Leandro Maglianella
K1833503

NETWORKING DESIGN COURSEWORK

CI5250 Computing Systems Coursework

Setter: Nada Philips

Leandro Maglianella – K1833503

Task 1

Table 1

Subnet Name	Subnet ID	First Host	Last Host	Broadcast	Subnet Mask
Network 1	192.135.1.0/24	192.135.1.1/24	192.135.1.254/24	192.135.1.255/24	255.255.255.0
Network 2	192.135.2.0/24	192.135.2.1/24	192.135.2.254/24	192.135.2.255/24	255.255.255.0
Network 3	192.135.3.0/24	192.135.3.1/24	192.135.3.254/24	192.135.3.255/24	255.255.255.0

Table 2

Device	Interface	IP Address	Subnet Mask	Default Gateway
Router	Gig 0/0	192.135.1.1	255.255.255.0	N/A
	Gig 0/1	192.135.2.1	255.255.255.0	N/A
	Gig 0/2	192.135.3.1	255.255.255.0	N/A
Laptop	Fa0	192.135.1.2	255.255.255.0	192.135.1.1
DHCP Server	Fa0	192.135.1.3	255.255.255.0	192.135.1.1
Web/HTTP Server	Fa0	192.135.2.2	255.255.255.0	192.135.2.1
DNS Server	Fa0	192.135.3.2	255.255.255.0	192.135.3.1

Task 2

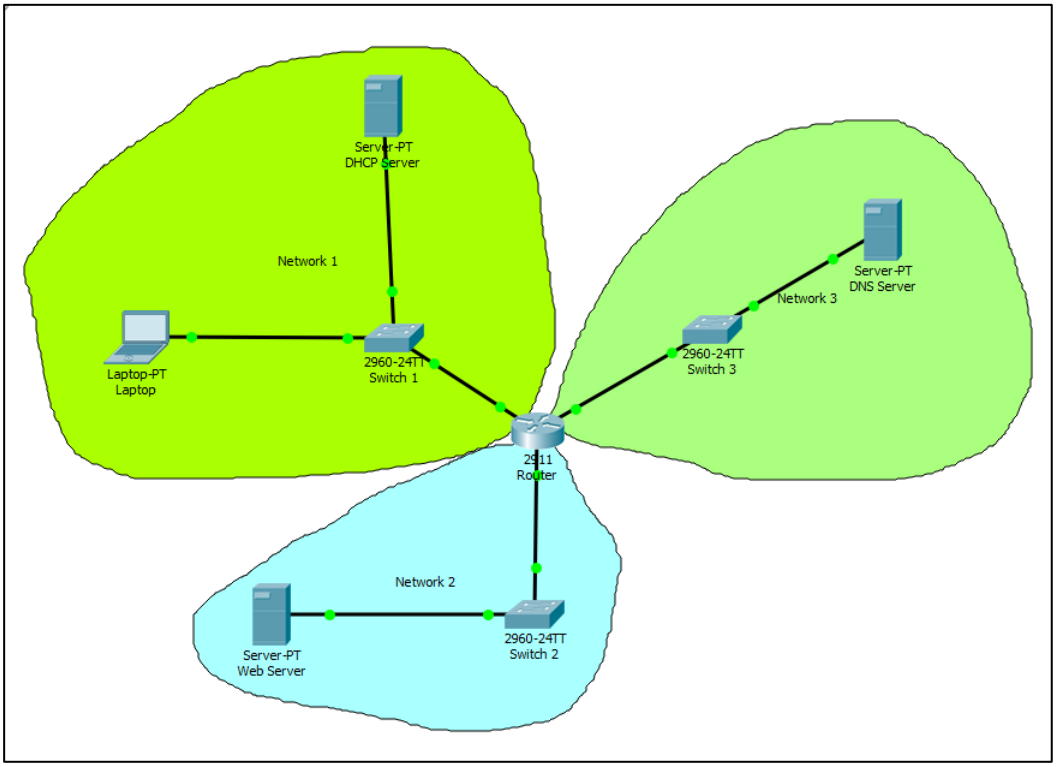


Figure 1: Packet Tracer Implementation.

