



# Configure L2VPN Autodiscovery and Signaling

This chapter describes the L2VPN Autodiscovery and Signaling feature which enables the discovery of remote Provider Edge (PE) routers and the associated signaling in order to provision the pseudowires.

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- [BGP-based VPLS Autodiscovery, on page 1](#)
- [BGP-based VPWS Autodiscovery, on page 6](#)

## L2VPN Autodiscovery and Signaling

Autodiscovery refers to the process of finding the Provider Edge (PE) routers that participates in a given L2VPN instance. One of the protocols used for this is BGP.

Once the PE routers are discovered, pseudowires are signaled and established across each pair of PE routers. Signaling refers to the exchange of Virtual Circuit (VC) labels between the PE routers. The signaling protocol can be either LDP or BGP.

## BGP-based VPLS Autodiscovery

VPLS is a multipoint Layer 2 bridging service for which BGP-based autodiscovery is well suited. BGP-based VPLS autodiscovery eliminates the need to manually provision the VPLS neighbors. VPLS autodiscovery enables each VPLS PE router to discover the other provider edge (PE) routers that are part of the same VPLS domain. VPLS Autodiscovery also tracks when PE routers are added to or removed from the VPLS domain. When the discovery process is complete, each PE router has the information required to setup VPLS pseudowires (PWs).

Even when BGP autodiscovery is enabled, pseudowires can be manually configured for VPLS PE routers that are not participating in the autodiscovery process.

## BGP-based VPLS Autodiscovery with BGP Signaling

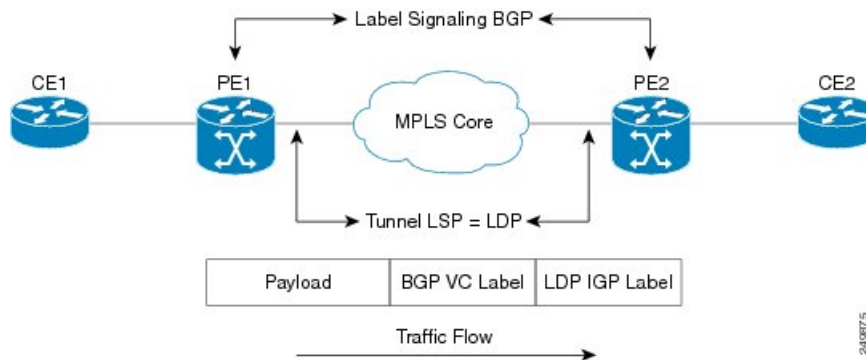
The BGP signaling and autodiscovery scheme have the following components:

- A means for a PE to learn which remote PEs are members of a given VPLS. This process is known as autodiscovery.

- A means for a PE to learn the pseudowire label expected by a given remote PE for a given VPLS. This process is known as signaling.

The BGP Network Layer Reachability Information (NLRI) takes care of the above two components simultaneously. The NLRI generated by a given PE contains the necessary information required by any other PE. These components enable the automatic setting up of a full mesh of pseudowires for each VPLS without having to manually configure those pseudowires on each PE.

**Figure 1: Discovery and Signaling Attributes**



## Configuring BGP and LDP for BGP-based Autodiscovery

This is the basic BGP and LDP configuration that is required before proceeding to configure BGP-based autodiscovery.

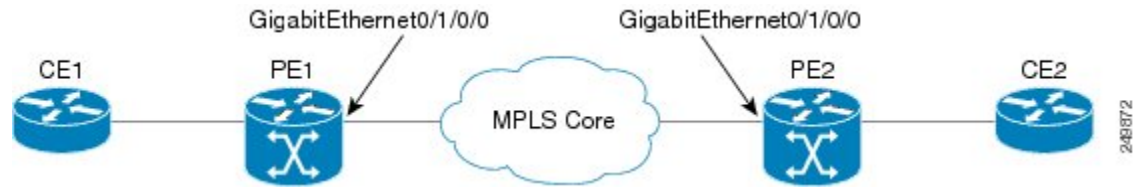
### Configuration Example:

```
Router(config)# interface loopback-interface
Router(config-if)# ipv4 address ipv4-address subnet-mask
Router(config-if)# exit
Router(config)# mpls ldp
Router(config-ldp)# router-id ipv4-address
Router(config-ldp-if)# interface interface-name
Router(config-ldp-if)# exit
Router(config-ldp)# exit
Router(config)# router bgp as-number
Router(config-bgp)# address-family l2vpn vpls-vpws
Router(config-bgp-af)# exit
Router(config-bgp)# neighbor loopback ipv4 address of neighbor
Router(config-bgp-nbr)# remote-as remote-as-number
Router(config-bgp-nbr)# update-source loopback-interface
Router(config-bgp-nbr)# address-family l2vpn vpls-vpws
```

