

Joint Channel and Mismatch Correction for OFDM Reception
with
Time-interleaved ADCs

All Digital Multi-Gigabit Baseband



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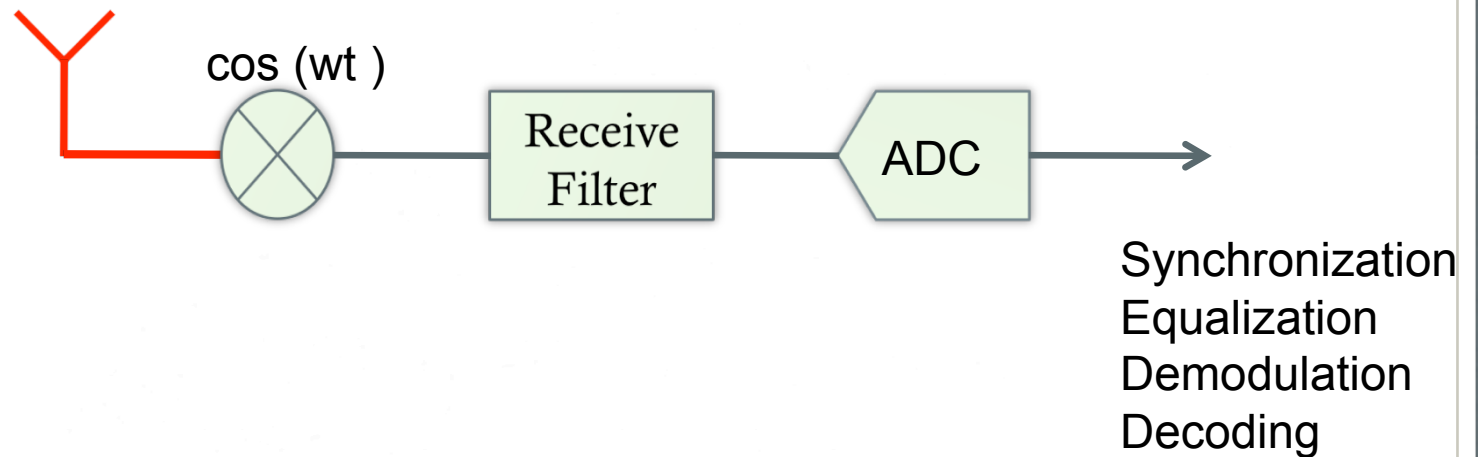
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National Science Foundation
WHERE DISCOVERIES BEGIN

All Digital Baseband

“Digital Baseband” Receiver



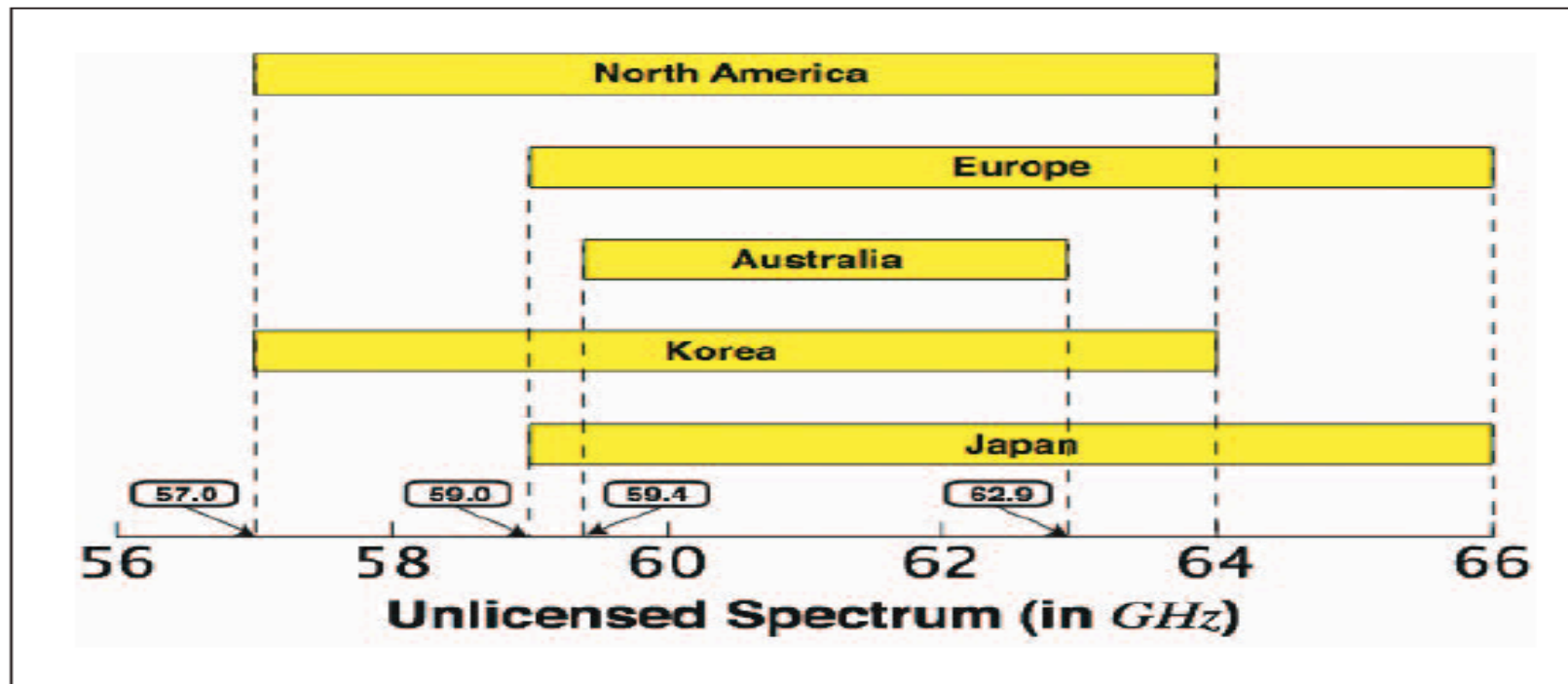
Signal Processing Issues

Analog-to-Digital Converter (ADC)

