

# Silicon Graphics® O2® Workstation Digital Media White Paper

## Abstract

An extremely high-bandwidth memory architecture, dedicated engines for image and video processing, and a suite of digital media tools give the SGI® O2 workstation unrivaled capabilities for digital media creation and manipulation, including video and audio capture, playback, editing, compression, and decompression. This paper addresses high-level O2 system features, underlying technology, software tools, and applications related to video, audio, and compression.

## Introduction

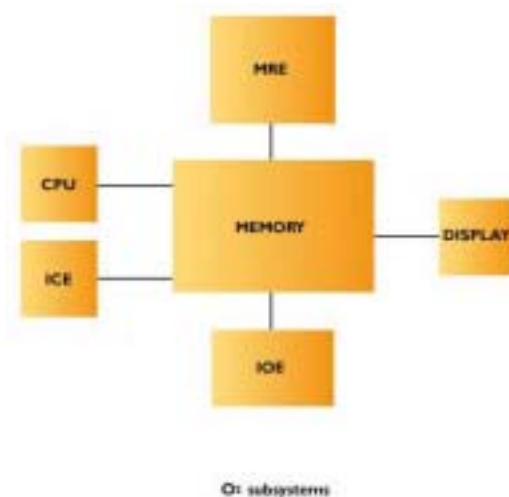
The O2 workstation from SGI makes advanced digital media technology accessible to every customer in any market. Fully integrating the O2 system's digital media functionality, which includes hardware-accelerated texture mapping and real-time motion-JPEG video compression and decompression, was a primary goal for the original product development team. As a result, the affordable O2 workstation is an ideal platform for enabling a diverse range of applications. Industry-standard memory and disk drives help keep costs low. Bundled Mac®/PC/Windows NT® connectivity software and standard high-speed network connections allow O2 systems to be easily incorporated into a mixed production environment.

O2 systems are in demand by game and video producers for cost-effective nonlinear video editing, compositing, 2D paint, and 3D modeling and animation systems. In the medical imaging market, O2 systems are sought for the visualization of ultrasound information in place of expensive proprietary hardware. In addition, O2 systems are being adopted by broadcast teams to produce on-air effects for weather graphics, sports annotation, and other real-time visuals.

In manufacturing and other industries, the O2 system's video collaboration tools help teams work together better through both the Internet and the intranet. Preparing video and audio clips for delivery through the World Wide Web or videotape becomes an easy desktop task with the rich suite of digital media tools bundled with the O2 system.

## O2 System Overview

The design of the O2 system is based on the integration of four core technology components in a Unified Memory Architecture (UMA): CPU, 3D graphics, image and video processing, and high-performance networking and I/O. The integrated design philosophy of the O2 system is based on the principle that all data, whether 3D geometry, 2D images, or video streams, have equal access to the same shared memory pool. High-performance synchronous DRAM (SDRAM) is used to accommodate these different memory-intensive data types with a system capacity up to 1GB. (O2 system support for memory configurations of greater than 256MB, totaling 1GB, is scheduled in late 1997.)



## CPU

The O2 system gets its compute power from the advanced MIPS® RISC family of R5000™ and R10000™ processors. These processors offer concurrent integer and floating-point operations for balanced performance with a broad range of customer applications. The R5000 processor also provides special instructions for calculating geometry setup, lighting, and transformation that improve the performance of the 3D graphics engine.

