H3C 交换机

与第三方交换机对接操作指导

资料版本：6W102-20231025

前 言

本文档主要用来介绍产品与友商设备的对接场景，以及对接参数的配置，指导用户完成对接操作。

前言部分包含如下内容：

读者对象

本手册主要适用于如下工程师：

- 具有一定网络技术基础的网络规划人员
- 负责网络配置和维护，且具有一定网络技术基础的网络管理员

本书约定

1. 各类标志

本书采用各种醒目标志来表示在操作过程中应该特别注意的地方，这些标志的意义如下：

 警告	该标志后的注释需给予格外关注，不当的操作可能会对人身造成伤害。
 注意	提醒操作中应注意的事项，不当的操作可能会导致数据丢失或者设备损坏。
 提示	为确保设备配置成功或者正常工作而需要特别关注的操作或信息。
 说明	对操作内容的描述进行必要的补充和说明。
 窍门	配置、操作、或使用设备的技巧、小窍门。

2. 图标约定

本书使用的图标及其含义如下：

	该图标及其相关描述文字代表一般网络设备，如路由器、交换机、防火墙等。
	该图标及其相关描述文字代表一般意义下的路由器，以及其他运行了路由协议的设备。
	该图标及其相关描述文字代表二、三层以太网交换机，以及运行了二层协议的设备。
	该图标及其相关描述文字代表无线控制器、无线控制器业务板和有线无线一体化交换机的无线控制引擎设备。

	该图标及其相关描述文字代表无线接入点设备。
	该图标及其相关描述文字代表无线终结单元。
	该图标及其相关描述文字代表无线终结者。
	该图标及其相关描述文字代表无线Mesh设备。
	该图标代表发散的无线射频信号。
	该图标代表点到点的无线射频信号。
	该图标及其相关描述文字代表防火墙、UTM、多业务安全网关、负载均衡等安全设备。
	该图标及其相关描述文字代表防火墙插卡、负载均衡插卡、NetStream插卡、SSL VPN插卡、IPS插卡、ACG插卡等安全插卡。

3. 示例约定

由于设备型号不同、配置不同、版本升级等原因，可能造成本手册中的内容与用户使用的设备显示信息不一致。实际使用中请以设备显示的内容为准。

本手册中出现的端口编号仅作示例，并不代表设备上实际具有此编号的端口，实际使用中请以设备上存在的端口编号为准。

文档使用前提

本文档不严格与具体软、硬件版本对应，如果使用过程中与产品实际情况有差异，请以设备实际情况为准。

本文档中的配置均是在实验室环境下进行的配置和验证，配置前设备的所有参数均采用出厂时的缺省配置。如果您已经对设备进行了配置，为了保证配置效果，请确认现有配置和本文档中举例的配置不冲突。

资料意见反馈

如果您在使用过程中发现产品资料的任何问题，可以通过以下方式反馈：

E-mail：info@h3c.com

感谢您的反馈，让我们做得更好！

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1 EVPN/VXLAN 对接操作指导

1.1 与思科设备对接操作指导

1.1.1 互通性分析

表1 EVPN/VXLAN 互通性分析

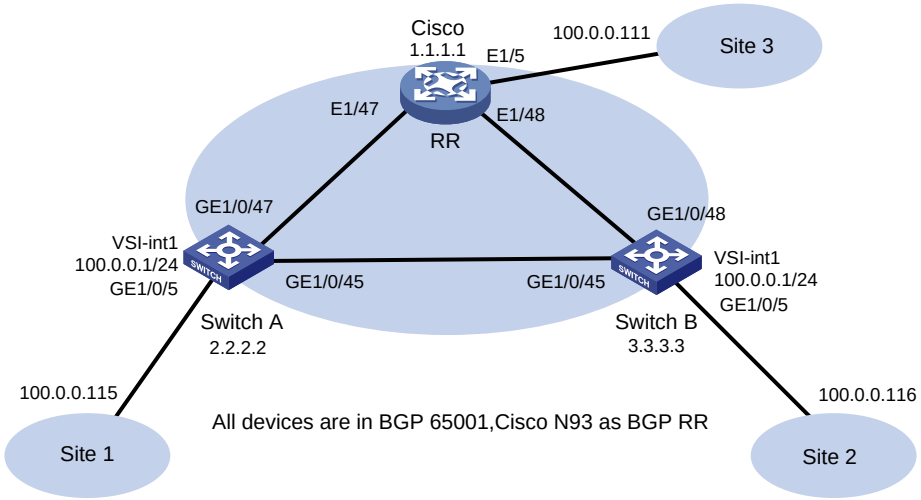
H3C	Cisco	互通结论
支持	支持	可以互通

1.1.2 采用 IBGP 模式对接案例

1. 组网需求

如图 1 所示，H3C Switch A、Switch B 为分布式 EVPN 网关设备，Cisco 设备作为 RR，负责在交换机之间反射 BGP 路由。现要求相同 VXLAN 之间可以二层互通；不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图1 采用 IBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
[SwitchA] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchA] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchA] vxlan tunnel mac-learning disable
```

```
[SwitchA] vxlan tunnel arp-learning disable
```
配置 OSPF。
```
[SwitchA] ospf 1
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchA] interface GigabitEthernet 1/0/45
[SwitchA-GigabitEthernet1/0/45] port link-mode route
[SwitchA-GigabitEthernet1/0/45] ip address 13.0.0.1 255.255.255.252
[SwitchA-GigabitEthernet1/0/45] ospf 1 area 0.0.0.0
[SwitchA-GigabitEthernet1/0/45] quit
[SwitchA] interface GigabitEthernet 1/0/47
[SwitchA-GigabitEthernet1/0/47] port link-mode route
[SwitchA-GigabitEthernet1/0/47] ip address 11.0.0.2 255.255.255.252
[SwitchA-GigabitEthernet1/0/47] ospf 1 area 0.0.0.0
[SwitchA-GigabitEthernet1/0/47] quit
```
创建 VLAN1001。
```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchA] bgp 65001
[SwitchA-bgp-default] peer 1.1.1.1 as-number 65001
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 GigabitEthernet1/0/5 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。

```
[SwitchA] interface gigabitethernet 1/0/5
[SwitchA-GigabitEthernet1/0/5] service-instance 1
[SwitchA-GigabitEthernet1/0/5-srv1] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-GigabitEthernet1/0/5-srv1] xconnect vsi v1
[SwitchA-GigabitEthernet1/0/5-srv1] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16777201，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16777201。

```
[SwitchA] interface vsi-interface 16777201
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16777201
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备（SwitchB）

开启 L2VPN 能力。

```
<SwitchB> system-view
[SwitchB] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchB] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
```

```
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchB] interface GigabitEthernet 1/0/45
[SwitchB-GigabitEthernet1/0/45] port link-mode route
[SwitchB-GigabitEthernet1/0/45] ip address 13.0.0.2 255.255.255.252
[SwitchB-GigabitEthernet1/0/45] ospf 1 area 0.0.0.0
[SwitchB-GigabitEthernet1/0/45] quit
[SwitchB] interface GigabitEthernet 1/0/48
[SwitchB-GigabitEthernet1/0/48] port link-mode route
[SwitchB-GigabitEthernet1/0/48] ip address 12.0.0.2 255.255.255.252
[SwitchB-GigabitEthernet1/0/48] ospf 1 area 0.0.0.0
[SwitchB-GigabitEthernet1/0/48] quit
```
创建 VLAN1001。
```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchB] bgp 65001
[SwitchB-bgp-default] peer 1.1.1.1 as-number 65001
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] quit
[SwitchB-bgp-default] quit
```
在接入服务器的接口 GigabitEthernet1/0/5 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。
```
[SwitchB] interface gigabitethernet 1/0/5
[SwitchB-GigabitEthernet1/0/5] service-instance 1
[SwitchB-GigabitEthernet1/0/5-srv1] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchB-GigabitEthernet1/0/5-srv1] xconnect vsi v1
[SwitchB-GigabitEthernet1/0/5-srv1] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchB] ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16777201，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16777201。

```
[SwitchB] interface vsi-interface 16777201
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16777201
[SwitchB-Vsi-interface3] quit
```

配置 VXLAN10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchB] vsi v1
[SwitchB-vsi-v1] gateway vsi-interface 1
[SwitchB-vsi-v1] quit
```

- 配置 Cisco 设备

如下配置以 Nexus9000 93180YC-EX 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2016, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
```

```
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(2)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.2.bin
 NXOS compile time:  7/21/2016 8:00:00 [07/21/2016 16:09:32]
Hardware
 cisco Nexus9000 93180YC-EX chassis
 Intel(R) Xeon(R) CPU  @ 1.80GHz with 24634044 kB of memory.
 Processor Board ID FDO20380BK7
 Device name: CN93
 bootflash: 53298520 kB
Kernel uptime is 1 day(s), 1 hour(s), 19 minute(s), 35 second(s)
Last reset at 776030 usecs after  Wed Sep 20 02:52:01 2017
  Reason: Reset Requested by CLI command reload
 System version: 7.0(3)I4(2)
 Service:
plugin
 Core Plugin, Ethernet Plugin
```

切换资源模式。

```
Cisco# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Cisco(config)# system routing template-vxlan-scale
```

使能相关特性。

```
Cisco(config)#
Cisco(config)# nv overlay evpn
Cisco(config)# feature ospf
Cisco(config)# feature bgp
Cisco(config)# feature interface-vlan
Cisco(config)# feature lldp
Cisco(config)# feature vn-segment-vlan-based
Cisco(config)# feature nv overlay
```

创建 VLAN 101 1001。

```
Cisco(config)# vlan 101 ,1001
Cisco(config-vlan)# exit
```

网关 MAC。

```
Cisco(config)# fabric forwarding anycast-gateway-mac 0000.2017.0001
```

去使能 igmp snooping。

```
Cisco(config)# no ip igmp snooping
```

创建 vn-segment 16777201。

```
Cisco(config)# vlan 101
Cisco(config-vlan)# vn-segment 16777201
Cisco(config-vlan)# exit
```

创建 vn-segment 10001。

```
Cisco(config)# vlan 1001
Cisco(config-vlan)# vn-segment 10001
Cisco(config-vlan)# exit
```

使能 OSPF。

```
Cisco(config)# router ospf 1
Cisco(config-router)# exit
```

创建 VRF。

```
Cisco(config)# vrf context vpn1
Cisco(config-vrf)# vni 16777201
Cisco(config-vrf)# rd 1.1.1.1:10001
Cisco(config-vrf)# address-family ipv4 unicast
Cisco(config-vrf-af-ipv4)# route-target import 65001:10001
Cisco(config-vrf-af-ipv4)# route-target import 65001:10001 evpn
Cisco(config-vrf-af-ipv4)# route-target export 65001:10001
Cisco(config-vrf-af-ipv4)# route-target export 65001:10001 evpn
Cisco(config-vrf-af-ipv4)# exit
Cisco(config-vrf)# exit
```

#创建 VLAN101 虚接口。

```
Cisco(config)# interface vlan 101
Cisco(config-if)# no shutdown
Cisco(config-if)# vrf member vpn1
Warning: Deleted all L3 config on interface Vlan101
Cisco(config-if)# exit
```

#创建 VLAN1001 虚接口。

```
Cisco(config)# interface vlan 1001
Cisco(config-if)# no shutdown
Cisco(config-if)# vrf member vpn1
Warning: Deleted all L3 config on interface Vlan1001
Cisco(config-if)# ip address 100.0.0.1/24
Cisco(config-if)# fabric forwarding mode anycast-gateway
Cisco(config-if)# exit
```

创建 NVE1 接口。

```
Cisco(config)# interface nve1
Cisco(config-if-nve)# no shutdown
Cisco(config-if-nve)# source-interface loopback0
Cisco(config-if-nve)# host-reachability protocol bgp
Cisco(config-if-nve)# member vni 10001
Cisco(config-if-nve-vni)# suppress-arp
Cisco(config-if-nve-vni)# ingress-replication protocol bgp
Cisco(config-if-nve-vni)# exit
Cisco(config-if-nve)# member vni 16777201 associate-vrf
Cisco(config-if-nve)# exit
```

与服务器相连接口配置。

```
Cisco(config)# interface ethernet 1/5
Cisco(config-if)# switchport
Cisco(config-if)# switchport mode trunk
```

```
Cisco(config-if)# switchport trunk allowed vlan 1001
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
```
配置 underlay 网络。
```
Cisco(config)# interface ethernet 1/47
Cisco(config-if)# ip address 11.0.0.1/30
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
Cisco(config)# interface ethernet 1/48
Cisco(config-if)# ip address 12.0.0.1/30
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
```
创建 Loopback0。
```
Cisco(config)# interface loopback0
Cisco(config-if)# ip address 1.1.1.1/32
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# exit
```
配置 BGP。
```
Cisco(config)# router bgp 65001
Cisco(config-router)# router-id 1.1.1.1
Cisco(config-router)# address-family l2vpn evpn
Cisco(config-router-af)# neighbor 2.2.2.2
Cisco(config-router-neighbor)# remote-as 65001
Cisco(config-router-neighbor)# update-source loopback 0
Cisco(config-router-neighbor)# address-family ipv4 unicast
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# route-reflector-client
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# address-family l2vpn evpn
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# route-reflector-client
Cisco(config-router-neighbor-af)#
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# exit
Cisco(config-router)# neighbor 3.3.3.3
Cisco(config-router-neighbor)# remote-as 65001
Cisco(config-router-neighbor)# update-source loopback 0
Cisco(config-router-neighbor)# address-family ipv4 unicast
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# route-reflector-client
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# address-family l2vpn evpn
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# route-reflector-client
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# exit
```

```
Cisco(config-router)# exit
```
配置 EVPN。
```
Cisco(config)# evpn
Cisco(config-evpn)# vni 10001 l2
Cisco(config-evpn-evi)# rd 1.1.1.1:10001
Cisco(config-evpn-evi)# route-target both 65001:10001
Cisco(config-evpn-evi)# exit
Cisco(config-evpn)# exit
```
3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体的信息。
```
[SwitchA] display bgp peer l2vpn evpn
 BGP local router ID: 2.2.2.2
 Local AS number: 65001
 Total number of peers: 1                 Peers in established state: 1
  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State
  1.1.1.1              65001      168      185    0       8 02:12:37 Established
```
验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。
```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2
VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
3.3.3.3:10001         3.3.3.3         3.3.3.3         VXLAN       10001
```
验证 VPN 实例对应 EVPN 的路由表信息。
```
[SwitchA] display evpn routing-table vpn-instance vpn1

VPN instance: vpn1                            Local L3VNI: 16777201
IP address         Next hop        Outgoing interface    NibID
100.0.0.111        1.1.1.1         Vsi-interface16777201 0x18000000
100.0.0.116        3.3.3.3         Vsi-interface16777201 0x18000001
```
验证 EVPN 的 ARP 信息。
```
[SwitchA] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping


VPN instance: vpn1                              Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  703d-15b5-1c8d  0           GL
100.0.0.111     0000-1ed4-45a1  006b-f183-c327  0           B
100.0.0.115     0000-32eb-e6bc  703d-15b5-1c8d  0           DL
100.0.0.116     0000-1279-80ce  703d-15b5-1cff  0           B
```
验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping
VSI name: v1
MAC address     Link ID/Name    Flags   Next hop
0005-0000-0001  Tunnel1         B       1.1.1.1
0000-1279-80ce  Tunnel0         B       3.3.3.3
0000-1ed4-45a1  Tunnel1         B       1.1.1.1
```

验证与 VXLAN 关联的 VXLAN 隧道的信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16777201, VSI name: Auto_L3VNI16777201_16777201
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchA] display arp suppression vsi
IP address      MAC address    Vsi Name                        Link ID    Aging
100.0.0.111     0000-1ed4-45a1 v1                              0x5000001  N/A
100.0.0.115     0000-32eb-e6bc v1                              0x0        16
100.0.0.116     0000-1279-80ce v1                              0x5000000  N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16777201_16777201
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16777201
  VXLAN ID                : 16777201

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
```

```
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name          Link ID    State    Type        Flood proxy
    Tunnel0              0x5000000  UP       Auto        Disabled
    Tunnel1              0x5000001  UP       Auto        Disabled
  ACs:
    AC                              Link ID  State       Type
    XGE1/0/5 srv1                   0        Up          Manual
```

- H3C 设备（SwitchB）

验证 BGP L2VPN 对等体的信息。

```
[SwitchB] display bgp peer l2vpn evpn

 BGP local router ID: 3.3.3.3
 Local AS number: 65001
 Total number of peers: 1                 Peers in established state: 1

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  1.1.1.1              65001      667      688    0       7 09:50:51 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchB] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                   PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001        1.1.1.1         1.1.1.1         VXLAN       10001
2.2.2.2:10001        2.2.2.2         2.2.2.2         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchB] display ip routing-table vpn-instance vpn1

Destinations : 14       Routes : 14

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
```

```
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.111/32     BGP     255 0           1.1.1.1         Vsi16777201
100.0.0.115/32     BGP     255 0           2.2.2.2         Vsi16777201
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
224.0.0.0/4        Direct  0   0           0.0.0.0         NULL0
224.0.0.0/24       Direct  0   0           0.0.0.0         NULL0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchB] display evpn routing-table vpn-instance vpn1

VPN instance: vpn1                              Local L3VNI: 16777201
IP address         Next hop        Outgoing interface    NibID
100.0.0.111        1.1.1.1         Vsi-interface16777201 0x18000000
100.0.0.115        2.2.2.2         Vsi-interface16777201 0x18000001
```

验证 EVPN 的 ARP 信息。

```
[SwitchB] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping


VPN instance: vpn1                              Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  703d-15b5-1cff  0           GL
100.0.0.111     0000-1ed4-45a1  006b-f183-c327  0           B
100.0.0.115     0000-32eb-e6bc  703d-15b5-1c8d  0           B
100.0.0.116     0000-1279-80ce  703d-15b5-1cff  0           DL
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchB] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping


VSI name: v1
MAC address     Link ID/Name    Flags   Next hop
0005-0000-0001  Tunnel1         B       1.1.1.1
0000-1279-80ce  0               DL      -
0000-1ed4-45a1  Tunnel1         B       1.1.1.1
0000-32eb-e6bc  Tunnel0         B       2.2.2.2
```

验证与 VXLAN 关联的 VXLAN 隧道的信息。

```
[SwitchB] display vxlan tunnel
Total number of VXLANs: 2
```

```
VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16777201, VSI name: Auto_L3VNI16777201_16777201
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchB] display arp suppression vsi
IP address      MAC address    Vsi Name                        Link ID    Aging
100.0.0.111     0000-1ed4-45a1 v1                              0x5000001  N/A
100.0.0.116     0000-1279-80ce v1                              0x0        11
100.0.0.115     0000-32eb-e6bc v1                              0x5000000  N/A
```

验证 VSI 信息。

```
[SwitchB] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16777201_16777201
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16777201
  VXLAN ID                : 16777201

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
```

```
  Tunnel Name          Link ID    State    Type        Flood proxy
  Tunnel0              0x5000000  UP       Auto        Disabled
  Tunnel1              0x5000001  UP       Auto        Disabled
ACs:
  AC                              Link ID  State       Type
  XGE1/0/5 srv1                   0        Up          Manual
```

- Cisco 设备

验证建立的 BGP EVPN 邻居信息。

```
Cisco# show bgp l2vpn evpn neighbors
BGP neighbor is 2.2.2.2,  remote AS 65001, ibgp link,  Peer index 1
  BGP version 4, remote router ID 2.2.2.2
  BGP state = Established, up for 02:14:17
  Using loopback0 as update source for this peer
  Last read 00:00:31, hold time = 180, keepalive interval is 60 seconds
  Last written 00:00:22, keepalive timer expiry due 00:00:37
  Received 194 messages, 0 notifications, 0 bytes in queue
  Sent 186 messages, 2 notifications, 0 bytes in queue
  Connections established 3, dropped 2
  Last reset by us 02:14:29, due to route-reflector configuration change
  Last reset by peer never, due to No error

  Neighbor capabilities:
  Dynamic capability: advertised (mp, refresh, gr)
  Dynamic capability (old): advertised
  Route refresh capability (new): advertised received
  Route refresh capability (old): advertised
  4-Byte AS capability: advertised received
  Address family IPv4 Unicast: advertised
  Address family L2VPN EVPN: advertised received
  Graceful Restart capability: advertised

  Graceful Restart Parameters:
  Address families advertised to peer:
    IPv4 Unicast  L2VPN EVPN
  Address families received from peer:
  Forwarding state preserved by peer for:
  Restart time advertised to peer: 120 seconds
  Stale time for routes advertised by peer: 300 seconds
  Extended Next Hop Encoding Capability: advertised

  Message statistics:
                              Sent               Rcvd
  Opens:                         3                  3
  Notifications:                 2                  0
  Updates:                      36                 26
  Keepalives:                  142                157
  Route Refresh:                 3                  8
  Capability:                    0                  0
```

```
  Total:                       186                194
  Total bytes:                5677               5698
  Bytes in queue:                0                  0

  For address family: IPv4 Unicast
  BGP table version 2, neighbor version 0
  0 accepted paths consume 0 bytes of memory
  0 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor
  Third-party Nexthop will not be computed.
  Route reflector client

  For address family: L2VPN EVPN
  BGP table version 76, neighbor version 76
  4 accepted paths consume 496 bytes of memory
  8 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor
  Third-party Nexthop will not be computed.
  Route reflector client

  Local host: 1.1.1.1, Local port: 35453
  Foreign host: 2.2.2.2, Foreign port: 179
  fd = 76

BGP neighbor is 3.3.3.3,  remote AS 65001, ibgp link,  Peer index 2
  BGP version 4, remote router ID 3.3.3.3
  BGP state = Established, up for 02:14:40
  Using loopback0 as update source for this peer
  Last read 00:00:33, hold time = 180, keepalive interval is 60 seconds
  Last written 00:00:13, keepalive timer expiry due 00:00:46
  Received 185 messages, 0 notifications, 0 bytes in queue
  Sent 185 messages, 2 notifications, 0 bytes in queue
  Connections established 3, dropped 2
  Last reset by us 02:14:52, due to route-reflector configuration change
  Last reset by peer never, due to No error

  Neighbor capabilities:
  Dynamic capability: advertised (mp, refresh, gr)
  Dynamic capability (old): advertised
  Route refresh capability (new): advertised received
  Route refresh capability (old): advertised
  4-Byte AS capability: advertised received
  Address family IPv4 Unicast: advertised
  Address family L2VPN EVPN: advertised received
  Graceful Restart capability: advertised
```

```
  Graceful Restart Parameters:
  Address families advertised to peer:
    IPv4 Unicast  L2VPN EVPN
  Address families received from peer:
  Forwarding state preserved by peer for:
  Restart time advertised to peer: 120 seconds
  Stale time for routes advertised by peer: 300 seconds
  Extended Next Hop Encoding Capability: advertised

  Message statistics:
                              Sent               Rcvd
  Opens:                         3                  3
  Notifications:                 2                  0
  Updates:                      40                 22
  Keepalives:                  137                152
  Route Refresh:                 3                  8
  Capability:                    0                  0
  Total:                       185                185
  Total bytes:                6589               5220
  Bytes in queue:                0                  0

  For address family: IPv4 Unicast
  BGP table version 2, neighbor version 0
  0 accepted paths consume 0 bytes of memory
  0 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor
  Third-party Nexthop will not be computed.
  Route reflector client

  For address family: L2VPN EVPN
  BGP table version 76, neighbor version 76
  4 accepted paths consume 496 bytes of memory
  8 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor
  Third-party Nexthop will not be computed.
  Route reflector client

  Local host: 1.1.1.1, Local port: 40155
  Foreign host: 3.3.3.3, Foreign port: 179
  fd = 77
```

验证 NVE Peer 的详细信息。

```
Cisco# show nve peers detail
Details of nve Peers:
---------------------------------------
Peer-Ip: 2.2.2.2
    NVE Interface       : nve1
```

```
    Peer State          : Up
    Peer Uptime         : 00:45:50
    Router-Mac          : 703d.15b5.1c8d
    Peer First VNI      : 16777201
    Time since Create   : 00:45:50
    Configured VNIs     : 10001,16777201
    Provision State     : add-complete
    Route-Update        : Yes
    Peer Flags          : RmacL2Rib, TunnelPD, DisableLearn
    Learnt CP VNIs      : 10001,16777201
    Peer-ifindex-resp   : Yes
---------------------------------------
Peer-Ip: 3.3.3.3
    NVE Interface       : nve1
    Peer State          : Up
    Peer Uptime         : 00:45:50
    Router-Mac          : 703d.15b5.1cff
    Peer First VNI      : 16777201
    Time since Create   : 00:45:50
    Configured VNIs     : 10001,16777201
    Provision State     : add-complete
    Route-Update        : Yes
    Peer Flags          : RmacL2Rib, TunnelPD, DisableLearn
    Learnt CP VNIs      : 10001,16777201
    Peer-ifindex-resp   : Yes
---------------------------------------
```

验证 NVE VNI 信息。

```
Cisco# show nve vni
Codes: CP - Control Plane        DP - Data Plane
       UC - Unconfigured         SA - Suppress ARP

Interface VNI      Multicast-group   State Mode Type [BD/VRF]      Flags
--------- -------- ----------------- ----- ---- ------------------ -----
nve1      10001    UnicastBGP        Up    CP   L2 [1001]          SA
nve1      16777201 n/a               Up    CP   L3 [vpn1]
```

验证 NVE VRF 信息。

```
Cisco# show nve vrf
VRF-Name     VNI        Interface Gateway-MAC
------------ ---------- --------- -----------------
vpn1         16777201   nve1      006b.f183.c327
```

验证 NVE VXLAN 参数信息。

```
Cisco# show nve vxlan-params
VxLAN Dest. UDP Port: 4789
```

验证 VXLAN 信息。

```
Cisco# show vxlan
Vlan            VN-Segment
====            ==========
```

```
101             16777201
1001            10001
```

验证 L2VPN EVPN 的 BGP 信息。

```
Cisco# show bgp l2vpn evpn
BGP routing table information for VRF default, address family L2VPN EVPN
BGP table version is 88, local router ID is 1.1.1.1
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-i
njected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup

   Network            Next Hop            Metric     LocPrf     Weight Path
Route Distinguisher: 1.1.1.1:10001    (L2VNI 10001)
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                      3.3.3.3                  0        100          0 i
*>l[2]:[0]:[0]:[48]:[0000.1ed4.45a1]:[0]:[0.0.0.0]/216
                      1.1.1.1                             100      32768 i
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[0]:[0.0.0.0]/216
                      2.2.2.2                  0        100          0 i
*>l[2]:[0]:[0]:[48]:[0005.0000.0001]:[0]:[0.0.0.0]/216
                      1.1.1.1                             100      32768 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                      3.3.3.3                  0        100          0 i
*>l[2]:[0]:[0]:[48]:[0000.1ed4.45a1]:[32]:[100.0.0.111]/272
                      1.1.1.1                             100      32768 i
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                      2.2.2.2                  0        100          0 i
*>l[3]:[0]:[32]:[1.1.1.1]/88
                      1.1.1.1                             100      32768 i

Route Distinguisher: 2.2.2.2:10001
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[0]:[0.0.0.0]/216
                      2.2.2.2                  0        100          0 i
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                      2.2.2.2                  0        100          0 i
*>i[3]:[0]:[32]:[2.2.2.2]/88
                      2.2.2.2                  0        100          0 i
*>i[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
                      2.2.2.2                  0        100          0 i

Route Distinguisher: 3.3.3.3:10001
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                      3.3.3.3                  0        100          0 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                      3.3.3.3                  0        100          0 i
*>i[3]:[0]:[32]:[3.3.3.3]/88
                      3.3.3.3                  0        100          0 i
*>i[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
```

```
                     3.3.3.3                 0        100          0 i

Route Distinguisher: 1.1.1.1:10001    (L3VNI 16777201)
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                     3.3.3.3                 0        100          0 i
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[0]:[0.0.0.0]/216
                     2.2.2.2                 0        100          0 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                     3.3.3.3                 0        100          0 i
*>i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                     2.2.2.2                 0        100          0 i
```

验证二层路由的 EVPN MAC。

```
Cisco# show l2route evpn mac all
Topology    Mac Address    Prod   Next Hop (s)
----------- -------------- ------ ---------------
101         703d.15b5.1c8d VXLAN  2.2.2.2
101         703d.15b5.1cff VXLAN  3.3.3.3
1001        0000.1279.80ce BGP    3.3.3.3
1001        0000.1ed4.45a1 Local  Eth1/5
1001        0000.32eb.e6bc BGP    2.2.2.2
1001        0005.0000.0001 Local  Eth1/5
```

验证二层路由的 EVPN MAC-IP 路由。

```
Cisco# show l2route evpn mac-ip all
Topology ID Mac Address    Prod Host IP                                 Next Hop
 (s)
----------- -------------- ---- --------------------------------------- --------
-------
1001        0000.1ed4.45a1 HMM  100.0.0.111                             N/A

1001        0000.32eb.e6bc BGP  100.0.0.115                             2.2.2.2

1001        0000.1279.80ce BGP  100.0.0.116                             3.3.3.3
```

验证 ARP 抑制缓存详细信息。

```
Cisco# show ip arp suppression-cache detail

Flags: + - Adjacencies synced via CFSoE
       L - Local Adjacency
       R - Remote Adjacency
       L2 - Learnt over L2 interface

Ip Address      Age      Mac Address    Vlan Physical-ifindex    Flags

100.0.0.111     00:10:00 0000.1ed4.45a1 1001 Ethernet1/5         L
100.0.0.116     01:05:23 0000.1279.80ce 1001 (null)              R
100.0.0.115     01:05:17 0000.32eb.e6bc 1001 (null)              R
```

验证指定 VPN1 的路由信息。

```
Cisco# show ip route vrf vpn1
```

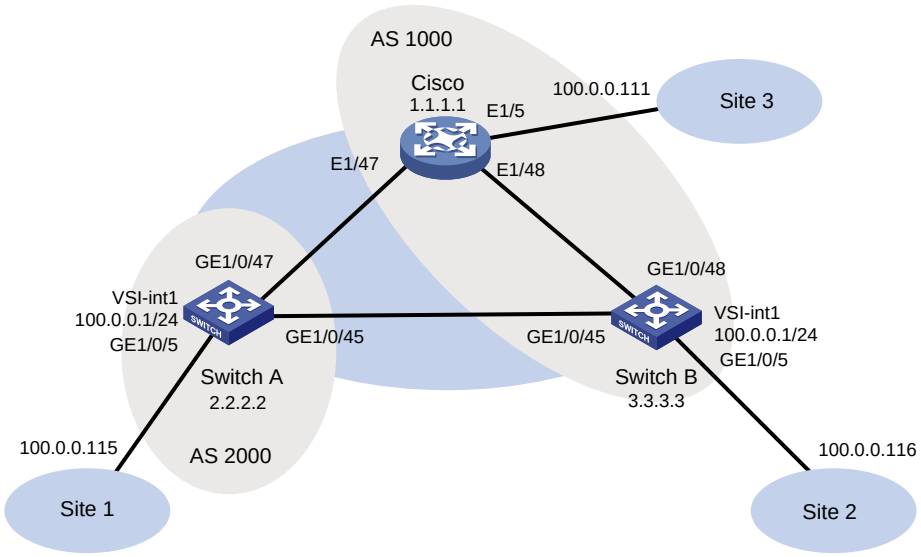
```
IP Route Table for VRF "vpn1"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

100.0.0.0/24, ubest/mbest: 1/0, attached
    *via 100.0.0.1, Vlan1001, [0/0], 07:51:12, direct
100.0.0.1/32, ubest/mbest: 1/0, attached
    *via 100.0.0.1, Vlan1001, [0/0], 07:51:12, local
100.0.0.111/32, ubest/mbest: 1/0, attached
    *via 100.0.0.111, Vlan1001, [190/0], 07:37:29, hmm
100.0.0.115/32, ubest/mbest: 1/0
    *via 2.2.2.2%default, [200/0], 07:36:52, bgp-65001, internal, tag 65001 (evp
n) segid: 16777201 tunnelid: 0x2020202 encap: VXLAN

100.0.0.116/32, ubest/mbest: 1/0
    *via 3.3.3.3%default, [200/0], 07:36:58, bgp-65001, internal, tag 65001 (evp
n) segid: 16777201 tunnelid: 0x3030303 encap: VXLAN
```

1.1.3 采用 EBGP 模式对接案例

1. 组网需求

如图 2所示，H3C Switch A、H3C Switch B 和 Cisco 设备均为分布式 EVPN 网关。现要求相同 VXLAN 之间可以二层互通，不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图2 采用 EBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
[SwitchA] l2vpn enable
```
配置 VXLAN 的硬件资源模式。
```
[SwitchA] hardware-resource vxlan border40k
```
关闭远端 MAC 地址和远端 ARP 自动学习功能。
```
[SwitchA] vxlan tunnel mac-learning disable
[SwitchA] vxlan tunnel arp-learning disable
```
配置 OSPF。
```
[SwitchA] ospf 1
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchA] interface GigabitEthernet 1/0/45
[SwitchA-GigabitEthernet1/0/45] port link-mode route
[SwitchA-GigabitEthernet1/0/45] ip address 13.0.0.1 255.255.255.252
[SwitchA-GigabitEthernet1/0/45] ospf 1 area 0.0.0.0
[SwitchA-GigabitEthernet1/0/45] quit
[SwitchA] interface GigabitEthernet 1/0/47
[SwitchA-GigabitEthernet1/0/47] port link-mode route
[SwitchA-GigabitEthernet1/0/47] ip address 11.0.0.2 255.255.255.252
[SwitchA-GigabitEthernet1/0/47] ospf 1 area 0.0.0.0
[SwitchA-GigabitEthernet1/0/47] quit
```
创建 VLAN1001。
```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchA] bgp 2000
[SwitchA-bgp-default] peer 1.1.1.1 as-number 1000
```

```
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] peer 1.1.1.1 ebgp-max-hop 10
[SwitchA-bgp-default] peer 3.3.3.3 as-number 1000
[SwitchA-bgp-default] peer 3.3.3.3 connect-interface loopback 0
[SwitchA-bgp-default] peer 3.3.3.3 ebgp-max-hop 10
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] peer 3.3.3.3 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 GigabitEthernet1/0/5 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。

```
[SwitchA] interface gigabitethernet 1/0/5
[SwitchA-GigabitEthernet1/0/5] service-instance 1
[SwitchA-GigabitEthernet1/0/5-srv1] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-GigabitEthernet1/0/5-srv1] xconnect vsi v1
[SwitchA-GigabitEthernet1/0/5-srv1] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16777201，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16777201。

```
[SwitchA] interface vsi-interface 16777201
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16777201
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备（SwitchB）

开启 L2VPN 能力。

```
<SwitchB> system-view
```

```
[SwitchB] l2vpn enable
```
配置 VXLAN 的硬件资源模式。
```
[SwitchB] hardware-resource vxlan border40k
```
关闭远端 MAC 地址和远端 ARP 自动学习功能。
```
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```
配置 OSPF。
```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchB] interface GigabitEthernet 1/0/45
[SwitchB-GigabitEthernet1/0/45] port link-mode route
[SwitchB-GigabitEthernet1/0/45] ip address 13.0.0.2 255.255.255.252
[SwitchB-GigabitEthernet1/0/45] ospf 1 area 0.0.0.0
[SwitchB-GigabitEthernet1/0/45] quit
[SwitchB] interface GigabitEthernet 1/0/48
[SwitchB-GigabitEthernet1/0/48] port link-mode route
[SwitchB-GigabitEthernet1/0/48] ip address 12.0.0.2 255.255.255.252
[SwitchB-GigabitEthernet1/0/48] ospf 1 area 0.0.0.0
[SwitchB-GigabitEthernet1/0/48] quit
```
创建 VLAN1001。
```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchB] bgp 1000
[SwitchB-bgp-default] peer 1.1.1.1 as-number 1000
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
```

```
[SwitchB-bgp-default] peer 2.2.2.2 as-number 2000
[SwitchB-bgp-default] peer 2.2.2.2 connect-interface loopback 0
[SwitchB-bgp-default] peer 2.2.2.2 ebgp-max-hop 10
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] peer 2.2.2.2 enable
[SwitchB-bgp-default-evpn] quit
[SwitchB-bgp-default] quit
```

在接入服务器的接口 GigabitEthernet1/0/5 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。

```
[SwitchB] interface gigabitethernet 1/0/5
[SwitchB-GigabitEthernet1/0/5] service-instance 1
[SwitchB-GigabitEthernet1/0/5-srv1] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchB-GigabitEthernet1/0/5-srv1] xconnect vsi v1
[SwitchB-GigabitEthernet1/0/5-srv1] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchB] ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16777201，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16777201。

```
[SwitchB] interface vsi-interface 16777201
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16777201
[SwitchB-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchB] vsi v1
[SwitchB-vsi-v1] gateway vsi-interface 1
[SwitchB-vsi-v1] quit
```

- 配置 Cisco 设备

如下配置以 Nexus9000 93180YC-EX 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
```

```
Copyright (C) 2002-2016, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(2)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.2.bin
 NXOS compile time:  7/21/2016 8:00:00 [07/21/2016 16:09:32]
Hardware
 cisco Nexus9000 93180YC-EX chassis
 Intel(R) Xeon(R) CPU  @ 1.80GHz with 24634044 kB of memory.
 Processor Board ID FDO20380BK7
 Device name: CN93
 bootflash: 53298520 kB
Kernel uptime is 1 day(s), 1 hour(s), 19 minute(s), 35 second(s)
Last reset at 776030 usecs after  Wed Sep 20 02:52:01 2017
  Reason: Reset Requested by CLI command reload
 System version: 7.0(3)I4(2)
 Service:
plugin
 Core Plugin, Ethernet Plugin
#切换资源模式。
Cisco# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Cisco(config)# system routing template-vxlan-scale
# 使能相关特性。
Cisco(config)# nv overlay evpn
Cisco(config)# feature ospf
Cisco(config)# feature bgp
Cisco(config)# feature interface-vlan
Cisco(config)# feature lldp
Cisco(config)# feature vn-segment-vlan-based
Cisco(config)# feature nv overlay
```

创建 VLAN 101 1001。

```
Cisco(config)# vlan 101 ,1001
Cisco(config-vlan)# exit
```

配置网关 MAC。

```
Cisco(config)# fabric forwarding anycast-gateway-mac 0000.2017.0001
```

去使能 igmp snooping。

```
Cisco(config)# no ip igmp snooping
```

创建 vn-segment 16777201。

```
Cisco(config)# vlan 101
Cisco(config-vlan)# vn-segment 16777201
Cisco(config-vlan)# exit
```

创建 vn-segment 10001。

```
Cisco(config)# vlan 1001
Cisco(config-vlan)# vn-segment 10001
Cisco(config-vlan)# exit
```

使能 OSPF。

```
Cisco(config)# router ospf 1
Cisco(config-router)# exit
```

创建 VRF。

```
Cisco(config)# vrf context vpn1
Cisco(config-vrf)# vni 16777201
Cisco(config-vrf)# rd 1.1.1.1:10001
Cisco(config-vrf)# address-family ipv4 unicast
Cisco(config-vrf-af-ipv4)# route-target import 65001:10001
Cisco(config-vrf-af-ipv4)# route-target import 65001:10001 evpn
Cisco(config-vrf-af-ipv4)# route-target export 65001:10001
Cisco(config-vrf-af-ipv4)# route-target export 65001:10001 evpn
Cisco(config-vrf-af-ipv4)# exit
Cisco(config-vrf)# exit
```

#创建 VLAN101 虚接口。

```
Cisco(config)# interface vlan 101
Cisco(config-if)# no shutdown
Cisco(config-if)# vrf member vpn1
Warning: Deleted all L3 config on interface Vlan101
Cisco(config-if)# exit
```

#创建 VLAN1001 虚接口。

```
Cisco(config)# interface vlan 1001
Cisco(config-if)# no shutdown
Cisco(config-if)# vrf member vpn1
Warning: Deleted all L3 config on interface Vlan1001
Cisco(config-if)# ip address 100.0.0.1/24
Cisco(config-if)# fabric forwarding mode anycast-gateway
Cisco(config-if)# exit
```

创建 nve1 接口。

```
Cisco(config)# interface nve1
Cisco(config-if-nve)# no shutdown
```

```
Cisco(config-if-nve)# source-interface loopback0
Cisco(config-if-nve)# host-reachability protocol bgp
Cisco(config-if-nve)# member vni 10001
Cisco(config-if-nve-vni)# suppress-arp
Cisco(config-if-nve-vni)# ingress-replication protocol bgp
Cisco(config-if-nve-vni)# exit
Cisco(config-if-nve)# member vni 16777201 associate-vrf
Cisco(config-if-nve)# exit
```

与服务器相连接口配置。

```
Cisco(config)# interface ethernet 1/5
Cisco(config-if)# switchport
Cisco(config-if)# switchport mode trunk
Cisco(config-if)# switchport trunk allowed vlan 1001
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
```

配置 underlay 网络。

```
Cisco(config)# interface ethernet 1/47
Cisco(config-if)# ip address 11.0.0.1/30
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
Cisco(config)# interface ethernet 1/48
Cisco(config-if)# ip address 12.0.0.1/30
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# no shutdown
Cisco(config-if)# exit
```

创建 Loopback0。

```
Cisco(config)# interface loopback0
Cisco(config-if)# ip address 1.1.1.1/32
Cisco(config-if)# ip router ospf 1 area 0.0.0.0
Cisco(config-if)# exit
```

配置 BGP。

```
Cisco(config)# router bgp 1000
Cisco(config-router)# router-id 1.1.1.1
Cisco(config-router)# address-family l2vpn evpn
Cisco(config-router-af)# neighbor 2.2.2.2
Cisco(config-router-neighbor)# remote-as 2000
Cisco(config-router-neighbor)# update-source loopback 0
Cisco(config-router-neighbor)# ebgp-multihop 10
Cisco(config-router-neighbor)# address-family ipv4 unicast
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# address-family l2vpn evpn
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# exit
Cisco(config-router)# neighbor 3.3.3.3
```

```
Cisco(config-router-neighbor)# remote-as 1000
Cisco(config-router-neighbor)# update-source loopback 0
Cisco(config-router-neighbor)# address-family ipv4 unicast
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# address-family l2vpn evpn
Cisco(config-router-neighbor-af)# send-community both
Cisco(config-router-neighbor-af)# exit
Cisco(config-router-neighbor)# exit
Cisco(config-router)# exit
```

配置 EVPN。

```
Cisco(config)# evpn
Cisco(config-evpn)# vni 10001 l2
Cisco(config-evpn-evi)# rd 1.1.1.1:10001
Cisco(config-evpn-evi)# route-target both 65001:10001
Cisco(config-evpn-evi)# exit
Cisco(config-evpn)# exit
```

3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体信息。

```
[SwitchA] display bgp peer l2vpn evpn
 BGP local router ID: 2.2.2.2
 Local AS number: 2000
 Total number of peers: 2                 Peers in established state: 2

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  1.1.1.1              1000       17       20    0       8 00:06:19 Established
  3.3.3.3              1000       20       17    0       8 00:08:47 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2
VSI name: v1
RD                   PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001        1.1.1.1         1.1.1.1         VXLAN       10001
3.3.3.3:10001        3.3.3.3         3.3.3.3         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchA] display ip routing-table vpn-instance vpn1

Destinations : 14       Routes : 14

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
```

```
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.111/32     BGP     255 0           3.3.3.3         Vsi16777201
100.0.0.116/32     BGP     255 0           3.3.3.3         Vsi16777201
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
224.0.0.0/4        Direct  0   0           0.0.0.0         NULL0
224.0.0.0/24       Direct  0   0           0.0.0.0         NULL0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchA] display evpn routing-table vpn-instance vpn1

VPN instance: vpn1                              Local L3VNI: 16777201
IP address         Next hop        Outgoing interface    NibID
100.0.0.111        3.3.3.3         Vsi-interface16777201 0x18000000
100.0.0.116        3.3.3.3         Vsi-interface16777201 0x18000000
```

验证 EVPN 的 ARP 信息。

```
[SwitchA] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping

VPN instance: vpn1                              Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  703d-15b5-1c8d  0           GL
100.0.0.111     0000-1ed4-45a1  006b-f183-c327  0           B
100.0.0.115     0000-32eb-e6bc  703d-15b5-1c8d  0           DL
100.0.0.116     0000-1279-80ce  703d-15b5-1cff  0           B
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping

VSI name: v1
MAC address     Link ID/Name    Flags   Next hop
0005-0000-0001  Tunnel0         B       3.3.3.3
0000-1ed4-45a1  Tunnel0         B       3.3.3.3
0000-1279-80ce  Tunnel0         B       3.3.3.3
```

