CHIP BATTLE
See This Chip?
It's Intel's most powerful processor ever. It has the ability to take on IBM, sink Sun, make or break HP, and crush or revive AMD. It's keeping every CEO in computing up at night. And it's just getting started. The multibillion-dollar battle between Itanium 2 and its rivals has begun.
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By David Kirkpatrick

(Photo: Tom Schierlitz)

It may be the most sophisticated factory ever built. In a cavernous building the size of several football fields, rows of multimillion-dollar machines loom over white-suited workers. Air scrubbed free of all dust circulates downward through holes in the floor. Robotic carts rumble overhead on ceiling-mounted rails. Periodically they stop, extend long metal arms down with a hiss, and lift sealed canisters full of what appear to be stacks of delicately preserved LP records. These disks are far more precious. They are silicon wafers that will soon be diced into Intel's most advanced microprocessor, the Itanium 2. The company already controls the brains of most PCs. With this plant in Hillsboro, Ore., and 12 others like it around the world, the $27-billion-a-year, Santa Clara, Calif., chip giant aims to complete its resolute march from the lowly desktop to the core of the enterprise.

Press your ear to the door of your company's data center. The hum you hear is actually the rumble of the next great battle in computing breaking out. With Itanium 2, Intel is trying to muscle IBM and Sun out of the $25-billion-a-year market for so-called 64-bit servers, the big iron of modern computing. Such machines account for only 5% of the units sold in the entire server market, but for 65% of the dollars. Intel's ambitions do not stop there. Itanium is a key element of the company's grand

strategy to make itself the sole supplier of the brains that power all computers.

But just because Intel has managed to win past chip wars doesn't mean it will win this one. Making the shift to 64-bit computing isn't just a matter of updating the Pentium 4, adding another digit to its name, and shipping it off. Itanium functions in entirely new ways, requiring computer makers to redesign their hardware and software companies to rewrite all their code. What's more, Itanium is late; originally planned to emerge at what turned out to be the peak of the tech boom, it is only now working its way into the market.

No wonder this critical sector of the business seems up for grabs. Chipmaking rivals such as IBM, Sun Microsystems, and Advanced Micro Devices that have long feared Intel now see an opportunity to hold it off and even gain ground against it. Computer makers are mostly refusing to choose sides, even though Intel is pounding the table and saying they must pledge allegiance or risk being left in the dust when Itanium becomes the standard. Yet so much is at stake that even Intel is hedging its bets: It's an open secret in the industry--though Intel won't comment--that it has a plan B in the event Itanium tanks.

"I've been doing this for many years, and I've never seen a time when questions this important were in the balance and up in the air," says Bill Zeitler, who heads the $16 billion systems group at IBM, which today commands more high-end computer revenue than any other company. "There are enormous pressures and forces at work. All the players are positioning themselves to take advantage, whichever way this all moves."

Shifts like these can redraw the computing landscape. Intel's last major architectural change, from 16-bit to 32-bit processors, occurred in 1985, when it introduced Pentium's granddaddy, the 386 chip. It gave PC makers the power they needed to complete their conquest of the desktop and usurp the hold of minicomputers on office computing. It also cemented Intel's dominance of microprocessors. An investor who spent $25,000 on Intel stock back then would today have nearly 30 times that in his pocket--a compound annual return of about 22%.

The stakes now are just as high--for investors, chipmakers, and computer users alike. In the grand struggle that is starting to unfold, each major player faces choices whose ramifications are impossible to compute. With that in mind, Fortune set out to chart the starting positions of the companies that have the most to win--and the most to lose.

But first it helps to understand the 64-Bit Question: What's so

great about a 64-bit chip anyway? Simply this: It beats the pants off almost all the chips in use today. A computer's speed is defined by how fast it digests the 1's or 0's --called bits--that compose every piece of information in the electronic world. Pentiums and other processors in PCs are 32-bit chips, meaning they swallow 32 of those 1's and 0's with each tick of their internal clock. (The clock ticks fast: 4.3 billion times a second in a 4.3-gigahertz Pentium.) Itanium and its rivals take in 64 bits at a time--they crunch double the data.

