



MEDIA TRANSMISI



KOMUNIKASI DATA

Media Transmisi

1. Terminologi transmisi

- Berhubungan dengan Bandwidth, Data rate
- Baseband dan broadband
- Media transmisi Guided dan Unguided

2. Karakteristik media transmisi

- Throughput, Capacity

3. Media transmisi Guided

- Unshielded Twisted Pair
- Coaxial Cable
- Optical Fiber Cable

4. Media transmisi Unguided

Terminology media transmisi Unguided

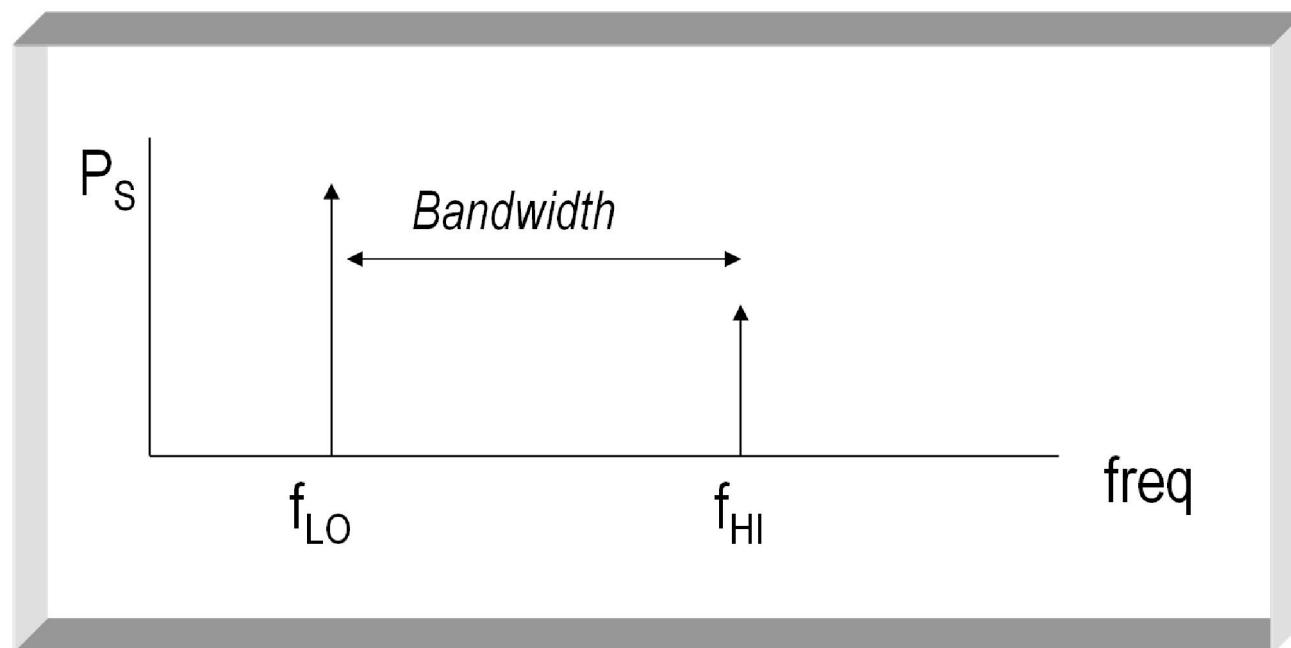
Teknologi Wireless LAN

5. Penyebab pelemahan

- Attenuation, Distortion, Noise, Performance

Terminologi Transmisi

Bandwidth → Range frekuensi yang ditentukan oleh kanal yang mana merupakan perbedaan antara frek. tertinggi dan frek. terendah yang mempunyai satuan *Hertz*.



Data Rate → Rate of data convey through transmission media, expressed in *bps* (*bit per second*)

Baseband → Transmission of signals without modulation. In a baseband network, digital signals (“1” or “0”) are inserted directly onto the cable as voltage pulses. The entire spectrum of the cable is consumed by the signal.

Broadband → Transmission of signals with modulation. The information signals are carried by another signal, which has the higher frequency than the information signal. Using the modulation system, the information signal could be transferred at the longer distance.

Media Guided

sering disebut *physical media*, media ini dapat dilihat dan disentuh.

Guided → guide dalam satu arah

Contoh : Kabel (semua tipe kabel transmisi)

Media transmisi menggunakan kabel dinamakan wireline

Media Unguided

sering disebut *non physical media*, media ini tidak dapat dilihat dan disentuh

Unguided → pada semua arah

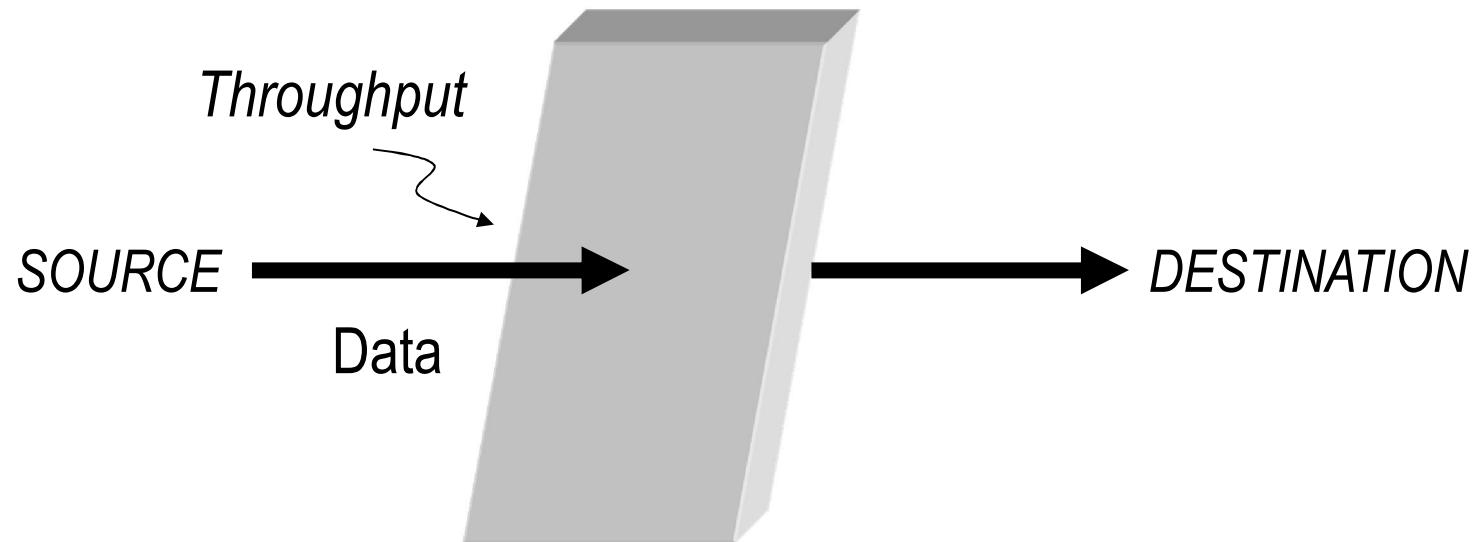
Contoh : media udara

Untuk mengirimkan informasi melalui media udara menggunakan sinyal microwave signal (disini mempunyai frekuensi sangat tinggi dibandingkan menggunakan *physical media*).

Media transmisi menggunakan udara dinamakan wireless

Throughput → banyaknya data pada medium yang dapat dikirimkan selama periode waktu yang diberikan.

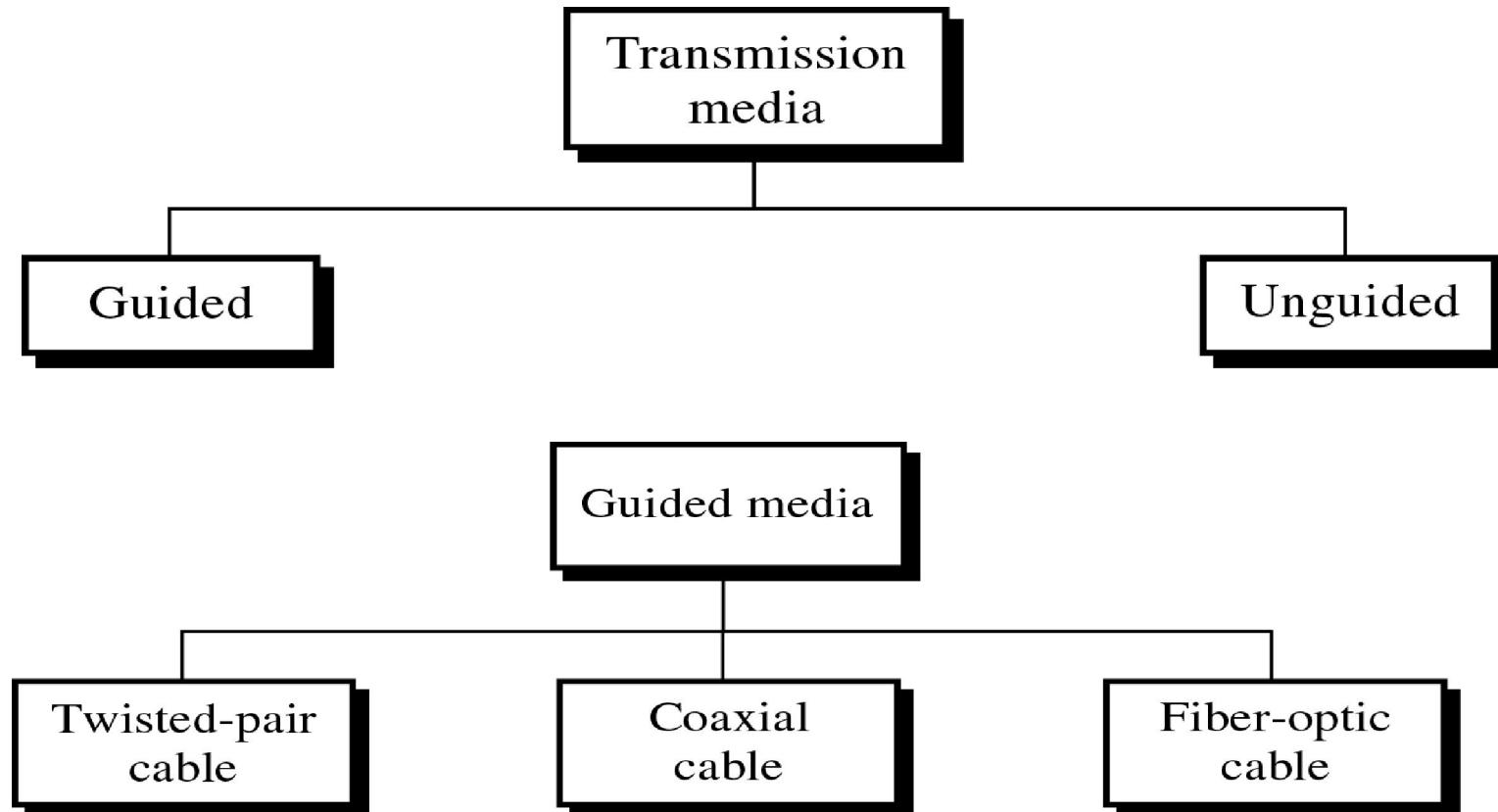
- Diukur dalam *Megabit* (1,000,000 bit) per second



Channel Capacity → rate data yang dapat dikirimkan melalui saluran komunikasi atau kanal dibawah bandwidth kanal yang diberikan.

