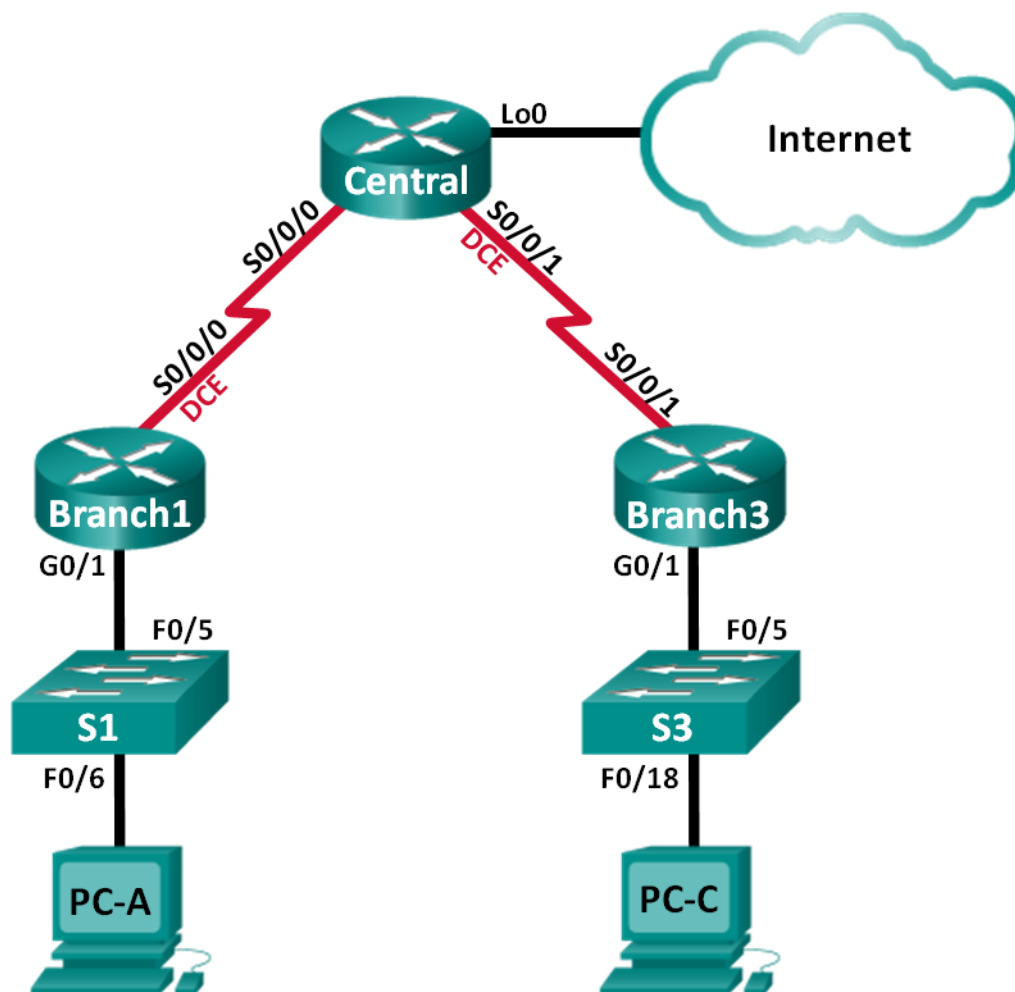


## Lab – Configuring Basic PPP with Authentication (Instructor Version)

**Instructor Note:** Red font color or Gray highlights indicate text that appears in the instructor copy only.

### Topology



### Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
Branch1	G0/1	192.168.1.1	255.255.255.0	N/A
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A
Central	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A
	Lo0	209.165.200.225	255.255.255.224	N/A
Branch3	G0/1	192.168.3.1	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1

### Objectives

**Part 1: Configure Basic Device Settings**

**Part 2: Configure PPP Encapsulation**

**Part 3: Configure PPP CHAP Authentication**

### Background / Scenario

The Point-to-Point Protocol (PPP) is a very common Layer 2 WAN protocol. PPP can be used to connect from LANs to service provider WANs and for connection of LAN segments within an enterprise network.

In this lab, you will configure PPP encapsulation on dedicated serial links between the branch routers and a central router. You will configure PPP Challenge Handshake Authentication Protocol (CHAP) on the PPP serial links. You will also examine the effects of the encapsulation and authentication changes on the status of the serial link.

**Note:** The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

**Note:** Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

**Instructor Note:** Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

### Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 2 Switches (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 2 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

### Part 1: Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic router settings, such as the interface IP addresses, routing, device access, and passwords.

#### Step 1: Cable the network as shown in the topology.

Attach the devices as shown in the Topology, and cable as necessary.

#### Step 2: Initialize and reload the routers and switches.

#### Step 3: Configure basic settings for each router.

- a. Disable DNS lookup.
- b. Configure the device name.
- c. Encrypt plain text passwords.
- d. Create a message of the day (MOTD) banner warning users that unauthorized access is prohibited.
- e. Assign **class** as the encrypted privileged EXEC mode password.
- f. Assign **cisco** as the console and vty password and enable login.
- g. Set console logging to synchronous mode.
- h. Apply the IP addresses to Serial and Gigabit Ethernet interfaces according to the Addressing Table and activate the physical interfaces.
- i. Set the clock rate to **128000** for DCE serial interfaces.
- j. Create **Loopback0** on the Central router to simulate access to the Internet and assign an IP address according to the Addressing Table.

#### Step 4: Configure routing.

- a. Enable single-area OSPF on the routers and use a process ID of 1. Add all the networks, except 209.165.200.224/27 into the OSPF process.
- b. Configure a default route to the simulated Internet on the Central router using Lo0 as the exit interface and redistribute this route into the OSPF process.
- c. Issue the **show ip route ospf**, **show ip ospf interface brief**, and **show ip ospf neighbor** commands on all routers to verify that OSPF is configured correctly. Take note of the router ID for each router.

##### Branch1:

```
Branch1# show ip route ospf
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, * - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP  
+ - replicated route, % - next hop override
```

```
Gateway of last resort is 10.1.1.2 to network 0.0.0.0
```

```
O*E2 0.0.0.0/0 [110/1] via 10.1.1.2, 00:04:10, Serial0/0/0
      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O      10.2.2.0/30 [110/128] via 10.1.1.2, 00:04:20, Serial0/0/0
O      192.168.3.0/24 [110/129] via 10.1.1.2, 00:03:21, Serial0/0/0
```

Branch1# **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Se0/0/0	1	0	10.1.1.1/30	64	P2P	1/1	
Gi0/1	1	0	192.168.1.1/24	1	DR	0/0	

Branch1# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
209.165.200.225	0	FULL/ -	00:00:33	10.1.1.2	Serial0/0/0

### Central:

Central# **show ip route ospf**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

```
O      192.168.1.0/24 [110/65] via 10.1.1.1, 00:07:43, Serial0/0/0
O      192.168.3.0/24 [110/65] via 10.2.2.1, 00:06:38, Serial0/0/1
```

Central# **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Se0/0/1	1	0	10.2.2.2/30	64	P2P	1/1	
Se0/0/0	1	0	10.1.1.2/30	64	P2P	1/1	

