

FPGA Computing and More!

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Field-programmable gate arrays (FPGAs) have been used as special function accelerators and reconfigurable platforms for more than three decades. In early designs, FPGA accelerators were plugged in to the backplane in desktops and workstations, whereas now with System-on-a-Chip (SoC) designs, it is possible to more tightly integrate FPGAs with embedded processors or other compute hosts. This issue of *IEEE Micro* presents seven articles on state-of-the-art topics in FPGA computing and a few other general articles.

Maya Gokhale of Lawrence Livermore Laboratories and Lesley Shannon of Simon Fraser University (Canada) served as the guest editors for this special issue. The special issue articles cover many interesting topics such as the integration of hardware accelerators and software in heterogeneous systems for SoC designs, binary translation solutions to convert designs described in software to a combination of hardware and software, FPGA-accelerated, cloud-hosted hardware emulation platform, acceleration of phylogenetic applications, acceleration of genomic analysis and weather prediction, mixed precision convolutional neural network inference accelerator on FPGAs, and use of FPGAs to accelerate quantum computing emulation. The guest editors have written a detailed introduction to the seven articles, to give you a better glimpse of the contents. I take this opportunity to thank the guest editors for their efforts in getting many submissions and in getting them reviewed.

In addition to the special issue articles, this issue also features a regular track article, an article on patents, a product review on AMD EPYC processors, and a Micro Economics column article.

In the general interest article, Kattan *et al.* present an energy-efficient thermal management for mobile processors. Read this article to find out how arrays of thin-film thermoelectric (TE) devices are integrated within the chip packaging for thermal management. The authors describe how the thermoelectric devices

can be used to absorb heat (when the on-chip temperature is above the critical temperature) or to harvest energy (when the on-chip temperature is underneath the critical temperature).

IN EARLY DESIGNS, FPGA ACCELERATORS WERE PLUGGED IN TO THE BACKPLANE IN DESKTOPS AND WORKSTATIONS, WHEREAS NOW WITH SYSTEM-ON-A-CHIP (SOC) DESIGNS, IT IS POSSIBLE TO MORE TIGHTLY INTEGRATE FPGAs WITH EMBEDDED PROCESSORS OR OTHER COMPUTE HOSTS.

IEEE Micro has been working on getting a regular column on patents. Here is the first of those. Joshua Yi, a patent lawyer with a Ph.D. degree in computer engineering, writes about the recent patents from major computer architecture companies. Yi examines the patents granted in the first quarter of 2021 in computing-related areas, makes observations on the dominant players, and highlights a few interesting patents.

Another interesting article that is presented is the Product Review article "Rome to Milan: AMD continues its tour of Italy," from Michael Mattioli. He surveys the AMD EPYC processors, giving an overview of recent AMD microprocessors and evolution of the AMD Zen microarchitecture, and briefly commenting on competing products from Intel.

This issue also presents a timely Micro Economics article by Shane Greenstein of Harvard Business School, titled "Shortages of integrated circuits." Greenstein describes the impact of the shortage of computer chips for automobiles, gaming platforms, displays, televisions, etc., and analyzes the reasons behind the shortage. Demand for integrated circuits keeps growing in general. In some sectors, demand increased with the "stay-at-home" economy. The decrease in demand at the beginning of the pandemic in some sectors such as automobiles led to adjusted forecasting, and that also impacted the supply chain.

Read this article to understand why there can even be a long-term shortage.

IEEE MICRO WILL BE CELEBRATING THE 50TH BIRTHDAY OF THE MICROPROCESSOR WITH A SPECIAL ISSUE IN NOVEMBER/DECEMBER 2021.

This is the year of the 50th birthday of the microprocessor. There is a historic panel with Federico Faggin, the designer of the first microprocessor Intel 4004 at the 2021 International Symposium on Computer Architecture (ISCA). Federico Faggin was the Editor-in-Chief of *IEEE Micro* in 1996 when microprocessor turned 25. I am enjoying the opportunity to organize this panel at ISCA 2021 with Faggin and co-founders/designers of many industry-successful microprocessors during these five decades of accomplishment. Participating in the panel are John Hennessy (MIPS co-founder, past Stanford President, Turing award winner), David Patterson (Turing award winner, SPARC designer, currently at Google), Glenn Henry (co-founder of Centaur), Kathy Papermaster (circuit designer at IBM for 26 years), Lee Smith (co-founder of ARM), Shekhar Borkar (34 years at Intel and now at Qualcomm), and Chris Rowen (co-founder of MIPS). The panel is moderated by J. Scott

Gardner, former Senior Analyst at Microprocessor Report, and Vice President of Intrinsity, which was acquired by Apple. Tune in to the ISCA website for more details.

<https://www.iscaconf.org/isca2021/program/>

IEEE Micro will be celebrating the 50th birthday of the microprocessor with a special issue in November/December 2021.

I am sure your heart is throbbing with your own personal story with microprocessors. If you have any stories or anecdotes that you would like to share, *IEEE Micro* would love to hear them. Send your favorite stories, anecdotes, and photographs to micro50@gmail.com

Selected stories will be printed in the November/December issue or displayed on the *IEEE Micro* website. I am eagerly looking forward to putting together the Special Issue on the 50th Anniversary of the Microprocessor.

I hope that this current issue makes you excited to read the various articles on state of the art of FPGA computing, and makes you waiting for the upcoming issues.

Until next time.

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