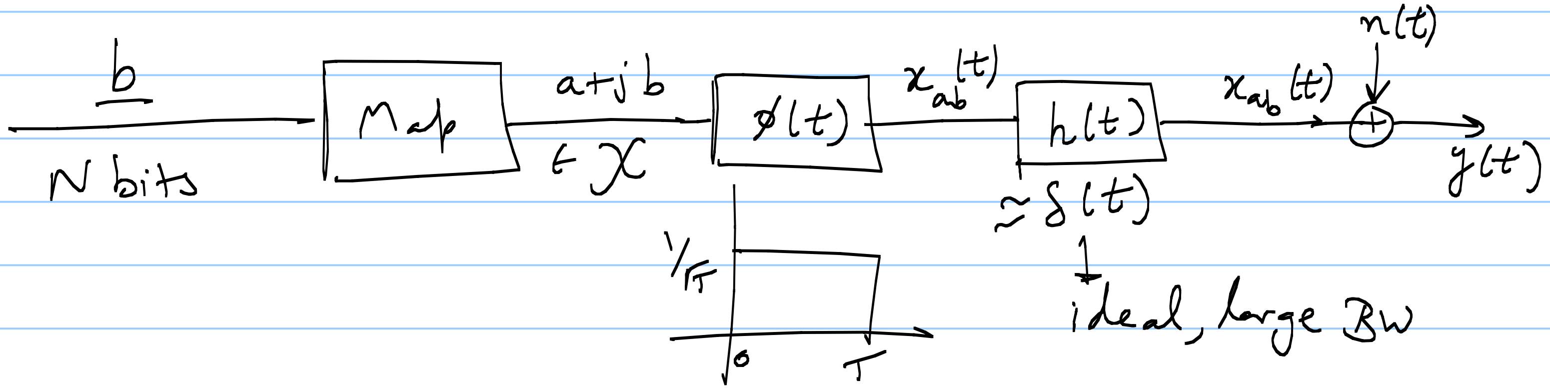
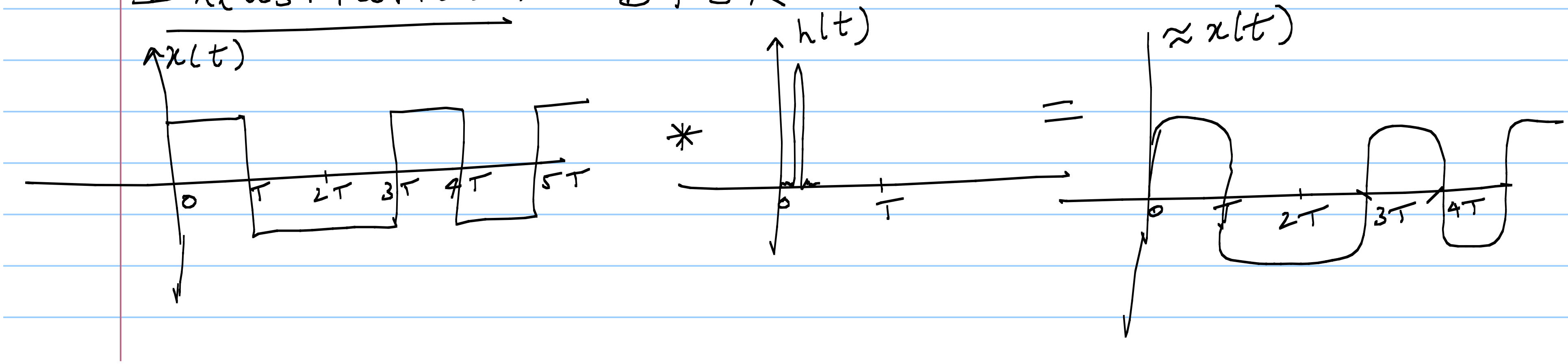
Lecture 14

Note Title 8/20/2008



Bit rate = $\frac{N}{T}$ bps

Illustration: BPSK



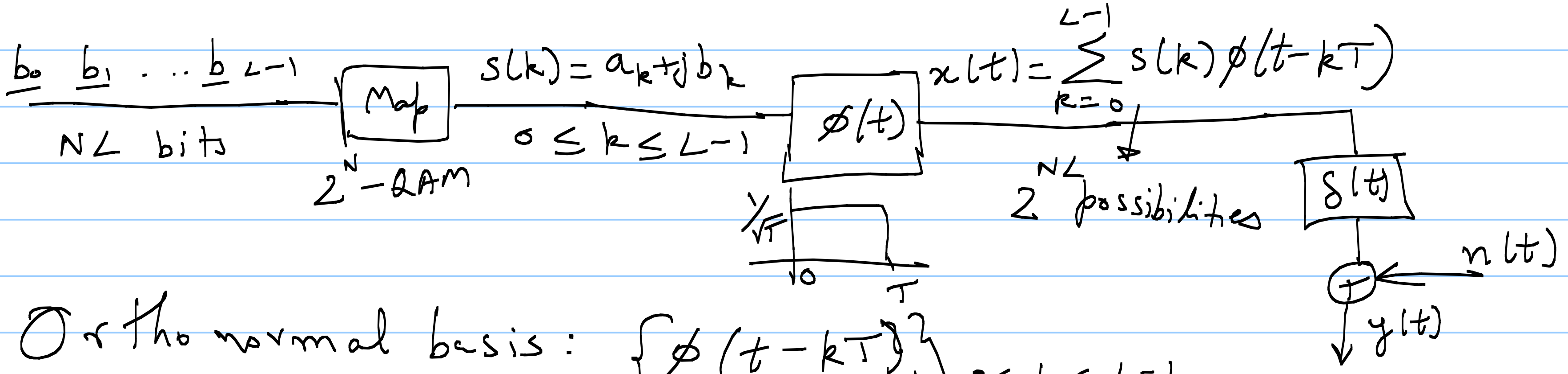
$T \approx \text{supp}\{h(t)\} \Longleftrightarrow BW(x(t)] \approx BW(h(t))$

