DSCP Marking

Revision history

Table 1: Revision history

Revision Details	Introductory Release
Provided support for DSCP marking of control plane signaling messages.	2021.01.0
First introduced.	Pre-2020.02.0

DSCP markings for QoS in SMF

The Differentiated Services Code Point (DSCP) marking feature is a mechanism that enables the SMF to

- mark packets with a specific value,
- perform traffic classification, and
- provide the appropriate quality of service (QoS) treatment in SMF.

The DSCP is a 6-bit field in the Differentiated Services (DiffServ) field of an IPv4 and IPv6 packet header.

Functionality of DSCP marking

SMF supports the DSCP marking feature for

- data packets and

- control plane signaling.

For more information, refer to the How the DSCP marking works for data packets and How the DSCP marking works for control plane signaling sections.

This feature uses CLI commands to configure DSCP parameters for both signaling messages and data packets.

Note This feature is also applicable on 4G calls with legacy interfaces.

How DSCP marking works for data packets

Summary

DSCP marking is a CLI-controlled feature that enables the creation and mapping of 5G QoS Identifier (5QI) and Allocation and Retention Priority (ARP) values to enforceable QoS parameters.

DSCP marking offers detailed configuration options for users. For Interactive Traffic Class (ITC), the SMF allows DSCP marking for Uplink and Downlink directions based on 5QI and ARP priority levels for each APN.

This feature allows the users to assign different DSCP values to flows with the same 5QI but different ARP priority values. For example, the ability to assign DSCP values that are based on 5QI+ARP can be used to meet compliance on priority and emergency calling via VoLTE.

Workflow

The method for allocating DSCP values to flows with the same 5QI but different ARP values is described here:

1. New 5QI and ARP configurations override any pre-existing DSCP marking of packets using a 5QI and ARP combination.
2. 5QI-only DSCP entry overrides all the existing 5QI and ARP configuration.
3. SMF sends the configured DSCP value to the UPF.
4. UPF applies the associated DSCP marking for 5QI and ARP for uplink and downlink traffic.

How DSCP marking works for control signaling

Workflow

The DSCP marking process for control signaling involves categorizing and marking network packets to ensure Quality of Service (QoS) in data transmission.

The key components involved in the DSCP marking process are:

- SMF
- Protocol endpoints

- Control packets

The DSCP marking for control signaling works with these characteristics:

1. SMF marks the incoming and outgoing packets after the QoS classification. The protocol endpoints provide the DSCP values when registering the endpoint and interface.
2. SMF marks the DSCP values on control packets as per the interface configuration.
3. DSCP marking feature supports dynamic configuration changes.
4. DSCP marking configuration is applicable to all the interfaces defined within the configured endpoints.
5. DSCP marking is supported only on a per-interface and per-protocol basis, not on a per-peer or per-session basis.
6. SMF uses the DSCP command in the endpoint and interface configurations to define the DSCP values.

   Understanding the DSCP code value range and its denoted priority is essential for DHCP marking.

   This table lists the commonly used DSCP values as described in RFC 2475.

Table 2: Commonly Used DSCP values

DSCP Value	Decimal Value	Meaning	Drop Probability	Equivalent IP Precedence Value
101 110	46	High Priority Expedited Forwarding (EF)	—	101 - Critical
000 000	0	Best Effort	—	000 - Routine
001 010	10	AF11	Low	001 - Priority
001 100	12	AF12	Medium	001 - Priority
001 110	14	AF13	High	001 - Priority
010 010	18	AF21	Low	010 - Immediate
010 100	20	AF22	Medium	010 - Immediate
010 110	22	AF23	High	010 - Immediate
011 010	26	AF31	Low	011 - Flash
011 100	28	AF32	Medium	011 - Flash
011 110	30	AF33	High	011 - Flash
100 010	34	AF41	Low	100 - Flash Override
100 100	36	AF42	Medium	100 - Flash Override

DSCP Value	Decimal Value	Meaning	Drop Probability	Equivalent IP Precedence Value
100 110	38	AF43	High	100 - Flash Override
001 000	8	CS1	—	1
010 000	16	CS2	—	2
011 000	24	CS3	—	3
100 000	32	CS4	—	4
101 000	40	CS5	—	5
110 000	48	CS6	—	6
111 000	56	CS7	—	7
000 000	0	Default	—	—
101 110	46	EF	—	—

Configure DSCP marking

To configure the DSCP Marking feature, perform these steps.

