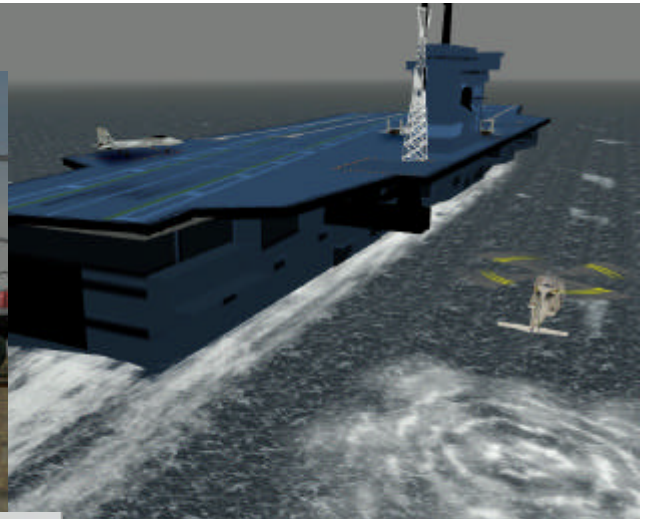# *Barracuda*

Technical Specification

Introduction

The best PC based Image Generation (IG) technology currently available, *Barracuda* is designed for the next generation of simulation and training applications that require the highest quality images at low cost.

Primary Image is the pioneer in the production of low cost image generators. *Barracuda* is a fifth generation product, incorporating Primary Image's extensive experience as well as the latest technological advances to provide an image generator of massive power and flexibility.

Barracuda is designed to meet the needs of real time systems builders who require high resolution three dimensional graphics performance and who may previously have used large scale, complex and expensive image generators. *Barracuda* based systems equal or exceed the functionality and features of more costly and less adaptable systems.

Barracuda is designed around open standards. Compatible with open standards, it also offers ultimate performance without compromise.

Barracuda is a successor to the highly successful Piranha image generator family offering the user the following major benefits:

- Scaleability and upgradeability built in
- Low initial and through-life cost
- PC platform for ease of use & low support cost
- Database interoperability
- Ultra High Quality Images for maximum realism

Key features

Architecture
- Parallel multi-pipelined multi-path flexible image generator
- Ultra high pixel and polygon throughput
- On board polygon and texture storage
- On board flexible, programmable polygon processor
- Advanced texture modes including anisotropic filtering, reflective and bump mapping, detail and projected texture
- Flexible and re-programmable video resolution modes
- Sub-pixel full screen anti-aliasing on pixels and depth buffer
- Supports OpenGL and GLIDE interface standards. Upgradable software to support custom or new render protocols
- PCI card form-factor

Compatibility

Software
CGI Applications running under Primary Image Tempest running on P10 or Piranha will move on to Barracuda without modification

Barracuda Hardware Architecture

3D Graphics processor:

Barracuda is a self-contained image generator that is based around high speed processing and pixel rendering processors. It has a powerful onboard polygon processor with dedicated local system memory that is expandable to a total of 128 Mbytes per card. Dedicated hardware rendering engines generate pixels in an 8 MByte double buffered video memory. Connection to the PC host is via a standard PCI bus expansion slot. Digital polygon and pixel interfaces provide dedicated data pathways for expansion to other boards in the *Barracuda* family.

The system performs both polygon geometry and pixel calculation on-board requiring minimal resources from the host PC processor.

On a single board either one or two pixel rendering chains are provided. Each pixel rendering chain provides approximately 100 Mpixels per second, and may be combined to give antialiasing or enhanced resolution.

