

# Networking with Router and Switch

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1. Network Terminology & Background
  2. Topology with Routers & Switches
  3. Network Connection & Configuration

# 1. Network Terminology & Background

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- (1) Frame - Relay
- (2) ISDN
- (3) Routing Protocols

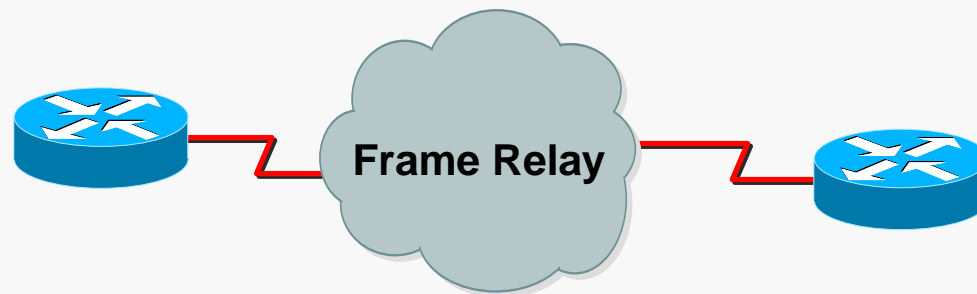
# 1. Network Terminology & Background

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## (1) Frame - Relay

- 
- 
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DLCI



# 1. Network Terminology & Background

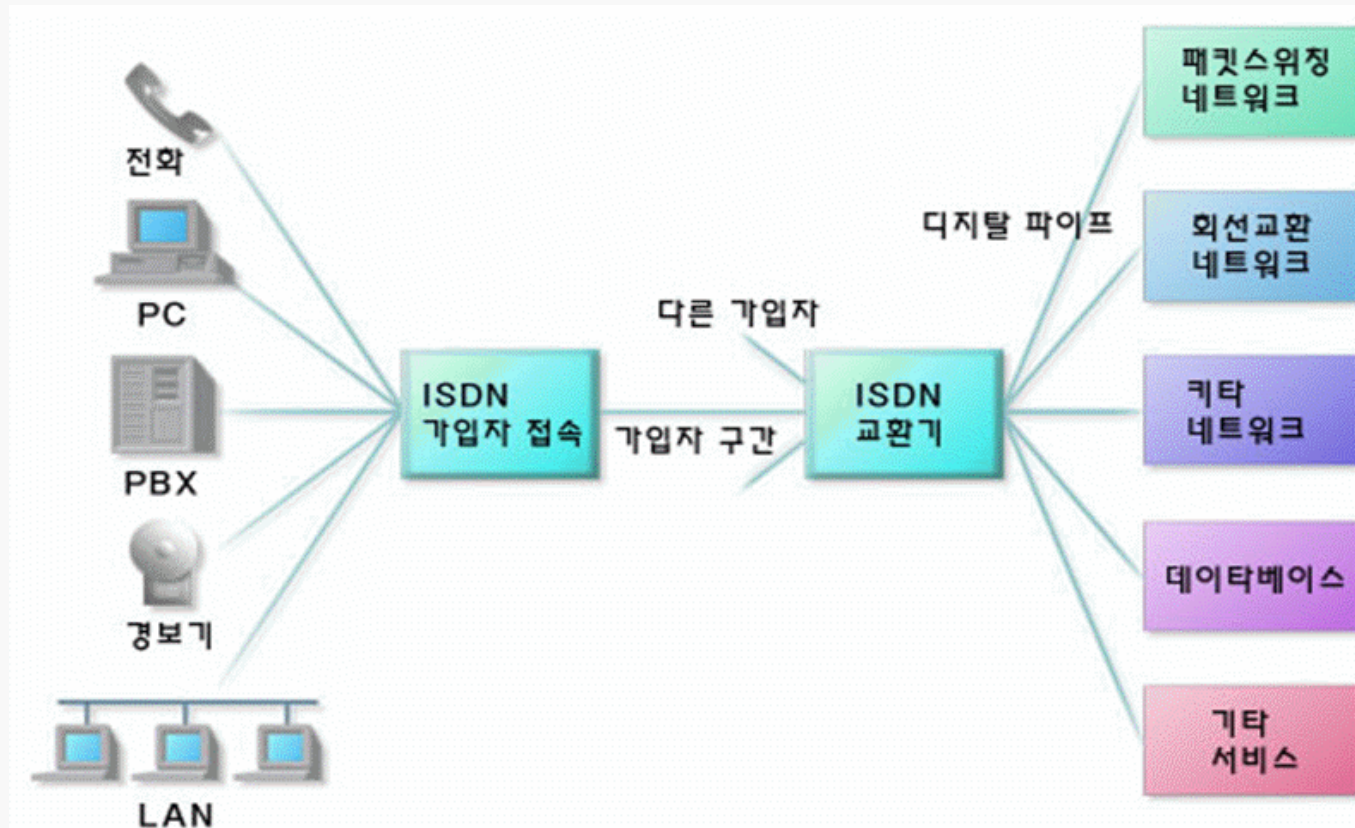
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## (2) ISDN

