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Too Much Of A Bad Thing

Just what should you do about desktop computers? Should you move up the line toward the fastest machines — 450 MHz PCs, these days — or down to less costly boxes that are still a lot more capable than even the heftiest PCs of the last generation? It's not an easy question to answer, but it can't be avoided, either.

The choice is easy for personal users who like the latest games. They always want the hottest machine they can afford. The same may be true for small business users who might have only one or a few machines and a demanding application or two that calls for a bit of extra computing power.

But companies that put PCs on the desktops of users for what these days is light use — ordinary productivity applications or typical client side commercial computing — don't necessarily need all the power high spec PCs offer. They might not even need the power, memory and graphics capability of bottom-of-the-line boxes, if by bottom they mean chips in the 300 MHz class, memory capacity in the 256 megabyte class and graphics cards that can display 24- or 32-bit color at 1024x768 or higher.

With workstation class (well, not quite) PCs costing around two grand, loaded, and basic machines going for half that amount or less (plus the cost of a monitor), it isn't easy to make a decision, even when saving money is a top priority. Sure, if you get the cheap PC you can replace it in a year (with one that's twice the power at the same price) and still be out less money than a high spec machine will cost. But that's only the case on the surface. It might actually cost your enterprise more to replace a PC

and make sure it's running right than to get the new machine to your receiving dock in the first place.

Yet if you think that observation yields a clear answer, you may be jumping to conclusions. What guarantee is there that the more costly PC will remain viable for a long time just because it has more power. Maybe some other aspect of PC technology — a functionality issue, not a performance issue — will be the determining factor. If that's the case, high end PCs acquired today might not be any more resistant to obsolescence than cheap ones.

This may sound like a case for that orphan of the industry, the network computer, but it's not. When cluster server issues are brought into the equation, the network computer presents just as many problems as a PC, maybe even more. Here's one: greater vulnerability to local server failure.

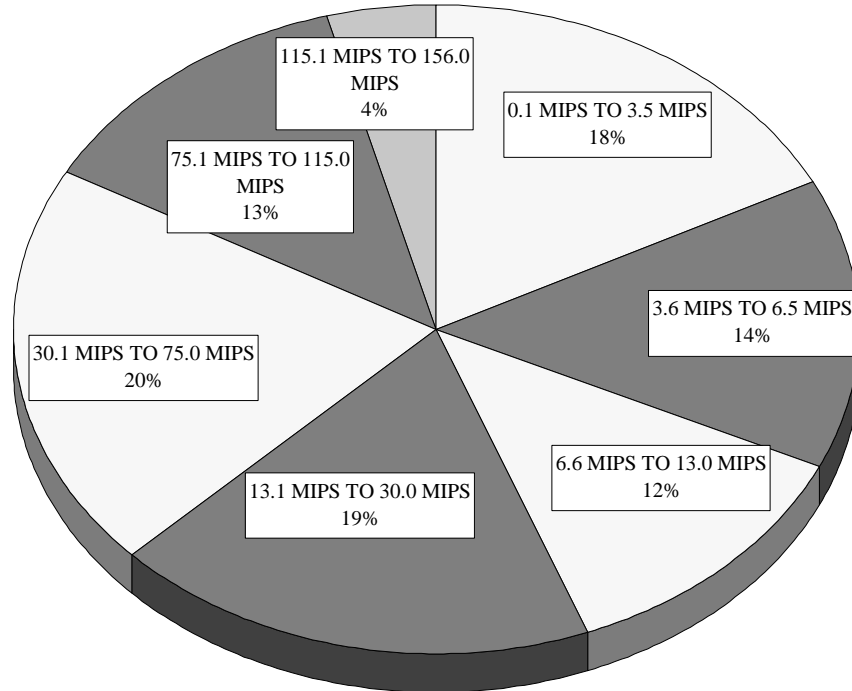
The answer, to the extent there is one, is unlikely to be found in the specifications of various PCs. It lies in operational strategy. An enterprise that can manage its PCs effectively — managing software configurations and assuring that locally generated files are stored in some central location — can select PCs with relative freedom. An enterprise that fails to impose order on its end user isn't going to be very effective whether it saves money on the boxes or not.

Making the whole matter even more annoying is the way various vendors are trying to come up with management solutions that also lock users into a load of client and server products. There are simply too few viable vendors, and too few truly helpful ones.

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US uses with S/390 and compatible systems up to 156 MIPS in power are overwhelmingly likely to have very small machines, according to surveys conducted by ZD Market Intelligence. About 18 percent of this base could support their work on a first generation P/390, while 32 percent could live with a current P/390 or Integrated Server. By next year, when the Integrated Server runs at 13 MIPS, 44 percent of this base could move to the miniature mainframe.

Smaller S/390 Servers: Big Base, Small Thinking

The big mainframe sites have it easier than the small ones. Big sites can get only one style of computer system — a processor with external peripherals — and just have to choose a vendor and model that fits their power requirements. If they buy from IBM, that means a 9672. Smaller sites can opt for a machine that is very much like the one at a large enterprise. But even if they consider only IBM equipment, depending on their

MIPS requirements, they can go for a 9672 (either new or used), a Multiprise 2000, an S/390 Integrated Server or a P/390.

You might think that with three or four options in below 15 MIPS, all of them providing the benefits of CMOS and year 2000 compliant designs, most users would have somehow made a choice and moved ahead. But this is, in fact, not the case. Surveys of users with up

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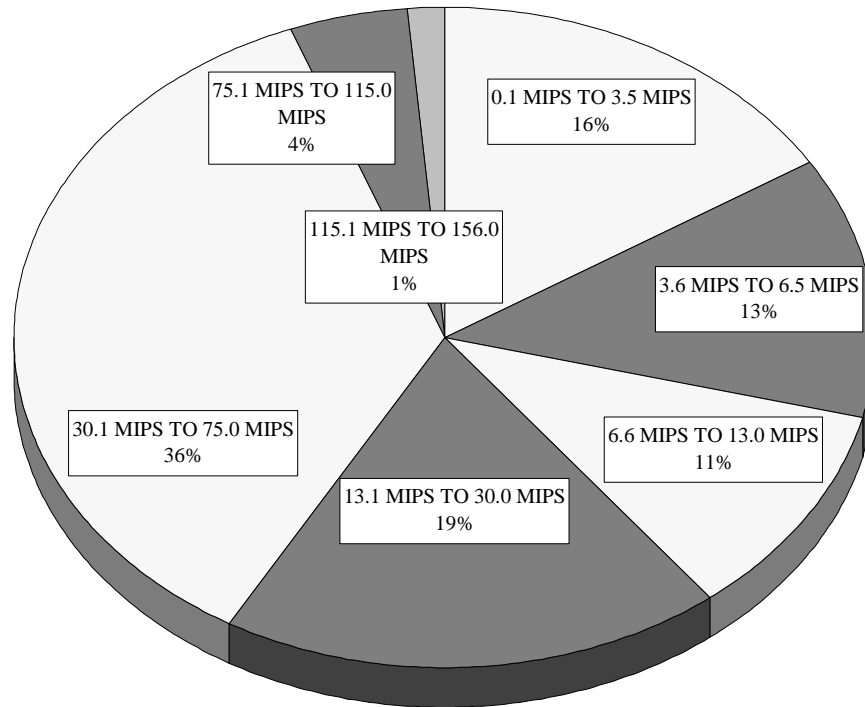
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In Europe, according to ZD Market Intelligence, only 1 percent of the S/390 and compatible systems with less than 156 MIPS of processor power run at more than 115 MIPS. About 16 percent of the base could move to a first generation P/390 and 29 percent could get by with a current P/390 or Integrated Server.

to 156 mainframe MIPS — that is the upper limit of the Multiprise range — show that two out of three ships are still using processors that are one, two or even three generations out of date.

While it is possible that all these users have got a way to unplug their mainframes in the near future and are only keeping them around until they port their workloads to Unix, NT or OS/400, that doesn't seem to be the case. What appears to have happened is that IBM failed to

bring its marketing into focus. The poor users, unsure about what to do, have decided that they might be better off doing absolutely nothing until IBM has made it a lot easier for customers to select a system with confidence.

This phenomenon is hardly new. IBM left most of its System/36 base behind when it introduced the AS/400, belatedly tried to pick it up a couple generations into the AS/400 line, dropped back and offered a compact replica of the S/36 and then pretty much gave up.

Viewpoints: Keep the mainframe, leave the disks

Overlooking the obvious

For the past three years IBM has offered Multiprise systems that include all the key features of its mainframe disk subsystems except for two things: Their total capacity is lower and they don't provide SnapShot. Well, total capacity has doubled and could soon double again. In theory, it could have been much greater all along. And the main virtue of SnapShot — backing up live data — can be done by other means.

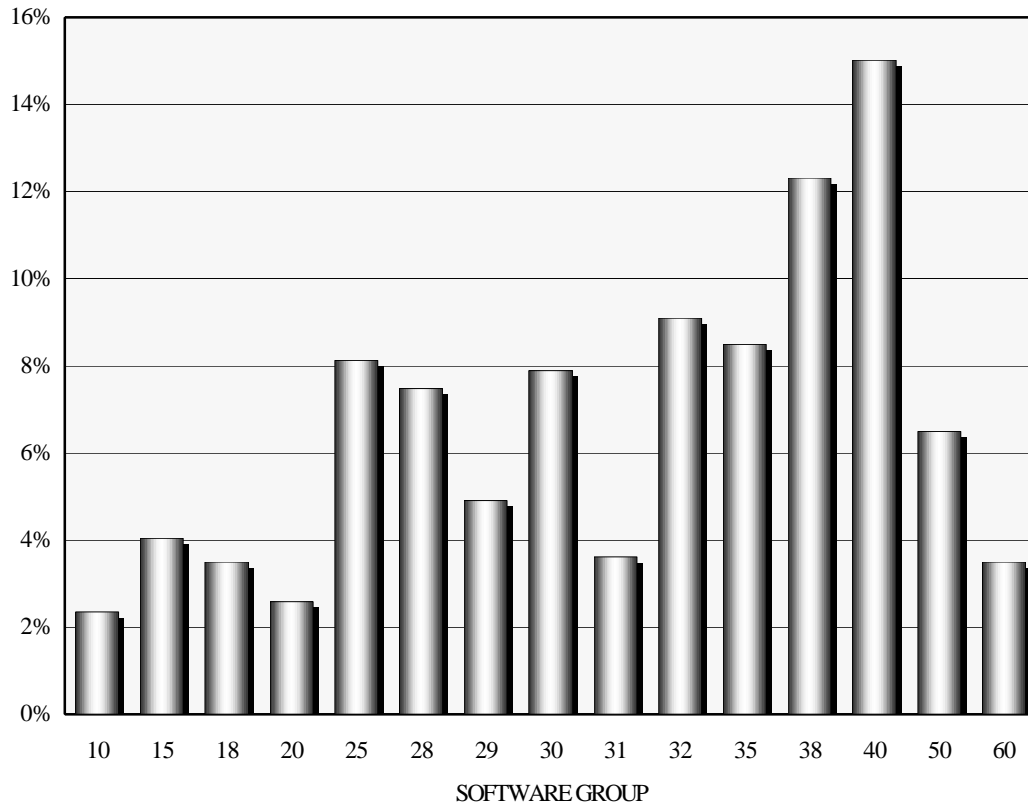
Own worst enemy

Had IBM considered the potential value of the Multiprise in a special storage manager configuration and offered Parallel Sysplex integration, it might have had a real winner on its hands. This would particularly be the case if IBM offered a limited function OS for free or cheap to make the box work. But IBM saw the Multiprise strictly as a small mainframe and not as a storage subsystem.

It's still there

The opportunity is still there, if IBM wants it. And if a Multiprise Storage Frame did catch on, IBM could make a new generation with only the hardware that was absolutely necessary. Or, alternatively, IBM might put a bit more function in place to give the machine better performance in a DB2, IMS and CICS systems setting.

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The installed base of systems up to 156 MIPS includes older machines that seem to be in higher software groups than newer processors of essentially the same power. This is one reason the group data gathered by ZD Market Intelligence differs slightly from the firm's analysis of the base by MIPS. Still, it is clear that users can easily spend more on software than hardware during a processor's useful life, particularly if they install an inexpensive used 9672 rather than a new Multiprise.

Something like that seems to be underway in the S/390 base. But for IBM and its users, the situation looks to be a lot more harrowing. The old S/390 base may have had its share of puzzles, but it didn't have to cope with the dilemmas that are driving users of small mainframes around the bend — year 2000 compliance, the Internet and, in some business segments, the almost mandatory consideration of client/server ERP suites.

IBM further confused the market by setting up a reseller network that is restricted in what it can offer customers. The reseller network includes two kinds of dealers, a relative larger firms that can get Multiprise machines directly from IBM and about 100 smaller outfits in the US plus a few dozen overseas that have to work through master distributors. This arrangement makes it difficult for smaller dealers to shave prices without getting some kind of break from their distributors.

