Lab 3: Static Routing, RIP and EIGRP

Student Name: .....
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Objectives:

- ✓ Understanding Static routing, RIP configuration.
- ✓ Practising Static routing, RIP and EIGRP configuration on Cisco routers.

Content:

I. Static routing:

1. Information About Static Routing

Routers forward packets using either route information from route table entries that you manually configure or the route information that is calculated using dynamic routing algorithms.

Static routes, which define explicit paths between two routers, cannot be automatically updated; you must manually reconfigure static routes when network changes occur. Static routes use less bandwidth than dynamic routes. No CPU cycles are used to calculate and analyze routing updates.

You can supplement dynamic routes with static routes where appropriate. You can redistribute static routes into dynamic routing algorithms but you cannot redistribute routing information calculated by dynamic routing algorithms into the static routing table.

You should use static routes in environments where network traffic is predictable and where the network design is simple. You should not use static routes in large, constantly changing networks because static routes cannot react to network changes. Most networks use dynamic routes to communicate between routers but might have one or two static routes configured for special cases. Static routes are also useful for specifying a gateway of last resort (a default router to which all unroutable packets are sent).

2. Configuring Static Routing

You can configure a static route on the router.

Static routing is manually configured by command: **ip route**

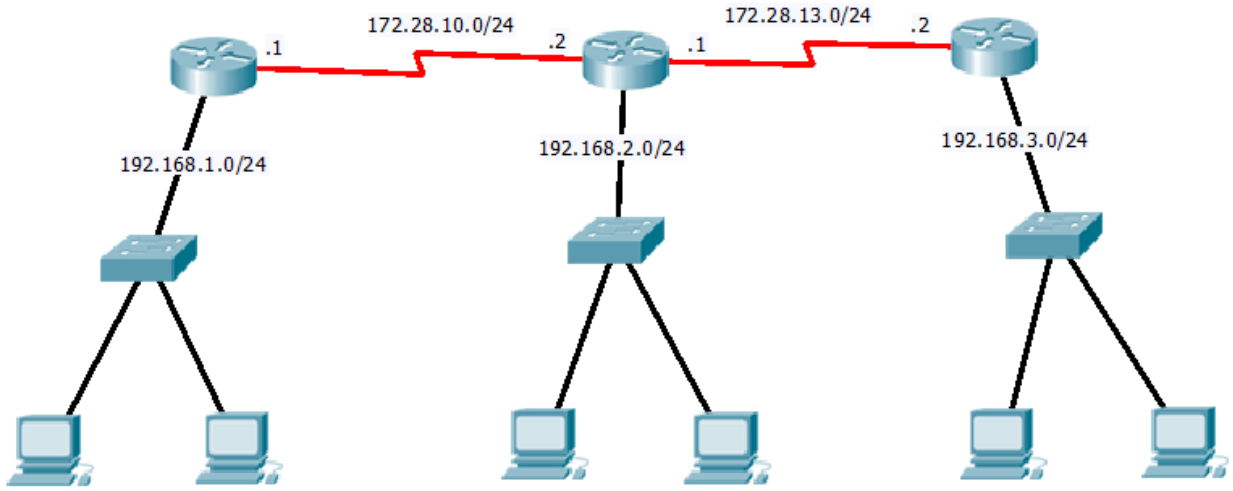
SUMMARY STEPS

1. **configure terminal**
2. **ip route** {*ip-prefix* | *ip-addr/ip-mask*} {[*next-hop* | *nh-prefix*] | [*interface next-hop* | *nh-prefix*]} [**name** *nexthop-name*] [**tag** *tag-value*] [*pref*]
3. (Optional) **show ip route**
4. (Optional) **copy running-config startup-config**

TIP: You can use **ip route** command in a simple way:

ip route <destination network> <subnet mask of destination network> <output gateway of current configured router | next hop's ip address>

Practice 1:



Requirement:

Configure static routing for 3 routers so that every computer in the topology can ping one another.

II. RIP

RIP Configuration Task List:

Enabling RIP

	Command	Purpose

Step 1	Router(config)#**router rip**	Enables a RIP routing process, which places you in router configuration mode.
Step 2	Router(config-router)#**network** *ip-address*	Associates a network with a RIP routing process.

