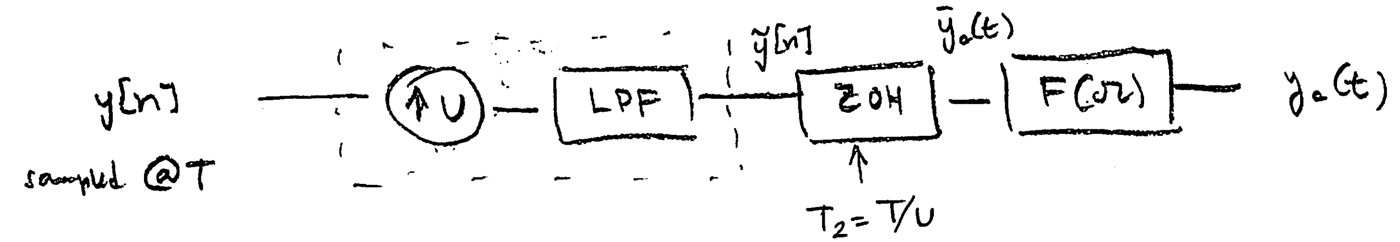
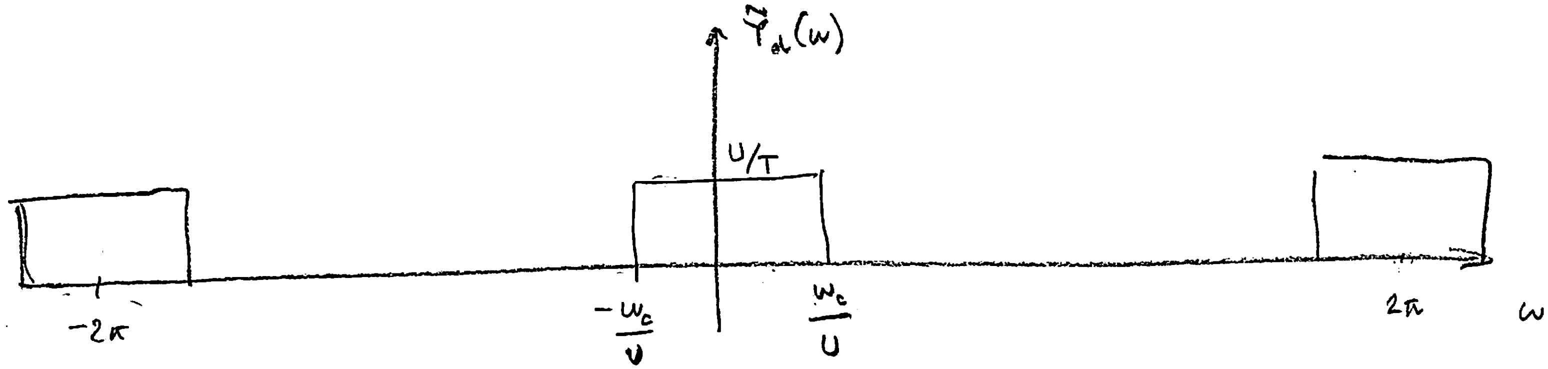
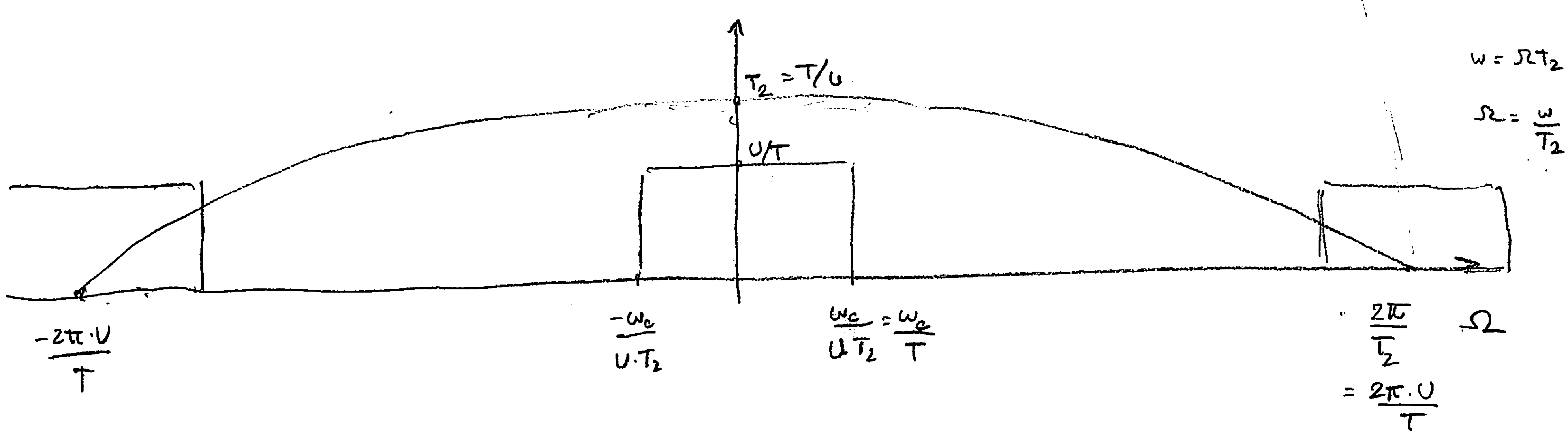
Lecture 27 (oversampling D/A cont.)

