

NETWORKS AND PROTOCOLS

Lab 5

Introduction

The objectives of this lab are to :

- Static routing configuration,
- Test and verify configurations.

Instructions

- Both topologies will be implemented via packet tracer following the same principles and approach, namely :
 - mounting,
 - interface configuration,
 - application of static routing rules,
 - and perform tests after each operation to ensure that it has been corrected before the next step.
 - On Packet Tracer, use the first generic router (router-PT).
- Use IP addresses 192.168.1.x, 192.168.2.x, 192.168.3.x and 192.168.4.x for networks LAN1, LAN2, LAN3 and LAN4 respectively, and addresses 192.168.5.x, 192.168.6.x and 192.168.7.x for each of the extended networks E1, E2 and E3 respectively.

Lab topology

See figure 1

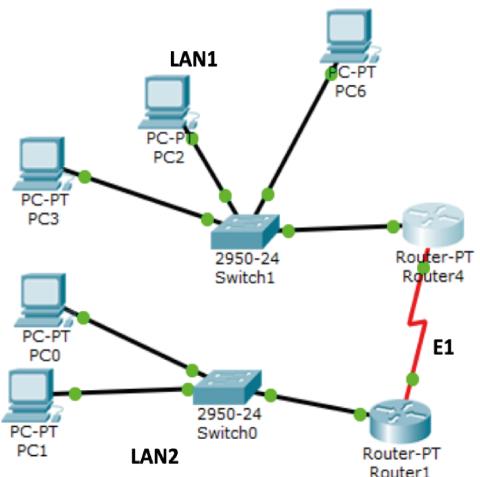
Task 1. Installation of topology 1:

- Choose the right material and cabling to set up this topology.

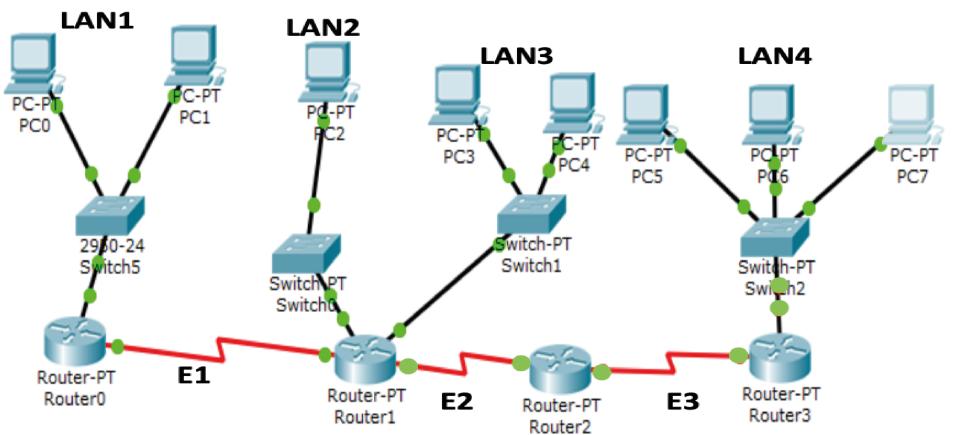
Task 2. Interface configuration

Step 1: Configure computer interfaces.

Step 2:



Topology 1



Topology 2

Figure 1: Lab topologies

- Configuring router interfaces: a special configuration is required for the serial interfaces of the two routers, as one of the two interfaces must act as DCE for clock synchronization and the other as DTE.
- In the CLI of the router whose serial interface is DCE (recognized as follows: if you hover the mouse over the serial interface, you'll see a small clock displayed), run the following command in interface configuration mode:

```
Router(config)#interface Serial2/0
Router(config-if)#clock rate 72000
no shutdown
```

Step 3:

- On each interface, including routers, execute **ping** commands to all interfaces on the same local network.
- If the **ping** test has revealed no connectivity errors, proceed to the next task; otherwise, correct the error.

Task 3. Static routing

Step 1:

- In each router's CLI, run the `show ip route` command in privileged mode;
- If the configuration is correct, the routing table of router 'router1' should look like this the following figure 2:

In the figure 2, the possible routing codes on this router are displayed, for example :

- C represents networks connected directly to the router,

```

Router#
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

```

Gateway of last resort is not set

```

C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.5.0/24 is directly connected, Serial2/0

```

Router#

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Figure 2: Simple routing table

- **S** represents networks configured statically using the ip route command,
- **I, R, B, ...** represent the routes learned respectively by the dynamic routing protocols **IGRP, RIP, BGP, ...**
- You can see that connected networks are automatically recognized by the router router, as they are directly attached to its interfaces.

Step 2: Static routing configuration.

