OFDMA

بسم الله الرحمن الرحيم

Q: Assume a Communication with BW = 720 kHz and subcarrier spacing of = 15 kHz and 1024-QAM is used.

A) determine the number of bits transmitted per OFDM resource element.

*Solution:

1) Calculate # of subcarriers = $\frac{BW}{\Delta f} = \frac{720 \text{ kHz}}{15 \text{ kHz}}$ = 48 Subcarrier.

⇒ Since 1024-QAM is used ∴ 10 bits are transmitted per Subcarrier

∴ # bits per OFDM recource element = 48 * 10 = 480 bit/Resource element

B) Assume 7 OFDM symbols per RB, determine the number of bits transmitted per Resource Block:

7 * 480 = 3360 bit/RB

RB = Resource Block

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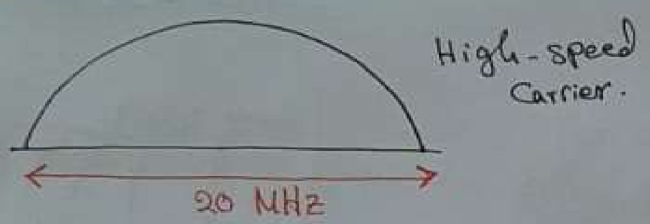
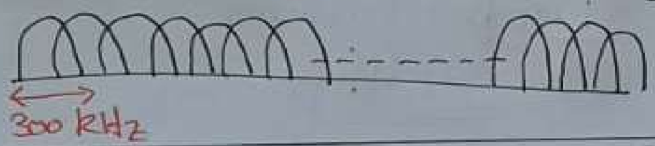
*Q: OFDM channels in IEE 802.11a.



broken up



52-Subchannels
- → 48 for data
- → 4 for error detection.

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* Now, We will Analyze Data Rate using the following Modulation techniques:

BPSK, QPSK, 16-QAM, 64-QAM

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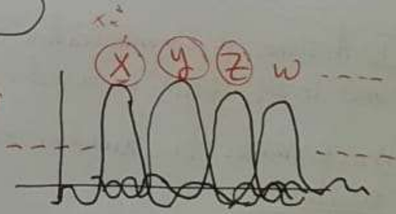
1) By BPSK:

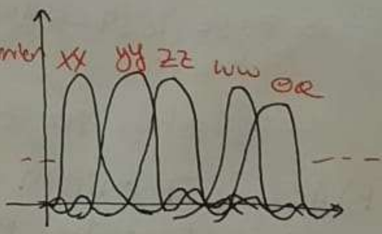
125 KBbs of data

∴ data Rate = 125 kbps * 48 Subcarrier
= 6000 kbps
= 6 MHz



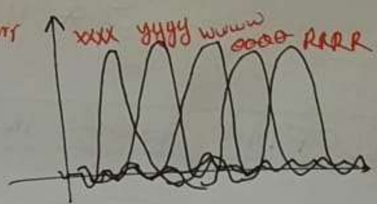
2) By QPSK:

data Rate = 250 kBbs * 48 _ Subcarrier
= 12000 kbps
= 12 Mbps



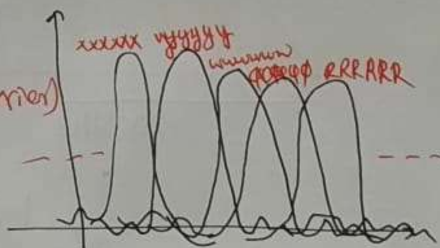
3) By 16 - QAM:

data Rate = 500 kbps * 48 _ Subcarr
= 24000 kbps
= 24 Mbps



4) By 64 - QAM:

data Rate = (125 * 6) * (48)
= (750 kbps) * (48 - subcarrier)
= 36 Mbps



But, if 64-QAM with ≈9 bit per subcarrier (6)

(9 * 125 (K)) (48) = 54 Mbps.

***Question:** A Communication system transmits (QPSK) symbols over a channel with flat noise spectral density of $N_o = 10^{-6}$ watt/Hz use the SNR Vs BER curves to determine the Req. Energy per bit for Probability Error rate $BER = 10^{-4}$

***Ans:**

$\frac{E_b}{N_o}$ @ X-axis , BER @ Y-axis

∴ أستخدم المنحنى الأزرق.

≡ find E_b

the X-axis in (dB) when $BER = 10^{-4}$ is $\cong 8.2$ (dB)

Convert it to unit-less.

$$\therefore 8.2 = 10 \log_{10} \boxed{\text{unit-less}} \rightarrow X$$

$$\therefore X = 10^{0.82} = 6.6$$

$\therefore 6.6 = $ X-axis Value $\Rightarrow 6.6 = \frac{E_b}{N_o} = \frac{E_b}{10^{-6}} = 6.6$

المطلوب.

$$\therefore \boxed{E_b = 6.6 * 10^{-6}}$$

***Question:** A Network uses Pure AloHA in the MAC layer to transmit frames at Rate of 4 kfps. Assume the size of each frame is 12 k-bit, Determine the data transmition Band width that achieves the Maximum throughput.

