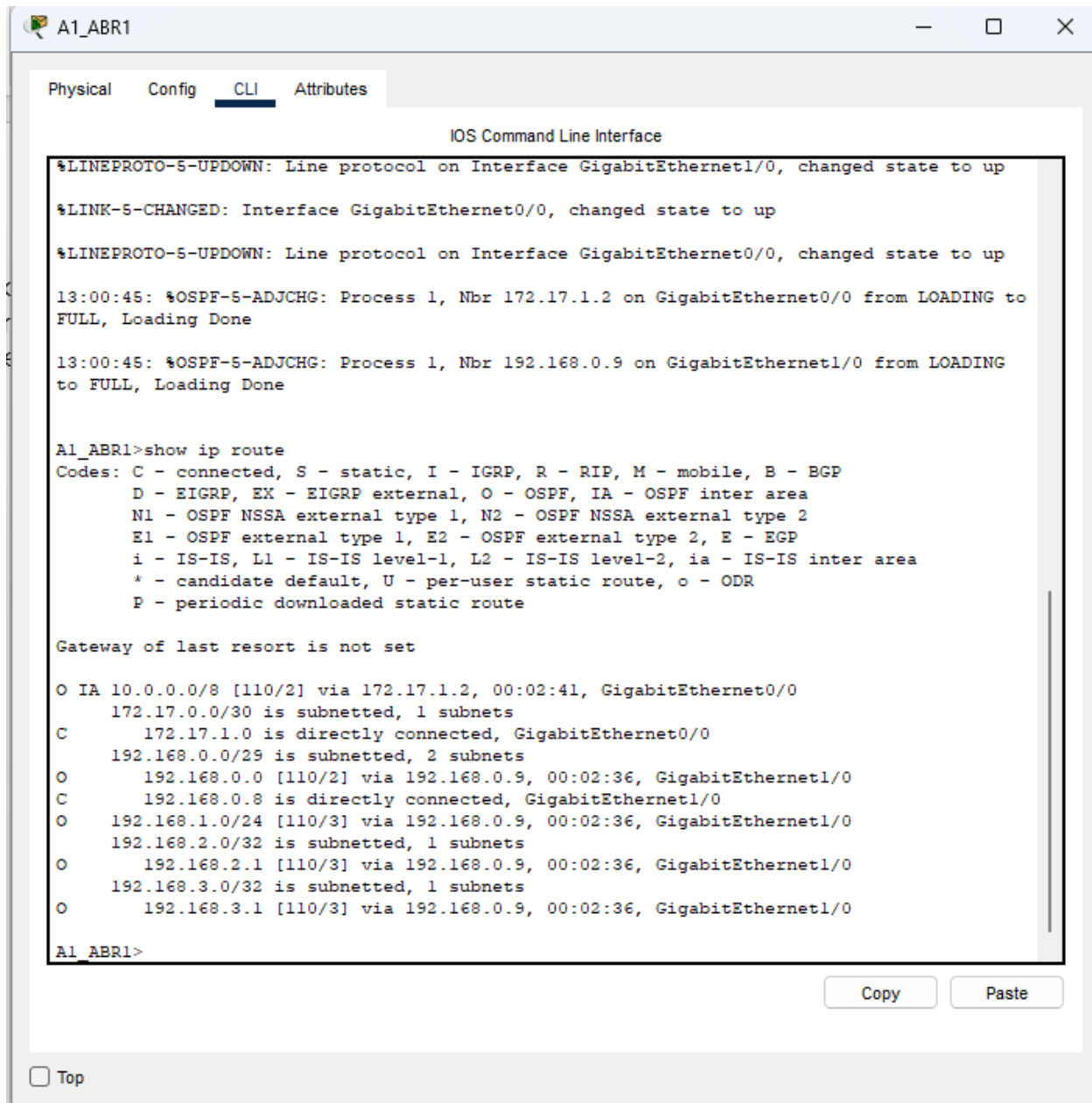


d. Execute the **show ip route** command. Notice that the routing table on router A1_ABR1 is shorter than it was on router B1_R5 in the single-area OSPF example in Part 1.



```

A1_ABR1
Physical Config CLI Attributes
IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0, changed state to up
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
13:00:45: %OSPF-5-ADJCHG: Process 1, Nbr 172.17.1.2 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
13:00:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.0.9 on GigabitEthernet1/0 from LOADING to FULL, Loading Done

A1_ABR1>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

O IA 10.0.0.0/8 [110/2] via 172.17.1.2, 00:02:41, GigabitEthernet0/0
