WPS Prioritization

Table 1: Feature History

Feature Name	Release Information	Description
WPS Prioritization on UPF	2023.04	The Wireless Priority Services (WPS) feature provides finer control for priority handling over multiple interfaces. UPF supports WPS services based on the message priority indicated by SMF. The configured priority value set on SMF will be sent to UPF over N4 as part of the PFCP header.

Feature Description

The Wireless Priority Services (WPS) feature provides finer control for priority handling over multiple interfaces. UPF supports WPS based on the message priority indicated by SMF.

The priority value set on SMF will be sent to UPF over N4 as part of the PFCP header. The message priority values from SMF and cnSGWc are currently supported for Emergency, VoLTE, and non-VoLTE IMS sessions.

Note WPS supports only N4 (SMF) and Sxa (cnSGW) terminations on UPF. WPS does not support Sxb (PGW-C) and Sxa (SGW-C) terminations in this release.

For information on WPS prioritization support on RCM, see the *UCC 5G RCM Configuration and Administration Guide*.

For information on WPS prioritization support on SMF, see the *UCC 5G SMF Configuration and Administration Guide*.

How it Works

This section describes how WPS prioritization works in UPF.

Priority Handling

The session-priority-profile maps the session-priority values from 0 to 15 to precedence values from 1 to 4. It is used internally in modules like RCM and data-queue distribution.

SR and ICSR

When the feature is not enabled, any session with a valid session-priority received over N4/SX will be prioritized for SR/ICSR as per earlier design.

When the feature enabled, there is a change such that only the Emergency and WPS sessions will be prioritized for SR/ICSR. During UPF downgrade, the priority values are recovered with an offset of +1.

Data Queue

The following table describes the traffic distribution over data queues based on session precedence:

Queue #	Details
3 (Highest priority)	Reserved for Sx
2	Used for Precedence 1,2 sessions
1	Used for Precedence 3,4 sessions
0 (Lowest priority)	Used for Data/Non-prioritized sessions

The default precedence values will be used when:

- Only session-type is configured and precedence is not defined for session-priority
- No priority value is configured in the session-priority profile
- WPS feature is enabled with the **default** session-priority profile

Note

- If the feature is disabled, UPF uses N-1 support prioritization.
- For session recovery of combo calls, the highest priority value received on Sxa or N4 will be used for both sessions.

Mapping to Session Type

UPF maps the session priority values (WPS, Emergency, and IMS) received over N4 to the session types using the "associate session-priority-profile" CLI configuration.

For VoLTE non-active sessions, mapping is not available. For VoLTE active sessions, the priority value 'ims' will be used, while the next priority value (+1) is implicitly used for VoLTE non-active sessions. Hence, "ims+1" priority should not be configured in the session-priority profile.

Version Compatibility

1. For the latest version (X) of RCM and a prior version (X-1) of UPF:
   a. RCM will support the previous UPF version (X-N), as the priority set is extended without affecting the previously supported set of priorities (1, 2, 3).
   b. During switchover, the flush sequence will be completely based on the priority received from the UPF, which was not the case in earlier versions.
2. For the prior version (X-1) of RCM and latest version (X) of UPF:
   a. RCM will not support the extended set of priorities, and the checkpoints received for priority 4 will be dropped.
   b. During switchover, calls for priority 1, 2, and 3 can be restored.

Control-Plane Compatibility

To enable WPS prioritization, upgrade the UPF to the new configuration. Prioritization will not be guaranteed in the following scenarios when:

- SMF/CP is not upgraded
- Priority values are sent based on N-1 support
- WPS prioritization is enabled on UPF

Based on the priority values received from the Control Plane, the following combinations will work:

S. No.	SMF / cnSGW / PGW-C / SGW-C Version	UPF Version	WPS prioritization enabled on UPF	UPF Behavior
1	N-1 Or N without config	N-1	N/A	No WPS prioritization - same as previous behavior.
2	N-1 Or N without config	N	No	No WPS prioritization - same as previous behavior.
3	N-1 Or N without config	N	Yes	Session prioritization will not be guaranteed.