Central# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.3.1	0	FULL/ -	00:00:33	10.2.2.1	Serial0/0/1
192.168.1.1	0	FULL/ -	00:00:36	10.1.1.1	Serial0/0/0

### Branch3:

Branch3# **show ip route ospf**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is 10.2.2.2 to network 0.0.0.0

```
O*E2 0.0.0.0/0 [110/1] via 10.2.2.2, 00:08:14, Serial0/0/1
      10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O      10.1.1.0/30 [110/128] via 10.2.2.2, 00:08:14, Serial0/0/1
O      192.168.1.0/24 [110/129] via 10.2.2.2, 00:08:14, Serial0/0/1
```

Branch3# **show ip ospf interface brief**

Interface	PID	Area	IP Address/Mask	Cost	State	Nbrs	F/C
Se0/0/1	1	0	10.2.2.1/30	64	P2P	1/1	
Gi0/1	1	0	192.168.3.1/24	1	DR	0/0	

Branch3# **show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
209.165.200.225	0	FULL/ -	00:00:37	10.2.2.2	Serial0/0/1

### Step 5: Configure the PCs.

Assign IP addresses and default gateways to the PCs according to the Addressing Table.

### Step 6: Verify end-to-end connectivity.

All devices should be able to ping other devices in the Topology. If not, troubleshoot until you can establish end-to-end connectivity.

**Note:** It may be necessary to disable the PC firewall to ping between PCs.

### Step 7: Save your configurations.

## Part 2: Configure PPP Encapsulation

### Step 1: Display the default serial encapsulation.

On the routers, issue **show interfaces serial interface-id** to display the current serial encapsulation.

```
Branch1# show interfaces s0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is WIC MBRD Serial
  Internet address is 10.1.1.1/30
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:02, output 00:00:05, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
```

```
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
 1003 packets input, 78348 bytes, 0 no buffer
Received 527 broadcasts (0 IP multicasts)
0 runs, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
1090 packets output, 80262 bytes, 0 underruns
0 output errors, 0 collisions, 3 interface resets
0 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
2 carrier transitions
DCD=up DSR=up DTR=up RTS=up CTS=up
```

What is the default serial encapsulation for a Cisco router? \_\_\_\_\_ **HDLC**

### Step 2: Change the serial encapsulation to PPP.

- a. Issue the **encapsulation ppp** command on the S0/0/0 interface for the Branch1 router to change the encapsulation from HDLC to PPP.

```
Branch1(config)# interface s0/0/0
```

```
Branch1(config-if)# encapsulation ppp
```

```
Branch1(config-if)#
```

```
Jun 19 06:02:33.687: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0
from FULL to DOWN, Neighbor Down: Interface down or detached
```

```
Branch1(config-if)#
```

```
Jun 19 06:02:35.687: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to down
```

- b. Issue the command to display the line status and line protocol for interface S0/0/0 on the Branch1 router. Document the command issued. What is current interface status for S0/0/0?

```
Branch1# show ip interface brief
```

```
Line status is up, and line protocol is down.
```

```
Branch1# show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	192.168.1.1	YES	manual	up	up
Serial0/0/0	10.1.1.1	YES	manual	up	down
Serial0/0/1	unassigned	YES	unset	administratively down	down

- c. Issue the **encapsulation ppp** command on interface S0/0/0 for the Central router to correct the serial encapsulation mismatch.

```
Central(config)# interface s0/0/0
```

```
Central(config-if)# encapsulation ppp
```

```
Central(config-if)#
```

```
.Jun 19 06:03:41.186: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up
```

```
.Jun 19 06:03:41.274: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial0/0/0 from
LOADING to FULL, Loading Done
```

- d. Verify that interface S0/0/0 on both Branch1 and Central routers is up/up and is configured with PPP encapsulation.

What is the status of the PPP Link Control Protocol (LCP)? \_\_\_\_\_ **Open**

Which Network Control Protocol (NCP) protocols have been negotiated?

---

### Internet Protocol Control Protocol (IPCP) and Cisco Discovery Protocol Control Protocol (CDPCP)

Branch1# **show interfaces s0/0/0**

**Serial0/0/0 is up, line protocol is up**

```
Hardware is WIC MBRD Serial
Internet address is 10.1.1.1/30
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, LCP Open
Open: IPCP, CDPCP, loopback not set
Keepalive set (10 sec)
Last input 00:00:00, output 00:00:00, output hang never
Last clearing of "show interface" counters 00:03:58
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  77 packets input, 4636 bytes, 0 no buffer
  Received 0 broadcasts (0 IP multicasts)
  0 runs, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  117 packets output, 5800 bytes, 0 underruns
  0 output errors, 0 collisions, 8 interface resets
  22 unknown protocol drops
  0 output buffer failures, 0 output buffers swapped out
  18 carrier transitions
DCD=up DSR=up DTR=up RTS=up CTS=up
```

Central# **show interfaces s0/0/0**

**Serial0/0/0 is up, line protocol is up**

```
Hardware is WIC MBRD Serial
Internet address is 10.1.1.2/30
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, LCP Open
Open: IPCP, CDPCP, loopback not set
Keepalive set (10 sec)
Last input 00:00:02, output 00:00:03, output hang never
Last clearing of "show interface" counters 00:01:20
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
```

```
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
 41 packets input, 2811 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)
 0 runs, 0 giants, 0 throttles
 0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
40 packets output, 2739 bytes, 0 underruns
 0 output errors, 0 collisions, 0 interface resets
 0 unknown protocol drops
 0 output buffer failures, 0 output buffers swapped out
 0 carrier transitions
 DCD=up DSR=up DTR=up RTS=up CTS=up
```

### Step 3: Intentionally break the serial connection.

- a. Issue the **debug ppp** commands to observe the effects of changing the PPP configuration on the Branch1 router and the Central router.

```
Branch1# debug ppp negotiation
PPP protocol negotiation debugging is on
Branch1# debug ppp packet
PPP packet display debugging is on
```

```
Central# debug ppp negotiation
PPP protocol negotiation debugging is on
Central# debug ppp packet
PPP packet display debugging is on
```

- b. Observe the debug PPP messages when traffic is flowing on the serial link between the Branch1 and Central routers.

```
Branch1#
Jun 20 02:20:45.795: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 84
Jun 20 02:20:49.639: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 84 link[ip]
Jun 20 02:20:50.147: Se0/0/0 LCP-FS: I ECHOREQ [Open] id 45 len 12 magic 0x73885AF2
Jun 20 02:20:50.147: Se0/0/0 LCP-FS: O ECHOREP [Open] id 45 len 12 magic 0x8CE1F65F
Jun 20 02:20:50.159: Se0/0/0 LCP: O ECHOREQ [Open] id 45 len 12 magic 0x8CE1F65F
Jun 20 02:20:50.159: Se0/0/0 LCP-FS: I ECHOREP [Open] id 45 len 12 magic 0x73885AF2
Jun 20 02:20:50.159: Se0/0/0 LCP-FS: Received id 45, sent id 45, line up
```

```
Central#
Jun 20 02:20:49.636: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 84
Jun 20 02:20:50.148: Se0/0/0 LCP: O ECHOREQ [Open] id 45 len 12 magic 0x73885AF2
Jun 20 02:20:50.148: Se0/0/0 LCP-FS: I ECHOREP [Open] id 45 len 12 magic 0x8CE1F65F
Jun 20 02:20:50.148: Se0/0/0 LCP-FS: Received id 45, sent id 45, line up
Jun 20 02:20:50.160: Se0/0/0 LCP-FS: I ECHOREQ [Open] id 45 len 12 magic 0x8CE1F65F
Jun 20 02:20:50.160: Se0/0/0 LCP-FS: O ECHOREP [Open] id 45 len 12 magic 0x73885AF2
Jun 20 02:20:55.552: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 84 link[ip]
```

- c. Break the serial connection by returning the serial encapsulation to HDLC for interface S0/0/0 on the Branch1 router. Record the command used to change the encapsulation to HDLC.



