

Cellular Network Slicing

This document outlines the architectural framework and operational parameters required to deploy cellular network slicing effectively.

- Cellular network slicing, on page 1
- Restrictions for cellular network slicing, on page 1
- Cellular network slicing with URSP, on page 2
- Configure cellular network slicing, on page 3
- Example for configuring cellular network slicing , on page 4
- Verify cellular network slicing configuration, on page 4
- Troubleshoot a URSP issue, on page 5

Cellular network slicing

Network slicing refers to the partitioning of a physical network into multiple virtual segments known as slices. This solution lets service providers divide a 5G physical network into several distinct virtual slices. A host platform can set up multiple simultaneous network connections, each with its own IP address. It uses slice types that match each host's requirements. This method enables service providers to allocate dedicated resources for different service types, ensuring optimal performance and efficiency.

5G network slicing is supported only on 5G standalone networks. It is not available on 5G non-standalone (NSA) networks. The slice or service types have a specific set of network functions and resources defined by the network provider. Service type defines how a network slice is expected to behave, based on its features and services. These service types are supported in network slicing:

- Enhanced Mobile Broadband (eMBB): for high-bandwidth and low-latency applications.
- Ultra-reliable low latency communications (URLLC): for high reliability and low latency transmission requirements.
- Massive Internet of Things (MIoT): for sending small quantities of data.

Restrictions for cellular network slicing

These restrictions apply when configuring cellular network slicing.

- You can enable network slicing for the cellular profile only on the P-5GS6-R16SA-GL module when using 5G standalone mode.
- You cannot configure network slicing parameters on profile one or the default profile for the carrier.

Cellular network slicing with URSP

The User Equipment Route Selection Policy (URSP) is a network-provided policy that lets the router select a network slice for each traffic flow.

Starting in Release 27.1.1, the router uses URSP rules to create cellular profiles and install routes automatically.

URSP policy and traffic steering

During 5G SA registration, the 5G network sends the policy to the user equipment (UE). The network downloads the policy through the Policy Control Function (PCF).

Before Release 27.1.1, each slice profile was configured manually. Starting in Release 27.1.1, the network operator defines URSP rules. The router uses these rules to select a network slice for each traffic flow, create cellular profiles, and install routes. URSP rules are not configured on the router.

Route application

The default rule applies to the first PDN. The router selects specific rules by precedence and uses dynamic access lists and route maps to represent them.

The router applies the route maps to non-WAN Layer 3 ingress interfaces and uses them as local policy for router-originated traffic. A generated route map manages routes to the different cellular interfaces. These generated route maps are not visible in the configuration.

The router does not apply URSP when only Layer 2 service-side ports are enabled. The network delivers the URSP rules, and the router applies their route effects automatically. Local URSP rule configuration is not required.

Automatic profile behavior

When the router receives URSP rules, it automatically creates cellular profiles and routes. The show cellular profile output for a URSP-created profile includes "URSP auto configured: Yes".

The network operator provisions and delivers the rules. This guide does not cover rule provisioning. See 3GPP TS 24.526 for the structure and encoding of URSP rules.

URSP rule structure

A URSP rule associates traffic descriptor components with route selection descriptors. Each rule has a precedence from 1 through 255. A lower number has higher priority, and precedence values are unique.

Exactly one default rule is allowed. Its traffic descriptor uses match-all. A generic rule has at least one traffic descriptor component and can have one or more route selection descriptors.

Traffic descriptors

A traffic descriptor (TD) identifies the traffic to which a rule applies. It can include:

- Application IDs
- DNNs
- IP three-tuples
- Connection capabilities
- Non-IP descriptors
- Domain descriptors

Route selection descriptors

A route selection descriptor (RSD) supplies the route or session characteristics for traffic that matches a TD. The router supports these descriptor types:

- Type 1 supplies PDU session parameters, including SSC mode, access type, S-NSSAI, DNN, and PDU session type.
- Type 2 indicates non-seamless non-3GPP offload.

