Project Report
Cisco mini project

Leonardo Fusser, 1946995
Maxime Huynh, 1961718
Josue Reisler, 1943006

Experiment Performed on **3 December 2021**
Report Submitted on **19 December 2021**

Department of Computer Engineering Technology
Network Systems Design
Day Yann Fong

VANIER
C É G E P / C O L L E G E
Learning today Leading tomorrow
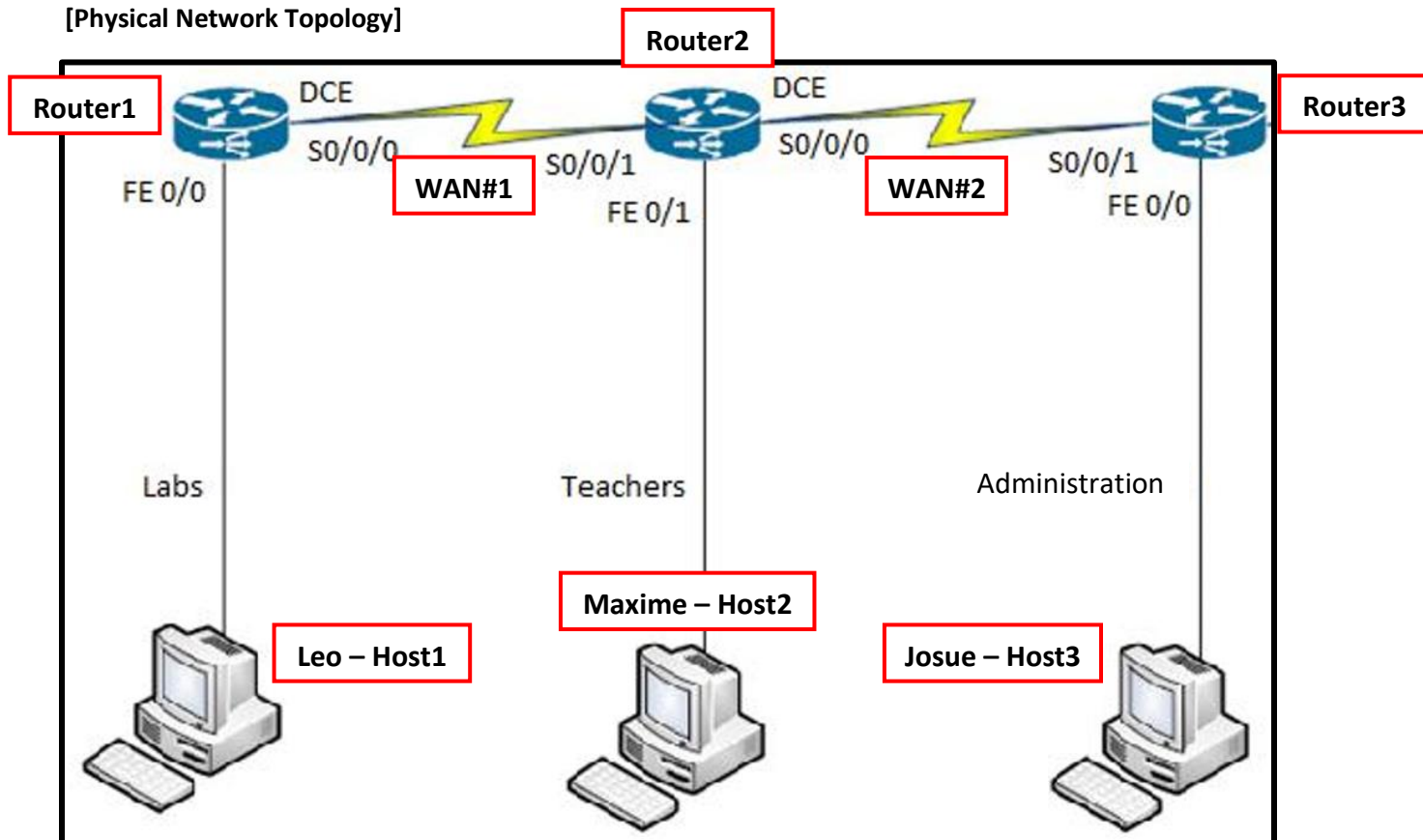
TABLE OF CONTENTS

1.0 PROJECT DESCRIPTION

Detailed description about the project and the network:

[Equipment list]

- (3x) Cisco 1841 routers with HWIC-2T card installed.
- (2x) Cisco smart serial cables (CAB-SS-2626X).
- (3x) Cisco console roll-over cables (72-3383-01).
- (3x) Cat5E copper-crossover UTP cables.
- (3x) host computers running Windows 10 OS.

[Physical Network Topology]

[Network Addressing]

Given constraints:

- Need to use Class B private address space.
- 3 subnets are desired (not counting WAN links).
  - Lab subnet: 600 hosts.
  - Teacher subnet: 350 hosts.
  - Administration subnet: 20 hosts.

