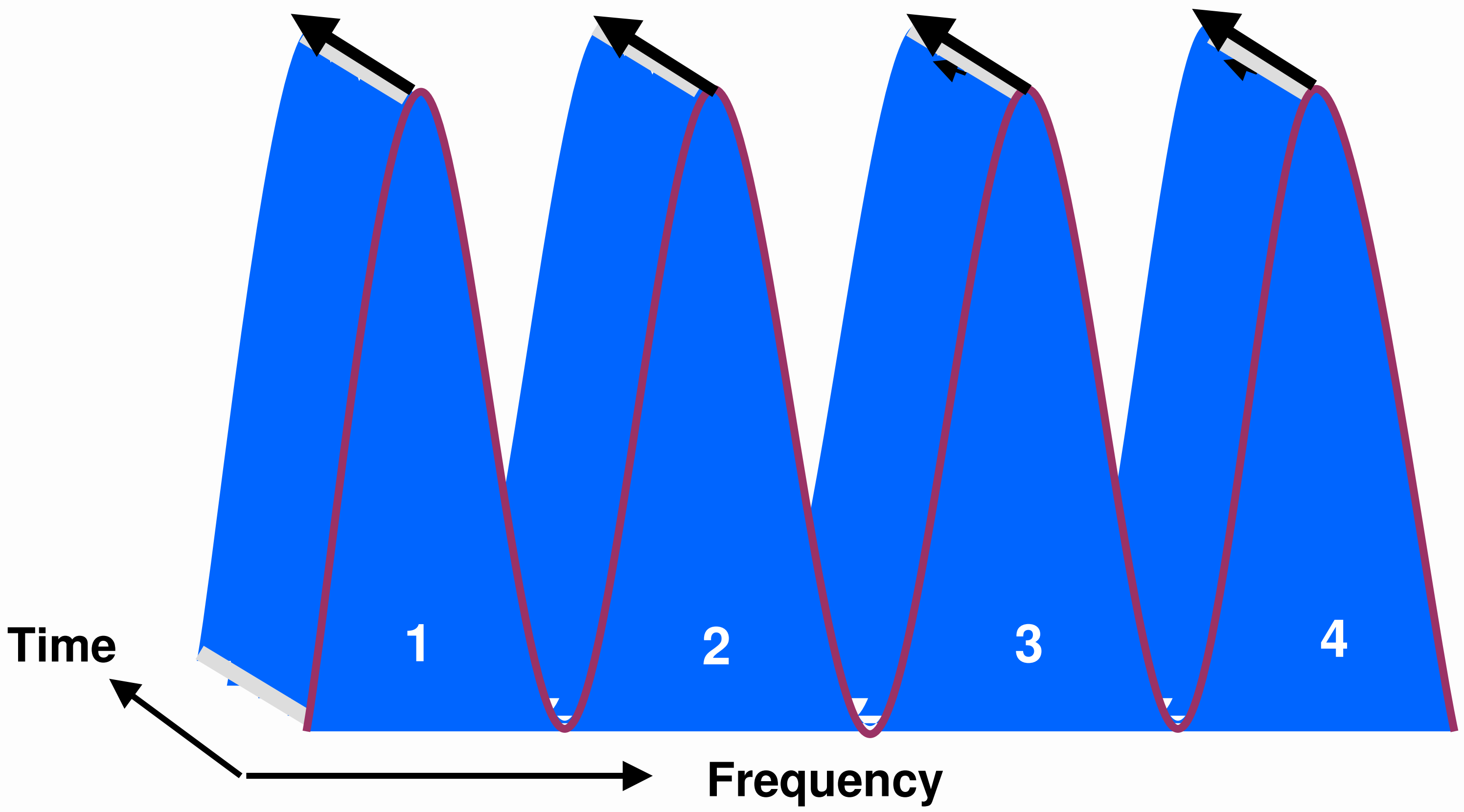
Multiple Access Techniques

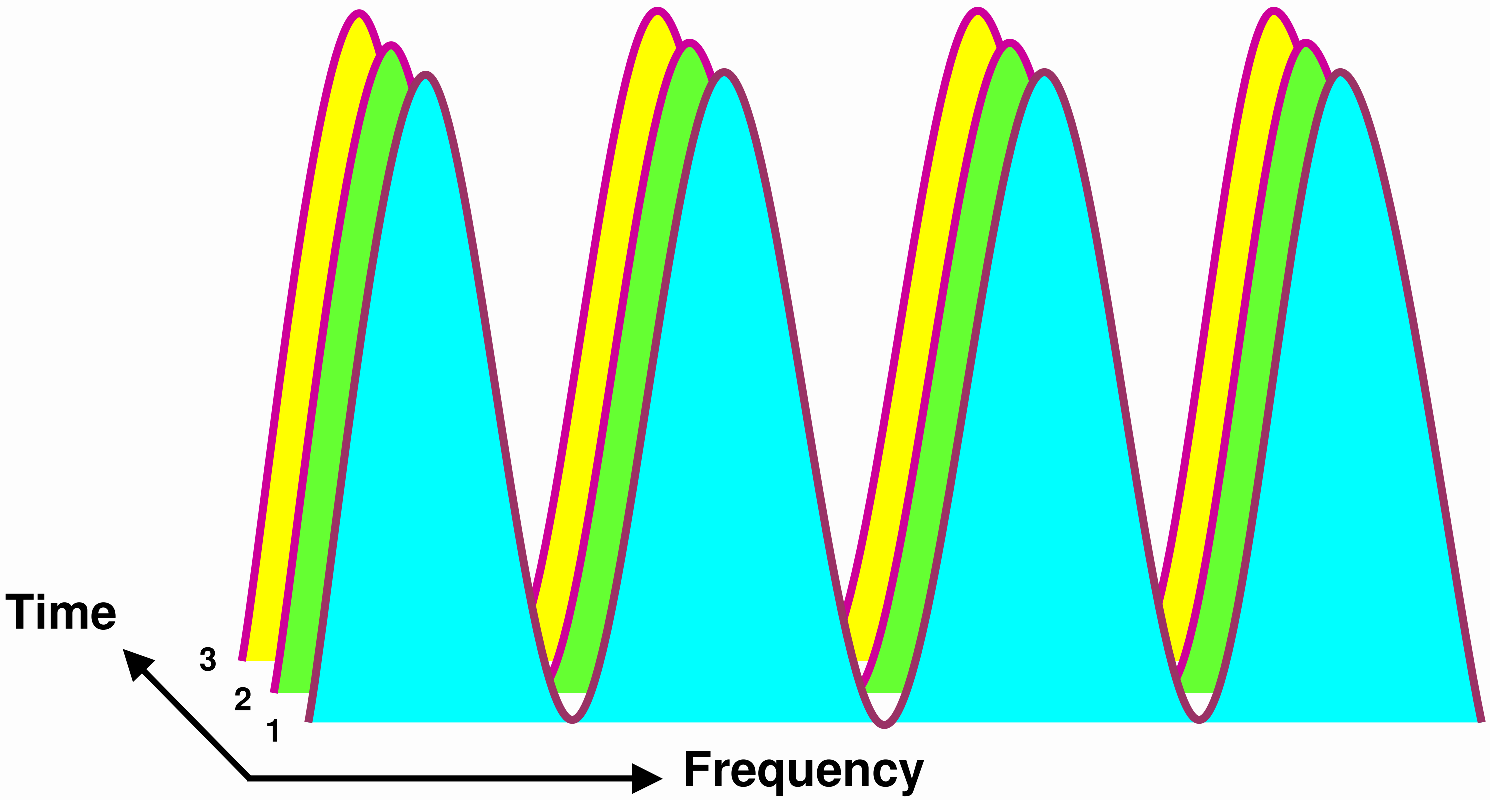
FDMA: Frequency Division Multiple Access

(one carrier for each user for all connection time)



