OSPF Operations

1. **Discover neighbours**
2. **Form adjacencies**
3. **Flood Link State Database (LSDB)**
4. Compute Shortest Path
5. Install best routes in routing table
6. Respond to network changes

OSPF Packet Types

- **Hello**: A router will send out and listen for Hello packets when OSPF is enabled on an interface, and form adjacencies with other OSPF routers on the link

- **DBD DataBase Description**: Adjacent routers will tell each other the networks they know about with the DBD packet

- **LSR Link State Request**: If a router is missing information about any of the networks in the received DBD, it will send the neighbour an LSR

- LSA Link State Advertisement: A routing update. (These are not an OSPF packet type, they are the info contained inside LSUs)

- **LSU Link State Update**: Contains a list of LSA's which should be updated, used during flooding

- **LSAck**: Receiving routers acknowledge LSAs

OSPF Protocol

- Packet:

| L2 | **L3** | L4 | L5 | L6 | L7 |

- IP Header:

Version (4 bits)	Header length (4 bits)	Priority and Type of Service (8 bits)	Total length (16 bits)
Identification (16 bits)		Flags (3 bits)	Fragmented offset (13 bits)
Time to live (8 bits)	**Protocol (8 bits)**	Header checksum (16 bits)	
Source IP address (32 bits)			
Destination IP address (32 bits)			
Options (up to 32 bits)			

- Protocol Number:
  - 6: TCP
  - 17: UDP
  - 89: OSPF

OSPF Packet
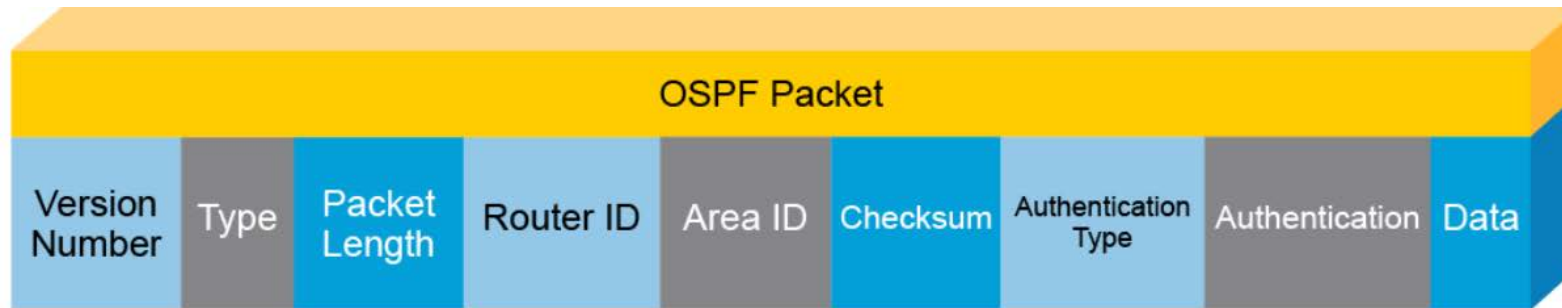
- **Version:** OSPFv2 or OSPFv3

- **Type:** 1- Hello, 2- DBD Database Descriptor, 3- LSR Link State Request, 4- LSU Link State Update, 5- Link State Acknowledgment

  (LSA Link State Advertisements are inside LSUs)

- **Router ID,** and **Area ID**: Of the advertising router, and interface

- **Authentication Type:** 0- No Password, 1- Plain-text password, 2- MD5 authentication

Hello Packets

- OSPF routers discover each other and form adjacencies via Hello packets

- They send Hello packets out each interface where OSPF is enabled (except passive interfaces)

- Multicast to 224.0.0.5 ('all OSPF routers')

- Sent every 10 seconds by default

Hello Packet Contents

- **Router ID:** 32 bit number that uniquely identifies each OSPF router

- **Hello Interval:** How often router sends Hello packets. Default 10 secs.

- **Dead Interval:** How long a router waits to hear from a neighbor before declaring it out of service. Default 4x Hello Interval.

- **Neighbors:** A list of adjacent OSPF routers that this router has received a Hello packet from.

Hello Packet Contents (Cont.)

- **Area ID:** The area configured for that interface
- **Router Priority:** An 8 bit number used to select DR and BDR.
- **DR and BDR IPv4 Address:** If known.
- **Authentication Flag:** Authentication details if configured.
- **Stub Area Flag:** If the area is a stub area. Stub areas have a default route to their ABR rather than learning routes outside the area.

Hello Packet Contents (Cont.)

These settings must match for a pair of OSPF routers to form an adjacency with each other:

- Must be in each other's Neighbor list
- Hello and Dead Intervals
- Area ID
- IP subnet
- Authentication Flag
- Stub Area Flag

MTU Mismatches

- If there is an MTU (Maximum Transmission Unit) setting mismatch then OSPF routers can become neighbors but they will not exchange routes with each other

- MTU is configured at the interface level (default 1500 bytes)

- You can set interface MTU (affects all packets) and/or interface IP MTU (affects only IP packets)

172.16.1.1/24

172.16.2.1/24

10.0.0.1/30

10.0.0.2/30

R1

R2

MTU: 1500 bytes

MTU: 1460 bytes

MTU Configuration

```
Router(config)#interface GigabitEthernet 0/0
Router(config-if)#mtu 1480
Router(config-if)#ip mtu 1460


Router #show interface GigabitEthernet 0/0
GigabitEthernet0/0 is up, line protocol is up
MTU 1480 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
       reliability 255/255, txload 1/255, rxload 1/255


Router #show ip interface GigabitEthernet 0/0
GigabitEthernet0/0 is up, line protocol is up
MTU is 1460 bytes
```
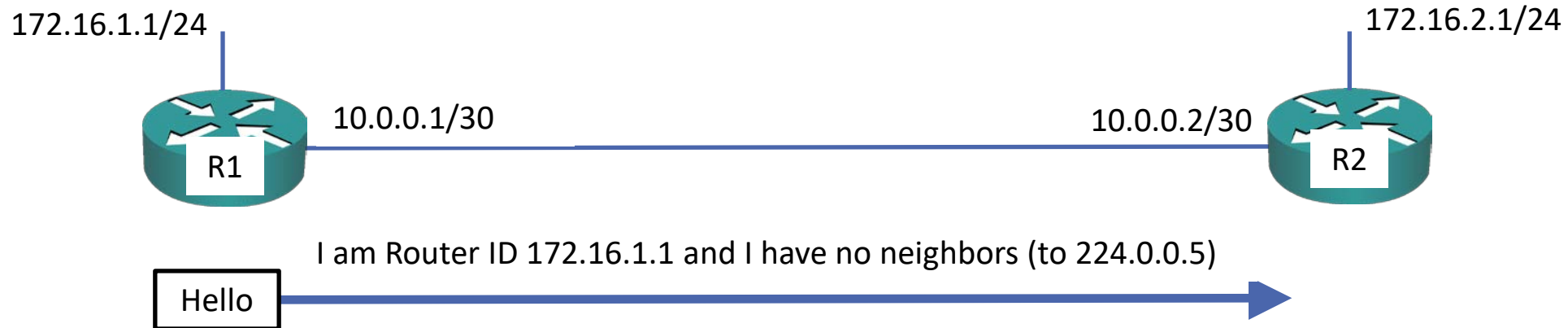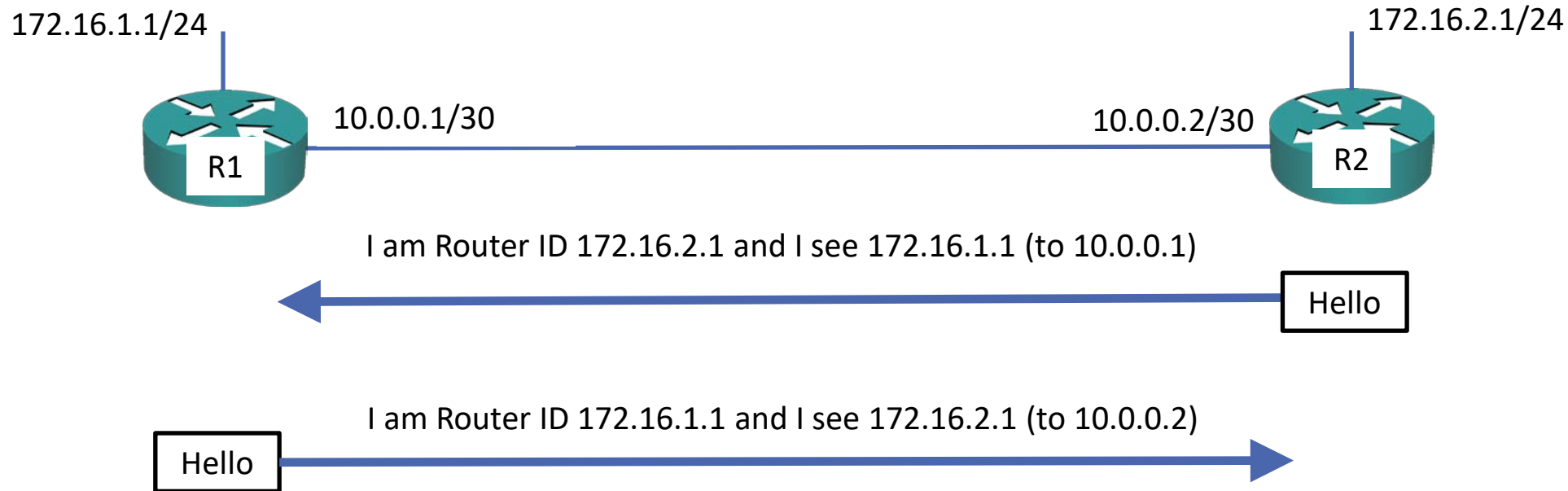
Neighbor States - Down
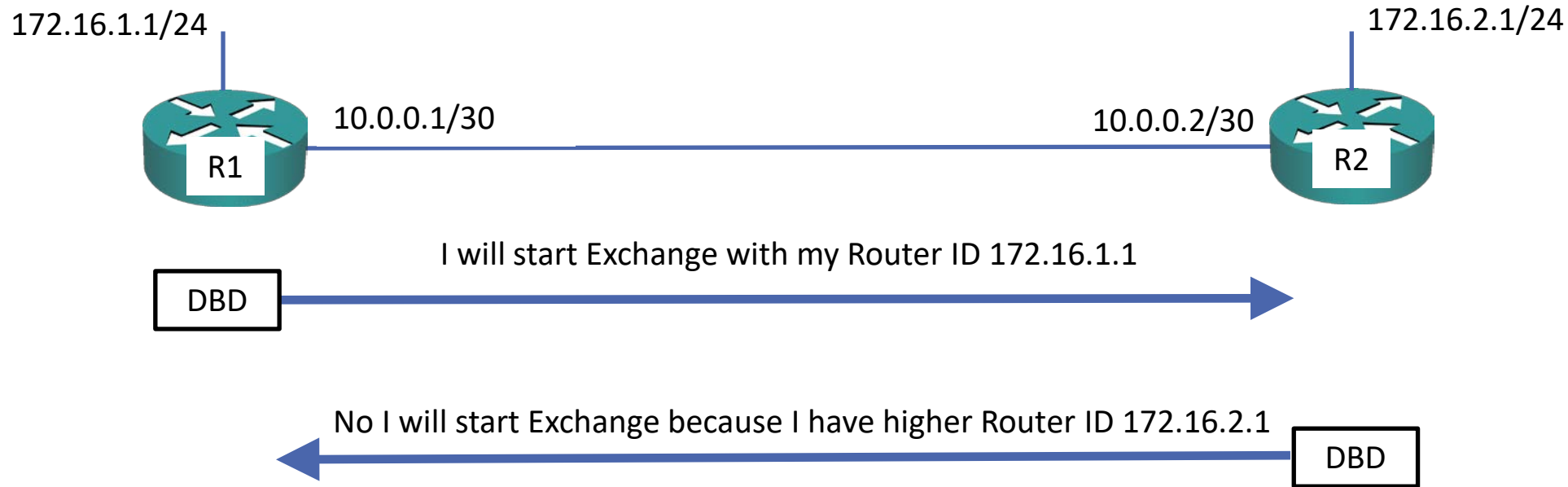

172.16.1.1/24

172.16.2.1/24

R1   10.0.0.1/30   10.0.0.2/30   R2

I am Router ID 172.16.1.1 and I have no neighbors (to 224.0.0.5)

Hello

Neighbor States – 2-Way

172.16.1.1/24

172.16.2.1/24

10.0.0.1/30

10.0.0.2/30

R1

R2

I am Router ID 172.16.2.1 and I see 172.16.1.1 (to 10.0.0.1)

Hello

I am Router ID 172.16.1.1 and I see 172.16.2.1 (to 10.0.0.2)

Hello

Neighbor States - Exchange

172.16.1.1/24

172.16.2.1/24

R1   10.0.0.1/30   10.0.0.2/30   R2

I will start Exchange with my Router ID 172.16.1.1

DBD →

No I will start Exchange because I have higher Router ID 172.16.2.1

← DBD

FLACKBOX
www.flackbox.com

Neighbor States – Exchange (Cont.)
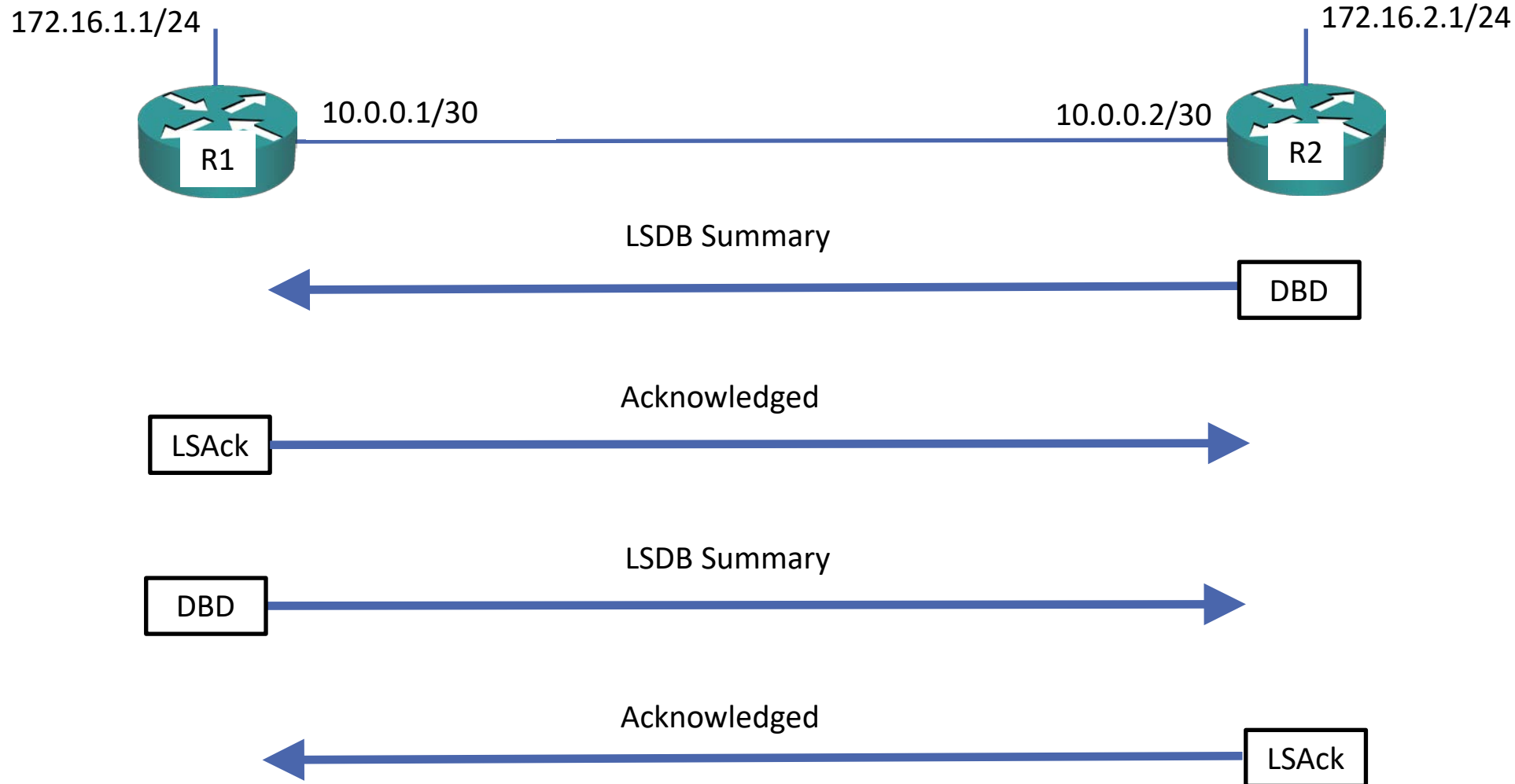
Neighbor States – Loading

172.16.1.1/24

172.16.2.1/24

R1 10.0.0.1/30   10.0.0.2/30 R2

I need full info on 172.16.1.0/24

LSR

Here's the info

LSU

I need full info on 172.16.2.0/24

LSR

Here's the info

LSU

Neighbor States - Full

172.16.1.1/24

172.16.2.1/24

10.0.0.1/30

R1

10.0.0.2/30

R2

Acknowledged

LSAck

Acknowledged

LSAck

FLACKBOX
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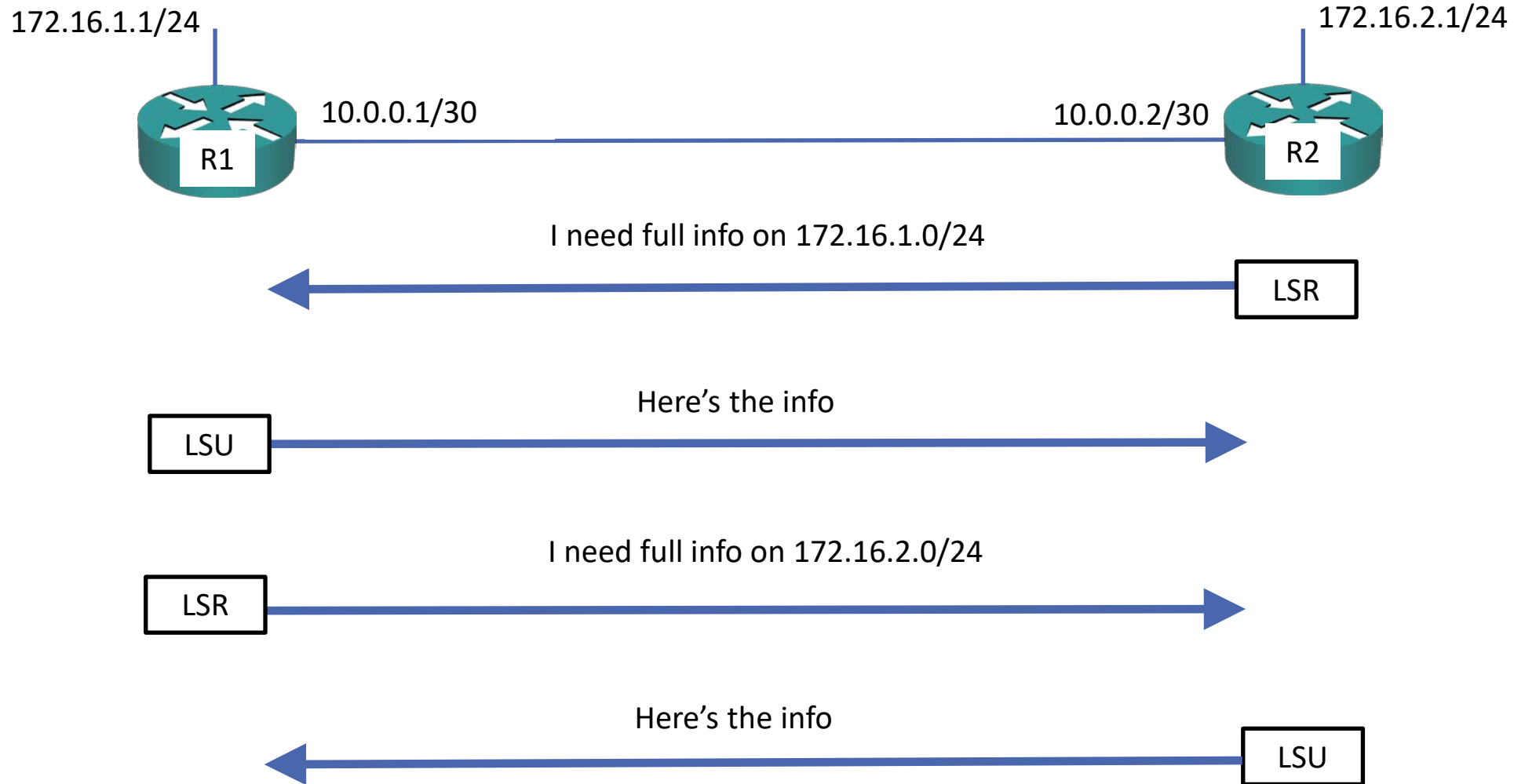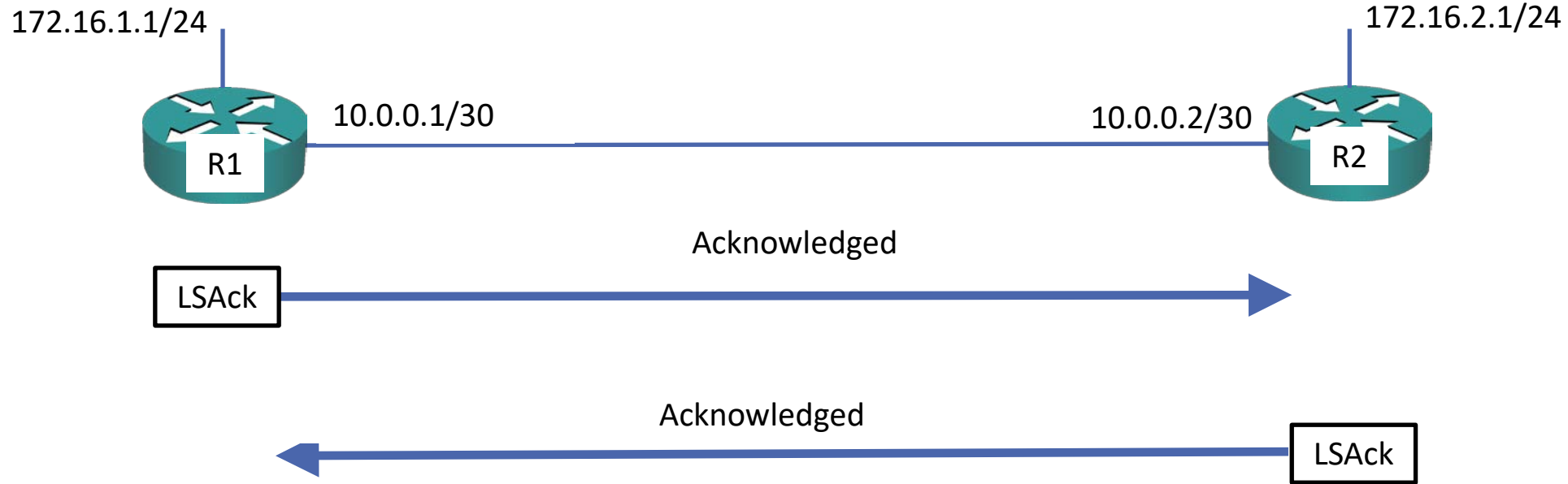
Neighbor State Summary

1. **Down**: No active neighbor detected
2. **INIT**: Hello packet is received from the neighbor
3. **2-WAY**: Own router ID in received hello
4. **Exstart**: Primary and secondary roles determined
5. **Exchange**: Database description packets sent
6. **Loading**: Exchange of LSRs and LSUs
7. **Full**: Neighbors fully adjacent