

## 2. CIKLUS AUDITORNE

1.

$$1. f_r = \frac{f_1 + f_0}{2} = \frac{1300 + 2100}{2} = 1700 \text{ Hz}$$

$$2. \Delta f = f_1 - f_r = f_r - f_0 = \frac{f_1 - f_0}{2} = 400 \text{ Hz}$$

3. indeks modulacije - „m“ što se maksimalno mijenja

$$m_f = 2 \cdot \Delta f \cdot T_b \Rightarrow T_b = \frac{1}{R_b} = \frac{1}{1200} = 833 \mu s$$

$$m_f = 2 \cdot 400 \cdot 833 \cdot 10^{-6} = 0.67$$

$$4. B_{FSK} \approx 2 \Delta f + \frac{1}{T_b} = 2 \cdot 400 + 1200 = 2000 \text{ Hz}$$

$$f_d = f_r - \frac{B_{FSK}}{2} = 700 \text{ Hz}$$

$$f_g = f_r + \frac{B_{FSK}}{2} = 2700 \text{ Hz}$$

2.

trajanje simbola = 2 · trajanje bita

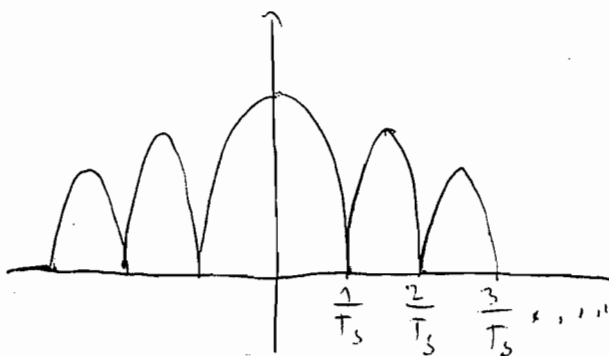
$$T_s = \frac{2}{R_b}$$

$$T_s = 2 T_b = \frac{2}{R_b}$$

$$1. B_N = \frac{1}{T_s} = \frac{R_b}{2} = 4.224 \text{ MHz}$$

$$2. B_d = B_N (1 + \alpha) = 5.49 \text{ MHz}$$

3.



$$1. f_s - f_r = 12 \text{ MHz} \Rightarrow R_s = 12 \text{ MHz}$$

$$R_{b(8-FSK)} = 3 \cdot R_s = 36 \frac{\text{nbit}}{\text{s}} \text{ laudi}$$

$$2. B_N = \frac{1}{T_s} = R_s = 12 \text{ MHz}$$

$$SPU = \frac{R_b}{B} = \frac{R_b}{B_N (1 + \alpha)} = \frac{36}{12 (1 + 0.25)} = 2.4 \text{ bit/s/Hz}$$

4.)

$$B_N = \frac{1}{T_s} = R_s = \frac{R_b}{2} = 9600 \text{ Hz}$$

$$B = B_N (1 + \alpha) = 14400 \text{ Hz}$$

$$N = N_0 B = 86,4 \text{ } \mu\text{W}$$

Suma se prila na širinski priručnik  
~~na širinski priručnik~~

1.  $\frac{C}{N} = \frac{10^{-9}}{86,4 \cdot 10^{-12}} = 11,57 \Rightarrow 10 \log \left( \frac{C}{N} \right) = 10,65 \text{ dB}$   
 (oznaka)   
 nula se oči

2.  $E_s = C \cdot T_s = C \cdot \frac{2}{R_b} = 1,04 \cdot 10^{-13} \text{ Ws}$

$$\frac{E_s}{N_0} = \frac{1,04 \cdot 10^{-13}}{6 \cdot 10^{-15}} = 17,36 \Rightarrow 10 \log \left( \frac{E_s}{N_0} \right) = 12,4 \text{ dB}$$

5.)