Doubling may not sound like much (doesn't computing always grow exponentially?), but giving computer architects 64 bits to work with frees them to imbue machines with better, more subtle logical processes--the computer equivalent of adding 30 or 40 IQ points. What's more--here is the exponential part--64-bit chips also make retrieving information enormously faster. A 32-bit chip can work with at most four gigabytes of memory, forcing it at times to tap relatively poky hard disks for information. But 64-bit chips can work with up to 16 exabytes (that's 16 billion gigabytes) of memory. Companies like Oracle and SAP crave such chips because it means that their databases and enterprise resource planning software can find and display information instantaneously, which customers increasingly demand.

As corporate software evolves, the need for 64-bit processing skyrockets. "The last wave of software investments was about improving processes," says Bob Parker, a senior analyst at the AMR corporate software research firm in Boston. "The next wave will be about reengineering decisions: How much credit should I grant that customer? Should I increase inventory because I received this order? For problems like that you need a lot more computing power."

And it may be only a matter of time--perhaps a very short time--before 64-bit chips also brighten everyday life. Already, specialized 64-bit chips have taken over the computer game industry--Nintendo 64 and Sony's PlayStation2 both use versions of IBM's so-called Power chips. For displaying the complex graphics critical to gaming, 64 bit is infinitely superior. And consumers may soon crave the chips in their PCs for the same reason they like to buy the latest Pentium--to keep up with the Joneses. Says Richard Newton, dean of engineering at the University of California at Berkeley: "Sixty-four bit is a no-brainer. It's the inevitable progression of technology. Once it's there, you gotta do it."

The Juggernaut: Intel

The Itanium onslaught has been a long time building. In 1994, Intel's microprocessors were facing new competition. IBM, Motorola, and Apple Computer were jointly developing a

promising technology called the PowerPC. HP was at work on an ambitious type of chip that embodied a computer architecture called PA-RISC and executed software instructions in parallel, radically improving processing speed. Unlike Intel's chips or the PowerPC, HP's technology was 64 bit. Instead of playing catch-up with HP, Intel CEO Andy Grove persuaded HP's Lew Platt to combine his research with Intel's development efforts. Together they would bear the multibillion-dollar expense of creating the 64-bit architecture of the future.

Intel aimed not just to beat its chip rivals but to bury them. Its ambition was to craft a high-end processor architecture that the entire industry would be forced to use. Grove would devote his company's manufacturing strength to building vast volumes of the chip at a price other chipmakers couldn't meet. That same formula had made Intel's chips the standard in the PC industry. Why wouldn't it work here as well?

In the following years every server maker but IBM and Sun joined Intel's camp. Those two decided to fight. In 1996, IBM started plans to build the Power4. And Sun continued to design new versions of the SPARC chip that powered its servers. SPARC chips became 64 bit in 1995. Still, everyone was waiting for the big chip to drop.

It was a long wait. Itanium did not launch until summer 2001--two years later than originally planned. It was a megaflop. Not only didn't it run 32-bit applications in the way Intel originally promised, but its performance wasn't a convincing improvement over the Pentium. Not surprisingly, few software makers were eager to plow resources into rewriting their programs to work well on Itanium.

Intel returned to the drawing board. In July 2002, CEO Craig Barrett relaunched the project, calling it Itanium 2. This time the chips worked better--Intel's manufacturing ability had finally caught up with the ambitions of its designers. Itanium 2 beat its predecessor in speed and convinced many critics that Itanium wasn't just a synonym for "white elephant." The two-year setback, however, meant that Intel was entering a market that was deeply depressed in the aftermath of the dot-com collapse. The delay also allowed Intel's rivals to become even more entrenched. Last year Sun sold $7.8 billion worth of 64-bit systems, and IBM sold $5.7 billion, calculates research firm Gartner Dataquest. Sales of Itanium-based systems amounted to a scant $100 million.

Part of the problem, ironically, lies in Intel's success: Its other microprocessor business--the Celeron, Pentium, and Xeon lines--has thrived. These 32-bit chips have gone further in their

capabilities and in the marketplace than almost anyone expected. Sales of servers based on these chips topped $16 billion in 2002, according to Gartner, which predicts that figure will rise to $21 billion by 2005. That's good for Intel but presents a serious issue for its Itanium project. Intel's 32-bit server processors are popular with many of the same corporate customers the company originally targeted with Itanium 2.