- , ,
- ISDN 2가 가
- BRI(144~192Kbps), PRI(1.544~2.048Mbps)

# 1. Network Terminology & Background

## (2) ISDN



# 1. Network Terminology & Background

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## (3) Routing Protocols

- **OSPF** (Open Shortest Path First)
- **RIP** (Routing Information Protocol)
- **EIGRP** (Enhanced Interior Gateway Routing Protocol)
- **ODR** (On Demand Routing)
- **BGP** (Border Gateway Protocol)
- **IPv6**

# 1. Network Terminology & Background

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## (3) Routing Protocols

### - OSPF Background

#### Area

-

- interface 가 Area

#### Topology Database

- Area

LSA(Link State Advertisement)

- Area



# 1. Network Terminology & Background

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## (3) Routing Protocols

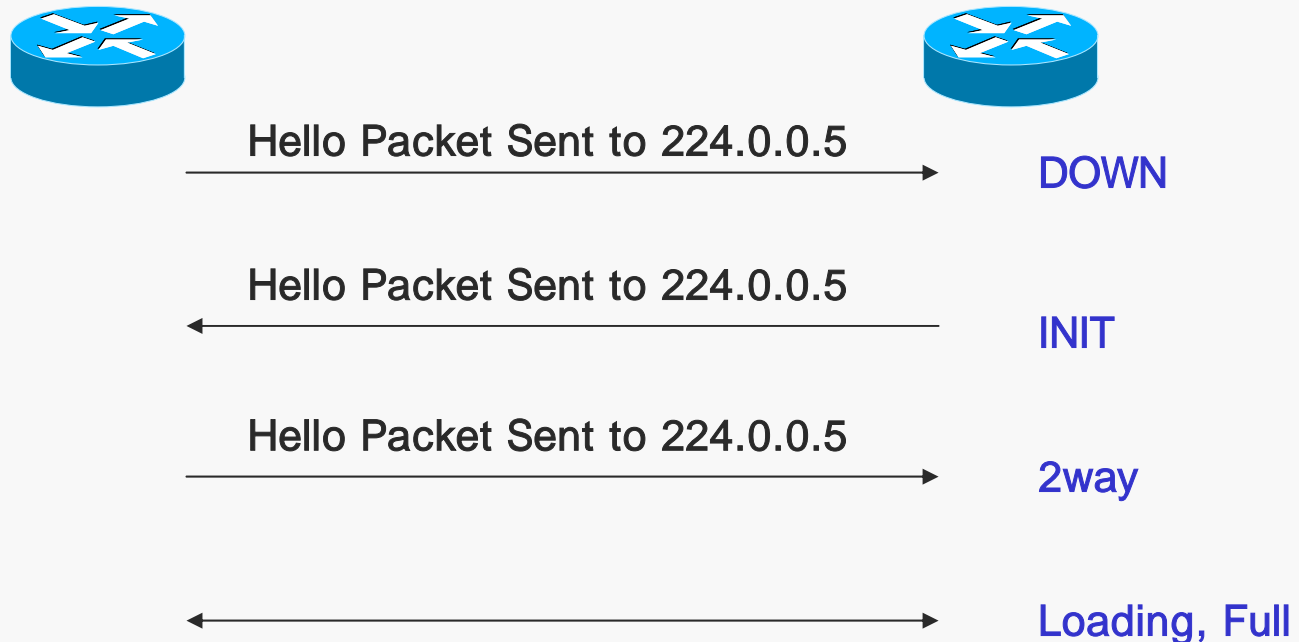
- OSPF Background

Internal Router (IR)	Area
Area Border Router (ABR)	Area
Autonomous System Border Router (ASBR)	AS AS
Designated Router (DR)	Area
Backup Designated Router (BDR)	DR