$$r_{Eb} = \frac{1}{2} e^{\left( -\frac{E_b}{N_0} \right)} \rightarrow \text{vj. pogreške bita (u QPSK je } \frac{E_b}{2N_0} \text{)}$$

$$\frac{E_b}{N_0} = \ln \left( \frac{1}{2 r_{Eb}} \right) = 10,82$$

$$E_b = 10,82 \cdot 4 \cdot 10^{-15} = 4,33 \cdot 10^{-14} \text{ Ws}$$

$$T_b = \frac{1}{R_b} = 0,49 \text{ } \mu\text{s}$$

→  $C_{Rx} = \frac{E_b}{T_b} = E_b \cdot R_b = 8,86 \cdot 10^{-8} \text{ W}$

priručnik

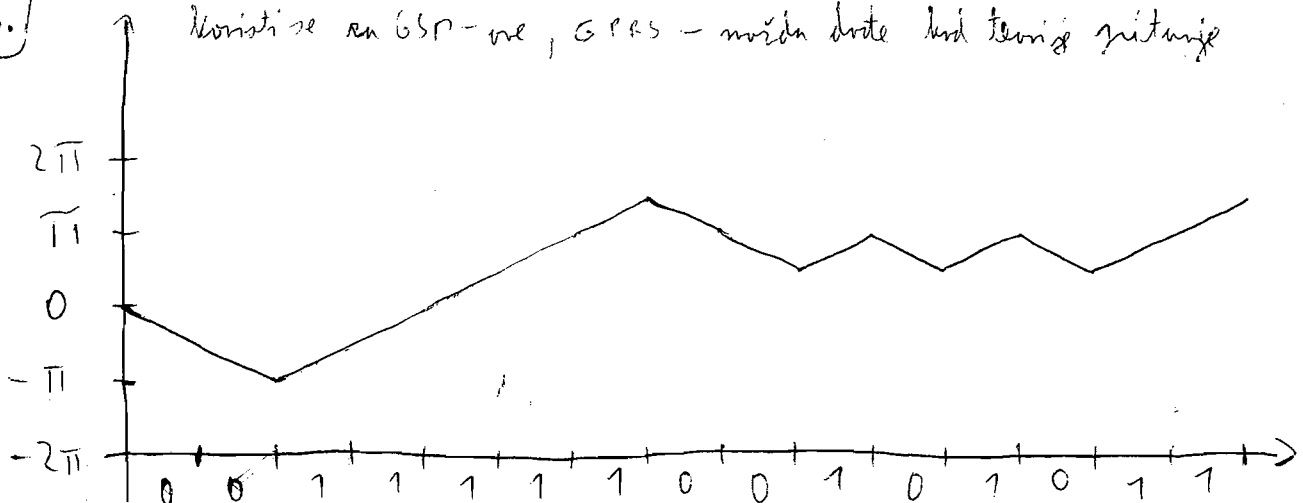
$\frac{A}{10} \rightarrow$  atenuacija = priručnik = 30 dB

→  $C_{Tx} = C_{Rx} \cdot 10^{\frac{A}{10}} = 88,6 \text{ W}$

odlični

6.)

Koristi se na GSP-ve, GPS - moćda drate kod termičko zračenje



7.

duž bita u simbolu bude minimalan

$$B = B_N (1 + \alpha) \Rightarrow B_N = \frac{B}{1 + \alpha} = 24 \text{ MHz}$$

$$R_s = B_N = 24 \text{ MHz} \leftarrow \text{budi}$$

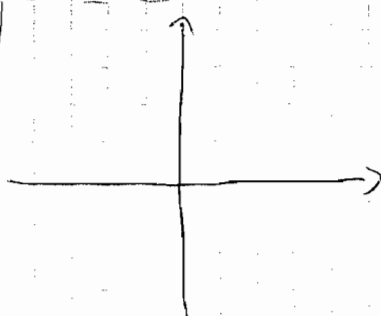
$$n = \frac{R_b}{R_s} = \frac{140}{24} = 5.83 \Rightarrow n = 6$$

$$M = 2^n = 64 \rightarrow \text{bilo bi postupak sa 64 stanja, tj. u jednom simbolu 64 bita (npr. FSK, PSK)}$$

8.

bin znak		1	0	1	1	0	0	0	1	0	0
trn	0	0	$\bar{1}$	$\bar{1}$	$\bar{1}$	0	$\bar{1}$	0	0	$\bar{1}$	0

9.



