



Competitive Strategies for the Microprocessor Market

**William Fan
Leon Liu
Simpson Zhang
Winston Zhao**

Executive Summary

Intel Corporation, founded 1968, is the largest microprocessor company in the world, with the greatest overall share of the microprocessor market worldwide. Along with its major competitor AMD, Intel is a participant in a highly volatile market environment born from the introduction of the personal computer and fed by the phenomenal growth of multimedia software and the Internet. To maintain this dominant position, Intel must recognize a paradigm shift currently taking place within the market, specifically the growth of mid-range highly power efficient and multi-threading computers, and adapt its product direction to compensate.

The modern microprocessor industry has been influenced greatly by Intel and the efforts of its competitors. There are highly stratified divisions between low, mid, and high end markets in addition to substantially differing design philosophies between desktop, laptop, embedded device, and server microprocessors. Intel's main product offerings are the Pentium, a mid to high range desktop processor; the Celeron, a low price model designed to secure the low end market; the Itanium, a high end server processor using a next generation architecture; and the Xeon, a mid to low range cost effective server processor. We devise a set of strategies for each sector of the market with the intention to maintain short term profitability and a superior future position.

For the desktop market, Intel should attempt to leverage its current dominant position, while continuing development on the integrated chipsets through intensive research investments. In the laptop market, however, Intel should focus its resources on developing energy-efficient performance technology, and differentiate products via bundling and specialization. It should also control low-end and emerging markets as well as consolidate its reputation and customer base. For the workstation/server market, Intel should first repair its negative reputation generated by its failure to meet initial performance expectations, through a shift in advertising to cover EPIC vs. RISC architecture advantages. This should be then followed by offering cash purchase incentive (such as rebates, exclusivity payments, etc.) for existing clients. Other strategies such as stressing forthcoming software solutions for the EPIC architecture in all advertising media and stratifying capital investments in Itanium and Xeon could also be considered. Lastly, for the specialized embedded market, we suggest Intel to focus on developing low-power embedded processor solutions, as well as to regain the mobile phone chip market that it ceded several years ago using its stronger technological background.

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Background

Intel is currently the world's largest microprocessor company. It was founded in 1968 and first competed in the SRAM, DRAM, and ROM markets. Their microprocessors were first produced in 1971, and eventually grew to be their core product in the 1980's. Intel began putting its microprocessors into personal computers for IBM and Compaq, which cemented its position as a key processor supplier. Intel introduced its first "Pentium" chip in 1993, which would grow to be a very popular and long lasting line. It also started its famous "Intel Inside" advertising campaign in 1990. Microsoft's successive Window's releases, from Windows 95 to 98 to 2000, created a constant need for faster and better processors, which propelled Intel sales of each new hardware release. In 2000, Intel had almost a monopoly on the processor market. However, after 2000, PC demand slowed as consumers turned towards cheaper systems. As a result, AMD experienced rapid growth with its low-end strategy. AMD would eventually become Intel's biggest rival. Both companies are constantly updating the technology onboard their mass-produced products, as a guiding principle set by Intel co-founder Gordon Moore calls for a certain doubling time for processor power that both companies are actively attempting to fulfill every few years. In fact, Moore's Law has shaped the entire microprocessor industry.

Currently, Intel and AMD are locked in a battle over multi-core processors. The release of Intel's Core2Duo line gave them a temporary advantage, as these processors were both more powerful and less expensive than AMD's Dual Core Athlon processors. This forced AMD on the defensive, as they had to drastically slash prices in order to keep up with Intel. Intel still has a technological advantage over AMD, but AMD is trying to fight back, and has recently released a large lineup of Quad-Core processors that they hope will give them an advantage. However, Intel fired back by announcing its own line of new Quad-Core processors and a new Six-Core processor that will ship at the end of the year. Intel has also been doing well with server processor sales. It has been supplying chips to companies like Google and Amazon for advanced tasks like cloud computing. Intel in recent years gained huge advantage over AMD with its introduction of dual-core which has made its processors both cheaper and more efficient. In this way the AMD/Intel competition has become one of the classic examples of barrier to entry by technology and how a rival company may respond to a much larger competitor in a volatile market environment.

Six Forces Analysis

Entry barriers

The two key ingredients to competition in the microprocessor industry, innovative technology and low price, serve as prohibitive entry barriers. Competitiveness demands tremendous amounts of patented and specialized technological expertise in manufacturing as well as new product design. An enormous economy of scale is also required for price competitiveness, which also often necessitates low profitability due to intense rivalry. For the desktop and server markets especially, large amount of time and sunk costs are associated with development of a performance oriented chips. Certain key technologies like EPIC and RISC also have extensive patents by the key players in the field. Along with the well established reputation of Intel, these factors make entry near impossible.

Nonetheless, in the emerging field of cheap ultra-portables where Intel has less experience, the entry barriers are lower. Asian semiconductor giant Via is already making its entry with the “Isaiah” chip that which is comparable to Intel’s Atom. Apple recently acquired a boutique microprocessor design company, P.A. Semi, which was known for its design of sophisticated, low-powered chips.¹ This most likely will not pronounce Apple’s entry into the industry, but it can mean losing a major customer for Intel if Apple begins to rely on its own chips.

Buyer Bargaining Power

In the desktop, laptop, and embedded markets, individual retail buyers have nearly no bargaining power due to their small influence on the overall market. Major computer manufacturers like Dell and HP have significantly larger bargaining power with Intel due to their high volume orders which contribute to large portions of the Intel overall revenue. On the server side, however, there is a large amount of buyer bargaining power due to compatibility issues with Intel’s EPIC architecture compared to competitors’ RISC architecture. There is little diversity of clients but the volume of purchase by each client is immense in volume. Software complement is essential to success, and there is overall less diversity in the audience of buyers. Reputation and partnerships are essential.

