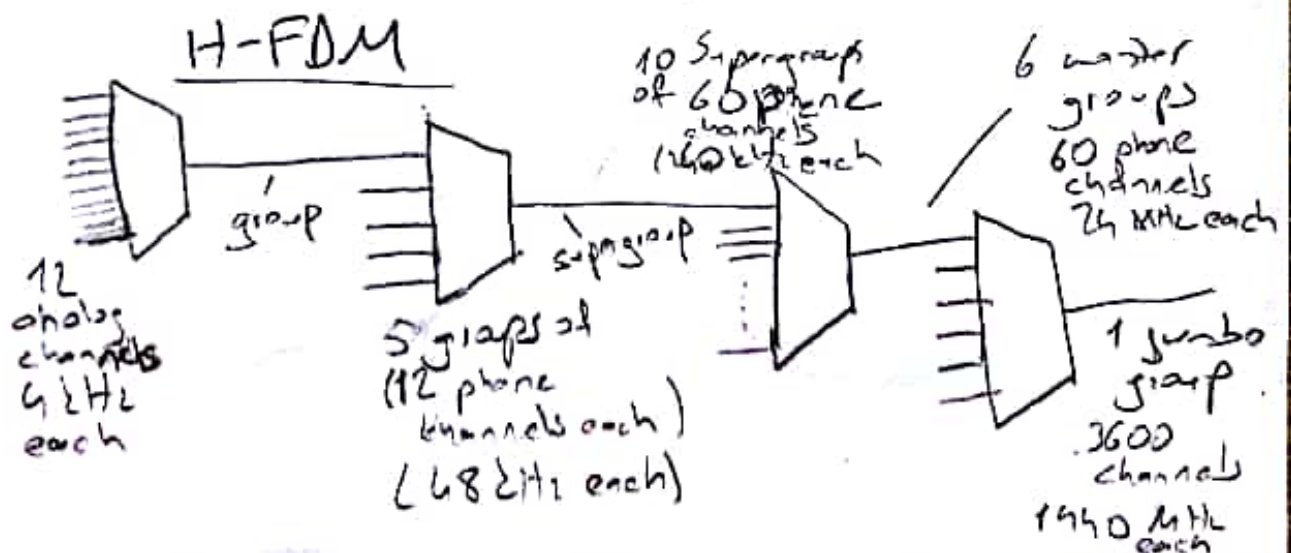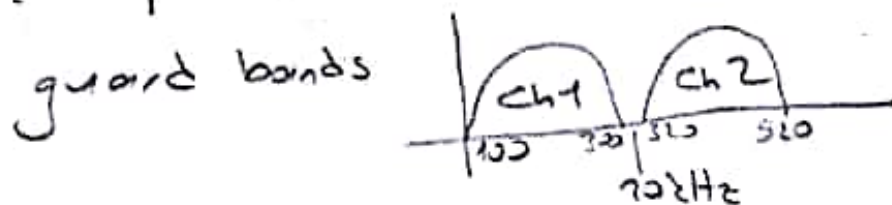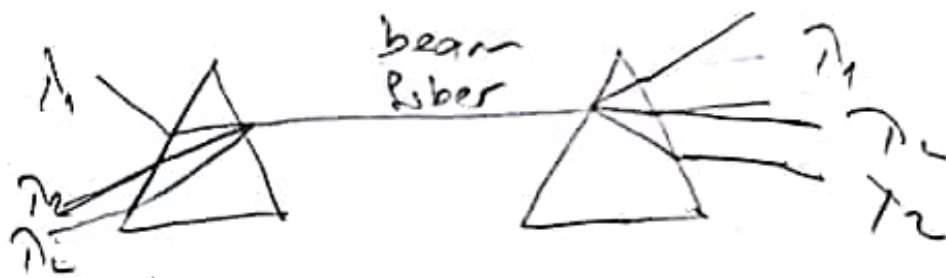- Selective - Reject (ARQ) genelde kullanılmıyor. Ama uydu iletişiminde propagation uzun olduğu için kullanılıyor.

- TCP Go-back-N variantını kullanıyor.

- Statistical TDM ile boş slotlar doldurulabilir.
- FDM ve TDM birlikte kullanılabilir.

