

COMP 3721 (Introduction to Data Communications)

Total mark: 20

GNS3 Lab: ARP and Switch

For this lab, four tasks need to be completed, which are as follows:

1.1. Creating a network topology with four hosts

In this task, you will create the topology shown in Figure 1. After **powering on** all the Alpine Linux hosts, open a console on each host (by right-click on the host and choose '**Console**') and assign the following IP addresses to interface **eth0** of each host using 'ip' command shown in Figure 2.

- 10.0.0.1/24 to AlpineLinux-1, 10.0.0.2/24 to AlpineLinux-2, 10.0.0.3/24 to AlpineLinux-3, and 10.0.0.4/24 to AlpineLinux-4.

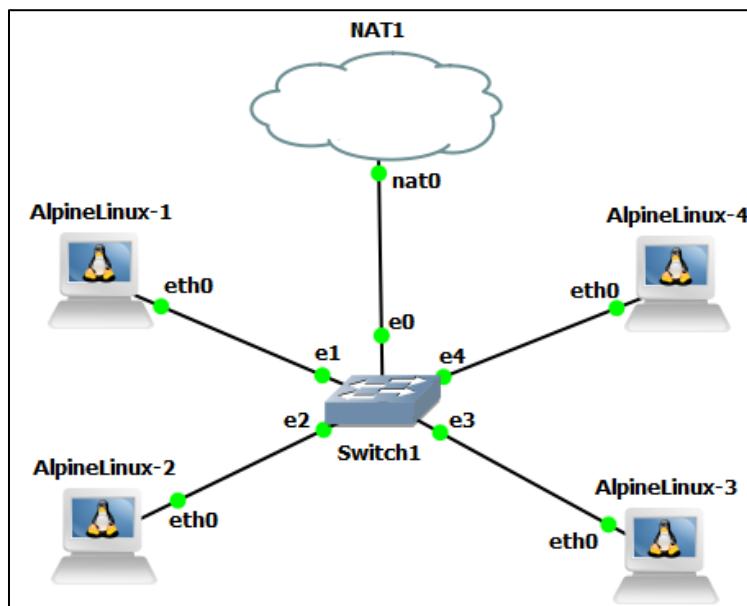


Figure 1. The first topology, including one Ethernet switch and four Alpine Linux hosts.

```
/ # ip address add 10.0.0.1/24 dev eth0
/ #
/ # ip address show eth0
8: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN
    qlen 1000
        link/ether 02:fc:1f:5d:18:6d brd ff:ff:ff:ff:ff:ff
            inet 10.0.0.1/24 scope global eth0
                valid_lft forever preferred_lft forever
            inet6 fe80::fc:ffff:fe5d:186d/64 scope link
                valid_lft forever preferred_lft forever
/ #
```

Figure 2. Assigning an IP address to the network interface of AlpineLinux-1 using ‘ip’ command.

As you can see, by running ‘**ip address add 10.0.0.1/24 dev eth0**’ you can set the IP address for AlpineLinux-1 and can do the same thing on other three hosts. To check the assigned IP to the network interface eth0, you may use ‘**ip address show eth0**’ as shown in Figure 2. In addition to ‘ip’ command, you can use ‘**ifconfig**’ command in Linux operating system as an alternative to set the IP address for the given network interface. The following ‘**ifconfig**’ command is a counterpart for the ‘**ip**’ command shown in Figure 2.

```
# ifconfig eth0 10.0.0.2 netmask 255.255.255.0
```

If you run the ‘**ifconfig**’ command with no input, it will show you the current IP address assigned to the active (up) interfaces of your Linux host. You can see the usage of ‘**ifconfig**’ command on AlpineLinux-2 for IP assignment in Figure 3.

```
AlpineLinux-2 console is now available... Press RETURN to get started.  
/ # ifconfig eth0 10.0.0.2 netmask 255.255.255.0  
/ #  
/ # ifconfig  
eth0      Link encap:Ethernet HWaddr F2:CF:A1:12:C2:51  
          inet addr:10.0.0.2 Bcast:10.0.0.255 Mask:255.255.255.0  
             inet6 addr: fe80::f0cf:alff:fe12:c251/64 Scope:Link  
               UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
             RX packets:834 errors:0 dropped:0 overruns:0 frame:0  
             TX packets:14 errors:0 dropped:0 overruns:0 carrier:0  
             collisions:0 txqueuelen:1000  
            RX bytes:44412 (43.3 KiB) TX bytes:1076 (1.0 KiB)  
  
lo       Link encap:Local Loopback  
          inet addr:127.0.0.1 Mask:255.0.0.0  
             inet6 addr: ::1/128 Scope:Host  
               UP LOOPBACK RUNNING MTU:65536 Metric:1  
             RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
             TX packets:0 errors:0 dropped:0 overruns:0 carrier:0  
             collisions:0 txqueuelen:1000  
            RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)  
  
/ #
```

Figure 3. Assigning an IP address to the network interface using ‘ifconfig’ command.