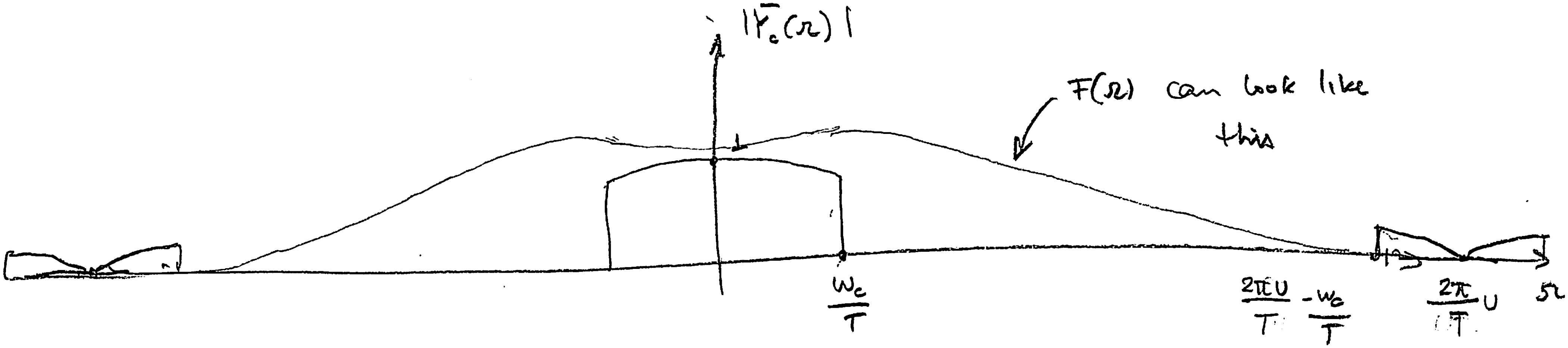


Digital interpolator squashes DTFT of $y[n]$



After ZOH: $\bar{Y}_c(\Omega) = P(\Omega)\,\tilde{Y}_d(\Omega T_2)$



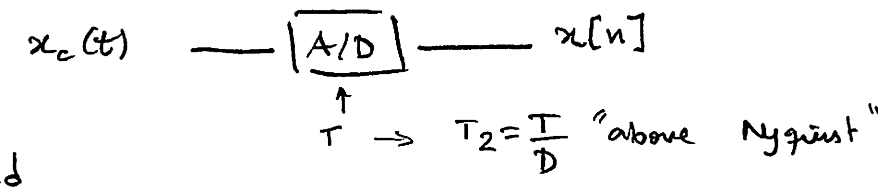


transition band can have width

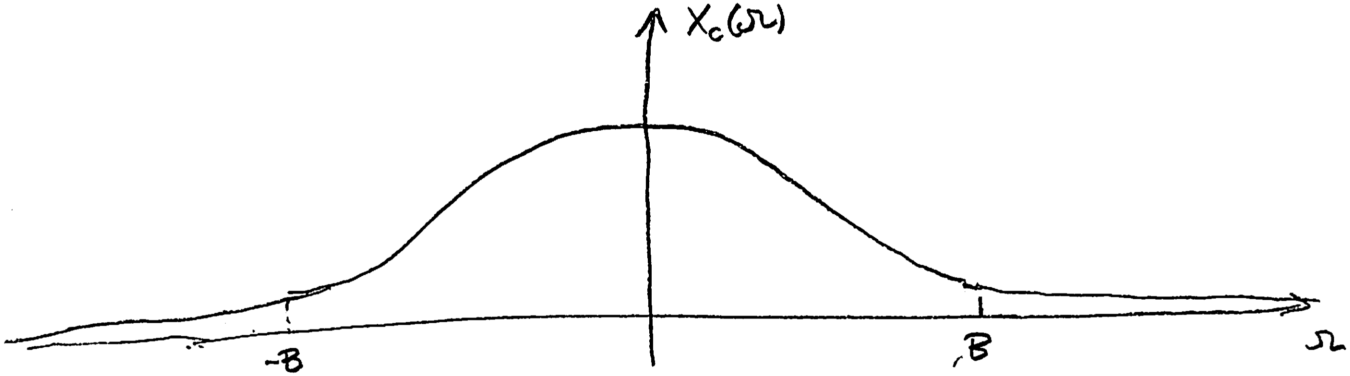
$$\frac{2\pi U}{T} - \frac{w_c}{T} - \frac{w_c}{T} = \frac{2(U\cdot\pi - w_c)}{T}$$

- transition band can be very wide
