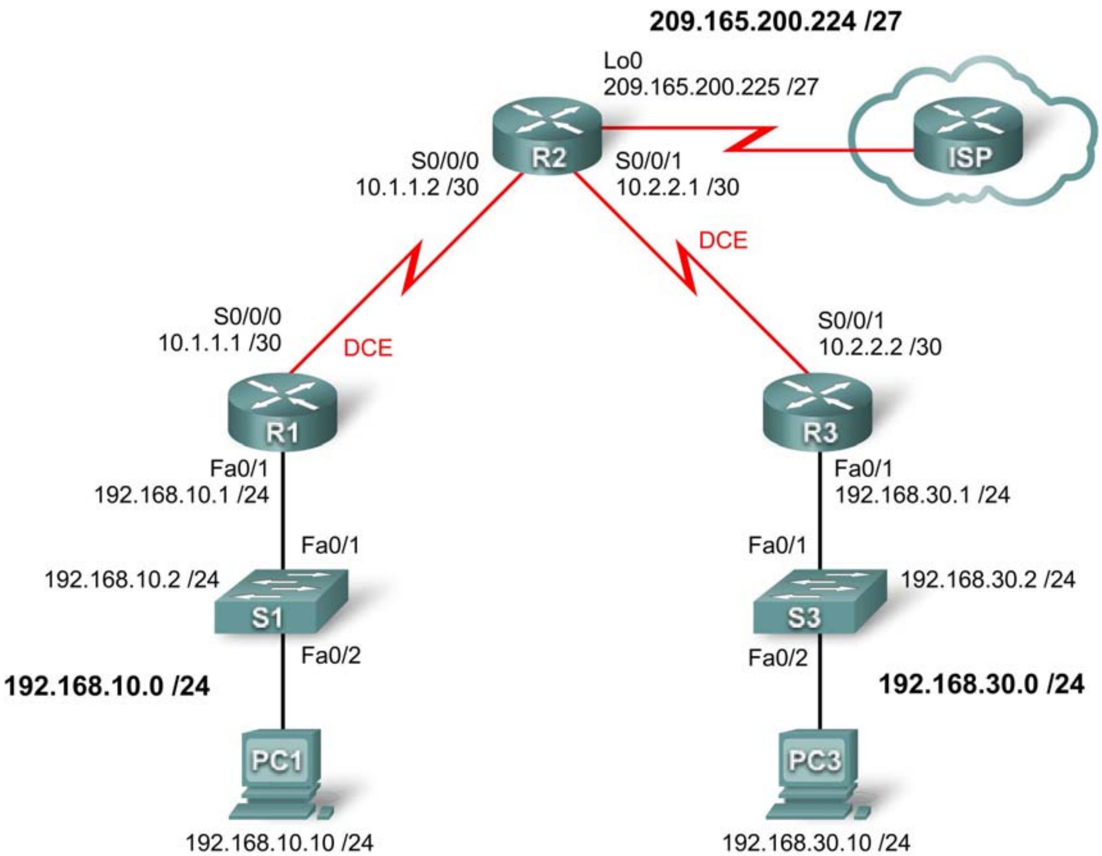
Cisco Networking Academy® Mind Wide Open™

Activity 2.5.1: Basic PPP Configuration

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/1	192.168.10.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	N/A
R2	Lo0	209.165.200.225	255.255.255.224	N/A
	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
R3	Fa0/1	192.168.30.1	255.255.255.0	N/A
	S0/0/1	10.2.2.2	255.255.255.252	N/A
PC1	NIC	192.168.10.10	255.255.255.0	192.168.10.1
PC3	NIC	192.168.30.10	255.255.255.0	192.168.30.1

Learning Objectives

- Configure OSPF routing on all routers
- Configure PPP encapsulation on all serial interfaces
- Intentionally break and restore PPP encapsulation
- Configure PPP PAP and CHAP authentication
- Intentionally break and restore PPP PAP and CHAP authentication

Introduction

In this lab, you will learn how to configure PPP encapsulation on serial links using the network shown in the topology diagram. You will also learn how to restore serial links to their default HDLC encapsulation. Finally, you will configure PPP PAP authentication and PPP CHAP authentication.

Task 1: Configure OSPF on the Routers

Step 1. Enable OSPF routing on R1, R2, and R3.

Issue the **router ospf** command with a process ID of 1 to enter the router configuration prompt. For each router, advertise all the attached networks.

```
R1(config)#router ospf 1
R1(config-router)#network 192.168.10.0 0.0.0.255 area 0
R1(config-router)#network 10.1.1.0 0.0.0.3 area 0
R1(config-router)#

R2(config)#router ospf 1
R2(config-router)#network 10.1.1.0 0.0.0.3 area 0
R2(config-router)#network 10.2.2.0 0.0.0.3 area 0
R2(config-router)#network 209.165.200.224 0.0.0.31 area 0
R2(config-router)#

R3(config)#router ospf 1
R3(config-router)#network 10.2.2.0 0.0.0.3 area 0
R3(config-router)#network 192.168.30.0 0.0.0.255 area 0
R3(config-router)#
```

Step 2. Verify that you have full network connectivity.

