Aalto University
School of Electrical
Engineering

Department of Communications and Networking
ELEC-E7330 Laboratory Course in Internet Technologies

34 – BGP

Instructions

18.11.2020 Juha Järvinen Juha.Tapio.Jarvinen@aalto.fi (updated)

1 General Information

This year, all the students do the BGP lab work at the same time, in the same room.

There is only one report to return in this lab work. Return it as the “final” report in MyCourses.

2 Goal

The purpose of the assignment is to show the reality of the network world – it is not enough that your own network is working properly, your neighbouring networks must also do the same.

3 Task Description

As a group you build up a small PoP (Point of Presence) on an APU[1] with an ESXi[2] virtualization tool before coming to the lab session. Then all the groups come at the same time to a lab room and you connect your own PoPs to each other. In the lab you have two scenarios: peering and transit traffic. For the final report, we have given you a couple of questions to consider.

4 Preliminary report

Build and configure a small network to an APU device (one APU per group) as shown in Figure 1. Your group number has been sent to your group by email. Note: group numbers have two digits (for example, 09). You will get the APU device from the course personnel beforehand.

If your group has no laptop to use, please contact Juha.Tapio.Jarvinen@aalto.fi.

[1] https://www.pcengines.ch
[2] https://www.vmware.com/products/esxi-and-esx.html

