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| Image result for cisco backgroun |
| MultiProtocol Label Switching (MPLS)Derek Liu |
| Periods 0,3,4  Mr. Mason & Mr. Hansen  CCNP Lab 10 |

**Implementing MPLS***Derek Liu*

Purpose

The purpose of this lab was to set up an MPLS network and also explore the functions of layer 3 switches.

Background Information

MPLS or multiprotocol label switching was developed alongside multiple organizations including the Internet Engineering Task Force (IETF) and Cisco Systems in the late 1990s. MPLS was developed from the concepts of IP switching and label switching and popularized by Cisco.

MPLS is a protocol that is used to efficiently route packets throughout the network. This is done by using labels to identify paths rather than checking the destination IP address at each hop. These labels are chosen based on requirements of the network and specific forwarding needs. Labels can be assigned manually or with LDP or TDP. When a packet enters a MPLS network, the ingress router assigns a label to the packet. As the packet moves throughout the network, the label can swap or be pushed. When the packet reaches its destination or egress router, the MPLS label is popped from the header, and it continues on with an IP header. For this reason, MPLS is also called IP over IP tunneling.

MPLS can be used in contexts beyond just service provider networks. It can be seen used in VPNs as it isolates traffic through labels but also in enterprise networks, data centers, cloud networks, and SDN networks. MPLS can also be used as a tool to create better QoS.

Both LDP (label distribution protocol) and TDP (tag distribution protocol) are protocols that are used to assign labels to packets travelling through a MPLS network. However, there are differences in terms of their usage and implementation. LDP is more widely used and is an industry standard. It also uses a target session approach when assigning label. Meanwhile, TDP is legacy protocol and a Cisco protectory protocol. TDP also uses a multi-cast approach when assigning labels which means it consumes more network resources and is less secure. Another option is to manually assign labels. This offers more control over the network but also allows for more error, is very time consuming, and isn’t very scalable.

A newer evolution of MPLS is segment routing where the forwarding path is directly encoded into the header rather than relying on distributed protocols such as OSPF.

Lab Summary

In this lab, we set up OSPF on all network devices as the distribution protocol. We treated the three layer 3 switches as the MPLS cloud network and used the “mpls ip” command on its interfaces. Loopbacks were used to simulate end devices and other networks.

At this point, an MPLS network has been set up. However, this is a MPLS network set up with LDP enabled by default. We enabled TDP and learned that it doesn’t really make a significant impact on the small network and works the same as LDP in this context. Note that it is recommended to use LDP over TDP.

We also wanted explore the concept of manually assigning labels to packets. This was done by creating a static label range with the “mpls label range 200 8191 static 16 199” command which identified the range in which labels can be assigned to packets. This command removed all labels in the forwarding table previously defined by TDP and LDP. At this point, we were able to manually assign labels with the “mpls static binding ipv4 (ip address) (subnet) output (next hop) (lablel/implicit-null)” command. By using this command multiple times, we were able to manually create a MPLS forwarding table.

Network functionality was confirmed with pings and the existence of MPLS on the network was confirmed using the command “show mpls forwarding-table.”

Lab Commands

ip routing – *enables IP routing on a layer 3 switch*

no switchport – *to turn a layer interface on a switch to a layer 3 interface*

mpls ip – *enables MPLS*

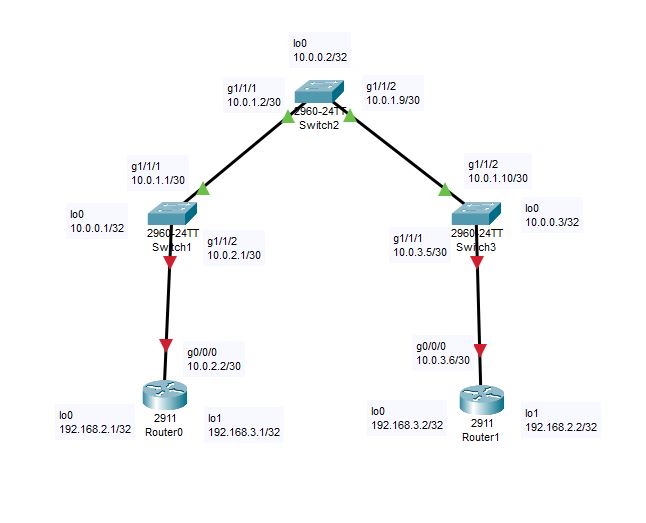
show mpls forwarding-table – *displays MPLS forwarding table*

mpls label protocol tdp – *switches from LDP to TDP*

mpls label range 200 8191 static 16 199 – *configure static label range for MPLS*

mpls static binding ipv4 192.168.3.2 255.255.255.255 output 10.0.1.2 22 – *configure static MPLS binding for ipv4 traffic*

