

ECE 504 - Lecture 23

Note Title

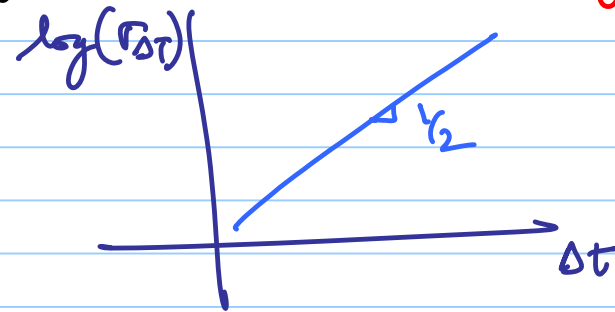
11/14/2016

Summary:

* Jitter accumulates indefinitely in an open loop VCO

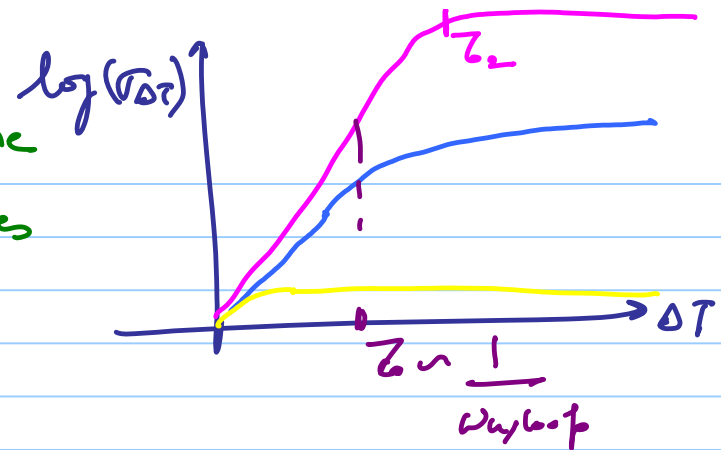
* In closed loop PLL
↳ jitter is suppressed by the PLL feedback

V_{sc} analogLib
↳ NMOS, NMOS4
instead of NCSV.

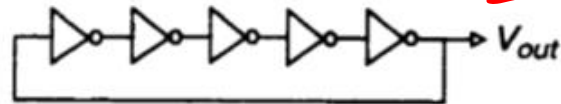


* Wider loop-BW, smaller the time for which jitter accumulates

$$\omega_{u,loop} < \frac{\omega_{ref}}{10}$$



Ring Oscillator



Delay Chain

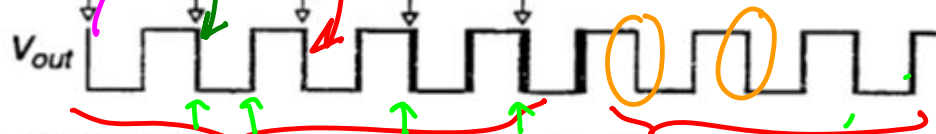
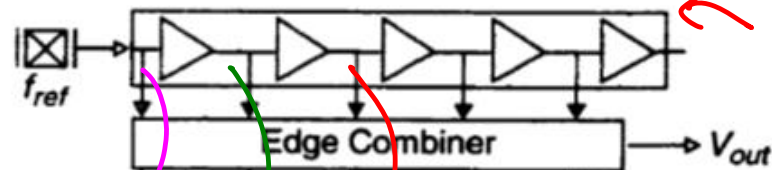
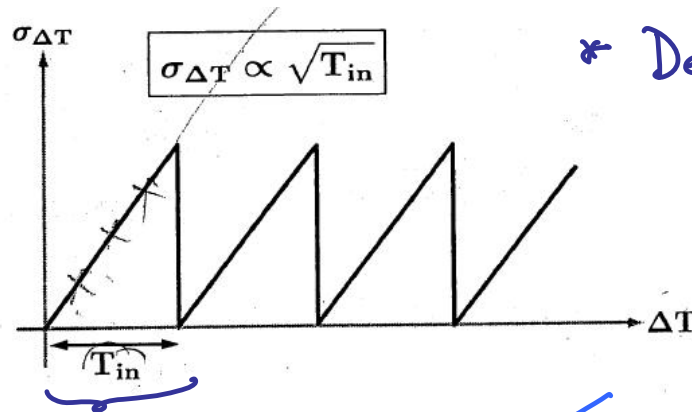


