

# **LAN Technologies**

## Lesson 7

# Objectives

## Exam Objective Matrix

Technology Skill Covered	Exam Objective	Exam Objective Number
LAN Technologies	<p>Compare and contrast different LAN technologies.</p> <ul style="list-style-type: none"><li>• Types:<ul style="list-style-type: none"><li>• Ethernet</li><li>• 10BaseT</li><li>• 100BaseT</li><li>• 1000BaseT</li><li>• 100BaseTX</li><li>• 100BaseFX</li><li>• 1000BaseX</li><li>• 10GBaseSR</li><li>• 10GBaseLR</li><li>• 10GBaseER</li><li>• 10GBaseSW</li><li>• 10GBaseLW</li><li>• 10GBaseEW</li><li>• 10GBaseT</li></ul></li><li>• Properties:<ul style="list-style-type: none"><li>• CSMA/CD</li><li>• CSMA/CA</li></ul></li></ul>	3.7

# Objectives

Exam Objective Matrix		
Technology Skill Covered	Exam Objective	Exam Objective Number
Other LAN Concepts	Compare and contrast different 3.7 LAN technologies. <ul style="list-style-type: none"><li>• Properties:</li><li>• Broadcast</li><li>• Collision</li><li>• Bonding</li><li>• Speed</li><li>• Distance</li></ul>	
Wireless LAN Technologies	Given a scenario, install and configure a wireless network. <ul style="list-style-type: none"><li>• WAP placement</li><li>• Antenna types</li><li>• Interference</li><li>• Frequencies</li><li>• Channels</li><li>• SSID (enable/disable)</li></ul>	2.2

# Objectives

Exam Objective Matrix		
Technology Skill Covered	Exam Objective	Exam Objective Number
	Given a scenario, implement appropriate wireless security measures. <ul style="list-style-type: none"><li>• Encryption protocols:<ul style="list-style-type: none"><li>• WEP</li><li>• WPA</li><li>• WPA2</li><li>• WPA Enterprise</li></ul></li><li>• MAC address filtering</li><li>• Device placement</li><li>• Signal strength</li></ul>	5.1
SOHO Network Technologies	Given a set of requirements, plan and implement a basic SOHO network. <ul style="list-style-type: none"><li>• List of requirements</li><li>• Cable length</li><li>• Device types/requirements</li><li>• Environment limitations</li><li>• Equipment limitations</li><li>• Compatibility requirements</li></ul>	2.6

## Ethernet Frames

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- Four types of Ethernet available, result of different frame types used over time
- Most widely used Ethernet frame type is Ethernet II, or Ethernet DIX

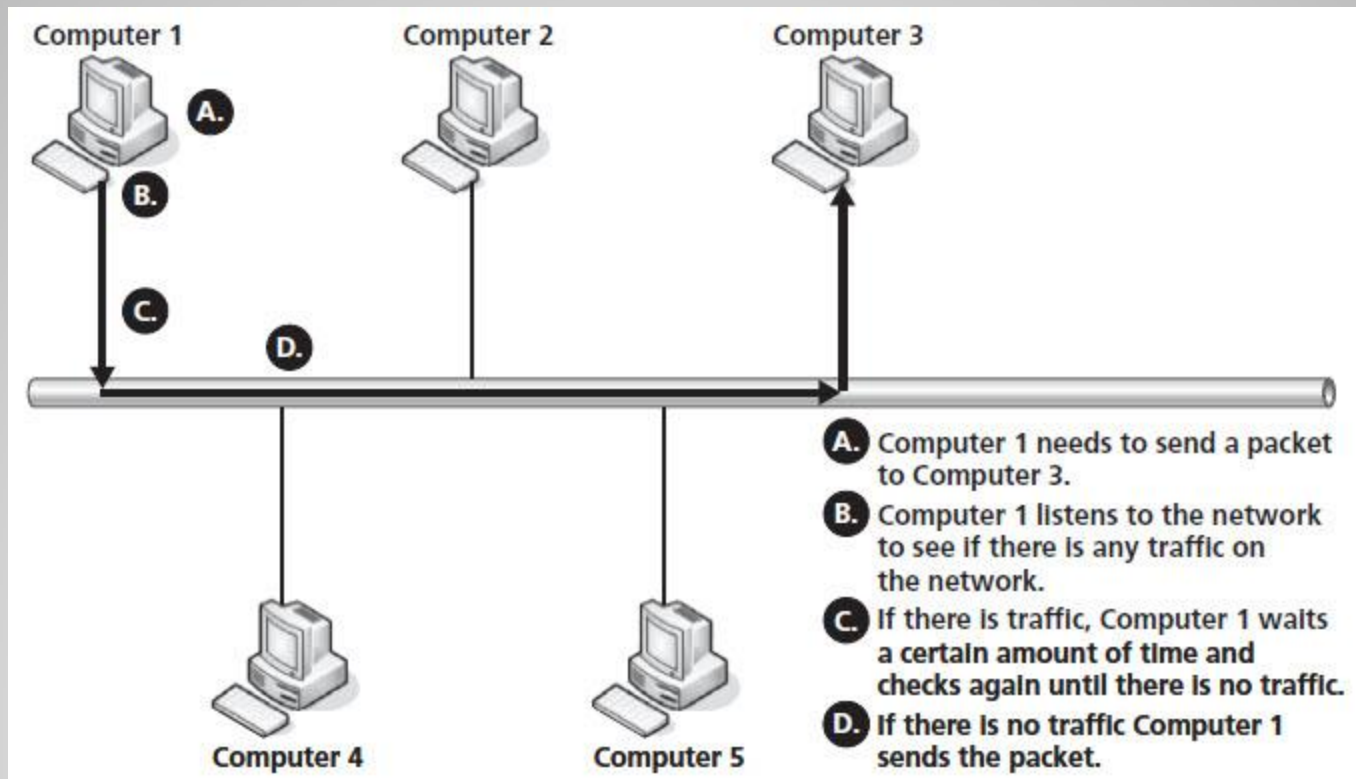
# Ethernet Communications Methods

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- How Ethernet transfers data on a network:
  - Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
  - Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
- Both are ***contention-based access methods***
  - Different nodes on the network segment compete to see which node is able to send out its packet first

