Performance & Analysis of RIP, OSPF and EIGRP Routing Protocols using OPNET

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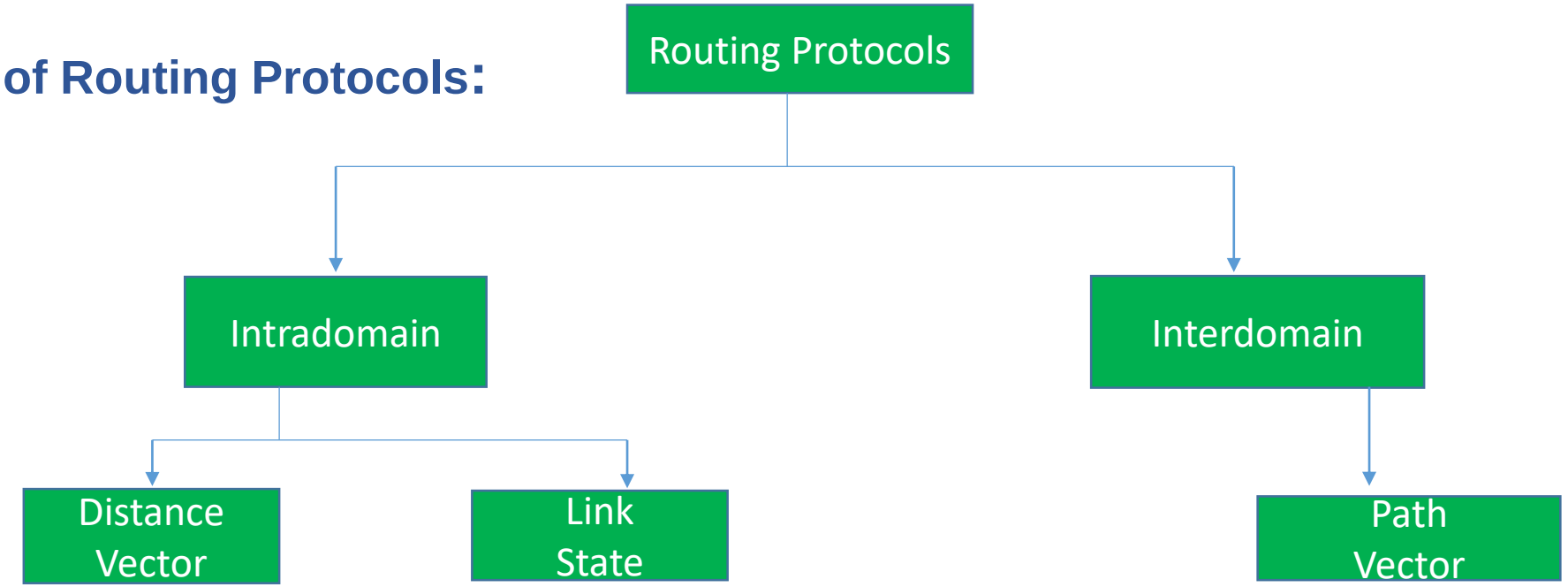
Objective

- Analyze the performance of the following routing protocols:
  - RIP: Routing Information Protocol
  - OSPF: Open Shortest Path First
  - EIGRP: Enhanced Interior Gateway Routing Protocol
- Create small and large network topologies to evaluate the impact of network size on routing behavior
- To compare the performance of RIP, OSPF, and EIGRP routing protocols and suggest best routing protocol for a given network topology

Intra and Interdomain routing

- Routing inside in an autonomous system called inter domain
- Routing between autonomous system called intra domain
- An **Interdomain routing protocol**: BGP (Border Gateway protocol)
- An **intra-domain routing protocol**: RIP, EIGRP, OSPF or IS-IS

- **Classification of Routing Protocols:**



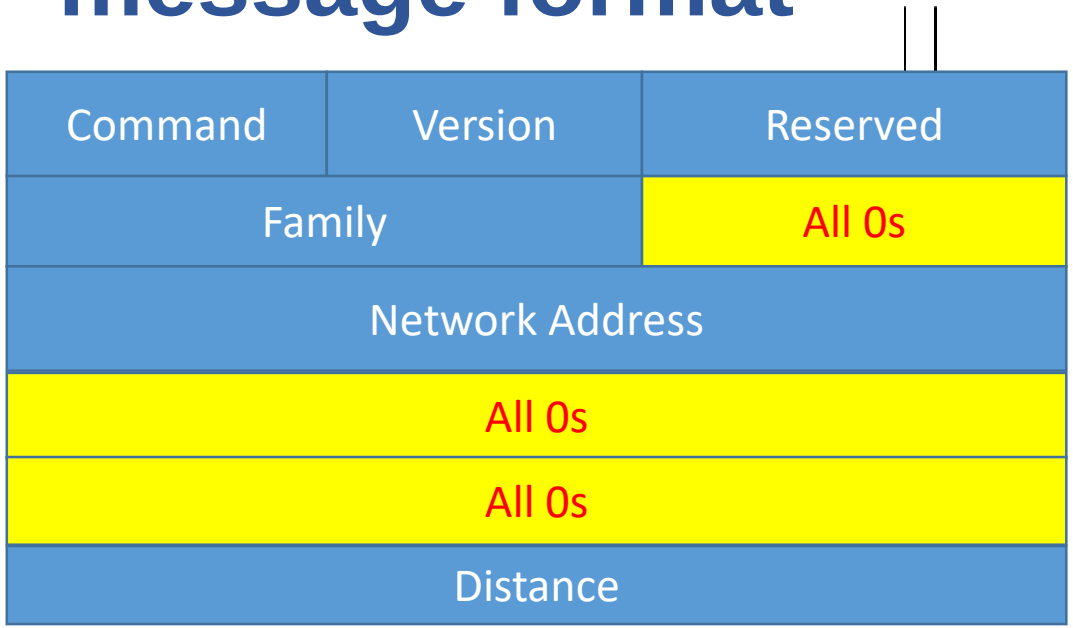
Routing Information Protocol (RIP)

