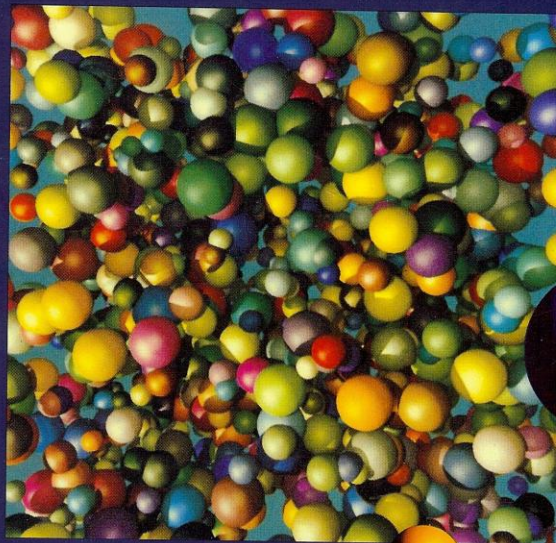# Realworld

Realtime

AT&T Pixel Machines
PXM 900 Series

AT&T

Supercomputer power for graphics and image processing

Image analysis, visual simulation, real-time 3-D graphics: These are applications that could best be performed with the processing power of supercomputers that carry out intensive computations—and carry million-dollar price tags.

Until now.

Now AT&T Pixel Machines introduces the PXM 900 Series: a family of image display systems that give you the power of a supercomputer—as much as 820 MegaFLOPS—at workstation prices.

Innovative design

You get a great deal more than high performance in these new systems. With its parallel architecture, the PXM 900 Series eliminates some inherent inefficiencies existing in traditional image display systems.

Frame buffer access, for example, can become a bottleneck in high-quality image synthesis and advanced image analysis. The PXM 900 Series resolves this problem through the application of innovative parallel processing techniques. With many processors accessing the frame buffer in a multiple instruction, multiple data (MIMD) configuration, interactive graphics and image processing can now be carried out at rates previously attainable only with a supercomputer.

Beyond the limits of specialized silicon

In current state-of-the-art systems, computation-intensive operations—transformation, shading and hidden surface removal, among others—are frequently designed into application-specific VLSI components. While these components offer high performance, they are restricted to performing only the limited set of functions built into them.

In contrast, you get versatility for the future, as well as performance, with the PXM 900 Series' set of powerful, programmable processors. Not only can you enhance your present graphics and image processing applications, you can also take advantage of future advances in algorithm development.
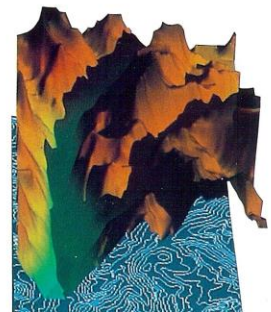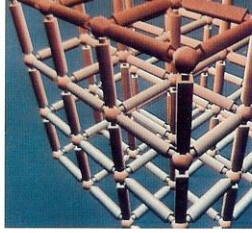
32-bit floating-point technology

The PXM 900 Series uses 32-bit floating-point processors exclusively. So floating-point-intensive algorithms—like those used for image processing and ray-tracing—can be implemented directly at the frame buffer level for real-time processing.
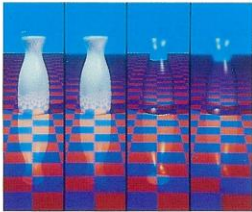
Modular approach

With the PXM 900 Series, upgrading is easy: You can add more computing modules to increase processing speed and frame buffer memory. Any configuration in the product line can be upgraded without affecting the compatibility of your existing software.
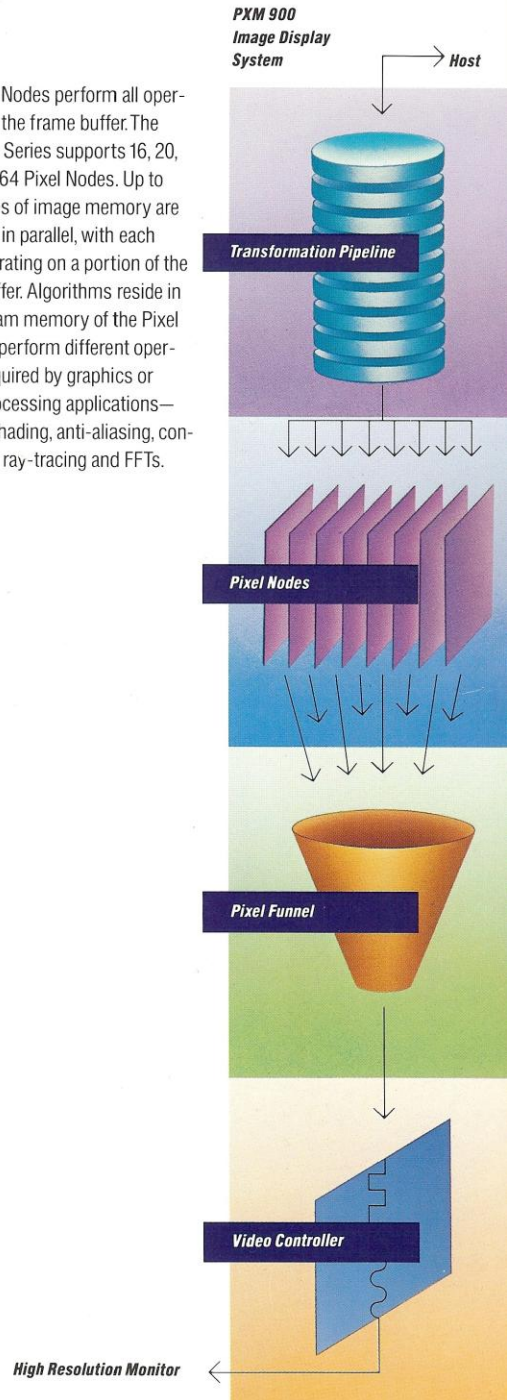
The architecture

