DTG1E3

DASAR TEKNIK TELEKOMUNIKASI

Pengenalan Sistem Transmisi

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Dimana Kita?

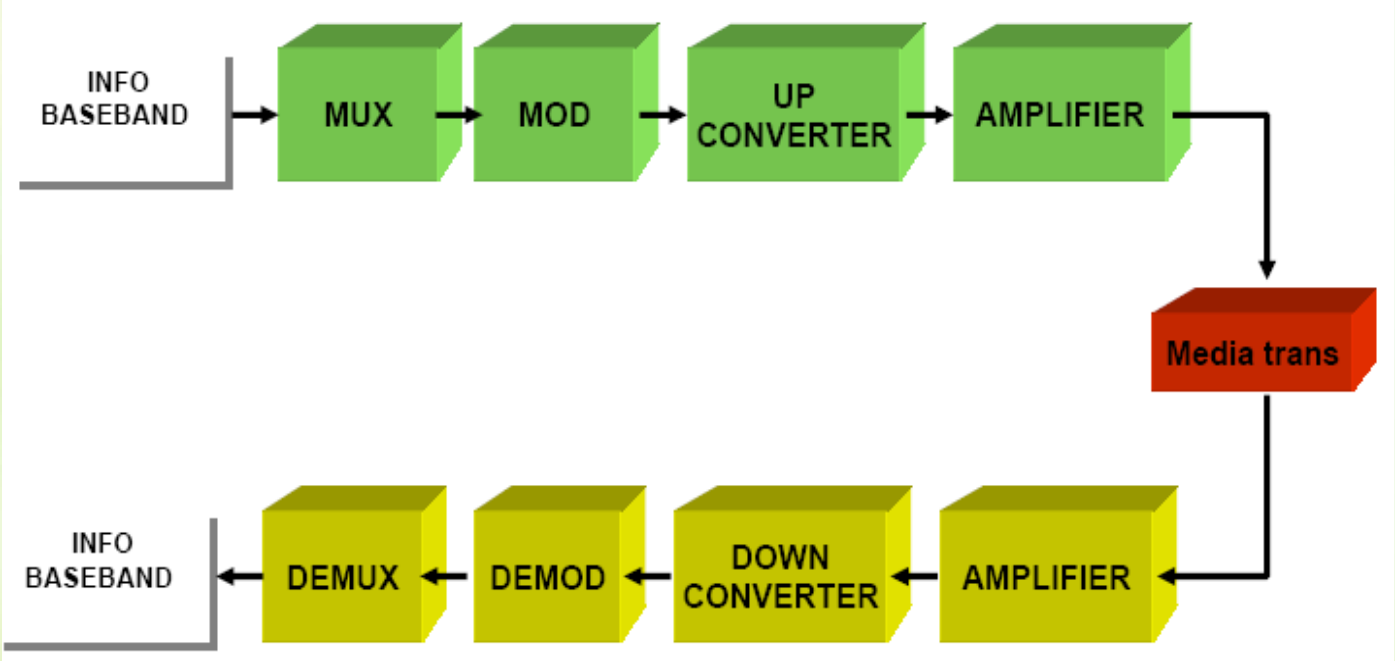
1. PENDAHULUAN
   - Perkenalan dan sosialisasi SAP&syllabus
   - Aturan Perkuliahan
2. KONSEP DASAR TELEKOMUNIKASI
   - Definisi Telekomunikasi
   - Elemen-elemen Penyusun Telekomunikasi
   - Jenis-jenis Komunikasi
   - Klasifikasi sinyal informasi
   - Proses ADC
3. KLASISFIKASI SISTEM KOMUNIKASI
   - Klasifikasi berdasarkan media(Media fisik dan non fisik)
   - Klasifikasi berdasarkan sinyal informasi (Analog dan Digital)
4. PENGENALAN JARINGAN TELEKOMUNIKASI KABEL
   - Elemen Jaringan Komunikasi berbasis Kabel
   - Hierarki Jaringan PSTN
   - Sistem Penomoran
   - Jaringan Akses PSTN
   - Pengenalan sentral
   - Fungsi sentral
   - Jenis-Jenis Sentral
5. PENGENALAN JARINGAN TELEKOMUNIKASI NIRKABEL (WIRELESS)
   - Definisi Telekomunikasi nirkabel
   - Elemen Penyusun Jaringan Telekomunikasi nirkabel
   - Contoh Konfigurasi jaringan Telekomunikasi nirkabel
6. PENGENALAN TOPOLOGI JARINGAN
   - Macam-macam topologi jaringan
   - Jaringan Masa depan
7. KONSEP DESIBEL
   - Satuan Daya, Gain dan Loss
   - Pemahaman dB, dBw, dBm
   - Contoh kasus perhitungan
8. PENGENALAN KUALITAS SISTEM TELEKOMUNIKASI
   - Pengenalan sinyal informasi dan daya sinyal informasi
   - Pengenalan sinyal noise dan daya sinyal noise
   - Konsep S/N dan BER
   - Contoh kasus untuk sistem telekomunikasi analog
   - Contoh kasus untuk sistem telekomunikasi digital

Dimana Kita?

9. **PENGENALAN SISTEM KOMUNIKASI OPTIK**
   - Elemen-elemen sistem Komunikasi optik
   - Spektrum sistem komunikasi optik
   - Jenis-Jenis sumber optik
   - Jenis-Jenis Serat optik
10. PENGANTAR SISTEM TRANSMISI TELEKOMUNIKASI
    - Klasifikasi Spektrum frekuensi
    - Pengenalan sistem transmisi dan elemen-elemennya
    - sistem multipleksing
    - sistem modulasi
    - Antena
11. SISTEM AKSES KOMUNIKASI RADIO
    - Definisi multiple akses
    - Jenis- Jenis multiple akses (FDMA, TDMA,CDMA
12. PENGANTAR SISTEM KOMUNIKASI BERGERAK
    - Konsep Wireless, mobile Communication
    - Dasar Perkembangan mobile Communication
    - Sistem komunikasi seluler
    - Pemodelan sel dan sel riil
    - Frekuensi reuse dan Handover
    - Konfigurasi sistem komunikasi seluler
    - Evolusi sistem komunikasi seluler dari 1G sampai 4G
13. **PENGENALAN SISTEM KOMUNIKASI SATELIT**
    - Pengenalan Sistem Komunikasi Satelit
    - Elemen-elemen sistem komunikasi satelit
    - Aplikasi sistem komunikasi satelit
14. PENGENALAN TRAFIK TELEKOMUNIKASI
    - Definisi Telekomunikasi nirkabel
    - Elemen Penyusun Jaringan Telekomunikasi nirkabel
    - Contoh Konfigurasi jaringan Telekomunikasi nirkabel
15. PENGENALAN KOMUNIKASI DATA DAN KLASIFIKASI JARINGAN
    - Konsep Routing
    - Definisi sistem komunikasi data
    - Pengenalan Lapisan Komunikasi
    - Definisi Protokol dan contohnya
    - Klasifikasi Jaringan
16. PENGENALAN FUTURE TECHNOLOGY
    - Wifi
    - Wimax
    - LTE

APA ITU TRANSMISI?

- Secara bahasa berarti pengiriman atau pergerakan. Artinya transmisi adalah proses pengiriman/ pergerakan informasi dari satu titik ke titik lainnya dalam sistem komunikasi.



