NACKADEMIN

IT-Infrastructure (LIA) ITI 22

Philippe Martinet

1. LIA 22 Project Specifications

You've just been employed at Cisco AB to work with one of their five IT-Infrastructure teams. Congratulation!!

Already today, your boss explained to you that the computer network has some critical issues that need to be solved before the Big conference that occurs in 8 weeks. New challenges will occur every Monday. Solutions need to be found and simulated using Packet Tracer (PT) from Cisco.

AT the end of the 8 weeks you'll have to present your solution in front of others IT-teams as well as your boss! and you have to deliver a copy of your final report.

The report need to have at least 10 pages long (in Times, 14pt). You'll describe in details using text, graphs, figures and references how your solution could be implemented physically and how it will solve all the issues of the physical network.

Each team will have to present a solution for every challenges that will occurs every weeks.

The company applies agilt/scrum working methodology. The sprint is one week long. Therefore, every Friday, your team will have to present in 15 minutes their solution of the challenge of the week, the problems they had and how they intended to solve these problems. Each teams will help and discuss every other team's solutions.

2. LIA Project Description

Your LIA project consists of four parts:

1) To install and understand how to use Packet Tracer (PT).
2) Find a solution to every week challenge using PT.
3) Participate at the Friday sprint discussions.
4) Write a final report of 10-20 pages.

Project Deadline: Thursday the 16 of Mars at 11:59 pm.

Presentation of all projects: Friday the 17 of Mars between 9:00 and 12:00,
(20 mn + 10 min discussion for each presentation)

3. First challenge: Address resolution protocol

The first challenge is to:

1) Use **arp** *command for address resolution*
2) Use Wireshark/tcpdump to examine arp exchanges.

Task 1: Install and explore PT Each team have to download, install and configure the computer network simulator Packet Tracer from Cisco. For that you need to create a free account using your email address.

Start at:

https://www.netacad.com/courses/packet-tracer

and then go to:

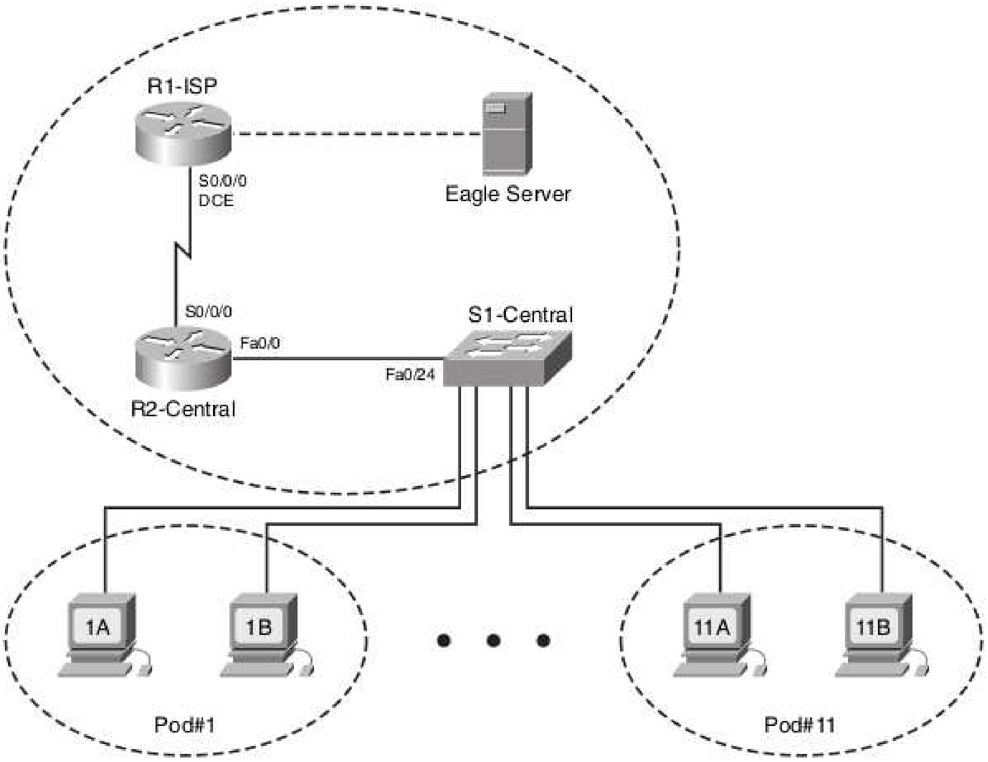
> https://skillsforall.com/?utm_source=netacad.com&utm_medium=referral&utm_campaign=packet-tracer&userlogin=0&userlogin=0