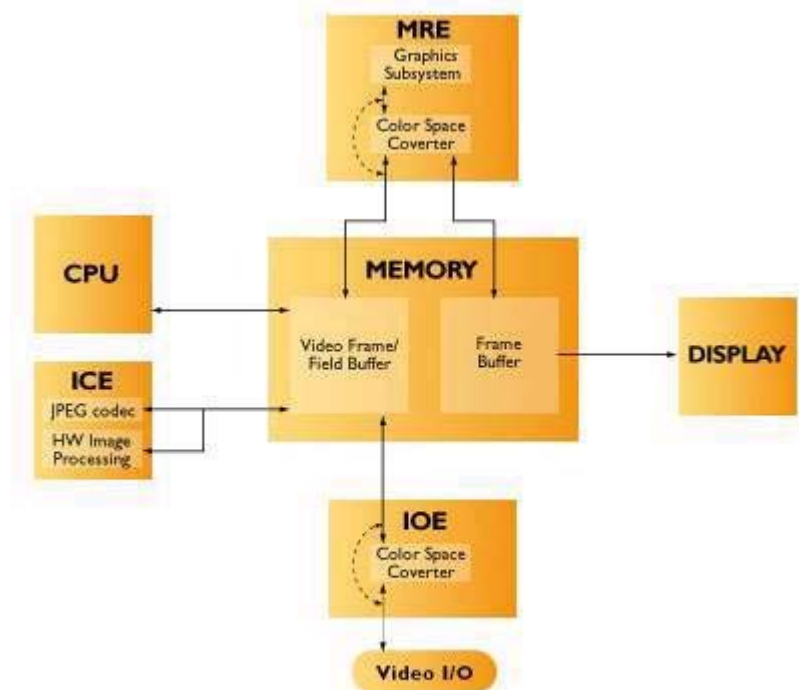
## 3D Graphics

Excellence in 3D graphics is the hallmark of all SGI systems. In the O2 system, an integrated 32-bit, double-buffered, OpenGL® graphics engine renders very high-quality images for display at up to 1280 x 1024 pixels at 75Hz. This graphics rendering engine, called the Memory and Rendering Engine (MRE), accelerates 3D graphics operations such as z-buffering, texture mapping, triangle rasterization, point and line anti-aliasing, and other OpenGL atmospheric effects. A 3D stereo adapter also enables dynamic visual effects through a head mount display (HMD) or glasses.

## Image and Video Processing

Image and video processing is managed by two dedicated engines in the O2 system: the Image and Compression Engine (ICE) and the I/O Engine (IOE). Optimum performance with minimal latencies is a key benefit of this dedicated processing because it offloads demands on the CPU. As a result, the O2 system offers the flexibility and headroom for many unique customer needs.

The O2 architecture enables impressive video processing performance, standard with every system. Essentially anything that can be done with graphics can be done with video on the O2 system. Video can be stored uncompressed to a disk array, compressed to the system disk, or used as texture map to create exceptional 3D digital video effects. Support for two simultaneous video input streams gives the customer creative options for using video.



**Path options for a video frame or field in the O2 system**

The high-performance Image and Compression Engine (ICE) is used to compress and decompress JPEG images in real-time from video streams or image texture maps. ICE also accelerates industry-standard OpenGL imaging extensions that allow customers to push the envelope in their image development. For example, Adobe Premiere™ 4.2 for SGI takes advantage of the OpenGL acceleration for its transition and 3D special effects plug-ins to decrease rendering times. ICE is flexible in design and will support additional compression and imaging algorithms through future software updates. For video processing, the I/O Engine (IOE) controls input, output, synchronization of audio and video data, and a host of other video processing functions normally found on dedicated audio/video (A/V) option boards.

## Networking and I/O

High-speed disk I/O is supported in the IOE through two Ultra Fast/Wide SCSI channels, each operating at a peak rate of 40 megabytes per second, for fast access to disk storage for large video and image files. For network connectivity, the O2 system includes industry-standard auto-sensing Ethernet™ 10Base-T and 100Base-TX functionality, while a half-length, 64-bit PCI slot provides expansion for additional network or storage requirements. Also, two high-speed RS-232 ports, a parallel port, and a high-resolution flat panel display option round out the baseline I/O for the O2 workstation.

## Unified Memory Architecture vs. PC Architectures

Traditionally, workstations and PCs have used multiple memory subsystems throughout the system, resulting in redundancies, bottlenecks, and reduced application flexibility. Demanding applications with high-resolution images, complex models, and other large blocks of data moving through the system quickly consume the limited bandwidth in a bus-based system. The O2 Unified Memory Architecture (UMA) replaces specialized local memory subsystems and multiple high-speed buses between them with one extremely high-bandwidth memory path of 2.1GB per second.

The O2 system's UMA uses dynamic allocation of as much memory as the application requires for functions such as texture mapping, alpha blending, and off-screen rendering. By combining memory resources in a single pool, the O2 system's UMA minimizes the need to copy large data blocks from one subsystem to another as PCs do. The result: less movement of data and more sharing. The net visual result is a dramatic speed improvement in 2D painting, airbrushing, 2D graphics compositing, and keying CGI (computer generated image) elements over live action backgrounds.