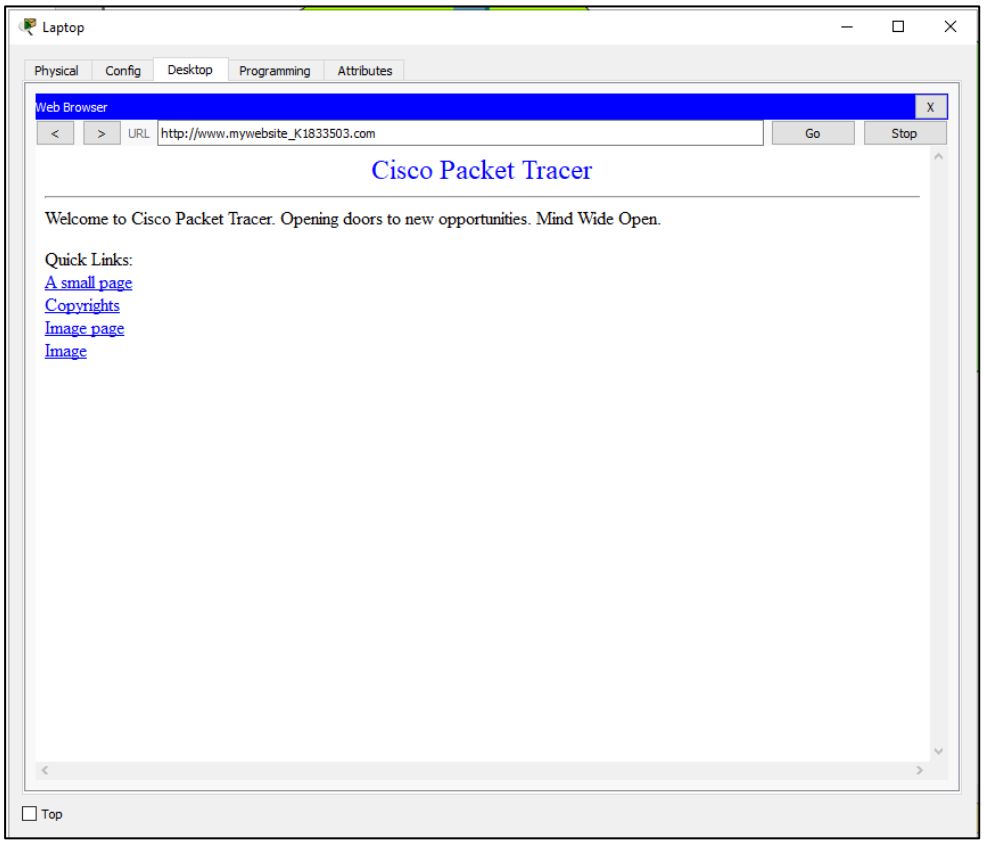


Figure 2: Successful appearance of the website "www.mywebsite_K1833503.com" on the laptop browser.

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.135.1.1

Pinging 192.135.1.1 with 32 bytes of data:

Reply from 192.135.1.1: bytes=32 time<1ms TTL=255
Reply from 192.135.1.1: bytes=32 time<1ms TTL=255
Reply from 192.135.1.1: bytes=32 time<1ms TTL=255
Reply from 192.135.1.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.135.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.135.1.2

Pinging 192.135.1.2 with 32 bytes of data:

Reply from 192.135.1.2: bytes=32 time=5ms TTL=128
Reply from 192.135.1.2: bytes=32 time=2ms TTL=128
Reply from 192.135.1.2: bytes=32 time<1ms TTL=128
Reply from 192.135.1.2: bytes=32 time=2ms TTL=128

Ping statistics for 192.135.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 2ms

