# Wide Area Network (WAN)

## Tujuan

Setelah mengikuti praktikum ini mahasiswa diharapkan dapat:

1. Menjelaskan WAN, koneksi dan protokol-protokol WAN
2. Mampu melakukan konfigurasi Protocol WAN

## Alat & Bahan

Alat & Bahan Yang digunakan adalah hardware perangkat PC beserta Kelengkapannya berjumlah 40 PC serta Software Packet Tracer yang telah terinstall pada masing-masing PC dan setiap PC terhubung Internet.

## Dasar Teori

### Pengantar WAN

WAN (Wide Area Network) merupakan jaringan yang menghubungkan computer atau jaringan LAN dalam area geografis yang lebih luas dan dihubungkan melalui telepon atau satelit.

Karakteristik WAN diantaranya adalah :

1. Bekerja di area geografis yang luas
2. Dapat diakses melalui Serial Interface dengan kecepatan yang rendah
3. Koneksi Full-Time dan Part-Time



**Figure 15.1** Perangkat yang umum digunakan

### Terminologi dalam WAN

Berikut adalah istilah – istilah yang biasa digunakan oleh service provider terkait dengan jenis layanan WAN :

* *Costumer Premises Equipment* (CPE) – Peralatan milik pelanggan

CPE adalah perlengkapan yang dimiliki oleh pelanggan dan berada di lokasi pelanggan

* *Demarcation Point* – Titik Demarkasi. – merupakan titik dimana tanggung jawab service provider berakhir dan CPE dimulai. Titik ini biasanya adalah sebuah *Telecomunication Closet* yang dimiliki dan dipasang oleh perusahaan telekomunikasi. Selanjutnya pelanggan bertanggung jawab pada kabel ( yang pada dasarnya adalah perpanjangan dari titik demarkasi) dari *Telecomunication Closet* ke CPE, yang biasanya adalah sebuah koneksi ke CSU/DSU atau interface ISDN
* *Local Loop*, yaitu digunakan untuk menghubungkan *demarcation point* dengan *switching office* terdekat (Central Office)
* *Central Office*. Titik ini menghubungkan pelanggan dengan jaringan *switching* dari service provider. Sebuah central office bisa disebut juga dengan istilah *Point of Presence* (POP)
* *Toll Network*, merupakan sebuah *trunk line* yang berada didalam jaringan provider WAN. Juga merupakan kumpulan dari switch-switch dan fasilitas yang dimiliki oleh ISP.

### Jenis – Jenis Koneksi WAN

Sebuah WAN dapat menggunakan sejumlah jenis koneksi yang berbeda. Jenis- jenis koneksi Wan yang berbeda ini dapat digunakan untuk menghubungkan jaringan – jaringan LAN dengan DTE melalui sebuah jaringan DCE. Jenis – jenis koneksi WAN adalah sebagai berikut :

1. *Leased Line*, biasa juga disebut dengan koneksi *point-to –point* atau koneksi *dedicated* (artinya koneksi yang disediakan khusus untuk pelanggan,dimana bandwidth-nya khusus untuk pelanggan itu juga. Sebuah leased line adalah sebuah alur komunikasi WAN dari CPE yang telah ditetepkan sebelumnya oleh service provider, yang melalui switch DCE, menuju ke CPE di lokasi remote, yang memungkinkan jaringan – jaringan DTE berkomunikasi pada setiap saat dengan tanpa melalui prosedur setup terlebih dahulu sebelum melaukan transmisi data. Koneksi ini menggunakan sambungan serial yang dapat mencapai 45 Mpbs. Enkapsulasi HDLC dan PPP sering digunakan di leased line.



1. *Circuit Switching*, yaitu koneksi melalui sambungan telepon dengan menggunakan modem dial-up atau ISDN untuk transfer data dengan bandwidth kecil. Keuntungannya, biaya dikenakan hanya saat pemakaian saja. Tidak ada data yang dipindahkan sebelum sebuah koneksi dari ujung ke ujung terbentuk.



1. *Packet Switching*, merupakan sebuah metode switching WAN yang memungkinkan kita untuk berbagi bandwidth dengan perusahaan lain dalam rangka menghemat biaya. Packet switching dapat dianggap sebagai sebuah jaringan yang dirancang agar mirip dengan leased line, tetapi dengan harga setara dengan circuit switching. Kekurangannya, packet switching hanya berjalan dengan baik jika transfer data bersifat tidak kontinyu atau hanya diperukan sewaktu-waktu (bursty). Frame Relay dan X.25 adalah contoh teknologi packet switching dengan kecepatan 64 Kpbs sampai dengan 45 Mpbs.



