

MPLS

Cisco MPLS

MPLS Introduction

The most up-to-date version of this test is at:

<http://networksims.com/i01.html>

Cisco Router Challenge 227

Outline

This challenge involves basic frame-mode MPLS configuration.

Objectives

The objectives of this challenge are to:

- Enable CEF globally.
- Enable CEF on S0.
- Define IGP routing protocol.
- Assign LDP router ID.
- Enable IPv4 MPLS on an interface (mpls ip).

Commands

```
> enable
# config t
(config)# ip cef
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip route-cache cef
(config-if)# mpls ip
(config-if)# exit
(config)# router ospf 101
(config-router)# network 10.0.0.0 0.0.0.255 area 1
(config)# mpls ldp router-id loopback5
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
```

Example

```
> enable
# config t
(config)# ip cef
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip route- ?
    cef                Enable Cisco Express Forwarding
    flow               Enable Flow fast-switching cache
    policy             Enable fast-switching policy cache for outgoing packets
    same-interface    Enable fast-switching on the same interface
    <cr>

(config-if)# ip route-cache cef
(config-if)# mpls ?
    accounting        Enable MPLS accounting on this interface
    ip                 Configure dynamic MPLS forwarding for IP
    label             Label properties
    ldp               Configure Label Distribution Protocol (LDP) parameters
    mtu               Set tag switching Maximum Transmission Unit
    netflow           Configure Egress Netflow Accounting
    traffic-eng       Configure Traffic Engineering parameters
(config-if)# mpls ip

(config-if)# exit
(config)# router ospf 101
(config-router)# network 10.0.0.0 0.0.0.255 area 1
(config-router)# exit
(config)# mpls ?
    atm               Configure ATM options
    ip                 Dynamic MPLS forwarding for IP
    ipv6              Dynamic MPLS forwarding for IPv6
    label             Label properties
    ldp               Label Distribution Protocol
    static            Configure static label bindings
    traffic-eng       Configure Traffic Engineering parameters

(config)# mpls ldp ?
    advertise-labels  Label advertisements
    atm               Configure ATM MPLS options
    backoff           Set LDP session backoff parameters
    discovery         LDP discovery
    explicit-null     Advertise Explicit Null label in place of Implicit Null
    graceful-restart  Configure LDP Graceful Restart
    holdtime          LDP session holdtime
    igp               Configure IGP-related LDP parameters
    logging           Enable LDP logging
    loop-detection    Enable LDP Loop Detection
    maxhops           Limit hop count for LDP LSP setup
    neighbor          Configure neighbor parameters
    path-vector       Path Vector for LDP LSP setup
    request-labels    Access list to specify valid downstream on demand
                    destinations.
    router-id         Select interface to prefer for LDP identifier address
    session           Configure session parameters
    tcp               Set TCP parameters for LDP

(config)# mpls ldp router-id ?
    Async            Async interface
    BVI               Bridge-Group Virtual Interface
    CDMA-Ix          CDMA Ix interface
```

CTunnel	CTunnel interface
Dialer	Dialer interface
Ethernet	IEEE 802.3
FastEthernet	FastEthernet IEEE 802.3
Group-Async	Async Group interface
Lex	Lex interface
Loopback	Loopback interface
MFR	Multilink Frame Relay bundle interface
Multilink	Multilink-group interface
Null	Null interface
Port-channel	Ethernet Channel of interfaces
Serial	Serial
TokenRing	IEEE 802.5
Tunnel	Tunnel interface
Vif	PGM Multicast Host interface
Virtual-PPP	Virtual PPP interface
Virtual-Template	Virtual Template interface
Virtual-TokenRing	Virtual TokenRing

```
(config)# mpls ldp router-id loopback5
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
```

Cisco Router Challenge 228

Outline

This challenge involves configuration of MPLS over a routed PVC in ATM.

Objectives

The objectives of this challenge are to:

- Enable CEF globally.
- Enable MPLS on ATM.
- Define ATM interface parameters.
- Define ATM sub-interface.

Commands

```
> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# exit
(config)# int atm0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config)# int atm0.1 point-to-point
(config-subif)# ip address 138.10.11.1 255.255.255.238
(config-subif)# mpls ip
(config-subif)# pvc 2/100
(config-if-atm-vc# encapsulation aal5snap
(config-if-atm-vc# exit
```

```
(config-if)# exit
(config)# router ospf 101
(config-router)# network 10.0.0.0 0.0.0.255 area 1
```

