OSPF, EIGRP, and RIP Performance Analysis Based on OPNET

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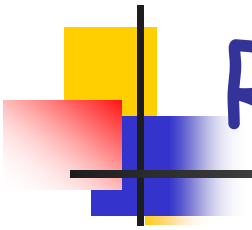


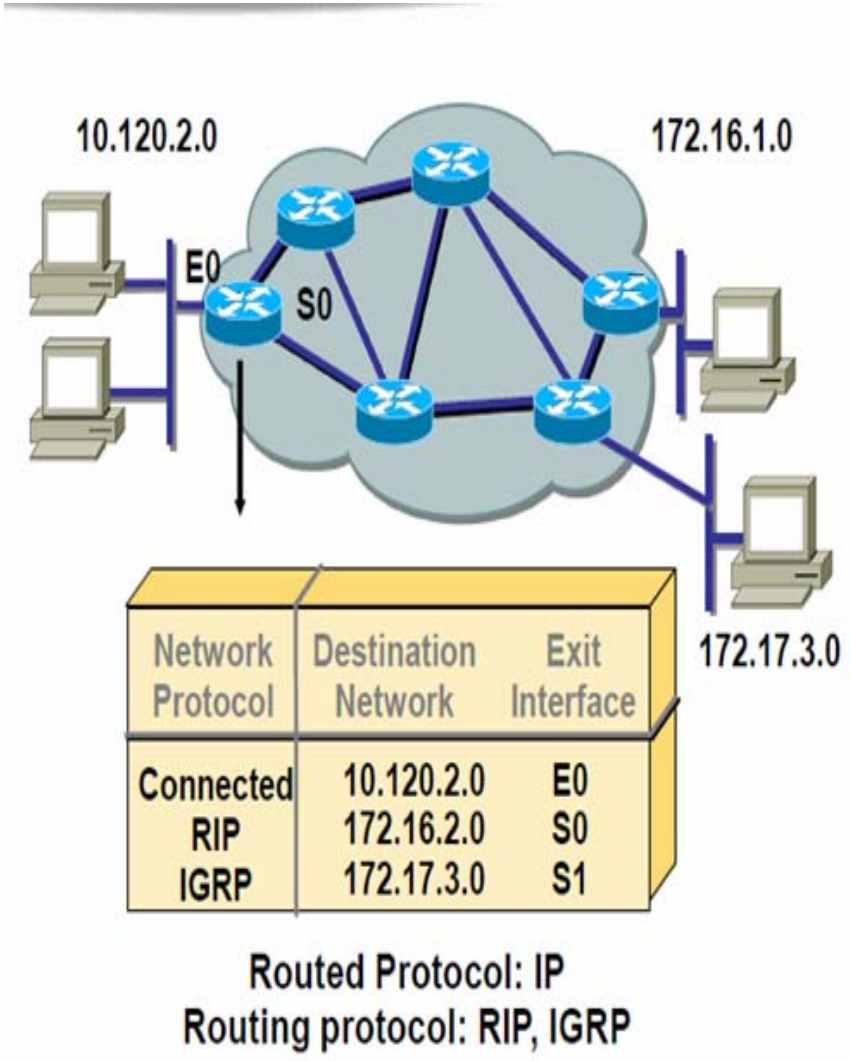
Roadmap

- Routing Protocol
- Routed Protocols Vs. Routing Protocols
- IGP Vs. EGP
- DV Vs. LS
- RIP,EIGRP, and OSPF
- OPNET Simulation
- Conclusion