Network Diagrams with IP



Configurations

***Pings***

R-1A#ping 192.168.2.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R-1A#ping 192.168.3.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.3.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R-1A#ping 10.0.2.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.2.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R-1A#ping 10.0.2.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.2.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/2 ms

R-1A#ping 10.0.0.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/6 ms

R-1A#ping 10.0.1.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.1.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

R-1A#ping 10.0.1.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.1.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/7 ms

R-1A#ping 10.0.0.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/3 ms

R-1A#ping 10.0.1.9

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.1.9, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/2 ms

R-1A#ping 10.0.1.10

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.1.10, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/6 ms

R-1A#ping 10.0.0.3

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/5 ms

R-1A#ping 10.0.3.5

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.3.5, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/5 ms

R-1A#ping 10.0.3.6

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.3.6, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R-1A#ping 192.168.3.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.3.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R-1A#ping 192.168.2.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.2.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

***Forwarding Table***

S2#show mpls forwarding-table

Local Outgoing Prefix Bytes Label Outgoing Next Hop

Label Label or Tunnel Id Switched interface

16 Pop Label 10.0.0.3/32 472 Gi1/1/2 10.0.1.10

17 Pop Label 10.0.0.1/32 1180 Gi1/1/1 10.0.1.1

18 Pop Label 10.0.2.0/30 1652 Gi1/1/1 10.0.1.1

19 19 192.168.3.1/32 0 Gi1/1/1 10.0.1.1

20 20 192.168.2.1/32 0 Gi1/1/1 10.0.1.1

21 Pop Label 10.0.3.4/30 3660 Gi1/1/2 10.0.1.10

22 22 192.168.3.2/32 610 Gi1/1/2 10.0.1.10

23 23 192.168.2.2/32 610 Gi1/1/2 10.0.1.10

S1#show mpls forwarding-table

Local Outgoing Prefix Bytes Label Outgoing Next Hop

Label Label or Tunnel Id Switched interface

16 Pop Label 10.0.0.2/32 0 Gi1/1/1 10.0.1.2

17 Pop Label 10.0.1.8/30 0 Gi1/1/1 10.0.1.2

18 22 192.168.3.2/32 0 Gi1/1/1 10.0.1.2

19 No Label 192.168.3.1/32 610 Gi1/1/2 10.0.2.2

20 No Label 192.168.2.1/32 610 Gi1/1/2 10.0.2.2

21 21 10.0.3.4/30 0 Gi1/1/1 10.0.1.2

22 23 192.168.2.2/32 0 Gi1/1/1 10.0.1.2

23 16 10.0.0.3/32 0 Gi1/1/1 10.0.1.2

S3#show mpls forwarding-table

Local Outgoing Prefix Bytes Label Outgoing Next Hop

Label Label or Tunnel Id Switched interface

16 Pop Label 10.0.0.2/32 0 Gi1/1/2 10.0.1.9

17 17 10.0.0.1/32 0 Gi1/1/2 10.0.1.9

18 Pop Label 10.0.1.0/30 0 Gi1/1/2 10.0.1.9

19 18 10.0.2.0/30 0 Gi1/1/2 10.0.1.9

20 19 192.168.3.1/32 0 Gi1/1/2 10.0.1.9

21 20 192.168.2.1/32 0 Gi1/1/2 10.0.1.9

22 No Label 192.168.3.2/32 0 Gi1/1/1 10.0.3.6

23 No Label 192.168.2.2/32 0 Gi1/1/1 10.0.3.6

***Switch 1 Config:***

hostname S1

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

ip routing

vtp domain CCNP

vtp mode transparent

mpls label range 200 8191 static 16 199

crypto pki trustpoint TP-self-signed-661422464

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-661422464

revocation-check none

rsakeypair TP-self-signed-661422464

crypto pki certificate chain TP-self-signed-661422464

certificate self-signed 01

3082023C 308201A5 A0030201 02020101 300D0609 2A864886 F70D0101 04050030

30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 36363134 32323436 34301E17 0D393330 33303130 30303130

