초고주파 집적 시스템 연구실

High-Frequency Integrated Circuits and Systems Research Group

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소개

연구 분야:

반도체 기술을 이용하여 초고주파 대역 (수 GHz 에서 수백 GHz)에서 동작하는 회로 및 시스템을 설계하고 계측하는 연구를 수행

응용 분야:

전자기파를 이용한 무선 통신 전반:
방송, 이동 통신, 위성 통신

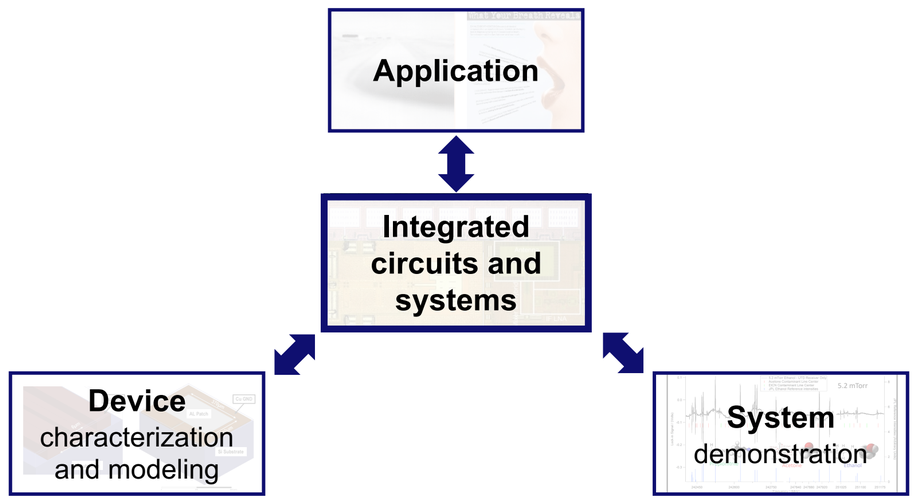
전자기파를 이용한 센싱 기술 전반:
기상, 전투기, 차량용 레이더, Radiometer, Spectrometer

세부 연구 방향:

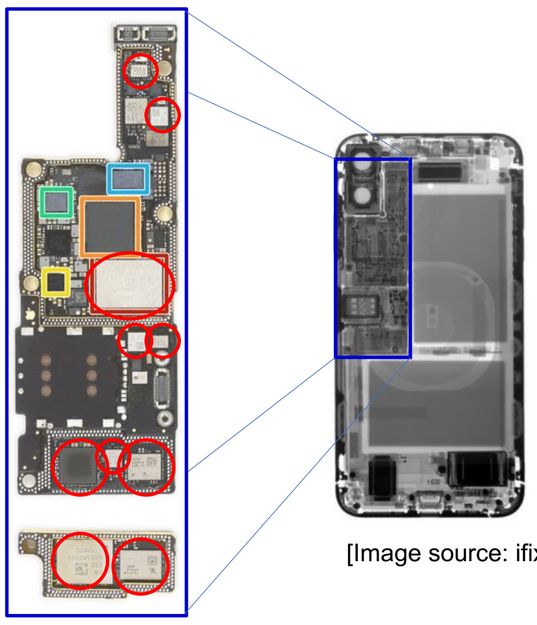
차세대 이동통신 및 센싱용 테라헤르츠 (>300 GHz) 집적시스템
초고주파 회로 설계 원천 기술 연구 – 대출력 고효율 증폭기
초고주파 시스템 응용 기술 연구 – 우주 통신, 통신 시스템

연구 목표

Advance high-frequency integrated circuit design knowledge to realize practical and affordable RF-to-THz integrated circuits and systems for everyday applications



초고주파 응용 – 차세대 이동통신

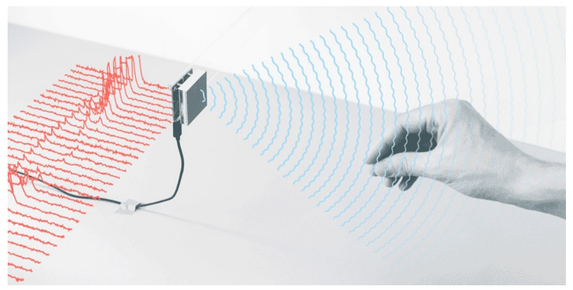


Microwave ICs

[Image source: ifixit]

- ✓ Crucial part of wireless devices
- ✓ RF/microwave circuit is >20% of total IC cost including AP, RAM, PMIC… [source: IHS Markit]
- ✓ Emerging 6G and beyond will need more microwave circuits.

초고주파 응용 – (레이더) 센싱



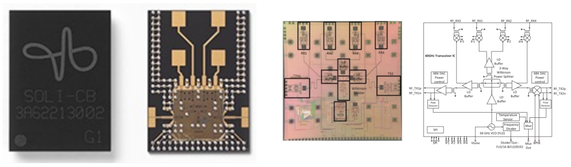


Image sources: Google project Soli,
I. Nasr *et al.*, *IEEE Journal of Solid-State Circuits*, 2016.