$y(t)$: T to $2T$ will depend on all $x(t)$

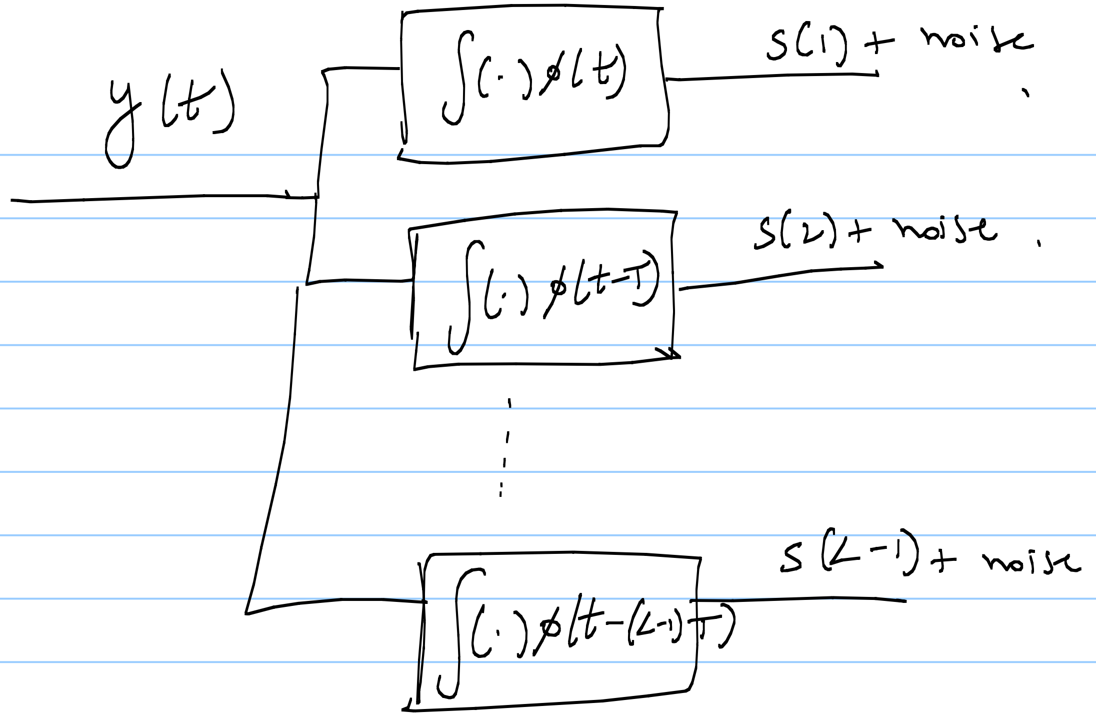
↓

Inter Symbol Interference.

In the ideal, large BW case:



Orthonormal basis: $\{\phi(t-kT)\}_{0 \le k \le L-1}$

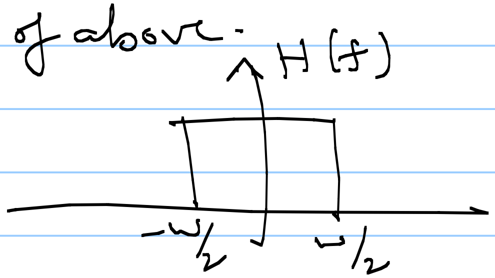


Detectors can be run independently.

