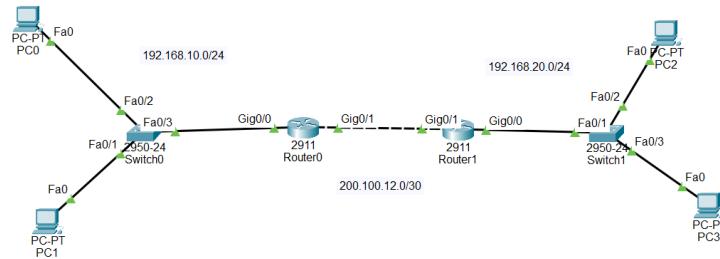
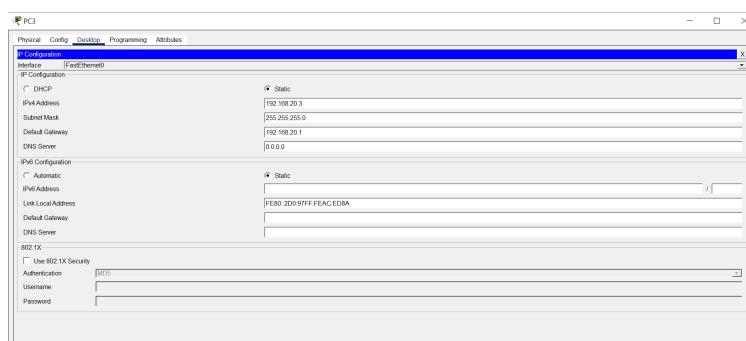
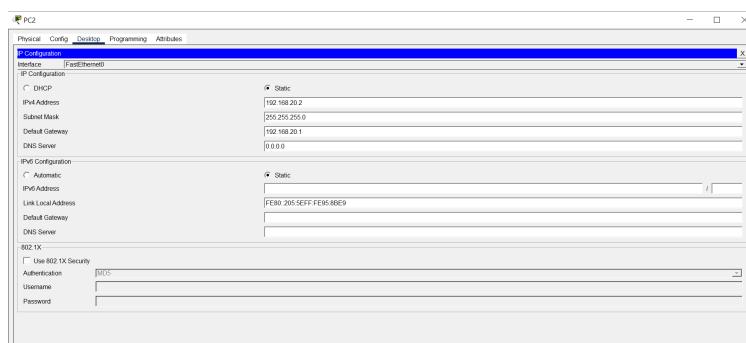
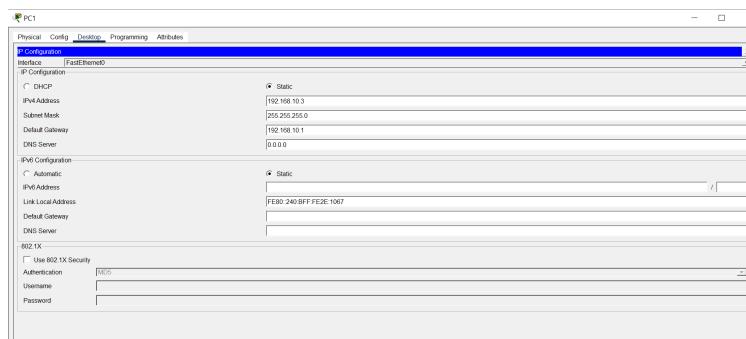
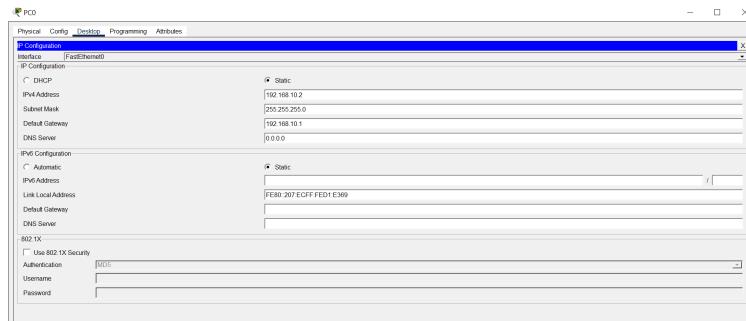


TP N° 3

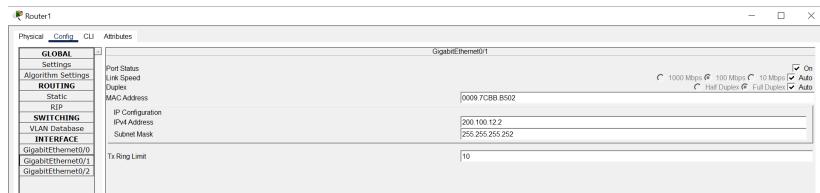
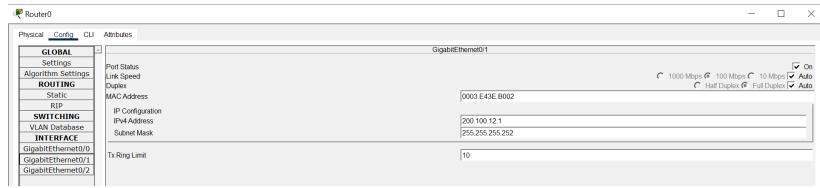
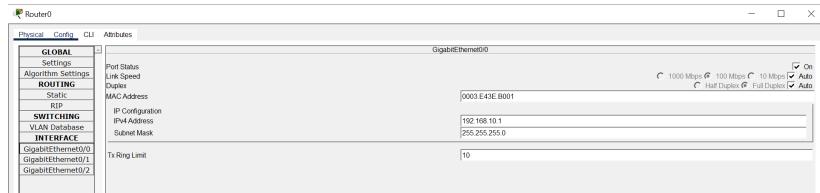
1. Réaliser la topologie suivante et configurer uniquement les adresses et gateway:



configuration Des PCs :



