TCP/IP Computer Networks

Laboratory guides

SESSION 4: ROUTING INTERFACES AND OSPF

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Routing interfaces and OSPF

Goals

Setup an interconnection of several LANs. Learn how to setup a simple OSPF working solution and test and analyse the basic features of the protocol: cost function, selection of the best routes and convergence.

Report

Use this guide to take your notes during the lab class. When asked for, write a report on your most relevant findings and try to explain them. The report should have around 5 pages (double spaced, 11 dots) and must be delivered one week after the end of this laboratory.

Work Plan

Clean up the active configuration of the router-switch and activate the spanning-tree protocol to remove network loops.

Analyse the network requirements and configure the required:

- VLANs,
- switch interfaces, and
- routers.

Activate the routing services (manual and OSPF), verify the routing tables and analyse the messages of each protocol.

Routing Interfaces

The Cisco 3750 implements both switching and routing functions in the same equipment. Different configurations will activate the routing or switching functions on physical interfaces or virtual interfaces. To activate the routing functions, extra layer 3 configuration commands need to be issued. Note that physical interfaces working as switch ports may be connected to a router through a virtual interface (SVI) created on the VLAN of that interface. Routed ports only route traffic between different networks. Switch ports only forward traffic between different interfaces on the same VLAN.

Explain the difference between switch ports, routed ports, and virtual interfaces.

Interfaces Configuration

In the following procedures, the specified interface must be one of these Layer 3 interfaces:

- A routed port: a physical port configured as a Layer 3 port by:

  interface Fa?/?/?

  no switchport

  ...

- A switch virtual interface (SVI): a VLAN interface created by:

  interface vlan vlan_id

  ...

  followed by the normal Layer 3 configuration commands.

Layer 3 Configuration

The layer 3 protocols of an interface (either physical or virtual), can be programmed to obtain its configuration automatically:

```
interface Fa?/?/?

description connection to FCT network

ip address dhcp
```

or it can also be programmed with manual configurations:

```
interface Fa?/?/?

description connection to North router

ip address 10.10.?.? 255.255.?.?
```

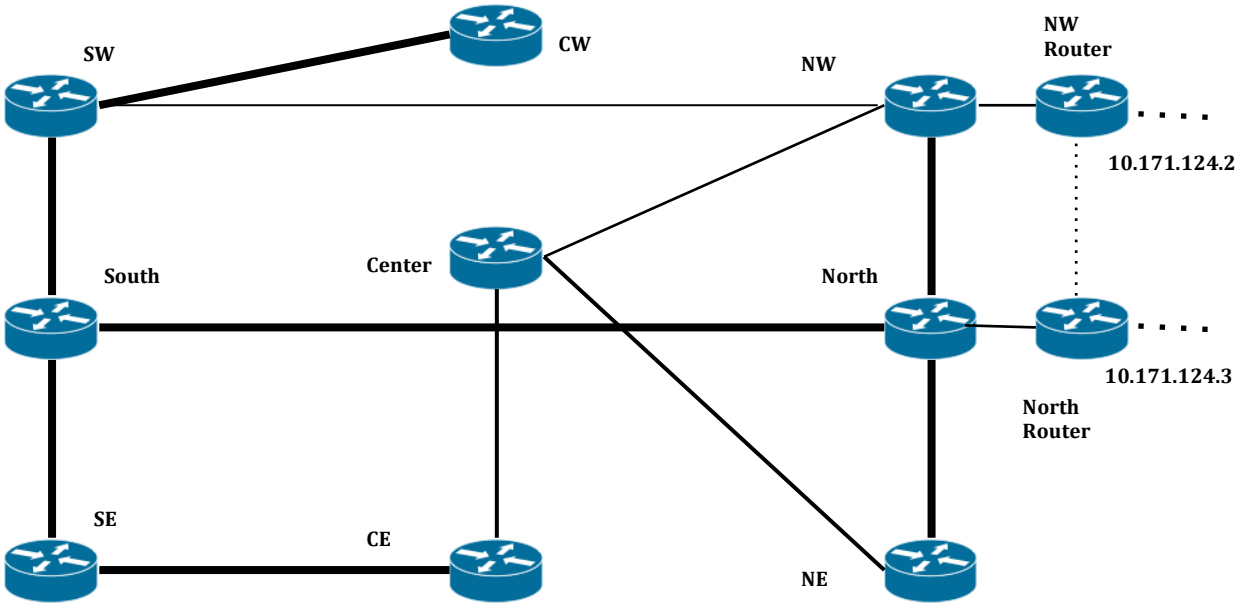
The setup and status of the different interfaces can be shown using commands: show int [Fa?/?/?], show interface description, show interface status, show interface summary, show ip interface brief.