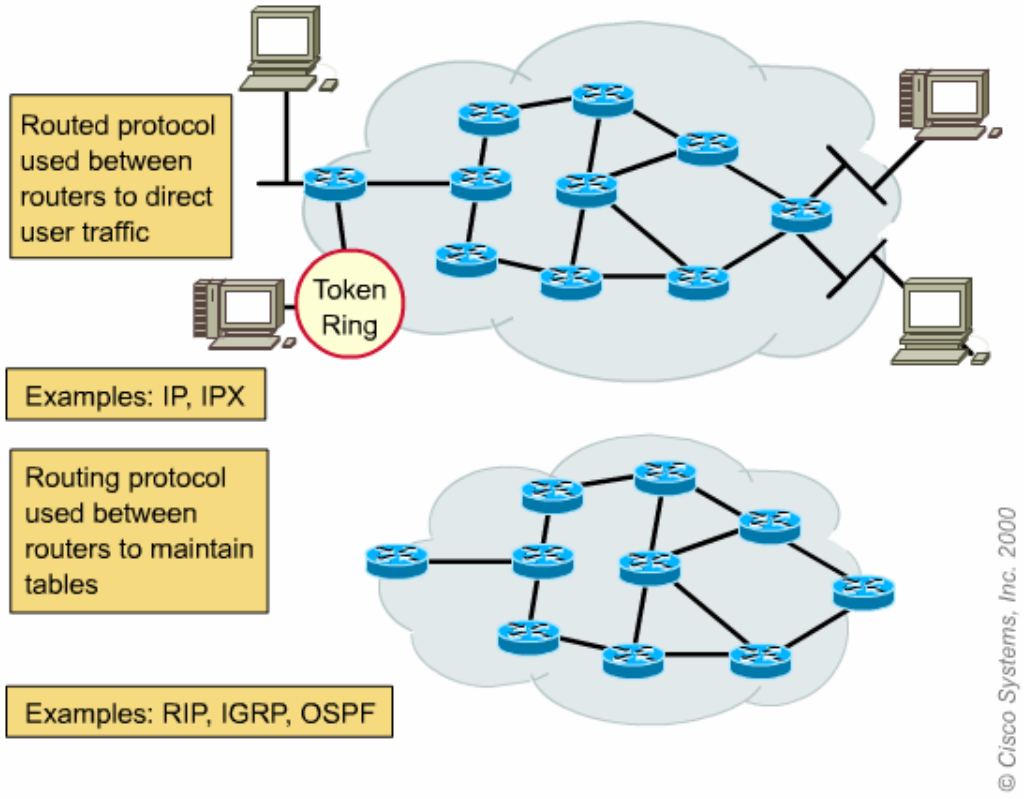
What is a Routing Protocol?

- Routing Protocols are used between routers to determine paths and maintain routing tables

- Once the path is determined a router can route a routed protocol



Routed Protocols Vs. Routing Protocols



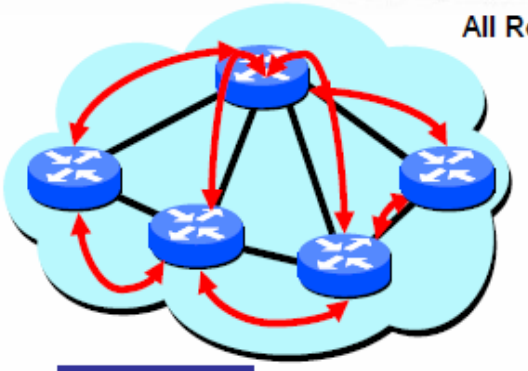
Routing protocols determine the path that routed protocols follow to their destinations.

Routing Categories

Autonomous System

- An Autonomous System (AS) is a group of IP networks, which has a single and clearly defined routing policy.
- Group of routers which can exchange updates
- AS are identified by numbers

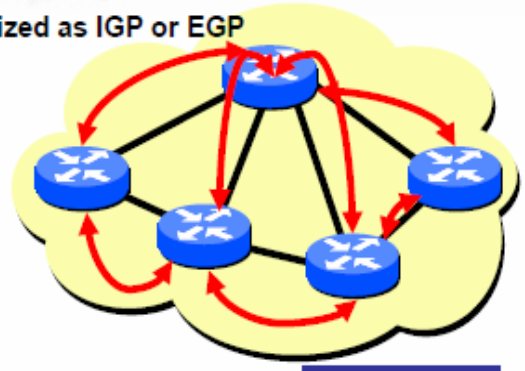
All Routing protocols are categorized as IGP or EGP