验证与 VXLAN 关联的 VXLAN 隧道的信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
```

```
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16777201, VSI name: Auto_L3VNI16777201_16777201
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchA] display arp suppression vsi
IP address      MAC address    Vsi Name                        Link ID    Aging
100.0.0.115     0000-32eb-e6bc v1                              0x0        7
100.0.0.116     0000-1279-80ce v1                              0x5000000  N/A
100.0.0.111     0000-1ed4-45a1 v1                              0x5000000  N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16777201_16777201
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16777201
  VXLAN ID                : 16777201

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name           Link ID    State    Type        Flood proxy
    Tunnel0               0x5000000  UP       Auto        Disabled
    Tunnel1               0x5000001  UP       Auto        Disabled
```

```
  ACs:
    AC                              Link ID  State       Type
    GE1/0/5 srv1                    0        Up          Manual
```

验证 BGP L2VPN 对等体的信息。

```
[SwitchA] display bgp l2vpn evpn

 BGP local router ID is 2.2.2.2
 Status codes: * - valid, > - best, d - dampened, h - history,
               s - suppressed, S - stale, i - internal, e - external
               Origin: i - IGP, e - EGP, ? - incomplete

 Total number of routes from all PEs: 16

 Route distinguisher: 1.1.1.1:10001
 Total number of routes: 8

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >e [2][0][48][0000-1ed4-45a1][0][0.0.0.0]/104
                        3.3.3.3                               0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [2][0][48][0000-1ed4-45a1][32][100.0.0.111]/136
                        3.3.3.3                               0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [2][0][48][0005-0000-0001][0][0.0.0.0]/104
                        3.3.3.3                               0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [3][0][32][1.1.1.1]/80
                        3.3.3.3                               0       1000i
*  e                    1.1.1.1                               0       1000i

 Route distinguisher: 2.2.2.2:10001(vpn1)
 Total number of routes: 5

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >e [2][0][48][0000-1279-80ce][32][100.0.0.116]/136
                        3.3.3.3         0                     0       1000i
* >e [2][0][48][0000-1ed4-45a1][32][100.0.0.111]/136
                        3.3.3.3                               0       1000i
* >  [2][0][48][0000-32eb-e6bc][32][100.0.0.115]/136
                        0.0.0.0         0          100        32768   i
* >  [3][0][32][2.2.2.2]/80
                        0.0.0.0         0          100        32768   i
* >  [5][0][24][100.0.0.0]/80
                        0.0.0.0         0          100        32768   i

 Route distinguisher: 3.3.3.3:10001
```

```
 Total number of routes: 8

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >e [2][0][48][0000-1279-80ce][0][0.0.0.0]/104
                        3.3.3.3         0                     0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [2][0][48][0000-1279-80ce][32][100.0.0.116]/136
                        3.3.3.3         0                     0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [3][0][32][3.3.3.3]/80
                        3.3.3.3         0                     0       1000i
*  e                    1.1.1.1                               0       1000i
* >e [5][0][24][100.0.0.0]/80
                        3.3.3.3         0                     0       1000i
*  e                    1.1.1.1                               0       1000i
```

- H3C 设备（SwitchB）

验证 BGP L2VPN 对等体信息。

```
[SwitchB] display bgp peer l2vpn evpn

 BGP local router ID: 3.3.3.3
 Local AS number: 1000
 Total number of peers: 2                 Peers in established state: 2

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  1.1.1.1                 1000       22       25    0       8 00:11:02 Established
  2.2.2.2                 2000       22       24    0       4 00:12:15 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchB] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
2.2.2.2:10001         2.2.2.2         2.2.2.2         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchB] display ip routing-table vpn-instance vpn1

Destinations : 14       Routes : 14

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
```

```
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.111/32     BGP     255 0           1.1.1.1         Vsi16777201
100.0.0.115/32     BGP     255 0           2.2.2.2         Vsi16777201
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
224.0.0.0/4        Direct  0   0           0.0.0.0         NULL0
224.0.0.0/24       Direct  0   0           0.0.0.0         NULL0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchB] display evpn routing-table vpn-instance vpn1

VPN instance: vpn1                              Local L3VNI: 16777201
IP address         Next hop        Outgoing interface    NibID
100.0.0.111        1.1.1.1         Vsi-interface16777201 0x18000001
100.0.0.115        2.2.2.2         Vsi-interface16777201 0x18000000
```

验证 EVPN 的 ARP 信息。

```
[SwitchB] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping


VPN instance: vpn1                              Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  703d-15b5-1cff  0           GL
100.0.0.111     0000-1ed4-45a1  006b-f183-c327  0           B
100.0.0.115     0000-32eb-e6bc  703d-15b5-1c8d  0           B
100.0.0.116     0000-1279-80ce  703d-15b5-1cff  0           DL
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchB] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping


VSI name: v1
MAC address     Link ID/Name    Flags   Next hop
0005-0000-0001  Tunnel1         B       1.1.1.1
0000-1ed4-45a1  Tunnel1         B       1.1.1.1
0000-32eb-e6bc  Tunnel0         B       2.2.2.2
0000-1279-80ce  0               DL      -
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchB] display vxlan tunnel
Total number of VXLANs: 2
```

```
VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16777201, VSI name: Auto_L3VNI16777201_16777201
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchB] display arp suppression vsi
IP address      MAC address    Vsi Name                        Link ID    Aging
100.0.0.116     0000-1279-80ce v1                              0x0        24
100.0.0.115     0000-32eb-e6bc v1                              0x5000000  N/A
100.0.0.111     0000-1ed4-45a1 v1                              0x5000001  N/A
```

验证 VSI 信息。

```
[SwitchB] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16777201_16777201
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16777201
  VXLAN ID                : 16777201

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
```

```
    Tunnel Name          Link ID    State    Type        Flood proxy
    Tunnel0              0x5000000  UP       Auto        Disabled
    Tunnel1              0x5000001  UP       Auto        Disabled
  ACs:
    AC                               Link ID  State       Type
    GE1/0/5 srv1                     0        Up          Manual
```

验证 BGP EVPN 路由信息。

```
[SwitchB] display bgp l2vpn evpn

 BGP local router ID is 3.3.3.3
 Status codes: * - valid, > - best, d - dampened, h - history,
               s - suppressed, S - stale, i - internal, e - external
               Origin: i - IGP, e - EGP, ? - incomplete

 Total number of routes from all PEs: 12

 Route distinguisher: 1.1.1.1:10001
 Total number of routes: 4

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >i [2][0][48][0000-1ed4-45a1][0][0.0.0.0]/104
                        1.1.1.1                    100        0       i
* >i [2][0][48][0000-1ed4-45a1][32][100.0.0.111]/136
                        1.1.1.1                    100        0       i
* >i [2][0][48][0005-0000-0001][0][0.0.0.0]/104
                        1.1.1.1                    100        0       i
* >i [3][0][32][1.1.1.1]/80
                        1.1.1.1                    100        0       i

 Route distinguisher: 2.2.2.2:10001
 Total number of routes: 8

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >e [2][0][48][0000-32eb-e6bc][0][0.0.0.0]/104
                        2.2.2.2         0                     0       2000i
*  i                    2.2.2.2         0          100        0       2000i
* >e [2][0][48][0000-32eb-e6bc][32][100.0.0.115]/136
                        2.2.2.2         0                     0       2000i
*  i                    2.2.2.2         0          100        0       2000i
* >e [3][0][32][2.2.2.2]/80
                        2.2.2.2         0                     0       2000i
*  i                    2.2.2.2         0          100        0       2000i
* >e [5][0][24][100.0.0.0]/80
                        2.2.2.2         0                     0       2000i
*  i                    2.2.2.2         0          100        0       2000i
```

```
 Route distinguisher: 3.3.3.3:10001(vpn1)
 Total number of routes: 6

     Network            NextHop         MED        LocPrf     PrefVal Path/Ogn

* >  [2][0][48][0000-1279-80ce][0][0.0.0.0]/104
                        0.0.0.0         0          100        32768   i
* >  [2][0][48][0000-1279-80ce][32][100.0.0.116]/136
                        0.0.0.0         0          100        32768   i
* >i [2][0][48][0000-1ed4-45a1][32][100.0.0.111]/136
                        1.1.1.1                    100        0       i
* >e [2][0][48][0000-32eb-e6bc][32][100.0.0.115]/136
                        2.2.2.2         0                     0       2000i
* >  [3][0][32][3.3.3.3]/80
                        0.0.0.0         0          100        32768   i
* >  [5][0][24][100.0.0.0]/80
                        0.0.0.0         0          100        32768   i
```

- Cisco 设备

验证建立的 BGP EVPN 邻居信息。

```
Cisco# show bgp l2vpn evpn neighbors
BGP neighbor is 2.2.2.2,  remote AS 2000, ebgp link,  Peer index 2
  BGP version 4, remote router ID 2.2.2.2
  BGP state = Established, up for 00:13:21
  Using loopback0 as update source for this peer
  External BGP peer might be upto 10 hops away
  Last read 00:00:52, hold time = 180, keepalive interval is 60 seconds
  Last written 00:00:20, keepalive timer expiry due 00:00:39
  Received 29 messages, 0 notifications, 0 bytes in queue
  Sent 27 messages, 1 notifications, 0 bytes in queue
  Connections established 2, dropped 1
  Last reset by us 00:13:33, due to address-family configuration change
  Last reset by peer never, due to No error

  Neighbor capabilities:
  Dynamic capability: advertised (mp, refresh, gr)
  Dynamic capability (old): advertised
  Route refresh capability (new): advertised received
  Route refresh capability (old): advertised
  4-Byte AS capability: advertised received
  Address family IPv4 Unicast: advertised
  Address family L2VPN EVPN: advertised received
  Graceful Restart capability: advertised

  Graceful Restart Parameters:
  Address families advertised to peer:
    IPv4 Unicast  L2VPN EVPN
  Address families received from peer:
```

```
  Forwarding state preserved by peer for:
  Restart time advertised to peer: 120 seconds
  Stale time for routes advertised by peer: 300 seconds
  Extended Next Hop Encoding Capability: advertised

  Message statistics:
                              Sent               Rcvd
  Opens:                         2                  2
  Notifications:                 1                  0
  Updates:                       8                 12
  Keepalives:                   16                 15
  Route Refresh:                 0                  0
  Capability:                    0                  0
  Total:                        27                 29
  Total bytes:                1111               1592
  Bytes in queue:                0                  0

  For address family: IPv4 Unicast
  BGP table version 2, neighbor version 0
  0 accepted paths consume 0 bytes of memory
  0 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor

  For address family: L2VPN EVPN
  BGP table version 46, neighbor version 46
  4 accepted paths consume 496 bytes of memory
  8 sent paths
  Community attribute sent to this neighbor
  Extended community attribute sent to this neighbor

  Local host: 1.1.1.1, Local port: 56082
  Foreign host: 2.2.2.2, Foreign port: 179
  fd = 78

BGP neighbor is 3.3.3.3,  remote AS 1000, ibgp link,  Peer index 1
  BGP version 4, remote router ID 3.3.3.3
  BGP state = Established, up for 00:14:35
  Using loopback0 as update source for this peer
  Last read 00:00:47, hold time = 180, keepalive interval is 60 seconds
  Last written 00:00:34, keepalive timer expiry due 00:00:25
  Received 30 messages, 0 notifications, 0 bytes in queue
  Sent 28 messages, 1 notifications, 0 bytes in queue
  Connections established 2, dropped 1
  Last reset by us 00:14:48, due to address-family configuration change
  Last reset by peer never, due to No error

  Neighbor capabilities:
```

```
Dynamic capability: advertised (mp, refresh, gr)
Dynamic capability (old): advertised
Route refresh capability (new): advertised received
Route refresh capability (old): advertised
4-Byte AS capability: advertised received
Address family IPv4 Unicast: advertised
Address family L2VPN EVPN: advertised received
Graceful Restart capability: advertised

Graceful Restart Parameters:
Address families advertised to peer:
  IPv4 Unicast  L2VPN EVPN
Address families received from peer:
Forwarding state preserved by peer for:
Restart time advertised to peer: 120 seconds
Stale time for routes advertised by peer: 300 seconds
Extended Next Hop Encoding Capability: advertised

Message statistics:
                            Sent               Rcvd
Opens:                         2                  2
Notifications:                 1                  0
Updates:                       8                 11
Keepalives:                   17                 17
Route Refresh:                 0                  0
Capability:                    0                  0
Total:                        28                 30
Total bytes:                1213               1497
Bytes in queue:                0                  0

For address family: IPv4 Unicast
BGP table version 2, neighbor version 0
0 accepted paths consume 0 bytes of memory
0 sent paths
Community attribute sent to this neighbor
Extended community attribute sent to this neighbor
Third-party Nexthop will not be computed.

For address family: L2VPN EVPN
BGP table version 46, neighbor version 46
8 accepted paths consume 992 bytes of memory
8 sent paths
Community attribute sent to this neighbor
Extended community attribute sent to this neighbor
Third-party Nexthop will not be computed.

Local host: 1.1.1.1, Local port: 54671
Foreign host: 3.3.3.3, Foreign port: 179
```

```
  fd = 77
```

验证 NVE Peer 的详细信息。

```
Cisco# show nve peers detail
Details of nve Peers:
---------------------------------------
Peer-Ip: 2.2.2.2
    NVE Interface       : nve1
    Peer State          : Up
    Peer Uptime         : 00:14:55
    Router-Mac          : 703d.15b5.1c8d
    Peer First VNI      : 10001
    Time since Create   : 00:14:55
    Configured VNIs     : 10001,16777201
    Provision State     : add-complete
    Route-Update        : Yes
    Peer Flags          : RmacL2Rib, TunnelPD, DisableLearn
    Learnt CP VNIs      : 10001,16777201
    Peer-ifindex-resp   : Yes
---------------------------------------
Peer-Ip: 3.3.3.3
    NVE Interface       : nve1
    Peer State          : Up
    Peer Uptime         : 00:14:55
    Router-Mac          : 703d.15b5.1cff
    Peer First VNI      : 16777201
    Time since Create   : 00:14:55
    Configured VNIs     : 10001,16777201
    Provision State     : add-complete
    Route-Update        : Yes
    Peer Flags          : RmacL2Rib, TunnelPD, DisableLearn
    Learnt CP VNIs      : 10001,16777201
    Peer-ifindex-resp   : Yes
---------------------------------------
```

验证 NVE VNI 的详细信息。

```
Cisco# show nve vni
Codes: CP - Control Plane        DP - Data Plane
       UC - Unconfigured         SA - Suppress ARP

Interface VNI      Multicast-group   State Mode Type [BD/VRF]      Flags
--------- -------- ----------------- ----- ---- ------------------ -----
nve1      10001    UnicastBGP        Up    CP   L2 [1001]          SA
nve1      16777201 n/a               Up    CP   L3 [vpn1]
```

验证 NVE VRF 的详细信息。

```
Cisco# show nve vrf
VRF-Name     VNI        Interface Gateway-MAC
------------ ---------- --------- -----------------
```

```
vpn1         16777201   nve1      006b.f183.c327
```

验证 NVE VXlAN 参数信息。

```
Cisco# show nve vxlan-params
VxLAN Dest. UDP Port: 4789
```

验证 VXLAN 信息。

```
Cisco# show vxlan
Vlan            VN-Segment
====            ==========
101             16777201
1001            10001
```

验证 L2VPN EVPN 的 BGP 信息。

```
Cisco# show bgp l2vpn evpn
BGP routing table information for VRF default, address family L2VPN EVPN
BGP table version is 52, local router ID is 1.1.1.1
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-i
njected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup

   Network            Next Hop            Metric     LocPrf     Weight Path
Route Distinguisher: 1.1.1.1:10001    (L2VNI 10001)
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                      3.3.3.3                  0        100          0 i
*>l[2]:[0]:[0]:[48]:[0000.1ed4.45a1]:[0]:[0.0.0.0]/216
                      1.1.1.1                           100      32768 i
*>l[2]:[0]:[0]:[48]:[0005.0000.0001]:[0]:[0.0.0.0]/216
                      1.1.1.1                           100      32768 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                      3.3.3.3                  0        100          0 i
*>l[2]:[0]:[0]:[48]:[0000.1ed4.45a1]:[32]:[100.0.0.111]/272
                      1.1.1.1                           100      32768 i
*>e[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                      2.2.2.2                  0                    0 2000 i
*>l[3]:[0]:[32]:[1.1.1.1]/88
                      1.1.1.1                           100      32768 i
*>e[3]:[0]:[32]:[2.2.2.2]/88
                      2.2.2.2                  0                    0 2000 i
*>i[3]:[0]:[32]:[3.3.3.3]/88
                      3.3.3.3                  0        100          0 i
* e[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
                      2.2.2.2                  0                    0 2000 i
*>i                   3.3.3.3                  0        100          0 i

Route Distinguisher: 2.2.2.2:10001
x i[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[0]:[0.0.0.0]/216
                      2.2.2.2                  0        100          0 2000 i
```

```
x e                  2.2.2.2                  0                    0 2000 i
*>e[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                     2.2.2.2                  0                    0 2000 i
* i                  2.2.2.2                  0        100         0 2000 i
*>e[3]:[0]:[32]:[2.2.2.2]/88
                     2.2.2.2                  0                    0 2000 i
* i                  2.2.2.2                  0        100         0 2000 i
*>e[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
                     2.2.2.2                  0                    0 2000 i
* i                  2.2.2.2                  0        100         0 2000 i

Route Distinguisher: 3.3.3.3:10001
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                     3.3.3.3                  0        100         0 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                     3.3.3.3                  0        100         0 i
*>i[3]:[0]:[32]:[3.3.3.3]/88
                     3.3.3.3                  0        100         0 i
*>i[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
                     3.3.3.3                  0        100         0 i

Route Distinguisher: 1.1.1.1:10001    (L3VNI 16777201)
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[0]:[0.0.0.0]/216
                     3.3.3.3                  0        100         0 i
*>i[2]:[0]:[0]:[48]:[0000.1279.80ce]:[32]:[100.0.0.116]/272
                     3.3.3.3                  0        100         0 i
*>e[2]:[0]:[0]:[48]:[0000.32eb.e6bc]:[32]:[100.0.0.115]/272
                     2.2.2.2                  0                    0 2000 i
*>e[3]:[0]:[32]:[2.2.2.2]/88
                     2.2.2.2                  0                    0 2000 i
*>i[3]:[0]:[32]:[3.3.3.3]/88
                     3.3.3.3                  0        100         0 i
* e[5]:[0]:[0]:[24]:[100.0.0.0]:[0.0.0.0]/224
                     2.2.2.2                  0                    0 2000 i
*>i                  3.3.3.3                  0        100         0 i
```

验证二层路由的 EVPN MAC。

```
Cisco# show l2route evpn mac all
Topology    Mac Address    Prod   Next Hop (s)
----------- -------------- ------ ---------------
101         703d.15b5.1c8d VXLAN  2.2.2.2
101         703d.15b5.1cff VXLAN  3.3.3.3
1001        0000.1279.80ce BGP    3.3.3.3
1001        0000.1ed4.45a1 Local  Eth1/5
1001        0000.32eb.e6bc BGP    2.2.2.2
1001        0005.0000.0001 Local  Eth1/5
```

验证二层路由的 EVPN MAC-IP。

```
Cisco# show l2route evpn mac-ip all
```

```
Topology ID Mac Address    Prod Host IP                                 Next Hop
 (s)
----------- -------------- ---- --------------------------------------- --------
-------
1001        0000.1ed4.45a1 HMM  100.0.0.111                             N/A

1001        0000.32eb.e6bc BGP  100.0.0.115                             2.2.2.2

1001        0000.1279.80ce BGP  100.0.0.116                             3.3.3.3
```

验证 ARP 抑制缓存详细信息。

```
Cisco# show ip arp suppression-cache detail

Flags: + - Adjacencies synced via CFSoE
       L - Local Adjacency
       R - Remote Adjacency
       L2 - Learnt over L2 interface

Ip Address      Age      Mac Address    Vlan Physical-ifindex    Flags

100.0.0.111     00:08:06 0000.1ed4.45a1 1001 Ethernet1/5         L
100.0.0.116     00:16:12 0000.1279.80ce 1001 (null)              R
100.0.0.115     00:14:57 0000.32eb.e6bc 1001 (null)              R
```

验证指定 VPN1 的路由信息。

```
Cisco# show ip route vrf vpn1
IP Route Table for VRF "vpn1"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

100.0.0.0/24, ubest/mbest: 1/0, attached
    *via 100.0.0.1, Vlan1001, [0/0], 08:47:51, direct
100.0.0.1/32, ubest/mbest: 1/0, attached
    *via 100.0.0.1, Vlan1001, [0/0], 08:47:51, local
100.0.0.111/32, ubest/mbest: 1/0, attached
    *via 100.0.0.111, Vlan1001, [190/0], 08:34:08, hmm
100.0.0.115/32, ubest/mbest: 1/0
    *via 2.2.2.2%default, [20/0], 00:15:05, bgp-1000, external, tag 2000 (evpn)
segid: 16777201 tunnelid: 0x2020202 encap: VXLAN

100.0.0.116/32, ubest/mbest: 1/0
    *via 3.3.3.3%default, [200/0], 00:16:20, bgp-1000, internal, tag 1000 (evpn)
 segid: 16777201 tunnelid: 0x3030303 encap: VXLAN
```

1.2 与华为设备对接操作指导

1.2.1 互通性分析

表2 EVPN/VXLAN 互通性分析

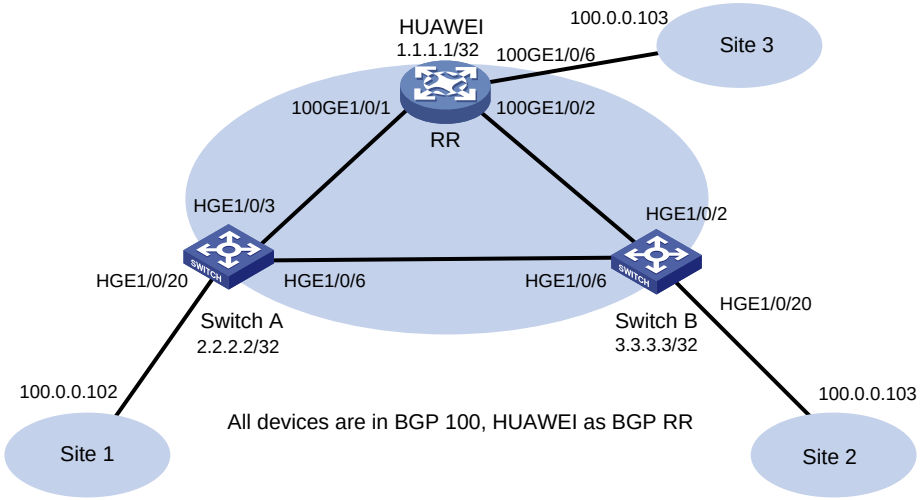
H3C	华为	互通结论
支持	支持	可以互通

1.2.2 采用 IBGP 模式对接案例

1. 组网需求

如图 3 所示，H3C SwitchA、SwitchB 为分布式 EVPN 网关设备，华为设备作为 RR，负责在交换机之间反射 BGP 路由。现要求相同 VXLAN 之间可以二层互通；不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图3 采用 IBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
[SwitchA] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchA] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchA] vxlan tunnel mac-learning disable
[SwitchA] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchA] ospf 1
```

```
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```

配置 underlay 网络。

```
[SwitchA] interface HundredGigE 1/0/3
[SwitchA-HundredGigE1/0/3] ip address 31.1.1.1 255.255.255.0
[SwitchA-HundredGigE1/0/3] ospf 1 area 0.0.0.0
[SwitchA-HundredGigE1/0/3] quit
[SwitchA]interface HundredGigE 1/0/6
[SwitchA-HundredGigE1/0/6] ip address 61.1.1.1 24
[SwitchA-HundredGigE1/0/6] ospf 1 area 0
[SwitchA-HundredGigE1/0/6] quit
```

创建 VLAN1001。

```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```

在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```

创建 VXLAN10001。

```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```

配置 BGP 发布 EVPN 路由。

```
[SwitchA] bgp 100
[SwitchA-bgp-default] peer 1.1.1.1 as-number 100
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/20 上创建以太网服务实例 1，该实例用来匹配 VLAN1001 的数据帧。

```
[SwitchA] interface HundredGigE 1/0/20
[SwitchA-HundredGigE1/0/20] service-instance 1
[SwitchA-HundredGigE1/0/20-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-HundredGigE1/0/20-srv1000] xconnect vsi v1
[SwitchA-HundredGigE1/0/20-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchA] interface vsi-interface 16383
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16383
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备(SwitchB)

开启 L2VPN 能力。

```
<SwitchB> system-view
[SwitchB] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchB] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
[SwitchB]
```

配置 underlay 网络。

```
[SwitchB] interface HundredGigE 1/0/2
[SwitchB-HundredGigE1/0/2] ip address 21.0.0.1 24
[SwitchB-HundredGigE1/0/2] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/2] quit
[SwitchB]interface HundredGigE 1/0/6
[SwitchB-HundredGigE1/0/6] ip address 61.1.1.2 24
[SwitchB-HundredGigE1/0/6] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/6] quit
```

创建 VLAN1001。

```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```

在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。

```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```

创建 VXLAN10001。

```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```

配置 BGP 发布 EVPN 路由。

```
[SwitchB] bgp 100
[SwitchB-bgp-default] peer 1.1.1.1 as-number 100
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] quit
[SwitchB-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/20 上创建以太网服务实例 1，该实例用来匹配 VLAN1001 的数据帧。

```
[SwitchB] interface HundredGigE 1/0/20
[SwitchB-HundredGigE1/0/20] service-instance 1
[SwitchB-HundredGigE1/0/20-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchB-HundredGigE1/0/20-srv1000] xconnect vsi v1
[SwitchB-HundredGigE1/0/20-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchB] ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
```

```
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```
配置 VSI 虚接口 VSI-interface1。
```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 24
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```
创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。
```
[SwitchB] interface vsi-interface 16383
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16383
[SwitchB-Vsi-interface3] quit
```
配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] gateway vsi-interface 1
[SwitchB-vsi-v1] quit
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```
配置 OSPF。
```
<HUAWEI> sys immediately
Enter system view, return user view with return command.
[HUAWEI] ospf 1
[HUAWEI-ospf-1-area-0.0.0.0] quit
[HUAWEI-ospf-1] quit
```
配置 underlay 网络。
```
[HUAWEI] interface 100GE 1/0/1
[HUAWEI-100GE1/0/1] undo portswitch
[HUAWEI-100GE1/0/1] ip address 31.1.1.2 24
```

```
[HUAWEI-100GE1/0/1] ospf enable 1 area 0
[HUAWEI-100GE1/0/1] quit
[HUAWEI] interface 100GE 1/0/2
[HUAWEI-100GE1/0/2] undo portswitch
[HUAWEI-100GE1/0/2] ip address 21.1.1.2 24
[HUAWEI-100GE1/0/2] ospf enable 1 area 0
[HUAWEI-100GE1/0/2] quit
```

创建 LoopBack 口。

```
[HUAWEI]interface LoopBack 0
[HUAWEI-LoopBack0] ip address 1.1.1.1 32
[HUAWEI-LoopBack0] ospf enable 1 area 0
[HUAWEI-LoopBack0] quit
```

使能 EVPN 作 VXLAN 控制平面功能。

```
[HUAWEI] evpn-overlay enable
```

配置 BGP 发布 EVPN 路由。

```
[HUAWEI] bgp 100
[HUAWEI-bgp] peer 2.2.2.2 as-number 100
[HUAWEI-bgp] peer 2.2.2.2 connect-interface LoopBack 0
[HUAWEI-bgp] peer 3.3.3.3 as-number 100
[HUAWEI-bgp] peer 3.3.3.3 connect-interface LoopBack 0
[HUAWEI-bgp] l2vpn-family evpn
[HUAWEI-bgp-af-evpn] peer 2.2.2.2 enable
Warning: This operation will reset the peer session. Continue? [Y/N]:y
[HUAWEI-bgp-af-evpn] peer 2.2.2.2 reflect-client
[HUAWEI-bgp-af-evpn] peer 3.3.3.3 enable
Warning: This operation will reset the peer session. Continue? [Y/N]:y
[HUAWEI-bgp-af-evpn] peer 3.3.3.3 reflect-client
[HUAWEI-bgp-af-evpn] undo policy vpn-target
[HUAWEI-bgp-af-evpn] quit
[HUAWEI-bgp] quit
```

创建 VLAN1001。

```
[HUAWEI] vlan 1001
[HUAWEI-vlan1001] quit
```

配置业务接入点。

```
[HUAWEI] bridge-domain 1001
[HUAWEI-bd1001] quit
[HUAWEI] interface 100GE 1/0/6.1 mode l2
[HUAWEI-100GE1/0/6.1] encapsulation dot1q vid 1001
[HUAWEI-100GE1/0/6.1] bridge-domain 1001
[HUAWEI-100GE1/0/6.1] quit
```

配置 VPN 实例和 EVPN 实例。

```
[HUAWEI] ip vpn-instance vpn1
[HUAWEI-vpn-instance-vpn1] vxlan vni 16383
[HUAWEI-vpn-instance-vpn1] ipv4-family
[HUAWEI-vpn-instance-vpn1-af-ipv4] route-distinguisher 1.1.1.1:10001
[HUAWEI-vpn-instance-vpn1-af-ipv4] vpn-target 65001:10001
 IVT Assignment result:
```

```
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-vpn-instance-vpn1-af-ipv4]vpn-target 65001:10001 evpn
 IVT Assignment result:
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-vpn-instance-vpn1-af-ipv4] quit
[HUAWEI-vpn-instance-vpn1] quit
[HUAWEI] bridge-domain 1001
[HUAWEI-bd1001] vxlan vni 10001
[HUAWEI-bd1001] evpn
[HUAWEI-bd1001-evpn] route-distinguisher 1.1.1.1:10001
[HUAWEI-bd1001-evpn] vpn-target 65001:10001
 IVT Assignment result:
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-bd1001-evpn] quit
[HUAWEI-bd1001] quit
```

使能头端复制功能。

```
[HUAWEI] int Nve 1
Info: Ensure that the IP addresses and MAC addresses of the NVE interfaces on Devices are
the same, as they are dual-active gateways using M-LAG.
[HUAWEI-Nve1] source 1.1.1.1
[HUAWEI-Nve1] vni 10001 head-end peer-list protocol bgp
[HUAWEI-Nve1] quit
```

配置业务环回接口，配置 VXLAN 三层网关。

```
[HUAWEI] int Eth-Trunk 1
[HUAWEI-Eth-Trunk1] service type tunnel
[HUAWEI-Eth-Trunk1] quit
[HUAWEI] int 100 1/0/5
[HUAWEI-100GE1/0/5] eth-trunk 1
[HUAWEI-100GE1/0/5] quit
[HUAWEI] int Vbdif 1001
[HUAWEI-Vbdif10] ip binding vpn-instance vpn1
Info: All IPv4 and IPv6 related configurations on this interface are removed.
[HUAWEI-Vbdif10] ip address 100.0.0.1 24
[HUAWEI-Vbdif10] mac-address 0000-2017-0001
Info: When configuring IP and MAC addresses on a VBDIF interface to implement M-LAG dual-active
gateways, you must configure a virtual MAC address.
[HUAWEI-Vbdif10] arp distribute-gateway enable
[HUAWEI-Vbdif10] arp collect host enable
[HUAWEI-Vbdif10] quit
```

3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体信息。

```
[SwitchA] display bgp peer l2vpn evpn

 BGP local router ID: 2.2.2.2
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 1.1.1.1                100     3053     2675    0        5 0043h54m Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
3.3.3.3:10001         61.1.1.2        3.3.3.3         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchA] display ip routing-table vpn-instance vpn1

Destinations : 11       Routes : 11

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.102/32     BGP     255 0           3.3.3.3         Vsi16383
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchA] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                           Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
100.0.0.102      3.3.3.3          Vsi-interface16383    0x18000000  -
```

验证 EVPN 的 ARP 信息。

```
[SwitchA] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
```

```
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VPN instance: vpn1                            Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  78aa-8233-2201  0           GL
100.0.0.101     0010-9400-0001  78aa-8233-2201  0           DL
100.0.0.102     0010-9400-0002  741f-4aa1-2508  0           B
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VSI name: v1
 MAC address    : 0010-9400-0001
  Link ID/Name  : 0x0
  Flags         : DL
  Encap         : VXLAN
  Next hop      : -
  Color         : -

 MAC address    : 0000-2017-0001
  Link ID/Name  : Tunnel1
  Flags         : BS
  Encap         : VXLAN
  Next hop      : 1.1.1.1
  Color         : -

 MAC address    : 0010-9400-0002
  Link ID/Name  : Tunnel0
  Flags         : B
  Encap         : VXLAN
  Next hop      : 3.3.3.3
  Color         : -
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel Name         Link ID        State       Type        Flood Proxy
Tunnel0             0x50000000     UP          Auto        Disabled
Tunnel1             0x50000001     UP          Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchA]display arp suppression vsi
IP address      MAC address    VSI Name                    Link ID    Aging(min)
```

```
100.0.0.101     0010-9400-0001 v1                          0x0        22
100.0.0.102     0010-9400-0002 v1                          0x50000000 N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16383_16383
  VSI Index               : 16383
  VSI State               : Down
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16383
  VXLAN ID                : 16383

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name         Link ID        State       Type        Flood Proxy
    Tunnel0             0x50000000     UP          Auto        Disabled
    Tunnel1             0x50000001     UP          Auto        Disabled
  ACs:
    AC                                                  Link ID    State       Type
    HGE1/0/20 srv1                                     0x0        Up          Manual
```

```
    Statistics: Disabled
```

- H3C 设备（SwitchB）

验证 BGP L2VPN 对等体信息。

```
[SwitchB] display bgp peer l2vpn evpn

 BGP local router ID: 61.1.1.2
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  1.1.1.1                100     3253     3047    0       6 0046h35m Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchB] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
2.2.2.2:10001         2.2.2.2         2.2.2.2         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchB] display ip routing-table vpn-instance vpn1

Destinations : 13       Routes : 13

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.101/32     BGP     255 0           2.2.2.2         Vsi16383
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
224.0.0.0/4        Direct  0   0           0.0.0.0         NULL0
224.0.0.0/24       Direct  0   0           0.0.0.0         NULL0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchB] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                          Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
```

```
100.0.0.101      2.2.2.2          Vsi-interface16383    0x18000000  -
```

验证 EVPN 的 ARP 信息。

```
[SwitchB] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid

VPN instance: vpn1                              Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  741f-4aa1-2508  0           GL
100.0.0.101     0010-9400-0001  78aa-8233-2201  0           B
100.0.0.102     0010-9400-0002  741f-4aa1-2508  0           DL
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchB] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid

VSI name: v1
MAC address     Link ID/Name    Flags   Nexthop
0000-2017-0001  Tunnel1         BS      1.1.1.1
0010-9400-0001  Tunnel0         B       2.2.2.2
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchB] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
```

验证 VSI 信息。

```
[SwitchB] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16383_16383
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16383
```

```
  VXLAN ID                : 16383

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name          Link ID    State    Type        Flood proxy
    Tunnel0              0x5000000  UP       Auto        Disabled
    Tunnel1              0x5000001  UP       Auto        Disabled
  ACs:
    AC                              Link ID  State       Type
    HGE1/0/20 srv1                  0        Up          Manual
```

- 华为设备

验证 BGP EVPN 对等体信息。

```
[HUAWEI] display bgp evpn peer
 Status codes: * - Dynamic
 BGP local router ID        : 1.1.1.1
 Local AS number            : 100
 Total number of peers      : 2
 Peers in established state : 2
 Total number of dynamic peers : 0

  Peer                          V         AS  MsgRcvd  MsgSent  OutQ  Up/Down       State
PrefRcv
  2.2.2.2                       4        100     2848     3248     0 0046h31m Established
3
  3.3.3.3                       4        100     3041     3247     0 0046h31m Established
3
```

验证指定实例的 EVPN 信息。

```
[HUAWEI] display evpn vpn-instance name 1001
  EVPN-Instance Name              RD                   Address-family
  1001                            1.1.1.1:10001        evpn
```

验证指定实例的路由信息。

```
[HUAWEI] display ip routing-table vpn-instance vpn1
Proto: Protocol        Pre: Preference
```

```
Route Flags: R - relay, D - download to fib, T - to vpn-instance, B - black hole route
------------------------------------------------------------------------------
Routing Table : vpn1
         Destinations : 6        Routes : 6

Destination/Mask    Proto   Pre  Cost        Flags NextHop         Interface

      100.0.0.0/24  Direct  0    0             D   100.0.0.1       Vbdif1001
      100.0.0.1/32  Direct  0    0             D   127.0.0.1       Vbdif1001
    100.0.0.101/32  IBGP    255  0             RD  2.2.2.2         VXLAN
    100.0.0.102/32  IBGP    255  0             RD  3.3.3.3         VXLAN
    100.0.0.255/32  Direct  0    0             D   127.0.0.1       Vbdif1001
255.255.255.255/32  Direct  0    0             D   127.0.0.1       InLoopBack0
```

验证 VXLAN 隧道。

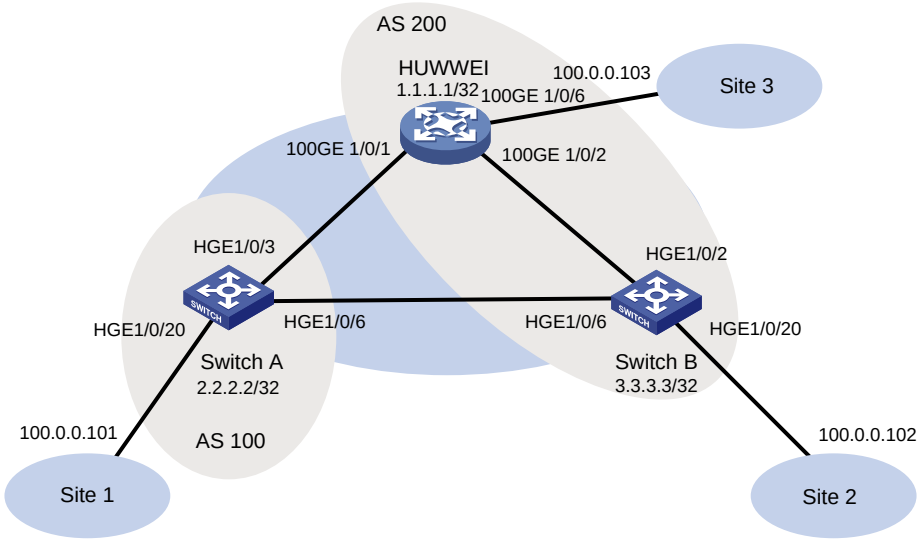
```
[HUAWEI] display vxlan tunnel
Number of vxlan tunnel : 2
Tunnel ID   Source                Destination           State  Type     Uptime
--------------------------------------------------------------------------------
4026531842  1.1.1.1               2.2.2.2               up     dynamic  0046h01m
4026531843  1.1.1.1               3.3.3.3               up     dynamic  0046h01m
```

1.2.3 采用 EBGP 模式对接案例

1. 组网需求

如图 4 所示，H3C SwitchA、SwitchB 和华为设备均为分布式 EVPN 网关。现要求相同 VXLAN 之间可以二层互通，不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图4 采用 EBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
```

```
[SwitchA] l2vpn enable
```
配置 VXLAN 的硬件资源模式。
```
[SwitchA] hardware-resource vxlan border40k
```
关闭远端 MAC 地址和远端 ARP 自动学习功能。
```
[SwitchA] vxlan tunnel mac-learning disable
[SwitchA] vxlan tunnel arp-learning disable
```
配置 OSPF。
```
[SwitchA] ospf 1
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchA] interface HundredGigE 1/0/3
[SwitchA-HundredGigE1/0/3] ip address 31.1.1.1 255.255.255.0
[SwitchA-HundredGigE1/0/3] ospf 1 area 0.0.0.0
[SwitchA-HundredGigE1/0/3] quit
[SwitchA]interface HundredGigE 1/0/6
[SwitchA-HundredGigE1/0/6] ip address 61.1.1.1 24
[SwitchA-HundredGigE1/0/6] ospf 1 area 0
[SwitchA-HundredGigE1/0/6] quit
```
创建 VLAN1001。
```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchA] bgp 100
[SwitchA-bgp-default] peer 1.1.1.1 as-number 200
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] peer 1.1.1.1 ebgp-max-hop 10
[SwitchA-bgp-default] peer 3.3.3.3 as-number 200
```

```
[SwitchA-bgp-default] peer 3.3.3.3 connect-interface loopback 0
[SwitchA-bgp-default] peer 3.3.3.3 ebgp-max-hop 10
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] peer 3.3.3.3 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/20 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。

```
[SwitchA] interface HundredGigE 1/0/20
[SwitchA-HundredGigE1/0/20] service-instance 1
[SwitchA-HundredGigE1/0/20-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-HundredGigE1/0/20-srv1000] xconnect vsi v1
[SwitchA-HundredGigE1/0/20-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 255.255.255.0
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchA] interface vsi-interface 16383
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16383
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备(SwitchB)

开启 L2VPN 能力。

```
<SwitchB> system-view
[SwitchB] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchB] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```
配置 OSPF。
```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```
创建 LoopBack 口。
```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
```
配置 underlay 网络。
```
[SwitchB] interface HundredGigE 1/0/2
[SwitchB-HundredGigE1/0/2] ip address 21.0.0.1 24
[SwitchB-HundredGigE1/0/2] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/2] quit
[SwitchB] interface HundredGigE 1/0/6
[SwitchB-HundredGigE1/0/6] ip address 61.1.1.2 24
[SwitchB-HundredGigE1/0/6] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/6] quit
```
创建 VLAN1001。
```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN 10001。
```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchB] bgp 200
[SwitchB-bgp-default] peer 1.1.1.1 as-number 200
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchB-bgp-default] peer 2.2.2.2 as-number 100
[SwitchB-bgp-default] peer 2.2.2.2 connect-interface loopback 0
[SwitchB-bgp-default] peer 2.2.2.2 ebgp-max-hop 10
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] peer 2.2.2.2 enable
[SwitchB-bgp-default-evpn] quit
```

```
[SwitchB-bgp-default] quit
```
在接入服务器的接口 HundredGigE1/0/20 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。
```
[SwitchB] interface HundredGigE 1/0/20
[SwitchB-HundredGigE1/0/20] service-instance 1
[SwitchB-HundredGigE1/0/20-srv1000] encapsulation s-vid 1001
```
配置以太网服务实例 1 与 VSI 实例 v1 关联。
```
[SwitchB-HundredGigE1/0/20-srv1000] xconnect vsi v1
[SwitchB-HundredGigE1/0/20-srv1000] quit
```
配置 L3VNI 的 RD 和 RT。
```
[SwitchB] ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```
配置 VSI 虚接口 VSI-interface1。
```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 24
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```
创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。
```
[SwitchB] interface vsi-interface 16383
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16383
[SwitchB-Vsi-interface3] quit
```
配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] gateway vsi-interface 1
[SwitchB-vsi-v1] quit
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
```

```
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

配置 OSPF。

```
<HUAWEI>system immediately
Enter system view, return user view with return command.
[HUAWEI] ospf 1
[HUAWEI-ospf-1-area-0.0.0.0] quit
[HUAWEI-ospf-1] quit
```

配置 underlay 网络。

```
[HUAWEI] interface 100GE 1/0/1
[HUAWEI-100GE1/0/1] undo portswitch
[HUAWEI-100GE1/0/1] ip address 31.1.1.2 24
[HUAWEI-100GE1/0/1] ospf enable 1 area 0
[HUAWEI-100GE1/0/1] quit
[HUAWEI] interface 100GE 1/0/2
[HUAWEI-100GE1/0/2] undo portswitch
[HUAWEI-100GE1/0/2] ip address 21.1.1.2 24
[HUAWEI-100GE1/0/2] ospf enable 1 area 0
[HUAWEI-100GE1/0/2] quit
```

创建 LoopBack 口。

```
[HUAWEI] interface LoopBack 0
[HUAWEI-LoopBack0] ip address 1.1.1.1 32
[HUAWEI-LoopBack0] ospf enable 1 area 0
[HUAWEI-LoopBack0] quit
```

使能 EVPN 作 VXLAN 控制平面功能。

