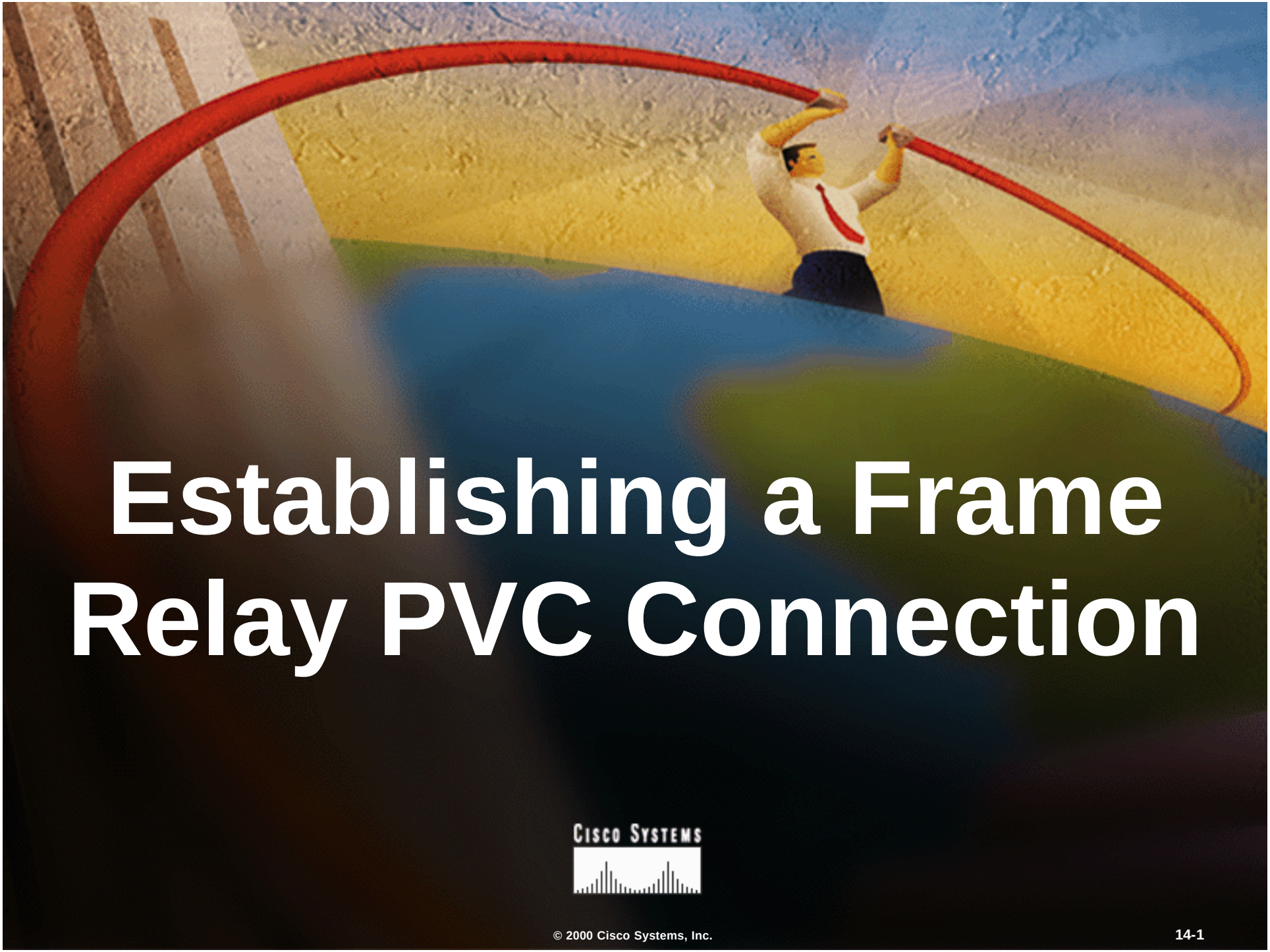


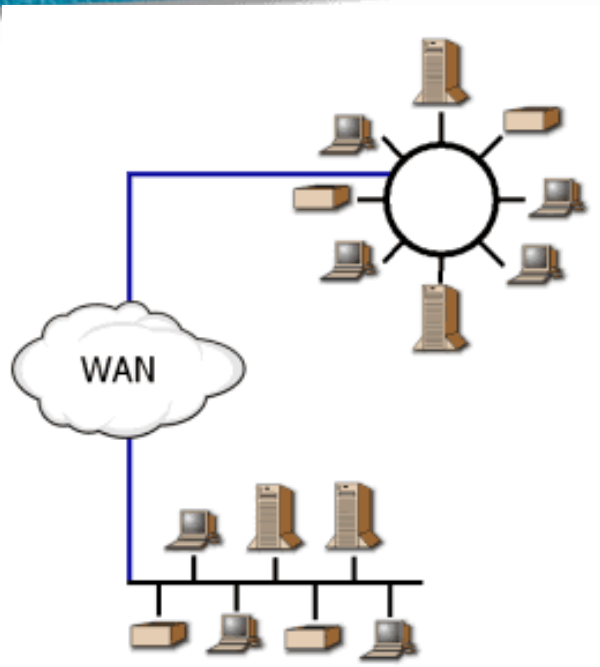
Establishing a Frame Relay PVC Connection

Objectives

Upon completion of this chapter, you will be able to perform the following tasks:

- **Determine how Frame Relay operates**
- **Configure Frame Relay**
- **Configure Frame Relay subinterfaces**
- **Verify Frame Relay operation**

Frame Relay Overview



- Way of sending information over a wide area network (WAN)
- Divides the information into frames or packets.
- Each frame has an address that the network uses to determine the destination of the frame.

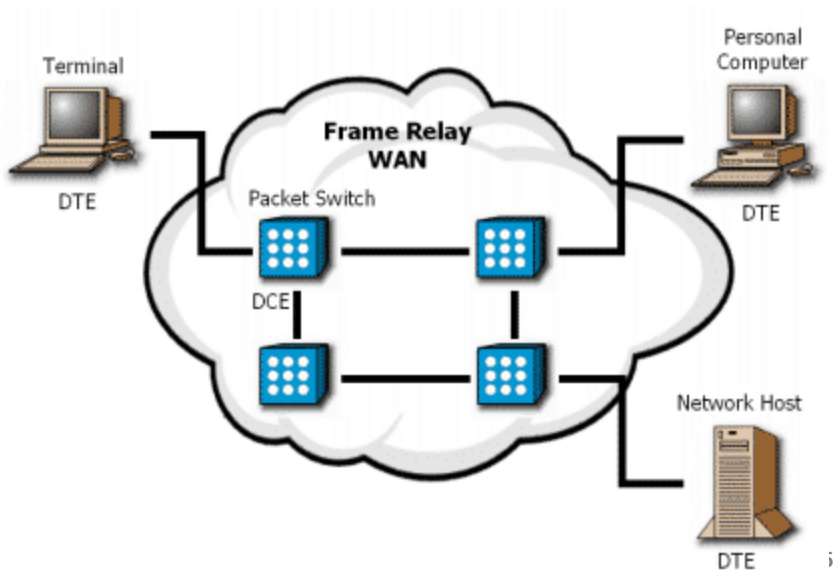
Frame Relay Features

- Increased Speeds
- Dynamic Bandwidth
- Smarter Attached Devices
- Higher Performance
- Low Overhead / High Reliability

Frame Relay Devices

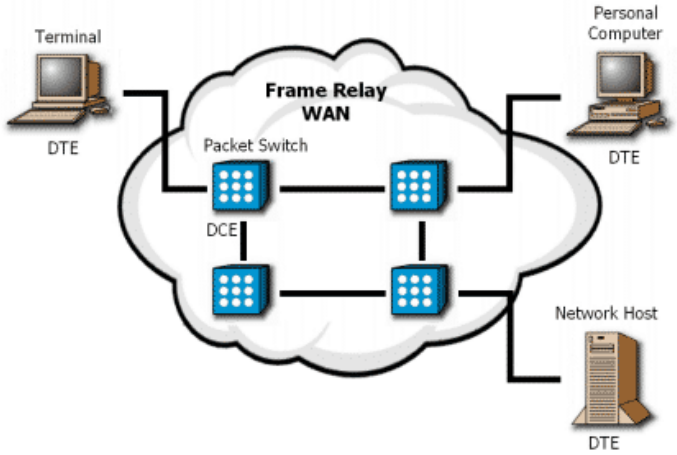
A frame relay network consists of endpoints, frame relay access network devices (e.g., bridges, routers, hosts, frame relay access devices switches, network routers, T1/E1multiplexers). These devices fall into two different categories:

- **DTE: Data Terminating Equipment**
- **DCE: Data Communication Equipment**



Frame Relay Network

A frame relay network will often be depicted as a network cloud



Frame relay network is not a single physical connection between endpoints. Logical paths are defined within the network. Based on the concept of using virtual circuits (VCs).

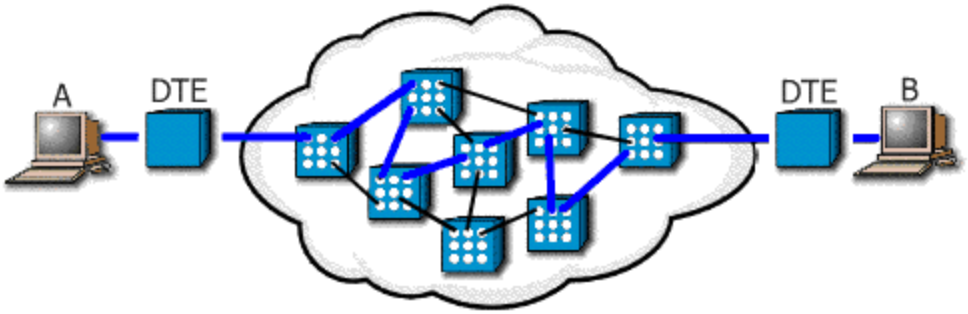
Virtual Circuits

VCs are two-way, software-defined data paths between two ports that act as private line replacements in the network.

