Lab 7: BGP - inter-autonomous system routing protocol

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I. Objectives:

- ✓ Reference: http://www.cisco.com/en/US/docs/ios/12_2/ip/configuration/guide/1cfbgp.html
- ✓ Understanding and learning how to configure Border Gateway Protocol (BGP), to set up an interdomain routing system that automatically guarantees the loop-free exchange of routing information between autonomous systems.
- ✓ Configuring BGP routing parameters.

II. Introduction

Section 1: Basic BGP Configuration Task List (*Lab Practice*)

- Enabling BGP Routing (Required)
- Configuring BGP Neighbors (Required)
- Managing Routing Policy Changes (Optional)
- Verifying BGP Soft Reset (Optional)
- Configuring BGP Interactions with IGPs (Optional)
- Configuring BGP Weights (Optional)
- Disabling Autonomous System Path Comparison (Optional)
- Configuring BGP Route Filtering by Neighbor (Optional)
- Configuring BGP Filtering Using Prefix Lists (Optional)
- Configuring BGP Path Filtering by Neighbor (Optional)

- Disabling Next Hop Processing on BGP Updates (Optional)
- Configuring the BGP Version (Optional)
- Configuring the MED Metric (Optional)

Section 2: Advanced BGP Configuration Task List (*Reading as Documentation*)

- Using Route Maps to Modify Updates (Optional)
- Resetting eBGP Connections Immediately upon Link Failure (Optional)
- Configuring Aggregate Addresses (Optional)
- Disabling Automatic Summarization of Network Numbers (Optional)
- Configuring BGP Community Filtering (Optional)
- Configuring BGP Conditional Advertisement (Optional)
- Configuring a Routing Domain Confederation (Optional)
- Configuring a Route Reflector (Optional)
- Configuring BGP Peer Groups (Optional)
- Disabling a Peer or Peer Group (Optional)
- Indicating Backdoor Routes (Optional)
- Modifying Parameters While Updating the IP Routing Table (Optional)
- Setting Administrative Distance (Optional)
- Adjusting BGP Timers (Optional)
- Changing the Default Local Preference Value (Optional)
- Redistributing Network 0.0.0.0 (Optional)
- Configuring the Router to Consider a Missing MED as Worst Path (Optional)
- Selecting Path Based on MEDs from Other Autonomous Systems (Optional)
- Configuring the Router to Use the MED to Choose a Path from Subautonomous System Paths (Optional)
- Configuring the Router to Use the MED to Choose a Path in a Confederation (Optional)
- Configuring Route Dampening (Optional)

1. Configuring Basic BGP Features

a. Enabling BGP Routing

	Command	Purpose
Step 1	Router(config)#**router bgp** as-number	Enables a BGP routing process, which places the router in router configuration mode.
Step 2	Router(config-router)#**network** network-number	Flags a network as local to this autonomous

	[**mask** *network-mask*] [**route-map** *route-map-name*]	system and enters it to the BGP table.

b. Configuring BGP Neighbors

Command	Purpose
Router(config-router)#**neighbor** {ip-address|peer-group-name}**remote-as** *as-number*	Specifies a BGP neighbor.

c. Managing Routing Policy Changes

Type of Reset	Advantages	Disadvantages
Hard reset	No memory overhead.	The prefixes in the BGP, IP, and Forwarding Information Base (FIB) tables provided by the neighbor are lost. Not recommended.
Outbound soft reset	No configuration, no storing of routing table updates. The procedure for an outbound reset is described in the section "Configuring BGP Soft Reset Using Stored Routing Policy Information."	Does not reset inbound routing table updates.
Dynamic inbound soft reset	Does not clear the BGP session and cache. Does not require storing of routing table updates, and has no memory overhead.	Both BGP routers must support the route refresh capability (in Cisco IOS Release 12.1 and later releases).
Configured inbound soft reset (uses the **neighbor soft-reconfiguration** router configuration command)	Can be used when both BGP routers do not support the automatic route refresh capability.	Requires pre-configuration. Stores all received (inbound) routing policy updates without modification; is memory-intensive. Recommended only when absolutely necessary, such as when both BGP routers do not support the automatic route refresh capability.

