A CMOS Direct Sampling Mixer Using Switched Capacitor Filter Technique for Software-Defined Radio

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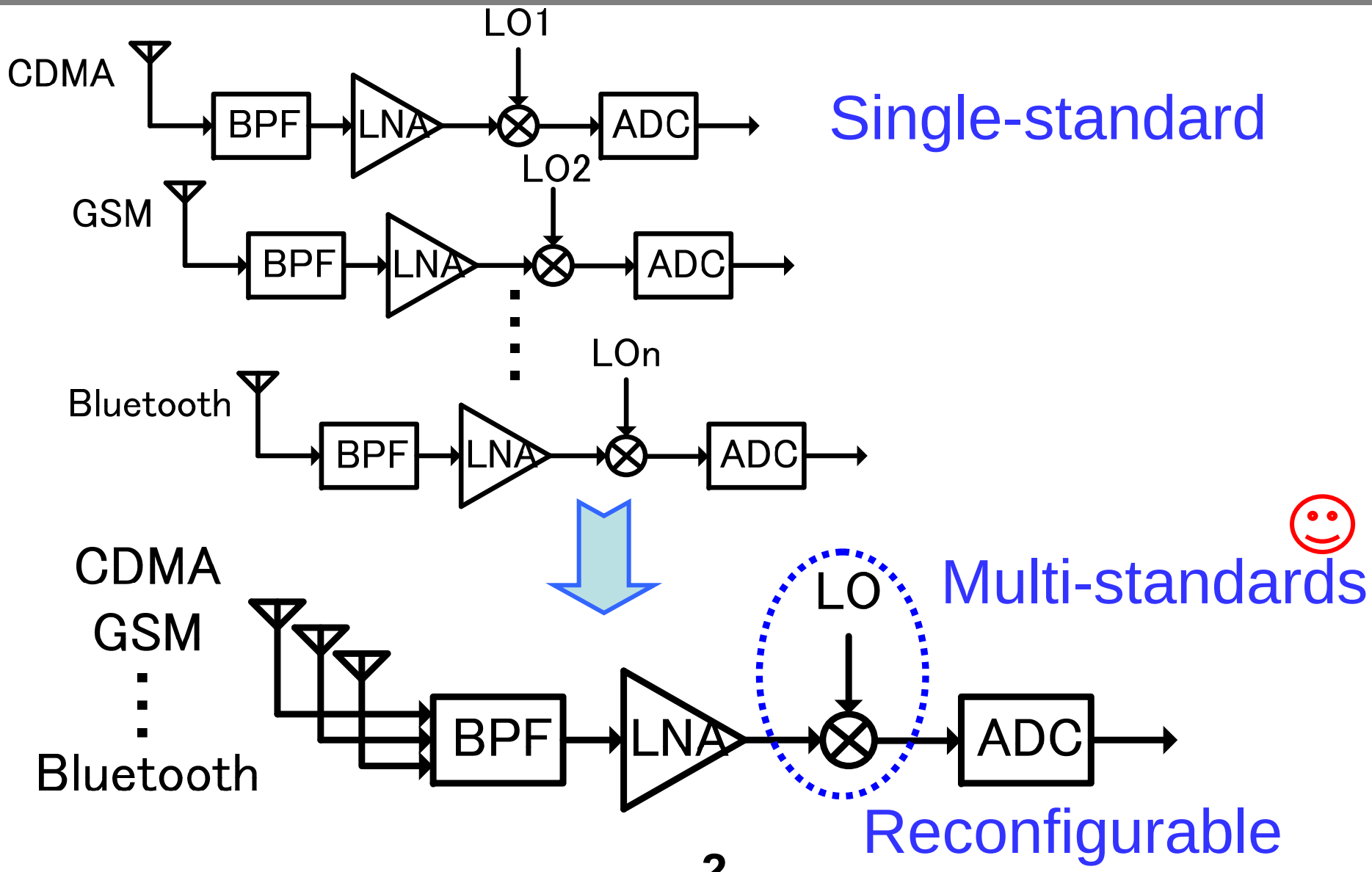
Outline

