



Nexthop Forwarding Support

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Revision History

Table 1: Revision History

Revision Details	Release
First introduced.	2022.01.0

Feature Description

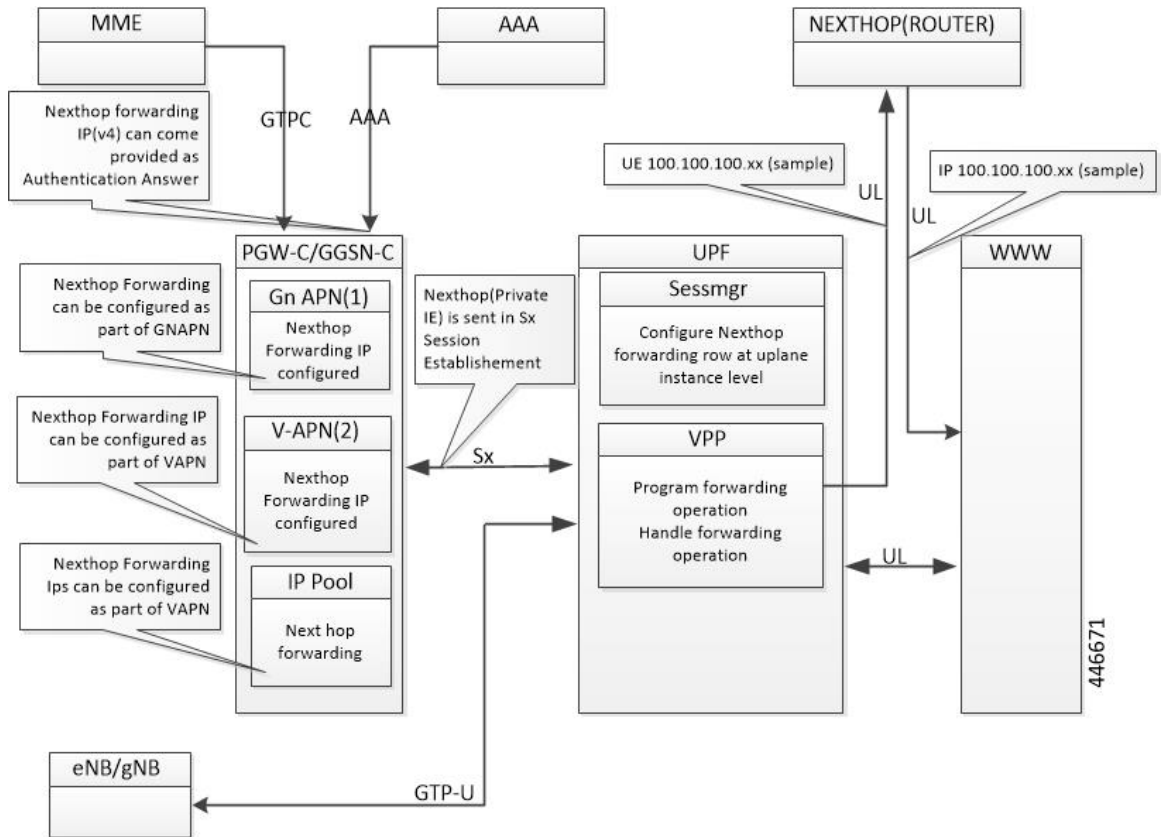
In uplink direction, the UE and the GI IP can be in a different subnet. The routing path in UPF is defined to allow the uplink packet to be forwarded accordingly.

How It Works

Architecture

The following illustration provides an overview of Nexthop Forwarding feature.

Figure 1: NextHop Forwarding



You can configure NextHop IP address at the SMF under DNN profile or IPAM profile. During PDU Establishment, the SMF relays the IPv4/IPv6 address over the N4 interface in the NEXT HOP IP private IE in a PFCP Session Establishment Request.

You can also configure NextHop IP address at the UPF through Charging-Action.



Note When NextHop address is provided by both SMF and UPF Charging-Action, the UPF Charging-Action NextHop address takes precedence.

