



Chips fall into place for IBM PS/2 compatibles

Mike Seither, Senior Editor

If imitation is a form of flattery, then at least two companies in California's Silicon Valley are laying it on thick.

In January, Adaptec Inc., Milpitas, and Chips and Technologies Inc., San Jose, announced that together they have developed the key pieces that will allow OEMs to build IBM Corp. PS/2-like systems. These systems not only will be 100-percent compatible but also will offer higher performance than IBM's PS/2 models 50, 60 and 80 machines.

Both Adaptec and Chips and Technologies have worked for some time on the PS/2 compatibility project. The result: Chips and Technologies now has chip sets that mimic the core

logic of the PS/2 as well as the Video Graphic Array (VGA), IBM's new analog display technology.

Adaptec has developed disk drive controllers and host bus adapters that will allow system integrators to attach drives with the small computer systems interface (SCSI) to IBM's Micro Channel, the backbone of the PS/2 machines. To date IBM has not offered SCSI support for the PS/2.

Another company that has made significant inroads into PS/2 cloning is Western Digital Corp., Irvine, Calif. Last year, the company announced CPU board-level products that mimic the PS/2 models 25, 30, 50 and 60 systems, including core logic chip sets, disk controllers and a video graphics controller. Western Digital also announced a series of

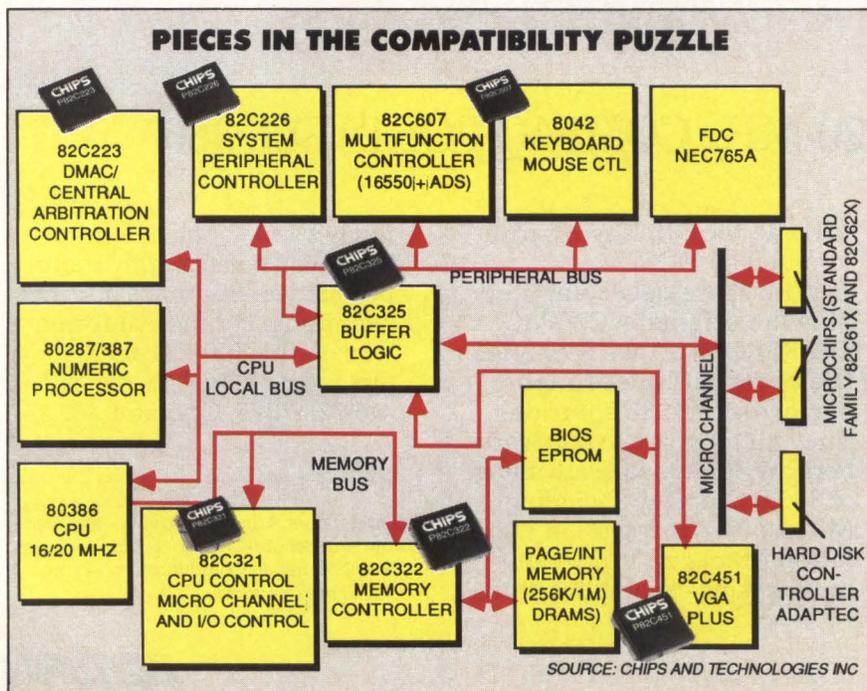
add-in boards that duplicate the functions of the Micro Channel.

Also playing in the clone game with Adaptec and Chips is quasi-development partner Phoenix Technologies Ltd., Norwood, Mass. This company supplies the ROM-based basic input-output system (BIOS) for PS/2 compatibles. For the last several weeks, all these companies have been on a worldwide road trip telling OEMs and systems integrators their story. Here's what they've been saying:

The Chips and Technologies' CHIPS/250 chip set recreates IBM PS/2 models 50 and 60, but with fewer components—68 for Chips compared to 119 for IBM. While models 50 and 60 now support only the 10-MHz version of Intel Corp.'s 80286 CPU, systems using CHIPS/250 components can use the 80286 running at 16 MHz and 20 MHz.

The CHIPS/280 chip set is for companies building systems compatible with the PS/2 Model 80, which uses Intel's 32-bit 80386 processor. CHIPS/280 uses 66 components to build a motherboard, compared to 179 for the Model 80. Chips claims that this level of integration will let OEMs build compact 32-bit systems to fill the gap in the PS/2 line between the desktop Model 50 and the floor-standing Model 80.