Use the **show ip route** and **ping** commands to verify connectivity.

```
R1#show ip route

<output omitted>

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.0 is directly connected, Serial0/0/0
O       10.2.2.0 [110/128] via 10.1.1.2, 00:02:22, Serial0/0/0
C    192.168.10.0/24 is directly connected, FastEthernet0/1
O    192.168.30.0/24 [110/129] via 10.1.1.2, 00:00:08, Serial0/0/0
     209.165.200.0/32 is subnetted, 1 subnets
O       209.165.200.225 [110/65] via 10.1.1.2, 00:02:22, Serial0/0/0

R1#ping 192.168.30.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.30.1, timeout is 2 seconds:
```



```
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
R1#

R2#show ip route

<output omitted>

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.0 is directly connected, Serial0/0/0
C       10.2.2.0 is directly connected, Serial0/0/1
O    192.168.10.0/24 [110/65] via 10.1.1.1, 00:02:31, Serial0/0/0
O    192.168.30.0/24 [110/65] via 10.2.2.2, 00:00:20, Serial0/0/1
     209.165.200.0/27 is subnetted, 1 subnets
C       209.165.200.224 is directly connected, Loopback0

R2#ping 192.168.30.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.30.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/16/16 ms
R2#ping 192.168.10.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/16/16 ms
R2#

R3#show ip route

<output omitted>

     10.0.0.0/30 is subnetted, 2 subnets
O       10.1.1.0 [110/128] via 10.2.2.1, 00:00:34, Serial0/0/1
C       10.2.2.0 is directly connected, Serial0/0/1
O    192.168.10.0/24 [110/129] via 10.2.2.1, 00:00:34, Serial0/0/1
C    192.168.30.0/24 is directly connected, FastEthernet0/1
     209.165.200.0/32 is subnetted, 1 subnets
O       209.165.200.225 [110/65] via 10.2.2.1, 00:00:34, Serial0/0/1

R3#ping 209.165.200.225

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.225, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/16/16 ms
R3#ping 192.168.10.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
R3#
```

Task 2: Configure PPP Encapsulation on Serial Interfaces

Step 1. Use the show interface command to check whether HDLC is the default serial encapsulation.

The default serial encapsulation on Cisco routers is HDLC. Use the **show interface** command on any of the serial interfaces to view the current encapsulation.

```
R1#show interface serial0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.1.1.1/30
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set

<output omitted>
```

If you check all the active serial interfaces, the encapsulation will be set to HDLC.

Step 2. Change the encapsulation of the serial interfaces from HDLC to PPP.

Change the encapsulation type on the link between R1 and R2, and observe the effects.

```
R1(config)#interface serial 0/0/0
R1(config-if)#encapsulation ppp
R1(config-if)#
*Aug 17 19:02:53.412: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on
Serial0/0/0 from F
ULL to DOWN, Neighbor Down: Interface down or detached
R1(config-if)#

R2(config)#interface serial 0/0/0
R2(config-if)#encapsulation ppp
R2(config-if)#
```

What happens when one end of the serial link is encapsulated with PPP and the other end of the link is encapsulated with HDLC?

What happens when PPP encapsulation is configured on each end of the serial link?

Step 3. Change the encapsulation from HDLC to PPP on both ends of the serial link between R2 and R3.

```
R2(config)#interface serial0/0/1
R2(config-if)#encapsulation ppp
R2(config-if)#
*Aug 17 20:02:08.080: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from FULL
 to DOWN, Neighbor Down: Interface down or detached
*Aug 17 20:02:13.080: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to down
*Aug 17 20:02:58.564: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
*Aug 17 20:03:03.644: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from LOAD
ING to FULL, Loading Done
*Aug 17 20:03:46.988: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
```



```
 state to down
R3(config)#interface serial 0/0/1
R3(config-if)#encapsulation ppp
R3(config-if)#
*Aug 17 20:04:27.152: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
*Aug 17 20:04:30.952: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on
Serial0/0/1 from L
OADING to FULL, Loading Done
```

When does the line protocol on the serial link come up and the OSPF adjacency is restored?

Step 4. Verify that PPP is now the encapsulation on the serial interfaces.

```
R1#show interface serial0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.1.1.1/30
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set

<output omitted>

R2#show interface serial 0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.1.1.2/30
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set

<output omitted>

R2#show interface serial 0/0/1
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.2.2.1/30
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set

<output omitted>
R3#show interface serial 0/0/1
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 10.2.2.2/30
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set

<output omitted>
```


Task 3: Break and Restore PPP Encapsulation

Step 1. Return both serial interfaces on R2 to their default HDLC encapsulation.

```
R2(config)#interface serial 0/0/0
R2(config-if)#encapsulation hdlc
R2(config-if)#
*Aug 17 20:36:48.432: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on
Serial0/0/0 from FULL
 to DOWN, Neighbor Down: Interface down or detached
*Aug 17 20:36:49.432: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to down
R2(config-if)#
*Aug 17 20:36:51.432: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to up
R2(config-if)#interface serial 0/0/1
*Aug 17 20:37:14.080: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to down
R2(config-if)#encapsulation hdlc
R2(config-if)#
*Aug 17 20:37:17.368: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from FULL
 to DOWN, Neighbor Down: Interface down or detached
*Aug 17 20:37:18.368: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to down
*Aug 17 20:37:20.368: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
*Aug 17 20:37:44.080: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to down
```

Why is it useful to intentionally break a configuration?