There are two types of virtual circuits:

Switched Virtual Circuits

Permanent Virtual Circuits

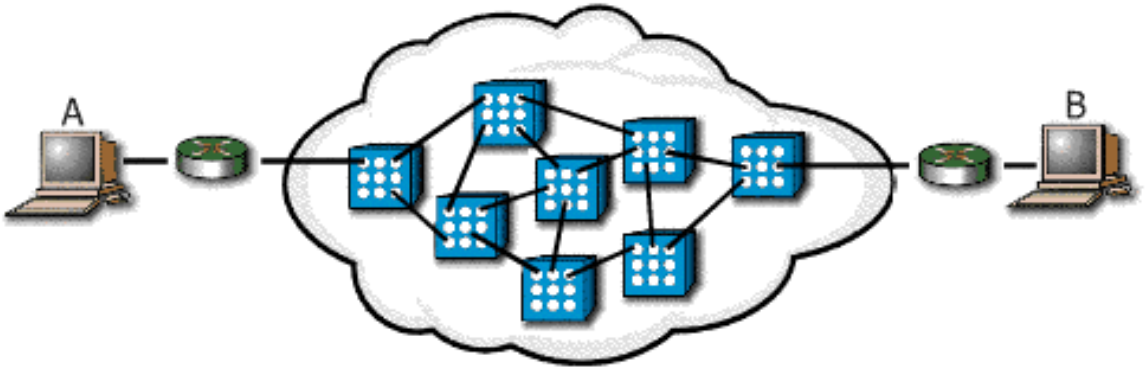


Switched Virtual Circuits

The Four States of SVC

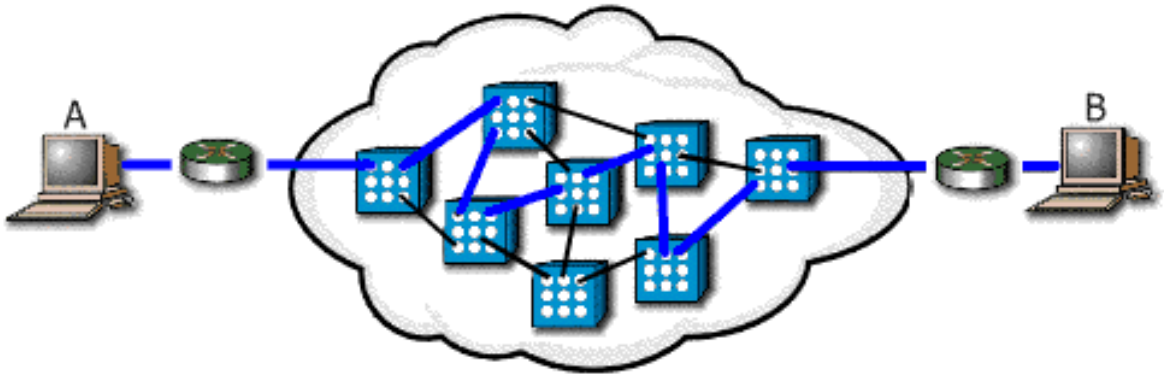
- Call setup
- Data transfer
- Idling
- Call termination

Call Setup



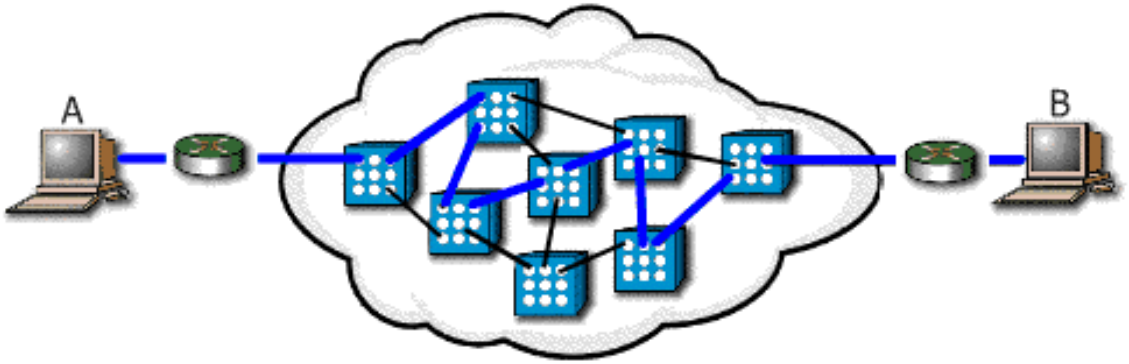
Call Setup: In this initial state, the virtual circuit between two Frame Relay DTE devices is established.

Data Transfer



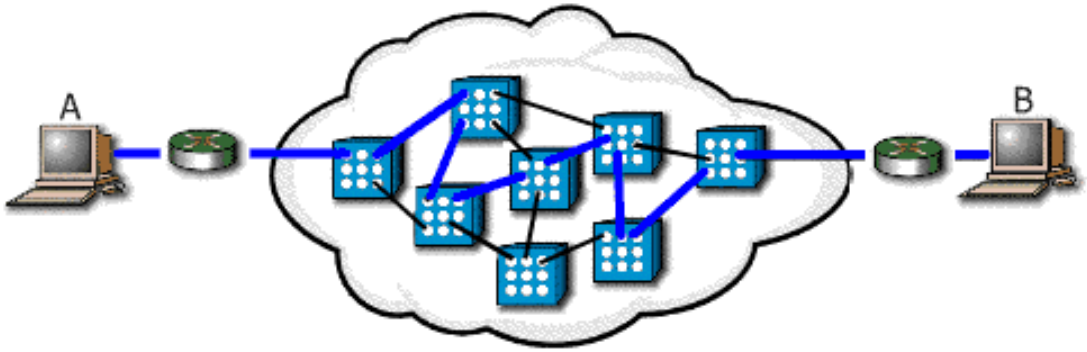
Data Transfer: Next, data is transmitted between the DTE devices over the virtual circuit.

Idling



Idling: In the idling stage, the connection is still open, but the data transfer has ceased.

Call Termination



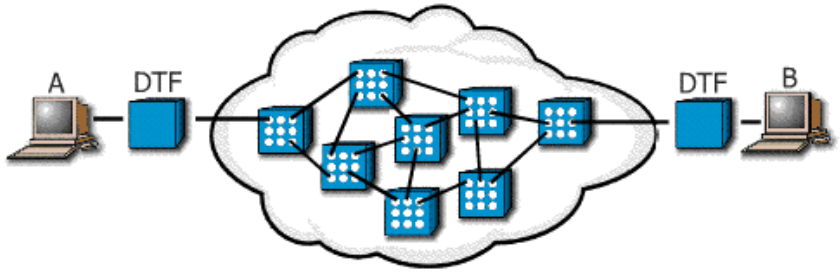
Call Termination: After the connection has idled for a particular period of time, the connection between the two DTEs is terminated.

Permanent Virtual Circuits

- PVCs are fixed paths.
- PVC is like a dedicated point-to-point circuit.
- PVCs are popular because they provide a cost-effective alternative to leased lines.

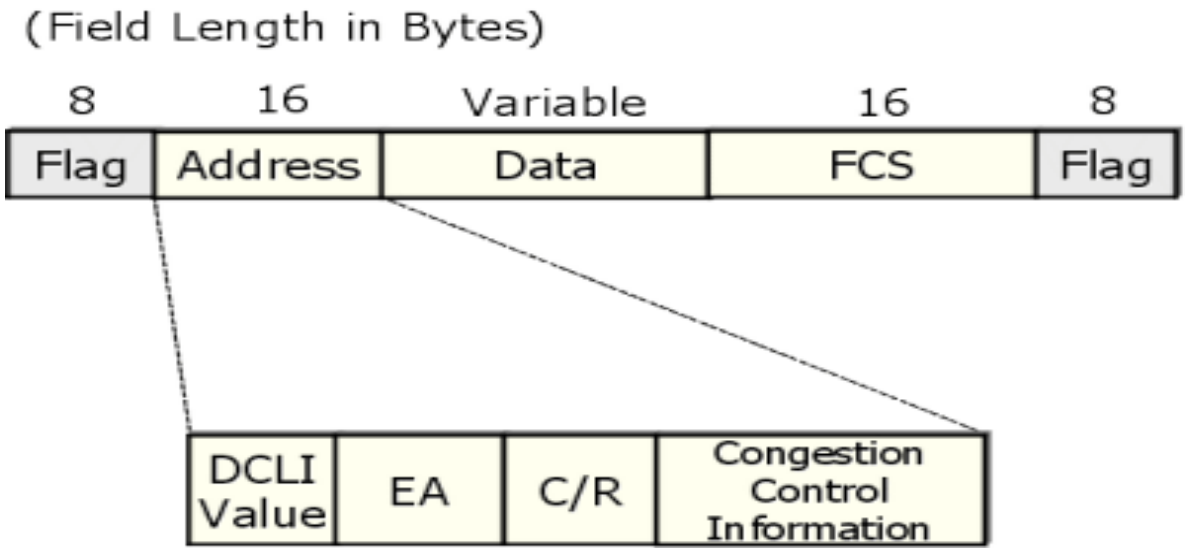
There are only two states PVC:

- Data transfer
- Idling

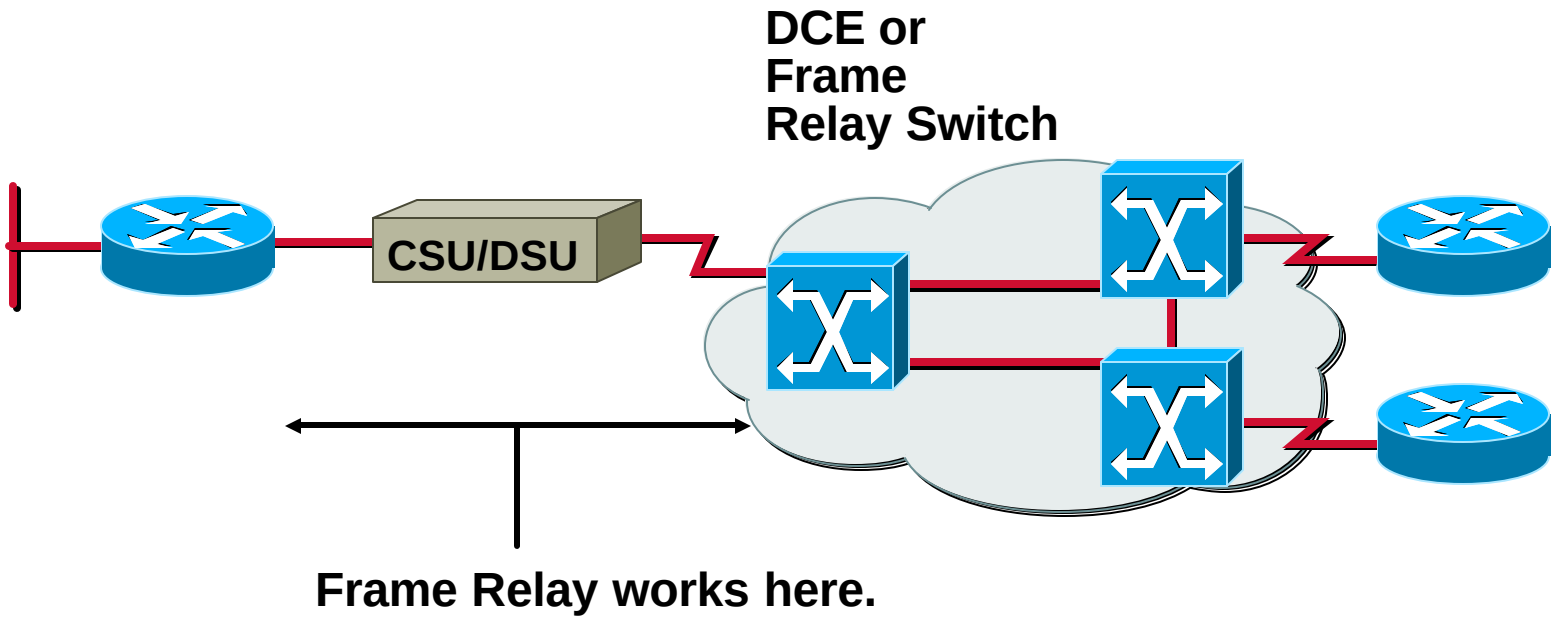


Frame Relay Frame Structure

Frame relay frame, user data packets are no changed in any way. Frame relay simply adds a two-byte header to the packets.

