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CHIP SETS GO 3D, INTEL SHIPS RDRAM

RDRAM Stumbles to Market, Chip-Set Vendors Add 3D Graphics

By Kevin Krewell {1/17/00-04}

It was an interesting year in which Intel stumbled in the desktop market and VIA stepped into the limelight. Clearly, for 1999, Intel has been center stage in the soap opera of the 820 chip set (code-named Camino), Rambus Direct RDRAM technology, and a mediocre-performing Intel 810 integrated chip set. Nominated for best supporting actor would be the scrappy little Taiwanese company, VIA, that dared to challenge Intel with a cheaper, more mainstream (i.e., evolutionary) solution. The rest of the market includes an unexciting AMD-750 chip set for Athlon; integrated chip sets from ALi, SiS, and VIA, which should ship soon, and interesting technology (but no silicon yet) from HotRail. Filling out the server segment were strong designs from Reliance and Profusion, which will provide the backbones for many Xeon servers. As far as mobile is concerned, this year was uneventful and it is not clear if or when a mobile RDRAM design will appear in 2000.

Intel Pushes and the Market Pushes Back

It was a tough year for Intel as it attempted to deliver some real system improvements and new technology. For its efforts, Intel got the appropriate number of arrows in the back. Intel introduced a random number generator for improved security, a faster, narrower bus between the north hub and south hub, AGP 4×, and a memory technology (Rambus RDRAM) that supports the full concurrent bandwidth requirements for the Coppermine processor, ATA-66 disk drives, graphics, and PCI traffic. That is a solid list of accomplishments and it's available on two chip sets—the 820 and 840.

The main problem with Intel's strategy is that, at present, RDRAM costs too much and supplies are short. These problems will be mitigated when volume ramps up and manufacturing yields improve as RDRAM comes down the learning curve. It was unfortunate that some understandable technical challenges delayed the introduction of the 820—twice. Intel apparently underestimated the difficulty of ramping a state-of-the-art, high-performance technology into a mainstream production environment. Any new, advanced system design also requires a learning curve and will be unforgiving at times. To Intel's credit, when it became clear that there was a real problem, Intel postponed the launch—that could not have been easy, and it certainly didn't improve Intel's reputation for timely product launches.

AMD also launched its first in-house designed chip set—the AMD-750. Unfortunately, AMD did not apply the resources to the 750 that it does to processors. The 750 is remarkably similar to Intel's aging 440BX chip set, with support for only AGP 2× and PC100 SDRAM, and it improves on the 440BX only with support for ATA-66. With its 200-MHz, server-class EV6 bus choked down to half its capability by PC100 memory, the 750 is definitely holding back Athlon's performance. Horrible as it sounds, it was probably the right decision. The only memory technology that could properly supply bandwidth to the EV6 bus today is RDRAM, which, as noted earlier, has supply and cost problems, and its availability could easily be influenced by Intel. PC133 memory will help Athlon somewhat when it

becomes available in VIA's Apollo KX133 chip set. But when a DDR SDRAM memory (or RDRAM) chip set is available for the Athlon, it should scream.

3D Graphics Gets Integrated

In 1999 every major chip-set vendor (except AMD) jumped on the integrated-chip-set-plus-graphics bandwagon, and there are a few of these chip sets that could have reasonable performance, despite some contention for main memory bandwidth. The top-performing integrated chip set will likely turn out to be the Aladdin TNT2, the result of a partnership between ALi and NVIDIA. It certainly won't get any awards for creativity in naming, but it is promising because it integrates a well-respected 3D engine. The concern is that ALi has not been as aggressive as VIA in the Slot 1/Socket 370 market, but an EV6 version would make a great companion chip for AMD's Athlon. ALi also announced a part with an ArtX graphics engine, but for Socket 7. Unfortunately, the Socket 7 market will die off in 2000.

The feature sets of the new highly integrated SiS chips, the 540 (Super7) and the 630 (Slot 1/Socket 370), looks impressive—128-bit graphics, PC133 virtual channel memory support, Ethernet core, good DVD support, 300-MHz RAMDAC, and south bridge functions. It could be a monster of a die, though. The chips are sampling now and should be in production soon. Another potential winner is the VIA/S3 team. The Aladdin TNT2 should have the best 3D performance, but SiS and VIA will do well in the OEM channel.

The downside of all these large chips will be long design times and multiple revision cycles. Many of the chip-set vendors have used the technique of producing a first revision chip quickly, followed by extensive testing, and then relying on rapid die turns to fix problems until the parts are production worthy. It will be difficult to continue this practice with the more complex chips that have integrated graphics.