Configuration des routeurs :



Remarque

On a mis comme mask 255.255.255.252 dans le réseau 200.100.12.0/30 car la partie réseau prend 30 bits :

$$\underbrace{11111111}_{8 \text{bits}=255} \cdot \underbrace{11111111}_{8 \text{bits}=255} \cdot \underbrace{11111111}_{8 \text{bits}=255} \cdot \underbrace{11111100}_{6 \text{bits}=252}$$

2. Comment Configure OSPF?

OSPF

On a deux methodes :

- **Configuration Mode Routeur :**

- On doit etre au niveau 3 pour activer le protocole **OSPF** avec la commande :
`router ospf <id_processus>`
- Apres avoir executer la commande on passe au niveau 4.
- Pour ajouter une route dynamic on utilise la commande :
`network <reseau_connue> <mask_inverse> area <id_region>`
- Le masque inverse c'est prendre chaque partie du mask normal et lui soustraire 255 :
$$255.255.255.0 \Rightarrow (255 - 255).(255 - 255).(255 - 255).(255 - 0) \Rightarrow 0.0.0.255$$

- **Configuration Mode Interface :**

- On doit etre au niveau 3 pour acceder a une interface avec la commande :
`interface <noum_interface>`
- Apres avoir executer la commande on passe au niveau 4.
- Pour activer le protocole **OSPF** pour l'interface on utilise :
`ip ospf <id_processus> area <id_region>`

Remarque

- On peut faire une configuration **multi-regional** ou chaque region a une collection de routeurs pour **faciliter le managment**
- Dans notre cas simple on va utiliser une configuration **mono-regional** on va juste utiliser region id = 0 pour dire qu'on a **une seule region globale**.
- L'id processus permet d'executer plusieurs instances de l'**OSPF** sur le meme routeur.

3. Configurer l'OSPF sur le routeur 0 avec la premiere methode et afficher la table de routage :

The image contains two side-by-side screenshots of a Windows application window titled "Router0". The window has tabs at the top: "Physical", "Config", "CLI" (which is selected), and "Attributes". Below the tabs is a title bar "IOS Command Line Interface".

Screenshot 1 (Top): Configuration Phase

```

Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf
Router(config-router)#network 192.168.10.0 0.0.0.255 area 0
Router(config-router)#network 200.100.12.0 0.0.0.3 area 0
Router(config-router)#

```

Screenshot 2 (Bottom): Routing Table Phase

```

Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf
Router(config-router)#network 192.168.10.0 0.0.0.255 area 0
Router(config-router)#network 200.100.12.0 0.0.0.3 area 0
Router(config-router)#
001401251 OSPF(5-AD)NCG: Process 1, Nbr 200.100.12.1 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
Router(config-router)#show ip route
Codes: C - connected, S - static, 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
      o - ODR
      p - periodic downloaded static route
Gateway of last resort is not set
 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.10.0/24 is directly connected, GigabitEthernet0/0
L 192.168.10.0/24 [110/0] via 200.100.12.2, 0.0.0.0
o 192.168.20.0/24 [110/0] via 200.100.12.2, 0.0.0.0
 200.100.11.0/24 is variably subnetted, 2 subnets, 2 masks
C 200.100.11.0/24 is directly connected, GigabitEthernet0/1
L 200.100.12.0/32 is directly connected, GigabitEthernet0/1
Router(config-router)#

```

Both screenshots show the "Activate Window" button at the bottom right.

4. Configurer l'OSPF sur le routeur 1 avec la deuxieme methode et afficher la table de routage :

The image shows a single screenshot of a Windows application window titled "Router1". The window has tabs at the top: "Physical", "Config", "CLI" (selected), and "Attributes". Below the tabs is a title bar "IOS Command Line Interface".

Configuration Phase

```

Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf
Router(config-router)#area 0
Router(config-router)#interface g0/0
Router(config-router)#ip ospf 1 area 0
Router(config-router)#
001401251 OSPF(5-AD)NCG: Process 1, Nbr 200.100.12.1 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
Router(config)#interface g1/0

```

Routing Table Phase

```

Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf
Router(config-router)#area 0
Router(config-router)#interface g0/0
Router(config-router)#
001401251 OSPF(5-AD)NCG: Process 1, Nbr 200.100.12.1 on GigabitEthernet0/1 from LOADING to FULL, Loading Done
Router(config)#show ip route
Codes: C - connected, S - static, 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
      o - ODR
      p - periodic downloaded static route
Gateway of last resort is not set
 192.168.10.0/24 [110/0] via 200.100.12.1, 0.0.0.0, GigabitEthernet0/1
C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
L 192.168.20.1/32 is directly connected, GigabitEthernet0/0
 200.100.11.0/30 is directly connected, GigabitEthernet0/1
C 200.100.11.0/30 is directly connected, GigabitEthernet0/1
L 200.100.12.0/32 is directly connected, GigabitEthernet0/1
Router(config)#

```

The "Top" button is visible at the bottom left of the window.

