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Research Objective

Reconfigurable Wideband Transceiver

This work

- Wide radio frequency range
- Various wireless communication modulations

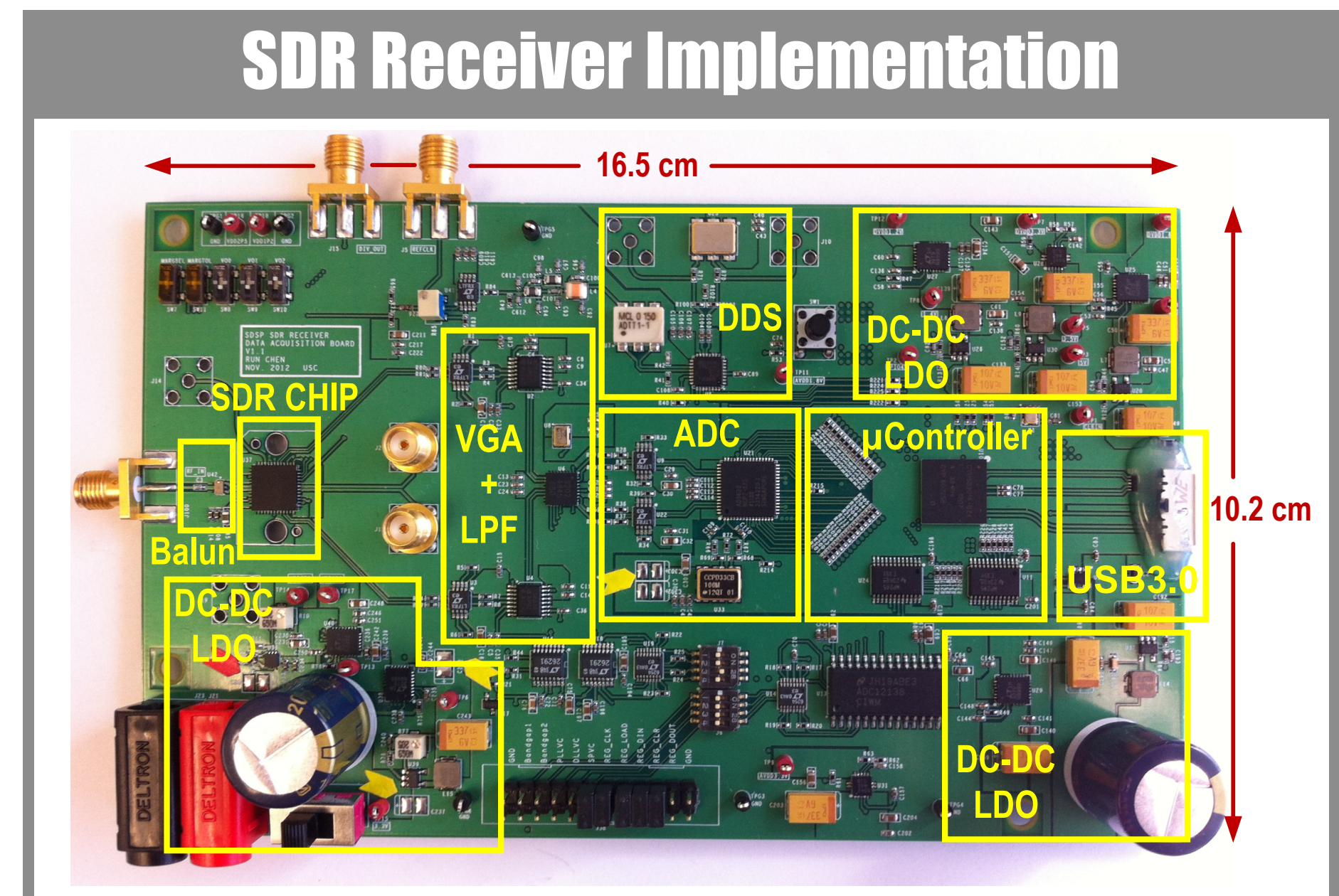
