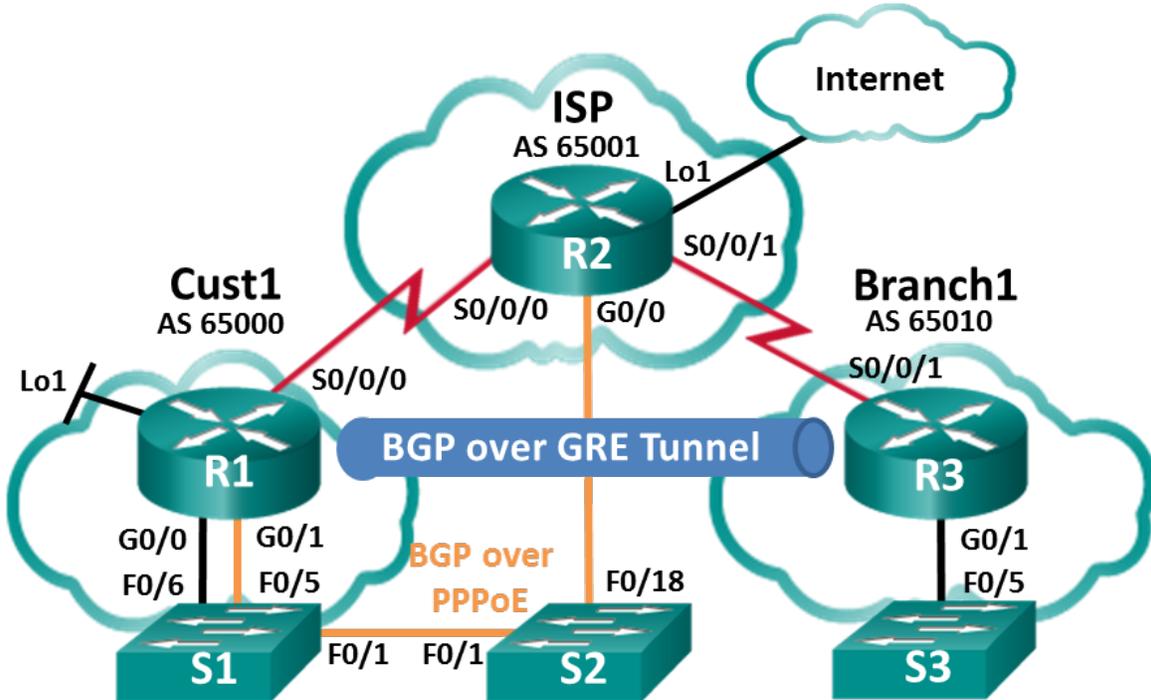


Lab – Configure a Branch Connection (Instructor Version)

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
R1	G0/0	192.168.1.1	255.255.255.0
	G0/1	PPPoE Client	
	Lo1	209.165.200.49	255.255.255.240
	S0/0/0 (DCE)	209.165.200.81	255.255.255.252
R2	G0/0	PPPoE Provider	
	Lo1	209.165.200.65	255.255.255.240
	S0/0/0	209.165.200.82	255.255.255.252
	S0/0/1 (DCE)	209.165.200.85	255.255.255.252
R3	G0/1	192.168.3.1	255.255.255.0
	S0/0/1 (DCE)	209.165.200.86	255.255.255.252

Objectives

Part 1: Build the Network and Load Device Configurations

Part 2: Configure a PPPoE Client Connection

Part 3: Configure a GRE Tunnel

Part 4: Configure BGP over PPPoE and BGP over a GRE Tunnel

Background / Scenario

In this lab, you will configure two separate WAN connections, a BGP route over a PPPoE connection, and a BGP route over a GRE tunnel. This lab is a test case scenario and does not represent a realistic BGP implementation.

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). Other routers 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: Ensure that the routers 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)
- 3 Switches (Cisco 2960 with Cisco IOS Release 15.0(2)lanbasek9 image or comparable)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables and Serial cables as shown in the topology

Part 1: Build the Network and Load Device Configurations

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

Step 2: Load router configurations.

