MPLS Workshop
Apricot 2015

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Lab Guide and Modules

Your course facilitators

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Lab Access

- Mac-mini

- mpls-lab.user32.com (192.168.40.142)

- Anonymous login with read write

- ssh login (apricot/2015)

- telnet to the routers (eg. telnet RX) X is router number

Agenda

- Module 1

  Lab CLI familiarization

  Configuring of IP links and loopback interfaces

  Deploy Routing protocol (ISIS/BGP)

- Module 2

  Deploying and troubleshooting of LDP

  Deploying L3 VPN on the core

- Module 3

  L3 VPN with PE-CE – static rotuing and BGP routing

  InterAS L3VPN

- Module 4

  ~~L2VPN EoMPLS configuration~~

  MPLS traffic engineering

Lab IP addressing scheme

TYPE	IP addess
IP link /30	172.16.78.0/16
Loopback /32	<router >.<router>.<router>.<router>/32
VPN <number>	10.<VPN number>.<router>.0/24
ASN	100, 200(For InterAS)

VPN	VPN num	VPN router	ASN	RT
Red	1	i1,i6,i11	65001	65001:1
Yellow	2	i2,i7,i12	65002	65002:1
Green	3	i3,i8,i13	65003	65003:1
Blue	4	i4,i9,i14	65004	65004:1
Purple	5	i5,i10	65005	65005:1

VPN assignment for EoMPLS

VPN	VPN router	VPN router
Red	i1,i6,i11	32,37
Yellow	i2,i7,i12	33,38
Green	i3,i8,i13	34,39
Blue	i4,i9,i14	35,40
Purple	i5,i10	36,41