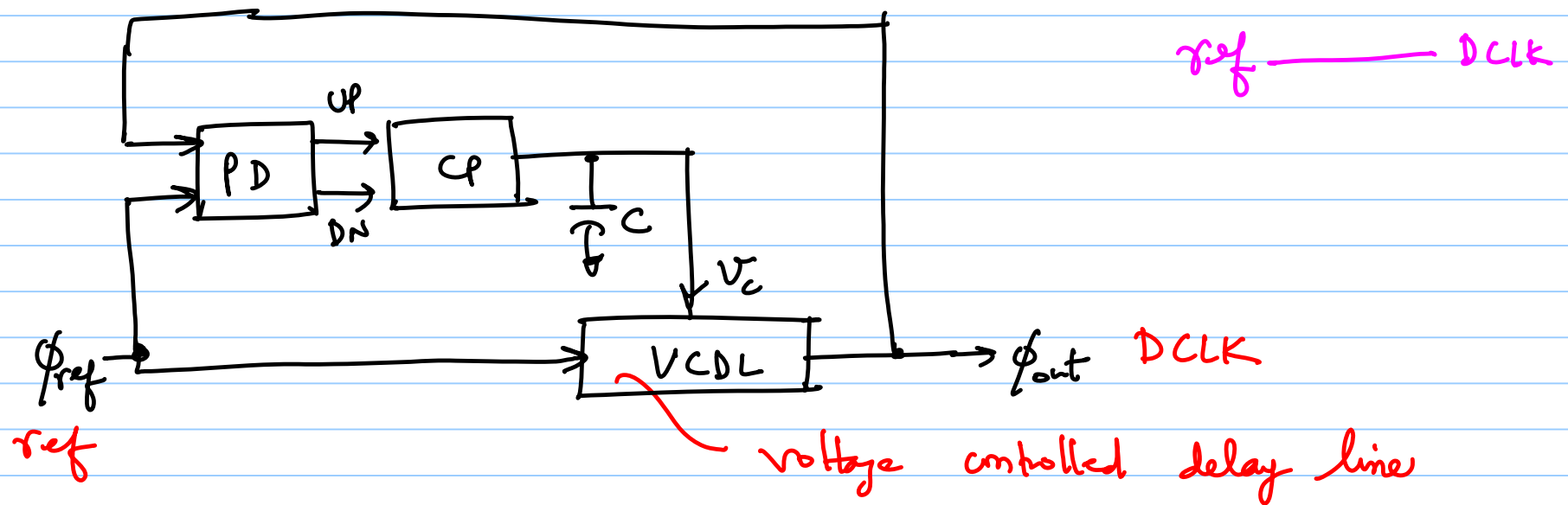
Fig. 4.3: Timing Jitter Accumulation for Ring Oscillator vs. Delay Chain.

