Tristan BRAU
Léo PHAV

Interconnexion des réseaux - Lab 3

PART 1. ICMP Route Redirect

```
PC2> ping 10.0.4.10

84 bytes from 10.0.4.10 icmp_seq=1 ttl=62 time=39.377 ms
84 bytes from 10.0.4.10 icmp_seq=2 ttl=62 time=49.716 ms
84 bytes from 10.0.4.10 icmp_seq=3 ttl=62 time=29.546 ms
84 bytes from 10.0.4.10 icmp_seq=4 ttl=62 time=31.279 ms
84 bytes from 10.0.4.10 icmp_seq=5 ttl=62 time=31.026 ms

PC2> arp

cc:01:1d:af:00:10  10.0.2.1 expires in 114 seconds
```

1. Calculation of the Average Round Trip Time (RTT)

In a ping, the displayed time (time=...) is the **RTT (Round Trip Time)**: it is the time the packet takes to go **to the destination (PC2 → PC4) and back (PC4 → PC2)**.

To calculate the average, we ignore the first packet that failed (timeout) and average the 4 successful packets:

Temps total=26.011+29.188+30.941+31.279=117.419 ms
Moyenne=4117.419≈29.35 ms

Note: The question asks for the time to "reach the destination" (one-way). In theory, this is half of the RTT (≈14.67 ms), but in network exercises (Packet Tracer/Cisco), the expected answer is usually the average RTT calculated above.

```
PC3> ping 10.0.1.10

84 bytes from 10.0.1.10 icmp_seq=1 ttl=62 time=43.902 ms
84 bytes from 10.0.1.10 icmp_seq=2 ttl=62 time=31.409 ms
84 bytes from 10.0.1.10 icmp_seq=3 ttl=62 time=32.175 ms
84 bytes from 10.0.1.10 icmp_seq=4 ttl=62 time=31.614 ms
84 bytes from 10.0.1.10 icmp_seq=5 ttl=62 time=33.414 ms

PC3> arp

cc:03:1d:e7:00:00  10.0.3.3 expires in 113 seconds
```

Tristan BRAU
Léo PHAV

Lab Questions :

• Is there a difference between the average time elapsed to reach the destination in steps 5 and 6? If so, why?
• When you viewed the cache after the ping, what did you observe?
• Describe how the ICMP route redirect works. Explain how R1, in the above example, knows that datagrams destined to network 10.0.3.10 should be forwarded to 10.0.2.2?

1. Yes, there is a difference.

- **PC2 → PC4:** The first ping may take longer because the routing cache on PC2 is empty and the ICMP redirect must be generated by R1. Subsequent packets benefit from the routing cache.

- **PC3 → PC1:** The path may be shorter or already cached in the routing tables, so the average RTT can be slightly lower.

Reason: The difference is caused by routing cache behavior and ICMP redirects. Initial packets require full routing table lookups, while later packets use cached routes, reducing delay.

2.

- The routing cache on PC2 now has an entry for 10.0.3.10 pointing to 10.0.2.2 (R2) instead of R1.

- R1 sent an ICMP Redirect to PC2 to inform it of the better route.

- No changes were made to the main routing tables on any router; only the host's cache was updated.

3.

When PC2 sends a packet to 10.0.3.10 via its default gateway (R1), R1 checks its routing table.

R1 sees that the optimal next-hop for the 10.0.3.0/24 network is R2 (10.0.2.2), not itself.

Since the packet came from a directly connected host (PC2), R1 generates an ICMP

PC2 receives the redirect and updates its routing cache, so future packets go directly to R2.

ICMP Redirects allow a host to learn a more efficient path from a router without modifying the router's main routing table, improving network efficiency.

Tristan BRAU
Léo PHAV

PART 2. Routing Loops

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is 10.0.2.2 to network 0.0.0.0

     10.0.0.0/24 is subnetted, 2 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
C       10.0.1.0 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 10.0.2.2
```

```
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
C       10.0.3.0 is directly connected, FastEthernet0/0
S       10.0.1.0 [1/0] via 10.0.3.3
S       10.0.4.0 [1/0] via 10.0.3.3
```