### Running Configuration

The following figure illustrates an example of LDP and BGP network topology that is required for enabling BGP based autodiscovery.

Figure 2: LDP and BGP Configuration Example

**Configuration at PE1:**

```
interface Loopback1
  ipv4 address 10.0.0.10 255.255.255.255
!
mpls ldp
  router-id 10.0.0.10
  interface GigabitEthernet0/1/0/0
!
router bgp 120
  address-family l2vpn vpls-vpws
!
  neighbor 172.16.0.10
  remote-as 120
  update-source Loopback1
  address-family l2vpn vpls-vpws
```

**Configuration at PE2:**

```
interface Loopback1
  ipv4 address 172.16.0.10 255.240.0.0
!
mpls ldp
  router-id 172.16.0.1
  interface GigabitEthernet0/1/0/0
!
router bgp 120
  address-family l2vpn vpls-vpws
!
  neighbor 10.0.0.10
  remote-as 120
  update-source Loopback1
  address-family l2vpn vpls-vpws
```

**Configuring BGP-based VPLS Autodiscovery with BGP Signaling**

BGP and LDP need to be configured as indicated in the section [Configuring BGP and LDP for BGP-based Autodiscovery, on page 2](#) before proceeding to the configurations in this section.

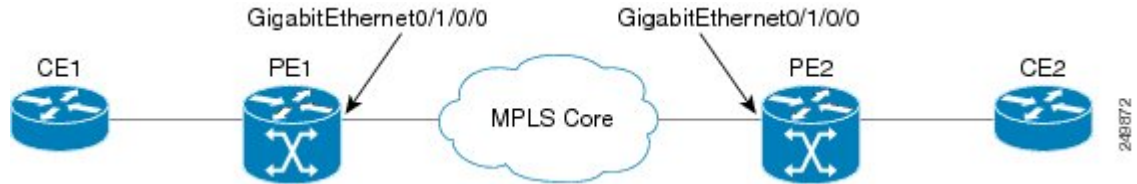
**Configuration Example:**

```
Router(config)# l2vpn
Router(config-l2vpn)# bridge group bridge-group-name
Router(config-l2vpn-bg)# bridge-domain bridge-domain-name
Router(config-l2vpn-bg-bd)# vfi vfi-name
Router(config-l2vpn-bg-bd-vfi)# autodiscovery bgp
Router(config-l2vpn-bg-bd-vfi-ad)# vpn-id vpn-id
Router(config-l2vpn-bg-bd-vfi-ad)# rd auto
```

```
Router(config-l2vpn-bg-bd-vfi-ad)# route-target 10.0.0.1:100
Router(config-l2vpn-bg-bd-vfi-ad-sig)# signaling-protocol bgp
Router(config-l2vpn-bg-bd-vfi-ad-sig)# ve-id 1
```

### Running Configuration:

Figure 3: BGP-based VPLS Autodiscovery with BGP signaling



### Configuration at PE1:

```
l2vpn
  bridge group gr1
  bridge-domain bd1
  interface GigabitEthernet0/1/0/1.1
  vfi vfl
  ! AD independent VFI attributes
  vpn-id 100
  ! Auto-discovery attributes
  autodiscovery bgp
  rd auto
  route-target 172.16.0.1:100
  ! Signaling attributes
  signaling-protocol bgp
  ve-id 3
```

### Configuration at PE2:

```
l2vpn
  bridge group gr1
  bridge-domain bd1
  interface GigabitEthernet0/1/0/2.1
  vfi vfl
  ! AD independent VFI attributes
  vpn-id 100
  ! Auto-discovery attributes
  autodiscovery bgp
  rd auto
  route-target 172.16.0.1:100
  ! Signaling attributes
  signaling-protocol bgp
  ve-id 5
```

