Performance Analysis of RIP, EIGRP, and OSPF using OPNET

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Roadmap

- Introduction
- Dynamic routing protocols overview:
  - Routing Information Protocol (RIP)
  - Enhanced Interior Gateway Routing Protocol (EIGRP)
  - Open Shortest Path First (OSPF)
- OPNET models of routing protocols
- Simulation scenarios
- Simulation results
- Conclusions
- References

Introduction

- Routing is the process of selecting paths in a network
- Routing protocols are key elements of modern communication networks
- Interior Gateway Protocols (IGP): within an Autonomous System (AS)
  - RIP, EIGRP, and OSPF
- Exterior Gateway Protocol (EGP): between ASs
  - Border Gateway Protocol (BGP)
- Metrics: cost, bandwidth, maximum transmission unit (MTU), packet delay, and hop count
- OPNET Modeler was used to compare performance of RIP, EIGRP, and OSPF

Dynamic Routing Protocols

- Dynamic routing protocols:
  - an important role in today's networks
  - router dynamically advertise and learn routes
  - determine available routes and identify the most efficient routes to a destination
- Advantages of dynamic routing protocols:
  - better scalability and adaptability
  - less administrative overhead
  - capability to maintain failure or topology change
- Distance vector (DV) vs. link state (LS) routing:
  - short distance vs. the best path
  - DV routing protocol: RIP, IGRP
  - LS routing protocol: EIGRP, OSPF, and IS-IS

Routing Information Protocol (RIP)

- RIP:
  - distance vector routing protocol
  - using UPD port 520
  - maximum hop number: 15
  - distance metric: number of hops
  - exchanged every 30 seconds
  - convergence time: 30 to 60 seconds
  - less power and memory
  - suitable for all types of routing devices

Enhanced Interior Gateway Routing Protocol (EIGRP)

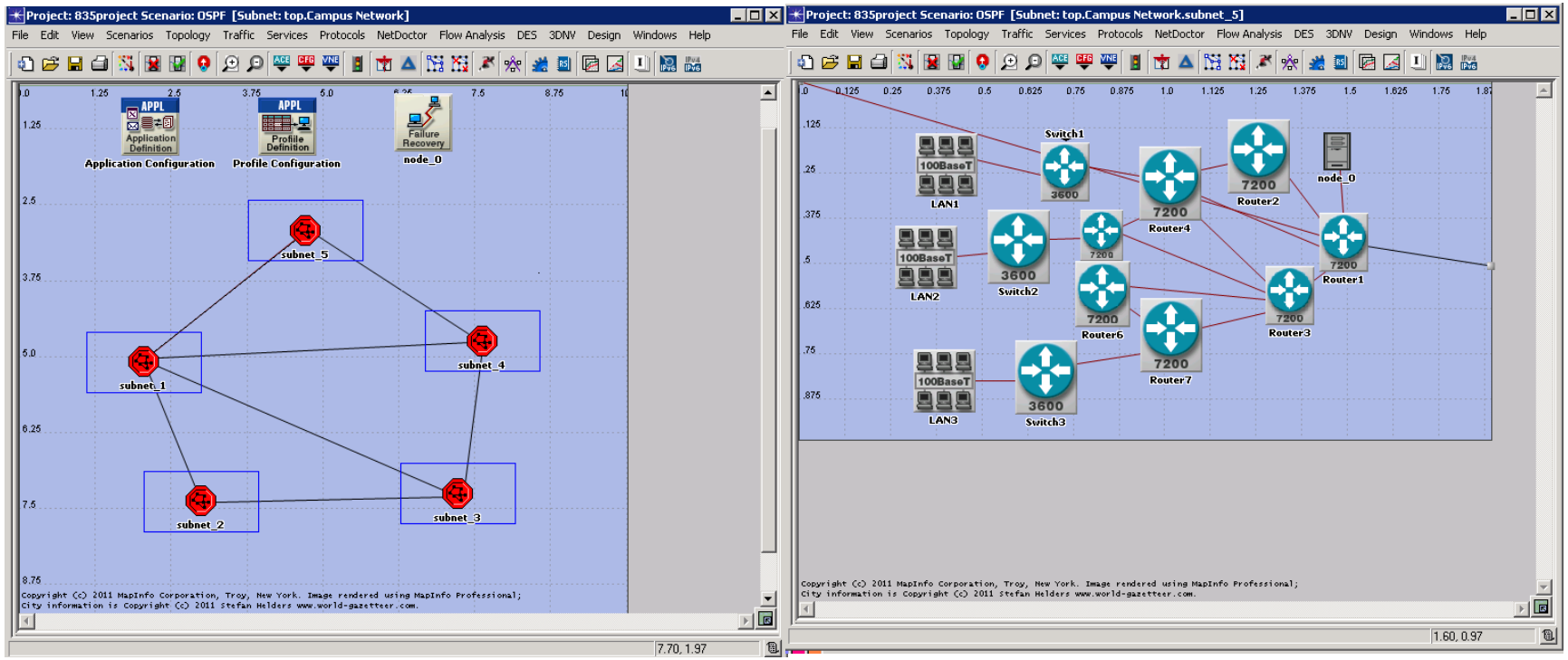
- EIGRP (Enhanced Interior Gateway Routing Protocol):
  - CISCO proprietary routing protocol
  - Diffusing Update Algorithm (DUAL)
  - Metrics: reliability, MTU, delay, load, and bandwidth
  - Three tables:
    - neighbor's table
    - topology table
    - routing table
  - Loop-free and fast convergence

