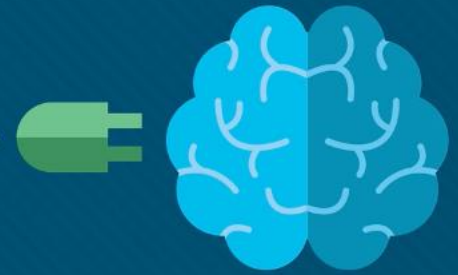


Module 7: Routing Between Networks

Networking Essentials (NETESS)

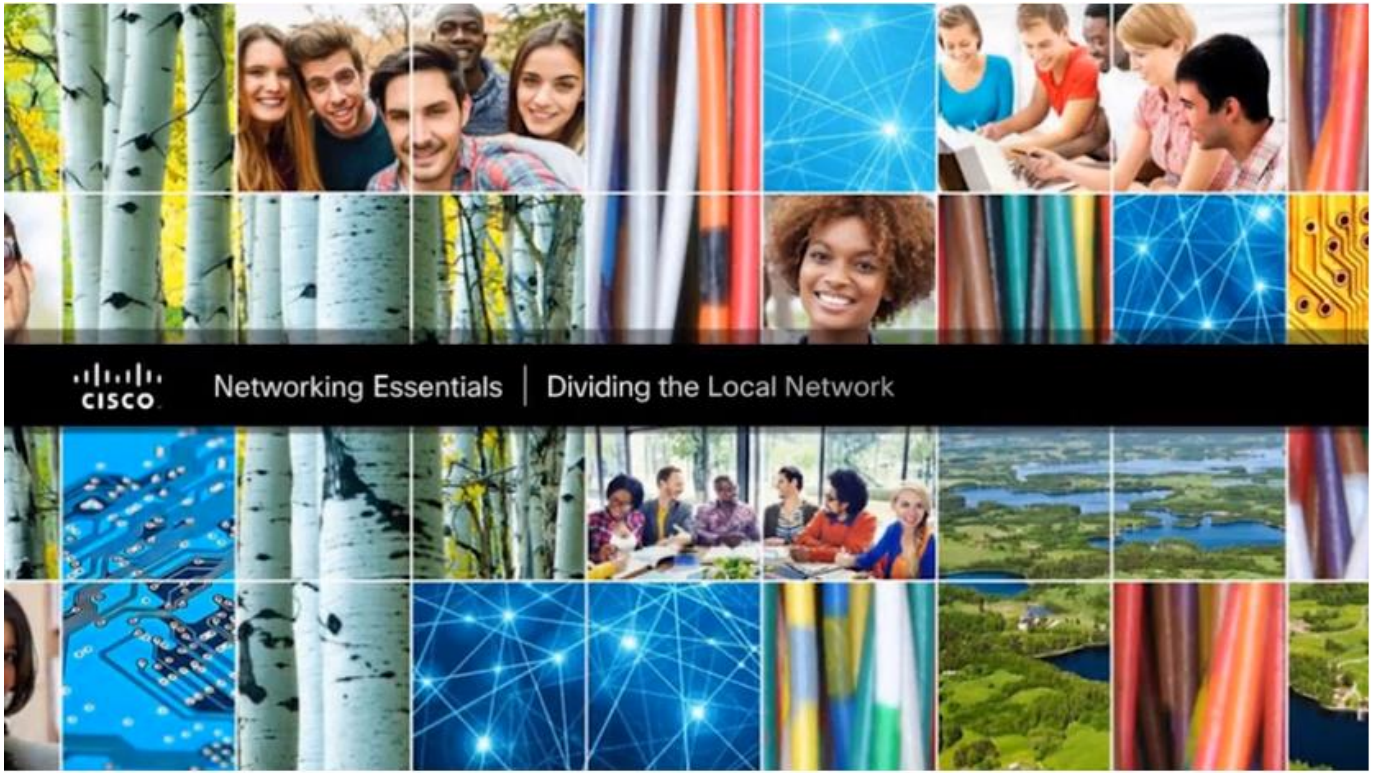
Module Objectives

Module Title: Routing Between Networks
Module Objective: Create a fully connected LAN.

