Bridging the Gap Between the PC and Digital Hollywood

Our Technology Vision

- Bridging the gap between Digital Hollywood and the PC
- Recreating reality for the ultimate visual experience
- Capturing the subtleties of light, color, and texture
- Deliver these technologies:
  - With real-time interactivity and frame rates
  - At consumer-friendly prices

3D Breakthroughs for Mainstream PCs

1997 Voodoo Graphics

- RGBA Rendering & frame buffer
- Real-time perspective-correct texture-mapping
- 30Hz @ 640x480

266MHz CPU

1998 Voodoo2 & 3

- Multi-texturing
- Trilinear Mip-mapping
- Detail Texturing
- Projected Texturing
- Triangle Setup
- 60 Hz @ 800x600

450MHz CPU

1999 FSAA / T-Buffer™

- T-Buffer™ cinematic effects
- Full-scene, sort-independent Anti-Aliasing
- Motion Blur
- Depth of Field
- 85 Hz @ 1024x768

700MHz CPU

Future

- Significantly enhanced real-time photorealism
- Real-time, interactive "Toy Story" on the PC

Next Gen CPU

3dfx Interactive

VSA-100 Technology

Introducing the 3dfx VSA-100 Engine

- **The graphics engine behind the new generation of Voodoo**
  - **AGP 4x / PCI**
  - **Up to 64MB graphics memory per chip**
  - **32-bit RGBA, 24-bit Z & W, 8-bit Stencil rendering**
  - **32-bit textures**
  - **2K x 2K texture size**
  - **350 MHz RAMDAC**
  - **166 - 183 MHz clock speeds**
  - **333 - 367 Mpixels / second per chip**
  - **0.25e, 6-metal process, 14M transistors**

Image Quality Features

- Single-Pass, Single-Cycle Multi-Texturing
- Single-Pass, Single-Cycle Bump Mapping
- Single-Pass, Single-Cycle Tri-Linear Mip-Mapping
- Per-Pixel MIP Mapping and Alpha Blending
- 8-Bit Palletized Textures:
  - No performance penalty
  - Game Compatibility
- Exponential Fog-Table
- Floating Point Z Buffer to Eliminate Z-Aliasing
  - Also Floating Point W Buffer
- Dynamic Environment Mapping

DVD Video Acceleration

- Hardware Assist With Planar-to-Packed Conversion
- Full 30fps MPEG2 Playback With No Dropped Frames
- Measured With 9.5Mb/Sec Content:
  - Celeron 333A: 80% CPU Utilization
  - Pentium2-450: 58%
  - PentiumIII 600: <50%

Key OEM Features

- All of the Voodoo3 Features Plus
  - AGP 4x
  - 32-bit rendering
  - 64MB frame buffer
- Driver forward/backward compatibility
- Enhanced video input
  - VMI1.4 + CCIR 656
- All DX6, DX7, and OpenGL 1.2 texture blends
- Guardband clipping
- Significantly improved video downscaling

Introducing:
3dfx VSA-100™ Technology

Extreme
Fill Rate

Scaleable
Architecture

Breakthrough
Anti-Aliasing

Texture
Compression

Cinematic
Effects Engine

3dfx Interactive

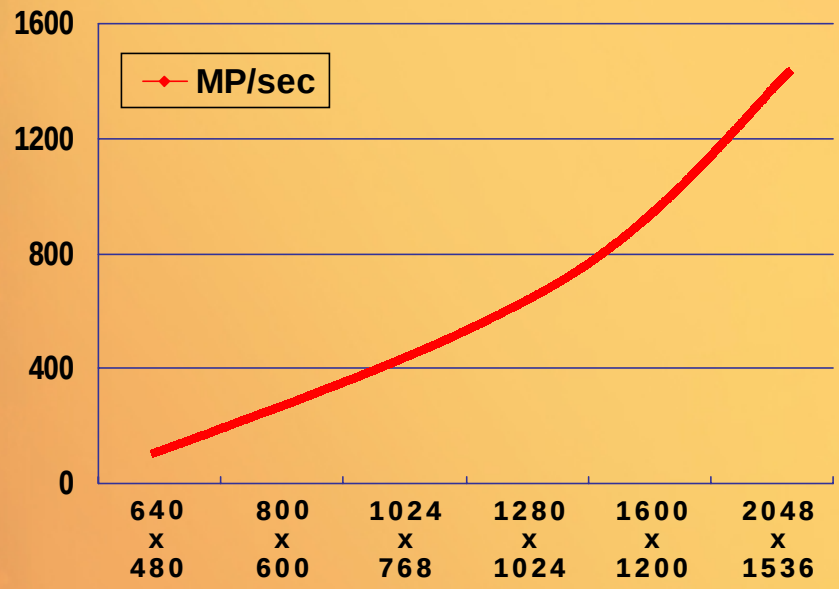
Scaleable Architecture

	Consumer 3dfx	Professional QuantumD
VSA-100™ Chips	1 - 4	8 - 32
Pixels/sec	333 Mpixels/sec - 1.47 Gpixels/sec	>3 Gpixels/sec
Video Memory	16 MB - 128 MB	Up to 2 GB
Price Range	~$179 - $599 (US)	Up to ~$40,000