```
Branch1(config)# interface s0/0/0
Branch1(config-if)# encapsulation hdlc
```

- d. Observe the debug PPP messages on the Branch1 router. The serial connection has terminated, and the line protocol is down. The route to 10.1.1.2 (Central) has been removed from the routing table.

```
Jun 20 02:29:50.295: Se0/0/0 PPP DISC: Lower Layer disconnected
Jun 20 02:29:50.295: PPP: NET STOP send to AAA.
Jun 20 02:29:50.299: Se0/0/0 IPCP: Event[DOWN] State[Open to Starting]
Jun 20 02:29:50.299: Se0/0/0 IPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 02:29:50.299: Se0/0/0 CDPCP: Event[DOWN] State[Open to Starting]
Jun 20 02:29:50.299: Se0/0/0 CDPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 02:29:50.29
Branch1(config-if)#9: Se0/0/0 LCP: O TERMREQ [Open] id 7 len 4
Jun 20 02:29:50.299: Se0/0/0 LCP: Event[CLOSE] State[Open to Closing]
Jun 20 02:29:50.299: Se0/0/0 PPP: Phase is TERMINATING
Jun 20 02:29:50.299: Se0/0/0 Deleted neighbor route from AVL tree: topoid 0, address 10.1.1.2
Jun 20 02:29:50.299: Se0/0/0 IPCP: Remove route to 10.1.1.2
Jun 20 02:29:50.299: Se0/0/0 LCP: Event[DOWN] State[Closing to Initial]
Jun 20 02:29:50.299: Se0/0/0 PPP: Phase is DOWN
Branch1(config-if)#
Jun 20 02:30:17.083: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to down
Jun 20 02:30:17.083: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
```

- e. Observe the debug PPP messages on the Central router. The Central router continues to attempt to establish a connection with Branch1 as indicated by the debug messages. When the interfaces are unable to establish a connection, the interfaces go back down again. Furthermore, OSPF cannot establish an adjacency with its neighbor due to the mismatched serial encapsulation.

```
Jun 20 02:29:50.296: Se0/0/0 PPP: Sending cstate DOWN notification
Jun 20 02:29:50.296: Se0/0/0 PPP: Processing CstateDown message
Jun 20 02:29:50.296: Se0/0/0 PPP DISC: Lower Layer disconnected
Jun 20 02:29:50.296: PPP: NET STOP send to AAA.
Jun 20 02:29:50.296: Se0/0/0 IPCP: Event[DOWN] State[Open to Starting]
Jun 20 02:29:50.296: Se0/0/0 IPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 02:29:50.296: Se0/0/0 CDPCP: Event[DOWN] State[Open to Starting]
Jun 20 02:29:50.296: Se0/0/0 CDPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 02:29:50.296: Se0/0/0 LCP: O TERMREQ [Open] id 2 len 4
Jun 20 02:29:50.296: Se0/0/0 LCP: Event[CLOSE] State[Open to Closing]
Jun 20 02:29:50.296: Se0/0/0 PPP: Phase is TERMINATING
Jun 20 02:29:50.296: Se0/0/0 Deleted neighbor route from AVL tree: topoid 0, address 10.1.1.1
Jun 20 02:29:50.296: Se0/0/0 IPCP: Remove route to 10.1.1.1
Jun 20 02:29:50.296: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial0/0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 02:29:50.296: Se0/0/0 LCP: Event[DOWN] State[Closing to Initial]
Jun 20 02:29:50.296: Se0/0/0 PPP: Phase is DOWN
Jun 20 02:29:52.296: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to down
Jun 20 02:29:52.296: Se0/0/0 PPP: Sending cstate UP notification
```

```
.Jun 20 02:29:52.296: Se0/0/0 PPP: Processing CstateUp message
.Jun 20 02:29:52.296: PPP: Alloc Context [29F9F32C]
.Jun 20 02:29:52.296: ppp3 PPP: Phase is ESTABLISHING
.Jun 20 02:29:52.296: Se0/0/0 PPP: Using default call direction
.Jun 20 02:29:52.296: Se0/0/0 PPP: Treating connection as a dedicated line
.Jun 20 02:29:52.296: Se0/0/0 PPP: Session handle[60000003] Session id[3]
.Jun 20 02:29:52.296: Se0/0/0 LCP: Event[OPEN] State[Initial to Starting]
.Jun 20 02:29:52.296: Se0/0/0 LCP: O CONFREQ [Starting] id 1 len 10
.Jun 20 02:29:52.296: Se0/0/0 LCP: MagicNumber 0x7397843B (0x05067397843B)
.Jun 20 02:29:52.296: Se0/0/0 LCP:Event[UP] State[Starting to REQsent]
.Jun 20 02:29:54.308: Se0/0/0 LCP: O CONFREQ [REQsent] id 2 len 10
.Jun 20 02:29:54.308: Se0/0/0 LCP: MagicNumber 0x7397843B (0x05067397843B)
.Jun 20 02:29:54.308: Se0/0/0 LCP: Event[Timeout+] State[REQsent to REQsent]
.Jun 20 02:29:56.080: Se0/0/0 PPP: I pkt type 0x008F, datagramsize 24 link[illegal]
.Jun 20 02:29:56.080: Se0/0/0 UNKNOWN(0x008F): Non-NCP packet, discarding
<output omitted>
.Jun 20 02:30:10.436: Se0/0/0 LCP: O CONFREQ [REQsent] id 10 len 10
.Jun 20 02:30:10.436: Se0/0/0 LCP: MagicNumber 0x7397843B (0x05067397843B)
.Jun 20 02:30:10.436: Se0/0/0 LCP: Event[Timeout+] State[REQsent to REQsent]
.Jun 20 02:30:12.452: Se0/0/0 PPP DISC: LCP failed to negotiate
.Jun 20 02:30:12.452: PPP: NET STOP send to AAA.
.Jun 20 02:30:12.452: Se0/0/0 LCP: Event[Timeout-] State[REQsent to Stopped]
.Jun 20 02:30:12.452: Se0/0/0 LCP: Event[DOWN] State[Stopped to Starting]
.Jun 20 02:30:12.452: Se0/0/0 PPP: Phase is DOWN
.Jun 20 02:30:14.452: PPP: Alloc Context [29F9F32C]
.Jun 20 02:30:14.452: ppp4 PPP: Phase is ESTABLISHING
.Jun 20 02:30:14.452: Se0/0/0 PPP: Using default call direction
.Jun 20 02:30:14.452: Se0/0/0 PPP: Treating connection as a dedicated line
.Jun 20 02:30:14.452: Se0/0/0 PPP: Session handle[6E000004] Session id[4]
.Jun 20 02:30:14.452: Se0/0/0 LCP: Event[OPEN] State[Initial to Starting]
.Jun 20 02:30:14.452: Se0/0/0 LCP: O CONFREQ [Starting] id 1 len 10
.Jun 20 02:30:14.452: Se0/0/0 LCP: MagicNumber 0x7397DADA (0x05067397DADA)
.Jun 20 02:30:14.452: Se0/0/0 LCP: Event[UP] State[Starting to REQsent]
.Jun 20 02:30:16.080: Se0/0/0 PPP: I pkt type 0x008F, datagramsize 24 link[illegal]
.Jun 20 02:30:16.080: Se0/0/0 UNKNOWN(0x008F): Non-NCP packet, discarding
<output omitted>
.Jun 20 02:30:32.580: Se0/0/0 LCP: O CONFREQ [REQsent] id 10 len 10
.Jun 20 02:30:32.580: Se0/0/0 LCP: MagicNumber 0x7397DADA (0x05067397DADA)
.Jun 20 02:30:32.580: Se0/0/0 LCP: Event[Timeout+] State[REQsent to REQsent]
.Jun 20 02:30:34.596: Se0/0/0 PPP DISC: LCP failed to negotiate
.Jun 20 02:30:34.596: PPP: NET STOP send to AAA.
.Jun 20 02:30:34.596: Se0/0/0 LCP: Event[Timeout-] State[REQsent to Stopped]
.Jun 20 02:30:34.596: Se0/0/0 LCP: Event[DOWN] State[Stopped to Starting]
.Jun 20 02:30:34.596: Se0/0/0 PPP: Phase is DOWN
.Jun 20 02:30:36.080: Se0/0/0 PPP: I pkt type 0x008F, discarded, PPP not running
.Jun 20 02:30:36.596: PPP: Alloc Context [29F9F32C]
.Jun 20 02:30:36.596: ppp5 PPP: Phase is ESTABLISHING
.Jun 20 02:30:36.596: Se0/0/0 PPP: Using default call direction
.Jun 20 02:30:36.596: Se0/0/0 PPP: Treating connection as a dedicated line
```