C:\>ping 192.135.1.3

Pinging 192.135.1.3 with 32 bytes of data:

Reply from 192.135.1.3: bytes=32 time<1ms TTL=128
Reply from 192.135.1.3: bytes=32 time<1ms TTL=128
Reply from 192.135.1.3: bytes=32 time<1ms TTL=128
Reply from 192.135.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.135.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.135.2.1

Pinging 192.135.2.1 with 32 bytes of data:

Reply from 192.135.2.1: bytes=32 time<1ms TTL=255
Reply from 192.135.2.1: bytes=32 time<1ms TTL=255
Reply from 192.135.2.1: bytes=32 time<1ms TTL=255
Reply from 192.135.2.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.135.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Figure 2, 4 and 5: Successful ping command between the laptop and all the different devices.

```
C:\>ping 192.135.2.2

Pinging 192.135.2.2 with 32 bytes of data:

Request timed out.
Reply from 192.135.2.2: bytes=32 time=2ms TTL=127
Reply from 192.135.2.2: bytes=32 time=5ms TTL=127
Reply from 192.135.2.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.135.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 2ms

C:\>ping 192.135.2.2

Pinging 192.135.2.2 with 32 bytes of data:

Reply from 192.135.2.2: bytes=32 time<1ms TTL=127
Reply from 192.135.2.2: bytes=32 time<1ms TTL=127
Reply from 192.135.2.2: bytes=32 time<1ms TTL=127
Reply from 192.135.2.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.135.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.135.3.1

Pinging 192.135.3.1 with 32 bytes of data:

Reply from 192.135.3.1: bytes=32 time<1ms TTL=255
Reply from 192.135.3.1: bytes=32 time<1ms TTL=255
Reply from 192.135.3.1: bytes=32 time<1ms TTL=255
Reply from 192.135.3.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.135.3.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.135.3.2

Pinging 192.135.3.2 with 32 bytes of data:

Request timed out.
Reply from 192.135.3.2: bytes=32 time=1ms TTL=127
Reply from 192.135.3.2: bytes=32 time<1ms TTL=127
Reply from 192.135.3.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.135.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
C:\>ping 192.135.3.2

Pinging 192.135.3.2 with 32 bytes of data:

Reply from 192.135.3.2: bytes=32 time<1ms TTL=127
Reply from 192.135.3.2: bytes=32 time<1ms TTL=127
Reply from 192.135.3.2: bytes=32 time=2ms TTL=127
Reply from 192.135.3.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.135.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Task 3

MAC (Media Access Control) addresses are identification numbers that uniquely identifies each device on a network and are used “locally” to get frame from one interface to another physically-connected interface. In the Link Layer, ARP (Address Resolution Protocol) translates IP addresses to MAC addresses. Each host has a table that maps MAC addresses to IP addresses, and each mapping is deleted when its TTL (time-to-live) expires.