Open Shortest Path First (OSPF)

- Open Shortest Path First (OSPF):
  - Publicly available
  - Uses Link State algorithm:
    - topology map at each node
    - route computation using Dijkstra's algorithm
    - Link State Advertisement (LSA)
    - Link State Database (LSD)
  - Scalabe and has faster convergence
  - More complex, processor intensive, and increased memory demands

OPNET Models of Routing Protocols

- OPNET 14.0A
- Network:
  - five subnets connected with PPP DS3 (44.736 Mbps)
  - subnets: Cisco 7200 routers, 3600 switches, Ethernet server, 100BaseT LANs



OPNET Models of Routing Protocols

Six simulation scenarios

- Subnet1 and Subnet5 fail at 300 s and recover at 500 s

Scenario name	Routing protocol	Failure link	Fail time	Recovery time
RIP no fail	RIP	N/A	N/A	N/A
EIGRP no fail	EIGRP	N/A	N/A	N/A
OSPF no fail	OSPF	N/A	N/A	N/A
RIP	RIP	Subnet1–5	300 s	500 s
EIGRP	EIGRP	Subnet1–5	300 s	500 s
OSPF	OSPF	Subnet1–5	300 s	500 s

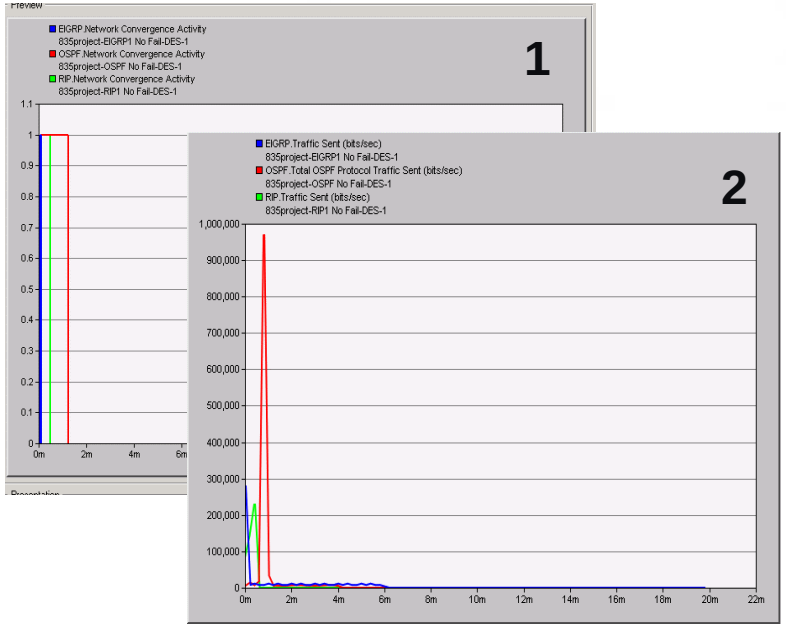
Application configurations

- Four applications:

Email	High load
HTTP	HTTP 1.1, heavy browsing
Video Conferencing	15 frames/s, 128x240 pixels
Voice	IP telephony and silence suppressed

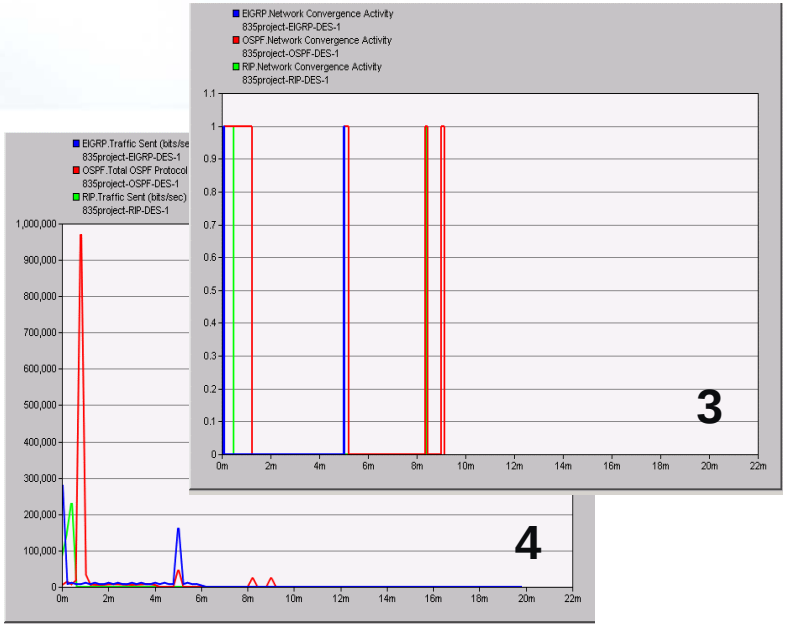
Simulation Scenarios:
(Network Convergence & Routing traffic)

- **Without failure**



1. Network Convergence: EIGRP is the shortest, OSPF is the longest
2. Routing traffic: RIP is the smallest, OSPF is the highest

