School of Business
Eastern Illinois University

Conducted and Wireless Media (Part I)

(October 3, 2016)

Learning Objectives

- Outline characteristics of conducted media
- Select conducted media in LAN design

Major categories of Media

- Conducted Media
  - Physically connect network devices
- Wireless Media
  - Use electromagnetic waves/radiation

Conducted Media

- Twisted Pair cable
- Coaxial cable
- Optical Fiber cable

Twisted Pair wire

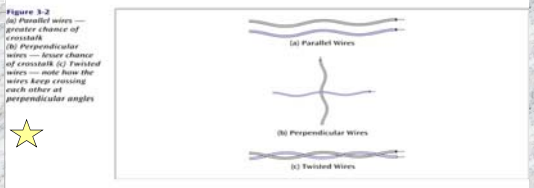

Figure 3-2
(a) Parallel wires — greater chance of crosstalk (b) Perpendicular wires — lesser chance of crosstalk (c) Twisted wires — note how the wires keep crossing each other at perpendicular angles

- Shielded Twisted Pair (STP) Versus Unshielded Twisted Pair (UTP)

- Typically 2 or more Twisted pair wires & different standards for different applications
- http://en.wikipedia.org/wiki/Twisted_pair

Twisted Pair wire

Table 3-1
A summary of the characteristics of twisted pair wires

UTP Category	Typical Use	Signaling Technique	Maximum Data Rate	Maximum Range	Advantages	Disadvantages
Category 1	Telephone wire	Analog and digital	<100 Kbps	3–4 miles	Inexpensive, easy to install and interface, widely used	Security, noise
Category 2	T-1, ISDN	Digital	<2 Mbps	3–4 miles	Same as Category 1	Security, noise
Category 3	LANs	Digital	10 Mbps	100 m (328 feet)	Same as Category 1, with less noise	Security, noise
Category 4	LANs	Digital	20 Mbps	100 m	Same as Category 1, with less noise	Security, noise
Category 5	LANs	Digital	100 Mbps (100 MHz)	100 m	Same as Category 1, with less noise	Security, noise
Category 5e	LANs	Digital	100 Mbps (100 MHz)	100 m	4-pair specification includes connectors, patch cords, and other components	Security, noise
Category 6	LANs	Digital	250 MHz	100 m	Draft standard in late stages	Security, noise
Category 7	LANs	Digital	600 MHz (?)	100 m (?)	Draft standard in very early stages	Security, noise

Q: Are Shielded Twisted Pairs (STP) affected by interference ?

Coaxial cable

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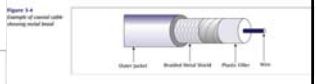
- A single wire wrapped in a foam (or plastic) insulation surrounded by a braided metal shield, then covered in a plastic jacket



- Cable can be thick or thin
- Provides for wide range of frequencies

Coaxial cable

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- Two major coaxial technologies:

Baseband Coaxial tech.	Broadband Coaxial tech.
Uses digital signaling	Transmits anal./digital signals
One channel of digital data	Multiple channels of data
~1 kilometer w/o repeater	~ 4 kilometer w/o repeater

- Thin coaxial cable
  - Typically used for digital data transmission in Ethernet LANs
  - Typically used for baseband transmission
- Thick coaxial cable
  - Typically for broadband transmission
  - Typically used for video transmission

Less noise/interference compared to twisted pairs

Coaxial cable

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- Coaxial cable standards:

Type①	Ohm rating②	Use
RG-11	75 ohm	Used in 10Base5 Ethernet (known as Thick Ethernet)
RG-58	50 ohm	Used in 10Base2 Ethernet

① **RG** (Radio Guide) specifies characteristics like wire thickness, insulation thickness, electrical properties, etc.

② **Ohm** is the measure of resistance within the medium

10Base5

Speed: 10 Mbps

Signal type: Baseband transmission

Distance: 500 meters

Fiber Optic

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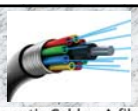
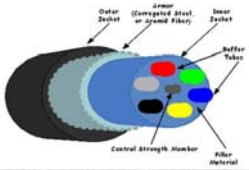


Fiber-optic Cable:- A fiber-optic cable is made of glass or plastic and transmits signals in the form of light



Fiber Optic

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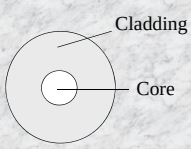
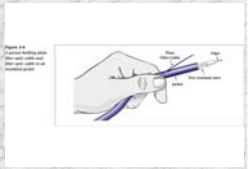
- A thin glass cable approximately a little thicker than a human hair
- Two concentric layers termed **Core** and **Cladding**





- Common types:
  - 62.5/125 microns
  - 50/125 microns

Fiber Optic

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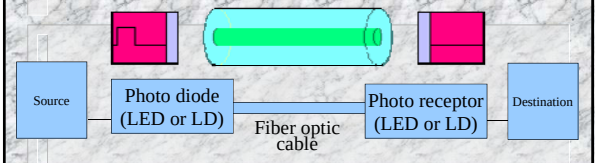

