Jaringan Komunikasi Data

E-Learning

Presents:

Infrastructure and QoS Performance

Minggu 3

Outline

- Perangkat Jaringan
- Connector & Cabling
- Quality of Service

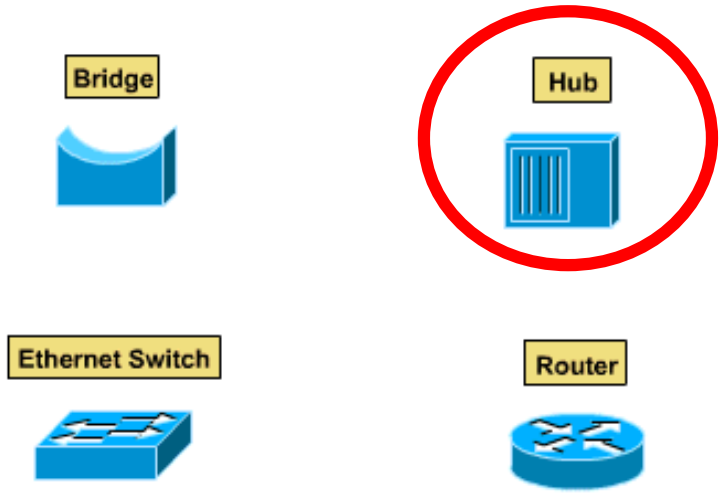
Perangkat Jaringan

Perangkat LAN

- Repeater
- Hub
- Switch
- Bridge
- Router

Devices

Hub



Hub melakukan fungsi:

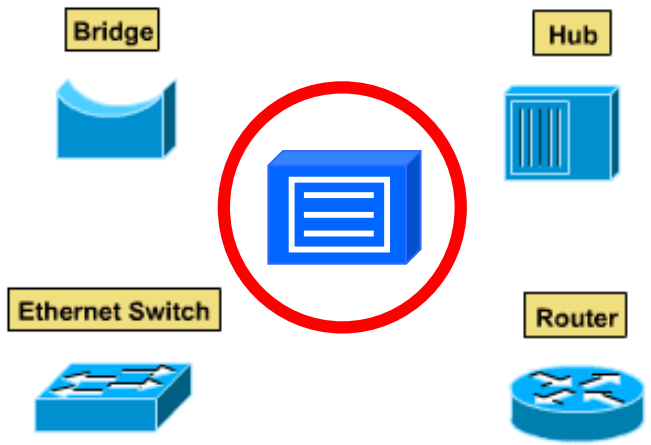
Sebagai konsentrator

Pada aktif hub dapat menjadi multiport repeater

Bekerja pada layer 1 model OSI (melihat sinyal pada level bit)

Devices

Repeater



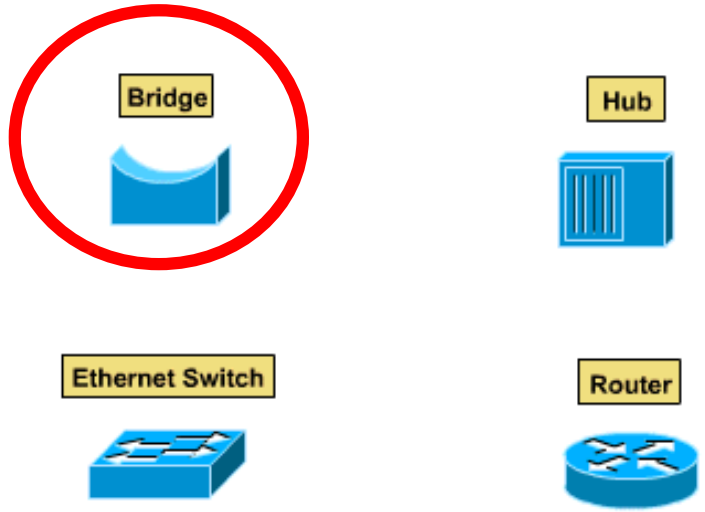
Fungsi utama *repeater* adalah

menerima sinyal dari satu segmen kabel LAN dan memancarkannya kembali dengan kekuatan yang sama dengan sinyal asli pada segmen (satu atau lebih) kabel LAN yang lain.

Repeater beroperasi pada *Physical layer* dalam model jaringan OSI.

Devices

Bridge

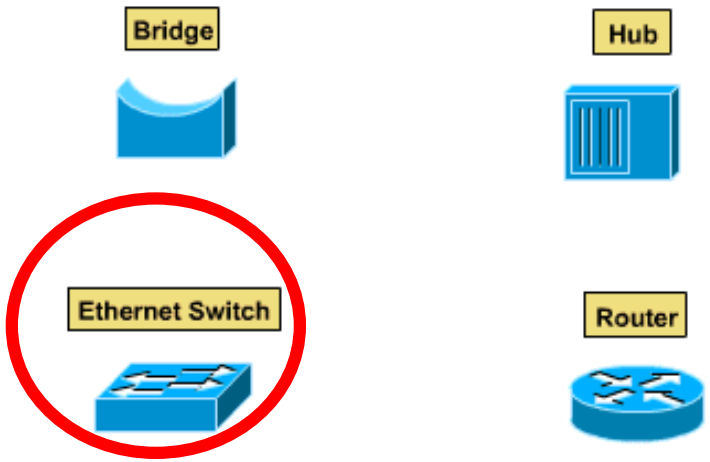


Kemampuan Bridge antara lain:

- Semua kemampuan repeater terdapat pada Bridge.
- Menghubungkan dua segmen dan regenerate signal pada level paket
- Berfungsi pada Data Link Layer (melihat sinyal melalui MAC Addressnya)
- Menghubungkan media fisik berbeda seperti twisted pair dengan coaxial ethernet.
- Menghubungkan antar segmen jaringan berbeda seperti ethernet dan token ring.

Devices

Switch



Fungsi Switch:

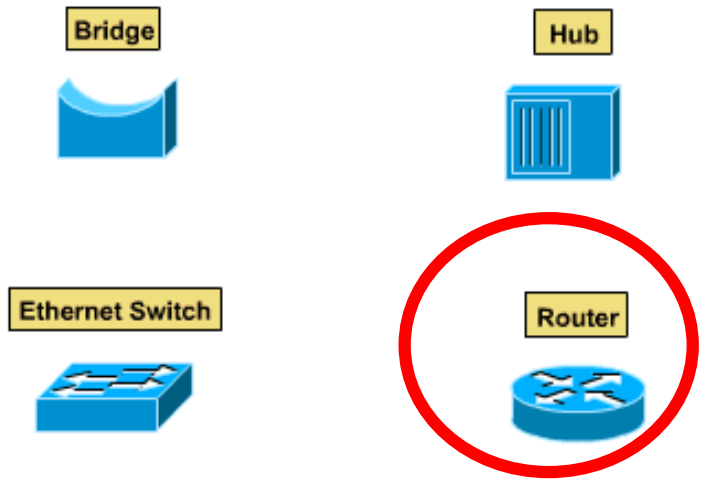
Sebagai konsentrator

Sebagai multiport bridge

Bekerja pada layer 2 OSI (melihat sinyal melalui MAC Address)

Devices

Router



Kemampuan router antara lain:

Membagi segmen jaringan yang besar menjadi segmen yang kecil-kecil.

Memfilter dan mengisolasi trafik.

Menghubungkan segman jaringan yang berbeda topologi dan metode akses.

Dapat melalukan routing paket dengan shorthest path, dari banyak pilihan jalur.

NIC, Repeater, & Hub

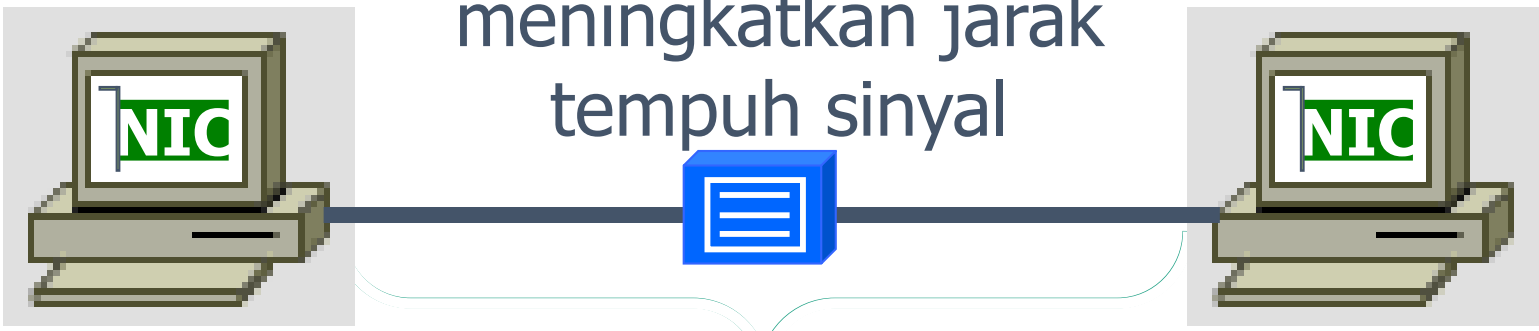
Untuk menghubungkan dua komputer, harus

Install sebuah NIC pada setiap komputer.

- Hubungkan komputer dengan kabel crossover (Tx pengirim → Rx penerima)

NICs, Repeaters, & Hubs

Repeaters dapat digunakan untuk meningkatkan jarak tempuh sinyal

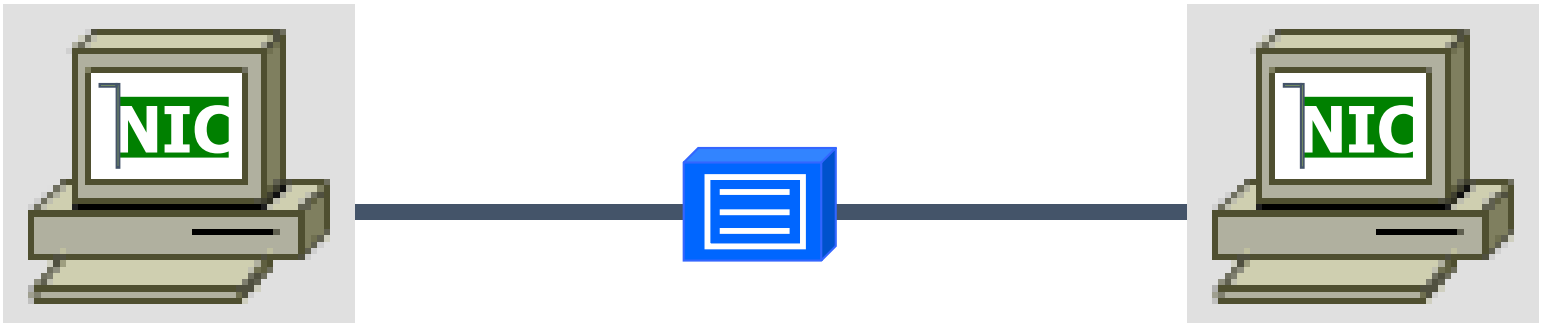


Jadi apa yang digunakan untuk meregenerasi sinyal kembali

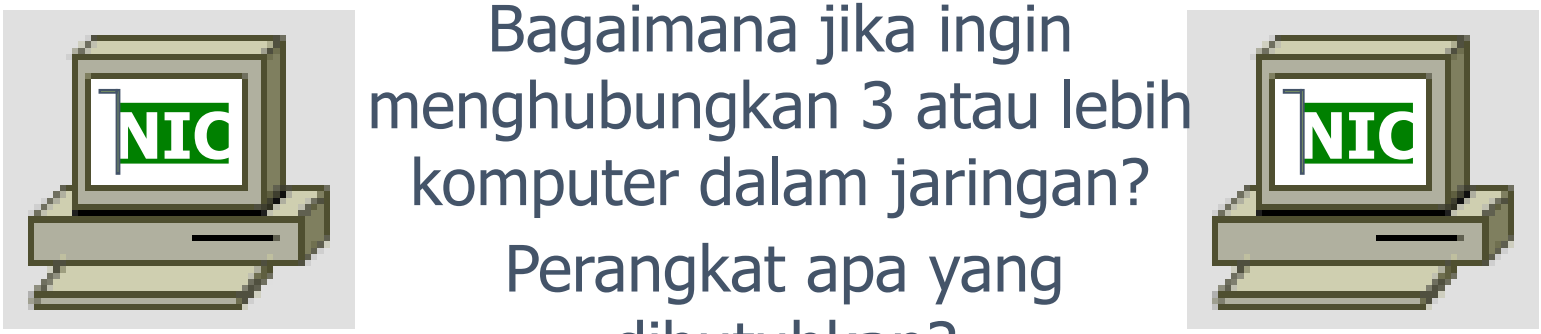
Berapa jarak maksimum ?

100 meter atau kira-kira 300 feet

NICs, Repeaters, & Hubs



Penggunaan repeater hanya terbatas untuk 2 komputer



Bagaimana jika ingin menghubungkan 3 atau lebih komputer dalam jaringan?

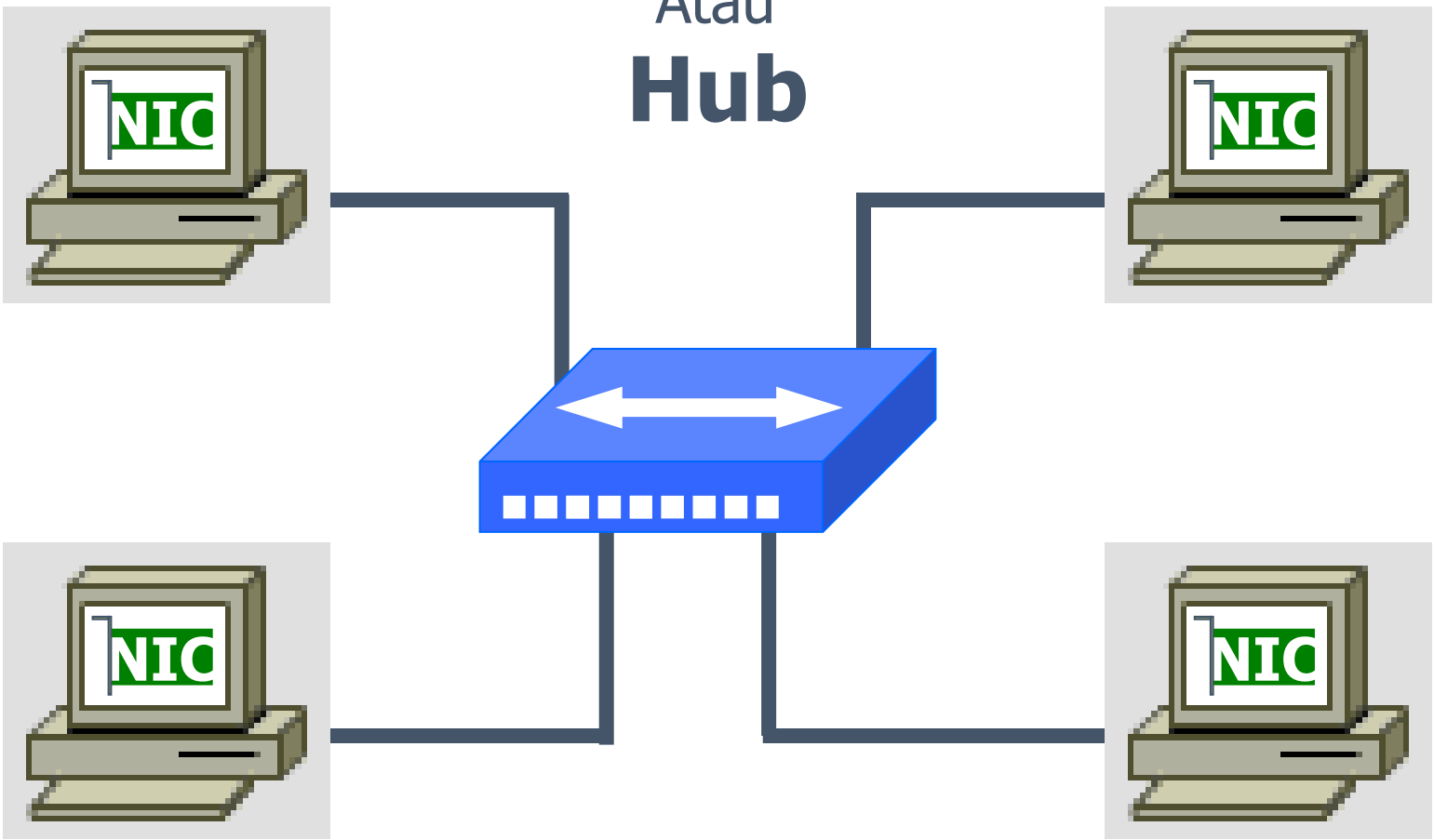
Perangkat apa yang dibutuhkan?