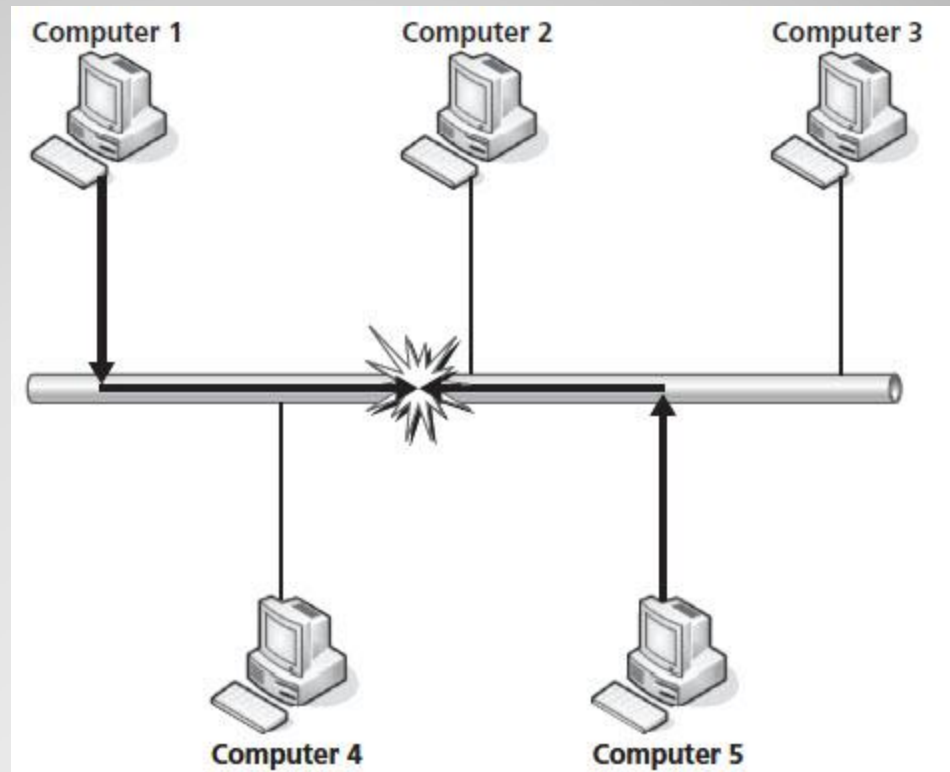
# Carrier Sense Multiple Access with Collision Detection (CSMA/CD)

- Primary method that Ethernet uses to access wired LANs



# Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (Continued)

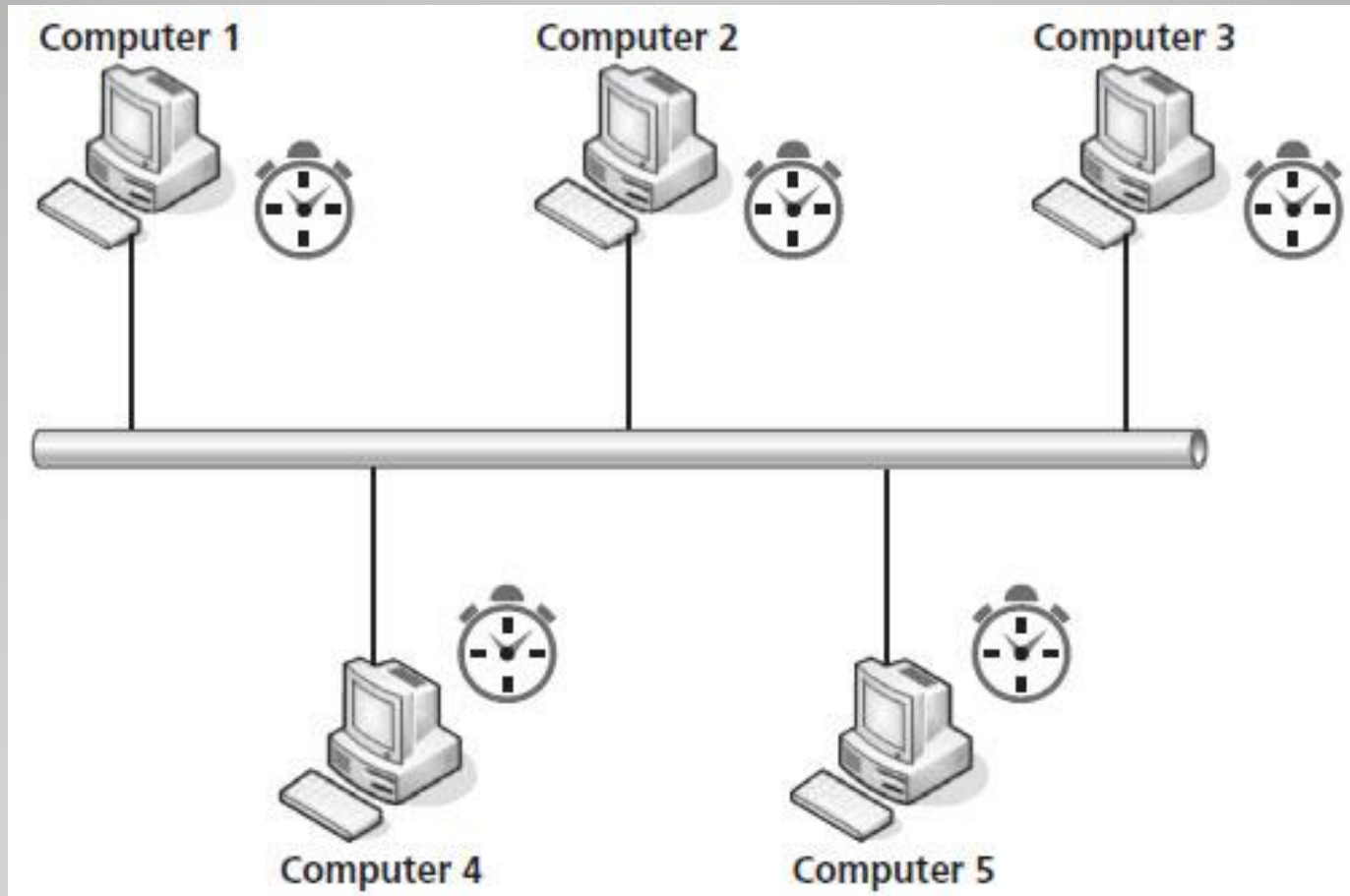
- Collision can occur when more than one computer sends data across the network at one time





