Ambarella / LES KOHN

Processor innovation

BRINGS PERFORMANCE BOOST

Ambarella's Les Kohn discusses CPU trends and compelling video applications, such as cameras and security.

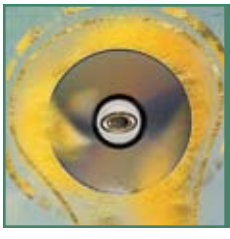
LES KOHN, co-founder and chief technology officer of Ambarella, has a lengthy history of processor innovation. After graduating from the California Institute of Technology with a degree in physics, he helped architect the NS32000 microprocessor family at National Semiconductor and then worked on the i860 CPU at Intel. Kohn subsequently was chief architect of the UltraSPARC (scalable-processor architecture) I and II at Sun Microsystems, where his experience with multimedia-tailored instruction sets prepared him for his next career turn, as chief architect of three generations' worth of video processors at C-Cube, which LSI Logic later acquired. From there, he became chief technology officer and co-founder of Afara, whose multicore-server microprocessor Sun Microsystems later acquired as the basis of the T1 server-CPU family.

As such, Kohn's big-picture thoughts on multicore-CPU-programming challenges derive from nearly three decades' worth of experience in the area. "Software developers have dealt successfully with using parallel processing in the server-computer space for some time," he explains. "Major data-center applications, such as Web services, application servers, and database servers, are designed for multiprocessor scalability using both loosely and tightly coupled processors. The key to this type of scalability is that there are a large number of concurrent clients that can be serviced in parallel, and the software architecture … [removes] dependencies between transactions."

Kohn says that designers have successfully parallelized large-scale scientific code by appropriately partitioning the large data sets. "The major problem is primarily with client-side applications that do not have a simple paradigm for evenly dividing up the work across many processors," he continues. Kohn thinks that neither development tools nor programmer training can solve this problem. "It will require intensive re-engineering of the code by analyzing performance bottlenecks and developing case-by-case solutions. In many cases, it will not be worth the effort to do this [task], and the applications will live with a gradual performance improvement from increasing cache sizes, clock-rate scaling, and microarchitecture optimizations," he says.

On the other hand, he adds, developers can parallelize the most interesting and computationally intensive tasks on the client side, including image, graphics, and video processing. Also, because the human brain is a parallel-processing engine, it seems clear that designers can also parallelize artificial-intelligence-type tasks, such as speech recognition and computer vision. And Kohn remains optimistic that people will figure out how to use whatever transistor budget future process technology provides.

On future process technology, Kohn's historical perspective reveals some troubling trends. "The first microprocessor I worked on 30 years ago used a 4.5-micron process," he says. "Now, 0.045-micron microprocessors are entering production, with a 10,000-times density improvement and bigger die. However, I believe the performance gain is only around 2000 times. Clearly, the rate of performance increase of general-purpose processing is slowing down, and the drive for power efficiency and performance will require more specialized processing engines. At the same time, the cost of developing state-of-the-art SOCs [systems on chips] and associated software is continuing to rise. There are not many markets that have the volume to justify this level of investment, and it has never been more challenging to be in a semiconductor start-up."



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Ambarella's management team is flush with C-Cube veterans, so it's probably no surprise that the company focuses on high-definition-video-processing silicon "engines." The company is standardizing on the H.264 video codec, otherwise known in the industry as MPEG-4 AVC (advanced video coding), MPEG-4 JVT (joint video team), and MPEG-4 Part 10. A notably high-volume destination for such chips is the high-resolution camcorder.

"HD camcorders accounted for 12% of unit shipments last year and are projected to reach around 40% by 2010," Kohn says. "New HD camcorders have moved to H.264 to improve recording time." He adds that manufacturers are using different container formats, including .mp4 and AVC-HD (advanced video coding high definition). "In addition to the traditional camcorder market, I expect that hybrid DSC/HD [digital still-camera/high-definition] videocameras will become increasingly popular as the incremental cost for HD video drops." Trendsetting versions of such products are now on the market. Manufacturers have based cameras on the Ambarella A2 that can capture 5M-pixel still images and 720P60/1080P30 HD-video formats. These cameras retail for approximately $200.

Will such video and video-plus-still cameras employ magnetic-tape, optical-disc, hard-disk-drive, or flash-memory options? "Tape-based camcorders, including DV and HDV [high-definition video], are rapidly declining segments of the camcorder market," says Kohn. Last year, MiniDV represented only 29% of unit shipments, and forecasts expect less than 20% this year. Optical-based formats are also fading due to recording time and performance limitations, leaving hard-disk- and flash-based storage as the media of choice. "Flash-based storage has many advantages over small hard disks, including lower power, smaller size, increased ruggedness, and better performance, and is becoming compelling as flash prices continue to drop dramatically," Kohn says. He predicts that the barrier to entry for flash-based camcorders is much lower than that for traditional tape-based camcorders. Kohn also predicts that the price of a basic HD-camcorder/hybrid-DSC model will drop to less than $100 as low-priced brands compete in the market.

Nonetheless, the company isn't putting all of its bets on a single market opportunity. "There are many applications for Ambarella chips beyond camcorders and hybrid cameras, including broadcast infrastructure," he says. Most H.264-encoder systems now use Ambarella chips. Although it was not the company's initial objective to address this market, it found that its low-power, single-chip-encoder quality was better than high-end multichip-DSP/FPGA alternatives. Another market for Ambarella's chips is in security, including both HD IP (Internet Protocol) cameras and multichannel DVR (digital-video-recorder) and NVR (network-video-recorder) encoders. The chips can also capture HD video for PCs, perform time-shifting for PVRs (personal video recorders), and enhance HD videoconferencing.

"Ambarella's biggest challenge today is not the number of applications or potential design wins but picking the right high-volume opportunities to focus on," Kohn concludes. That's a good problem to have.

—Brian Dipert

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