3dfx Interactive

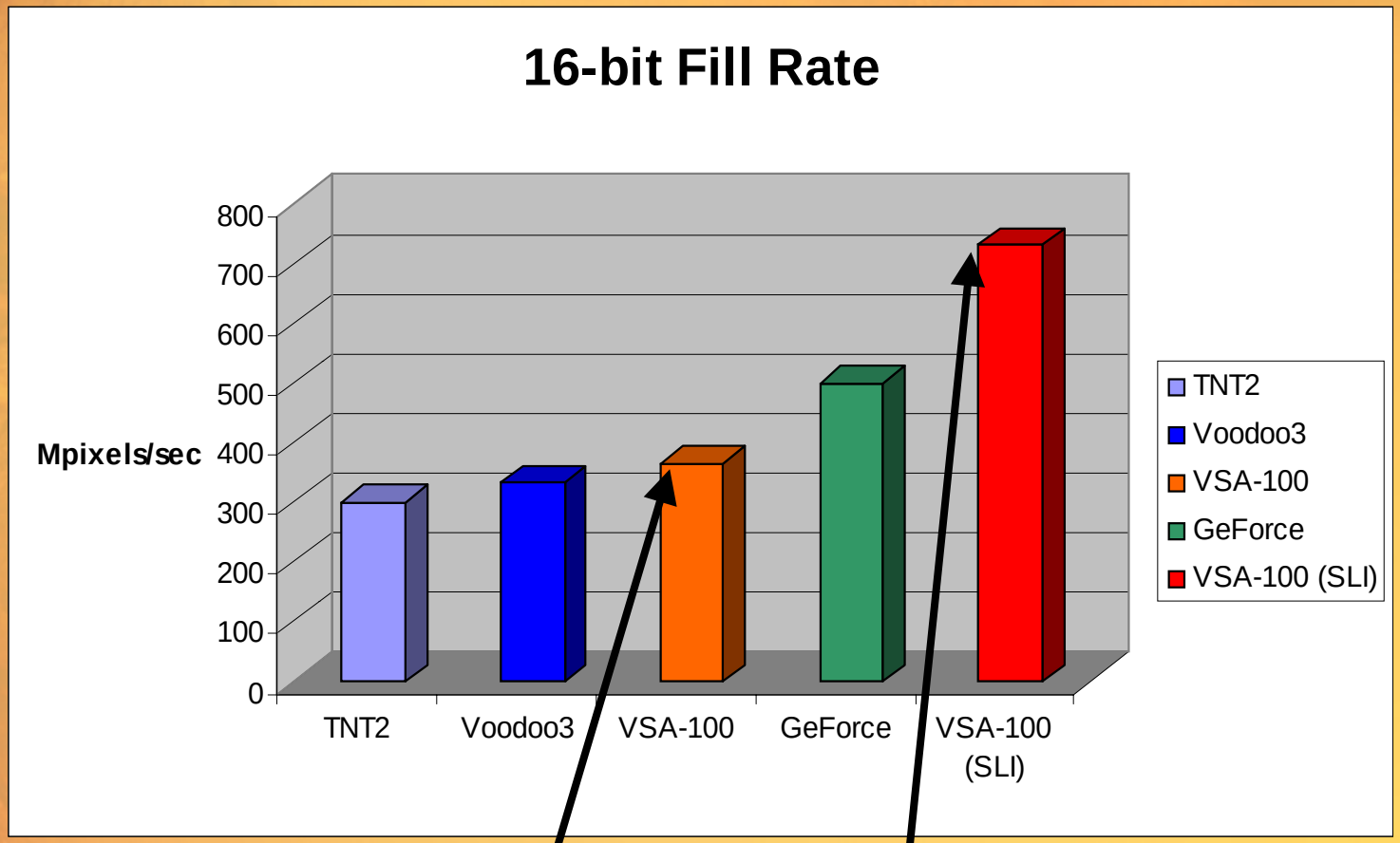
Insane Fill Rates

- 333 Mpixels/sec to 3.2 Gpixels/sec
- Enables:
  - High resolutions
  - Significant depth complexity
  - Highest visual quality
  - Digital cinematic effects



Quake3 32bpp fill rate requirements (MP/sec) for 60 fps at various resolutions

Performance



VSA-100 offers 20% better fill rate than TNT2.

VSA-100 (SLI) offers 45% better fill rate than GeForce.