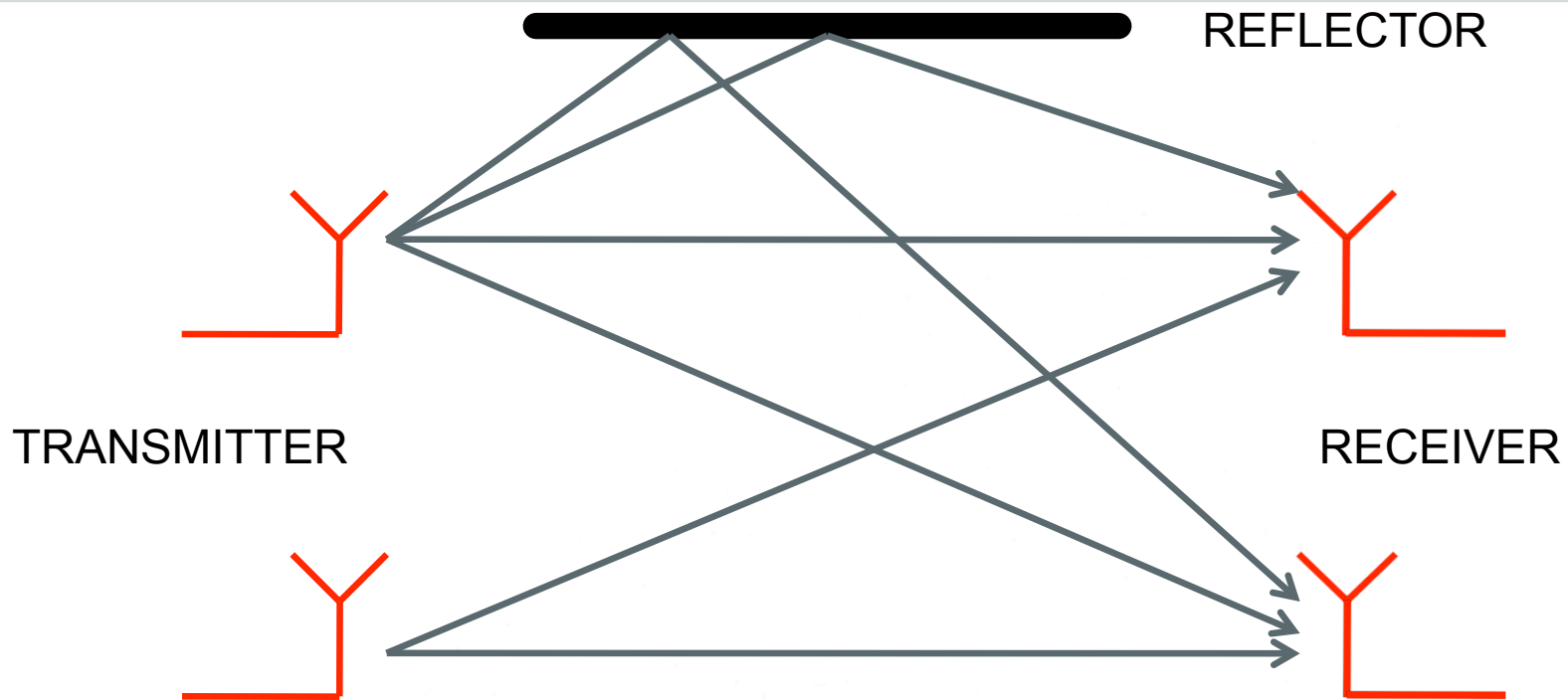


Sampling rate & Output resolution

Large bandwidth !



Need for Resolution



16 QAM

High precision
ADC
(like 10 bits)

ADCs available

Sigma-Delta

SAR

Pipelined

Flash

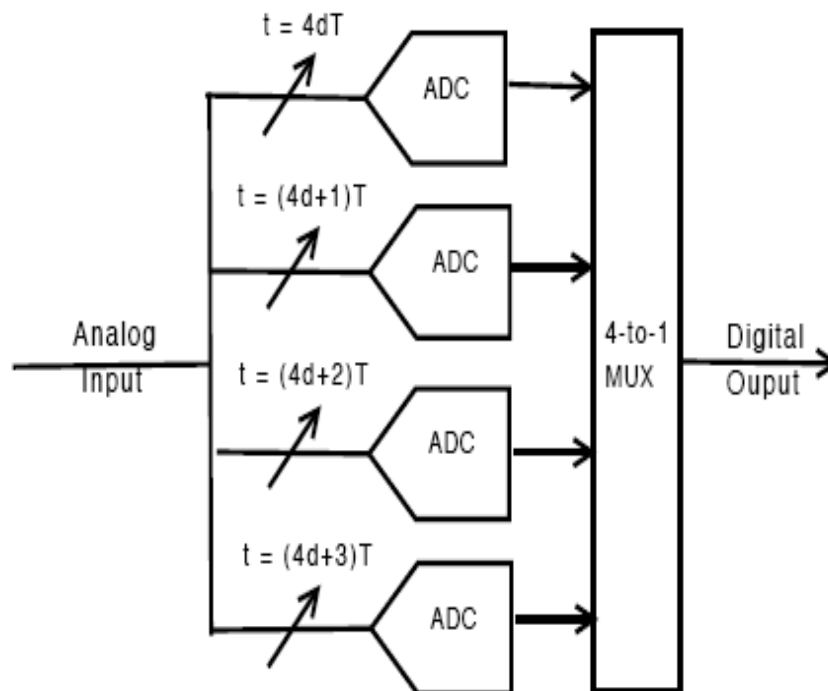


| | | | | |
|-------------------|----------------|-----------------|-----------------|--------------|
| Speed | 100 KHz | 10MHz | 100MHz | 1 GHz |
| Resolution | 24 bit | 18 bit | 15 bit | 8 bit |
| Power | 1-10mW | 10-100mW | 100mW-1W | 1-10W |

High speed, moderate resolution ADCs ?