The laptop and the Network 1 gateway belong to the same network, therefore:

1) Assuming that the laptop knows the IP address of the gateway, the laptop broadcasts an ARP query packet containing the IP address of the gateway.

   Laptop sends to: MAC: FF-FF-FF-FF-FF-FF IP: 192.135.1.1

2) When the gateway receives the ARP packet, recognizes its own IP address and replies to the laptop with its MAC address

3) The Laptop saves IP-to-MAC address pair in its ARP table until the TTL expires.

Task 4

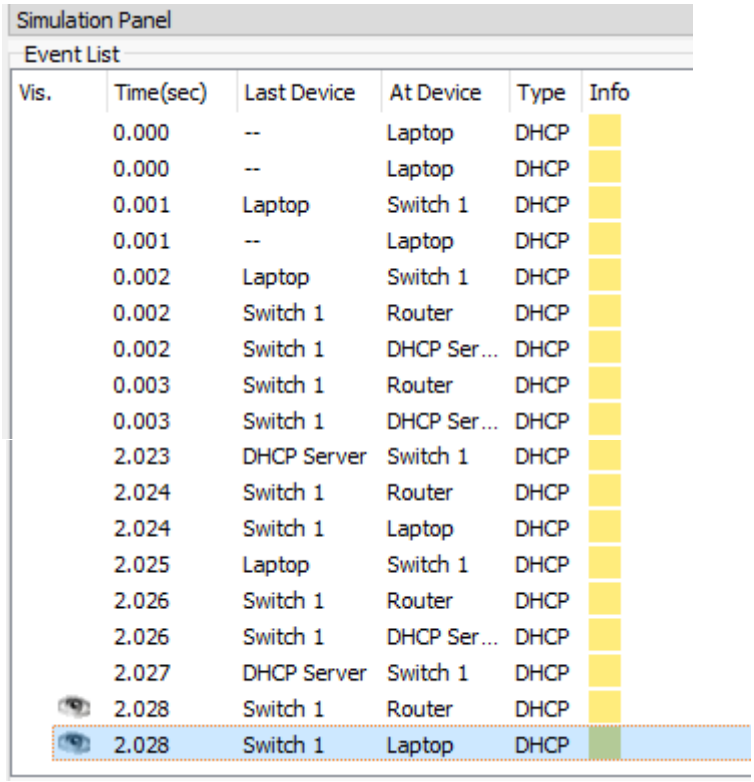
When the laptop joins the network for the first time, it obtains its IP (Internet Protocol) address in the Network Layer using the DHCP (Dynamic Host Configuration Protocol):

1) DHCP discovery:
   The laptop broadcasts a DHCPDISCOVER message to find out if a working DHCP server exists in the network.

2) DHCP offer:
   When the DHCP server receives the message, it reserves an IP address for the laptop and makes an offer by sending a DHCPOFFER message (which contains the IP address) to the laptop.

3) DHCP request:
   The laptop replies with a DHCPREQUEST message, confirming to accept the server offer.

4) DHCP acknowledgement:
   The server responds with a DHCPACK message, confirming the requested configuration parameters. At this point the laptop configures its network interface with the agreed IP address and parameters.



Simulation Panel

Event List

	Vis.	Time(sec)	Last Device	At Device	Type	Info
1		0.000	--	Laptop	DHCP	
		0.000	--	Laptop	DHCP	
		0.001	Laptop	Switch 1	DHCP	
		0.001	--	Laptop	DHCP	
		0.002	Laptop	Switch 1	DHCP	
		0.002	Switch 1	Router	DHCP	
		0.002	Switch 1	DHCP Ser...	DHCP	
		0.003	Switch 1	Router	DHCP	
		0.003	Switch 1	DHCP Ser...	DHCP	
2		2.023	DHCP Server	Switch 1	DHCP	
		2.024	Switch 1	Router	DHCP	
		2.024	Switch 1	Laptop	DHCP	
3		2.025	Laptop	Switch 1	DHCP	
		2.026	Switch 1	Router	DHCP	
		2.026	Switch 1	DHCP Ser...	DHCP	
4		2.027	DHCP Server	Switch 1	DHCP	
		2.028	Switch 1	Router	DHCP	
		2.028	Switch 1	Laptop	DHCP	

Task 5

When a user searches for a website on the laptop's web browser, the URL name for the Web page requested (in this case, "www.mywebsite_K1833503.com") is converted to an IP address in the Application Layer using the DNS (Domain Name System). This protocol uses a distributed database implemented in a hierarchy of DNS servers located worldwide:

1) The laptop contacts the local DNS server located in Network 3.

2) The local DNS server contacts one of the root servers, which returns IP addresses for TLD (top-level domain) servers for the domain "com".

3) The local DNS server contacts one of these TLD servers, which returns the IP address of an authoritative server for "mywebsite_K1833503.com".

4) The local DNS server contacts the authoritative server for mywebsite_K1833503.com, which returns the IP address for the host-name "www.mywebsite_K1833503.com".

5) Finally, the local DNS server returns the IP address for the host-name "www.mywebsite_K1833503.com" to the laptop.

