

History of Silicone Graphics (SGI)



**The original SGI logo is still used today
as well as the newer "initials" logo.**

Silicon Graphics

Silicon Graphics, Incorporated, commonly called SGI, began as a maker of graphics display terminals in 1982. It was founded by Jim Clark based on his work with geometry pipelines, specialized software or hardware that accelerates the display of three dimensional images. SGI was originally incorporated as a California corporation in November 1981, and reincorporated as a Delaware corporation in January 1990.

The first machines were designed to be connected to a DEC VAX computer as a terminal, handling only the actual display. After that, SGI began using Motorola 68000 microprocessors running the UNIX operating system to power the machine. Their height was reached with the SGI 3130, a complete UNIX workstation using the 68030 microprocessor with an attached Weitek (I think) math coprocessor.

The 3X30 was powerful enough to support a complete 3D animation and rendering package on its own without mainframe support. With large capacity hard drives (300MB X 2), streaming tape and 10baseT ethernet it could be the centerpiece of an animation operation.

With the introduction of the 4D series, SGI switched over to using the MIPS RISC microprocessors. These machines were correspondingly more powerful, able to address more memory and with powerful on board math capability. These machines made much of the SGI name as 3D graphics became more popular on television and film.

SGI expanded these machines up to the massive Onyx supercomputers, the size of refrigerators and capable of supporting up to 64 processors while managing up to three streams of high resolution, fully realized 3D graphics.

In 1992, SGI released the first 64-bit MIPS microprocessor, the R4000, which was one of the first 64-bit microprocessors along with Digital's Alpha chip.

Now that inexpensive PCs are beginning to catch up in terms of graphics performance, SGI is concentrating on its high performance server capabilities, offering servers for digital video and the

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Web. Many SGI graphics engineers have left to work at newer companies, driving the PC 3D graphics revolution. In response to these market changes, Silicon Graphics Inc. changed its corporate identity to SGI in an attempt to clarify their current market position as a more than simply a graphics company. The legal name of the company remains unchanged. SGI has evolved into a significant player in other fields such as high end web servers and high-performance computing.

In February 1996, SGI purchased Cray Research, and began to use marketing names such as "CrayLink" for (SGI developed) technology integrated into the SGI server line. SGI later sold part of the Cray product line to Tera Computer Company on March 31, 2000. SGI also distributed its remaining interest in MIPS Technologies, Inc. through a spin-off effective June 20, 2000. Another purchase was AliasWavefront, makers of the Maya 3D software package.

SGI has also been a big booster for the Linux operating system, supporting several projects (such as Samba) and providing some previously proprietary code (such as XFS) to the free software world.

The company has been drifting in recent years, since its high cost structure makes it tough to compete with cheaper alternatives. An attempt to introduce workstations running under Windows NT angered its true believer customers without generating significant interest among outsiders.

Those who use SGI computers tend to be fiercely loyal, but the companies that spend tens of thousands of dollars on them are rapidly losing patience. The porting of Maya to GNU/Linux and the Apple Macintosh is looking like a watershed in this development; there will soon be little reason to buy a \$40,000 SGI machine when a \$3,500 Macintosh would do.

Conventional wisdom holds that SGI's core market has traditionally been Hollywood special effects studios. In fact, SGI's largest markets in terms of dollars of revenue generated have always been government and defense applications, energy, and scientific and technical computing.

In recent years, SGI has continued to enhance its line of servers (some go so far as to call them supercomputers) based around the SN architecture. SN, for Scalable Node, is a technology developed by SGI in the mid-1990s. SN is an example of NUMA: non-uniform memory access. In an SN system, processors, memory, and a memory and bus controller are coupled together into an entity known as a node. A node is usually a single circuit board. Nodes are connected via a high-speed interconnect originally called CrayLink, since renamed NUMALink. The result is a system that has no internal bus whatsoever. Rather, access between processors, memory, and I/O devices is facilitated through a switched fabric of links and routers. SN systems scale along several axes at once: as CPU count increases, so does memory capacity, I/O capacity, and system bisection bandwidth.

The first SN system, known as SN-0, was released in 1996 as the Origin family. Based on the MIPS R10000 processor, the Origin 200 scaled from one to four processors, and the Origin 2000 scaled from two to 128 processors. Later enhancements to the Origin 2000 line enabled systems of as large as 512 processors.

