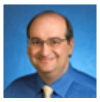
LEIBSON'S LAW



Leibson's Law: It takes 10 years for any disruptive technology to become pervasive in the design community. This blog is about the disruptive technologies that either have or will win over electronic engineers, some that won't, and why. Written by Steve Leibson, **Tensilica**'s Technology Evangelist. See my history site at **www.hp9825.com**.

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Tuesday, June 10, 2008

Field Notes from DAC 2008: Intel's Chief CTO Justin Rattner Speaks on Multi-Radios and System Engineering in General

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Intel's Chief CTO Justin Rattner gave a really insightful talk as this morning's DAC keynote. Although his talk was supposedly about "multi-radios" (more on those in a bit), he was really speaking much more broadly about no-nonsense approaches to system engineering. Rattner framed his talk by discussing one of Intel's current technological visions: "Carry Small, Living Large" or CSLL. The "carry small" part intuitively refers to small systems that you carry around with you all the time. These platforms give you the essential computing resources needed to run a wide variety of applications. The platforms are also power-efficient, allow anytime/anywhere collaboration via the Internet, and sense the world around themselves to maximize their utility. The "living large" description means that the user gets an "amplified experience" (whatever that means); seamless access to the highest-available networking bandwidth; context awareness and composability (whatever that means); and utility at work, at play, at home, or while traveling.

Devices that conform to Intel's CSLL vision will be based on SOCs with multiple processors and crypto, speech-processing, graphics, image-processing, and multi-radio blocks. The power envelope for these end-unit devices is limited to 3W so as not to burn the user's hand. They also need to be kind to batteries; must not cost a lot; have few connectors (possibly just one); and be less complex to use than today's PCs.

Rattner noted that we interact with the world in an analog way and so do our devices but silicon technology clearly favors digital circuits. As a consequence, ITRS data shows that only 10% of the SOCs designed in 1999 had on-chip analog interfaces while 50% had analog interfaces in 2005 and 70% of SOCs had analog interfaces by 2006. "Even so," said Rattner, "analog isn't getting any easier." Transistor scaling

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arclight_arclight on Field Notes from DAC 2008: Intel's Chief CTO Justin makes analog harder. There are many device-scaling issues for analog including increased variation in device characteristics, transistor output impedances that do not scale, increased 1/f noise, and increases in both leakage and leakage variation. These challenges are not stoppers, but they do require R&D to fight. Sometimes, said Rattner, the fight simply feels like were trying to stave off the inevitable.

One approach to reducing the amount of analog required in a system is simply to replicate the existing processing chains while converting as much analog circuitry to digital as possible. For example, you can perform minimal amounts of analog signal conditioning—just enough to get into an A/D converter—and then digitize the analog signal to transition into the digital domain, where you perform as much processing as possible. This design approach doesn't really result in a new system architecture. It merely reduces the analog content in the existing system architecture.

Another way to approach the problem is to completely rethink the system. As an example, Rattner described cameras, which have just undergone their own transition from analog to digital. Analog cameras used film, chemicals, and printing paper to capture and reproduce images. Very analog. Digital cameras replace the film with silicon sensors so there's no analog film processing.

However, today's digital cameras have system architectures that closely resemble their analog predecessors because there's still a precision-ground lens performing the most important analog processing on the incoming light. The lens focuses incoming rays onto a rectangular sensor. "We left the camera intact," said Rattner. "We just changed the sensor." It need not be so.

It turns out that it's possible to greatly simplify the camera's lens design if you assume a lot of post processing will be performed on the captured image. Case in point: a PhD graduate at Stanford named Ren Ng refined the concept of "light field" photography initially developed at MIT. Instead of capturing only the parallel incoming light rays from a scene, a "Light-field" camera captures all of the rays using an array of microlenses over a sensor. The resulting 'image" actually contains a range of images that can be resolved with some prodigious computing power. The result is a camera with cheaper lenses that can produce multiple photos with different depths of field and even different viewing angles from one captured "light field" image. A company in Mountain View named **Refocus Imaging** is now commercializing the idea.

The same concept of reconceptualizing systems designs can be applied to radios. In the old days (before 2007) we put multiple discrete radio sets in PCs that needed different WLAN abilities. Intel's vision is a "multi-radio" that can jump from one WLAN or WAN protocol to another quickly. Here, as with the camera example, the idea is to fully exploit radio's inherent computational nature. "What kind of computational nature does radio have?" you might ask. It so happens that radio designers already think of radio in terms of algorithms. They simply implement these algorithms with analog components at the moment, as they have for the last 100 years. According to Rattner, system implementations that exploit digital computational resources to execute radio algorithms provide increased flexibility, better time to market, lower costs, lower power consumption, higher integration, and digital calibration and compensation.

Intel has already developed various pieces of the digital multi-radio and has described these pieces at various conferences. The company has developed a class-D digital power amplifier in 65nm silicon, a fractional-N synthesizer in 90nm silicon, and a spectrum-sensing sigma-delta A/D converter in 90nm silicon. "The bits and pieces are coming together," said Rattner.

There are many more rethinking opportunities as well, in robotics and user interfaces. Instead of "light fields," think of processing sound fields, visual fields, and RF fields to create much smarter sensing systems.

By the way, Rattner would sure like some system-level EDA tools that could help his teams rethink more systems.

Rattner Speaks on Multi-Radios and System Engineering in General

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"Chief CTO"? Is that really his title? Funny.

at 6/12/2008 4:34:34 AM, arclight_arclight said:
This is all well and good, and desirable; however, for radios that have to hear very weak signals in the presence of very strong interferors, the amount of signal conditioning ahead of the ADC becomes significant. Once an amplifier creates cochannel IM distortion in the receiver it's basically impossible to get rid of it.

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