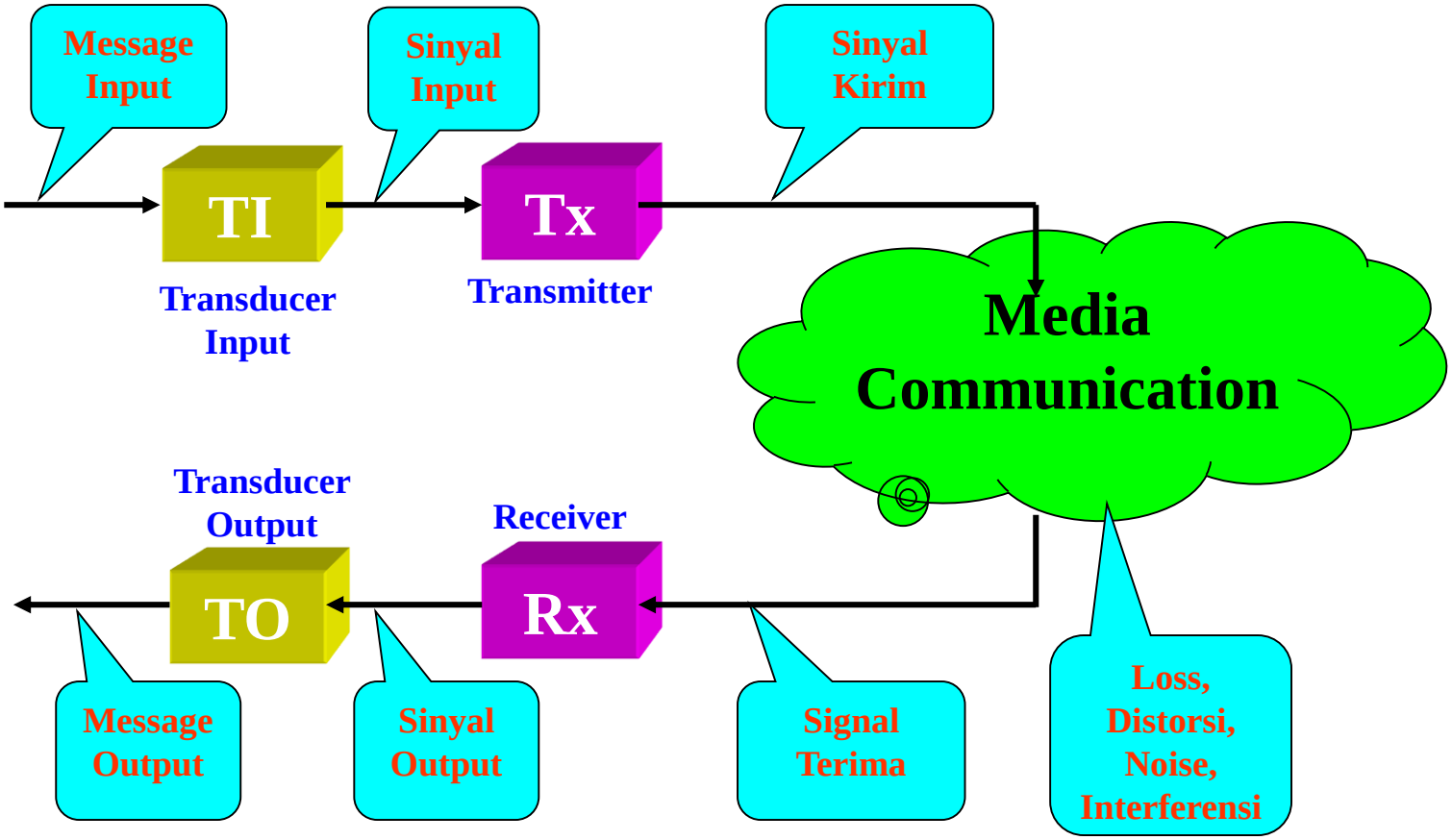
PENGENALAN TEKNIK TELEKOMUNIKASI

Modul : 07
Transmisi

Faculty of Electrical Engineering

BANDUNG, 2015

BLOK SISTEM KOMUNIKASI

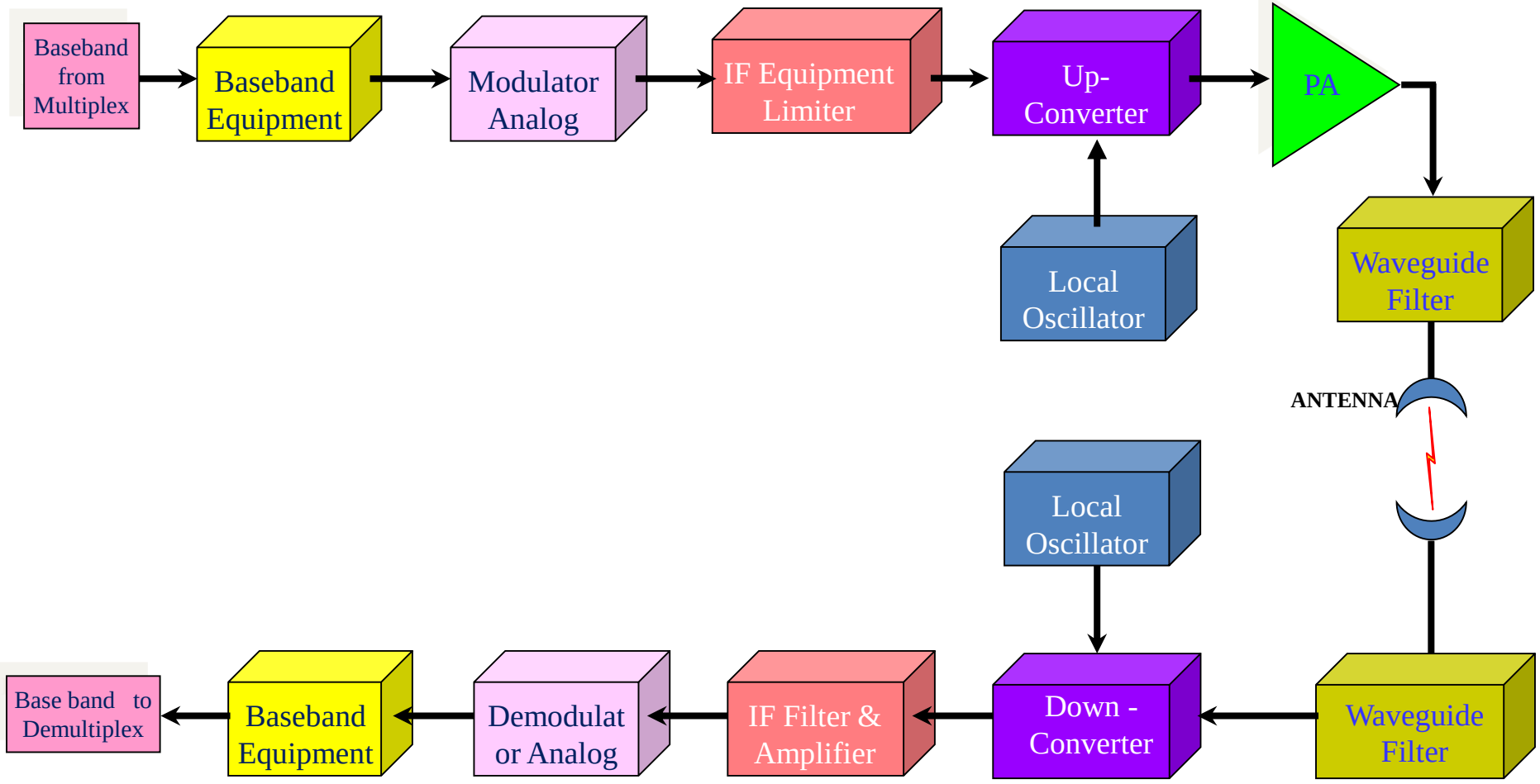


Message : informasi seperti suara, data, gambar, video, kode

Signal : bentuk listrik dari informasi

Transducer : mengubah informasi menjadi sinyal listrik dan sebaliknya

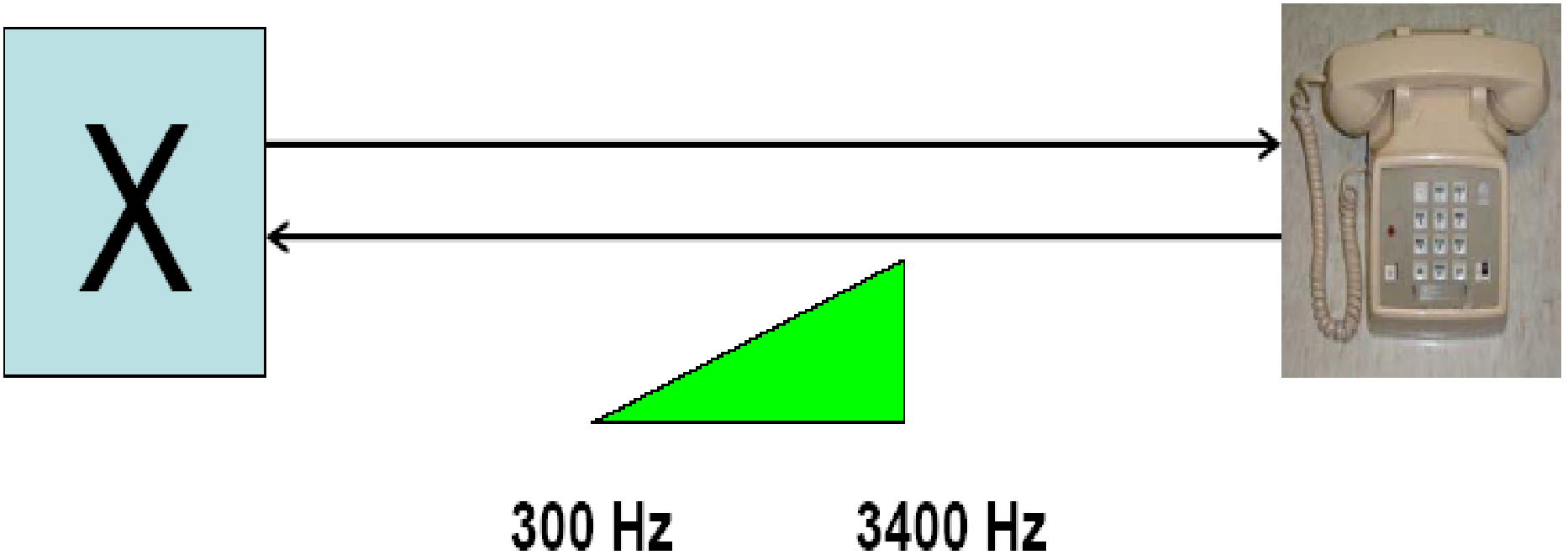
BLOK SISTEM KOMUNIKASI RADIO ANALOG



Gel Pembawa

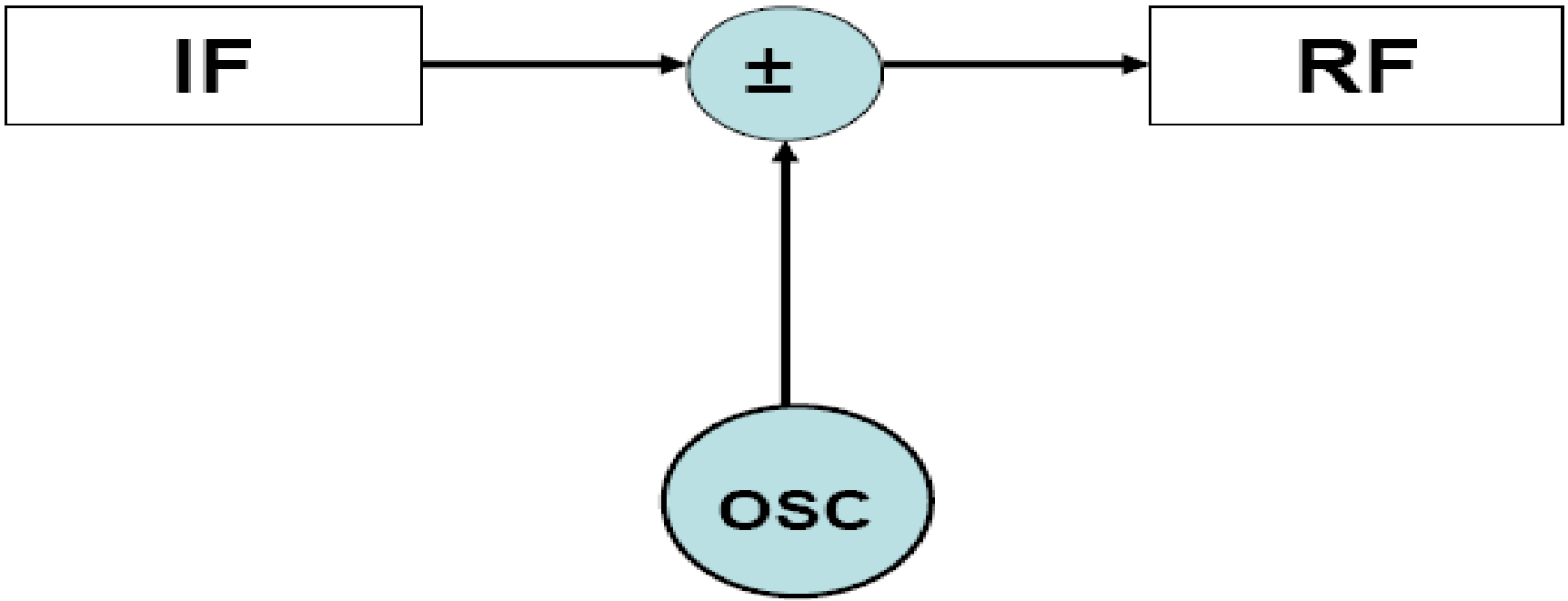
- Tanpa gel pembawa :
  - **Sinyal info ditransmisikan pd frek baseband (pita frek dasar)**
  - **Mis : transmisi suara antara pelanggan dan sentral**
  - **Menggunakan media kawat : OWC, kabel urat jamak**
- Dgn gel pembawa :
  - **Sinyal info ditrasmisikan tidak pd frek baseband**
  - **Sinyal ditumpangkan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