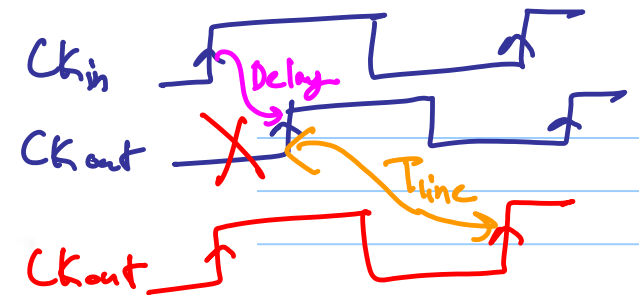
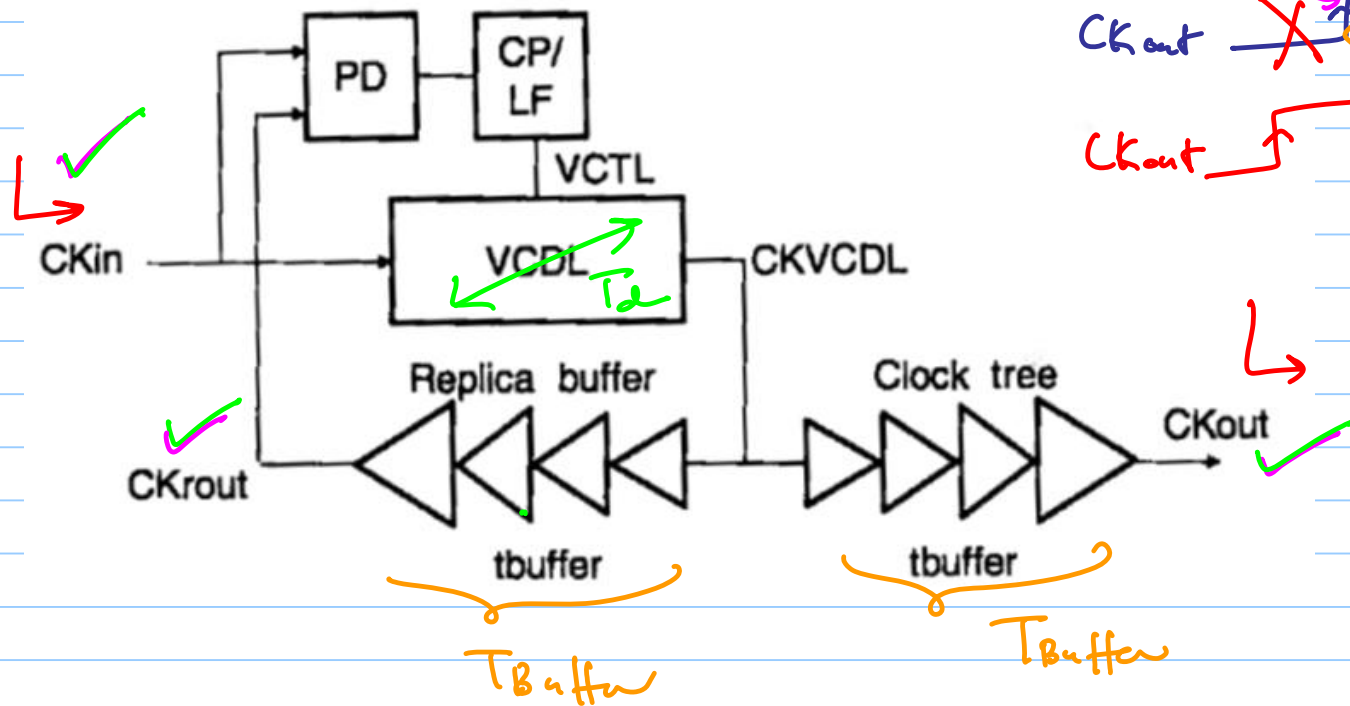