***Solution:** when we using pure ALOHA ∴ Max-throughput when $G = 0.5$, we know that $G = gT$ (g → packet rate)

$$0.5 = (4000)\,T$$

$$\boxed{T = 1.25 * 10^{-4}}$$

$$T = \frac{\text{frame size}}{BW} = 1.25 * 10^{-4} = \frac{12 * 10^{3}}{BW}$$

$$\boxed{\therefore BW = 96 \text{ MHz}}$$

* **Question:** A network has a data ~~Rate~~ Bandwidth = 20 Mbps, it uses unslotted nonpersistent CSMA in the MAC layer. The Maximum signal Propagation time for the Node is 40 μsec. determine the throughput in Percent Assuming 10 kbit frames size and frame Rate = 5 kfps.

Solution:

BW = 20 Mbps

$\tau = 40\ \mu sec.$

frame - size = 10kbit.

g = 5 kfps.

the equation: $S_{th} = \dfrac{G e^{-2\alpha T}}{G(1+2\alpha) + e^{-\alpha G}}$

→ find T to find G

$$T = \frac{\text{frame size}}{BW} = \frac{1\text{kbit}}{20\text{Mbps}} = \frac{10*10^{3}}{20*10^{6}} = 50*10^{-5}\ \text{sec} = 0.5\ \text{mse}$$

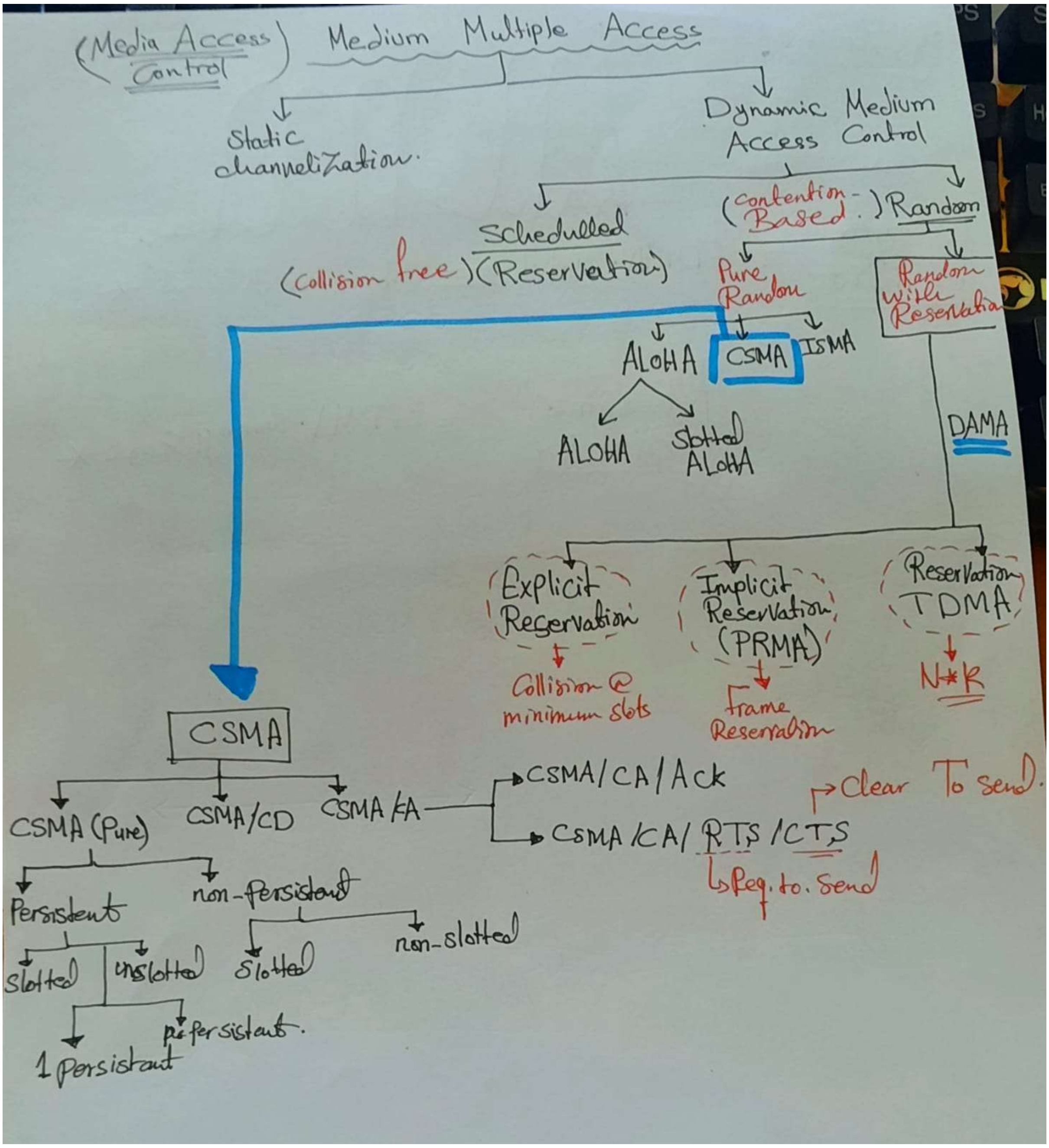
$$G = gT = 5*10^{3} * 0.5 * 10^{-3} = \boxed{2.5 = G}$$

