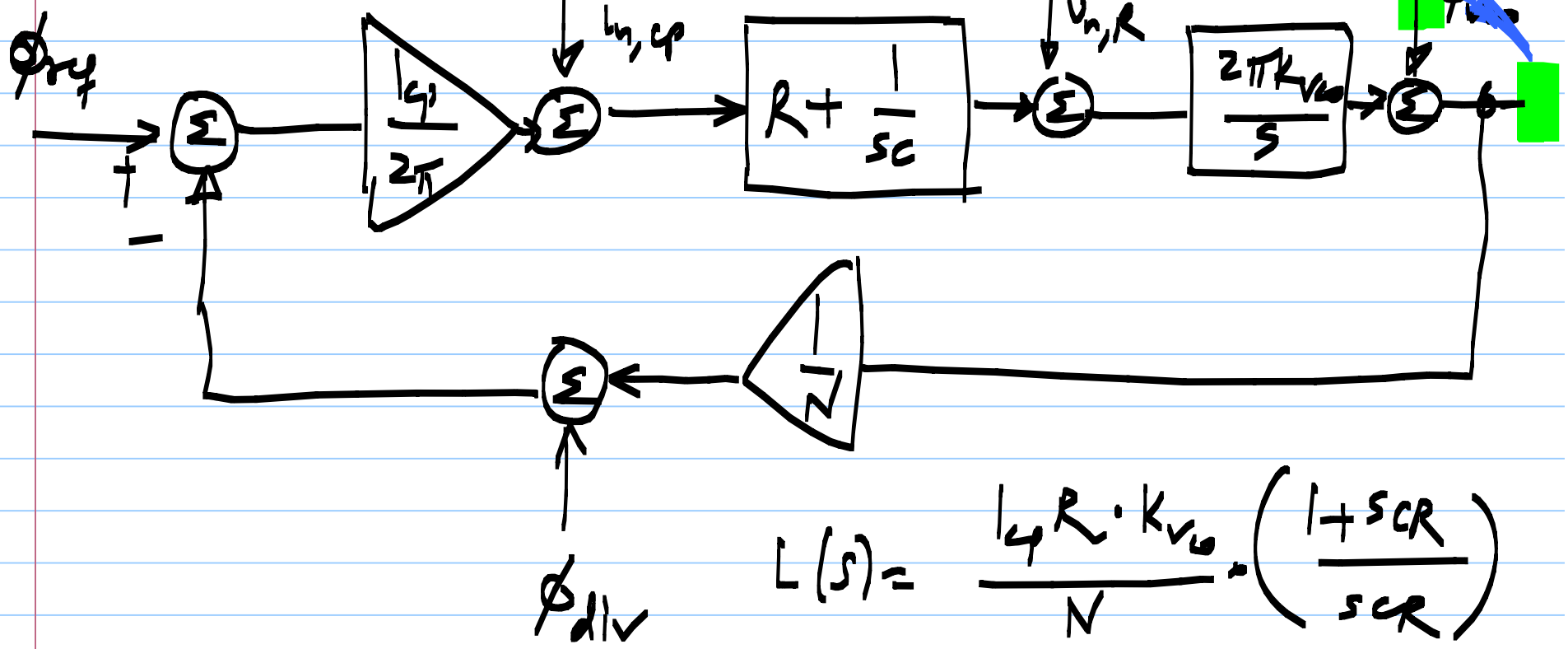
EE6322 PLL phase domain model 19/3/2018



$$L(s) = \frac{I_{cp} R \cdot K_{VCO}}{N} \cdot \left(\frac{1 + sCR}{sCR} \right)$$

$$\frac{\phi_{out}}{\phi_{ref}} = \left(-\frac{\phi_{out}}{\phi_{div}} = \frac{\phi_{out}}{i_{ncp}/(I_{cp}/2\pi)} \right) = [N] \frac{1+sCR}{1+sCR+s^2\frac{CN}{I_{cp}\cdot K_{vco}}}$$

"dc" gain of N

CDR PLL

Z_1 : $1/CR$ $1/CR$

$\omega_{n,loop}$ $I_{cp}RK_{vco}$ $\frac{I_{cp}RK_{vco}}{N}$

CDR :

$$\frac{\phi_{out}}{\phi_{in}} = \frac{1+sCR}{1+sCR+s^2\frac{C}{I_{cp}\cdot K_{vco}}}$$

$$\frac{\phi_{out}}{\phi_{ref}} : \text{dc gain } N \qquad \frac{1+s/z_1}{1+s/z_1+s^2\cdot\frac{1}{z_1\cdot\omega_{n,loop}}}$$

peaking (because of z_1)