315A170D 32303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F

532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3636 31343232

34363430 819F300D 06092A86 4886F70D 01010105 0003818D 00308189 02818100

D36BB700 D69149C7 3A90EF4B 3CFD4B27 1BC7990D 107F5E91 07743DED EDA8607A

0264F4CD 1B3D0C59 2C873BAA 31307B83 EE0B2E47 2D63D175 1C9B7AFB 470FCC60

DDD24F11 A5B23F2B A0FEB63A 46959C47 8328B23E 6A21EE3B D4211F0A 0C6BF28E

BCBF5613 101CB3B0 E3EDD552 CCB356B0 E88389C1 AF6F503C 07732BFF FE471A6B

02030100 01A36630 64300F06 03551D13 0101FF04 05300301 01FF3011 0603551D

11040A30 08820653 77697463 68301F06 03551D23 04183016 80144AB7 2EC34C23

DD69C33E 5EAE038F BCA9FAA0 5360301D 0603551D 0E041604 144AB72E C34C23DD

69C33E5E AE038FBC A9FAA053 60300D06 092A8648 86F70D01 01040500 03818100

5576EED9 9F157EBA 7CBD14B6 8ACF18CF 314E39A7 83AF69B1 4311808A 11390773

5EFDEA78 AADC3D28 440497B1 70366890 9639713D 7C06E7CB 1198F3C0 B8FAD80C

77641C99 173036A9 86F29966 1F33494F 08B33E78 71103631 30539AAD 6C0292D7

3F54EFF8 822778EB D030E7D1 E01D60F2 6CE474BC ADD43D58 5D5ADA82 01AC7FB9

quit

spanning-tree mode pvst

spanning-tree extend system-id

vlan internal allocation policy ascending

interface Loopback0

ip address 10.0.0.1 255.255.255.255

ip ospf 1 area 0

interface FastEthernet1/0/1

interface FastEthernet1/0/2

interface FastEthernet1/0/3

interface FastEthernet1/0/4

interface FastEthernet1/0/5

interface FastEthernet1/0/6

interface FastEthernet1/0/7

interface FastEthernet1/0/8

interface FastEthernet1/0/9

interface FastEthernet1/0/10

interface FastEthernet1/0/11

interface FastEthernet1/0/12

interface FastEthernet1/0/13

interface FastEthernet1/0/14

interface FastEthernet1/0/15

interface FastEthernet1/0/16

interface FastEthernet1/0/17

interface FastEthernet1/0/18

interface FastEthernet1/0/19

interface FastEthernet1/0/20

interface FastEthernet1/0/21

interface FastEthernet1/0/22

interface FastEthernet1/0/23

interface FastEthernet1/0/24

interface GigabitEthernet1/0/1

interface GigabitEthernet1/0/2

interface GigabitEthernet1/1/1

no switchport

ip address 10.0.1.1 255.255.255.252

ip ospf 1 area 0

speed auto 1000

mpls ip

interface GigabitEthernet1/1/2

no switchport

ip address 10.0.2.1 255.255.255.252

ip ospf 1 area 0

speed auto 1000

interface Vlan1

no ip address

shutdown

router ospf 1

router-id 1.1.1.1

network 10.0.0.1 0.0.0.0 area 0

network 10.0.1.0 0.0.0.3 area 0

network 10.0.2.0 0.0.0.3 area 0

ip http server

ip http secure-server

logging esm config

mpls static binding ipv4 10.0.0.2 255.255.255.255 output 10.0.1.2 implicit-null

mpls static binding ipv4 10.0.0.3 255.255.255.255 output 10.0.1.2 16

mpls static binding ipv4 10.0.1.8 255.255.255.252 output 10.0.1.2 implicit-null

mpls static binding ipv4 10.0.3.4 255.255.255.252 output 10.0.1.2 21

mpls static binding ipv4 192.168.2.2 255.255.255.255 output 10.0.1.2 23

mpls static binding ipv4 192.168.3.2 255.255.255.255 output 10.0.1.2 22

line con 0

line vty 0 4

login

line vty 5 15

login

end

***Switch 2 Config:***

hostname S2

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

ip routing

vtp mode transparent

mpls label range 200 8191 static 16 199

mpls label protocol tdp

crypto pki trustpoint TP-self-signed-666922496

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-666922496

revocation-check none

rsakeypair TP-self-signed-666922496

crypto pki certificate chain TP-self-signed-666922496

certificate self-signed 01

3082023C 308201A5 A0030201 02020101 300D0609 2A864886 F70D0101 04050030

30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 36363639 32323439 36301E17 0D393330 33303130 30303130