Metoda Transmisi

DIGITAL TRANSMISSION → Baseband Transmission VS Bandpass Transmission

Transmitted power;
bandpass/baseband signal

Information:
- analog:BW & dynamic range
- digital:bit rate

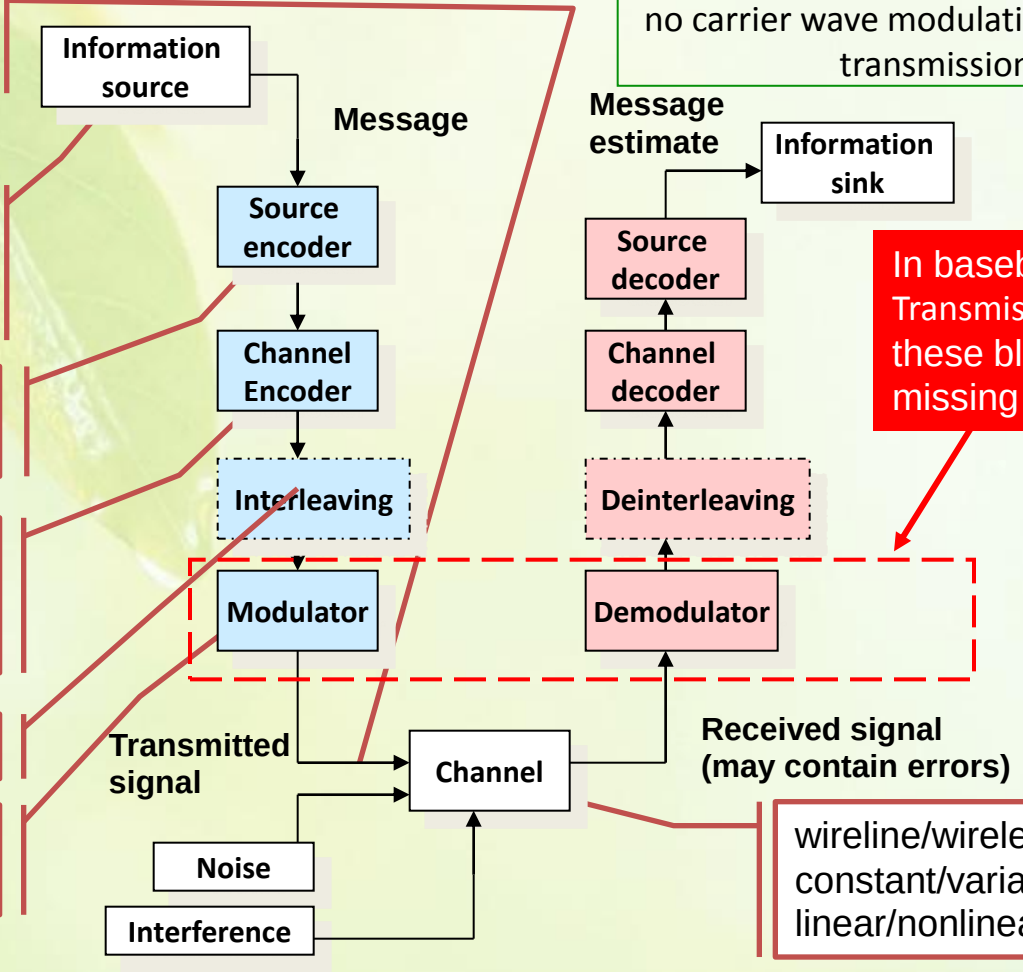
Maximization of information transferred

Message protection & channel adaptation;
convolution, block coding

Fights against burst errors

M-PSK/FSK/ASK..., depends on channel BW & characteristics

"**Baseband'Transmission**" means that no carrier wave modulation is used for transmission



In baseband Transmission these blocks are missing

wireline/wireless
constant/variable
linear/nonlinear

Metoda Transmisi

- Tanpa gel pembawa :
  - **Sinyal info ditransmisikan pd frek baseband (pita frek dasar)**
  - **Mis : transmisi suara antara pelanggan dan sentral**
  - **Menggunakan media kawat : OWC, kabel urat jamak**
- Dgn gel pembawa :
  - **Sinyal info ditrasmisikan tidak pd frek baseband**
  - **Sinyal ditumpangkan pd frek gel pembawa**
  - **Hampir semua trans menggunakan gel pembawa**

