# Intel Stakes 3D Claim, But ATI Takes Lead

## *Some Players Change, But No Consolidation Yet in PC 3D Market*


*by Peter N. Glaskowsky*

The 3D year of 1998 began with Intel's introduction of its 740, a graphics chip that was expected to take the world by storm. Instead, that chip quietly sank beneath the waves. In 1999, Intel graphics will rise above the waves a second time, and a third. But the company will need to do a much better job of meeting the 3D market's needs if it expects to survive as a 3D-chip vendor.

It's not entirely Intel's fault. Few vendors truly understand the graphics market. For example, Cirrus Logic, the former market leader, withdrew entirely from the fray last January, selling its entire portfolio of graphics patents to former competitor S3. At the same time, S3 purchased the CPU patents of Exponential, the defunct PowerPC developer. S3 took quite a risk to establish this library of intellectual property, but by the end of the year, the company had parlayed its improved patent position into a P6 bus license from Intel that could eventually be worth far more than it spent.

While S3 plans for the future, ATI dominates the current graphics-chip market. Figure 1 shows ATI's unit share of the business: over a third of all 3D chips. With average sales prices well above those of S3 or Intel, we believe ATI's share of total chip revenue is well above 50%.

### Intel Shows Its Name Is Not Enough

Although the ATI and S3 stories are interesting, there's more to learn from Intel's experiences to date in the PC graphics market. With its unmatched access to every system OEM and retail sales channel in the PC market, Intel represented a terrible threat to established graphics-chip vendors. Intel's arrival in what was already a hotly contested market probably encouraged Cirrus, Oak, and other 3D-chip companies to give up the fight in 1998.

After the 740 began shipping, however, it quickly became apparent that the chip code-named Auburn was no stronger against the competition than its namesake university's 3-8 football team. Despite good benchmark results, the 740 fell well behind established alternatives from 3Dfx and Nvidia on real 3D applications, especially game titles.


Over the course of 1998, the 740's average selling price declined rapidly from about $25 to less than $10 as it became another faceless alternative at the low end. Even so, Intel achieved respectable sales volume with the 740. According to 4th Wave, Intel sold 6.5 million 740s in 1998. This was more than enough to establish the Intel name in the 3D-chip business. Unfortunately, the 740 may lead users to associate the Intel name with poor graphics performance, an association Intel can ill afford.

Intel's second generation of graphics chips is unlikely to alter this perception. The most significant of these new products will be the Intel 810 chip set, code-named Whitney, which combines core-logic and graphics functions. Like the 740, the 810 will face serious pressure from competitors. Existing integrated-graphics chip sets from SiS and VIA are priced just $10 above otherwise equivalent chip sets without graphics. Though the Intel brand may justify a modest price premium, the 810 will be aimed at system vendors that are accustomed to rock-bottom prices.

The 810 will share a graphics core with Portola, a standalone device. Both chips, due out midyear, will offer just a fraction of the 3D performance of competing graphics accelerators, relegating them to the low end of the market. We expect combined sales of the 740, 810, and Portola to exceed 10 million units in 1999, but the average chip price (including the premium for the 810's graphics core) will continue to decline, perhaps to as little as $5.

Intel's third try is scheduled for 4Q99. Previous plans for a chip code-named Coloma were canceled, and a new device code-named Capitola is being developed instead. Capitola, equipped with a new 3D core and 4× AGP, will be aimed at Katmai-based PCs. Sources say Coloma was killed because it was too slow; Capitola is said to be much more competitive.

Unless it breaks out of the low-end mold, Intel cannot recoup its substantial investment in intellectual-property licenses and chip development, which we estimate at over $300 million. With no more than $75 million in gross revenues to date, Intel's graphics group is far from paying its own way. Nor is it making strategic contributions to the overall PC market that might accelerate the adoption of faster, more expensive Intel processors. Intel surely must already be evaluating a strategic retreat from this sector; if Capitola is not successful, surrender is a real possibility.