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Why do both serial interfaces go down, come back up, and then go back down?

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Can you think of another way to change the encapsulation of a serial interface from PPP to the default HDLC encapsulation other than using the encapsulation hdlc command? (Hint: It has to do with the **no** command.)

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Step 2. Return both serial interfaces on R2 to PPP encapsulation.

```
R2(config)#interface s0/0/0
R2(config-if)#encapsulation ppp
*Aug 17 20:53:06.612: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to up
R2(config-if)#interface s0/0/1
*Aug 17 20:53:10.856: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on
Serial0/0/0 from LOAD
ING to FULL, Loading Done
R2(config-if)#encapsulation ppp
*Aug 17 20:53:23.332: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
*Aug 17 20:53:24.916: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from LOAD
ING to FULL, Loading Done
R2(config-if)#
```

Task 4: Configure PPP Authentication

Step 1. Configure PPP PAP authentication on the serial link between R1 and R2.

```
R1(config)#username R1 password cisco
R1(config)#int s0/0/0
R1(config-if)#ppp authentication pap
R1(config-if)#
*Aug 22 18:58:57.367: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to down
*Aug 22 18:58:58.423: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on
Serial0/0/0 from F
ULL to DOWN, Neighbor Down: Interface down or detached
R1(config-if)#ppp pap sent-username R2 password cisco
```

What happens when PPP PAP authentication is only configured on one end of the serial link?

```
R2(config)#username R2 password cisco
R2(config)#interface Serial0/0/0
R2(config-if)#ppp authentication pap
R2(config-if)#ppp pap sent-username R1 password cisco
R2(config-if)#
*Aug 23 16:30:33.771: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/0, changed
 state to up
*Aug 23 16:30:40.815: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on
Serial0/0/0 from LOAD
ING to FULL, Loading Done
```

What happens when PPP PAP authentication is configured on both ends of the serial link?

Step 2. Configure PPP CHAP authentication on the serial link between R2 and R3.

In PAP authentication, the password is not encrypted. While this is certainly better than no authentication at all, it is still highly preferable to encrypt the password that is being sent across the link. CHAP encrypts the password.

```
R2(config)#username R3 password cisco
R2(config)#int s0/0/1
R2(config-if)#ppp authentication chap
R2(config-if)#
*Aug 23 18:06:00.935: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to down
R2(config-if)#
*Aug 23 18:06:01.947: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from FULL
 to DOWN, Neighbor Down: Interface down or detached
R2(config-if)#
R3(config)#username R2 password cisco
*Aug 23 18:07:13.074: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
R3(config)#int s0/0/1
R3(config-if)#
*Aug 23 18:07:22.174: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on
Serial0/0/1 from L
OADING to FULL, Loading Done
R3(config-if)#ppp authentication chap
R3(config-if)#
```

Notice that the line protocol on interface serial 0/0/1 changes state to UP even before the interface is configured for CHAP authentication. Can you guess why this is the case?

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Task 5: Intentionally Break and Restore PPP CHAP Authentication

Step 1. Break PPP CHAP authentication.

On the serial link between R2 and R3, change the authentication protocol on interface serial 0/0/1 to PAP.

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int s0/0/1
R2(config-if)#ppp authentication pap
R2(config-if)#^Z
R2#
*Aug 24 15:45:47.039: %SYS-5-CONFIG_I: Configured from console by console
R2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R2#reload
```

Does changing the authentication protocol to PAP on interface serial 0/0/1 break authentication between R2 and R3?

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Step 2. Restore PPP CHAP authentication on the serial link.

Notice that it is not necessary to reload the router for this change to take effect.

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int s0/0/1
R2(config-if)#ppp authentication chap
R2(config-if)#
*Aug 24 15:50:00.419: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed
 state to up
R2(config-if)#
*Aug 24 15:50:07.467: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on
Serial0/0/1 from LOAD
ING to FULL, Loading Done
R2(config-if)#
```

Step 3. Intentionally Break PPP CHAP authentication by changing the password on R3.

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#username R2 password ciisco
R3(config)#^Z
R3#
*Aug 24 15:54:17.215: %SYS-5-CONFIG_I: Configured from console by console
R3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R3#reload
```

After reloading, what is the status of the line protocol on serial 0/0/1?

Step 4. Restore PPP CHAP authentication by changing the password on R3.

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#username R2 password cisco
R3(config)#
*Aug 24 16:11:10.679: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0/1, changed state to up
R3(config)#
*Aug 24 16:11:19.739: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on
Serial0/0/1 from LOADING to FULL, Loading Done
R3(config)#
```

Note that the link has come back up. Test connectivity by pinging from PC1 to PC3.

