

An Ultra-Wideband Technology Workshop: From Research to Reality  
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# Ultra-Wideband Hardware Design

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# UWB Characteristics

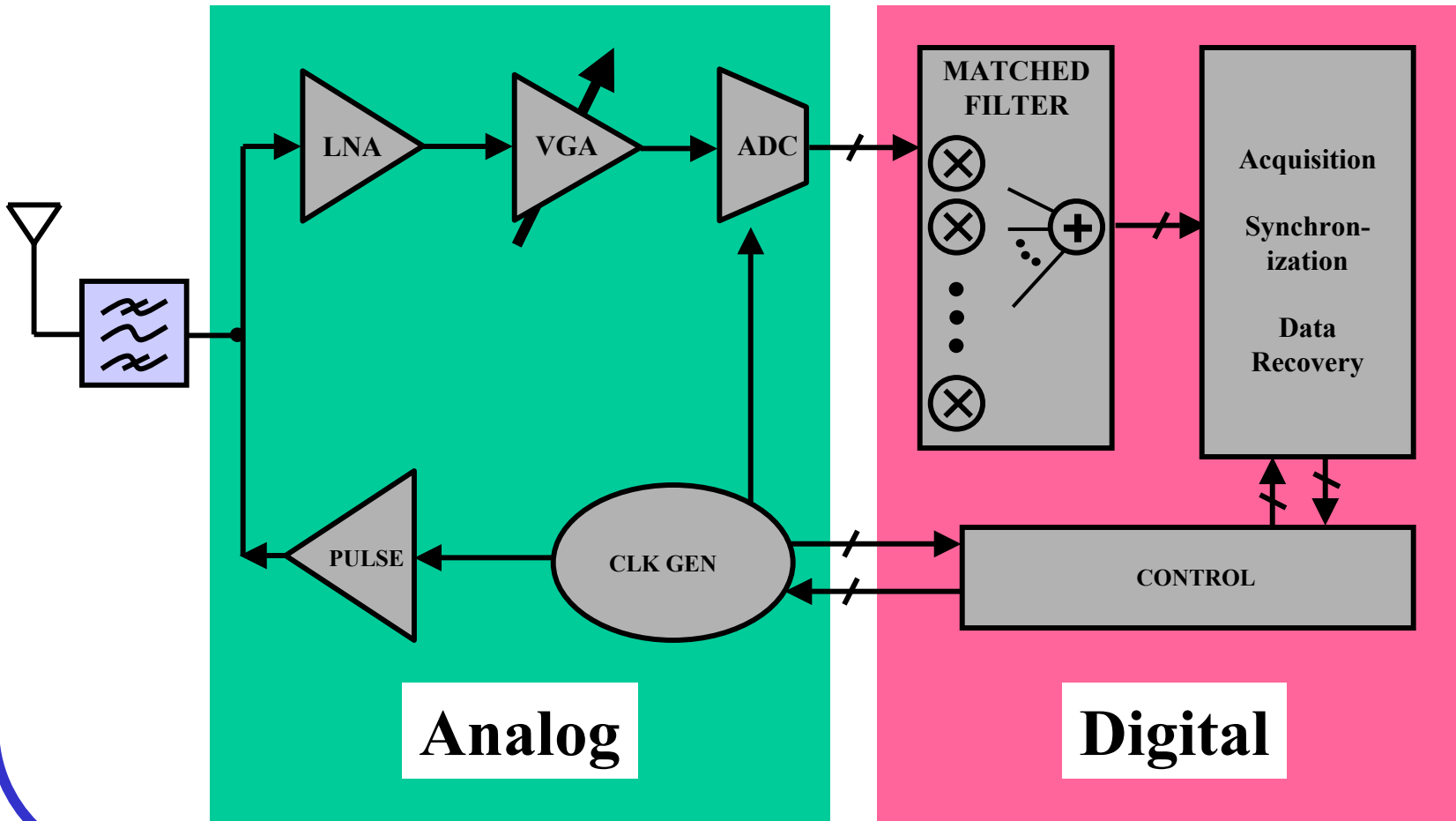
## **Advantages:**

- Simple Implementation
  - Low Cost, Low Power, Easily Integrated, “Digital”
- High Throughput
- Fine Time Resolution