Technology Details

Next Generation
Scan Line Interleave (SLI)

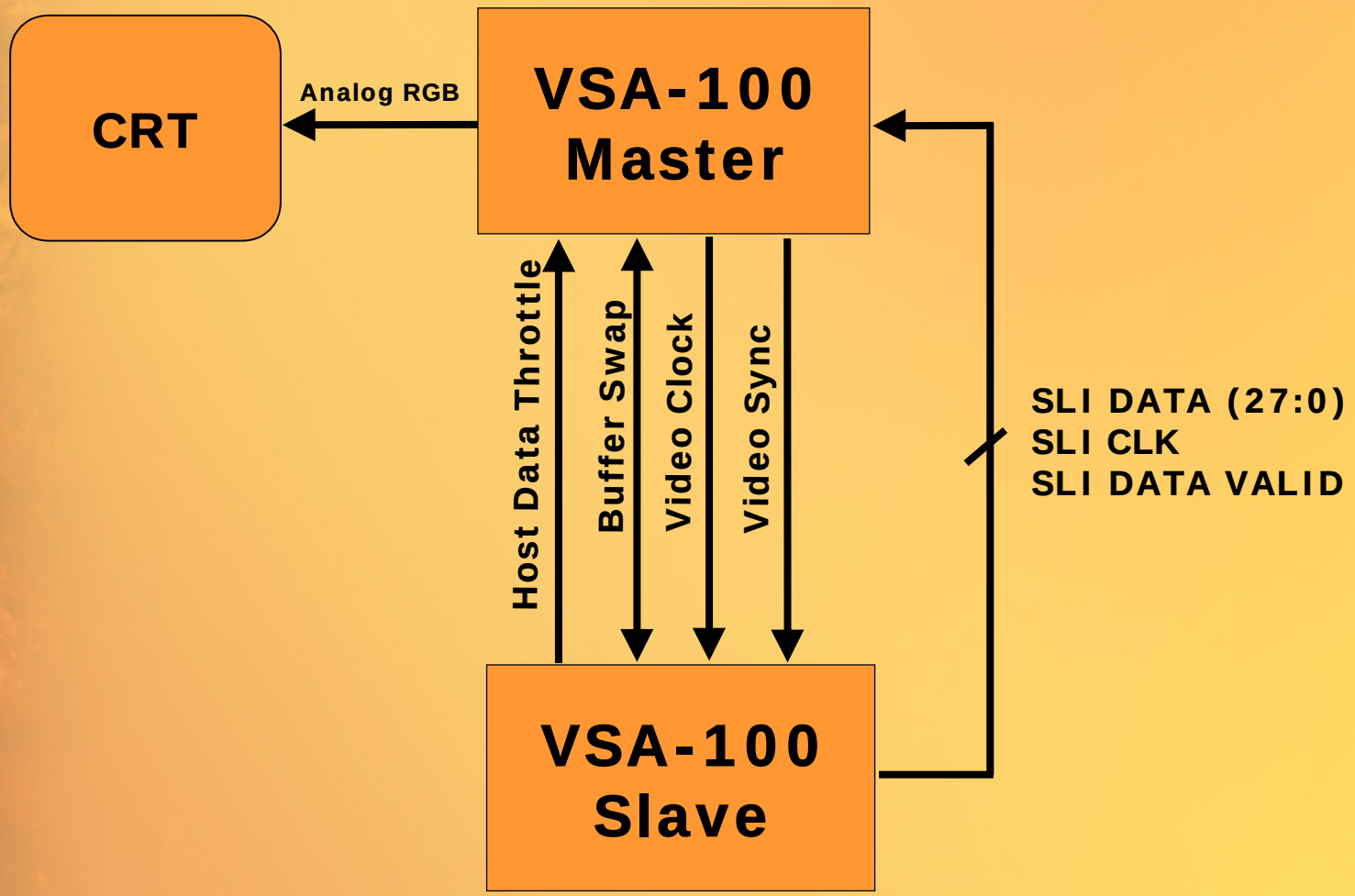
Voodoo2 SLI

- First consumer implementation of scanline interleaving, but with some limitations...
- Limited to 2 interleaved boards
  - One board renders even scan lines, the other renders odd scan lines
- PCI only
- Requires multiple PCI slots
- Resolution limitations
  - Maximum resolution of 1024x768

VSA-100 SLI

- True multi-chip communication protocol
  - Scanline interleaving
  - Full-scene anti-aliasing
  - T-Buffer™ cinematic effects
- Supports up to 32 interleaved chips
  - Programmable number (1-128) of scan lines rendered per chip
  - Fill rates and effects never before possible
- Support for both PCI and AGP
- Support for High Resolution
  - 1600x1200 and beyond...