# Carrier Sense Multiple Access with Collision Detection (CSMA/CD) (Continued)

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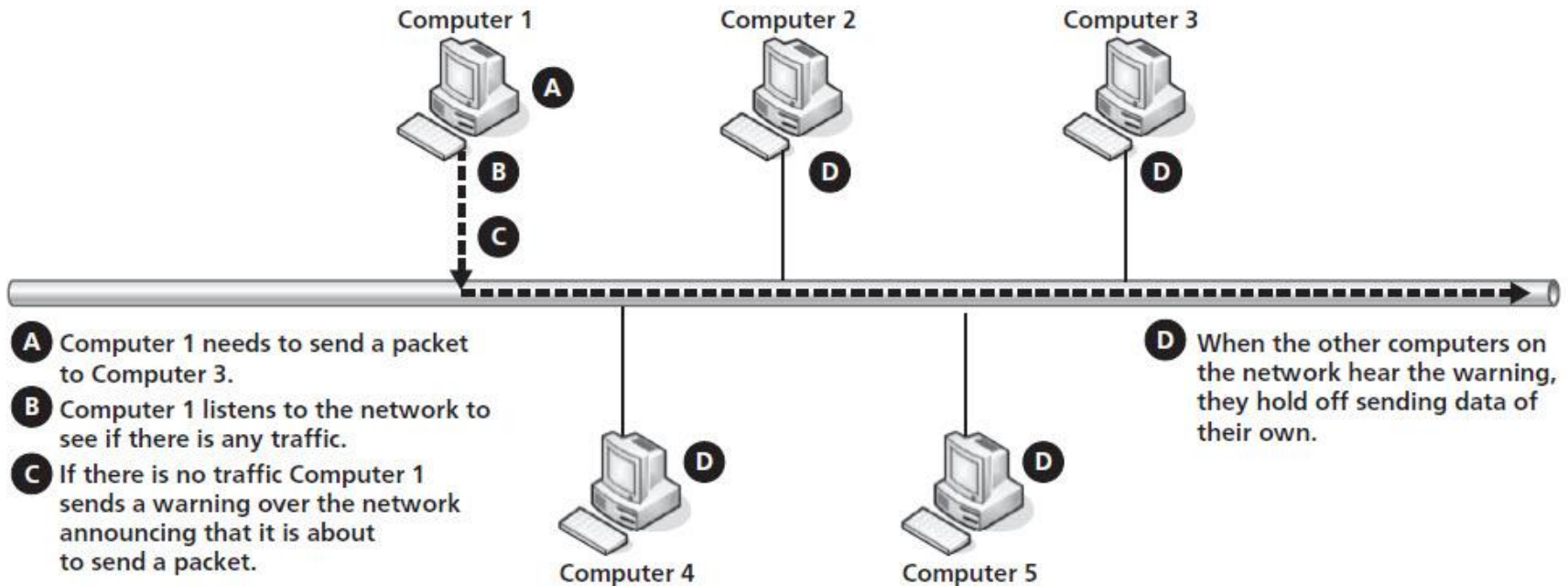


## **Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)**

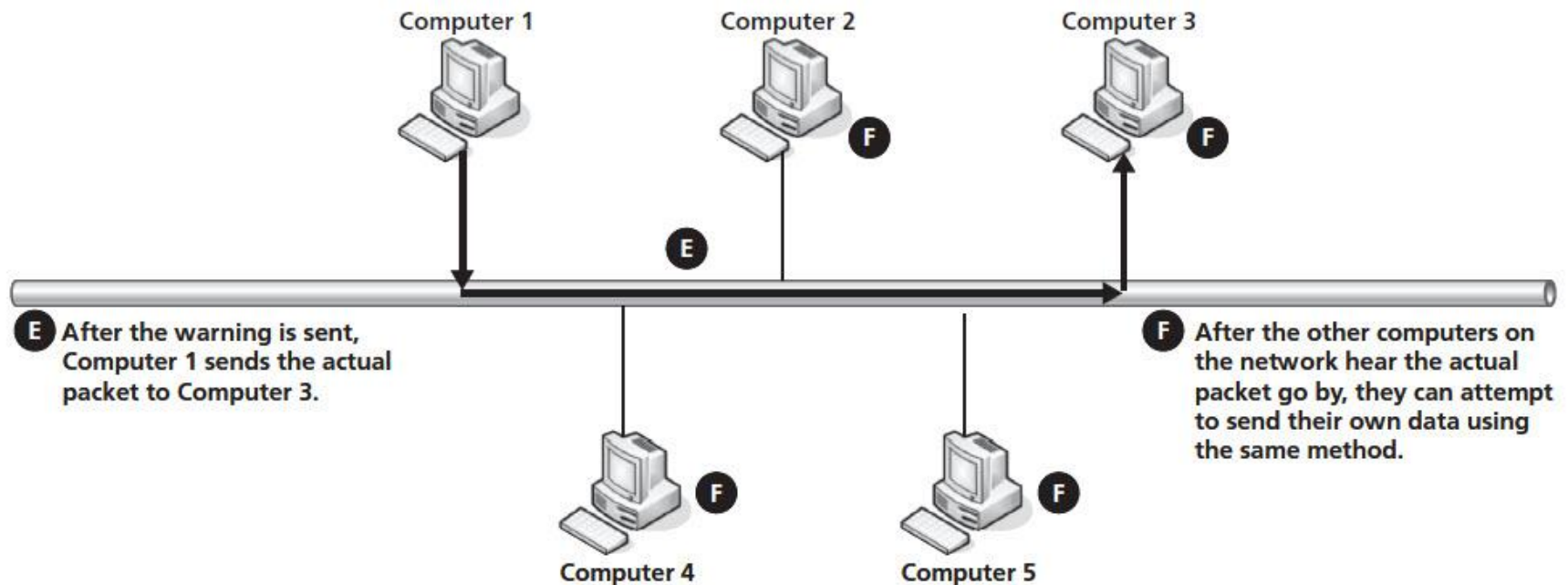
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- A method used by Ethernet to access a local area network
- Most commonly used for wireless networks
- Differs from CSMA/CD in that CSMA/CA first sends out a warning message letting all the other computers on the network know that a data packet is coming

# Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) (Continued)



# Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) (Continued)



## Baseband Ethernet Technologies

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- **Baseband** means that a cable can only carry one signal one way at one time
  - In most modern Ethernet cables, one line for sending signals and another line for receiving signals
  - Can result in collisions
- **Broadband** media type can carry multiple data signals on the same wire using some type of multiplexing