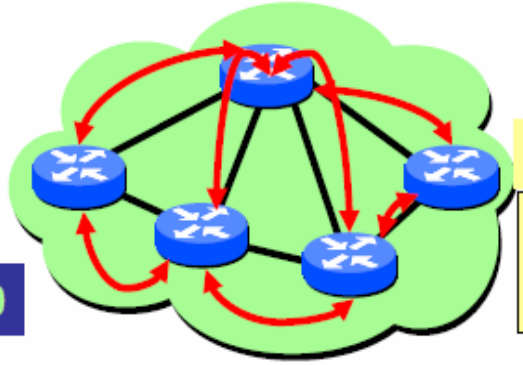
AS 1000

EGP

Exterior Gateway Protocols are used for routing between Autonomous Systems



AS 3000



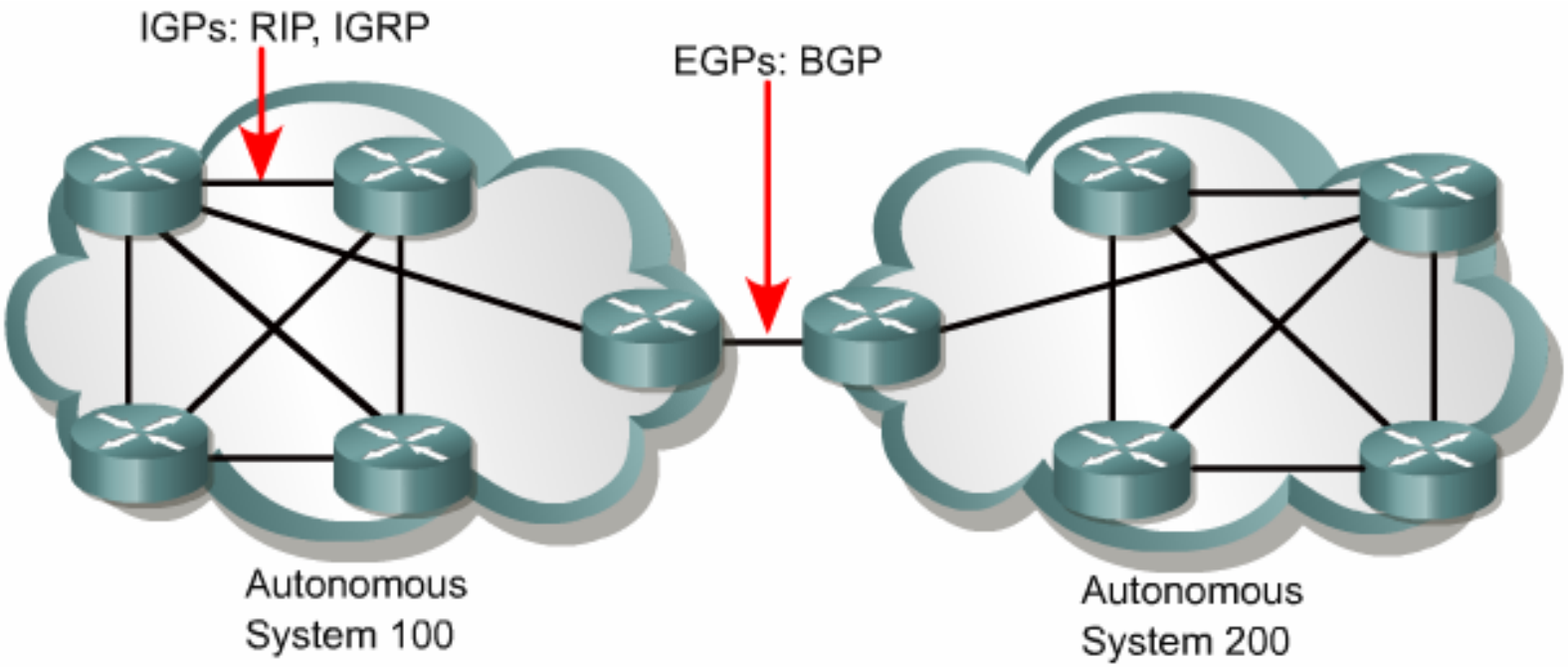
AS 2000

IGP

Interior Gateway Protocols are used for routing decisions within an Autonomous System.