```
[HUAWEI] evpn-overlay enable
```

配置 BGP 发布 EVPN 路由。

```
[HUAWEI] bgp 200
[HUAWEI-bgp] peer 2.2.2.2 as-number 100
[HUAWEI-bgp] peer 2.2.2.2 connect-interface LoopBack 0
[HUAWEI-bgp] peer 2.2.2.2 ebgp-max-hop 10
[HUAWEI-bgp] peer 3.3.3.3 as-number 200
[HUAWEI-bgp] peer 3.3.3.3 connect-interface LoopBack 0
[HUAWEI-bgp] l2vpn-family evpn
[HUAWEI-bgp-af-evpn] peer 2.2.2.2 enable
Warning: This operation will reset the peer session. Continue? [Y/N]:y
[HUAWEI-bgp-af-evpn] peer 3.3.3.3 enable
Warning: This operation will reset the peer session. Continue? [Y/N]:y
[HUAWEI-bgp-af-evpn] undo policy vpn-target
[HUAWEI-bgp-af-evpn] quit
[HUAWEI-bgp] quit
```

创建 VLAN1001。

```
[HUAWEI] vlan 1001
```

```
[HUAWEI-vlan1001] quit
```
配置业务接入点。
```
[HUAWEI] bridge-domain 1001
[HUAWEI-bd1001] quit
[HUAWEI] interface 100GE 1/0/6.1 mode l2
[HUAWEI-100GE1/0/6.1] encapsulation dot1q vid 1001
[HUAWEI-100GE1/0/6.1] bridge-domain 1001
[HUAWEI-100GE1/0/6.1] quit
```
配置 VPN 实例和 EVPN 实例。
```
[HUAWEI] ip vpn-instance vpn1
[HUAWEI-vpn-instance-vpn1] vxlan vni 16383
[HUAWEI-vpn-instance-vpn1] ipv4-family
[HUAWEI-vpn-instance-vpn1-af-ipv4] route-distinguisher 1.1.1.1:10001
[HUAWEI-vpn-instance-vpn1-af-ipv4] vpn-target 65001:10001
 IVT Assignment result:
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-vpn-instance-vpn1-af-ipv4]vpn-target 65001:10001 evpn
 IVT Assignment result:
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-vpn-instance-vpn1-af-ipv4] quit
[HUAWEI-vpn-instance-vpn1] quit
[HUAWEI] bridge-domain 1001
[HUAWEI-bd1001] vxlan vni 10001
[HUAWEI-bd1001] evpn
[HUAWEI-bd1001-evpn] route-distinguisher 1.1.1.1:10001
[HUAWEI-bd1001-evpn] vpn-target 65001:10001
 IVT Assignment result:
Info: VPN-Target assignment is successful.
 EVT Assignment result:
Info: VPN-Target assignment is successful.
[HUAWEI-bd1001-evpn] quit
[HUAWEI-bd1001] quit
```
使能头端复制功能。
```
[HUAWEI] interfce Nve 1
Info: Ensure that the IP addresses and MAC addresses of the NVE interfaces on Devices are
the same, as they are dual-active gateways using M-LAG.
[HUAWEI-Nve1] source 1.1.1.1
[HUAWEI-Nve1] vni 10001 head-end peer-list protocol bgp
[HUAWEI-Nve1] quit
```
配置业务环回接口，配置 VXLAN 三层网关。
```
[HUAWEI] interface Eth-Trunk 1
[HUAWEI-Eth-Trunk1] service type tunnel
[HUAWEI-Eth-Trunk1] quit
```

```
[HUAWEI]interface 100GE 1/0/5
[HUAWEI-100GE1/0/5] eth-trunk 1
[HUAWEI-100GE1/0/5] quit
[HUAWEI] interface Vbdif 1001
[HUAWEI-Vbdif10] ip binding vpn-instance vpn1
Info: All IPv4 and IPv6 related configurations on this interface are removed.
[HUAWEI-Vbdif10] ip address 100.0.0.1 24
[HUAWEI-Vbdif10] mac-address 0000-2017-0001
Info: When configuring IP and MAC addresses on a VBDIF interface to implement M-LAG dual-active
gateways, you must configure a virtual MAC address.
[HUAWEI-Vbdif10] arp distribute-gateway enable
[HUAWEI-Vbdif10] arp collect host enable
[HUAWEI-Vbdif10] quit
```

3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体信息。

```
[SwitchA] display bgp peer l2vpn evpn

 BGP local router ID: 2.2.2.2
 Local AS number: 100
 Total number of peers: 2                 Peers in established state: 2

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 1.1.1.1                200        5       14    0        2 00:00:44 Established
 3.3.3.3                200        9        9    0        5 00:00:53 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         3.3.3.3         VXLAN       10001
3.3.3.3:10001         61.1.1.2        3.3.3.3         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchA] display ip routing-table vpn-instance vpn1

Destinations : 11       Routes : 11

Destination/Mask    Proto   Pre Cost        NextHop         Interface
0.0.0.0/32          Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24        Direct  0   0           100.0.0.1       Vsi1
100.0.0.0/32        Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32        Direct  0   0           127.0.0.1       InLoop0
100.0.0.102/32      BGP     255 0           3.3.3.3         Vsi16383
```

```
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchA] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                            Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
100.0.0.102      3.3.3.3          Vsi-interface16383    0x18000000  -
```

验证 EVPN 的 ARP 信息。

```
[SwitchA] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VPN instance: vpn1                             Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  78aa-8233-2201  0           GL
100.0.0.101     0010-9400-0001  78aa-8233-2201  0           DL
100.0.0.102     0010-9400-0002  741f-4aa1-2508  0           B
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VSI name: v1
 MAC address    : 0010-9400-0001
  Link ID/Name  : 0x0
  Flags         : DL
  Encap         : VXLAN
  Next hop      : -
  Color         : -

 MAC address    : 0010-9400-0002
  Link ID/Name  : Tunnel0
  Flags         : B
  Encap         : VXLAN
  Next hop      : 3.3.3.3
  Color         : -

 MAC address    : 0000-2017-0001
  Link ID/Name  : Tunnel0
  Flags         : BS
```

```
  Encap          : VXLAN
  Next hop       : 3.3.3.3
  Color          : -
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 1 (1 up, 0 down, 0 defect, 0 blocked)
Tunnel Name         Link ID        State       Type        Flood Proxy
Tunnel0             0x50000000     UP          Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
[SwitchA]dis arp suppression vsi
IP address      MAC address    VSI Name                   Link ID    Aging(min)
100.0.0.101     0010-9400-0001 v1                         0x0        24
100.0.0.102     0010-9400-0002 v1                         0x50000000 N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16383_16383
  VSI Index               : 16383
  VSI State               : Down
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16383
  VXLAN ID                : 16383

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
```

```
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name         Link ID        State       Type        Flood Proxy
    Tunnel0             0x50000000     UP          Auto        Disabled
  ACs:
    AC                                                  Link ID    State       Type
    HGE1/0/20 srv1                                      0x0        Up          Manual
    Statistics: Disabled
```

- H3C 设备（SwitchB）

验证 BGP L2VPN 对等体信息。

```
[SwitchB] display bgp peer l2vpn evpn

 BGP local router ID: 61.1.1.2
 Local AS number: 200
 Total number of peers: 2                Peers in established state: 2

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  1.1.1.1                200       27       41    0       2 00:14:58 Established
  2.2.2.2                100       20       18    0       3 00:08:48 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchB] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
2.2.2.2:10001         2.2.2.2         2.2.2.2         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchB] display ip routing-table vpn-instance vpn1

Destinations : 13       Routes : 13

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.0/24       Direct  0   0           100.0.0.1       Vsi1
100.0.0.0/32       Direct  0   0           100.0.0.1       Vsi1
100.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
100.0.0.101/32     BGP     255 0           2.2.2.2         Vsi16383
```

```
100.0.0.255/32     Direct  0   0           100.0.0.1       Vsi1
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
224.0.0.0/4        Direct  0   0           0.0.0.0         NULL0
224.0.0.0/24       Direct  0   0           0.0.0.0         NULL0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchB] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                           Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
100.0.0.101      2.2.2.2          Vsi-interface16383    0x18000000  -
[SwitchB]display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid

VPN instance: vpn1                            Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  741f-4aa1-2508  0           GL
100.0.0.101     0010-9400-0001  78aa-8233-2201  0           B
100.0.0.102     0010-9400-0002  741f-4aa1-2508  0           DL
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchB] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid

VSI name: v1
MAC address     Link ID/Name    Flags   Nexthop
0010-9400-0001  Tunnel0         B       2.2.2.2
0000-2017-0001  Tunnel1         BS      1.1.1.1
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchB] display vxlan tunnel
Total number of VXLANs: 2

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel name          Link ID    State    Type        Flood proxy
Tunnel0              0x5000000  UP       Auto        Disabled
Tunnel1              0x5000001  UP       Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchB] display arp suppression vsi
IP address      MAC address    Vsi Name                        Link ID    Aging
100.0.0.102     0010-9400-0002 v1                              0x0        16
```

```
100.0.0.101     0010-9400-0001 v1                                0x5000000  N/A
```

验证 VSI 信息。

```
[SwitchB] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16383_16383
  VSI Index               : 1
  VSI State               : Down
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16383
  VXLAN ID                : 16383

VSI Name: v1
  VSI Index               : 0
  VSI State               : Up
  MTU                     : 1500
  Bandwidth               : Unlimited
  Broadcast Restrain      : Unlimited
  Multicast Restrain      : Unlimited
  Unknown Unicast Restrain: Unlimited
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name          Link ID    State    Type        Flood proxy
    Tunnel0              0x5000000  UP       Auto        Disabled
    Tunnel1              0x5000001  UP       Auto        Disabled
  ACs:
    AC                               Link ID  State       Type
    HGE1/0/20 srv1                   0        Up          Manual
```

- 华为设备

验证 BGP EVPN 对等体信息。

```
[HUAWEI] display bgp evpn peer
 Status codes: * - Dynamic
 BGP local router ID        : 1.1.1.1
```

```
 Local AS number            : 200
 Total number of peers      : 2
 Peers in established state : 2
 Total number of dynamic peers : 0

  Peer                     V         AS  MsgRcvd  MsgSent  OutQ  Up/Down       State
PrefRcv
  2.2.2.2                  4        100       24       12     0 00:06:58 Established
3
  3.3.3.3                  4        200       38       25     0 00:13:17 Established
6
```

验证指定实例的 EVPN 信息。

```
[HUAWEI] display evpn vpn-instance name 1001
  EVPN-Instance Name              RD                   Address-family
  1001                            1.1.1.1:10001        evpn
```

验证指定实例的路由信息。

```
[HUAWEI] display ip routing-table vpn-instance vpn1
Proto: Protocol        Pre: Preference
Route Flags: R - relay, D - download to fib, T - to vpn-instance, B - black hole route
------------------------------------------------------------------------------
Routing Table : vpn1
         Destinations : 6        Routes : 6

Destination/Mask    Proto   Pre  Cost        Flags NextHop         Interface

      100.0.0.0/24  Direct  0    0             D   100.0.0.1       Vbdif1001
      100.0.0.1/32  Direct  0    0             D   127.0.0.1       Vbdif1001
    100.0.0.101/32  EBGP    255  0             RD  2.2.2.2         VXLAN
    100.0.0.102/32  IBGP    255  0             RD  3.3.3.3         VXLAN
    100.0.0.255/32  Direct  0    0             D   127.0.0.1       Vbdif1001
255.255.255.255/32  Direct  0    0             D   127.0.0.1       InLoopBack0
```

验证 VXLAN 隧道。

```
[HUAWEI] display vxlan tunnel
Number of vxlan tunnel : 2
Tunnel ID   Source                Destination           State  Type     Uptime
------------------------------------------------------------------------------
4026531845  1.1.1.1               3.3.3.3               up     dynamic  00:14:12
4026531846  1.1.1.1               2.2.2.2               up     dynamic  00:08:01
```

1.3 与锐捷设备对接操作指导

1.3.1 互通性分析

表3 EVPN/VXLAN 互通性分析

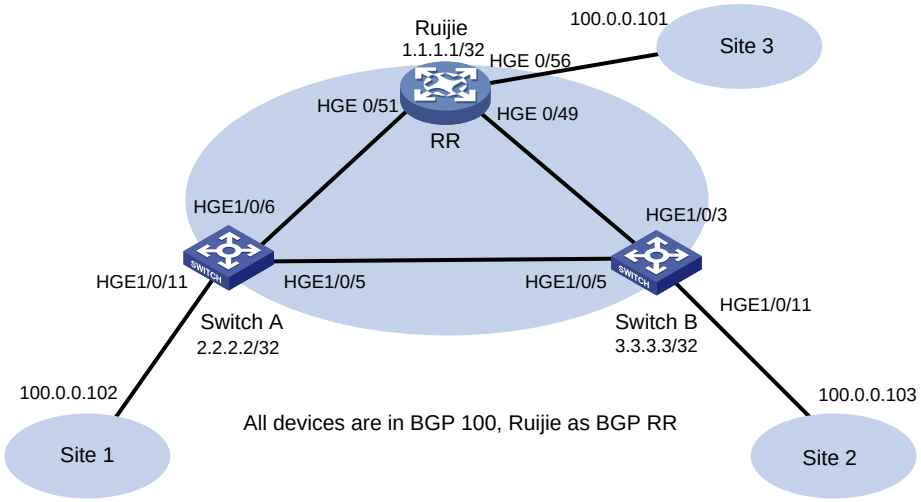
H3C	锐捷	互通结论
支持	支持	可以互通

1.3.2 采用 IBGP 模式对接案例

1. 组网需求

如图 5 所示，H3C SwitchA、SwitchB 为分布式 EVPN 网关设备，锐捷设备作为 RR，负责在交换机之间反射 BGP 路由。现要求相同 VXLAN 之间可以二层互通；不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图5 采用 IBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
[SwitchA] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchA] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchA] vxlan tunnel mac-learning disable
[SwitchA] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchA] ospf 1
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```

配置 underlay 网络。

```
[SwitchA]interface HundredGigE 1/0/6
```

```
[SwitchA-HundredGigE1/0/6] ip address 61.1.1.1 24
[SwitchA-HundredGigE1/0/6] ospf 1 area 0.0.0.0
[SwitchA-HundredGigE1/0/6] quit
[SwitchA]interface HundredGigE 1/0/6
[SwitchA-HundredGigE1/0/5] ip address 51.1.1.1 24
[SwitchA-HundredGigE1/0/5] ospf 1 area 0
[SwitchA-HundredGigE1/0/5] quit
```

创建 VLAN1001。

```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```

在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```

创建 VXLAN10001。

```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```

配置 BGP 发布 EVPN 路由。

```
[SwitchA] bgp 100
[SwitchA-bgp-default] peer 1.1.1.1 as-number 100
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/11 上创建以太网服务实例 1，该实例用来匹配 VLAN1001 的数据帧。

```
[SwitchA] interface HundredGigE 1/0/11
[SwitchA-HundredGigE1/0/11] service-instance 1
[SwitchA-HundredGigE1/0/11-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-HundredGigE1/0/11-srv1000] xconnect vsi v1
[SwitchA-HundredGigE1/0/11-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 24
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchA] interface vsi-interface 16383
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16383
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备(SwitchB)

开启 L2VPN 能力。

```
<SwitchB> system-view
[SwitchB] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchB] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
```

配置 underlay 网络。

```
[SwitchB] interface HundredGigE 1/0/3
[SwitchB-HundredGigE1/0/3] ip address 110.0.0.1 24
[SwitchB-HundredGigE1/0/3] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/3] quit
[SwitchB] interface HundredGigE 1/0/5
[SwitchB-HundredGigE1/0/5] ip address 51.1.1.2 24
[SwitchB-HundredGigE1/0/5] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/5] quit
```

创建 VLAN1001。

```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```
在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。
```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```
创建 VXLAN10001。
```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```
配置 BGP 发布 EVPN 路由。
```
[SwitchB] bgp 100
[SwitchB-bgp-default] peer 1.1.1.1 as-number 100
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] quit
[SwitchB-bgp-default] quit
```
在接入服务器的接口 HundredGigE1/0/11 上创建以太网服务实例 1，该实例用来匹配 VLAN1001 的数据帧。
```
[SwitchB]interface HundredGigE 1/0/11
[SwitchB-HundredGigE1/0/11] service-instance 1
[SwitchB-HundredGigE1/0/11-srv1000] encapsulation s-vid 1001
```
配置以太网服务实例 1 与 VSI 实例 v1 关联。
```
[SwitchB-HundredGigE1/0/11-srv1000] xconnect vsi v1
[SwitchB-HundredGigE1/0/11-srv1000] quit
```
配置 L3VNI 的 RD 和 RT。
```
[SwitchB] ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```
配置 VSI 虚接口 VSI-interface1。
```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 24
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```
创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchB] interface vsi-interface 16383
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16383
[SwitchB-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchB]vsi v1
[SwitchB-vsi-v1]gateway vsi-interface 1
[SwitchB-vsi-v1]quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie> show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

配置 VXLAN 的硬件资源模式。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#switch-mode vxlan slot 0
```

网关 MAC。

```
Ruijie(config)#fabric anycast-gateway-mac 0000.2017.0001
```

配置 OSPF。

```
Ruijie(config)#route ospf 1
Ruijie(config-router)#area 0
Ruijie(config-router)#router-id 1.1.1.1
Ruijie(config-router)#exit
```

创建 LoopBack 口。

```
Ruijie(config)#interface loopback 0
Ruijie(config-if-Loopback 0)#ip address 1.1.1.1 32
Ruijie(config-if-Loopback 0)#ip ospf 1 area 0
Ruijie(config-if-Loopback 0)#exit
```

配置 underlay 网络。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 110.0.0.2 24
```

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip ospf 1 area 0
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
Ruijie(config)#interface hundredGigabitEthernet 0/51
Ruijie(config-if-HundredGigabitEthernet 0/51)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/51)#ip address 61.1.1.2 24
Ruijie(config-if-HundredGigabitEthernet 0/51)#ip ospf 1 area 0
Ruijie(config-if-HundredGigabitEthernet 0/51)#exit
```

配置 vtep。

```
Ruijie(config)#vtep
Ruijie(config-vtep)#source loopback 0
Ruijie(config-vtep)#arp suppress enable
Ruijie(config-vtep)#exit
```

创建 VRF。

```
Ruijie(config)#ip vrf vpn1
Ruijie(config-vrf)#rd 1.1.1.1:10001
Ruijie(config-vrf)#route-target both 65001:10001
Ruijie(config-vrf)#exit
```

创建 overlayrouter 接口。

```
Ruijie(config)#interface overlayrouter 1
Ruijie(config-if-OverlayRouter 1)#ip vrf forwarding vpn1
Ruijie(config-if-OverlayRouter 1)#ip address 100.0.0.1 24
Ruijie(config-if-OverlayRouter 1)#anycast-gateway
Ruijie(config-if-OverlayRouter 1)#route-in-vni
Ruijie(config-if-OverlayRouter 1)#exit
```

创建 VXLAN10001。

```
Ruijie(config)#vxlan 10001
Ruijie(config-vxlan)#extend-vlan 1001
Ruijie(config-vxlan)#router-interface overlayRouter 1
Ruijie(config-vxlan)#arp suppress enable
Ruijie(config-vxlan)#exit
```

配置 BGP 发布 EVPN 路由。

```
Ruijie(config)#route bgp 100
Ruijie(config-router)#neighbor 2.2.2.2 remote-as 100
Ruijie(config-router)#neighbor 2.2.2.2 update-source Loopback 0
Ruijie(config-router)#neighbor 3.3.3.3 remote-as 100
Ruijie(config-router)#neighbor 3.3.3.3 update-source Loopback 0
Ruijie(config-router)#address-family l2vpn evpn
Ruijie(config-router-af)#neighbor 2.2.2.2 activate
Ruijie(config-router-af)#neighbor 2.2.2.2 route-reflector-client
Ruijie(config-router-af)#neighbor 3.3.3.3 activate
Ruijie(config-router-af)#neighbor 3.3.3.3 route-reflector-client
Ruijie(config-router-af)#exit
Ruijie(config-router)#exit
```

配置 EVPN。

```
Ruijie(config)#evpn
Ruijie(config-evpn)#vni 10001
Ruijie(config-evpn-vni)#rd 1.1.1.1:10001
```

```
Ruijie(config-evpn-vni)#route-target both 65001:10001
Ruijie(config-evpn-vni)#exit
```

3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体信息。

```
[SwitchA] display bgp peer l2vpn evpn

 BGP local router ID: 2.2.2.2
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 1.1.1.1                100      116      109    0        8 01:30:19 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
3.3.3.3:10001         3.3.3.3         3.3.3.3         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchA] display ip routing-table vpn-instance vpn1

Destinations : 7        Routes : 7

Destination/Mask   Proto   Pre Cost        NextHop         Interface
0.0.0.0/32         Direct  0   0           127.0.0.1       InLoop0
100.0.0.103/32     BGP     255 0           3.3.3.3         Vsi16383
127.0.0.0/8        Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32       Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32       Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
255.255.255.255/32 Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchA] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                          Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
100.0.0.103      3.3.3.3          Vsi-interface16383    0x18000000  -
```

验证 EVPN 的 ARP 信息。

```
[SwitchA] display evpn route arp
```

```
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VPN instance: vpna                            Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  -               3           BGI
100.0.0.101     0010-9400-000e  -               3           B
100.0.0.102     0010-9400-000f  743a-2021-ae01  3           DL
100.0.0.103     0010-9400-000d  0000-fc00-0243  3           B
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VSI name: v1
 MAC address    : 0010-9400-000f
  Link ID/Name  : 0x0
  Flags         : DL
  Encap         : VXLAN
  Next hop      : -
  Color         : -

 MAC address    : 0010-9400-000e
  Link ID/Name  : Tunnel1
  Flags         : B
  Encap         : VXLAN
  Next hop      : 1.1.1.1
  Color         : -

 MAC address    : 0000-2017-0001
  Link ID/Name  : -
  Flags         : BGI
  Encap         : VXLAN
  Next hop      : 1.1.1.1
  Color         : -

 MAC address    : 0010-9400-000d
  Link ID/Name  : Tunnel0
  Flags         : B
  Encap         : VXLAN
  Next hop      : 3.3.3.3
  Color         : -
```

验证与 VXLAN 关联的 VXLAN 隧道信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 4
```

```
VXLAN ID: 10, VSI name: vpna

VXLAN ID: 1000, VSI name: Auto_L3VNI1000_1000

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel Name         Link ID        State       Type        Flood Proxy
Tunnel0             0x50000000     UP          Auto        Disabled
Tunnel1             0x50000001     UP          Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchA] display arp suppression vsi
IP address      MAC address    VSI Name                    Link ID    Aging(min)
100.0.0.1       0000-2017-0001 v1                          0x50000001 N/A
100.0.0.102     0010-9400-000f v1                          0x0        20
100.0.0.103     0010-9400-000d v1                          0x50000000 N/A
100.0.0.101     0010-9400-000e v1                          0x50000001 N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI1000_1000
  VSI Index               : 16383
  VSI State               : Down
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1000
  VXLAN ID                : 1000

VSI Name: v1
  VSI Index               : 3
  VSI State               : Up
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
```

```
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name         Link ID        State       Type        Flood Proxy
    Tunnel0             0x50000000     UP          Auto        Disabled
    Tunnel1             0x50000001     UP          Auto        Disabled
  ACs:
    AC                                                  Link ID    State       Type
    HGE1/0/11 srv1                                      0x0        Up          Manual
```

- 锐捷设备

验证 VXLAN 信息。

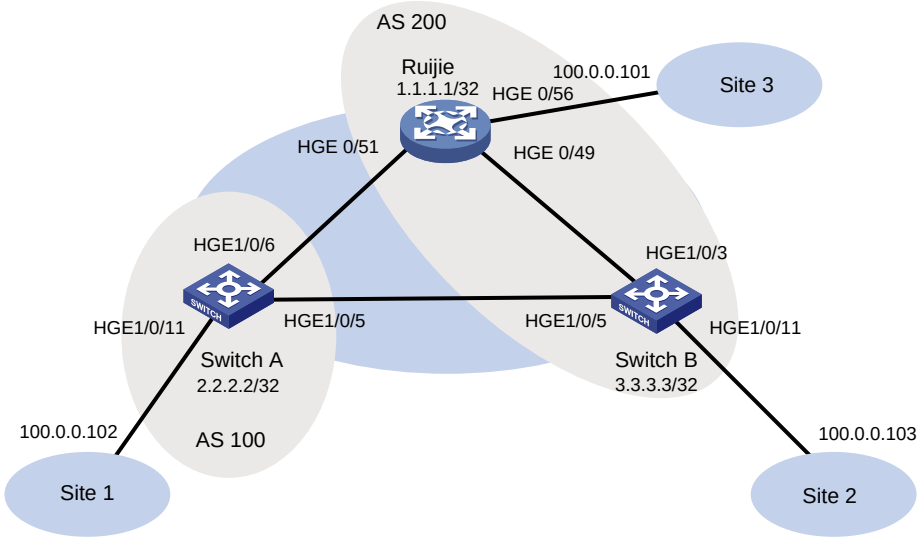
```
Ruijie(config)#show vxlan
VXLAN Total Count: 1
VXLAN Capacity   : 4000

VXLAN 10001
    Symmetric property  : FALSE
    Router Interface    : overlayrouter 1 (anycast)
    Extend VLAN         : 1001
    VTEP Adjacency Count: 2
    VTEP Adjacency List :
    Interface              Source IP       Destination IP  Type
    ---------------------- --------------- --------------- -------
    OverlayTunnel 6145     1.1.1.1         3.3.3.3         dynamic
    OverlayTunnel 6147     1.1.1.1         2.2.2.2         dynamic
```

1.3.3 采用 EBGP 模式对接案例

1. 组网需求

如图 6 所示，H3C Switch A、H3C Switch B 和锐捷设备均为分布式 EVPN 网关。现要求相同 VXLAN 之间可以二层互通，不同 VXLAN 之间通过分布式 EVPN 网关实现三层互通。

图6 采用 EBGP 模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备（SwitchA）

开启 L2VPN 能力。

```
<SwitchA> system-view
[SwitchA] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchA] hardware-resource vxlan border40k
```

关闭远端 MAC 地址和远端 ARP 自动学习功能。

```
[SwitchA] vxlan tunnel mac-learning disable
[SwitchA] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchA] ospf 1
[SwitchA-ospf-1] area 0
[SwitchA-ospf-1-area-0.0.0.0] quit
[SwitchA-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchA] interface LoopBack 0
[SwitchA-LoopBack0] ip address 2.2.2.2 32
[SwitchA-LoopBack0] ospf 1 area 0
[SwitchA-LoopBack0] quit
```

配置 underlay 网络。

```
[SwitchA] interface HundredGigE 1/0/6
[SwitchA-HundredGigE1/0/6] ip address 61.1.1.1 24
[SwitchA-HundredGigE1/0/6] ospf 1 area 0.0.0.0
[SwitchA-HundredGigE1/0/6] quit
[SwitchA]interface HundredGigE 0/0/5
[SwitchA-HundredGigE1/0/5] ip address 51.1.1.1 24
[SwitchA-HundredGigE1/0/5] ospf 1 area 0
[SwitchA-HundredGigE1/0/5] quit
```

创建 VLAN1001

```
[SwitchA] vlan 1001
[SwitchA-vlan1001] quit
```

在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] arp suppression enable
[SwitchA-vsi-v1] flooding disable all
[SwitchA-vsi-v1] evpn encapsulation vxlan
[SwitchA-vsi-v1-evpn-vxlan] route-distinguisher 2.2.2.2:10001
[SwitchA-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchA-vsi-v1-evpn-vxlan] quit
```

创建 VXLAN10001。

```
[SwitchA-vsi-v1] vxlan 10001
[SwitchA-vsi-v1-vxlan-10001] quit
[SwitchA-vsi-v1] quit
```

配置 BGP 发布 EVPN 路由。

```
[SwitchA] bgp 100
[SwitchA-bgp-default] peer 1.1.1.1 as-number 200
[SwitchA-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchA-bgp-default] peer 1.1.1.1 ebgp-max-hop 10
[SwitchA-bgp-default] peer 3.3.3.3 as-number 200
[SwitchA-bgp-default] peer 3.3.3.3 connect-interface loopback 0
[SwitchA-bgp-default] peer 3.3.3.3 ebgp-max-hop 10
[SwitchA-bgp-default] address-family l2vpn evpn
[SwitchA-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchA-bgp-default-evpn] peer 3.3.3.3 enable
[SwitchA-bgp-default-evpn] quit
[SwitchA-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/11 上创建以太网服务实例 1，该实例用来匹配 VLAN1001 的数据帧。

```
[SwitchA] interface HundredGigE 1/0/11
[SwitchA-HundredGigE1/0/11] service-instance 1
[SwitchA-HundredGigE1/0/11-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchA-HundredGigE1/0/11-srv1000] xconnect vsi v1
[SwitchA-HundredGigE1/0/11-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchA] ip vpn-instance vpn1
[SwitchA-vpn-instance-vpn1] route-distinguisher 2.2.2.2:10001
[SwitchA-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchA-vpn-instance-vpn1] address-family evpn
[SwitchA-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchA-vpn-evpn-vpn1] quit
[SwitchA-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchA] interface vsi-interface 1
```

```
[SwitchA-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface1] ip address 100.0.0.1 24
[SwitchA-Vsi-interface1] mac-address 0000-2017-0001
[SwitchA-Vsi-interface1] distributed-gateway local
[SwitchA-Vsi-interface1] quit
[SwitchA]
```

创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchA]interface vsi-interface 16383
[SwitchA-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchA-Vsi-interface3] l3-vni 16383
[SwitchA-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchA] vsi v1
[SwitchA-vsi-v1] gateway vsi-interface 1
[SwitchA-vsi-v1] quit
```

- 配置 H3C 设备（SwitchB）

开启 L2VPN 能力。

```
<SwitchB> system-view
[SwitchB] l2vpn enable
```

配置 VXLAN 的硬件资源模式。

```
[SwitchB] hardware-resource vxlan border40k
# 关闭远端 MAC 地址和远端 ARP 自动学习功能。
[SwitchB] vxlan tunnel mac-learning disable
[SwitchB] vxlan tunnel arp-learning disable
```

配置 OSPF。

```
[SwitchB] ospf 1
[SwitchB-ospf-1] area 0
[SwitchB-ospf-1-area-0.0.0.0] quit
[SwitchB-ospf-1] quit
```

创建 LoopBack 口。

```
[SwitchB] interface LoopBack 0
[SwitchB-LoopBack0] ip address 3.3.3.3 32
[SwitchB-LoopBack0] ospf 1 area 0
[SwitchB-LoopBack0] quit
```

配置 underlay 网络。

```
[SwitchB] interface HundredGigE 1/0/3
[SwitchB-HundredGigE1/0/3] ip address 110.0.0.1 24
[SwitchB-HundredGigE1/0/3] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/3] quit
[SwitchB]interface HundredGigE 1/0/5
[SwitchB-HundredGigE1/0/5] ip address 51.1.1.2 24
[SwitchB-HundredGigE1/0/5] ospf 1 area 0.0.0.0
[SwitchB-HundredGigE1/0/5] quit
```

创建 VLAN1001。

```
[SwitchB] vlan 1001
[SwitchB-vlan1001] quit
```

在 VSI 实例 v1 下创建 EVPN 实例，并配置 EVPN 实例的 RD 和 RT。

```
[SwitchB] vsi v1
[SwitchB-vsi-v1] arp suppression enable
[SwitchB-vsi-v1] flooding disable all
[SwitchB-vsi-v1] evpn encapsulation vxlan
[SwitchB-vsi-v1-evpn-vxlan] route-distinguisher 3.3.3.3:10001
[SwitchB-vsi-v1-evpn-vxlan] vpn-target 65001:10001
[SwitchB-vsi-v1-evpn-vxlan] quit
```

创建 VXLAN10001。

```
[SwitchB-vsi-v1] vxlan 10001
[SwitchB-vsi-v1-vxlan-10001] quit
[SwitchB-vsi-v1] quit
```

配置 BGP 发布 EVPN 路由。

```
[SwitchB] bgp 200
[SwitchB-bgp-default] peer 1.1.1.1 as-number 200
[SwitchB-bgp-default] peer 1.1.1.1 connect-interface loopback 0
[SwitchB-bgp-default] peer 2.2.2.2 connect-interface LoopBack0
[SwitchB-bgp-default] peer 2.2.2.2 ebgp-max-hop 10
[SwitchB-bgp-default] address-family l2vpn evpn
[SwitchB-bgp-default-evpn] peer 1.1.1.1 enable
[SwitchB-bgp-default-evpn] peer 2.2.2.2 enable
[SwitchB-bgp-default-evpn] quit
[SwitchB-bgp-default] quit
```

在接入服务器的接口 HundredGigE1/0/11 上创建以太网服务实例 1，该实例用来匹配 VLAN 1001 的数据帧。

```
[SwitchB]interface HundredGigE 1/0/11
[SwitchB-HundredGigE1/0/11] service-instance 1
[SwitchB-HundredGigE1/0/11-srv1000] encapsulation s-vid 1001
```

配置以太网服务实例 1 与 VSI 实例 v1 关联。

```
[SwitchB-HundredGigE1/0/11-srv1000] xconnect vsi v1
[SwitchB-HundredGigE1/0/11-srv1000] quit
```

配置 L3VNI 的 RD 和 RT。

```
[SwitchB]ip vpn-instance vpn1
[SwitchB-vpn-instance-vpn1] route-distinguisher 3.3.3.3:10001
[SwitchB-vpn-instance-vpn1] vpn-target 65001:10001
[SwitchB-vpn-instance-vpn1] address-family evpn
[SwitchB-vpn-evpn-vpn1] vpn-target 65001:10001
[SwitchB-vpn-evpn-vpn1] quit
[SwitchB-vpn-instance-vpn1] quit
```

配置 VSI 虚接口 VSI-interface1。

```
[SwitchB] interface vsi-interface 1
[SwitchB-Vsi-interface1] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface1] ip address 100.0.0.1 24
[SwitchB-Vsi-interface1] mac-address 0000-2017-0001
[SwitchB-Vsi-interface1] distributed-gateway local
[SwitchB-Vsi-interface1] quit
```

创建 VSI 虚接口 VSI-interface16383，在该接口上配置 VPN 实例 vpn1 对应的 L3VNI 为 16383。

```
[SwitchB] interface vsi-interface 16383
[SwitchB-Vsi-interface3] ip binding vpn-instance vpn1
[SwitchB-Vsi-interface3] l3-vni 16383
[SwitchB-Vsi-interface3] quit
```

配置 VXLAN 10 所在的 VSI 实例和接口 VSI-interface1 关联。

```
[SwitchB] vsi v1
[SwitchB-vsi-v1] gateway vsi-interface 1
[SwitchB-vsi-v1] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie> show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

配置 VXLAN 的硬件资源模式。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#switch-mode vxlan slot 0
```

配置网关 MAC。

```
Ruijie(config)#fabric anycast-gateway-mac 0000.2017.0001
```

配置 OSPF。

```
Ruijie(config)#route ospf 1
Ruijie(config-router)#area 0
Ruijie(config-router)#router-id 1.1.1.1
Ruijie(config-router)#exit
```

创建 LoopBack 口。

```
Ruijie(config)#interface loopback 0
Ruijie(config-if-Loopback 0)#ip address 1.1.1.1 32
Ruijie(config-if-Loopback 0)#ip ospf 1 area 0
Ruijie(config-if-Loopback 0)#exit
```

配置 underlay 网络。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
```

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 110.0.0.2 24
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip ospf 1 area 0
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
Ruijie(config)#interface hundredGigabitEthernet 0/51
Ruijie(config-if-HundredGigabitEthernet 0/51)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/51)#ip address 61.1.1.2 24
Ruijie(config-if-HundredGigabitEthernet 0/51)#ip ospf 1 area 0
Ruijie(config-if-HundredGigabitEthernet 0/51)#exit
```

配置 vtep。

```
Ruijie(config)#vtep
Ruijie(config-vtep)#source loopback 0
Ruijie(config-vtep)#arp suppress enable
Ruijie(config-vtep)#exit
```

创建 VRF。

```
Ruijie(config)#ip vrf vpn1
Ruijie(config-vrf)#rd 1.1.1.1:10001
Ruijie(config-vrf)#route-target both 65001:10001
Ruijie(config-vrf)#exit
```

创建 overlayrouter 接口。

```
Ruijie(config)#interface overlayrouter 1
Ruijie(config-if-OverlayRouter 1)#ip vrf forwarding vpn1
Ruijie(config-if-OverlayRouter 1)#ip address 100.0.0.1 24
Ruijie(config-if-OverlayRouter 1)#anycast-gateway
Ruijie(config-if-OverlayRouter 1)#route-in-vni
Ruijie(config-if-OverlayRouter 1)#exit
```

创建 VXLAN10001。

```
Ruijie(config)#vxlan 10001
Ruijie(config-vxlan)#extend-vlan 1001
Ruijie(config-vxlan)#router-interface overlayRouter 1
Ruijie(config-vxlan)#arp suppress enable
Ruijie(config-vxlan)#exit
```

配置 BGP 发布 EVPN 路由。

```
Ruijie(config)#route bgp 200
Ruijie(config-router)#neighbor 2.2.2.2 remote-as 100
Ruijie(config-router)#neighbor 2.2.2.2 ebgp-multihop 10
Ruijie(config-router)#neighbor 2.2.2.2 update-source Loopback 0
Ruijie(config-router)#neighbor 3.3.3.3 remote-as 200
Ruijie(config-router)#neighbor 3.3.3.3 update-source Loopback 0
Ruijie(config-router)#address-family l2vpn evpn
Ruijie(config-router-af)#neighbor 2.2.2.2 activate
Ruijie(config-router-af)#neighbor 3.3.3.3 activate
Ruijie(config-router-af)#exit
Ruijie(config-router)#exit
```

配置 EVPN。

```
Ruijie(config)#evpn
Ruijie(config-evpn)#vni 10001
Ruijie(config-evpn-vni)#rd 1.1.1.1:10001
```

```
Ruijie(config-evpn-vni)#route-target both 65001:10001
Ruijie(config-evpn-vni)#exit
```

3. 验证配置

- H3C 设备（SwitchA）

验证 BGP L2VPN 对等体信息。

```
[SwitchA] display bgp peer l2vpn evpn

 BGP local router ID: 2.2.2.2
 Local AS number: 100
 Total number of peers: 2                Peers in established state: 2

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 1.1.1.1                200       31       42    0        6 00:18:08 Established
 3.3.3.3                200       34       39    0        6 00:18:05 Established
```

验证通过包含性组播以太网标签路由（Inclusive multicast Ethernet tag route）发现的 IPv4 邻居信息。

```
[SwitchA] display evpn auto-discovery imet
Total number of automatically discovered peers: 2

VSI name: v1
RD                    PE_address      Tunnel_address  Tunnel mode VXLAN ID
1.1.1.1:10001         1.1.1.1         1.1.1.1         VXLAN       10001
3.3.3.3:10001         3.3.3.3         3.3.3.3         VXLAN       10001
```

验证 VPN1 的路由表信息。

```
[SwitchA] display ip routing-table vpn-instance vpn1

Destinations : 7        Routes : 7

Destination/Mask    Proto   Pre Cost        NextHop         Interface
0.0.0.0/32          Direct  0   0           127.0.0.1       InLoop0
100.0.0.103/32      BGP     255 0           3.3.3.3         Vsi16383
127.0.0.0/8         Direct  0   0           127.0.0.1       InLoop0
127.0.0.0/32        Direct  0   0           127.0.0.1       InLoop0
127.0.0.1/32        Direct  0   0           127.0.0.1       InLoop0
127.255.255.255/32  Direct  0   0           127.0.0.1       InLoop0
255.255.255.255/32  Direct  0   0           127.0.0.1       InLoop0
```

验证 VPN 实例对应 EVPN 的路由表信息。

```
[SwitchA] display evpn routing-table vpn-instance vpn1
Flags: E - with valid ESI   A - AD ready   L - Local ES exists

VPN instance:vpn1                           Local L3VNI:16383
IP address       Nexthop          Outgoing interface    NibID       Flags
100.0.0.103      3.3.3.3          Vsi-interface16383    0x18000000  -
```

验证 EVPN 的 ARP 信息。

```
[SwitchA] display evpn route arp
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VPN instance: vpna                            Interface: Vsi-interface1
IP address      MAC address     Router MAC      VSI index   Flags
100.0.0.1       0000-2017-0001  -               3           BGI
100.0.0.101     0010-9400-000e  -               3           B
100.0.0.102     0010-9400-000f  743a-2021-ae01  3           DL
100.0.0.103     0010-9400-000d  0000-fc00-0243  3           B
```

验证 IPv4 EVPN 的 MAC 地址信息。

```
[SwitchA] display evpn route mac
Flags: D - Dynamic   B - BGP      L - Local active
       G - Gateway   S - Static   M - Mapping        I - Invalid
       E - Multihoming ES sync    F - Leaf

VSI name: v1
 MAC address    : 0010-9400-000f
  Link ID/Name  : 0x0
  Flags         : DL
  Encap         : VXLAN
  Next hop      : -
  Color         : -

 MAC address    : 0010-9400-000e
  Link ID/Name  : Tunnel1
  Flags         : B
  Encap         : VXLAN
  Next hop      : 1.1.1.1
  Color         : -

 MAC address    : 0000-2017-0001
  Link ID/Name  : -
  Flags         : BGI
  Encap         : VXLAN
  Next hop      : 1.1.1.1
  Color         : -

 MAC address    : 0010-9400-000d
  Link ID/Name  : Tunnel0
  Flags         : B
  Encap         : VXLAN
  Next hop      : 3.3.3.3
  Color         : -
```

验证 VXLAN 隧道信息。

```
[SwitchA] display vxlan tunnel
Total number of VXLANs: 4
```

```
VXLAN ID: 10, VSI name: vpna

VXLAN ID: 1000, VSI name: Auto_L3VNI1000_1000

VXLAN ID: 10001, VSI name: v1, Total tunnels: 2 (2 up, 0 down, 0 defect, 0 blocked)
Tunnel Name         Link ID        State       Type        Flood Proxy
Tunnel0             0x50000000     UP          Auto        Disabled
Tunnel1             0x50000001     UP          Auto        Disabled

VXLAN ID: 16383, VSI name: Auto_L3VNI16383_16383
```

验证 VSI 的 ARP 泛洪抑制表项信息。

```
[SwitchA] display arp suppression vsi
IP address      MAC address    VSI Name                   Link ID    Aging(min)
100.0.0.102     0010-9400-000f v1                         0x0        24
100.0.0.1       0000-2017-0001 v1                         0x50000001 N/A
100.0.0.101     0010-9400-000e v1                         0x50000001 N/A
100.0.0.103     0010-9400-000d v1                         0x50000000 N/A
```

验证 VSI 信息。

```
[SwitchA] display l2vpn vsi verbose
VSI Name: Auto_L3VNI16383_16383
  VSI Index               : 16382
  VSI State               : Down
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Enabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 16383
  VXLAN ID                : 16383

VSI Name: v1
  VSI Index               : 3
  VSI State               : Up
  MTU                     : 1500
  Diffserv Mode           : -
  Bandwidth               : Unlimited
  Broadcast Restrain      : 4294967295 kbps
  Multicast Restrain      : 4294967295 kbps
  Unknown Unicast Restrain: 4294967295 kbps
```

```
  MAC Learning            : Enabled
  MAC Table Limit         : -
  MAC Learning rate       : -
  Drop Unknown            : -
  PW Redundancy Mode      : Slave
  Flooding                : Disabled
  Statistics              : Disabled
  Gateway Interface       : VSI-interface 1
  VXLAN ID                : 10001
  Tunnels:
    Tunnel Name         Link ID        State       Type        Flood Proxy
    Tunnel0             0x50000000     UP          Auto        Disabled
    Tunnel1             0x50000001     UP          Auto        Disabled
  ACs:
    AC                                                  Link ID    State       Type
    HGE1/0/11 srv1                                      0x0        Up          Manual
    Statistics: Disabled
```

- 锐捷设备

验证 VXLAN 信息。

