Lab3: Routing and Network Connectivity

in Cisco Packet Tracer

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Computer Communication Remote Lab
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Lab3, 7 tasks, 22 questions.

Contents

1 Introduction to the virtual lab room

The "real" lab starts now so please enter in our virtual lab room. To do so, start by downloading the packet tracer file representing our room: lab3.pkt from `http://www.cse.chalmers.se/~duvignau/packet-tracer-lab`.

Open the file in Packet Tracer and you should see the same network as Figure 1.

Tips

If you have problem seeing the different elements because of the background picture, just press **Shift + i** then click **Reset**.

The computers in the lab are configured in a *Peer-to-Peer LAN* connection. As described in the preparation instructions, they are connected two by two to switches and each switch is connected to its own router and finally the routers are interconnected forming a ring.

First, you should find out which seat you should "take" in the virtual room. Just compute **your group number modulo 8, plus 1** to find "your table" in the room, for instance "ComputerCommunicationLabGroup 88" gets $88\%8 = 0$, so the group should use PC1-1 and PC1-2. Let's call these two computers sitting on "your table" in the following **PCX-1** (or simply **your computer**) and **PCX-2** (or **your neighbour's computer**); here $X = 1 + (N\%8)$ where N is

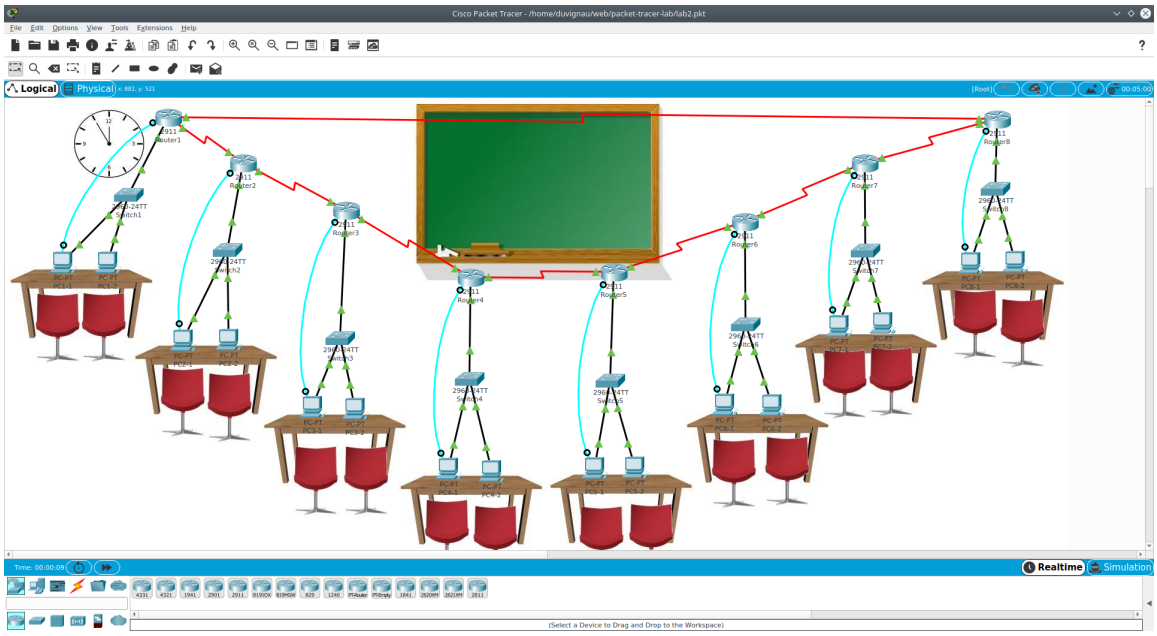

Figure 1: Our virtual lab room in Packet Tracer: your table is *your group number modulo 8 plus 1*, so **please take a seat!**

your group number. Those 2 neighbouring PCs are connected to the same switch called in the following **your switch** which itself is connected to **your router**.

Tips

In the following, always wait a little bit (20-30sec) after loading the packet tracer file so that the network stabilizes (you'll notice computers are changing IP addresses at the beginning).

2 Routing and Router Configuration

Configuration of routers is outside the scope of this course, but we will now look at **how the routers are already configured**. Each router is configured to be your default gateway and receives all traffic from your network that is destined for other networks. You will soon investigate two router commands: "**show run**" and "**show ip route**", both of them can be entered either using a **telnet session** or via the **router's console**.