Channel	Freq. (kHz)
1	100-300
2	320-520
3	540-740
⋮	⋮

$\quad$ 100-300 $\rangle$ 20 kHz → guard bands
$\quad$ 320-520 $\rangle$ 20 kHz
$\quad$ 540-740

guard bands

ch1 $\quad$ ch 2
100 $\quad$ 320 313 $\quad$ 520
20 kHz

H-FDM

10 Supergroup of 60 phone channels (60 kHz each)

6 master groups 60 phone channels 24 MHz each

group

supgroup

12 analog channels 4 kHz each

5 groups of (12 phone channels each) (48 kHz each)

1 jumbo group 3600 channels 1440 MHz each

①

beam
fiber

λ_1 λ_2 λ_c → λ_1 λ_c λ_2

* TDM $\xrightarrow{\text{efficient}}$ digital

* Flow control ⟶ TDM integra dynamic

H-TDM

24 DS-0
digital phone
channels
64 kbps
each

4 DS-1
digital phone
channels
1.544 Mbps
each

7 DS-2
dig. phone ch.
6.312 Mbps
each

6 DS-3
dig. ph.ch.
44.736.
Mbps each

1 DS-4
dig. ph.ch.
274.976
Mbps
each
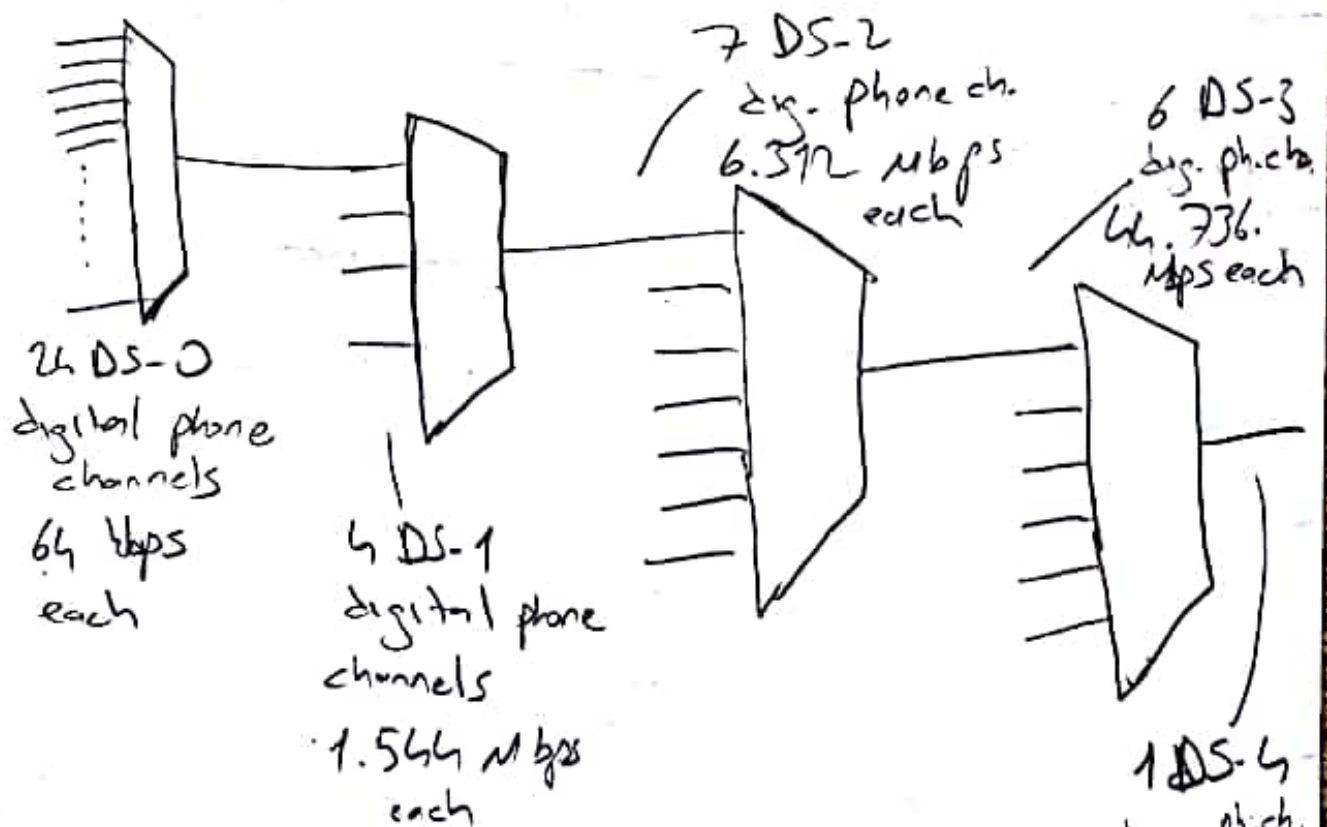
2.2 — Multiple Access   FDMA/-TDMA/...

↓
youtube

fundamentals of 4G

Comparison Table

	TDM	FDM
Borsics	Time scale is shared	Frequency is shared
Used with	Digital and analog signal	Analog signals
Necessry requerement	Signal pulses	Guard bands
Inferrence	Low or neglrigible [1]	High
Circuitry	Simpler	Complex
Utilization	Efficiently used	Inefficient

*Finalde teorik sorular diagramla destellenebilir.

* Cell sectoring:
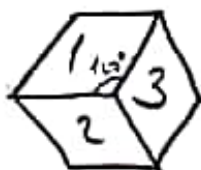
Frequincy channels;   3 sectors   6 sectors

1 → 9·10
2 → 11·W   3 directional → at the base
3 → 41·50   antenna in use   station