```
.Jun 20 02:30:36.596: Se0/0/0 PPP: Session handle[34000005] Session id[5]
.Jun 20 02:30:36.596: Se0/0/0 LCP: Event[OPEN] State[Initial to Starting]
```

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

The link goes down, and the OSPF adjacency is broken. PPP keeps trying to establish a connection with the opposite end of the link as indicated by the message "Phase is ESTABLISHING". However, because it keeps receiving a non-NCP packet, LCP fails to negotiate and the link stays down.

- f. Issue the **encapsulation ppp** command on the S0/0/0 interface for the Branch1 router to correct mismatched encapsulation.

```
Branch1(config)# interface s0/0/0
Branch1(config-if)# encapsulation ppp
```

- g. Observe the debug PPP messages from the Branch1 router as the Branch1 and Central routers establish a connection.

```
Branch1(config-if)#
Jun 20 03:01:57.399: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0
from FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 03:01:59.399: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to down
Jun 20 03:01:59.399: Se0/0/0 PPP: Sending cstate UP notification
Jun 20 03:01:59.399: Se0/0/0 PPP: Processing CstateUp message
Jun 20 03:01:59.399: PPP: Alloc Context [30F8D4F0]
Jun 20 03:01:59.399: ppp9 PPP: Phase is ESTABLISHING
Jun 20 03:01:59.399: Se0/0/0 PPP: Using default call direction
Jun 20 03:01:59.399: Se0/0/0 PPP: Treating connection as a dedicated line
Jun 20 03:01:59.399: Se0/0/0 PPP: Session handle[BA000009] Session id[9]
Jun 20 03:01:59.399: Se0/0/0 LCP: Event[OPEN] State[Initial to Starting]
Jun 20 03:01:59.399: Se0/0/0 LCP: O CONFREQ [Starting] id 1 len 10
Jun 20 03:01:59.399: Se0/0/0 LCP: MagicNumber 0x8D0EAC44 (0x05068D0EAC44)
Jun 20 03:01:59.399: Se0/0/0 LCP: Event[UP] State[Starting to REQsent]
Jun 20 03:01:59.407: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]
Jun 20 03:01:59.407: Se0/0/0 LCP: I CONFREQ [REQsent] id 1 len 10
Jun 20 03:01:59.407: Se0/0/0 LCP: MagicNumber 0x73B4F1AF (0x050673B4F1AF)
Jun 20 03:01:59.407: Se0/0/0 LCP: O CONFACK [REQsent] id 1 len 10
Jun 20 03:01:59.407: Se0/0/0 LCP: MagicNumber 0x73B4F1AF (0x050673B4F1AF)
Jun 20 03:01:59.407: Se0/0/0 LCP: Event[Receive ConfReq+] State[REQsent to ACKsent]
Jun 20 03:01:59.407: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]
Jun 20 03:01:59.407: Se0/0/0 LCP: I CONFACK [ACKsent] id 1 len 10
Jun 20 03:01:59.407: Se0/0/0 LCP: MagicNumber 0x8D0EAC44 (0x05068D0EAC44)
Jun 20 03:01:59.407: Se0/0/0 LCP: Event[Receive ConfAck] State[ACKsent to Open]
Jun 20 03:01:59.439: Se0/0/0 PPP: Phase is FORWARDING, Attempting Forward
Jun 20 03:01:59.439: Se0/0/0 LCP: State is Open
Jun 20 03:01:59.439: Se0/0/0 PPP: Phase is ESTABLISHING, Finish LCP
Jun 20 03:01:59.439: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up
```

```
Jun 20 03:01:59.439: Se0/0/0 PPP: Outbound cdp packet dropped, line protocol not up
Jun 20 03:01:59.439: Se0/0/0 PPP: Phase is UP
Jun 20 03:01:59.439: Se0/0/0 IPCP: Protocol configured, start CP. state[Initial]
Jun 20 03:01:59.439: Se0/0/0 IPCP: Event[OPEN] State[Initial to Starting]
Jun 20 03:01:59.439: Se0/0/0 IPCP: O CONFREQ [Starting] id 1 len 10
Jun 20 03:01:59.439: Se0/0/0 IPCP: Address 10.1.1.1 (0x03060A010101)
Jun 20 03:01:59.439: Se0/0/0 IPCP: Event[UP] State[Starting to REQsent]
Jun 20 03:01:59.439: Se0/0/0 CDPCP: Protocol configured, start CP. state[Initial]
<output omitted>
Jun 20 03:01:59.471: Se0/0/0 Added to neighbor route AVL tree: topoid 0, address 10.1.1.2
Jun 20 03:01:59.471: Se0/0/0 IPCP: Install route to 10.1.1.2
Jun 20 03:01:59.471: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80
Jun 20 03:01:59.479: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 80 link[ip]
Jun 20 03:01:59.479: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 84
Jun 20 03:01:59.483: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 84 link[ip]
Jun 20 03:01:59.483: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 68
Jun 20 03:01:59.491: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 68 link[ip]
Jun 20 03:01:59.491: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 148
Jun 20 03:01:59.511: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 148 link[ip]
Jun 20 03:01:59.511: %OSPF-5-ADJCHG:Process 1, Nbr 209.165.200.225 on Serial0/0/0 from LOADING to FULL, Loading Done
Jun 20 03:01:59.511: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 68
Jun 20 03:01:59.519: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 60 link[ip]
```

- h. Observe the debug PPP messages from the Central router as the Branch1 and Central routers establish a connection.