Intel's big seller in 1999 has been the 810 and 810E integrated memory hub and graphics controller, despite its having an anemic 64-bit, 80-Mpixel/s, 16-bit-color 3D-graphics engine. The 3D performance of this part is a least one year behind the discrete 3D-graphics solutions. There are a couple of nice features introduced in the 810—a PCI bus with up to six slots and an interhub bus that has enough bandwidth (266 MB/s) to support concurrent PCI and ATA-66 transfers. The addition of a true random number generator was also a good idea for security enhancements. The 810E added support for the 133-MHz P6 bus, but it wastes the extra bandwidth by supporting only PC100 SDRAM, as Table 1 shows. The 810 has the Intel brand name and is inexpensive enough and good enough for undemanding 2D, but its 3D capability is merely a check-box item.

Workstation, Server Chip Sets Toil in Obscurity

The workstation and server market segments do not have the spotlight very often. Although most of the attention goes to desktop chip sets, workstations and servers are important to Intel's plans to grow its market and AMD's plans to move beyond the cut-throat retail PC market.

This year the most significant workstation product was Intel's 840 chip set, which it launched rather quietly with (working) two-channel RDRAM, AGP 4×, and the option for a 64-bit 66-MHz PCI bus.

In the small server segment, Reliance has good technology, a proven team, a good track record, and an aggressive goal—to double its market share to 60%. Founded in 1995, Reliance has executed well, with its second generation shipping over two million units. The Enterprise SetServer III provides up to 3.2 GB/s of peak bandwidth, using readily available PC100 memory, and supports up to four Pentium III Xeon processors on a 100-MHz P6 bus. The Departmental SetServer III and Entry SetServer III support PC133 memory and a 133-MHz P6 bus. All three provide support for 64-bit 66-MHz PCI.

Intel's eight-way Profusion chip set (created by its Corollary subsidiary) will be a key technology for Intel in the medium-size to large server market. Execution could be better, as some validation issues have delayed the deployment of Profusion. The feature set is good, with 64-bit 66-MHz PCI and support for memory up to 32G of 64-bit PC100 SDRAM in two banks.

HotRail (the company previously known as Poseidon) disclosed plans for an aggressive cache-coherency switch-based architecture, and it is shooting for higher performance than Profusion. Its initial configurations will be four-way and eight-way systems. A 3.2-GB/s HotRail Channel (HRC) connects the central switching fabric to individual bridge chips and should provide sufficient bandwidth for the most challenging application. HotRail has HRC test chips working today. Unfortunately, HRC looks a lot like AMD's Lightning Data Transport (LDT), which might make licensing it to other peripheral-chip makers difficult. It would be best for both parties if AMD

	Intel			AMD	VIA	ALi	SiS
System Features	440BX	810E	820	AMD-750	A Pro 133A	TNT2	SiS 630
Memory	PC100	PC100	RDRAM*	PC100	PC133VM	PC133VM	PC133VM
Graphics	AGP 2×	Integrated	AGP 4×	AGP 2×	AGP 4×	Integrated	Integrated
Disk I/F	ATA-33	ATA-66	ATA-66	ATA-66	ATA-66	ATA-66	ATA-66
Front-side Bus (MHz)	P6 (100)	P6 (133)	P6 (133)	EV6 (200)	P6 (133)	P6 (100)	P6 (100)
Interchip Bandwidth	133 MB/s	266 MB/s	266 MB/s	133 MB/s	133 MB/s	133 MB/s	N/A
Unique Features	–	RNG	RNG	–	–	–	I/O + Enet

Table 1. AMD matched Intel's venerable 440BX with its AMD-750 chip set for Athlon but was outclassed by Intel's 820, which supports faster memory, faster graphics, and faster I/O. SiS produced the chip set with the highest level of integration. *Supports PC100 with optional memory-translator hub. RNG = random number generator.

licensed HRC for the physical layer of LDT. The target processor is AMD's Athlon, which is unproved in the server space. Recently, HotRail raised $8.9 million to develop this chip set, and additional funding will be forthcoming.

Chip Sets Party Like It's 1999

The end of the year is also the time we get to throw cold water on hot technologies, expose half-baked strategies and give out awards.

Our **Chip Set Hall of Fame** award goes to Intel's venerable 440BX chip set—very stable, good performance, reliable, and more than 100 million shipped. It is still in demand as the mainstream chip set of choice for OEM desktop designs, despite having only AGP 2×, PC100 SDRAM memory, and an ATA-33 disk-drive interface.

The **Shooting Yourself in the Foot** award goes to Intel's execution on the 820 chip-set introduction. The technology is laudable. Unfortunately, Intel tried too hard to shove it down the throats of a reluctant industry, and with the rise of the sub-$1,000 PC, OEMs have been more worried about cost than performance. The additional injury is that because of the delays, these systems missed much of the holiday retail sales cycle.

Our It's Better to be Lucky Than Good award goes to VIA for the Apollo Pro133A chip set, which, despite its PC133 Virtual Channel memory support and AGP 4×, performs on a par with Intel's BX chip set with PC100 memory and AGP 2×. But it has the right check-box marketing bullets to sell to consumers.

A **Just Getting By** award goes to the AMD-750 chip set—nothing fancy, nothing extra. It has only the basic features of a 1998 chip set: PC100 SDRAM and AGP 2×, but it did add ATA-66, and it works.