VSA-100 in 2-way SLI / AA

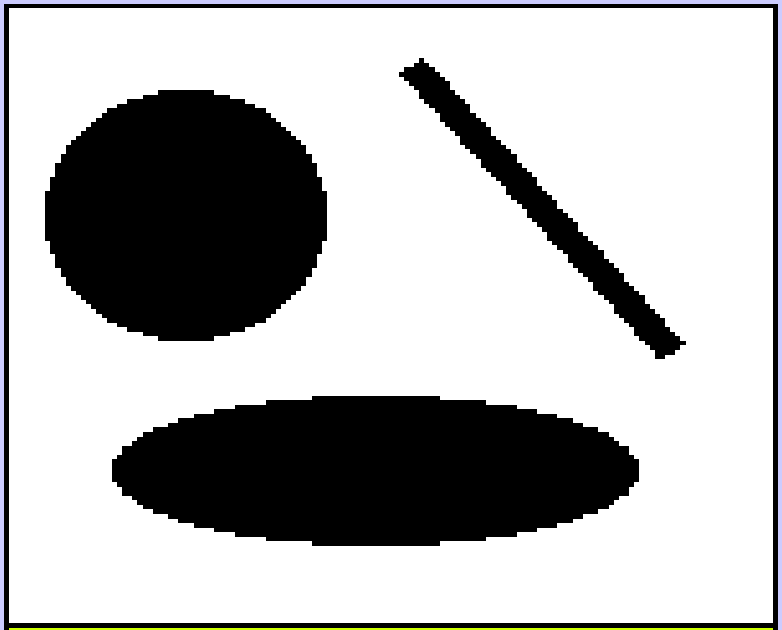


Technology Details

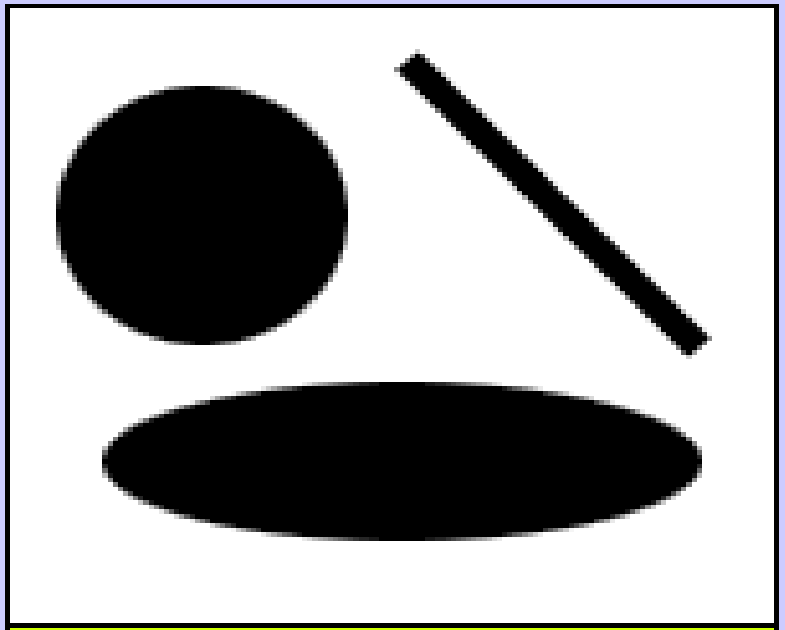
Full-Scene HW Anti-Aliasing

Full-Scene Anti-Aliasing

- The "Holy Grail" of 3D image quality
- AA is the smoothing of rough spatial edges or “jaggies” that always exist in real-time digitally-generated artwork
- Removes triangle edge “jaggies”
- Eliminates pixel “popping”
- 100% compatible with standard API’s
- Automatically upgrades existing and future games



aliased



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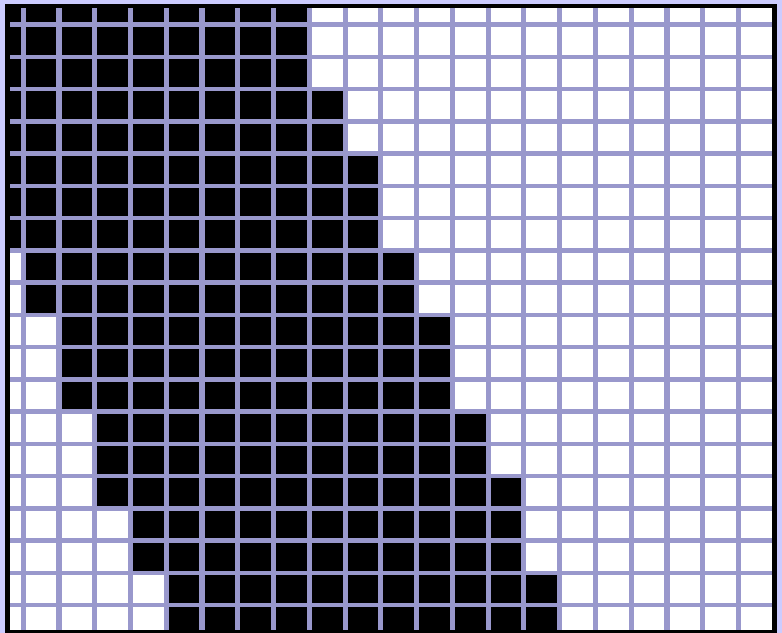