1.2. Generating ICMP traffic and checking the ARP cache table

After completing the IP assignment to all four Alpine Linux hosts, carry out the following steps and answer to the stated questions:

1. Run ‘arp –n’ on each host and check the output for each one of them.
2. On AlpineLinux-1, run ‘ping –c 5 10.0.0.2’ and then run ‘arp –n’ command again on AlpineLinux-1. Do you see any difference in its output?
3. From AlpineLinux-1, ping remaining (two) hosts and check the output for ‘arp –n’. Any change? What is the output of ‘arp –n’ command on the other hosts that you pinged them from AlpineLinux-1?
4. On AlpineLinux-2, first check the output of ‘arp –n’ command. You will see there is a line that starts with AlpineLinux-1 IP address (10.0.0.1). Then, run ‘arp –d 10.0.0.1’ on AlpineLinux-2 and check the output of ‘arp –n’ again.
5. Based on your observations, what ‘arp’ command does (in simple words)?

1.3. Creating VLANs and connecting two switches using a trunk port

In this part, first you need to create the topology shown in Figure 4 in GNS3. As you can see, we have four Alpine Linux hosts that are connected to the switches two by two. AlpineLinux-1 and AlpineLinux-3 are placed in **VLAN1** and AlpineLinux-2 and AlpineLinux-4 are in **VLAN2**. As we discussed before, we can extend a VLAN to more than one switch. Switch1 is connected to a NAT cloud via its **port 3 (e3)** which is placed in **VLAN1**. In GNS3, you can configure ports of switches by right-clicking on the switch and selecting ‘**Configure**’ option. Please apply the configuration shown in Figures 5 and 6 to both switches.

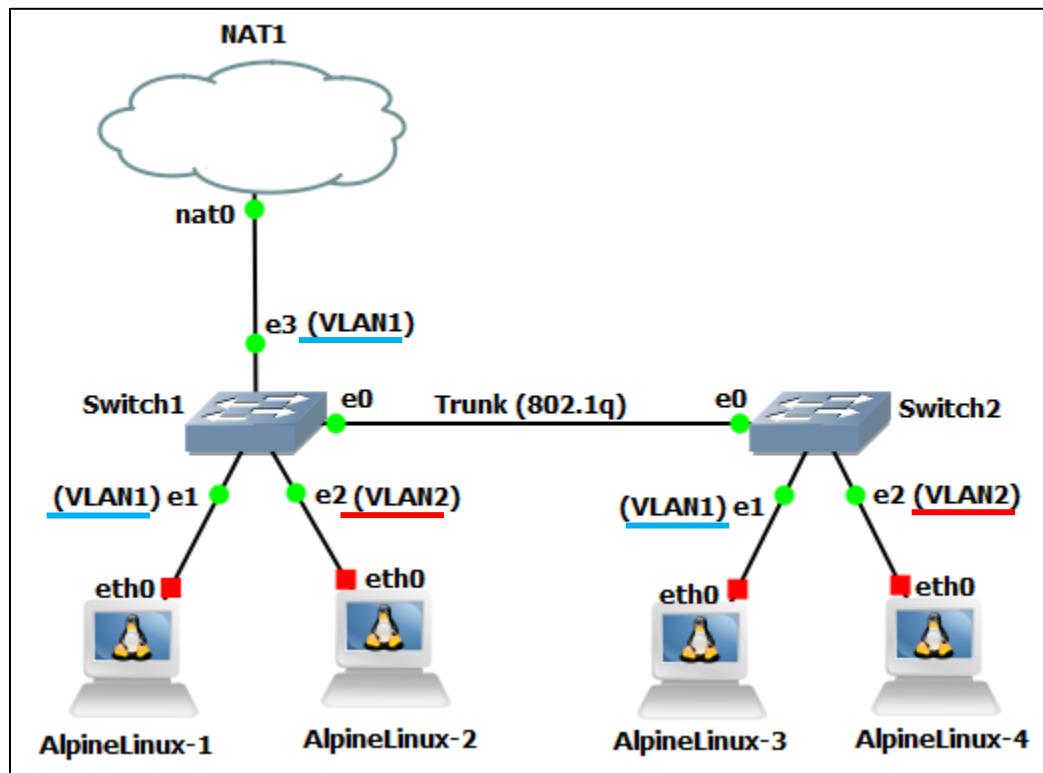


Figure 4. Two Ethernet switches connected to each other via a trunk port.