For more information about the O2 system's UMA, see the O2 Unified Memory Architecture white paper.

## O2 Video

The O2 system offers a uniquely impressive feature set for video, audio, and compression. The O2 system connects to video devices through either the O2 Analog A/V module or the O2 Digital Video module. The O2 Analog A/V module provides standard RCA composite and Y/C input and output connectors, as well as a digital port for the optional O2Cam or other digital video devices such as third-party video connector boxes. This module can accommodate NTSC video at 720 x 486 pixels and 30 frames (or 60 fields) per second and PAL video at 720 x 576 pixels and 25 frames (or 50 fields) per second sampled at nonsquare resolution. The O2 Digital Video module provides two 8-bit or 10-bit CCIR 601/SMPTE 259M digital inputs and one output with simultaneous key channel. This option supports 525/60 and 625/50 timings and resolutions.

The modular design of the O2 workstation centralizes video encoder/decoder hardware in the video option module, while the video processing attributes are managed internally through the I/O Engine (IOE). This means that enhancements or improvements to the O2 video option module can be provided at a much lower cost to the customer.

The O2 video architecture provides two DMA (direct memory access) input channels for uninterrupted direct access to memory. While the O2 graphics engine processes data in 8-bit per component RGBA color space, video is processed as 4:2:2 YCrCb, 8-bit or 10-bit per component. Therefore, the video input stream coming in the YCrCb color space format must be color space converted. The O2 has dedicated logic in the IOE for real-time color space conversion.

An additional advantage of the O2 architecture is that it offers both native support for nonsquare pixel format and square pixel conversion in real time in the IOE. A major difference between computer and video data is the aspect ratio of the pixel format. Video data has a nonsquare or rectangular pixel format versus the square pixel format of computer graphics. To properly display square computer graphics on a video monitor, a conversion to nonsquare must take place. Computer systems that do not offer this conversion often exhibit an "ellipse" syndrome where a circle on the computer screen becomes elliptical when it's displayed on a conventional video monitor.

Another unique feature of the O2 is the ability to generate mipmaps from a real-time video stream that can then be used as a texture map. High-quality texture mapping is paramount for true 3D digital video effects or 3D animation models.

With tightly integrated video capabilities, the O2 system provides enough bandwidth and processing power to support full-size, full-rate video with or without compression, to or from disk storage. (See the chart below for approximate data rates.)

## Bandwidths of Various Video Signals

Resolution		Bandwidth	
Total Resolution	Active Resolution	MBytes/sec (burst)	MBytes/sec (average)
ITU-R BT.601 (30 Frames per Second)			

QSIF	176 x 120	1.68	1.27
SIF	352 x 240	6.74	5.07
858 x 525	7201 x 480	27.0	20.74
ITU-R BT.601 (25 Frames per Second)			
QSIF	176 x 144	1.69	1.27
SIF	352 x 288	6.74	5.07
864 x 625	7201 x 576	27.0	20.74
Square Pixel (30 Frames per Second)			
QSIF	160 x 120	1.53	1.15
SIF	320 x 240	6.13	4.61
780 x 525	640 x 480	24.55	18.43
Square Pixel (25 Frames per Second)			
QSIF	192 x 144	1.84	1.38
SIF	384 x 288	7.36	5.53
944 x 625	768 x 576	29.5	22.12

Average column indicates entire frame time is used to transmit active video. 16-bit 4:2:2 YCbCr format assumed. Multiply these numbers by 1.5 if 24-bit RGB or YCbCr data is used.  
1 704 true active pixels.

Table source: Video Demystified by Jack Clark, Second Edition, © 1996 HighTech Interactive Inc.

## O2 Compression

The Image and Compression Engine (ICE) supports JPEG for real-time video compression and decompression. One stream of NTSC/PAL or CCIR 601/SMPTE 259M size can be encoded or decoded in real time, or multiple smaller sized streams can be decoded at nonreal-time rates. The compression rate is based on the constant quantization factor or "Q Factor" that determines the quality of each frame. This compression scheme includes software for conversion to data formats that require constant bit rates, such as MPEG-1 for CDRom or Internet distribution.