Topic Title	Topic Objective
The Need for Routing	Explain the need for routing.
The Routing Table	Explain how routers use tables.
Create a LAN	Build a fully connected network.

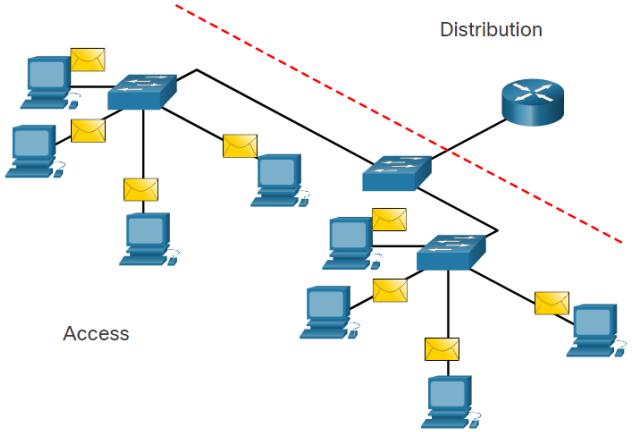
7.1 The Need for Routing

Video - Dividing the Local Network

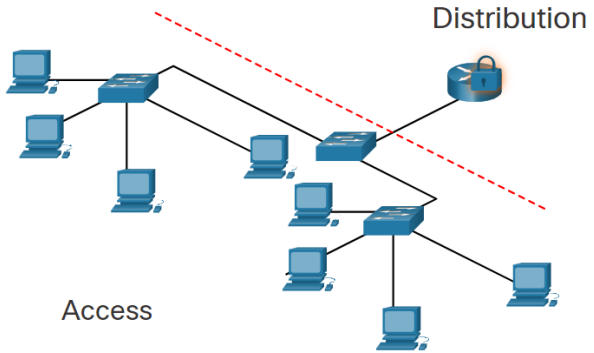


Criteria for Dividing the Local Network

Broadcast Containment
Routers in the distribution layer can limit broadcasts to the local network where they need to be heard. Although broadcasts are necessary, too many hosts connected on the same local network can generate excessive broadcast traffic and slow down the network.

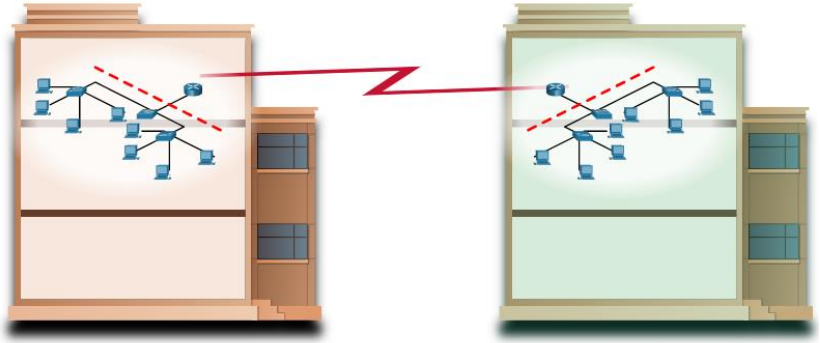


Security
Routers in the distribution layer can separate and protect certain groups of computers where confidential information resides. Routers can also hide the addresses of internal computers from the outside world to help prevent attacks, and control who can get into or out of the local network.

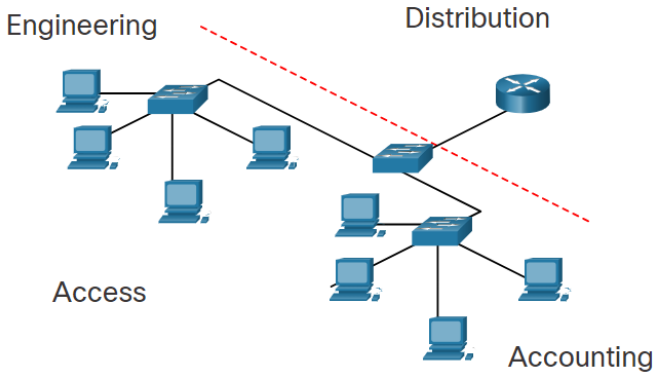


Criteria for Dividing the Local Network (Cont.)