Procedure

Step 1 Configure DSCP marking for data packets, on page 4

Step 2 Configure DSCP marking for control signaling, on page 6

Configure DSCP marking for data packets

Use this procedure to create and map 5QI values to QoS parameters.

Procedure

Step 1 Specify the name of the QoS profile in the global configuration mode to configure the QoS profile.

profile qos <*qos_profile_name*>

Example:

```
[smf] smf(config)# profile qos test
```

Step 2 Specify the ID for the authorized QoS parameters.

dscp-map qi5 <*qos_id*>

Example:

```
[smf] smf(config-qos-profile_name)# dscp-map qi5 1
```

The qos_id value must be an integer in the range of 1 to 255.

Note
Use the DSCP configuration from the QoS profile level if it is unavailable at the QoS flow level.

Step 3 Set the ARP priority level and DSCP value in the inner IP header in the Uplink direction to apply the value to the packet.

arp-priority-level <*arp_value*> **uplink user-datagram dscp-marking** <*dscp_marking_value*>

Example:

```
[smf] smf(config-qos-profile_name)# dscp-map qi5 1arp-priority-level  2 uplink
user-datagram dscp-marking 0X00
```

The arp_value must be an integer in the range of 1 to 255.

The dscp_marking_value must be a hexadecimal number from 0x00 through 0x3F.

Step 4 Set the ARP priority level and DSCP value either in the encapsulation header or user datagram in Downlink direction.

arp-priority-level *arp_value* **downlink { encsp-header { copy-inner | dscp-marking** *dscp_marking_value* **} | user-datagram dscp-marking** *dscp_marking_value* **}**

Example:

```
[smf] smf(config-qos-profile_name)# dscp-map qi5 1arp-priority-level 1  downlink
encsp-header copy-inner
[smf] smf(config-qos-profile_name)# dscp-map qi5 1arp-priority-level 1  downlink
encsp-header dscp-marking 0x3b
```

- If encsp-header is configured, set the DSCP in the outer IP header in the Downlink direction or copy the DSCP value from the inner IP header to the outer IP header.
- If the user-datagram is configured, set the DSCP in the inner IP header in the Downlink direction.
- The arp_value must be an integer in the range of 1 to 255.
- The dscp_marking_value must be a hexadecimal number from 0x00 through 0x3F.

Step 5 [Optional] Use the **show running-config profile qos** command to verify the DSCP configuration for UP packets.

Example:

```
[smf] smf# show running-config profile qos
profile qos abc
 ambr ul "250 Kbps"
 ambr dl "500 Kbps"
 qi5      7
 arp priority-level 14
 arp preempt-cap NOT_PREEMPT
 arp preempt-vuln PREEMPTABLE
 priority 120
 max data-burst 2000
exit
```

```
profile qos qos_1
 dscp-map qi5 1 arp-priority-level 5 uplink user-datagram dscp-marking 0x1e
 dscp-map qi5 1 arp-priority-level 5 downlink user-datagram dscp-marking 0x22 encsp-header copy-inner

 dscp-map qi5 2 arp-priority-level 6 uplink user-datagram dscp-marking 0x3e
 dscp-map qi5 2 arp-priority-level 6 downlink user-datagram dscp-marking 0x23 encsp-header copy-inner

 dscp-map qi5 3 arp-priority-level 12 uplink user-datagram dscp-marking 0x2f
 dscp-map qi5 3 arp-priority-level 12 downlink user-datagram dscp-marking 0x14 encsp-header copy-inner

 dscp-map qi5 6 downlink encsp-header copy-inner
 dscp-map qi5 7 downlink encsp-header dscp-marking 0x01
exit
```