NICs, Repeaters, & Hubs

A multi-port repeater!

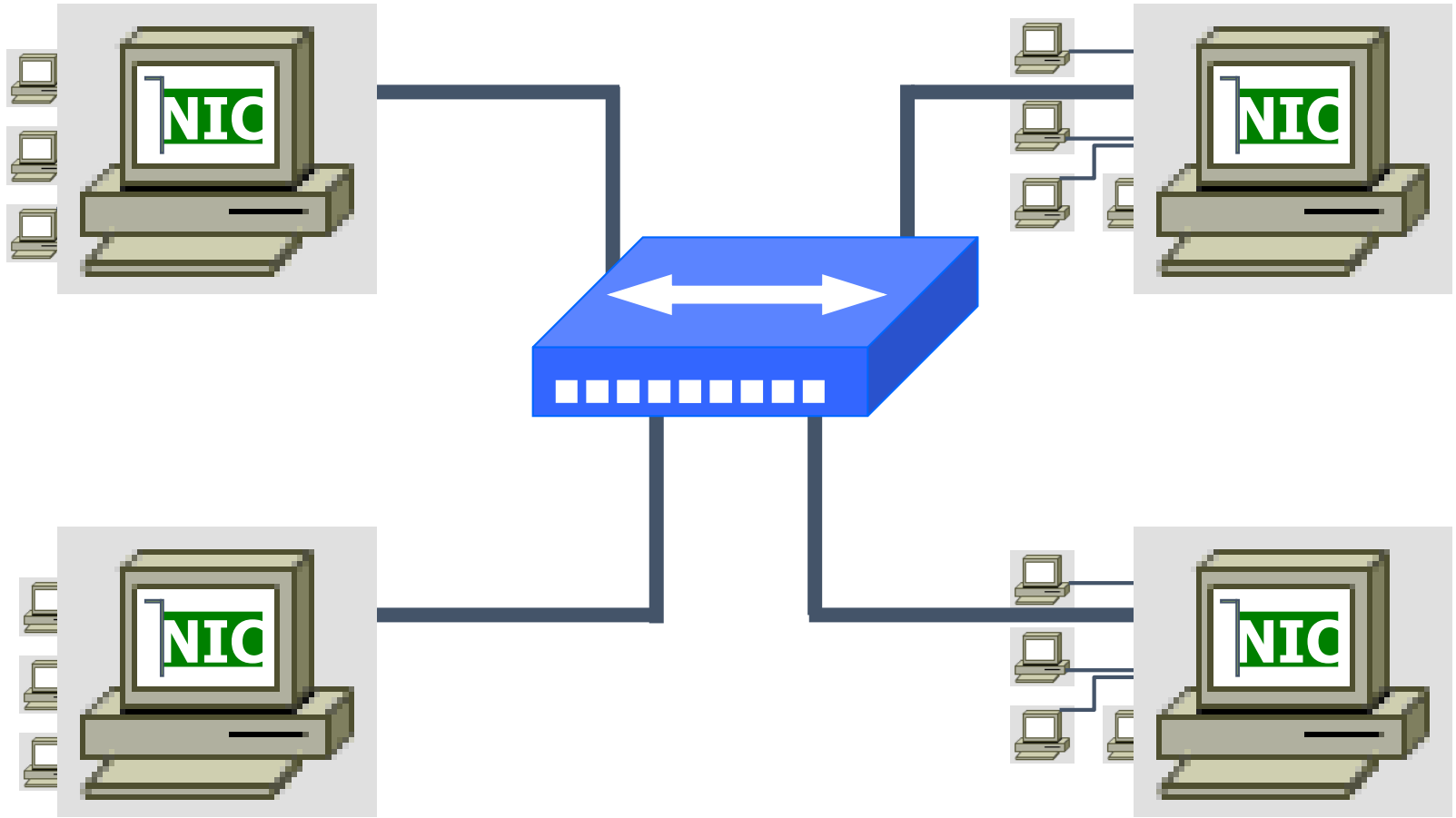
Atau

Hub



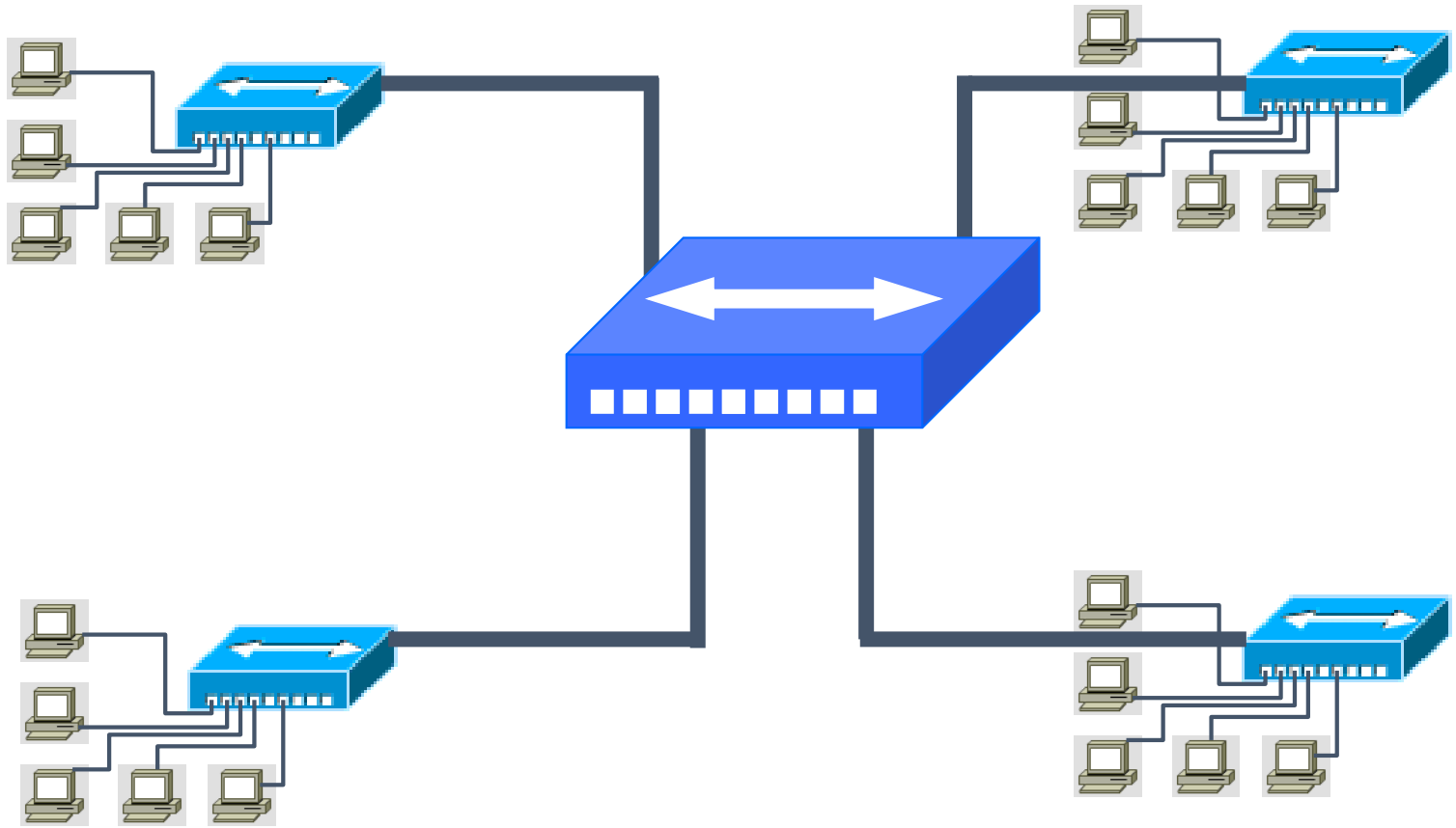
A Dilemma!

Saat jaringan diperluas, akan terbentuk cascade hubs.



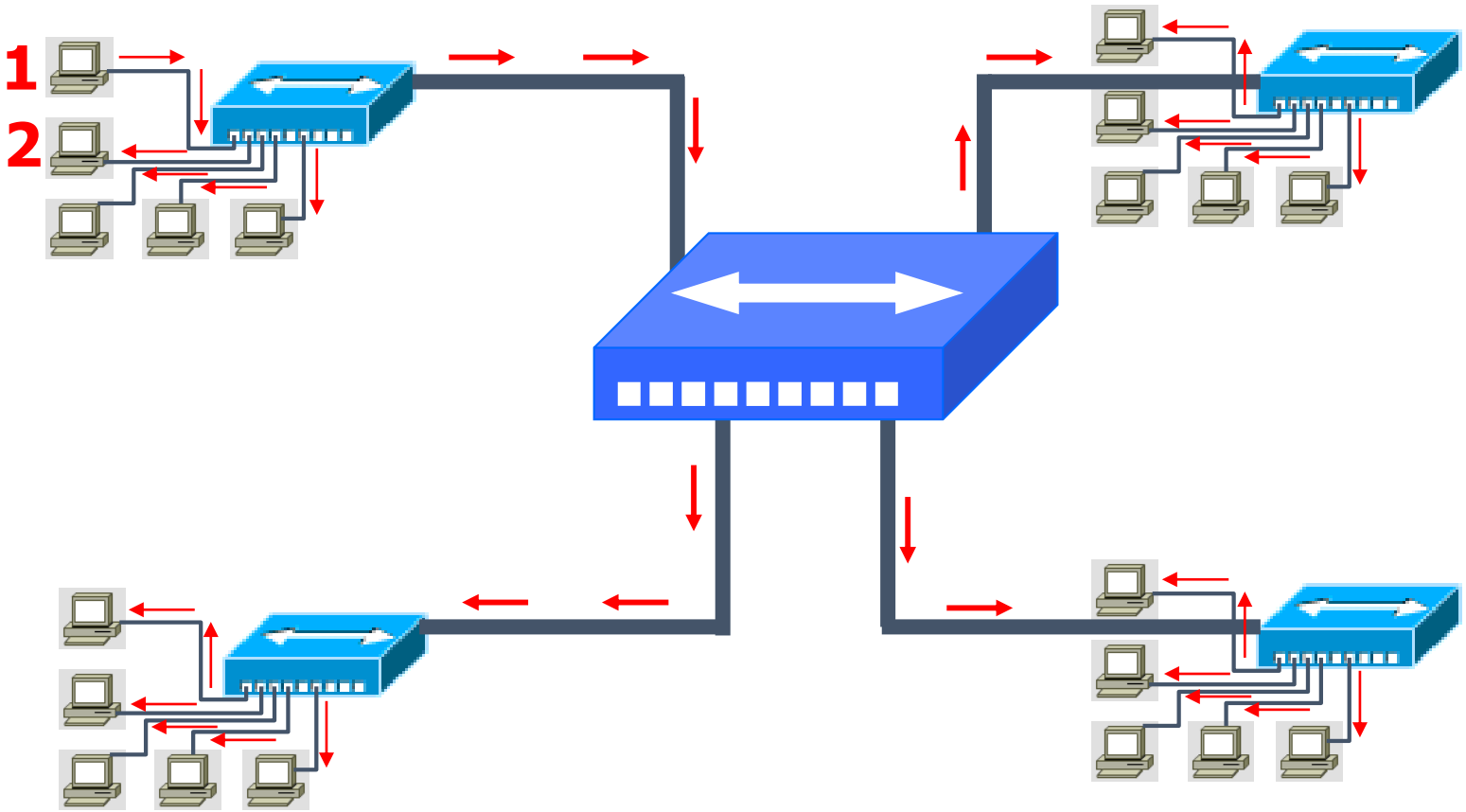
Broadcasts

Semua hub memforward semua traffic ke semua perangkat



Broadcasts

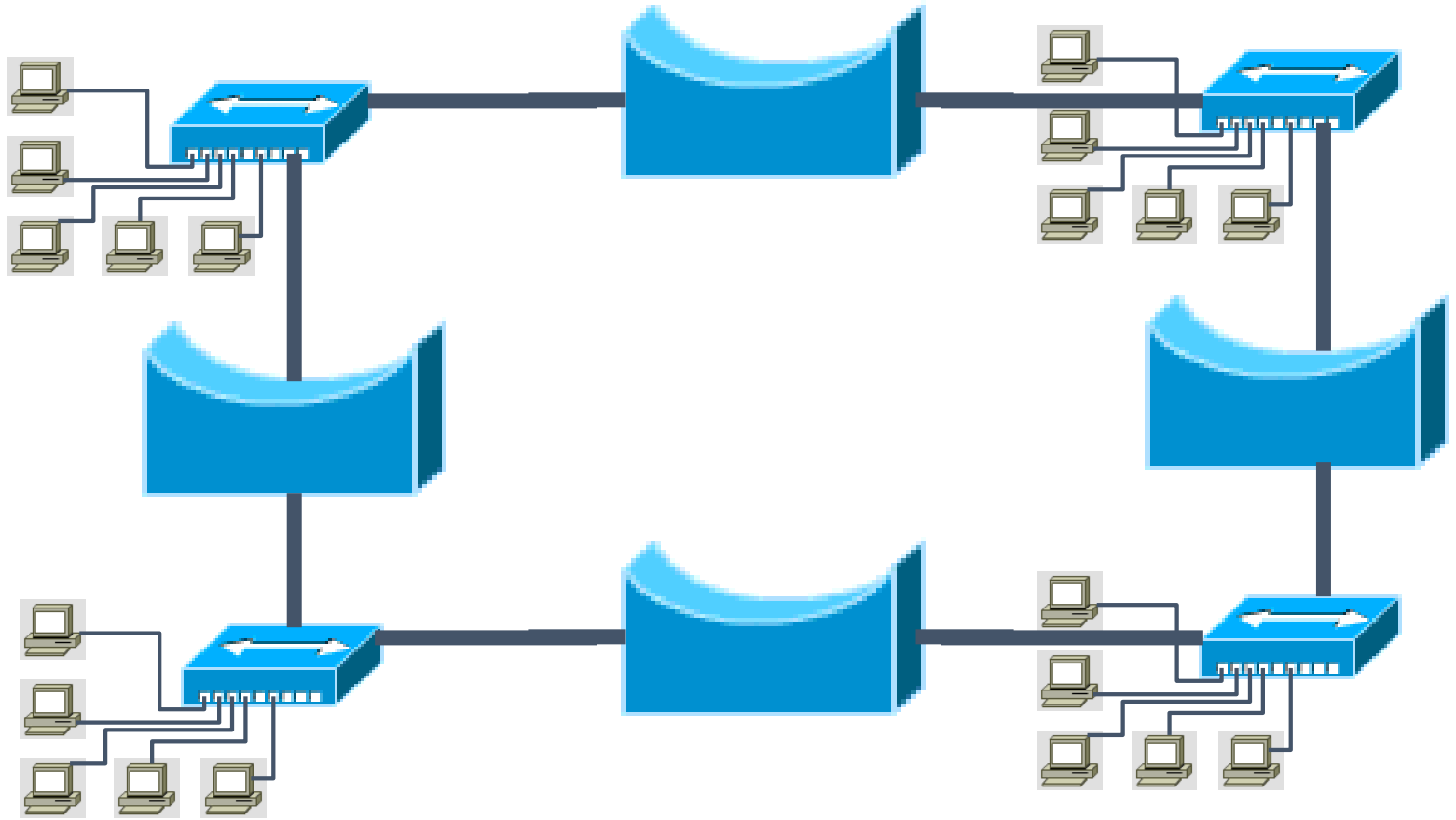
Jadi jika Host 1 ingin melakukan ping Host 2, semua perangkat akan melihat paket ping yang dikirimkan.



