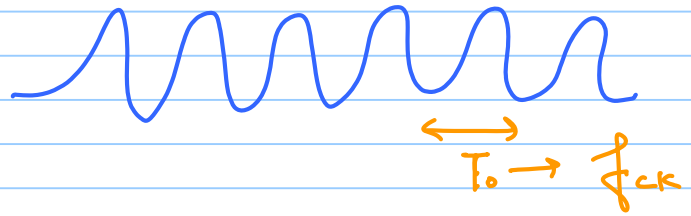
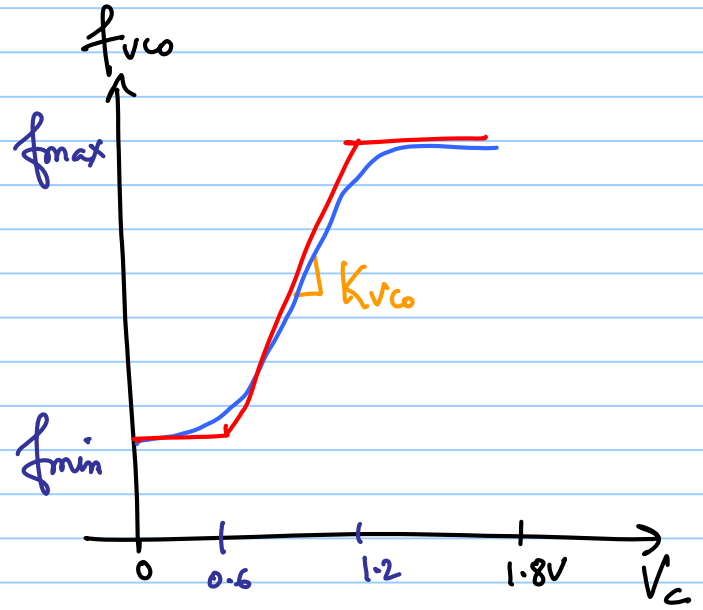
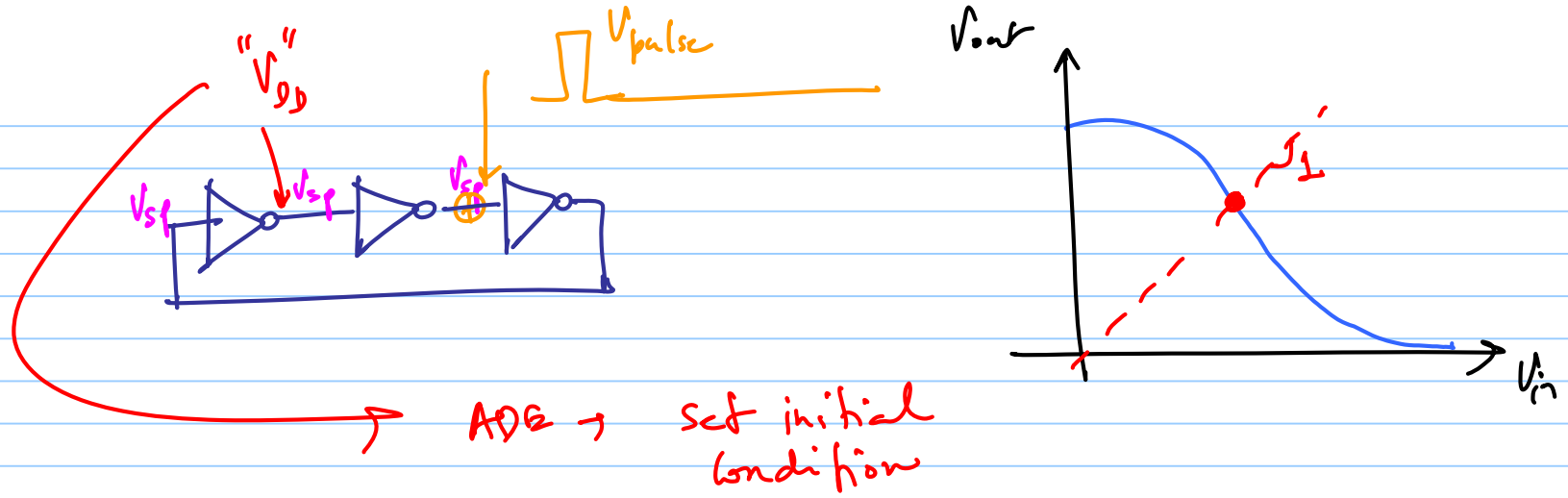
ECE 504 - Lecture 22