Multiple boards may also be combined to enhance the rendering performance or the number of sub-pixels being calculated to enhance image quality
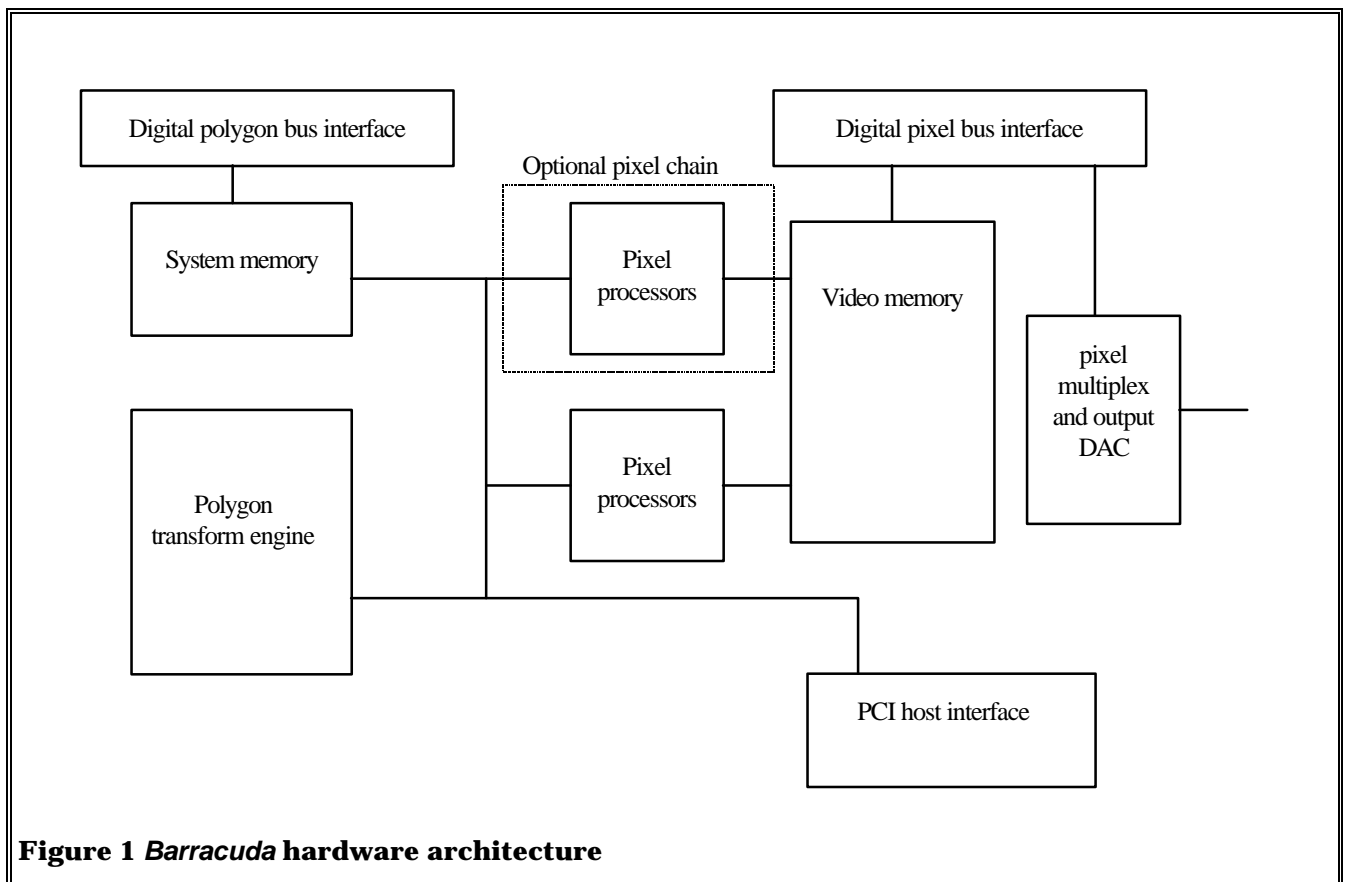

Figure 1 *Barracuda* **hardware architecture**

Polygon modes

- Flat, Gouraud shaded
- Texture may be combined with any of the above modes at no performance penalty
- Fog / distance fading calculated per pixel, linear or exponential
- Anti-aliasing; 2 to 8 pixel sub-sample on pixel and depth buffer

Pixel rendering

Mapping

Multi-texture rendering in single pass (no performance penalty). Two simultaneous maps per pass with tri-linear interpolation
e.g. Main texture + detail
Main texture + projected texture
Main texture + bump map (embossed method)
Main texture + environmental map

Lighting

Multiple simultaneous light sources per polygon

Transparency

Alpha Defined per texel up to 256 levels

Texture filtering

Linear, bi-linear, tri-linear, detail, anisotropic, anisotropic detail

Fading

Linear, exponential, exp2, programmable density & color

Overlays

Overlays are generally drawn as a last pass in the rendering process. Overlays may be aliased or anti-aliased depending on requirements.