Tanpa gel pembawa



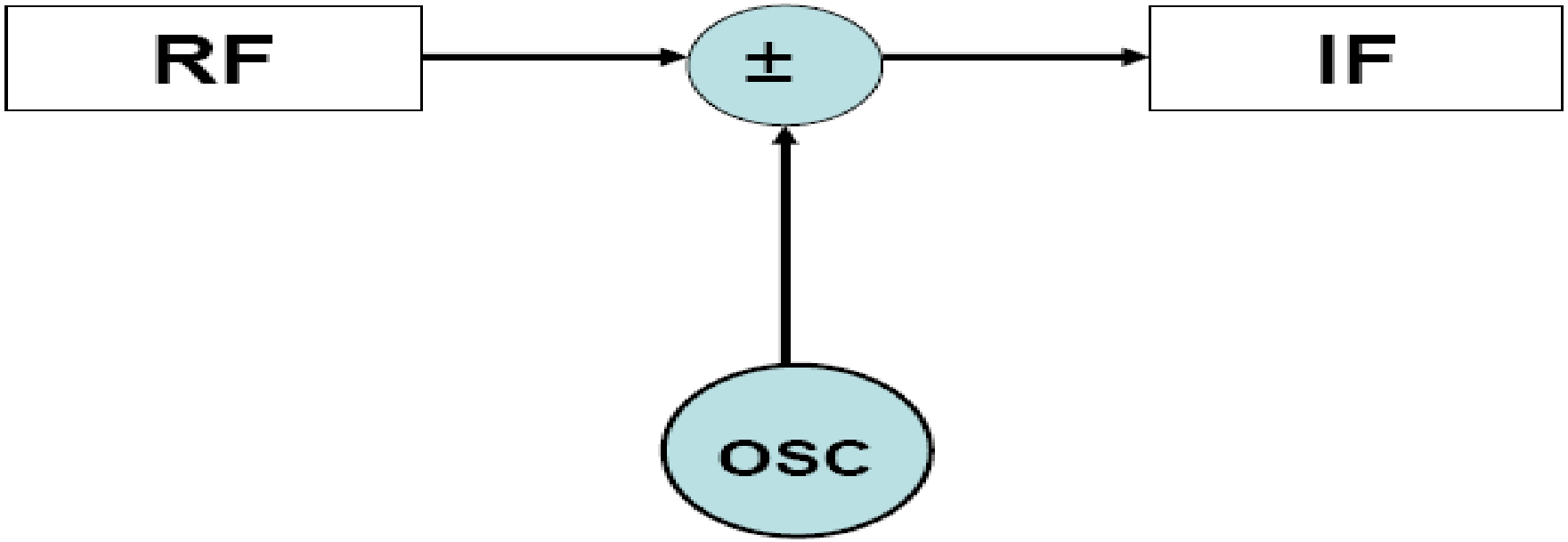
UP CONVERTER

Fungsi : mentranslasikan dr frek IF ke frek RF agar dpt ditransmisikan



DOWN CONVERTER

Fungsi : mentranslasikan dr frek RF ke frek IF utk didemodulasi



AMPLIFIER

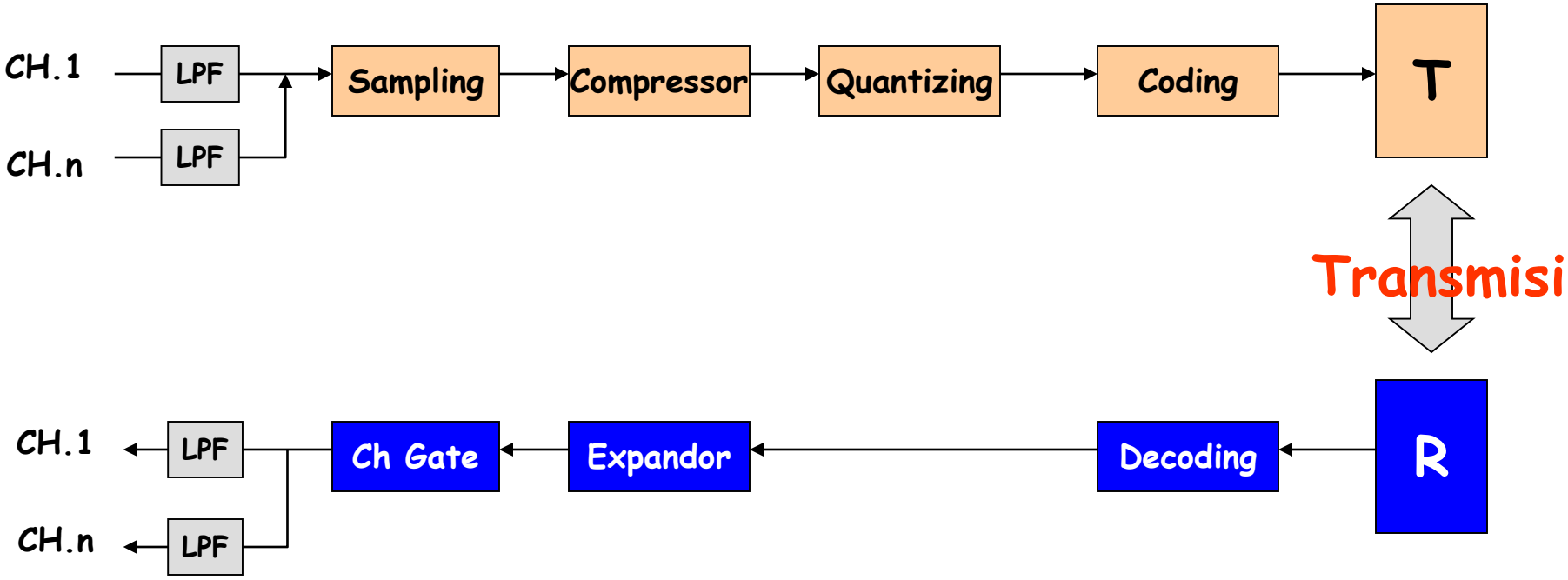
- Fungsi : menguatkan sinyal RF agar memiliki daya yang sesuai dengan kebutuhan yg diperlukan shg dpt menghasilkan kualitas yg distandarkan.
- TX : Daya relatif besar, noise figure tidak perlu rendah.
- RX : Daya tidak perlu besar, noise figure harus rendah.

Modulasi / Demodulasi

- Modulasi adalah proses menumpangkan sinyal informasi kedalam gelombang pembawa
- Demodulasi adalah proses mengambil kembali sinyal informasi yang ditumpangkan
- Teknik Modulasi / Demodulasi dilakukan dengan mengubah parameter gelombang pembawa, antara lain :
  - Amplitudo
  - Frekwensi
  - Phasa

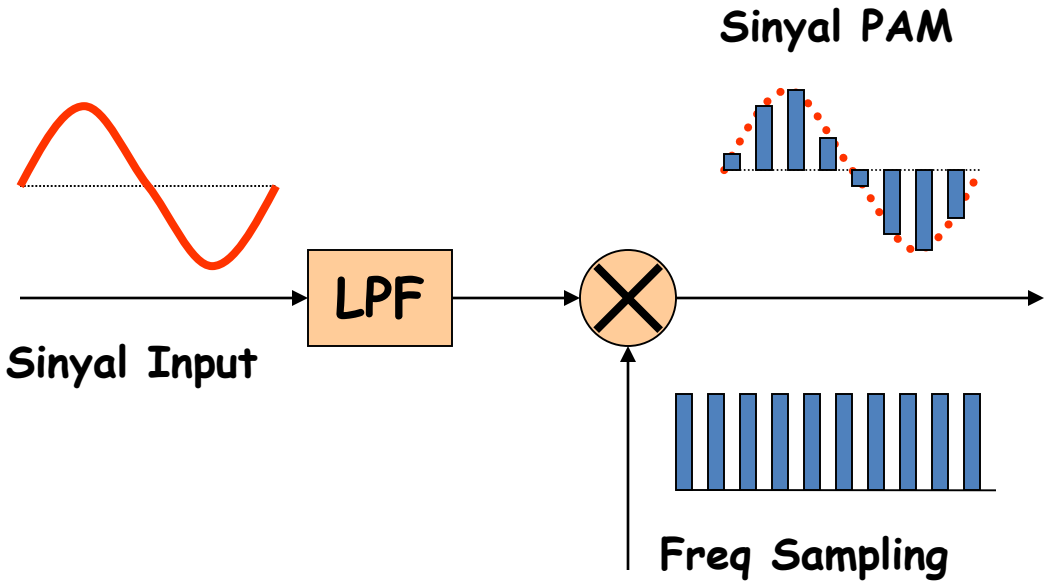
PCM

- Sisi Kirim
  - Sampling,Compressing, Quantizing, Coding
- Sisi Terima
  - Decoding,Expanding,Low Pass Filter



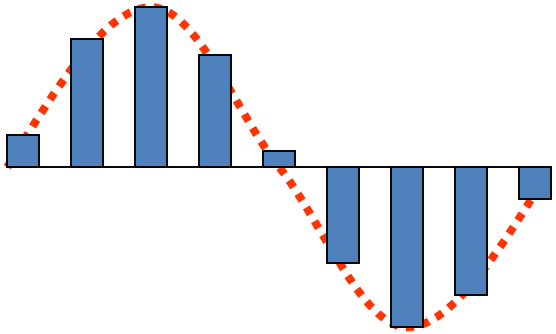
Sampling

- Adalah proses modulasi amplitudo yang merupakan langkah persiapan untuk merubah sinyal analog menjadi sinyal digital atau sinyal PAM

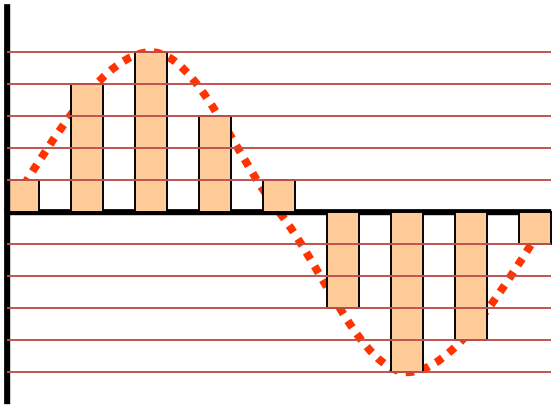


Quantizing

- Adalah proses awal untuk merubah sinyal PAM menjadi susunan digit, dimana sinyal hasil sampling dihargakan pada tegangan pembanding terdekat
- Quantisasi Uniform
- Quantisasi Non-Uniform



Sinyal PAM

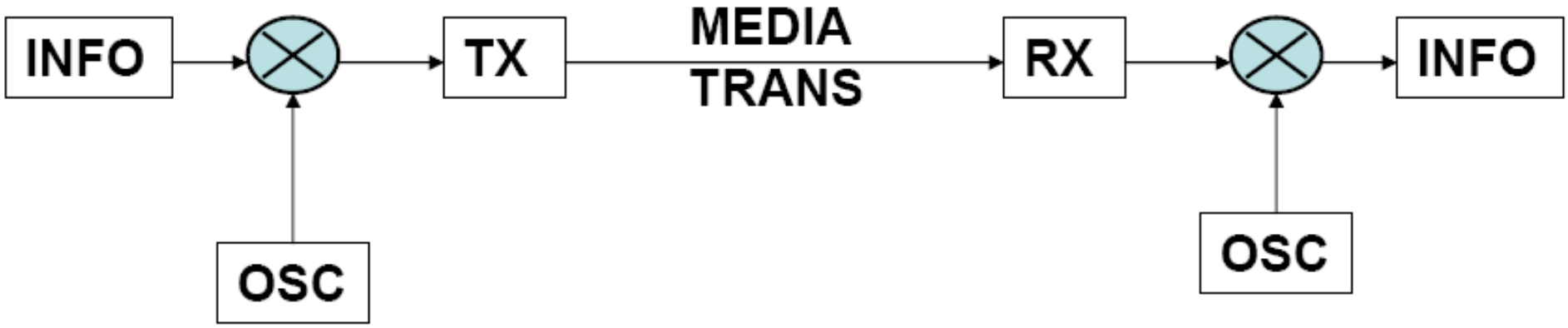


Sinyal PAM Ter-Kuantisasi

Coding

- Pada tahapan ini semua sinyal yang sudah dikuantisasi diubah menjadi kode 8 bit
- S A B C W X Y Z
- S = Polaritas sinyal PAM
- ABC = Nomor Segmen dalam 0 s/d 7 (biner)
- WXYZ = Nomor interval 0 s/d 15 (Biner)

Dgn Gel Pembawa



Ada translasi frekuensi dr frek baseband ke frek transmisi.

Info :

- Tunggal

- Jamak (perlu multipleks)

Multiplexing

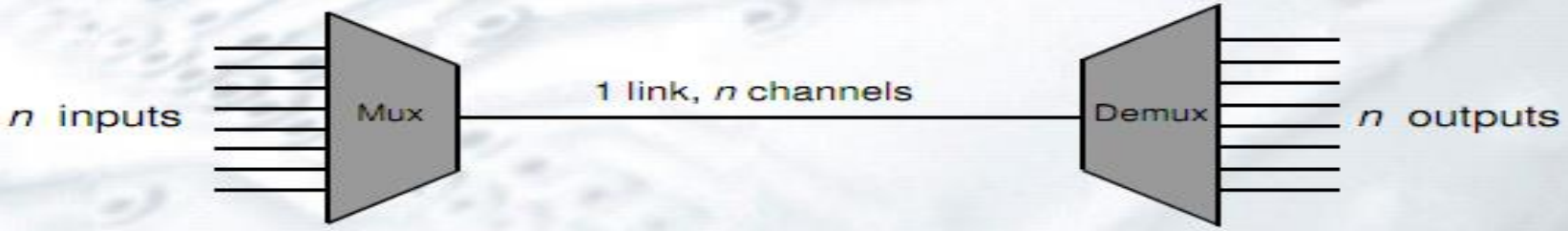
- Adalah proses penggabungan beberapa saluran atau kanal pembicaraan (VBW) menjadi satu kedalam bentuk sinyal lain, untuk disalurkan secara bersamaan tanpa saling mengganggu
- Jenis-jenis Multiplexer
  - FDM (Frequency Division Multiplex)
  - TDM (Time Division Multiplex)

- *Multiplexing*:

  Proses penggabungan beberapa sinyal informasi untuk dikirimkan secara bersamaan pada suatu saluran transmisi dan tidak saling mengganggu satu sama lainnya.

- *Demultiplexing*:

  Proses pemisahan gabungan sinyal-sinyal dimaksud di sisi penerima untuk disampaikan sesuai dengan tujuan masing–masing.



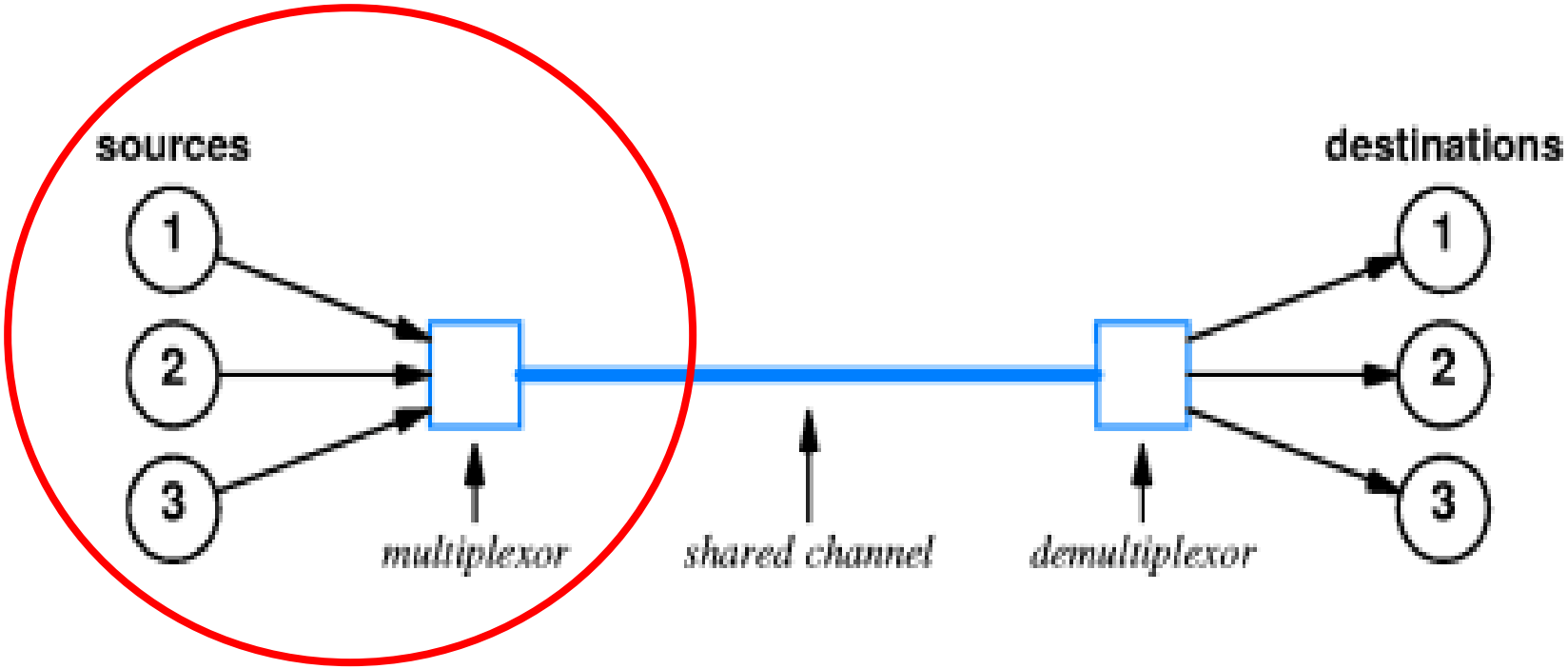
Multiplexing

- Multiplexing is sending more than one signal on a carrier.
- There are two standard types of multiplexing.
  - Frequency-Division Multiplexing (FDM): the medium carries a number of signals, which have different frequencies; the signals are carried simultaneously.
  - Time-Division Multiplexing (TDM): different signals are transmitted over the same medium but they do so at different times – they take turns.

