A Ultra-Low-Voltage LC-VCO with a Frequency Extension Circuit for Future 0.5-V Clock Generation

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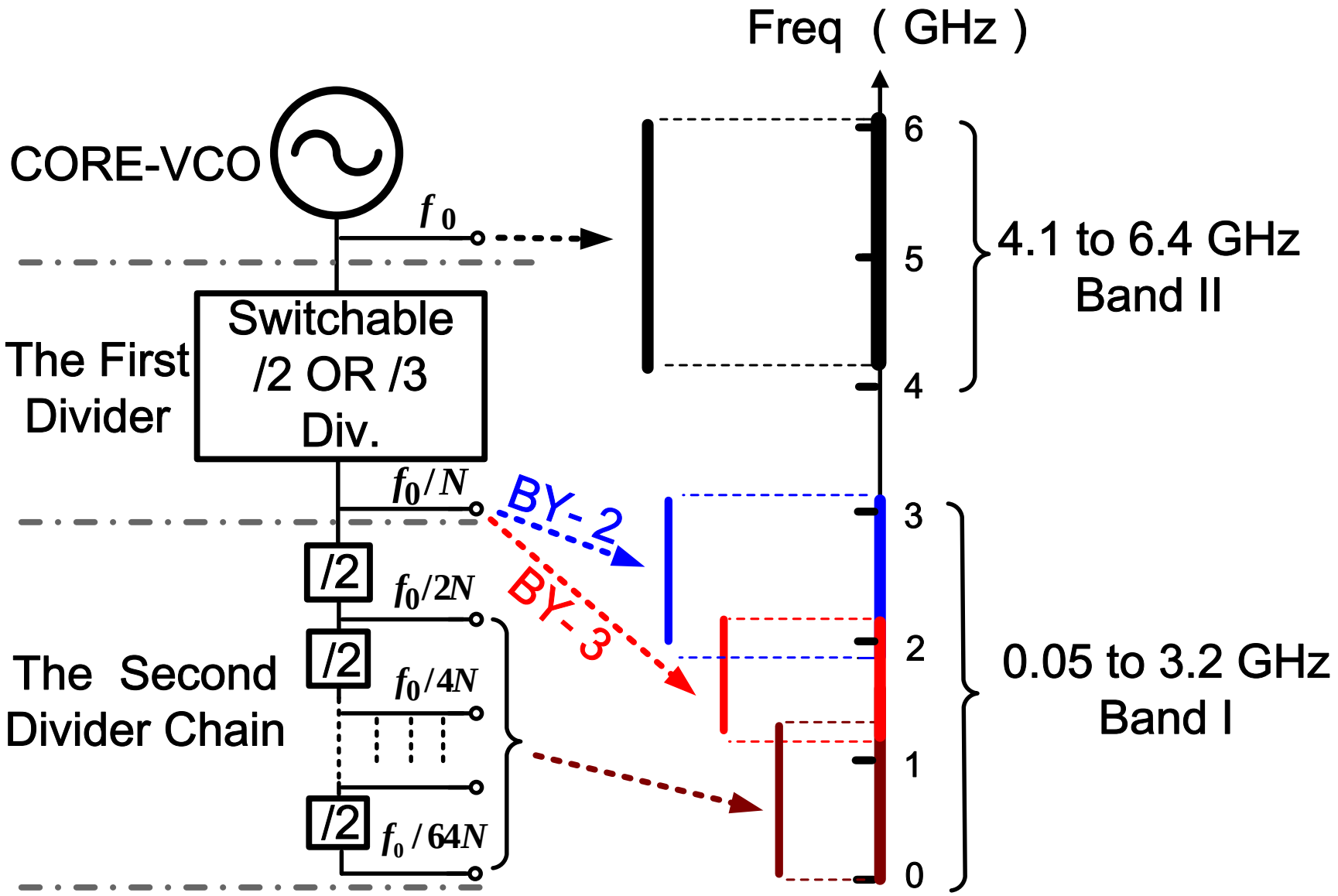
Challenging for Clock Generator

Year	CMOS	V_{DD}
2000	0.35μm	3.3-V
2010	40nm	1.0-V
2024	8nm	**0.5**-V

Under low supply voltage

- **LC-VCO based**
  - **Small jitter**
  - **Narrow tuning range**
- **Ring oscillator based**
  - **Large jitter**
  - **Wide tuning range**

Proposed Architecture



Comparison of Low-voltage VCOs

-	Unit	[1]	[2]	[3]	This work
Topology	-	LC	LC	Ring	LC + Divider
P_{DC}	mW	3.0	0.365	1.157	0.75~1.0
Jitter	ps	<1	<1	>15	<1
Tuning Range	%	8.1	20	176	194

[1] K. Kwok, *et al., JSSC* 2005 [2] D. Park, *et al., TMTT* 2009 [3] K.H. Cheng, *et al., TCAS I* 2010

Conclusion

- **The necessity of LC VCO for ultra-low-voltage clock generation is investigated in depth.**

- **A 0.5-V, 0.05-to-3.2 GHz, 4.1-to-6.4 GHz, LC-VCO for sub-picosecond-jitter clock generation is realized.**