What's more, Chips and Technologies supports "matched memory cycles" for Model 50 and Model 60 compatibles. IBM uses this scheme only in the Model 80 to get around the limitations of the 10-MHz Micro Channel while not "violating" the specifications of the bus. Add-in memory cards using this method have four additional pins that carry control signals, shortening memory access



time from 300 nsecs to 187.5 nsecs. That means OEMs can offer Model 50 and Model 60 clones that have 50 percent greater memory throughput than comparable IBM machines, according to Chips.

For PS/2 Model 80 clones, Chips says it beats IBM at the matched-memory game by a margin of 33 percent for 20-MHz machines—that is, Chips' "fast" cycle is 150 nsecs, vs. 200 nsecs for IBM. This system relies on configurable registers and most likely will be used by large OEMs who design their own memory add-in cards and bundle them in the clone.

A discrete goodbye

Both CHIPS/250 and CHIPS/280 are built around an asynchronous direct memory access (DMA) controller that Chips claims will allow OEMs to

"fine tune" their I/O systems to take full advantage of the Micro Channel. According to Chips' engineers, IBM appears to have implemented a syn-

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chronous DMA scheme that runs at either the same speed as, or half the speed of, the CPU clock in order to stay within the 10-MHz bounds of the Micro Channel.

With a 10-MHz CPU, for example, IBM and Chips-based clones would have an equal DMA performance of 10 MHz. But with a 12-MHz CPU, IBM systems would have a DMA

speed of 6 MHz; with a 16-MHz CPU, IBM systems run at 8 MHz. On the other hand, Chips says that its asynchronous DMA clips along at a steady 10 MHz, regardless of CPU speed.

Two other features round out Chips' value-added offerings in both of its chip sets. First are mapping registers that support the Lotus/Intel/Microsoft (LIM) Extended Memory Specification 4.0. Each task, or application, running under Microsoft Corp.'s Windows 2.0 can have its own 1M-byte register. That provides fast context switching between applications under Windows.

Second, Chips has added four programmable decoders that let OEMs avoid adding discrete logic devices to control such things as panel lights, password control and networking

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Answers in the chips for IBM PS/2 compatibility

When IBM Corp. unveiled its Personal System/2 series of computers last April, it made two things very clear to the competition.

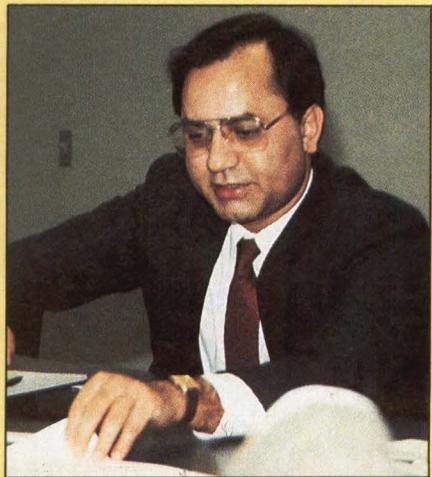
First, because of the complexity of such things as the high-end PS/2's Micro Channel, clone-makers would find it difficult to make a less expensive duplicate system. It would also take some time, possibly a year or two,

to develop such a system without getting snagged on the myriad of patents and proprietary secrets that were embedded in the new IBM series.

Second, if anyone should duplicate the PS/2 systems and the Micro Channel, then IBM would use all of its legal clout to nab those who had violated even the slightest patent, be it an IBM patent or the patent of some other

manufacturer who contributed to the system design. In fact, IBM president William Lowe himself said IBM would not tolerate those who chose to illegally ride on IBM's coattails.

Despite these warning shots fired across the bows of clone makers, the PS/2 lookalikes are here. In January, Chips and Technologies Inc., Adaptec Inc. and others debuted the working



"Our design allows OEMs to get into a lower footprint board. That's a less expensive solution compared to IBM which is using twice as many signal chips," says Sikander Naqvi of Chips and Technologies.

