Analog to Digital Converters for Wireless LAN 802.11a

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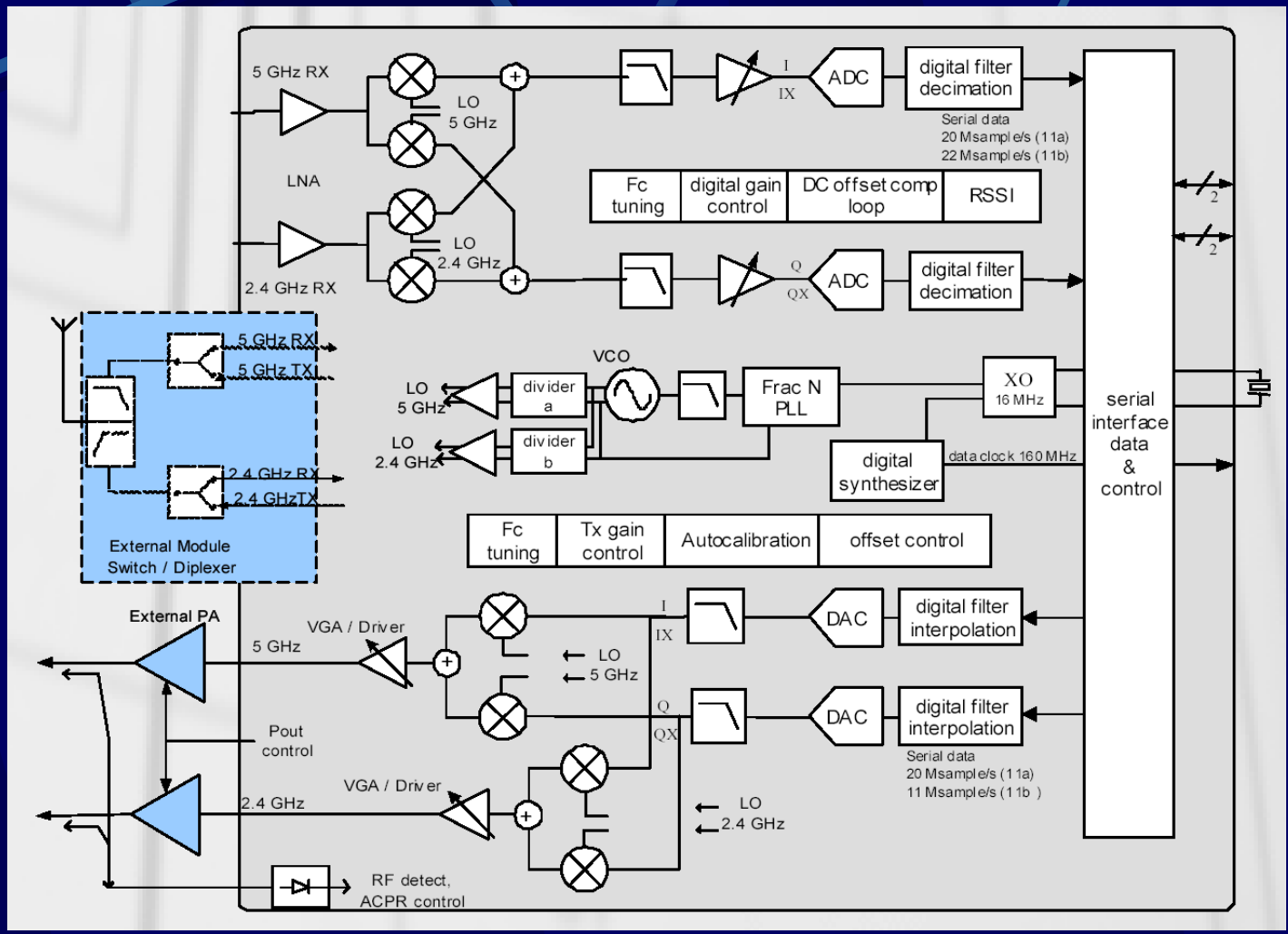
Outline

- Introduction
- IEEE 802.11a ADC Requirements
- Interpolation/Averaging ADC
- Pipelined ADC
- Recent Research
- Future Directions
- Conclusions

Introduction

- IEEE 802.11a
  - IEEE standard for Wireless LAN (WLAN)
  - Operates in the 5Ghz frequency band
  - Channel bandwidth of 20Mhz
  - OFDM data modulation
  - Variable data rate from 6-54Mbps