Semua host akan menerima paket ping request dari host 1, tapi hanya host 2 yang akan menjawab

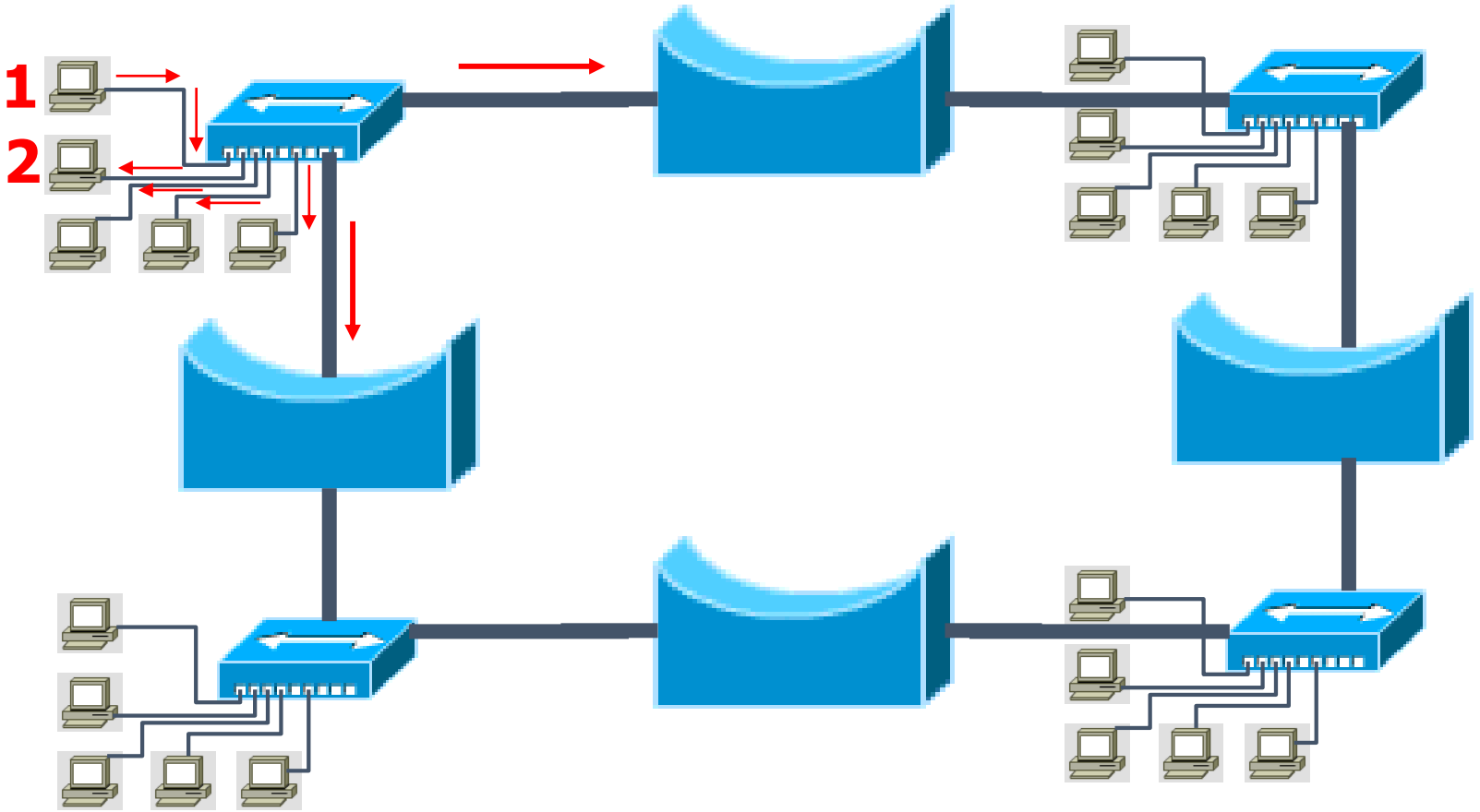
Bridge

Untuk mengurangi jumlah traffik, mulai digunakan bridges untuk memfilter paket berdasar alamat MAC



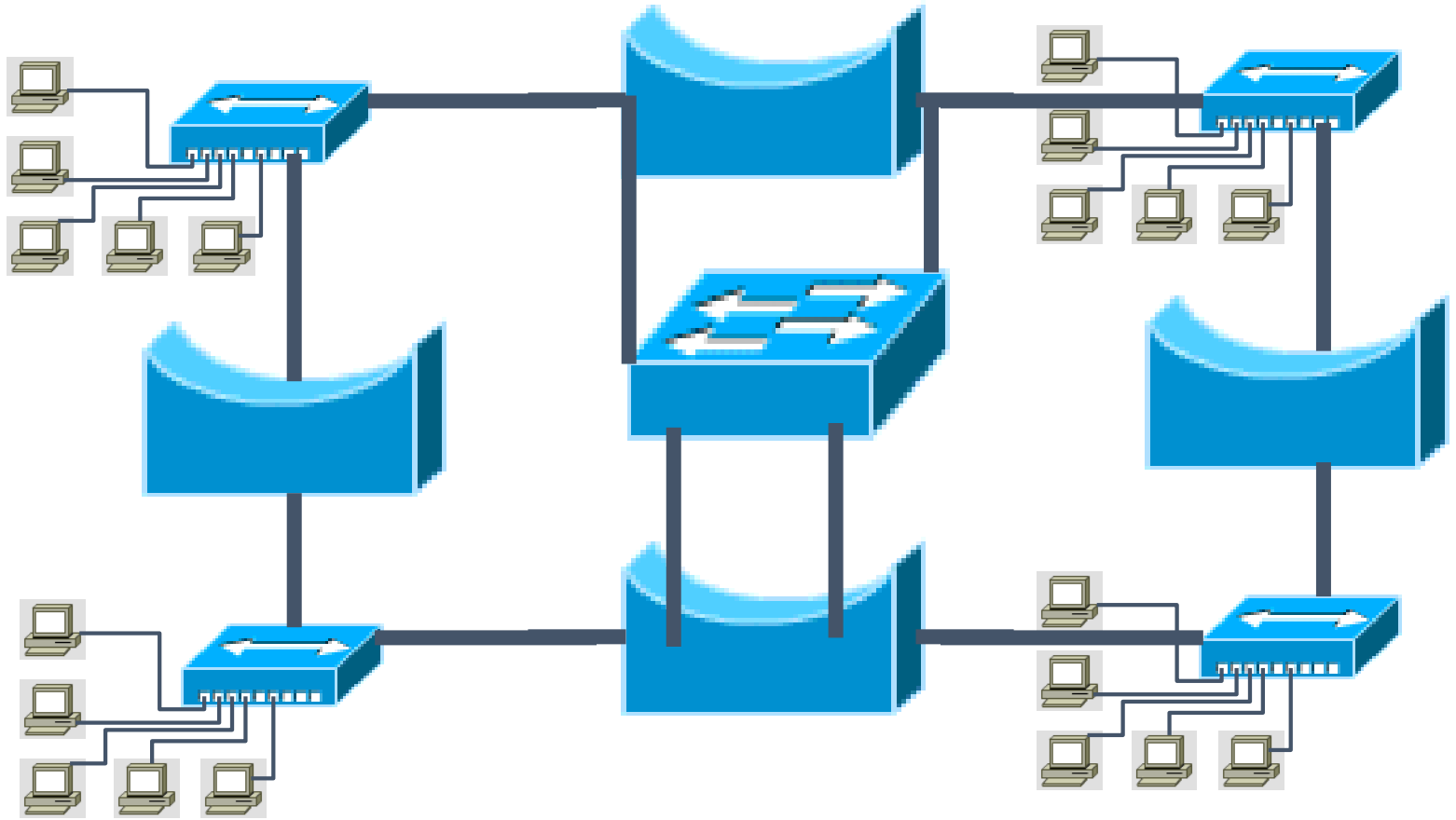
Bridge

Sekarang, jika Host 1 melakukan ping ke Host 2, maka hanya semua host dalam satu LAN segment yang melihat paket ping. *Bridges stop the ping*.



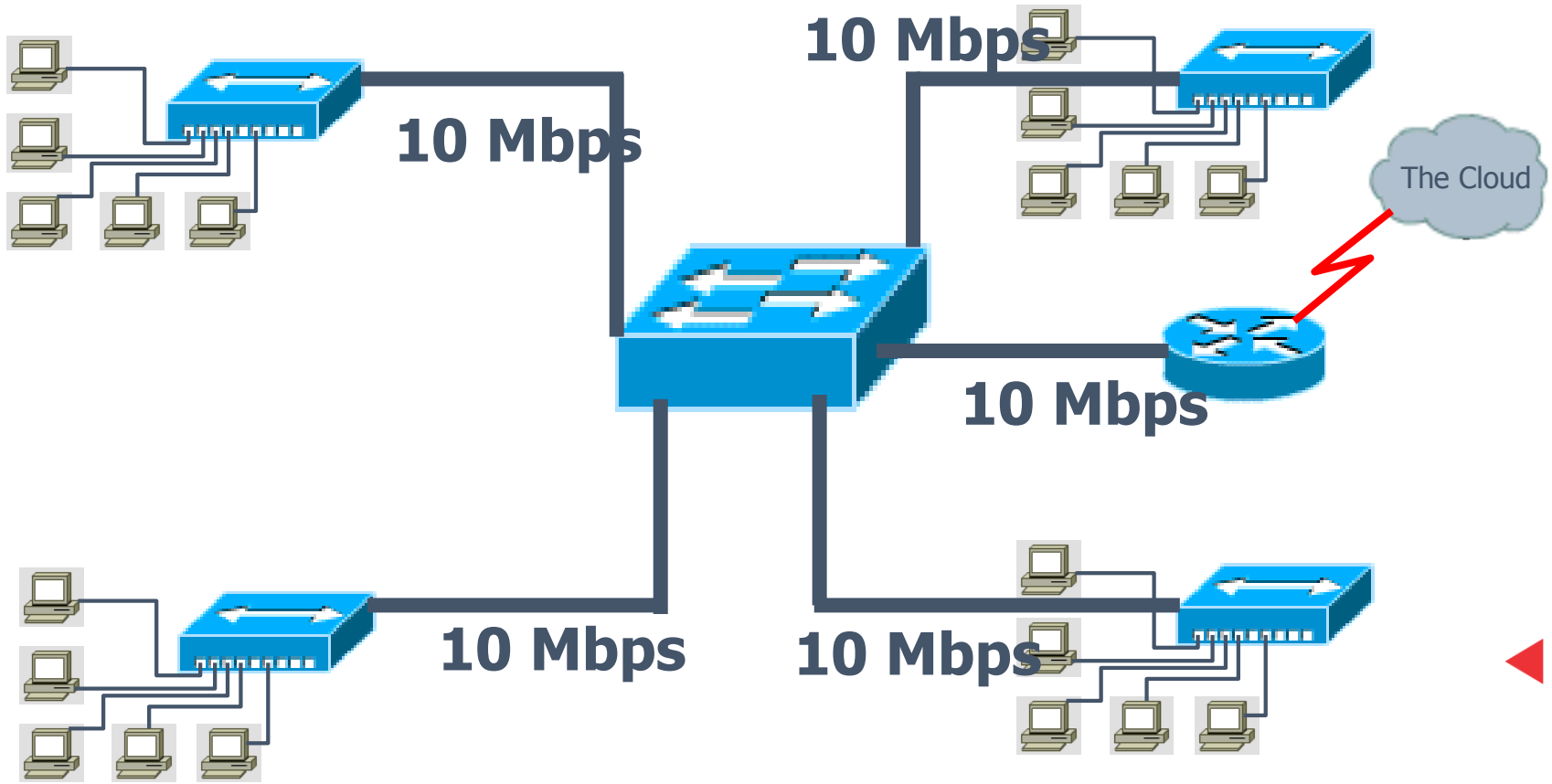
Switch

Sebuah switch (multi-port bridge), secara efektif menggantikan keempat bridge yang digunakan.



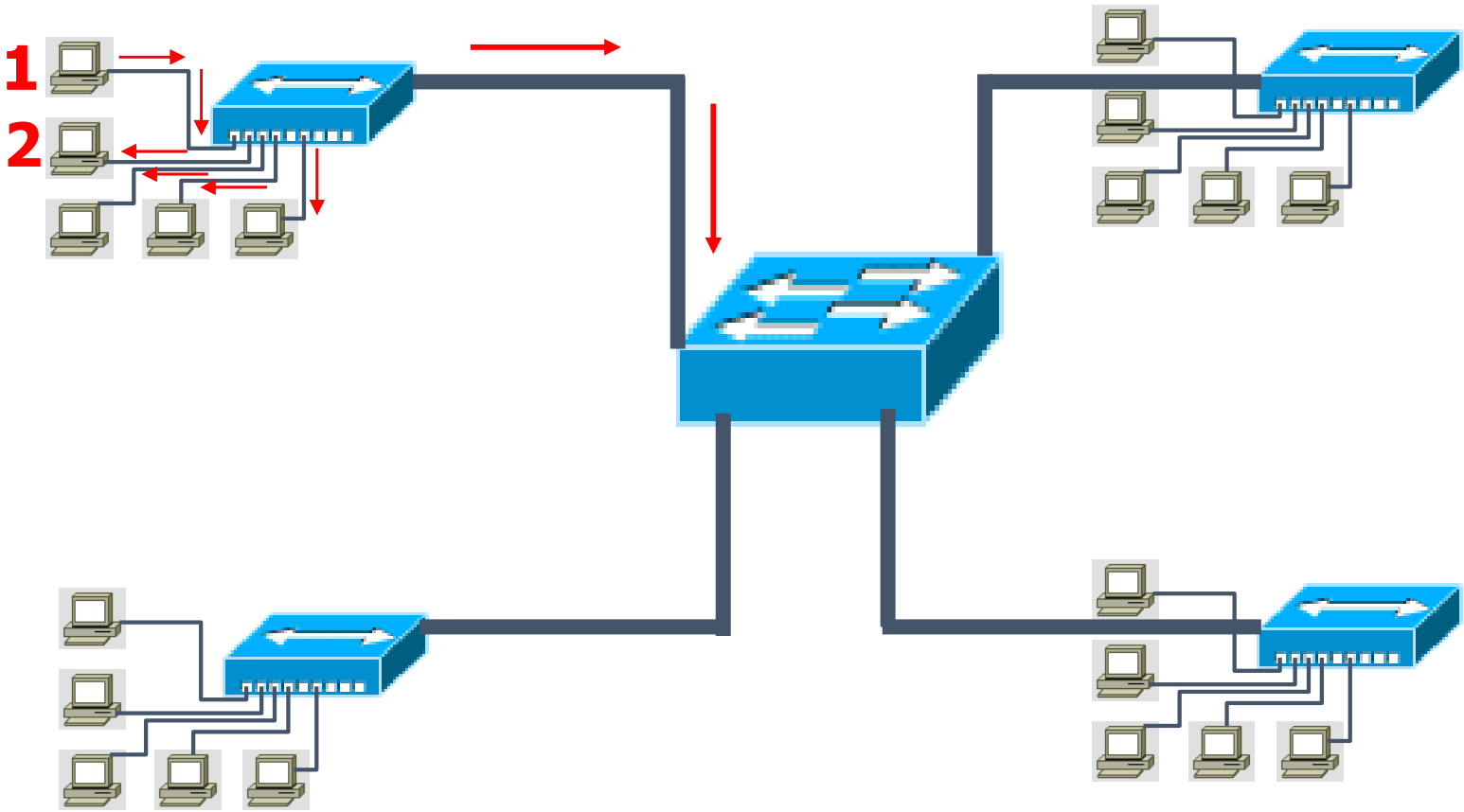
Switch

Keunggulan lain yaitu setiap LAN segment akan memperoleh dedicated bandwidth.