Handoff → move from one cell to another

③ [1] Digital sngrller'n inferrence için ethellenmess daha az

Transmission   Reflection   Refraction
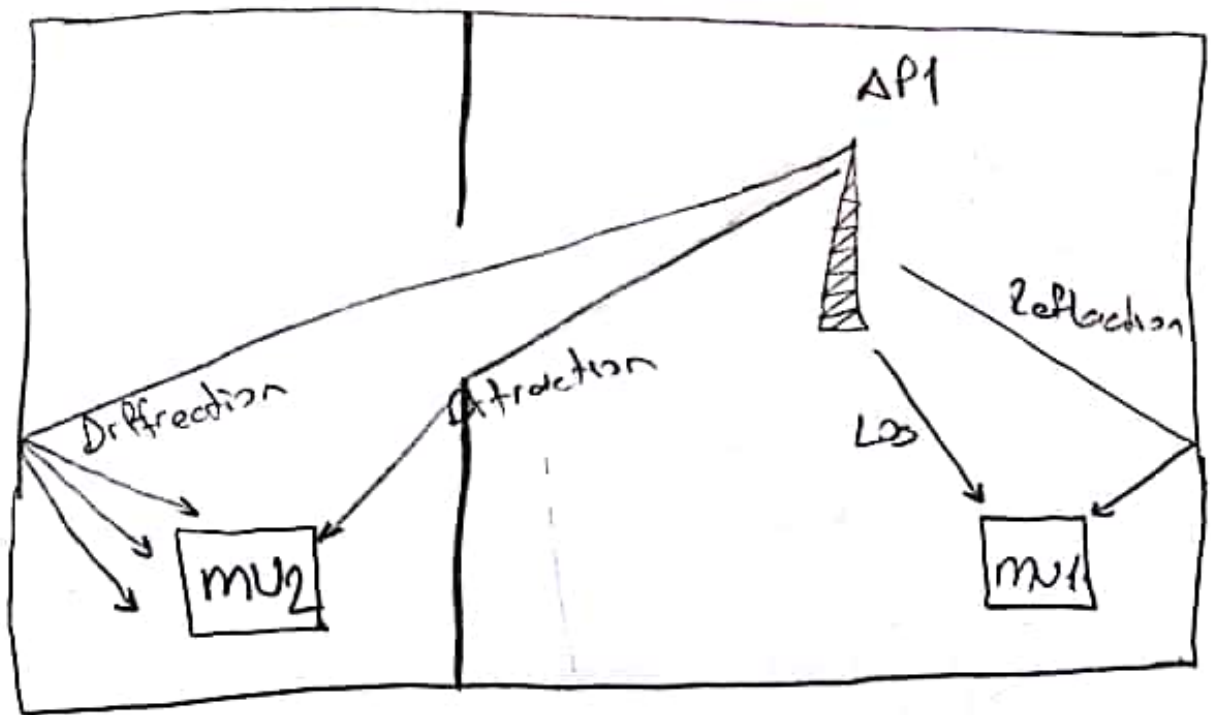