Media Guided

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Transmission Characteristics of Guided Media

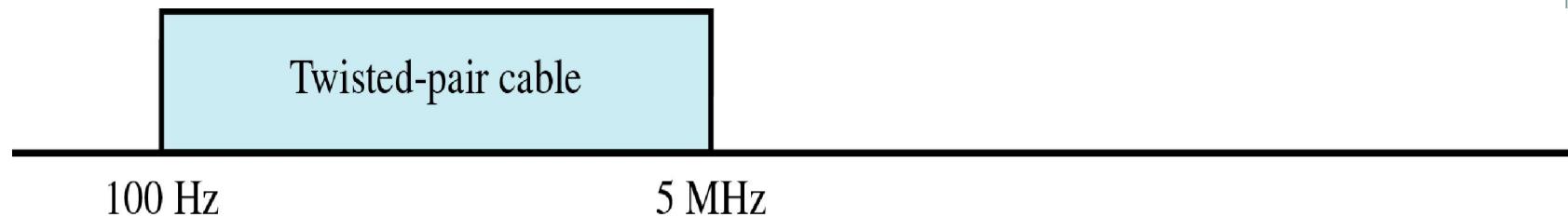


	Frequency Range	Typical Attenuation	Typical Delay	Repeater Spacing
Twisted pair (with loading)	0 to 3.5 kHz	0.2 dB/km @ 1 kHz	50 µs/km	2 km
Twisted pairs (multi-pair cables)	0 to 1 MHz	0.7 dB/km @ 1 kHz	5 µs/km	2 km
Coaxial cable	0 to 500 MHz	7 dB/km @ 10 MHz	4 µs/km	1 to 9 km
Optical fiber	186 to 370 THz	0.2 to 0.5 dB/km	5 µs/km	40 km

Kabel Twisted-Pair

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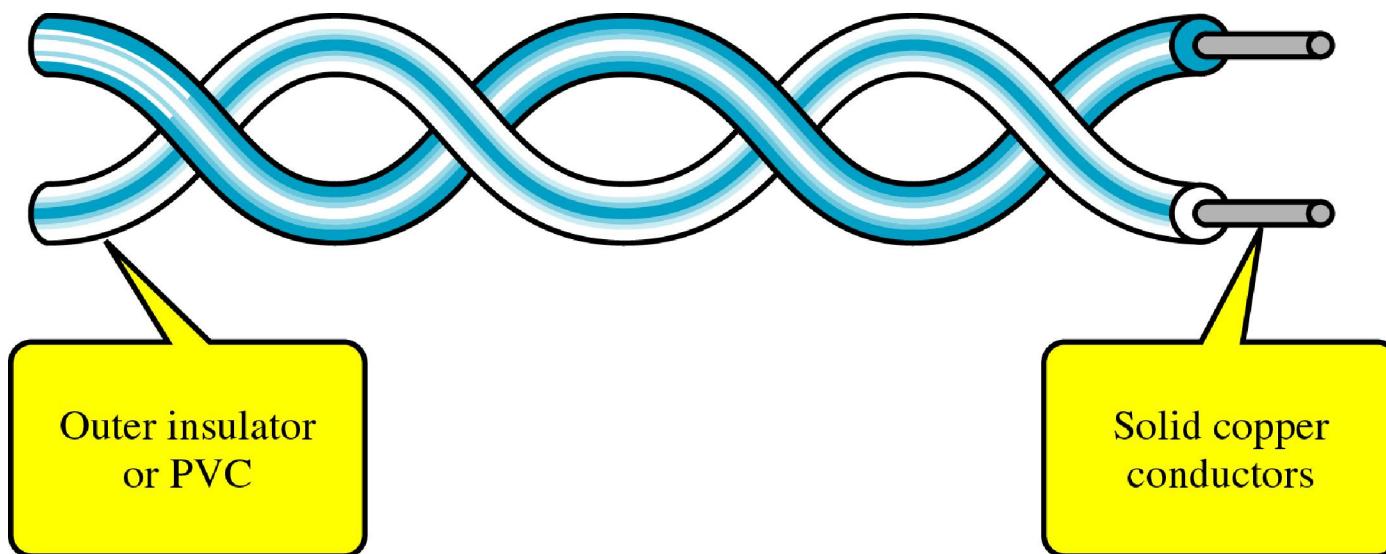
- Dua bentuk
 - Unshielded twisted-pair (UTP)
 - Shielded twisted-pair (STP)



Kabel unshielded Twisted-Pair (UTP)

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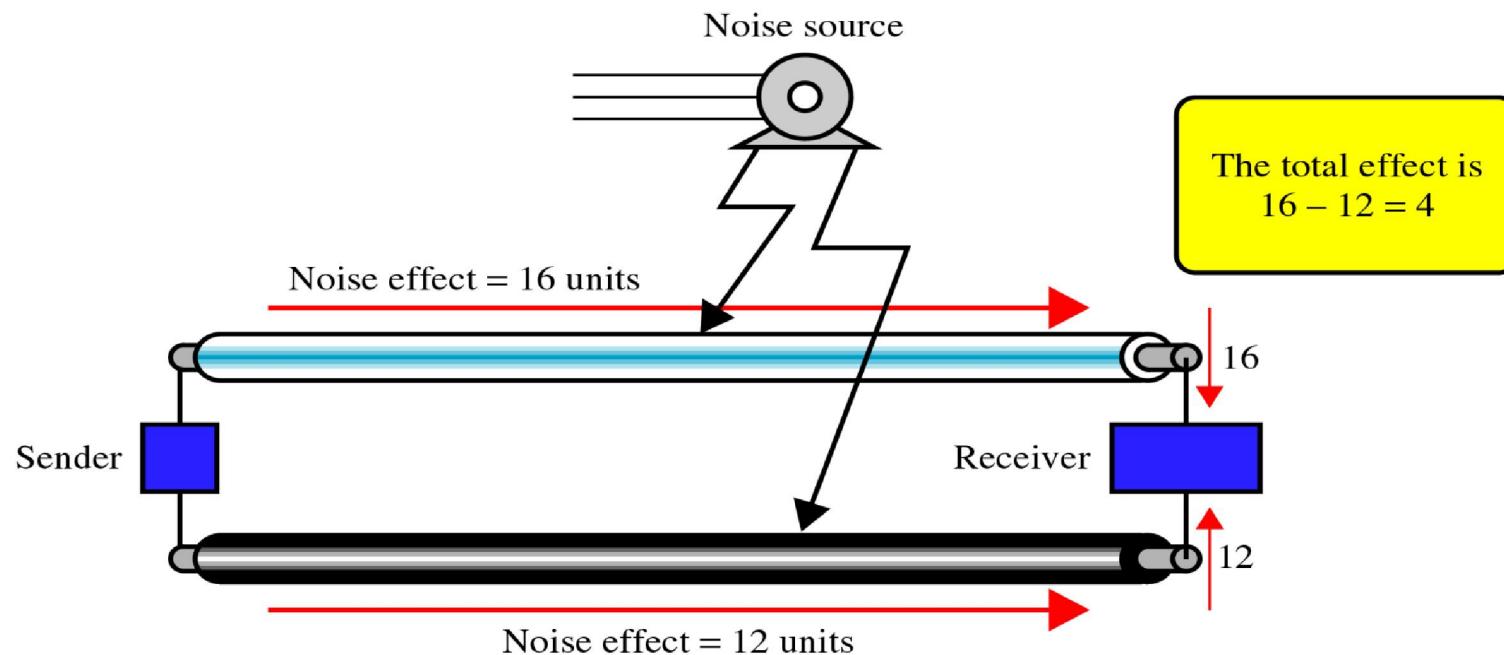
- Terdiri dari dua konduktor yang masing-masing dilingkupi oleh sebuah material isolator



Kawat Parallel Flat

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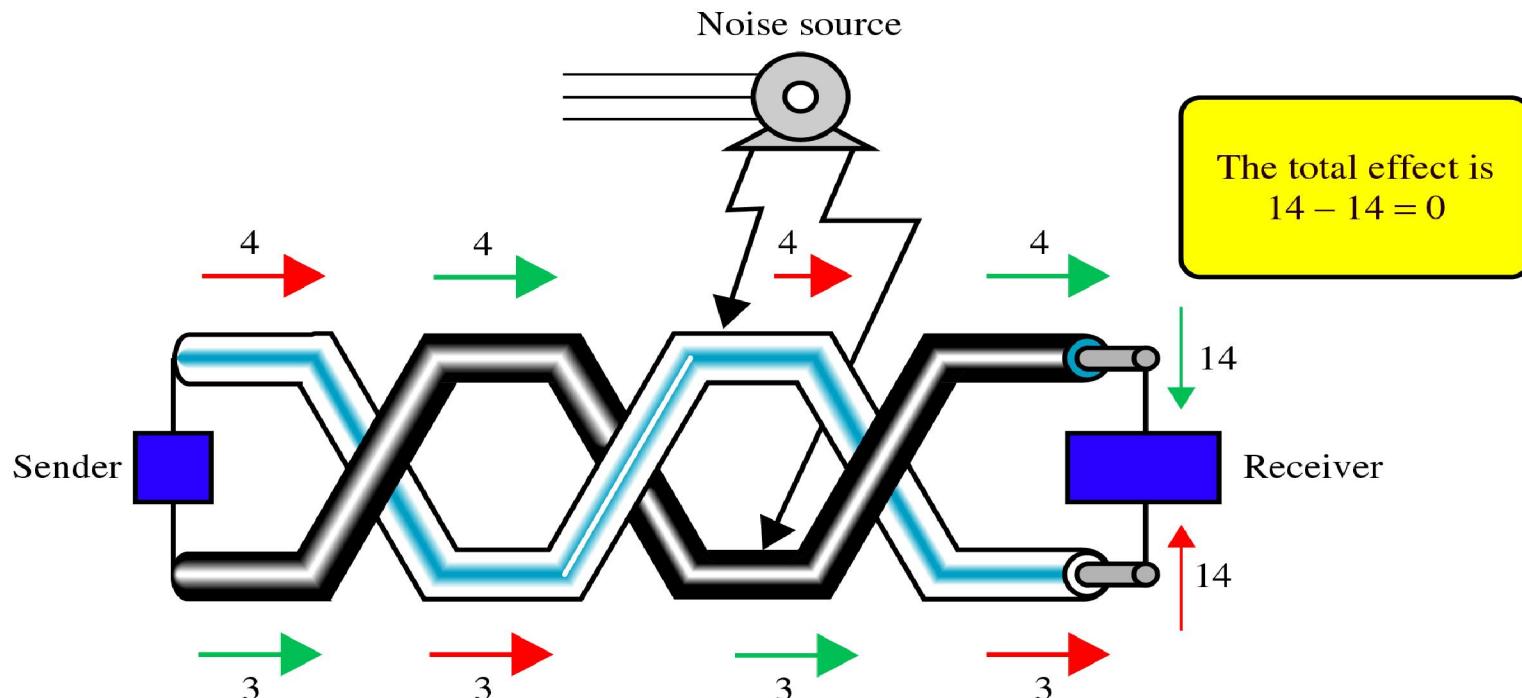
- Interferensi gelombang elektromagnetik dapat membangkitkan noise
- Noise melalui kabel paralel menghasilkan beban yang tidak seimbang dan sinyal akan berubah bentuk



