

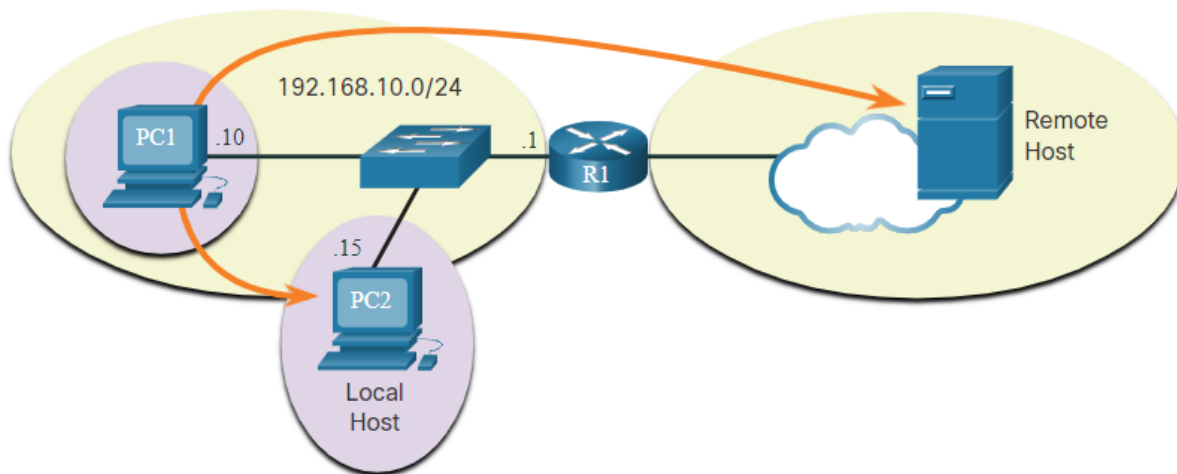
Host Forwarding Decision

With both IPv4 and IPv6, packets are always created at the source host. The source host must be able to direct the packet to the destination host. To do this, host end devices create their own routing table. This topic discusses how end devices use routing tables.

Another role of the network layer is to direct packets between hosts. A host can send a packet to the following:

- **Itself** - A host can ping itself by sending a packet to a special IPv4 address of 127.0.0.1 or an IPv6 address ::1, which is referred to as the loopback interface. Pinging the loopback interface tests the TCP/IP protocol stack on the host.
- **Local host** - This is a destination host that is on the same local network as the sending host. The source and destination hosts share the same network address.
- **Remote host** - This is a destination host on a remote network. The source and destination hosts do not share the same network address.

The figure illustrates PC1 connecting to a local host on the same network, and to a remote host located on another network.



The diagram shows a host, PC1, connecting to a local host, PC2, on the same network and to a remote host, a server, on another network. PC1 and PC2 are connected to a switch on network 192.168.10.0/24. PC1 has an address of .10 and PC2 has an address of .15. The switch is connected to a router, R1, at address .1. On the other side of the R1 is a connection to the cloud where the remote host resides.

Whether a packet is destined for a local host or a remote host is determined by the source end device. The source end device determines whether the destination IP address is on the same network that the source device itself is on. The method of determination varies by IP version:

- **In IPv4** - The source device uses its own subnet mask along with its own IPv4 address and the destination IPv4 address to make this determination.
- **In IPv6** - The local router advertises the local network address (prefix) to all devices on the network.

In a home or business network, you may have several wired and wireless devices interconnected together using an intermediary device, such as a LAN switch or a wireless access point (WAP). This intermediary device provides interconnections between local hosts on the local network. Local hosts can reach each other and share information without the need for any additional devices. If a host is sending a packet to a device that is configured with the same IP network as the host device, the packet is simply forwarded out of the host interface, through the intermediary device, and to the destination device directly.

Of course, in most situations we want our devices to be able to connect beyond the local network segment, such as out to other homes, businesses, and the internet. Devices that are beyond the local network segment are known as remote hosts. When a source device sends a packet to a remote destination device, then the help of routers and routing is needed. Routing is the process of identifying the best path to a destination. The router connected to the local network segment is referred to as the default gateway.

Default Gateway

The default gateway is the network device (i.e., router or Layer 3 switch) that can route traffic to other networks. If you use the analogy that a network is like a room, then the default gateway is like a doorway. If you want to get to another room or network you need to find the doorway.