Metoda Transmisi

TANPA GELOMBANG PEMBAWA → Baseband Transmission

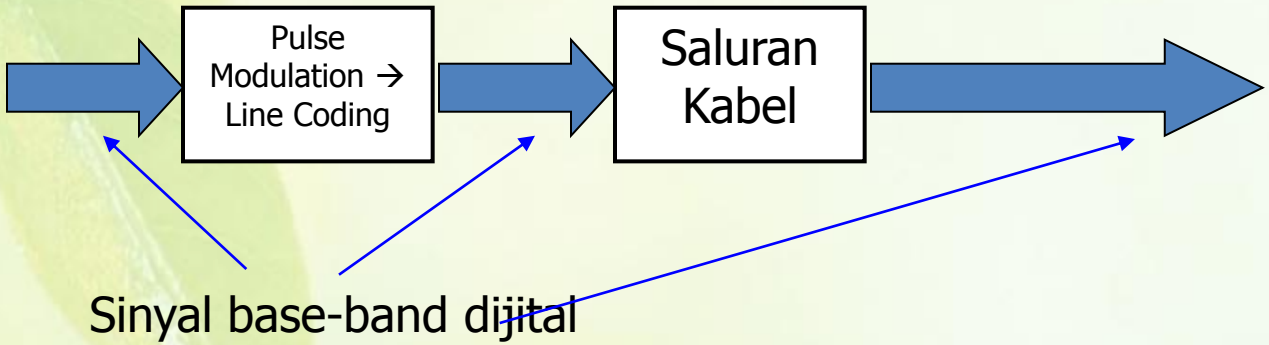
-output ADC

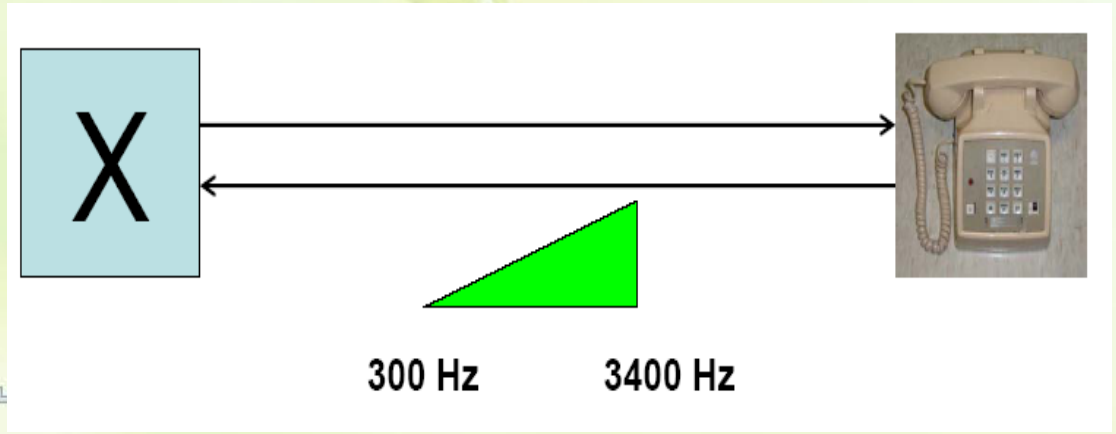
- sinyal TDM

-Sinyal data text

-Output scrambler

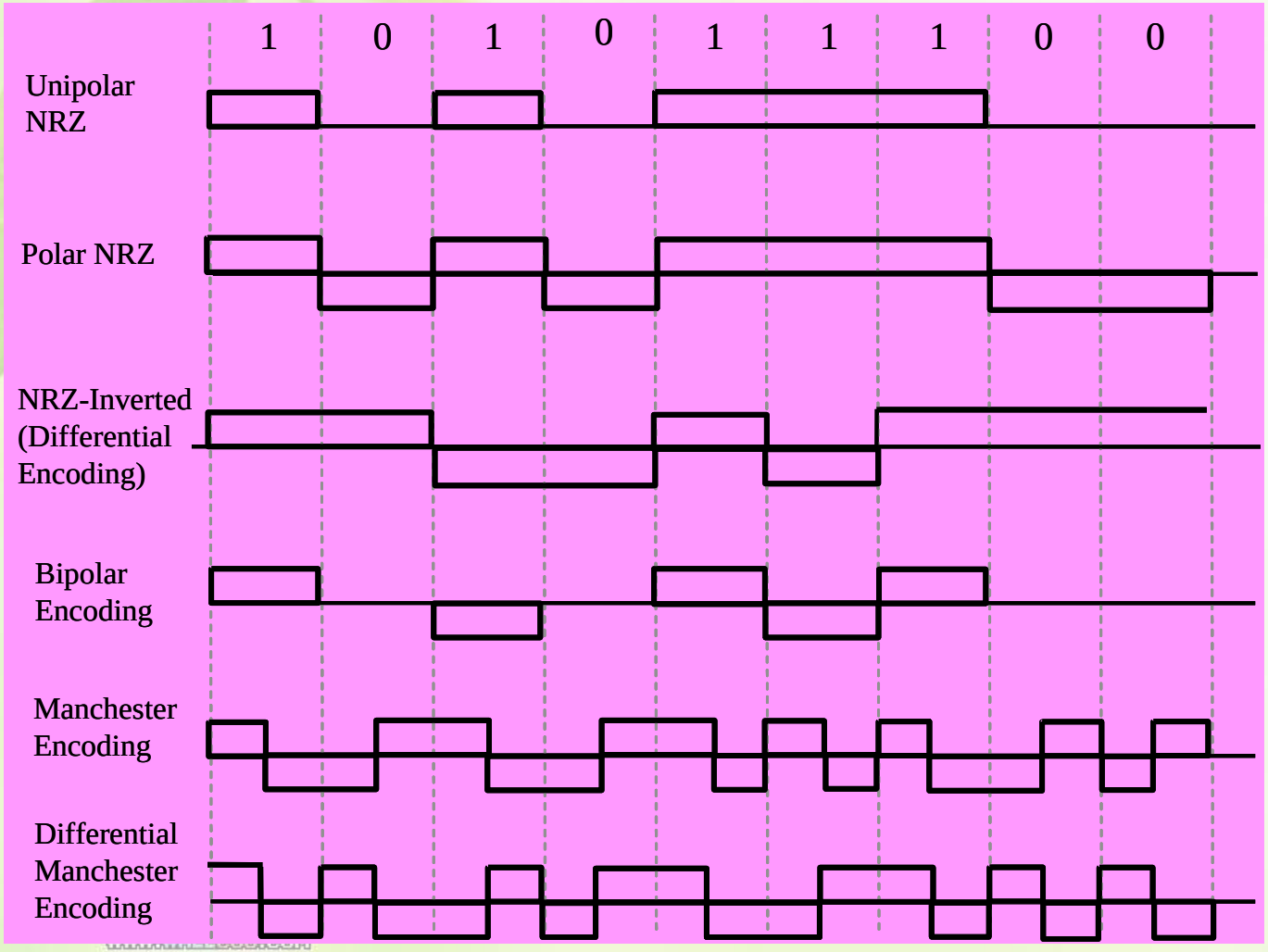
-Output FEC





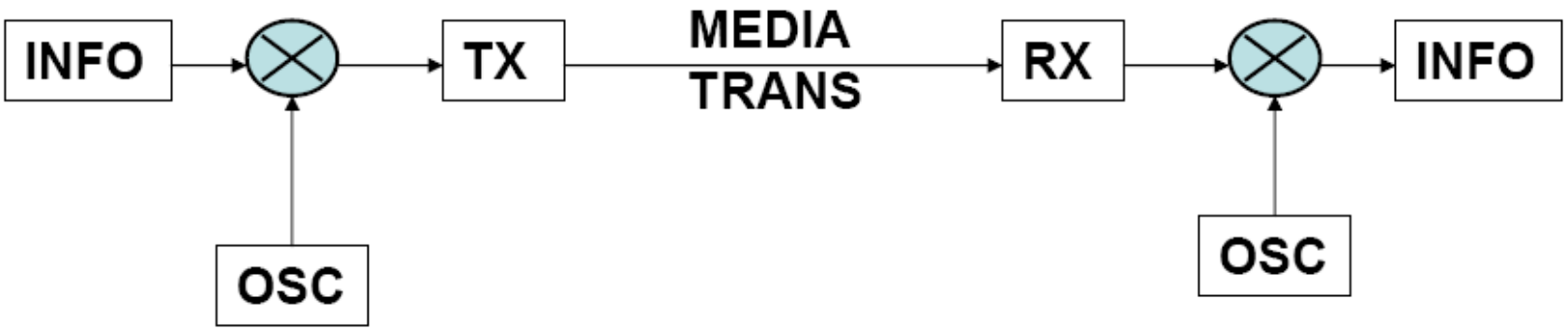
Metoda Transmisi

TANPA GELOMBANG PEMBAWA → Baseband Transmission



Metoda Transmisi

DENGAN GELOMBANG PEMBAWA



Ada translasi frekuensi dr frek baseband ke frek transmisi.

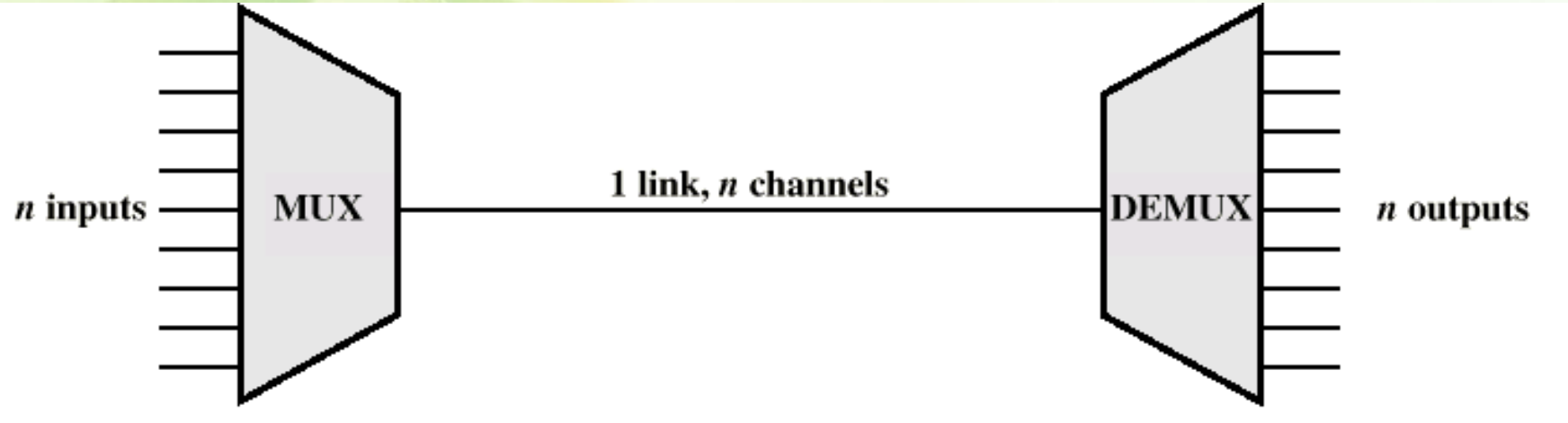
Info :

- Tunggal

- Jamak (perlu multipleks)

Transmisi

MULTIPLEXING



Multiplexing merupakan proses penggabungan beberapa kanal sinyal informasi kedalam satu kanal informasi dengan tujuan agar sinyal informasi dapat dikirimkan secara simultan dalam satu kanal

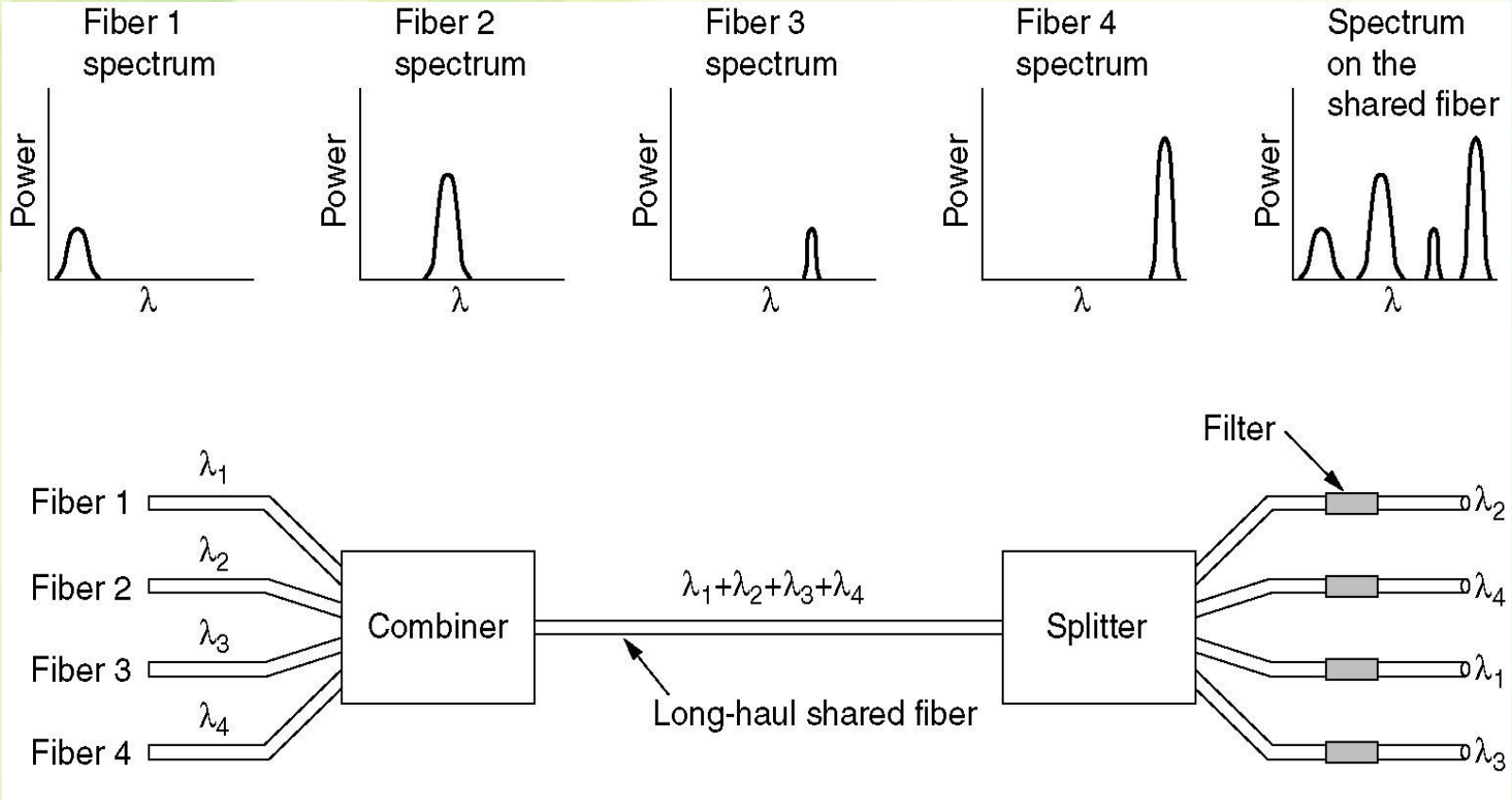
Jenis – Jenis Multiplexing:

- Frequency Division Multiplexing (FDM)
- Wavelength Division Multiplexing (WDM) → Khusus Serat Optik
- Time Division Multiplexing (TDM)

Transmisi

MULTIPLEXING

WDM

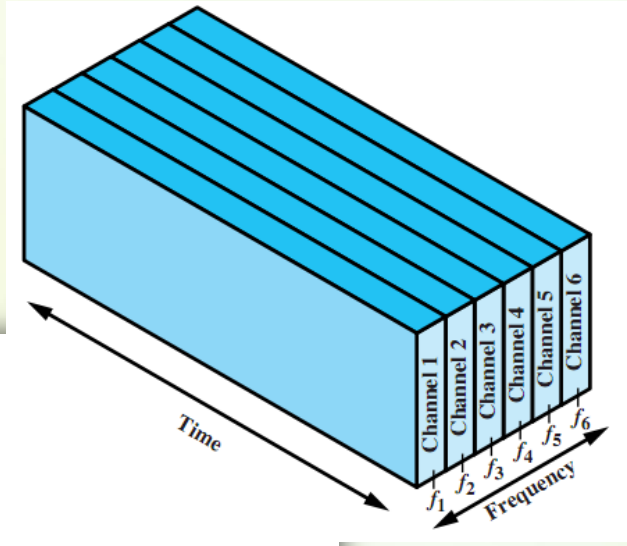


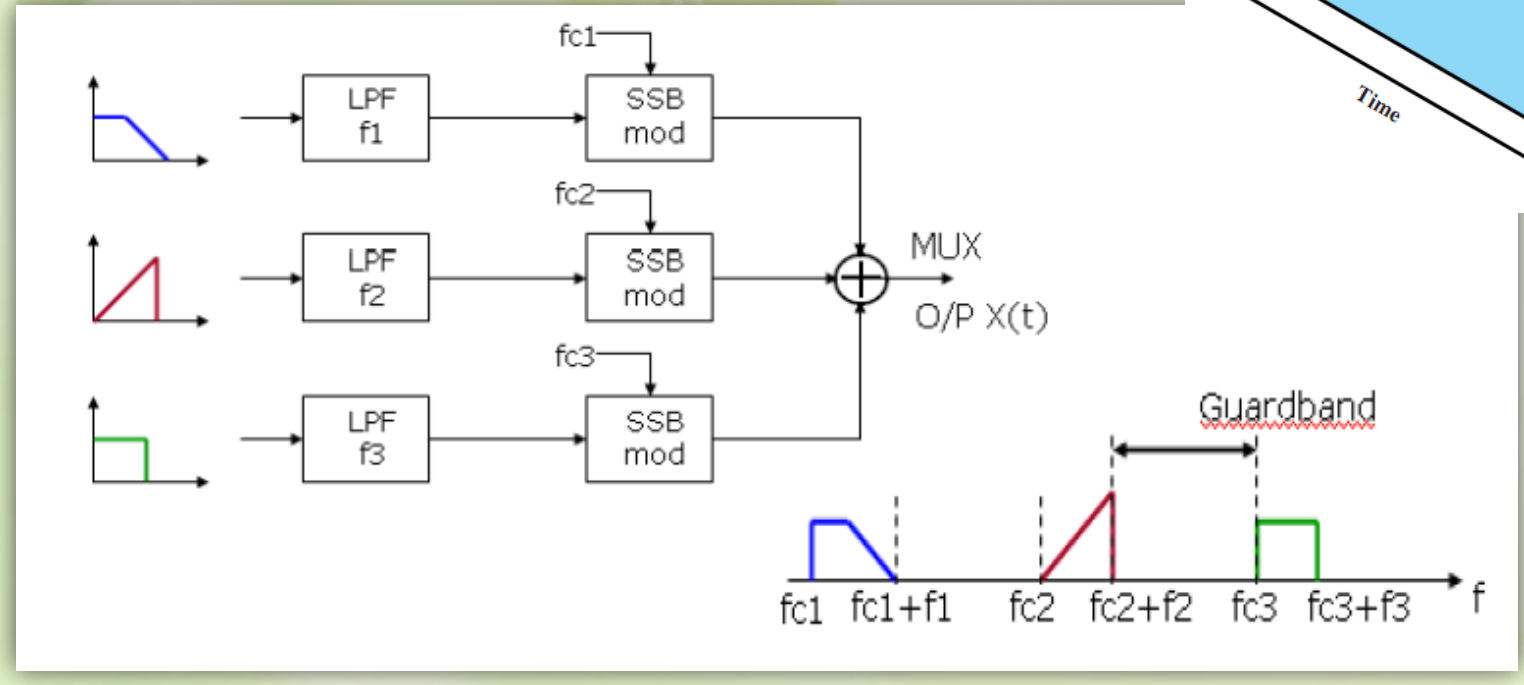
Transmisi

MULTIPLEXING

FDM

FDM yaitu proses multiplexing sejumlah sinyal yang dibawa secara simultan dimana tiap sinyal dimodulasikan ke frekuensi carier yang berlainan, yang kemudian dibawa menuju media yang sama dengan cara mengalokasikan band frekuensi yang berlainan ke masing-masing sinyal.