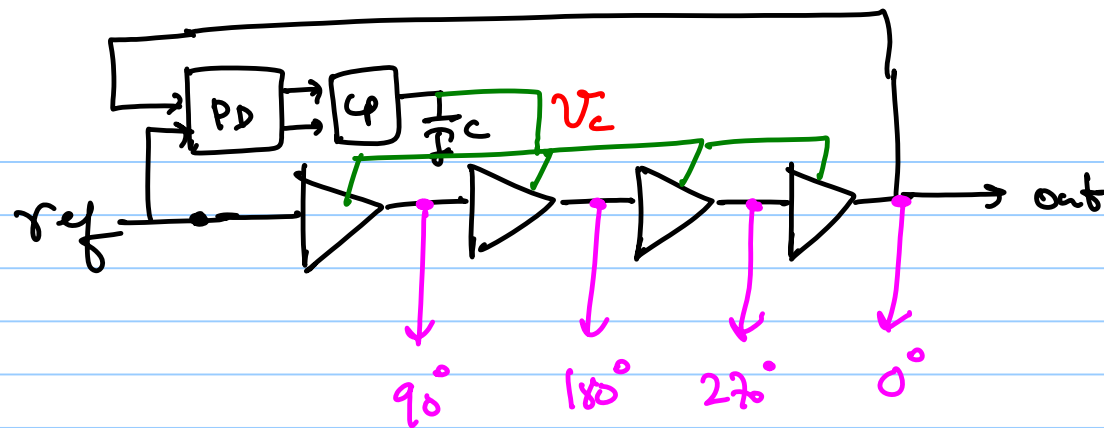
* Delay line jitter accumulation



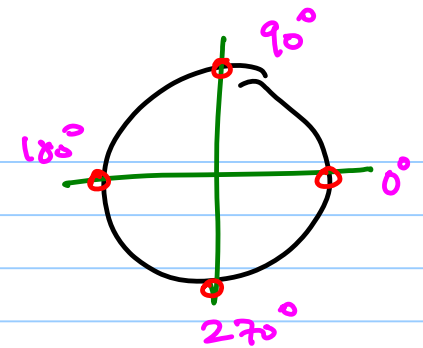
Delay locked loop (DLL)







