

Microprocessor at 50: Industry Leaders Speak

Lizy Kurian John , *The University of Texas at Austin, Austin, TX, 78712, USA*

Vijaykrishnan Narayanan , *Pennsylvania State University, State College, PA, 16802, USA*

At this landmark event when the microprocessor turns 50, we asked leaders at major microprocessor companies to reflect on this remarkable achievement, their favorite processor,

coolest features of microprocessors, or their special personal microprocessor memories. Please read on to find what NVIDIA, Intel, AMD, ARM, and TSMC leaders have to say.

The year 2021 marks the 50th Anniversary of the 4004 chip. Few tech companies can even fathom reaching such a milestone. From a 4-bit CPU that clocked a whopping 740 kilohertz, capable of executing 92,000 instructions per second and accessing 4 KB of program memory and 640 bytes of RAM to a chip with two to eight cores, a 4.8-GHz CPU clock rate that can cache up to 12 MB, a quad-channel 3,200-MHz memory and high-definition immersive graphics. (And that's just where we are today!)

I often say I grew up in Intel's hallways—pushed and inspired by the likes of Robert Noyce, Gordon Moore, and Andy Grove. The frightening yet exhilarating experience of architecting the 486 and then the manager that took it into production will always be a career-defining experience. My faith in the power of technology to improve the life of every human has only grown stronger. Bob Noyce's integrated circuits and those 4 KB took us to the moon. Today, my grandkids can explore the universe from a handheld computer. Moore's law remains alive and well. Such progress is just a part of our daily reality today. While this may be the microprocessor's golden anniversary, we will be relentless in our path to innovate in the magic of silicon until the periodic table is exhausted.

Pat Gelsinger, Chief Executive Officer of Intel Corporation

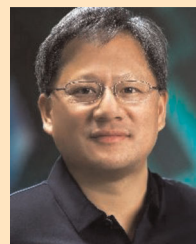


If there are such things as Infinity Stones, then the microprocessor is surely one of them. It has been thrilling to see its evolution from microcode, to pipelining, RISC, superscalar, out-of-order execution, to multithreading and multicore. No technology has contributed to human advance like the microprocessor.

One of my favorite features of the microprocessor is the peripheral bus—a memory-mapped I/O feature that enables new technologies to be connected to the computer. It has enabled the addition of new inventions like networking, modems, Wi-Fi, video processing, and close and dear to my heart, the GPU, which opened the world of accelerated computing.

Happy first half century! Can't wait to see the world at your centennial!!!

Jensen Huang, President and CEO of NVIDIA Corporation.



It's not easy choosing a favorite—I've had the opportunity to work on so many processors that I'm proud of during my career. But I have to say AMD Ryzen—our first processor with the new "Zen" core that put AMD on a new performance trajectory toward leadership—that's a special one for me. Ryzen brought millions of PC enthusiasts along on a journey—the first public demo, the reveal of the name "Ryzen," the first performance numbers. . . all the way to today with Ryzen being one of the most popular processors in the world powering everything from gaming PCs to business laptops to game consoles to electric vehicles.

Lisa Su, President and CEO of Advanced Micro Devices, Inc.



I can't overstate the role that processors have played in transforming every aspect of our lives. Over the course of three decades, we at Arm and our partners saw a huge opportunity in developing solutions to embed power-efficient processors within sophisticated systems that would unshackle compute from mainframes and desktops. We had no idea what the killer application would be, and it turns out it's everything and everywhere. Now, 30 years later, there's a supercomputer in your pocket and microprocessors are helping us understand more everyday about planet Earth and beyond. We couldn't have predicted that, and I can't wait to see what innovation is sparked in the coming decades as a result of ubiquitous compute.

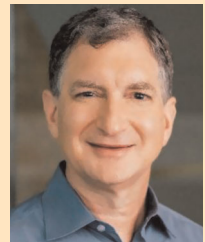
Simon Segars, Chief Executive Officer of ARM Holdings plc.



The Zen family of CPUs has been an incredible journey, driving a rebirth of industry competition in high-performance microprocessors and underpinning AMD's turn around. Zen1 brought competition back with a 52% generational IPC improvement, and Zen3 took the leadership crown across both single and multithread x86 workloads. Zen2 was incredibly special though, as it had to be reimaged in the middle of its development cycle. AMD CPU team is incredibly good at predictive metrics, and the metrics clearly indicated we would miss our window to market. Too many new microarchitectural design elements that could not be verified in time. Great job by the team to propose an alternate design that surgically added key design elements to Zen1 baseline RTL, focused on full optimization for 7 nm, which was already well under way, and lead the way with an industry-first dual-node chiplet approach with separate CPU and I/O die chiplets. This type of "failure is not an option" approach, is part of the AMD CPU team culture and indeed we hit our time to market leadership product.

The birth of PowerPC is definitely a special memory. I was invited to an unmarked, unoccupied IBM building and when we all arrived, a group of leaders across Apple, IBM, and Motorola were assembled to collaborate on a new processor family. We hatched a plan to develop the first processor such that it could tape out within one year. A derivation of IBM's RISC Power architecture RSC chip, and Motorola bus architecture, and key requirements from Apple: the PowerPC 601 was defined over a matter of days. We assembled a cross-company team and with considerable esprit de corps, innovation, and sheer sweat equity achieved that challenging schedule, and delivered a leadership processor to market in Apple Mac and IBM workstations.

Mark Papermaster, Executive Vice President and CTO of Advanced Micro Devices, Inc.



For 50 years, the microprocessor has been a key driver of innovation for semiconductor technologies. With billions shipped, microprocessors have touched the lives of almost everybody on this planet. Since our founding in 1987, TSMC's vision was to democratize semiconductor innovations through our Pure-Play foundry business model. Today, TSMC delivers an effective integration of the world's most advanced semiconductor and 3DIC advanced package technology, along with unmatched manufacturing scale, enabling customer design ecosystems, produces a variety of advanced microprocessors that better the lives of billions on this planet. We look forward to the next 50 years of microprocessor and semiconductor innovations.

Mark Liu, Executive Chairman of Taiwan Semiconductor Manufacturing Co.



LIZY KURIAN JOHN is a Cullen Trust for Higher Education Endowed Professor with the Electrical and Computer Engineering Department, The University of Texas at Austin, Austin, TX, USA. Contact her at ljohn@ece.utexas.edu.

VIJAYKRISHNAN NARAYANAN is the Robert Noll Chair Professor of Computer Science and Engineering and Electrical Engineering at the Pennsylvania State University, State College, PA, USA. Contact him at vx9@psu.edu.



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