Multiplexing

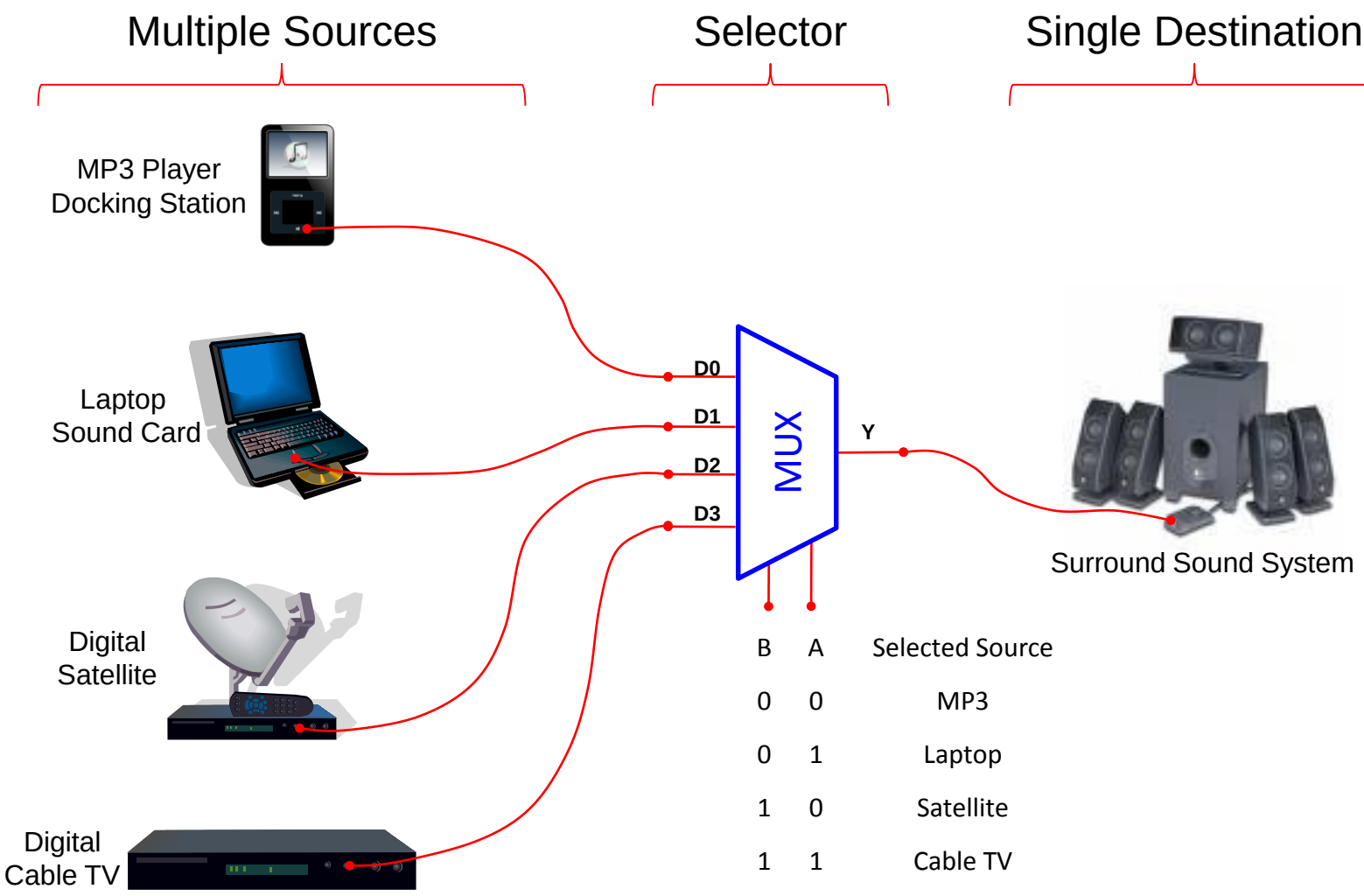
- There are **several data inputs** and **one** of them is routed to the **output** (possibly the shared communication channel).
  - Like selecting a television channel (although that example is FDM).
- In addition to data inputs, there must be ***select inputs***.
  - The select inputs determine which data input gets through.
- How many select pins are needed?
  - Depends on number of data inputs.

Mutiplexing

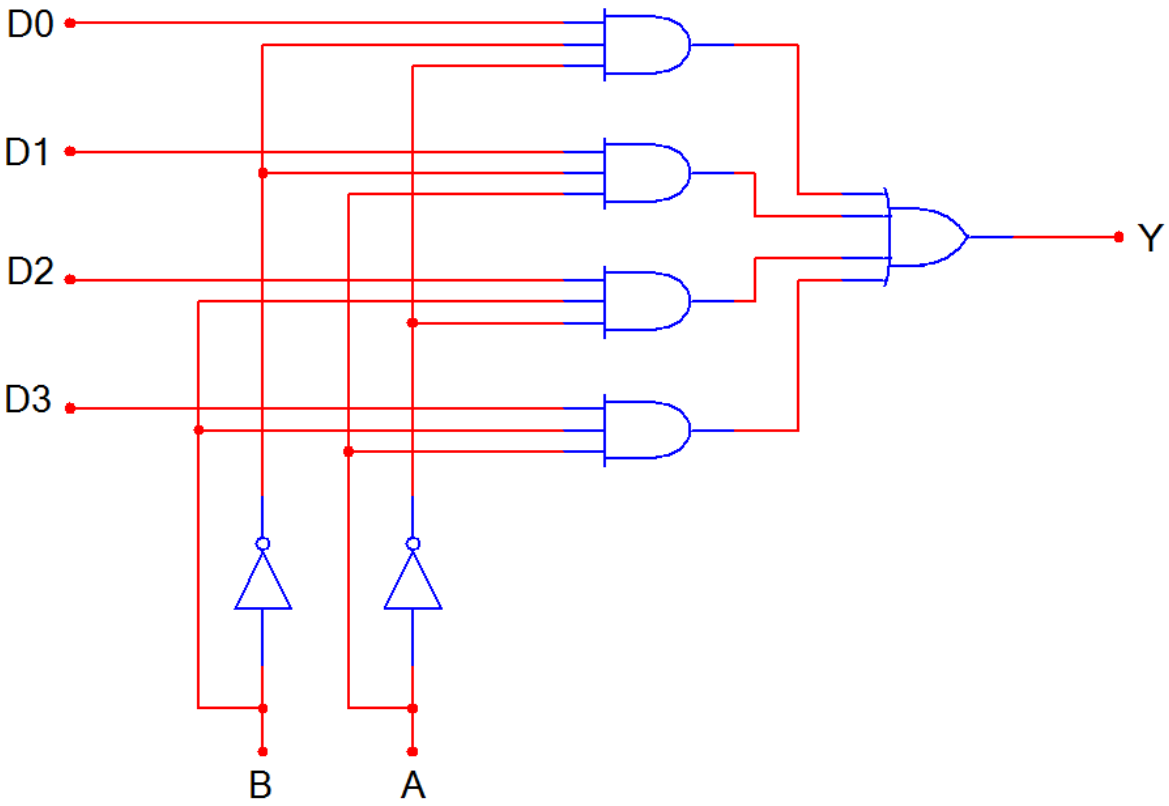


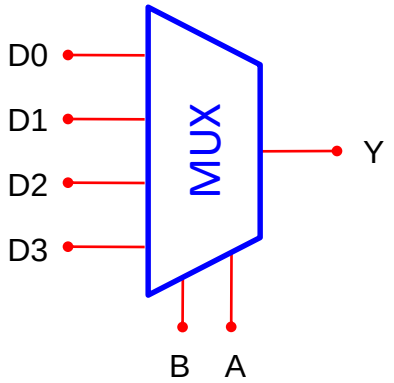
Multiplexing allows one to select one of the many possible sources.

Typical Application of a MUX



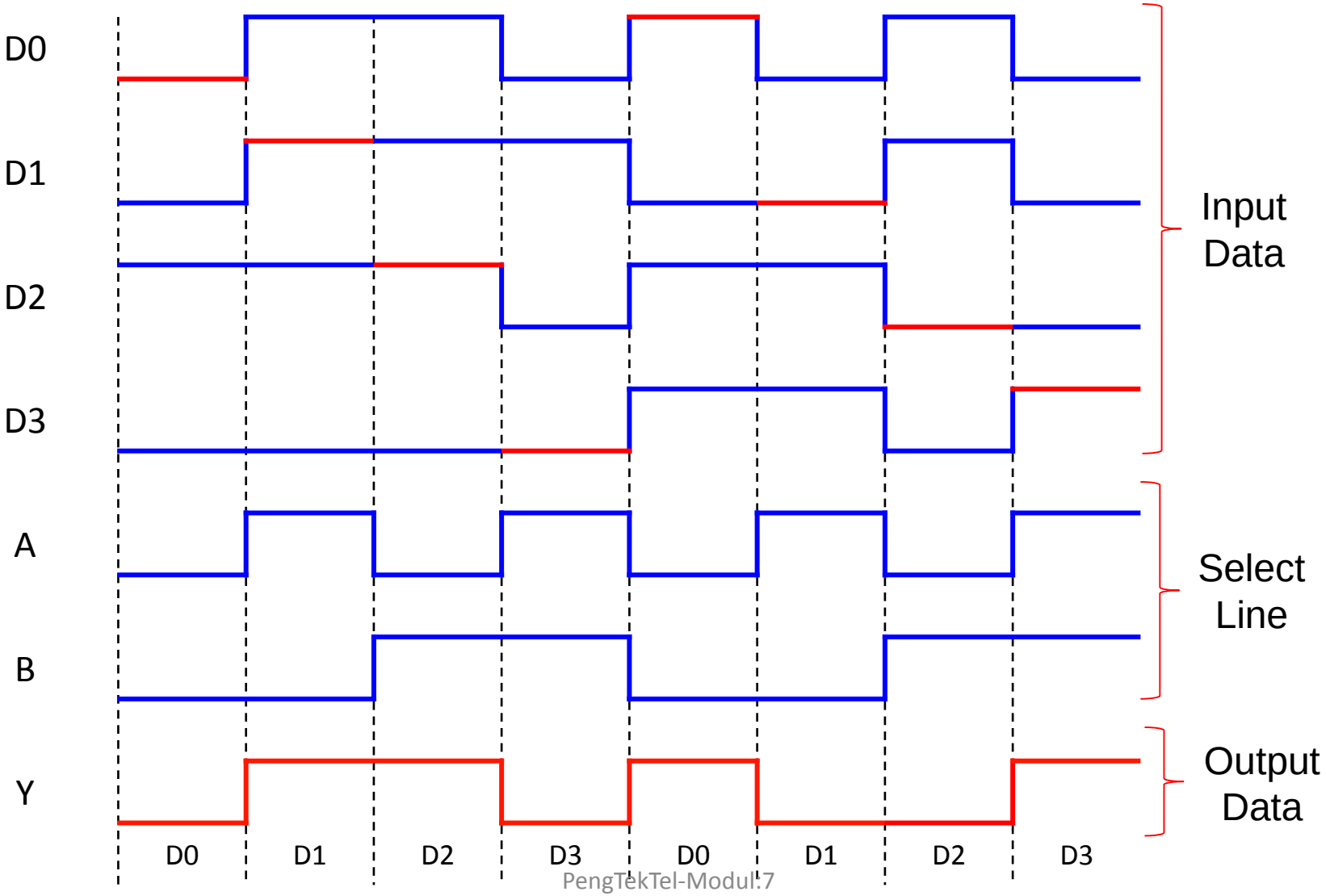
4-to-1 Multiplexer (MUX)



