Layer 3 VPN Over IPv4 Unicast GRE Tunnel

GRE Overview

Generic Routing Encapsulation (GRE) tunneling protocol provides a simple generic approach to transport packets of one protocol over another protocol by means of encapsulation.

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.

MPLS networks provide VPN functionality by tunneling customer data through public networks using routing labels. Service Providers (SP) provide MPLS L3VPN, 6PE/6VPE and L2VPN services to their customers who have interconnected private networks.

MPLS and L3VPN are supported over regular interfaces on routers. MPLS support is extended over GRE tunnels between routers as the provider core may not be fully MPLS aware.

GRE Features

GRE supports the following features:

- MPLS/L3VPN over GRE
- 6PE/6VPE over GRE

The following features are supported in Cisco ASR 900 RSP3 Module:

- IPv4/IPv6 Global over GRE (IPv4 Core)

- VRF Lite over GRE

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Starting Cisco IOS XE release 16.11.x, unicast GRE tunnel supports IPv4 as transport protocol and payload protocol of also type IPv4.

The unicast IPv4 GRE tunnels support the following:

- When all the packets are sent over the tunnel, the additional headers such as GRE header and GRE transport header are encapsulated over the packets.
- At the destination, the GRE headers for packets are decapsulated.

Note IPv4 payload over IPv4 transport is supported only on the data plane for ASR 900 RSP2. All other combinations such as MPLS, IPv6, and so on are supported from the control plane and not from the data plane.

Limitation for IPv4 Unicast GRE Tunnel

- In-Service Software Upgrade (ISSU) is *not* supported, hence GRE tunnels running on the router do not provide service during software upgrade or downgrade for Cisco ASR 900 RSP2 Module.
- GRE over BDI core is *not* supported.
- GRE over MPLS core is *not* supported.
- Tunnel Checksum is *not* supported
- BFD over tunnel is *not* supported.
- ISIS over Tunnel is *not* supported.
- ECMP for GRE tunnels is not supported.
- QOS over tunnel is not supported.
- TTL and TOS is supported in PIPE mode.
- Tunnel Interface Statistics not supported.
- Tunnel Key is not supported.
- Path MTU discovery is not supported for GRE tunnel.
- Convergence lesser than 50 ms is *not* guaranteed.
- Maximum GRE scale support is 510.
- ACL and QoS are *not* supported over GRE tunnel.
- 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.
- Explicit null in the tunnel end router is *not* supported if MPLS is configured in the core.
- GRE over VPLS or pseudowire is *not* supported.
- MPLS and GRE cannot co-exist. When LDP tunnel is configured in the core for transport, MPLS cannot be enabled over the tunnel.
- GRE with indirection LB (either PIC core or PIC Edge) is *not* supported.
- GRE over TE tunnel core is *not* supported (mid-chain pointing to mid-chain support).
- ECMP or Load balancing between GRE tunnels is *not* supported. But, LB paths for a single GRE tunnel can be configured and the tunnel can be used only in one of the paths.

How to Configure Generic Routing Encapsulation

This section describes the tasks that are required to implement GRE.

Configuring a GRE Tunnel

To configure a GRE Tunnel:

```
configure
interface tunnel number
ip address ip address mask
tunnel source [interface | ip address]
tunnel destination [interface | ip address]
end
```

Configuring a VRF Interface

To configure a VRF Interface:

```
configure
interface tunnel number
vrf forwarding vrf-name
ip address ip address mask
ipv6 address ipv6 address mask
tunnel source [interface | ip address]
tunnel destination [interface | ip address]
end
```

Configuring VRF Routing Protocol

To configure VRF Routing Protocol:

```
configure terminal
router bgp process-name
address-family ipv4 vrf vrf name
neighbor remote ip address remote-as AS number
neighbor remote ip address activate
exit-address-family
```

IPv4 Unicast GRE Tunnel Configuration Examples

This section provides examples to configure GRE.

Example : Configuring an IPv4 GRE Tunnel

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

```
configure
interface tunnel0
ip address 192.0.2.1 255.255.255.0
ipv6 address 2001:DB8:0:1::/64
ipv6 ospf 1 area 0
tunnel source Loopback0
tunnel destination 3.3.3.3
end
```

Example : Configuring Global VRF

Use **show interface tunnel** command to verify global VRF configuration.

```
configure
vrf definition vpn_1
rd 100:1
!
address-family ipv4
route-target export 100:1
route-target import 100:1
exit-address-family
!
address-family ipv6
route-target export 100:1
route-target import 100:1
exit-address-family
```

Example : Configuring VRF Interface

Use **show interface tunnel** command to verify VRF interface configuration.

```
configure
interface tunnel12
vrf forwarding vpn_1
ip address 192.0.2.1 255.255.255.0
ipv6 address 2001:DB8:0:1::/64
tunnel source loopback22
tunnel destination 3.3.11.12
```

Example : Configuring VRF Routing Protocol

Use **show interface tunnel** command to verify VRF routing protocol configuration.

```
configure
router bgp 100
address-family ipv4 vrf vpn_1
neighbor 192.168.22.2 remote-as 100
neighbor 192.168.22.2 activate
```