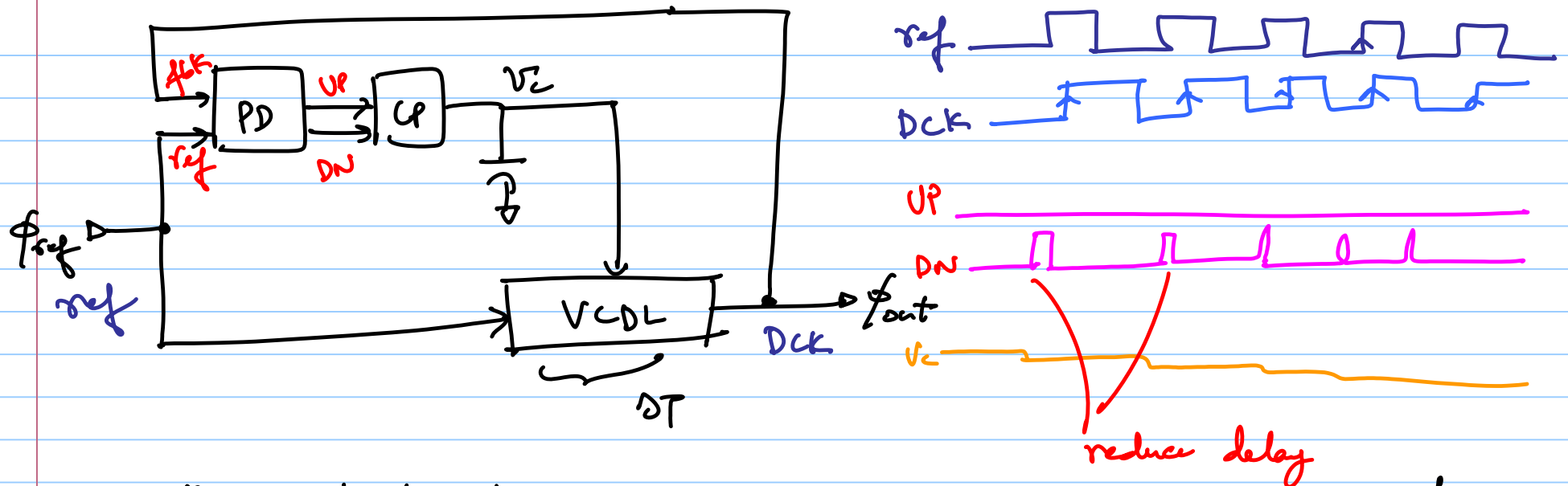
Quadrature clock
phases



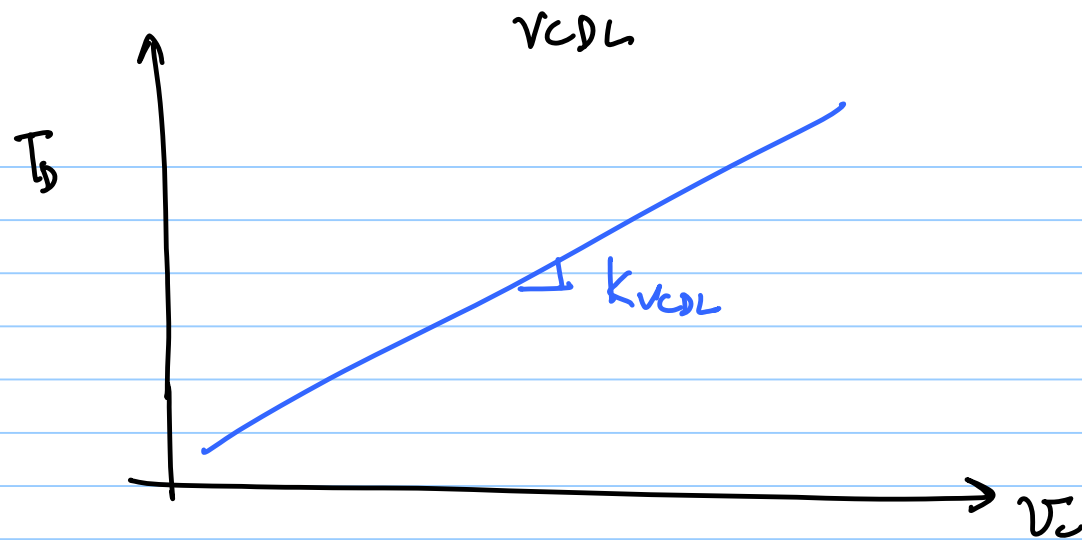
Quadrature
Clock

Can generate intermediate clock phases

↳ delay mismatch needs to be considered
depending upon the application

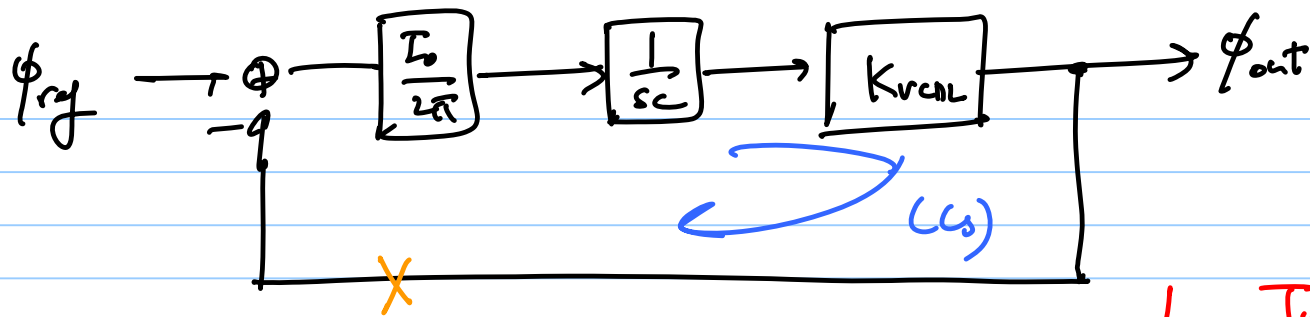


* In steady-state, VCDL delay (ΔT) equals one reference clock period (T_{ref})



V_{CDL} gain: $K_{V_{CDL}} = \frac{\Delta T_b}{\Delta V_c}$, $\frac{\text{sec}}{\text{V}}$

$= \frac{2\pi}{T_{ref}} \cdot \frac{\Delta T_b}{\Delta V_c} \quad (\text{rad/V})$



