15cf-2ef0-4cff-8004-47bbe0664a09>



---

## 3 PoC Technical Details

### 3.1 PoC Overview

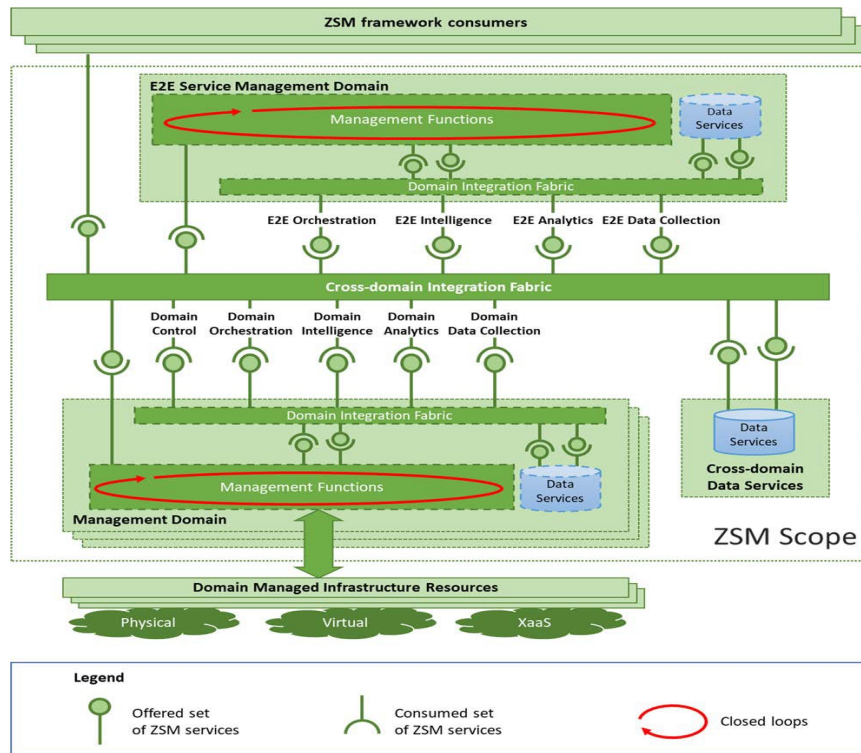
#### 3.1.1 Use-case Description

In the 5G-era, with the introduction of network slicing and other techniques, the network will be complex and layered and require more advanced and diversified operation processes. It is an issue for operators to perform network operation with 5G services at the same level as conventional 3G and 4G services with existing human resource.

Furthermore, operators also need to consider how to utilize standardizations with existing systems.

This PoC will combine ZSM assets with other standardizations, technologies, products and operator's existing environment to validate the feasibility of autonomous network slice management. The network slice instance is based on the 3GPP NRM defined in TS28.541. 3GPP and TMF operation which are referred in ZSM are also taken into account. About each management domain, ONF TAPI specifications are referred by TN, 3GPP is for CN and TMF open API is for DN.

This PoC is based on the ZSM framework as Figure 1 and covers E2E service management domain and management domains. The latest version of GSMA GST (Generic Network Slice Template) v5.0 will be adopted to create the service order.



**Figure 1 ZSM framework**

The PoC will demonstrate management services (defined in ZSM 002), network sling management (defined in ZSM 003) and cross-domain orchestration (ZSM 008). Table 1 summarizes the content of the PoC.

**Table 1 Content of the PoC**

Demo No.	Use-case Scenario	ZSM Management Service/ Sequence	Details
1	Network Slice Management	<ul style="list-style-type: none"> <li>- Managed services catalogue management service (Creation)</li> <li>- Network Slice Instance Creation</li> <li>- E2E services inventory management</li> <li>- Domain inventory management</li> </ul>	<ul style="list-style-type: none"> <li>- Catalogue creation to create E2E services</li> <li>- Network slice instance creation according to service order</li> <li>- Inventory management with E2E services/slices information</li> </ul>
2	Network Slice Management	<ul style="list-style-type: none"> <li>- Network Slice Instance Deletion</li> </ul>	<ul style="list-style-type: none"> <li>- Network slice instance deletion according to service order</li> </ul>
3	Service Operation	<ul style="list-style-type: none"> <li>- Network Slice Modification</li> </ul>	<ul style="list-style-type: none"> <li>- Network slice modification(e.g. due to FM/PM notification or service order) or network slice instance scaling/healing</li> </ul>

\*: The use-case scenarios may be included in other scenarios.

### 3.1.2 Scope and Content of the PoC

The scope of the PoC is as the red part in Figure 2. The PoC covers the E2E service management domain and TN, CN, DN\* management domain to demonstrate the end-to-end orchestration with multi management domains.

RAN is not in the scope, however, a gNB simulator is used to provide call signal.

\*In this PoC, DN management domain not only provides management function to the DN, but also to the multi-domain (TN and CN) as described in 3.2. Hence, “DN management domain” is named as “interwork management domain” here.

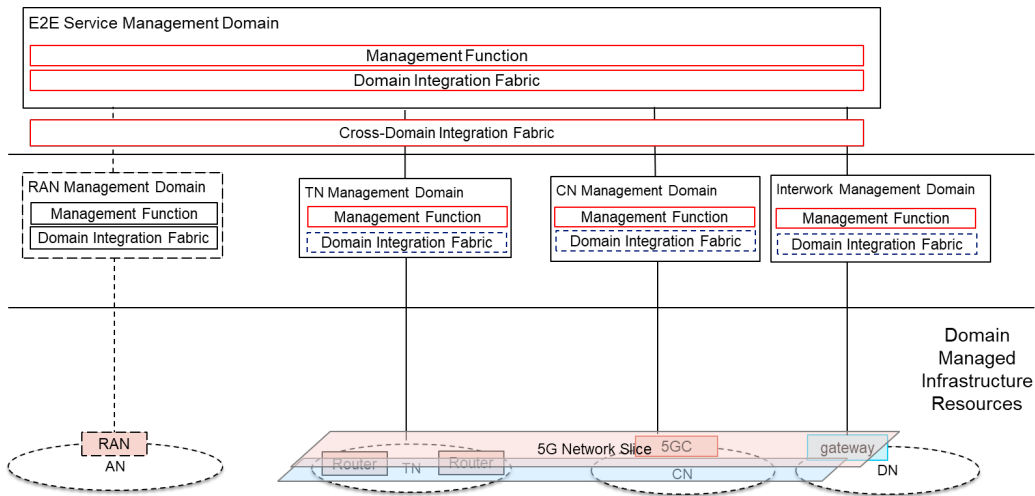


Figure 2 Scope of the PoC

### 3.2 PoC Architecture

Figure 3 depicts the PoC architecture. It is based on the ZSM framework and adopts some commercial products.

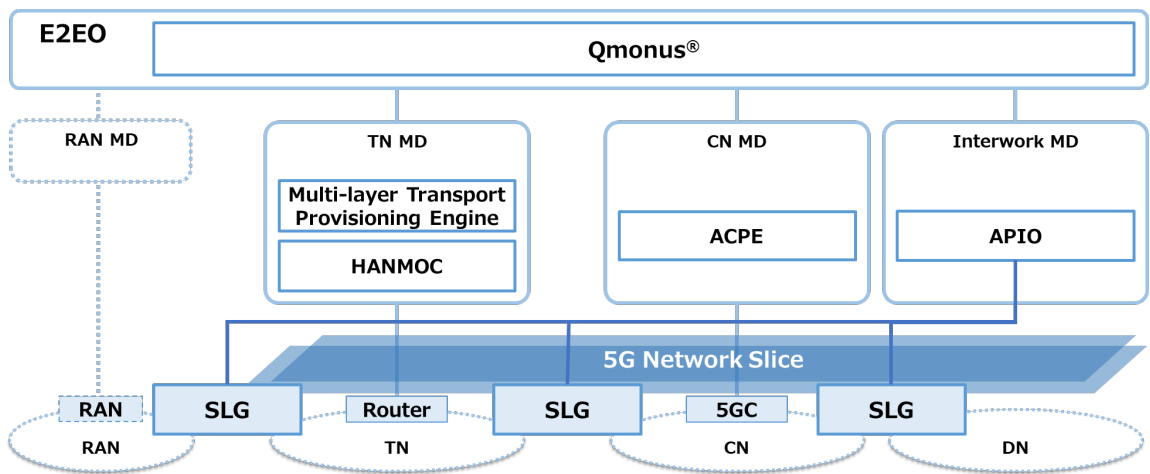


Figure 3 PoC Architecture

Qmonus[1], which is a PaaS for advanced cloud-native application development, delivery and management, is adopted to the implementation of E2E service management domain.

