# Problem Set 1
Due Friday Feb. 6, 2009

1. Analyze the effects of gain/phase mismatches in the Weaver architecture. Derive the image-reject ratio IIR.

2. Design a 1MHz transmitter (broadcaster) to cover 100 mi using a small space of 3m^3 (basestation size). The antenna must be contained within this space but it is mounted on a building that is 260m tall (tallest building in San Francisco). Assume that the data rate of only 10 kHz is required for voice communication. Specify the required transmit power and the likely efficiency of the system. Compare FM and AM approaches. Include a link margin of 10dB. Use the NIST outdoor propagation calculator to estimate the path loss.

3. Construct a spreadsheet to calculate the input-referred gain, NF, and IIP3 of the following receiver. Assume the input LNA is matched to 50Ω, while the LNA/mixer interface is 300Ω, and the mixer load is 1kΩ differential. The filter input impedance is capacitive (high-Z), and the VGA drives a 10kΩ//5pF differential load.
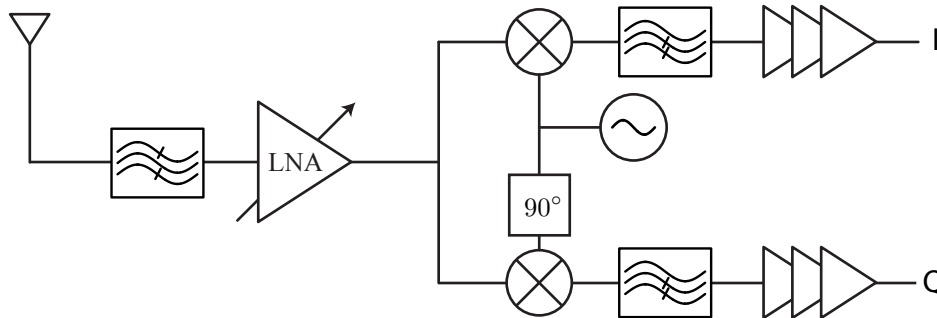
4. Using your spreadsheet, plug in reasonable gains, IP3, and NF values to realize a receiver with $NF < 3$ dB, IIP3 > -10 dBm, and >95 dB of voltage gain.