Allowing Unicast Updates for RIP

Because RIP is normally a broadcast protocol, in order for RIP routing updates to reach nonbroadcast networks, you must configure to permit this exchange of routing information.

Command	Purpose
Router(config-router)#**neighbor** *ip-address*	Defines a neighboring router with which to exchange routing information.

Applying Offsets to Routing Metrics (Optional)

An offset list is the mechanism for increasing incoming and outgoing metrics to routes learned via RIP.

Command	Purpose
Router(config-router)#**offset-list** [access-list-number| access-list-name]{**in**|**out**} offset [interface-type interface-number]	Applies an offset to routing metrics.

Adjusting Timers

- The rate (time in seconds between updates) at which routing updates are sent
- The interval of time (in seconds) after which a route is declared invalid
- The interval (in seconds) during which routing information regarding better paths is suppressed
- The amount of time (in seconds) that must pass before a route is removed from the routing table
- The amount of time for which routing updates will be postponed

Command	Purpose
Router(config-router)#**timers basic** update invalid holddown flush [sleeptime]	Adjusts routing protocol timers.

Specifying a RIP Version

Configure the software to send and receive packets from only one version:

Command	Purpose
Router(config-router)#**version**{**1**|**2**}	Configures the software to receive and send only RIP Version 1 or only RIP Version 2 packets.

Control which RIP version an interface sends:

Command	Purpose

Router(config-if)#**ip rip send version 1**	Configures an interface to send only RIP Version 1 packets.
Router(config-if)#**ip rip send version 2**	Configures an interface to send only RIP Version 2 packets.
Router(config-if)#**ip rip send version 1 2**	Configures an interface to send RIP Version 1 and Version 2 packets.

Control how packets received from an interface are processed:

Command	**Purpose**
Router(config-if)#**ip rip receive version 1**	Configures an interface to accept only RIP Version 1 packets.
Router(config-if)#**ip rip receive version 2**	Configures an interface to accept only RIP Version 2 packets.
Router(config-if)#**ip rip receive version 1 2**	Configures an interface to accept either RIP Version 1 or 2 packets.

Enabling RIP Authentication

	Command	**Purpose**
Step 1	Router(config-if)#**ip rip authentication key-chain** *name-of-chain*	Enables RIP authentication.
Step 2	Router(config-if)#**ip rip authentication mode**{**text**|**md5**}	Configures the interface to use MD5 digest authentication (or let it default to plain text authentication).

RIP Route Summarization

Auto-summary and ip summary-address rip

The summary address 10.x.0.0 overrides the automatic summary address of 10.0.0.0

```
Router(config)#interface Ethernet1
Router(config-if)#ip address 10.x.x.x 255.255.255.0
Router(config-if)#ip summary-address rip 10.x.0.0 255.255.0.0
Router(config-if)#no ip split-horizon
….....
Router(config)#router rip
Router(config-router)#network 10.0.0.0
```

Restrictions to RIP Route Summarization

```
interface Ethernet1
…....

ip summary-address rip 10.0.0.0 252.0.0.0 (invalid supernet summarization)

…....

ip summary-address rip 10.1.0.0 255.255.0.0
ip summary-address rip 10.2.0.0 255.255.0.0 (or different mask)
```

Configuring Route Summarization on an Interface

	Command	Purpose
Step 1	Router(config)#**interface ethernetx/y**	Enters interface configuration mode for the ethernet 1 port.
Step 2	Router(config-if)#**ip summary-address rip** ip_address ip_network_mask	Specifies the IP address and network mask that identify the routes to be summarized.

Verifying IP Route Summarization

```
Router#show ip protocols
 Routing Protocol is "rip"

    Sending updates every 30 seconds, next due in 8 seconds

    Invalid after 180 seconds, hold down 180, flushed after 240

    Outgoing update filter list for all interfaces is

    Incoming update filter list for all interfaces is

    Redistributing: rip

    Default version control: send version 2, receive version 2

      Interface        Send  Recv  Triggered RIP  Key-chain

      Ethernet2        2     2

      Ethernet3        2     2

      Ethernet4        2     2

      Ethernet5        2     2

    Automatic network summarization is not in effect

    Address Summarization:

      10.a.0.0/16 for Ethernetx/y

Router#show ip rip database
 10.0.0.0/8    auto-summary

 10.x.y.0/24    directly connected, Ethernet2

 10.a.0.0/8    auto-summary

 10.b.0.0/16    int-summary
```

Disabling Automatic Route Summarization

Command	Purpose
Router(config-router)#**no auto-summary**	Disables automatic summarization.