Locations
Routers in the distribution layer can be used to interconnect local networks at various locations of an organization that are geographically separated.



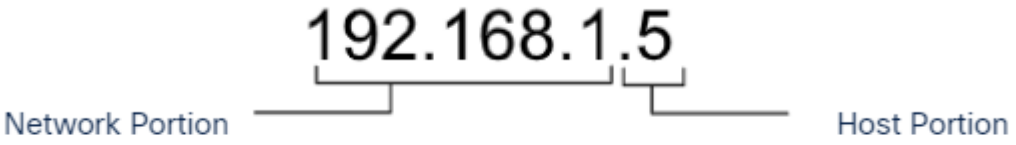
Logical Grouping
Routers in the distribution layer can be used to logically group users, such as departments within a company, who have common needs or for access to resources.



Now We Need Routing

A switch examines MAC addresses.

A router examines IP addresses.



Lab - IPv4 Addresses and Network Communication

In this lab, you will complete the following objectives:

- Build a simple peer-to-peer network and verify physical connectivity.
- Assign various IP addresses to hosts and observe the effects on network communication.

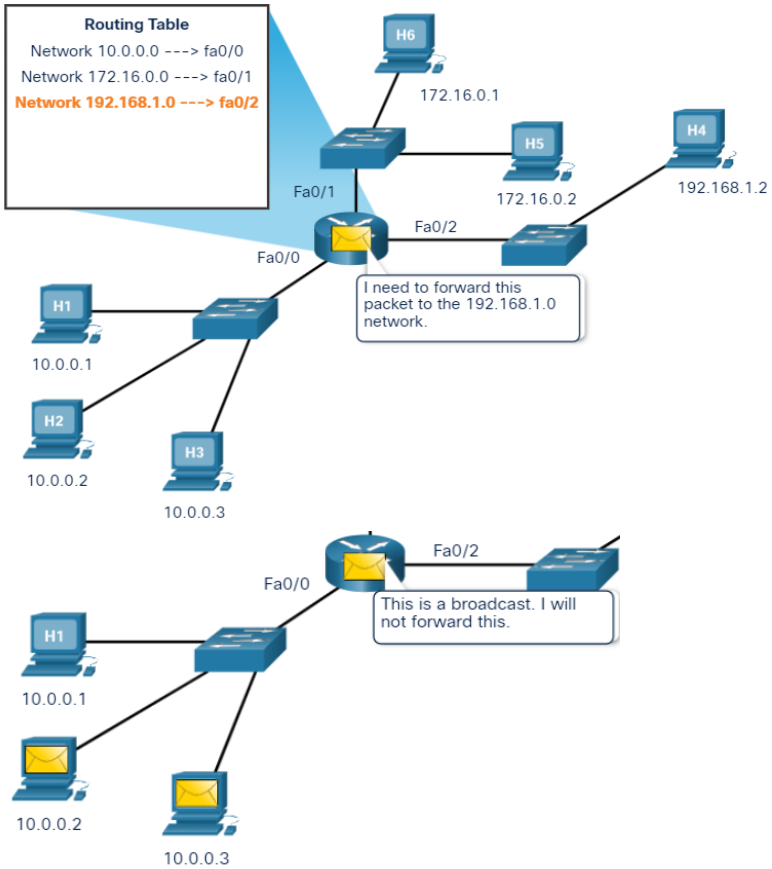
7.2 The Routing Table

Video - Router Packet Forwarding

Path Selection

- Each router interface connects to a different network.
- A routing table contains information for how to reach local and remote networks.
- The destination IP address is used and compared with the networks in the routing table to determine the interface to forward the packet out of.

- Routers do not forward broadcast messages.

