

Low Cost Remote Antenna Units for Fiber-fed Distributed Antenna Systems

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Outline

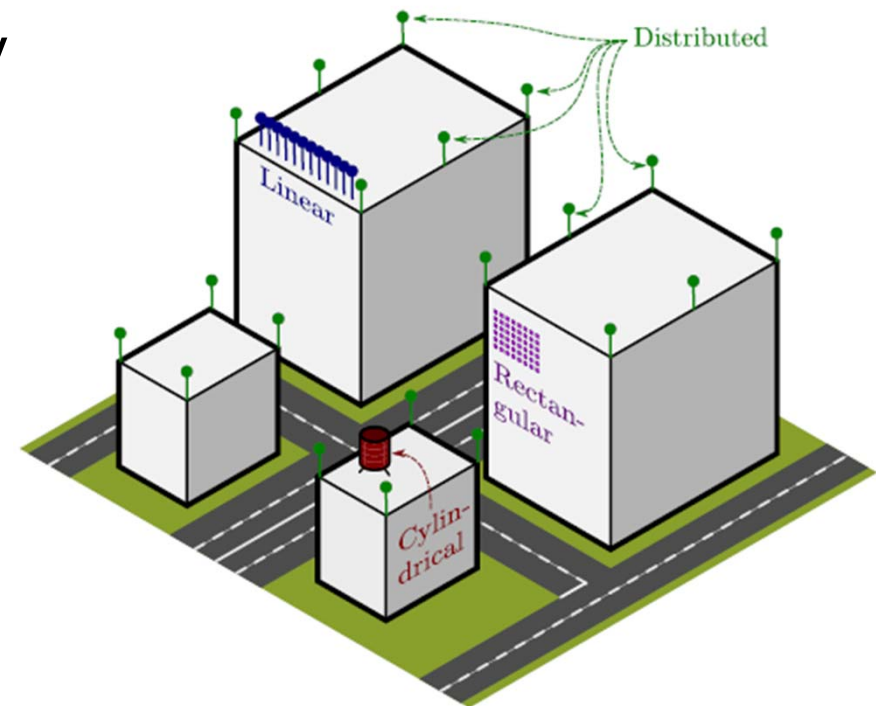
- Motivation
- CMOS Integrated RAU
- RoF Downlink IC
- Measurements
- Conclusions

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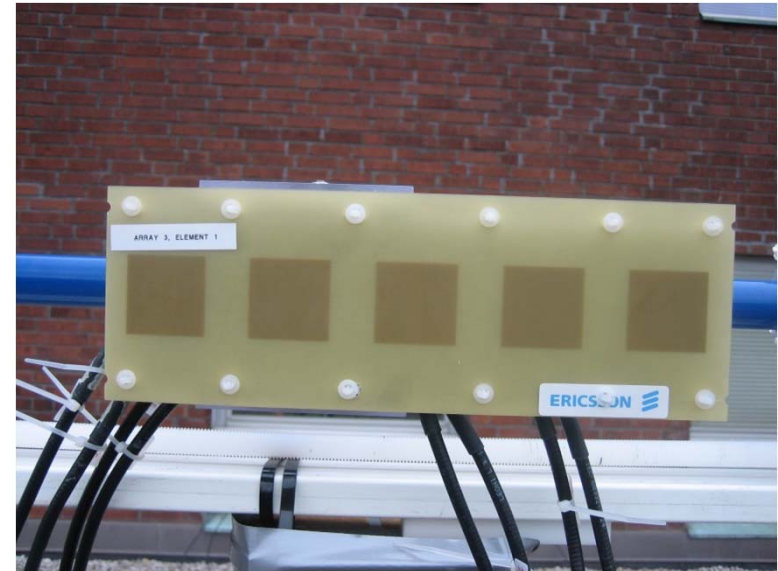
Distributed Multi-antenna System

- ❑ Massive MIMO for future cellular systems
 - ❑ High data rates
 - ❑ Very good spectral efficiency
 - ❑ High reliability
- ❑ Antennas can be
 - ❑ Grouped together
 - ❑ **Distributed**
- ❑ Signal Distribution
 - ❑ Coaxial cables
 - ❑ Optical fibers



Remote Antenna Units

- ❑ Remote antenna units for fiber-fed DAS
- ❑ Full integration in CMOS
- ❑ Low cost solution
 - ❑ VCSEL as an optical transmitter
 - ❑ Multi-mode fiber (MMF)