peaking ↑ if z_1 approaches $\omega_{n,loop}$

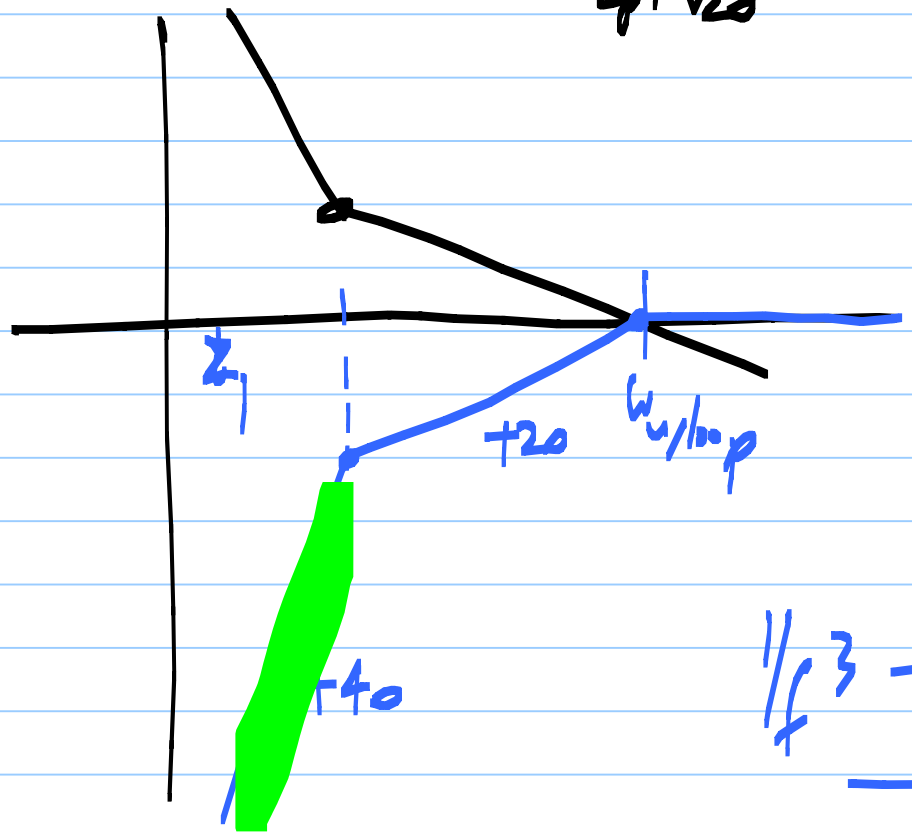
Actual behavior: hybrid (discrete-time + cont. time)

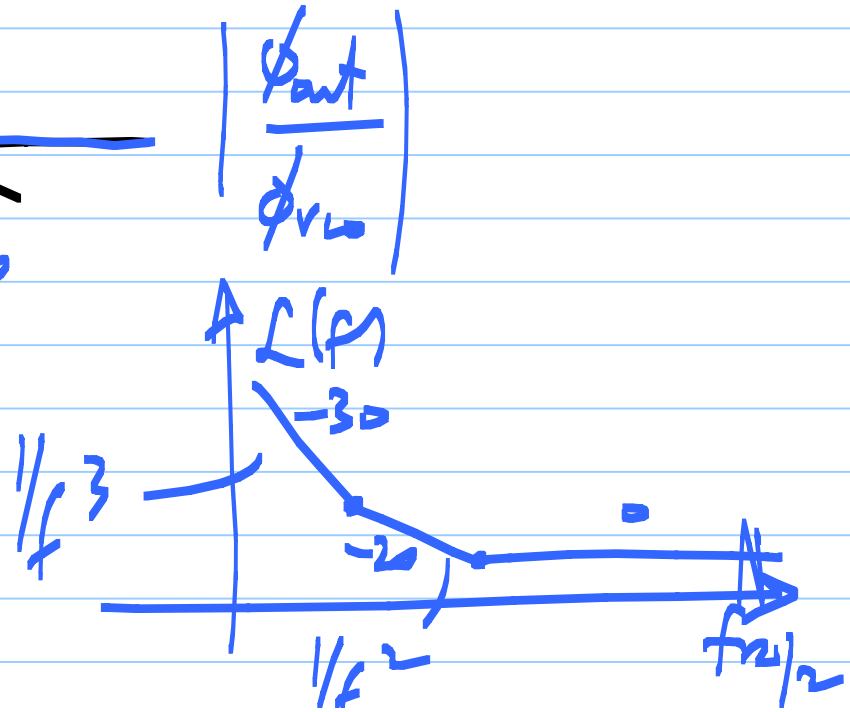
CT behavior (model) valid if $f_{loop\ BW} < f_{sw}/10$

$$\frac{\omega_{n,loop}}{2\pi} < f_{sw}/10$$

Cannot realize large bandwidths (approaching $f_{sw}/2$) and have stability

$$\frac{\phi_{out}}{\phi_{vco}} = \frac{\frac{s^2 CN}{I_{cp} \cdot K_{vco}}}{1 + sCR + \frac{s^2 CN}{I_{cp} K_{vco}}} = \frac{s^2 / z_1 \cdot \omega_{u/loop}}{1 + \frac{s}{z_1} + \frac{s^2}{z_1 \cdot \omega_{u/loop}}}$$