Subnet	Needed Size	Required number of host bits	Allocated size
Lab	600	10 ($\log_2 600 = 10$)	1'024 ($2^{10} = 1'024$)
Teacher	350	9 ($\log_2 350 = 9$)	512 ($2^9 = 512$)
Administration	20	5 ($\log_2 20 = 5$)	32 ($2^5 = 32$)
WAN#1	4	2 ($\log_2 4 = 2$)	4 ($2^2 = 4$)
WAN#2	4	2 ($\log_2 4 = 2$)	4 ($2^2 = 4$)
TOTAL	**978**	**11 ($\log_2 1'576 = 11$)**	**1'576**

Given IP: 172.16.0.0

Subnet mask: 255.255.248.0 (to satisfy the requirements in the table above -> 32 – 11 = /21).

Partial subnetting table for 172.16.0.0 /21 network:

Subnet ID	Subnet Address	Usable Range	Broadcast Address	Prefix (mask)
0	172.16.0.0	172.16.0.1 to 172.16.7.254	172.16.7.255 (172.16.0000 0111.255)	/21
1	172.16.8.0 (172.16.0000 1000.0)	172.16.8.1 to 172.16.15.254	172.16.15.255 (172.16.0000 1111.255)	/21
2	172.16.16.0 (172.16.0001 0000.0)	172.16.16.1 to 172.16.23.254	172.16.23.255 (172.16.0001 0111.255)	/21
3	172.16.24.0 (172.16.0001 1000.0)	172.16.24.1 to 172.16.31.254	172.16.31.255 (172.16.0001 1111.255)	/21
		! output omitted !		
29	172.16.232.0 (172.16.1110 1000.0)	172.16.232.1 to 172.16.239.254	172.16.239.255 (172.16.1110 1111.255)	/21
30	172.16.240.0 (172.16.1111 0000.0)	172.16.240.1 to 172.16.247.254	172.16.247.255 (172.16.1111 0111.255)	/21
31	172.16.248.0 (172.16.1111 1000.0)	172.16.248.1 to 172.16.254.254	172.16.255.255 (172.16.1111 1111.255)	/21

Green represents host bits and yellow represents subnet bits.

Assigned subnet to be further subnetted (from table on previous page): 1.

Assigned IP: 172.16.8.0

Subnet mask: 255.255.248.0

Complete subnetting table for 172.16.8.0 /21 network:

Subnets	Required Host bits	Subnet Address	Usable Range	Broadcast Address	Prefix (mask)
Lab: 600 hosts	10 ($\log_2 600 = 10$)	172.16.8.0	172.16.8.1 to 172.16.11.254	172.16.11.255 (172.20.0000 0011.255)	/22 (255.255.1111 1100.0)
Teacher: 350 hosts	9 ($\log_2 350 = 9$)	172.16.12.0 (172.16.11.254 + 1)	172.16.12.1 to 172.16.13.254	172.16.13.255 (172.20.0000 001.255)	/23 (255.255.1111 1110.0)
Administration: 20 hosts	5 ($\log_2 20 = 5$)	172.16.14.0 (172.16.13.255 + 1)	172.16.14.1 to 172.16.14.30	172.16.14.31 (172.16.14.0001 1111)	/27 (255.255.255.1110 0000)
WAN#1: 4 hosts	2 ($\log_2 4 = 2$)	172.16.14.32 (172.16.14.31 + 1)	172.16.14.33 to 172.16.14.34	172.16.14.35 (172.16.14.0010 0011)	/30 (255.255.255.1111 1100)
WAN#2: 4 hosts	2 ($\log_2 4 = 2$)	172.16.14.36 (172.16.14.35 + 1)	172.16.14.37 to 172.16.14.38	172.16.14.39 (172.16.14.0010 0111)	/30 (255.255.255.1111 1100)

Yellow represents host bits.

IP assignment table for 172.16.8.0 /21 network:

Device	Interface	Subnet	IP Address	Default Gateway	Prefix
Host1	NIC	Lab	172.16.8.1	172.16.11.254	/22
Host2	NIC	Teacher	172.16.12.1	172.16.13.254	/23
Host3	NIC	Administration	172.16.14.1	172.16.14.30	/27
Router1	Fa0/0	Lab	172.16.11.254	N/A	/22
	S0/0/0 (DCE)	WAN#1	172.16.14.33	N/A	/30
Router2	Fa0/1	Teacher	172.16.13.254	N/A	/23
	S0/0/0 (DCE)	WAN#2	172.16.14.37	N/A	/30
	S0/0/1 (DTE)	WAN#1	172.16.14.34	N/A	/30
Router3	Fa0/0	Administration	172.16.14.30	N/A	/27
	S0/0/1 (DTE)	WAN#2	172.16.14.38	N/A	/30

2.0 ADMINISTRATOR GUIDE

Configuration and network expansion guide for future use:

[Configuring the system]

➢ Before changing the existing configuration on the Cisco 1841 routers, ensure that all necessary planning was done beforehand, such as functional requirements, in order to mitigate any issues during the configuration phase.