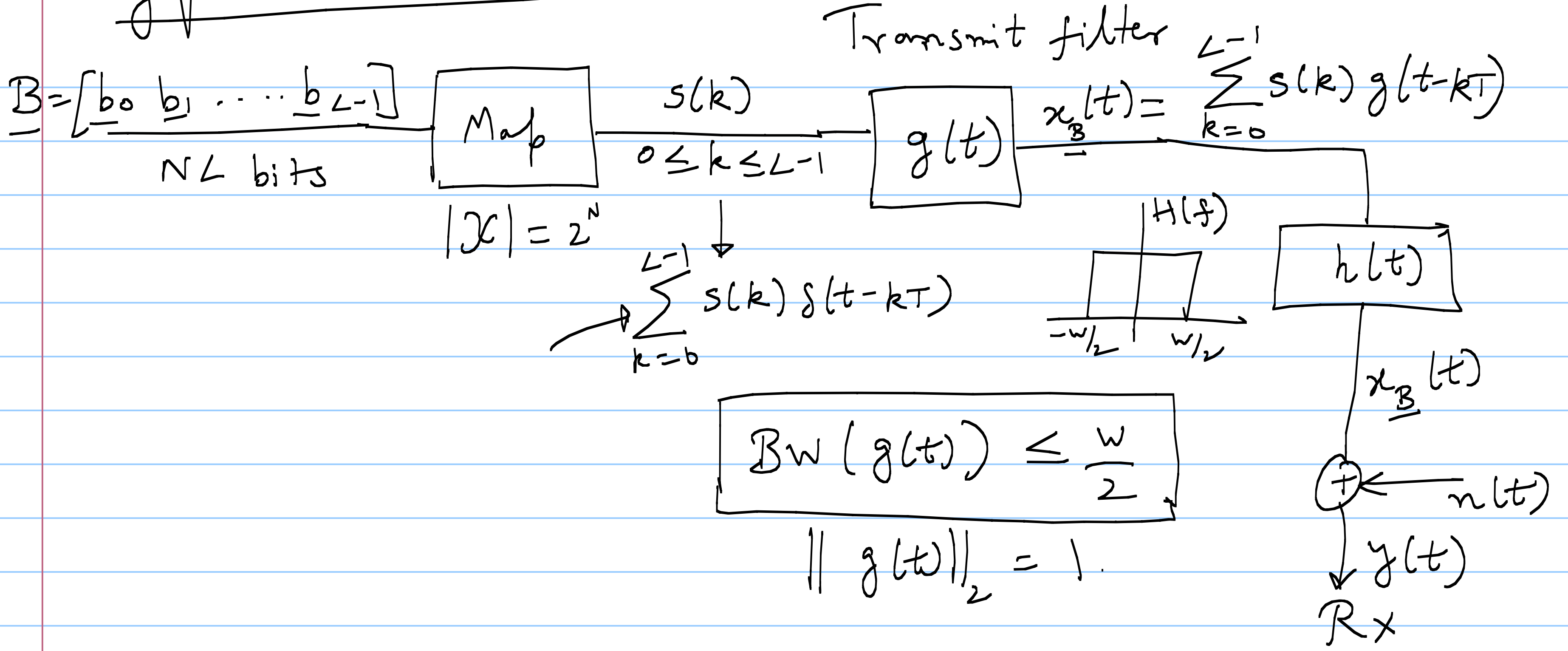
→ ISI case is a generalization of above.

$\phi(t)$: $BW(\phi(t)) \approx W/2$

$\{\phi(t-kT)\}$: orthonormal.



Nyquist Criteria:



$$\boxed{BW(g(t)) \le \frac{W}{2}}$$

$$\|g(t)\|_2 = 1.$$

$$\langle g(t-kT), g(t-lT)\rangle = 0, \quad k \neq l$$

$$\Updownarrow$$

$$\langle g(t), g(t-lT)\rangle = 0, \quad l = 1, 2, \dots, L-1, \dots$$

$$l \neq 0$$

$$\int_{t=-\infty}^{\infty} g(t)\, g(t-\ell T)\, dt = 0$$

$$\underbrace{g(t) * g^{*}(-t)}_{\parallel}\Big|_{\ell T} = 0 \quad , \ell \neq 0$$

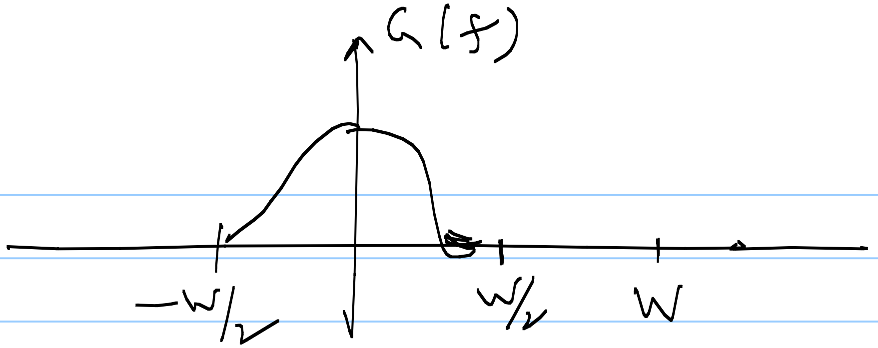
$$c(t) \xleftrightarrow{FT} C(f) = |G(f)|^{2}$$

$$c[\ell] = c(\ell T) = \delta[\ell]$$

$$\Big\updownarrow \text{DTFT}$$

$$\frac{1}{T}\sum_{m=-\infty}^{\infty} C\left(f - \frac{m}{T}\right) = \tilde{C}\left(e^{j2\pi f T}\right) = 1$$

$$\underline{\underline{\text{for all } f}}$$



If $\frac{1}{T} > W \Rightarrow$ Nyquist criteria will be violated.

$\Rightarrow$ $\boxed{\text{Symbol rate} \leq W \text{ for } BW = W/2}$