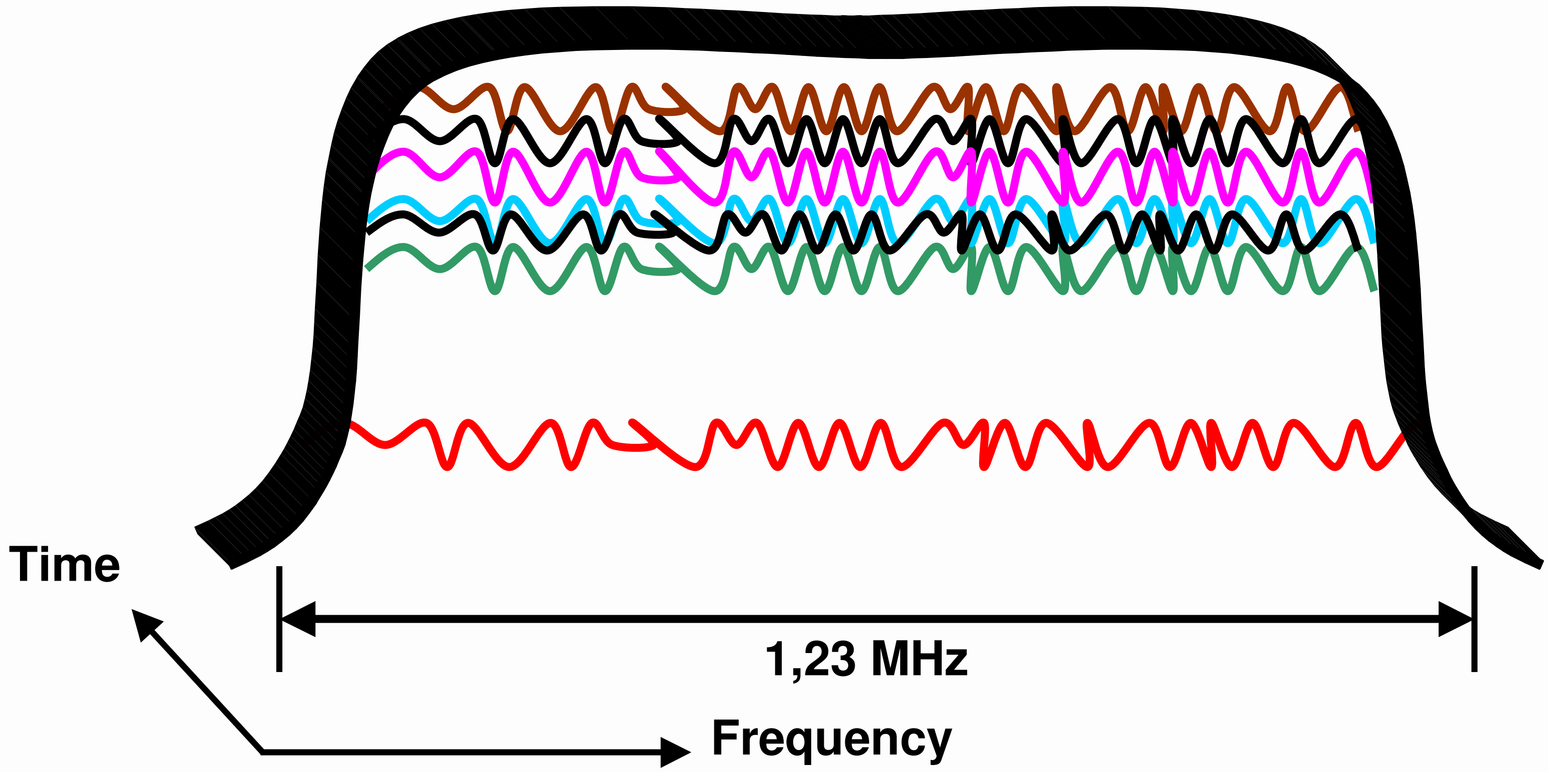
TDMA: Time Division Multiple Access

(one carrier for a group of users in a time division principle)

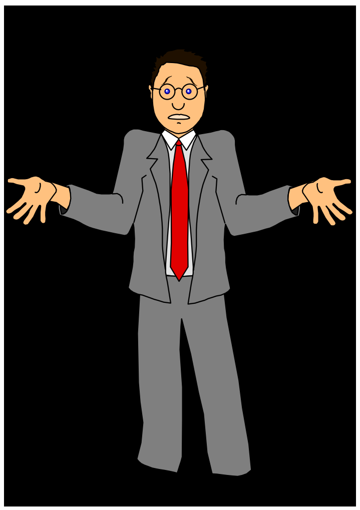


CDMA: Code Division Multiple Access

(one carrier for all users for all time in a code division principle)