Running IGRP and RIP Concurrently

The IGRP information will override the RIP information by default because of the administrative distance of IGRP. Running IGRP and RIP concurrently does not work well when the network topology changes, and will result in routing loops.

Disabling the Validation of Source IP Addresses

By default, the software validates the source IP address of incoming RIP routing updates.

Command	Purpose
Router(config-router)#**no validate-update-source**	Disables the validation of the source IP address of incoming RIP routing updates.

Enabling or Disabling Split Horizon

Split horizon blocks information about routes from being advertised by a router out of any interface from which that information originated.

Command	Purposes
Router(config-if)#**ip split-horizon**	Enables split horizon.
Router(config-if)#**no ip split-horizon**	Disables split horizon.

Configuring Inter-packet Delay

Command	Purpose
Router(config-router)#**output-delay** delay	Adds interpacket delay for RIP updates sent.

Connecting RIP to a WAN

There are two problems using RIP to connect to a WAN:

- Periodic broadcasting by RIP generally prevents WAN circuits from being closed.
- Even on fixed, point-to-point links, the overhead of periodic RIP transmissions could seriously interrupt normal data transfer because of the quantity of information that passes through the line every 30 seconds.

To overcome these limitations, triggered extensions to RIP cause RIP to send information on the WAN only when there has been an update to the routing database.

	Command	Purpose
Step 1	Router(config)#**interface serial** *controller*-number	Configures a serial interface.
Step 2	Router(config-if)#**ip rip triggered**	Enables triggered extensions to RIP.

Command	Purpose
Router#**show ip rip database** [prefix mask]	Displays the contents of the RIP private database.

RIP Debug Commands

- debug ip rip: Turn on RIP debugging to display information on RIP routing transactions.
- show ip rip: To display the current state of the routing table.
- show ip protocols: To display the parameters and current state of the active routing protocol process.
- debug rip events: debug rip events will show RIP events. Sending and receiving packets, timers, and changes in interfaces are events.
- debug rip packet: debug rip packet will display detailed information about the RIP packets. The origin and port number of the packet as well as a packet dump is shown.
- show debugging rip: Show debugging rip will show all information currently set for rip debug.
- show ip rip database: To display the contents of the RIP private database when triggered extensions to RIP are enabled.

Practice 2: Complete the Lab practice in Practice 1 using RIP for each router.

III. EIGRP

EIGRP (Enhanced Interior Gateway Routing Protocol) is an enhanced version of the IGRP developed by Cisco. EIGRP uses the same distance vector algorithm and distance information as IGRP. However, the convergence properties and the operating efficiency of EIGRP have improved substantially over IGRP.

EIGRP provides the following features:

- Automatic redistribution—IGRP routes can be automatically redistributed into EIGRP, and EIGRP routes can be automatically redistributed into IGRP. If desired, you can turn off redistribution. You can also completely turn off EIGRP and IGRP on the router or on individual interfaces.

- Increased network width—With IP Routing Information Protocol (RIP), the largest possible width of your network is 15 hops. When EIGRP is enabled, the largest possible width is increased to 100 hops, and the metric is large enough to support thousands of hops.

EIGRP offers the following features:

- Fast convergence—The DUAL algorithm allows routing information to converge as quickly as any currently available routing protocol.
- Partial updates—EIGRP sends incremental updates when the state of a destination changes, instead of sending the entire contents of the routing table. This feature minimizes the bandwidth required for EIGRP packets.
- Less CPU usage than IGRP—This occurs because full update packets need not be processed each time they are received.
- Neighbor discovery mechanism—This is a simple hello mechanism used to learn about neighboring routers. It is protocol-independent.
- Variable-length subnet masks (VLSMs).
- Arbitrary route summarization.
- Scaling—EIGRP scales to large networks.

