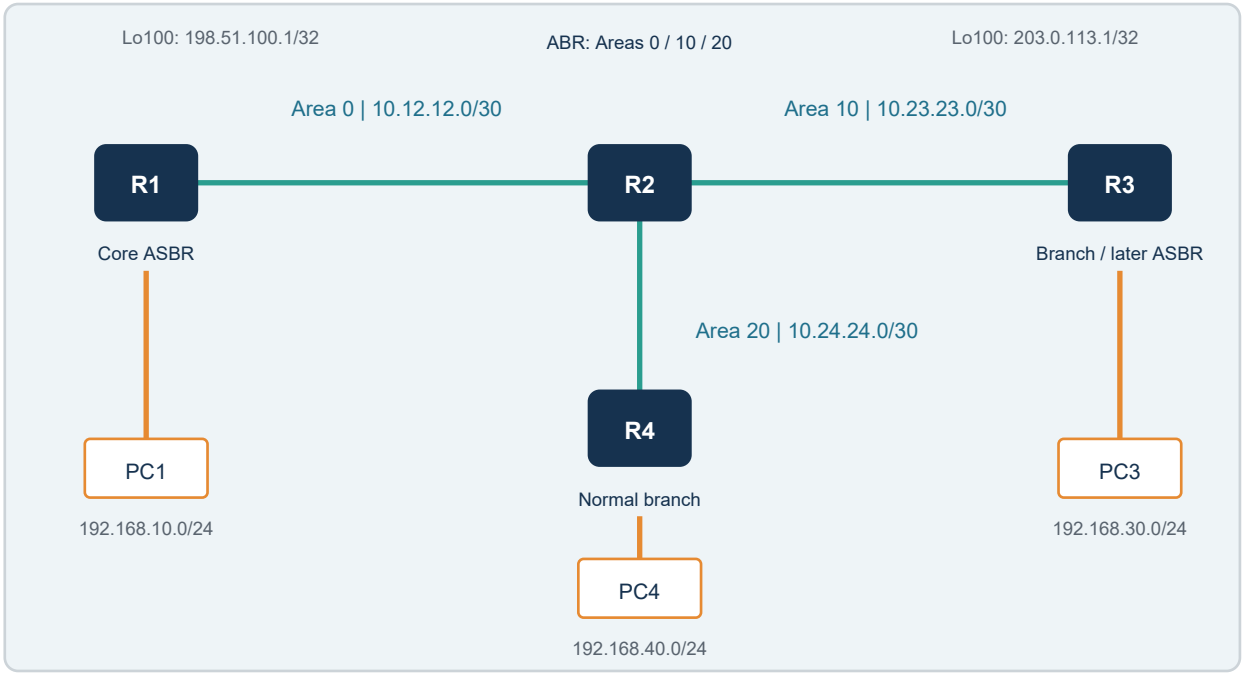
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Lab 04

Stub, Totally Stub & NSSA Area Behavior



Guided workbook | 4 IOL L3 routers + 3 VPCS

Compare four area states, observe Type 7 translation and prove external service forwarding.

Blueprint	Level	Estimated time	Platform
1.10.c(ii)-(iii); IPv4 / peers	Intermediate	180-210 minutes	EVE-NG / approved IOL L3

CLI annotations: GREEN - expected healthy result; YELLOW - warning or interpretation required; RED - fault or failed requirement. Colors are workbook annotations, not native CLI colors. Variable timers and ages may differ. Yellow/red items include a one-line reason.

1. Lab overview

Change one enterprise branch from a normal OSPF area to Stub, Totally Stub and NSSA. Prove which advertisements are retained or excluded and why a default route can preserve forwarding without a specific external route. Build an NSSA ASBR and observe Type7-to-Type5 translation. Guided IPv4 lab; intermediate level; estimated 180-210 minutes. Blueprint focus: 1.10.c(ii) area types and 1.10.c(iii) router types, supported by IPv4 and neighbor verification.

2. Observable objectives

Distinguish Type3, Type4, Type5 and Type7 evidence. Identify R2 as the ABR, R1 as the core ASBR and R3 as the later NSSA ASBR. Compare Stub and Totally Stub default behavior with ordinary NSSA. Prove the impact of a deliberate Area10 type mismatch while Area0/20 service remains healthy. Finish with ordinary NSSA, local external injection and an explicit NSSA Type7 default; verify every client direction and twelve remote Router-ID paths.

3. Production and interview value

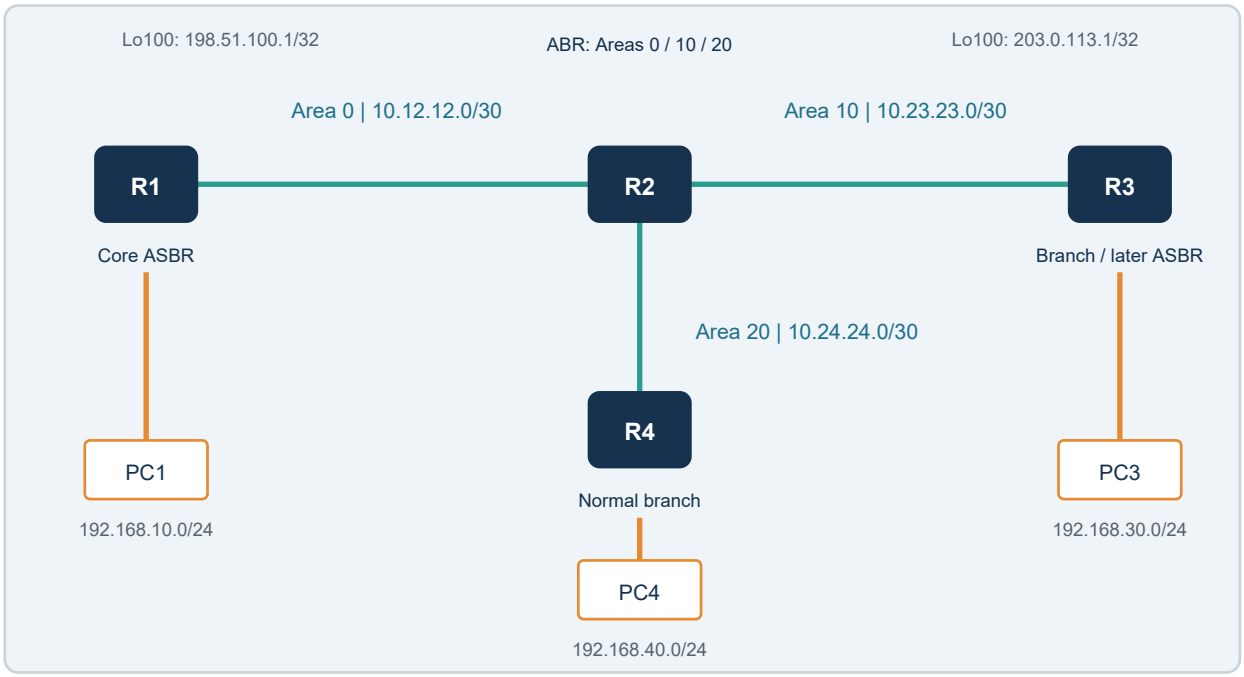
A branch has one ABR uplink. Initially it only consumes enterprise destinations; later it must publish a local service from outside interface-level OSPF. Area policies reduce advertisements, but they do not directly block packets. The other branch remains normal and is the service-preservation reference during change. Interview outcomes: explain why Stub cannot host this ASBR, why no-summary is configured at the ABR, why ordinary NSSA needs an explicit default in this design, and why translated advertisements have a different Advertising Router. This single-uplink topology teaches policy behavior, not redundant availability.

4. Required prior knowledge

Complete Labs01-03. Know point-to-point FULL adjacency, passive interfaces, O versus O IA, ABR/backbone roles, Type1/Type3 scope, /30 transits, /24 LANs, /32 loopbacks and ping source selection. Refresher: Router ID is identity, not proof of forwarding; a connected service is not advertised unless explicitly enabled or redistributed. An ASBR introduces routes from outside the OSPF interface topology. A route map matches the prefix list here; its implicit deny excludes other connected networks. Loopback100 creates an isolated, responding service address and is not an Internet destination.

5. Topology, roles and addressing

Four approved IOL L3 routers plus three VPCS. R1-R2 is Area0; R2-R3 is Area10; R2-R4 is normal Area20. R2 is the only ABR. Loopback0 belongs to the indicated router area. Explicit cost10 applies to transits/LANs and cost1 to Loopback0. R1 Loopback100 is 198.51.100.1/32; R3 Loopback100 is 203.0.113.1/32. Neither service loopback is enabled with ip ospf; both exist in the IP baseline, but only selected redistribution later advertises them.