Supplier Bargaining Power

Contractors which construct factories and equipment have little bargaining power. These are hired by prior agreement and play no part in the competition between corporations. There are also many choices of contractors, so pricing is aggressive. Engineers and research staff that have gone through extensive training and have acquired significant amount of working experience are more indispensable to the company and hence have greater bargaining power. Suppliers such as motherboard and chipset

¹ Erika Brown, E. C. (2008, 04 23). *Apple buys Chip Designer*. Retrieved 05 04, 2008, from Forbes: http://www.forbes.com/technology/2008/04/23/apple-buys-pasemi-tech-ebiz-cz_eb_0422apple.html

manufacturers only have a small amount of bargaining power because they need the processor giants like Intel to find use of their products.

Substitutes

There are almost no substitutes for the CPU since because it is an essential component for a computer. The only way to substitute for a CPU is to substitute for the computer itself.

Rivalry

The processor industry is extremely price competitive. There is little differentiation between Intel and AMD microprocessors in terms of function. There are also high fixed costs in this market, but low marginal costs. Therefore, each company has a strong incentive to undercut the other. Furthermore, the product life cycle is very short, and technologies and industry standards evolve rapidly. In order to gain market share, both companies are forced to quickly introduce new products and slice away margins, a strategy that results in significant dips in profits which forced Intel and AMD to reduce cost by respectively laying off 10% of their workforce in 2006 and 2008.^{2,3} Finally, high exits costs due to the sunk costs increases competition.

Complements

In general all the separate markets demanding microprocessors, PC software, other hardware components, and operating systems have high need for better and cheaper processors. For the laptop market, the Centrino platform is a classic example of creating complementary synergy with its bundle of CPU, chipset, and wireless modules. In addition to providing better performance and compatibility, this integration simplified brand name and consumer choice. The development of graphically advanced demanding software such as Windows Vista and many video games raises expectations for performance. The growing demand for thinner and lighter notebooks call for smaller size and greater power efficiency, which makes a great future for the Intel Atom line. In the desktop and server markets, High Performance Computing (HPC) programs such as biological simulations, weather prediction, oil exploration and financial analysis all benefit much from multithreading processors.

² Associated Press. (2006, 09 06). *Intel to lay off 10,500*. Retrieved 05 04, 2008, from msnbc: <http://www.msnbc.msn.com/id/14679917/>

³ Reuters. (2008, 04 07). *A.M.D. to Cut 1,600 Jobs as It Lowers Forecast*. Retrieved 05 06, 2008, from New York Times: <http://www.nytimes.com/2008/04/07/technology/AP-Chip.html?ref=business>

SWOT Analysis

- Diverse customer base.
- Good brand loyalty in desktops and laptops.
- Large amounts of free cash for investments, lawsuits, advertising, etc.
- Backlog of patented technology to implement.
- Existing and consistent lead in technology.
- Well-established presence in foreign countries.

Strengths

- Lackluster performance in the server microprocessor market.
- Failure to induce public acceptance of EPIC architecture over RISC.
- High operating costs.
- Brand loyalty in foreign nations.
- Pursuit of market in embedded devices.

Weaknesses

- Mobile internet device revolution – chance to lead market with Atom.
- Continued growth of computer gaming frontends the high end market.
- Expansion of tech-savvy population buffers the mid range market.
- Press current leading position in the desktop and laptop markets.
- Current partnerships to improve software compatibility with EPIC architecture.

Opportunities

- IBM and AMD in the server market.
- Shift away from primary emphasis on clock speed to multi-threading, high reliability, low power consumption, low temperature.
- AMD's acquisition of ATI and subsequent product bundling practices to threaten Intel platform offerings.
- Various local startups in Asian markets.

Threats

Desktop Market

The desktop market is comprised of several large computer companies that sell to many individual buyers of all demographics worldwide. It is currently the largest and most valuable processor market, but has experienced slow growth recently compared to the notebook market. Current sales are around 150 million units worldwide, but projected future growths are not large⁴. Intel currently has strong advantages in technology and resources over AMD in both the high and low end markets, and can try either pressing its advantage to squeeze out AMD, or accommodate AMD by giving them one part of this market.

Low End Market

The common person orders computers online or buys them in large computer stores. These people will mostly care about the price or the name of the computer company. They will pay little attention to the actual processor, and will not be knowledgeable about the benchmarks of each processor. The power of the processor is not very important, as all current processors can handle mundane tasks like using the internet or uploading photos. It is important to get deals, particularly exclusive ones, with the major computer manufacturers. Since these companies buy in bulk, Intel can offer them special rates, or wield its dominant position in the market to assert pressure. However, Intel must be careful about pressuring for exclusive deals, because AMD can retaliate by suing them with antitrust cases⁵.

Intel should continue developing integrated platform solutions, which combine the CPU, graphics, and sound together. Although they are usually on the low end for each part, these platforms can cost substantially less than buying each part separately, making them very attractive to low-end consumers. This is particularly good for computer manufacturers because of the significant cost reduction². The average consumer does not need a better graphics processor, so any cost reduction is extremely beneficial. By utilizing their current dominant position, Intel could convince computer manufacturers to buy platforms from them instead of graphics cards from somewhere else, thus giving them an advantage in the processor and graphics card markets. AMD is currently trying to utilize its acquisition of ATI by creating its own platforms. They are currently developing the AMD GAME! line that will utilize ATI graphics cards. Intel can only compete on the lower end by making their platforms cheaper than AMD, which is possible. Intel will have to cede the higher end to AMD unless they can reach a deal with Nvidia to incorporate their graphics cards.