# 1. Network Terminology & Background

## (3) Routing Protocols

### - OSPF Background

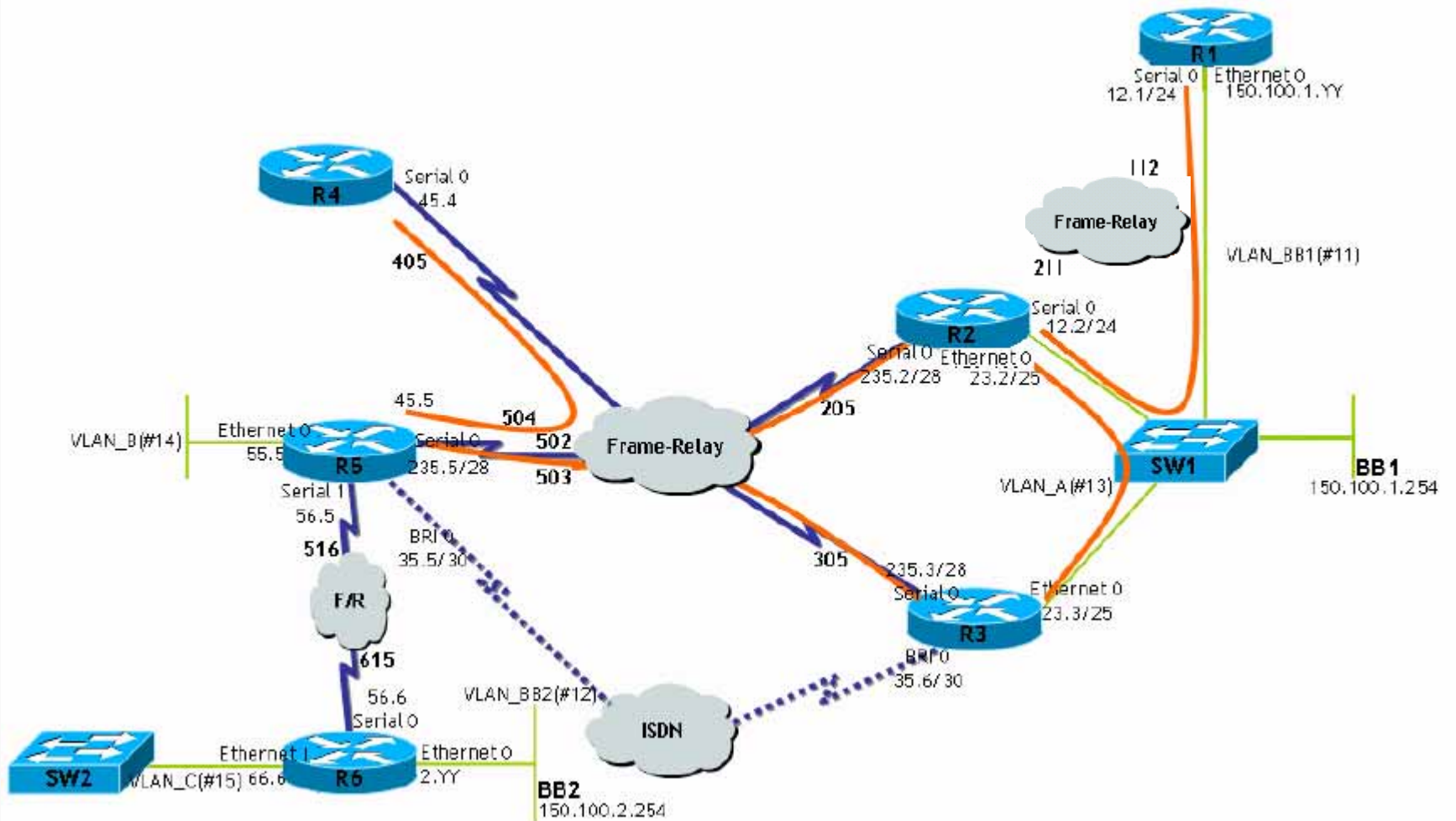


## 2. Topology with Router & Switch

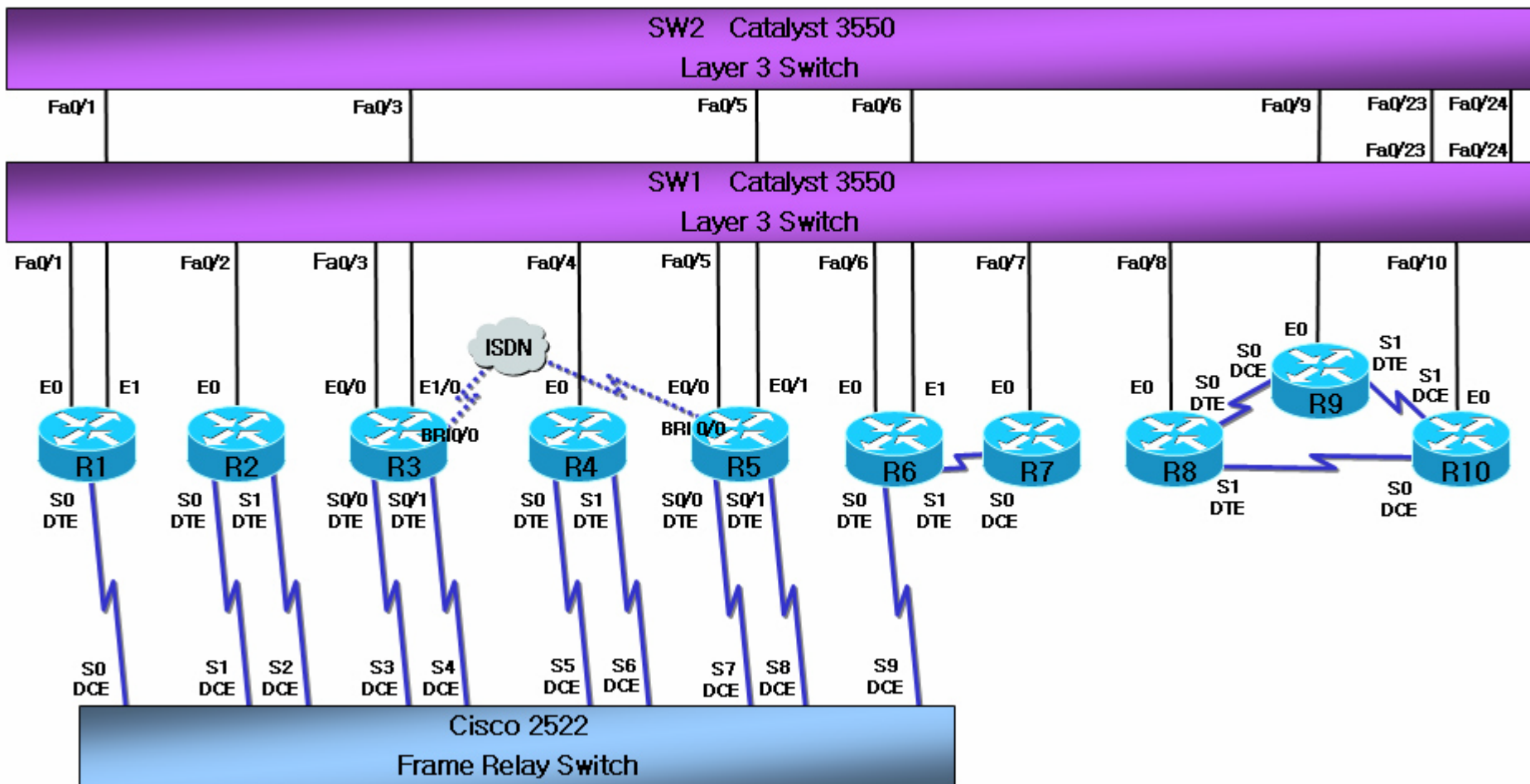
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- (1) Frame-Relay                      Router    WAN
- (2) Catalyst Switch    Router    LAN
- (3) Routing Protocols                      Networking
- (4) ISDN                      ISDN
- (5) IPv4                      IPv6