Network Configuration

The idea is to simulate a backbone covering several offices of a nation wide corporation. Each workbench simulates an office. Each office has an independent LAN, which is interconnected to the other offices using IP routing. Each office needs 253+1+1=255 different addresses. You can use prefix 192.168.0.0/16 (addresses 192.168.0.0 up to 192.168.255.255) to number your national network and hosts. Leave prefix 192.168.0.0/24 for latter usage, use prefix 192.168.1.0/24 in the northwest workbench, prefix 192.168.2.0/24 for north workbench and so on. In each office, VLAN 1 (the default VLAN) will be used as local LAN with the router in address .1 of its prefix. For link numbering use prefixes of the form 10.10.x.0/24 with x allowing a simple recognition of the link concerned.

Network Design

Consider the following network:



Workbenches addressing plan:

Offices	Prefix	Mask	Gateway Address	GW Type (SVI/RP)
NW	192.168.1.0 /24	255.255.255.0	192.168.1.1	VLAN1
N	192.168.2.0 /24	255.255.255.0	192.168.2.1	VLAN1
NE	192.168.3.0 /24	255.255.255.0	192.168.3.1	VLAN1
SW	192.168.4.0 /24	255.255.255.0	192.168.4.1	VLAN1
S	192.168.5.0 /24	255.255.255.0	192.168.5.1	VLAN1
SE	192.168.6.0 /24	255.255.255.0	192.168.6.1	VLAN1
C	192.168.7.0 /24	255.255.255.0	192.168.7.1	VLAN1
CE	192.168.8.0 /24	255.255.255.0	192.168.8.1	VLAN1
CW	192.168.9.0 /24	255.255.255.0	192.168.9.1	VLAN1

Layer 3 Topology

Draw the Layer 3 (Network) topology, identifying all routers, networks and their interfaces:

Routers

In each router define the status of each port and their network addresses:

Office	Routing ports and addresses	Switch ports range
NW	Local loop address - 192.168.0.1/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24 NWRouter - port address – 10.10. . /24	
N	Local loop address - 192.168.0.2/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24 NorthRouter - port address – 10.10. . /24	
NE	Local loop address - 192.168.0.3/32 - port address – 10.10. . /24 - port address – 10.10. . /24	
SW	Local loop address - 192.168.0.4/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24	
S	Local loop address - 192.168.0.5/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24	
SE	Local loop address - 192.168.0.6/32 - port address – 10.10. . /24 - port address – 10.10. . /24	
C	Local loop address - 192.168.0.7/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24	
CE	Local loop address - 192.168.0.8/32 - port address – 10.10. . /24 - port address – 10.10. . /24 - port address – 10.10. . /24	
CW	Local loop address - 192.168.0.9/32 - port address – 10.10. . /24	
North West router	Local loop address - 192.168.0.21/32 - FastEthernet 0/0 - FCT/UNL – 10.171.124.2 / - FastEthernet 0/1 – North West – 10.10. . /24 - Serial 0/0 - North Router – 10.10. . /24	none
North router	Local loop address - 192.168.0.22/32 - FastEthernet 0/0 - FCT/UNL – 10.171.124.3 / - FastEthernet 0/1 - North – 10.10. . /24 - Serial 0/0 – North West Route – 10.10. . /24	none

OSPF

Setup the ID of each router using interface loopback 1 (e.g. address 192.168.0.1/32).