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CMOS Integrated RAU

- ❑ CMOS Integrated optical receivers
 - ❑ Challenge due to the poor photodiode performance
 - ❑ Some numbers for CMOS photodiodes

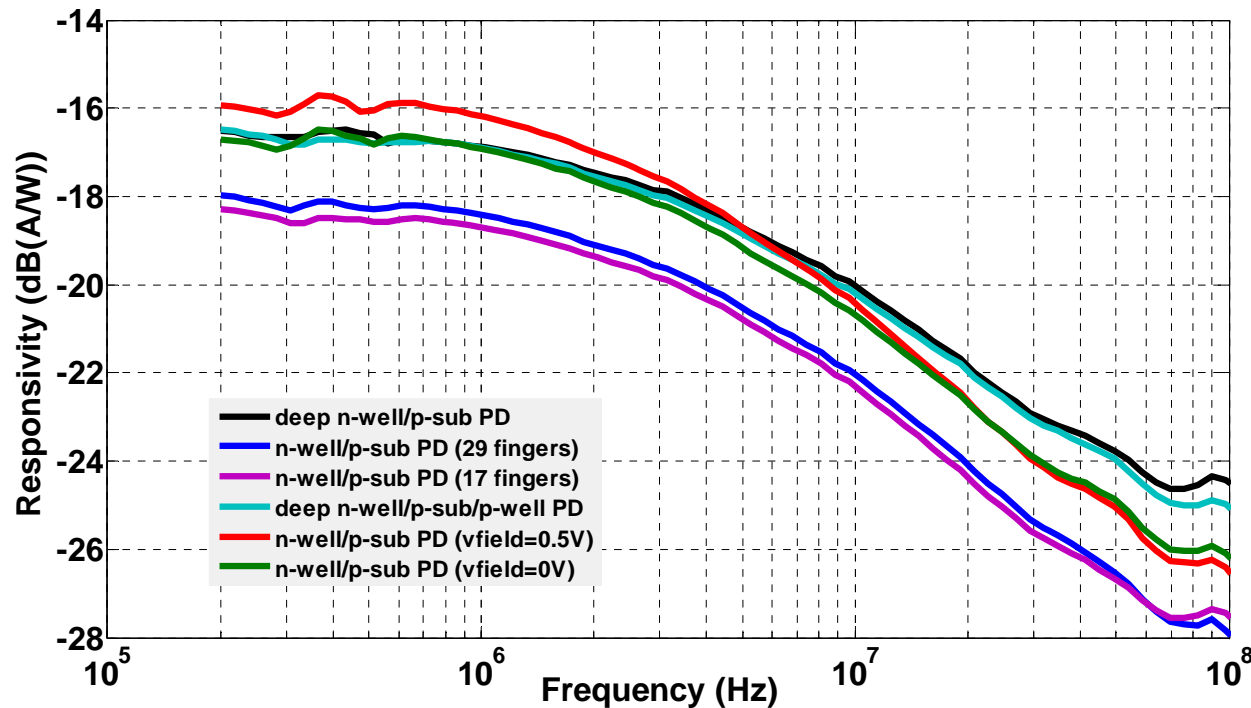
Process	Responsivity(A/W)	Bandwidth (MHz)
180nm	0.378	~5
130nm	0.300	~5
90nm	0.233	~5
65nm*	0.03	2.5