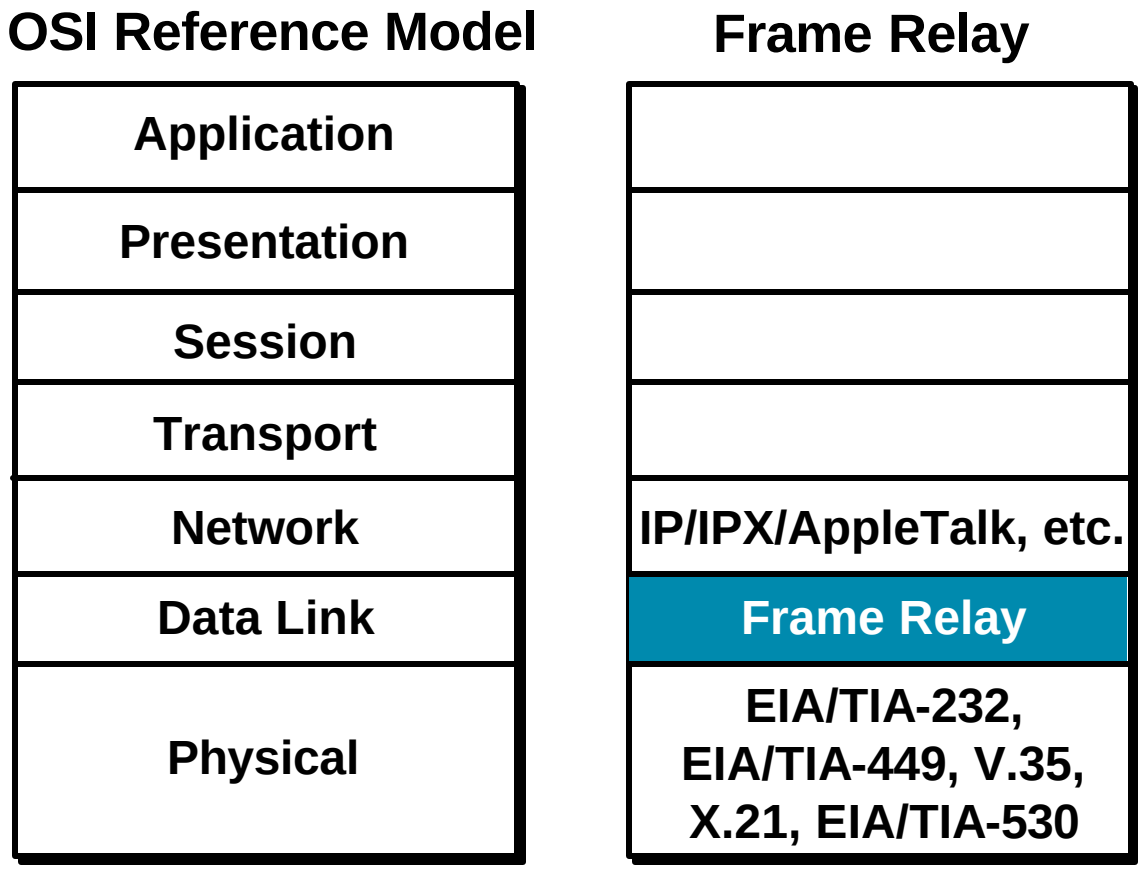


Frame Relay

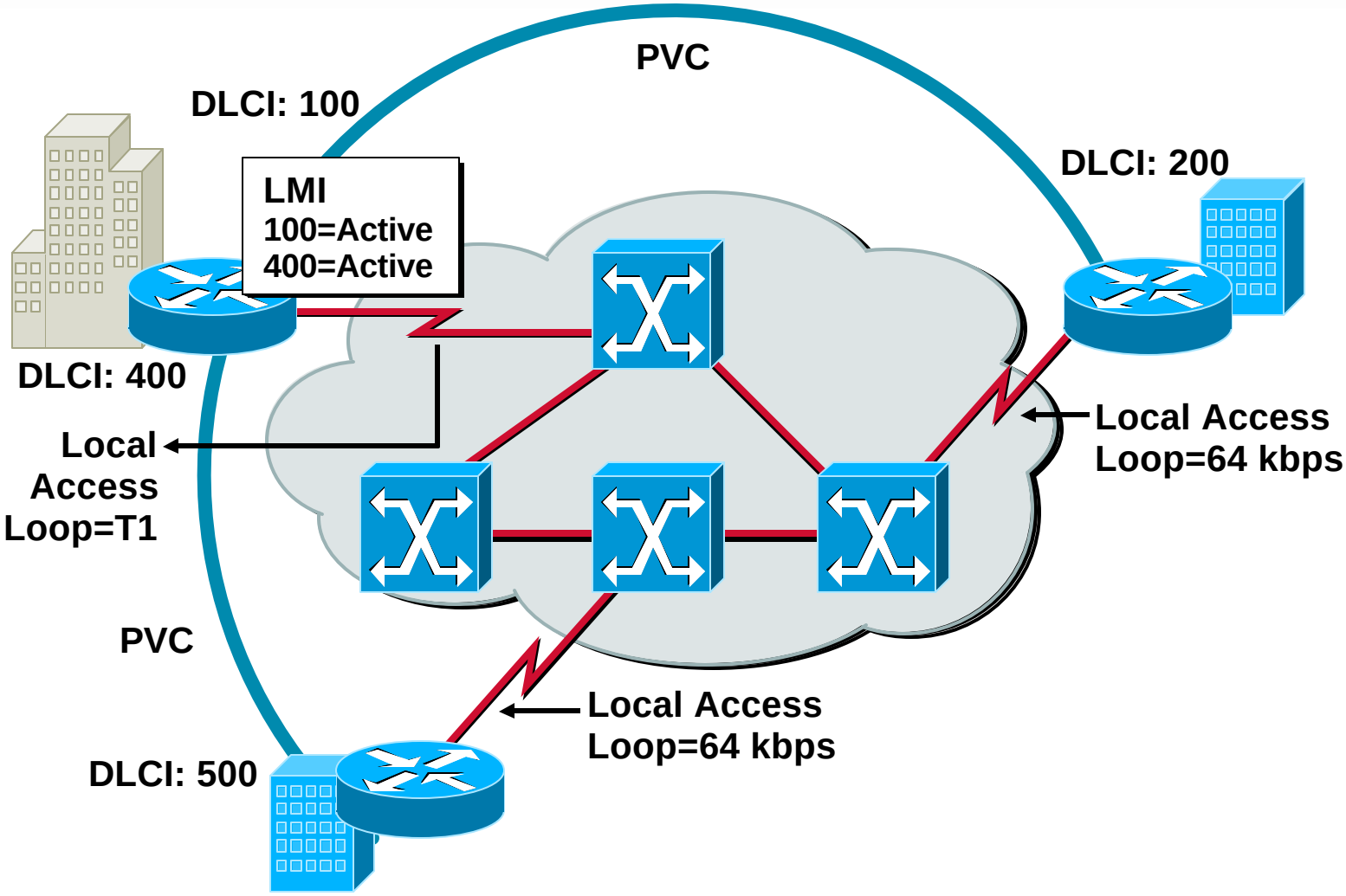


- Virtual circuits make connections
- Connection-oriented service

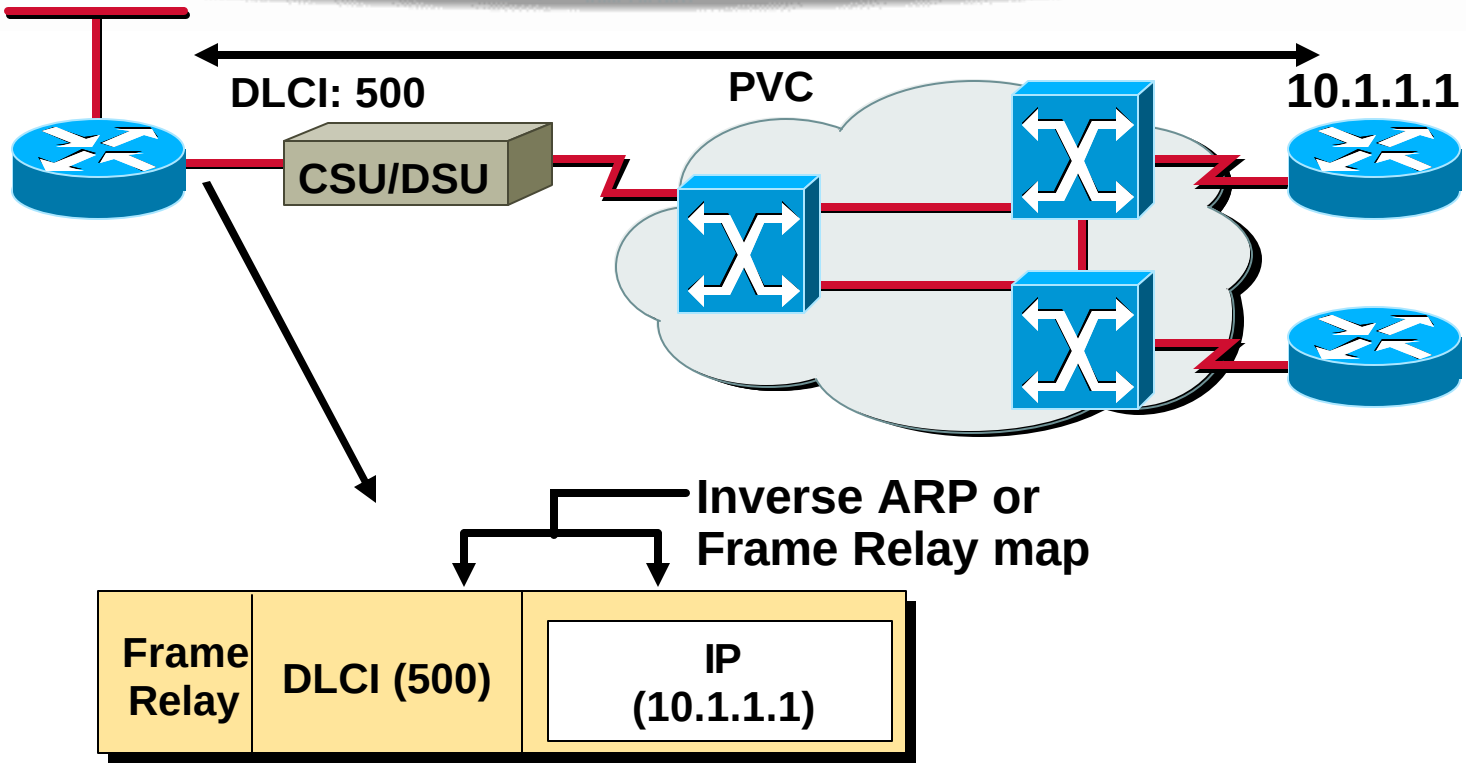
Frame Relay Stack



Frame Relay Terminology

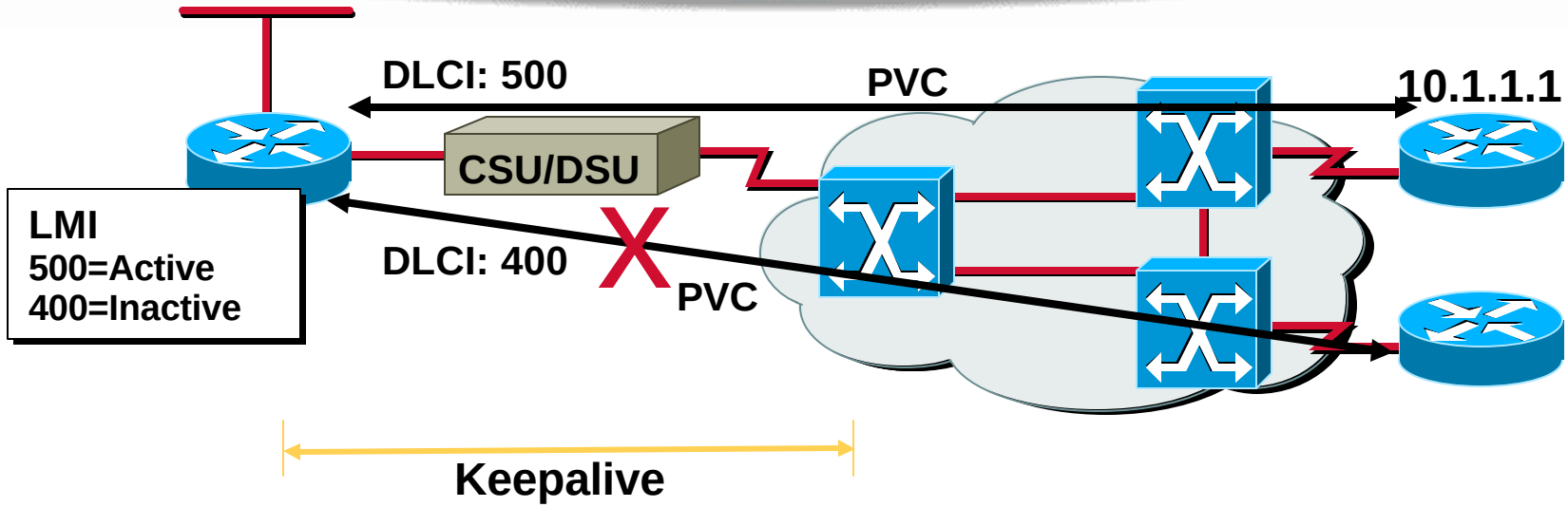


Frame Relay Address Mapping