```
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
S       10.0.2.0 [1/0] via 10.0.3.2
C       10.0.3.0 is directly connected, FastEthernet0/0
S       10.0.1.0 [1/0] via 10.0.4.4
C       10.0.4.0 is directly connected, FastEthernet1/0
```

Tristan BRAU
Léo PHAV

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 3 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
S       10.0.1.0 [1/0] via 10.0.2.2
C       10.0.4.0 is directly connected, FastEthernet0/0
```

```
PC4> trace 10.0.1.10
trace to 10.0.1.10, 8 hops max, press Ctrl+C to stop
 1   10.0.4.3   9.648 ms  9.936 ms  10.013 ms
 2   10.0.1.10   8.945 ms  8.704 ms  9.833 ms
 3   10.0.4.4   9.718 ms  20.099 ms  10.083 ms
 4   10.0.2.2   20.203 ms  10.017 ms  20.114 ms
 5   10.0.3.3   9.751 ms  30.289 ms  9.234 ms
```

Lab Question :

• Why does the ICMP Echo Request packet not loop forever in the network?

The ICMP Echo Request packet does not loop forever in a network because of the Time-To-Live (TTL) field in the IP header. Each time the packet passes through a router, the TTL is decreased by 1. If the TTL reaches 0, the router discards the packet and may send an ICMP Time Exceeded message back to the sender. This mechanism ensures that even if there is a routing loop, packets are eventually removed from the network, preventing infinite circulation and network congestion.

Tristan BRAU
Léo PHAV

PART 3. Configuring RIP on a Cisco Router

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
R       10.0.3.0 [120/1] via 10.0.2.2, 00:00:13, FastEthernet1/0
C       10.0.1.0 is directly connected, FastEthernet0/0
R       10.0.4.0 [120/2] via 10.0.2.2, 00:00:13, FastEthernet1/0
```

```
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/1] via 10.0.2.1, 00:00:19, FastEthernet1/0
R       10.0.4.0 [120/1] via 10.0.3.3, 00:00:15, FastEthernet0/0
```

```
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.3.2, 00:00:12, FastEthernet0/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/2] via 10.0.3.2, 00:00:12, FastEthernet0/0
C       10.0.4.0 is directly connected, FastEthernet1/0
```

Tristan BRAU
Léo PHAV

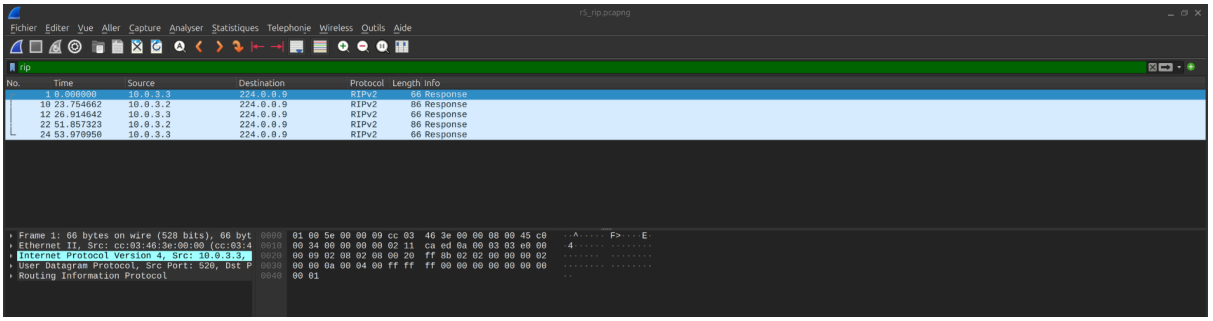
```
R5#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.3.2, 00:00:15, FastEthernet0/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/2] via 10.0.3.2, 00:00:15, FastEthernet0/0
R       10.0.4.0 [120/1] via 10.0.3.3, 00:00:21, FastEthernet0/0
```

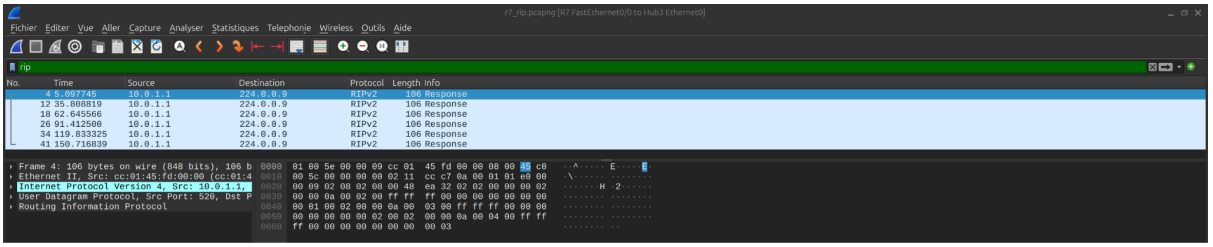
```
R6#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/2] via 10.0.4.3, 00:00:10, FastEthernet0/0
R       10.0.3.0 [120/1] via 10.0.4.3, 00:00:10, FastEthernet0/0
R       10.0.1.0 [120/3] via 10.0.4.3, 00:00:10, FastEthernet0/0
C       10.0.4.0 is directly connected, FastEthernet0/0
```

