DIGITAL PREDISTORTION WITH LOW-PRECISION ADCS

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Motivation

- **Spectrum scarcity is leading to more frequency-agile standards**
  - Non-contiguous transmission
  - Carrier Aggregation (CA) in LTE-Advanced
  - Cognitive radio
  - 5G New Radio (NR) cellular
  - Citizens Broadband Radio Service
- **Non-contiguous carriers intermodulate**
  - Caused by nonlinearities in power amplifiers (PAs)
  - Undesired spurious emissions (spurs) and spectral regrowth
  - Exacerbated high-PAPR signals (OFDM)
  - Could interfere with nearby channels
  - Self-interference to own receiver when using FDD
- ***DPD requires extra hardware***
  - Extra RX chains with fast sampling rates
  - Larger area
  - More power
- ***Need computationally and hardware efficient way to linearize for this scenario***

Main Idea

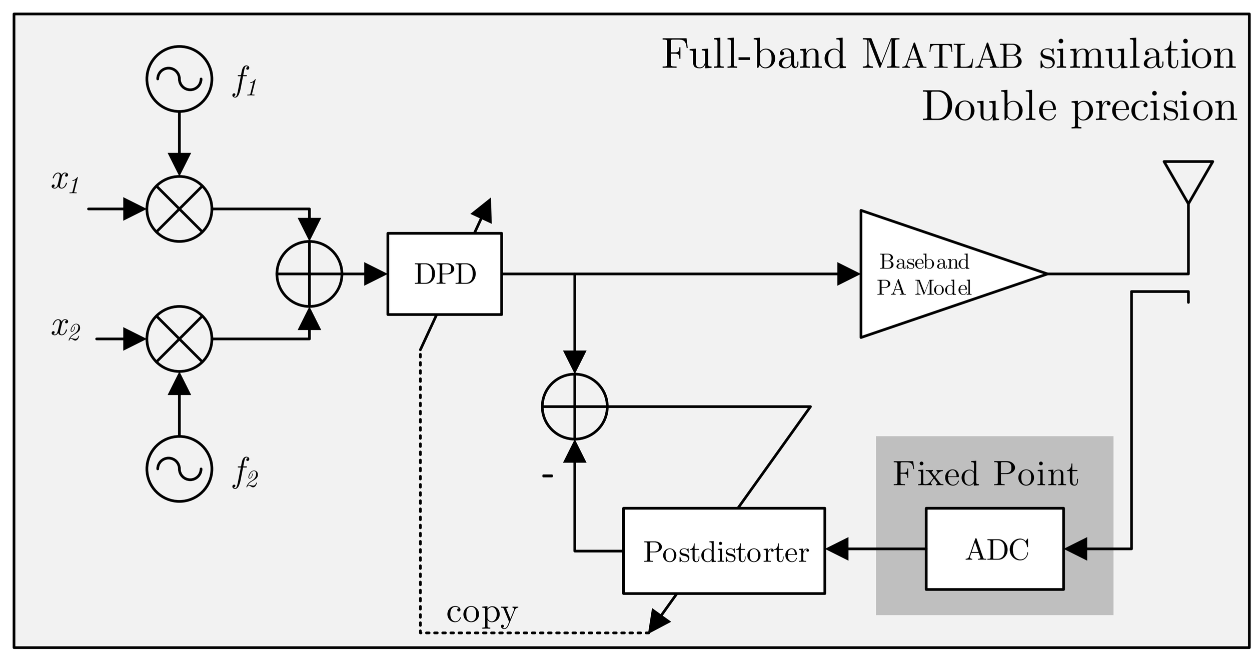
- ***Use a lower precision ADC for DPD on a UE device***
  - Reduce the necessary area
  - Reduce the power
  - Reduce the cost
  - Reduce the computational complexity by using shorter word lengths
  - Increase sampling rates to support DPD for larger BWs

