The Future of Computing Hardware

Superconducting Digital Computing

Q. Herr
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Abstract

Superconducting Digital Computing based on Single-Flux-Quantum data encoding is a cryogenic, beyond-CMOS technology with near-term development potential relative to Quantum Computing. Superconducting digital offers 10x improved clock rate and 100x improved power efficiency relative to advanced-node CMOS at scale. The superlative properties of superconducting logic and interconnect give power densities of less than 1W per square cm, enabling 3D packaging with unprecedented computational density. Circuit demonstrations to date have shown progress but remain modest by CMOS standards, scaling the technology will require development of a fabrication stack using novel materials, which would also be applicable to superconducting Quantum implementations.

Biography

I have spent my career in technology development of superconductor integrated circuits, which has application in beyond-CMOS digital, mixed-signal, and quantum computing. After several years as a staff scientist at TRW in Los Angeles and as a Northrop Grumman Fellow in Baltimore, I am very pleased to be part of imec as a Scientific Director on a team focused on superconductor digital systems, circuits, and materials. My experience has included technical leadership of projects large and small, mentoring the next generation, and teaching seminars on superconductor technology. I have written about 40 peer-reviewed publications and 50 patents, and hold an MA in Physics and a Ph.D. in Electrical Engineering from the University of Rochester.

Frugal Artificial Intelligence For Edge Devices

T. Signamarcheix
Vice President Strategic Development
CEA-Leti, Grenoble, France

Abstract

Considering the huge demand for edge devices, frugality has become a critical challenge and still require deep innovation . Thomas Signamarcheix, CEA-Leti's Vice President Strategic Development, will present how new hardware could provide disruptive solutions for edge devices and especially event based sensors .

Biography

Joined CEA-Leti in 2008 and was named manager of a research laboratory on substrates engineering in 2011. From 2015 to 2019, he was promoted to business development management for Leti's Silicon Component Division and Architecture and Embedded Software Division. Also, as Key Account Manager of several strategic collaborations, he directly managed a wide range of activity (semiconductor, alternative energy, sensor, radio-frequency, etc.) promoting innovation at both hardware and architectures level. He has served as vice president of CEA-Leti's strategic development since 2020, managing Leti's strategic program (Quantum Electronic, Artificial Intelligence, wearable healthcare devices and mixed reality) and strategic partnerships. He has a Ph.D. degree in the physics of semiconductor devices from Grenoble Institute of Technology (INPG).

Semiconductor Enabling Vr/AR as the New Dimension Of Human Connection

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Abstract

As the world Digitalization is rapidly accelerating and providing real benefit to each one of us, a spate of emerging technologies—especially, artificial intelligence (AI), virtual reality (VR), and augmented reality (AR)—are gaining prominence across industries. These technologies have their unique capability to reduce the distance between people and deliver fully immersive experiences in all kinds of environments. The power of VR/AR combined with AI also allows machines to operate at the cognitive level as humans and allows us to interact naturally with machines. Such emerging technologies bring huge opportunities to semiconductor, but also new challenges that need our attentions: see-through near eye microdisplay, real-time image sensing & processing, low-weight low-power for round the day usage. Those requirements are not only challenging for design house, but also for semiconductor technology. Instead of chasing down the advance node, the industry needs to collaborate vertically and find the right trade-off between speed, power and cost. In GlobalFoundries, we are taking up on this challenge with our partners to enable the next-generation VR/AR products based on our unique solutions.
GlobalFoundries® (GF®) Microdisplay solutions are optimized to improve process speed and reduce leakage while enabling enhanced pixel driver functionality.