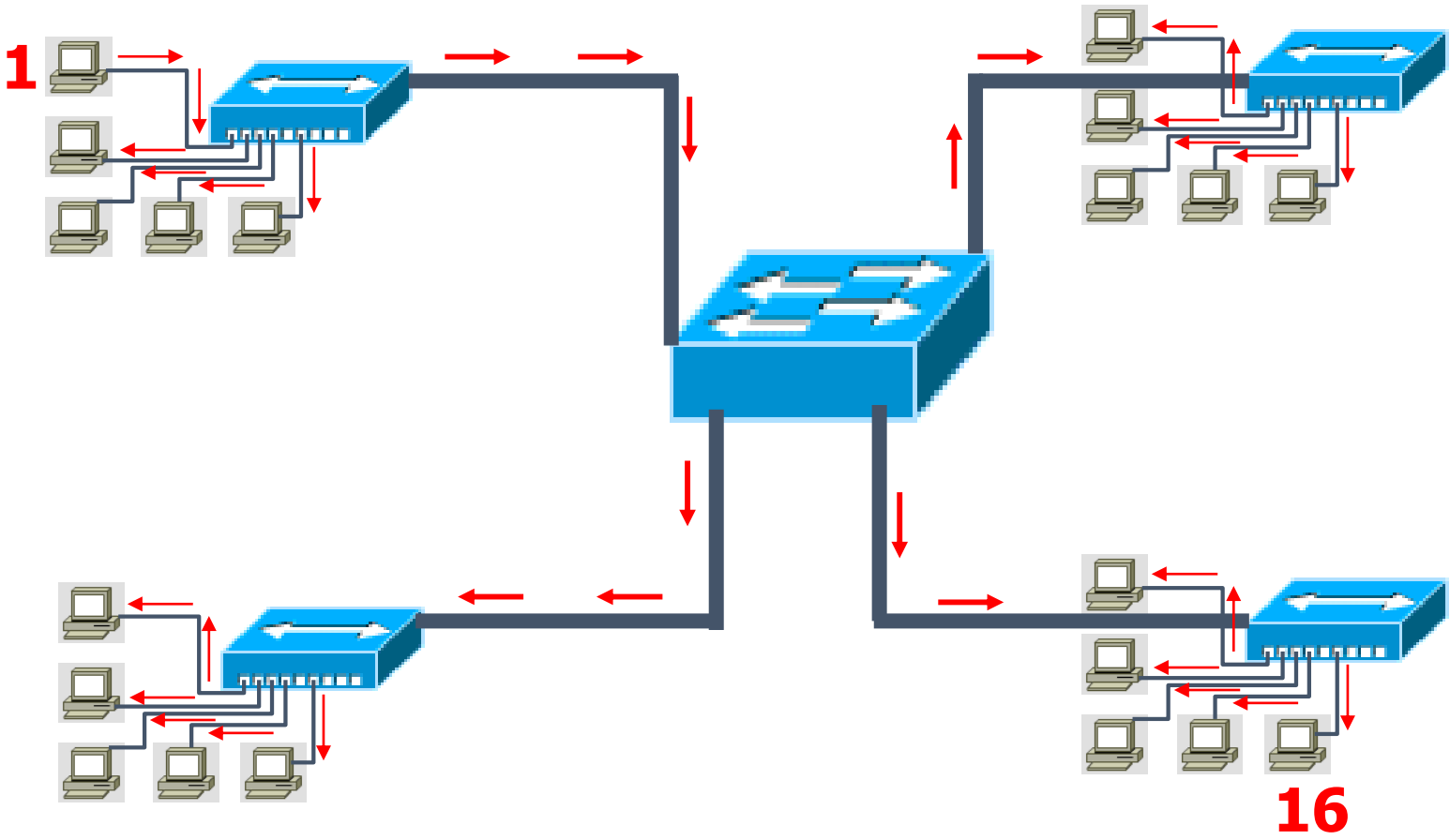
Switch

Sebuah switch tidak bisa menghentikan paket ping yang ditujukan pada LAN segment yang berbeda, sehingga ditujukan ke semua port dari switch.



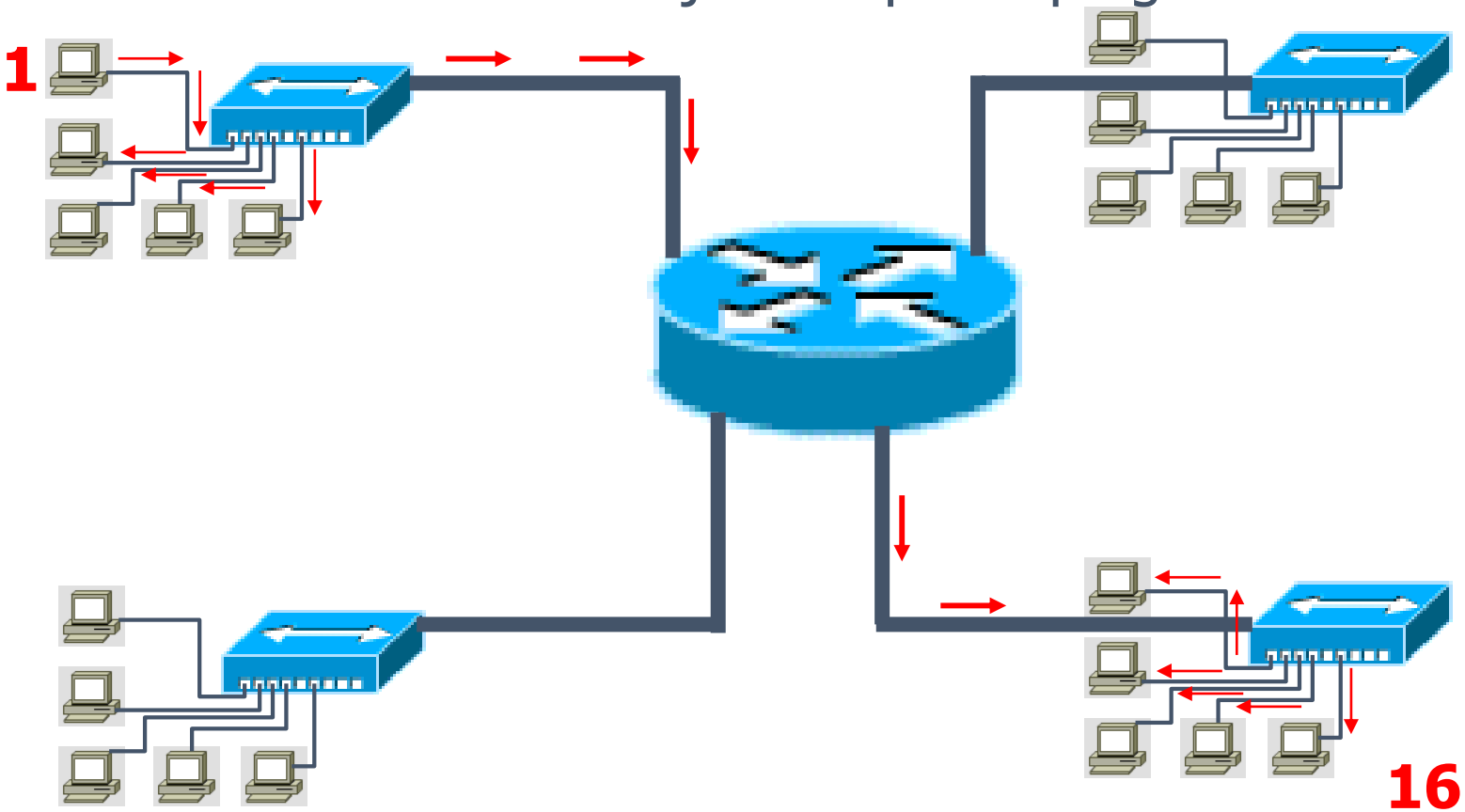
Switch

Perangkat apa yang bisa memperbaikinya?

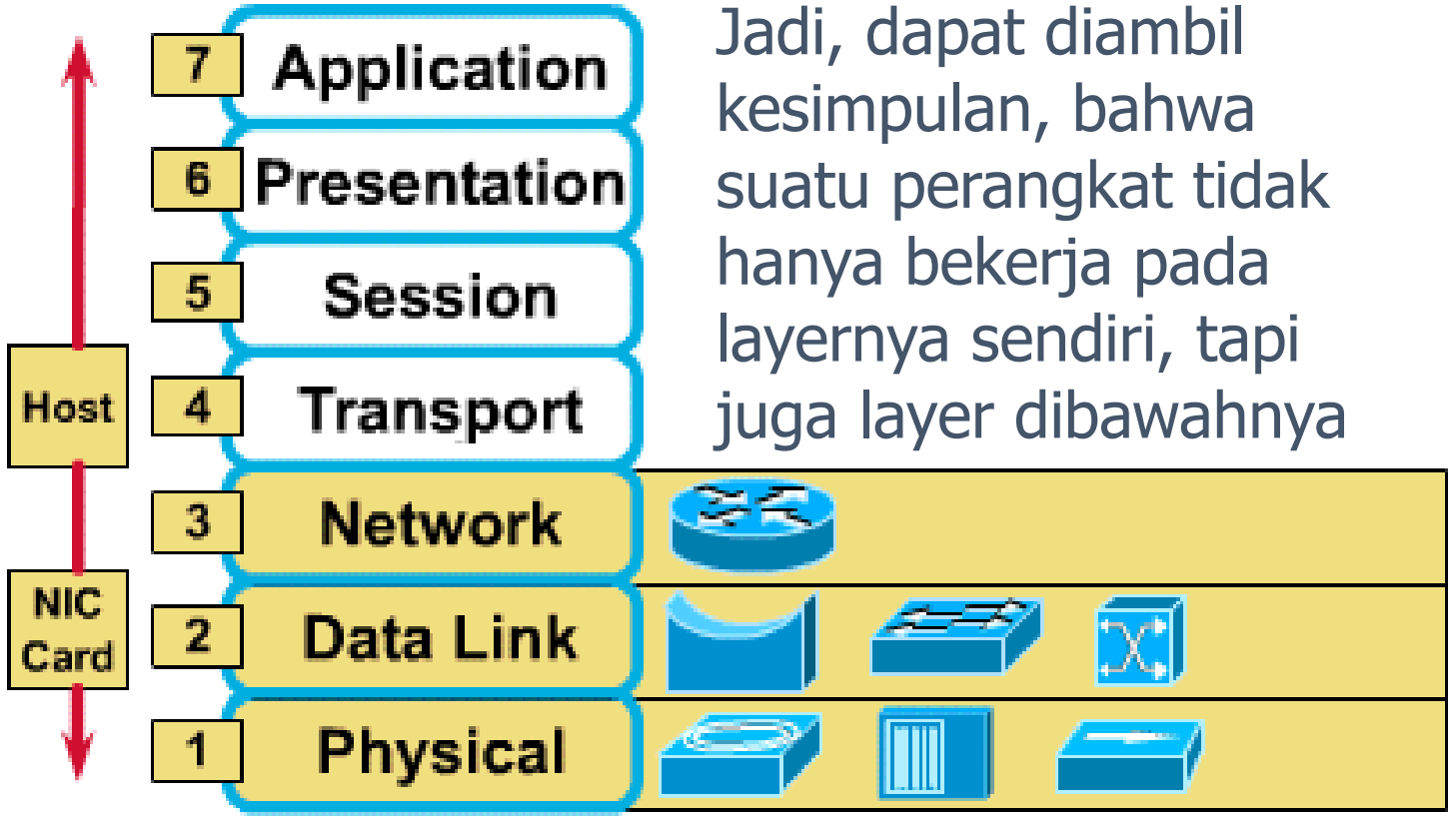


Router

Routers memfilter traffic berdasarkan alamat IP, dimana alamat IP akan memberitahu router segment mana yang harus dituju oleh paket ping.

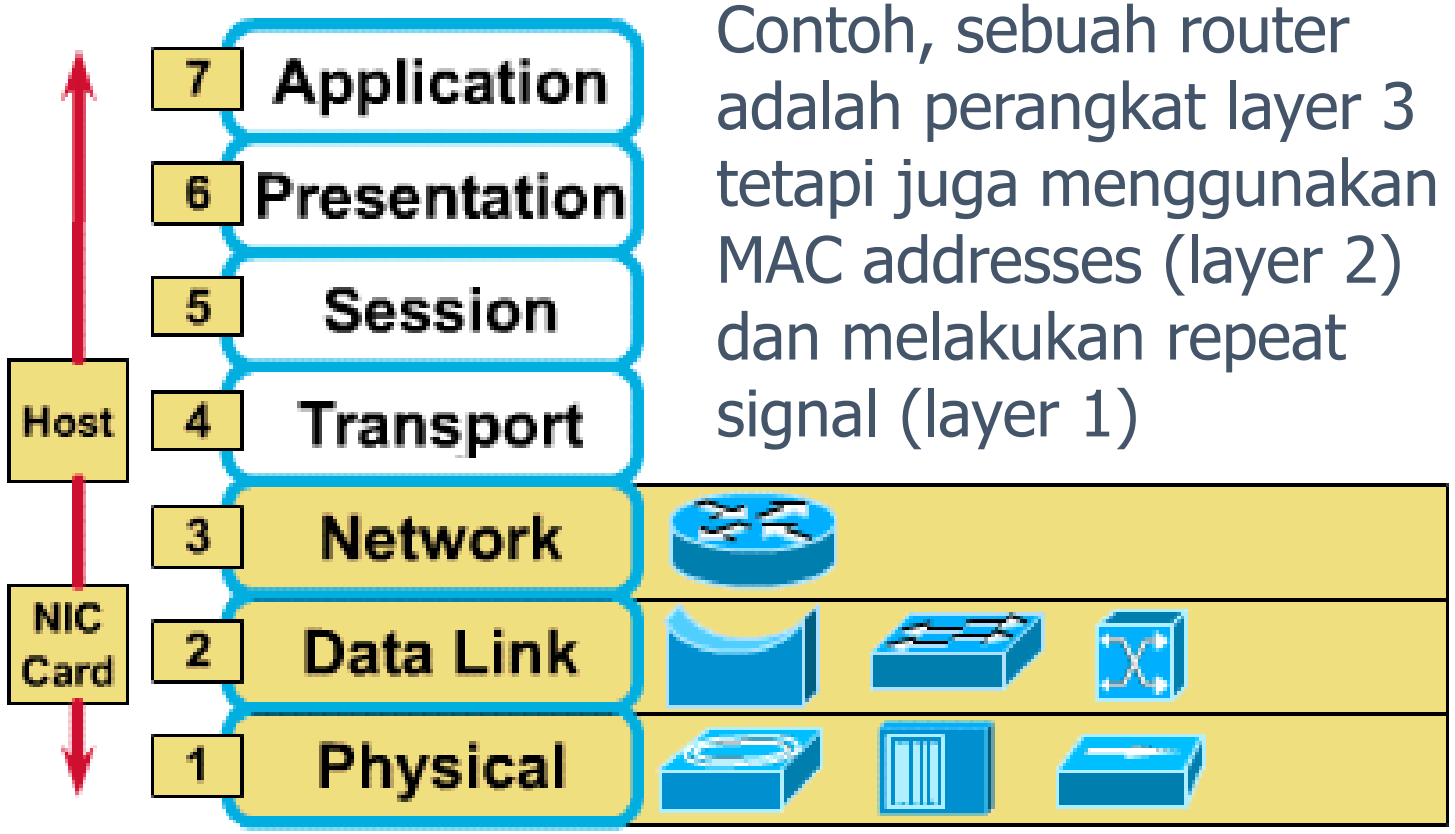


Devices Function At Layers



Jadi, dapat diambil kesimpulan, bahwa suatu perangkat tidak hanya bekerja pada layernya sendiri, tapi juga layer dibawahnya

Devices Function At Layers



Contoh, sebuah router adalah perangkat layer 3 tetapi juga menggunakan MAC addresses (layer 2) dan melakukan repeat signal (layer 1)