Device role table

Device	Role	Loopback0 /32	Area
R1	Core ASBR	1.1.1.1	0
R2	ABR / Backbone	2.2.2.2	0
R3	Internal / later NSSA ASBR	3.3.3.3	10
R4	Internal / Branch	4.4.4.4	20

Node connection table

Endpoint A	Endpoint B	Area
R1 Ethernet0/0	R2 Ethernet0/0	0
R2 Ethernet0/1	R3 Ethernet0/0	10
R2 Ethernet0/2	R4 Ethernet0/0	20
R1 Ethernet0/1	PC1 eth0	0
R3 Ethernet0/1	PC3 eth0	10
R4 Ethernet0/1	PC4 eth0	20

Addressing table

Link / LAN	IPv4 network	Endpoints / gateway	Area
R1-R2	10.12.12.0/30	R1: .1 / R2: .2	0
R2-R3	10.23.23.0/30	R2: .1 / R3: .2	10

Link / LAN	IPv4 network	Endpoints / gateway	Area
R2-R4	10.24.24.0/30	R2: .1 / R4: .2	20
PC1 LAN	192.168.10.0/24	R1: .1 / PC1: .10	0
PC3 LAN	192.168.30.0/24	R3: .1 / PC3: .10	10
PC4 LAN	192.168.40.0/24	R4: .1 / PC4: .10	20
R1 Loopback100	198.51.100.1/32	Core external service	None
R3 Loopback100	203.0.113.1/32	Branch external service	None

Every PC uses local router .1 as gateway. Process10, Ethernet0/x transits, cost10 on transit/LAN and cost1 on Loopback0. Service loopbacks are excluded from interface-level OSPF.

Area10 evidence comparison

Stage	Remote Type3	Core Type5	Default on R3
Normal	Present	Present	Absent
Stub	Present	Absent	Type3 / O*IA
Totally Stub	Default only	Absent	Type3 / O*IA
Ordinary NSSA initial	Present	Absent	Absent
Final NSSA	Present	Absent	Type7 / O*N2

6. Choose a starting state

raw: begin section8 and build the entire exercise. save-ip-configuration: names, interfaces, both service loopbacks and PC gateways exist; allow60 seconds after starting the saved nodes for startup commands to finish before entering CLI commands. Begin section9, then build OSPF. save-config: all final NSSA configuration is complete; boot seven nodes, allow60 seconds for saved startup execution and at least60 seconds after router startup for OSPF convergence, then execute section17 plus the final NSSA verification in section16. Do not replay Stub transitions in the completed variant unless intentionally repeating the guided exercise. Three files share identical topology. For repeated identical probes, output boxes display the last recorded result.

Item	raw	save-ip-configuration	save-config
Topology	Identical	Identical	Identical
Names / IPs	Absent	Present	Present
OSPF exercise	Absent	Absent	Complete / healthy
Learner action	Build all	Build OSPF	Verify / ping

7.1 Deep dive: advertisement policy versus forwarding

Type1 describes router links within an area; point-to-point transits avoid a DR-created Type2 network LSA. Type3 carries inter-area destination information, and Type4 describes reachability to an ASBR outside the receiving area. Type5 advertises an external destination across normal areas. A Stub area rejects Type5 and Type4, retains ordinary Type3 destinations and receives an ABR-originated Type3 default. A Totally Stub area adds no-summary at its ABR, leaving the summary default while suppressing ordinary inter-area summaries. Internal area routes remain. The absence of a specific remote prefix does not prove traffic is blocked: longest-prefix lookup can select the default. This lab proves that distinction with the core service ping.

7.2 Deep dive: NSSA and local external services

NSSA excludes incoming Type5 advertisements while allowing a local ASBR to originate Type7 external advertisements. R3 creates a Type7 for its selected service; R2 translates eligible Type7 information into Type5 for the normal OSPF domain. Inspect the translation option/P-bit, Link State ID, Advertising Router and forwarding address. The forwarding address must itself be reachable through the OSPF topology; inspect its actual value rather than assuming it equals Router ID. Outside the NSSA the translated service is E2; inside, external routes learned from a different NSSA originator can appear N2. R3 owns its service as connected, so it need not install its own service as N2.

7.3 Deep dive: defaults and safe area changes

Ordinary NSSA does not automatically supply the Stub-style default in this lab. R3 can reach internal enterprise LANs through Type3 routes, yet initially cannot reach the core external service because incoming Type5 is excluded and no default exists. At R2, area10 nssa default-information-originate supplies a Type7 default; R3 can then forward that external traffic to the ABR. This area command differs from process-level default-information originate for normal areas. ABR origination here does not require an installed default on R2, so advertising it is a deliberate reachability promise. All routers in the area must agree on Stub/NSSA capability. Changing only one endpoint intentionally interrupts its adjacency; keep the change scoped to Area10, prove Area0/20 service, then change the second endpoint and revalidate. Area0 cannot be a Stub area, and Stub/NSSA is unsuitable as a virtual-link transit. The Stub summary default in this topology has metric11: transit cost10 plus advertised summary metric1. The final N2 default has external metric1; Type2 does not add the internal transit cost to that displayed external metric. Compare actual route fields before interpreting those values as path quality. Final saved state is ordinary NSSA, not Totally Stub or Totally NSSA.

8.1 Configure R1 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

R1

```
enable
conf t
hostname R1
no ip domain lookup
interface Loopback0
description ROUTER_ID
ip address 1.1.1.1 255.255.255.255
interface Ethernet0/0
description TO_R2_AREA0
ip address 10.12.12.1 255.255.255.252
no shutdown
interface Ethernet0/1
description USER_LAN_AREA0
ip address 192.168.10.1 255.255.255.0
no shutdown
interface Loopback100
description EXTERNAL_SERVICE_NOT_OSPF_ENABLED
ip address 198.51.100.1 255.255.255.255
end

end
```

8.2 Configure R2 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

R2

```
enable
conf t
hostname R2
no ip domain lookup
interface Loopback0
description ROUTER_ID
ip address 2.2.2.2 255.255.255.255
interface Ethernet0/0
description TO_R1_AREA0
ip address 10.12.12.2 255.255.255.252
no shutdown
interface Ethernet0/1
description TO_R3_AREA10
ip address 10.23.23.1 255.255.255.252
no shutdown
interface Ethernet0/2
description TO_R4_AREA20
ip address 10.24.24.1 255.255.255.252
no shutdown
end

end
```

8.3 Configure R3 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

R3

```
enable
conf t
hostname R3
no ip domain lookup
interface Loopback0
description ROUTER_ID
ip address 3.3.3.3 255.255.255.255
interface Ethernet0/0
description TO_R2_AREA10
ip address 10.23.23.2 255.255.255.252
no shutdown
interface Ethernet0/1
description USER_LAN_AREA10
ip address 192.168.30.1 255.255.255.0
no shutdown
interface Loopback100
description EXTERNAL_SERVICE_NOT_OSPF_ENABLED
ip address 203.0.113.1 255.255.255.255
end

end
```

8.4 Configure R4 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

R4

```
enable
conf t
hostname R4
no ip domain lookup
interface Loopback0
description ROUTER_ID
ip address 4.4.4.4 255.255.255.255
interface Ethernet0/0
description TO_R2_AREA20
ip address 10.24.24.2 255.255.255.252
no shutdown
interface Ethernet0/1
description USER_LAN_AREA20
ip address 192.168.40.1 255.255.255.0
no shutdown
end

end
```

8.5 Configure PC1 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

PC1

```
set pcname PC1
ip 192.168.10.10 192.168.10.1 24
save
```

8.6 Configure PC3 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

PC3

```
set pcname PC3
ip 192.168.30.10 192.168.30.1 24
save
```

8.7 Configure PC4 baseline

Apply the device name and local addressing from the tables. No OSPF process or solution exists yet. PC names are explicitly stored so prompts match the workbook.

PC4

```
set pcname PC4
ip 192.168.40.10 192.168.40.1 24
save
```

9.1 Verify R1 local reachability

Require all used interfaces up/up, no OSPF process and five replies on each repeated directly connected probe.