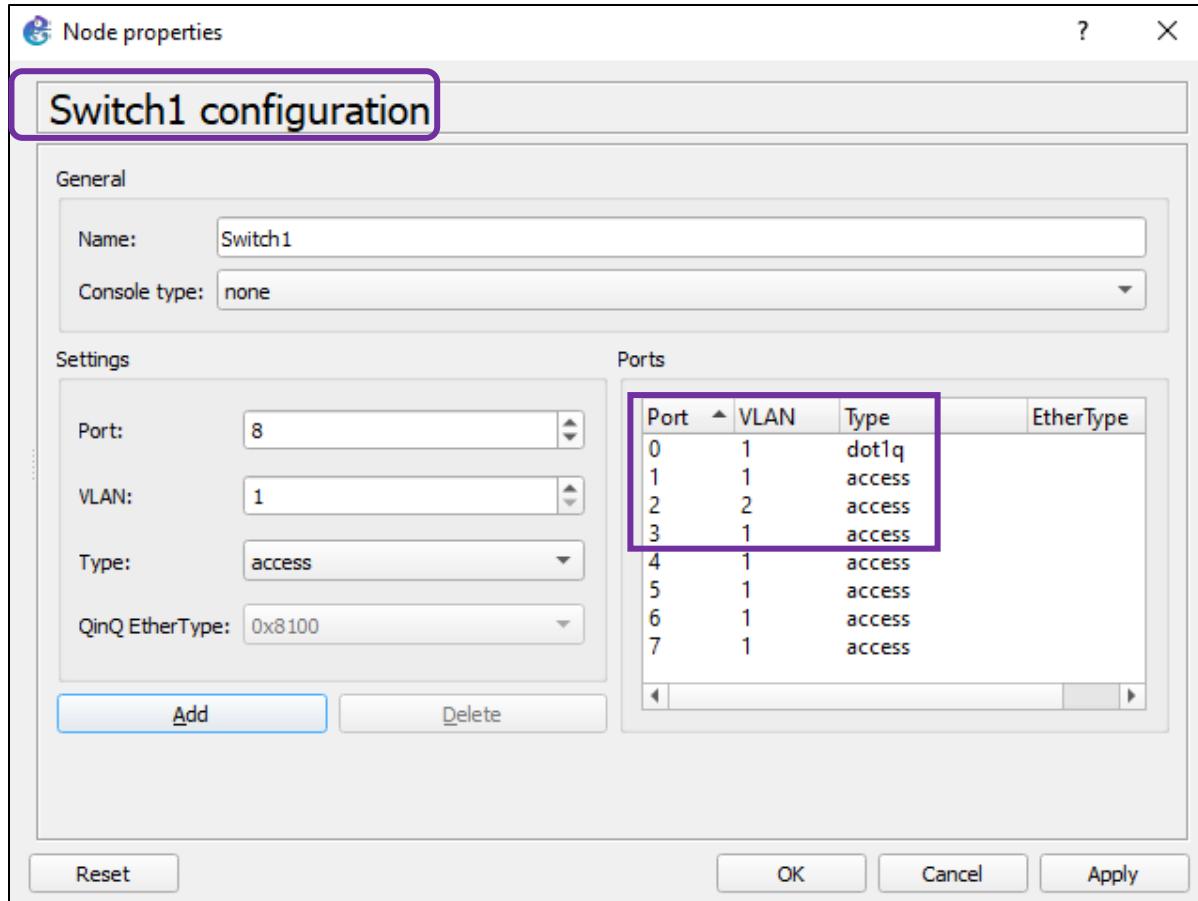


Figure 5. Configuration of ports 0 to 3 on Switch1.