- response in $\frac{-w_c}{T} \le \Omega \le \frac{w_c}{T}$ can be almost flat
- very "cheap" analog filter will do the job.

Oversampling A/D:



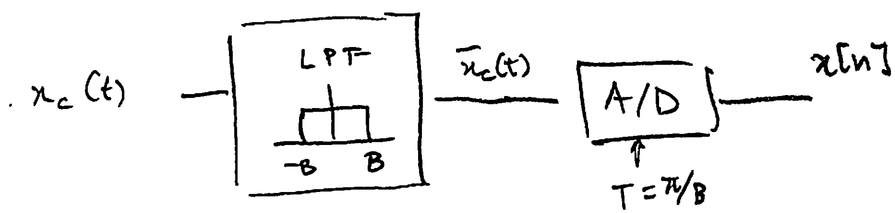
Suppose $x_c(t)$ is nearly bandlimited



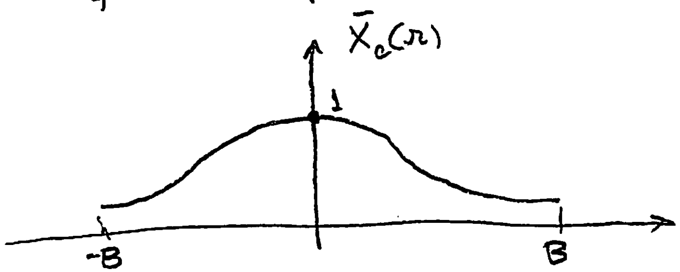
We would like to sample at $T = \pi/B$, but that will cause aliasing

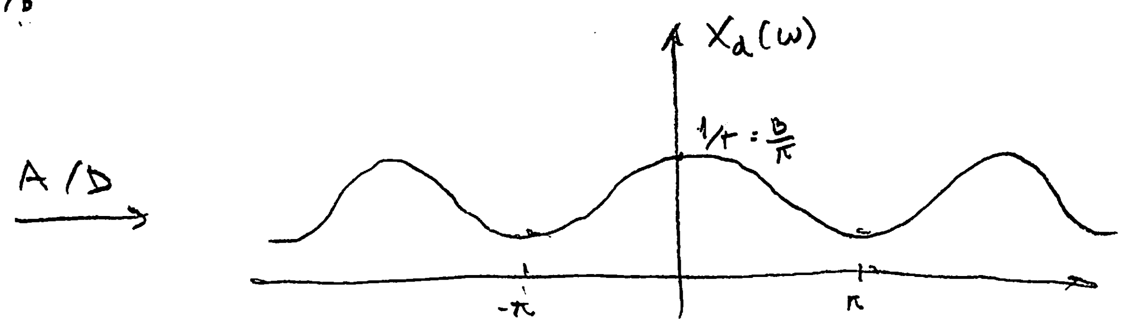
What do we do?