- prelazi se tačke  $\rightarrow 64 \rightarrow 2^6$

(- tim tačkama se definiše najmanji vektorski prostor simbolima - ?)

6 bit/s

10.

- ovo tačka da će biti prema vizuelnom asistenciji
- pojedini postupak  $\rightarrow$  tehnika  $\rightarrow$  neki kanal je odvojen

$$f_g (1 + \alpha) = \frac{360}{2} = 180 \text{ kHz} \rightarrow \text{BASE BAND}$$

$$f_g (1 - \alpha) = 320 \text{ kHz}$$

$$T_b = \frac{1}{R_b} = 5 \mu s \rightarrow 200 \cdot 10^3$$

$$f_g = 400 \text{ kHz}$$

$$T_s = 2 T_b = 10 \mu s \Rightarrow f_0 = \frac{1}{T_s} = 100 \text{ kHz}$$

ovo je BASE BAND, tj. pojedini postupak

$$P = \frac{1}{2} \cdot \frac{16}{\pi^2} \left( 1 + \frac{1}{9} \right) = 0.9006 \approx 90\% \text{ ukupne moći}$$

1, 3, harmonike

$$u(t) = \frac{4}{\pi} \sum_{n=1}^{\infty} (-1)^{n+1} \frac{1}{2n-1} \sin \left( \frac{(2n-1) \cdot \pi \cdot t}{T} \right)$$

$\rightarrow$  predstaviti signalom  $\rightarrow$  bilo koji tačka - ? ? ?

OFDM - niži modulacijski postupak

- puna nosioca jedan do drugog, rešavaju se sum

11.

$$1. T_{Z1} = \frac{T_0}{4} = \frac{896}{4} = 224 \mu s$$

$$2. N_{BITA} = \log_2(n) \cdot m_p = 4 \cdot 6817 = 27268$$

$$3. T_{OFDM} = T_0 + T_{Z1} = \frac{5}{4} T_0 = 1120 \mu s$$

$$R_{BRUTO} = \frac{N_{BITA}}{T_{OFDM}} = 24,346 \text{ bit/s}$$

$$4. \Delta f = \frac{1}{T_0} = \frac{1}{896} = 1116 \text{ Hz}$$

→ manje mesta podvođenja

$$5. B_{OFDM} = N \cdot \Delta f = 6817 \cdot 1116 = 7,61 \text{ MHz}$$

→ ukupna širina pojasa

12.

MINIMALNA BRZINA

MAKSIMALNA BRZINA

$$1. T_{Z1} = \frac{1}{4} T_0 \text{ , BPSK}$$

$$T_{Z1} = \frac{1}{32} T_0 \text{ , 64-QAM}$$

$$T_0 = \frac{1}{\Delta f} = \frac{1}{15625} = 64 \mu s$$

$$T_{OFDM} = T_0 + T_{Z1} = \frac{5}{4} T_0 = 80 \mu s$$

$$R = \frac{N_{BITA}}{T_{OFDM}} = 2,4 \text{ bit/s}$$

$$T_{OFDM} = T_0 + T_{Z1} = \frac{33}{32} T_0 =$$

$$R = \frac{N_{BITA}}{T_{OFDM}} = \frac{64 \cdot N_{MODULA}}{T_{OFDM}}$$

$$R = 17,45 \text{ bit/s}$$

$$2. S.P.L = \frac{R_e}{B} = \frac{17,45 \cdot 10^6}{3,5 \cdot 10^6} = 4,99 \text{ bit/s/Hz}$$