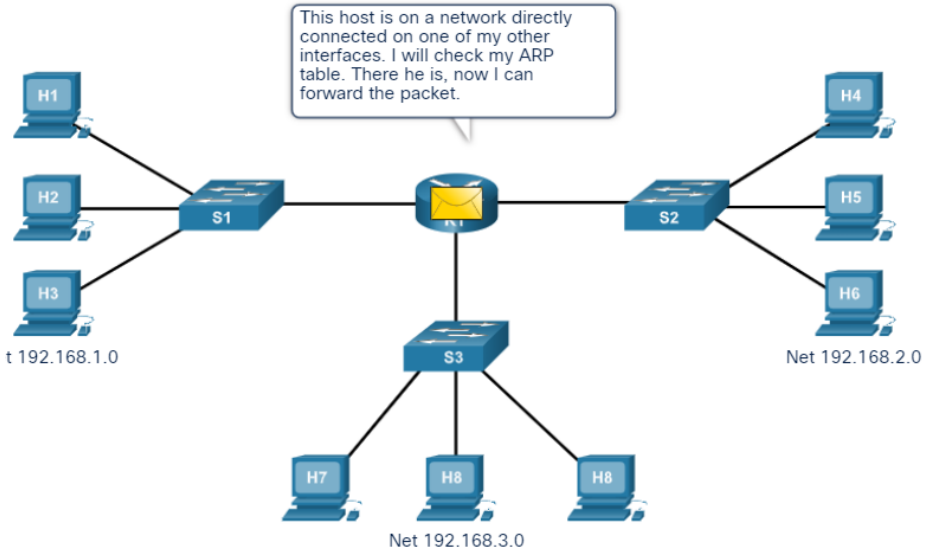


Video - Messages Within and Between Networks - Part 1

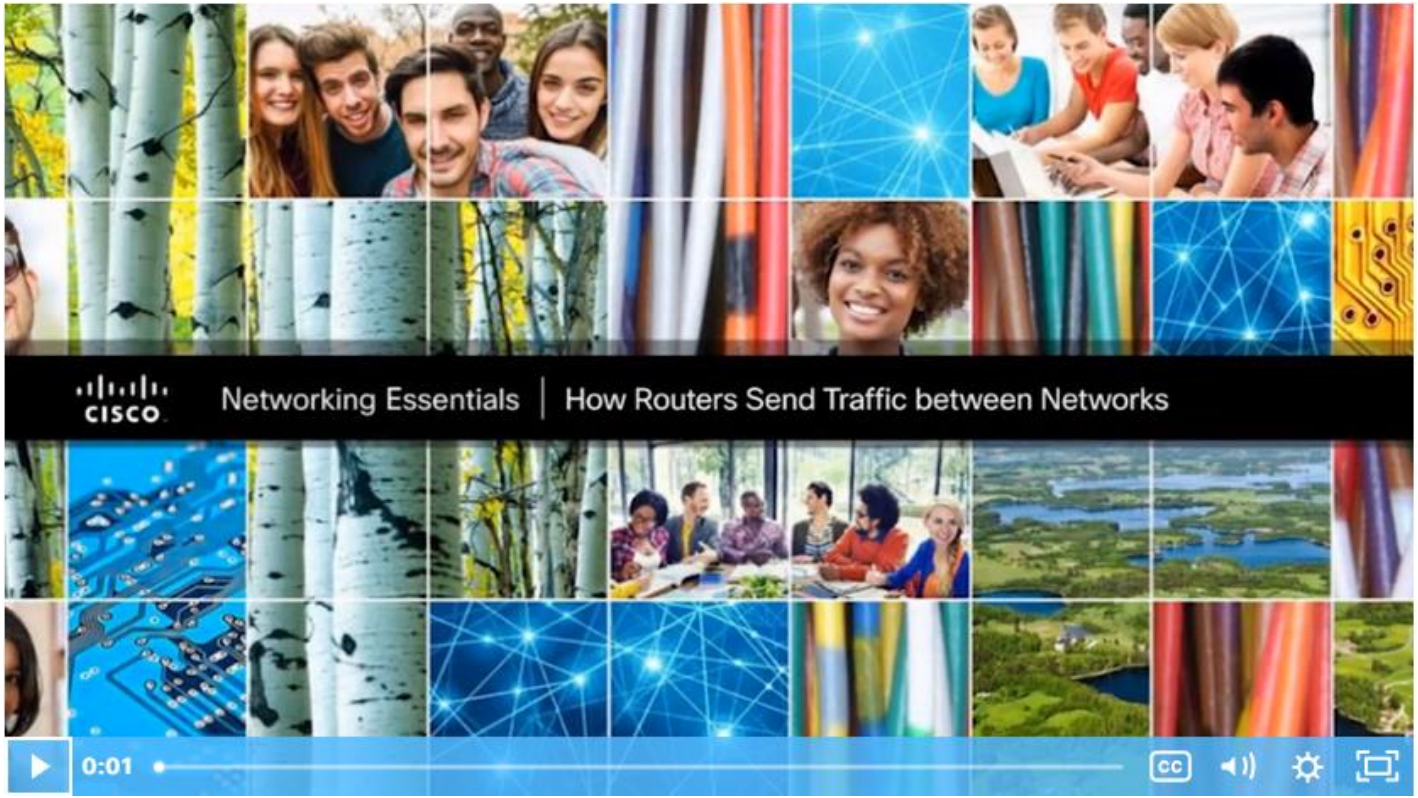
Video - Messages Within and Between Networks - Part 2