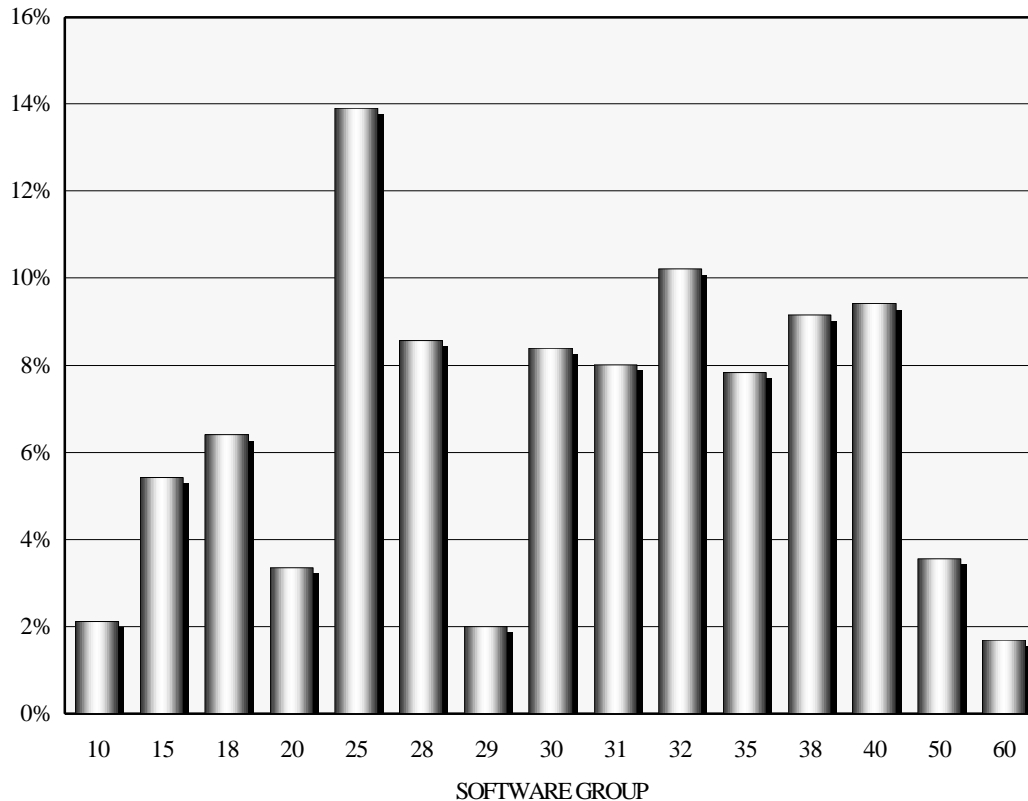
Without special permission from IBM, S/390 resellers can't make deals on systems that are much faster

than the top of the Multiprise line. In general those deals have to involve the displacement of a non-IBM processor. There are exceptions, but S/390 resellers are often not inclined to wrestle with IBM for special permission. They feel their time is better spent seeking smaller deals they can close without spending inordinate amounts of time in debate with IBM. This can be disadvantageous to IBM and to users, because IBM's own sales reps may not pay as much attention to small, slow-moving customers as resellers would.

Another factor affecting the market is IBM's commission structure. It puts dealers under some pressure to sell new systems rather than used ones. This, too, may distort the picture a user sees. During the past few months, IBM has changed its stance somewhat, making it easier for resellers to offer used 9672 processors, but there still isn't a lot of reseller activity.

It has added up to a spotty market, in which some resellers are apparently doing a very good job of reaching

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European users with up to 156 MIPS tend to have somewhat smaller machines, on average, than their US counterparts. A larger percentage of the base can run on an Integrated Server or P/390 and achieve the savings offered by IBM's ESL licensing agreement.

customers while others are for all practical purposes dormant. Because the effectiveness of the resellers varies so much, IBM has probably lost a lot of sales opportunities.

But the sluggishness at the low end of the S/390 market is not simply a matter of some inept sales reps. As IBM discovered to its dismay, users with small mainframes often do not want to move to a Multiprise. The cost per MIPS at the low end of the Multiprise line can be considerable, because the customer has to buy the same frame that is used in much larger machines. So, about a year ago, IBM reexamined a product it had originally designed strictly for use by software developers, the P/390.

IBM has brought out the P/390 as a PC server with a single-card 3.5 MIPS S/390 engine. The S/309 engine used its host processor to handle I/O.

The system was integrated by software that ran under OS/2card and supported a parallel channel card and a RAID array that imitated standard IBM disks.

It supported all IBM S/390 operating systems and its software was licensed under an affordable one-time charge .plan called the Entry Systems License, or ESL.

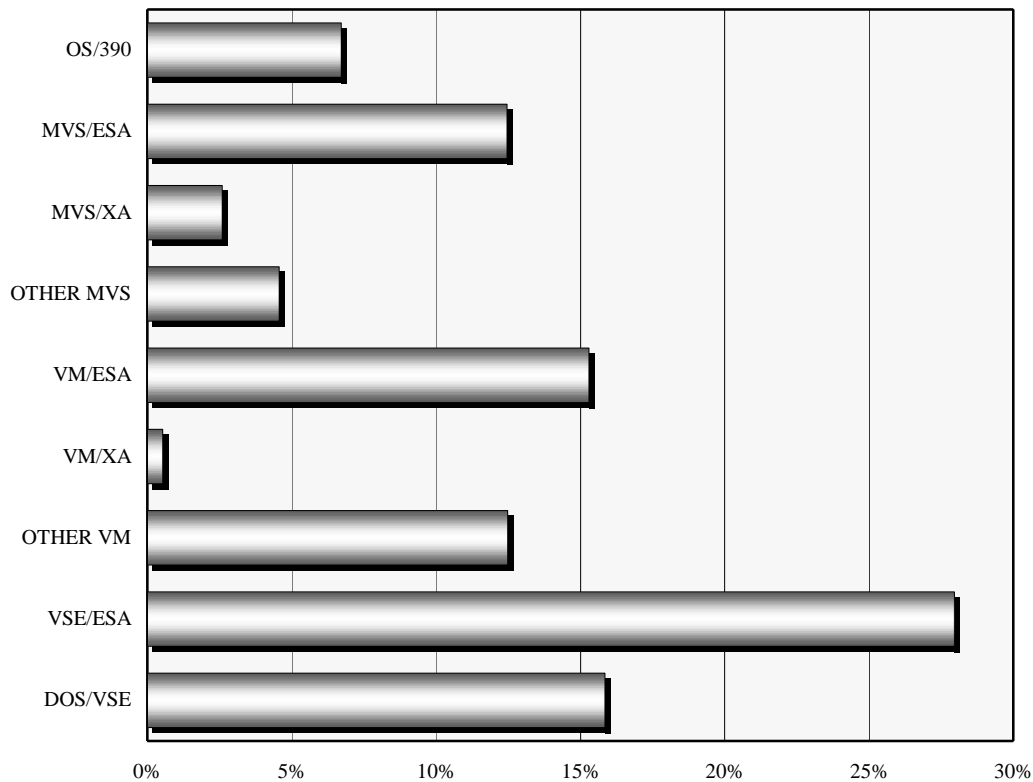
The machine used 128 megabytes of memory on the S/390 card as main memory. In addition, any memory that was available on the PC host after the augmented OS/2 was loaded as extended memory.

Whatever IBM's intentions, the P/390 got into the hands of some resellers who discovered they couldn't make out just selling to software developers, but they could build a respectable business if they also hunted down end users who could do all their work on a box with 3.5 MIPS. To make this into a regular business, all IBM had to do was decide to emphasize the value of the P/390 to end users.

Once it decided to keep the P/390 around, IBM found it had to recreate the processor card with a PCI interface, because it ceased manufacture of PC servers with Micro channel slots. More recently, IBM made two more significant changes to the product.

First, IBM doubled the power of the S/390 engine and also doubled the main memory on the engine card. Second, IBM decided that its new host PC, the model 330 server, wasn't really sturdy enough for the (small) enter-

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In the US base of S/390 systems with up to 30 MIPS, VSE and VM are the dominant operating systems.

prise processor market. This led to the creation of the Integrated Server, a box that could hold more disks, provide redundant power supplies plus some other survival features and generally fit into the mainframe group's concept of a central system.

While the Integrated Server has no more power than the P/390, it does offer one key feature that the P/390 does not: Escon channel support. The machine can handle up to 2 Escon channels or up to 4 parallel channels. It also offers substantial RAID 5 disk capacity, up to 255 gigabytes in its base case and up to 510 gigabytes with an expansion cabinet. That gives it about the same volume of file capacity as much larger Multiprise.

At this point, the Integrated Server is a real, if small, S/390 mainframe and resellers know it. They also know IBM plans to double the S/390 board speed at least once again, making it approximately as powerful (in processing terms but not I/O bandwidth or maximum memory) as a 9672-R11 or a 2003-205. This third generation of the system that began as a P/390 will become available in 1999. There is some speculation among dealers regarding other aspects of the forthcoming 13-14 MIPS Integrated Server. It could come with a gigabyte of main memory and an equal amount of potential expanded

memory on its Netfinity host. It could use 36-gigabyte disks that IBM is now putting into volume production. It could support Fibre Channel interconnect technology.

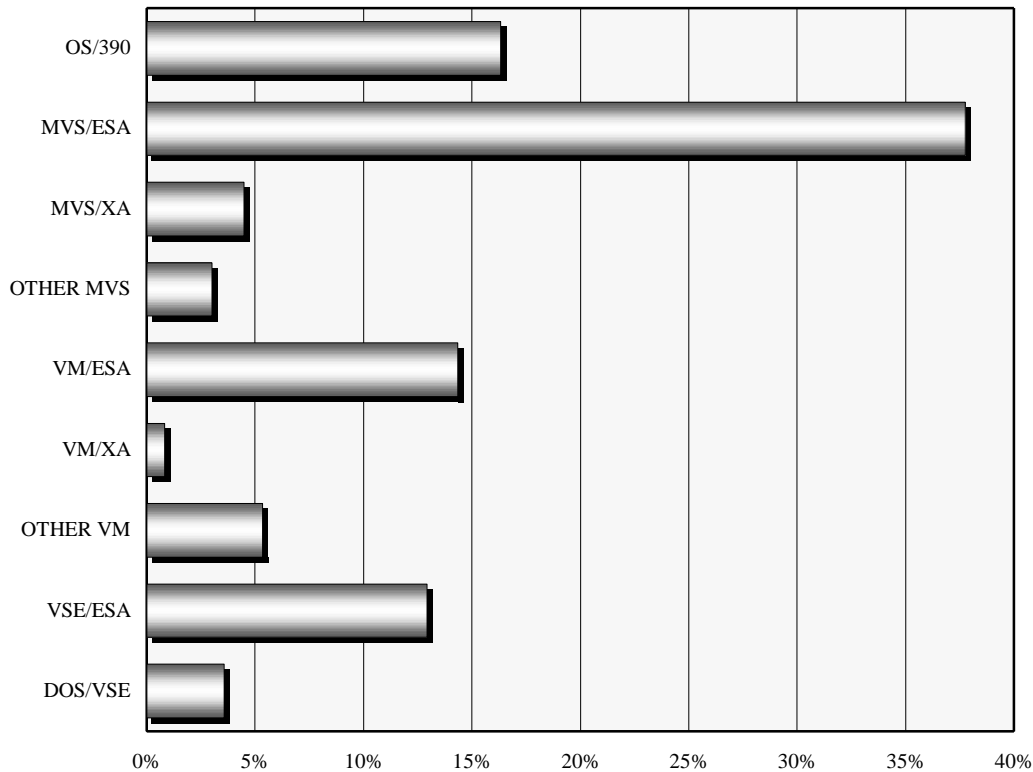
The P/390 is not expected to get the 13 MIPS engine and it will almost certainly be pulled from the IBM catalog by the time the faster Integrated Server is put into production. It is already being de-emphasized.

Industry estimates suggest that IBM has sold about 2,500 P/390s worldwide, but there is no way to determine how many of these computers are used in production information processing. Even IBM may not be quite sure what all these machines are used for.

What is clear is that the installed base of P/390 processors, in population terms, is comparable to the base of Multiprise systems. But this base is so young that it is impossible to say whether it will come back to live, upgrading to faster S/390 engines as they become available, or whether it is like the AS/36 base, which has generally not moved into the AS/400 mainstream.

Data on the installed base of Multiprise systems is too thin to trust, but it seems doubtful that there are many installed machines with 3.6 (models 102 and 202) or 6 MIPS (models 103 and 203). With the Integrated Server now in production, it is doubtful whether IBM will sell

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S/390 systems with 30 to 75 MIPS often run MVS, but VSE and VM are still quite popular.

any more of these machines. Moreover, the promise of a next generation Integrated Server makes it unlikely that IBM will sell many 104, 105, 204 or 205 machines.

Above the 13 MIPS level, prospective users of Multiprise mainframes can also consider used 9672 servers, which would be less costly to acquire. The main advantage a Multiprise offers compared to a 9672 is its internal disk subsystem, which is much less costly new than outboard disks. But even that advantage could be offset if a user was comfortable with a secondhand IBM RVA. A number of used RVA subsystems have been sold by IBM Credit Corp in the US and by IBM's captive leasing companies in other countries at prices that have now fallen to about 10 percent of nominal list price and they are likely to move even lower.

