ECE4016 Computer Networks

Assignment 3 Network Design Simulation

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November 17, 2024

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0. Environment

Ubuntu 22.04
Wireshark 4.0.10
macOS arm64

1 Task 1 Basic Simulation

1.1 Network Topology Overview

Device and IP address assignments are as follows:

- **Router 1:**
  - Interface0: 192.168.1.1/24
  - Interface1: 192.168.2.1/24
- **Router 2:**
  - Interface0: 192.168.2.2/24
  - Interface1: 192.168.3.1/24
- **PCs:**
  - PC1: 192.168.1.10/24
  - PC2: 192.168.1.11/24
  - PC3: 192.168.3.10/24
  - PC4: 192.168.3.11/24

1.2 Router Configuration

Module Installation:

- In Cisco Packet Tracer, open the 2620XM router.
- Add the **NM-4E** module (to expand Ethernet interfaces).
- Add the **WIC-1T** module (to provide a serial interface).

Router 1 Configuration:

```
Router1> enable
Router1# configure terminal

# Configure Interface0 (connected to PC1 and PC2 via Switch1)
Router1(config)# interface fastethernet0/0
Router1(config-if)# ip address 192.168.1.1 255.255.255.0
```

```
Router1(config-if)# no shutdown
Router1(config-if)# exit

# Configure Interface1 (connected to Router2)
Router1(config)# interface fastethernet0/1
Router1(config-if)# ip address 192.168.2.1 255.255.255.0
Router1(config-if)# no shutdown
Router1(config-if)# exit


Router1# write memory
```

Router 2 Configuration:

```
Router2> enable
Router2# configure terminal

# Configure Interface0 (connected to Router1)
Router2(config)# interface fastethernet0/0
Router2(config-if)# ip address 192.168.2.2 255.255.255.0
Router2(config-if)# no shutdown
Router2(config-if)# exit

# Configure Interface1 (connected to PC3 and PC4 via Switch2)
Router2(config)# interface fastethernet0/1
Router2(config-if)# ip address 192.168.3.1 255.255.255.0
Router2(config-if)# no shutdown
Router2(config-if)# exit


Router2# write memory
```

1.3 Switch Configuration

Switch 1 Configuration:

```
Switch1> enable
Switch1# configure terminal

# Configure port for PC1
Switch1(config)# interface fastethernet0/1
Switch1(config-if)# switchport mode access
Switch1(config-if)# no shutdown
Switch1(config-if)# exit

# Configure port for PC2
```

```
Switch1(config)# interface fastethernet0/2
Switch1(config-if)# switchport mode access
Switch1(config-if)# no shutdown
Switch1(config-if)# exit

# Configure port for Router1
Switch1(config)# interface fastethernet0/3
Switch1(config-if)# switchport mode access
Switch1(config-if)# no shutdown
Switch1(config-if)# exit

Switch1# write memory
```

Switch 2 Configuration:

```
Switch2> enable
Switch2# configure terminal

# Configure port for PC3
Switch2(config)# interface fastethernet0/1
Switch2(config-if)# switchport mode access
Switch2(config-if)# no shutdown
Switch2(config-if)# exit

# Configure port for PC4
Switch2(config)# interface fastethernet0/2
Switch2(config-if)# switchport mode access
Switch2(config-if)# no shutdown
Switch2(config-if)# exit

# Configure port for Router2
Switch2(config)# interface fastethernet0/3
Switch2(config-if)# switchport mode access
Switch2(config-if)# no shutdown
Switch2(config-if)# exit

Switch2# write memory
```

1.4 PC Configuration

Each PC requires manual IP address configuration.

PC1 Configuration:

```
IP Address: 192.168.1.10
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.1.1
```

PC4 Configuration:

```
IP Address: 192.168.3.11
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.3.1
```

Repeat for other PCs according to the table.

1.5 Testing Connectivity

- **Same Subnet Communication:** Use `ping` to test communication within the same subnet (e.g., PC1 to PC2).
- **Cross Subnet Communication:** Use `ping` to test communication across subnets (e.g., PC1 to PC4).

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.11

Pinging 192.168.1.11 with 32 bytes of data:

Reply from 192.168.1.11: bytes=32 time=2ms TTL=128
Reply from 192.168.1.11: bytes=32 time<1ms TTL=128
Reply from 192.168.1.11: bytes=32 time<1ms TTL=128
Reply from 192.168.1.11: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Figure 1: Same Subnet Communication

1.6 Troubles I encountered while implementing.

- During the implementation, I found out that routers connecting with switches had problems, which meant that the setting up was wrong. After searching online, I found that I need to set up `Configure Interface` correctly so that it could work.
- When testing cross-subnet communication (e.g., from PC1 to PC4), I found that the first `ping` packet failed while **subsequent packets succeeded**. I was confused at first, then I found out that: Before a PC can communicate with a device in another subnet, it sent an ARP request to resolve the MAC address of its default gateway. The first ICMP (ping) packet is sent but held until the ARP process is complete. Once the **ARP table** is updated, subsequent packets are sent successfully.