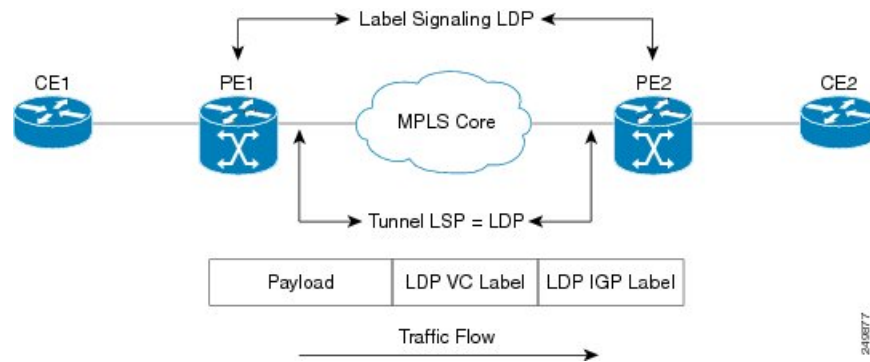
## BGP-based VPLS Autodiscovery with LDP Signaling

A PE router advertises an identifier through BGP for each VPLS instance. This identifier is unique within the VPLS instance and acts like a VPLS ID. The identifier enables the PE router receiving the BGP advertisement to identify the VPLS associated with the advertisement and import it to the correct VPLS instance. In this manner, for each VPLS, a PE router learns the other PE routers that are members of the VPLS.

The signaling of pseudowires between provider edge devices, uses targeted LDP sessions to exchange label values and attributes. Forwarding Equivalence Class (FEC) 129 is used for the signaling. The information carried by FEC 129 includes the VPLS ID, the Target Attachment Individual Identifier (TAII) and the Source Attachment Individual Identifier (SAII).

The LDP advertisement also contains the inner label or VPLS label that is expected for the incoming traffic over the pseudowire. This enables the LDP peer to identify the VPLS instance with which the pseudowire is to be associated and the label value that it is expected to use when sending traffic on that pseudowire.

**Figure 4: Discovery and Signaling Attributes**



## Configuring BGP-based VPLS Autodiscovery with LDP Signaling

BGP and LDP need to be configured as indicated in the section [Configuring BGP and LDP for BGP-based Autodiscovery, on page 2](#) before proceeding to the configurations in this section.

### Configuration Example:

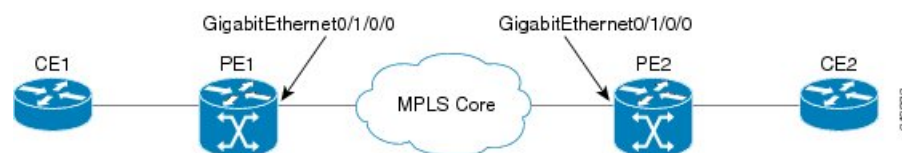
The below code block shows the basic configuration steps required for BGP-based VPLS autodiscovery with LDP Signaling.

```
Router(config)# l2vpn
Router(config-l2vpn)# bridge group {bridge group name}
Router(config-l2vpn-bg)# bridge-domain {bridge domain name}
Router(config-l2vpn-bg-bd)# vfi {vfi name}
Router(config-l2vpn-bg-bd-vfi)# autodiscovery bgp
Router(config-l2vpn-bg-bd-vfi-ad)# vpn-id 10
Router(config-l2vpn-bg-bd-vfi-ad)# rd auto
Router(config-l2vpn-bg-bd-vfi-ad)# route-target 10.0.0.1:100
Router(config-l2vpn-bg-bd-vfi-ad)# signaling-protocol ldp
Router(config-l2vpn-bg-bd-vfi-ad-sig)# vpls-id 120:200
Router(config-l2vpn-bg-bd-vfi-ad-sig)# commit
```

### Running Configuration:

The following figure illustrates an example of configuring VPLS with BGP autodiscovery (AD) and LDP Signaling.

