ghaff@
illuminata.com

Copyright © 2004 Illuminata, Inc.

internal use only

Gordon R Haff
Illuminata, Inc.

Copyright © 2004 Illuminata, Inc.
Personally licensed to Gordon R Haff of Illuminata, Inc. to educate him/her and assist him/her in performing internal job functions. Providing its contents to external parties, including by excerpt or quotation, is a violation of our copyright and is expressly forbidden. Email license@illuminata.com for broader rights.

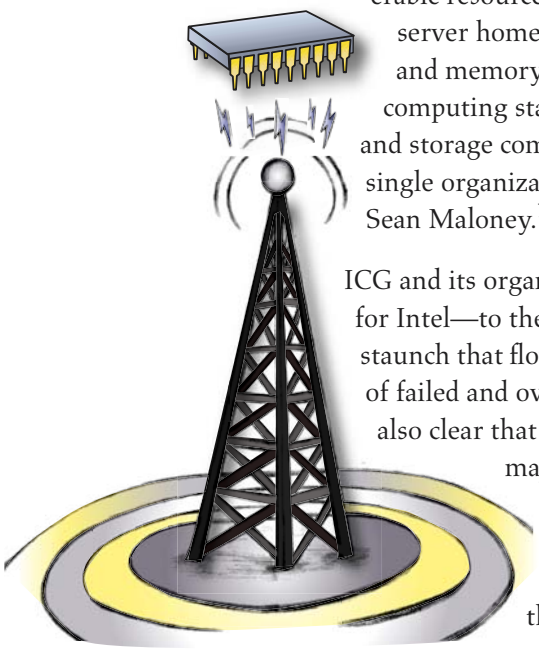
Intel's Newest Ecosystem

Quick Note

Gordon Haff
22 June 2004

Processors rarely live or die by their architectural elegance or their ultimate performance. If they did, Alpha would be the reigning microprocessor king and creaky, old x86 would be in the dustbin. Rather, it is the ecosystem—the breadth of its support within and by other products—that is most important, especially for designs whose ambitions are to be mainstream and to sell in high volume. Certainly that's the case with x86, which is supported by a staggering array of chipsets, motherboards, system makers, complementary standards like USB and PCI, development tools, operating systems, and, most of all, application software.

Intel has helped foster—if not really create from whole cloth—that processor-centric ecosystem over the years. However, more recently, it's begun to put considerable resources behind projects considerably removed from its desktop and server home base. Intel houses this new-style menagerie of processors and memory for PDAs and handsets and chips in support of mobile computing standards like WiFi—together with its enterprise networking and storage components and telco infrastructure components—under a single organization, the Intel Communications Group (ICG) headed by Sean Maloney.[1]



ICG and its organizational antecedents have been mammoth money-losers for Intel—to the tune of multiple billions of dollars. Intel certainly needs to staunch that flow, the worst of which is likely now behind with the write-off of failed and over-valued acquisitions from the Internet bubble.[2] But it's also clear that the most important near-term task for ICG isn't to create a major new revenue stream for Intel. Rather, it's to ensure that the processors that bring in over 70 percent of Intel's revenues keep producing. And *that* means helping to put in place a new-style ecosystem for Intel processors that keeps them relevant in today's rapidly shifting landscape of computing devices, many of which are more mobile than ever.

1. LCOS (Liquid Crystal on Silicon), a new display technology for which Intel has high hopes, used to be part of ICG as well but is now part of Louis Burns' Desktop Platforms group (which is the lead on Intel's "Digital Home" initiatives as well as its more traditional client business). ICG also used to encompass Intel-branded home networking products including access points and routers, but those have since been discontinued.
2. ICG's traditional business was heavily oriented towards telco, one of the segments hit hardest by the spending downturn.

*F2707CE32161DDED3C6C

internal use only

Gordon R Haff
Illuminata, Inc.

The Legacy Ecosystem

Intel has put a lot of effort into supporting developers directly as well as spearheading some of the standards that are integral indeed to today's systems. It's helped develop or promote components and technologies that make building systems easier and less costly, as well as the software that makes the systems useful.

That said, Intel's role is often overstated; x86 represented a large and important market—and therefore an attractive development target for third-parties—even before Intel became involved with complementary technologies like PCI and integration-enablers like chipsets. And, although Intel has successfully shepherded important related technologies such as USB, its track record is hardly unblemished. USB itself took many years to hit a tipping point, despite the pressing need that it addressed; legacy PC interconnects such as serial had a multitude of problems, from low speed to complexity to poor reliability. And other efforts into which Intel put considerable energy such as its initial "Wired for Management" attempt, I_2O, and InfiniBand can only charitably be described as "did not meet expectations."