Efek noise pada twisted-pair

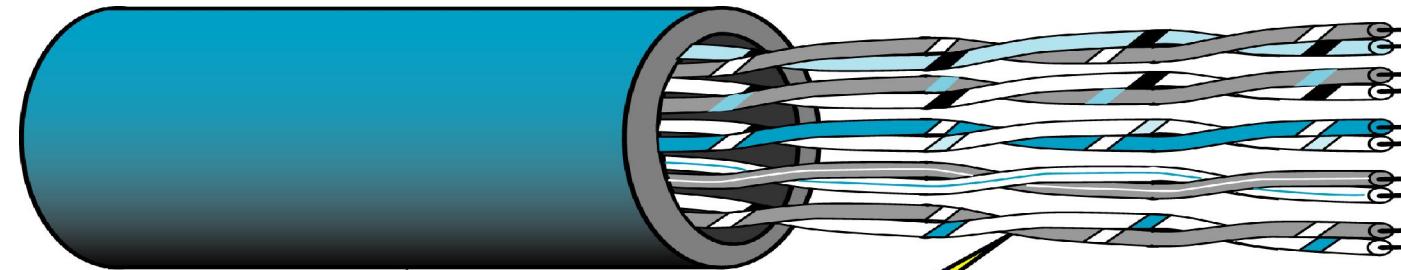
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- Efek noise kumulatif adalah sama dengan pada kedua sisi
- Twisting tidak selalu menghilangkan noise tetapi akan menekan noise menjadi tidak berarti



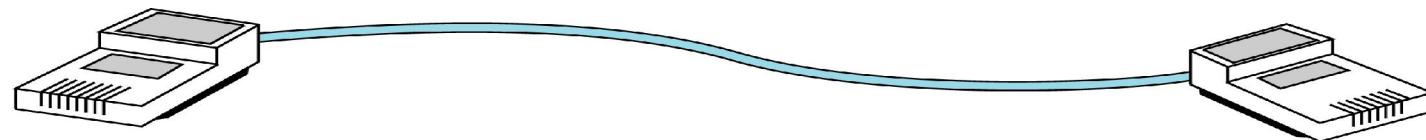
Kabel UTP & Konektor

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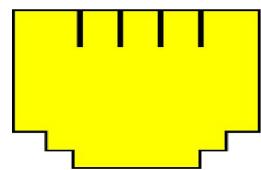


Plastic cover

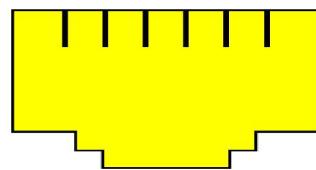
Twisted pairs
(5 pairs)



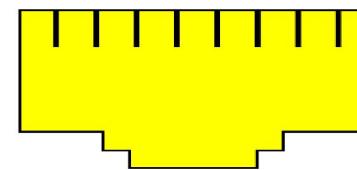
4-conductor



6-conductor



8-conductor



Kabel UTP (cat 5)

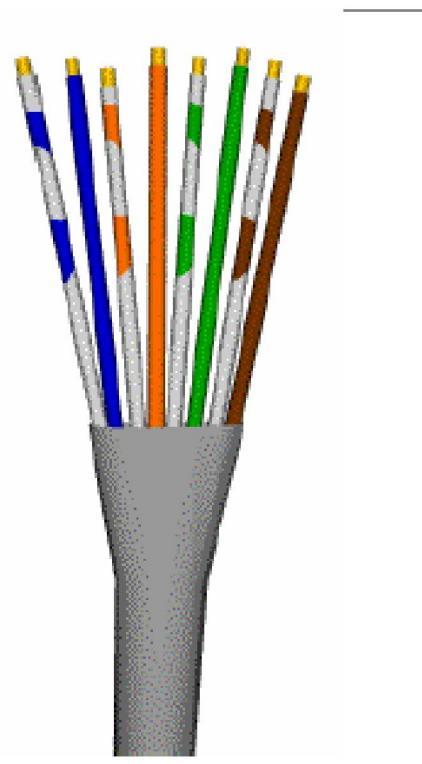
TIA/EIA 568A Wiring

1		white and Green
2		Green
3		white and Orange
4		Blue
5		white and Blue
6		Orange
7		white and Brown
8		Brown

TIA/EIA 568B Wiring

1		White and Orange
2		Orange
3		White and Green
4		Blue
5		White and Blue
6		Green
7		White and Brown
8		Brown

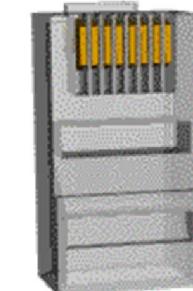
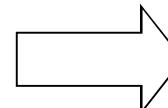
Wire pair #1:	White/Blue Blue
Wire pair #2:	White/Orange Orange
Wire pair #3:	White/Green Green
Wire pair #4:	White/Brown Brown



Konektor kabel dan Jack

- Konektor kabel dan jack umumnya digunakan dengan CAT 5 kabel UTP yang dinamakan **RJ45**.
- RJ maksudnya adalah *Registered Jack* dan 45 menunjukkan spesifikasi banyaknya pin
- Konektor akan mengikat kabel dan jack adalah peralatan didalam connector plugs, apakah dihubungkan didalam dinding, interface card untuk jaringan atau hub

RJ-45

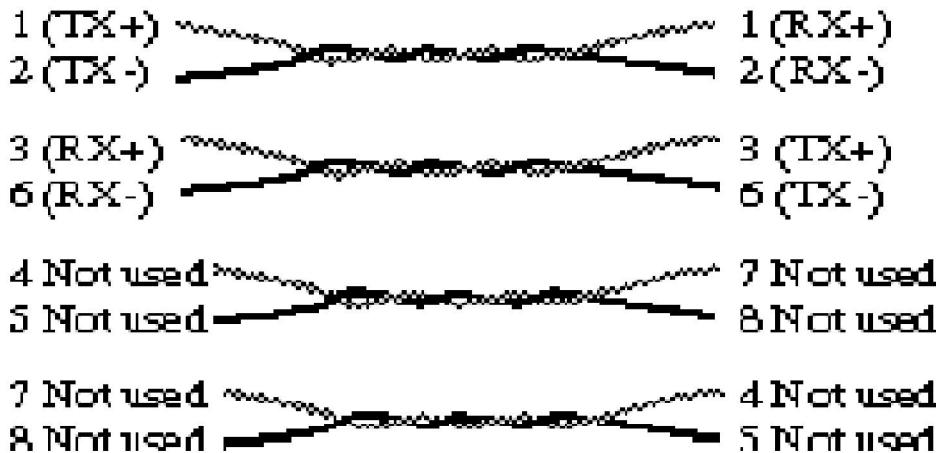


2 type Wiring Connection pada UTP :

Straight-through Cable → digunakan untuk koneksi client ke hub / switch

Crossover Cable → digunakan untuk koneksi langsung dari client ke client

NIC RJ-45 (MDI)

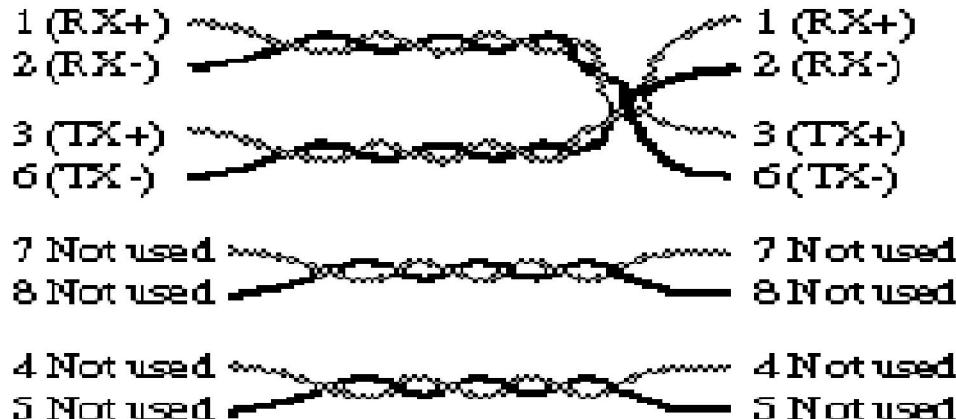


Switch/Hub RJ-45 (MDI-X)

A straight-through
(standard) cable connects
MDI ports to MDI-X ports.

straight-through cable, kabel satu pada satu sisi harus terhubung dengan satu kabel pada sisi yang lain, atau dengan kata lain pin 1 pada sisi satu harus terhubung dengan pin 1 pada sisi yang lain.

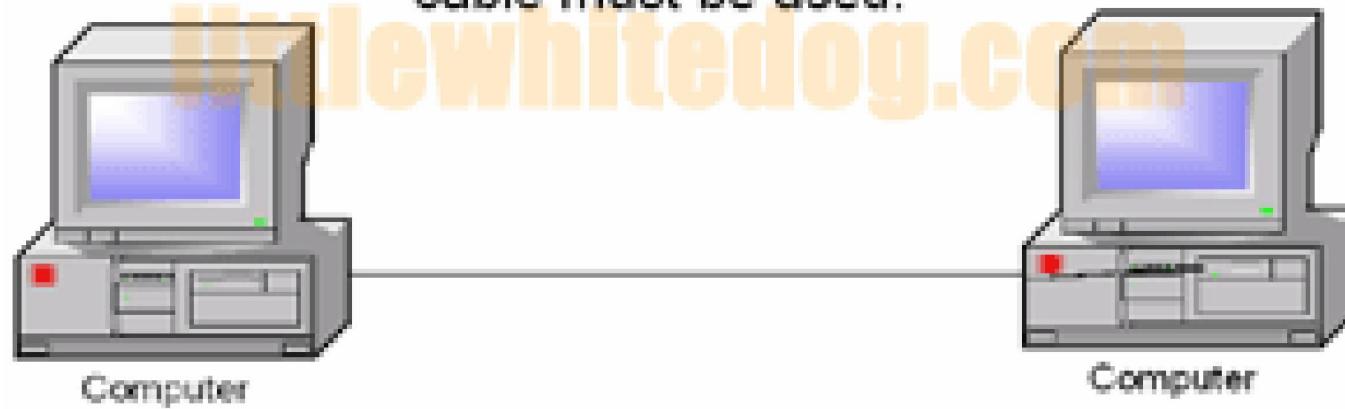
Switch/Hub RJ-45 (MDI-X)



Switch/Hub RJ-45 (MDI-X)

A crossover cable
connects MDI-X ports to
MDI-X ports (or MDI ports
to MDI ports).