The low-end market is much larger than the high end one. Around 80% of the market is comprised of PC's costing less than \$1000. Thus, it is essential that Intel keep a lead in this market. The Core 2 line is currently more cost effective than AMD's new Phenom line, and it will be at least a year for AMD to be able to catch up. Also, given Intel's significantly larger resources, they can invest more heavily in research to keep ahead. Overall, the low-end market is the more profitable one, so Intel should not accommodate AMD, especially given their early lead. This is the desktop market portion that should be concentrated on most heavily, with aggressive price-cutting and landing exclusivity deals with computer manufacturers. Intel can continue to invest heavily in research. Intel invested almost 6 billion in

⁴ Perlmutter, D. (n.d.). *Personalizing Your Computing Experience*. Retrieved 05 05, 2008, from Intel: http://download.intel.com/pressroom/kits/events/idspr_2008/2008_0402_IDF-PRC_Perlmutter_EN.pdf

⁵ Don Clark, R. R. (n.d.). *AMD Expands Intel Accusations*. Retrieved 05 05, 2008, from Wall Street Journal Online: http://online.wsj.com/article/SB121002216518768677.html?mod=googlenews_wsj

2006, about half of their total operating expenses. This is compared to only 1.2 billion for AMD⁶. Given Intel's huge financial advantage, they can continue to improve on their technological lead over AMD through even more research. There is little AMD can do about this because of their weaker financial position. AMD can try to fight back in this market by greatly cutting their prices, but this will only hurt them in the short run, and Intel can fight back by cutting its own prices, thus triggering a disastrous price war neither side wants. Unless AMD can get lucky with the next round of chips, they do not seem to have many options.

High End Market

There is a much smaller market composed of knowledgeable individuals who purchase separate parts online and build the computer themselves. Intel sells OEM products to websites, which these people then buy from. Frequently, the people that build their own computers are high-end gamers who actively read benchmark tests in order to discover the best processor. New games present a wonderful complement because they constantly push the technological limits of a machine and demand better hardware, forcing gamers to upgrade. Marketing is not as necessary, because these consumers actively search for all products by each company. Price and technology are the most important factors, as consumers will go for the optimal mix of cost and performance. This market is too small to be a focus for Intel, but given that they need to do very little to reach this market, it can be a profitable one. Currently, Intel has both a price and technological advantage over AMD, so it has captured the majority of this market.

This could be a potential market to accommodate AMD in. It is much smaller than the low-end mass market, so it would not be extremely costly for Intel. Intel could possibly scale back development of the high end chips and let AMD do it instead. AMD would probably be happy in this role, as they would be able to make decent profits through lowered competition. On the other hand, if Intel pushes aggressively into AMD on all fronts, AMD may retaliate by either pursuing massive anti-trust lawsuits, or concentrate its efforts on an area that Intel is weak in, as it has done in the past. A cooperative strategy would avoid such potential destructive competition. However, the risk is that once AMD controls the very high-end market, they may extend their grasps into the slightly less high end, entertainment PC segment. Also, AMD would be able to build a reputation as having the very best chips, which may impact the less educated consumers for whom reputation is more important than actual chip performance. Intel does not really need to accommodate AMD currently given its favorable position, but it may be propitious to back off the competition in this area to give AMD room to breathe.

The desktop processor market is a highly volatile and unpredictable one. Given the extremely price competitive nature of the market, each company must constantly be on the forefront of new technology and breakthroughs. Products may see less than a year of life, so companies must be agile enough to constantly change their product lineups in accordance with quickly changing demand and technology. On the other hand, the market is changing towards a longer, 6-year cycle. This is because software has not been able to advance sufficiently to require constant computer updating. This definitely slows down potential future growth, since the market will be much more easily saturated with a longer chip lifespan. As stated earlier, the desktop market will soon be eclipsed by notebooks, so Intel should anticipate this by shifting research from desktops to notebooks.

⁶ AMD. (2006). AMD 2006 Annual Report. AMD.

Laptop Market

In contrast to the desktop market where achieving high processor performance with front-end technologies constitutes the primary focus of competitive strategy, the mobile market demands a best balance between performance, energy efficiency, and wireless connectivity (Fig. 1). Due to the trend of growing emphasis on mobile computing by consumers along with the proliferation of wireless connectivity in the world, there is seen a shift in sale from desktop microprocessors to mobile microprocessors (Fig. 2). The sales of microprocessors in the Mobility Group as a percentage of the Intel consolidated net revenue has increased steadily from 22% in 2005, to 26% in 2006, to 28% in 2007.⁷

The following are some key strategies for success in this market.

“The Heart of a New Generation”⁷

The emerging trend for thinner and lighter laptops places high demand on energy efficiency because higher energy efficiency diminishes the need for larger batteries and CPU cooling devices. It is this trend that completely separates strategy for the laptop processor market from that for desktops where performance is often maximized at the expense of energy and size. Intel’s forthcoming Atom line of processors revolutionizes the field by combining high performance and energy efficiency with low cost. The technologies employed in this product, including the 45-nm CMOS for high performance and the Deep Power Down (C6) power management system, neither of which has appeared in AMD’s products, will keep Intel ahead, but not for long. Due to cross-licensing agreements, AMD will have access to certain patented technologies developed by Intel after some time. It has already matured its 45-nm technology and is ready to release product in the second half of 2008 as a part of its new generation Puma Platform⁸. To secure its dominance in the mobile market, Intel should heavily reinvest in R & D, especially in developing more advanced energy efficient performance technology in order to maintain or even elongate the technological time gap ahead of its rival AMD.

Differentiate Product via Bundling and Specialization

AMD is capable of imitating or improving on most of Intel’s technologies. Without such technological barriers, competition often degrades into price wars, causing both companies to lose profit. It can avoid costly price wars by differentiating its products towards the specific orientations of the customer. This can be done by bundling components into platforms, as it has successfully done with the Centrino platform, and also developing technologies fit the specific needs of a certain customer group, such as with the vPro technology which enhances security for businesses. However, AMD has followed suit with its own bundling and differentiation schemes. The forthcoming Puma platform includes a powerful GPU unit by ATI, which AMD has acquired⁹, fits the taste of the high-end gamers. Intel can potentially compete directly by acquiring NVIDIA, but this move would be costly, and the long-term benefits are uncertain. Unable to gain dominance in the general markets, AMD is likely to concentrate efforts in the niche graphic market for gaming machines. In the short term, Intel should try to keep up at least technologically in the graphics end by cooperating with NVIDIA, since falling behind would

⁷ Intel. (2007). Intel 2007 Annual Report. Santa Clara: Intel.

