

Introduction

- ❖ Topic
 - 60GHz Down-conversion Mixers using CMOS Schottky-barrier Diodes

- ❖ Team member
 - Team member: M. Ko

- ❖ Sponsor
 - None.

Introduction

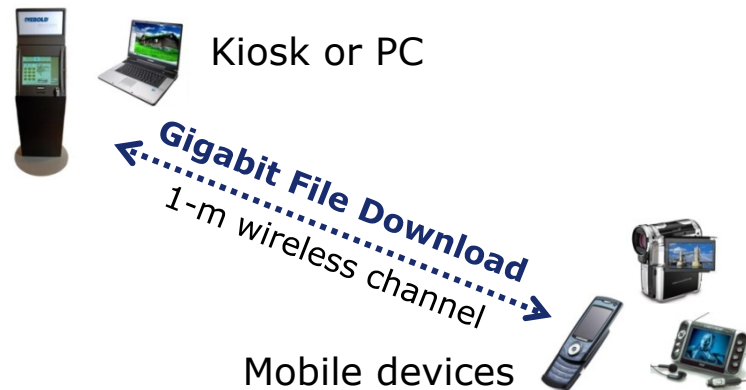
Motivation Low-cost, low-complexity, and low-power RF systems for 60-GHz Wireless Personal Area Networks (WPANs)

<Communication in 60 GHz>

- Unlicensed 7-GHz band
 - Wide bandwidth for gigabit transmission
- Short wavelength
 - High-gain and small-size antenna
- High material and O₂ absorption
 - Line-of-sight and short-range applications

IEEE 802.15.3c standard for 60-GHz WPANs

<Application for 802.15.3c Systems>



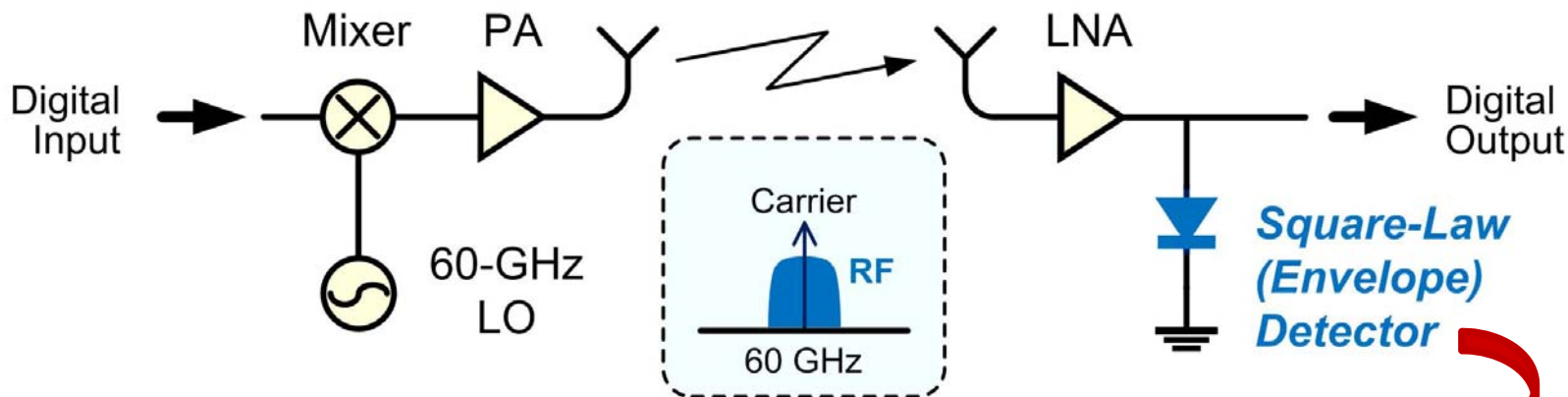
Development of 802.15.3c mobile devices

- Compact and cheap
- Low power consumption
- Fast time to market



60-GHz Systems Utilizing Diodes

<CMOS-Compatible 60-GHz ASK Systems>



CMOS-Compatible Schottky-Barrier Diode (SBD)