The O2 system also includes software support for MPEG-1, H.261, Cinepak® and Indeo® compression algorithms and compatibility with Apple® QuickTime™, SGI, and Microsoft® AVI file formats.

Because the I/O Engine (IOE) offloads the CPU, video stream management can function simultaneously with other applications. The following sequence is an example of a video to compression path in the O2 system. First, incoming video is passed through the IOE for storage into a memory buffer as 4:2:2 YCrCb data. The stream is then sent to ICE, which compresses the image and writes the results back to another memory buffer. From this memory buffer, the compressed image is stored to disk and assembled as a contiguous movie file. Application developers have many options for defining this capture sequence, such as displaying the incoming video on the graphics screen, compressing the stream in real time to disk, and at the same time viewing the incoming stream on an external video monitor.

An uncompressed stream can also be captured and played back with an adequate disk storage device such as a disk array.

## Informational Chart of Movie Compression Schemes

Compression Scheme Available Through Media Recorder	Best Used For...	Approximate Level of Compression	Decompression Speed (processing time per movie frame)	Compression Speed (how long it takes to compress)	Visual Quality of Movie After Compression
RLE24	Animation and screen recording (SGI format)	Animation & screen: about 8 times smaller. Live video: 1.4 times smaller.	Fast	Fast	Very high (lossless)
RLE8	Animation and screen recording (SGI format)	Animation & screen: about 8 times smaller	Fast	Fast	Very high (lossless)
Apple Compact Video (CinePak)	Web and CD-ROM content	File is 17 to 30 times smaller, depending on user's quality choice.	Very fast	Slow	Medium to high (adjustable); Higher results in larger file
MVC1	Video (SGI)	File is about 5 times	Fast	Fast	High

	format)	smaller.			
MVC2	Video (SGI format)	File is about 20 times smaller.	Fast	Average	Average
Software JPEG	Still images	16 to 75 times smaller, depending on quality choice	Slow	Slow	Medium to high (adjustable) (lossy)
Hardware JPEG	Full-sized, full-motion video	16 to 75 times smaller, depending on quality choice	Fast	Fast	Medium to high (adjustable)
Apple QuickTime Video	Video	5 to 25 times smaller, depending on quality choice	Fast	Fast	Medium
Apple QuickTime Animation	Animation and screen recording	Animation & screen: about 8 times smaller. Live video: 1.4 times smaller.	Fast	Fast	Very high (lossless)
Indeo	Web content	25 to 30 times smaller, depending on quality choice	Fast	Average	High (adjustable)

## O2 Audio

The O2 system provides the high-quality audio essential for an all-purpose multimedia workstation, as well as optional equipment for professional audio requirements. An audio codec and associated circuitry on the audio-only board and the O2 Analog A/V module provide one analog stereo input channel (two independent channels in) and two analog stereo output channels (four independent channels out) with a 3.5mm stereo headphone output, dual-RCA stereo outputs, an additional 3.5mm stereo output, and a 3.5mm microphone input. The system allows programmable control of gain, attenuation, mute, and sampling rates in 1kHz increments between 5.5 and 48kHz. The O2 Digital Video module only provides two independent channels in and out.

For professional-quality audio applications, the optional PCI Digital Audio Option board from SGI offers eight channels of 24-bit ADAT optical I/O with stereo 24-bit AES3, AES11 synchronization I/O, professional jitter attenuation, and video composite sync loop-through to lock audio and video together.

## Synchronizing Audio, Video, Serial and MIDI Streams

The O2 system's synchronization capabilities are among its strengths as a digital media content creation platform. Applications can use the Unadjusted System Time/Media Stream Counter (UST/MSC) support in all O2 systems to synchronize recording and playback of audio and video signals to within  $\pm 200$  microseconds (a few video lines) of each other, or to external timecode signals such as LTC or VITC. Applications can also synchronize audio and video signals to incoming or outgoing serial or MIDI signals to within  $\pm 1$  millisecond, which is useful for applications like field-accurate RS-422 video deck control and audio-, video- or MIDI timecode- synchronized MIDI sequencing.

PCI option cards also have access to the O2 system's UST support; the PCI Digital Audio Option board supports even higher-accuracy timestamping than the O2 system's built-in audio. All O2 audio options are able to lock their sampling clock to a reference video signal, providing precise, drift-free synchronization for long-format audio and video material.