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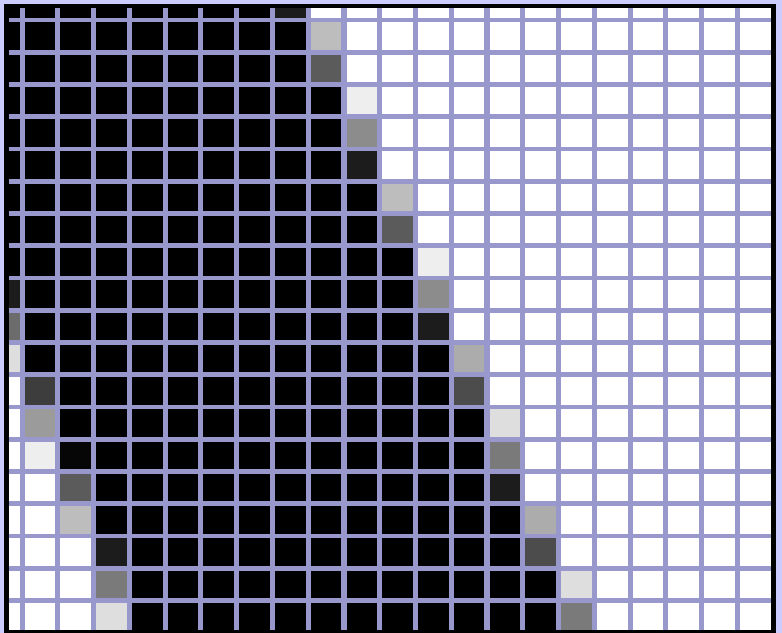