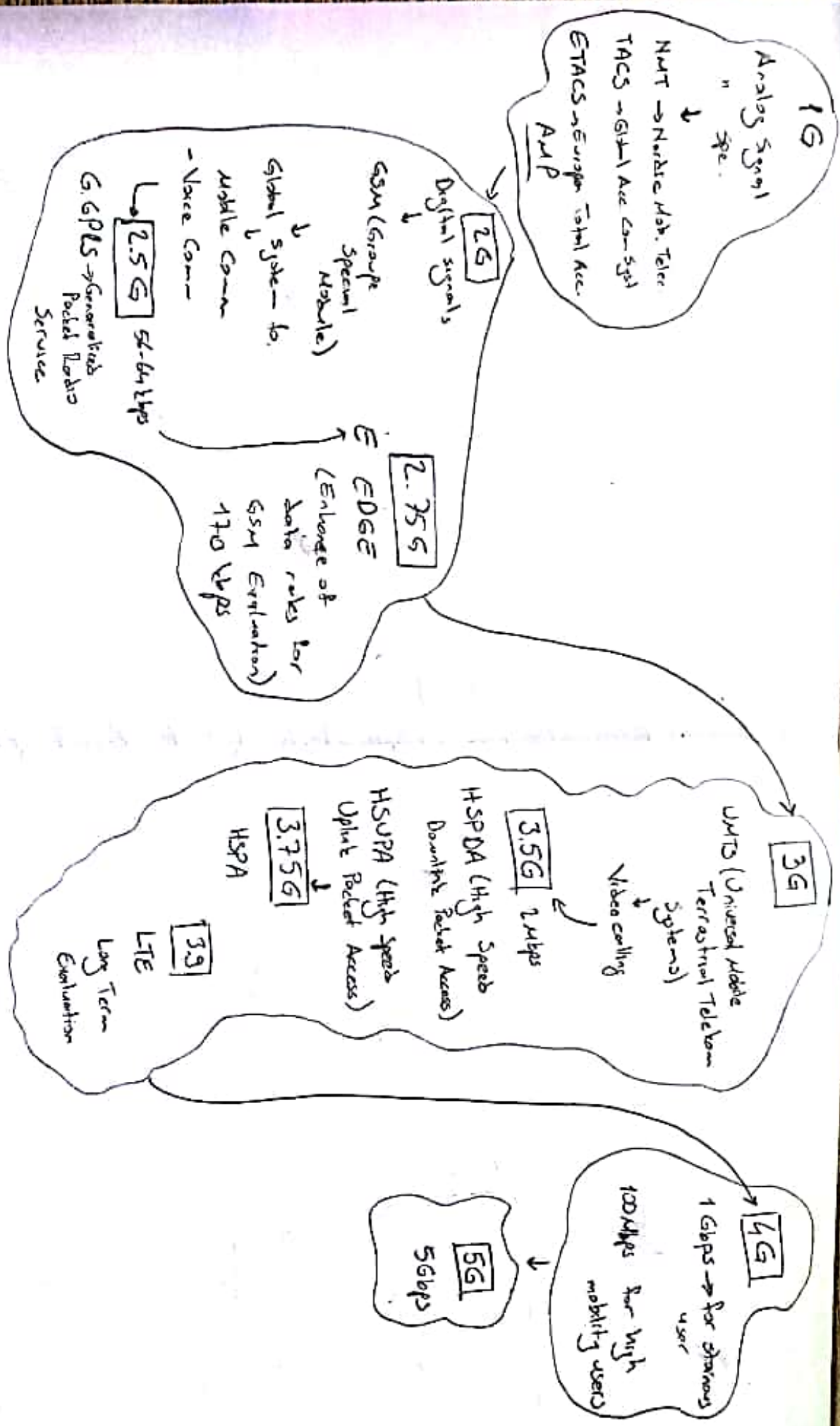
Diffraction   Scattering
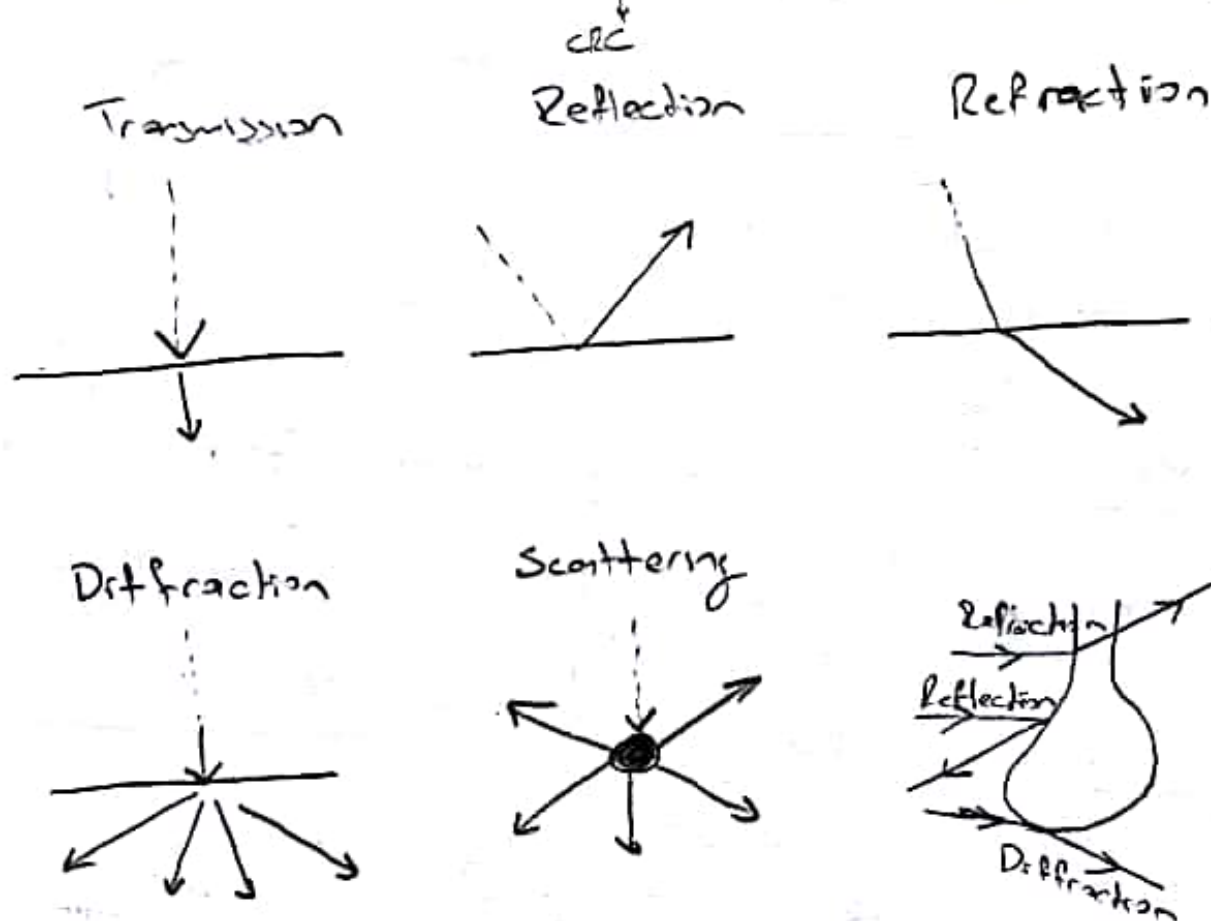
reflection : change in direction when it bounce
              off a barrier