R1

```
enable
terminal length 0
show ip interface brief
show running-config | section router ospf
ping 10.12.12.2
ping 10.12.12.2
```

Actual CLI output - R1

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Ethernet0/0            10.12.12.1      YES manual up                    up
Ethernet0/1            192.168.10.1    YES manual up                    up
Ethernet0/2            unassigned      YES unset  administratively down down
Ethernet0/3            unassigned      YES unset  administratively down down
Loopback0              1.1.1.1         YES manual up                    up
Loopback100            198.51.100.1    YES manual up                    up
```

Actual CLI output - R1

```
R1# show running-config | section router ospf
```

Actual CLI output - R1

```
R1# ping 10.12.12.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.12.12.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

9.2 Verify R2 local reachability

Require all used interfaces up/up, no OSPF process and five replies on each repeated directly connected probe.

R2

```
enable
terminal length 0
show ip interface brief
show running-config | section router ospf
ping 10.12.12.1
ping 10.12.12.1
ping 10.23.23.2
ping 10.23.23.2
ping 10.24.24.2
ping 10.24.24.2
```

Actual CLI output - R2

```
R2# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Ethernet0/0            10.12.12.2      YES manual up                    up
Ethernet0/1            10.23.23.1      YES manual up                    up
Ethernet0/2            10.24.24.1      YES manual up                    up
Ethernet0/3            unassigned      YES unset  administratively down down
Loopback0              2.2.2.2         YES manual up                    up
```

Actual CLI output - R2

```
R2# show running-config | section router ospf
```

Actual CLI output - R2

```
R2# ping 10.12.12.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.12.12.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 10.23.23.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.23.23.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 10.24.24.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.24.24.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

9.3 Verify R3 local reachability

Require all used interfaces up/up, no OSPF process and five replies on each repeated directly connected probe.

R3

```
enable
terminal length 0
show ip interface brief
show running-config | section router ospf
ping 10.23.23.1
ping 10.23.23.1
```

Actual CLI output - R3

```
R3# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Ethernet0/0            10.23.23.2      YES manual up                    up
Ethernet0/1            192.168.30.1    YES manual up                    up
Ethernet0/2            unassigned      YES unset  administratively down down
Ethernet0/3            unassigned      YES unset  administratively down down
Loopback0              3.3.3.3         YES manual up                    up
Loopback100            203.0.113.1     YES manual up                    up
```

Actual CLI output - R3

```
R3# show running-config | section router ospf
```

Actual CLI output - R3

```
R3# ping 10.23.23.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.23.23.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

9.4 Verify R4 local reachability

Require all used interfaces up/up, no OSPF process and five replies on each repeated directly connected probe.

R4

```
enable
terminal length 0
show ip interface brief
show running-config | section router ospf
ping 10.24.24.1
ping 10.24.24.1
```

Actual CLI output - R4

```
R4# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Ethernet0/0            10.24.24.2      YES manual up                    up
Ethernet0/1            192.168.40.1    YES manual up                    up
Ethernet0/2            unassigned      YES unset  administratively down down
Ethernet0/3            unassigned      YES unset  administratively down down
Loopback0              4.4.4.4         YES manual up                    up
```

Actual CLI output - R4

```
R4# show running-config | section router ospf
```

Actual CLI output - R4

```
R4# ping 10.24.24.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.24.24.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

9.5 Verify PC1

Compare NAME, IP/MASK and gateway. Require the repeated local-gateway probe to return five replies.

PC1

```
show ip
ping 192.168.10.1
ping 192.168.10.1
```

Actual CLI output - PC1

```
PC1> show ip
NAME        : PC1[1]
IP/MASK     : 192.168.10.10/24
GATEWAY     : 192.168.10.1
MAC         : 00:50:79:66:68:05
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC1

```
PC1> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=0.530 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=0.580 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=0.551 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=0.570 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=0.617 ms
```

9.6 Verify PC3

Compare NAME, IP/MASK and gateway. Require the repeated local-gateway probe to return five replies.

PC3

```
show ip
ping 192.168.30.1
ping 192.168.30.1
```

Actual CLI output - PC3

```
PC3> show ip
NAME        : PC3[1]
IP/MASK     : 192.168.30.10/24
GATEWAY     : 192.168.30.1
MAC         : 00:50:79:66:68:06
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC3

```
PC3> ping 192.168.30.1
84 bytes from 192.168.30.1 icmp_seq=1 ttl=255 time=0.651 ms
84 bytes from 192.168.30.1 icmp_seq=2 ttl=255 time=0.765 ms
84 bytes from 192.168.30.1 icmp_seq=3 ttl=255 time=0.530 ms
84 bytes from 192.168.30.1 icmp_seq=4 ttl=255 time=0.473 ms
84 bytes from 192.168.30.1 icmp_seq=5 ttl=255 time=0.630 ms
```

9.7 Verify PC4

Compare NAME, IP/MASK and gateway. Require the repeated local-gateway probe to return five replies.

PC4

```
show ip
ping 192.168.40.1
ping 192.168.40.1
```

Actual CLI output - PC4

```
PC4> show ip
NAME        : PC4[1]
IP/MASK     : 192.168.40.10/24
GATEWAY     : 192.168.40.1
MAC         : 00:50:79:66:68:07
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC4

```
PC4> ping 192.168.40.1
84 bytes from 192.168.40.1 icmp_seq=1 ttl=255 time=0.473 ms
84 bytes from 192.168.40.1 icmp_seq=2 ttl=255 time=0.788 ms
84 bytes from 192.168.40.1 icmp_seq=3 ttl=255 time=0.406 ms
84 bytes from 192.168.40.1 icmp_seq=4 ttl=255 time=0.498 ms
84 bytes from 192.168.40.1 icmp_seq=5 ttl=255 time=0.512 ms
```

10.1 Build normal OSPF on R2

Start with all three areas normal so the same prefix can be compared before and after area policy. Approve router transits only, keep user interfaces passive, and exclude Loopback100.

R2

```
enable
conf t
router ospf 10
router-id 2.2.2.2
passive-interface default
no passive-interface Ethernet0/0
no passive-interface Ethernet0/1
no passive-interface Ethernet0/2
exit
interface Loopback0
ip ospf cost 1
ip ospf 10 area 0
interface Ethernet0/0
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 0
interface Ethernet0/1
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 10
interface Ethernet0/2
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 20
end

end
```

10.2 Build normal OSPF on R1

Start with all three areas normal so the same prefix can be compared before and after area policy. Approve router transits only, keep user interfaces passive, and exclude Loopback100.

R1

```
enable
conf t
router ospf 10
router-id 1.1.1.1
passive-interface default
no passive-interface Ethernet0/0
exit
interface Loopback0
ip ospf cost 1
ip ospf 10 area 0
interface Ethernet0/0
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 0
interface Ethernet0/1
ip ospf cost 10
ip ospf 10 area 0
end

end
```

10.3 Build normal OSPF on R4

Start with all three areas normal so the same prefix can be compared before and after area policy. Approve router transits only, keep user interfaces passive, and exclude Loopback100.

R4

```
enable
conf t
router ospf 10
router-id 4.4.4.4
passive-interface default
no passive-interface Ethernet0/0
exit
interface Loopback0
ip ospf cost 1
ip ospf 10 area 20
interface Ethernet0/0
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 20
interface Ethernet0/1
ip ospf cost 10
ip ospf 10 area 20
end

end
```

10.4 Build normal OSPF on R3

Start with all three areas normal so the same prefix can be compared before and after area policy. Approve router transits only, keep user interfaces passive, and exclude Loopback100.

R3

```
enable
conf t
router ospf 10
router-id 3.3.3.3
passive-interface default
no passive-interface Ethernet0/0
exit
interface Loopback0
ip ospf cost 1
ip ospf 10 area 10
interface Ethernet0/0
ip ospf network point-to-point
ip ospf cost 10
ip ospf 10 area 10
interface Ethernet0/1
ip ospf cost 10
ip ospf 10 area 10
end

end
```

Wait at least 60 seconds, then verify the required state.

10.5 Introduce the core external service

Redistribute only the explicitly permitted /32 connected service. The prefix list and route map prevent accidental redistribution of transit, user LAN or Router-ID interfaces. Loopback100 is a real responding endpoint and is deliberately excluded from interface-level OSPF.

R1

```
enable
conf t
ip prefix-list SERVICE_ONLY seq 5 permit 198.51.100.1/32
route-map SERVICE_ONLY permit 10
match ip address prefix-list SERVICE_ONLY
exit
router ospf 10
redistribute connected subnets metric 20 metric-type 2 route-map SERVICE_ONLY
end
```

Wait at least 15 seconds, then verify the required state.

10.6 Allow external propagation

Wait for route installation before comparing external LSA and forwarding.

R1

```
enable
terminal length 0
show ip ospf
```

Wait at least 10 seconds, then verify the required state.