⁸ AMD. (n.d.). *AMD 45nm Process Technology Generation*. Retrieved 05 05, 2008, from http://www.amd.com/us-en/assets/content_type/DownloadableAssets/AMD_45nm_Press_Q-A.pdf

⁹ Rivas, M. (2007, 12). AMD 2007 Financial Analyst Day Presentation. U.S.A

potentially allow AMD to establish a reputation in this high prestige market first that can proliferate to other sectors.

Control Low-End and Emerging Markets

The cost effectiveness of the Atom processor makes it Intel's best weapon for waging an aggressive campaign against AMD in the market for low-end laptop processors. Among all sectors, the low-end market was one of Intel's weakest points both because of the lack of focus as well as the success of the AMD Athlon 64 processor which cost less than Intel's equivalent Core 2 Duo and performed better than Intel's low-end Celeron. But now armed with a cheap high performance processor better suited for this market than anything AMD can immediately offer, Intel should take this golden opportunity to "Atom" bomb the low-end market before AMD can respond in kind.

There are several risk factors for this move. Since the Atom's performance understandably trails that of AMD's low end processors, AMD can defend its low-end laptop market share by lowering prices and appeal to customers' need for performance. AMD can also hit the desktop market, which in the short-run is still dominant, if Intel decides to shift focus away from it now. Intel would still maintain an impregnable position in the high-end business market with its various business class solutions like vPro, but AMD can potentially snatch away the high prestige gaming market with its emphasis on GPU integration. In the long run, AMD can even hope to develop similar or even better inexpensive energy efficient performance technologies.

Despite these possible challenges, the benefit of controlling the low-end market far out-weighs the snag of losing shares in the niche markets because of the much larger growth potential in inexpensive portable low-end laptops in the long-term perspective. If this strategy is adopted, Intel should try to maintain its position in the other markets with its large quantities of diversifiable resources and also continuing innovation of the Atom line to prepare for future competitions in this field.

In the emerging markets of affordable Mobile Internet Devices and classmate PC's targeted toward first time users¹⁰ (e.g. Asus Eee PC), the threat of competition is even higher due to Intel's lack of a well-established position as in the traditional PC market relative to the numerous competitors, but the potential for growth here is incredible. Intel must plant a strong foothold early by continually improving the Atom processor and developing strong ties with manufacturers of these products.

Consolidate Reputation and Customer Base

AMD has in recent years attracted many new customers, especially in the world market (Fig. 3). However, its revenue has also become increasingly dependent on its major customers. AMD's lack of success recently also caused it to be tight on capital, the lack of which can seriously impair its future competitiveness². Intel can exploit these weaknesses by attempting to win over major customers by persuasive advertising and obtaining exclusivity contracts through payments. General advertising campaigns like the Intel Inside and for the Centrino platform have been great success for developing a solid reputation among customers. More ideas like the World Ahead program and Intel Talent Search should be implemented and expanded. Intel should also especially focus on the global market, such as China, where AMD has grown rapidly in popularity. Recent establishment of a fab plant in Dalian and cooperation with major Chinese electronic retailers like Suning are the first steps. Intel should attempt to win the allegiance of large producers by convincing them the superiority and higher cost-effectiveness of

¹⁰ Chandrasekher, A. (2008, 4 2). The Heart of A New Generation. Shanghai, China.

its products. Similarly Intel should be flexible and specific with each of its computer manufacturer customer's demands in all markets.

In response, AMD's most convenient tactic for undermining Intel's reputation is to sue it for anti-trust and anti-competitive practices around the world, like others have done to Microsoft, to produce an image of Intel as a ruthless monopoly. But as long as Intel's products stay competitive, lawsuits are unlikely to harm sales. Furthermore, Intel can counterattack in court by reporting AMD's mistakes as causes of their lack of success.¹¹

A strong reputation among future consumers will lead to a higher demand for laptops with Intel processors. Add to this pot contracts, such as one recently made between Intel and Apple, and Intel will be able to dominate the global market.

¹¹ (Whelan 2005)

Identify Oversight on EPIC Technology Initiative

Among the four stratifications of Intel's product offerings, enterprise technology comprises mostly of server microprocessors such as the Itanium and multi-purpose Xeon processors. Contrary to the significant growth of low-cost mid-range end user PCs which disrupted overall Intel dominance of consumer microprocessors in 2000 to 2003, the enterprise server market remains in strong demand of ever improved performance. This fits well with Intel's consistently high capital investments into research for both x86 and x64 architectures. However, the flagship server offering by Intel, the IA-64 Itanium, was in 2007 ranked only a distant fourth among all enterprise level server deployments by volume¹², accounting for only 7% of all server orders by a 2005 survey¹³. As a result, actual earnings fell substantially below projected amounts (Fig. 1), with additional losses from the tremendous time and capital investment involved in implementing explicit parallel instruction computing architecture (EPIC), an accomplishment that was scientifically groundbreaking but commercially unsuccessful due to EPIC's failure to deliver enough of a performance advantage over existing reduced instruction set computing (RISC) architectures to justify for clients the cost of switching¹³. Despite extensive advertising and product partnerships, critical reception of Itanium and Xeon has continued to constrain Intel market share in enterprise server markets worldwide. To salvage market profitability and ensure future viability of both products, Intel needs to counteract negative reputation around its products and reevaluate its product placement.

Redefine and Press Itanium Niche Market

One of the major obstacles which limited Intel success in enterprise server markets was the nature of EPIC architecture (Fig. 2). Initial responses to announcements of Itanium were enthusiastic, with hopes that EPIC would replace RISC and several companies making preparations for migration to Itanium. However, initial software platform development in Sun's Solaris¹⁴ and IBM's Monterey-64¹⁵ revealed difficulties previously unknown and necessitated compiler options which did not exist. Later iterations of the Itanium have improved compatibility issues, introduced faster performance, and added support for multithreading applications. While these improvements are publically noted, the Itanium is still reputed as a niche processor enjoying small success against RISC because of the large investment Intel is putting into it¹⁶. To counter negative image of the Itanium, Intel must shift current advertising for their server products in a different direction. Current web and media based advertising efforts for server products is nearly identical to that of desktop and notebook offerings, placing emphasis on high performance, low power, and reliability. While this may work in the desktop and notebook market where Intel already has a significant lead in market share, the strategy fails to underscore any concrete merits of an already tarnished product. Instead, the Itanium and Xeon products must be portrayed as next generation enterprise server options, for which extensive software solutions already exist and can be readily deployed in any environment. Next, Intel needs to exploit the follower effect, citing HP, Bull, Hitachi, Unisys, NEC, and Fujitsu all as licensees of Itanium hardware for their server products¹⁷. As hardware support for the

¹³ Shankland, Stephen. [Itanium: A Cautionary Tale](http://news.zdnet.com/2100-9584-5984747.html), 7 12 2005. 05 05 2008 <<http://news.zdnet.com/2100-9584-5984747.html>>.

