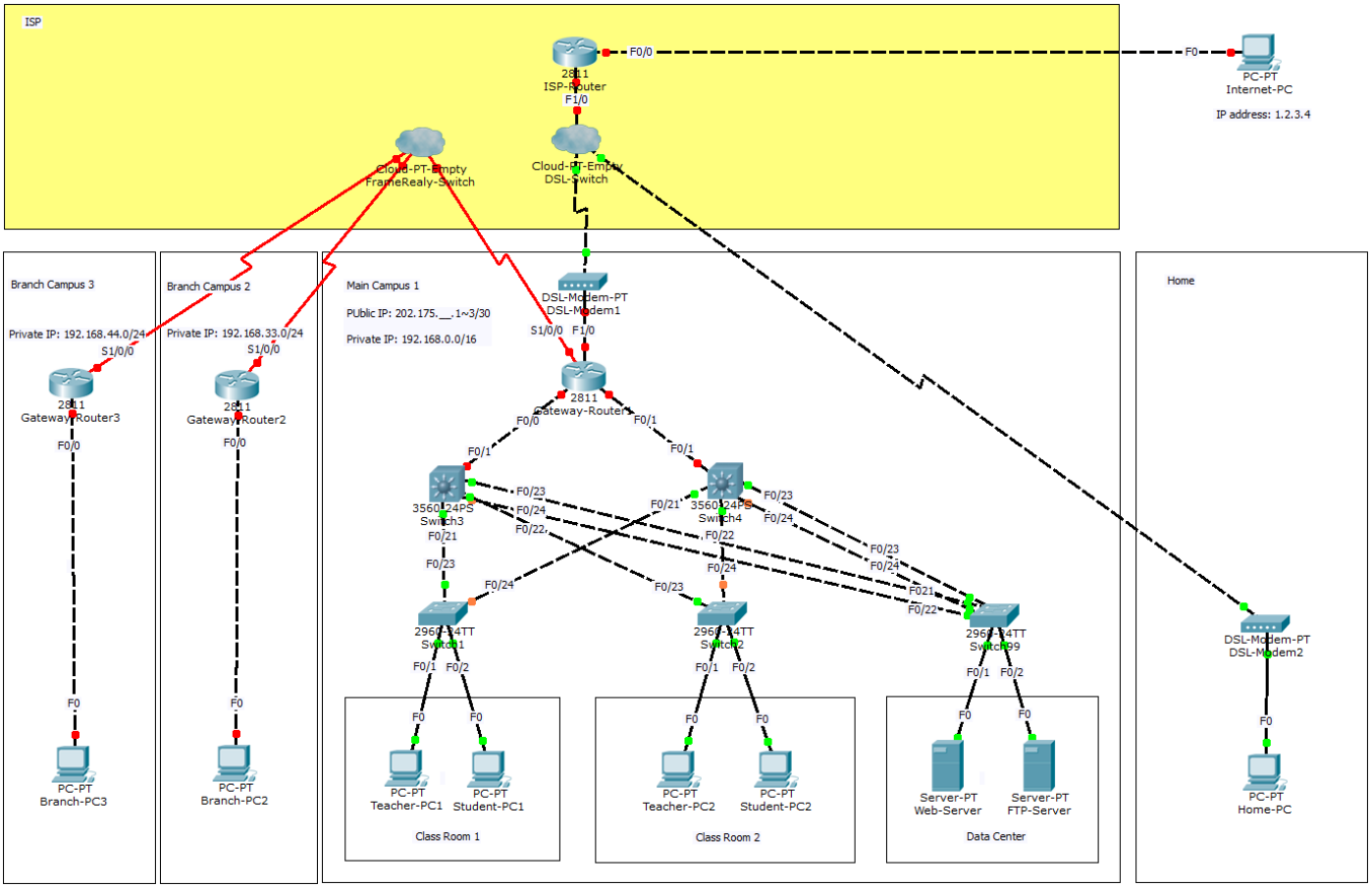
Lab 7.Frame Relay

Objective

- Understand the WAN technologies of Frame Relay.