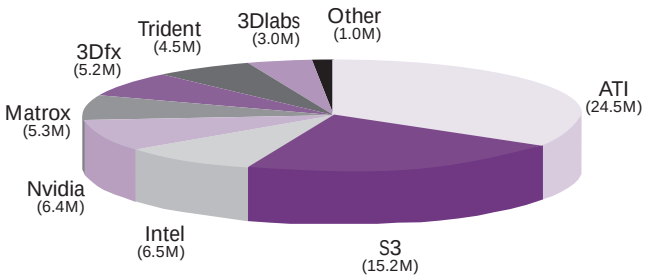


**Figure 1.** According to 4th Wave (*www.fourthwave.com*), ATI had 34% of the 71.55M-unit market for 3D graphics chips in 1998.

### ATI Seizes Lead in Mainstream 3D

ATI may be the only 3D-chip company not at risk of failure in 1999. The company's Rage Pro was the greatest success story of last year, helping to boost ATI's sales figures beyond those of any competitor. ATI's revenue for calendar year 1998 exceeded $1.2 billion, with $136 million in net income. It's likely that ATI earned more profit in 1998 than all other PC 3D hardware companies combined.

The Rage Pro's successor, the Rage 128, was released in August. With overall performance to match the best 3D chips on the market today and unmatched support for digital video, the Rage 128 earns our Editor's Choice award for the best combination of features and performance among mainstream graphics accelerators. We believe the Rage 128 will be the best-selling 3D chip of this year, virtually guaranteeing ATI another year at the top.

### Add-In Boards Add Value

ATI enjoys another critical advantage over most 3D-chip makers—it makes its own graphics cards. It is these cards, far more than the graphics chips that power them, that are responsible for ATI's high revenues and profit margins.

The value of an add-in-board business has not escaped the notice of ATI's competitors. Shortly after it began shipping the 740, Intel introduced a line of 740-based graphics cards, primarily aimed at smaller system integrators. The results were disastrous for Intel. Board makers knew they could not compete with Intel on 740-based cards and turned to other chip vendors, cutting into the 740's sales. Within months, Intel withdrew from the board business.

The point Intel overlooked is that combining a chip business with a board business is an all-or-nothing decision within each market segment. ATI sells chips to some customers, but only for motherboard designs—a market ATI does not itself pursue. Ironically, Intel's own motherboard group has shown no interest in the 740; the only modern 3D chip available on an Intel motherboard is ATI's Rage Pro.

Other 3D-chip companies also took the plunge and became board vendors in the past year. After 3Dlabs acquired the chip and board business of former competitor Dynamic Pictures, it launched its own line of professional 3D cards. Its mainstream Permedia chip family remains available only on the merchant market, since Dynamic Pictures had no existing sales channels for high-volume products.

The acquisition of board maker STB by 3Dfx was much riskier. STB is a major supplier of graphics cards to the retail market, but 3Dfx is already doing well at retail. STB's line of high-end CAD accelerator cards is based on 3Dlabs chips and is no longer a significant business. Only STB's OEM channels offer the potential to increase 3Dfx's market share, but much of STB's OEM sales come from other chip families, particularly Nvidia's RIVA 128 and TNT.

We doubt that 3Dfx can preserve STB's business while greatly reducing the range of products it offers. STB's success now depends on 3Dfx's expanding its line of graphics chips.

### PC 3D Market Continues to Grow

The clearest indication of the lack of good business sense among 3D-chip companies is the ongoing growth in this already overcrowded market. Last year, we listed 45 companies offering or believed to be developing 3D chips or technology; this year, there are 52. More than 43 chips or IP cores are currently available (shown in bold).