Typical 802.11a Transceiver



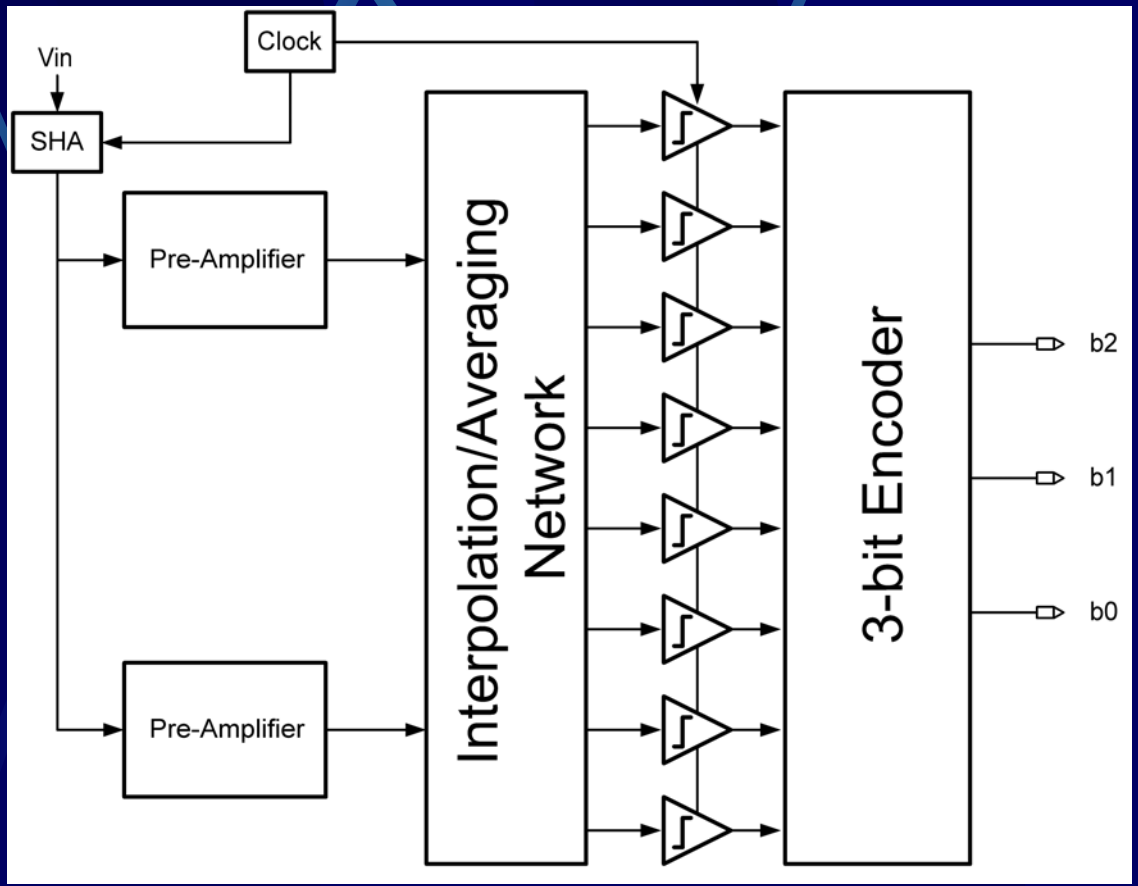
Note:
Newlogic Inc.
WiLD 802.11a radio

ADC Requirements for IEEE 802.11a

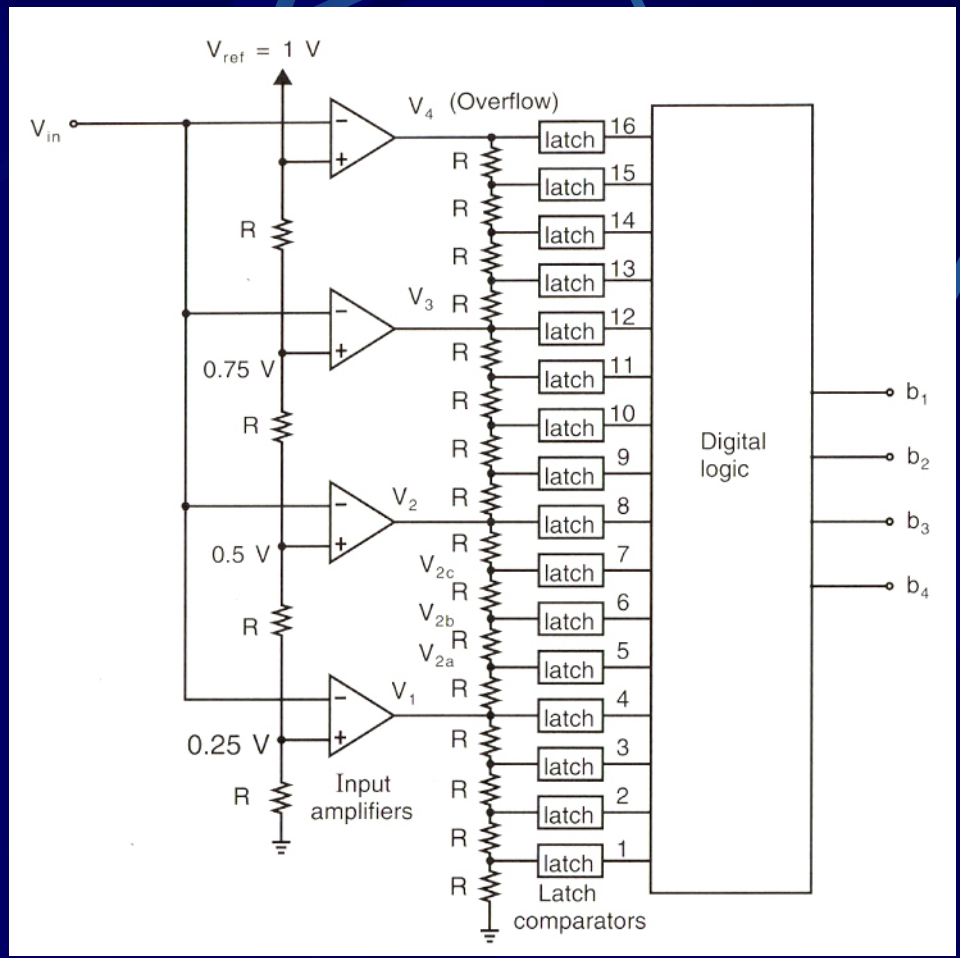
- 8 - 10 bits of resolution
- Low in power consumption
- Input bandwidth of at least 20Mhz