However, even if Intel shepherds more often than mandates, and even though it loses a battle here and there, it remains an influential player in evolving various aspects of the "old style" computing infrastructure to new standards and ways of doing things. One example is a new form factor, BTX (Balanced Technology eXtended), that deals with both noise and with CPUs and graphics cards that generate excessive heat better than does today's ATX standard. Another example is the work Intel has done on various management interfaces like DMI 2.0 that define standard interfaces and data structures to manage systems from multiple vendors with a single piece of software.[3] A third example is the ongoing removal of legacy interfaces that continue to hobble many of today's x86 systems with technology from the early eighties such as BIOS; Intel's firmware Foundation code from the "Tiano" project is an implementation of the Extensible Firmware Interface (EFI) that replaces the BIOS. But all these are fundamentally tweaks to a relatively mature x86 platform. The real ecosystem opportunity lies in creating markets and uses for Intel microprocessors in devices that are more mobile or less like traditional computers (or both) than the main thrust of Intel's historical business.

The New Ecosystem

Intel was a bit slow to fully grasp the implications of the shift away from traditional form factors and usage models. For example, Intel's Pentium M may now deliver great performance for the power it uses—critical for notebook CPUs.[4] But it was, in large part, a defensive move. Transmeta and AMD had already raised the need and stolen the lead in the race for the low-power processor market. And many laptop manufacturers who did decide to use the Pentium M when it became available used an alternative communications chip rather than taking the whole Intel "Centrino" package, which encompasses the Pentium M, its associated chipset, and associated WiFi communications chip. This was at least in part driven by the fact that competitors provided 54 Mbps networking (802.11g) at a time that Centrino topped out at 11 Mbps (802.11b).

Intel wasn't the prime driver in other aspects of the shift to more mobile and more connected computing either. Although Intel had its own line of (now discontinued) home networking products, it was companies like D-Link, Linksys (now part of Cisco), and NETGEAR that delivered the inexpensive—and, for their intended market, innovative—routers, hubs, and access points that made networked homes commonplace, rather than an emblem of geek priesthood. But, in the end, Intel

3. In practice, vendors often don't fully populate the standard data structures in a consistent way, which limits how deeply third-party tools can manage their systems. But at least this is an improvement over the past Tower of Babel.

4. Intel also recently accelerated a shift to x86 multi-core designs for servers and desktops that emphasize parallelism through multiple threads, rather than extracting it from within a single thread. Intel seems likely to leverage the Pentium M architecture in many of these designs, which value power efficiency more than ultimate single-core performance, as well.

benefited from the work of these other members of its ecosystem—because their products advanced Intel's larger and ultimately strategic goal: making its processors more attractive.

The cornerstone of Intel's strategy when it comes to communications is the simple premise that the best-connected PC is the best PC. It buttresses this tenet with statistics such as the following: Users with broadband spend twice as much time on their PCs as do those with dialup; and Intel employees with WiFi at home use their PCs 30 percent more. This is good for Intel and its partners because more PC usage tends to lead to more purchases of better gear. Even if high PC usage sometimes drives broadband use—rather than the other way around—it's hard to argue with the general principle that connectivity makes PCs more useful and more likely to be used in richer ways.

The Developing Ecosystems

But the communications ecosystem isn't merely or even mostly about the devices and their local connections. Certainly the evolution and sometimes convergence of cell phones, PDAs, notebooks, and tablets will be a topic of ongoing and often fractious debate. Some of that evolution could well favor Intel—especially the increased features and functions that make what were once mere "telephones" look and act more and more like mobile PCs. However, the device wars of tomorrow will play out against a landscape of beyond-the-home and beyond-the-office connectivity battles that are as much about economics as electronics.

Take WiFi, for example. Intel has been a major cheerleader, sponsoring "WiFi Days", and the like, to generate consumer demand. And it's sold plenty of WiFi components to the industry—although it's lost money doing so. But Intel doesn't ultimately exert that much control over the public wireless networking arena. The creation of WiFi hotspots is a business model and social interaction issue—not a technical one. We already have inexpensive commoditized components. The bigger questions are: how much will people pay for wireless; will it be for business people or the masses; will restaurants and coffee shops come to see it as a necessary free perk or a profit center; will local government get involved; what pricing models will work for the aggregators, the sites, *and* the users? Fundamentally, who will pay and how much?

Companies like Starbucks, McDonalds, Marriott, Wayport, T-Mobile, and Verizon own the business control points here—not Intel. Unless Intel were to take a huge leap out of its comfort zone and core competency to become a public WiFi aggregator, it will continue in the role of a promoter whose products are both driving demand and profiting from adoption—but not setting the industry direction.