There are two types of soft reset:

- When soft reset is used to generate inbound updates from a neighbor, it is called dynamic inbound soft reset.
- When soft reset is used to send a new set of updates to a neighbor, it is called outbound soft reset.

✓ Resetting a Router Using BGP Dynamic Inbound Soft Reset

To determine whether a router supports the route refresh capability:

Command	Purpose
Router#**show ip bgp neighbors** *ip-address*	Displays whether a neighbor supports the route refresh capability. If the specified router supports the route refresh capability, the following message is displayed: Received route refresh capability from peer.

To perform a dynamic soft reset of the inbound routing table:

Command	Purpose
Router#**clear ip bgp** {*|*neighbor*-address| peer-group-name} **soft in**	Performs a dynamic soft reset on the connection specified in the command. The *neighbor*-address argument specifies the connection to be reset. Use the * keyword to specify that all connections be reset.

✓ Resetting a Router Using BGP Outbound Soft Reset

Command	Purpose
Router#**clear ip bgp** {*|*neighbor*-address| peer-group-name} **soft out**	Performs a soft reset on the connection specified in the command. The *neighbor*-address argument specifies the connection to be reset. Use the * keyword to specify that all connections be reset.

✓ Configuring BGP Soft Reset Using Stored Routing Policy Information

soft reset using stored routing policy information, use the following commands beginning in router configuration mode:

	Command	Purpose
Step 1	Router(config-router)#**neighbor** {ip-address|peer-group-name} **soft-reconfiguration inbound**	Resets the BGP session and initiates storage of inbound routing table updates from the specified neighbor or peer group. From that point forward, a copy of the BGP routing table for the specified neighbor or peer group is maintained on the router.

		The Cisco implementation of BGP supports BGP Versions 2, 3, and 4. If the neighbor does not accept default Version 4, dynamic version negotiation is implemented to negotiate down to Version 2. If you specify a BGP peer group by using the *peer-group-name* argument, all members of the peer group will inherit the characteristic configured with this command.
Step 2	Router#**clear ip bgp** {*|*neighbor*-address|peer-group-name} **soft in**	Performs a soft reset on the connection specified in the command, using the stored routing table information for that connection.

d. Verifying BGP Soft Reset

Step 1 Enter the **show ip bgp** EXEC command to display entries in the BGP routing table.

Router#**show ip bgp**

Step 2 Enter the **show ip bgp neighbors** EXEC command to display information about the BGP and TCP connections to neighbors.

Router#**show ip bgp neighbors**

e. Configuring BGP Interactions with IGPs

Command	Purpose
Router(config-router)#**no synchronization**	Disables synchronization between BGP and an IGP.

f. Configuring BGP Weights

A weight is a number that you can assign to a path so that you can control the path selection process.

A weight can be a number from 0 to 65535 (default weight of 32768).

g. Disabling Autonomous System Path Comparison

Command	Purpose
Router(config-router)#**bgp bestpath as-path ignore**	Configures the router to ignore autonomous system path length in selecting a route.

h. Configuring BGP Route Filtering by Neighbor

Command	Purpose
Router(config-router)#**neighbor** {ip-address|peer-group-name} **distribute-list**{access-list-number|*access-list-*	Filters BGP routing updates to and from neighbors as specified in an access list.

name}{**in**|**out**}	**Note** The **neighbor prefix-list** router configuration command can be used as an alternative to the **neighbor distribute-list** router configuration command, but you cannot use both commands to configure the same BGP peer in any specific direction. These two commands are mutually exclusive, and only one command (**neighbor prefix-list** or **neighbor distribute-list**) an be applied for each inbound or outbound direction.

i. Configuring BGP Filtering Using Prefix Lists

✓ How the System Filters Traffic by Prefix List

- An empty prefix list permits all prefixes.
- An implicit deny is assumed if a given prefix does not match any entries of a prefix list.
- When multiple entries of a prefix list match a given prefix, the longest, most specific match is chosen.

✓ Creating a Prefix List

Command	Purpose
Router(config-router)#**ip prefix-list** *list-name* [**seq** sequence-value] {**deny**|**permit** network/length}[**ge** ge-value] [**le** le-value]	Creates a prefix list with the name specified for the list-name argument.

