Iowa State University
Department of Electrical and Computer Engineering
Cpr E 489: Computer Networking and Data Communications
Lab Experiment #6
CloudLab Experiment: IPv4 Routing Basics
(Total Points: 100)

Objective

In this GENI lab, you will get familiar with the static routing protocol and manually updating the routing tables.

Lab Expectations

Work through the lab and let the TA know if you have any questions. After the lab, write up a lab report and be sure to:

- **Summarize what you learned in a few paragraphs. (25 points)**
- **Include your answers for all questions, with screenshots. (70 points)**
- **Cleanup. (5 points)**

Procedure

Prepare Your Experiment

1) If you haven't already, login to Cloudlab at: https://www.cloudlab.us/login.php
2) Select **Experiments** and **Start Experiment**
3) Select **Change profile**, search for CPRE489-lab6, and select it.
4) Click **Select Profile** and then **Next**
5) Use your net-id for the name of the experiment and select a cluster with a green dot next to it. Then select **Next** and then **Finish**.
6) Wait for your resources to be ready. This may take several minutes. If you receive an email regarding the image of your nodes being outdated, ignore it.
7) Log into the three nodes via SSH. Use the same technique you used in Lab 4

Exercise 1: Examine the Network Topology

The network you will be working with is depicted in a figure below. We will be concerned with the eth1 and eth2 interfaces for each of the 3 nodes. **We will not be using eth0 for this lab.**
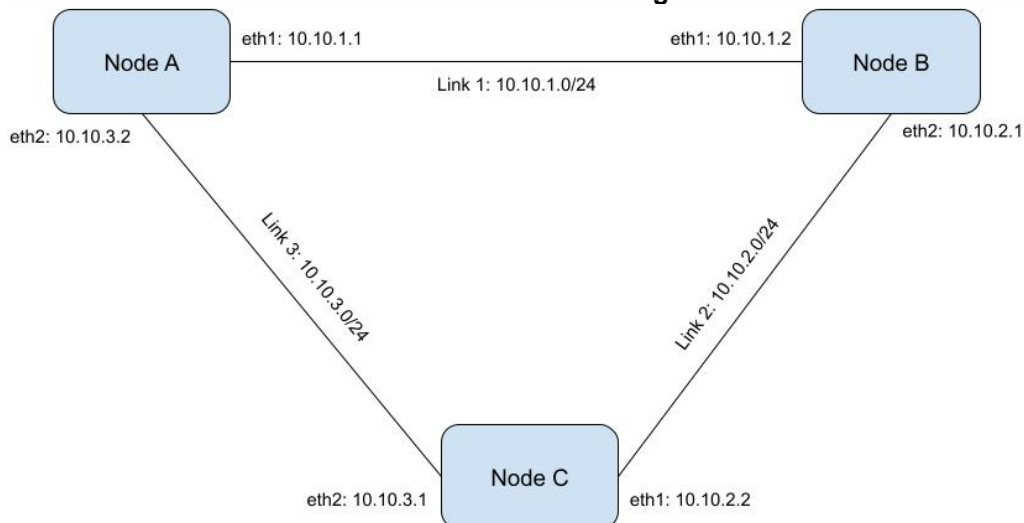
1. Execute the **route -n** command in each of the three nodes to show their respective routing tables. The "-n" option prints IP addresses rather than assigned names. **All route screenshots should be done with the "-n" option. Include a screenshot of the tables in your lab report. (10 points)**

2. From node A, try to ping the other addresses of nodes B and C (two IP addresses for each node). **Include a screenshot of the ping outputs and explain the results. (10 points)**

3. **What happens when you traceroute from A to IP address 10.10.2.2 before you set up the static routes? Why? Include a screenshot of the traceroute output in your lab report. (10 points)**

4. If you get a message like "-sh: 7: traceroute: not found" when trying to execute traceroute, use 'sudo apt-get install traceroute' to install traceroute.

Exercise 2: Setting Up Static Routes

The following command will add the destination subnet **destiny** (A.B.C.0) to the local routing table and use IP address **thisway** (W.X.Y.Z) accessible via interface **intf** as the gateway:
  sudo route add -net **destiny** netmask 255.255.255.0 gw **thisway intf**
More specifically, in the above command:
- **destiny** is the subnet address (A.B.C.0) that will indicate where to send packets that have a matching destination IP address (e.g., if you want to direct traffic for the subnet 192.168.254.0/24, then you would set the destination to 192.168.254.0 with netmask 255.255.255.0 accounting for the /24. Note: netmask 255.255.255.0 should be sufficient for the purposes of this lab);
- **intf** is the name of the interface on <u>this</u> computer from which traffic will be sent out; and
- **thisway** is the IP address of the interface on the gateway that will receive the traffic that is sent (W.X.Y.Z).

Note: The gateway IP address **thisway** must be an address that the interface **intf** can access directly (i.e., it is not further routed before getting to **destiny**). It is also not the IP address of the interface on the current computer.
- To delete this entry in the table, simply replace **add** with **del**.
  sudo route **del** -net **destiny** netmask 255.255.255.0 gw **thisway intf**

- Now, modify the routing tables to allow for node A to reach the IP addresses that you could not reach in step 6. **Include a screenshot of the routing table of node A (10 points).**

- **Take a screenshot of node A successfully pinging and using traceroute on 10.10.2.2 (10 points).**

- Setup up more static route(s) so that every node can access every interface in the system. **Take screenshots of routing tables of nodes B and C as well (10 points).**

- Show a traceroute from node B using traceroute on the four interfaces it does not own. **Take a screenshot of each traceroute output. (10 points).** For example:
  user@node-b$ traceroute 10.10.1.1
  [OUTPUT]
  user@node-b$ traceroute 10.10.3.2
  [OUTPUT]
  user@node-b$ traceroute 10.10.3.1
  [OUTPUT]
  user@node-b$ traceroute 10.10.2.2
  [OUTPUT]

Cleanup

After you are done with the experiment, you should always release your resources so that other experimenters can use the resources. Terminate your resources and i**nclude a screenshot of your experiment with no resources on the Manage Resources panel. (5 points)**

Tips

- Remember that you can use "ifconfig" to determine which Ethernet interface (e.g., eth0) is bound to what IP address at each of the nodes.
- The routing table matches the destination address to the newest, valid entry.
- Ping and traceroute use ICMP which gets sent to the receiver, processed, and sent back. The response also needs to know how to reach its destination.
- A useful tool to debug the packet flow is **tcpdump**.