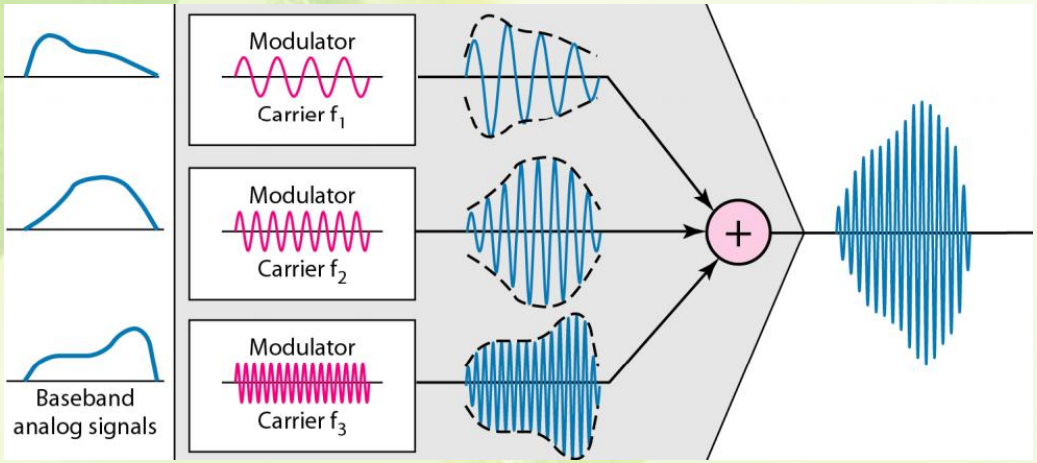




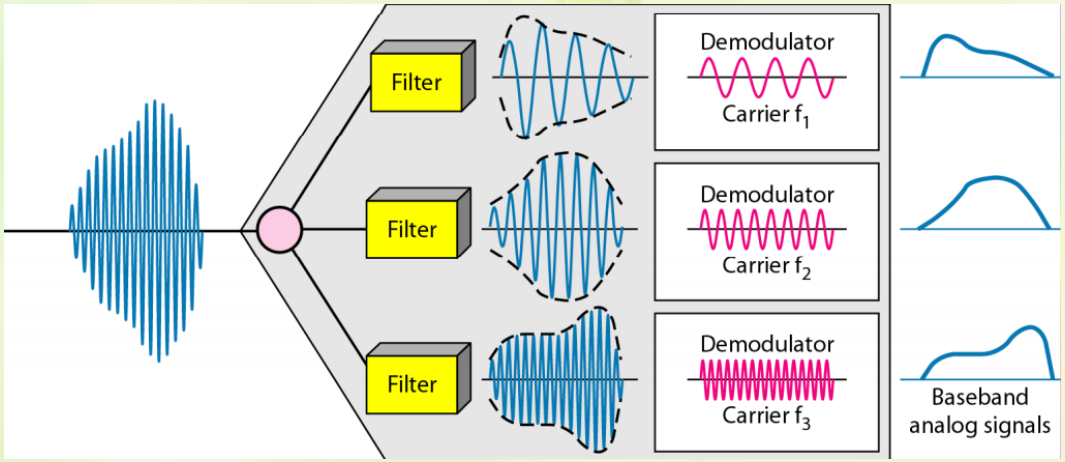
Transmisi

FDM

MULTIPLEXING



DEMULTIPLEXING

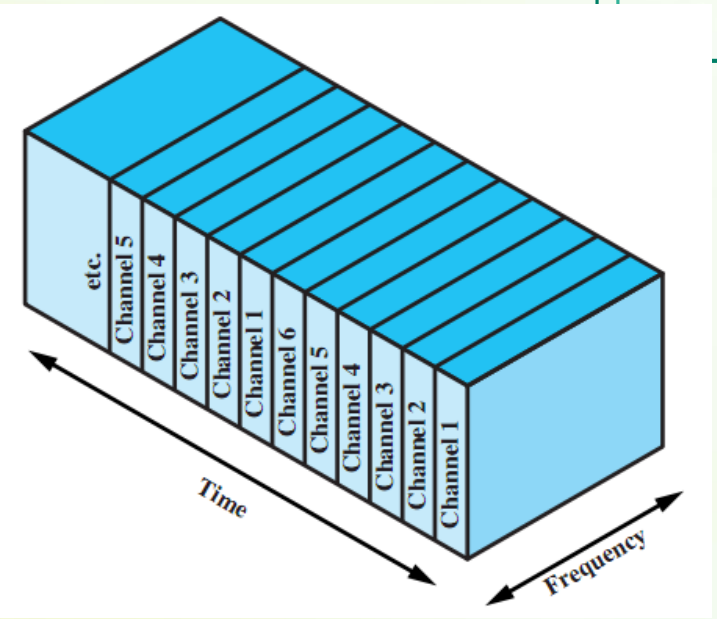


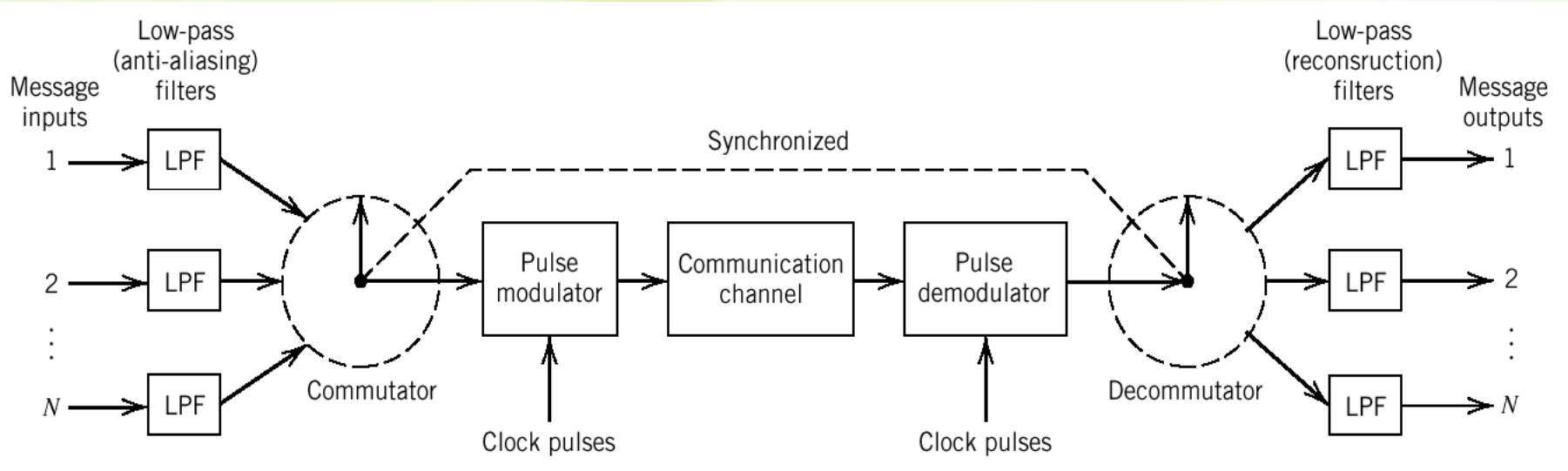
Transmisi

MULTIPLEXING

TDM

- Time Division Multiplexing merupakan proses multiplexing
dengan cara membagi waktu menjadi slot-slot waktu yang
menyatakan informasi dari tiap kanal
- TDM – PCM (Time Division Multiplexing – Pulse Code Modulation) merupakan proses multiplexing sinyal yang menggunakan teknik pengkodean PCM



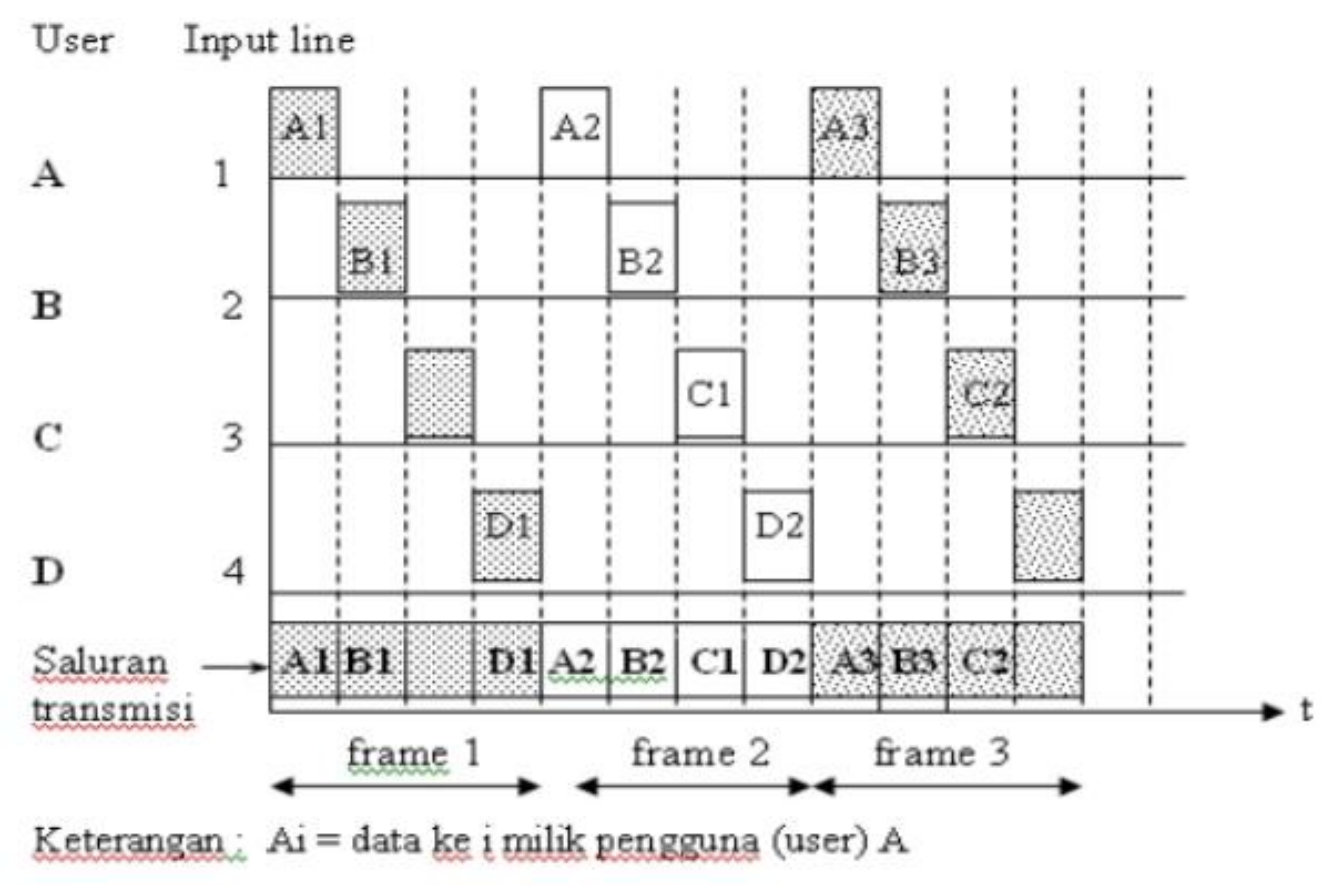


Transmisi

TDM

TDM terdiri Atas :