```
Ruijie(config)#show vxlan
VXLAN Total Count: 1
VXLAN Capacity   : 4000

VXLAN 10001
    Symmetric property  : FALSE
    Router Interface    : overlayrouter 1 (anycast)
    Extend VLAN         : 1001
    VTEP Adjacency Count: 2
    VTEP Adjacency List :
    Interface              Source IP       Destination IP  Type
    ---------------------- --------------- --------------- -------
    OverlayTunnel 6145     1.1.1.1         2.2.2.2         dynamic
    OverlayTunnel 6147     1.1.1.1         16.1.105.99     dynamic
```

2 MSTP/PVST 对接操作指导

2.1 与思科设备对接操作指导

2.1.1 互通性分析

H3C 支持的 STP/RSTP/MSTP 均是 IEEE 标准组织制定的标准协议。Cisco 支持的生成树协议中，MSTP 为标准协议，Rapid-Pvst 为 Cisco 私有协议。

如表 4 所示，H3C 和 Cisco 生成树协议的互通性情况如下：

- H3C 的 MSTP 与 Cisco 的 MSTP 可以完全互通

为了实现互通，在保证相连的 H3C 交换机域配置和 Cisco 交换机域配置完全一致的前提下，还需要在 H3C 设备上通过 stp config-digest-snooping 命令，在每一个和 Cisco 交换机相连的端口上开启摘要侦听功能功能。

另外，H3C 设备的 Comware V5 MSTP 默认 BPDU 封装格式为 legacy，Comware V7 MSTP 默认 BPDU 封装格式为 802.1s。在 Cisco 设备上需要通过 spanning-tree mst pre-standard（legacy）或 no spanning-tree mst pre-standard（802.1s）命令，将 MSTP BPDU 封装格式修改为 legacy 或 802.1s，使得 H3C 设备和 Cisco 设备的 MSTP BPDU 封装格式一致。

- H3C 的 MSTP 与 Cisco 的 Rapid-Pvst 可以在一定程度上完成互通

  如果 H3C 设备采用 Access 端口对接，H3C 设备会将 Cisco 设备当作一个支持 IEEE802.1D 的设备，正常进行生成树计算。如果 H3C 设备采用 Trunk 接口对接，标准的 STP 设备可以与 Rapid-Pvst 设备的 VLAN 1 互通；但在其他 VLAN 上，标准 STP 设备无法识别 Rapid-Pvst 报文，要求物理环路必须在标准 STP 设备上来阻断，也就是说 Blocking 端口必须在标准 STP 设备（H3C）上而不是 Rapid-Pvst 设备（Cisco）上，否则就可能导致 VLAN 1 以外的其他 VLAN 出现广播风暴。

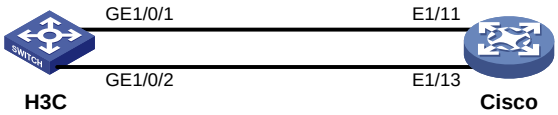
表4 MSTP/PVST 互通性分析

H3C	Cisco	互通结论
STP模式	MSTP模式（Legacy和802.1s封装）	在实例0中可以互通
STP模式	Rapid-Pvst模式	在Cisco设备上不取消VLAN 1的Rapid-Pvst功能的情况下，可以互通
RSTP模式	MSTP模式（Legacy和802.1s封装）	在实例0中可以互通
RSTP模式	Rapid-Pvst模式	在Cisco设备上不取消VLAN 1的Rapid-Pvst功能的情况下，可以互通
MSTP模式	MSTP模式（Legacy和802.1s封装）	在H3C设备配置stp config-digest-snooping命令的情况下，可以互通
MSTP模式	Rapid-Pvst模式	在Cisco设备上不取消VLAN 1的Rapid-Pvst功能的情况下，可以互通

2.1.2 组网需求

如图 7 所示，H3C 设备与 Cisco 设备通过两条链路相互连接。现要求在 H3C 设备和 Cisco 设备上分别配置 MSTP，实现 MSTP 互通。

图7 MSTP 对接配置组网图



2.1.3 配置步骤

- 配置 H3C 设备

创建 VLAN 接口 2，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] vlan 2
[H3C-vlan2] quit
[H3C] interface Vlan-interface 2
[H3C-Vlan-interface2] ip address 16.1.11.55 255.255.255.0
[H3C-Vlan-interface2]quit
```

在端口 GigabitEthernet1/0/1 上开启摘要侦听功能。

```
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] stp config-digest-snooping
```

配置端口 GigabitEthernet1/0/1 为 Trunk 端口，允许 VLAN2 通过。

```
[H3C-GigabitEthernet1/0/1] port link-type trunk
[H3C-GigabitEthernet1/0/1] port trunk permit vlan 2
[H3C-GigabitEthernet1/0/1] quit
```

在端口 GigabitEthernet1/0/2 上开启摘要侦听功能。

```
[H3C] interface gigabitethernet 1/0/2
[H3C-GigabitEthernet1/0/2] stp config-digest-snooping
```

配置端口 GigabitEthernet1/0/2 为 Trunk 端口，允许 VLAN2 通过。

```
[H3C-GigabitEthernet1/0/2] port link-type trunk
[H3C-GigabitEthernet1/0/2] port trunk permit vlan 2
[H3C-GigabitEthernet1/0/2] quit
```

全局开启摘要侦听功能。

```
[H3C] stp global config-digest-snooping
```

全局开启生成树协议。

```
[H3C] stp global enable
```

说明

为保证 H3C 交换机的路径开销计算标准与第三方交换机一致，需要确认第三方交换机的开销计算标准，然后在 H3C 交换机上进行相应的修改。

当 Cisco 设备采用缺省路径开销计算标准，H3C 交换机需要配置按照 IEEE 802.1D-1998 标准来计算缺省路径开销。

```
[H3C] stp pathcost-standard dot1d-1998
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
```

```
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

进入 VLAN2 的配置模式，并配置 IP 地址。

```
Cisco# configure terminal
Cisco(config)# interface vlan 2
Cisco(config-if)#ip address 16.1.11.56 255.255.255.0
Cisco(config-if)#exit
```

配置接口 Ethernet1/11 为 Trunk 口，并指定为 VLAN2 的成员端口。

```
Cisco(config)# interface Ethernet 1/11
Cisco(config-if)# switchport mode trunk
Cisco(config-if)# switchport access vlan 2
Cisco(config-if)# switchport trunk allowed vlan 2
Cisco(config-if)# exit
```

配置接口 Ethernet1/13 为 Trunk 口，并指定为 VLAN2 的成员端口。

```
Cisco(config-if)# interface Ethernet 1/13
Cisco(config-if)# switchport mode trunk
Cisco(config-if)# switchport access vlan 2
Cisco(config-if)# switchport trunk allowed vlan 2
Cisco(config-if)# end
```

2.1.4 验证配置

在 H3C 设备上验证生成树状态和统计的简要信息。

```
[H3C] display stp brief
 MST ID   Port                    Role   TP State   Protection
 0        GigabitEthernet1/0/1    DESI   FORWARDING  NONE
 0        GigabitEthernet1/0/2    DESI   FORWARDING  NONE
```

在 H3C 设备上验证在 MSTP 模式下，显示 MSTI0 在端口 GigabitEthernet1/0/2 上生成树状态和统计的信息。

```
[H3C] display stp instance 0 interface gigabitethernet 1/0/2
-------[CIST Global Info][Mode MSTP]-------
 Bridge ID           : 32768.1cab-3496-09f6
 Bridge times        : Hello 2s MaxAge 20s FwdDelay 15s MaxHops 20
 Root ID/ERPC        : 32768.1cab-3496-09f6, 0
 RegRoot ID/IRPC     : 32768.1cab-3496-09f6, 0
 RootPort ID         : 0.0
 BPDU-Protection     : Disabled
 Bridge Config-
 Digest-Snooping     : Enabled
 TC or TCN received  : 2
 Time since last TC  : 0 days 0h:34m:14s

----[Port391(GigabitEthernet1/0/2)][FORWARDING]----
 Port protocol       : Enabled
 Port role           : Designated Port
 Port ID             : 128.391
 Port cost(Legacy)   : Config=auto, Active=1
 Desg.bridge/port    : 32768.1cab-3496-09f6, 128.391
 Port edged          : Config=disabled, Active=disabled
 Point-to-Point      : Config=auto, Active=true
 Transmit limit      : 10 packets/hello-time
 TC-Restriction      : Disabled
 Role-Restriction    : Disabled
 Protection type     : Config=none, Active=none
 MST BPDU format     : Config=auto, Active=802.1s
 Port Config-
 Digest-Snooping     : Enabled
 Rapid transition    : False
 Num of VLANs mapped : 2
 Port times    : Hello 2s MaxAge 20s FwdDelay 15s MsgAge 0s RemHops 20
 BPDU sent           : 1784
          TCN: 0, Config: 0, RST: 0, MST: 1784
 BPDU received       : 0
          TCN: 0, Config: 0, RST: 0, MST: 0
```

在 H3C 设备上验证在 MSTP 模式下，显示 MSTI0 在端口 GigabitEthernet1/0/1 上生成树状态和统计的信息。

```
[H3C] display stp instance 0 interface gigabitethernet 1/0/1
```

```
-------[CIST Global Info][Mode MSTP]-------
 Bridge ID            : 32768.1cab-3496-09f6
 Bridge times         : Hello 2s MaxAge 20s FwdDelay 15s MaxHops 20
 Root ID/ERPC         : 32768.1cab-3496-09f6, 0
 RegRoot ID/IRPC      : 32768.1cab-3496-09f6, 0
 RootPort ID          : 0.0
 BPDU-Protection      : Disabled
 Bridge Config-
 Digest-Snooping      : Enabled
 TC or TCN received   : 2
 Time since last TC   : 0 days 0h:34m:21s

----[Port381(GigabitEthernet1/0/1)][FORWARDING]----
 Port protocol        : Enabled
 Port role            : Designated Port (Boundary)
 Port ID              : 128.381
 Port cost(Legacy)    : Config=auto, Active=1
 Desg.bridge/port     : 32768.1cab-3496-09f6, 128.381
 Port edged           : Config=disabled, Active=disabled
 Point-to-Point       : Config=auto, Active=true
 Transmit limit       : 10 packets/hello-time
 TC-Restriction       : Disabled
 Role-Restriction     : Disabled
 Protection type      : Config=none, Active=none
 MST BPDU format      : Config=auto, Active=802.1s
 Port Config-
 Digest-Snooping      : Enabled
 Rapid transition     : False
 Num of VLANs mapped  : 2
 Port times       : Hello 2s MaxAge 20s FwdDelay 15s MsgAge 0s RemHops 20
 BPDU sent            : 1787
          TCN: 0, Config: 0, RST: 0, MST: 1787
 BPDU received        : 2
          TCN: 0, Config: 0, RST: 2, MST: 0
```

2.2 与华为设备对接操作指导

2.2.1 互通性分析

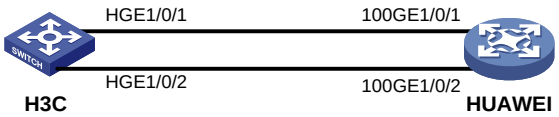
表5 MSTP/PVST 互通性分析

H3C	华为	互通结论
MSTP模式	MSTP模式	可以互通

2.2.2 组网需求

如图 8 所示，H3C 设备与华为设备通过两条链路相互连接。现要求在 H3C 设备和华为设备上分别配置 MSTP，实现 MSTP 互通。

图8 MSTP 对接配置组网图



2.2.3 配置步骤

- 配置 H3C 设备

全局开启生成树协议。

```
<H3C>system-view
[H3C] stp global enable
```

创建 VLAN 接口 10，并为该接口配置 IP 地址和子网掩码。

```
[H3C] vlan 10
[H3C-vlan10] quit
[H3C]interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 255.255.255.0
[H3C-Vlan-interface10] quit
```

在端口 HundredGigE1/0/1 上开启摘要侦听功能。

```
[H3C]interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] stp config-digest-snooping
```

配置端口 HundredGigE1/0/1 为 Trunk 端口，允许 VLAN 10 通过。

```
[H3C-HundredGigE1/0/1] port link-type trunk
[H3C-HundredGigE1/0/1] port trunk permit vlan 10
[H3C-HundredGigE1/0/1] quit
```

在端口 HundredGigE1/0/2 上开启摘要侦听功能。

```
[H3C]interface HundredGigE 1/0/2
[H3C-HundredGigE1/0/2] stp config-digest-snooping
```

配置端口 HundredGigE1/0/2 为 Trunk 端口，允许 VLAN 10 通过。

```
[H3C-HundredGigE1/0/2] port link-type trunk
[H3C-HundredGigE1/0/2] port trunk permit vlan 10
[H3C-HundredGigE1/0/2] quit
```

全局开启摘要侦听功能。

```
[H3C] stp global config-digest-snooping
```

说明

为保证 H3C 交换机的路径开销计算标准与第三方交换机一致，需要确认第三方交换机的开销计算标准，然后在 H3C 交换机上进行相应的修改。

当华为设备采用缺省路径开销计算标准，H3C 交换机需要配置按照 IEEE 802.1t 标准来计算缺省路径开销。

```
[H3C] stp pathcost-standard dot1t
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

使能设备的 STP/RSTP/MSTP 功能。

```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI]stp enable
```

创建 VLAN 接口 10，并为该接口配置 IP 地址和子网掩码。

```
[HUAWEI]vlan 10
[HUAWEI-vlan10]quit
[HUAWEI]interface vlanif 10
[HUAWEI-Vlanif10]ip address 100.0.0.2 24
[HUAWEI-Vlanif10]quit
```

配置端口 100GE1/0/1 属于 VLAN10。

```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]port link-type trunk
[HUAWEI-100GE1/0/1]port trunk allow-pass vlan 10
[HUAWEI-100GE1/0/1]quit
```

配置端口 100GE1/0/2 属于 VLAN10。

```
[HUAWEI]interface 100GE 1/0/2
[HUAWEI-100GE1/0/2]port link-type trunk
[HUAWEI-100GE1/0/2]port trunk allow-pass vlan 10
[HUAWEI-100GE1/0/2]quit
```

2.2.4 验证配置

在 H3C 设备上验证生成树状态和统计的简要信息。

```
[H3C] display stp brief
 MST ID   Port                                Role  STP State   Protection
 0        HundredGigE1/0/1                    DESI  FORWARDING  NONE
 0        HundredGigE1/0/2                    DESI  FORWARDING  NONE
```

在 H3C 设备上验证在 MSTP 模式下，显示 MSTI 0 在端口 HundredGigE1/0/1 上生成树状态和统计的信息。

```
[H3C] display stp instance 0 interface HundredGigE 1/0/1
-------[CIST Global Info][Mode MSTP]-------
 Bridge ID           : 32768.743a-2021-ae00
 Bridge times        : Hello 2s MaxAge 20s FwdDelay 15s MaxHops 20
 Root ID/ERPC        : 32768.743a-2021-ae00, 0
 RegRoot ID/IRPC     : 32768.743a-2021-ae00, 0
 RootPort ID         : 0.0
 BPDU-Protection     : Disabled
 Bridge Config-
 Digest-Snooping     : Enabled
 TC or TCN received  : 0
 Time since last TC  : 0 days 0h:41m:50s

----[Port51(HundredGigE1/0/1)][FORWARDING]----
 Port protocol       : Enabled
 Port role           : Designated Port (Boundary)
 Port ID             : 128.51
 Port cost(Legacy)   : Config=auto, Active=1
 Desg.bridge/port    : 32768.743a-2021-ae00, 128.51
 Port edged          : Config=disabled, Active=disabled
 Point-to-Point      : Config=auto, Active=true
 Transmit limit      : 10 packets/hello-time
 TC-Restriction      : Disabled
 Role-Restriction    : Disabled
 Protection type     : Config=none, Active=none
 MST BPDU format     : Config=auto, Active=802.1s
 Port Config-
 Digest-Snooping     : Enabled
 Rapid transition    : True
 Num of VLANs mapped : 2
 Port times          : Hello 2s MaxAge 20s FwdDelay 15s MsgAge 0s RemHops 20
 BPDU sent           : 1256
          TCN: 0, Config: 0, RST: 0, MST: 1256
 BPDU received       : 3
          TCN: 0, Config: 0, RST: 0, MST: 3
```

2.3 与锐捷设备对接操作指导

2.3.1 互通性分析

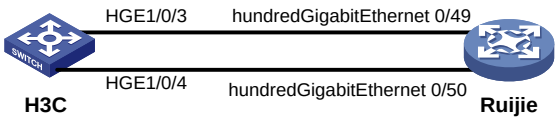
表6 MSTP/PVST 互通性分析

H3C	锐捷	互通结论
MSTP模式	MSTP模式	可以互通

2.3.2 组网需求

如图 9 所示，H3C 设备与锐捷设备通过两条链路相互连接。现要求在 H3C 设备和锐捷设备上分别配置 MSTP，实现 MSTP 互通。

图9 MSTP 对接配置组网图



2.3.3 配置步骤

- 配置 H3C 设备

全局开启生成树协议。

```
<H3C> system-view
[H3C] stp global enable
```

创建 VLAN 接口 10，并为该接口配置 IP 地址和子网掩码。

```
[H3C] vlan 10
[H3C-vlan10] quit
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 24
[H3C-Vlan-interface10] quit
```

配置端口 HundredGigE1/0/3 为 Trunk 端口，允许 VLAN10 通过。

```
[H3C] interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] port link-type trunk
[H3C-HundredGigE1/0/3] port trunk permit vlan 10
```

在端口 HundredGigE1/0/3 上开启摘要侦听功能。

```
[H3C-HundredGigE1/0/3] stp config-digest-snooping
[H3C-HundredGigE1/0/3] quit
```

配置端口 HundredGigE1/0/4 为 Trunk 端口，允许 VLAN 10 通过。

```
[H3C]interface HundredGigE 1/0/4
[H3C-HundredGigE1/0/4] port link-type trunk
[H3C-HundredGigE1/0/4] port trunk permit vlan 10
```

在端口 HundredGigE1/0/4 上开启摘要侦听功能。

```
[H3C-HundredGigE1/0/4] stp config-digest-snooping
[H3C-HundredGigE1/0/4] quit
```

全局开启摘要侦听功能。

```
[H3C] stp global config-digest-snooping
```

说明

为保证 H3C 交换机的路径开销计算标准与第三方交换机一致，需要确认第三方交换机的开销计算标准，然后在 H3C 交换机上进行相应的修改。

当锐捷设备采用缺省路径开销计算标准，H3C 交换机需要配置按照 IEEE 802.1t 标准来计算缺省路径开销。

```
[H3C] stp pathcost-standard dot1t
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQI 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

打开 spanning-tree 功能。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#spanning-tree
```

配置 IP 地址。

```
Ruijie(config)#interface vlan 10
Ruijie(config-if-VLAN 10)#ip address 100.0.0.2 24
Ruijie(config-if-VLAN 10)#no shutdown
Ruijie(config-if-VLAN 10)#exit
```

配置 hundredGigabitEthernet 0/49 为 Trunk 端口，且该接口附带 switchport trunk allowed vlan only 10。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport mode trunk
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport trunk allowed vlan only 10
Ruijie(config-if-HundredGigabitEthernet 0/49)#no shutdown
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

配置 hundredGigabitEthernet 0/50 为 Trunk 端口，且该接口附带 switchport trunk allowed vlan only 10。

```
Ruijie(config)#interface hundredGigabitEthernet 0/50
Ruijie(config-if-HundredGigabitEthernet 0/50)#switchport
Ruijie(config-if-HundredGigabitEthernet 0/50)#switchport mode trunk
Ruijie(config-if-HundredGigabitEthernet 0/50)#switchport trunk allowed vlan only 10
Ruijie(config-if-HundredGigabitEthernet 0/50)#no shutdown
Ruijie(config-if-HundredGigabitEthernet 0/50)#exit
```

2.3.4 验证配置

在 H3C 设备上验证生成树状态和统计的简要信息。

```
[H3C] display stp brief
 MST ID   Port                                Role  STP State   Protection
 0        HundredGigE1/0/3                    DESI  FORWARDING  NONE
 0        HundredGigE1/0/4                    DESI  FORWARDING  NONE
```

在 H3C 设备上验证在 MSTP 模式下，显示 MSTI 0 在端口 HundredGigE1/0/3 上生成树状态和统计的信息。

```
[H3C] display stp instance 0 interface HundredGigE 1/0/3
-------[CIST Global Info][Mode MSTP]-------
 Bridge ID           : 32768.0000-fc00-0242
 Bridge times        : Hello 2s MaxAge 20s FwdDelay 15s MaxHops 20
 Root ID/ERPC        : 32768.0000-fc00-0242, 0
 RegRoot ID/IRPC     : 32768.0000-fc00-0242, 0
 RootPort ID         : 0.0
 BPDU-Protection     : Disabled
 Bridge Config-
 Digest-Snooping     : Disabled
 TC or TCN received  : 0
 Time since last TC  : 0 days 0h:7m:27s

----[Port5(HundredGigE1/0/3)][FORWARDING]----
 Port protocol       : Enabled
 Port role           : Designated Port (Boundary)
 Port ID             : 128.5
 Port cost(Legacy)   : Config=auto, Active=1
 Desg.bridge/port    : 32768.0000-fc00-0242, 128.5
 Port edged          : Config=disabled, Active=disabled
 Point-to-Point      : Config=auto, Active=true
 Transmit limit      : 10 packets/hello-time
 TC-Restriction      : Disabled
 Role-Restriction    : Disabled
 Protection type     : Config=none, Active=none
 MST BPDU format     : Config=auto, Active=802.1s
 Port Config-
 Digest-Snooping     : Enabled
 Rapid transition    : True
 Num of VLANs mapped : 2
```

```
Port times          : Hello 2s MaxAge 20s FwdDelay 15s MsgAge 0s RemHops 20
BPDU sent           : 240
        TCN: 0, Config: 0, RST: 0, MST: 240
BPDU received       : 1
        TCN: 0, Config: 0, RST: 0, MST: 1
```

3 LACP 链路聚合对接操作指导

3.1 与思科设备对接操作指导

3.1.1 互通性分析

表7 互通性分析

H3C	Cisco	互通结论
Static（缺省）	On（缺省）	可以互通
Dynamic	Active	可以互通

3.1.2 采用静态聚合模式对接案例

1. 组网需求

如图 10 所示，H3C 设备与 Cisco 设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和 Cisco 设备上分别配置静态链路聚合，实现增加链路带宽、提高链路可靠性的目的。

图10 采用静态聚合模式对接配置组网图

2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] interface Route-aggregation 1
[H3C-Route-Aggregation1] ip address 16.1.105.33 24
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 GigabitEthernet1/0/1 加入三层聚合组 1 中。

```
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] port link-aggregation group 1
[H3C-GigabitEthernet1/0/1] quit
```

将三层以太网接口 GigabitEthernet1/0/2 加入三层聚合组 1 中。

```
[H3C] interface GigabitEthernet 1/0/2
[H3C-GigabitEthernet1/0/2] port link-aggregation group 1
```

```
[H3C-GigabitEthernet1/0/2] quit
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

配置聚合口的 IP 地址。

```
Cisco# configure terminal
Cisco(config)# interface channel-group 1
Cisco(config-if)# ip address 16.1.105.34 255.255.255.0
Cisco(config-if)# exit
```

设置接口 Ethernet1/3 的聚合模式为手动方式。

```
Cisco(config)# interface Ethernet 1/3
Cisco(config-if)# channel-group 1 mode on
Cisco(config-if)# exit
```

设置接口 Ethernet1/5 的聚合模式为手动方式。

```
Cisco(config-if)# interface Ethernet 1/5
Cisco(config-if)# channel-group 1 mode on
Cisco(config-if)# end
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired

Aggregate Interface: Route-Aggregation1
Aggregation Mode: Static
Loadsharing Type: Shar
Management VLANs: None
  Port             Status  Priority Oper-Key
  GE1/0/1(R)       S       32768    1
  GE1/0/2          S       32768    1
```

在 H3C 设备上能 Ping 通对端设备。

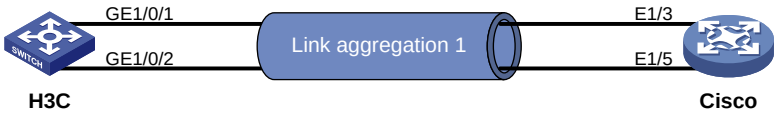
```
[H3C ] ping 16.1.105.34
Ping 16.1.105.34 (16.1.105.34): 56 data bytes, press CTRL_C to break
56 bytes from 16.1.105.34: icmp_seq=0 ttl=255 time=2.537 ms
56 bytes from 16.1.105.34: icmp_seq=1 ttl=255 time=2.000 ms
56 bytes from 16.1.105.34: icmp_seq=2 ttl=255 time=1.935 ms
56 bytes from 16.1.105.34: icmp_seq=3 ttl=255 time=2.044 ms
56 bytes from 16.1.105.34: icmp_seq=4 ttl=255 time=2.143 ms

--- Ping statistics for 16.1.105.34 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.935/2.132/2.537/0.214 ms
```

3.1.3 采用动态聚合模式对接案例

1. 组网需求

如图 11 所示，H3C 设备与 Cisco 设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和 Cisco 设备上分别配置动态链路聚合，实现增加链路带宽、提高链路可靠性的目的。

图11 采用动态聚合模式对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] interface Route-aggregation 1
[H3C-Route-Aggregation1] ip address 16.1.105.33 24
```

配置三层聚合接口 1 对应的聚合组工作在动态聚合模式下。

```
[H3C-Route-Aggregation1] link-aggregation mode dynamic
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 GigabitEthernet1/0/1 加入三层聚合组 1 中。

```
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] port link-aggregation group 1
[H3C-GigabitEthernet1/0/1] quit
```

将三层以太网接口 GigabitEthernet1/0/2 加入三层聚合组 1 中。

```
[H3C] interface gigabitethernet 1/0/2
[H3C-GigabitEthernet1/0/2] port link-aggregation group 1
[H3C-GigabitEthernet1/0/2] quit
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
```

```
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

启动 LACP。

```
Cisco# configure terminal
Cisco(config)# feature lacp
```

设置聚合接口的 IP 地址。

```
Cisco(config)# interface channel-group 1
Cisco(config-if)# ip address 16.1.105.34 255.255.255.0
Cisco(config-if)# exit
```

将 Ethernet1/3 接口设置为 LACP 的 active 模式。

```
Cisco(config)# interface Ethernet 1/3
Cisco(config-if)# channel-group 1 mode active
Cisco(config-if)# exit
```

将 Ethernet1/5 接口设置为 LACP 的 active 模式。

```
Cisco(config-if)# interface Ethernet 1/5
Cisco(config-if)# channel-group 1 mode active
Cisco(config-if)# end
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired
Aggregate Interface: Route-Aggregation1
Aggregation Mode: Dynamic
Loadsharing Type: Shar
Management VLANs: None
```

```
System ID: 0x8000, 1cab-3496-09f6
Local:
  Port               Status   Priority Index    Oper-Key               Flag
  GE1/0/1(R)          S        32768    1        1                     {ACDEF}
  GE1/0/2             S        32768    2        1                     {ACDEF}
Remote:
  Actor            Priority  Index    Oper-Key    SystemID               Flag
   GE1/0/1         32768    265      32768    0x8000, 2c33-113a-eaef {ACDEF}
   GE1/0/2         32768    273      32768    0x8000, 2c33-113a-eaef {ACDEF}
```

在 H3C 设备上能 Ping 通对端设备。

```
[H3C] ping 16.1.105.34
Ping 16.1.105.34 (16.1.105.34): 56 data bytes, press CTRL_C to break
Request time out
56 bytes from 16.1.105.34: icmp_seq=1 ttl=255 time=2.331 ms
56 bytes from 16.1.105.34: icmp_seq=2 ttl=255 time=2.063 ms
56 bytes from 16.1.105.34: icmp_seq=3 ttl=255 time=2.202 ms
56 bytes from 16.1.105.34: icmp_seq=4 ttl=255 time=2.219 ms

--- Ping statistics for 16.1.105.34 ---
5 packet(s) transmitted, 4 packet(s) received, 20.0% packet loss
round-trip min/avg/max/std-dev = 2.063/2.204/2.331/0.095 ms
```

3.2 与华为设备对接操作指导

3.2.1 互通性分析

表8 互通性分析

H3C	华为	互通结论
Static（缺省）	Normal	可以互通
Dynamic	Lacp-Static/lacp-Dynamic	可以互通

3.2.2 采用静态聚合模式对接案例

1. 组网需求

如图 12 所示，H3C 设备与华为设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和华为设备上分别配置静态链路聚合，实现增加链路带宽、提高链路可靠性的目的。

图12 采用静态聚合模式对接配置组网图

2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] interface Route-aggregation 1
[H3C-Route-Aggregation1] ip address 100.0.0.1 24
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 HundredGigE1/0/1 加入三层聚合组 1 中。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-aggregation group 1
[H3C-HundredGigE1/0/1] quit
```

将三层以太网接口 HundredGigE1/0/2 加入三层聚合组 1 中。

```
[H3C] interface HundredGigE 1/0/2
[H3C-HundredGigE1/0/2] port link-aggregation group 1
[H3C-HundredGigE1/0/2] quit
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

配置 Eth-Trunk 接口 1 的 IP 地址。

```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI] interface Eth-Trunk 1
[HUAWEI-Eth-Trunk1]undo portswitch
[HUAWEI-Eth-Trunk1]ip address 100.0.0.2 24
[HUAWEI-Eth-Trunk1]quit
```

将接口 100GE1/0/1 加入 ID 为 1 的 Eth-Trunk 接口。

```
[HUAWEI] interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]eth-trunk 1
[HUAWEI-100GE1/0/1]quit
```

将接口 100GE1/0/2 加入 ID 为 1 的 Eth-Trunk 接口。

```
[HUAWEI] interface 100GE 1/0/2
[HUAWEI-100GE1/0/2]eth-trunk 1
```

```
[HUAWEI-100GE1/0/2]quit
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired

Aggregate Interface: Route-Aggregation1
Aggregation Mode: Static
Loadsharing Type: Shar
  Port             Status  Priority Oper-Key
  HGE1/0/1         S       32768    1
  HGE1/0/2(R)      S       32768    1
```

在 H3C 设备上能 Ping 通对端设备。

```
[H3C] ping 100.0.0.2
Ping 100.0.0.2 (100.0.0.2): 56 data bytes, press CTRL+C to break
56 bytes from 100.0.0.2: icmp_seq=0 ttl=254 time=0.927 ms
56 bytes from 100.0.0.2: icmp_seq=1 ttl=254 time=0.614 ms
56 bytes from 100.0.0.2: icmp_seq=2 ttl=254 time=0.603 ms
56 bytes from 100.0.0.2: icmp_seq=3 ttl=254 time=1.021 ms
56 bytes from 100.0.0.2: icmp_seq=4 ttl=254 time=0.631 ms

--- Ping statistics for 100.0.0.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.603/0.759/1.021/0.178 ms
[H3C] %Oct 19 17:29:07:624 2021 H3C PING/6/PING_STATISTICS: Ping statistics for 100.0.0.2:
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss, round-trip
min/avg/max/std-dev = 0.603/0.759/1.021/0.178 ms.
```

3.2.3 采用动态聚合模式对接案例

1. 组网需求

如图 13 所示，H3C 设备与华为设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和华为设备上分别配置动态链路聚合，实现增加链路带宽、提高链路可靠性的目的。

图13 采用动态聚合模式对接配置组网图

2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] interface Route-Aggregation 1
[H3C-Route-Aggregation1] ip address 100.0.0.1 24
```

配置三层聚合接口 1 对应的聚合组工作在动态聚合模式下。

```
[H3C-Route-Aggregation1] link-aggregation mode dynamic
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 GigabitEthernet1/0/1 加入三层聚合组 1 中。

```
[H3C]interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-aggregation group 1
[H3C-HundredGigE1/0/1] quit
```

将三层以太网接口 GigabitEthernet1/0/2 加入三层聚合组 1 中。

```
[H3C]interface HundredGigE 1/0/2
[H3C-HundredGigE1/0/2] port link-aggregation group 1
[H3C-HundredGigE1/0/2] quit
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

指定 Eth-Trunk 接口 1 的工作模式为动态 LACP 模式。

```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI]interface Eth-Trunk 1
[HUAWEI-Eth-Trunk1]mode lacp-dynamic
[HUAWEI-Eth-Trunk1]quit
```

将接口 100GE1/0/1 加入 ID 为 1 的 Eth-Trunk 接口。

```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]eth-trunk 1
[HUAWEI-100GE1/0/1]quit
```

将接口 100GE1/0/2 加入 ID 为 1 的 Eth-Trunk 接口。

```
[HUAWEI]interface 100GE 1/0/2
```

```
[HUAWEI-100GE1/0/2]eth-trunk 1
[HUAWEI-100GE1/0/2]quit
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired

Aggregate Interface: Route-Aggregation1
Creation Mode: Manual
Aggregation Mode: Dynamic
Loadsharing Type: Shar
System ID: 0x8000, 743a-2021-ae00
Local:
  Port                Status   Priority Index    Oper-Key               Flag
  HGE1/0/1(R)         S        32768    1        1                      {ACDEF}
  HGE1/0/2            S        32768    2        1                      {ACDEF}
Remote:
  Actor               Priority Index    Oper-Key SystemID               Flag
  HGE1/0/1            32768    1        337      0x8000, a4be-2b3a-50d1 {ACDEF}
  HGE1/0/2            32768    2        337      0x8000, a4be-2b3a-50d1 {ACDEF}
```

在 H3C 设备上能 Ping 通对端设备。

```
[H3C] ping 100.0.0.2
Ping 100.0.0.2 (100.0.0.2): 56 data bytes, press CTRL+C to break
56 bytes from 100.0.0.2: icmp_seq=0 ttl=254 time=1.094 ms
56 bytes from 100.0.0.2: icmp_seq=1 ttl=254 time=0.753 ms
56 bytes from 100.0.0.2: icmp_seq=2 ttl=254 time=0.666 ms
56 bytes from 100.0.0.2: icmp_seq=3 ttl=254 time=0.686 ms
56 bytes from 100.0.0.2: icmp_seq=4 ttl=254 time=0.566 ms

--- Ping statistics for 100.0.0.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.566/0.753/1.094/0.181 ms
round-trip min/avg/max/std-dev = 2.063/2.204/2.331/0.095 ms
```

3.3 与锐捷设备对接操作指导

3.3.1 互通性分析

表9 互通性分析

H3C	锐捷	互通结论
Static（缺省）	On（缺省）	可以互通
Dynamic	active	可以互通

3.3.2 采用静态聚合模式对接案例

1. 组网需求

如图 14 所示，H3C 设备与锐捷设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和锐捷设备上分别配置静态链路聚合，实现增加链路带宽、提高链路可靠性的目的

图14 采用静态聚合模式对接配置组网图

2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C> system-view
[H3C] interface Route-Aggregation 1
[H3C-Route-Aggregation1] ip address 100.0.0.1 24
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 HundredGigE1/0/3 加入三层聚合组 1 中。

```
[H3C] interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] port link-aggregation group 1
[H3C-HundredGigE1/0/3] quit
```

将三层以太网接口 HundredGigE1/0/4 加入三层聚合组 1 中。

```
[H3C]interface HundredGigE 1/0/4
[H3C-HundredGigE1/0/4] port link-aggregation group 1
[H3C-HundredGigE1/0/4] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
```

```
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

进入 Aggregateport1 的配置模式。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#interface aggregatePort 1
```

将接口设置为 3 层模式。

```
Ruijie(config-if-AggregatePort 1)#no switchport
```

配置接口的 IP 地址。

```
Ruijie(config-if-AggregatePort 1)#ip address 100.0.0.2 24
Ruijie(config-if-AggregatePort 1)#exit
```

将接口 0/49 设置为 3 层模式，并配置成静态 AP1 成员。

```
Ruijie(config)# interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#port-group 1
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

将接口 0/50 设置为 3 层模式，并配置成静态 AP1 成员。

```
Ruijie(config)# interface hundredGigabitEthernet 0/50
Ruijie(config-if-HundredGigabitEthernet 0/50)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/50)#port-group 1
Ruijie(config-if-HundredGigabitEthernet 0/50)#exit
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired
Role: P -- Primary, S -- Secondary

Aggregate Interface: Route-Aggregation1
Aggregation Mode: Static
Loadsharing Type: Shar
Management VLANs: None
  Port             Status  Priority Oper-Key  Role
  HGE1/0/3(R)      S       32768    1         None
  HGE1/0/4         S       32768    1         None
```

在 H3C 设备上能 Ping 通对端设备。

```
[H3C] ping 100.0.0.2
Ping 100.0.0.2 (100.0.0.2): 56 data bytes, press CTRL_C to break
56 bytes from 100.0.0.2: icmp_seq=0 ttl=64 time=23.359 ms
```

```
56 bytes from 100.0.0.2: icmp_seq=1 ttl=64 time=1.215 ms
56 bytes from 100.0.0.2: icmp_seq=2 ttl=64 time=1.395 ms
56 bytes from 100.0.0.2: icmp_seq=3 ttl=64 time=1.237 ms
56 bytes from 100.0.0.2: icmp_seq=4 ttl=64 time=1.223 ms

--- Ping statistics for 100.0.0.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.215/5.686/23.359/8.837 ms
```

3.3.3 采用动态聚合模式对接案例

1. 组网需求

如图 15所示，H3C 设备与锐捷设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备和锐捷设备上分别配置动态链路聚合，实现增加链路带宽、提高链路可靠性的目的。

图15 采用动态聚合模式对接配置组网图

2. 配置步骤

- 配置 H3C 设备

创建三层聚合接口 1，并为该接口配置 IP 地址和子网掩码。

```
<H3C>system-view
[H3C] interface Route-Aggregation 1
[H3C-Route-Aggregation1] ip address 100.0.0.1 24
```

配置三层聚合接口 1 对应的聚合组工作在动态聚合模式下。

```
[H3C-Route-Aggregation1] link-aggregation mode dynamic
[H3C-Route-Aggregation1] quit
```

将三层以太网接口 HundredGigE1/0/3 加入三层聚合组 1 中。

```
[H3C]interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] port link-aggregation group 1
[H3C-HundredGigE1/0/3] quit
```

将三层以太网接口 HundredGigE1/0/4 加入三层聚合组 1 中。

```
[H3C]interface HundredGigE 1/0/4
[H3C-HundredGigE1/0/4]port link-aggregation group 1
[H3C-HundredGigE1/0/4]quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
```

```
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

进入 Aggregateport 1 的配置模式。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#interface aggregatePort 1
```

将接口设置为三层模式。

```
Ruijie(config-if-AggregatePort 1)#no switchport
```

配置接口的 IP 地址。

```
Ruijie(config-if-AggregatePort 1)#ip address 100.0.0.2 24
Ruijie(config-if-AggregatePort 1)#exit
```

将接口 0/49 设置为 3 层模式，并配置成 LACP AP1 成员，且聚合模式为主动模式。

```
Ruijie(config)# interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#port-group 1 mode active
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

将接口 0/50 设置为 3 层模式，并配置成 LACP AP1 成员，且聚合模式为主动模式。

```
Ruijie(config)# interface hundredGigabitEthernet 0/50
Ruijie(config-if-HundredGigabitEthernet 0/50)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/50)#port-group 1 mode active
Ruijie(config-if-HundredGigabitEthernet 0/50)#exit
Ruijie(config)#
```

3. 验证配置

在 H3C 设备上验证聚合组的详细信息。

```
[H3C] display link-aggregation verbose
Loadsharing Type: Shar -- Loadsharing, NonS -- Non-Loadsharing
Port Status: S -- Selected, U -- Unselected, I -- Individual
Port: A -- Auto port, M -- Management port, R -- Reference port
Flags:  A -- LACP_Activity, B -- LACP_Timeout, C -- Aggregation,
        D -- Synchronization, E -- Collecting, F -- Distributing,
        G -- Defaulted, H -- Expired
Role: P -- Primary, S -- Secondary

Aggregate Interface: Route-Aggregation1
Creation Mode: Manual
Aggregation Mode: Dynamic
Loadsharing Type: Shar
Management VLANs: None
```

```
System ID: 0x8000, 0000-fc00-0242
Local:
  Port                Status   Priority Index    Oper-Key               Flag
  HGE1/0/3(R)         S        32768    1        1                      {ACDEF}
  HGE1/0/4            S        32768    2        1                      {ACDEF}
Remote:
  Actor               Priority Index    Oper-Key SystemID               Flag
  HGE1/0/3            32768    49       1        0x8000, c0b8-e672-cd08 {ACDEF}
  HGE1/0/4            32768    50       1        0x8000, c0b8-e672-cd08 {ACDEF}
```

在 H3C 设备上能 Ping 通对端设备。

```
[H3C] ping 100.0.0.2
Ping 100.0.0.2 (100.0.0.2): 56 data bytes, press CTRL_C to break
56 bytes from 100.0.0.2: icmp_seq=0 ttl=64 time=1.596 ms
56 bytes from 100.0.0.2: icmp_seq=1 ttl=64 time=1.342 ms
56 bytes from 100.0.0.2: icmp_seq=2 ttl=64 time=1.376 ms
56 bytes from 100.0.0.2: icmp_seq=3 ttl=64 time=1.354 ms
56 bytes from 100.0.0.2: icmp_seq=4 ttl=64 time=1.299 ms

--- Ping statistics for 100.0.0.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.299/1.393/1.596/0.104 ms
```

4 ISIS 对接操作指导

4.1 与思科设备对接操作指导

4.1.1 互通性分析

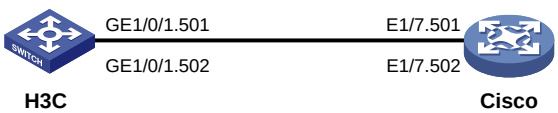
表10 ISIS 互通性分析

H3C	Cisco	互通结论
增加配置**isis small-hello**命令	增加配置**no isis hello-padding always**命令	由于H3C和Cisco的MTU不同（H3C为1500，Cisco为9000），因此需要增加特定配置后，设备间ISIS邻居才可以建立

4.1.2 组网需求

如图 16 所示，H3C 设备与 Cisco 设备通过各自的三层以太网接口相互连接，现要求实现 H3C 设备与 Cisco 设备对接建立 ISIS 邻居。

图16 ISIS 对接配置组网



4.1.3 配置步骤

- 配置 H3C 设备

在 IS-IS 进程 1 中使能 NSR 功能。

```
<H3C> system-view
[H3C] isis 1
[H3C-isis-1] non-stop-routing
```

配置路由器的 Level 级别为 Level-2。

```
[H3C-isis-1] is-level level-2
```

配置 IS-IS 进程 1 的带宽参考值为 10000Mbps。

```
[H3C-isis-1] bandwidth-reference 100000
```

配置路由器只可以接收和发送采用 **wide** 方式表示到达目的地路径开销的报文。

```
[H3C-isis-1] cost-style wide
```

配置 IS-IS 路由计算的最大时间间隔为 1 秒，最小时间间隔为 50 毫秒，惩罚增量为 50 毫秒。

```
[H3C-isis-1] timer spf 1 50 50
```

为本地 IS 配置主机名称。

```
[H3C-isis-1] is-name 12516
```

指定 NET 为 48.0001.1001.7220.0160.00。

```
[H3C-isis-1] network-entity 48.0001.1001.7220.0160.00
[H3C-isis-1] quit
```

配置接口 GigabitEthernet1/0/1.501 的 IP 地址。

```
[H3C] interface gigabitethernet 1/0/1.501
[H3C-GigabitEthernet1/0/1.501] ip address 172.16.16.46 255.255.255.252
```

在接口 GigabitEthernet1/0/1.501 上使能 IS-IS 功能。

```
[H3C-GigabitEthernet1/0/1.501] isis enable 1
```

配置接口 GigabitEthernet1/0/1.501 的网络类型为 P2P。

```
[H3C-GigabitEthernet1/0/1.501] isis circuit-type p2p
```

指定接口 GigabitEthernet1/0/1.501 发送小型 Hello 报文。

```
[H3C-GigabitEthernet1/0/1.501] isis small-hello
[H3C-GigabitEthernet1/0/1.501] quit
```

配置接口 GigabitEthernet1/0/1.502 的 IP 地址。

```
[H3C] interface gigabitethernet 1/0/1.502
[H3C-GigabitEthernet1/0/1.502] ip address 172.16.16.50 255.255.255.252
```

在接口 GigabitEthernet1/0/1.502 上使能 IS-IS 功能。

```
[H3C-GigabitEthernet1/0/1.502] isis enable 1
```

配置接口 GigabitEthernet1/0/1.502 的网络类型为 P2P。

```
[H3C-GigabitEthernet1/0/1.502] isis circuit-type p2p
```

指定接口 GigabitEthernet1/0/1.502 发送小型 Hello 报文。

```
[H3C-GigabitEthernet1/0/1.502] isis small-hello
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
```

```
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

配置 ISIS。

```
Cisco# configure terminal
Cisco(config)# router isis 1
Cisco(config-router)# net 48.0001.0000.0000.0001.00
Cisco(config-router)#  is-type level-1-2
Cisco(config-router)#  address-family ipv4 unicast
Cisco(config-router-af)# default-information originate
Cisco(config-router)# exit
```