*N+/psub PD

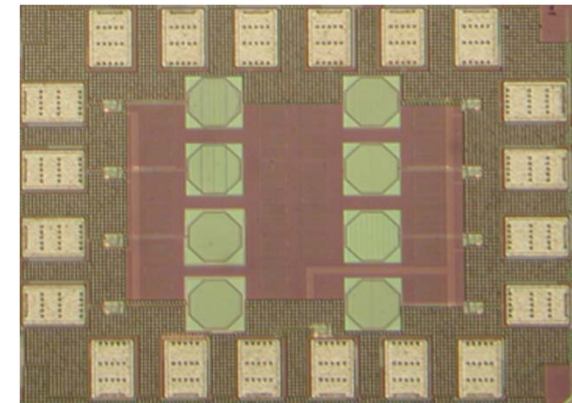


CMOS Integrated RAU

□ Characterization of photodiodes is 65nm CMOS



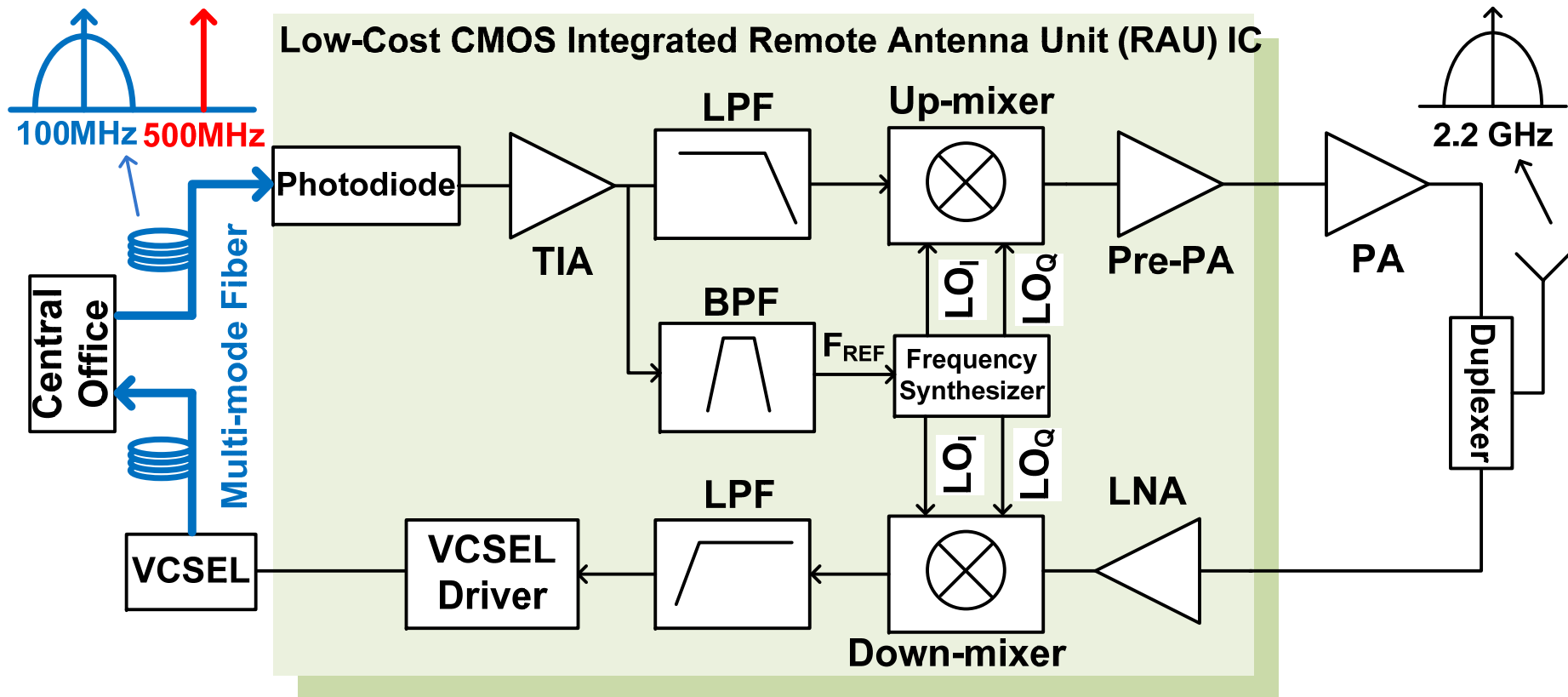
Measured frequency response



Area= 0.4mm²