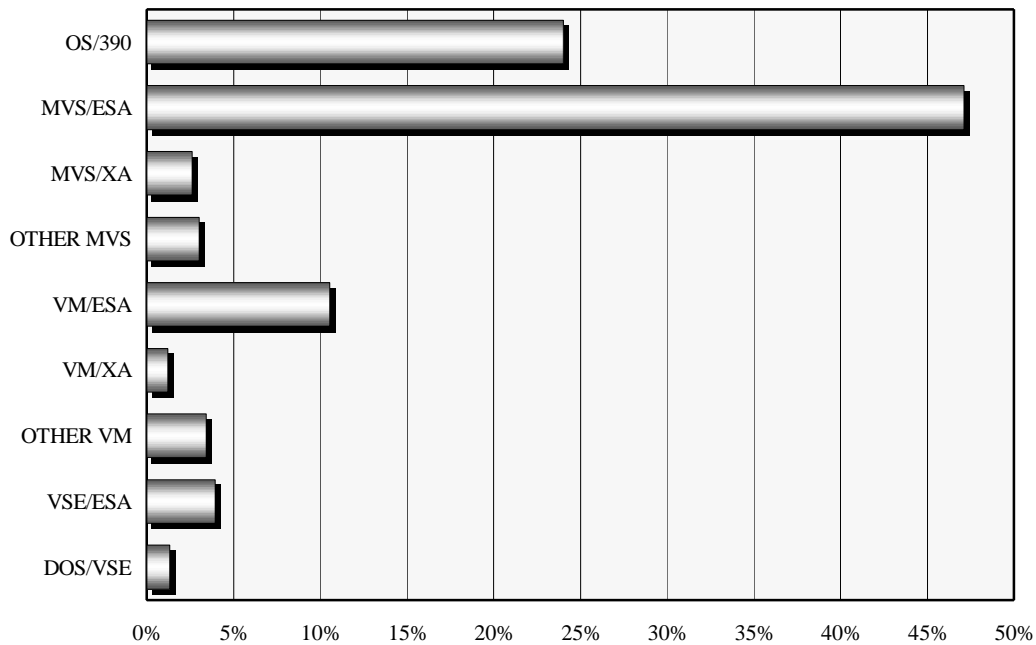
With all these alternatives, it is not so easy for customers to see why they might want a Multiprise at all. The most attractive (or least attractive) aspect of one of these systems is likely to be the dealer. Multiprise resellers may be able to provide better support and technical service than IBM at a lower cost. This can be very important to smaller companies that simply don't have sufficient technical talent to manage migration, year 2000 compliance and the ongoing challenges that stem from ordinary operations. Many of these companies would not

even consider an S/390 at all if they didn't have legacy data and applications software. But they do have legacies and they must provide continuity, so they have to select a system from among those that can be put right to work.

Because their focus is mainly on immediate problems, Multiprise users may not spend much time thinking about the strategic aspects of their systems. This takes some pressure off IBM, which has not paid as much attention to the Multiprise line as it has to the 9672 above it or the Integrated Server at the bottom of the S/390 range. But IBM will at some point have to refresh the Multiprise line...or drop it entirely. IBM has been updating the 9672 on an annual basis, but it hasn't ever made any significant changes to the Multiprise. A year ago, IBM boosted the speed of some Multiprise models and renumbered the whole line as the 200 series. It moved from 9-gigabyte to 18-gigabyte disk drives for the internal storage subsystem (and offered the same disks to users of 100 series machines). And there were some upgrades in the Multiprise microcode. But IBM's far more dramatic accomplishments in its other server families made the Multiprise upgrades pale by comparison.

The current Multiprise line is based on a engine that runs at up to 37 MIPS. This engine provides more than enough power for most low-end S/390 users, but it

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S/390 systems with 75 to 156 MIPS are mainly in the MVS camp, which these days means OS/390.

leaves IBM with a substantial gap between the Multiprise and the 9672, which currently has an engine capable of delivering more than 115 MIPS. IBM still offers new G4 machines, with 63 MIPS engines, but the base under 156 MIPS needs more granularity and it would prefer a set of uniprocessor options that produced the best possible batch processing results.

The Multiprise design, with its multiple engines, is very costly compared to the needs of users at the low end of the S/390 range. It is also expensive compared to other platforms, which are particularly tempting to any users who can move some work off their mainframes.

While most Multiprise shops would be inclined to concentrate all their information processing into a single frame to conserve technical talent and simplify operations, the cost of that consolidation could be punishing.

Multiprise resellers cannot easily get customers to move up in MIPS and consolidate their servers as they move to current technology because the costs are so hard to justify.

The comparisons become a significant factor in manufacturing and distribution, ERP configurations that include a Multiprise host for database serving are monumentally more costly than configurations the use alternative platforms for all functions.

The comparisons are not so obvious in banking, insurance, government or other segments where the widespread use of S/390 systems and software makes a mainframe the standard platform. Nevertheless, IBM cannot

afford to sacrifice any market segment and users do not feel comfortable if they believe the machine they prefer is used by only a relatively narrow slice of the market.

Users of IBM mainframes like big crowds. That is very likely why they went with IBM in the first place, a long time ago, and it is reason they have stuck with IBM through many generations of machinery and software.

The IBM strategy that would produce the best results in the customer base would be the replacement of the current Multiprise line with systems that include only one or two active processors (plus one or two system control processors, which could be slower). Using its G5 technology, IBM could offer a single engine machine that scaled up to 125 MIPS based on microcode or a twin that ran at nearly 250 MIPS. It could allow peak usage billing options on both hardware and software and base or standard billing at other times.

With fewer engines, the machine should cost a lot less than current Multiprise systems at the manufacturing level, and IBM could easily pass this along to customers. In addition, if the Multiprise and 9672 systems used the same chip sets, progress in the 9672 line, which will result in 250 MIPS chip sets next year, could be echoed in the Multiprise. Users of Multiprise systems would not longer feel they are out of the mainframe mainstream.

Whether IBM chose to use the same chip sets for SAP functions as for processing would be a small matter. Users might find the availability of one or two spare engines comforting, and be more willing to pay a premium

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2003 MODEL	FIRST AVAIL	INITIAL US PRICE	US MAINT	APPROX MIPS	MSU	SW GROUP	LSPR RELATIVE PERFORMANCE (R15=1)			2003 MODEL
							OS/390 R 1	VM/ESA 2.2	VSE/ESA2.1.1	
M102	1Q 97	\$87,500	\$110	3.5	1	25	0.06	0.06	0.06	M102
M103	3Q 96	\$120,000	\$190	6	1	28	0.09	0.09	0.08	M103
M104	3Q 96	\$170,000	\$315	10	2	30	0.14	0.16	0.14	M104
M105	3Q 96	\$204,000	\$380	12	2	31	0.20	0.22	0.19	M105
M106	3Q 96	\$240,000	\$505	16	3	32	0.26	0.28	0.25	M106
M107	3Q 97	\$180,000	\$756	24	4	35	0.40	0.39	0.37	M107
M115	3Q 96	\$319,000	\$915	29	5	35	0.48	0.48	0.45	M115
M116	3Q 96	\$367,500	\$1,135	36	6	38	0.59	0.60	0.55	M116
M124	3Q 97	\$367,500	\$1,544	49	8	38	0.81	0.86	NA	M124
M125	3Q 96	\$574,000	\$1,700	54	9	40	0.87	0.95	NA	M125
M126	3Q 96	\$686,750	\$2,080	66	12	40	1.09	1.17	NA	M126
M135	3Q 96	\$830,250	\$2,995	77	13	40	1.23	1.39	NA	M135
M1C5	3Q 97	\$645,000	\$2,709	86	15	40	1.40	1.55	NA	M1C5
M136	3Q 96	\$1,004,500	\$2,995	95	17	50	1.53	1.7	NA	M136
M146	4Q 96	\$1,199,250	\$3,715	118	21	50	1.96	2.19	NA	M146
M156	4Q 96	\$1,527,250	\$4,440	145	23	60	2.26	2.67	NA	M156
M202	2Q 98	\$50,000	\$110	3.7	1	25	0.06	0.06	0.06	M202
M203	4Q 97	\$60,000	\$189	6	1	28	0.09	0.09	0.08	M203
M204	4Q 97	\$76,500	\$315	9	2	30	0.14	0.16	0.14	M204
M205	4Q 97	\$97,500	\$378	13	2	31	0.20	0.22	0.19	M205
M206	4Q 97	\$114,750	\$504	17	3	32	0.26	0.28	0.25	M206
M207	4Q 97	\$162,500	\$756	25	4	35	0.40	0.39	0.37	M207
M215	4Q 97	\$180,000	\$914	30	5	35	0.48	0.50	0.45	M215
M216	4Q 97	\$231,250	\$1,134	37	6	38	0.60	0.62	0.55	M216
M224	4Q 97	\$306,000	\$1,544	51	8	38	0.80	0.91	NA	M224
M225	4Q 97	\$368,000	\$2,016	64	11	40	1.04	1.18	NA	M225
M227	4Q 97	\$431,200	\$2,427	77	13	40	1.23	1.29	NA	M227
M2C5	4Q 97	\$475,200	\$2,709	88	15	40	1.41	1.54	NA	M2C5
M237	4Q 97	\$556,500	\$3,308	105	18	50	1.73	1.88	NA	M237
M246	4Q 97	\$625,400	\$3,717	118	21	50	1.98	2.19	NA	M246
M247	4Q 97	\$693,000	\$4,158	132	24	60	2.21	2.44	NA	M247
M257	4Q 97	\$829,500	\$4,914	158	27	60	2.53	2.98	NA	M257

The Multiprise line spans a wide performance range, but its relatively small engines make for excessively complex and expensive processors. The same capabilities in a simpler, cheaper package would have more appeal.

for this reliability feature. But if IBM chose to use a less costly SAP technology, that, too, would have appeal in some segments of the customer base.

The major financial advantage of engine consolidation would be financial. Users who did not need the full power of a G5 engine could keep their systems for a long time, buying microcode acceleration as their workloads increased. This potential for long life would encourage longer leases with a structure that could accommodate MIPS upgrades, reducing hardware costs.

The design would also make the systems easier to remarket if they came back to a lessor (presumably IBM) because they could be scaled up or down to meet prevailing opportunities. That, too, would help reduce costs yet very likely boost IBM's profit margins.

IBM would not be sacrificing many upgrades. Users who still have not moved to current mainframes are

clearly not very keen on upgrades anyway. They are precisely the kind of customers who would go for a system that promised long potential life and also offered on-site instant MIPS upgrades via microcode. Where a customer only wanted a speed upgrade, the whole process could be done by phone, particularly if the speed change did not require a fresh IPL.

IBM is already selling mainframes with extra engines and memory that can be activated in the field. This approach is part of the 9672 G5. But it is in fact more appropriate for the Multiprise market than for the 9672. One physical machine could be transformed into all available models for an entire processor generation!

We are not surprised that IBM has not taken this course yet, even though it uses similar techniques to minimize the engineering and manufacturing costs of the AS/400 line. But we are surprised that Amdahl has

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2003 MODEL	CPU	MEMORY OPTIONS (GB)	CHANNELS (INCR) PARA / ESCON / TOTAL	INTERNAL DISK	POWER KVA	HEAT KBTU/HR	FOOT SQ M	W KG	2003 MODEL
M102	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M102
M103	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M103
M104	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M104
M105	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M105
M106	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M106
M107	1	.125, .25, .5, 1, 2	0-64 (4) / 0-64 (4) / 3-64	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M107
M115	1	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M115
M116	1	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M116
M124	2	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M124
M125	2	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M125
M126	2	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M126
M135	3	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M135
M1C5	3	.125, .25, .5, 1, 2	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M1C5
M136	3	.5, 1, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M136
M146	4	.5, 1, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M146
M156	5	.5, 1, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.54 - 5.8	1.8 - 16.4	1 - 1.8	550 - 1083	M156
M202	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M202
M203	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M203
M204	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M204
M205	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M205
M206	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M206
M207	1	.125, .25, .5, 1, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M207
M215	1	.25, .5, 1, 1.5, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M215
M216	1	.25, .5, 1, 1.5, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M216
M224	2	.25, .5, 1, 1.5, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M224
M225	2	.25, .5, 1, 1.5, 2	0-48 (4) / 0-48 (4) / 3-48	0-576 GB	.54 - 4	1.8 - 13.6	1	488 - 755	M225
M227	2	.5, 1, 1.5, 2, 3, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M227
M2C5	3	.5, 1, 1.5, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M2C5
M237	3	.5, 1, 1.5, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M237
M246	4	.5, 1, 1.5, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M246
M247	4	.5, 1, 1.5, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M247
M257	5	.5, 1, 1.5, 2, 4	0-96 (4) / 0-128 (4) / 3-128	0-576 GB	.74 - 4.8	2.4 - 16.4	1 - 1.8	551 - 1083	M257

Multiprise systems offer more memory and channel capacity than users want, but instead of making the systems more tempting it contributes to higher costs that make low MIPS models unattractive.

overlooked the obvious opportunity to simplify its manufacturing and increase sales in a performance segment it has failed to penetrate for its entire corporate life.