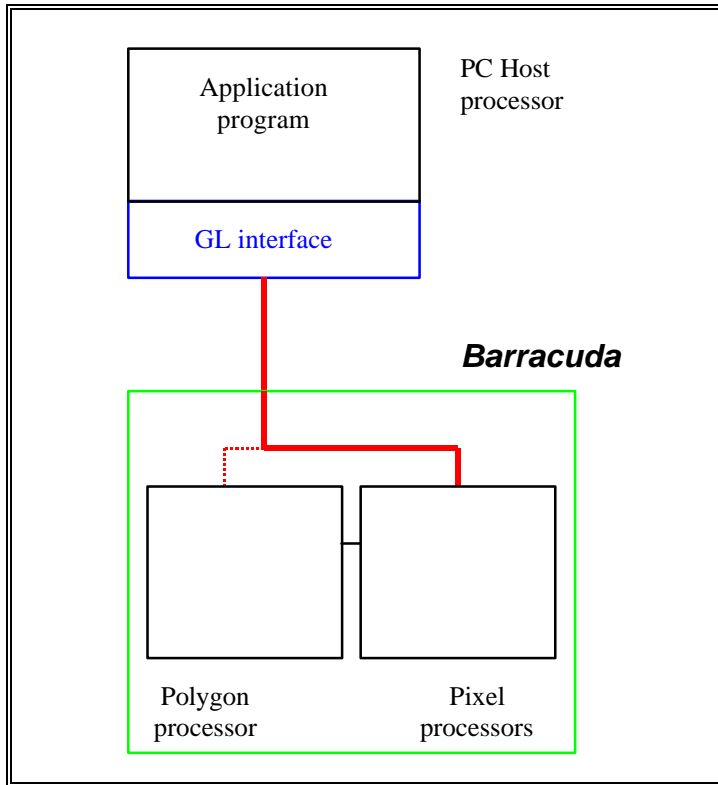### Depth buffer

Hardware Z-buffer floating point equivalent to 22 bit in certain configurations
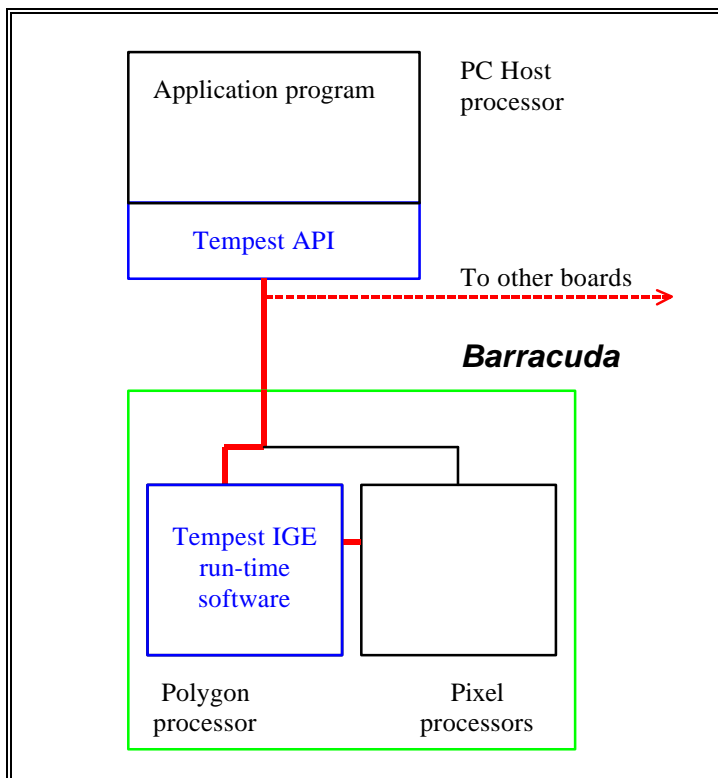
Open System architecture

Barracuda has been designed to provide compatibility with open systems. It may be used in a number of ways.