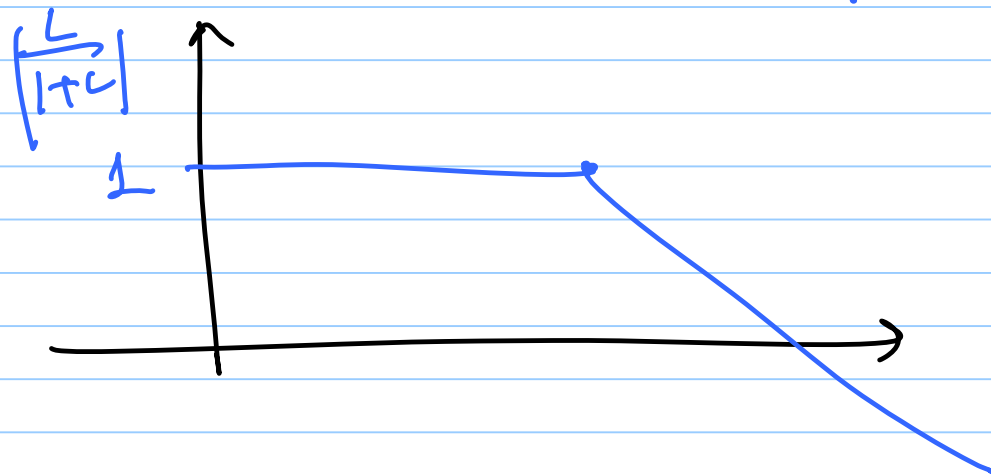
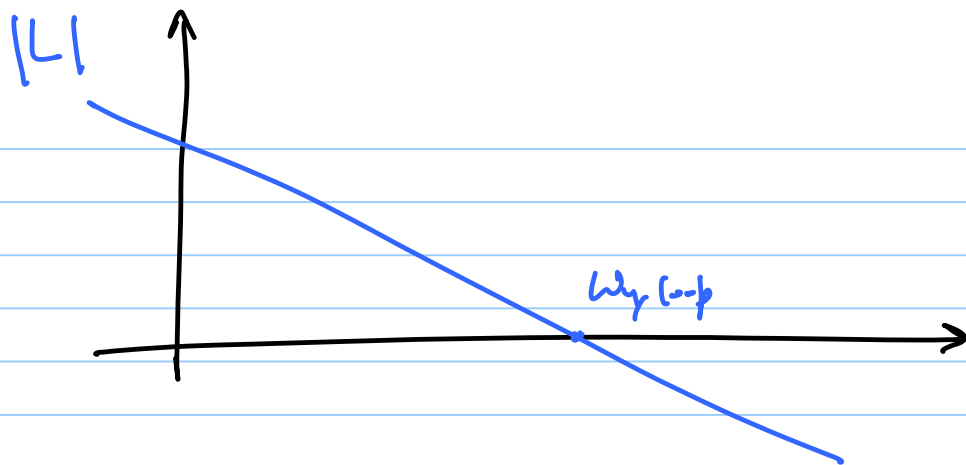
↳ Type-I

