Routing protocols: RIP and OSPF Dynamic Routing

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1 Objective

The purpose of this lab is to analyze and compare the behavior of two routing protocols : **the Routing Information Protocol (RIP)**, a distance-vector protocol, and **Open Shortest Path First (OSPF)**, a link-state protocol. The experiments focused on how routes are discovered, how updates propagate, how failures are handled, and how convergence times differ.

2 Topology and Setup

The experiments use a **Netkit** network with four routers (R1–R4) interconnected and multiple links configured to test both RIP and OSPF. **Wireshark** is employed to capture routing updates and analyze protocol behavior.

3 Procedure and Results

3.1 Routing Information Protocol (RIP)

At the start, the forwarding table of R1 only contained directly connected destinations. Once the RIP daemon was launched on R2, it advertised its known destinations, their distance (metric in hop count), and the next hop to reach them. R1 updated its forwarding table accordingly. As R3 and R4 joined, their routing information propagated as well, until all destinations became reachable from R1.

Captured RIP packets showed advertisements of destination networks, associated metrics, and next hops. A metric value of 16 was sometimes observed, which represents infinity in RIP (since the maximum hop count is 15). This mechanism is used to signal unreachable routes. For example, if router A uses router B to reach router C, A advertises to B that the route to C has a metric of 16. This technique, called *poisoned reverse*, prevents routing loops by ensuring that B does not continue to use A as a path to C.

In the stable topology, the chosen path from R2 to R4 was :

$$R2 \rightarrow R3 \rightarrow R4$$

When the interface `eth2` of R3 was shut down, traceroute from R2 to R4 initially failed for about 15 seconds. During this time, R2 still attempted to use the old path via R3, which was no longer available. After the forwarding table updated, R2 recalculated the route to R4 as :

$$R2 \rightarrow R1 \rightarrow R4$$

The metric increased from 2 to 3, reflecting the longer path.

In the case of a complete router failure (R3 removed), convergence required about 1–2 minutes, as routing updates propagated at periodic intervals. Unlike a single link failure, where traceroute continued searching until another path was found, here traceroute returned errors until tables stabilized. RIP's reliance on periodic updates and its timers explained this slower recovery.

3.2 Open Shortest Path First (OSPF)

In the **OSPF** experiment, the backbone routers (bb0–bb4) were assigned IP addresses as follows :

- bb0 : 10.0.2.3
- bb1 : 10.0.3.1
- bb2 : 10.0.1.1
- bb3 : 10.0.2.2

— bb4 : 10.0.3.2

Routers exchanged *Link State Advertisements* (LSAs), which contained information about destination, source, checksum, flags, Area ID, collision domains, and link costs. These LSAs propagated throughout the network, allowing every router to build a complete view of the topology. With this global knowledge, each router computed the shortest paths using Dijkstra's algorithm.

The link costs were configured as :

— x0 : 10
— x1 : 45
— y0 : 21
— y1 : 36
— z0 : 10
— z1 : 10

The optimal path from `bb1` to `10.0.2.1` was :

$$bb1 \rightarrow bb2 \rightarrow bb3 \rightarrow 10.0.2.1$$

This path avoided the high-cost links x1 and y1, instead preferring multiple lower-cost links. The total cost of 41 was the lowest possible.

OSPF updates were nearly instantaneous. For example, when a link failed, the state change was multicast across the relevant collision domains and rapidly propagated through the network. In practice, convergence required only about ten seconds, significantly faster than RIP.

4 Analysis

The experiments confirmed key differences between RIP and OSPF :

— RIP relies on periodic distance-vector updates and has slow convergence, making it unsuitable for large or dynamic networks.
— RIP uses poisoned reverse to mitigate loops but still suffers from count-to-infinity issues.
— OSPF propagates LSAs quickly, enabling fast convergence and better scalability.
— OSPF's cost-based metrics ensure that paths are chosen based on efficiency rather than simple hop count.

5 Conclusion

This lab demonstrated the fundamental differences between distance-vector and link-state routing protocols. RIP highlighted the limitations of hop-based metrics and periodic updates, while OSPF showed the efficiency of global topology knowledge and shortest-path computation. Overall, OSPF provided faster convergence, more accurate routing decisions, and greater scalability compared to RIP.