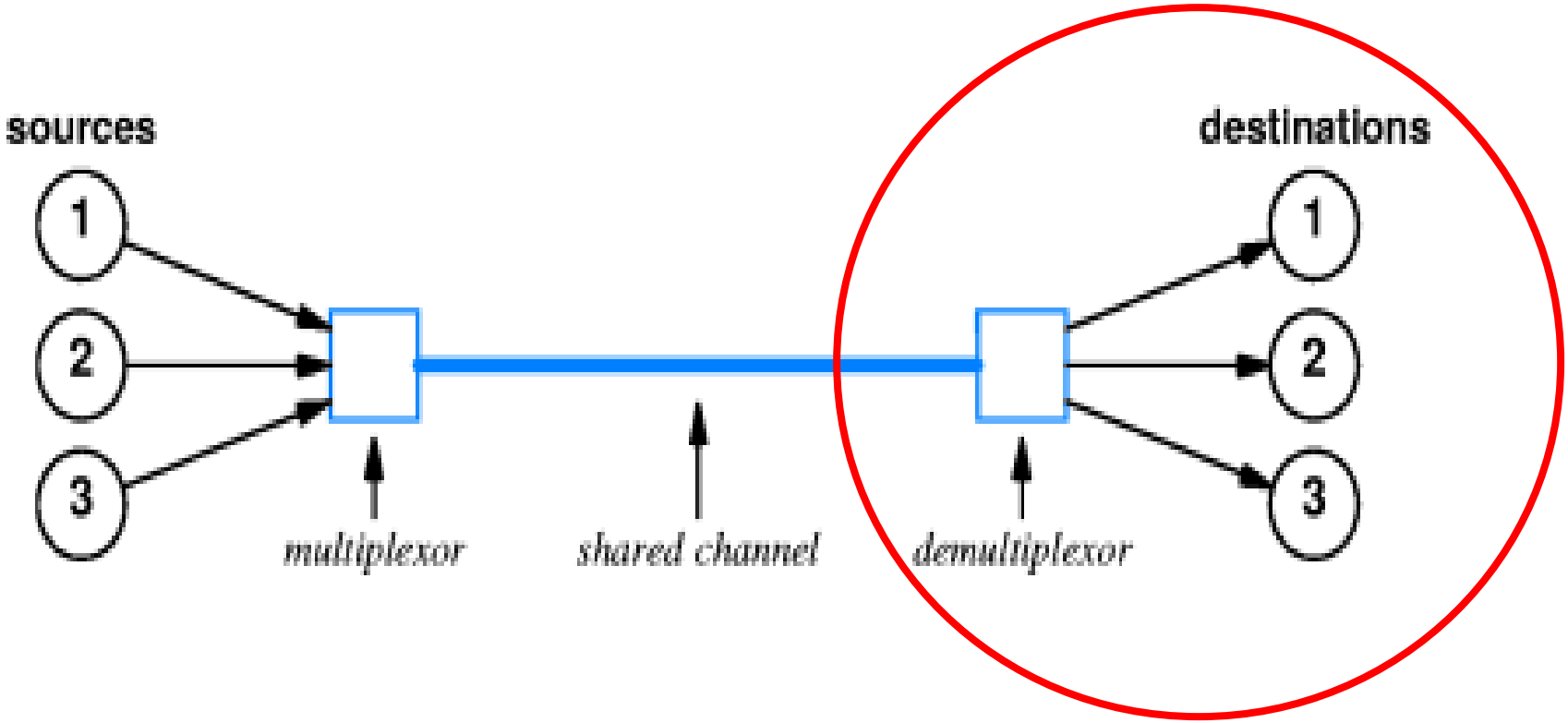


B	A	Y
0	0	D0
0	1	D1
1	0	D2
1	1	D3

4-to-1 Multiplexer Waveforms

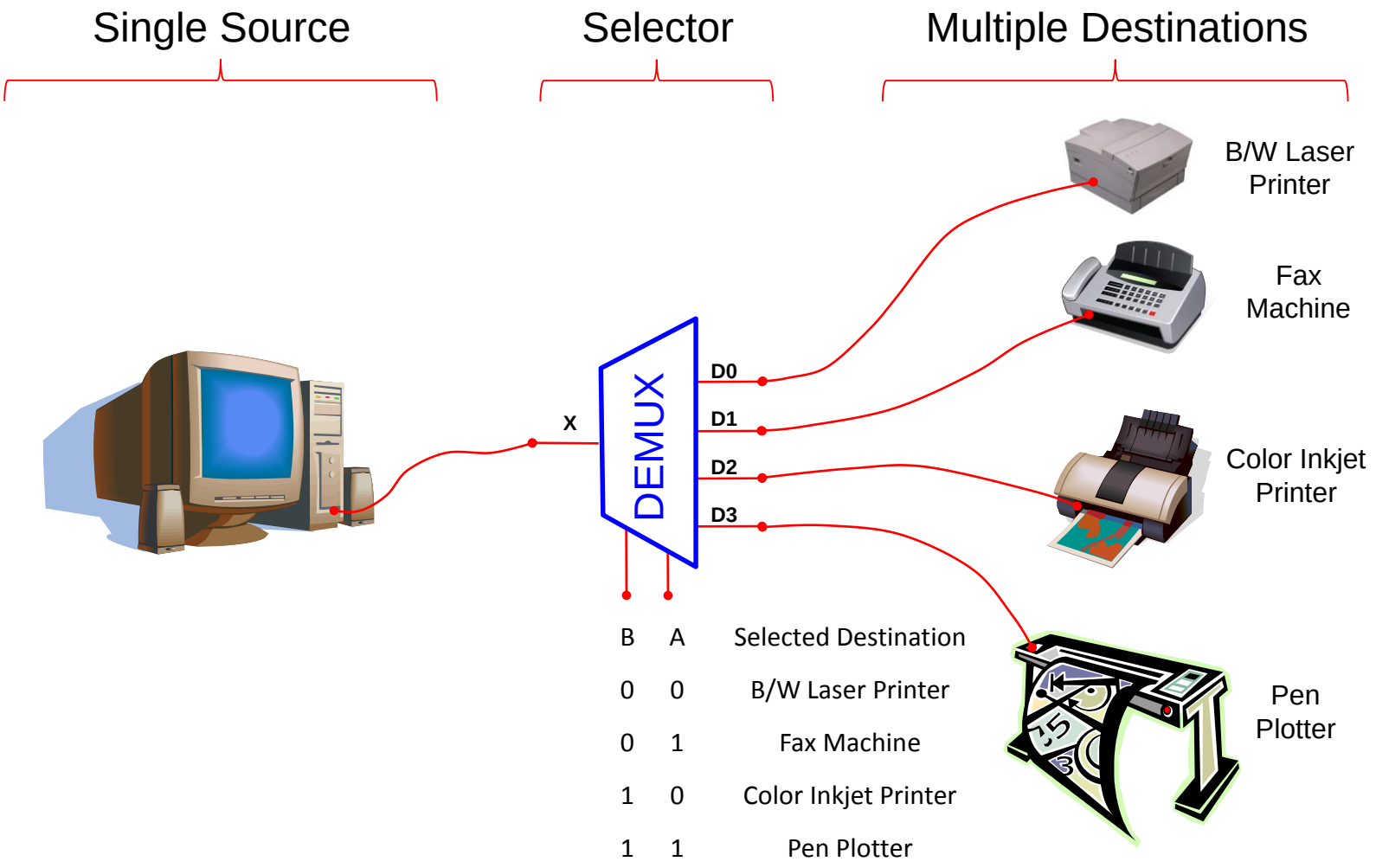


Demultiplexing

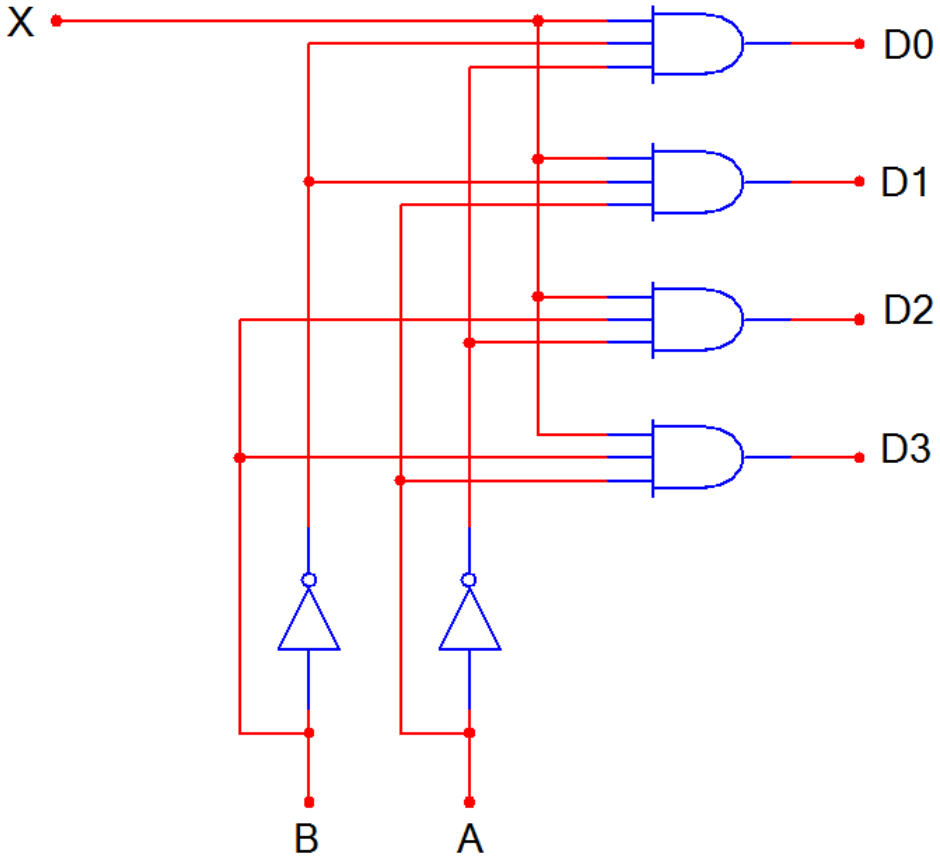


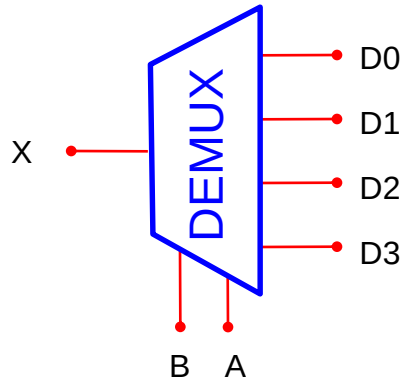
Demultiplexing allows one to select one of the many possible destinations.

Typical Application of a DEMUX



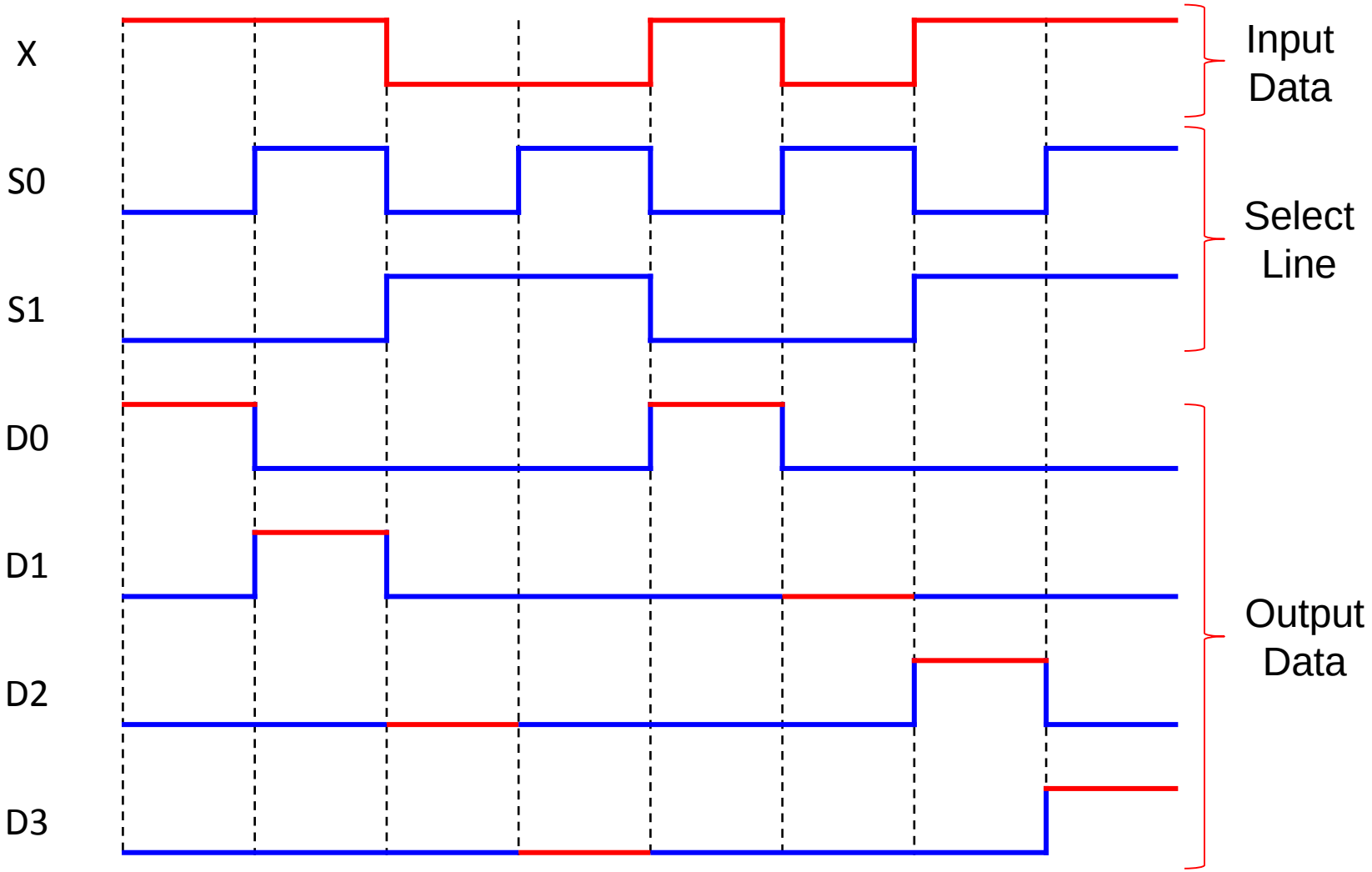
1-to-4 De-Multiplexer (DEMUX)





B	A	D0	D1	D2	D3
0	0	X	0	0	0
0	1	0	X	0	0
1	0	0	0	X	0
1	1	0	0	0	X

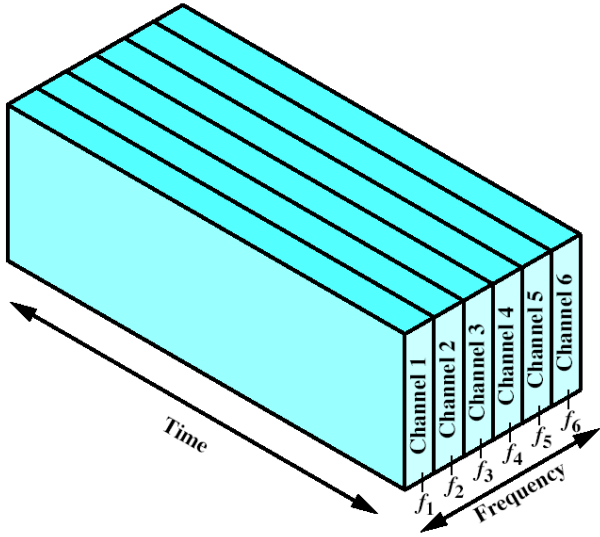
1-to-4 De-Multiplexer Waveforms



Multiplexing Techniques

Frequency Division Multiplexing (FDM)

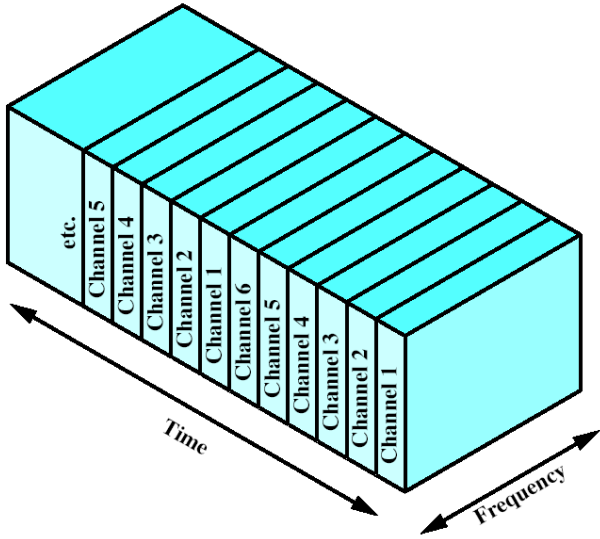
- Each signal is allocated a different frequency band
- Usually used with analog signals
- Modulation equipment is needed to move each signal to the required frequency band (channel)
- Multiple carriers are used, each is called sub-carrier
- Multiplexing equipment is needed to combine the modulated signals



(a) Frequency division multiplexing

Time Division Multiplexing (TDM)

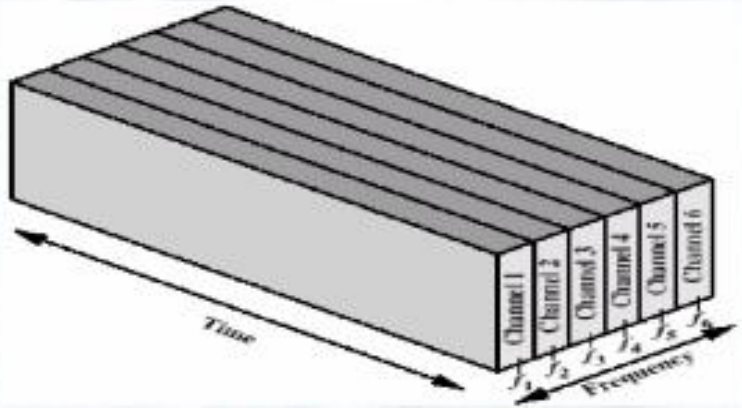
- Usually used with digital signal is carrying digital data
- Data from various sources are carried in repetitive frames
- Each frame consists of of a set of time slots
- Each source is assigned one or more time slots per frame