CHIPS AND TECHNOLOGIES' PS/2 ALTERNATIVES

Function	CHIPS/250 (IBM Models 50/60)	CHIPS/280 (IBM Model 80)
System Logic	CS8225	CS8238
Graphics	82C451/2	82C451/2
COMM/FD/IO	82C607	82C607
Micro Channel Adapter Interface	82C6XX	82C6XX

Source: Chips and Technologies Inc.

support. These signal lines can be programmed from the BIOS.

Count on color

Finally, the CHIPS/450 graphics family provides two levels of support for IBM's VGA. The two controller chips in the family, the 451 and 452, are pin-compatible, allowing OEMs to design one board and upgrade it, depending on the performance requirements of their market. The 451

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pieces of a PS/2-compatible system that are available to OEMs and system integrators. At that time, they promised that functioning system would be available within a month. Not only would they be 100 percent compatible with IBM PS/2 systems but they would also be less expensive and more powerful than IBM PS/2 machines.

Recently, Mini-Micro Systems talked to Chips and Technologies product marketing manager Sikander Naqvi about the company's PS/2 chip sets, which are the heart and soul of the new generation of IBM-compatibles. Taking part in the interview were editors George Kotelly, James Donohue, Doug Pryor and Megan Nields. Following are excerpts of that interview.

MMS. What precautions has IBM taken with its PS/2 systems to make it difficult to copy their design?

Naqvi. If you look into the PS/2 families, they have done exactly what they did in mainframes in terms of the proprietary nature of the hardware and the software. They are also doing their own internal design at the chip level, at the software level and even at the manufacturing level. For example, PC/ATs were usually manufactured outside, but this is the first time they have integrated almost everything from chips to the operating system software all internally. This is nothing different, if you compare that to their mainframes.

MMS. What kind of problems have these proprietary roadblocks created

for you?

Naqvi. Our efforts had to change, too. When we started out, we looked at the overall system and basically decided there would be two different solutions to the problem: one in the hardware, and one in the software.

They are very tightly coupled because that's how they [IBM] have developed their system. So, when we designed the system about nine or 10 months ago, we started by tying all the systems logic into the main motherboard logic. On the mass-storage side we started talking to Adaptec, Phoenix Technologies [Ltd.], and SCO [The Santa Cruz Operation] for the XENIX side, because we'd like to have XENIX on the machines.

We also had extensive discussions with Microsoft Corp., because now the operating system is very tightly coupled to the hardware. In planning the hardware, you have to understand the software, and who would know more about software than Microsoft?

MMS. Have you talked to IBM at all?

Naqvi. We have talked to IBM to the extent that they know exactly what we have been doing. We have kept them abreast of all our development activities and will address the legal issue later. In fact, we have been talking with them extensively over the last six months at every level.

MMS. Do you feel that IBM is in any way actively trying to stop systems makers from producing PS/2 clones?

Naqvi. Every indication we have is that they are not out there to stop somebody from doing it. They want to control it this time, unlike the situation they had with their PCs.

And they will control it through licensing.

MMS. What exactly have you developed?

Naqvi. We have two distinct solutions, one for the Model 50 and one for the Model 80, each comprised of the graphics, systems logic and hardware. Basically, we are putting all the pieces together right now which allow compatible manufacturers to have a 100 percent compatible machine by just going to us and Adaptec.

We designed the whole system before we actually started on the actual chip design. What that means is that all the subsystems are really a collection of tightly coupled chips. For example, there are seven chips for our Model 50.

MMS. How are you positioning your system against IBM?

Naqvi. This product is really targeted toward a hole we see in IBM's product line between the Model 50 and the Model 80. Our customers will be able to come up with a Model 80 machine with the same footprint, or a lot smaller, than the Model 50. It will also be a real high-performance, 20-MHz machine.

At the same time, we are coming out with another chip set that puts the performance well above the Model 80. So, we're trying to squeeze them from both sides, one from the low end which can be put on a desktop, and one from the higher-end which is a cache-based system.

MMS. In what ways does your design benefit the OEM customer?

Naqvi. What we want to bring to our OEM customer is essentially the same as in the past. Our machine would have to clearly be a better per-

has control signals for the IBM PC, PC/AT and Micro Channel. The 452, a superset of the 451, supports 256 colors in 640-by-480 resolution mode (IBM offers 16 colors) and 16 colors in 960-by-720 mode (IBM has four colors).