配置接口 Ethernet1/7.501 的 dot1q 封装及 IP 地址。

```
Cisco(config-)# interface Ethernet1/7.501
Cisco(config-if)# encapsulation dot1q 501
```

```
Cisco(config-if)# ip address 172.16.16.45/30
```
#在接口下配置 ISIS。
```
Cisco(config- if)# no isis hello-padding always
Cisco(config- if)# isis network point-to-point
Cisco(config- if)# isis circuit-type level-1-2
Cisco(config- if)# ip router isis 1
Cisco(config- if)# no shutdown
Cisco(config- if)# exit
```
配置接口 Ethernet1/7.502 的 dot1q 封装及 IP 地址。
```
Cisco(config)# interface Ethernet1/7.502
Cisco(config- if)# encapsulation dot1q 502
Cisco(config- if)# ip address 172.16.16.49/30
```
#在接口下配置 ISIS。
```
Cisco(config- if)# no isis hello-padding always
Cisco(config- if)# isis network point-to-point
Cisco(config- if)# isis circuit-type level-1-2
Cisco(config- if)# ip router isis 1
Cisco(config- if)# no shutdown
Cisco(config- if)# exit
```
#在接口下配置 ISIS 及 IP 地址。
```
Cisco(config)# interface Ethernet1/7
Cisco(config- if)# ip address 116.1.1.1/30
Cisco(config- if)# ip router isis 1
Cisco(config- if)# exit
```

4.1.4 验证配置

在 H3C 设备上验证 IS-IS 的邻居信息。
```
[H3C] display isis peer

                        Peer information for IS-IS(1)
                        ------------------------------

 System ID: Cisco
 Interface: GE1/0/1.501           Circuit Id:  001
 State: Up     HoldTime: 27s        Type: L2           PRI: --

 System ID: Cisco
 Interface: GE1/0/1.502           Circuit Id:  001
 State: Up     HoldTime: 29s        Type: L2           PRI: --
```
在 H3C 设备上验证所有 ISIS 路由信息。
```
[H3C] display ip routing-table protocol isis

Summary count : 4

ISIS Routing table status : <Active>
Summary count : 2
```

```
Destination/Mask    Proto   Pre Cost        NextHop         Interface
116.1.1.0/30        IS_L2   15  11          172.16.16.45    GE1/0/1.501
                                            172.16.16.49    GE1/0/1.502

ISIS Routing table status : <Inactive>
Summary count : 2

Destination/Mask    Proto   Pre Cost        NextHop         Interface
172.16.16.44/30     IS_L2   15  10          0.0.0.0         GE1/0/1.501
172.16.16.48/30     IS_L2   15  10          0.0.0.0         GE1/0/1.502
```

4.2 与华为设备对接操作指导

4.2.1 互通性分析

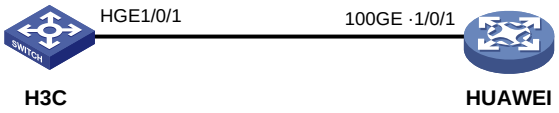
表11 ISIS 互通性分析

H3C	华为	互通结论
支持	支持	可以互通

4.2.2 组网需求

如图 17 所示，H3C 设备与华为设备通过各自的三层以太网接口相互连接，现要求实现 H3C 设备与华为设备对接建立 ISIS 邻居。

图17 ISIS 对接配置组网



4.2.3 配置步骤

- 配置 H3C 设备

配置路由器的 Level 级别为 Level-2。

```
<H3C> system-view
[H3C] isis 1
[H3C-isis-1] is-level level-2
```

配置路由器只可以接收和发送采用 wide 方式表示到达目的地路径开销的报文。

```
[H3C-isis-1] cost-style wide
```

指定 NET 为 48.0001.1001.7220.0160.00。

```
[H3C-isis-1] network-entity 48.0001.1001.7220.0160.00
[H3C-isis-1] quit
```

配置接口 HundredGigE1/0/1 的 IP 地址。

```
[H3C]interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```
在指定接口上使能 IS-IS 功能，并配置与该接口关联的 IS-IS 进程。
```
[H3C-HundredGigE1/0/1] isis enable 1
```
配置接口的网络类型为 P2P。
```
[H3C-HundredGigE1/0/1] isis circuit-type p2p
[H3C-HundredGigE1/0/1] quit
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI>display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```
使能 IS-IS 协议，并进入 IS-IS 视图。
```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI]isis 1
```
设置当前交换机工作在 Level-2。
```
[HUAWEI-isis-1]is-level level-2
Info: IS-IS level changed. The process 1 will be reset.
```
配置 IS-IS 进程的网络实体名称 NET 为 48.0001.1001.7220.0170.00。
```
[HUAWEI-isis-1]network-entity 48.0001.1001.7220.0170.00
```
指定 IS-IS 设备只能接收和发送开销类型为 wide 的路由。
```
[HUAWEI-isis-1]cost-style wide
Info: Cost style Changed. IS-IS process 1 will be reset.
[HUAWEI-isis-1]quit
```
设置接口 1/0/1 的 IP 地址。
```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]ip address 100.0.0.2 24
```
创建 IS-IS 路由进程 1，并在接口 100GE1/0/1 上激活这个路由进程。
```
[HUAWEI-100GE1/0/1]isis enable 1
```
将 IS-IS 广播网接口的网络类型模拟为 P2P 类型。

```
[HUAWEI-100GE1/0/1]isis circuit-type p2p
[HUAWEI-100GE1/0/1]quit
```

4.2.4 验证配置

在 H3C 设备上验证 IS-IS 的邻居信息。

```
[H3C] display isis peer

                        Peer information for IS-IS(1)
                        ------------------------------

 System ID: 1001.7220.0170
 Interface: HGE1/0/1               Circuit Id:  061
 State: Up     HoldTime: 25s       Type: L2           PRI: --
```

在 H3C 设备上验证所有 ISIS 路由信息。

```
[H3C] display ip routing-table protocol isis

Summary count : 2

ISIS Routing table status : <Active>
Summary count : 0

ISIS Routing table status : <Inactive>
Summary count : 1

Destination/Mask    Proto   Pre Cost        NextHop         Interface
100.0.0.0/24        IS_L2   15  10          0.0.0.0         HGE1/0/1
```

4.3 与锐捷设备对接操作指导

4.3.1 互通性分析

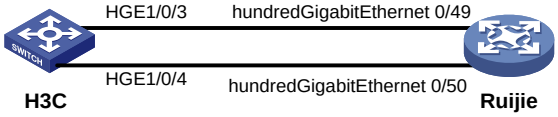
表12 ISIS 互通性分析

H3C	锐捷	互通结论
支持	支持	可以互通

4.3.2 组网需求

如图 18 所示，H3C 设备与锐捷设备通过各自的三层以太网接口相互连接，现要求实现 H3C 设备与锐捷设备对接建立 ISIS 邻居。

图18 ISIS 对接配置组网



4.3.3 配置步骤

- 配置 H3C 设备

启动 IS-IS，并进入 IS-IS 视图。

```
<H3C> system-view
[H3C] isis 1
```

配置路由器的 Level 级别为 Level-2。

```
[H3C-isis-1] is-level level-2
```

配置路由器只可以接收和发送采用 **wide** 方式表示到达目的地路径开销的报文。

```
[H3C-isis-1] cost-style wide
```

指定 NET 为 48.0001.1001.7220.0160.00。

```
[H3C-isis-1] network-entity 48.0001.1001.7220.0160.00
[H3C-isis-1] quit
```

配置接口 HundredGigE1/0/3 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] ip address 100.0.0.1 24
```

在接口 HundredGigE1/0/3 上使能 IS-IS 功能。

```
[H3C-HundredGigE1/0/3] isis enable 1
```

配置接口 HundredGigE1/0/3 的网络类型为 P2P。

```
[H3C-HundredGigE1/0/3] isis circuit-type p2p
[H3C-HundredGigE1/0/3] quit
```

配置接口 HundredGigE1/0/4 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/4
[H3C-HundredGigE1/0/4] ip address 200.0.0.1 24
```

在接口 HundredGigE1/0/4 上使能 IS-IS 功能。

```
[H3C-HundredGigE1/0/4] isis enable 1
```

配置接口 HundredGigE1/0/4 的网络类型为 P2P。

```
[H3C-HundredGigE1/0/4] isis circuit-type p2p
[H3C-HundredGigE1/0/4] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
```

```
Boot version                : 1.3.8
Software version          : S6500_RGOS 11.0(5)B9P59
Serial number              : G1QH10Q10637A
```

创建 IS-IS 实例。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#route isis 1
```

设置 IS-IS 的 NET 地址。

```
Ruijie(config-router)#net 48.0001.1001.7220.0170.00
```

指定 IS-IS 所运行的 Level。

```
Ruijie(config-router)#is-type level-1-2
Ruijie(config-router)#exit
```

将接口设置为 3 层模式，并配置 IP 地址。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#no shutdown
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 100.0.0.2 24
```

在接口上设置该接口支持 IPv4 IS-IS 路由。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip router isis 1
```

将 Broadcast 类型的接口设置为 Point-to-Point 类型。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#isis network point-to-point
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

将接口设置为 3 层模式，并配置 IP 地址。

```
Ruijie(config)#interface hundredGigabitEthernet 0/50
Ruijie(config-if-HundredGigabitEthernet 0/50)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/50)#no shutdown
Ruijie(config-if-HundredGigabitEthernet 0/50)#ip address 200.0.0.2 24
```

在接口上设置该接口支持 IPv4 IS-IS 路由。

```
Ruijie(config-if-HundredGigabitEthernet 0/50)#ip router isis 1
```

将 Broadcast 类型的接口设置为 Point-to-Point 类型。

```
Ruijie(config-if-HundredGigabitEthernet 0/50)#isis network point-to-point
Ruijie(config-if-HundredGigabitEthernet 0/50)#exit
```

4.3.4 验证配置

在 H3C 设备上验证 IS-IS 的邻居信息。

```
<H3C> display isis peer

                         Peer information for IS-IS(1)
                         ----------------------------


 System ID: 1001.7220.0170
 Interface: HGE0/0/3               Circuit Id:  001
 State: Up     HoldTime: 29s       Type: L2          PRI: --
```

```
 System ID: 1001.7220.0170
 Interface: HGE1/0/4                Circuit Id:  002
 State: Up     HoldTime: 26s        Type: L2           PRI: --
```

在 H3C 设备上验证所有 ISIS 路由信息。

```
<H3C> display ip routing-table protocol isis

Summary count : 2

ISIS Routing table status : <Active>
Summary count : 0

ISIS Routing table status : <Inactive>
Summary count : 2

Destination/Mask    Proto   Pre Cost        NextHop         Interface
100.0.0.0/24        IS_L2   15  10          0.0.0.0         HGE1/0/3
200.0.0.0/24        IS_L2   15  10          0.0.0.0         HGE1/0/4
```

5 NTP 对接操作指导

5.1 与思科设备对接操作指导

5.1.1 互通性分析

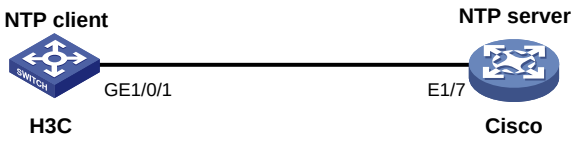
表13 NTP 互通性分析

H3C	Cisco	互通结论
作为NTP Server	作为NTP单播Client	可以时间同步
作为NTP单播Client	作为NTP Server	可以时间同步

5.1.2 组网需求

如图 19所示，H3C 设备与 Cisco 设备通过各自的三层以太网接口相互连接，现要求 H3C 设备作为 NTP 客户端，Cisco 设备作为 NTP 服务器，实现 H3C 设备与 Cisco 设备的时间同步。

图19 NTP 对接配置组网图



5.1.3 配置步骤

- 配置 H3C 设备

配置接口 GigabitEthernet1/0/1 的 IP 地址。

```
<H3C> system-view
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] ip address 16.10.10.11 255.255.255.0
[H3C-GigabitEthernet1/0/1] quit
```

开启 NTP 服务。

```
[H3C] ntp-service enable
```

配置通过 NTP 协议获取时间。

```
[H3C] clock protocol ntp
```

配置设备的 NTP 服务器为 16.10.10.10。

```
[H3C] ntp-service unicast-server 16.10.10.10
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
```

```
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

配置 NTP。

```
Cisco# configure terminal
Cisco(config)# interface Ethernet 1/7
Cisco(config-if)# ip address 16.10.10.10/24
Cisco(config-if)# exit
Cisco(config)# feature ntp
Cisco(config)# ntp master
```

5.1.4 验证配置

在 H3C 设备上验证系统当前日期和时间。

```
[H3C] display clock
06:07:42.650 UTC Tue 03/29/2011
```

在 H3C 设备上验证 NTP 服务的所有 IPv4 会话的简要信息。

```
[H3C] display ntp-service sessions
       source          reference       stra reach poll  now offset  delay disper
**************************************************************************
[12345]16.10.10.10     127.127.1.0        9   255   64   22 -2.882 2.9144 2.7313
Notes: 1 source(master), 2 source(peer), 3 selected, 4 candidate, 5 configured.
 Total sessions: 1
```

在 Cisco 设备上验证显示系统当前日期和时间。

```
Cisco(config)# show clock
06:06:51.294 UTC Tue Mar 29 2011
```

5.2 与华为设备对接操作指导

5.2.1 互通性分析

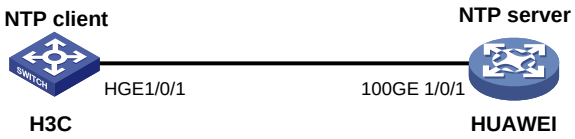
表14 NTP 互通性分析

H3C	华为	互通结论
作为NTP Server	作为NTP 单播Client	可以时间同步
作为NTP 单播Client	作为NTP Server	可以时间同步

5.2.2 组网需求

如图 20 所示，H3C 设备与华为设备通过各自的三层以太网接口相互连接，现要求 H3C 设备作为 NTP 客户端，华为设备作为 NTP 服务器，实现 H3C 设备与华为设备的时间同步。

图20 NTP 对接配置组网图



5.2.3 配置步骤

- 配置 H3C 设备

配置接口 HundredGigE 1/0/1 的 IP 地址。

```
<H3C> system-view
[H3C]interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
[H3C-HundredGigE1/0/1] quit
```

开启 NTP 服务。

```
[H3C] ntp-service enable
```

配置通过 NTP 协议获取时间。

```
[H3C] clock protocol ntp
```

配置设备的 NTP 服务器为 100.0.0.2。

```
[H3C] ntp-service unicast-server 100.0.0.2
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI>display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

设置接口的 IP 地址。

```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]ip address 100.0.0.2 24
```

```
[HUAWEI-100GE1/0/1]quit
```
开启 IPv4 和 IPv6NTP 功能。
```
[HUAWEI]undo ntp server disable
```
设置本地时钟作为 NTP 主时钟，为其它设备提供同步时间。
```
[HUAWEI]ntp-service refclock-master 2
```

5.2.4 验证配置

在 H3C 设备上验证系统当前日期和时间。
```
[H3C] display clock
11:19:56 UTC Thu 03/31/2022
```
在华为设备上验证显示系统当前日期和时间。
```
[HUAWEI] display clock
2022-03-31 11:20:01
Thursday
Time Zone(DefaultZoneName) : UTC
```

5.3 与锐捷设备对接操作指导

5.3.1 互通性分析

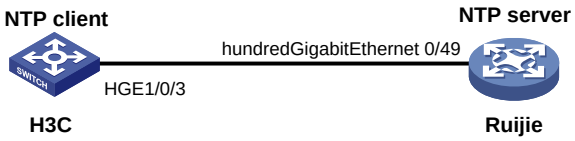
表15 NTP 互通性分析

H3C	锐捷	互通结论
作为NTP Server	作为NTP 单播Client	可以时间同步
作为NTP 单播Client	作为NTP Server	可以时间同步

5.3.2 组网需求

如图 21 所示，H3C 设备与锐捷设备通过各自的三层以太网接口相互连接，现要求 H3C 设备作为 NTP 客户端，锐捷设备作为 NTP 服务器，实现 H3C 设备与锐捷设备的时间同步。

图21 NTP 对接配置组网图



5.3.3 配置步骤

- 配置 H3C 设备

配置接口 HundredGigE1/0/3 的 IP 地址。
```
<H3C>system-view
```

```
[H3C]interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] ip address 100.0.0.1 24
[H3C-HundredGigE1/0/3] quit
```

开启 NTP 服务。

```
[H3C] ntp-service enable
```

配置通过 NTP 协议获取时间。

```
[H3C] clock protocol ntp
```

配置设备的 NTP 服务器为 100.0.0.2。

```
[H3C] ntp-service unicast-server 100.0.0.2
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

将接口设置为 3 层模式，并配置 IP 地址。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#no shutdown
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 100.0.0.2 24
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

设置 NTP 主时钟功能。

```
Ruijie(config)#ntp master
```

5.3.4 验证配置

在 H3C 设备上验证系统当前日期和时间。

```
[H3C] display clock
19:51:01 UTC Mon 04/11/2022
```

在锐捷设备上验证显示系统当前日期和时间。

```
Ruijie(config)#show clock
19:51:18 UTC Mon, Apr 11, 2022
```

6 LLDP 对接操作指导

6.1 与思科设备对接操作指导

6.1.1 互通性分析

LLDP（Link Layer Discovery Protocol，链路层发现协议）为链路发现标准协议，可以使不同厂商的设备能够在网络中相互发现并交互各自的系统及配置信息。在与其它厂商的设备异构对接时，两端设备均开启 LLDP 功能即可。如果思科使用私有协议 CDP，则需要在 H3C 设备端开启 LLDP 兼容 CDP 功能。

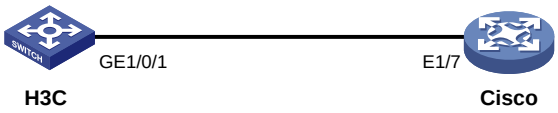
表16 LLDP 互通性分析

H3C	Cisco	互通结论
LLDP工作模式为TxRx	LLDP工作模式为TxRx	可以建立LLDP邻居
LLDP	CDP	在H3C设备上开启LLDP兼容CDP功能的情况下，可以互通

6.1.2 组网需求

如图 22 所示，H3C 设备与 Cisco 设备通过各自的二层以太网接口相互连接，现要求 H3C 设备与 Cisco 设备对接建立 LLDP 邻居，实现双方能够在网络中相互发现并交互各自的系统及配置信息。

图22 LLDP 对接配置组网图



6.1.3 配置步骤

- 配置 H3C 设备

全局开启 LLDP 功能。

```
<H3C> system-view
[H3C] lldp global enable
```

在接口 GigabitEthernet1/0/1 上开启 LLDP 功能。

```
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] lldp enable
```

配置接口 GigabitEthernet1/0/1 上最近客户桥代理 LLDP 的工作模式为 TxRx。

```
[H3C-GigabitEthernet1/0/1] lldp admin-status txrx
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C9236C 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
```

```
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2017, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
 BIOS: version 07.56
 NXOS: version 7.0(3)I4(6)
 BIOS compile time:  06/08/2016
 NXOS image file is: bootflash:///nxos.7.0.3.I4.6.bin
 NXOS compile time:  3/9/2017 22:00:00 [03/10/2017 07:05:18]
Hardware
 cisco Nexus9000 C9236C chassis
Intel(R) Xeon(R) CPU  @ 1.80GHz with 16400984 kB of memory.
 Processor Board ID FDO20511FC7
Device name: switch
 bootflash:   53298520 kB
Kernel uptime is 17 day(s), 20 hour(s), 9 minute(s), 30 second(s)
Last reset
Reason: Unknown
 System version: 7.0(3)I4(6)
 Service:
plugin
 Core Plugin, Ethernet Plugin
Active Package(s):
```

配置 LLDP。

```
Cisco# configure terminal
Cisco(config)# interface Ethernet 1/7
Cisco(config-if)# lldp receive
Cisco(config-if)# lldp transmit
Cisco(config-if)# exit
```

6.1.4 验证配置

在 H3C 设备上验证所有接口最近桥代理收到的由邻居设备发来的 LLDP 详细信息。

```
[H3C] display lldp neighbor-information
LLDP neighbor-information of port 371[GigabitEthernet1/0/1]:
LLDP agent nearest-bridge:
 LLDP neighbor index : 1
 ChassisID/subtype    : 2c33-113a-eb08/MAC address
 PortID/subtype       : Ethernet1/7/Interface name
 Capabilities         : Bridge, Router
```

在 H3C 设备上验证按列表显示由邻居设备发来的 LLDP 信息。

```
[H3C] display lldp neighbor-information list
Chassis ID : * -- -- Nearest nontpmr bridge neighbor
             # -- -- Nearest customer bridge neighbor
             Default -- -- Nearest bridge neighbor
Local Interface Chassis ID      Port ID                 System Name
GE1/0/1         2c33-113a-eb08  Ethernet1/7             Cisco
```

6.2 与华为设备对接操作指导

6.2.1 互通性分析

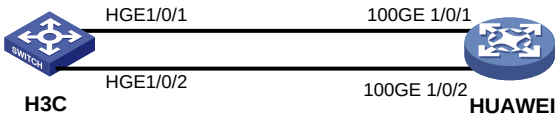
表17 LLDP 互通性分析

H3C	华为	互通结论
工作模式为TxRx	工作模式为TxRx	可以建立LLDP邻居

6.2.2 组网需求

如图 23 所示，H3C 设备与华为设备通过各自的二层以太网接口相互连接，现要求 H3C 设备与华为设备对接建立 LLDP 邻居，实现双方能够在网络中相互发现并交互各自的系统及配置信息。

图23 LLDP 对接配置组网图



6.2.3 配置步骤

- 配置 H3C 设备

全局开启 LLDP 功能。

```
<H3C> system-view
[H3C] lldp global enable
```

在接口 HundredGigE1/0/1 上开启 LLDP 功能。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] lldp enable
```

配置接口 HundredGigE1/0/1 上最近客户桥代理 LLDP 的工作模式为 TxRx。

```
[H3C-HundredGigE1/0/1] lldp admin-status txrx
[H3C-HundredGigE1/0/1] quit
```
在接口 HundredGigE1/0/2 上开启 LLDP 功能。
```
[H3C] interface HundredGigE 1/0/2
[H3C-HundredGigE1/0/2] lldp enable
```
配置接口 HundredGigE1/0/2 上最近客户桥代理 LLDP 的工作模式为 TxRx。
```
[H3C-HundredGigE1/0/2] lldp admin-status txrx
[H3C-HundredGigE1/0/2] quit
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI>display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```
使能全局的 LLDP 功能。
```
<HUAWEI> system-view immediately
Enter system view, return user view with return command.
[HUAWEI]lldp enable
```
使能接口的 LLDP 功能。
```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]undo lldp disable
```
指定 LLDP 工作在 Tx 和 Rx 模式。
```
[HUAWEI-100GE1/0/1]lldp admin-status txrx
[HUAWEI-100GE1/0/1]quit
```
使能接口的 LLDP 功能。
```
[HUAWEI]interface 100GE 1/0/2
[HUAWEI-100GE1/0/2]undo lldp disable
```
指定 LLDP 工作在 Tx 和 Rx 模式。
```
[HUAWEI-100GE1/0/2]lldp admin-status txrx
[HUAWEI-100GE1/0/2]quit
```

6.2.4 验证配置

在 H3C 设备上验证所有接口最近桥代理收到的由邻居设备发来的 LLDP 详细信息。

```
[H3C] display lldp neighbor-information
LLDP neighbor-information of port 51[HundredGigE1/0/1]:
LLDP agent nearest-bridge:
 LLDP neighbor index : 2
 ChassisID/subtype   : a4be-2b3a-50d1/MAC address
 PortID/subtype      : 100GE1/0/1/Interface name
 Capabilities        : Bridge, Router

LLDP neighbor-information of port 98[HundredGigE1/0/2]:
LLDP agent nearest-bridge:
 LLDP neighbor index : 2
 ChassisID/subtype   : a4be-2b3a-50d1/MAC address
 PortID/subtype      : 100GE1/0/2/Interface name
 Capabilities        : Bridge, Router
```

在 H3C 设备上验证按列表显示由邻居设备发来的 LLDP 信息。

```
[H3C] display lldp neighbor-information list
Chassis ID : * -- -- Nearest nontpmr bridge neighbor
             # -- -- Nearest customer bridge neighbor
             Default -- -- Nearest bridge neighbor
Local Interface Chassis ID      Port ID                       System Name
HGE1/0/1        a4be-2b3a-50d1  100GE1/0/1                    HUAWEI
HGE1/0/2        a4be-2b3a-50d1  100GE1/0/2                    HUAWEI
```

6.3 与锐捷设备对接操作指导

6.3.1 互通性分析

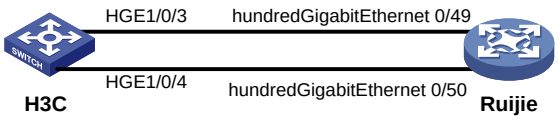
表18 LLDP 互通性分析

H3C	锐捷	互通结论
工作模式为TxRx	工作模式为TxRx	可以建立LLDP邻居

6.3.2 组网需求

如图 24 所示，H3C 设备与锐捷设备通过各自的二层以太网接口相互连接，现要求 H3C 设备与锐捷设备对接建立 LLDP 邻居，实现双方能够在网络中相互发现并交互各自的系统及配置信息。

图24 LLDP 对接配置组网图



6.3.3 配置步骤

- 配置 H3C 设备

全局开启 LLDP 功能。

```
<H3C> system-view
[H3C] lldp global enable
```

在接口 HundredGigE1/0/3 上开启 LLDP 功能。

```
[H3C]interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] lldp enable
```

配置接口 HundredGigE1/0/3 上最近客户桥代理 LLDP 的工作模式为 TxRx。

```
[H3C-HundredGigE1/0/3] lldp admin-status txrx
[H3C-HundredGigE1/0/3] quit
```

在接口 HundredGigE1/0/4 上开启 LLDP 功能。

```
[H3C]interface HundredGigE 1/0/4
[H3C-HundredGigE1/0/4] lldp enable
```

配置接口 HundredGigE1/0/3 上最近客户桥代理 LLDP 的工作模式为 TxRx。

```
[H3C-HundredGigE1/0/4] lldp admin-status txrx
[H3C-HundredGigE1/0/4] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQI 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

打开 LLDP 功能。

```
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#lldp enable
```

打开接口的 LLDP 功能。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#lldp enable
```

配置 LLDP 的工作模式。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#lldp mode txrx
```

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```
打开接口的 LLDP 功能。
```
Ruijie(config)#interface hundredGigabitEthernet 0/50
Ruijie(config-if-HundredGigabitEthernet 0/50)#lldp enable
```
配置 LLDP 的工作模式。
```
Ruijie(config-if-HundredGigabitEthernet 0/50)#lldp mode txrx
Ruijie(config-if-HundredGigabitEthernet 0/50)#exit
```

6.3.4 验证配置

在 H3C 设备上验证所有接口最近桥代理收到的由邻居设备发来的 LLDP 详细信息。
```
[H3C] display lldp neighbor-information
LLDP neighbor-information of port 5[HundredGigE1/0/3]:
LLDP agent nearest-bridge:
 LLDP neighbor index : 1
 ChassisID/subtype   : c0b8-e672-cd08/MAC address
 PortID/subtype      : HundredGigabitEthernet 0/49/Interface name
 Capabilities        : Repeater, Bridge, Router

LLDP neighbor-information of port 6[HundredGigE1/0/4]:
LLDP agent nearest-bridge:
 LLDP neighbor index : 1
 ChassisID/subtype   : c0b8-e672-cd08/MAC address
 PortID/subtype      : HundredGigabitEthernet 0/50/Interface name
 Capabilities        : Repeater, Bridge, Router
```
在 H3C 设备上验证按列表显示由邻居设备发来的 LLDP 信息。
```
[H3C] display lldp neighbor-information list
Chassis ID : * -- -- Nearest nontpmr bridge neighbor
             # -- -- Nearest customer bridge neighbor
             Default -- -- Nearest bridge neighbor
Local Interface Chassis ID      Port ID                         System Name
HGE1/0/3        c0b8-e672-cd08  HundredGigabitEthernet 0/49     Ruijie
HGE1/0/4        c0b8-e672-cd08  HundredGigabitEthernet 0/50     Ruijie
```

7 PIM SM 对接操作指导

7.1 与思科设备对接操作指导

7.1.1 互通性分析

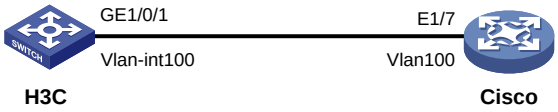
表19 PIM SM 互通性分析

H3C	Cisco	互通结论
启动PIM SM协议	启动PIM SM协议	实现三层组播点播

7.1.2 组网需求

如图 25 所示，H3C 设备与 Cisco 设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备与 Cisco 设备之间实现三层组播互通。

图25 PIM SM 对接配置组网图



7.1.3 配置步骤

- 配置 H3C 设备

先使能公网中的 IP 组播路由，再进入公网的 PIM 视图。

```
<H3C> system-view
[H3C] multicast routing
[H3C-mrib] quit
[H3C] pim
```

将 IP 地址为 16.1.10.4 的设备配置为 Global 域的 C-BSR。

```
[H3C-pim] c-bsr 16.1.10.4
```

指定 C-RP 的 IP 地址为 16.1.10.4 。

```
[H3C-pim] c-rp 16.1.10.4
[H3C-pim] quit
```

创建 VLAN 100。

```
[H3C] vlan 100
[H3C-Vlan100] quit
```

配置 VLAN 接口 100 的 IP 地址。

```
[H3C] interface vlan-interface 100
[H3C-Vlan-interface-100] ip address 16.1.10.4 255.255.255.0
```

使能 PIM-SM。

```
[H3C-Vlan-interface-100] pim sm
[H3C-Vlan-interface-100] quit
```

配置端口 GigabitEthernet1/0/1 配置为 Trunk 端口，允许 VLAN 100 通过。

```
[H3C] interface gigabitethernet 1/0/1
[H3C-GigabitEthernet1/0/1] port link-type trunk
[H3C-GigabitEthernet1/0/1] port trunk permit vlan 100
[H3C-GigabitEthernet1/0/1] quit
```

- 配置 Cisco 设备

如下配置以 Cisco Nexus9000 C93180YC-FX 为例进行介绍，设备具体信息如下：

```
Cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2019, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
```

```
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.

Software
  BIOS: version 05.43
 NXOS: version 9.3(3)
  BIOS compile time:  11/22/2020
  NXOS image file is: bootflash:///nxos.9.3.3.bin
  NXOS compile time:  12/22/2019 2:00:00 [12/22/2019 14:00:37]



Hardware
  cisco Nexus9000 C93180YC-FX Chassis
  Intel(R) Xeon(R) CPU D-1528 @ 1.90GHz with 32827212 kB of memory.
  Processor Board ID FDO25250294

  Device name: cisco-leaf2
  bootflash:  115805708 kB
Kernel uptime is 167 day(s), 6 hour(s), 51 minute(s), 41 second(s)

Last reset at 744629 usecs after Thu Jan 13 02:02:26 2022
  Reason: Module PowerCycled
  System version:
  Service: HW check by card-client

plugin
  Core Plugin, Ethernet Plugin

Active Package(s):
```

配置 PIM。

```
Cisco# configure terminal
Cisco(config)# feature pim
Cisco(config)# ip pim auto-rp forward listen
Cisco(config)# ip pim bsr forward listen
```

配置接口的 IP 地址。

```
Cisco(config)# interface vlan 100
```

```
Cisco(config-if)# ip address 16.1.10.2 255.255.255.0
```
配置组播 PIM Sparse 模式。
```
Cisco(config-if)# ip pim sparse-mode
Cisco(config-if)# exit
```
设置 Ethernet1/9 为 Trunk，且端口为 vlan100 的成员端口。
```
Cisco(config)# interface Ethernet 1/9
Cisco(config-if)# switchport
Cisco(config-if)# switchport mode trunk
Cisco(config-if)# switchport trunk allowed vlan 100
Cisco(config-if)# exit
```

7.1.4 验证配置

在 H3C 设备上验证所有接口上的 PIM 信息。
```
[H3C] display pim interface
 Interface         NbrCnt  HelloInt  DR-Pri     DR-Address
 Vlan100           1       30        1          16.1.10.4 (local)
```
在 H3C 设备上验证所有 PIM 邻居。
```
[H3C] display pim neighbor
 Total Number of Neighbors = 1

 Neighbor        Interface           Uptime   Expires  DR-Priority Mode
 16.1.10.2       Vlan100             00:12:15 00:01:26 1           B
```
在 H3C 设备上显示 PIM-SM 域中的 BSR 信息
```
[H3C] display pim bsr-info
 Scope: non-scoped
     State: Elected
     Bootstrap timer: 00:00:27
     Elected BSR address: 16.1.10.4
       Priority: 64
       Hash mask length: 30
       Uptime: 00:00:53
     Candidate BSR address: 16.1.10.4
       Priority: 64
       Hash mask length: 30
```
在 H3C 设备上所有组播组对应的 RP 信息
```
[H3C] display pim rp-info
 BSR RP information:
   Scope: non-scoped
     Group/MaskLen: 224.0.0.0/4
       RP address               Priority  HoldTime  Uptime    Expires
       16.1.10.4 (local)        192       180       00:17:12  00:02:47
```
在思科设备上验证所有接口上的 PIM 信息
```
Cisco(config-if)# show ip pim interface
PIM Interface Status for VRF "default"
Vlan100, Interface status: protocol-up/link-up/admin-up
  IP address: 16.1.10.2, IP subnet: 16.1.10.0/24
  PIM DR: 16.1.10.4, DR's priority: 1
```

```
  PIM neighbor count: 1
  PIM hello interval: 30 secs, next hello sent in: 00:00:17
  PIM neighbor holdtime: 105 secs
  PIM configured DR priority: 1
  PIM configured DR delay: 3 secs
  PIM border interface: no
  PIM GenID sent in Hellos: 0x21f2f9b7
  PIM Hello MD5-AH Authentication: disabled
  PIM Neighbor policy: none configured
  PIM Join-Prune inbound policy: none configured
  PIM Join-Prune outbound policy: none configured
  PIM Join-Prune interval: 1 minutes
  PIM Join-Prune next sending: 0 minutes
  PIM BFD enabled: no
  PIM passive interface: no
  PIM VPC SVI: no
  PIM Auto Enabled: no
  PIM Interface Statistics, last reset: never
    General (sent/received):
      Hellos: 61/55 (early: 0), JPs: 0/0, Asserts: 0/0
      Grafts: 0/0, Graft-Acks: 0/0
      DF-Offers: 0/0, DF-Winners: 0/0, DF-Backoffs: 0/0, DF-Passes: 0/0
    Errors:
      Checksum errors: 0, Invalid packet types/DF subtypes: 0/0
      Authentication failed: 0
      Packet length errors: 0, Bad version packets: 0, Packets from self: 0
      Packets from non-neighbors: 0
          Packets received on passiveinterface: 0
      JPs received on RPF-interface: 0
      (*,G) Joins received with no/wrong RP: 0/0
      (*,G)/(S,G) JPs received for SSM/Bidir groups: 0/0
      JPs filtered by inbound policy: 0
      JPs filtered by outbound policy: 0
```

在思科设备上验证所有 PIM 邻居。

```
Cisco(config-if)# show ip pim neighbor
PIM Neighbor Status for VRF "default"
Neighbor       Interface          Uptime    Expires   DR      Bidir-  BFD    ECMP Redirect
                                                      Priority Capable State   Capable
16.1.10.4       Vlan100             00:23:12  00:01:43  1        no     n/a     no
```

在思科设备上验证所有 RP 信息。

```
Cisco(config-if)# show ip pim rp
PIM RP Status Information for VRF "default"
BSR: 16.1.10.4, uptime: 00:05:41, expires: 00:01:49,
     priority: 64, hash-length: 30
Auto-RP RPA: unknown
BSR RP Candidate policy: None
BSR RP policy: None
Auto-RP Announce policy: None
```

```
Auto-RP Discovery policy: None

RP: 16.1.10.4, (0),
 uptime: 00:05:20   priority: 192,
 RP-source: 16.1.10.4 (B),
 group ranges:
 224.0.0.0/4   , expires: 00:02:39 (B)
cisco-leaf2(config-if)#
```

在思科设备上验证所有 route 信息。

```
Cisco(config-if)# show ip pim route
PIM Routing Table for VRF "default" - 1 entries

(*, 232.0.0.0/8), expires 00:02:20
  Incoming interface: Null, RPF nbr 0.0.0.0
  Oif-list:       (0) 00000000, Timeout-list: (0) 00000000
  Immediate-list: (0) 00000000, Immediate-timeout-list: (0) 00000000
  Sgr-prune-list: (0) 00000000  Timeout-interval: 2, JP-holdtime round-up: 3
```

7.2 与华为设备对接操作指导

7.2.1 互通性分析

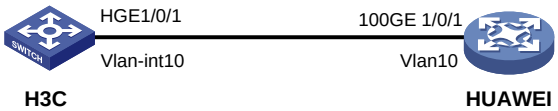
表20 PIM SM 互通性分析

H3C	华为	互通结论
支持	支持	可以互通

7.2.2 组网需求

如图 26 所示，H3C 设备与华为设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备与华为设备之间实现三层组播互通。

图26 PIM SM 对接配置组网图



7.2.3 配置步骤

- 配置 H3C 设备

先使能公网中的 IP 组播路由，再进入公网的 PIM 视图。

```
<H3C> system-view
[H3C] multicast routing
[H3C-mrib] quit
[H3C] pim
```

将 IP 地址为 100.0.0.1 的设备配置为 Global 域的 C-BSR。

```
[H3C-pim] c-bsr 100.0.0.1
```
指定 C-RP 的 IP 地址为 100.0.0.1 。
```
[H3C-pim] c-rp 100.0.0.1
[H3C-pim] quit
```
创建 VLAN 10。
```
[H3C] vlan 10
[H3C-vlan10] quit
```
配置端口 HundredGigE1/0/1 配置为 Trunk 端口，允许 VLAN 10 通过。
```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-type trunk
[H3C-HundredGigE1/0/1] port trunk permit vlan 10
[H3C-HundredGigE1/0/1] quit
```
配置 VLAN 接口 100 的 IP 地址。
```
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] undo shutdown
[H3C-Vlan-interface10] ip address 100.0.0.1 24
```
使能 PIM-SM。
```
[H3C-Vlan-interface10] pim sm
[H3C-Vlan-interface10] quit
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```
使能组播功能。
```
<HUAWEI>system-view immediately
Enter system view, return user view with return command.
[HUAWEI]multicast routing-enable
```
创建一个 ID 为 2 的 VLAN。
```
[HUAWEI]vlan 10
[HUAWEI-vlan10]quit
```
将接口 100GE1/0/1 的链路类型设置为 Trunk，并允许通过的 VLAN 为 10。

```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]port link-type trunk
[HUAWEI-100GE1/0/1]port trunk allow-pass vlan 10
[HUAWEI-100GE1/0/1]quit
```

配置 VLANIF 接口的 IP 地址。

```
[HUAWEI]interface Vlanif 10
[HUAWEI-Vlanif10]ip address 100.0.0.2 24
```

在接口上使能 PIM-SM。

```
[HUAWEI-Vlanif10]pim sm
[HUAWEI-Vlanif10]quit
```

7.2.4 验证配置

在 H3C 设备上验证所有接口上的 PIM 信息。

```
[H3C] display pim interface
 Interface         NbrCnt  HelloInt  DR-Pri     DR-Address
 Vlan10            1       30        1          100.0.0.2
```

在 H3C 设备上验证所有 PIM 邻居。

```
[H3C] display pim neighbor
 Total Number of Neighbors = 1

 Neighbor        Interface           Uptime   Expires  DR-Priority Mode
 100.0.0.2       Vlan10              00:02:29 00:01:16 1
```

在 H3C 设备上显示 PIM-SM 域中的 BSR 信息。

```
[H3C] display pim bsr-info
 Scope: non-scoped
     State: Elected
     Bootstrap timer: 00:00:56
     Elected BSR address: 100.0.0.1
       Priority: 64
       Hash mask length: 30
       Uptime: 00:02:13
     Candidate BSR address: 100.0.0.1
       Priority: 64
       Hash mask length: 30
```

在 H3C 设备上所有组播组对应的 RP 信息。

```
[H3C] display pim rp-info
 BSR RP information:
   Scope: non-scoped
     Group/MaskLen: 224.0.0.0/4
       RP address               Priority  HoldTime  Uptime    Expires
       100.0.0.1 (local)        192       180       00:02:34  00:02:25
```

在 HUAWEI 设备上验证所有接口上的 PIM 信息。

```
[HUAWEI] display pim interface
 VPN-Instance: public net
 Interface           State NbrCnt HelloInt     DR-Pri     DR-Address
 Vlanif10            up         1       30          1     100.0.0.2 (local)
```

HUAWEI 设备上显示所有 PIM 邻居。

```
[HUAWEI] display pim neighbor
 VPN-Instance: public net
 Total: 1

        Neighbor           Interface   Uptime  Expires  Dr-Priority BFD-Session
       100.0.0.1            Vlanif10 00:32:53 00:01:30            1          N
```

在 HUAWEI 设备上显示 PIM-SM 域中的 BSR 信息。

```
[HUAWEI] display pim bsr-info
 VPN-Instance: public net
 Elected AdminScoped BSR Count: 0
 Elected BSR Address: 100.0.0.1
     Priority: 64
     Hash mask length: 30
     State: Accept Preferred
     Scope: Not scoped
```

在 HUAWEI 设备上所有组播组对应的 RP 信息。

```
[HUAWEI] display pim rp-info
 VPN-Instance: public net
 PIM-SM BSR RP Number:1
 Group/MaskLen: 224.0.0.0/4
     RP: 100.0.0.1
     Priority: 192
     Uptime: 00:08:58
     Expires: 00:02:48
     BIDIR: N
     Uptime: 00:09:16
     Expires: 00:01:40
     C-RP Count: 1
```

7.3 与锐捷设备对接操作指导

7.3.1 互通性分析

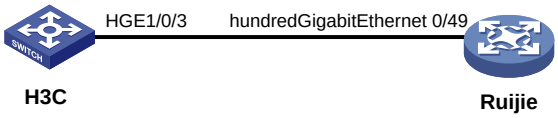
表21 PIM SM 互通性分析

H3C	锐捷	互通结论
支持	支持	可以互通

7.3.2 组网需求

如图 27 所示，H3C 设备与锐捷设备通过各自的二层以太网接口相互连接。现要求在 H3C 设备与锐捷设备之间实现三层组播互通。

图27 PIM SM 对接配置组网图



7.3.3 配置步骤

- 配置 H3C 设备

先使能公网中的 IP 组播路由，再进入公网的 PIM 视图。

```
<H3C>system-view
[H3C] multicast routing
[H3C-mrib] quit
[H3C] pim
```

将 IP 地址为 100.0.0.1 的设备配置为 Global 域的 C-BSR。

```
[H3C-pim] c-bsr 100.0.0.1
```

指定 C-RP 的 IP 地址为 100.0.0.1。

```
[H3C-pim] c-rp 100.0.0.1
[H3C-pim] quit
```

创建 VLAN10。

```
[H3C] vlan 10
[H3C-vlan10] quit
```

配置端口 HundredGigE1/0/3 配置为 Trunk 端口，允许 VLAN10 通过。

```
[H3C] interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] port link-type trunk
[H3C-HundredGigE1/0/3] port trunk permit vlan 10
[H3C-HundredGigE1/0/3] quit
```

配置 VLAN 接口 10 的 IP 地址。

```
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 24
```

使能 PIM-SM。

```
[H3C-Vlan-interface10] pim sm
[H3C-Vlan-interface10] quit
```

- 配置锐捷设备

如下配置以锐捷 RG-S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
```

```
Slot 0 : RG-S6510-48VS8CQ
   Hardware version        : 2.30
   Boot version               : 1.3.8
   Software version         : S6500_RGOS 11.0(5)B9P59
   Serial number             : G1QH10Q10637A
```

启动组播路由。

```
Ruijie>enable
Ruijie#configure terminal
Ruijie(config)#ip multicast-routing
```

创建 VLAN10。

```
Ruijie(config)#vlan 10
Ruijie(config-vlan)#exit
```

将一个二层 Trunk 接口 HundredGigabitEthernet0/49 加入 VLAN10。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport mode trunk
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport trunk allowed vlan only 10
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

#进入 VLAN10 的配置模式，配置 IP 地址。

```
Ruijie(config)#interface vlAN 10
Ruijie(config-if-VLAN 10)#ip address 100.0.0.2 24
```

在当前接口上启用 PIM-SM。

```
Ruijie(config-if-VLAN 10)#ip pim sparse-mode
Ruijie(config-if-VLAN 10)#exit
```

7.3.4 验证配置

在 H3C 设备上验证所有接口上的 PIM 信息。