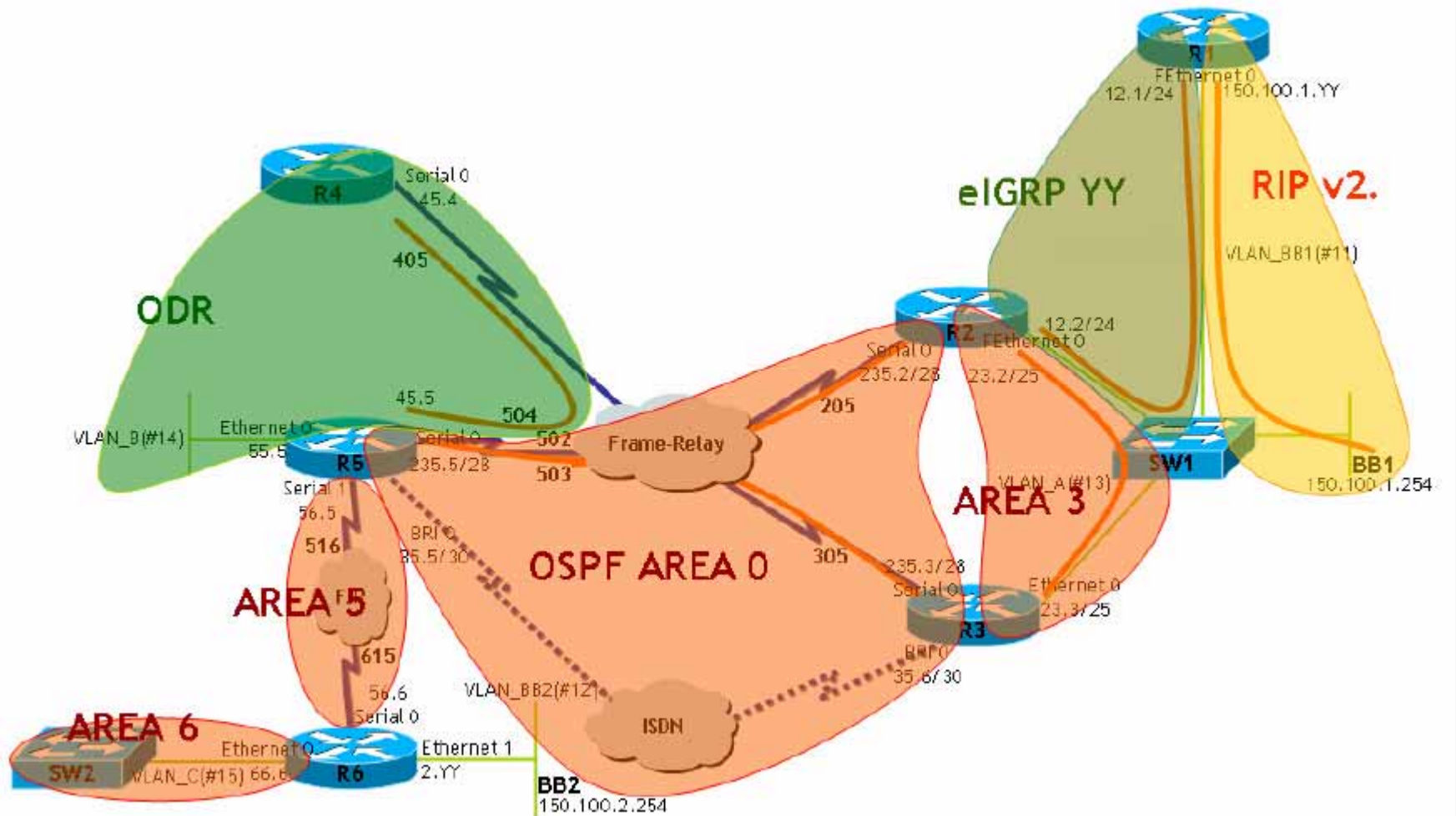
## 2. Topology with Router & Switch



## 2. Topology with Router & Switch



## 2. Topology with Router & Switch



# 3. Network Connection & Configuration

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(1) Frame-Relay Router WAN

# R5

```
interface serial 0/0
  encapsulation frame-relay
  no frame-relay inverse-arp
!
interface serial 0/0.45 multipoint
  no frame-relay inverse-arp
  frame-relay map ip 1.1.45.4 504 broadcast
!
interface serial 0/0.235 multipoint
  no frame-relay inverse-arp
  frame-relay map ip 1.1.235.2 502 broadcast
  frame-relay map ip 1.1.235.3 503 broadcast
!
```

# 3. Network Connection & Configuration

---

(1) Frame-Relay Router WAN

# R2

```
interface serial 0
  encapsulation frame-relay
  no frame-relay inverse-arp
  frame-relay map ip 1.1.235.5 205 broadcast
  frame-relay map ip 1.1.235.3 205 broadcast
```

# R3

```
interface serial 0
  encapsulation frame-relay
  no frame-relay inverse-arp
  frame-relay map ip 1.1.235.5 305 broadcast
  frame-relay amp ip 1.1.235.2 305 broadcast
```



# 3. Network Connection & Configuration

---

(1) Frame-Relay Router WAN

# R5

```
interface serial 0/0.45 multipoint
  no frame-relay inverse-arp
  frame-relay map ip 1.1.45.4 504 broadcast
```

# R4

```
interface serial 0
  encapsulation frame-relay
  no frame-relay inverse-arp
  frame-relay map ip 1.1.45.5.5 405 broadcast
```

# 3. Network Connection & Configuration

---

(1) Frame-Relay Router WAN

# R2

```
interface serial 1
  encapsulation frame-relay
  no frame-relay inverse-arp
  frame-relay map ip 1.1.12.1 211 broadcast
```

# R1

```
interface serial 0
  encapsulation frame-relay
  no frame-relay inverse-arp
  frame-relay map ip 1.1.12.2 112 broadcast
```