W. Ahmad et. al, IEEE ESSDERC, 2013

CMOS Integrated RAU

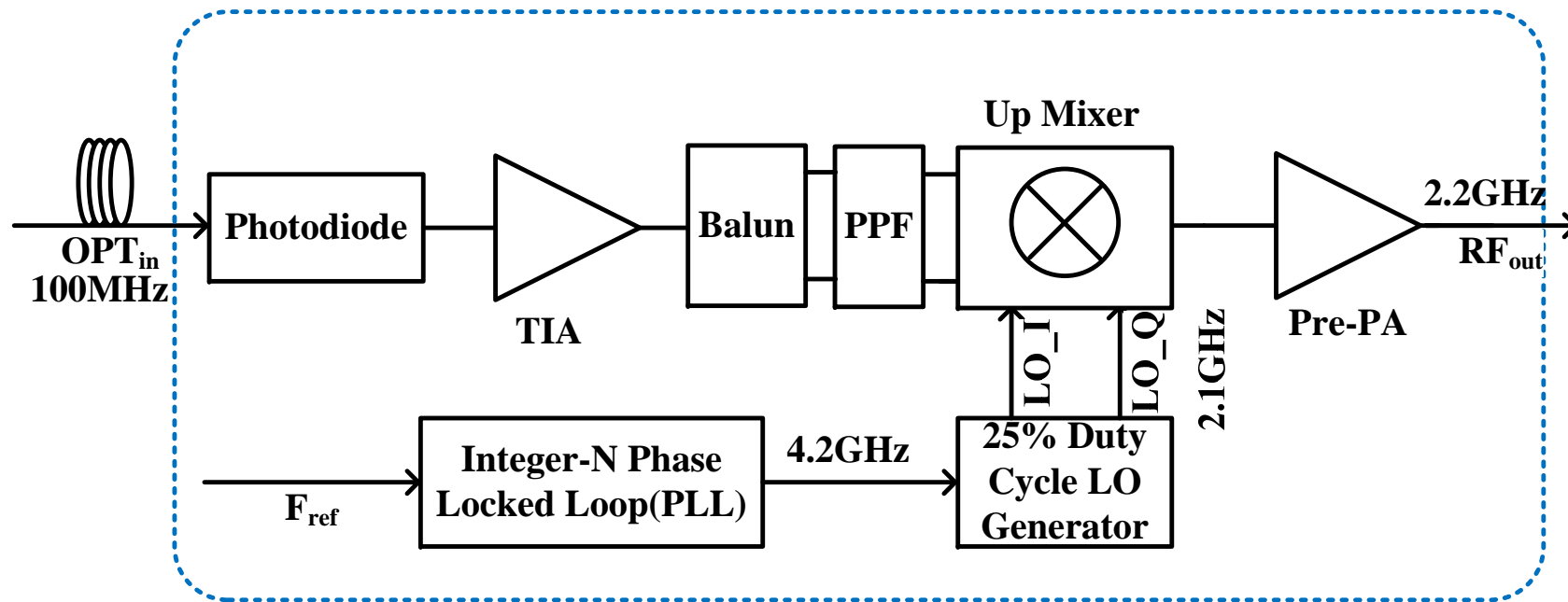


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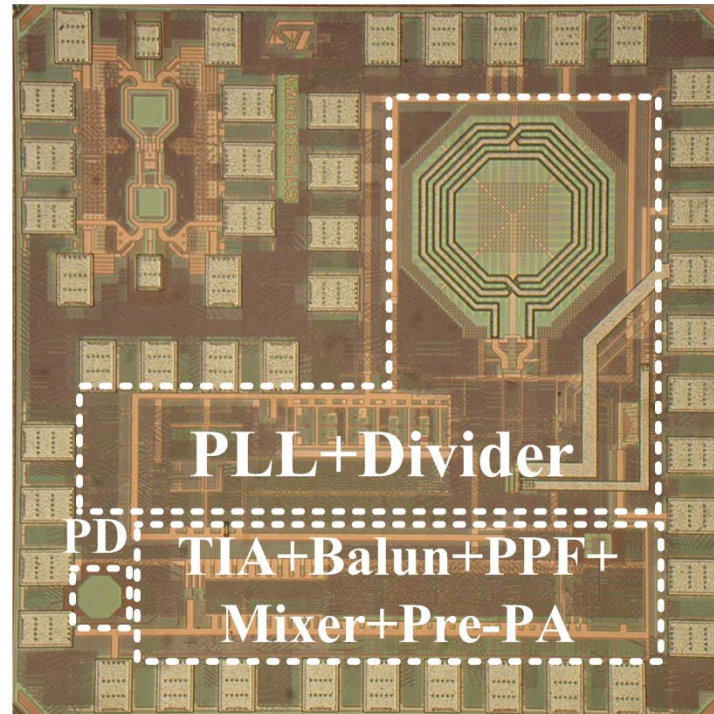
RoF Downlink IC