Copy and paste the following configurations into the appropriate routers and switch.

Cust 1 (R1) Configuration:

```
conf t
hostname Cust1
no cdp run
interface Loopback1
 ip address 209.165.200.49 255.255.255.240
interface GigabitEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 no shut
interface Serial0/0/0
 ip address 209.165.200.81 255.255.255.252
 no shut
ip route 0.0.0.0 0.0.0.0 s0/0/0 25
end
```

Lab – Configure a Branch Connection

Note: In the Cust1 configuration above, CDP is disabled with the **no cdp run** command. The static default route with an administrative distance is manually configured to 25 instead of the default 1. The significance of these configurations will be explained later in the lab.

ISP (R2) Configuration:

```
conf t
hostname ISP
username Cust1 password 0 ciscoppoe
bba-group pppoe global
  virtual-template 1
interface Loopback 1
  ip address 209.165.200.65 255.255.255.240
interface GigabitEthernet0/0
  ip tcp adjust-mss 1452
  pppoe enable group global
  no shut
interface Serial0/0/0
  ip address 209.165.200.82 255.255.255.252
  no shut
interface Serial0/0/1
  ip address 209.165.200.85 255.255.255.252
  no shut
interface Virtual-Template1
  mtu 1492
  ip address 209.165.200.30 255.255.255.224
  peer default ip address pool PPPoEPOOL
  ppp authentication chap callin
router bgp 65001
  network 0.0.0.0
  neighbor 209.165.200.1 remote-as 65000
ip local pool PPPoEPOOL 209.165.200.1 209.165.200.20
ip route 0.0.0.0 0.0.0.0 Loopback1
end
```

Branch1 (R3) Configuration:

```
conf t
hostname Branch1
interface GigabitEthernet0/1
  ip address 192.168.3.1 255.255.255.0
  no shut
interface Serial0/0/1
  ip address 209.165.200.86 255.255.255.252
  no shut
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
end
```



```
Cust1(config)# interface GigabitEthernet0/1
Cust1(config-if)# ip tcp adjust-mss 1452
Cust1(config-if)# pppoe enable group global
Cust1(config-if)# pppoe-client dial-pool-number 1
Cust1(config-if)# no shut
Cust1(config-if)# interface Dialer1
Cust1(config-if)# mtu 1492
Cust1(config-if)# ip address negotiated
Cust1(config-if)# encapsulation ppp
Cust1(config-if)# dialer pool 1
Cust1(config-if)# ppp authentication chap callin
Cust1(config-if)# ppp chap hostname Cust1
Cust1(config-if)# ppp chap password ciscopppoe
```

If the Cust1 router is configured correctly, it should receive an IP address from the ISP router. What IP address did Cust1 receive and on what interface? What command did you use to check for the IP address and interface?

209.165.200.1 on interface Dialer1. The show command **show ip interface brief** or **show interface dialer1**

Note: If Cust1 had CDP running on interface dialer1, it could produce the following repeating log message: *PPP: Outbound cdp packet dropped, NCP not negotiated.* To prevent this, CDP was globally turned off.

Part 3: Configure a GRE Tunnel

In Part 3, following the GRE requirements listed below, you will configure a GRE tunnel between Cust1 and Branch1.

GRE tunnel requirements:

- On Cust1 and Branch1, configure **interface Tunnel 0** with the following settings:
 - **IP address 192.168.2.1/24 and 192.168.2.2/24 respectively**
 - **Tunnel mode GRE over IP**
 - **Tunnel source interface and destination address using serial interfaces**

List the commands used to configure a GRE tunnel between Cust1 and Branch1:

```
Cust1(config)# interface Tunnel0
Cust1(config-if)# ip address 192.168.2.1 255.255.255.0
Cust1(config-if)# tunnel mode gre ip
Cust1(config-if)# tunnel source s0/0/0
Cust1(config-if)# tunnel dest 209.165.200.86
```

```
Branch1(config)# interface Tunnel0
Branch1(config-if)# ip address 192.168.2.2 255.255.255.0
Branch1(config-if)# tunnel mode gre ip
Branch1(config-if)# tunnel source s0/0/1
Branch1(config-if)# tunnel dest 209.165.200.81
```

How can you tell if the tunnel was created successfully? What command could you use to test the tunnel?