- Low in data latency

Interpolation ADC

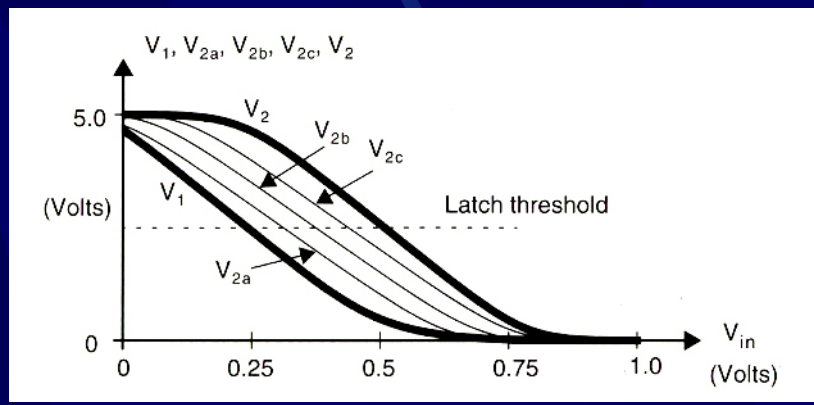
- Fast in conversion rate
- Reduce effect of comparator offset
- Lower input capacitance
- Low in data latency
- Lower power consumption
- Averaging improves accuracy



