ﷺ Routing Protocol Simulation Report – ns-3

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Course / Assignment: Routing Protocol Simulation in ns-3
Simulator: ns-3
Routing Protocols Studied:

- **RIP** (Dynamic Distance Vector)
- **Global Routing** (Static Link State Initialization)

1. Introduction

This experiment evaluates the behavior of **static vs dynamic routing protocols** in ns-3 under normal operation and after the introduction of a link failure.

The routing protocols studied are:

Global Routing (Link-State, Static in this simulation)

- Computes routes **once at the beginning**.
- Does **not** recompute after link failures.
- Behaves as a **static routing protocol** in this assignment.

RIP (Routing Information Protocol – Distance Vector, Dynamic)

- Updates routing tables **periodically**.
- Automatically adapts to **link failures**.
- Behaves as a **dynamic routing protocol**.

Traffic flow in the network:

- **Source:** Node 1 → 10.0.1.1
- **Destination:** Node 6 → 10.0.3.2

The tasks performed were:

- Compare performance of RIP and Global Routing without link failure
- Introduce a link failure and measure performance
- Log routing tables and identify gateway changes
- Extend topology and analyze effects on packet delivery

2. Q1 — Results Without Link Failure

The original topology was simulated **with no link failure**.

Results (from simulation output):

Protocol	Packet Delivery Ratio	Packets Delivered
RIP	**97.2103%**	**177,278**
Global Routing	**97.2103%**	**177,279**

Explanation

Both protocols perform almost identically because:

- No link breaks during the simulation
- Routing tables remain valid
- The topology is simple and loop-free
- Both use the same shortest path N1 → N2 → N3 → N6

3. Q2 — Results With Link Failure (N2–N3 at 20s)

A link failure was simulated at **t = 20 seconds** between **Node 2** ↔ **Node 3**.

Results (from simulation output):

Protocol	Packet Delivery Ratio	Packets Delivered
RIP	**41.7496%**	**75,252**
Global Routing	**6.16565%**	**11,252**

Explanation

Global Routing fails (PDR = 6%)

- Does **not recompute** routes after failure
- Continues to send packets into the broken N2–N3 link
- Almost all packets are dropped

RIP adapts (PDR = 41%)

- Detects link failure
- Exchanges routing updates
- Eventually switches to an alternate path via **Nodes 4 → 5 → 6 ●**

Some packet loss occurs during RIP convergence

4. Q3 — Routing Table Analysis

Routing-table logging was enabled, producing:

- **rip-routing.routes**
- **global-routing.routes**

We examined the gateway for **destination 10.0.3.2** at different times.

Gateway Comparison Table

Time Gateway (Global Routing) Gateway (RIP) 10 sec Same

static gateway Initial gateway (before failure) **60 sec** No change

Updated gateway after failure

120 sec
No change Updated
180 sec **240 sec**

change Updated

300 sec
No change Updated No

change Updated No

Justification: RIP is Dynamic

- Global Routing **never changes** → confirms static behavior ● RIP gateway **changes after link failure** → confirms dynamic behavior ● RIP recomputes routes based on new topology conditions

Reason for PDR Differences (from Q2)

- **RIP recovers** by selecting an alternate path → moderate PDR ● **Global Routing never recovers** → near-total packet loss

5. Q4 — Extended Topology (Adding Nodes 7 and 8)

Topology was extended with two new nodes:

3 — 7 — 8 — 6

New networks introduced:

- 10.0.8.0/24
- 10.0.9.0/24
- 10.0.10.0/24

Results After Rerunning Simulation

- **Packet delivery ratio increases significantly ● Both RIP and Global Routing deliver the same PDR ● Packet loss becomes minimal**

Explanation (Supported by Routing Tables)

The reason for improved and equal performance:

Before:

Only one alternate path existed → RIP needed time to converge.

After Adding Nodes 7 and 8:

- A **redundant, stable alternate path** exists:
  N3 → N7 → N8 → N6
- Global Routing computes this path **from the start** ● RIP converges quickly because more valid next-hops exist ● Even after the N2–N3 failure, both protocols still have:
  - A working path
  - No need for long convergence
  - No dead-end forwarding

Routing Tables Confirm

Both protocols choose the path via **Nodes 7 and 8**. Hence,

PDR for RIP and Global Routing becomes **identical**.

6. Conclusion

This assignment demonstrates:

- Without link failure, RIP and Global Routing perform equally well

- After link failure:
    - **Global Routing collapses** (static, no recalculation)
      RIP adapts dynamically (recalculates routes)

- Routing tables prove:
    - Global Routing → static gateway
    - RIP → gateway changes after failure

- Adding nodes 7 and 8 provides redundancy, stabilizing routing ● Both protocols then achieve **high and equal PDR**

Final Conclusion:

RIP is dynamic and adjusts to network changes.
Global Routing is static and fails under topology changes.