Configuring DHCP Relay in a BGP EVPN VXLAN Fabric

Restrictions for DHCP Relay in a BGP EVPN VXLAN Fabric

- DHCP relay in a BGP EVPN VXLAN fabric is supported in the following scenarios only when VRF-Lite is configured on the border VTEP and the border VTEP is connected to the DHCP server through an external router.
  - DHCP client in the tenant VRF and DHCP server in the Layer 3 default VRF
  - DHCP client in the tenant VRF and DHCP server in a different tenant VRF
  - DHCP client in the tenant VRF and DHCP server in a non-default non-VXLAN VRF
- DHCPv6 relay is not supported.

Information About DHCP Relay in a BGP EVPN VXLAN Fabric

Networks use DHCP relay to forward DHCP packets between host devices and a DHCP server. In a BGP EVPN VXLAN fabric, you can configure a VTEP as a relay agent to provide DCHP relay services in a multi-tenant VXLAN environment.

When a network uses DHCP relay, DHCP messages move through the same switch in both directions. DHCP relay generally uses the gateway IP address (GiAddr) for scope selection and DHCP response messages. In a BGP EVPN VXLAN fabric that has distributed IP anycast gateway enabled, DHCP messages can return to any switch that hosts the respective GiAddr.

Deploying DHCP relay in an EVPN VXLAN network requires a different method for scope selection and a unique IP address for each switch in the network. The unique Loopback interface for a switch becomes the GiAddr that a switch uses to respond to the correct switch. DHCP option 82, also referred to as DHCP option VPN, is used for scope selection based on the Layer 2 VNI.

In a multi-tenant EVPN environment, DHCP relay uses the following sub-options of option 82:

- **Sub-Option 151(0x97)—Virtual Subnet Selection:**

  The virtual subnet selection sub-option is used to convey VRF-related information to the DHCP server in an MPLS VPN and a VXLAN EVPN multi-tenant environment.

  RFC 6607 provides the definition for this sub-option.

- **Sub-Option 11(0xb)—Server ID Override**

  The server identifier or server ID override sub-option allows the DHCP relay agent to specify a new value for the server ID option. The DHCP server inserts this new value in the reply packet. This sub-option allows the DHCP relay agent to act as the actual DHCP server. The DHCP relay agent begins to receive all the renew requests instead of the DHCP server. The server ID override sub-option contains the incoming interface IP address. The DHCP client accesses the DHCP relay agent using the incoming interface IP address. The DHCP client uses this information to send all the renew and release request packets to the DHCP relay agent. The DHCP relay agent adds all the appropriate sub-options and then forwards the renew and release request packets to the original DHCP server.

  For this function, Cisco's proprietary implementation is sub-option 152(0x98). To implement the suboption and manage the function, run the **ip dhcp relay sub-option type cisco** command in global configuration mode on the VTEP that acts as the DHCP relay agent.

  RFC 5107 provides the definition for this sub-option.

- **Sub-Option 5(0x5)—Link Selection:**

  The link selection sub-option provides a mechanism to separate the subnet or link, on which the DHCP client resides, from the GiAddr. The DHCP server uses this mechanism to communicate with the DHCP relay agent. The DHCP relay agent sets the sub-option to the correct subscriber subnet. The DHCP server then uses this value to assign an IP address different from the GiAddr. The DHCP relay agent sets the GiAddr to its own IP address to ensure that it is possible to forward the DHCP messages over the network.

  For this function, Cisco's proprietary implementation is sub-option 150(0x96). To manage the function, run the **ip dhcp relay sub-option type cisco** command in global configuration mode on the VTEP that acts as the DHCP relay agent.

  RFC 3527 provides the definition for this sub-option.

DHCP Relay on VTEPs

DHCP relay is generally configured on the default gateway that faces the DHCP client. You can configure a VTEP as a DHCP relay agent in different ways to automate IP addressing. The configuration depends on whether the DHCP server is present in the same network, the same VRF, or a different VRF compared to the DHCP client. When the DHCP server and DHCP client are in different VRFs, traffic is forwarded across the tenant or VRF boundaries.