The second generation system, originally called SN-1 but later redubbed SN-MIPS, was released in July, 2000, under the product name Origin 3000. The Origin 3000 scaled from four to 256 processors, with 512- and 1,024-processor configurations delivered by special order to some customers. A smaller, less scalable implementation of the technology followed later under the name Origin 300.

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In November, 2002, SGI announced their third-generation SN system, SN-2, under the name Origin 3900. The Origin 3900 quadrupled the per-square-foot processor density of the SN-MIPS system, from 32 processors per rack up to 128 processors per rack.

In January, 2003, SGI announced a variant of the SN-MIPS platform to be sold under the name Altix 3000. Known internally as SN-IA, the Altix 3000 used Intel Itanium 2 processors in place of the MIPS R1x000 processors in the SN-0, SN-MIPS, and SN-2 families. The Altix 3000 ran the Linux operating system. At the time it was released, the Altix 3000 was the world's most scalable Linux-based computer, supporting up to 64 processors in a single system node. Multiple nodes could be connected together with a distributed shared memory technology called Myrinet to form what SGI predictably termed "superclusters."

Silicon Graphics, Inc. (commonly initialised to SGI, historically sometimes referred to as Silicon Graphics Computer Systems or SGCS) is a company manufacturing high-performance computing solutions, including computer hardware and software. SGI was founded by Jim Clark and Abbey Silverstone in 1982, initially as a maker of 3D graphics display terminals. SGI's products, strategies and market positions have varied. Its initial products were based on the Geometry Engine that Clark and Marc Hannah had developed at Stanford University, and derived from Clark's broader background in computer graphics. The Geometry Engine was the first very-large-scale integration (VLSI) implementation of a geometry pipeline: specialized hardware that accelerated the "inner-loop" geometric computations needed to display three-dimensional images.

SGI was originally incorporated as a California corporation in November 1981, and reincorporated as a Delaware corporation in January 1990. On 8 May 2006, SGI filed for Chapter 11 bankruptcy protection from which it emerged on 17 October 2006.[5] SGI is headquartered in Sunnyvale, California.

History

Early years

Dr. James H. Clark left his position as an electrical engineering associate professor at Stanford University to found SGI in 1982 along with a group of seven graduate students and research staff from Stanford: Kurt Akeley, David J. Brown, Tom Davis, Rocky Rhodes, Marc Hannah, Herb Kuta, and Mark Grossman; Abbey Silverstone - a former manufacturing executive at Xerox; and a few others. The Mayfield Fund venture capital group supplied the initial funding.

Motorola 680x0-based systems

SGI's first generation products, starting with the IRIS 1000 (Integrated Raster Imaging System) series of high-performance graphics terminals, were based on the Motorola 68000 family of microprocessors. The later IRIS 2000 and 3000 models evolved into full UNIX workstations.

IRIS 1000 series

The first entries in the 1000 series (models 1000 and 1200, introduced in 1984) were graphics terminals, peripherals to be connected to a general-purpose computer such as a Digital Equipment Corporation VAX, to provide graphical raster display abilities. They used 8 MHz Motorola 68000 CPUs with 768KB of RAM and had no disk drives. They booted over the network (via an Excelan EXOS/101 ethernet card) from their controlling computer. They used the "PM1" CPU board, which was a variant of the Stanford University SUN board that was used in the SUN workstation and later the Sun-1 workstation from Sun Microsystems. The graphics system was composed of the GF1 Frame buffer,

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the UC3 "Update Controller", DC3 "Display Controller", and the BP2 bitplane. The 1000-series machines were designed around the Multibus standard.

Later 1000-series machines, the 1400 and 1500, ran at 10 MHz and had 1.5 MB of RAM. The 1400 had a 73 MB ST-506 disk drive, while the 1500 had a 474 MB SMD-based disk drive with a Xylogics 450 disk controller. They may have used the PM2 CPU and PM2M1 RAM board from the 2000 series. The usual monitor for the 1000 series ran at 30 Hz interlaced.