## **Caveats:**

- Low TX Power (Short Range)
- Interference/Coexistence
- Amount of Digital Computation

# Simple UWB Architecture

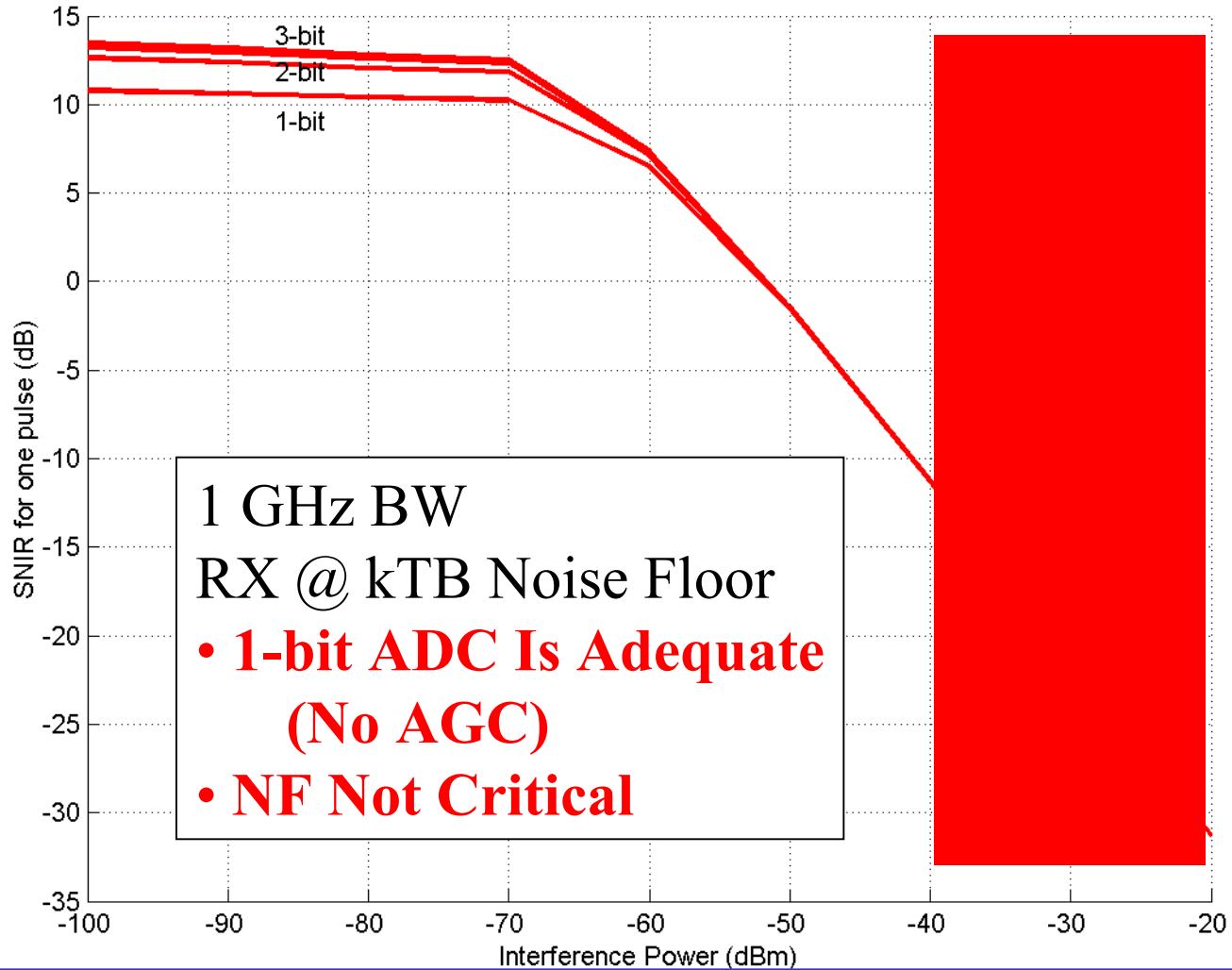


# Impact on Hardware?

## Specifications:

- ADC Bit-Width
  - AGC: VGA / Peak-Detect-and-Hold
- Noise Figure
- Energy Capture
  - Additional Spreading Gain / RAKE
- Acquisition Time vs. Area
- Oscillator Accuracy / Precision
- Interference Cancellation
  - Filters, Analog vs. Digital, Adaptable