```
[H3C] display pim interface
 Interface          NbrCnt  HelloInt  DR-Pri     DR-Address
 Vlan10             1       30        1          100.0.0.2
```

在 H3C 设备上验证所有 PIM 邻居。

```
[H3C] display pim neighbor
 Total Number of Neighbors = 1

 Neighbor        Interface           Uptime   Expires  DR-Priority Mode
 100.0.0.2       Vlan10              00:03:25 00:01:20 1
```

在 H3C 设备上验证 PIM-SM 域中的 BSR 信息。

```
[H3C] display pim bsr-info
 Scope: non-scoped
     State: Elected
     Bootstrap timer: 00:00:37
     Elected BSR address: 100.0.0.1
       Priority: 64
       Hash mask length: 30
       Uptime: 00:06:33
     Candidate BSR address: 100.0.0.1
```

```
       Priority: 64
       Hash mask length: 30
```
#在显示 H3C 设备上所有组播组对应的 RP 信息。
```
[H3C] display pim rp-info
 BSR RP information:
   Scope: non-scoped
     Group/MaskLen: 224.0.0.0/4
       RP address              Priority  HoldTime  Uptime    Expires
       100.0.0.1 (local)       192       180       02:59:48  00:02:12
```
在锐捷设备上验证所有接口上的 PIM 信息。
```
Ruijie#show ip pim sparse-mode interface
Address         Interface               VIFindex Ver/Mode Nbr-Count DR-Prior    DR
100.0.0.2       VLAN 10                 1        v2/S     1         1           100.0.0.2
```
在锐捷设备上查看所有的 PIM 邻居。
```
Ruijie#show ip pim sparse-mode neighbor
Neighbor          Interface               Uptime/Expires      Ver   DR
Address                                                             Priority/Mode
100.0.0.1         VLAN 10                 02:55:09/00:01:20   v2    1 /
```
在锐捷设备上查看 BSR 信息。
```
Ruijie#show ip pim sparse-mode bsr-router
PIMv2 Bootstrap information
  BSR address: 100.0.0.1
  Uptime:      00:36:06, BSR Priority: 64, Hash mask length: 30
  Expires:     00:01:24
  Role: Non-candidate BSR   Priority: 0, Hash mask length: 10
  State: Accept Preferred
```
在锐捷设备上查看本机上所有的 RP 及其服务的组。
```
Ruijie#show ip pim sparse-mode rp mapping
PIM Group-to-RP Mappings
Group(s): 224.0.0.0/4
  RP: 100.0.0.1(Not self)
    Info source: 100.0.0.1, via bootstrap, priority 192
         Uptime: 00:36:04, expires: 00:02:16
```

8 BFD 对接操作指导

8.1 与思科设备对接操作指导

8.1.1 互通性分析

表22 BFD 互通性分析

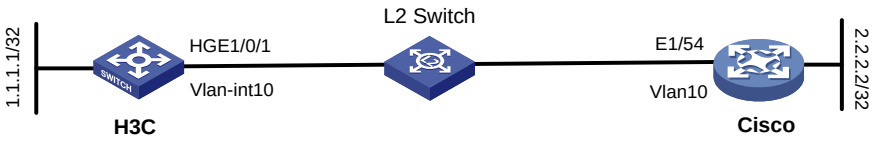
H3C	思科	互通结论
支持	支持	可以互通

8.1.2 采用静态路由联动 BFD 对接案例

1. 组网需求

如图 28 示，H3C 设备与思科设备通过二层交换机连接。现要求使用静态路由与 BFD 联动技术，实现 H3C 设备或思科设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告静态路由。

图28 采用静态路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 VLAN 10。

```
<H3C> system-view
[H3C] vlan 10
[H3C-vlan10] quit
```

配置端口 HundredGigE1/0/1 为 Trunk 口，并允许 VLAN10 通过。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-type trunk
[H3C-HundredGigE1/0/1] port trunk permit vlan 10
[H3C-HundredGigE1/0/1] undo port trunk permit vlan 1
[H3C-HundredGigE1/0/1] quit
```

配置接口 Vlan-interface10 的 IP 地址为 100.0.0.1。

```
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 24
```

配置接口 Vlan-interface10 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-Vlan-interface10] bfd min-transmit-interval 300
```

配置接口 Vlan-interface10 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-Vlan-interface10] bfd min-receive-interval 300
```

配置接口 Vlan-interface10 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-Vlan-interface10] bfd detect-multiplier 3
[H3C-Vlan-interface10] quit
```

配置接口 LoopBack0 的 IP 地址。

```
[H3C] interface LoopBack0
[H3C-LoopBack0] ip address 1.1.1.1 32
[H3C-LoopBack0] quit
```

配置静态路由，并使能 BFD（Bidirectional Forwarding Detection，双向转发检测）功能，对静态路由下一跳的可达性进行快速检测，当下一跳不可达时可以快速切换到备份路由。

```
[H3C] ip route-static 2.2.2.2 32 Vlan-interface10 100.0.0.2 bfd control-packet
```

- 配置思科设备

如下配置以 Cisco Nexus9000 C93180YC-FX 为例进行介绍，设备具体信息如下：

```
cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2019, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
  BIOS: version 05.43
 NXOS: version 9.3(3)
  BIOS compile time:  11/22/2020
  NXOS image file is: bootflash:///nxos.9.3.3.bin
  NXOS compile time:  12/22/2019 2:00:00 [12/22/2019 14:00:37]


Hardware
  cisco Nexus9000 C93180YC-FX Chassis
  Intel(R) Xeon(R) CPU D-1528 @ 1.90GHz with 32827212 kB of memory.
  Processor Board ID FDO25250294
  Device name: cisco-leaf2
  bootflash:  115805708 kB
Kernel uptime is 167 day(s), 6 hour(s), 51 minute(s), 41 second(s)
Last reset at 744629 usecs after Thu Jan 13 02:02:26 2022
  Reason: Module PowerCycled
  System version:
  Service: HW check by card-client
plugin
  Core Plugin, Ethernet Plugin
Active Package(s):
```

创建 vlan10。

```
cisco# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
cisco(config-if)# vlan 10
cisco(config-vlan)# exit
```

将接口 ETH1/54 的链路类型设置为 Trunk，并允许通过的 VLAN 为 10。

```
cisco(config)# interface ethernet 1/54
cisco(config-if)# no shutdown
cisco(config-if)# switchport
cisco(config-if)# switch mode trunk
cisco(config-if)# switchport trunk allowed vlan 10
cisco(config-if)# exit
```

配置 Vlan-interface10 的 IP 地址,Vlan-interface10 的 BFD 参数。

```
cisco(config)# interface vlan 10
cisco(config-if)# no shutdown
cisco(config-if)# ip address 100.0.0.2 255.255.255.0
cisco(config-if)# bfd interval 300 min_rx 300 multiplier 3
cisco(config-if)# exit
```

配置 LoopBack 接口的 IP 地址。

```
cisco(config)# interface loopback 0
cisco(config-if)# ip address 2.2.2.2 255.255.255.255
cisco(config-if)# exit
```

使能静态路由绑定动态 BFD 会话进行快速故障检测。

```
cisco(config)# ip route static bfd vlan 10 100.0.0.1
```

3. 验证配置

在 H3C 设备上验证 BFD 会话概要信息。

```
[H3C] display bfd session
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active
 IPv4 session working in control packet mode:
 LD/RD          SourceAddr      DestAddr        State    Holdtime    Interface
 257/1090519047 100.0.0.1       100.0.0.2       Up       674ms       Vlan10
```

在 H3C 设备上验证 BFD 会话详细信息。

```
[H3C] display bfd session verbose
Total Session Num: 1     Up Session Num: 1     Init Mode: Active
 IPv4 session working in control packet mode:
       Local Discr: 257                 Remote Discr: 1090519047
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
     Session State: Up                      Interface: Vlan-interface10
      Min Tx Inter: 300ms                 Act Tx Inter: 300ms
      Min Rx Inter: 300ms                 Detect Inter: 900ms
          Rx Count: 1300                      Tx Count: 1359
      Connect Type: Direct              Running Up for: 00:05:45
         Hold Time: 784ms                      Auth mode: None
       Detect Mode: Async                           Slot: 1
          Protocol: STATIC
           Version: 1
         Diag Info: No Diagnostic
```

在思科设备上验证 BFD 邻居信息。

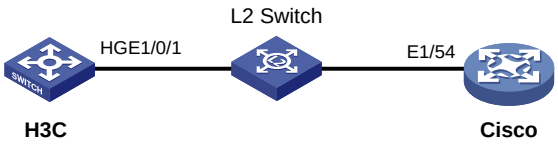
```
cisco(config-if)# show bfd neighbors
OurAddr     NeighAddr    LD/RD    RH/RS   Holdown(mult)   State    Int     Vrf      Type
100.0.0.2    100.0.0.1    1090519047/257   Up    737(3)     Up     Vlan10   default   SH
```

8.1.3 采用 OSPF 路由联动 BFD 对接案例

1. 组网需求

如图 29 所示，H3C 设备与思科设备通过二层交换机连接。现要求使用 OSPF 与 BFD 联动技术，实现 H3C 设备或思科设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 OSPF 路由。

图29 采用 OSPF 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 OSPF 区域 0 并进入 OSPF 区域视图。

```
<H3C> system-view
[H3C] ospf 100
[H3C-ospf-100] area 0
[H3C-ospf-100-area-0.0.0.0]qu
[H3C-ospf-100] quit
```

配置接口 HundredGigE1/0/1 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

配置接口 HundredGigE1/0/1 使能 OSPF 进程 100，接口所在的 OSPF 区域 ID 为 0。

```
[H3C-HundredGigE1/0/1] ospf 100 area 0
```

使能 OSPF 的 BFD 功能。

```
[H3C-HundredGigE1/0/1] ospf bfd enable
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

- 配置思科设备

如下配置以 Cisco Nexus9000 C93180YC-FX 为例进行介绍，设备具体信息如下：

```
cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2019, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
```

```
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
  BIOS: version 05.43
 NXOS: version 9.3(3)
  BIOS compile time:  11/22/2020
  NXOS image file is: bootflash:///nxos.9.3.3.bin
  NXOS compile time:  12/22/2019 2:00:00 [12/22/2019 14:00:37]


Hardware
  cisco Nexus9000 C93180YC-FX Chassis
  Intel(R) Xeon(R) CPU D-1528 @ 1.90GHz with 32827212 kB of memory.
  Processor Board ID FDO25250294
  Device name: cisco-leaf2
  bootflash:  115805708 kB
Kernel uptime is 167 day(s), 6 hour(s), 51 minute(s), 41 second(s)
Last reset at 744629 usecs after Thu Jan 13 02:02:26 2022
  Reason: Module PowerCycled
  System version:
  Service: HW check by card-client
plugin
  Core Plugin, Ethernet Plugin
Active Package(s):
```

运行 OSPF 协议，使能 bfd。

```
cisco# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
cisco(config)# router ospf 100
cisco(config-router)# area 0 default-cost 1
cisco(config-router)# bfd
cisco(config-router)# exit
```

配置接口的 IP 地址。

```
cisco(config)# interface ethernet 1/54
cisco(config-if)# ip address 100.0.0.2 255.255.255.0
```

#使能接口到 OSPF 指定区域。

```
cisco(config-if)# ip router ospf 100 area 0.0.0.0
```

在接口上使能 BFD 特性。

```
cisco(config-if)# ip ospf bfd
cisco(config-if)# exit
```

配置 BFD 会话的参数值。

```
cisco(config)# bfd interval 300 min_rx 300 multiplier 3
```

3. 验证配置

在 H3C 设备上验证 OSPF 邻居信息。

```
[H3C] display ospf peer
 OSPF Process 100 with Router ID 3.3.3.4
              Neighbor Brief Information
 Area: 0.0.0.0
 Router ID       Address         Pri Dead-Time  State             Interface
 2.2.2.2         100.0.0.2       1   33         Full/BDR          HGE1/0/1
```

在 H3C 设备上验证 BFD 会话的概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active
 IPv4 session working in control mode:
 LD/RD            SourceAddr      DestAddr       State   Holdtime    Interface
 40768/16389      100.0.0.1       100.0.0.2       Up     616ms       HGE0/0/1
```

在 H3C 设备上验证 BFD 会话的详细信息。

```
[H3C] display bfd session verbose
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active

 IPv4 session working in control packet mode:
       Local Discr: 257                  Remote Discr: 1090519048
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
     Session State: Up                      Interface: HundredGigE1/0/1
      Min Tx Inter: 300ms                 Act Tx Inter: 300ms
      Min Rx Inter: 300ms                 Detect Inter: 900ms
          Rx Count: 749                       Tx Count: 846
      Connect Type: Direct              Running Up for: 00:03:40
         Hold Time: 817ms                     Auth mode: None
       Detect Mode: Async                          Slot: 1
          Protocol: OSPF
           Version: 1
         Diag Info: No Diagnostic
```

在思科设备上验证 ospf 邻居信息。

```
cisco(config)# show ip ospf neighbors
 OSPF Process ID 100 VRF default
 Total number of neighbors: 1
 Neighbor ID     Pri State            Up Time  Address         Interface
 3.3.3.4           1 FULL/DR          00:01:59 100.0.0.1       Eth1/54
```

在思科设备上验证 bfd 邻居信息。

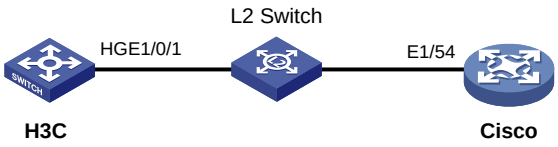
```
cisco(config)# show bfd neighbors
OurAddr   NeighAddr   LD/RD     RH/RS    Holdown(mult)  State     Int      Vrf        Type
100.0.0.2   100.0.0.1   1090519048/257    Up   810(3)    Up      Eth1/54    default      SH
```

8.1.4 采用 ISIS 路由联动 BFD 对接案例

1. 组网需求

如图 30 所示，H3C 设备与思科设备通过二层交换机连接。现要求使用 ISIS 与 BFD 联动技术，实现 H3C 设备或思科设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 ISIS 路由。

图30 采用 ISIS 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 IS-IS 进程 1。

```
<H3C> system-view
[H3C] isis 1
```

配置路由器的 Level 级别为 Level-2。

```
[H3C-isis-1] is-level level-2
```

配置网络实体名称为 10.0000.0000.0000.0002.00。

```
[H3C-isis-1] network-entity 10.0000.0000.0000.0002.00
[H3C-isis-1] quit
```

配置接口 HundredGigE1/0/1 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

在接口 HundredGigE1/0/1 上使能 IS-IS 功能。

```
[H3C-HundredGigE1/0/1] isis enable 1
```

配置接口 HundredGigE1/0/1 的网络类型为 P2P。

```
[H3C-HundredGigE1/0/1] isis circuit-type p2p
```

使能接口 HundredGigE1/0/1 的 IS-IS BFD 功能。

```
[H3C-HundredGigE1/0/1] isis bfd enable
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

- 配置思科设备

如下配置以 Cisco Nexus9000 C93180YC-FX 为例进行介绍，设备具体信息如下：

```
cisco# show version
Cisco Nexus Operating System (NX-OS) Software
```

```
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2019, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
  BIOS: version 05.43
 NXOS: version 9.3(3)
  BIOS compile time:  11/22/2020
  NXOS image file is: bootflash:///nxos.9.3.3.bin
  NXOS compile time:  12/22/2019 2:00:00 [12/22/2019 14:00:37]


Hardware
  cisco Nexus9000 C93180YC-FX Chassis
  Intel(R) Xeon(R) CPU D-1528 @ 1.90GHz with 32827212 kB of memory.
  Processor Board ID FDO25250294
  Device name: cisco-leaf2
  bootflash:  115805708 kB
Kernel uptime is 167 day(s), 6 hour(s), 51 minute(s), 41 second(s)
Last reset at 744629 usecs after Thu Jan 13 02:02:26 2022
  Reason: Module PowerCycled
  System version:
  Service: HW check by card-client
plugin
  Core Plugin, Ethernet Plugin
Active Package(s):
```

使能 isis feature 启动 ISIS 路由进程 1。

```
cisco# configure terminal
cisco(config)# feature isis
cisco(config)# router isis 1
```

设置 ISIS 设备级别为 level-2。

```
cisco(config-router)# is-type level-2
```

指定 ISIS 进程的网络实体名称。

```
cisco(config-router)# net 10.0000.0000.0000.0001.00
```

配置接口的 IP 地址。

```
cisco(config)# interface ethernet 1/54
cisco(config-if)# ip address 100.0.0.2 255.255.255.0
```

在接口上激活这个路由进程。

```
cisco(config-if)# ip router isis 1
```

设置接口类型为 P2P 类型。

```
cisco(config-if)# medium p2p
```

在接口上使能 BFD 特性。

```
cisco(config-if)# isis bfd
```

配置 BFD 会话的参数值。

```
cisco(config)# bfd interval 300 min_rx 300 multiplier 3
```

3. 验证配置

在 H3C 设备上验证 ISIS 邻居信息。

```
[H3C] display isis peer
                         Peer information for IS-IS(1)
                         ----------------------------

 System ID: 0000.0000.0001
 Interface: HGE1/0/1               Circuit Id:  001
 State: Up     HoldTime: 20s        Type: L2           PRI: --
```

在 H3C 设备上验证 BFD 会话概要信息。

```
[H3C] display bfd session
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active
 IPv4 session working in control packet mode:
 LD/RD          SourceAddr      DestAddr        State    Holdtime    Interface
 257/1090519050 100.0.0.1       100.0.0.2       Up       778ms       HGE1/0/1
```

在 H3C 设备上验证 BFD 会话详细信息。

```
[H3C] display bfd session verbose
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active

 IPv4 session working in control packet mode:
       Local Discr: 257                  Remote Discr: 1090519050
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
     Session State: Up                      Interface: HundredGigE1/0/1
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900
Rx Count: 234128                   Tx Count: 267540
      Connect Type: Direct             Running Up for: 19:29:08
         Hold Time: 820ms                   Auth mode: None
       Detect Mode: Async                        Slot: 1
          Protocol: ISIS_P2P
           Version: 1
         Diag Info: No Diagnostic
```

在思科设备上验证 ISIS 路由信息。

```
cisco(config-if)# show isis route
```

```
IS-IS process: 1 VRF: default
IS-IS IPv4 routing table

100.0.0.0/24, L2, direct
   *via Ethernet1/54, metric 1, L2, direct
```

在思科设备上验证 bfd 邻居信息。

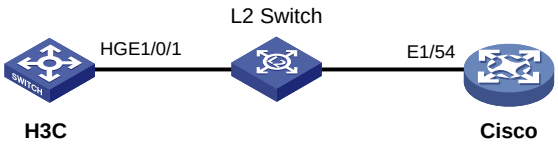
```
cisco(config-if)# show bfd neighbors
OurAddr      NeighAddr  LD/RD      RH/RS      Holdown(mult)   State    Int     Vrf       Type
100.0.0.2    100.0.0.1  1090519050/257   Up     641(3)    Up     Eth1/54   default    SH
```

8.1.5 采用 BGP 路由联动 BFD 对接案例

1. 组网需求

如图 31 所示，H3C 设备与思科设备通过二层交换机连接。现要求使用 BGP 与 BFD 联动技术，实现 H3C 设备或思科设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 BGP 路由。

图31 采用 BGP 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

配置接口 HundredGigE1/0/1 的 IP 地址。

```
<H3C> system-view
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

在 BGP 实例视图下，指定对等体组的 AS 号为 100。

```
[H3C] bgp 100
[H3C-bgp-default] peer 100.0.0.2 as-number 200
```

配置通过 BFD 检测本地路由器和指定 BGP 对等体/对等体组之间的链路。

```
[H3C-bgp-default] peer 100.0.0.2 bfd
```

在 BGP 实例视图下，创建 BGP IPv4 单播地址族，并进入 BGP IPv4 单播地址族视图。

```
[H3C-bgp-default] address-family ipv4 unicast
```

在 BGP IPv4 单播地址族视图下，使能本地路由器与对等体 100.0.0.2 交换 IPv4 单播路由信息的能力。

```
[H3C-bgp-default-ipv4] peer 100.0.0.2 enable
[H3C-bgp-default-ipv4] quit
[H3C-bgp-default] quit
```

- 配置思科设备

如下配置以 Cisco Nexus9000 C93180YC-FX 为例进行介绍，设备具体信息如下：

```
cisco# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (C) 2002-2019, Cisco and/or its affiliates.
All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under their own
licenses, such as open source.  This software is provided "as is," and unless
otherwise stated, there is no warranty, express or implied, including but not
limited to warranties of merchantability and fitness for a particular purpose.
Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or
GNU General Public License (GPL) version 3.0  or the GNU
Lesser General Public License (LGPL) Version 2.1 or
Lesser General Public License (LGPL) Version 2.0.
A copy of each such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://opensource.org/licenses/gpl-3.0.html and
http://www.opensource.org/licenses/lgpl-2.1.php and
http://www.gnu.org/licenses/old-licenses/library.txt.
Software
  BIOS: version 05.43
 NXOS: version 9.3(3)
  BIOS compile time:  11/22/2020
  NXOS image file is: bootflash:///nxos.9.3.3.bin
  NXOS compile time:  12/22/2019 2:00:00 [12/22/2019 14:00:37]


Hardware
  cisco Nexus9000 C93180YC-FX Chassis
  Intel(R) Xeon(R) CPU D-1528 @ 1.90GHz with 32827212 kB of memory.
  Processor Board ID FDO25250294
  Device name: cisco-leaf2
  bootflash:  115805708 kB
Kernel uptime is 167 day(s), 6 hour(s), 51 minute(s), 41 second(s)
Last reset at 744629 usecs after Thu Jan 13 02:02:26 2022
  Reason: Module PowerCycled
  System version:
  Service: HW check by card-client
plugin
  Core Plugin, Ethernet Plugin
Active Package(s):
```

配置接口的 IP 地址。

```
cisco# configure terminal
cisco(config)# interface ethernet 1/54
cisco(config-if)# ip address 100.0.0.2 255.255.255.0
cisco(config-if)# exit
```
配置对等体的对端 AS 号为 100。
```
cisco(config)# router bgp 200
cisco(config-router)# neighbor 100.0.0.1 remote-as 100
cisco(config-router-neighbor)# address-family ipv4 unicast
cisco(config-router-neighbor-af)# neighbor 100.0.0.1 remote-as 100
```
为对等体配置 BFD 功能。
```
cisco(config-router-neighbor)# bfd
```
配置 BFD 会话参数。
```
cisco(config)# bfd interval 300 min_rx 300 multiplier 3
```
3. 验证配置

#在 H3C 设备上验证所有 BGP IPv4 单播对等体的简要信息。
```
[H3C] display bgp peer ipv4

 BGP local router ID: 3.3.3.4
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  100.0.0.2               200        8       19    0       0 00:04:50 Established
```
在 H3C 设备上验证 BFD 会话的简要信息。
```
[H3C] display bfd session
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active

 IPv4 session working in control packet mode:

 LD/RD          SourceAddr      DestAddr        State    Holdtime    Interface
 257/1090519049 100.0.0.1       100.0.0.2       Up       900ms       HGE1/0/1
```
在 H3C 设备上验证 BFD 会话的详细信息。
```
[H3C] display bfd session verbose
 Total Session Num: 1     Up Session Num: 1     Init Mode: Active

 IPv4 session working in control packet mode:
       Local Discr: 257                 Remote Discr: 1090519049
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
     Session State: Up                      Interface: HundredGigE1/0/1
      Min Tx Inter: 300ms                 Act Tx Inter: 300ms
      Min Rx Inter: 300ms                 Detect Inter: 900ms
          Rx Count: 1355                      Tx Count: 1406
      Connect Type: Direct              Running Up for: 00:05:33
         Hold Time: 688ms                     Auth mode: None
```

```
       Detect Mode: Async                        Slot: 1
          Protocol: BGP
           Version: 1
         Diag Info: No Diagnostic
```

在思科设备上验证 bgp 会话信息。

```
cisco(config)# show bgp sessions
Total peers 1, established peers 1
ASN 200
VRF default, local ASN 200
peers 1, established peers 1, local router-id 2.2.2.2
State: I-Idle, A-Active, O-Open, E-Established, C-Closing, S-Shutdown

Neighbor        ASN    Flaps LastUpDn|LastRead|LastWrit St Port(L/R)  Notif(S/R)
100.0.0.1         100 0     00:05:55|00:00:49|00:00:54 E   44009/179        0/0
```

在思科设备上验证 bfd 会话信息。

```
cisco(config)# show bfd neighbors
OurAddr   NeighAddr   LD/RD      RH/RS    Holdown(mult)  State    Int         Vrf      Type
100.0.0.2    100.0.0.1   1090519049/257   Up    878(3)     Up     Eth1/54   default    SH
```

8.2 与华为设备对接操作指导

8.2.1 互通性分析

表23 BFD 互通性分析

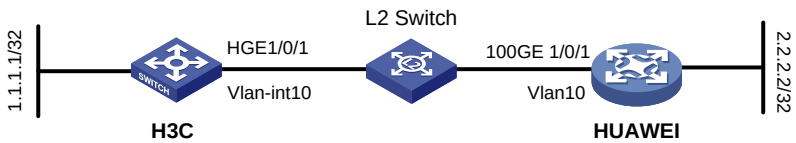
H3C	华为	互通结论
支持	支持	可以互通

8.2.2 采用静态路由联动 BFD 对接案例

1. 组网需求

如图 32 所示，H3C 设备与华为设备通过二层交换机连接。现要求使用静态路由与 BFD 联动技术，实现 H3C 设备或华为设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告静态路由。

图32 采用静态路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 VLAN10。

```
<H3C> system-view
[H3C] vlan 10
[H3C-vlan10] quit
```
配置端口 HundredGigE1/0/1 为 Trunk 口，并允许 VLAN10 通过。
```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-type trunk
[H3C-HundredGigE1/0/1] port trunk permit vlan 10
[H3C-HundredGigE1/0/1] undo port trunk permit vlan 1
[H3C-HundredGigE1/0/1] quit
```
配置接口 Vlan-interface10 的 IP 地址为 100.0.0.1。
```
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 24
```
配置接口 Vlan-interface10 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。
```
[H3C-Vlan-interface10] bfd min-transmit-interval 300
```
配置接口 Vlan-interface10 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。
```
[H3C-Vlan-interface10] bfd min-receive-interval 300
```
配置接口 Vlan-interface10 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。
```
[H3C-Vlan-interface10] bfd detect-multiplier 3
[H3C-Vlan-interface10] quit
```
配置接口 LoopBack0 的 IP 地址。
```
[H3C] interface LoopBack0
[H3C-LoopBack0] ip address 1.1.1.1 32
[H3C-LoopBack0] quit
```
配置静态路由，并使能 BFD（Bidirectional Forwarding Detection，双向转发检测）功能，对静态路由下一跳的可达性进行快速检测，当下一跳不可达时可以快速切换到备份路由。
```
[H3C] ip route-static 2.2.2.2 32 Vlan-interface10 100.0.0.2 bfd control-packet
```
- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：
```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```
使能 IP 组播功能。

```
<HUAWEI>system-view immediately
[HUAWEI]multicast routing-enable
# 创建 vlan 10。
[HUAWEI]vlan 10
[HUAWEI-vlan10]quit
```

将接口 100GE1/0/1 的链路类型设置为 Trunk，并允许通过的 VLAN 为 10。

```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]port link-type trunk
[HUAWEI-100GE1/0/1]port trunk allow-pass vlan 10
[HUAWEI-100GE1/0/1]undo port trunk allow-pass vlan 1
[HUAWEI-100GE1/0/1]quit
```

配置 VLANIF 接口的 IP 地址。

```
[HUAWEI]interface Vlanif 10
[HUAWEI-Vlanif10]ip address 100.0.0.2 24
[HUAWEI-Vlanif10]quit
```

配置 LoopBack 接口的 IP 地址。

```
[HUAWEI]interface LoopBack 0
[HUAWEI-LoopBack0]ip address 2.2.2.2 32
[HUAWEI-LoopBack0]quit
```

配置静态路由的 BFD 参数。

```
[HUAWEI]ip route-static bfd Vlanif 10 100.0.0.1 local-address 100.0.0.2 min-tx-interval 300
min-rx-interval 300 detect-multiplier 3
```

使能静态路由绑定动态 BFD 会话进行快速故障检测。

```
[HUAWEI]ip route-static 1.1.1.1 32 Vlanif 10 100.0.0.1 bfd enable
```

3. 验证配置

在 H3C 设备上验证 BFD 会话概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:

 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/16385      100.0.0.1       100.0.0.2       Up     762ms       Vlan10
```

在 H3C 设备上验证 BFD 会话详细信息。

```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768                Remote Discr: 16385
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: Vlan-interface10
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900ms
          Rx Count: 1109                     Tx Count: 1160
      Connect Type: Direct              Running Up for: 00:07:15
```

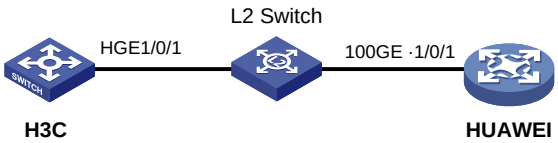
```
  Hold Time: 734ms                  Auth Mode: None
Detect Mode: Async                       Slot: 0
   Protocol: STATIC
    Version: 1
  Diag Info: No Diagnostic
```

8.2.3 采用 OSPF 路由联动 BFD 对接案例

1. 组网需求

如图 33 所示，H3C 设备与华为设备通过二层交换机连接。现要求使用 OSPF 与 BFD 联动技术，实现 H3C 设备或华为设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 OSPF 路由。

图33 采用 OSPF 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 OSPF 区域 0 并进入 OSPF 区域视图。

```
<H3C> system-view
[H3C] ospf 100
[H3C-ospf-100] area 0
[H3C-ospf-100] quit
```

配置接口 HundredGigE1/0/1 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

配置接口 HundredGigE1/0/1 使能 OSPF 进程 1，接口所在的 OSPF 区域 ID 为 0。

```
[H3C-HundredGigE1/0/1] ospf 100 area 0
```

使能 OSPF 的 BFD 功能。

```
[H3C-HundredGigE1/0/1] ospf bfd enable
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
```

```
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

运行 OSPF 协议。

```
<HUAWEI>system-view immediately
[HUAWEI]ospf 100
[HUAWEI-ospf-100-area-0.0.0.0]quit
[HUAWEI-ospf-100]quit
```

配置接口的 IP 地址。

```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]ip address 100.0.0.2 255.255.255.0
```

#使能接口到 OSPF 指定区域。

```
[HUAWEI-100GE1/0/1]ospf enable 100 area 0.0.0.0
```

在接口上使能 BFD 特性。

```
[HUAWEI-100GE1/0/1]ospf bfd enable
```

配置 BFD 会话的参数值。

```
[HUAWEI-100GE1/0/1]ospf bfd min-tx-interval 300 min-rx-interval 300 detect-multiplier 3
[HUAWEI-100GE1/0/1]quit
```

3. 验证配置

在 H3C 设备上验证 OSPF 邻居信息。

```
[H3C] display ospf peer

         OSPF Process 100 with Router ID 1.1.1.1
               Neighbor Brief Information

 Area: 0.0.0.0
 Router ID       Address         Pri Dead-Time  State             Interface
 16.1.111.51     100.0.0.2       1   37         Full/DR           HGE1/0/1
```

在 H3C 设备上验证 BFD 会话的概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
```

```
 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/16389      100.0.0.1       100.0.0.2       Up     616ms       HGE1/0/1
```

在 H3C 设备上验证 BFD 会话的详细信息。

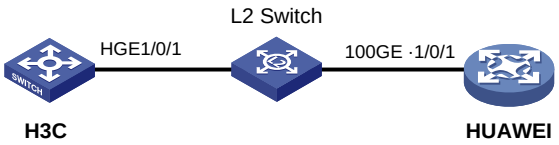
```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768                Remote Discr: 16389
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: HundredGigE1/0/1
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900ms
          Rx Count: 19560                    Tx Count: 19548
      Connect Type: Direct             Running Up for: 05:22:40
         Hold Time: 776ms                   Auth Mode: None
       Detect Mode: Async                        Slot: 0
          Protocol: OSPF
           Version: 1
         Diag Info: No Diagnostic
```

8.2.4 采用 ISIS 路由联动 BFD 对接案例

1. 组网需求

如图 34 所示，H3C 设备与华为设备通过二层交换机连接。现要求使用 ISIS 与 BFD 联动技术，实现 H3C 设备或华为设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 ISIS 路由。

图34 采用 ISIS 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 IS-IS 进程 1。

```
<H3C> system-view
[H3C] isis 1
```

配置路由器的 Level 级别为 Level-2。

```
[H3C-isis-1] is-level level-2
```

配置路由器只可以接收和发送采用 wide 方式。

```
[H3C-isis-1] cost-style wide
```

配置网络实体名称为 48.0001.1001.7220.0160.00。

```
[H3C-isis-1] network-entity 48.0001.1001.7220.0160.00
[H3C-isis-1] quit
```

配置接口 HundredGigE1/0/1 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

在接口 HundredGigE1/0/1 上使能 IS-IS 功能。

```
[H3C-HundredGigE1/0/1] isis enable 1
```

配置接口 HundredGigE1/0/1 的网络类型为 P2P。

```
[H3C-HundredGigE1/0/1] isis circuit-type p2p
```

使能接口 HundredGigE1/0/1 的 IS-IS BFD 功能。

```
[H3C-HundredGigE1/0/1] isis bfd enable
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

启动 ISIS 路由进程 1。

```
<HUAWEI>system-view immediately
[HUAWEI]isis 1
```

设置 ISIS 设备级别为 level-2。

```
[HUAWEI-isis-1]is-level level-2
```

指定 ISIS 进程的网络实体名称。

```
[HUAWEI-isis-1]network-entity 48.0001.1001.7220.0170.00
```

指定 ISIS 设备只能接收和发送开销类型为 wide 的路由。

```
[HUAWEI-isis-1]cost-style wide
```

```
[HUAWEI-isis-1]quit
```
配置接口的 IP 地址。
```
[HUAWEI]interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]ip address 100.0.0.2 24
```
在接口 100GE1/0/1 上激活这个路由进程。
```
[HUAWEI-100GE1/0/1]isis enable 1
```
设置 100GE1/0/1 为 P2P 类型。
```
[HUAWEI-100GE1/0/1]isis circuit-type p2p
```
在 100GE1/0/1 接口上使能 BFD 特性。
```
[HUAWEI-100GE1/0/1]isis bfd enable
```
配置 BFD 会话的参数值。
```
[HUAWEI-100GE1/0/1]isis bfd min-tx-interval 300 min-rx-interval 300 detect-multiplier 3
[HUAWEI-100GE1/0/1]quit
```
3. 验证配置
在 H3C 设备上验证 ISIS 邻居信息。
```
[H3C] display isis peer

                        Peer information for IS-IS(1)
                        ------------------------------

 System ID: 1001.7220.0170
 Interface: HGE1/0/1               Circuit Id:  061
 State: Up     HoldTime: 26s       Type: L2          PRI: --
```
在 H3C 设备上验证 BFD 会话概要信息。
```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:

 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/16390      100.0.0.1       100.0.0.2       Up     797ms       HGE1/0/1
```
在 H3C 设备上验证 BFD 会话详细信息。
```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768               Remote Discr: 16390
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: HundredGigE1/0/1
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900ms
          Rx Count: 481                      Tx Count: 494
      Connect Type: Direct             Running Up for: 00:03:12
         Hold Time: 653ms                   Auth Mode: None
       Detect Mode: Async                       Slot: 0
```

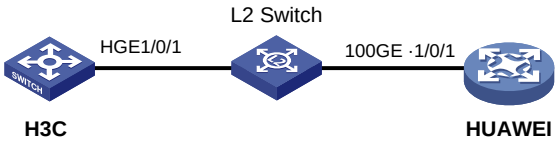
```
Protocol: ISIS_P2P
 Version: 1
Diag Info: No Diagnostic
```

8.2.5 采用 BGP 路由联动 BFD 对接案例

1. 组网需求

如图 35 所示，H3C 设备与华为设备通过二层交换机连接。现要求使用 BGP 与 BFD 联动技术，实现 H3C 设备或华为设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 BGP 路由。

图35 采用 BGP 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

配置接口 HundredGigE1/0/1 的 IP 地址。

```
<H3C> system-view
System View: return to User View with Ctrl+Z.
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] ip address 100.0.0.1 24
```

配置接口 HundredGigE1/0/1 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/1 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/1] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/1 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/1] bfd detect-multiplier 3
[H3C-HundredGigE1/0/1] quit
```

在 BGP 实例视图下，指定对等体组的 AS 号为 100。

```
[H3C] bgp 100
[H3C-bgp-default] peer 100.0.0.2 as-number 200
```

配置通过 BFD 检测本地路由器和指定 BGP 对等体/对等体组之间的链路。

```
[H3C-bgp-default] peer 100.0.0.2 bfd
```

在 BGP 实例视图下，创建 BGP IPv4 单播地址族，并进入 BGP IPv4 单播地址族视图。

```
[H3C-bgp-default] address-family ipv4 unicast
```

在 BGP IPv4 单播地址族视图下，使能本地路由器与对等体 100.0.0.2 交换 IPv4 单播路由信息的能力。

```
[H3C-bgp-default-ipv4] peer 100.0.0.2 enable
[H3C-bgp-default-ipv4] quit
[H3C-bgp-default] quit
```

- 配置华为设备

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEI> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

配置接口的 IP 地址。

```
<HUAWEI>system-view immediately
[HUAWEI] interface 100GE 1/0/1
[HUAWEI-100GE1/0/1]ip address 100.0.0.2 24
[HUAWEI-100GE1/0/1]quit
```

配置对等体的对端 AS 号为 100。

```
[HUAWEI]bgp 200
[HUAWEI-bgp]peer 100.0.0.1 as-number 100
```

为对等体配置 BFD 功能。

```
[HUAWEI-bgp]peer 100.0.0.1 bfd enable
```

配置 BFD 会话参数。

```
[HUAWEI-bgp]peer 100.0.0.1 bfd min-tx-interval 300 min-rx-interval 300 detect-multiplier 3
[HUAWEI-bgp]quit
```

3. 验证配置

#在 H3C 设备上验证所有 BGP IPv4 单播对等体的简要信息。

```
[H3C] display bgp peer ipv4

 BGP local router ID: 1.1.1.1
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 100.0.0.2              200       12      216    0        0 00:08:30 Established
```

在 H3C 设备上验证 BFD 会话的简要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active
```

```
 IPv4 session working in control mode:

 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/16391      100.0.0.1       100.0.0.2       Up     737ms       HGE1/0/1
```

在 H3C 设备上验证 BFD 会话的详细信息。

```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768                Remote Discr: 16391
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: HundredGigE1/0/1
     Min Tx Inter: 300ms                 Act Tx Inter: 300ms
     Min Rx Inter: 300ms                 Detect Inter: 900ms
          Rx Count: 131                      Tx Count: 212
     Connect Type: Direct              Running Up for: 00:00:42
        Hold Time: 694ms                    Auth Mode: None
      Detect Mode: Async                         Slot: 0
         Protocol: BGP
          Version: 1
        Diag Info: No Diagnostic
```

8.3 与锐捷设备对接操作指导

8.3.1 互通性分析

表24 BFD 互通性分析

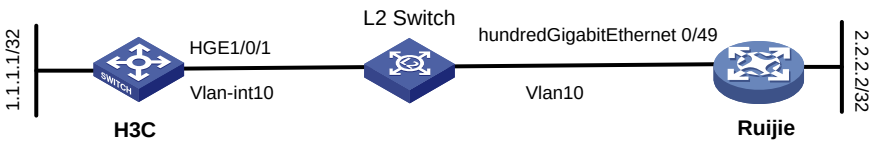
H3C	锐捷	互通结论
支持	支持	可以互通

8.3.2 采用静态路由联动 BFD 对接案例

1. 组网需求

如图 36 所示，H3C 设备与锐捷设备通过二层交换机连接。现要求使用静态路由与 BFD 联动技术，实现 H3C 设备或锐捷设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告静态路由。

图36 采用静态路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 VLAN 10。

```
<H3C> system-view
[H3C] vlan 10
[H3C-vlan10] quit
```

配置端口 HundredGigE1/0/1 为 Trunk 口，并允许 vlan 10 通过。

```
[H3C] interface HundredGigE 1/0/1
[H3C-HundredGigE1/0/1] port link-type trunk
[H3C-HundredGigE1/0/1] port trunk permit vlan 10
[H3C-HundredGigE1/0/1] undo port trunk permit vlan 1
[H3C-HundredGigE1/0/1] quit
```

配置接口 Vlan-interface10 的 IP 地址为 100.0.0.1。

```
[H3C] interface Vlan-interface 10
[H3C-Vlan-interface10] ip address 100.0.0.1 24
```

配置接口 Vlan-interface10 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-Vlan-interface10] bfd min-transmit-interval 300
```

配置接口 Vlan-interface10 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-Vlan-interface10] bfd min-receive-interval 300
```

配置接口 Vlan-interface10 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-Vlan-interface10] bfd detect-multiplier 3
[H3C-Vlan-interface10] quit
```

配置接口 LoopBack0 的 IP 地址。

```
[H3C] interface LoopBack0
[H3C-LoopBack0] ip address 1.1.1.1 32
[H3C-LoopBack0] quit
```

配置静态路由，并使能 BFD（Bidirectional Forwarding Detection，双向转发检测）功能，对静态路由下一跳的可达性进行快速检测，当下一跳不可达时可以快速切换到备份路由。

```
[H3C] ip route-static 2.2.2.2 32 Vlan-interface10 100.0.0.2 bfd control-packet
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
```

```
Boot version                : 1.3.8
Software version          : S6500_RGOS 11.0(5)B9P59
Serial number              : G1QH10Q10637A
```

使能 IP 组播功能。

```
Ruijie>enable
Ruijie#configure terminal
```

将接口 0/49 的链路类型设置为 Trunk，并允许通过的 VLAN 为 10。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport mode trunk
Ruijie(config-if-HundredGigabitEthernet 0/49)#switchport trunk allowed vlan only 10
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

配置 VLAN10 接口的 IP 地址。

```
Ruijie(config)#interface vlAN 10
Ruijie(config-if-VLAN 10)#ip address 100.0.0.2 24
```

配置 BFD 参数。

```
Ruijie(config-if-VLAN 10)#bfd interval 300 min_rx 300 multiplier 3
Ruijie(config-if-VLAN 10)#exit
```

配置静态路由。

```
Ruijie(config)#ip route 1.1.1.1 255.255.255.255 VLAN 10 100.0.0.1
```

配置静态路由绑定 BFD 会话。

```
Ruijie(config)#ip route static bfd VLAN 10 100.0.0.1 source 100.0.0.2
```

3. 验证配置

在 H3C 设备上验证 BFD 会话概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:

 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/8192       100.0.0.1       100.0.0.2       Up     788ms       Vlan10
```

在 H3C 设备上验证 BFD 会话详细信息。

```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768               Remote Discr: 8192
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: Vlan-interface10
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900ms
          Rx Count: 1375                     Tx Count: 1372
      Connect Type: Direct             Running Up for: 00:01:07
         Hold Time: 888ms                   Auth Mode: None
       Detect Mode: Async                        Slot: 0
```

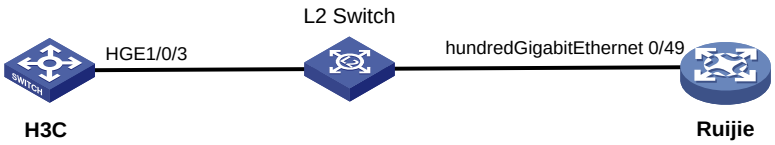
```
Protocol: STATIC
 Version: 1
Diag Info: No Diagnostic
```

8.3.3 采用 OSPF 路由联动 BFD 对接案例

1. 组网需求

如图 37 所示，H3C 设备与锐捷设备通过二层交换机连接。现要求使用 OSPF 与 BFD 联动技术，实现 H3C 设备或锐捷设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 OSPF 路由。

图37 采用 OSPF 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 OSPF 区域 0 并进入 OSPF 区域视图。

```
<H3C> system-view
[H3C] ospf 1
[H3C-ospf-1] area 0
[H3C-ospf-1-area-0.0.0.0] quit
[H3C-ospf-1] quit
```

配置接口 HundredGigE1/0/3 的 IP 地址。

```
[H3C]interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] ip address 100.0.0.1 255.255.255.0
```

配置接口 HundredGigE1/0/3 使能 OSPF 进程 1，接口所在的 OSPF 区域 ID 为 0。

```
[H3C-HundredGigE1/0/3] ospf 1 area 0
```