```
Jun 20 03:01:59.393: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]
Jun 20 03:01:59.393: Se0/0/0 LCP: I CONFREQ [Open] id 1 len 10
Jun 20 03:01:59.393: Se0/0/0 LCP: MagicNumber 0x8D0EAC44 (0x05068D0EAC44)
Jun 20 03:01:59.393: Se0/0/0 PPP DISC: PPP Renegotiating
Jun 20 03:01:59.393: PPP: NET STOP send to AAA.
Jun 20 03:01:59.393: Se0/0/0 LCP: Event[LCP Reneg] State[Open to Open]
Jun 20 03:01:59.393: Se0/0/0 IPCP: Event[DOWN] State[Open to Starting]
Jun 20 03:01:59.393: Se0/0/0 IPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 03:01:59.393: Se0/0/0 CDPCP: Event[DOWN] State[Open to Starting]
Jun 20 03:01:59.393: Se0/0/0 CDPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 03:01:59.393: Se0/0/0 LCP: Event[DOWN] State[Open to Starting]
Jun 20 03:01:59.393: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to down
Jun 20 03:01:59.393: Se0/0/0 PPP: Outbound cdp packet dropped, NCP not negotiated
Jun 20 03:01:59.393: Se0/0/0 PPP: Phase is DOWN
Jun 20 03:01:59.393: Se0/0/0 Deleted neighbor route from AVL tree: topoid 0, address 10.1.1.1
Jun 20 03:01:59.393: Se0/0/0 IPCP: Remove route to 10.1.1.1
Jun 20 03:01:59.393: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial0/0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 03:01:59.397: PPP: Alloc Context [29F9F32C]
Jun 20 03:01:59.397: ppp38 PPP: Phase is ESTABLISHING
Jun 20 03:01:59.397: Se0/0/0 PPP: Using default call direction
Jun 20 03:01:59.397: Se0/0/0 PPP: Treating connection as a dedicated line
```

```
<output omitted>
.Jun 20 03:01:59.401: Se0/0/0 LCP: MagicNumber 0x73B4F1AF (0x050673B4F1AF)
.Jun 20 03:01:59.401: Se0/0/0 LCP: Event[Receive ConfAck] State[ACKsent to Open]
.Jun 20 03:01:59.433: Se0/0/0 PPP: Phase is FORWARDING, Attempting Forward
.Jun 20 03:01:59.433: Se0/0/0 LCP: State is Open
.Jun 20 03:01:59.433: Se0/0/0 PPP: I pkt type 0x8021, datagramsize 14 link[ip]
.Jun 20 03:01:59.433: Se0/0/0 PPP: Queue IPCP code[1] id[1]
.Jun 20 03:01:59.433: Se0/0/0 PPP: I pkt type 0x8207, datagramsize 8 link[cdp]
.Jun 20 03:01:59.433: Se0/0/0 PPP: Discarded CDPCP code[1] id[1]
.Jun 20 03:01:59.433: Se0/0/0 PPP: Phase is ESTABLISHING, Finish LCP
.Jun 20 03:01:59.433: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up
.Jun 20 03:01:59.433: Se0/0/0 PPP: Outbound cdp packet dropped, line protocol not up
.Jun 20 03:01:59.433: Se0/0/0 PPP: Phase is UP
.Jun 20 03:01:59.433: Se0/0/0 IPCP: Protocol configured, start CP. state[Initial]
.Jun 20 03:01:59.433: Se0/0/0 IPCP: Event[OPEN] State[Initial to Starting]
.Jun 20 03:01:59.433: Se0/0/0 IPCP: O CONFREQ [Starting] id 1 len 10
.Jun 20 03:01:59.433: Se0/0/0 IPCP: Address 10.1.1.2 (0x03060A010102)
.Jun 20 03:01:59.433: Se0/0/0 IPCP: Event[UP] State[Starting to REQsent]
.Jun 20 03:01:59.433: Se0/0/0 CDPCP: Protocol configured, start CP. state[Initial]
.Jun 20 03:01:59.433: Se0/0/0 CDPCP: Event[OPEN] State[Initial to Starting]
.Jun 20 03:01:59.433: Se0/0/0 CDPCP: O CONFREQ [Starting] id 1 len 4
.Jun 20 03:01:59.433: Se0/0/0 CDPCP: Event[UP] State[Starting to REQsent]
<output omitted>
.Jun 20 03:01:59.465: Se0/0/0 IPCP: State is Open
.Jun 20 03:01:59.465: Se0/0/0 Added to neighbor route AVL tree: topoid 0, address
10.1.1.1
.Jun 20 03:01:59.465: Se0/0/0 IPCP: Install route to 10.1.1.1
.Jun 20 03:01:59.465: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80
.Jun 20 03:01:59.465: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 80 link[ip]
.Jun 20 03:01:59.469: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 84
.Jun 20 03:01:59.477: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 84 link[ip]
.Jun 20 03:01:59.477: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 68
.Jun 20 03:01:59.481: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 68 link[ip]
.Jun 20 03:01:59.489: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 148 link[ip]
.Jun 20 03:01:59.493: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 148
.Jun 20 03:01:59.505: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 68 link[ip]
.Jun 20 03:01:59.505: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 60
.Jun 20 03:01:59.517: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 88 link[ip]
.Jun 20 03:01:59.517: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial0/0/0 from
LOADING to FULL, Loading Done
.Jun 20 03:01:59.561: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80
.Jun 20 03:01:59.569: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 80 link[ip]
Jun 20 03:02:01.445: Se0/0/0 PPP: I pkt type 0x8207, datagramsize 8 link[cdp]
Jun 20 03:02:01.445: Se0/0/0 CDPCP: I CONFREQ [ACKrcvd] id 2 len 4
Jun 20 03:02:01.445: Se0/0/0 CDPCP: O CONFACK [ACKrcvd] id 2 len 4
Jun 20 03:02:01.445: Se0/0/0 CDPCP: Event[Receive ConfReq+] State[ACKrcvd to Open]
Jun 20 03:02:01.449: Se0/0/0 CDPCP: State is Open
Jun 20 03:02:01.561: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80
Jun 20 03:02:01.569: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 80 link[ip]
```

## Lab – Configuring Basic PPP with Authentication