```
R7#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.1.1, 00:00:07, FastEthernet0/0
R       10.0.3.0 [120/2] via 10.0.1.1, 00:00:07, FastEthernet0/0
C       10.0.1.0 is directly connected, FastEthernet0/0
R       10.0.4.0 [120/3] via 10.0.1.1, 00:00:07, FastEthernet0/0
```

Tristan BRAU
Léo PHAV

```
R8#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet0/0
R       10.0.3.0 [120/1] via 10.0.2.2, 00:00:12, FastEthernet0/0
R       10.0.1.0 [120/1] via 10.0.2.1, 00:00:02, FastEthernet0/0
R       10.0.4.0 [120/2] via 10.0.2.2, 00:00:12, FastEthernet0/0
```






```
R7#trace 10.0.4.10

Type escape sequence to abort.
Tracing the route to 10.0.4.10

  1 10.0.1.1 44 msec 64 msec 44 msec
  2 10.0.2.2 88 msec 88 msec 92 msec
  3 10.0.3.3 116 msec 124 msec 116 msec
  4 10.0.4.10 116 msec 116 msec 124 msec
R7#
```

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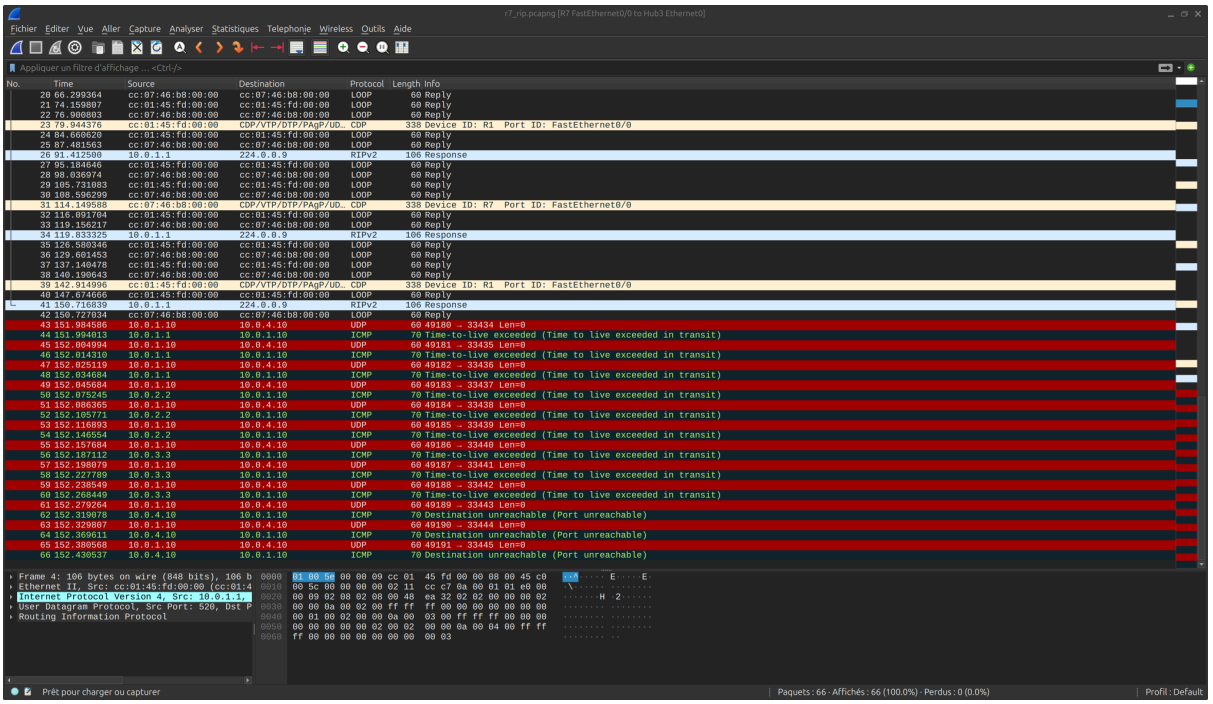

Lab Questions :

- Use the captured data of a single RIP packet and explain the fields in a RIP message.
- Analyze the output of trace from Step 8.
- Answer the following questions using the captured packets:
    - o What is the destination IP address of RIP packets?
    - o Do routers forward RIP packets? In other words, does Router5 receive RIP packets sent by Router8?
    - o What type of routing RIP messages do you observe? The type of a RIP message is indicated by the value of the field command. For each packet type that you observed, explain the role that this message type plays in the RIP protocol.
    - o A RIP message may contain multiple routing table entries. How many bytes are consumed in a RIP message for each routing table entry? Which information is transmitted for each message?

Tristan BRAU
Léo PHAV

Note : The RIP (Routing Information Protocol) is used to exchange routing information between routers so they know paths to remote networks.

1.

Field	Description
Command	Type of RIP message: 1 = Request, 2 = Response.
Version	RIP version, here 2.
Address Family Identifier (AFI)	Indicates the type of address (2 for IP).
Route Tag	Optional field for external routes.
IP Address	Destination network IP.
Subnet Mask	Mask of the destination network (RIPv2 only).
Next Hop	IP address of the next-hop router.
Metric	Hop count to the destination (1–15; 16 = unreachable).

2.

The trace shows the path packets take:
Router7 → Router1 → Router2 → Router3 → Router6.

Each hop represents a router along the route.
The RTTs show the time for packets to travel between hops.
RIP uses hop count as the metric, so the path chosen is the shortest number of hops according to the current routing tables.

3.

a. RIPv2 packets are sent to the multicast address 224.0.0.9, which ensures all RIP-enabled neighbors on the same segment receive updates.

b. No RIP packets are not forwarded beyond directly connected interfaces. That means that RIP packets are only sent to directly connected routers, not beyond.

c. Request (Command = 1): A router asks neighbors to send their routing tables.Response (Command = 2): A router sends its routing table to

neighbors. In the lab, most packets are Response messages, used to update neighbors' routing tables.

d. Each entry uses **20 bytes:**

1. AFI (2 bytes)
2. Route Tag (2 bytes)
3. IP Address (4 bytes)
4. Subnet Mask (4 bytes)
5. Next Hop (4 bytes)
6. Metric (4 bytes)

Information transmitted: destination network, subnet mask, next hop, metric, and optionally route tag.

PART 4. Reconfiguring the Topology in RIP