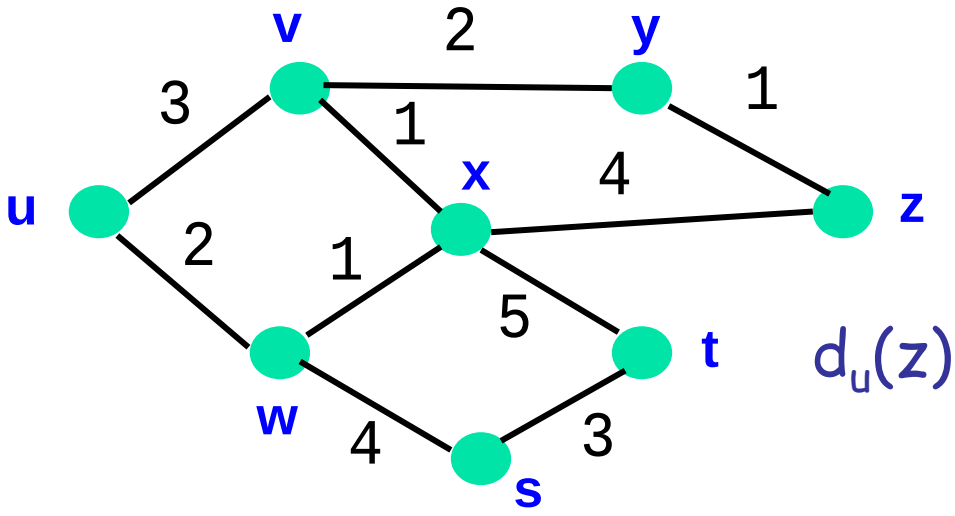
IGP Vs. EGP

- IGPs route data within an autonomous system.
  - RIP, RIPv2, IGRP, EIGRP, OSPF, IS-IS
- EGPs route data between autonomous systems
  - Border Gateway Protocol (BGP)



Distance Vector Routing: Bellman-Ford

- Define distances at each node x
  - $d_x(y)$ = cost of least-cost path from x to y
- Update distances based on neighbors
  - $d_x(y) = \min \{c(x,v) + d_v(y)\}$ over all neighbors v

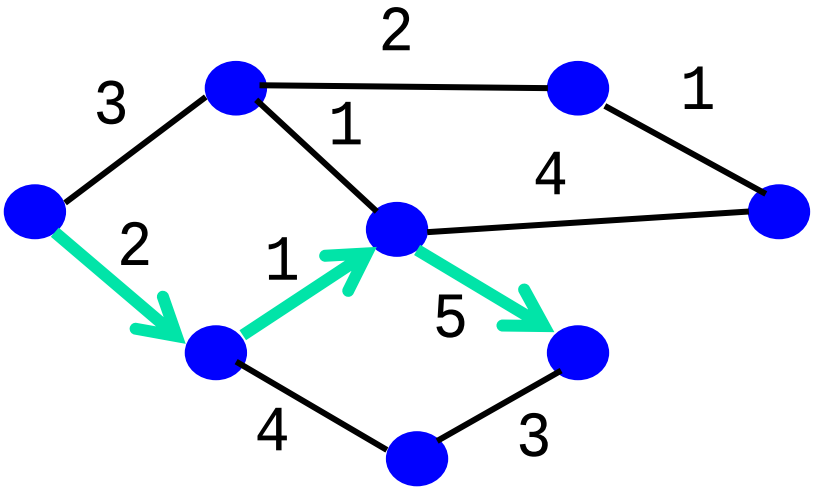


$d_u(z) = \min\{c(u,v) + d_v(z),$
$c(u,w) + d_w(z)\}$

E.g., RIP and EIGRP

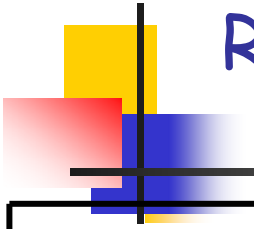
Link-State Routing: Dijsktra's Algorithm