    172.17.0.0/30 is subnetted, 1 subnets
C    172.17.1.0 is directly connected, GigabitEthernet0/0
    192.168.0.0/29 is subnetted, 2 subnets
O    192.168.0.0 [110/2] via 192.168.0.9, 00:02:36, GigabitEthernet1/0
C    192.168.0.8 is directly connected, GigabitEthernet1/0
O    192.168.1.0/24 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0
    192.168.2.0/32 is subnetted, 1 subnets
O    192.168.2.1 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0
    192.168.3.0/32 is subnetted, 1 subnets
O    192.168.3.1 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0

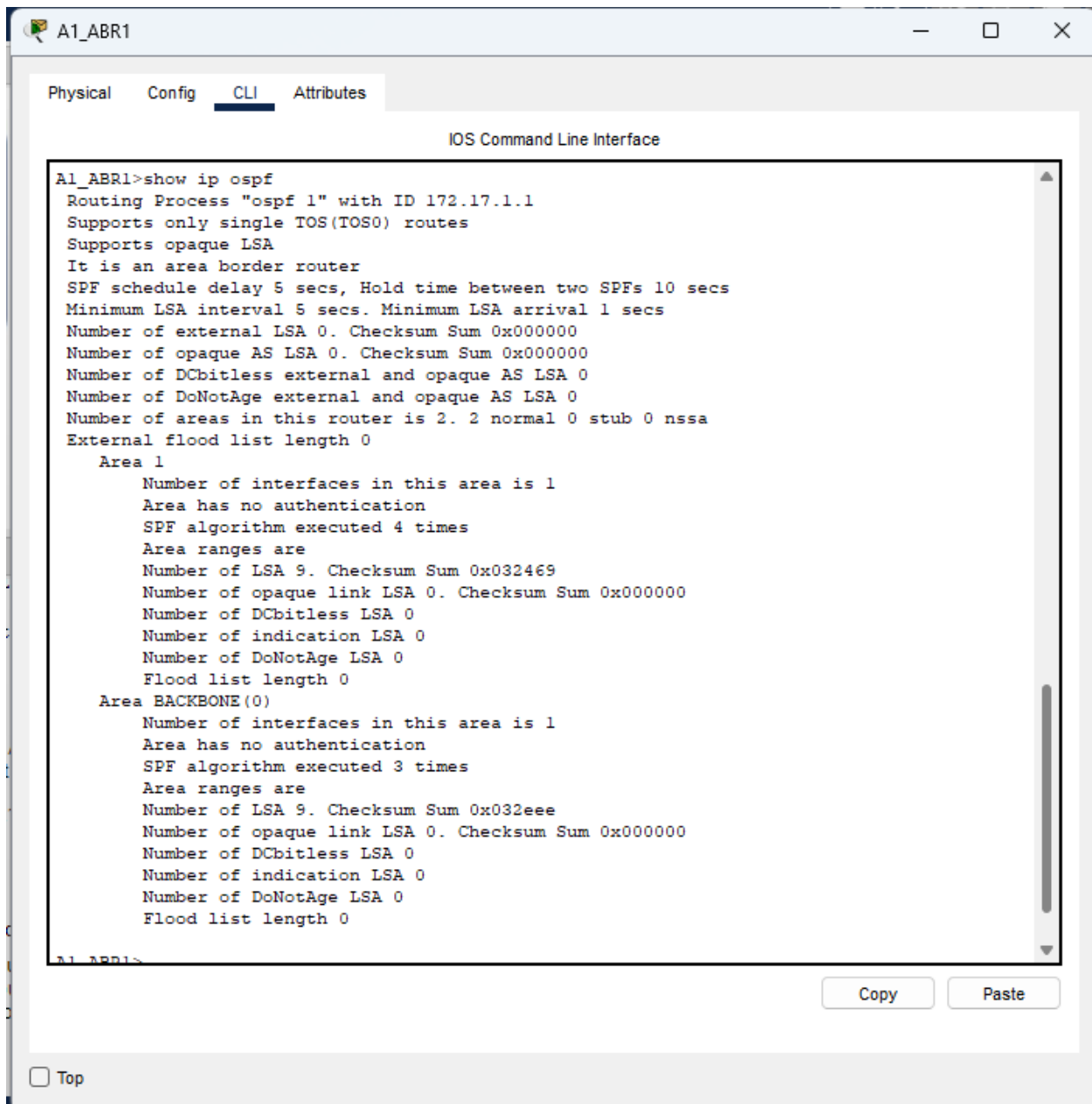
A1_ABR1>
  
```

How are the networks from Area 51 displayed in the routing table of A1_ABR1?