```
R1#ping 10.0.4.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms
R1#ping 10.0.2.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.2.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/62/68 ms
```

```
R6#ping 10.0.4.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/61/64 ms
R6#ping 10.0.2.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.2.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/71/88 ms
```

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
R       10.0.3.0 [120/1] via 10.0.2.2, 00:00:27, FastEthernet1/0
C       10.0.1.0 is directly connected, FastEthernet0/0
R       10.0.4.0 [120/1] via 10.0.2.4, 00:00:24, FastEthernet1/0
```

10.0.4.0 goes through 10.0.2.4 (and then 10.0.2.2).

```
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/1] via 10.0.2.1, 00:00:25, FastEthernet1/0
R       10.0.4.0 [120/1] via 10.0.3.3, 00:00:16, FastEthernet0/0
                 [120/1] via 10.0.2.4, 00:00:26, FastEthernet1/0
```

Tristan BRAU
Léo PHAV

Add 1 connection :

```
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.4.4, 00:00:22, FastEthernet1/0
                 [120/1] via 10.0.3.2, 00:00:19, FastEthernet0/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/2] via 10.0.4.4, 00:00:22, FastEthernet1/0
                 [120/2] via 10.0.3.2, 00:00:19, FastEthernet0/0
C       10.0.4.0 is directly connected, FastEthernet1/0
```

Add 2 connections :

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet1/0
R       10.0.3.0 [120/1] via 10.0.4.3, 00:00:11, FastEthernet0/0
                 [120/1] via 10.0.2.2, 00:00:05, FastEthernet1/0
R       10.0.1.0 [120/1] via 10.0.2.1, 00:00:24, FastEthernet1/0
C       10.0.4.0 is directly connected, FastEthernet0/0
```

```
R5#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.3.2, 00:00:05, FastEthernet0/0
C       10.0.3.0 is directly connected, FastEthernet0/0
R       10.0.1.0 [120/2] via 10.0.3.2, 00:00:05, FastEthernet0/0
R       10.0.4.0 [120/1] via 10.0.3.3, 00:00:06, FastEthernet0/0
```

Nothing changed