Solution

Time-interleaving



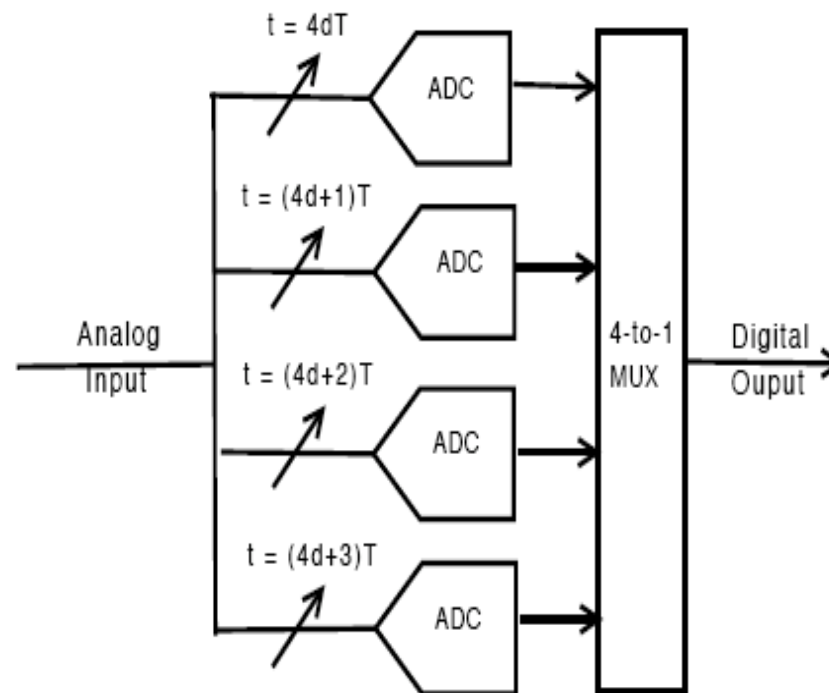
Example

4 GSa/s
4 (1GHz) Flash
40 (100MHz) SAR

Added advantage :
Low power

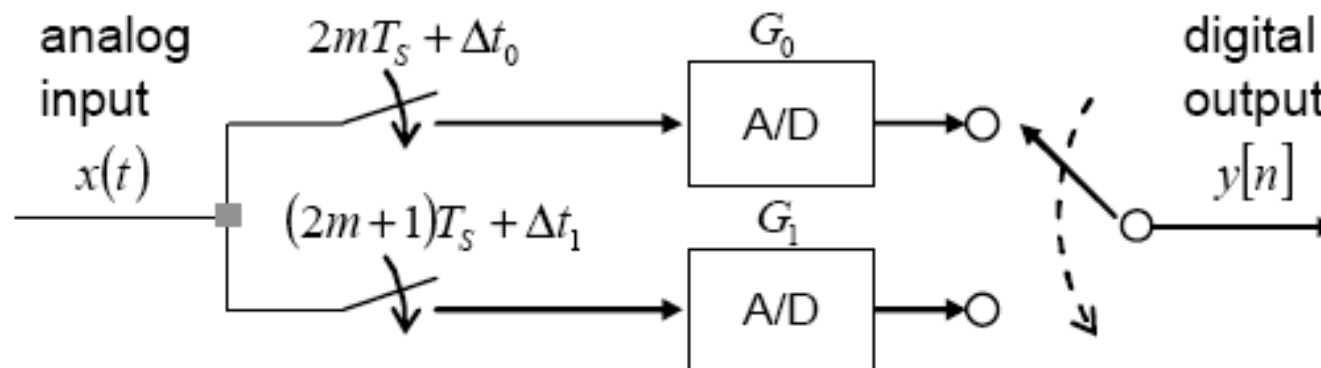
Issues ?

- Mismatch between parallel channels



Mismatch model

Gain and timing mismatch



TI ADCs for multi-Gigabit Communication

Conventional approach

Make a better ADC

Mismatch Estimation

(1) Training
(Extra hardware)

(2) Blind
(Input statistics)



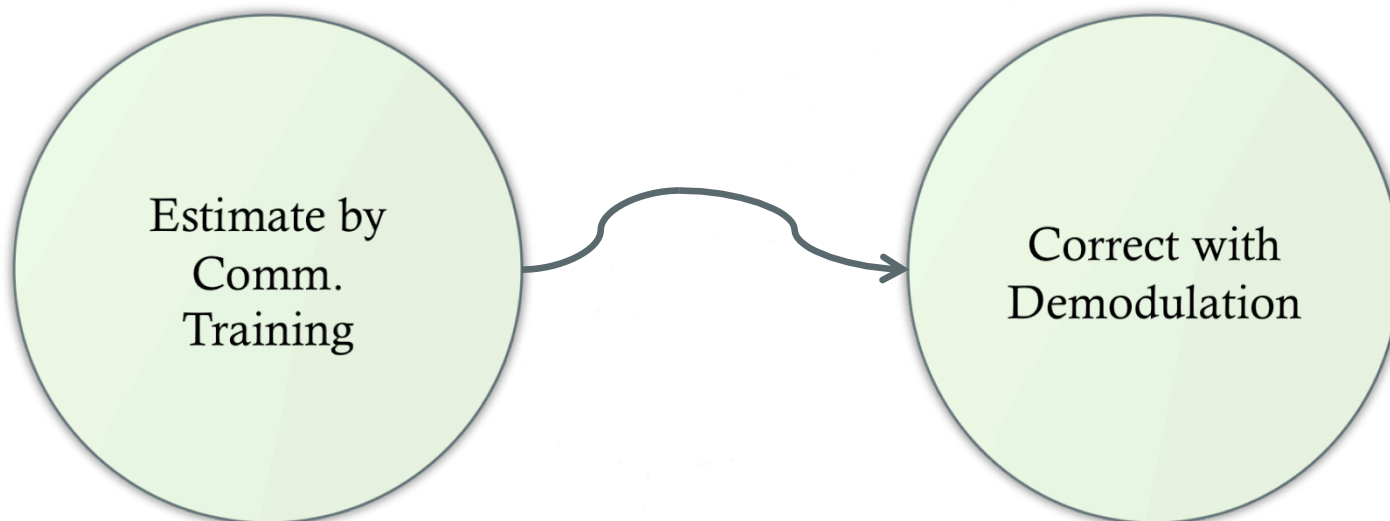
Mismatch Correction

(1) Analog
(not reliable)

(2) Digital
(reliable)