Lab Topology

Lab design
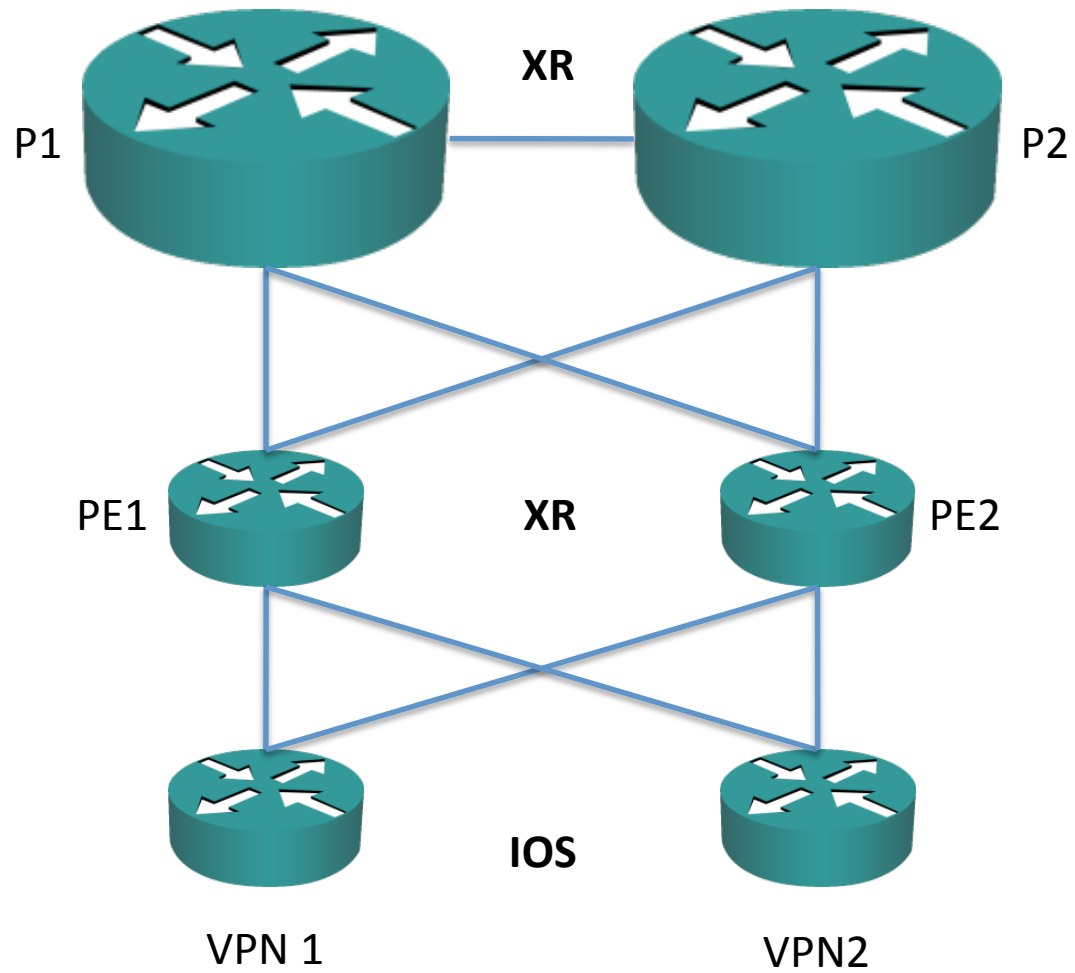
Lab assigment

Number	PE	CE
1	xrvr-5	iosv-1
2	xrvr-6	iosv-2
3	xrvr-7	iosv-3
4	xrvr-8	Iosv-4
5	xrvr-9	iosv-5
6	xrvr-10	iosv-6
7	xrvr-11	iosv-7
8	xrvr-12	iosv-8
9	xrvr-13	iosv-9
10	xrvr-14	iosv-10

Number	PE	CE
11	xrvr-15	Iosv-11
12	xrvr-16	iosv-12
13	xrvr-17	iosv-13
14	xrvr-18	iosv-14

Module 1

- Objectives:
  - CLI familiarization. Able to configure, save and amend XR router configuration
  - Understand the lab setup and topology. Able to gain access to all devices
  - Basic connectivity test between routers to routers
  - IGP routing (ISIS) for all the devices on the network
  - Enable IPv4 BGP routing among all the devices (P and PE only, ignore CE devices)

Module 1

- Login to the management interface of the router (user: cisco/cisco)

- Familiarize with XR CLI (show/write command)

- Setup inband access to allow other routers to telnet into all routers inband

- Understand the topology and locate the neighbor routers

- Configure the IP link addresses and Loopback address for the assigned routers

- Check connectivity using the ping and "show cdp neighbor" command to confirm the topology and connections

- Configure IGP routing

```
router isis 1
 net 49.1234.1000.1000.<router>.00
 address-family ipv4 unicast
  metric-style wide
  mpls traffic-eng level-2-only
  mpls traffic-eng router-id Loopback0
```

Module 1 (Cont')

- Enable ISIS on the core facing interfaces and passive interface on loopback

```
router isis 1
  interface Loopback0
  passive
  circuit-type level-2-only
  address-family ipv4 unicast
  !
   interface GigabitEthernet0/0/1/10
  circuit-type level-2-only
  point-to-point
  address-family ipv4 unicast
```

- Using "show isis interface" and "show isis neighbor" to confirm the correctness of the IGP configuration

- Confirm that all the routing is correct and with loopback interfaces of all the routers in global routing table. "show isis route | inc /32"

Module 1 (Cont')

- Enable iBGP on all PE except Core device. R1 and R2 routers now becomes the Route reflectors for the entire netwtork

```
router  bgp 100
  bgp router-id <loopback>
  address-family ipv4 unicast
    network <router>/32
  address –family vpnv4 unicast
  neighbor <router>
    remote-as 100
    update-source Loopback 0
    address-family ipv4 unicast
    address-family vpnv4 unicast
```

- Using "show bgp sum" and "show bgp vpnv4 uncast sum" to confirm the correctness of the BGP operation
- Trouble shoot if necessary
- Confirm that all the routing is correct and with loopback interfaces of all the routers in bgp routing table. "show bgp route | inc /32"

Module 2

- Objectives:
  - Understand and deploy LDP
  - Able to troubleshoot LDP
  - Deploy best practice configuration
  - Perform minimum L3VPN configuration on the core network
  - Identify the critical components in the L3VPN setup
  - Ability to read and familiar with VPN configuration

Module 2 (Cont')

- Enable LDP on the routers using the following command:

- Turn up LDP on core facing interfaces

```
mpls ldp
 router-id X.X.X.X
 label
  allocate for host-routes
 !
 interface GigabitEthernet0/0/0/0
 !
 interface GigabitEthernet0/0/0/1
 !
```

- "show mpls interface" and "show mpls ldp interface" to debug and understand the ldp state

- "show mpls forwarding-table" to check the label switching table

- "show mpls ldp neighbor" to confirm the working of ldp state

Module 2 (Cont')