Connector & Cabling

Medium Type

Guided Media

1. Twisted pair (10 Hz - 100 MHz)
2. Kabel koaksial (1 kHz – 1 GHz)
3. Serat optik (100 – 1000 THz)

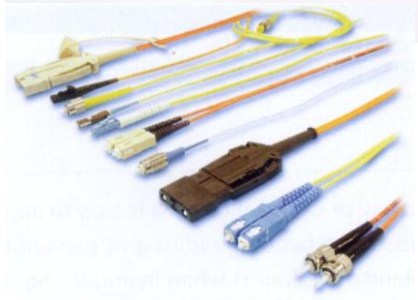
Unguided Media

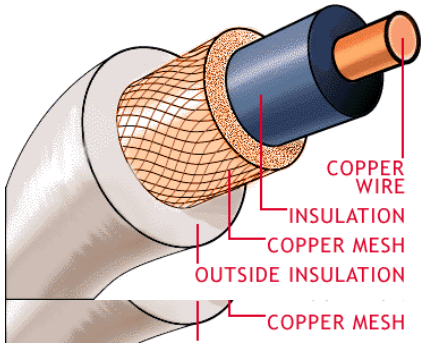
1. Radio
2. Gelombang Mikro

Media Fisik Jaringan

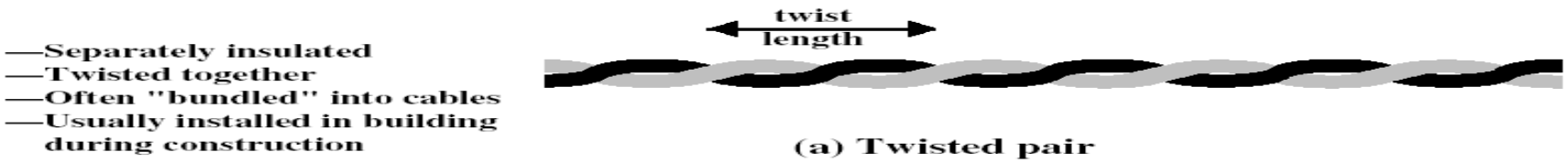
Terdapat beberapa media yang sering digunakan dalam mentransmisikan data dari node-1 ke node yang lain, diantaranya:

1) Twisted Pair
2) Coaxial Cabel
3) Optic Fiber
4) Wireless



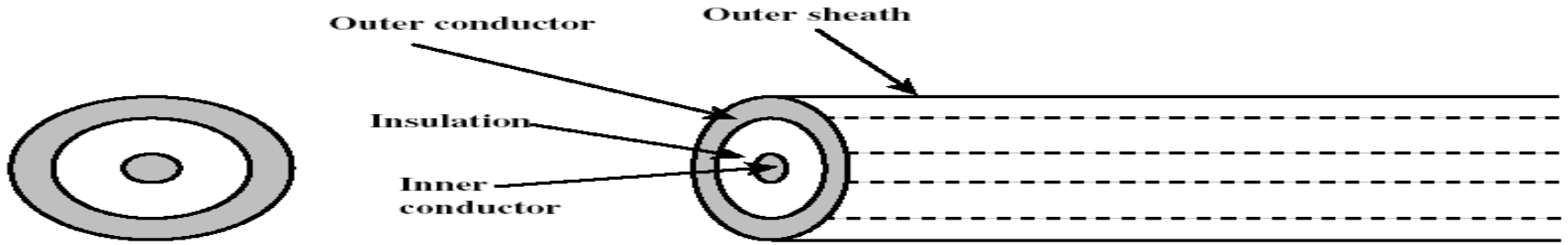


Media Fisik Jaringan



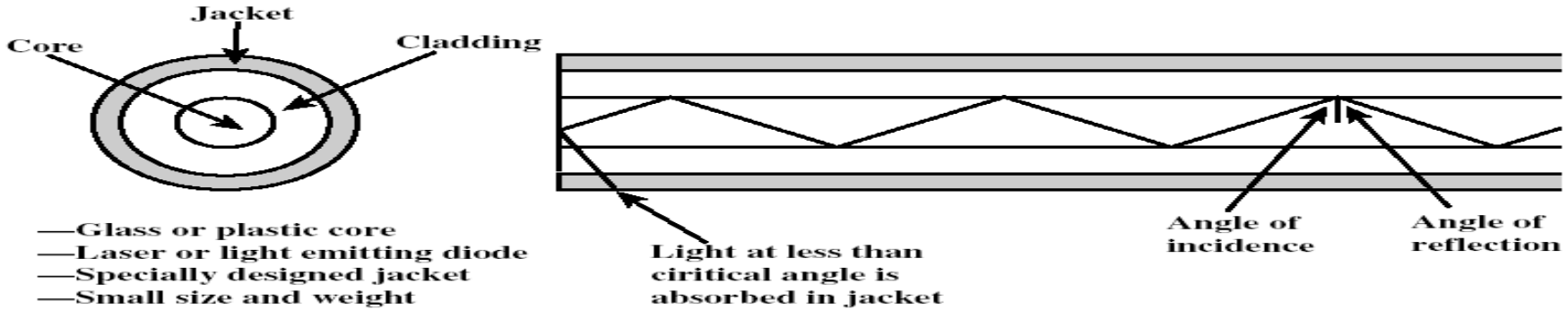
—Separately insulated
—Twisted together
—Often "bundled" into cables
—Usually installed in building during construction

(a) Twisted pair



—Outer conductor is braided shield
—Inner conductor is solid metal
—Separated by insulating material
—Covered by padding

(b) Coaxial cable



—Glass or plastic core
—Laser or light emitting diode
—Specially designed jacket
—Small size and weight

(c) Optical fiber

Twisted Pair

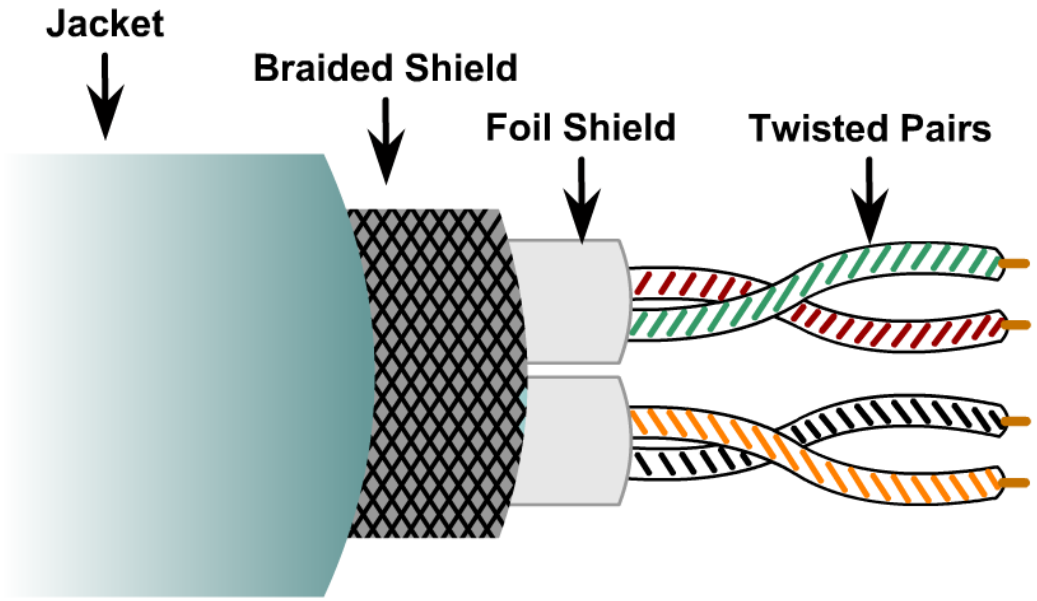
	Attenuation (dB per 100 m)			Near-end Crosstalk (dB)		
Frequency (MHz)	Category 3 UTP	Category 5 UTP	150-ohm STP	Category 3 UTP	Category 5 UTP	150-ohm STP
1	2.6	2.0	1.1	41	62	58
4	5.6	4.1	2.2	32	53	58
16	13.1	8.2	4.4	23	44	50.4
25	—	10.4	6.2	—	41	47.5
100	—	22.0	12.3	—	32	38.5
300	—	—	21.4	—	—	31.3

	Category 3 Class C	Category 5 Class D	Category 5E	Category 6 Class E	Category 7 Class F
Bandwidth	16 MHz	100 MHz	100 MHz	200 MHz	600 MHz
Cable Type	UTP	UTP/FTP	UTP/FTP	UTP/FTP	SSTP
Link Cost (Cat 5 =1)	0.7	1	1.2	1.5	2.2

UTP = Unshielded twisted pair
FTP = Foil twisted pair
SSTP = Shielded screen twisted pair

- Tabel di samping menunjukkan kinerja UTP kategori 3, 5, dan STP
- Skema pengkabelan baru berada pada level yang lebih tinggi, yaitu kategori 5E (enhanced), 6, dan 7

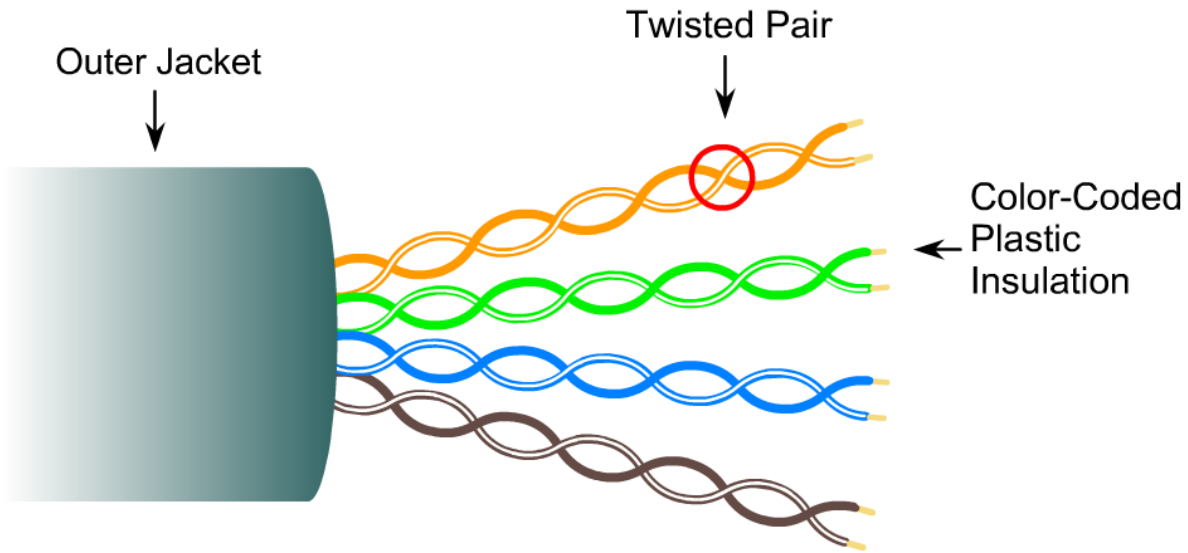
Twisted Pair



SHIELDED TWISTED PAIR (UTP)

- Speed and throughput: 0 - 100 Mbps
- Cost: Moderate
- Media and connector size: Medium to Large
- Maximum cable length: 100m

Twisted Pair

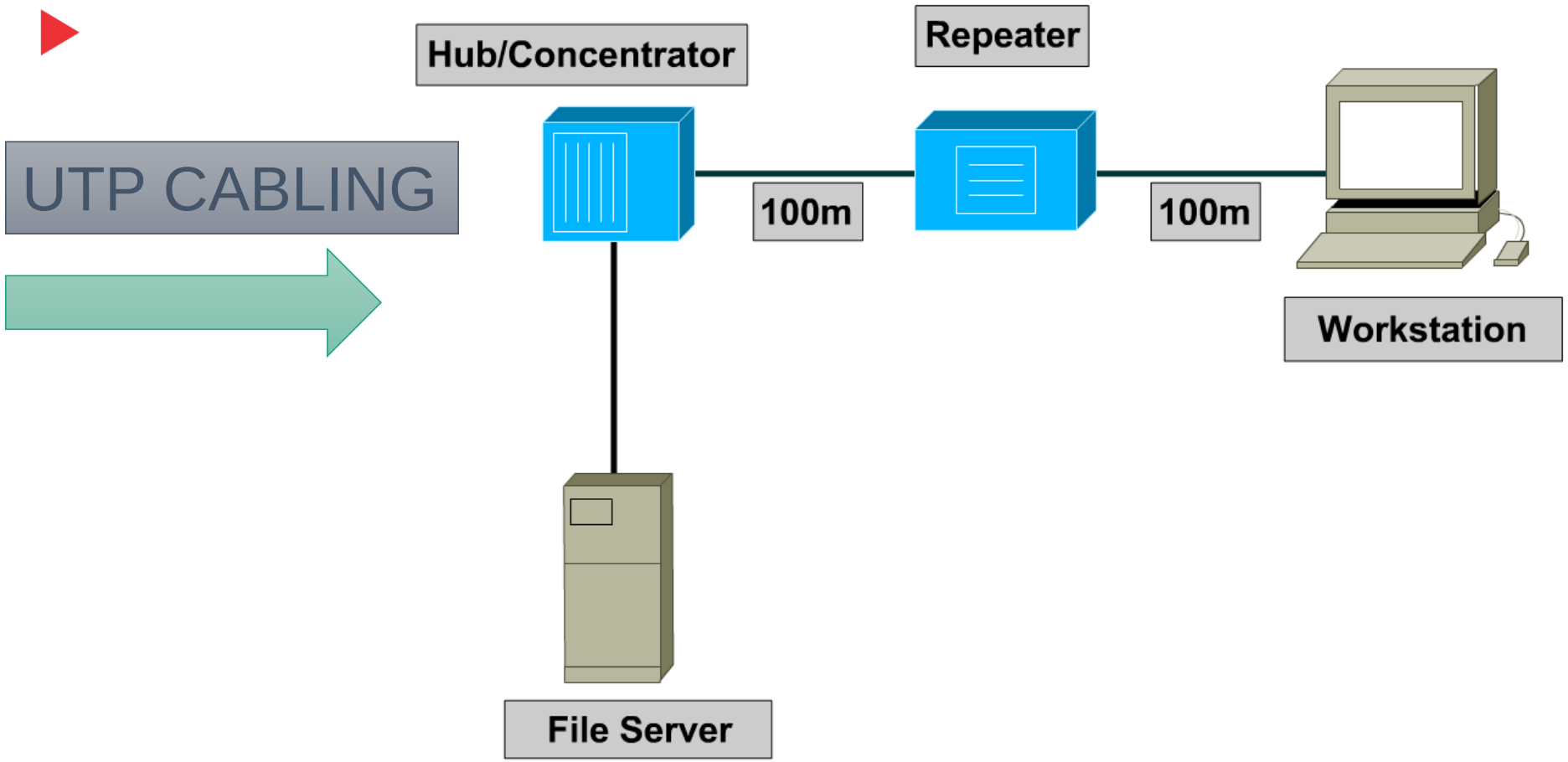


UNSHIELDED TWISTED PAIR (UTP)

- Speed and throughput: 10 - 100 - 1000 Mbps (depending on the quality/category of cable)
- Cost: Least Expensive
- Media and connector size: Small
- Maximum cable length: 100m