Command	Purpose
Router(config-router)#**no ip prefix-list** *list-name* [**seq** sequence-value] {**deny**|**permit** network/length}[**ge** ge-value] [**le** le-value]	Removes a prefix list with the name specified for list-name.

✓ Configuring a Prefix List Entry

Command	Purpose
Router(config-router)#**ip prefix-list** *list-name* [**seq** *sequence-value*]{**deny**|**permit** network/length} [**ge** ge-value] [**le** le-value]	Creates an entry in a prefix list and assigns a sequence number to the entry.

✓ Configuring How Sequence Numbers of Prefix List Entries Are Specified

Command	Purpose

Router(config-router)#**no ip prefix-list sequence-number**	Disables the automatic generation of the sequence numbers for prefix list entries.

To re-enable automatic generation of the sequence numbers of prefix list entries, use the **ip prefix-list sequence number**command in router configuration mode:

Command	**Purpose**
Router(config-router)#**ip prefix-list sequence-number**	Enables the automatic generation of the sequence numbers of prefix list entries. The default is enable.

✓ Deleting a Prefix List or Prefix List Entries

Command	**Purpose**
Router(config-router)#**no ip prefix-list** list-name	Deletes a prefix list.

Command	**Purpose**
Router(config-router)#**no ip prefix-list seq** *sequence-value*	Deletes an entry in a prefix list.

✓ Displaying Prefix Entries

Command	**Purpose**
Router#**show ip prefix-list** [**detail**|**summary**]	Displays information about all prefix lists.
Router#**show ip prefix-list** [**detail**|**summary**] *prefix-list*-name	Displays a table showing the entries in a prefix list.
Router#**show ip prefix-list** *prefix-list*-name [*network*/*length*]	Displays the policy associated with the node.
Router#**show ip prefix-list** *prefix-list*-name [**seq** sequence-number]	Displays the prefix list entry with a given sequence number.
Router#**show ip prefix-list** *prefix-list*-name [*network*/*length*] **longer**	Displays all entries of a prefix list that are more specific than the given network and length.
Router#**show ip prefix-list** *prefix-list*-name [*network*/*length*] **first-match**	Displays the entry of a prefix list that matches the given prefix (network and length of prefix).

✓ Clearing the Hit Count Table of Prefix List Entries

Command	Purpose
Router#**clear ip prefix-list** *prefix-list*-name[*network*/*length*]	Clears the hit count table of the prefix list entries.

j. Configuring BGP Path Filtering by Neighbor

	Command	Purpose
Step 1	Router#**ip as-path access-list** access-list-number {**permit**|**deny**} as-regexp	Defines a BGP-related access list.
Step 2	Router#**router bgp** *as-number*	Enters router configuration mode.
Step 3	Router(config-router)#**neighbor** {ip-address|peer-group-name} **filter-list** *access-list-number* {**in**|**out**}	Establishes a BGP filter.

k. Disabling Next Hop Processing on BGP Updates

✓ Disabling Next Hop Processing Using a Specific Address

Command	Purpose
Router(config-router)#**neighbor** {ip-address|peer-group-name} **next-hop-self**	Disables next hop processing on BGP updates to a neighbor.

✓ Disabling Next Hop Processing Using a Route Map

Command	Purpose
Router(config-route-map)#**set ip next-hop** *ip-address* [...ip-address] [**peer-address**]	In an inbound route map of a BGP peer, sets the next hop of the matching routes to be the neighbor peering address, overriding any third-party next hops and allowing the same route map to be applied to multiple BGP peers to override third-party next hops. With an outbound route map of a BGP peer, sets the next hop of the received address to the peering address of the local router, disabling the next hop calculation. The next hop must be an adjacent router.

✓ Configuring BGP Next Hop Propagation

Command	Purpose
Router(config-router)#**neighbor** *ip-address* **next-hop-unchanged**	Configures the router to send BGP updates to BGP peers without modifying the next hop attribute. **Caution:** This command should be configured only on route-reflector clients and not on a route reflector.

l. Configuring the BGP Version

Command	Purpose
Router(config-router)#**neighbor** {ip-address|peer-group-name} **version** *number*	Specifies the BGP version to use when communicating with a neighbor.

m. Configuring the MED Metric

Command	Purpose
Router(config-router)#**default-metric** *number*	Sets an MED.

n. Monitoring and Maintaining BGP

✓ Clearing Caches, Tables, and Databases

You can remove all contents of a particular cache, table, or database. Clearing a cache, table, or database can become necessary when the contents of the particular structure have become, or are suspected to be, invalid.