3Dfx (**Voodoo2**, **Banshee**); 3Dlabs (**Glint**, **Permedia**, Jetstream); Accelerix (PhantASM); Acer Labs (M3151); Advanced Rendering Technology (**AR250**); Alliance (**ProMotion**); ATI (**Rage**, future Chromatic media processor); Avance Logic (ALG 27000); BitBoys Oy (**Glaze3D**); Broadcom (**BCM7014**); Equator (**MAP1000**); Evans & Sutherland (**REALimage**); FourFold (LightWing); Fujitsu (**Pinolite**); GigaPixel (**unnamed**); Hewlett-Packard (**Visualize**); Hitachi (**Spherix**); IBM (**GXT**); IDT (future CPU with integrated graphics); IGS (**CyberPro**); Intel (**i740**); Interactive Silicon (MediaF/X); Intergraph (**RealiZm**, **Wildcat**); IXMicro (**TwinTurbo 128-3D**); Matrox (**G100**, **G200**); Micron/Rendition (**Vérité**); Microsoft (Talisman); Mitsubishi (**VolumePro**); National (Cyrix **MediaGX**, MXi); NEC (unnamed 3D CAD accelerator); Neomagic; Number Nine (**Ticket to Ride**); Nvidia (**RIVA**, Vanta); PixelFusion (Fuzion); Primary Image (**P10**); Raycer Graphics; Real3D (**Pro-1000**); RealVision (**GA330**); S3 (**Savage3D**); Silicon Engineering (**Mojo**); Silicon Graphics (**Cobalt**); Silicon Magic; Silicon Motion (**Lynx**); Silicon Reality (**Taz**); SiS (**63x6, 530, 620**); SP3D (EnVision); Stellar (**PixelSquirt**); TeraLogic (**TL850**); Trident (Blade); Tseng Labs (**ET6300**); VIA (**MVP4**); VideoLogic/NEC (**PowerVR**)

Removed from this year's list are Cirrus Logic, Oak, Philips, TriTech, and Vsis. TriTech's technology has been transferred to BitBoys Oy, the Finnish winner of the **Most Entertaining Name** award for 1998. Also gone are Chromatic and Dynamic Pictures, which have been absorbed by ATI and 3Dlabs, respectively.

The companies added last year were generally concerned with specific market niches outside the PC mainstream, and these have all survived. The greatest growth this year comes in one of those niches, the professional 3D CAD market, which is clearly too small for the dozen vendors that will fight over it in 1999.

For a second year, those who expected the 3D market to collapse have been disappointed—and as we predicted, the market actually grew in the past year. This growth is likely to continue, allowing hundreds of talented design engineers to develop unwanted products for this interesting but excessively competitive industry.

### New 3D Benchmarks Debut

In 1998, two new 3D benchmarks appeared, making it much easier to make valid comparisons among the many shipping 3D accelerators.

The game-based GameGauge benchmark from *Computer Gaming World* magazine uses semi-automated scripts to measure frame rates in six popular 3D games. Because GameGauge is based on real applications, its results have immediate significance to gamers. The 3Dfx Voodoo2 and Voodoo Banshee and Nvidia's RIVA TNT have the highest scores to date on this benchmark.

The new 3D WinBench 99 from the Ziff-Davis Benchmark Operation represents a substantial improvement over last year's version, which was already quite useful. The new benchmark adds scenes that mimic the behavior of real games, and it runs in triple- or double-buffered mode, like most games. It also spans a wider range of scene complexities than last year's tests. In addition, it reduces the influence of CPU speed by running at higher resolutions and by using texture blending to simulate lighting effects instead of using Direct3D's lighting calculations, which are rarely used in games.

Other changes in 3D WinBench remove rarely used rendering modes from the tests, ensuring that all current 3D chips can run all of the tests. This prevents feature-list differences from influencing performance results, a common problem with 3D WinBench 98.

Testing by *PC Magazine* ranked the Voodoo Banshee faster than all other PC graphics chips in the standard 1,024 × 768-pixel resolution with 16-bit color. The RIVA TNT received the highest scores at higher resolutions and color depths, however, a consequence of the TNT's higher pixel-drawing speed.

More information on the GameGauge benchmark is available online from *Computer Gaming World* magazine at *cgw.gamespot.com*. For 3D WinBench information, see ZDBOp's Web site: *www.zdbop.com*.

## Bad Branding Blocks Business Buying

Though 3Dfx's Voodoo 2 dominates the PC-gaming segment, and its Banshee is slowly establishing itself as an option for other consumer systems, the company has no presence in the larger market for business desktops. It's easy to understand why not—no sane MIS manager would issue PCs equipped with a chip called the "Voodoo Banshee." Such an act would be tantamount to inviting employees to run Quake during business hours—or so the company's CIO might conclude. ATI has achieved success in business PCs with the Rage Pro, despite its name, but this chip is not a very good game engine.