- Get locally significant DLCIs from provider
- Map your network addresses to DLCIs

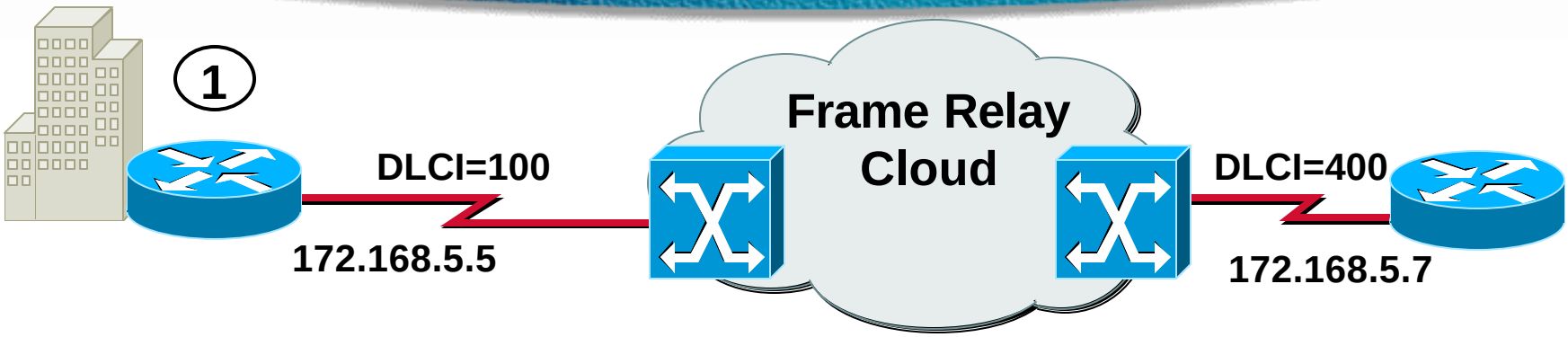
Frame Relay Signaling



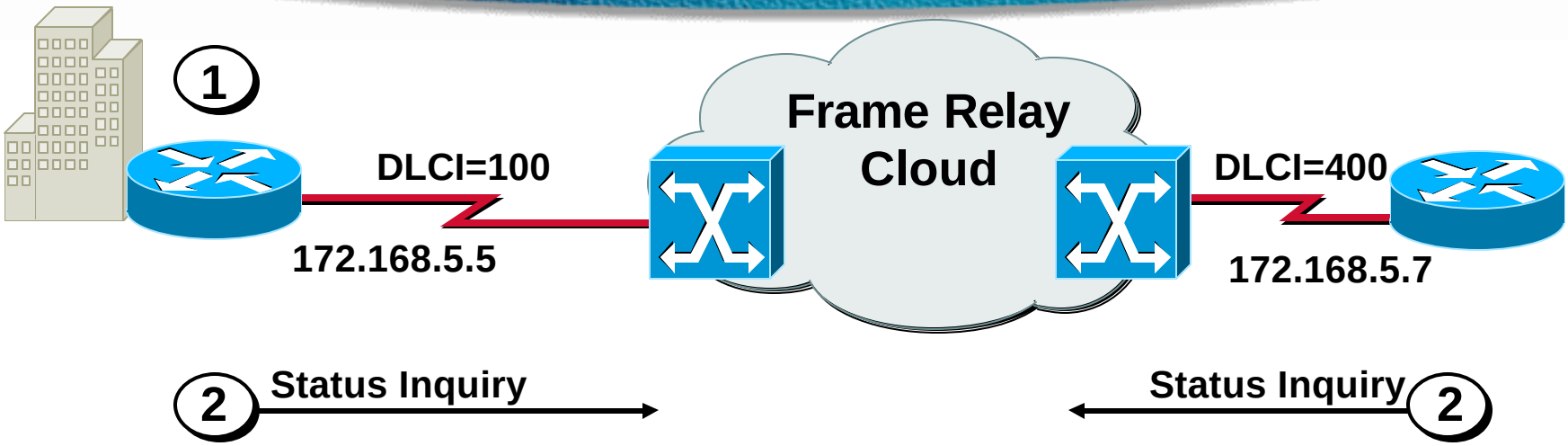
Cisco supports three LMI standards:

- Cisco
- ANSI T1.617 Annex D
- ITU-T Q.933 Annex A

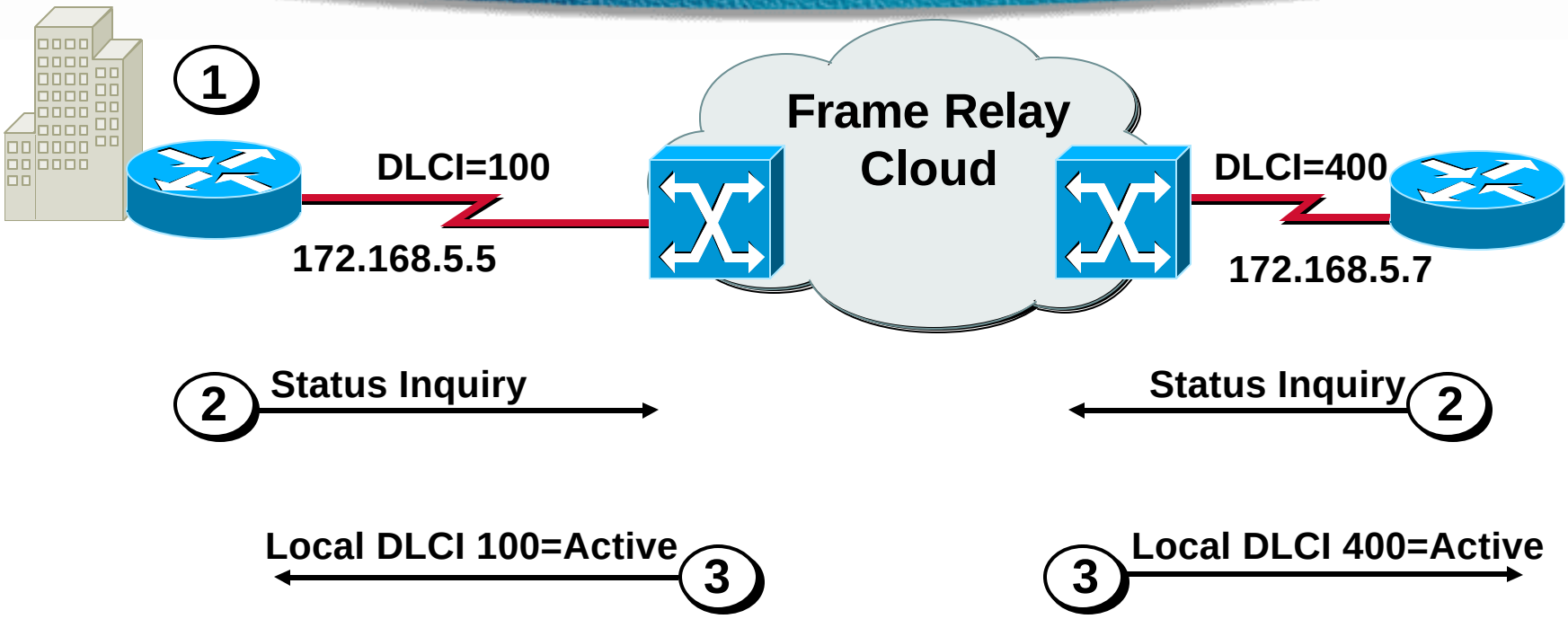
Frame Relay Inverse ARP and LMI Operation