Customers also have no reason to buy into a new architecture that won't yet run their software--an area where Intel still has a lot of catching up to do. So far just over 100 applications run on Itanium, vs. more than 10,000 that run on Sun's platform. The software that has already been rewritten for Itanium includes some of the biggest and most important applications, such as the Oracle and Microsoft SQL Server databases and SAP's enterprise products. But smaller programmers are still staying away. Last summer Len Tsai, a senior systems designer at NEC, the world's fifth-largest server maker, remarked at a conference that it would take many years for programmers to learn to write the kind of code Itanium required. Such talk frustrates Mike Fister, who runs Intel's Enterprise Platforms Group. "Doggone it! That doesn't mean we haven't made progress," he says. "We're going to get there."

The Power Player: IBM

The fastest way to make Itanium the dominant 64-bit chip, in Intel's view, would be to bring IBM onboard. While Big Blue now does big business selling servers based on its own Power4 chip, it also builds machines with Pentiums and Itaniums inside. Intel believes it would ultimately do better if it dropped Power4, thereby saving itself the vast expense of designing and fabricating microprocessors. "Our goal would be for IBM to move its entire high-end architecture to Intel," says Intel president Paul Otellini.

Not surprisingly, the $81-billion-a-year company has a different view. IBM systems boss Zeitler is sitting in a conference room at IBM's sleek headquarters set in the woods of Armonk, N.Y. As a deer just outside his window placidly munches leaves, Zeitler makes a declaration sure to reverberate through the 64-bit world. In five years, he predicts, there will be only two players in the high-end microprocessor business: IBM and Intel. He's hoping it will be in that order, too, with IBM keeping the high ground for itself and perhaps selling more chips to others.

His confidence suggests that Intel won't have this market to itself. When IBM created the Power4 in the late 1990s, it was the product of a crash development program. Its unexpected success helped convince IBM that it had the technological capability to keep even Intel at bay. How? By constructing every part of its

64-bit servers, from the chip design to the operating system to the software and hardware that enable multiple processors to operate as one superstrength machine. "To get the optimum performance from a computer, you have to tune the whole stack," says John Kelly, who supervised the development of Power4 and now runs IBM's chipmaking business. "We can tune our systems like you'd tune a Formula 1 car."

IBM also knows Itanium's weaknesses better than perhaps any other rival--in part as a result of information divulged by Intel in its quest to win over Big Blue. Says Ravi Arimilli, IBM's chief microprocessor developer: "Intel has had meetings with us asking how they could enhance [the chip] to get us on it. So we're very aware of its limitations."

IBM even thinks it can keep pace with Intel's manufacturing prowess. While Intel gets vast volumes by putting its desktop chips through the same plants as Itanium and 32-bit Xeon server chips, IBM now churns out versions of Power4 for Sony, Nintendo, and many other customers.

The Pest: AMD

The company holding what would seem to be the weakest hand is AMD. With $3 billion in annual revenues--less than a ninth of Intel's--the Sunnyvale, Calif., chipmaker has long tried to steal Intel's thunder. Since 1999, AMD has periodically claimed the title of having the world's fastest chips. Each time, Intel tweaked its Pentiums and took the bragging rights back. AMD does control 18% of the market with its 32-bit chips, but virtually none of that comes from server sales, and AMD has yet to officially launch a 64-bit chip. Itanium 2 should be way out of its league.

Yet industry watchers think the 64-bit battle could be where AMD finally proves itself against Intel. In April, AMD plans to release Opteron, a 64-bit chip with big ambitions. Unlike Itanium, which is designed primarily to run new 64-bit software, the Opteron is optimized to be Pentium compatible. It can readily run programs written for today's 32-bit machines, as well as new 64-bit software. AMD will not only stick its 64-bit chips in servers but also offer them for conventional PCs starting in September. And it will sell both types of chips for prices comparable to Intel's 32-bit chips--and much less than Itanium. Or so AMD claims. The chip isn't shipping yet, though customers and software companies have been using early versions for tests.

"We're the lone guy here providing what the customers really want," says AMD CEO Hector Ruiz, who took over from company founder and longtime CEO Jerry Sanders. Sanders was

known for his outspokenness, and Ruiz is similarly blunt, though less arrogant. "Now the battle is finding a way to get it to them. We're working our butts off to figure out how."