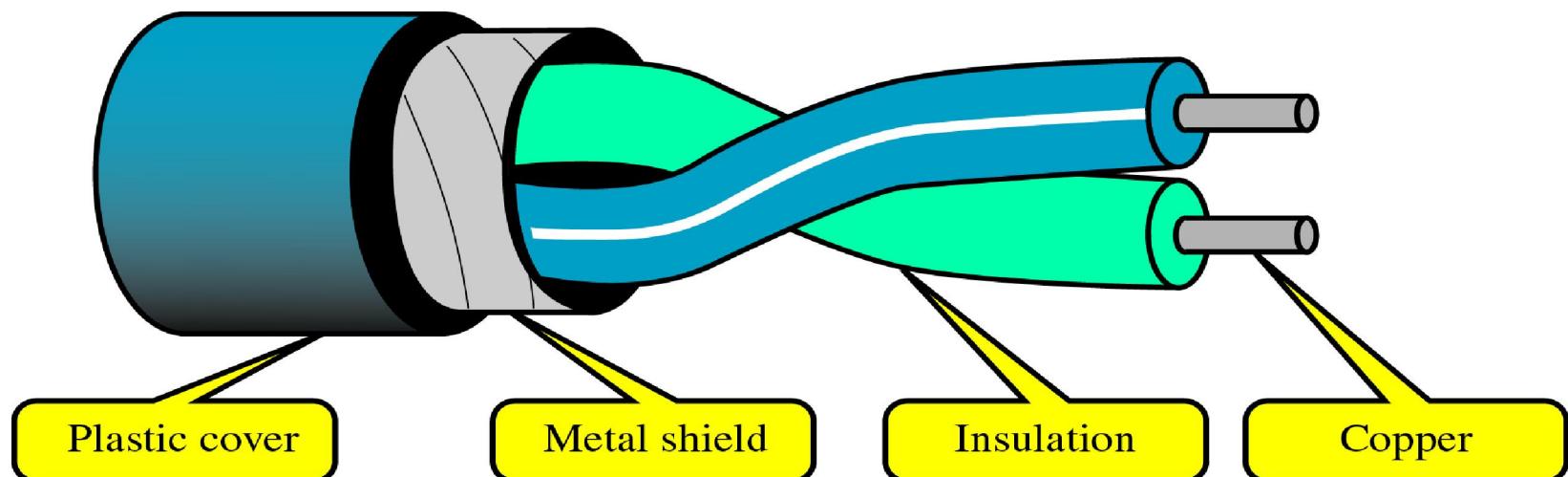
When connecting two computers together without the use of a hub or switch, a "Crossover Cable" cable must be used.



Kabel Shielded Twisted-Pair (STP)

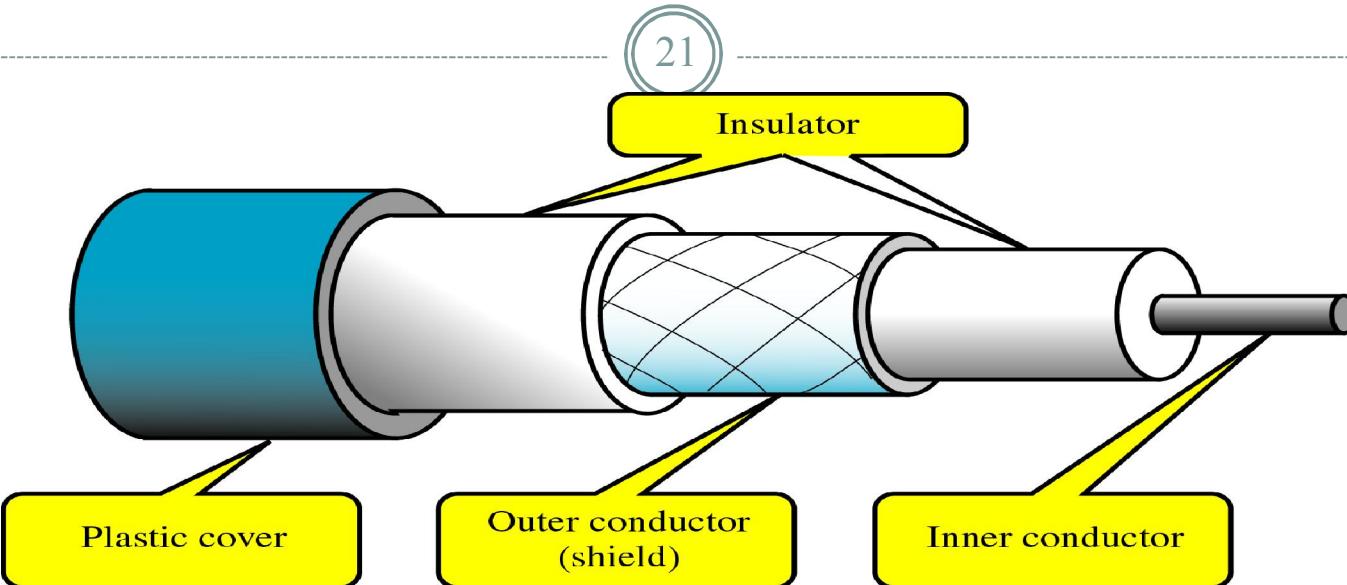
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- Kabel UTP + metal casing (foil or braided-mesh)
- Metal casing untuk mencegah noise electromagnetic
- Juga untuk eliminate **crosstalk**, yang mana terjadi bila sinyal pada satu line berada pada line lainnya.



Kabel Coaxial

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- Inner conductor + outer conductor (foil or braid)
- Outer conductor is both a shield and a conductor

Coaxial cable

100 KHz

500 MHz

Kabel Coaxial



- Pada segala medium
- Distribusi TV
 - Aerial to TV
 - Cable TV
- Transmisi telefon jarak jauh
 - Dapat membawa 10,000 panggilan bersamaan
 - Digantikan oleh fiber optik
- Sistem komputer jarak dekat
- Local area networks

Kabel Coaxial Standard dan Connectors

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- RG(Radio Government) standards
 - RG-8, RG-9, RG-11: Digunakan untuk thick Ethernet
 - RG-58: Digunakan untuk thin Ethernet
 - RG-59: Digunakan untuk TV
- Barrel connectors
 - BNC(bayonet network connector): Pushes on and locks into place with a half turn
 - Screw type: more effort to install
 - Push-on type: Without locking, less secure
- Other connectors: T-connectors, terminators

Tipe-tipe kabel Coaxial

Designation	Type	Impedance	Description
RG-58 /U	Thinwire	50 ohm	Solid copper
RG-58 A/U	Thinwire	50 ohm	Stranded
RG-58 C/U	Thinwire	50 ohm	military
RG-59	CATV	75 ohm	Broadband
RG-6	CATV	75 ohm	Broadband
RG-8	Thickwire	50 ohm	Solid core
RG-11	Thickwire	50 ohm	Standard
RG-62	Baseband	90 ohm	ARCNET

Coaxial Cable

Thicknet

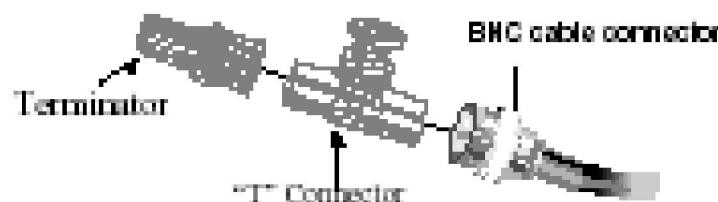


Thinnet

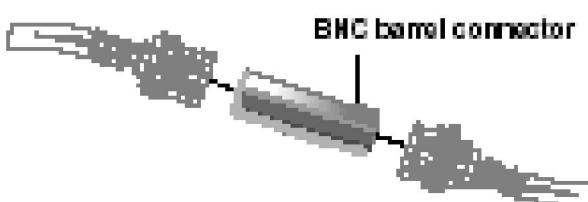


Thinnet Connectors

Terminator



"T" Connector

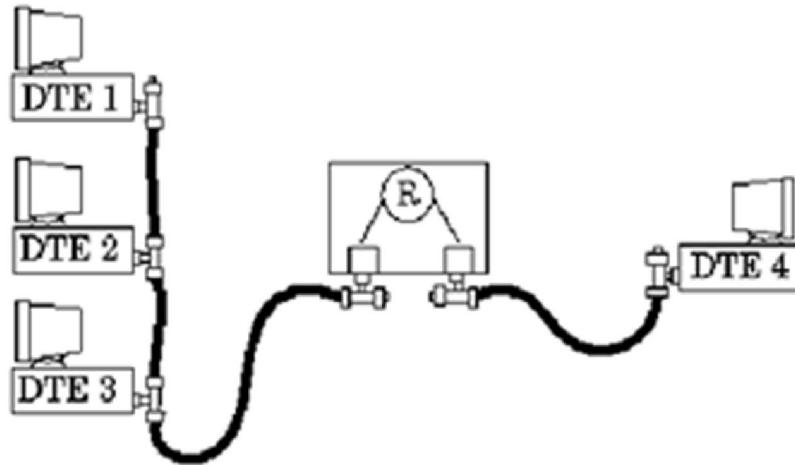


BNC barrel connector

BNC cable connector

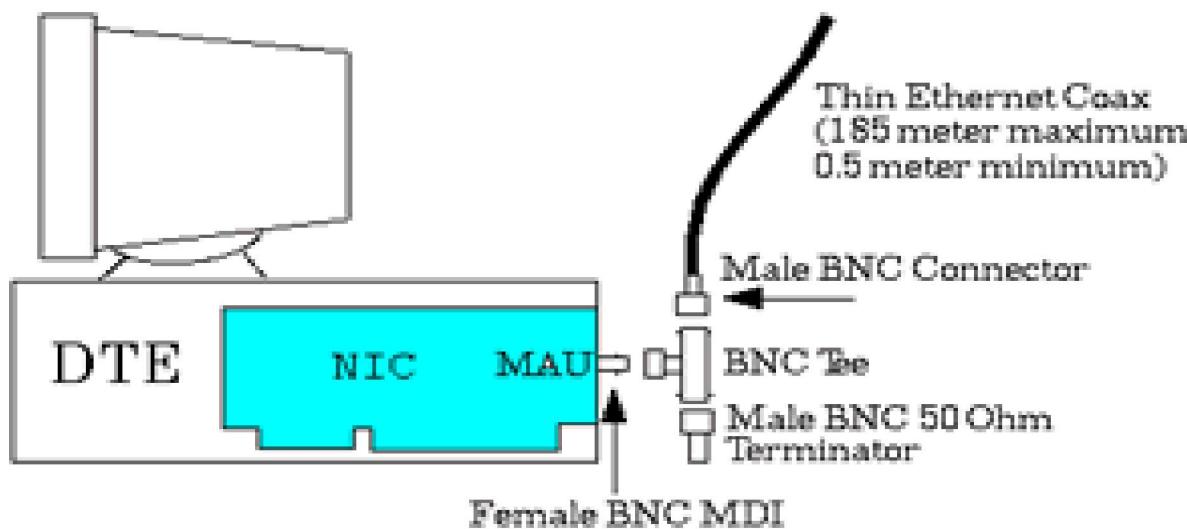
Thinnet (10Base2)

- Throughput – 10Mbps
- Cost – More than UTP
- Size & Scale – Maximum of 185 meters / segment
 - 30 nodes per segment
 - Min separation - .5 m
 - Max network length 550 meters



Thin coaxial with diameter
0,2 inch (5 mm)

Bus Topology using 10Base2



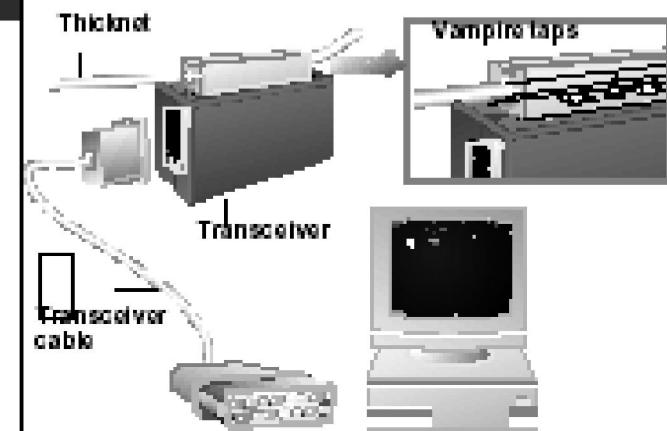
10Base2 Network Structure

NIC = Network Interface Card
MAU = Medium Attachment Unit
DTE = Data Terminal Equipment