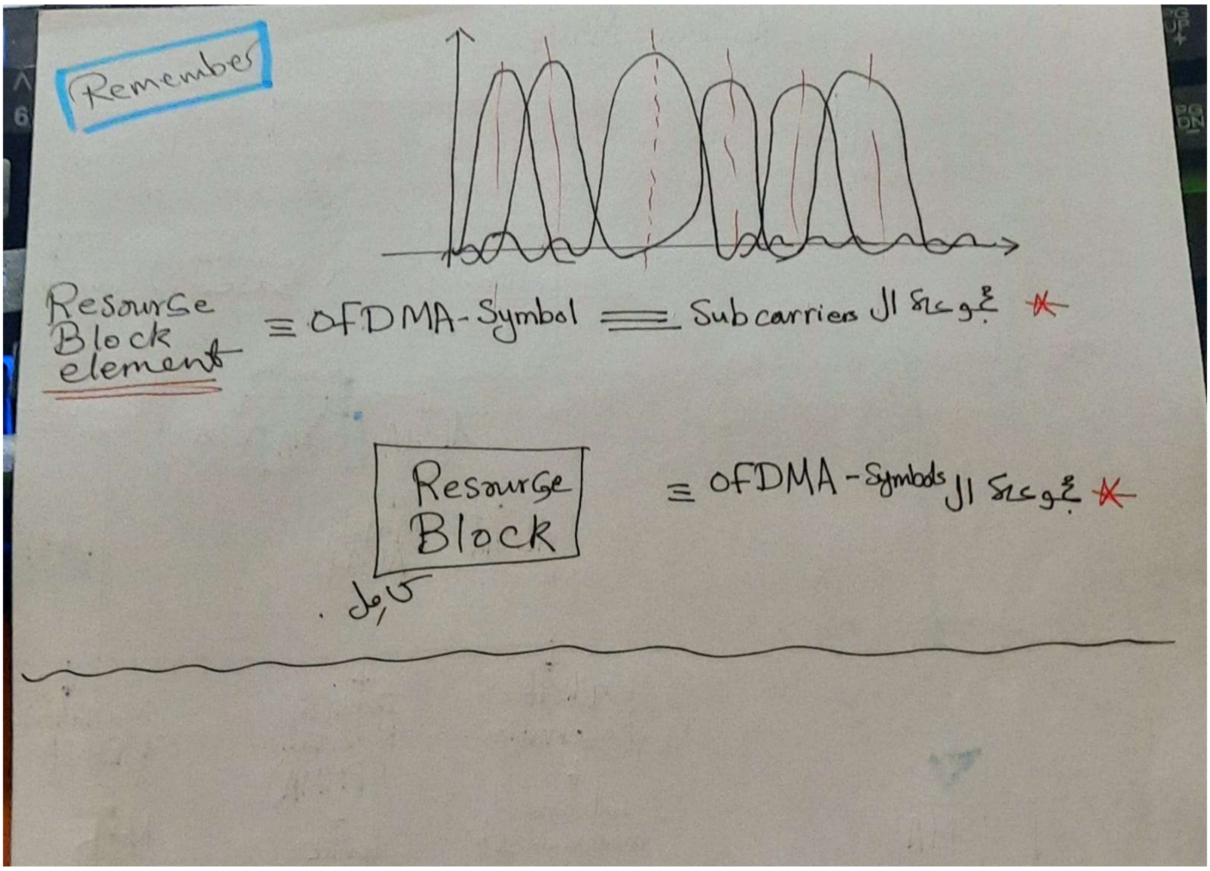
$$\alpha = \tau / T = \frac{40*10^{-6}}{0.5*10^{-3}} = 0.8*10^{-1} = 0.08$$

$$\therefore S_{th} = \frac{(2.5)\left(e^{-1.6(2.5*10^{-3})}\right)}{(2.5)(1+1.6) + e^{(-0.8)(2.5)}}$$

$$= \frac{(2.5)(0.999)}{3.718} * 100\%$$

$$\boxed{S_{th} = 67.17\%}$$


(Media Access Control)
Medium Multiple Access
Static channelization.
Dynamic Medium Access Control
Schedulled
(Collision free)(Reservation)
(Contention-Based.) Random
Pure Random
Random with Reservation
ALOHA
CSMA
ISMA
ALOHA
Slotted ALOHA
DAMA
Explicit Reservation
Collision @ minimum slots
Implicit Reservation (PRMA)
Frame Reservation
Reservation TDMA
N*K
CSMA
CSMA (Pure)
CSMA/CD
CSMA/CA
CSMA/CA/Ack
CSMA/CA/RTS/CTS
Clear To send.
Req. to. Send
Persistent
non-Persistent
slotted
unslotted
Slotted
non-slotted
1 Persistant
p-persistant.


Remember
Resourse Block element
≡ OFDMA-Symbol ≡ Subcarriers مجموعة ال
Resourse Block
≡ OFDMA-Symbols مجموعة ال
كامل