① Analog anti-aliasing LPF

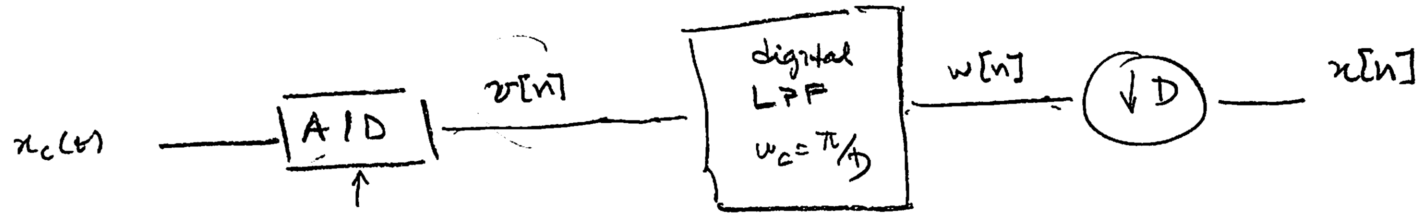


In freq domain:



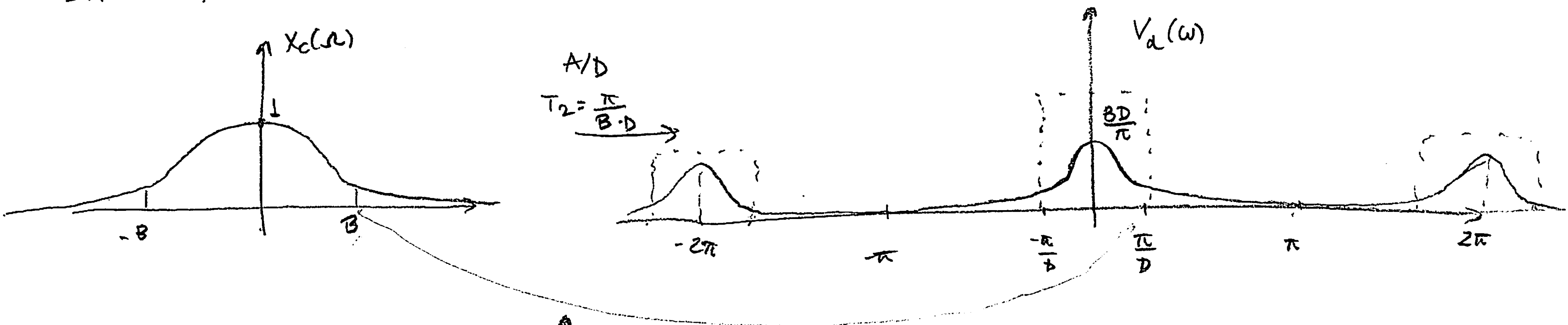


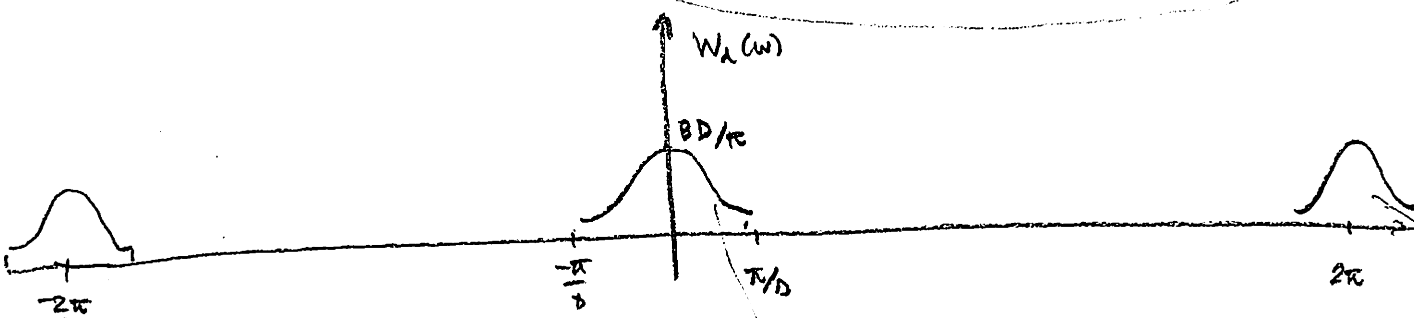
(2) Oversampling A/D :



$T_2 = \dfrac{\pi}{B D}$ → large enough to virtually prevent all aliasing

In frequency domain:

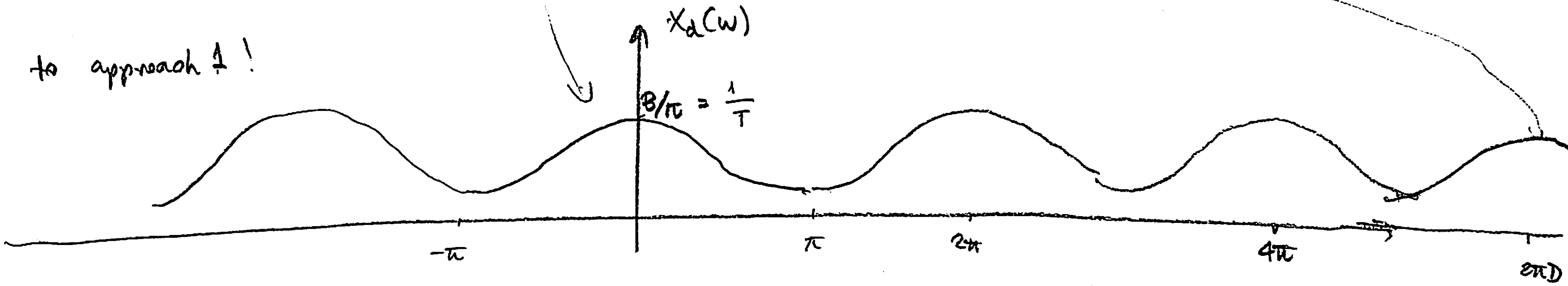




Nex step: downsampler

$$X_d(\omega) = \frac{1}{D}\sum_{k=0}^{D-1} W_d\left(\frac{\omega - 2k\pi}{D}\right)$$

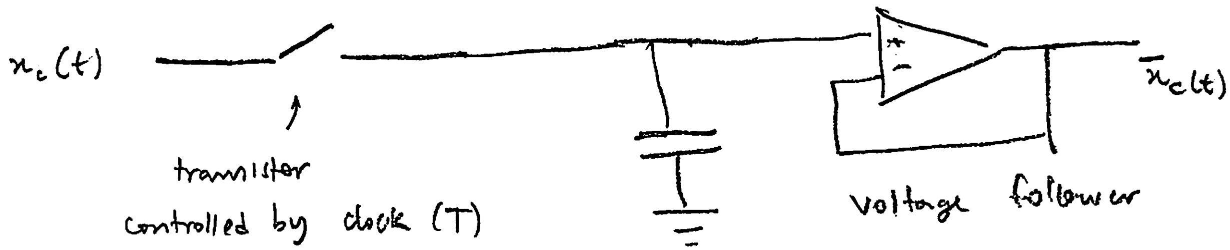
identical to approach 1 !