## Digital Media Tools for the Desktop

The robust suite of SGI digital media tools gives any user the ability to easily develop compelling digital media content for Web pages, training material, and presentations that incorporate video, audio, and 3D graphics. All tools support drag-and-drop functionality for desktop files and a wide range of industry-standard file formats, making data management efficient and intuitive.

The following is a brief description of the bundled Digital Media tool set for the O2 workstation.

### MediaRecorder

MediaRecorder is a tool for real-time capture of video from an external source (movies), graphics from the screen, audio from CD or microphone, or still images. Controls help select the source and destination, file format, compression algorithm, frame rate and size among other helpful options. Pre-defined settings also make the tool very intuitive for the novice user.

### MediaConvert

MediaConvert is used for converting movie, audio, and image files to other file formats or compression algorithms. It

provides complete control of image sizes, frame and sample rates, and processing of a single file at a time or in batch mode. A large list of industry standard file formats is available to choose from.

## **MovieMaker**

MovieMaker is an application for composing and editing multitrack movie files with video, image, and audio. MovieMaker has an intuitive interface, similar to a basic text editor. It also includes filters for adding special audio and video effects, as well as a title palette for adding graphics and text to movies. MovieMaker produces movies in SGI, QuickTime, AVI, or MPEG-1 format.

## **FX Builder**

FX Builder is an SGI plug-in to Adobe Premiere and MovieMaker for editing and building 3D filters and transitions. 3D objects can be animated and textured with movies or images. FX Builder can be accessed from the menu of Adobe Premiere and MovieMaker.

## **MediaPlayer**

MediaPlayer is a tool with intuitive VCR-like controls for viewing movies or playing audio files on the O2 system. It offers a number of viewing options and transport control functions as well as volume control.

## **CD Player and DAT Player**

Both CD Player and DAT Player share the same GUI for ease of operation. CD Player enables playing audio compact discs from the SCSI CD-ROM drive through the system. DAT Player enables playing digital audio tapes from the SCSI DAT drive through the system. The tools also support capture from compact disc or DAT for audio production.

## **SoundTrack**

SoundTrack is a program for creating and editing multitrack audio compositions. The user can record (basic nondestructive editing and playback with waveform display), process audio and take advantage of the Adobe Premiere plug-in specification, synchronize audio with digital video files on the system disk, and import and export multiple audio file formats.

## **MIDI Keyboard**

MIDI Keyboard is a virtual MIDI (Musical Instrument Digital Interface) controller used for the output of MIDI data (such as note numbers and controller data) on 16 channels to either the internal SGI software-based virtual synthesizer (MIDI Synthesizer) or to external MIDI devices attached via a MIDI interface to the O2 system's serial port.

## **MIDI Synthesizer**

MIDI Synthesizer is a General MIDI-compatible sampling synthesizer that is entirely software-based. It has multistage envelopes, resonant filters, and other professional features for rendering audio for music, visual simulation, VRML, and other applications. It has extremely low latency and can be controlled in real time via an external MIDI controller.

## **Synthesizer Panel**

Synthesizer Panel is an application for controlling the MIDI Synthesizer that allows selection of the sound (preset), volume, and panning setting on each of 16 MIDI channels.

## **Video Control Panel**

The Video Control Panel provides signal control settings for the external video devices connected to the system.

## **Audio Control Panel**

The Audio Control Panel provides control settings for the external audio devices connected to the system.

## **Video Diagnostics Panel**

The Video Diagnostics Panel includes various test functions for the incoming video signal. A vector and waveform monitor allow precise measurement and monitoring of the video signal.

## **O2 Application Solutions**

The O2 workstation brings a uniquely powerful combination of capabilities to a number of applications for broadcast graphics, video editing and compositing, 3D animation, manufacturing, and medical imaging that were previously available only in much more expensive workstations.

## **O2 Studio with Adobe Premiere**

For multimedia professionals, the O2 Studio solution delivers a high-performance workstation with a complete suite of software tools. The complete O2 Studio environment provides applications for designing world-class graphics and video, including Adobe Premiere, Adobe Photoshop™, Adobe Illustrator™, Kai's Power Tools™, and Wavefront ComposerLite™. FX Builder from SGI, a plug-in tool for Adobe Premiere, lets the user create, edit, and animate complex 3D video effects quickly and easily.

