Catalog

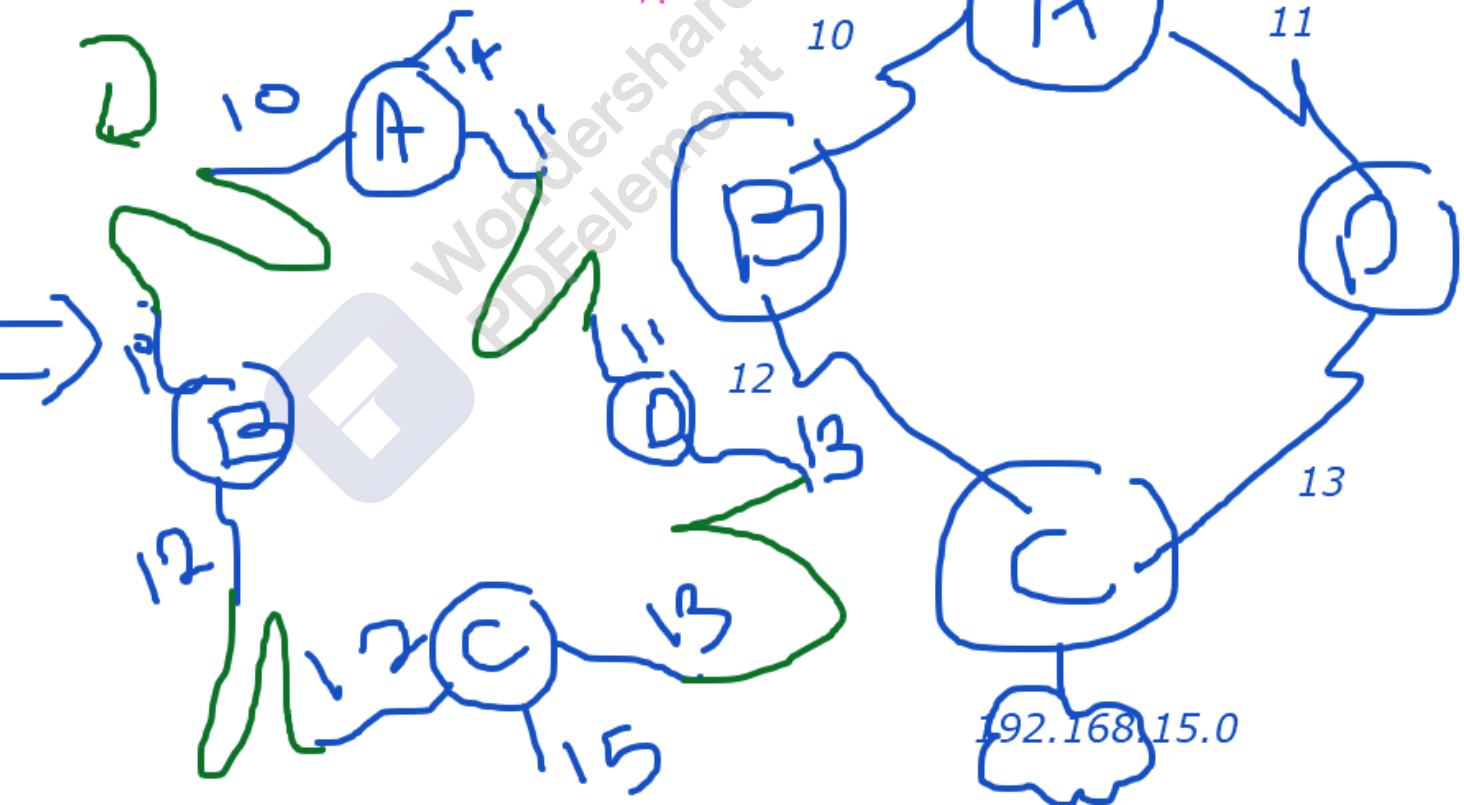
Link State Routing Protocol
OSPS

Link State means the router will advertise Link state advertisement (Not routing table) for all routers at the same AS .

Link State Database of R_A

A	10 up 11 up 14 up
B	10 up 12 up
C	12 up 13 up 15 up
D	11 up 13 up

Link State Tree of R_A



What is OSPF Router ID ?

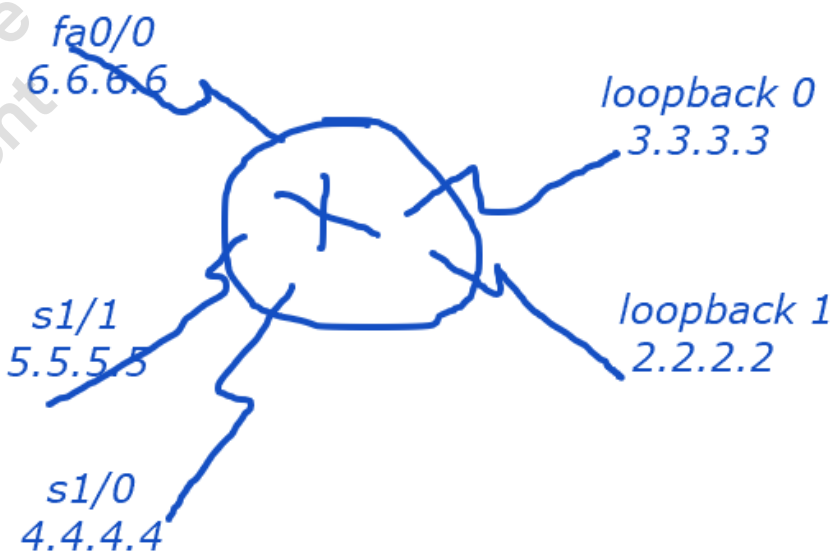
1-Manually Configured

```
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
```