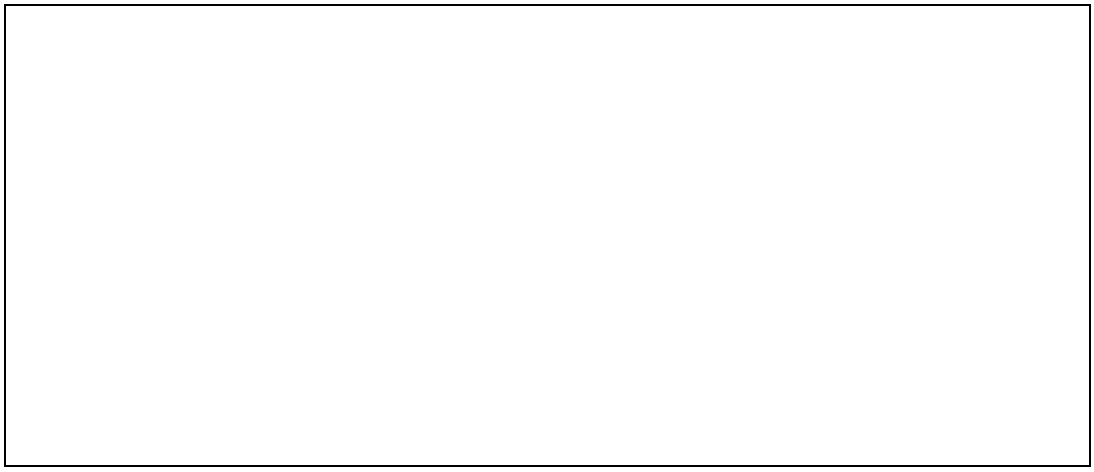
Setup an OSPF routing process in each router using the following IOS commands (in configuration mode):

```
router ospf 10
network net_address      inverted_mask area 0
...
network 0.0.0.0          0.0.0.0 area 0
default-information originate metric 30 metric-type 1
```

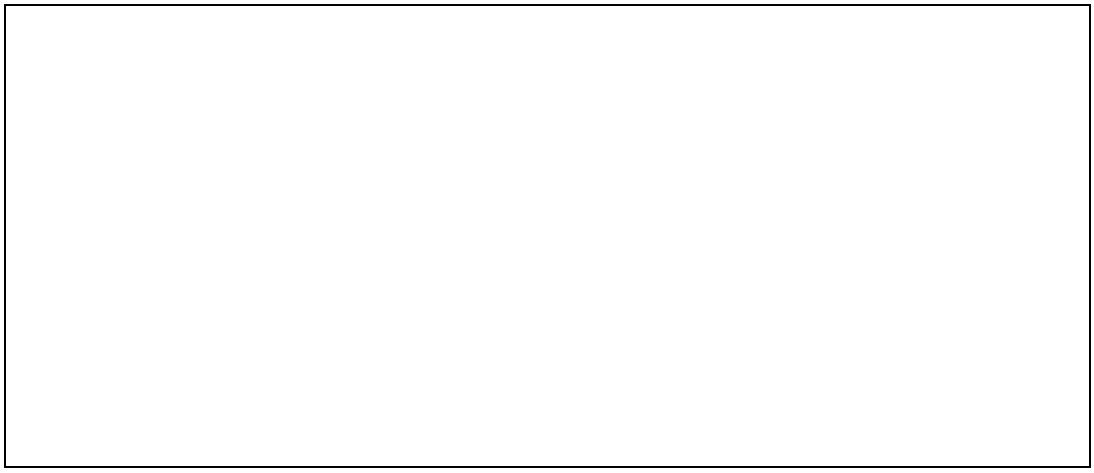
Inspect the routing table using command show ip route. Explain the different types of routes that are present on the routing table. Explain their costs.

Verify the adjacencies that your router created and your routerID using *show ip ospf neighbor*. What is the purpose of the adjacencies?