The following are the common DHCP relay deployment scenarios for a BGP EVPN VXLAN fabric:

1. DHCP client in the tenant VRF and DHCP server in the Layer 3 default VRF
2. DHCP client in the tenant VRF and DHCP server in the same tenant VRF
3. DHCP client in the tenant VRF and DHCP server in a different tenant VRF
4. DHCP client in the tenant VRF and DHCP server in a non-default non-VXLAN VRF

Note The deployment scenarios 1, 3, and 4 are supported only when VRF-Lite is configured on the border VTEP and the border VTEP is connected to the DHCP server through an external router.

How to Configure DHCP Relay in a BGP EVPN VXLAN Fabric

You must configure EVPN VXLAN Layer 2 and Layer 3 overlay networks before configuring BGP EVPN VXLAN interworking with DHCP relay. See How to Configure EVPN VXLAN Integrated Routing and Bridging for detailed steps.

Perform the following set of procedures to configure BGP EVPN VLAN interworking with DHCP relay:

Configuring DHCP Relay on a VTEP

To configure DHCP relay on a VTEP, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip dhcp relay information option vpn** **Example:** `Device(config)# ip dhcp relay information option vpn`	Enables the device to insert VPN suboptions into the DHCP relay agent information option in the messages forwarded to the DHCP server and sets the GiAddr on the outgoing interface towards the DHCP server.
Step 4	**ip dhcp relay information option** **Example:** `Device(config)# ip dhcp relay information option`	Enables the system to insert a DHCP relay agent information option in the messages forwarded to the DHCP server.
Step 5	**ip dhcp relay override** *gateway-ip-address* **link-selection** **Example:** `Device(config)# ip dhcp relay override giaddr link-selection`	Sets the gateway IP address as the IP address of the DHCP relay agent and configures the server to assign an IP address that is different from the GiAddr to the DHCP clients.

	Command or Action	Purpose
Step 6	**ip dhcp compatibility suboption server-override standard** **Example:** `Device(config)# ip dhcp compatibility suboption server-override standard`	Configures the DHCP client to use the Internet Assigned Numbers Authority (IANA) standard relay agent server ID override suboption.
Step 7	**ip dhcp snooping vlan** *vlan-id-list* **Example:** `Device(config)# ip dhcp snooping vlan 201-202`	Enables DHCP snooping on the specified list of VLANs.
Step 8	**ip dhcp snooping** **Example:** `Device(config)# ip dhcp snooping`	Enables DHCP snooping on the VTEP.
Step 9	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuring DHCP Relay on the Access SVI of a VTEP

Perform this procedure on all the VTEPs for each VLAN that is associated with the Layer 2 VNI configured in the EVPN VXLAN network.

To configure DHCP relay on the access SVI of a VTEP, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface vlan** *vlan-id* **Example:** `Device(config)# interface Vlan 201`	Enters interface configuration mode for the specified VLAN interface. This VLAN interface acts as the GiAddr.
Step 4	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding green`	Associates the VRF with the interface. The interface must be associated with the same VRF for which the Layer 3 VNI has been configured for the EVPN VXLAN network.

	Command or Action	Purpose
Step 5	**ip dhcp relay information option vpn-id** **Example:** `Device(config-if)# ip dhcp relay information option vpn-id`	Enables the device to insert VPN suboptions into the DHCP relay agent information option in the messages forwarded to the DHCP server and sets the GiAddr on the outgoing interface towards the DHCP server.
Step 6	**ip dhcp relay source-interface Loopback** *loopback-interface-id* **Example:** `Device(config-if)# ip dhcp relay source-interface Loopback13`	Configures the specified Loopback interface as the source interface for DHCP relay messages. The DHCP relay agent uses the IP address of the source interface as the source IP address to relay messages. **Note** The IP address configured on the Loopback interface must be unique per VTEP per VRF.
Step 7	**ip address** *ip-address* **Example:** `Device(config-if)# ip address 192.168.1.201 255.255.255.0`	Sets the IP address for the VLAN interface.
Step 8	**ip helper-address** *ip-address* **Example:** `Device(config-if)# ip helper-address 192.168.3.100`	Sets the DHCP IP helper address for the VLAN interface.
Step 9	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuring the Router Interface on the Border VTEP for DHCP Server Reachability

DHCP server reachability can be achieved through a physical Layer 3 interface or subinterface, or a Layer3 Portchannel interface.