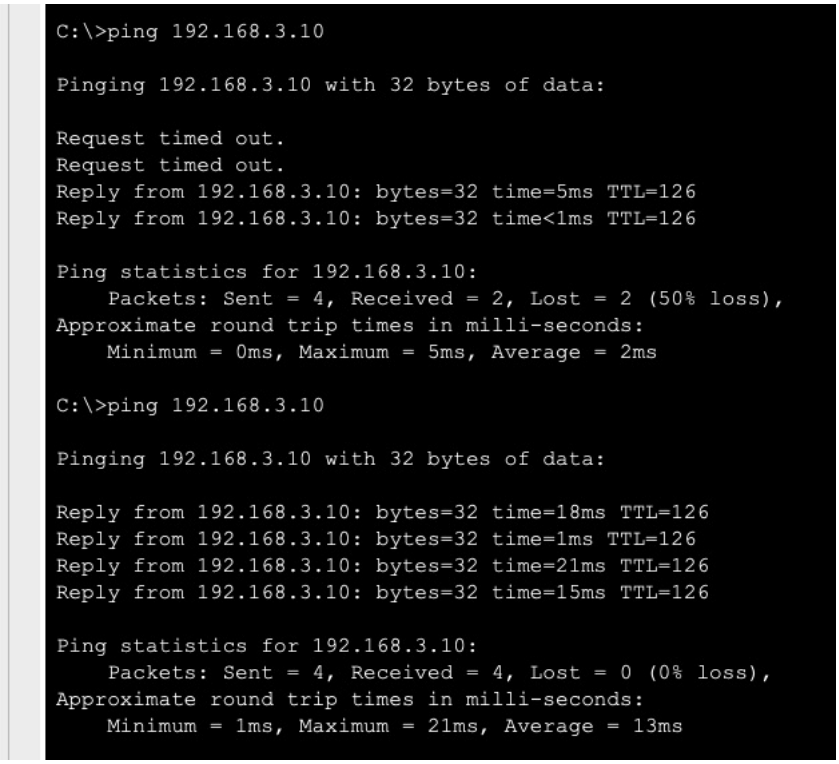

Figure 2: Cross Subnet Communication

2 Task 2 VLAN

2.1 VLAN Configuration on Switches

- Create VLANs on all switches for VLAN 10 and VLAN 20.
- Assign ports connected to PCs to the correct VLANs.
- Configure trunk links between switches to allow VLAN traffic.

Commands for VLAN configuration:

On Switch1 (Switch-PT):

```
Switch1> enable
Switch1# configure terminal
Switch1(config)# vlan 10
Switch1(config-vlan)# name VLAN10
Switch1(config-vlan)# exit
Switch1(config)# vlan 20
Switch1(config-vlan)# name VLAN20
Switch1(config-vlan)# exit

Switch1(config)# interface fastethernet0/1
```

```
Switch1(config-if)# switchport mode access
Switch1(config-if)# switchport access vlan 10
Switch1(config-if)# exit

Switch1(config)# interface fastethernet1/1
Switch1(config-if)# switchport mode access
Switch1(config-if)# switchport access vlan 20
Switch1(config-if)# exit

Switch1(config)# interface fastethernet2/1
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# switchport trunk allowed vlan 10,20
Switch1(config-if)# exit
```

Repeat similar commands for Switch2 and Switch3 with corresponding VLANs.

2.1.1 Configure PCs

Each PC needs an IP address and subnet mask according to the table. For example:

PC1 (VLAN 10):

```
IP Address: 192.12.10.11
Subnet Mask: 255.255.255.0
```

Repeat for all PCs using the given IP table.

2.2 Verify Connectivity and Results

- Test connectivity between PCs in the same VLAN using the `ping` command.
- Example: From PC1, ping PC2.
- From the results shown in the following pictures, we can find out that end devices with the same VLAN can communicate with each other, while those don't have(e.g. VLAN10 and VLAN20) cannot communicate.