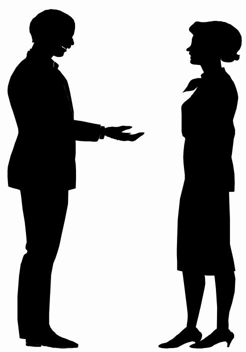
CDMA Philosophy



Swedish

English

Hungarian



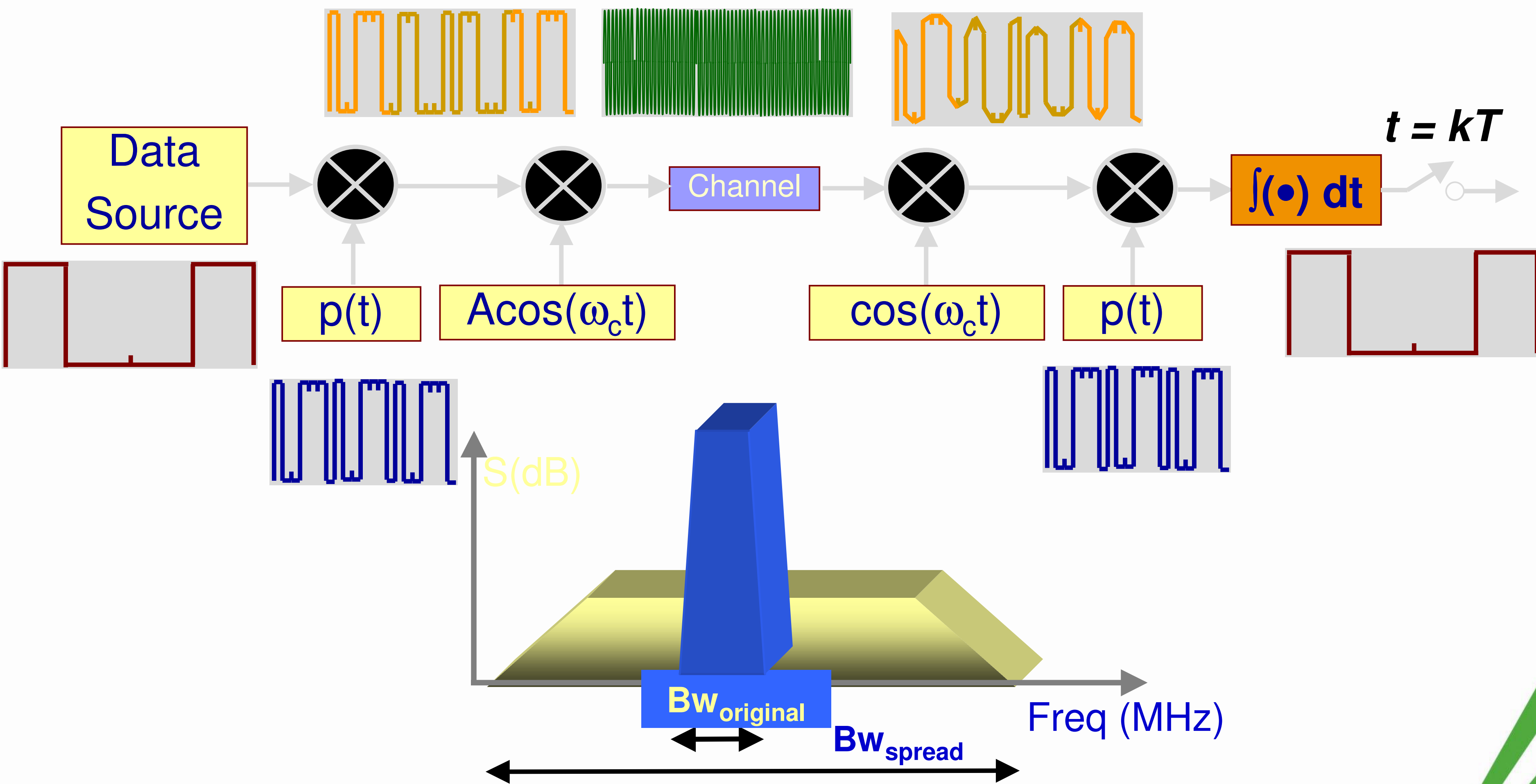
Japanese

French

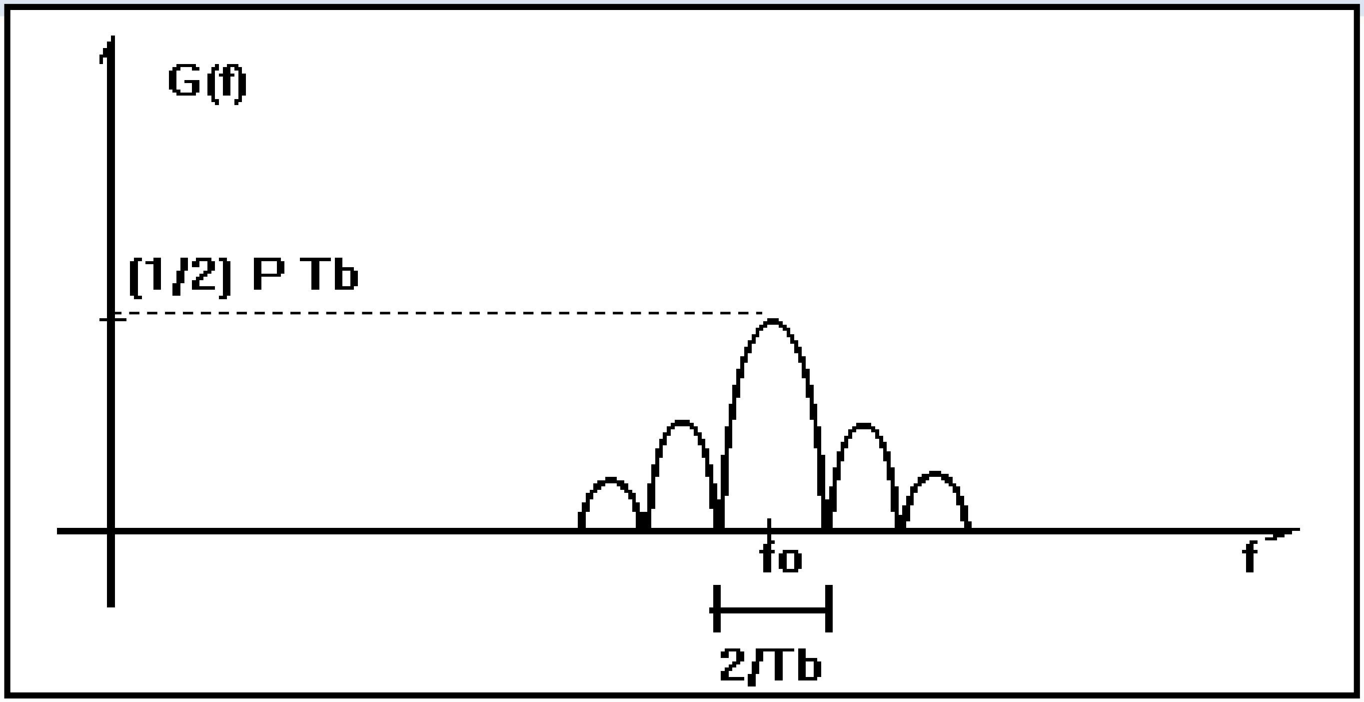
Greek