- **Synchronous TDM**
- **Asynchronous TDM**



Transmisi

PULSE CODE MODULATION

Proses yang terjadi dalam ADC→PCM (Pulse Code Modulation) :

Sampling (pencuplikan)
Quantizing (kuantiasasi)
Encoding (pengkodean)

Bit Rate Kanal Voice

Frekuensi sampling (f_s) > 2 . BW
> 2 . frekuensi informasi maksimum
(berdasarkan kriteria Nyquist)

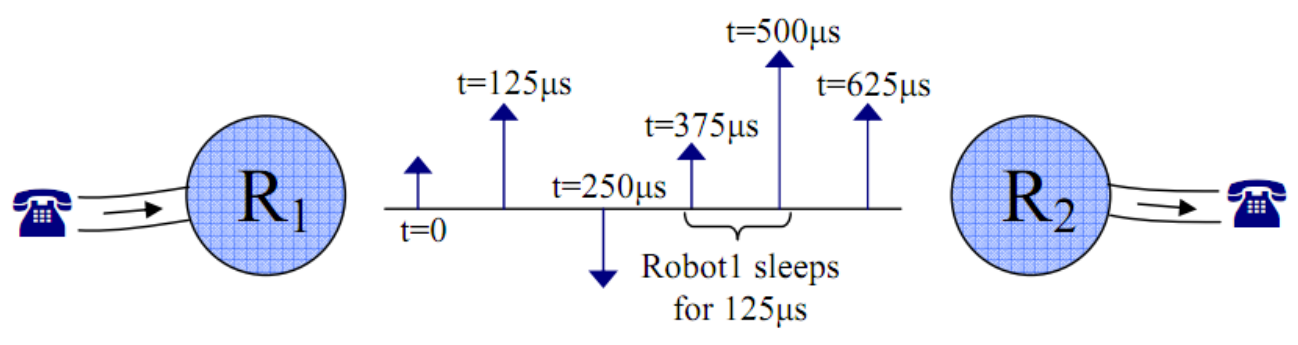
BW kanal suara ~ 4 kHz (300 – 3400 Hz)
Kecepatan sampling untuk tiap kanal suara = 2 x 4000 = 8000 sample/s
1 sample dikodekan menjadi 8 bit

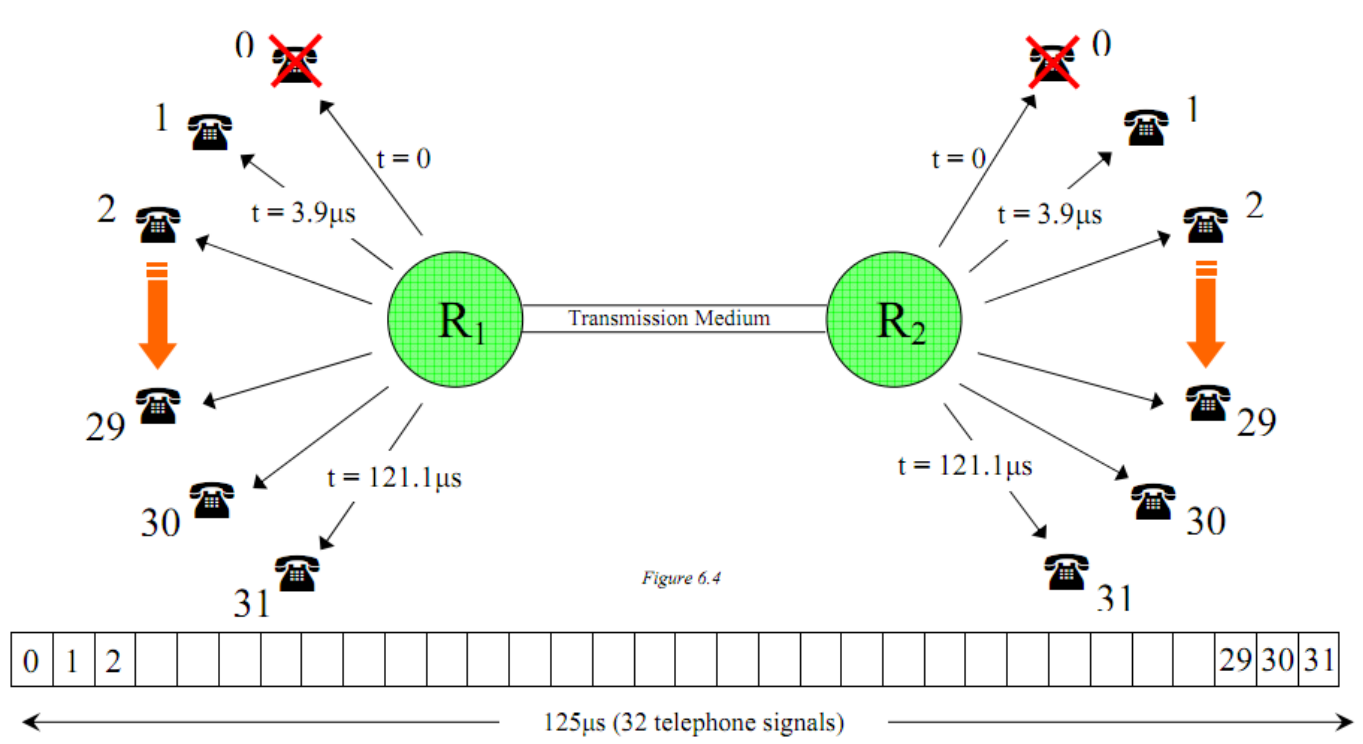
Bit rate 1 kanal voice :