Thicknet

- Throughput - 10Mbps
- Cost – Less than fiber more than others
- Connector – Vampire tap
- Noise – excellent shielding
- Size & Scale – Max segment – 500 Meters
 - 100 nodes per segment
 - Min distance 2.5 meters

Thicknet (10Base5)



10Base5

Throughput : 10 MBps

5 → thick coaxial cable dengan diameter 0,5 inch (10 mm)

Colour : kuning

Resistance : 50Ω

Bila menggunakan repeater jarak maximum 2,5 km

Fiber Optik (Optical Fiber)

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- Fiber optik terbuat dari kaca atau plastik
- Mengirimkan sinyal dalam bentuk cahaya

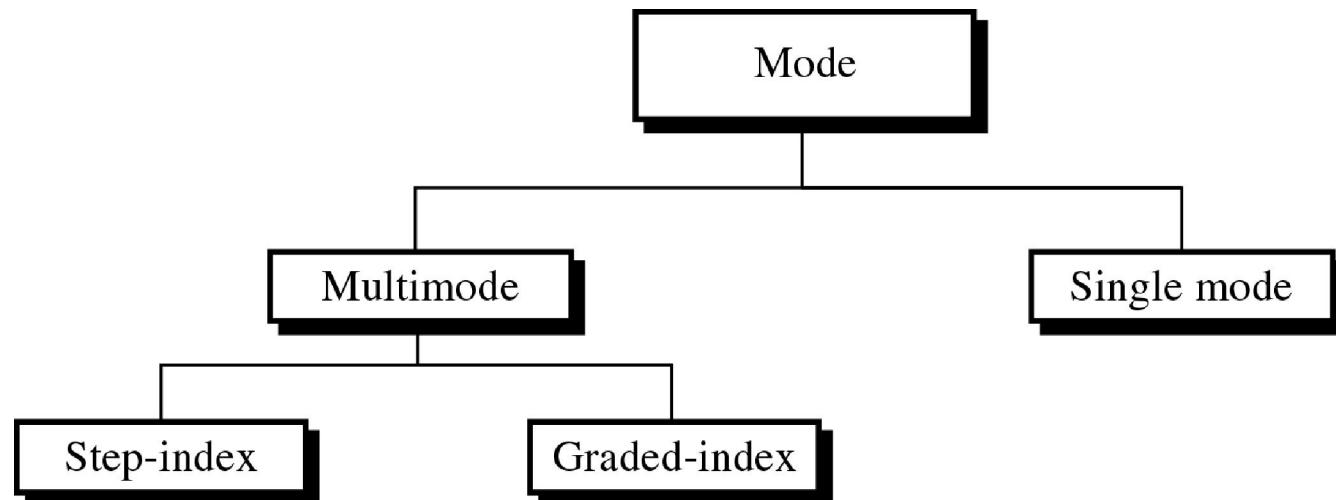
Sifat dasar cahaya

- Kecepatan cahaya
 - 300,000 Km/sec dalam ruang vacuum
 - Tergantung pada kerapatan medium yang dilalui untuk perambatan
- Sifat lain cahaya
 - Refraction, Critical angle, Reflection

Mode Propagation (Perambatan)

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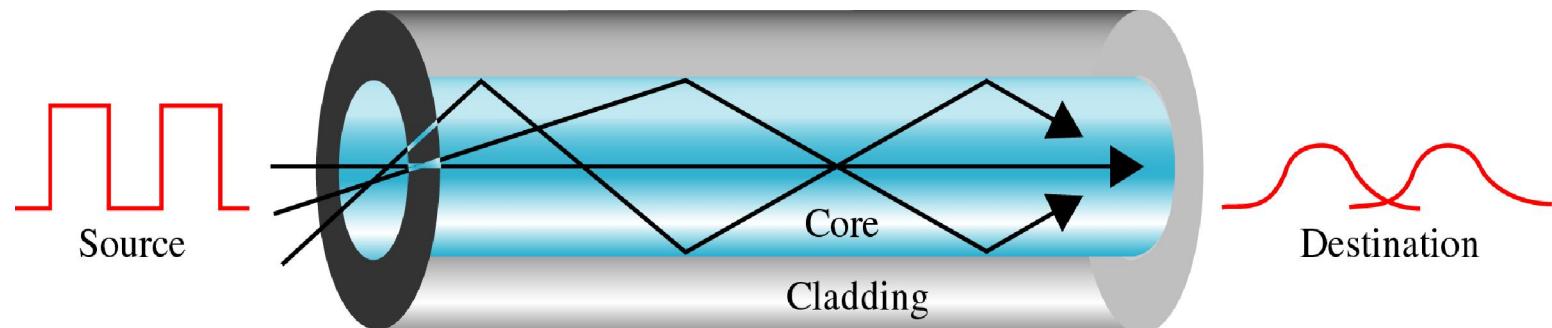
- Fiber optik menggunakan pantulan (reflection) untuk perambatan melewati kanal
- Dua mode untuk perambatan gelombang cahaya sepanjang kabel fiber optik



Fiber Multimode Step-Index

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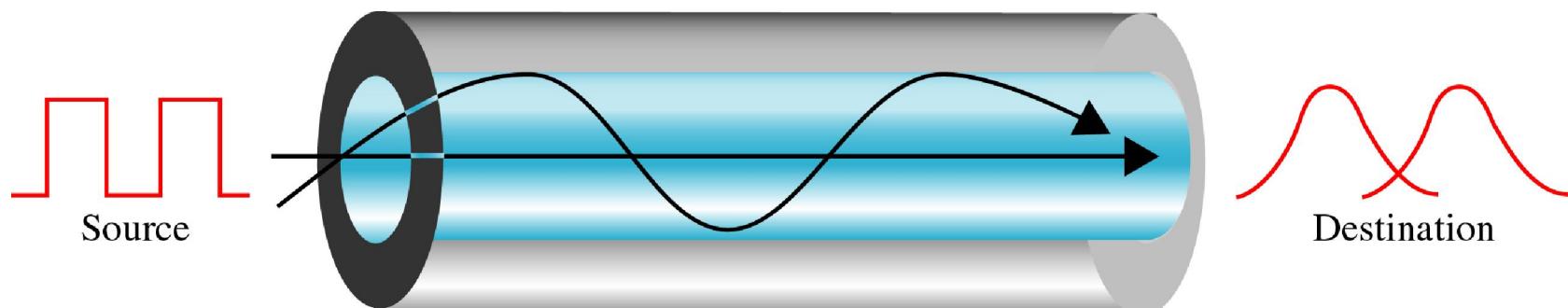
- Cahaya dirambatkan melalui core (high-density)
- Core dilingkupi oleh cladding (low density)
- Sorotan dengan sudut kedatangan yang kecil akan hilang
- Cahaya yang dikirimkan bila mempunyai perbedaan panjang saluran  signal terdistorsi



Fiber Multimode Graded-Index

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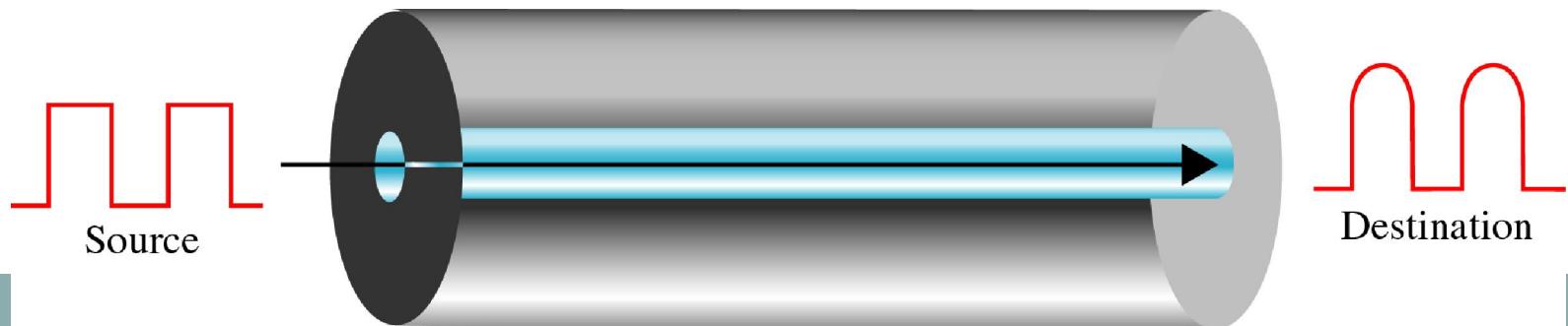
- Mengurangi terjadinya distorsi sinyal
- Core mempunyai bermacam-macam densities
- Density tertinggi terjadi pada pusat dan akan berkurang secara berangsur-angsur sampai pada bagian tepi
- Lebih presisi dari pada step-index multimode



Fiber Single Mode

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- Menggunakan fiber step-index dan sumber cahaya yang mempunyai fokus tinggi
- Diameter core sangat kecil dan low density (\Rightarrow sudut kritisnya sampai 90 derajat)
- Perambatan cahaya mendekati horizontal
 \Rightarrow Delays dan distortions dapat diabaikan



Ukuran Fiber

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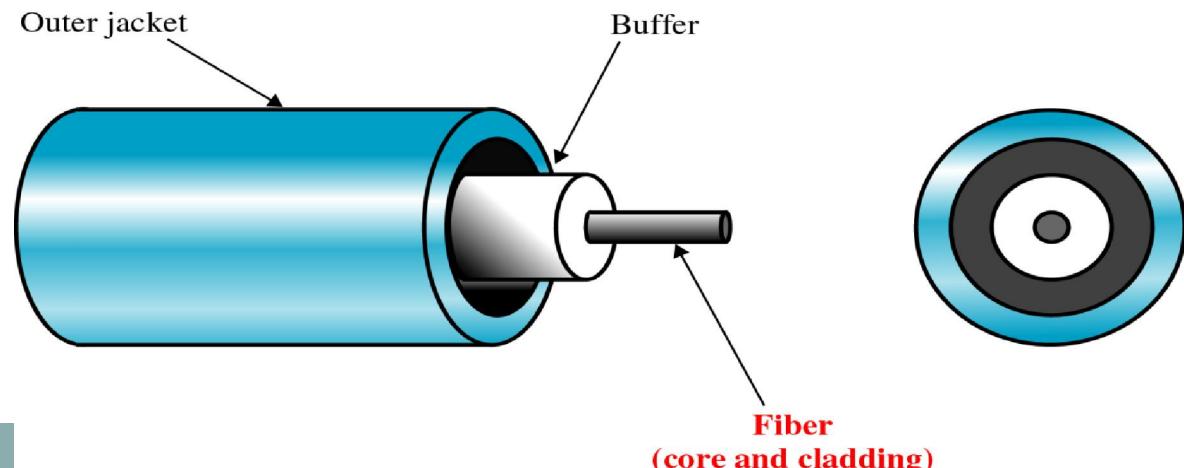
- Didefinisikan sebagai rasio diameter core terhadap diameter cladding, dalam satuan *microns*
- Tipe-tipe fiber