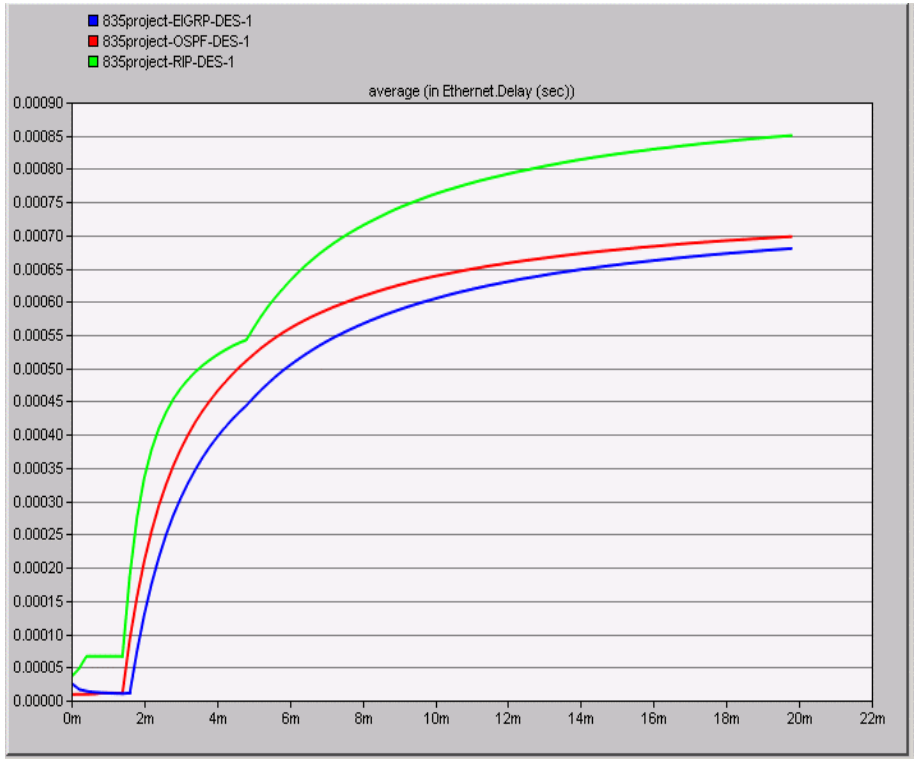
- **With failure**

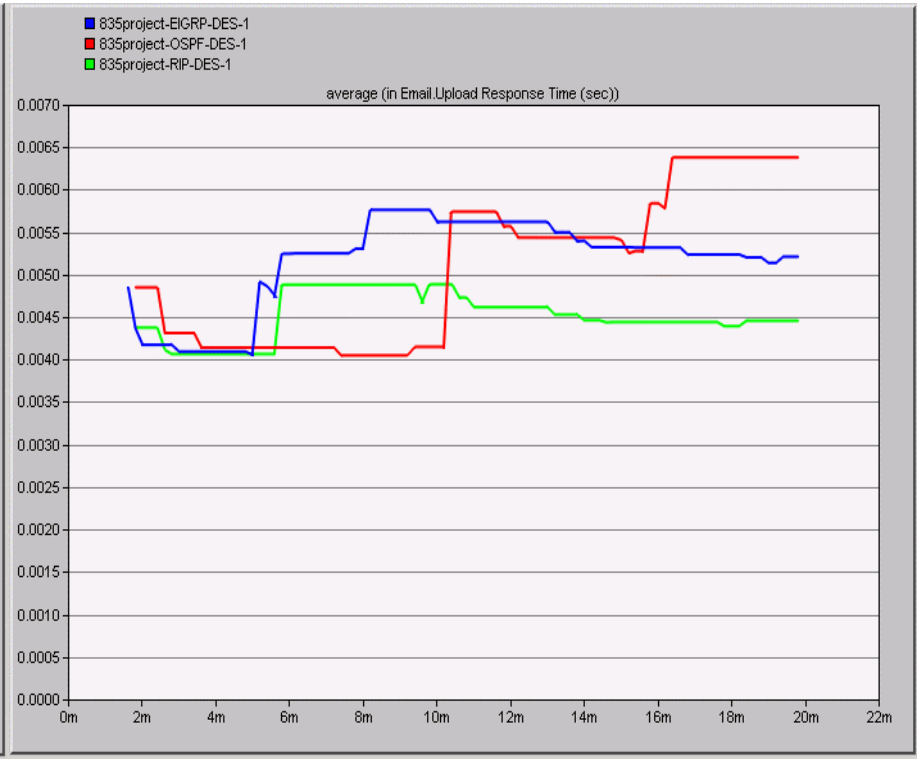


3. After failure, NC: EIGRP is the shortest, OSPF is the longest
4. After failure, RT: RIP is the smallest, EIGRP is the highest

Simulation Scenarios with failure: (Ethernet delay & Email upload response time)

- Ethernet delay:
  EIGRP is the lowest
  RIP the highest
- Email upload response time:
  OSPF is the shortest before failure and the highest after recovery