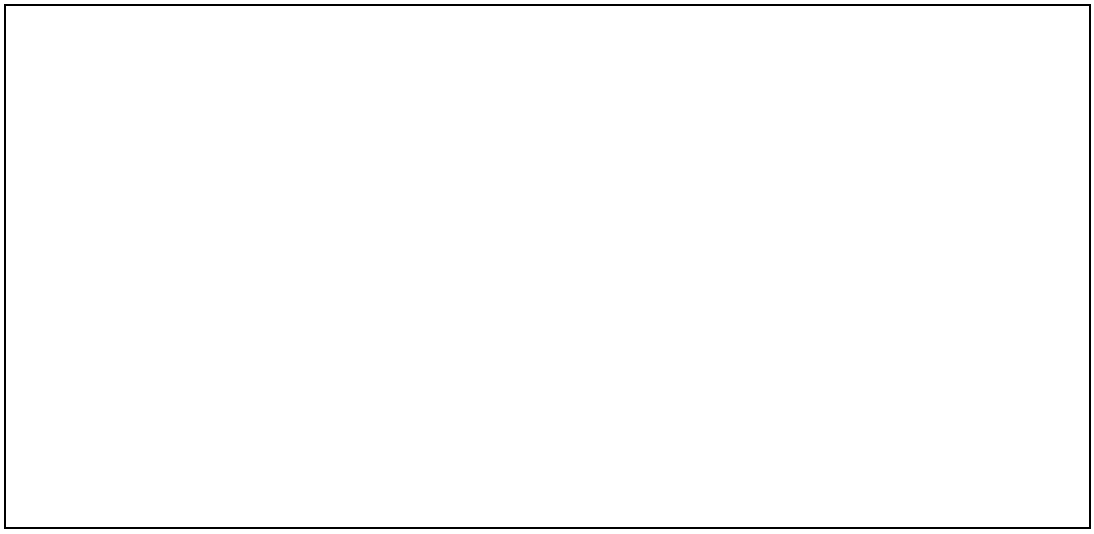
Verify and explain the content of the LSAs database (show ip ospf database).



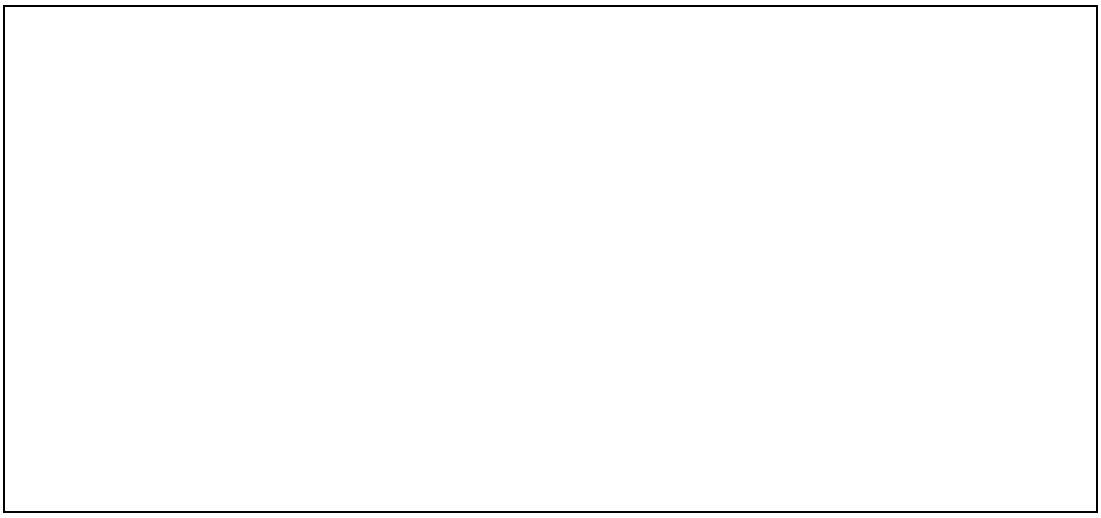
Connect a computer to your local LAN. Try to capture the hello messages of OSPF and explain them.



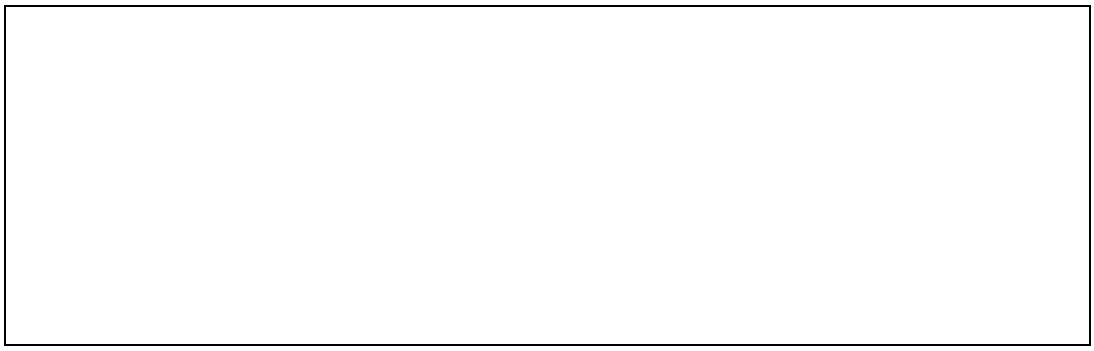
Verify and explain the output of the show ip protocols command.