To configure the router interface on the border VTEP for DHCP server rechability, perform the following steps:

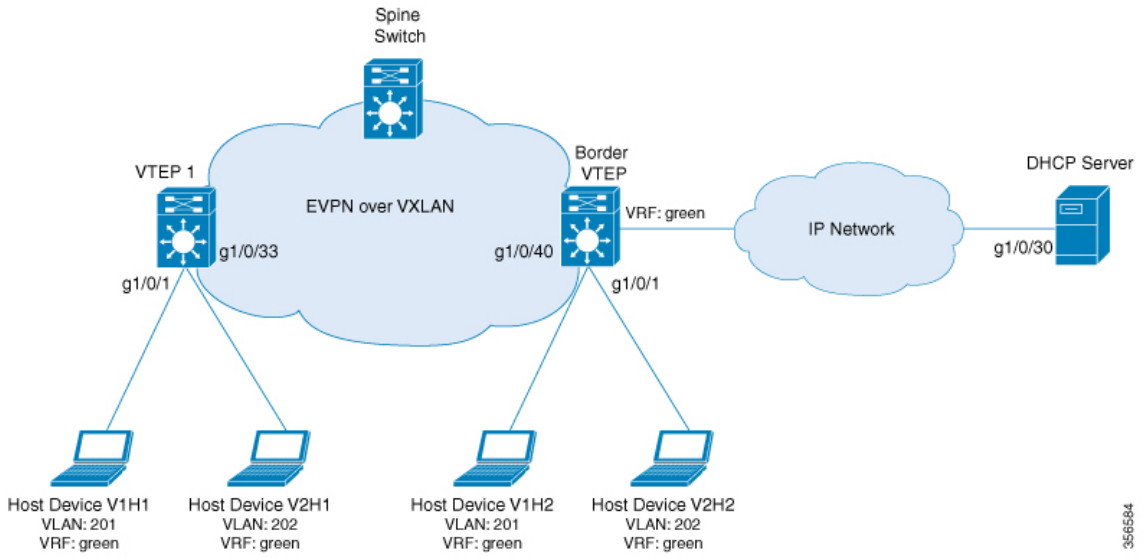
Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface vlan***vlan-id* **Example:** `Device(config)# interface vlan 203`	Enters interface configuration mode for the specified VLAN interface.
Step 4	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding green`	Configures the SVI for the VLAN and associates the specified VRF with the interface.
Step 5	**ip address** *ip-address* **Example:** `Device(config-if)# ip address 192.168.3.203 255.255.255.0`	Configures the IP address for the VLAN.
Step 6	**ipv6 address** *ipv6-address* **Example:** `Device(config-if)# ipv6 address 2001:203::203/64`	Configures the IPv6 address for the VLAN.
Step 7	**ipv6 enable** **Example:** `Device(config-if)# ipv6 enable`	Enables IPv6 processing on the VLAN interface.
Step 8	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 9	**interface** *interface-id* **Example:** `Device(config)# interface GigabitEthernet1/0/30`	Enters interface configuration mode for the specified interface.
Step 10	**switchport access vlan** *vlan-id* **Example:** `Device(config-if)# switchport access vlan 203`	Specifies the VLAN to be used as access VLAN when the interface is in access mode.

	Command or Action	Purpose
Step 11	**switchport mode access** **Example:** `Device(config-if)# switchport mode access`	Configures the interface as an access interface.
Step 12	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 13	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configuration Examples for DHCP Relay in a BGP EVPN VXLAN Fabric

This section provides an example to show the configuration and verification of DHCP relay deployment in an EVPN VXLAN network. The example uses the following topology where the DHCP client and the DHCP server are in the same tenant VRF:



The illustration shows an EVPN VXLAN network with two VTEPs, VTEP 1 and Border VTEP. Border VTEP is connected to the DHCP server.

DHCP server reachability can be achieved through a physical Layer 3 interface or subinterface, or a Layer3 Portchannel interface. The example shown here deploys DHCP relay using an SVI interface and a switchport.