- Photo diode (light/laser source) at the transmitting end
  - Generate light/laser and modulate it to represent binary data received from Source
- Photo receptor (optic sensor) at the receiving end
  - Receive the light/laser and convert it into digital signal

Fiber Optic

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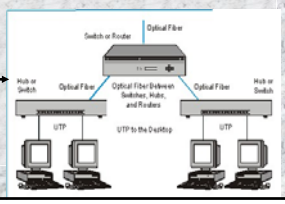
- Many advantages over Twisted pair and Coaxial cable
  - Speed
  - No significant noise
  - No interference
  - Less signal attenuation, i.e. longer distance
  - Low-power transceivers could be used (less electric consumption)
- Typical use in Businesses



Conducted Media

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Table 3-3
A summary of the characteristics of conducted media

Type of Conducted Media	Typical Use	Signaling Technique	Maximum Data Rate	Maximum Range	Advantages	Disadvantages
Twisted Pair						
Category 1 – 2	Telephone systems	Analog, digital	<2 Mbps	2–3 miles	Inexpensive, common	Noise, security
Category 3 – 6	LANs	Digital	250 Mbps	100 m (328 feet)	Inexpensive, versatile	Noise, security
Coaxial Cable						
Thin baseband single channel	LANs	Digital	10 Mbps	100 m	Low noise	Security
Thick broad-band multi-channel	LANs, cable TV, long-distance telephone, short-run computer system links	Analog	10 Mbps	2–3 miles	Low noise, multiple channels	Security
Fiber Optic	Data, video, audio, LANs, WANs	Light pulses	10 Gbps	100 miles	Secure, high capacity, very low noise	Interface expensive but coming down in cost

Case study

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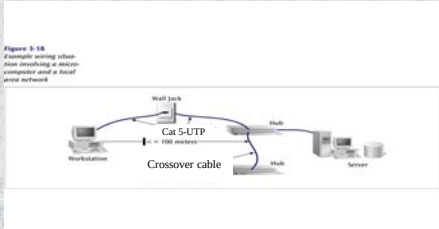
- The following figure shows a common situation in LANs.
- Remember :
  - Using Category 5 UTP, the maximum segment length is 100 meters.
  - A wall jack is a passive device that does not regenerate signals



Case study

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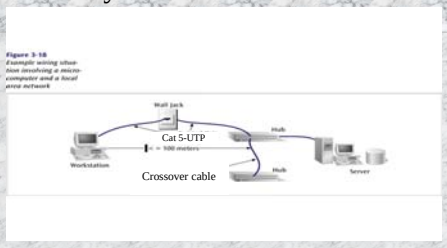

- What kind of problem there will be if the distance between the Workstation and the Hub is more than 100 meters? What solution can be applied ?
- If the cable that connects the workstation and the hub passes through a noisy environment (Heating or cooling mechanical room) what action could be taken to prevent interference?

Case study

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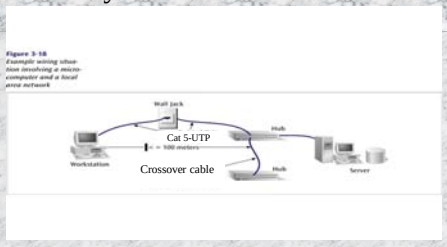

- If the needed data rate is higher than 100 Mbps, what are the possible solutions?

Summary Questions

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- What does cross talk interference mean ? How can crosstalk interference be reduced ?

  If transmission wires are placed side by side, electromagnetic radiation is emitted by one wire and picked up by the other. Twisting pair of wire reduce crosstalk interference.
- What categories of twisted pair are usually used in LANs ?

  Categories 3, 4, 5, 6, 7, 8
- What are the advantages and disadvantages of STP compared to UTP ?

  Advantage: better level of isolation from interference. Disadvantage: cost
- What is the main difference between baseband coaxial cable and broadband coaxial cable ?

  Baseband carries digital signals with a single channel. Broadband carries analog or digital signals with multiple channels.
- What are the advantages of Optical fiber compared twisted pair and coaxial cable ?

  Speed, No significant noise, No interference, Long distance
- Can you transmit video signal over twisted pair wire ? Explain

  You can. Noise used to be a limitating factor, but it's no longer the case.

Baseband signaling

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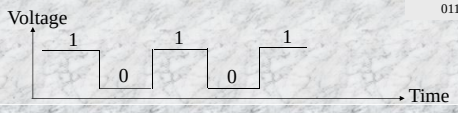
1010100 T
1110010 r
1100001 a
1101110 n
1110011 s
1100110 f
1100101 e
1110010 r
0100000 space
0100100 $
0110001 1
0110010 2
0110000 0
0110000 0
0101110 .
0110000 0
0110000 0

- Single transmission channel
  - ➔ Only one bit at a time

.....1110011 1101110 1100001 1010100 1010100

- Uses TDM (Time Division Multiplexing)



Broadband signaling

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1010100 T
1110010 r
1100001 a
1101110 n
1110011 s
1100110 f
1100101 e
1110010 r

- Multiple transmission channels
  - ➔ Multiple bits at a time

1111111
0111111
1100100
0001000
1001000
0101110
0010101

- Uses FDM (Frequency Division Multiplexing)