- First routing protocol implemented on TCP/IP
- Distance-vector algorithm
- Uses a hop count mechanism for optimal path.
- Max 16-hop count is used to prevent infinite loops
- Advantage: Simple & easy to implement
- Disadvantage: Network size limitation

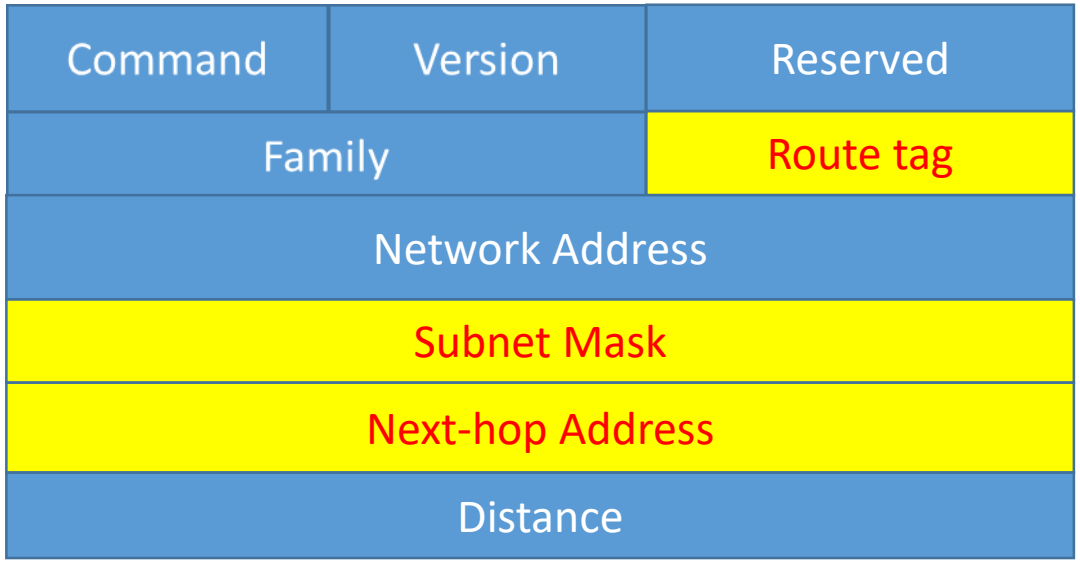
➢Distance Vector Routing:

- RIP is simply an implementation of Distance Vector routing
- Routers running RIP, send their advertisements on every 30 seconds, a router also sends an update message whenever update from the other routers causing to change routing tables.