Nvidia's RIVA brand is bland enough, but its game fame has probably limited its success among business buyers. Though its previous RIVA 128 found a home in a few "serious" systems, the TNT's gaming prowess is likely to discourage its inclusion in business-desktop product lines. Compaq offers Nvidia-based cards as extra-cost options in its Prosignia line, but ATI and Matrox are standard equipment in these systems. Nvidia's new Vanta brand should help the company go after such designs. The Vanta program includes some funding to encourage development of business 3D software.

Following Nvidia's lead would be good for 3Dfx. The Banshee has class-leading 2D performance, and, with a new name and without its support for 3Dfx's game-oriented Glide API, it would make a fine graphics chip for business PCs. A renamed and defeatured Banshee could give 3Dfx access to a market more than twice the size of its current territory.

## Poor Execution Remains a Problem

The greatest problem facing graphics-chip vendors in 1998 was simply executing on their corporate strategies. Many 3D chips planned for 1998 releases simply didn't arrive by the end of the year. Some of these may not appear until the 1999 chip-selling season begins in the second quarter of this year.

Our 3D Vaporware award for the most-delayed 3D chip of 1998 goes to Rendition's V3000. Originally intended for a May '98 announcement, Rendition only began discussing the V3000 several months later, in weekly factoids on its Web site in preparation for a planned Comdex announcement. Micron's purchase of Rendition created an excuse to call off those plans. It now seems likely that the V3000, at least in its original form, will never appear—though this nomenclature will probably be used for a beefed-up derivative we expect to see by mid-1999.

Second place in this category goes to NEC and Videologic for the PC-targeted member of their PowerVR Second Generation (PVRSG) family. The PowerVR partners have a much better reason for their delay than did Rendition—they were busy working on a PVRSG derivative for Sega's Dreamcast console game, which shipped (in Japan) in time for the Christmas season. Another PVRSG chip was released for arcade-game systems.

Still, NEC/Videologic promised to ship not one but three different PC graphics chips in 1998, and to date only one of these chips has begun sampling. Its specifications, which looked promising enough eight months ago, today appear to be inadequate to re-establish PowerVR as a viable alternative to 3Dfx for 3D gaming. It's also highly unlikely that PowerVR will make significant inroads in the mainstream consumer or business markets.

The announcement of 3Dlabs' Permedia 3 was made midyear, but the chip has yet to ship, while Permedia 2 sales continue to sputter. This delay will have an adverse impact on 3Dlabs' high-end product line as well, since future Glint rendering engines are derivatives of the Permedia 3 design. It won't help 3Dlabs to offer graphics boards if it doesn't have updated chips to put on them.

### 3D Market Moves Toward Malthusian Solution

In nature, severe overcrowding leads to famine, disease, and death. Unfortunately, the crowds of companies in the 3D arena merely seem to draw in even more players. We believe the ultimate solution to this problem is still at least a year away, but many vendors are already suffering.

For example, some 3D-chip companies are showing signs of rabies. Litigation over contractual obligations and intellectual property (much of which was directed at Nvidia) rose dramatically in 1998, and some of these cases have already left one or both of the litigants vulnerable to further predation. Typically, the predators are other 3D companies. Few outsiders seem interested in taking the weaklings of this industry, though some would be easy pickings indeed.

As with diets and lotteries, hope sustains the 3D market. There is new technology due this year that may change the balance of power among 3D vendors—or so today's also-rans and tomorrow's wannabes believe. The arrival of 4× AGP and Direct RDRAM will greatly increase the potential performance of conventional 3D solutions. Increased transistor counts enabled by 0.18-micron fab technology permits more parallel processing as well as new opportunities for integrated solutions.

Even in the 3D market, however, customers aren't buying technology *per se*. Inadequate features or performance can cause a chip to fail, but market-leading technology is no guarantee of end-user acceptance. Software developers produce applications that require a certain level of performance, but beyond some point, a faster chip can't improve the user's experience. Graphics vendors must also pay attention to factors that are softer and less quantifiable, such as brand names, sales channels, and overall product quality.