315A170D 32303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F

532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3636 36393232

34393630 819F300D 06092A86 4886F70D 01010105 0003818D 00308189 02818100

C527C9FE 5ED533D8 BA046768 EB5A04D5 1C74CB75 9B6DD512 1F7D63CB CDA9BD3B

EC43EC5A 8CBCF64C 77375F3B 07BB67D7 7D8F9B89 5841946B D9BED2C5 10EDB787

77847779 A400CD85 CF84FF59 122582BA 25635745 CD558BE8 AA9E0AFD B0AB4CBF

82874F04 387129E4 254CC909 9ABECEC8 D84D7F32 65EEEA9C A7B0F3D4 E2BAE383

02030100 01A36630 64300F06 03551D13 0101FF04 05300301 01FF3011 0603551D

11040A30 08820653 77697463 68301F06 03551D23 04183016 8014E6BF AA3DAB08

87125262 EBC5FC3E 671F8256 C338301D 0603551D 0E041604 14E6BFAA 3DAB0887

125262EB C5FC3E67 1F8256C3 38300D06 092A8648 86F70D01 01040500 03818100

7DAFF1B3 23D9B987 9D8E4982 7096ABB5 810292E5 CA1494AD D2E761B5 4EF947BC

9A3512A1 281074DC 9EB8BCC0 5CE85317 05CF6553 E93EFDAC BE64F3A8 E10D8020

43216718 BCFA9953 A23CCD0A 1084C35E 8CC98FBD 3FA923A8 0282354A 46B057E2

6A1B2248 7E3AD995 6DFBA57E E1C02E90 30CDBA54 863339F3 2245BBEB EF56E313

quit

spanning-tree mode pvst

spanning-tree extend system-id

vlan internal allocation policy ascending

interface Loopback0

ip address 10.0.0.2 255.255.255.255

ip ospf 1 area 0

interface FastEthernet1/0/1

interface FastEthernet1/0/2

interface FastEthernet1/0/3

interface FastEthernet1/0/4

interface FastEthernet1/0/5

interface FastEthernet1/0/6

interface FastEthernet1/0/7

interface FastEthernet1/0/8

interface FastEthernet1/0/9

interface FastEthernet1/0/10

interface FastEthernet1/0/11

interface FastEthernet1/0/12

interface FastEthernet1/0/13

interface FastEthernet1/0/14

interface FastEthernet1/0/15

interface FastEthernet1/0/16

interface FastEthernet1/0/17

interface FastEthernet1/0/18

interface FastEthernet1/0/19

interface FastEthernet1/0/20

interface FastEthernet1/0/21

interface FastEthernet1/0/22

interface FastEthernet1/0/23

interface FastEthernet1/0/24

interface GigabitEthernet1/0/1

interface GigabitEthernet1/0/2

interface GigabitEthernet1/1/1

no switchport

ip address 10.0.1.2 255.255.255.252

ip ospf 1 area 0

speed auto 1000

mpls ip

interface GigabitEthernet1/1/2

no switchport

ip address 10.0.1.9 255.255.255.252

ip ospf 1 area 0

speed auto 1000

mpls ip

interface Vlan1

no ip address

shutdown

router ospf 1

router-id 2.2.2.2

network 10.0.0.2 0.0.0.0 area 0

network 10.0.1.0 0.0.0.3 area 0

network 10.0.1.8 0.0.0.3 area 0

ip http server

ip http secure-server

ip sla enable reaction-alerts

logging esm config

mpls static binding ipv4 10.0.0.1 255.255.255.255 output 10.0.1.1 implicit-null

mpls static binding ipv4 10.0.0.3 255.255.255.255 output 10.0.1.10 implicit-null

mpls static binding ipv4 10.0.2.0 255.255.255.252 output 10.0.1.1 implicit-null

mpls static binding ipv4 192.168.2.1 255.255.255.255 output 10.0.1.1 20

mpls static binding ipv4 192.168.3.1 255.255.255.255 output 10.0.1.1 19

line con 0

line vty 0 4

login

line vty 5 15

login

end

***Switch 3 Config:***

hostname S3

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

ip routing

vtp domain CCNP

vtp mode transparent

mpls label range 200 8191 static 16 199

mpls label protocol tdp

spanning-tree mode pvst

spanning-tree extend system-id

vlan internal allocation policy ascending

interface Loopback0

ip address 10.0.0.3 255.255.255.255

ip ospf 1 area 0

interface FastEthernet1/0/1

interface FastEthernet1/0/2

interface FastEthernet1/0/3

interface FastEthernet1/0/4

interface FastEthernet1/0/5