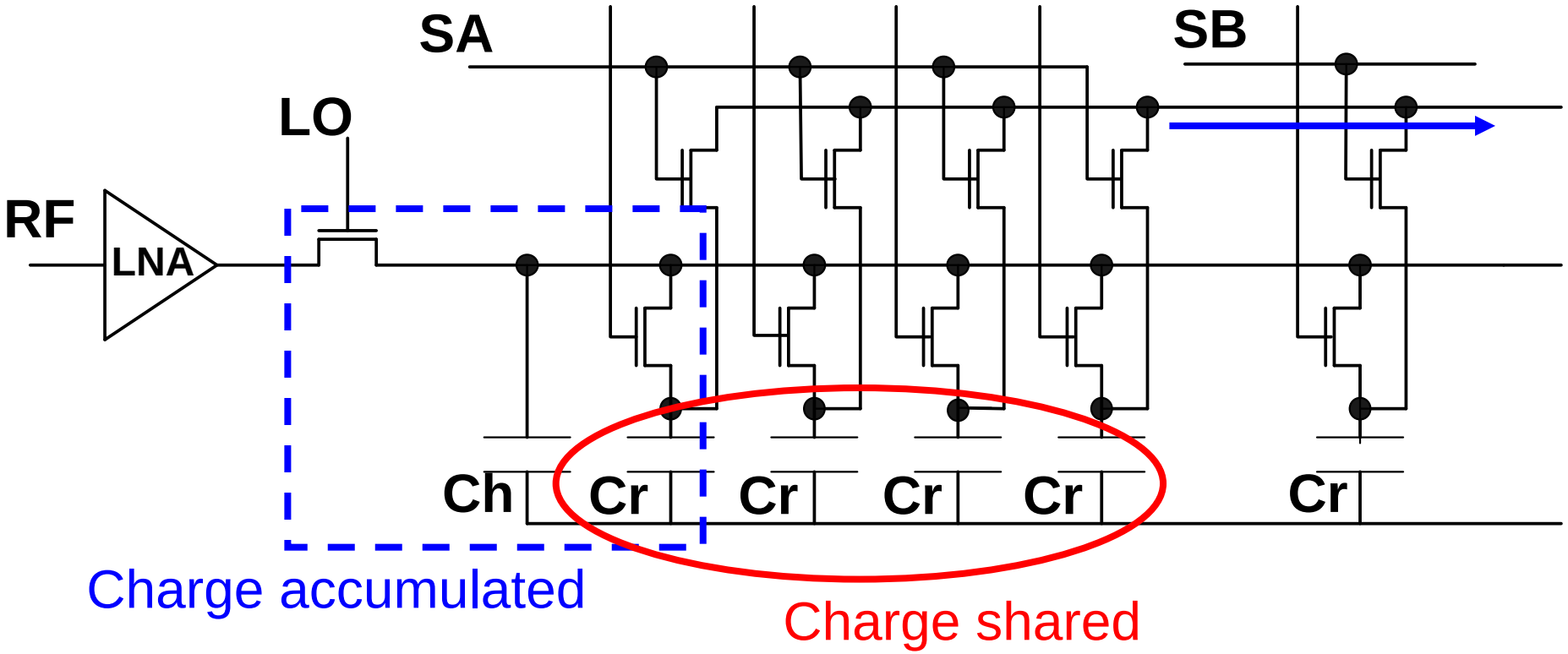
- **Background**
- **Proposed circuit**
- **Measurement results**
- **Conclusion**

Background


LO1
CDMA
BPF
LNA
ADC
Single-standard
LO2
GSM
BPF
LNA
ADC
LOn
Bluetooth
BPF
LNA
ADC
CDMA
GSM
Bluetooth
LO
Multi-standards
BPF
LNA
ADC
Reconfigurable

Previous work

Multi-Tap Direct Sampling Mixer(MTDSM)



R. B. Staszewski(TI) et al, “All-Digital TX Frequency Synthesizer and Discrete-Time Receiver for Bluetooth Radio in 130-nm CMOS”, JSSC Vol.39, No.12, pp. 2278-2291, Dec. 2004.