➢ Once all planning has been sorted out, you may proceed with modifying the existing configuration on any of the three Cisco 1841 routers. At the time of writing this document, the only way this can be done is through the console port on any of the three Cisco 1841 routers. Refer to the "maintaining" section under "maintenance guide" to view how to connect a PC to any of the three Cisco 1841 routers (to see how to access the CLI of any of these three devices). Also, **only authorized personnel are allowed to access the CLI on any of these three devices**.

➢ Once you gain access to the CLI on any of the three Cisco 1841 routers, there are many options as to what you can configure on the Cisco 1841 router. For simplistic reasons, following on the next few pages are a few common tasks that can be configured on any of the three Cisco 1841 routers:

(Refer to next few pages)

*Note: the following snippets assume that the router has default settings applied, meaning that there are no passwords, hostnames, etc., that are configured/applied onto the router.

At the time of writing this document, the login password for the Cisco 1841 routers is "cisco" and the password for user EXEC mode is "class" (assuming there has been no modification done to these passwords).

[Configuring a login banner]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#banner motd %
Enter TEXT message. End with the character '%'.
<enter your text and once your done enter the '%' key>
Router(config)#end
...
Router#copy run start
...
```

[Configuring a login password]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#line console 0
Router(config-line)#password <your password>
Router(config-line)#login
Router(config)#end
...
Router#copy run start
...
```

[Configuring a user EXEC password]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#enable secret <your password>
Router(config)#end
...
Router#copy run start
...
```

[Configuring a hostname]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#hostname <your hostname>
X(config)#end
...
X#copy run start
...
```

Note: "X" refers to the new hostname that is applied onto the router.

[Configuring the Fa0/x interface]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#int Fa0/X
Router(config-if)#ip address <ip address> <subnet mask>
Router(config-if)#description <your description>
Router(config-if)#no shut
...
Router(config-if)#end
...
Router#copy run start
...
```

[Configuring the S0/0/X interface (as DCE)]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#int S0/0/X
Router(config-if)#ip address <ip address> <subnet mask>
Router(config-if)#clock rate <desired clock rate>
Router(config-if)#description <your description>
Router(config-if)#no shut
...
Router(config-if)#end
...
Router#copy run start
...
```

[Configuring the S0/0/X interface (as DTE)]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)#int S0/0/X
Router(config-if)#ip address <ip address> <subnet mask>
Router(config-if)#description <your description>
Router(config-if)#no shut
...
Router(config-if)#end
...
Router#copy run start
...
```

➢ If none of the previous snippets don't contain what you are looking for, refer to the following link for more documentation about the Cisco 1841 router and what you can configure on it:

https://www.cisco.com/c/en/us/support/routers/1800-series-integrated-services-routers-isr/series.html#~tab-documents

[Expanding the network]

➢ If there is a need to expand the network, there are few ways to do so without the need of acquiring new hardware. At the time of writing this document, the network can be further expanded through the use of these unused network interfaces on the three Cisco 1841 routers:

Device	Interface
Router1	Fa0/1 and S0/0/1
Router2	Fa0/0
Router3	Fa0/1 and S0/0/0

➢ Before changing the existing configuration on the Cisco 1841 routers to expand the network, proper subnetting/network addressing should be done beforehand in order to mitigate any issues that may occur during the configuration phase.

➢ Once all addressing has been sorted out, you may proceed with modifying the existing configuration on any of the three Cisco 1841 routers. At the time of writing this document, the only way this can be done is through the console port on any of the three Cisco 1841 routers. Refer to the "maintaining" section under "maintenance guide" to view how to connect a PC to any of the Cisco 1841 routers (to see how to access the CLI of any of these three devices). Also, **only authorized personnel are allowed to access the CLI on any of these three devices**.

➢ Once you gain access to the CLI on any of the three Cisco 1841 routers, depending on the interface being used to expand the network and which device is being used for the expansion, use any of the appropriate commands found on the next few pages.

*Note: depending on the context, "X" refers to router number or interface number in the following snippets that are on the next few pages.

At the time of writing this document, the login password for the Cisco 1841 routers is "cisco" and the password for user EXEC mode is "class" (assuming there has been no modification done to these passwords).

[Configuring the Fa0/X interface on any of the routers]

```
...
User Access Verification

Password: cisco
RouterX>en
Password: class
RouterX#config t
...
RouterX(config)#int Fa0/X
RouterX(config-if)#ip address <ip address> <subnet mask>
RouterX(config-if)#description <your description>
RouterX(config-if)#no shut
...
RouterX(config-if)#end
...
RouterX#copy run start
...
```

[Configuring the S0/0/X interface on any of the routers (as DCE)]