5. C'est quoi la distance administrative et le cout de l'OSPF?

Distance Administrative & Cout

- Distance Administrative = 110.
- Le cout est calculer avec la bandwidth (capacité de transfert de données) des cables avec la formule suivant :

$$\sum_{i=1}^m \text{round} \left(\frac{\text{Reference Bandwidth}}{\text{interface}_i \text{ Bandwidth}} \right)$$

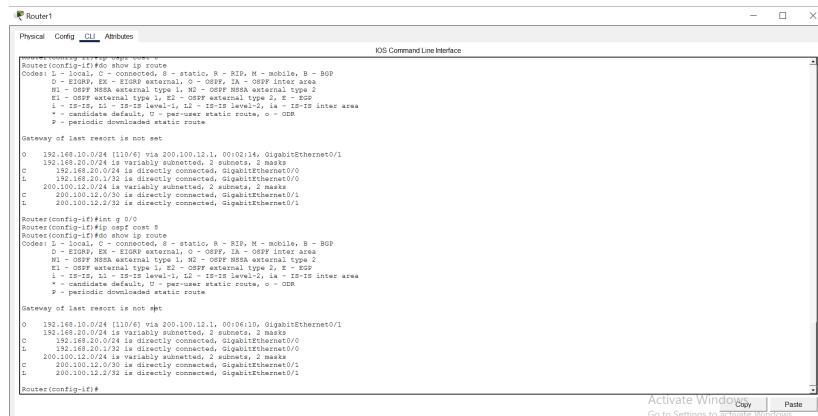
$$\text{round}(n) = \begin{cases} \text{if } n < 1 & : 1 \\ \text{if } n \in \mathbb{N} & : n \\ \text{if } n \in \mathbb{R} & : \text{Integer Part} + 1 \end{cases}$$

- m est le nombre d'interfaces émetteur pour atteindre la switch du réseau récepteur.
- Par défaut la référence bandwidth est de 100Mbps donc $100 \times 10^6 \text{ bps} = 10^8 \text{ bps}$.

6. changer le cout des interface g 0/0 des deux routeurs , afficher la table de routage expliquer le nouveau cout :

Changer Le Cout

Pour changer le cout on doit être au niveau 4 (conf interface) et on utilise la commande :
ip ospf cost <nouveau_cout>



```
Router1# show ip route
Codes: L - Local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF external, 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 - ECMP
       * - candidate default, U - per-user static route, o - ODR
       p - periodic downloaded static route

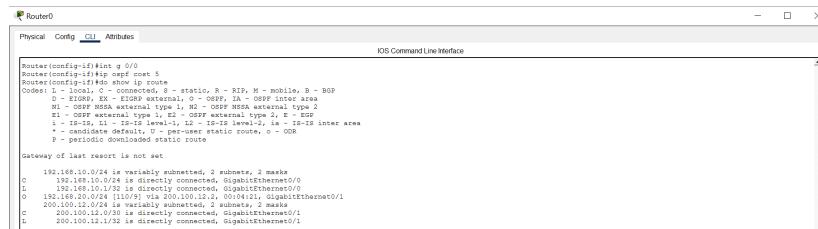
Gateway of last resort is not set

O 192.168.10.0/24 [110/0] via 200.100.11.1, 00:03:14, GigabitEthernet0/1
C 192.168.20.0/24 is directly connected, 2 subnets, 2 masks
C 192.168.20.0/24 is directly connected, GigabitEthernet0/0
L 200.100.11.0/24 is variably subnetted, 2 subnets, 2 masks
C 200.100.11.0/30 is directly connected, GigabitEthernet0/1
C 200.100.11.2/32 is directly connected, GigabitEthernet0/1

Router1# config t
Router1(config)# ip route 0.0.0.0 0.0.0.0 200.100.11.1
Router1(config)# exit
Router1# show ip route
Codes: L - Local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF external, 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 - ECMP
       * - candidate default, U - per-user static route, o - ODR
       p - periodic downloaded static route

Gateway of last resort is not set

O 192.168.10.0/24 [110/0] via 200.100.11.1, 00:04:10, GigabitEthernet0/1
C 192.168.20.0/24 is directly connected, 2 subnets, 2 masks
C 192.168.20.0/24 is directly connected, GigabitEthernet0/0
L 200.100.11.0/24 is variably subnetted, 2 subnets, 2 masks
C 200.100.11.0/30 is directly connected, GigabitEthernet0/1
C 200.100.11.2/32 is directly connected, GigabitEthernet0/1
Router1#
```



```
Router0# show ip route
Codes: L - Local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF external, 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 - ECMP
       * - candidate default, U - per-user static route, o - ODR
       p - periodic downloaded static route

Gateway of last resort is not set

O 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.10.0/24 is directly connected, GigabitEthernet0/0
C 192.168.10.0/24 is directly connected, 2 subnets, 2 masks
O 192.168.20.0/24 [110/0] via 200.100.12.2, 00:04:21, GigabitEthernet0/1
L 200.100.11.0/24 is variably subnetted, 2 subnets, 2 masks
C 200.100.11.0/30 is directly connected, GigabitEthernet0/1
C 200.100.11.2/32 is directly connected, GigabitEthernet0/1
Router0#
```