To clear caches, tables, and databases for BGP, use the following commands in EXEC mode, as needed:

Command	Purpose
Router#**clear ip bgp** neighbor-address	Resets a particular BGP connection.
Router#**clear ip bgp ***	Resets all BGP connections.
Router#**clear ip bgp peer-group** *tag*	Removes all members of a BGP peer group.

✓ Displaying System and Network Statistics

You can display specific statistics such as the contents of BGP routing tables, caches, and databases. Information provided can be used to determine resource utilization and solve network problems. You can also display information about node reachability and discover the routing path that the packets of your device are taking through the network.

To display various routing statistics, use the following commands in EXEC mode, as needed:

Command	Purpose
Router#**show ip bgp** *prefix*	Displays peer groups and peers not in peer groups to which the prefix has been advertised. Also displays prefix attributes such as the next hop and the local prefix.
Router#**show ip bgp cidr-only**	Displays all BGP routes that contain subnet and supernet network masks.
Router#**show ip bgp community** community-number [**exact**]	Displays routes that belong to the specified communities.
Router#**show ip bgp community-list** community-list-number [**exact**]	Displays routes that are permitted by the community list.
Router#**show ip bgp filter-list** *access-list-number*	Displays routes that are matched by the specified autonomous system path access list.
Router#**show ip bgp inconsistent-as**	Displays the routes with inconsistent originating autonomous systems.
Router#**show ip bgp regexp** *regexp*	Displays the routes that have an autonomous system path that matches the specified regular expression entered on the command line.
Router#**show ip bgp**	Displays the contents of the BGP routing table.
Router#**show ip bgp neighbors** [neighbor-address]	Displays detailed information on the BGP and TCP connections to individual neighbors.
Router#**show ip bgp neighbors** [address] [**received-routes**|**routes**|**advertised-routes**|**paths** *regexp*|**dampened-routes**]	Displays routes learned from a particular BGP neighbor.
Router#**show ip bgp paths**	Displays all BGP paths in the database.
Router#**show ip bgp peer-group** [tag] [**summary**]	Displays information about BGP peer groups.
Router#**show ip bgp summary**	Displays the status of all BGP connections.