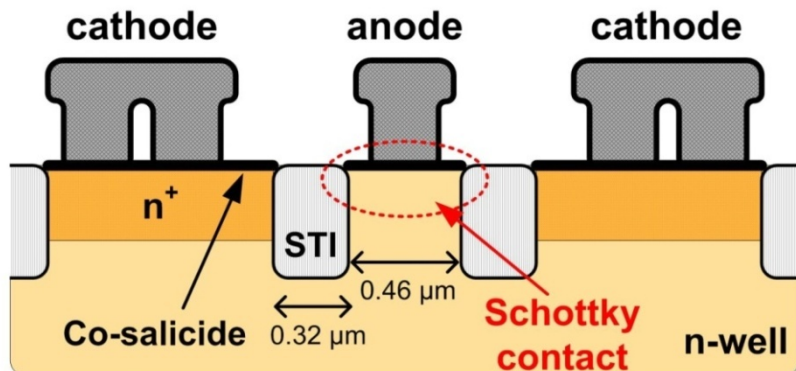
❖ Advantages

- No Rx local oscillators
- Phase noise tolerance
- Less PA linearity requirement
- Less ADC overhead

❖ Disadvantages

- Poor spectral efficiency
- Bad SNR performance

CMOS Schottky-Barrier Diodes

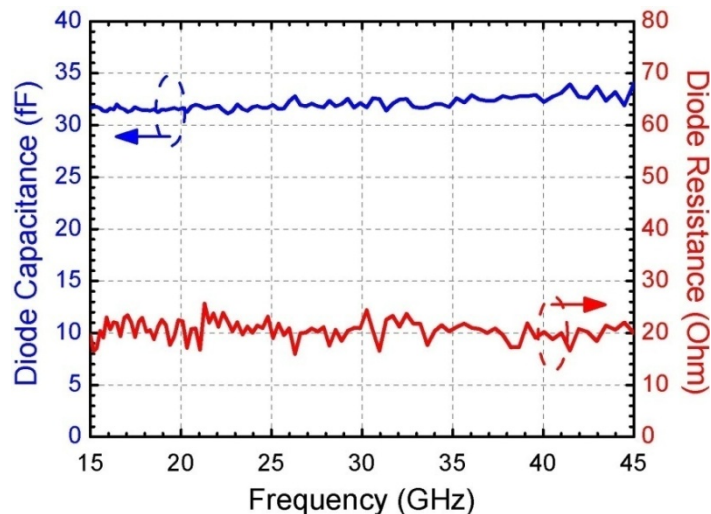
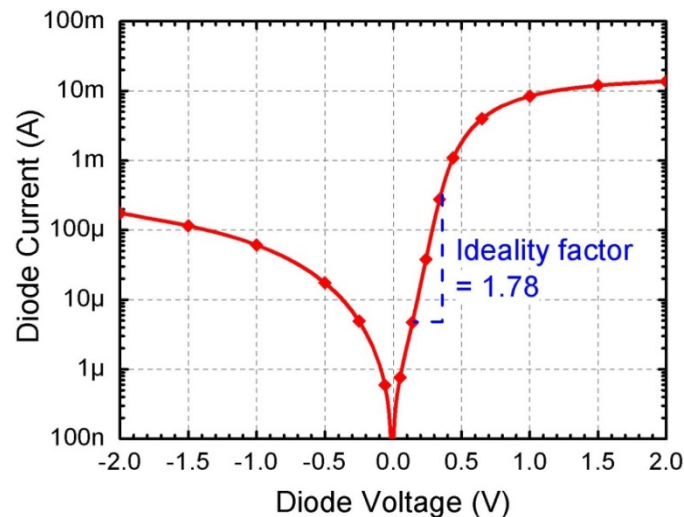