11.1 Prove normal Area10 behavior

Read the route code, selected prefix, default next hop and LSA scope together. Check whether inter-area advertisements, core externals and a default exist; then compare forwarding to the actual service endpoint. Empty LSA output is meaningful only for the stated area/stage.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf database summary
show ip ospf database asbr-summary
show ip ospf database external 198.51.100.1
show ip route ospf
show ip route 192.168.40.0
show ip route 198.51.100.1
show ip route 0.0.0.0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:30    10.23.23.1      Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip ospf database summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Summary Net Link States (Area 10)
  LS age: 91
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 1.1.1.1 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 93
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 2.2.2.2 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 1
  LS age: 89
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 4.4.4.4 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 93
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.12.12.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 93
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.24.24.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 91
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.10.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
  LS age: 89
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.40.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
```

Actual CLI output - R3

```
R3# show ip ospf database asbr-summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Summary ASB Link States (Area 10)
  LS age: 26
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(AS Boundary Router)
  Link State ID: 1.1.1.1 (AS Boundary Router address)
  Advertising Router: 2.2.2.2
  Network Mask: /0
MTID: 0  Metric: 10
```

Actual CLI output - R3

```
R3# show ip ospf database external 198.51.100.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Type-5 AS External Link States
  LS age: 27
  Options: (No TOS-capability, DC, Upward)
  LS Type: AS External Link
  Link State ID: 198.51.100.1 (External Network Number )
  Advertising Router: 1.1.1.1
  Network Mask: /32
Metric Type: 2 (Larger than any link state path)
MTID: 0
Metric: 20
Forward Address: 0.0.0.0
External Route Tag: 0
```

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is not set
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.23.23.1, 00:01:28, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.23.23.1, 00:01:28, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.23.23.1, 00:01:28, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.23.23.1, 00:01:28, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.23.23.1, 00:01:28, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.23.23.1, 00:01:28, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.23.23.1, 00:01:28, Ethernet0/0
      198.51.100.0/32 is subnetted, 1 subnets
O E2     198.51.100.1 [110/20] via 10.23.23.1, 00:00:26, Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip route 192.168.40.0
Routing entry for 192.168.40.0/24
  Known via "ospf 10", distance 110, metric 30, type inter area
  Last update from 10.23.23.1 on Ethernet0/0, 00:01:28 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 2.2.2.2, 00:01:28 ago, via Ethernet0/0
      Route metric is 30, traffic share count is 1
```

Actual CLI output - R3

```
R3# show ip route 198.51.100.1
Routing entry for 198.51.100.1/32
  Known via "ospf 10", distance 110, metric 20, type extern 2, forward metric 20
  Last update from 10.23.23.1 on Ethernet0/0, 00:00:26 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 1.1.1.1, 00:00:26 ago, via Ethernet0/0
      Route metric is 20, traffic share count is 1
```

Actual CLI output - R3

```
R3# show ip route 0.0.0.0
% Network not in table
```

WARNING - No normal-area default was configured; the specific E2 service route supplies reachability.

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
```

12.1 Make R2 Area10 Stub

All Area10 routers must advertise compatible Stub capability. Configure both endpoints; temporary interruption during the change is expected. No external redistribution is active on R3 yet. R1/R4 remain in normal areas.

R2

```
enable
conf t
router ospf 10
area 10 stub
end
```

12.2 Make R3 Area10 Stub

All Area10 routers must advertise compatible Stub capability. Configure both endpoints; temporary interruption during the change is expected. No external redistribution is active on R3 yet. R1/R4 remain in normal areas.

R3

```
enable
conf t
router ospf 10
area 10 stub
end
```

Wait at least 60 seconds, then verify the required state.

12.3 Prove Stub summaries and default

Read the route code, selected prefix, default next hop and LSA scope together. Check whether inter-area advertisements, core externals and a default exist; then compare forwarding to the actual service endpoint. Empty LSA output is meaningful only for the stated area/stage.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf database summary
show ip ospf database asbr-summary
show ip ospf database external 198.51.100.1
show ip route ospf
show ip route 192.168.40.0
show ip route 198.51.100.1
show ip route 0.0.0.0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:35    10.23.23.1      Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip ospf database summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Summary Net Link States (Area 10)
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 0.0.0.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /0
MTID: 0  Metric: 1
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 1.1.1.1 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 2.2.2.2 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 1
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 4.4.4.4 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.12.12.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.24.24.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.10.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
  LS age: 61
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.40.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
```

Actual CLI output - R3

```
R3# show ip ospf database asbr-summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip ospf database external 198.51.100.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is 10.23.23.1 to network 0.0.0.0
O*IA  0.0.0.0/0 [110/11] via 10.23.23.1, 00:00:55, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.23.23.1, 00:00:55, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.23.23.1, 00:00:55, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.23.23.1, 00:00:55, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.23.23.1, 00:00:55, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.23.23.1, 00:00:55, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.23.23.1, 00:00:55, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.23.23.1, 00:00:55, Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip route 192.168.40.0
Routing entry for 192.168.40.0/24
  Known via "ospf 10", distance 110, metric 30, type inter area
  Last update from 10.23.23.1 on Ethernet0/0, 00:00:55 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 2.2.2.2, 00:00:55 ago, via Ethernet0/0
      Route metric is 30, traffic share count is 1
```

Actual CLI output - R3

```
R3# show ip route 198.51.100.1
% Network not in table
```

WARNING - This specific route is absent under the stated area policy; inspect the default before judging forwarding.

Actual CLI output - R3

```
R3# show ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "ospf 10", distance 110, metric 11, candidate default path, type inter area
  Last update from 10.23.23.1 on Ethernet0/0, 00:00:55 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 2.2.2.2, 00:00:55 ago, via Ethernet0/0
      Route metric is 11, traffic share count is 1
```

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

13.1 Add no-summary at the ABR

Apply no-summary only at R2. R3 stays plain Stub; the ABR suppresses non-default inter-area summaries into Area10, not internal Area10 routes.

R2

```
enable
conf t
router ospf 10
area 10 stub no-summary
end
```

Wait at least 20 seconds, then verify the required state.

13.2 Prove Totally Stub forwarding

Read the route code, selected prefix, default next hop and LSA scope together. Check whether inter-area advertisements, core externals and a default exist; then compare forwarding to the actual service endpoint. Empty LSA output is meaningful only for the stated area/stage.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf database summary
show ip ospf database asbr-summary
show ip ospf database external 198.51.100.1
show ip route ospf
show ip route 192.168.40.0
show ip route 198.51.100.1
show ip route 0.0.0.0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:32    10.23.23.1      Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip ospf database summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Summary Net Link States (Area 10)
  LS age: 21
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 0.0.0.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /0
MTID: 0  Metric: 1
```

Actual CLI output - R3

```
R3# show ip ospf database asbr-summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip ospf database external 198.51.100.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is 10.23.23.1 to network 0.0.0.0
O*IA  0.0.0.0/0 [110/11] via 10.23.23.1, 00:01:17, Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip route 192.168.40.0
% Network not in table
```

WARNING - This specific route is absent under the stated area policy; inspect the default before judging forwarding.

Actual CLI output - R3

```
R3# show ip route 198.51.100.1
% Network not in table
```

WARNING - This specific route is absent under the stated area policy; inspect the default before judging forwarding.

Actual CLI output - R3

```
R3# show ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "ospf 10", distance 110, metric 11, candidate default path, type inter area
  Last update from 10.23.23.1 on Ethernet0/0, 00:01:17 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 2.2.2.2, 00:01:17 ago, via Ethernet0/0
      Route metric is 11, traffic share count is 1
```

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
```

14.1 Begin a scoped NSSA transition

Deliberately change only R2 from Stub to NSSA first. Area10 capability mismatch must remove R2-R3 adjacency and Branch3 routes. This is a controlled maintenance observation. Area0/20 adjacencies and PC1-PC4 service must survive.

R2

```
enable
conf t
router ospf 10
no area 10 stub
area 10 nssa
end
```

Wait at least 60 seconds, then verify the required state.

14.2 Verify surviving core and branch routes

R2 must retain R1/R4 FULL neighbors while the Branch3 LAN is withdrawn. Any loss of surviving service fails the change-scope requirement.

R2

```
enable
terminal length 0
show ip ospf neighbor
show ip route 192.168.30.0
show ip route 192.168.40.0
```

Actual CLI output - R2

```
R2# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           0   FULL/  -        00:00:30    10.12.12.1      Ethernet0/0
3.3.3.3           0   DOWN/  -           -        10.23.23.2      Ethernet0/1
4.4.4.4           0   FULL/  -        00:00:33    10.24.24.2      Ethernet0/2
```

ERROR - This Area10 neighbor is DOWN because Stub and NSSA capabilities disagree.