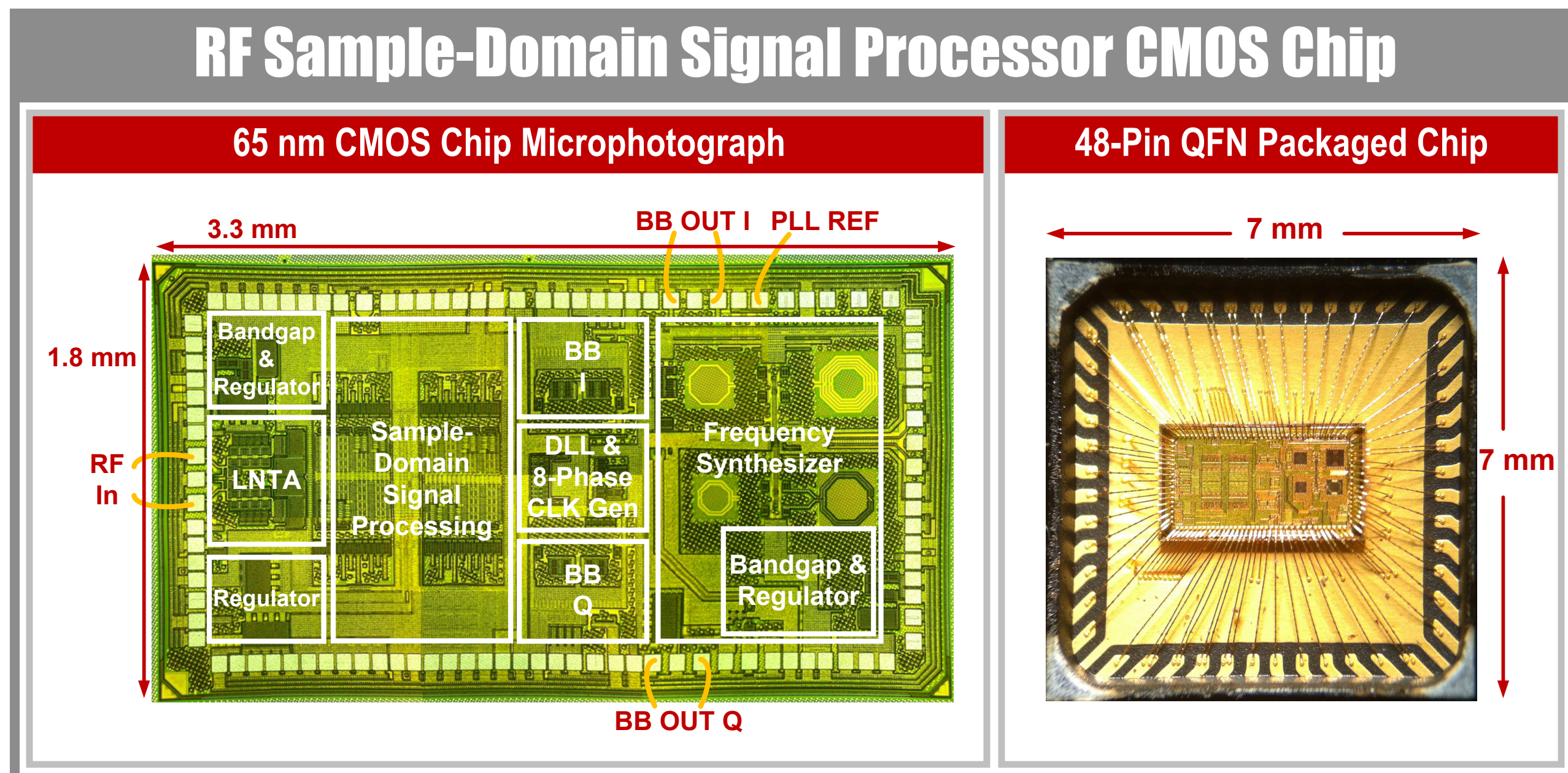
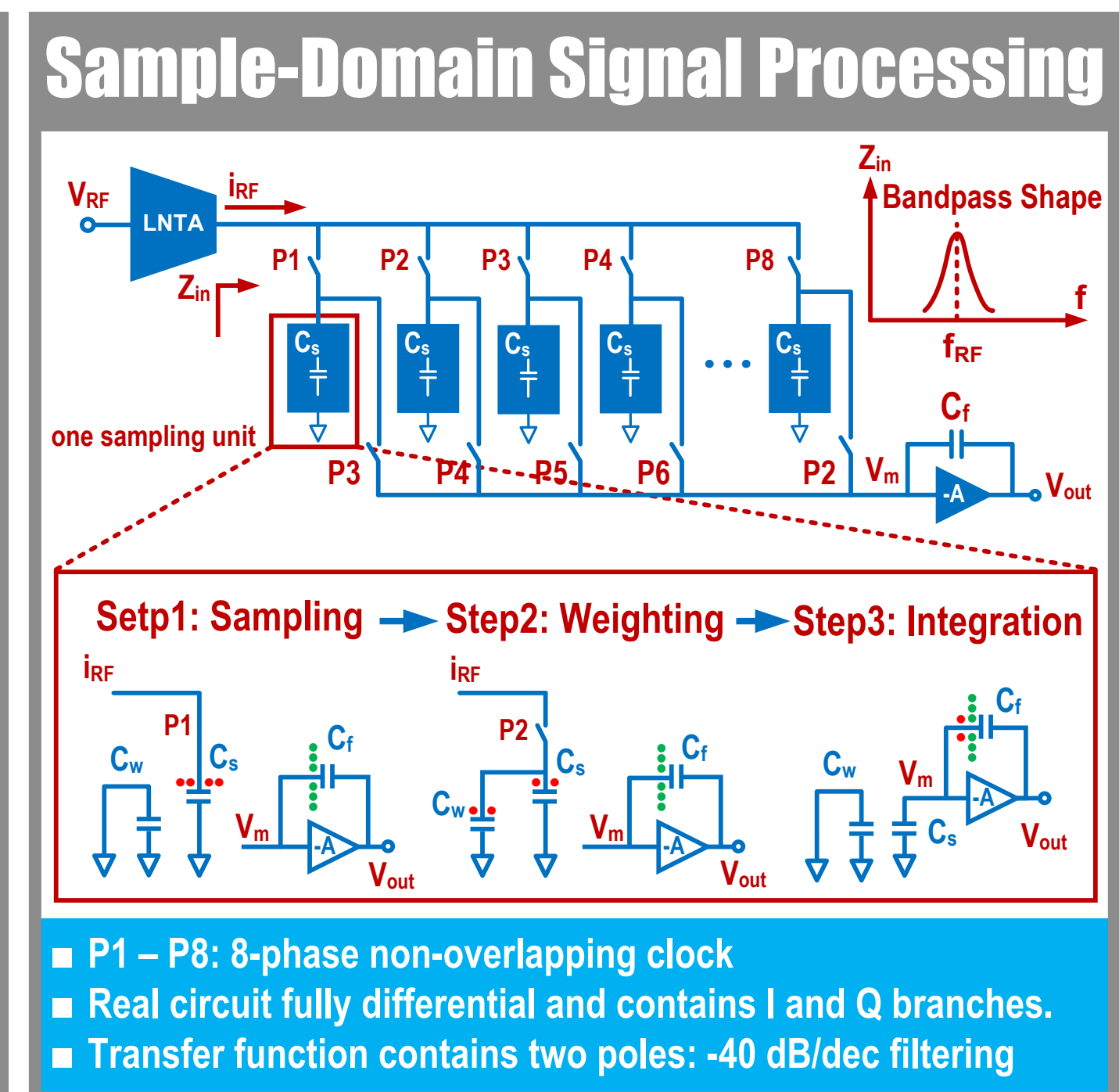