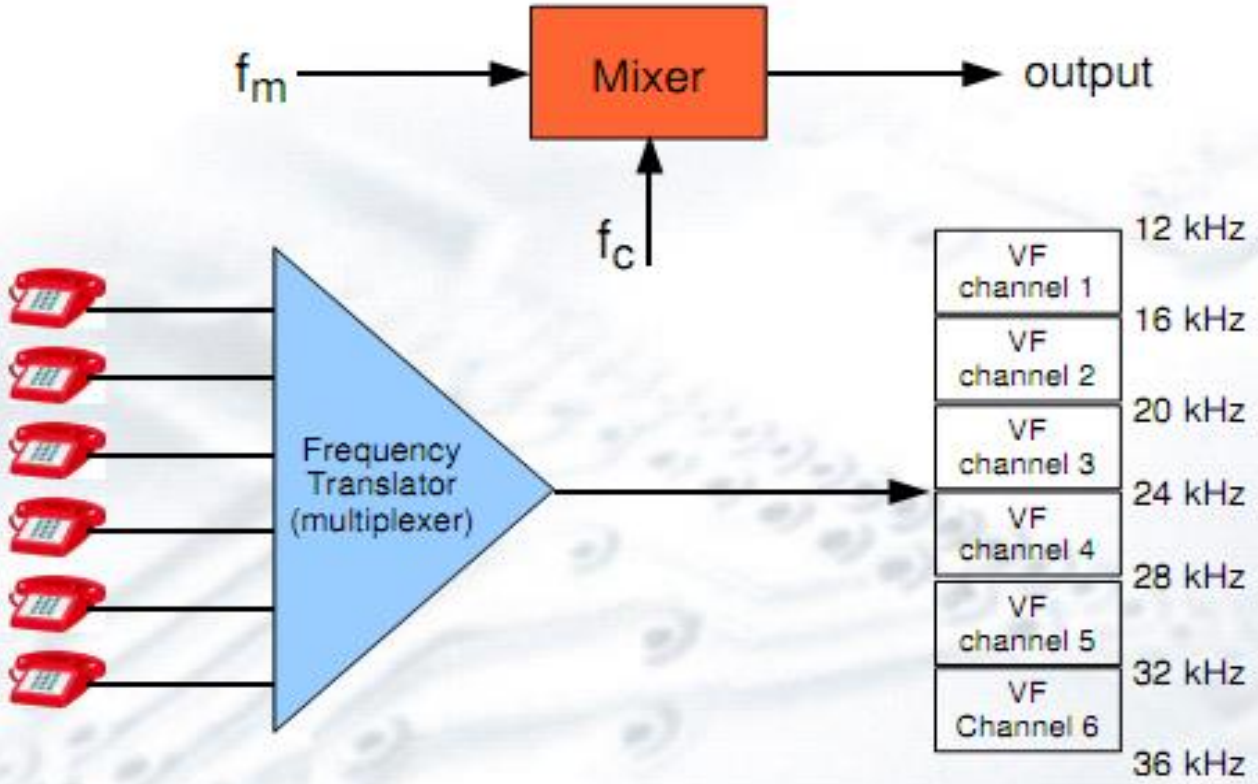
(b) Time division multiplexing

Frequency Division Multiplexing (FDM)

- Sinyal informasi ditransmisikan pada waktu yang bersamaan dengan frekuensi yang berbeda.
- Pita frekuensi dibagi ke dalam beberapa kanal pita sempit (narrow-band channel).
- FDM dimungkinkan jika bandwidth media transmisi jauh lebih besar daripada B/W sinyal yang diperlukan & akan dikirim
- Frekuensi carrier dipisah sehingga sinyal-sinyal tidak saling bertumpang-tindih.
- Dipakai secara umum untuk telepon, radio atau televisi



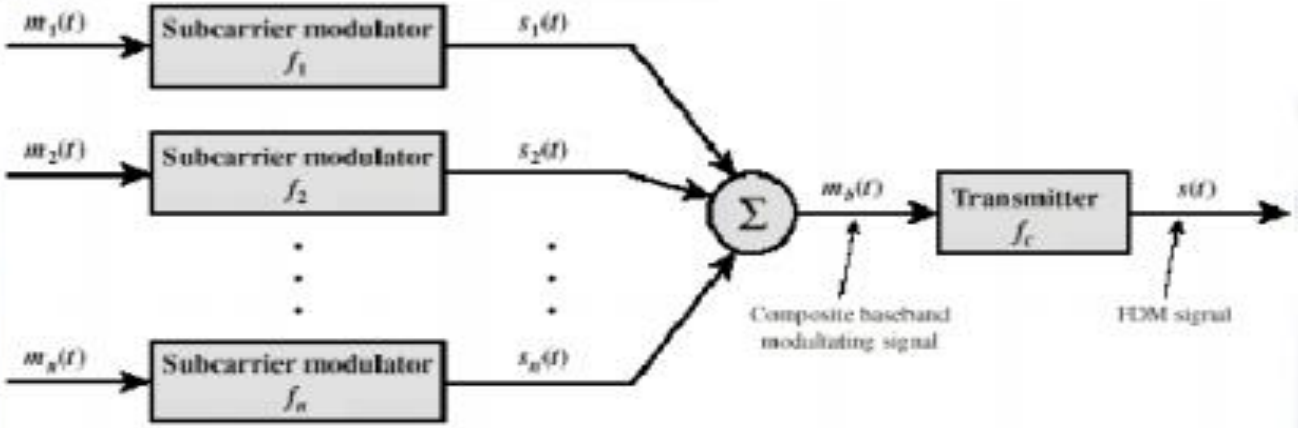
Konsep FDM (1)



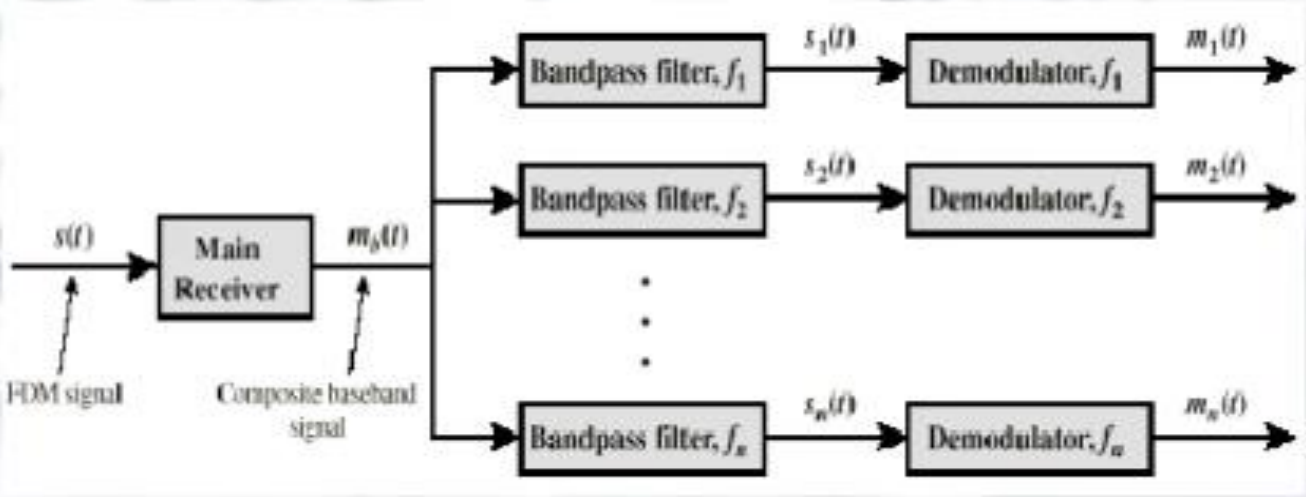
- Frequency translator menggunakan modulasi single sideband dari frekuensi radio (RF) pembawa.
- Setiap RF pembawa yang berbeda digunakan untuk setiap kanal yang akan dimultipleks.

Konsep FDM (2)

a. Transmitter



b. Receiver



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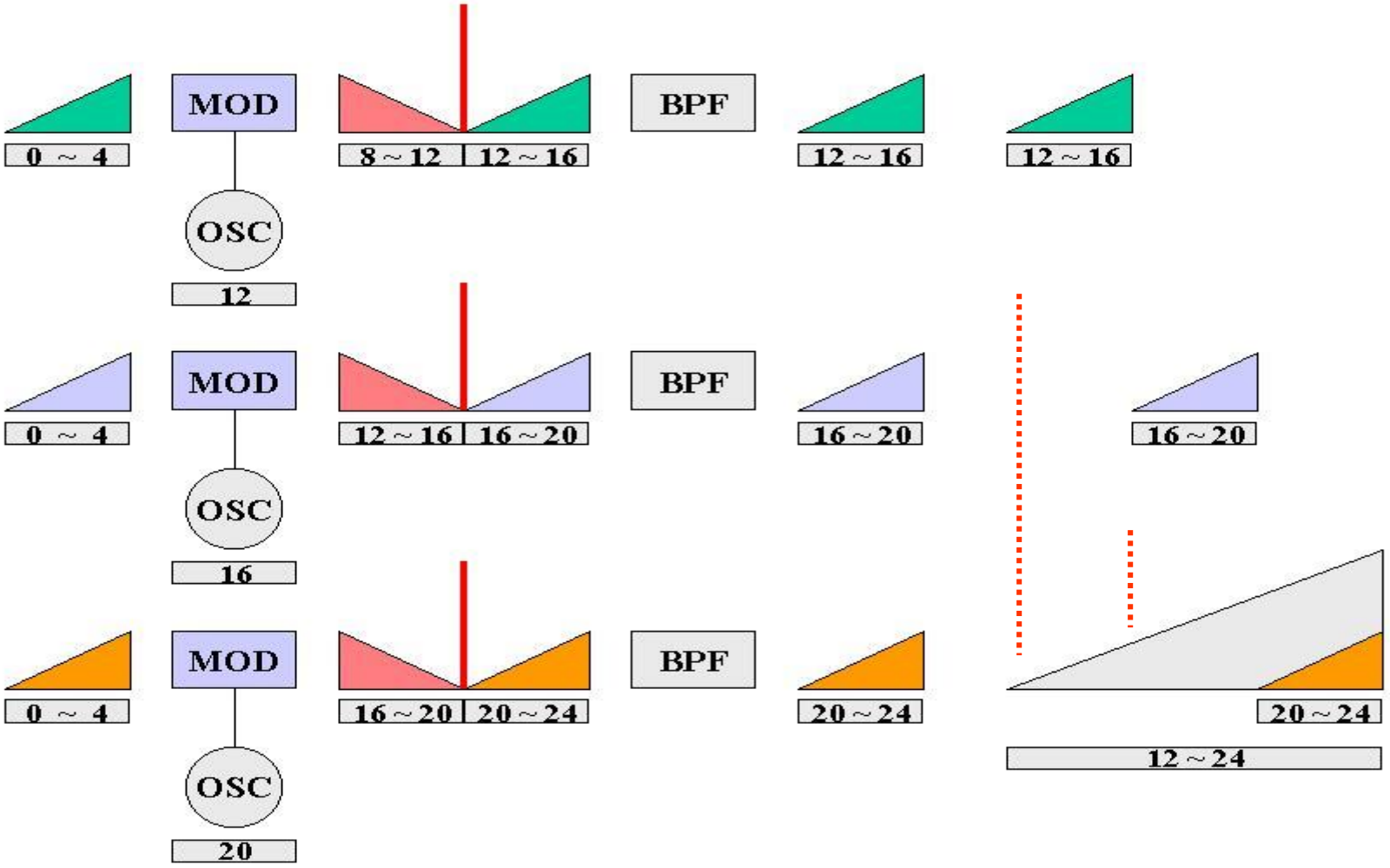
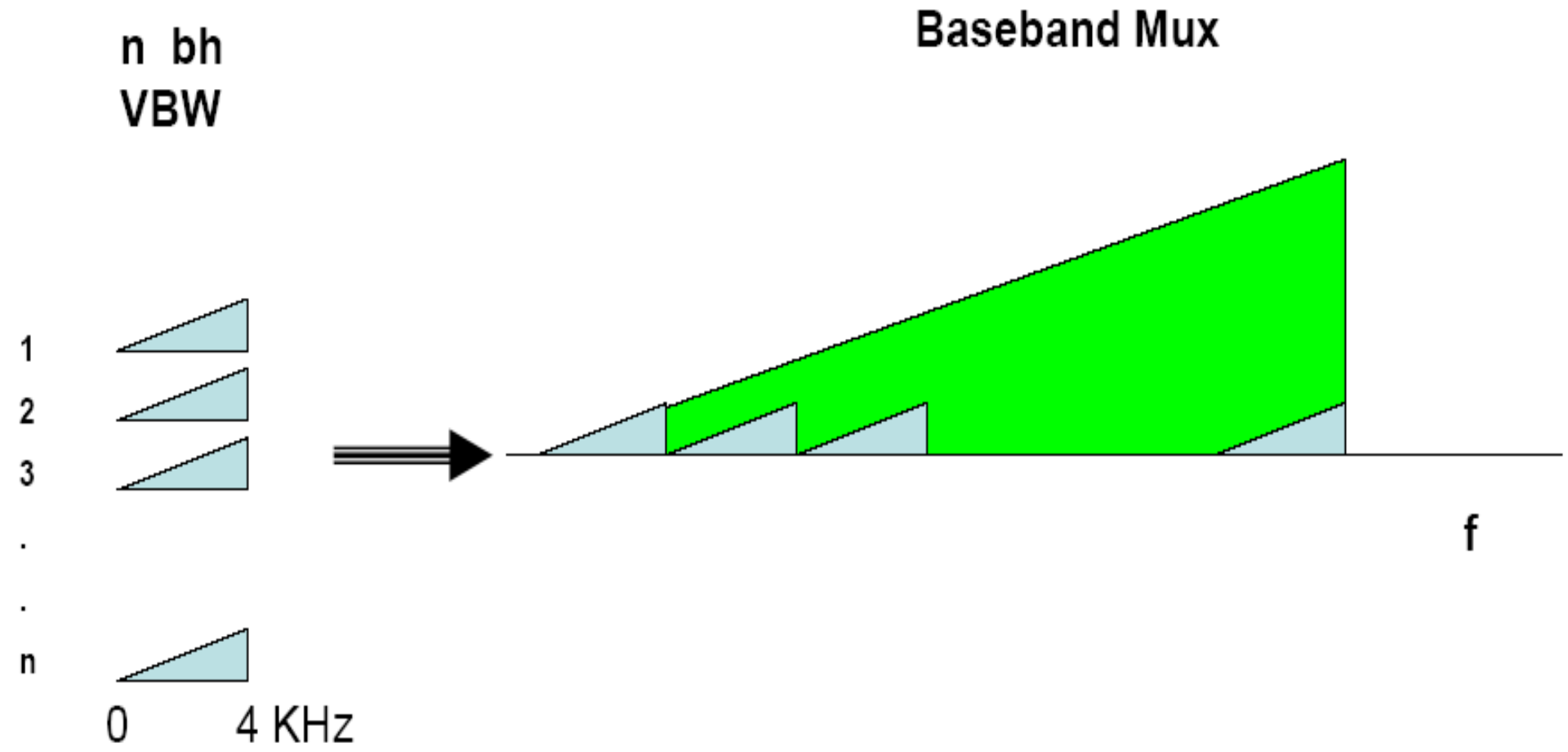
Hirarki FDM

Level	Voice Circuits	Frequency band (kHz)	Bandwidth (kHz)
1. Voice channel	1	0 - 4	4
2. Group	12 (12 voice channels)	60 – 108	48
3. Supergroup	60 (5 groups)	312 - 552	240
4. Mastergroup	600 (10 supergroups)	564 - 3084	2520
5. Jumbogroup	3600 (6 mastergroups)	564 - 17548	16984