2.1 Console connection

Let's first try the console connection first. If an error is made when configuring the router, it may not be possible to connect to it over the network anymore. Therefore, the router has a console interface (with a dedicated serial communication cable), which is always possible to use when you have physical access to the router. Identify which computer on your desk has a console access to the router and open **Terminal** on the PC's Desktop (this is equivalent of Windows' "Hyper Terminal"). Leave default parameters unchanged and press "**OK**" and you will be able to communicate directly with the router in console mode.

First press "**Enter**" as instructed then the first password asked is "**cisco**", then to be able to configure the router, another login is required using the "**enable**" command and the password is this time "**class**". Now you are working in privileged mode and configuration is possible. Please don't try any router configuration!

Task 1. After successfully connecting to the router in privileged mode, run the command "`show run`" (showing running configuration) and read throughout the output (try to figure most of it by yourself). Insert a screenshot and answer the following questions:

(a) What is the IP address of the default gateway of your computer? Does that match one of your router's interfaces?

(b) Which router interface belongs to your network and what IP address does the interface have?

(c) What routing protocol is configured for the router and for what networks?

Tips

To see "more" of the output of commands in the router command-line's interface, just press **Enter**.

2.2 Remote connection and routing

Now let's try accessing the router remotely using a **telnet session**. First **pick a router that is 3 hops away** (eg Router4 is 3 hops away from Router1) from *your local router* (that is the router connected to your local switch and your default gateway). Now on **PCX-2**, run telnet to connect to the *foreign* router using the IP address of one of the appropriate interfaces. Start **Telnet** to connect to the router you have picked. After successful authentication (the login and passwords are the same as before), you are in user mode where some of the router settings can be checked. For the next task, we only need **user privileges**.

Tips

You'll find telnet on the **Desktop**: click on an icon for **Telnet / SSH Client**, then choose **Telnet**. Telnet is also available using its usual command-line interface in the *Command Prompt* and works on port number 23 (dedicated to telnet protocol) which is the default port number of the command when left unspecified.

Task 2. After successfully connecting to the remote router in user mode, run the command "`show ip route`" (showing routing table) and insert in your report a screenshot of the result, and answer the following questions:

(a) What are the networks (prefix and mask) that the router you've picked has direct connection with? Differentiate between the local interfaces and a direct link.

(b) Determine the route from the selected router to your LAN from the routing table. What is the interface to go to your LAN?

(c) Check how many hops away there are to reach the LAN according to the routing table. Determine possible routes to your LAN by examining the network topology. Does the route provided correspond to the best route possible? Hint: Cisco routers show the metrics using $[120/x]$ notation where x is the metric (here the hop count).

Hint

A **hop** is a unit of distance in networks: "n hops" means that n link traversals are required to reach the destination, regardless of the capacity and traffic on the different links.

The maximum number of hops in the full network refers to the maximum number of router traversals to reach any computer on the network, and this **from any starting router** (not only

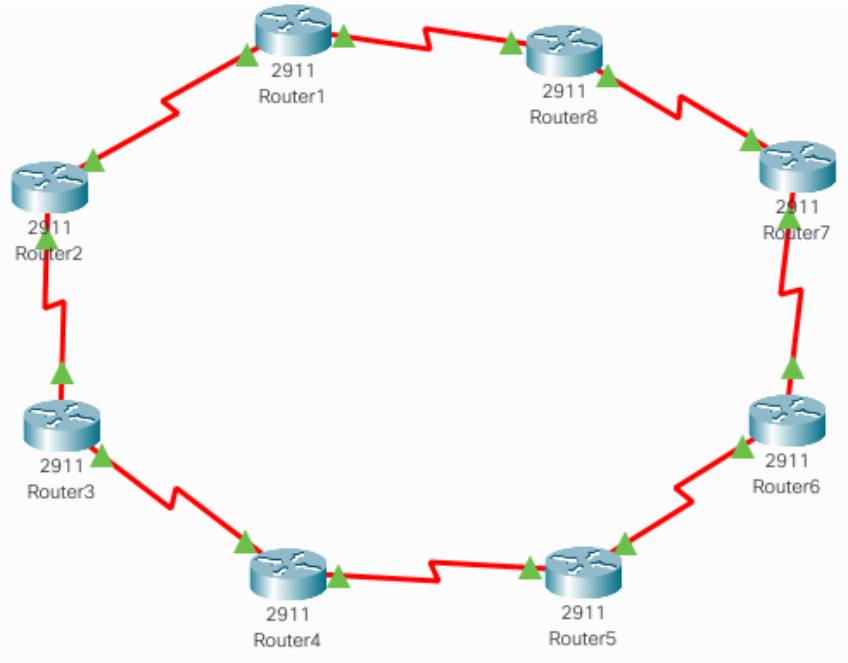

Figure 2: The routers form what we call a "ring topology", a very well known and efficient configuration to connect different machines.

yours). The next task explores this maximum number of hops or "max-hop" in the provided network.