Some General Characteristics

DS/SS Block Diagram

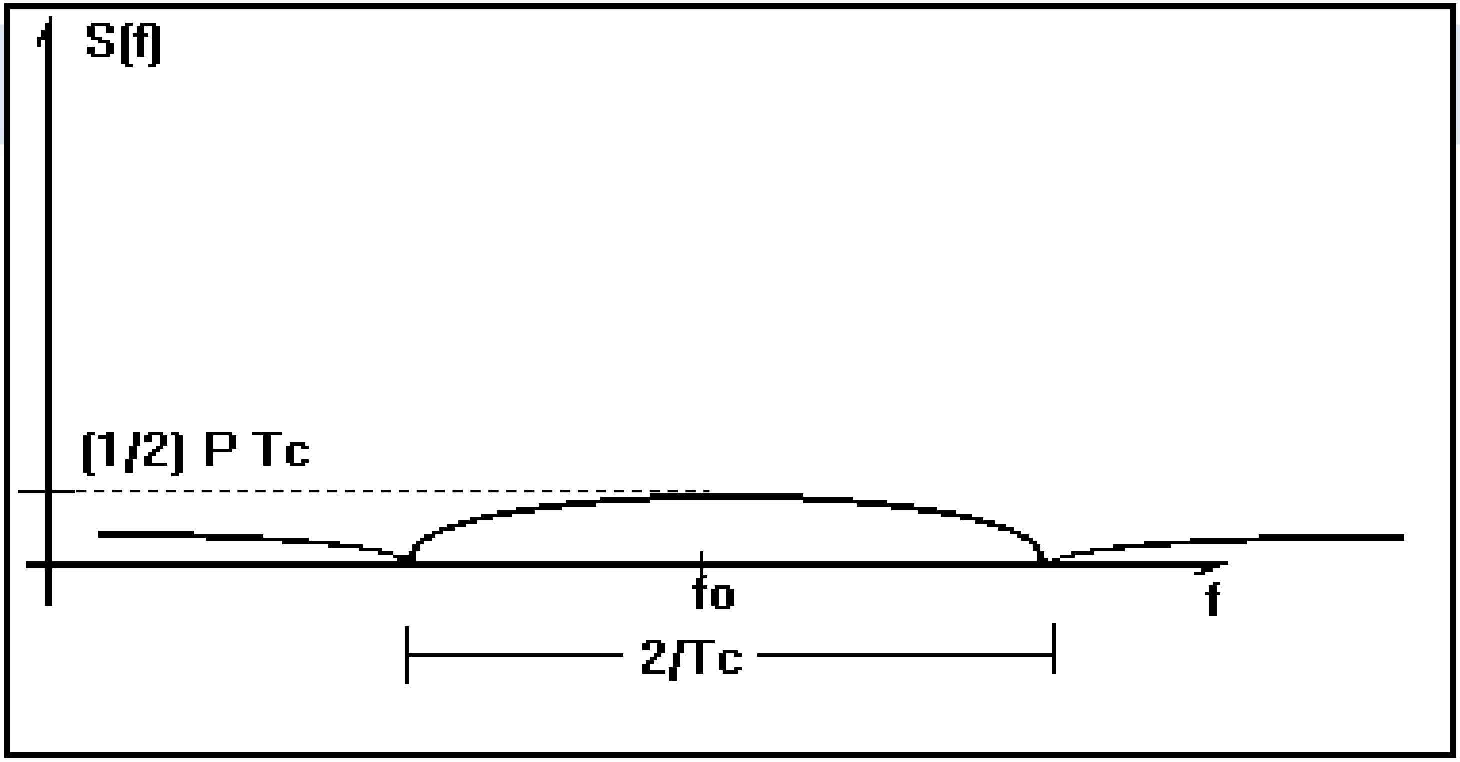


Power Spectral Densities (PSD) of DS/SS Signals



BPSK signal with power P, carrier frequency f_o and a data rate $R_b=1/T_b$

