ONAP 5G Network Slicing Quick Guide

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<th>Version</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Bring up guide for ONAP network slicing</td>
</tr>
</tbody>
</table>

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1. Introduction

ONAP-based Slice Management Overall Architecture Choices

Figure-Intro-1: ONAP slice architecture choices

ONAP has provided various architecture choices for slice management. In this quick reference guide, we will uncover steps required to bring up ONAP cluster with architecture choice#4 as shown in Figure-Intro-1 above.

2. ONAP deployment and image changes on Guilin/Honolulu.

Here are the steps.

a. For ONAP Guilin and Honolulu release, if one doesn't want to exercise the transport domain of the slice, we need to disable the transport slice. We use the below patch in the SO helm charts to perform the same.

---

+a/kubernetes/so/components/so-bpmn-infra/resources/config/overrides/override.yaml
+++ b/kubernetes/so/components/so-bpmn-infra/resources/config/overrides/override.yaml
@@ -160,6 +160,8 @@ mso:
     endpoint: https://oof-osdf.{{ include "common.namespace" }}:8698
     timeout: PT30M
     workflow:
+    TnNssmf:
+    enableSDNCNetworkConfig: 'false'
CreateGenericVNFV1:
b. For ONAP Honolulu release as of 22nd July we need to apply the below patch.
https://gerrit.onap.org/r/c/oom/+/121768

We need to add an override value to SDNC, otherwise SDNC will not work. (Note: This can be done by deploying SDNC separately at the end with the command line parameter)

Adding override:

global:
  cmpv2Enabled: false

c. After the deployment is complete, we have to follow the steps mentioned in the below wiki. We need to make sure that the image versions of different components are matching with what is specified in the wiki.

https://wiki.onap.org/display/DW/Setup+related+issues

3. SDC Template creation

We use the below wiki link for the details on how to build the slicing template.

https://wiki.onap.org/display/DW/Template+Design+for+Option2

Below are some additional screenshots for reference.
Figure-SDC-1: Creating new service category in SDC

Figure-SDC-2: Adding a property attribute to selected service in SDC
Figure SDC-3: Create Artifact in SDC for service eMBB

Figure SDC-4: Allotted Resource property assignment
Sometimes you may see the error like below, this can be safely ignored. It is due to network connectivity issues.
In some cases distribution fails. Like below.

![Error screen](image)

In such a case, make sure that the below components are added to AAI. The below steps ensure that all the necessary components are added to AAI.

```bash
https://10.43.71.18:8443/aai/v21/business/customers/customer/5GCustomer

https://10.43.71.18:8443/aai/v21/business/customers/customer/5GCustomer/service-subscriptions/service-subscription/5G

curl --user AAI:AAI -X PUT -H "X-FromAppId:AAI" -H "X-TransactionId:get_aai_subscr" -H "Accept:application/json" -H "Content-Type:application/json" -k -d '{ "model-invariant-id": "8f50cc5d-3fb4-493f-90a6-b1273383ec8d", "model-type": "resource", "model-vers": { "model-ver": [ { "model-version-id": "4d80d99-5e82-4ba4-a4a8-badf25497df8", "model-name": "Slice_AR", "model-version": "1.0" } ] } }'
```

Figure-SDC-6: Error screen

Figure-SDC-7: Distribution failed screen for eMBB service for NST
curl --user AAI:AAI -X PUT -H "X-FromApplId:AAI" -H "X-TransactionId:get_aai_subscr" -H "Accept:application/json" -H "Content-Type:application/json" -k -d '{ "model-invariant-id": "6a37bb9e-0741-416e-97ca-aa3e276db74a", "model-type": "service", "model-vers": { "model-ver": [ { "model-version-id": "e26c11c0-1625-47a0-a2e8-6ae1732870a1", "model-name": "EmbbNst_O2", "model-version": "1.0" } ] } }' "https://10.43.71.18:8443/aai/v21/service-design-and-creation/models/model/6a37bb9e-0741-416e-97ca-aa3e276db74a" | python -m json.tool


Policy update in OOF pod. Use the below commands to update the policy.

```python
python3 policy_utils.py create_policy_types policy_types
python3 policy_utils.py generate_nsi_policies EmbbNst_O2
python3 policy_utils.py create_and_push_policies gen_nsi_policies
python3 policy_utils.py generate_nssi_policies EmbbAn_NF minimize latency
python3 policy_utils.py create_and_push_policies gen_nssi_policies
python3 policy_utils.py generate_nssi_policies Tn_ONAP_internal_BH minimize latency
python3 policy_utils.py create_and_push_policies gen_nssi_policies
python3 policy_utils.py generate_nssi_policies EmbbCn_External minimize latency
```