2-Highest ip which is assigned for logical interface

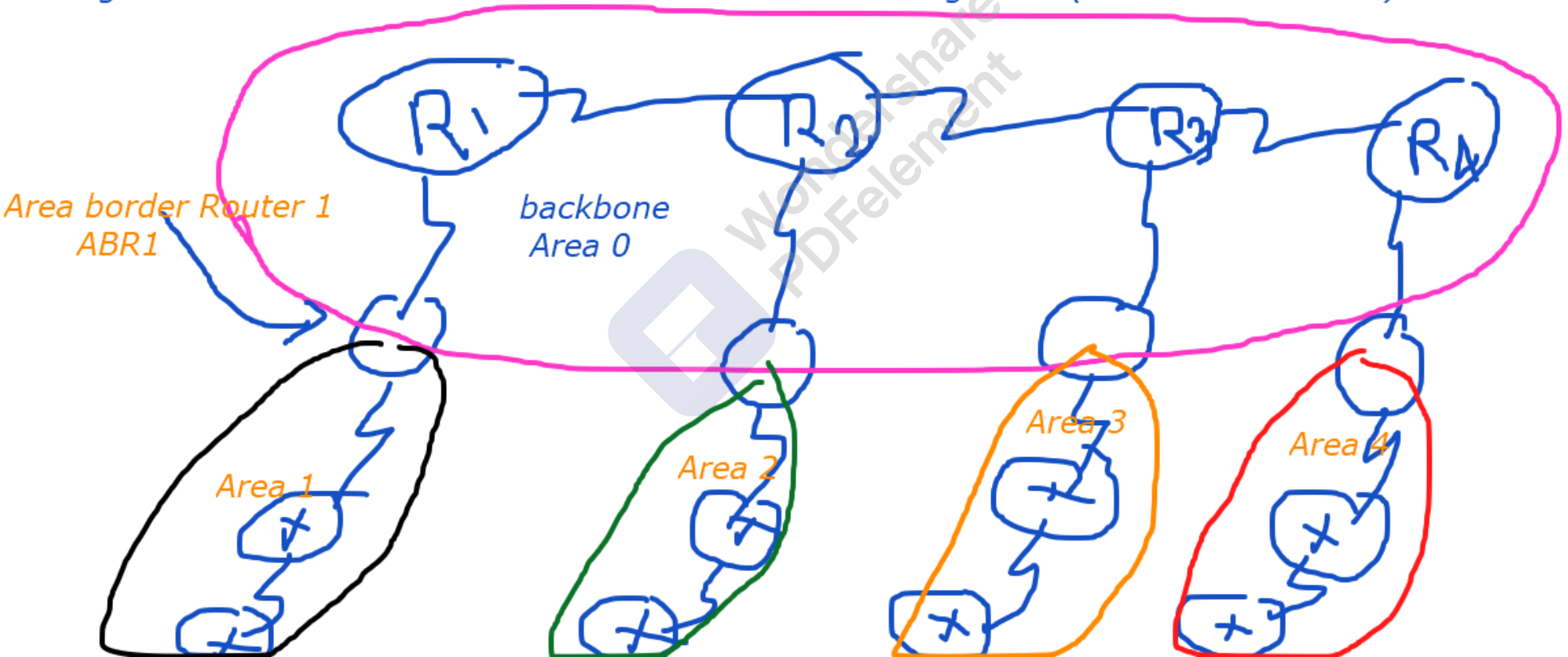
```
R(config)#interface loopback 0
R(config-if)#ip address  2.2.2.2 255.255.255.0
```

3-Highest ip which is assigned for physical interface



- OSPF would support unlimited number of router and so it will use Area concept which is used to regulate and restrict LSA's propagation through OSPF AS .

