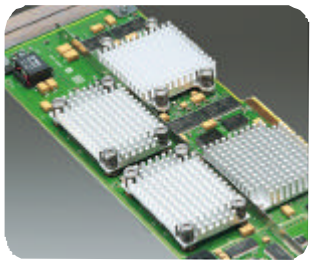
hp visualize-*fx*^{5} *pro*/*fx*^{10} *pro* UNIX graphics accelerators



white paper

leadership graphics technology

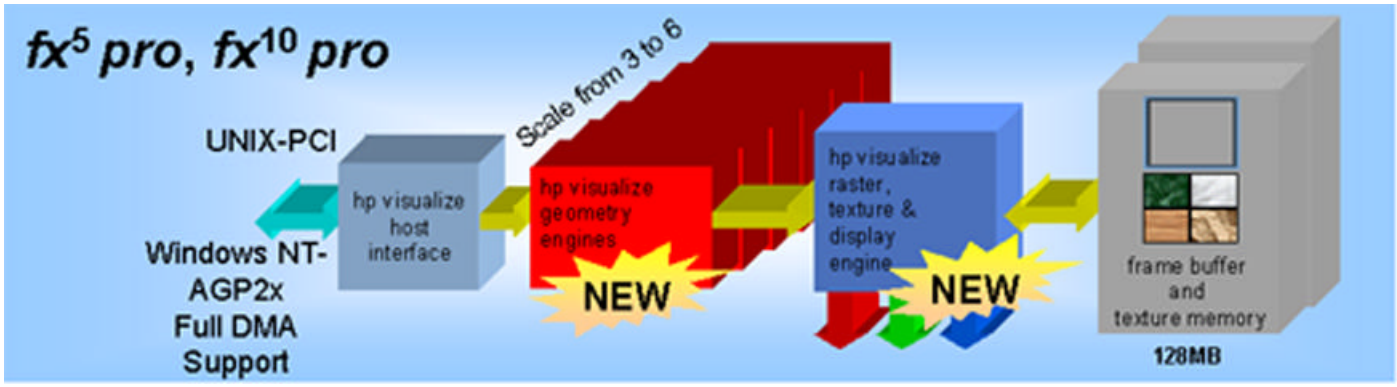
HP set the standard for UNIX®, Windows NT®, and Linux 3D graphics performance and functionality with the introduction of the visualize-*fx pro* family in 1997. The subsequent introduction of newer members of the visualize-*fx pro* family provided further gains in performance at a wide range of price points.

Now, HP continues to evolve its visualize family of graphics accelerators with the introduction of the visualize -*x*^{5}*pro* and visualize *fx*^{10}*pro* graphics accelerators. The fx^5 *pro* and fx^{10} *pro* feature industry leading application performance, with a feature set typically found on much more expensive high-end graphics workstations. The hardware is designed for HP-UX providing full support for OpenGL 1.1, Starbase, PEX, and PHIGS.

Significant features of the *fx*^{5} *pro* and *fx*^{10} *pro*:

- 3D and depth texture mapping for volume visualization and real time shadows
- texture maps up to 2048x2048 in size
- a hardware accelerated accumulation buffer for special effects like motion blur
- parallel visibility testing of bounding boxes for fast occlusion culling
- support for multiple display syncs for “cave” and “cove” displays
- up to 128MB of fully configurable shared framebuffer/texture memory. The flexible shared memory design allows the user to balance texture map storage requirements with desktop size and other memory intensive features like stereographics and accumulation buffers
- identical software interfaces and device drivers for both the *fx*^{5}*pro* and *fx*^{10}*pro* to reduce ISV certification expenses
- designed with the entire computer system in mind to maximize high-end 3D application performance

a detailed look at the architecture and features



	fx⁵ pro	*fx¹⁰ pro*
host interface chip	1	1
geometry engines	3	6
rasterizer/texture/display chip	1	1
shared framebuffer/texture memory	64MB SDR	128MB SDR
software interface/device driver	identical for both devices	

architectural summary

Both the *fx⁵ pro* and *fx¹⁰ pro* contain sufficient framebuffer memory to support an identical list of pixel formats. The *fx¹⁰ pro* provides twice the geometry performance of the *fx⁵ pro*.

