Experiment 6: Performance Analysis of Routing Protocols using Simulator

Aim

To study and analyze the performance of different routing protocols (RIP, OSPF, and EIGRP) in a simulated environment using Packet Tracer or GNS3.

Objectives

1. Configure RIP, OSPF, and EIGRP in simulated networks.
2. Compare protocol performance in terms of convergence, delay, and scalability.
3. Observe packet forwarding in Simulation Mode.
4. Analyze which protocol is best suited for different network sizes.

Background Theory

Routing protocols are used by routers to determine the best path for forwarding packets.

1. RIP (Routing Information Protocol)

Distance-vector protocol.
Uses hop count as a metric.
Maximum hop count = 15.
Simple but inefficient for large networks.

2. OSPF (Open Shortest Path First)
- Link-state protocol.
- Uses Dijkstra's shortest path algorithm.
- Metric: Cost (based on bandwidth).
- Faster convergence, scalable for large networks.

3. EIGRP (Enhanced Interior Gateway Routing Protocol)
- Cisco proprietary (hybrid protocol).
- Combines distance vector and link state features.
- Uses DUAL (Diffusing Update Algorithm).
- Efficient, fast convergence, less bandwidth consumption.

Performance Comparison Parameters:
- Convergence Time – how quickly routers agree on new routes.
- Throughput – successful data transfer rate.

- Delay/Latency – time taken for packets to reach destination.
- Scalability – how protocol performs in large networks.

Software/Tools Required

• Cisco Packet Tracer

Algorithm

1. Design a network topology with multiple routers and PCs.
2. Assign IP addresses to all devices.
3. Configure routers with RIP protocol and test connectivity.
4. Repeat using OSPF protocol and test.
5. Repeat using EIGRP protocol and test.
6. Generate traffic (ping, FTP, HTTP) and observe performance.
7. Compare metrics like convergence, throughput, and delay.

Step-by-Step Procedure

Step 1: Create Topology
- Open Packet Tracer.
- Place 3 routers (R1, R2, R3), 3 PCs, and 2 switches.
- Connect: PCs to Switches, Switches to Routers, Routers interconnected via Serial or FastEthernet.
- Ensure all links are active (green).

Step 2: Assign IP Addresses
- Configure PCs with static IPs (e.g., PC1: 192.168.1.2, PC2: 192.168.2.2, PC3: 192.168.3.2).
- Configure routers with IP addresses on each interface using commands.

R1> enable
R1# configure terminal
R1(config)# interface fa0/0
R1(config-if)# ip address 192.168.1.1 255.255.255.0
R1(config-if)# no shutdown
R1(config)# interface s0/0/0
R1(config-if)# ip address 10.0.0.1 255.255.255.0
R1(config-if)# no shutdown

Repeat for R2, R3

Step 3: Configure RIP
1. On each router
Router(config)# router rip
Router(config-router)# version 2
Router(config-router)# network 192.168.1.0
Router(config-router)# network 10.0.0.0

2. Verify routes with
Router# show ip route

3. Test Connectivity with ping

Step 4: Configure OSPF
1. Remove RIP Config

2. On each router

Router(config)# router ospf 1
Router(config-router)# network 192.168.1.0 0.0.0.255 area 0
Router(config-router)# network 10.0.0.0 0.0.0.255 area 0

3. Verify routes with show ip route
4. Test connectivity with ping

Step 5: Configure EIGRP
1. Remove OSPF config

2. On each router

Router(config)# router eigrp 100
Router(config-router)# network 192.168.1.0
Router(config-router)# network 10.0.0.0

3. Verify routes with show ip route
4. Test Connectivity with ping

Step 6: Performance Testing
1. Switch to Simulation Mode.
2. Generate traffic using ping and HTTP.
3. Compare

i. Time taken to update routing tables (convergence)
ii. Delay in packet delivery
iii. Throughput when sending multiple packets

Expected Output

i. RIP: Slower convergence, inefficient in larger networks.
ii. OSPF: Fast convergence, scalable, efficient routing.
iii. EIGRP: Faster than RIP, performs well in medium to large networks, Cisco-specific.

Result

Routing protocols were successfully implemented. OSPF and EIGRP performed better than RIP in terms of convergence and scalability.

Pre-Viva Questions

1. Differentiate between static and dynamic routing.
2. What is the maximum hop count in RIP?
3. What algorithm does OSPF use for path calculation?
4. Why is EIGRP called a hybrid protocol?

Post-Viva Questions

1. Which protocol is best for large enterprise networks and why?
2. How does convergence time affect network performance?
3. Can RIP still be useful in modern networks?
4. Why might an organization choose EIGRP over OSPF?