Problems of previous work

MTDSM's issues

- **Poor variability of filter characteristic**
  - **Low order of the filter**
- **Bad Noise Figure**
  - **Effect of flicker noise**
- **Not good for wideband**
  - **Pass-bands appear at multiples of LO**

Proposed solution

Realize MTDSM using Switched Capacitor Filter (SCF) Technique

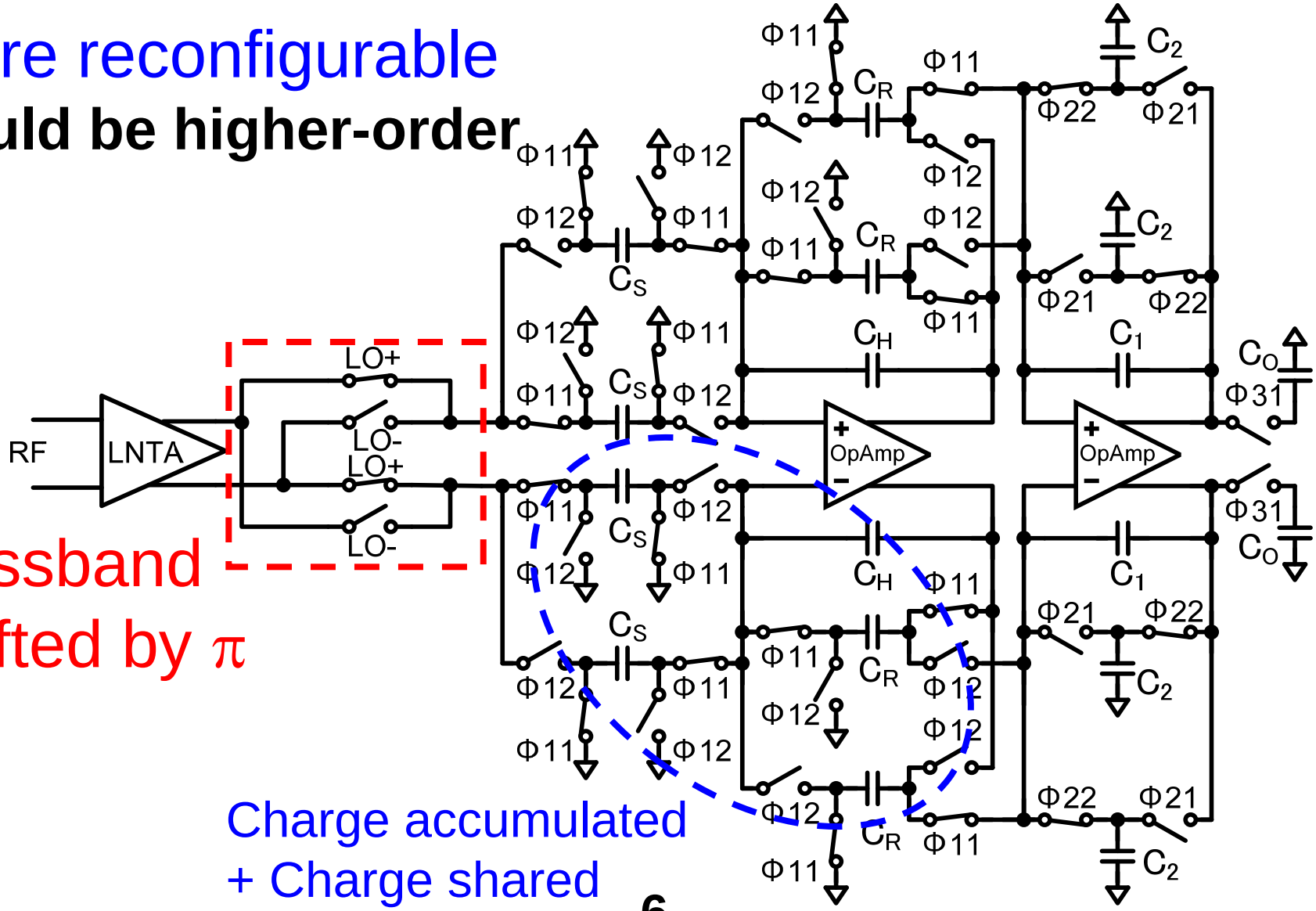
Features

- **Filter characteristic is reconfigurable**
- **Promise higher-order filtering**
- **NF improvement (pass-band is shifted)**
- **Better for wideband (pass-band is shifted)**