Note Title 11/9/2016

$V_c = 0.6,\ 0.7,\ 0.8$






"V_{DD}"
V_{pulse}
V_{sf}
V_{sr}
V_{sr}
V_{out}
V_{in}
V_1
ADE → set initial condition

$$S_{V_R} = 4KTR$$

$$S_{\phi_{out}}^{V_R} \propto K_{vco}^2 \cdot R$$

↳ Large K_{vco} ⇒ more noise contribution from R

↳ Reduce R

$\omega_z = \frac{1}{RC}$, C ↑

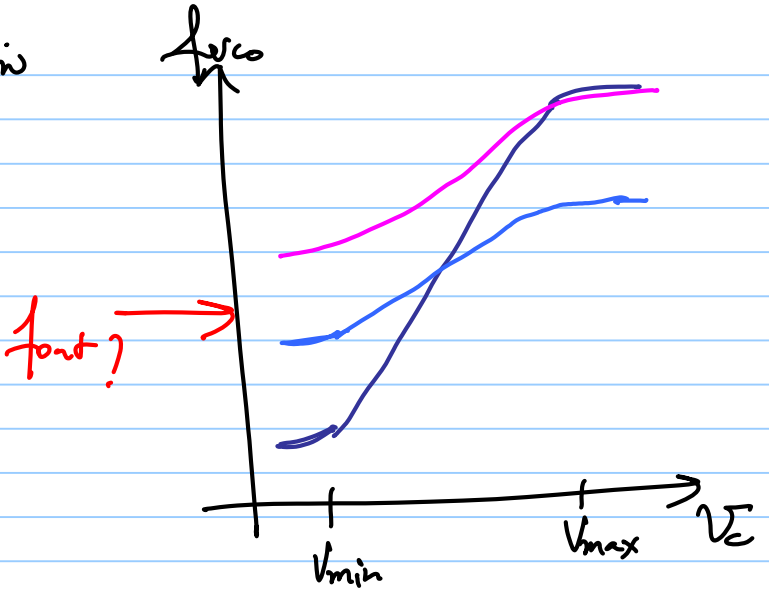
Tradeoffs in reducing V_{CO} gain

(−) Reduced V_{CO} operating range

(+) Better phase noise performance for the overall PLL

(+) Smaller C_1 & C_2

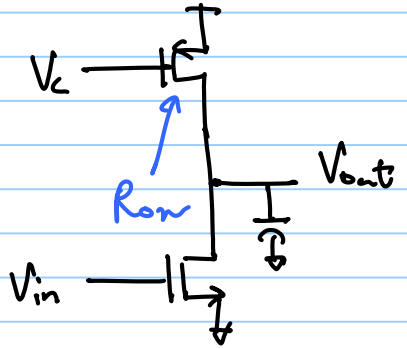
(+) Better spur performance



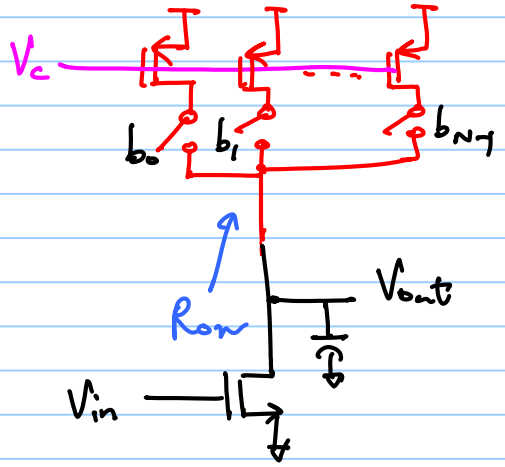
We want large V_{CO} operating range to cover PVT variation