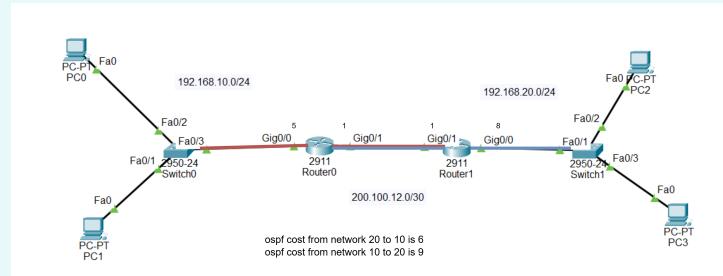
Nouveau Cout

- cout de la route vers 192.168.10.0 est :

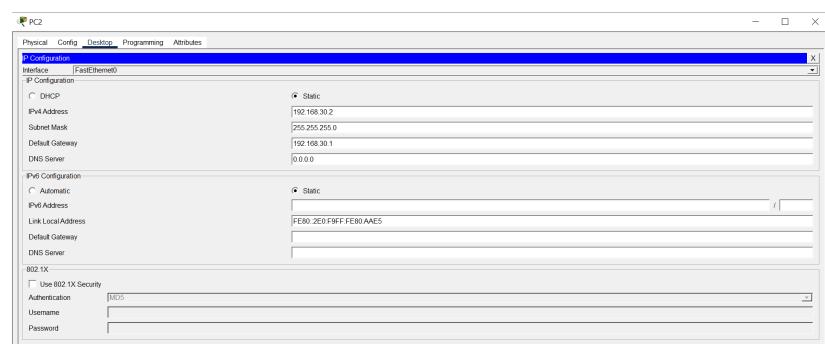
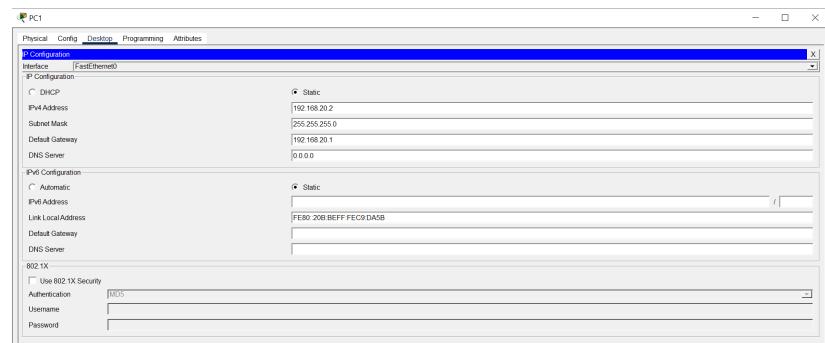
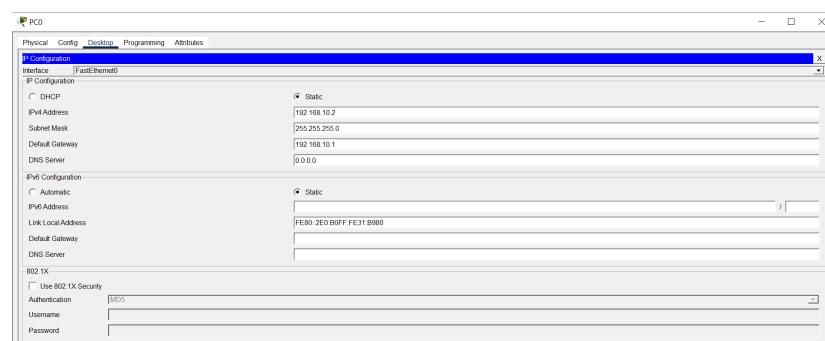
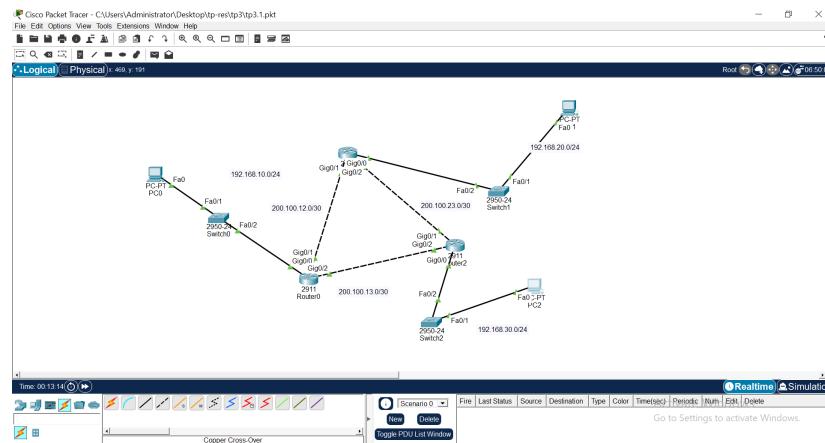
$$\begin{aligned}\text{cout}_{192.168.10.0} &= \text{cout}(g0/1_{\text{router } 1}) + \text{cout}(g0/0_{\text{router } 0}) \\ &= \text{round}\left(\frac{10^8 \text{bps}}{1 \text{Gbps}}\right) + 5 \\ &= \text{round}\left(\frac{10^8 \text{bps}}{10^9 \text{bps}}\right) + 5 \\ &= \text{round}(0.1) + 5 \\ &= 1 + 5 \\ &= \boxed{6}\end{aligned}$$

