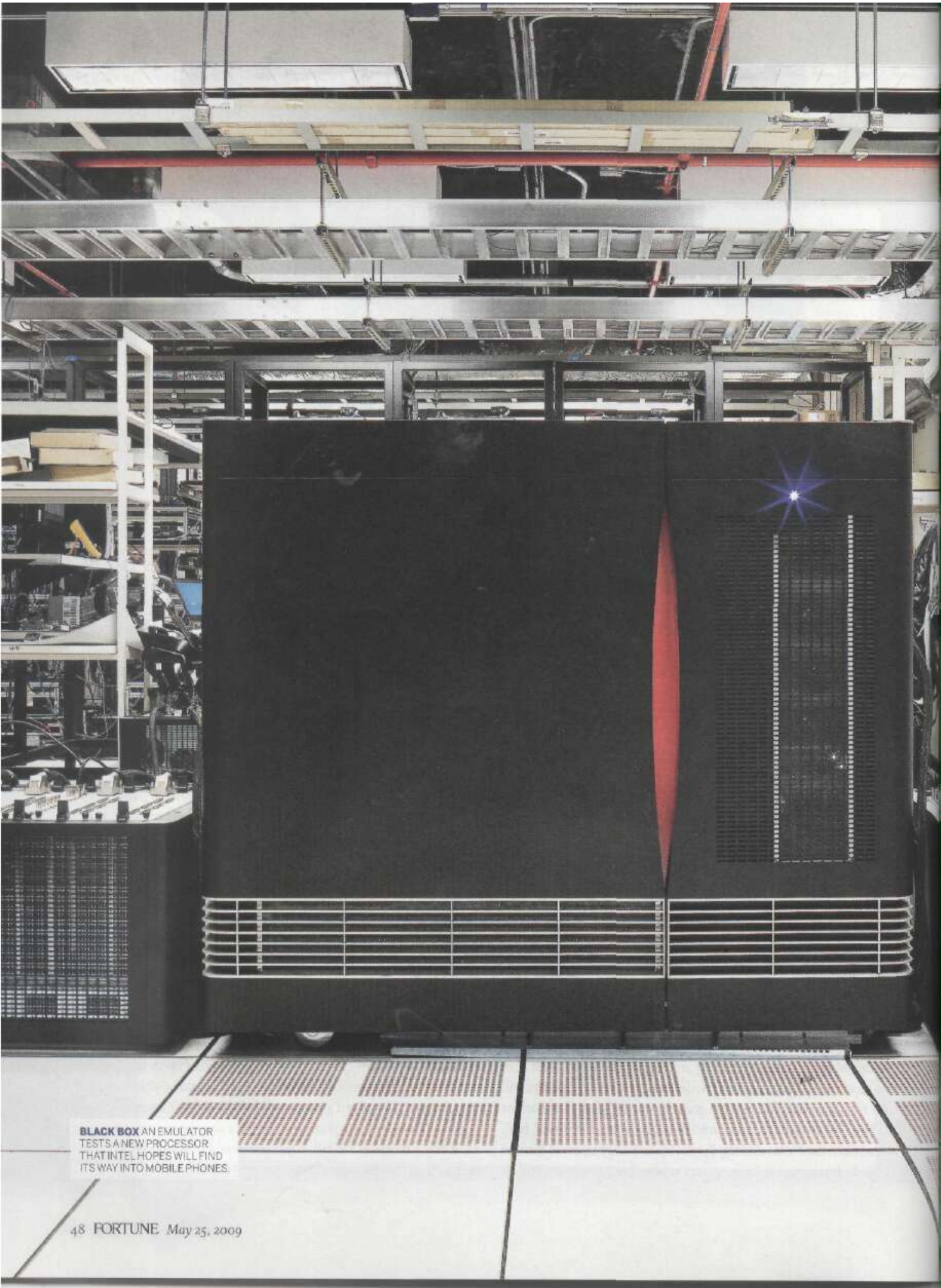


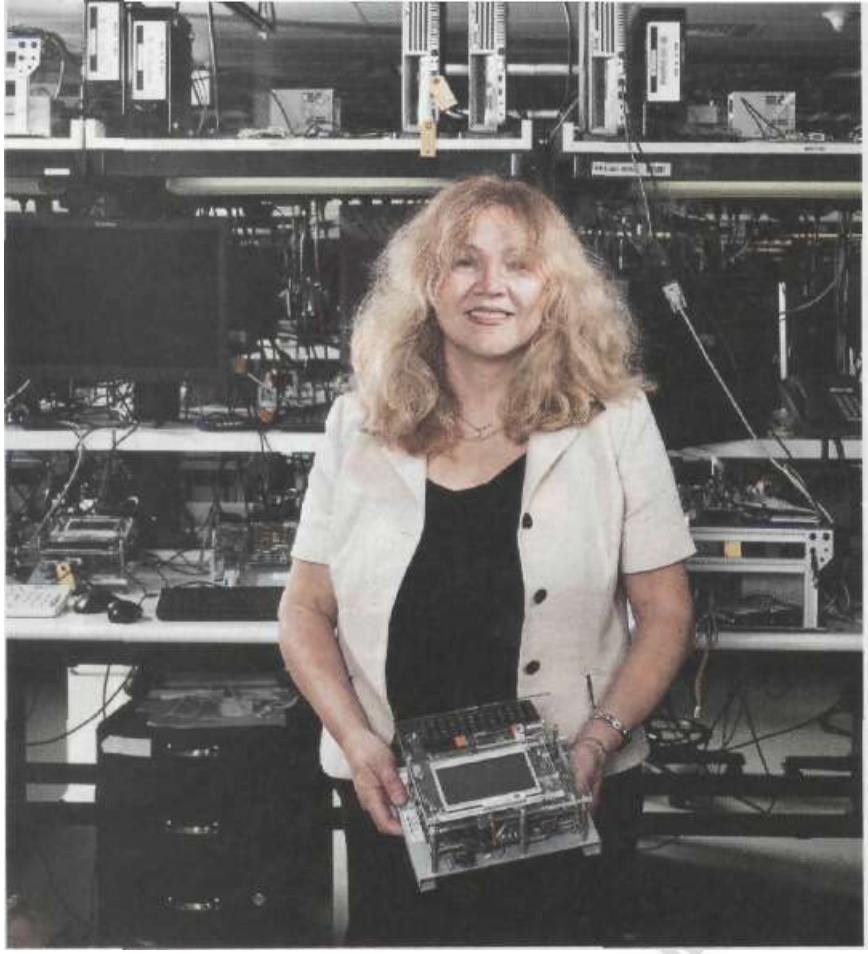
BLACK BOX AN EMULATOR TESTS A NEW PROCESSOR THAT INTEL HOPES WILL FIND ITS WAY INTO MOBILE PHONES.

INTEL'S SECRET PLAN

This giant box contains a super-hush-hush project that promises to transform Intel's business. Can the company inside millions of PCs find a way to power billions of phones and other gadgets?

BY MICHAEL V. COPELAND
Photographs by Misha Gravenor

AT INTEL'S OFFICES IN AUSTIN, visitors are welcomed by security, then pass through yet another gauntlet of guards and buffers as they make their way past a set of stout metal doors into the facility's fourth-floor labs. Once inside, they find a chaotic tangle of circuit boards and wires and the animated chatter of engineers huddling around computers and workbenches. At one end of the room a mysterious-looking box about the size of a refrigerator conceals a project so top-secret that the engineers won't tell you its code name at first; later, one lets it slip: Medfield.



INTEL INSIDERS ELENORA YOELI (LEFT), PHOTOGRAPHED IN AUSTIN, LEADS THE TEAM DEVELOPING CHIPS FOR CONSUMER ELECTRONICS AND EVENTUALLY SMARTPHONES. MARKETING HEAD MALONEY (ABOVE) PUSHES EXECUTIVES TO MAINTAIN MARGINS EVEN AS INTEL PURSUES HIGH-VOLUME BUSINESSES.

What the team in Austin—arid their bosses at Intel's headquarters in Santa Clara, Calif.—will disclose is that the microprocessor they're testing inside that black box is the culmination of a decade-long effort to push the world's leading supplier of brawny, energy-hungry chips for enterprise computers and PCs into an important new market: portable devices. The march started with the development of Centrino, a low-power Wi-Fi-enabled chip launched in 2003 that made laptops as functional as desktop computers. Last year Intel followed up with Atom, a super-low-power processor that is fueling the nascent market for so-called netbooks, those clutch-sized, bare-bones computers such as the HP Mini 1000 and Acer's Aspire One line.

For its next act, Intel is getting ready to launch an even lower-power "system on a chip" (silicon lingo for a single circuit that contains all the components of a computer), codenamed "Moorestown," that marries the low-power Atom processor with graphics processors, a memory controller, and other circuitry—a potent combination of technologies that has the potential to propel Intel into businesses that have long eluded the chipmaker: consumer electronics and wireless gadgets.