Multi-layer Transport Provisioning Engine provides transport slice resource optimization engine configuring both of optical and packet transport networks dynamically.

HANMOC[2] realizes the simulation of the latency and manages the network domain with network routing technology.

ACPE is a server resource design optimization engine for 5G cloud-native network capabilities.

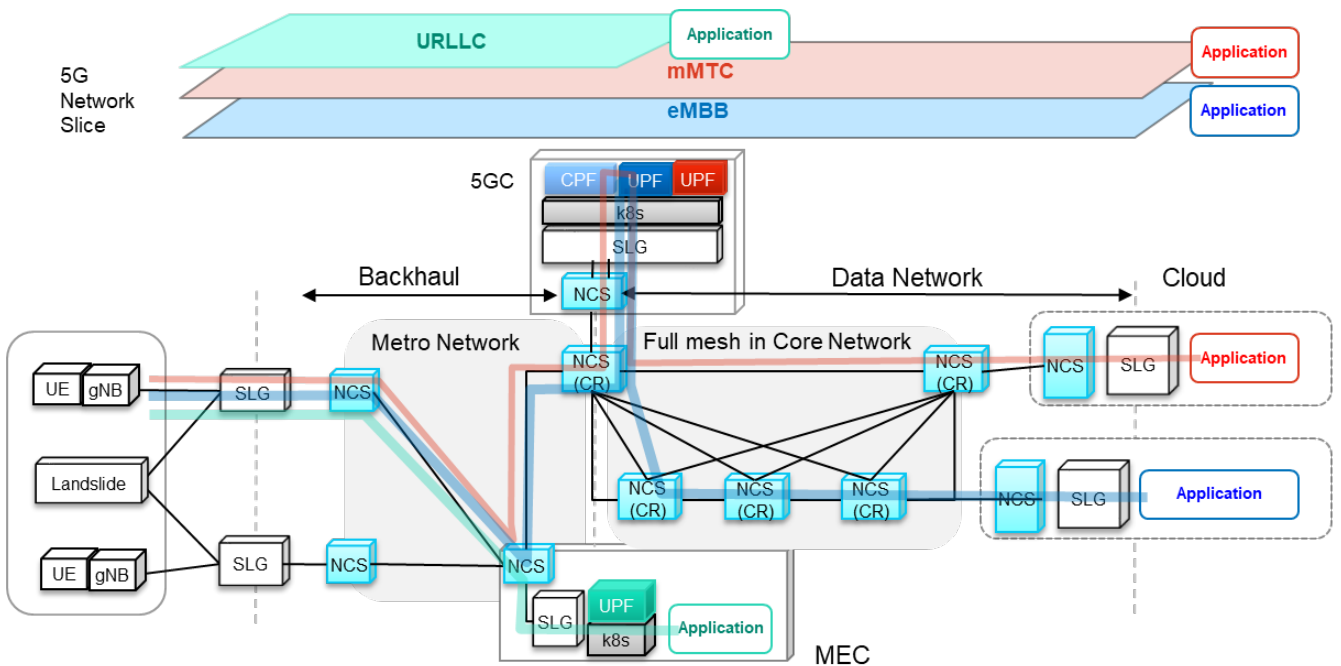
One-stop construction agent technology (APIO) realizes one-stop provisioning of multi-domain services through coordinating APIs.

SLG provides a virtual gateway function that provides 5G network slice connectivity by connecting paths between domains and network quality control.

### 3.3 Network Topology

The network topology (Data-plane) of this PoC is shown as figure 4.

The network is consisted of metro network as known as backhaul (between gNB and UPF) and data network as known as core network (between UPF and application).



**Figure 4 Network Topology**

### 3.4 Scenarios

This section details the scenarios of demos.

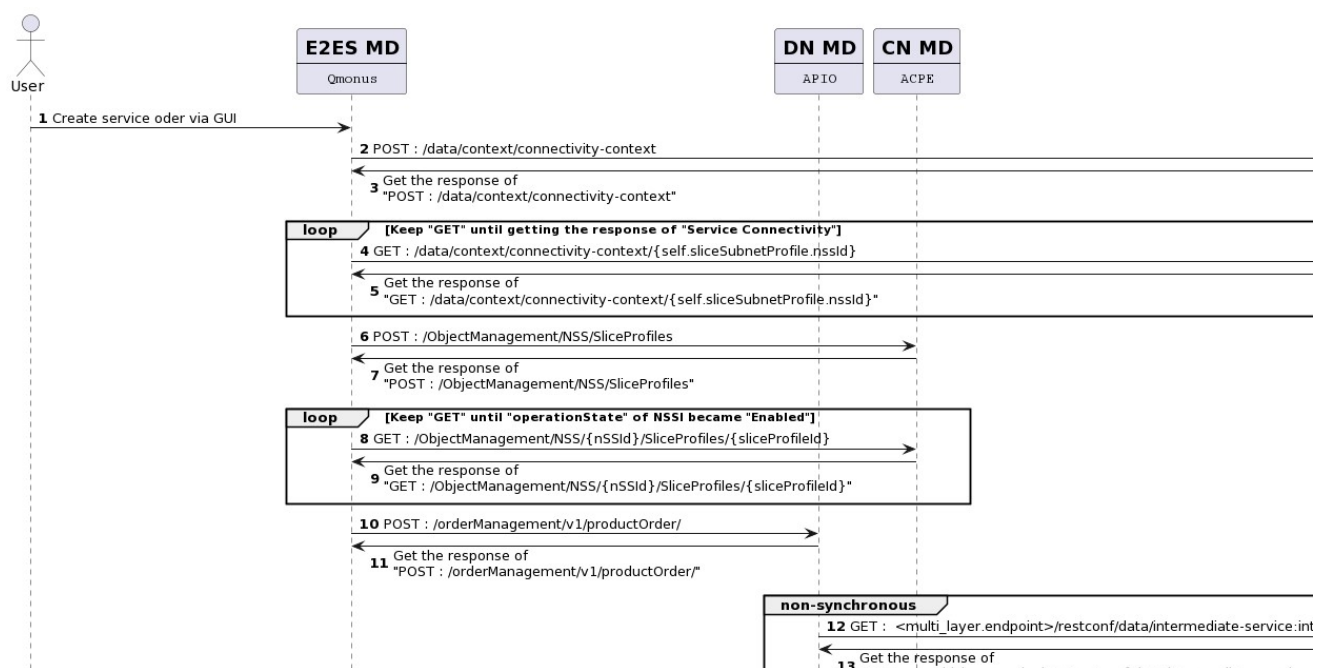
In general, the standardizations as below are adopted in this PoC.

- GSMA GST v5.0 (Generic Network Slice Template) is adopted to create the service order.

- Network slice instance is based on the 3GPP NRM defined in TS 28.541 (5G; Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3) v17.4.0.
- About each management domain, ONF TAPI TR-547 (Reference Implementation Agreement) v2.1.3 is referred by TN, 3GPP TS 28.531 (5G; Management and orchestration; Provisioning) Rel.16 is for CN. TMF open API TMF 622 (Product Ordering API REST Specification) v4.0.1 is for DN.

### 3.4.1 Demo 1: Network Slice Management (Network Slice Creation)

This procedure creates a network slice instance by requesting the orchestration of the domain service instances that make up the network slice from TN, CN, DN management domains.



**Figure 5 Network Slice Creation**

#### PRECONDITIONS:

- The network slice catalogue has been onboarded.

The procedure, as illustrated in figure 5, consists of the following steps:

1. The ZSM framework consumer requests service management domain for the service order of network slice creation.
2. The E2E service management domain requests transport management domain for allocating the network slice subnet instance serve as "AllocateNssi" operation with data API defined in ONF TAPI TR-547.
3. The E2E service management domain gets the "uuid" of "connectivity service" from transport management domain as the response of service order of network slice creation.
4. The E2E service management domain requests transport management domain for service connectivity.



5. The E2E service management domain gets the result of "Connectivity Service" from transport management domain.
6. The E2E service management domain requests core management domain for allocating the network slice subnet instance with "AllocateNssi" operation defined in TS 28.531.
7. The E2E service management domain gets the "nssId" from core management domain as the response of the network slice subnet instance allocation.
8. The E2E service management domain requests core management domain for enabling the network slice subnet instance.
9. The E2E service management domain gets the "Enabled" from core management domain as the response of "operationState".
10. The E2E service management domain requests data management domain for allocating the network slice subnet instance serve as "AllocateNssi" operation with TMF "productOrder" API defined in TMF 622.
11. The E2E service management domain gets the "productOrderId" from data management domain as the response of the network slice subnet instance allocation.
12. The data management domain request transport management domain for connecting.
13. The data management domain gets the response of transport management domain connecting.
14. The E2E service management domain requests data management domain for completing the network slice creation with TMF "productOrder" API defined in TMF 622.
15. The E2E service management domain gets the "Completed" from data management domain as the response of "productOrder.state".
16. The ZSM framework consumer gets the result from E2E service management domain as the response of service creation.

