Implementing IP in IP Tunnel

This chapter module provides conceptual and configuration information for IP in IP tunnels on Cisco ASR 9000 Series Router.

Note For a complete description of the IP in IP tunnel commands listed in this chapter, see the *VPN and Ethernet Services Command Reference for Cisco ASR 9000 Series Routers*.

Table 1: Feature History for IP in IP tunnel

Release	Modification
Release 5.3.1	This feature was introduced on Cisco ASR 9000 Series Router.

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IP in IP Tunneling

IP in IP tunneling refers to the encapsulation of an IP packet as a payload in another IP packet. ASR9K routers support IP in IP tunnels with all possible combinations of IPv4 and IPv6; that is, IPv4 over IPv4, IPv6 over IPv4, IPv4 over IPv6, and IPv6 over IPv6. For example, an IPv4 over IPv6 refers to an IPv4 packet as a payload encapsulated within an IPv6 packet and routed across an IPv6 network to reach the destination IPv4 network, where it is decapsulated.

IP in IP tunneling does not require any additional header such as a GRE header used in the GRE tunnels. So, IP in IP tunneling is preferred over GRE tunnels if both the networks are IP networks.

Restrictions

The following are not supported in IP in IP tunnels:

- MPLS
- Multicast packets

- Keep-Alive packets
- Path MTU (Maximum Transmission Unit) discovery
- DF (Do not Fragment) bit configuration in IPv6 tunnel mode.

Note If DF bit is configured for the tunnel interface, you cannot enable IPv6 tunnel mode.

Configuring IP in IP Tunnel

Perform the following steps to configure an IP in IP tunnel.

SUMMARY STEPS

1. **configure**
2. **interface tunnel-ip** *tunnel-id*
3. {**ipv4** | **ipv6**} **address** *ip-address*
4. **tunnel mode** {*ipv4* | *ipv6*}
5. **tunnel source** {*interface-id* | *ipv4/v6-address*}
6. **tunnel destination** *ipv4/v6-address*
7. *(Optional)* **tunnel df-bit** {*copy* | *disable*}
8. *(Optional)* **tunnel tos** *tos-value*
9. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

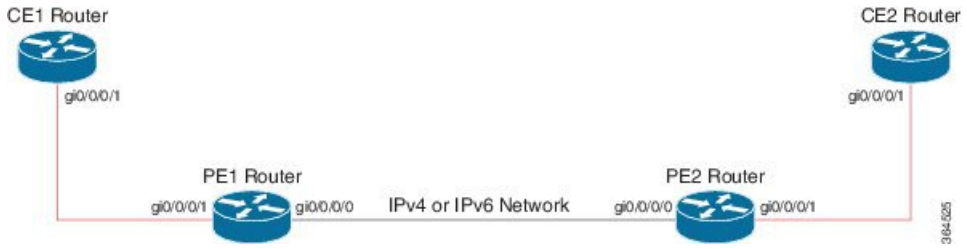
	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters the Global Configuration mode.
Step 2	**interface tunnel-ip** *tunnel-id* **Example:** `RP/0/RSP0/CPU0:router(config)# interface tunnel-ip 1`	Creates a tunnel interface and enters the tunnel configuration sub-mode. The *tunnel-id* is the numeric identifier for the tunnel interface.
Step 3	{**ipv4** | **ipv6**} **address** *ip-address* **Example:**	Sets the IPv4 or IPv6 address, as required, for the tunnel interface.

	Command or Action	Purpose
	`RP/0/RSP0/CPU0:router(config-if)# ipv6 address 10::1/64`	
Step 4	**tunnel mode** {*ipv4* | *ipv6*} **Example:** `RP/0/RSP0/CPU0:router(config-if)# tunnel mode ipv6`	Sets the tunnel mode as IPv4 or IPv6. This states the tunnel is in an IPv4 or IPv6 transport network.
Step 5	**tunnel source** {*interface-id* | *ipv4/v6-address*} **Example:** `RP/0/RSP0/CPU0:router(config-if)# tunnel source GigabitEthernet0/0/0/0`	Specifies an IP address or an interface that serves as the tunnel source. The encapsulated packet uses this IP address as the source address. If the tunnel mode is set to IPv4 or IPv6, an IPv4 or IPv6 address is selected as a tunnel source address from the specified source interface respectively.
Step 6	**tunnel destination** *ipv4/v6-address* **Example:** `RP/0/RSP0/CPU0:router(config-if)# tunnel destination 100::2`	Specifies the destination IP address for the tunnel. The encapsulated packet uses this IP address as the destination address.
Step 7	*(Optional)* **tunnel df-bit** {*copy* | *disable*} **Example:** `RP/0/RSP0/CPU0:router(config-if)# tunnel df-bit disable`	**Note** This is valid only for a tunnel that uses an IPv4 transport network. Configures the DF bit value for the outer IP packet. For details on this **tunnel df-bit** command, see the *VPN and Ethernet Services Command Reference for Cisco ASR 9000 Series Routers*.
Step 8	*(Optional)* **tunnel tos** *tos-value* **Example:** `RP/0/RSP0/CPU0:router(config-if)# tunnel tos 1`	Sets the TOS value for the outer IP packet in the tunnel. For details on this **tunnel tos** command, see the *VPN and Ethernet Services Command Reference for Cisco ASR 9000 Series Routers*.
Step 9	Use the **commit** or **end** command.	**commit** —Saves the configuration changes and remains within the configuration session. **end** —Prompts user to take one of these actions: • **Yes** — Saves configuration changes and exits the configuration session. • **No** —Exits the configuration session without committing the configuration changes. • **Cancel** —Remains in the configuration session, without committing the configuration changes.