-Area concepet is number from 0 to 255 . Area 0 is called the backbone Area and Area 1,2,3,.....etc is called regular area which is connected to backbone Area through ABR (Area border Router)



OSPF Processing

1-Startup state

a)Neighbor discovery

ospf interface would send hello packet included (Area id , hello interval , dead interval , Authentication method)with interface source ip and destination multicast 224.0.0.5

b)Link state update Exchange

1-Lsupdate packet
2-Ack packet

2-Convergence state

OSPF interface still send hellp packet to establish neighbor relationship

OSPF neighbor must have
1-The same hello interval
2-The same dead interval
3-The same area ID
4-The same authentication

3-Update state

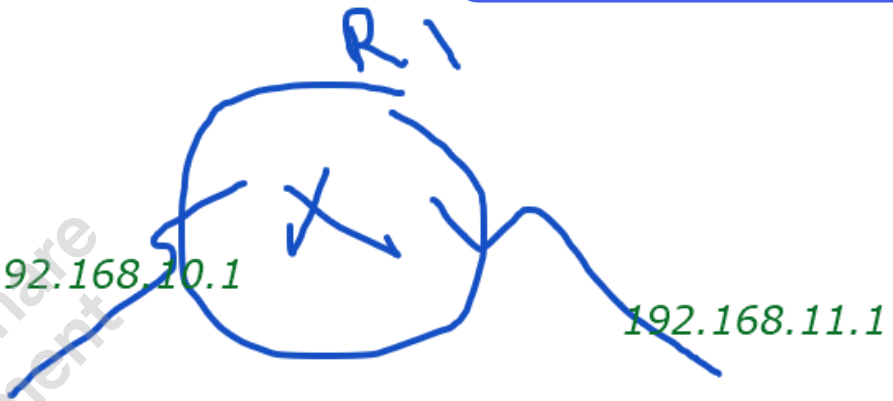
1-LSupdate
2-ACK

OSPF configuration

process id which is number from 1 to 65535

```
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1

R1(config -router)#network 192.168.10.1 0.0.0.0 Area 0
R1(config-router)#network 192.168.11.1 0.0.0.0 Area 0
```



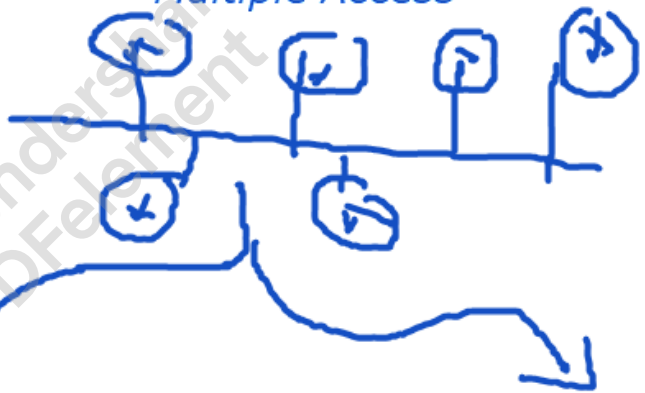
network 192.168.0.0 0.255.255.255 area 0

OSPF Topology

Point to Point

(By default on Cisco Serial Interface)

Multiple Access



Broadcast MA

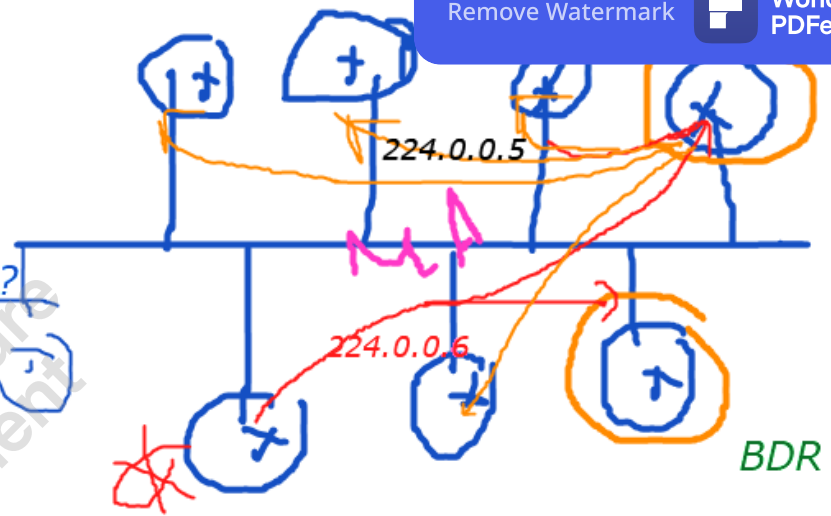
(by default on Cisco ethernet interface)

None Broadcas Multiple Access (NBMA)

(By configuration on cisco Serial int)

What is the behavior of the OSPF at Multiple Access ?

Any OSPF updates will be send To DR and BDR as multicast 224.0.0.6 , after tahr DR or BDR will send this OSPF updates for all OSPF routers at this MA region



How do the ospf routers elect DR and BDR at Multiple Access ?