POSTCONDITIONS:

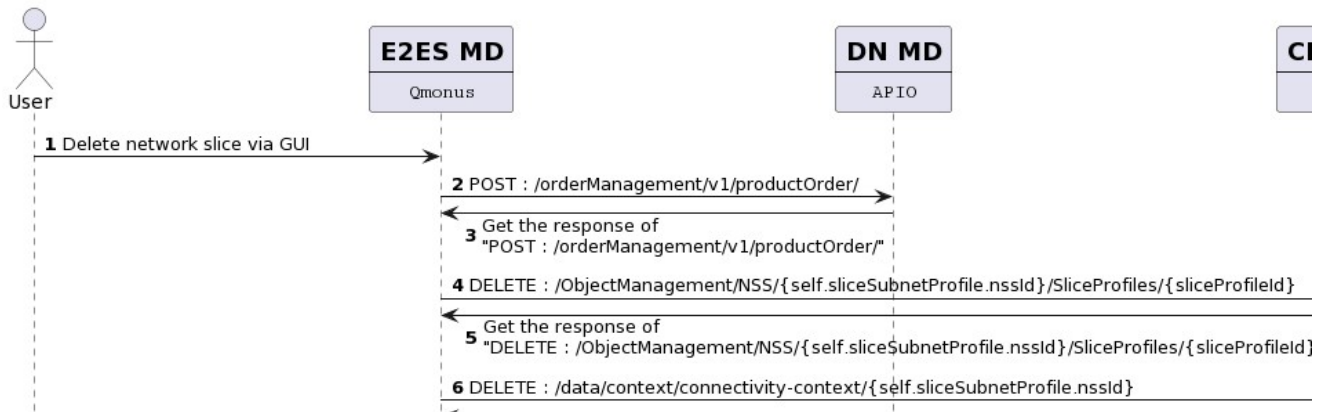
- The network slice has been created.

ERROR CONDITIONS:

- Failing individual steps of this procedure will terminate the procedure with an error.

### 3.4.2 Demo 2: Network Slice Management (Network Slice Deletion)

This procedure deletes a network slice instance by requesting the orchestration of the domain service instances that make up the network slice from TN, CN, DN management domains.



**Figure 6 Network Slice Deletion**

**PRECONDITIONS:**

- The network slice instance has been activated.

The procedure, as illustrated in figure 6, consists of the following steps:

1. The ZSM framework consumer requests service management domain for the service order of network slice deletion.
2. The E2E service management domain requests data management domain for deallocating the network slice subnet instance serve as “DeallocateNssi” operation with TMF “productOrder” API defined in TMF 622.
3. The E2E service management domain gets the response from data management domain.
4. The E2E service management domain requests core management domain for deallocating the network slice subnet instance with “DeallocateNssi” operation defined in TS 28.531.
5. The E2E service management domain gets the response from core management domain.
6. The E2E service management domain requests transport management domain for deallocating the network slice subnet instance serve as “DeallocateNssi” operation.
7. The E2E service management domain gets the response from transport management domain.
8. The ZSM framework consumer gets the result from E2E service management domain as the response of network slice deletion.

**POSTCONDITIONS:**

- The network slice has been deleted.

**ERROR CONDITIONS:**

- Failing individual steps of this procedure will terminate the procedure with an error.

### 3.4.3 Demo 3: Service Operation

This procedure uses the closed-loop to manage the service and network slice according to the policy.

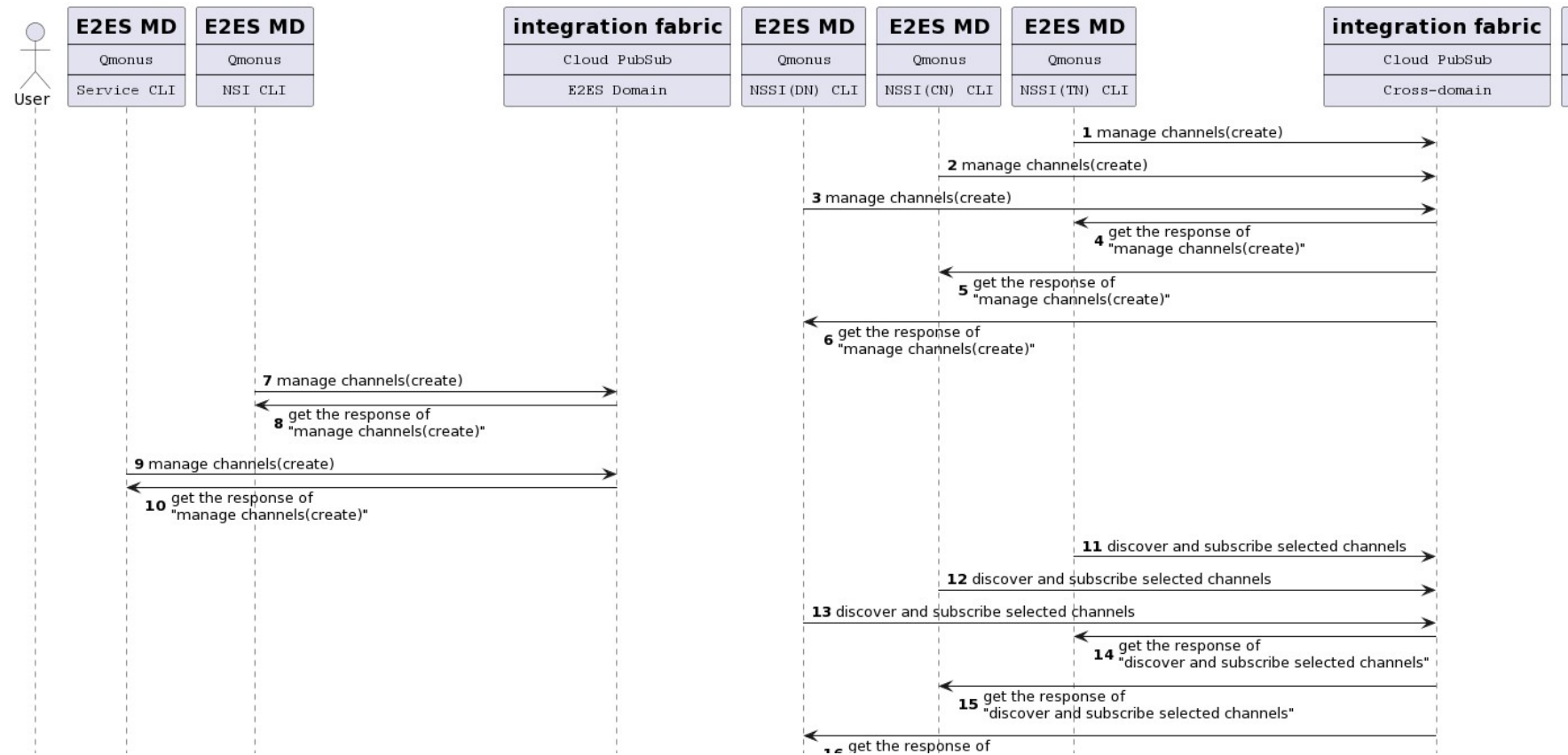


Figure 7-1 Service Operation

#### PRECONDITIONS:

- The network slice instance has been activated.
- The closed-loop has been created during the allocation process.
- The channel creation and subscription of integration fabric has been done during the allocation process.
- The channel deletion and unsubscription of integration fabric has been done during the deallocation process.

The procedure, as illustrated in figure 7-1, consists of the following steps:

Step 1 to step 20 are based on the Figure 5.4.2.2.2-1 “Consumer-initiated set-up of information collection related to domain service instances” of ZSM008.

From step 1 to step 3 are executed simultaneously.

1. The E2E service management domain (NSSI CLI of transport management domain) requests integration fabric to create the channels to provide the information of nssId and schema created by E2E service management domain.
2. The E2E service management domain (NSSI CLI of core management domain) requests integration fabric to create the channels to provide the information of nssId and schema created by E2E service management domain.
3. The E2E service management domain (NSSI CLI of data management domain) requests integration fabric to create the channels to provide the information of nssId and schema created by E2E service management domain.

Step 4 to step 6 are executed simultaneously.

4. The E2E service management domain (NSSI CLI of transport management domain) gets the response from integration fabric.
5. The E2E service management domain (NSSI CLI of core management domain) gets the response from integration fabric.
6. The E2E service management domain (NSSI CLI of data management domain) gets the response from integration fabric.
7. The E2E service management domain (NSI CLI) requests integration fabric to create the channels to provide the information of nsId and schema created by E2E service management domain.
8. The E2E service management domain (NSI CLI) gets the response from integration fabric.
9. The E2E service management domain (service CLI) requests integration fabric to create the channels to provide the information of servicId and schema created by E2E service management domain.
10. The E2E service management domain (service CLI) gets the response from integration fabric.

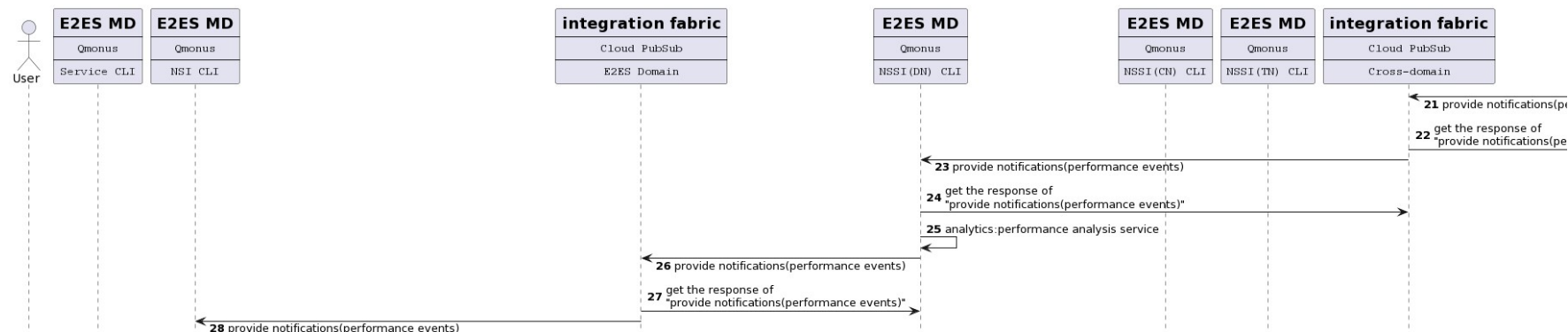
From step 11 to step 13 are executed simultaneously.

11. The E2E service management domain (NSSI CLI of transport management domain) requests integration fabric to discover and subscribe selected channels.
12. The E2E service management domain (NSSI CLI of core management domain) requests integration fabric to discover and subscribe selected channels.
13. The E2E service management domain (NSSI CLI of data management domain) requests integration fabric to discover and subscribe selected channels.

From step 14 to step 16 are executed simultaneously.

14. The E2E service management domain (NSSI CLI of transport management domain) gets the response from integration fabric.
15. The E2E service management domain (NSSI CLI of core management domain) gets the response from integration fabric.
16. The E2E service management domain (NSSI CLI of data management domain) gets the response from integration fabric.

17. The E2E service management domain (NSI CLI) requests integration fabric to discover and subscribe selected channels.
18. The E2E service management domain (NSI CLI) gets the response from integration fabric.
19. The E2E service management domain (service CLI) requests integration fabric to discover and subscribe selected channels.
20. The E2E service management domain (service CLI) gets the response from integration fabric.



**Figure 7-2 Service Operation**

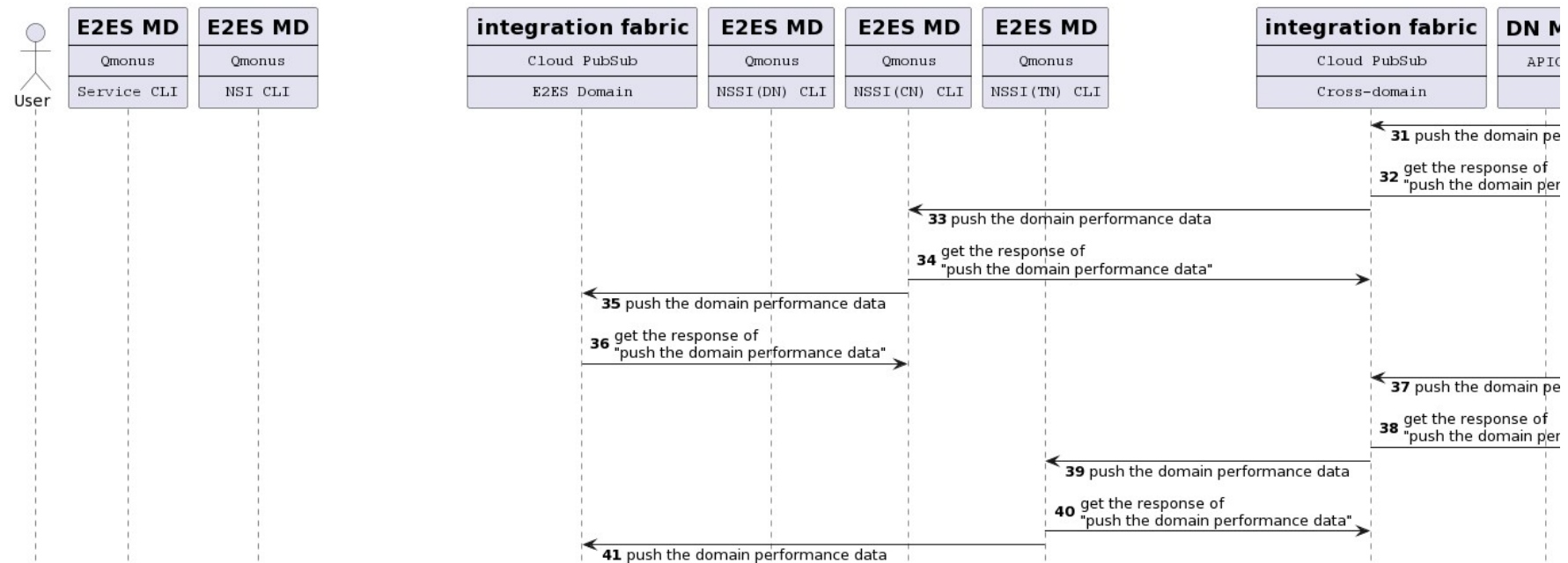
The procedure, as illustrated in figure 7-2, consists of the following steps:

Step 21 to step 30 are based on the Figure 5.4.3.2-1 "Managing service quality" of ZSM008.

21. The data management domain provides notifications on performance events (such as threshold crossings) to integration fabric. The operation and attributes are based on "notifyThresholdCrossing request" of 3GPP TS 28.532.
22. The data management domain gets the response from integration fabric. The operation and attributes are based on "notifyThresholdCrossing response" of 3GPP TS 28.532.

Due to step 23, NSSI CLI status of data management domain changes from "Monitoring" to "Analysis".

23. The integration fabric provides notifications on performance events (such as threshold crossings) to E2E service management domain (NSSI CLI of data management domain).
24. The integration fabric gets the response from E2E service management domain (NSSI CLI of data management domain).
25. The E2E service management domain (NSSI CLI of data management domain) analyses the performance event with "Performance analysis service".
26. The E2E service management domain (NSSI CLI of data management domain) provides notifications on performance events (such as threshold crossings) to integration fabric.
27. The E2E service management domain (NSSI CLI of data management domain) gets the response from integration fabric.
28. The integration fabric provides notifications on performance events (such as threshold crossings) to E2E service management domain (NSI CLI).
29. The integration fabric gets the response from E2E service management domain (NSI CLI).
30. The E2E service management domain (NSI CLI) determines whether additional domain performance data is necessary or not.



**Figure 7-3 Service Operation**

The procedure, as illustrated in figure 7-3, consists of the following steps:

Step 31 to step 44 are based on the Figure 5.4.3.2-1 "Managing service quality" of ZSM008.

Step 31 to step 36 and step 37 to step 42 occur when management domain gets the performance events periodically.

31. The core management domain pushes performance events (such as threshold crossings) data to integration fabric. The operation and attributes are based on "reportStreamData request" of 3GPP TS 28.532.

32. The core management domain gets the response from integration fabric. The operation and attributes are based on "reportStreamData response" of 3GPP TS 28.532.

Due to step 33, NSSI CLI status of core management domain changes from "Monitoring" to "Analysis".

33. The integration fabric pushes performance events (such as threshold crossings) data to E2E service management domain (NSSI CLI of core management domain).

- 34. The integration fabric gets the response from E2E service management domain (NSSI CLI of core management domain).
- 35. The E2E service management domain (NSSI CLI of core management domain) pushes performance events (such as threshold crossings) data to integration fabric.
- 36. The E2E service management domain (NSSI CLI of core management domain) gets the response from integration fabric.

- 37. The transport management domain pushes performance events (such as threshold crossings) data to integration fabric.
- 38. The transport management domain gets the response from integration fabric.