## XBase-Y Naming Convention

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- X indicates possible transfer rates for particular media type
  - Usually some multiple of megabits per second (mbps)
  - A capital G after the number indicates gigabits per second (gbps)
- *Base* indicates a baseband media type
  - If *Broad*, means broadband
- Y indicates type of media being used

## 10Base-5

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- First version of Ethernet widely used (but no longer)
- Called Thick Ethernet
- A baseband technology
- 10 mbps throughput
- A range of up to 500 meters

## 10Base-2

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- Defined as the IEEE 802.3a standard
- Used a thinner coaxial cable than 10Base-5
  - 10Base-2 came to be known as Thin Ethernet
  - 10Base-5 was known as Thick Ethernet
- Range of up to 185 meters



## 10Base-T

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- Used CAT 3 unshielded twisted pair (UTP)
  - Became known as Twisted Pair Ethernet
- A baseband technology
- Carries 10 mbps of throughput for a distance of 100 meters

## 100Base-T

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- Functions at speeds of 100 mbps
- Became known as Fast Ethernet
- Fast Ethernet designation refers to both copper and fiber based versions of Ethernet that runs at 100 mbps

## 100Base-FX

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- Version of Fast Ethernet intended to be used over fiber-optic cable
- 100Base-FX introduced at same time as 100Base-TX
  - Part of the same IEEE 802.3y standard
- Can be used in either half-duplex mode or in full-duplex mode
- Throughput of 100 mbps in all usage modes

## 1000Base-X

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- First 1,000 megabit or 1gigabit Ethernet standard to be released
- Known as Gigabit Ethernet
- Intended for use with fiber-optic cables

## 1000Base-T

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- Copper version of Gigabit Ethernet
- Used the IEEE 802.3ab standard
  - 802.3ab designed to use CAT 5, 5e, or 6
  - Allowed businesses to use Gigabit Ethernet on their current installations
- 1000Base-T can reach 100 meters on CAT 5 cable, but CAT 5e is recommended for twisted-pair Gigabit Ethernet implementations

## 10 Gigabit Ethernet

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- Supports full-duplex communications only
- Does not support CSMA/CD
- Proposed under the IEEE 802.3ae standard in 2002
- Ethernet standards proposed under 802.3ae
- Potential to become an alternative to different WAN technologies

## 40 Gigabit and 100 Gigabit Ethernet

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- The latest Ethernet standards
- Defined under IEEE 802.3ba
- 40/100 Gigabit Ethernet is full-duplex, and intended to be used with multimode fiber, single-mode fiber, and copper cabling
- 100 Gigabit Ethernet is intended to have range of up to 40 km using single-mode fiber
- 40/100 Gigabit Ethernet does not support CSMA/CD

# Broadcast

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- A computer sends data across a network by sending the data frame containing the data to all computers directly connected to it on a local network
- Broadcasts send data across a local network
- Ethernet is a broadcast-based network technology



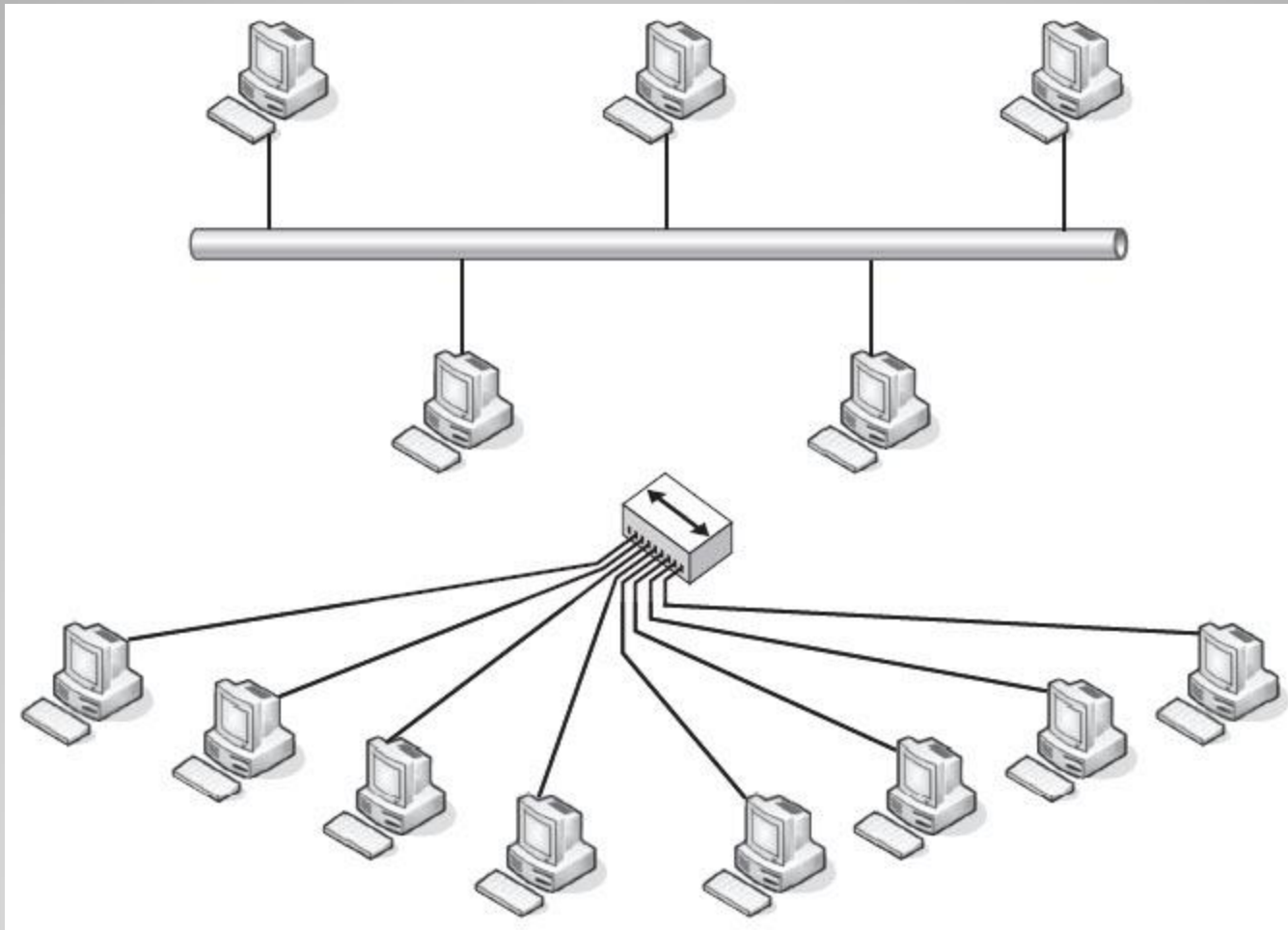
## Collision

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- Two different data frames from two different computers interfere with each other because they were released onto the network at the same time
- CSMA/CD and CSMA/CA were developed to:  
(1) limit the number of collisions that take place on a network (2) so the network and the computers on it know how to recover when a collision takes place