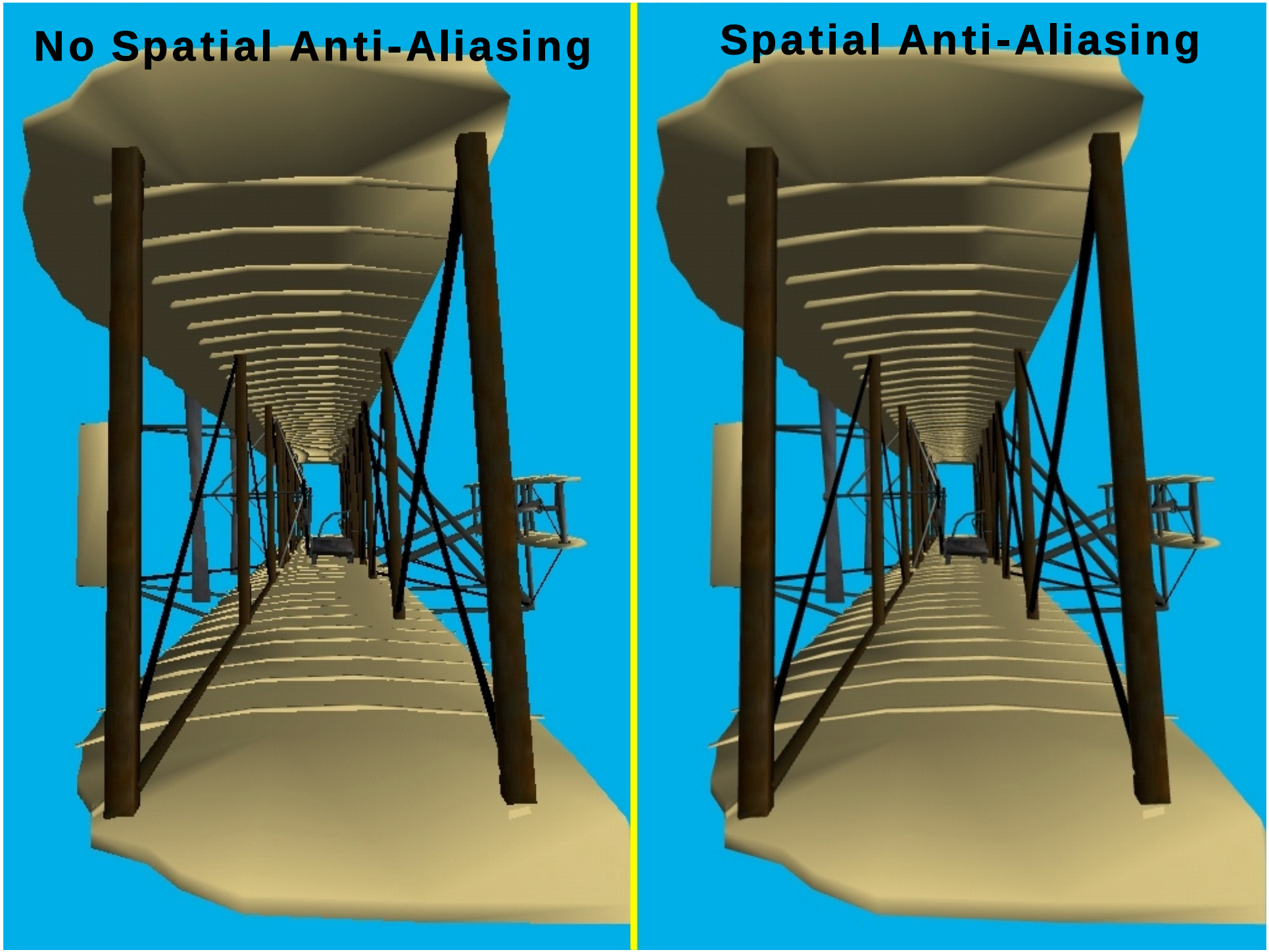
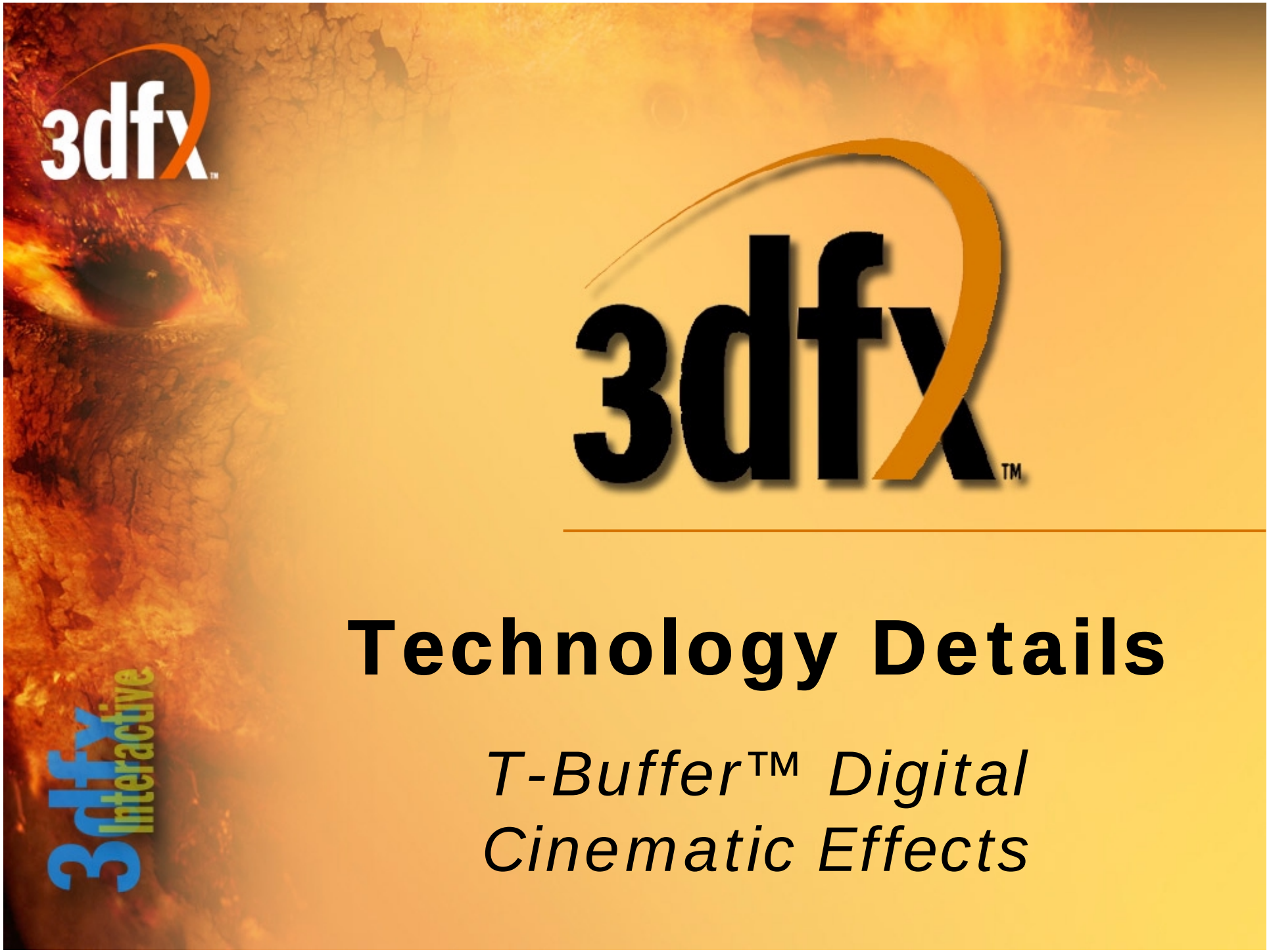