- Each router keeps track of its incident links
  - Link cost, and whether the link is up or down
- Each router broadcasts the link state
  - To give every router a complete view of the graph
- Each router runs Dijkstra's algorithm
  - To compute shortest paths and forwarding table

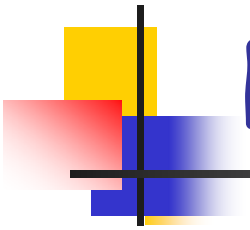


E.g., OSPF and IS-IS

Routing Protocols

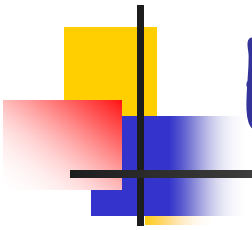


	Link State	Distance Vector	Path Vector
Dissem-ination	Flood link state advertisements to all routers	Update distances from neighbors' distances	Update paths based on neighbors' paths
Algorithm	Dijsktra's shortest path	Bellman-Ford shortest path	Local policy to rank paths
Converge	Fast due to flooding	Slow, due to count-to-infinity	Slow, due to path exploration
Protocols	OSPF, IS-IS	RIP, EIGRP	BGP



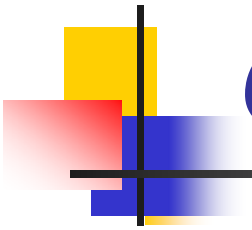
RIP

- Routing Information Protocol(RIP) is a true distance-vector routing protocol.
- It sends the complete routing table out to all active interfaces every 30 seconds
- RIP only uses hop count to determine the best way to remote network
- It has a maximum allowable hop count of 15
- Bellman-ford algorithm
- RIP version1 uses only classful routing, which means that all devices in the network must use the same subnet mask
- RIP version2 does send subnet mask information with the route updates. This is called classless routing



EIGRP

- EIGRP (Enhanced Interior Gateway Routing Protocol) is CISCO proprietary Routing Protocol
- Several metrics (delay, bandwidth, reliability, load etc)
- Uses TCP to exchange routing updates
- Loop-free routing via Distributed Updating Alg. (DUAL) based on diffused computation