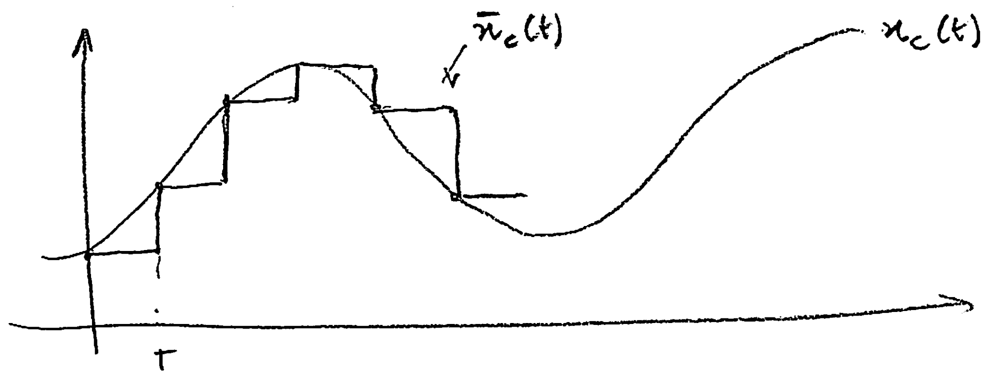


A/D and D/A circuits :

