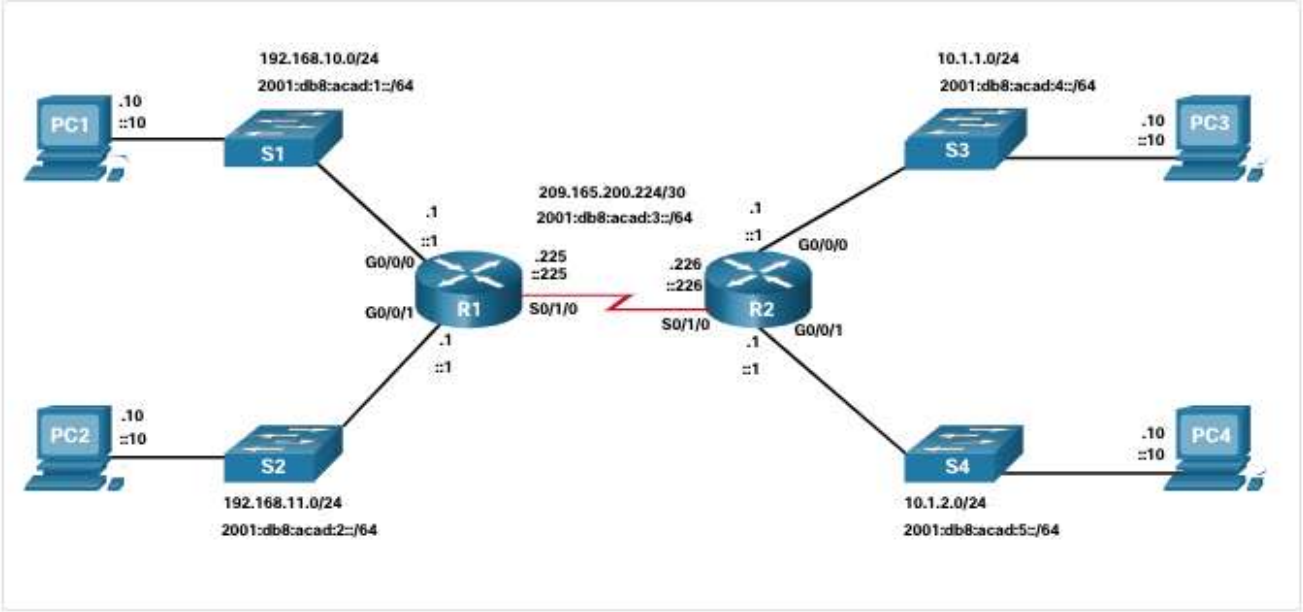
Basic Router Configuration

Dual Stack Topology

One distinguishing feature between switches and routers is the type of interfaces supported by each. For example, Layer 2 switches support LANs; therefore, they have multiple FastEthernet or Gigabit Ethernet ports. The dual stack topology in the figure is used to demonstrate the configuration of router IPv4 and IPv6 interfaces.



Configure Router Interfaces

Routers support LANs and WANs and can interconnect different types of networks; therefore, they support many types of interfaces. For example, G2 ISRs have one or two integrated Gigabit Ethernet interfaces and High-Speed WAN Interface Card (HWIC) slots to accommodate other types of network interfaces, including serial, DSL, and cable interfaces.

To be available, an interface must be:

- **Configured with at least one IP address** - Use the **ip address** *ip-address subnet-mask* and the **ipv6 address** *ipv6-address/prefix* interface configuration commands.
- **Activated** - By default, LAN and WAN interfaces are not activated (**shutdown**). To enable an interface, it must be activated using the **no shutdown** command. (This is similar to powering on the interface.) The interface must also be connected to another device (a hub, a switch, or another router) for the physical layer to be active.
- **Description** - Optionally, the interface could also be configured with a short description of up to 240 characters. It is good practice to configure a description on each interface. On production networks, the benefits of interface descriptions are quickly realized as they are helpful in troubleshooting and in identifying a third-party connection and contact information.

Configure Router Interfaces (Cont.)

The example shows the configure for the interfaces on R1:

```
R1(config)# interface gigabitethernet 0/0/0
R1(config-if)# ip address 192.168.10.1 255.255.255.0
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# description Link to LAN 1
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)# interface gigabitethernet 0/0/1
R1(config-if)# ip address 192.168.11.1 255.255.255.0
R1(config-if)# ipv6 address 2001:db8:acad:2::1/64
R1(config-if)# description Link to LAN 2
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)# interface serial 0/0/0
R1(config-if)# ip address 209.165.200.225 255.255.255.252
R1(config-if)# ipv6 address 2001:db8:acad:3::225/64
R1(config-if)# description Link to R2
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)#
```

IPv4 Loopback Interfaces

Another common configuration of Cisco IOS routers is enabling a loopback interface.