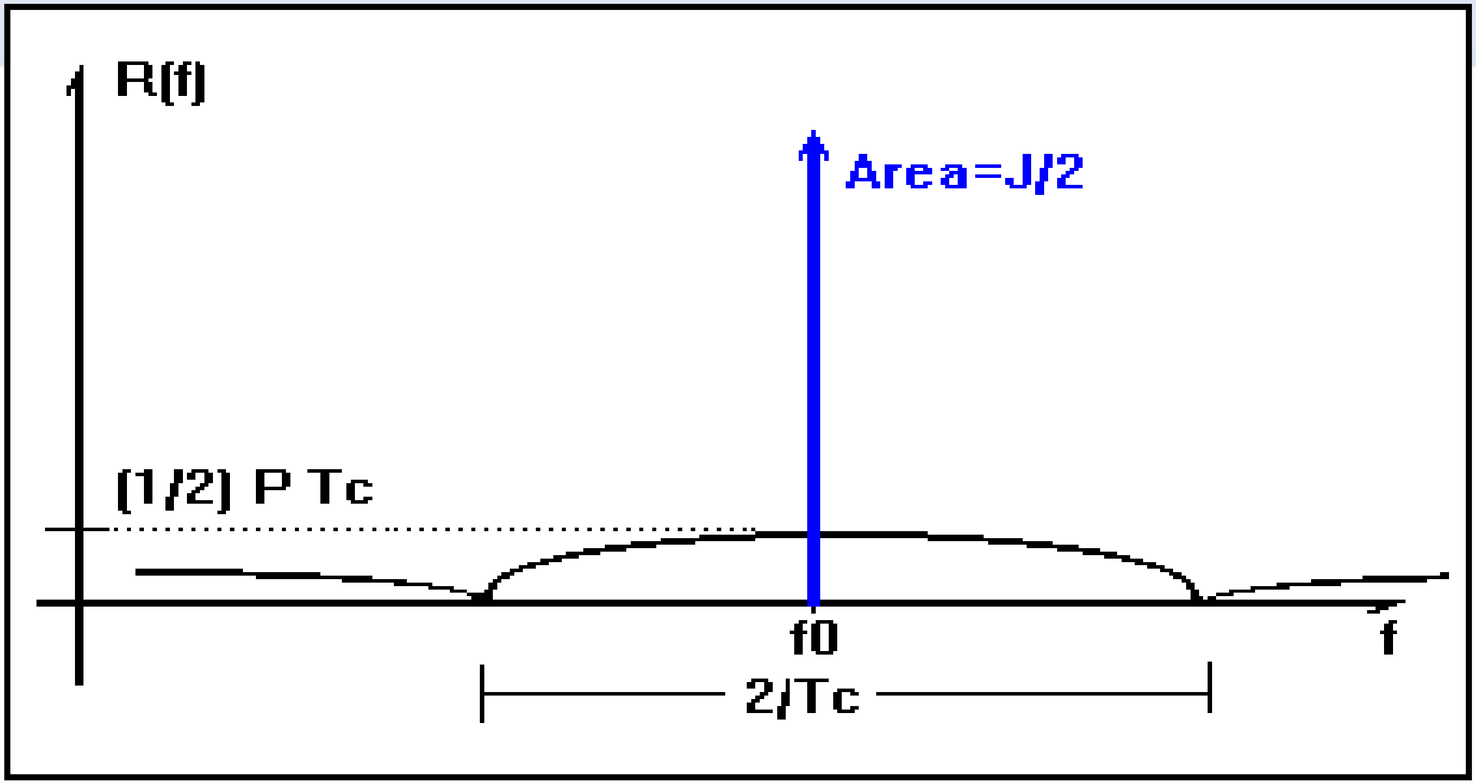
$$G(f) = \frac{PT_b}{2}[\text{sinc}^2(f - f_0)T_b + \text{sinc}^2(f + f_0)T_b]$$



Previous BPSK signal spread by a code with a chip rate $R_c=1/T_c$

- Note that spreading maintains unchanged the total power P;

- The ratio $G = R_c/R_b = T_b/T_c$ is known as processing gain and determines the interference rejection capability.