# Two Types of Collision Domains

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## Bonding

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- Using two or more NICs, channels, or connections to push data through instead of just one
- Works somewhat like disk striping in a RAID setup
- Increases throughput
- Provides redundancy for a network connection

## Network Speed

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- Referred to as network speed, bandwidth, or throughput
- The measure of how much data can move through the network in a given amount of time
- Measured in kilobits per second (kbps), megabits per second (mbps), gigabits per second (gbps), or terabits per second (tbps)

## Network Speed (Continued)

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- Network's actual speed or a specific connection's actual speed can be measured by going to sites such as [www.speedtest.net](http://www.speedtest.net)
- The potential speed of a network or network connection is usually the “stated” speed
  - When buying network services and technologies, you are purchasing potential speed not actual speed

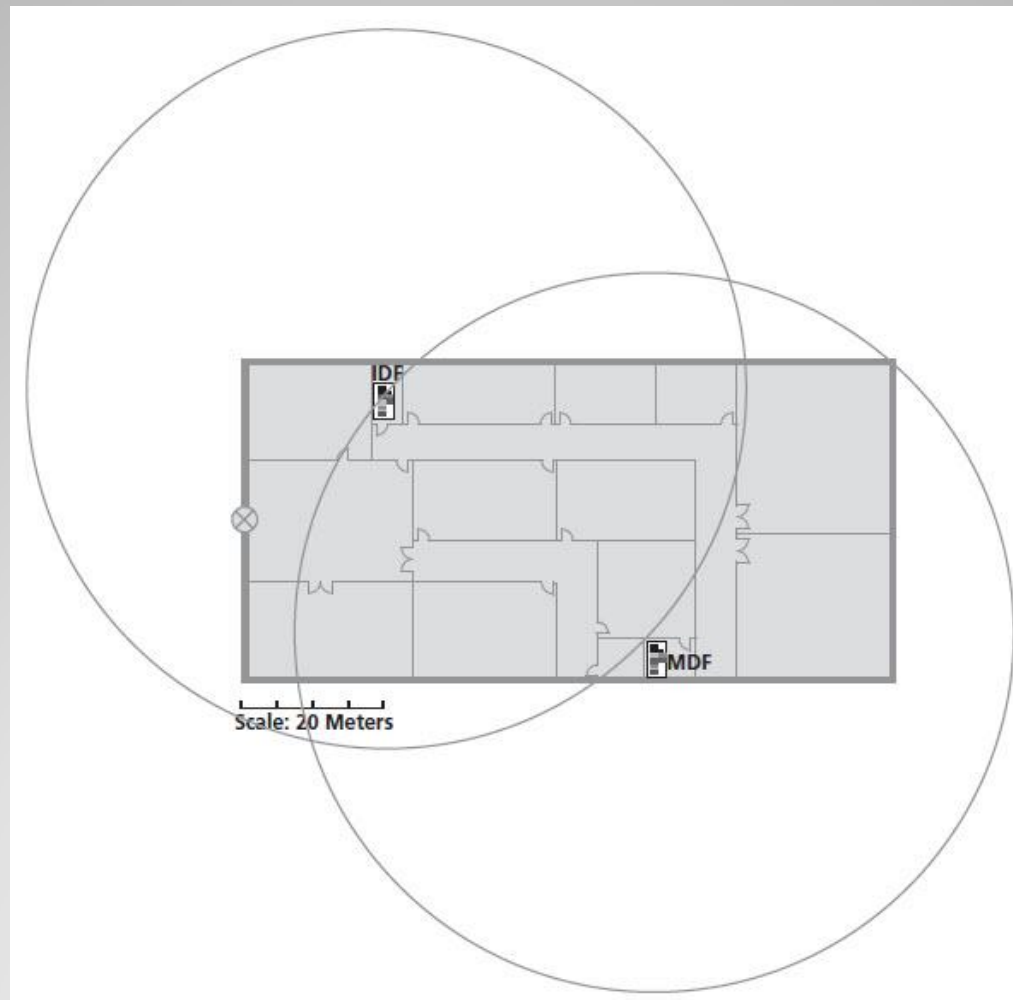
# Distance

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- How far data has to travel to get from one point on a network to another
- Regarding media, distance refers to how far a data signal can travel before it needs to be rebuilt, such as by a switch
- Actual versus subjective distance

# The Distance a Cable Can Carry Data Affects Placement of IDFs and the MDF

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## Wireless LAN Technologies

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- This section reviews installation and configuration issues for wireless LANs
- Examples use a Linksys WRT54GS2 Wireless-G router and Windows 7



## Install Client

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- Involves installing the wireless NIC in your computer
- Most modern laptop and smaller computers have built-in wireless NICs -- no installation needed
- Otherwise, two options:
  - Install a wireless NIC using your laptop's PCMCIA slot, also known as PC card slot
  - Use a USB port-based wireless NIC