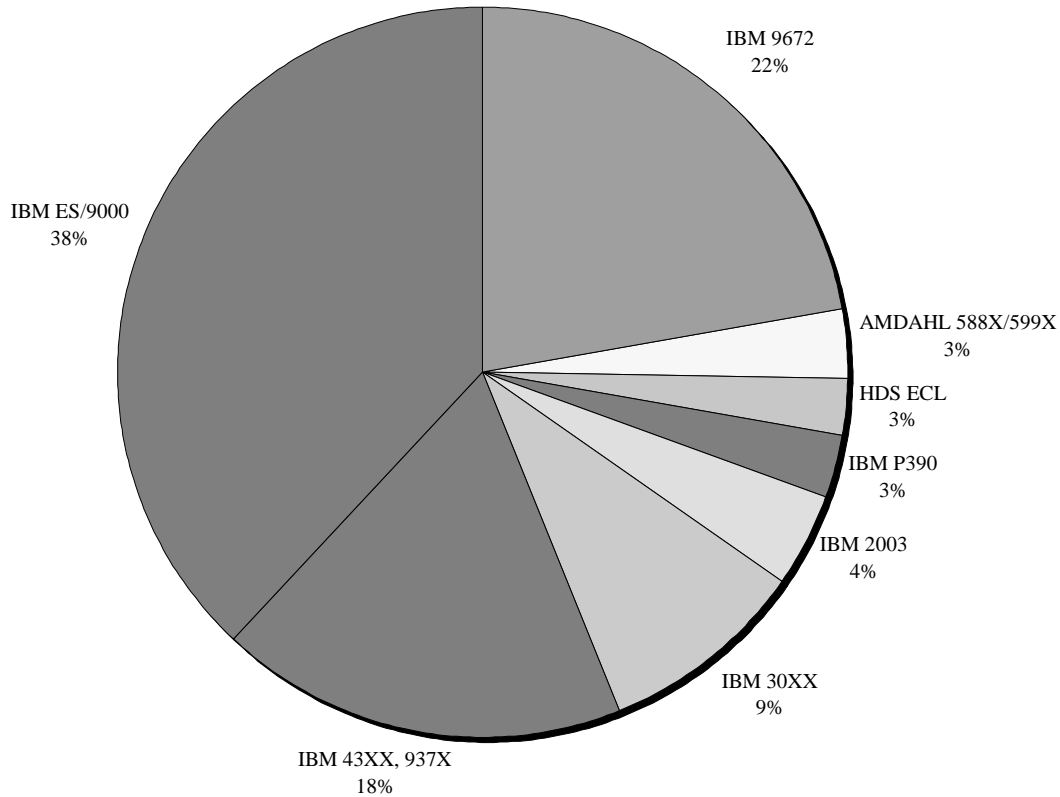
Another version of this strategy could be used to extend the Integrated Server to better attack the segment of the base with machines of less than, say, 50 MIPS.

We believe the Integrated Server design would be acceptable to many users whose power requirements are far in excess of the machine's current 6.5 MIPS limit.

Users who have not moved off old iron, much of it bipolar, might well prefer an Integrated Server with its mix of legacy technology and OS/2-based networking to whatever they currently have installed. (They might like the machine even more if it offered an NT alternative like other Netfinity platforms.) Here, again, a processor with microcode-based scalability could provide uniformity, economy and flexibility that is simply unavailable in the

low end of S/390 product line. And if the machine had LPAR technology, which the Integrated Server lacks, it would enable users with VM and VSE family software to realistically consider migration to OS/390. This would particularly be the case if IBM stuck with the lower software pricing available to users of the Integrated Server.

Our sources close to IBM say it is pretty much resigned to losing large portions of its low end S/390 base during the next year or two. And we agree with the IBM marketing executives who feel that a considerable loss of smaller shops is inevitable. But we also believe IBM has become overly devoted to the giant enterprises. While IBM's efforts on behalf of its largest customers make a lot of sense, we don't see why IBM has snubbed the more numerous smaller organizations that depend on an S/390. More thoughtfully executed, IBM's strategy could serve the needs of the full range of S/390 customers.



Surveys of the US S/390 base conducted by ZD Market Intelligence reveal that there are quite a few older S/390 systems with less than 156 MIPS of processor power. Most of these machines are so inferior to current processors — the 30XX is a striking example — that their persistence is almost unbelievable. Is it possible that IBM will leave two-thirds of this base alone until it leaves the mainframe world? Unless it can make its low end systems more attractive, the answer will be yes.

Smaller S/390 Servers: Strategic Considerations

The companies with truly ancient computers whose sites are represented in the chart above have strong (if not good) reasons for keeping their old computer around. We suspect that the reason so many users still have 30XX, 9370, 4300, 9221 and 9121 systems is not that they particularly like these machines. Instead, these companies probably think they are going to move that last suite of applications off the mainframe in the very near future and then they can unplug the old dinosaur forever.

We doubt that this will be the universal case, and it might not even be the case at the majority of these sites. Whatever has kept the old mainframe in use this long must be something that is vital to the user company's operations. And it also must be something that is not easily ported to a new system. Further, it very likely is some-

thing that is not integrated with the user company's main workload, because it is improbable that an enterprise with a 30XX or other very old computer that is central to its operations could have resisted forward migration this long. Somewhere along the line IBM or some other vendor would have gotten to corporate management with a spreadsheet showing how much cheaper it is to operate a newer machine than a very, very old one.

So we return to our point. Users with these older machines didn't necessarily think they would have them this long and don't necessarily want them around any longer...but they are unwilling to put in new mainframe.

We believe the Integrated Server will dislodge a fair number of the systems with under 6 MIPS...unless the owners of the old iron are actually at the threshold of a

move to some other platform. Another portion of this base will be wooed by service bureaus. And there will always be some diehards who keep their machines until a year 2000 failure or other tragedy makes migration an absolute necessity.

Obviously, IBM would like to pick up all the potential business at these sites, either directly or through its dealer network. And just as obviously it has not been able to do this despite its best marketing efforts.

We think many of these users are ignoring the facts and could save money by moving to more modern systems even if they unplugged those newer machines in a year or two. But if they are struggling to move their operations to alternative platforms, retrain their end users and cope with year 2000, they would clearly be taking unwarranted risks if they also added a mainframe migration to their list of projects.

The solution, from IBM's standpoint, would be to offer guaranteed, affordable, fixed price migration services to these shops. But IBM hasn't done this, presumably because there is no way for it to do so and come out ahead — at least not in the quarter-to-quarter terms that it seems to favor these days.

But if you think that IBM's strategy is based on a great deal of research into the thinking of users who have stalled along the path to modernity, think again. IBM is aware that these shops are out there. It knows where its software licenses have gone and where it has maintenance contracts. However, that's about all it knows.

IBM has not systematically visited the thousands of users with ancient mainframes and tried to understand why they won't move ahead. If it had, that base of old machinery would be a lot smaller. Also, IBM would not be trying to find out what's going on at these sites through its small army of resellers.

What IBM is telling resellers is that these sites are out there...and nothing more. IBM has estimated what it would cost for it to send its own sales reps around to pry old iron off glass house floors and that number is more than it's worth to the power in Armonk.

Now anyone knows that IBM is not particularly efficient at certain things, among them catering to smaller companies. So its decision to give up on selling directly to these users is pretty much in line with common sense. So, too, is its claim to resellers that these same sites are worth a visit. S/390 resellers are a lot more efficient than IBM. They do more work for less money. If things were otherwise, IBM wouldn't have resellers.

The problem, at sites with small mainframes, particularly those with 30 MIPS or less, is that the resellers can't always make out either. Even if they can sell a Multiprise, Integrated Server or P/390, their profit on the transaction is relatively modest. If they encounter too much resistance or even just recalcitrance, they have to

give up. Their stature in the IBM reseller world and their financial success depends more on accurately discerning users who are willing to move ahead if they are subjected to a reasonable amount of persuasion and lubricated with a reasonable amount of technical support.

If a reseller spends too much of its sales reps' scarce time on the hard cases, it will go out of business.

Until recently, business conditions in the user base were pretty good, at least in the US and Europe. Whatever progress IBM and its resellers were making was about as good as it could get. Users who didn't succumb before the world got so jittery are generally less likely to make decisions now.

Having failed at persuasion, IBM has to try Plan B, which involves creating more attractive products. (Plan C is losing the site to another vendor or at least another platform.) And we think IBM is in no position to disregard these users, even if they were not the appropriate targets when conditions were better just a little while ago.

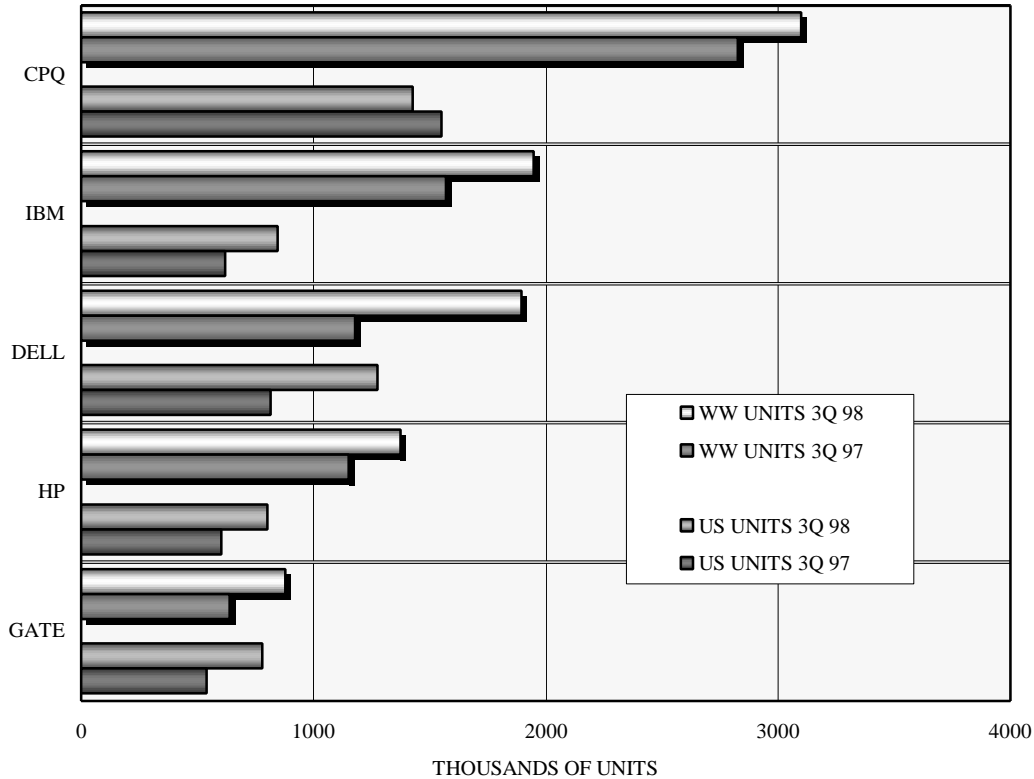
We believe there is a good chance IBM will revise its products and pricing at the low end of the S/390 line. It will have to come up with a scheme that doesn't knock out sales of smaller 9672s, so the next round of IBM processors might look best to users below 100 MIPS, not to all those below 156 MIPS.

Whatever IBM does, it will also have to address users in the same power class who already have moved to 9672 or Multiprise systems. They have to be made to feel that they made the right choice and that there is a good forward path from their present systems to the next mainframe they acquire. Some of these users have G2 systems with a bit more than 156 MIPS and, if they are growing, their next move might be to a G5 or G6 box but it might be to a Multiprise successor.

The advantage to IBM of moving these users to a Multiprise successor is that it might be able to knock out some EMC disks when it brings in a machine with half a terabyte or a full terabyte of internal storage capacity. Most of the profit in the deal will come from software anyway. So, IBM has nothing to lose if it some users move to a Multiprise successor rather than a 9672, even if the Multiprise successor has a somewhat lower processor price...as long as there is a good drag-along in disks.

Another incentive for IBM is the increased chance that a user who moves to new machinery also considers migration to OS/390, even if that user is currently running VSE or VM. OS/390 opens doors to growth for IBM and its customers that do not exist in the VM or VSE worlds. An example is electronic commerce, which doesn't absolutely require OS/390 but is more sophisticated in that environment than in any other S/390 systems setting.

Not only do we expect IBM to act decisively and rescue its small S/390 base from oblivion, but we expect it to act soon. The company really has no other choice.



Compaq is leading the PC industry in worldwide shipments, according to Dataquest, but has lost ground in the US since last year. This has allowed fast-growing Dell, which has passed IBM in the US, to catch up. If trends continue, Dell could be number one in US PC sales by the end of this year. In revenue terms, Dell is stronger than this graph suggests. Dell doesn't sell low end consumer machines, as do all the other leading vendors, so Dell has an higher average unit selling price.