interface FastEthernet1/0/6

interface FastEthernet1/0/7

interface FastEthernet1/0/8

interface FastEthernet1/0/9

interface FastEthernet1/0/10

interface FastEthernet1/0/11

interface FastEthernet1/0/12

interface FastEthernet1/0/13

interface FastEthernet1/0/14

interface FastEthernet1/0/15

interface FastEthernet1/0/16

interface FastEthernet1/0/17

interface FastEthernet1/0/18

interface FastEthernet1/0/19

interface FastEthernet1/0/20

interface FastEthernet1/0/21

interface FastEthernet1/0/22

interface FastEthernet1/0/23

interface FastEthernet1/0/24

interface GigabitEthernet1/0/1

interface GigabitEthernet1/0/2

interface GigabitEthernet1/1/1

no switchport

ip address 10.0.3.5 255.255.255.252

ip ospf 1 area 0

speed auto 1000

interface GigabitEthernet1/1/2

no switchport

ip address 10.0.1.10 255.255.255.252

ip ospf 1 area 0

speed auto 1000

mpls ip

interface Vlan1

no ip address

shutdown

router ospf 1

router-id 3.3.3.3

network 10.0.1.8 0.0.0.3 area 0

network 10.0.3.0 0.0.0.0 area 0

network 10.0.3.4 0.0.0.3 area 0

ip http server

ip http secure-server

logging esm config

line con 0

line vty 5 15

end

***Router 1 Config:***

hostname R-1A

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

subscriber templating

vtp domain cisco

vtp mode transparent

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21482HYV

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface Loopback0

ip address 192.168.2.1 255.255.255.255

ip ospf 1 area 0

interface Loopback1

ip address 192.168.3.1 255.255.255.255

ip ospf 1 area 0

interface GigabitEthernet0/0/0

ip address 10.0.2.2 255.255.255.252

ip ospf 1 area 0

negotiation auto

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

router ospf 1

redistribute connected subnets

network 10.0.2.0 0.0.0.3 area 0

network 192.168.2.1 0.0.0.0 area 0

network 192.168.3.1 0.0.0.0 area 0

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

***Router 2 Config:***

hostname R-2B

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO214913GF

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface Loopback0

ip address 192.168.3.2 255.255.255.255

ip ospf 1 area 0

interface Loopback1

ip address 192.168.2.2 255.255.255.255

ip ospf 1 area 0

interface GigabitEthernet0/0/0

ip address 10.0.3.6 255.255.255.252

ip ospf 1 area 0

negotiation auto

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

router ospf 1

network 10.0.3.4 0.0.0.3 area 0

network 192.168.2.2 0.0.0.0 area 0

network 192.168.3.2 0.0.0.0 area 0

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Problems

The main problem that we ran into was trying to assign IP address to interfaces on the layer 3 switch. Since we were originally unable to figure out the cause of the problem, we set up OSPF first and enabled IP routing. After that, we figured out that the interfaces needed to be switched from layer 2 to layer 3 with the command “no switchport.” The other problem we ran into was that the command “

mpls static binding ipv4 192.168.3.2 255.255.255.255 22” didn’t work since it was changing the input label. This was fixed by specifying that we were changing the output label.

Conclusion

Overall, MPLS is a very useful and versatile protocol. It is very simple to configure and allows for multiple different options in terms of configuration. To set up an MPLS network with default configurations, the only command that is required is “mpls ip” with a distribution protocol. In this lab, we explored different configurations of MPLS as well as its variety of uses.