```
Jun 20 03:02:02.017: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 68
Jun 20 03:02:02.897: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 112 link[ip]
Jun 20 03:02:03.561: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80
```

From the debug message, what phases does PPP go through when the other end of the serial link on the Central router is configured with PPP encapsulation?

PPP goes through the following phases: DOWN, ESTABLISHING, and UP.

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

The link comes up, and the OSPF adjacency is restored.

- i. Issue the **undebg all** (or **u all**) command on the Branch1 and Central routers to turn off all debugging on both routers.
- j. Issue the **show ip interface brief** command on the Branch1 and Central routers after the network converges. What is the status for interface S0/0/0 on both routers?

Serial 0/0/0 has status up and protocol up.

Branch1# **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	192.168.1.1	YES	manual	up	up
Serial0/0/0	10.1.1.1	YES	manual	up	up
Serial0/0/1	unassigned	YES	unset	administratively down	down

Central# **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
Embedded-Service-Engine0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/0	unassigned	YES	unset	administratively down	down
GigabitEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/0/0	10.1.1.2	YES	manual	up	up
Serial0/0/1	10.2.2.2	YES	manual	up	up
Loopback0	209.165.200.225	YES	manual	up	up

- k. Verify that the interface S0/0/0 on both Branch1 and Central routers are configured for PPP encapsulation.

Record the command to verify the PPP encapsulation in the space provided below.

Branch1# **show interfaces s0/0/0**

Central# **show interfaces s0/0/0**

- l. Change the serial encapsulation for the link between the Central and Branch3 routers to PPP encapsulation.

Central(config)# **interface s0/0/1**

```
Central(config-if)# encapsulation ppp
Central(config-if)#
Jun 20 03:17:15.933: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial0/0/1 from
FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 03:17:17.933: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to down
Jun 20 03:17:23.741: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to up
Jun 20 03:17:23.825: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial0/0/1 from
LOADING to FULL, Loading Done

Branch3(config)# interface s0/0/1
Branch3(config-if)# encapsulation ppp
Branch3(config-if)#
Jun 20 03:17:21.744: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1
from FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 03:17:21.948: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to down
Jun 20 03:17:21.964: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to up
Jun 20 03:17:23.812: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1
from LOADING to FULL, Loading Done
```

- m. Verify that end-to-end connectivity is restored before continuing to Part 3.

## Part 3: Configure PPP CHAP Authentication

### Step 1: Verify that PPP encapsulation is configured on all serial interfaces.

Record the command used to verify that PPP encapsulation is configured.

---

**show running-config** with output modifiers or **show interfaces *interface-id***

### Step 2: Configure PPP CHAP authentication for the link between the Central router and the Branch3 router.

- Configure a username for CHAP authentication.  

```
Central(config)# username Branch3 password cisco
Branch3(config)# username Central password cisco
```
- Issue the **debug ppp** commands on the Branch3 router to observe the process, which is associated with authentication.  

```
Branch3# debug ppp negotiation
PPP protocol negotiation debugging is on
Branch3# debug ppp packet
PPP packet display debugging is on
```
- Configure the interface S0/0/1 on Branch3 for CHAP authentication.  

```
Branch3(config)# interface s0/0/1
Branch3(config-if)# ppp authentication chap
```
- Examine the debug PPP messages on the Branch3 router during the negotiation with the Central router.



```
Branch3(config-if)#
Jun 20 04:25:02.079: Se0/0/1 PPP DISC: Authentication configuration changed
Jun 20 04:25:02.079: PPP: NET STOP send to AAA.
Jun 20 04:25:02.079: Se0/0/1 IPCP: Event[DOWN] State[Open to Starting]
Jun 20 04:25:02.079: Se0/0/1 IPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 04:25:02.079: Se0/0/1 CDPCP: Event[DOWN] State[Open to Starting]
Jun 20 04:25:02.079: Se0/0/1 CDPCP: Event[CLOSE] State[Starting to Initial]
Jun 20 04:25:02.079: Se0/0/1 LCP: Event[DOWN] State[Open to Starting]
Jun 20 04:25:02.079: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to down
Jun 20 04:25:02.079: Se0/0/1 PPP: Outbound cdp packet dropped, NCP not negotiated
Jun 20 04:25:02.079: Se0/0/1 PPP: Phase is DOWN
Jun 20 04:25:02.079: Se0/0/1 Deleted neighbor route from AVL tree: topoid 0, address
10.2.2.2
Jun 20 04:25:02.079: Se0/0/1 IPCP: Remove route to 10.2.2.2
Jun 20 04:25:02.079: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1
from FULL to DOWN, Neighbor Down: Interface down or detached
Jun 20 04:25:02.083: PPP: Alloc Context [29F4DA8C]
Jun 20 04:25:02.083: ppp73 PPP: Phase is ESTABLISHING
Jun 20 04:25:02.083: Se0/0/1 PPP: Using default call direction
Jun 20 04:25:02.083: Se0/0/1 PPP: Treating connection as a dedicated line
Jun 20 04:25:02.083: Se0/0/1 PPP: Session handle[2700004D] Session id[73]
<output omitted>
Jun 20 04:25:02.091: Se0/0/1 PPP: I pkt type 0xC021, datagramsize 19 link[ppp]
Jun 20 04:25:02.091: Se0/0/1 LCP: I CONFACK [ACKsent] id 1 len 15
Jun 20 04:25:02.091: Se0/0/1 LCP: AuthProto CHAP (0x0305C22305)
Jun 20 04:25:02.091: Se0/0/1 LCP: MagicNumber 0xF7B20F10 (0x0506F7B20F10)
Jun 20 04:25:02.091: Se0/0/1 LCP: Event[Receive ConfAck] State[ACKsent to Open]
Jun 20 04:25:02.123: Se0/0/1 PPP: Phase is AUTHENTICATING, by this end
Jun 20 04:25:02.123: Se0/0/1 CHAP: O CHALLENGE id 1 len 28 from "Branch3"
Jun 20 04:25:02.123: Se0/0/1 LCP: State is Open
Jun 20 04:25:02.127: Se0/0/1 PPP: I pkt type 0xC223, datagramsize 32 link[ppp]
Jun 20 04:25:02.127: Se0/0/1 CHAP: I RESPONSE id 1 len 28 from "Central"
Jun 20 04:25:02.127: Se0/0/1 PPP: Phase is FORWARDING, Attempting Forward
Jun 20 04:25:02.127: Se0/0/1 PPP: Phase is AUTHENTICATING, Unauthenticated User
Jun 20 04:25:02.127: Se0/0/1 PPP: Sent CHAP LOGIN Request
Jun 20 04:25:02.127: Se0/0/1 PPP: Received LOGIN Response PASS
Jun 20 04:25:02.127: Se0/0/1 IPCP: Authorizing CP
Jun 20 04:25:02.127: Se0/0/1 IPCP: CP stalled on event[Authorize CP]
Jun 20 04:25:02.127: Se0/0/1 IPCP: CP un stall
Jun 20 04:25:02.127: Se0/0/1 PPP: Phase is FORWARDING, Attempting Forward
Jun 20 04:25:02.135: Se0/0/1 PPP: Phase is AUTHENTICATING, Authenticated User
Jun 20 04:25:02.135: Se0/0/1 CHAP: O SUCCESS id 1 len 4
Jun 20 04:25:02.135: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to up
Jun 20 04:25:02.135: Se0/0/1 PPP: Outbound cdp packet dropped, line protocol not up
Jun 20 04:25:02.135: Se0/0/1 PPP: Phase is UP
Jun 20 04:25:02.135: Se0/0/1 IPCP: Protocol configured, start CP. state[Initial]
Jun 20 04:25:02.135: Se0/0/1 IPCP: Event[OPEN] State[Initial to Starting]
Jun 20 04:25:02.135: Se0/0/1 IPCP: O CONFREQ [Starting] id 1 len 10
```