Packet Forwarding

- The destination MAC address is used to forward the packet to either the router if the destination IP address is for a different network or a specific network device on the local network.
- The ARP table shows a mapping of IP address to MAC address.

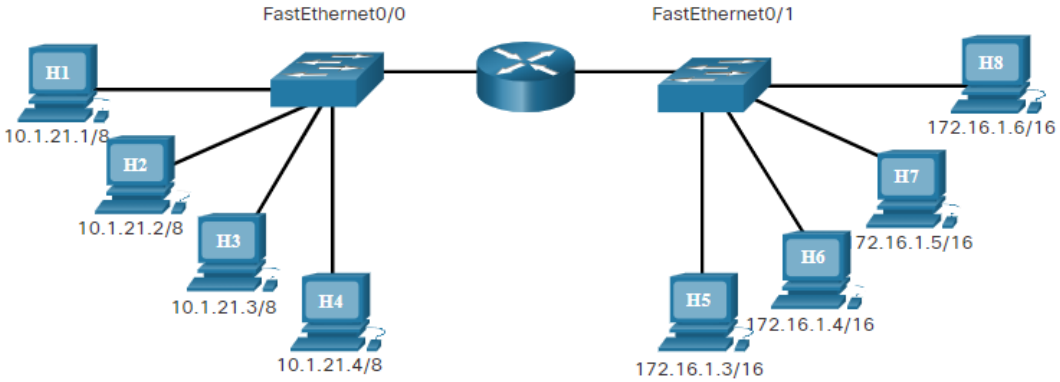


Video - Messages Sent to Remote Networks



Routing Table Entries

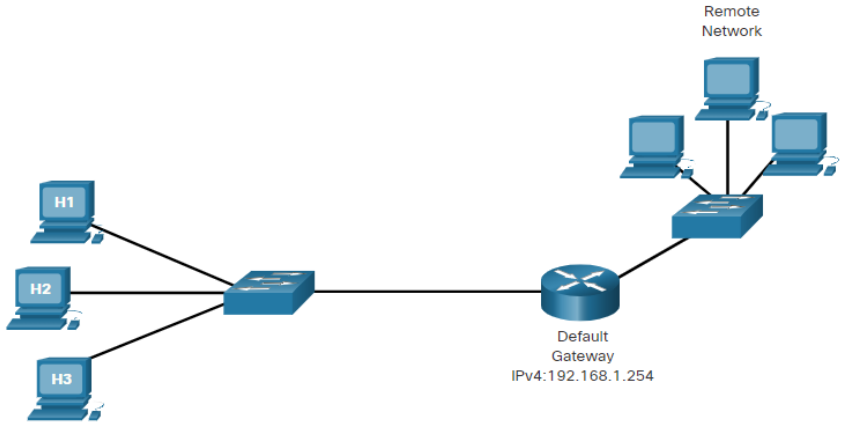
- A routing table contains network addresses and the best path to reach a network.
- Two ways routes can be added to a routing table
  - Dynamically learned from other routers
  - Manually entered by a network administrator
- A default route is the router interface used when forwarding packets to a destination that is not in the routing table.
- If a packet is destined for a network that is not in the routing table and no default route exists, the packet will be dropped.