EIGRP has the following four basic components:

- Neighbor discovery of neighbor recovery
- Reliable transport protocol
- DUAL finite state machine
- Protocol-dependent modules

EIGRP Configuration Task List

Enabling EIGRP

To create an EIGRP routing process, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# router eigrp`*autonomous-system*	Enables an EIGRP routing process in global configuration mode.
Step 2	`Router(config-router)# network`*network-number*	Associates networks with an EIGRP routing process in router configuration mode.

Logging EIGRP Neighbor Adjacency Changes

By default, the system logs EIGRP neighbor adjacency changes to help you monitor the stability of the routing system and detect problems. If you disabled logging of such changes and want to reenable the logging, use the following command in router configuration mode:

Command	Purpose
`Router(config-router)# eigrp log-neighbor-changes`	Enables logging of EIGRP neighbor adjacency changes.

Configuring the Percentage of Link Bandwidth Used

By default, EIGRP packets consume a maximum of 50 percent of the link bandwidth, as configured with the bandwidth interface configuration command. You might want to change that value if a different level of link utilization is required or if the configured bandwidth does not match the actual link bandwidth (it may have been configured to influence route metric calculations).

To configure the percentage of bandwidth that may be used by EIGRP on an interface, use the following command in interface configuration mode:

Command	Purpose
`Router(config-if)# ip bandwidth-percent eigrp` *percent*	Configures the percentage of bandwidth that may be used by EIGRP on an interface.

Adjusting the EIGRP Metric Weights

EIGRP uses the minimum bandwidth on the path to a destination network and the total delay to compute routing metrics. You can use the eigrp metric weights command to adjust the default behavior of EIGRP routing and metric computations. For example, this adjustment allows you to tune system behavior to allow for satellite transmission. EIGRP metric defaults have been carefully selected to provide optimal performance in most networks.

Note Adjusting EIGRP metric weights can dramatically affect network performance. Because of the complexity of this task, we recommend that you do not change the default values without guidance from an experienced network designer.

To adjust the EIGRP metric weights, use the following command in router configuration mode:

Command	Purpose
`Router(config-router)# metric weights` *tos k1 k2 k3 k4 k5*	Adjusts the EIGRP metric or K value. EIGRP uses the following formula to determine the total metric to the network: metric = [K1*bandwidth + (K2*bandwidth)/(256 - load) + K3*delay] * [K5/(reliability + K4)]

By default, the EIGRP composite metric is a 32-bit quantity that is a sum of the segment delays and the lowest segment bandwidth (scaled and inverted) for a given route. For a network of homogeneous media, this metric reduces to a hop count. For a network of mixed media (FDDI, Ethernet, and serial lines running from 9600 bits per second to T1 rates), the route with the lowest metric reflects the most desirable path to a destination.

Disabling Route Summarization

You can configure EIGRP to perform automatic summarization of subnet routes into network-level routes. For example, you can configure subnet 131.108.1.0 to be advertised as 131.108.0.0 over interfaces that have subnets of 192.31.7.0 configured. Automatic summarization is performed when there are two or more network router configuration commands configured for the EIGRP process. By default, this feature is enabled.

To disable automatic summarization, use the following command in router configuration mode:

Command	Purpose
`Router(config-router)# no auto-summary`	Disables automatic summarization.

Route summarization works in conjunction with the ip summary-address eigrp interface configuration command, in which additional summarization can be performed. If automatic summarization is in effect, there usually is no need to configure network level summaries using the ip summary-address eigrpcommand.

Configuring Summary Aggregate Addresses

You can configure a summary aggregate address for a specified interface. If any more specific routes are in the routing table, EIGRP will advertise the summary address out the interface with a metric equal to the minimum of all more specific routes.

To configure a summary aggregate address, use the following command in interface configuration mode:

Command	Purpose
`Router(config-if)# ip summary-address eigrp` *autonomous-system-number ip-address mask*	Configures a summary aggregate address.

Practice 3: Complete the Lab practice in Practice 1 using EIGRP for each router.

IV. Submission

Complete the practice 1,2, 3 on GNS3. Compress all the project into Lab3_<student_code>.zip and submit this file onto Sakai.

References:

http://www.cisco.com/en/US/docs/ios/12_2/ip/configuration/guide/1cfrip.html

http://www.cisco.com/c/en/us/td/docs/ios/12_2/ip/configuration/guide/fipr_c/1cfeigrp.html