```
R6#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.4.4, 00:00:25, FastEthernet0/0
R       10.0.3.0 [120/1] via 10.0.4.3, 00:00:17, FastEthernet0/0
R       10.0.1.0 [120/2] via 10.0.4.4, 00:00:25, FastEthernet0/0
C       10.0.4.0 is directly connected, FastEthernet0/0
```

10.0.2.0 goes through 10.0.4.4 (and then 10.0.4.3).
Similarly, 10.0.4.4 goes through 10.0.2.4 (and then 10.0.2.1).

```
R7#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
R       10.0.2.0 [120/1] via 10.0.1.1, 00:00:18, FastEthernet0/0
R       10.0.3.0 [120/2] via 10.0.1.1, 00:00:18, FastEthernet0/0
C       10.0.1.0 is directly connected, FastEthernet0/0
R       10.0.4.0 [120/2] via 10.0.1.1, 00:00:18, FastEthernet0/0
```

```
R8#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 4 subnets
C       10.0.2.0 is directly connected, FastEthernet0/0
R       10.0.3.0 [120/1] via 10.0.2.2, 00:00:09, FastEthernet0/0
R       10.0.1.0 [120/1] via 10.0.2.1, 00:00:02, FastEthernet0/0
R       10.0.4.0 [120/1] via 10.0.2.4, 00:00:05, FastEthernet0/0
```

10.0.4.0 goes through 10.0.2.4 (and then 10.0.2.2).

```
R7#trace 10.0.4.10

Type escape sequence to abort.
Tracing the route to 10.0.4.10

  1 10.0.1.1 60 msec 56 msec 60 msec
  2 10.0.2.4 88 msec 80 msec 92 msec
  3 10.0.4.10 88 msec 88 msec 92 msec
```

Lab Questions :

• Compare the routing tables of the Routers before the topology was changed (Exercise 3(A)) and after Router4 was added and the routing tables converged (Exercise 4(A)).
• Discuss the time it took to update the routing tables.
• Compare the output of the trace in step 5 Exercise 4(A) to that of step 8 Exercise 3(A)

1.

Before Router4 (Exercise 3(A)):

Each router had routes to directly connected networks and remote networks learned via RIP from the other routers (Routers 1–3 and 5–8).
No paths existed to networks behind Router4 (10.0.4.0/24 and 10.0.2.4/24).

Tristan BRAU
Léo PHAV

After Router4 (Exercise 4(A)):

Router4 appears in the network, so RIP updates propagated its connected networks to all other routers.The routing tables now include additional routes to networks behind Router4, e.g., 10.0.4.0/24 and 10.0.2.4/24.Remote routes now reflect the new shortest paths via Router4 where applicable.

Observation: RIP automatically updated the tables, so routers now have a complete view of the topology including Router4.

2.

RIP sends updates every 30 seconds by default.
After adding Router4, it typically takes a few update cycles (60-90 mseconds) for all routers to converge with the new routes.
Convergence time depends on the number of routers and network size.

3.

Before Router4 (Exercise 3(A), Step 8):

Trace from Router7 to Router6 likely followed a longer path :
Router7 → Router1 → Router2 → Router3 → Router6

After Router4 (Exercise 4(A), Step 5):

With Router4 in the topology, RIP may have updated the shortest path:
Router7 → Router1 → Router4 → Router6

The trace shows fewer hops or a more optimal route depending on the metrics learned via RIP.

Observation: The addition of Router4 allows RIP to discover better paths, reducing hop count and improving routing efficiency.

Tristan BRAU
Léo PHAV

Exercise 4(B). Convergence of RIP after a link failure

```
R4#
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#inter
R4(config)#interface Fas
R4(config)#interface FastEthernet 0/0
R4(config-if)#shutdown
R4(config-if)#end
```

```
R4#ping 10.0.1.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.1.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 88/90/92 ms
```

Lab Questions

• Count the number of lost packets and calculate the time it took RIP to update the routing tables. (The ping command issues an ICMP Echo Request message approximately once every second.)

• How quickly are RIP messages sent after the cable is disconnected?

- o How many RIP messages are sent?
- o Which type of RIP packet is used for sending update information?
- o Describe the process propagation of information to all routers. Which type of encapsulation is used for RIP packets (TCP, UDP, or other)?