**Figure 5: VPLS with BGP autodiscovery and LDP signaling**



**Configuration at PE1:**

```

l2vpn
  router-id 10.0.0.10
  bridge group bg1
  bridge-domain bd1
  vfi vfl
  vpn-id 100
  autodiscovery bgp
  rd 1:100
  router-target 12:12
  signaling-protocol ldp
  vpls-id 120:200

```

**Configuration at PE2:**

```

l2vpn
  router-id 172.16.0.1
  bridge group bg1
  bridge-domain bd1
  vfi vfl
  vpn-id 100
  autodiscovery bgp
  rd 2:200
  router-target 12:12
  signaling-protocol ldp
  vpls-id 120:100

```

## BGP-based VPWS Autodiscovery

BGP-based autodiscovery is possible even for point-to-point L2VPN services such as VPWS. However, true autodiscovery is not possible in VPWS as it is in VPLS. In VPWS, in order to connect the Customer Edge (CE) routers, an explicit configuration has to be done at each PE. Only the existence of other PEs can be indicated by autodiscovery.

## BGP-based VPWS Autodiscovery with BGP Signaling

The two primary functions of the VPWS control plane are: auto-discovery and signaling. Both of these functions are accomplished with a single BGP Update advertisement.

When a VPWS cross-connect is configured with BGP autodiscovery and signaling enabled, BGP distributes NLRI for the cross-connect with the PE as the BGP next-hop and appropriate CE-ID. Additionally, the cross-connect is associated with one or more BGP export Route Targets (RTs) that are also distributed (along with NLRI).

## Configuring BGP-based VPWS Autodiscovery with BGP Signaling

BGP and LDP need to be configured as indicated in the section [Configuring BGP and LDP for BGP-based Autodiscovery, on page 2](#) before proceeding to the configurations in this section.

**Configuration Example:**

The below code block shows the basic configuration steps required for BGP-based VPWS autodiscovery with BGP Signaling.

```

Router(config)# l2vpn
Router(config-l2vpn)# xconnect group {xconnect group name}
Router(config-l2vpn-xc)# mp2mp {instance name}
Router(config-l2vpn-xc-mp2mp)# vpn-id {vpn-id}
Router(config-l2vpn-xc-mp2mp)# l2-encapsulation vlan
Router(config-l2vpn-xc-mp2mp)# autodiscovery bgp
Router(config-l2vpn-xc-mp2mp-ad)# rd auto
Router(config-l2vpn-xc-mp2mp-ad)# route-target 172.16.0.1:100
Router(config-l2vpn-xc-mp2mp-ad)# signaling-protocol bgp
Router(config-l2vpn-xc-mp2mp-ad-sig)# ce-id 1
Router(config-l2vpn-xc-mp2mp-ad-sig-ce)# interface GigabitEthernet0/1/0/1.1 remote-ce-id 2

```

### Running Configuration:

The following figure illustrates an example of configuring VPWS with BGP autodiscovery and BGP Signaling.

**Figure 6: VPWS with BGP autodiscovery and BGP signaling**



### Configuration at PE1:

```

l2vpn
xconnect group gr1
mp2mp mp1
vpn-id 100
l2 encapsulation vlan
autodiscovery bgp
rd auto
route-target 172.16.0.1:100
! Signaling attributes
signaling-protocol bgp
ce-id 1
interface GigabitEthernet0/1/0/1.1 remote-ce-id 2

```

### Configuration at PE2:

```

l2vpn
xconnect group gr1
mp2mp mp1
vpn-id 100
l2 encapsulation vlan
autodiscovery bgp
rd auto
route-target 172.16.0.1:100
! Signaling attributes
signaling-protocol bgp
ce-id 2
interface GigabitEthernet0/1/0/2.1 remote-ce-id 1

```

### Verification:

#### PE1:

```
PE1# show l2vpn discovery xconnect
```

```
Service Type: VPWS, Connected
```

```
List of VPNs (1 VPNs):
```

```
XC Group: gr1, MP2MP mp1
```

```
List of Local Edges (1 Edges):
```

```
Local Edge ID: 1, Label Blocks (1 Blocks)
```

Label base Offset	Size	Time Created
16030	10	01/24/2009 21:23:04

```
Status Vector: 9f ff
```

```
List of Remote Edges (1 Edges):
```

```
Remote Edge ID: 2, NLRIs (1 NLRIs)
```

