Towards All-digital mmWave Massive MIMO: Designing around Nonlinearities
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Motivation
- Tiny carrier wavelength at mm-wave \(\Rightarrow\) small nodes with many antennas
- RF beamforming is the state of the art
- Large available spectrum at mm-wave \(\Rightarrow\) taking turns among users using RF beamforming is wasteful
- Our goal: "mostly digital" massive multiuser MIMO

Problem Statement
We consider mostly digital multiuser MIMO uplink with conventional linear receiver. How relaxed can our analog design specs be as we push the limits of system bandwidth and carrier frequency?
- Guidelines on ADC precision,
- RF Frontend specifications (P1dB).

Approach
1. **Step 1: SNR due to self-noise**
   a) Take into consideration: Nonlinearities
   b) Use Bussgang approximation and define the intrinsic SNR
   c) Ignore Thermal Noise + Noise Enhancement + Interference

2. **Step 2: SNR due to self-noise and thermal noise**
   a) Take into consideration: Nonlinearities + Thermal Noise
   b) Ignore Noise Enhancement + Interference

3. **Step 3: SINR at linear MMSE receiver output**
   a) Take into consideration: Nonlinearities + Thermal Noise + Noise Enhancement due to Interference Suppression
   b) Use Noise Enhancement of Ideal System as an upper bound

System Description

Intrinsic SNR
\[ \text{Intrinsic SNR: } SNR(g) = \frac{\sigma^2}{\sigma^2_g} \]

Results
- The SNR needed by the edge user, that at 100 m, to meet the performance criterion, for various values of the load factor if we restrict the receiver chains in the base station to ADC only
- The SNR needed by the edge user, that at 100 m, to meet the performance criterion, for various values of the load factor if we restrict the receiver chains in the base station to Passband nonlinearity only

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