# 3. Network Connection & Configuration

---

(1) Frame-Relay Router WAN

# R5

```
interface serial 0/1
  encapsulation frame-relay
  no frame-relay inverse-arp
!
interface s 0/1.56 point-to-point
  frame-relay interface-dlci 516 ppp virtual-template 1
!
interface virtual-template 1
  ip address 1.1.56.5 255.255.255.0
!
```

# 3. Network Connection & Configuration

---

(1) Frame-Relay Router WAN

# R6

```
interface serial 0
  encapsulation frame-relay
  no frame-relay inverse-arp
!
interface serial 0/1.56 point-to-point
  frame-relay interface-dlci 615 ppp virtual-template 1
!
interface virtual-template 1
  ip address 1.1.56.6 255.255.255.0
!
```

show frame-relay map → Verifying

# 3. Network Connection & Configuration

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(2) Catalyst Switch    Router    LAN

**# sw1**

```
vtp mode transparent
!  
vlan 11
  name VLAN_BB1
!  
vlan 13
  name VLAN_A
!  
vlan 14
  name VLAN_B
!  
vlan 12
  name VLAN_BB2
```

**# sw2**

```
vtp mode transparent
!  
vlan 15
  name VLAN_C
```

**# sw1, sw2**

```
interface range fastethernet 0/23 – 24
  switchport trunk encapsulation isl
  switchport mode trunk
```

# 3. Network Connection & Configuration

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(2) Catalyst Switch    Router    LAN

# sw1

```
interface fastethernet 0/1
  switchport mode access
  switchport access vlan 11
interface fastethernet 0/8
  switchport mode access
  switchport access vlan 11
interface fastethernet 0/2
  switchport mode access
  switchport access vlan 13
interface fastethernet 0/3
  switchport mode access
  switchport access vlan 13
interface fastethernet 0/5
  switchport mode access
  switchport access vlan 14
```

```
interface fastethernet 0/6
  switchport mode access
  switchport access vlan 12
interface fastethernet 0/9
  switchport mode access
  switchport access vlan 12
```

# sw2

```
interface fastethernet 0/6
  switchport mode access
  switchport access vlan 15
```

# 3. Network Connection & Configuration

(3) Routing protocol

Networking

OSPF AREA 0

# R5

```
router ospf 1
  router-id 1.1.5.5
  network 1.1.5.5 0.0.0.0 area 0
  network 1.1.235.5 0.0.0.0 area 0
  network 1.1.35.5 0.0.0.0 area 0
!
interface loopback 0
  ip ospf network point-to-point
!
interface serial 0/0.235 multipoint
  ip ospf priority 2
```

# R2

```
router ospf 1
  router-id 1.1.2.2
  network 1.1.2.2 0.0.0.0 area 0
  network 1.1.235.2 0.0.0.0 area 0
!
interface loopback 0
  ip ospf network point-to-point
!
interface serial 0
  ip ospf priority 0
```

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

OSPF AREA 0

**# R3**

```
router ospf 1
  router-id 1.1.3.3
  network 1.1.3.3 0.0.0.0 area 0
  network 1.1.235.3 0.0.0.0 area 0
!
interface loopback 0
  ip ospf network point-to-point
!
interface serial 0
  ip ospf priority 0
```

**# Verifying**

- show ip ospf neighbor
- show ip route



# 3. Network Connection & Configuration

(3) Routing protocol

Networking

OSPF AREA 3

# R2

```
router ospf 1
  network 1.1.23.2 0.0.0.0 area 3
!
```

# R3

```
router ospf 1
  network 1.1.23.3 0.0.0.0 area 3
!
```

# sw1

```
interface vlan 13
  ip address 1.1.23.7 255.255.255.0
!
```

ip routing

!

```
router ospf 1
  router-id 1.1.7.7
  network 1.1.7.7 0.0.0.0 area 3
  network 1.1.23.7 0.0.0.0 area 3
```

!

```
int loopback 0
  ip ospf network point-to-point
```

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

OSPF AREA 5

# R5

```
router ospf 1
  network 1.1.56.5 0.0.0.0 area 5
!
```

# R6

```
router ospf 1
  router-id 1.1.6.6
  network 1.1.6.6 0.0.0.0 area 5
  network 1.1.56.6 0.0.0.0 area 5
!
interface loopback 0
  ip ospf network point-to-point
```