Actual CLI output - R2

```
R2# show ip route 192.168.30.0
% Network not in table
```

ERROR - Area10 endpoints deliberately disagree on area type; branch remote service is interrupted.

Actual CLI output - R2

```
R2# show ip route 192.168.40.0
Routing entry for 192.168.40.0/24
  Known via "ospf 10", distance 110, metric 20, type intra area
  Last update from 10.24.24.2 on Ethernet0/2, 00:01:00 ago
  Routing Descriptor Blocks:
  * 10.24.24.2, from 4.4.4.4, 00:01:00 ago, via Ethernet0/2
      Route metric is 20, traffic share count is 1
```

14.3 Verify isolated branch

No FULL neighbor is expected while area types differ. PC3 must retain its local gateway; remote service is temporarily unavailable.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip route ospf
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
```

ERROR - Stub and NSSA capabilities do not match, so no branch FULL neighbor can form.

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is not set
```

14.4 Prove PC1 impact boundary

PC1/PC4 remote probes must succeed in both directions. PC3 local gateway must succeed but its remote ping must fail during the isolated change.

PC1

```
ping 192.168.10.1
ping 192.168.10.1
ping 192.168.40.10
ping 192.168.40.10
```

Actual CLI output - PC1

```
PC1> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=0.447 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=0.608 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=0.823 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=0.577 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=0.508 ms
```

Actual CLI output - PC1

```
PC1> ping 192.168.40.10
84 bytes from 192.168.40.10 icmp_seq=1 ttl=61 time=2.203 ms
84 bytes from 192.168.40.10 icmp_seq=2 ttl=61 time=2.853 ms
84 bytes from 192.168.40.10 icmp_seq=3 ttl=61 time=1.635 ms
84 bytes from 192.168.40.10 icmp_seq=4 ttl=61 time=1.550 ms
84 bytes from 192.168.40.10 icmp_seq=5 ttl=61 time=1.873 ms
```

14.5 Prove PC4 impact boundary

PC1/PC4 remote probes must succeed in both directions. PC3 local gateway must succeed but its remote ping must fail during the isolated change.

PC4

```
ping 192.168.40.1
ping 192.168.40.1
ping 192.168.10.10
ping 192.168.10.10
```

Actual CLI output - PC4

```
PC4> ping 192.168.40.1
84 bytes from 192.168.40.1 icmp_seq=1 ttl=255 time=0.690 ms
84 bytes from 192.168.40.1 icmp_seq=2 ttl=255 time=0.979 ms
84 bytes from 192.168.40.1 icmp_seq=3 ttl=255 time=0.900 ms
84 bytes from 192.168.40.1 icmp_seq=4 ttl=255 time=0.499 ms
84 bytes from 192.168.40.1 icmp_seq=5 ttl=255 time=0.545 ms
```

Actual CLI output - PC4

```
PC4> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=61 time=2.509 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=61 time=1.144 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=61 time=1.607 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=61 time=1.576 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=61 time=1.620 ms
```

14.6 Prove PC3 impact boundary

PC1/PC4 remote probes must succeed in both directions. PC3 local gateway must succeed but its remote ping must fail during the isolated change.

PC3

```
ping 192.168.30.1
ping 192.168.30.1
ping 192.168.10.10
ping 192.168.10.10
```

Actual CLI output - PC3

```
PC3> ping 192.168.30.1
84 bytes from 192.168.30.1 icmp_seq=1 ttl=255 time=1.287 ms
84 bytes from 192.168.30.1 icmp_seq=2 ttl=255 time=0.555 ms
84 bytes from 192.168.30.1 icmp_seq=3 ttl=255 time=1.242 ms
84 bytes from 192.168.30.1 icmp_seq=4 ttl=255 time=0.650 ms
84 bytes from 192.168.30.1 icmp_seq=5 ttl=255 time=1.051 ms
```

Actual CLI output - PC3

```
PC3> ping 192.168.10.10
*192.168.30.1 icmp_seq=1 ttl=255 time=0.508 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.30.1 icmp_seq=2 ttl=255 time=0.985 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.30.1 icmp_seq=3 ttl=255 time=0.501 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.30.1 icmp_seq=4 ttl=255 time=0.568 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.30.1 icmp_seq=5 ttl=255 time=0.541 ms (ICMP type:3, code:1, Destination host unreachable)
```

ERROR - Area10 endpoints deliberately disagree on area type; branch remote service is interrupted.

15.1 Complete the NSSA transition

Change R3 to match R2. Preserve addresses, costs and passive policy; wait for adjacency and internal routes. Ordinary NSSA now needs a deliberate external reachability policy.

R3

```
enable
conf t
router ospf 10
no area 10 stub
area 10 nssa
end
```

Wait at least 60 seconds, then verify the required state.

15.2 Prove ordinary NSSA without a default

Read the route code, selected prefix, default next hop and LSA scope together. Check whether inter-area advertisements, core externals and a default exist; then compare forwarding to the actual service endpoint. Empty LSA output is meaningful only for the stated area/stage.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf database summary
show ip ospf database asbr-summary
show ip ospf database external 198.51.100.1
show ip route ospf
show ip route 192.168.40.0
show ip route 198.51.100.1
show ip route 0.0.0.0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:35    10.23.23.1      Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip ospf database summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Summary Net Link States (Area 10)
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 1.1.1.1 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 2.2.2.2 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 1
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 4.4.4.4 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /32
MTID: 0  Metric: 11
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.12.12.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 10.24.24.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /30
MTID: 0  Metric: 10
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.10.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
  LS age: 187
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.168.40.0 (summary Network Number)
  Advertising Router: 2.2.2.2
  Network Mask: /24
MTID: 0  Metric: 20
```

Actual CLI output - R3

```
R3# show ip ospf database asbr-summary
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip ospf database external 198.51.100.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is not set
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.23.23.1, 00:00:58, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.23.23.1, 00:00:58, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.23.23.1, 00:00:58, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.23.23.1, 00:00:58, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.23.23.1, 00:00:58, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.23.23.1, 00:00:58, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.23.23.1, 00:00:58, Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip route 192.168.40.0
Routing entry for 192.168.40.0/24
  Known via "ospf 10", distance 110, metric 30, type inter area
  Last update from 10.23.23.1 on Ethernet0/0, 00:00:59 ago
  Routing Descriptor Blocks:
  * 10.23.23.1, from 2.2.2.2, 00:00:59 ago, via Ethernet0/0
      Route metric is 30, traffic share count is 1
```

Actual CLI output - R3

```
R3# show ip route 198.51.100.1
% Network not in table
```

WARNING - NSSA excludes the core Type5 and has no default yet; core external forwarding is unavailable.

Actual CLI output - R3

```
R3# show ip route 0.0.0.0
% Network not in table
```

WARNING - NSSA excludes the core Type5 and has no default yet; core external forwarding is unavailable.

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
.....
Success rate is 0 percent (0/5)
```

WARNING - NSSA excludes the core Type5 and has no default yet; core external forwarding is unavailable.

15.3 Introduce the NSSA branch service

Redistribute only the explicitly permitted /32 connected service. The prefix list and route map prevent accidental redistribution of transit, user LAN or Router-ID interfaces. Loopback100 is a real responding endpoint and is deliberately excluded from interface-level OSPF.

R3

```
enable
conf t
ip prefix-list SERVICE_ONLY seq 5 permit 203.0.113.1/32
route-map SERVICE_ONLY permit 10
match ip address prefix-list SERVICE_ONLY
exit
router ospf 10
redistribute connected subnets metric 20 metric-type 2 route-map SERVICE_ONLY
end
```

Wait at least 15 seconds, then verify the required state.

15.4 Inspect the branch Type7

R3 originates its service as Type7 with translation eligibility. Its local service remains connected. Wait for the new advertisement to be originated before reading it. In this tested image the service forwarding address is 3.3.3.3; prove its internal reachability rather than assuming all images choose the same value.

R3

```
enable
terminal length 0
show ip ospf database nssa-external 203.0.113.1
show ip route 203.0.113.1
show ip ospf interface brief
```

Wait at least 10 seconds, then verify the required state.