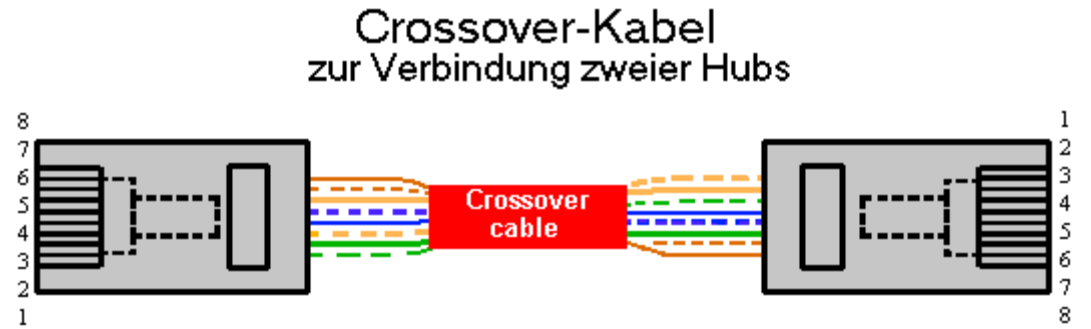
Twisted Pair

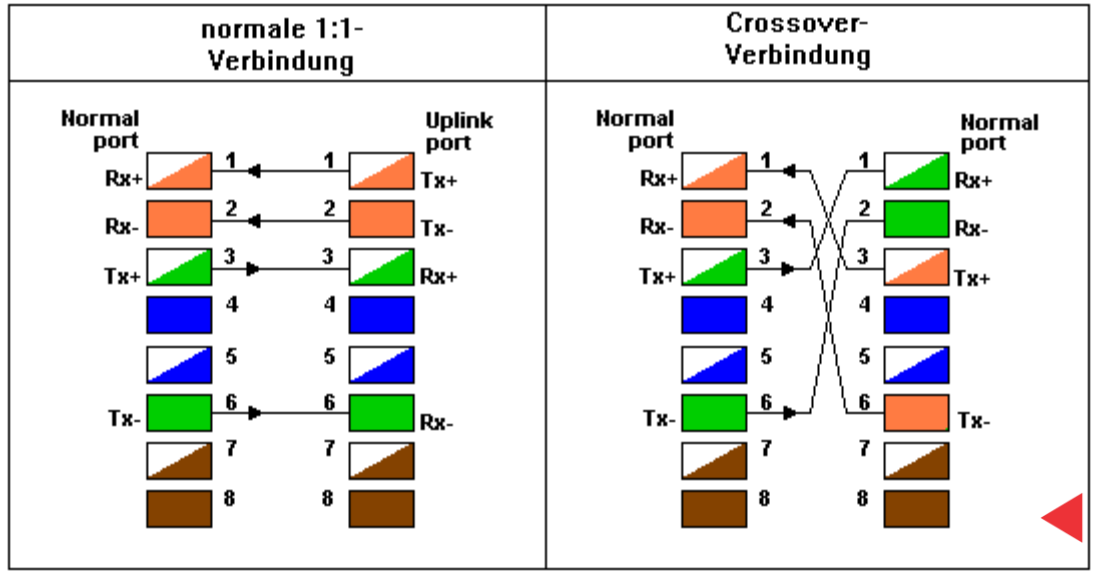
UTP CABLING



Twisted Pair

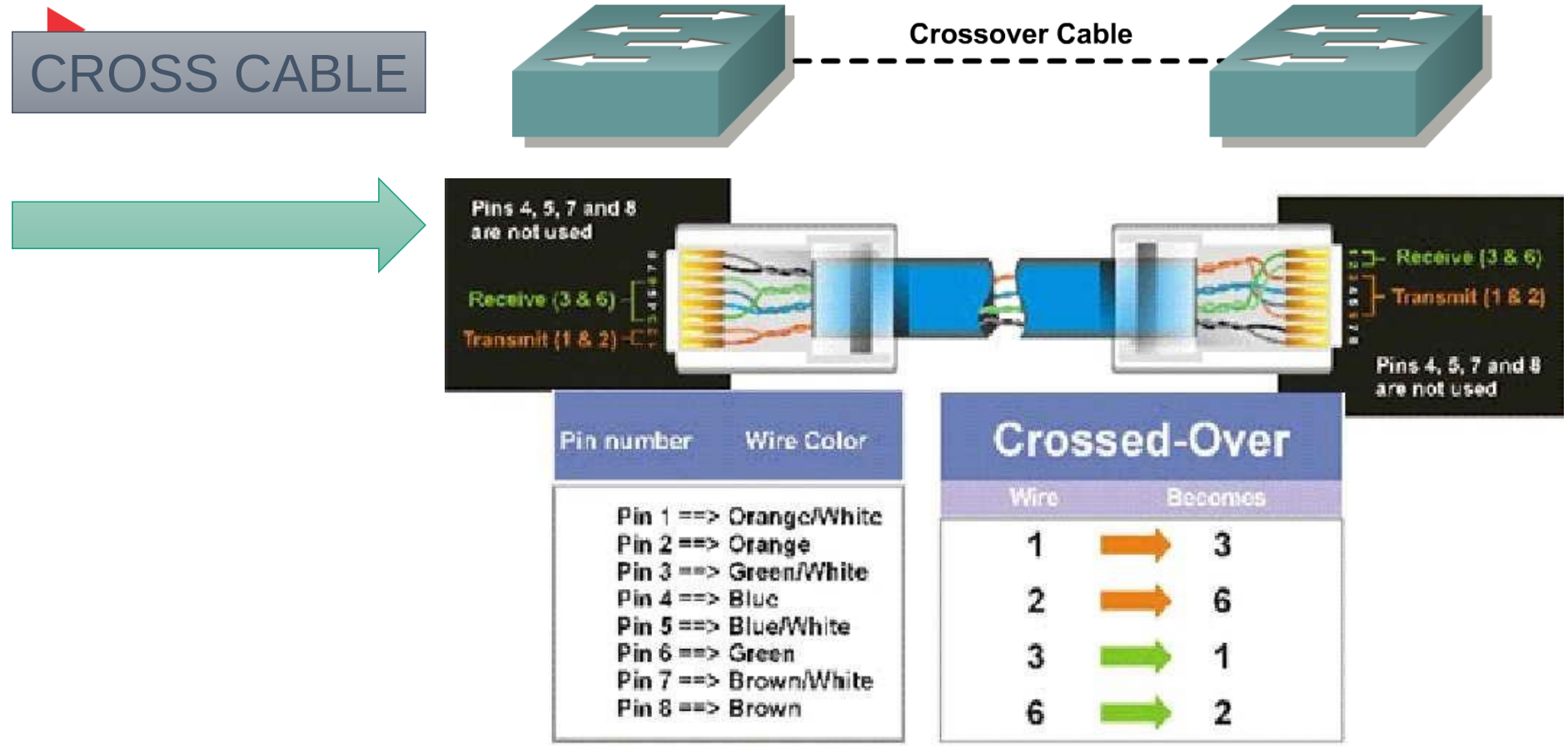
STRAIGHT CABLE





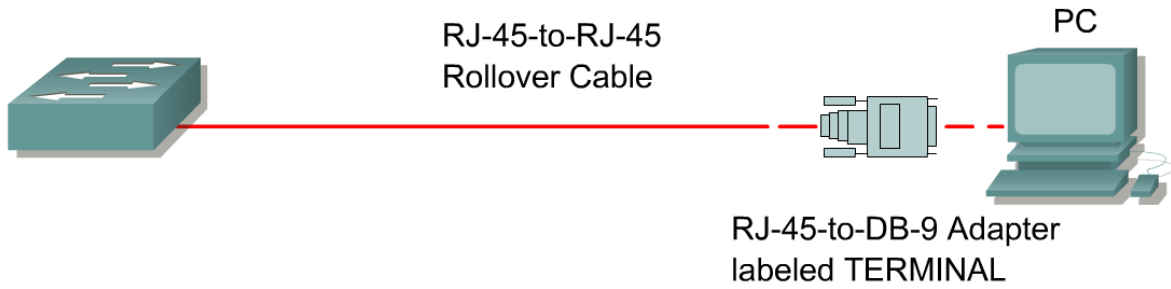
Twisted Pair

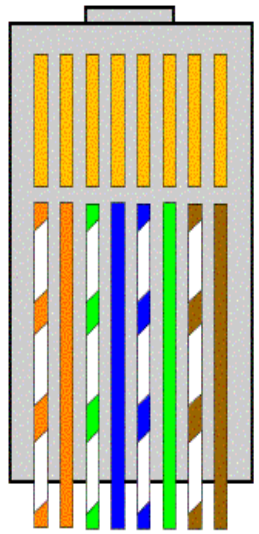
CROSS CABLE

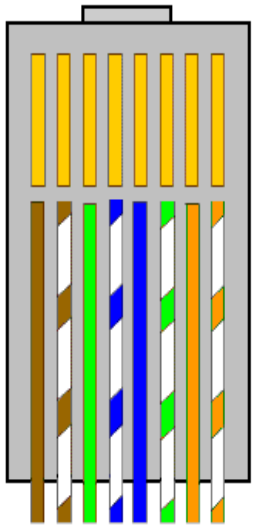


Twisted Pair

ROLLOVER CABLE





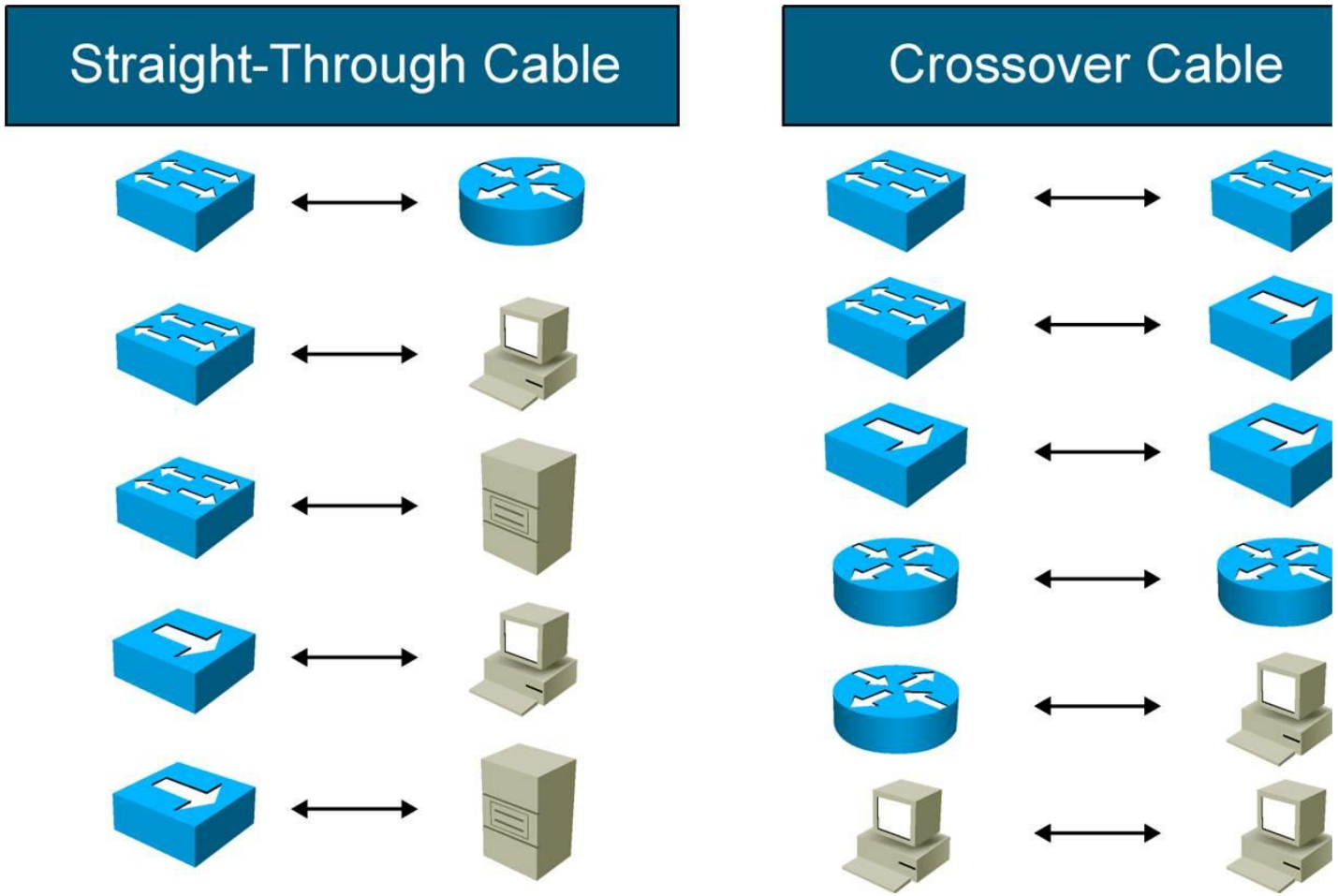


- PCs require an RJ-45 to DB-9 or RJ-45 to DB-25 adapter.
- COM port settings are 9600 bps, 8 data bits, no parity, 1 stop bit, no flow control.
- This provides out-of-band console access.
- AUX switch port may be used for a modem-connected console.

Twisted Pair

LAN TESTER

Penggunaan

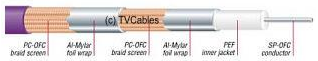


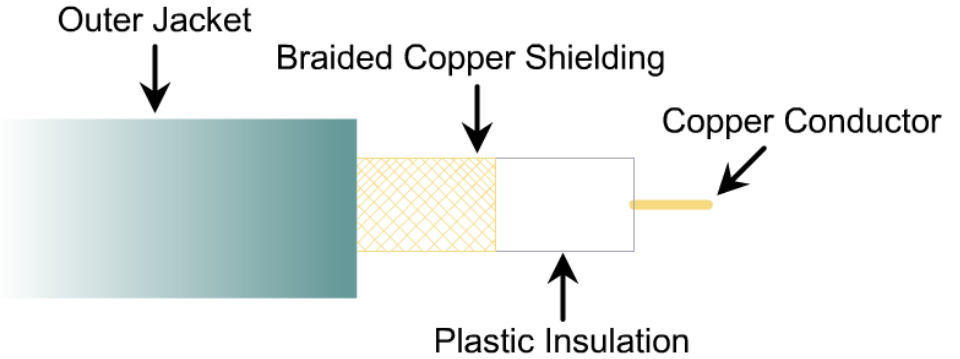
Coaxial Cable

Karakteristik :

1. Terdiri dari 2 konduktor dengan konstruksi yang berbeda dengan twisted pair
2. Konduktor dalam ditahan oleh beberapa cincin insulasi atau bahan dielektrik padat, konduktor luar ditutup dengan jaket
3. Diameter 1-2,5 cm, kapasitas 10.000 kanal suara
4. Spektrum dapat mencapai 500 MHz
5. Laju data ratusan Mbps untuk jarak 1 km
6. Jarak antar repeater 1 km
7. Aplikasi: distribusi TV, SLJJ, LAN
8. Lebih tahan terhadap interferensi dan crosstalk dibanding twisted pair, jarak jangkauan lebih jauh

