Lab 10: Configuring Routers

Overview

In this lab you will configure the IP settings on a couple of computers in the lab to allow communication between different network segments. Additionally, we will add DNS and HTTP services to enable web browsing of our newly configured networks.

Everyone in lab will be participating in creating a “mini-Internet” by configuring a host as a web server for their “city”. Then a router will be configured that allows other remote networks to connect to and view the home page for their city. Once everyone’s router has been configured properly, each city’s host will be able to view the homepage of each remote city. The concepts presented in this lab are exactly the ones that support and enable the world-wide Internet to function. In our case, we are simply connecting 4 “cities” together.

Notes:

1. You will be working in pairs. Each pair will be responsible for two machines. To help distinguish between the machines, each pair will have a router on the center table and a web server against the wall.

2. You will have admin rights to the lab machines for the duration of the lab.

3. You will need to work “synchronously”. You will not be finished with the lab until you can successfully browse the homepage for your city as well as each of the three remote cities. This may require you to wait for other groups to finish configuring their routers.

Initial configuration and setup:

Select a machine against the wall as your web-server and a machine in the middle of the room as your router.

Select the city you will be configuring using the following table so you will know what IP addresses to use when configuring your hosts. Write your
selection on the whiteboard to ensure no two groups use the same city name. **Identify your city name on the hand-in worksheet.**

<table>
<thead>
<tr>
<th>City</th>
<th>IP Network</th>
<th>Router’s IP</th>
<th>Web server IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>192.168.10.0 / 24</td>
<td>192.168.10.1</td>
<td>192.168.10.10</td>
</tr>
<tr>
<td>New York</td>
<td>10.10.10.0 / 24</td>
<td>10.10.10.1</td>
<td>10.10.10.10</td>
</tr>
<tr>
<td>Oslo</td>
<td>172.16.1.0 / 24</td>
<td>172.16.1.1</td>
<td>172.16.1.10</td>
</tr>
<tr>
<td>Rome</td>
<td>10.1.1.0/ 24</td>
<td>10.1.1.1</td>
<td>10.1.1.10</td>
</tr>
</tbody>
</table>

**Step 1: Create a web page on your web server**

Create a simple web page using HTML that welcomes a visitor to your city. Name the file index.html and place it in the directory C:\inetpub\wwwroot (If you need help with the HTML you can copy the file index.html from cscourses \ CS 254 and then modify the contents.)

Open a browser on your webserver and browse to the localhost. Have your instructor verify that this works correctly.

**Step 2: Configure the IP addresses of your web server and router**

To configure the IP address of a machine as well as other network settings:
- Right-click on the network connection icon in the lower right of the screen and select **Open Network and Sharing Center**
- Click on the **Change adapter settings** link along the left
- Double click to open the **Ethernet connection** then click on the **Properties** button
- Double-click on **Internet Protocol Version 4 (TCP/IPv4)**, you should see this dialog:
- Click on the radio button for **Use the following IP address** then set your **IP address** and **Subnet mask** fields
- Click **OK** and close all the dialogs

Configure the IP address of your web server according to the table above. Similarly configure the IP address of your router according to the table above.
Open a browser on your web server and browse to your web page using the IP address of your web server. Verify that this works. Open a browser on your router and browse to your web page using the IP address of your web server. Verify that this works.

**Ping** your router from your web server and **ping** your web server from your router.

Capture the results of both **ping**’s and include with your lab hand-in.

### Step 3: Configure your router’s outside interface

The routers are connected via an Ethernet segment with address 172.20.20.0/24. Using the table below, select the IP address for your router and add it to a second interface on the router.

<table>
<thead>
<tr>
<th>City</th>
<th>Outside IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>172.20.20.40</td>
</tr>
<tr>
<td>New York</td>
<td>172.20.20.10</td>
</tr>
<tr>
<td>Oslo</td>
<td>172.20.20.30</td>
</tr>
<tr>
<td>Rome</td>
<td>172.20.20.20</td>
</tr>
</tbody>
</table>

You can create a second Ethernet interface on your router by opening the **Internet Protocol Version 4 (TCP/IPv4)** dialog, clicking on the **Advanced ...** button and adding another IP address.

A Windows machine will not route even though it has two network interfaces until routing is enabled. Doug Patrone has already configured the machines on the center tables to enable the routing of IP packets across the two interfaces.

Attempt to **ping** your router’s outside address from your web server host. Can you determine why it doesn’t work?

The problem is that your web server doesn’t know anything about the 172.20.20.0 network. What setting can you make on your web server for this to work? Fix it then ping your router’s outside address again.

Capture the result of this **ping** and include it with your hand-in.

Can you **ping** another router that is already configured (from your web server host)? Use their external IP address. Capture the result of this ping and include it with your hand-in.