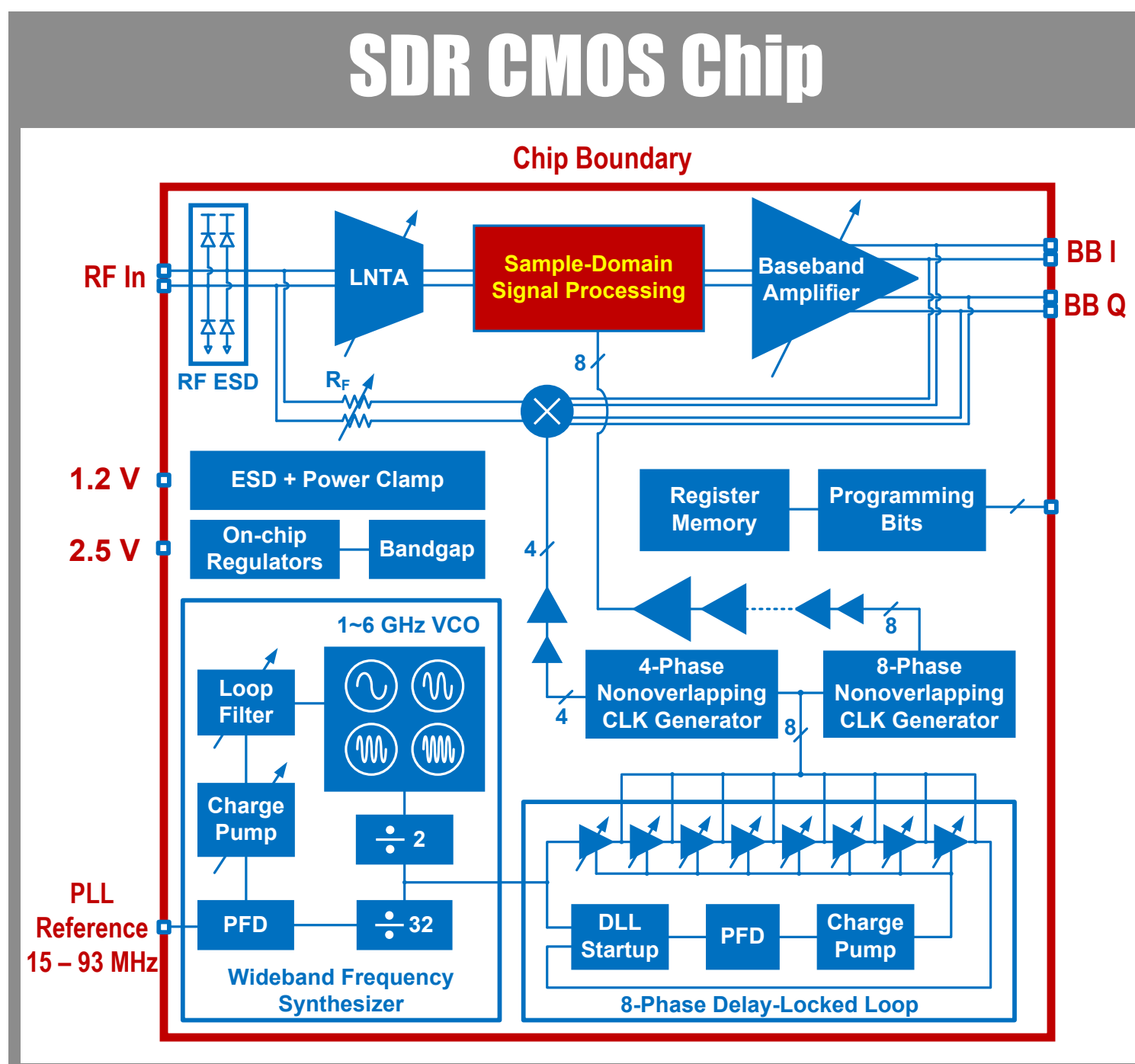
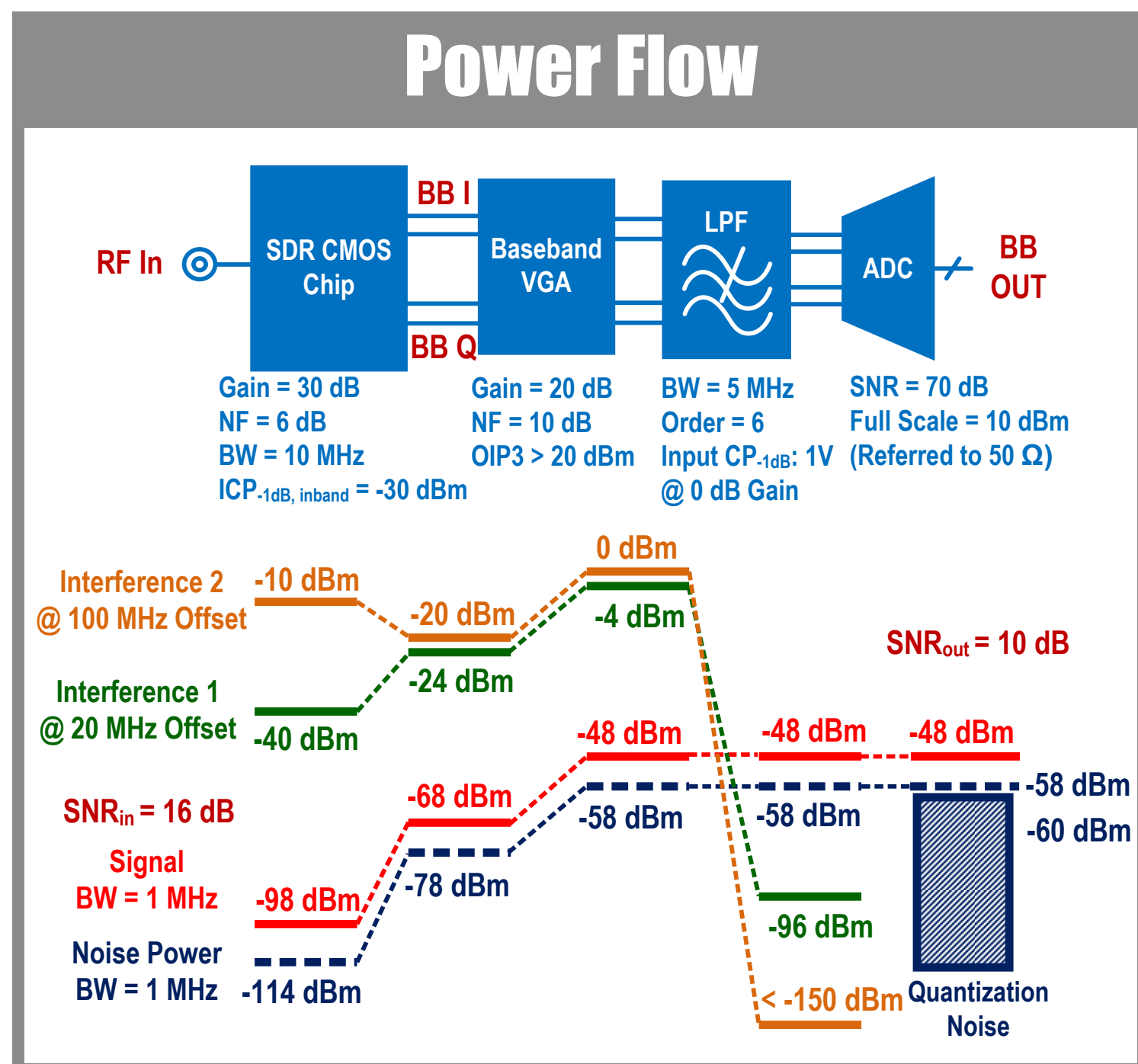
Receiver Challenges