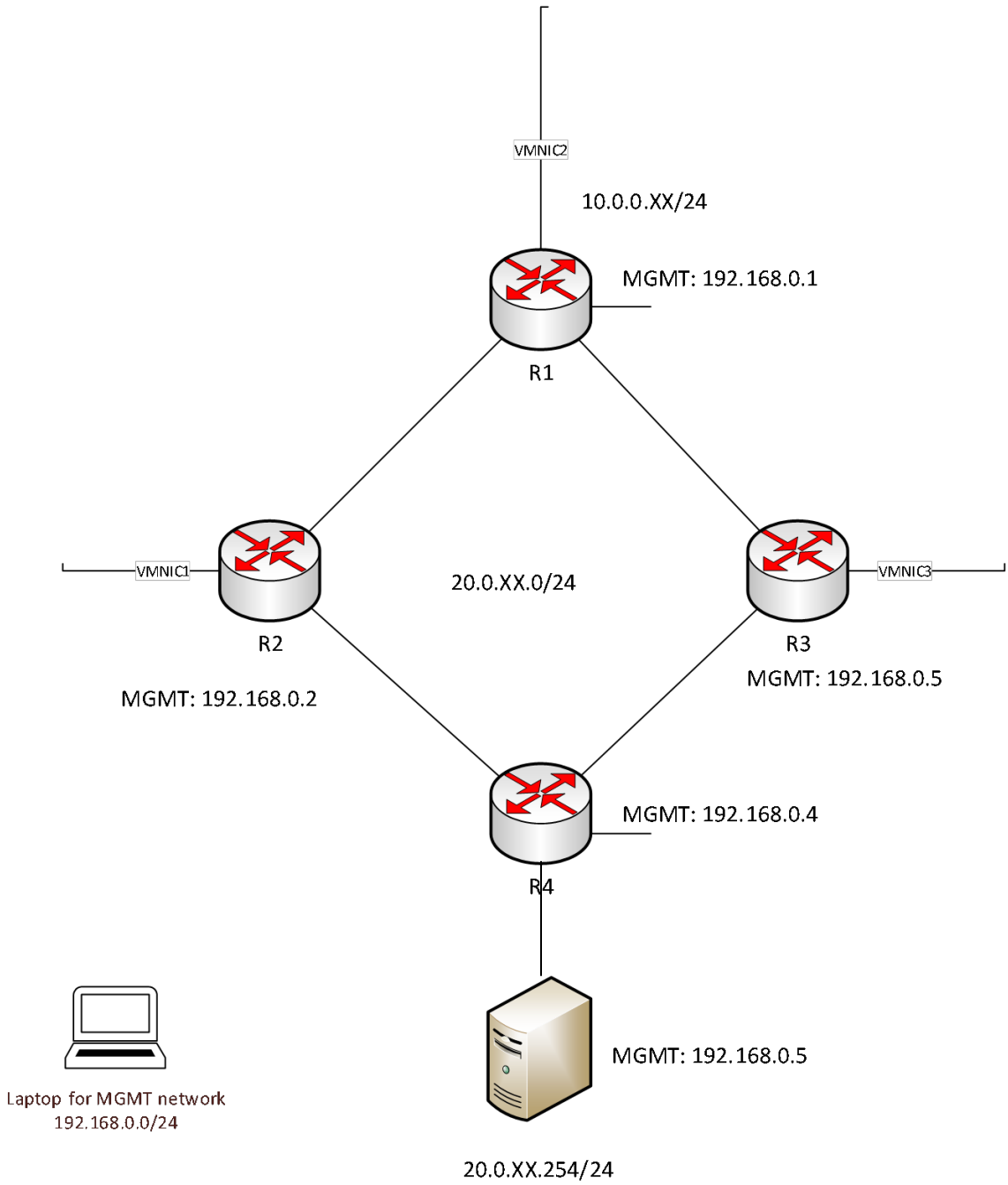

Figure 1. A Network topology build on your virtualization software.

On ESXi, build up four routers and one Linux computer (Debian). Internally you can do links between routers as you like, but externally use must physical NICs. Connect your laptop to the left-most Ethernet port, its IP address is 192.168.0.254/24. **When you have powered up your APU, please wait for 10 minutes and then go with a www browser to http://192.168.0.254** Credentials are *root/VyosVyos!!* Do **not** connect your APU to the Internet in any case!

In the figures we have used the first six groups as an example. The number of the groups varies from year to year (session to session).

Your PoP is connected other neighbors in the following way; In Figure 2 the topology is presented.

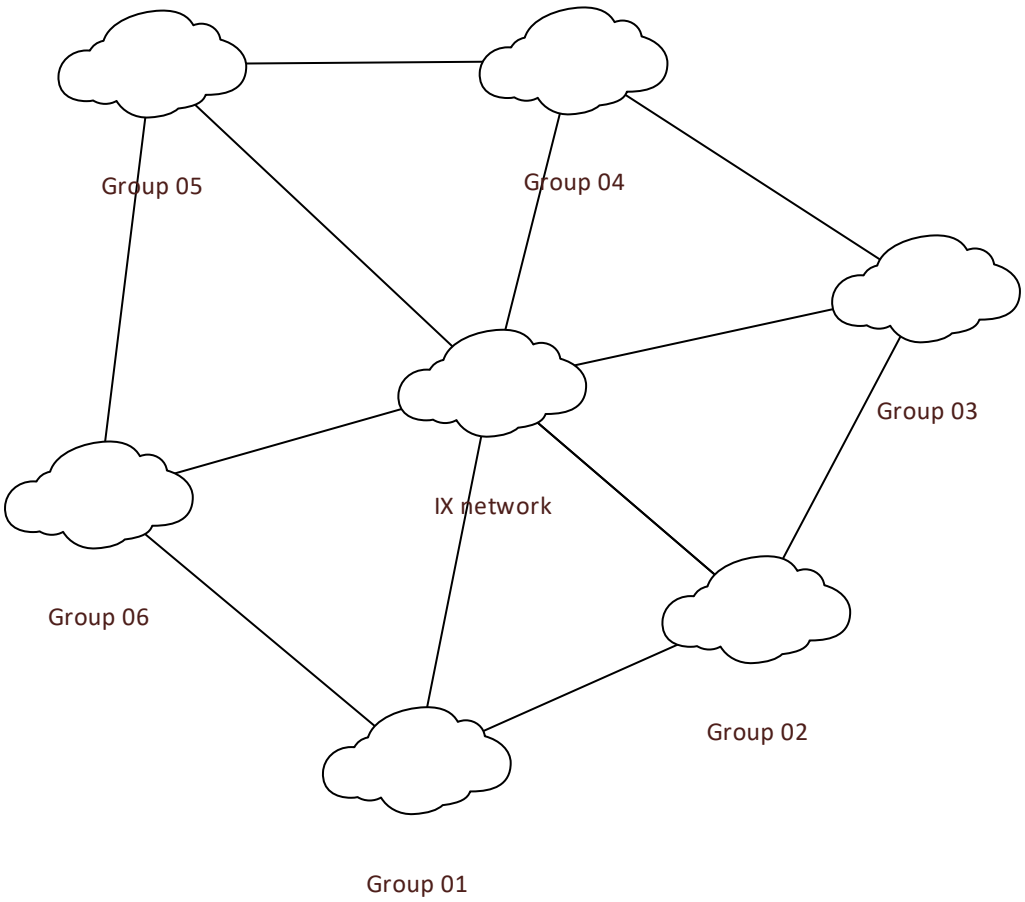

Figure 2. The topology. Number of groups is only referential.

