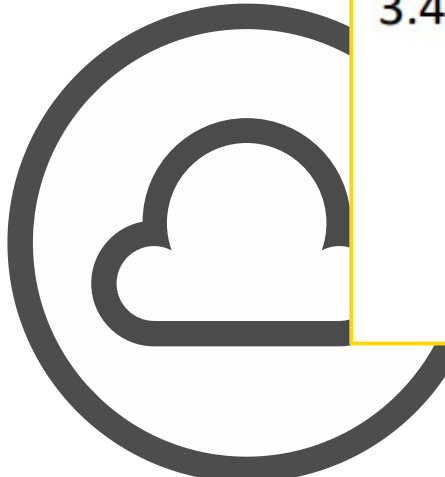


CCNA 200-301 Day 28

OSPF Part 3

- 
- 3.4 Configure and verify single area OSPFv2
 - 3.4.a Neighbor adjacencies
 - 3.4.b Point-to-point
 - 3.4.c Broadcast (DR/BDR selection)
 - 3.4.d Router ID

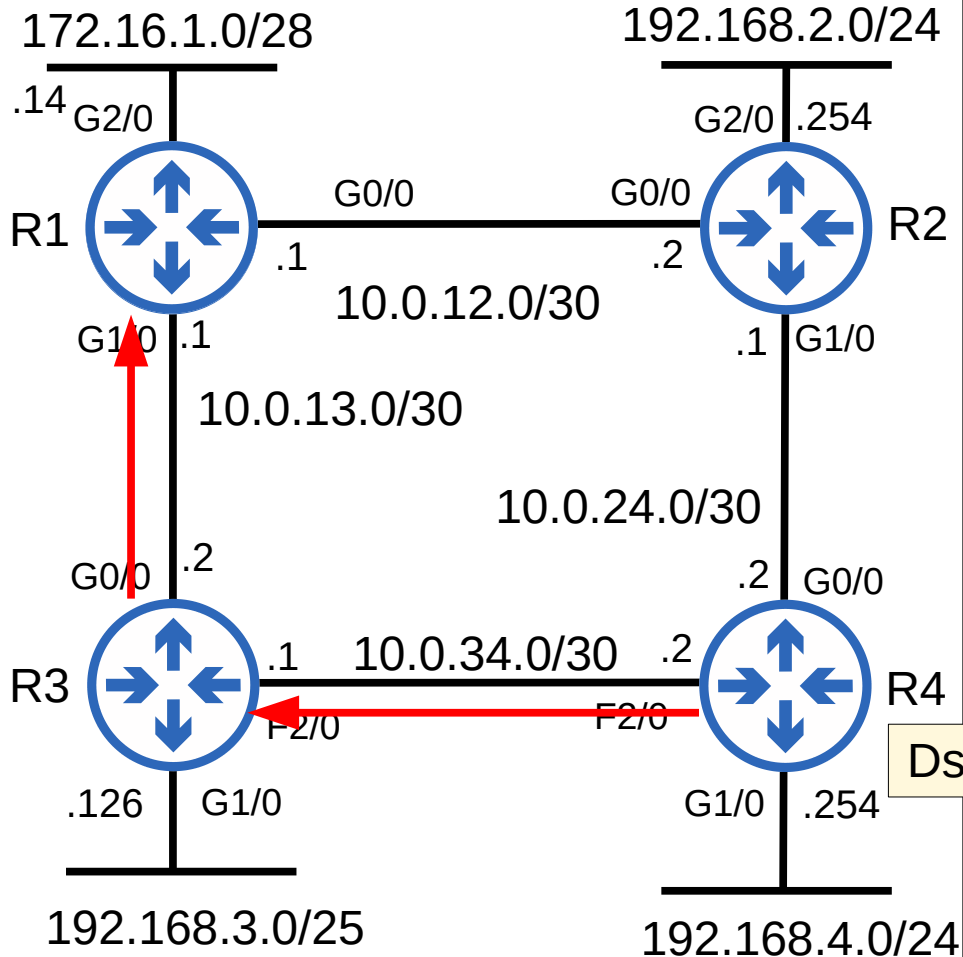


Things we'll cover

- OSPF network types
- OSPF neighbor/adjacency requirements
- OSPF LSA types

Loopback Interfaces

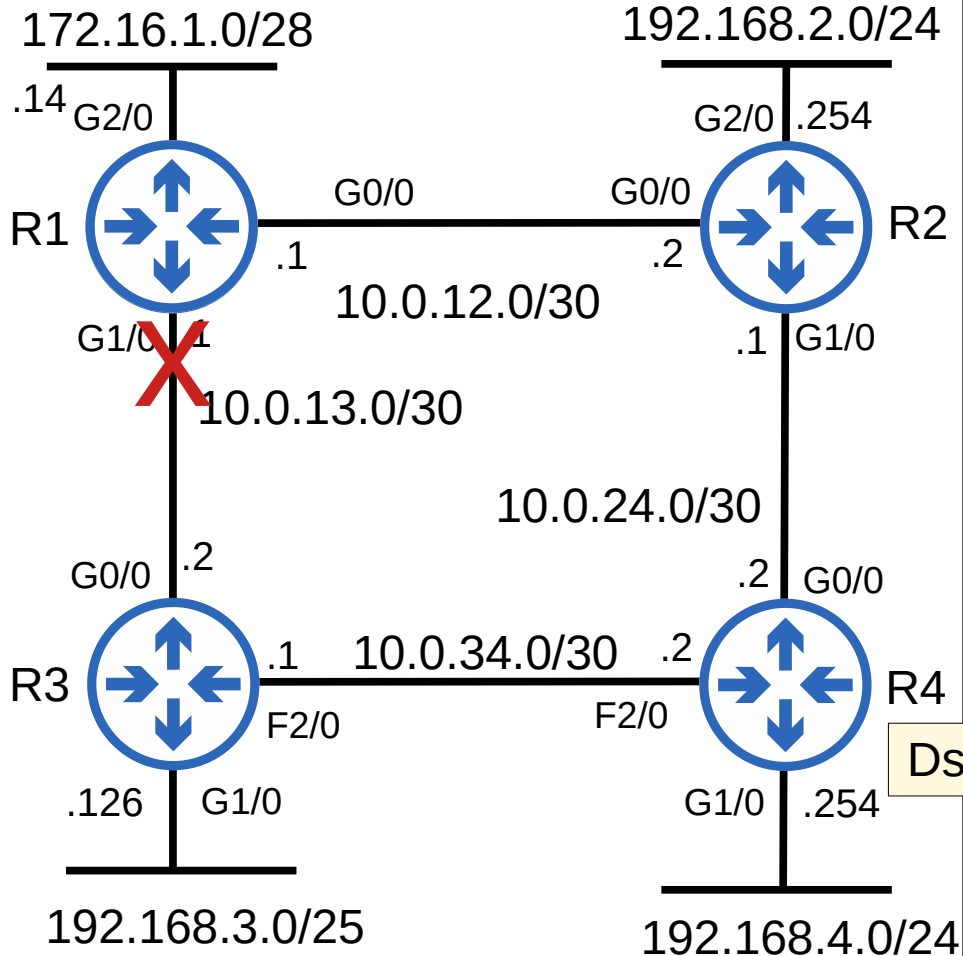
OSPF Area 0



- A loopback interface is a virtual interface in the router.
- It is always up/up (unless you manually shut it down)
- It is not dependent on a physical interface.
- So, it provides a consistent IP address that can be used to reach/identify the router.

Loopback Interfaces

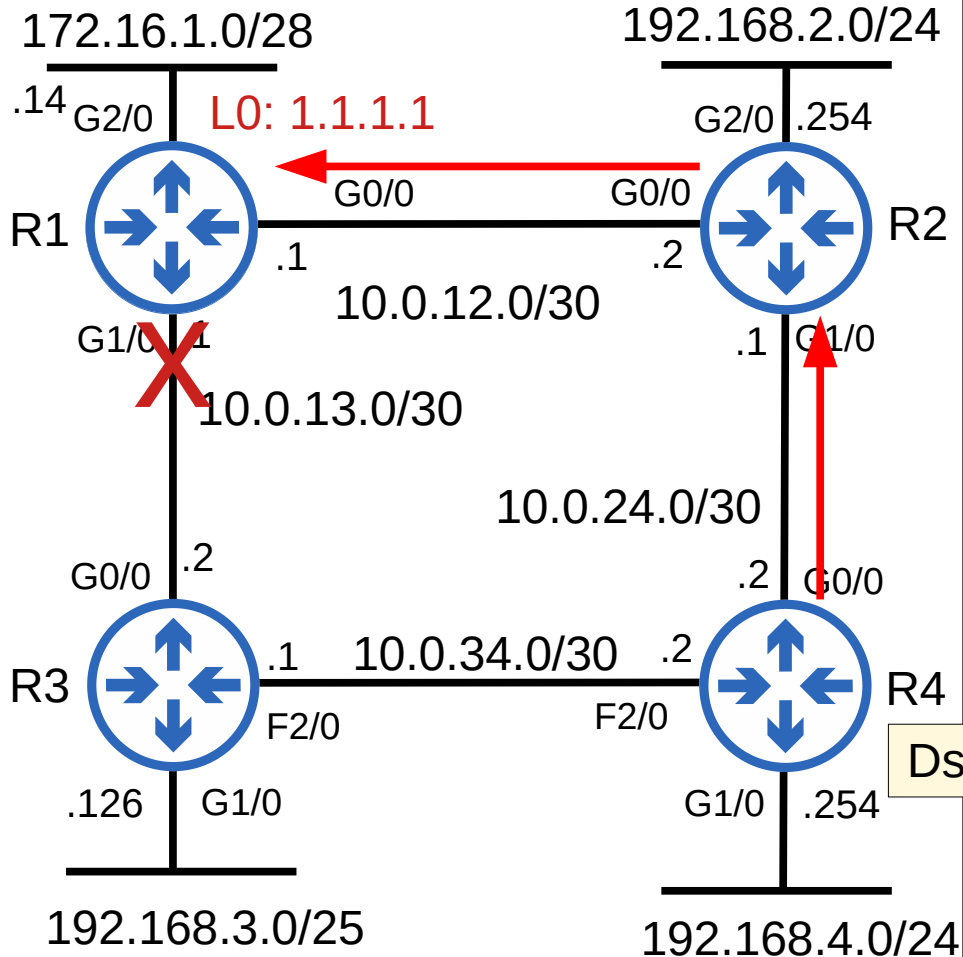
OSPF Area 0



- A loopback interface is a virtual interface in the router.
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- So, it provides a consistent IP address that can be used to reach/identify the router.

Loopback Interfaces

OSPF Area 0



- A loopback interface is a virtual interface in the router.
- It is always up/up (unless you manually shut it down)
- It is not dependent on a physical interface.
- So, it provides a consistent IP address that can be used to reach/identify the router.