### Protokol – Protocol Dalam WAN

Protokol – protocol WAN yang masih umum digunakan diantaranya adalah Frame Relay, ISDN, LAPB,

HDLC, PPP dan ATM [2]

1. Frame Relay

Merupakan teknologi packet switched dengan spesifikasi layer data link dan layer physical yang menyediakan unjuk kerja yang bagus. Lebih efektif dari segi iaya dibandingkan dengan PPP, dapat berjalan dengan kecepatan 64 Kpbs – 45 Mpbs. Dapat menyediakan fungsi-fungsi tambahan untuk alokasi bandwidth dinamis dan pengendalian *congestion* (congestion control)

1. ISDN (Integrated Services Digital Network)

Merupakan sekumpulan layanan digital yang memindahkan suara dan data melalui sambungan telepon yang ada. ISDN dapat menyediakan sebuah solusi yang efektif dari segi biaya untuk pengguna remote yang membutuhkan konesi yang lebih cepat dari pada yang ditawarkan oleh sambungan dial-up. ISDN adalah pilihan yang baik sebagai link backup untuk jenis koneksi lain seperti frame relay.

1. LAPB (Link Access Prosedure Balanced)

Diciptakan untuk menjadi sebuah protocol connection oriented pada layer data link untuk digunakan dengan X.25. Juga dapat digunaan sebagai sebuah transport data link yang sederhana. Namun LAPB menyebabkan overhead (waktu pemrosesan) yang besar karena teknik timeout dan windowing-nya yang kaku.

1. HDLC (High-Level Data-Link Control)

Dikembangkan dari *Synchronous Data Link Control* (SDLC) yang diciptakan oleh IBM sebagai sebuah protocol koneksi *Data Link*. HDLC adalah sebuah protocol di layer Data Link yang memiliki overhead yang lebih kecil dibandingkan dengan LAPB. HDLC tidak dimaksudkan untuk membungkus protocol-protokol layer network yang berbeda-beda melalui link yang sama. Header HDLC tidak membawa identifikasi dari jenis protocol yang dibawa di dalam enkapsulasi HDLC. Karena itu, setiap vendor yang menggunakan HDLC memiliki cara mereka sendiri dalam melakukan identifikasi protocol layer network, yang berarti setiap HDLC yang dimiliki sebuah vendor bersifat *proprietary* (hanya dapat dipakai untuk perlengkapan buatan mereka sendiri).

1. PPP (Point-to-Point Protocol)

Merupakan sebuah protocol standar industry yang bersifat *proprietary* dimana protokol ini dapat digunakan untuk menciptakan sambungan titik-ke-titik antara perlengkapan dari vendor-vendor yang berbeda. PPP menggunakan sebuah field Network Control Protocol di header Data Link untuk melakukan indentifikasi protocol layer network. PPP mengizinkan authentikasi dan koneksi multilink serta dapat berjalan melalui link yang asynchronous dan synchronous.

1. ATM (Asynchronous Transfer Mode)

Diciptakan untuk lalu lintas data yang sensitive terhadap waktu, menyediakan transmisi suara, video dan data yang serentak. ATM menggunakan *isochronous clocking* (Clocking external) untuk mempercepat pemindahan data.

### WAN Cabling

Impelemntasi layer physical pada WAN cabling sangat bervariasi bergantung pada jarak antar perangkat jaringan, kecepatan dan tipe layanan yang digunakan. Serial connections digunakan untuk mendukung WAN service seperti dedicated leased lines yang menggunakan PPP atau frame relay.

Tipe kabel serial yang digunakan pada WAN cabling

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**Figure 15.2** WAN Cabling

Keterangan :

* **CSU/DSU** : Chanel Service Unit/ Data Service Unit yang berfungsi untuk membangun koneksi secara langsung ke service provider atau perangkat yang digunakan untuk mengatur signal clocking (kecepatan transfer data)
* **DTE** : Data Terminal Equipment, berfungsi sebagai koneksi antara client dengan WAN
* **DCE** : Data Communication Equipment, berfungsi sebagai koneksi antara WAN dengan service provider

## Latihan : Konfigurasi PPP Dasar

Diketahui topologi dan Addressin table sebagai berikut :





**Skenario**

Pada lab ini, kita akan belajar bagaimana mengkonfigurasi enkapsulasi PPP link serial menggunakan jaringan ditunjukkan dalam diagram topologi. Juga akan belajar tentang bagaimana untuk mengembalikan link serial ke default HDLC enkapsulasi. Perhatikan apa output dari router yang terlihat seperti ketika terjadi pelanggaran enkapsulasi PPP. Ini akan membantu saat troubleshooting dalam laboratorium terkait bahasan ini. Dan akhirnya kita telah mengkonfigurasi PPP PAP authentication dan PPP CHAP authentication.

