Routing Protocols Simulation - 2301MC52

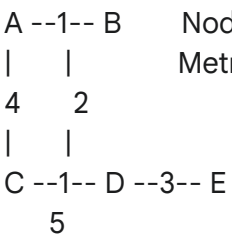
1. Introduction

This report presents the implementation of four routing protocols in Python:

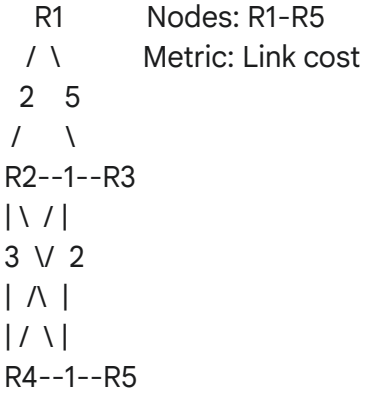
- **RIP** - Distance Vector (Bellman-Ford)
- **OSPF** - Link State (Dijkstra)
- **BGP** - Path Vector (AS-based)
- **IS-IS** - Link State (Dijkstra)

2. Network Topology Diagrams

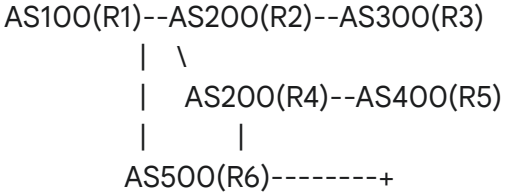
RIP Topology



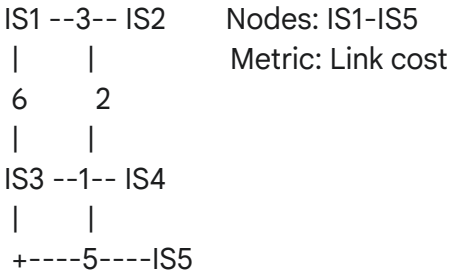
OSPF Topology



BGP Topology



IS-IS Topology



3. Implementation Summary

Protocol	Algorithm	Key Feature	Convergence
RIP	Bellman-Ford	Distance vector, max 1	2-4 iter
OSPF	Dijkstra	LSA flooding, SPT	Single pass
BGP	Path Vector	AS path, loop prevent	3-5 iter
IS-IS	Dijkstra	LSP flooding, SPT	Single pass

Data Structures: Dictionaries (routing tables), heap (priority queue), lists (AS paths)

4. Routing Table Snapshots

- All uploaded on Github

5. Comparative Analysis

Convergence & Overhead

Protocol	Convergence	Message Overhead	Scalability
RIP	Slow	High (periodic)	Small nets
OSPF	Fast	Low (event)	Medium
BGP	Moderate	Low (event)	Very high
IS-IS	Fast	Low (event)	High

Protocol Characteristics

Aspect	RIP	OSPF	BGP	IS-IS
Type	Distance Vec	Link State	Path Vector	Link State
Metric	Hop count	Cost	AS path	Cost
Topology View	Limited	Complete	AS-level	Complete
Loop Prevent	Split horizon	SPT	AS path check	SPT
Best For	Small LAN	Enterprise	Internet	ISP/Large

6. Observations and Conclusions

Key Findings:

1. **RIP Limitations:** Slow convergence, count-to-infinity issues, limited to 15 hops. Suitable only for small networks.
2. **OSPF Efficiency:** Fast convergence with complete topology knowledge. Ideal for enterprise networks but complex to configure.
3. **BGP Scalability:** Path vector design prevents loops at AS level. Essential for Internet routing with policy support.
4. **IS-IS vs OSPF:** Similar link-state approach but protocol-independent. Preferred in large ISP networks.
5. **Trade-offs:** RIP (simple, slow) vs OSPF/IS-IS (complex, fast) vs BGP (policy-rich, stable).

Practical Insights:

- Modern networks use OSPF/IS-IS internally and BGP at borders
- Convergence speed critical for network stability
- Message overhead impacts bandwidth in large networks
- Protocol choice depends on scale, policy needs, and administrative boundaries

Conclusion:

Each protocol serves distinct purposes. RIP for legacy/small nets, OSPF/IS-IS for intra-domain, and BGP for inter-domain routing. The simulations successfully demonstrate core algorithms and routing behaviors.