Proposed circuit

More reconfigurable

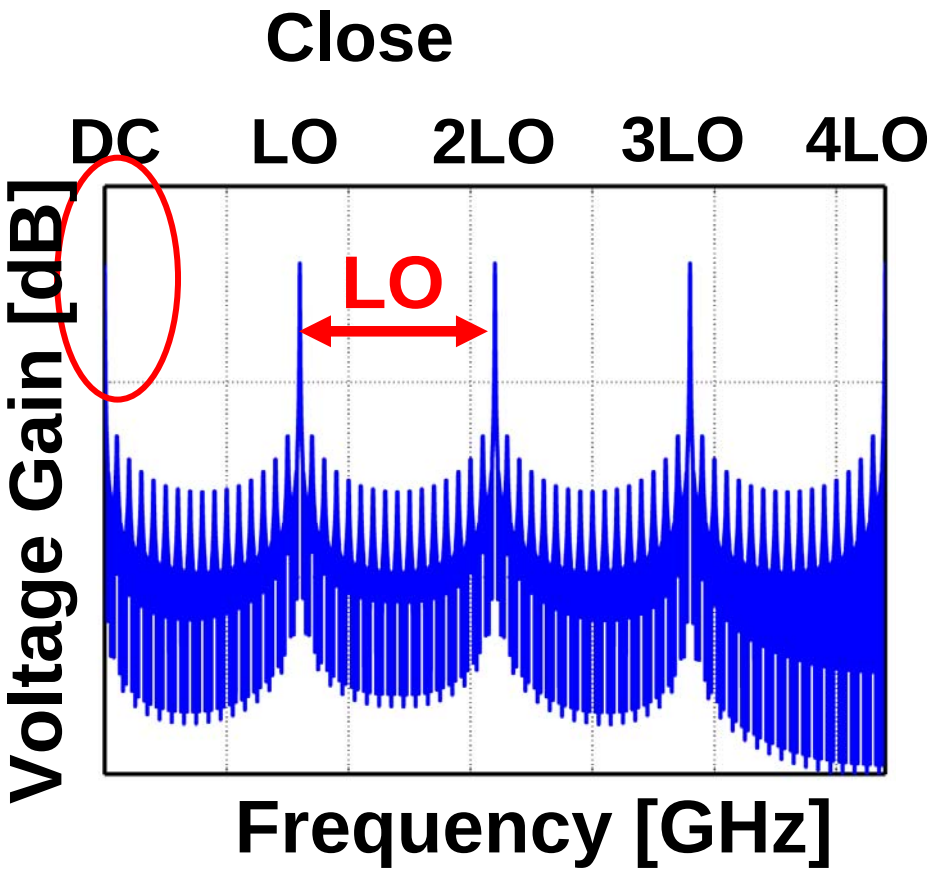
Could be higher-order