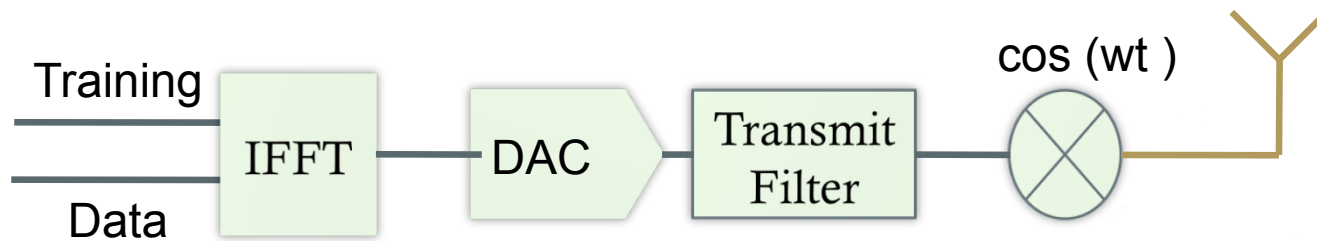
Our approach to mismatch

Adapt mismatch correction to Communication signal

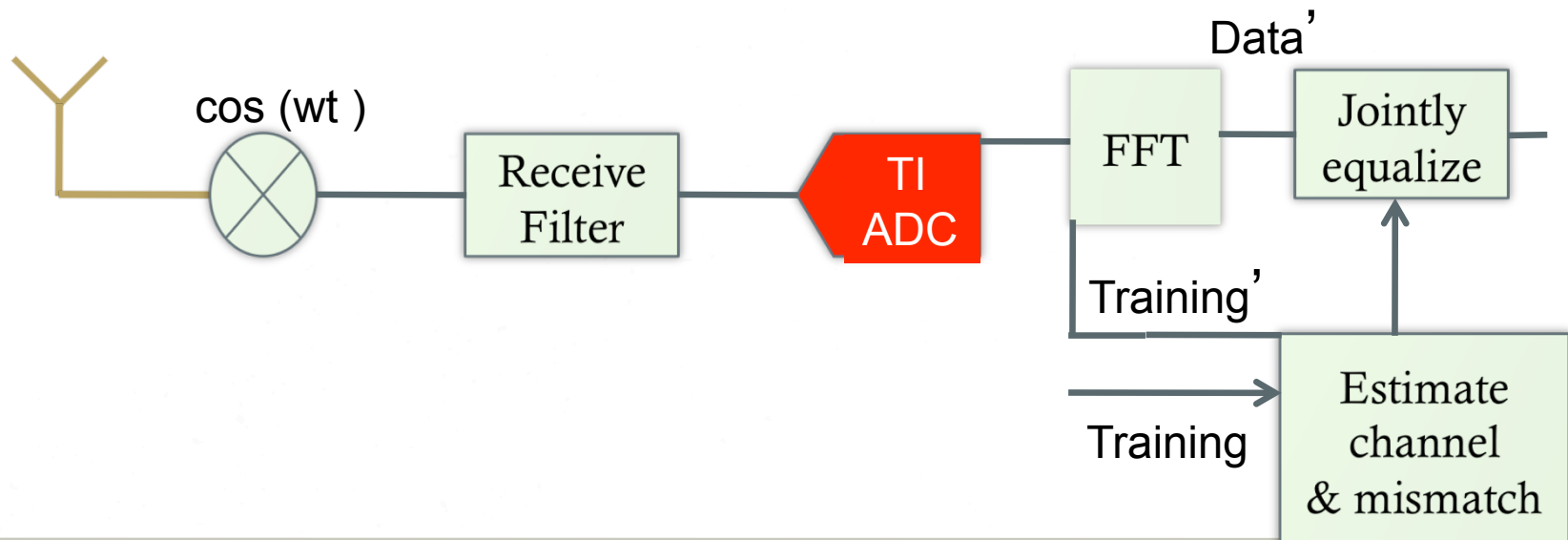


Example : TI-ADC in OFDM system

OFDM transceiver

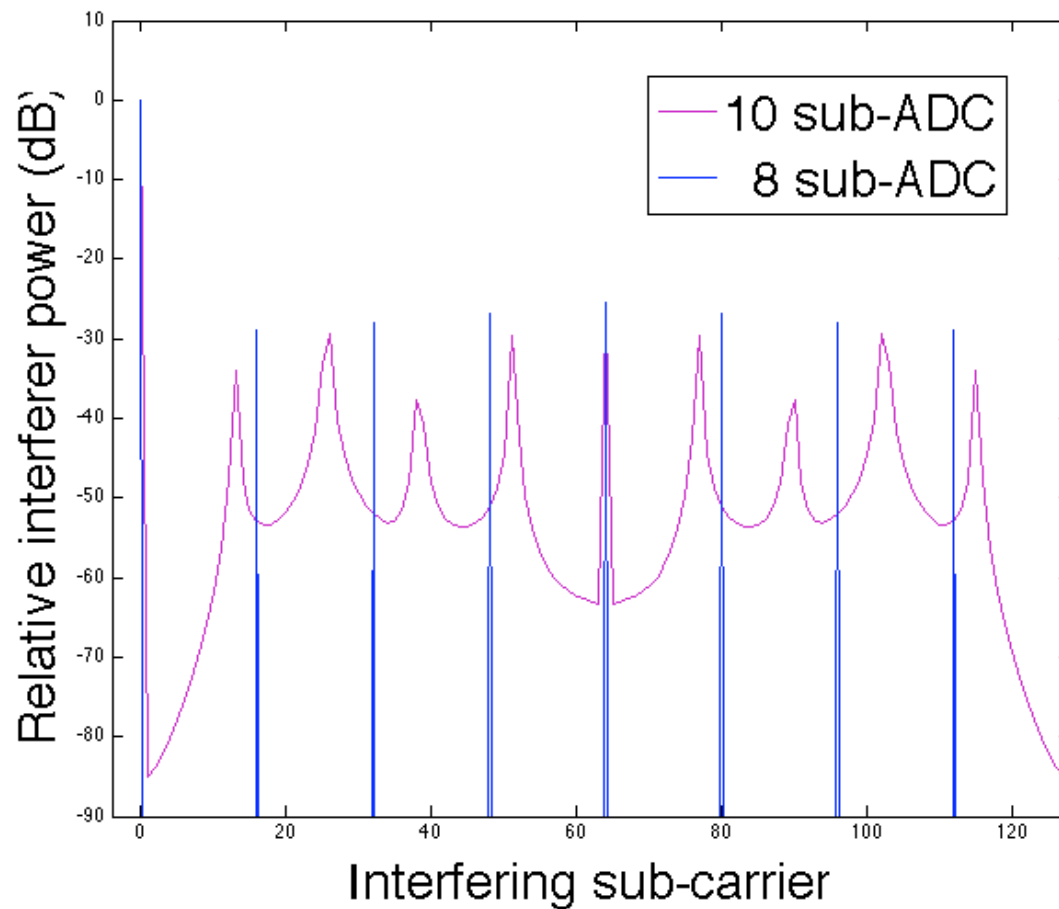


OFDM transceiver



**Structure of
mismatch induced interference**

Signal at sub-carrier '0'