ATI continues to lead the market in these areas, and its Rage 128 is also among the fastest chips available. We expect S3 to recover from its slump, though it may never again challenge ATI for market leadership. S3's Savage3D is a solid product, but it appears to be S3's only profitable offering. Although S3 has announced plans for a 0.18-micron graphics chip, that chip is unlikely to appear until late in the year, having little effect on S3's success in 1999.

Other chip vendors with solid prospects for 1999 include 3Dfx, Matrox, and Nvidia. Trident continues to struggle despite significant unit volume, new graphics chips, and a deal to provide graphics technology to VIA for an integrated chip-set product. The success or failure of 3Dlabs hinges on its ability to deliver the Permedia 3 with the promised features and performance, then follow up with the P3's pro-3D derivatives and the rest of the high-end Jetstream family. The host of also-rans that share the few remaining chip sales are unlikely to have much effect on the market this year.

The only thing keeping some of these 3D companies alive is venture capital, but the seemingly endless supplies of capital surely are not infinite after all. When the VCs stop feeding the frenzy, the resulting carnage may be unprecedented in the history of the computer industry. M

### Key 3D Events of 1998

Competitors fear the arrival of **Intel's** 740 (1/26/98, p. 3), but it fails to live up to its hype (2/16/98, p. 1). Intel buys 20% of 740 codeveloper **Real3D** and all of 740 codeveloper **Chips & Technologies** (1/26/98, p. 4). Later, Intel takes a stake in Evans & Sutherland as well (8/24/98, p. 4).

Both **Cirrus** and **Oak** pull out of the PC 3D market (2/16/98, p. 4), perhaps to avoid competing with Intel. **S3** decides to fight, not switch, and buys critical CPU-design patents from **Exponential** that it later licenses to Intel in exchange for access to the P6 bus for future integrated-graphics products (12/28/98, p. 4).

**NEC** and **VideoLogic** announce their next-generation PowerVR graphics chips (3/9/98, p. 16). The first of these ships in **Sega's** Dreamcast console game, but the PC version is delayed until 1999.

**Nvidia** announces the RIVA TNT, which became the world's fastest single-chip 3D accelerator when it began shipping later in the year (3/30/98, p. 4).

**SGI** dumps MIPS to produce x86-based Windows NT 3D workstations (4/20/98, p. 1), though these systems would not ship for eight months.

**Microsoft** debuts Chromeffects, a set of 3D enhancements for the Windows user interface optimized for Web browsing (4/20/98, p. 21). An intriguing idea but a weak implementation; Chromeffects is later withdrawn.

**Micron** and **Rendition** propose the "Socket X" standard for embedded-DRAM desktop graphics chips (6/1/98, p. 4), which finds no takers. Weeks later, Micron buys Rendition (7/13/98, p. 4). Rendition also teams with **IBM** and **Fujitsu** to offer a graphics card with hardware geometry acceleration, but their Conspiracy board mysteriously disappears shortly thereafter.

**Matrox's** MGA-G200 and **3Dfx's** Voodoo Banshee duel with S3's Savage3D for mainstream acceptance (7/13/98, p. 16); Matrox ships first, winning by default.

New 3D accelerators from **3Dlabs** and **Number Nine** hope to compete with the RIVA TNT at the high end of the market (8/3/98, p. 1), but at the end of the year, Nvidia has a dramatic lead in sales volume.

3Dlabs buys competitor **Dynamic Pictures** to enter the add-in-board business (8/3/98, p. 4).

**SiS** and **VIA** announce chip sets with integrated graphics, stealing a march on Intel's 810 (8/24/98, p. 4).

**ATI's** Rage 128 debuts with the best combination of performance and features seen to date (9/14/98, p. 16). **Apple** later becomes the first OEM to adopt the chip.

3Dlabs describes its professional Jetstream architecture (11/16/98, p. 20), while **Mitsubishi** announces VolumePro, a single-chip volume-rendering engine (11/16/98, p. 22).