<i>Fiber type</i>	<i>Core</i>	<i>Cladding</i>
62.5/125	62.5	125
50/125	50	125
100/140	100	140
8.3/125	8.3	125 (single mode)

Komposisi Kabel

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- Fiber = core + cladding (keduanya kaca atau plastik)
- Core: Ultra-pure dan completely regular dalam ukuran dan bentuk untuk menghindari terjadinya distorsi dari sinyal
- Menjaga fiber dari udara lembab
- Dikelilingi jacket yang terbuat dari plastik, metal atau teflon



Sumber cahaya dan konektor

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- **Sumber cahaya**

- LED(Light Emitting Diode): murah, cahaya tidak fokus, uncontrollable, digunakan untuk jarak dekat
- ILD(Injection Laser Diode): fokus, digunakan untuk jarak jauh

- **Konektor Fiber optik harus tepat**

- Konektor yang tidak tepat mengakibatkan terjadinya pantulan
- Perbedaan ukuran menyebabkan sudut sinyal bergeser
- Terdapat gap antara core, menyebabkan sinyal terhambur

Keuntungan dan kerugian Optical Fiber

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- Keuntungan
 - Tahan terhadap noise
 - Atenuasi(redaman) sinyal rendah
 - Bandwidth jauh lebih besar
- Kerugian
 - Biaya
 - Instalasi / perawatan
 - Mudah rusak

Standard pemasangan

Structured wiring → ditempatkan permanen pada dinding, biasanya digunakan untuk hubungan telepon

Unstructured wiring → peralatan aktif (servers, hubs, etc) yang ditempatkan dalam perkantoran

Pada penggunaan jangka panjang, structured wiring akan lebih mudah dalam hal perawatan dan upgrade

EIA / TIA Structured cabling

- Joint 568 Commercial Building Wiring Standard
 - Entrance facilities
 - Separates LANs from WANs
 - Service carrier accepts responsibility for (external) wire
 - Backbone wiring
 - Interconnection between telecommunication closets
 - Risers – vertical connections between floors
 - Equipment room
 - Location where significant networking hardware is located

EIA / TIA Structured cabling

- Telecommunications closet (Telco room)
 - Connectivity for groups of workstations in its area
 - Cross connections to equipment
 - Punch down blocks, hubs, switches
 - Patch panel
- Horizontal wiring
 - Connects workstations to the telecommunications closet in their area

Backbone Wiring

The Recommended Backbone Media:

MEDIA	USE
62.5/125 multimode fiber-dual window 850 and 1300 nanometers	Multiple uses (Ethernet, FDD)
100-ohm unshielded twisted pair	Usually used for voice (multipair)
50-ohm shielded twisted pair (two-pair)	Usually used for 4/16 Mbps IEEE 802.5 Token Ring
50-ohm coax (thick) – IEEE 10BASE5	Usually used for IEEE 802.3

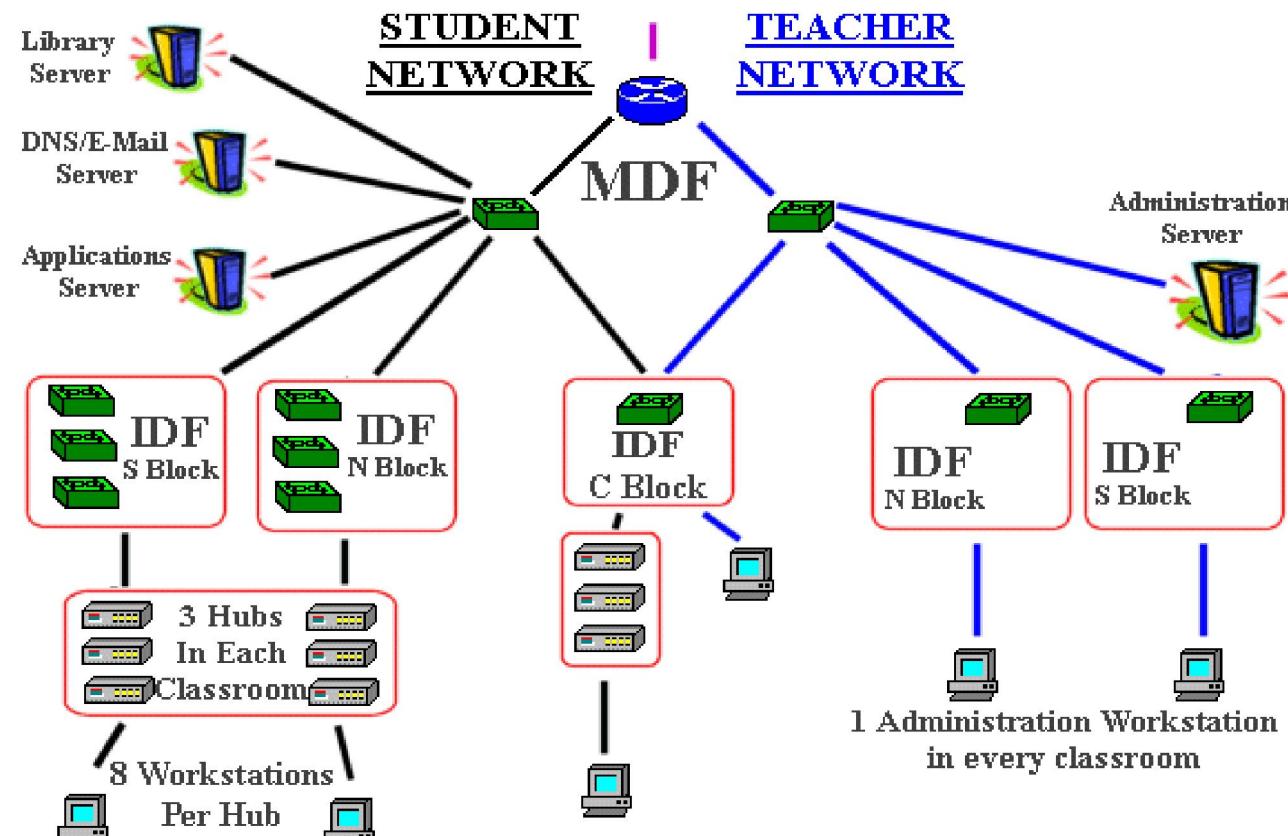
Un-guided Media

Point of view :

1. Air medium
2. Any direction (usually, sometimes one direction)
3. Radiowave propagation
4. Antenna is needed to catch the radiowave signal
5. Frequency allocation is : $10^9 - 10^{14}$ Hz

LAN

Local Area Network, a cabling system providing intercommunications between devices operating in the same general area.



LAN topology

WirelessLAN Historically :

Pre IEEE 802.11 – 1970 SS

IEEE 802.11 2 Mbps FHSS/DSSS - 1996

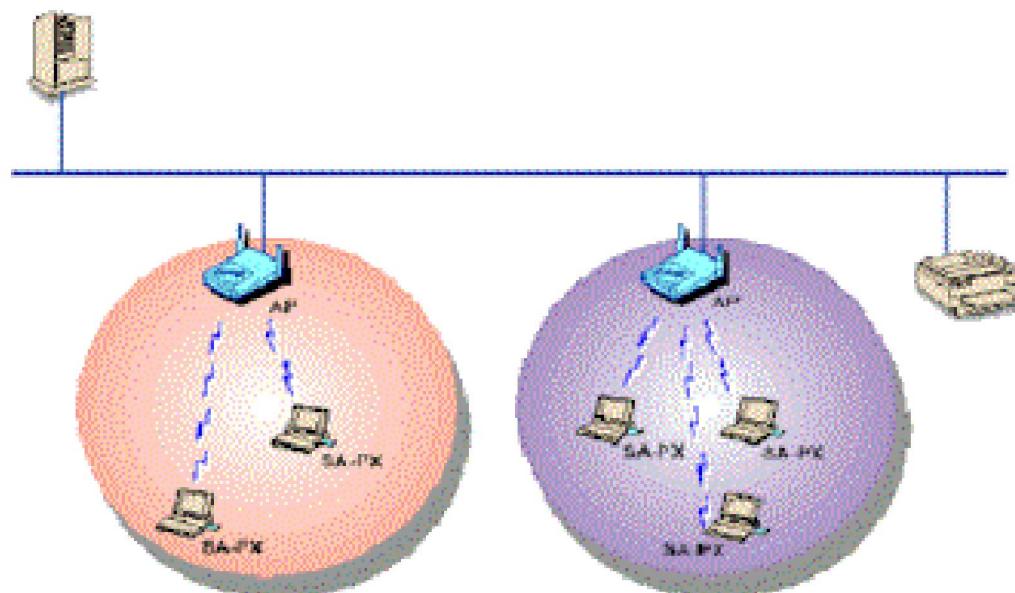
IEEE 802.11b 11 Mbps DSSS - 1999

IEEE 802.11a 54 Mbps OFDM - 1999

IEEE 802.11g 54/22 Mbps OFDM/PBCC - 2001

The Access Point

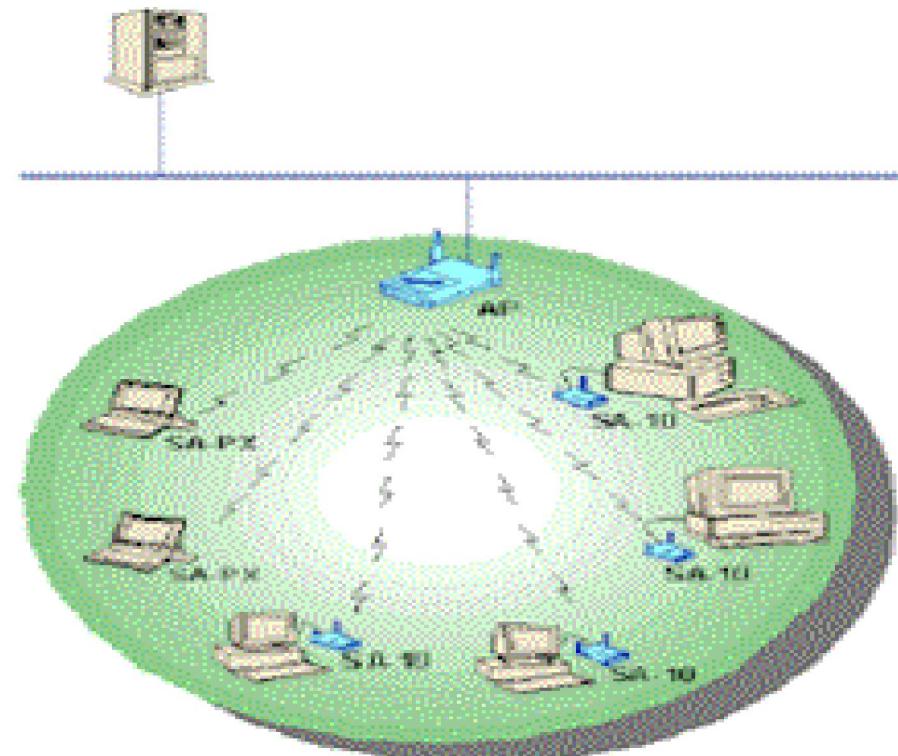
- The Access Point connects wireless LAN cells to a wired Ethernet LAN
 - The Access Point connects the cells of the wireless LAN with one another via a cable connection to an Ethernet LAN outlet



(example of a simple BreezeNET PRO.11 LAN topology)

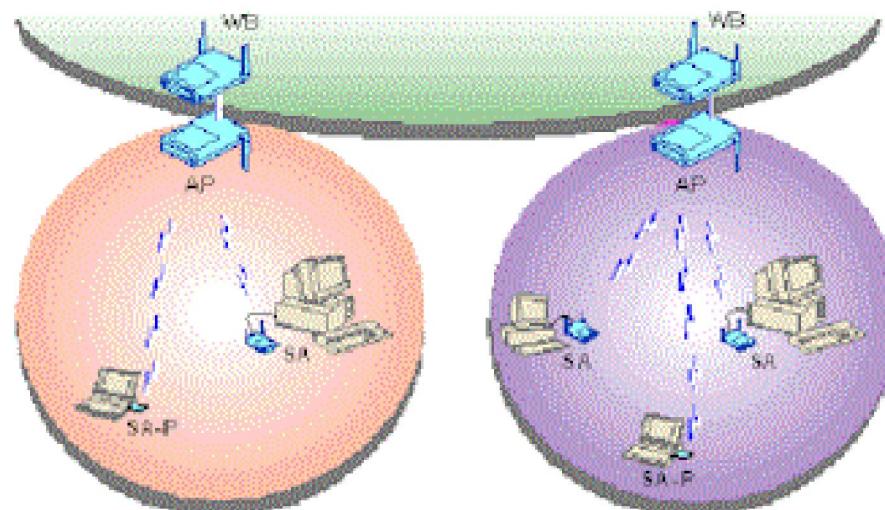
Stand Alone

A stand-alone cell is an ideal method of setting up a small to medium-sized LAN between a number of workstations or workgroups. This type of cell requires no cabling.