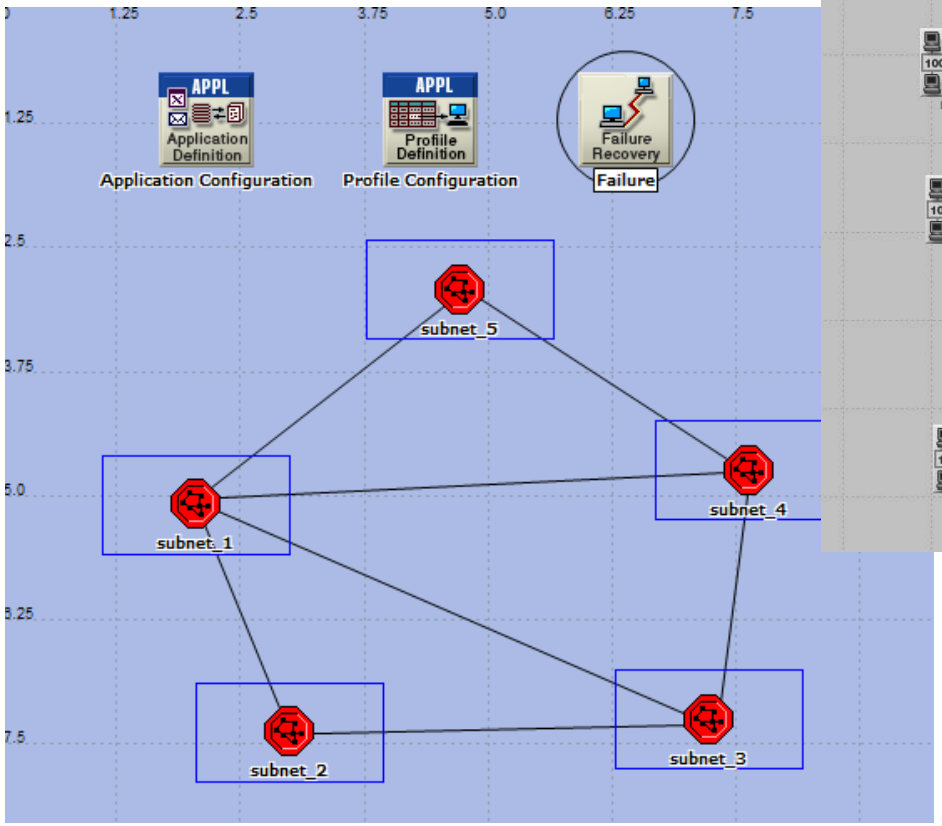


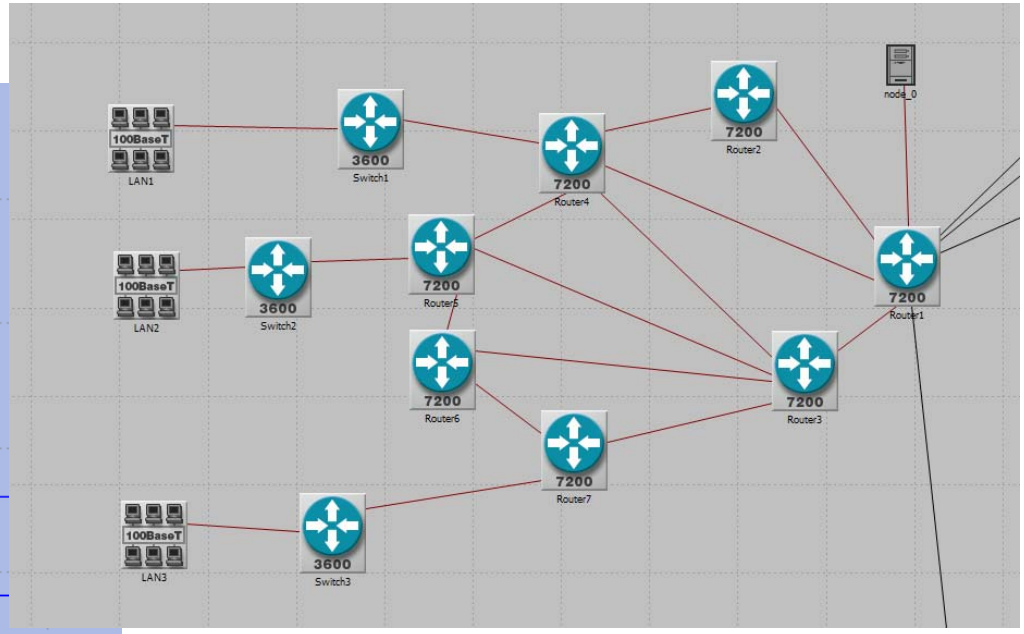
OSPF

- OSPF(Open Shortest Path First) is an open standards routing protocol
- This works by using the Dijkstra algorithm
- Minimizes routing update traffic
- Allows scalability, has unlimited hop count (e.g. RIP is limited to 15 hops)
- Allows multi-vendor deployment (open standard)

Simulation Scenario

- Simulation tool: OPNET Modeler v. 14.5
- Simulation Design:





Simulation Scenario

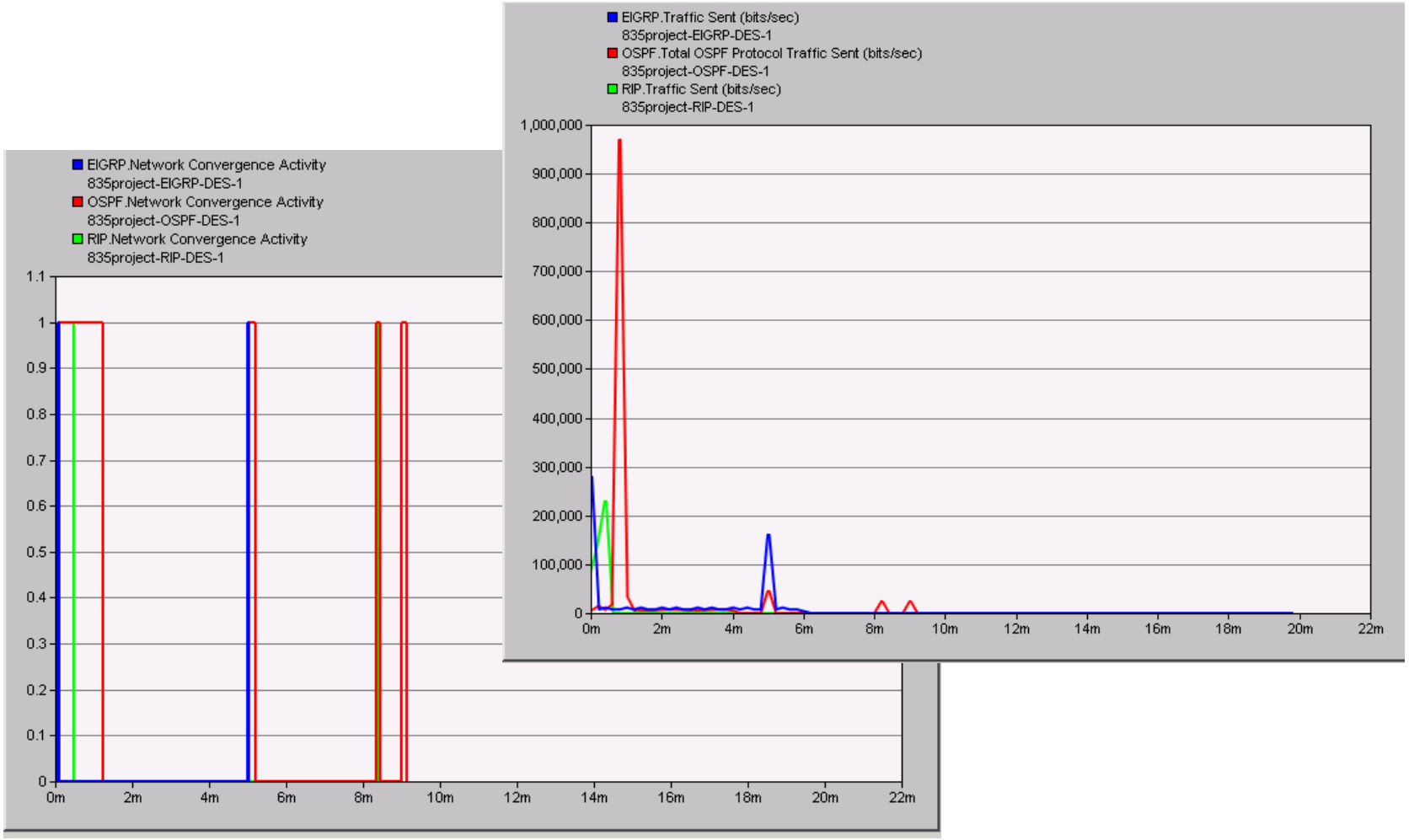
Application Attributes

Video Conferencing	15 frames/sec, 128X240 Pixels
Voice	IP Telephony and Silence Suppressed
Http	Http1.1, Heavy Browsing
Email	High Load