Making the chips is one of AMD's problems: AMD has design chops but is weak in marketing and manufacturing. Worse is that no major computer company has yet agreed to sell Opteron-based servers. And no major computer company will deny that Intel is working hard to keep it that way. When asked about the threat posed by AMD's Pentium-compatible approach, Intel's Fister turns cocky--in stark contrast to his otherwise unflappable demeanor. "It may create more problems with applications than people expect," he says darkly. "I'm a little jaundiced because who knows better about this than we do? Who sells most of the processors in the world? So the fact that we did or didn't [follow AMD's approach] is meaningful. We're relatively smart and extremely methodical. And the smartest guy about making the 64-bit transition is yours truly--the guy who did Itanium."

Still, the smartest men haven't always been able to predict the wants of the people. And here's another thing AMD is counting on: By imbedding its 64-bit chips into PCs, AMD may be able to promote its products as, well, cooler. That's nothing to dismiss, especially in a market where computer makers are desperate for gimmicks to persuade people to upgrade and processor speeds have become a yawner. Not that Ruiz has any illusions about what he's up against. "Intel's clout is strong enough to make a dud successful," he says.

The Early Adopter: HP

Early on, HP, which for years had made its own processors, realized that it would rather not be in AMD's spot--that is, going toe-to-toe with Intel. If execs at the $72-billion-a-year company are having second thoughts about that decision, they're not saying. How can they? HP put all its eggs in one basket when it bet on Itanium, committing to phase out its PA-RISC chip and two other processor architectures it owns. Intel's Otellini calls it, approvingly, a "burn the boats" decision for HP. And HP can't back down now. "We don't think it's wise to bet against Intel," says HP's determined CEO, Carly Fiorina. Nonetheless, she concedes, "Itanium has happened more slowly than we had thought it would."

Like every company betting on Itanium, HP is counting on Intel to pump out the chips--something it's expert at--freeing HP to fine-tune its servers. HP will even gain a share of the revenues from the chips since it helped fund and design the Itanium from the start. Says Peter Blackmore, executive vice president for enterprise systems: "We can use our dollars for things that give us more differentiation in systems, like management software,

technology for clustering many processors together--things above the chip." Scott Stallard, who supervises HP's high-end servers, says that by switching to Itanium his group will free up $400 million to $500 million a year in R&D. That's the thought, at least. HP's inability to count on Itanium so far is one reason its enterprise group has been bleeding hundreds of millions of dollars per quarter.

"We made the right bet, without a doubt," insists CEO Fiorina. "Itanium is superior in price/performance, and it will be broadly adopted." Counters IBM's Zeitler: "Intel will do fine because Intel is an extraordinarily powerful, talented, rich company. Whether HP will do fine is an enormous question."

Odd Man Out: Sun

While HP and IBM fight over their fortunes, one thing they agree on--along with most industry watchers--is that whatever happens with Itanium, it's not good for Sun. Sun CEO Scott McNealy, not surprisingly, disagrees. In his office on a recent afternoon, he rages over a visitor's question about the threat posed by Intel. For customers buying high-end servers, McNealy declares, "it's IBM and Sun on the short list [for high-end servers]. We never run into Itanium."

That may be true, but the game is still in its early stages. Sun is entrenched in the data center--it gained more market share last year than any other high-end server maker--yet nobody outside the company thinks Sun can keep SPARC competitive long term. Gartner projects stagnant sales for Sun in the years ahead. The company's future, say many analysts, is in eventually adopting Itanium. McNealy defends his chip. "You wrongly assume we can't build price-competitive microprocessors," he says, pointing out that Sun owns no fabs and keeps its capital costs low by relying on independent foundries to turn out its chips. Just as quickly, though, he insists it's not SPARC but "SunOne"--a software layer based on Sun's Java code--that customers really care about. "How we wiggle it doesn't matter," he asserts.

The Spoilers: Dell and Microsoft

Pundits watching the computer world often refer to the power of Wintel--that is, Windows and Intel. But an even bigger friend of Intel's has long been Dell, the only major computer maker never to offer an AMD chip. Michael Dell made his fortune by relying on industry standards, and the Intel standard has been very good to him. But that's all in the 32-bit world. In high-end corporate hardware Dell is hardly a player, and it covets the 50%-plus margins such machines command.

Dell hopes that Itanium takes off with customers, and that Intel

supplies it with sufficiently engineered complete systems so that it can take itself higher up the corporate-computing food chain. It plans this year to ship a relatively simple Itanium 2 system. Ask president Kevin Rollins how high up into the data center Dell can go and he replies, "I don't see any limit."