The 452 also runs a graphics cursor and has a scheme to move blocks of text around quickly via hardware assist. Chips claims its VGA controllers offer six to seven times the perfor-

mance of IBM's. The reasons: a 16-bit VGA interface, vs. an 8-bit interface for IBM, and direct access to the CPU controller, giving Chips a 187.5-nsec cycle vs. a 300-nsec cycle for IBM.

For its part, Adaptec is bringing out three rigid disk controllers and a pair of Micro Channel-to-SCSI host bus adapters for the PS/2. For models 50, 60 and 80, Adaptec has a pair of controllers for drives with the ST506 interface. The company claims the

controllers, the ACB-2610 and the ACB-2670, can burst data at transfer rates of 10M bytes per second, compared with IBM's 3.3M bytes per second.

The controllers also feature a read-ahead cache that loads a buffer with sector information beyond the original request. Adaptec believes this feature will show noticeable performance increases, not so much for single-user applications as for multi-

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forming machine than IBM's—not marginally better, but clearly a better machine than IBM's. Also, in order to compete in this marketplace, you have to make sure that the cost factor is such that they [OEMs] can come out with a machine that can be priced below IBM's. These two recipes haven't changed in the PS/2 market.

MMS. Why exactly is your system much cheaper than IBM's?

Naqvi. Our design allows them [OEMs] to get into a lower footprint board. In turn, that's a less expensive solution compared to an IBM which is using twice as many signal chips. With the reduction in chip count, and the way we have packaged them, and the way we are pricing it, we know our

customers can build a system which can effectively compete with IBM.

MMS. What other benefits does your system solution offer besides a lower price tag?

Naqvi. IBM's PS/2s now have a standard clock rate of 10 MHz and offer a one-wait-state operation, and that's really much like the way they have done in the past. It's not surprising coming from IBM. However, the machine we have designed is going to operate at 16 MHz today, and the whole architecture is designed for 20 MHz. We have reason to believe that 20 MHz will eventually be a standard. We also have less than one wait-state in this system, less than IBM's.

At every level our effort has been to optimize more performance, while at the same time keep the cost factor in our minds since those are the two things that make our OEMs compete

in the marketplace.

MMS. What about the design of IBM's Micro Channel? Has it presented any technical problems for you?

Naqvi. We believe the Micro Channel IBM has designed is very slow for the Model 50, so we have implemented what we call "bank memory timing." Because of this mass memory timing, our bus bandwidth is at least 60 percent faster than IBM's, even at 10 MHz. Typically their Micro Channel cycle time is 300 nsec; ours is 200 nsec. In most applications, you probably won't notice the significant improvement until you start accessing your hard disk or you try to send something over a Token Ring or an Ethernet card. Then you will see the advantage of this wider bandwidth.

Once you combine the Micro Channel bandwidth improvement and the system memory . . . the real performance benefit of our 16-MHz system is twice that of the IBM Model 50. Even at 12 MHz, it's at least 30 to 40 percent better than IBM's. I don't think anyone will be designing a 10-MHz system. It has to be either 12 MHz or 16 MHz.

MMS. The obvious question, of course, concerns compatibility. Just how compatible are your PS/2 alternatives?

Naqvi. Compatibility, as far as we're concerned, is where we start. It's not something we do as another feature. We take it for granted that it will be 100 percent compatible. In this case, however, compatibility wasn't as easy as in the case of the IBM PC. IBM hasn't published any schematics for the PS/2 or for its



Mini-Micro Systems editors team up to question Chips and Technologies about its PS/2 chip sets.

MICROCOMPUTER SYSTEMS

user programs under UNIX and XENIX, where data is retrieved from storage in large blocks. The ACB-2610 uses the modified frequency modulation (MFM) scheme, while the ACB-2670 uses run-length limited (RLL), an encoding method that squeezes 50 percent more capacity from standard ST506 drives.

At the high end, Adaptec's ACB-26M20 is for drives using the enhanced small device interface (ESDI).

Like its ST506 cousin for the PS/2, the ESDI controller supports a bus transfer rate of 10M bytes a second and can operate two 780M-byte ESDI drives. IBM's Model 80 top-end ESDI drive stores 314M bytes.

