PoC Report

1 PoC Project Details

1.1 PoC Project Review

PoC Number:	13
PoC Project Name:	Intent-based RAN resource management
PoC Project Host:	DOCOMO Communications Lab., NTT Comware Corp., NTT Communications, Corp., NTT DOCOMO, INC.
Short Description:	This PoC is based on ZSM(24)000152r1 which is our discussion paper presented at ZSM#28 and corresponds to “PoC 1” in P.8 of the discussion paper. This PoC demonstrates the use case of the Intent-based RAN resource management. The scope of this PoC is to verify how the RAN MD checks the feasibility of the intent delivered from E2E MD based on RAN resource usage and reservation status, and sends the result of the intent feasibility check and recommendation to E2E MD. The implementation of the solution of this PoC use the 3GPP standards and ZSM standards as a reference. The design architecture of the use case follows ZSM 002 [1] (ZSM framework) and uses the intent-driven management service (including intent management operations and intent information model) defined in 3GPP TS 28.312 [2].
PoC Project Status : *(Ongoing/Completed)*	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	Choonming Chen <choonming.chen.nu@nttdocomo.com> Shinsaku Akiyama <akiyamashi@nttdocomo.com>	X	Research center	In charge of the study and implement to integrate all these products with the PoC scenarios and standard specification.
2	NTT Comware Corp.	no	Masataka Murai <masataka.murai.md@nttcom.co.jp> Takayuki Nakamura <nakamura.takayuki@nttcom.co.jp>		Service Provider	In charge of the study and implement to integrate all these products with the PoC scenarios and standard specification.
3	NTT Communications, Corp.	no	Yousuke Mizuno <yo.mizuno@ntt.com> Senri Hirabaru <s.hirabaru@ntt.com>		Network operator	Take over the "Qmonus" as a PaaS for the implementation of E2E MD and RAN MD.
4	NTT DOCOMO, INC.	no	Shinichi Minamimoto <shinichi.minamimoto.nv@nttdocomo.com>		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 (*)
Topic 3 (Intent-driven Closed-loop automation)	Intent-based RAN resource management	ZSM011, ZSM016	Demo	April 2025	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 Proposal submission	Nov 2024	Official PoC proposal submission.	During the ZSM#29.
P.D	PoC Expected Contribution (Demo)	April 2025	Demonstrate feasibility check of the intent and notification about the result of the intent feasibility check and recommendation.	During the ZSM#30.
P.R	PoC Report	April 2025	PoC Project Feedback.	During the ZSM#30.
P.E	PoC Project End	April 2025		

2 Additional information

The demo video of this PoC will be presented at ZSM’s meeting (ZSM#30).

3 PoC Technical Details

3.1 PoC Overview

3.1.1 Use-case Description

In order to realize automation of the process, it may be needed that network slice service provider builds the mechanism that can derive end-user's expectations from their ambiguous request and provide optimal slice service to satisfy them. In details, the mechanism has the capabilities to automatically extracts requirements (e.g., setting values for RAN resources, etc.) necessary for slice service provisioning from end-user’s abstract request in order to reserve needed resources, and provide the end-user with appropriate feedback to help determine the best requirements for them.

By using an intent-driven approach in the process of network slice service provisioning, it may be possible to achieve the mechanism that have been mentioned above. Through intent-related interfaces, by translating end-user’s intents to resource intents (e.g., intents representing RAN resource requirements) between the upper layer system and E2E MD and MDs, and sending recommendation that support them to decide a next action, it may be possible to realize a mechanism that can automatically provide optimal slice service that satisfies end-user requests.

As a first step, this PoC project will verify RAN resource management by using an intent-driven approach. Based on the results of the verification at this PoC, we will plan to consider a PoC that verifies automation of the process of network slice service provisioning in an architecture that includes the upper layer of E2E MD (e.g., BSS and Chat bot) in the future.

This PoC uses an intent between an operator, E2E MD and RAN MD. The operator acts as an intent owner, in which case the NSMF acts as an intent handler. On the other hand, the NSMF also acts as an intent owner, in which case the RAN-NSSMF acts as an intent handler.

The PoC implementation refers to the intent management operation and intent information model defined in 3GPP TS 28.312[2]. From the description in ZSM011 [3] 3.1, intent owner and intent handler can be mapped to MnS consumer and MnS producer defined in 3GPP TS 28.312.

3.1.2 PoC scope

In this PoC project, the scope is intent-based interaction between an operator, E2E MD and RAN MD. It is assumed that RAN Network Slice Subnet Management Function (RAN-NSSMF) in RAN MD manages RAN resource usage and reservation status. Based on the request for intent creation from the operator, Network Slice Management Function (NSMF) in E2E MD creates the intent representing RAN requirements and the intent report associated with the intent. When the intent is received from NSMF, RAN-NSSMF performs a feasibility check of the received intent to check whether the intent is feasible or not. If the result of the intent feasibility check is "feasible", RAN-NSSMF reserves RAN resources that satisfy the intent. If it is "infeasible", it sends the result of the intent feasibility check including recommendations to NSMF. When the result is received from RAN-NSSMF, NSMF updates the intent report and sends it to the operator. The recommendations help an operator of E2E MD to derive the next action to take (e.g., update the intent or delete the intent).

3.2 PoC Architecture

Figure 1 shows the PoC architecture. It is based on the ZSM framework and adopts some commercial products.

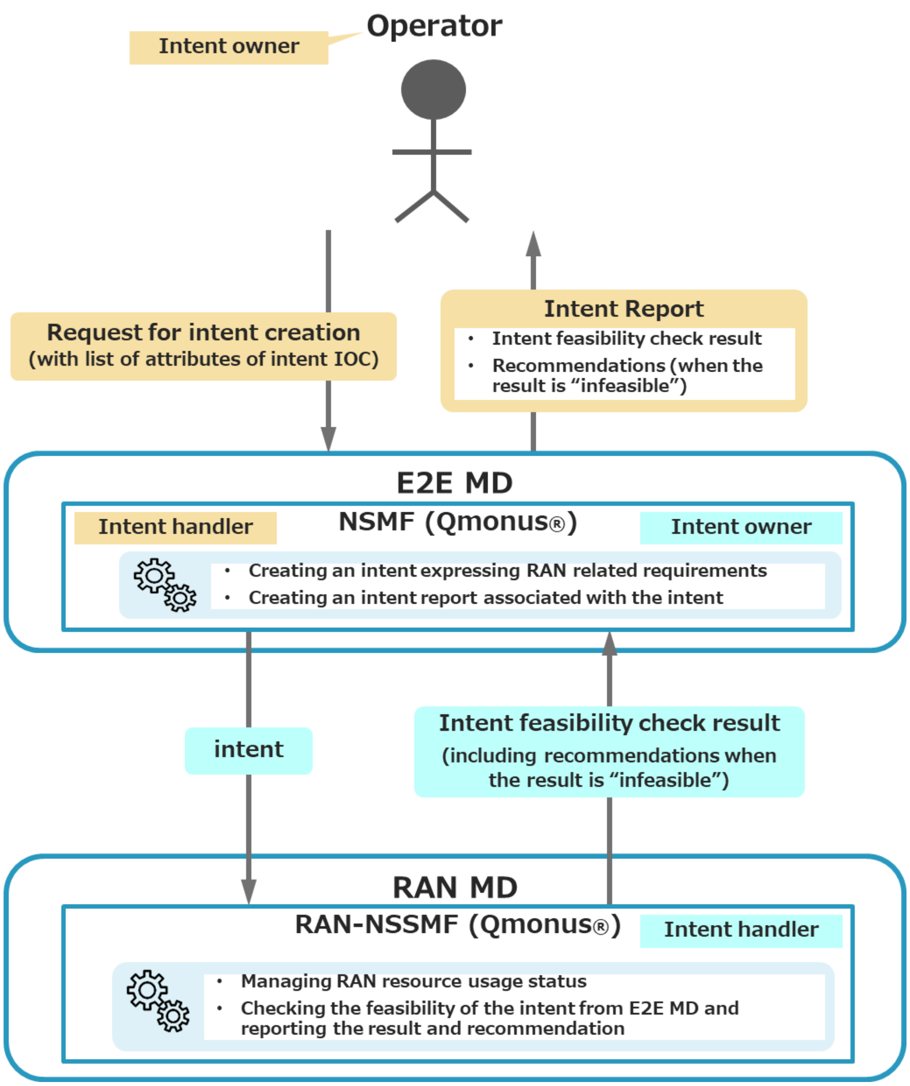

Figure 1: Architecture of this PoC

The E2E MD and RAN MD are implemented using Qmonus [4], a PaaS for the development, delivery, and management of advanced cloud-native applications. As Figure 1 shows, the NSMF delivers the intent to the RAN-NSSMF. The RAN-NSSMF performs a feasibility check on the intent received from the E2E MD based on the managed RAN resource usage and reservation status and sends the check result and recommendation to the NSMF.

3.4 PoC procedure flow

This section details the procedure flow of the PoC demonstration.

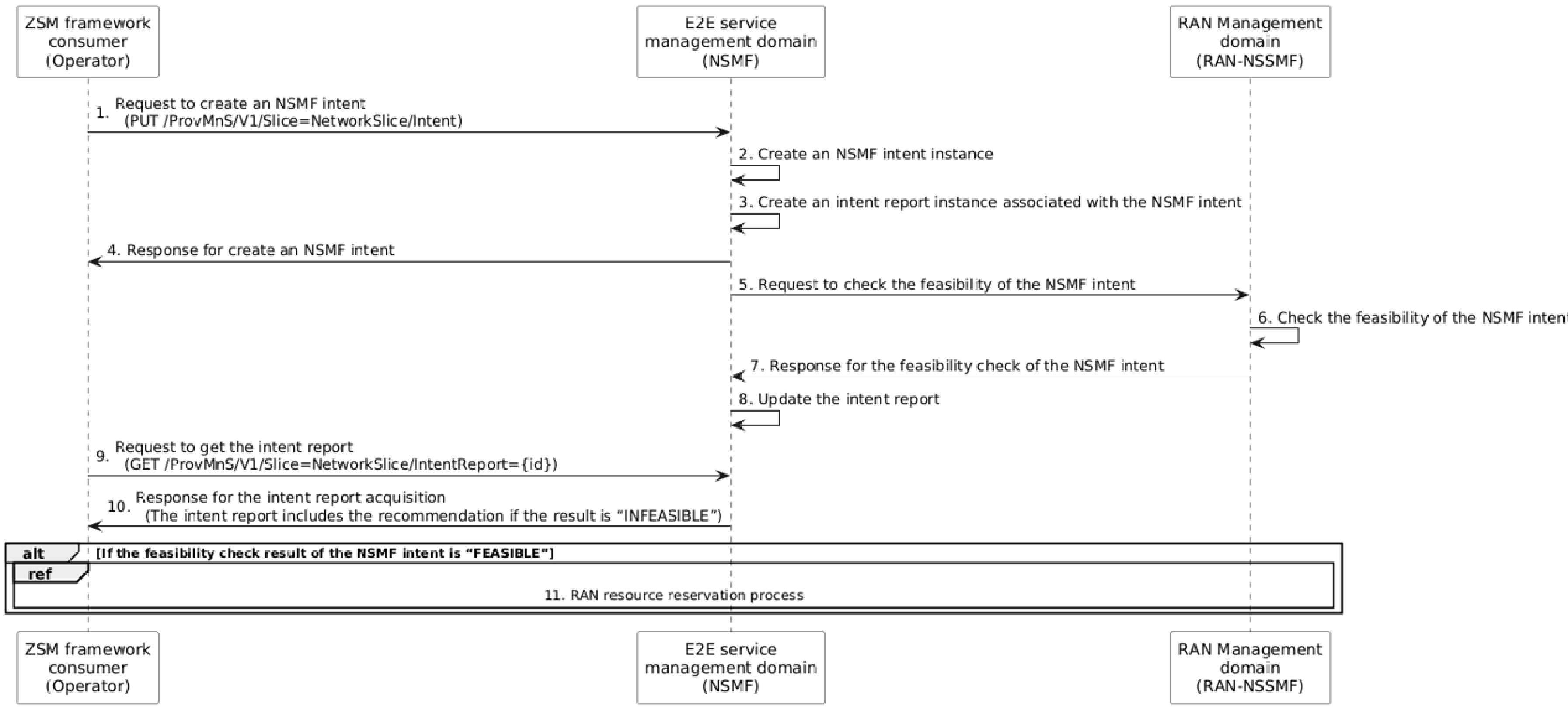

Figure 2: PoC Procedure flow

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

Basically, step 1 to step 10 follows the procedure of create an intent defined in 3GPP TS 28.312 [2], and step 11 follows the procedure of feasibility check and reservation of NSI defined in 3GPP TS 28.531 [5]

1. The ZSM framework consumer requests the NSMF to create an NSMF intent.

2. When the request is received, the NSMF create an NSMF intent instance.

3. The NSMF create an intent report instance associated with the NSMF intent.

4. The ZSM framework consumer gets the response for create an NSMF intent from the NSMF.
5. The NSMF requests the RAN-NSSMF to assess the feasibility of the NSMF intent.
6. When the request is received, the RAN-NSSMF assess the feasibility of the NSMF intent.
7. When the feasibility check of the NSMF intent finished, the NSMF gets the response for the feasibility check of the NSMF intent from the RAN-NSSMF. If the result is "INFEASIBLE," the recommendation is included.
8. Based on the feasibility check result from the RAN-NSSMF, the NSMF updates the intent report.
9. The ZSM framework consumer requests to get the intent report.
10. The ZSM framework consumer gets the response from the NSMF. The intent report includes the recommendation if the feasibility check result is "INFEASIBLE."
11. If the feasibility check result of the NSMF intent is "FEASIBLE," the process for RAN resource reservation is executed.

3.5 Demo screen

This session provides the demo screen with description. We have two PoC scenarios:

- Scenario 1: Intent feasibility check success

  In the first scenario, we will begin by creating an NSMF intent and assessing its feasibility. After that, we will receive an intent report that confirms the feasibility check result as "FEASIBLE." Once we have verified that the check is indeed "FEASIBLE," we will proceed to reserve the necessary RAN resources. Lastly, we will obtain a confirmation report indicating that the reservation has been successfully completed.

- Scenario 2: Intent feasibility check failure

  In the second scenario, we will start by creating an NSMF intent and assessing its feasibility, just as we did in Scenario 1. Next, we will receive an intent report indicating that the result of the feasibility check is "INFEASIBLE," along with a recommendation for reducing the RAN resources.

3.5.1 Scenario 1: Intent feasibility check success

3.5.1.1 NSMF intent creation and intent feasibility check

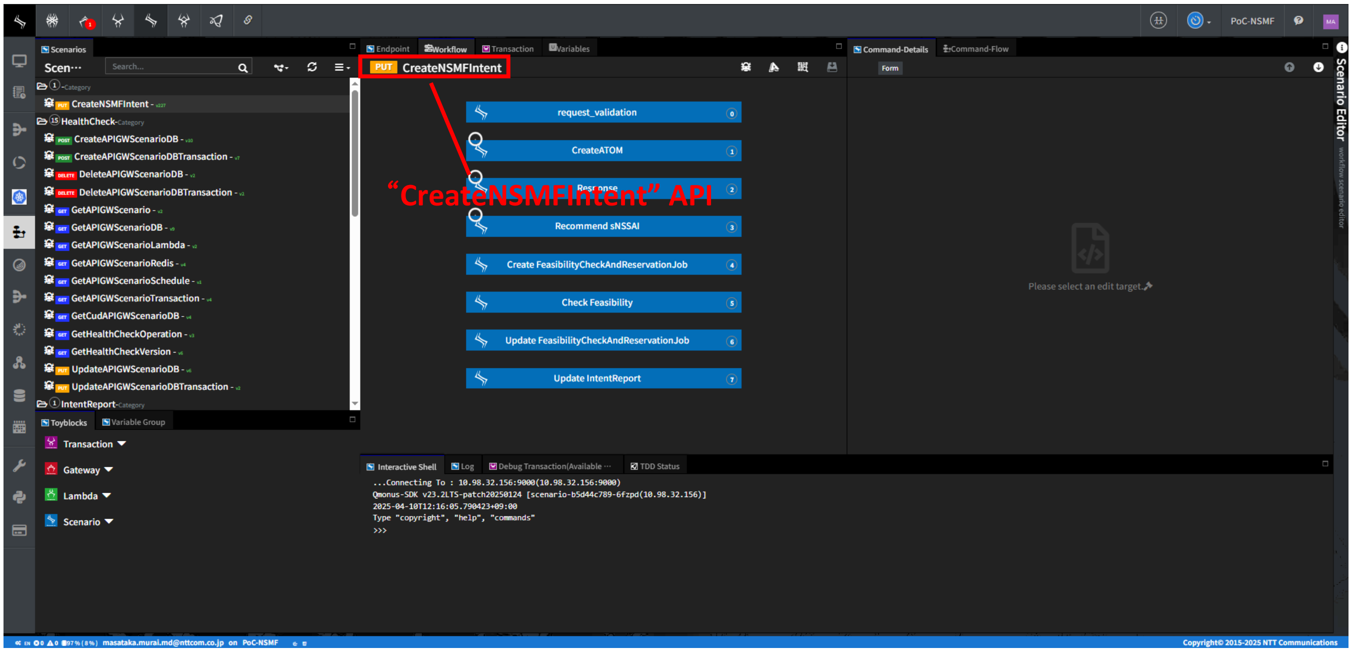

Figure 2: Selection of “CreateNSMFIntent” API executing an NSMF intent creation and intent feasibility check

Figure 2 is a screen selecting a specific API. Operator selects the “CreateNSMFIntent” API. Calling the API triggers to create an NSMF intent instance and assess its feasibility.

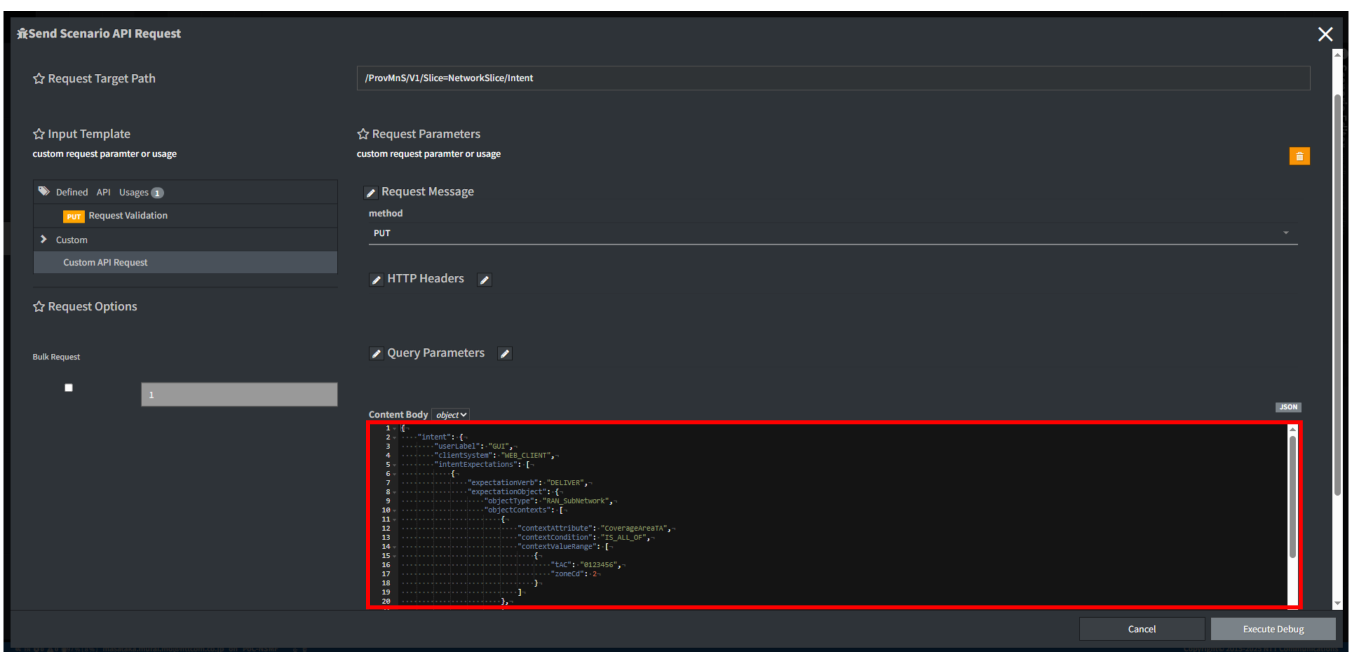

Figure 3: The relevant parameters entry needed to create NSMF intent instance

Figure 3 is a screen initiating the “CreateNSMFIntent” API. Operator enters the relevant parameters needed to create the NSMF intent in the request body of the API and then initiates the API.

The parameters are tracking area code, service type, start time, end time of the intent, and RRM policy ratio. The sample values of these parameters are as follows:

- Tracking area code= 0123456
- Service type= Service 1
- Start time of the intent= 2025/4/1 9:00
- End time of the intent= 2025/4/7 9:00
- RRM policy ratio (uplink)= 10%
- RRM policy ratio (downlink)= 10%


```
{
    "intent": {
        "userLabel": "GUI",
        "clientSystem": "WEB_CLIENT",
        "intentExpectations": [
            {
                "expectationVerb": "DELIVER",
                "expectationObject": {
                    "objectType": "RAN_SubNetwork",
                    "objectContexts": [
                        {
                            "contextAttribute": "CoverageAreaTA",
                            "contextCondition": "IS_ALL_OF",
                            "contextValueRange": [
                                {
                                    "tAC": "0123456",
                                    "zoneCd": 2
                                }
                            ]
                        },
                        {
                            "contextAttribute": "ServiceType",
                            "contextCondition": "IS_EQUAL_TO",
                            "contextValueRange": "Service 1"
                        },
                        {
                            "contextAttribute": "TimeWindow",
                            "contextCondition": "IS_EQUAL_TO",
                            "contextValueRange": {
                                "startTime": "2025-04-01T00:00:00+09:00",
                                "endTime": "2025-04-07T00:00:00+09:00"
                            }
                        },
```

Figure 4: Sample of NSMF intent creation payload

Figure 4 shows a sample JSON payload to create an NSMF intent. It is based on 3GPP TS 28.312 v 18.4.0.

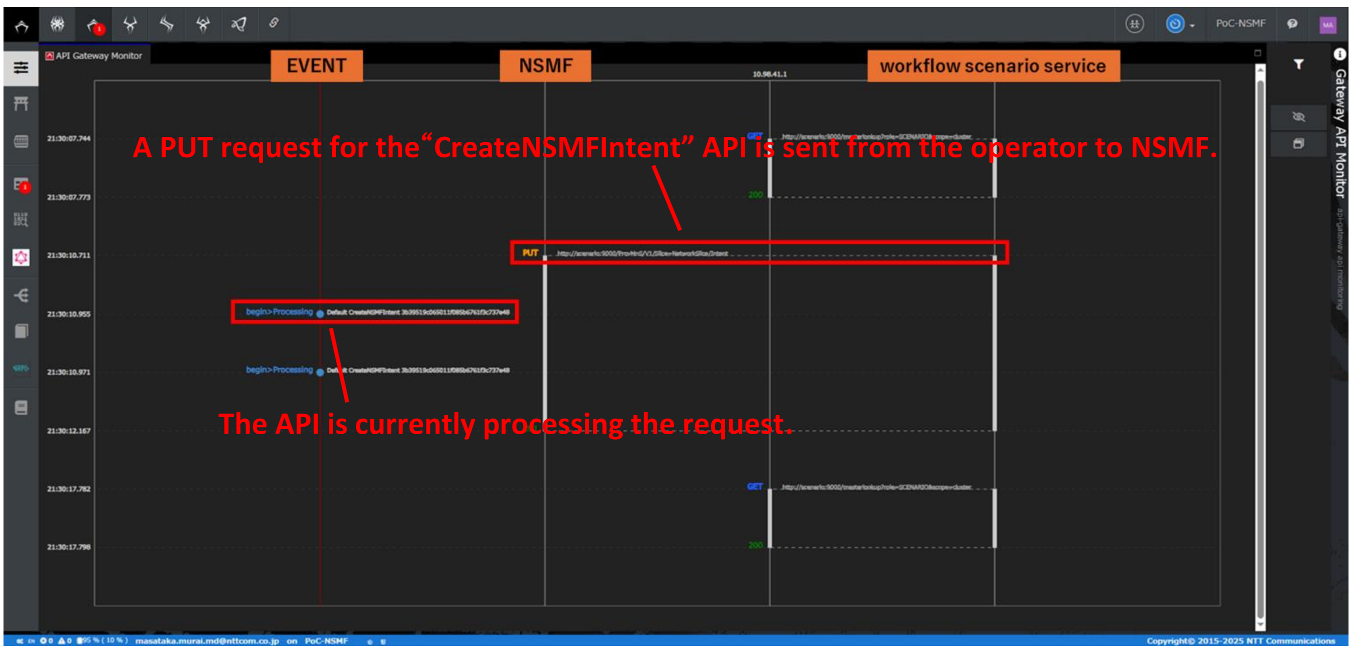

Figure 5: Confirmation of the progress of the "CreateNSMFIntent" API from the API gateway monitor for the NSMF

Figure 5 is a screenshot of the API gateway monitor for the NSMF. By checking this monitor, the progress of the "CreateNSMFIntent" API can be confirmed.

When a PUT request for the "CreateNSMFIntent" API is sent from the operator to NSMF, the workflow scenario service initiates the process, which includes creating the NSMF intent.

By observing the "EVENT" section, the current processing of the request by the API can be observed.

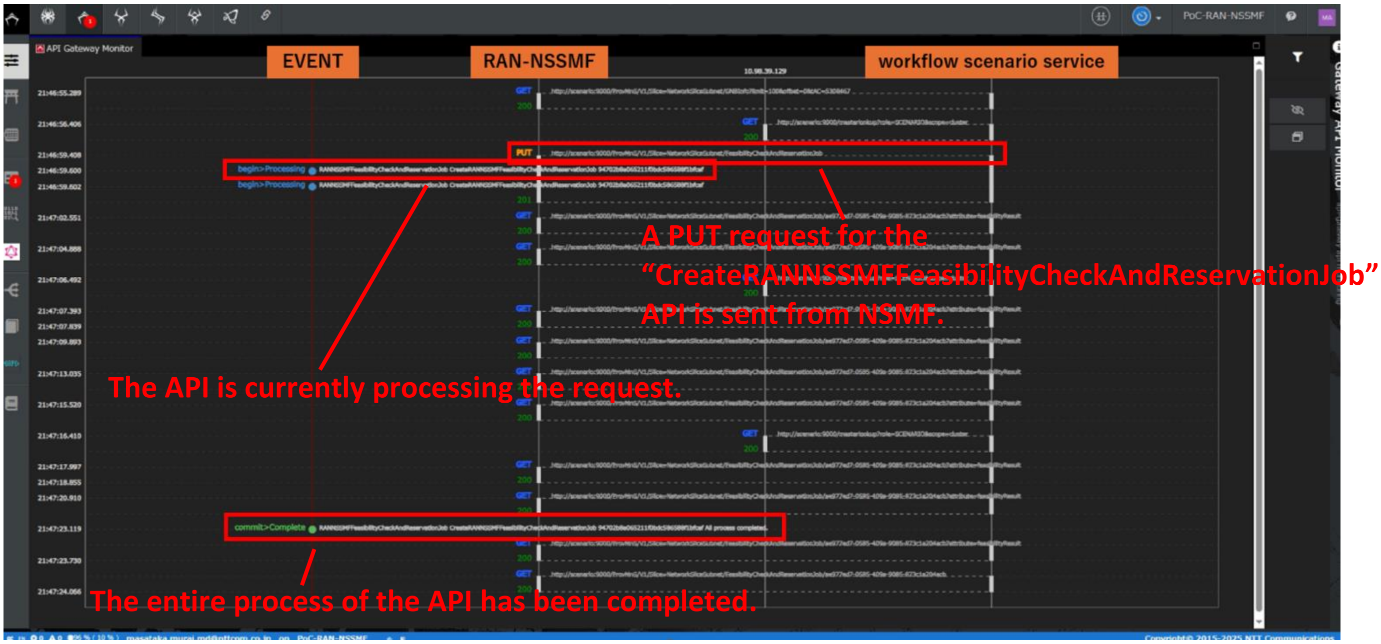

Figure 6: Confirmation of the progress of the "CreateRANNSSMFFeasibilityCheckAndReservationJob" API from the API gateway monitor for the RAN-NSSMF

Figure 6 is a screenshot of the API gateway monitor for the RAN-NSSMF. By checking this monitor, the progress of the "CreateRANNSSMFFeasibilityCheckAndReservationJob" API can be confirmed.

When a PUT request for the "CreateRANNSSMFFeasibilityCheckAndReservationJob" API is sent from the NSMF, which is triggered by the "CreateNSMFIntent" API, the workflow scenario service executes the process including the feasibility check of the NSMF intent. By examining the "EVENT" section, the current processing of the request by the API can be observed.

At the end, the completion of the entire process for the "CreateRANNSSMFFeasibilityCheckAndReservationJob" API can be confirmed.

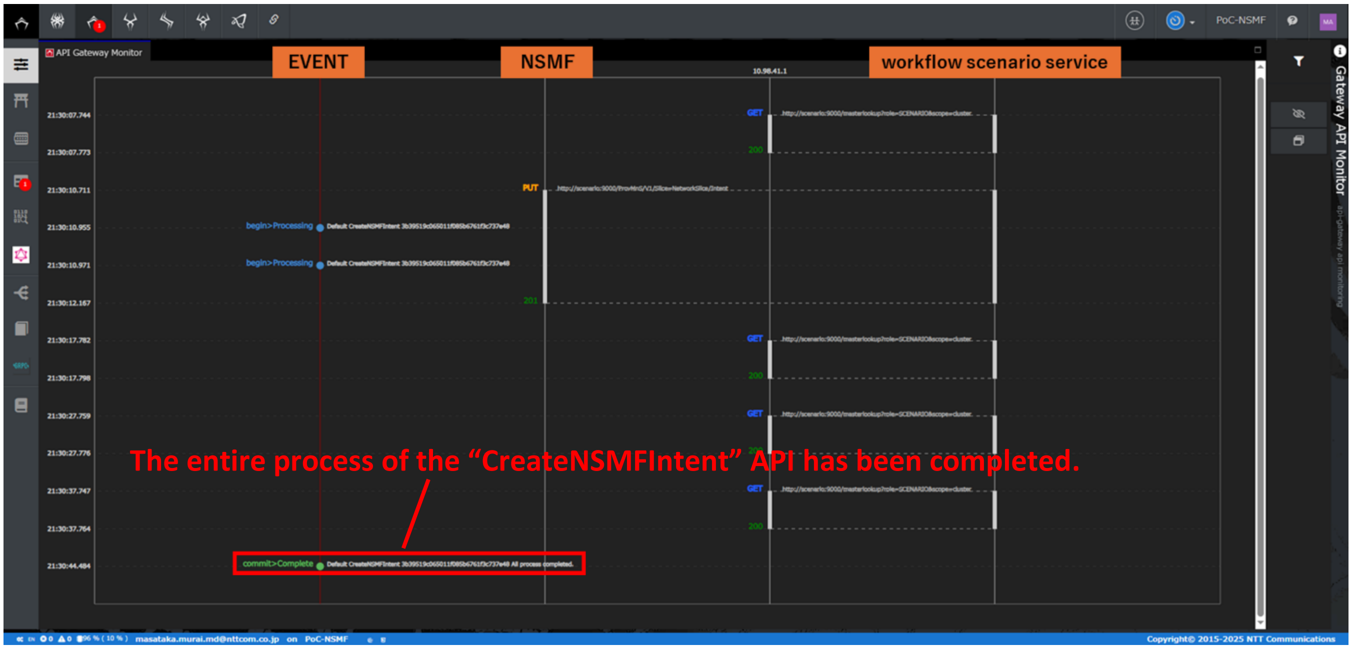

Figure 7: Confirmation of completion of the entire process for the “CreateNSMFIntent” API from the API gateway monitor for the NSMF

In the API gateway monitor for the NSMF, the completion of the entire process for the “CreateNSMFIntent” API can be confirmed as shown in the figure 7. This means that the entire process for the NSMF intent creation and the feasibility check has been completed.

3.5.1.2 Intent feasibility check result acquisition

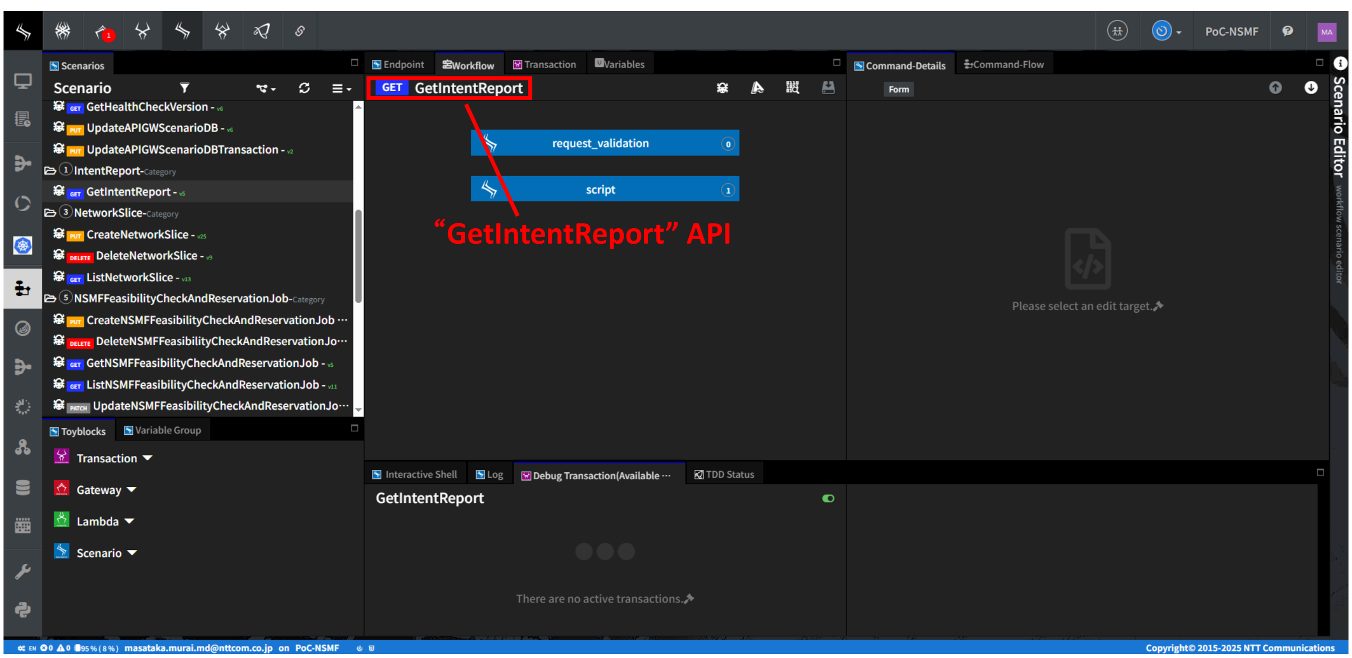

Figure 8: Selection of "GetIntentReport" API to retrieve the feasibility check result for the created NSMF intent

As shown in the figure 8, operator selects and initiates the "CreateNSMFIntent" API to retrieve the feasibility check result for the created NSMF intent.

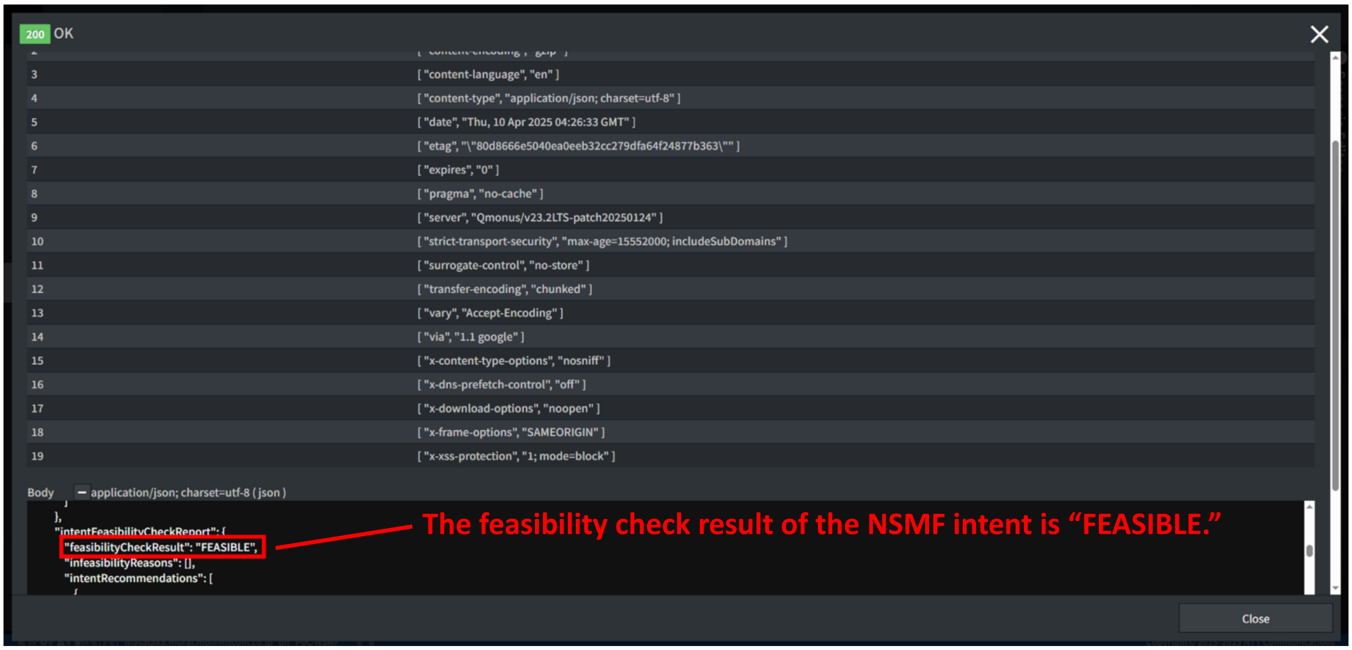

Figure 9: Confirmation of success for the feasibility check of the NSMF intent

After a GET request for the "GetIntentReport" API was sent from the operator, the response from the API has been received from the NSMF.

Looking at the figure 9, the result of the intent feasibility check is "FEASIBLE." This means that there are available RAN resources in the specific tracking area.

3.5.1.3 RAN resource reservation

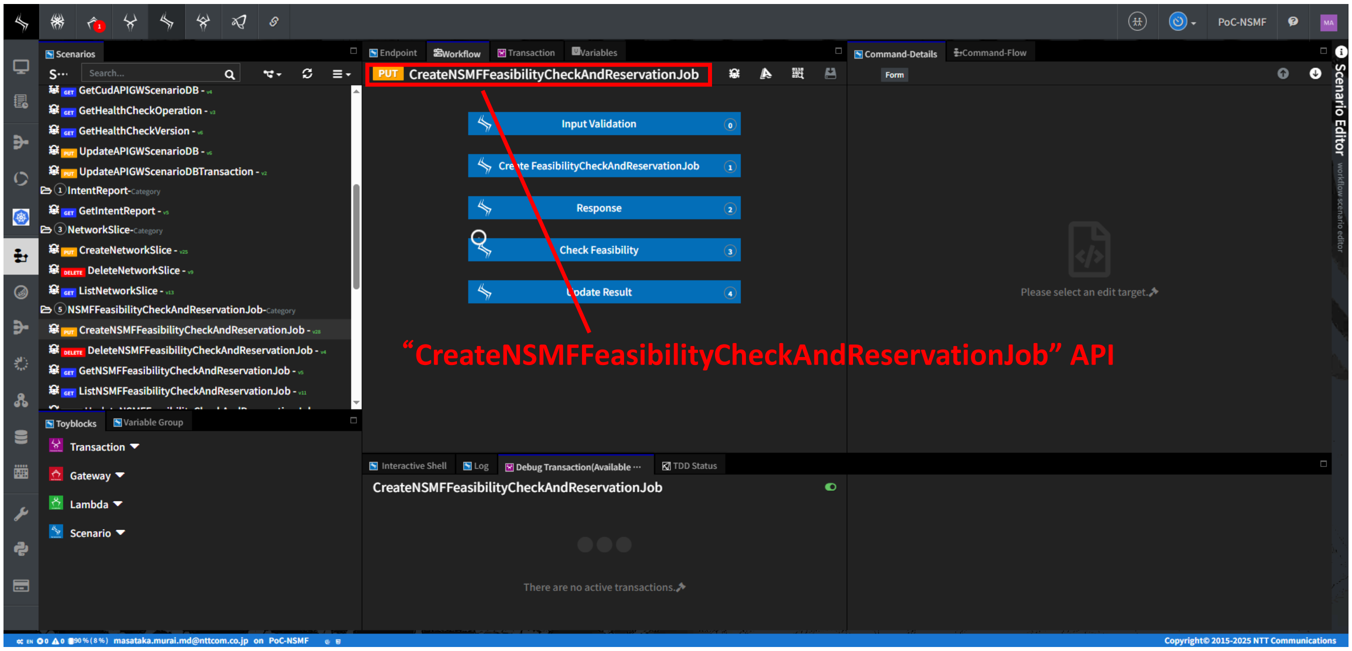

Figure 10: Selection of “CreateNSMFFeasibilityCheckAndReservationJob” API executing the reservation of RAN resources

As shown in the figure 10, operator selects and initiates the “CreateNSMFFeasibilityCheckAndReservationJob” API to reserve RAN resources.

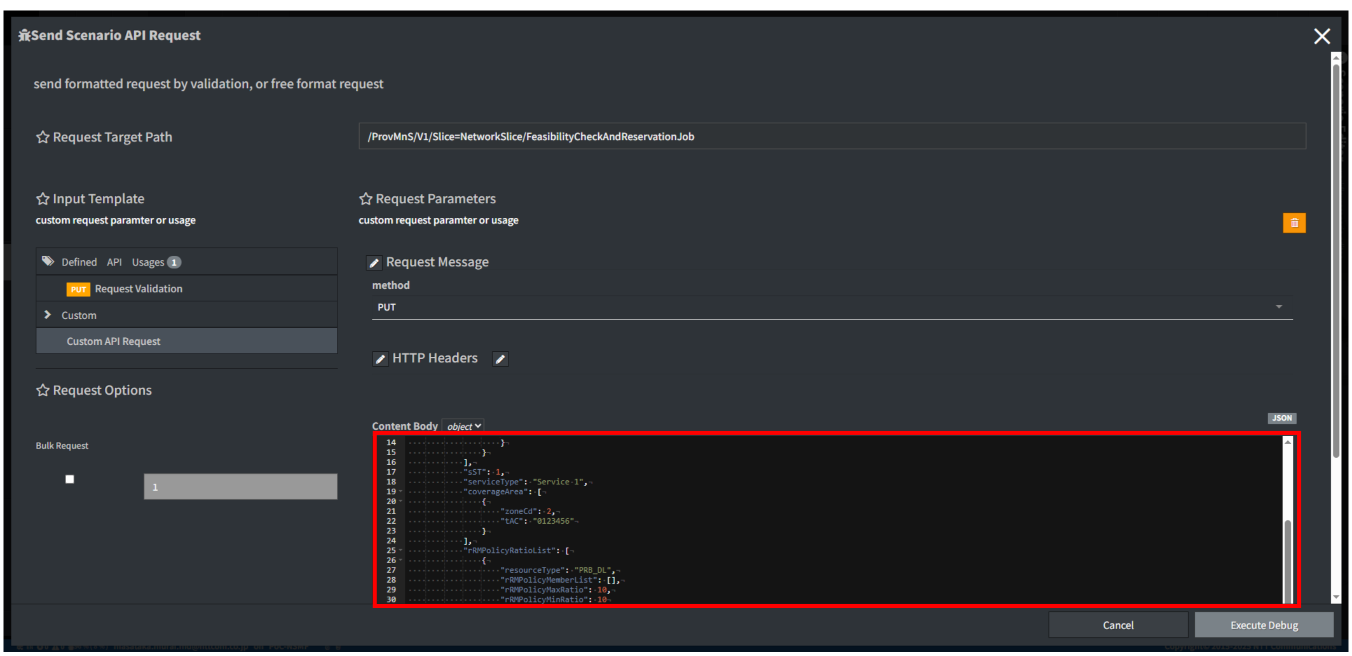

Figure 11: The relevant parameters entry needed to reserve RAN resources associated with a specific slice ID

Figure 11 is a screen initiating the “CreateNSMFFeasibilityCheckAndReservationJob” API.

From clause 3.5.1.2, The availability of RAN resources in the specific tracking area “0123456” has been confirmed. The operator inputs the relevant parameters needed to reserve RAN resources associated with a specific slice ID in the API's request body.

The parameters are tracking area code, Slice ID, service type, start time, end time of the intent, and RRM policy ratio. The sample values of these parameters are as follows:

- Tracking area code= 0123456
- Slice ID= 000001
- Service type= Service 1
- Start time of the reservation= 2025/4/1 9:00
- End time of the reservation= 2025/4/7 9:00
- RRM policy ratio (uplink)= 10%
- RRM policy ratio (downlink)= 10%

3.5.1.4 Reservation result acquisition

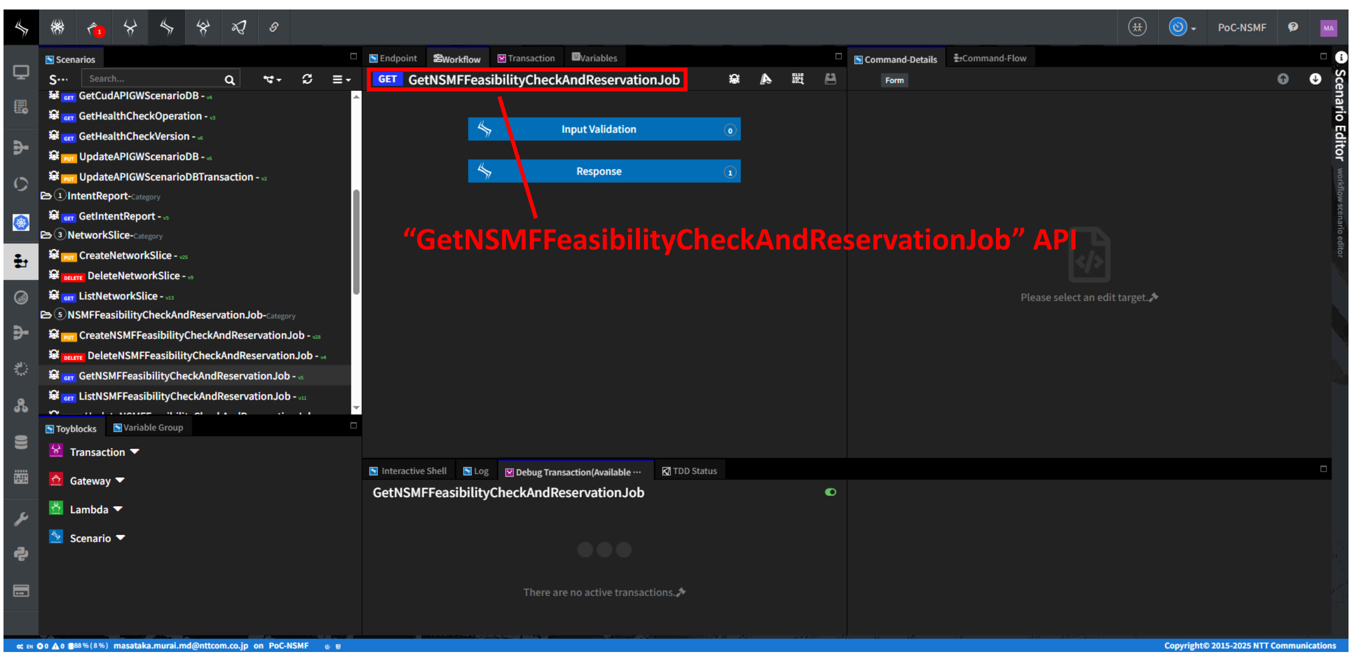

Figure 12: Selection of the “GetNSMFFeasibilityCheckAndReservationJob” API to retrieve the result of the RAN resource reservation

As shown in the figure 12, operator selects and initiates the “GetNSMFFeasibilityCheckAndReservationJob” API to retrieve the result of the RAN resource reservation.

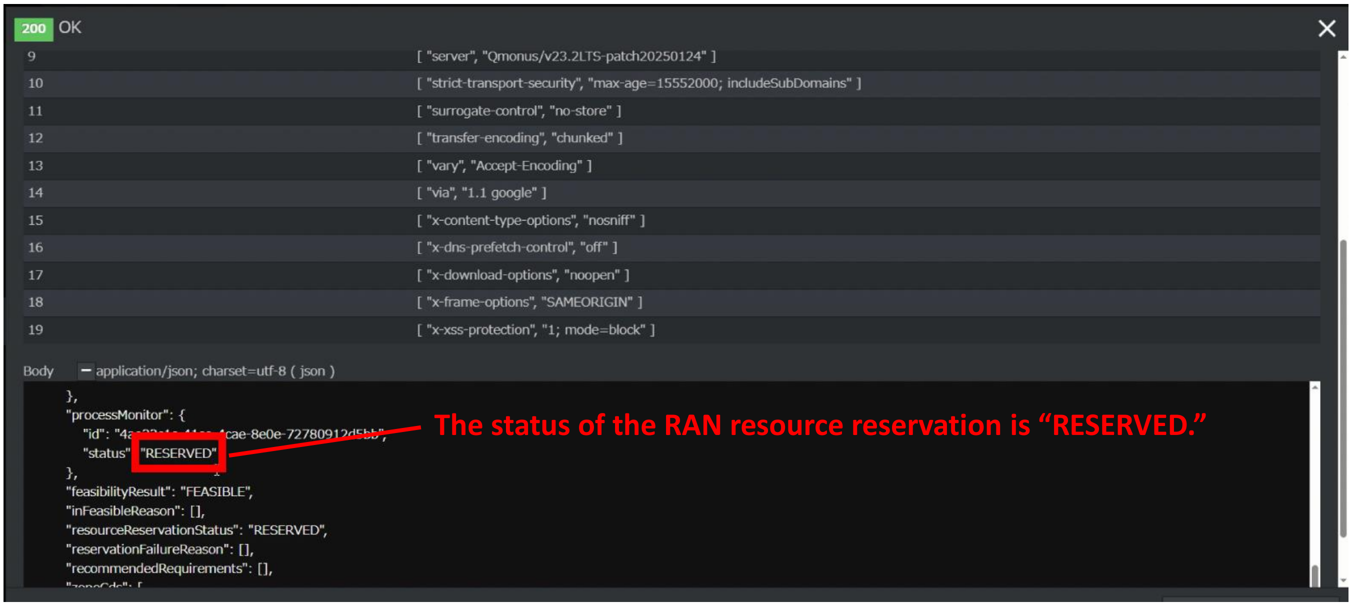

Figure 13: Confirmation of success for the process of RAN resource reservation

After a GET request for the “GetNSMFFeasibilityCheckAndReservationJob” API was sent from the operator, the response from the API has been received from the NSMF.

As in figure 13, the process of RAN resource reservation was successful.

3.5.2 Scenario 2: Intent feasibility check failure

3.5.1.1 NSMF intent creation and Intent feasibility check

Similar to Scenario 1, the operator selects and initiates the “CreateNSMFIntent” API to create an NSMF intent instance and assess its feasibility.

The screenshot for Selection of “CreateNSMFIntent” API is omitted, as it is the same as in scenario 1

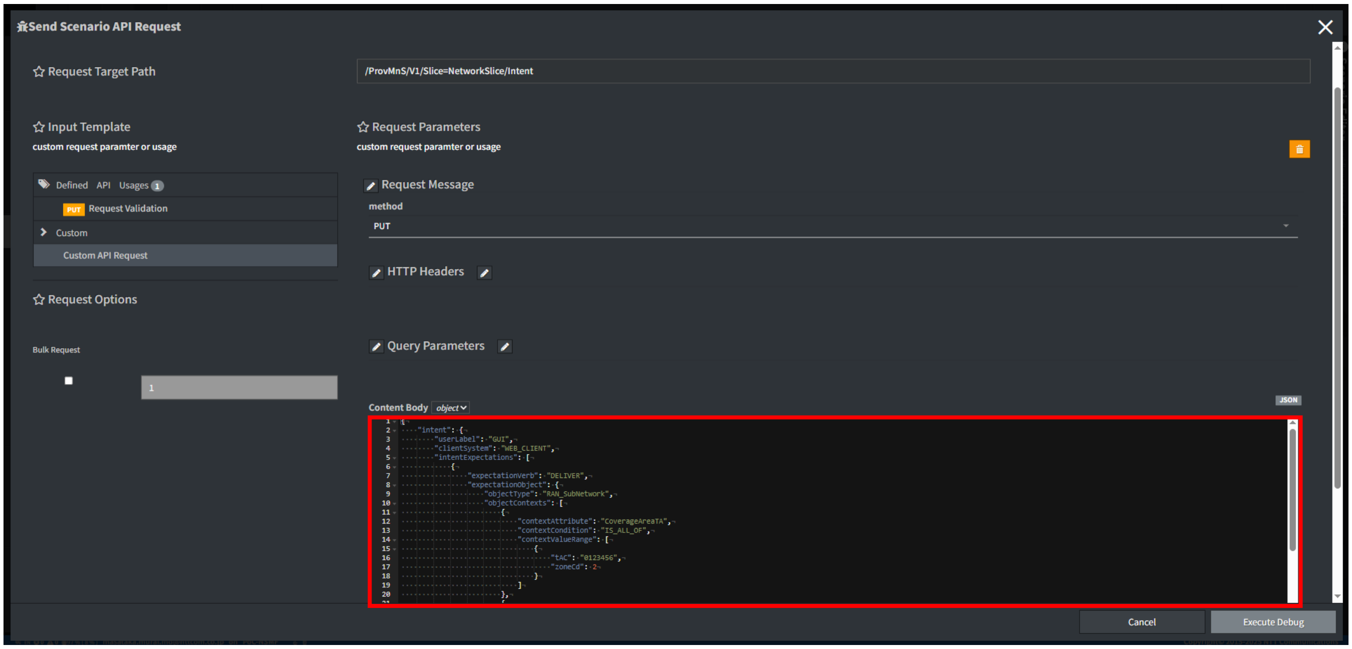

Figure 14: The relevant parameters entry needed to create NSMF intent instance

Figure 14 is a screen initiating the "CreateNSMFIntent" API. Similar to Scenario 1, the operator inputs the relevant parameters needed to create the NSMF intent in the API's request body.

The parameters are the same as scenario 1. The sample values of these parameters are as follows:

- Tracking area code= 0123456
- Service type= Service 1
- Start time of the intent= 2025/4/1 9:00
- End time of the intent= 2025/4/7 9:00
- RRM policy ratio (uplink)= 90%
- RRM policy ratio (downlink)= 90%

In this scenario, setting the value of "90%" for the RRM policy ratio will result in the feasibility check of the NSMF intent being marked as "INFEASIBLE."

The screenshot of a sample JSON payload to create an NSMF intent is omitted, as it is the same except for the value of the RRM policy ratio as in scenario 1.

3.5.1.2 Intent feasibility check result acquisition and recommendation

Similar to Scenario 1, the operator selects and initiates the "GetIntentReport" API to retrieve the feasibility check result for the created NSMF intent.

The screenshot for Selection of "GetIntentReport" API is omitted, as it is the same as in scenario 1.

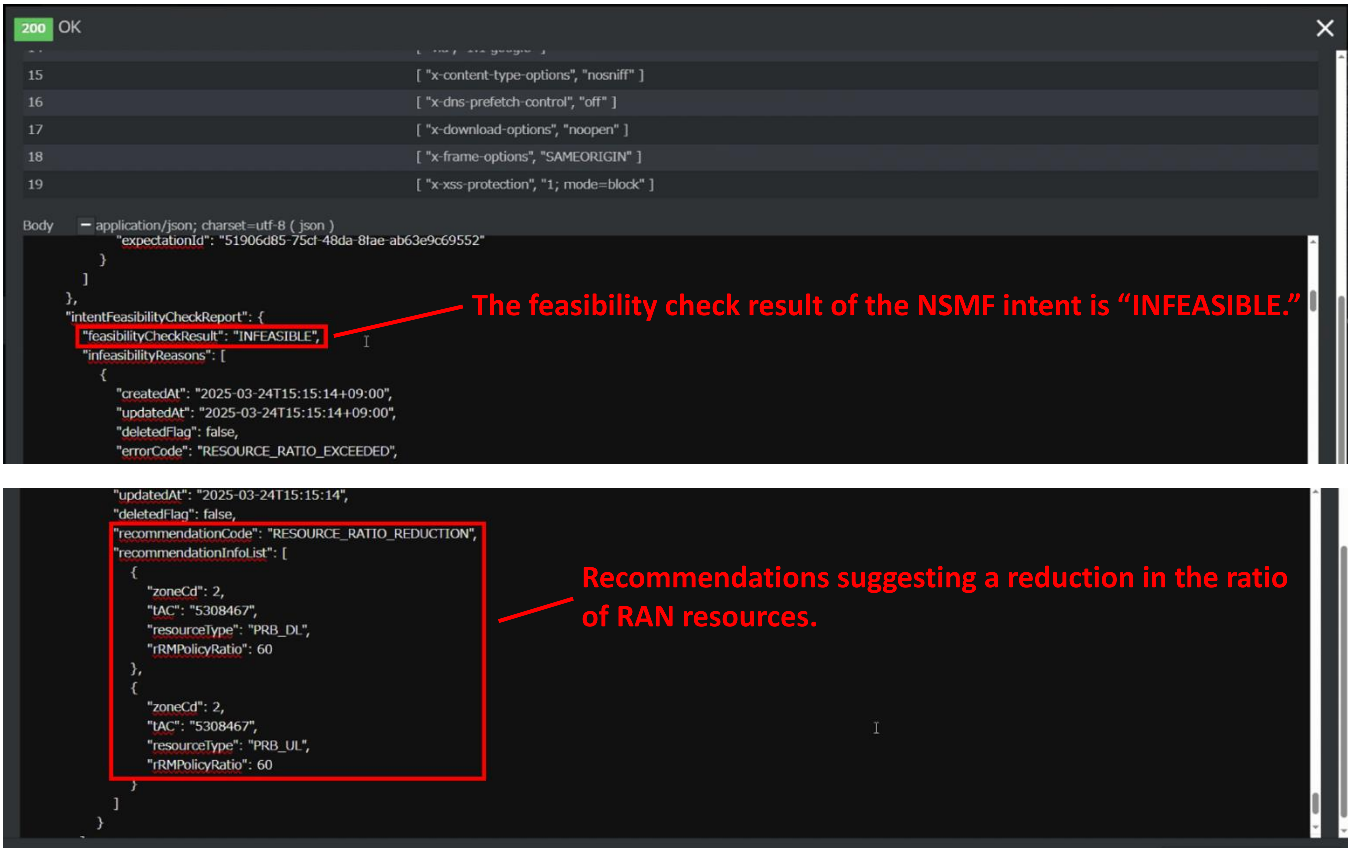

Figure 15: Confirmation that the result for the feasibility check of the NSMF intent and recommendations are returned

After a GET request for the "GetIntentReport" API was sent from the operator, the response from the API has been received from the NSMF.

Looking at the figure 15, the result of the intent feasibility check is "INFEASIBLE." This means that there are no available RAN resources at the specified RRM policy ratio in the specific tracking area. Additionally, the recommendations suggesting a reduction in the ratio of RAN resources in the tracking area can also be confirmed.

3.6 Additional information

The references used throughout this document are listed below.

[1] ETSI GS ZSM 002: Zero-touch network and Service Management (ZSM); Reference Architecture."

[2] 3GPP TS 28.312 V18.4.0: "Technical Specification Group Services and System Aspects; Management and orchestration; Intent driven management services for mobile networks."

[3] ETSI GS ZSM 011: "Zero-touch network and Service Management (ZSM);".

[4] The information about Qmonus is available at the following link: https://sandbox-portal.qmonus.ntt.com/

[5] 3GPP TS 28.531 V18.6.1: "Technical Specification Group Services and System Aspects; Management and orchestration; Provisioning."