Simulation Panel

Event List

	Vis.	Time(sec)	Last Device	At Device	Type	Info
1		0.000	--	Laptop	DNS	
		0.004	--	Laptop	DNS	
		0.005	Laptop	Switch 1	DNS	
		0.006	Switch 1	Router	DNS	
		0.007	Router	Switch 3	DNS	
2, 3, 4		0.008	Switch 3	DNS Server	DNS	
5		0.009	DNS Server	Switch 3	DNS	
		0.010	Switch 3	Router	DNS	
		0.011	Router	Switch 1	DNS	
		0.012	Switch 1	Laptop	DNS	

Task 6

In our scenario, the result of the DNS is the IP address of the Web Server located in Network 2. At this point another Application Layer protocol starts: the HTTP (HyperText Transfer Protocol), which uses TCP (Transmission Control Protocol) as its transport protocol ensuring a reliable data transfer between the laptop and the Web Server and a flow and congestion control. Non-persistent HTTP will be used, meaning that only one object will be sent over TCP connection.

Steps:

- TCP "handshake":

    1) The laptop sends a SYN message to the Web Server on port 80.

    2) The Web Server sends a SYN-ACK message to the laptop.

    3) The laptop sends an ACK message to the Web Server. Connection established.

- HTTP:

    4) The Web browser sends HTTP request message to the Web Server, indicating that it wants the webpage "www.mywebsite_K1833503.com".

    5) The Web Server receives the request message, forms the response message containing the webpage and sends it to the Web browser.

- TCP:

    6) The laptop sends a FIN message to the Web Server.

    7) The Web Server sends an ACK message and a FIN message to the laptop.

    8) The laptop sends an ACK message to the Web Server. Connection terminated.

Simulation Panel

Event List

	Vis.	Time(sec)	Last Device	At Device	Type	Info
1		0.012	--	Laptop	TCP	
		0.013	Laptop	Switch 1	TCP	
		0.014	Switch 1	Router	TCP	
		0.015	Router	Switch 2	TCP	
		0.016	Switch 2	Web Server	TCP	
2		0.017	Web Server	Switch 2	TCP	
		0.018	Switch 2	Router	TCP	
		0.019	Router	Switch 1	TCP	
		0.020	Switch 1	Laptop	TCP	
3		0.020	--	Laptop	HTTP	
4		0.021	Laptop	Switch 1	TCP	
		0.021	--	Laptop	HTTP	
		0.022	Laptop	Switch 1	HTTP	
		0.022	Switch 1	Router	TCP	
		0.023	Switch 1	Router	HTTP	
		0.023	Router	Switch 2	TCP	
		0.024	Router	Switch 2	HTTP	
		0.024	Switch 2	Web Server	TCP	
		0.025	Switch 2	Web Server	HTTP	
5		0.026	Web Server	Switch 2	HTTP	
		0.027	Switch 2	Router	HTTP	
		0.028	Router	Switch 1	HTTP	
		0.029	Switch 1	Laptop	HTTP	
6		0.029	--	Laptop	TCP	
		0.030	Laptop	Switch 1	TCP	
		0.031	Switch 1	Router	TCP	
		0.032	Router	Switch 2	TCP	
		0.033	Switch 2	Web Server	TCP	
7		0.034	Web Server	Switch 2	TCP	
		0.035	Switch 2	Router	TCP	
		0.036	Router	Switch 1	TCP	
		0.037	Switch 1	Laptop	TCP	
8		0.038	Laptop	Switch 1	TCP	
		0.039	Switch 1	Router	TCP	
		0.040	Router	Switch 2	TCP	
		0.041	Switch 2	Web Server	TCP	

References

- Kurose, J. and Ross, K. (2017) Computer Networking: A Top-Down Approach, Global Edition, Seventh edition.