- The loopback interface is a logical interface that is internal to the router. It is not assigned to a physical port and can never be connected to any other device. It is considered a software interface that is automatically placed in an "up" state, as long as the router is functioning.
- The loopback interface is useful in testing and managing a Cisco IOS device because it ensures that at least one interface will always be available. For example, it can be used for testing purposes, such as testing internal routing processes, by emulating networks behind the router.
- Loopback interfaces are also commonly used in lab environments to create additional interfaces. For example, you can create multiple loopback interfaces on a router to simulate more networks for configuration practice and testing purposes. The IPv4 address for each loopback interface must be unique and unused by any other interface. In this curriculum, we often use a loopback interface to simulate a link to the internet.
- Enabling and assigning a loopback address is simple:

```
Router(config)# interface loopback number
Router(config-if)# ip address ip-address subnet-mask
```


Packet Tracer – Configure Router Interfaces

In this Packet Tracer activity, you will do the following:

- Configure IPv4 addressing and verify connectivity
- Configure IPv6 addressing and verify connectivity

1.5 Verify Directly Connected Networks

Verify Directly Connected Networks

Interface Verification Commands

There are several **show** commands that can be used to verify the operation and configuration of an interface.

The following commands are especially useful to quickly identify the status of an interface:

- **show ip interface brief** and **show ipv6 interface brief** - These display a summary for all interfaces including the IPv4 or IPv6 address of the interface and current operational status.
- **show running-config interface** *interface-id* - This displays the commands applied to the specified interface.
- **show ip route** and **show ipv6 route** - These display the contents of the IPv4 or IPv6 routing table stored in RAM. In Cisco IOS 15, active interfaces should appear in the routing table with two related entries identified by the code '**C**' (Connected) or '**L**' (Local). In previous IOS versions, only a single entry with the code '**C**' will appear.

Verify Directly Connected Networks

Verify Interface Status

The output of the **show ip interface brief** and **show ipv6 interface brief** commands can be used to quickly reveal the status of all interfaces on the router. You can verify that the interfaces are active and operational as indicated by the Status of “up” and Protocol of “up”, as shown in the example. A different output would indicate a problem with either the configuration

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   192.168.10.1    YES manual up                    up
GigabitEthernet0/0/1   192.168.11.1    YES manual up                    up
Serial0/1/0            209.165.200.225 YES manual up                    up
Serial0/1/1            unassigned      YES unset  administratively down down
R1# show ipv6 interface brief
GigabitEthernet0/0/0   [up/up]
    FE80::7279:B3FF:FE92:3130
    2001:DB8:ACAD:1::1
GigabitEthernet0/0/1   [up/up]
    FE80::7279:B3FF:FE92:3131
    2001:DB8:ACAD:2::1
Serial0/1/0            [up/up]
    FE80::7279:B3FF:FE92:3130
    2001:DB8:ACAD:3::1
Serial0/1/1            [down/down]     Unassigned
```

Verify IPv6 Link Local and Multicast Addresses

The output of the **show ipv6 interface brief** command displays two configured IPv6 addresses per interface. One address is the IPv6 global unicast address that was manually entered. The other address, which begins with FE80, is the link-local unicast address for the interface. A link-local address is automatically added to an interface whenever a global unicast address is assigned. An IPv6 network interface is required to have a link-local address, but not necessarily a global unicast address.

The **show ipv6 interface gigabitethernet 0/0/0 c**ommand displays the interface status and all of the IPv6 addresses belonging to the interface. Along with the link local address and global unicast address, the output includes the multicast addresses assigned to the interface, beginning with prefix FF02, as shown in the example.

```
R1# show ipv6 interface gigabitethernet 0/0/0
GigabitEthernet0/0/0 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::7279:B3FF:FE92:3130
  No Virtual link-local address(es):
  Global unicast address(es):
    2001:DB8:ACAD:1::1, subnet is 2001:DB8:ACAD:1::/64
  Joined group address(es):
    FF02::1
    FF02::1:FF00:1
    FF02::1:FF92:3130
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
```


Verify Directly Connected Networks

Verify Interface Configuration

The output of the **show running-config interface** command displays the current commands applied to the specified interface, as shown.

The following two commands are used to gather more detailed interface information:

- **show interfaces**- Displays interface information and packet flow count for all interfaces on the device.
- **show ip interface** and **show ipv6 interface** - Displays the IPv4 and IPv6 related information for all interfaces on a router

```
R1 show running-config interface gigabitethernet 0/0/0
Building configuration...
Current configuration : 158 bytes
!
interface GigabitEthernet0/0/0
 description Link to LAN 1
 ip address 192.168.10.1 255.255.255.0
 negotiation auto
 ipv6 address 2001:DB8:ACAD:1::1/64
end
R1#
```

Verify Directly Connected Networks

Verify Routes

The output of the **show ip route** and **show ipv6 route** commands reveal the three directly connected network entries and the three local host route interface entries, as shown in the example.

The local host route has an administrative distance of 0. It also has a /32 mask for IPv4, and a /128 mask for IPv6. The local host route is for routes on the router that owns the IP address. It is used to allow the router to process packets destined to that IP.