On a network, a default gateway is usually a router with these features:

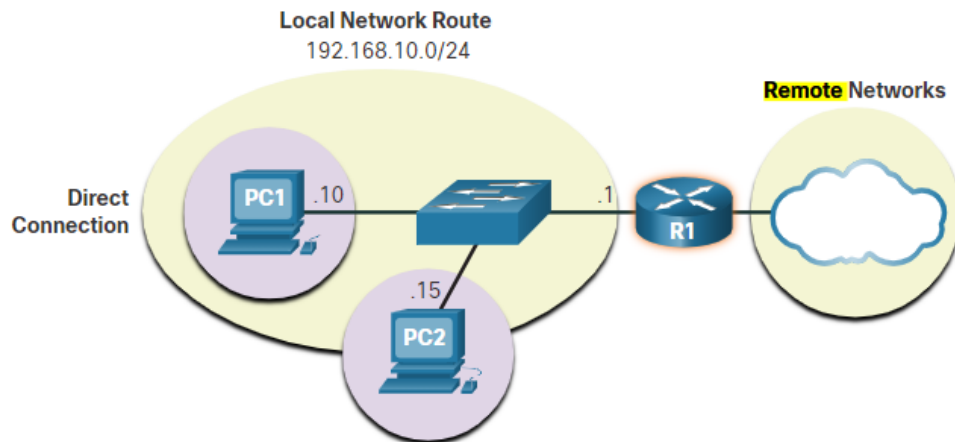
- It has a local IP address in the same address range as other hosts on the local network.
- It can accept data into the local network and forward data out of the local network.
- It routes traffic to other networks.

A default gateway is required to send traffic outside of the local network. Traffic cannot be forwarded outside the local network if there is no default gateway, the default gateway address is not configured, or the default gateway is down.

A Host Routes to the Default Gateway

A host routing table will typically include a default gateway. In IPv4, the host receives the IPv4 address of the default gateway either dynamically from Dynamic Host Configuration Protocol (DHCP) or configured manually. In IPv6, the router advertises the default gateway address or the host can be configured manually.

In the figure, PC1 and PC2 are configured with the IPv4 address of 192.168.10.1 as the default gateway.



The diagram shows two hosts, PC1 and PC2, connected to a switch on network 192.168.10.0/24, the local network route. The switch is connected to a router, R1, which is then connected to the cloud representing remote networks. PC1 has an address of .10, PC2 has an address of .15, and the router interface to which the switch is connected has an address of .1. The PCs, the switch, and the router interface all have a direct connection.

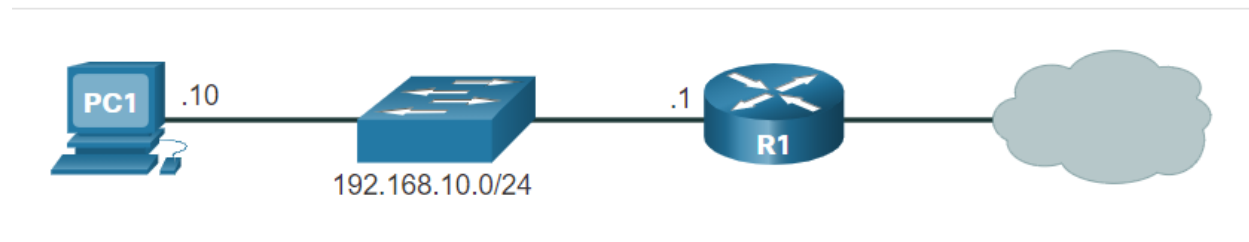
Having a default gateway configured creates a default route in the routing table of the PC. A default route is the route or pathway your computer will take when it tries to contact a remote network.

Both PC1 and PC2 will have a default route to send all traffic destined to remote networks to R1.

Host Routing Tables

On a Windows host, the **route print** or **netstat -r** command can be used to display the host routing table. Both commands generate the same output. The output may seem overwhelming at first, but is fairly simple to understand.

The figure displays a sample topology and the output generated by the **netstat -r** command.



Entering the **netstat -r** command or the equivalent **route print** command displays three sections related to the current TCP/IP network connections:

- **Interface List** - Lists the Media Access Control (MAC) address and assigned interface number of every network-capable interface on the host, including Ethernet, Wi-Fi, and Bluetooth adapters.
- **IPv4 Route Table** - Lists all known IPv4 routes, including direct connections, local network, and local default routes.
- **IPv6 Route Table** - Lists all known IPv6 routes, including direct connections, local network, and local default routes.