To satisfy the need for frame-accurate video and audio capture and recording, every O2 Studio workstation includes Diaquest software and cables for connecting video tape recorders. Video, graphics, and compression hardware make video editing with O2 Studio systems fast and efficient. Compression hardware optimizes disk storage and transfer times with variable bit rate algorithms, while hardware graphics technology accelerates filters and image processing elements. For professional video, audio and graphics editing, the O2 Studio configuration delivers a solid foundation.

### **WebFORCE® O2 and WebFORCE MediaBase**

WebFORCE O2 provides a complete environment for creative professionals and programmers who author multimedia, interactive HTML, VRML, and Java™ applications for the intranet or commercial web sites. With the addition of Adobe Premiere for advanced video editing and Progressive Networks RealAudio® and RealVideo™ server for serving streaming media content, the WebFORCE O2 bundle provides an integrated author and serve solution for video on the Web. In addition to Adobe Premiere, the WebFORCE O2 solution includes the Cosmo™ software suite for streamlined Web authoring and development, Adobe Photoshop, Adobe Illustrator, and Kai's Power Tools. For direct video input, add the O2 video option.

For an even more scalable solution, WebFORCE MediaBase offers up to 20 content streams from the server on a single-processor O2, scaling up to 450 streams on a six-processor Origin® 2000.

### **Video Editing and Compositing**

The O2 workstation is a solid entry-level system that provides all the necessary elements for professional-quality serial D1 digital video editing and compositing.

The native video streaming and processing capabilities provide an ideal basis for video compositing tools. With the O2 system's built-in compression, graphics acceleration, high CPU performance, dual Ultra SCSI channels, and very fast networking, it is a very effective platform for manipulating graphics, texture mapping, and audio and video data. A number of third party applications for video editing and compositing are currently available for the O2 system and additional applications are scheduled for release by end of calendar year 1997 and early 1998.

### **Broadcast Graphics**

Broadcast graphics solutions from SGI are quickly changing the process and economics of broadcast production. With the Onyx2 visualization supercomputer and Octane and O2 desktop systems, graphic designers can realize their vision in a way never before possible. Broadcasters can attract more viewers by incorporating state-of-the-art visuals such as virtual sets and rapid graphics for election and event coverage, sports segments, financial news, 3D weather, and interactive fly-throughs.

The O2 is a breakthrough product for the broadcast market with its high-quality 3D graphics, real-time texture mapping, and affordable price. There are many solutions for weather graphics, character generation, 2D paint, and compositing. Built-in functionality for mixing live video with real-time graphics and effects makes O2 systems ideal for emerging opportunities in cable head-end advertising and graphics insertion. The modular design of the O2 system allows it to fit into an optional rack-mountable chassis for easy connection and service. (An optional rack-mountable chassis is scheduled to be available in late 1997.)

### **3D Animation**

O2 establishes the industry standard as an affordable, high quality 3D animation, 2D animation, or cel animation workstation. In the 3D animation market, texture mapping is a requirement for producing more complex models and environments. With the O2 UMA architecture, the texture memory is dynamically scalable to provide even greater levels of realism. The O2 R10000 system's rendering and geometry performance is an ideal combination for faster model prototyping.

### **Manufacturing**

In addition to the O2 system's graphics and CPU horsepower for solid modeling applications, its screen capture and compression capabilities are used by globally dispersed teams for efficient manufacturing design review. With the bundled digital media tools, prototypes can be digitally captured for distribution and viewing across intranets or the Internet. For example, a designer uses the MediaRecorder application to capture a window on the screen and save the

information to disk in real time as a JPEG-encoded QuickTime file. By dragging the movie file into MovieMaker, the designer adds titles, captions, or audio to highlight specific details. Dragging the modified file to MediaConvert makes it possible to re-encode to industry-standard formats such as MPEG-1. Finally, the designer publishes the file to the OutBox to make the movie available for instant viewing by any viewer with an Internet browser.