(I) A/D consists of sample and hold and a quantizer

S/H



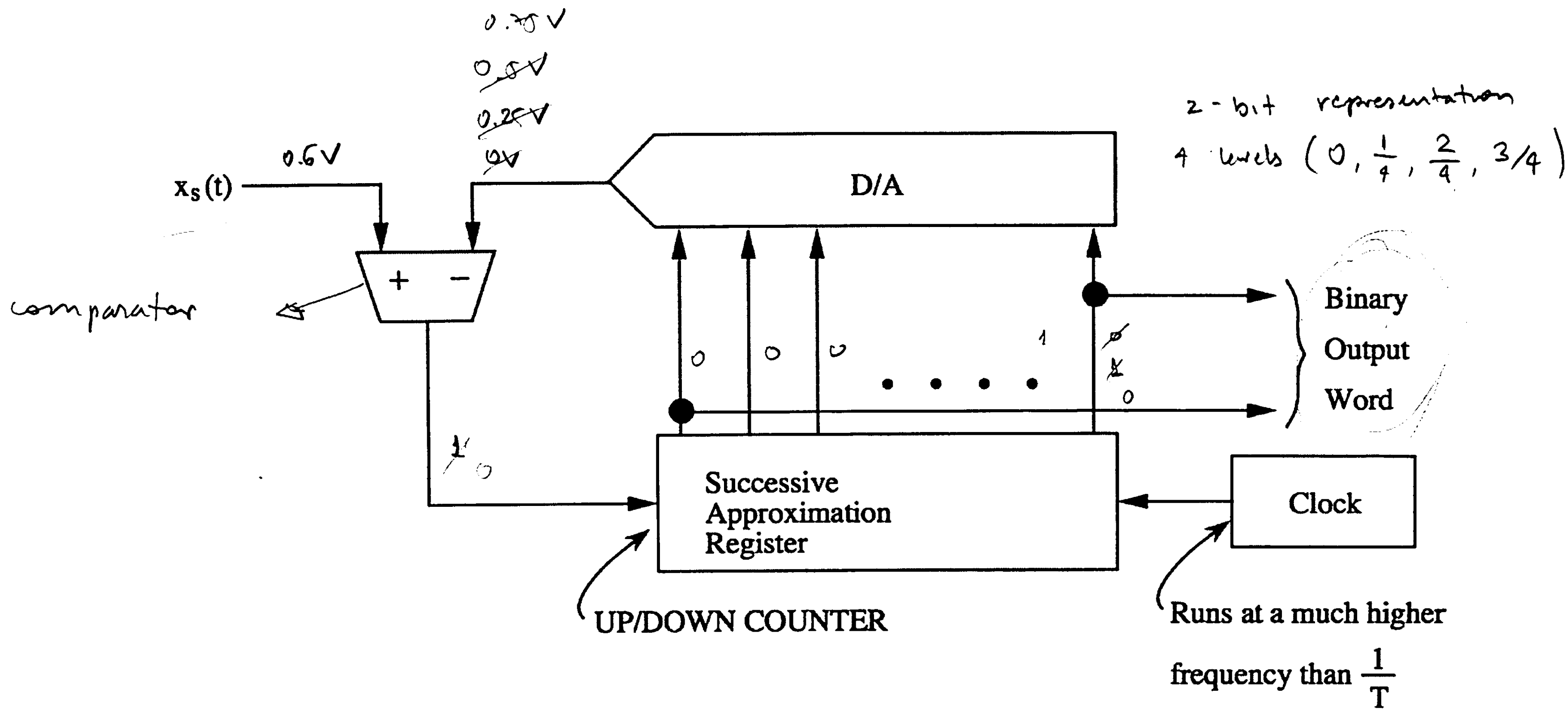


Two approaches to quantizing :