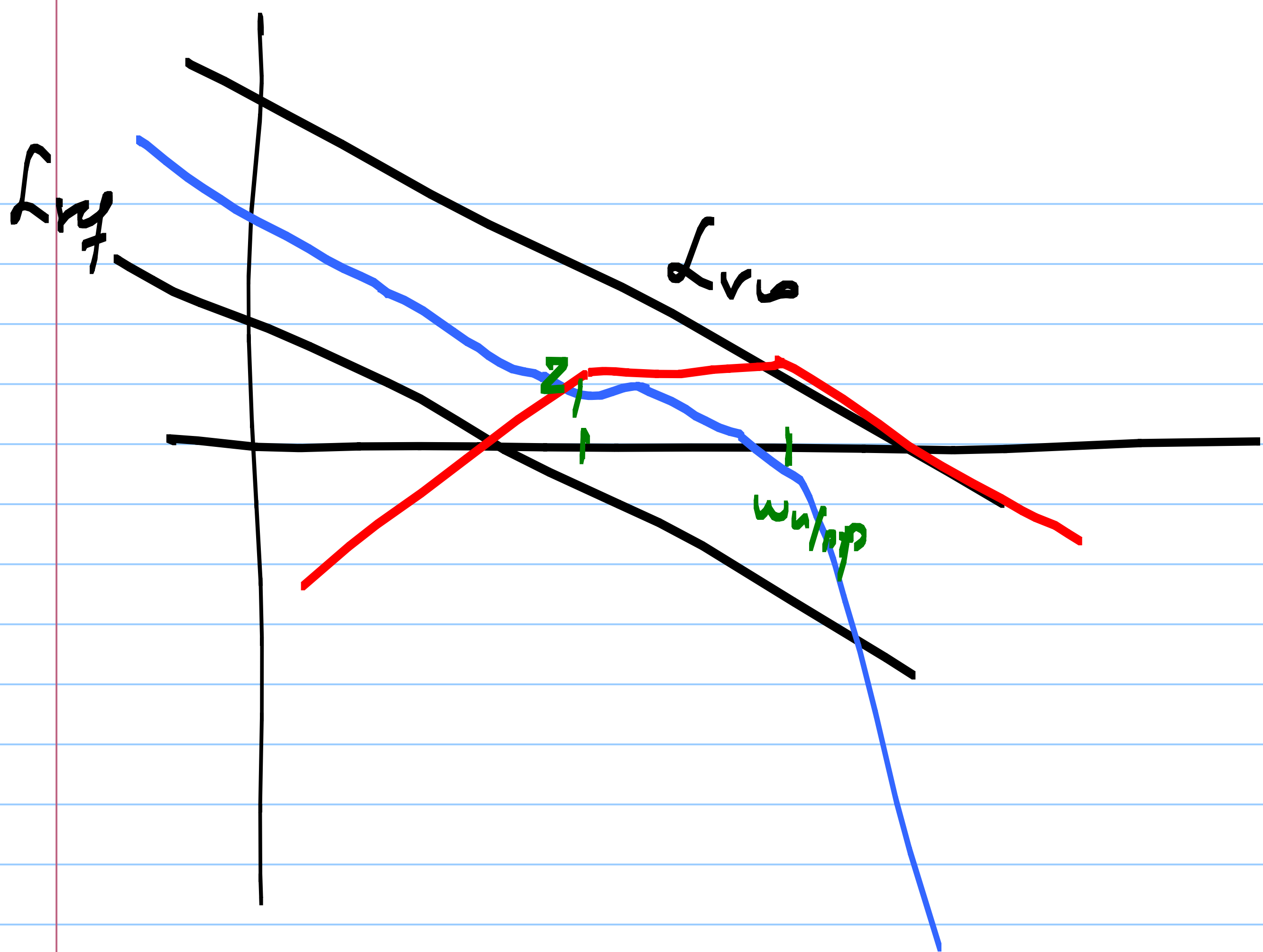




Noisy reference : Use low BW, clean VCO to get a clean periodic o/p

Clean reference, noisy VCO : Use high BW to get a clean periodic o/p.

Low noise PLL : Choose as high an f_{ref} as possible ; $\Rightarrow$ small N


Lrf
Lvco
z1
ωu/pp

Charge pump current mismatch.