- In the absence of compact selective tunable front-end filters, the SDR receiver should maintain a large dynamic range (> 100 dB) across a wide instantaneous frequency band (> 1 GHz).
- Other challenges include harmonic rejection and low-spur, low phase noise, wideband frequency synthesizer.

System Architecture

Key Features

- Wide frequency coverage
- Reconfigurable
- Interference rejection
- Input impedance matching
- Harmonic rejection
- Image rejection
- Low-spur LO generation



Measurement Results

Spectrum for Over-the-Air Signals

Frequency Response

SDR Chip Performance Summary and Comparison

Parameter	Goel TMTT '12	Andrews ISSCC '10	Murphy ISSCC '12	Bagheri JSSC '10	Borremans ISSCC '11	Geis JSSC '10	This work
CMOS Technology	130 nm	65 nm	40 nm	90 nm	40 nm	90 nm	65 nm LP
Supply Voltage (V)	1.8	1.2 / 2.5	1.3	1 / 2.5	1.2 / 2.5	1.2	1.2 / 2.5 ³
Frequency (GHz)	0 - 6	0.1 - 2.4	0.08 - 2.7	0.8 - 6 ²	0.4 - 6	0.5 - 3.8	0.5 - 3
Signal Domain	Continuous	Continuous	Continuous	Continuous + Sample	Continuous	Sample	Sample
Gain (dB)	68	40 - 70	72	> 20	70	60	35
NF (dB)	> 15	5.5	1.5 - 2.4	5 @ 0.9 GHz, 5.5 @ 2.5 GHz	3 - 7.5	5.1 - 6	5.5 @ 0.5 GHz, 8.8 @ 3 GHz
IB IIP ₃ (dBm)	-48	-67	-	-3.5 ²	+6	-13 - -3	-12.4 ⁴
OOB IIP ₃ (dBm)	10	+25	13.5	-	+10	2.5	11.7
IIP ₂ (dBm)	40	58	54	+60	+70	+50	> 58
OOB Blocker Power for CP _{-1dB} (dBm)	-	-	-	-13.5	-8	-	-1
3 rd Order HR (dB)	-	35.4	42	38	No	No	> 47
5 th Order HR (dB)	-	42.6	45	40	No	No	> 52
HR Frequency Range (GHz)	0 - 6	< 1	0.08 - 2.7	< 1.05	-	-	0.5 - 3
Synthesizer Frequency (GHz)	6 - 12	No	No	0.82 - 5.4 ²	6 - 12	No	1 - 6
Phase Noise (dBc/Hz) @ 1 MHz offset	-118.5 @ 5.5 GHz	-	-	-	-	-	-120 - -110
Power Consumption (mW)	670	30 - 70 ¹	35 - 78 ¹	> 100	64 - 100	47 - 115 ¹	250 @ 0.5 GHz, 600 @ 3 GHz
Area (mm ²)	14.4	2	2	3.8	2	0.45	5.9

Communication Test

SDR Receiver Performance

Parameter	Performance
RF Carrier Frequency (GHz)	0.5 - 3 (Continuous Tuned)
Receiver Gain (dB)	0 - 80 (Continuous Tuned)
Channel Bandwidth (MHz)	1 - 30 (1 MHz Step)
NF (dB)	6.8 @ 0.5 GHz, 13.2 @ 3 GHz
Dynamic Range (dB)	100
Max. Baseband Data Speed (Gb/s)	2.56
Power Supply (V)	5
Power Consumption (W)	1 - 2
PCB Area	16.5 cm x 10.2 cm

¹ Without frequency synthesizer.

² RF frequency not completely covered from 0.8 to 6 GHz. IIP₃ not specify frequency.

³ 2.5 V only used for regulators and I/O buffers. The core circuit 1.2 V power supply only.

⁴ IB IIP₃ measured @ max gain setting.