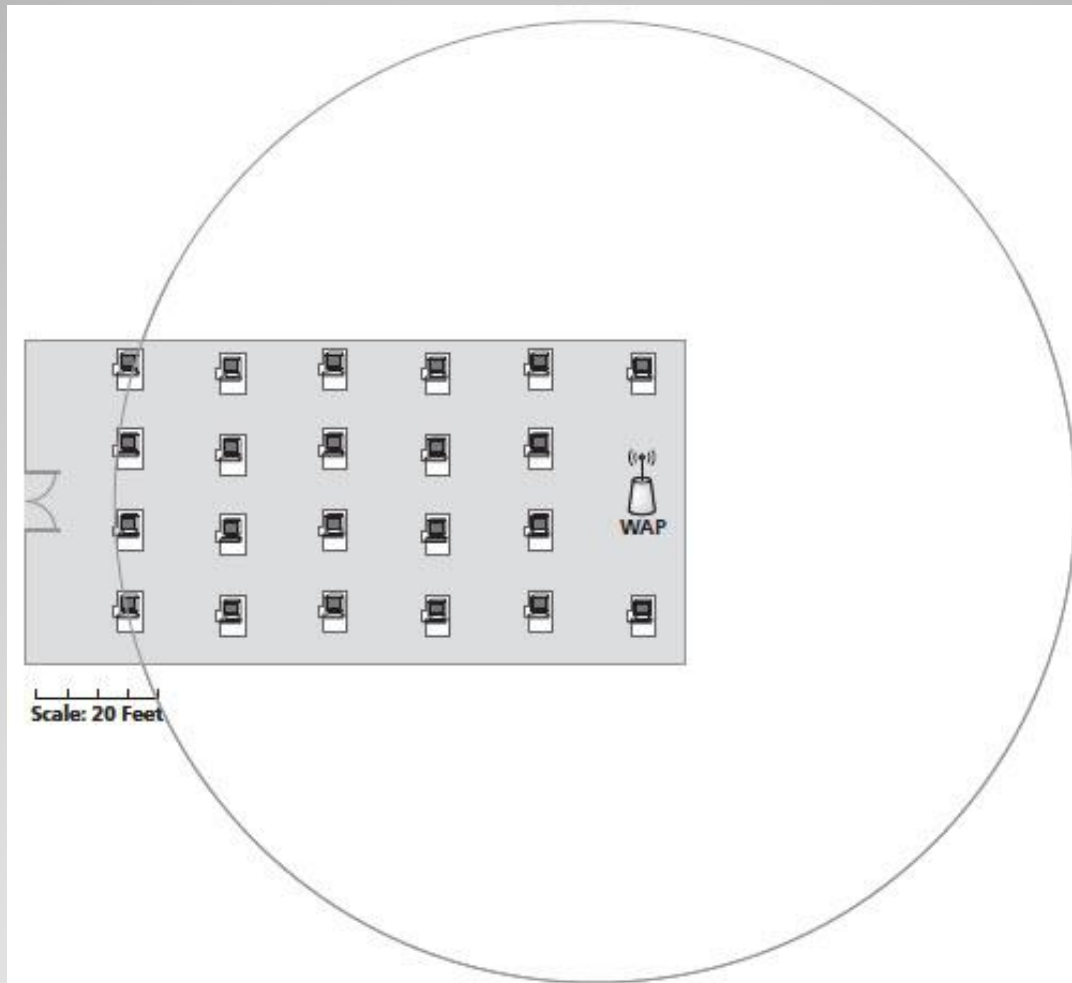
## **Wireless Access Point (WAP) Placement**

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- If single access point, locate centrally in relationship to computers
- Keep in mind
  - The further a computer is from the access point, the slower the data throughput for the computer