Task 3. Knowing the maximum number of hops is "**4**" in this network, and based on the information and knowledge you have acquired in previous tasks, answer the following questions:

(a) Give 2 routers with a hop-distance of 4 (cf. Figure 2).

(b) Suggest **2 new links** to be added to the network to reduce max-hop by 1, that is to get a max-hop value of 3. Add them to the routers.png picture[a] (Figure 2).

(c) Reproduce in your report and complete Table 1 that should display the new routing table at **your local router** (the one closest to your switch) once max-hop has been reduced by 1. This routing table, that you will calculate "**by hand**", should reflect the state of the system once *all shortest paths* have been discovered. The new added links should use the hypothetical interface `Serial0/0/2`. Finally, highlight in the table the lines that are different from your own router's routing table.

[a] http://www.cse.chalmers.se/~duvignau/packet-tracer-lab/routers.png

Hint

You will have to create shortcuts! Here, we assume that each edge has unit cost (i.e. the cost of a path is the number of hops). Note running Dijkstra's algorithm with unit cost is nothing more than doing a **Breadth-First Search** starting from the source, over the graph describing the network!

Destination	Hop-count	via (Router's name)	Interface
200.88.202.0/25			
197.44.117.0/25			
199.87.133.0/25			
193.84.101.0/25			
190.34.131.0/25			
191.89.181.0/25			
202.43.132.0/25			
207.31.182.0/25			

Table 1: Routing table at your local router.

3 Ping, Tracert and Packet Capture

3.1 Ping command

The ping command is an important network tool in order to check connectivity in a particular network.

Task 4. Ping your neighbour's computer (PCX-2), and insert a small screenshot in your report.

(a) How many IP packets are sent by the host in total when you run ping? How many bytes are used by default in each packet for ping?

(b) What information do you get from running the ping? The answer must be the interpretation of the result and not a copy of what is displayed.

(c) Ping now 1 computer one of the other tables. What are the main differences you note in the output compared with your neighbor's computer's response?

Tips

Remember that to copy-paste one device's IP address, you can **Inspect** a device and choose "**Port Status Summary Table**". To inspect elements, use the **Inspect** (Magnifying glass) action in the Action bar next to *Select*.

3.2 Tracert command

In the next task, we will run the command `tracert` from your computer to a computer in some other group's LAN. Check carefully the trace hop by hop and look at the network topology.

Task 5. First pick 2 computers that are at *different hop-distances* from your local computer.

(a) Execute `tracert` for each of them and insert a screenshot with all output.

(b) How many hops do you get in each case? How does this compare to the distance metric provided by the router when you run "`show ip route`"?

(c) What about your neighbouring computer in your LAN? How many hops should you get? Check your answer by using tracert.

Tips

Since there will be a lot of generated packets in **the next task**, you may want to accelerate the animation speed (slide the bar to the right) or just click rapidly on ⏭, but of course, you are going to miss watching Cisco's cutting-edge animations!

Start the *simulation mode* in order to visualize local traffic. Run the command `tracert` again but to a computer in another group *2 hops away from your router* and answer the following task.

Task 6. (a) What are the **Network Layer** protocols (+ code and type of messages) involved in the operation when you run "`tracert`"? Insert a screenshot with the simulation panel and the PDU Information.

(b) How many times is each *tracert* round repeated?

(c) Do a `ping` to the same destination of *tracert*. What messages (protocol and type) are used? What's the difference with those of the `tracert` command?

Hint

You may need to analyze deeply the captured packets and look for the appropriate layer or *PDU details*. Upon inspecting a packet, you can check **Inbound/Outbound PDU Details** on the right of **OSI Model** tab to get more information about header content.

3.3 RIP packets

Continue to capture packets with the simulation mode, and let the simulation run till you capture some RIP packets.

Task 7. (a) What RIP version is used? Which protocol is used for transport and using which port? What are the source and destination IP addresses used for the RIP messages that are sent by the router on your LAN?

(b) Among all entities that receive such messages, which ones take actions?

(c) Examine in details the different fields of the RIP message itself (go through first all "Rip Route Packet" information). Can you guess the meaning of the different fields? Which routing algorithm is based on the exchange of such information?

(d) Based on your prior knowledge of routing algorithms, deduce how the information contained in RIP packets is going to get processed by the receiver.