ENCS4130 Computer Networks Laboratory

EXP#3 Dynamic Routing 1 (Distance Vector Routing Protocols) RIP & EIGRP

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Objectives

- Learn how to configure and verify IP routing with Cisco routers.
- Dynamic routing RIP and EIGRP.





Introduction

• Static Routing

- Definition: Manually configured routes.
- Advantages: Simple and predictable and low overhead.
- Disadvantages: Requires manual updates and not scalable for large networks.

Dynamic Routing

- Definition: Automatically updates routes using protocols.
- Advantages: Adapts to network changes and scalable and supports load balancing.
- Disadvantages: More complex to manage and higher resource usage.







Dynamic Routing

• Main Categories:

- Interior Gateway Protocols (IGP): Used for routing within an Autonomous System
- Exterior Gateway Protocols (EGP): Used for routing between different Autonomous Systems.











Administrative Distances (AD)

- **Definition:** Rates the trustworthiness of routing info from a neighbouring router.
- Range:
 - 0 = Most trusted (e.g., directly connected)
 - 255 = Untrusted (route won't be used)
- Key Points:
 - First criterion used by routers to select a routing protocol.
 - Purpose: Helps choose between multiple routing protocols for the same destination.
 - Local Significance: AD is only relevant on the router itself and is not shared in updates.





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Administrative Distances (AD) Cont.

Route Source	Administrative Distance (AD)
Connected interface (directly)	0
Static Route	1
EIGRP	90
IGRP	100
RIP	120
Unreachable	255

• Process:

1. Route with the lowest AD is placed in the routing table.

2. If ADs are the same, metrics (e.g., hop count) are used.

3. If both AD and metrics are identical, load-balancing occurs.



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Administrative Distances (AD) Example



- What happens if two routes have the same ad and metric?
 - RIP: Number of hops.
 - EIGRP: Combination of bandwidth, delay, load, and reliability.
- What if both advertised routes have the same ad and metric?

Load Balancing occurs, meaning traffic is distributed across multiple routes.
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Distance Vector Routing

- Metric-based: Routers advertise known networks with their own metric.
- Periodic Updates: Entire routing tables are shared regularly with neighbours.
- **Path Calculation:** Uses the Bellman-Ford algorithm.
- Limited View: Routers don't know the entire network topology.
- Examples: RIP, EIGRP.

Routing Table Ri Next-Ronter Net Metric Dest. Кз 5 2 Uploaded By: anon

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Routing Information Protocol (RIP)

- **Overview:** Dynamic routing protocol using hop count to determine the best path.
- Key Features:
 - Hop Count: Maximum of 15 hops (16 is unreachable).
 - Load Balancing: Supports round robin for up to 6 equal-cost links (default is 4).
 - Classful Subnetting: Only supports Class A, B, and C networks, without sending subnet mask.
- Configuration:
 - 1. Enable RIP:
 - Router(config)# router rip
 - **2.** Advertise Networks:
 - Router(config-router)# network <ID-OF-CONNECTED-NETWORKS>



Classful Subnetting Example (RIP)

- Can the networks 130.5.0.7 and 130.5.0.0 be configured in RIP?
- 130.5.0.7:
 - No, because it is classful and does not support subnet masks. RIP will interpret it as the entire Class B network 130.5.0.0/16.
- 130.5.0.0:
 - Yes, since 130.5.0.0 is a Class B network (130.0.0.0 130.255.255.255), RIP will handle it as 130.5.0.0/16 without any issues.

	Address Class	IP Range	Slash	
	Class A	1.0.0.1 – 126.255.255.254	/8	
	Class B	128.0.0.1 – 191.255.255.254	/16	a,
	Class C	192.0.0.1-223.255.255.254	/24	
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Routing Information Protocol (RIP) Example







Enhanced Interior Gateway Routing Protocol (EIGRP)

- **Overview:** Cisco-proprietary distance-vector routing protocol designed to overcome RIP limitations.
- Key Features:
 - Hop Count: Max of 255 (default 100).
 - Composite Metric: Uses bandwidth, load, delay and reliability to determine best routes.
- Characteristics:
 - Supports large internetworks.
 - Requires Autonomous System (AS) number for activation.
 - Full route table updates every 90 seconds.