FDM

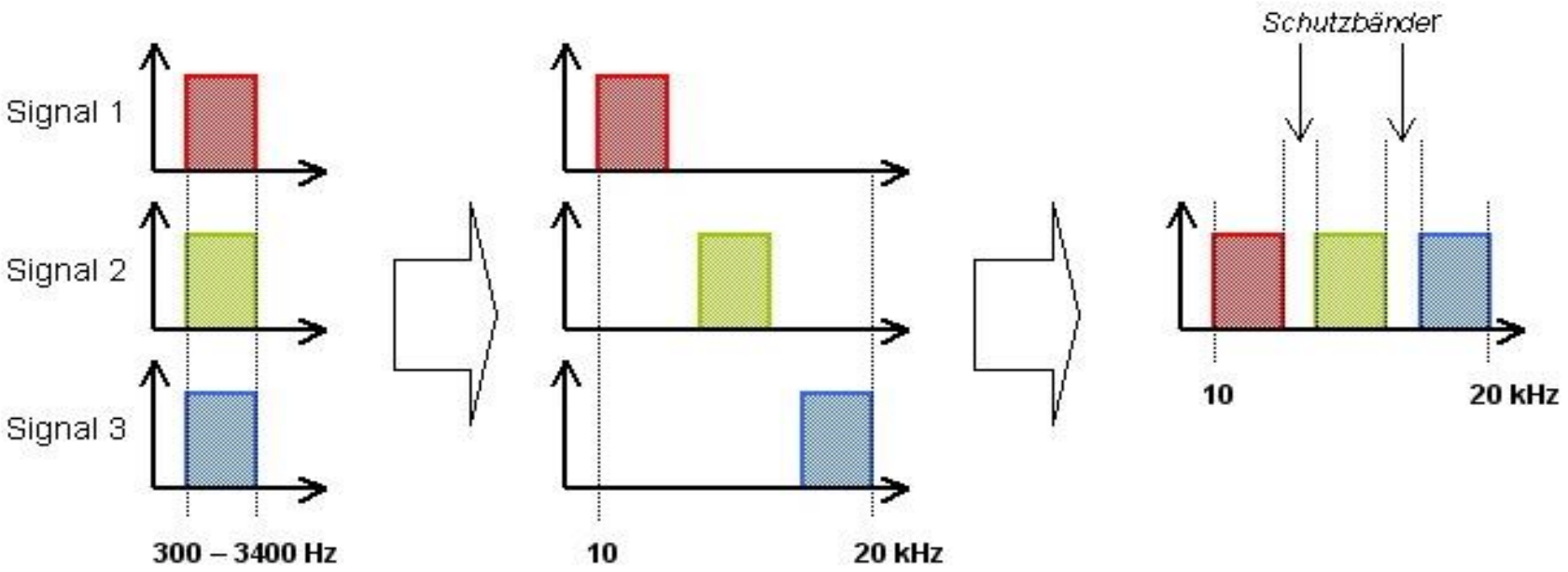

MOD
OSC
12
0 ~ 4
8 ~ 12
12 ~ 16
BPF
12 ~ 16
12 ~ 16
MOD
OSC
16
0 ~ 4
12 ~ 16
16 ~ 20
BPF
16 ~ 20
16 ~ 20
MOD
OSC
20
0 ~ 4
16 ~ 20
20 ~ 24
BPF
20 ~ 24
20 ~ 24
12 ~ 24

FDM

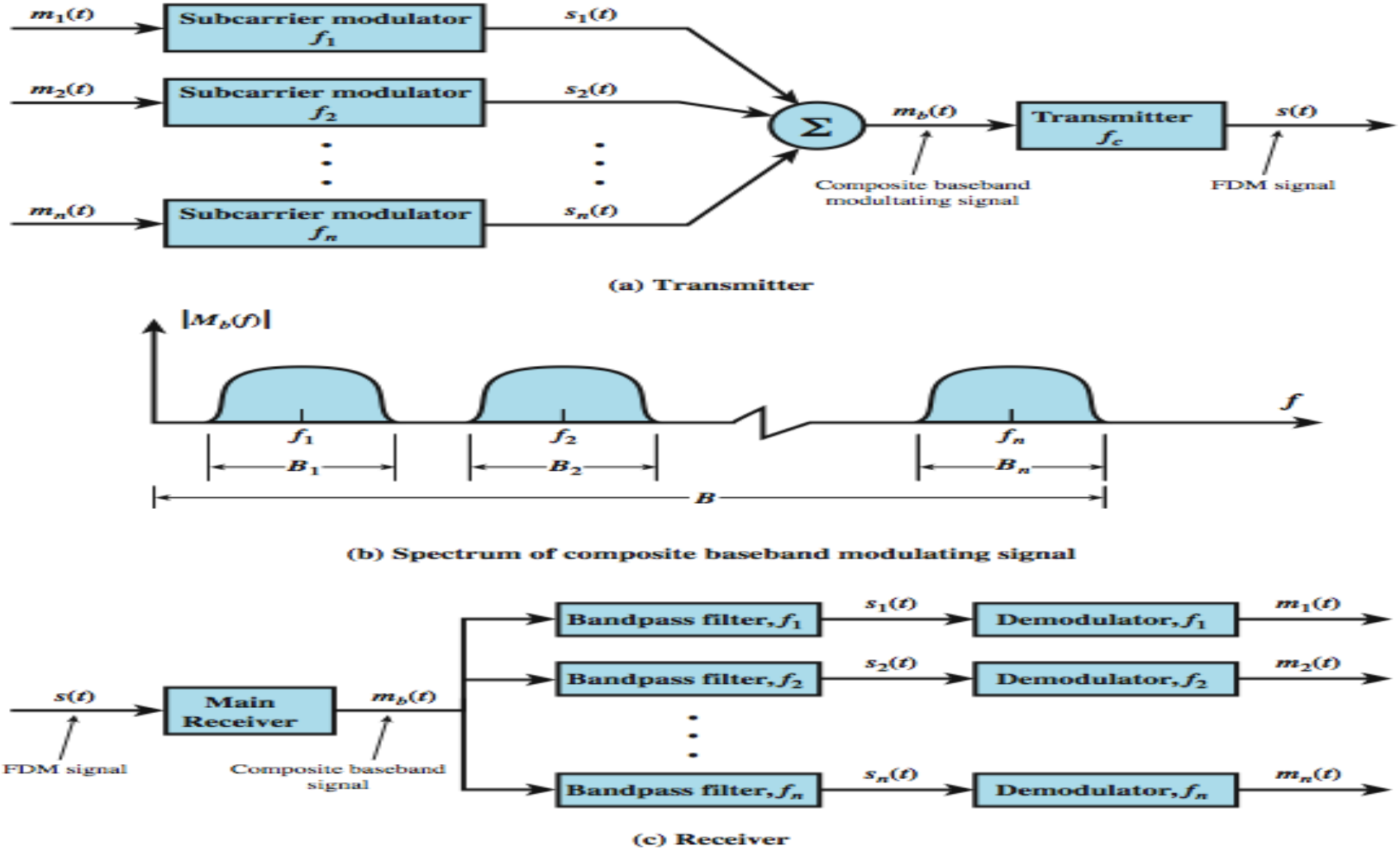


Frequency-Division Multiplexing (FDM)

- All signals are sent simultaneously, each assigned its own frequency
- Using filters all signals can be retrieved

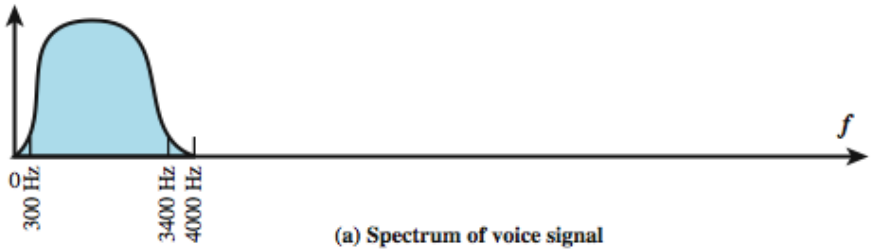


FDM System Overview

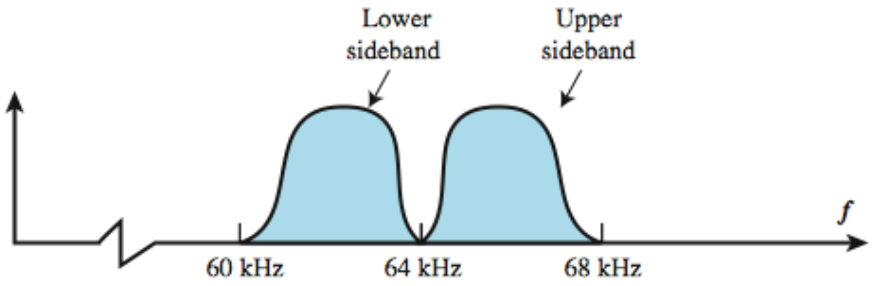


FDM example: multiplexing of three voice signals

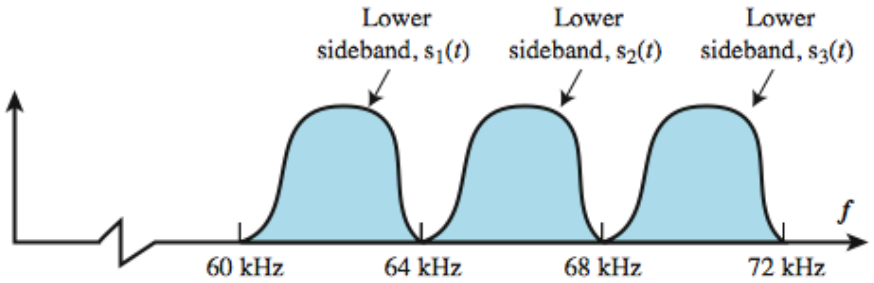
- The bandwidth of a voice signal is generally taken to be 4KHz, with an effective spectrum of 300-3400Hz
- Such a signal is used to AM modulate 64 KHz carrier
- The bandwidth of the modulated signal is 8KHz and consists of the Lower Side Band (LSB) and USB as in (b)
- To make efficient use of bandwidth, transmit only the LSB
- If three voice signals are used to modulate carriers at 64, 68 and 72 KHz, and only the LSB is taken, the resulting spectrum will be as shown in (c)



(a) Spectrum of voice signal



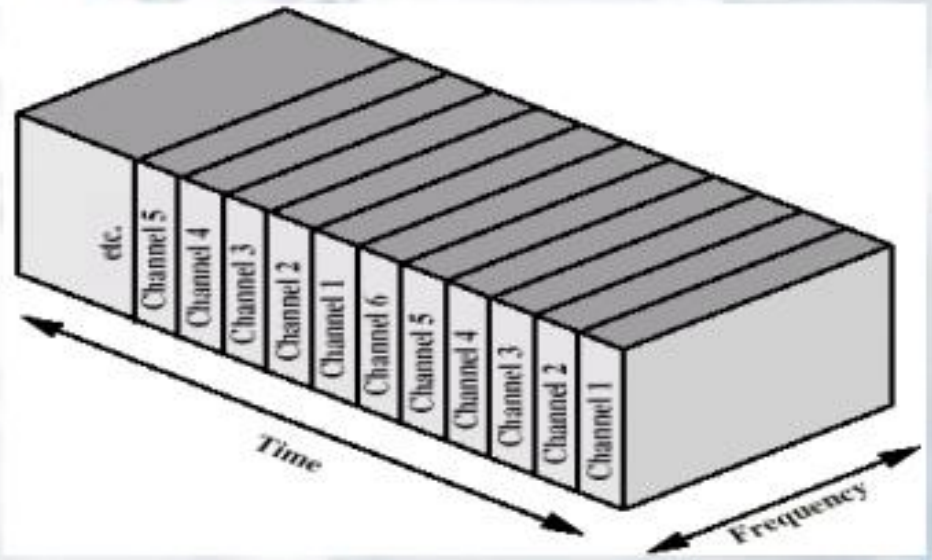
(b) Spectrum of voice signal modulated on 64 kHz frequency



(c) Spectrum of composite signal using subcarriers at 64 kHz, 68 kHz, and 72 kHz

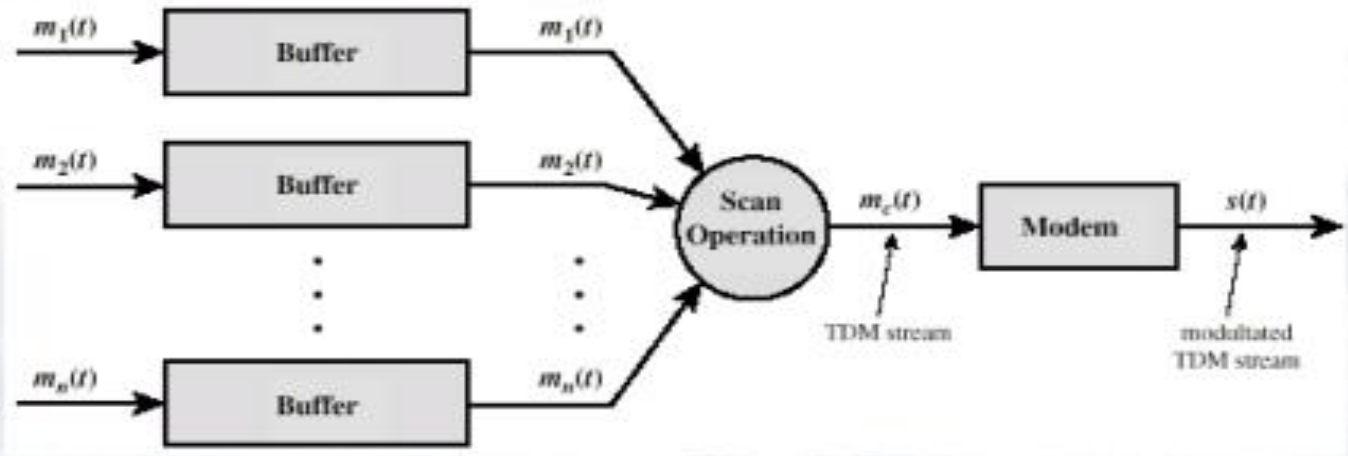
Time Division Multiplexing (TDM)

- Menerapkan prinsip penggiliran waktu pemakaian saluran transmisi dengan mengalokasikan satu slot waktu (*time slot*) bagi setiap pemakai saluran (user).
- Beberapa sinyal input berupa deretan bit (*bit stream*) ditransmisikan melalui satu saluran dengan metoda *bit-interleaved* (bit dari sinyal input dikirim dalam satu *time frame* dengan menduduki *time slot* yang berbeda)
- Terbagi atas:
  - Synchronous TDM
  - Asynchronous TDM