¹⁴ Sun Microsystems. [Sun to Deliver Enterprise-Class Solaris for Intel's Merced Processor](http://www.sun.com/smi/Press/sunflash/1997-12/sunflash.971216.3.xml), 16 12 1997. 05 05 2008 <<http://www.sun.com/smi/Press/sunflash/1997-12/sunflash.971216.3.xml>>.

¹⁵ Shankland, Stephen. [Next-Generation Chip Passes Key Milestone](http://www.news.com/2100-1001-229335.html), 17 09 1999. 05 05 2008 <<http://www.news.com/2100-1001-229335.html>>.

¹⁶ Patrizio, Andy. [Intel Plows Forward With Itanium](http://www.internetnews.com/ent-news/article.php/3705016), 12 10 2007. 05 05 2008 <<http://www.internetnews.com/ent-news/article.php/3705016>>.

¹⁷ Byte and Switch. [Itanium Solutions Alliance Formed](http://www.byteandswitch.com/document.asp?doc_id=81342), 26 09 2005. 05 05 2008 <http://www.byteandswitch.com/document.asp?doc_id=81342>.

Itanium increases and compatible software becomes more accessible, Intel should take advantage of increased market share by implementing more aggressive pricing strategies, offering preferred customer rebates, and forming additional product partnerships as they become available. When confronted with any further discontinuations of support such as been done by IBM¹⁸ and Dell¹⁹, Intel should respond by reducing prices on existing chips and offering cash incentives to discourage such behavior. The Itanium has largely failed to become a mainstream server microprocessor due to its cost and interoperability issues. However, the Itanium has a small niche as a high end workhorse for growing enterprise databases demanding high reliability and performance. That niche will not cease to exist, and therefore the demand for Intel server chips will continue. To ensure success, Intel must start with that niche, positioning the Itanium as a powerful next-generation server solution scalable beyond RISC. Aggressive targeting of that niche will build solid product reputation and develop valuable brand loyalty. Once the superscaling of RISC becomes terminal, Intel is poised to re-introduce EPIC from this niche and take over the market as the swiftest provider of the product.

Xeon and the Low End Market

The other server microprocessor offering by Intel is the Xeon. The Xeon is currently being adopted for a number of low-end applications. Due to product reputation and third-party benchmarking, the Xeon is identified as specifically a lower temperature, mid-range performance product. As a result, the Xeon is not bought in large quantities by any large clients. It would be difficult for Intel to salvage this situation. Instead, the optimal strategy is to redefine all advertisement efforts for the Xeon and target specifically emerging server clients, such as new domain providers or small scale academic needs. This plan would largely salvage all current capital involved in the Xeon, such as advertisement and research costs, while positioning the Xeon in a market where it is most likely to succeed. Together with the Itanium, this strategy leaves Intel most susceptible to missed revenue in the mid-range server market, but defines a superior long-term position and ensures short-term safety of the greatest number of existing assets.

¹⁸ Shankland, Stephen. Itanium Dealt Another Blow. 28 02 2005. 05 05 2008 <<http://news.zdnet.co.uk/hardware/0,1000000091,39189451,00.htm>>.

¹⁹ Singer, Michael. Dell Shuttering Itanium Server Business. 15 09 2005. 05 05 2008 <http://www.news.com/Dell-shuttering-Itanium-server-business/2100-1006_3-5867239.html>.

Embedded Systems

An embedded microprocessor is a special-purpose computer system designed to perform dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. It is found in a wide variety of applications, including automobile information and entertainment devices, ATMs, information kiosks, wired or wireless communications infrastructure, tablet PCs, printers and network storage systems, as well as factory and medical equipment. Intel has been in the embedded microprocessor market for 31 years, and has longer experience in product technologies and industry application than any other company. Currently, the market is primarily dominated by Intel, with small shares by Samsung and AMD.

Pursue Development Initiatives

One of the primary strategies for Intel is still to make use of its strong technological background and focus its energy and resources on research in order to maintain its lead in the embedded market. For example, the quad-core Intel® Xeon® processor 5300 series with extended life cycle support that Intel introduced recently was the first to bring architecture-based quad-core performance to the embedded segment. Since embedded processors are dedicated to perform very specialized tasks in different applications, developing such customer-tailored capabilities is very important. Moreover, given the nature of the applications in which embedded processors are used, e.g. medical and communication devices, the reliability of the processors is of extreme importance. Thus, more resources should be spent on ensuring and improving the reliability of Intel's products.

Developing Low-Power Solutions

Given that the demand for smaller and lighter devices, e.g. PDA, iPhone, continues to rise, the power consumption of the devices are increasingly being emphasized, since higher energy efficiency is intricately tied to portability. Intel should therefore focus on developing low-power embedded processor solutions, and aim to offer a variety of processors for a broad range of demanding, low-power embedded applications, in order to meet customers' demand of smaller processors with higher performance/power ratio and low power consumption. As Intel increases its R&D budget, it could be anticipated that Samsung or AMD will react similarly by pushing forward its own competing products, for example the Geode series of x86-compatible system-on-a-chip microprocessors. Thus, Intel should constantly keep such response in mind and make sure its products are not technologically out-competed by its competitors.