And press "Get Started"

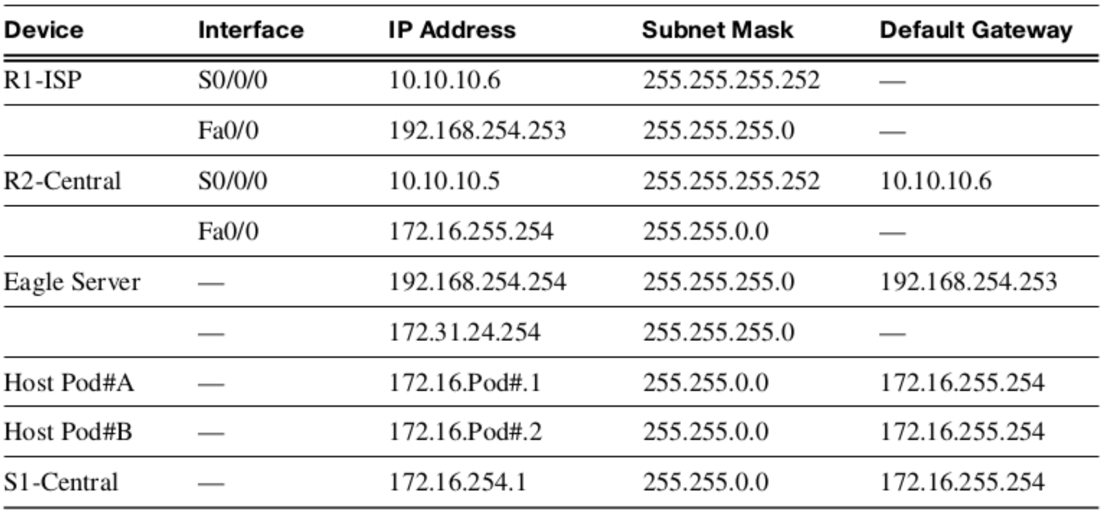
Open an account and you should be able to download Packet Tracer (PT).

Task 2: Create the network using PT

Create the following network using PT



Addressing Table:



Device	Interface	IP Address	Subnet Mask	Default Gateway
R1-ISP	S0/0/0	10.10.10.6	255.255.255.252	—
	Fa0/0	192.168.254.253	255.255.255.0	—
R2-Central	S0/0/0	10.10.10.5	255.255.255.252	10.10.10.6
	Fa0/0	172.16.255.254	255.255.0.0	—
Eagle Server	—	192.168.254.254	255.255.255.0	192.168.254.253
	—	172.31.24.254	255.255.255.0	—
Host Pod#A	—	172.16.Pod#.1	255.255.0.0	172.16.255.254
Host Pod#B	—	172.16.Pod#.2	255.255.0.0	172.16.255.254
S1-Central	—	172.16.254.1	255.255.0.0	172.16.255.254

Task 3: Create the physical network

Create the same network using the physical devices available at Nackademin.

Task 4: ARP Labortation

Apply **arp** to map a layer 3 IP address to a Layer 2 Mac address.

We consider the communication between hosts in the same network segment. To put a packet on the network segment, the sending host wraps the packet in a Layer 2 header, which must include the destination MAC address.

The sending host needs to know the receiver's MAC address before it can try to send the packet. If it doesn't know the MAC address, it will try to find out using ARP.

On each host, run

```
arp -i eth1 -n
```

to see the entire ARP table for the eth1 interface (if there are any entries). If there are no ARP entries, the output will say

```
arp: in X entries no match found.
```

which is OK!

Observe that if there are any ARP entries, all the IP addresses displayed are on the same network segment.

If the "juliet" host (10.10.0.101) is already listed in an ARP table, then delete it with

```
sudo arp -d 10.10.0.101
```

Then, run

```
arp -i eth1 -n
```

again, and save the ARP tables from each host for your report.

On "romeo", run

```
sudo tcpdump -i eth1 -w $(hostname -s)-arp.pcap
```

Leave this running. Then, open a second SSH session to "romeo", and in that session, run

```
ping -c 1 10.10.0.101
```

to send an ICMP echo request to 10.10.0.101 ("juliet").