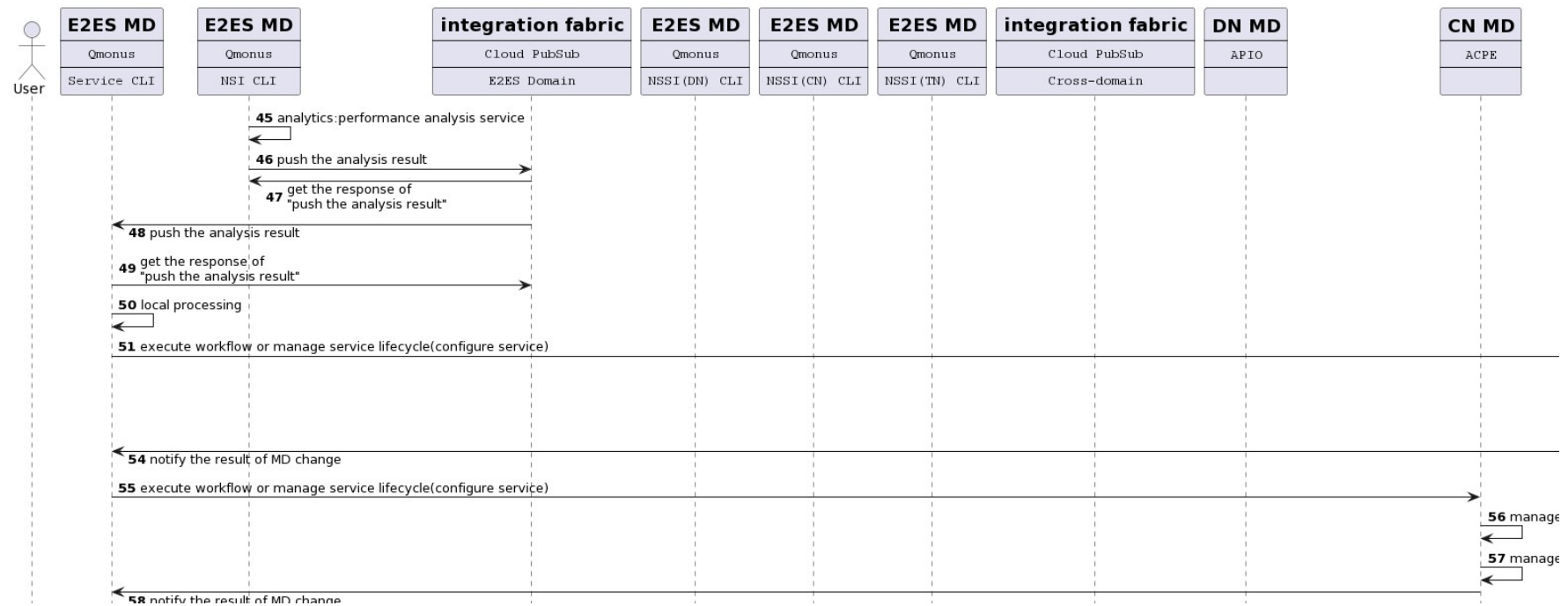
Due to step 39, NSSI CLI status of transport management domain changes from “Monitoring” to “Analysis”.

- 39. The integration fabric pushes performance events (such as threshold crossings) data to E2E service management domain (NSSI CLI of transport management domain).
- 40. The integration fabric gets the response from E2E service management domain (NSSI CLI of transport management domain).
- 41. The E2E service management domain (NSSI CLI of transport management domain) pushes performance events (such as threshold crossings) data to integration fabric.
- 42. The E2E service management domain (NSSI CLI of transport management domain) gets the response from integration fabric.

Due to step 43, NSI CLI status changes from “Monitoring” to “Analysis”.

- 43. The integration fabric pushes performance events (such as threshold crossings) data to E2E service management domain (NSI CLI).
- 44. The integration fabric gets the response from E2E service management domain (NSI CLI).





**Figure 7-4 Service Operation**

The procedure, as illustrated in figure 7-4, consists of the following steps:

Step 45 to step 62 are based on the Figure 5.4.3.2-1 “Managing service quality” of ZSM008.

45. The E2E service management domain (NSI CLI) analyses the performance event with “Impact analysis service”.

46. The E2E service management domain (NSI CLI) pushes the analysis result to integration fabric.

47. The E2E service management domain (NSI CLI) gets the response from integration fabric.

Due to step 48, service CLI status changes from “Monitoring” to “Analysis”.

48. The integration fabric pushes the analysis result to E2E service management domain (service CLI).

49. The integration fabric gets the response from E2E service management domain (service CLI).

Due to step 50, service CLI status changes from “Analysis” to “Decision”.

50. The E2E service management domain (service CLI) decides the action to solve the performance event.

Due to step 51, service CLI status changes from “Decision” to “Execution”.

51. The E2E service management domain (service CLI) requests transport management domain to execute workflow or manage service lifecycle to modify NSI/NSSI.

52. The transport management domain manages the resource configuration such as to modify the throughput.

53. The transport management domain manages the resource lifecycle.

54. The transport management domain notifies the change to E2E service management domain (service CLI).

55. The E2E service management domain (service CLI) requests core management domain to execute workflow or manage service lifecycle to modify NSI/NSSI.

56. The core management domain manages the resource configuration such as to modify the throughput. The operation and attributes are based on “modifyMOI request” of 3GPP TS 28.532.

57. The core management domain manages the resource lifecycle. The operation and attributes are based on “modifyMOI response” of 3GPP TS 28.532.

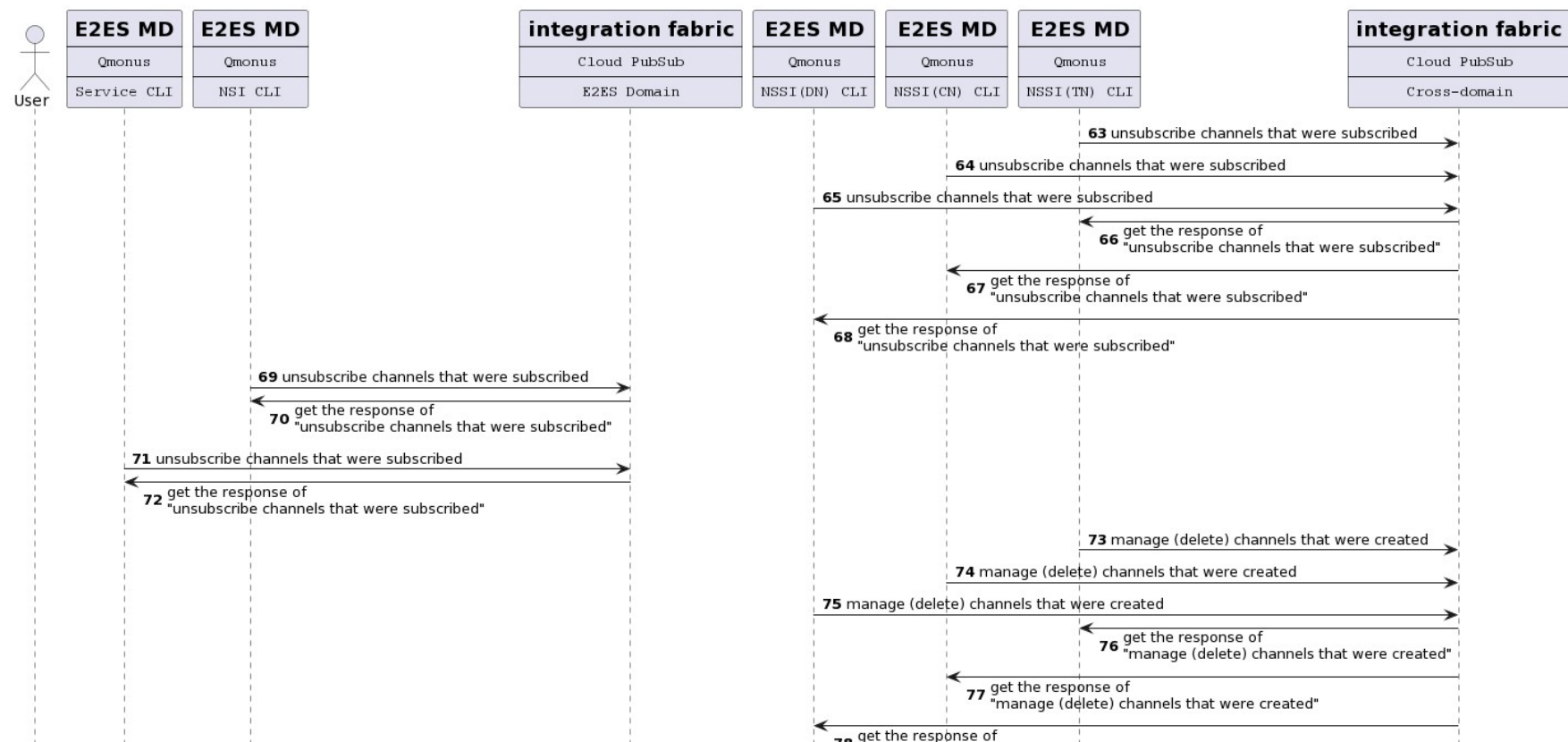
58. The core management domain notifies the change to E2E service management domain (service CLI).