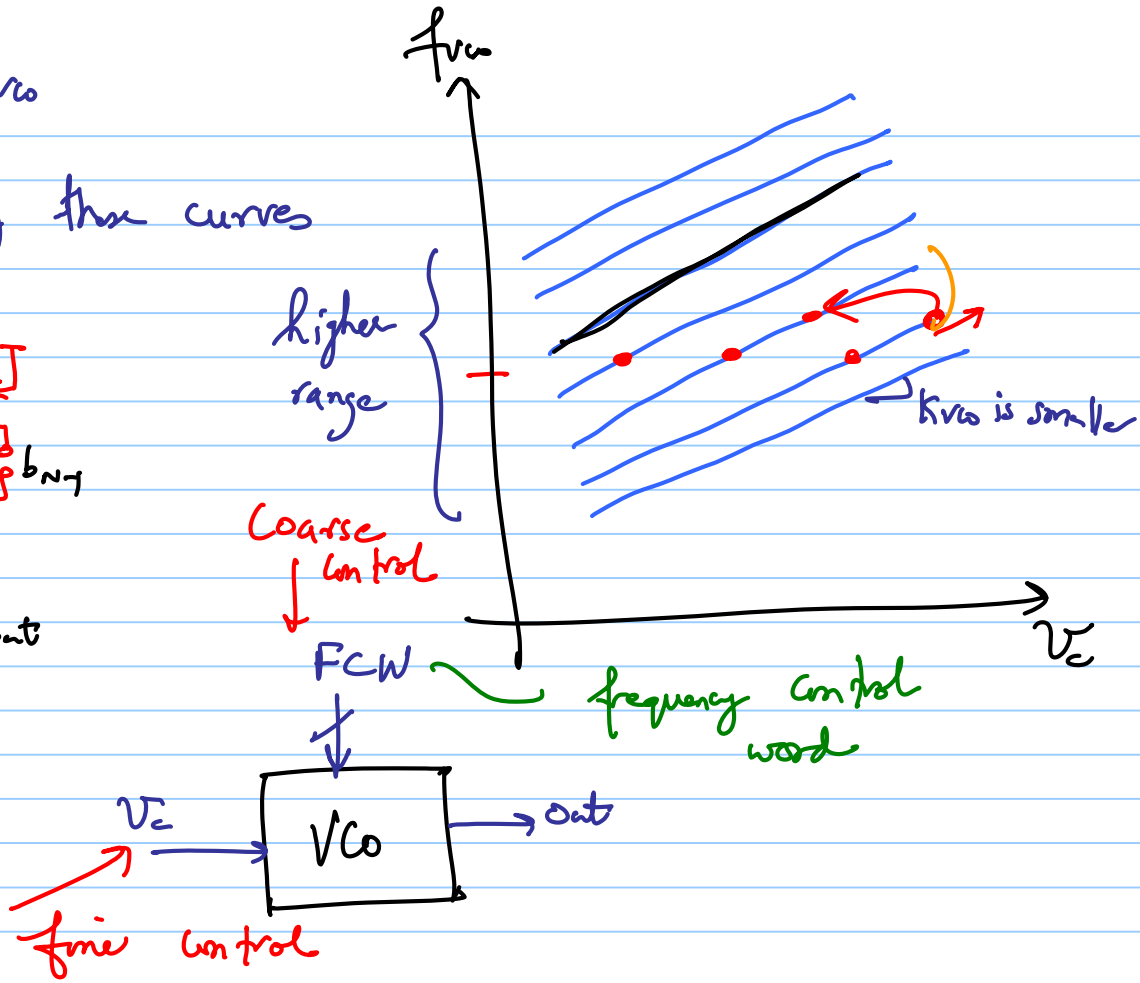
* Each curve has low K_{VCO}

* goal is to select one of these curves

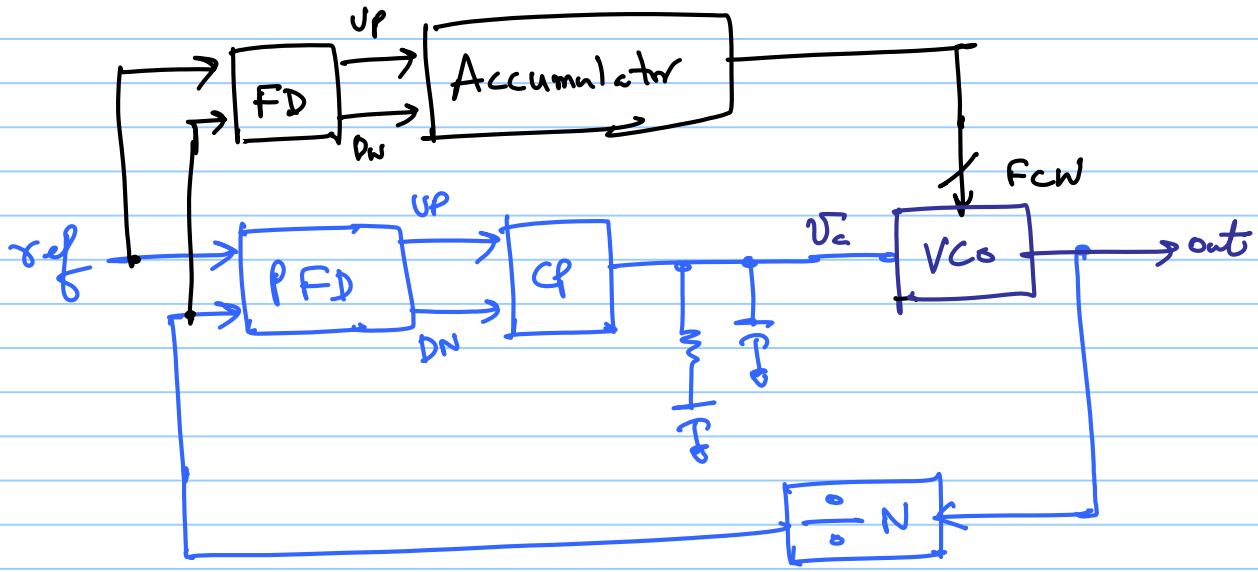


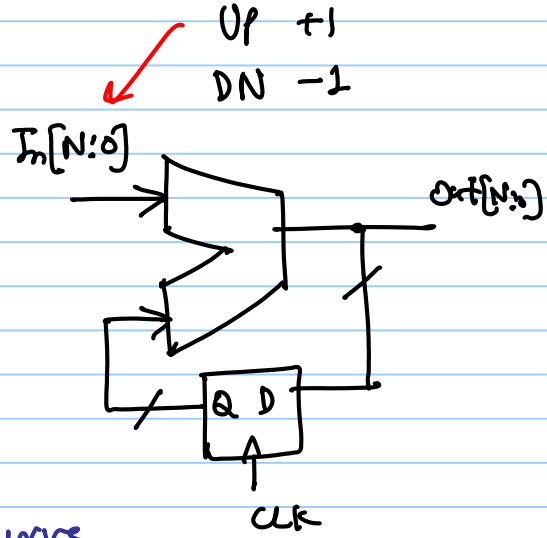
Delay Cell



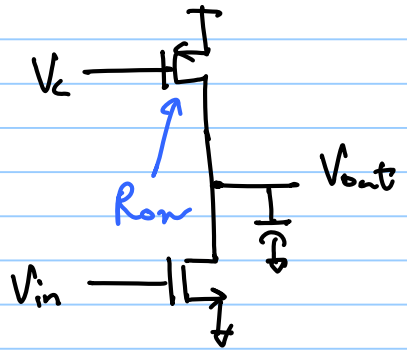


$$f_{out} \propto \frac{1}{\tau} = \frac{1}{RC} = \frac{G}{C} = \frac{\sum_{i=0}^{N-1} b_i \cdot \zeta_i}{C} \qquad b_i \in \{0, 1\}$$