Terminate tcpdump with Ctrl+C.

Run

```
arp -i eth1 -n
```

on each host, again. Save the new ARP tables for your report.

The tcpdump application will have saved a new file named "romeo-arp.pcap" in your home directory on the "romeo" node. You can "play back" a summary of the capture file in the terminal using

```
tcpdump -enX -r $(hostname -s)-arp.pcap
```

Note: You'll see that a new line is added to juliet's ARP table with romeo's address, even though "juliet" did not send an ARP request to resolve romeo's address!

When "juliet" receives and responds to an ARP request for its own address, it will also update its ARP table to include the IP address and MAC address of the host that sent the ARP request.

Next, run

```
sudo tcpdump -i eth1 -w $(hostname -s)-no-arp.pcap
```

on "romeo", and in a second terminal on "romeo", run

```
ping -c 1 10.10.0.101
```

again. Terminate tcpdump with Ctrl+C. Then "play back" a summary of the capture file in the terminal using

```
tcpdump -enX -r $(hostname -s)-no-arp.pcap
```

Use scp to transfer both packet capture files to your laptop. Then, you can open them in Wireshark for further analysis.

Note: In your packet capture, depending on the timing of your experiment, you may observe an ARP request and reply after the ICMP echo request and response are exchanged. And if you look closely at this unexpected ARP request, you may notice that the destination MAC address is not the broadcast address (as with a *regular* ARP request, when the sender needs to resolve an IP address and does not know the associated MAC address) this ARP request has a unicast destination MAC address. This type of ARP request is an **ARP poll**. ARP polls can be sent by a host that wants to confirm the validity of an existing entry in their ARP table, for example an entry that might be getting a little bit old.

In your report: Show the summary tcpdump output for both packet captures. In the first case, an ARP request was sent and a reply was received before the ICMP echo request was sent.

In the second case, no ARP request was sent before the ICMP echo request. Why? Show evidence from the output of the arp commands to support your answer.

From the first saved tcpdump output, answer the following questions:

1) What is the target IP address in the ARP request?

2) At the MAC layer, what is the destination Ethernet address of the frame carrying the ARP request? Why?

3) What is the frame type field in the Ethernet frame?

4) Of the four hosts on your network segment, which host sends the ARP reply? Why?

5) When an ARP request and ARP reply appear on a network segment, which hosts on the network segment will add the target of the ARP request to their ARP table?

6) Which hosts on the network segment will add the sender of the ARP request to their ARP table? Explain in general, as well as for the specific case of this network.
Use the ARP tables you captured to support your answer.

Task 5: ARP for a non-existent host For this lab, you will need three terminal windows on the "romeo" host.

On the "romeo" host, run

```
sudo tcpdump -i eth1 -w $(hostname -s)-eth1-nonexistent.pcap
```

In a second terminal window on "romeo", run

```
sudo tcpdump -i lo -w $(hostname -s)-lo-nonexistent.pcap icmp
```

to capture ICMP traffic on the loopback interface (i.e. ICMP messages sent from romeo to itself).

Then, in a third terminal window on "romeo", run

```
ping -c 1 10.10.0.200
```

Note that there is no host with this IP address in your network configuration.

Wait for it to finish. Terminate both tcpdump processes with Ctrl+C.

The message "Destination Host Unreachable" in the ping output reflects that an ICMP message of type Destination Unreachable with code Host Unreachable was received! This message is sent by the host to itself when it cannot resolve an IP address (e.g. due to ARP timeout).

"Play back" a summary of the loopback capture file in the terminal using

```
tcpdump -enX -r $(hostname -s)-lo-nonexistent.pcap
```

Observe this message in the loopback interface capture.

Also, "play back" a summary of the Ethernet capture file in the terminal using

```
tcpdump -enX -r $(hostname -s)-eth1-nonexistent.pcap
```

You can also use scp to transfer the packet captures to your laptop, and open them in Wireshark to see these packets in more detail.

In your report: Show the summary tcpdump output from the Ethernet interface, and use it to answer the following questions:

In the previous exercise, after sending an ARP request and receiving a reply, "romeo" sends an ICMP echo request. In this exercise, is an ICMP echo request ever sent? Why or why not? From the tcpdump output, describe how the ARP timeout and retransmission were performed.

How many attempts were made to resolve a non-existing IP address? How much time separates each attempt?

Show the ICMP message you captured on the loopback interface, and answer these