Label base Offset	Size	Peer ID	Time Created
16045	10	10.0.0.1	01/24/2009 21:29:35

```
Status Vector: 7f ff
```

```
PE1# show l2vpn xconnect mp2mp detail
```

```
Group gr1, MP2MP mp1, state: up
```

```
VPN ID: 100
```

```
VPN MTU: 1500
```

```
L2 Encapsulation: VLAN
```

```
Auto Discovery: BGP, state is Advertised (Service Connected)
```

```
Route Distinguisher: (auto) 192.168.0.1:32770
```

```
Import Route Targets:
```

```
172.16.0.1:100
```

```
Export Route Targets:
```

```
172.16.0.1:100
```

```
Signaling protocol: BGP
```

```
CE Range: 10
```

```
...
```

```
Group gr1, XC mp1.1:2, state is up; Interworking none
```

```
Local CE ID: 1, Remote CE ID: 2, Discovery State: Advertised
```



```

AC: GigabitEthernet0/1/0/1.1, state is up
  Type VLAN; Num Ranges: 1
  VLAN ranges: [1, 1]
  MTU 1500; XC ID 0x2000013; interworking none
PW: neighbor 10.0.0.1, PW ID 65538, state is up ( established )
  PW class not set, XC ID 0x2000013
  Encapsulation MPLS, Auto-discovered (BGP), protocol BGP
  MPLS          Local          Remote
  -----
  Label          16031          16045
  MTU            1500          1500
  Control word enabled          enabled
  PW type        Ethernet VLAN      Ethernet VLAN
  CE-ID          1              2
  -----
  
```

...

```

PE1# show bgp l2vpn vpws
BGP router identifier 192.168.0.1, local AS number 100
BGP generic scan interval 60 secs
BGP table state: Active
Table ID: 0x0
BGP main routing table version 913
BGP NSR converge version 3
BGP NSR converged
BGP scan interval 60 secs
Status codes: s suppressed, d damped, h history, * valid, > best
                i - internal, S stale
Origin codes: i - IGP, e - EGP, ? - incomplete
  Network          Next Hop      Rcvd Label    Local Label
Route Distinguisher: 10.0.0.1:32775
*>i2:1/32          10.0.0.1      16045         nolabel
  
```

```
*>i3:1/32          110.0.0.1          16060          nolabel
Route Distinguisher: 192.168.0.1:32770 (default for vrf gr1:mp1)
*> 1:1/32          0.0.0.0            nolabel        16030
*>i2:1/32          10.0.0.1           16045          nolabel
*>i3:1/32          10.0.0.1           16060          nolabel
```

Processed 5 prefixes, 5 paths

### **PE2:**

```
PE2# show l2vpn discovery xconnect
```

Service Type: VPWS, Connected

List of VPNs (1 VPNs):

XC Group: gr1, MP2MP mp1

List of Local Edges (2 Edges):

Local Edge ID: 2, Label Blocks (1 Blocks)

Label base	Offset	Size	Time Created
-----	-----	----	-----
16045	1	10	01/24/2009 21:09:14

Status Vector: 7f ff

Local Edge ID: 3, Label Blocks (1 Blocks)

Label base	Offset	Size	Time Created
-----	-----	----	-----
16060	1	10	01/24/2009 21:09:14

Status Vector: 7f ff

List of Remote Edges (1 Edges):

Remote Edge ID: 1, NLRIs (1 NLRIs)

Label base	Offset	Size	Peer ID	Time Created
-----	-----	----	-----	-----
16030	1	10	192.168.0.1	01/24/2009 21:09:16

Status Vector: 9f ff

```
PE2# show l2vpn xconnect mp2mp detail
```

Group gr1, MP2MP mp1, state: up

```

VPN ID: 100

VPN MTU: 1500

L2 Encapsulation: VLAN

Auto Discovery: BGP, state is Advertised (Service Connected)
    Route Distinguisher: (auto) 10.0.0.1:32775

Import Route Targets:
    172.16.0.1:100

Export Route Targets:
    172.16.0.1:100

Signaling protocol:BGP
    CE Range:10

...

Group grp1, XC mpl.2:1, state is up; Interworking none

Local CE ID: 2, Remote CE ID: 1, Discovery State: Advertised

AC: GigabitEthernet0/1/0/2.1, state is up
    Type VLAN; Num Ranges: 1
    VLAN ranges: [1, 1]
    MTU 1500; XC ID 0x2000008; interworking none

PW: neighbor 192.168.0.1, PW ID 131073, state is up ( established )
    PW class not set, XC ID 0x2000008

Encapsulation MPLS, Auto-discovered (BGP), protocol BGP
    MPLS          Local          Remote
    -----
    Label         16045          16031
    MTU           1500          1500
    Control word  enabled        enabled
    PW type       Ethernet VLAN  Ethernet VLAN
    CE-ID         2              1
    -----
...

PE2# show bgp l2vpn vpws