59. The E2E service management domain (service CLI) requests data management domain to execute workflow or manage service lifecycle to modify NSI/NSSI.

60. The data management domain manages the resource configuration such as to modify the throughput. The operation and attributes are based on “modifyMOI request” of 3GPP TS 28.532.

61. The data management domain manages the resource lifecycle. The operation and attributes are based on “modifyMOI response” of 3GPP TS 28.532.

62. The data management domain notifies the change to E2E service management domain (service CLI).



**Figure 7-5 Service Operation**

The procedure, as illustrated in figure 7-5, consists of the following steps:

Step 63 to step 82 are based on the Figure 5.4.5.2.2-1 “Consumer-initiated tear-down of collecting `E2E-service specific` information related to domain service instances” of ZSM008.

Due to step 63, NSSI CLI status of transport management domain changes from “Analysis” to “Decision”.

63. The E2E service management domain (NSSI CLI of transport management domain) requests integration fabric to unsubscribe channels that were subscribed.

Due to step 64, NSSI CLI status of core management domain changes from “Analysis” to “Decision”.

64. The E2E service management domain (NSSI CLI of core management domain) requests integration fabric to unsubscribe channels that were subscribed.

Due to step 65, NSSI CLI status of data management domain changes from “Analysis” to “Decision”.

65. The E2E service management domain (NSSI CLI of data management domain) requests integration fabric to unsubscribe channels that were subscribed.

Due to step 66, NSSI CLI status of transport management domain changes from “Decision” to “Monitoring”.

66. The E2E service management domain (NSSI CLI of transport management domain) gets the response from integration fabric.

Due to step 66, NSSI CLI status of core management domain changes from “Decision” to “Monitoring”.

67. The E2E service management domain (NSSI CLI of core management domain) gets the response from integration fabric.

Due to step 66, NSSI CLI status of data management domain changes from “Decision” to “Monitoring”.

68. The E2E service management domain (NSSI CLI of data management domain) gets the response from integration fabric.

Due to step 69, NSI CLI status changes from “Analysis” to “Decision”.

69. The E2E service management domain (NSI CLI) requests integration fabric to unsubscribe channels that were subscribed.

Due to step 70, NSI CLI status changes from “Decision” to “Monitoring”.

70. The E2E service management domain (NSI CLI) gets the response from integration fabric.

71. The E2E service management domain (service CLI) requests integration fabric to unsubscribe channels that were subscribed.

Due to step 72, service CLI status changes from “Execution” to “Monitoring”.

72. The E2E service management domain (service CLI) gets the response from integration fabric.

73. The E2E service management domain (NSSI CLI of transport management domain) requests integration fabric to delete the channels.

74. The E2E service management domain (NSSI CLI of core management domain) requests integration fabric to delete the channels.

75. The E2E service management domain (NSSI CLI of data management domain) requests integration fabric to delete the channels.

76. The E2E service management domain (NSSI CLI of transport management domain) gets the response from integration fabric.

77. The E2E service management domain (NSSI CLI of core management domain) gets the response from integration fabric.

78. The E2E service management domain (NSSI CLI of data management domain) gets the response from integration fabric.

79. The E2E service management domain (NSI CLI) requests integration fabric to delete the channels.

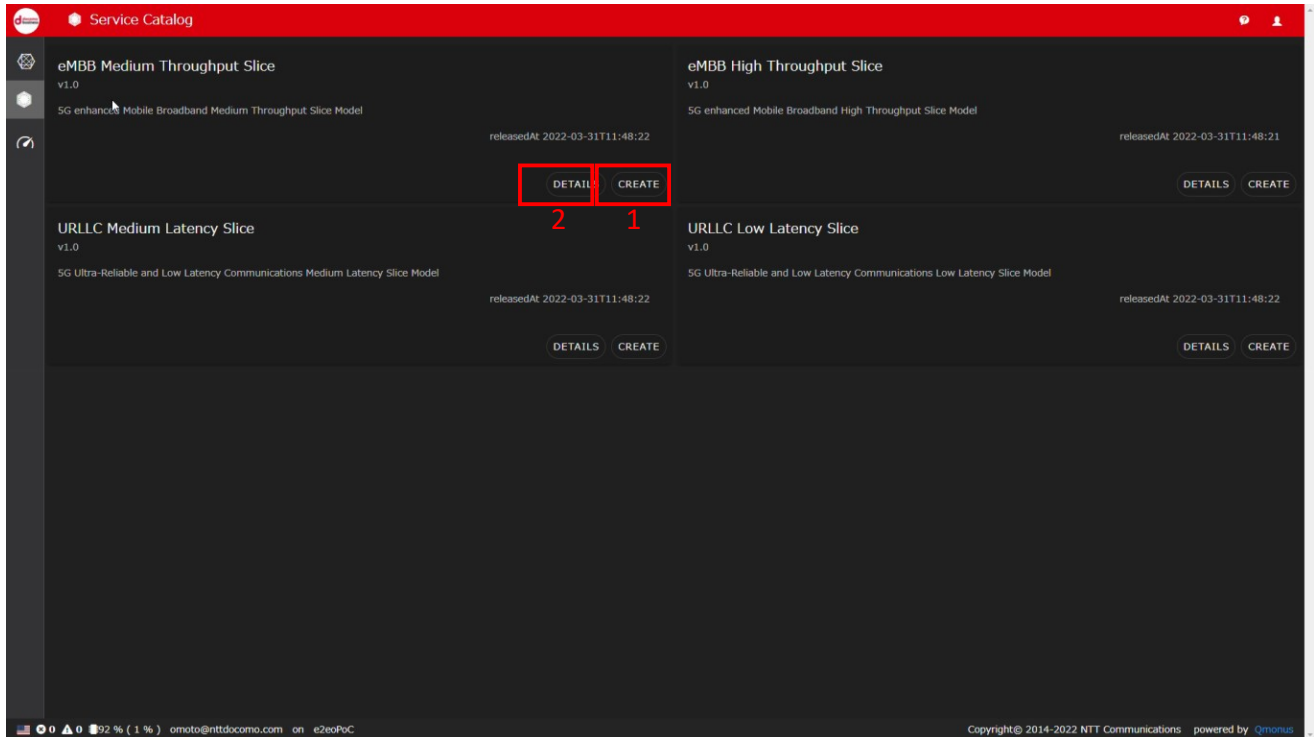
80. The E2E service management domain (NSI CLI) gets the response from integration fabric.

81. The E2E service management domain (service CLI) requests integration fabric to delete the channels.

82. The E2E service management domain (service CLI) gets the response from integration fabric.

## 3.5 Demo screen

This session provides the demo screen for each part with description.



**Figure 8 Service Catalogue on Qmonus**

Four slice templates in a catalogue named eMBB medium throughput slice, eMBB high throughput slice, URLLC medium latency slice, URLLC low latency slice, are prepared in this PoC.

The difference between these catalogues are the value of Throughput and latency.