Table 1: Configuration Example for Deploying DHCP Relay in a BGP EVPN VXLAN Fabric when the DHCP Client and the DHCP Server are in the Same Tenant VRF

VTEP 1

```
VTEP1# show running-config

<snip: only dhcp relevant config is shown>
ip dhcp relay information option vpn
ip dhcp relay information option
ip dhcp compatibility suboption link-selection standard
ip dhcp compatibility suboption server-override standard
ip dhcp snooping vlan 201-202
ip dhcp snooping
!
vlan configuration 200
 member vni 5000
vlan configuration 201
 member evpn-instance 1 vni 6000
vlan configuration 202
 member evpn-instance 2 vni 7000
!
interface Loopback13
 vrf forwarding green
 ip address 10.1.13.13 255.255.255.0

interface Vlan200
 description core svi for l3vni
 vrf forwarding green
 ip unnumbered Loopback0
 ip pim sparse-mode
 ipv6 enable
 no autostate

interface Vlan201
 vrf forwarding green
 ip dhcp relay information option vpn-id
 ip dhcp relay source-interface Loopback13
 ip address 192.168.1.201 255.255.255.0
 ip helper-address 192.168.3.100

interface Vlan202
 vrf forwarding green
 ip dhcp relay information option vpn-id
 ip dhcp relay source-interface Loopback13
 ip address 192.168.2.201 255.255.255.0
 ip helper-address 192.168.3.100

interface nve10
 no ip address
 source-interface Loopback0
 host-reachability protocol bgp
 member vni 7000 mcast-group 231.1.1.1
 member vni 6000 mcast-group 231.1.1.1
 member vni 5000 vrf green
```

Border VTEP

```
Border_VTEP# show running-config

<snip: only dhcp relevant config is shown>
ip dhcp relay information option vpn
ip dhcp relay information option
ip dhcp relay override giaddr link-selection
ip dhcp compatibility suboption server-override standard
ip dhcp snooping vlan 201-202
ip dhcp snooping
!
vlan configuration 200
 member vni 5000
vlan configuration 201
 member evpn-instance 1 vni 6000
vlan configuration 202
 member evpn-instance 2 vni 7000
!
interface Loopback14
 vrf forwarding green
 ip address 10.1.14.14 255.255.255.0

interface Vlan200
 description core svi for l3vni
 vrf forwarding green
 ip unnumbered Loopback0
 ip pim sparse-mode
 ipv6 enable
 no autostate

interface Vlan201
 vrf forwarding green
 ip dhcp relay information option vpn-id
 ip dhcp relay source-interface Loopback14
 ip address 192.168.1.201 255.255.255.0
 ip helper-address 192.168.3.100

interface Vlan202
 vrf forwarding green
 ip dhcp relay information option vpn-id
 ip dhcp relay source-interface Loopback14
 ip address 192.168.2.201 255.255.255.0
 ip helper-address 192.168.3.100


interface nve10
 no ip address
 source-interface Loopback0
 host-reachability protocol bgp
 member vni 7000 mcast-group 231.1.1.1
 member vni 6000 mcast-group 231.1.1.1
 member vni 5000 vrf green
```

VTEP 1	Border VTEP
As VTEP 1 is not a border VTEP, DHCP server reachability is not configured on VTEP 1.	interface Vlan203 vrf forwarding green ip address 192.168.3.203 255.255.255.0 ipv6 address 2001:203::203/64 ipv6 enable end interface GigabitEthernet1/0/30 description connected to DHCP server switchport access vlan 203 switchport mode access

The following examples provide sample outputs for the **show ip route vrf** command on VTEP 1 and Border VTEP to verify the reachability of the DHCP server from both VTEPs:

VTEP 1

The following example shows the output for the **show ip route vrf** command on VTEP 1:

```
VTEP1# show ip route vrf green 192.168.3.100

Routing Table: green
Routing entry for 192.168.3.0/24
  Known via "bgp 10", distance 200, metric 0, type internal
  Last update from 10.2.2.20 on Vlan200, 18:28:43 ago
  Routing Descriptor Blocks:
  * 10.2.2.20 (default), from 10.5.5.50, 18:28:43 ago, via Vlan200
      opaque_ptr 0x7FEEA41D09C8
      Route metric is 0, traffic share count is 1
      AS Hops 0
      MPLS label: none
      MPLS Flags: NSF
```

Border VTEP

The following example shows the output for the **show ip route vrf** command on VTEP 2:

```
Border_VTEP# show ip route vrf green 192.168.3.100

Routing Table: green
Routing entry for 192.168.3.0/24
  Known via "connected", distance 0, metric 0 (connected, via interface)
  Redistributing via bgp 10
  Advertised by bgp 10
  Routing Descriptor Blocks:
  * directly connected, via Vlan203
      Route metric is 0, traffic share count is 1
```