```

```

BGP router identifier 10.0.0.1, local AS number 100

BGP generic scan interval 60 secs

BGP table state: Active

Table ID: 0x0

BGP main routing table version 819

BGP NSR converge version 7

BGP NSR converged

BGP scan interval 60 secs

Status codes: s suppressed, d damped, h history, * valid, > best
                i - internal, S stale

Origin codes: i - IGP, e - EGP, ? - incomplete

   Network             Next Hop           Rcvd Label         Local Label
Route Distinguisher: 10.0.0.1:32775 (default for vrf gr1:mpl)
*>i1:1/32              192.168.0.1       16030              nolabel
*> 2:1/32              0.0.0.0           nolabel            16045
*> 3:1/32              0.0.0.0           nolabel            16060

Route Distinguisher: 192.168.0.1:32770
*>i1:1/32              192.168.0.1       16030              nolabel

Processed 4 prefixes, 4 paths

```

## BGP-based VPWS Autodiscovery with LDP Signaling

Signaling of pseudowires requires exchange of information between two endpoints. LDP is better suited for point-to-point signaling.

A PE router advertises an identifier through BGP for the VPWS instance. The signaling of pseudowires between provider edge devices uses targeted LDP sessions to exchange label values and attributes and to configure the pseudowires. FEC 129 is used for the signaling. The information carried by FEC 129 includes the **xconnect** ID, the Target Attachment Individual Identifier (TAII) and the Source Attachment Individual Identifier (SAII).

### Configuring BGP-based VPWS Autodiscovery with LDP Signaling

BGP and LDP need to be configured as indicated in the section [Configuring BGP and LDP for BGP-based Autodiscovery, on page 2](#) before proceeding to the configurations in this section.

**Configuration Example:**

The below code block shows the basic configuration steps required for BGP based VPWS autodiscovery with LDP Signaling.

```
Router(config)# l2vpn
Router(config-l2vpn)# xconnect group {xconnect group name}
Router(config-l2vpn-xc)# mp2mp {instance name}
Router(config-l2vpn-xc-mp2mp)# vpn-id {vpn-id}
Router(config-l2vpn-xc-mp2mp)# l2-encapsulation vlan
Router(config-l2vpn-xc-mp2mp)# autodiscovery bgp
Router(config-l2vpn-xc-mp2mp-ad)# rd auto
Router(config-l2vpn-xc-mp2mp-ad)# route-target 172.16.0.1:100
Router(config-l2vpn-xc-mp2mp-ad)# signaling-protocol ldp
Router(config-l2vpn-xc-mp2mp-ad-sig)# ce-id 1
Router(config-l2vpn-xc-mp2mp-ad-sig-ce)# interface GigabitEthernet0/1/0/1.1 remote-ce-id 2
```

**Running Configuration:**

The following figure illustrates an example of configuring VPWS with BGP autodiscovery and LDP Signaling.

**Figure 7: VPWS with BGP autodiscovery and LDP signaling**

**Configuration at PE1:**

```
l2vpn
xconnect group gr1
mp2mp mp1
vpn-id 100
l2 encapsulation vlan
autodiscovery bgp
rd auto
route-target 172.16.0.1:100
! Signaling attributes
signaling-protocol ldp
ce-id 1
interface GigabitEthernet0/1/0/1.1 remote-ce-id 2
```

**Configuration at PE2:**

```
l2vpn
xconnect group gr1
mp2mp mp1
vpn-id 100
l2 encapsulation vlan
autodiscovery bgp
rd auto
route-target 172.16.0.1:100
! Signaling attributes
signaling-protocol ldp
ce-id 2
interface GigabitEthernet0/1/0/2.1 remote-ce-id 1
```

