Phase Noise (I)

Behzad Razavi

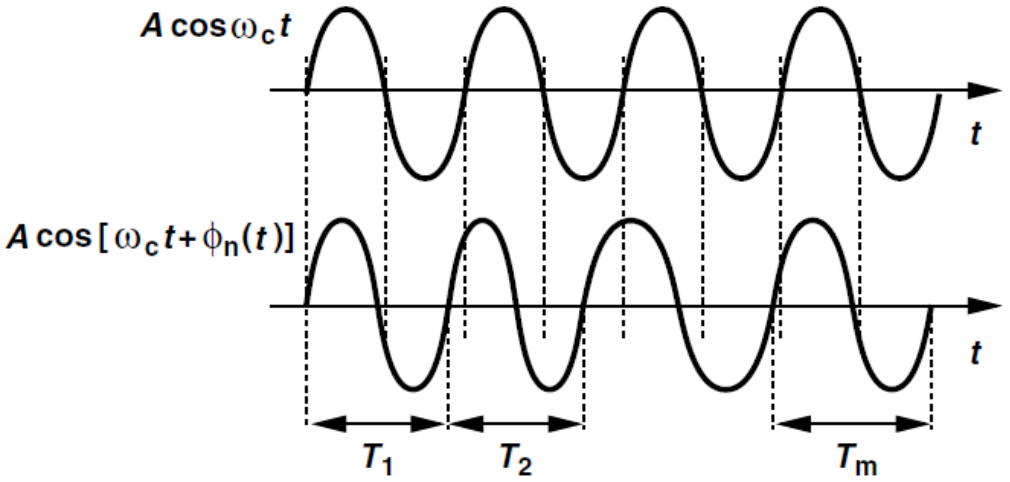
University of California, Los Angeles

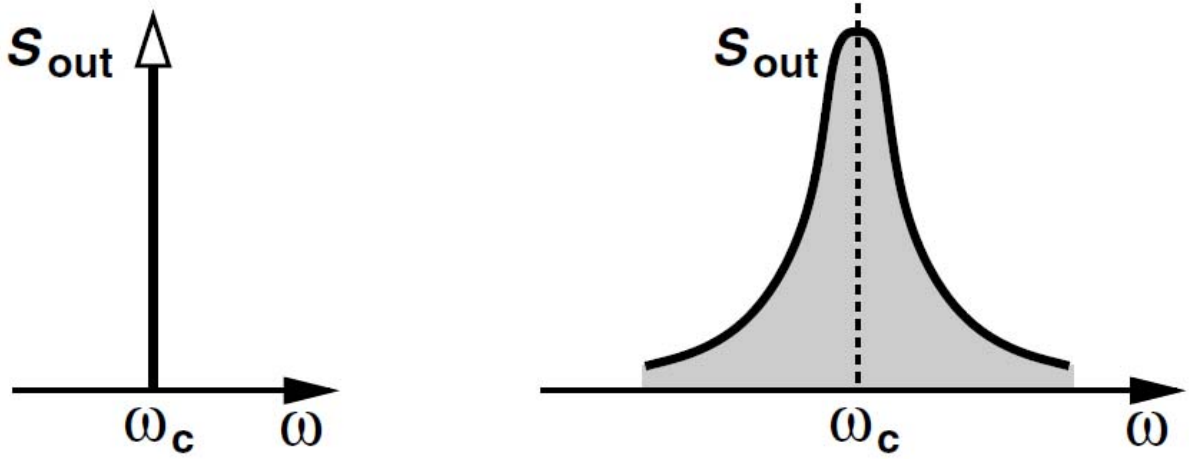
Outline

- What is phase noise?
- Why do we care?
- Where does it come from?

Phase Noise in Time and Freq. Domains

- Phase noise is random variation of period of a nominally-periodic waveform:

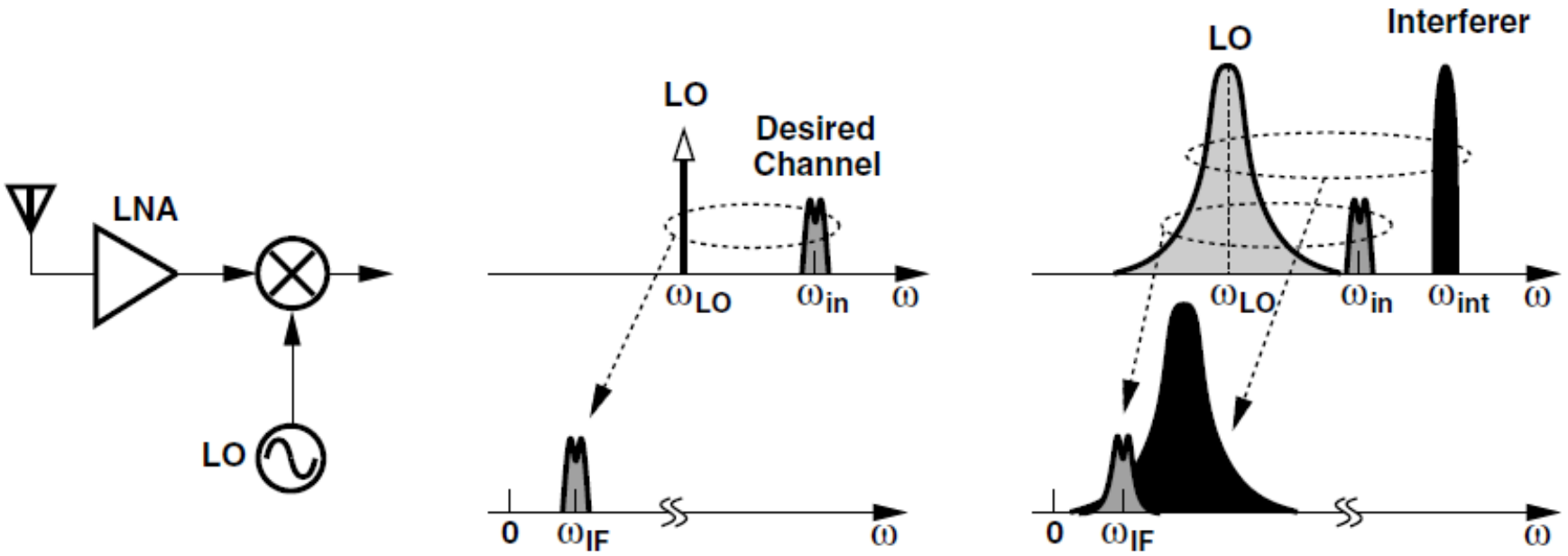




- Phase noise is measured in dBc/Hz at a certain frequency offset.

Effect of Phase Noise on RX

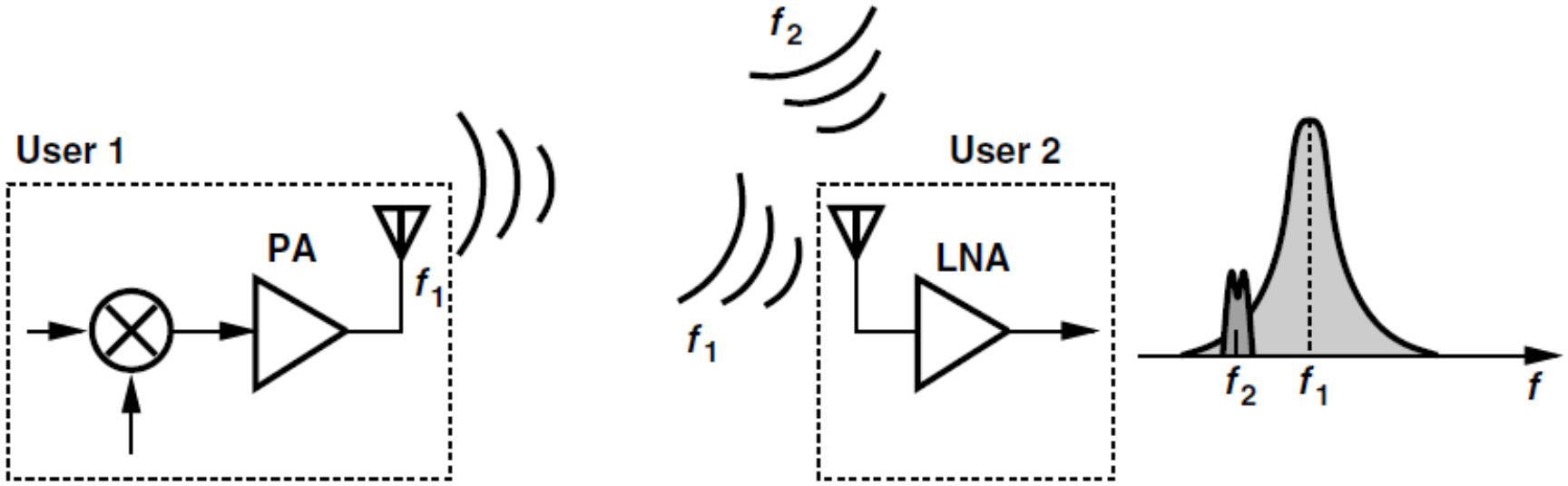
Reciprocal Mixing



- In typical systems, if phase noise is low enough to make reciprocal mixing negligible, corruption of signal itself is also negligible.