## Medical Imaging

Processing and visualizing raw ultrasound information used to require expensive, proprietary hardware. With its dedicated image processing engine and high-performance graphics engine, the O2 workstation is an ideal, off-the-shelf replacement for custom black box medical imaging products. The O2 system's texture-mapping hardware facilitates the scan conversion of ultrasound temporal information in real time. Also, the O2 system can be used as a high-resolution image review station because of its accelerated image processing capabilities. For example, the O2 system can easily manipulate 4,000 x 4,000 pixel images.

## Software Development

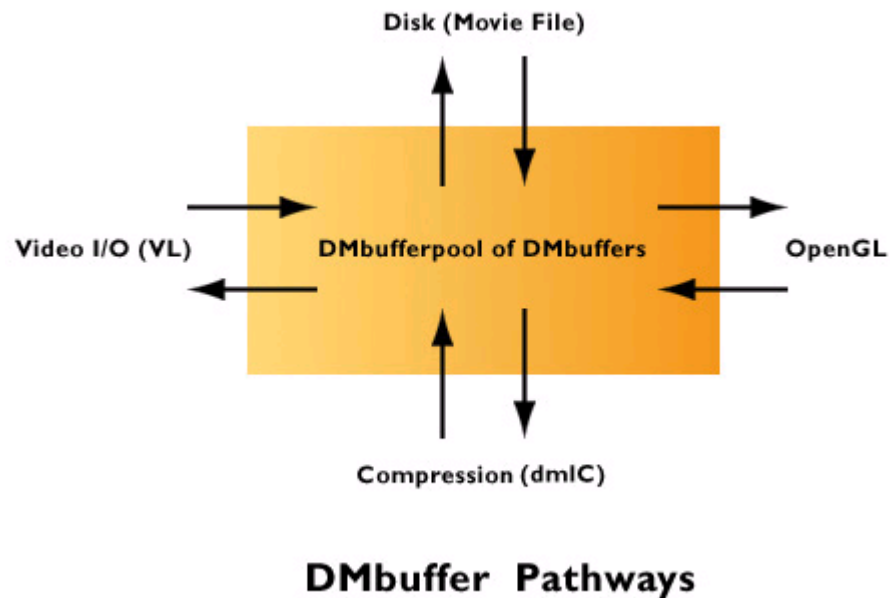
The Digital Media Libraries from SGI provide developers the necessary tools for incorporating image processing, graphics, video, audio, and compression in their applications. Extensive APIs handle data format descriptions, real-time audio and video I/O with built-in format conversion, data conversion and compression, and industry-standard file reading, writing, editing, and playback.

Separate APIs provide access to digital media buffers, image conversion, color space, and audio conversion. Through these libraries, developers have access to multiple streams of audio and video, transparent codec interfaces, and control over every aspect of video, audio, and image data. (For tips about writing video applications and optimizing the video data flow, see the SGI Developer Toolbox.)

The following is a brief description of the APIs in the Digital Media Libraries.

### DMbuffer

Digital media buffer (DMbuffer) is the name of a new API and data type for working with compression hardware and algorithms, video I/O, 3D graphics, and host processors. The DMbuffer API defines the interface between the other digital media APIs and helps application programmers optimize for the O2 Unified Memory Architecture. OpenGL and the DMIC, Movie File, Movie Playback, and Video libraries use the DMbuffer data type. DMbuffer is a cross-platform API. On O2 in IRIXTM 6.3, it is embedded in the system hardware; on the Octane workstation and Onyx2 supercomputer, it is supported in software APIs.



### OpenGL

The O2 workstation implements high-performance graphics with OpenGL, the industry standard for 2D and 3D imaging. On the O2 system, new OpenGL extensions utilize the DMbuffer API to optimize graphics performance. OpenGL extensions for O2 allow the use of the DMbuffers as either puffers or texture maps. Also new is an OpenGL extension



for rendering YCrCb (4:2:2) interlaced data, which allows video display pixels to be saved in a pixel format, rather than converting them to bits. Applications using these extensions can enable hardware color space conversions from YCrCb to RGB. In addition to the new OpenGL extensions, O2 provides hardware acceleration for the following existing routines:

- Color scale and bias
- Color table look-ups
- Convolutions: 3x3, 5x5, and 7x7 (separable and general)
- Color matrix multiply
- Histogram and MinMax

## DMIC

The Digital Media Image Conversion (dmIC) library provides convenient conversion between still and video image formats and compression algorithms. DMIC utilizes both hardware-enhanced and software-only compression techniques.