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

OSPF AREA 6

# R6

```
router ospf 1
  network 1.1.66.6 0.0.0.0 area 6
!
```

# sw2

```
interface vlan 15
  ip address 1.1.66.8 255.255.255.0
!
ip routing
!
router ospf 1
  router-id 1.1.8.8
  network 1.1.8.8 0.0.0.0 area 6
  network 1.1.66.8 0.0.0.0 area 6
!
interface loopback 0
  ip ospf network point-to-point
```

# 3. Network Connection & Configuration

(3) Routing protocol

Networking

Virtual-link, totally stubby

# R5

```
router ospf 1
  area 5 virtual-link 1.1.6.6
!
```

# R6

```
router ospf 1
  area 5 virtual-link 1.1.5.5
```

# sw2

```
router ospf 1
  area 6 stub
!
```

# R6

```
router ospf 1
  area 6 stub no-summary
```

show ip route → routing table



# 3. Network Connection & Configuration

(3) Routing protocol

Networking

EIGRP      loopback interface      가

# R1

```
router eigrp 1
  eigrp router-id 1.1.1.1
  no auto-summary
  network 1.1.1.1 0.0.0.0
  network 1.1.12.1 0.0.0.0
!
```

# R2

```
router eigrp 1
  eigrp router-id 1.1.2.2
  no auto-summary
  network 1.1.12.2 0.0.0.0
```

# R1

```
interface loopback 1
  ip address 151.100.32.1 255.255.255.0
!
interface loopback 2
  ip address 151.100.33.1 255.255.255.0
!
interface loopback 3
  ip address 151.100.34.1 255.255.255.0
!
interface loopback 4
  ip address 151.100.35.1 255.255.255.0
!
```

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking



# R1

```
router eigrp 1
network 151.100.32.0 0.0.3.255
```

# R1

```
interface serial 0
ip summary-address eigrp 1 151.100.32.0 255.255.252.0
```



R2

route

.

# 3. Network Connection & Configuration

(3) Routing protocol

Networking

ODR

# R4

```
interface serial 0
  cdp enable
!
```

ODR    cisco CDP

# R5

```
interface serial 0/0.45 multipoint
  cdp enable
!
router odr
  network 1.1.0.0
```

\*

- cdp가 enable
- Hub Router    network



# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

Redistribution ( )

# (redistribution)

- Routing Information

- Routing

static route

redistribution

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

Redistribution ( )

# R1

```
router rip
```

```
  redistribute eigrp 1 metric 5
```

```
!
```

```
router eigrp 1
```

```
  bandwidth, delay, reliability, load, mtu
```

```
  redistribute rip metric 10000 1000 255 1 1500
```

# R2

```
router eigrp 1
```

```
  redistribute ospf 1 metric 10000 1000 255 1 1500
```

```
!
```

```
router ospf 1
```

```
  redistribute eigrp 1 metric 300 subnets
```

# 3. Network Connection & Configuration

---

(3) Routing protocol

Networking

Redistribution ( )

# R5

```
router ospf
  redistribute odr metric 300 subnets
!
```

# R6

```
router ospf 1
  redistribute connected metric 300 subnets
```

# 3. Network Connection & Configuration

---

(4) ISDN

ISDN



# R3

```
isdn switch-type basic-ni
username R5 password cisco
dialer-list 1 protocol ip permit
!
interface bri 0
  encapsulation ppp
  ppp authentication chap
  dialer-group 1
  dialer map ip 1.1.35.5 name R5 broadcast 5002222
  no cdp enable
  no peer neighbor-route
  ip ospf demand-circuit
```

# 3. Network Connection & Configuration

---

(4) ISDN

ISDN



# R5

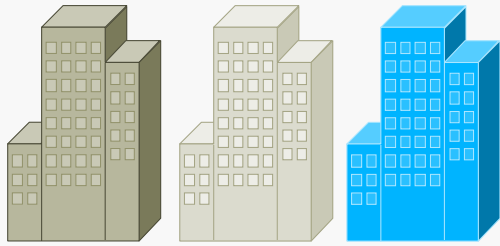
```
isdn switch-type basic-ni
username R3 password cisco
dialer-list 1 protocol ip permit
!
interface bri 0/0
  encapsulation ppp
  ppp authentication chap
  dialer-group 1
  dialer map ip 1.1.35.6 name R3 broadcast 5001111
  no cdp enable
  no peer neighbor-route
  ip ospf demand-circuit
```

# 3. Network Connection & Configuration

(4) ISDN

ISDN

ISDN (CALLBACK)