Answer: All of Area 51 networks are displayed as one summarized network.

O IA 10.0.0.0/8 [110/3] via 192.168.0.10, 00:00:10, GigabitEthernet0/0/1

e. Execute the **show ip ospf** command on router A1_ABR1.



The screenshot shows a web-based interface for router A1_ABR1. The 'CLI' tab is selected, displaying the 'IOS Command Line Interface'. The command 'show ip ospf' has been entered, and the output is displayed in a scrollable text area. The output provides detailed information about the OSPF process, including the router ID (172.17.1.1), supported features, SPF schedule, LSA intervals, and the configuration of two areas: Area 1 and Area BACKBONE(0). Area 1 has 1 interface and the SPF algorithm was executed 4 times. Area BACKBONE(0) also has 1 interface and the SPF algorithm was executed 3 times. Both areas have no authentication and show various LSA counts and checksums.

```
A1_ABR1>show ip ospf
Routing Process "ospf 1" with ID 172.17.1.1
Supports only single TOS(TOS0) routes
Supports opaque LSA
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 2. 2 normal 0 stub 0 nssa
External flood list length 0
  Area 1
    Number of interfaces in this area is 1
    Area has no authentication
    SPF algorithm executed 4 times
    Area ranges are
    Number of LSA 9. Checksum Sum 0x032469
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 1
    Area has no authentication
    SPF algorithm executed 3 times
    Area ranges are
    Number of LSA 9. Checksum Sum 0x032eee
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
A1_ABR1>
```

Which areas are displayed on router A1_ABR1?

Answer: The backbone area 1 and area 0 are displayed.

Record the number of times that the SPF algorithm has been executed in each area.

Answer: Most likely 4 times for Area 1 and 3 times for Area 0.

f. Keep the console window for A1_ABR1 open and select **router A1_R2**. Execute the **show ip route** and **show ip ospf** commands, and then compare the output with the output on A1_ABR1. Similar networks should be displayed and the number of SPF algorithm executions should be similar.

Question:

Record the number of SPF algorithm executions.

Answer:

The image displays two side-by-side screenshots of network device CLI windows, labeled A1_ABR1 and A1_R2. Both windows show the 'IOS Command Line Interface' with tabs for Physical, Config, CLI, and Attributes. The CLI tab is active in both.

A1_ABR1 Output:

```
A1_ABR1>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

O IA 10.0.0.0/8 [110/2] via 172.17.1.2, 00:02:41, GigabitEthernet0/0
  172.17.0.0/30 is subnetted, 1 subnets
  C 172.17.1.0/30 is directly connected, GigabitEthernet0/0
O 192.168.0.0/24 is variably subnetted, 3 subnets, 2 masks
  C 192.168.0.0/24 is directly connected, GigabitEthernet1/0
O 192.168.0.8/24 is directly connected, GigabitEthernet1/0
O 192.168.1.0/24 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0
O 192.168.2.0/24 is subnetted, 1 subnets
O 192.168.2.1 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0
O 192.168.3.0/32 is subnetted, 1 subnets
O 192.168.3.1 [110/3] via 192.168.0.9, 00:02:36, GigabitEthernet1/0

A1_ABR1>show ip ospf
Routing Process "ospf 1" with ID 172.17.1.1
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs, Minimum LSA arrival 1 secs
Number of external LSA 0, Checksum Sum 0x00000000
Number of opaque AS LSA 0, Checksum Sum 0x00000000
Number of DoNotAge external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 3. 3 normal 0 stub 0 nssa
External flood list length 0
  Area 1
    Number of interfaces in this area is 1
    Area has no authentication
    SPF algorithm executed 4 times
    Area ranges are
      Number of LSA 9, Checksum Sum 0x032469
      Number of opaque link LSA 0, Checksum Sum 0x00000000
      Number of DoNotAge LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0
      Flood list length 0

  Area 2
    Number of interfaces in this area is 1
    Area has no authentication
    SPF algorithm executed 3 times
    Area ranges are
      Number of LSA 9, Checksum Sum 0x032469
      Number of opaque link LSA 0, Checksum Sum 0x00000000
      Number of DoNotAge LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0
      Flood list length 0

  Area 3
    Number of interfaces in this area is 1
    Area has no authentication
    SPF algorithm executed 3 times
    Area ranges are
      Number of LSA 9, Checksum Sum 0x032469
      Number of opaque link LSA 0, Checksum Sum 0x00000000
      Number of DoNotAge LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0
      Flood list length 0

A1_ABR1>
A1_ABR1>
A1_ABR1>
```