```
...
User Access Verification

Password: cisco
RouterX>en
Password: class
RouterX#config t
...
RouterX(config)#int S0/0/X
RouterX(config-if)#ip address <ip address> <subnet mask>
RouterX(config-if)#clock rate <desired clock rate>
RouterX(config-if)#description <your description>
RouterX(config-if)#no shut
...
RouterX(config-if)#end
...
RouterX#copy run start
...
```

[Configuring the S0/0/X interface on any of the routers (as DTE)]

```
...
User Access Verification

Password: cisco
RouterX>en
Password: class
RouterX#config t
...
RouterX(config)#int S0/0/X
RouterX(config-if)#ip address <ip address> <subnet mask>
RouterX(config-if)#description <your description>
RouterX(config-if)#no shut
...
RouterX(config-if)#end
...
RouterX#copy run start
...
```

- Once the interface(s) on any of the three Cisco 1841 routers are configured for the network expansion, the next step is to apply a new route to the router's local routing table in order to have successful communication between networks. Here is a general way to do so:

[Adding a new route on any of the three routers]

```
...
User Access Verification

Password: cisco
RouterX>en
Password: class
RouterX#config t
...
RouterX(config)#ip route <network address> <subnet mask>
                            <next hop or exit interface>
RouterX(config)#end
...
RouterX#copy run start
...
```

- Should issues arise after performing any of the previously mentioned commands or if the result is not what you are expecting, refer to the "troubleshooting" section under "maintenance guide" to view any of the possible troubleshooting techniques to diagnose any networking related problems.

- If none of the previous snippets don't contain what you are looking for, refer to the following link for more documentation about the Cisco 1841 router to see how you can expand the network:

https://www.cisco.com/c/en/us/support/routers/1800-series-integrated-services-routers-isr/series.html#~tab-documents

3.0 MAINTENANCE GUIDE

Helpful maintenance, troubleshooting and restore guide for future use:

[Maintaining]

➢ If there is a need, at any point in time, to change or simply maintain the network, you can do so by accessing the CLI of any of the three Cisco 1841 routers. There are many ways of accessing the CLI, such as Telnet, SSH, but at the time of writing this document, the only way to do so is via the console port on any of these three devices.

➢ Before trying to access the CLI on the Cisco 1841 routers to maintain the network, proper planning, such as functional requirements, should be done beforehand in order to mitigate any issues that may occur during the configuration phase. Also, **only authorized personnel are allowed to access the CLI on any of these three devices**.

➢ Once all planning has been completed, you may proceed with accessing the CLI of any of the three Cisco 1841 routers. There is a physical hookup and software configuration that needs to be done. Below is a typical example of how to do so:

[Typical physical hookup]
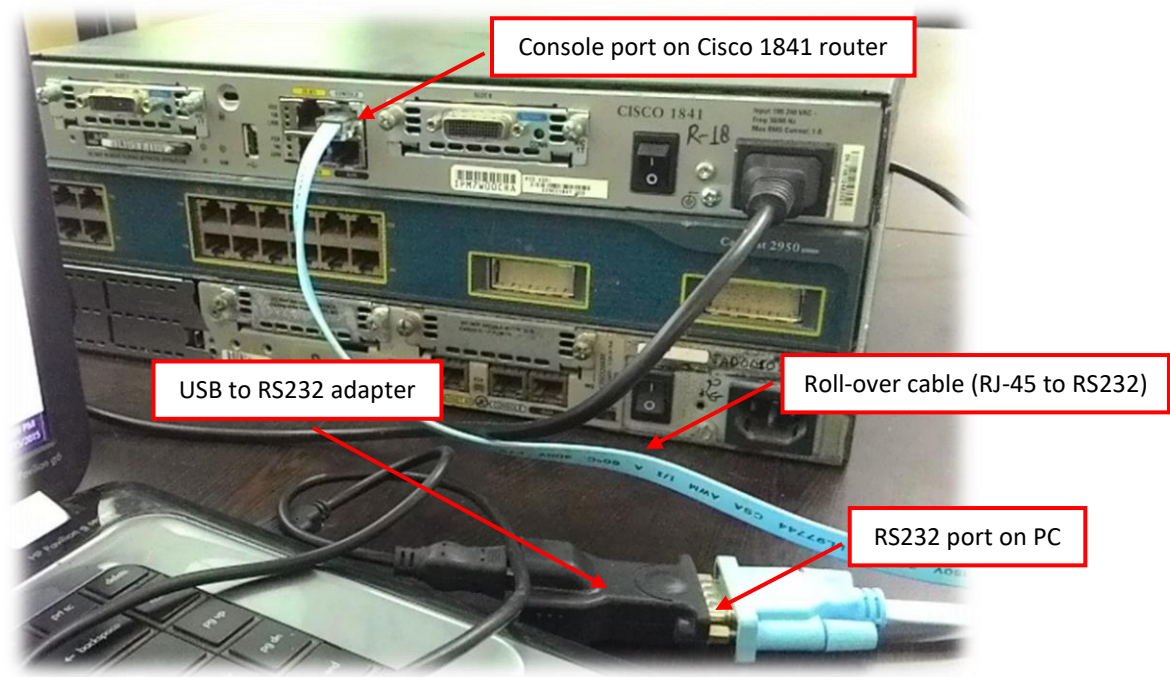
➢ Depending on your computer, it might not have a RS232 port for the roll-over cable. In that case, a USB to RS232 adapter (like the one used in the previous picture) can be used. Refer to your computer's documentation if you are uncertain if your computer has a RS232 port or not.

[Software configuration]

➢ Once the physical hookup is complete, the next step is to configure your computer to view the CLI on any of the three Cisco 1841 routers. A terminal emulation software is needed in order to do so. Popular terminal emulation software such as Tera Term or Putty can be used. Refer to the following links for documentation and steps to install the software onto your computer:

Tera Term: https://ttssh2.osdn.jp/index.html.en
Putty: https://www.putty.org/

➢ Once appropriate terminal emulation software has been installed onto your computer, the next step is to launch the software and to configure it for the serial communication between the PC and any of the three Cisco 1841 routers. Refer to table on next page for exact details. Below is an example how to do so in Putty (refer to terminal emulation software documentation if you are uncertain how to do so):

