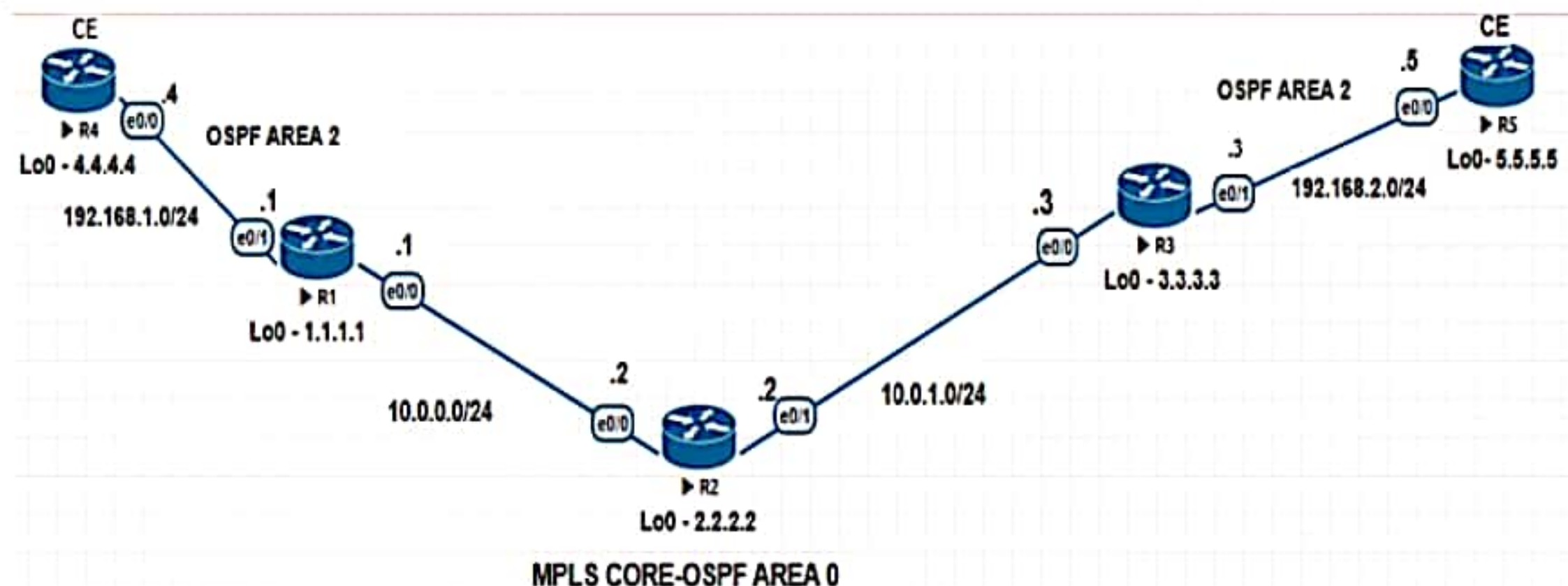


Practical 9

NETWORK TOPOLOGY



R1

Router>enable

Router#conf t

Router(config)#hostname R1

R1(config)# interface loopback 0

R1(config-if)#ip address 1.1.1.1 255.255.255.255

R1(config-if)#exit

R1(config)#int e0/0

R1(config-if)#ip address 10.0.0.1 255.255.255.0

R1(config-if)#no shut

R1(config)#int e0/1

R1(config-if)#ip address 192.168.1.1 255.255.255.0

R1(config-if)#no shut

R1(config)#router ospf 1

R1(config-router)#network 1.1.1.0 0.0.0.255 area 0

R1(config-router)#network 10.0.0.0 0.0.0.255 area 0 R1(config-router)#exit

R1(config)#mpls label range 100 199

R1(config)#mpls label protocol ldp

R1(config)#mpls ldp router-id loopback 0

R1(config)#int e0/0

R1(config-if)#mpls ip

R1(config)#ip vrf A-1

R1(config-vrf)#rd 500:1

R1(config-vrf)#route-target import 500:1

R1(config-vrf)#route-target export 500:1

R1(config-vrf)#exit

R1(config)#exit

R1#sh ip vrf Name Default RD Interfaces A-1 500:1 R1#sh ip vrf detail VRF A-1 (VRF Id = 1);


```

default RD 500:1;
default VPNID Old CLI format, supports IPv4 only Flags: 0xC No interfaces
Address family ipv4 unicast (Table ID = 0x1): Flags: 0x0 Export VPN route-
target communities RT:500:1 Import VPN route-target communities RT:500:1
No import route-map No global export route-map No export route-map VRF
label distribution protocol: not configured VRF label allocation mode: per-
prefix
R1(config)#int e0/1
R1(config-if)#ip vrf forwarding A-1 % Interface Ethernet0/1 IPv4 disabled and
address(es) removed due to enabling VRF A-1 R1(config-if)#ip address
192.168.1.1 255.255.255.0
R1(config-if)#end
R1#sh ip route vrf A-1
Routing Table: A-1 Codes: L - local, C - connected, S - static, R - RIP, M -
mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF
external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS
summary,
L1 - IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate default, U -
per-user static route o - ODR, P - periodic downloaded static route, H - NHRP,
I - LISP a - application route + - replicated route, % - next hop override
Gateway of last resort is not set
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, Ethernet0/1
L 192.168.1.1/32 is directly connected, Ethernet0/1
R1#sh ip vrf Name Default RD Interfaces A-1 500:1 Et0/1
R1(config)#router ospf 10 vrf A-1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 10
R1(config-router)#end
R1#sh ip ospf neighbor Neighbor ID Pri State Dead Time Address In
terface 2.2.2.2 1 FULL/DR 00:00:39 10.0.0.2 Ethernet0/0 4.4.4.4 1 FULL/DR
00:00:38 192.168.1.4 Ethernet0/1 R1#sh ip ospf 10 neighbor Neighbor ID Pri
State Dead Time Address Interface 4.4.4.4 1 FULL/DR 00:00:38 192.168.1.4
Ethernet0/1
R1#sh ip route vrf A-1 ospf