Berikut adalah penjelasan tentang PAP dan CHAP sebagai protocol autentikasi PPP, istilah yang kita gunakan dalam praktikum ini :

**a. Password Authentication Protocol (PAP)**, adalah prosedur otentifikasi dengan dua langkah yaitu

* User yang ingin mengakses sistem mengirimkan otentifikasi identitas biasanya berupa username dan password.
* Sistem mengecek validitas identifikasi dan password dengan cara menerima atau menolak koneksi.

**b. Challenge Handshake Authentication (CHAP)** adalah protokol otentifikasi *three-way-handshaking* yang memberikan keamanan yang lebih tinggi dari PAP. Dalam metode ini password akan disimpan secara aman dan tidak pernah dikirimkan secara online.



**IP Loopback** adalah ip yang digunakan sebagai router ID untuk menandai sebuah router secara virtual (sebagai interface logical), karena routing OSPF merupakan link state routing yang membutuhkan konvergensi yang baik untuk menghubungkan antar router yang mengimplementasikan OSPF.

**Task 1: Prepare the Network**

**Step 1: Cable a network that is similar to the one in the topology diagram.**

You can use any current router in your lab as long as it has the required interfaces shown in the topology diagram.

**Note:** If you use 1700, 2500, or 2600 routers, the router outputs and interface descriptions appear differently.

**Step 2: Clear any existing configurations on the routers.**

**Task 2: Perform Basic Router Configuration**

Configure the R1, R2, and R3 routers according to the following guidelines:

* Configure the router hostname.
* Disable DNS lookup.
* Configure an EXEC mode password.
* Configure a message-of-the-day banner.
* Configure a password for console connections.
* Configure synchronous logging.
* Configure a password for vty connections.

R1> enable

R1(config)#configure terminal

R1(config)#no ip domain-lookup

R1(config)#enable secret class

R1(config)#banner motd “Unauthorized access strictly prohibited and

 prosecuted to the full extent of the law”

R1(config)#line con 0

R1(config-line)#exec-timeout 0 0

R1(config-line)#logging synchronous

R1(config-line)#password cisco

R1(config-line)#login

R1(config-line)#exit

R1(config)#line vty 0 4

R1(config-line)#password cisco

R1(config-line)#login

R1(config-line)#end

R1#copy running-config starting-config

**Task 3: Configure and Activate Serial and Ethernet Addresses**

**Step 1: Configure interfaces on R1, R2, and R3.**

Configure the interfaces on the R1, R2, and R3 routers with the IP addresses from the addressing table at the beginning of the lab. Be sure to include the clock rate on the serial DCE interfaces.

**R1**

R1(config)#interface FastEthernet0/1

R1(config-if)#ip address 192.168.10.1 255.255.255.0

R1(config-if)#no shutdown

R1(config-if)#exit

R1(config)#interface Serial0/0/0

R1(config-if)#ip address 10.1.1.1 255.255.255.252

R1(config-if)#no shutdown

R1(config-if)#clock rate 64000

**R2**

R2(config)#interface Loopback0

R2(config-if)#ip address 209.165.200.225 255.255.255.224

R2(config-if)#exit

R2(config)#interface Serial0/0/0

R2(config-if)#ip address 10.1.1.2 255.255.255.252

R2(config-if)#no shutdown

R2(config-if)#exit

R2(config)#interface Serial0/0/1

R2(config-if)#ip address 10.2.2.1 255.255.255.252

R2(config-if)#clock rate 64000

R2(config-if)#no shutdown

**R3**

R3(config)#interface FastEthernet0/1

R3(config-if)#ip address 192.168.30.1 255.255.255.0

R3(config-if)#no shutdown

R3(config-if)#exit

R3(config)#interface Serial0/0/1

R3(config-if)#ip address 10.2.2.2 255.255.255.252

R3(config-if)#no shutdown

**Step 2: Verify IP addressing and interfaces.**

Use the **show ip interface brief** command to verify that the IP addressing is correct and that the interfaces are active.