Succeeding in this new market is critical for $38-billion-a-year Intel, which, like the rest of the industry, is seeing a slowdown in PC sales. Partly as a result of sluggish revenue in

CHIPS OFF THE OLD BLOCK

A brief history of iconic chips.

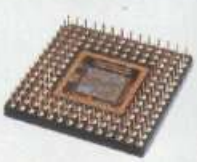
1972

8080
The first general-purpose microprocessor, it goes into traffic lights, cash registers, and, in 1975, one of the first PCs.

1981

8088
Gives birth to an industry; IBM uses it to power PCs.

1985



386
Launches a computer architecture that is core to Intel's chip design to this day.

its main business, the company's stock has been hit badly (down 31% in the past 12 months, underperforming Nasdaq slightly), and in the fourth quarter Intel reported its first loss in 21 years,

CEO Paul Otellini says he's confident that Intel can conquer consumer electronics, noting that such devices are increasingly becomingrmore like computers, something Intel knows intimately. "All consumer electronics—and I mean all—are aimed at bringing the Internet into devices," he says. Indeed, Otellini optimistically predicts that Moorestown will spawn a new category of handheld devices, much the way Atom seeded the netbook business. Intel already pulls in $2 billion a year in revenue from "embedded" chips—processors installed in medical devices, cars, and other machines. Otellini believes the next generation of Intel chips, starting with Medfield, eventually will populate all electronics, from wireless phones to M?3 players to heart monitors and household appliances.

But the shift Otellini is gearing Intel to make is fraught with major challenges. The big dog in computers, Intel finds itself the underdog in consumer electronics and phones—a decade ago it tried to make a chip for small devices and failed miserably. And Intel's aggressive push into portable products threatens to upend its driven culture, which has focused on churning out high-performance chips, and its earnings statement. Instead of selling tens of millions of high-performance chips at, say, $100 a pop, Intel has to try to sell hundreds of millions of low-power products at $20 apiece.

"The soul of the company has to drift away from 'We build the biggest and the baddest' to 'We build the most,'" says Sean Maloney, head of sales and marketing at Intel. "And we have to do it in such a way that we don't move into these markets and tank our margins." As we sit in a windowless conference room in Santa Clara, I ask him whether Intel absolutely has to crack into high-end cellphones and other "smart" consumer devices. Maloney, whom analysts believe is being groomed to take over after Otellini, draws in a breath, waits a beat, and then exhales. "Yeah, we do," he says softly. "Now we have to get there."

INTEL HAS MADE COMPANY-CHANGING bets before. Management seizes on a future trend, and the center of the company shifts. It happened in 1986, when then-CEO Andy Grove bet the future of Intel on the nascent PC and microprocessors. Several years later the company bet that speed would win the day, and in 1993 it unveiled another blockbuster, the Pentium chip, which helped desktop computers go mainstream.

Otellini is entrusting his company's current bet on small gadgets to a team led by Elenora Yoeli, a vice president in Intel's mobility group. Yoeli, who was part of the Israel-based team that delivered the PentiunH processor in 2000, helped launch the Austin lab, and in 2004 received these marching orders: Build a chip compatible with Intel's existing architecture, and make it consume one-tenth the power of the latest Centrino chip. She started with a $1 billion budget and a metaphorical blank sheet of paper. "We didn't spend time scaring ourselves—you don't do that at Intel," she says. The team built the chip by going through each feature and examining how much power it would consume. Features that delivered subpar performance or required too much power were ditched. The result: Atom, which met Yoeli's power and performance targets. "The design went very well, and we have done something no one was really expecting us to do: take a small design and put it into one of the most advanced processors in the world," she says, allowing herself a small smile. Now she's doing it again with Moorestown.

Intel, says Maloney, must shift from We build the biggest and baddest" to "We build the most" It won't be an easy sell.

Moorestown is actually two chips, each the size of the nail on your little finger, combined in a single module. One chip is the Atom processing core, which can handle graphics, video, and memory control. The second chip can enable a range of tasks, which might include digital imaging for a still or video camera, high-end audio, or some special security requirements. It is de-

REPORTEK ASSOCIATES *Anu Partanen and Anna Kattan*

signed for flexibility, depending on the gadget the system is ultimately crammed into. At the Austin lab Intel displays a handful of prototypes that suggest the kinds of devices that might eventually house the Moorestown platform: One looks like a long, narrow remote control with a smooth, flat face; another is slightly chunkier, with a five-inch screen dominating and no obvious buttons—clearly meant for watching video, or maybe gaming. A third device resembles an oversized iPhone. All of them are smaller than a netbook but larger than a phone; executives admit they need to get Moorestown's power requirements down even more in order to reside in a smartphone. (That's where Medfield comes in: It will be one chip instead of a two-chip system. That will make it a more efficient power user, suitable for phones. Sources expect Medfield to appear in devices in 2011,)