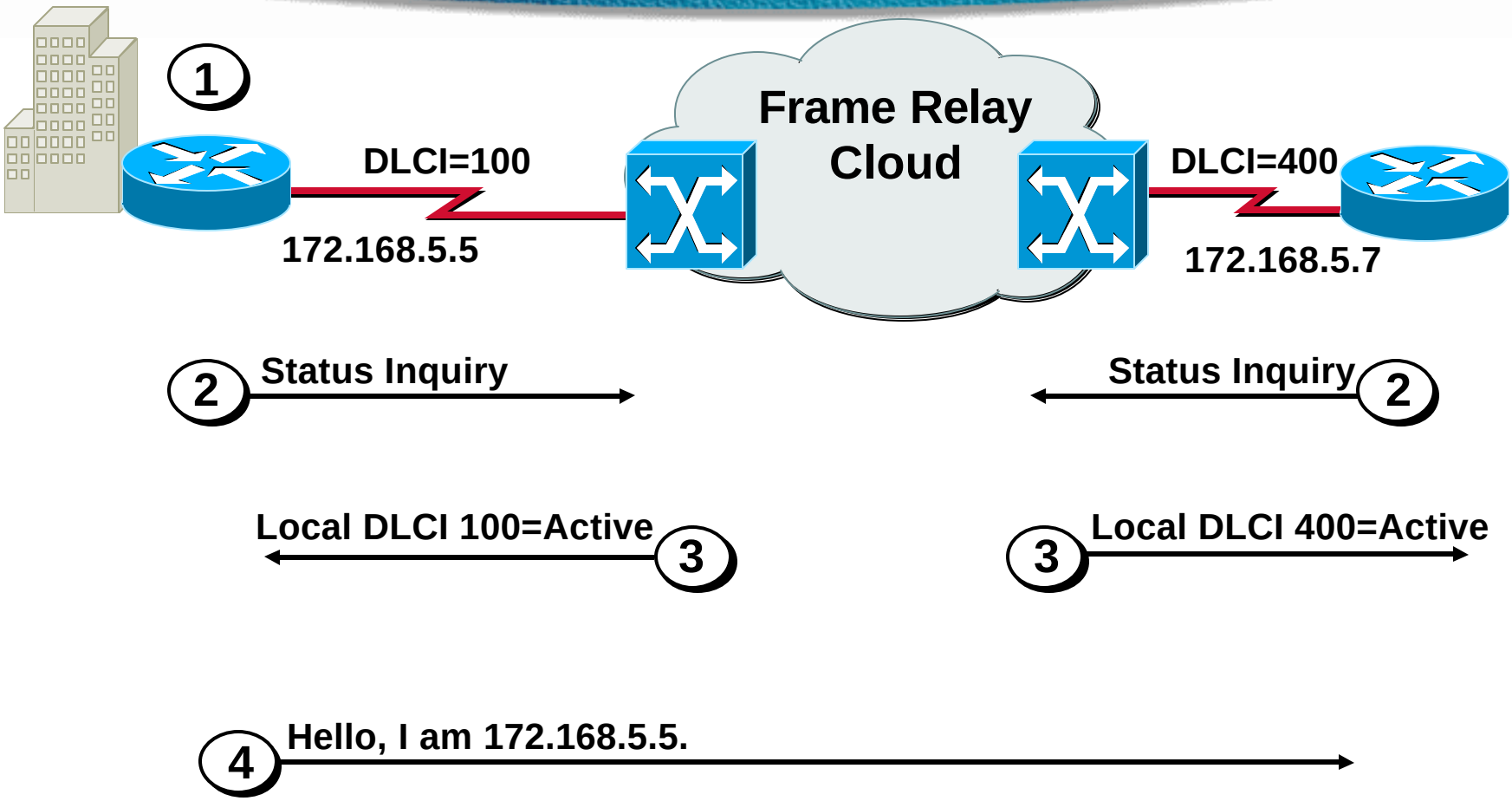
Frame Relay Inverse ARP and LMI Operation



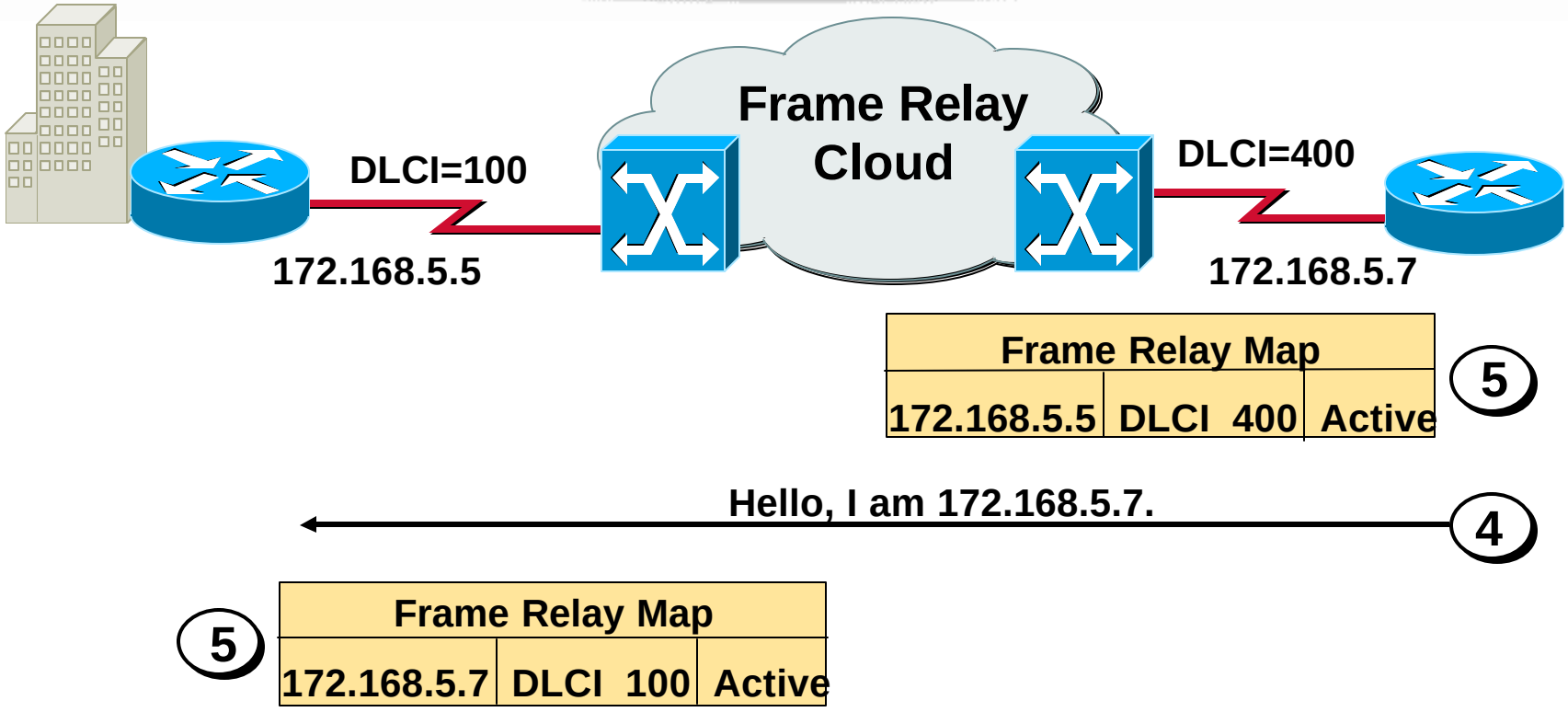
Frame Relay Inverse ARP and LMI Operation



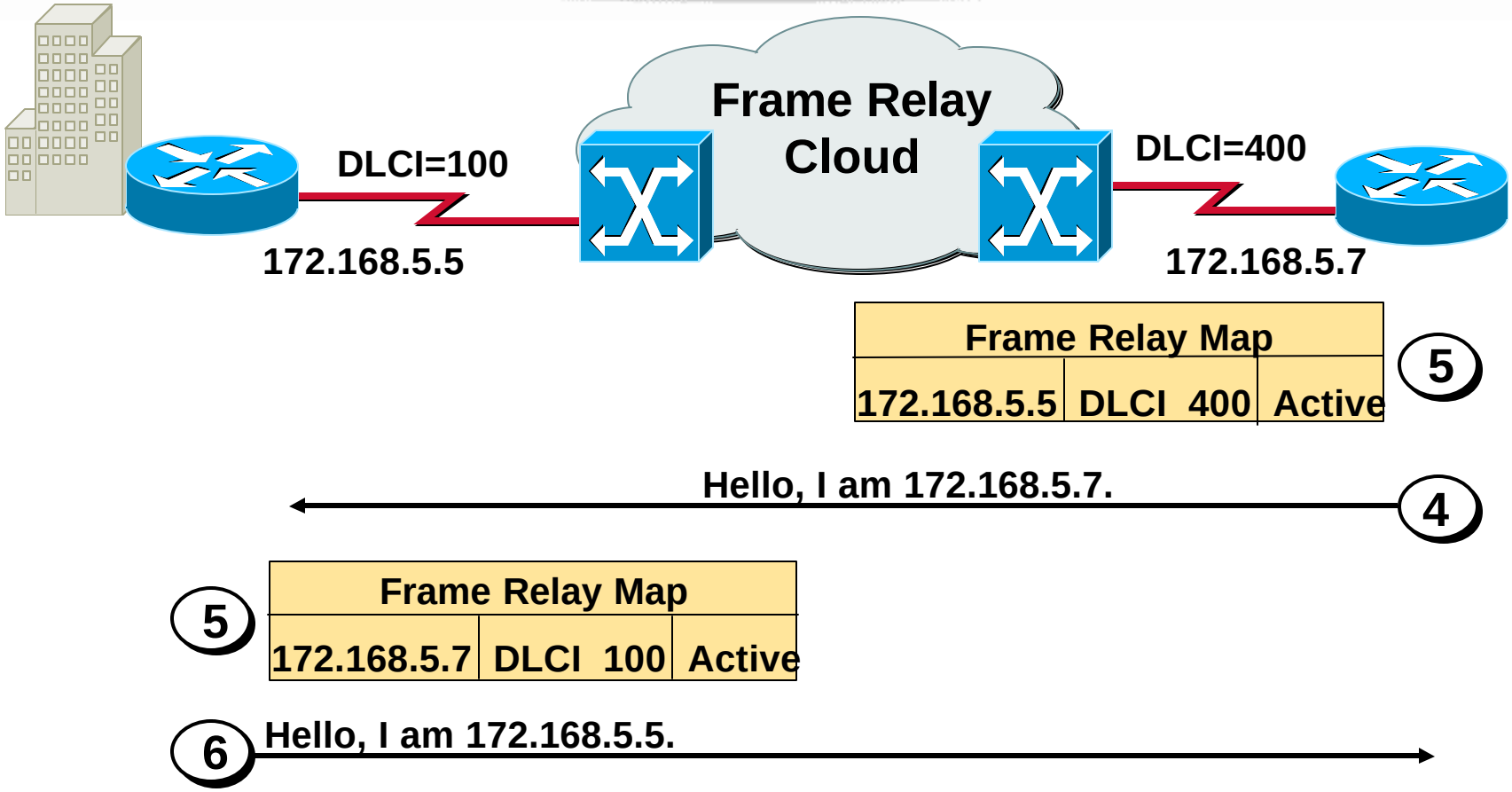
Frame Relay Inverse ARP and LMI Operation