2.3 Troubles I encountered while implementing.

During the implementation, I found out that the center switch that were between two switches have trouble connecting with them, which meant that the VLAN setting up was wrong. After checking the manual and searching online, I found that I need to use the command `switchport trunk allowed vlan 10,20` to set up the VLAN correctly.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.12.10.12

Pinging 192.12.10.12 with 32 bytes of data:

Reply from 192.12.10.12: bytes=32 time=30ms TTL=128
Reply from 192.12.10.12: bytes=32 time<1ms TTL=128
Reply from 192.12.10.12: bytes=32 time<1ms TTL=128
Reply from 192.12.10.12: bytes=32 time=1ms TTL=128

Ping statistics for 192.12.10.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 30ms, Average = 7ms

C:\>ping 192.12.10.13

Pinging 192.12.10.13 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.12.10.13:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 192.12.10.14

Pinging 192.12.10.14 with 32 bytes of data:

Reply from 192.12.10.14: bytes=32 time<1ms TTL=128
Reply from 192.12.10.14: bytes=32 time=1ms TTL=128
Reply from 192.12.10.14: bytes=32 time<1ms TTL=128
Reply from 192.12.10.14: bytes=32 time<1ms TTL=128

Ping statistics for 192.12.10.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Figure 3: VLAN10

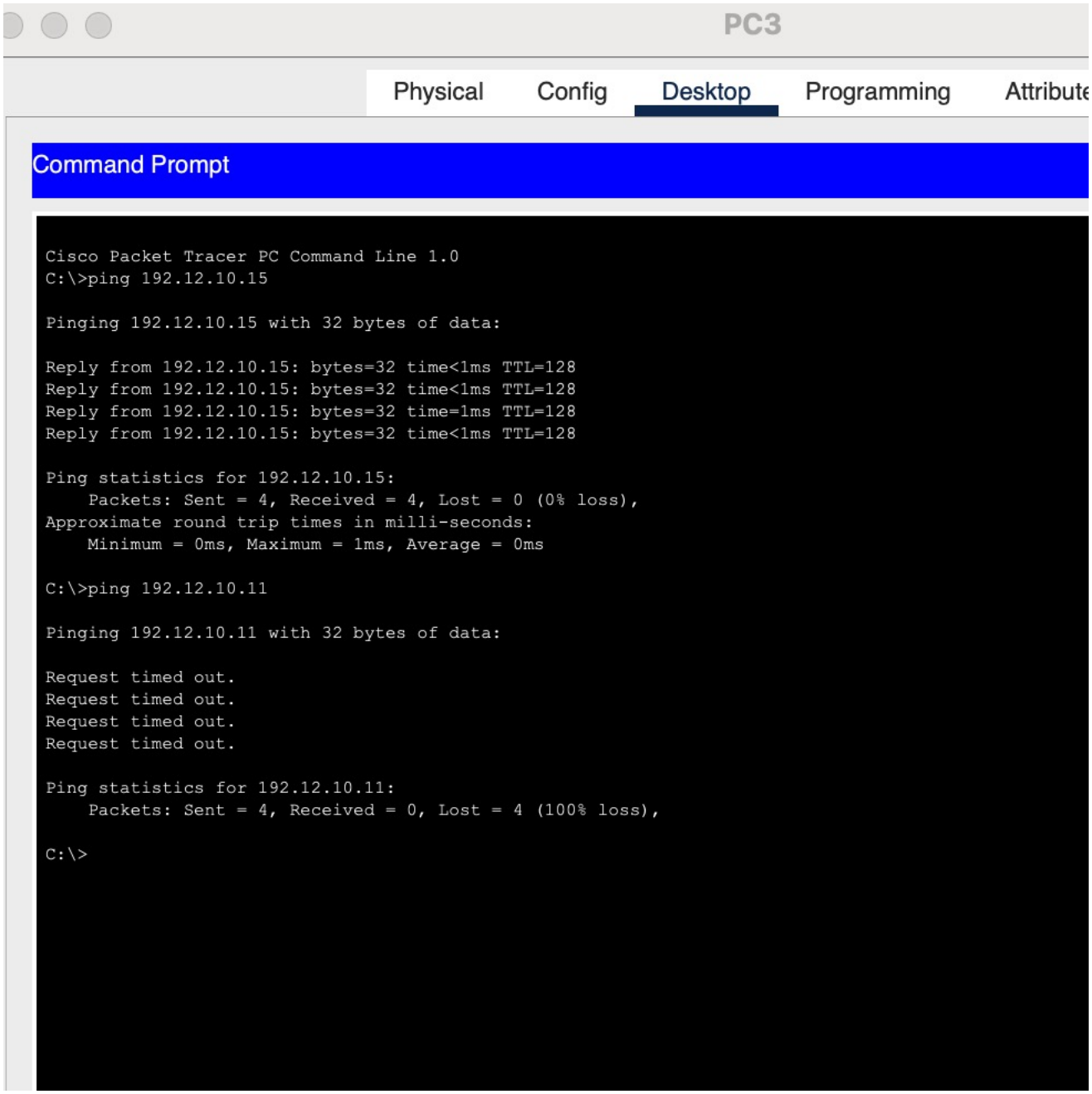

Figure 4: VLAN20