Previous signal and a centred tonal jammer with power J at receiver’s input

The composed signal at detector's input, r(t), can be written as

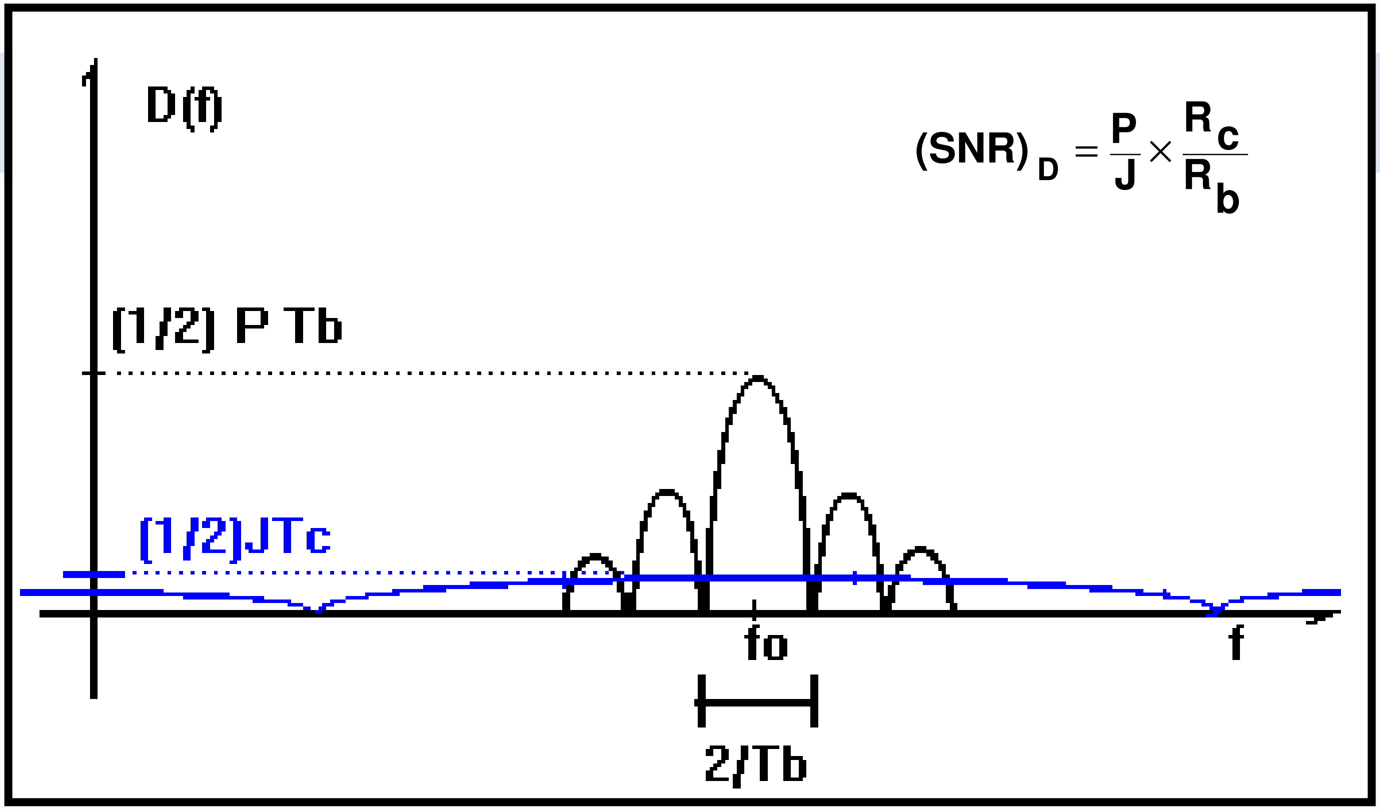
$$\begin{aligned} r(t) &= s(t) + j(t) \\ s(t) &= \sqrt{2P}d(t)p(t)co(\omega_0 t + \varphi) \\ j(t) &= \sqrt{2J}\cos\omega_0 t \end{aligned}$$

Admitting a perfect code synchronism (i. e., p(t) has exactly recovered in the synchronism stage $\Rightarrow$ $p^2(t) = 1$) after de-spreading we have

$$\begin{aligned} r'(t) &= r(t)p(t) = s'(t) + j'(t) \\ s'(t) &= \sqrt{2P}d(t)co(\omega_0 t + \varphi) \\ j'(t) &= \sqrt{2J}p(t)\cos\omega_0 t \end{aligned}$$

Therefore the de-spread effect is to return the desirable signal to its original form and to spread the interference (next slide).

Prominp



Previous signals now at detector’s output

This set of PSD figures shows the interference rejection capability and also the low probability of interception (LPI) for DS-SS signals.