Example

```
> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# exit
(config)# int atm0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config)# int atm0.1 ?
  mpls          Treat as an MPLS link
  multipoint    Treat as a multipoint link
  point-to-point Treat as a point-to-point link
  tag-switching Treat as a tag switching link (obsolete, use mpls)
<cr>
(config)# int atm0.1 point-to-point
(config-subif)# ip address 138.10.11.1 255.255.255.238
(config-subif)# mpls ?
  atm          Tag controlled ATM parameters
  ip           Configure dynamic MPLS forwarding for IP
  label        Label properties
  ldp          Configure Label Distribution Protocol (LDP) parameters
  mtu          Set tag switching Maximum Transmission Unit
  netflow      Configure Egress Netflow Accounting
  traffic-eng  Configure Traffic Engineering parameters
(config-subif)# mpls ip
(config-subif)# pvc ?
  <0-7>        Enter VPI/VCI value (slash required)
  <1-1023>     Enter VCI value
  WORD         Optional handle to refer to this connection
(config-subif)# pvc 2/100
(config-if-atm-vc)# encapsulation ?
  aal5cisco    Cisco PPP over AAL5 Encapsulation
  aal5mux      AAL5+MUX Encapsulation
  aal5nlpid    AAL5+NLPIID Encapsulation
  aal5snap     AAL5+LLC/SNAP Encapsulation
(config-if-atm-vc)# encapsulation aal5snap
(config-if)# exit
(config)# router ospf 101
(config-router)# network 10.0.0.0 0.0.0.255 area 1
```

Cisco MPLS

MPLS Basics

The most up-to-date version of this test is at:

<http://networksims.com/i02.html>

Cisco Router Challenge 229

Outline

This challenge involves an MPLS VPN configuration, which is often seen in ISP applications, and uses MPLS forwarding and VRF (Virtual Routing and Forwarding). VRF is used to create multiple instances of a routing table within the same router, at the same time. Thus the same, or overlapping, IP addresses can be used without a conflict, as all of these routing instances are independent. VRF uses Forwarding Information Bases (FIBs), which are distinct routing tables. With an MPLS domain, the **Provider Edge (PE)** routing switch is the only device to have knowledge of the multiple different virtual routing engines, and **Customer Edge (CE)** devices then participate in their MPLS VPN routing via **route dissemination (RD)** to and from the PE, using a routing engine such as eBGP, OSPF or static routing. All the other Provider (P) switches in backbone do not have any knowledge of IP routing within this context. The PE traffic travels over the core network using label switching. This challenge involves the configuration of the VRF on the PE routers, and the next challenge sets up BGP PE-PE Routing on PE Routers, which is required to transport the routes over the backbone.

Objectives

The objectives of this challenge are to:

- Configure VRF.
- Configure RD (which is used to make a unique IP address).
- Configure import and export policy (RT).
- Associate VRF with an interface

Commands

```
> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# ip vrf forwarding Testing
(config-if)# exit
(config)# ip vrf Testing
(config-vrf)# rd 1:100
(config-vrf)# route-target both 1:100
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip vrf forwarding Testing
(config-if)# exit
```

Example

```

> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# ip vrf forwarding Testing
(config-if)# exit
(config)# ip vrf ?
WORD VPN Routing/Forwarding instance name
(config)# ip vrf Testing
(config-vrf)# ?
IP VPN Routing/Forwarding instance configuration commands:
bgp          Commands pertaining to BGP
context      Associate SNMP context with this vrf
default      Set a command to its defaults
description  VRF specific description
exit         Exit from VRF configuration mode
maximum      Set a limit
mdt          Backbone Multicast Distribution Tree
no           Negate a command or set its defaults
rd           Specify Route Distinguisher
route-target Specify Target VPN Extended Communities
vpn         Configure VPN ID as specified in rfc2685

(config-vrf)# rd 1:100
(config-vrf)# rd ?
ASN:nn or IP-address:nn VPN Route Distinguisher

(config-vrf)# route-target ?
ASN:nn or IP-address:nn Target VPN Extended Community
both          Both import and export Target-VPN community
export        Export Target-VPN community
import        Import Target-VPN community

(config-vrf)# route-target both ?
ASN:nn or IP-address:nn Target VPN Extended Community
(config-vrf)# route-target both 1:100
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip vrf ?
forwarding   Configure forwarding table
receive      Add Interface Address into VRF Table
sitmap       Configure route-map for routes received from this site

(config-if)# ip vrf forwarding ?
WORD Table name
(config-if)# ip vrf forwarding Testing
(config-if)# exit

```

The RD value creates routing and forwarding tables. It is added at the beginning of customer IP addresses, to convert them to unique IP address. It can either be:

- 16-bit AS number: 32-bit number. For example 1:100, which has an AS of 1, and a 32-bit number of 100.
- 32-bit IP number: 16-bit number. For example 192.168.1.1:1, which has a 16-bit value of 1.

The VRF is associated with an interface with:

```
(config-if)# ip vrf forwarding Testing
```

Cisco Router Challenge 230

Outline

The previous challenge involved the configuration of the VRF on the PE routers, and this next challenge sets up BGP PE-PE Routing on PE Routers, which is required to transport the routes over the backbone.

Objectives

The objectives of this challenge are to:

- Configure VRF.
- Configure RD (which is used to make a unique IP address).
- Configure import and export policy (RT).
- Associate VRF with an interface.
- Configure BGP PE-PE on a PE device.