MATLAB Simulator

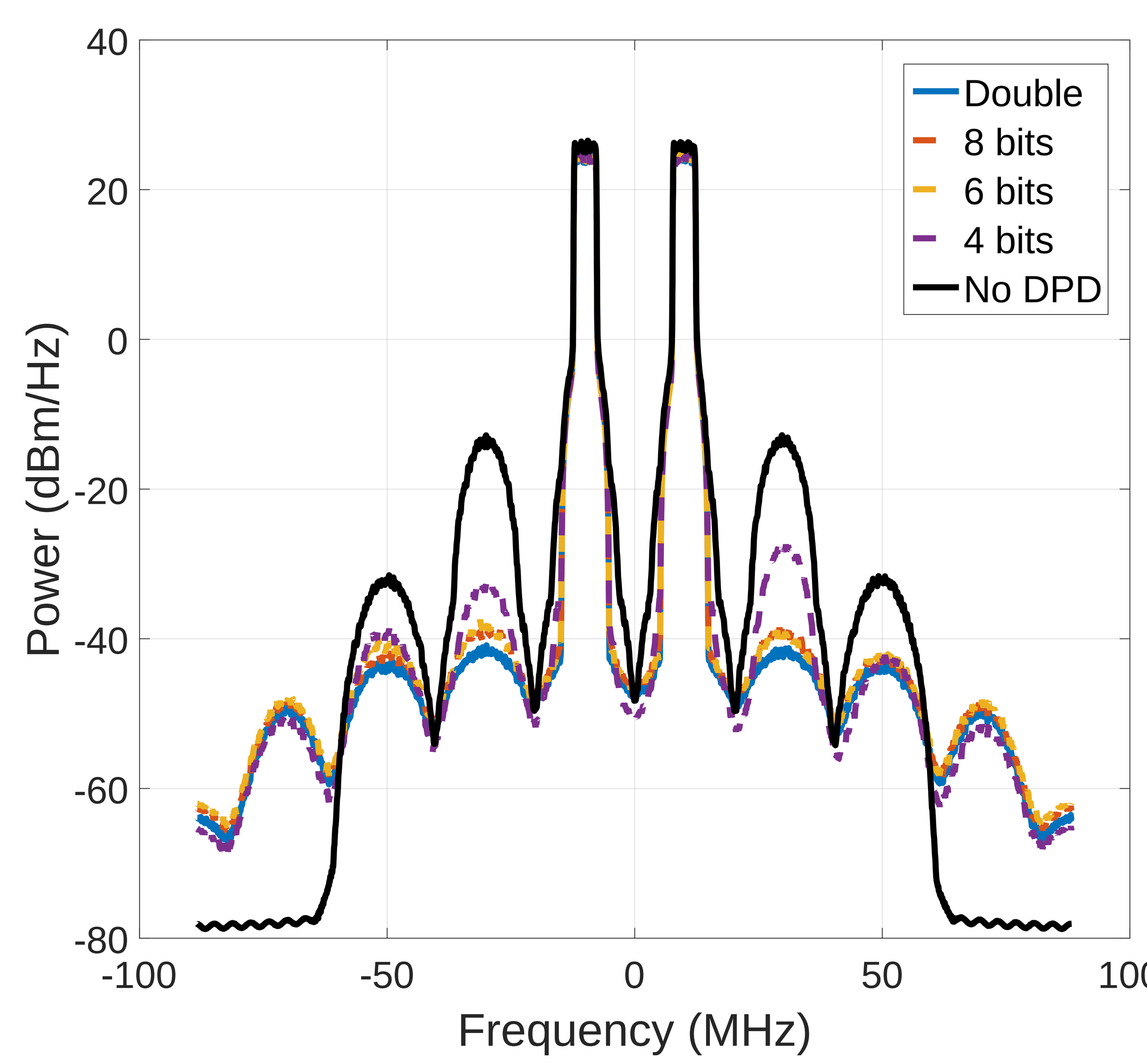
- **LTE-Advanced CA Scenario**
  - Two, 5 MHz component carriers
  - Intraband CA with 20 MHz spacing
  - 5^{th} order, parallel Hammerstein PA model
  - Fixed point toolbox to emulate ADC

Full-band DPD Simulations

- **Simulation Architecture**



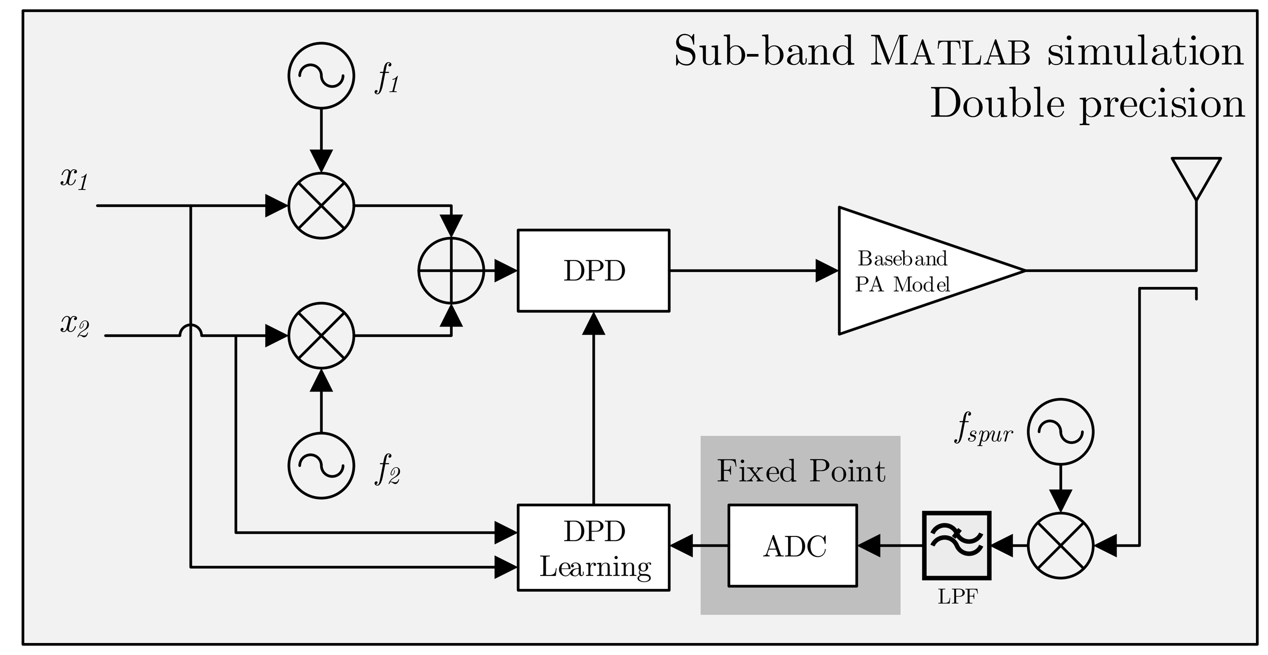
  - Traditional, indirect-learning DPD
- **Suppression Results:**