Topology



Address Scheme for NAT		
	Public IPv4 addresses	Private IPv4 addresses
Teacher-PC1~2 Student-PC1~2	202.175.11.1/30	192.168.11.101~199/24 192.168.22.101~199/24
Web-Server FTP-Server	202.175.11.2 202.175.11.3	192.168.99.101 192.168.99.102

Host name	Interface	IPv4/IPv6 address	Memo
Switch1	F0/1	N/A	VLAN ID = 11
	F0/2	N/A	VLAN ID = 22
	F0/23~24	N/A	VLAN ID = All VLANs (trunk)
Switch2	F0/1	N/A	VLAN ID = 11
	F0/2	N/A	VLAN ID = 22
	F0/23~24	N/A	VLAN ID = All VLANs (trunk)
Switch3	F0/1	N/A	VLAN ID = 101
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
	Vlan 11	IPv4: 192.168. 11. 1/24	SVI
	Vlan 22	IPv4: 192.168. 22. 1/24	SVI
	Vlan 99	IPv4: 192.168. 99. 1/24	SVI
	Vlan 101	IPv4: 192.168.101. 2/24	SVI
Switch4	F0/1	N/A	VLAN ID = 102
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
	Vlan 11	IPv4: 192.168. 11. 2/24	SVI
	Vlan 22	IPv4: 192.168. 22. 2/24	SVI
	Vlan 99	IPv4: 192.168. 99. 2/24	SVI
	Vlan 102	IPv4: 192.168.102. 2/24	SVI
Switch99	F0/1	N/A	VLAN ID = 99
	F0/2	N/A	VLAN ID = 99
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
Gateway-Router1 (DHCP-Server)	F0/0	IPv4: 192.168.101. 1/24	N/A
	F0/1	IPv4: 192.168.102. 1/24	N/A
	F1/0 (PPPoE)	IPv4: 202.175. 0. 2~100/24 (DHCP)	N/A
	S1/0/0 (Frame Relay)	IPv4: 172. 18. 0. 1/24	DLCI = 102, 103
Teacher-PC1~2	F0	IPv4: 192.168. 11.101~199/24 (DHCP)	N/A
Student-PC1~2	F0	IPv4: 192.168. 22.101~199/24 (DHCP)	N/A
Web-Server	F0	IPv4: 192.168. 99.101/24	N/A
FTP-Server	F0	IPv4: 192.168. 99.102/24	N/A
ISP-Router	F0/0	IPv4: 1. 1. 1. 1/8	N/A
	F1/0 (PPPoE)	IPv4: 202.175. 0. 1/24	N/A
Internet-PC	F0	IPv4: 1. 2. 3. 4/8	N/A
Home-PC	F0 (PPPoE)	IPv4: 202.175. 0. 101~199/24 (DHCP)	N/A
Gateway-Router2	F0/0	IPv4: 192.168. 33. 1/24	N/A
	S1/0/0 (Frame Relay)	IPv4: 172. 18. 0. 2/24	DLCI = 201
Gateway-Router3	F0/0	IPv4: 192.168. 44. 1/24	N/A
	S1/0/0 (Frame Relay)	IPv4: 172. 18. 0. 3/24	DLCI = 301
Branch-PC2	F0	IPv4: 192.168. 33. 33/24	N/A
Branch-PC3	F0	IPv4: 192.168. 44. 44/24	N/A

Part 1 - Frame Relay in the subscriber's site.

Step 1 - Configure Frame Relay encapsulation in the physical interface.

1. Configure the Frame Relay encapsulation the physical interface (e.g. Serial 1/0/0).
   Gateway-Router1~3(config)# ***interface Serial*** 1/0/0
   Gateway-Router1~3(config-if)# ***encapsulation frame-relay***
   Gateway-Router1~3(config-if)# ***no ip address***
   Gateway-Router1~3(config-if)# ***no shutdown***

2. Display the Frame Relay PVC.
   Gateway-Router1~3# ***show frame-relay pvc***

   Output of Gateway-Router1:

```
PVC Statistics for interface Serial1/0/0 (Frame Relay DTE)
DLCI = 102, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1/0/0

input pkts 14055       output pkts 32795        in bytes 1096228
out bytes 6216155      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 32795   out bcast bytes 6216155

DLCI = 103, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1/0/0

input pkts 14055       output pkts 32795        in bytes 1096228
out bytes 6216155      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 32795   out bcast bytes 6216155
```

   Output of Gateway-Router2:

```
PVC Statistics for interface Serial1/0/0 (Frame Relay DTE)
DLCI = 201, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1/0/0

input pkts 14055       output pkts 32795        in bytes 1096228
out bytes 6216155      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 32795   out bcast bytes 6216155
```

   Output of Gateway-Router3:

```
PVC Statistics for interface Serial1/0/0 (Frame Relay DTE)
DLCI = 301, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1/0/0

input pkts 14055       output pkts 32795        in bytes 1096228
out bytes 6216155      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 32795   out bcast bytes 6216155
```

3. How many Frame Relay PVCs are available in each Gateway-Router?
   There are two PVCs (DLCI=102, DLCI=103) in Gateway-Router1.