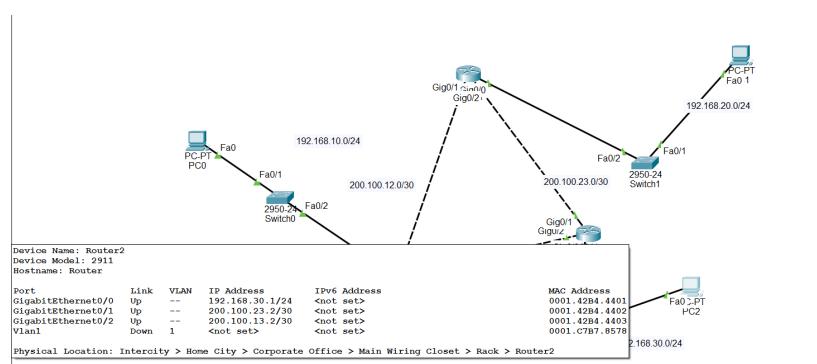
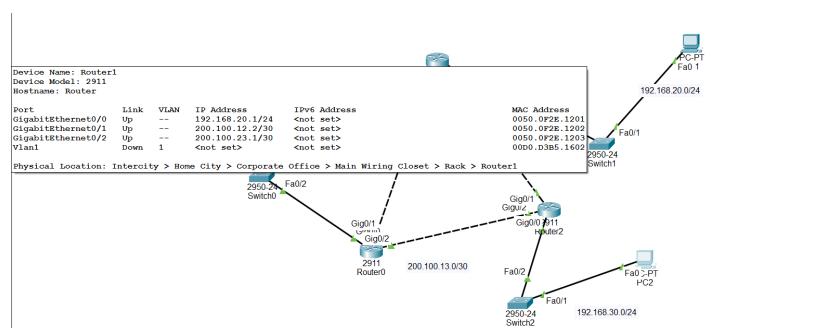
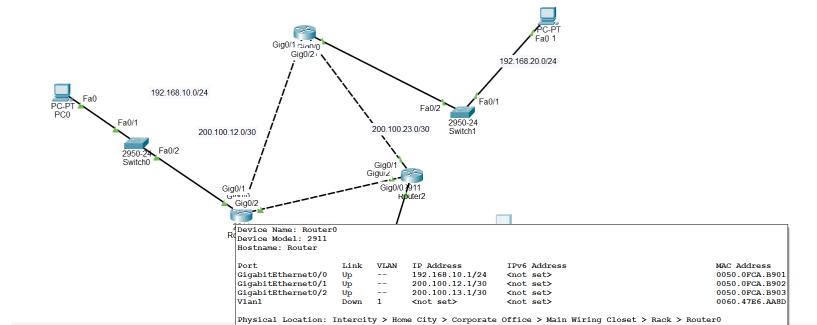
- cout de la route vers 192.168.20.0 est :

$$\begin{aligned}\text{cout}_{192.168.20.0} &= \text{cout}(g0/1_{\text{router } 0}) + \text{cout}(g0/0_{\text{router } 1}) \\ &= \text{round}\left(\frac{10^8 \text{bps}}{1 \text{Gbps}}\right) + 8 \\ &= \text{round}\left(\frac{10^8 \text{bps}}{10^9 \text{bps}}\right) + 8 \\ &= \text{round}(0.1) + 8 \\ &= 1 + 8 \\ &= \boxed{9}\end{aligned}$$



7. Faites la topologie suivante et configurer les adresses et les gateway :





8. configurer L'**OSPF** sur chaque routeur avec la deuxieme methode :