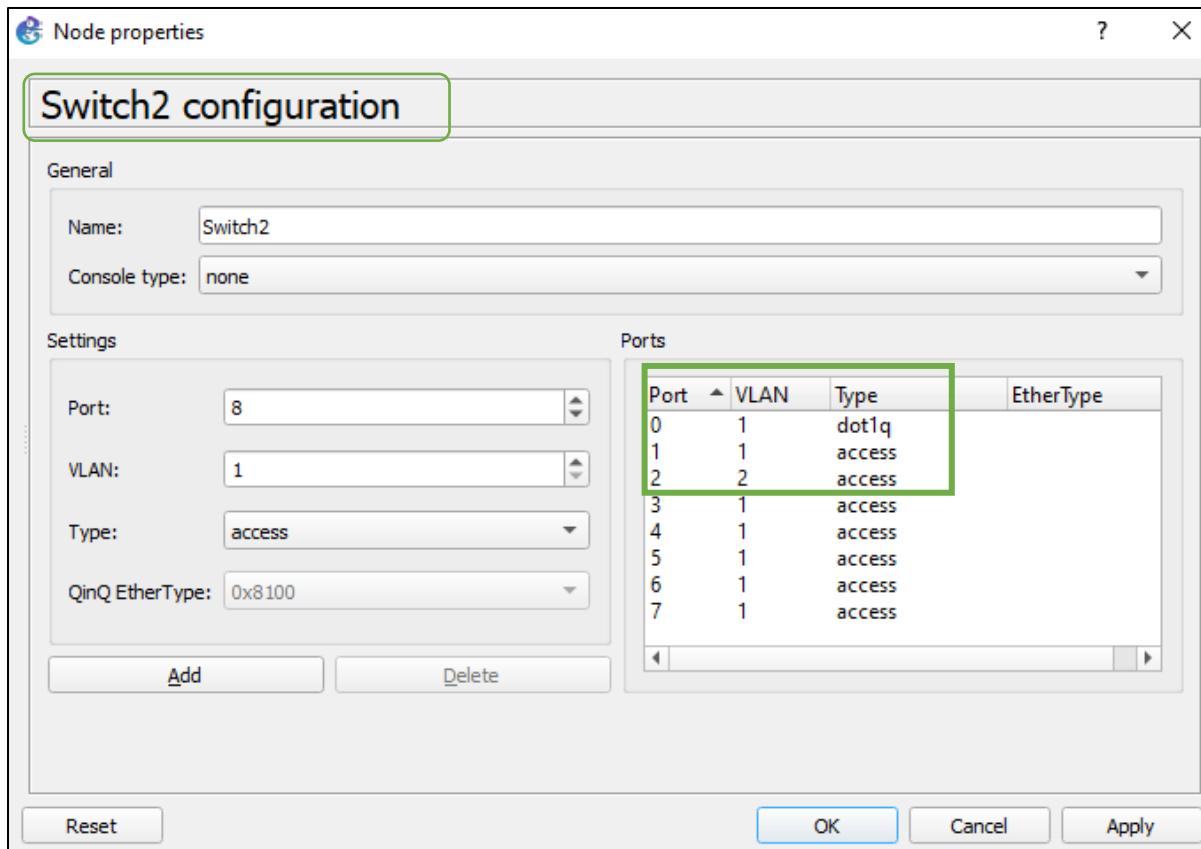


Figure 6. Configuration ports 0 to 2 on Switch2.

Note that **port 0 (e0)** on both switches are used as a **trunk port** which carries the traffic from different VLANs between switches. This assignment will be done by setting the type for this port to '**dot1q**' as shown in Figures 5 and 6. Also, note that this port has a default VLAN value which is **1** (i.e. VLAN1) and can be seen in VLAN columns in screenshots shown in Figure 5 and 6. After applying the configuration, press '**Apply**' and '**OK**' buttons

1. Power on (start) all four Alpine Linux hosts. On all four Alpine Linux hosts, open console window and run '**udhcpc -i eth0**' command on all of them. Wait for around 10-15 seconds and then check the results. Could all the hosts obtain an IP address from the DHCP server? The hosts in which VLAN could obtain IP addresses successfully? Why?
2. On Alpine Linux hosts that obtained IP from the DHCP server, use '**ifconfig eth0**' to see the assigned IP address and then ping their IPs from each other. In this case, AlpineLinux-1 and AlpineLinux-3 should be able to ping each other. Run the ping command on each host (to ping the other host) and take screenshot from the output. Note that these hosts are connected to two different switches, but still can ping each other. How do you explain this?