A1_R2 Output:

```
A1_R2>show ip route
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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

O IA 10.0.0.0/8 [110/4] via 192.168.0.4, 00:16:19, GigabitEthernet0/0/0
  172.17.0.0/30 is subnetted, 1 subnets
O IA 172.17.1.0/30 [110/3] via 192.168.0.4, 00:16:19, GigabitEthernet0/0/0
O 192.168.0.0/24 is variably subnetted, 3 subnets, 2 masks
  C 192.168.0.0/24 is directly connected, GigabitEthernet0/0/0
L 192.168.0.8/24 is directly connected, GigabitEthernet0/0/0
O 192.168.1.0/24 [110/2] via 192.168.0.1, 00:16:19, GigabitEthernet0/0/0
O 192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
  C 192.168.2.0/24 is directly connected, Loopback0
L 192.168.2.1/32 is directly connected, Loopback0
O 192.168.3.0/32 is subnetted, 1 subnets
O 192.168.3.1/32 [110/2] via 192.168.0.3, 00:16:19, GigabitEthernet0/0/0

A1_R2>
A1_R2>show ip ospf
Routing Process "ospf 1" with ID 192.168.2.1
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs, Minimum LSA arrival 1 secs
Number of external LSA 0, Checksum Sum 0x00000000
Number of opaque AS LSA 0, Checksum Sum 0x00000000
Number of DoNotAge external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
  Area 1
    Number of interfaces in this area is 2
    Area has no authentication
    SPF algorithm executed 2 times
    Area ranges are
      Number of LSA 9, Checksum Sum 0x032469
      Number of opaque link LSA 0, Checksum Sum 0x00000000
      Number of DoNotAge LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0

A1_R2>
A1_R2>
```

f. Execute the **show ip route** command. Compare the output of A51_R4 to the output of A1_ABR1 and A1_R2. Notice that other than a few connected or local routes, the same networks are displayed.

Question:

Record the number of IA routes displayed.

Answer: 6 IA routes are displayed.

The image displays three side-by-side screenshots of Cisco IOS command-line interfaces for routers A51_R4, A1_ABR1, and A1_R2. Each screenshot shows the output of the 'show ip route' command, which lists the routing table for each router. The routers are configured with OSPF and have several interfaces connected to each other. The output shows various network addresses and their associated metrics, including OSPF cost and interface details. The A51_R4 screenshot shows a large number of routes, including many connected and local routes. The A1_ABR1 and A1_R2 screenshots show a smaller number of routes, primarily those learned from the A51_R4 router via OSPF. The A1_R2 screenshot also shows the output of the 'show ip ospf' command, which displays OSPF configuration details for the router.

g. Execute the **show ip ospf** command.

Question:

Record the number of SPF calculations.

Answer: 4 Times

IOS Command Line Interface

```
O IA 192.168.1.0 [110/2] via 10.10.0.2, 00:19:37, GigabitEthernet4/0
192.168.0.0/29 is subnetted, 2 subnets
O IA 192.168.0.0 [110/4] via 10.10.0.2, 00:19:37, GigabitEthernet4/0
O IA 192.168.0.8 [110/3] via 10.10.0.2, 00:19:47, GigabitEthernet4/0
O IA 192.168.1.0/24 [110/5] via 10.10.0.2, 00:19:37, GigabitEthernet4/0
192.168.2.0/32 is subnetted, 1 subnets
O IA 192.168.2.1 [110/5] via 10.10.0.2, 00:19:37, GigabitEthernet4/0
192.168.3.0/32 is subnetted, 1 subnets
O IA 192.168.3.1 [110/5] via 10.10.0.2, 00:19:37, GigabitEthernet4/0
```

```
A51_R4>show ip ospf
Routing Process "ospf 1" with ID 4.4.4.4
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
  Area 51
    Number of interfaces in this area is 4
    Area has no authentication
    SPF algorithm executed 4 times
    Area ranges are
    Number of LSA 17. Checksum Sum 0x059231
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
```

```
A51_R4>
A51_R4>
A51_R4>
```

Copy

Paste

- h. Keep the console window for A51_R4 open. Click **A51_R2**. On the **Physical** tab, turn the power off to simulate a power failure.
- i. Return to the console window for **A51_R4**. You should see a console message that the adjacency with A51_R2 is down.