9. Afficher la table de routage de tout les routeurs :

```

Router0#show ip route
Gateway of last resort is not set

C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.10.0/24 is directly connected, GigabitEthernet0/0
C    192.168.20.0/24 [110/2] via 200.100.12.2, 00:05:18, GigabitEthernet0/1
O  192.168.20.0/24 [110/2] via 200.100.12.2, 00:05:18, GigabitEthernet0/1
O  192.168.20.0/24 [110/2] via 200.100.13.2, 00:04:32, GigabitEthernet0/2
  200.100.12.0/24 is Variably subnetted, 2 subnets, 2 masks
    C 200.100.12.0/24 is directly connected, GigabitEthernet0/0
    L 200.100.12.1/32 is directly connected, GigabitEthernet0/0
    C 200.100.13.0/24 is variably subnetted, 2 subnets, 2 masks
      C 200.100.13.0/24 is directly connected, GigabitEthernet0/1
      L 200.100.13.1/32 is directly connected, GigabitEthernet0/1
    O  200.100.13.0/30 [110/2] via 200.100.12.2, 00:04:32, gigabitethernet0/1
      [110/2] via 200.100.13.2, 00:04:32, gigabitethernet0/1

Router1#show ip route
Gateway of last resort is not set

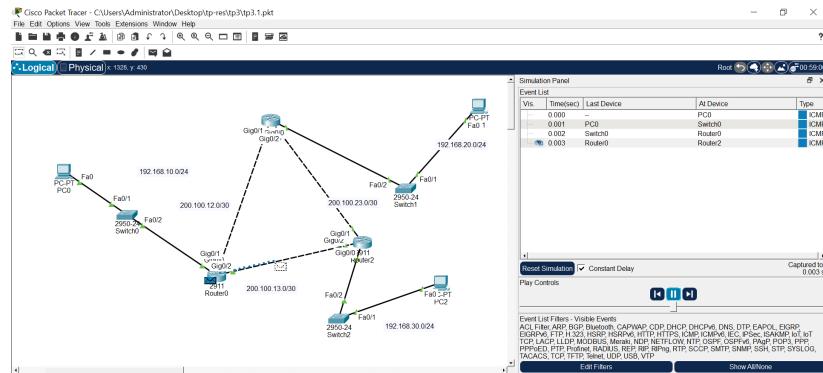
C 192.168.10.0/24 [110/2] via 200.100.12.1, 00:06:09, GigabitEthernet0/1
C 192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.20.0/24 is directly connected, GigabitEthernet0/0
C    192.168.20.0/24 [110/2] via 200.100.23.2, 00:05:06, GigabitEthernet0/2
  200.100.12.0/24 is Variably subnetted, 1 subnets
    O  200.100.12.0/24 [110/2] via 200.100.23.2, 00:05:06, GigabitEthernet0/2
C 200.100.13.0/24 is Variably subnetted, 2 subnets, 2 masks
  200.100.13.0/30 [110/2] via 200.100.23.2, 00:05:06, GigabitEthernet0/2
C 200.100.23.0/30 is directly connected, GigabitEthernet0/2
L  200.100.23.1/32 is directly connected, GigabitEthernet0/2

Router2#show ip route
Gateway of last resort is not set

C 192.168.10.0/24 [110/2] via 200.100.13.1, 00:09:52, GigabitEthernet0/1
O  192.168.10.0/24 [110/2] via 200.100.13.1, 00:09:52, GigabitEthernet0/1
C 192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.20.0/24 is directly connected, GigabitEthernet0/0
C    192.168.20.0/24 [110/2] via 200.100.13.1, 00:09:52, GigabitEthernet0/1
  200.100.12.0/30 is submitted, 1 subnets
    O  200.100.12.0/30 [110/2] via 200.100.13.1, 00:09:52, GigabitEthernet0/1
  200.100.12.0/24 is Variably subnetted, 2 subnets, 2 masks
    C 200.100.12.0/24 is directly connected, GigabitEthernet0/2
    C 200.100.12.0/24 is directly connected, GigabitEthernet0/2
  200.100.13.0/24 is Variably subnetted, 2 subnets, 2 masks
    C 200.100.13.0/24 is directly connected, GigabitEthernet0/1
    C 200.100.13.0/24 is directly connected, GigabitEthernet0/1
  200.100.21.0/30 is submitted, 1 subnets
    O  200.100.21.0/30 [110/2] via 200.100.13.1, 00:09:52, GigabitEthernet0/1
  200.100.21.0/24 is Variably subnetted, 2 subnets, 2 masks
    C 200.100.21.0/24 is directly connected, GigabitEthernet0/2
    C 200.100.21.0/24 is directly connected, GigabitEthernet0/2
  200.100.23.0/32 is directly connected, GigabitEthernet0/1

```

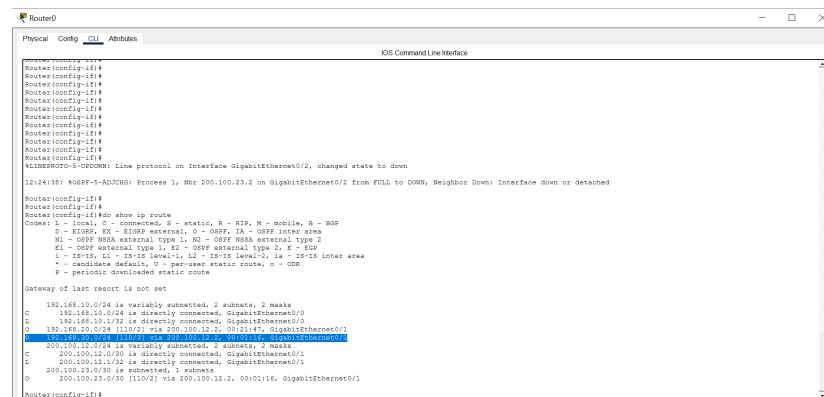
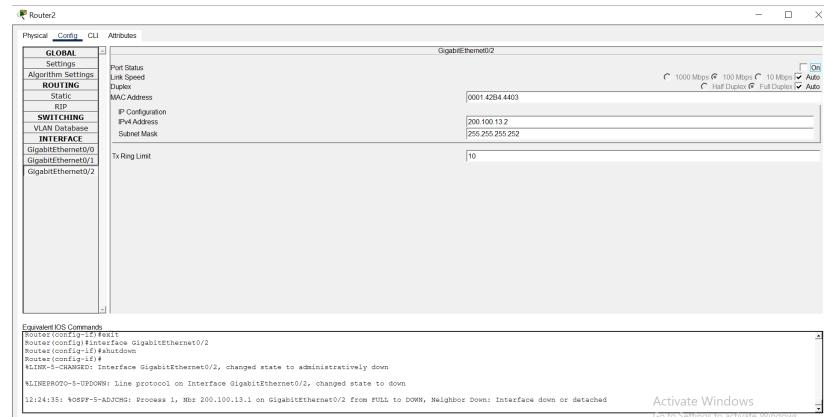
10. Faite un ping en simulation depuis le PC0 au PC1:



Remarque

On remarque que le routeur préfère passer directement par le routeur 2 (cout OSPF = 2) au lieu de passer par le routeur 1 puis le routeur 2 (cout OSPF = 3).

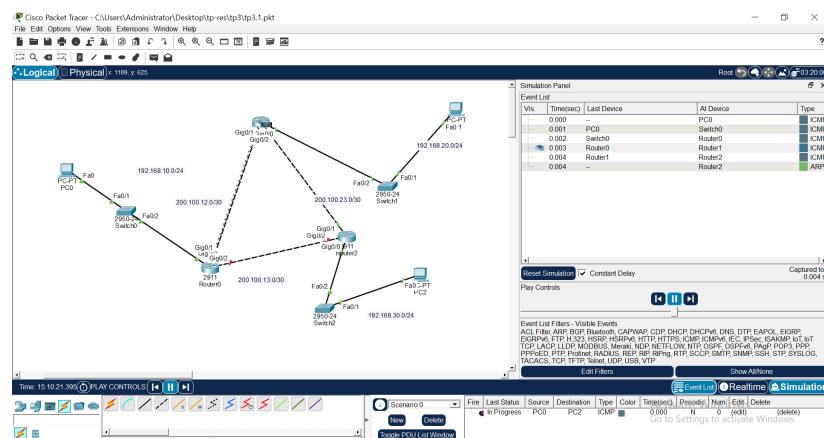
11. Desactiver l'interface g0/2 du routeur 2 pour simuler une panne puis affiche la table de routage du routeur 1:



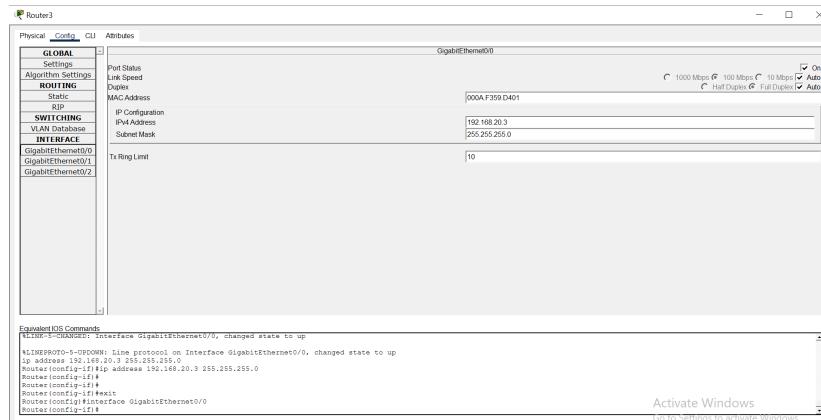
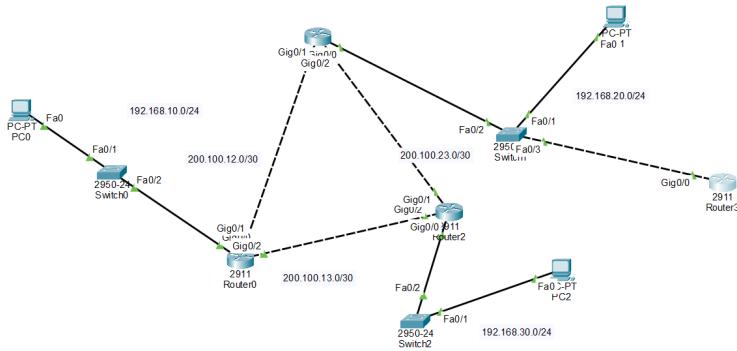
Remarque

Puisque l'interface reliant le routeur 2 au 0 n'est plus fonctionnelle , **OSPF** a dynamiquement mis à jour la route vers 192.168.30.0 du routeur 0 pour qu'il passe par le routeur 1 et le cout deviendra 3.

12. Refaire le ping en simulation :



13. Ajouter un routeur et configurer son adresse :

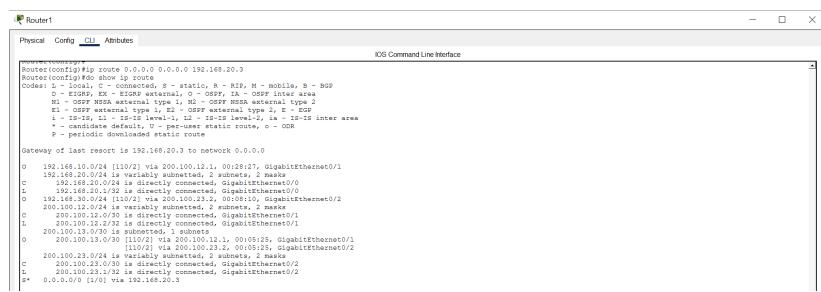


14. Le routeur 3 qu'on a ajouter est un routeur provider donc il ya des possibilite et combinaison infini d'adresse ip venant depuis ce routeur comment alors on va configurer cette route ?

0.0.0.0

On va utiliser un routage static et on dit que l'adresse et mask du réseau inconnu est 0.0.0.0 signifiant n'importe quelle réseau qui ne figurent pas dans la table de routage du routeur, elle est appellée la **route par défaut**.

15. Configure la route static dans le routeur 1 :



16. Est-ce qu'on va configurer la **route par defaut** sur tout les autre routeurs? Ou peut on propager cette route automatiquement au routeurs?

Propagation

- OSPF nous permet de propager une **route par defaut** definit sur un routeur au autre routeurs voisin.
- On doit etre au niveau 4 **OSPF** avec la commande :

```
router ospf <id_processus>
```
- On utilise cette commande pour propager la **route par defaut** :

```
default-information originate
```



```
Router1#show ip route
Codes: C - connected, S - static, 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
      i - IS-IS level-1, L1 - IS-IS level-2, L2 - IS-IS inter area
      * - candidate default, + - local static route, o - OSPF
      p - periodic downloaded static route

Gateway of last resort is 200.100.12.2 to network 0.0.0.0

C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
   D 192.168.10.0/24 is directly connected, GigabitEthernet0/0
   L 192.168.10.0/24 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
o 192.168.20.0/24 [110/2] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
o 192.168.30.0/24 [110/2] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/2
o 200.100.10.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.10.0/30 is directly connected, GigabitEthernet0/1
   L 200.100.10.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
   200.100.13.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.13.0/30 is directly connected, GigabitEthernet0/2
   L 200.100.13.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/2
o 200.100.23.0/24 is variably subnetted, 1 subnets
   C 200.100.23.0/30 is directly connected, GigabitEthernet0/1
   L 200.100.23.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
```

17. Afficher la table de routage des deux autre routeur pour s'assure que la **route par defaut** c'est propage :



```
Router0#show ip route
Codes: C - connected, S - static, 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
      i - IS-IS level-1, L1 - IS-IS level-2, L2 - IS-IS inter area
      * - candidate default, + - local static route, o - OSPF
      p - periodic downloaded static route

Gateway of last resort is 200.100.12.2 to network 0.0.0.0

C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
   D 192.168.10.0/24 is directly connected, GigabitEthernet0/0
   L 192.168.10.0/24 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
o 192.168.20.0/24 [110/2] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
o 192.168.30.0/24 [110/2] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/2
o 200.100.10.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.10.0/30 is directly connected, GigabitEthernet0/1
   L 200.100.10.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
   200.100.13.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.13.0/30 is directly connected, GigabitEthernet0/2
   L 200.100.13.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/2
o 200.100.23.0/24 is variably subnetted, 1 subnets
   C 200.100.23.0/30 is directly connected, GigabitEthernet0/1
   L 200.100.23.0/30 [110/0] via 200.100.12.2, 00:01:01:55, GigabitEthernet0/1
```



```
Router1#show ip route
Codes: C - connected, S - static, 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
      i - IS-IS level-1, L1 - IS-IS level-2, L2 - IS-IS inter area
      * - candidate default, + - local static route, o - OSPF
      p - periodic downloaded static route

Gateway of last resort is 200.100.12.2 to network 0.0.0.0

C 192.168.10.0/24 [110/2] via 200.100.13.1, 00:01:01:52
o 192.168.20.0/24 [110/2] via 200.100.23.1, 00:01:01:51, GigabitEthernet0/1
o 192.168.30.0/24 [110/2] via 200.100.23.1, 00:01:01:51, GigabitEthernet0/2
o 192.168.10.0/24 is directly connected, GigabitEthernet0/0
L 192.168.10.0/24 [110/0] via 200.100.13.1, 00:01:01:52, GigabitEthernet0/0
   200.100.10.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.10.0/30 is directly connected, GigabitEthernet0/0
   L 200.100.10.0/30 [110/0] via 200.100.13.1, 00:01:01:52, GigabitEthernet0/0
   200.100.13.0/24 is variably subnetted, 2 subnets, 2 masks
   C 200.100.13.0/30 is directly connected, GigabitEthernet0/0
   L 200.100.13.0/30 [110/0] via 200.100.13.1, 00:01:01:52, GigabitEthernet0/0
o 200.100.23.0/24 is variably subnetted, 1 subnets
   C 200.100.23.0/30 is directly connected, GigabitEthernet0/0
   L 200.100.23.0/30 [110/0] via 200.100.13.1, 00:01:01:52, GigabitEthernet0/0
```