First order system

$$L(s) = \frac{I_0}{2\pi} \cdot \frac{K_{vcl}}{sC}$$

$$H_{cl}(s) = \frac{L(s)}{1 + L(s)} = \frac{1}{1 + \frac{s}{\omega_{2dB}}}$$

$$\omega_{2dB} = \omega_{c, loop} = \frac{I_0 K_{vcl}}{2\pi C}$$



$$T_{ref} = 10 \text{ ns}$$

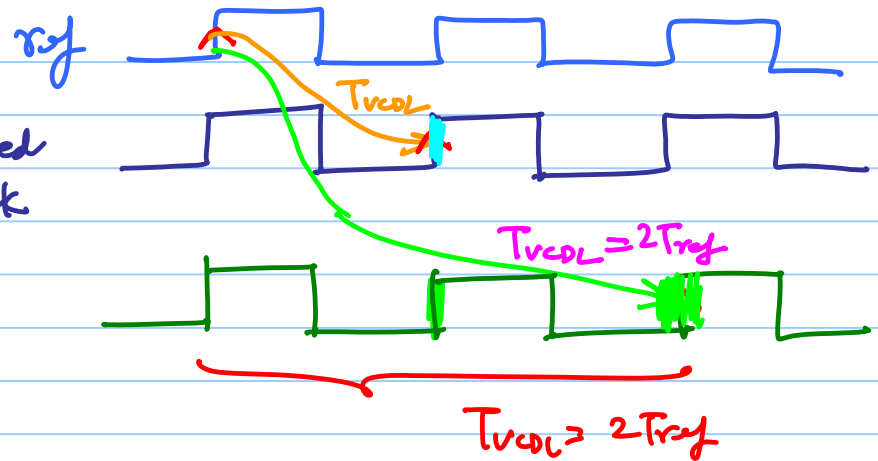
$$? < \Delta T < ?$$

$$> \frac{T_{ref}}{2}$$

$$< 3T_{ref}$$

$$< 2T_{ref} < 1.5T_{ref}$$

Desired
DCLK

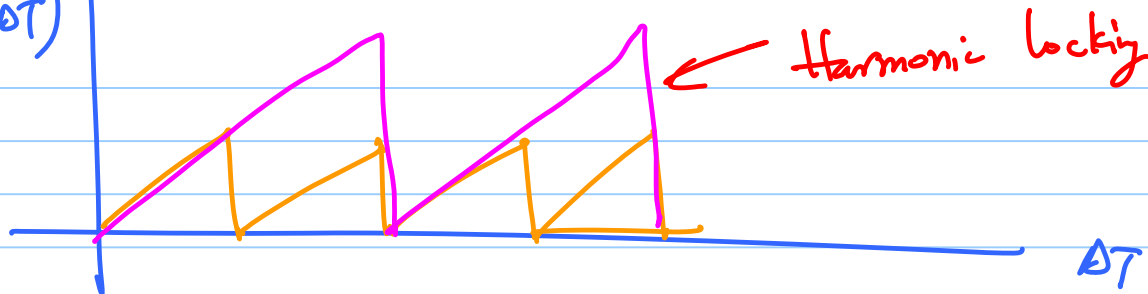


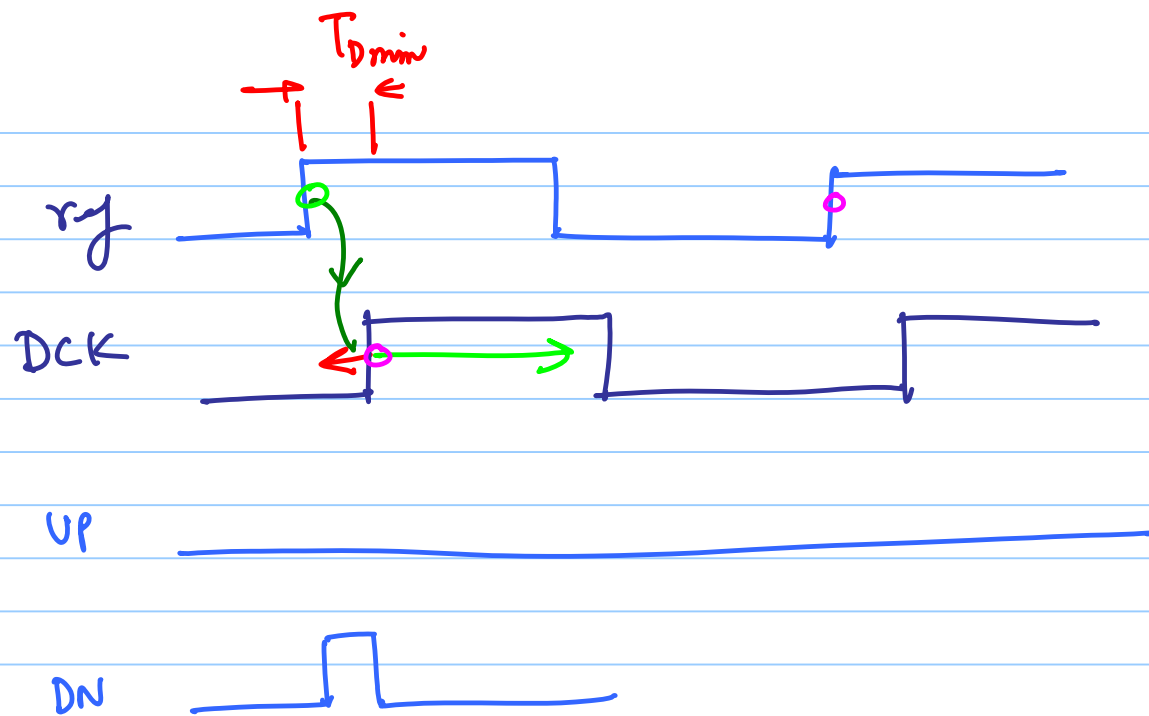
* DLL can lock to integer multiples of
reference clock period