Routing Table: A-1 Codes: L - local, C - connected, S - static, R - RIP, M -
mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF
external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS
summary,

```


L1 - IS-IS level-1,
 L2 - IS-IS level-2 ia - IS-IS inter area,
 * - candidate default,
 U - per-user static route o – ODR
 , P - periodic downloaded static route, H - NHRP,
 I - LISP a - application route + - replicated route,
 % - next hop override Gateway of last resort is not set 4.0.0.0/32 is
 subnetted, 1 subnets O 4.4.4.4 [110/11] via 192.168.1.4, 00:03:58,
 Ethernet0/1 R1(config)#router bgp 500
 R1(config-router)#no bgp default ipv4-unicast
 R1(config-router)#neighbor 3.3.3.3 remote-as 500
 R1(config-router)#neighbor 3.3.3.3 update-source loopback 0
 R1(config-router)#address-family vpnv4 unicast
 R1(config-router-af)#neighbor 3.3.3.3 activate R1(config-router-af)#neighbor
 3.3.3.3 send-community extended R1(config-router-af)#neighbor 3.3.3.3
 next-hop-self R1(config-router-af)#end
 R1#sh ip bgp vpnv4 all summary
 BGP router identifier 1.1.1.1, local AS number 500 BGP table version is 1,
 main routing table version 1 Neighbor V AS MsgRcvd MsgSent TblVer InQ
 OutQ Up/Down State/PfxRcd 3.3.3.3 4 500 6 7 1 0 0 00:03:19 0
 R1(config)#router bgp 500
 R1(config-router)#address-family ipv4 vrf A-1
 R1(config-router-af)#redistribute ospf 10 vrf A-1 match internal external 1
 external 2
 R1(config-router-af)#exit R1(config-router)#exit
 R1(config)#router ospf 10 vrf A-1
 R1(config-router)#redistribute bgp 500 subnets
 R1(config-router)#end R1#sh ip bgp vpnv4 all BGP table version is 7, local
 router ID is 1.1.1.1 Status codes: s suppressed, d damped, h history, * valid, >
 best, i - internal, r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
 x best-external, a additional-path, c RIB-compressed, Origin codes: i - IGP, e -
 EGP, ? - incomplete RPKI validation codes: V valid, I invalid, N Not found
 Network Next Hop Metric LocPrf Weight Path Route Distinguisher:
 500:1 (default for vrf A-1)
 *> 4.4.4.4/32 192.168.1.4 11 32768 ?
 *>i 5.5.5.5/32 3.3.3.3 11 100 0 ?
 *> 192.168.1. 0 0.0.0.0 0 32768 ?
 *>i 192.168.2.0 3.3.3.3 0 100 0 ?
 R1#sh ip route vrf A-1

Routing Table: A-1 Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override Gateway of last resort is not set

4.0.0.0/32 is subnetted, 1 subnets O 4.4.4.4 [110/11] via 192.168.1.4, 07:36:09, Ethernet0/1 5.0.0.0/32 is subnetted, 1 subnets B 5.5.5.5 [200/11] via 3.3.3.3, 00:06:15 192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks C 192.168.1.0/24 is directly connected, Ethernet0/1 L 192.168.1.1/32 is directly connected, Ethernet0/1 B 192.168.2.0/24 [200/0] via 3.3.3.3, 00:06:15