Configuration Priority

S. No.	Configuration	Priority
1.	UPF (Charging Action)	1
2.	DNN profile	2
3.	IP Pool	3

Configuration Use Cases

Case	IP Type	DNN	IP Pool	UPF (Charging Action)	NextHop IP Selection
NextHop supplied only in DNN	IPv4	209.165.201.18	Not configured	Not configured	NextHop Address is selected from DNN: IPv4: 209.165.201.18 IPv6: 8001::10
	IPv6	8001::10	Not applicable		
NextHop supplied only in IP pool	IPv4	Not configured	209.165.201.19	Not configured	NextHop Address is selected from IP Pool: IPv4: 209.165.201.19
	IPv6	Not configured	Not applicable		
IPv4 and IPv6 configured in DNN, and IPv4 in IP pool	IPv4	209.165.201.18	209.165.201.19	Not configured	NextHop Address is selected from DNN: IPv4: 209.165.201.18 IPv6: 9001::3
	IPv6	9001::3	Not applicable		
IPv6 configured in DNN, and IPv4 in IP pool	IPv4	Not configured	209.165.201.19	Not configured	NextHop IPv4 is selected from IP pool: 209.165.201.19 NextHop IPv6 selected from DNN : 8001::10
	IPv6	8001::10	Not applicable		
IPv6 configured in DNN, IPv4 in IP pool, and IPv4 in UPF Charging Action	IPv4	209.165.201.18	209.165.201.19	209.165.201.20	NextHop Address is selected from UPF (CA): 209.165.201.20
	IPv6	8001::10	Not applicable	Not configured	
IPv6 configured in DNN, IPv4 in IP pool, and IPv6 in UPF Charging Action	IPv4	209.165.201.18	209.165.201.19	Not configured	NextHop Address is selected from UPF(CA) : 9001::10
	IPv6	8001::10	Not applicable	9001::10	

Interface

The following Private IEs are introduced in Sx/N4 Session Establishment message.

2 3 8	PFCP _IE_ NEXT HOP	PFCP_IE_NEXTHOP							Sx/N4 Session Establish ment Request	Private IE: UPF: nexthop forward ing support- IPv4 /IPv6 address	
		BITS									
		Octets	7	6	5	4	3	2	1		
		1 to 2	Type = 238 (decimal)								
		3 to 4	Length = n								
		5 to 10	PFCP_IE_NEXTHOP_ID								
		11-14	PFCP_IE_NEXTHOP_IP								

2 3 9	PFCP _IE_ NEXIHOP _ID	PFCP_IE_NEXTHOP_ID							1. Inside Create FAR IE of Sx Session Establish ment Request	Private IE : UPF: nexthop forward ing support- IPv4 /IPv6 address	
		BITS							2. Inside PFCP _IE_ NEXIHOP IE of Sx/N4 Session Establish ment Request		
		Octets	7	6	5	4	3	2	1		
		1 to 2	Type = 239 (decimal)								PFCP _IE_ NEXIHOP of Sx/N4 Session Establish ment Request
		3 to 4	Length = 5								
		5 to 10									

2 4 0	PFCP_IE_NEXTHOP_IP	PFCP_IE_NEXTHOP_IP										
		Bits								PFCP_IE_NEXTHOP of Sx/N4 Session Establishment Request	Private IE : UPF: nexthop forwarding support- IPv4/ IPv6 address	
		Octets	7	6	5	4	3	2	1			
		1 to 2	Type = 240 (decimal)									
		3 to 4	Length = n									
		5	spare				V4	V6				
		m to m+3	IPv4 Address									
		p to p+15	IPv6 Address									

The following is a sample output of SX_SESSION_ESTABLISHMENT_REQUEST in which the SMF relays the Nexthop IP to the UPF.

```

CREATE FAR:
  Type: 3
  Value:
    FAR ID:
      Type: 108
      Value: 0x80000002
  APPLY ACTION:
    Type: 44
    Value:
      DROP: 0
      FORW: 1
      BUFF: 0
      NOCP: 0
      DUPL: 0
  FORWARDING PARAMETERS:
    Type: 4
    Value:
      DESTINATION INTERFACE:
        Type: 42
        Value: CORE (1)
      PDN INSTANCE:
        Type: 22
        Value: intershat
      INNER PACKET MARKING:
        Type: 220
        TOS/TRAFFIC CLASS: 0xB8 0xFC