- Cross-sectional View of a SBD Cell -

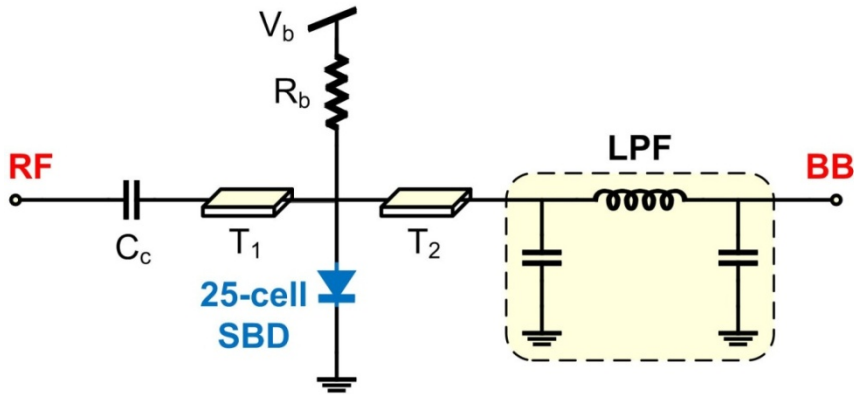
Ref.: S. Sankaran et al., IEEE EDL, Vol. 26, No. 7, pp. 492-494

In the 0.18- μm CMOS technology,

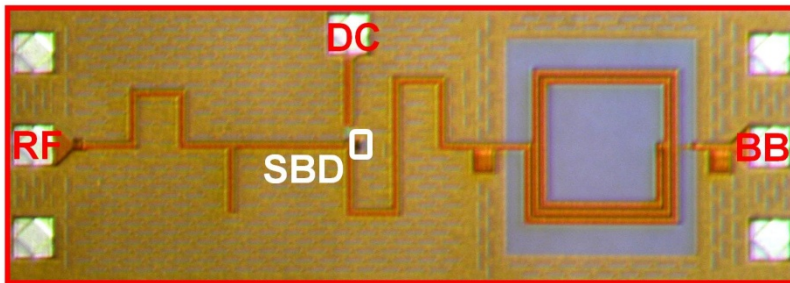
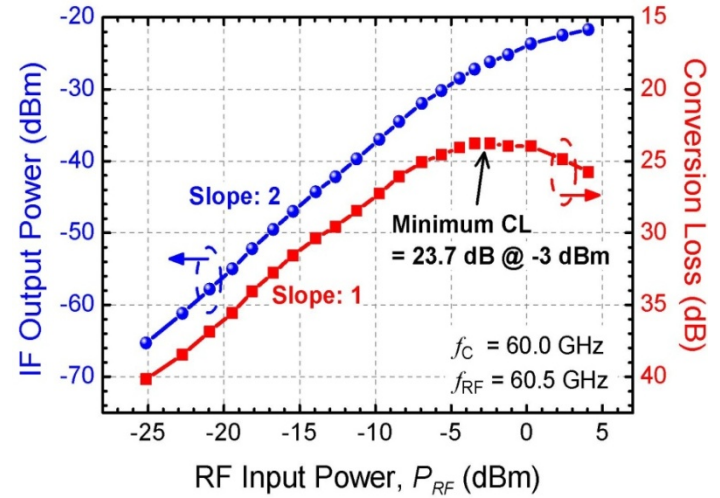
- Diode capacitance: 32 fF
- Diode resistance: 20 Ω
- ➔ **Cut-off frequency: 250 GHz**