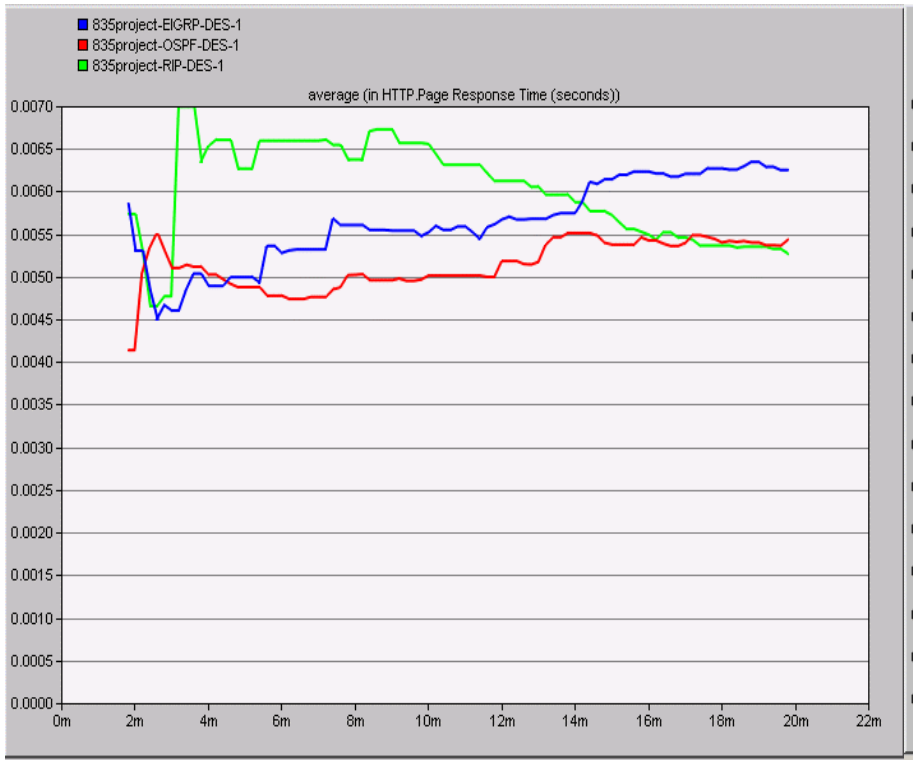


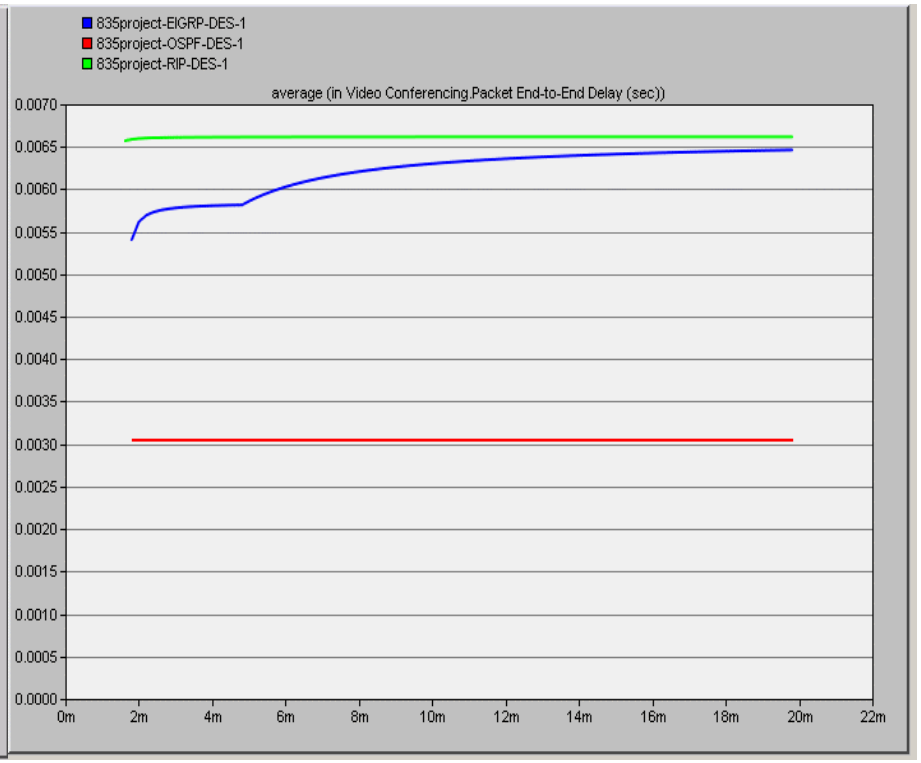


Simulation Scenarios with failure:
(HTTP page response time & Video packet delay)