Regaining Mobile Phone Chip Market

One important sector of the embedded market is the high-stakes, ultra-high-volume mobile phone chip market, which recorded its two billionth customer in 2006 (Fig. 3). However, both Intel and AMD currently do not have share of this market. AMD sold its MIPS-basedAlchemy chip line to Raza Microelectronics, and Intel sold its ARM-based XScale applications and baseband processors to Marvell, a few years ago. According to the latest market research from ABI, the mobile phone market is gradually turning towards the low-end, driven by the needs from developing nations. This is especially so for Asian markets, where the number of users are growing most rapidly. The near-term focus for handset manufacturers and operators appears to be on \$40 handsets that do not even have separate applications

processors. Given that AMD is currently very much pre-occupied with the high-performance, high-margin chips for workstations and servers, as well as the fact that it lacks the engineering resources to compete outside its core strength, it is an opportune time for Intel to regain this market.

According to Strategy Analytics, the reason that Intel quitted the phone chips market is due to its low profit margins, which were further constrained by low production yields.² And the last thing Intel needs right now is low-margin business. For example, in its 2006 first quarter earnings report, Intel reported earnings of \$1.3 billion on revenues of \$8.9 billion with a gross margin of 55.1%, down from the 59% forecast.³ The gross margins were even predicted to fall below 50%, due to "a higher proportion of lower-margin product in the overall mix."² In other words, AMD's success in the high-end chip market has forced Intel to lower prices on its highest-margin products, which in turn has driven down its overall margins. However, with its increased technological prowess in embedded processors over the past few years, Intel should be able to drive up the profit margin in this market, and thus re-entering might be a wise strategy.

CONCLUSION

Intel is currently holds a dominant position in several of its markets. It enjoys both a capital surplus and a technologically lead over AMD. However, given the cyclical and unpredictable nature of this market, its lead could quickly disappear if it is not well prepared.

Intel needs to utilize its capital advantage by pouring more money into research than AMD. Environmentally friendly and energy efficient chips are currently very hot, so research into these areas is essential. In the laptop and embedded markets especially, energy efficiency can be more important than performance. Given the current focus on global warming, Intel can create a potential “Green Chip” marketing campaign that will attract positive PR.

Intel can also capitalize from its dominant position by pushing integrated chipset platforms onto computer manufacturers. These platforms, such as Centrino and Viiv, are advantageous for consumers in both the laptop and desktop markets because they are low cost and convenient. They also expand Intel’s business into low end graphics processors.

The server market has been one area where Intel has not met with the same success it has enjoyed with the desktop and laptop markets. However, the fact remains that EPIC represents a generational advantage over RISC, in spite of the current superscaling of the latter. Intel must be poised to enter the market with the first EPIC processor offering as soon as RISC superscaling comes to an end. Current strategies for the server market represent this ideology, and attempt to setup a more advantageous future position for Intel.

Finally, Intel’s large amount of capital should be used for investment in other areas. The embedded market could be grown considerably. The cell phone market is expanding particularly fast, and Intel currently has no share in it. Buying back into this market could be a profitable strategy.

Intel is more prepared than AMD for an aggressive price war, given AMD’s large debt amount. Although past attempts to overwhelm AMD’s competition, such as with the Celeron, have met with failure, Intel could accommodate AMD by allowing them small subsets of the high end and low end markets, while ensuring generous cash incentives as only Intel can afford will keep AMD market share as low as possible.

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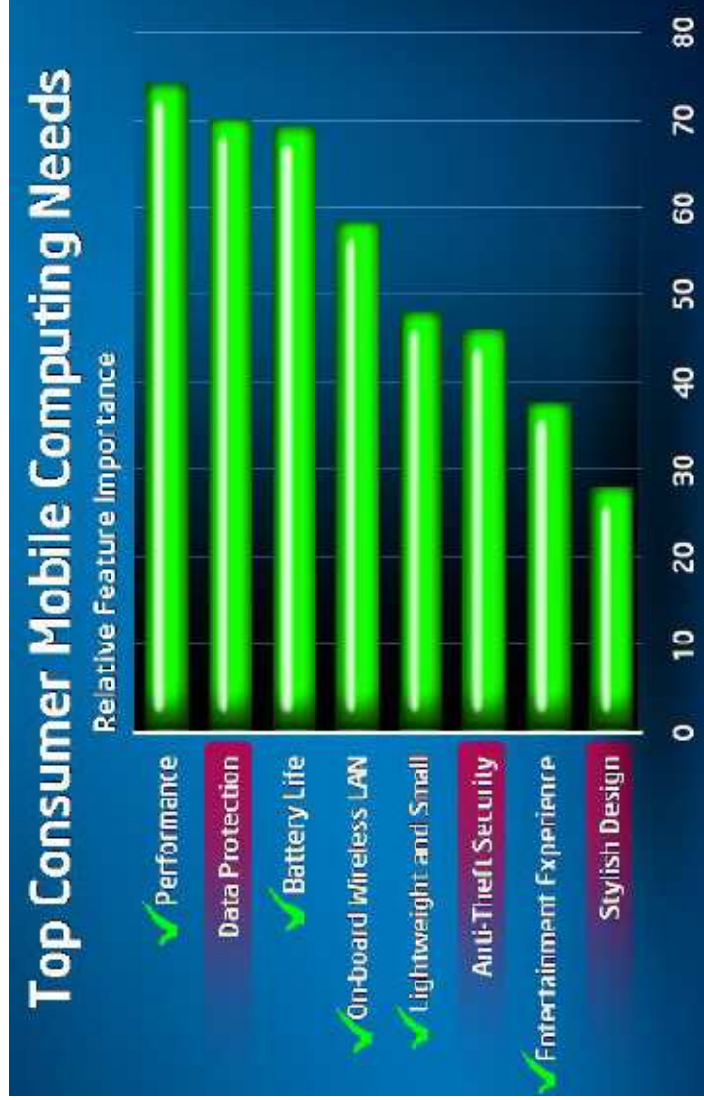
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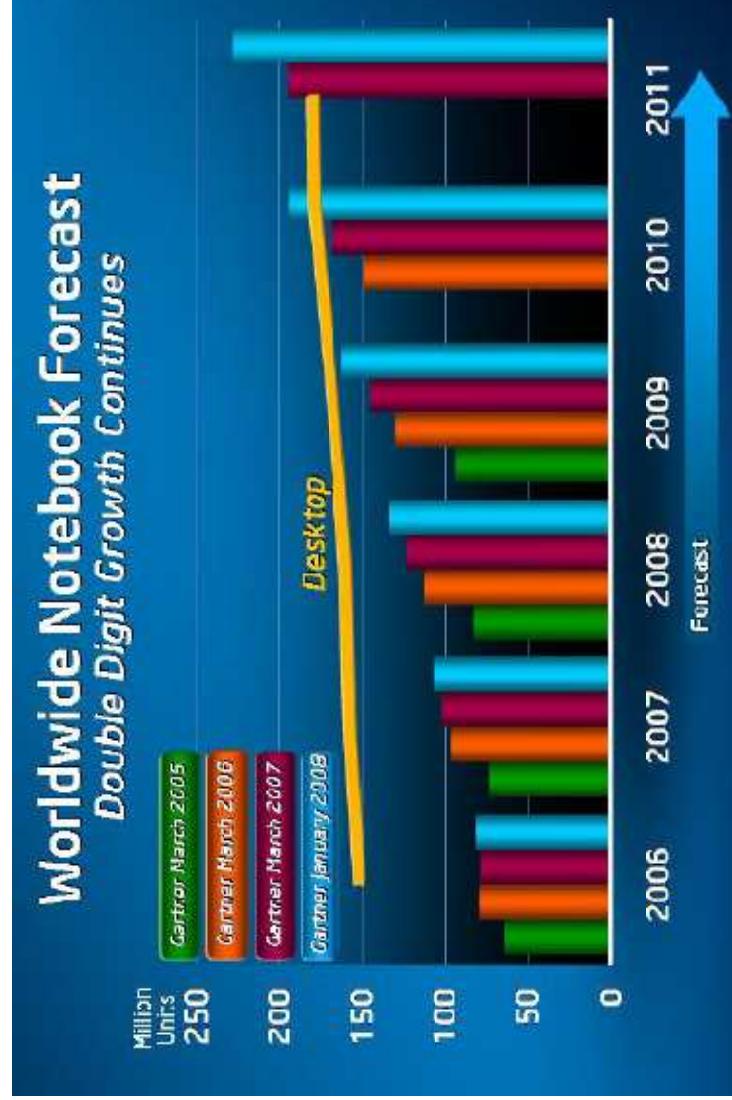
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Figure 1: Needs of the Laptop Consumer