□ Initial Attempt



RoF Downlink IC

□ Fabricated chip



65nm CMOS

Area= 0.8mm²

W. Ahmad et. al, IEEE Photonics Tech. Letters, March, 2014

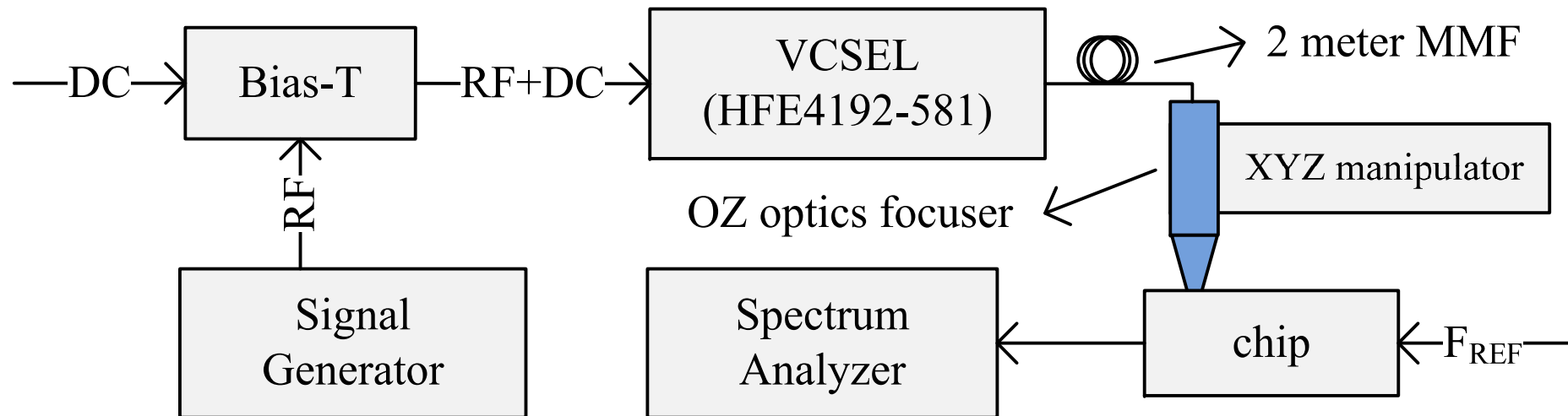


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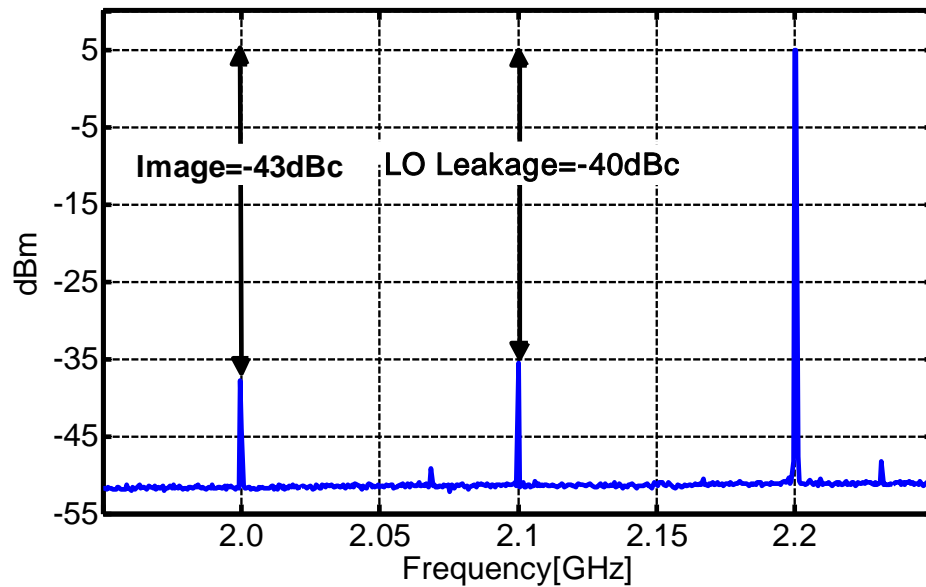
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Measurements