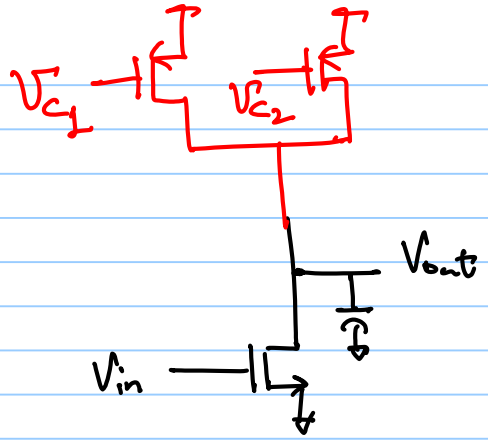




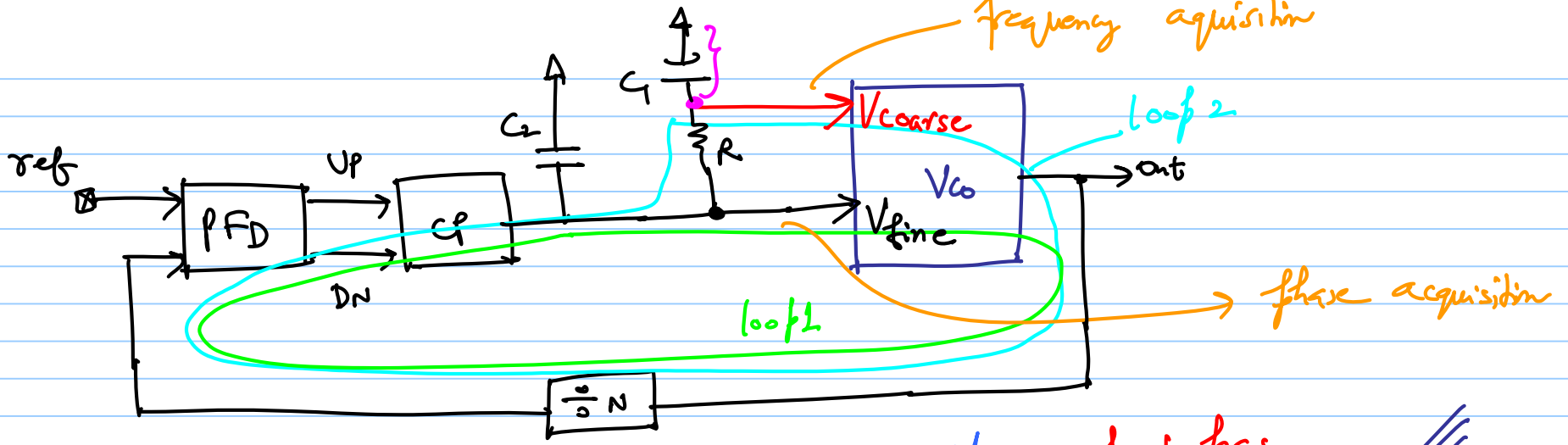
↳ Jitter due to abrupt jumps from one curve to another



Delay Cell



* Split-tuned with continuous tuning



* VCO is controlled using two voltages → Vcoarse, Vfine
  - Vcoarse port has high gain
  - high gain Vcoarse → works similar to a FLL
  - low gain Vfine port → lower KVCO → better total phase noise performance