That said, Intel is using its brand, its financial resources, and its network of relationships to nurture and nudge where it can. It's validated 32,000 hotspots worldwide for Centrino compatibility under its Wireless Verification Program. It's actively involved in many of the enhancements to the 802.11 spec—such as 802.11n (higher throughput) and 802.11i (improved security). And, through Intel Capital, it's making investments in areas such as cross-vendor roaming aimed at improving both the ubiquity and the usability of wireless.

The situation with the forthcoming WiMAX standard—or 802.16 as it's less euphoniously known—is similar. WiMAX is a longer-distance technology than WiFi, extending out to about 30 miles and providing average bandwidth of about 70 Mbits/sec.[5] It will initially be a "backhaul" technology that connects an antenna outside a home or small business to the wide area network—replacing today's cable or DSL (or, in a few cases, satellite) connection. Over time, WiMAX connectivity will make its way into individual PCs.[6] As with WiFi, Intel will be happy to make what money it can from WiMAX componentry, but that's not its main

5. The core 802.16 specification is based on a point-to-multipoint infrastructure that operates at radio frequencies between 10 GHz and 66 GHz with peak data rates up to 268 Mbits/sec. Similarly to WiFi, throughput drops off with distance and other factors; at the limit of its range, WiMAX will operate at a small fraction of its nominal "average" bandwidth.
6. Intel projects production deployments of WiMAX in its backhaul form in 2005, notebook connectivity in 2006, and handset integration in 2007.

reason it's taking a leadership role in working on the spec and implementing it in hardware. Rather, Intel aims to increase what until now has been a relatively low penetration of broadband among home and small-business users, which is at least partly due to the difficulties of laying wire the last mile in many locations.[7] More broadband, richer client experience, more processing power; combined, they result—if in a diffuse way—in more profits for Intel.

As with WiFi, Intel's challenge will be to drive widespread deployment of WiMAX, something which will require significant infrastructure deployment by telcos, cable providers, or some other infrastructure-building and billing entities. WiMAX may be designed to bound over the last-mile gap, but that doesn't mean making the leap won't still be a lot of work and take a lot of money. Here too, Intel has less direct influence than in its traditional computer-centric domain. But it's trying mightily to establish a new circle of partners by working with and influencing industry standards groups[8] and by establishing alliances with WiMAX equipment vendors such as Alcatel, Alvarion, and Proxim.

And beyond wireless LANs (like WiFi) and wireless MANs[9] (like WiMAX), lies the wireless telco WAN alphabet soup—GPRS, GSM, CDMA, etc.—that require not only expensive physical infrastructure but also costly spectrum licenses. Intel has less involvement here than in shorter-haul wireless approaches, but the adoption, use, and pricing of these cellular technologies will also strongly influence what mobile devices people buy and how they use them. That's doubtless the reason that Intel CTO Pat Gelsinger and Intel Senior Fellow Kevin Kahn meet frequently with Bob Peppar, the chief of the office of plans and policy at the FCC, and with Michael Powell, the FCC Chairman.

7. In general, broadband availability is very spotty on geographic scales, both large and small. Even within seemingly *über*-connected places like Silicon Valley, Boston, and London, hooking up a given house, street, or community can fall victim to the vagaries of cable company service or distance from the telco central office.
8. The WiMAX forum is chaired by Ron Resnick of the Intel Wireless Networking Group
9. Metropolitan Area Networks, connecting distances range between the truly local and the truly wide area.

Supporting Intel's Processor Future

Ongoing demand for Intel's historical processor franchise depends in large part on keeping its chips at the center of a computing world that increasingly revolves around mobility issues rather than CPU horsepower. Intel has its own specialized processors like the PDA- and handset-oriented XScale, and the Big Iron-oriented Itanium, but x86 anchors its processor revenues and profits.

Maintaining that relevancy requires a communications infrastructure that keeps traditional x86-based devices like laptops a viable form factor in a world of picture-taking smartphones and keyboard-equipped PDAs. This means rich bandwidth at the right price—because the richer the media, the more advantages a PC has over its newer-fangled brethren.[10] This dependence is a major reason Intel has heavily invested—and continues to invest in communications products and markets in spite of their money-losing ways to date.

It seems unlikely that Intel will ever attain the same level of direct influence on this new ecosystem that it developed over time with its older, more computing-centric, one. Intel would certainly like a strong hand in setting the agenda for ubiquitous mobile computing. However, it's easy to overstate the influence that Intel *ever* had in setting the agenda for how and where its processors were used. Being adaptable to the ultimately uncontrollable changes in form-factor and usage, while using its many levers to gently tilt the industry in favorable directions, may ultimately be the most important attribute for Intel to have.

10. Consider the opposite case: If all you wanted to do was text message, would you prefer a laptop or a Blackberry?