Mode 0: Accelerator mode

Application program

PC Host processor

GL interface

Barracuda

Polygon processor

Pixel processors

GLIDE or GL commands are sent to the card through a standard GLIDE or GL library running on the host PC. **Barracuda** acts in a similar fashion to standard GLIDE or GL accelerators. This offers a quick way to use **Barracuda**. Applications that support access to multiple GLIDE or GL accelerators can use multiple boards to provide multi-channel operation. In both retained and non-retained mode, polygon processing occurs on the host processor, the on-board polygon processor is used in GL retained mode but otherwise only for house-keeping operations. The Barracuda will operate in both anti-aliased and non anti-aliased modes depending on the system configuration.
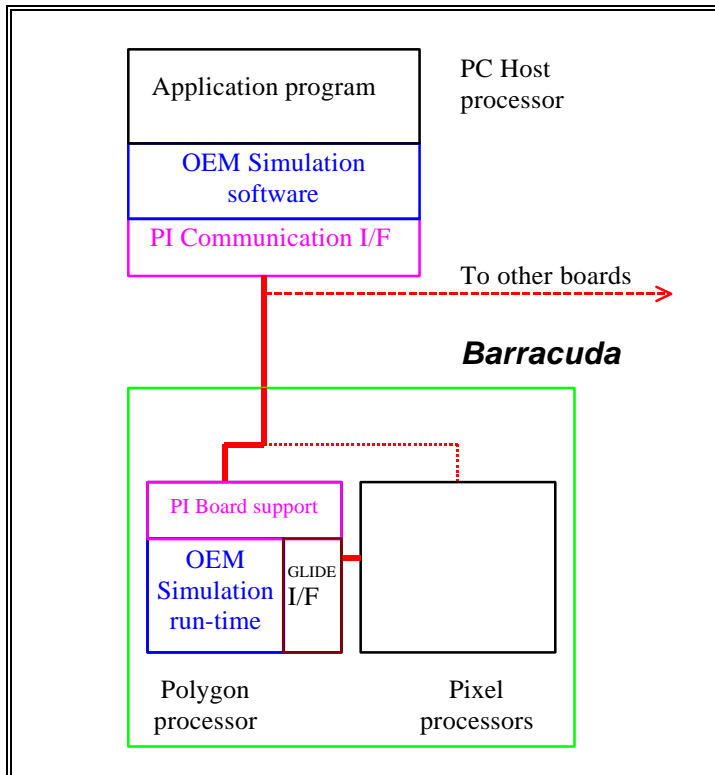
Mode 1: Tempest software mode

Application program

PC Host processor

Tempest API

To other boards

Barracuda

Tempest IGE run-time software

Polygon processor

Pixel processors

Tempest software run on **Barracuda**. This offers existing P10 and Piranha customers a route to upgrade without modification of databases or application software. Many existing applications will benefit from the additional performance. **Barracuda** does not directly support interlaced video modes though external converters can be used.

The on-board polygon processor is used to run Tempest software. The host processor is used for collision detection functionality within the Tempest software library. All **Barracuda** operating modes are supported including anti-aliasing and texture modes. Existing Tempest databases and applications will automatically take advantage of **Barracuda**'s improved functionality and performance.

Mode 2: Open Software structure (OSS) mode

Application program	PC Host processor
OEM Simulation software	
PI Communication I/F	

To other boards

Barracuda

PI Board support	
OEM Simulation run-time	GLIDE I/F
Polygon processor	Pixel processors

Barracuda is designed so that third party software can be run to make full use of the advanced features available on the system. Software currently running on other platforms can be ported to **Barracuda** making use of a mixture of GLIDE calls and a limited sub-set of other calls. Third party software can make full use of the scaleability of the system and best use of the hardware performance to provide maximum cost-effectiveness.

Support for integrators using OSS includes compilers and libraries specifically designed to reduce the amount of platform specific code.

Scaleability

A single *Barracuda* board is suitable for many applications. The board is available in single and dual pixel chain versions, with dual pixel chains being the standard.

The second pixel chain consists of a separate daughter module which attaches to the main board. The addition of this daughter doubles the pixel performance.

In addition multiple Barracuda boards can be connected together. Up to 8 boards can be combined to form a single visual channel. The addition of these boards allows full screen anti-aliasing or high resolution modes to be used .

In a multiple board channel, each Barracuda board contributes to the final display image, the end result being a better quality picture. The user may select the particular Barracuda combination that is right for their application.

For higher polygon performance a Barracuda Cruncher board provides enhanced polygon processing. In this situation polygons are transferred to the Barracuda boards across the dedicated Barracuda high speed polygon bus which eliminates PCI bus bottlenecks.

Multiple boards can also be used to provide multiple independent visual channels. Each independent channel is pixel locked to another, either within the same PC host, or in different PC hosts.

Some typical configurations are shown below:

Physical resolution	Overdraw / update rate requirement	Boards required per channel	Equivalent resolution
900x700 antialiased (4 sub-pixel)	5 @ 30Hz	2	1800 x 1400
1280x1024 no antialiasing	3 @ 60Hz	1	1280 x 1024
1024x768 antialiased (2 sub-pixel)	8 @ 30Hz	2	1448 x 1086
1280x1024 antialiased (4 sub-pixels)	5 @ 30 Hz	4	2560 x 2048

Upgrades

Various upgrades of the system are available:

Addition of another card in a visual channel	Field upgrade
Channel reconfiguration	Field upgrade
Addition of Cruncher board (for higher polygon counts)	Field upgrade
Memory upgrade: From 32 MB to 64 MB or 128MB	Factory upgrade
Addition of pixel module	Factory upgrade
Processor or Cache upgrade	Factory upgrade

Transport Delay

The transport delay in a *Barracuda* system (using Tempest software) is between 2 and 3 times the frame time. For example: the transport delay is between 33 and 50 ms at a 60 Hz update rate and between 66 ms and 100 ms at a 30 Hz update rate.