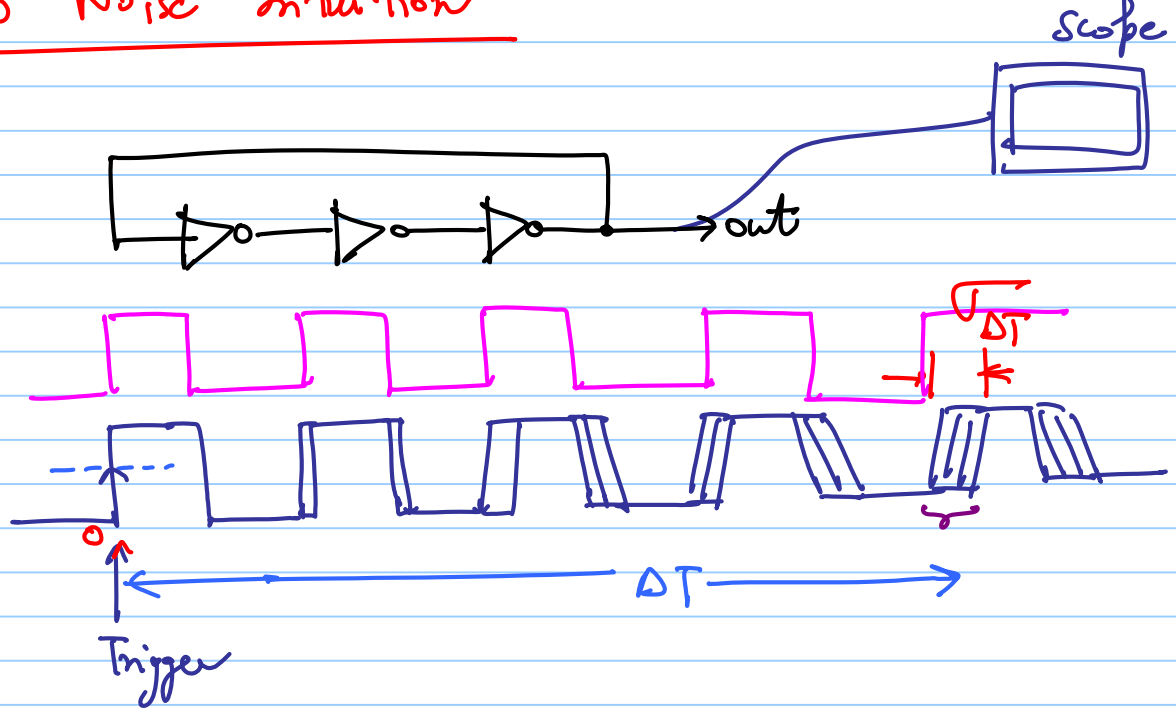
⇒ Two coupled-feedback loops

↳ potential instability

↳ Need low gain path to determine loop dynamics (fast)

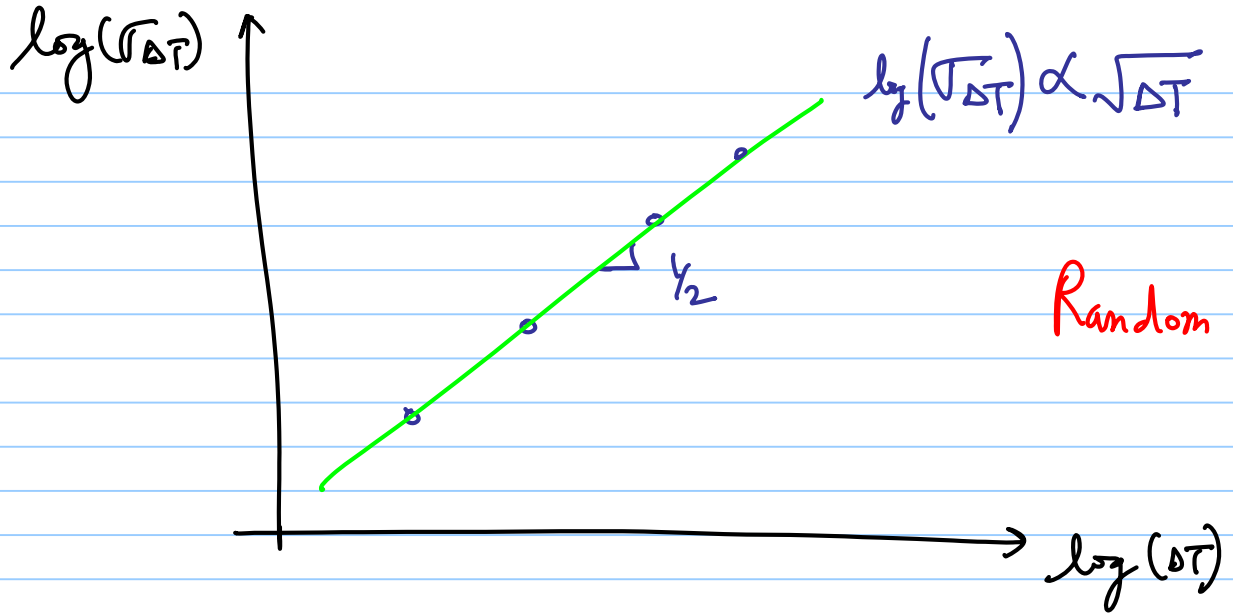
[See Scanned Note on analytical details]