OSPF Network Types

- The OSPF 'network type' refers to the type of connection between OSPF neighbors (Ethernet, etc)
- There are three main OSPF network types:

Broadcast

-enabled by default on **Ethernet** and **FDDI** (Fiber Distributed Data Interface) interfaces

Point-to-point

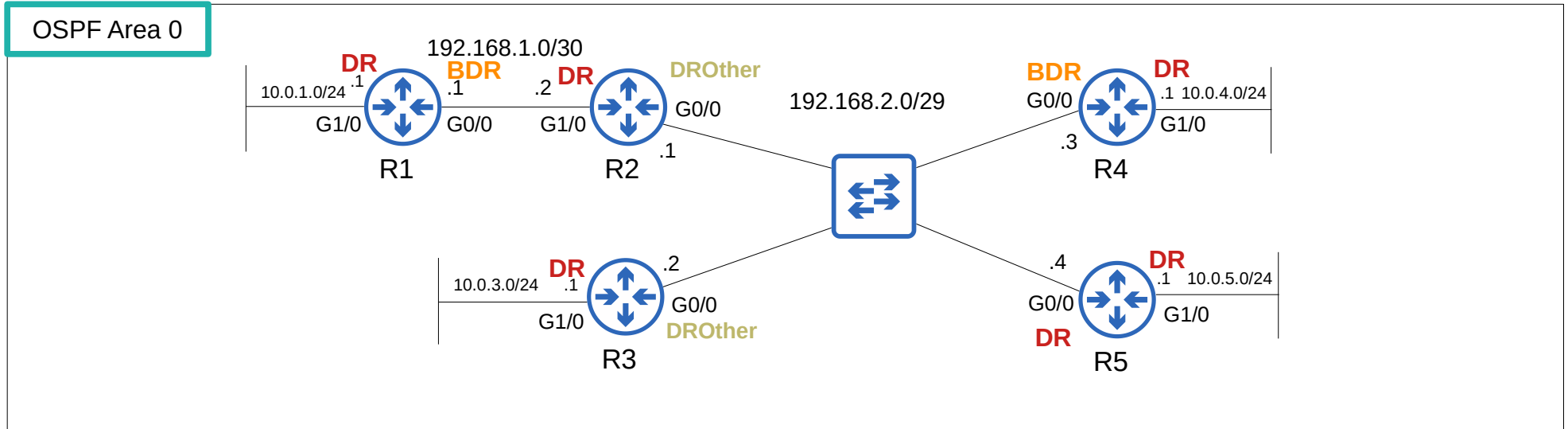
-enabled by default on **PPP** (Point-to-Point Protocol) and **HDLC** (High-Level Data Link Control) interfaces

Non-broadcast

-enabled by default on **Frame Relay** and **X.25** interfaces

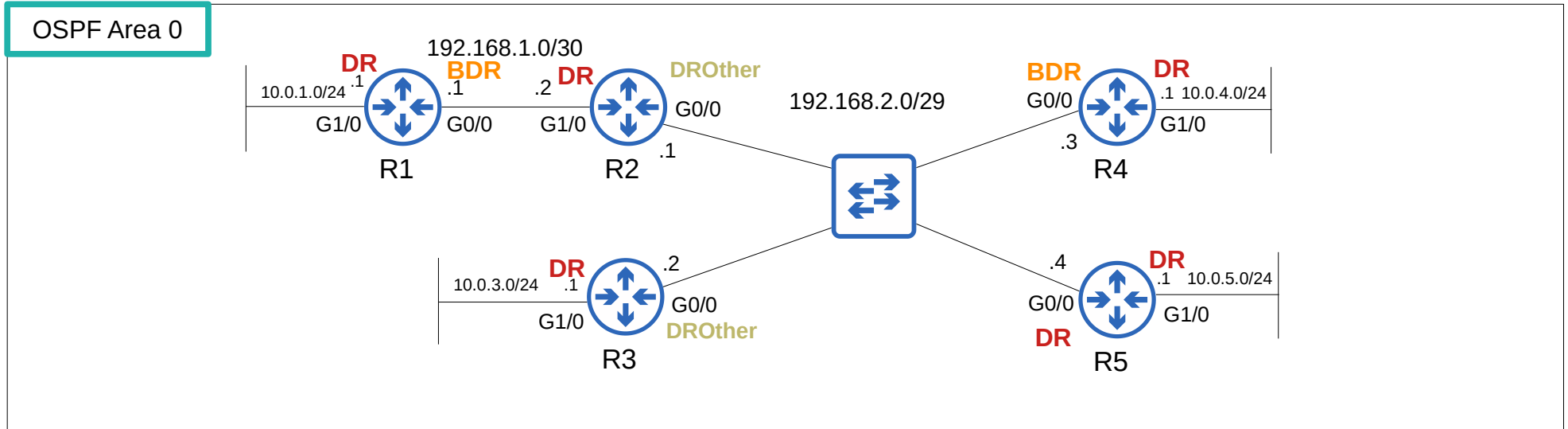
- 3.4 Configure and verify single area OSPFv2
 - 3.4.a Neighbor adjacencies
 - 3.4.b Point-to-point
 - 3.4.c Broadcast (DR/BDR selection)
 - 3.4.d Router ID

OSPF Broadcast Network Type



- Enabled on **Ethernet** and **FDDI** interfaces by default.
- Routers *dynamically discover* neighbors by sending/listening for OSPF Hello messages using multicast address 224.0.0.5.
- A **DR** (designated router) and **BDR** (backup designated router) must be elected on each subnet (only DR if there are no OSPF neighbors, ie. R1's G1/0 interface)
- Routers which aren't the DR or BDR become a **DROther**.

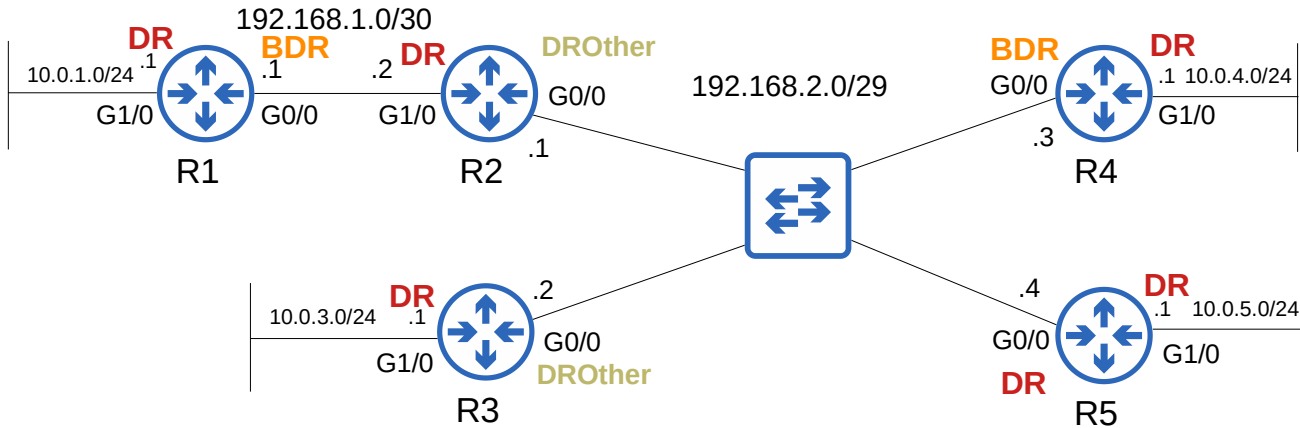
OSPF Broadcast Network Type



- The DR/BDR election order of priority:
 - 1: Highest **OSPF interface priority**
 - 2: Highest OSPF Router ID
- 'First place' becomes the DR for the subnet, 'second place' becomes the BDR
- The default OSPF interface priority is 1 on all interfaces

OSPF Broadcast Network Type

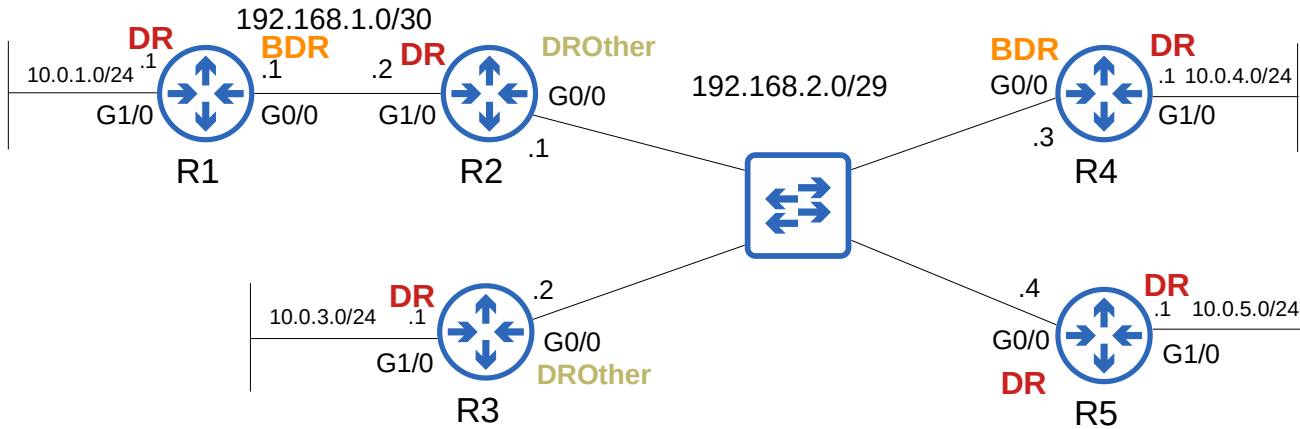
OSPF Area 0



```
R5#show ip ospf interface g0/0
GigabitEthernet0/0 is up, line protocol is up
Internet Address 192.168.2.4/29, Area 0, Attached via Network Statement
Process ID 1, Router ID 5.5.5.5, Network Type BROADCAST, Cost: 1
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
      0          1          no            no            Base
Transmit Delay is 1 sec, State DR, Priority 1
Designated Router (ID) 5.5.5.5, Interface address 192.168.2.4
Backup Designated router (ID) 4.4.4.4, Interface address 192.168.2.3
```

OSPF Broadcast Network Type

OSPF Area 0



```
R2#show ip ospf int g0/0
```

```
GigabitEthernet0/0 is up, line protocol is up
```

```
Internet Address 192.168.2.1/29, Area 0, Attached via Network Statement
```

```
Process ID 1, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 1
```

```
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
```

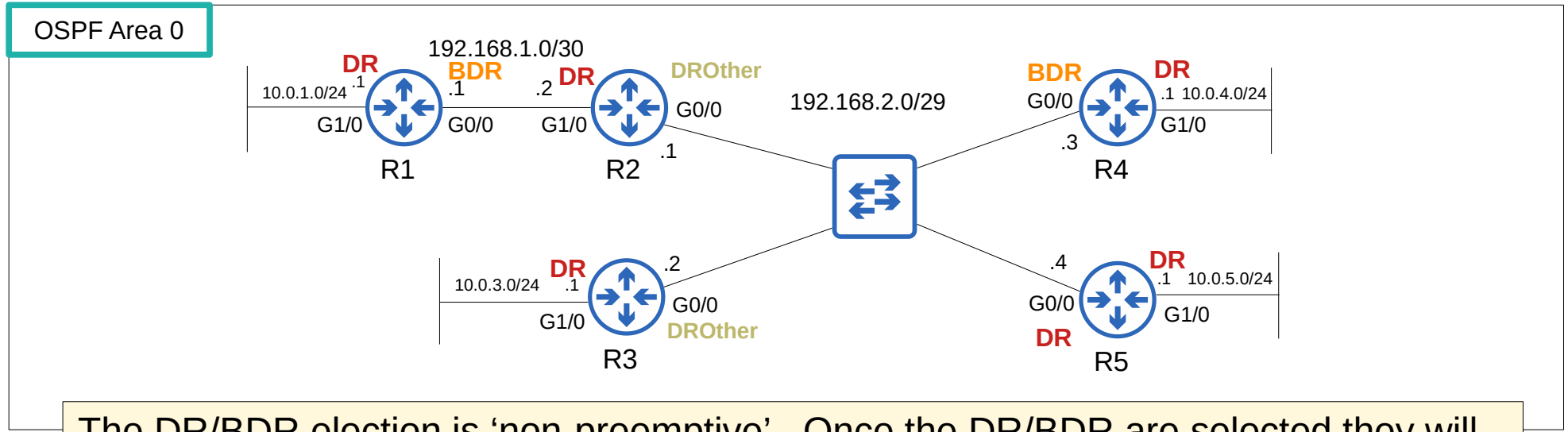
```
0                  1          no            no            Base
```

```
Transmit Delay is 1 sec, State DROTHER, Priority 1
```

```
Designated Router (ID) 5.5.5.5, Interface address 192.168.2.4
```

```
Backup Designated router (ID) 4.4.4.4, Interface address 192.168.2.3
```

OSPF Broadcast Network Type



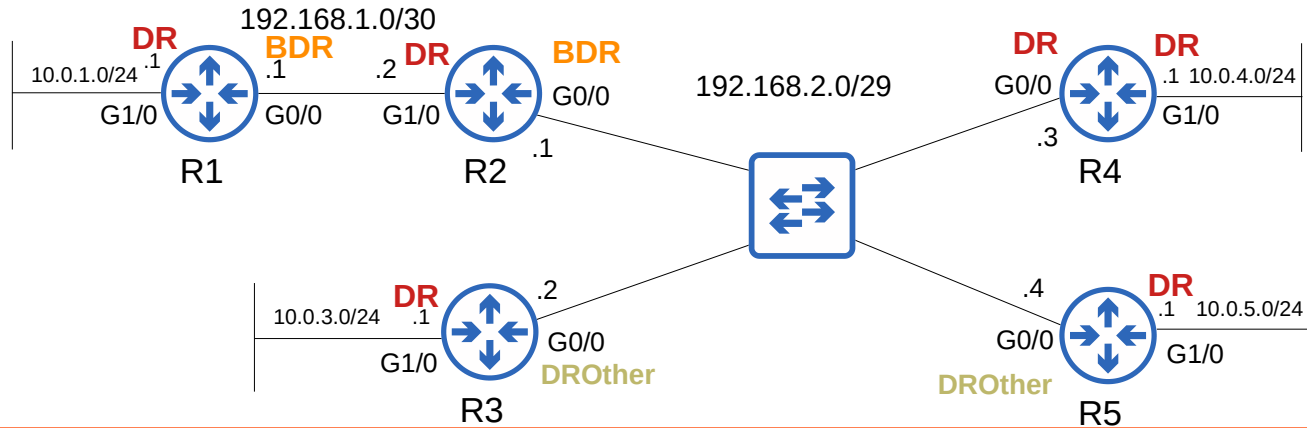
The DR/BDR election is 'non-preemptive'. Once the DR/BDR are selected they will keep their role until OSPF is reset, the interface fails/is shut down, etc.

```
R2(config)#int g0/0
R2(config-if)#ip ospf priority ?
<0-255> Priority
R2(config-if)#ip ospf priority 255
```

```
R2#show ip ospf int g0/0
GigabitEthernet0/0 is up, line protocol is up
Internet Address 192.168.2.1/29, Area 0, Attached via Network Statement
Process ID 1, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 1
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
0                  1         no           no           Base
Transmit Delay is 1 sec, State DROTHER, Priority 255
Designated Router (ID) 5.5.5.5, Interface address 192.168.2.4
Backup Designated router (ID) 4.4.4.4, Interface address 192.168.2.3
```

OSPF Broadcast Network Type

OSPF Area 0



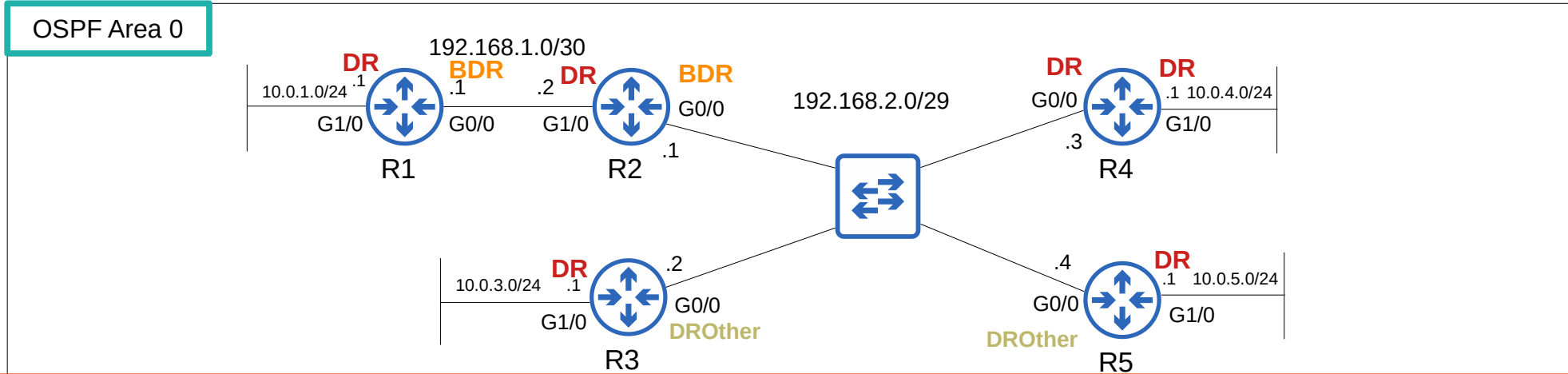
```
R5#clear ip ospf process
Reset ALL OSPF processes? [no]: yes
R5#
*Aug 22 04:25:05.307: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 22 04:25:05.311: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
*Aug 22 04:25:05.311: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
```

```
R5#
*Aug 22 04:25:13.903: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
*Aug 22 04:25:13.907: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

```
R5#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
2.2.2.2	255	FULL/BDR	00:00:37	192.168.2.1	GigabitEthernet0/0
3.3.3.3	1	2WAY/DROTHER	00:00:37	192.168.2.2	GigabitEthernet0/0
4.4.4.4	1	FULL/DR	00:00:39	192.168.2.3	GigabitEthernet0/0

OSPF Broadcast Network Type



```

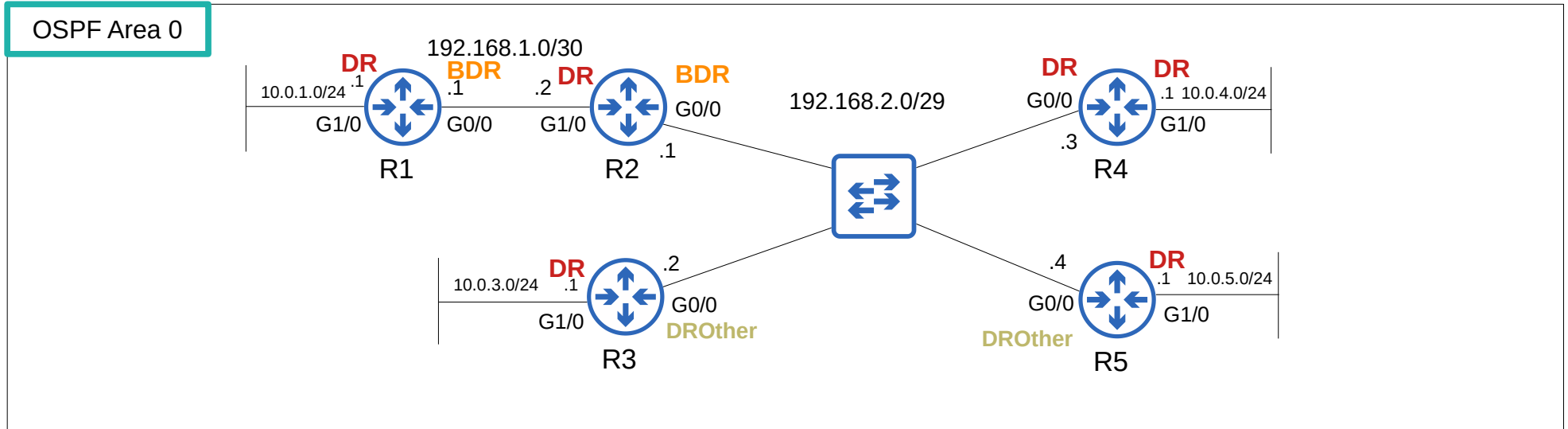
R5#clear ip ospf process
Reset ALL OSPF processes? [no]: yes
R5#
*Aug 22 04:25:05.307: %OSPF-5-ADJCHG: Process 1,
*Aug 22 04:25:05.311: %OSPF-5-ADJCHG: Process 1,
*Aug 22 04:25:05.311: %OSPF-5-ADJCHG: Process 1,
R5#
*Aug 22 04:25:13.903: %OSPF-5-ADJCHG: Process 1,
*Aug 22 04:25:13.907: %OSPF-5-ADJCHG: Process 1,
R5#show ip ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Neighbor IP	Interface
2.2.2.2	255	FULL/BDR	00:00:37	192.168.2.2	GigabitEthernet0/0
3.3.3.3	1	2WAY/DROTHER	00:00:37	192.168.2.3	GigabitEthernet0/0
4.4.4.4	1	FULL/DR	00:00:39	192.168.2.4	GigabitEthernet0/0

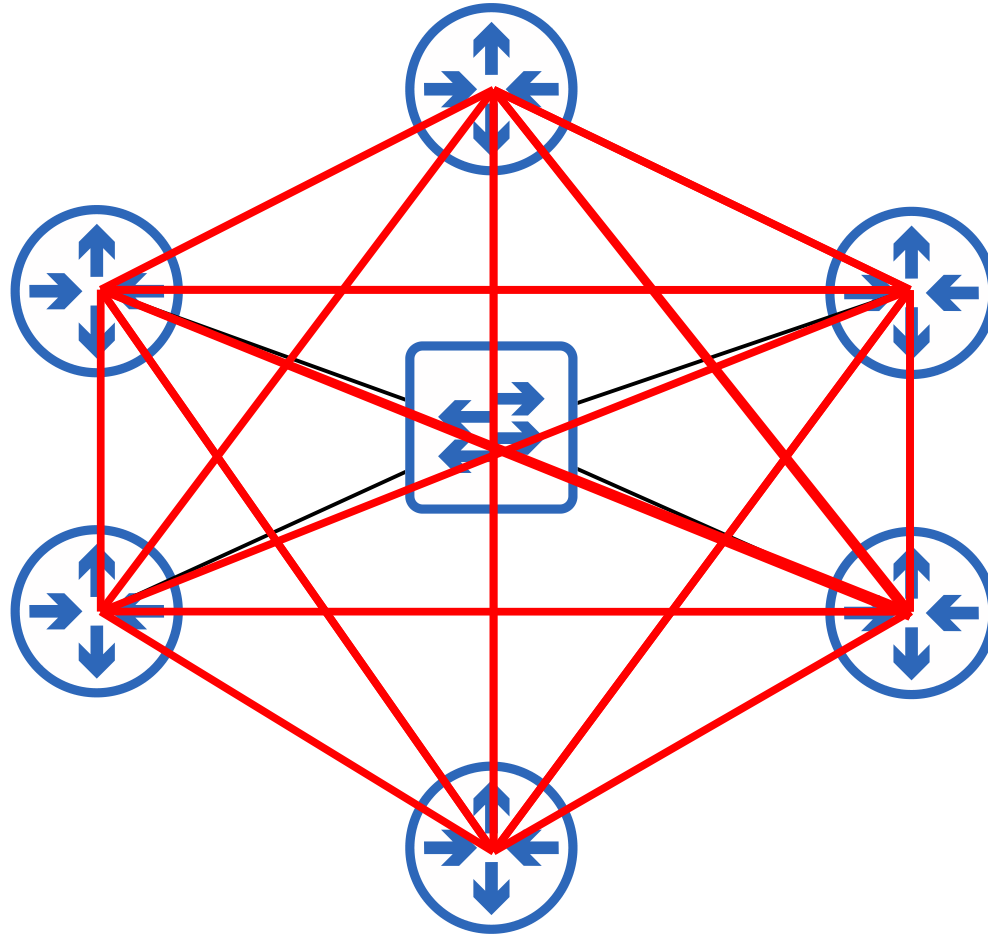
- **R4 became the DR, not R2. R2 became the BDR.**
 → When the DR goes down, the BDR becomes the new DR. Then an election is held for the next BDR.
- **R3 is a DROther, and is stable in the 2-way state.**
 → DROthers (R3 and R5 in this subnet) will only move to the FULL state with the DR and BDR. The neighbor state with other DROthers will be 2-way.

OSPF Broadcast Network Type



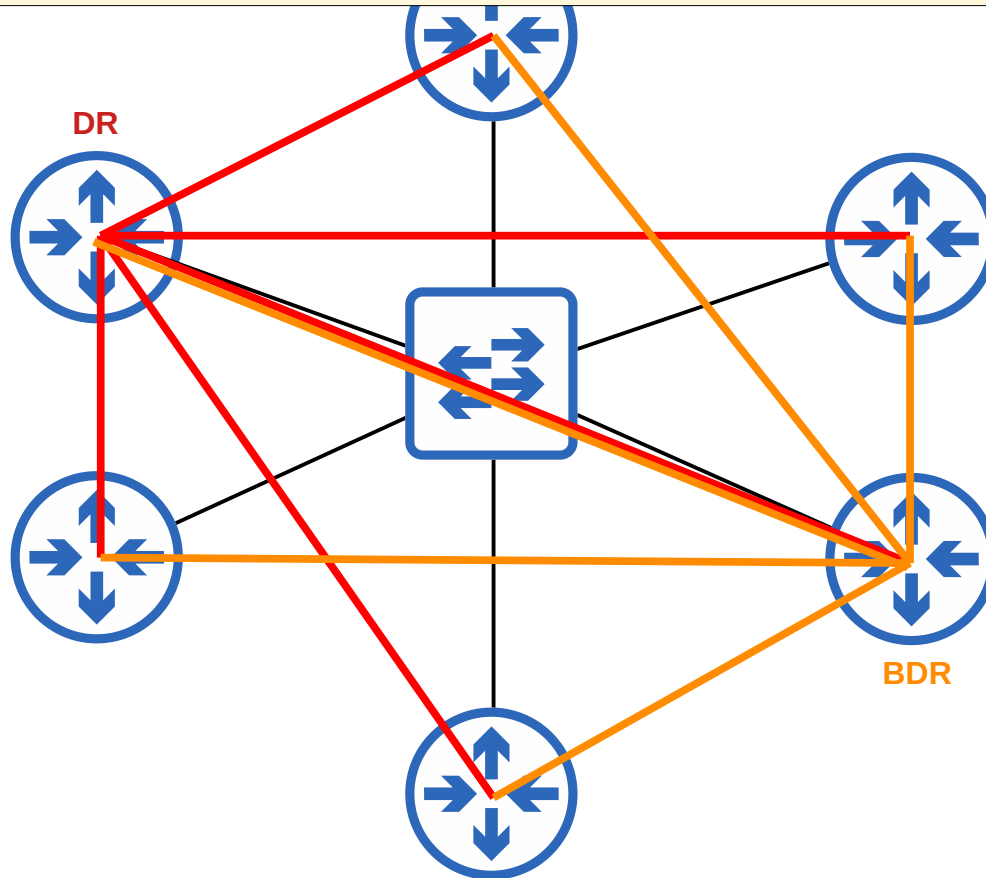
- In the broadcast network type, routers will only form a full OSPF adjacency with the DR and BDR of the segment.
- Therefore, routers only exchange LSAs with the DR and BDR. DROthers will not exchange LSAs with each other.
- All routers will still have the same LSDB, but this reduces the amount of LSAs flooding the network.

OSPF Broadcast Network Type



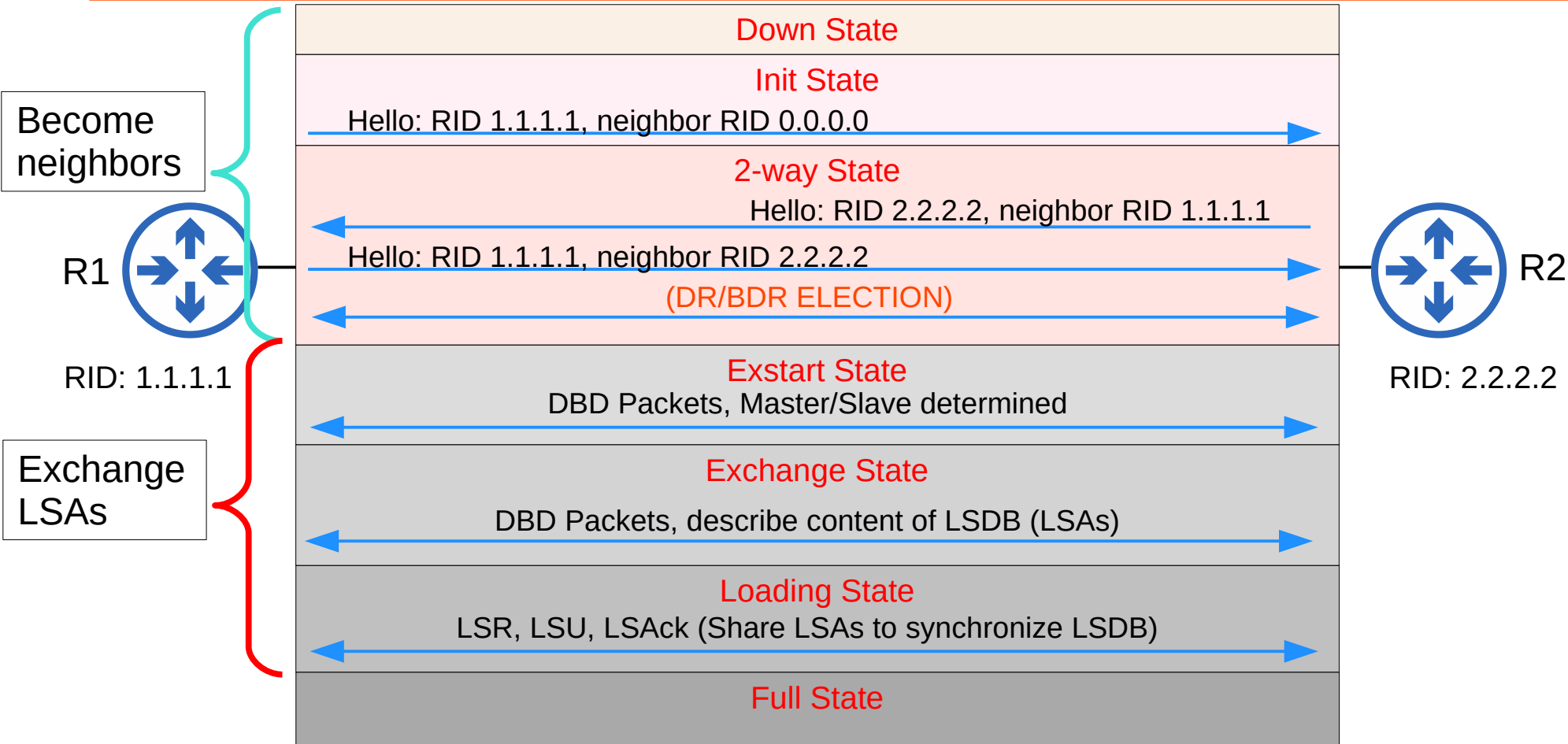
OSPF Broadcast Network Type

Messages to the DR/BDR are multicast using address 224.0.0.6



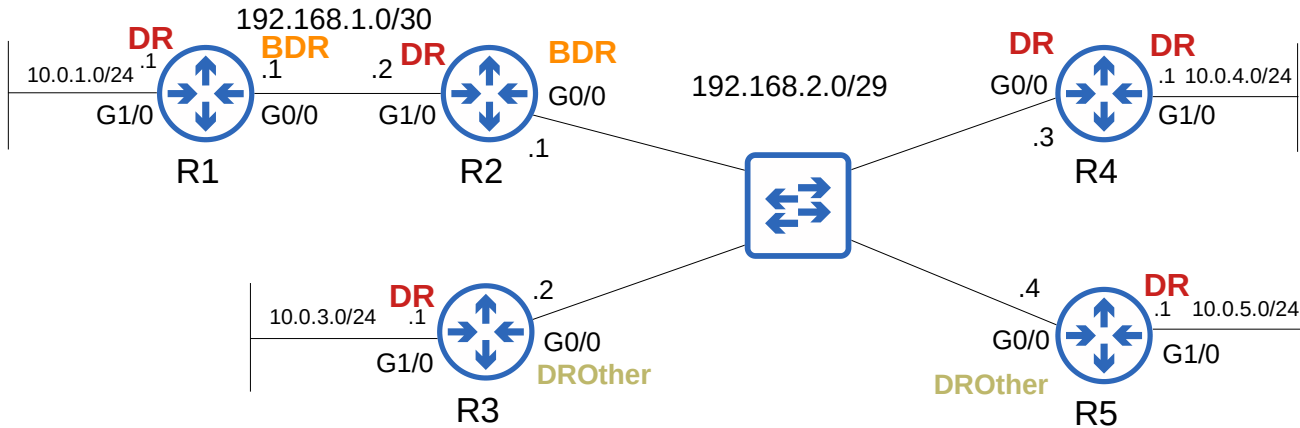
OSPF Neighbors

The DR and BDR will form a FULL adjacency with ALL routers in the subnet.
 DROthers will form a FULL adjacency only with the DR/BDR.



OSPF Broadcast Network Type

OSPF Area 0



```
R3#show ip ospf interface brief
```

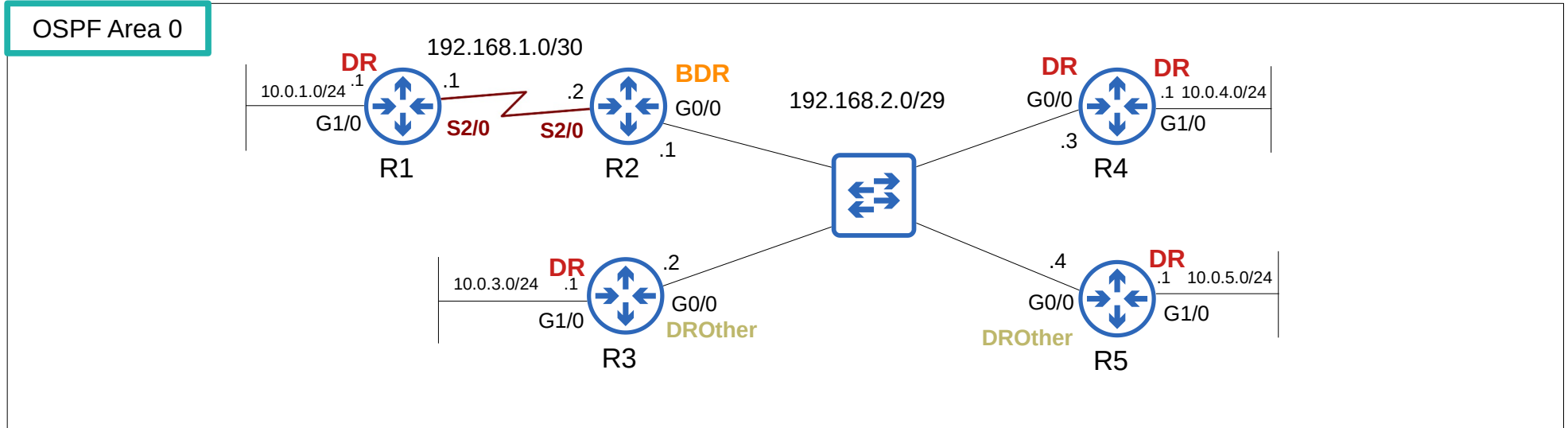
Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs F/C
Gi0/0	1	0	192.168.2.2/29	1	DROTH	2/3
Gi1/0	1	0	10.0.3.1/24	1	DR	0/0

OSPF Broadcast Network Type

```

R3#show ip ospf interface g0/0
GigabitEthernet0/0 is up, line protocol is up
  Internet Address 192.168.2.2/29, Area 0, Attached via Network Statement
  Process ID 1, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 1
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
    0                1         no            no            Base
  Transmit Delay is 1 sec, State DROTHER, Priority 1
  Designated Router (ID) 4.4.4.4, Interface address 192.168.2.3
  Backup Designated router (ID) 2.2.2.2, Interface address 192.168.2.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:09
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 1
  Last flood scan time is 0 msec, maximum is 4 msec
  Neighbor Count is 3, Adjacent neighbor count is 2
    Adjacent with neighbor 2.2.2.2 (Backup Designated Router)
    Adjacent with neighbor 4.4.4.4 (Designated Router)
  Suppress hello for 0 neighbor(s)
  
```

OSPF Point-to-Point Network Type



- Enabled on **serial** interfaces using the **PPP** or **HDLC** encapsulations by default.
- Routers *dynamically discover* neighbors by sending/listening for OSPF Hello messages using multicast address 224.0.0.5.
- A DR and BDR are **not** elected.
- These encapsulations are used for 'point-to-point' connections.
- Therefore there is no point in electing a DR and BDR.
- The two routers will form a Full adjacency with each other.

Serial Interfaces

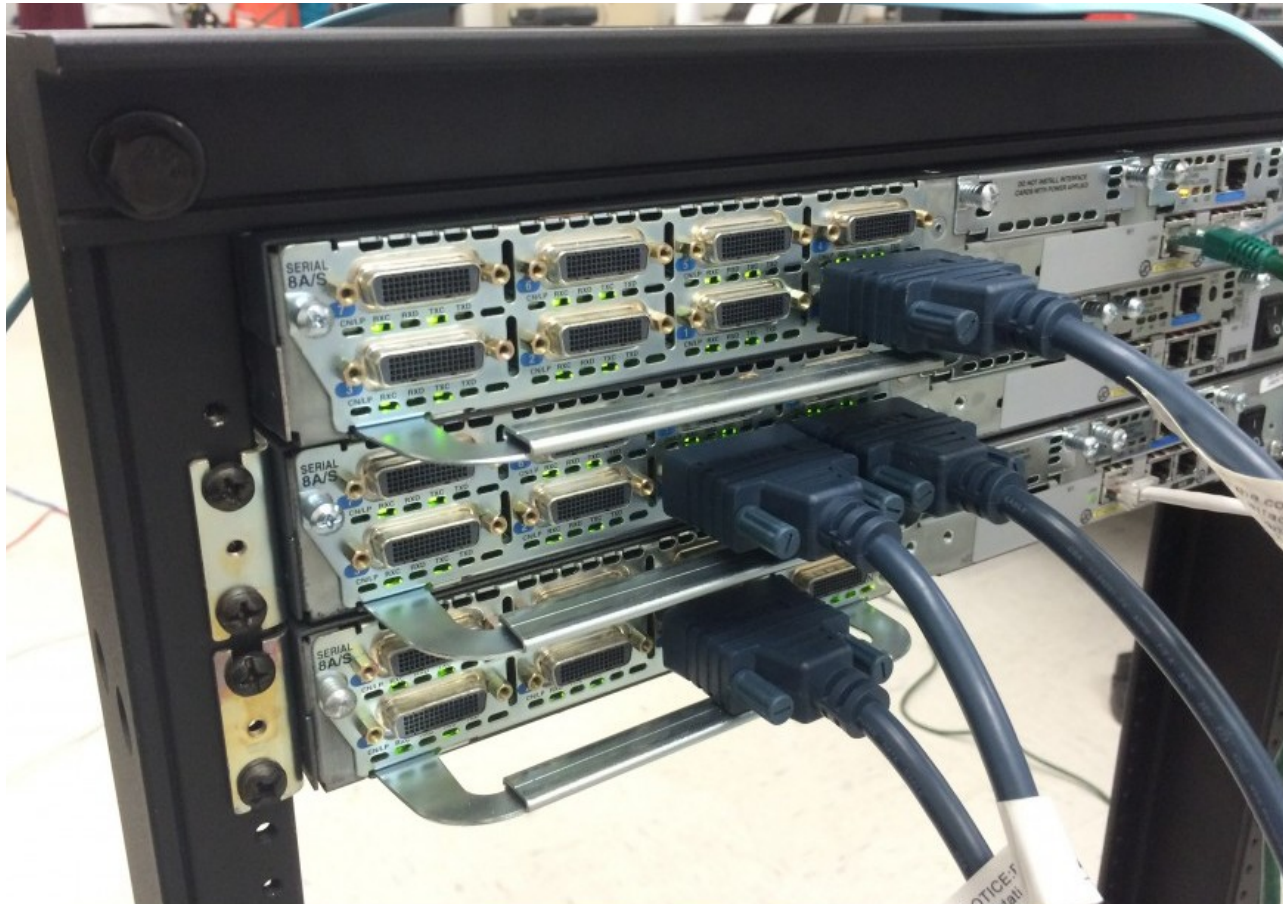
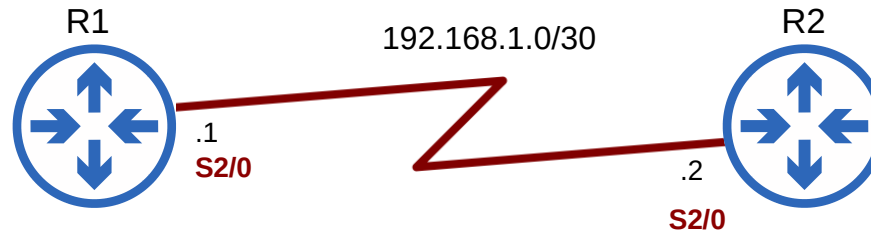


Photo from: learnnetworkinglab.wordpress.com

Serial Interfaces



```
R1(config)#interface s2/0
R1(config-if)#clock rate ?
  With the exception of the following standard values not subject to rounding,

    1200 2400 4800 9600 14400 19200 28800 38400
    56000 64000 128000 2015232

accepted clockrates will be bestfitted (rounded) to the nearest value
supportable by the hardware.

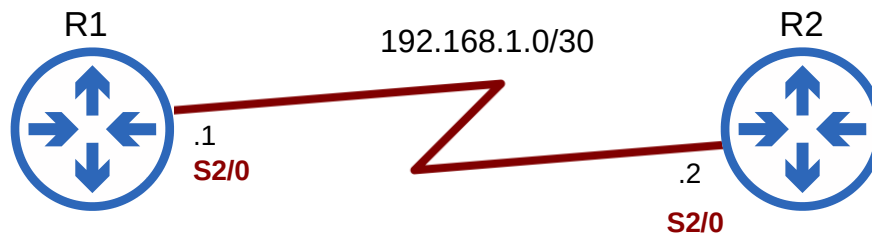
<246-8064000>    DCE clock rate (bits per second)
```

```
R1(config-if)#clock rate 64000
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shut
```

Ethernet interfaces use the **speed** command to configure the interface's operating speed. Serial interfaces use the **clock rate** command.

- One side of a serial connection functions as DCE (Data Communications Equipment)
- The other side functions as DTE (Data Terminal Equipment)
- The DCE side needs to specify the *clock rate* (speed) of the connection

Serial Interfaces

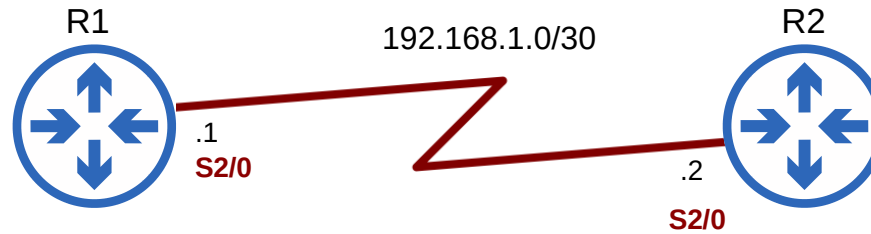


```
R1#show interface s2/0
Serial2/0 is up, line protocol is up
Hardware is M4T
Internet address is 192.168.1.1/24
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC  crc 16, loopback not set
```

```
R1(config)#int s2/0
R1(config-if)#encapsulation ppp
R1(config-if)#do show interface s2/0
Serial2/0 is up, line protocol is up
Hardware is M4T
Internet address is 192.168.1.1/24
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP  LCP Open
```

- The default encapsulation on a serial interface is HDLC.
**actually cHDLC (Cisco HDLC)
- If you change the encapsulation, it must match on both ends or the interface will go down.

Serial Interfaces



```
R1#show interface s2/0
Serial2/0 is up, line protocol is up
Hardware is M4T
Internet address is 192.168.1.1/24
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC  crc 16, loopback not set
```

- The default encapsulation on a serial interface is HDLC.
**actually cHDLC (Cisco HDLC)
- If you change the encapsulation, it must match on both ends or the interface will go

```
R1(config)#int s2/0
```

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

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

```
Serial2/0 is
```

```
Hardware is
```

```
Internet ad
```

```
MTU 1500 by
```

```
reliabil
```

```
Encapsulati
```

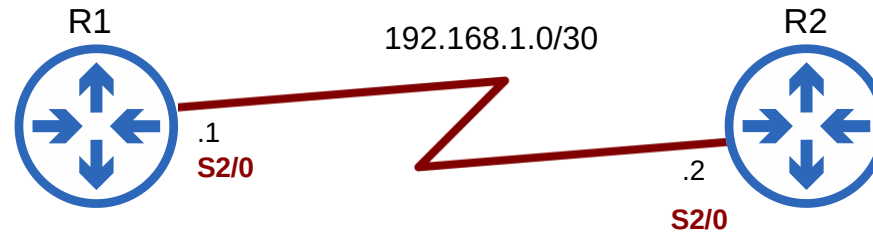
cHDLC frame structure [\[edit\]](#)

The following table describes the structure of a cHDLC frame on the wire. [citation needed]

Address	Control	Protocol Code	Information	Frame Check Sequence (FCS)	Flag
8 bits	8 bits	16 bits	Variable length, 0 or more bits, in multiples of 8	16 bits	8 bits

- The Address field is used to specify the type of packet contained in the cHDLC frame; 0x0F for Unicast and 0x8F for Broadcast packets.
- The Control field is always set to zero (0x00).
- The Protocol Code field is used to specify the protocol type encapsulated within the cHDLC frame (e.g. 0x0800 for [Internet Protocol](#)).

Serial Interfaces



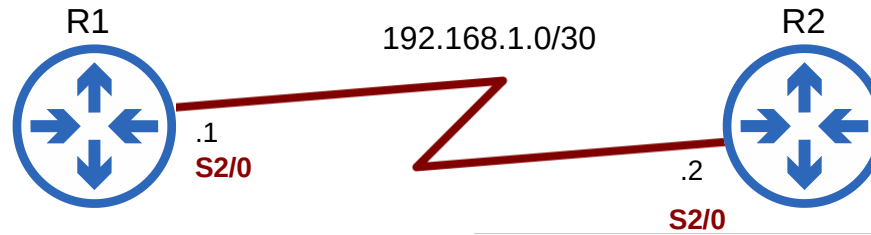
```
R1#show running-config interface s2/0
Building configuration...

Current configuration : 126 bytes
!
interface Serial2/0
 ip address 192.168.1.1 255.255.255.0
 encapsulation ppp
 serial restart-delay 0
 clock rate 64000
end
```

```
R2#show running-config interface s2/0
Building configuration...

Current configuration : 110 bytes
!
interface Serial2/0
 ip address 192.168.1.2 255.255.255.252
 encapsulation ppp
 serial restart-delay 0
end
```

Serial Interfaces



```

R1
R1#show con
R1#show controllers s2/0
Interface Serial2/0
Hardware is PowerQUICC MPC860
DCE V.35, clock rate 64000
!db at 0x81081AC4, driver data structure at 0x81084AC0
SCC Registers:
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E
Interrupt Registers:
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000
Command register [CR]=0x580
  
```

Ctrl+F6 to exit CLI focus

Top

```

R2
R2#show controllers s2/0
Interface Serial2/0
Hardware is PowerQUICC MPC860
DTE V.35 TX and RX clocks detected
!db at 0x81081AC4, driver data structure at 0x81084AC0
SCC Registers:
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E
Interrupt Registers:
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000
Command register [CR]=0x580
Port A [PADIR1]=0x1030 [PAPAR1]=0xFFFF
  
```

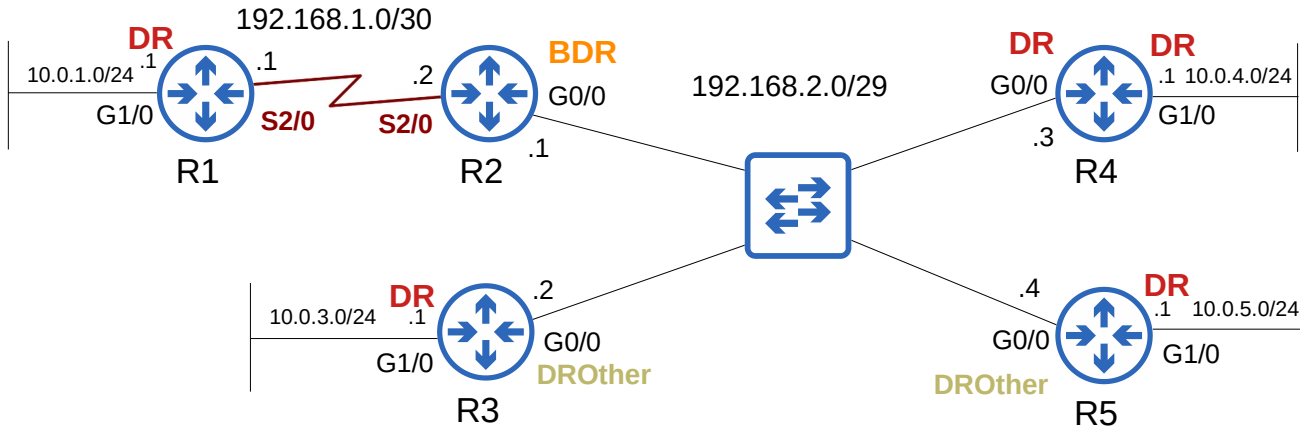
Ctrl+F6 to exit CLI focus

Top

- The default encapsulation is HDLC.
- You can configure PPP encapsulation with this command:
R1(config-if)# **encapsulation ppp**
- One side is DCE, one side is DTE.
- Identify which side is DCE/DTE:
R1# **show controllers interface-id**
- You must configure the clock rate on the DCE side:
R1(config-if)# **clock rate bits-per-second**

OSPF Point-to-Point Network Type

OSPF Area 0



```
R2#show ip ospf neighbor
```

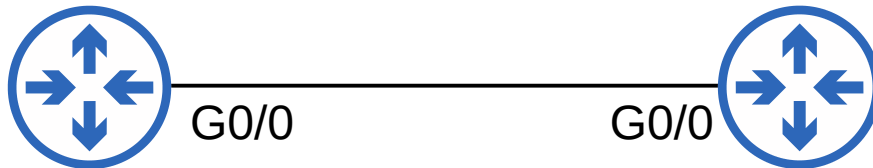
Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.1	0	FULL/ -	00:00:31	192.168.1.1	Serial2/0
3.3.3.3	1	2WAY/DROther	00:00:39	192.168.2.2	GigabitEthernet0/0
4.4.4.4	1	FULL/DR	00:00:38	192.168.2.3	GigabitEthernet0/0
5.5.5.5	1	FULL/BDR	00:00:31	192.168.2.4	GigabitEthernet0/0

Configure the OSPF Network Type

```

R1(config-if)#ip ospf network ?
broadcast          Specify OSPF broadcast multi-access network
non-broadcast      Specify OSPF NBMA network
point-to-multipoint Specify OSPF point-to-multipoint network
point-to-point     Specify OSPF point-to-point network
  
```

- You can configure the OSPF network type on an interface with **ip ospf network type**
- For example, if two routers are directly connected with an Ethernet link, there is no need for a DR/BDR. You can configure the point-to-point network type in this case.
- NOTE: Not all network types work on all link types (for example, a serial link cannot use the broadcast network type)



Configure the OSPF Network Type

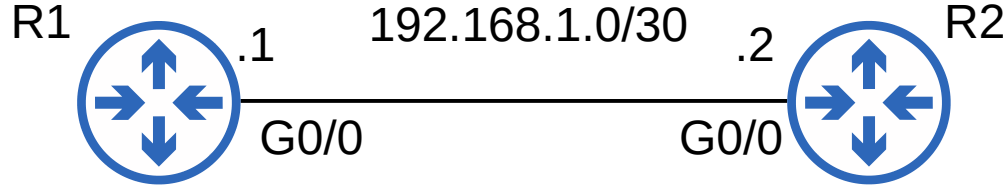
Broadcast	Point-to-point
Default on Ethernet, FDDI interfaces	Default on HDLC, PPP (serial) interfaces
DR/DBR elected	No DR/BDR
Neighbors dynamically discovered	Neighbors dynamically discovered
Default timers: Hello 10, Dead 40	Default timers: Hello 10, Dead 40

(**Non-broadcast** network type default timers = Hello 30, Dead 120)

OSPF Neighbor Requirements

- 1) Area number must match

OSPF Neighbor Requirements



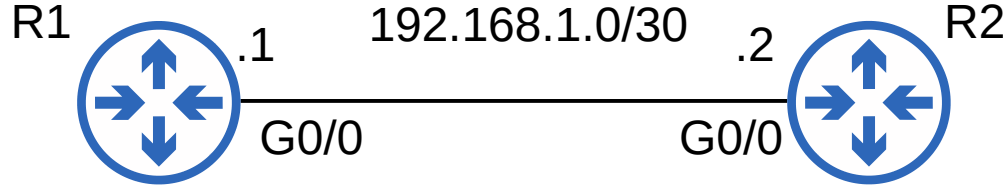
```
R1#show running-config | section ospf
router ospf 1
network 192.168.1.0 0.0.0.3 area 0
```

```
R2#show running-config | section ospf
router ospf 1
network 192.168.1.0 0.0.0.3 area 1
```

```
R1#show ip ospf neighbor
R1#
R1#
```

```
R2#show ip ospf neighbor
R2#
R2#
```


OSPF Neighbor Requirements



```
R1#show running-config | section ospf
router ospf 1
network 192.168.1.0 0.0.0.3 area 0
```

```
R2#show running-config | section ospf
router ospf 1
network 192.168.1.0 0.0.0.3 area 0
```

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.2	1	FULL/BDR	00:00:34	192.168.1.2	GigabitEthernet0/0

R1#

```
R2#show ip ospf neighbor
```

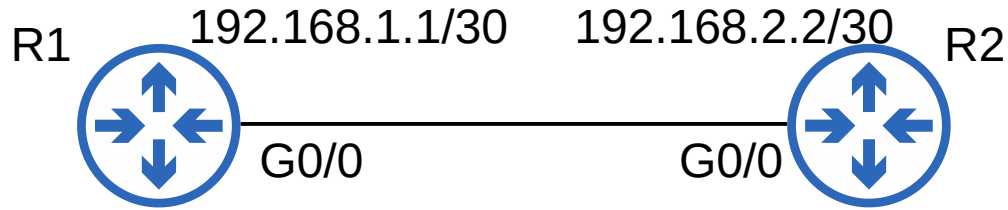
Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/DR	00:00:39	192.168.1.1	GigabitEthernet0/0

R2#

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet

OSPF Neighbor Requirements



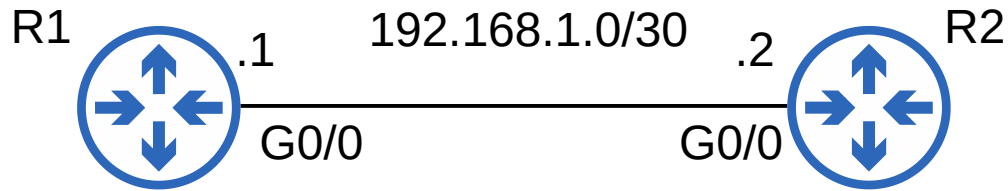
```
R1#show running-config | section ospf
router ospf 1
 network 192.168.1.0 0.0.0.3 area 0
R1#
```

```
R2#show running-config | section ospf
router ospf 1
 network 192.168.2.0 0.0.0.3 area 0
R2#
```

```
R1#show ip ospf neighbor
R1#
R1#
```

```
R2#show ip ospf neighbor
R2#
R2#
```

OSPF Neighbor Requirements



```
R1#show running-config | section ospf
router ospf 1
 network 192.168.1.0 0.0.0.3 area 0
R1#
```

```
R2#show running-config | section ospf
router ospf 1
 network 192.168.1.0 0.0.0.3 area 0
R2#
```

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.2	1	FULL/BDR	00:00:34	192.168.1.2	GigabitEthernet0/0

R1#

```
R2#show ip ospf neighbor
```

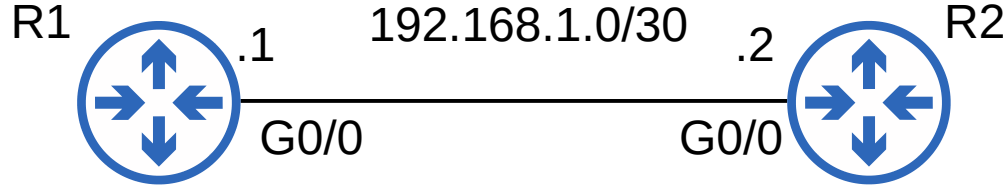
Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/DR	00:00:39	192.168.1.1	GigabitEthernet0/0

R2#

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**

OSPF Neighbor Requirements



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

```
*Aug 23 03:43:31.719: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Int
R2(config-router)#do show ip ospf neighbor
R2(config-router)#
```

```
R2(config-router)#no shutdown
R2(config-router)#
```

```
*Aug 23 03:49:52.931: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
R2(config-router)#do show ip ospf neighbor
```

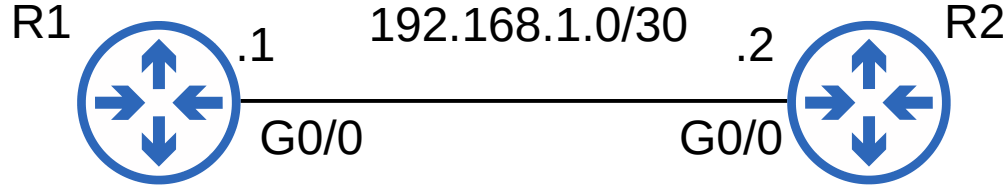
Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/DR	00:00:38	192.168.1.1	GigabitEthernet0/0

```
R2(config-router)#
```

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique

OSPF Neighbor Requirements



```

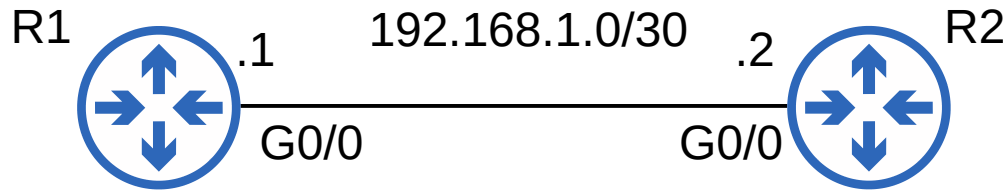
R2(config-router)#router-id 192.168.1.1
% OSPF: Reload or use "clear ip ospf process" command, for this to take effect
R2(config-router)#end
R2#clear ip
*Aug 23 03:57:58.835: %SYS-5-CONFIG_I: Configured from console by console
R2#clear ip ospf process
Reset ALL OSPF processes? [no]: yes
R2#
*Aug 23 03:58:04.055: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or c
R2#
*Aug 23 03:58:06.495: %OSPF-4-DUP_RTRID_NBR: OSPF detected duplicate router-id 192.168.1.1 from 192.168.1.1 on interface GigabitEthernet0/0
R2#show ip ospf neighbor
R2#
R2(config-router)#no router-id
R2(config-router)#
*Aug 23 04:10:10.207: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
R2(config-router)#do show ip ospf neighbor

Neighbor ID      Pri   State           Dead Time   Address        Interface
192.168.1.1      1    FULL/DR         00:00:35   192.168.1.1   GigabitEthernet0/0
R2(config-router)#
  
```


OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match

OSPF Neighbor Requirements



```
R2(config-if)#ip ospf hello-interval ?
<1-65535> Seconds
```

```
R2(config-if)#ip ospf hello-interval 5
```

```
R2(config-if)#ip ospf dead-interval ?
<1-65535> Seconds
minimal Set to 1 second
```

```
R2(config-if)#ip ospf dead-interval 20
```

```
R2(config-if)#
```

```
*Aug 23 04:29:30.623: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Dead timer expired
```

```
R2(config-if)#do show ip ospf neighbor
```

```
R2(config-if)#
```

```
R2(config-if)#no ip ospf hello-interval
```

```
R2(config-if)#no ip ospf dead-interval
```

```
R2(config-if)#
```

```
*Aug 23 04:31:32.727: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

```
R2(config-if)#do show ip ospf neighbor
```

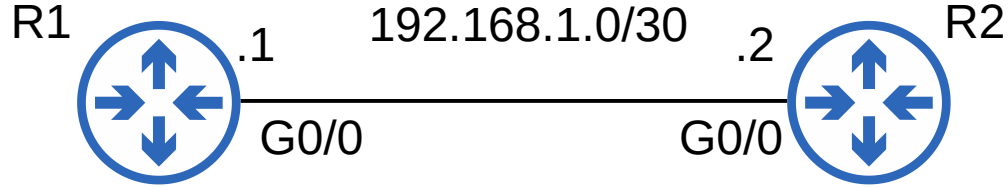
Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/BDR	00:00:35	192.168.1.1	GigabitEthernet0/0

```
R2(config-if)#
```

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match
- 6) Authentication settings must match

OSPF Neighbor Requirements



```
R2(config-if)#ip ospf authentication-key jeremy
```

```
R2(config-if)#ip ospf authentication
```

```
R2(config-if)#
```

```
*Aug 23 04:56:28.435: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: [
```

```
R2(config-if)#do show ip ospf neighbor
```

```
R2(config-if)#
```

```
R2(config-if)#no ip ospf authentication
```

```
R2(config-if)#no ip ospf authentication-key jeremy
```

```
*Aug 23 04:59:37.315: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

```
R2(config-if)#do show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/BDR	00:00:34	192.168.1.1	GigabitEthernet0/0

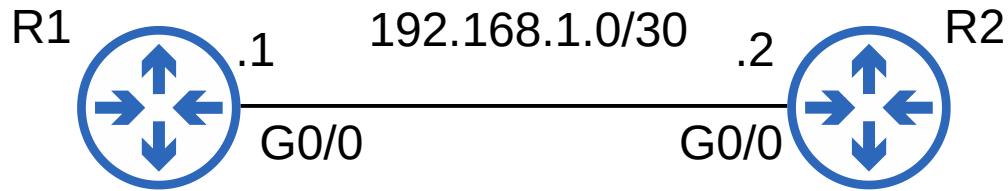
```
R2(config-if)#
```

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match
- 6) Authentication settings must match
- 7) IP MTU settings must match

Can become OSPF neighbors, but OSPF doesn't operate properly.

OSPF Neighbor Requirements



```
R2(config-if)#ip mtu ?
<68-1500> MTU (bytes)
```

```
R2(config-if)#ip mtu 1400
```

```
R2(config-if)#do show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	FULL/BDR	00:00:34	192.168.1.1	GigabitEthernet0/0

```
R2(config-if)#do clear ip ospf process
```

```
Reset ALL OSPF processes? [no]: yes
```

```
R2(config-if)#
```

```
*Aug 23 05:16:07.474: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
```

```
R2(config-if)#do show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.1	1	EXSTART/DR	00:00:38	192.168.1.1	GigabitEthernet0/0

```
*Aug 23 05:21:12.946: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from EXSTART to DOWN, Neighbor Down: Too many retransmissions
```

```
R2(config-if)#
```

```
*Aug 23 05:22:12.946: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from DOWN to DOWN, Neighbor Down: Ignore timer expired
```

```
R2(config-if)#no ip mtu
```

```
R2(config-if)#
```

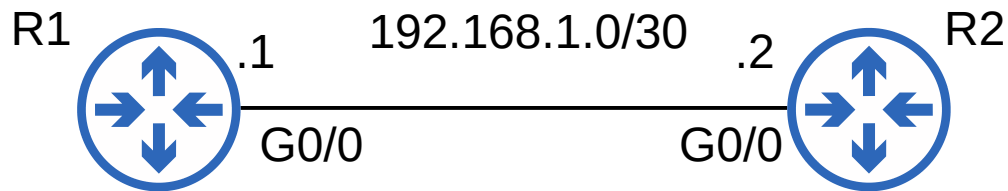
```
*Aug 23 05:25:49.362: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match
- 6) Authentication settings must match
- 7) IP MTU settings must match
- 8) OSPF Network Type must match

Can become OSPF neighbors, but OSPF doesn't operate properly.

OSPF Neighbor Requirements

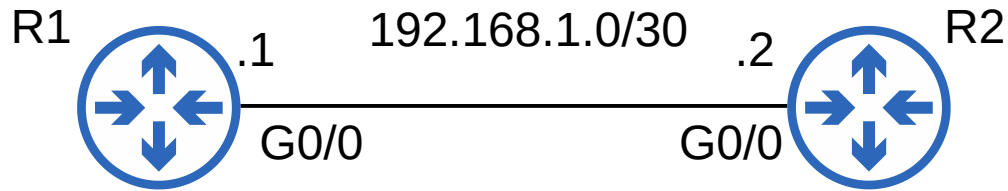


```

R2(config)#interface l0
R2(config-if)#
*Aug 23 05:52:53.898: %LINK-3-UPDOWN: Interface Loopback0, changed state to up
*Aug 23 05:52:54.898: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R2(config-if)#ip address 2.2.2.2 255.255.255.255
R2(config-if)#router ospf 1
R2(config-router)#network 2.2.2.2 0.0.0.0 area 0
R2(config-router)#interface g0/0
R2(config-if)#ip ospf network point-to-point
R2(config-if)#
*Aug 23 05:53:34.818: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from FULL to DOWN, Neighbor Down: Interface
*Aug 23 05:53:34.914: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
R2(config-if)#do show ip ospf neighbor

Neighbor ID      Pri   State           Dead Time   Address         Interface
192.168.1.1      0     FULL/ -         00:00:36   192.168.1.1    GigabitEthernet0/0
R2(config-if)#
  
```


OSPF Neighbor Requirements



```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.1.2	1	FULL/BDR	00:00:31	192.168.1.2	GigabitEthernet0/0

```
R1#show ip route
```

Codes: L - local, 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, H - NHRP, l - LISP
 + - replicated route, % - next hop override

```
Gateway of last resort is not set
```

```

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/30 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0

```

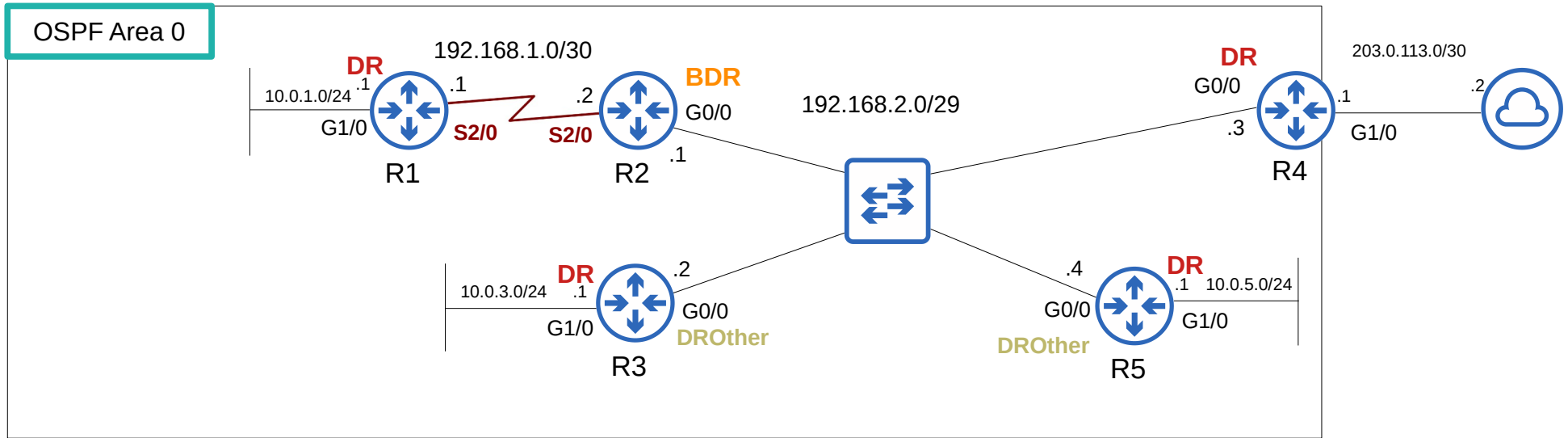
```
R1#
```

OSPF Neighbor Requirements

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match
- 6) Authentication settings must match
- 7) IP MTU settings must match
- 8) OSPF Network Type must match.

Can become OSPF neighbors, but OSPF doesn't operate properly.

OSPF LSA Types

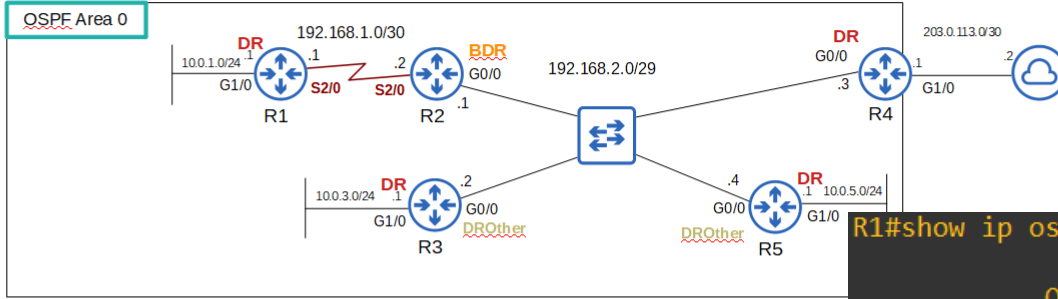


- The OSPF LSDB is made up of LSAs.
- There are 11 types of LSA, but there are only 3 you should be aware of for the CCNA:
 - Type 1 (Router LSA)
 - Type 2 (Network LSA)
 - Type 5 (AS External LSA)

OSPF LSA Types

- **Type 1 (Router LSA)**
 - Every OSPF router generates this type of LSA.
 - It identifies the router using its router ID.
 - It also lists networks attached to the router's OSPF-activated interfaces.
- **Type 2 (Network LSA)**
 - Generated by the DR of each 'multi-access' network (ie. the **broadcast** network type).
 - Lists the routers which are attached to the multi-access network.
- **Type 5 (AS-External LSA)**
 - Generated by ASBRs to describe routes to destinations outside of the AS (OSPF domain).

OSPF LSA Types



```
R1#show ip ospf database
```

```
OSPF Router with ID (1.1.1.1) (Process ID 1)
```

```
Router Link States (Area 0)
```

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	1396	0x80000002	0x00FE8D	4
2.2.2.2	2.2.2.2	932	0x80000005	0x00753F	4
3.3.3.3	3.3.3.3	974	0x80000004	0x00AD70	2
4.4.4.4	4.4.4.4	975	0x80000005	0x004CC2	2
5.5.5.5	5.5.5.5	976	0x80000004	0x00D212	3

```
Net Link States (Area 0)
```

Link ID	ADV Router	Age	Seq#	Checksum
192.168.2.3	4.4.4.4	932	0x80000002	0x00740D

```
Type-5 AS External Link States
```

Link ID	ADV Router	Age	Seq#	Checksum	Tag
0.0.0.0	4.4.4.4	273	0x80000002	0x00C0E0	1

```
R1#
```

Things we covered

- OSPF network types
- OSPF neighbor/adjacency requirements
- OSPF LSA types

Which option states a characteristic of the OSPF **point-to-point** network type that is different than the OSPF **broadcast** network type?

- a) DR/BDR elections are held.
- b) DR/BDR elections are not held.
- c) Neighbors are dynamically discovered.
- d) Neighbors are not dynamically discovered.

Quiz 2

There is an OSPF broadcast network with 5 connected routers. R1 is the DR on its G0/0 interface. How many **FULL** OSPF adjacencies does R1 have on the interface?

- a) 1, with the BDR.
- b) 2, with the DR and BDR.
- c) 4, with all neighbors.
- d) 5, with all routers connected to the segment.

Which of the following are requirements for routers to become OSPF neighbors?
(select two)

- a) Hello and Dead timers must match
- b) OSPF Process IDs must match
- c) OSPF Router IDs must match
- d) Interfaces must be in the same area
- e) Interfaces must be in different areas
- f) Interfaces must be in different subnets

- 1) Area number must match
- 2) Interfaces must be in the same subnet
- 3) OSPF process must not be **shutdown**
- 4) OSPF Router IDs must be unique
- 5) Hello and Dead timers must match
- 6) Authentication settings must match
- 7) IP MTU settings must match
- 8) OSPF Network Type must match.

Can become OSPF neighbors, but OSPF doesn't operate properly.

Which of the following OSPF LSA types is generated only by the DR of a multi-access network, such as the **broadcast** network type?

- a) Type 1
- b) Type 2
- c) Type 3
- d) Type 5

R1 is connected to an OSPF Broadcast network on its G0/0 interface. R4 is the DR of the segment and R3 is the BDR. All routers on the segment have the default OSPF priority. You issue the **ip ospf priority 100** command on R1's G0/0 to make it the DR. Which of the following statements are true about the network after you issue the command? (Select two)

- a) R1 is the DR.
- b) R1 is the BDR.
- c) R1 is still a DROther because its priority isn't high enough.
- d) If you issue the **clear ip ospf process** command on R4, R1 will become the BDR.
- e) If you issue the **clear ip ospf process** command on R4, R1 will become the DR.
- f) The DR and BDR of the network are unchanged.