```
R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

Gateway of last resort is not set
      192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.10.0/24 is directly connected, GigabitEthernet0/0/0
L        192.168.10.1/32 is directly connected, GigabitEthernet0/0/0
      192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.11.0/24 is directly connected, GigabitEthernet0/0/1
L        192.168.11.1/32 is directly connected, GigabitEthernet0/0/1
      209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C        209.165.200.224/30 is directly connected, Serial0/1/0
L        209.165.200.225/32 is directly connected, Serial0/1/0A
R1# show ipv6 route
IPv6 Routing Table - default - 7 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

C   2001:DB8:ACAD:1::/64 [0/0]
     via GigabitEthernet0/0/0, directly connected
L   2001:DB8:ACAD:1::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
C   2001:DB8:ACAD:2::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:DB8:ACAD:2::1/128 [0/0]
     via GigabitEthernet0/0/1, receive
C   2001:DB8:ACAD:3::/64 [0/0]
     via Serial0/1/0, directly connected
L   2001:DB8:ACAD:3::1/128 [0/0]
     via Serial0/1/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
R1#
```

Verify Directly Connected Networks

Verify Routes (Cont.)

A '**C**' next to a route within the routing table indicates that this is a directly connected network. When the router interface is configured with a global unicast address and is in the "up/up" state, the IPv6 prefix and prefix length are added to the IPv6 routing table as a connected route.

The IPv6 global unicast address applied to the interface is also installed in the routing table as a local route. The local route has a /128 prefix. Local routes are used by the routing table to efficiently process packets with the interface address of the router as the destination.

```
R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

Gateway of last resort is not set
      192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.10.0/24 is directly connected, GigabitEthernet0/0/0
L        192.168.10.1/32 is directly connected, GigabitEthernet0/0/0
      192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.11.0/24 is directly connected, GigabitEthernet0/0/1
L        192.168.11.1/32 is directly connected, GigabitEthernet0/0/1
      209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C        209.165.200.224/30 is directly connected, Serial0/1/0
L        209.165.200.225/32 is directly connected, Serial0/1/0A
R1# show ipv6 route
IPv6 Routing Table - default - 7 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

C   2001:DB8:ACAD:1::/64 [0/0]
     via GigabitEthernet0/0/0, directly connected
L   2001:DB8:ACAD:1::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
C   2001:DB8:ACAD:2::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:DB8:ACAD:2::1/128 [0/0]
     via GigabitEthernet0/0/1, receive
C   2001:DB8:ACAD:3::/64 [0/0]
     via Serial0/1/0, directly connected
L   2001:DB8:ACAD:3::1/128 [0/0]
     via Serial0/1/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
R1#
```

Verify Directly Connected Networks

Filter Show Command Output

Commands that generate multiple screens of output are, by default, paused after 24 lines. At the end of the paused output, the --More-- text displays. Pressing **Enter** displays the next line and pressing the spacebar displays the next set of lines. Use the **terminal length** command to specify the number of lines to be displayed. A value of 0 (zero) prevents the router from pausing between screens of output.

Another very useful feature that improves the user experience in the CLI is the filtering of **show** output. Filtering commands can be used to display specific sections of output. To enable the filtering command, enter a pipe (|) character after the **show** command and then enter a filtering parameter and a filtering expression.

There are four filtering parameters that can be configured after the pipe:

- section - Shows the entire section that starts with the filtering expression.
- include - Includes all output lines that match the filtering expression.
- exclude - Excludes all output lines that match the filtering expression.
- begin - Shows all the output lines from a certain point, starting with the line that matches the filtering expression

Command History Feature

The command history feature is useful because it temporarily stores the list of executed commands to be recalled.

- To recall commands in the history buffer, press **Ctrl+P** or the **Up Arrow** key. The command output begins with the most recent command. Repeat the key sequence to recall successively older commands. To return to more recent commands in the history buffer, press **Ctrl+N** or the **Down Arrow** key. Repeat the key sequence to recall successively more recent commands.
- By default, command history is enabled and the system captures the last 10 command lines in its history buffer. Use the **show history** privileged EXEC command to display the contents of the buffer.
- It is also practical to increase the number of command lines that the history buffer records during the current terminal session only. Use the **terminal history size** user EXEC command to increase or decrease the size of the buffer.

Packet Tracer – Verify Directly Connected Networks

In this Packet Tracer activity, you will complete the following objectives:

- Verify IPv4 directly connected networks
- Verify IPv6 directly connected networks
- Troubleshoot connectivity issues

1.6 Module Practice and Quiz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