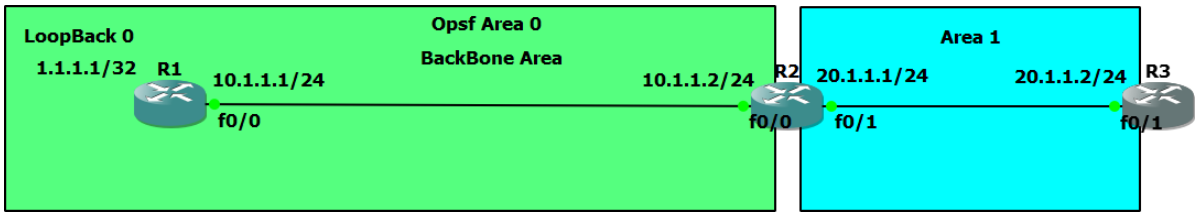
Create the physical topology in GNS3 as shown in the image below :



Step 2: Configure the IPv4 address on the physical interface on the routers :

On R1 :

```
R1(config)#int f0/0
R1(config-if)#ip
R1(config-if)#ip addr
R1(config-if)#ip address 10.1.1.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#exit
```

R1(config)#interface FastEthernet0/0

R1(config-if)#ip address 10.1.1.1

255.255.255.0 On R2 :

```
R2(config)#int f0/0
R2(config-if)#ip addr
R2(config-if)#ip address 10.1.1.2 255.255.255.0
R2(config-if)#no shut
R2(config-if)#exit
```

R2(config)#interface FastEthernet0/0

R2(config-if)#ip address 10.1.1.2 255.255.255.0

```
R2(config)#int f0/1
R2(config-if)#ip addr
R2(config-if)#ip address 20.1.1.1 255.255.255.0
R2(config-if)#no shut
R2(config-if)#exit
```

R2(config-if)#interface FastEthernet1/0

R2(config-if)#ip address 20.1.1.1

255.255.255.0 On R3 :

```
R3(config)#int f0/1
R3(config-if)#ip addtr
R3(config-if)#ip addr
R3(config-if)#ip address 20.1.1.2 255.255.255.0
R3(config-if)#no shut
R3(config-if)#exit
```

R3(config)#interface FastEthernet1/0

R3(config-if)#ip address 20.1.1.2 255.255.255.0

Step 3: Configure a loopback interface on R1 with an IPv4 address :

R1(config)#interface Loopback0

R1(config-if)#ip address 1.1.1.1 255.255.255.255

```
R1(config)#int loo
R1(config)#int loopback 0
R1(config-if)#ip addre
*Mar  1 00:00:49.523: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R1(config-if)#ip address 1.1.1.1 255.255.255.255
R1(config-if)#no shut
R1(config-if)#exit
```

Step 4: Configuring the OSPF process on all three routers with the command router OSPF <process-id> :

```
R1(config)#router ospf 1
```

```
R1(config-if)#exit
```

R1(config)#router

ospf 1

R1(config-router)#e

xit

```
R2(config)#router ospf 1
R2(config-router)#exit
```

R2(config)#router

ospf 1

R2(config-router)#e

xit

```
R3(config)#router ospf 1
R3(config-router)#exit
```

R3(config)#router

ospf 1

R3(config-router)#e

xit

Step 5: Enabling OSPF on the interfaces with the interface level sub-command IP OSPF <process-id> area <area-id> :

```
R1(config)#int loopback 0
R1(config-if)#ip ospf 1 area 0
R1(config-if)#
*Mar  1 00:10:22.455: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R1(config-if)#int f0/0
R1(config-if)#ip ospf 1 area 0
R1(config-if)#no shut
```

R1(config)#interface

FastEthernet0/0 R1(config-if)#ip

ospf 1 area 0

R1(config)#interface

Loopback0 R1(config-if)#ip

ospf 1 area 0

```
R2(config)#int f0/0
R2(config-if)#ip ospf 1 area 0
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#
*Mar  1 00:08:32.391: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R2(config)#int f0/1
R2(config-if)#ip ospf 1 area 1
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#
*Mar  1 00:10:49.687: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.2 on FastEthernet0/1 from LOADING to FULL, Loading Done
```