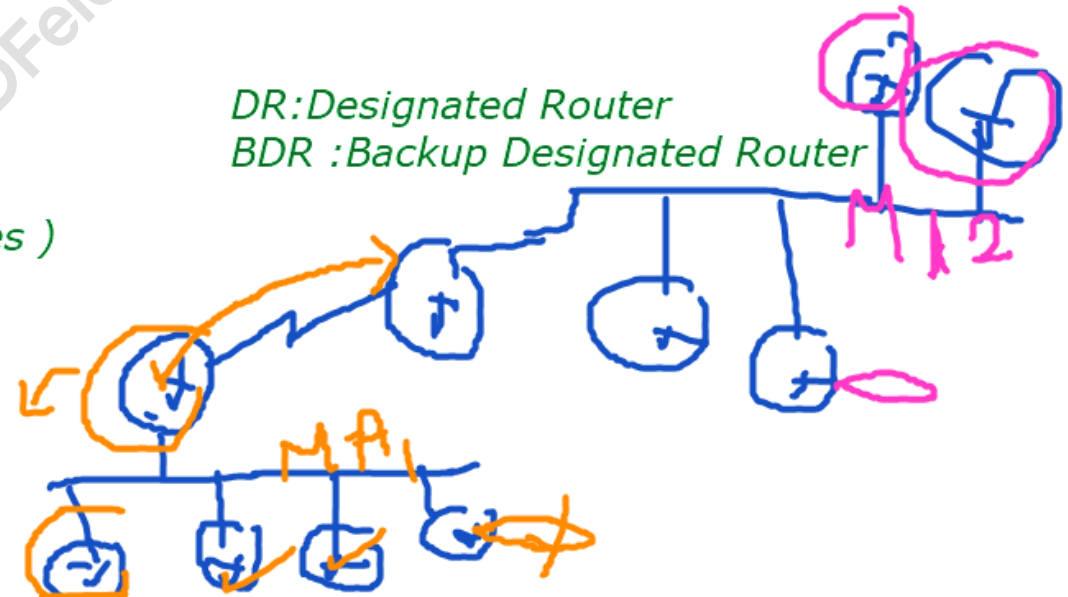
1-It is the router with highest priority

The priority is a value from 0 to 255 which is assigned for OSPF interface
By default this Value is 0 at point to point and 1 at multiple Access
By configuration

```
R(config)#interface fa0/0
R(config-if)#ip ospf priority 15
```

2-It is the router with highest Router ID

R#clear ip ospf process (to refresh ospf updates)



R#sh ip ospf database

LSA Types

1-LSA type 1 which is list of all router ID at the same area

Router link State → O

2-LSA type 2 which is advertised from DR router at MA region to inform all routers at this MA "Iam DR"

Network Link State

3-LSA type 3 which is advertised from ABR to inform its regular area about the network from different Area

Summary network link state → O I A

4-LSA type 4 which is advertised from ABR to inform its regular area about "who is ASBR " in case this regual area has not ASBR

Summary ASB link State

5-LSA type 5 which is advertised from ASBR to inform all routers at OSPF AS aboute the network from External AS

Type 5 AS external → O E

6-LSA type 7 which appears only at NSSA area → O N

Area Types

Area is number from 0 to 255 which is used to regulate and restrict LSA's propagtion through OSPF AS
Area 0 is called Backbone Area and Area 1 , 2 ,3 ,.....etc is called regular area
Area 0 must be ordinary area which permit all link state types and the regular area's are ordinary by default
Regular area my be changed from ordinary area to none ordinary area (regular Area types)

1-Stub area

This Area type is isolated externally (LSA type 5 prevention)but not isolated internally (LSA type 3 allowing) .It replaces all OE network with default route toward ABR (O*IA)

Stub Area configuration
At all router of this arae including the ABR type the following

```
R2(config)#router ospf 1
R2(config-router)#area 20 stub
```

```
R4(config)#router ospf 1
R4(config-router)#area 20 stub
```

2-Total stub area

This Area types is isolated externally (LSA type 5 prevention)and also isolated internally (LSA type 3 prevention) . it will replace all OE and OIA with default route towards the ABR (O*IA)

Totally stub area configuration : At all routers of this area except the ABR type R5(config-router)#area 30 stub
At ABR router of this Area type the following R3(config-router)#area 30 stub no-summary

3-Not So Totally Stub (NSSA)

This Area types is isolated internally (LSA type 3 prevention)and no isolated externally but all LSA type 5 will be replaced by LSA type 7 which resuilt in appearing ON network not OE network at this area , It replaces all OIA route with default route toward the ABR (O*IA)

NSSA area configuration : At all routers of this area except the ABR type the following R2(config-router)#area 20 NSSA
At ABR router of this Area type the following R1(config-router)#area 20 NSSA no-summary

OSPF Summarization

1-Area Summarization

The ABR will advertise summary about all network at its regular area for all other areas at the OSPF AS .This is as soon as possible

```
R2(config)#router ospf 1
R2(config-router)#area 20 range 20.1.0.0 255.255.252.0
```

2-AS Summarization

The ASBR will advertise summary about all network from external AS for internal OSPF AS . This is as soon as posible

```
ASBR(config)#router ospf 1
ASBR(config-router)#summary-address 70.1.0.0 255.255.252.0
```

OSPF Configuration CLI

```
R1(config)#router ospf process-id [1 to 65235]
R1(config-router)#Router-ID  1.1.1.1
R1(config-Router)#network net-id wildcard Area areaID
R1#sh ip route
R1#sh ip ospf database \*to show LSA types*\
R1#sh ip ospf neighbor
R1(config-if)#ip ospf hello-interval 20
R1(config-if)#ip ospf Dead-interval 80
R1(config-if)#ip ospf priority [ 0 to 255]
R1(config-if)#ip ospf process-id  Area 0
R1(config-if)#ip ospf network point-to point \* on loopback interface to advertise it as /24
ABR(config-router)#area 20 range 20.1.0.0 255.255.252.0    \*Area summarization*\
ASBR(config-router)#summary-address 70.1.0.0 255.255.252.0  \* AS summarization for external network *\
R1(config-route )#default-information originate    \*to advertise default route and it will appear at diff router as O*E

ASBR(config)#router ospf 1
ASBR(config-router)#redistribute RIP subnet  metric 50 metric-type 1
```

→ To distribute RIP in OSPF with seed value 50 and type 1

```
R1(config-route)#Area 20 stub
ABR(R1Iconfig-route)#Area 20 stub no-summary
```

→ totally stub Area configuration

```
R1(config-router)#Area 20 NSSA
ABR (config-router)#Area 20 NSSA no-summary
```

→ NSSA Area configuration

```
R1#sh ip protocol
```

```
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
R1(config-router)#network  10.1.1.1 0.0.0.0 Area 0
```

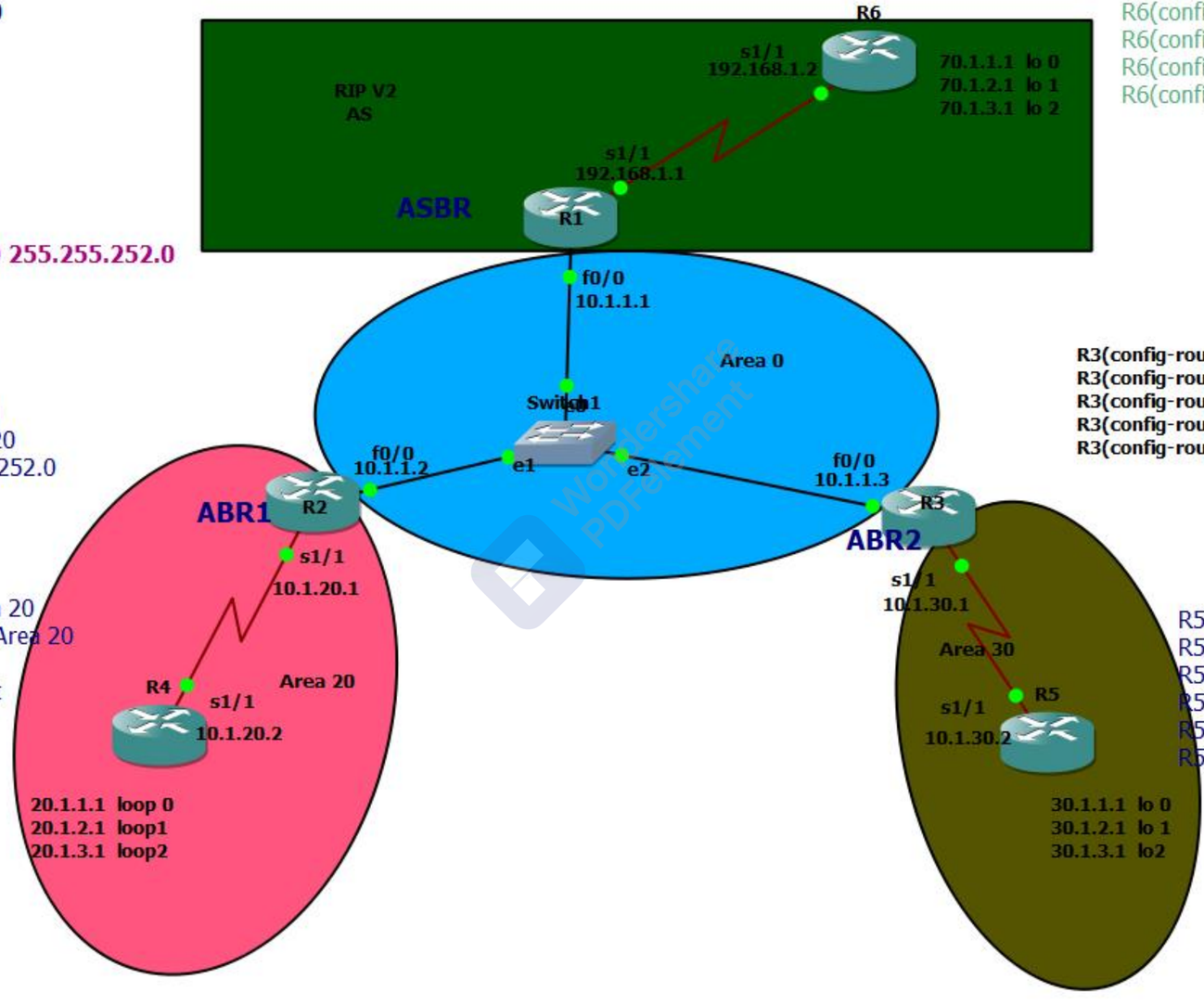
```
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#no auto-summary
R1(config -router)#network 192.168.1.0
```

```
R1(config)#router ospf 1
R1(config-router)#redistribute rip subnet
```

```
R1(config-router)#summary-address 70.1.0.0 255.255.252.0
```

```
R2(config)#router ospf 1
R2(config-router)#router-id 2.2.2.2
R2(config-router)#network 10.1.1.2  0.0.0.0 Area 0
R2(config-router)#network 10.1.20.1 0.0.0.0 Area 20
R2(config-router)#Area 20 range 20.1.0.0 255.255.252.0
```

```
R4(config)#router ospf 1
R4(config-router)#router-id 4.4.4.4
R4(config-router)#network 10.1.20.2  0.0.0.0 Area 20
R4(config-router)#network 20.1.0.0. 0.0.255.255 Area 20
R4(config)#interface range loopback 0 - 2
R4(config-range-if)#ip ospf network point -to-point
```




```
R6(config)#router rip
R6(config-router)#version 2
R6(config-router)#no auto-summary
R6(config -router)#network 192.168.1.0
R6(config-router)#network 70.0.0.0
```

```
R3(config-router)#router ospf 1
R3(config-router)#router-id 3.3.3.3
R3(config-router)#network 10.1.1.3 0.0.0.0 area 0
R3(config-router)#network 10.1.30.1 0.0.0.0 area 30
R3(config-router)#area 30 range 30.1.0.0  255.255.252.0
```

```
R5(config)#router ospf 1
R5(config-router)#router-id 5.5.5.5
R5(config-router)#network 10.1.30.2  0.0.0.0 Area 30
R5(config-router)#network 30.1.0.0. 0.0.255.255 Area 30
R5(config)#interface range loopback 0 - 2
R5(config-range-if)#ip ospf network point-to-point
```