Compaq And Dell Fight For PC Leadership

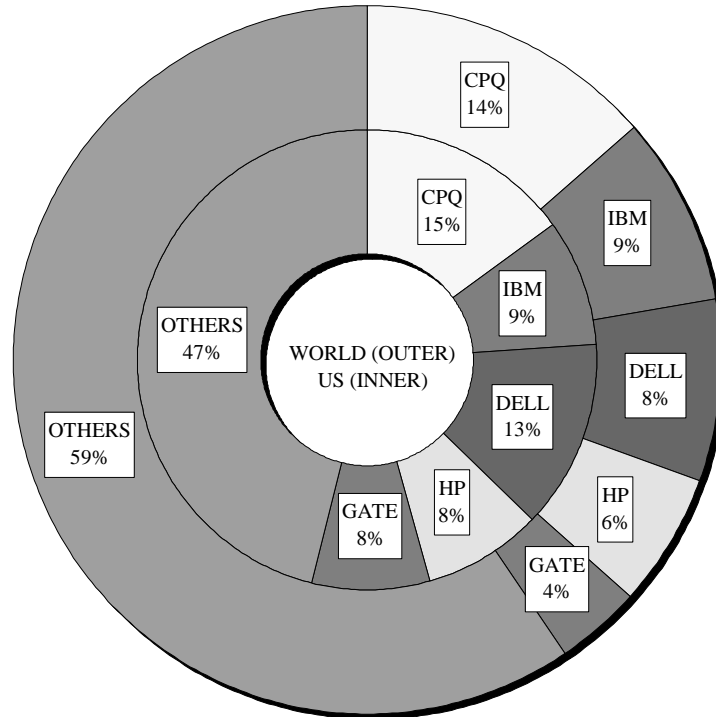
The race for the top slot in the PC business is currently a contest between Compaq and Dell. Compaq is well ahead of Dell in worldwide unit sales, according to market research published by Dataquest, but in the US market Dell has nearly caught Compaq and it could be ahead by the end of this calendar year. IBM is far behind Compaq on both a worldwide and a US basis. IBM is only marginally ahead of Dell in worldwide unit shipments, and Dell is growing faster.

In revenue terms, Dell now appears to have a strong PC business than IBM, because IBM's average selling price is lower. IBM has emphasized the low end of the consumer market, most recently by announcing a PC that lists for \$599. Dell has thus far kept out of the lowest pricing tier, and instead has concentrated on PCs with the features (and prices) that

match business budgets. Another advantage Dell has is its devotion to direct sales, which help it retain profits IBM, Compaq and HP must leave at various distribution and retailing points in their channels.

Gateway, the other giant direct seller, is growing rapidly in the US and worldwide, but its offshore business is small compared with that of others in the top five. Nevertheless, Gateway could pass HP in the US market by the end of this year, selling more units and almost certainly bringing in more revenue due to its higher average unit price.

One of the factors that has made a big difference this year is the delays in product innovation that Compaq, IBM and HP suffer by virtue of their reliance on distributors. As new processor chips and associated motherboards become available, direct sellers with small inventories — epitomized by Dell and Gateway — can bring new machines to market



The PC business includes hundreds of manufacturers, most of them operating only within their own countries. These vendors account for 59 percent of worldwide trade and 47 percent of US PC unit shipments. Pundits say the "others" segment will keep shrinking as the big players get even bigger.

with less impact on older models that are caught up in the assembly and sales processes. Indirect marketers must allow their distributors to flush out older stock before bring newer machines to the market, particularly if the newer machines offer more performance at the same or lower prices than older models.

This year, Intel made the transition from its first Pentium II chips, called Klamath, which ran at up to 300 MHz, to Dechutes versions that include 350, 400 and 450 MHz implementations of essentially the same architecture.

The Dechutes family also includes the less powerful Celeron series (with no L1 cache or a small L1 cache in a version called Mendocino) and the more powerful Xeon chips that are aimed at the server market and the very top of the workstation segment.

Dechutes chips in the Pentium II family use the Intel BX chipset, which can support one or two CPUs and up to 1 gigabyte of 100 MHz main memory. The Xeon chips use either the FX or more capable NX chipsets, which support 2 or 8 gigabytes of 100 MHz memory, respectively.

Next year Intel will add both new chips and new chipsets. Pentium II processors evolve from current

0.25 micron line technology to 0.18 micron line technology. Speeds will rise to 500 MHz or possibly 600 MHz in speed, memory bus speeds will increase to 100 MHz and new instructions for faster 3D rendering plus an even faster AGP port will have a substantial impact on the workstation and server markets.

Even as IBM moved to Dechutes this year, Compaq, IBM and HP were sitting on tons of pre-Dechutes systems, to say nothing of even earlier models.

The catch with the pre-Dechutes chips is that they use 0.35 micron line technology and consume a lot more power. As a result, they run very hot compared to faster Dechutes chips and while this is not expected to lead to significant differences in chip failure rates, only time will tell.

In any event, the change in technology along with the price cuts Intel made to help its newer chips take off quickly really socked the PC makers with large inventories in the channel. Dell and Gateway were selling tons of 400 and 450 MHz boxes while IBM, Compaq and HP were forced to sit still until their distributors could clear out older machines.

With several new technologies and associated price cuts on Intel's calendar for 1999, chances are the problems will recur. And next year Compaq, IBM and HP might not have as hot a market around to absorb their excess PCs.

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	1998	1997	CHANGE		1998	1997	CHANGE
REVENUE				NET EARNINGS			
FIRST QUARTER	17,618	17,308	1.8%	FIRST QUARTER	1,036	1,195	(13.3%)
SECOND QUARTER	18,823	18,872	(0.3%)	SECOND QUARTER	1,452	1,446	0.4%
SIX MONTHS	36,441	36,180	0.7%	SIX MONTHS	2,488	2,641	(5.8%)
THIRD QUARTER	20,095	18,605	8.0%	THIRD QUARTER	1,494	1,359	9.9%
NINE MONTHS	56,536	54,785	3.2%	NINE MONTHS	3,982	4,000	(0.5%)
FOURTH QUARTER		23,723		FOURTH QUARTER		2,093	
YEAR		78,508		YEAR		6,093	
EARNINGS BEFORE INCOME TAXES				EARNINGS PER SHARE			
FIRST QUARTER	1,523	1,852	(17.8%)	FIRST QUARTER	1.08	1.19	(9.2%)
SECOND QUARTER	2,083	2,180	(4.4%)	SECOND QUARTER	1.50	1.43	4.9%
SIX MONTHS	3,606	4,032	(10.6%)	SIX MONTHS	2.58	2.56	0.8%
THIRD QUARTER	2,132	1,983	7.5%	THIRD QUARTER	1.60	1.38	15.9%
NINE MONTHS	5,738	6,015	(4.6%)	NINE MONTHS	4.22	4.03	4.7%
FOURTH QUARTER		3,012		FOURTH QUARTER		2.16	
YEAR		9,027		YEAR		6.18	

IBM's solid third quarter results propelled its share price toward \$150 as Wall Street decided to overlook the fact that pretax profit is still down from last year. Investors' optimism about the fourth quarter may be justified by the excellent reception IBM says its G5 mainframes have received. On the other hand, turmoil in Asia, Latin America and elsewhere could pose a threat to IBM's growth next year.

IBM Shows Strength In Its Third Quarter Results

Do share prices reflect the past, the present or the future? All three, we suppose, and not at all consistently. IBM's stock soared in the wake of its report of excellent third quarter financial results. IBM also said that it was doing very well in two key segments, mainframes and services. But the company's executives additionally expressed some caution about the more arduous conditions IBM may face in 1999. No surprises there, except that Wall Street seemed to accept the first statement, applaud the second and pay only token heed to the third.

IBM's quarterly revenue grew 8 percent from last year, finally lifting its year-to-date intake above 1997 levels. The big growth came from services, which rose 22.6 percent to \$5.8 billion. Services and software together now contribute more to IBM's revenue and gross profit than hardware sales. But hardware sales increased 4.2 percent to \$8.7 billion. IBM remains a giant hardware manufacturer.

The hardware sales figure includes a large but unspecified component for mainframe sales, which stock analysts say increased 20 percent. This 20 percent in revenue comes on a jump in mainframe MIPS shipments of 135 percent. A dollar in mainframe sales in last year's third quarter grew to \$1.20; a MIPS shipped grew to 2.35 MIPS. So, the sales price of a mainframe MIPS has fallen approximately in half in one year. And by every indication — mainly the improving price/performance of processors in every market segment — this very high rate of

price decline will continue. If an average G5 MIPS costs \$4,000 today, it will cost \$2,000 a year from now.

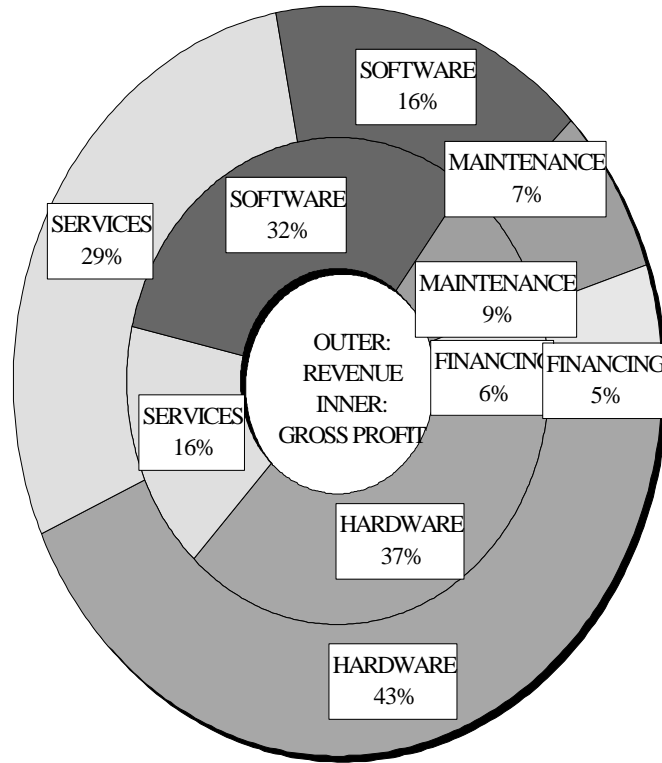
Comparably great improvements in technology also characterize the disk drive business, where IBM says its revenue increased a whopping 65 percent year-to-year. That could well mean the total storage capacity of all the disks IBM shipped tripled, although that is not necessarily the case. IBM's disk revenue may have jumped because it is moving very forcefully into booming disk submarkets, for instance drives for laptop machines, which can be sold at substantially higher price levels per gigabyte of storage than 3.5-inch drives used in servers and desktop systems. Still, IBM is now shipping 3.5-inch drives with 36 gigabytes of capacity and performance comparable to that of 18-gigabyte drives offered a year ago.

IBM also did well in the AS/400 market, increasing sales by about 11 percent. Price/performance is on the rise in the AS/400 family, too, so the upturn in MIPS is much greater than the rise in revenue.

IBM did not do as well in the RS/6000 line, where its progress may be very good at the high end. Most observers believe IBM got killed in the markets for RISC workstations and small RISC servers. IBM has updated the RS/6000 product line, but not in time to make a difference in the third quarter.

IBM is taking a beating in hardware in some other areas. The company said its microelectronics business had produced disappointing results, due mainly to chip

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Software and services now account for more revenue and much more profit than hardware sales at IBM. But services is considerably less profitable than software, and as that business grows IBM's overall margins may be under pressure. Tough competition in the hardware business is adding to the toll. Still, investors see nothing but blue skies ahead for Big Blue, and its stock price has hit record heights.

price declines. IBM's end user disk business is weak, particularly in comparison to the OEM side of the storage division. And its printer business is suffering from uncertainty surrounding the future of the division, which is on the block.

IBM's software sales rose at about the same level as hardware sales, an understandable result because most of IBM's software revenue comes from the mainframe segment, where software fees are related to host MIPS. A very nice thing about software at IBM is its huge profit margin. IBM retains about 75 percent of each software dollar before applying sales, administrative and research costs. IBM feels this is a very secure market segment and, with user bases clinging to their legacy databases and applications, it does not appear to be pressed to make any big price cuts. Users either pay IBM or jump platforms, and the big customers haven't jumped.

The brightest spot in the IBM revenue picture is the services business, which produces the weakest gross margins of any segment but has by far the fastest growth. Services revenue grew 22.6 percent in the most recent quarter, a rate that has been sustained all year. IBM's re-

ported gross margin in services is only 21.3 percent, and the company's total overhead — it does not report this figure by business segment — was 20.2 percent. So, if the selling, general and administrative costs associated with the services business is at the company average, this is essentially a break-even operation.

Services revenue will shoot past \$20 billion this year and could be in the vicinity of \$25 billion in 1999. Meanwhile, IBM's hardware revenue is likely to be flat for the year and it could decline next year as price erosion more than offsets MIPS growth in key server segments.

IBM's maintenance revenue is declining, which is hardly a surprise as the reliability of most of its products has risen and, as a result, their associated maintenance charges have fallen substantially. If IBM sells off its printer business, as it said it would, its \$5 billion-a-year maintenance business could be shrink by as \$600 to \$700 million. Maintenance and consumables account for about \$1 billion a year in revenue for IBM.

IBM's worldwide financing business is growing, but the US segment dipped slightly in the most recent quarter. Still, the picture looks solid for 1998.