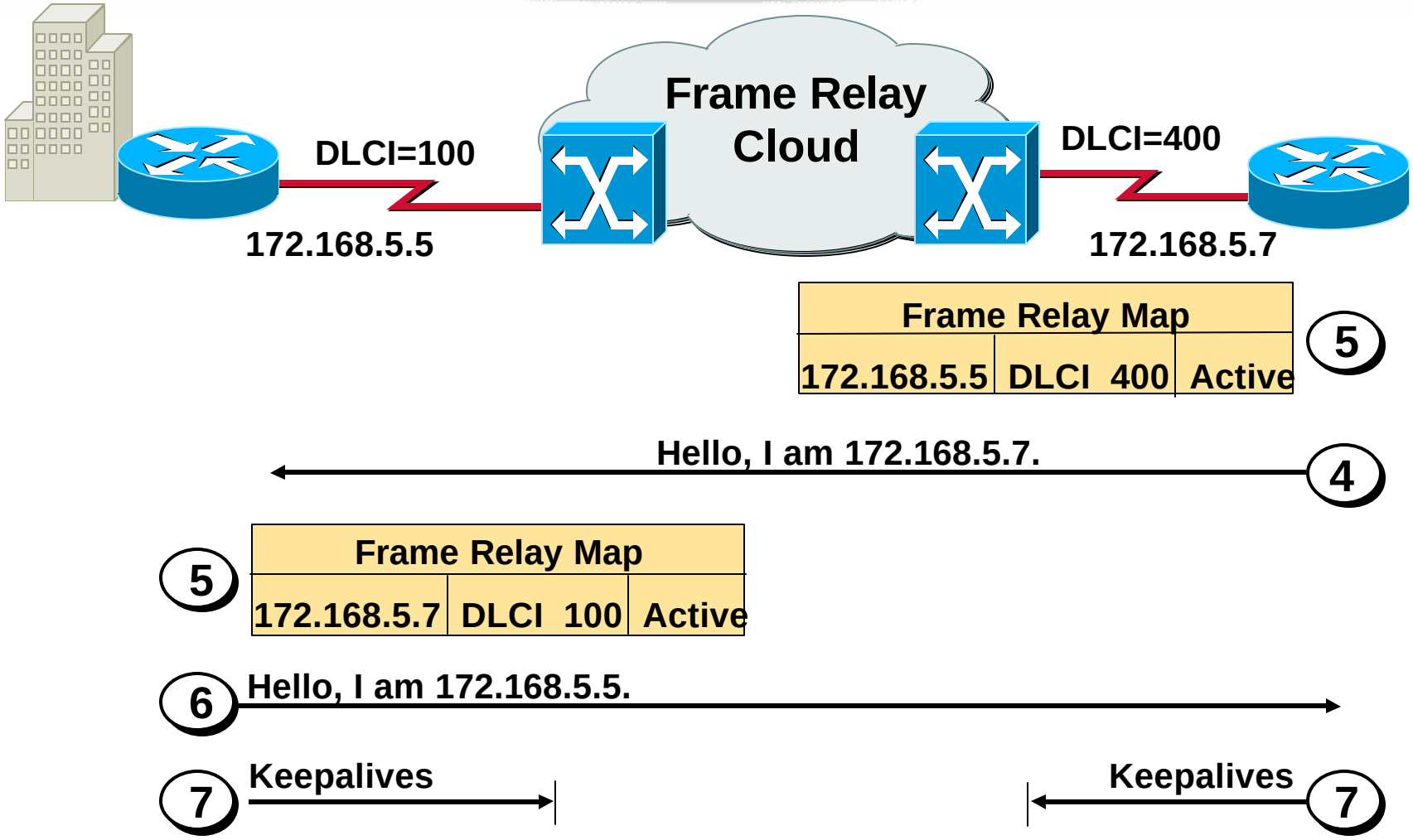
Frame Relay Inverse ARP and LMI Operation (cont.)



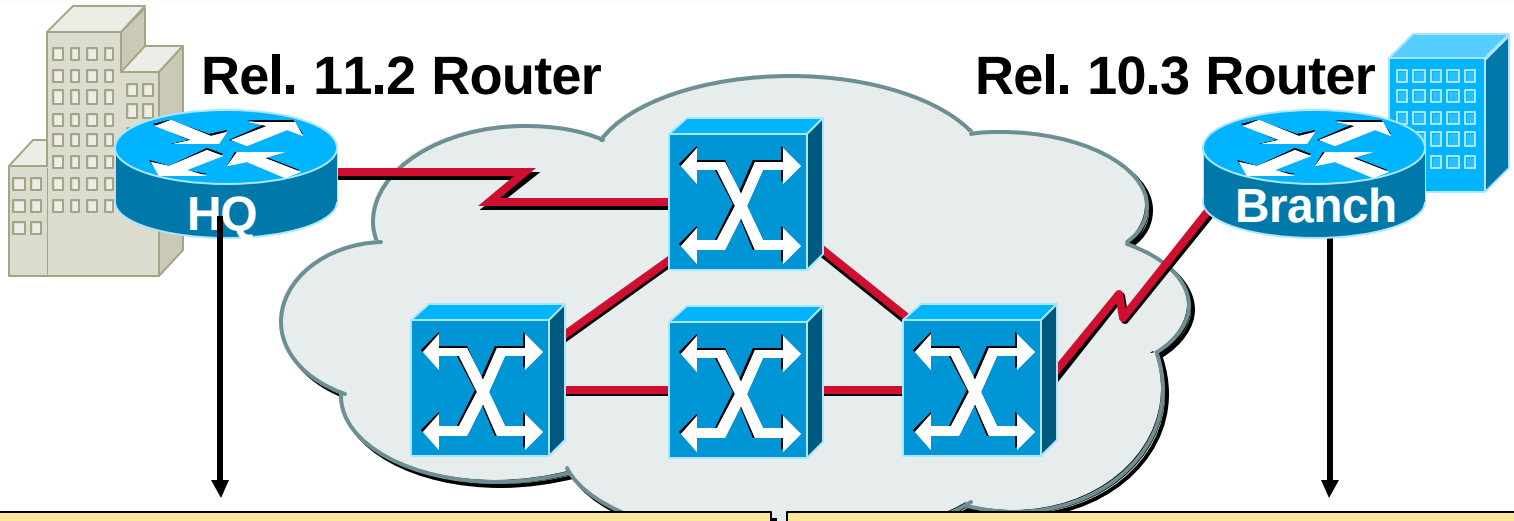
Frame Relay Inverse ARP and LMI Operation (cont.)



Frame Relay Inverse ARP and LMI Operation (cont.)



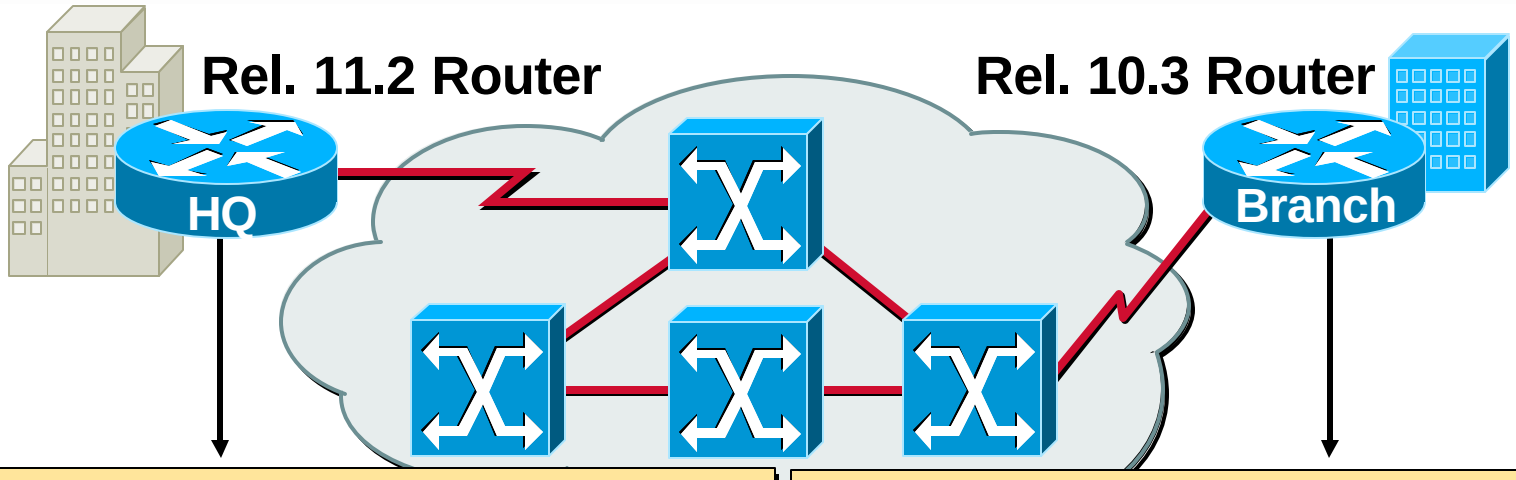
Configuring Basic Frame Relay




```
interface Serial1
 ip address 10.16.0.1 255.255.255.0
 encapsulation frame-relay
 bandwidth 64
```

```
interface Serial1
 ip address 10.16.0.2 255.255.255.0
 encapsulation frame-relay
 bandwidth 64
 frame-relay lmi-type ansi
```

Configuring Basic Frame Relay (cont.)



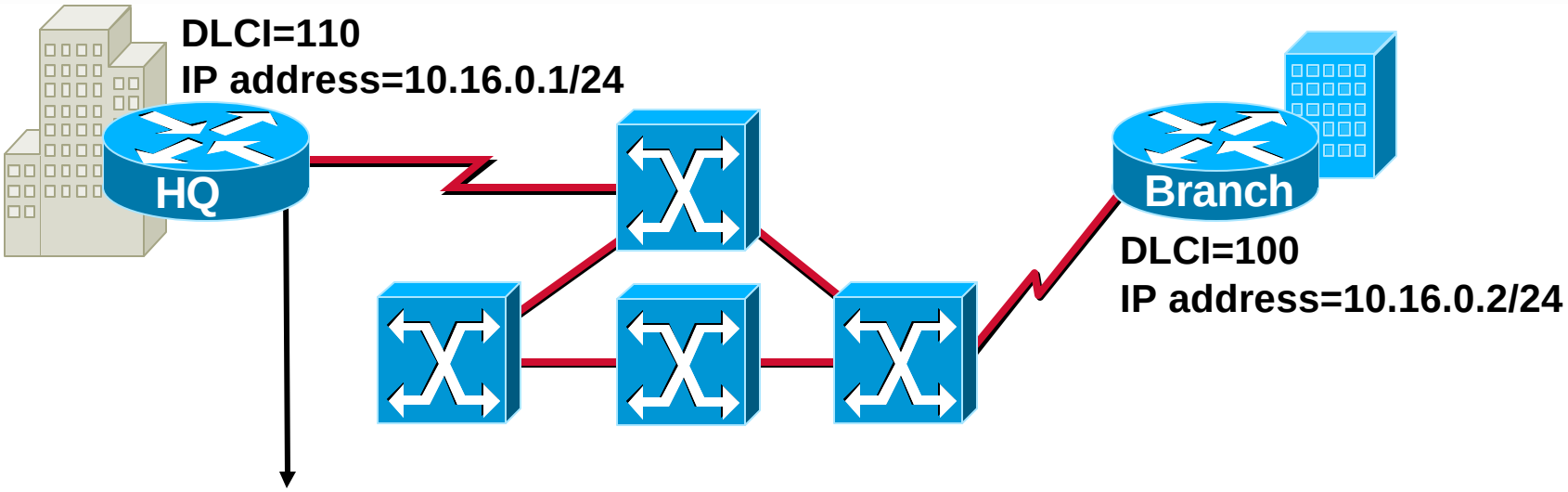

```
interface Serial1
 ip address 10.16.0.1 255.255.255.0
 encapsulation frame-relay
 bandwidth 64
```

```
interface Serial1
 ip address 10.16.0.2 255.255.255.0
 encapsulation frame-relay
 bandwidth 64
 frame-relay lmi-type ansi
```

Inverse ARP

- **Enabled by default**
- **Does not appear in configuration output**

Configuring a Static Frame Relay Map




```
interface Serial1
ip address 10.16.0.1 255.255.255.0
encapsulation frame-relay
bandwidth 64
frame-relay map ip 10.16.0.2 110 broadcast
```