Adaptec hopes to make a big splash with its AHA-1640, a SCSI host bus adapter that can run a variety of SCSI devices (magnetic and optical disk drives, tape drives, scanners and printers) off the PS/2 Micro

Channel.

The AHA-1640 features a bus transfer rate of 8M bytes a second (compared to 3.3M bytes a second for IBM). According to Adaptec, in multitasking operations the host adapter can handle up to 255 tasks at a time, vs. only 3 simultaneous tasks for the IBM Model 80. In addition, the adapter supports synchronous and asynchronous peripherals concurrently. □

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BIOS [basic input-output system], so it was difficult to know how to go about being compatible.

Our solution is to be 100 percent gate-level compatible with IBM. In fact, we are so compatible with IBM that when we build a machine, we can take the IBM PROM [programmable ROM], put in into our system and then boot it up from the IBM PROM. That's where we started. We have also added a number of enhancements that are built into our system. Since they are not there in IBM's PROM at boot-up time, the system goes through the BIOS to turn them on. Aside from these enhancements, however, the [boot-up] default is identical to IBM's, so there is no question of compatibility at boot-up time.

MMS. In designing your systems, you have had the opportunity to closely examine IBM's PS/2 design and system logic. What are some of your findings?

Naqvi. We've found some very interesting things. For example, IBM hasn't augmented and is not even using quite a few things that are there in the chips, which gives us an indication that they may have some secret development programs.

This is a benefit to us, since we have taken these unused registers and have tailored the BIOS from Phoenix [Technologies Ltd.] to take advantage of that.

MMS. Any idea what these hidden registers are being reserved for by IBM? Are they suitable for graphics or communications or database?

Naqvi. In some cases, we know that these things they are not using are suitable for graphics. And, on the logic side, they are mostly related to a bigger DMA [direct memory access] bandwidth and a larger address space for DMA. Other areas are more related to how you discover when you have a physical error in the system.

MMS. When you say you've found some undocumented DMA registers, what do you think that suggests about the addition of smart controllers and multiprocessors. Do you expect a multiprocessor machine from IBM?

Naqvi. What [IBM] has put in there are mainly some generic enhancements. But the higher DMA bandwidth would definitely be a help in multiuser applications.

MMS. What about your relationship with IBM. Is it strictly verbal or legal, or do you have some other arrangement?

Naqvi. We have been talking with IBM through our lawyers for the last six months, and we continue talking with them. They know exactly what we have done. Basically, we deal with IBM as a customer or, rather, a potential customer—even if they are not a customer. On the legal side we have worked along with IBM. Our point has been that we are not going to violate anybody's right to intellectual property.

MMS. What about recent disclosures that Computer Automation [Inc.] retains some key patents on the Micro Channel, and that IBM licenses these patents from them? Does that make things more difficult for you?

Naqvi. I think what it indicates is that all the pieces are falling into

place right now. Most of it has to do with the status of these patents.

MMS. In the event you are wrong, and clone-makers make a PS/2 with your chips and IBM sues, are they going to be the one held accountable in court? More important, is there the possibility they can be found guilty of patent infringement?

Naqvi. What we're telling all our OEM manufacturers is go tell IBM what you are going to do. Tell them exactly what you are doing, and ask them what are the legal obligations before announcing anything. I don't think anyone will risk putting something on the market without first telling IBM what they are doing.

IBM will then tell them to fix it or pay up. They will be the final judge to tell if it fails or if it passes.

MMS. Do you have any plans to enhance your AT chip sets in such areas as extended I/O and extended memory since OS/2 is not Micro Channel-dependent? What specifically are you going to do in the AT area to support OS/2?

Naqvi. We had announced an AT chip set last September. If you look inside that, we have all of these built-in hooks to take advantage of OS/2. IBM has also done similar things in their PS/2 systems to take advantage of OS/2, and that's the reason that their 10-MHz PS/2 runs faster than their 10-MHz PC. We have the same things in our AT systems, and in fact they're already in production now. So, our [AT] machines can run at the same speed as the PS/2s.

As far as the EMS [extended memory specification] is concerned, we support the LIM 5.0 [the Lotus-Intel-Microsoft] standard on the chip itself.