Intel hopes that Moorestown's flexibility will appeal to electronics makers, and the company is already in discussions with Sony, Toshiba, Canon, and health-care- and auto-device manufacturers about equipment that could be powered by the new chip system. First, though, Intel must find a way to manufacture Moorestown so that it doesn't, in Maloney parlance, tank margins,

That job falls to Gadi Singer, general manager of system-on-a-chip (yes, that's his real title), who must ensure that Moorestown can be built using as many of Intel's standard processes as possible. Singer learned the hard way how important standardization is: He was part of the team involved in Intel's failed foray into mobile devices 10 years ago when it inherited a low-power chip as part of its 1997 acquisition of a Digital Equipment Corp. unit. That chip, called XScale, was based on Advanced RISC Machine (ARM) architecture, a design system that was incompatible

Consumer electronics are becoming more PC-like, which *benefits Intel, says Otellini: "The market is coming to us."*[1]

CRAIG BARRETT'S EXIT INTERVIEW

At the end of May, Craig Barrett, the 69-year-old chairman and former CEO of Intel, will retire. He has spent much of his career turning Intel into an industry leader and manufacturing juggernaut. He spoke with *Fortune* contributor Brent Schlender about his tenure.

FORT ONE; Intel has had only marginal success in mobile communications technology, compared with the Pentium phenomenon. Why is that?

BARRETT: If you look back through the '90s, we were growing at 30% or 35% a year, top and bottom line. That's a pretty damn good business, and we were struggling to build factories and get the next-generation Pentium architecture out there. We pretty much had our hands full there, as opposed to bifurcating and to say, "Okay, half the company, you go off and chase this cellphone business."

So we single-rnindedly focused on the computer.

So what markets represent the next probable big opportunities for Intel?

You do see kind of a collision between the handset and the laptop. There's a huge opportunity in that space for full Internet functionality in a decreasing form factor. 1 also believe the consumer electronics devices are finally getting to the point where you're going to really integrate the Internet into those too.

You've always placed big beta investing in more and better manufacturing capacity in down cycles.

You can't save your way out of a recession; you can only invest your way out, [Intel founders] Bob Noyce and Gordon Moore said that, and Andy Grove and 1 have said that, and we're doing it again now. Paul [Otellini] made the announcement a few weeks ago of Intel's $7 billion investment in the next generation of manufacturing during a terrible recessionary time.

Is this basically the same as stimulus spending by the government to get the economy back on track?

In our industry we have no choice but to invest, in good times or bad. If we miss a development cycle, we pay for it. Actually we screwed up back in the 2004-05 time frame. We focused on putting higher performance in the laptop or the desktop PC and prioritized it way ahead of power consumption. But once you do that, battery life suffers. So we left the door open to another class of architecture to corrte in, which is focused on low power consumption, as opposed to the highest possible performance. We actually shut down work on a generation of chips to refocus on power consumption.

That sounds like what Andy Grove would call an "Oh, shit" moment. Any others stand out during your tenure at Intel?

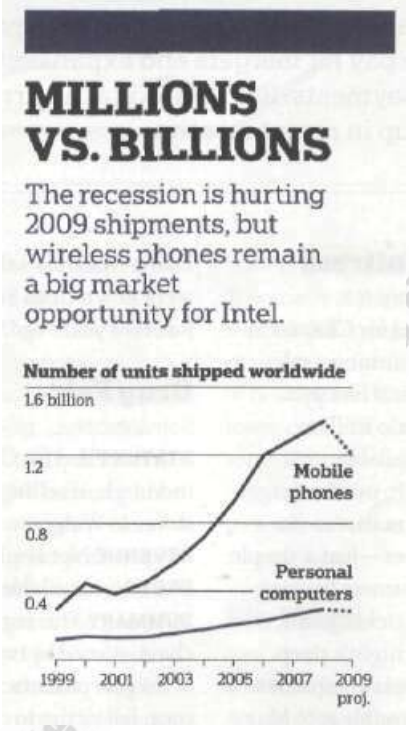
You know, most of the more recent "Oh, shit" moments have been probably associated with the unbounded euphoria with the technology in 2000. It was an "Oh, shit" moment when we woke up one day and realized that, in fact, the total throughput of the inter-net was not going to double every 30 days and all of this talk about unbridled needs and capability was absurd, and suddenly the P/E ratios of 60 disappeared.

with Intel's PC architecture. Originally designed for modems in cellphones, XScale chips were stupendous at operating at very low power, a necessity in mobile phones. But Intel had very little advantage in the market: Any company can license the ARM chip design and add its own unique features, which is exactly what Intel's competitors did. The chip barely got more than a 1% share of the cellphone business or about 16% of the PDA market. In 2006, well after the idea for Atom had been hatched, Intel sold the XScale business to Marvell for $600 million.