Packet Capture for Spine Switch

The following example shows the packet capture details for the spine switch from the topology configured above:

```
    6  12.749326   10.1.13.13 b^F^R 192.168.3.100 DHCP 449 DHCP Discover - Transaction ID
0x228f
    7  12.750463 192.168.3.100 b^F^R 10.1.13.13   DHCP 447 DHCP Offer    - Transaction ID
0x228f
    8  12.755776   10.1.13.13 b^F^R 192.168.3.100 DHCP 467 DHCP Request  - Transaction ID
0x228f
    9  12.756701 192.168.3.100 b^F^R 10.1.13.13   DHCP 447 DHCP ACK      - Transaction ID
0x228f
   11  12.803031 00:59:dc:50:ae:42 b^F^R ff:ff:ff:ff:ff:ff ARP 110 Gratuitous ARP for
192.168.2.3 (Reply)
   14  15.760480 00:59:dc:50:ae:42 b^F^R ff:ff:ff:ff:ff:ff ARP 110 Who has 192.168.2.201?
Tell 192.168.2.3
   15  15.761058 38:0e:4d:9b:6a:42 b^F^R 00:59:dc:50:ae:42 ARP 110 192.168.2.201 is at
38:0e:4d:9b:6a:42
```

Discover Packet Details for VTEP 1

The following example shows the packet discovery details for VTEP 1 from the topology configured above:

```
Frame 6: 449 bytes on wire (3592 bits), 449 bytes captured (3592 bits) on interface 0
    Interface id: 0 (/tmp/epc_ws/wif_to_ts_pipe)
        Interface name: /tmp/epc_ws/wif_to_ts_pipe
    Encapsulation type: Ethernet (1)
    Arrival Time: Mar 28, 2020 09:03:26.742700000 UTC
    [Time shift for this packet: 0.000000000 seconds]
    Epoch Time: 1585386206.742700000 seconds
    [Time delta from previous captured frame: 7.090744000 seconds]
    [Time delta from previous displayed frame: 7.090744000 seconds]
    [Time since reference or first frame: 12.749326000 seconds]
    Frame Number: 6
    Frame Length: 449 bytes (3592 bits)
    Capture Length: 449 bytes (3592 bits)
    [Frame is marked: False]
    [Frame is ignored: False]
    [Protocols in frame: eth:ethertype:ip:udp:vxlan:eth:ethertype:ip:udp:bootp]
Ethernet II, Src: 00:a3:d1:5a:03:61 (00:a3:d1:5a:03:61), Dst: 38:0e:4d:9b:6a:45
(38:0e:4d:9b:6a:45)
    Destination: 38:0e:4d:9b:6a:45 (38:0e:4d:9b:6a:45)
        Address: 38:0e:4d:9b:6a:45 (38:0e:4d:9b:6a:45)
        .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Source: 00:a3:d1:5a:03:61 (00:a3:d1:5a:03:61)
        Address: 00:a3:d1:5a:03:61 (00:a3:d1:5a:03:61)
        .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Type: IPv4 (0x0800)
Internet Protocol Version 4, Src: 10.1.1.10, Dst: 10.2.2.20
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
        0000 00.. = Differentiated Services Codepoint: Default (0)
        .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
    Total Length: 435
    Identification: 0xc29c (49820)
    Flags: 0x4000, Don't fragment
        0... .... .... .... = Reserved bit: Not set
        .1.. .... .... .... = Don't fragment: Set
        ..0. .... .... .... = More fragments: Not set
        ...0 0000 0000 0000 = Fragment offset: 0
```

```
    Time to live: 253
    Protocol: UDP (17)
    Header checksum: 0xa27c [validation disabled]
    [Header checksum status: Unverified]
    Source: 10.1.1.10
    Destination: 10.2.2.20
User Datagram Protocol, Src Port: 65294, Dst Port: 4789
    Source Port: 65294
    Destination Port: 4789
    Length: 415
    [Checksum: [missing]]
    [Checksum Status: Not present]
    [Stream index: 0]
Virtual eXtensible Local Area Network
    Flags: 0x0800, VXLAN Network ID (VNI)
        0... .... .... .... = GBP Extension: Not defined
        .... .... .0.. .... = Don't Learn: False
        .... 1... .... .... = VXLAN Network ID (VNI): True
        .... .... .... 0... = Policy Applied: False
        .000 .000 0.00 .000 = Reserved(R): 0x0000
    Group Policy ID: 0
