

IP Routing: GRE Configuration Guide, Cisco IOS XE 17 (Cisco ASR 900 Series)

First Published: 2021-05-05

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED “AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

All printed copies and duplicate soft copies of this document are considered uncontrolled. See the current online version for the latest version.

Cisco has more than 200 offices worldwide. Addresses and phone numbers are listed on the Cisco website at www.cisco.com/go/offices.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: https://www.cisco.com/c/en/us/about/legal/trademarks.html. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1721R)

© 2024 Cisco Systems, Inc. All rights reserved.

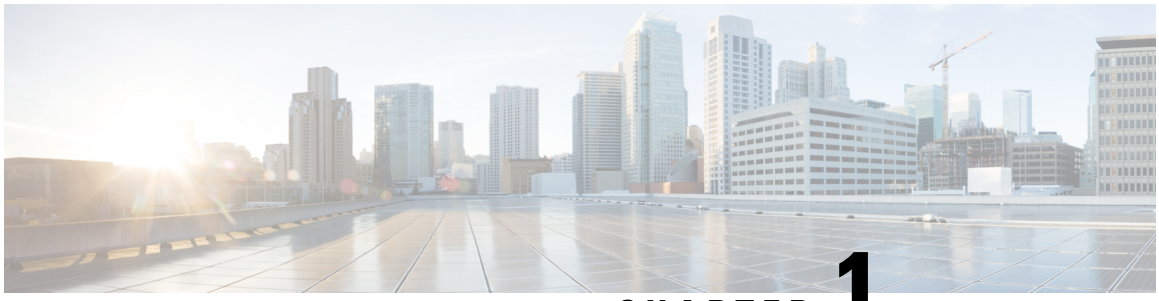


CONTENTS

CHAPTER 1 **Feature History** 1

CHAPTER 2 **IPv4 Unicast Generic Routing Encapsulation Tunnel Overview** 3

- Restrictions 4
- How to Configure IPv4 GRE Tunnel 5
  - Configure IPv4 Unicast Generic Routing Encapsulation Tunnel 5
- Verification of IPv4 Unicast Generic Routing Encapsulation Tunnel Configuration 6
- Establish GRE Tunnel over VRF Routes 7
  - Limitations 7
  - Configure GRE Tunnel over VRF Routes 7

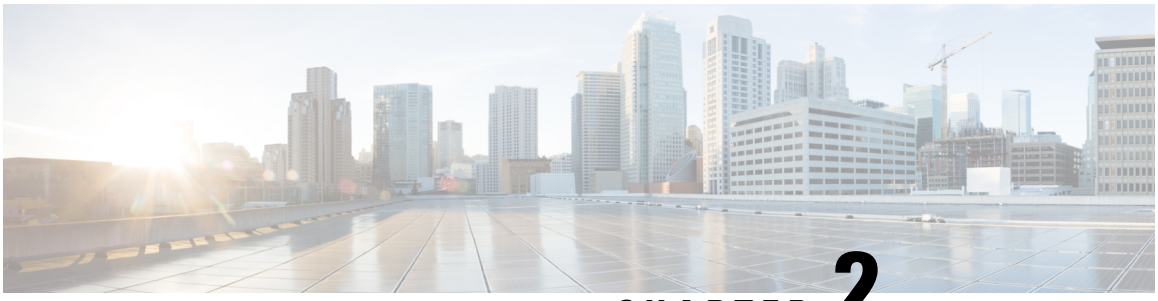


CHAPTER 1

Feature History

The following table lists the new and modified features supported in the IP Routing: GRE Configuration Guide in Cisco IOS XE 17 releases.

Feature	Description
Cisco IOS XE Bengaluru 17.6.1	
Establish GRE Tunnel over VRF Routes	This feature establishes GRE tunnels over Virtual Route Forward (VRF) routes. This feature is not supported with the Cisco RSP3 module. It is only supported with the Cisco ASR RSP2 module.



CHAPTER 2

IPv4 Unicast Generic Routing Encapsulation Tunnel Overview

IPv4 unicast Generic Routing Encapsulation Tunnel (GRE) tunneling protocol provides a simple generic approach to transport packets of one protocol over another protocol by means of encapsulation. The term GRE tunnels in this document implies only unicast IPv4 GRE tunnel that supports IPv4 payload.

GRE encapsulates a payload, that is, an inner packet that needs to be delivered to a destination network inside an outer IP packet. GRE tunnel endpoints send payloads through GRE tunnels by routing encapsulated packets through intervening IP networks. Other IP routers along the way do not parse the payload (the inner packet); they only parse the outer IP packet as they forward it towards the GRE tunnel endpoint. Upon reaching the tunnel endpoint, GRE encapsulation is removed and the payload is forwarded to it's ultimate destination.

Prior to Cisco IOS XE Gibraltar Release 16.12.x, GRE tunnels could provide a speed of 520 kbps for unidirectional and 250 kbps for bidirectional traffic. Starting with Cisco IOS XE Gibraltar Release 16.12.x, GRE tunnels enable the traffic to pass at a speed according to the size of the interface.