IP in IP Tunneling: Examples

The following examples provide configurations for an IPv4 or IPv6 tunnel, with the transport VRF as the default VRF for the following simplified network topology.

Figure 1: IP in IP tunnel network topology



Configuration example for an IPv4 tunnel

PE1 Router Configuration	PE2 Router Configuration

`interface GigabitEthernet0/0/0/0`
`  !! Link between PE1-PE2`
`  ipv4 address 100.1.1.1/64`
`!`
`interface GigabitEthernet0/0/0/1`
`  !! Link between CE1-PE1`
`ipv4 address 20.1.1.1/24`
`  ipv6 address 20::1/64`
`!`
`interface tunnel-ip 1`
`ipv4 address 10.1.1.1/24`
`  ipv6 address 10::1/64`
`  tunnel mode ipv4`
`  tunnel source GigabitEthernet0/0/0/0`
`  tunnel destination 100.1.1.2`
`  !`
 	
`router static`
`address-family ipv4 unicast`
`    30.1.1.0/24 tunnel-ip1`
`   address-family ipv6 unicast`
`    30::0/64 tunnel-ip1`
`   !`
`  !`
`!`
	`interface GigabitEthernet0/0/0/0`
	`!! Link between PE1-PE2`
	`  ipv4 address 100.1.1.2/64`
	`!`
	`interface GigabitEthernet0/0/0/1`
	`  !! Link between PE2-CE2`
	`ipv4 address 30.1.1.1/24`
	`  ipv6 address 30::1/64`
	`!`
	`interface tunnel-ip 1`
	`ipv4 address 10.1.1.2/24`
	`  ipv6 address 10::2/64`
	`  tunnel mode ipv4`
	`  tunnel source GigabitEthernet0/0/0/0`
	`  tunnel destination 100.1.1.1`
	`  !`
	
	`router static`
	`address-family ipv4 unicast`
	`    20.1.1.0/24 tunnel-ip1`
	`   address-family ipv6 unicast`
	`    20::0/64 tunnel-ip1`
	`   !`
	`  !`
	`!`

CE1 Router Configuration	CE2 Router Configuration

```
interface GigabitEthernet0/0/0/1
!! Link between CE1-PE1
 ipv4 address 20.1.1.2 255.255.255.0
 ipv6 address 20::2/64
!
router static
 address-family ipv4 unicast
  30.1.1.0/24 20.1.1.1
 address-family ipv6 unicast
  30::0/64 20::1
 !
!
```

```
interface GigabitEthernet0/0/0/1
!! Link between CE2-PE2
 ipv4 address 30.1.1.2 255.255.255.0
 ipv6 address 30::2/64
!
router static
 address-family ipv4 unicast
  20.1.1.0/24 30.1.1.1
address-family ipv6 unicast
  20::0/64 30::1
 !
!
```

Configuration example for an IPv6 tunnel

PE1 Router Configuration

```
interface GigabitEthernet0/0/0/0
 !! Link between PE1-PE2
 ipv6 address 100::1/64
!
interface GigabitEthernet0/0/0/1
 !! Link between CE1-PE1
 vrf RED
 ipv4 address 20.1.1.1/24
 ipv6 address 20::1/64
!
interface tunnel-ip 1
 vrf RED
 ipv4 address 10.1.1.1/24
 ipv6 address 10::1/64
 tunnel mode ipv6
 tunnel source GigabitEthernet0/0/0/0
 tunnel destination 100::2
 !
vrf RED
 address-family ipv6 unicast
  import route-target
   2:1
  !
  export route-target
   2:1
  !
 address-family ipv4 unicast
  import route-target
   2:1
  !
  export route-target
   2:1
  !
router static
vrf RED
  address-family ipv4 unicast
   30.1.1.0/24 tunnel-ip1
  address-family ipv6 unicast
   30::0/64 tunnel-ip1
  !
 !
!
```

PE2 Router Configuration

```
interface GigabitEthernet0/0/0/0
!! Link between PE1-PE2
 ipv6 address 100::2/64
!
interface GigabitEthernet0/0/0/1
 !! Link between PE2-CE2
 vrf RED
 ipv4 address 30.1.1.1/24
 ipv6 address 30::1/64
!
interface tunnel-ip 1
 vrf RED
 ipv4 address 10.1.1.2/24
 ipv6 address 10::2/64
 tunnel mode ipv6
 tunnel source GigabitEthernet0/0/0/0
 tunnel destination 100::1
 !
vrf RED
 address-family ipv6 unicast
  import route-target
   2:1
  !
  export route-target
   2:1
  !
 address-family ipv4 unicast
  import route-target
   2:1
  !
  export route-target
   2:1
  !
router static
vrf RED
  address-family ipv4 unicast
   20.1.1.0/24 tunnel-ip1
  address-family ipv6 unicast
   20::0/64 tunnel-ip1
  !
 !
!
```

CE1 Router Configuration

CE2 Router Configuration

```
interface GigabitEthernet0/0/0/1
!! Link between CE1-PE1
 ipv4 address 20.1.1.2 255.255.255.0
 ipv6 address 20::2/64
!
router static
 address-family ipv4 unicast
  30.1.1.0/24 20.1.1.1
 address-family ipv6 unicast
  30::0/64 20::1
 !
!
```

```
interface GigabitEthernet0/0/0/1
!! Link between CE2-PE2
 ipv4 address 30.1.1.2 255.255.255.0
 ipv6 address 30::2/64
!
router static
 address-family ipv4 unicast
  20.1.1.0/24 30.1.1.1
address-family ipv6 unicast
  20::0/64 30::1
 !
!
```