    VXLAN Network Identifier (VNI): 5000
    Reserved: 0
Ethernet II, Src: a0:f8:49:10:00:00 (a0:f8:49:10:00:00), Dst: 38:0e:4d:9b:6a:4a
(38:0e:4d:9b:6a:4a)
    Destination: 38:0e:4d:9b:6a:4a (38:0e:4d:9b:6a:4a)
        Address: 38:0e:4d:9b:6a:4a (38:0e:4d:9b:6a:4a)
        .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Source: a0:f8:49:10:00:00 (a0:f8:49:10:00:00)
        Address: a0:f8:49:10:00:00 (a0:f8:49:10:00:00)
        .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Type: IPv4 (0x0800)
Internet Protocol Version 4, Src: 10.1.13.13, Dst: 192.168.3.100
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
        0000 00.. = Differentiated Services Codepoint: Default (0)
        .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
    Total Length: 385
    Identification: 0x083f (2111)
    Flags: 0x0000
        0... .... .... .... = Reserved bit: Not set
        .0.. .... .... .... = Don't fragment: Not set
        ..0. .... .... .... = More fragments: Not set
        ...0 0000 0000 0000 = Fragment offset: 0
    Time to live: 254
    Protocol: UDP (17)
    Header checksum: 0xd812 [validation disabled]
    [Header checksum status: Unverified]
    Source: 10.1.13.13
    Destination: 192.168.3.100
User Datagram Protocol, Src Port: 67, Dst Port: 67
    Source Port: 67
    Destination Port: 67
    Length: 365
    Checksum: 0x26ca [unverified]
    [Checksum Status: Unverified]
    [Stream index: 2]
Bootstrap Protocol (Discover)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
```

```
Hops: 1
Transaction ID: 0x0000228f
Seconds elapsed: 0
Bootp flags: 0x8000, Broadcast flag (Broadcast)
    1... .... .... .... = Broadcast flag: Broadcast
    .000 0000 0000 0000 = Reserved flags: 0x0000
Client IP address: 0.0.0.0
Your (client) IP address: 0.0.0.0
Next server IP address: 0.0.0.0
Relay agent IP address: 10.1.13.13
Client MAC address: 00:59:dc:50:ae:42 (00:59:dc:50:ae:42)
Client hardware address padding: 00000000000000000000
Server host name not given
Boot file name not given
Magic cookie: DHCP
Option: (53) DHCP Message Type (Discover)
    Length: 1
    DHCP: Discover (1)
Option: (57) Maximum DHCP Message Size
    Length: 2
    Maximum DHCP Message Size: 1152
Option: (61) Client identifier
    Length: 27
    Type: 0
    Client Identifier: cisco-0059.dc50.ae42-Vl202
Option: (12) Host Name
    Length: 12
    Host Name: host-switch1
Option: (55) Parameter Request List
    Length: 8
    Parameter Request List Item: (1) Subnet Mask
    Parameter Request List Item: (6) Domain Name Server
    Parameter Request List Item: (15) Domain Name
    Parameter Request List Item: (44) NetBIOS over TCP/IP Name Server
    Parameter Request List Item: (3) Router
    Parameter Request List Item: (33) Static Route
    Parameter Request List Item: (150) TFTP Server Address
    Parameter Request List Item: (43) Vendor-Specific Information
Option: (60) Vendor class identifier
    Length: 8
    Vendor class identifier: ciscopnp
Option: (82) Agent Information Option
    Length: 44
    Option 82 Suboption: (1) Agent Circuit ID
        Length: 12
        Agent Circuit ID: 010a000800001b5801010000
    Option 82 Suboption: (2) Agent Remote ID
        Length: 8
        Agent Remote ID: 0006a0f84910bc80
    Option 82 Suboption: (151) VRF name/VPN ID
        Length: 6
        VRF name:
    Option 82 Suboption: (5) Link selection
        Length: 4
        Link selection: 192.168.2.0
    Option 82 Suboption: (11) Server ID Override
        Length: 4
        Server ID Override: 192.168.2.201
Option: (255) End
    Option End: 255
```