Verifying Frame Relay Operation

```
Router#show interface s0
Serial0 is up, line protocol is up
  Hardware is HD64570
  Internet address is 10.140.1.2/24
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
  LMI enq sent  19, LMI stat recvd 20, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent  0, LMI upd sent  0
  LMI DLCI 1023  LMI type is CISCO  frame relay DTE
  FR SVC disabled, LAPF state down
  Broadcast queue 0/64, broadcasts sent/dropped 8/0, interface broadcasts 5
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  <Output omitted>
```

- **Displays line, protocol, DLCI, and LMI information**

Verifying Frame Relay Operation (cont.)

```
Router#show frame-relay lmi

LMI Statistics for interface Serial0 (Frame Relay DTE) LMI TYPE = CISCO
  Invalid Unnumbered info 0 Invalid Prot Disc 0
  Invalid dummy Call Ref 0 Invalid Msg Type 0
  Invalid Status Message 0 Invalid Lock Shift 0
  Invalid Information ID 0 Invalid Report IE Len 0
  Invalid Report Request 0 Invalid Keep IE Len 0
  Num Status Enq. Sent 113100 Num Status msgs Rcvd 113100
  Num Update Status Rcvd 0 Num Status Timeouts 0
```

- **Displays LMI information**

Verifying Frame Relay Operation (cont.)

```
Router#show frame-relay pvc 100

PVC Statistics for interface Serial0 (Frame Relay DTE)

DLCI = 100, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

  input pkts 28          output pkts 10          in bytes 8398
  out bytes 1198          dropped pkts 0          in FECN pkts 0
  in BECN pkts 0          out FECN pkts 0         out BECN pkts 0
  in DE pkts 0           out DE pkts 0
  out bcast pkts 10        out bcast bytes 1198
  pvc create time 00:03:46, last time pvc status changed 00:03:47
```

- **Displays PVC traffic statistics**

Verifying Frame Relay Operation (cont.)

```
Router#show frame-relay map
Serial0 (up): ip 10.140.1.1 dlci 100(0x64,0x1840), dynamic,
              broadcast,, status defined, active
```

- **Displays the route maps, either static or dynamic**

Verifying Frame Relay Operation (cont.)

```
Router#show frame-relay map
Serial0 (up): ip 10.140.1.1 dlci 100(0x64,0x1840), dynamic,
              broadcast,, status defined, active
Router#clear frame-relay-inarp
Router#sh frame map
Router#
```

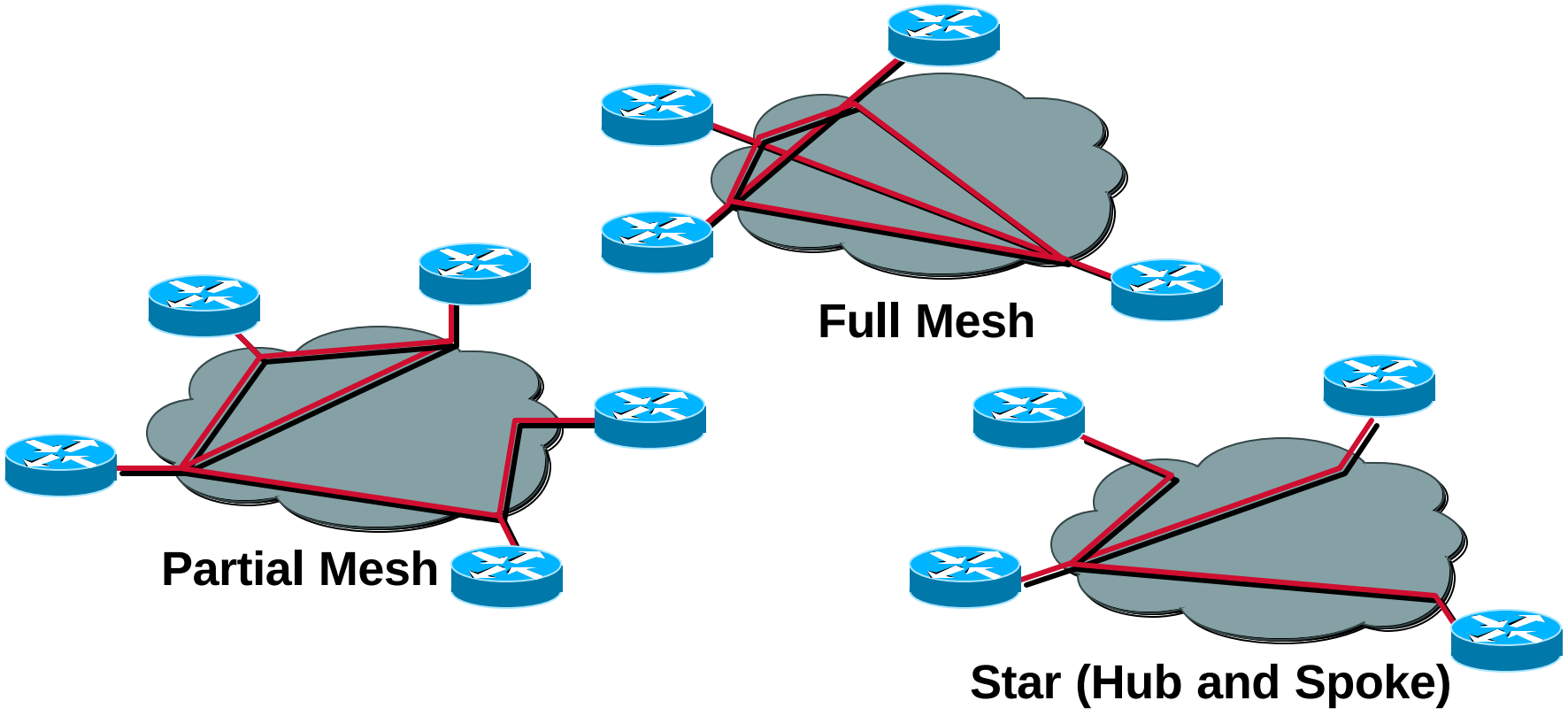
- **Clears dynamically created Frame Relay maps**

Verifying Frame Relay Operation (cont.)

```
Router#debug Frame lmi
Frame Relay LMI debugging is on
Displaying all Frame Relay LMI data
Router#
1w2d: Serial0(out): StEnq, myseq 140, yourseen 139, DTE up
1w2d: datagramstart = 0xE008EC, datagramsize = 13
1w2d: FR encap = 0xFCF10309
1w2d: 00 75 01 01 01 03 02 8C 8B
1w2d:
1w2d: Serial0(in): Status, myseq 140
1w2d: RT IE 1, length 1, type 1
1w2d: KA IE 3, length 2, yourseq 140, myseq 140
1w2d: Serial0(out): StEnq, myseq 141, yourseen 140, DTE up
1w2d: datagramstart = 0xE008EC, datagramsize = 13
1w2d: FR encap = 0xFCF10309
1w2d: 00 75 01 01 01 03 02 8D 8C
1w2d:
1w2d: Serial0(in): Status, myseq 142
1w2d: RT IE 1, length 1, type 0
1w2d: KA IE 3, length 2, yourseq 142, myseq 142
1w2d: PVC IE 0x7 , length 0x6 , dlci 100, status 0x2 , bw 0
```

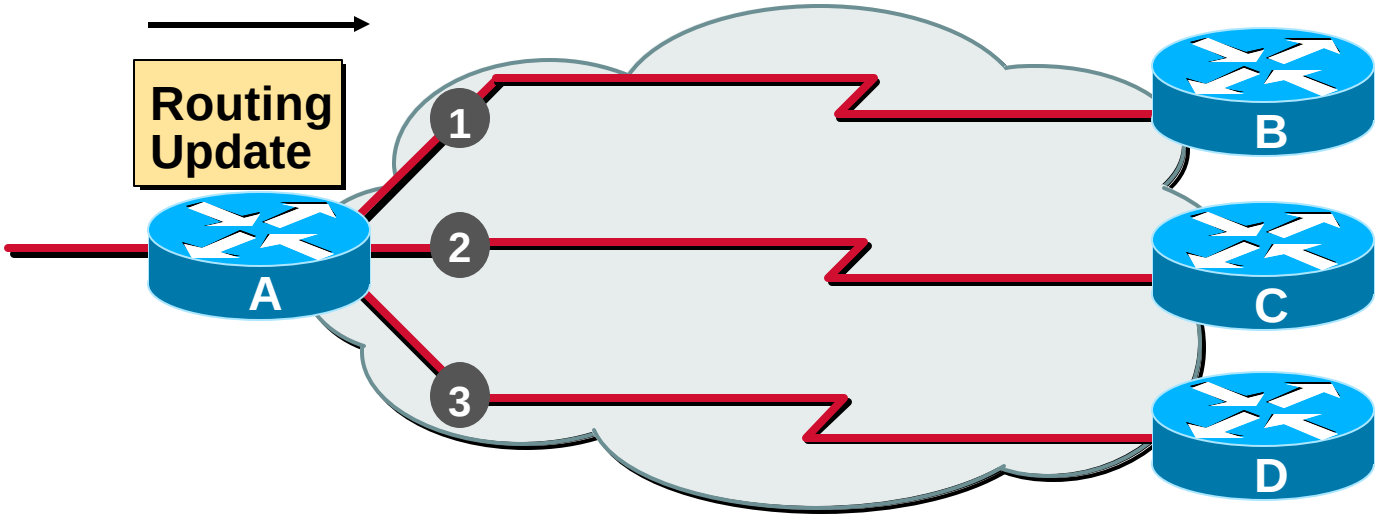
- **Displays LMI debug information**

Selecting a Frame Relay Topology



Frame Relay default: nonbroadcast, multiaccess (NBMA)

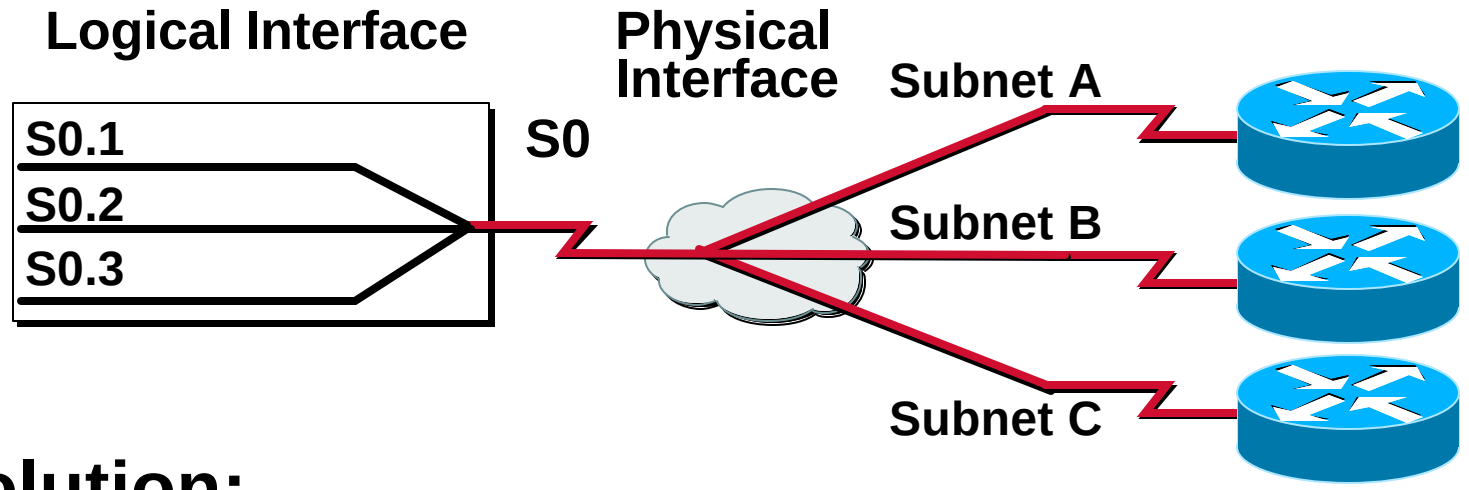
Reachability Issues with Routing Updates