RS232 port name on PC (check device manager)

These parameters need to be set as they are shown in order to view the router's CLI properly
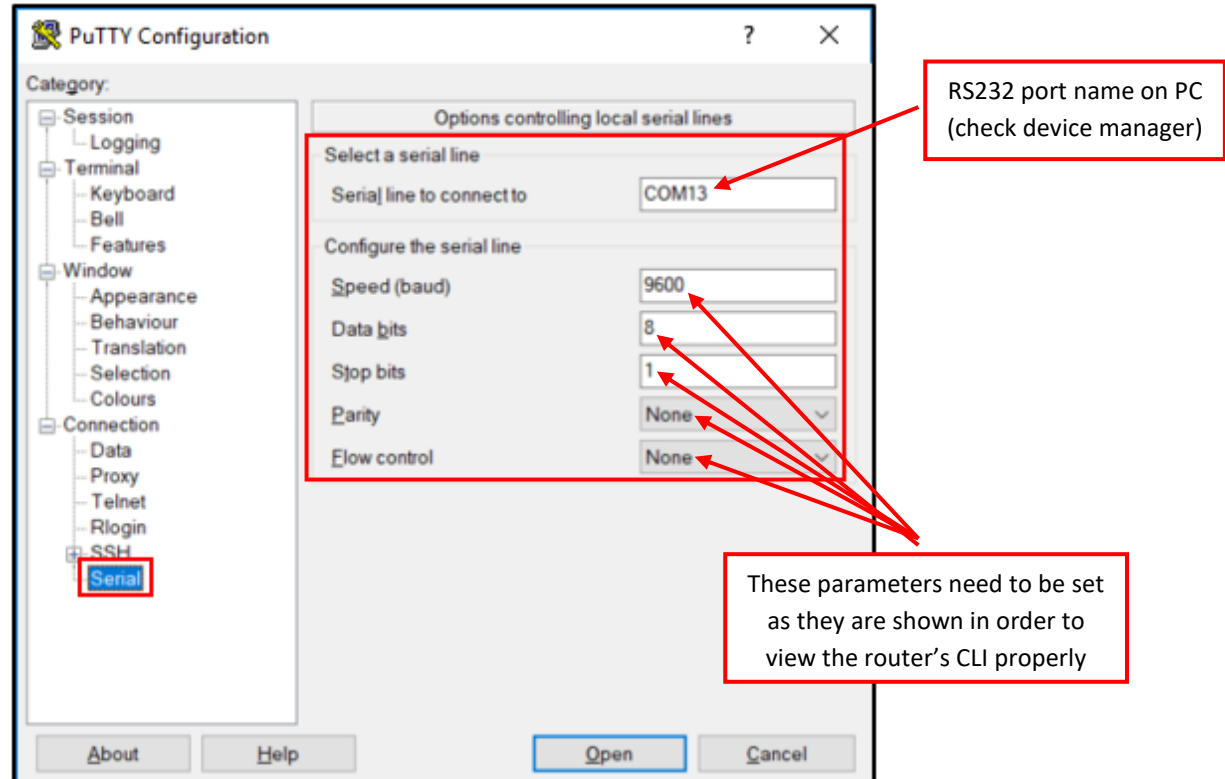
Parameter	Value
Serial port	COMx (x -> RS232 port number)
Speed (baud)	9600
Data bits	8
Stop bits	1
Parity	None
Flow control	None

Serial parameters that need to be set in terminal emulation software

> Once the terminal software serial parameters are set, initiate the serial communication and a black window should show up like the following with the login prompt to the router:
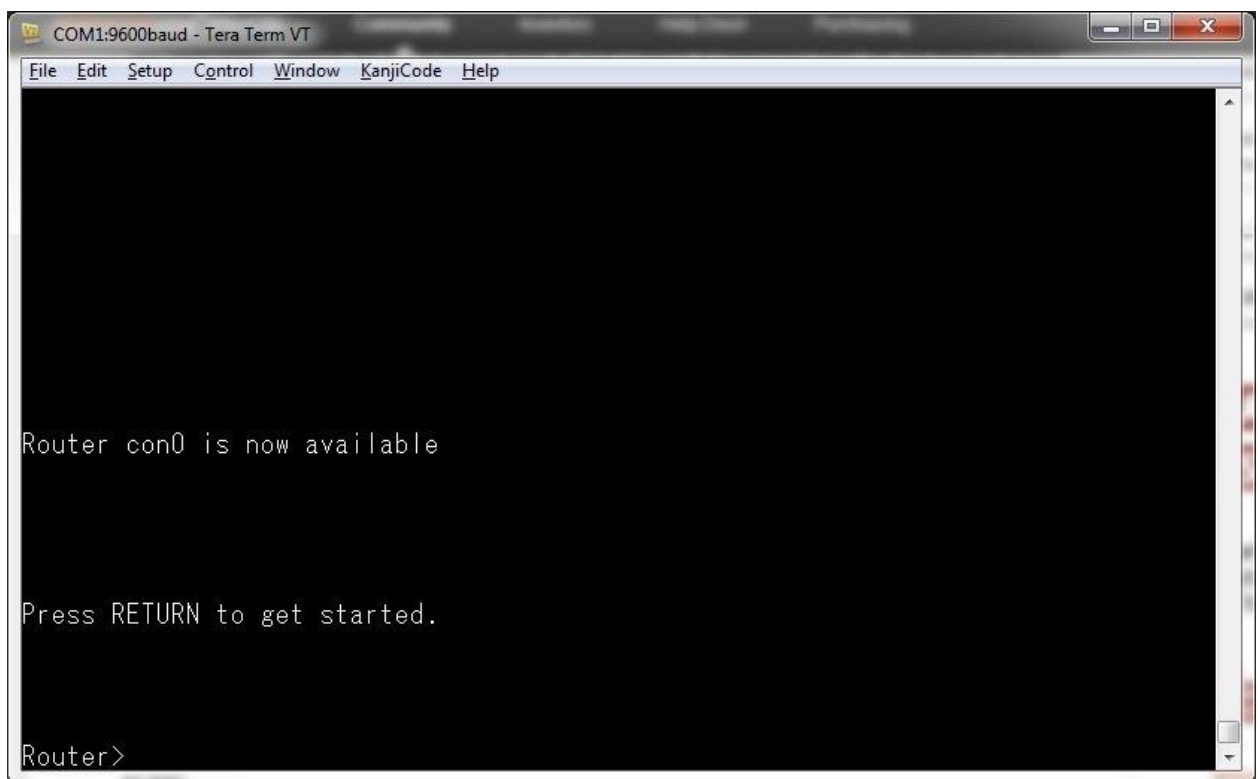
You now have access to the router's CLI. As a side note, **you can only access the CLI of any of the three devices one at a time if your computer has only one RS232 port, since the serial communication is a peer-to-peer one**.

[Troubleshooting]

➢ If computer networking issues arise while performing any computer networking related tasks, there are some basic troubleshooting steps that can be taken in order to find the source of the problem. Followed on the next few pages are the most common issues with possible solutions:

[Problem #1: Cisco router does not retain configuration after power cycle]

- The issue is that the startup-configuration is may be empty besides having the default configuration (or any previously saved configuration). The user needs to copy the running-configuration to the startup-configuration in order to retain all newly added configuration after a power cycle. The user will have to re-enter all proper Cisco IOS commands or obtain a previous configuration from a backup before they can copy the running-configuration to the startup-configuration. Below is an example of how the user can copy the running-configuration to the startup-configuration once all configuration has been completed on the router:

```
...
Press return to get started!

Router>en
Router#copy run start
...
```

The user can verify if the procedure was successful by observing if the changes were saved to the startup-config. Below is an example how to do so:

```
...
Press return to get started!

Router>en
Router#show startup-config
...
```

[Problem #2: Cannot ping from one computer to another that is on a different LAN]

- Before proceeding with this issue, ensure that all links are green in the network. If they are not, refer to the "Links are down" troubleshooting on the next page.
- If all links are green, then the issue could be one of two issues:
  - ❖ There might be a route missing in the router's local routing table. Depending on which portion of the network you are trying to access, the router's local routing table will differ. The user has to first analyze the router's local routing table to examine for missing routes and needs to take corrective action if it is the case:

    [To view the router's local routing table]

    ```
    ...
    Press return to get started!

    Router>en
    Router#show ip route
    ...
    ```

    [To add a missing route to the router's local routing table]

    ```
    ...
    Press return to get started!

    Router>en
    Router#config t
    ...
    RouterX(config)#ip route <network address>
                             <prefix>
                             <next hop or exit
                             interface>
    RouterX(config)#end
    ...
    RouterX#copy run start
    ...
    ```

  - ❖ If the above issue is not the case for you, then the issue might lie with your computer's firewall. Ensure that your computer's firewall is not blocking any communication that is going on in the network.

[Problem #3: Links are not showing green status (down)]

- The problem can be one of two issues:
  - ❖ The physical interfaces on the routers or on the PCs are not enabled and are in a "shutdown" state. The user has to enable this interfaces in order to see a green status on the physical adapters. On a PC, make sure the physical adapter that is being used to connect to the network is not disabled and that the cable is not unplugged. The same applies for the router. Below is an example how to verify if any of the physical interfaces are disabled and how to enable them if it is the case:

    [To view the status of any of the physical adapters]

    ```
    ...
    Press return to get started!

    Router>en
    Router#show ip interface brief
    ...
    ```

    [To enable any of the physical adapters]

    ```
    ...
    Press return to get started!

    Router>en
    Router#config t
    ...
    Router(config)#int <interface>
    Router(config-if)#no shut
    ...
    Router(config-if)#end
    ...
    Router#copy run start
    ```

  - ❖ If the above issue is not the case for you, then the cable being used between the router and the PC is not the correct type or it might be damaged. Ensure that a functional copper-crossover cable is being used to connect between the router and the PC.

[Problem #4: Forgotten password on one of the Cisco routers]

- If the issue arises that you are unable to access one of the router's CLI because of a "password incorrect error", then the issue lies with a forgotten password. In the case for a forgotten password, you need to follow the password recovery procedure that is available at the link included below:

  https://www.cisco.com/c/en/us/support/docs/routers/1700-series-modular-access-routers/22187-pswdrec-1700.html

[Restoring (to factory defaults)]

➢ If there is a need, at any point in time, to restore the system to a previous working configuration, the user can do so by accessing the CLI on any of the three Cisco 1841 routers and copying and pasting a known working configuration file (included on the next few pages) onto the CLI on any of the three devices. If you are uncertain about how to access the CLI, refer to the "maintaining" section shown previously in this section of this document (this is the Maintenance Guide section).

➢ Before trying to access the CLI on the Cisco 1841 routers to perform a configuration restore procedure, proper planning, such as down-time, should be done beforehand in order to mitigate any issues that may occur during the restore phase. Also, **only authorized personnel are allowed to access the CLI on any of these three devices**.

➢ Once all planning has been completed, you may proceed with accessing the CLI of any of the three Cisco 1841 routers to copy and paste the appropriate configuration file onto the CLI. Below is a typical example of how to do so:

[To copy and paste a configuration file onto one of the routers]

```
...
Press return to get started!

Router>en
Router#config t
...
Router(config)# <copy and paste the config file here>
...
X#copy run start
```

➢ Depending on the router you are trying to restore, select the appropriate configuration file that is shown on the next few pages to copy and paste onto the router's CLI as shown in the example above.

[Router1 configuration file]

```
hostname Router1
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
 description Lab-LAN
 ip address 172.16.11.254 255.255.252.0
 duplex auto
 speed auto
 no shutdown
!
```

```
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 description WAN1-Interface#1
 ip address 172.16.14.33 255.255.255.252
 clock rate 2000000
 no shutdown
!
interface Serial0/0/1
 no ip address
 clock rate 2000000
 shutdown
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
ip route 172.16.12.0 255.255.254.0 172.16.14.34
ip route 172.16.14.0 255.255.255.224 172.16.14.34
ip route 172.16.14.36 255.255.255.252 172.16.14.34
!
ip flow-export version 9
!
!
!
banner motd ^C
```

<!continues on next page!>

```
******************************************************************
*                                                                *
* Network Systems Design                                         *
* Day Yann Fong                                                  *
* Mini-Project                                                   *
*                                                                *
* Team: Leo, Maxime, Josue.                                      *
*                                                                *
* Device: Router1                                                *
*                                                                *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
*                          WARNING!                              *
*              UNAUTHORIZED ACCESS NOT ALLOWED!                  *
*                                                                *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
******************************************************************
^C
!
!
!
!
!
line con 0
 password cisco
 login
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

<!End of configuration file for Router1!>

[Router2 configuration file]

```
hostname Router2
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
```