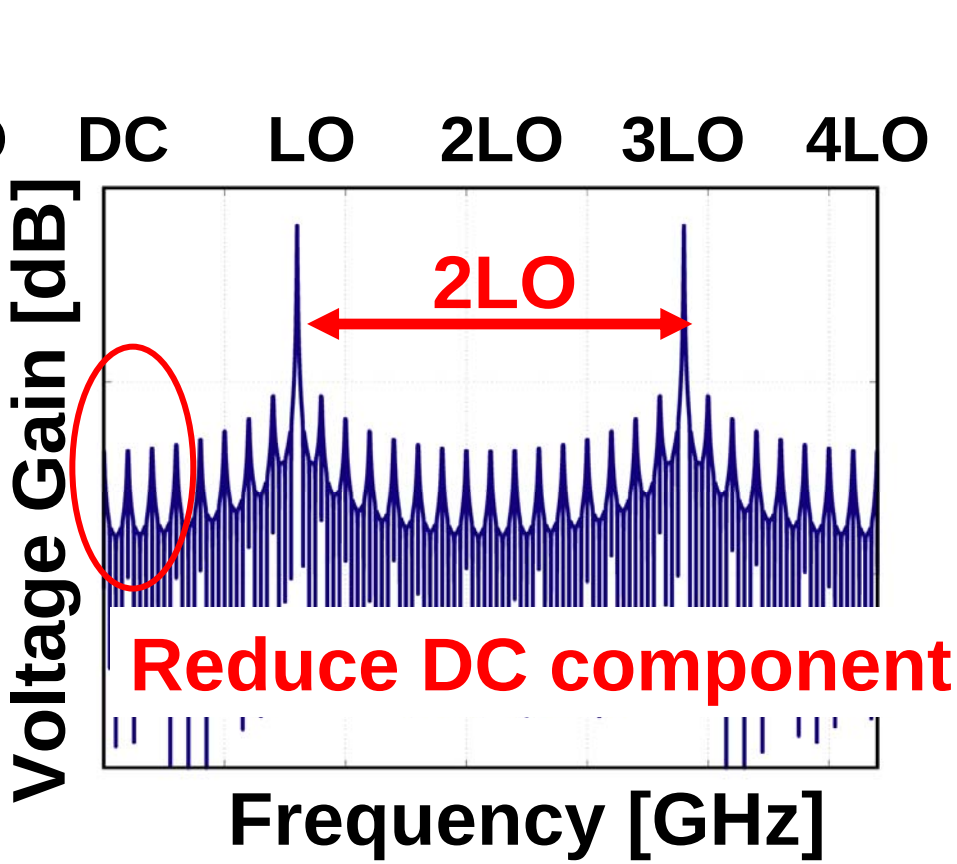
Passband shifted by π

Charge accumulated
+ Charge shared

NF improvement (pass-band shifted)