Problem:

Broadcast traffic must be replicated for each active connection

Resolving Reachability Issues



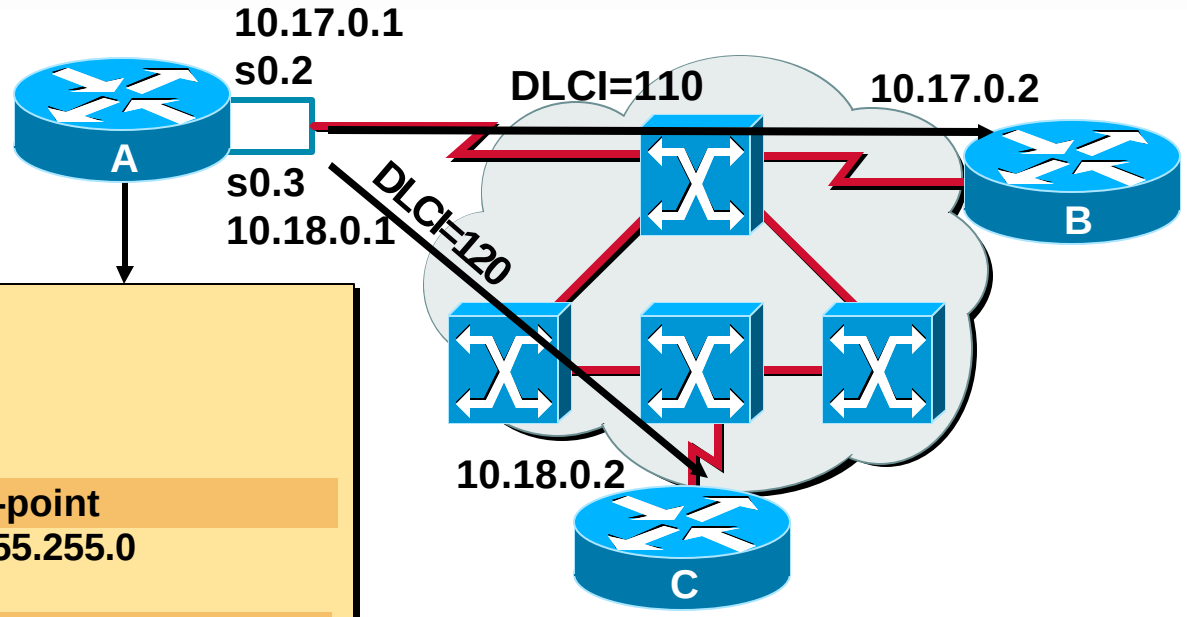
Solution:

- Split horizon can cause problems in NBMA environments
- Subinterfaces can resolve split horizon issues
- A single physical interface simulates multiple logical interfaces

Configuring Subinterfaces

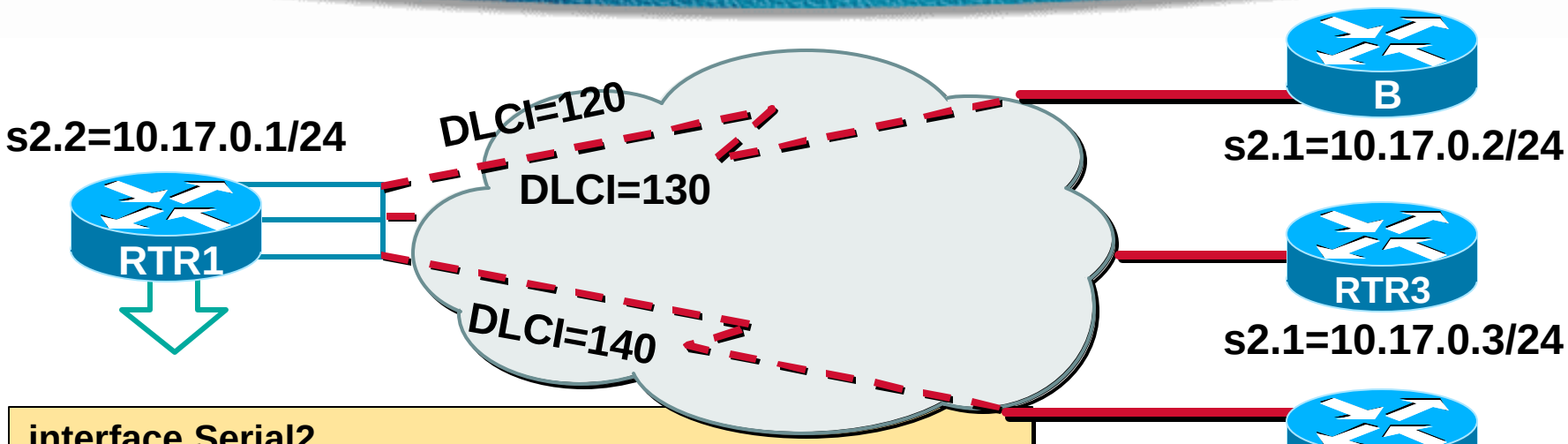
- **Point-to-Point**
  - **Subinterfaces act as leased line**
  - **Each point-to-point subinterface requires its own subnet**
  - **Applicable to hub and spoke topologies**
- **Multipoint**
  - **Subinterfaces act as NBMA network so they do not resolve the split horizon issue**
  - **Can save address space because uses single subnet**
  - **Applicable to partial-mesh and full-mesh topology**

Configuring Point-to-Point Subinterfaces



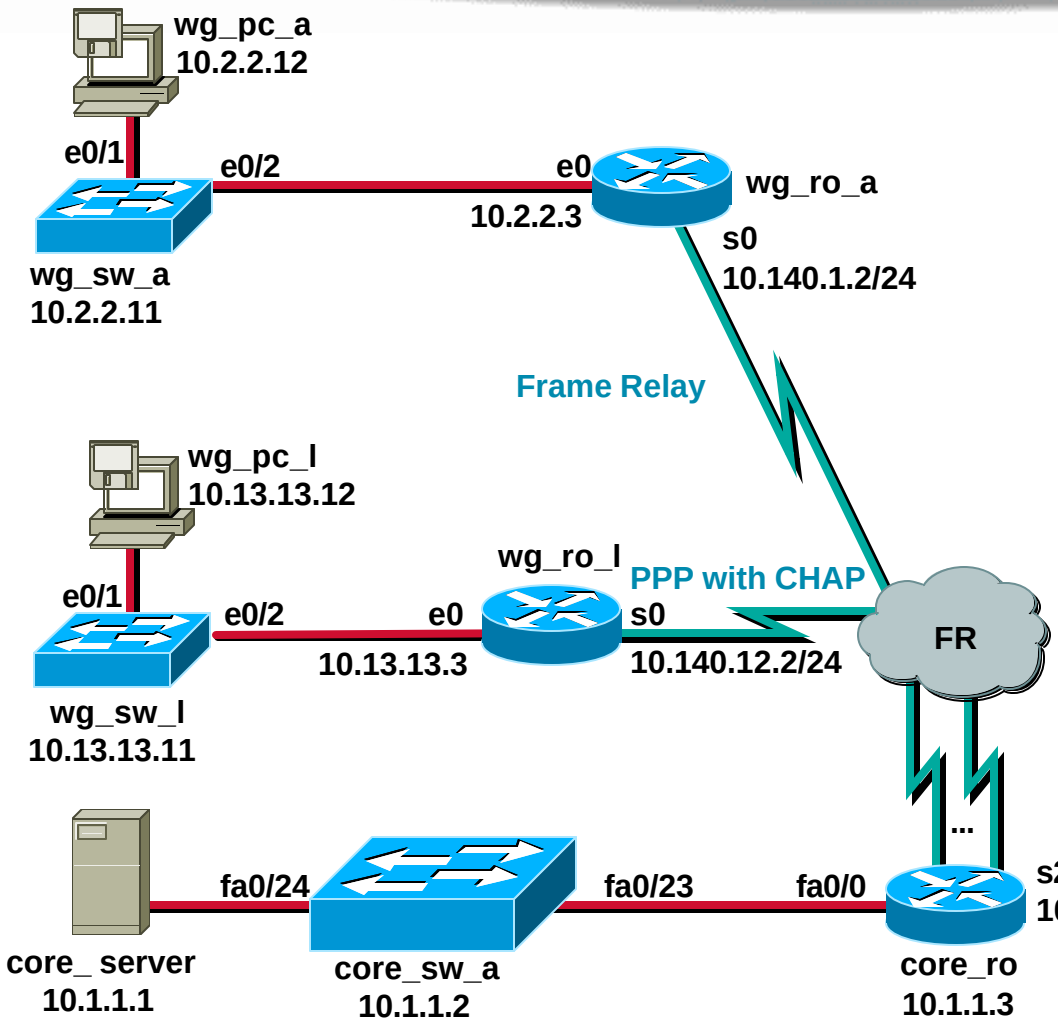

```
interface Serial0
 no ip address
 encapsulation frame-relay
!
interface Serial0.2 point-to-point
 ip address 10.17.0.1 255.255.255.0
 bandwidth 64
 frame-relay interface-dlci 110
!
interface Serial0.3 point-to-point
 ip address 10.18.0.1 255.255.255.0
 bandwidth 64
 frame-relay interface-dlci 120
!
```

Multipoint Subinterfaces Configuration Example




```
interface Serial2
 no ip address
 encapsulation frame-relay
!
interface Serial2.2 multipoint
 ip address 10.17.0.1 255.255.255.0
 bandwidth 64
 frame-relay map ip 10.17.0.2 120 broadcast
 frame-relay map ip 10.17.0.3 130 broadcast
 frame-relay map ip 10.17.0.4 140 broadcast
```

Visual Objective



pod	ro's s0
A	10.140.1.2
B	10.140.2.2
C	10.140.3.2
D	10.140.4.2
E	10.140.5.2
F	10.140.6.2
G	10.140.7.2
H	10.140.8.2
I	10.140.9.2
J	10.140.10.2
K	10.140.11.2
L	10.140.12.2

Summary

After completing this chapter, you should be able to perform the following tasks:

- **Configure a Frame Relay PVC on a serial interface**
- **Configure Frame Relay subinterfaces**
- **Verify Frame Relay operation with show commands**

Review Questions

1. What is a DLCI?
2. What are two methods to map a network layer address to a DLCI on a Cisco router?
3. What are the advantages of configuring Frame Relay subinterfaces?