```
<output omitted>
.Jun 20 04:25:02.143: Se0/0/1 CDPCP: I CONFACK [ACKsent] id 1 len 4
.Jun 20 04:25:02.143: Se0/0/1 CDPCP: Event[Receive ConfAck] State[ACKsent to Open]
.Jun 20 04:25:02.155: Se0/0/1 IPCP: State is Open
.Jun 20 04:25:02.155: Se0/0/1 CDPCP: State is Open
.Jun 20 04:25:02.155: Se0/0/1 Added to neighbor route AVL tree: topoid 0, address
10.2.2.2
.Jun 20 04:25:02.155: Se0/0/1 IPCP: Install route to 10.2.2.2
.Jun 20 04:25:02.155: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 80
.Jun 20 04:25:02.155: Se0/0/1 PPP: I pkt type 0x0021, datagramsize 80 link[ip]
.Jun 20 04:25:02.155: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 84
.Jun 20 04:25:02.167: Se0/0/1 PPP: I pkt type 0x0021, datagramsize 84 link[ip]
.Jun 20 04:25:02.167: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 68
.Jun 20 04:25:02.171: Se0/0/1 PPP: I pkt type 0x0021, datagramsize 68 link[ip]
.Jun 20 04:25:02.171: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 148
.Jun 20 04:25:02.191: Se0/0/1 PPP: I pkt type 0x0021, datagramsize 148 link[ip]
.Jun 20 04:25:02.191: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1
from LOADING to FULL, Loading Done
.Jun 20 04:25:02.191: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 68
.Jun 20 04:25:02.571: Se0/0/1 PPP: O pkt type 0x0021, datagramsize 80
.Jun 20 04:25:03.155: Se0/0/1 PPP: I pkt type 0x0207, datagramsize 333 link[cdp]
.Jun 20 04:25:03.155: Se0/0/1 PPP: O pkt type 0x0207, datagramsize 339
.Jun 20 04:25:04.155: Se0/0/1 PPP: O pkt type 0x0207, datagramsize 339
```

From the PPP debug messages, what phases did the Branch3 router go through before the link is up with the Central router?

---

PPP goes through the following phases: DOWN, ESTABLISHING, AUTHENTICATING, and UP.

- e. Issue the **debug ppp authentication** command to observe the CHAP authentication messages on the Central router.

```
Central# debug ppp authentication
PPP authentication debugging is on
```

- f. Configure CHAP authentication on S0/0/1 on the Central router.

```
Central(config)# interface s0/0/1
Central(config-if)# ppp authentication chap
```

- g. Observe the debug PPP messages relating to CHAP authentication on the Central router.

```
Central(config-if)#
.Jun 20 05:05:16.057: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to down
.Jun 20 05:05:16.061: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial0/0/1 from
FULL to DOWN, Neighbor Down: Interface down or detached
.Jun 20 05:05:16.061: Se0/0/1 PPP: Using default call direction
.Jun 20 05:05:16.061: Se0/0/1 PPP: Treating connection as a dedicated line
.Jun 20 05:05:16.061: Se0/0/1 PPP: Session handle[12000078] Session id[112]
.Jun 20 05:05:16.081: Se0/0/1 CHAP: O CHALLENGE id 1 len 28 from "Central"
.Jun 20 05:05:16.089: Se0/0/1 CHAP: I CHALLENGE id 1 len 28 from "Branch3"
.Jun 20 05:05:16.089: Se0/0/1 PPP: Sent CHAP SENDAUTH Request
```

```
.Jun 20 05:05:16.089: Se0/0/1 PPP: Received SENDAUTH Response PASS
.Jun 20 05:05:16.089: Se0/0/1 CHAP: Using hostname from configured hostname
.Jun 20 05:05:16.089: Se0/0/1 CHAP: Using password from AAA
.Jun 20 05:05:16.089: Se0/0/1 CHAP: O RESPONSE id 1 len 28 from "Central"
.Jun 20 05:05:16.093: Se0/0/1 CHAP: I RESPONSE id 1 len 28 from "Branch3"
.Jun 20 05:05:16.093: Se0/0/1 PPP: Sent CHAP LOGIN Request
.Jun 20 05:05:16.093: Se0/0/1 PPP: Received LOGIN Response PASS
.Jun 20 05:05:16.093: Se0/0/1 CHAP: O SUCCESS id 1 len 4
.Jun 20 05:05:16.097: Se0/0/1 CHAP: I SUCCESS id 1 len 4
.Jun 20 05:05:16.097: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to up
.Jun 20 05:05:16.165: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial0/0/1 from
LOADING to FULL, Loading Done
```

- h. Issue the **undebg all** (or **u all**) command on the Central and Branch3 routers to turn off all debugging.

```
Central# undebg all
```

All possible debugging has been turned off

### Step 3: Intentionally break the serial link configured with authentication.

- a. On the Central router, configure a username for use with Branch1. Assign **cisco** as the password.

```
Central(config)# username Branch1 password cisco
```

- b. On the Central and Branch1 routers, configure CHAP authentication on interface S0/0/0. What is happening with the interface?

---

The interface S0/0/0 is going up and down.

**Note:** To speed up the process, shut down the interface and enable it again.

```
.Jun 20 05:23:55.032: %LINK-3-UPDOWN: Interface Serial0/0/0, changed state to up
Central(config-if)#
.Jun 20 05:23:57.064: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up
.Jun 20 05:23:57.076: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to down
Central(config-if)#
.Jun 20 05:24:03.144: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up
.Jun 20 05:24:03.156: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to down
Central(config-if)#
```

- c. Use a **debug ppp negotiation** command to examine what is happening.

```
Central# debug ppp negotiation
```

PPP protocol negotiation debugging is on

```
Central(config-if)#
```

```
.Jun 20 05:25:26.229: Se0/0/0 PPP: Missed a Link-Up transition, starting PPP
.Jun 20 05:25:26.229: Se0/0/0 PPP: Processing FastStart message
.Jun 20 05:25:26.229: PPP: Alloc Context [29F9F32C]
.Jun 20 05:25:26.229: ppp145 PPP: Phase is ESTABLISHING
.Jun 20 05:25:26.229: Se0/0/0 PPP: Using default call direction
.Jun 20 05:25:26.229: Se0/0/0 PPP: Treating connection as a dedicated line
```

## Lab – Configuring Basic PPP with Authentication