- Enable MPLS L3VPN service by turning on the core facing VPNV4 and IPV4 unicast (default) configuration

```
router bgp  100
 bgp router-id  X.X.X.X
 address-family ipv4 unicast
 !
 address-family vpnv4 unicast
```

- Turn up the BGP session to the route reflector. Correspondingly, the route reflector turn up the session with the Pes

- Verify the BGP session is up by "show bgp sum" (for ipv4) an "show bgp vpnv4 unicast all sum"

- No routes should be propagate and receive in VPNV4 instance.

```
neighbor X.X.X.X
  remote-as 100
  description RR parent C-1
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
```

Module 3

- Understand the concept of vrf routing
- Able to configure static routing on vrf instances
- Prorogate and receive VPN routes
- Concept of RT and RD
- Troubleshoot the VPN routing
- Differentiate IPv4 and VPNv4 instances
- Understand the concept of vrf lite and vrf routing
- Dynamic eBGP routing

Module 3 (cont')

- Enable MPLS L3VPN service by turning on the user facing IPV4 unicast configuration

- Configure a vrf on the PE

- Configure static routing for vrf on the PE

- Confirm that the route is propagate and receive in VPNV4 instance

```
vrf BLUE
address-family ipv4 unicast
 import route-target
  133097:1
  !
 export route-target
  133097:1
```

```
Router bgp 100
vrf BLUE
 rd 133097:1
address-family ipv4 unicast
  redistribute connected
  redistribute static
```

```
router static
vrf BLUE
 address-family ipv4 unicast
  X.X.X.X/24 GigabitEthernet0/0/0/0
```

Module 3 (cont')

- Enable MPLS L3VPN dynamic routing using eBGP
- Establish BGP session between the PE and CE using the following format:
  - Customer edge (CE) device : AS 650<number> eg CE9 uses ASN 65009
  - Provider Edge (PE) : ASN 100
- Setup loopback interfaces for testing.
- Announce loopback address using eBGP
- Verify connectivity
- Troubleshoot the eBGP session
- Verify the CE link failure

```
 vrf BLUE
  rd 133097:1
 address-family ipv4 unicast
 neighbor 10.0.0.2
   remote-as 200
   description eBGP peer NNI vrf BLUE
   address-family ipv4 unicast
    route-policy bgp_in in
    route-policy bgp_out out
    as-override
    !
 route-policy bgp_in
  pass
 end-policy
 route-policy bgp_out
  pass
 end-policy
```

Module 3 (cont')

- VPN multi-homing
- In accordance to the IP addressing scheme, establish the VPN multi-homing scenario
- Apply the BGP route policy
- Apply prefix filters
- Change the BGP timers to 20 seconds keepalive 60 seconds holdtime
- As multi-homing is carried out using same VPN ASN, use allow-as in to facilitate same VPN ASN
- Test the failover (CE – PE link failure)
- Setup overlapping VPN for management purpose

Module 4

Objectives:

- Understand and troubleshoot MPLS TE tunnels
- Perform explicit routing using TE tunnel
- Understand the various signaling mechanism in Layer 2 VPN
- Configure Point to Point Layer 2 VPN
- Configure Point to multi-point Layer 2 VPN
- Understand the concept of VFI and PE auto-discovery

Module4 (Cont')

- Enable RSVP signalling on all MPLS routers (PE and P)
- Configure traffic engineering (TE extensions) for ISIS routing (PE and P)
- Deploy MPLS point to point tunnel using explicit path option.
- All TE Tunnels must transit the two CORE (P) routers
- Please follow the tunnel mapping table to create TE tunnels to the respective PEs

Module4 (Cont')

- Enable RSVP signalling on all MPLS routers (PE and P)
- Configure traffic engineering (TE extensions) for ISIS routing (PE and P)
- Deploy MPLS point to point tunnel using explicit path option.
- All TE Tunnels must transit the two CORE (P) routers
- Please follow the tunnel mapping table to create TE tunnels to the respective PEs

Module4 (Cont')

TE Tunnels Mapping

Tunnel Head end	Tunnel Tail end
PE-5	PE-14
PE-6	PE-13
PE-7	PE-12
PE-8	PE-11
PE-9	PE-10
PE-10	PE-9
PE-11	PE-8
PE-12	PE-7
PE-13	PE-6
PE-14	PE-5

Lab InterAS Topology