   There is one PVC (DLCI=201) in Gateway-Router2.

   There is one PVC (DLCI=301) in Gateway-Router3.

   (Note: The DLCIs are learned by the router via Local Management Interface (LMI). LMI is a signaling standard of Frame Relay used between the CPE device and the Frame Relay switch that is responsible for managing the connection and maintaining status between the devices.)

4. What are the states of these Frame Relay PVCs?
   Active.

   (Note: Three possible states appear in the Frame Relay PVC are:
   - Active state, indicates a successful connection between the endpoints (DTE devices).
   - Inactive state, indicates a successful connection to from the local endpoint to the switch, without a remote endpoint detected on the PVC.
   - Deleted state, indicates that the local endpoint is configured for a DLCI that the switch does not recognize as valid for that interface.)

Step 2 - Configure Frame Relay DLCI in the logical sub-interface.

5. Configure the Frame Relay DLCI in the logical sub-interface.
   Gateway-Router1(config)# ***interface Serial*** 1/0/0.1 ***multipoint***
   (Note: The keyword multipoint is used to create a multi-access network, whereas the keyword point-to-point is used to create a point-to-point network.)
   Gateway-Router1(config-subif)# ***frame-relay interface-dlci*** 102
   Gateway-Router1(config-subif)# ***frame-relay interface-dlci*** 103
   Gateway-Router1(config-subif)# ***ip address*** 172.18.0.1 255.255.255.0

   Gateway-Router2(config)# ***interface Serial*** 1/0/0.2 ***multipoint***
   Gateway-Router2(config-subif)# ***frame-relay interface-dlci*** 201
   Gateway-Router2(config-subif)# ***ip address*** 172.18.0.2 255.255.255.0

   Gateway-Router3(config)# ***interface Serial*** 1/0/0.3 ***multipoint***
   Gateway-Router3(config-subif)# ***frame-relay interface-dlci*** 301
   Gateway-Router3(config-subif)# ***ip address*** 172.18.0.3 255.255.255.0

6. Display the Frame Relay map.
   Gateway-Router1~3# ***show frame-relay map***

   Output of Gateway-Router1:

```
Serial1/0/0.1 (up): ip 172.18.0.2 dlci 102, dynamic,
              broadcast,
              CISCO, status defined, active
Serial1/0/0.1 (up): ip 172.18.0.3 dlci 103, dynamic,
              broadcast,
              CISCO, status defined, active
```

Output of Gateway-Router2:

```
Serial1/0/0.2 (up): ip 172.18.0.1 dlci 201, dynamic,
              broadcast,
              CISCO, status defined, active
```

Output of Gateway-Router3:

```
Serial1/0/0.3 (up): ip 172.18.0.1 dlci 301, dynamic,
              broadcast,
              CISCO, status defined, active
```

7. What IP address is associated with the local DLCI in each Frame Relay map?
   The next-host IP address (The IP address of the remote Router).

   (Note: Inverse ARP is used to request the next-hop layer 3 address (IP address) associated with the local DLCI. The Inverse ARP mechanism allows the router to automatically build the Frame Relay map. By default, the routers exchange Inverse ARP messages every 60 seconds, and sends keepalive messages every 10 seconds to verify that the Frame Relay switch is still active.)