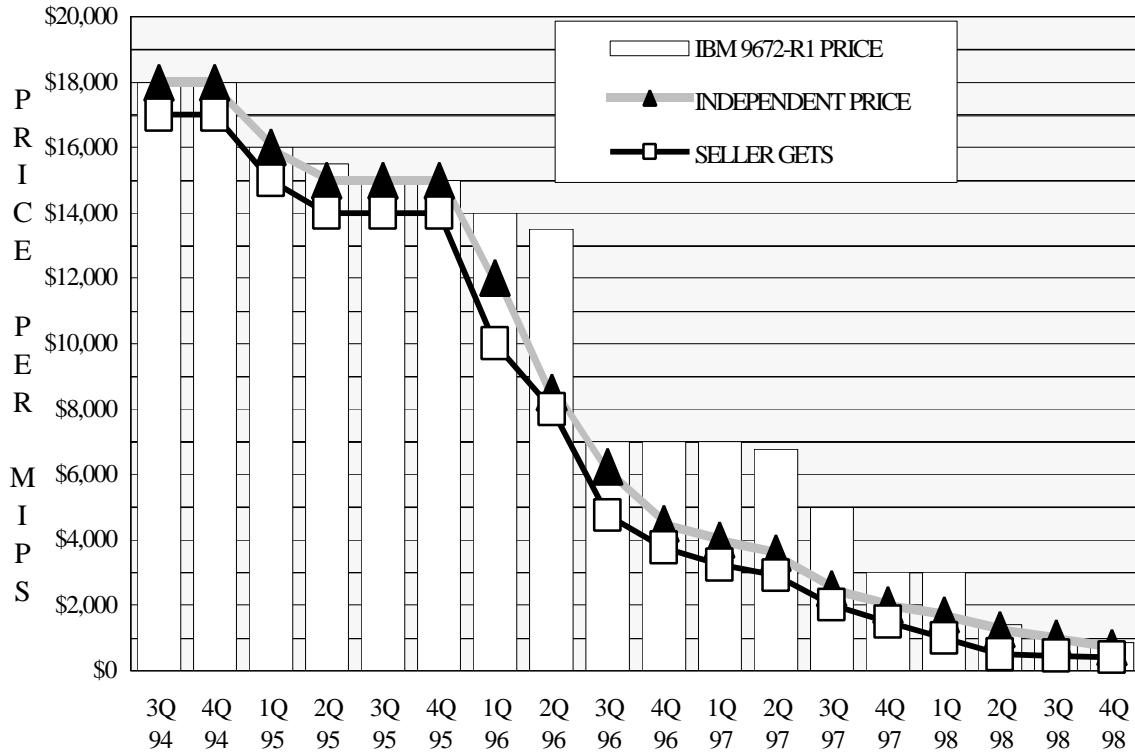
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CPU MODEL (ENGINES)	MEM & CHNNLS	APPROX MIPS	MSU PER HR	FIRST AVAIL	IBM US PRICE	IBM US MAINT \$	SELLER GETS		BUYER PAYS	
							%	\$	%	\$
9672-R11 (1)	128x12	15.0	2.5	3Q 94	13,000 S	785	6,000	46	11,000	85
9672-R21 (2)	256x18	27.5	5.0	3Q 94	23,000 S	1,045	11,000	48	19,000	83
9672-R31 (3)	256x24	39.0	6.0	3Q 94	33,000 S	1,345	16,000	48	27,000	82
9672-R41 (4)	512x30	49.0	8.0	3Q 94	42,000 S	1,975	20,000	48	34,000	81
9672-R51 (5)	512x30	57.0	8.0	3Q 94	48,000 S	2,195	23,000	48	40,000	83
9672-R61 (6)	1024x36	63.0	10.0	3Q 94	54,000 S	2,395	25,000	46	44,000	81
9672-RA2 (1)	128x12	15.0	3.0	4Q 95	18,000 S	505	11,000	61	15,000	83
9672-R12 (1)	126x16	21.0	4.0	4Q 95	25,000 S	840	15,000	60	21,000	84
9672-R22 (2)	256x24	40.0	8.0	4Q 95	48,000 S	1,575	29,000	60	40,000	83
9672-R32 (3)	512x24	57.0	11.0	4Q 95	68,000 S	2,240	41,000	60	57,000	84
9672-R42 (4)	512x32	73.0	14.0	4Q 95	88,000 S	2,905	53,000	60	73,000	83
9672-R52 (5)	1024x48	87.0	17.0	4Q 95	104,000 S	3,465	63,000	61	87,000	84
9672-R72 (7)	1024x48	109.0	21.0	4Q 95	131,000 S	4,340	79,000	60	109,000	83
9672-R53 (5)	512x24	95.7	18.0	3Q 95	129,000 S	3,745	77,000	60	105,000	81
9672-R63 (6)	512x32	108.9	20.0	3Q 95	147,000 S	4,340	87,000	59	120,000	82
9672-R73 (7)	1024x32	122.1	23.0	3Q 95	165,000 S	4,935	98,000	59	134,000	81
9672-R83 (8)	1024x64	138.8	26.0	3Q 95	187,000 S	5,495	111,000	59	153,000	82
9672-RX3 (10)	2048x64	161.0	30.0	3Q 95	217,000 S	6,405	129,000	59	177,000	82
9672-RA4 (1)	512x64	33.0	6.0	3Q 96	80,000 S	1,120	54,000	68	76,000	95
9672-R14 (1)	512x64	48.0	8.0	3Q 96	120,000 S	1,575	79,000	66	110,000	92
9672-RB4 (2)	1024x96	63.0	11.0	3Q 96	160,000 S	2,135	104,000	65	145,000	91
9672-R24 (2)	1024x96	92.0	15.0	3Q 96	230,000 S	3,045	152,000	66	212,000	92
9672-RC4 (3)	1024x96	120.0	20.0	3Q 96	300,000 S	4,025	198,000	66	276,000	92
9673-R34 (3)	1024x96	133.0	22.0	3Q 96	330,000 S	4,445	219,000	66	306,000	93
9672-R44 (4)	2048x128	172.0	28.0	3Q 96	430,000 S	5,460	284,000	66	396,000	92
9672-R54 (5)	2048x128	209.0	35.0	3Q 96	520,000 S	7,000	345,000	66	481,000	93
9672-R64 (6)	2048x128	243.0	41.0	3Q 96	610,000 S	8,155	401,000	66	559,000	92
9672-R74 (7)	4096x128	273.0	46.0	3Q 96	680,000 S	9,240	450,000	66	628,000	92
9672-R84 (8)	4096x128	300.0	51.0	3Q 96	750,000 S	10,185	495,000	66	690,000	92
9672-R94 (9)	4096x192	322.0	55.0	3Q 96	810,000 S	10,990	531,000	66	741,000	91
9672-RX4 (10)	4096x192	339.0	59.0	3Q 96	850,000 S	11,655	559,000	66	780,000	92
9672-RY4 (10)	4096x192	374.0	64.0	4Q 96	940,000 S	11,655	617,000	66	860,000	91
9672-RA5 (1)	1024x96	49.0	8.0	2Q 97	180,000 S	1,680	NA	NA	NA	NA
9672-R15 (1)	1024x96	63.0	11.0	2Q 97	230,000 S	2,135	NA	NA	NA	NA
9672-RB5 (2)	1024x96	89.0	15.0	2Q 97	320,000 S	2,975	NA	NA	NA	NA
9672-R25 (2)	1024x96	117.0	20.0	2Q 97	420,000 S	4,025	NA	NA	NA	NA
9672-RC5 (3)	2048x128	146.0	24.0	2Q 97	530,000 S	4,900	NA	NA	NA	NA
9672-R35 (3)	2048x128	165.0	28.0	2Q 97	590,000 S	5,775	NA	NA	NA	NA
9672-R45 (4)	2048x128	209.0	35.0	2Q 97	750,000 S	7,350	NA	NA	NA	NA
9672-R55 (5)	2048x128	264.0	45.0	2Q 97	950,000 S	9,275	NA	NA	NA	NA
9672-R65 (6)	2048x128	301.0	51.0	2Q 97	1,080,000 S	10,675	NA	NA	NA	NA
9672-R75 (7)	4096x192	333.0	57.0	2Q 97	1,200,000 S	11,725	NA	NA	NA	NA
9672-R85 (8)	4096x192	361.0	61.0	2Q 97	1,300,000 S	12,600	NA	NA	NA	NA
9672-R95 (9)	4096x192	383.0	65.0	2Q 97	1,380,000 S	13,300	NA	NA	NA	NA
9672-RX5 (10)	8192x192	401.0	69.0	2Q 97	1,440,000 S	14,000	NA	NA	NA	NA
9672-RY5 (10)	8192x192	445.0	78.0	4Q 97	1,600,000 S	15,750	NA	NA	NA	NA
9021-942 (4)	256x64	210.0	38.0	1Q 93	74,000 S	31,725	NA	NA	15,000	20
9021-952 (5)	384x64	265.0	46.0	1Q 93	93,000 S	37,070	NA	NA	20,000	22
9021-962 (6)	512x128	315.0	53.0	1Q 93	110,000 S	43,515	NA	NA	25,000	23
9021-972 (7)	512x128	360.0	60.0	1Q 93	126,000 S	49,815	NA	NA	32,500	26
9021-982 (8)	512x128	400.0	67.0	1Q 93	140,000 S	55,515	NA	NA	40,000	29
9021-9X2 (10)	512x128	475.0	78.0	4Q 94	166,000 S	66,295	NA	NA	60,000	36

Used IBM Mainframe Spot Prices

Please note: The spot prices in this table represent the cost of configurations we consider indicative of market values on or about October 29. IBM prices are street prices and marked S. List prices are have become

meaningless for the purchase of most new equipment. Trading is thin and IBM's captive credit agencies are by far the largest owner of mainframes, so markets can be volatile when IBM adjusts its portfolio strategy.



Although 9672-R1 computers are puny compared to G5 systems — the fastest machine in this generation the 9672-R61, has only half the computing power of a 9672-R16 — these systems are considerably faster than many installed mainframes. If IBM were willing to license software at ESL rates to users of these boxes instead of restricting the bargain software fees to Integrated Servers and P/390s, a lot of mainframe users might reconsider their plans to migrate away from the S/390.

Used IBM Mainframe Market Trends

When large enterprises first began trying out IBM's 9672-R1 CMOS mainframes in late 1994, chances are they didn't think the computers they bought would get so old so fast. After all, when IBM announced its first CMOS processors, they were not the R (and later Y and T) models but the E models, with up to 8 engine clusters, each with up to 6 processors. IBM stepped into CMOS country with a sysplex-in-a-box.

It didn't go over very well.

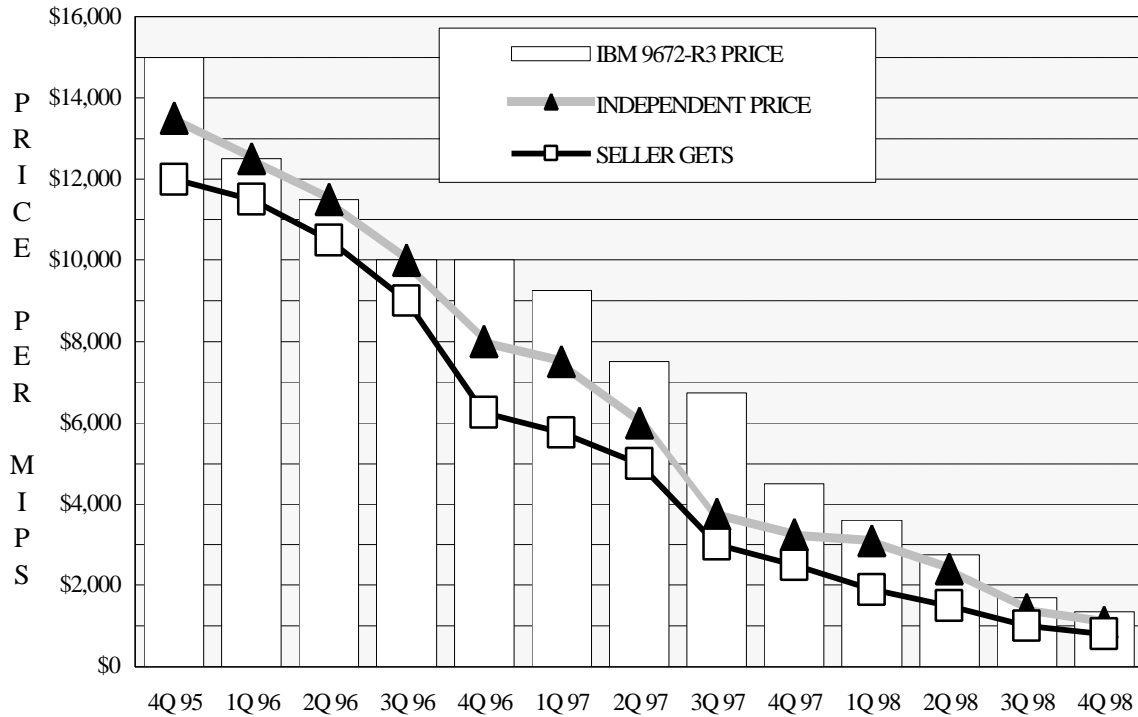
IBM then announced the R machines, which had just one engine cluster.