使能 OSPF 的 BFD 功能。

```
[H3C-HundredGigE1/0/3] ospf bfd enable
```

配置接口 HundredGigE1/0/3 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/3 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/3 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/3] bfd detect-multiplier 3
[H3C-HundredGigE1/0/3] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
```

```
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

创建 OSPF 路由进程并进入 OSPF 路由配置模式。

```
Ruijie>enable
Ruijie#configure terminal
Ruijie(config)#route ospf 1
```

配置指定区域。

```
Ruijie(config-router)#area 0
Ruijie(config-router)#exit
```

#配置接口 0/49 的 IP 地址。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet0/49)#ip address 100.0.0.2 24
```

配置接口加入指定区域。

```
Ruijie(config-if-HundredGigabitEthernet0/49)#ip ospf 1 area 0
```

配置运行 OSPF 的指定接口启动 BFD 进行链路检测。

```
Ruijie(config-if-HundredGigabitEthernet0/49)#ip ospf bfd
```

配置 BFD 的参数。

```
Ruijie(config-if-HundredGigabitEthernet0/49)#bfd interval 300 min_rx 300 multiplier 3
Ruijie(config-if-HundredGigabitEthernet0/49)#exit
```

3. 验证配置

在 H3C 设备上验证 OSPF 邻居信息。

```
[H3C] display ospf peer

         OSPF Process 1 with Router ID 16.1.105.99
               Neighbor Brief Information

 Area: 0.0.0.0
 Router ID       Address         Pri Dead-Time  State             Interface
 2.2.2.2         100.0.0.2       1   39         Full/DR           HGE0/0/3
```

在 H3C 设备上验证 BFD 会话的概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
```

```
 LD/RD            SourceAddr      DestAddr        State   Holdtime    Interface
 40768/8192       100.0.0.1       100.0.0.2       Up      836ms       HGE1/0/3
```

在 H3C 设备上验证 BFD 会话的详细信息。

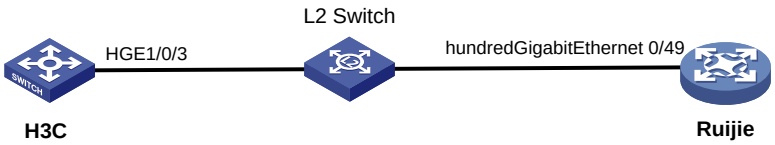
```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40768                Remote Discr: 8192
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: HundredGigE1/0/3
     Min Tx Inter: 300ms                 Act Tx Inter: 300ms
     Min Rx Inter: 300ms                 Detect Inter: 900ms
          Rx Count: 164                      Tx Count: 188
     Connect Type: Direct              Running Up for: 00:00:48
        Hold Time: 727ms                    Auth Mode: None
      Detect Mode: Async                         Slot: 0
         Protocol: OSPF
          Version: 1
        Diag Info: No Diagnostic
```

8.3.4 采用 ISIS 路由联动 BFD 对接案例

1. 组网需求

如图 38 所示，H3C 设备与锐捷设备通过二层交换机连接。现要求使用 ISIS 与 BFD 联动技术，实现 H3C 设备或锐捷设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 ISIS 路由。

图38 采用 ISIS 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

创建 IS-IS 进程 1。

```
<H3C> system-view
[H3C] isis 1
```

配置路由器的 Level 级别为 Level-2。

```
[H3C-isis-1] is-level level-2
```

配置路由器只可以接收和发送采用 wide 方式。

```
[H3C-isis-1] cost-style wide
```

配置网络实体名称为 48.0001.1001.7220.0160.00。

```
[H3C-isis-1] network-entity 48.0001.1001.7220.0160.00
[H3C-isis-1] quit
```

配置接口 HundredGigE1/0/3 的 IP 地址。

```
[H3C] interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] ip address 100.0.0.1 24
```

在接口 HundredGigE1/0/3 上使能 IS-IS 功能。

```
[H3C-HundredGigE1/0/3] isis enable 1
```

配置接口 HundredGigE1/0/3 的网络类型为 P2P。

```
[H3C-HundredGigE1/0/3] isis circuit-type p2p
```

使能接口 HundredGigE1/0/3 的 IS-IS BFD 功能。

```
[H3C-HundredGigE1/0/3] isis bfd enable
```

配置接口 HundredGigE1/0/3 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/3 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/3 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/3] bfd detect-multiplier 3
[H3C-HundredGigE1/0/3] quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

创建 ISIS 实例。

```
Ruijie>enable
Ruijie#configure terminal
Ruijie(config)#route isis 1
```

设置 ISIS 的 NET 地址。

```
Ruijie(config-router)#net 48.0001.1001.7220.0170.00
```

指定 ISIS 所运行的 Level。

```
Ruijie(config-router)#is-type level-1-2
```

设置 metric 类型。

```
Ruijie(config-router)#metric-style wide
Ruijie(config-router)#exit
```

配置接口 0/49 的 IP 地址，并在该接口上启用 ISIS 路由。

```
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 100.0.0.2 24
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip router isis 1
```

将 Broadcast 类型的接口设置为 Point-to-Point 类型。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#isis network point-to-point
```

在接口上使能 ISIS 与 BFD 联动。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#isis bfd
```

配置 BFD 参数值。

```
Ruijie(config-if-HundredGigabitEthernet 0/49)#bfd interval 300 min_rx 300 multiplier 3
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

3. 验证配置

在 H3C 设备上验证 ISIS 邻居信息。

```
[H3C] display isis peer

                      Peer information for IS-IS(1)
                      ------------------------------

 System ID: 1001.7220.0170
 Interface: HGE1/0/3               Circuit Id:  002
 State: Up     HoldTime: 24s       Type: L2          PRI: --
```

在 H3C 设备上验证 BFD 会话概要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:

 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40769/8192       100.0.0.1       100.0.0.2       Up     680ms       HGE1/0/3
```

在 H3C 设备上验证 BFD 会话详细信息。

```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
       Local Discr: 40769               Remote Discr: 8192
         Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
         Interface: HundredGigE1/0/3
      Min Tx Inter: 300ms                Act Tx Inter: 300ms
      Min Rx Inter: 300ms                Detect Inter: 900ms
          Rx Count: 1863                     Tx Count: 1893
      Connect Type: Direct              Running Up for: 00:09:23
         Hold Time: 633ms                   Auth Mode: None
       Detect Mode: Async                        Slot: 0
          Protocol: ISIS_P2P
```

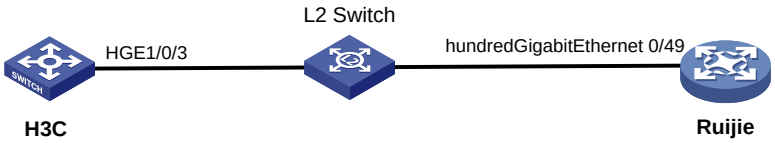
```
  Version: 1
Diag Info: No Diagnostic
```

8.3.5 采用 BGP 路由联动 BFD 对接案例

1. 组网需求

如图 39 所示，H3C 设备与锐捷设备通过二层交换机连接。现要求使用 BGP 与 BFD 联动技术，实现 H3C 设备或锐捷设备与二层交换机之间的链路出现故障时，BFD 能够快速感知并通告 BGP 路由。

图39 采用 BGP 路由联动 BFD 对接配置组网图



2. 配置步骤

- 配置 H3C 设备

配置接口 HundredGigE1/0/3 的 IP 地址。

```
<H3C> system-view
[H3C]interface HundredGigE 1/0/3
[H3C-HundredGigE1/0/3] ip address 100.0.0.1 255.255.255.0
```

配置接口 HundredGigE1/0/3 发送单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-transmit-interval 300
```

配置接口 HundredGigE1/0/3 接收单跳 BFD 控制报文的最小时间间隔为 300 毫秒。

```
[H3C-HundredGigE1/0/3] bfd min-receive-interval 300
```

配置接口 HundredGigE1/0/3 的控制报文方式单跳检测和 Echo 报文方式的 BFD 检测时间倍数为 3。

```
[H3C-HundredGigE1/0/3] bfd detect-multiplier 3
[H3C-HundredGigE1/0/3] quit
```

在 BGP 实例视图下，指定对等体组的 AS 号为 100。

```
[H3C] bgp 100
[H3C-bgp-default] peer 100.0.0.2 as-number 200
```

配置通过 BFD 检测本地路由器和指定 BGP 对等体/对等体组之间的链路。

```
[H3C-bgp-default] peer 100.0.0.2 bfd
```

在 BGP 实例视图下，创建 BGP IPv4 单播地址族，并进入 BGP IPv4 单播地址族视图。

```
[H3C-bgp-default] address-family ipv4 unicast
```

在 BGP IPv4 单播地址族视图下，使能本地路由器与对等体 100.0.0.2 交换 IPv4 单播路由信息的能力。

```
[H3C-bgp-default-ipv4] peer 100.0.0.2 enable
[H3C-bgp-default-ipv4] quit
[H3C-bgp-default ]quit
```

- 配置锐捷设备

如下配置以锐捷 S6510-48VS8CQ 为例进行介绍，设备具体信息如下：

```
Ruijie>show version
```

```
System description        : Ruijie Full 25G Routing Switch(S6510-48VS8CQ) By Ruijie Networks
System start time              : 2022-06-10 17:56:53
System uptime                  : 16:16:51:47
System hardware version : 2.30
System software version  : S6500_RGOS 11.0(5)B9P59
System patch number      : NA
System serial number      : G1QH10Q10637A
System boot version        : 1.3.8
Module information:
            Slot 0 : RG-S6510-48VS8CQ
               Hardware version        : 2.30
               Boot version               : 1.3.8
               Software version         : S6500_RGOS 11.0(5)B9P59
               Serial number             : G1QH10Q10637A
```

#设置接口 0/49 的 IP 地址及 BFD 参数。

```
Ruijie>enable
Ruijie#configure terminal
Ruijie(config)#interface hundredGigabitEthernet 0/49
Ruijie(config-if-HundredGigabitEthernet 0/49)#no switchport
Ruijie(config-if-HundredGigabitEthernet 0/49)#ip address 100.0.0.2 24
Ruijie(config-if-HundredGigabitEthernet 0/49)#bfd interval 300 min_rx 300 multiplier 3
Ruijie(config-if-HundredGigabitEthernet 0/49)#exit
```

开启 BGP 协议，设置本地 AS 为 100。

```
Ruijie(config)#route bgp 200
```

创建对等体 100.0.0.1。

```
Ruijie(config-router)#neighbor 100.0.0.1 remote-as 100
```

关联 BFD 应用。

```
Ruijie(config-router)#neighbor 100.0.0.1 fall-over bfd
Ruijie(config-router)#exit
```

3. 验证配置

#在 H3C 设备上验证所有 BGP IPv4 单播对等体的简要信息。

```
[H3C] display bgp peer ipv4

 BGP local router ID: 1.1.1.1
 Local AS number: 100
 Total number of peers: 1                 Peers in established state: 1

 * - Dynamically created peer
 Peer                    AS  MsgRcvd  MsgSent OutQ  PrefRcv Up/Down  State

 100.0.0.2              200       12      216    0        0 00:08:30 Established
```

在 H3C 设备上验证 BFD 会话的简要信息。

```
[H3C] display bfd session
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
```

```
 LD/RD            SourceAddr      DestAddr        State  Holdtime    Interface
 40768/16391      100.0.0.1       100.0.0.2       Up     737ms       HGE1/0/3
```

在 H3C 设备上验证 BFD 会话的详细信息。

```
[H3C] display bfd session verbose
 Total sessions: 1     Up sessions: 1     Init mode: Active

 IPv4 session working in control mode:
      Local Discr: 40768                Remote Discr: 16391
        Source IP: 100.0.0.1          Destination IP: 100.0.0.2
  Destination port: 3784                Session State: Up
        Interface: HundredGigE1/0/3
     Min Tx Inter: 300ms                Act Tx Inter: 300ms
     Min Rx Inter: 300ms                Detect Inter: 900ms
         Rx Count: 131                      Tx Count: 212
     Connect Type: Direct             Running Up for: 00:00:42
        Hold Time: 694ms                   Auth Mode: None
      Detect Mode: Async                        Slot: 0
         Protocol: BGP
          Version: 1
        Diag Info: No Diagnostic
```

9 MPLS-LDP 对接操作指导

9.1 与华为设备对接操作指导

9.1.1 互通性分析

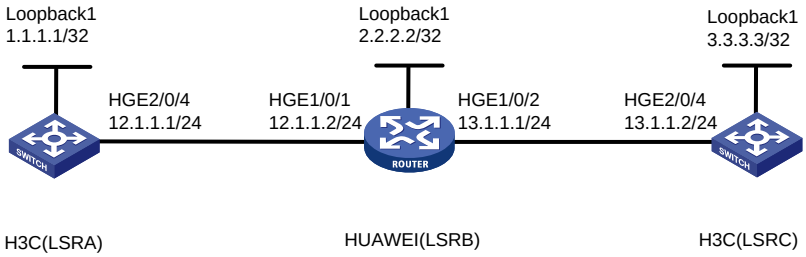
表25 MPLS-LDP 互通性分析

H3C	Cisco	互通结论
配置OSPF和本地LDP会话	配置OSPF和本地LDP会话	可以建立LDP LSP互通

9.1.2 组网需求

如图40所示，两台H3C设备与华为设备组成MPLS网络；在3台设备上分别配置OSPF和本地LDP会话，可以建立从LSRA到LSRC的LDP LSP连通。因为LDP根据路由信息动态分配标签，因此，利用LDP动态建立LSP时，需要配置路由协议（本举例采用OSPF协议），使得各设备之间路由可达。

图40 采用 MPLS-LDP 对接配置组网图



9.1.3 配置步骤

配置各接口的 IP 地址，按照图 40https://press.h3c.com/MaterialExpoDocumentLibrary/ComwareV7B70D064%E5%88%86%E6%94%AF/B70D064%E5%88%86%E6%94%AF%E4%B8%AD%E6%96%87/10-MPLS/03-LDP/LDP%E9%85%8D%E7%BD%AE.htm - _Ref294687824 配置各接口 IP 地址和掩码，包括 Loopback 接口，具体配置过程略。

- 配置 LSRA。

配置 OSPF。

```
<LSRA> system-view
[LSRA] ospf 1
[LSRA-ospf-1] area 0
[LSRA-ospf-1-area-0.0.0.0] network 1.1.1.1 0.0.0.0
[LSRA-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[LSRA-ospf-1-area-0.0.0.0] quit
[LSRA-ospf-1] quit
```

配置 MPLS 和 LDP 功能。

```
[LSRA] mpls lsr-id 1.1.1.1
[LSRA] mpls ldp
[LSRA-ldp] quit
[LSRA] interface HundredGigE 2/0/4
[LSRA-HundredGigE2/0/4] mpls enable
[LSRA-HundredGigE2/0/4] mpls ldp enable
[LSRA-HundredGigE2/0/4] quit
```

- 配置 LSRC。

配置 OSPF。

```
<LSRC> system-view
[LSRC] ospf 1
[LSRC-ospf-1] area 0
[LSRC-ospf-1-area-0.0.0.0] network 3.3.3.3 0.0.0.0
[LSRC-ospf-1-area-0.0.0.0] network 13.1.1.0 0.0.0.255
[LSRC-ospf-1-area-0.0.0.0] quit
[LSRC-ospf-1] quit
```

配置 MPLS 和 LDP 功能。

```
[LSRC] mpls lsr-id 3.3.3.3
```

```
[LSRC] mpls ldp
[LSRC-ldp] quit
[LSRC] interface HundredGigE 2/0/4
[LSRC-HundredGigE2/0/4] mpls enable
[LSRC-HundredGigE2/0/4] mpls ldp enable
[LSRC-HundredGigE2/0/4] quit
```

- 配置华为设备

如下配置以华为 CE6860-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<LSRB> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.180 (CE6860EI V200R005C10SPC800)
Copyright (C) 2012-2018 Huawei Technologies Co., Ltd.
HUAWEI CE6860-48S8CQ-EI uptime is 2 days, 13 hours, 54 minutes

CE6860-48S8CQ-EI(Master) 1 : uptime is  2 days, 13 hours, 53 minutes
        StartupTime 2023/02/08   20:04:57
Memory    Size    : 2048 M bytes
Flash     Size    : 1024 M bytes
CE6860-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP01    VER A
2. MAB    Version : 2
3. Board  Type    : CE6860-48S8CQ-EI
4. CPLD1  Version : 104
5. CPLD2  Version : 104
6. BIOS   Version : 192
```

配置 OSPF。

```
<LSRB> system-view
[LSRB] ospf 1
[LSRB-ospf-1] area 0
[LSRB-ospf-1-area-0.0.0.0] network 2.2.2.2 0.0.0.0
[LSRB-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[LSRB-ospf-1-area-0.0.0.0] network 13.1.1.0 0.0.0.255
[LSRB-ospf-1-area-0.0.0.0] quit
[LSRB-ospf-1] quit
```

配置 MPLS 和 LDP 功能。

```
[LSRB] mpls lsr-id 2.2.2.2
[LSRB] mpls
[LSRB-mpls] quit
[LSRB] mpls ldp
[LSRB-mpls-ldp] quit
[LSRB] interface 100GE 1/0/1
[LSRB-100GE1/0/1] mpls
[LSRB-100GE1/0/1] mpls ldp
[LSRB-100GE1/0/1] quit
[LSRB] interface 100GE 1/0/2
[LSRB-100GE1/0/2] mpls
[LSRB-100GE1/0/2] mpls ldp
```

```
[LSRB-100GE1/0/2] quit
```

9.1.4 验证配置

在 H3C 设备上执行 **display mpls ldp lsp** 命令，可以看到 LDP LSP 的建立情况。以 LSRA 为例：

```
<LSRA> display mpls ldp lsp
Status Flags: * - stale, L - liberal, B - backup, N/A - unavailable
FECs: 3           Ingress: 2           Transit: 2           Egress: 1

FEC                In/Out Label        Nexthop         OutInterface
1.1.1.1/32         3/-
2.2.2.2/32         -/3                 12.1.1.2        HGE2/0/4
                   24128/3             12.1.1.2        HGE2/0/4
3.3.3.3/32         -/45                12.1.1.2        HGE2/0/4
                   24127/45            12.1.1.2        HGE2/0/4
```

在 LSRA 上检测 LSRA 到 LSRC 的 LDP LSP 的可达性。

```
<LSRA> ping mpls ipv4 3.3.3.3 32
MPLS ping FEC 3.3.3.3/32 with 100 bytes of data:
100 bytes from 13.1.1.2: Sequence=1 time=1 ms
100 bytes from 13.1.1.2: Sequence=2 time=1 ms
100 bytes from 13.1.1.2: Sequence=3 time=1 ms
100 bytes from 13.1.1.2: Sequence=4 time=1 ms
100 bytes from 13.1.1.2: Sequence=5 time=1 ms

--- Ping statistics for FEC 3.3.3.3/32 ---
5 packets transmitted, 5 packets received, 0.0% packet loss
Round-trip min/avg/max = 1/1/1 ms
<LSRA>%Feb 10 15:44:06:798 2023 H3C LSPV/6/LSPV_PING_STATIS_INFO: -MDC=1; Ping statistics
for FEC 3.3.3.3/32: 5 packets transmitted, 5 packets received, 0.0% packets loss, round-trip
min/avg/max = 1/1/1 ms.
```

在 LSRC 上检测 LSRC 到 LSRA 的 LDP LSP 的可达性。

```
<LSRC> ping mpls ipv4 1.1.1.1 32
MPLS ping FEC 1.1.1.1/32 with 100 bytes of data:
100 bytes from 12.1.1.1: Sequence=1 time=1 ms
100 bytes from 12.1.1.1: Sequence=2 time=1 ms
100 bytes from 12.1.1.1: Sequence=3 time=1 ms
100 bytes from 12.1.1.1: Sequence=4 time=1 ms
100 bytes from 12.1.1.1: Sequence=5 time=1 ms

--- Ping statistics for FEC 1.1.1.1/32 ---
5 packets transmitted, 5 packets received, 0.0% packet loss
Round-trip min/avg/max = 1/1/1 ms
<LSRC> %Feb 10 15:46:52:766 2023 H3C LSPV/6/LSPV_PING_STATIS_INFO: -MDC=1; Ping statistics
for FEC 1.1.1.1/32: 5 packets transmitted, 5 packets received, 0.0% packets loss, round-trip
min/avg/max = 1/1/1 ms.
```

在华为设备上执行**display mpls ldp session**命令，可以查看LDP对等体间的会话信息。

```
<LSRB> display mpls ldp session
```

```
 LDP Session(s) in Public Network
 LAM: Label Advertisement Mode,  KA: KeepAlive
 SsnAge: Session Age, Unit(DDDD:HH:MM)
 An asterisk (*) before a session means the session is being deleted.
------------------------------------------------------------------------------
 PeerID             Status      LAM  SsnRole  SsnAge       KASent/Rcv
------------------------------------------------------------------------------
 1.1.1.1:0          Operational DU   Active   0000:20:32   4930/4928
 3.3.3.3:0          Operational DU   Passive  0000:20:21   4889/4888
------------------------------------------------------------------------------
TOTAL: 2 Session(s) Found.
```

在 LSRB 上检测到 LSRA 和 LSRC 的 LDP LSP 的可达性。

```
<LSRB> ping lsp -a 2.2.2.2 ip 1.1.1.1 32
  LSP PING FEC: IPV4 PREFIX 1.1.1.1/32/ : 100  data bytes, press CTRL_C to break
    Reply from 12.1.1.1: bytes=100 Sequence=1 time=2 ms
    Reply from 12.1.1.1: bytes=100 Sequence=2 time=1 ms
    Reply from 12.1.1.1: bytes=100 Sequence=3 time=1 ms
    Reply from 12.1.1.1: bytes=100 Sequence=4 time=2 ms
    Reply from 12.1.1.1: bytes=100 Sequence=5 time=2 ms

  --- FEC: IPV4 PREFIX 1.1.1.1/32 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/1/2 ms

<LSRB> ping lsp -a 2.2.2.2 ip 3.3.3.3 32
  LSP PING FEC: IPV4 PREFIX 3.3.3.3/32/ : 100  data bytes, press CTRL_C to break
    Reply from 13.1.1.2: bytes=100 Sequence=1 time=2 ms
    Reply from 13.1.1.2: bytes=100 Sequence=2 time=2 ms
    Reply from 13.1.1.2: bytes=100 Sequence=3 time=2 ms
    Reply from 13.1.1.2: bytes=100 Sequence=4 time=2 ms
    Reply from 13.1.1.2: bytes=100 Sequence=5 time=2 ms

  --- FEC: IPV4 PREFIX 3.3.3.3/32 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 2/2/2 ms
```

10 LDP 方式 VPLS 对接操作指导

10.1 与华为设备对接操作指导

10.1.1 互通性分析

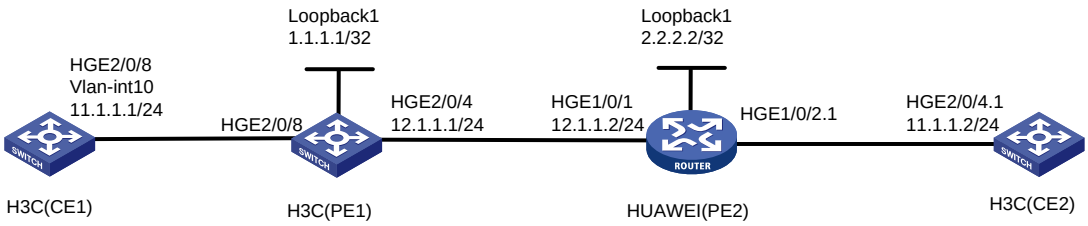
表26 LDP 方式 VPLS 互通性分析

H3C	华为	互通结论
配置OSPF和LDP方式VPLS	配置OSPF和BD接入的LDP方式VPLS	可以互通

10.1.2 组网需求

如图41所示，三台H3C设备和华为设备组成VPLS网络；在PE1和PE2上分别配置OSPF协议和LDP方式VPLS，最终实现从CE1到CE2的互通。

图41 LDP 方式 VPLS 对接配置组网图



说明

华为设备只支持 BD 接入的 LDP 方式 VPLS。

10.1.3 配置步骤

- 配置 H3C 设备（CE1）

配置 VLAN 接口 10。

```
<CE1> system-view
[CE1] vlan 10
[CE1-vlan10] quit
[CE1] interface Vlan-interface 10
[CE1-Vlan-interface10] ip address 11.1.1.1 255.255.255.0
[CE1-Vlan-interface10] quit
```

配置 HundredGigE2/0/8 接口。

```
[CE1]interface HundredGigE 2/0/8
[CE1-HundredGigE2/0/8] port link-mode bridge
[CE1-HundredGigE2/0/8] port link-type trunk
```

```
[CE1-HundredGigE2/0/8] port trunk permit vlan 10
[CE1-HundredGigE2/0/8] quit
```

- 配置 H3C 设备（PE1）

创建 LoopBack 口。

```
<PE1> system-view
[PE1] interface loopback 0
[PE1-LoopBack0] ip address 1.1.1.1 32
[PE1-LoopBack0] quit
```

配置 HundredGigE2/0/8 接口。

```
[PE1] interface HundredGigE 2/0/8
[PE1-HundredGigE2/0/8] port link-mode bridge
[PE1-HundredGigE2/0/8] port link-type trunk
[PE1-HundredGigE2/0/8] port trunk permit vlan 10
[PE1-HundredGigE2/0/8] quit
```

配置 HundredGigE2/0/4 接口。

```
[PE1] interface HundredGigE 2/0/4
[PE1-HundredGigE2/0/8] port link-mode route
[PE1-HundredGigE2/0/8] ip address 12.1.1.1 24
[PE1-HundredGigE2/0/8] quit
```

配置 OSPF。

```
[PE1] ospf 1
[PE1-ospf-1] area 0
[PE1-ospf-1-area-0.0.0.0] network 1.1.1.1 0.0.0.0
[PE1-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[PE1-ospf-1-area-0.0.0.0] quit
[PE1-ospf-1] quit
```

配置 MPLS。

```
[PE1] mpls lsr-id 1.1.1.1
[PE1] mpls ldp
[PE1-ldp] quit
```

开启 L2VPN 功能。

```
[PE1] l2vpn enable
```

创建 PW 模板并配置 PW 的数据封装类型。

```
[PE1] pw-class h3c
[PE1-pw-h3c] pw-type ethernet
[PE1-pw-h3c] quit
```

指定名为 aaa 的 VSI 使用 LDP 信令建立 PW。

```
[PE1] vsi aaa
[PE1-vsi-aaa] pwsignaling ldp
```

配置远端 PE 的地址为 2.2.2.2，PW ID 为 500，并指定 PW 的数据封装类型为 ethernet；如果不指定 PW 数据封装类型，则默认封装类型为 VLAN；需要保证与对端华为交换机 PW 封装类型一致。

```
[PE1-vsi-aaa-ldp] peer 2.2.2.2 pw-id 500 pw-class h3c
[PE1-vsi-aaa-ldp-2.2.2.2-500] quit
```

在接口 GigabitEthernet2/0/8 上创建服务实例，并绑定 VSI 实例 aaa。

```
[PE1] interface gigabitethernet 2/0/8
[PE1-GigabitEthernet2/0/8] port link-mode bridge
[PE1-GigabitEthernet2/0/8] service-instance 10
```

```
[PE1-GigabitEthernet2/0/8-srv10] encapsulation s-vid 10
[PE1-GigabitEthernet2/0/8-srv10] xconnect vsi aaa access-mode ethernet
[PE1-GigabitEthernet2/0/8-srv10] quit
[PE1-GigabitEthernet2/0/8] quit
```

- # 配置 H3C 设备（CE2）

配置子接口可以终结的 VLAN 报文的最外两层 VLAN ID。(当 CE1 以 VLAN 方式接入 PE1 时，华为交换机出来的报文中带两个 VLAN 头，所以需要在 CE2 侧对两个 VLAN 头剥离才能保证 CE1 和 CE2 互通)

```
<CE2> system-view
[CE2]interface HundredGigE 2/0/4.1
[CE2-HundredGigE2/0/4.1]ip address 11.1.1.2 255.255.255.0
[CE2-HundredGigE2/0/4.1] vlan-type dot1q vid 10 second-dot1q 10
[CE2-HundredGigE2/0/4.1] quit
```

- 配置华为设备（PE2）

如下配置以华为 CE6860-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<PE2> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.180 (CE6860EI V200R005C10SPC800)
Copyright (C) 2012-2018 Huawei Technologies Co., Ltd.
HUAWEI CE6860-48S8CQ-EI uptime is 2 days, 13 hours, 54 minutes

CE6860-48S8CQ-EI(Master) 1 : uptime is  2 days, 13 hours, 53 minutes
        StartupTime 2023/02/08   20:04:57
Memory    Size    : 2048 M bytes
Flash     Size    : 1024 M bytes
CE6860-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP01    VER A
2. MAB    Version : 2
3. Board  Type    : CE6860-48S8CQ-EI
4. CPLD1  Version : 104
5. CPLD2  Version : 104
6. BIOS   Version : 192
```

配置 Loopback1 口。

```
<PE2> system-view immediately
[PE2] interface loopback1
[PE2-Loopback1] ip address 2.2.2.2 32
[PE2-Loopback1] quit
```

配置 100GE1/0/1 口。

```
[PE2] interface 100GE 1/0/1
[PE2-100GE1/0/1] undo portswitch
[PE2-100GE1/0/1] ip address 12.1.1.2 24
[PE2-100GE1/0/1] quit
[PE2] interface 100GE 1/0/2.1 mode l2
[PE2-100GE1/0/2.1] quit
```

配置 OSPF。

```
[PE2] ospf 1
```

```
[PE2-ospf-1] area 0
[PE2-ospf-1-area-0.0.0.0] network 2.2.2.2.0.0.0.0
[PE2-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[PE2-ospf-1-area-0.0.0.0] quit
[PE2-ospf-1] quit
```

配置 MPLS。

```
[PE2] mpls lsr-id 2.2.2.2
[PE2] mpls
[PE2-mpls] quit
[PE2] mpls ldp
[PE2-mpls-ldp] quit
[PE2] interface 100ge 1/0/1
[PE2-10GE1/0/1] mpls
[PE2-10GE1/0/1] mpls ldp
[PE2-10GE1/0/1] quit
```

配置 MPLS L2VPN。

```
[PE2] mpls l2vpn
[PE2-l2vpn] quit
```

配置 VSI(CE6860EI V200R005C10SPC800 只支持 BD 模式下创建 VSI)。

```
[PE2] vsi aaa bd-mode
[PE2-vsi-aaa] encapsulation ethernet
[PE2-vsi-aaa] pwsignal ldp
[PE2-vsi-aaa-ldp] vsi-id 500
[PE2-vsi-aaa-ldp] peer 1.1.1.1
[PE2-vsi-aaa-ldp] quit
[PE2-vsi-aaa] quit
```

配置 VSI。

```
[PE2] bridge-domain 500
[PE2-bd10] l2 binding vsi aaa
[PE2-bd10] quit
```

配置 VSI 与接口 100GE 1/0/2.1 绑定。

```
[PE2] interface 100GE 1/0/2.1 mode l2
[PE2-100GE1/0/2.1] encapsulation dot1q vid 10
[PE2-100GE1/0/2.1] bridge-domain 500
[PE2-100GE1/0/2.1] quit
```

10.1.4 验证配置

在 PE1 上执行 **display l2vpn pw verbose** 命令，可以看到建立的 PW，状态为 up。

```
[PE1] display l2vpn pw verbose
VSI Name: aaa
  Peer: 2.2.2.2          PW ID: 500
    Signaling Protocol  : LDP
    Link ID             : 1024       PW State : Up
    In Label            : 24253      Out Label: 54
    MTU                 : 1500
    PW Attributes       : Main
```

```
    VCCV CC             : -
    VCCV BFD            : -
    Tunnel Group ID     : 0x800000330000000
    Tunnel NHLFE IDs    : 6
```

#在 PE 2 上执行 **display vpls vsi name aaa** 命令，可以看到名为 aaa 的 VSI 建立了一条 PW 到 PE2，VSI 状态为 up。

```
[PE2] display vpls vsi name aaa verbose

 ***VSI Name               : aaa
    Administrator VSI      : no
    Isolate Spoken         : disable
    VSI Index              : 3
    PW Signaling           : ldp
    Member Discovery Style : --
    Bridge-domain Mode     : enable
    Service Type           : e-lan
    PW MAC Learn Style     : qualify
    Encapsulation Type     : ethernet
    MTU                    : 1500
    Ignore AcState         : disable
    P2P VSI                : disable
    Create Time            : 2 days, 17 hours, 40 minutes, 37 seconds
    VSI State              : up
    Resource Status        : --

    VSI ID                 : 500
   *Peer Router ID         : 1.1.1.1
    Negotiation-vc-id      : 500
    Encapsulation Type     : ethernet
    primary or secondary   : primary
    ignore-standby-state   : no
    VC Label               : 54
    Peer Type              : dynamic
    Session                : up
    Tunnel ID              : 0x0000000001004c4b81
    Broadcast Tunnel ID    : --
    Broad BackupTunnel ID  : --
    CKey                   : 129
    NKey                   : 16777583
    Stp Enable             : 0
    PwIndex                : 129
    Control Word           : disable
    BFD for PW             : unavailable

    Access Bridge-domain   : Bridge-domain 500
    Vac State              : up
    Last Up Time           : 2023/02/15 11:33:44
    Total Up Time          : 1 days, 20 hours, 35 minutes, 47 seconds
```

```
  **PW Information:

   *Peer Ip Address        : 1.1.1.1
    PW State               : up
    Local VC Label         : 54
    Remote VC Label        : 24253
    Remote Control Word    : disable
    PW Type                : label
    Local  VCCV            : alert lsp-ping bfd
    Remote VCCV            : lsp-ping
    Tunnel ID              : 0x0000000001004c4b81
    Broadcast Tunnel ID    : --
    Broad BackupTunnel ID  : --
    Ckey                   : 129
    Nkey                   : 16777583
    Main PW Token          : 0x0
    Slave PW Token         : 0x0
    Tnl Type               : ldp
    OutInterface           : --
    Backup OutInterface    : --
    Stp Enable             : 0
    Mac Flapping           : 0
    Monitor Group Name     : --
    PW Last Up Time        : 2023/02/15 19:33:36
PW Total Up Time       : 2 days, 11 hours, 14 minutes, 45 seconds
```

在 PE1 上查看 VSI 的 MAC 地址表信息。

```
[PE1] display l2vpn mac-address vsi aaa
MAC Address    State     VSI Name                        Link ID/Name   Aging
7485-c41b-4201 Dynamic   aaa                             HGE2/0/8       Aging
74d6-cb83-2081 Dynamic   aaa                             1024           Aging
--- 2 mac address(es) found  ---
```

在 PE2 上查看 MAC 地址表信息。

```
[PE2] display mac-address
Flags: * - Backup
       # - forwarding logical interface, operations cannot be performed based
           on the interface.
BD   : bridge-domain   Age : dynamic MAC learned time in seconds
--------------------------------------------------------------------------------
MAC Address    VLAN/VSI/BD   Learned-From        Type                Age
--------------------------------------------------------------------------------
7485-c41b-4201 -/aaa/500     1.1.1.1             dynamic           18077
74d6-cb83-2081 -/aaa/500     100GE1/0/2.1        dynamic           12868
--------------------------------------------------------------------------------
Total items: 2
```

在 CE1(11.1.1.1)上能够 ping 通 CE2(11.1.1.2)。

```
[CE1] ping 11.1.1.2
Ping 11.1.1.2 (11.1.1.2): 56 data bytes, press CTRL+C to break
```

```
56 bytes from 11.1.1.2: icmp_seq=0 ttl=255 time=1.495 ms
56 bytes from 11.1.1.2: icmp_seq=1 ttl=255 time=1.149 ms
56 bytes from 11.1.1.2: icmp_seq=2 ttl=255 time=2.108 ms
56 bytes from 11.1.1.2: icmp_seq=3 ttl=255 time=1.277 ms
56 bytes from 11.1.1.2: icmp_seq=4 ttl=255 time=1.157 ms

--- Ping statistics for 11.1.1.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.149/1.437/2.108/0.358 ms
[CE1]%Feb 16 05:51:35:465 2023 Switch B PING/6/PING_STATISTICS: -MDC=1; Ping statistics for
11.1.1.2: 5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss, round-trip
min/avg/max/std-dev = 1.149/1.437/2.108/0.358 ms.
```

在 CE2(11.1.1.2)上能够 ping 通 CE1(11.1.1.1)。

```
[CE2] ping 11.1.1.1
Ping 11.1.1.1 (11.1.1.1): 56 data bytes, press CTRL+C to break
56 bytes from 11.1.1.1: icmp_seq=0 ttl=255 time=1.768 ms
56 bytes from 11.1.1.1: icmp_seq=1 ttl=255 time=1.823 ms
56 bytes from 11.1.1.1: icmp_seq=2 ttl=255 time=1.392 ms
56 bytes from 11.1.1.1: icmp_seq=3 ttl=255 time=1.343 ms
56 bytes from 11.1.1.1: icmp_seq=4 ttl=255 time=1.222 ms

--- Ping statistics for 11.1.1.1 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.222/1.510/1.823/0.241 ms
[CE2]%Feb 16 13:45:49:212 2023 H3C PING/6/PING_STATISTICS: Ping statistics for 11.1.1.1: 5
packet(s) transmitted, 5 packet(s) received, 0.0% packet loss, round-trip
min/avg/max/std-dev = 1.222/1.510/1.823/0.241 ms.
```

11 MPLS L3VPN 对接操作指导

11.1 与华为设备对接操作指导

11.1.1 互通性分析

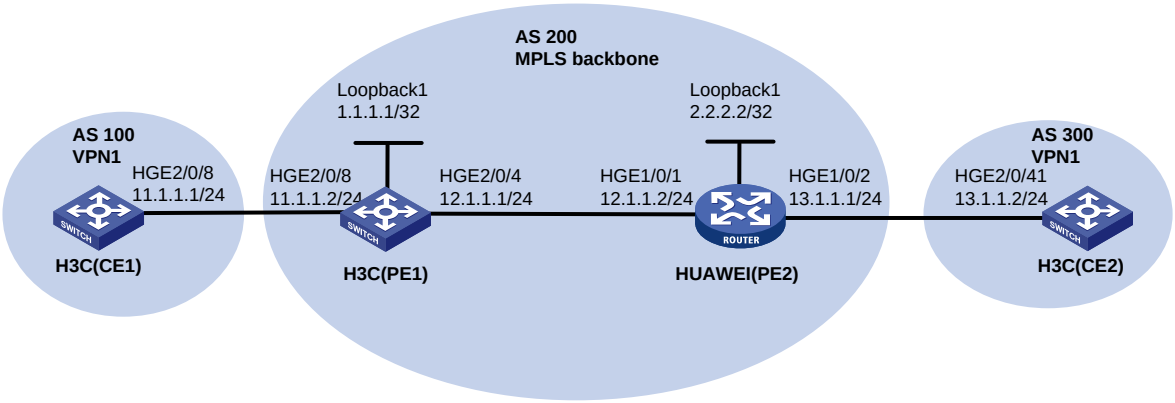
表27 MPLS L3VPN 互通性分析

H3C	华为	互通结论
支持	支持	可以互通

11.1.2 组网需求

如图42所示，三台H3C设备和华为设备组成MPLS L3VPN网络，在CE与PE之间配置EBGP交换VPN路由信息，在PE1和PE2之间配置OSPF实现PE内部的互通、配置MP-IBGP交换VPN路由信息，最终实现从CE1到CE2的互通。

图42 MPLS L3VPN 对接配置组网图



11.1.3 配置步骤

- 配置 H3C 设备（PE1）

配置 Loopback1 口。

```
<PE1> system-view
[PE1] interface loopback 1
[PE1-LoopBack1] ip address 1.1.1.1 32
[PE1-LoopBack1] quit
```

配置 HundredGigE2/0/4 口。

```
[PE1] interface HundredGigE 2/0/4
[PE1-HundredGigE2/0/4] ip address 12.1.1.1 24
[PE1-HundredGigE2/0/4] quit
```

配置 OSPF。

```
[PE1] ospf 1
[PE1-ospf-1] area 0
[PE1-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[PE1-ospf-1-area-0.0.0.0] network 1.1.1.1 0.0.0.0
[PE1-ospf-1-area-0.0.0.0] quit
[PE1-ospf-1] quit
```

配置 MPLS 和 LDP 功能。

```
[PE1] mpls lsr-id 1.1.1.1
[PE1] mpls ldp
[PE1-ldp] quit
[PE1] interface HundredGigE 2/0/4
[PE1-HundredGigE2/0/4] mpls enable
[PE1-HundredGigE2/0/4] mpls ldp enable
[PE1-HundredGigE2/0/4] quit
```

配置 VPN 实例，将 CE1 接入 PE1。

```
[PE1] ip vpn-instance vpn1
[PE1-vpn-instance-vpn1] route-distinguisher 100:1
[PE1-vpn-instance-vpn1] vpn-target 111:1
[PE1-vpn-instance-vpn1] quit
```

```
[PE1] interface HundredGigE 2/0/8
[PE1-HundredGigE2/0/8] ip binding vpn-instance vpn1
[PE1-HundredGigE2/0/8] ip address 11.1.1.2 24
[PE1-HundredGigE2/0/8] quit
```

在 PE 与 CE 之间建立 EBGP 对等体，引入 VPN 路由。

```
[PE1] bgp 200
[PE1-bgp-default] ip vpn-instance vpn1
[PE1-bgp-default-vpn1] peer 11.1.1.1 as-number 100
[PE1-bgp-default-vpn1] address-family ipv4 unicast
[PE1-bgp-default-ipv4-vpn1] peer 11.1.1.1 enable
[PE1-bgp-default-ipv4-vpn1] quit
[PE1-bgp-default-vpn1] quit
[PE1-bgp-default] quit
```

PE 之间建立 MP-IBGP 对等体

```
[PE1] bgp 200
[PE1-bgp-default] peer 2.2.2.2 as-number 200
[PE1-bgp-default] peer 2.2.2.2 connect-interface loopback 1
[PE1-bgp-default] address-family vpnv4
[PE1-bgp-default-vpnv4] peer 2.2.2.2 enable
[PE1-bgp-default-vpnv4] quit
[PE1-bgp-default] quit
```

- 配置 H3C 设备（CE1）

配置 HundredGigE2/0/8 口。

```
<CE1> system-view
[CE1] interface HundredGigE 2/0/8
[CE1-HundredGigE2/0/8] ip address 11.1.1.1 24
[CE1-HundredGigE2/0/8] quit
```

#在 PE 与 CE 之间建立 EBGP 对等体，引入 VPN 路由。

```
[CE1] bgp 100
[CE1-bgp-default] peer 11.1.1.2 as-number 200
[CE1-bgp-default] address-family ipv4 unicast
[CE1-bgp-default-ipv4] peer 10.1.1.2 enable
[CE1-bgp-default-ipv4] import-route direct
[CE1-bgp-default-ipv4] quit
[CE1-bgp-default] quit
```

- 配置 H3C 设备（CE2）

配置 HundredGigE2/0/4 口。

```
<CE2> system-view
[CE2] interface HundredGigE 2/0/4
[CE2-HundredGigE2/0/8] ip address 13.1.1.2 24
[CE2-HundredGigE2/0/8] quit
```

#在 PE 与 CE 之间建立 EBGP 对等体，引入 VPN 路由。

```
[CE2] bgp 300
[CE2-bgp-default] peer 13.1.1.1 as-number 200
[CE2-bgp-default] address-family ipv4 unicast
[CE2-bgp-default-ipv4] peer 13.1.1.1 enable
```

```
[CE2-bgp-default-ipv4] import-route direct
[CE2-bgp-default-ipv4] quit
[CE2-bgp-default] quit
```

- 配置华为设备（PE2）

如下配置以华为 CE6860-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<PE2> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.180 (CE6860EI V200R005C10SPC800)
Copyright (C) 2012-2018 Huawei Technologies Co., Ltd.
HUAWEI CE6860-48S8CQ-EI uptime is 2 days, 13 hours, 54 minutes

CE6860-48S8CQ-EI(Master) 1 : uptime is  2 days, 13 hours, 53 minutes
        StartupTime 2023/02/08   20:04:57
Memory    Size    : 2048 M bytes
Flash     Size    : 1024 M bytes
CE6860-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP01    VER A
2. MAB    Version : 2
3. Board  Type    : CE6860-48S8CQ-EI
4. CPLD1  Version : 104
5. CPLD2  Version : 104
6. BIOS   Version : 192
```