- This step consists in telling the router what the next hop is that will enable it to route a data packet to a particular network.
- For example, in topology 1, **router1** uses **router4**'s serial interface as the next hop to the **192.168.2.0** networks, and in topology 2 **router0** uses **router1**'s serial interface as the next hop to the **192.168.2.0**, **192.168.3.0** and **192.168.4.0** networks (LAN2, LAN3 and LAN4 respectively).
- The static routing configuration command in global configuration mode is:
`ip route <destination network> <destination network mask> <next hop IP address>`

This command configures static routing to a given destination network.
It must be executed for all remote networks present in the architecture.

- In the case of topology 2, on **router0**, this configuration must be carried out as follows, figure 3:
- You are asked to configure static routing on routers in topology 1 and topology 2.

```

Router(config-if)#exit
Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.5.2
Router(config)#
Router(config)#ip route 192.168.4.0 255.255.255.0 192.168.5.2
Router(config)#{^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.5.0/24 is directly connected, Serial2/0
S    192.168.3.0/24 [1/0] via 192.168.5.2
S    192.168.4.0/24 [1/0] via 192.168.5.2
Router#

```

Figure 3: Routing table config

Step 3:

- Check that static routing has been established.
- As described above, the `show ip route` command in privileged mode can be used to display the routing table and check that it is correct.

Step 4:

- Check connectivity.
- Connectivity on each local network has already been checked (step 3 of the previous task).
- This step involves checking connectivity outside each local network. So, from each computer, ping all other computers. Also ping between computers and router interfaces and vice versa.

Hint: How to proceed with the ping test?

In fact, the ping test, as seen above and in the previous labs, reveals connectivity problems. If a ping between 2 machines reveals an error, this means that these two machines can't exchange information.

The problem may be due to several factors, and must be detected methodically:

- Firstly, the problem may be due to incorrect configuration of the IP addresses of one or both machines; the addressing plan must be well established before switching to machines. However, typing errors cannot be ruled out;
- Secondly, the default gateways on one or both machines may not correspond to the router interfaces;
- The next error to suspect may be due to misconfiguration of the IP addresses of the router interfaces on the path between the two source and destination machines. In this case, perform the necessary checks on all interfaces. Cisco IOS offers interface diagnostic commands in privileged mode:

```
#show interfaces for details of interface ip configuration,  
#show ip interface brief for information on interface operation  
#show ip interface <interface name> for information on a specific interface.
```

- It is also possible to ping one of the two machines to the output interfaces of the routers on the path. In this way, IP address misconfigurations are corrected step by step;
- The problem may also be linked to a routing error. In this case, a rigorous analysis of the established paths is required, using the command: show ip route.

```
Router#show in
Router#show interfaces
FastEthernet0/0 is up, line protocol is up (connected)
  Hardware is Lance, address is 0006.2a71.63ea (bia 0006.2a71.63ea)
  Internet address is 192.168.3.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last input 00:00:08, output 00:00:06, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 input packets with dribble condition detected
    0 packets output, 0 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
FastEthernet1/0 is up, line protocol is up (connected)
  Hardware is Lance, address is 00e0.f731.19be (bia 00e0.f731.19be)
  Internet address is 192.168.4.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
```

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Figure 4: show interfaces

Physical Config CLI

IOS Command Line Interface

```

IP multicast fast switching is disabled
IP multicast distributed fast switching is disabled
Router Discovery is disabled
IP output packet accounting is disabled
IP access violation accounting is disabled
TCP/IP header compression is disabled
RTP/IP header compression is disabled
Probe proxy name replies are disabled
Policy routing is disabled
Network address translation is disabled
BGP Policy Mapping is disabled
Input features: MCI Check
WCCP Redirect outbound is disabled
WCCP Redirect inbound is disabled
WCCP Redirect exclude is disabled
Serial2/0 is up, line protocol is up (connected)
Internet address is 192.168.2.2/24
Broadcast address is 255.255.255.255
Address determined by setup command
MTU is 1500
Helper address is not set
Directed broadcast forwarding is disabled
Outgoing access list is not set
Inbound access list is not set
Proxy ARP is enabled
Security level is default
Split horizon is enabled
ICMP redirects are always sent
ICMP unreachables are always sent
--More--

```

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Figure 5: show interfaces / next

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.3.1	YES	manual	up	up
FastEthernet1/0	192.168.4.1	YES	manual	up	up
Serial2/0	192.168.2.2	YES	manual	up	up
Serial3/0	unassigned	YES	unset	administratively down	down
FastEthernet4/0	unassigned	YES	unset	administratively down	down
FastEthernet5/0	unassigned	YES	unset	administratively down	down

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Figure 6: show interfaces brief

Physical Config CLI

IOS Command Line Interface

```

Router#show ip interface fastEthernet 1/0
FastEthernet1/0 is up, line protocol is up (connected)
  Internet address is 192.168.4.1/24
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Outgoing access list is not set
  Inbound access list is not set
  Proxy ARP is enabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachable are always sent
  ICMP mask replies are never sent
  IP fast switching is disabled
  IP fast switching on the same interface is disabled
  IP Flow switching is disabled
  IP Fast switching turbo vector
  IP multicast fast switching is disabled
  IP multicast distributed fast switching is disabled
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Probe proxy name replies are disabled
  Policy routing is disabled
  Network address translation is disabled
  BGP Policy Mapping is disabled
  Input features: MCI Check
  WCCP Redirect outbound is disabled
  WCCP Redirect inbound is disabled
  WCCP Redirect exclude is disabled
Router#
Router#

