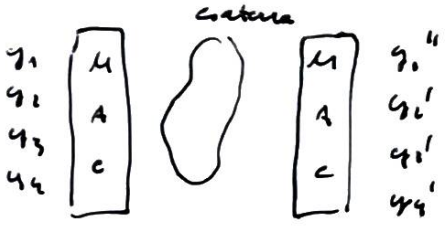
InfoCode Előadás

Multiple Access Control

Technikai Generáció:



TDMA (Time Division M.A.)

FDMA (Frequency Division M.A.)

DS

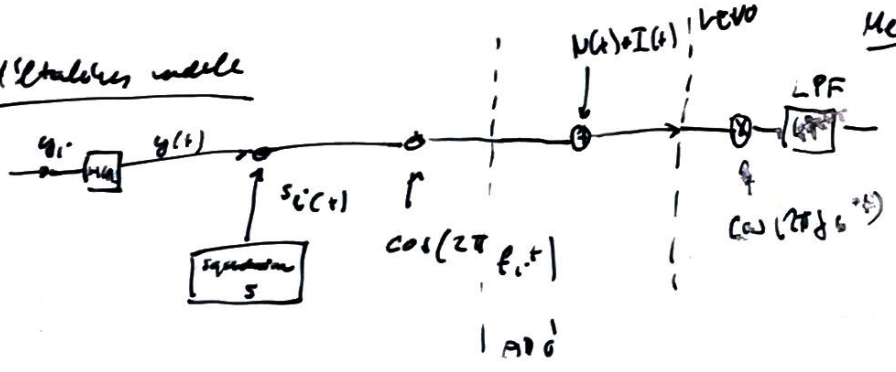
CDMA (Code D. M.A)

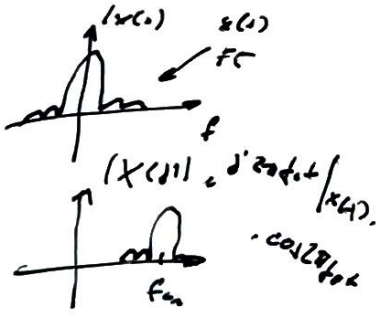
FH Frequency Hopping

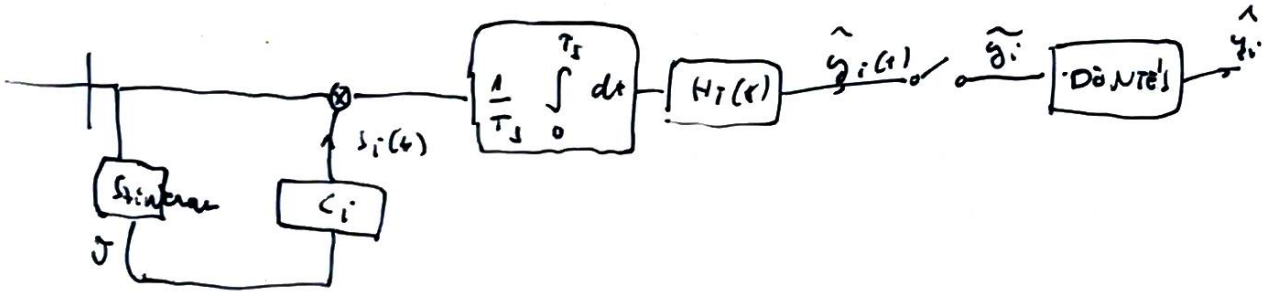
Vezeték nélküli hozz. v. (Cellás v.)

- GSM / ... / 3G / 4G / 5G / ...
- WiFi (IEEE 802.11)