S. No.	SMF / cnSGW / PGW-C / SGW-C Version	UPF Version	WPS prioritization enabled on UPF	UPF Behavior
4	N (Config present)	N-1	N/A	This is not recommended as session prioritization will not be guaranteed. RCM checkpoints will be dropped for priority>3.
5	N (Config present)	N	Yes	WPS prioritization works.
6	N (Config present)	N	No	This is not recommended as session prioritization will not be guaranteed.

Limitations

The WPS Prioritization feature has the following limitations:

- In a multi-Sx/N4 scenario, all Control Plane nodes must use the same process to send MP values. This applies to SMF/cnSGW and PGW-C/SGW-C working with the same UPF.
- The sessions recovered during the UPF software upgrade will retain their prioritization values. As a result, after the UPF upgrade between N-1 and N, the prioritization for existing sessions will not work as expected, and the show CLI output will be undetermined.
- In the case of a configuration change at the SMF that changes existing priority values or a configuration change at the UPF that changes the session type, the session type and priority are not re-evaluated. As a result of such a configuration change, incorrect statistics updates may occur.
- Due to any mid-session priority changes, some of the statistics may be inconsistent.

Message Prioritization for Overload Scenarios

Table 2: Feature History

Feature Name	Release Information	Description
Handling PFCP Messages Using Message Prioritization during an Overload Scenario	2024.04.1	This feature allows the UPF to use message prioritization to ensure uninterrupted receival of incoming PFCP messages during an overload scenario or self-protection mode. Message Prioritization allows the network operator to define the message priority using the configuration to throttle the PFCP messages in overload scenarios for a WPS session. **Command Enhanced**: **session-priority-profile** *spp_name* **priority** *priority_value* **type { wps | emergency | ims } { throttle | precedence** *precedence_value* **}** **Default Setting:** Disabled-Configuration required to enable.

Message Priority for PFCP Messages

During an overload condition, UPF handles the incoming PFCP messages using Message Priority. UPF receives the message priority bits in the PFCP signaling, based on the operator policy. UPF sets the same message priority in the outgoing response message that it receives in the incoming request message.

UPF compares this message priority with the message priority defined in the configuration. UPF then throttles or exempts from throttling according to the configuration in the overload or self-protection mode.

UPF exempts the priority traffic from throttling unless it is impossible to achieve the requested traffic reduction without throttling the priority traffic as well. By default, UPF exempts the priority PFCP messages from throttling. However, you can throttle the priority PFCP sessions by defining specifically in the configuration.

To throttle the priority PFCP messages, see the Mapping the Session Priority Profile section.

Configuring WPS Prioritization

This section describes how to configure the WPS Prioritization feature.

Enabling WPS Prioritization

Use the following configuration to enable or disable WPS prioritization support and associate a session-priority-profile with the user-plane-service:

```
config
   context context_name
      user-plane-service up_service_name
         [ no ] associate session-priority-profile { name | default } [
name_string ]
         end
```

NOTES:

- **associate session-priority-profile { name | default } [** *name_string* **]**: Enables WPS prioritization support.
  - **name**: Specify the name of the session priority profile to be associated with the User Plane service.
  - **default**: Specify the default precedence value associated with the session priority.
  - *name_string* : Specify the name string associated with the session priority.
- **no associate session-priority-profile** : Disables WPS prioritization support.
- On a given UPF, you can configure a total number of 16 session-priority profiles. Only one session-priority profile can be associated with a user-plane service.
- When a session does not receive any message-priority within the N4/Sx messages, it is classified as a 'Normal' session with a 'precedence' value set to 0.
- If a priority is not specified in the session-priority-profile configuration, the session-type will be shown as 'Unclassified' and uses the default1 precedence value.
- When there is no session-priority-profile association in the user-plane-service, UPF utilizes the existing (N-1) behavior with fixed priority values, including Emergency, IMS-VoLTE, and IMS-nonVoLTE.