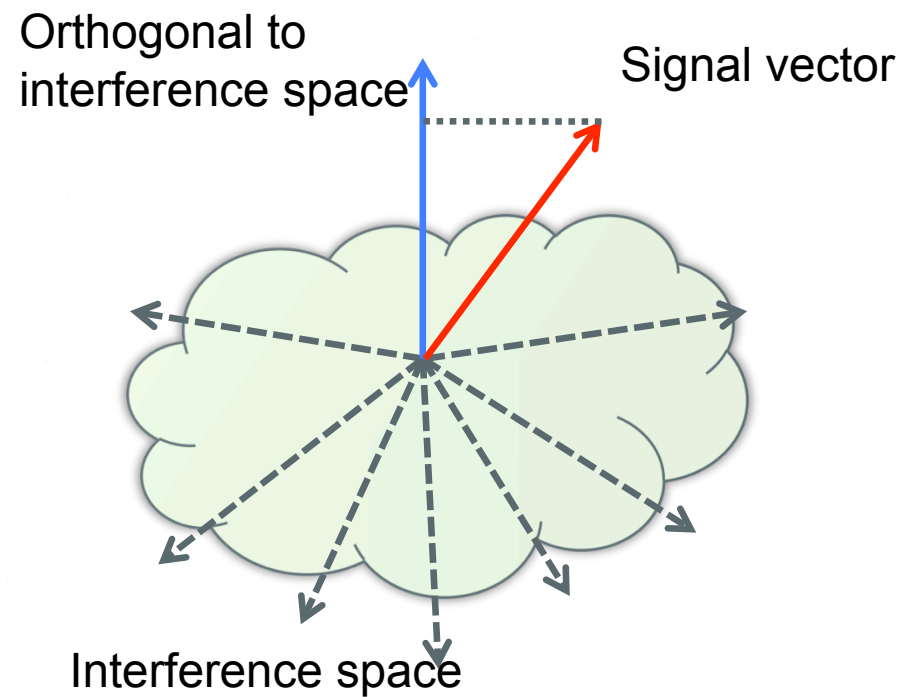
of ADCs
divides
of subcarriers

**Special
Structure**

Zero-forcing Equalization

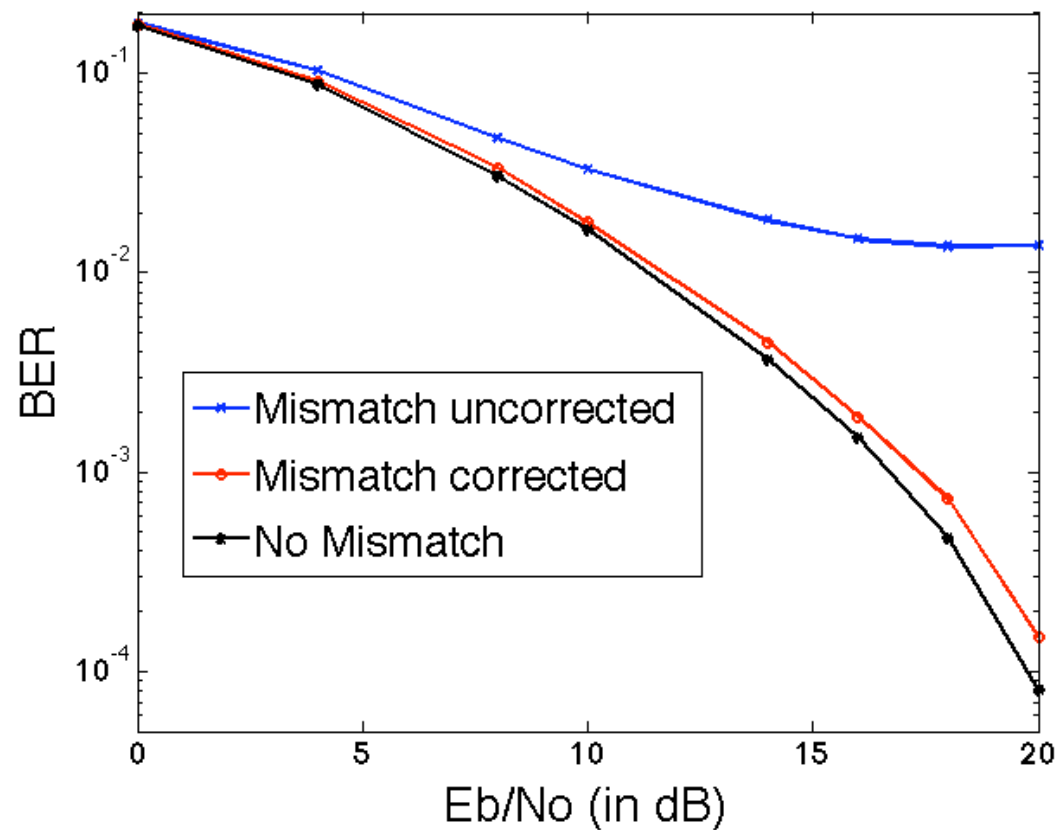
of ADCs = 8

of interferers = 8



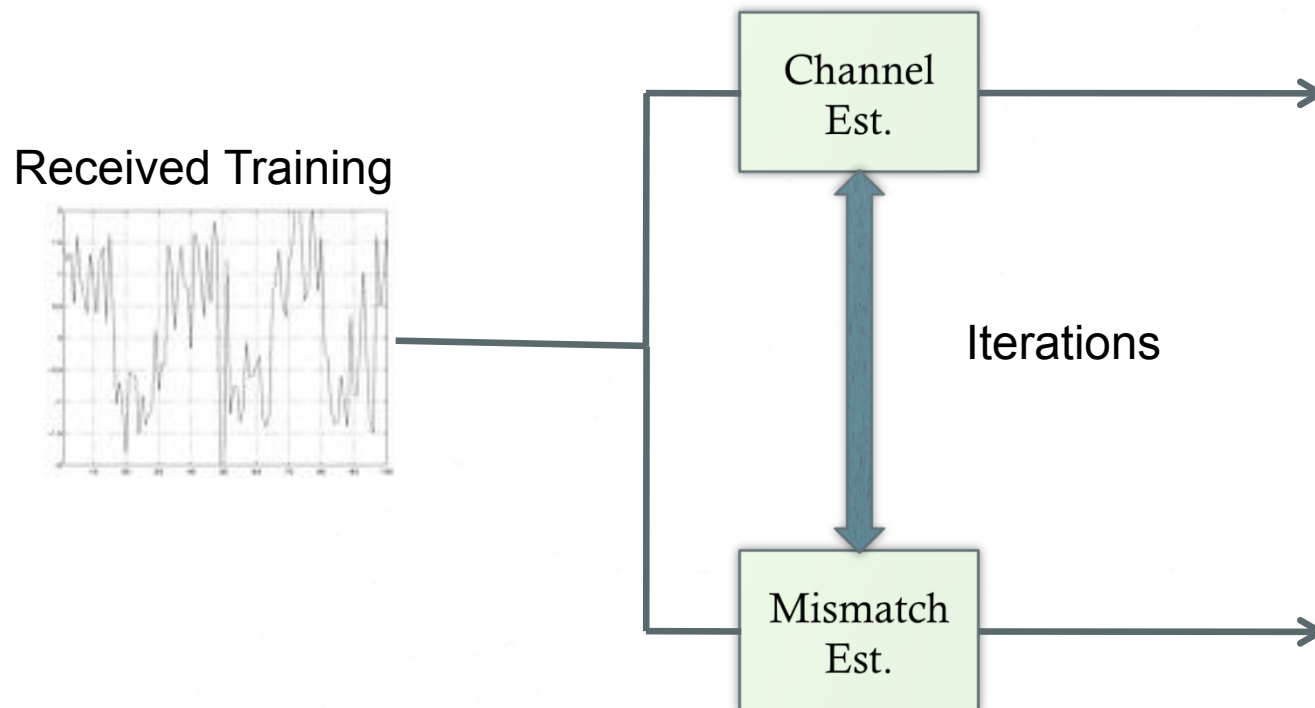
Equalization performance

- 16 QAM, OFDM
- 8 parallel-ADCs
- 10% mismatch
(~20ps, 5GSa/s)