R1#**show ip interface brief**

Interface IP-Address OK? Method Status Protocol

FastEthernet0/0 unassigned YES unset administratively down down

FastEthernet0/1 192.168.10.1 YES manual up up

Serial0/0/0 10.1.1.1 YES manual up up Serial0/0/1 unassigned YES unset administratively down down

R2#**show ip interface brief**

Interface IP-Address OK? Method Status Protocol

FastEthernet0/0 unassigned YES unset administratively down down

FastEthernet0/1 unassigned YES unset administratively down down

Serial0/0/0 10.1.1.2 YES manual up up

Serial0/0/1 10.2.2.1 YES manual up up Loopback0 209.165.200.225YES manual up up

R3#**show ip interface brief**

Interface IP-Address OK? Method Status Protocol

FastEthernet0/0 unassigned YES unset administratively down down

FastEthernet0/1 192.168.30.1 YES manual up up

Serial0/0/0 unassigned YES unset administratively down down Serial0/0/1 10.2.2.2 YES manual up up

When you have finished, be sure to save the running configuration to the NVRAM of the router.

**Step 3: Configure the Ethernet interfaces of PC1 and PC3.**

Configure the Ethernet interfaces of PC1 and PC3 with the IP addresses and default gateways from the addressing table.

**Step 4: Test the configuration by pinging the default gateway from the PC.**

**Task 4: Configure OSPF on the Routers**

If you need to review the OSPF commands, see next module (Dynamic Routing)

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

Use the **router ospf** command with a process ID of 1. Be sure to advertise the 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**

01:13:03: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0 from LOADING to FULL, Loading Done

R1(config-router)#

R2(config)#**router ospf 1**

R2(config-router)#**network 10.1.1.0 0.0.0.3 area 0**

01:05:31: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on Serial0/0/0 from LOADING to FULL, Loading Done

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**

01:08:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on Serial0/0/1 from LOADING to FULL, Loading Done

R2(config-router)#

R3(config)#**router ospf 1**

R3(config-router)#**network 10.2.2.0 0.0.0.3 area 0**

01:15:07: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1 from LOADING to FULL, Loading Done

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**

 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, 00:17:42, 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, 00:00:36, Serial0/0/0

 209.165.200.0/32 is subnetted, 1 subnets

O 209.165.200.225 [110/65] via 10.1.1.2, 00:16:51, 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 = 2/12/29 ms)

R2#**show ip route**

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, 00:44:19, Serial0/0/0

O 192.168.30.0/24 [110/65] via 10.2.2.2, 00:26:36, 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 = 1/9/22 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 = 1/9/40 ms

R2#

R3#**show ip route**

10.0.0.0/30 is subnetted, 2 subnets

O 10.1.1.0 [110/128] via 10.2.2.1, 00:44:06, 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, 00:44:06, 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, 00:44:06, 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 = 1/9/25 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 = 2/7/27 ms

**Task 5: Configure PPP Encapsulation on Serial Interfaces**

**Step 1: Use the show interface command to check whether HDLC is the default serial 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>

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 HDLC, 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 HDLC, 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 HDLC, loopback not set

<output omitted>

**Step 2: Use debug commands on R1 and R2 to see the effects of configuring PPP.**

R1#**debug ppp negotiation**

PPP protocol negotiation debugging is on

R1#**debug ppp packet**

PPP packet display debugging is on

R1#

R2#**debug ppp negotiation**

PPP protocol negotiation debugging is on

R2#**debug ppp packet**

PPP packet display debugging is on

R2#

**Step 3: 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. If you start to receive too much debug data, use the **undebug all** command to turn debugging off.

R1(config)#**interface serial 0/0/0**

R1(config-if)#**encapsulation ppp**

R1(config-if)#

\* 19:02:53.412: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0 from FULL to DOWN, Neighbor Down: Interface down or detached

R1(config-if)#

\* 19:02:53.416: Se0/0/0 PPP: Phase is DOWN, Setup

\* 19:02:53.416: Se0/0/0 PPP: Using default call direction

\* 19:02:53.416: Se0/0/0 PPP: Treating connection as a dedicated line

\* 19:02:53.416: Se0/0/0 PPP: Session handle[E4000001] Session id[0]

\* 19:02:53.416: Se0/0/0 PPP: Phase is ESTABLISHING, Active Open

\* 19:02:53.424: Se0/0/0 LCP: O CONFREQ [Closed] id 1 len 10

\* 19:02:53.424: Se0/0/0 LCP: MagicNumber 0x63B994DE

(0x050663B994DE)

R1(config-if)#

\* 19:02:55.412: Se0/0/0 PPP: Outbound cdp packet dropped

\* 19:02:55.432: Se0/0/0 LCP: TIMEout: State REQsent

\* 19:02:55.432: Se0/0/0 LCP: O CONFREQ [REQsent] id 2 len 10

\* 19:02:55.432: Se0/0/0 LCP: MagicNumber 0x63B994DE

(0x050663B994DE)