Presentation "Personalizing your computing experience" by Dadi Perlmutter at the Intel Developer Forum Shanghai. April 2, 2008. <http://download.intel.com/pressroom/kits/events/idfspr_2008/2008_0402_IDF-PRC_Perlmutter_EN.pdf>

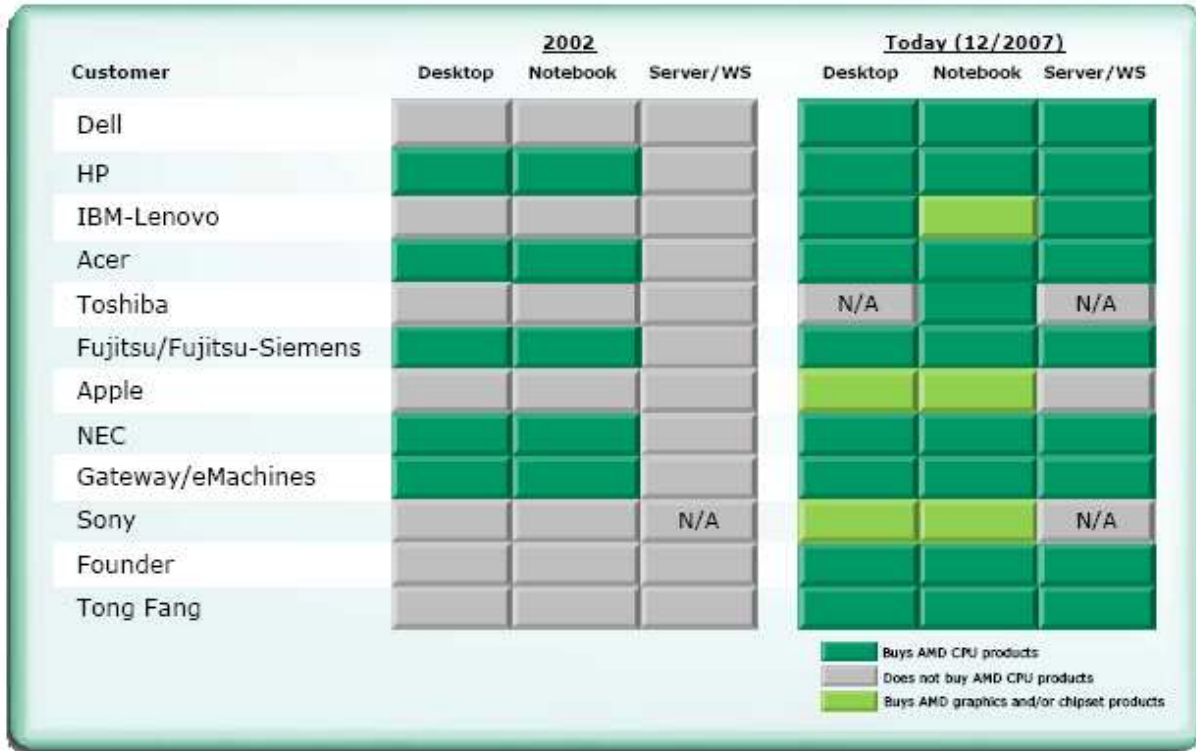
Figure 2: Trends in the Market



Presentation "Personalizing your computing experience" by Dadi Perlmutter at the Intel Developer Forum Shanghai. April 2, 2008. <http://download.intel.com/pressroom/kits/events/idfspr_2008/2008_0402_IDF-PRC_Perlmutter_EN.pdf>