Type	Network	Port
C	10.0.0.0/8	FastEthernet0/0
C	172.16.0.0/16	FastEthernet0/0

The Default Gateway

- When a host sends a message to a device on the same network, it forwards the message directly and uses ARP to discover the MAC address.
- When a host sends a message to a device on a remote network, the hosts uses the MAC address of the router as the destination, but still has the IP address of the remote host as the Layer 3 destination.
- It is very important that each host has the correct default gateway that is the IP address of the router on the same network.

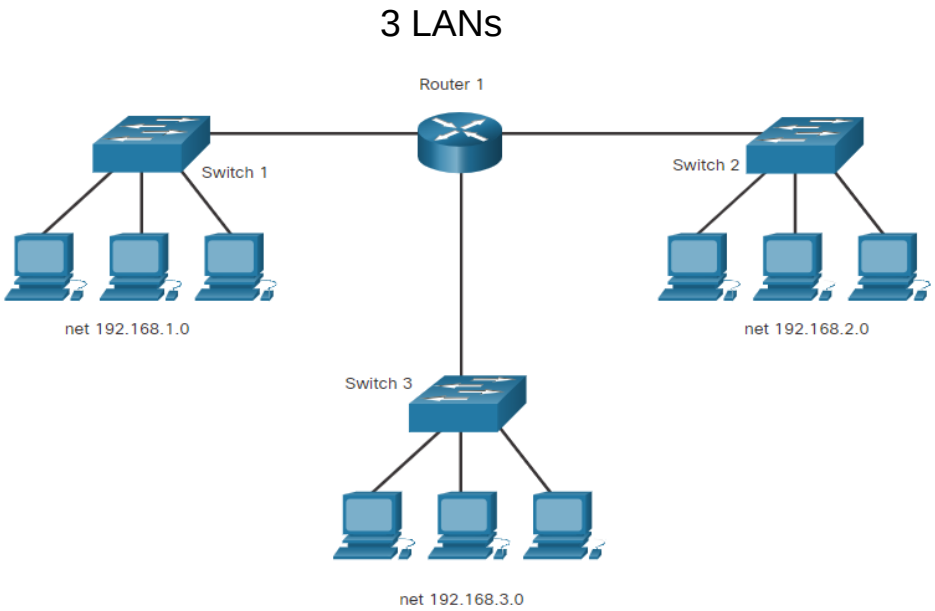


PC	IPv4 Address	Subnet Mask	Default Gateway
H1	192.168.1.1	255.255.255.0	192.168.1.254
H2	192.168.1.2	255.255.255.0	192.168.1.254
H3	192.168.1.3	255.255.255.0	192.168.1.254

7.3 Create a LAN

Local Area Networks

- LANs are under one administrative control.
- LANs are usually either wired Ethernet or wireless.