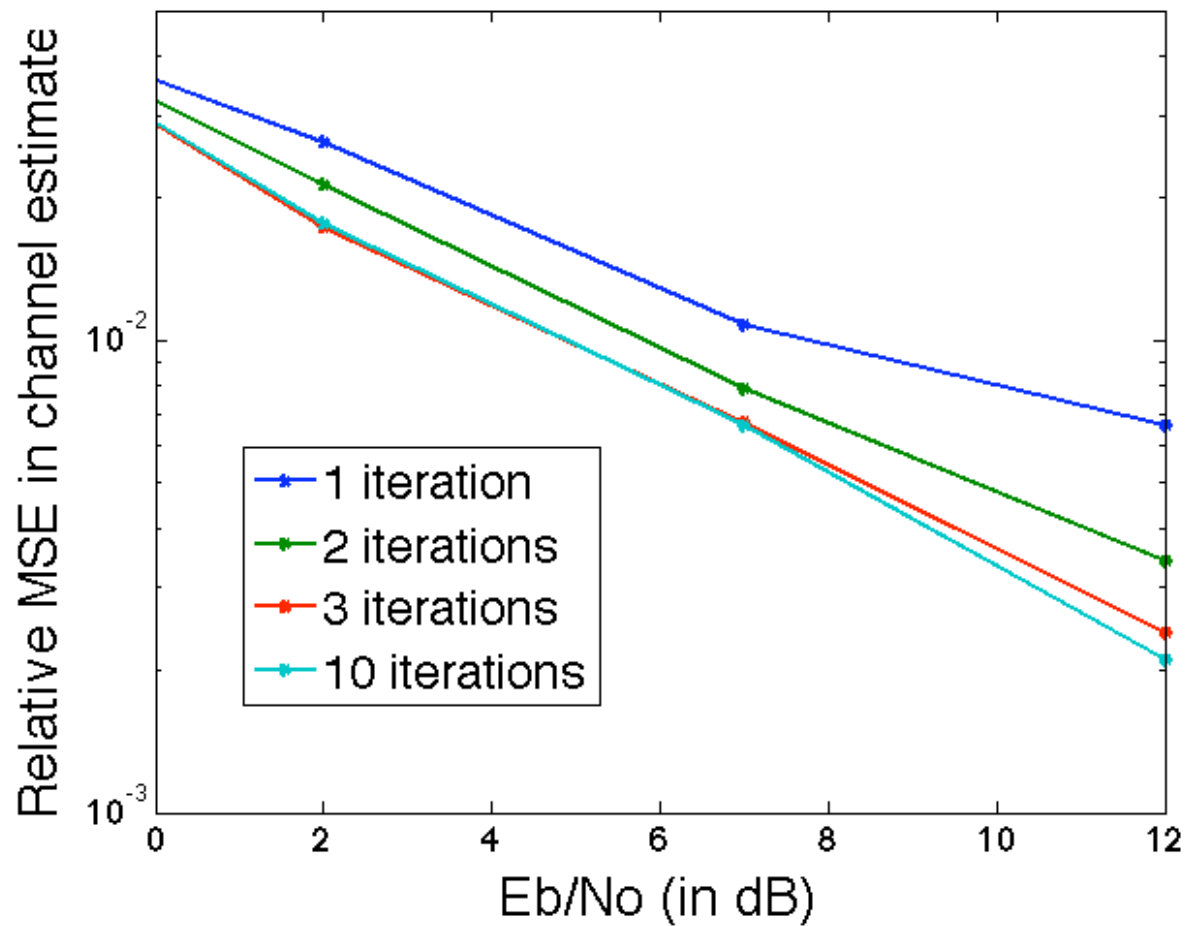


Estimation of mismatch

Joint channel-mismatch estimation

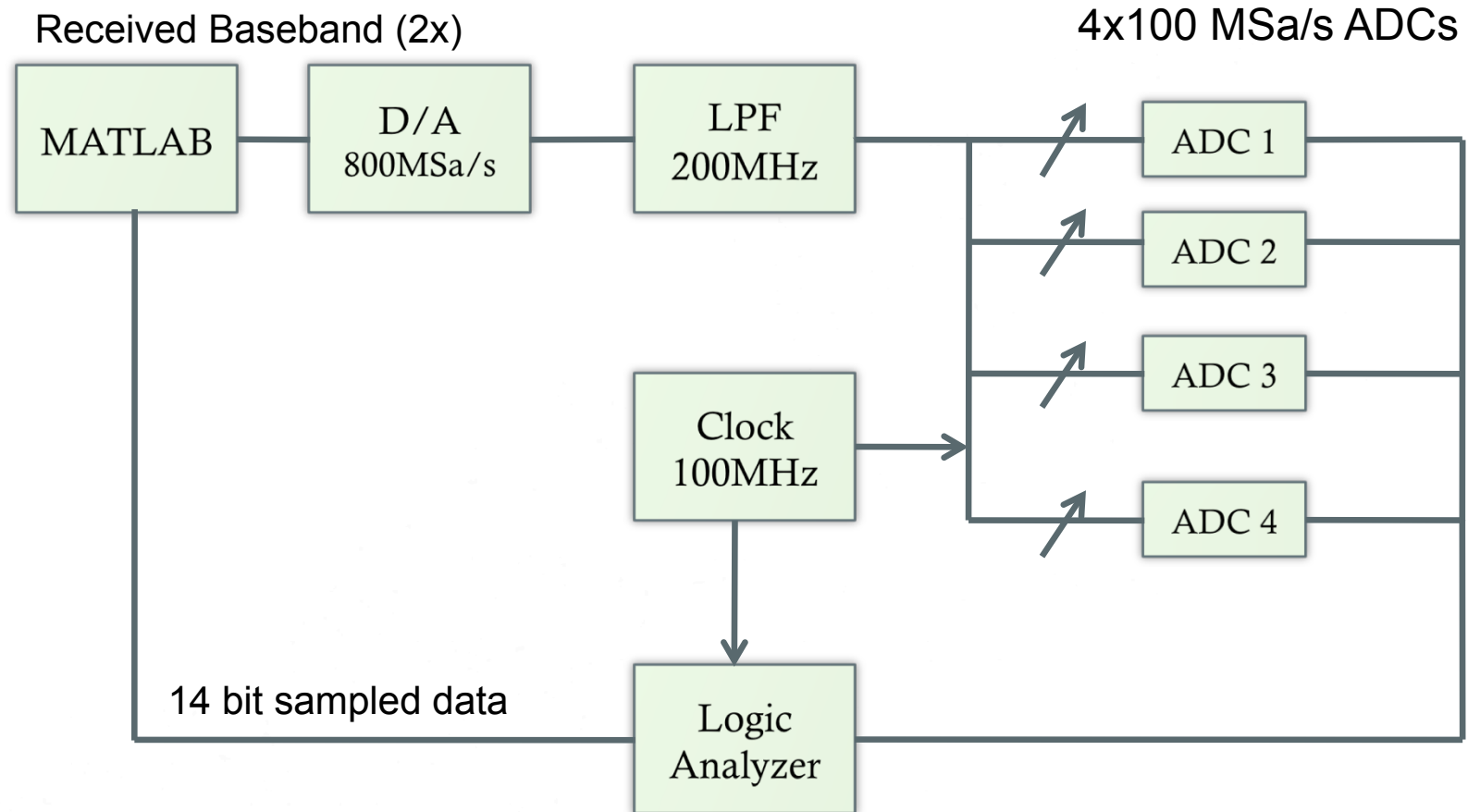


Accuracy in estimates



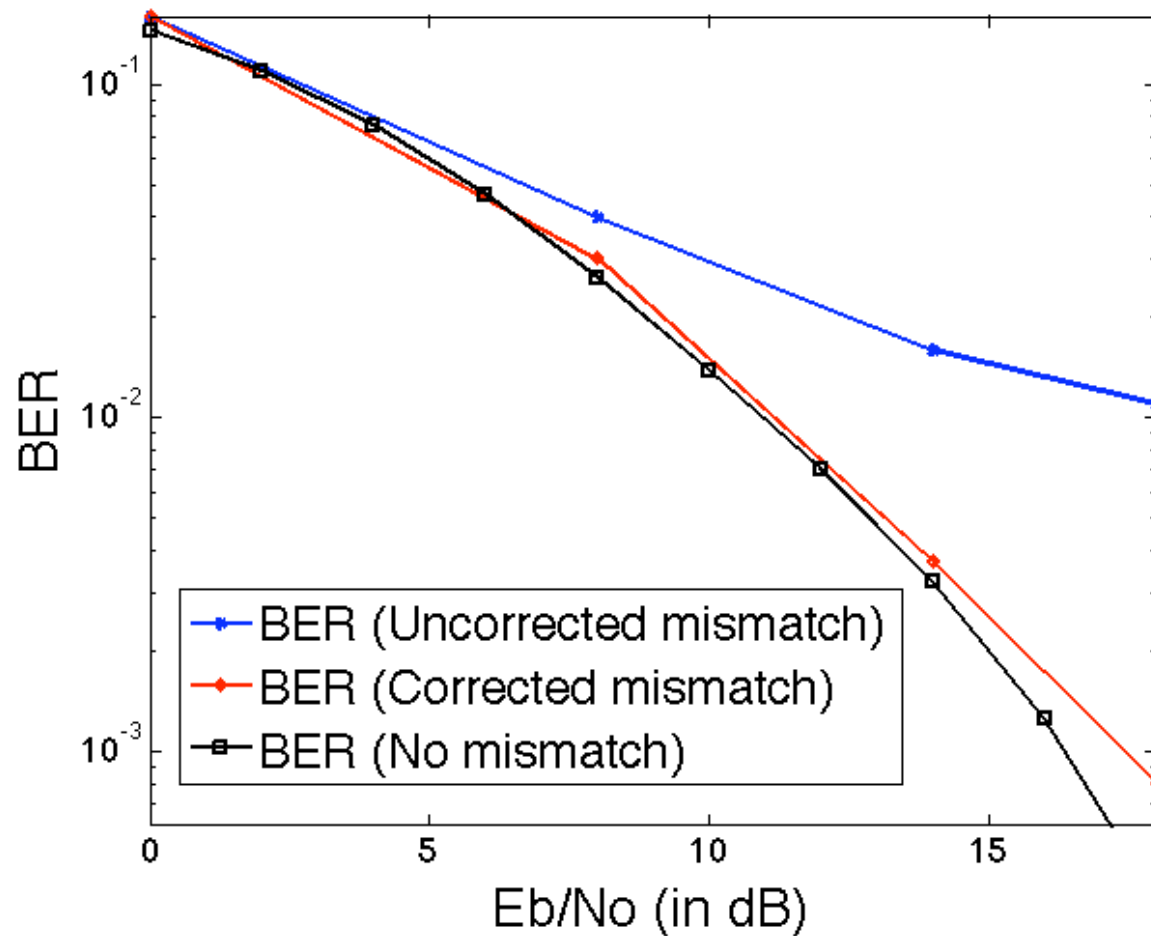
Hardware Experiment

Setup¹