\* 19:02:56.024: Se0/0/0 PPP: I pkt type 0x008F, datagramsize 24 link[illegal]

\* 19:02:56.024: Se0/0/0 UNKNOWN(0x008F): Non-NCP packet, discarding

R1(config-if)#

\* 19:02:57.252: Se0/0/0 PPP: I pkt type 0x000F, datagramsize 84 link[illegal]

\* 19:02:57.252: Se0/0/0 UNKNOWN(0x000F): Non-NCP packet, discarding

\* 19:02:57.448: Se0/0/0 LCP: TIMEout: State REQsent

\* 19:02:57.448: Se0/0/0 LCP: O CONFREQ [REQsent] id 3 len 10

\* 19:02:57.448: Se0/0/0 LCP: MagicNumber 0x63B994DE

(0x050663B994DE)

R1(config-if)#

\* 19:02:58.412: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/0, changed state to down



R2(config)#**interface serial 0/0/0**

R2(config-if)#**encapsulation ppp**

R2(config-if)#

\* 19:06:48.848: Se0/0/0 PPP: Phase is DOWN, Setup

\* 19:06:48.848: Se0/0/0 PPP: Using default call direction

\* 19:06:48.848: Se0/0/0 PPP: Treating connection as a dedicated line

\* 19:06:48.848: Se0/0/0 PPP: Session handle[C6000001] Session id[0]

\* 19:06:48.848: Se0/0/0 PPP: Phase is ESTABLISHING, Active Open

\* 19:06:48.856: Se0/0/0 LCP: O CONFREQ [Closed] id 1 len 10

\* 19:06:48.856: Se0/0/0 LCP: MagicNumber 0x63BD388C

(0x050663BD388C)

\* 19:06:48.860: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]

\* 19:06:48.860: Se0/0/0 LCP: I CONFACK [REQsent] id 1 len 10

R2(config-if)#

\* 19:06:48.860: Se0/0/0 LCP: MagicNumber 0x63BD388C

(0x050663BD388C)

R2(config-if)#

\* 19:06:50.864: Se0/0/0 LCP: TIMEout: State ACKrcvd

\* 19:06:50.864: Se0/0/0 LCP: O CONFREQ [ACKrcvd] id 2 len 10

\* 19:06:50.864: Se0/0/0 LCP: MagicNumber 0x63BD388C

(0x050663BD388C)

\* 19:06:50.868: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]

\* 19:06:50.868: Se0/0/0 LCP: I CONFREQ [REQsent] id 61 len 10

\* 19:06:50.868: Se0/0/0 LCP: MagicNumber 0x63BDB9A8

(0x050663BDB9A8)

\* 19:06:50.868: Se0/0/0 LCP: O CONFACK [REQsent] id 61 len 10

\* 19:06:50.868: Se0/0/0 LCP: MagicNumber 0x63BDB9A8

(0x050663BDB9A8)

\* 19:06:50.868: Se0/0/0 PPP: I pkt type 0xC021, datagramsize 14 link[ppp]

\* 19:06:50.868: Se0/0/0 LCP: I CONFACK [ACKsent] id 2 len 10

\* 19:06:50.868: Se0/0/0 LCP: MagicNumber 0x63BD388C

(0x050663BD388C)

\* 19:06:50.868: Se0/0/0 LCP: State is Open

\* 19:06:50.872: Se0/0/0 PPP: Phase is FORWARDING, Attempting Forward

\* 19:06:50.872: Se0/0/0 PPP: Phase is ESTABLISHING, Finish LCP

\* 19:06:50.872: Se0/0/0 PPP: Phase is UP

\* 19:06:50.872: Se0/0/0 IPCP: O CONFREQ [Closed] id 1 len 10

\* 19:06:50.872: Se0/0/0 IPCP: Address 10.1.1.2

(0x03060A010102)

\* 19:06:50.872: Se0/0/0 CDPCP: O CONFREQ [Closed] id 1 len 4

\* 19:06:50.872: Se0/0/0 PPP: Process pending ncp packets \* 19:06:50.876: Se0/0/0 PPP: I pkt type 0x8021, datagramsize 14 link[ip]

\* 19:06:50.876: Se0/0/0 IPCP: I CONFREQ [REQsent] id 1 len 10

\* 19:06:50.876: Se0/0/0 IPCP: Address 10.1.1.1

(0x03060A010101)

\* 19:06:50.876: Se0/0/0 PPP: I pkt type 0x8207, datagramsize 8 link[cdp]

\* 19:06:50.876: Se0/0/0 IPCP: O CONFACK [REQsent] id 1 len 10

\* 19:06:50.876: Se0/0/0 IPCP: Address 10.1.1.1

(0x03060A010101)

\* 19:06:50.876: Se0/0/0 CDPCP: I CONFREQ [REQsent] id 1 len 4

\* 19:06:50.876: Se0/0/0 CDPCP: O CONFACK [REQsent] id 1 len 4

\* 19:06:50.876: Se0/0/0 PPP: I pkt type 0x8021, datagramsize 14 link[ip]

\* 19:06:50.876: Se0/0/0 IPCP: I CONFACK [ACKsent] id 1 len 10

\* 19:06:50.876: Se0/0/0 IPCP: Address 10.1.1.2 (0x03060A010102)

\* 19:06:50.876: Se0/0/0 IPCP: State is Open

\* 19:06:50.876: Se0/0/0 PPP: I pkt type 0x8207, datagramsize 8 link[cdp]

\* 19:06:50.876: Se0/0/0 IPCP: Install route to 10.1.1.1

\* 19:06:50.880: Se0/0/0 CDPCP: I CONFACK [ACKsent] id 1 len 4

\* 19:06:50.880: Se0/0/0 CDPCP: State is Open

\* 19:06:50.880: Se0/0/0 PPP: O pkt type 0x0021, datagramsize 80

\* 19:06:50.880: Se0/0/0 IPCP: Add link info for cef entry

10.1.1.1

\* 19:06:50.884: Se0/0/0 PPP: I pkt type 0x0021, datagramsize 80 link[ip]

\* 19:06:51.848: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/0, changed state to up

R2(config-if)#

\* 19:06:51.888: Se0/0/0 LCP-FS: I ECHOREQ [Open] id 1 len 12 magic 0x63BDB9A8

\* 19:06:51.888: Se0/0/0 LCP-FS: O ECHOREP [Open] id 1 len 12 magic 0x63BD388C

\* 19:07:00.936: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on

Serial0/0/0 from LOADING to FULL, Loading Done

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

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What steps does PPP go through when the other end of the serial link on R2 is configured with PPP encapsulation?

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

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**Step 4: Turn off debugging.**

 Turn off debugging if you have not already used the **undebug all** command.

R1#**undebug all**

Port Statistics for unclassified packets is not turned on.

All possible debugging has been turned off

R1#

R2#**undebug all**

Port Statistics for unclassified packets is not turned on.

All possible debugging has been turned off

R2#

**Step 5: 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)#

\* 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 R2(config-if)#

\* 20:02:13.080: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to down

R2(config-if)#

\* 20:02:58.564: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

R2(config-if)#

\* 20:03:03.644: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on

Serial0/0/1 from LOADING to FULL, Loading Done

R2(config-if)#

\* 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)#

\* 20:04:27.152: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

\* 20:04:30.952: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on

Serial0/0/1 from LOADING to FULL, Loading Done

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

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**Step 7: 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 7: Break and Restore PPP Encapsulation**

By intentionally breaking PPP encapsulation, you will learn about the error messages that are generated. This will help you later in the Troubleshooting lab.

**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)#

\* 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

\* 20:36:49.432: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/0, changed state to down

R2(config-if)#

\* 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**

\* 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)#

\* 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

\* 20:37:18.368: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to down

R2(config-if)#

\* 20:37:20.368: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

R2(config-if)#

\* 20:37:44.080: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to down

R2(config-if)#

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**

\* 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**

\* 20:53:10.856: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on

Serial0/0/0 from LOADING to FULL, Loading Done

R2(config-if)#**encapsulation ppp**

\* 20:53:23.332: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

R2(config-if)#

\* 20:53:24.916: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on

Serial0/0/1 from LOADING to FULL, Loading Done

R2(config-if)#

**Task 8: 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

R1(config-if)#

\*Aug 22 18:58:58.423: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/0 from FULL 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?

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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)#

\* 16:30:33.771: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/0, changed state to up

R2(config-if)#

\* 16:30:40.815: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.1 on

Serial0/0/0 from LOADING to FULL, Loading Done

R2(config-if)#

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

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**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)#

\* 18:06:00.935: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to down

R2(config-if)#

\* 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**

\* 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)#

\* 18:07:22.174: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on

Serial0/0/1 from LOADING 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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**Step 3: Review the debug output.**

To better understand the CHAP process, view the output of the **debug ppp authentication** command on R2 and R3. Then shut down interface serial 0/0/1 on R2, and issue the **no shutdown** command on interface serial 0/0/1 on R2.

R2#**debug ppp authentication**

PPP authentication debugging is on

R2#**conf t**

Enter configuration commands, one per line. End with CNTL/Z.

R2(config)#**int s0/0/1**

R2(config-if)#**shutdown**

R2(config-if)#

\* 18:19:21.059: %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)#

\* 18:19:23.059: %LINK-5-CHANGED: Interface Serial0/0/1, changed state to administratively down

\* 18:19:24.059: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to down

R2(config-if)#**no shutdown**

\* 18:19:55.059: Se0/0/1 PPP: Using default call direction

\* 18:19:55.059: Se0/0/1 PPP: Treating connection as a dedicated line

\* 18:19:55.059: Se0/0/1 PPP: Session handle[5B000005] Session id[49]

\* 18:19:55.059: Se0/0/1 PPP: Authorization required

\* 18:19:55.063: %LINK-3-UPDOWN: Interface Serial0/0/1, changed state to up

\* 18:19:55.063: Se0/0/1 CHAP: O CHALLENGE id 48 len 23 from "R2"

\* 18:19:55.067: Se0/0/1 CHAP: I CHALLENGE id 2 len 23 from "R3"

\* 18:19:55.067: Se0/0/1 CHAP: Using hostname from unknown source

\* 18:19:55.067: Se0/0/1 CHAP: Using password from AAA

\* 18:19:55.067: Se0/0/1 CHAP: O RESPONSE id 2 len 23 from "R2"

\* 18:19:55.071: Se0/0/1 CHAP: I RESPONSE id 48 len 23 from "R3"

\* 18:19:55.071: Se0/0/1 PPP: Sent CHAP LOGIN Request

\* 18:19:55.071: Se0/0/1 PPP: Received LOGIN Response PASS

\* 18:19:55.071: Se0/0/1 PPP: Sent LCP AUTHOR Request

\* 18:19:55.075: Se0/0/1 PPP: Sent IPCP AUTHOR Request

\* 18:19:55.075: Se0/0/1 LCP: Received AAA AUTHOR Response PASS

\* 18:19:55.075: Se0/0/1 IPCP: Received AAA AUTHOR Response PASS

\* 18:19:55.075: Se0/0/1 CHAP: O SUCCESS id 48 len 4

\* 18:19:55.075: Se0/0/1 CHAP: I SUCCESS id 2 len 4

\* 18:19:55.075: Se0/0/1 PPP: Sent CDPCP AUTHOR Request

\* 18:19:55.075: Se0/0/1 CDPCP: Received AAA AUTHOR Response PASS

\* 18:19:55.079: Se0/0/1 PPP: Sent IPCP AUTHOR Request

\* 18:19:56.075: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

R2(config-if)#

\* 18:20:05.135: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.30.1 on

Serial0/0/1 from LOADING to FULL, Loading Done

R3#**debug ppp authentication**

PPP authentication debugging is on

R3#

\* 18:19:04.494: %LINK-3-UPDOWN: Interface Serial0/0/1, changed state to down

R3#

\* 18:19:04.494: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on Serial0/0/1 from FULL to DOWN, Neighbor Down: Interface down or detached

\* 18:19:05.494: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to down

R3#

\* 18:19:36.494: %LINK-3-UPDOWN: Interface Serial0/0/1, changed state to up

\* 18:19:36.494: Se0/0/1 PPP: Using default call direction

\* 18:19:36.494: Se0/0/1 PPP: Treating connection as a dedicated line

\* 18:19:36.494: Se0/0/1 PPP: Session handle[3C000034] Session id[52]

\* 18:19:36.494: Se0/0/1 PPP: Authorization required

\* 18:19:36.498: Se0/0/1 CHAP: O CHALLENGE id 2 len 23 from "R3"

\* 18:19:36.502: Se0/0/1 CHAP: I CHALLENGE id 48 len 23 from "R2"

\* 18:19:36.502: Se0/0/1 CHAP: Using hostname from unknown source \* 18:19:36.506: Se0/0/1 CHAP: Using password from AAA

\* 18:19:36.506: Se0/0/1 CHAP: O RESPONSE id 48 len 23 from "R3"

\* 18:19:36.506: Se0/0/1 CHAP: I RESPONSE id 2 len 23 from "R2"