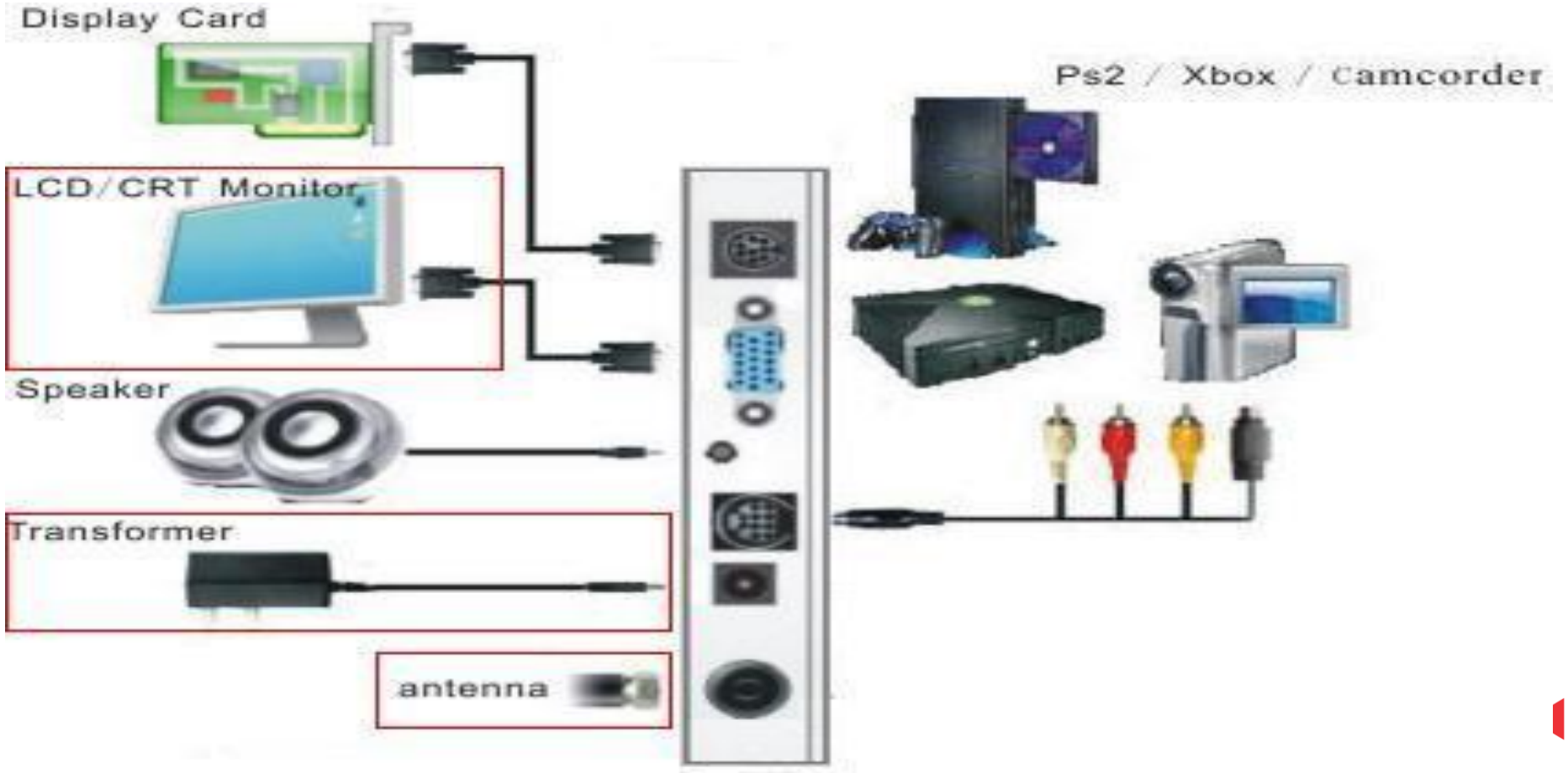
Coaxial Cable





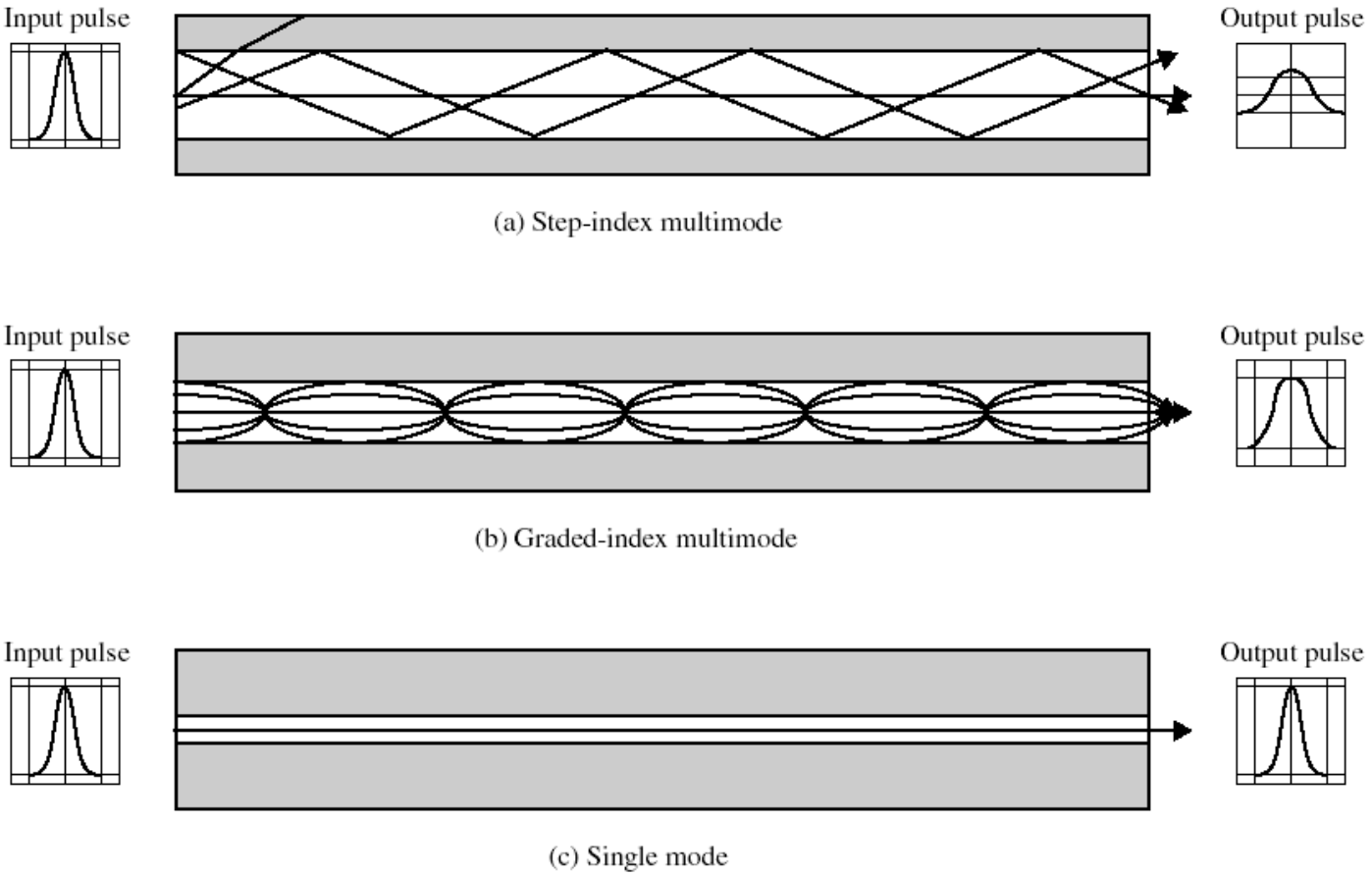
- Speed and throughput: 10 - 100 Mbps
- Cost: Inexpensive
- Media and connector size: Medium
- Maximum cable length: 500m

Coaxial Cable



Serat Optik

MODE TRANSMISI



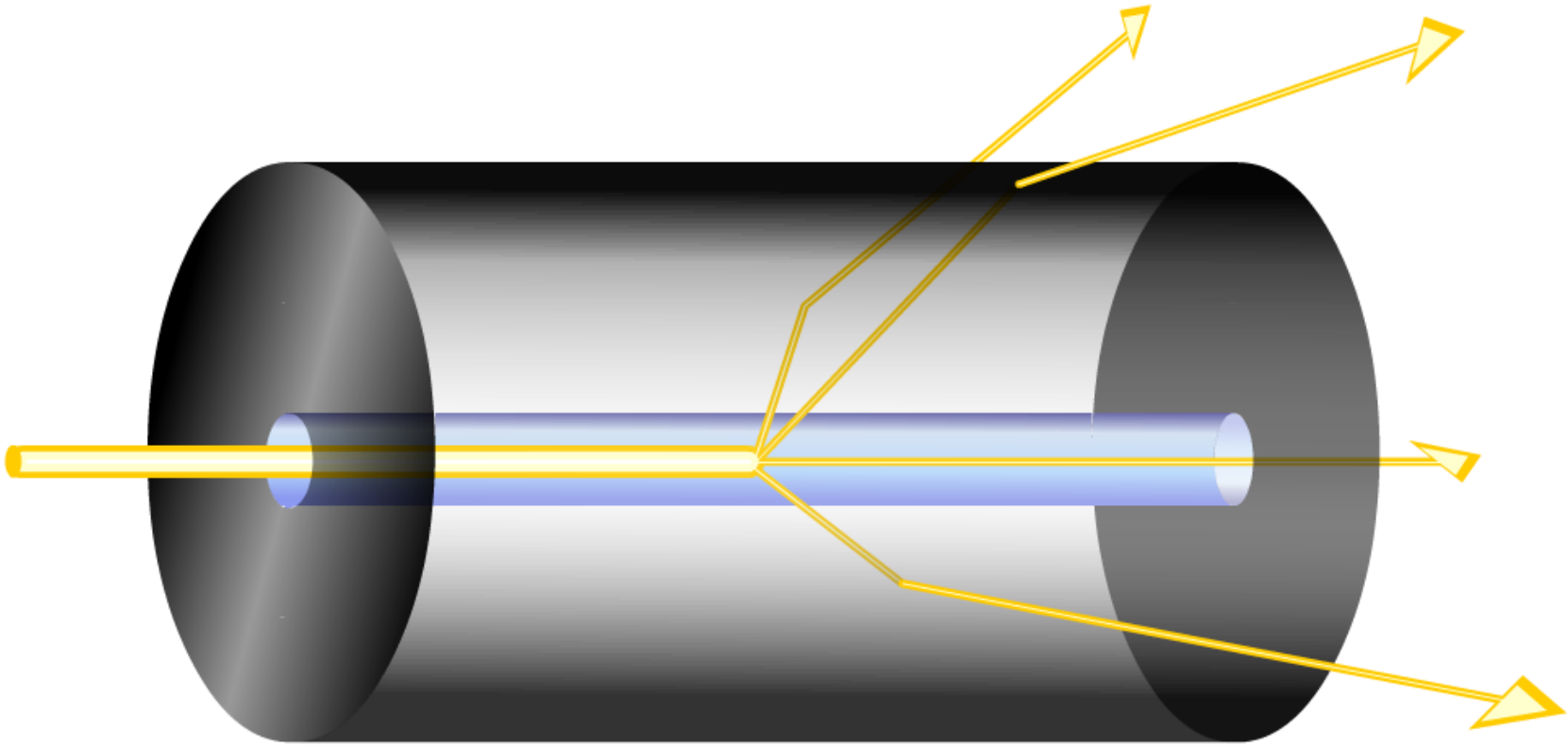
Serat Optik

Beberapa hal yang dapat menurunkan kualitas Optik :

1. Scattering
2. Bending
3. Splicing

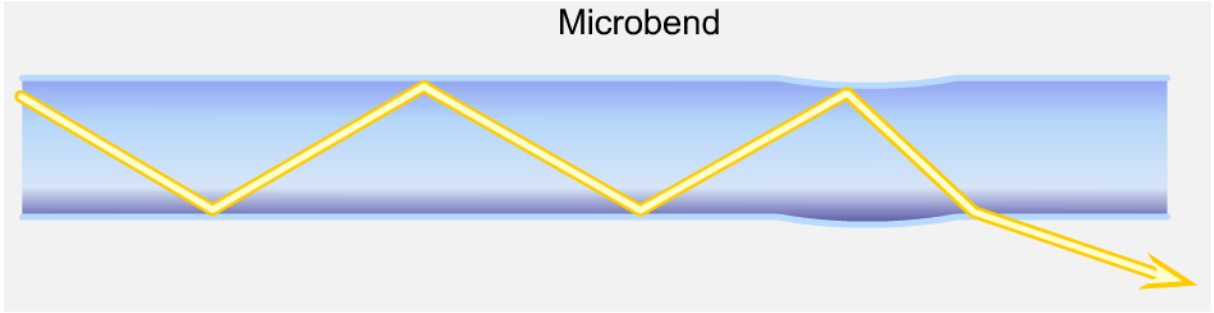
Serat Optik

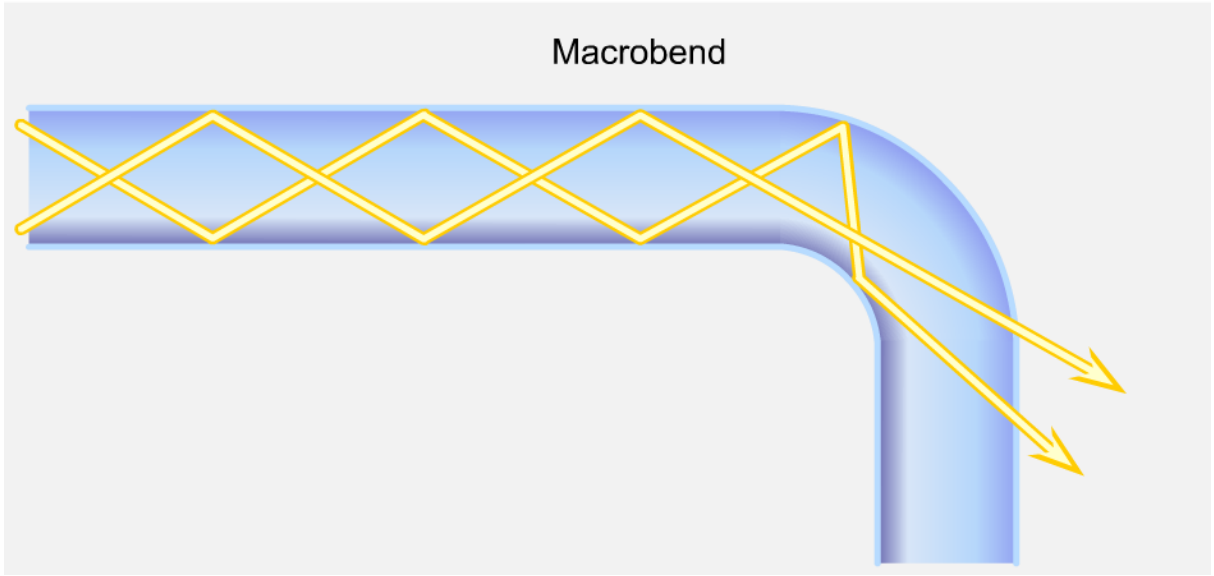
- Scattering



Serat Optik

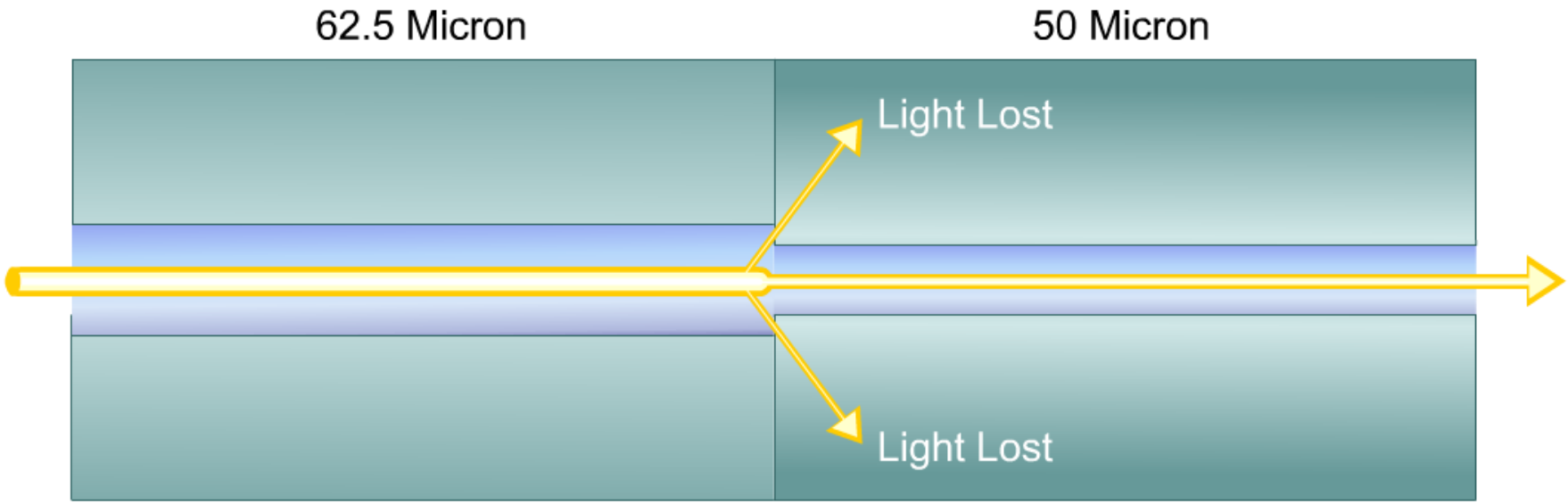
- Bending





Serat Optik

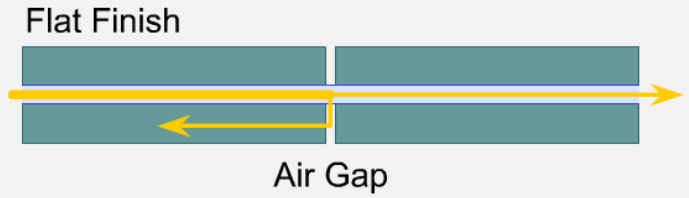
- Splicing



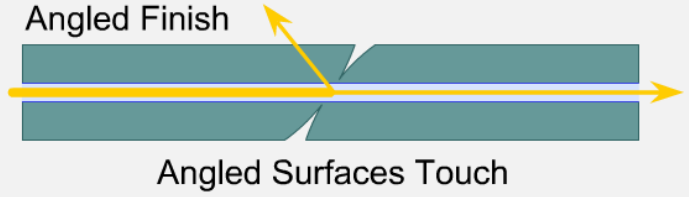
Serat Optik

- Fiber End Face Finished

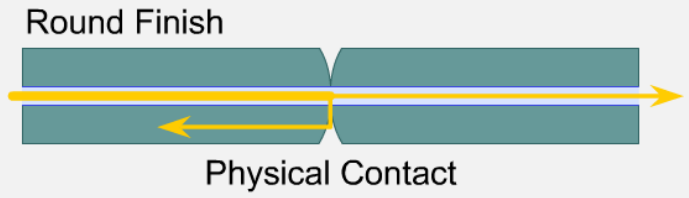
Flat: Finish causes light to be reflected back into the fiber due to a step in the refractive index caused by the glass-air-glass interface.