✓ Logging Changes in Neighbor Status

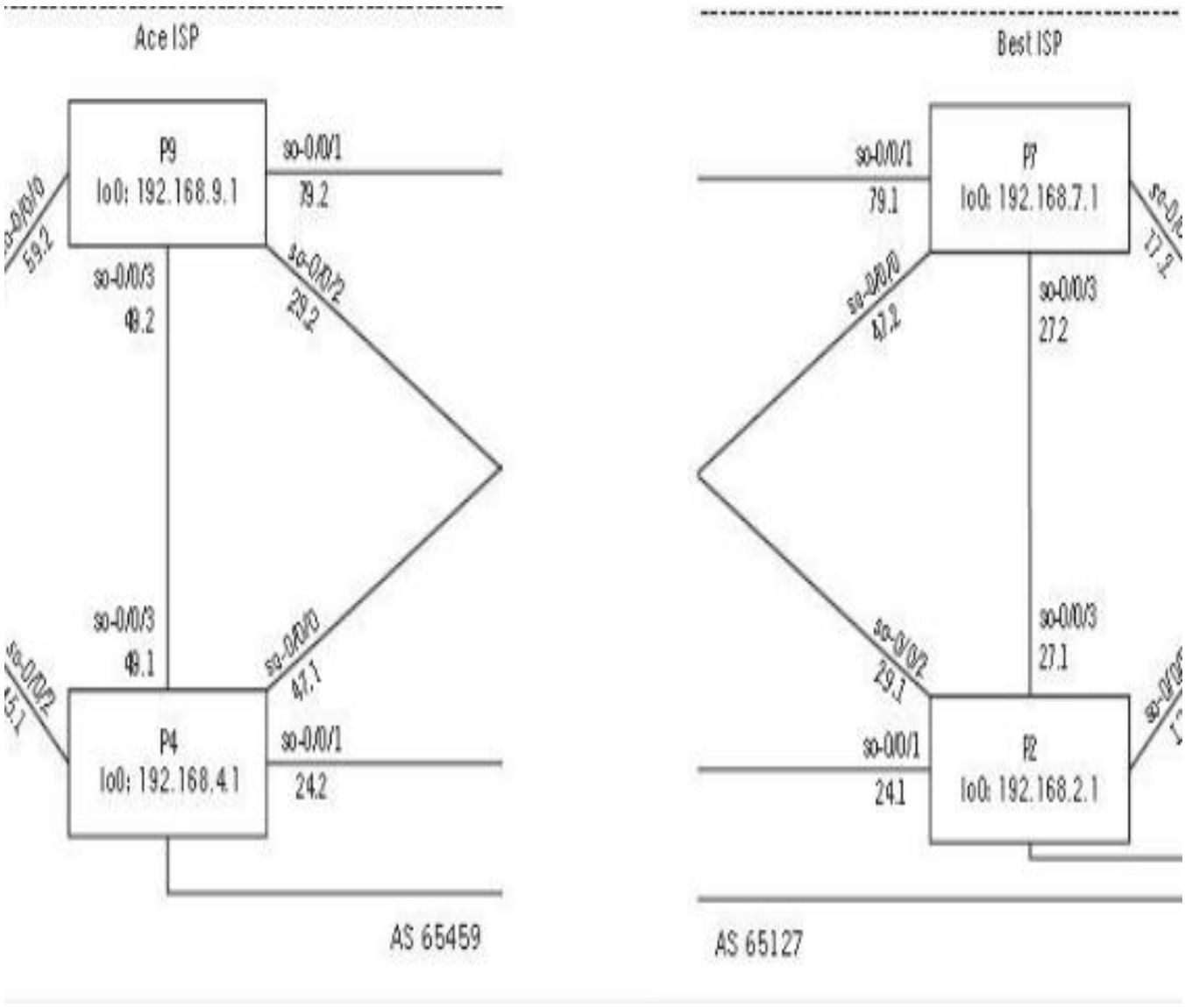
To enable the logging of messages generated when a BGP neighbor resets, comes up, or goes down, use the following command in router configuration mode:

Command	Purpose
Router(config-router)#**bgp log-neighbor-changes**	Logs messages generated when a BGP neighbor

	goes up or down, or resets

III. Lab practice

1. Network Layout



2. Lab steps

Using GNS3 to complete all tasks.

- **Configure basic BGP tasks on all routers**, using AS number in the network layout.

  Basic BGP Configuration Task List (*Lab Practice*)

  1) Enabling BGP Routing (Required)
  2) Configuring BGP Neighbors (Required)
  3) Managing Routing Policy Changes (Optional)
  4) Verifying BGP Soft Reset (Optional)
  5) Configuring BGP Interactions with IGPs (Optional)
  6) Configuring BGP Weights (Optional)
  7) Disabling Autonomous System Path Comparison (Optional)
  8) Configuring BGP Route Filtering by Neighbor (Optional)
  9) Configuring BGP Filtering Using Prefix Lists (Optional)
  10) Configuring BGP Path Filtering by Neighbor (Optional)
  11) Disabling Next Hop Processing on BGP Updates (Optional)
  12) Configuring the BGP Version (Optional)
  13) Configuring the MED Metric (Optional)

- Each step in BGP configuration task, you have to use some commands of **BGP monitoring commands** to show or troubleshoot the consequence.
- Check out **BGP Configuration Examples** in the link given.
- To configure **BGP basic features**, complete the tasks in the following sections. Enabling BGP and configuring BGP neighbors are mandatory; the other tasks are optional, but might be required for your application.
- In case of Lab time limit, you just try to experience some tasks: **(1),(2),(3),(4),(8),(9),(10),(12),(13).**

IV. Result

- Finish your work by reporting your network status and explaining your solution on place.
- Complete the topology in section III.1 in GNS3, using basic BGP configuration, guarantee the reachability amongst all routers.