PPP

Network Design & Simulation Lab

By
Dr. Ahmed Awad
Eng. Ibrahim Amreya

An-Najah National University

PPP

Topology

Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
Jenin				
Ramallah				
	Lo0	209.165.200.225	255.255.255.224	N/A
Nablus				
PC-A	NIC			
PC-B	NIC			

Introduction

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 Ramallah 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.

The Network

Your Company has an HQ in Ramallah city and two branches one in Jenin and the other is in Nablus. Leased lines have been chosen to connect the branches to the HQ. Each branch consists of one LAN. The HQ router has an internet connection.

The IP addressing scheme to be used is as follows:

1. Classful class C networks for the Branch LANS.
2. Class A subnets of block size 4 on the WAN connections.
3. The internet connection on HQ has the IP address 209.165.200.225/27.

Use the first Ethernet interface of each router for the LANs. The internet connection is simulated by Lo0 on Ramallah router.

The **first** serial interface of Jenin router is to be connected to the **first** serial interface of Ramallah router.

The **second** serial interface of Ramallah router in connected to the **second** serial interface of Nablus router.

Design the network as per the requirements, fill the addressing table, and draw the network topology in page 1.

Required Resources

Fill the required resources:

- ___ Routers
- ___ Switches
- ___ PCs
- ___ Ethernet and ___ serial cables.

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.

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

Step 2: Initialize and reload the routers and switches as necessary.

Step 3: Configure basic settings for each router.

a. Configure the device name.

b. Assign **pass** as the encrypted privileged EXEC mode password.

c. Assign **pass** as the console and vty password and enable login.

d. Set console logging to synchronous mode.

e. Apply the IP addresses to all interfaces according to the Addressing Table and activate the physical interfaces.

f. Create **Loopback0** on the Ramallah 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 Ramallah 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.
Jenin Router ID:_____
Nablus Router ID:_____
Ramallah Router ID:_____

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.

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.

```
Jenin# show interfaces s0/0/0
….
  Encapsulation HDLC, loopback not set
….
```

What is the default serial encapsulation for a Cisco router? _____

Step 2: Change the serial encapsulation to PPP.

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

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

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

_____

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

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

d. Verify that interface S0/0/0 on both Jenin and Ramallah routers is up/up and is configured with PPP encapsulation.

What is the status of the PPP Link Control Protocol (LCP)? _____

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

_____

```
Jenin# show interfaces s0/0/0
Serial0/0/0 is up, line protocol is up
…
  Encapsulation PPP, LCP Open
  Open: IPCP, CDPCP, loopback not set
…
Ramallah# show interfaces s0/0/0
Serial0/0/0 is up, line protocol is up
…
  Encapsulation PPP, LCP Open
  Open: IPCP, CDPCP, loopback not set
…
```

Step 3: Intentionally break the serial connection.

a. Issue the **debug ppp** commands to observe the effects of changing the PPP configuration on the Jenin router and the Ramallah router.

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

Ramallah# debug ppp negotiation
PPP protocol negotiation debugging is on
Ramallah# 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 Jenin and Ramallah routers.

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

_____

d. Observe the debug PPP messages on the Jenin router. The serial connection has terminated, and the line protocol is down. The route to Ramallah has been removed from the routing table.

```
Jun 20 02:29:50.295: Se0/0/0 PPP DISC: Lower Layer disconnected
…
Jun 20 02:29:50.299: Se0/0/0 PPP: Phase is TERMINATING
```

…

```
Jun 20 02:29:50.299: Se0/0/0 PPP: Phase is DOWN
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 Ramallah router. The Ramallah router continues to attempt to establish a connection with Jenin 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.

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

_____

_____

_____

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

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

g. Observe the debug PPP messages from the Jenin router as the Jenin and Ramallah routers establish a connection.

h. Observe the debug PPP messages from the Ramallah router as the Jenin and Ramallah routers establish a connection.

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

_____

_____

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

_____

i. Issue the **undebug all** (or **u all**) command on the Jenin and Ramallah routers to turn off all debugging on both routers.

j. Issue the **show ip interface brief** command on the Jenin and Ramallah routers after the network converges. What is the status for interface S0/0/0 on both routers?

_____

k. Verify that the interface S0/0/0 on both Jenin and Ramallah routers are configured for PPP encapsulation.

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

_____

_____

l. Change the serial encapsulation for the link between the Ramallah and Nablus routers to PPP encapsulation.

```
Ramallah(config)# interface s0/0/1
Ramallah(config-if)# encapsulation ppp
```

```
Nablus(config)# interface s0/0/1
Nablus(config-if)# encapsulation ppp
```

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.

_____

Step 2: Configure PPP CHAP authentication for the link between the Ramallah router and the Nablus router.

a. Configure a username for CHAP authentication.

```
Ramallah(config)# username Nablus password pass
Nablus(config)# username Ramallah password pass
```

b. Issue the **debug ppp** commands on the Nablus router to observe the process, which is associated with authentication.

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

c. Configure the interface S0/0/1 on Nablus for CHAP authentication.

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

d. Examine the debug PPP messages on the Nablus router during the negotiation with the Ramallah router.

```
…
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: %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: ppp73 PPP: Phase is ESTABLISHING
…
.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 "Nablus"
…
.Jun 20 04:25:02.127: Se0/0/1 CHAP: I RESPONSE id 1 len 28 from "Ramallah"
…
.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 04:25:02.135: 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 04:25:02.191: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1
from LOADING to FULL, Loading Done
```

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

_____

_____

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

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

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

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

```
Ramallah(config-if)#
.Jun 20 05:05:16.057: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to down
…
.Jun 20 05:05:16.081: Se0/0/1 CHAP: O CHALLENGE id 1 len 28 from "Ramallah"
.Jun 20 05:05:16.089: Se0/0/1 CHAP: I CHALLENGE id 1 len 28 from "Nablus"
…
.Jun 20 05:05:16.089: Se0/0/1 CHAP: Using hostname from configured hostname
…
.Jun 20 05:05:16.097: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,
changed state to up
```

h. Issue the **undebug all** (or **u all**) command on the Ramallah and Nablus routers to turn off all debugging.

```
Ramallah# undebug all
```

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

a. On the Ramallah router, configure a username for use with Jenin. Assign **pass** as the password.

```
Ramallah(config)# username Jenin password pass
```

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

_____

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

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

```
Ramallah# debug ppp negotiation
…
.Jun 20 05:25:26.229: ppp145 PPP: Phase is ESTABLISHING
…
.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 "Ramallah"
…
.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 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.

_____

_____

_____

d. Issue the **undebug all** command on all routers to turn off debugging.

e. Verify end-to-end connectivity.

DONE