

# **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, IPv6 over IPv4, IPv6 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**  $\{ipv4 \mid ipv6\}$
- **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**

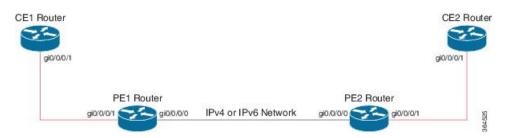
	Command or Action	Purpose
Step 1	configure	Enters the Global Configuration mode.
	Example:	
	RP/0/RSP0/CPU0:router# configure	
Step 2	interface tunnel-ip tunnel-id	Creates a tunnel interface and enters the tunnel configuration sub-mode. The <i>tunnel-id</i> is the numeric identifier for the tunnel interface.
	Example:	
	RP/0/RSP0/CPU0:router(config)# interface tunnel-ip 1	
Step 3	{ipv4   ipv6} address ip-address	Sets the IPv4 or IPv6 address, as required, for the tunnel interface.
	Example:	
	<pre>RP/0/RSP0/CPU0:router(config-if)# ipv6 address 10::1/64</pre>	

	Command or Action	Purpose
Step 4	<pre>tunnel mode {ipv4   ipv6} Example: RP/0/RSP0/CPU0:router(config-if)# tunnel mode ipv6</pre>	Sets the tunnel mode as IPv4 or IPv6. This states the tunnel is in an IPv4 or IPv6 transport network.
Step 5	<pre>tunnel source {interface-id   ipv4/v6-address} Example: RP/0/RSP0/CPU0:router(config-if)# tunnel source GigabitEthernet0/0/0/0</pre>	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	<pre>tunnel destination ipv4/v6-address Example: RP/0/RSP0/CPU0:router(config-if)# tunnel destination 100::2</pre>	Specifies the destination IP address for the tunnel. The encapsulated packet uses this IP address as the destination address.
Step 7	<pre>(Optional) tunnel df-bit {copy   disable} Example: RP/0/RSP0/CPU0:router(config-if)# tunnel df-bit disable</pre>	NoteThis 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 
Step 8	<pre>(Optional) tunnel tos tos-value Example: RP/0/RSP0/CPU0:router(config-if)# tunnel tos 1</pre>	Sets the TOS value for the outer IP packet in the tunnel. For details on this <b>tunnel tos</b> command, see the <i>VPN and</i> <i>Ethernet Services Command Reference for Cisco ASR 9000</i> <i>Series Routers</i> .
Step 9	Use the <b>commit</b> or <b>end</b> command.	<ul> <li>commit —Saves the configuration changes and remains within the configuration session.</li> <li>end —Prompts user to take one of these actions:</li> <li>Yes — Saves configuration changes and exits the configuration session.</li> <li>No —Exits the configuration session without committing the configuration changes.</li> <li>Cancel —Remains in the configuration changes.</li> </ul>

# **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
<pre>interface GigabitEthernet0/0/0/0   !! Link between PE1-PE2   ipv4 address 100.1.1.1/64   !</pre>	<pre>interface GigabitEthernet0/0/0/0 !! Link between PE1-PE2 ipv4 address 100.1.1.2/64 '</pre>
<pre>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   !</pre>	<pre>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   !</pre>
<pre>router static address-family ipv4 unicast     30.1.1.0/24 tunnel-ip1     address-family ipv6 unicast     30::0/64 tunnel-ip1    !   ! </pre>	<pre>router static address-family ipv4 unicast 20.1.1.0/24 tunnel-ip1 address-family ipv6 unicast 20::0/64 tunnel-ip1 ! ! !</pre>
CE1 Router Configuration	CE2 Router Configuration
<pre>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 ! !</pre>	<pre>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 ! </pre>

Configuration example for an IPv6 tunnel

PE1 Router Configuration

PE2 Router Configuration

interface GigabitEthernet0/0/0/0	interface GigabitEthernet0/0/0/0
!! Link between PE1-PE2	!! Link between PE1-PE2
ipv6 address 100::1/64	ipv6 address 100::2/64
!	!
interface GigabitEthernet0/0/0/1	interface GigabitEthernet0/0/0/1
!! Link between CE1-PE1	!! Link between PE2-CE2
vrf RED	vrf RED
ipv4 address 20.1.1.1/24	ipv4 address 30.1.1.1/24
ipv6 address 20::1/64	ipv6 address 30::1/64
!	!
interface tunnel-ip 1	interface tunnel-ip 1
vrf RED	vrf RED
ipv4 address 10.1.1.1/24	ipv4 address 10.1.1.2/24
ipv6 address 10::1/64	ipv6 address 10::2/64
tunnel mode ipv6	tunnel mode ipv6
tunnel source GigabitEthernet0/0/0/0	tunnel source GigabitEthernet0/0/0/0
tunnel destination 100::2	tunnel destination 100::1
!	!
vrf RED	vrf RED
address-family ipv6 unicast	address-family ipv6 unicast
import route-target	import route-target
2:1	2:1
!	!
export route-target	export route-target
2:1	2:1
!	!
address-family ipv4 unicast	address-family ipv4 unicast
import route-target	import route-target
2:1	2:1
!	!
export route-target	export route-target
2:1	2:1
!	!
router static	router static
vrf RED	vrf RED
address-family ipv4 unicast	address-family ipv4 unicast
30.1.1.0/24 tunnel-ip1	20.1.1.0/24 tunnel-ip1
address-family ipv6 unicast	address-family ipv6 unicast
30::0/64 tunnel-ip1	20::0/64 tunnel-ip1
!	!
!	!
!	!
CE1 Router Configuration	CE2 Router Configuration
interface GigabitEthernet0/0/0/1	interface GigabitEthernet0/0/0/1
!! Link between CE1-PE1	!! Link between CE2-PE2
ipv4 address 20.1.1.2 255.255.255.0	ipv4 address 30.1.1.2 255.255.255.0
ipv6 address 20::2/64	ipv6 address 30::2/64
!	!
router static	router static
address-family ipv4 unicast	address-family ipv4 unicast
30.1.1.0/24 20.1.1.1	20.1.1.0/24 30.1.1.1
addross_family inv6 uniquet	addrogg-family invé uniquet

address-family ipv6 unicast

30::0/64 20::1

!

!

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address-family ipv6 unicast

20::0/64 30::1

!

!

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