eMBB medium throughput slice: Throughput= 2.5Gbps, Latency= 100ms

eMBB high throughput slice: Throughput= 5Gbps, Latency= 150ms

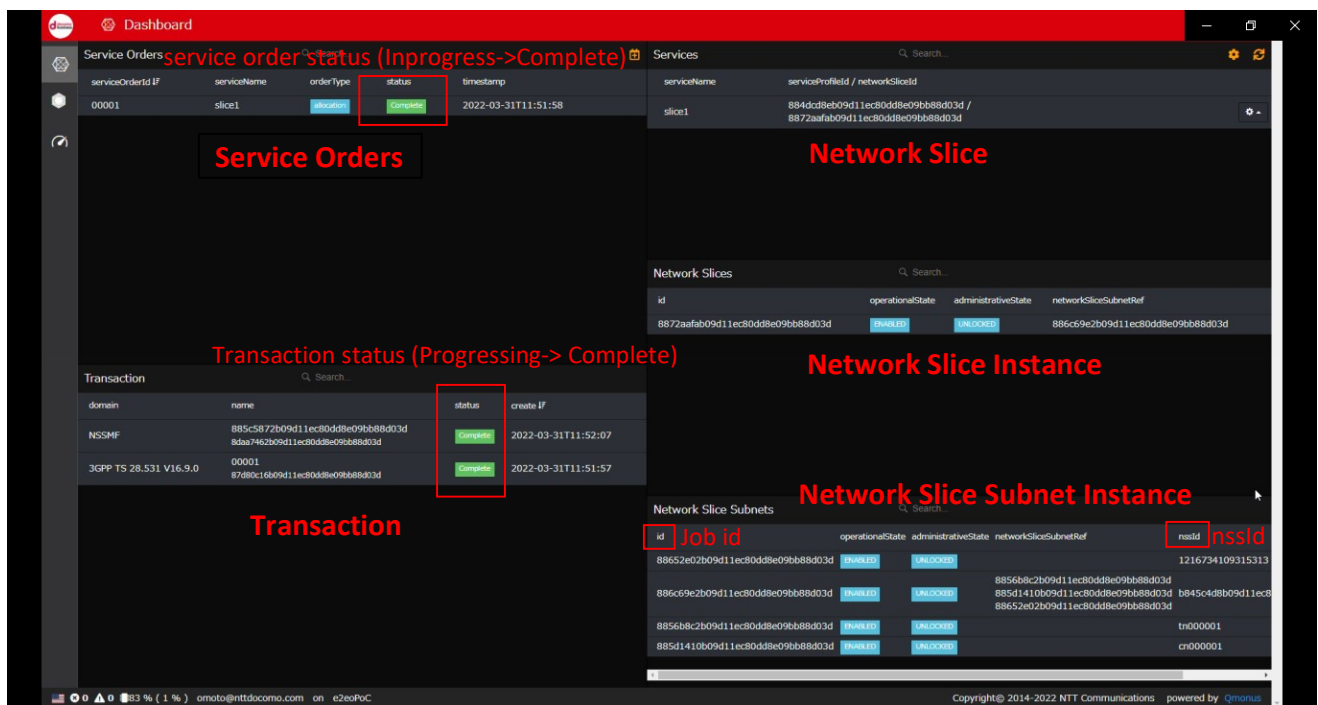
URLLC medium latency slice: Throughput= 0.5Gbps, Latency= 15ms

URLLC low latency slice: Throughput= 0.25Gbps, Latency= 10ms

These are based on the 3GPP Network Resource Model and can be customized with domain specific parameters.

Operator can create network slice and confirm the parameters with operations as below.

1. "CREATE": create a network slice with the catalog.
2. "DETAILS": confirm the parameters of the catalogue.



**Figure 9 Service and Slice Management on Qmonus**

According to the service order, one network slice instance and network slice subnet instance for each management domain are created.

Operator can check all the service order and whether it is complete or not. Before completed, the status will be shown as "Inprogress" in blue.

If all network slice instance and network slice subnet instance are created, the transaction of the service order will change from "Progressing" in blue to "Complete" in green.

"id" means the number of Qmonus job id and NSSID is shown for each job.

Only the network slice whose status is shown as green can be deleted.

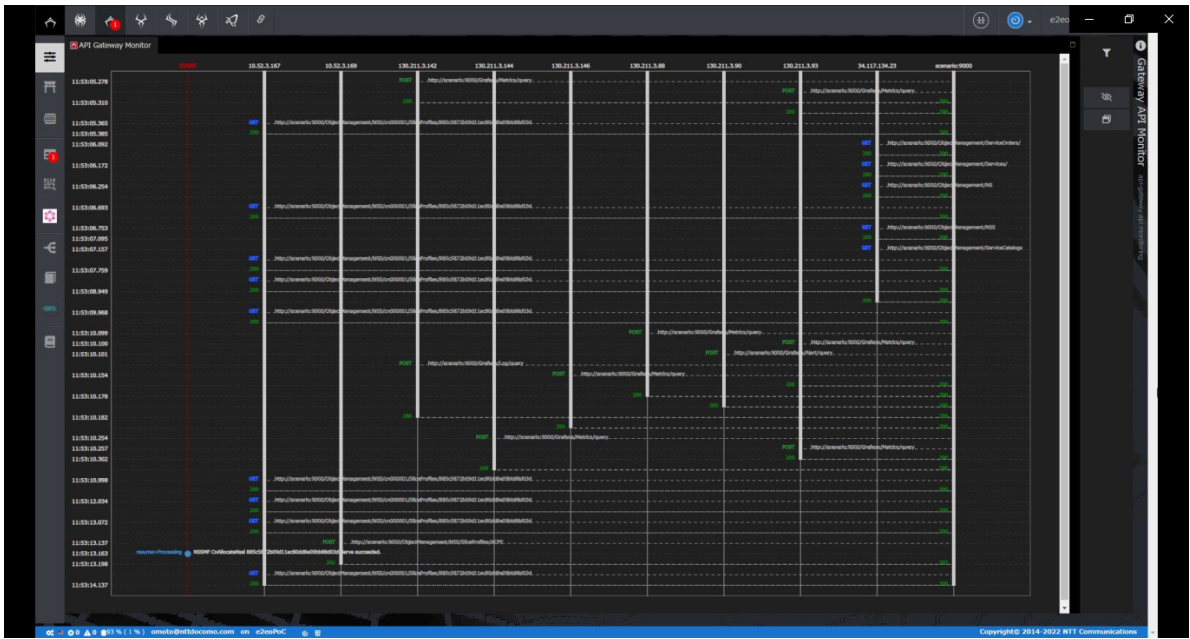


Figure 10 Procedure Dashboard

The procedure dashboard shows the real-time procedures for user to check the processes between E2E service management domain and management domains.



Figure 9 Slice Status Monitoring



With Slice Monitoring, operator can get the details whose data are collected from the transport, core and data management domain.

Operator can choose the domain at the upper left and then “Current Throughput”, “Max of Uplink Throughput” and “Max of Downlink Throughput” on the left hand, will be kept updating.

If fault management alert occurs, it will be shown at the upper right.

And if operation is executed due to the closed-loop, the closed-loop event log will also be updated at the lower right.

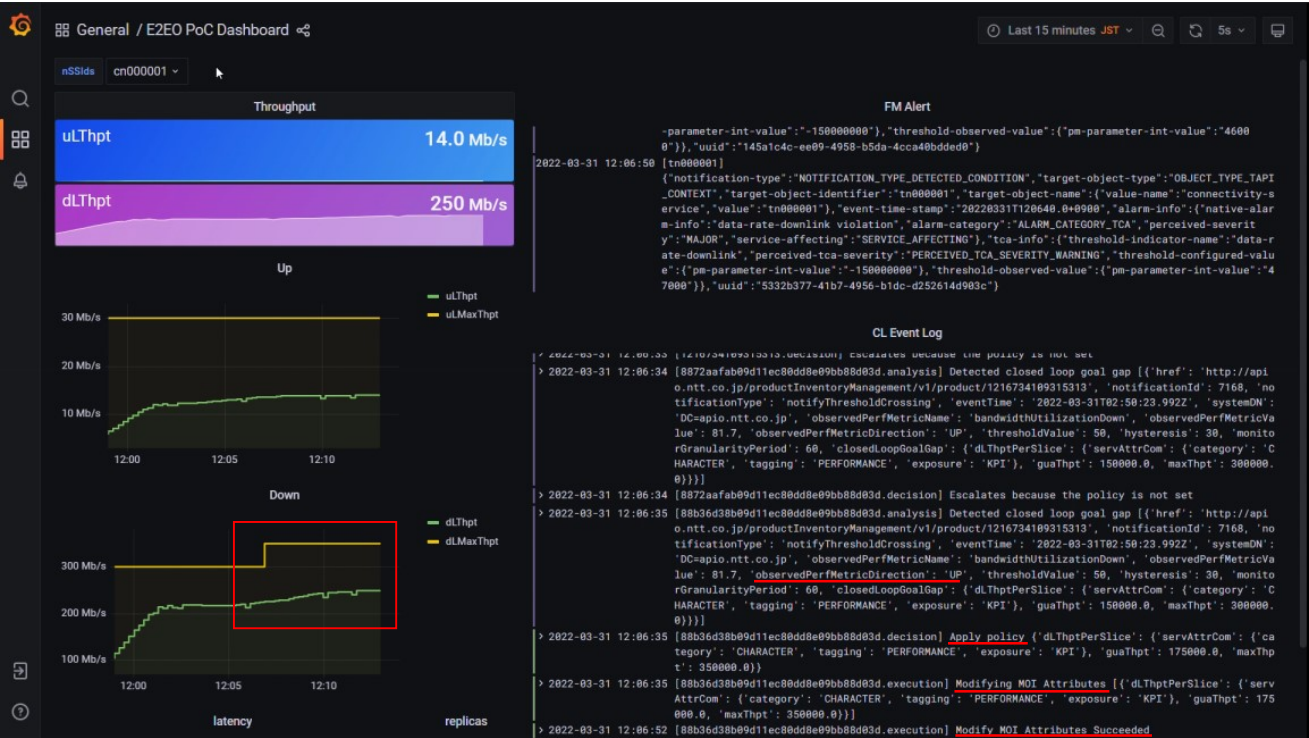


Figure 10-1 Slice Management with Closed-loop

As shown in Figure 10-1, “Max of Downlink Throughput” went over the threshold (“observedPerfMetricDirection”:“UP”), and Fault management alert occurred.