The screenshot displays two Packet Tracer windows. The left window, titled 'A51_R4', shows the 'CLI' tab with the following output from the 'show ip ospf' command:

```
IOS Command Line Interface
A51_R4>show ip ospf
Routing Process "ospf 1" with ID 4.4.4.4
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs, Minimum LSA arrival 1 secs
Number of external LSA 0, Checksum Sum 0x0000000
Number of opaque AS LSA 0, Checksum Sum 0x0000000
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
Area 51
Number of interfaces in this area is 4
Area has no authentication
SPF algorithm executed 4 times
Area ranges are
Number of LSA 17, Checksum Sum 0x059231
Number of opaque link LSA 0, Checksum Sum 0x0000000
Number of DoNotAge LSA 0
Number of indication LSA 0
Number of DoNotAge LSA 0
Flood list length 0

A51_R4>
A51_R4>
A51_R4>
%LINK-3-UPDOWN: Interface GigabitEthernet2/0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet2/0, changed state to down
13:25:46: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet2/0 from FULL to DOWN, Neighbor Down: Interface down or detached
```

The right window, titled 'A51_R2', shows the 'Physical' tab. It displays a 'Physical Device View' of the router hardware. The 'MODULES' list on the left includes: PT-ROUTER-NM-1AM, PT-ROUTER-NM-1CE, PT-ROUTER-NM-1CFE, PT-ROUTER-NM-1CGE, PT-ROUTER-NM-1FFE, PT-ROUTER-NM-1FGE, PT-ROUTER-NM-1S, PT-ROUTER-NM-1SS, and PT-ROUTER-NM-COVER. The main view shows the router with a power button. Below the router, there is a note: 'The PT-ROUTER-NM-1AM card features dual RJ-11 connectors, which are used for basic telephone service connections. The WIC-1AM uses one port for connection to a standard telephone line, and the other port can be connected to a basic analog telephone for use when the modem is idle.'

- j. Re-issue the **show ip route** and **show ip ospf** commands.

The screenshot shows a window titled 'A51_R4' with tabs for 'Physical', 'Config', 'CLI', and 'Attributes'. The 'CLI' tab is active, displaying the 'IOS Command Line Interface'. The terminal output shows the following commands and their results:

```
A51_R4>show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

    10.0.0.0/30 is subnetted, 3 subnets
C       10.10.0.0 is directly connected, GigabitEthernet4/0
C       10.10.0.4 is directly connected, GigabitEthernet3/0
C       10.10.0.8 is directly connected, GigabitEthernet1/0
    172.17.0.0/30 is subnetted, 1 subnets
O IA    172.17.1.0 [110/2] via 10.10.0.2, 00:26:30, GigabitEthernet4/0
    192.168.0.0/29 is subnetted, 2 subnets
O IA    192.168.0.0 [110/4] via 10.10.0.2, 00:26:05, GigabitEthernet4/0
O IA    192.168.0.8 [110/3] via 10.10.0.2, 00:26:15, GigabitEthernet4/0
O IA    192.168.1.0/24 [110/5] via 10.10.0.2, 00:26:05, GigabitEthernet4/0
    192.168.2.0/32 is subnetted, 1 subnets
O IA    192.168.2.1 [110/5] via 10.10.0.2, 00:26:05, GigabitEthernet4/0
    192.168.3.0/32 is subnetted, 1 subnets
O IA    192.168.3.1 [110/5] via 10.10.0.2, 00:26:05, GigabitEthernet4/0

A51_R4>show ip ospf
Routing Process "ospf 1" with ID 4.4.4.4
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
  Area 51
    Number of interfaces in this area is 3
    Area has no authentication
    SPF algorithm executed 5 times
    Area ranges are
    Number of LSA 15. Checksum Sum 0x04ed16
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
```

At the bottom right of the CLI window, there are 'Copy' and 'Paste' buttons. At the bottom left, there is a 'Top' button with a small square icon next to it.