The PXM 900 Series is configured on a standard VMEbus and connects to a host computer through a high-speed parallel interface. The PXM 900 Series consists of several modules. A pipeline of proce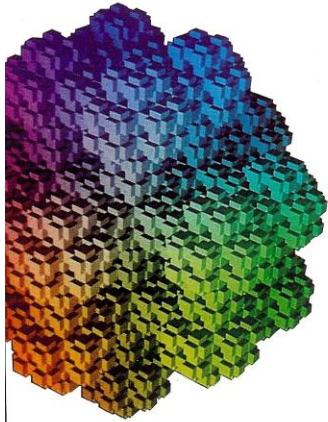ssors called the *Transformation Pipeline* receives data from the host and broadcasts its output to an array of processors called the *Pixel Nodes*.

Pixel Nodes access the frame buffer in parallel and direct their output to the video controller through a high-speed bus called the *Pixel Funnel*.

The Transformation Pipeline performs all the operations required for manipulation of objects in 3-D: transformation, clipping and projections. It also carries out other functions required for object rendering or image processing, such as the generation of shading coefficients. The PXM 900 Series can support two Pipelines, operating concurrently or in series, with each Pipeline consisting of nine Transformation Nodes.

The Pixel Nodes perform all operations on the frame buffer. The PXM 900 Series supports 16, 20, 32, 40 or 64 Pixel Nodes. Up to 48 MBytes of image memory are managed in parallel, with each Node operating on a portion of the frame buffer. Algorithms reside in the program memory of the Pixel Nodes to perform different operations required by graphics or image processing applications—such as shading, anti-aliasing, convolutions, ray-tracing and FFTs.

PXM 900 Image Display System

Host

Transformation Pipeline

Pixel Nodes

Pixel Funnel

Video Controller

High Resolution Monitor

Because of the size of the frame buffer, the PXM 900 Series provides you with the capability to do real-time manipulation of high-quality images: Even in its basic configuration, the PXM 900 Series comes equipped with 96 bits per pixel, used for two 32-bit/pixel frame buffers, and a 32-bit/pixel off-screen memory. The off-screen memory is used for 32-bit floating-point z-buffering or for other functions. In image processing applications, for instance, the z-buffer can serve as extra memory.

At the heart of the PXM 900 Series is AT&T's DSP32 Digital Signal Processor, used for both Transformation and Pixel Nodes. A thoroughly proven, second-generation product, the DSP32 can execute up to 10 million 32-bit floating-point operations per second.

Because the DSP32 is a programmable processor, both Transformation and Pixel Nodes can be reprogrammed to perform different sets of functions. If you are a software developer and you wish to achieve greater functionality than that provided by the standard library, you can develop and download your own programs directly into the PXM 900 Series.
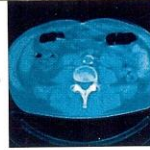
Software

Software available with the PXM 900 Series includes graphics algorithms, diagnostic programs and software tools. A high-level library provides the software interface to the PXM 900 Series.

Among the software tools available are a C compiler, assembler, linker and symbolic debugger—for advanced users who require higher performance or wish to customize the PXM 900 Series.

Pixel Machines

AT&T Pixel Machines' business is to satisfy your needs in high-performance graphics and image processing.

Premier resources from AT&T Bell Laboratories—in graphics software, image processing and DSP32 technology—have come together to provide the technology and support you require.

The PXM 900 Series was designed to grow with you, taking into account your expanding needs and changing requirements. As new applications emerge, and traditional applications become more sophisticated, the PXM 900 Series will continue to offer the functionality and performance you need.

Inside and back cover pictures courtesy of Michael Potmesil, Eric Hoffert and AT&T Bell Laboratories.

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