Procedure



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IP Address

The IP address as follows: 192.X.10.0 → where X is : for example, student ID is 1224530, X = 30, and so the network will be 192.30.10.0/S.M





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Topology

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• The topology contains:

Name	Quantity	Symbol
Router-PT	3	Router-PT
Switch-PT	2	Switch-PT
PC-PT	6	PC-PT

Use Automatically use connection type:





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Topology (Cont.)





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IP Address Distribution Network 0



Network	Device/Interface	IP address	Subnet mask
Network 0 192.X.0.0/24	Router0 Fa0/0	192.X.0.1/24	255.255.255.0
	PC0	192.X.0.2/24	255.255.255.0
	PC1	192.X.0.3/24	255.255.255.0



IP Address Distribution Network 1



Network	Device/Interface	IP address	Subnet mask
Network 1 192.X.1.0/24	Router1 Fa0/0	192.X.1.1/24	255.255.255.0
	PC2	192.X.1.2/24	255.255.255.0

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IP Address Distribution Network 2



Network	Device/Interface	IP address	Subnet mask
Network 2 192.X.2.0/24	Router2 Fa0/0	192.X.2.1/24	255.255.255.0
	PC3	192.X.2.2/24	255.255.255.0
	PC4	192.X.2.3/24	255.255.255.0



IP Address Distribution Network 3



Network	Device/Interface	IP address	Subnet mask
Network 3 192.X.3.0/24	Router2 Fa1/0	192.X.3.1/24	255.255.255.0
	PC5	192.X.3.2/24	255.255.255.0

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IP Address Distribution Network 4



Network	Device/Interface	IP address	Subnet mask
Network 4 192.X.4.0/24	Router1 Se3/0	192.X.4.1/24	255.255.255.0
	Router2 Se2/0	192.X.4.2/24	255.255.255.0

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IP Address Distribution Network 5



Network	Device/Interface	IP address	Subnet mask
Network 5 192.X.5.0/24	Router0 Se2/0	192.X.5.1/24	255.255.255.0
	Router1 Se2/0	192.X.5.2/24	255.255.255.0

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Show the port labels



Interface Administrative	Show/Hide Font	Miscellaneous Answer Tree	e Custom Interfaces Publishers Image Cleanup	
Customize User Experience				
Show Animation			Show Link Lights	
Play Sound			Play Telephony Sound	
Show Device Model Lab	els		Show QoS Stamps on Packets	
Show Device Name Lab	els		Show Port Labels When Mouse Over in Logical Workspace	
3 Always Show Port Labe	s in Logical Workspace		Enable Cable Length Effects	
Disable Auto Cable			Use CLI as Device Default Tab	
🔽 Use Metric System (Und	check to use Imperial)		Show Cable Info Popup in Physical Workspace	
Align logical workspace	objects		Align physical workspace objects	
Logging				
Enable Logging				



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Configuring IPs for the PCs

PC0 × Desktop Physical Config Custom Interface run http: IP Command Dial-up Terminal Web Browser Configuration Prompt ((·<u>႙</u>›)) MIB A **Cisco IP** Traffic PC Wireless VPN **MIB Browser** Generator Communicator 11111 IPv4 IPv6 ____ **IPv6** Firewall **PPPoE Dialer Text Editor** Firewall Email 3

PC0		- 🗆 X
Physical Config Desktop Prog	ramming Attributes	
IP Configuration		Х
Interface FastEthernet0		~
IP Configuration		
O DHCP	• Static 4	
IPv4 Address	192.30.0.2	
Subnet Mask 5	255.255.255.0	
Default Gateway	192.30.0.1	
DNS Server	0.0.0.0	
IPv6 Configuration		Don't forget to enter the IP
O Automatic	Static	address of the gateway.
IPv6 Address		
Link Local Address	FE80::2D0:58FF:FE54:B8	16
Default Gateway		
DNG George		

→ Assign the rest of the IP addresses to the rest of the PCs. STUDENTS-HUB.com



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Configuring IPs for the Routers

1	Router0 2 Physical Config (CLI Attributes	- C × Don't forget to turn
3	GLOBAL Settings Algorithm Settings ROUTING Static RIP INTERFACE FastEthernet0/0 FastEthernet1/0 Serial2/0 Serial3/0 FastEthernet4/0 FastEthernet5/0	 Port Status Bandwidth Duplex MAC Address IP Configuration IPv4 Address Subnet Mask Tx Ring Limit 	FastEthernet0/0 Image: Contract internacted Image: Contract internacted Image: Contract internacted Image: Contract interistic inten

\rightarrow Assign the rest of the IP addresses to the rest of the router interfaces.