(1) successive approximation (slow)

(2) Flash A/D

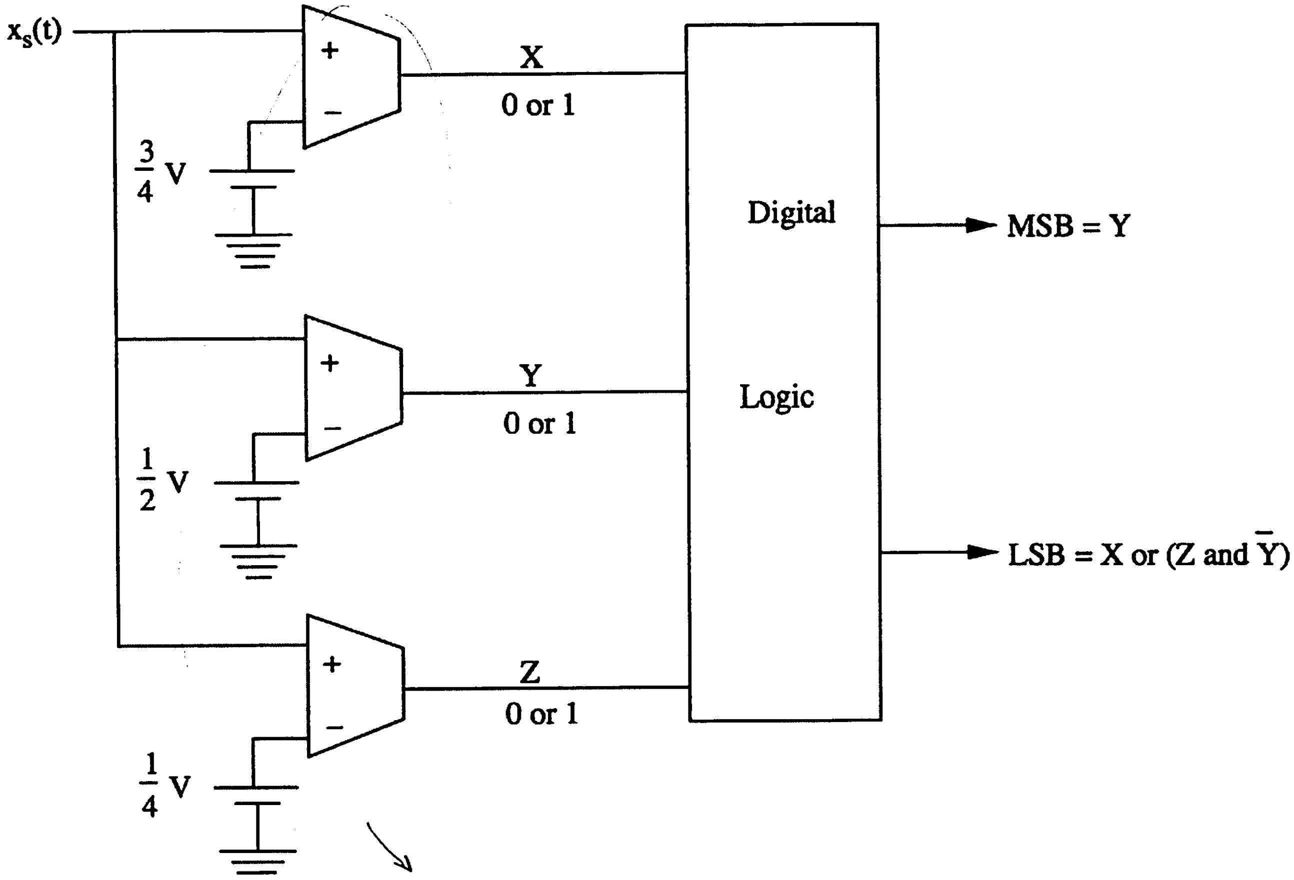
Successive approximation



Suppose $0 < x_s(t) < 1V$.