```

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Figure 7: show ip interface with one interface

```

Router(config-if)#exit
Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.5.2
Router(config)#
Router(config)#ip route 192.168.4.0 255.255.255.0 192.168.5.2
Router(config)#{^Z
Router#
*SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.5.0/24 is directly connected, Serial2/0
S    192.168.3.0/24 [1/0] via 192.168.5.2
S    192.168.4.0/24 [1/0] via 192.168.5.2
Router#

```

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Figure 8: show ip route

Task 4: Creating topology 2 with Packet Tracer

Step 1: Propose an addressing plan for topology 2 using the following network address address:
192.168.1.0/24

Step 2:

- Set up and configure network topology 2,
- Establish static routing of computers,
- Perform the necessary connectivity tests.

Step 3:

- Run the tracert <IP address of PC7> command from the PC0 terminal.
- Interpret the result. Please explain:
.....
.....

Step 4:

- Change the IP address of router 3's serial interface to cause an error,
- Repeat step 3.
- Explain the result
.....
.....

Appendix: Adding a new interface to a generic router on Packet Tracer

Once the router has been added to the desktop, click on it to display an image of the router's rear panel:

Step 1: To switch off the router, click on the switch (1).

Step 2: Choose the appropriate interface (2).

Step 3: Drag and drop the image of the new interface into a free slot on the router (3 and 4).

Step 4: Switch on the router and wait for it to start up. The new interface will be added to the "Config" tab.

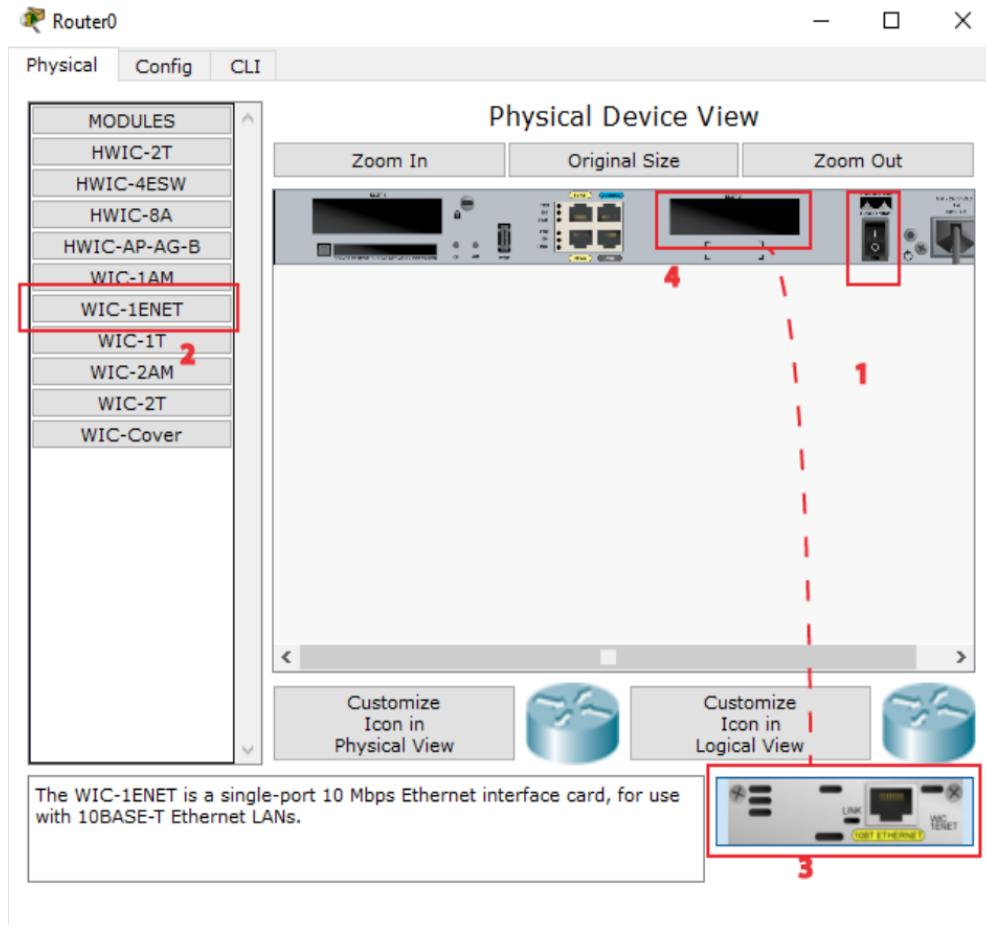


Figure 9: Adding a new interface