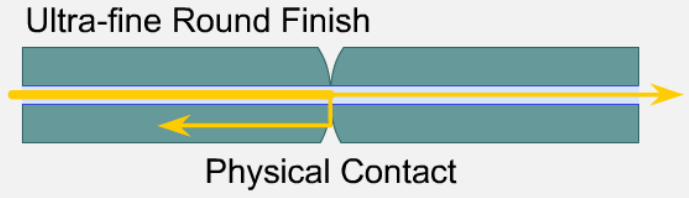
Angle: Polish connectors cause the reflection to exit the core and dissipate in the cladding.



Physical Contact (PC): Finish minimizes backreflection due to the very small refractive index discontinuity.



Ultra: Polish connector finish uses several grades of polishing film to achieve an untra-smooth surface.



Wireless

- **Transmisi Wireless :**
  1. Pengiriman dan penerimaan sinyal dilakukan dengan antena
  2. Frekuensi
     - ✓ Gelombang mikro: 2 - 40 GHz
     - ✓ Radio broadcast: 30 MHz - 1 GHz
     - ✓ Infra merah: 3.10^{11} – 2.10^{14} Hz
  3. Gelombang mikro terestrial
     - ✓ Antena microwave yang umum adalah piringan parabola
     - ✓ Diameter parabola 3 m
     - ✓ Jarak maksimum $d = 7{,}14\sqrt{Kh}$

Wireless

Perambatan Wireless

Band	Frequency Range	Free-Space Wavelength Range	Propagation Characteristics	Typical Use
ELF (extremely low frequency)	30 to 300 Hz	10,000 to 1000 km	GW	Power line frequencies; used by some home control systems.
VF (voice frequency)	300 to 3000 Hz	1000 to 100 km	GW	Used by the telephone system for analog subscriber lines.
VLF (very low frequency)	3 to 30 kHz	100 to 10 km	GW; low attenuation day and night; high atmospheric noise level	Long-range navigation; submarine communication
LF (low frequency)	30 to 300 kHz	10 to 1 km	GW; slightly less reliable than VLF; absorption in daytime	Long-range navigation; marine communication radio beacons
MF (medium frequency)	300 to 3000 kHz	1,000 to 100 m	GW and night SW; attenuation low at night, high in day; atmospheric noise	Maritime radio; direction finding; AM broadcasting.
HF (high frequency)	3 to 30 MHz	100 to 10 m	SW; quality varies with time of day, season, and frequency.	Amateur radio; international broadcasting, military communication; long-distance aircraft and ship communication
VHF (very high frequency)	30 to 300 MHz	10 to 1 m	LOS; scattering because of temperature inversion; cosmic noise	VHF television; FM broadcast and two-way radio, AM aircraft communication; aircraft navigational aids
UHF (ultra high frequency)	300 to 3000 MHz	100 to 10 cm	LOS; cosmic noise	UHF television; cellular telephone; radar; microwave links; personal communications systems
SHF (super high frequency)	3 to 30 GHz	10 to 1 cm	LOS; rainfall attenuation above 10 GHz; atmospheric attenuation due to oxygen and water vapor	Satellite communication; radar; terrestrial microwave links; wireless local loop
EHF (extremely high frequency)	30 to 300 GHz	10 to 1 mm	LOS; atmospheric attenuation due to oxygen and water vapor	Experimental; wireless local loop
Infrared	300 GHz to 400 THz	1 mm to 770 nm	LOS	Infrared LANs; consumer electronic applications
Visible light	400 THz to 900 THz	770 nm to 330 nm	LOS	Optical communication

Quality Of Service (QoS)

Why Quality of Service (QoS)?

📖 Definition:

QoS is the concept for specifying how “good” the offered services are.

✍Concept:

Quality of service is a concept based on the statement that not all applications need the same performance from the system/network over which they run.

Thus, applications may indicate their specific requirements to the network, including cost, before they actually start transmitting data.

Major Parameters Defining QoS

Throughput – the total amount of work completed during a specific time interval.

Delay – the elapsed time from when a request is first submitted to when the desired result is produced.

Jitter – the delays that occur during playback of a stream.

Reliability – how errors are handled during transmission and processing of continuous media.

Communication QoS Parameters

- Average Throughput (bit rate, bandwidth)
- Burstiness (average to peak ratio)
- Minimum/Maximum transit (delay)
  - ✓ Important for response time and RT perception
- Maximum Jitter (delay variance),
  - ✓ Important for synchronization
- Reliability
  - ✓ Acceptable bit error rate
  - ✓ Acceptable packet error rate

Throughput

Rate rata – rata suatu message atau paket sukses terkirim pada kanal komunikasi, satuan bps

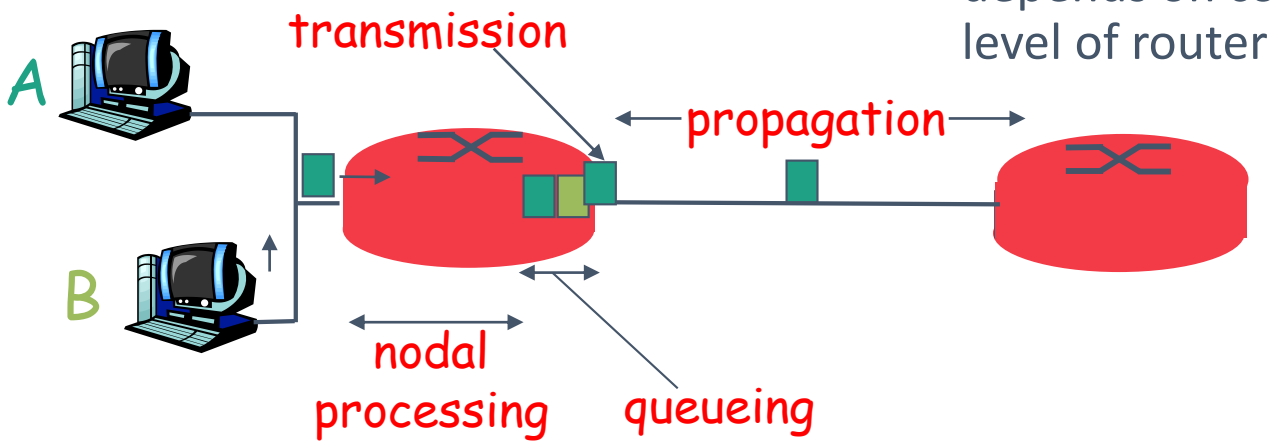
$$T = \frac{\text{Jumlah paket sukses selama pengamatan x ukuran paket x 8}}{\text{Lama pengamatan}}$$

Delay in packet-switched networks (1)

Packets experience delay on end-to-end path

- four sources of delay at each hop:

- nodal processing:
  - ✓ check bit errors
  - ✓ determine output link
- queuing
  - ✓ time waiting at output link for transmission
  - ✓ depends on congestion level of router



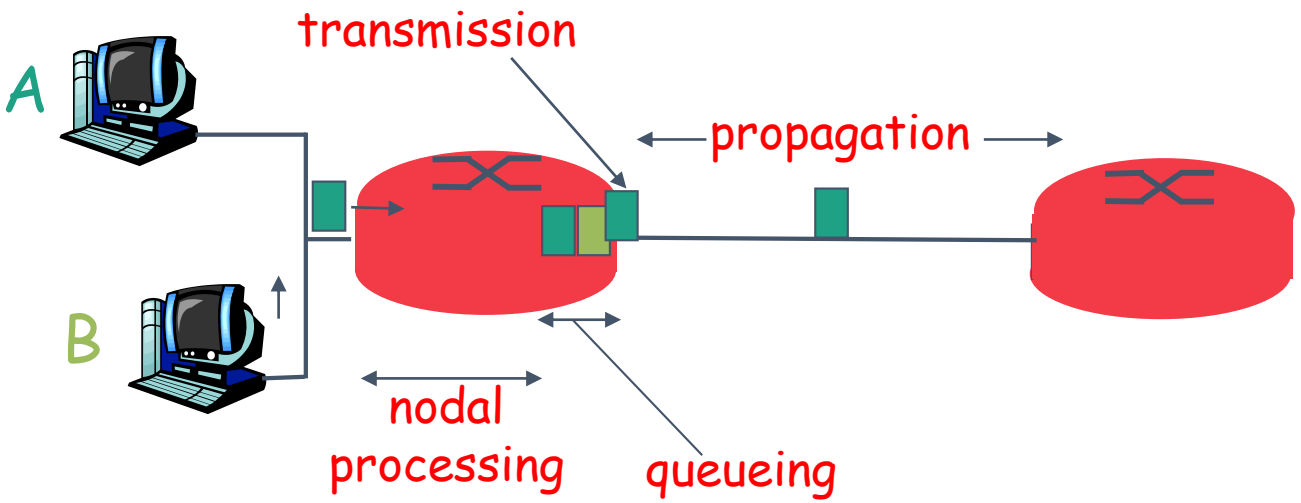
Delay in packet-switched networks (2)

Transmission delay:

- R = link bandwidth (bps)
- L = packet length (bits)
- time to send bits into link = L/R

Propagation delay:

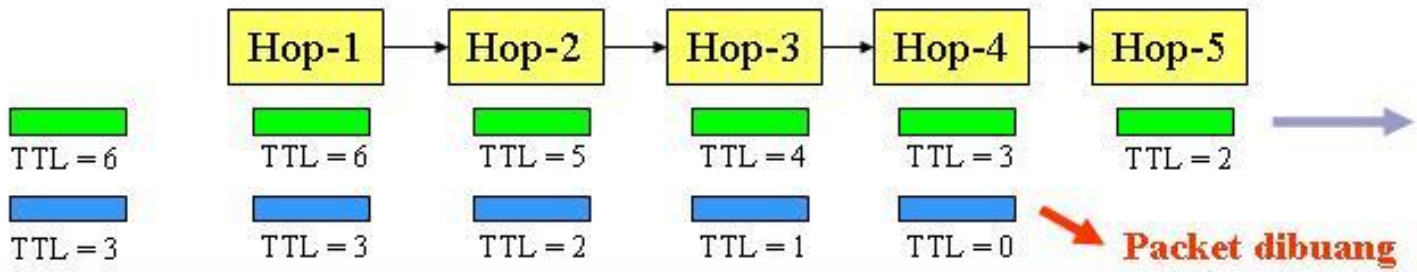
- d = length of physical link
- s = propagation speed in medium (~$2x10^8$ m/sec)
- propagation delay = d/s



Note: s and R are *very* different quantities!

Packet loss pada jaringan

- Kapan packet loss pada jaringan terjadi?
  - **Ketika trafik pada router sangat padat**
    - Buffer pada router penuh
    - Tanpa prioritas : paket yang baru datang akan di-drop/ dibuang
  - **Ketika jumlah hop yang dilalui terlalu banyak**
    - Pada IP header terdapat parameter TTL (time to live)
    - TTL berisi jumlah hop yang boleh dilalui paket sampai ke tujuan. Setiap sampai di suatu hop angka TTL dikurangi 1.
    - Jika jumlah hop yang dilewati sudah melebihi angka dalam TTL, maka paket dibuang. Delay dianggap sudah terlalu lama dan kemungkinan ada kesalahan pada routing



Jitter

Jitter atau juga disebut variasi delay

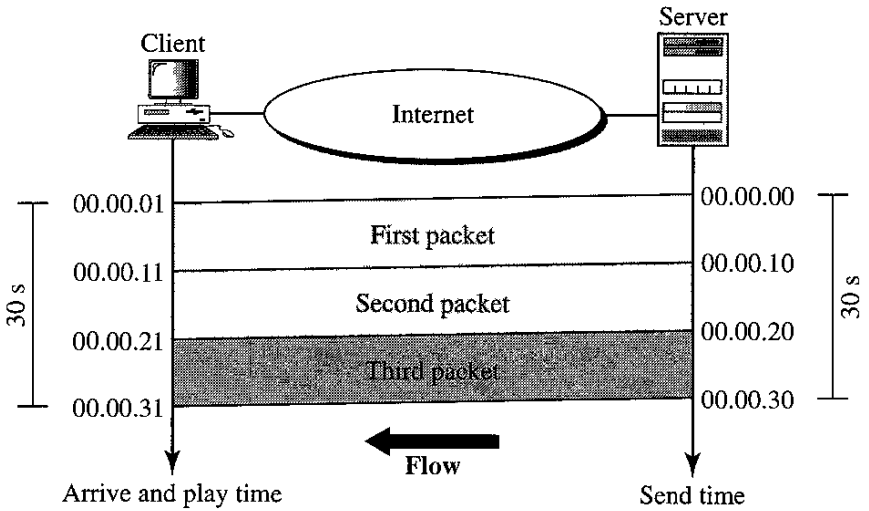
Contoh :

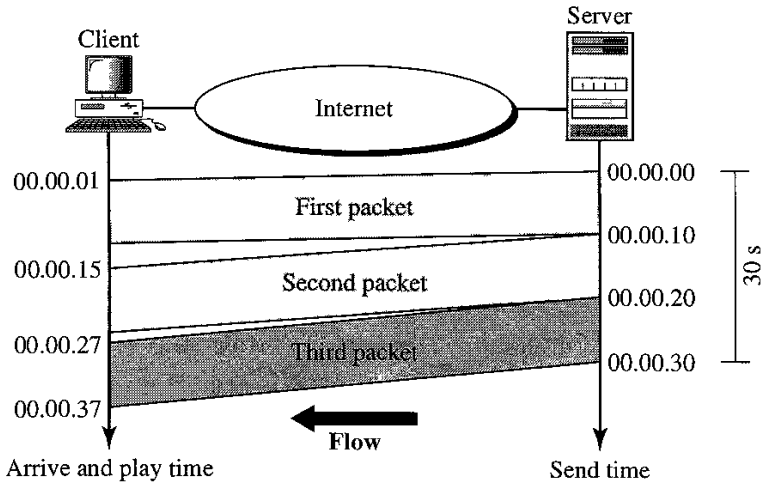
Paket Number	Kirim	Terima	Delay
0	0	20	20
1	1	21	20
2	2	22	20
3	3	23	20

Paket Number	Kirim	Terima	Delay
0	0	10	10
1	1	13	12
2	2	11	9
3	3	17	14

Paket Number	Kirim	Terima
1	0	1
2	10	11
3	20	21

Paket Number	Kirim	Terima
1	0	1
2	10	15
3	20	27





BER

Dikirim : 0 1 1 0 0 0 1 0 1 1

Diterima : 0 0 1 0 1 0 1 0 0 1