IRIS 2000 and 3000 series

SGI rapidly evolved its machines into workstations with its second product line — the IRIS 2000 series[when?]. SGI began using the UNIX System V operating system. There were five models in two product ranges, the 2000/2200/2300/2400/2500 range which used 68010 CPUs (the PM2 CPU module), and the later "Turbo" systems, the 2300T, 2400T and 2500T, which had 68020's (the IP2 CPU module). All used the Excelan EXOS/201 ethernet card, the same graphics hardware (GF2 Frame Buffer, UC4 Update Controller, DC4 Display Controller, BP3 Bitplane). Their main differences were the CPU, RAM, and Weitek Floating Point Accelerator boards, disk controllers and disk drives (both ST-506 and SMD were available). These could be upgraded, for example from a 2400 to a 2400T. The 2500 and 2500T had a larger chassis, a standard 6' 19" EIA rack with space at the bottom for two SMD disk drives weighing approximately 150 lb each[6]. The non-Turbo models used the Multibus for the CPU to communicate with the floating point accelerator, while the Turbos added a ribbon cable dedicated for this. 60 Hz monitors were used for the 2000 series.

The height of the machines using Motorola CPUs was reached with the IRIS 3000 series (somewhere around 1989, models 3010/3020/3030 and 3110/3115/3120/3130, the 30's both being full-size rack machines). They used the same graphics subsystem and ethernet as the 2000s, but could also use up to 12 "geometry engines", the first widespread use of hardware graphics accelerators. The standard monitor was a 19" 60 Hz non-interlaced unit with a tilt/swivel base; 19" 30 Hz interlaced and a 15" 60 Hz non-interlaced (with tilt/swivel base) were also available.

The IRIS 3130 and its smaller siblings were impressive for the time, being complete UNIX workstations. The 3130 was powerful enough to support a complete 3D animation and rendering package without mainframe support. With large capacity hard drives by standards of the day (two 300 MB drives), streaming tape and ethernet, it could be the centerpiece of an animation operation. The line was formally discontinued in 1989, with about 3500 systems shipped of all 2000 and 3000 models combined.

RISC era

With the introduction of the IRIS 4D series, SGI switched to using the MIPS Computer Systems RISC microprocessor architecture. These machines were more powerful, able to address more memory and came with powerful on-board math capability. They made much of the SGI name, as 3D graphics became more popular on television and film.

SGI produced a broad range of MIPS-based workstations and servers during the 1990s, running SGI's version of UNIX System V, now called IRIX. These included the massive Onyx visualization systems, the size of refrigerators and capable of supporting up to 64 processors while managing up to three streams of high resolution, fully realized 3D graphics.

In 1992, MIPS released the first 64-bit MIPS microprocessor, the R4000, which was the first commercially released 64-bit RISC microprocessor (a market soon joined by Digital's Alpha chip and others). IRIX 6.2 was the first fully 64-bit IRIX release, including 64-bit pointers.

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In August 2006, SGI announced the end of production for MIPS/IRIX systems. As of 29 December 2006, MIPS/IRIX products are no longer generally available from SGI.

IRIS GL and OpenGL

Until the second generation Onyx Reality Engine machines, SGI offered access to its high performance 3D graphics subsystems through a proprietary API known as 'IRIS Graphics Language' (IRIS GL). As more features were added over the years, IRIS GL became harder to maintain and cumbersome to use. In 1992, SGI decided to clean up and reform IRIS GL and made the bold move of allowing the resulting OpenGL API to be cheaply licensed by SGI's competitors, and set up an industry-wide consortium to maintain the OpenGL standard (the OpenGL Architecture Review Board).

This meant that for the first time, fast, efficient, cross-platform graphics programs could be written. To this day, OpenGL remains the only real-time 3D graphics standard to be portable across a variety of operating systems. Its main competitor ('Direct3D' from Microsoft) runs only on Microsoft Windows-based machines including the Sega Dreamcast and Xbox consoles.

ACE Consortium

SGI was part of the early-90s Advanced Computing Environment initiative with 20 others, including Compaq, Digital Equipment Corporation, MIPS Computer Systems, Groupe Bull, Siemens, NEC, NeTpower, Microsoft and Santa Cruz Operation to introduce workstations based on the MIPS architecture and able to run Windows NT and SCO UNIX. The group produced the Advanced RISC Computing or ARC specification. The consortium fell apart, apparently for political reasons.

Entertainment industry

A SGI computer with the FSN three-dimensional file system navigator appeared in the 1993 movie Jurassic Park. One hallmark of this scene is Lex's line, "This is a Unix system. I know this."

In the movie Twister, the heroes can be seen using a SGI laptop, however the unit seen was not an actual working computer but rather a fake laptop shell built around a SGI Corona LCD flatscreen display [8]. The 1995 film Congo, also features a SGI laptop being used by Dr. Ross (Laura Linney) to communicate via satellite to TraviCom HQ. An SGI monitor can be seen in the 2001 cyber thriller Swordfish while Stanley Jobson (Hugh Jackman) compiles a hydra computer worm. Other on-screen credit includes Disclosure (Michael Douglas and Demi Moore) and Lost in Space (William Hurt).

Once inexpensive PCs began to have graphics performance close to the more expensive specialized graphical workstations (which were SGI's core business), SGI concentrated on its high performance server capabilities, offering servers for digital video and the Web. Many SGI graphics engineers have left to work at other computer graphics companies like ATI and NVIDIA, contributing to the PC 3D graphics revolution.

Name and logo changes

In response to these market changes, Silicon Graphics Inc. changed its corporate identity to "SGI" in an attempt to clarify their current market position as more than a graphics company, although its legal name was unchanged.

At the same time in 1999, SGI announced a new logo — simply the letters "sgi" in a stylized lowercase font and a proprietary typeface called "SGI", created by branding and design consulting firm Landor Associates, in collaboration with designer Joe Stitzlein. The new logo drew criticism for

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wasting the professional goodwill associated with the previous box-outline logo (known inside of the company as "The Bug"). SGI later re-adopted the cube logo, and now uses both logos.

Acquisition of Alias, Wavefront, Cray and Intergraph

In 1995, SGI purchased Alias Research and Wavefront Technologies and merged the companies into Alias|Wavefront, now known as Alias Systems Corporation. Later, in June 2004, SGI sold Alias to the private equity investment firm Accel-KKR for \$57.1 million. On October 4, 2005, Autodesk, Inc. (NASDAQ: ADSK) announced that it signed a definitive agreement to acquire Alias for \$182 million in cash.

In February 1996, SGI purchased the well-known supercomputer manufacturer Cray Research for \$740 million [9], and began to use marketing names such as "CrayLink" for (SGI-developed) technology integrated into the SGI server line. Three months later, it sold the SPARC/Solaris part of the Cray business to Sun Microsystems for an undisclosed amount (widely believed to be \$50 million). Many of the Cray T3E engineers designed and developed the SGI Altix and NUMalink technology. SGI sold the Cray brand and product lines to Tera Computer Company on March 31, 2000 for \$35 million plus one million shares[1]. SGI also distributed its remaining interest in MIPS Technologies through a spin-off effective June 20, 2000.

In September 2000, SGI acquired the Zx10 series of Windows workstations and servers from Intergraph Computer Systems. These models were rebadged as SGI systems, but discontinued in June 2001.

Late 1990s and recent developments

Another attempt by SGI in the late 1990s to introduce its own family of Intel-based workstations running Windows NT (see also SGI Visual Workstation) proved to be a financial disaster, and shook customer confidence in SGI's commitment to its own MIPS-based line.

SGI has also been a big booster of free software, supporting several projects (such as Linux and Samba) and providing some previously proprietary code (such as XFS) to the free software world.

Switch to Itanium

In 1998, SGI announced that future generations of its machines would be based not on their own MIPS processors, but the new "super-chip" from Intel, the Itanium. Funding for its own high-end processors was constrained, and it was planned that the R10000 would be the last MIPS mainstream processor. MIPS would focus entirely on the embedded market, where it was having some success, and SGI would no longer have to fund development of a CPU that, since the failure of ARC, found use only in their own machines.

But this plan quickly went awry. As early as 1999 it was clear the Itanium was going to be delivered very late, and then that it would have nowhere near the performance originally expected. As the production delays increased, MIPS's existing R10000-based machines grew increasingly uncompetitive. Eventually it was forced to introduce faster MIPS processors, the R12000, R14000 and R16000, which were used in a series of models from 2002 until 2006.

SGI's first Itanium-based system was the short-lived SGI 750 workstation, launched in 2001. SGI's MIPS-based systems were not to be superseded until the launch of the Itanium 2-based Altix servers and Prism workstations some time later. Unlike the MIPS systems, these models used GNU/Linux (SuSE Linux Enterprise Server with SGI enhancements) as their operating system instead of IRIX.

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SGI uses Transitive Corporation's QuickTransit software to allow their old MIPS/IRIX applications to run (in emulation) on the new Itanium/Linux platform.

In the server space the Itanium 2-based Altix eventually replaced the MIPS-based Origin product line. In the workstation space, the switch to Itanium was not completed before SGI exited this market.

The Altix was the most powerful computer in the world in 2006, if a "computer" is defined as a collection of hardware running under a single instance of an operating system. The Altix had 512 Itanium processors running under a single instance of Linux. A cluster of 20 machines was then the eighth fastest supercomputer. All faster supercomputers were clusters, but none have as many FLOPS per machine. However, more recent supercomputers are massive clusters of machines that are individually less capable. SGI acknowledged this and in 2007 moved away from the "massive NUMA" model to efficient clusters.

Switch to Xeon

Although SGI continues to market Itanium-based machines, its more recent machines are based on the Intel Xeon processor. The first Altix XE systems were relatively low-end machines, but by December 2006 the XE systems were more capable than the Itanium machines by some measures (e.g., power consumption in FLOP/W, density in FLOP/m³, cost/FLOP). The XE1200 and XE1300 servers use a cluster architecture. This is a departure from the pure NUMA architectures of the earlier Itanium and MIPS servers.

in June 2007, SGI announced the Altix ICE 8200.[10] This is a blade-based Xeon system with up to 512 Xeon cores per rack. An Altix ICE 8200 installed at New Mexico Computing Applications Center (with 14336 processors) ranked at number 3 on the TOP500 list of November 2007.

Decline

The addition of 3D graphic capabilities to PCs, and the ability of clusters of Linux- and BSD-based PCs to take on many of the tasks of larger SGI servers has eaten into SGI's core markets. The porting of Maya to Linux, Mac OS X and Microsoft Windows has further eroded the low end of SGI's product line.

And, SGI's premature announcement of its migration from MIPS to Itanium and its abortive ventures into IA-32 architecture systems (the Visual Workstation line, the ex-Intergraph Zx10 range and the SGI 1000-series Linux servers) damaged SGI's credibility in the market.

In November 2005, SGI announced that it had been delisted from the New York Stock Exchange because its common stock had fallen below the minimum share price for listing on the exchange. SGI's market capitalization dwindled from a peak of over seven billion dollars in 1995 to just \$120 million at the time of delisting. In February 2006, SGI noted that it could run out of cash by the end of the year.

Re-emergence

In mid-2005, SGI hired Alix Partners to advise it on returning to profitability and received a new line of credit. SGI announced it was postponing its scheduled annual December stockholders meeting until March 2006. It proposed a reverse stock split to deal with the de-listing from the New York Stock Exchange.

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In January 2006, SGI hired Dennis McKenna as its new CEO and chairman of the board of directors. Mr McKenna succeeded Robert Bishop, who remained vice chairman of the board of directors.

On 8 May 2006, SGI announced that it had filed for Chapter 11 bankruptcy protection for itself and US subsidiaries as part of a plan to reduce debt by \$250 million. Two days later, the US Bankruptcy Court approved its first day motions and its use of a \$70 million financing facility provided by a group of its bondholders. Foreign subsidiaries were unaffected.

In a press release on 6 September 2006, SGI announced the end of development for the MIPS/IRIX line and the IRIX operating system. Production would end on 29 December and the last orders would be fulfilled by March 2007. Support for these products would end after December 2013.

SGI emerged from bankruptcy protection on 17 October, 2006. Its stock symbol SGID.pk was canceled, and its stock is now traded under the symbol SGIC. This new stock was distributed to the company's creditors, and the SGID common stockholders were left with worthless shares.

SGI also moved its headquarters from Mountain View to Sunnyvale at the time of this reorganization. The previous North Shoreline headquarters is now occupied by the Computer History Museum, whereas the Amphitheater Parkway headquarters is occupied by Google. Both of these previous locations are in Mountain View and were award winning designs by Studios Architecture.

In April 2008, SGI re-entered the visualization market with the SGI Virtu range of visualization servers and workstations. These are re-badged systems from BOXX Technologies, based on Intel Xeon or AMD Opteron processors and Nvidia Quadro graphics chipsets, running Red Hat Enterprise Linux, SUSE Linux Enterprise Server or Windows Compute Cluster Server.

NASDAQ delisting

In December 2008, SGI received delisting notification from NASDAQ as the market value had been below the minimum \$35 million requirement. Further, as SGI stockholders' equity is below \$2.5 million and net income from continuing operations is below \$500,000, SGI does not meet the alternative NASDAQ requirement.

User base and core market

Conventional wisdom holds that SGI's core market has traditionally been Hollywood visual effects studios. In fact, SGI's largest revenue has always been generated by government and defense applications, energy, and scientific and technical computing. The rise of cheap yet powerful commodity workstations running Linux, Windows and Mac OS X, and the availability of diverse professional software for them, effectively pushed SGI out of the visual effects industry in all but the most niche markets, as studios have adopted the newer, cheaper technology. There are some tasks in modeling, animation, visual effects creation, video compositing, post-processing, broadcasting, and other areas related to computer graphics where a Silicon Graphics Altix server or Tezro workstation may outshine the x86 competitor.[citation needed]

High-end server market

In recent years, SGI has continued to enhance its line of servers (including some supercomputers) based on the SN architecture. SN, for Scalable Node, is a technology developed by SGI in the mid-1990s, that uses cache-coherent non-uniform memory access (cc-NUMA). In an SN system, processors, memory, and a bus- and memory-controller are coupled together into an entity called a node, usually on a single circuit board. Nodes are connected by a high-speed interconnect called

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NUMALink (originally branded CrayLink). There is no internal bus, and instead access between processors, memory, and I/O devices is done through a switched fabric of links and routers.

Thanks to the cache-coherence of the distributed shared memory, SN systems scale along several axes at once: as CPU count increases, so does memory capacity, I/O capacity, and system bisection bandwidth. This allows the combined memory of all the nodes to be accessed under a single OS image using standard shared-memory synchronization methods. This makes an SN system far easier to program and able to achieve higher sustained-to-peak performance than non-cache-coherent systems like conventional clusters or massively parallel computers which require applications code to be written (or re-written) to do explicit message-passing communication between their nodes.

The first SN system, known as SN-0, was released in 1996 under the product name Origin 2000. Based on the MIPS R10000 processor, it scaled from 2 to 128 processors and a smaller version, the Origin 200 (SN-00), scaled from 1 to 4. Later enhancements enabled systems of as large as 512 processors.

The second generation system, originally called SN-1 but later SN-MIPS, was released in July 2000, as Origin 3000. It scaled from 4 to 512 processors, and 1,024-processor configurations were delivered by special order to some customers. A smaller, less scalable implementation followed, called Origin 300.

In November 2002, SGI announced a repackaging of its SN system, under the name Origin 3900. It quadrupled the processor area density of the SN-MIPS system, from 32 up to 128 processors per rack while moving to a "fat tree" interconnect topology.

In January 2003, SGI announced a variant of the SN platform called the Altix 3000 (internally called SN-IA). It used Intel Itanium 2 processors and ran the Linux operating system kernel. At the time it was released, it was the world's most scalable Linux-based computer, supporting up to 64 processors in a single system node[19]. Nodes could be connected using the same NUMALink technology to form what SGI predictably termed "superclusters".

In February 2004, SGI announced general support for 128 processor nodes to be followed by 256 and 512 processor versions that year. In April 2004, SGI announced the selling of Alias for approximately \$57 million.

In October 2004, SGI built the supercomputer Columbia for the NASA Ames Research Center, which broke the world record for computer speed. It was a cluster of 20 Altix supercomputers each with 512 Intel Itanium 2 processors running Linux, and achieved sustained speed of 42.7 trillion floating-point operations per second (teraflops), easily topping Japan's famed Earth Simulator, of 35.86 teraflops. But about a week later IBM's upgraded Blue Gene/L clocked in at 70.7 teraflops. As of November 2005, Columbia ranked No. 4, behind Blue Gene/L (now achieving 280.6 teraflops), a smaller Blue Gene, and ASC Purple, all built by IBM.

In July 2006, SGI announced an SGI Altix 4700 system with 1,024 processors and 4 TB of memory running a single Linux system image.