Routers R1-R4 use VyOS[3] software. The VyOS image for ESXi is downloadable in Mycourses. Install and do the networking as described earlier. The “VM Network” is in the 192.168.0.0/24 address space. Please use this management network in the following way: R1 gets for the management address 192.168.0.1, and R2 .2 etc. The Debian host gets .5.

Credentials for the VyOS for ESXi image are *vyos/vyos*. In the image, the *install image* command has already been run.

1. Download the image from MyCourses

2. Unzip the zip file (it includes three files)

3. At the ESXi www site, go to “Virtual Machines”, then click “Create / Register VM”, then choose “Deploy a virtual machine from an OVF or OVA file”.

4. Choose a name for your appliance, for example “Vyos1”. Drag and drop all three files into the window (You will only see two files included). Do not change anything, just “Next” and finally “Finish”.

5. Now power up your appliance, and in the ESXi console it is a good idea to change the language to German (the language won’t actually change, just the keyboard layout). Then configure a management interface:

[3] https://vyos.io

a. *configure*

b. *set interfaces ethernet eth0 address 192.168.0.X/24*

c. *set service ssh*

d. *commit*

e. *save*

6. Repeat steps 3-5 for all the routers, and for 1- for the Debian image. Credentials for that image are also *vyos/vyos*.

Now for the host, download the “Debian for ESXi” image from MyCourses. Both interfaces are connected by default to the “VM Network”. Change one of the interfaces to the 20.0.XX.254/24 network. Credentials for the image are *lab/lab.* Configure in Debian the interfaces in the */etc/network/interface* file.

There is the Apache2 www server installed in the image. Configure it and create a simple HTML page “This is Group XX’s site”.

Congratulations, all the images are installed! Now you are able to connect to each device by SSH. Use it for configuring devices.

Now create internal networks, for them you can decide a name (and VLAN ID) as you like. Attach them to the correct networks.

1. All the interfaces are attached by default to the “VM Network” (Management network)

2. Now create internal links, for example, between R1 and R2:

    a. “Networking” -> “Virtual switches” -> “Add standard virtual switch”. Give some name, for example, “r1-r2”. Since the link is apparently virtual, remove the “Uplink” option.

    b. In the “Security” section accept everything

    c. Now from a drop-down menu of an interface of a virtual image, you can choose the correct name where you would like to bind the interface to.

3. Now create external links, for example, between R2 to your neigbour:

    a. Similar way as with the internal links, but now bind the interface to a physical interface (vmnicX, where X=1-3). Vmnic0 is bound to the “VM Network” (192.168.0.0/24).

Now use some IGP routing protocol inside of you PoP, for example, OSPF or IS-IS but neither RIP nor static routes. Test your network with ping and check your routing tables.

IGP:

- In Figure 1 you can see IP addresses. Only R1’s IP address toward IX network and the IP address of the test computer are predefined.

- In the lab session agree on IP addresses with your neighbors (and other groups). Allocate them from the 50.0.0.0/24 address space.

Then try to build a BGP configuration, or least a schema:

- Your AS number is 650XX
- Each PoP is peering with each other.
- You should be able to ping each host computer in each PoP.
- You only serve transit to your nearest neighbors. The closest neighbor on your left-hand side can connect to the closest neighbor on your right-hand side via your PoP (and vice versa). This kind of traffic should use your network. Your traffic should be able to do the same with the neighbouring networks.
- **But** if your own traffic is heading to your closest neighbors it should go via the IX point.
- The rest of all traffic goes via the IX point.

Remember to run *commit/save* commands before you shut down your APU!

5 Lab session

Connect your APU to the switch. Start agreeing on issues with other groups, configure, test, modify your network. Discuss, help other groups.

This is a group work of all the groups, co-operation is key.

6 Final report

Write a final report:

- Include the configuration of IGP and EGP of each router
- How well did you prepare (after your opinion) for this lab work?' If not 'fully prepared', why not? Be honest – we would like to just know challenges/problems etc.
- What do you think of this kind of lab work? What did you learn?
- Fill a questionnaire at https://mycourses.aalto.fi/mod/questionnaire/pre-view.php?id=660232