PowerPC 604 Emerges in Systems

First IBM Power Personal PCs, First PCI Power Macintoshes Debut

by Linley Gwennap

The long-awaited PowerPC 604 has suddenly appeared in a bevy of system announcements. IBM has rolled out its first Power Personal systems, including notebooks and desktop PCs based on the PowerPC 603 and 604. The company also announced aggressively priced 604-based workstations. At the same time, Apple announced its first PCI-based Power Macintosh, which uses the 604. Other vendors, including Canon, Harris, and IPC, have also announced 604 systems.

The 604, due last December, encountered several delays, but both IBM and Motorola are now shipping the part. The delays allowed the partners to boost the clock speed from the original 100 MHz to as high as 133 MHz. On a per-clock basis, however, the performance of the 604 has not reached its goals.

Production Achieved After Long Odyssey

The 604 was claimed to be in volume production last December, but production was almost immediately halted when several functional problems were found. A new version emerged around April, fixing the known uniprocessor bugs; this version is used in the current round of systems. Another spin, which repairs a few latent multiprocessor bugs, is due soon.

During the delay, IBM and Motorola were able to move the design from the original 0.65-micron CMOS-5L process to the 0.5-micron CMOS-5S process. This change boosted clock speeds 33%, to 133 MHz. Because the 5L and 5S processes use the same metal layers *(see **080504.PDF**)*, the die size of the part remains 196 mm^2. The higher wafer cost of the new process drives the manufacturing cost to $120 for the faster parts, 20% higher than the original cost.

This speed upgrade, however, barely allows the 604 to meet its original performance goals. At introduction, the 100-MHz chip was touted at 160 SPECint92 *(see **080501.PDF**)*. Despite liberalization of SPEC rules in the interim, actual 100-MHz 604 systems deliver no more than 141 SPECint92. The fastest 133-MHz systems manage 176 SPECint92 and 157 SPECfp92.

The partners claim that the 100-MHz 604 will eventually reach its 160 SPECint92 goal, and that 133-MHz systems will deliver 200 SPECint92. Increasing performance by 15% will require 1M caches, SDRAM main memory, and "future compiler enhancements." For comparison purposes, we will use the performance of today's systems until IBM can demonstrate better results.

Both companies are in production of the 100-MHz version, but only IBM is currently producing the faster parts. Motorola is still qualifying its version of the CMOS-5S process and has not released pricing or availability for the 120- and 133-MHz versions, saying only that they would be ready sometime in 2H95. IBM has priced its 133-MHz part at $756, more than twice the price of the 100-MHz version.

Table 1 compares IBM's 3Q95 PowerPC prices with Intel's CPU pricing. IBM continues to deliver a substantial price/performance advantage over Intel. But with the introduction of the 133-MHz Pentium *(see **0908MSB.PDF**)*, Intel's fastest chip now reaches 155 SPECint92, putting it within 15% of the 604's integer performance.

IBM	Price	SPEC-int92	Intel	Price	SPEC-int92
PPC 601-66	$152	74	Pentium-66	$260	80
PPC 601-80	$166	90	Pentium-75	$275	90
PPC 601-100	$208	112	Pentium-90	$377	110
PPC 603-66	$125	62	DX4-100	$245	55
PPC 603-80	$152	75	Pentium-75vrt	$275	90
PPC 603e-80	$166	96	Pentium-75vrt	$275	90
PPC 603e-100	$187	120	Pentium-90vrt	$427	110
PPC 604-100	$343	141	Pentium-120	$734	140
PPC 604-120	$583	158	Pentium-133	$935	155
PPC 604-133	$756	176			

Table 1. PowerPC continues to offer price/performance superior to Pentium's, but the integer performance of the latest 604 processor is only slightly better than that of the fastest Pentium. Prices are current 1,000-piece list prices. (Source: IBM, Intel)

IBM Builds Top-of-the-Line PCs

IBM's Power Personal products are PowerPC systems aimed at PC users. The new products include two 603-based notebooks and two 604-based desktop systems. The notebooks were codeveloped with Canon and will be sold by both companies.

The notebooks, which IBM sells as the ThinkPad 820 and 850, are high-end units with a 10.4" active-matrix color TFT display, double-speed CD-ROM, and stereo speakers. They both include a 100-MHz 603 with 256K of secondary cache, although the 820 restricts the system bus to 32 bits while the 850 uses the full 64-bit bus. The 850 even includes an integrated video camera. System weight (without the camera) is about 7 lbs. The systems ship with an NiMH battery rated at 2.5 hours.

IBM has put a high price on these notebooks: the 820 starts at about $6,000, while the 850 tips the scale at $8,000. Canon, which doesn't have an existing notebook

line to protect, is much more aggressive, offering its equivalent to the 820 notebook for $3,500, including 16M of memory, an 810M hard drive, and Windows NT.