R2(config)#interface

FastEthernet0/0 R2(config-if)#ip

ospf 1 area 0

R2(config-if)#interface

FastEthernet1/0 R2(config-if)#ip

ospf 1 area 1

```
R3(config)#int f0/1
R3(config-if)#ip ospf 1 area 1
R3(config-if)#no shut
R3(config-if)#exit
R3(config)#
*Mar  1 00:10:19.735: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
```

R3(config)#interface

FastEthernet1/0 R3(config-if)#ip

ospf 1 area 1

Step 6: Configuring area 2 as a stub area with the router sub-command area <area-id> stub

```
R2(config)#router ospf 1
R2(config-router)#area 1 stub
R2(config-router)#
*Mar  1 00:11:59.735: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.2 on FastEthernet0/1 from FULL to DOWN, Neighbor Down: Adjacency forced to reset
R2(config-router)#exit
R2(config)#
*Mar  1 00:12:30.367: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.2 on FastEthernet0/1 from LOADING to FULL, Loading Done
```

R2(config)#router ospf 1

R2(config-router)#area 1

stub

R2(config-router)#exit

```
R3(config)#router ospf 1
R3(config-router)#area 1 stub
R3(config-router)#
*Mar  1 00:11:59.971: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.1 on FastEthernet0/1 from FULL to DOWN, Neighbor Down: Adjacency forced to reset
*Mar  1 00:12:00.415: %OSPF-5-ADJCHG: Process 1, Nbr 20.1.1.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
```

```
R3(config-router)#exit
```

R3(config)#router ospf 1

R3(config-router)#area 1

stub

R3(config-router)#exit

Step 7: Verifying OSPF configuration on the routers :

R1#show ip protocol

```
R1(config)#do show ip protocol
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
  Routing on Interfaces Configured Explicitly (Area 0):
    Loopback0
    FastEthernet0/0
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    20.1.1.1             110      00:03:11
  Distance: (default is 110)
```

R2#show ip protocol

```
R2(config)#do show ip protocol
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 20.1.1.1
  It is an area border router
  Number of areas in this router is 2. 1 normal 1 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
  Routing on Interfaces Configured Explicitly (Area 0):
    FastEthernet0/0
  Routing on Interfaces Configured Explicitly (Area 1):
    FastEthernet0/1
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.1              110      00:01:07
  Distance: (default is 110)
```

R3#show ip protocol

```
R3(config)#do show ip protocol
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 20.1.1.2
  Number of areas in this router is 1. 0 normal 1 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
  Routing on Interfaces Configured Explicitly (Area 1):
    FastEthernet0/1
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    20.1.1.1             110      00:00:39
  Distance: (default is 110)
```

Step 8: Checking the IPv4 routing table on the routers and seeing OSPF route entry :

R1#show ip route

```
R1(config)#do 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, su - IS-IS summary, 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

     1.0.0.0/32 is subnetted, 1 subnets
C       1.1.1.1 is directly connected, Loopback0
     20.0.0.0/24 is subnetted, 1 subnets
O IA    20.1.1.0 [110/20] via 10.1.1.2, 00:04:21, FastEthernet0/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
```

R2#show ip route

```
R2(config)#do 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, su - IS-IS summary, 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

     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/11] via 10.1.1.1, 00:02:47, FastEthernet0/0
     20.0.0.0/24 is subnetted, 1 subnets
C       20.1.1.0 is directly connected, FastEthernet0/1
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
```

R3#show ip route

```
R3(config)#do 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, su - IS-IS summary, 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 20.1.1.1 to network 0.0.0.0

     1.0.0.0/32 is subnetted, 1 subnets
O IA    1.1.1.1 [110/21] via 20.1.1.1, 00:02:18, FastEthernet0/1
     20.0.0.0/24 is subnetted, 1 subnets
C       20.1.1.0 is directly connected, FastEthernet0/1
     10.0.0.0/24 is subnetted, 1 subnets
O IA    10.1.1.0 [110/20] via 20.1.1.1, 00:02:18, FastEthernet0/1
O*IA 0.0.0.0/0 [110/11] via 20.1.1.1, 00:02:18, FastEthernet0/1
```