Mapping the Session Priority Profile

Use the following configuration to configure the session priority value with a session type and precedence value.

```
config
   session-priority-profile spp_name
     priority priority_value type { wps | emergency | ims } [ throttle |
precedence precedence_value ]
     end
```

NOTES:

- **session-priority-profile**: Specify the session priority profile name.
- **priority**: Specify the priority value as an integer in the range of 0–15.
- **type { wps | emergency | ims }**: Specify the session type.
- **throttle**: Defines the behavior for flows of priority sessions during overload/self-protection state to be throttled. The default value of this keyword is Enabled, if the priority is not configured.
- **precedence**: Specify the precedence value as an integer in the range of 1–4.
- The session-priority profile must not be configured with the priority value next to the one assigned for **ims**.

OAM Support

Show Commands Support

This section provides information about show commands and their outputs in support of this feature.

show subscribers user-plane-only full all

The output of this CLI command is enhanced to display the session-type value.

The following is a sample output of this command:

```
show subscribers user-plane-only full all | more

  Local SEID      : [0x0004000000000000] 1125899906842624
  Remote SEID     : [0x0004000000000002] 1125899906842626
  State           : Connected
  Connect Time    : Thu Jun  8 09:36:49 2023
Idle time       : 00h00m11s
  Access Type: uplane-ipv4              Network Type: IP
  user-plane-service-name: user-plane-service
  active-service-scheme-name:
  Callid: 00004e21
  Rulebase: prepaid
  Interface Type: Sxb
  eMPS Session: Yes
  eMPS Session Priority: 6
  Session-Type: wps
```

```
  Precedence-Order: 1
  Data Queue: 2
```

show user-plane-service all

The output of this CLI command is enhanced to display the Session Priority Profile name.

The following is a sample output of this command:

```
show user-plane-service all

Service name : user-plane-service
Service-Id : 7
Context : ingress
Status : STARTED
PGW Ingress GTPU Service : sx-gtpu-service
…
Nf-Instance-Id : Not defined
Session Priority Profile          : sp1
```

show user-plane-service session-priority-profile name | all

The output of this CLI command displays the session priority profile name, along with type and precedence value per priority.

The following is a sample output of this command:

```
show user-plane-service session-priority-profile name spp1

  Session Priority Profile Name: spp1
  Priority     Type            Precedence
  ---------------------------------------
  0            unclassified    1
  1            wps             1
  2            unclassified    1
  3            emergency       2
  4            unclassified    2
  5            ims             3
  6            ims             3
  7            unclassified    2
  8            unclassified    3
  9            unclassified    3
  10           unclassified    3
  11           unclassified    3
  12           unclassified    4
  13           unclassified    4
  14           unclassified    4
  15           unclassified    4

Total session priority profile(s) found: 1
```

show user-plane-service statistics all

The output of this command is enhanced to display the number of WPS sessions.

The following is a sample output of this command:

```
show user-plane-service statistics all
…
  eMPS PDNs Total:
    Active:                          0        Setup:                          0
    Released:                        0        Rejected:                       0
```

```
WPS PDNs Total:
  Active:                          0        Setup:                           0
  Released:                        0        Rejected:                        0
```

show user-plane-service statistics session-priority-profile

The output of this CLI command displays the number of prioritized and non-prioritized sessions. This command also displays prioritized sessions based on the 'type' configuration in the 'session-priority-profile'.

The following is a sample output of this command:

```
show user-plane-service statistics session-priority-profile

  Total Non-Prioritized (Normal) sessions: 0

  Total Prioritized sessions: 121
    WPS sessions            Total: 11          Active: 11
      Precedence            Config match       Default match
      ----------           --------------     ---------------
        1                              1                   0
        2                              0                  10
        3                              0                   0
        4                              0                   0

    Emergency sessions      Total: 110         Active: 110
      Precedence            Config match       Default match
      ----------           --------------     ---------------
        1                              0                  10
        2                              0                   0
        3                              0                 100
        4                              0                   0

    IMS sessions            Total: 0           Active: 0
      Precedence            Config match       Default match
      ----------           --------------     ---------------
        1                              0                   0
        2                              0                   0
        3                              0                   0
        4                              0                   0

    Unclassified sessions   Total: 0           Active: 0
      Precedence            Config match       Default match
      ----------           --------------     ---------------
        1                              0                   0
        2                              0                   0
        3                              0                   0
        4                              0                   0
```