antialiased


No Spatial Anti-Aliasing
Spatial Anti-Aliasing


No Spatial Anti-Aliasing


Spatial Anti-Aliasing
Lap:
Best:
Clock:
Back:
Place: 3/3
Lap: 1/3

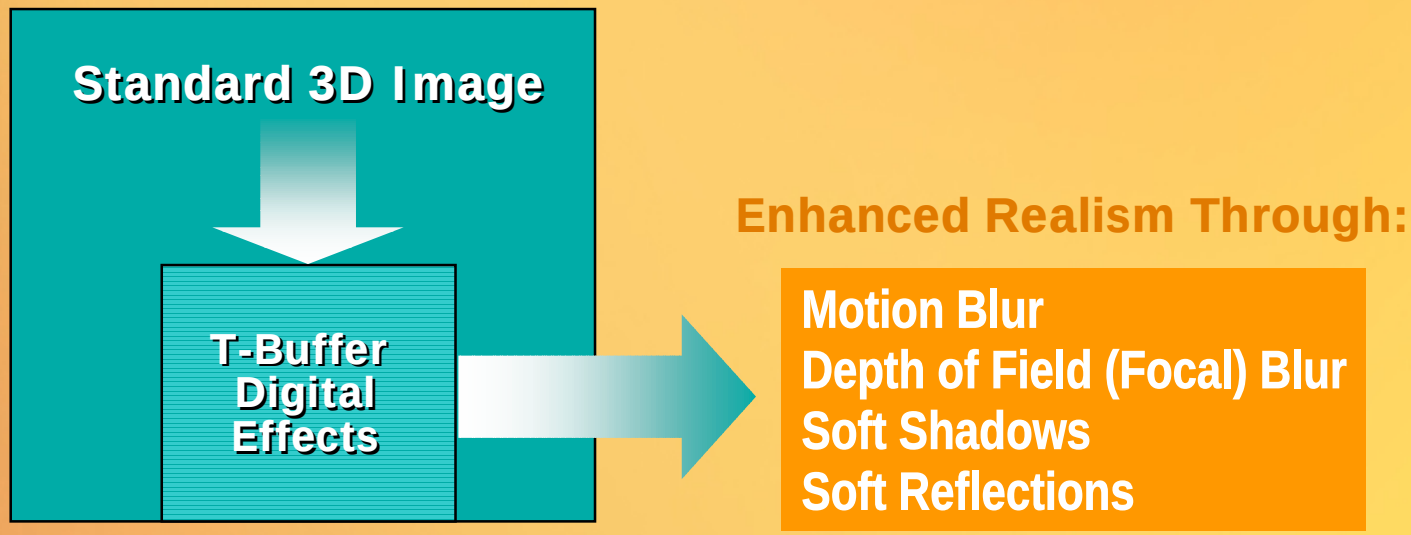


Technology Details

T-Buffer™ Digital Cinematic Effects

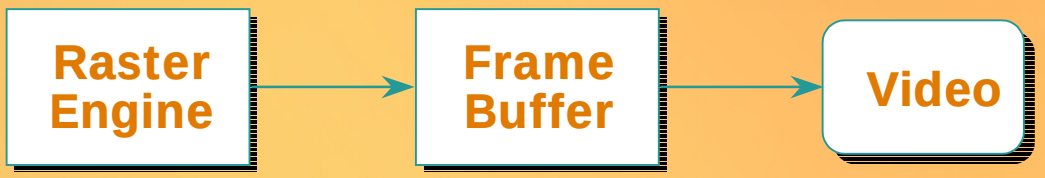
T-Buffer™ Technology: What Is It?

- Proprietary image enhancement and digital effects engine
- Enables spatial, temporal, and focal effects previously unavailable in mainstream PCs
- One more step toward fulfilling 3dfx's mission to bring Hollywood-like digital effects to the mainstream PC



T-Buffer™: What Is It?

Conventional PC Accelerator



3dfx T-Buffer™

- **Special rendering and video architecture**
  - **Accumulates multiple renderings**
  - **Similar to the Accumulation Buffer but…**
    - **Able to apply effects to certain portions of the display for higher performance**
    - **Much lower memory space and bandwidth requirements**
    - **No need to "accumulate" results**

Visual Reality: The T-Buffer™

Motion Blur

Depth Of Field Blur

Soft Reflections & Shadows

Developers Become “Content Directors”

T-Buffer™ Benefit: Motion Blur

- Temporal anti-aliasing is a method to introduce *Motion Blur* into a rendered scene
- Simulate objects' motion during period of time that a "camera shutter" is open
- Store multiple time samples of a scene, or an object within a scene, using the multiple buffers supported in the T-Buffer


Motion Blur
*Image from “A Bug’s Life,” Copyright 1998, Pixar Animation Studios

Motion Blur

*Image from “Quake3”, Copyright 1999

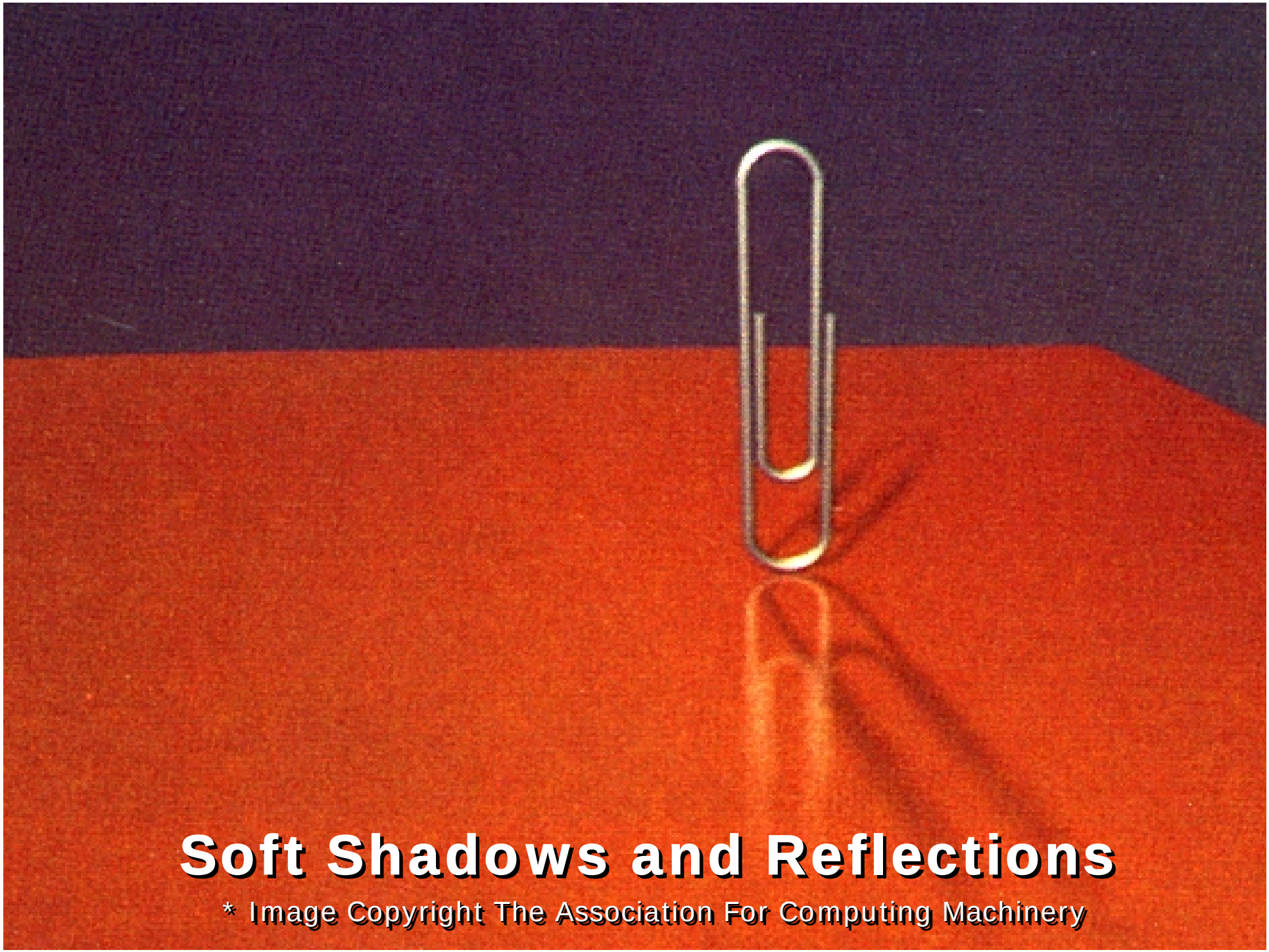
T-Buffer™ Benefit: Depth Of Field Effects