## Movie File and Playback Libraries

The O2 development environment provides easy mechanisms for selecting and viewing video files.

The Movie File Library (libmoviefile) provides facilities to read, write, and edit movie files with appropriate file formats and compression standards. The Movie Playback Library (libmovieplay) includes straightforward mechanisms for integrating digital movie playback into any application.

The following formats are supported in the Movie File Library and Movie Playback Library:

- SGI versions 1, 2 and 3 (supported compression formats: uncompressed, MVC1, MVC2, JPEG, RLE8, RLE24, RLE32)
- Apple QuickTime (supported compression formats: uncompressed, CinepakTM, IndeoTM 3.2, Apple Video, Apple Animation, JPEG)
- Microsoft AVI (Audio Video Interleaved); read only (supported compression formats: Cinepak, Indeo 3.2)
- MPEG-1 (ISO 11172); read, play, and append are supported. (MPEG-1 is both a file format and a compression format.)

## Video Library

The Video Library (VL) provides a software interface for working with video devices and image data. The Video Library is fully integrated with the O2 architecture and can share video data with other compression and graphics interfaces via the DMbuffer API. The new Video Library calls enable receiving video data (fields or pairs of fields interleaving to form frames) into DMbuffers and sending video data using DMbuffers. In addition, the video I/O path can handle mipmap generation for live video.

## Audio and Audio File, and Audio Conversion Libraries

The Audio Library (AL) gives application developers complete access to audio I/O and control of physical sound parameters, while the Audio File Library (libaudiofile) provides convenient access to sound files in a variety of industry standard formats. The new Audio Conversion Library (dmAC) is a low-level API for memory-to-memory audio sample format conversion, sample rate conversion and compression/decompression. IRIX 6.3 supports the following audio compression algorithms:

- CCITT G.711 mu-law and A-law
- CCITT G.722
- CCITT G.726 16, 24, 32 and 40Kb per second
- CCITT G.728
- GSM
- Intel DVI ADPCM
- MPEG audio

## MIDI

For music developers, the Musical Instrument Digital Interface library provides the programming interface to communicate with musical instruments, recording equipment, input devices, and special effects generators through a serial MIDI interface.

## Conclusion

Advanced system architecture, powerful software tools, and integrated video, audio, imaging and compression capabilities make O2 workstations the platform of choice for affordable digital media production on the desktop. The SGI product line with high-performance Octane and Onyx2 systems gives O2 customers a scalable path to follow as projects require additional resources.

For challenging digital media applications that require sophisticated capabilities on a budget, there is really only one solution, the O2 workstation from SGI.

## Related Reading

The following is a list of related resources:

O2 Unified Memory Architecture white paper.

SGI Developer Toolbox.

For general video information, Video Demystified by Jack Clark, Second Edition, © 1996 HighTech Interactive Inc.

© 1997 Silicon Graphics, Inc. All rights reserved. Specifications subject to change without notice. SGI OpenGL, Onyx, WebFORCE and the SGI logo are registered trademarks, and O2, Origin2000, Onyx2, Octane, Cosmo, and IRIX are trademarks of Silicon Graphics, Inc. MIPS is a registered trademark and R5000 and R1000 are trademarks of MIPS Technologies, Inc. Mac and Apple are registered trademarks, and QuickTime is a trademark of Apple Computer, Inc. Microsoft and Windows NT are registered trademarks of Microsoft Corporation. Adobe Premiere, Adobe Photoshop, and Adobe Illustrator are trademarks of Adobe Systems, Inc. Ethernet is a trademark of Xerox Corporation. Cinepak is a registered trademark of Radius. Kai's Power Tools is a registered trademark of MetaTools. Wavefront ComposerLite is a trademark of Alias|Wavefront. Indeo is a registered trademark of Intel Corporation. Java is a trademark of Sun Microsystems, Inc. Progressive Networks and RealAudio are registered trademarks, and RealVideo is a trademark of Progressive Networks, Inc. All other trademarks mentioned herein are the property of their respective owners.  
1480 (11/97)