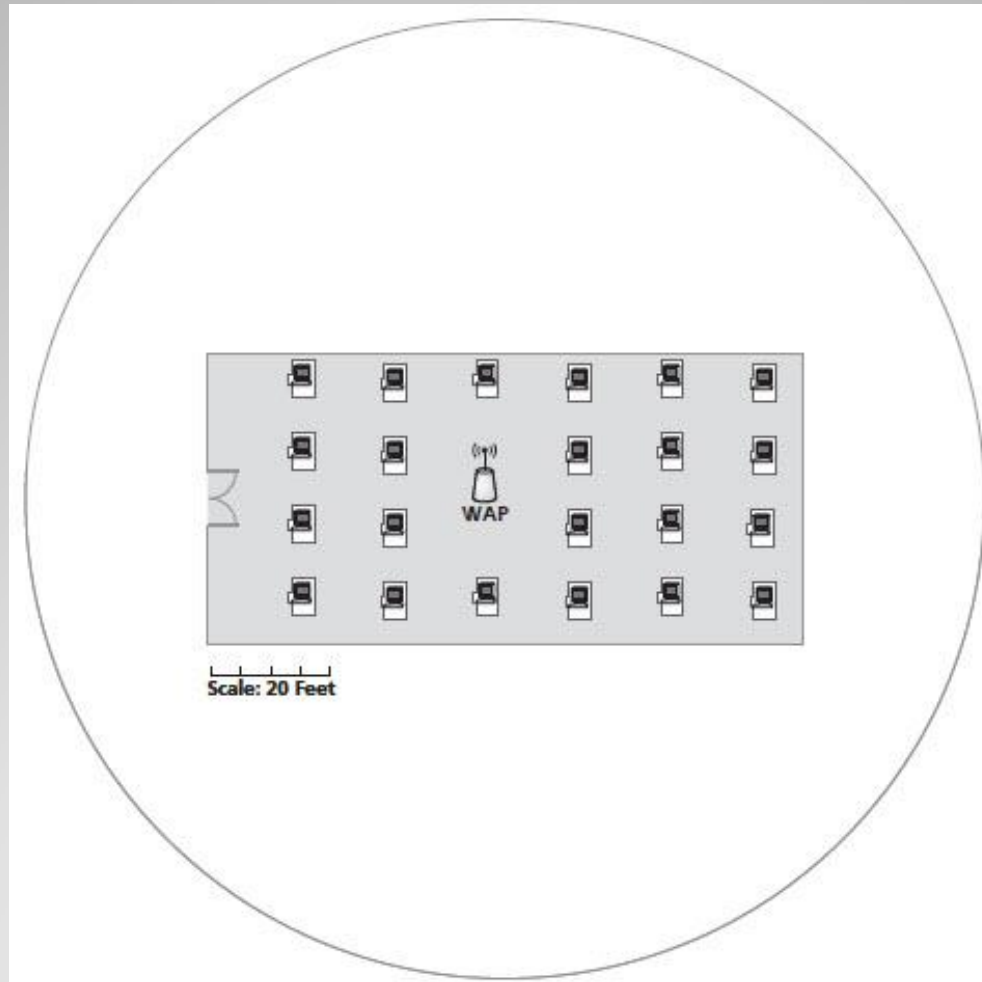
# A Poorly Placed WAP

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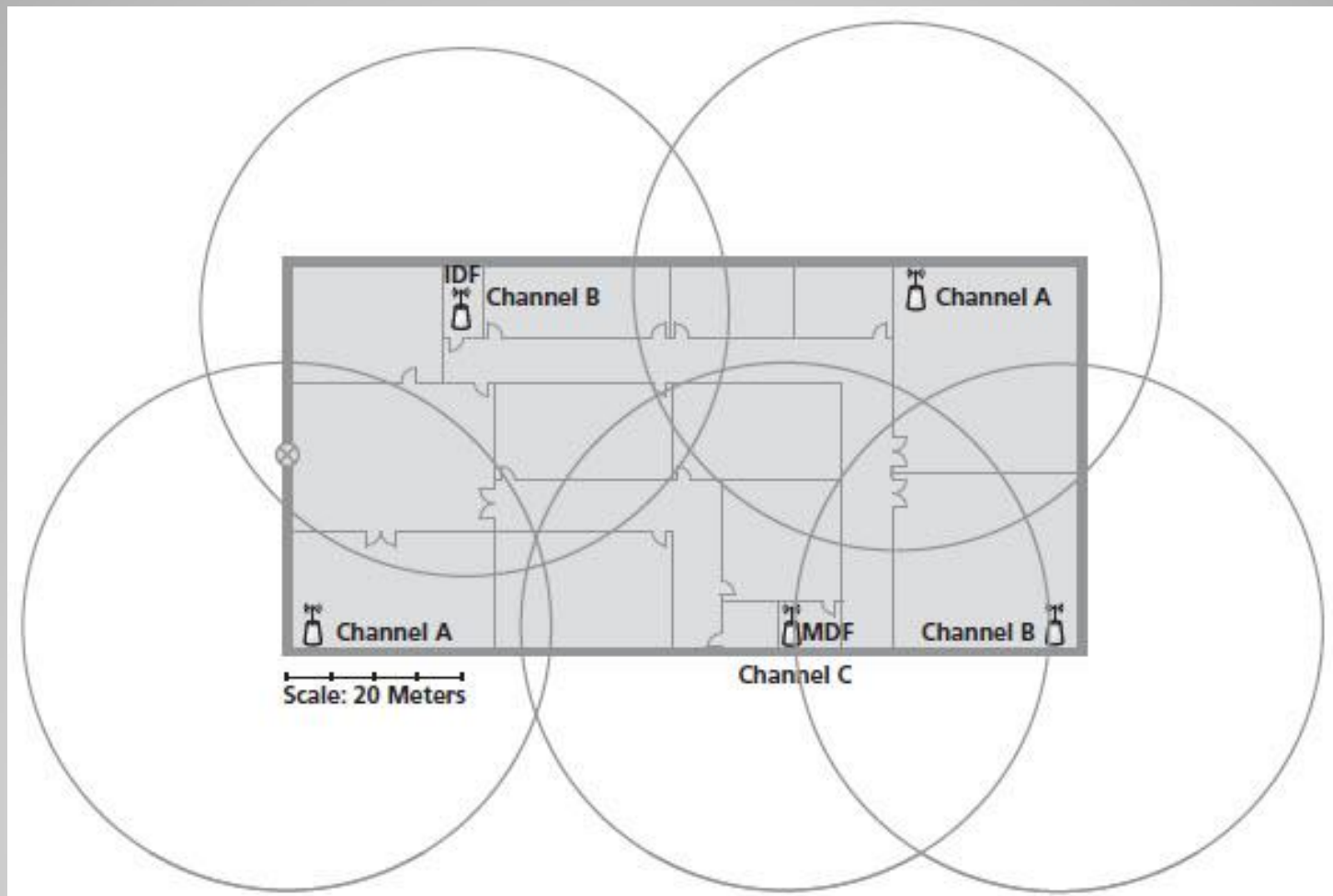
# A Well-Placed WAP

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# Well Placed WAPs in a Large Network Ensure no WAP Channels Overlap

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## Install Access Point

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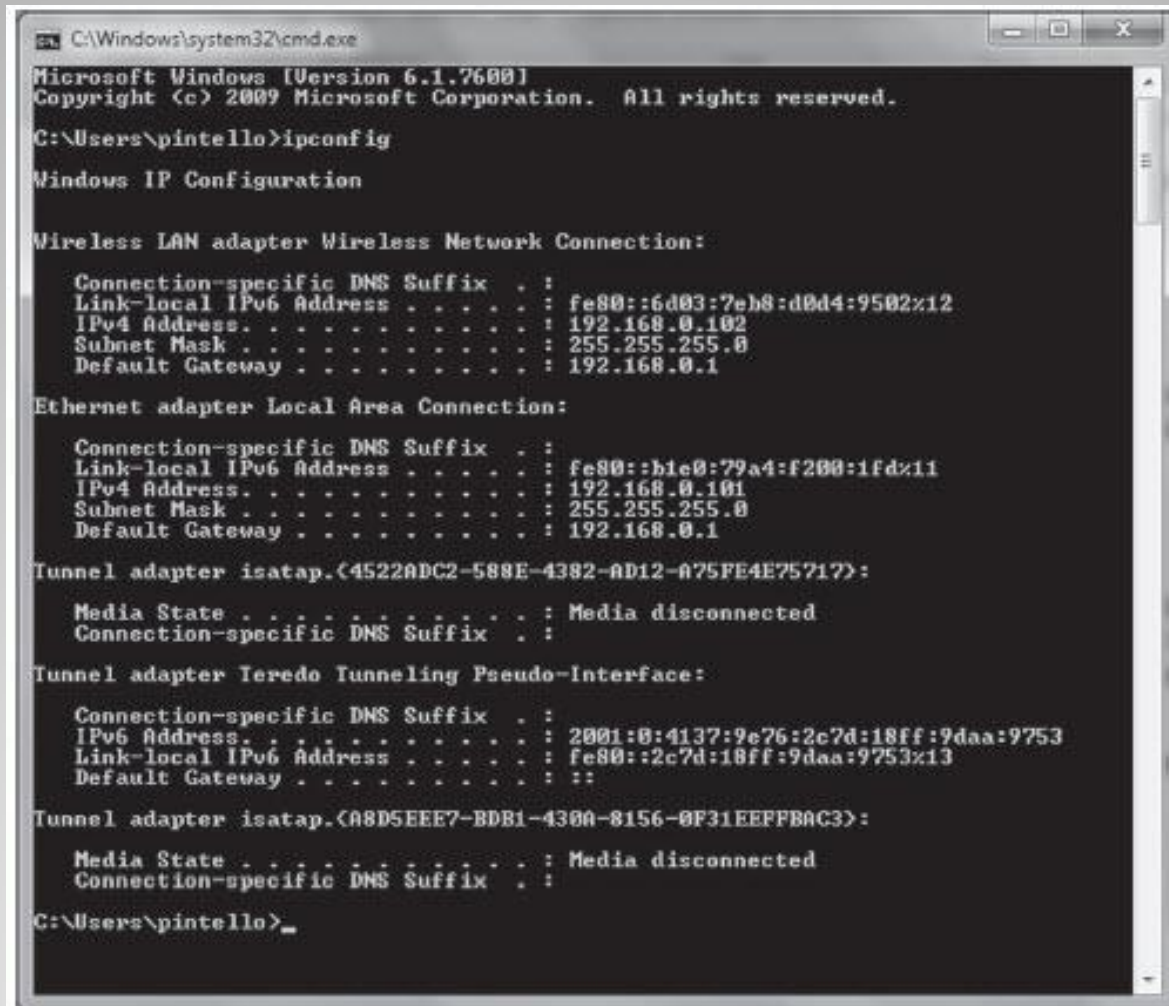
- Link to main network server via a switch and a wired connection, or to client computer if at home
  - Can perform wirelessly but wired bandwidth is better
- Run WAP setup software on computer connected to WAP
- Change the Service Set Identifier (SSID) and admin password