Due to the closed-loop event, “ModifyAPI” operation is requested to expand the “Downlink throughput” and the “Maximum of Downlink Throughput” has been changed.



Figure 10-2 Slice Management with Closed-loop

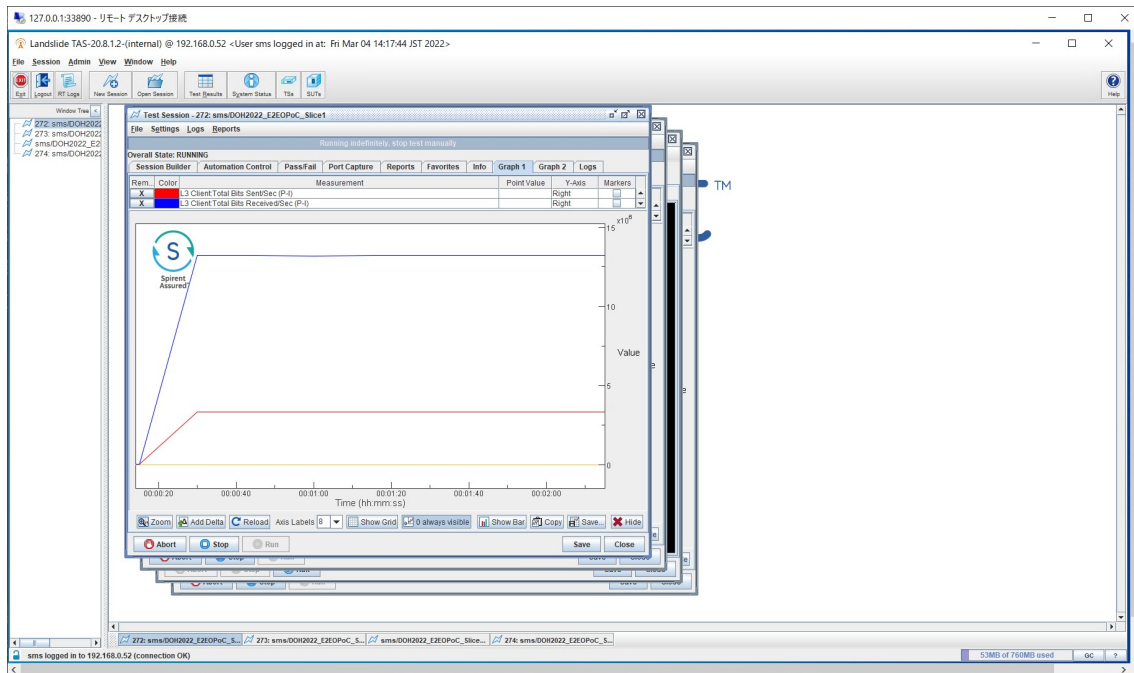
As shown in Figure 10-2, closed-loop event also works in an opposite case.



Figure 11 Traffic Flow Simulator Landslide

Landslide is used as traffic flow simulator in this PoC.

When network slice is active once, selected test session can be executed. Otherwise, an error occurs.



**Figure 12 Traffic Flow Test on Landslide**

When traffic flow test session is executed, gNB and device instance will be launched.

After 5GC registration and set-up of session, traffic flow will be shown.

Since several device instance is launched, throughput will increase for a while and then remain flat.

### 3.6 Gaps identified in ZSM standardization

This session provides the gaps between ZSM standardization and PoC implement for your reference.

### 3.6.1 Demo 1 and Demo 2 (Network Slice Management)

Object 1	Object 2	Object 3	Action	Remarks
Process	allocate	Feasibility check	Not implemented in the PoC	"Feasibility check" is omitted since the resource is available in the PoC.
	modify	Feasibility check	Not implemented in the PoC	"Feasibility check" is omitted since the resource is available in the PoC.
	activation	Topology configure	Not implemented in the PoC	Topology management is out of scope of the PoC.
	deactivation	Topology configure	Not implemented in the PoC	Topology management is out of scope of the PoC.
IF parameter	allocateNssi	cPlaneCallCtlProcessFreq	Added in the PoC	It is necessary for the implement of ACPE.
	modifyNssi	modificationListOut	Not implemented in the PoC	"modificationListOut" is omitted since it is "n/a" in the PoC.
Lifecycle of network slice instance	Preparation	Design On-boarding	Not implemented in the PoC	Design/Onboarding is out of scope of the PoC.  The value of catalogue is pre-set in the PoC.

### 3.6.2 Demo 3 (Service Operation)

Object 1	Object 2	Object 3	Action	Remarks
Process	Closedloop	configure monitoring	Not implemented in the PoC	Threshold is configured from management domain side in the PoC.
		provide streaming measurements provide batch availability notification	Not implemented in the PoC	Only "FM alter" is provided in the PoC.
		"if issue could not be fixed"	Not implemented in the PoC	Issue can be fixed in the PoC.
IF parameter	PM data	connectionId	Not implemented in the PoC	Connection is instead of channel in the PoC.

Closed-loop	Closed loop models	closedLoopLifeCyclePhases(M)	- ZSM: enum  PoC: array - "value" = "Operataion" (default)	- For implementation  - Only "Operation" is used in the PoC.
		currentClosedLoopLifeCyclePhase(M)	- "value" = "Operataion" (default)	- For implementation  - Only "Operation" is used in the PoC.
		closedLoopPriority(M)	- ZSM: enum  PoC: string	For implementation
		manageableEntityList(M)	- ZSM: managedEntity  PoC: array	For implementation
		escalationClosedLoops	Added in the PoC	For implementation
		closedLoopGoalId(M)	(NULL)	For implementation
		closedLoopGoalStatement(M)	- ZSM: goalStatement  PoC: object	For implementation
		managedEntityType(M)	- ZSM: enum  PoC: string	For implementation
		producedManagementCapabilitiesList(M)	- ZSM: enum  PoC: array	For implementation
		consumedManagementCapabilitiesList(M)	- ZSM: enum  PoC: array	For implementation
	CLInstance	Peer Closed Loops	Not implemented in the PoC	Only one network slice in the PoC.
		Management services for Closed Loop Coordination	Not implemented in the PoC	Only one network slice in the PoC and conflict will not happen.

		NSI stage - monitoring - analysis - decision	"execution" is not implemented in the PoC	"execution" of "ServiceCLI" is executed to update the value of "ServiceProfile/SliceProfile" so that "execution" of "NSICLI" is not necessary in the PoC.
		NSSI stage - monitoring - persistNotifications - standardization - analysis - decision	"execution" is not implemented in the PoC  "persistNotifications" and "standardization" are added in the PoC	- "execution" of "ServiceCLI" is executed to update the value of "ServiceProfile/SliceProfile" so that "execution" of "NSSICLI" is not necessary in the PoC.  - For implementation
	stage	persistNotifications	Added in the PoC	For implementation
		standardization	Added in the PoC	For implementation
	Component (closed-loop stage)	knowledge	Not implemented in the PoC	Data is not stored as "knowledge" in the PoC.
Closed-loop usecase	Event notification services	Fault events service(M)	Not implemented in the PoC	Only "Performance events service" is implemented in the PoC.
		Security events service(M)	Not implemented in the PoC	Only "Performance events service" is implemented in the PoC.

### 3.7 PoC Suggested Action Items

This PoC leveraged ETSI ZSM and other standardization specifications to validate network slice management and service operation scenarios in the operator's existing environment. Based on the specifications, operators are able to realize the basic functions in a short time with minor modifications to the product.

Since some parameters of closed-loop model don't have detailed definitions, it is better to provide specific usage examples in further specification.

Moreover, there is few information on the integration fabric, hence a product is adopted in the PoC to provide the management services.

Due to time constraints of the PoC, only basic scenarios are implemented in this PoC. It is worth a further PoC such as on “closed-loop coordination with shared network slice”, “resource management and optimization with AI/ML”.

## 3.8 Reference information

- [1] The information about Qmonus is available at the following link (Japanese only):

<https://axis-edge.github.io/qmonus-developer-portal/#/>

- [2] The information about HANMOC is available at the following link.

<https://www.rd.ntt/e/research/NIC0008.html>