High density SRAM cross node comparing
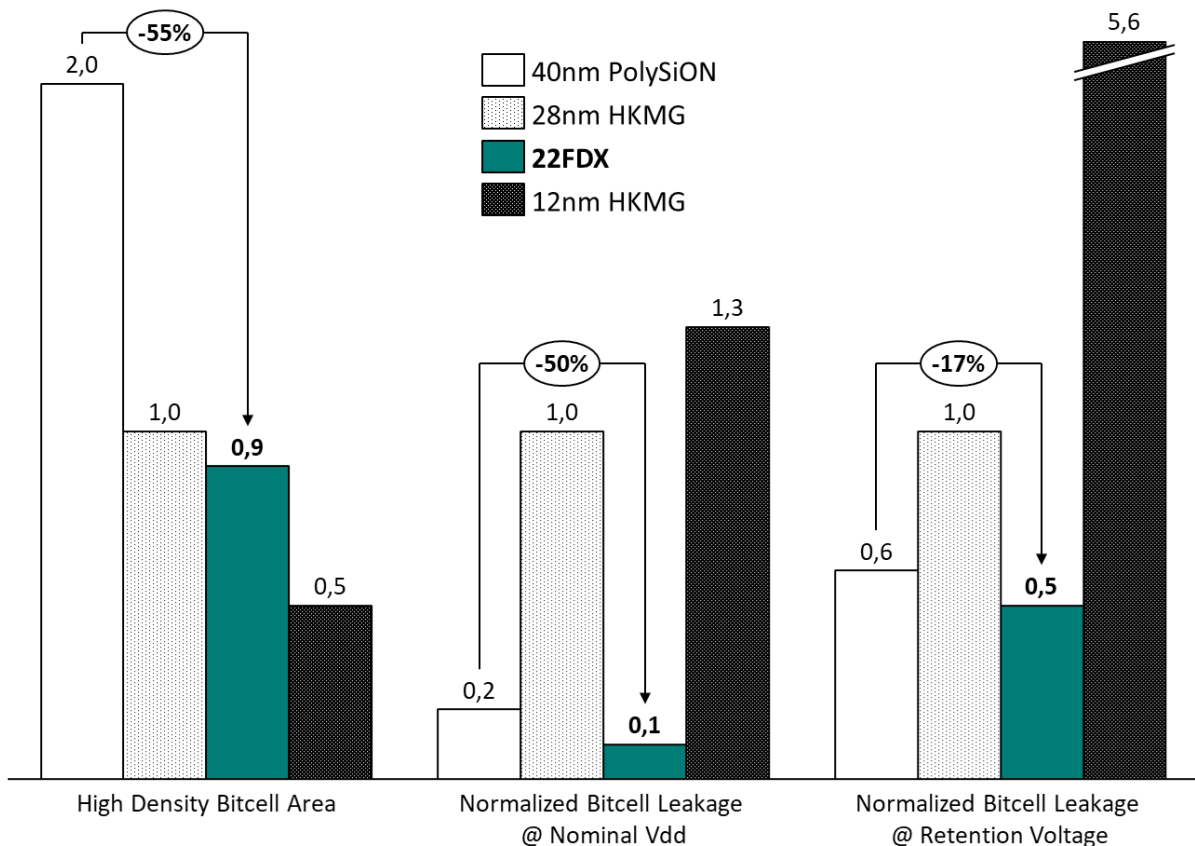
High density area and leakage reduce with technology node shrinking

It significantly speeds up VR/AR applications to support real-time data analysis and edge computing. Our platform is compatible with multiple display technologies, like LCOS, and microLED.

LCOS	microLED
22FDX Supports pixel size down to 2.5um with up to 2K x 2K resolution. Mirror reflectivity >65% at 450nm-650nm wavelengths.	22FDX Supports pixel size down to 2.5um. Supports ultra-high density ultra-low leakage Memory-In-Pixel design.

Globalfoundries microdisplay solutions

We are aiming to enable our technology down to 22nm to reach 4K resolution within 2 inches diagonal MicroDisplay.
There are still more challenges to overcome before widespread consumer VR/AR applications. However, with our effort to advance foundry technology and collaboration with industry partners, in the not-too-distant future, we will see AR everywhere in our life and connect us in real-time without any "distance".

Biography
After 10 years working in semiconductor and GLOBALFOUNDRIES® (GF®), I am so proud to be part of this vital industry and hold my exciting position as business line manager for Human-Machine-Interaction (HMI) products. My vision is to reshape HMI technologies all over the world and enable the AR/VR foundry solution with a special focus on MicroDisplay and image sensors. In GF®, we know we cannot do it alone. That is why I am glad to have our industry partners, research institutes, and government bodies support us, especial in Europe.
In addition, we must have human needs in our hearts and do not forget about the minorities. Therefore, I am also a Diversity & Inclusion Partner in our German site to build better technology, a better workplace, and a better society.
I hold an EMBA from ESCP Business school and a Ph.D. in Microelectronic Engineering from the National University of Ireland, Cork.