OSPF Properties

1-It is Open Standard not specific vendor .

2-It uses Link state algorithm to build its routing table .

3-AD value is 110

4-Metric is $\frac{10^8}{\text{Bandwidth}}$

5-It is Classless Routing protocol

6-Updating Address is 224.0.0.5 and it uses 224.0.0.6 to send the updates to DR and BDR at mutiple Access .

7-It supports the Equal Load sharing (by default the max pathes is 4 and by config is 6 pathes)

8-Max hop count at OSPF is unlimited and so it uses Area concept .

9-Area ID is number from 0 to 255 which is used to regulate and restrict the LSA's propagation .

10-Area 0 is called backbone Area and Area 1, 2 , 3, ...etc is called Regular Area .

11-Regualr Area must be connected to backbone Area through ABR Router of this Area

12-Regular area by default is ordinary area and by configuraion may be

1-Stub (which prevents Type 5 LSA and replace all OE with O*IA)

At all router of this Area included the ABR R(config-router)#area 20 stub

2-Totally Stub (which prevents LSA Type 5 and Type 3 and replaces all OE and OIA with O*IA)

At all router of this Area except the ABR type the following R(config-router)#area 30 stub (to prevent LSA type 5)

At ABR router R(config-router)#area 30 stub no-summary (tp prevent LSA type 3)

3-NSSA (which prevent LSA type 3 and allow type 7 and replaces all OIA with O*IA)

At all routers of this Area except the ABR type the followings R(config-router)#area 20 NSSA
At ABR router of rhis AREA R(config-router)#Area 20 NSSA no-summary

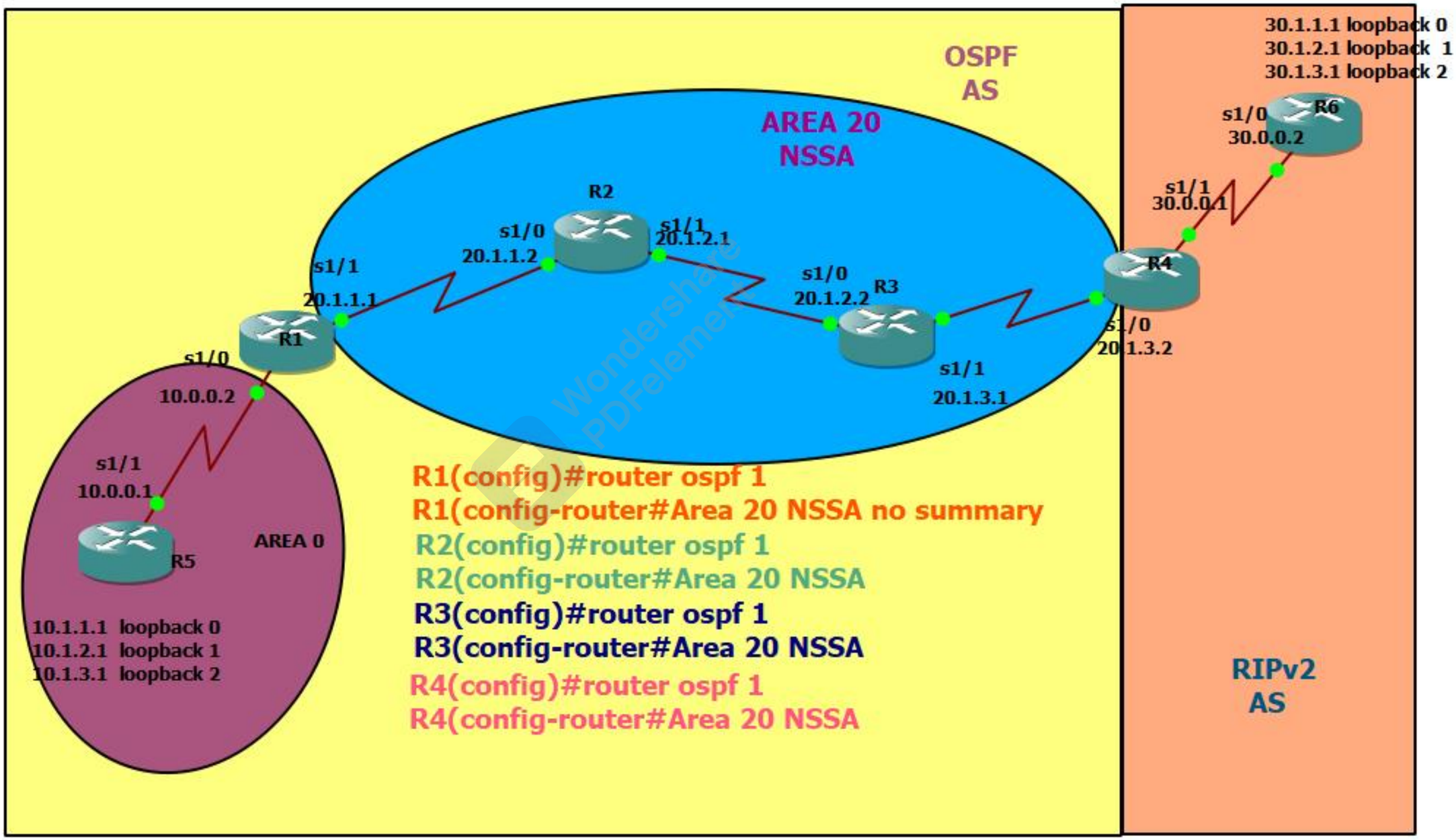
13-OSPF neighbor must be the same of all hello protocol packet attributes

a)hello interval (by default is 10 sec and by configuration R(config-if)#ip ospf hello-interval 15
b)dead interval (by default is 40 sec and by configuration R(config-if)#ip ospf dead-interval 60)
c)Area ID R(config-router)#network 192.168.1.0 0.0.0.255 area 0 OR R(config-if)#ip ospf 1 area 0
d)Authentication

14-LSA types (1 ,2 ,3 ,4, 5, 7) R# sh ip ospf database

15-OSPF route may be **(O , OIA , OE1 , OE2 , ON1 , ON2 , O*IA , O*E2)**

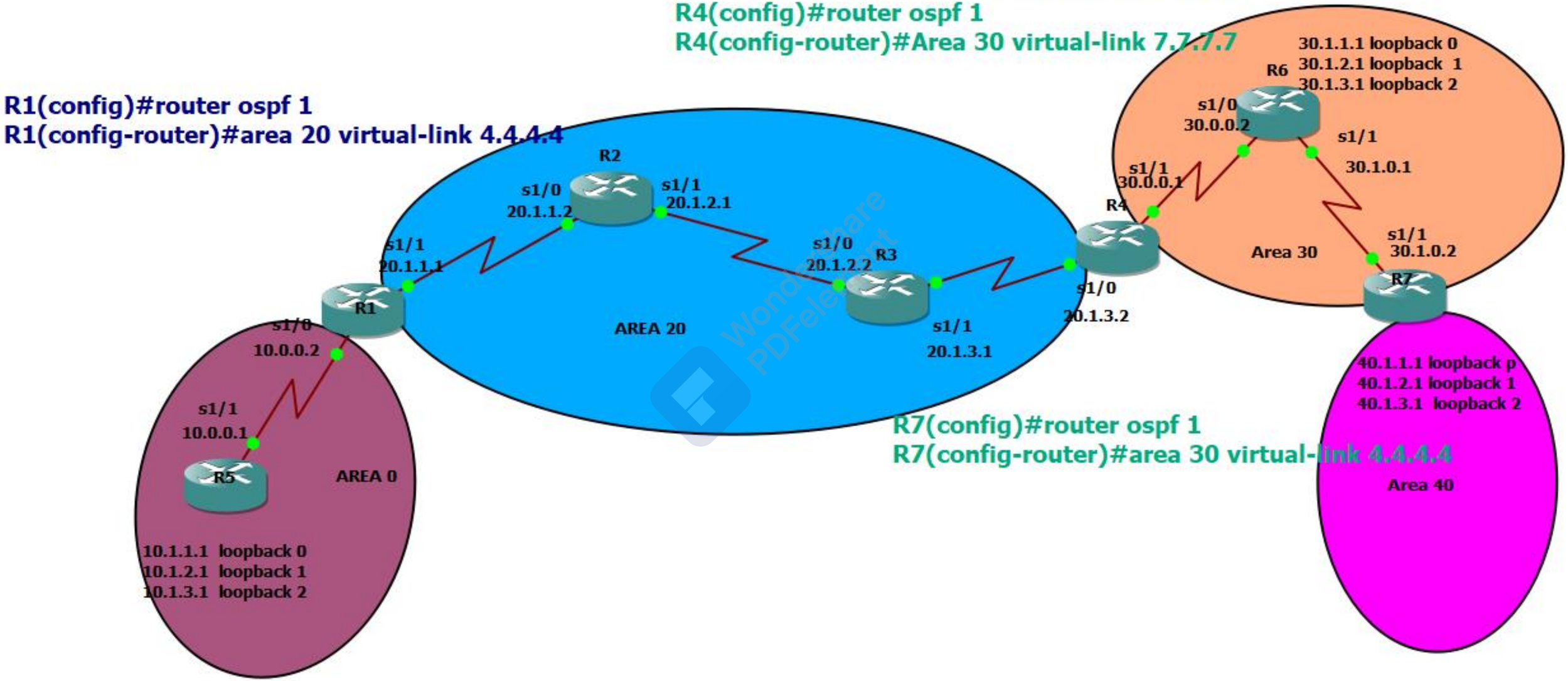
NSSA area LAB



R4(config)#router ospf 1
R4(config-router)#area 20 virtual-link 1.1.1.1

R4(config)#router ospf 1
R4(config-router)#Area 30 virtual-link 7.7.7.7

R1(config)#router ospf 1
R1(config-router)#area 20 virtual-link 4.4.4.4



R7(config)#router ospf 1
R7(config-router)#area 30 virtual-link 4.4.4.4

R#sh ip ospf interface

1-Hello interval → (By default is 10 and by configuration R1(config-if)#ip ospf hello-interval 15

2-Dead Interval → (By default is 40 and by configuration R1 (config-if)#ip ospf dead-interval 60

3-Area ID → Area ID is used to regulate and filter LSA propagation between the diff Areas because ospf supports unlimmited number of routers . AREA is vlaue from 0 to 255 . area 0 is clalled backbone area and area 1, 2 3....etc is called regular Area which must be connected to Area 0 through ABR of this AREA . R1(config-if)#ip ospf 1 area 0 or R1(config-router)#network 10.1.1.1 0.0.0.0 AREA 0 . Regular Area by default is ordinary and by configuration may be Stub , Totally Stub or NSSA

4-Mertric → $(10^8/Bw(bps))$

- Ethernet is 10
- fastethernet is 1
- giga is 0.1
- srial is 64

5-priority → Priority is value from 0 to 255 by default is 0 at point to point and 1 at MA
By configuration R(config-if)#ip ospf priority 15

6-Router-ID →
1-Manual configured R(config-router)#router-ID 1.1.1.1
2-Highest ip which is assigned for logical interface R(config)#interface loopback 0
3-Highest ip which is assigned for physical interface

7-Network Type →
- Point to point (by default on serial interface)
- Multiple Access
  - Broadcast MA (BMA) By default on ethernet interface
  - None Broadcast MA (By configuration on Serial interface)

8-State → DR & BDR or Drother

9-DR →

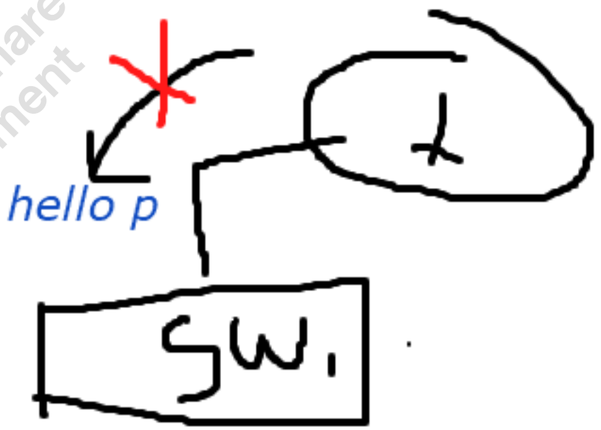
10-BDR → 1-The router with highest priority
2-The router with higest Router ID

Security Through OSPF updataes

OSPF Authentication


```
R(config)#interface fa0/0
R(config-if)#ip ospf authentication
R(config-if)#ip ospf authentication message-digest
R(config-if)#ip ospf authentication-key 123
```

Passive interface




```
R(config)#router ospf 1
R(config-router)#passive-inteface fa0/0
```