↳ reduce spreading range

↳ increased noise due to jitter accumulation

$\log(\vec{V}_{OT})$



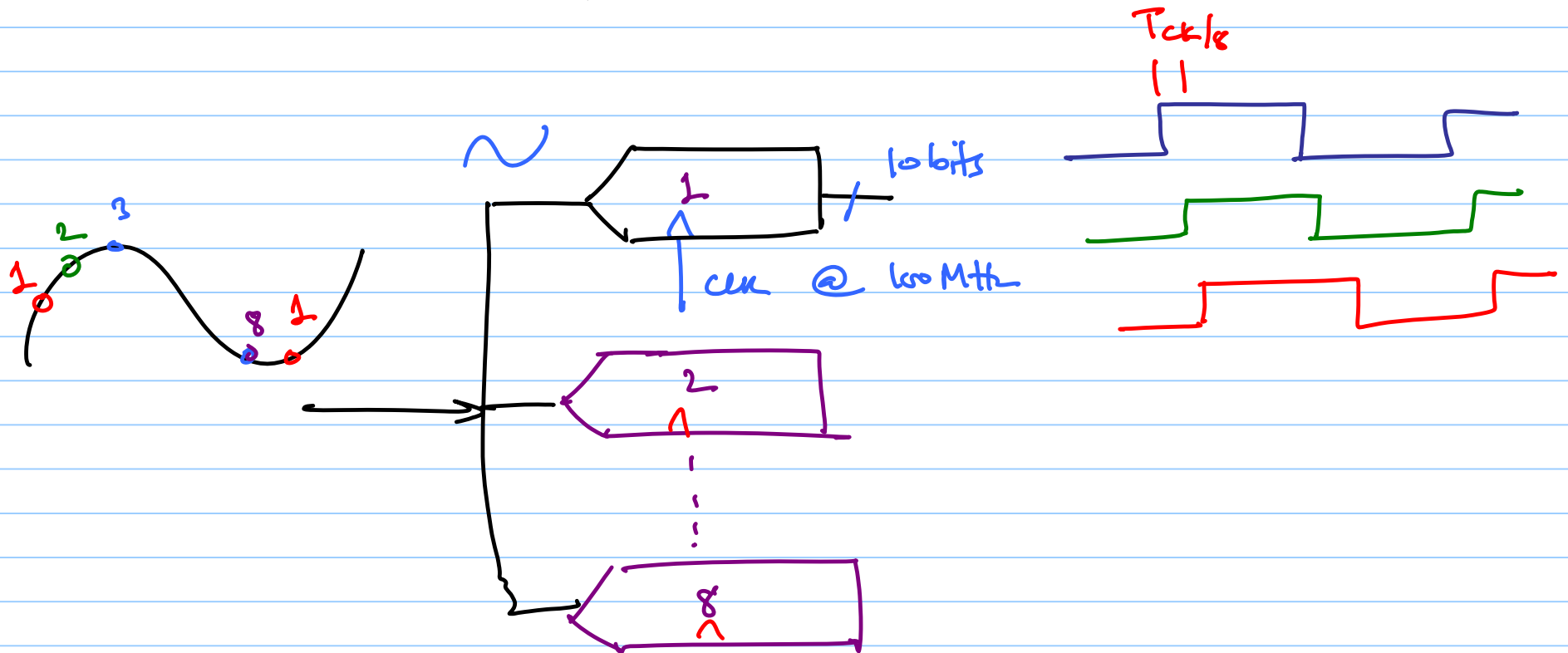


Stuck at min delay
occurs when

$$T_{D,min} < \frac{T_{rpf}}{2}$$

$$\text{Set } T_{D,min} > \frac{T_{rpf}}{2}$$

Time interleaved A/Dc



5G mmWave wireless

6 GHz $\rightarrow$ 30 GHz $\rightarrow$

60 $\rightarrow$ 31.60 GHz