As management examined the problem, it realized that Intel's own PC-centric architecture could actually work to its advantage in^the post-PC world. "By 2004 it became clear that a lot of the devices outside the PC space would soon be touched by the Internet," Singer says. "With the Internet come a variety of requirements and expectations that everything works as it does on your PC—that is where Intel architecture has something significant to offer." Singer and Maloney saw that Intel needed a chip with even stingier power needs, a sort of scaled-down Centrino. The Atom project was launched soon afterward.

Still, the XScale debacle has left Intel insiders wondering whether the company can pull off this high-stakes incursion into the mobile world. "That's certainly the question my board asks the most," says Anand Chandrasekher, senior VP and general manager of Intel's ultra-mobility group. Chandrasekher explains to the directors that this time Intel isn't offering a plain-vanilla version of some other guy's architecture; it's peddling the same Intel architecture that runs Microsoft Windows and Apple's Mac OS X, and on which most of the Internet runs—just in a low-power package. The Atom line is part of the x86 architecture, which has the deepest library of applications, everything from Excel and Outlook to the vast majority of device drivers on the planet—the stuff that makes "plug and play" possible. Intel contends that bringing computing power to the mobile world is a lot easier than taking a chip designed for mobility and giving it the ability to handle computing applications.

"Moorestown, from a performance standpoint," Chandrasekher says, "will clean the clocks of the competition."



THE COMPETITION, NOT SURPRISINGLY, feels different. "There is nothing so sacred about the Intel architecture, about x86, that the world has to follow it wherever it goes," says Dan Vivoli, who heads strategic marketing for what is perhaps Intel's most persistent competitor these days, graphics-chip maker Nvidia. "The iPhone is the best mobile Internet device out there, and it has nothing to do with Intel architecture."

Vivoli has a point. The iPhone, which already runs ARM, does a great job of rendering web pages. What it doesn't do is run full-blown versions of Microsoft Office. "But is anyone really going to want that?" Vivoli asks rhetorically.

While Intel is prepping Moorestown for the market, Nvidia is shopping Tegra, an ARM-based systern-on-a-chip that it says offers all the performance at a much lower power cost than the current version of Atom. Qualcomm is offering Snapdragon. Texas Instruments has announced OMAP4- All these system-on-a-chip solutions are slated to appear in a variety of gadgets by the end of the year. With the exception of Intel's Moorestown, they are based on ARM. Expect a battle royal, with companies that have cellphone experience and market share (Qualcomm and TI) taking on newcomers bringing serious computing chops to the fight (Nvidia and Intel).

"This is going to be a polarizing year," says Francis Sideco, senior wireless analyst with research firm iSuppli. "You are going to see all the partnerships lining up. If Intel had come in a year later, I might have said the ARM world had it all wrapped up. But this is Intel. They are still the biggest semiconductor maker on the planet, and you can't put anything past that R&D machine they have over there." Intel also has a slew of customers, including Hewlett-Packard, Dell, and Microsoft, that surely are interested in following the Intel architecture wherever it goes. They, too, must figure out a future that extends beyond the PC, and Intel can help them do that.

Fred Weber, former CTO of Advanced Micro Devices, has battled Intel longer and harder than most. From a technical perspective, he is impressed by what Intel has accomplished with Atom. His view is that Intel's success in low-power processors depends almost entirely on management's commitment to the transition, which could be rough: Investors trade Intel stock based almost entirely on the profitability of its main business, PC chips, where margins are in the 40% to 60% range. The fear, near term at least, is that moving into the high-volume and highly competitive wireless-chip business will erode Intel s profitability, and the stock will tumble.

But in my conversations with Intel executives, none seemed to waver from belief in a low-power, high-volume future. Indeed, Otellini suggests that Intel has little choice but to develop chips for consumer electronics and other communications gadgets. "The market is coming to us more than we are chasing after the market," he says. Put another way, Intel's direction seems clear, even if some of its future products are hidden from view, a

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COPELAND, Michael V. Intel´s secret plan, **Fortune**, Amsterdan, n. 10, p. 48-53, June. 2009.