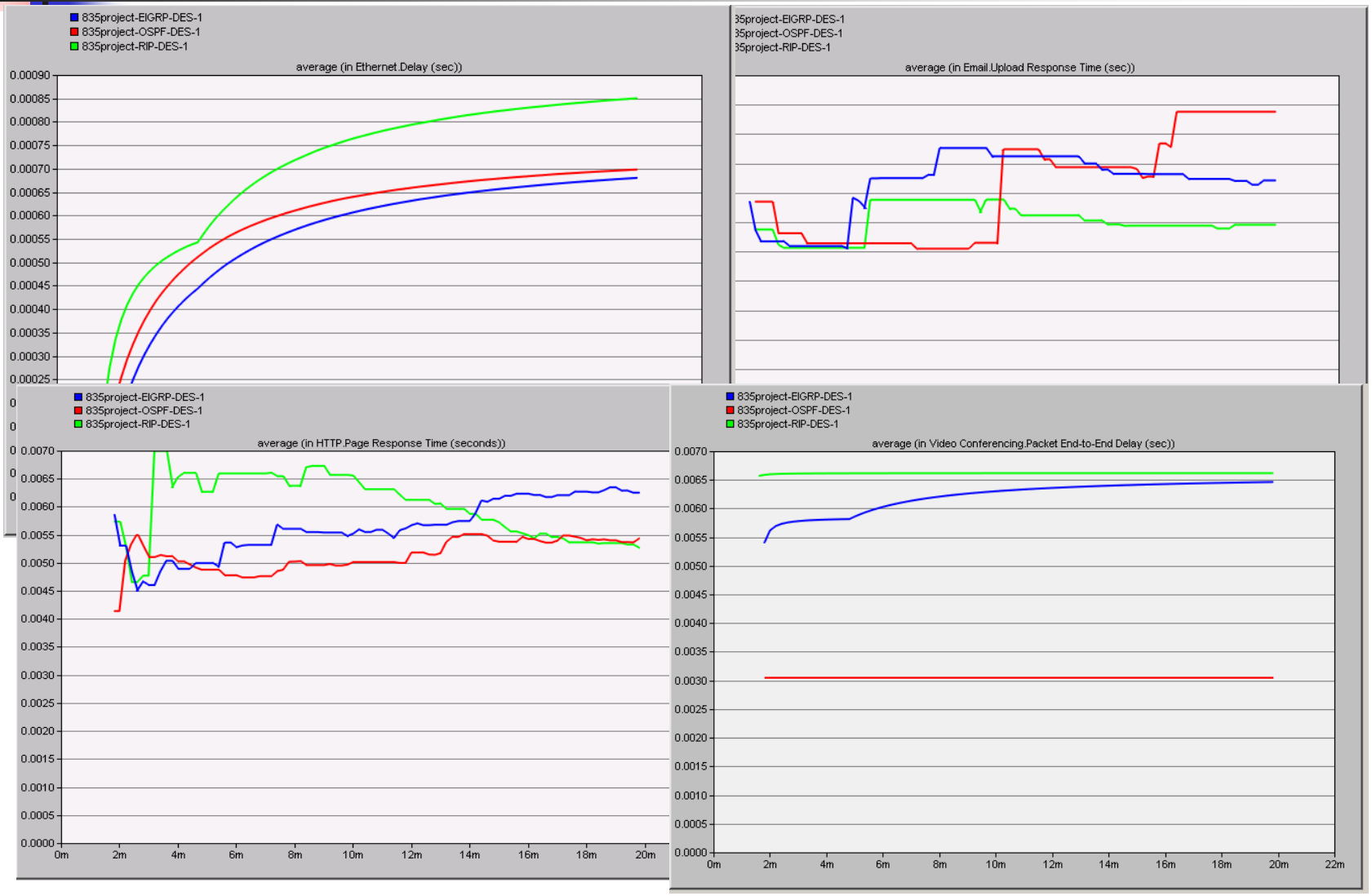
Simulation Scenarios

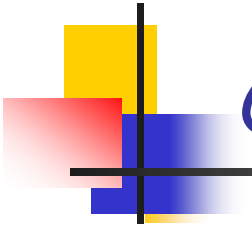
Scenario Name	Routing Protocol	Failure Link	Fail Time	Recovery Time
OSPF	OSPF	Subnet 1-Subnet5	300s	500s
EIGRP	EIGRP	Subnet 1-Subnet5	300s	500s
RIP	RIP	Subnet 1-Subnet5	300s	500s

Simulation Results 1



Simulation Results 2





Conclusion

Compare OSPF, EIGRP, and RIP in terms of:

- Network convergence activity
- Network convergence duration
- Routing protocol traffic
- CPU utilization
- Network bandwidth utilization
- throughput and queuing delay

Choose the right protocol for different network and proposes

References

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Thank You