Interpolation ADC

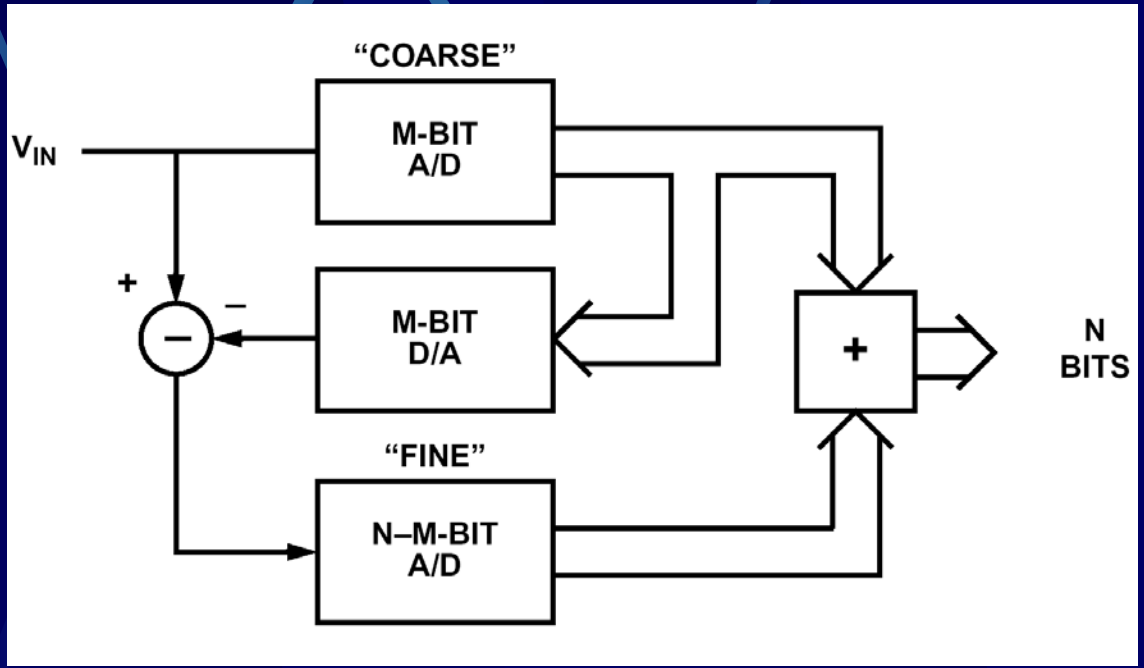


- 4 bit ADC
- 4X interpolation



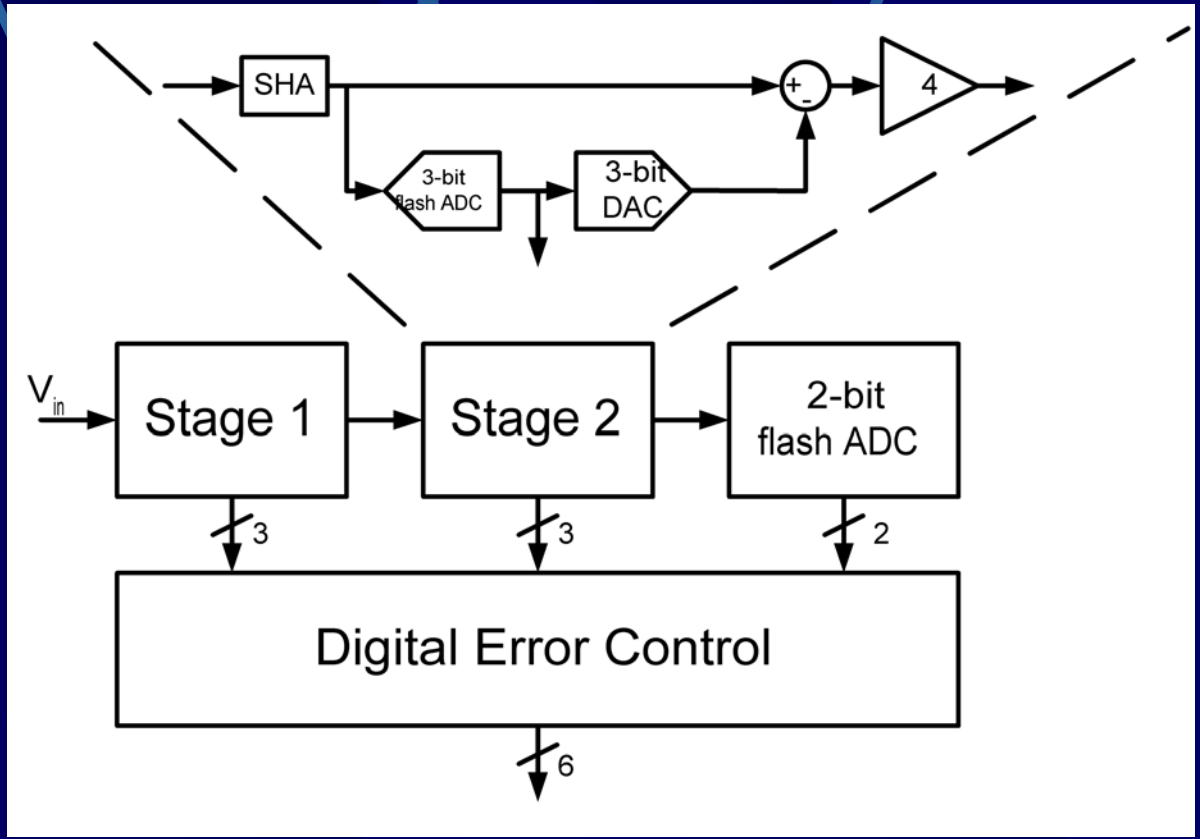
Pipelined ADC

- Less comparators needed
- Lower power consumption