Sample configuration of DSCP marking for data packets

This sample configuration defines the QoS with specific DSCP mapping rules for both uplink and downlink traffic, including ARP packets.

```
profile qos test
 dscp-map qi5 1 downlink encaps-header copy-inner
 dscp-map qi5 1 downlink encaps-header dscp-marking 0x3b
 dscp-map qi5 2 downlink user-datagram dscp-marking 0x3b
 dscp-map qi5 3 downlink user-datagram dscp-marking 0x3b encaps-header copy-inner
 dscp-map qi5 4 downlink user-datagram dscp-marking 0x3b encaps-header dscp-marking 0x3f
 dscp-map qi5 2 uplink user-datagram dscp-marking 0x3b

 dscp-map qi5 1 arp-priority-level 1 downlink encaps-header copy-inner
 dscp-map qi5 2 arp-priority-level 2 downlink encaps-header dscp-marking 0x3b
 dscp-map qi5 4 arp-priority-level 3 downlink user-datagram dscp-marking 0x3b
 dscp-map qi5 2 arp-priority-level 4 downlink user-datagram dscp-marking 0x3b encaps-header
 copy-inner
 dscp-map qi5 4 arp-priority-level 5 downlink user-datagram dscp-marking 0x3b encaps-header
 dscp-marking 0x3f
 dscp-map qi5 4 arp-priority-level 5 uplink user-datagram dscp-marking 0x3b
```

Configure DSCP marking for control signaling

Use this procedure to configure the DSCP marking for control signaling at the endpoint and interface:

Procedure

Step 1 Specify the instance and group instance ID in the global configuration mode.

instance instance-id *<gr_instance_id>*

Example:

```
[smf] smf(config)# instance instance-id 1
```

Step 2 Specify the endpoint for DSCP marking.

endpoint { gtp | li | protocol | radius | sbi }

Example:

```
[smf] smf(config-instance-instance-id-1)# endpoint gtp
```

The DSCP marking configuration is applicable only to these endpoints:

- protocol
- sbi
- gtp
- radius
- li

Step 3 Specify the DSCP value for the control plane signaling messages.

dscp <*dscp_value* >

Example:

```
[smf] smf(config-endpoint-gtp)# dscp 24
```

The dscp_value must be a hexadecimal number from 0x00 to 0x3F or a decimal value from 0 to 63.

Step 4 Specify the interface within the selected endpoint for DSCP marking.

interface { coa-nas | gtpu | n4 | n7 | n10 | n11 | n16 | n40 |nrf | radius-client | s2b | s5 | s8 | upf-rcm-connupf-rcm-reg }

Example:

```
[smf] smf(config-endpoint-gtp)# interface nrf
```

The Service-based Interface (SBI) configuration applies to all the interfaces. If a specific interface configuration is present, it overrides the DSCP values.

Note
Configure vip-ip, vip-port, and loopbackPort at each interface level for the proper functionality of the interfaces.

Step 5 Specify the DSCP value for the control plane signaling messages and save the configuration.

dscp <*dscp_value* >

Example:

```
[smf] smf(config-interface-nrf)# dscp 24
```

The dscp_value must be a hexadecimal number from 0x00 to 0x3F or a decimal value from 0 to 63.

Step 6 [Optional] Use the **show running-config instance instance-id gr_instance_id endpoint** command to verify the DSCP configuration for control packets.

Example:

```
smf# show running-config instance instance-id 1 endpoint
instance instance-id 1
 endpoint sbi
  replicas 2
  nodes 1
  dscp 24
  vip-ip 209.165.200.230
  interface nrf
   loopbackPort 9050
```

```
   vip-ip 209.165.200.236 vip-port 8090
   dscp 24
  exit
 exit
exit
```

Monitor the DSCP marking value

Use these commands to view the configured DSCP value:

- **monitor protocol**
- **monitor subscriber**