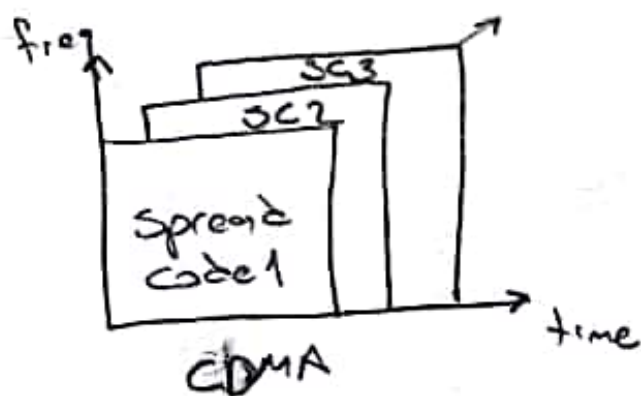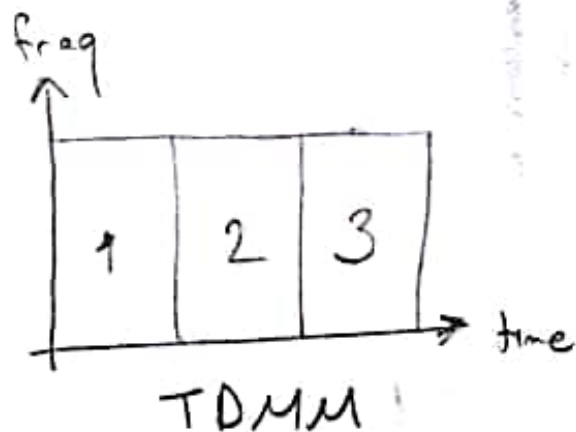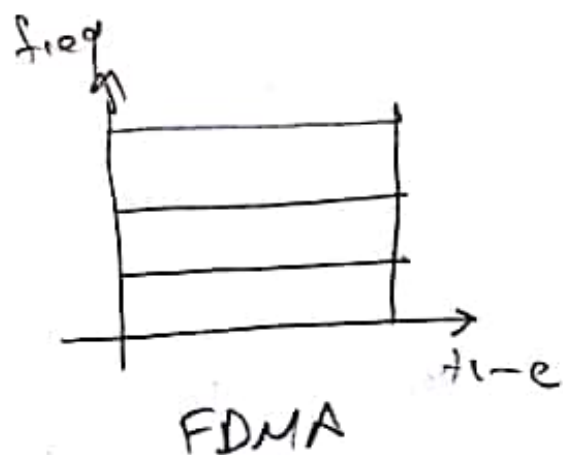refraction : change in direction of waves
           -- when they pass from one medium
              to another