Setting Up Two Topologies

- Step 1: Create the Base Topology
 - Design the network with routers and devices (connections, IP addresses).
- Step 2: Duplicate the Topology
 - Copy 1: Configure routers with RIP Protocol.
 - Copy 2: Configure routers with EIGRP Protocol.





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Configuring RIP Routing

- 1. Enable RIP:
 - Router(config)# router rip
 - Router(config-router)# network <ID-OF-CONNECTED-NETWORKS>

2. Router Configurations:

	Doutor 0	Router(config-router)# network 192.X.0.0	
	Router U	Router(config-router)# network 192.X.5.0	
		Router(config-router)# network 192.X.1.0	
	Router 1	Router(config-router)# network 192.X.4.0	
		Router(config-router)# network 192.X.5.0	
	Router 2	Router(config-router)# network 192.X.2.0	
		Router(config-router)# network 192.X.3.0	
		Router(config-router)# network 192.X.4.0	
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Verifying the RIP Routing Tables





Configuring EIGRP Routing

- **1.** Enable EIGRP Protocol:
 - Router(config)# router EIGRP <AS>
 - Router(config-router)# network <ID-OF-CONNECTED-NETWORKS>







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Configuring EIGRP Routing Cont.

2. Router Configurations:

	Router(config)# router eigrp 10
Router 1	Router(config-router)# network 192.X.0.0
	Router(config-router)# network 192.X.5.0
	Router(config)# router eigrp 10
Deuter 0	Router(config-router)# network 192.X.1.0
Router Z	Router(config-router)# network 192.X.4.0
	Router(config-router)# network 192.X.5.0
	Router(config)# router eigrp 10
Router 3	Router(config-router)# network 192.X.2.0
	Router(config-router)# network 192.X.3.0
	Router(config-router)# network 192.X.4.0







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Verifying the EIGRP Routing Tables

Router1				×
Physical Con	fig <u>CLI</u> Attributes			
	IOS Command Line Interface			
2 Router(confi Router(confi Router# *SYS-5-CONFI Router# Router# Router# Router#show Codes: C = C D = I N1 = E1 = i = : * = C	<pre>ig)# ig)# ig)# ig)# ig)# ig)#exit IG_I: Configured from console by console ip route connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area OSPF NSSA external type 1, N2 - OSPF NSSA external type 2 OSPF external type 1, E2 - OSPF external type 2, E - EGP IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter a candidate default, U - per-user static route, o - ODR periodic downloaded static route</pre>	area		
Gateway of :	last resort is not set			
3 D 192.99 C 192.99 D 192.99 D 192.99 C 192.99 C 192.99 C 192.99	.0.0/24 [90/20514560] via 192.99.5.1, 00:01:10, Serial2/0 .1.0/24 is directly connected, FastEthernet0/0 .2.0/24 [90/20514560] via 192.99.4.2, 00:00:34, Serial3/0 .3.0/24 [90/20514560] via 192.99.4.2, 00:00:34, Serial3/0 .4.0/24 is directly connected, Serial3/0 .5.0/24 is directly connected, Serial2/0			a.,
ected by EIGRP.	[90/20514560] represents the administrative distance (90) and the metric value (20514560) for the EIGRP route.		ι	 Jploaded By: anon





Verifying Router Configurations

- Router# show ip route
- Router# show protocols
- Router# show ip protocols
- Router# debug ip rip
- Router# debug eigrp packets
- Router# debug ip eigrp notifications
- Router# debug ip eigrp neighbor

Displays the routing table.

Shows the status of routing protocols.

Details configured routing protocols.

Enables real-time RIP packet debugging.

Enables EIGRP packet debugging.

Shows EIGRP notification details.

Displays EIGRP neighbour information.

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Saving Configurations

• Don't forget to save the configurations on your router.

→ Router# write
→ Router# copy run start





Video explaining the experiment

https://www.youtube.com/watch?v=IQR3uVKWdvQ&ab_channel=TariqOdeh







References

- Manual for ENCS4130 Computer Networks Laboratory.
- Lecture Notes from Dr. Ahmed Shawahna
- Slides from Dr. Amr Slimi.