They were successful.

The implication of the E models remained part of users' thinking, however. The way IBM described the E machines, it seemed as if there would be upgrades in the form of faster engine clusters that could go into an E box. Customers who bought R machines may well have anticipated IBM taking a similar approach, by which we mean that there would be field upgrades available as IBM de-

veloped faster S/390 chip sets. But just as IBM had to switch its emphasis from the E to the R, it also had to give up on the idea of field upgrades. Along with faster chip sets, IBM had to develop faster glue chips, memory controllers and memory. And in CMOS country, faster chips have come to mean lower voltage chips. In mainframes, as in every other class of computer, whole systems, not just processors, move ahead. Here and there a major system component might last a couple of generations, but in general S/390 servers are no different from AS/400, Unix or NT servers — systems, not just CPUs, evolve.

The whole process is governed not just by technological progress, itself a difficult master, but also by the fierce competition among various platforms. This competition has intensified because features of Unix systems (and, later, NT systems aimed at the same target) not available to mainframe users have become absolutely vital. Paramount among these features are those associated with the Internet, such as TCP/IP and the related collec-



Used 9672-R3 processors have more than enough pep to meet the needs of 9221 and most 9121 shops, but IBM failed to displace many of these aging machines. At this point, IBM may believe it is impossible to market mainframes to all but the largest enterprises and the most committed mid-sized companies. But IBM's perception may be based on assumptions about market elasticity that are all wrong. Lots of users are spending more on their Unix and NT systems than on their mainframes. The S/390 could win some of this business if more customers felt the machines delivered comparable value and functionality.

tion of Web, file transfer and email protocols. Basically, the Internet stuff was the best thing since sliced bread or spreadsheets...and a good value, too.

And just as pragmatic IBM junked the E machines and went to the R models, it has also junked its mainframe software and gone over to Unix. Sure, this is taking a long time, but software isn't like hardware. Customers are more bound up in software, because their data and business logic are bound up in it. And with the rise of object oriented software, whatever distinctions there used to be between data and logic have changed and in a sense diminished. In the old world of procedure oriented programming, data was everything and program logic surrounded it. In the new world of object oriented programming, methods and object models are everything and data, even voluminous data, goes along for the ride.

Under the emerging rules, which IBM may influence but which it cannot control, preserving architectural features are artifacts of obsolete technologies would be suicidal. So, just as IBM is obliged to replace systems rather than upgrade installed computers, it is also pretty much stuck with the chore of extending S/390 hardware

and software architectures to its flagship systems can do the work customers will require. In computing right now, it's be quick or be dead.

IBM has failed to see its older CMOS machines and their systems software as great containers for the vast collection of legacy data and logic that are obviously doomed but which may spend years on death row before their moment of truth. If it did, it might also see the great opportunity it has to extend the S/390 and OS/390 into a single system that can serve the emerging needs of enterprise users.

That larger vision is Microsoft's goal for Windows NT and its successors...and, implicitly, for computer platforms based on Intel chips.

It won't matter if MVS must be tucked under AIX to do this (reversing the current state of affairs) or if the S/390 becomes a subset of the RS/6000 or AS/400 architecture.

IBM is not going to find some glue to unite multi-platform shops, not in Tivoli, not in Java, not anywhere. Without some unified vision, IBM's hardware components, such as the 9672, can't have much future value.

Infoperspectives

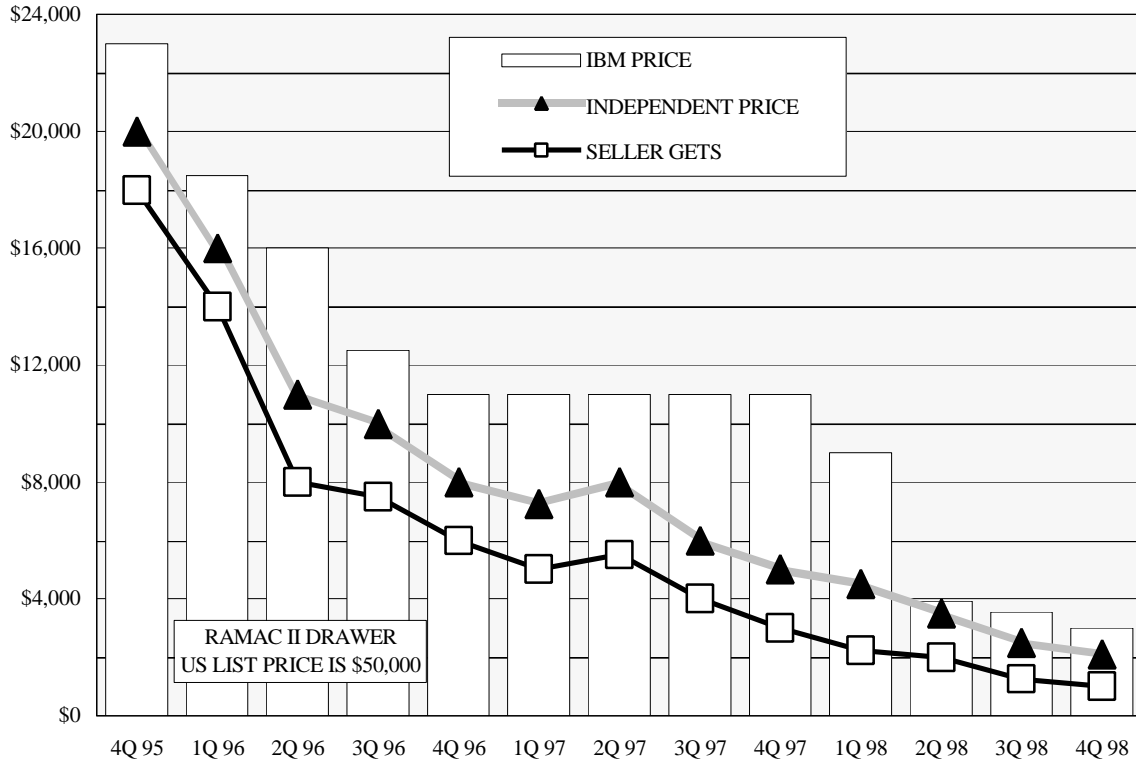
DISK OR CTRL	CAPACITY (MB)	AVERAGE ACCESS	TRANSFER RATE	FIRST AVAIL	IBM US PRICE	IBM US MAINT \$	SELLER GETS % \$	BUYER PAYS %		
3390-A24	7,560	19.6 MS	4.2 MB/S	4Q 89	132,550	175	NA	NA	200	< 1
3390-A28	15,100	19.6 MS	4.2 MB/S	4Q 89	219,000	315	NA	NA	200	< 1
3390-B24	7,560	19.6 MS	4.2 MB/S	4Q 89	115,300	150	NA	NA	200	< 1
3390-B28	15,100	19.6 MS	4.2 MB/S	4Q 89	201,750	290	NA	NA	250	< 1
3390-B2C	22,700	19.6 MS	4.2 MB/S	4Q 89	288,200	430	NA	NA	250	< 1
3390-A34	11,350	22.1 MS	4.2 MB/S	3Q 91	152,450	175	NA	NA	250	< 1
3390-A38	22,700	22.1 MS	4.2 MB/S	3Q 91	258,850	315	NA	NA	300	< 1
3390-B34	11,350	22.1 MS	4.2 MB/S	3Q 91	135,200	150	NA	NA	300	< 1
3390-B38	22,700	22.1 MS	4.2 MB/S	3Q 91	241,600	290	NA	NA	300	< 1
3390-B3C	34,050	22.1 MS	4.2 MB/S	3Q 91	348,000	430	NA	NA	300	< 1
3990-604	CTRL, 256 MB	NA	NA	3Q 93	400,720	903	700	< 1	2,000	< 1
9390-001	CTRL, 512 MB	NA	NA	4Q 96	413,860	981	NA	NA	NA	NA
9390-002	CTRL, 1 GB	NA	NA	4Q 96	824,370	1,888	NA	NA	NA	NA
9343-C02	CTRL	NA	NA	1Q 92	45,650	190	NA	NA	NA	NA
9343-C04	CTRL	NA	NA	1Q 92	69,300	305	NA	NA	NA	NA
9343-D04	CTRL	NA	NA	1Q 92	69,300	305	NA	NA	NA	NA
9343-CC2	CTRL, 32 MB	NA	NA	4Q 92	57,200	215	NA	NA	1,300	2
9343-CC4	CTRL, 64 MB	NA	NA	4Q 92	92,400	355	NA	NA	1,600	2
9343-DC4	CTRL, 64 MB	NA	NA	4Q 92	92,400	305	NA	NA	2,900	3
9345-B22	3 GB			1Q 92	31,790	60	NA	NA	1,200	4
9391-A10	RACK	NA	NA	3Q 94	50,000	55	NA	NA	500	< 1
9392-B13	5,670	15R/17W	5.2 MB/S	3Q 94	30,000	50	NA	NA	350	1
9392-B23	11,350	12.1R/13.6W	9.5 - 12 MB/S	3Q 95	50,000	65	1,000	2	2,100	4
9392-B33	22,700	16.6 MS	4.4 MB/S	4Q 96	90,000	85	4,000	4	8,250	9
9394-001	CTRL, 64 MB	NA	NA	3Q 94	135,000	415	3,750	3	6,000	4
9394-002	CTRL, 64 MB	NA	NA	3Q 94	150,000	425	6,000	4	12,000	8
9394-003	CTRL, 128 MB	NA	NA	3Q 94	215,000	550	12,500	6	19,500	9
9395-B13	5,670	15R/17W	5.2 MB/S	3Q 94	30,000	50	NA	NA	500	2
9395-B23	11,350	12.1R/13.6W	9.5 - 12 MB/S	3Q 95	50,000	65	1,200	2	2,850	6
9393-1-A22	1GB x 180GB	NA	NA	3Q 96	540,832	1,414	9,000	2	17,000	3
9393-1-A32	1.75GB x 270 GB	NA	NA	3Q 96	678,129	1,726	12,500	2	21,000	3
9393-1-A42	2GB x 360GB	NA	NA	3Q 96	725,152	1,833	14,000	2	27,000	4
9393-002	1GB x 160GB	5.8 MS	NA	4Q 96	837,376	1,423	9,750	1	15,000	2
9393-T42	420 GB+2GB CACHE	4.8 MS	NA	2Q 97	210,133	4,491	NA	NA	185,000	88
9393-T82	420 GB+2GB CACHE	NA	NA	3Q 97	210,133	4,491	NA	NA	190,000	90
9396-1	464 GB+1GB CACHE	NA	NA	4Q 96	250,288	3003	NA	NA	225,000	90
9396-200	456 GB+1GB CACHE	NA	NA	2Q 97	301,987	4833	NA	NA	275,000	91

IBM is at the forefront of the merchant disk drive market. As a result, the cost and performance of its end user subsystems continue to improve. IBM has been passing its cost reductions to buyers of new equipment, putting considerable pressure on the prices of used machines.

Used IBM Disk Drive And Controller Spot Prices

The figures in this table are drawn from actual transactions reported to us on or about October 29. The information on which the table is based has been obtained from sources we believe to be reliable. We suggest you

read the essay on the next page before making plans based solely on current prices. Transactions arranged for future execution will be carried out at prices that are almost always lower than those reported here.



Ramac II RAID modules store about 11.35 gigabytes of data, less than the capacity of disks that are now common on home PCs. The disks sold to ordinary consumers also locate data more quickly and transfer it at a faster rate than old Ramac modules. Server disks — usually with high specification SCSI interfaces — are considerably quicker than disks made for the home PC market. As a result, the value of used Ramac modules is strictly a reflection of users' desire to keep working equipment in place.

Used IBM Disk Drive And Controller Price Trends

One of the most costly strategic errors IBM made in the disk business stems from its gamble that the market in end user disk subsystems for S/390 users would be shielded from trends in storage for other platforms and from conditions in the merchant raw drive market. By contrast, EMC based its strategy on the theory that memory chip and disk drive prices would fall and, more importantly, mainframe disk subsystems using these components would track the market, perhaps belatedly.

The upshot is that IBM went from linear disks to RAID 5 and controllers with moderate cache memory capacity while EMC went from linear disks to mirrored disks and subsystems with large cache

The components markets evolved along lines that made EMC's decisions look brilliant (rather than merely fortunate) and the rest is history.

IBM, with a big merchant disk business as well as formidable semiconductor production talent must have seen the trends even more clearly than EMC. Where IBM

went astray was in assuming that the market in high end disk subsystems could somehow be kept apart from other segments served by the storage industry. So while IBM's AS/400 and RS/6000 divisions were learning new rules, its mainframe group was content to offer storage subsystems with jarringly different cost and performance characteristics. IBM eventually threw in the towel, dropping its Ramac products and marketing more suitable equipment made by StorageTek. But even with the StorageTek products, IBM was unable to take advantage of its own disks. And customers are still waiting for IBM to field end user products that can put it back in first place.