- Has latency problem
- Fast in conversion rate



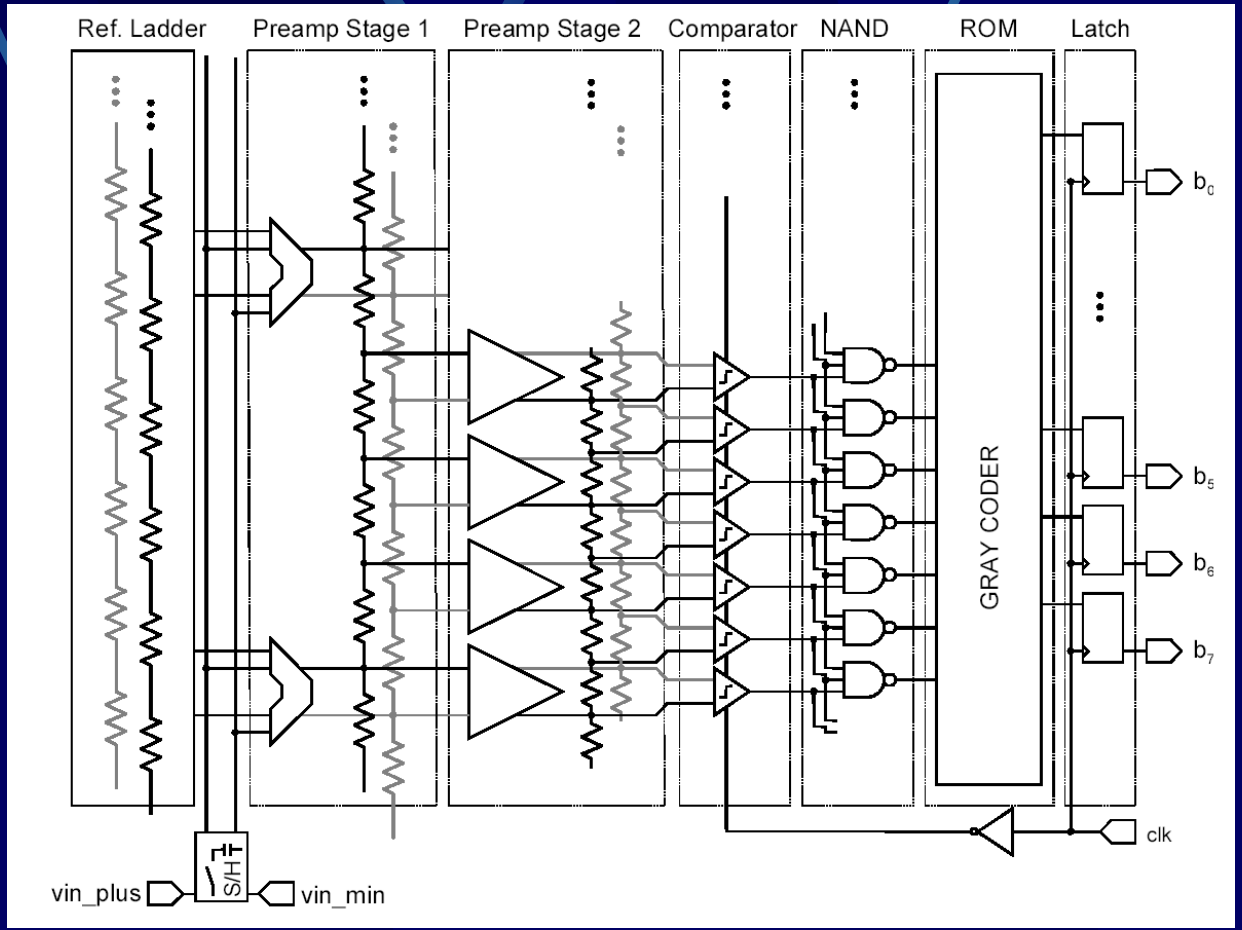
Pipelined ADC

- One extra bit per stage
- Has digital error control
- Use redundancy to correct offset error