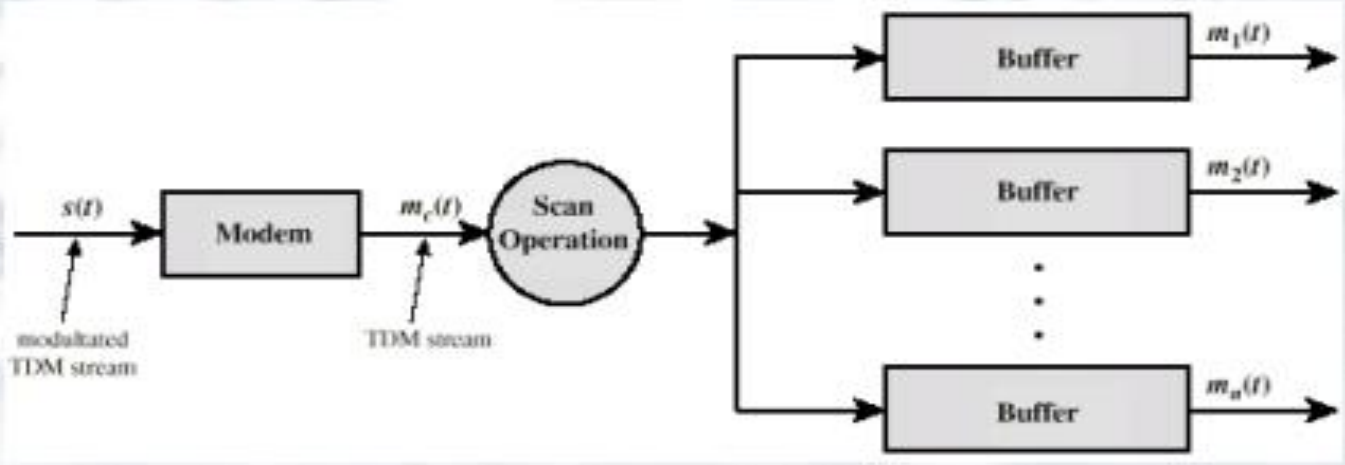


Konsep TDM (1)

a. Transmitter

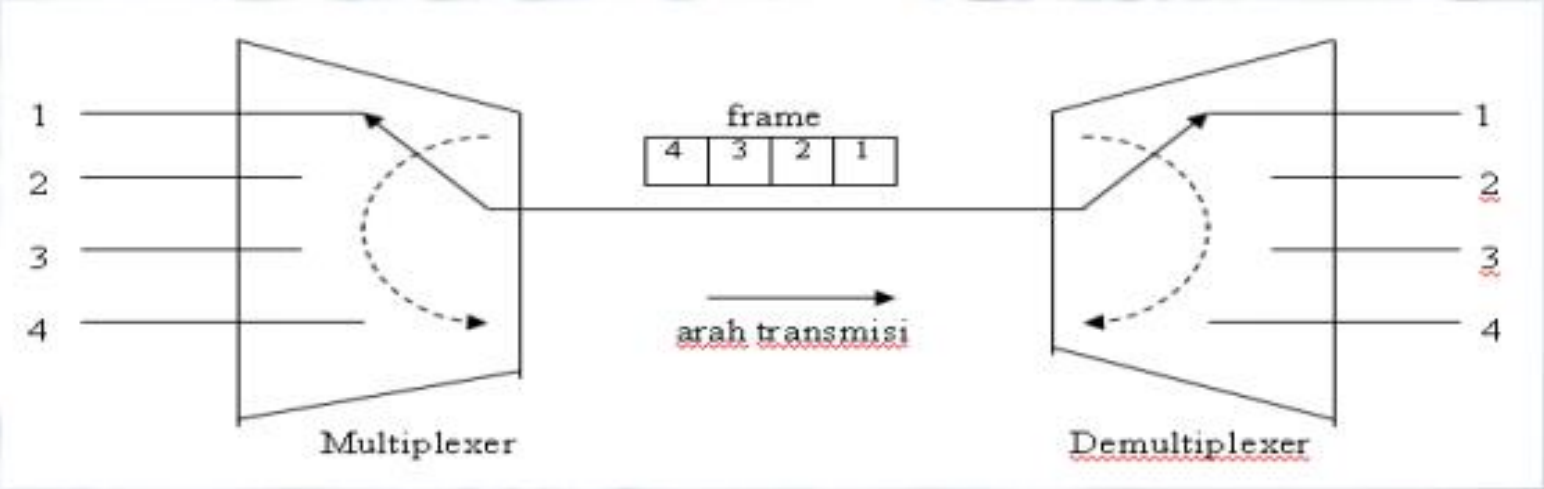


b. Receiver

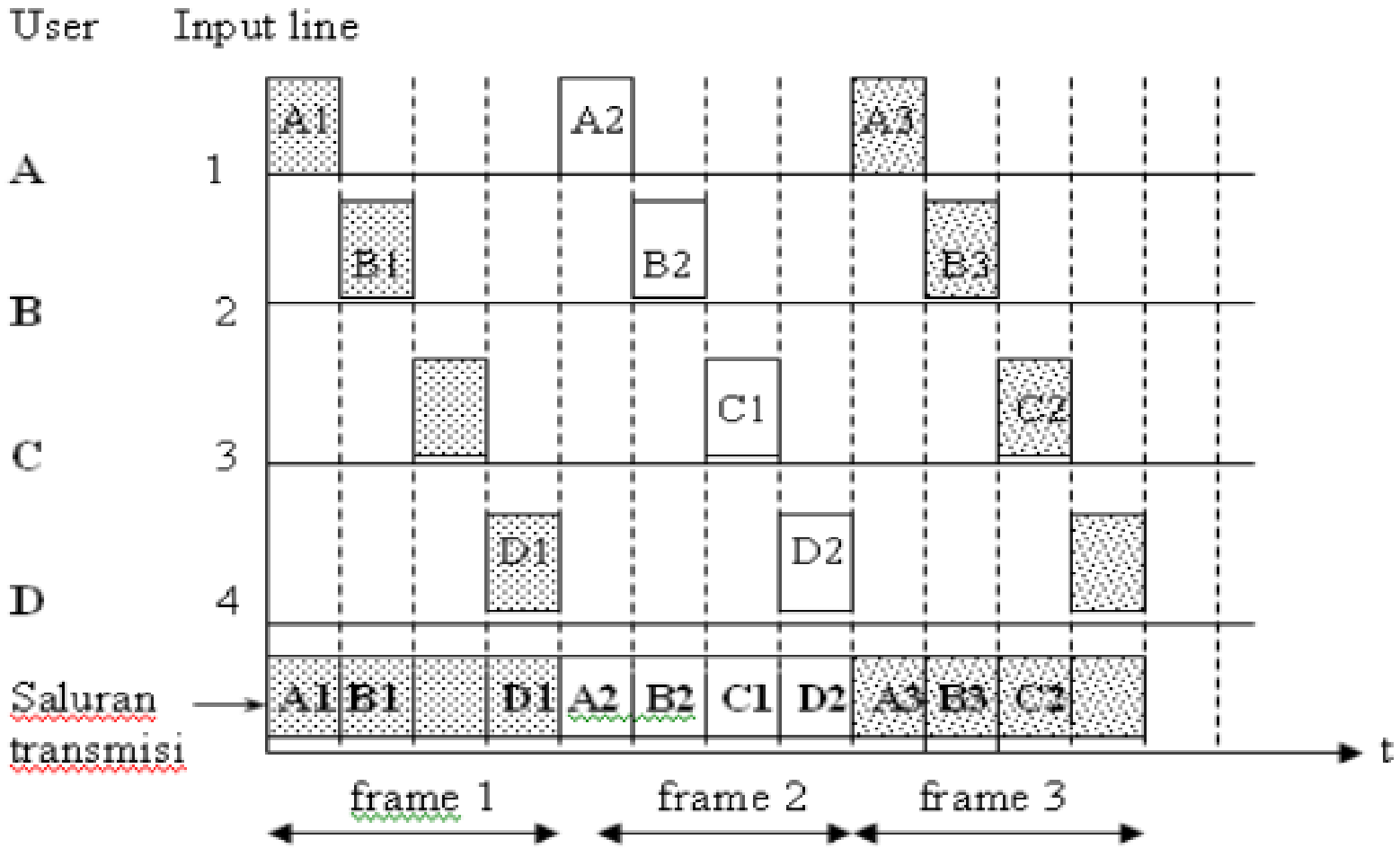


Synchronous TDM

- Data rate media transmisi > data rate sinyal yang ditransmisikan.
- *Time-slot* dialokasikan ke *source* tertentu walaupun tidak ada data.
- *Time-slot* tidak harus selalu disebarkan ke *source.*

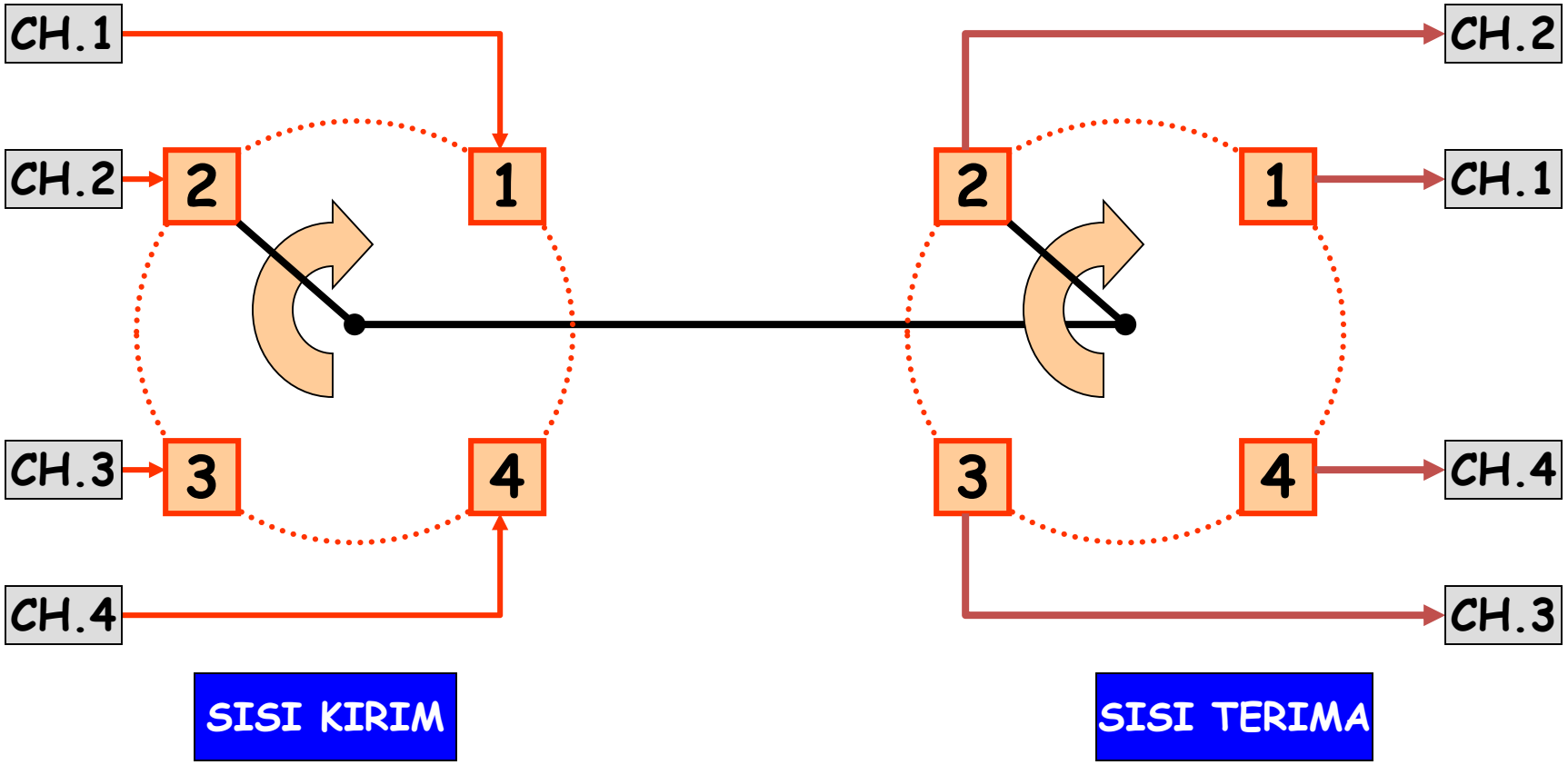


Ilustrasi Synchronous TDM



Keterangan : Ai = data ke i milik pengguna (user) A

TDM


CH.1
CH.2
CH.3
CH.4
2
1
3
4
2
1
3
4
CH.2
CH.1
CH.4
CH.3
SISI KIRIM
SISI TERIMA

Time-Division Multiplexing

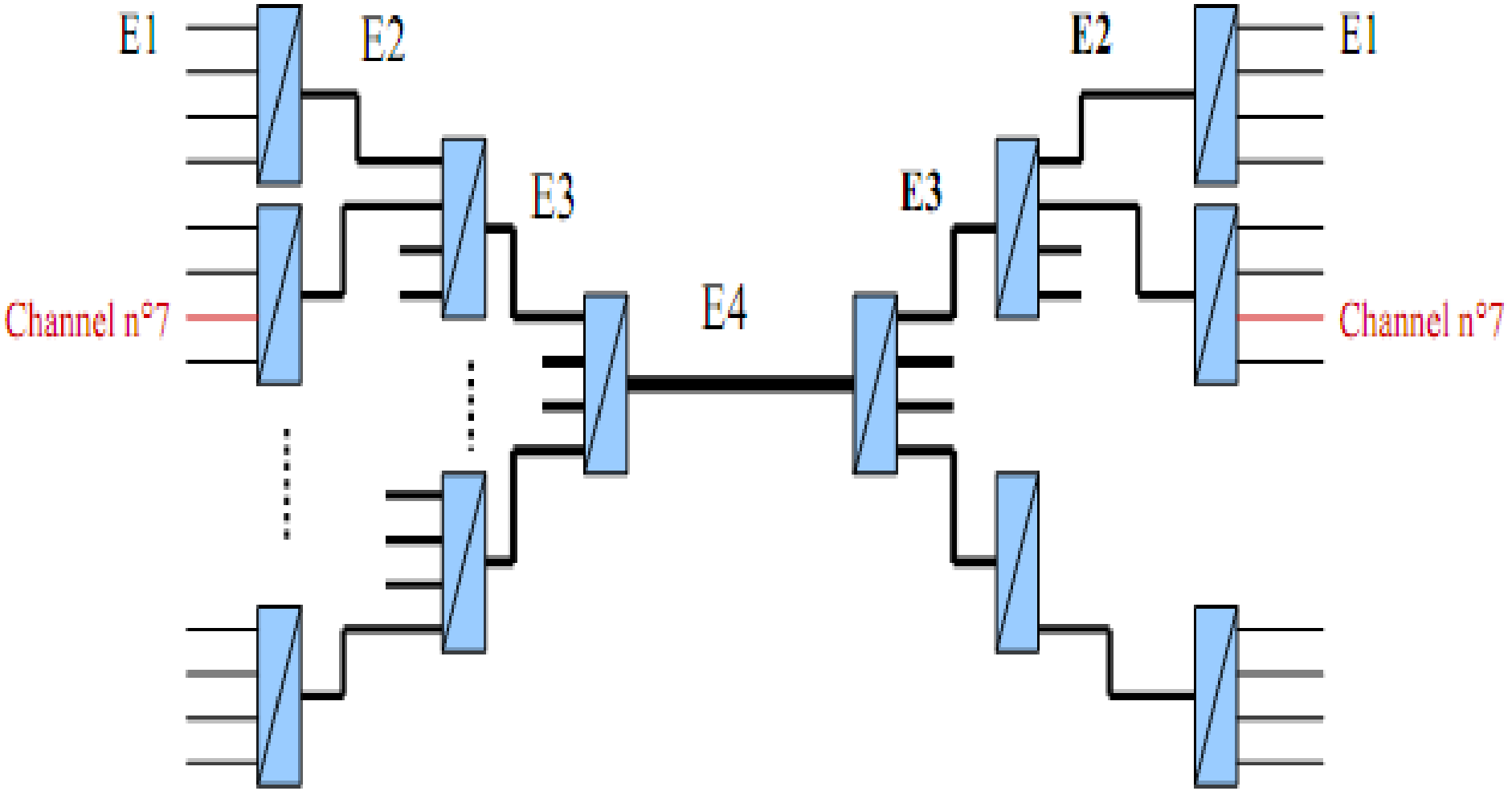
– Transmitting digitized data over one medium
  - Wires or optical fibers
  - Pulses representing bits from different time slots