VCO Noise Intuition



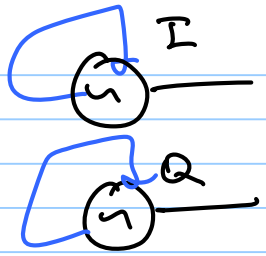
accumulating Jitter

$\sigma_{\Delta T} \propto \frac{1}{2} \log(\Delta T)$

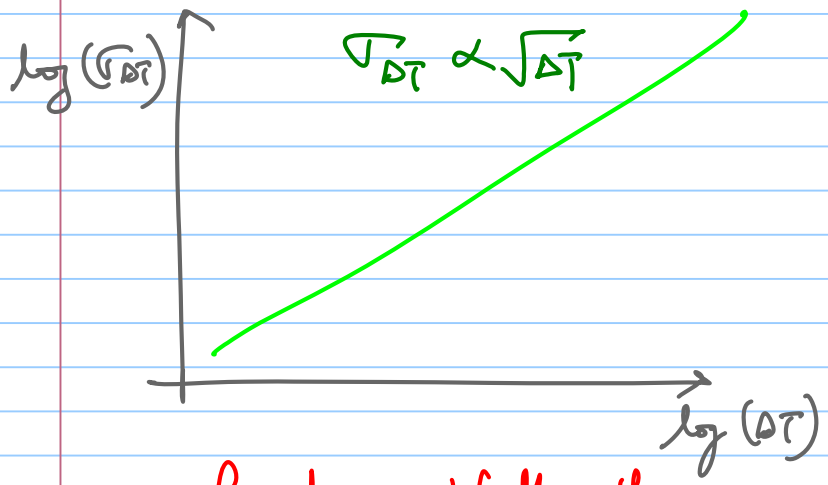


Random Walk process
(Brownian motion)

Accumulated jitter depends upon the # of edge transitions
↳ NOT the number of stgs in the VCO

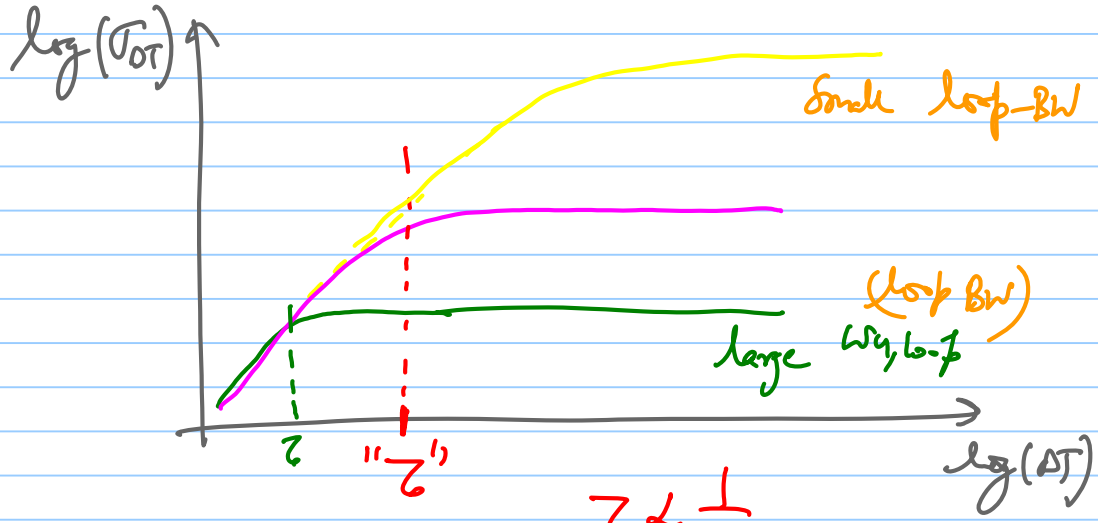

I
Q

Open-loop VCO



Random Walk process

Closed-loop VCO (PLL)



$\tau \propto \frac{1}{\omega_{y,l.p}}$

Truncated Random Walk process