<!continues on next page!>

```
interface FastEthernet0/1
 description Teacher-LAN
 ip address 172.16.13.254 255.255.254.0
 duplex auto
 speed auto
 no shutdown
!
interface Serial0/0/0
 description WAN2-Interface#1
 ip address 172.16.14.37 255.255.255.252
 clock rate 2000000
 no shutdown
!
interface Serial0/0/1
 description WAN1-Interface#2
 ip address 172.16.14.34 255.255.255.252
 no shutdown
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
ip route 172.16.8.0 255.255.252.0 172.16.14.33
ip route 172.16.14.0 255.255.255.224 172.16.14.38
!
ip flow-export version 9
!
!
!
banner motd ^C
```

<!continues on next page!>

```
*********************************************************************
*                                                                   *
* Network Systems Design                                            *
* Day Yann Fong                                                     *
* Mini-Project                                                      *
*                                                                   *
* Team: Leo, Maxime, Josue.                                         *
*                                                                   *
* Device: Router2                                                   *
*                                                                   *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
*                          WARNING!                                 *
*              UNAUTHORIZED ACCESS NOT ALLOWED!                     *
*                                                                   *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
*********************************************************************
^C
!
!
!
!
!
line con 0
 password cisco
 login
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

<!End of configuration file for Router2!>

[Router3 configuration file]

```
hostname Router3
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
 description Administration-LAN
 ip address 172.16.14.30 255.255.255.224
 duplex auto
 speed auto
 no shutdown
!
```

<!continues on next page!>

```
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 no ip address
 clock rate 2000000
 shutdown
!
interface Serial0/0/1
 description WAN2-Interface#2
 ip address 172.16.14.38 255.255.255.252
 no shutdown
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
ip route 172.16.8.0 255.255.252.0 172.16.14.37
ip route 172.16.12.0 255.255.254.0 172.16.14.37
ip route 172.16.14.32 255.255.255.252 172.16.14.37
!
ip flow-export version 9
!
!
!
banner motd ^C
```

<!continues on next page!>

```
****************************************************************
*                                                              *
* Network Systems Design                                       *
* Day Yann Fong                                                *
* Mini-Project                                                 *
*                                                              *
* Team: Leo, Maxime, Josue.                                    *
*                                                              *
* Device: Router3                                              *
*                                                              *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
*                         WARNING!                             *
*               UNAUTHORIZED ACCESS NOT ALLOWED!               *
*                                                              *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
****************************************************************
^C
!
!
!
!
!
line con 0
 password cisco
 login
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

<!End of configuration file for Router3!>

4.0 SYSTEM SPECIFICATIONS & LIMITATIONS

Project specifications and limitations:

➢ The "Labs" subnet can accommodate 1'022 unique usable hosts inside the subnet.

The reasoning for this is because we must subtract 2 from the total allocated size since we want to find the total number of usable hosts. In other words, we need to exclude the network address as well as the broadcast address in order to find the total number of usable hosts in this subnet.

Below is the general formula to find out the total number of usable hosts in the subnet:

(Number of usable hosts) = *(allocated network size for the subnet) – (2)*

Thus: *1'022* = *(2^10) - 2*

➢ The "Teachers" subnet can accommodate 510 unique usable hosts inside the subnet.

The reasoning for this is because we must subtract 2 from the total allocated size since we want to find the total number of usable hosts. In other words, we need to exclude the network address as well as the broadcast address in order to find out the total number of usable hosts in this subnet.

Below is the general formula to find out the total number of usable hosts in the subnet:

(Number of usable hosts) = *(allocated network size for the subnet) – (2)*

Thus: *510* = *(2^9) - 2*

➢ The "Administration" subnet can accommodate 30 unique usable hosts inside the subnet.

The reasoning for this is because we must subtract 2 from the total allocated size since we want to find the total number of usable hosts. In other words, we need to exclude the network address as well as the broadcast address in order to find out the total number of usable hosts in this subnet.

Below is the general formula to find out the total number of usable hosts in the subnet:

(Number of usable hosts) = *(allocated network size for the subnet) – (2)*

Thus: *30* = *(2^5) - 2*

5.0 DISCUSSION & CONCLUSION

Discussion & Conclusion for the project:

[Discussion]

➤ What was learned:
- How to work on our teamwork skills by communicating with each other. In the beginning, we didn't do so which resulted in some of us wasting time doing the same tasks (redundant tasks).
- Learned how to build a complete network using Cisco devices (such as the Cisco 1841 router).
- Solved problems in an organized manner using brainstorming, analysis and debugging techniques.
- Built on prior knowledge and acquired new knowledge throughout the project.
- Worked on managing group meetings and recording them using formal minutes to note all actions and decisions.

➤ Improvements:
- Something we could've improved on was communication. We could've communicated a bit more since we didn't talk much about the project at home. This resulted in making some of us assuming the role of each team member and having some of us overlap the work. On the other hand, it does help for verification, but it does waste a bit of time.

[Conclusion]

➤ Successfully built a complete Cisco network using Cisco devices.
➤ Successfully solved problems in an organized manner.
➤ Successfully added on knowledge from prior knowledge about computer networking.
➤ Successfully worked and managed work in a group.
➤ Successfully documented all networking details in a report.