Fibre Channel connectivity is beginning to present the whole storage industry with new opportunities. This would be a good time for IBM to make its move. And it is also a good time for other vendors to enter with superior cross-platform storage solutions.

It all adds up to a case for leasing rather than buying disks and for keeping terms as short as possible.

Infoperspectives

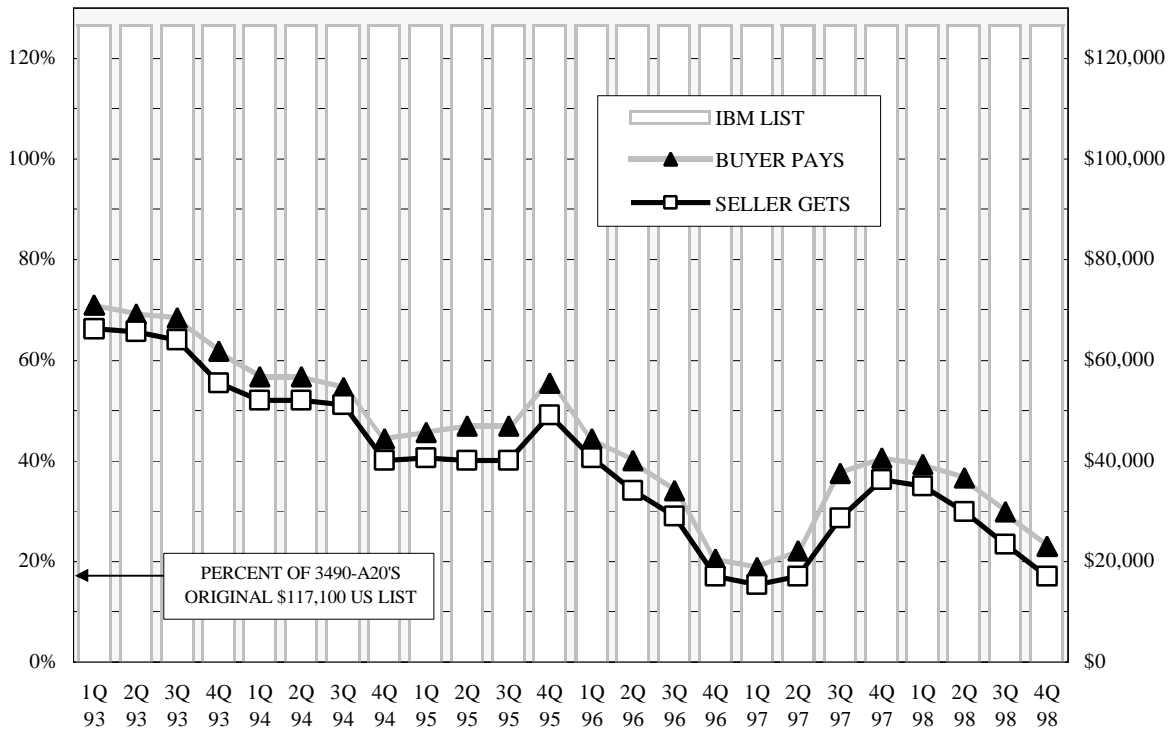
MAINFRAME PERIPHERALS	PEAK SPEED	FIRST AVAIL	IBM US LIST	IBM US MAINT	SELLER GETS		BUYER PAYS		
					\$	%	\$	%	
TAPE TRANSPORTS AND CONTROLLERS									
3480-A22	CTRL	1Q 85	69,230	448	NA	NA	500	< 1	
3480-A22+3305 IDRC	CTRL	3Q 89	86,590	498	1,000	1	1,750	2	
3480-B22	3 MB/S	1Q 85	48,450	279	NA	NA	200	< 1	
3480-B22 + 2511 LOADER	3 MB/S	1Q 85	58,445	345	NA	NA	400	< 1	
3490-A02 + 3356 CH ADAPT	CTRL	1Q 90	127,330	700	16,000	13	20,000	16	
3490-B04	4.5 M B/S	1Q 90	111,100	815	2,750	2	5,000	5	
3490-A20	CTRL	2Q 91	126,600	560	20,000	16	27,000	21	
3490-B40	4.5 M B/S	2Q 91	122,200	692	17,500	14	22,500	18	
3590-A00	CTRL	3Q 96	7,500	80	1,000	13	2,750	37	
3590-A14	RACK	3Q 96	21,000	25	5,500	26	9,500	45	
3590-B1A (ATL)	20 MB/S	3Q 95	43,500	190	14,500	33	21,000	48	
PRINTERS									
4245-12	1200 LPM	3Q 85	38,410	304	NA	NA	1,000	3	
4245-20	2000 LPM	3Q 85	44,270	488	NA	NA	1,150	3	
4248-2	4000 LPM	1Q 87	95,760	848	500	< 1	1,500	2	
6262-14	1400 LPM	3Q 88	33,820	286	2,000	6	3,500	10	
6262-22	2200 LPM	4Q 89	47,940	374	6,000	13	10,000	21	
3825-1	58 PPM	3Q 89	159,350	1,972	NA	NA	1,900	1	
3827-1	92 PPM	2Q 88	240,200	3,235	NA	NA	1,500	< 1	
3835-1	88 PPM	2Q 88	175,300	1,525	3,500	2	6,500	4	
3835-2	92 PPM	1Q 93	147,400	1,200	30,000	20	35,000	24	
3900	229 PPM	2Q 91	295,000	1,550	12,000	4	26,000	9	
CRTS AND CRT CONTROLLERS									
3191-A10		2Q 86	634	6	NA	NA	100	16	
3192-C10		1Q 87	1,730	9	40	2	110	6	
3192-D10		1Q 87	754	7	50	7	125	17	
3192-G10		1Q 87	2,555	11	55	2	135	5	
3471-EA1		3Q 89	1,060	7	50	5	115	11	
3472-FC1		3Q 91	1,730	10	100	6	200	12	
3472-HC1		3Q 89	1,730	10	100	6	210	12	
3174-1L		3Q 86	19,044	31	NA	NA	360	2	
3174-1R		3Q 86	13,942	25	NA	NA	360	3	
3174-51R		3Q 86	7,520	19	NA	NA	375	5	
3745-210		1Q 88	290,790	492	NA	NA	20,000	7	
3745-410		3Q 88	642,180	902	NA	NA	35,000	5	

IBM still hasn't unloaded its printer business, although there is widespread expectation that it will do so during the fourth quarter if it can get a good price and in the first quarter of next year if there will be a large associated write-off. In the meantime, uncertainty is working against IBM and in favor of Xerox (across the board) and Hewlett-Packard (in the low end and midrange). Prospective buyers of new IBM printers are in a pretty good position to bargain with Big Blue right now.

Used IBM Tape, Printer And CRT Spot Prices

Prices listed in this table are drawn from actual transactions reported to us on or about October 29. The information on which the table is based has been obtained from sources we believe to be reliable. Please note, how-

ever, that some of the equipment listed is subject to rapid price fluctuations. Further, many recent products are not widely available in the used market, so we cannot list prices that are acceptably accurate.



While the price of a 3490-B transport has been relatively stable, A20 controller market has been diving. It's hard to say whether this is due to consolidation — users putting more tape on fewer controllers — or actual growth in the size of installed tape subsystems. What is clear is that 3490-A40 controllers are coming into the market faster than customers are buying them. Regardless of spot market conditions, it wouldn't be surprising if the B40 machines followed the A20 boxes downward.

Used IBM Tape, Printer And CRT Price Trends

Usually, the used market prices of tape controllers and their associated transports track pretty closely. When there is divergence, it is generally temporary. But this has not been the case in the 3490E market during the past several months.

The spot price of a 3490-A20 controller has fallen by half since the beginning of the year. During the same period, used 3490-B40 transports have also become less costly, too. They have shed about 25 percent of their market value.

The disparity is the result of change in the ratio of installed controllers to transports. And it's surprising, as the 3490s are old. They are a standard for enterprise tape storage, of course, but a standard from the past. Whatever lies ahead — Magstar, other tape formats, DVD or a yet-undiscovered medium — the 3490 is in use today only because it was in use yesterday.

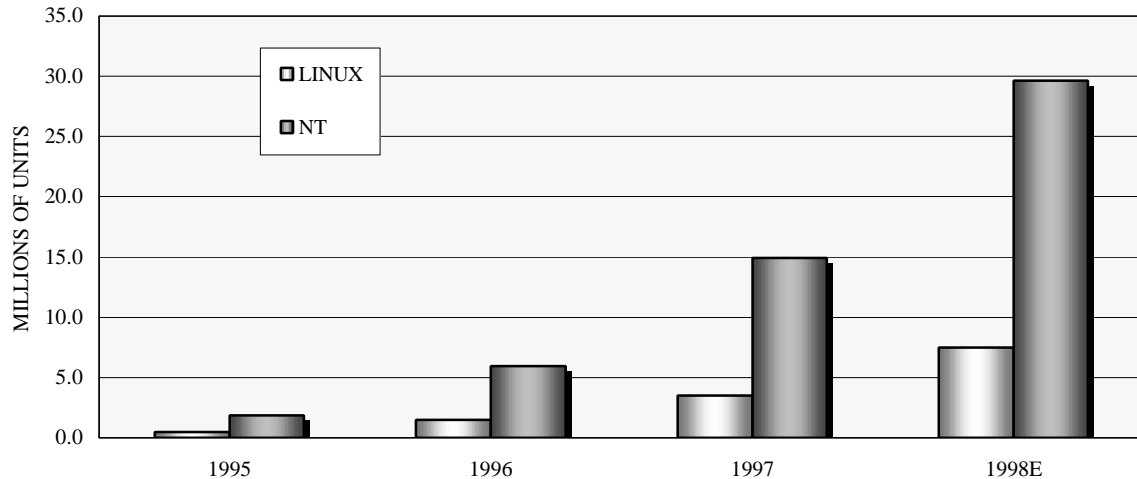
Our guess is that users are consolidating older tape equipment, putting more transports on fewer controllers,

and finally shedding 3480s tape cartridge capacity less than that of backup devices used on PCs.

The market aberration is puzzling. Even newer products, including tape devices in the 3590 Magstar family, are falling faster than 3490 transports.

While it is possible for 3490 controllers to rebound as they have in the past, we feel it is more likely that the transports will fall sharply in price to match the declining value of their controllers. If they don't, bargain hunters will find used StorageTek or Hitachi machines to use for backup. The high cost of 3490 subsystems is terribly out of line with their actual value in a computer site, and that will ultimately force even the most traditionally Blue users to look around for alternatives.

We're surprised IBM has not seen the possibility of losing a lot of tape footprints and instituted a campaign to move prospective buyers of 3490 equipment all the way to virtual tape servers. IBM says VTS is selling well, but the market says it's not yet selling well enough.



Shipments of Windows NT and Linux are growing exponentially. Neither is a branded Unix. While NT is very similar to Unix, users must add third party products if they want true Unix services. And Linux, in the GNU family, complies with Posix standards that are slightly different from those of branded Unix systems. What makes these systems so important is their price. NT is cheap. Linux is free, although most business users buy the code, support and some related products from resellers like Red Hat.

Fluctuations: We Have Seen The Future And It's Cheap

The future belongs to the bargains. Or so it would seem, based on the boom in shipments of two operating systems that stand for value in the minds of users and which can be used on servers as well as workstations. The two operating systems we're talking about are the very popular Windows NT (soon to become Windows 2000) and dark horse (or possibly dark gnu) Linux, or more accurately, GNU/Linux.

The success of these systems — and the realization among business users that Windows 9X may be a dead end — has put increasing pressure on other quality environments for Intel-based hardware, including SCO Unix.

The growth of NT and Linux has apparently not frightened IBM, which said it is working with SCO and Sequent to create a Unix system for Intel that includes some technology from its AIX operating system.

In the meantime, NT is selling at the rate of 30 million copies a year and rising. Industry sources say about 90 percent of the NT base is using it to power workstations. Linux is estimated to be entering the base

at a quarter the rate of NT, but with free software it's hard to tell. We reckon a fourth of the Linux base is using it for a server system, making it a more serious competitor to NT than raw unit shipments would indicate.

Linux is used by small ISPs all over the world to support Web, FTP and email services. Corporate users are evaluating Linux for the same purposes and other kinds of applications, too. Some experts say Linux, free or not, is more stable and secure than NT. This could well be the case, as the kernel is a Unix-like bit of code. Linux is also tiny compared to NT, but it's hard to make a clear comparison because Linux is a base operating system and NT includes many features that are add-ins in a Linux environment...and lacks some features that are in Linux.

What seems clear is that Linux is forcing all the players in the Intel market to rethink their business models. Microsoft doesn't seem worried about Linux; it has lots of other issues to face. And IBM seems to be moving away from a possible adoption of Linux...which may turn out to be positive for the freeware product.

Coming Up . . .

Next month we will look at recent developments in software for Intel-based workstations. Businesses that have finally learned to live with Window95 may have to migrate to NT and integrate their clients with the Internet.

The following month we will present our annual survey of PC usage at enterprise computing sites. The gap between the technology of the installed base and that of the industry's current offerings has become a chasm.