R1#sh ip route vrf A-1 bgp

Routing Table: A-1 Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override Gateway of last resort is not set 5.0.0.0/32 is subnetted, 1 subnets B 5.5.5.5 [200/11] via 3.3.3.3, 00:07:31 B 192.168.2.0/24 [200/0] via 3.3.3.3, 00:07:31

R1#ping vrf A-1 4.4.4.4

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds: !!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/6 ms

R2

Router>enable

Router#conf t

Router(config)#hostname R2

R2(config)# interface loopback 0

R2(config-if)#ip address 2.2.2.2 255.255.255.255

R2(config-if)# exit

R2(config)#int e0/0

R2(config-if)#ip address 10.0.0.2 255.255.255.0

R2(config-if)#no shut

R2(config)#int e0/1


```

R2(config-if)#ip address 10.0.1.2 255.255.255.0
R2(config-if)#no shut
R2(config)#router ospf 1
R2(config-router)#network 2.2.2.0 0.0.0.255 area 0
R2(config-router)#network 10.0.0.0 0.0.0.255 area 0
R2(config-router)#network 10.0.1.0 0.0.0.255 area 0
R2(config-router)#exit
R2(config)#mpls label range 200 299 R2(config)#mpls label protocol ldp
R2(config)#mpls ldp router-id loopback 0
R2(config)#int e0/0 R2(config-if)#mpls ip
R2(config-if)#int e0/1
R2(config-if)#mpls ip
R3
Router>enable
Router#conf t
Router(config)#hostname
R3
R3(config)#interface loopback 0
R3(config-if)#ip address 3.3.3.3 255.255.255.255
R3(config-if)#exit
R3(config)#int e0/0
R3(config-if)#ip address 10.0.1.3 255.255.255.0
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#interface e0/1
R3(config-if)#ip address 192.168.2.3 255.255.255.0
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#router ospf 1
R3(config-router)#network 3.3.3.0 0.0.0.255 area 0
R3(config-router)#network 10.0.1.0 0.0.0.255 area 0
R3(config-router)#exit
R3(config)#mpls label range 300 399
R3(config)#mpls label protocol ldp
R3(config)#mpls ldp router-id loopback 0
R3(config)#int e0/0
R3(config-if)#mpls ip
R3(config)#ip vrf A-2
R3(config-vrf)#rd 500:1
R3(config-vrf)#route-target import 500:1

```



```

R3(config-vrf)#route-target export 500:1
R3#sh ip vrf Name Default RD Interfaces A-2 500:1
R3#sh ip vrf detail
VRF A-2 (VRF Id = 1);
default RD 500:1; default VPNID Old CLI format, supports IPv4 only Flags: 0xC
No interfaces Address family ipv4 unicast (Table ID = 0x1): Flags: 0x0 Export
VPN route-target communities RT:500:1 Import VPN route-target
communities RT:500:1 No import route-map No global export route-map No
export route-map VRF label distribution protocol: not configured VRF label
allocation mode: per-prefix R3(config)#int e0/1 R3(config-if)#ip vrf
forwarding A-2 % Interface Ethernet0/1 IPv4 disabled and address(es)
removed due to enabling VRF A-2 R3(config-if)#ip address 192.168.2.3
255.255.255.0
R3(config-if)#end
R3#sh ip route vrf A-2 Routing Table: A-2
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D -
EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA
external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2
- OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o -
ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application
route + - replicated route, % - next hop override
Gateway of last resort is not set
192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks C 192.168.2.0/24 is
directly connected,
Ethernet0/1 L 192.168.2.3/32 is directly connected,
Ethernet0/1
R3#sh ip vrf Name Default RD Interfaces A-2 500:1 Et0/1
R3(config)#router ospf 10 vrf A-2
R3(config-router)#network 192.168.2.0 0.0.0.255 area 0 R3(config-
router)#end R3#sh ip ospf 10 neighbor Neighbor ID Pri State Dead Time
Address Interface 5.5.5.5 1 FULL/DR 00:00:33 192.168.2.5 Ethernet0/1
R3#sh ip route vrf A-2 ospf
Routing Table: A-2
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D -
EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA
external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2
- OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o -

```


ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override

Gateway of last resort is not set

5.0.0.0/32 is subnetted, 1 subnets O 5.5.5.5 [110/11] via 192.168.2.5, 00:06:37,

Ethernet0/1

R3(config)#router bgp 500

R3(config-router)#no bgp default ipv4-unicast R3(config-router)#neighbor 1.1.1.1 remote-as 500

R3(config-router)#neighbor 1.1.1.1 update-source loopback 0 R3(config-router)#address-family vpnv4 unicast