3. On two other hosts that could not obtain an IP address from the DHCP server, stop ‘udhcpc’ command by pressing ‘Ctrl + C’ keys in their consoles. Explain why these hosts were not able to obtain an IP address from the DHCP server?
4. Now, try to assign a manual IP address to Alpine Linux 2 and Alpine Linux 4 by running the following commands on these hosts:

AlpineLinux2# ifconfig eth0 10.0.0.2 netmask 255.255.255.0
AlpineLinux4# ifconfig eth0 10.0.0.4 netmask 255.255.255.0

Then, on AlpineLinux-2, run ‘ping 10.0.0.4’ command and take a screenshot from the output. Indeed, by running this command, you are trying to check the connectivity between AlpineLinux-2 and AlpineLinux-4. Remember that you connected these hosts to ports of two different switches which are placed on the same VLAN. While the ping command is running on AlpineLinux-2, open the configuration box for **Switch1** (right-click on the switch and click ‘Configure’) and change the type value for **port 0** from ‘dot1q’ to ‘access’ as shown in Figure 7. Then press ‘Apply’ and ‘OK’ buttons and check the output of ping command on AlpineLinux-2. Do you see any changes in the output? Why?

5. Now, while you have already changed the type value for **port 0** on **Switch1** to ‘access’, try to ping AlpineLinux-3 from AlpineLinux-1. Note that you already have the IP addresses obtained by these two hosts from section 3.3.2. Are you still able to ping AlpineLinux-3 from AlpineLinux-1? Why?

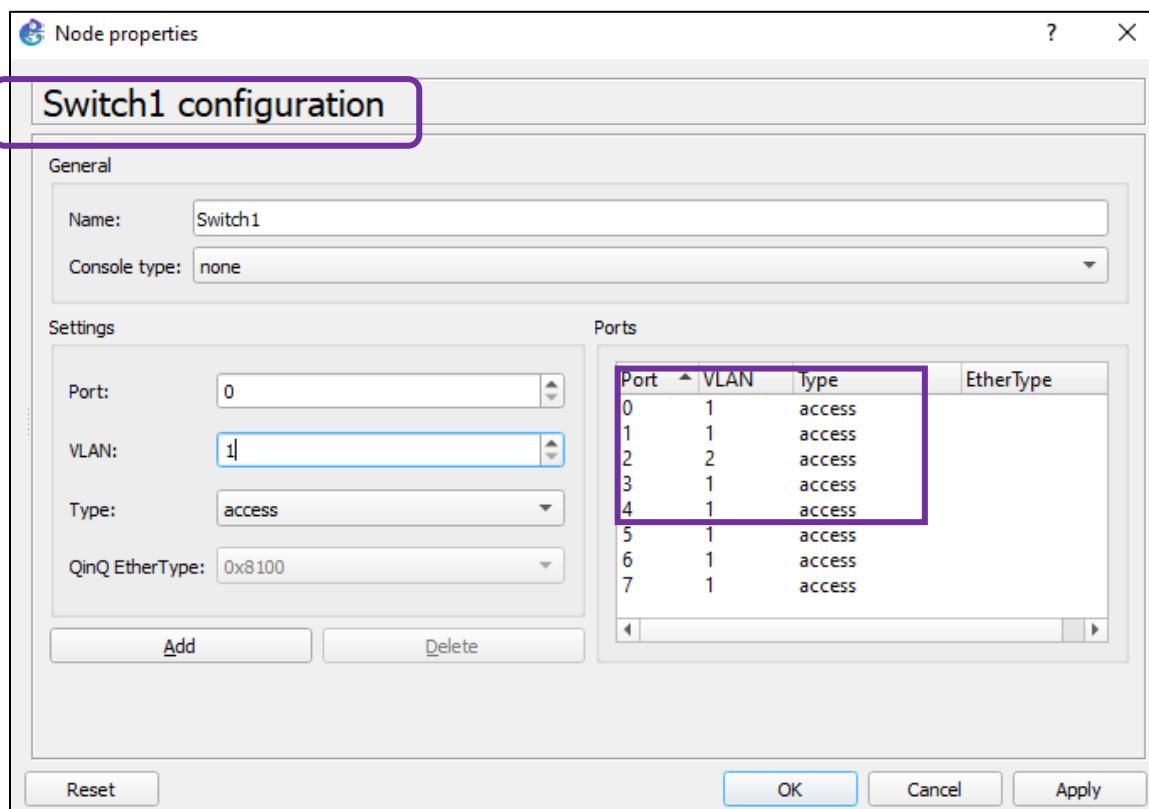


Figure 7. Changing the Type of port0 on Switch1 from dot1q to access.

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