Effect of Phase Noise on TX

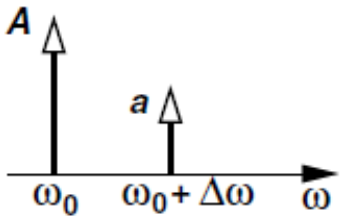
Interference with Other Users

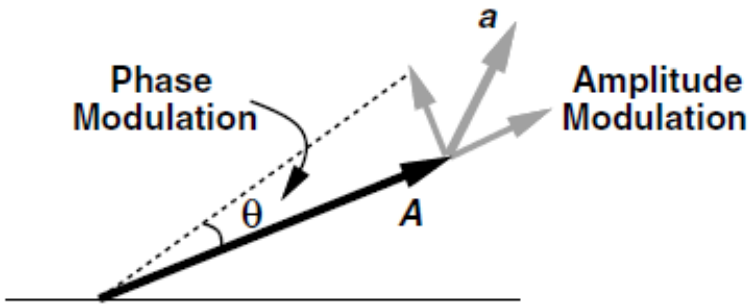


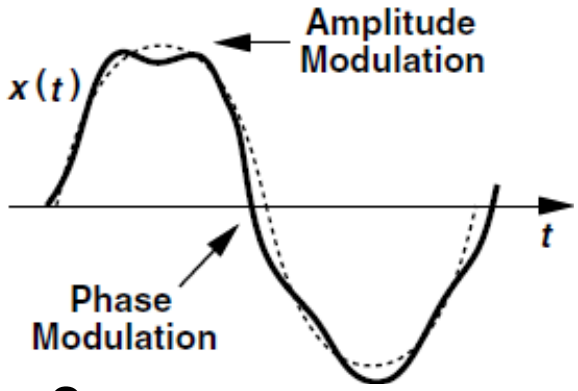
- **Except for GSM, cellular standards place tougher phase noise specs on RX than on TX.**
- **In IEEE802.11a/g (with 64QAM), TX phase noise is as stringent as that of RX.**

Let's model narrowband noise by a sine for now

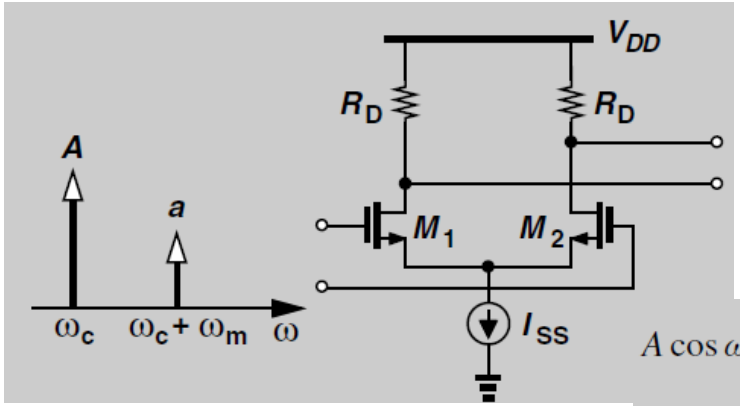
$$x(t) = A\cos\omega_0 t + a\cos(\omega_0 + \Delta\omega)t$$

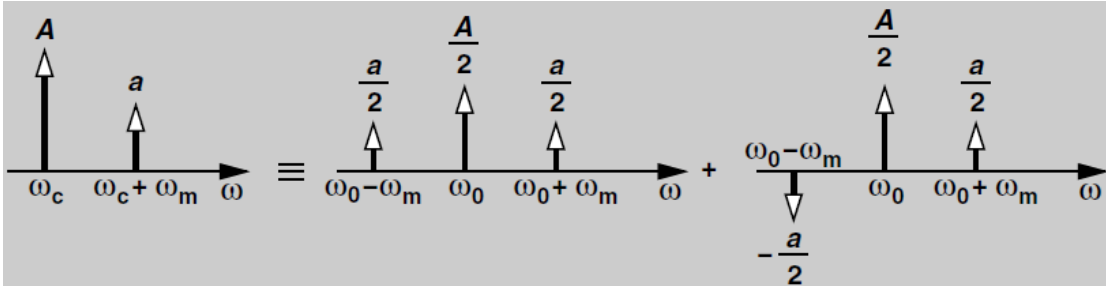






- **What happens if this goes thru a limiting stage?**





$$A\cos\omega_c t + a\cos(\omega_c + \omega_m)t = \frac{A}{2}\cos\omega_c t + \frac{a}{2}\cos(\omega_c + \omega_m)t + \frac{a}{2}\cos(\omega_c - \omega_m)t$$
$$+ \frac{A}{2}\cos\omega_c t + \frac{a}{2}\cos(\omega_c + \omega_m)t$$
$$- \frac{a}{2}\cos(\omega_c - \omega_m)t. \qquad (3.17)$$