But Dell isn't following its archrival HP and betting all its chips on Intel. For the first time the $34-billion-a-year company seems to be weighing whether to offer AMD's Opteron chip--either instead of or as well as Itanium. "What makes this different from past AMD discussions is that until now AMD's value proposition has been Intel compatibility at a lower cost," says Randy Groves, Dell's chief technology officer, who also runs its business selling enterprise products. "Now it's not a pricing discussion. This is something Intel doesn't have."

Yet Dell will commit to nothing. Its executives get cagey when discussing how AMD is playing in Austin. Says Rollins: "There is a lot of customer interest. We are looking very closely at AMD's products right now." He then goes on to say that AMD still has to prove that the chip performs and that it can make it consistently in volume. And CEO Michael Dell, collared in a hallway at the World Economic Forum in Davos, Switzerland, mused, "The customers up until now who have accepted AMD have been more consumer than business. So what are the chances that AMD will jump from the consumer desktop to the business server?" Not very good, was the strong implication. "But we're open to whatever our customers want," concludes Dell as a writer for a Chinese magazine thrusts a digital recorder under his nose.

Perhaps the most surprising source of enthusiasm for AMD is Microsoft. It's easy to think of the software powerhouse as hand in glove with Intel. But Microsoft's main interest will always be selling more of its software--or getting consumers to upgrade their Windows operating systems--and AMD may be about to give it a great opportunity. Microsoft planned to announce in early February that it will soon start shipping a version of Windows for AMD's 64-bit chips. Jim Allchin, the man in charge of Microsoft's operating systems, calls the performance of software on the AMD machines "pretty amazing." Microsoft took applications written for today's 32-bit chips and ran them on an Opteron server loaded with the new Windows 64-bit operating system. The programs performed considerably better than the same ones using 32-bit Windows. Microsoft's new operating system allows any application to reach deeper into memory. "We can give any 32-bit application an additional gigabyte of memory, and you don't have to write a single byte of code," says Allchin. Programs written especially for 64 bits get further "dramatic performance advantages," he says.

It's too early to say exactly how all this will play out. Intel says its chip, unlike Opteron, is designed for the next 20 years. To stir demand for it now, Intel is building what it calls an "ecosystem" around the chip. Intel's Fister is overseeing a few thousand employees who work on things like writing software and developing chipsets. Almost like a computer company, they are essentially designing entire systems around Itanium 2. That allows assemblers like Dell to easily package and sell complete servers. And at 17 centers around the country, Fister's people work with corporate customers to make sure they get maximum performance out of Itanium systems.

That kind of handholding helps, but Intel's rivals won't let the chipmaker's customers get too cozy. In mid-January, IBM struck an agreement with AMD that roiled an already confused market. Big Blue announced it would be sharing technology and manufacturing know-how with AMD, potentially opening the door for AMD's Opteron and Athlon 64 chips to be built in IBM's plants. That could help keep IBM's fabs humming--something IBM needs--and could make it harder for Intel to convince customers that they must junk their existing software and make the big leap to Itanium. "Backward compatibility almost always wins over a radical shift," says IBM's Zeitler. "Customers want to protect the investment that's been made."

If IBM helps Opteron, it could also force Intel's hand and create an awkward choice for HP. Intel is widely believed to have a contingency plan in place: a 64-bit chip, reportedly called Yamhill, that features the same Pentium compatibility as AMD's Opteron. If Opteron takes off, the thinking goes, it's only a matter of time before Intel unleashes Yamhill. And the better Yamhill does, the less software writers would feel the need to write programs that run on Itanium. Sitting in a sun-dappled room in Davos, Fiorina remains sanguine. She says there's no reason that HP couldn't ship Opteron-based servers. "People misunderstand," she says. "We don't have a gun to our head. We will migrate at the pace our customers want."

Whether Itanium thrives, dies, or cedes its place to Yamhill, two outcomes are likely: Sun gets hurt and Dell doesn't. Nobody predicts McNealy's total departure from the scene--his company has enough customers and software to stay alive. Change in technology, as many point out, is evolutionary, seldom revolutionary. The evolution in Dell's case will be its steady increase in market share, moving up the corporate ladder with its stock of industry-standard parts. Whatever chip catches on is what Dell will use.

For Intel, the game is just beginning. The rumble in the server room is only going to get louder.