R3(config-router-af)#neighbor 1.1.1.1 activate

R3(config-router-af)#neighbor 1.1.1.1 send-community extended

R3(config-router-af)#neighbor 1.1.1.1 next-hop-self

R3#sh ip bgp vpnv4 all

summary

BGP router identifier 3.3.3.3, local AS number 500 BGP table version is 1, main routing table version 1 Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd 1.1.1.1 4 500 7 6 1 0 0 00:03:01

R3(config)#router bgp 500

R3(config-router)#address-family ipv4 vrf A-2

R3(config-router-af)#redistribute ospf 10 vrf A-2 match internal external 1 external 2

R3(config-router-af)#exit R

R3(config-router)#exit

R3(config)#router ospf 10 vrf A-2

R3(config-router)#redistribute bgp 500 subnets

R3(config-router)#end

R3#sh ip bgp vpnv4 all

BGP table version is 7, local router ID is 3.3.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter, x best-external, a additional-path, c RIB-compressed, Origin codes: i - IGP, e - EGP, ? -

incomplete RPKI validation codes: V valid, I invalid, N Not found

Network Next Hop Metric LocPrf Weight Path Route Distinguisher:

500:1 (default for vrf A-2)

*>i 4.4.4.4/32 1.1.1.1 11 100 0 ?

*> 5.5.5.5/32 192.168.2.5 11 32768 ?

*>i 192.168.1.0 1.1.1.1 0 100 0 ?

*> 192.168.2.0 0.0.0.0 0 32768 ?

R3#sh ip route vrf A-2

Routing Table: A-2

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override

Gateway of last resort is not set

4.0.0.0/32 is subnetted, 1 subnets B 4.4.4.4 [200/11] via 1.1.1.1, 00:55:23

5.0.0.0/32 is subnetted, 1 subnets O 5.5.5.5 [110/11] via 192.168.2.5, 01:50:21,

Ethernet0/1 B 192.168.1.0/24 [200/0] via 1.1.1.1, 00:55:23 192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks C 192.168.2.0/24 is directly connected,

Ethernet0/1 L 192.168.2.3/32 is directly connected, Ethernet0/1 R3#ping vrf A-2 5.5.5.5 T

ype escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds: !!!!!

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

R4 Router>enable

Router#conf t

Router(config)#hostname R4

R4(config)#int loopback 0

R4(config-if)#ip address 4.4.4.4 255.255.255.255

R4(config-if)#exit

R4(config)#int e0/0

R4(config-if)#ip address 192.168.1.4 255.255.255.0

R4(config-if)#no shutdown

R4(config-if)#exit

R4(config)#router ospf 1

R4(config-router)#network 4.4.4.0 0.0.0.255 area 10

R4(config-router)#network 192.168.1.0 0.0.0.255 area 10

R4(config-router)#exit

R4#sh ip route ospf

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS

level-2 ia - IS-IS inter area, * - candidate default, U - per-user static route o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override

Gateway of last resort is not set

5.0.0.0/32 is subnetted, 1 subnets O IA 5.5.5.5 [110/21] via 192.168.1.1, 00:23:41,

Ethernet0/0 O IA 192.168.2.0/24 [110/11] via 192.168.1.1, 00:23:41,

Ethernet0/0 R4#ping 5.5.5.5 source lo 0

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:

Packet sent with a source address of 4.4.4.4 !!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms R5

Router>enable

Router#conf t

Router(config)#hostname R5

R5(config)#int loopback 0

R5(config-if)#ip address 5.5.5.5 255.255.255.255

R5(config-if)#exit

R5(config)#int e0/0

R5(config-if)#ip address 192.168.2.5 255.255.255.

R5(config-if)#no shutdown

R5(config-if)#exit

R5(config)#router ospf 1

R5(config-router)#network 5.5.5.0 0.0.0.255 area 0

R5(config-router)#network 192.168.2.0 0.0.0.255 area 0 R5(config-router)#exit

R5#sh ip route ospf Codes: L - local, C - connected, S - static, R - RIP, M -

mobile, B - BGP D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 E1 - OSPF

external type 1, E2 - OSPF external type 2 i - IS-IS, su - IS-IS

summary, L1 - IS-IS level-1, L2 - IS-IS level-2 ia - IS-IS inter area, * - candidate

default, U - per-user static route o - ODR, P - periodic downloaded static

route, H - NHRP, I - LISP a - application route + - replicated route, % - next hop override

Gateway of last resort is not set 4.0.0.0/32 is subnetted, 1 subnets O IA

4.4.4.4 [110/21] via 192.168.2.3, 00:23:51, Ethernet0/0 O IA 192.168.1.0/24

[110/11] via 192.168.2.3, 00:23:51, Ethernet0/0

R5#ping 4.4.4.4 source lo 0

Type escape sequence to abort. Sending 5, 100-byte ICMP Echos to 4.4.4.4,

timeout is 2 seconds: Packet sent with a source address of 5.5.5.5 !!!!!

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