A detailed look at the individual components of the *fx⁵ pro* and *fx¹⁰ pro* follows.

host interface chip

Communication between the host computer system and the graphics device is via a host interface chip residing on the *fx⁵ pro* and *fx¹⁰ pro*.

The Intel workstation versions of the *fx⁵ pro* and *fx¹⁰ pro* use an AGP/2X host interface chip. The HP-UX versions of these cards use a PCI host interface chip. The *fx⁵ pro* uses a single 64-bit slot, either 33MHz or 66MHz. The *fx¹⁰ pro* uses only a 64-bit, 66MHz slot. HP-UX graphics libraries communicate with the host interface chip using a combination of programmed I/O and DMA.

The host interface chip also supports fast hardware state switching for acceleration of multiple concurrent rendering applications. Applications that use multiple OpenGL rendering contexts will also benefit from this feature. An application that caches state for different rendering scenarios in multiple OpenGL contexts will be able to rapidly switch between them.

geometry engines

The geometry engines perform geometric transformations, lighting, model clipping, and other vertex operations on incoming geometric data. This frees the host CPU, leaving more processing power available for application work.

The geometry engines use floating point units based on HP PA-RISC processor technology to achieve maximum floating point performance.

There are three geometry engines per geometry accelerator chip. The *fx*^{5} *pro* has a single geometry accelerator, while the *fx*^{10} *pro* has two chips for a total of six full geometry engines.

Each hardware geometry engine supports a rich geometry feature set, including:

- lighting and shading for up to eight separate OpenGL light sources
- all OpenGL primitive types
- transformations
- view volume and model space clipping
- material properties for accelerated rendering of lit surfaces
- texture coordinate generation, useful in Scientific Visualization applications
- environment mapping for fast realistic surface reflections
- second generation hardware occlusion culling implementing faster rejection of invisible geometry based on its bounding volume.

raster, texture, and display engine chip

A single chip combines the raster, texture and display processors, maximizing the performance and efficiency of these operations.

the raster processor

The raster processor converts incoming geometric primitives into pixel data for storage in the framebuffer. It supports all RGBA OpenGL per-pixel operations, including:

Depth, alpha, and stencil tests for hidden line and hidden surface removal (HLR/HSR), billboarding, Composite Solid Geometry (CSG) and other effects

Linear and exponential fog for depth cueing and atmospheric effects

Blending and logical operations for transparency effects and image processing applications

Antialiased lines and points

the texture processor

The texture processor contains built-in support for OpenGL 1.1 texture mapping. Texture mapping for Starbase, PEX, and PHIGS is not supported and is accomplished using software only.

In addition to standard features such as mipmapping and bilinear and trilinear filtering, the following features are supported:

- 3D texture maps, for volume visualization
- depth textures, for creating shadows
- pre-specular texture lighting for better realism

Since textures are stored in the same block of memory as the framebuffer, desktop size, pixel format, and texture format determine the maximum texture size. The texture processor supports texture sizes of up to 2048 x 2048.

the display processor

The video display processor combines the contents of the framebuffer to produce a displayed image. Features provided by the Video Display Processor include:

- four color look up tables (LUTs), allowing individual windows to maintain their own set of colors
- gamma correction of 3D windows
- 8-bit/pixel overlay
- synchronized stereo display, with support for industry standard stereo glasses or head mounted displays
- a hardware accelerated asynchronous mouse cursor for improved system responsiveness
- intelligent buffer swaps synchronized to the display refresh rate (may be disabled to achieve maximum performance at the expense of image quality)
- analog (DB15) and digital (DVI) video output connections
- support for multiple syncs for “cave” and “cove” displays

Resolution	True Color (24-bit) Double Buffered	Stereo Double Buffered	Refresh Rate (Hz) PA
1024x76	✔	✔	75
1280x1024	✔	✔	75
1600x1200	✔		75
1920x1080	✔		68
1920X1200	✔		60

supported display configurations

memory architecture

The *fx⁵ pro* and *fx¹⁰ pro* feature fully configurable framebuffer and texture memory. The device driver manages the memory to satisfy a broad range of framebuffer configurations and store memory-intensive texture maps.