Commands

```
> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# ip vrf forwarding Testing
(config-if)# exit
(config)# ip vrf Testing
(config-vrf)# rd 1:100
(config-vrf)# route-target both 1:100
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip vrf forwarding Testing
(config-if)# exit
(config)# router bgp 1
(config-router)# neighbor 138.199.17.1 remote-as 1
(config-router)# neighbor 138.199.17.1 update-source loopback5
(config-router)# address-family vpn4
(config-router-af)# neighbor 1.2.3.4 send-community extended
(config-router-af)# neighbor 1.2.3.4 activate
```

Example

```
> enable
# config t
(config)# ip cef
(config)# int loopback5
(config-if)# ip address 138.199.17.2 255.255.255.248
(config-if)# ip vrf forwarding Testing
```

```

(config-if)# exit
(config)# ip vrf ?
    WORD VPN Routing/Forwarding instance name
(config)# ip vrf Testing
(config-vrf)# ?
IP VPN Routing/Forwarding instance configuration commands:
    bgp          Commands pertaining to BGP
    context      Associate SNMP context with this vrf
    default      Set a command to its defaults
    description  VRF specific description
    exit         Exit from VRF configuration mode
    maximum      Set a limit
    mdt          Backbone Multicast Distribution Tree
    no          Negate a command or set its defaults
    rd           Specify Route Distinguisher
    route-target Specify Target VPN Extended Communities
    vpn         Configure VPN ID as specified in rfc2685

(config-vrf)# rd 1:100
(config-vrf)# rd ?
    ASN:nn or IP-address:nn VPN Route Distinguisher

(config-vrf)# route-target ?
    ASN:nn or IP-address:nn Target VPN Extended Community
    both                    Both import and export Target-VPN community
    export                  Export Target-VPN community
    import                  Import Target-VPN community

(config-vrf)# route-target both ?
    ASN:nn or IP-address:nn Target VPN Extended Community
(config-vrf)# route-target both 1:100
(config)# int s0
(config-if)# ip address 138.199.17.1 255.255.255.248
(config-if)# ip vrf ?
    forwarding  Configure forwarding table
    receive     Add Interface Address into VRF Table
    sitemap     Configure route-map for routes received from this site

(config-if)# ip vrf forwarding ?
    WORD Table name
(config-if)# ip vrf forwarding Testing
(config-if)# exit
(config-if)# exit
(config)# router bgp 1
(config-router)# neighbor 138.199.17.1 remote-as 1
(config-router)# neighbor 138.199.17.1 update-source loopback5
(config-router)# address-family vpn4
(config-router-af)# ?
Router Address Family configuration commands:
    auto-summary      Enable automatic network number summarization
    autonomous-system Specify AS number for Address Family
    default           Set a command to its defaults
    default-information Control distribution of default information
    default-metric    Set metric of redistributed routes
    distance          Define an administrative distance
    distribute-list    Filter networks in routing updates
    eigrp             EIGRP specific commands
    exit-address-family Exit from Address Family configuration mode
    help             Description of the interactive help system
    maximum-paths     Forward packets over multiple paths
    metric            Modify EIGRP routing metrics and parameters
    network           Enable routing on an IP network
    no               Negate a command or set its defaults

```

```

offset-list          Add or subtract offset from RIP metrics
redistribute         Redistribute information from another routing protocol
variance            Control load balancing variance
(config-router-af)# neighbor ?
A.B.C.D             Neighbor address
WORD                Neighbor tag
X:X:X:X::X         Neighbor IPv6 address

(config-router-af)# neighbor 1.2.3.4 ?
activate            Enable the Address Family for this Neighbor
advertise-map       specify route-map for conditional advertisement
advertisement-interval Minimum interval between sending BGP routing updates
allowas-in          Accept as-path with my AS present in it
description         Neighbor specific description
distribute-list     Filter updates to/from this neighbor
dmzlink-bw          Propagate the DMZ link bandwidth
ebgp-multihop      Allow EBGp neighbors not on directly connected
                    networks
filter-list         Establish BGP filters
local-as            Specify a local-as number
maximum-prefix      Maximum number of prefix accept from this peer
next-hop-self       Disable the next hop calculation for this neighbor
password           Set a password
peer-group          Member of the peer-group
prefix-list         Filter updates to/from this neighbor
remote-as           Specify a BGP neighbor
remove-private-AS   Remove private AS number from outbound updates
route-map           Apply route map to neighbor
route-reflector-client Configure a neighbor as Route Reflector client
send-community      Send Community attribute to this neighbor
shutdown            Administratively shut down this neighbor
soft-reconfiguration Per neighbor soft reconfiguration
timers              BGP per neighbor timers
unsuppress-map      Route-map to selectively unsuppress suppressed routes
update-source       Source of routing updates
version             Set the BGP version to match a neighbor
weight             Set default weight for routes from this neighbor

(config-router-af)# neighbor 1.2.3.4 send ?
both               Send Standard and Extended Community attributes
extended           Send Extended Community attribute
standard           Send Standard Community attribute
<cr>

(config-router-af)# neighbor 1.2.3.4 send-community extended
(config-router-af)# neighbor 1.2.3.4 activate

```