Rs = Simbolos por segundo transmitidos
Ts = Tiempo de símbolo
Eb = energia de un bit (db?)
SNR = Relacion señal a ruido (dB?)
N0= constante normalizadora
Bw = ancho de banda disponible en hz
Si la atenuación es muy grande SNR va a ser muy mala
Si el Bw es pequeño podemos transmitir pocos simbolos/s
C (maxima Vt teorica b/s) = Bw * log2(1+SNR)
h_{ij}=constante que representa la atenuacion entre la amplitud de T_x y R_x

$$\varphi=\frac{\pi}{2} \Rightarrow e^{i\cdot\frac{\pi}{2}}=\cos\frac{\pi}{2}+i\sin\frac{\pi}{2} \Rightarrow e^{i\cdot\frac{\pi}{2}}=0+1\cdot i=i,$$

$$\varphi=\pi \Rightarrow e^{i\cdot\pi}=\cos\pi+i\sin\pi \Rightarrow e^{i\cdot\pi}=-1+0\cdot i=-1,$$

$$\varphi=\frac{3\pi}{2} \Rightarrow e^{i\cdot\frac{3\pi}{2}}=\cos\frac{3\pi}{2}+i\sin\frac{3\pi}{2} \Rightarrow e^{i\cdot\frac{3\pi}{2}}=0-1\cdot i=-i,$$

$$\varphi=2\pi \Rightarrow e^{i\cdot 2\pi}=\cos 2\pi+i\sin 2\pi \Rightarrow e^{i\cdot 2\pi}=1+0\cdot i=1.$$

E_b/N_0 and R/Bw

SNR= P_{Rx}/P_N

We can express P_{Rx} and P_N as:

$$\begin{cases} P_{Rx} = E_b R \\ P_N = N_0 Bw \end{cases}$$

Does not include code bits!!

Obtaining

SNR = $(E_b/N_0)(R/Bw)$

Spectral efficiency
No units: (b/s)/(1/s)

Energy per bit to noise power spectral density ratio
No units: J/(W/s)

$$R_s = 1/T_s$$

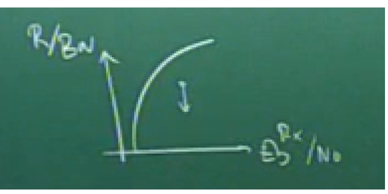
$$P_N = B_w \cdot N_0$$

$$P_{Rx} = P_{tx} \cdot 10^{-\frac{dB}{10}}$$

$$P_{Rx} = R \cdot E_b^{Rx}$$

$$SNR = \frac{P_{Rx}}{P_N} = \frac{E_b^{Rx}}{N_0} \cdot \frac{R}{B_w}$$

$$C = B_w \log_2(1+SNR)$$



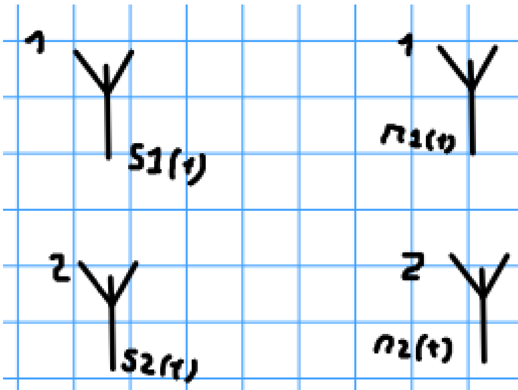
$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} h_{11} \\ h_{21} \end{bmatrix} \cdot X(t) + \begin{bmatrix} m_1 \\ m_2 \end{bmatrix}$$

$$h_{11} = \frac{A_1}{A} e^{i\varphi_1}$$

$$dB = 10\log\frac{P}{P(ref)}$$

$$r_1(t) = S_1(t)\cdot h_{11} + S_2(t)\cdot h_{12} + N(t)$$

Prefix		Base 10	Decimal
Name	Symbol		
yotta	Y	10^{24}	1 000 000 000 000 000 000 000 000
zetta	Z	10^{21}	1 000 000 000 000 000 000 000
exa	E	10^{18}	1 000 000 000 000 000 000
peta	P	10^{15}	1 000 000 000 000 000
tera	T	10^{12}	1 000 000 000 000
giga	G	10^{9}	1 000 000 000
mega	M	10^{6}	1 000 000
kilo	k	10^{3}	1 000
hecto	h	10^{2}	100
deca	da	10^{1}	10
		10^{0}	1
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000 001
nano	n	10^{-9}	0.000 000 001
pico	p	10^{-12}	0.000 000 000 001
femto	f	10^{-15}	0.000 000 000 000 001
atto	a	10^{-18}	0.000 000 000 000 000 001
zepto	z	10^{-21}	0.000 000 000 000 000 000 001
yocto	y	10^{-24}	0.000 000 000 000 000 000 000 001



$$S1(t) = \cos(\omega t) \longleftrightarrow \mathbb{R}e\left(e^{i\cdot(\omega t)}\right)$$

$$r1(t) = 0'5\,\text{Sim}(\omega t) \longleftrightarrow 0'5 e^{i(\omega t + \alpha)} \longleftrightarrow \underbrace{0'5 \cdot e^{i\pi}}_{h} \cdot e^{i(\omega t)}$$

$$r2(t) = -0'25 \cos(\omega t) \longleftrightarrow \underbrace{-0'25 \cdot e^{0}}_{h} \cdot e^{i(\omega t)}$$

Equación vectorial
señal recibida

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} h_{11} \\ h_{21} \end{bmatrix} \cdot X(t) + \begin{bmatrix} m_1 \\ m_2 \end{bmatrix}$$

$$h_{11} = \frac{0'5}{1} e^{i\pi/2} \longleftrightarrow \frac{1}{2} \cdot \left|\cos\frac{\pi}{2} + i\,\text{sen}\,\frac{\pi}{2}\right| = 0'5i$$

$$h_{21} = \frac{-0'25}{1} \cdot e^{i0} = -0'25$$

$$h_{12} = \frac{0'5}{1} e^{i0} = 0'5$$

$$h_{22} = \frac{1}{1} e^{i\pi} = -1$$

$$-\frac{1}{1} e^{i0} = -1$$