Supported framebuffer configurations include:

- 32-bit/pixel RGBA or 24-bit/pixel RGB single or double buffered, mono or stereo
- a 24-bit depth buffer

- a 4-bit stencil buffer
- 8-bits of single or double buffered overlay planes
- a hardware accelerated accumulation buffer for fast full scene antialiasing
- a clip plane plus four hardware clip rectangles for accelerated window clipping
- additional bit planes to support per-window attributes such as fast buffer swaps

Texture maps are stored in framebuffer memory at up to 32-bits/pixel RGBA.

OpenGL support

The *fx⁵ pro* and *fx¹⁰ pro* provide industry leading OpenGL performance, featuring an optimized display list execution path and enhanced state change architecture.

Both the *fx⁵ pro* and *fx¹⁰ pro* meet the conformance requirements for the OpenGL 1.1 industry standard. In addition, the *fx⁵ pro* and *fx¹⁰ pro* support several OpenGL extensions, so applications can access hardware features that are not exposed through the OpenGL 1.1 API. The extensions include:

- Industry standard OpenGL 1.1 texture mapping extensions, such as generate mipmap, texture border clamp, shadow, and depth texture.
- Many features which are part of the OpenGL 1.2 standard are supported through extensions, including: RGBA pixel formats; three dimensional texture maps; normal rescaling; texture coordinate edge clamping; and texture lighting.
- The HP texture color table extension.
- The HP draw array set extension, which allows rendering of multiple individual primitives through the vertex array feature.
- HP extensions for visibility testing, which can be used directly by an OpenGL application, or indirectly via the DirectModel or Fahrenheit APIs.
- The HP supersample extension, which provides support for full scene antialiasing.
- The vertex array, polygon offset, and subtexture features, which were only available as extensions under OpenGL 1.0, are supported via both the OpenGL 1.1 interface as well as the OpenGL 1.0 extension interface for backwards compatibility.
- Support for standard Windows NT extensions, including paletted textures and swap hint.

The *fx⁵ pro* and *fx¹⁰ pro* are identical in terms of OpenGL feature support. An OpenGL application that runs on one device will run on the other.

2D support

The *fx⁵ pro* and *fx¹⁰ pro* provide exceptional 2D performance for operations such as area fill, hardware BLT(Bit Block Transfer), hardware cursor, text display, and line rendering.

comparing the fx⁵ pro and fx¹⁰ pro to the fx⁴ pro and fx⁶ pro

The *fx⁵ pro* and *fx¹⁰ pro* represent an evolution of the previous *fx⁴ pro* and *fx⁶ pro* graphics accelerators. The following table illustrates the difference in features and functionality between the two sets of devices.

feature	***fx⁴ prolfx⁶ pro***	***fx⁵ prolfx¹⁰ pro***
available video memory	18MB SGRAM	128MB
maximum display resolution	1600x1200	1920x1200
visibility testing and occlusion culling	✔	✔
multiple visibility test results in parallel		✔
visibility statistics		✔
hardware accumulation buffer	✔	✔
antialiased points and lines	✔	✔
hardware full-scene antialiasing		
8-bit destination alpha planes		✔
hardware Direct3D support		✔
double buffered overlay	software	software
flat panel display		✔
extended video support		✔
texture map hardware	optional	integrated
texture memory	16MB/32MB dedicated	110MB integrated with FB
on-chip texture cache		✔
hardware environment mapping	✔	✔
texture LOD		✔
paletted textures, texture color tables		✔

Printed in the USA
Revised March, 2001
5980-5176EN