Local and Remote Network Segments

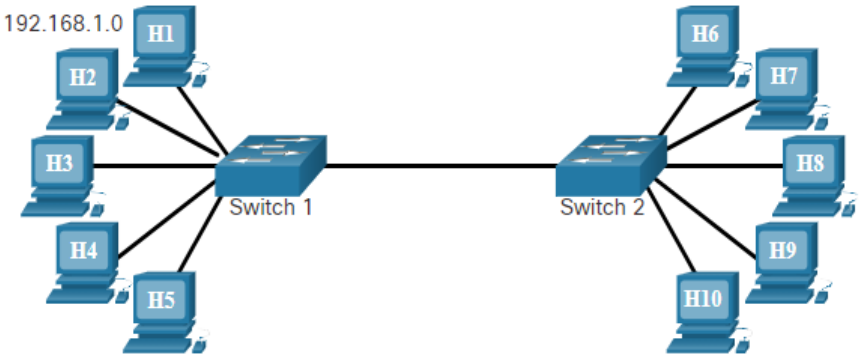
Advantages of a single local segment:

- Appropriate for simpler networks
- Less complexity and lower network cost
- Allows devices to be "seen" by other devices
- Faster data transfer - more direct communication
- Ease of device access

Disadvantages of a single local segment:

- All hosts are in one broadcast domain which causes more traffic on the segment and may slow network performance
- Harder to implement QoS
- Harder to implement security

All Hosts in One Local Segment



Local and Remote Network Segments (Cont.)

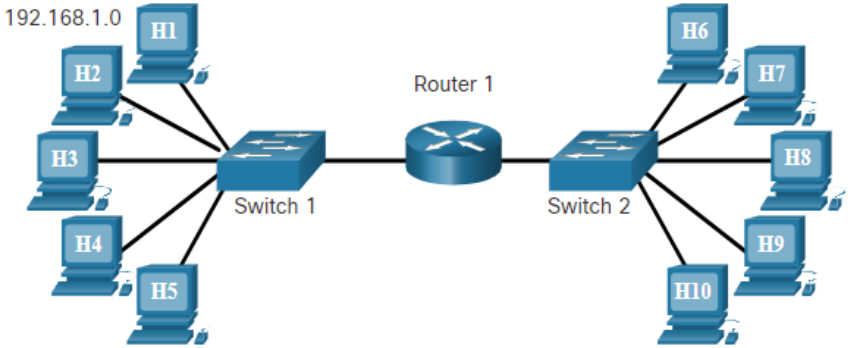
Advantages of having hosts on a remote segment

- More appropriate for larger, more complex networks
- Splits up broadcast domains and decreases traffic
- Can improve performance on each segment
- Makes the machines invisible to those on other local network segments
- Can provide increased security
- Can improve network organization

Disadvantages of having hosts on a remote segment

- Requires the use of routing (distribution layer)
- Router can slow traffic between segments
- More complexity and expense (requires a router)

Hosts on a Remote Segment



Packet Tracer - Observe Data Flow in a LAN

In this activity, you will complete the following objectives:

- Develop an understanding of the basic functions of Packet Tracer.
- Create/model a simple Ethernet network using 3 hosts and a switch.
- Observe traffic behavior on the network.
- Observe data flow of ARP broadcasts and pings.

Lab - Connect to a Wireless Router

In this lab, you will complete the following objectives:

- Connect a PC to a wireless router using Ethernet cable.
- Configure the PC with an appropriate IP address.
- Verify the PC configuration using a command prompt.

7.4 Routing Between Networks Summary

What Did I Learn in this Module?

- Routers are needed to connect multiple Layer 3 IP networks.
- Switches make their forwarding decision based on the destination Layer 2 MAC address.
- Routers make their forwarding decision based on the destination Layer 3 IP address.
- Each router has a routing table.
- A routing table contains all locally connected networks and the interfaces that connect to the networks.
- A routing can contain remote networks learned dynamically from other routers or entered manually by a network administrator.
- A default route in the routing table is the router interface used when forwarding packets to a destination that is not in the routing table.
- If a packet is destined for a network that is not in the routing table and no default route exists, the packet will be dropped.
- A local area network (LAN) is under the same administrative control and typically is wired Ethernet or wireless.
- A simple network design keeps all hosts on a single local network.
- If a network design has multiple local networks, a router is needed for communication between networks.

Routing Between Networks Summary

New Terms and Commands

- broadcast containment
- logical grouping
- routing table
- path selection
- default gateway
- default route
- local area network (LAN)
- local network
- remote network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