- HTTP page response time:
  OSPF is the lowest
  RIP is the highest

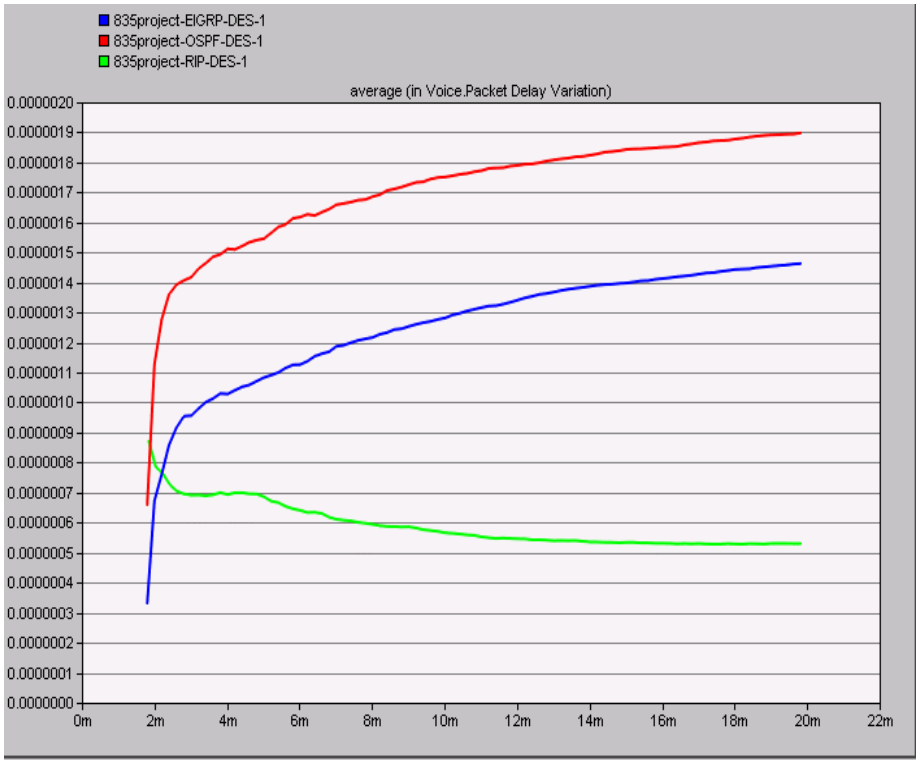
- Video conferencing packet delay:
  OSPF is the lowest
  RIP is the highest





Simulation Scenarios with failure: (Voice packet delay)

- Voice packet delay:
  RIP is the lowest, OSPF is the highest



Analysis of Simulation Results

- RIP
  - better in voice packet delay
  - simple routing protocol and less protocol traffic
  - slower convergence time
- EIGRP
  - better in network convergence, routing traffic, and Ethernet delay
  - less CPU and memory and short Convergence time
  - only using for Cisco
- OSPF
  - better in HTTP page response time and video conferencing delay
  - little bandwidth without change
  - fast converge, better for large network
  - more complex

Conclusions

- Routing protocols are key elements of communication networks
- Use OPNET Modeler as a powerful tool for network planners
- Design various scenarios and topologies
- Simulate within specific terms an metrics
- Analyze the performance of RIP, EIGRP, and the OSPF
- Select the most suitable routing protocol
- Optimize network operation efficiency

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