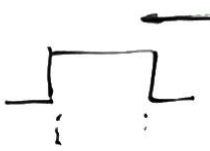
Adóoldali modell



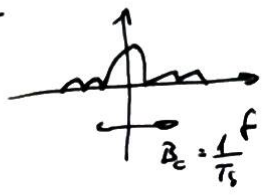




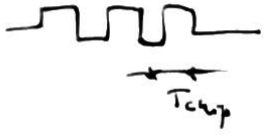
g_i $y_i(t)$



$\Rightarrow$ FT

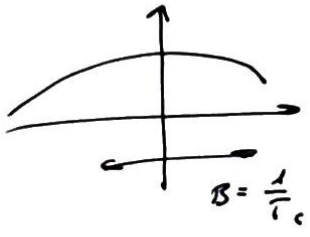


c_i $s_i(t)$



$T_c << T_s$

$B >> B_s$



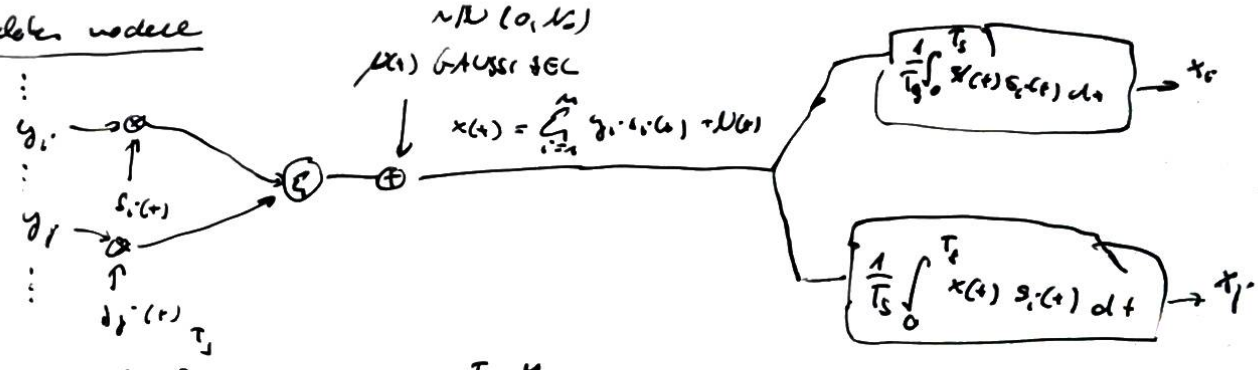
wobei spektrum weiß

$i = 1, \dots, M$ $\quad g_i \in \{-1, 1\} \rightarrow \underline{g} = (g_1\ g_2 \cdots g_i \cdots g_M) \in \{-1,1\}^M$

$\underline{c}^{(i)} \rightarrow s_i(t)$ $\quad$ also $\underline{c}^{(i)} = N = \frac{T_s}{T_c}$

$$\underline{c} = \begin{pmatrix} \underline{c}^{(1)} \\ \underline{c}^{(2)} \\ \vdots \\ \underline{c}^{(M)} \end{pmatrix}$$

Blockbild modell



$$x_i(t) = \frac{1}{T_s}\int_0^{T_s} x(t) s_i(t)\, dt = \frac{1}{T_s}\int_0^{T_s} \left(\sum_{k=1}^{M} g_k s_k(t) + \mu(t) \right) s_i(t)\, dt =$$

$$= \sum_{k=1}^{M} g_k \frac{1}{T_s}\int_0^{T_s} s_k(t)\, s_i(t)\, dt + \frac{1}{T_s}\int_0^{T_s} \mu(t)\, s_i(t)\, dt$$

$$\underline{R} := R_{ik} = \frac{1}{N}\sum_{i=1}^{N} c_m^{(i)} c_m^{(k)} = \frac{1}{N}\underline{c}^{(i)} \cdot \underline{c}^{(k)T}$$

$\nu_k \sim N\left(0, \frac{N_0}{T_s}\underline{R}\right)$

$$= \sum_{k=1}^{M} R_{ik} g_k + \nu_k = \underbrace{R_{ii}}_{=1} \cdot g_i + \sum_{\substack{k=1 \\ i \neq k}}^{M} R_{ik} g_k + \nu_k$$

MULTI USER INTERFERENCE

$$\underline{g}_{opt} = \min_{\underline{g} \in \{\pm 1\}^N} \underline{g}^T \underline{R}\, \underline{g} = \min_{\underline{g} \in \{-1,1\}^N} \underline{g}^T \underline{g} - 2\underline{x}^T \underline{g} \,.$$

$$= \min_{g_i \in \{-1,1\}} \sum_{i=1}^{N} g_i g_i - \sum_{i=1}^{M} 2 x_i g_i = N$$

$$= N + \min - 2 \sum_{i=1}^{M} x_i g_i = N - \max \sum_{i=1}^{M} x_i g_i \rightarrow \boxed{\hat{g}_i = \operatorname{sgn}(x_i)} \rightarrow \hat{\underline{g}} = \operatorname{sgn}(\underline{x})$$

Walsh - Hadamard Matrizen

$$\boxed{\begin{aligned} \underline{\underline{C}}(0) &= 1 \\ \underline{\underline{C}}(k+1) &= \begin{pmatrix} \underline{\underline{C}}(k) & \underline{\underline{C}}(k) \\ \underline{\underline{C}}(k) & -\underline{\underline{C}}(k) \end{pmatrix} \end{aligned}} \rightarrow \dim \underline{\underline{C}}(k) = 2^k$$

$$\underline{\underline{C}}(2) = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{pmatrix} \begin{matrix} \rightarrow C(1) \\ \rightarrow C(2) \\ \rightarrow C(3) \\ \rightarrow C(4) \end{matrix} \qquad \underline{\underline{C}}(1) = \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \begin{matrix} \rightarrow C(1) \\ \rightarrow C(2) \end{matrix}$$

$M \leq N$