Best Graphics Partner for a Chip-Set Vendor goes to ALi for signing up NVIDIA and reselling the ArtX design. It will be interesting to see how the unified memory architecture (UMA) affects these reasonably up-to-date 3D engines.

The **Long Shot of the Year** award goes to HotRail (ex-Poseidon), which has an aggressive system architecture that is yet to be proved in the market. The first processor the company has targeted is AMD's Athlon, which has potential as a workstation/server processor. Unfortunately, AMD has no track record in that market and, in fact, has a reputation as a consumer-processor vendor to overcome. On the basis of these challenges, HotRail appears to be the longest shot of the group.

Memory Bandwidth, Graphics to Drive Chip Sets

Intel will be the most interesting company to watch in 2000, as two new processors, with new system buses and new chip sets, will be introduced—Willamette and Itanium (Merced). Intel will introduce a new system bus for Willamette, which will have enough bandwidth to utilize the potential of the Rambus channels (or DDR SDRAM). Speaking of Rambus, we project that RIMM prices will drop from ridiculous to merely outrageous. Intel will also introduce in 2000 the 460GX chip set for Itanium, which will not support RDRAM but rather the more-mainstream SDRAM still favored for server applications.

For the mainstream and value segments, Intel will introduce Solano in 2Q00, which is an integrated graphics chip set, but with an AGP port for people who actually care about 3D performance. By the end of the year, the very low end of the market will be served by integrated processors, such as the Intel processor code-named Timna.

In early 2000, AMD's Athlon processor will finally get a chip set solution for AGP 4× and PC133 memory from

Chip Set News for 1999

For the performance desktop:

- The big news was from **Intel**, but not all of it was good. The 820 was revealed with Rambus RDRAM support (*MPR 10/6/99-06* p. 30). Later it finally shipped (*MPR11/15/99-msb*, p. 4).
- **VIA** put itself toe-to-toe with Intel with the Apollo-Pro-133A (*MPR 10/25/99-sp*, p. 31).
- **AMD** introduced the competent, but hardly exciting, AMD-750 chip set for Athlon (*MPR 8/23/99-02*, p. 12).

In the integrated and value segment:

- **Intel** announced the 810 integrated memory hub with graphics (*MPR 5/10/99-04*, p. 17), which it later updated to the 810E with a 133-MHz front-side bus, but it retained PC100 SDRAM support (*MPR 10/6/99-06*, p. 31).
- The response from **SiS** to Intel's 810 was swift but premature—the 540 and 630 (*MPR 5/31/99-06*, p. 22).
- Other integrated graphics moves: **ALi** + **NVIDIA** = Aladdin TNT2 (*MPR 10/6/99-??*, p. 5), and **VIA** partners with **S3** (*MPR 11/15/99-msb*, p. 4).

For the workstation and server market:

- **HotRail** (Poseidon) announced its new architecture targeted at AMD's Athlon (*MPR 7/12/99-05*, p. 12). **Profusion** will certainly be a key technology for Intel in the medium-size to large server market (*MPR 8/23/99-06*, p. 22).
- The NGIO and Future I/O groups got together to create System I/O (*MPR 9/13/99-msb*, p. 4). Later, System I/O was renamed **InfiniBand**.
- **Reliance** showed some solid technology for Xeon processors with lots of I/O channels (*MPR 9/13/99-03*, p. 16).
- **Intel** announced the 840, the workstation companion to the 820 (*MPR 10/25/99-07*, p. 28).

VIA. Later in the year, AMD will improve the EV6 bus by making it more designer friendly, lowering its power consumption and increasing it from 200 MHz to 266 MHz. In the second half of 2000, multiprocessing chip sets from HotRail, Alpha Processors Inc. (API), and AMD will allow Athlon to enter the workstation and server markets.

Parallel system buses for servers will move forward, as server and workstation chip sets with PCI-X will ship and InfiniBand (formerly known as System I/O) will develop as a specification during 2000. Serial buses for PCs and consumer appliances will also improve as USB 2.0 arrives and IEEE-1394 advances to 800 Mb/s. The memory wars will continue as new challengers emerge to take on Rambus—DDR SDRAM and DDR-2.

As processors pass through the gigahertz barrier this year, chip sets and memory subsystems will struggle to keep up. System design techniques, such as double-data-rate (transferring data on both edges of a clock) and clock forwarding, where data and its clock are routed together on a PCB, will help designers keep up with the system bandwidth needs for this year. The trend toward very high speed narrow channels like those on RDRAM, HotRail's HRC, and AMD's LDT will continue, but eventually those channels will need to exceed 1-GHz data rates and ship on four-layer PCBs to reach mainstream designs. Those challenges will remain for system designers and motherboard manufacturers into 2001, with Rambus and the EV6 bus on the leading, bleeding edge for the mainstream market, and Reliance, HotRail, and Intel meeting server needs.