## Enforce MAC Filtering

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- Only preprogrammed MAC addresses will be allowed access to a specific WAP
- Need configuration info from computer
- Run ipconfig command at command line

# Running Ipconfig



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\pintello>ipconfig

Windows IP Configuration

Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix . : 
    Link-local IPv6 Address . . . . . : fe80::6d03:7eb8:d0d4:9502%12
    IPv4 Address. . . . . : 192.168.0.102
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . : 
    Link-local IPv6 Address . . . . . : fe80::b1e0:79a4:f200:1fd%11
    IPv4 Address. . . . . : 192.168.0.101
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Tunnel adapter isatap.{4522ADC2-588E-4382-AD12-A75FE4E75717}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

Tunnel adapter Teredo Tunneling Pseudo-Interface:

    Connection-specific DNS Suffix . : 
    IPv6 Address. . . . . : 2001:0:4137:9e76:2c7d:18ff:9daa:9753
    Link-local IPv6 Address . . . . . : fe80::2c7d:18ff:9daa:9753%13
    Default Gateway . . . . . : ::

Tunnel adapter isatap.{A8D5EEE7-BDB1-430A-8156-0F31EEFFBAC3}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 

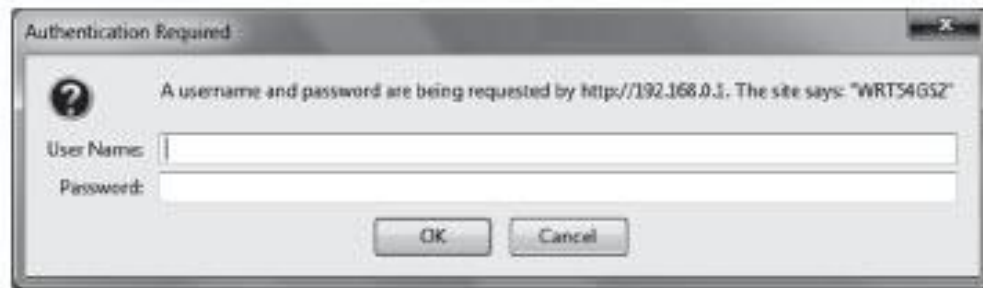
C:\Users\pintello>
```



# Configure Appropriate Encryption

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- Log in to WAP administrative interface
  - Usually requires you to use a web browser
- Select a WPA encryption scheme that most network users can use
- Do not use WEP



## Channels and Frequencies

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- 2.4 GHz radio-frequency range
- Frequency range broken up into several channels, or sub-ranges of frequency
- There can be no overlap of channels on the same network

## Service Set Identifiers (SSIDs)

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- Extended Service Set Identifier (ESSID)
- Basic Service Set Identifier (BSSID)
- Both identify wireless networks
- BSSIDs identify independent wireless networks
  - Ad hoc or have a central access point
- ESSIDs used when two or more independent wireless networks are connected

# Antenna Types

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- Omni-directional antenna
  - Broadcasts a signal in all directions
- Directional antenna
  - Sends a signal in only one general direction

# Interference

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- Interference
  - Any electromagnetic signal that interferes with passing data over a wireless network  
**Examples:** Electric motors and microwave ovens
  - Something that redirects wireless signals  
**Example:** A building that uses steel studs in its walls rather than wooden ones

## Signal Strength

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- The strength of a wireless signal when you are trying to send or receive information across a wireless network
- Factors that affect signal strength
  - Actual distance to WAP
  - Interference

## Beacon Frames

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- A frame periodically broadcasted by a WAP to announce presence of the wireless network
- Contains:
- A MAC header identifying its MAC address
- A body with relevant information about the wireless network
  - Timestamp, interval the beacon frame is broadcast on, and basic summary

## Verify Installation

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- After installation and configuration, verify that:
  - You changed the default SSID and password
  - All network devices know the SSID
  - All devices that need access to the network are entered correctly into the MAC filter list (if applicable)
- Test wireless network to make sure that data is flowing across it



## SOHO Network Technologies

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- Considerations before setup:
  - Wired or wireless?
  - Peer-to-peer or client/server-based?
  - Location of SOHO network?
- Cable length (if wired), device types and requirements, and compatibility issues are similar to larger environments
- Main limitation is number of devices

## Summary

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- Ethernet transfers data on a network via Carrier Sense Multiple Access with Collision Detection (CSMA/CD) or Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).
- CSMA/CD is commonly used in wired environment.
- CSMA/CA is geared toward wireless environments.
- Baseband means that a cable can only carry one signal one way at one time. A broadband media type can carry multiple data signals on the same wire using some type of multiplexing.

## Summary (Continued)

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- Ethernet follows the *XBase-Y* naming convention.
- 10Base-T is known as Fast Ethernet; it functions at speeds of 100 mbps.
- 10 Gigabit Ethernet has the potential to become an alternative to different WAN technologies.
- Collisions result when two different data frames from two different computers interfere with each other because they were released onto the network at the same time.

## Summary (Continued)

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- Network speed comes in two flavors: actual and potential.
- To install a wireless network, install NICs in clients (if necessary), locate and configure a WAP, and then verify and test connectivity.
- To set up a wireless network in a SOHO environment, you will encounter many of the same issues as a much larger environment. A SOHO's main limitation is the number of devices that can be installed.