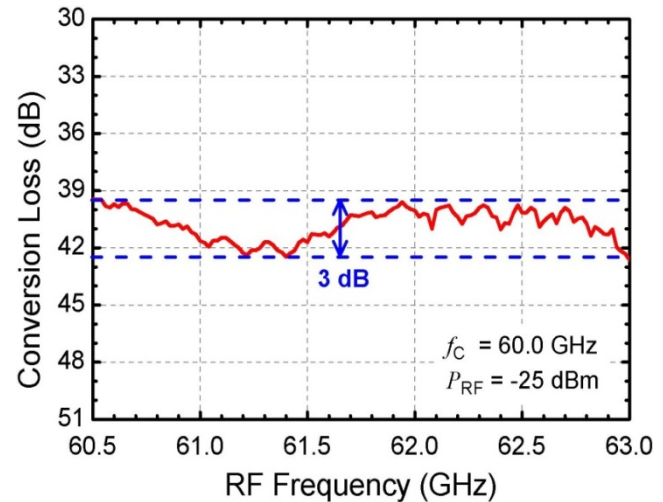
60-GHz Square-Law Mixers



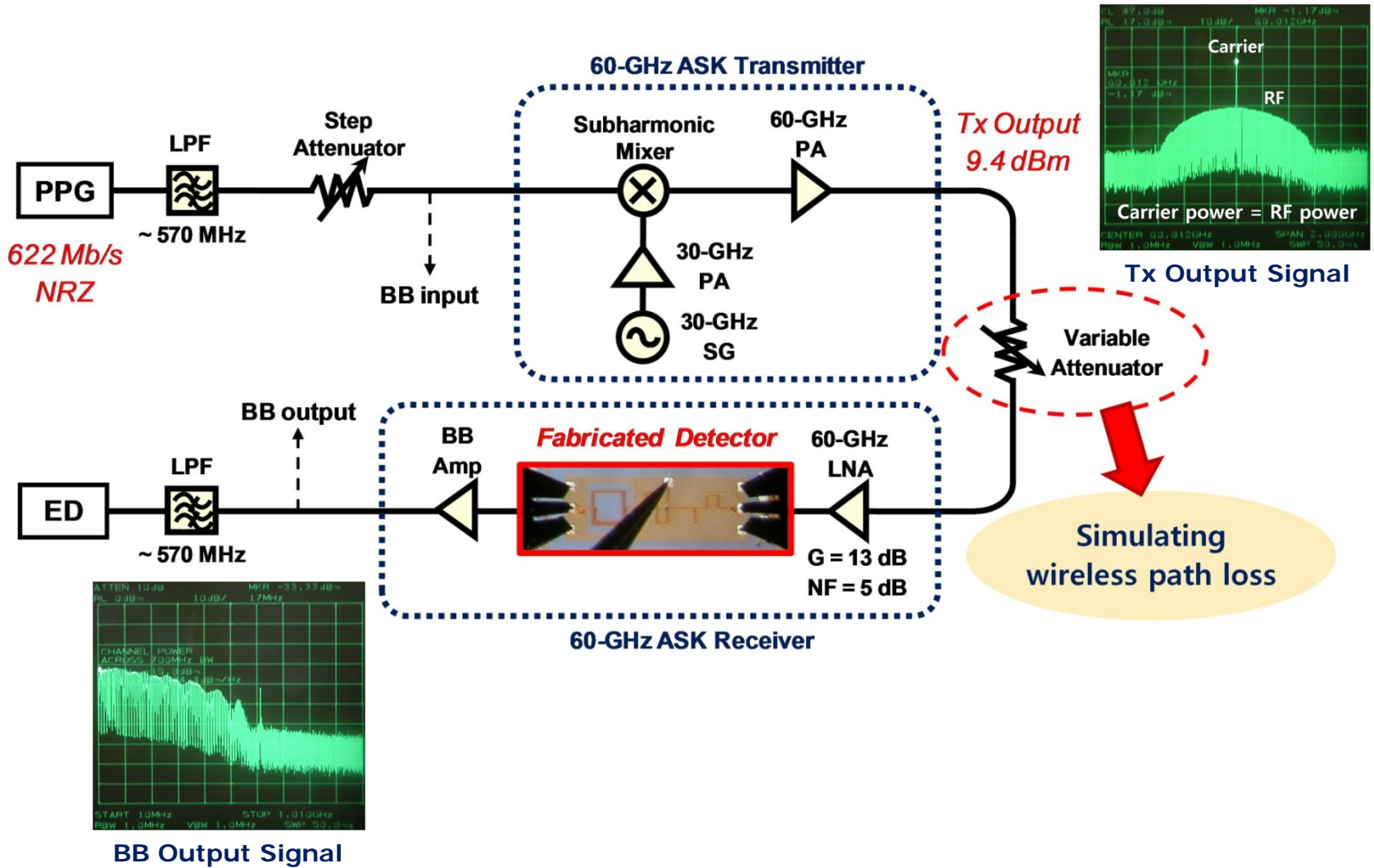
- Schematic of 60-GHz Square-law Mixer -