Texture and Polygon Memory

Between 28 Mbytes and 124 Mbytes of space is available for Polygon and Texture storage on board.

Texture and polygon paging is available as a function of the simulation software.

In multi-board configurations, each *Barracuda* board within a single display channel should have the same memory configuration.

Display Formats

Barracuda drives a variety of display devices. Display timings and synchronisation modes are user programmable using a simple ASCII file format.

Video Resolutions

Display formats supported include:

- 1280*1K,
- 1152 * 900
- 1024*1024,
- XVGA (1024*768),
- SVGA (800*600),
- VGA (640*480),
- Field sequential (VGA, SVGA at 180Hz)

Synchronisation modes

Barracuda drives 5 wire synchronisation: Red, Green, Blue, Horizontal Sync, Vertical Sync

The display outputs are at RS343 standard voltage levels designed to drive standard 75 ohm terminated loads. Synchronisation signals are TTL compatible with negative active levels.

Genlocking

Barracuda can accept synchronising signals from other sources, genlock input is made using balanced ECL or TTL input sources. Up to 1 metre separation between synchronized channels is allowed

Barracuda inter-channel connectors work within one PC system or between adjacent PC systems allowing very large pixel-locked configurations to be built.

Gamma Correction

Full 256 entry non monotonic gamma correction is provided. Multiple projectors and monitors are supported

Host Computer Requirements

Barracuda hardware is compatible with all architectures supporting PCI slots however drivers are not available for all PCI hosting architectures. Contact Primary Image for a list of currently supported architectures.

Barracuda does not generally require a high performance PC host, however sufficient power and cooling must be provided. This is especially the case in systems where 2 or more **Barracuda** cards are used together as these multiboard systems consume power and generate significant heat.

Primary Image sells many different PC chassis which are capable of supporting the power and cooling requirements.

General advice for selection of PC host
- Boards should be mounted vertically wherever possible
- Expansion card cooling fan must be operating
- A standard desk or tower PC should have no more than 2 boards in it
- Use at least a 250W supply with a single board, 400W supply with 2 boards, 750W more with than 2 boards.

Physical and Environmental

Size
Connector and electrical interface: conforms to PCI 32 bit standard (V2.1)
Height : 106.7 mm (max.) PCI standard
Length : 312 mm (max.) PCI Long card standard
Depth : 17 mm
Weight : 400 g

Electrical
Supply + 5.0V 3 Amps maximum on main bus
+12V 0.01 Amps
5.0V 6 Amps on auxiliary power connector

Power consumption 25 W typical, 45 W maximum (2 pixel chains)

Interface connections
- PCI host connection

- Video out: 15 way compressed VGA high density D-type

- Auxiliary power (+5V)

- Board interconnect:
  - digital TTL/ECL channel sync bus, flexible interconnect
  - digital pixel bus
  - digital polygon bus

- RS232 Serial port – for head tracker or diagnostic for software development

Reliability
Mean Time Between Failure (MTBF)
(using MIL-217F calculations) Ground-based benign environment

Barracuda single pixel chain	32MB	79,000 Hours
Barracuda dual pixel chain	64MB	70,000 Hours

Mean Time to Repair (MTTR)
10 minutes typical to replace board in industrial PC configuration

Environmental

Operating conditions:

Temperature (on board):	+5°C to +50°C
Humidity:	20° to 80° relative non-condensing

Storage conditions:

Temperature:	-10°C to +80°C
Humidity:	0° to 95° relative non-condensing

Regulatory approval

EMC:

      CE Approval within approved chassis

Further Details

Primary Image has a policy of continuous development of its products. If you are interested in any of the Primary Image product range or require further information, please contact us at the addresses given below.

PRIMARY IMAGE (Graphics) Ltd.	PRIMARY IMAGE Inc.
Millbank House	P.O. Box 781207
171-185 Ewell Road	Orlando,
Surbiton	FL 32878-1207
Surrey, KT6 6AP	USA
UK	
TEL: +44 (0)208 339 9669	TEL: +1 407 382 7100
FAX: +44 (0)208 339 9091	FAX: +1 407 382 8004
email: contact@primary-image.com	email: corp@primary-image.com

web site http://www.primary-image.com

Copyright Primary Image 1999

Barracuda is a registered trade mark of Primary Image (Graphics) Ltd or is used under licence.   All other trade marks acknowledged.   Specifications subject to change without notice

REF: ***Barracuda*** spec
Issue 1.0, March 1999