The IPv4 unicast GRE tunnels work on the following conditions:

- The unicast GRE tunnels work only with IPv4 as the transport protocol.
- The payload protocol is of type IPv4.
- SDM templates are supported only by the Metro Aggregation Services license. The license to use should be either **advancedmetroipaccess** or **metroaggrservices**.

IPv4 unicast GRE tunnels provide support to transport multiple protocols and packet types over the core network. More importantly, GRE tunnels can be used to form VPN networks by encapsulating the private addressing packets as payload with the tunnel header to transport the packet to the remote end. In the remote end, the packet is decapsulated and then routed based on private routing table. GRE tunnels can also carry multiple packet types such as unicast and multicast.

The tunnel comprises of the following three components:

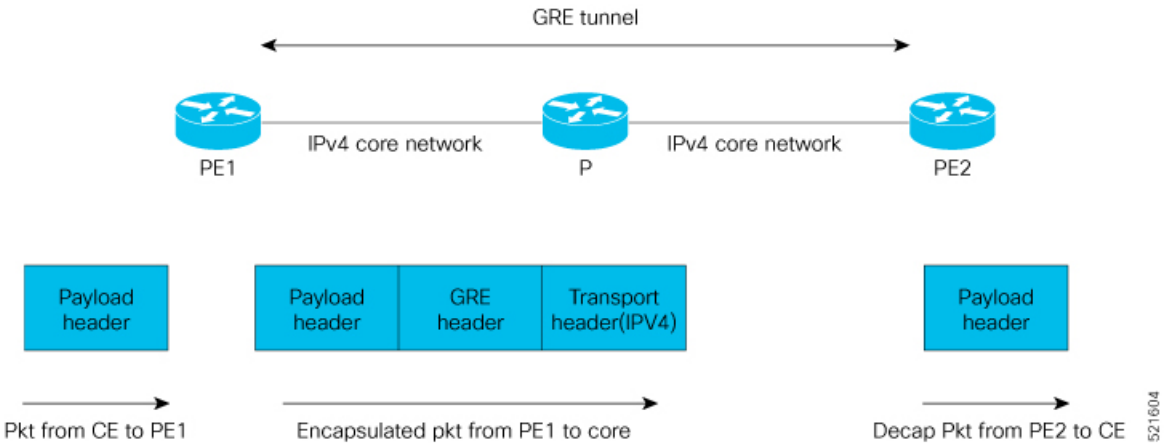
1. Payload packet or the passenger protocol
2. GRE header or the carrier protocol
3. Delivery header or the transport protocol

Figure 1: Packet Format in GRE Network



The following image shows a typical topology using GRE tunnel where IPv4 acts as both the transport protocol and the payload protocol.

Figure 2: Typical Unicast IPv4 GRE Topology



- Restrictions, on page 4
- How to Configure IPv4 GRE Tunnel, on page 5
- Verification of IPv4 Unicast Generic Routing Encapsulation Tunnel Configuration, on page 6
- Establish GRE Tunnel over VRF Routes, on page 7

Restrictions

- Tunnel destination under VRF and command **tunnel vrf** is *not* supported. Tunnel destination prefix must be in global routing table for IPV4 unicast GRE to be functional.
- Convergence lesser than 50 msec is not guaranteed.
- Maximum supported GRE scale is 510.
- Tunnel key is *not* supported. Hence, you must configure unique pair of source or destination IP address per tunnel.
- ACL and QoS are *not* supported over GRE tunnel.
- Time To Live (TTL) and Type of Service (TOS) are supported in Pipe mode.
- Tunnel Interface Statistics is *not* supported.
- Maximum Transmission Unit (MTU) is *not* supported for GRE tunnel and hence path MTU is also *not* supported.
- Recursive routing is *not* supported as control plane support is not available.
- Netflow and Policy-Based Routing (PBR) are *not* supported over the GRE tunnel.

- GRE over Virtual Private LAN Services (VPLS) or PW is *not* supported.
- GRE with indirection LB, Prefix Independent Convergence (PIC) core or PIC Edge, is *not* supported.
- GRE over Traffic Engineering (TE) tunnel core (mid-chain pointing to mid-chain support) is *not* supported.
- Equal-Cost Multi-Path Routing (ECMP) or load balancing between GRE tunnels is *not* supported. But, when you can configure LB paths for a single GRE tunnel, the tunnel uses only one of the paths.
- Bidirectional Forwarding Detection (BFD) over IPv4 unicast tunnel is *not* supported.
- MPLS over GRE tunnel and GRE over MPLS are *not* supported.

The following restrictions apply only to Cisco RSP3 module:

- GRE over BDI core is *not* supported.
- Tunnel checksum is *not* supported.
- System-to-Intermediate System (IS-IS) over tunnel is *not* supprted.
- ECMP for GRE tunnels is *not* supported.
- QoS over tunnel is *not* supported.
- GRE Tunnel Recursive loop formed with **ip unnumbered loopack** *x* is *not* supported.

How to Configure IPv4 GRE Tunnel

- Each IP address should be learned in global routing table.
- The IPv4 GRE tunnel can be established using any routing protocols enabled between Provider Edge 1 (PE1) router and PE2 router.
- Tunnel number should be identical in both the nodes.