RIP message format



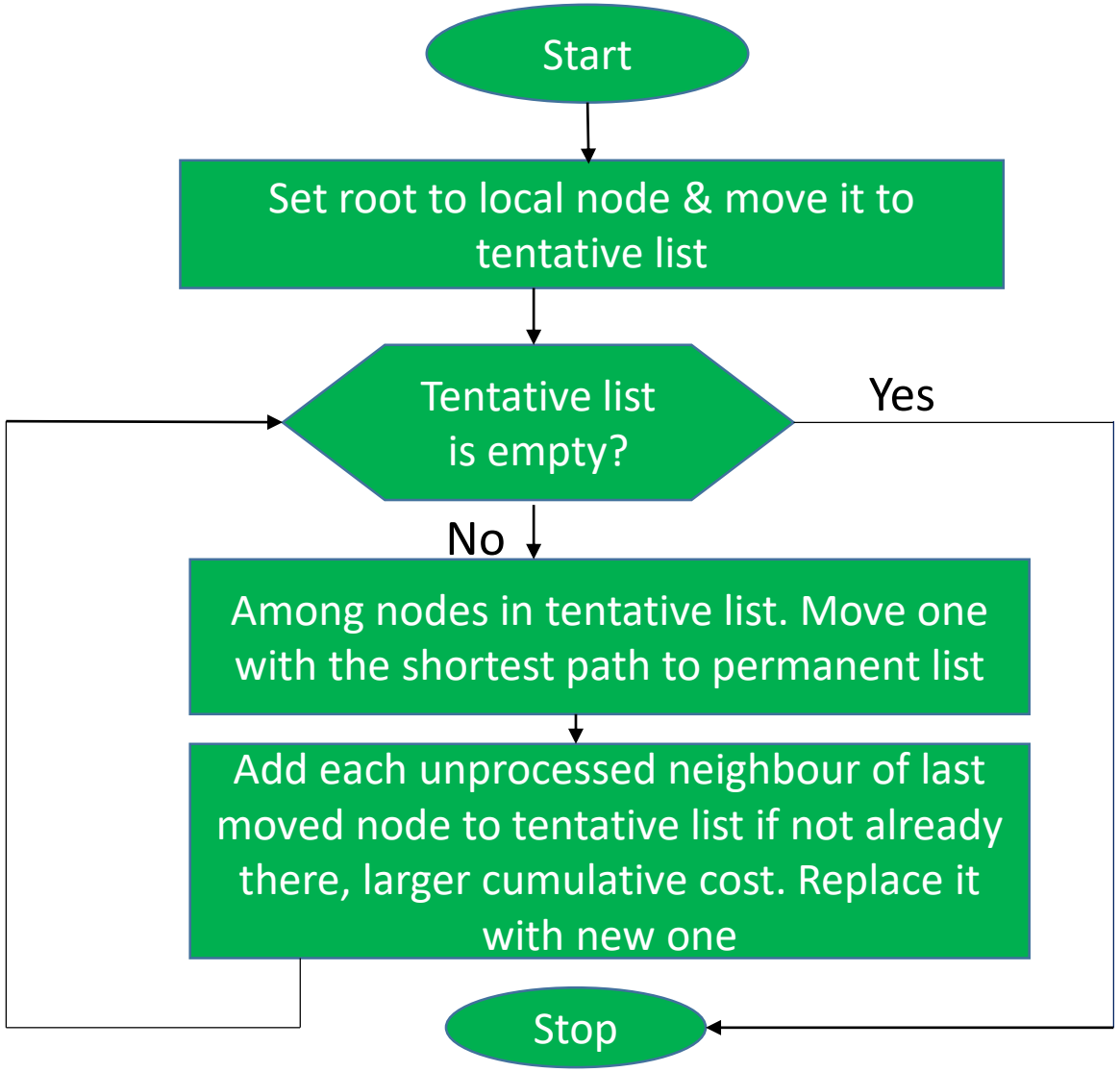
RIP version-2 format



Open Shortest Path First (OSPF)

- Link-state algorithm
- Uses Djisktra's algorithm to find the shortest path to a destination
- Send different types of messages:
  - ❖ Hello
  - ❖ Database Description
  - ❖ Link State Request, Update, and Acknowledgement
- Advantage: Fast detection of topology changes, flexibility in modifying parameters.
- Disadvantage: Most complex routing protocol

Djisktra's algorithm

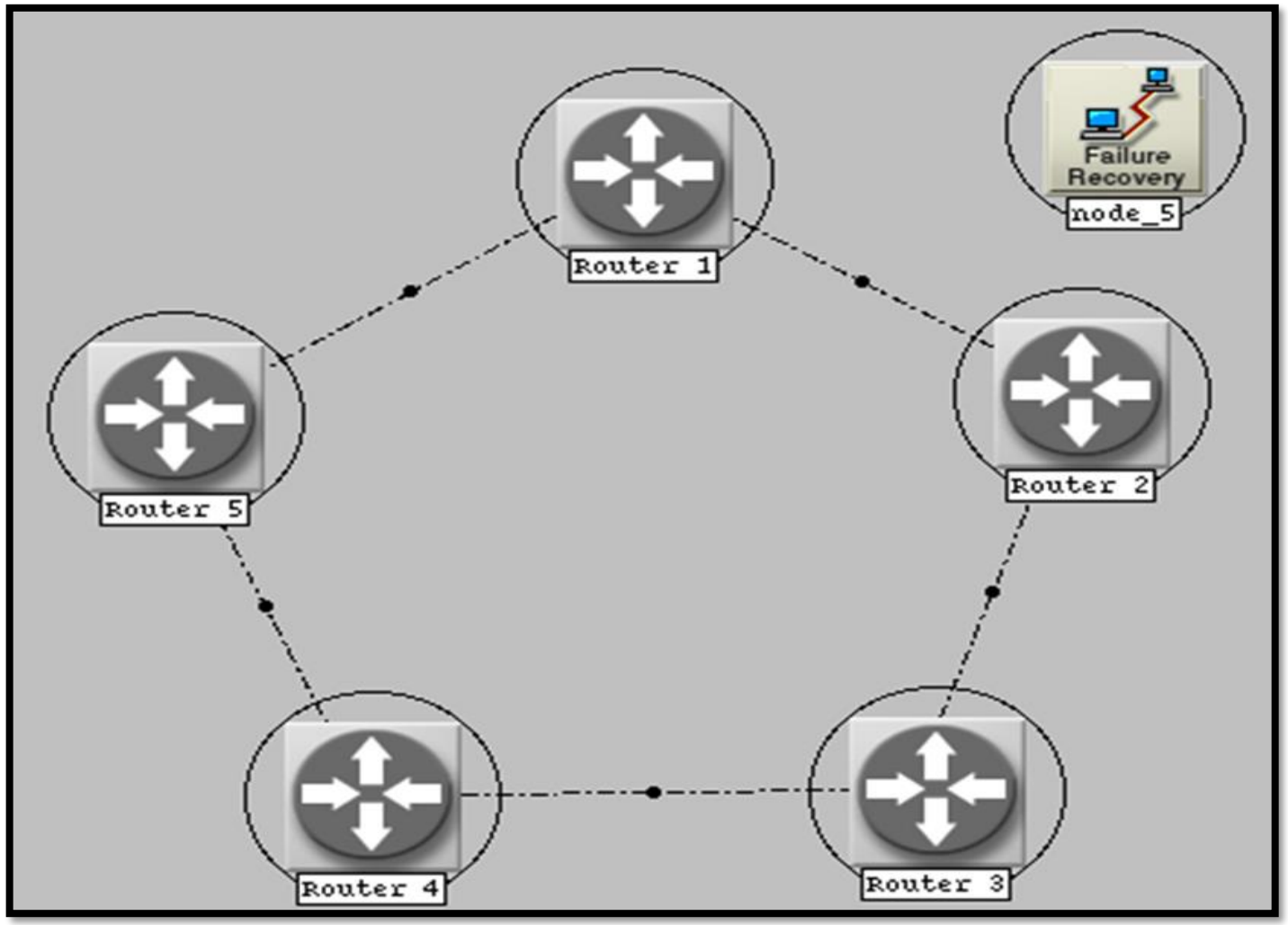


Enhanced Interior Gateway Routing Protocol (EIGRP)