Before

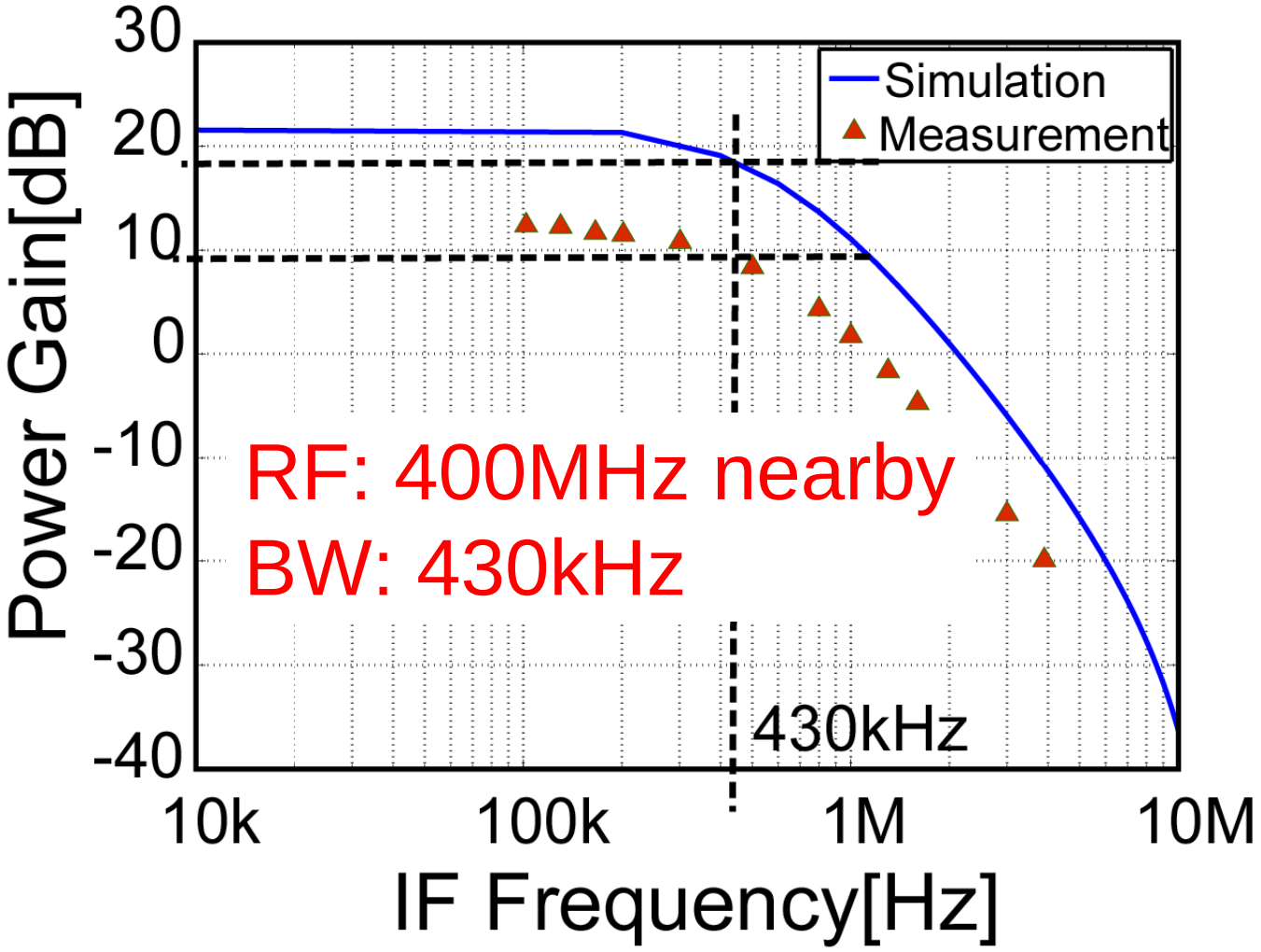


After shifted

- Better NF (about 25dB)
- Better for wideband

Measurement results

MTDSM for Digital Terrestrial Television (ISDB-T) 1-segment was fabricated.



Measurement results (2)

Technology	0.18μm CMOS process
Local Oscillator	800 MHz
Bandwidth	430 kHz
Power Gain @ 400.1 MHz input	12.4 dB
Attenuation @ 3MHz offset	27.3 dB
Supply Voltage VDD	1.8 V
LNTA + DSM core current	18 ~ 20 mA
Power consumption	32.4 ~ 36 mW
Chip area	1150μm x 750μm

	Previous work	SCF
Reconfigurability	Medium	Better
NF	Medium	Better
Gain	Bad	Better
Power	Better	Bad
Area	Medium	Medium

Conclusion

- **A direct sampling mixer using switched capacitor filter technique is proposed.**

- **It improves the reconfigurability while not increasing the power, area so much.**

SCF's Features

- **Easier to reconfigure**
- **Promise higher-order filtering**
- **NF improvement (pass-band shifted)**
- **Better for wideband (pass-band is shifted)**

Thank you for your interest!

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