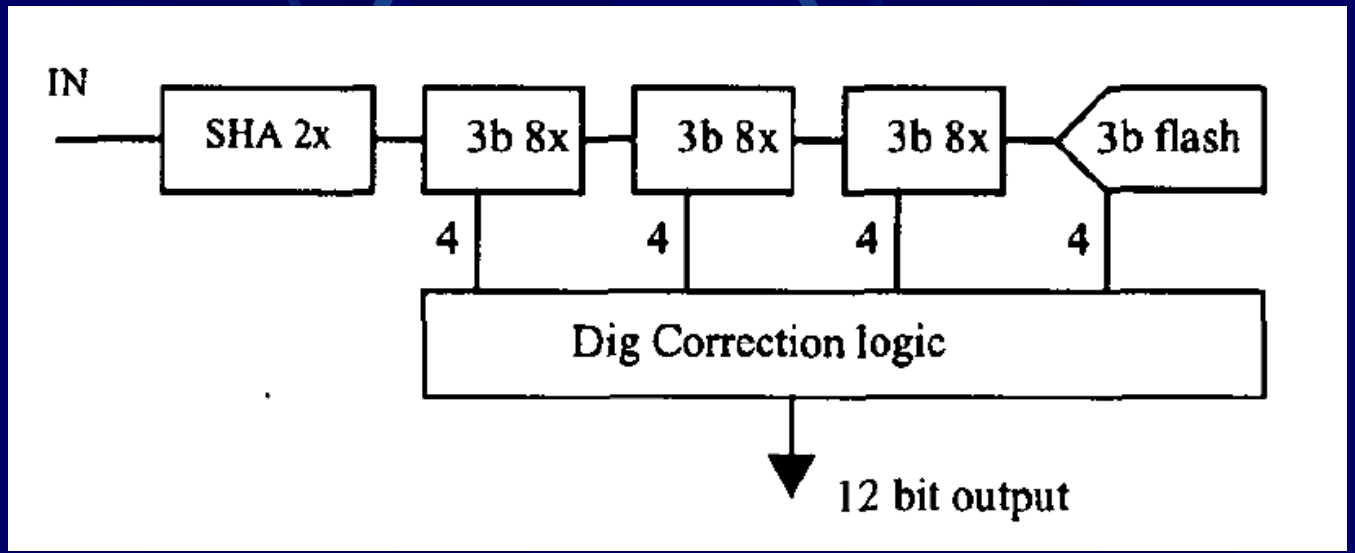
Recent Research

- Interpolation ADC
- J. Vandenbussche, 2002
- 8 bit resolution
- Input bandwidth of 30Mhz
- 0.35um technology
- 300mW power consumption



Recent Research

- Pipelined ADC
- S. Mathur, 2002
- 12 bit resolution
- Input bandwidth of 10Mhz
- Used only 4 stages to reduced latency
- 115mW power consumption
- 0.18um technology



System Architecture and ADC

- IEEE 802.11a has 20Mhz channel
- I and Q data each has 10Mhz
- Separation of I and Q data can be done in analog or digital domain
- Digital domain separation
  - Homodyne receiver
  - Interpolation ADC
- Analog domain separation
  - Super-heterodyne receiver
  - Pipelined ADC

Future Direction

- C. Aust designed variable resolution ADC based on the RSD cyclic algorithm
- 1 bit per clock cycle
- Too slow for IEEE 802.11a standard
- Apply this idea on pipelined ADC
- Dynamically change the number of pipeline stages to save power

Conclusions

- IEEE 802.11a is future standard for WLAN
- Required low power ADC
- High input bandwidth, 20Mhz
- Interpolation ADC
  - Moderate power consumption
  - Fast conversion rate
  - System with digital I/Q data separation
- Pipelined ADC
  - Lower power consumption
  - Moderate conversion rate
  - System with analog I/Q data separation