# A/D Bit-Width



# Energy Capture

Matched Filter Against Window of Samples



**RMS Channel Delay Spread is ~13ns [Intel].**

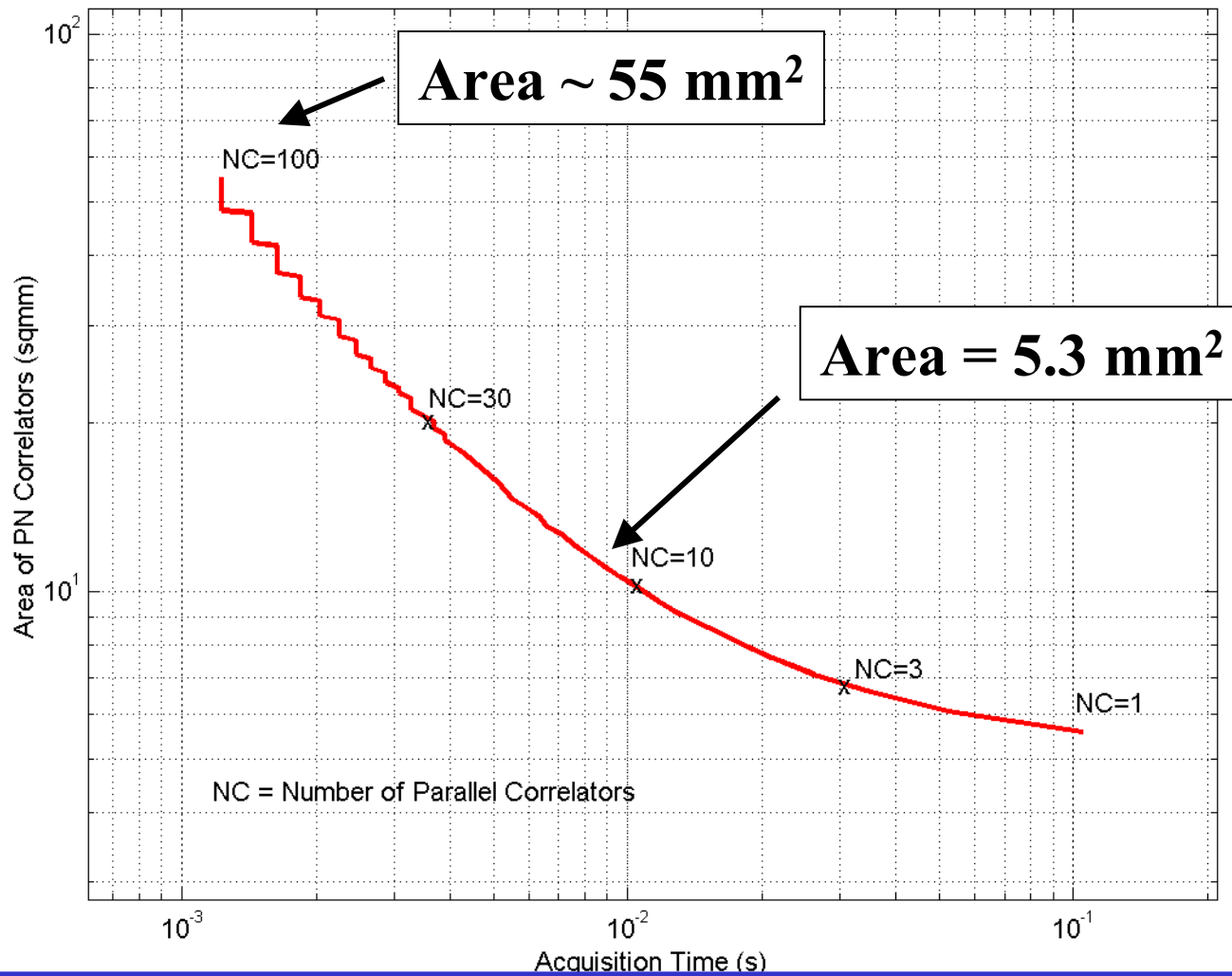
**Nyquist Sampling (10GHz) = 130 Samples/Pulse.**