Figure 3: Laptop Market

Customers Are Responding



AMD 2007 Financial Analyst. Presentation by Mario Rivas. Executive Vice President, Computing Products Group.
<http://download.amd.com/Corporate/MarioRivasDec2007AMDAnalystDay.pdf>

Figure 3: Itanium Market Performance²⁰

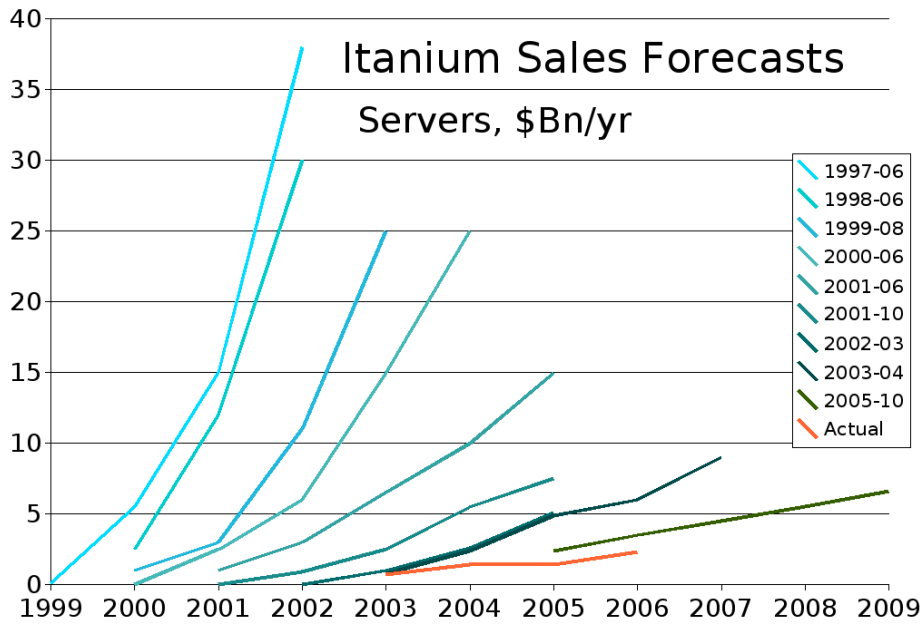
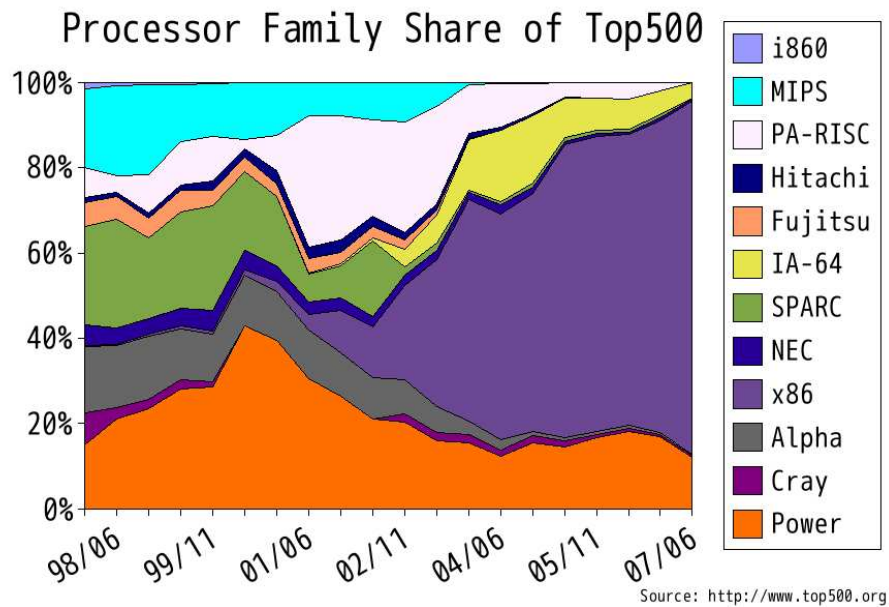
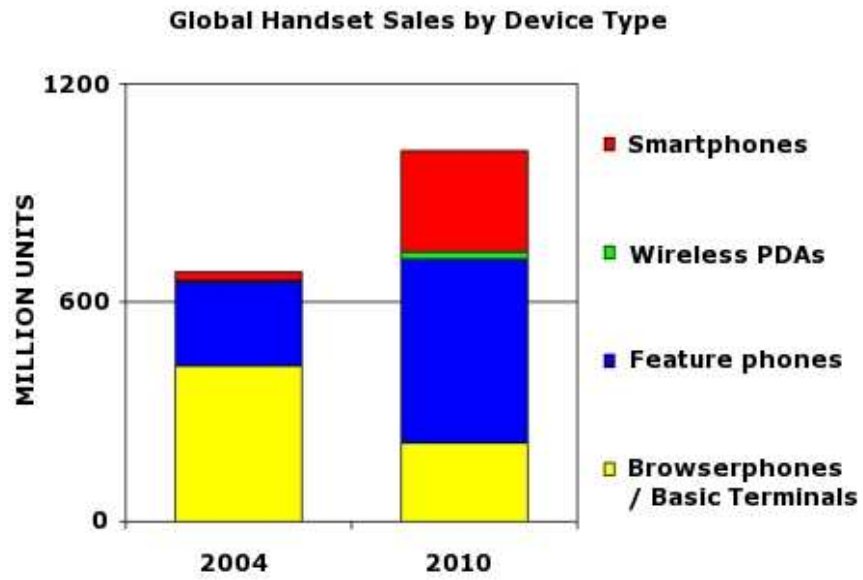


Figure 4: Itanium (IA-64) Share in the Server Market



²⁰ Mining Itanium, CNet News December 7, 2005, accessed 2007-03-19
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 IBM mocks Itanium server sales - again, The Register 30th August 2004, accessed 2008-04-26

Figure 5: Mobile Device Projections



Source: Strategy Analytics, Oct. 2005