When the above policy update command is performed, one may see various warning messages and logs generated as shown below for reference. These can be ignored.

```
InsecureRequestWarning: Unverified HTTPS request is being made to host 'policy-api'. Adding certificate verification is strongly advised. See: https://urllib3.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings
`

Policy type created

```
InsecureRequestWarning: Unverified HTTPS request is being made to host 'policy-api'. Adding certificate verification is strongly advised. See: https://urllib3.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings
```
Policy type created

Policy vnfPolicy_EmbbNst_O2_non_shared created

Policy minimizeLatency_EmbbNst_O2 created

Policy maximizeCost_EmbbNst_O2 created
4. Core Network and Radio Access Network NSSMF simulator

In this section we shall cover following items about CN and RAN NSSMF simulator

- How to download the CN and RAN NSSMF simulator.
- Registering CN and RAN NSSMF simulator with ESR.
- How to run the NSSMF simulators for CN and RAN.

4.1 Download CN and RAN NSSMF simulator

- One can download the community built Core Network (CN) NSSMF simulator by following the below steps.
  
  a. Perform `wget` to download the software on the master node.
     
     ```
     ```
  
  b. Untar the download file into a directory
     
     ```
     tar -xvf cn-nssmf-simulator-docker-compose.tar.gz
     ```
     
     One can verify following files been present
     
     - cn-nssmf-simulator-docker-compose/
     - cn-nssmf-simulator-docker-compose/application.properties
     - cn-nssmf-simulator-docker-compose/simulator-0.0.1-SNAPSHOT.jar
     - cn-nssmf-simulator-docker-compose/dcae/
     - cn-nssmf-simulator-docker-compose/docker-compose.yml
     - cn-nssmf-simulator-docker-compose/luk.keystore
  
  c. Check and configure `server.port` value in application.properties file matches the `ports` value in docker-compose.yml
     
     ```
     Snippet of application.properties file is shown below:
     ```
     
     ```bash
     $ cat application.properties
     server.port=60053
     notifyurl=http://192.168.122.145:30472/v1/pm/notification
     ftppath=sftp://root:oom@192.168.122.145:22/home/ubuntu/dcae/PM.tar.gz
     fixeddelay=900000
     filepath=/app/dcae
     amffilepath=/app/dcae/AMF.xml.gz
     upffilepath=/app/dcae/UPF.xml.gz
     ```
     
     ```
     Snippet of docker-compose.yml file is shown below:
     ```
     ```bash
     $ cat docker-compose.yml
     version: '3'
     services:
     ```
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cn-simulator-docker-compose:
  image: openjdk:8-jre-slim
  container_name: cn-simulator-test-1
  ports:
    - "60053:60053"
  restart: always
  volumes:
    - ./:/app
  working_dir: /app
  entrypoint: java -jar simulator-0.0.1-SNAPSHOT.jar

- One can download the community built RAN NSSMF simulator by following the below steps.
  a. Download the integration repository in the master node of ONAP deployment.
     - git clone https://gerrit.onap.org/r/integration
  b. Install the requirements of RAN NSSMF.
     - cd integration/test/mocks/ran-nssmf-simulator
     - sudo apt update
     - sudo apt install python3-pip
     - sudo pip3 install -r requirements.txt

4.2 Register Core Network (CN) NSSMF simulator with ESR

- Follow the below steps to register CN NSSMF simulator with ONAP external registry system (ESR). The IP address (192.168.122.145) is an example referenced and needs to be replaced with the appropriate master node IP address of the ONAP deployment cluster.
  a. Create a placeholder for resource id: 12345 in esr-thirdparty-sdnc
     - curl -v -k -X PUT
nc-list/esr-thirdparty-sdnc/12345" -H 'Accept: application/json' -H
'X-FromAppId: AAI' -H 'X-TransactionId: 1'
  b. Add the resource details as below:
     - curl -v -k -X PUT
c-list/esr-thirdparty-sdnc/12345/esr-system-info-list/esr-system-info/1234
5" \
-H 'Accept: application/json' \
-H 'X-FromAppId: AAI' \
-H 'X-TransactionId: 1' \
-H 'Content-Type: application/json'
-d '{

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c. Verify the above addition of resource in ESR is reflecting correctly or not by performing a GET operation as shown below:

```bash
  curl -v -k -X GET
  -H 'Accept: application/json' \
  -H 'X-FromAppId: AAI' \
  -H 'X-TransactionId: 1'
```

Result output from the above command will look like this with appropriate resource-version value:

```json
{
  "esr-system-info-id": "12345",
  "system-name": "E2E",
  "type": "cn",
  "vendor": "huawei",
  "service-url": "",
  "user-name": "",
  "password": "",
  "system-type": "thirdparty_SDNC",
  "ip-address": "192.168.122.51",
  "port": "60053",
  "resource-version": "1618387830497"
}
```

### 4.3 Register RAN NSSMF simulator with ESR

- Follow the below steps to register RAN NSSMF simulator with ONAP external registry system (ESR). The IP address (192.168.122.145) is an example referenced and needs to be replaced with the appropriate master node IP address of the ONAP deployment cluster.
a. Check if already the RAN NSSMF simulator is register by any chance with resource name as “sdnc-an-01”
   ■ If not registered, you will see a sample output like below:
     {
     "requestError": {
     "serviceException": {
     "messageId": "SVC3001",
     "text": "Resource not found for %1 using id %2 (msg=%3) (ec=%4)",
     "variables": ["GET",
     "external-system/esr-thirdparty-sdnclist/esr-thirdparty-sdnc/sdnc-an-01/esr-system-info-list",
     "Node Not Found:No Node of type esr-system-info found at: external-system/esr-thirdparty-sdnclist/esr-thirdparty-sdnc/sdnc-an-01/esr-system-info-list",
     "ERR.5.4.6114"
     ]
     }
     }
     }

b. Add esr-thirdparty-sdnc to ESR.
   ■ Use JSON payload in the file: sdnc-an-01.json as shown below:
     {
     "thirdparty-sdnc-id": "sdnc-an-01"
     }

c. Add esr-system-info (RAN NSSMF) to ESR:
   ■ Use JSON payload in the file: nssmf-an-01.json as shown below:


```json
{
    "esr-system-info-id": "nssmf-an-01",
    "type": "an",
    "vendor": "huawei",
    "system-type": "thirdparty-sdnc",
    "ip-address": "192.168.122.145",
    "port": "8443",
    "user-name": "admin",
    "password": "123456",
    "ssl-cacert": "test.ca"
}
```

d. Validate esr-system-info added is reflecting or not in ESR:

   - The above command will generate an output like below if successfully registered with ESR.

   - Result output:
     ```json
     {
         "esr-system-info": [
             {
                 "esr-system-info-id": "nssmf-an-01",
                 "type": "an",
                 "vendor": "huawei",
                 "user-name": "admin",
                 "password": "123456",
                 "system-type": "thirdparty-sdnc",
                 "ssl-cacert": "test.ca",
                 "ip-address": "10.200.132.27",
                 "port": "8443",
                 "resource-version": "1618391040155"
             }
         ]
     }
     ```

4.4 Running CN NSSMF simulator in ONAP cluster

   - Follow the below steps to run the CN NSSMF simulator
     a. Goto directory `cn-nssmf-simulator-docker-compose` as part of download procedure mentioned above.
     b. Perform command:

```
```
4.5 Running RAN NSSMF simulator in ONAP cluster

- Follow the below steps to run the RAN NSSMF simulator
  a. Goto directory `ran-nssmf-simulator` as part of download procedure mentioned above. i.e.
     ```bash
     cd integration/test/mocks/ran-nssmf-simulator
     ```
  b. Perform command:
     ```bash
     sudo python3 main.py
     ```
     Sample reference output is shown below:
     ```bash
     aarna@anod-master:~/ran-nssmf/integration/test/mocks/ran-nssmf-simulator$ sudo python3 main.py
     * Serving Flask app 'RanNssmfSimulator.MainApp' (lazy loading)
     * Environment: production
     WARNING: This is a development server. Do not use it in a production deployment.
     [...]
     ```

5. RestAPIs on NSSMF simulator.

In this section we are listing down the RestAPIs defined in the NSSMF simulator for Core Network and Radio Access Network domains

5.1 CN NSSMF simulator RestAPIs

<table>
<thead>
<tr>
<th>Slice Events</th>
<th>Operation Type</th>
<th>Slice Domain</th>
<th>URI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocate NSSI</td>
<td>POST</td>
<td>CN</td>
<td>&quot;/api/rest/provMns/v1/NSS/SliceProfiles&quot;</td>
</tr>
<tr>
<td>Activate NSSI</td>
<td>PUT</td>
<td>CN</td>
<td>&quot;/api/rest/provMns/v1/NSS/<a href="">string:snssai</a>/activation&quot;</td>
</tr>
<tr>
<td>Deactivate NSSI</td>
<td>PUT</td>
<td>CN</td>
<td>&quot;/api/rest/provMns/v1/NSS/<a href="">string:snssai</a>/deactivation&quot;</td>
</tr>
</tbody>
</table>
5.2 RAN NSSMF simulator RestAPIs

<table>
<thead>
<tr>
<th>Slice Events</th>
<th>Operation Type</th>
<th>Slice Domain</th>
<th>URI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocate NSSI</td>
<td>POST</td>
<td>AN</td>
<td>&quot;/ObjectManagement/NSS/SliceProfiles&quot;</td>
</tr>
<tr>
<td>DeAllocate NSSI</td>
<td>DELETE</td>
<td>AN</td>
<td>&quot;/ObjectManagement/NSS/SliceProfiles/<a href="">string:sliceProfileId</a>&quot;</td>
</tr>
</tbody>
</table>

Table-1: NBI Interface exposed from CN NSSMF towards NSMF

Table-2: NBI Interface exposed from RAN NSSMF towards NSMF

6. Use case UI (UUI)

In this section, we shall cover details of slice service creation process and essentially showcase the lifecycle management of network slicing inclusive of following:

- Slice Creation
- Slice Activation
- Slice Deactivation
- Slice Termination

6.1 Operational steps for 5G network slices

- Navigate to UUI home page using portal link: https://hostIP:30283/iui/usecaseui/#/home as shown below in Figure-uui-1.
● Navigate to 5G Slice Management under Services, as shown below in *Figure-uui-2*.

![Figure-uui-2: 5G Slice Management](image)

**Figure-uui-2: 5G Slice Management**

● Slice Creation steps
  a. Click ‘Create’ as shown in *Figure-uui-3* and fill the required parameters as shown in *Figure-uui-4* and *Figure-uui-5*.
**Figure-uui-3:** Slice Creation

**Figure-uui-4:** Create communication service

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b. Switch to the Slice Task Management tab and click Process Task when the Status of the newly created task is ‘WaitingToConfirm’ as shown in Figure-uui-6.

![Slice Task Management](image)

**Figure-uui-6: Slice Task Management**

- **Task ID**: 3b1880d8-a700-4549-9235-820f7758733b
- **Task Name**: SliceServiceTask
- **5-NSSAI**: 01-266F296F
- **Service Type**: embm
- **Created time**: 2020-01-07 19:34:07
- **Status**: Completed
- **Action**: View Result

- **Task ID**: d212b62-eab6-40b7-aaa2-610d21a8733b
- **Task Name**: SliceServiceTask
- **5-NSSAI**: 01-1325005E
- **Service Type**: embm
- **Created time**: 2020-01-07 19:39:54
- **Status**: Completed
- **Action**: View Result

- **Task ID**: f6b21f2d-d838-40aa-a372-5f1332a0b58a
- **Task Name**: SliceServiceTask
- **5-NSSAI**: 01-2645E445
- **Service Type**: embm
- **Created time**: 2020-01-07 20:27:56
- **Status**: WaitingToConfirm
- **Action**: Process Task

![Switch Tab and Click Process Task](image)

**Figure-uui-7: Selecting the task and clicking Process Task**

c. Decide whether to use a shared slice or create a new slice NSI by default as shown in Figure-uui-7. Fill in subdomain parameters for the AN and CN domain as per your requirement along with the Endpoint required by TN, refer Figure-uui-8 and Figure-uui-9

- **An**: Access Network
- **Tn**: Transport Network
### Cn: Core Network

**Figure-uuui-7: New slice NSI**

5. Select a shared NSI (Optional)

6. Update domain parameters (Optional)

7. Click ‘OK’ to create

**Figure-uuui-8: Navigate AN and CN to fill Endpoint details**
d. Once the creation step is completed, switch to **Slice Resource Management** tab to view the NSI and NSSI resource information. Refer below **Figure-uui-10**.

**Figure-uui-9**: Fill in Endpoint details

<table>
<thead>
<tr>
<th>Script Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall User Density:</td>
<td>0</td>
</tr>
</tbody>
</table>

* Endpoint: 10.2.3.4 12

* Coverset the endpoint

Beijing | Beijing | Haidian... | Beijing | Beijing | Xicheng... | Beijing | Beijing | Changp... |

---

**Figure-uui-10**: Slice Resource Management

- Steps for Slice Activation/Deactivation/Termination operation. By default, when the slice is created it remains in status as Deactivation. Refer below **Figure-uui-11** showing other operations (Activation/Deactivation/Termination).

---

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7. References

ONAP Setup related Issues
- https://wiki.onap.org/x/uj6LBQ

ONAP SDC
- Template Design for Option-2 (Guilin)
- Design Service Template (Frankfurt)

ONAP Use case UI