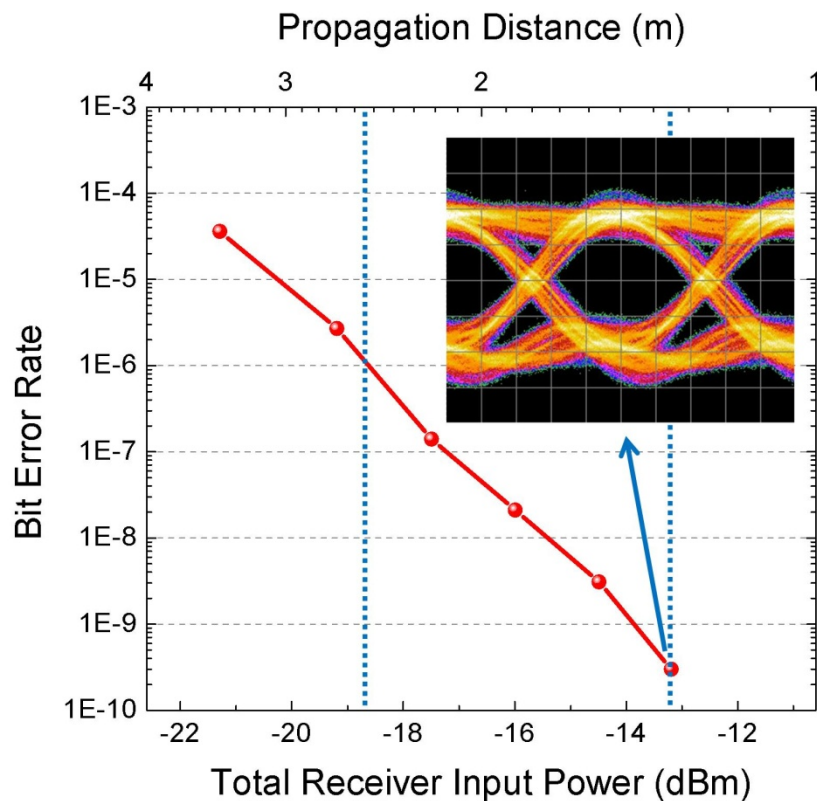
- Chip Photo of the mixer -



Broadband Data Transmission



Broadband Data Transmission



Propagation distance is estimated from signal attenuation between Tx and Rx assuming each of TRx antennas has 24-dBi antenna gain.

- BER of 10^{-10} @ 1.3 m
 - BER of 10^{-6} @ 2.5 m
- Satisfies IEEE 802.15.3c usage model #5 (1-m distance) at 622-Mb/s data rate

❖ Conference

- Minsu Ko, Hyo-Soon Kang, and Woo-Young Choi, “A CMOS-Compatible Schottky-Barrier Diode Detector for 60-GHz Amplitude-Shift Keying (ASK) Systems”, *IEEE MTT-S International Microwave Symposium*, pp.1557-1560, Atlanta, USA., 15-20 June, 2008