Have the SPF algorithm executions increased?

Answer: **Yes**

Record the number of SPF algorithm executions.

Answer: **5 times**

What networks are missing from the A51_R4 routing table?

Answer: **All networks that were advertised by A51_R2 are missing.**

k. Navigate to A1_R2 and issue the **show ip route** and **show ip ospf** commands again.

Questions:

Is the summary route for Area 51 still in the routing table?

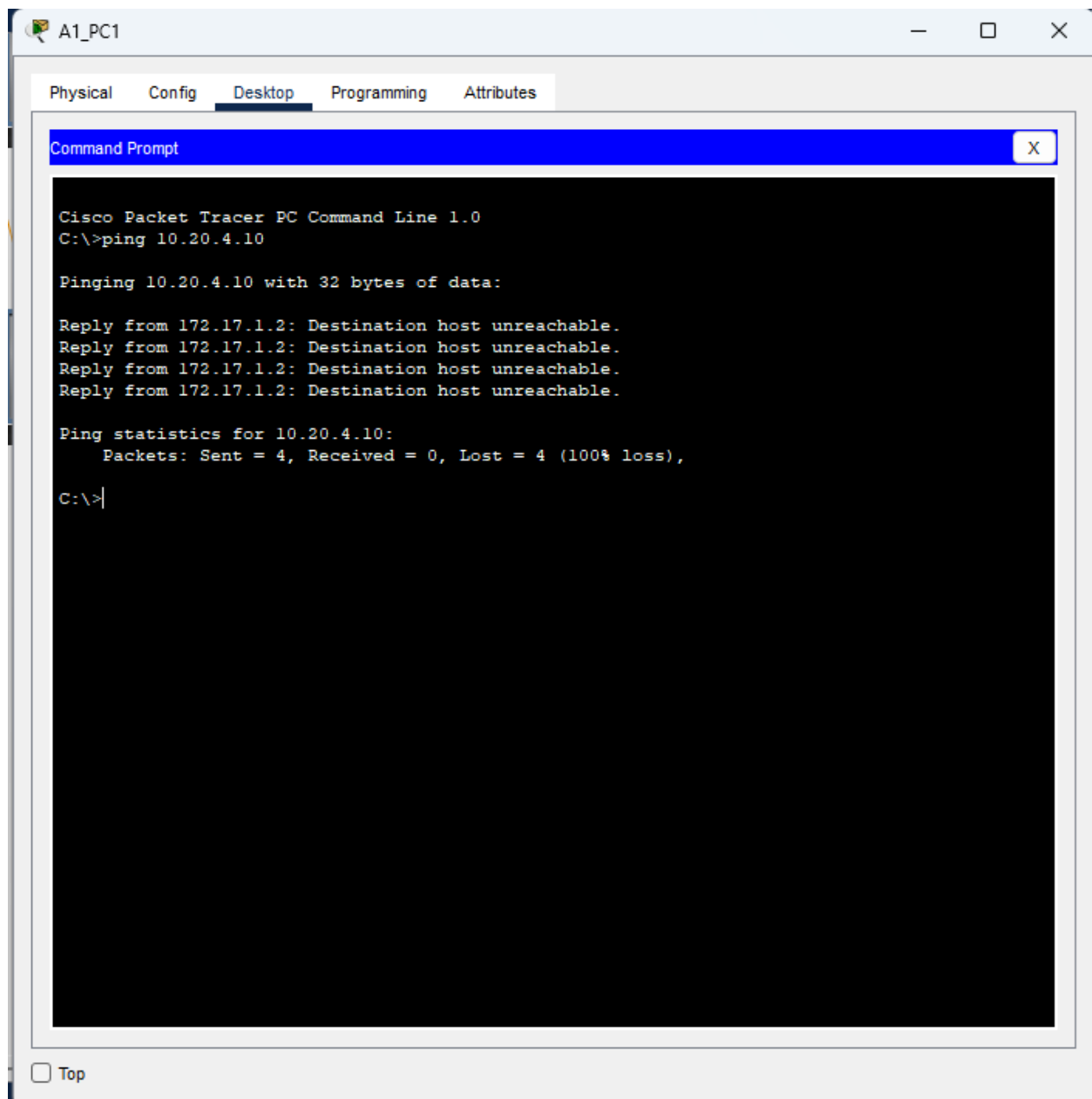
Answer: **Yes**

Has the value for the SPF algorithm executions increased from Step 1g?