R3#

\* 18:19:36.506: Se0/0/1 PPP: Sent CHAP LOGIN Request

\* 18:19:36.506: Se0/0/1 PPP: Received LOGIN Response PASS

\* 18:19:36.510: Se0/0/1 PPP: Sent LCP AUTHOR Request

\* 18:19:36.510: Se0/0/1 PPP: Sent IPCP AUTHOR Request

\* 18:19:36.510: Se0/0/1 LCP: Received AAA AUTHOR Response PASS

\* 18:19:36.510: Se0/0/1 IPCP: Received AAA AUTHOR Response PASS

\* 18:19:36.510: Se0/0/1 CHAP: O SUCCESS id 2 len 4

\* 18:19:36.510: Se0/0/1 CHAP: I SUCCESS id 48 len 4

\* 18:19:36.514: Se0/0/1 PPP: Sent CDPCP AUTHOR Request

\* 18:19:36.514: Se0/0/1 PPP: Sent IPCP AUTHOR Request

\* 18:19:36.514: Se0/0/1 CDPCP: Received AAA AUTHOR Response PASS R3#

\* 18:19:37.510: %LINEPROTO-5-UPDOWN: Line protocol on Interface

Serial0/0/1, changed state to up

R3#

\* 18:19:46.570: %OSPF-5-ADJCHG: Process 1, Nbr 209.165.200.225 on

Serial0/0/1 from LOADING to FULL, Loading Done

R3#

**Task 9: 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 LOADING 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)#

**Task 10: Document the Router Configurations**

On each router, issue the **show run** command and capture the configurations.

R1#show run

!<output omitted>

!

hostname R1

!

!

enable secret class

!

!

!

no ip domain lookup

!

username R1 password 0 cisco

!

!

! interface FastEthernet0/1

ip address 192.168.10.1 255.255.255.0

no shutdown

!

!

interface Serial0/0/0

ip address 10.1.1.1 255.255.255.252 encapsulation ppp

clockrate 64000

ppp authentication pap

ppp pap sent-username R2 password 0 cisco

no shutdown

!

!

!

router ospf 1

network 10.1.1.0 0.0.0.3 area 0

network 192.168.10.0 0.0.0.255 area 0

!

!

banner motd ^CCUnauthorized access strictly prohibited and prosecuted to the full extent of the law^C

!

line con 0

exec-timeout 0 0

password cisco

logging synchronous

login

line aux 0

line vty 0 4

password cisco

login

!

end

R2#show run

!<output omitted> !

hostname R2

!

!

enable secret class

!

!

no ip domain lookup

!

username R3 password 0 cisco username R2 password 0 cisco

!

!

!

interface Loopback0

 ip address 209.165.200.225 255.255.255.224

!

!

!

interface Serial0/0/0

ip address 10.1.1.2 255.255.255.252 encapsulation ppp

ppp authentication pap

 ppp pap sent-username R1 password 0 cisco

no shutdown

!

interface Serial0/0/1

ip address 10.2.2.1 255.255.255.252 encapsulation ppp

clockrate 64000

ppp authentication chap

no shutdown

!

!

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

network 209.165.200.224 0.0.0.31 area 0

!

!

banner motd ^CUnauthorized access strictly prohibited and prosecuted to the full extent of the law^C

!

line con 0

exec-timeout 0 0

password cisco

logging synchronous

login

line aux 0

line vty 0 4

password cisco

login

!

end

R3#show run

!<output omitted> !

hostname R3

!

!

enable secret class

!

!

!

no ip domain lookup

!

username R2 password 0 cisco

!

!

!

interface FastEthernet0/1

ip address 192.168.30.1 255.255.255.0

no shutdown

!

!

interface Serial0/0/1

ip address 10.2.2.2 255.255.255.252 encapsulation ppp

ppp authentication chap

no shutdown

!

router ospf 1

 network 10.2.2.0 0.0.0.3 area 0

network 192.168.30.0 0.0.0.255 area 0

!

!

banner motd ^CUnauthorized access strictly prohibited and prosecuted to the full extent of the law^C

!

line con 0

exec-timeout 0 0

password cisco

logging synchronous

login

line aux 0

line vty 0 4 password cisco login

!

end

**Task 11: Clean Up**

Erase the configurations and reload the routers. Disconnect and store the cabling. For PC hosts that are normally connected to other networks, such as the school LAN or the Internet, reconnect the appropriate cabling and restore the TCP/IP settings.

**DAFTAR PUSTAKA**

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| [1] Networking Academy (2015), CCNA Exploration : Accessing the WAN PPP Network  Fundamental, Cisco Networking Academy[2] Lammle, Todd.( 2004) CCNA Cisco Certified Network Associate Study Guide. Sybex |
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