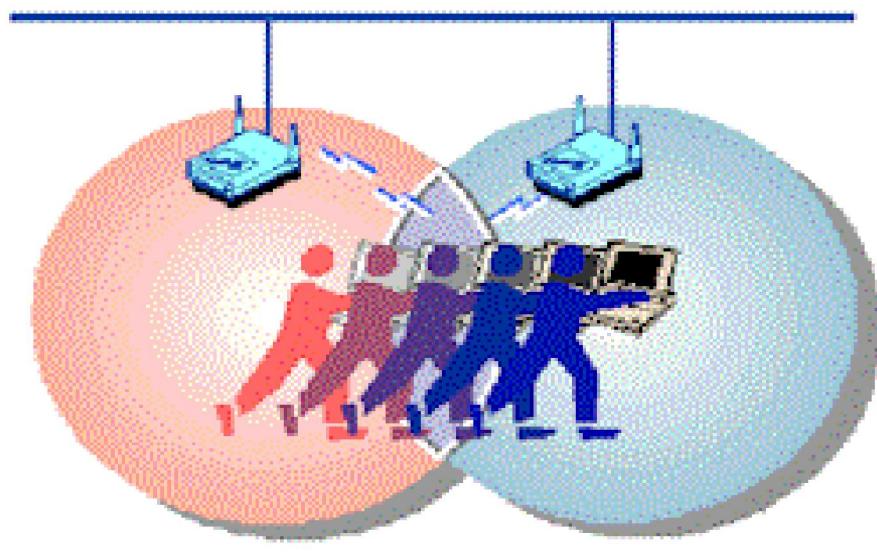
Linked Cells

- BreezeNET PRO.11 cells can be connected to remote BreezeNET PRO.11 LANs by using a wireless bridge.
- The bridge can be mounted back-to-back with an access point enabling connectivity between a cloud of networks and linking buildings that are miles apart.



Overlapping

- When any area in the building is within reception range of more than one access point, the cells' coverage is said to *overlap*.
- Each wireless station automatically establishes the best possible connection with one of the access points.
- Overlapping coverage area is an important attribute of the wireless LAN setup, because it enables seamless roaming between the overlapping cells.



Supported Equipment for Wireless LAN

1. Wireless Access Point
802.11b, 2.4 GHz, 11 MBps



2. PCMCIA Card

3. USB Wireless LAN Card



4. PCI Card 2.4 GHz, 11 MBps

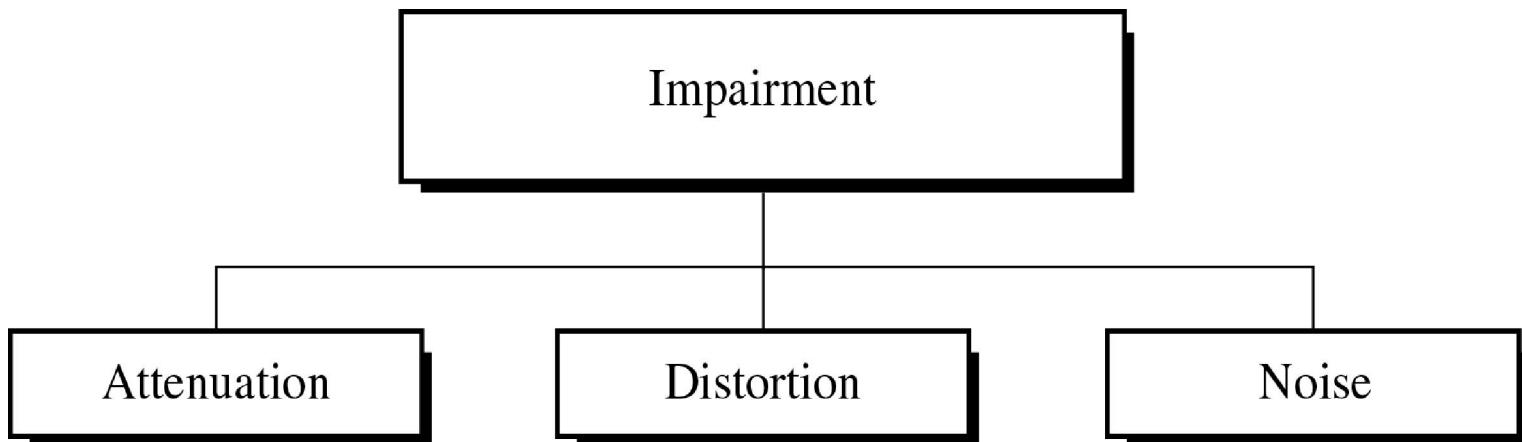


5. USB Network Adapter

Transmission Impairment

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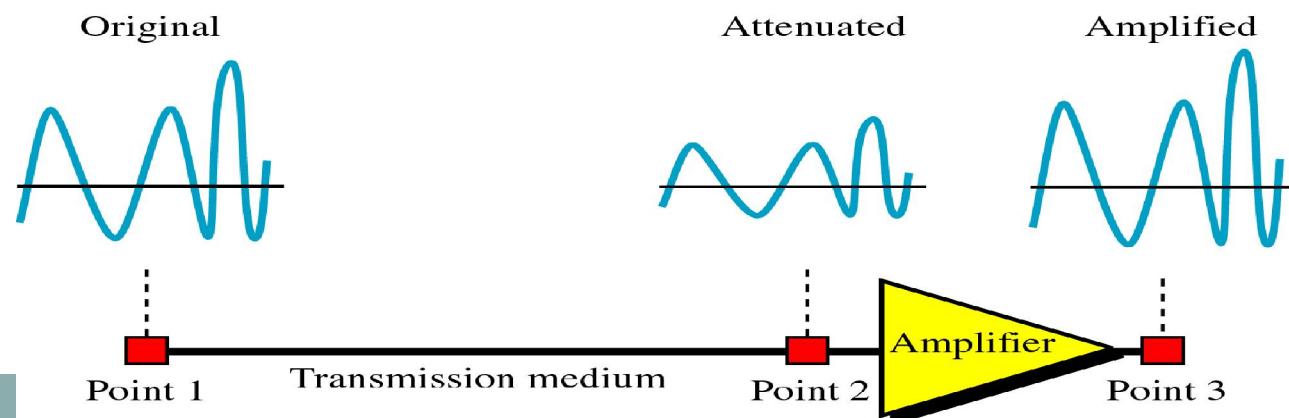
- Transmission media are not perfect
- What is sent is not what is received



Attenuation

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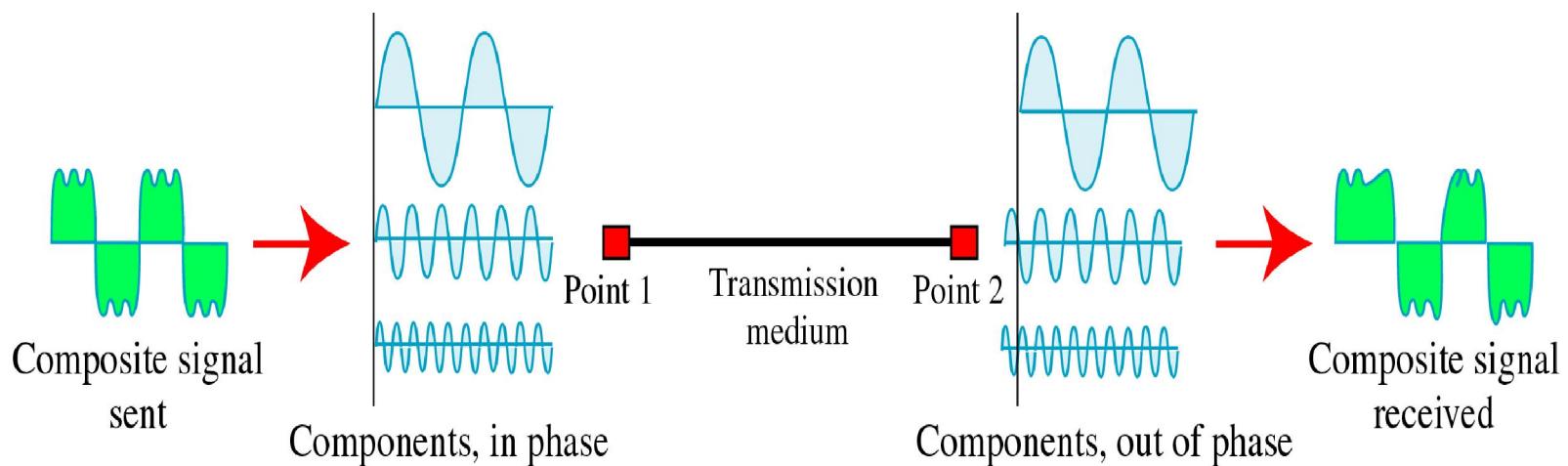
- Attenuation means *loss of energy*
- Some of electrical energy is converted to heat
- Decibel (dB)
 - Relative strengths of two signals or a signal at two points
 - $\text{dB} = 10 \log_{10} (P_2/P_1)$, P_2 and P_1 are signal powers
 - Negative dB means attenuation, positive dB means amplification