Actual CLI output - R3

```
R3# show ip ospf database nssa-external 203.0.113.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Type-7 AS External Link States (Area 10)
  LS age: 14
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 203.0.113.1 (External Network Number )
  Advertising Router: 3.3.3.3
  Network Mask: /32
Metric Type: 2 (Larger than any link state path)
MTID: 0
Metric: 20
Forward Address: 3.3.3.3
External Route Tag: 0
```

Actual CLI output - R3

```
R3# show ip route 203.0.113.1
Routing entry for 203.0.113.1/32
  Known via "connected", distance 0, metric 0 (connected, via interface)
  Redistributing via ospf 10
  Advertised by ospf 10 metric 20 subnets route-map SERVICE_ONLY
  Routing Descriptor Blocks:
  * directly connected, via Loopback100
      Route metric is 0, traffic share count is 1
```

Actual CLI output - R3

```
R3# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    10              3.3.3.3/32         1     LOOP  0/0
Et0/1        10    10              192.168.30.1/24    10    DR    0/0
Et0/0        10    10              10.23.23.2/30      10    P2P   1/1
```

15.5 Inspect the translated Type5

R1 receives a Type5 originated by R2 for the same /32 service. Compare its forwarding address with the Type7 and inspect the installed E2 route. R1 is not a member of Area10.

R1

```
enable
terminal length 0
show ip ospf database external 203.0.113.1
show ip route 203.0.113.1
ping 203.0.113.1 source Loopback0
ping 203.0.113.1 source Loopback0
```

Actual CLI output - R1

```
R1# show ip ospf database external 203.0.113.1
            OSPF Router with ID (1.1.1.1) (Process ID 10)
Type-5 AS External Link States
  LS age: 25
  Options: (No TOS-capability, DC, Upward)
  LS Type: AS External Link
  Link State ID: 203.0.113.1 (External Network Number )
  Advertising Router: 2.2.2.2
  Network Mask: /32
Metric Type: 2 (Larger than any link state path)
MTID: 0
Metric: 20
Forward Address: 3.3.3.3
External Route Tag: 0
```

Actual CLI output - R1

```
R1# show ip route 203.0.113.1
Routing entry for 203.0.113.1/32
  Known via "ospf 10", distance 110, metric 20, type extern 2, forward metric 21
  Last update from 10.12.12.2 on Ethernet0/0, 00:00:25 ago
  Routing Descriptor Blocks:
  * 10.12.12.2, from 2.2.2.2, 00:00:25 ago, via Ethernet0/0
      Route metric is 20, traffic share count is 1
```

Actual CLI output - R1

```
R1# ping 203.0.113.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

16.1 Originate the explicit NSSA default

Use the area-specific command on R2 to originate Type7 default. R2 can forward the core external service through Area0; the default promises that service to R3. This restores its external forwarding without importing the core Type5 into Area10.

R2

```
enable
conf t
router ospf 10
area 10 nssa default-information-originate
end
```

Wait at least 20 seconds, then verify the required state.

16.2 Prove the final NSSA control plane

Require Type7 service and Type7 default, R3 O*N2 default, retained Type3 enterprise routes and no core Type5 in Area10. The external core ping must now succeed. The default Type7 has no translation option, so it must not be translated into an external default in the normal core.

R3

```
enable
terminal length 0
show ip ospf
show ip ospf database nssa-external 0.0.0.0
show ip ospf database nssa-external 203.0.113.1
show ip ospf database external 198.51.100.1
show ip route ospf
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf
 Routing Process "ospf 10" with ID 3.3.3.3
 It is an autonomous system boundary router
 Number of areas in this router is 1. 0 normal 0 stub 1 nssa
 Number of areas transit capable is 0
    Area 10
        Number of interfaces in this area is 3 (1 loopback)
        It is a NSSA area
Area has no authentication
SPF algorithm last executed 00:00:46.917 ago
SPF algorithm executed 14 times
Area ranges are
Number of LSA 11. Checksum Sum 0x05F68E
```

Actual CLI output - R3

```
R3# show ip ospf database nssa-external 0.0.0.0
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Type-7 AS External Link States (Area 10)
  LS age: 21
  Options: (No TOS-capability, No Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 0.0.0.0 (External Network Number )
  Advertising Router: 2.2.2.2
  Network Mask: /0
Metric Type: 2 (Larger than any link state path)
MTID: 0
Metric: 1
Forward Address: 0.0.0.0
External Route Tag: 0
```

WARNING - The P-bit is clear; this NSSA default is not eligible for Type5 translation.

Actual CLI output - R3

```
R3# show ip ospf database nssa-external 203.0.113.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
Type-7 AS External Link States (Area 10)
  LS age: 46
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 203.0.113.1 (External Network Number )
  Advertising Router: 3.3.3.3
  Network Mask: /32
Metric Type: 2 (Larger than any link state path)
MTID: 0
Metric: 20
Forward Address: 3.3.3.3
External Route Tag: 0
```

Actual CLI output - R3

```
R3# show ip ospf database external 198.51.100.1
            OSPF Router with ID (3.3.3.3) (Process ID 10)
```

WARNING - The selected incoming external/ASBR LSA is intentionally excluded from Area10.

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is 10.23.23.1 to network 0.0.0.0
O*N2  0.0.0.0/0 [110/1] via 10.23.23.1, 00:00:21, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.23.23.1, 00:02:07, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.23.23.1, 00:02:07, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.23.23.1, 00:02:07, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.23.23.1, 00:02:07, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.23.23.1, 00:02:07, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.23.23.1, 00:02:07, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.23.23.1, 00:02:07, Ethernet0/0
```

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
```

17.1 Final router regression R1

Require expected FULL counts R1=1, R2=3, R3=1, R4=1. Test all three remote Router IDs from Loopback0 and both selected external service endpoints; repeat probes and require the last five replies. R1 also checks that no Type5 default was translated from the NSSA; its default P-bit is clear.

R1

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf interface brief
show ip route ospf
show ip ospf database external 0.0.0.0
ping 2.2.2.2 source Loopback0
ping 2.2.2.2 source Loopback0
ping 3.3.3.3 source Loopback0
ping 3.3.3.3 source Loopback0
ping 4.4.4.4 source Loopback0
ping 4.4.4.4 source Loopback0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
ping 203.0.113.1 source Loopback0
ping 203.0.113.1 source Loopback0
```

Actual CLI output - R1

```
R1# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:31    10.12.12.2      Ethernet0/0
```

Actual CLI output - R1

```
R1# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    0               1.1.1.1/32         1     LOOP  0/0
Et0/1        10    0               192.168.10.1/24    10    DR    0/0
Et0/0        10    0               10.12.12.1/30      10    P2P   1/1
```

Actual CLI output - R1

```
R1# show ip route ospf
Gateway of last resort is not set
      2.0.0.0/32 is subnetted, 1 subnets
O        2.2.2.2 [110/11] via 10.12.12.2, 00:07:13, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/21] via 10.12.12.2, 00:02:08, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.12.12.2, 00:07:11, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.23.23.0/30 [110/20] via 10.12.12.2, 00:07:13, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.12.12.2, 00:07:13, Ethernet0/0
O IA  192.168.30.0/24 [110/30] via 10.12.12.2, 00:02:08, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.12.12.2, 00:07:10, Ethernet0/0
      203.0.113.0/32 is subnetted, 1 subnets
O E2     203.0.113.1 [110/20] via 10.12.12.2, 00:00:48, Ethernet0/0
```

Actual CLI output - R1

```
R1# show ip ospf database external 0.0.0.0
            OSPF Router with ID (1.1.1.1) (Process ID 10)
```

WARNING - The NSSA default P-bit is clear; no translated Type5 default is expected in the core.

Actual CLI output - R1

```
R1# ping 2.2.2.2 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R1

```
R1# ping 3.3.3.3 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
```

Actual CLI output - R1

```
R1# ping 4.4.4.4 source Loopback0
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 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
```

Actual CLI output - R1

```
R1# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R1

```
R1# ping 203.0.113.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

17.2 Final router regression R2

Require expected FULL counts R1=1, R2=3, R3=1, R4=1. Test all three remote Router IDs from Loopback0 and both selected external service endpoints; repeat probes and require the last five replies.

R2

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf interface brief
show ip route ospf
ping 1.1.1.1 source Loopback0
ping 1.1.1.1 source Loopback0
ping 3.3.3.3 source Loopback0
ping 3.3.3.3 source Loopback0
ping 4.4.4.4 source Loopback0
ping 4.4.4.4 source Loopback0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
ping 203.0.113.1 source Loopback0
ping 203.0.113.1 source Loopback0
```

Actual CLI output - R2

```
R2# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           0   FULL/  -        00:00:32    10.12.12.1      Ethernet0/0
3.3.3.3           0   FULL/  -        00:00:35    10.23.23.2      Ethernet0/1
4.4.4.4           0   FULL/  -        00:00:33    10.24.24.2      Ethernet0/2
```