BR = 8000 sample/detik x 8 bit/sample
= 64 kbps

Transmisi

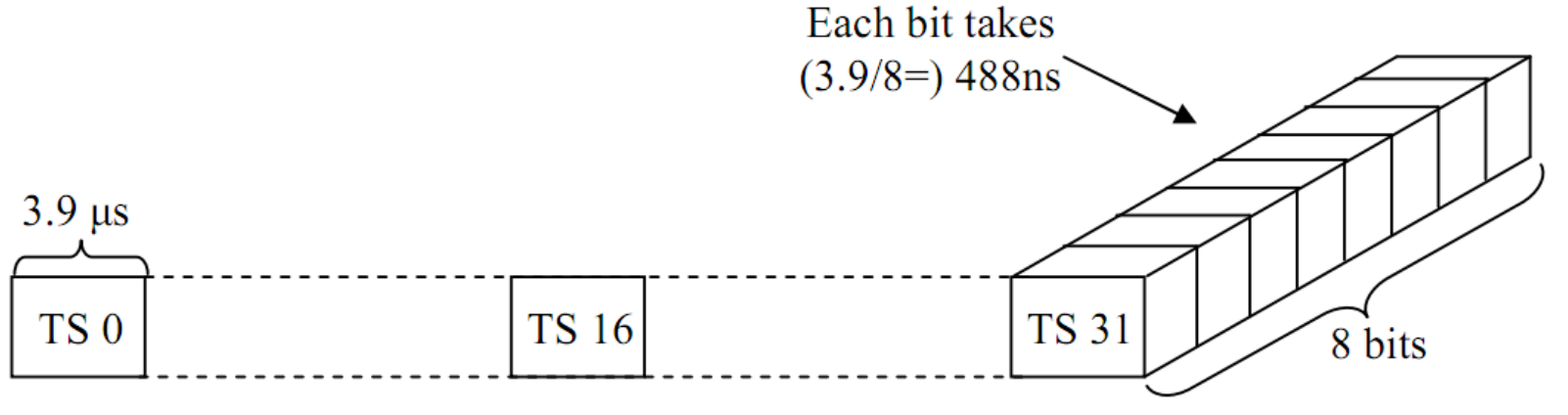
TDM Concept





Transmisi

TDM



Time taken for the whole frame = 125µs

Number of bits in a frame = 32 x 8
= 256 bits

Hence the speed of the frame = 256 bits / 125µs

$$= \frac{256 \text{ bits}}{(125 \times 10^{-6}) \text{ s}}$$

= 2.048 Mb/s

Number of bits in a single time slot = 8 bits

Hence the speed of one telephone channel $= \frac{8 \text{ bits}}{3.9\mu s}$

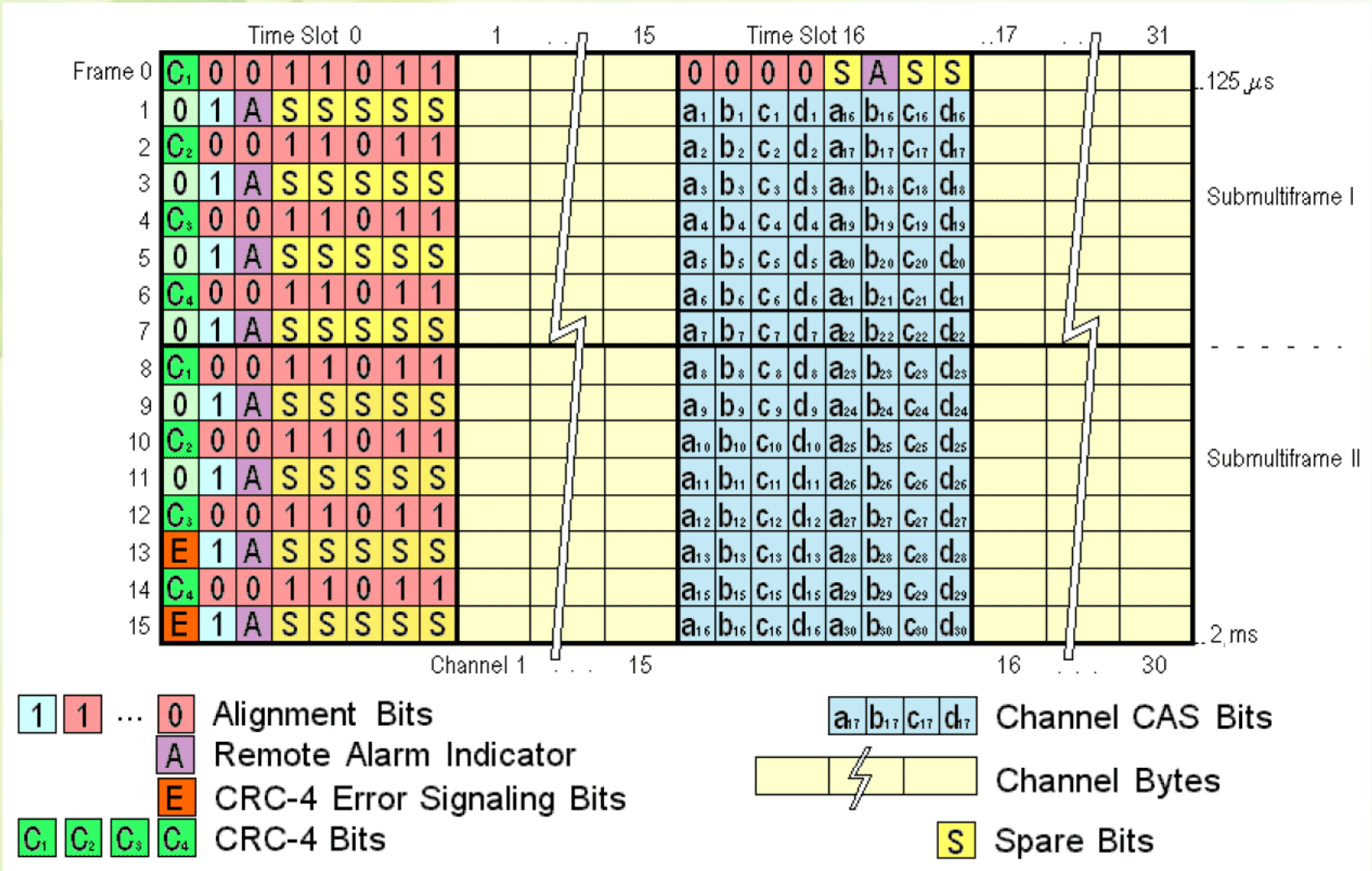
$$= \frac{8 \text{ bits}}{(125 \times 10^{-6}) \text{ s}}$$

= 64 kb/s

Therefore the speed of any telephone channels is 64 kb/s.

Transmisi

TDM – E Carrier



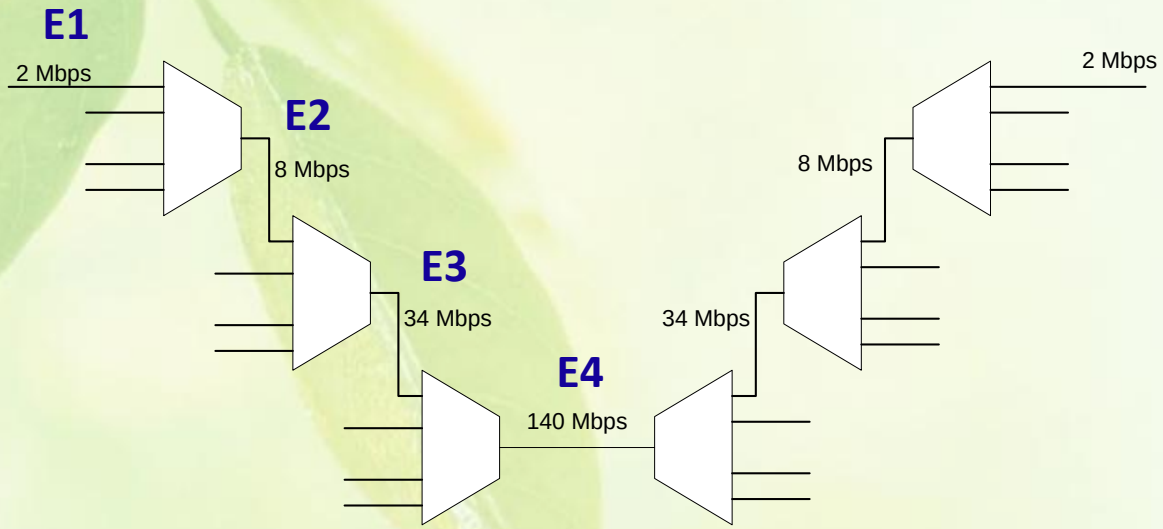
Transmisi

TDM – PDH (Plesiochronous Digital Hierarchy)

- A TECHNOLOGY USED IN TELECOMMUNICATIONS NETWORK TO TRANSPORT LARGE QUANTITY OF DATA OVER DIGITAL TRANSPORT EQUIPMENT SUCH AS FIBRE OPTIC AND MICROWAVE RADIO WAVE SYSTEMS.
- THE TERM "PLESIOCHRONOUS" IS DERIVED FROM Greek *plesio* which means near, and chronous, time.
- IT MEANS THAT PDH NETWORKS RUN IN A STATE WHERE DIFFERENT PARTS OF THE NETWORK ARE ALMOST, BUT NOT QUITE PERFECTLY SYNCHRONISED.
- PDH ALLOWS TRANSMISSION OF DATA STREAMS THAT ARE NOMINALLY RUNNING AT THE SAME RATE, BUT ALLOWING SOME VARIATION ON THE SPEED AROUND A NOMINAL RATE.
- BY ANALOGY, ANY TWO WATCHES ARE NOMINALLY RUNNING AT THE SAME RATE, CLOCKING UP 60 SECONDS EVERY MINUTE.
- HOWEVER, THERE IS NO LINK BETWEEN WATCHES TO GUARANTEE THEY RUN AT EXACTLY THE SAME RATE.
- IT IS HIGHLY LIKELY THAT ONE IS RUNNING SLIGHTLY FASTER THAN THE OTHER.

Transmisi

TDM – PDH (Plesiochronous Digital Hierarchy)



T-carrier and E-carrier systems	North American	Japanese	European (CEPT)
Level zero (channel data rate)	64 kbit/s (DS0)	64 kbit/s	64 kbit/s
First level	1.544 Mbit/s (DS1) (24 user channels) (T1)	1.544 Mbit/s (24 user channels)	2.048 Mbit/s (32 user channels) (E1)
(Intermediate level, T-carrier hierarchy only)	3.152 Mbit/s (DS1C) (48 Ch.)	–	–
Second level	6.312 Mbit/s (DS2) (96 Ch.) (T2)	6.312 Mbit/s (96 Ch.), or 7.786 Mbit/s (120 Ch.)	8.448 Mbit/s (128 Ch.) (E2)
Third level	44.736 Mbit/s (DS3) (672 Ch.) (T3)	32.064 Mbit/s (480 Ch.)	34.368 Mbit/s (512 Ch.) (E3)
Fourth level	274.176 Mbit/s (DS4) (4032 Ch.)	97.728 Mbit/s (1440 Ch.)	139.264 Mbit/s (2048 Ch.) (E4)
Fifth level	400.352 Mbit/s (DS5) (5760 Ch.)	565.148 Mbit/s (8192 Ch.)	565.148 Mbit/s (8192 Ch.) (E5)

https://en.wikipedia.org/wiki/E-carrier

Transmisi

TDM – SDH (Synchronous Digital Hierarchy)

SYNCHRONOUS :
ONE MASTER CLOCK & ALL ELEMENTS SYNCHRONISE WITH IT.