Configure IPv4 Unicast Generic Routing Encapsulation Tunnel

Before You Begin

Bring up any routing process between two PEs.

Configure IPv4 GRE tunnel with a destination IP address:

```
interface Tunnel10
   ip address 10.1.1.1 255.255.255.255
   tunnel source 16.1.1.1
   tunnel destination 17.1.1.1
  end
```

Bring Up IGP over GRE Tunnel :

```
router ospf 100
   router-id 1.1.1.51
   nsr
   nsf ietf

  interface Tunnel10
```

```
   ip ospf network point-to-point
   ip ospf 100 area 100
end
```

Note ISIS process is not supported for Cisco RSP3 module.

Verification of IPv4 Unicast Generic Routing Encapsulation Tunnel Configuration

Use **show interface tunnel***10* command to verify IPv4 unicast GRE tunnel configuration.

```
Router#show interface Tunnel10
   Tunnel10 is up, line protocol is up
     Hardware is Tunnel
     Internet address is 10.1.1.1/32
     MTU 17916 bytes, BW 100 Kbit/sec, DLY 50000 usec,
        reliability 255/255, txload 1/255, rxload 1/255
     Encapsulation TUNNEL, loopback not set
     Keepalive not set
     Tunnel linestate evaluation up
     Tunnel source 16.1.1.1, destination 17.1.1.1
     Tunnel protocol/transport GRE/IP
       Key disabled, sequencing disabled
       Checksumming of packets disabled
     Tunnel TTL 255, Fast tunneling enabled
     Tunnel transport MTU 9178 bytes
     Tunnel transmit bandwidth 8000 (kbps)
     Tunnel receive bandwidth 8000 (kbps)
     Last input 00:00:00, output 00:00:01, output hang never
     Last clearing of "show interface" counters 3d08h
     Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
     Queueing strategy: fifo
     Output queue: 0/0 (size/max)
     5 minute input rate 0 bits/sec, 0 packets/sec
     5 minute output rate 0 bits/sec, 0 packets/sec
        41447 packets input, 4841002 bytes, 0 no buffer
        Received 0 broadcasts (0 IP multicasts)
        0 runts, 0 giants, 0 throttles
        0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
        44429 packets output, 5043980 bytes, 0 underruns
        Output 0 broadcasts (0 IP multicasts)
        0 output errors, 0 collisions, 0 interface resets
        0 unknown protocol drops
        0 output buffer failures, 0 output buffers swapped out
```

Establish GRE Tunnel over VRF Routes

Table 1: Feature History

Feature Name	Release Information	Description
Establish GRE Tunnel over VRF Routes	Cisco IOS XE Bengaluru 17.6.1	This feature establishes GRE tunnels over Virtual Route Forward (VRF) routes. This feature is not supported with Cisco RSP3 module. It is only supported with Cisco RSP2 module.

Starting with Cisco IOS XE Bengaluru Release 17.6.1, you can establish GRE tunnels over Virtual Route Forward (VRF) routes or IPv4 and VPNv4 routes.

Limitations

- VRF GRE tunnel is supported only with **max-ipv4-tunnel** SDM template.
- From Cisco IOS XE 17.6.x, GRE tunnel is supported only with **max-ipv4-tunnel** SDM template. This is the maximum line rate the router can achieve under optimal conditions. This is not applicable for the RSP3 module.
- Per-vrf label allocation mode is mandatory to operate VRF GRE tunnels for a particular VRF.
- Once you configure a VRF GRE tunnel for a VRF, only tunnel traffic works for that particular VRF. L3VPN traffic from core may get dropped at PE node if the packets are ingressed via non-tunnel interface.
- The source and destination addresses of the VRF GRE tunnel must *only* be present in the VRF routing table.
- Open Shortest Path First (OSPF) and Intermediate System-to-Intermediate System (IS-IS) cannot be established over VRF GRE tunnels. Use static routes to route traffic over the tunnel.
- VRF GRE tunnels cannot process fragmented IP packets.
- VRF GRE supports a maximum of 256 tunnels.
- You cannot establish OSPF, ISIS over VRF GRE tunnels.

Configure GRE Tunnel over VRF Routes

VRF Configuration:

To configure VRF:

```
ip vrf vpn1
rd 100:1
route-target export 100:1
route-target import 100:1
```

GRE Tunnel over VRF Routes Configuration:

To configure GRE tunnel over VRF routes at PE1:

```
interface Loopback1
ip vrf forwarding vpn1
ip address 22.22.22.22 255.255.255.255


interface Tunnel1
ip vrf forwarding vpn1
ip address 192.168.1.1 255.255.255.0
tunnel source Loopback1
tunnel destination 33.33.33.33
tunnel vrf vpn1
```

To configure GRE tunnel over VRF routes at PE2:

```
interface Loopback1
ip vrf forwarding vpn1
ip address 33.33.33.33 255.255.255.255

interface Tunnel1
ip vrf forwarding vpn1
ip address 192.168.1.2 255.255.255.0
tunnel source Loopback1
tunnel destination 22.22.22.22
tunnel vrf vpn1
```