IBM's Power Series desktops come with 100-, 120-, or 133-MHz 604s. The systems are PCI-based and include S3's 864 graphics accelerator with 2M of VRAM on the motherboard. An entry-level system—with a 100-MHz 604, 256K L2 cache, 16M of DRAM, a 540M hard drive, CD-ROM, Ethernet interface, and three expansion slots—lists for $2,795. Tacking on a 15" color monitor at IBM prices and Windows NT, however, runs the price of a complete system to about $3,700.

All the Power Personal systems will be offered with a variety of operating systems, although Windows NT 3.51 is the only one currently available. IBM's PowerPC version of AIX should be available in August. The mainstream OS for these systems will be OS/2; a PowerPC version is currently in beta testing, with production slated for 4Q95. These systems will also support the PowerPC version of Solaris, which has been demonstrated but has no announced release date.

The robust configurations and high price tags of these systems reflect the minimum requirements of Windows NT or AIX. The Power Personal systems will have little impact on the PC market with either of these resource-hungry operating systems. The arrival of OS/2 for PowerPC will hopefully spur IBM to deliver systems at lower price points than $3,700.

IBM Workstations Aggressively Priced

IBM also announced a series of 604-based workstations. These systems, the RS/6000 43P family, are highly leveraged from the Power Personal units, retaining the CPU subsystem and PCI and ISA buses. The workstations add a faster memory system, better graphics, and SCSI interfaces rather than IDE. By using high-volume PC components, IBM is able to price these systems very attractively compared with other workstations.

The entry-level 100-MHz workstation is priced at $6,500 and delivers 128 SPECint92. The 133-MHz version, rated at 176 SPECint92, lists for just $8,000. Both prices include the features listed for the 604-based PCs described above, a 15" monitor, and AIX.

Today, only Digital is delivering workstations faster than 176 SPECint92, and those systems cost well over $20,000. HP's latest workstations *(see **0908MSB.PDF**)*, which offer integer performance comparable to the high-end 43P, are over $40,000. The severe price compression represented by these hybrid PC/workstations will cause other workstation vendors to rethink their product strategy. Both HP and Digital have high-volume PC lines to leverage, but neither has taken advantage of this opportunity to date. Neither Sun nor Silicon Graphics has a PC business, but both could see significant cost reductions by adopting standard PC technology.

Price & Availability

The PowerPC 604 is available from IBM at speeds up to 133 MHz. See Table 1 for pricing. For more information, contact IBM Microelectronics (Essex Junction, Vt.) at 800.POWERPC or 708.296.9332.

Motorola is also in production of the 604 at speeds up to 100 MHz. The company is also sampling 120- and 133-MHz versions but has not announced pricing; these chips are expected to reach volume production in 2H95. For more information, contact your local Motorola sales office or call 800.845.MOTO.

Apple Moves Macintosh to PCI

Apple's new high-end 9500 series is the first of the company's PCI-based Macintoshes. Ultimately, the company plans to move its entire product line from its own NuBus to the industry-standard PCI, allowing Apple to use the same add-on chips and boards as x86-based PCs. This move will greatly increase the number of video and peripheral options for Macintosh systems, improving performance and reducing Apple's costs.

These lower costs are not reflected in the company's initial pricing. The new machine, code-named Tsunami, carries a list price of $4,699 for a system with a 120-MHz 604, or $5,399 for a 133-MHz system. The standard configuration is loaded with 16M of RAM, an ATI graphics card with 2M of VRAM, quad-speed CD-ROM, and 1G hard drive, but no monitor or keyboard.

The 9500 is an impressive machine for Mac users, delivering far more CPU and graphics performance than any other Macintosh. The price, however, puts it out of range of all but a few power users. Hopefully, some of Apple's future products will bring the power of the 604 into the hands of everyday users, although this may not happen until next year.

Other vendors also have announced new PowerPC systems. Both Canon and IPC (Austin, Texas) are selling systems designed and built by startup FirePower *(see **0815MSB.PDF**)*. These products include single- and dual-processor systems with 100- to 133-MHz 604s and are intended solely for Windows NT. Canon's prices start at $3,499 for a complete 100-MHz system, including 16M of memory, a 4× CD-ROM, monitor, and NT; IPC's prices start a bit higher at $3,995. Harris has introduced a multiprocessor system that includes software workarounds to work with the current 604 stepping.

All of these systems will be competitive in niche markets where PowerPC has already been established, but they do not offer the combination of low price, high performance, and applications software needed to compete with x86-based PCs *(see **0908ED.PDF**)*. As more vendors introduce 604-based systems, however, we expect prices to drop, spurring interest in PowerPC. ♦