¹ On TI ADC testbed of Dr. Munkyo Seo, Prof Rodwell's Lab

Results

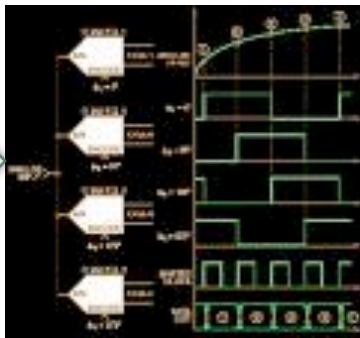


Conclusions

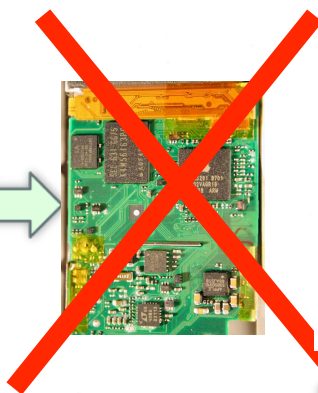
Gigabit Wireless



Time-interleaved ADC



Mismatch compensation



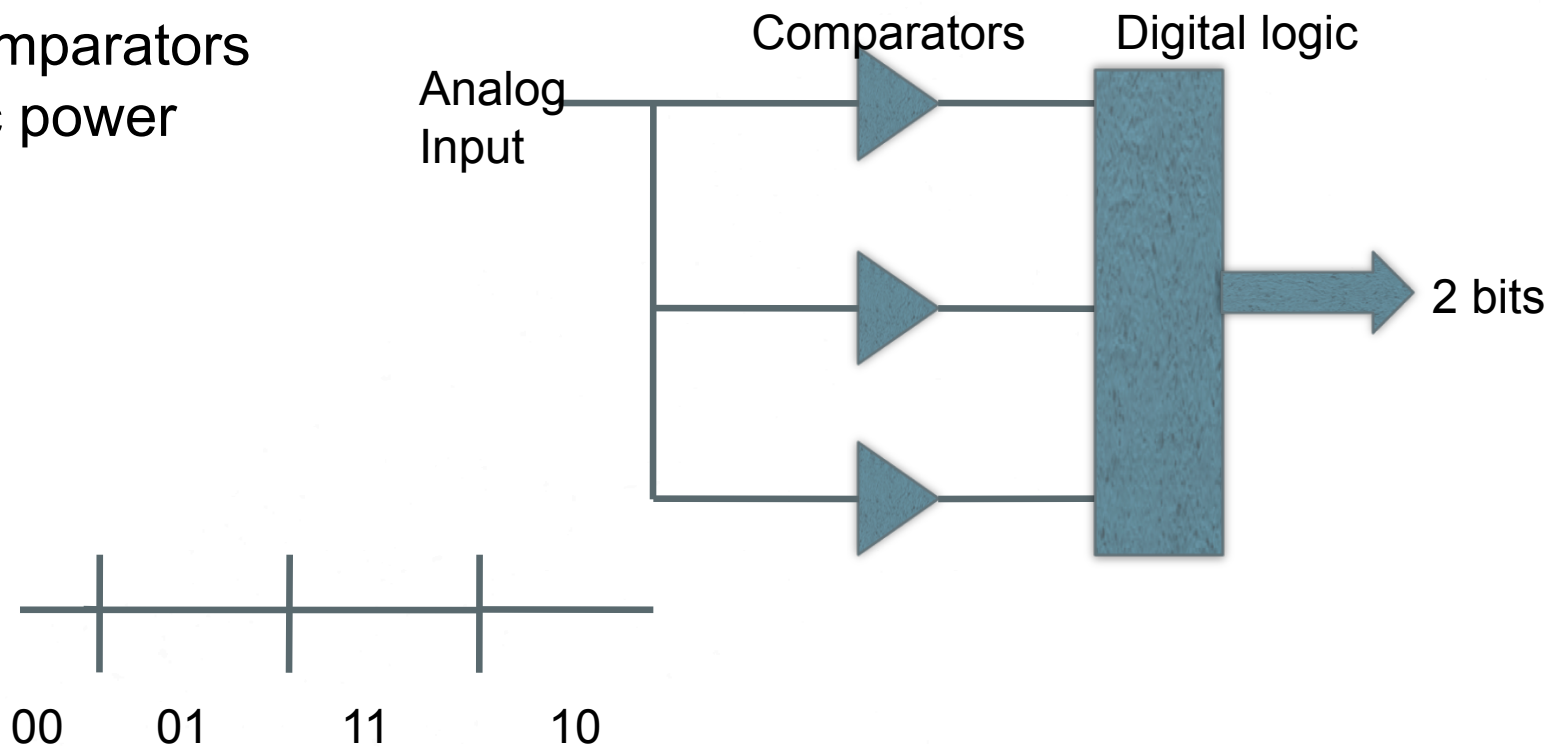