diffraction : change in direction of waves
              when they pass through an opening
           or around a barrier, their path

(4)

a) Path Loss ⟶ ⎫
                ⎬ Slow change
b) Shadowing ⟶ ⎭

c) Multi-path ⟶
        ↓
     fast change

⑤

1G

Analog Signal
" spe.

NMT → Nordic Mob. Telec
TACS → Global Acc Co-Syst
ETACS → Europe Total Acc.
&nd P

2G

Digital Signals

GSM (Group
Special
Mobile)

Global System to
Mobile Comm.

- Voice Comm.

2.5 G 56-64 Ups

G.GPRS → Generalised
Packet Radio
Service

2.75 G

E EDGE
(Enhance of
data rates for
GSM Evolution)
170 Ups

3G

UMTS (Universal Mobile
Terrastrial Telebom
System)

Video calling

3.5G 2 Mbps

HSPDA (High Speed
Downlink Packet Access)

HSUPA (High Speed
Uplink Packet Access)

3.75G

HSPA

3.9

LTE
Long Term
Evoluation

4G

1 Gbps → for Stationary
user

100 Mbps for high
mobility user

5G

5 Gbps

freq

FDMA

freq

TDMM

freq

SC3
SC2

Spread
Code 1

CDMA

time

-RFC , 811 ailesi protokollerini indirip
bakabilirsin.

(8)

17.1 17.3

6, 7, 8, 10, 13, 17 ⇒ chapters

exclude
7.3

exclude
13.3

✓ Adsl, cable ~characterie

- Teorit Test
- Problem klasit (CRC kesin)

---

cellular capacity

$d = \sqrt{3} R$

$\frac{D}{R} = \sqrt{3N}$ ⟶ minimum distance between cochannels

⟶ reuse factor

distance
between
adjacent
base stations

radius
of a
cell

$N = I^2 + J^2 + (I \times J)$

⟶ total # of frequencies (channels)

K/N ⟶ each cell can have

$1.5 R^2 \sqrt{3}$ ⟶ area of a hexagon

CRC (Modulo 2)

D ⟶ message (k-bit)

P ⟶ pattern ⟶ predetermined (n-k+1 bit) least and most
significant bits most 1

R ⟶ FCS (Frame check sequence) (n-k bits or #(P-1) bits)

- $D2^{n-k}$ (append n-k (#(P-1)) 0's to the right of D
- Find R ⟶ modulo 2 arithmetic $\xrightarrow{sum}$ T

⑨

se factor

x J)

cies (channels)

an have

agan

d

R

least most