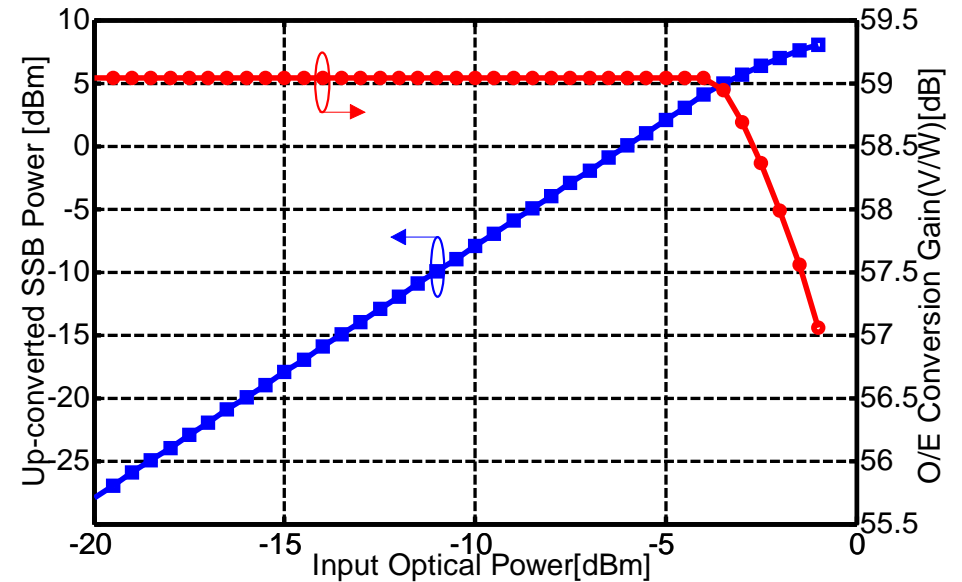
□ Optical measurement setup



Measurements



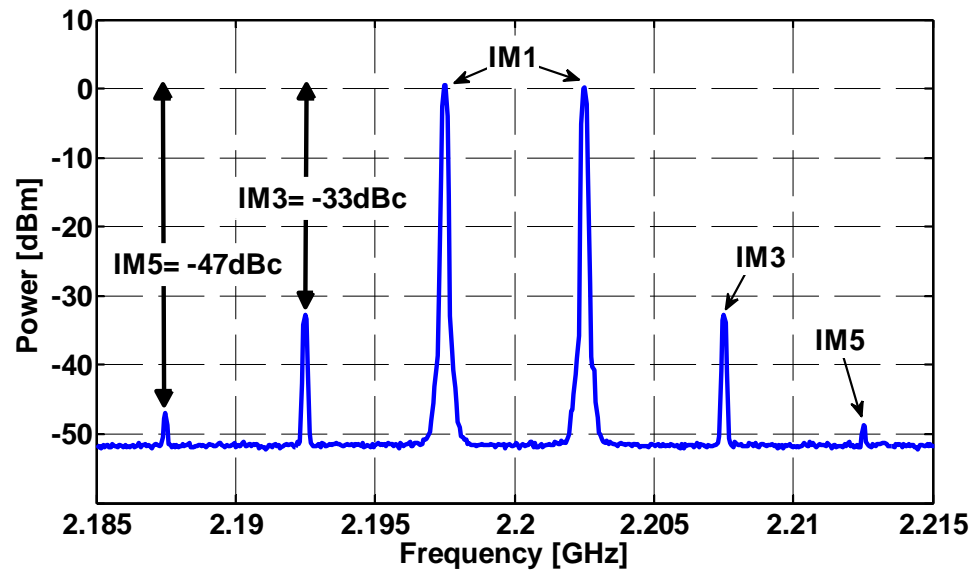
Single tone transmission



O/E Gain & power sweep



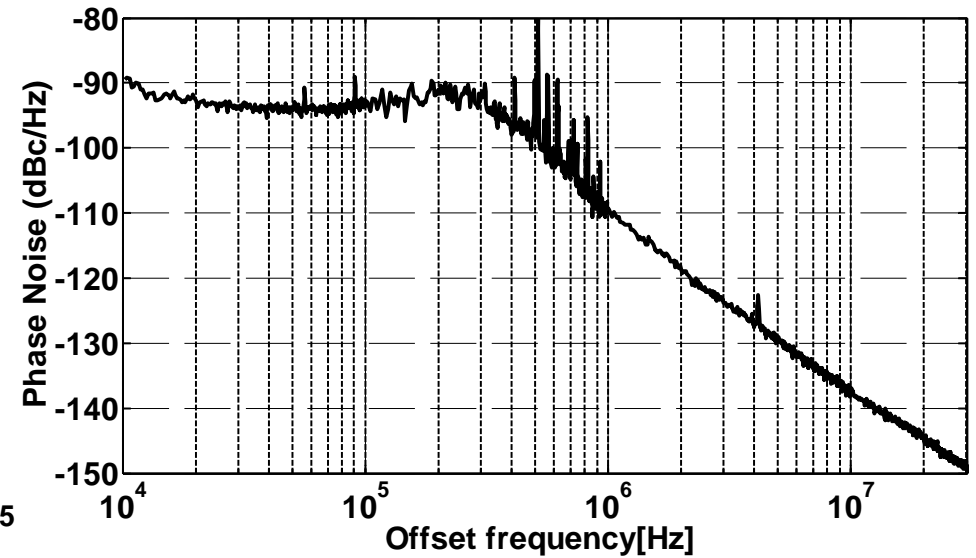
Measurements



Two tone test

OIP3=+17dBm

SFDR =96.5dB.Hz^{2/3}

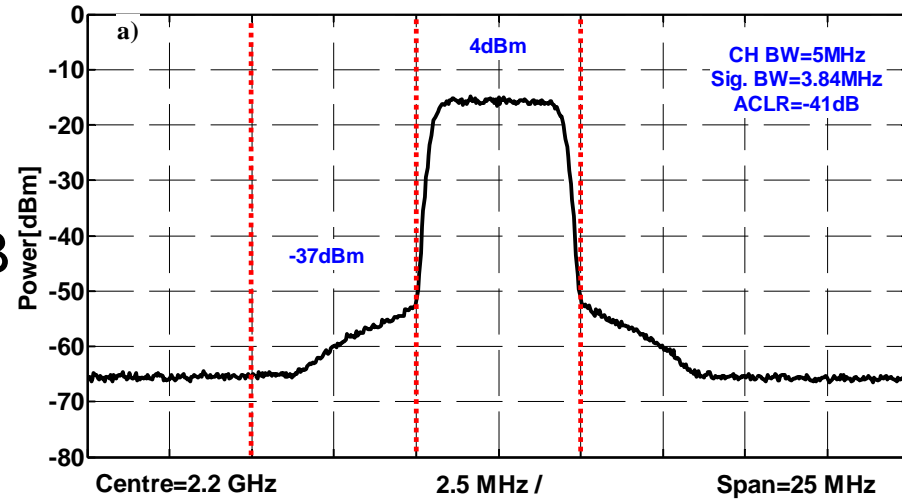