Headquarters

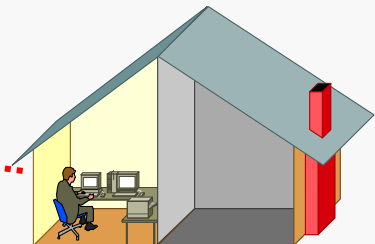
Home Office      Headquarters

Headquarters      call

Headquarters      Home Office



Home Office



# 3. Network Connection & Configuration

---

(4) ISDN

ISDN

ISDN CALLBACK

# R3

```
interface bri 0  
  ppp callback request
```

# R5

```
interface bri 0/0  
  ppp callback accept  
  dialer callback-secure  
  dialer map ip 1.1.35.6 name R3 class CALLBACK broadcast 5001111  
!  
map-class dialer CALLBACK  
  dialer callback-server username
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

# IPv6 Address

- Site Local Address      IPv4      Private Address
- Link Local Address      IPv4      Public Address
- Aggregatable Global Unicast Address  
    IPv4      Summary Address



# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6

# R1

ipv6 unicast-routing

!

interface loopback 0

  ipv6 enable

  ipv6 address FEC0:0:0:1::1/64

!

interface serial 0

  ipv6 enable

  ipv6 address FEC0:0:0:C::1/64

  frame-relay map ipv6 FEC0:0:0:C::2 112 broadcast

  frame-relay map ipv6 FE80::2E0:B0FF:FE5A:A6F8 112 broadcast

Site Local Address

Subnet ID

Interface ID

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6

# R2

```
ipv6 unicast-routing
```

```
!
```

```
interface loopback 0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:1::1/64
```

```
!
```

```
interface ethernet 0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:17::2/64
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6

# R2

```
interface serial 1
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:C::2/64
```

```
  frame-relay map ipv6 FEC0:0:0:C::1 211 broadcast
```

```
  frame-relay map ipv6 FE80::210:7BFF:FE81:1CD4 211 broadcast
```

```
!
```

```
interface serial 0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:EB::2/64
```

```
  frame-relay map ipv6 FEC0:0:0:EB::3 205 broadcast
```

```
  frame-relay map ipv6 FEC0:0:0:EB::5 205 broadcast
```

```
  frame-relay map ipv6 FE80::203:6BFF:FE91:8500 205 broadcast
```

```
  frame-relay map ipv6 FE80::230:94FF:FE40:C720 205 broadcast
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6

**# R3**

```
interface loopback 0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:3::3/64
```

```
interface ethernet 0/0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:17::3/64
```

```
interface serial 0/0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:EB::3/64
```

```
  frame-relay map ipv6 FEC0:0:0:EB::2 305 broadcast
```

```
  frame-relay map ipv6 FEC0:0:0:EB::5 305 broadcast
```

```
  frame-relay map ipv6 FE80::2E0:B0FF:FE5A:A6F8 305 broadcast
```

```
  frame-relay map ipv6 FE80::230:94FF:FE40:C720 305 broadcast
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6

# R5

```
interface loopback 0
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:5::5/64
```

```
!
```

```
interface serial 0/0.235 multipoint
```

```
  ipv6 enable
```

```
  ipv6 address FEC0:0:0:EB::5/64
```

```
  frame-relay map ipv6 FEC0:0:0:EB::2 502 broadcast
```

```
  frame-relay map ipv6 FEC0:0:0:EB::3 503 broadcast
```

```
  frame-relay map ipv6 FE80::203:6BFF:FE91:8500 503 broadcast
```

```
  frame-relay map ipv6 FE80::2E0:B0FF:FE5A:A6F8 502 broadcast
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6 RIPng

**# R1**

```
interface loopback 0
  ipv6 rip 1 enable
!
interface serial 0
  ipv6 rip 1 enable
```

**# R2**

```
interface loopback 0
  ipv6 rip 2 enable
!
interface serial 0
  ipv6 rip 2 enable
!
interface ethernet 0
  ipv6 rip 2 enable
!
interface serial 0
  ipv6 rip 2 enable
```

# 3. Network Connection & Configuration

---

(5) IPv4

IPv6

IPv6 RIPng

**# R3**

```
interface loopback 0
  ipv6 rip 3 enable
!
interface ethernet 0/0
  ipv6 rip 3 enable
!
interface serial 0/0
  ipv6 rip 3 enable
```

**# R5**

```
interface loopback 0
  ipv6 rip 5 enable
!
interface serial 0/0.235 multipoint
  ipv6 rip 5 enable
!
ipv6 router rip
  no split-horizon
```

# Reference

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- [www.cisco.com/univercd](http://www.cisco.com/univercd)
- CCIE Practical Studies vol 1. vol 2.
- [www.ionthenet.co.kr](http://www.ionthenet.co.kr)
- [www.ciscocamp.net](http://www.ciscocamp.net)



# Q & A

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