```
.Jun 20 05:25:26.229: Se0/0/0 PPP: Session handle[6000009C] Session id[145]
.Jun 20 05:25:26.229: Se0/0/0 LCP: Event[OPEN] State[Initial to Starting]
.Jun 20 05:25:26.229: Se0/0/0 LCP: O CONFREQ [Starting] id 1 len 15
.Jun 20 05:25:26.229: Se0/0/0 LCP: AuthProto CHAP (0x0305C22305)
.Jun 20 05:25:26.229: Se0/0/0 LCP: MagicNumber 0x74385C31 (0x050674385C31)
.Jun 20 05:25:26.229: Se0/0/0 LCP: Event[UP] State[Starting to REQsent]
.Jun 20 05:25:26.229: Se0/0/0 LCP: I CONFREQ [REQsent] id 1 len 10
.Jun 20 05:25:26.229: Se0/0/0 LCP: MagicNumber 0x8D920101 (0x05068D920101)
.Jun 20 05:25:26.229: Se0/0/0 LCP: O CONFACK [REQsent] id 1 len 10
.Jun 20 05:25:26.229: Se0/0/0 LCP: MagicNumber 0x8D920101 (0x05068D920101)
.Jun 20 05:25:26.229: Se0/0/0 LCP: Event[Receive ConfReq+] State[REQsent to ACKsent]
.Jun 20 05:25:26.233: Se0/0/0 LCP: I CONFACK [ACKsent] id 1 len 15
.Jun 20 05:25:26.233: Se0/0/0 LCP: AuthProto CHAP (0x0305C22305)
.Jun 20 05:25:26.233: Se0/0/0 LCP: MagicNumber 0x74385C31 (0x050674385C31)
.Jun 20 05:25:26.233: Se0/0/0 LCP: Event[Receive ConfAck] State[ACKsent to Open]
.Jun 20 05:25:26.261: Se0/0/0 PPP: Phase is AUTHENTICATING, by this end
.Jun 20 05:25:26.261: Se0/0/0 CHAP: O CHALLENGE id 1 len 28 from "Central"
.Jun 20 05:25:26.261: Se0/0/0 LCP: State is Open
.Jun 20 05:25:26.265: Se0/0/0 LCP: I TERMREQ [Open] id 2 len 4
.Jun 20 05:25:26.265: Se0/0/0 PPP DISC: Received LCP TERMREQ from peer
.Jun 20 05:25:26.265: PPP: NET STOP send to AAA.
.Jun 20 05:25:26.265: Se0/0/0 PPP: Phase is TERMINATING
.Jun 20 05:25:26.265: Se0/0/0 LCP: O TERMACK [Open] id 2 len 4
.Jun 20 05:25:26.265: Se0/0/0 LCP: Event[Receive TermReq] State[Open to Stopping]
.Jun 20 05:25:26.265: Se0/0/0 PPP: Sending cstate DOWN notification
.Jun 20 05:25:26.265: Se0/0/0 PPP: Processing CstateDown message
.Jun 20 05:25:26.265: Se0/0/0 LCP: Event[CLOSE] State[Stopping to Closing]
.Jun 20 05:25:26.265: Se0/0/0 LCP: Event[DOWN] State[Closing to Initial]
.Jun 20 05:25:26.265: Se0/0/0 PPP: Phase is DOWN
```

Explain what is causing the link to terminate. Correct the issue and document the command issued to correct the issue in the space provided below.

The link terminated because the CHAP handshake cannot be completed without the correct user credential on Branch1.

```
Branch1(config)# username Central password cisco
```

- d. Issue the **undebg all** command on all routers to turn off debugging.
- e. Verify end-to-end connectivity.

## Reflection

1. What are the indicators that you may have a serial encapsulation mismatch on a serial link?

Some of the indicators are: the network is no longer converged because some of the routes are removed and the line protocol for the link is down.

2. What are the indicators that you may have an authentication mismatch on a serial link?

Some of the indicators are: the route is removed from the routing table and the line protocol goes up and down.

### Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

**Note:** To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

### Device Configs

#### Branch1

```
Branch1# show run
Building configuration...

Current configuration : 1832 bytes
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname Branch1
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
```

## Lab – Configuring Basic PPP with Authentication

---

```
!  
no aaa new-model  
memory-size iomem 15  
!  
ip cef  
!  
!  
!  
!  
!  
no ip domain lookup  
no ipv6 cef  
multilink bundle-name authenticated  
!  
!  
!  
!  
username Central password 7 1511021F0725  
!  
!  
!  
!  
!  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!  
interface GigabitEthernet0/0  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
ip address 192.168.1.1 255.255.255.0  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
ip address 10.1.1.1 255.255.255.252  
encapsulation ppp  
ppp authentication chap  
clock rate 128000  
!  
interface Serial0/0/1  
no ip address  
shutdown  
!
```

## Lab – Configuring Basic PPP with Authentication

---

```
router ospf 1
 network 10.1.1.0 0.0.0.3 area 0
 network 192.168.1.0 0.0.0.255 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
!
control-plane
!
!
banner motd ^C
    Unauthorized Access Prohibited.^C
!
line con 0
 password 7 094F471A1A0A
 logging synchronous
 login
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password 7 121A0C041104
 login
 transport input all
line vty 5 15
 password 7 110A1016141D
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

### Central

```
Central#show run
Building configuration...

Current configuration : 1964 bytes
```

## Lab – Configuring Basic PPP with Authentication

---

```
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname Central
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH6lwAE/kLkDq9BGholQM5EnRtoyr8cHAUg.2
!
no aaa new-model
memory-size iomem 15
!
ip cef
!
!
!
!
!
!
!
no ip domain lookup
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
username Branch3 password 7 1511021F0725
username Branch1 password 7 05080F1C2243
!
redundancy
!
!
!
!
!
!
!
!
!
!
!
!
```

## Lab – Configuring Basic PPP with Authentication

---

```
interface Loopback0
 ip address 209.165.200.225 255.255.255.224
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 10.1.1.2 255.255.255.252
 encapsulation ppp
 ppp authentication chap
!
interface Serial0/0/1
 ip address 10.2.2.2 255.255.255.252
 encapsulation ppp
 ppp authentication chap
 clock rate 128000
!
router ospf 1
 network 10.1.1.0 0.0.0.3 area 0
 network 10.2.2.0 0.0.0.3 area 0
 default-information originate
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Loopback0
!
!
!
!
!
control-plane
!
!
banner motd ^C
```



```
Unauthorized Access Prohibited.^C
!
line con 0
  password 7 00071A150754
  logging synchronous
  login
line aux 0
line 2
  no activation-character
  no exec
  transport preferred none
  transport input all
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
  stopbits 1
line vty 0 4
  password 7 060506324F41
  login
  transport input all
line vty 5 15
  password 7 14141B180F0B
  login
  transport input all
!
scheduler allocate 20000 1000
!
end
```

### Branch3

```
Branch3# show run
Building configuration...
```

```
Current configuration : 1929 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname Branch3
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
memory-size iomem 15
!
```

```
ip cef
!
!
!
!
!
no ip domain lookup
no ipv6 cef
!
multilink bundle-name authenticated
!
!
username Central password 7 0822455D0A16
!
redundancy
!
!
!
!
!
!
!
!
!
interface Embedded-Service-Engine0/0
  no ip address
  shutdown
!
interface GigabitEthernet0/0
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  ip address 192.168.3.1 255.255.255.0
  duplex auto
  speed auto
!
interface Serial0/0/0
  no ip address
  shutdown
  clock rate 2000000
!
interface Serial0/0/1
  ip address 10.2.2.1 255.255.255.252
  encapsulation ppp
  ppp authentication chap
!
```

## Lab – Configuring Basic PPP with Authentication

---

```
router ospf 1
 network 10.2.2.0 0.0.0.3 area 0
 network 192.168.3.0 0.0.0.255 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
!
control-plane
!
!
banner motd ^C
    Unauthorized Access Prohibited.^C
!
line con 0
 password 7 13061E010803
 logging synchronous
 login
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password 7 045802150C2E
 login
 transport input all
line vty 5 15
 password 7 13061E010803
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```