Answer: **No**

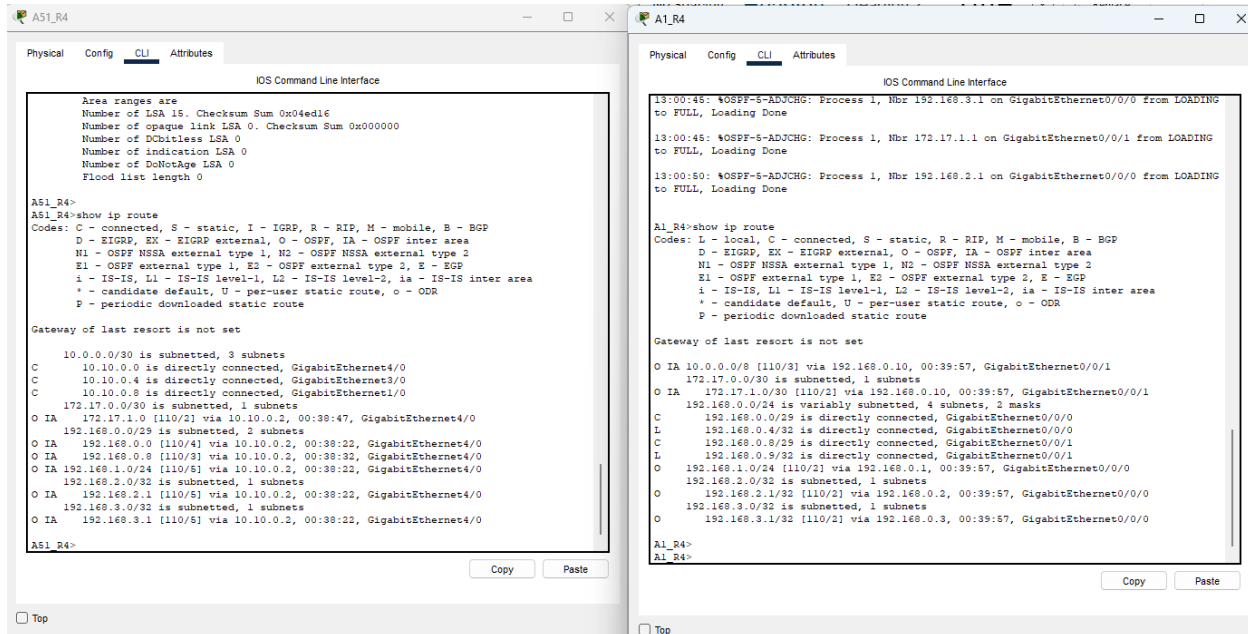
Will a **ping** or a **tracert** between A1_PC1 (192.168.1.10) and A51_PC1 (10.20.4.10) be successful?

Answer: No. Destination host unreachable



a. Select router **A51_R4** and execute the **show ip route**.

Compare the output of A51_R4 to the output of A1_R4. You should notice that all of the 192.168.0.0 networks from area 1 are showing inside the routing table.



If a cleaning crew accidentally removed the cable on A1_R1 (192.168.1.0/24), how will the routers in area 51 be affected?

Answer: All area 51 routers would have SPF algorithm executions and would have to update their routing tables.

What could be done to avoid the area 51 recalculations?

Answer: Router A1_ABR1 should summarize the 192.168.0.0/16 networks of area 1.

b. Navigate to **A1_ABR1**. Using the CLI tab, enter the following commands to implement OSPF summarization for the 192.168.0.0 network in area 1:

```
A1_ABR1>
A1_ABR1>
A1_ABR1>
A1_ABR1>
A1_ABR1>router ospf 1
^
% Invalid input detected at '^' marker.

A1_ABR1>en
A1_ABR1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
A1_ABR1(config)#router ospf 1
A1_ABR1(config-router)#area 1 range 192.168.0.0 255.255.0.0
A1_ABR1(config-router)#end
A1_ABR1#
%SYS-5-CONFIG_I: Configured from console by console

Top
```

c. Return to the screen of **A51_R4** and execute a **show ip route** command.

Question:

How is the routing table output different following the summarization?

Answer: The networks from area 1 are all summarized with an interarea route:
IA 10.0.0.0/8 [110/2] via 172.17.1.2, 00:44:30, GigabitEthernet0/0