Actual CLI output - R2

```
R2# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    0               2.2.2.2/32         1     LOOP  0/0
Et0/0        10    0               10.12.12.2/30      10    P2P   1/1
Et0/1        10    10              10.23.23.1/30      10    P2P   1/1
Et0/2        10    20              10.24.24.1/30      10    P2P   1/1
```

Actual CLI output - R2

```
R2# show ip route ospf
Gateway of last resort is not set
      1.0.0.0/32 is subnetted, 1 subnets
O        1.1.1.1 [110/11] via 10.12.12.1, 00:00:23, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O        3.3.3.3 [110/11] via 10.23.23.2, 00:00:23, Ethernet0/1
      4.0.0.0/32 is subnetted, 1 subnets
O        4.4.4.4 [110/11] via 10.24.24.2, 00:00:23, Ethernet0/2
O     192.168.10.0/24 [110/20] via 10.12.12.1, 00:00:23, Ethernet0/0
O     192.168.30.0/24 [110/20] via 10.23.23.2, 00:00:23, Ethernet0/1
O     192.168.40.0/24 [110/20] via 10.24.24.2, 00:00:23, Ethernet0/2
      198.51.100.0/32 is subnetted, 1 subnets
O E2     198.51.100.1 [110/20] via 10.12.12.1, 00:00:23, Ethernet0/0
      203.0.113.0/32 is subnetted, 1 subnets
O N2     203.0.113.1 [110/20] via 10.23.23.2, 00:00:23, Ethernet0/1
```

Actual CLI output - R2

```
R2# ping 1.1.1.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 3.3.3.3 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 4.4.4.4 source Loopback0
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 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R2

```
R2# ping 203.0.113.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, timeout is 2 seconds:
Packet sent with a source address of 2.2.2.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

17.3 Final router regression R3

Require expected FULL counts R1=1, R2=3, R3=1, R4=1. Test all three remote Router IDs from Loopback0 and both selected external service endpoints; repeat probes and require the last five replies.

R3

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf interface brief
show ip route ospf
ping 1.1.1.1 source Loopback0
ping 1.1.1.1 source Loopback0
ping 2.2.2.2 source Loopback0
ping 2.2.2.2 source Loopback0
ping 4.4.4.4 source Loopback0
ping 4.4.4.4 source Loopback0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
ping 203.0.113.1 source Loopback0
ping 203.0.113.1 source Loopback0
```

Actual CLI output - R3

```
R3# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:39    10.23.23.1      Ethernet0/0
```

Actual CLI output - R3

```
R3# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    10              3.3.3.3/32         1     LOOP  0/0
Et0/1        10    10              192.168.30.1/24    10    DR    0/0
Et0/0        10    10              10.23.23.2/30      10    P2P   1/1
```

Actual CLI output - R3

```
R3# show ip route ospf
Gateway of last resort is 10.23.23.1 to network 0.0.0.0
O*N2  0.0.0.0/0 [110/1] via 10.23.23.1, 00:00:25, Ethernet0/0
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.23.23.1, 00:02:11, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.23.23.1, 00:02:11, Ethernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O IA     4.4.4.4 [110/21] via 10.23.23.1, 00:02:11, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.23.23.1, 00:02:11, Ethernet0/0
O IA     10.24.24.0/30 [110/20] via 10.23.23.1, 00:02:11, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.23.23.1, 00:02:11, Ethernet0/0
O IA  192.168.40.0/24 [110/30] via 10.23.23.1, 00:02:11, Ethernet0/0
```

Actual CLI output - R3

```
R3# ping 1.1.1.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/8/36 ms
```

Actual CLI output - R3

```
R3# ping 2.2.2.2 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R3

```
R3# ping 4.4.4.4 source Loopback0
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 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R3

```
R3# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Actual CLI output - R3

```
R3# ping 203.0.113.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

17.4 Final router regression R4

Require expected FULL counts R1=1, R2=3, R3=1, R4=1. Test all three remote Router IDs from Loopback0 and both selected external service endpoints; repeat probes and require the last five replies.

R4

```
enable
terminal length 0
show ip ospf neighbor
show ip ospf interface brief
show ip route ospf
ping 1.1.1.1 source Loopback0
ping 1.1.1.1 source Loopback0
ping 2.2.2.2 source Loopback0
ping 2.2.2.2 source Loopback0
ping 3.3.3.3 source Loopback0
ping 3.3.3.3 source Loopback0
ping 198.51.100.1 source Loopback0
ping 198.51.100.1 source Loopback0
ping 203.0.113.1 source Loopback0
ping 203.0.113.1 source Loopback0
```

Actual CLI output - R4

```
R4# show ip ospf neighbor
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           0   FULL/  -        00:00:32    10.24.24.1      Ethernet0/0
```

Actual CLI output - R4

```
R4# show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    20              4.4.4.4/32         1     LOOP  0/0
Et0/1        10    20              192.168.40.1/24    10    DR    0/0
Et0/0        10    20              10.24.24.2/30      10    P2P   1/1
```

Actual CLI output - R4

```
R4# show ip route ospf
Gateway of last resort is not set
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/21] via 10.24.24.1, 00:07:15, Ethernet0/0
      2.0.0.0/32 is subnetted, 1 subnets
O IA     2.2.2.2 [110/11] via 10.24.24.1, 00:07:15, Ethernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/21] via 10.24.24.1, 00:02:12, Ethernet0/0
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O IA     10.12.12.0/30 [110/20] via 10.24.24.1, 00:07:15, Ethernet0/0
O IA     10.23.23.0/30 [110/20] via 10.24.24.1, 00:07:15, Ethernet0/0
O IA  192.168.10.0/24 [110/30] via 10.24.24.1, 00:07:15, Ethernet0/0
O IA  192.168.30.0/24 [110/30] via 10.24.24.1, 00:02:12, Ethernet0/0
      198.51.100.0/32 is subnetted, 1 subnets
O E2     198.51.100.1 [110/20] via 10.24.24.1, 00:06:11, Ethernet0/0
      203.0.113.0/32 is subnetted, 1 subnets
O E2     203.0.113.1 [110/20] via 10.24.24.1, 00:00:52, Ethernet0/0
```

Actual CLI output - R4

```
R4# ping 1.1.1.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, 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
```

Actual CLI output - R4

```
R4# ping 2.2.2.2 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, 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 = 1/1/1 ms
```

Actual CLI output - R4

```
R4# ping 3.3.3.3 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, 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 = 2/4/14 ms
```

Actual CLI output - R4

```
R4# ping 198.51.100.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 198.51.100.1, 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 = 1/1/1 ms
```

Actual CLI output - R4

```
R4# ping 203.0.113.1 source Loopback0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 203.0.113.1, 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
```

17.5 Final client regression PC1

Verify the stored PC name/IP/gateway. Require five replies on repeated probes to both other clients and both external services; these directed tests cover gateways, forward and return routes.

PC1

```
show ip
ping 192.168.30.10
ping 192.168.30.10
ping 192.168.40.10
ping 192.168.40.10
ping 198.51.100.1
ping 198.51.100.1
ping 203.0.113.1
ping 203.0.113.1
```

Actual CLI output - PC1

```
PC1> show ip
NAME        : PC1[1]
IP/MASK     : 192.168.10.10/24
GATEWAY     : 192.168.10.1
MAC         : 00:50:79:66:68:05
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC1

```
PC1> ping 192.168.30.10
84 bytes from 192.168.30.10 icmp_seq=1 ttl=61 time=1.239 ms
84 bytes from 192.168.30.10 icmp_seq=2 ttl=61 time=0.901 ms
84 bytes from 192.168.30.10 icmp_seq=3 ttl=61 time=1.322 ms
84 bytes from 192.168.30.10 icmp_seq=4 ttl=61 time=1.316 ms
84 bytes from 192.168.30.10 icmp_seq=5 ttl=61 time=1.635 ms
```

Actual CLI output - PC1

```
PC1> ping 192.168.40.10
84 bytes from 192.168.40.10 icmp_seq=1 ttl=61 time=2.471 ms
84 bytes from 192.168.40.10 icmp_seq=2 ttl=61 time=2.150 ms
84 bytes from 192.168.40.10 icmp_seq=3 ttl=61 time=1.448 ms
84 bytes from 192.168.40.10 icmp_seq=4 ttl=61 time=1.800 ms
84 bytes from 192.168.40.10 icmp_seq=5 ttl=61 time=2.120 ms
```

Actual CLI output - PC1

```
PC1> ping 198.51.100.1
84 bytes from 198.51.100.1 icmp_seq=1 ttl=255 time=0.727 ms
84 bytes from 198.51.100.1 icmp_seq=2 ttl=255 time=0.568 ms
84 bytes from 198.51.100.1 icmp_seq=3 ttl=255 time=0.564 ms
84 bytes from 198.51.100.1 icmp_seq=4 ttl=255 time=0.798 ms
84 bytes from 198.51.100.1 icmp_seq=5 ttl=255 time=0.538 ms
```

Actual CLI output - PC1

```
PC1> ping 203.0.113.1
84 bytes from 203.0.113.1 icmp_seq=1 ttl=253 time=1.070 ms
84 bytes from 203.0.113.1 icmp_seq=2 ttl=253 time=1.215 ms
84 bytes from 203.0.113.1 icmp_seq=3 ttl=253 time=0.945 ms
84 bytes from 203.0.113.1 icmp_seq=4 ttl=253 time=1.132 ms
84 bytes from 203.0.113.1 icmp_seq=5 ttl=253 time=1.241 ms
```

17.6 Final client regression PC3

Verify the stored PC name/IP/gateway. Require five replies on repeated probes to both other clients and both external services; these directed tests cover gateways, forward and return routes.