PLL phase noise at 4.2GHz

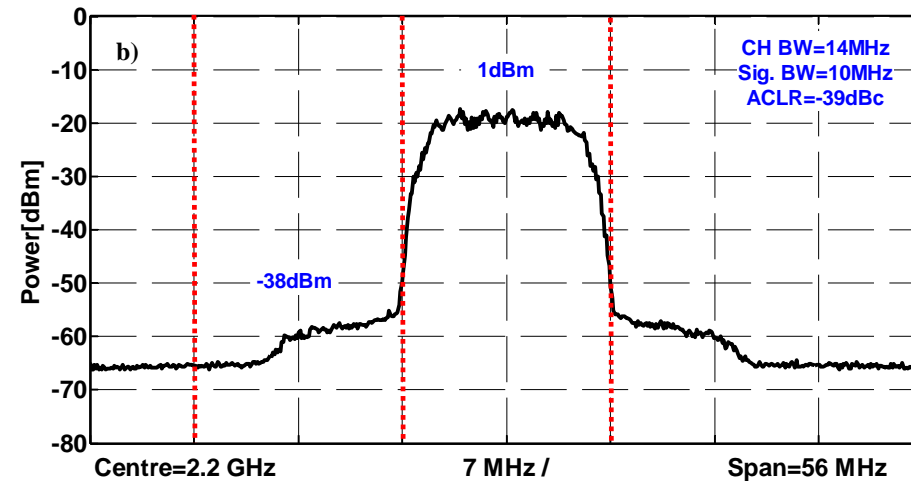


Measurements

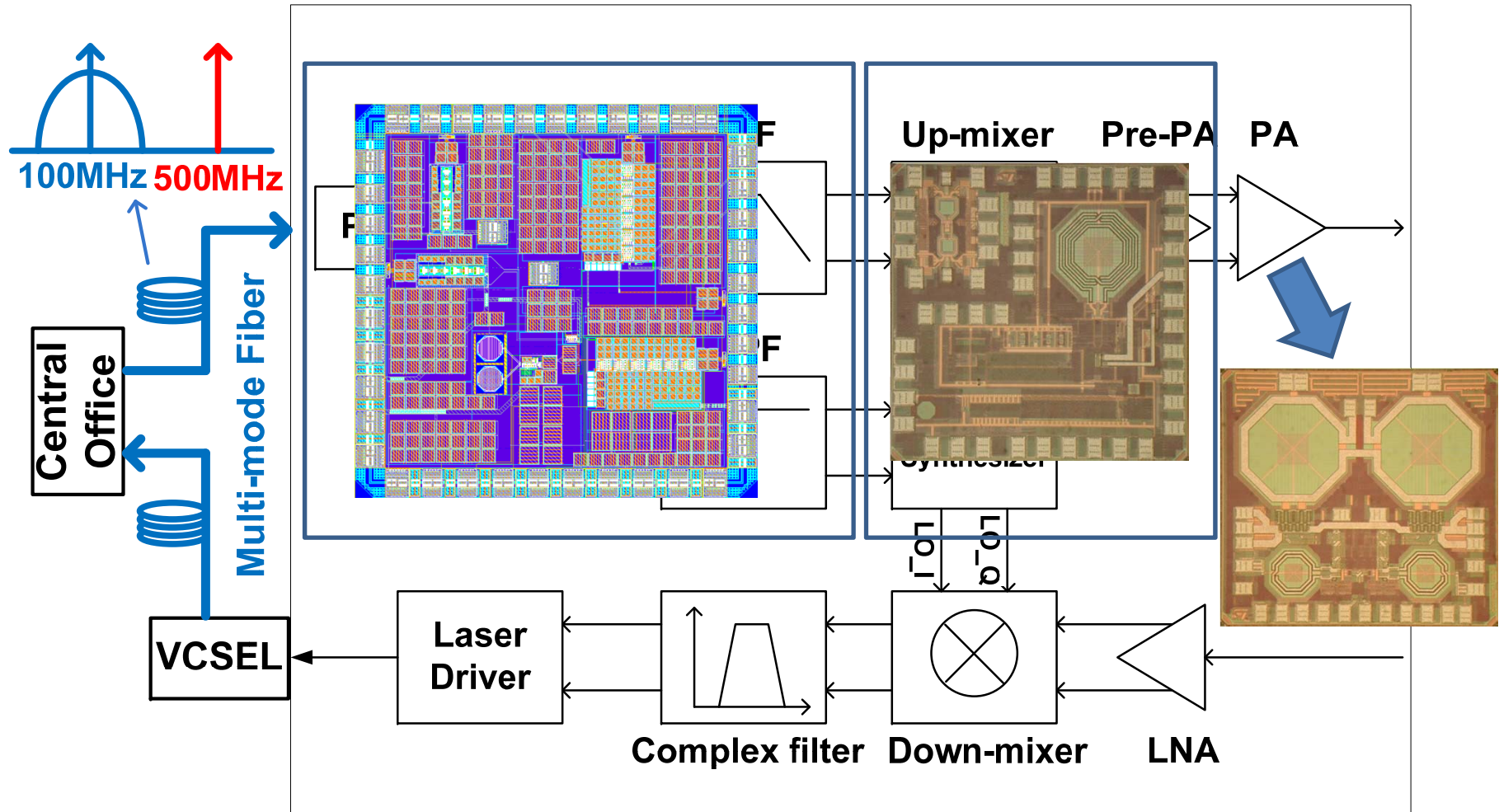
3.84MHz QPSK PAPR=5.8dB



10MHz 32-QAM PAPR=6.9dB



Current Status



Complete system TO: March 2015



Conclusions

- ❑ Fully integrated radio fiber interface is presented for fiber-fed distributed antenna systems

- ❑ IF over fiber: Relaxed requirements on optical devices
 - ❑ On chip photodetector
 - ❑ Low cost optical transmitters (VCSELs)
 - ❑ Multi-mode fibers (MMFs)

- ❑ Measurements indicate great potential towards realizing low cost RAUs

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