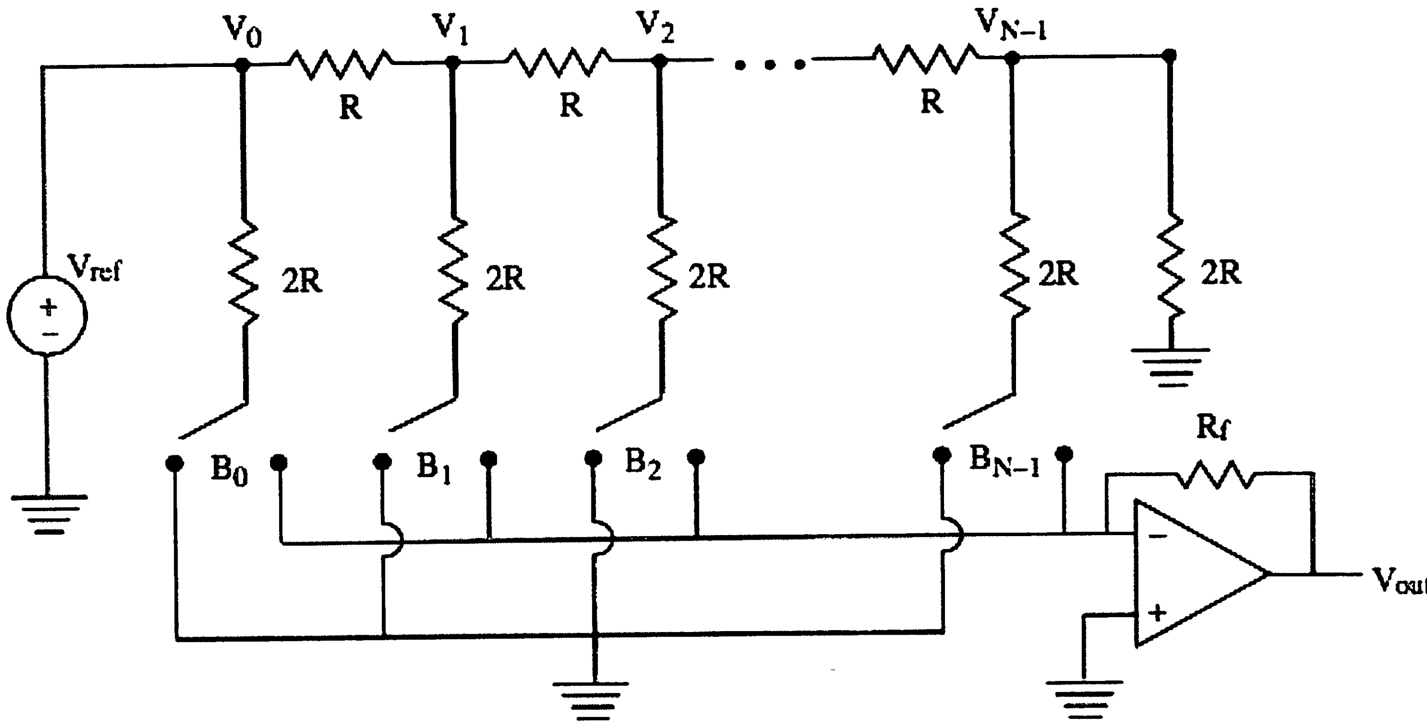
Very slow.

Flash A/D



$2^N - 1$ comparator for N-bit representation

ZOH resistor ladder



Vout is proportional to $\underbrace{2^{N-1} B_0 + 2^{N-2} B_1 + \cdots + B_{N-1}}_{y[n]}$