PC3

```
show ip
ping 192.168.10.10
ping 192.168.10.10
ping 192.168.40.10
ping 192.168.40.10
ping 198.51.100.1
ping 198.51.100.1
ping 203.0.113.1
ping 203.0.113.1
```

Actual CLI output - PC3

```
PC3> show ip
NAME        : PC3[1]
IP/MASK     : 192.168.30.10/24
GATEWAY     : 192.168.30.1
MAC         : 00:50:79:66:68:06
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC3

```
PC3> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=61 time=1.253 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=61 time=1.415 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=61 time=1.391 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=61 time=1.730 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=61 time=1.671 ms
```

Actual CLI output - PC3

```
PC3> ping 192.168.40.10
84 bytes from 192.168.40.10 icmp_seq=1 ttl=61 time=1.528 ms
84 bytes from 192.168.40.10 icmp_seq=2 ttl=61 time=1.329 ms
84 bytes from 192.168.40.10 icmp_seq=3 ttl=61 time=1.782 ms
84 bytes from 192.168.40.10 icmp_seq=4 ttl=61 time=1.337 ms
84 bytes from 192.168.40.10 icmp_seq=5 ttl=61 time=1.083 ms
```

Actual CLI output - PC3

```
PC3> ping 198.51.100.1
84 bytes from 198.51.100.1 icmp_seq=1 ttl=253 time=1.113 ms
84 bytes from 198.51.100.1 icmp_seq=2 ttl=253 time=1.332 ms
84 bytes from 198.51.100.1 icmp_seq=3 ttl=253 time=1.597 ms
84 bytes from 198.51.100.1 icmp_seq=4 ttl=253 time=3.512 ms
84 bytes from 198.51.100.1 icmp_seq=5 ttl=253 time=1.562 ms
```

Actual CLI output - PC3

```
PC3> ping 203.0.113.1
84 bytes from 203.0.113.1 icmp_seq=1 ttl=255 time=1.036 ms
84 bytes from 203.0.113.1 icmp_seq=2 ttl=255 time=0.432 ms
84 bytes from 203.0.113.1 icmp_seq=3 ttl=255 time=0.718 ms
84 bytes from 203.0.113.1 icmp_seq=4 ttl=255 time=0.623 ms
84 bytes from 203.0.113.1 icmp_seq=5 ttl=255 time=0.726 ms
```

17.7 Final client regression PC4

Verify the stored PC name/IP/gateway. Require five replies on repeated probes to both other clients and both external services; these directed tests cover gateways, forward and return routes.

PC4

```
show ip
ping 192.168.10.10
ping 192.168.10.10
ping 192.168.30.10
ping 192.168.30.10
ping 198.51.100.1
ping 198.51.100.1
ping 203.0.113.1
ping 203.0.113.1
```

Actual CLI output - PC4

```
PC4> show ip
NAME        : PC4[1]
IP/MASK     : 192.168.40.10/24
GATEWAY     : 192.168.40.1
MAC         : 00:50:79:66:68:07
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Actual CLI output - PC4

```
PC4> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=61 time=1.333 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=61 time=3.050 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=61 time=1.390 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=61 time=1.707 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=61 time=1.632 ms
```

Actual CLI output - PC4

```
PC4> ping 192.168.30.10
84 bytes from 192.168.30.10 icmp_seq=1 ttl=61 time=1.440 ms
84 bytes from 192.168.30.10 icmp_seq=2 ttl=61 time=1.687 ms
84 bytes from 192.168.30.10 icmp_seq=3 ttl=61 time=2.279 ms
84 bytes from 192.168.30.10 icmp_seq=4 ttl=61 time=1.319 ms
84 bytes from 192.168.30.10 icmp_seq=5 ttl=61 time=1.513 ms
```

Actual CLI output - PC4

```
PC4> ping 198.51.100.1
84 bytes from 198.51.100.1 icmp_seq=1 ttl=253 time=1.790 ms
84 bytes from 198.51.100.1 icmp_seq=2 ttl=253 time=1.350 ms
84 bytes from 198.51.100.1 icmp_seq=3 ttl=253 time=1.413 ms
84 bytes from 198.51.100.1 icmp_seq=4 ttl=253 time=2.394 ms
84 bytes from 198.51.100.1 icmp_seq=5 ttl=253 time=1.791 ms
```

Actual CLI output - PC4

```
PC4> ping 203.0.113.1
84 bytes from 203.0.113.1 icmp_seq=1 ttl=253 time=1.634 ms
84 bytes from 203.0.113.1 icmp_seq=2 ttl=253 time=1.420 ms
84 bytes from 203.0.113.1 icmp_seq=3 ttl=253 time=1.796 ms
84 bytes from 203.0.113.1 icmp_seq=4 ttl=253 time=1.600 ms
84 bytes from 203.0.113.1 icmp_seq=5 ttl=253 time=1.382 ms
```

18.1 Persist verified R1

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

R1

```
enable
write memory
```

Actual CLI output - R1

```
R1# write memory
Building configuration...
[OK]
```

18.2 Persist verified R2

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

R2

```
enable
write memory
```

Actual CLI output - R2

```
R2# write memory
Building configuration...
[OK]
```

18.3 Persist verified R3

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

R3

```
enable
write memory
```

Actual CLI output - R3

```
R3# write memory
Building configuration...
[OK]
```

18.4 Persist verified R4

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

R4

```
enable
write memory
```

Actual CLI output - R4

```
R4# write memory
Building configuration...
[OK]
```

18.5 Persist verified PC1

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

PC1

```
save
```

Actual CLI output - PC1

```
PC1> save
Saving startup configuration to startup.vpc
.  done
```

18.6 Persist verified PC3

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

PC3

```
save
```

Actual CLI output - PC3

```
PC3> save
Saving startup configuration to startup.vpc
.  done
```

18.7 Persist verified PC4

Save only after all final checks succeed. The exported save-config must independently boot in ordinary NSSA and pass final read-only verification.

PC4

```
save
```

Actual CLI output - PC4

```
PC4> save
Saving startup configuration to startup.vpc
.  done
```

19. Diagnostic reasoning and interview review

Missing external LSA in Stub/NSSA can be expected area policy; missing adjacency during area mismatch is a controlled fault. Distinguish those states before changing configuration. Explain why external forwarding survives in Totally Stub through a default, why ordinary NSSA initially lacks it, and why R2 translates R3 service into a new external advertisement. Identify connected versus learned external routes, forwarding address reachability and which services survived the maintenance transition. No blanket redistribution or static default was required. Final configuration is ordinary NSSA with explicit Type7 default; the previous Stub configurations are temporary learning stages.

20. Final validation record

RAW and save-ip-configuration workflows and independent save-config boot passed live verification on the approved pilot. All final router/client service probes returned five replies. Area10 mismatch was isolated and recovered.

Gate	Result
Topology, names, interfaces, IPs and three variants agree	PASS
Ordered RAW and saved-IP workbook workflows executed live	PASS
Complete save-config passed independent boot without configuration entry	PASS
CLI excerpts match their actual exercise stage	PASS
Area10 mismatch impact, unaffected service and recovery verified	PASS
Final PDF technical content and rendered page layout reviewed	PASS

Validation scope: exact approved IOL L3 image on the pilot EVE-NG. All CLI excerpts come from the RAW exercise stage stated above. Timers, LSA ages, sequence numbers and timings may vary. Selected LSDB detail is omitted only when unrelated to the objective. RAW and IP workflows, isolation/recovery and a separate no-configuration cold boot of save-config were executed.

References: Cisco ENARSI v1.1 blueprint; Cisco OSPF NSSA.