DIGITAL:
INFORMATION IN BINARY.

HIERARCHY:
SET OF BIT RATES IN A HIERARCHIAL ORDER.

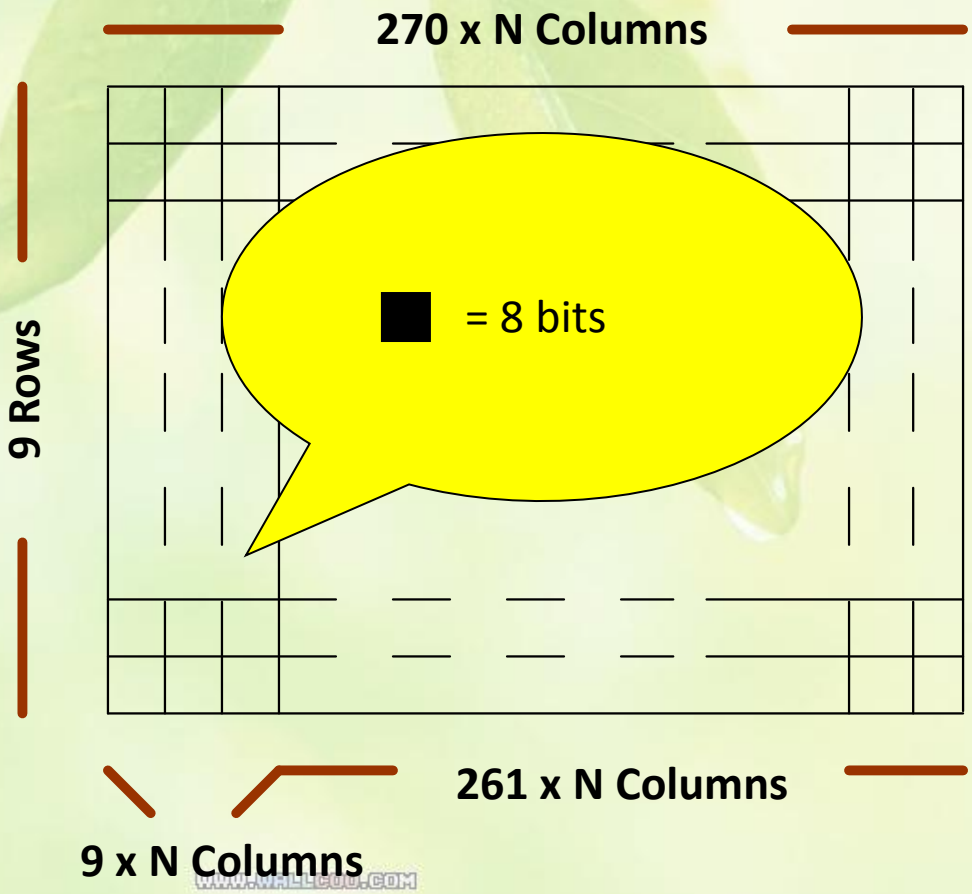
- 2 clocks are said to be synchronous (syn=same chronos=time)
  - if they *tick in time*, i.e. have precisely the same frequency
- 2 clocks are said to be plesiochronous (plesio=near chronos=time)
  - if they are nominally if the same frequency
  - but are not *locked*

Transmisi

TDM – SDH (Synchronous Digital Hierarchy)

SDH FRAME STRUCTURE

STM-N FRAME STRUCTURE



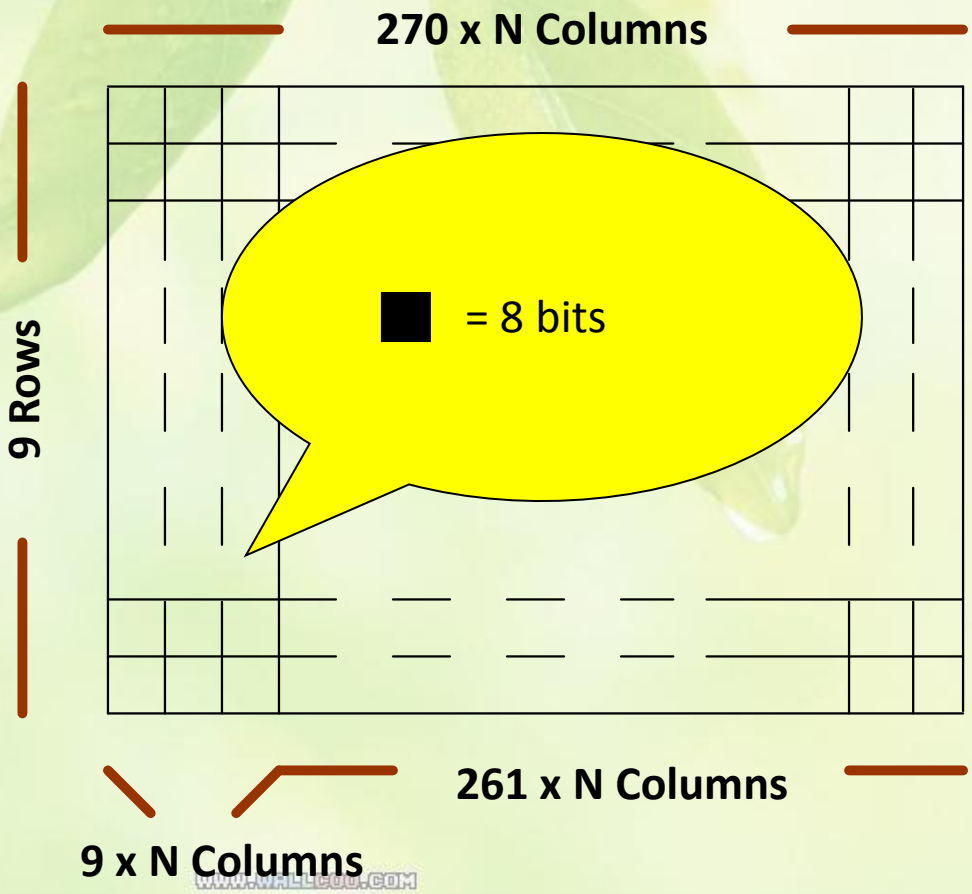
The principle for SDH signal frame transmission is: the bytes (8-bit) within the frame structure is transmitted byte-by-byte (bit-by-bit) from left to right and from top to bottom. After one row is transmitted, the next row will follow. After one frame is completed, the next frame will start

Transmisi

TDM – SDH (Synchronous Digital Hierarchy)

SDH FRAME STRUCTURE

STM-N FRAME STRUCTURE



ITU-T defines the frequency to be 8000 frames per second for all levels in STM hierarchy

STM-1 Rate :

9 rows x 270 columns x 8 bits/byte x 8000 frames per second

= 155.52 Mb/s

STM-4 Rate :

9 rows x (270 x 4) columns x 8 bits/byte x 8000 frames per second

= 622 Mb/s

Transmisi

TDM – SDH (Synchronous Digital Hierarchy)

SDH Multiplexing Hierarchy

Data Rate (Mbps)	SONET (USA)	SDH (Europe)
51.84	STS-1, OC-1	*(not defined)*
155.52	STS-3, OC-3	STM-1
466.56	STS-9, OC-9	STM-3
622.08	STS-12, OC-12	STM-4
933.12	STS-18, OC-18	STM-6
1244.16	STS-24, OC-24	STM-8
1866.24	STS-36, OC-36	STM-12
2488.32	STS-48, OC-48	STM-16
9953.28	STS-192, OC-192	STM-64

STS = Synchronous Transport Signal

OC = Optical carrier

STM = Synchronous Transport Module

Transmisi

TDM – SDH (Synchronous Digital Hierarchy)

SONET	SDH	T1	T3	E1	E3	E4
STS-1		28	1	21	1	
STS-3	STM-1	84	3	63	3	1
STS-12	STM-4	336	12	252	12	4
STS-48	STM-16	1344	48	1008	48	16
STS-192	STM-64	5376	192	4032	192	64

Metoda Transmisi

TUGAS

1. Jelaskan yang dimaksud **E1** dan **T1**
2. Jelaskan Perbedaan *Synchronous TDM* dengan *Asynchronous TDM!*
3. Jelaskan perbedaan ***SDH*** *(Synchronous Digital Hierarchy)* dan ***PDH*** *(Plesiochronous Digital Hierarchy)*

Questions??