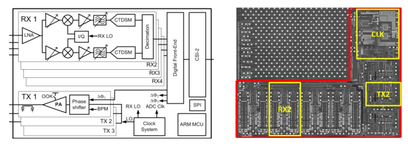
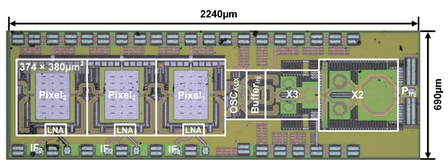


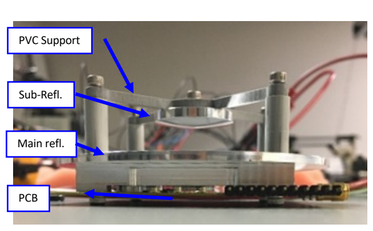
Image sources: NXP, Siemens VDO,
B. P. Ginsburg *et al.*, in *2018 IEEE International Solid-State Circ. Conf.*

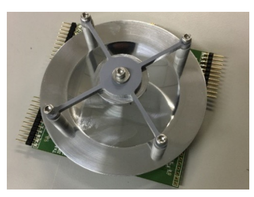
최근 연구성과

430-GHz Imaging Radar Array

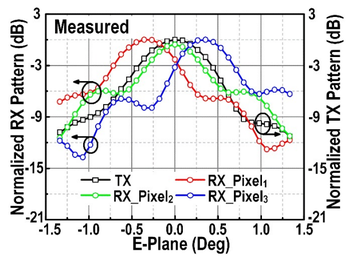


Radar Chip





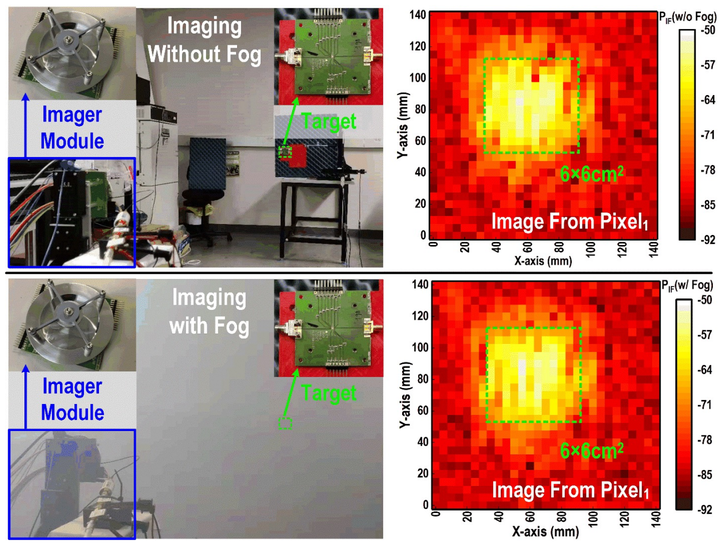
Module



Measured Antenna Characteristics

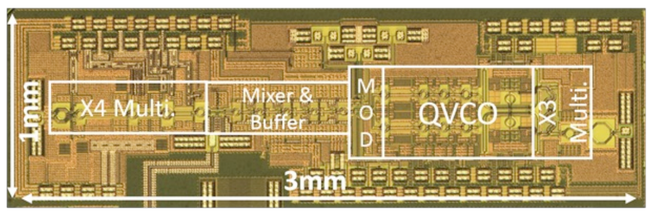
- ✓ 5x higher frequency than car radar
- ✓ 5x higher angular resolution w/ 4x smaller antenna
- ✓ 3 radars on one chip
- ✓ Fully integrated transceiver pixel

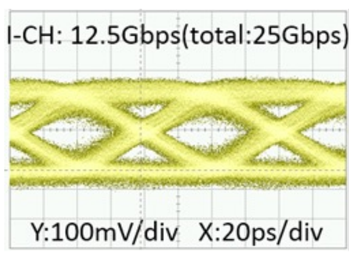
430-GHz Imaging Through Heavy Fog

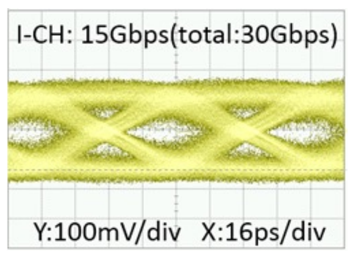


- ✓ 2.5 cm resolution at 3 m
- ✓ No attenuation through heavy fog
- ✓ Stand-off imaging through harsh weather conditions demonstrated!

300-GHz 30-Gbps Transmitter







- ✓ 10x higher frequency than 5G
  - ✓ ~30GHz vs. 300GHz
- ✓ >10x faster data rate than 5G
  - ✓ 3Gbps vs. 30Gbps
- ✓ Optical comm level datarate over wireless!
- ✓ Compact and low-cost CMOS chip

연구 환경 및 기회

- ✓ 최첨단 초고주파 집적회로 및 시스템 설계 연구
- ✓ 국제 학회 참석, 인턴십, 취업 기회 지원
  (미국 Texas Instruments, Semiconductor Research Corp. 연구과제 참여)

지도교수



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2023-present, Asst. Prof., Seoul National Univ.
2018 – 2023, Asst. Prof., Oklahoma State Univ.
- THz/MMW channel and propagation modeling (Co-PI)
- RF/FSO hybrid space communication (Co-PI)

2013 – 2018, Asst. Research Prof., Univ. Texas at Dallas
- CMOS THz RX for rotational spectroscopy (PI)
- Compact CMOS TRX pixels for THz imaging (PI, Co-PI)
- CMOS TX/RX for THz dielectric waveguide comm. (Designer, Architect)

2011 – 2013, Research Associate, Univ. Texas at Dallas
- Multi-harmonic active load-pull measurement for high-power high-efficiency GaN and InP PA (Co-PI)
- CMOS integrated circuits for THz imaging

2011, Ph.D.E.E, Seoul National University, Korea
- GaAs and CMOS circuits for MMW communications

2001, B.S.E.E, Yonsei University, Korea

Research Partners: