SiliconGraphics
Computer Systems

Onyx2™

Scalable Visualization Supercomputers

Product Guide

Visualization and Supercomputing for Champions in One World-Class Machine

The Onyx2 Legend

To build the world's most powerful visualization engine, we combined the ultimate in supercomputing and visualization technologies, then designed a way to simultaneously process 3D graphics, imaging, and video data in real time. We achieved our goals. This enables you to tackle the world's most demanding visual computing challenges. So you can achieve your goals.

Whether you are concerned with science, art, engineering, or research, we know you want to deliver your best. No compromises. That is why you want the planet's most responsive, reliable tool for accessing the applications, images, and information you want, when you want them. Instantly. Resourcefully. Perfectly.

That is why Silicon Graphics builds Onyx2.

The Onyx2 Scalability

Power and wisdom through visualization. Leadership and innovation through the richest, deepest feature set in the industry. Based on an acclaimed architecture, Onyx2 will impress you with its groundbreaking performance and speed, its record-setting bandwidth, and its robust parallel compute technology. Configurable modules boast scalable system bandwidth and low-latency memory access while supporting a familiar programming environment. This is the right technical computing approach for any organization planning to extend its leadership into the next century.

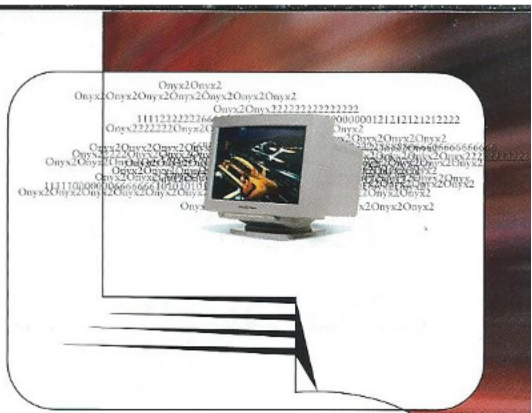
The Onyx2 Millennium

Attain the interactive, dynamic rendering that visionaries desire. Stimulate creativity and profitability through unique tools such as clip-mapping, texture paging, volume rendering, anti-aliased full-frame HDTV display, and multichannel, multioutput immersion support. Tap into numerous software and hardware products that harness the power of Onyx2 and today's high-performance MIPS® RISC processors, industry-proven Geometry Engine® technology, and exceptional development tools. Whether you want to expand your perception via hypersonic visualization or

Onyx2
InfiniteReality® Multirack System

Supports up to 64 R10000® processors and up to eight visualization subsystems in two to eight racks. Each InfiniteReality subsystem can support one, two, or four Raster Managers and up to 320MB frame buffer.

- 256MB to 128GB system RAM
- Up to 400GB internal disk storage
- RealityMonster™ multisubsystem rendering mode provides up to 80 million polygons per second, eight sample anti-aliasing, 5.3 gigapixels per second fill rate, and 512MB physical texture memory for grand-challenge applications
- Integrated audio and standard CD-ROM
- Up to 72 I/O slots (optional PCI)
- 24-inch SuperWide™, ultrahigh-resolution 1920x1200 monitor



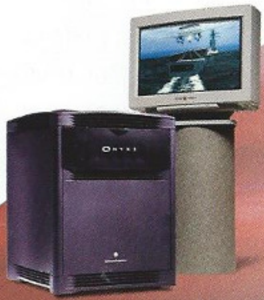
make your first move into multiprocessor supercomputing, Onyx2 fits your needs and budget.

The Affordable Onyx2 Supercomputer

That's right: affordable supercomputing to empower budget-conscious commercial and academic teams. Scale your graphics, compute power, memory, storage, and networking technology to suit your application needs. Just as Onyx2 offers unmatched I/O bandwidth, it adds unmatched video I/O scalability for digital media excellence.

Likewise, distributed applications can rely on the Onyx2 architecture, which meets all the demands of complex, collaborative virtual environments.

Onyx2. Legendary performance. Astounding realism. Exceptional in every way. Just like you.



Onyx2 Reality™

For a great price you get up to four MIPS R10000 processors, 64MB of texture memory, up to 45GB of internal disk storage, one graphics subsystem with one or two Raster Managers.

- Up to 80MB frame buffer
- 256MB to 8GB system RAM
- 5.5 million polygons per second
- Four-sample anti-aliasing
- Integrated audio and standard CD-ROM
- Four I/O slots (optional PCI)
- 20-inch monitor

Onyx2 InfiniteReality Deskside System

Supports one visualization subsystem with one or two Raster Managers and 64MB texture memory. Includes up to four R10000 processors with 4MB secondary cache.

- 80MB or 160MB frame buffer
- 256MB to 8GB system RAM
- Up to 45GB internal disk storage
- 11 million polygons per second
- Eight-sample anti-aliasing
- Integrated audio and standard CD-ROM
- Four I/O slots (optional PCI)
- 24-inch SuperWide, ultrahigh-resolution 1920x1200 monitor

Onyx2 InfiniteReality Single-Rack System

Supports up to eight R10000 processors and up to two visualization subsystems. One subsystem supports one, two, or four Raster Managers and up to 320MB frame buffer; the other supports one or two Raster Managers and up to 160MB frame buffer.

- 256MB to 16GB system RAM
- Up to 100GB internal disk storage
- 11 million polygons per second
- Eight-sample anti-aliasing
- Integrated audio and standard CD-ROM
- Nine I/O slots (optional PCI)
- 24-inch SuperWide, ultrahigh-resolution 1920x1200 monitor

Onyx2 appears in compact deskside and rack configurations. A rack system can be configured with multiple graphics subsystems driving one rendered display for scalable graphics performance—or, as the Onyx2 GroupStation, can support up to eight operators, each working with large data sets on individual displays while sharing the system's memory and bandwidth.

Onyx2
in Your World

Manufacturing, Architecture, Engineering, and Construction

"Is it just me, or are production cycles getting shorter and customers more discerning? Either way, we're pushing the envelope in conceptual design, engineering implementation, assembly review, and ergonomics studies. All on Onyx2. We build complex digital prototypes in a sliver of the time it takes to build expensive physical models, saving cash and accelerating time-to-market. You can bet that my competitors are choking.

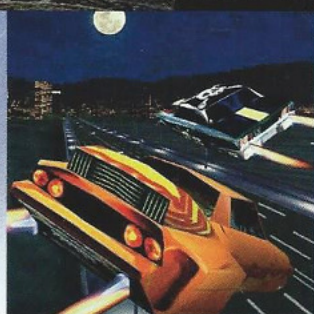
"A pal of mine works in plant design, engineering, and construction. I tell him that high-fidelity, real-time walkthrough is a planning tool that wins contracts. 'Bud,' I tell him, 'Visualize every part of a complex design. From concept to concrete!' Engineering, procurement, and construction teams avoid big mistakes and build consensus *before* construction. Walkthroughs help everyone—managers, engineers, shareholders, tenants. The result: satisfied customers.

"Here's how I see it: design means inventing entirely new forms. Engineering means understanding how things work. Digital prototyping means never having to say you're sorry."

"Our customers can't tolerate a dropped frame here or there. It has to be rock solid and at 60Hz. We feel Onyx2 is the only way to do that."

Bruce Caridi,
Vice President of Sales and Marketing, Paradigm Systems

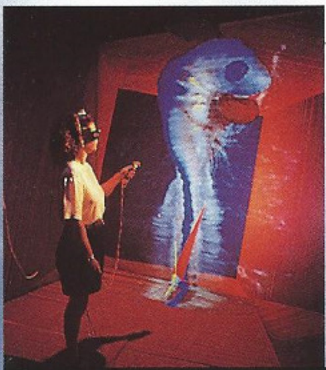
Entertainment



"At that wrap party, Mr. Media Critic droned on about how computer tech moves too quickly for anyone to make art with it. I said I could make art with *mud*, then moved on to the baked Brie. Of course tech moves. The *true* challenge is to bridge the gap between creative chaos and corporate bureaucracy. Well, I found the way. My creative people get an incredible leap in I/O and CPU power, more video output channels, hot graphics at HD rez *and* film rez, all on a stable box running scads of apps. And my finance people love the investment protection of the scalability. That's right, I'm talking about Onyx2.

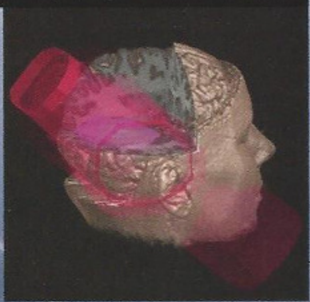
"For broadcast projects, we do mind-blowing effects, virtual sets, virtual actors, and the sexiest, fastest news graphics. Our virtual sets breeze along with only one- or two-frame delays while the other guys go out with five- to ten-frame delays. *Their* viewers channel-surf. Our client's viewers stay tuned in, even *after* sweeps week. What? Post-production? Sure, life is too short to waste time waiting for new image sequences. Our Onyx2 provides the fastest throughput, which means we bill for more creativity and more projects completed in less time. We're also loving the new performance animation and digital theme park jobs. In LBE [location-based entertainment], running a multiple-seat experience from a single Onyx2 means we drive the cost-per-seat down considerably. We create gorgeous interactive fantasies. That texture memory and faster pixel fill means incredibly realistic motion and radical characters.

"Darlin', we take fun seriously. And we *never* separate 'art' from 'entertainment.'"



"Every project is a race against time. The sooner we understand a problem and solve it, the greater the impact, and we do strive to make an impact. In one lab we're visualizing correlations between therapeutic targets and disease. In another lab, we're searching for synthetic compounds. Our geophysicists also use ultrarealistic visualization; they interact with subsurface data to better understand geologic makeup and improve seismic interpretation. Our university hospital affiliates help diagnose disease through virtual endoscopy and study methods for training the surgeons of tomorrow. People are our most valuable resource, and we give our people the tools to solve leading-edge, large-scale problems. Our multidisciplinary approach requires Onyx2, which offers the broadest range of applications and the speed and power we need to stand out.

Science, Research, and Education



"Do you realize that the ivory tower of academia has become entrepreneurial? We're living in a time of superstar scholars, reduced tenure rights, and increased demand for interdisciplinary abilities. Grant-writing is *de rigeur*. The best grants cover the kind of research problems that only Onyx2 can handle. Thankfully, its scalability means any university can afford to provide its students and faculty with visual supercomputing capabilities. More of us are empowered to do what we live for: gaining greater understanding of large, complex data, making insight a daily occurrence.

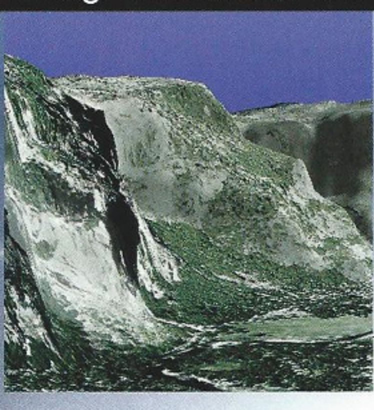
"Why, yes, I strive to make the world a better place. Isn't that why we're here?"

"At a constant 60Hz, the Silicon Graphics image generator produced twice the display resolution of any system we've tested to date."

Steve Stephens,
Air Force Simulation Systems Expert, U.S. Air Force Research Laboratory

The Colonel leaned back in his chair and spoke freely. "Even in times of peace and prosperity, those of us who serve the public must continue to stay on alert. What better way to prepare than with visualization and simulation? We're implementing new methods of preparation with mission planning and battlefield visualization. We generate 60Hz, photo-real, high-resolution, out-the-window, and sensor imagery. Free from visual anomalies. With Onyx2 we exceed the requirements for training, engineering, and C4I applications. We also concurrently process imagery, video, 3D terrain, and geospatial data, so we are advancing in defense imaging and intelligence.

Modeling, Simulation, and Imaging



"Let's be frank about flight simulators: the better they get, the more we want. High resolution is critical for simulating real-world conditions. Today we provide our flight-sim pilots with twice the display resolution of any system we've tested in a networked, real-time, distributed, full-mission training environment. This is the first time a commercial-off-the-shelf product has surpassed traditional image generators in display resolution. So we need an organization like Silicon Graphics to support our world-class R&D. Its people and its systems help us push the edge.

"It's all about government and industry working together to move modeling and simulation into the 21st century."

Onyx2

for Supreme Performance and Flexibility

A Catalyst for Discovery

It's one thing to fly faster than other visualization workstations. It's another to offer wholly unique capabilities. Onyx2 does both. It is the only advanced visualization platform that doubles as a tightly coupled supercomputer—one equipped with **superb media tools**, such as digital audio for up to 10 channels of quality sound, video reference input, **real-time graphics-to-video** option, and **digital video** option for routing multiple video and audio streams. Broadcast-quality video maps directly onto any 3D surface while image processing functions enhance the video stream in real time.

Onyx2 operators consistently leverage a whole that is indeed greater than the sum of its parts, tapping into the richest, deepest feature set anywhere:

- Interactive imaging of unbounded 3D volumes (such as those in grand-challenge medical and scientific visualization, and seismic interpretations) and unbounded 2D texture maps (vital for training and urban simulation, defense imaging, geographic information systems [GIS], design review, and interactive entertainment)
- Data fusion: the ability to visualize scenes comprising 2D imagery, 3D polygons, and video with little or no performance penalty (crucial in broadcast and video, scientific visualization, 3D GIS, and so many other application areas)
- Real-time support across application segments: pilot/driver/soldier/fighter training, and also for surgical training, molecular modeling, performance animation, and engineering simulation
- Integral support for virtual reality, real-time, 6DOF interaction *and* sensory immersion, including support for most display resolutions—the result of the Onyx2 system's out-of-the-box PCI compatibility with advanced interfaces, including force-feedback, motion capture, telerobotics, stereoscopic display systems, and Visionarium/Reality Center facilities

Bigger Is Better, and You Can Start Small

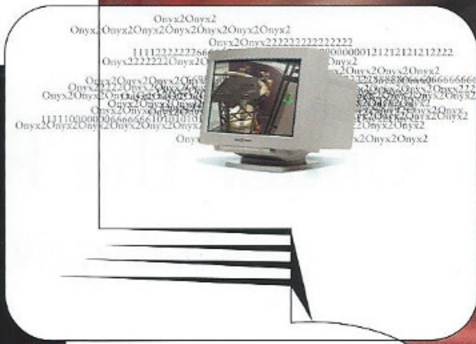
By using high-bandwidth crossbar interconnects, the revolutionary Onyx2 CC-NUMA (Cache Coherent Non-Uniform Memory Access) architecture eliminates the bottleneck associated with bus-based designs. On Onyx2 rack systems, CC-NUMA enables you to integrate additional modules any time you need more processing power, main memory, I/O connectivity, graphics, or system bandwidth. The high system bandwidth and low memory latency unique to CC-NUMA make it possible to combine multiple InfiniteReality subsystems into a single rendered display. This unprecedented capability delivers increased frame update rates for complex geometries and increased texture memory for massive volume rendering.

The immersive Silicon Graphics Visionarium enables collaborative decision-making and stunning, larger-than-life graphics and digital media.

Supreme Flexibility for Peak ROI

An idle system earns no return on investment, so Silicon Graphics designed Onyx2 to offer varied operating modes to keep it rocking around the clock. Employ Onyx2 as an interactive visualization station by day and a batch compute processing machine by night. Rack configurations offer several additional modes: multiuser GroupStation (driving multiple independent seats), multi-display driver (for stereoscopic immersion rooms, VR walls, vehicle simulators, and so on), and multisubsystem rendering called MonsterMode, in which multiple InfiniteReality subsystems focus on a single rendering task. You move from one mode to another by flipping a software switch; no hardware reconfiguration required.

Onyx2 GroupStation, the ultimate work group resource.



Onyx2 GroupStation: A New Pathway to Increased Productivity

Here is the ideal solution for teams that need to interact with data sets that exceed the memory capacity, disk storage, and processing capabilities of desktop workstations. An Onyx2 GroupStation can be configured for up to eight operators to work with large models while sharing memory and bandwidth on the same machine. Faster application performance, massive local disk space, and unparalleled compute power make Onyx2 GroupStation the ultimate work group resource.

Only Onyx2 drives advanced interfaces and stereoscopic displays right out of the box at true real-time rates.

Under the Hood of Onyx2:
Distinctive Technology

Drawing on a decade's experience of designing best-of-class multiprocessing supercomputers, we created an awe-inspiring implementation of CC-NUMA architecture. This tightly coupled architecture with automatic scaling of system and graphics bandwidth is central to the Onyx2 system's breakthrough visual performance and feature set. It's why Onyx2 system-based simulators deliver the lowest transport latency *plus* the unique ability to handle continuous, real-time fly-overs of arbitrarily large, geospecific terrain (up to and including the entire globe). It's why Onyx2 supports preview at full film resolution. And it's why Onyx2 supports interactive, immersive visualization of "unbounded" volumes (the *entire* Visible Human) and full-product digital prototyping (entire cars, airplanes, factories). Thanks to the monstrous bandwidth unique to CC-NUMA, you can engage several InfiniteReality subsystems simultaneously, focusing incredible power on solving a single visual problem.

The heart of CC-NUMA is the crossbar interconnect that moves data from CPUs and memory to every other part of the system: I/O, graphics, and other node boards. Each interconnect consists of eight bidirectional links. This means even the entry-level Onyx2 boasts 6.4GB per second of bandwidth—more than five times that of the largest Onyx® system of the past.

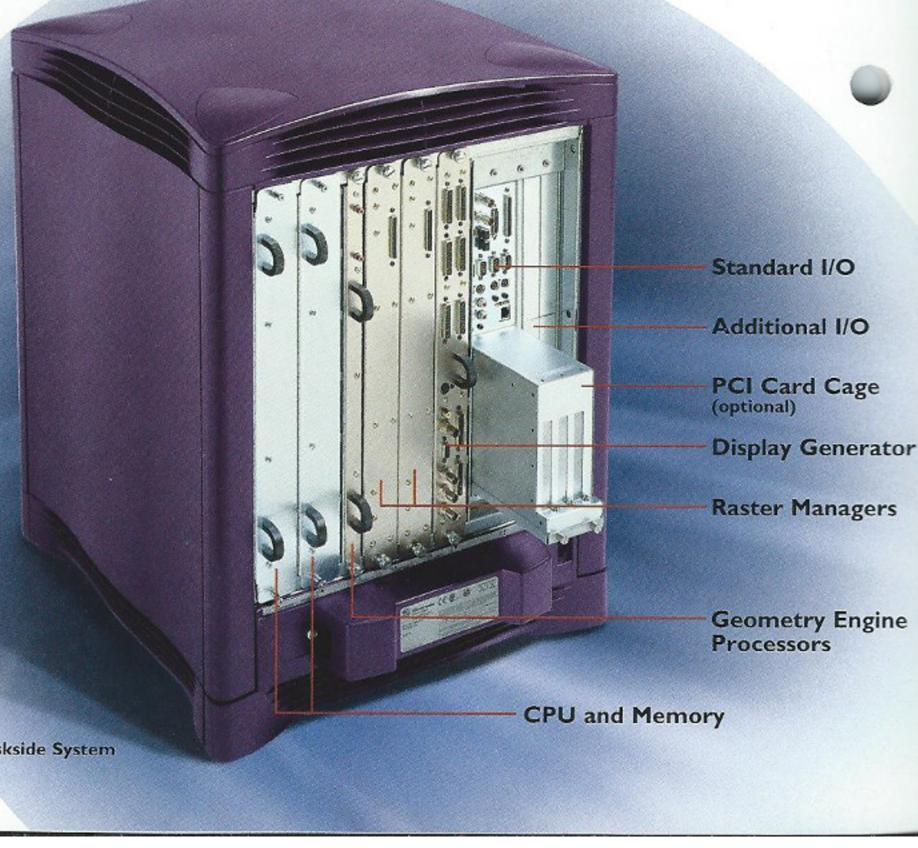
Each processor and every megabyte of memory are seamlessly interconnected to form a single machine image. Adding CPUs and memory increases bandwidth of the entire system. Adding visualization subsystems increases total host-to-graphics throughput.

Bandwidth no longer means bottleneck. Scalability rules.

High-Performance Connectivity: Seamless Integration with Your World

Onyx2 visualization supercomputers feature versatile networking options including industry-standard **Ethernet**, **HIPPI**, and **FDDI interfaces**. Fibre Channel and Asynchronous Transfer Mode connections take network capabilities to a new level of communications performance. With unrivaled system bandwidth, I/O devices in Onyx2 systems operate at peak performance, avoiding bandwidth contentions among graphics, video, storage, and other I/O.

The optional peripheral component interconnect (PCI) local bus gives Onyx2 systems access to a wide range of standard peripherals. The PCI bus supports 32-bit and 64-bit PCI boards with a peak bandwidth of 264MB per second. For applications requiring VME, an optional XIO VME adapter is available, with an easy-to-program interface for system integrators.

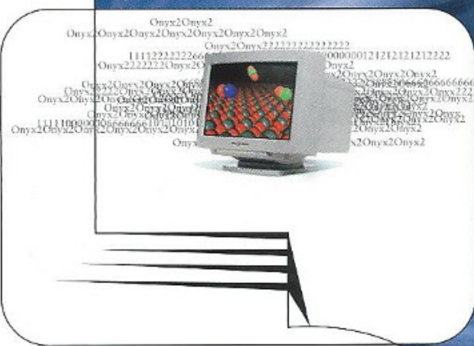


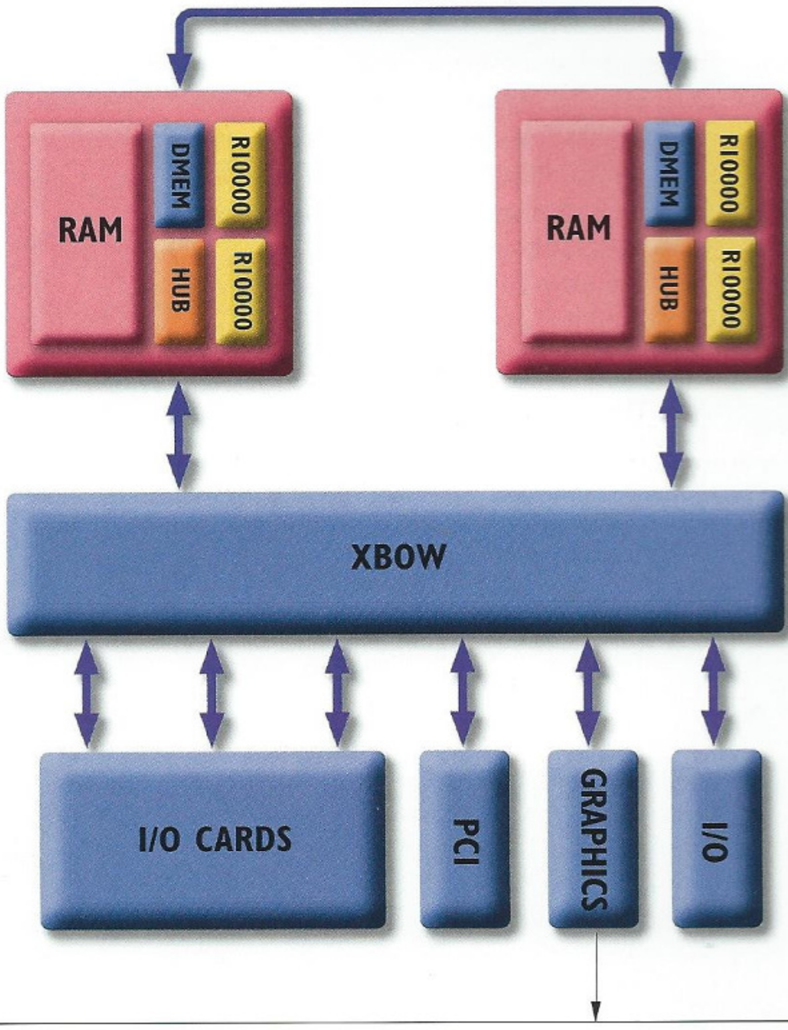
Onyx2 InfiniteReality Deskside System

MIPS R10000: Extraordinary Horsepower

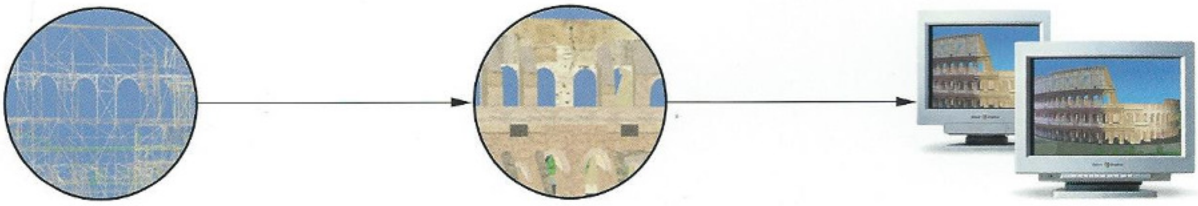
The 64-bit MIPS R10000 processor is the engine that drives the blazing compute performance of Onyx2. This superscalar RISC dynamo is the same processor used in the industry-leading Origin™ line. Processing power is not an option with Onyx2. It's the standard.

- **High clock rate accelerates every system function**
- **Four-way superscalar architecture, dynamic out-of-order instruction issue, and speculative execution maximize utilization of processing units**
- **Large nonblocking cache keeps essential data in fast memory**





The high-speed bidirectional interconnects in a four-processor deskside Onyx2. Each node board communicates with other parts of the system via turbo-speed interconnects operating at 1.6GB per second, full duplex. That's 800MB per second in each direction.



High-performance **Geometry Engine (GE)** processors perform lighting calculations and geometric transformations such as translation, rotation, and scaling. Geometry Engine processors also execute image processing functions such as convolution and histogram equalization, representing a more effective approach than with CPUs.

Raster Managers (RMs) scan-convert data from Geometry Engine processors into digital images. RMs perform pixel operations including z-buffer testing, color and transparency blending, texture mapping, and multisample anti-aliasing at real-time rates.

The **Display Generator (DG)** converts digital data from the RMs into analog video signals for display. A two-channel DG provides one high-resolution analog output and a second high-resolution analog or NTSC/PAL output. An optional eight-channel DG provides up to eight distinct analog outputs. Multiple channels are used to drive visual trainers, stereo devices, and other advanced interfaces.

Industry-Standard

Power Tools for Developers

Great hardware is only part of the solution. Silicon Graphics provides a suite of application programming interfaces (APIs) to help you achieve the best performance with your hardware investment. The Onyx2 APIs were built on OpenGL®, *the* industry standard for graphics application development, pioneered by Silicon Graphics. Its APIs package OpenGL algorithms as higher-level calls, which are employed by programmers to shorten development time and reduce the lines of code to maintain.

OpenGL: The Industry's Foundation for High-Performance Graphics

Application programmers access Onyx2 graphics through the industry-standard OpenGL environment to develop 2D and 3D graphics applications. The OpenGL API helps developers quickly and easily create advanced, portable graphics applications. OpenGL fosters innovation by providing low-level access to the advanced rendering capabilities of Onyx2.

Building with OpenGL Optimizer™

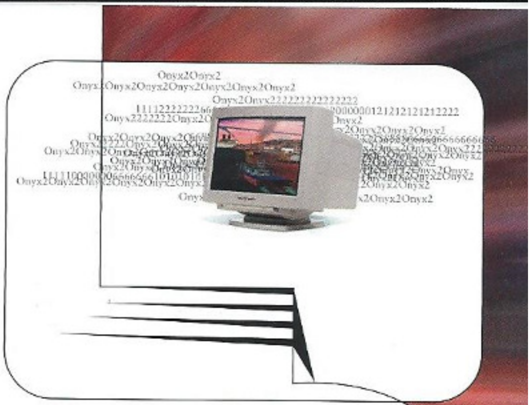
The award-winning OpenGL Optimizer development environment is a multiplatform toolkit providing higher-level constructs for interacting with extremely large geometric databases. Applications in computer-aided design, computer-aided manufacturing, computer-aided engineering, digital prototyping, and architecture, engineering, and construction (AEC) will achieve optimal graphics performance. The OpenGL Optimizer toolkit includes multiprocessing, occlusion culling, topological synthesis, and full support for all complex higher-order trimmed parametric curves and surfaces. These capabilities enable applications that provide efficient rendering performance while maintaining the underlying properties of the model. OpenGL Optimizer combined with Onyx2 revolutionizes complex surface evaluation with RealityMapping.

Real-Time 3D Rendering for High-Performance Interactive Graphics

IRIS Performer™ is the renowned 3D rendering toolkit for developers of real-time, multiprocessed, interactive graphics applications. IRIS Performer dramatically simplifies your development of complex applications in visual simulation, simulation-based design, virtual reality, interactive entertainment, broadcast video, and architectural walk-through. Your application can make automatic and optimal use of all available system features—including peak performance rendering, multiple CPUs, multiple graphics subsystems, filesystem and disk access, and real-time scheduling features. IRIS Performer provides efficient access to Onyx2 capabilities by automatically managing multiple levels-of-detail, paging of huge textures, and dynamic animated geometry.

Volume Imaging

Our new volume imaging API is a library of C++ classes that facilitate visualization of voxel-based data sets common in geoscience, medical, and scientific and engineering applications such as computation fluid dynamics and finite element analysis, as well as those implementing physics-based models for special effects such as smoke, fog, and liquid. Developers can more easily create applications to display and manipulate volumetric data



(with geometric data if desired). Its use of tetrahedral primitives is an innovative and powerful approach to volume imaging.

Powerful ImageVision Library® AE Tools

For manipulating, processing, and displaying images, Silicon Graphics offers ImageVision Library. ImageVision Library tools comprise a powerful development environment that provides more than 70 robust image operators to use multiple processors and unequaled hardware graphics acceleration. ImageVision Library includes great debugging tools, functions for color conversion, geometric transformation, filtering, edge detection, and graphics subsystem statistics, along with robust caching and data management functions.

Cellular IRIX™

Onyx2 systems use the state-of-the-art, 64-bit Cellular IRIX operating system from Silicon Graphics. Cellular IRIX is based on industry-standard UNIX® System V, Release 4 technology. Innovative software technology maintains a familiar, shared-memory programming environment and provides backward compatibility with existing applications, while new capabilities support extensive scalability and high-availability features, and XFS™.

REACT™ Real-Time Performance

The REACT extensions for Cellular IRIX deliver deterministic performance capabilities for real-time applications. REACT tools give users control over system overhead, process priority and processor allocation and scheduling; real-time disk access; and synchronization to external events.

Fahrenheit

Silicon Graphics, Inc., and Microsoft Corporation have formed a strategic alliance aimed at increasing the capabilities of visualization applications for a wide variety of customers. One goal is to develop ways to harness the power of Silicon Graphics API technology in the Windows NT® environment. Toward that end, the companies are collaborating on a project code named "Fahrenheit" to provide a common set of low-level and high-level APIs that integrate Silicon Graphics and Microsoft concepts for visualization and graphics for future versions of DirectX for Silicon Graphics and Windows® platforms. Until these technologies are delivered, Silicon Graphics and Microsoft are working together to support the development of graphics applications for professionals through the OpenGL API.

Onyx2

Technical Specifications

	Onyx2 Reality	Onyx2 InfiniteReality Deskside	Onyx2 InfiniteReality Single- or Multirack/ GroupStation	Onyx2 InfiniteReality Multirack with RealityMonster Software
				