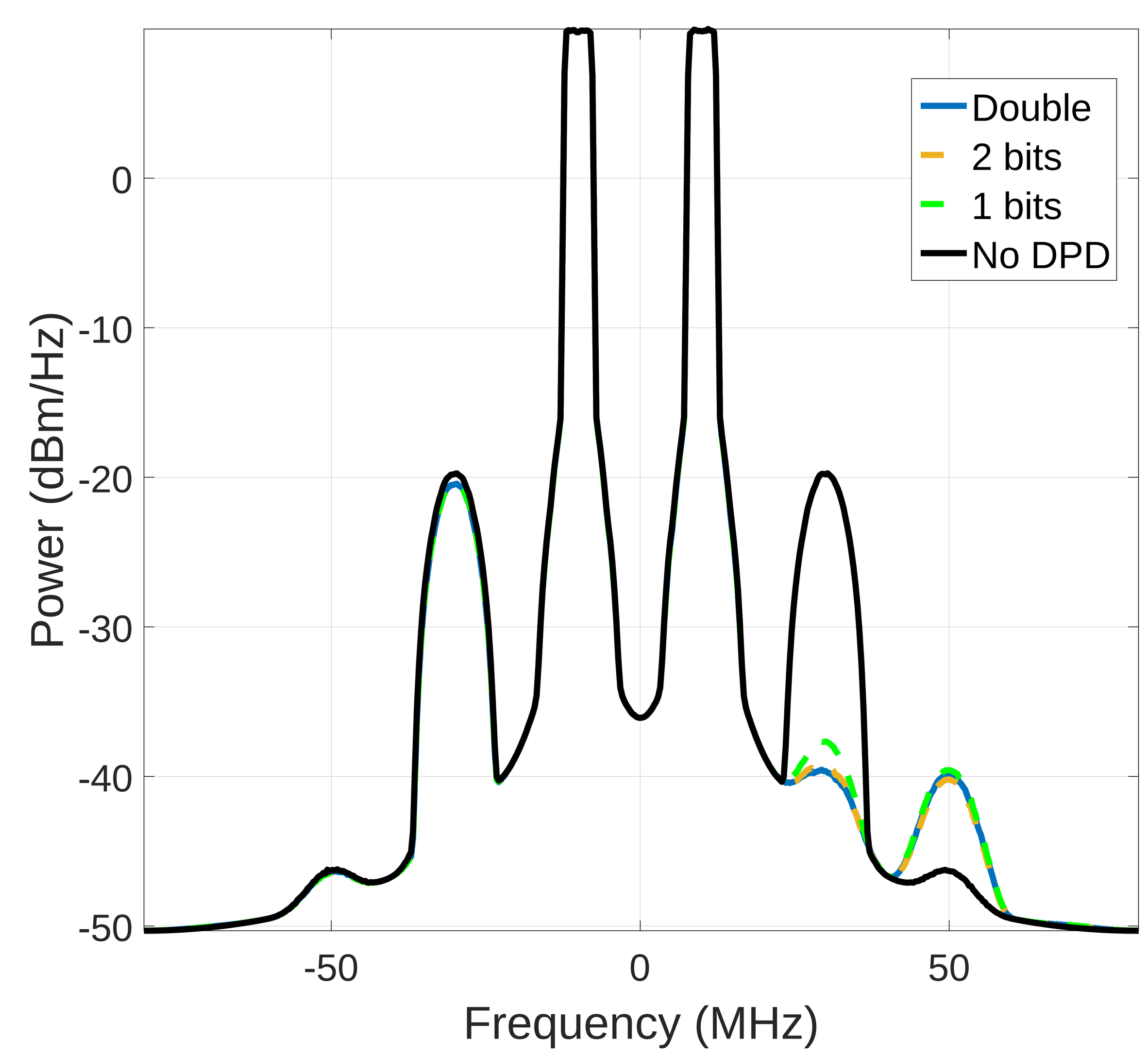
  - Near ideal performance for as low as 6 bits
  - Main carriers begin to saturate the ADC at low precisions

Sub-band DPD Simulations

- **Simulation Architecture**



  - Uses LMS adaptive training to learn inverse of PA nonlinearities
- **Suppression Results:**



  - Near ideal performance for as low as 1 bit
  - RX feedback gain can be set to get better resolution of the spurious signal
  - Main carriers no longer likely to saturate the ADC

Future Work

- **Multi sub-band, single-bit DPD solution**
- **Hardware testing with a real PA using the WARP SDR platform**