8. Test the IP connectivity from Gateway-Router1 to Gateway-Router2 and from Gateway-Router1 to Gateway-Router3 using ***ping***.
   Gateway-Router1# ***ping*** 172.18.0.2

   Output of Gateway-Router1:

```
Gatweay-Router1#ping 172.18.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/32/100 ms
```

   Gateway-Router1# ***ping*** 172.18.0.3

   Output of Gateway-Router1:

```
Gatweay-Router1#ping 172.18.0.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 10/16/29 ms
```

9. Test the IP connectivity from Gateway-Router2 to Gateway-Router1 and from Gateway-Router2 to Gateway-Router3 using ***ping***.
   Gateway-Router2# ***ping*** 172.18.0.1

Output of Gateway-Router2:

```
Gateway-Router2#ping 172.18.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 15/25/48 ms
```

Gateway-Router2# ***ping*** 172.18.0.3

Output of Gateway-Router2:

```
Gateway-Router2#ping 172.18.0.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.3, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

10. Test the IP connectivity from Gateway-Router3 to Gateway-Router1 and from Gateway-Router3 to Gateway-Router2 using ***ping***.
    Gateway-Router3# ***ping*** 172.18.0.1

    Output of Gateway-Router3:

```
Gateway-Router3#ping 172.18.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/34/98 ms
```

    Gateway-Router3# ***ping*** 172.18.0.2

    Output of Gateway-Router3:

```
Gateway-Router3#ping 172.18.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

11. Is the test of ping successful between Gateway-Router2 and Gateway-Router3? Why?
    No, because there is no Frame Relay PVC between Gateway-Router2 and Gateway-Router3.

Step 3 - Configure Frame Relay map.

12. Configure the Frame Relay map in the logical sub-interface of Gateway-Router2 and Gateway-Router3.
    Gateway-Router2(config)# ***interface Serial*** 1/0/0.2 ***multipoint***
    Gateway-Router2(config-subif)# ***frame-relay map ip*** 172.18.0.3 201 ***broadcast***

    Gateway-Router3(config)# ***interface Serial*** 1/0/0.3 ***multipoint***

Gateway-Router3(config-subif)# ***frame-relay map ip*** 172.18.0.2 301 ***broadcast***

13. Display the Frame Relay map.
    Gateway-Router2~3# ***show frame-relay map***

    Output of Gateway-Router2:

```
Serial1/0/0.2 (up): ip 172.18.0.1 dlci 201, dynamic,
              broadcast,
              CISCO, status defined, active
Serial1/0/0.2 (up): ip 172.18.0.3 dlci 201, static,
              broadcast,
              CISCO, status defined, active
```

    Output of Gateway-Router3:

```
Serial1/0/0.3 (up): ip 172.18.0.1 dlci 301, dynamic,
              broadcast,
              CISCO, status defined, active
Serial1/0/0.3 (up): ip 172.18.0.2 dlci 301, static,
              broadcast,
              CISCO, status defined, active
```

14. Test the IP connectivity from Gateway-Router2 to Gateway-Router3 and from Gateway-Router3 to Gateway-Router2 using ***ping***.
    Gateway-Router2# ***ping*** 172.18.0.3

    Output of Gateway-Router2:

```
Gateway-Router2#ping 172.18.0.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/30/83 ms
```

    Gateway-Router3# ***ping*** 172.18.0.2

    Output of Gateway-Router3:

```
Gateway-Router3#ping 172.18.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/41/72 ms
```

15. Is the test of ping successful between Gateway-Router2 and Gateway-Router3? Why?
    Yes, because they forward the frames to each other via Gateway-Router1.

Part 2 - Routing in the subscriber's site.

Step 1 - Configure the internal networks access.

16. Configure the static routes in the main campus.
    Gateway-Router1(config)# ***ip route*** 192.168.33.0 255.255.255.0 172.18.0.2
    Gateway-Router1(config)# ***ip route*** 192.168.44.0 255.255.255.0 172.18.0.3

17. Configure the static routes in the branch campus.
    Gateway-Router2(config)# ***ip route*** 192.168.0.0 255.255.0.0 172.18.0.1
    Gateway-Router2(config)# ***ip route*** 192.168.44.0 255.255.255.0 172.18.0.3

    Gateway-Router3(config)# ***ip route*** 192.168.0.0 255.255.0.0 172.18.0.1
    Gateway-Router3(config)# ***ip route*** 192.168.33.0 255.255.255.0 172.18.0.2

Step 2 - Configure the external networks (Internet) access.

18. Configure the default route in the main campus.
    Gateway-Router1(config)# ***ip route 0.0.0.0 0.0.0.0*** 202.175.0.1

19. Configure the default route in the branch campus.
    Gateway-Router2~3(config)# ***ip route 0.0.0.0 0.0.0.0*** 172.18.0.1