```

NextHop ID:
Value: 0x0001

```

CREATE TRAFFIC ENDPOINT:
  Type: 127 Length: 20
  Value:
    Traffic Endpoint ID:
      Type: 131 Length: 1
      Value: 0x0004
      Hex: 0083 0001 04

```

```

Local F-TEID:
  Type: 21 Length: 1
  Value:
    CH: 1
    IPv4: 0
    IPv6: 0
    CHID: 0
    Hex: 0015 0001 04
Bearer Info:
  Type: 225 Length: 6
  QCI: 5
  ARP: 84
  Charging ID: 5592407
  Hex: 00E1 0006 0554 0055 5557
Hex: 007F 0014 0083 0001 0400 1500 0104 00E1
      0006 0554 0055 5557

```

NEXT HOP IP:**Type: 237 Length: 14****Value:****NextHop ID:****Type: 238 Length: 1****Value: 0x0001****Hex: 00EE 0001 01****IP ADDR:****Type: 239 Length: 5****Value:****IPv4: 1****IPv6: 0****IPv4: 209.165.202.150****IPv6:****Hex: 00EF 0005 020F 0F0F 0F****Hex: 00ED 000E 00EE 0001 0100 EF00 0502 0F0F
0F0F**

Limitations

The following are the known limitations to this feature in this release:

- Currently, configuring NextHop forwarding through AAA isn't supported.
- IPv6 configuration from SMF via IPAM profile isn't supported.
- NextHop address sent on RADIUS and Diameter (Redirect information from PCF) interfaces isn't qualified.
- When you configure NextHop forwarding in DNN profile and IPAM, next hop is only seen in Sx Establishment, and not in Create FAR IE of Sx Session Modification Request.

Configuring Nexthop Forwarding Support

Configuring Nexthop Forwarding through Charging Action

At the UPF, use the following CLI commands to configure Nexthop Forwarding through Charging Action.

```
configure
  active-charging service service_name
    charging-action charging_action_name
      nexthop-forwarding-address ipv4_address/ipv6_address
```

NOTES:

- **charging-action** *charging_action_name*: Specifies the name of a charging action. *charging_action_name* must be an alphanumeric string of 1–63 characters and can contain punctuation characters. Each charging action must have a unique name.
- **nexthop-forwarding-address** *ipv4_address/ipv6_address*: Configures the nexthop forwarding address.

Configuring Nexthop Forwarding through DNN Profile

At the SMF, use the following CLI commands to configure Nexthop Forwarding through DNN profile.

```
configure
  profile dnn intershat
    nexthop-forwarding-address { ipv4 ipv4_address | ipv6 ipv6_address }
  end
```

NOTES:

- **nexthop-forwarding-address** { **ipv4** *ipv4_address* | **ipv6** *ipv6_address* }: Configures the Nexthop Forwarding address.
 - *ipv4_address*: Configures IPv4 address.
 - *ipv6_address*: Configures IPv6 address (supports colon-separated hexadecimal notation).

Configuring Nexthop Forwarding at IP Pool through IPAM Profile

At the SMF, use the following CLI command to configure Nexthop Forwarding at IP pool through IPAM profile.

```
address-range start_address end_address nexthop-forwarding-address ipv4_address
```

NOTES:

- **address-range** *start_address end_address* **nexthop-forwarding-address** *ipv4_address*: Configures the IPv4 address as Nexthop Forwarding address for this IP pool.

Monitoring and Troubleshooting

This section provides information about CLI commands available for monitoring and troubleshooting the feature.

Show Commands and Outputs

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

show subscriber user-plane-only full all

The output of this show command is enhanced to include the following fields introduced in support of this feature.

- **Next Hop Ip Address** - Displays the configured Nexthop IP address.



Note **Next Hop Ip Address** field is displayed only if the Nexthop IP address is relayed from the SMF. This field is not displayed if Nexthop IP address is configured only at the UPF using Charging-Action.