Do not continue on to step 4 until you can ping your router’s outside interface from your web server.
Step 4: Configure routes to other networks

In order for your router to know where to route requests destined to remote networks, you must manually set up routes. You will need to configure 3 routes (one for each of the remote city networks). **Fill out the hand-in worksheet with the 3 routes you need to configure on your router.**

Using a command prompt (with admin privileges) and the `route` command, apply your 3 routes to your router. You can display your routing table with `route print`. Here is the command to add a route:

```
route add <network address> mask <subnet mask> <remote IP> metric 1
```

Identify on the whiteboard when your routes have been added.

Can you ping each of the remote routers from your router? Can you ping each of the remote web servers from your router? Finally, can you ping each of the remote web servers from your web server?

For groups who have completed step 4 properly, **pings** between the web server and the remote city’s web server should be successful. Identify on the whiteboard the successful ping of the web server in each remote city.

Capture the result of a successful ping between your web server and each of the other three web servers. Include this with your lab hand-in.

Browse to each of the remote web servers from your web server. You will need to use the IP addresses of the remote servers since we haven’t set up DNS yet. Verify that you can do this successfully.

Do not move on to step 5 until **all** cities have identified that their ping tests to all remote cities have been successful.

Step 5: Configure DNS

In the real world, we don’t browse to Internet web sites using IP addresses. Instead we use easy to remember names such as [www.google.com](http://www.google.com). These domain names translate to IP addresses of the web servers through the use of a DNS server.

To browse our web sites by name instead of IP, each host must be configured to use a DNS server. For this lab, we will all be using a single DNS server located at 149.76.129.251. The lab instructor should have already populated all the domain name to IP address mappings by this time.

Once you have made that configuration change to your TCP/IP settings, attempt to browse to another city’s web server using their name instead of IP address. The following table lists the names of the web sites:
<table>
<thead>
<tr>
<th>City</th>
<th>Domain Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td><a href="http://www.london.com">www.london.com</a></td>
</tr>
<tr>
<td>Rome</td>
<td><a href="http://www.rome.com">www.rome.com</a></td>
</tr>
<tr>
<td>Oslo</td>
<td><a href="http://www.oslo.com">www.oslo.com</a></td>
</tr>
<tr>
<td>New York</td>
<td><a href="http://www.newyork.com">www.newyork.com</a></td>
</tr>
</tbody>
</table>

You need to make one last change to your router for the DNS to work correctly. Your router needs to know how to route traffic destined for the 149.76.129.0/24 network. Add a route to this network to your router that points to the address 172.20.20.1.

Now verify that you can browse to other cities using their DNS names. Once you have this working correctly, capture the `ipconfig /all` listing of your IP parameters on both your router and your web server and include them with your lab hand-in. Also capture the results of `route print` for your router.

When you connect to a remote network, you can view the router “hops” each packet takes by issuing a `tracert` command with the remote host as an argument. For example: `tracert london.com` will show each interface the packet traverses to get to www.london.com. Run `tracert` from your web server to a remote web server, capture the results and include them with your lab hand-in.

**Step 6: Network map**

Draw a network map of the network showing the 4 routers, the 4 web servers, the router that connects to the 149.76.129.0/24 network. Draw the connections between the machines and label the interfaces with the IP addresses. Include this map with your lab hand-in.

**Extra Credit 1:**

What is another way to configure your city’s router so the specific route to the network with the DNS doesn’t have to be added manually?
HAND IN WORKSHEET:

Name(s):
__________________________________________
__________________________________________

CITY Name: ___________________________

Router’s (internal) IP: __________ Subnet mask: __________

Web Server IP: _______________ Subnet mask: ______________

Did you need to configure anything specific to allow your web server to ping your router’s outside host? (YES) / (NO) If yes, what did you do to resolve the problem (be very specific)?

Routing table:

(IGNORE YOUR OWN CITY’S ROW WHEN FILLING OUT ROUTING TABLE)

<table>
<thead>
<tr>
<th>Route</th>
<th>Destination</th>
<th>Subnet Mask</th>
<th>Router</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oslo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Attach your text file containing all the pings requested, the IPCONFIG /all output for both your router and web server, as well as the route print output for your router and the tracert output, and the network map.
Extra Credit 2: Modifying the Topology

Now you need to consider the changes you would be required to make if there are changes to the topology of the internet.

Assume a single cross-Atlantic link has been added with two additional routers. Here is a diagram to help:

Assume Philadelphia and Paris are connected by a network with network id: 2.2.2.0/24

Assume New York, Los Angeles, and Philadelphia are on a network with network id: 3.3.3.0/24
Assume further that the IP addresses assigned to Philadelphia are 3.3.3.3 and 2.2.2.2

Assume London, Oslo, Rome, and Paris are on a network with network id: 4.4.4.0/24
Assume further that the IP address assigned to Paris are 2.2.2.4 and 4.4.4.4

Describe the changes you need to make to the network settings on your web server and on your router to allow everyone to communicate. Do not actually change the settings. This is a paper-and-pencil exercise only.