Answers will vary, but may include the following: a console message will display when the tunnel is up, an ICMP Ping can be used to test each end of the tunnel, as well as **show interface tunnel0** and **show ip interface brief**.

What would happen if Cust1 did not have a static default route? Test it by removing the static default route. What was the result? Make sure to replace the static default route, as shown in the Cust1 configuration in Part 1 Step2, before moving on.

The GRE tunnel goes down without the presence of the default route. The tunnel goes back up when the static default route is replaced.

Part 4: Configure BGP over PPPoE and BGP over a GRE Tunnel

In Part 4, following the BGP requirements listed below, you will configure BGP on Cust1 and Branch1. The ISP router configuration is already complete.

BGP requirements:

- On Cust1:
 - Create a BGP routing process AS 65000
 - Advertise networks attached to Loopback 1 and G0/0
 - Configure BGP neighbors to the ISP and Branch1 routers
- On Branch1:
 - Create a BGP routing process AS 65010
 - Advertise the network attached to G0/1
 - Configure BGP neighbor to Cust1 only

List the commands used to configure BGP on Cust1 and Branch1:

Lab – Configure a Branch Connection

```
Cust1(config)# router bgp 65000
Cust1(config-router)# network 192.168.1.0 mask 255.255.255.0
Cust1(config-router)# network 209.165.200.48 mask 255.255.255.240
Cust1(config-router)# neighbor 192.168.2.2 remote-as 65010
Cust1(config-router)# neighbor 209.165.200.30 remote-as 65001

Branch1(config)# router bgp 65010
Branch1(config-router)# network 192.168.3.0 mask 255.255.255.0
Branch1(config-router)# neighbor 192.168.2.1 remote-as 65000
```

On Cust1, did you receive console messages regarding BGP neighbor relationships to ISP and Branch1?

Yes.

On Cust1, can you ping the ISP at 209.165.200.30 over PPPoE? Can you ping the Branch1 local network at 192.168.3.1?

Yes and yes.

Check the routing table of Cust1. What routes were learned by BGP? There should be a route learned from both ISP and Branch1.

```
B* 0.0.0.0/0 [20/0] via 209.165.200.30, 19:41:23
```

```
B 192.168.3.0/24 [20/0] via 192.168.2.2, 21:30:16.
```

```
Cust1# show ip route
```

```
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 209.165.200.30 to network 0.0.0.0
```

```
B* 0.0.0.0/0 [20/0] via 209.165.200.30, 00:15:25
   192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/24 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0
```

Lab – Configure a Branch Connection

```
192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.2.0/24 is directly connected, Tunnel0
L    192.168.2.1/32 is directly connected, Tunnel0
B    192.168.3.0/24 [20/0] via 192.168.2.2, 00:15:24
209.165.200.0/24 is variably subnetted, 6 subnets, 3 masks
C    209.165.200.1/32 is directly connected, Dialer1
C    209.165.200.30/32 is directly connected, Dialer1
C    209.165.200.48/28 is directly connected, Loopback1
L    209.165.200.49/32 is directly connected, Loopback1
C    209.165.200.80/30 is directly connected, Serial0/0/0
L    209.165.200.81/32 is directly connected, Serial0/0/0
```

Examine the two routes learned by BGP in the Cust1 routing table. What do they show about routes in the network now?

The BGP candidate default route has an administrative distance of 20, which means it replaced the less desirable manually configured default route with an administrative distance of 25. The BGP default route is via 209.165.200.30 which means it routes over the PPPoE connection to the ISP G0/1 interface, instead of the S0/0/0 interface used by the previous manually configured default route.

The BGP route to the 192.168.3.0 network is via the Branch1 tunnel0 interface at 192.168.2.2 proving that BGP routing information is being carried across the GRE tunnel.