配置 Loopback1 口。

```
<PE2> system-view immediately
[PE2] interface loopback1
[PE2-Loopback1] ip address 2.2.2.2 32
[PE2-Loopback1] quit
```

配置 100GE1/0/1 口。

```
[PE2] interface 100GE 1/0/1
[PE2-100GE1/0/1] undo portswitch
[PE2-100GE1/0/1] ip address 12.1.1.2 24
[PE2-100GE1/0/1] quit
```

配置 OSPF。

```
[PE2] ospf 1
[PE2-ospf-1] area 0
[PE2-ospf-1-area-0.0.0.0] network 12.1.1.0 0.0.0.255
[PE2-ospf-1-area-0.0.0.0] network 2.2.2.2 0.0.0.0
[PE2-ospf-1-area-0.0.0.0] quit
[PE2-ospf-1] quit
```

配置 MPLS 和 LDP。

```
[PE2] mpls lsr-id 2.2.2.2
[PE2] mpls
[PE2-mpls] quit
[PE2] mpls ldp
[PE2-mpls-ldp] quit
[PE2] interface 100GE 1/0/1
[PE2-100GE1/0/1] mpls
```

```
[PE2-100GE1/0/1] mpls ldp
[PE2-100GE1/0/1] quit
```

配置 VPN 实例，将 CE2 接入 PE2。

```
[PE2] ip vpn-instance vpn1
[PE2-vpn-instance-vpn1] ipv4-family
[PE2-vpn-instance-vpn1-af-ipv4] route-distinguisher 100:1
[PE2-vpn-instance-vpn1-af-ipv4] vpn-target 111:1 both
[PE2-vpn-instance-vpn1-af-ipv4] quit
[PE2-vpn-instance-vpn1] quit
[PE2] interface 100GE 1/0/2
[PE2-100GE1/0/1] undo portswitch
[PE2-100GE1/0/1] ip binding vpn-instance vpn1
[PE2-100GE1/0/1] ip address 13.1.1.1 24
[PE2-100GE1/0/1] quit
```

在 PE2 与 CE2 之间建立 EBGP 对等体，引入 VPN 路由。

```
[PE2] bgp 200
[PE2-bgp] ipv4-family vpn-instance vpn1
[PE2-bgp-vpn1] peer 13.1.1.2 as-number 300
[PE2-bgp-vpn1] quit
[PE2-bgp] quit
```

11.1.4 验证配置

在 PE1 上执行 **display bgp peer vpnv4** 命令，可以看到 PE 之间的 IBGP 对等体关系已建立，并达到 Established 状态。

```
[PE1] display bgp peer vpnv4

 BGP local router ID: 1.1.1.1
 Local AS number: 200
 Total number of peers: 1                 Peers in established state: 1

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  2.2.2.2                200     1720     1912    0       3 24:51:49 Established
```

在 PE1 上执行 **display bgp peer vpnv4** 命令，可以看到 PE1 与 CE1 之间的 EBGP 对等体关系已建立，并达到 Established 状态。

```
[PE1] display bgp peer ipv4 vpn-instance vpn1

 BGP local router ID: 1.1.1.1
 Local AS number: 200
 Total number of peers: 1                 Peers in established state: 1

  * - Dynamically created peer
  Peer                    AS  MsgRcvd  MsgSent OutQ PrefRcv Up/Down  State

  11.1.1.1               100      328      307    0       2 04:51:03 Established
```

在 PE1 上 Ping CE1，可以 Ping 通。

```
<PE1> ping -vpn-instance vpn1 11.1.1.1
Ping 11.1.1.1 (11.1.1.1): 56 data bytes, press CTRL+C to break
56 bytes from 11.1.1.1: icmp_seq=0 ttl=255 time=2.323 ms
56 bytes from 11.1.1.1: icmp_seq=1 ttl=255 time=1.274 ms
56 bytes from 11.1.1.1: icmp_seq=2 ttl=255 time=1.405 ms
56 bytes from 11.1.1.1: icmp_seq=3 ttl=255 time=1.230 ms
56 bytes from 11.1.1.1: icmp_seq=4 ttl=255 time=1.497 ms

--- Ping statistics for 11.1.1.1 in VPN instance vpn1 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.230/1.546/2.323/0.400 ms
<PE1>%Feb 22 16:32:25:730 2023 H3C PING/6/PING_VPN_STATISTICS: -MDC=1; Ping statistics for
11.1.1.1 in VPN instance vpn1: 5 packet(s) transmitted, 5 packet(s) received, 0.0% packet
loss, round-trip min/avg/max/std-dev = 1.230/1.546/2.323/0.400 ms.
```

在 PE2 上执行 **display bgp vpnv4 all peer** 命令，可以看到 PE2 与 PE1、CE2 的 BGP 对等体关系已建立，并达到 Established 状态。

```
[PE2] display bgp vpnv4 all peer
 BGP local router ID        : 2.2.2.2
 Local AS number            : 200
 Total number of peers      : 2
 Peers in established state : 2

  Peer            V          AS  MsgRcvd  MsgSent  OutQ  Up/Down       State  PrefRcv
  1.1.1.1         4         200     1925     1734     0 0025h03m Established        2

  Peer of IPv4-family for vpn instance :

  VPN-Instance vpn1, Router ID 2.2.2.2:
  Peer            V          AS  MsgRcvd  MsgSent  OutQ  Up/Down       State  PrefRcv
  13.1.1.2        4         300     1305     1666     0 21:26:10 Established        3
```

在 PE2 上 Ping CE2，可以 Ping 通。

```
<PE2> ping -vpn-instance vpn1 13.1.1.2
  PING 13.1.1.2: 56  data bytes, press CTRL_C to break
    Reply from 13.1.1.2: bytes=56 Sequence=1 ttl=255 time=4 ms
    Reply from 13.1.1.2: bytes=56 Sequence=2 ttl=255 time=2 ms
    Reply from 13.1.1.2: bytes=56 Sequence=3 ttl=255 time=1 ms
    Reply from 13.1.1.2: bytes=56 Sequence=4 ttl=255 time=1 ms
    Reply from 13.1.1.2: bytes=56 Sequence=5 ttl=255 time=2 ms

  --- 13.1.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/2/4 ms
```

#在 CE1 上 Ping CE2，可以 Ping 通。

```
<CE1> ping 13.1.1.2
Ping 13.1.1.2 (13.1.1.2): 56 data bytes, press CTRL+C to break
```

```
56 bytes from 13.1.1.2: icmp_seq=0 ttl=253 time=1.953 ms
56 bytes from 13.1.1.2: icmp_seq=1 ttl=253 time=1.355 ms
56 bytes from 13.1.1.2: icmp_seq=2 ttl=253 time=1.166 ms
56 bytes from 13.1.1.2: icmp_seq=3 ttl=253 time=1.063 ms
56 bytes from 13.1.1.2: icmp_seq=4 ttl=253 time=1.177 ms

--- Ping statistics for 13.1.1.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.063/1.343/1.953/0.319 ms
<CE1>%Feb 22 08:40:23:685 2023 Switch B PING/6/PING_STATISTICS: -MDC=1; Ping statistics for
13.1.1.2: 5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss, round-trip
min/avg/max/std-dev = 1.063/1.343/1.953/0.319 ms.
```

在 CE 2 上 Ping CE1，可以 Ping 通。

```
<CE2> ping 11.1.1.1
Ping 11.1.1.1 (11.1.1.1): 56 data bytes, press CTRL+C to break
56 bytes from 11.1.1.1: icmp_seq=0 ttl=253 time=1.732 ms
56 bytes from 11.1.1.1: icmp_seq=1 ttl=253 time=1.256 ms
56 bytes from 11.1.1.1: icmp_seq=2 ttl=253 time=1.279 ms
56 bytes from 11.1.1.1: icmp_seq=3 ttl=253 time=2.485 ms
56 bytes from 11.1.1.1: icmp_seq=4 ttl=253 time=2.700 ms

--- Ping statistics for 11.1.1.1 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.256/1.890/2.700/0.602 ms
<CE2>%Feb 22 16:34:49:957 2023 H3C PING/6/PING_STATISTICS: Ping statistics for 11.1.1.1: 5
packet(s) transmitted, 5 packet(s) received, 0.0% packet loss, round-trip
min/avg/max/std-dev = 1.256/1.890/2.700/0.602 ms.
```

12 M-LAG 对接操作指导

12.1 与华为设备对接操作指导

12.1.1 互通性分析

表28 互通性分析

H3C	华为	互通结论
支持	支持	可以互通

12.1.2 本文适用产品及版本

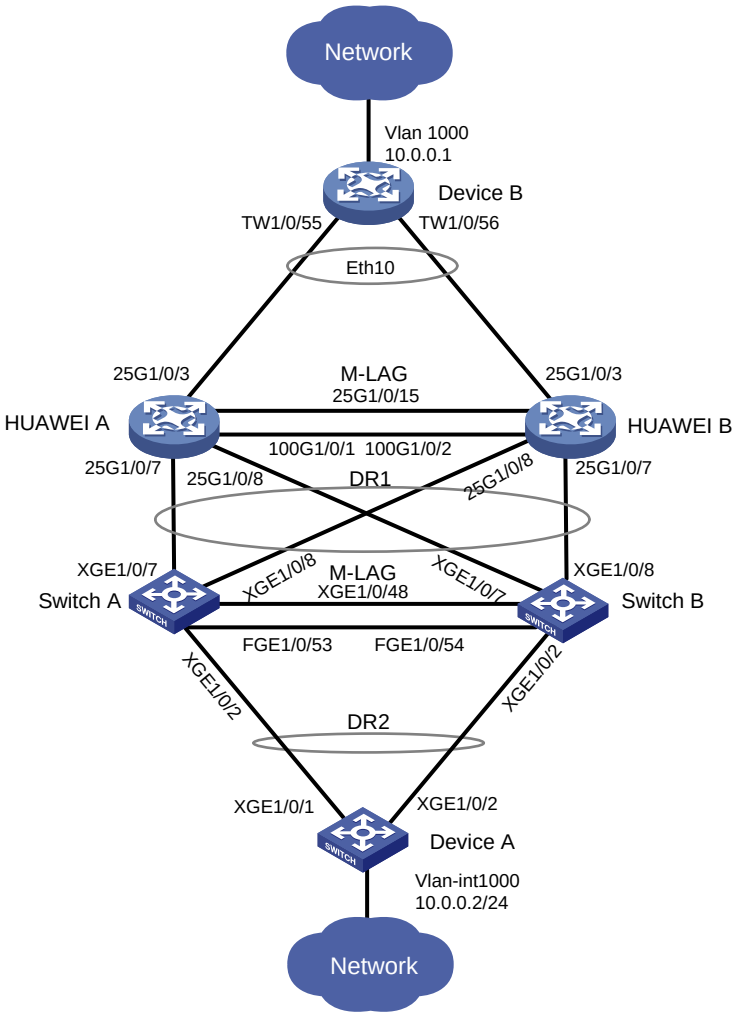
场景	产品型号	推荐版本
数据中心	S12500X-AF/S12500G-AF/S12500F-AF	• S12500X-AF/S12500F-AF H 系列单板：R2825 • S12500G-AF 全系列单板：R7625 及以上的版本

场景	产品型号	推荐版本
	S9820/S9850	S9820/S9850：R6710
	S6800/S6860/S6812[S6813]/S6805/S6825/S6850/S6890/S6900	• S6800/S6860/S6900/S6805/S6850/S6825：R6710 • S6890：R2825 • S6812/S6813：F6628P22
园区	S12500G-AF/S12500-XS	R7625及以上的版本
	S10500X	R7625及以上的版本
	S7600/S7600E-X/S7500X	R7625及以上的版本
	S6550XE-HI/S6525XE-HI/S6520X-EI/S6520X-HI/S5560X-EI/S5560X-HI	• S6550XE-HI/S6525XE-HI：E8106 及以上版本 • S6520X-EI/S6520X-HI：F6628P11 及以上版本 • S5560X-EI/S5560X-HI：F6628P11 及以上版本

12.1.3 组网需求

如图 43 所示，H3C 设备与华为设备通过各自的二层以太网聚合接口相互连接。现要求在 H3C 设备和华为设备上分别配置 M-LAG，实现两台物理设备在聚合层面虚拟成一台设备来实现跨设备链路聚合，从而提供设备级冗余保护和流量负载分担。

图43 M-LAG 对接配置组网图



12.1.4 配置步骤

- 配置 H3C 设备（SwitchA）

配置 M-LAG 系统 MAC 地址。

```
<SwitchA> system-view
[SwitchA] m-lag system-mac 0000-0000-1111
```

配置 M-LAG 系统编号。

```
[SwitchA] m-lag system-number 1
```

配置 M-LAG 系统优先级。

```
[SwitchA] m-lag system-priority 100
```

创建 VLAN 1000。

```
[SwitchA] vlan 1000
[SwitchA-vlan1000] quit
```

配置端口 Ten-GigabitEthernet1/0/48 工作在三层模式，并配置 IP 地址为 Keepalive 报文的源 IP 地址。

```
[SwitchA] interface Ten-GigabitEthernet1/0/48
```

```
[SwitchA-Ten-GigabitEthernet1/0/48] port link-mode route
[SwitchA-Ten-GigabitEthernet1/0/48] ip address 22.254.121.7 255.255.255.254
[SwitchA-Ten-GigabitEthernet1/0/48] quit
```

配置 Keepalive 报文的目的 IP 地址和源 IP 地址。

```
[SwitchA] m-lag keepalive ip destination 22.254.121.6 source 22.254.121.7
```

配置 Keepalive 链路接口为保留接口。

```
[SwitchA] m-lag mad exclude interface Ten-GigabitEthernet 1/0/48
```

创建二层聚合接口 1、256、1002，并配置该接口为动态聚合模式。

```
[SwitchA] interface Bridge-Aggregation 1
[SwitchA-Bridge-Aggregation1] link-aggregation mode dynamic
[SwitchA-Bridge-Aggregation1] quit
[SwitchA] interface Bridge-Aggregation 256
[SwitchA-Bridge-Aggregation256] link-aggregation mode dynamic
[SwitchA-Bridge-Aggregation256] quit
[SwitchA] interface Bridge-Aggregation 1002
[SwitchA-Bridge-Aggregation1002] link-aggregation mode dynamic
[SwitchA-Bridge-Aggregation1002] quit
```

分别将端口 Ten-GigabitEthernet1/0/7、Ten-GigabitEthernet1/0/8 加入到聚合组 1，将端口 Ten-GigabitEthernet1/0/2 加入到聚合组 1002，将端口 FortyGigE1/0/53 和 FortyGigE1/0/54 加入到聚合组 256。

```
[SwitchA] interface Ten-GigabitEthernet1/0/7
[SwitchA-Ten-GigabitEthernet1/0/7] port link-aggregation group 1
[SwitchA-Ten-GigabitEthernet1/0/7] quit
[SwitchA] interface Ten-GigabitEthernet1/0/8
[SwitchA-Ten-GigabitEthernet1/0/8] port link-aggregation group 1
[SwitchA-Ten-GigabitEthernet1/0/8] quit
[SwitchA] interface Ten-GigabitEthernet1/0/2
[SwitchA-Ten-GigabitEthernet1/0/2] port link-aggregation group 1002
[SwitchA-Ten-GigabitEthernet1/0/2] quit
[SwitchA] interface FortyGigE 1/0/53
[SwitchA-FortyGigE1/0/53] port link-aggregation group 256
[SwitchA-FortyGigE1/0/53] quit
[SwitchA] interface FortyGigE 1/0/54
[SwitchA-FortyGigE1/0/54] port link-aggregation group 256
[SwitchA-FortyGigE1/0/54] quit
```

将二层聚合接口 256 配置为 IPP 口。

```
[SwitchA] interface Bridge-Aggregation 256
[SwitchA-Bridge-Aggregation256] port m-lag peer-link 1
[SwitchA-Bridge-Aggregation256] quit
```

聚合端口 1 和 1002 加入 VLAN 1000。

```
[SwitchA] interface Bridge-Aggregation 1
[SwitchA-Bridge-Aggregation1] port link-type trunk
[SwitchA-Bridge-Aggregation1] undo port trunk permit vlan 1
[SwitchA-Bridge-Aggregation1] port trunk permit vlan 1000
[SwitchA-Bridge-Aggregation1] quit
[SwitchA] interface Bridge-Aggregation 1002
[SwitchA-Bridge-Aggregation1002] port link-type trunk
```

```
[SwitchA-Bridge-Aggregation1002] undo port trunk permit vlan 1
[SwitchA-Bridge-Aggregation1002] port trunk permit vlan 1000
[SwitchA-Bridge-Aggregation1002] quit
```

将二层聚合接口 1 加入分布式聚合组 1000，二层聚合接口 1002 加入分布式聚合组 1002。

```
[SwitchA] interface Bridge-Aggregation 1
[SwitchA-Bridge-Aggregation1] port m-lag group 1000
[SwitchA-Bridge-Aggregation1] quit
[SwitchA] interface Bridge-Aggregation 1002
[SwitchA-Bridge-Aggregation1002] port m-lag group 1002
[SwitchA-Bridge-Aggregation1002] quit
```

- 配置 H3C 设备（SwitchB）

配置 M-LAG 系统 MAC 地址。

```
<SwitchB> system-view
[SwitchB] m-lag system-mac 0000-0000-1111
```

配置 M-LAG 系统编号。

```
[SwitchB] m-lag system-number 2
```

配置 M-LAG 系统优先级。

```
[SwitchB] m-lag system-priority 100
```

创建 VLAN 1000。

```
[SwitchB] vlan 1000
[SwitchB-vlan1000] quit
```

配置端口 Ten-GigabitEthernet1/0/48 工作在三层模式，并配置 IP 地址为 Keepalive 报文的源 IP 地址。

```
[SwitchB] interface Ten-GigabitEthernet1/0/48
[SwitchB-Ten-GigabitEthernet1/0/48] port link-mode route
[SwitchB-Ten-GigabitEthernet1/0/48] ip address 22.254.121.6 255.255.255.254
[SwitchB-Ten-GigabitEthernet1/0/48] quit
```

配置 Keepalive 报文的目的 IP 地址和源 IP 地址。

```
[SwitchB] m-lag keepalive ip destination 22.254.121.7 source 22.254.121.6
```

配置 Keepalive 链路接口为保留接口。

```
[SwitchB] m-lag mad exclude interface Ten-GigabitEthernet 1/0/48
```

创建二层聚合接口 1、256、1002，并配置该接口为动态聚合模式。

```
[SwitchB] interface Bridge-Aggregation 1
[SwitchB-Bridge-Aggregation1] link-aggregation mode dynamic
[SwitchB-Bridge-Aggregation1] quit
[SwitchB] interface Bridge-Aggregation 256
[SwitchB-Bridge-Aggregation256] link-aggregation mode dynamic
[SwitchB-Bridge-Aggregation256] quit
[SwitchB] interface Bridge-Aggregation 1002
[SwitchB-Bridge-Aggregation1002] link-aggregation mode dynamic
[SwitchB-Bridge-Aggregation1002] quit
```

分别将端口 Ten-GigabitEthernet1/0/7、Ten-GigabitEthernet1/0/8 加入到聚合组 1，将端口 Ten-GigabitEthernet1/0/2 加入到聚合组 1002，将端口 FortyGigE 1/0/53 和 FortyGigE 1/0/54 加入到聚合组 256。

```
[SwitchB] interface Ten-GigabitEthernet1/0/7
[SwitchB-Ten-GigabitEthernet1/0/7] port link-aggregation group 1
```

```
[SwitchB-Ten-GigabitEthernet1/0/7] quit
[SwitchB] interface Ten-GigabitEthernet1/0/8
[SwitchB-Ten-GigabitEthernet1/0/8] port link-aggregation group 1
[SwitchB-Ten-GigabitEthernet1/0/8] quit
[SwitchB] interface Ten-GigabitEthernet1/0/2
[SwitchB-Ten-GigabitEthernet1/0/2] port link-aggregation group 1002
[SwitchB-Ten-GigabitEthernet1/0/2] quit
[SwitchB] interface FortyGigE 1/0/53
[SwitchB-FortyGigE 1/0/53] port link-aggregation group 256
[SwitchB-FortyGigE 1/0/53] quit
[SwitchB] interface FortyGigE 1/0/54
[SwitchB-FortyGigE 1/0/54] port link-aggregation group 256
[SwitchB-FortyGigE 1/0/54] quit
```

将二层聚合接口 256 配置为 IPP 口。

```
[SwitchB] interface Bridge-Aggregation 256
[SwitchB-Bridge-Aggregation256] port m-lag peer-link 1
[SwitchB-Bridge-Aggregation256] quit
```

聚合端口 1 和 1002 加入 VLAN 1000。

```
[SwitchB] interface Bridge-Aggregation 1
[SwitchB-Bridge-Aggregation1] port link-type trunk
[SwitchB-Bridge-Aggregation1] undo port trunk permit vlan 1
[SwitchB-Bridge-Aggregation1] port trunk permit vlan 1000
[SwitchB-Bridge-Aggregation1] quit
[SwitchB] interface Bridge-Aggregation 1002
[SwitchB-Bridge-Aggregation1002] port link-type trunk
[SwitchB-Bridge-Aggregation1002] undo port trunk permit vlan 1
[SwitchB-Bridge-Aggregation1002] port trunk permit vlan 1000
[SwitchB-Bridge-Aggregation1002] quit
```

将二层聚合接口 1 加入分布式聚合组 1000，二层聚合接口 1002 加入分布式聚合组 1002。

```
[SwitchB] interface Bridge-Aggregation 1
[SwitchB-Bridge-Aggregation1] port m-lag group 1000
[SwitchB-Bridge-Aggregation1] quit
[SwitchB] interface Bridge-Aggregation 1002
[SwitchB-Bridge-Aggregation1002] port m-lag group 1002
[SwitchB-Bridge-Aggregation1002] quit
```

- 配置华为设备（HUAWEIA）

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEIA> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
```

```
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

创建 VLAN 1000。

```
<HUAWEIA> system-view
Enter system view, return user view with return command.
[~HUAWEIA] vlan 1000
[~HUAWEIA-vlan1000] quit
[~HUAWEIA] commit
```

配置端口 25GE1/0/15 工作在三层模式，并配置 IP 地址为 Keepalive 报文的源 IP 地址。

```
[~HUAWEIA] interface 25GE 1/0/15
[~HUAWEIA-25GE1/0/15] undo portswitch
[~HUAWEIA-25GE1/0/15] ip address 10.254.120.2 255.255.255.0
[~HUAWEIA-25GE1/0/15] quit
[~HUAWEIA] commit
```

创建动态交换服务组 DFS Group，并配置 DFS Group 优先级，配置 DFS Group 绑定的 IPv4 地址。

```
[~HUAWEIA] dfs-group 1
[~HUAWEIA-dfs-group-1] priority 150
[~HUAWEIA-dfs-group-1] source ip 10.254.120.2
[~HUAWEIA-dfs-group-1] quit
[~HUAWEIA] commit
```

创建二层聚合接口 Eth-Trunk1、Eth-Trunk10，并配置该接口为动态 LACP 模式。

```
[~HUAWEIA] interface Eth-Trunk 1
[~HUAWEIA-Eth-Trunk1] mode lacp-dynamic
[~HUAWEIA-Eth-Trunk1] quit
[~HUAWEIA] interface Eth-Trunk 10
[~HUAWEIA-Eth-Trunk10] mode lacp-dynamic
[~HUAWEIA-Eth-Trunk10] quit
```

创建二层聚合接口 Eth-Trunk0，并配置该接口为静态 LACP 模式。

```
[~HUAWEIA] interface Eth-Trunk 0
[~HUAWEIA-Eth-Trunk0] mode lacp-static
[~HUAWEIA-Eth-Trunk0] quit
[~HUAWEIA] commit
```

分别将端口 25G1/0/7、25G1/0/8 加入到聚合组 1，将端口 25G1/0/3 加入到聚合组 10，将端口 100GE1/0/1、100GE1/0/2 加入到聚合组 0。

```
[~HUAWEIA] interface 25GE 1/0/7
[~HUAWEIA-25GE1/0/7] eth-trunk 1
[~HUAWEIA-25GE1/0/7] quit
[~HUAWEIA] interface 25GE 1/0/8
[~HUAWEIA-25GE1/0/8] eth-trunk 1
[~HUAWEIA-25GE1/0/8] quit
[~HUAWEIA] interface 100GE 1/0/1
```

```
[~HUAWEIA-100GE1/0/1] eth-trunk 0
[~HUAWEIA-100GE1/0/1] quit
[~HUAWEIA] interface 100GE 1/0/2
[~HUAWEIA-100GE1/0/2] eth-trunk 0
[~HUAWEIA-100GE1/0/2] quit
[~HUAWEIA] interface 25GE 1/0/3
[~HUAWEIA-25GE1/0/3] eth-trunk 10
[~HUAWEIA-25GE1/0/3] quit
[~HUAWEIA] commit
```

指定 Eth-Trunk0 接口为 peer-link 接口。

```
[~HUAWEIA] interface Eth-Trunk 0
[~HUAWEIA-Eth-Trunk0] peer-link 1
[*HUAWEIA-Eth-Trunk0] qui
[*HUAWEIA] commit
Committing....done.
```

配置 Eth-Trunk1、Eth-Trunk10 加入 VLAN1000。

```
[~HUAWEIA]interface Eth-Trunk 1
[~HUAWEIA-Eth-Trunk1] port link-type trunk
[~HUAWEIA-Eth-Trunk1] undo port trunk allow-pass vlan 1
[~HUAWEIA-Eth-Trunk1] port trunk allow-pass vlan 1000
[~HUAWEIA-Eth-Trunk1] quit
[~HUAWEIA]interface Eth-Trunk 10
[~HUAWEIA-Eth-Trunk10] port link-type trunk
[~HUAWEIA-Eth-Trunk10] undo port trunk allow-pass vlan 1
[~HUAWEIA-Eth-Trunk10] port trunk allow-pass vlan 1000
[~HUAWEIA-Eth-Trunk10] quit
[*HUAWEIA] commit
```

- 配置华为设备（HUAWEIB）

如下配置以华为 CE6865-48S8CQ-EI 为例进行介绍，设备具体信息如下：

```
<HUAWEIB> display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 8.191 (CE6865EI V200R019C10SPC800)
Copyright (C) 2012-2020 Huawei Technologies Co., Ltd.
HUAWEI CE6865-48S8CQ-EI uptime is 3 days, 18 hours, 29 minutes

CE6865-48S8CQ-EI(Master) 1 : uptime is  3 days, 18 hours, 28 minutes
        StartupTime 2022/06/23   19:58:16
Memory    Size    : 4096 M bytes
Flash     Size    : 2048 M bytes
CE6865-48S8CQ-EI version information
1. PCB    Version : CEM48S8CQP04 VER A
2. MAB    Version : 1
3. Board  Type    : CE6865-48S8CQ-EI
4. CPLD1  Version : 102
5. CPLD2  Version : 102
6. BIOS   Version : 205
```

创建 VLAN 1000。

```
<HUAWEIB> system-view
[~HUAWEIB] vlan 1000
[~HUAWEIB-vlan1000] quit
[~HUAWEIB] commit
```

配置端口 25GE1/0/15 工作在三层模式，并配置 IP 地址为 Keepalive 报文的源 IP 地址。

```
[~HUAWEIB] interface 25GE 1/0/15
[~HUAWEIB-25GE1/0/15] undo portswitch
[~HUAWEIB-25GE1/0/15] ip address 10.254.120.2 255.255.255.0
[~HUAWEIB-25GE1/0/15] quit
[~HUAWEIB] commit
```

创建动态交换服务组 DFS Group，并配置 DFS Group 优先级，配置 DFS Group 绑定的 IPv4 地址。

```
[~HUAWEIB] dfs-group 1
[~HUAWEIB-dfs-group-1] priority 150
[~HUAWEIB-dfs-group-1] source ip 10.254.120.2
[~HUAWEIB-dfs-group-1] quit
[~HUAWEIB] commit
```

创建二层聚合接口 Eth-Trunk1、Eth-Trunk10，并配置该接口为动态 LACP 模式。

```
[~HUAWEIB] interface Eth-Trunk 1
[~HUAWEIB-Eth-Trunk1] mode lacp-dynamic
[~HUAWEIB-Eth-Trunk1] quit
[~HUAWEIB] interface Eth-Trunk 10
[~HUAWEIB-Eth-Trunk10] mode lacp-dynamic
[~HUAWEIB-Eth-Trunk10] quit
```

创建二层聚合接口 Eth-Trunk0，并配置该接口为静态 LACP 模式。

```
[~HUAWEIB] interface Eth-Trunk 0
[~HUAWEIB-Eth-Trunk0] mode lacp-static
[~HUAWEIB-Eth-Trunk0] quit
[~HUAWEIB] commit
```

分别将端口 25G1/0/7、25G1/0/8 加入到聚合组 1，将端口 25G1/0/3 加入到聚合 10，将端口 100GE1/0/1、100GE1/0/2 加入到聚合组 0。

```
[~HUAWEIB] interface 25GE 1/0/7
[~HUAWEIB-25GE1/0/7] eth-trunk 1
[~HUAWEIB-25GE1/0/7] quit
[~HUAWEIB] interface 25GE 1/0/8
[~HUAWEIB-25GE1/0/8] eth-trunk 1
[~HUAWEIB-25GE1/0/8] quit
[~HUAWEIB] interface 100GE 1/0/1
[~HUAWEIB-100GE1/0/1] eth-trunk 0
[~HUAWEIB-100GE1/0/1] quit
[~HUAWEIB] interface 100GE 1/0/2
[~HUAWEIB-100GE1/0/2] eth-trunk 0
[~HUAWEIB-100GE1/0/2] quit
[~HUAWEIB] interface 25GE 1/0/3
[~HUAWEIB-25GE1/0/3] eth-trunk 10
[~HUAWEIB-25GE1/0/3] quit
[~HUAWEIB] commit
```

指定 Eth-Trunk 0 接口为 peer-link 接口。

```
[~HUAWEIB] interface Eth-Trunk 0
[~HUAWEIB-Eth-Trunk0] peer-link 1
Info: Prepare for configuring the peer-link. Please wait.....done.
[*HUAWEIB-Eth-Trunk0] qui
[*HUAWEIB] commit
```

配置 Eth-Trunk1、Eth-Trunk10 加入 VLAN1000。

```
[~HUAWEIB]interface Eth-Trunk 1
[~HUAWEIB-Eth-Trunk1] port link-type trunk
[~HUAWEIB-Eth-Trunk1] undo port trunk allow-pass vlan 1
[~HUAWEIB-Eth-Trunk1] port trunk allow-pass vlan 1000
[~HUAWEIB-Eth-Trunk1] quit
[~HUAWEIB]interface Eth-Trunk 10
[~HUAWEIB-Eth-Trunk10] port link-type trunk
[~HUAWEIB-Eth-Trunk10] undo port trunk allow-pass vlan 1
[~HUAWEIB-Eth-Trunk10] port trunk allow-pass vlan 1000
[~HUAWEIB-Eth-Trunk10] quit
[*HUAWEIB] commit
```

12.1.5 验证配置

在 H3C 设备上验证 M-LAG 的详细信息。

```
[SwitchA] display m-lag summary
Flags: A -- Aggregate interface down, B -- No peer M-LAG interface configured
       C -- Configuration consistency check failed

Peer-link interface: BAGG256
Peer-link interface state (cause): UP
Keepalive link state (cause): UP

                    M-LAG interface information
M-LAG IF    M-LAG group  Local state (cause)  Peer state  Remaining down time(s)
BAGG1       1000         UP                   UP          -
BAGG1002    1002         UP                   UP          -
[SwitchB] display m-lag summary
Flags: A -- Aggregate interface down, B -- No peer M-LAG interface configured
       C -- Configuration consistency check failed

Peer-link interface: BAGG256
Peer-link interface state (cause): UP
Keepalive link state (cause): UP

                    M-LAG interface information
M-LAG IF    M-LAG group  Local state (cause)  Peer state  Remaining down time(s)
BAGG1       1000         UP                   UP          -
BAGG1002    1002         UP                   UP          -
```

在华为设备上验证 M-LAG 的详细信息。

```
[~HUAWEIA] display dfs-group 1 m-lag
```

```
*                : Local node
Heart beat state : OK
Node 1 *
  Dfs-Group ID   : 1
  Priority       : 150
  Address        : ip address 10.254.120.2
  State          : Master
  Causation      : -
  System ID      : ccbb-fe01-abf1
  SysName        : HUAWEIA
  Version        : V200R019C10SPC800
  Device Type    : CE6865EI
Node 2
  Dfs-Group ID   : 1
  Priority       : 100
  Address        : ip address 10.254.120.3
  State          : Backup
  Causation      : -
  System ID      : ccbb-fe01-abe1
  SysName        : HUAWEIB
  Version        : V200R019C10SPC800
  Device Type    : CE6865EI
[~HUAWEIA]disp dfs-group 1 m-lag
*                : Local node
Heart beat state : OK
Node 2 *
  Dfs-Group ID   : 1
  Priority       : 100
  Address        : ip address 10.254.120.3
  State          : Backup
  Causation      : -
  System ID      : ccbb-fe01-abe1
  SysName        : HUAWEIB
  Version        : V200R019C10SPC800
  Device Type    : CE6865EI
Node 1
  Dfs-Group ID   : 1
  Priority       : 150
  Address        : ip address 10.254.120.2
  State          : Master
  Causation      : -
  System ID      : ccbb-fe01-abf1
  SysName        : HUAWEIA
  Version        : V200R019C10SPC800
  Device Type    : CE6865EI
[~HUAWEI-2]
```

在 Device A 上 Ping Device B，可以 Ping 通。

```
<DeviceA> ping 10.0.0.1
```

```
Ping 10.0.0.1 (10.0.0.1): 56 data bytes, press CTRL+C to break
56 bytes from 10.0.0.1: icmp_seq=0 ttl=255 time=1.519 ms
56 bytes from 10.0.0.1: icmp_seq=1 ttl=255 time=1.262 ms
56 bytes from 10.0.0.1: icmp_seq=2 ttl=255 time=1.256 ms
56 bytes from 10.0.0.1: icmp_seq=3 ttl=255 time=1.184 ms
56 bytes from 10.0.0.1: icmp_seq=4 ttl=255 time=1.116 ms

--- Ping statistics for 10.0.0.1 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.116/1.267/1.519/0.137 ms
```

在 Device B 上 Ping Device A，可以 Ping 通。

```
<DeviceB> ping 10.0.0.2
Ping 10.0.0.2 (10.0.0.2): 56 data bytes, press CTRL+C to break
56 bytes from 10.0.0.2: icmp_seq=0 ttl=255 time=1.519 ms
56 bytes from 10.0.0.2: icmp_seq=1 ttl=255 time=1.262 ms
56 bytes from 10.0.0.2: icmp_seq=2 ttl=255 time=1.256 ms
56 bytes from 10.0.0.2: icmp_seq=3 ttl=255 time=1.184 ms
56 bytes from 10.0.0.2: icmp_seq=4 ttl=255 time=1.116 ms

--- Ping statistics for 10.0.0.2 ---
5 packet(s) transmitted, 5 packet(s) received, 0.0% packet loss
round-trip min/avg/max/std-dev = 1.116/1.267/1.519/0.137 ms
```

13 MRP 对接操作指导

13.1 与赫斯曼设备对接操作指导

13.1.1 互通性分析

表29 互通性分析

H3C	赫斯曼	互通结论
支持	支持	可以互通

13.1.2 组网需求

如图 44 所示，H3C 设备作为 MRC 接入赫斯曼设备的 MRP 环网。现要求将 H3C 设备作为 MRP 环网的 MRM，对 MRP 环网的环路状态进行检测，并对环网进行管理，如图 45 所示。

图44 H3C 设备接入赫斯曼 MRP 环网配置组网图

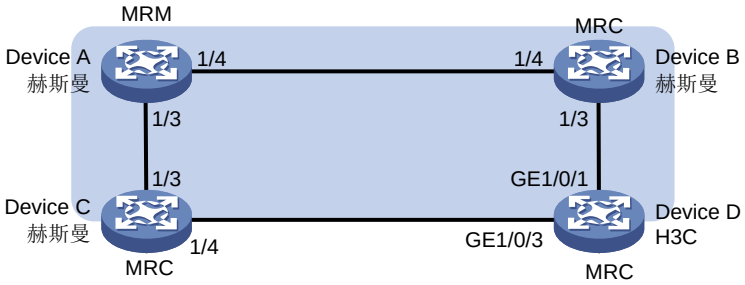
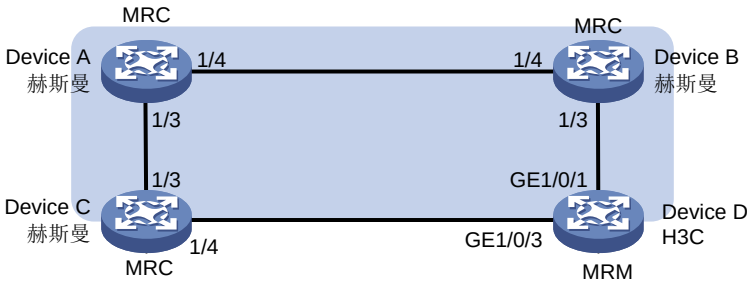


图45 将 H3C 设备作为 MRP 环网的 MRM 配置组网图



13.1.3 配置步骤

1. H3C 设备接入赫斯曼 MRP 环网

- 配置 H3C 设备（DeviceD）

创建 VLAN 4000。

```
<H3C> system-view
[H3C] vlan 4000
```

在 MRP 冗余域视图下，配置该 MRP 冗余域中用于传输 MRP 协议报文的 VLAN ID 为 4000。

```
[H3C] iec-mrp redundancy-domain 1
[H3C-iec-mrp-redundancy-domain1] iec-mrp vlan 4000
```

配置设备在 MRP 冗余域中的节点角色。

```
[H3C-iec-mrp-redundancy-domain1] iec-mrp role client
[H3C-iec-mrp-redundancy-domain1] quit
```

配置端口 GigabitEthernet1/0/1 绑定 MRP 冗余域。

```
[H3C] interface GigabitEthernet1/0/1
[H3C-GigabitEthernet1/0/1] port link-type trunk
[H3C-GigabitEthernet1/0/1] port trunk permit vlan all
[H3C-GigabitEthernet1/0/1] undo stp enable
[H3C-GigabitEthernet1/0/1] port iec-mrp redundancy-domain 1
[H3C-GigabitEthernet1/0/1] quit
```

配置端口 GigabitEthernet1/0/3 绑定 MRP 冗余域。

```
[H3C] interface GigabitEthernet1/0/3
[H3C-GigabitEthernet1/0/3] port link-type trunk
[H3C-GigabitEthernet1/0/3] port trunk permit vlan all
[H3C-GigabitEthernet1/0/3] undo stp enable
```

```
[H3C-GigabitEthernet1/0/3] port iec-mrp redundancy-domain 1
[H3C-GigabitEthernet1/0/3] quit
```

开启 MRP 功能。

```
[H3C] iec-mrp redundancy-domain 1
[H3C-iec-mrp-redundancy-domain1] iec-mrp enable
[H3C-iec-mrp-redundancy-domain1] quit
```

- 配置赫斯曼设备（DeviceA）

创建 VLAN，并配置端口允许通过。

```
(Hirschmann Railswitch) (Config)# vlan participation all include 100
(Hirschmann Railswitch) (Config)# vlan participation all include 4000
(Hirschmann Railswitch) (Config)# interface 1/3
(Hirschmann Railswitch) (Interface 1/3)# vlan acceptframe all
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 100
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 100
(Hirschmann Railswitch) (Interface 1/3)# no spanning-tree port mode
(Hirschmann Railswitch) (Interface 1/3)# exit
```

配置 MRP 的角色为 MRM。

```
(Hirschmann Railswitch) (Config)# mrp current-domain mode manager
```

配置 MRP 协议交互 VLAN。

```
(Hirschmann Railswitch) (Config)# mrp current-domain vlan 4000
```

配置 MRP 主副端口。

```
(Hirschmann Railswitch) (Config)# mrp current-domain port primary 1/3
(Hirschmann Railswitch) (Config)# mrp current-domain port secondary 1/4
```

开启 MRP。

```
(Hirschmann Railswitch) (Config)# mrp current-domain operation enable
```

- 配置赫斯曼设备（DeviceB）

创建 VLAN，并配置端口允许通过。

```
(Hirschmann Railswitch) (Config)# vlan participation all include 100
(Hirschmann Railswitch) (Config)# vlan participation all include 4000
(Hirschmann Railswitch) (Config)# interface 1/3
(Hirschmann Railswitch) (Interface 1/3)# vlan acceptframe all
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 100
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 100
(Hirschmann Railswitch) (Interface 1/3)# no spanning-tree port mode
(Hirschmann Railswitch) (Interface 1/3)# exit
```

配置 MRP 的角色为 MRC。

```
(Hirschmann Railswitch) (Config)# mrp current-domain mode client
```

配置 MRP 协议交互 VLAN。

```
(Hirschmann Railswitch) (Config)# mrp current-domain vlan 4000
```

配置 MRP 主副端口。

```
(Hirschmann Railswitch) (Config)# mrp current-domain port primary 1/3
```

```
(Hirschmann Railswitch) (Config)# mrp current-domain port secondary 1/4
```

开启 MRP。

```
(Hirschmann Railswitch) (Config)# mrp current-domain operation enable
```

- 配置赫斯曼设备（DeviceC）

创建 VLAN，并配置端口允许通过。

```
(Hirschmann Railswitch) (Config)# vlan participation all include 100
(Hirschmann Railswitch) (Config)# vlan participation all include 4000
(Hirschmann Railswitch) (Config)# interface 1/3
(Hirschmann Railswitch) (Interface 1/3)# vlan acceptframe all
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 4000
(Hirschmann Railswitch) (Interface 1/3)# vlan participation include 100
(Hirschmann Railswitch) (Interface 1/3)# vlan tagging 100
(Hirschmann Railswitch) (Interface 1/3)# no spanning-tree port mode
(Hirschmann Railswitch) (Interface 1/3)# exit
```

配置 MRP 的角色为 MRC。

```
(Hirschmann Railswitch) (Config)# mrp current-domain mode client
```

配置 MRP 协议交互 VLAN。

```
(Hirschmann Railswitch) (Config)# mrp current-domain vlan 4000
```

配置 MRP 主副端口。

```
(Hirschmann Railswitch) (Config)# mrp current-domain port primary 1/3
(Hirschmann Railswitch) (Config)# mrp current-domain port secondary 1/4
```

开启 MRP。

```
(Hirschmann Railswitch) (Config)# mrp current-domain operation enable
```

2. 将 H3C 设备作为 MRP 环网的 MRM

- 配置 H3C 设备（DeviceD）

配置设备在 MRP 冗余域中的节点角色。

```
<H3C> system-view
[H3C-iec-mrp-redundancy-domain1] iec-mrp role manager
[H3C-iec-mrp-redundancy-domain1] quit
```

- 配置赫斯曼设备（DeviceA）

配置 MRP 的角色为 MRC。

```
(Hirschmann Railswitch) (Config)# mrp current-domain mode client
```

13.1.4 验证配置

在 H3C 设备上查看 MRP 状态。

```
[H3C] display iec-mrp redundancy-domain 1 ver
Redundancy domain ID   : 1
  Domain name          : N/A
  Domain UUID          : FFFFFFFF-FFFF-FFFF-FFFF-FFFFFFFFFFFF
  Device role          : MRM
  Device priority      : 32768
  VLAN ID              : 4000
  Enhanced mode        : Disabled
```

```
  Convergence profile  : 500 ms
  Block state          : Supported
  Ring ports           : GigabitEthernet1/0/1   forwarding
                       : GigabitEthernet1/0/3   forwarding
  Link down change interval : 20 ms
  Link up change interval   : 20 ms
  Link change count         : 4
```

在赫斯曼交换机上查看 MRP 状态。

```
(Hirschmann Railswitch) #show mrp current-domain summary

Domain ID: 255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255
           (Default MRP domain)

ConfigurationSettings:
Advanced Mode(react on link change)...........n/a(Switch is notManager)
ManagerPriority..............................n/a(Switch is notManager)
Mode of Switch(administrative setting).........Client
Mode of Switch(real operating state)..........Client
DomainName.....................................<empty>
Recovery delay.................................500ms
Port Number,Primary............................1/3,State:Forwarding
Port Number,Secondary..........................1/4,State:NotConnected
VLANID.........................................4000
Operation......................................Enabled

GeneralOperatingStates:
MRP Setup Info(Config.Failure)...............Ring PortLinkError

Client-relatedOperatingStates:
Link DownInterval..............................20msec
Link UpInterval................................20msec
Link ChangeCount...............................8
BlockedSupport.................................Enabled
```