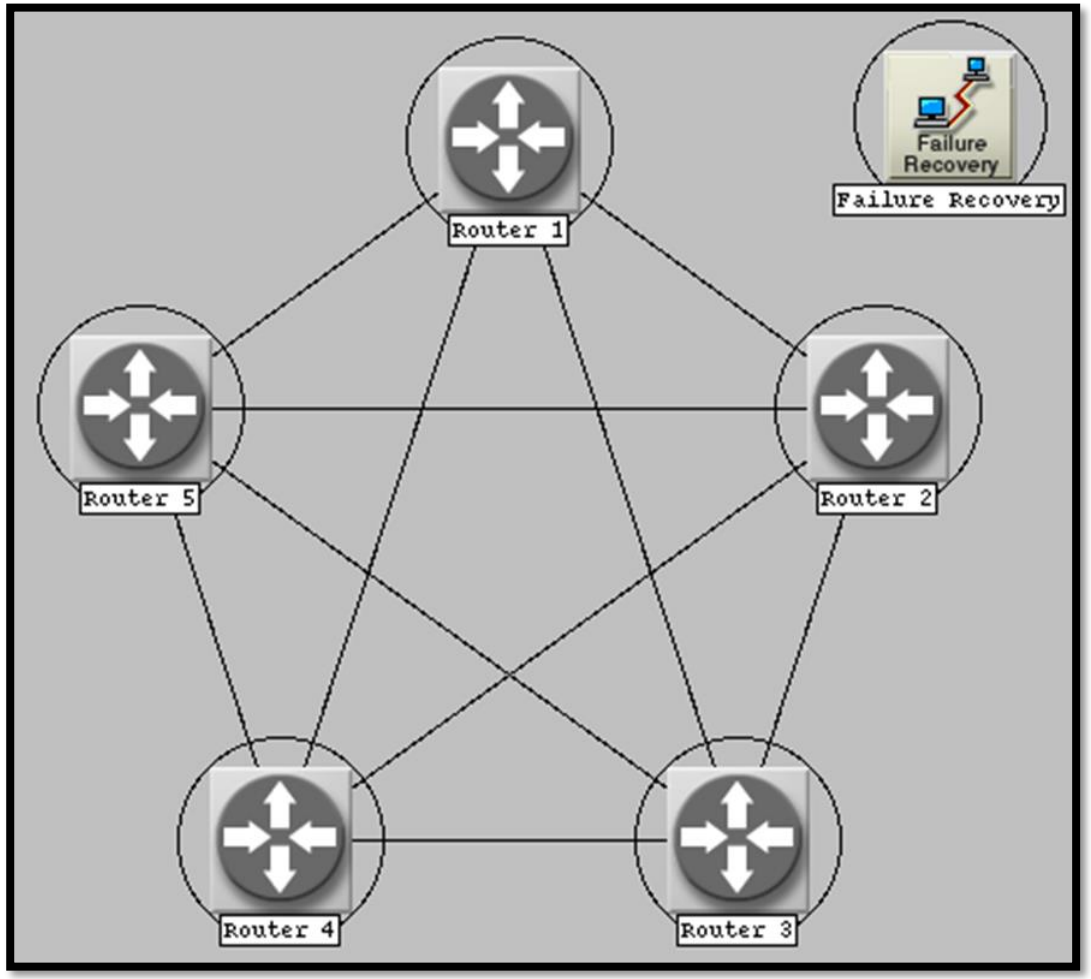
- Advanced distance-vector algorithm
- Full routing information only exchanged once upon neighbor establishment, after which only partial updates are sent
- Advantage: Reduces traffic by using “need-based” updates
- Disadvantage: Proprietary protocol (only compatible with Cisco technology)

Network Topologies: Ring

- **Link failure from 300 – 480 seconds (between Router 1 & 2)**

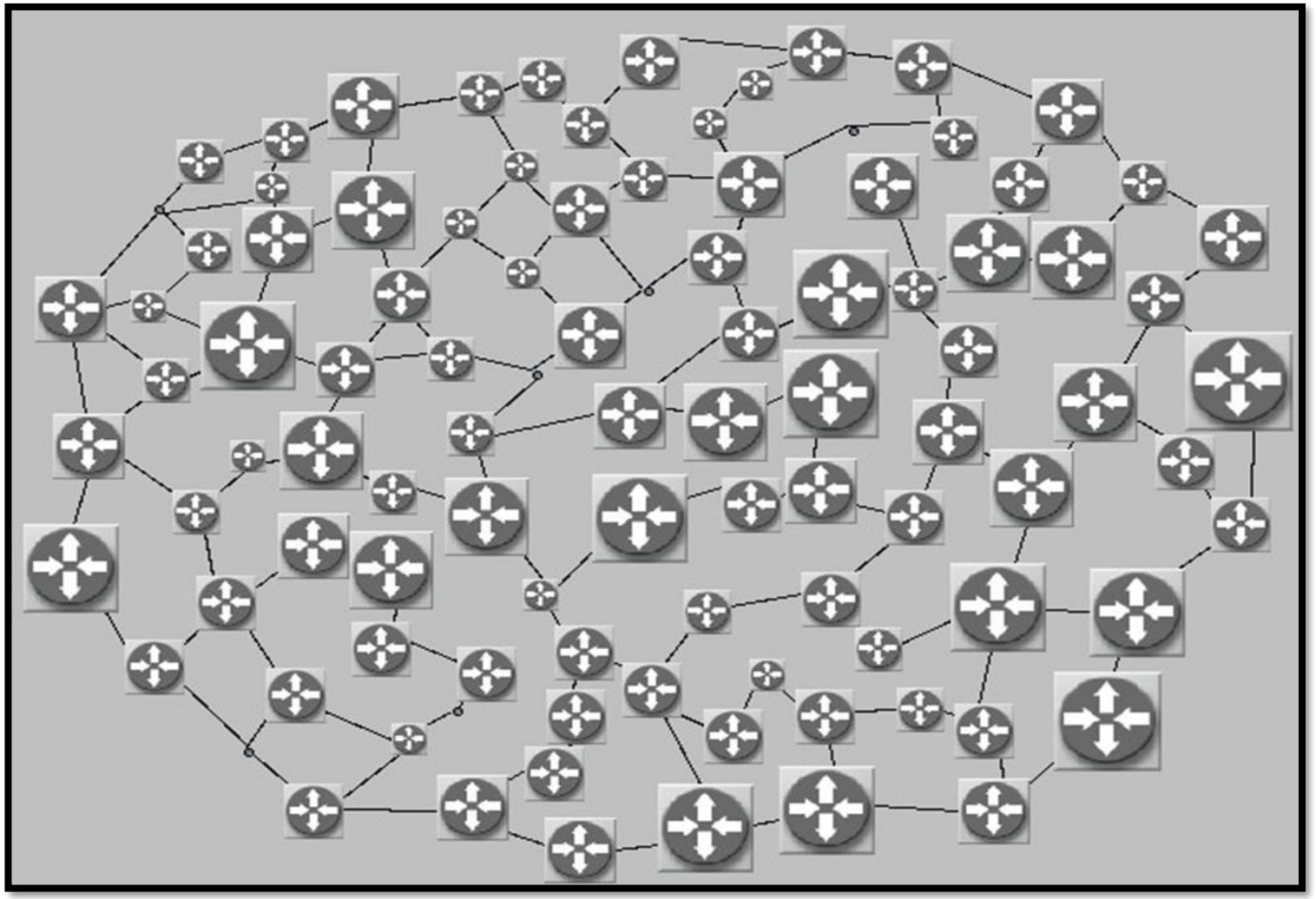


Network Topologies: Mesh



Network Topologies: Random Big Topology

100 routers, 2 -3 link per node



Analysis and Results for Ring, Mesh and Big Mesh Topology

- RIP Properties:
  - Max hop count: 16
  - Update Interval: 30 seconds

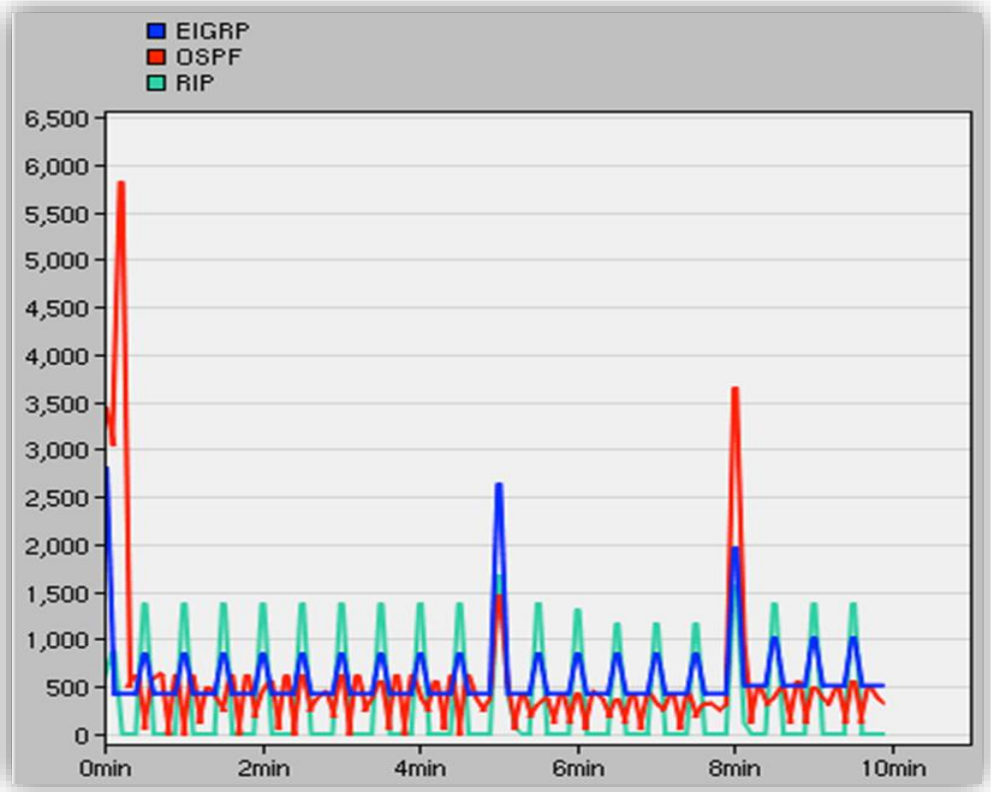
- OSPF Properties:
  - Interface costs
  - Hello interval and router dead interval: 10 and 40 seconds

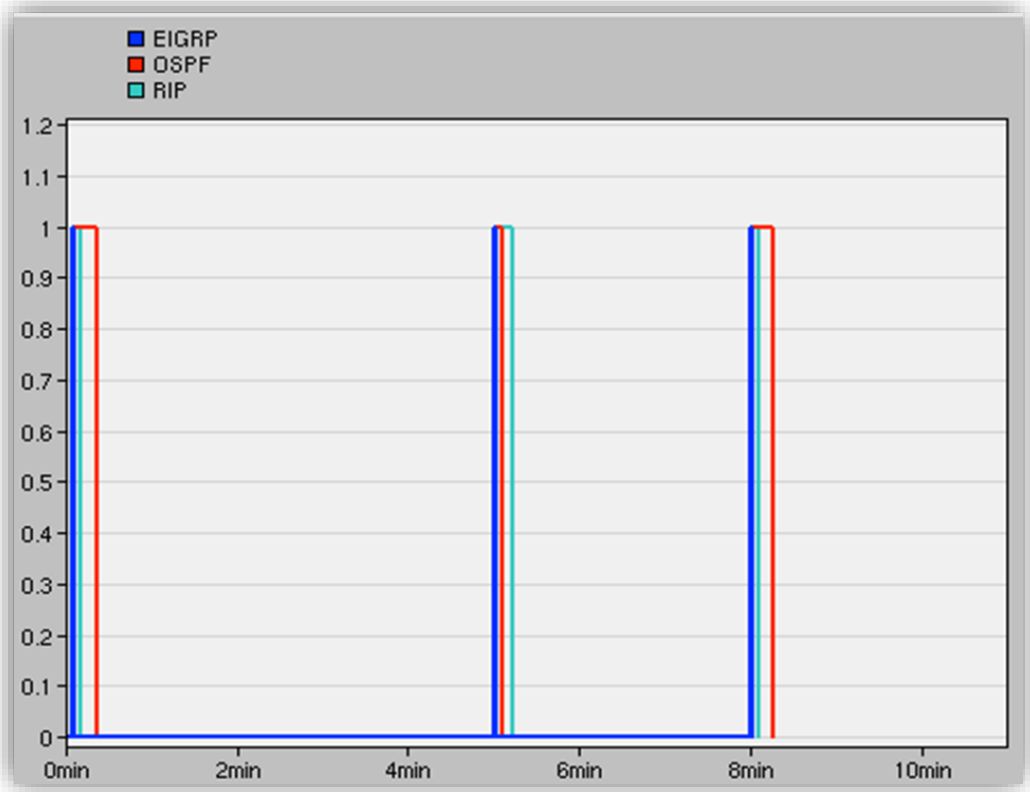
- EIGRP Properties:
  - Max hop count: 100
  - Hello interval and hold time: 5 and 15 seconds

Results: of Ring Topology

Graph shows initial setup, link-failure, and link recovery in the network

- **Convergence activity: EIGRP is fastest.**
- **Traffic Sent (bits/sec): OSPF sends most packets at initialization & has highest initial peak**
- **EIGRP has the highest bandwidth efficiency while RIP has lowest & OSPF has better than EIGRP.**





Initial Convergence:

RIP: 4 sec

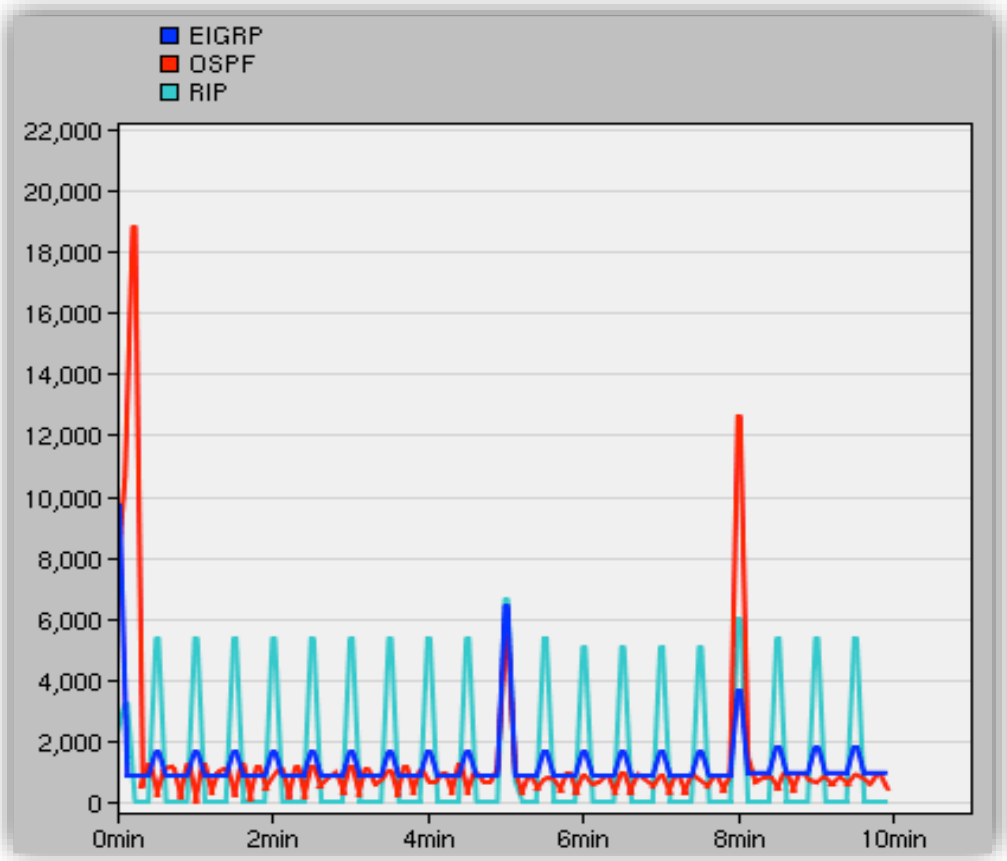
OSPF: 15 sec

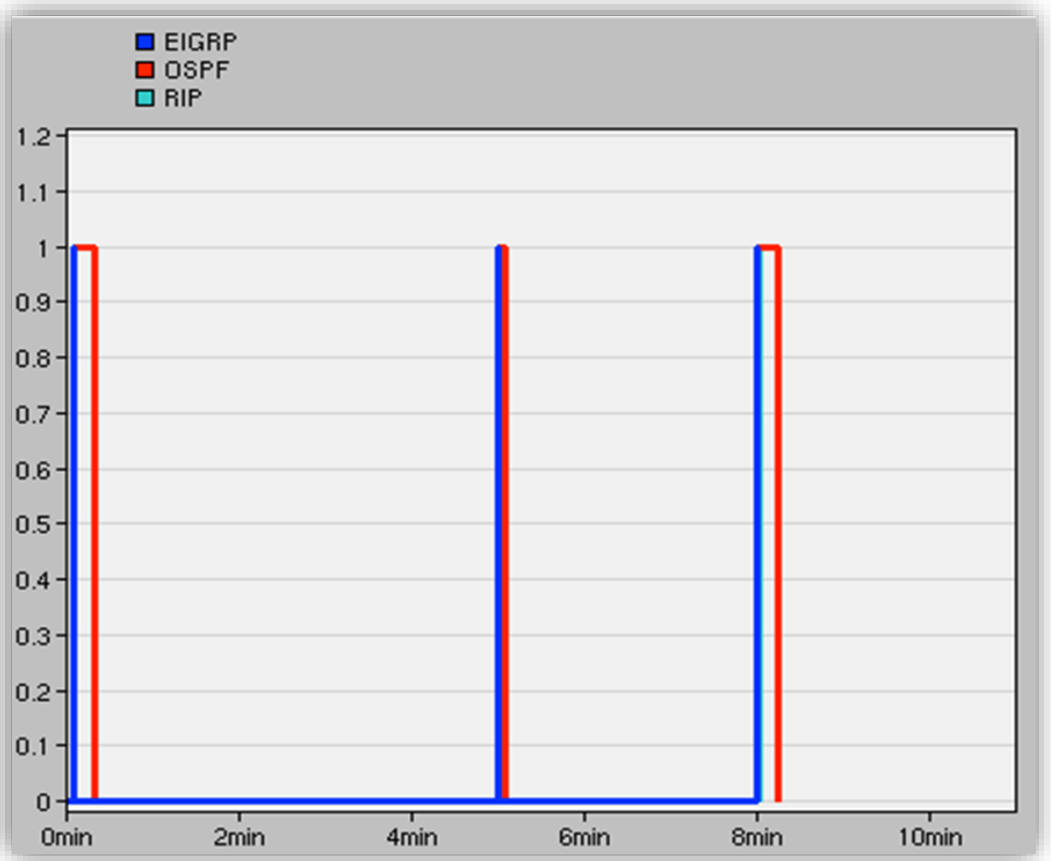
EIGRP: < 1 sec

Results: Mesh Topology

Graph shows initial setup, link-failure, and link recovery in the network

- **Convergence activity: OSPF is slowest**
- **Traffic Sent (bits/sec): Similar to Ring results**





Initial Convergence:

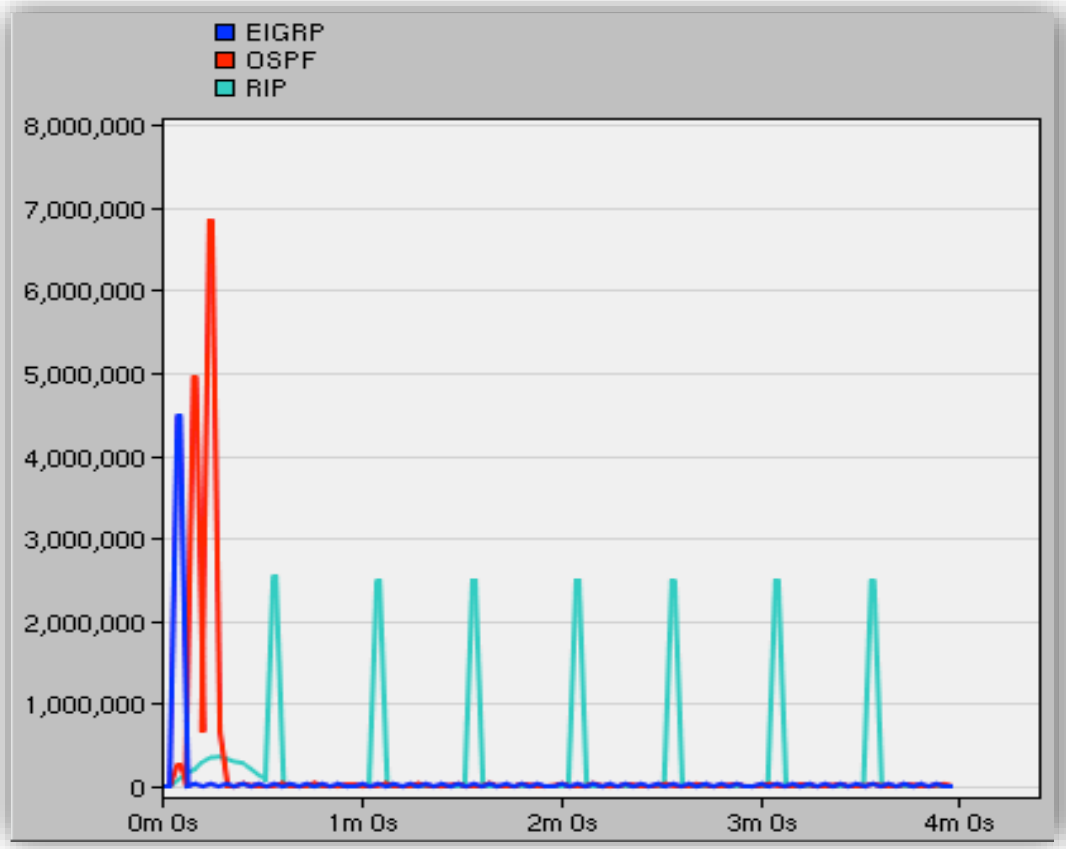
RIP: < 1 sec

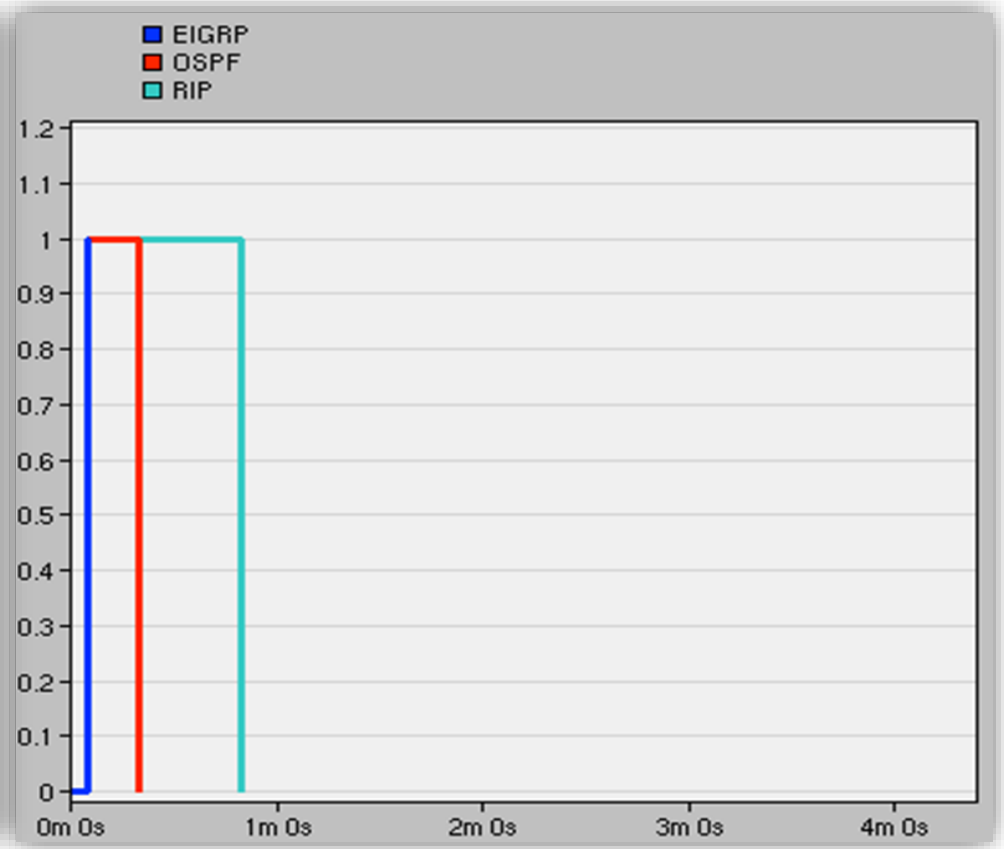
OSPF: 15 sec

EIGRP:< 1sec

Results: Big Random Topology

- **Convergence activity: EIGRP significantly faster.**
- **Traffic Sent (bits/sec): RIP wastes bandwidth**





Initial Convergence:
RIP: 45 sec

OSPF: 15 sec

EIGRP: < 1 sec

Conclusion

- EIGRP: has fastest convergence for all network topologies and uses bandwidth efficiently
- OSPF: performs better than RIP on larger topologies
- RIP:
  - Outperforms OSPF for small topologies
  - For large topologies RIP wastes bandwidth with full periodic updates

Future Works

- Improvement or future works for this project can include adding metrics on interfaces such as cost, bandwidth, distance, Bit Error Rate (BER), and delay

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- [1] D. Xu. “OSPF, EIGRP, and RIP performance analysis based on OPNET.”Internet: www.sfu.ca/~donx, [Mar. 15, 2013].
- [2] B. Wu. “Simulation Based Performance Analyses on RIPv2, EIGRP, and OSPF Using OPNET.” Internet: http://digitalcommons.uncfsu.edu/cgi/viewcontent.cgi?article=1011&context=macsc_wp, Aug. 20, 2011, [Mar.15, 2013]
- [3] U.D. Black, in IP routing protocols : RIP, OSPF, BGP, PNNI, and Cisco routing protocols, Upper Saddle River, NJ: Prentice Hall, 2000.