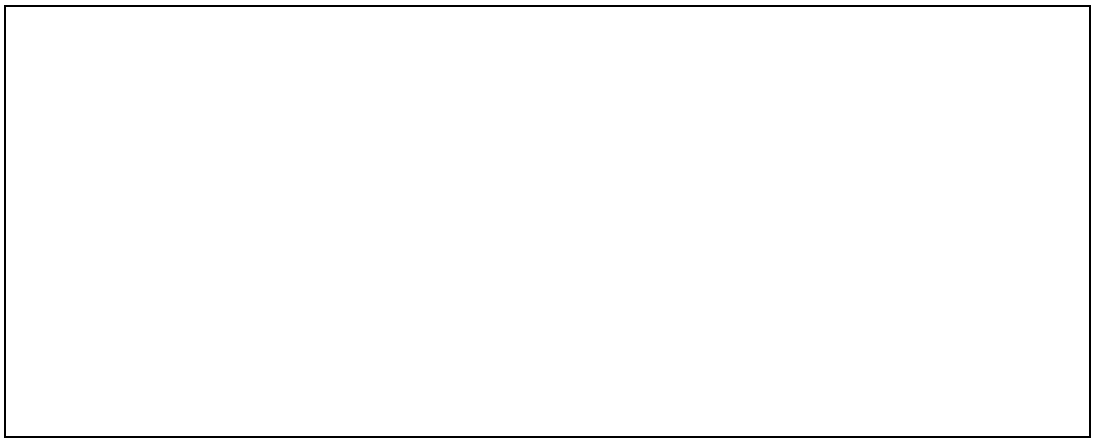
Using a traffic monitoring session, capture the OSPF messages after resetting the OSPF process (clear ip ospf process). Visualize and analyse the OSPF messages. Try to measure how long it takes a link changing state event to be taken into consideration by each router.



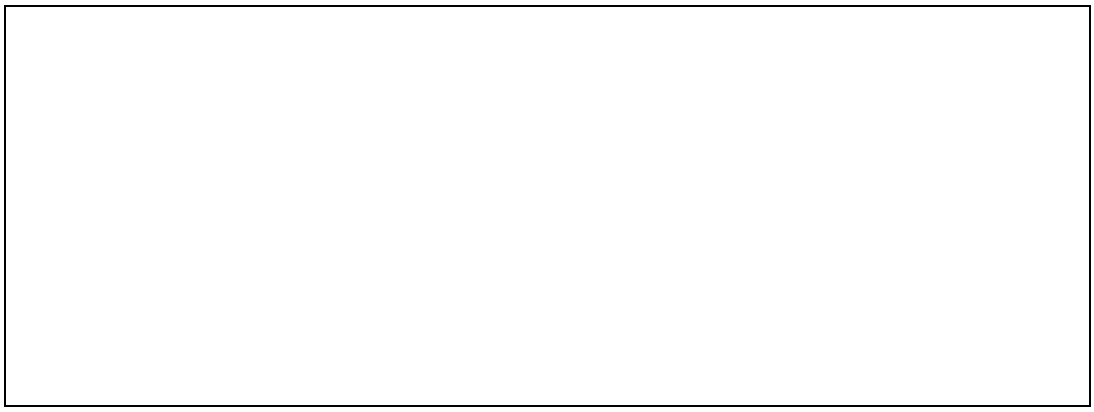
Shutdown links between router Centre West and the router South West side analyse how OSPF deals with links failures.



Connect router NorthWestRouter to your network, inspect its configuration and verify that it injects a default route in your network.



Setup a computer connected to your workbench (use one of the VLAN1 local available addresses), setup the default route of your computer and verify that it can now access hosts in the Internet. Inspect how router NorthWestRouter allows this access.



Explain how NAT works. Analyse the NAT tables of NorthWestRouter when some computer in your workbench sends packets (belonging to a TCP connection or to an UDP flow) to the public Internet. Explain what is going on.