Configure cellular network slicing

Follow these steps to configure cellular network slicing.

Procedure

Step 1 Use **config terminal** command to enter the global configuration mode.

Example:

```
Router# configure terminal
```

Step 2 Use the **controller cellular** <*slot*> command to enter the cellular controller configuration mode.

Example:

```
Router(config)# controller cellular x/x/x
```

Step 3 Use the **profile id** *number* **apn** *name* **authentication** *type* **pdn-type** *type* command to associate the profile with the PDN.

Example:

```
Router(config-controller)# profile id 3 apn apn-ns authentication none pdn-type ipv4
```

Step 4 Use the **profile id** *number* **apn** *name* **authentication** *type* **pdn-type** *type* **slice-type** *type* to associate the profile with the slice type.

Example:

```
Router(config-controller)# profile id 3 apn apn-ns authentication none pdn-type ipv4 slice- type miot
```

<1-3> slice type *number*: 1(eMBB), 2(URLLC), 3(MioT)

Step 5 Use the **profile id** *number* **apn** *name* **authentication** *type* **pdn-type** *type***slice-type** *type* **slice-differentiator** *number* to associate tslice differentiator with the slice type.

Example:

```
Router(config-controller)# profile id 3 apn apn-ns authentication none pdn-type ipv4 slice- type miot
 slice-differentiator 6
```

slice differentiator *number*: 0-16777214

If slice differentiator is bypassed, then "FF FF FF" is used internally as the slice differentiator to indicate that there is no slice differentiator associated with this slice type.

Example for configuring cellular network slicing

This example shows how to configure a cellular network slicing.

```
Device(config-controller)# profile id 3 apn apn-ns authentication none pdn-type ipv4
        no-overwrite
        slot            Associated sim slot
        slice-type Associated network slice type(SST)

        Device(config-controller)# profile id 3 apn apn-ns authentication none pdn-type
ipv4 slice-type
        <1-3>  Slice type number: 1(eMBB), 2(URLLC), 3(MioT)
        Device(config-controller)# profile id 3 apn apn-ns authentication none pdn-type
ipv4 slice- type embb
        slice-differentiator Associated Slice Differentiator(SD)  <--- if SD is bypassed
here,"FF FF FF" will be used internally as the SD to indicate that there is no SD associated
 with this SST.
        slot                            Associated sim slot

        Device(config-controller)# profile id 3 apn apn-ns authentication none pdn-type
ipv4 slice-type
        embb slice-differentiator
        <0-16777214>  Slice Differentiator
        Device(config-controller)#
        Device(config-controller)#$ pdn ipv6  slice-type miot slice-differentiator 6
        slot  Associated sim slot
```

Verify cellular network slicing configuration

This is a sample output from the **show cellular** command that displays network slicing configuration and slice type details.

```
Device# show cellular profile 3

                Profile 3 = ACTIVE
                --------
                PDP Type = IPv6
                Access Point Name (APN) = TestNSSAI6_MIOT1
                Authentication = None
                S-NSSAI Slice Type is MIOT
                S-NSSAI Slice Differentiator = 6
```

Troubleshoot a URSP issue

Use this procedure to check why the router does not display URSP rules or to control URSP-installed routes.

The admin-tech output includes URSP show commands and cellular call control debugs. URSP debugging uses cellular call control debugs.

Follow these steps to troubleshoot a URSP issue.

Procedure

Step 1 If no URSP rules are displayed, verify that the router is registered on a 5G standalone (SA) network and that the network operator enables URSP for the subscription and device.

Step 2 Confirm that the modem runs firmware version 2.17.08.00 or later and that the router runs Release 27.1.1 or later.

Step 3 Run the test command to deactivate routes installed by URSP.

Example:

```
Router# test cellular <controller> ursp-deactivate-routes
```

Step 4 Run the test command to activate routes installed by URSP.

Example:

```
Router# test cellular <controller> ursp-activate-routes
```