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

Cust1 (Final)

```
Cust1# show run
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Cust1
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 10
!
ip cef
!
no ipv6 cef
!
multilink bundle-name authenticated
!
redundancy
!
```

Lab – Configure a Branch Connection

```
interface Loopback1
 ip address 209.165.200.49 255.255.255.240
!
interface Tunnel0
 ip address 192.168.2.1 255.255.255.0
 tunnel source Serial0/0/0
 tunnel destination 209.165.200.86
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 ip tcp adjust-mss 1452
 duplex auto
 speed auto
 pppoe enable group global
 pppoe-client dial-pool-number 1
!
interface Serial0/0/0
 ip address 209.165.200.81 255.255.255.252
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
!
interface Dialer1
 mtu 1492
 ip address negotiated
 encapsulation ppp
 dialer pool 1
 ppp authentication chap callin
 ppp chap hostname Cust1
 ppp chap password 0 ciscopppoe
 no cdp enable
!
router bgp 65000
 bgp log-neighbor-changes
 network 192.168.1.0
 network 209.168.200.48 mask 255.255.255.240
 neighbor 192.168.2.2 remote-as 65010
 neighbor 209.165.200.30 remote-as 65001
```

Lab – Configure a Branch Connection

```
!  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server  
!  
ip route 0.0.0.0 0.0.0.0 Serial0/0/0 25  
!  
no cdp run  
!  
control-plane  
!  
line con 0  
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  
  login  
  transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```

ISP (Final)

```
ISP# show run  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname ISP  
!  
boot-start-marker  
boot-end-marker  
!  
no aaa new-model  
!  
ip cef  
!  
no ipv6 cef  
multilink bundle-name authenticated  
!  
username Cust1 password 0 ciscoppoe
```

Lab – Configure a Branch Connection

```
!  
bba-group pppoe global  
  virtual-template 1  
!  
interface Loopback1  
  ip address 209.165.200.65 255.255.255.240  
!  
interface Embedded-Service-Engine0/0  
  no ip address  
  shutdown  
!  
interface GigabitEthernet0/0  
  no ip address  
  ip tcp adjust-mss 1452  
  duplex auto  
  speed auto  
  pppoe enable group global  
!  
interface GigabitEthernet0/1  
  no ip address  
  shutdown  
  duplex auto  
  speed auto  
!  
interface Serial0/0/0  
  ip address 209.165.200.82 255.255.255.252  
!  
interface Serial0/0/1  
  ip address 209.165.200.85 255.255.255.252  
  clock rate 2000000  
!  
interface Virtual-Template1  
  mtu 1492  
  ip address 209.165.200.30 255.255.255.224  
  peer default ip address pool PPPoEPOOL  
  ppp authentication chap callin  
!  
router bgp 65001  
  bgp log-neighbor-changes  
  network 0.0.0.0  
  neighbor 209.165.200.1 remote-as 65000  
!  
ip local pool PPPoEPOOL 209.165.200.1 209.165.200.20  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server  
!  
ip route 0.0.0.0 0.0.0.0 Loopback1
```

Lab – Configure a Branch Connection

```
!  
control-plane  
!  
line con 0  
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  
login  
transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```

Branch1 (Final)

```
Branch1# show run  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname Branch1  
!  
boot-start-marker  
boot-end-marker  
!  
no aaa new-model  
memory-size iomem 10  
!  
ip cef  
!  
no ipv6 cef  
multilink bundle-name authenticated  
!  
interface Tunnel0  
ip address 192.168.2.2 255.255.255.0  
tunnel source Serial0/0/1  
tunnel destination 209.165.200.81  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!
```

Lab – Configure a Branch Connection

```
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 209.165.200.86 255.255.255.252
!
router bgp 65010
bgp log-neighbor-changes
network 192.168.3.0
neighbor 192.168.2.1 remote-as 65000
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
!
control-plane
!
line con 0
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
login
transport input all
!
scheduler allocate 20000 1000
!
end
```