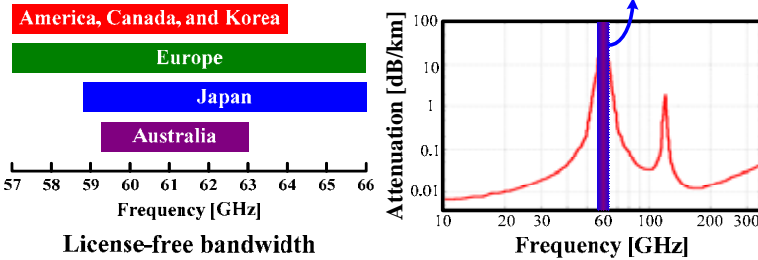


High-Speed Analog-to-Digital Converters for mmWave Transceivers

Matsuzawa and Okada Laboratory
Tokyo Institute of Technology, Japan

mmWave

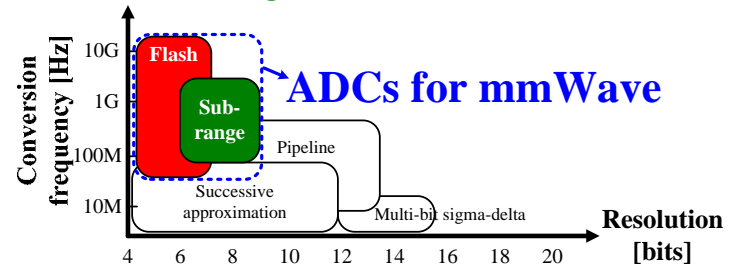
1. Low interference
 - Resonance with oxygen molecules at 60 GHz
2. License-free bandwidth of 7 GHz
3. Prepare future demand for Gbps wireless transmission



Research

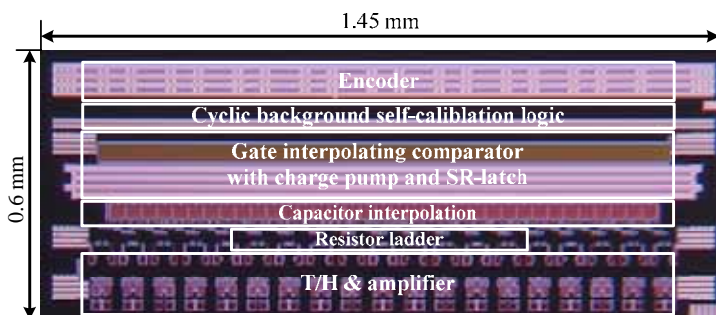
Developing ADCs for Gbps wireless data transmission

1. Fixed Wireless Access (38 GHz)
 - Transmitting a huge amount of data in rural area
 - ✓ 8-bit flash
2. Wireless Personal Area Network (60 GHz)
 - Intended range of 10 meters or less
 - ✓ 6-bit subrange, 5-bit flash



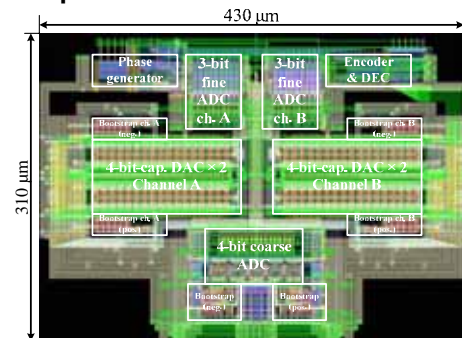
A Fabricated 8-bit Flash ADC

- Amplifier
 - ✓ Increase input-referred accuracy of comparators
- Capacitor
 - ✓ 1-bit interpolation
 - ✓ Remove offsets of the amplifiers
- Comparator
 - ✓ 3-bit interpolation
 - ✓ Calibrating circuit is implemented
 - Charge pump

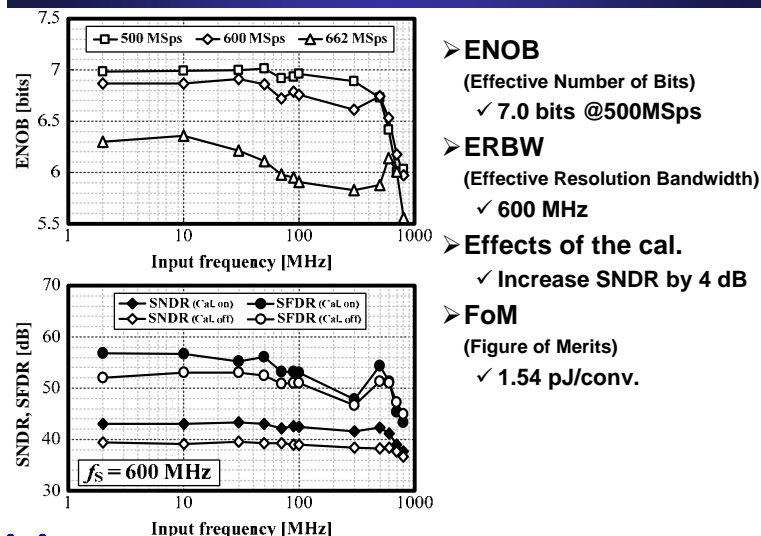


A Fabricated 6-bit Subranging ADC

- Merit of Subrange
 - ✓ Need a smaller number of comparator than the flash
- Capacitor DAC
 - ✓ Sampling for fine ADC + Subtraction
 - ✓ Linear-array DAC is used to increase speed
- Comparator
 - ✓ 2-bit interpolation
 - ✓ Calibrating circuit is implemented
 - Load capacitance

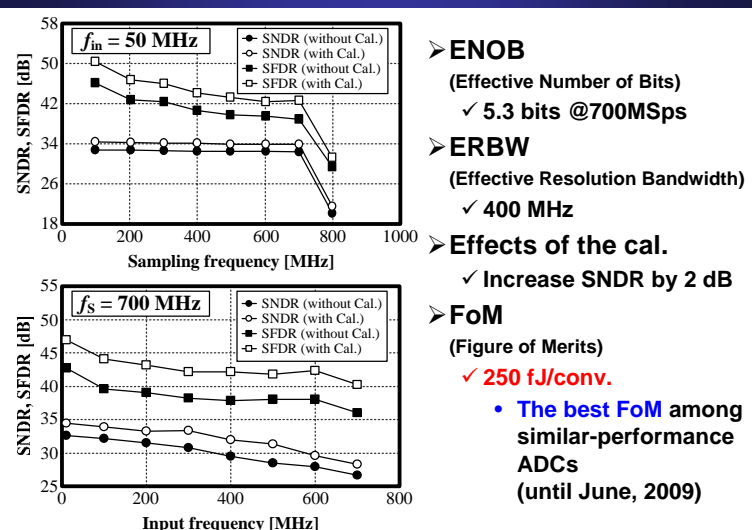


Measurement Results of the 8-bit ADC



- ENOB (Effective Number of Bits)
 - ✓ 7.0 bits @500MSps
- ERBW (Effective Resolution Bandwidth)
 - ✓ 600 MHz
- Effects of the cal.
 - ✓ Increase SNDR by 4 dB
- FoM (Figure of Merits)
 - ✓ 1.54 pJ/conv.

Measurement Results of the 6-bit ADC



- ENOB (Effective Number of Bits)
 - ✓ 5.3 bits @700MSps
- ERBW (Effective Resolution Bandwidth)
 - ✓ 400 MHz
- Effects of the cal.
 - ✓ Increase SNDR by 2 dB
- FoM (Figure of Merits)
 - ✓ 250 fJ/conv.
 - The best FoM among similar-performance ADCs (until June, 2009)