Multi Protocol Label Switiching

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**Purpose:**

In this lab we were give 3 switches with ES ports and we had to use those 3 switches for an MPLS cloud to make a MPLS network, and by doing so we are now educated on how MPLS works and what it does and will be able to use it in a real life scenario when needed.

**Background:**

MPLS or multi-protocol label switching is a method used in networks to efficiently route and forward data packets. It uses the benefits of a traditional routing with the speed and simplicity of switching making it usable for large scale networks. Label switching operates by assigning labels to data packets as they enter the network, and these labels are used to determine the path of the packet across the network. Instead of looking at the packets network layer header at every hop the routers only look at the label and forward the packet based on the predetermined path and this is called label switched paths (LSPs). MPLS also enables network administrators to control the flow of traffic and make full use of the network’s resources, they do this by assigning different labels and paths to types of traffics like voice and video for example, and the administrator can prioritize and allocate bandwidth more effectively. And this is called traffic engineering and all it does to sum it up is allows for efficient utilization of network capacity and avoids congestion. And talking about avoiding congestion MPLS provides mechanisms for implementing Quality of Service policies in the network and basically QoS enables administrators to prioritize types of traffic ensuring that critical applications receive sufficient bandwidth, low latency and minimal packet loss. With MPLS based QoS you can help guarantee better end to end performance for real time applications like voice and video. MPLS supports the creation of VPN networks by enabling secure communication between geographically distributed sites. By establishing MPLS based VPNs organizations can connect their remote offices and branch location over a shared infrastructure while maintaining privacy and security. I mentioned in the beginning that MPLS is designed to handle large scale networks efficiently by using label switching, MPLS simplifies the forwarding process and reduces the burden on routes. This scalability allows service providers to build extensive networks with a high number of devices and paths without compromising performance. Overall MPLS offers improved performance and flexibility and control in managing complex networks making it a popular choice for service provides and enterprises

**New Commands:**

Ip-routing - manages static routes in the routing table

no switchport - puts the interface in L3 mode and makes it operate more like a router interface rather than a switch port

mpls ip - enables MPLS routing

show mpls forwarding-table – this command shows you all the labels that change on an already labeled packet

mpls lable protocol tdp – the use the Tag Distribution Protocol to communicate tag binding information to their peers

mpls label range 200 8191 static 16 199 – sets a range of what value your label tag can be

mpls static binding ipv4 192.168.3.2 255.255.255.255 output 10.0.1.2 22 – provides the means to configure the binding between a label and an IPv4 prefix statically

**Topology:**

![A picture containing text, diagram, screenshot, line

Description automatically generated]()

**Configs**

**Switch 1**

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

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**

hostname S2

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

ip routing

vtp domain BUSD

vtp mode transparent

mpls label protocol ldp

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

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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

line con 0

line vty 0 4

login

line vty 5 15

login

end

**Switch 3**

hostname S3

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

ip routing

vtp domain CCNP

vtp mode transparent

spanning-tree mode pvst

spanning-tree extend system-id

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 FastEthernet1/0/1

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**

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

vlan 2,10,20

vlan 996

name CUSTOMER\_NATIVE

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**

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

redistribute connected subnets

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:**

Did not know the commands

**Conclusion:**

Now I know how to set up MPLS with ES ports on a switch