– Two Types:
  - Synchronous TDM
  - Asynchronous TDM

Pengenalan PDH

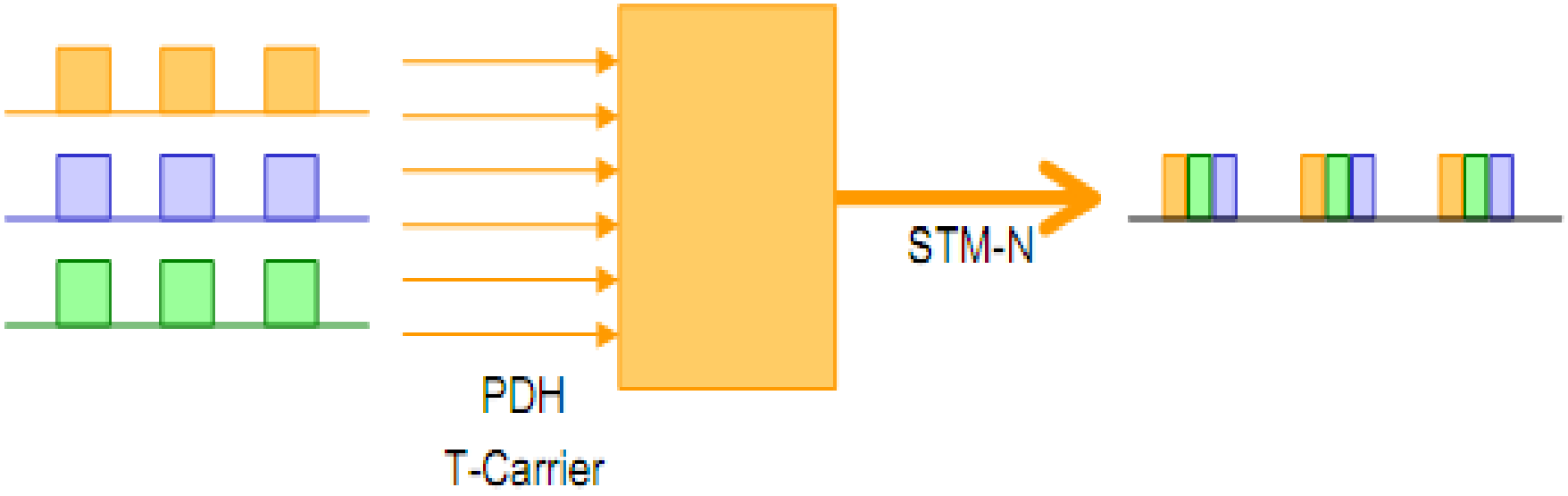
System Type	Level 1	2	3	4	5
North American T/D type	1	2	3	4	
Number of voice channels	24	96	672	4032	
Line bit rate (Mbps)	1.544	6.312	44.736	274.176	
Japan					
Number of voice channels	24	96	480	1440	5760
Line bit rate (Mbps)	1.544	6.312	32.064	97.728	400.362
Europe					
Number of voice channels	30	120	480	1920	
Line bit rate (Mbps)	2.048	8.448	34.368	139.264	

PDH principle

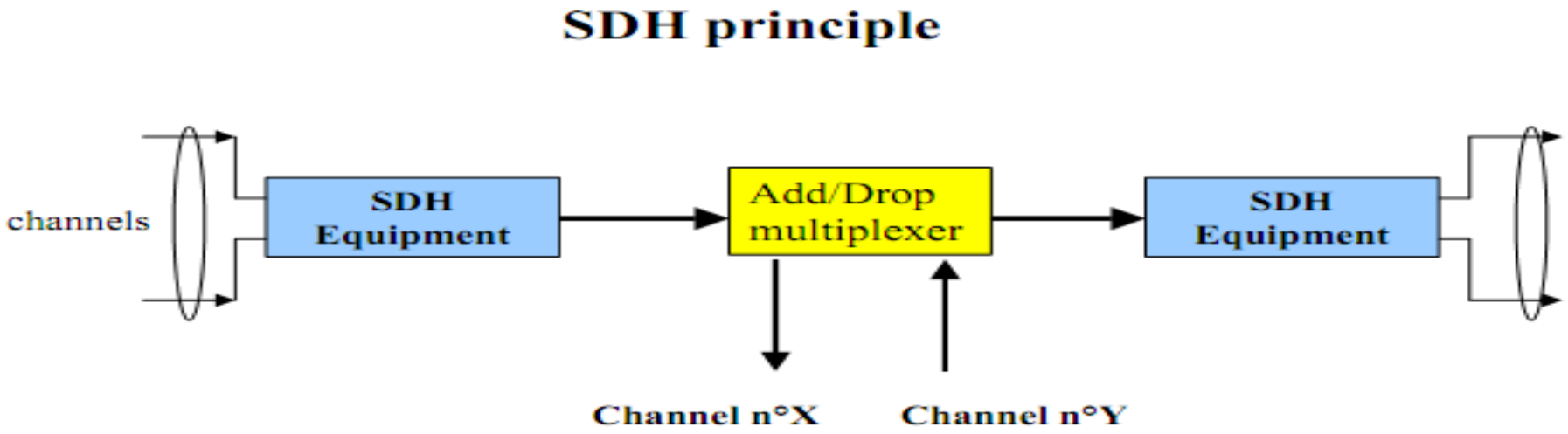


SDH equipments : Terminal Multiplexer

- *Input:* Low Bit Rate and PDH/T-Carrier Tributaries
- *Output:* High Bit Rate SDH Signals



Pengenalan SDH

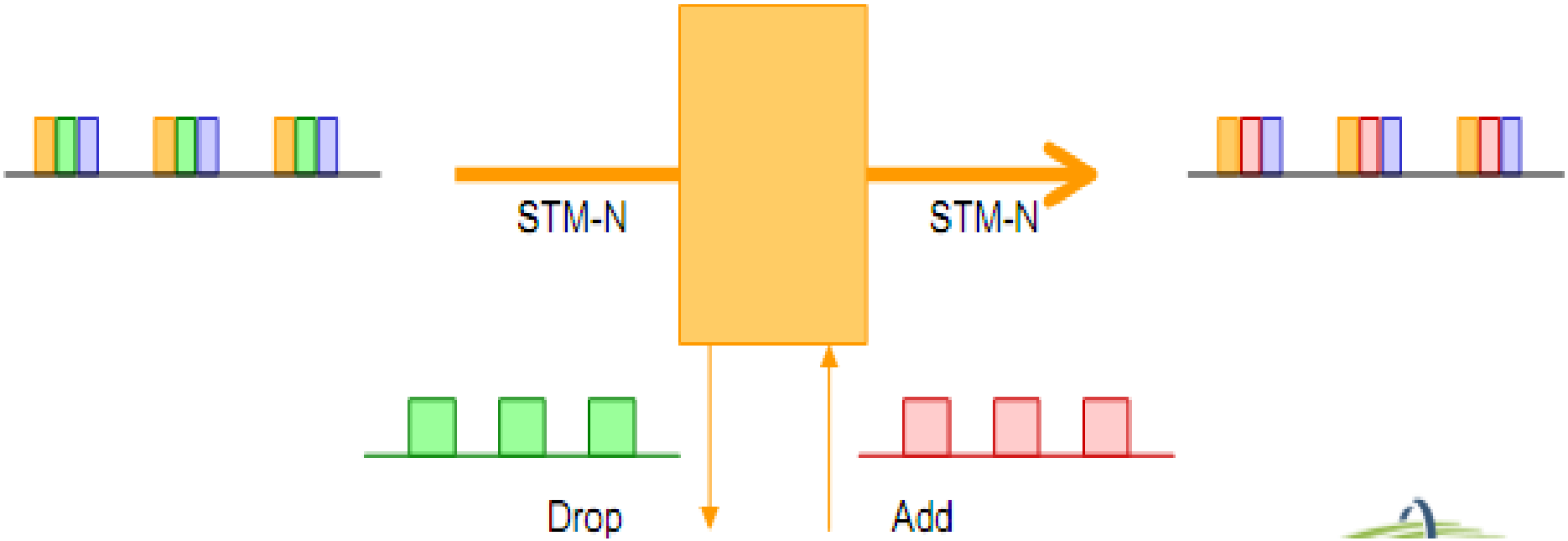


- SDH Advantages versus PDH

- SDH is based on the principal of direct synchronous multiplexing.
- Essentially, separate, slower signals can be multiplexed directly onto higher speed SDH signals without intermediate stages of multiplexing.
- SDH is more flexible than PDH and provides advanced network management and maintenance features.
- Can be used in the three traditional telecommunications areas: long-haul networks, local networks and loop carriers. It can also be used to carry CATV video traffic.

SDH equipments : Add/Drop Multiplexer

- *Input:* STM-N Synchronous Signal
- *Output:* STM-N Synchronous Signal
- Allows the Extraction and Injection of Synchronous Tributaries



- Bit Rates

International organization defined standardized bit rates :

155, 520 Mbit/s	→	STM1
622, 080 Mbit/s	→	STM4
2,488 Gbit/s	→	STM16
9,953 Gbit/s	→	STM64

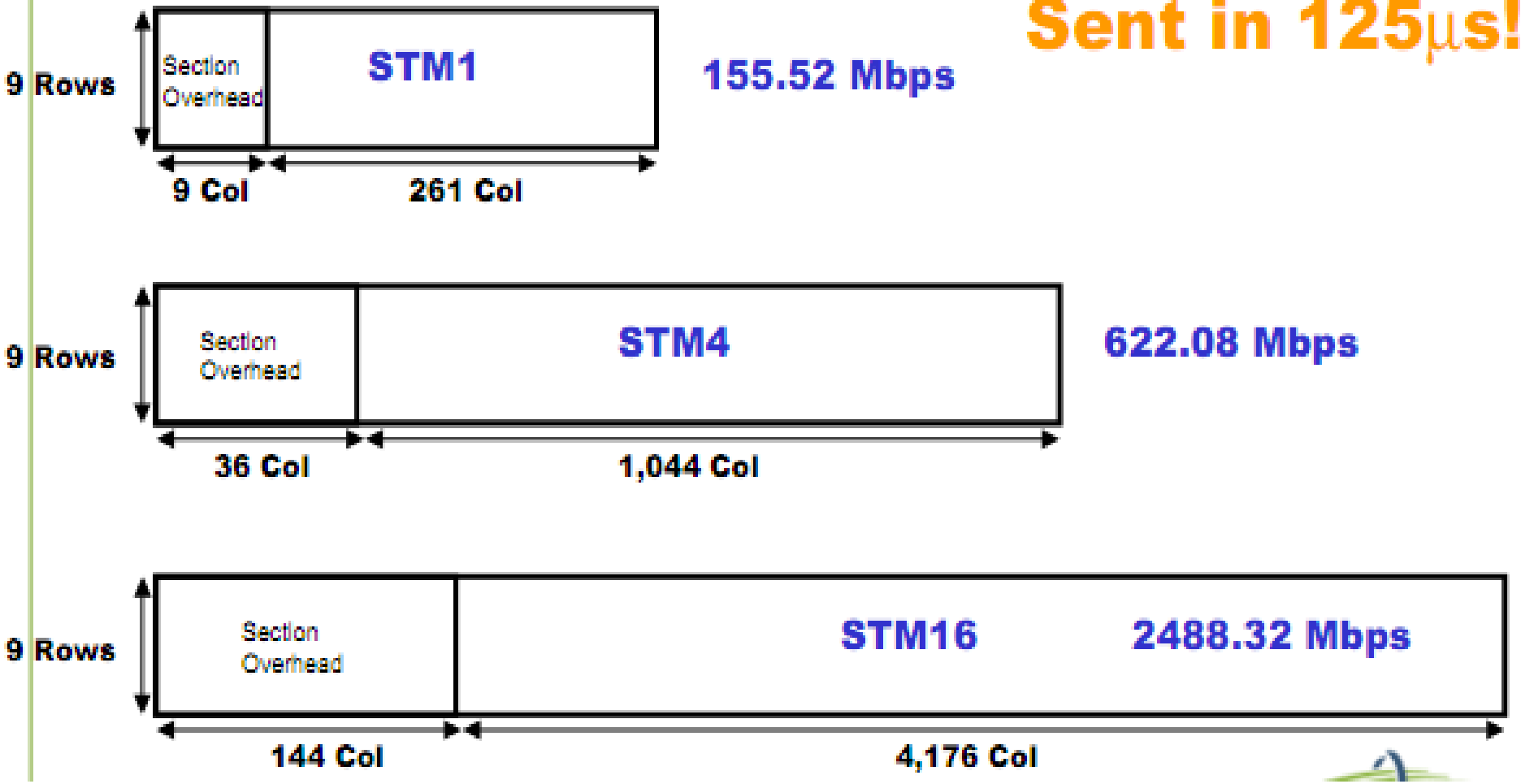
BIT RATE SDH

Optical Level	Electrical Level	Line Rate (Mbps)	SDH Equivalent
OC-1	**STS-1**	**51.84**	**---**
OC-3	STS-3	155.520	STM-1
OC-9	**STS-9**	**466.56**	**STM-3**
OC-12	STS-12	622.080	STM-4
OC-18	**STS-18**	**933.120**	**STM-6**
OC-24	**STS-24**	**1244.160**	**STM-8**
OC-36	**STS-36**	**1866.240**	**STM-13**
OC-48	STS-48	2488.320	STM-16
OC-96	**STS-92**	**4976.640**	**STM-32**
OC-192	STS-192	9953.280	STM-64

Synchronous Digital Hierarchy (SDH)

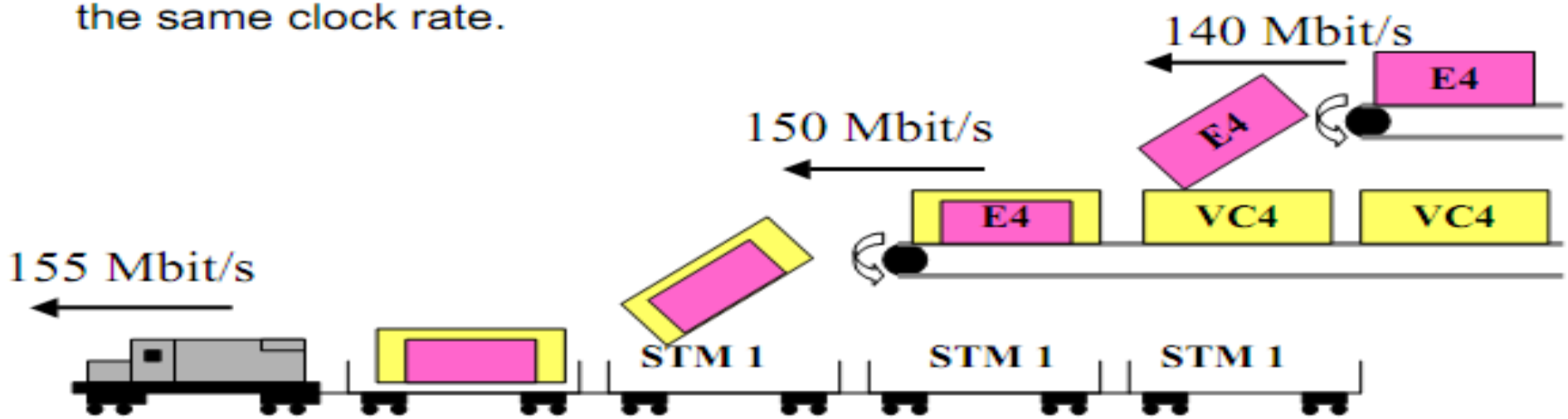
- SDH frame structure

Each Frame is Sent in 125μs!



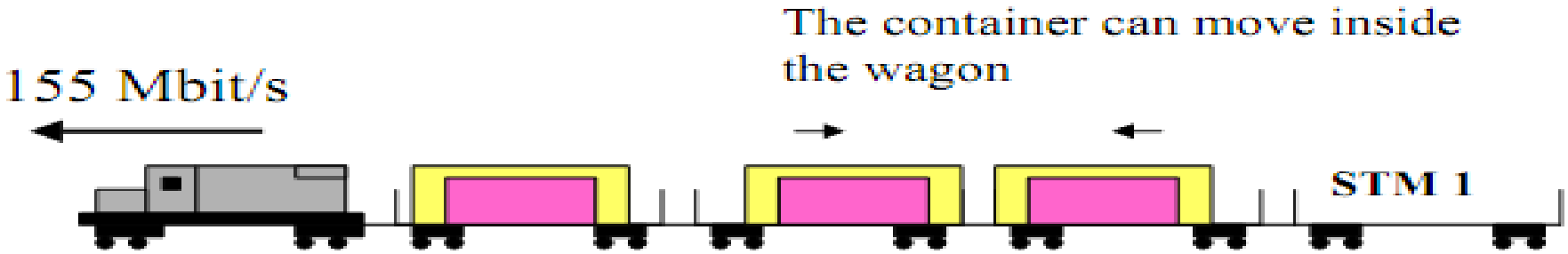
- SDH Multiplexing

SDH is a new way of multiplexing slow signals onto a faster signal. It has mechanisms for dealing with tributaries that are not running at the same clock rate.



- Transport Overhead : AU4 pointer

In order to illustrate the pointer working, have a look on the following picture :



The SDH Multiplexing map