GRAPHICS				
Polygons/sec	5.5M	11M	11M	80M
Pixel fill, smooth, Z	224M to 448M	224M to 448M	224M to 896M	5.3 billion
Pixel fill, textured, AA	67M to 135M	194M to 388M	194M to 776M	4.7 billion
Anti-aliased vectors/sec	3.7M	7.4M	7.4M	60 billion
Trilinear interpolations/sec	100M to 200M	200M to 400M	200M to 800M	6.4 billion
Convolutions/sec (5x5)	30M	60M	60M	TBD
Voxels/sec	100M to 200M	200M to 400M	200M to 800M	4.8 billion
24-bit floating-point Z	yes	yes	yes	yes
Color	48-bit RGBA	48-bit RGBA	48-bit RGBA	48-bit RGBA
Overlay planes	16	16	16	16
Anti-aliasing multisampling	4x4	8x8	8x8	8x8
Max. bits/pixel	128 to 512	256 to 2048	256 to 2048	256 to 2048
Graphics pipelines	1	1	1 to 8	1 to 8
Geometry Engine processors/pipeline	2	4	4	4
Raster Managers/pipeline	1 to 2	1 to 2	1 to 4 and 1 to 2	1 to 4 and 1 to 2
Texture memory/pipeline	16 or 64MB	64MB	64MB	Up to 512MB combined texture memory capacity
Frame buffer size/pipeline	40 to 80MB	80 to 160MB	80 to 320MB	80 to 320MB
Display channels/pipeline	2 or 8	2 or 8	2 or 8	2 or 8
Display capability	VGA to HDTV	VGA to HDTV	VGA to HDTV	VGA to HDTV
Std. monitor size resolution	20" 1280x1024	24" 1920x1200	24" 1920x1200	24" 1920x1200
COMPUTER PLATFORM				
CPU	MIPS R10000	MIPS R10000	MIPS R10000	MIPS R10000
Quantity	1 to 4	1 to 4	2 to 64	2 to 64
Primary caches (ins./data)	32KB/32KB	32KB/32KB	32KB/32KB	32KB/32KB
Secondary cache	1 or 4MB	4MB	4MB	4MB
RAM memory	256MB to 8GB	256MB to 8GB	256MB to 128GB	256MB to 128GB
Disk storage (internal)	1 to 5 4.5GB or 9.1GB Ultra SCSI	1 to 5 4.5GB or 9.1GB Ultra SCSI or 10 3.5" Fibre Channel	1 to 11 4.5GB or 9.1GB Ultra SCSI or 10 3.5" Fibre Channel per rack	1 to 11 4.5GB or 9.1GB Ultra SCSI or 10 3.5" Fibre Channel per rack
Expansion slots	4 XIO-slots standard and 3-slot PCI optional	4 XIO-slots standard and 3-slot PCI optional	9* XIO-slots standard and 3-slot PCI optional per rack	9* XIO-slots standard and 3-slot PCI optional per rack
Dimensions	25.5" H, 23" D, 21" W	25.5" H, 23" D, 21" W	73" H, 40" D, 28" W per rack	73" H, 40" D, 28" W per rack
Weight (max. configuration)	215 lbs (98kg)	215 lbs (98kg)	800 lbs (364kg) per rack	800 lbs (364kg) per rack
Standard monitor weight	71.6 lbs (32.5kg)	90.2 lbs (41kg)	90.2 lbs (41kg)	90.2 lbs (41kg)
ELECTRICAL AND POWER				
Voltage	110 to 220 VAC	110 to 220 VAC	220 VAC single phase	220 VAC single phase
Frequency	50 to 60Hz	50 to 60Hz	50 to 60Hz	50 to 60MHz
Power	2,500 watts	2,500 watts	7,000 watts per rack	7,000 watts per rack
Heat dissipation	8,500BTU/hr	8,500BTU/hr	23,900BTU/hr per rack	23,900BTU/hr per rack
Electrical service type (110 VAC capabilities are configuration limited)	NEMA5-20, 110 VAC	NEMA5-20, 110 VAC	NEMA6-30 (1 per rack plus 1 per graphics module)	NEMA6-30 (1 per rack plus 1 per graphics module)
Noise	50 dBa	50 dBa	65 to 70 dBa	65 to 70 dBa

I/O, NETWORKING, AND COMMUNICATION

Standard data	40MB/sec Ultra SCSI, 10Base-T/100Base-TX Ethernet, 4 460 kbaud asynchronous serial ports, 2 keyboard ports, 2 mouse ports, parallel port
Standard audio	2.75 ohm BNC AES/EBU stereo in/out, 2 optical ADAT 8-channel in/out, RCA phono jack stereo line-level input output, 3.5mm stereo analog headphone output, mono microphone input jack
Optional data	XIO to PCI adapter (1 full-height, 2 double-height slots, 132MB to 264MB/sec), XIO to VME adapter (6U, 9U), FDDI single attach, FDDI dual attach, UTP FDDI, Token Ring, ISDN, high-speed synchronous serial, 100MB/sec Fibre Channel (2 port), 40MB/sec Ultra SCSI (4 port), 100Base-TX (4 port) combined with 460 kbaud asynchronous serial (6 ports), ATMOC3 (4 port) and ATMOC12, DIVO in/out (CCIR601, SMPTE 259)

REMOVABLE MEDIA

Standard	CD-ROM
Optional	DDS-2 (DAT), 8mm Exabyte, DLT tape

ENVIRONMENTAL (NON-OPERATING)

Temperature	-20° to +60° C
Humidity	10% to 95% non-condensing
Altitude	40,000 MSL

ENVIRONMENTAL (OPERATING)

Temperature	+5° to +35° C altitude 5,000 MSL, +5° to +30° C altitude 10,000 MSL
Humidity	10% to 90% non-condensing

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