**If RAKE, LOS ~ 10 Paths, but NLOS > 30 Paths.**

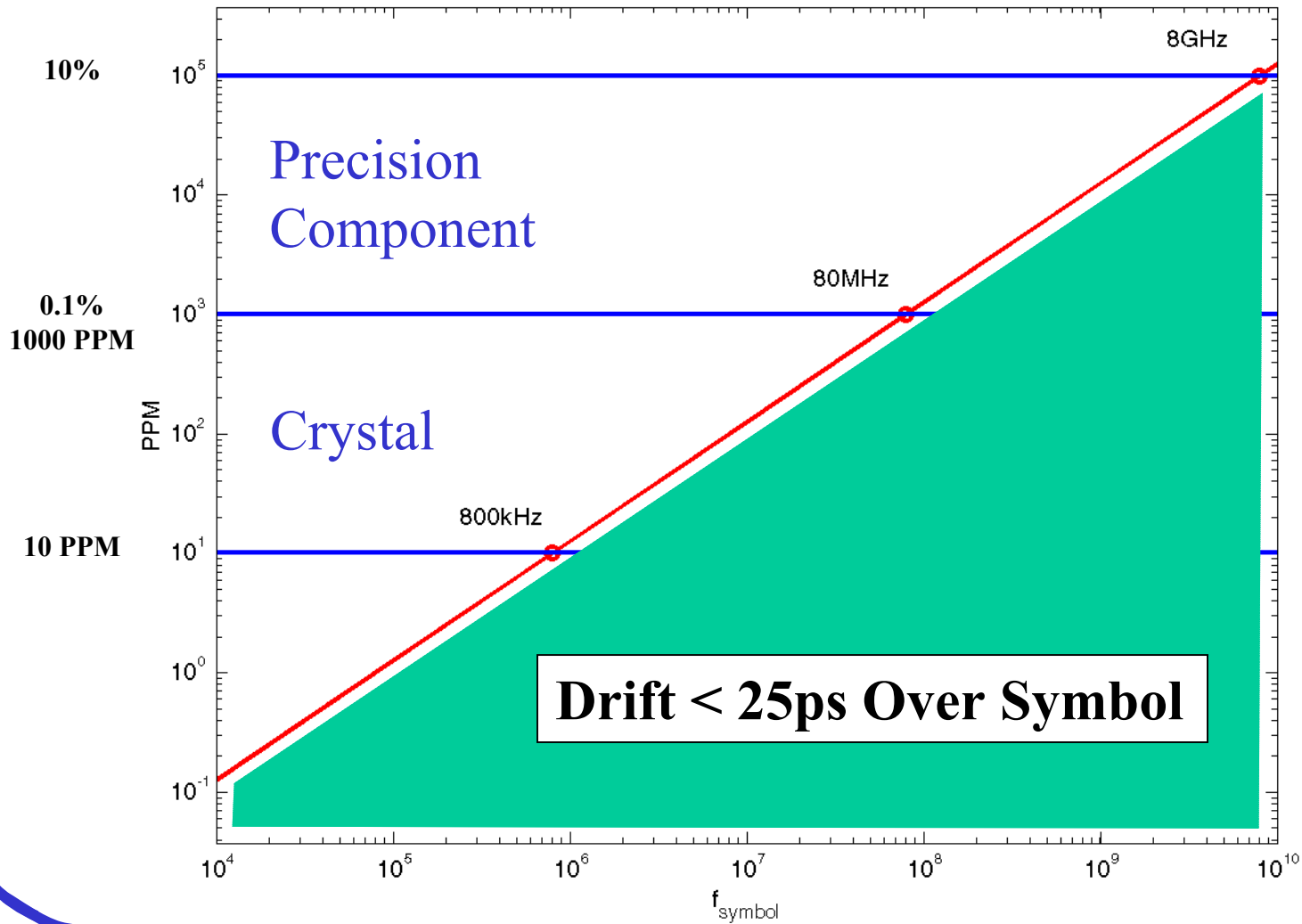
And What About Channel Estimation?

**Digital Complexity is Growing!**

# MF/Correlator Area vs. Acquisition



# Oscillator Accuracy (Matching)



# Oscillator Precision (Jitter)