Joint demodulation
& mismatch correction



THANKS

Flash ADC

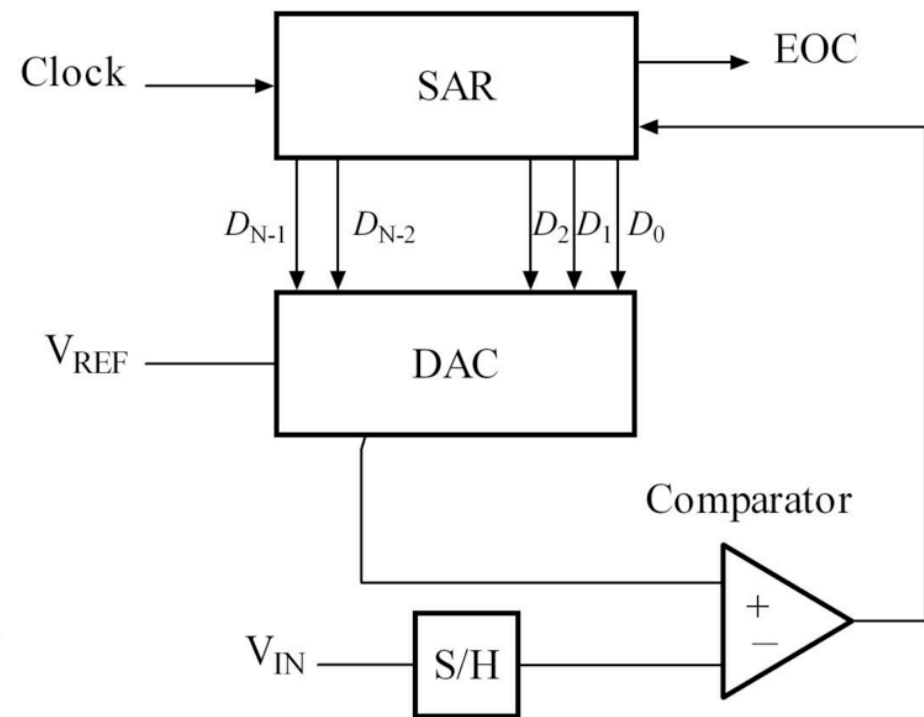
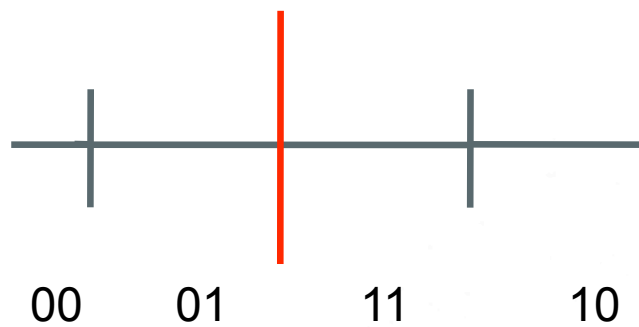
Flash ADC
 2^N comparators
Static power



SAR ADC

Successive Approximation

Register



MIMO Receiver