Distortion

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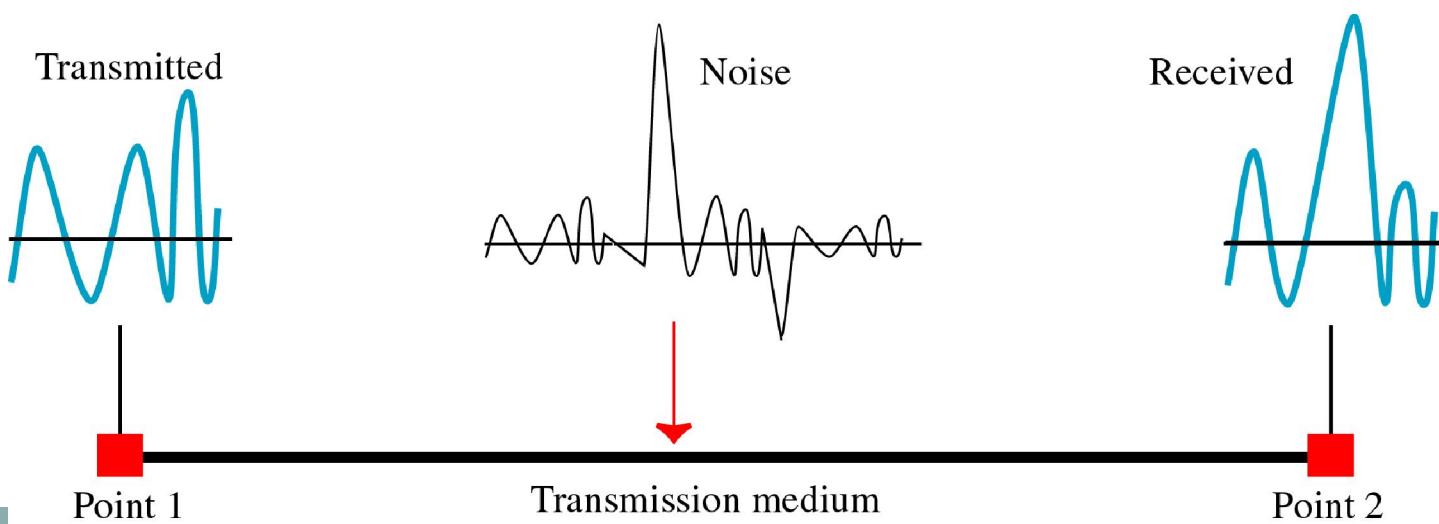
- Distortion means that the signal changes its form or shape
- Distortion occurs in a composite signal
 - Each component has its own propagation speed and its own delay



Noise

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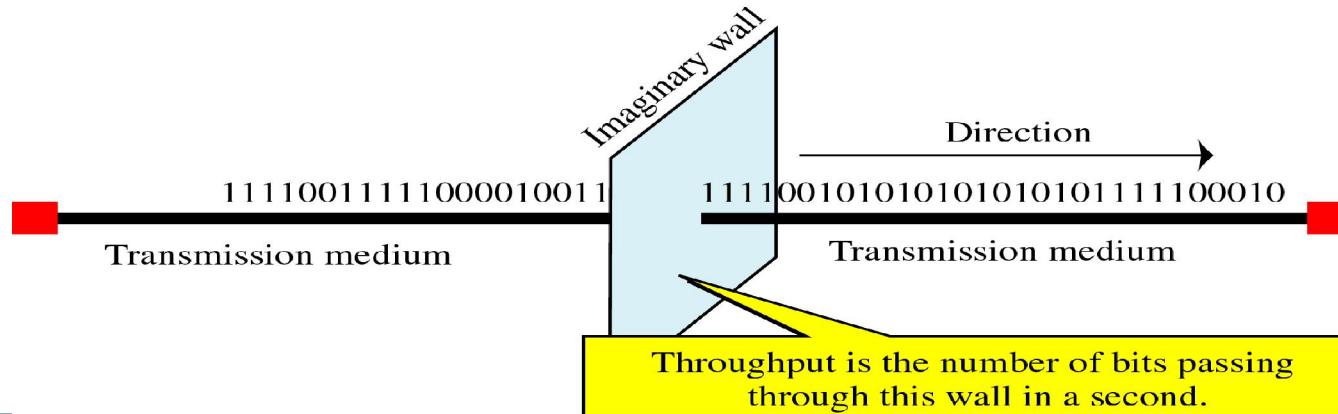
- Thermal noise: Random motion of electrons
- Induced noise: From sources such as motors
- Crosstalk: Effect of one wire on the other
- Impulse noise: Spike from power lines or lightning



Performance (1)

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- Performance of media can be measured in *throughput, propagation speed, propagation time*
- Throughput: How fast data can pass through a point in the medium
- Propagation speed: The distance a signal (or a bit) can travel through a medium in one second

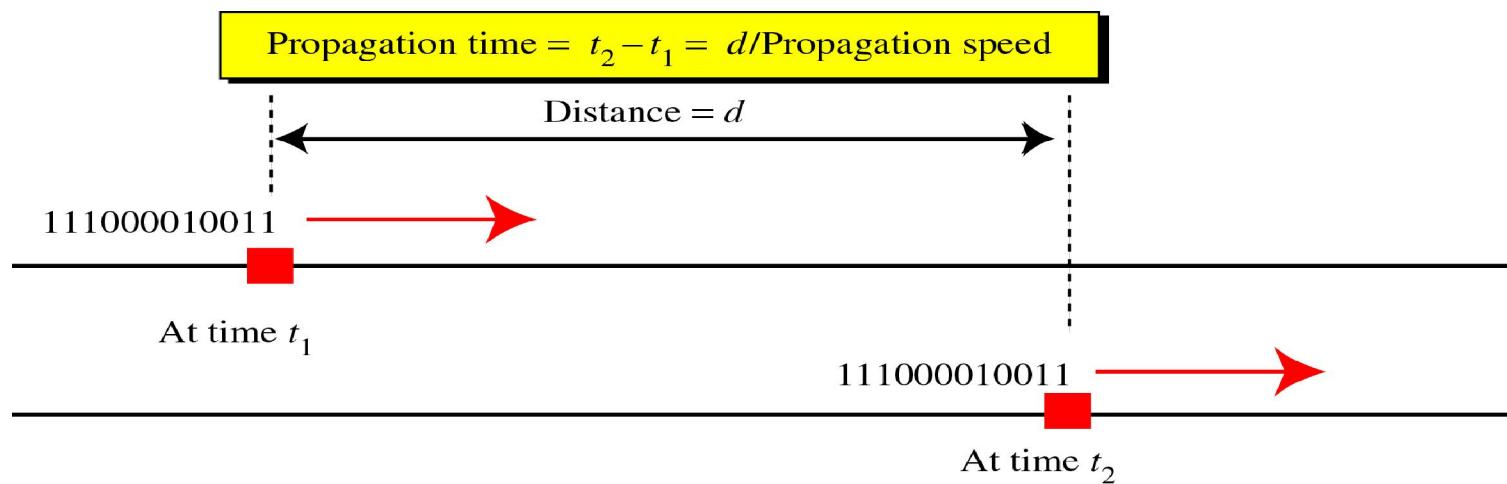


Performance (2)

56

- Propagation time

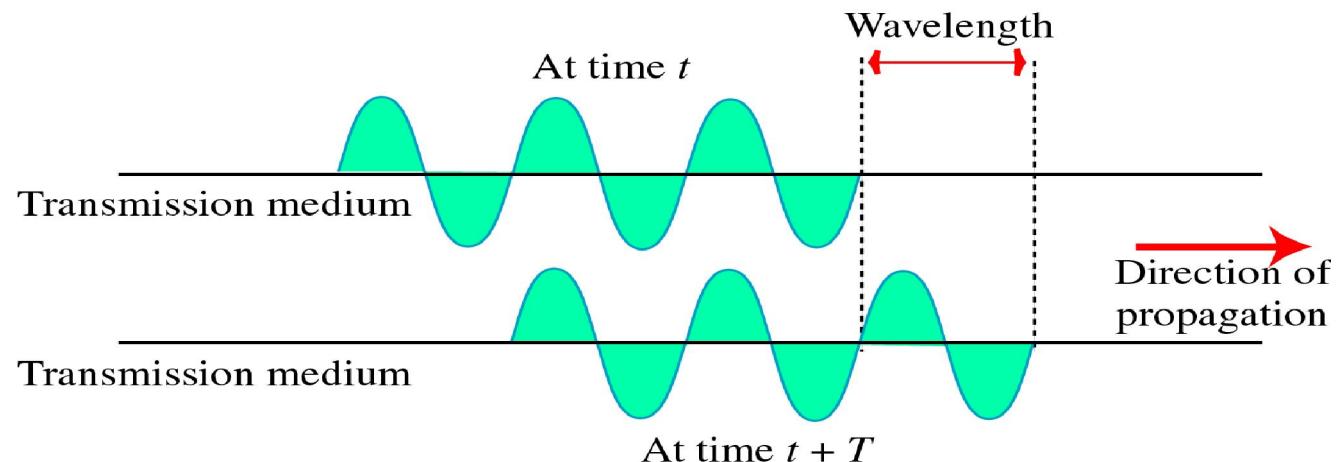
- The time a signal (or a bit) to travel from one point of a medium to another
- Propagation time = distance / propagation speed
- 3.33 $\mu\text{s}/\text{km}$ for twisted pair
- 5 $\mu\text{s}/\text{km}$ for coaxial or fiber optic cable



Wavelength

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- Distance a simple signal can travel in one period
- The wavelength depends on both the frequency and the medium
 - Wavelength = Propagation speed * period
 - Wavelength = Propagation speed / frequency
 - Example: For light, 0.75 μm in air and 0.5 μm in cable



Media Comparison

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- When evaluating the suitability of a medium to an application five factors should be kept in mind
 - Cost
 - Cost of materials plus installation
 - Speed
 - Maximum number of bps that a medium transmit reliably
 - Attenuation
 - Electromagnetic interference (EMI) – static, snow
 - Security
 - Protection against eavesdropping

Glossary of Terms

1. 100BASE-T4/100BASE-TX/100BASE-FX

100BASE-x – this refers to the type of actual wire used to carry 100 megabit/second traffic.

The -T refers to cable (-T4 uses all 8 wires [4 pairs] of a typical CAT5 cable, whereas -TX uses only 4 wires) and –FX refers to fiber-optic cable.

The term BASE means that the wires are used to carry Ethernet and nothing else.

2. 10BASE-2/10BASE-5/10BASE-F/10BASE-36/10BASE-T

10BASE-x – this refers to the type of actual wire used to carry 10 megabit/second Ethernet traffic.

The –2, -5 and –36 refer to coaxial cable, -T refers to cable and –F refers to fiber-optic cable.

The term BASE means that the wires are used to carry Ethernet and nothing else.

3. CAT1/CAT3/CAT5/CAT6

Category 1/3/5/6 – a specification for the type of copper wire (most telephone and network wire is copper) and jacks.

The number (1, 3, 5, etc) refers to the revision of the specification, and in practical terms refers to the number of twists inside the wire (or the quality of connection in a jack).

CAT1 is typically telephone wire.

This type of wire is not capable of supporting computer network traffic and is not twisted.

CAT3, CAT5 and CAT6 are network wire specifications.

This type of wire can support computer network and telephone traffic.

For higher network speeds (100Mbps plus) you must use CAT5 wire, but for 10Mbps CAT3 will suffice. CAT3 and CAT5 cable is actually 4 pairs of twisted copper wires, and CAT5 has more twists per inch than CAT3.

CAT6 wire was originally designed to support gigabit Ethernet (although there are forthcoming standards that will allow gigabit transmission over CAT5 wire).

4. Ethernet

A local area network protocol using a carrier sense multiple access with collision detection (CSMA/CD) scheme to arbitrate the use of a 10 Mbps baseband coaxial cable (often referred to as IEEE 802.3).

5. IEEE 802.3

The Institute of Electrical and Electronic Engineers is an information exchange, publishing, and standard-making body responsible for many standards used in Local Area Networks, notably the 802 series.

6. LAN

Local Area Network, a cabling system providing intercommunications between devices operating in the same general area.

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