- Depth of Field (DOF) simulates the blurring of objects at varying distances from the focal point of a lens (like a camera or your eye)
- DOF Effects benefits:
  - Enables “aperture” effect for cinema-like image quality
    - Important cinematic effect previously unavailable on a PC
    - Heavily used by directors to draw attention to specific points in a scene
  - Advanced effects like double-vision: get bonked on the head and your vision is blurred


Foreground Focus
Depth Of Field Focus
Background Focus
3dfx Interactive
*Images from "A Bug's Life," Copyright 1998, Pixar Animation Studios

Soft Shadows & Reflections

- Soft shadows accurately depict the effects of area lights and diffraction
- Soft reflections deliver a realistic reflection from real-world surfaces


Soft Shadows and Reflections
* Image Copyright The Association For Computing Machinery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3dfx™
Technology Details
FXT1™
Texture Compression
3dfx Interactive

Texture Compression

- Both FXT1 and DXTC (all five modes)
- Increases image quality and performance
  - More textures available for rendering
  - Higher resolution textures
  - Less memory bandwidth needed

256x256 Texture

2048x2048 Texture

FXT1™: Texture Compression
Benefits

- No perceptible loss in image quality
- Enables use of very high-resolution textures
- Decreases memory storage requirements
- Decreases memory bandwidth requirements
- Maximizes available memory bandwidth
- Increases sustained fill-rate and frame rates

FXT1™: Texture Compression
Benefits

- **Increases total number of textures available for rendering**
  - Store up to 8x number of compressed textures in same space that used to be required for just one
- **Enables use of higher resolution textures for better image quality**
  - Uncompressed 2048x2048 32bpt texture requires 16MB memory (almost unusable on current hardware) compared 2MB when FXT1 compressed

FXT1™: Texture Compression
Benefits

- **Permits use of more textures per polygon for advanced effects**
  - FXT1 texture compression makes more bandwidth available
  - More textures can be used to render a given object allowing for effects like bump mapping, light maps, detail textures, etc.

FXT1™: Texture Compression
How does it work?

- **Encoding:**
  - Divides image up into multiple 4x4 or 4x8 texel blocks
  - Individual texel blocks encoded using one of four different algorithms to maximize image quality
  - Results in 4 bit-per-texel storage and bandwidth requirements
  - Compressed textures can be encoded during installation, when a scene loads, or stored on CD

FXT1™: Texture Compression
How does it work?

- **Decoding:**
  - Compressed textures are stored natively in system memory or local frame buffer memory
  - Decompression is performed by 3D hardware accelerator during run-time only when the compressed texture is used for rendering
  - Each texel block includes a 2-bit field used to identify which of the four different compression algorithms is used

FXT1™: Texture Compression

How does it look?

Uncompressed Image

24 bits-per-texel

FXT1 Compressed Image

4 bits-per-texel

FXT1™: Texture Compression

What FXT1 delivers that other texture compression doesn't

- **Open Source format**
- **Cross Platform Support**
  - Windows, Macintosh, Linux and BeOS
- **Includes free tools for encoding and decoding**
  - No royalty or licensing fees for content developers or independent hardware vendors
  - Allows anyone to innovate with higher quality and/or faster implementations

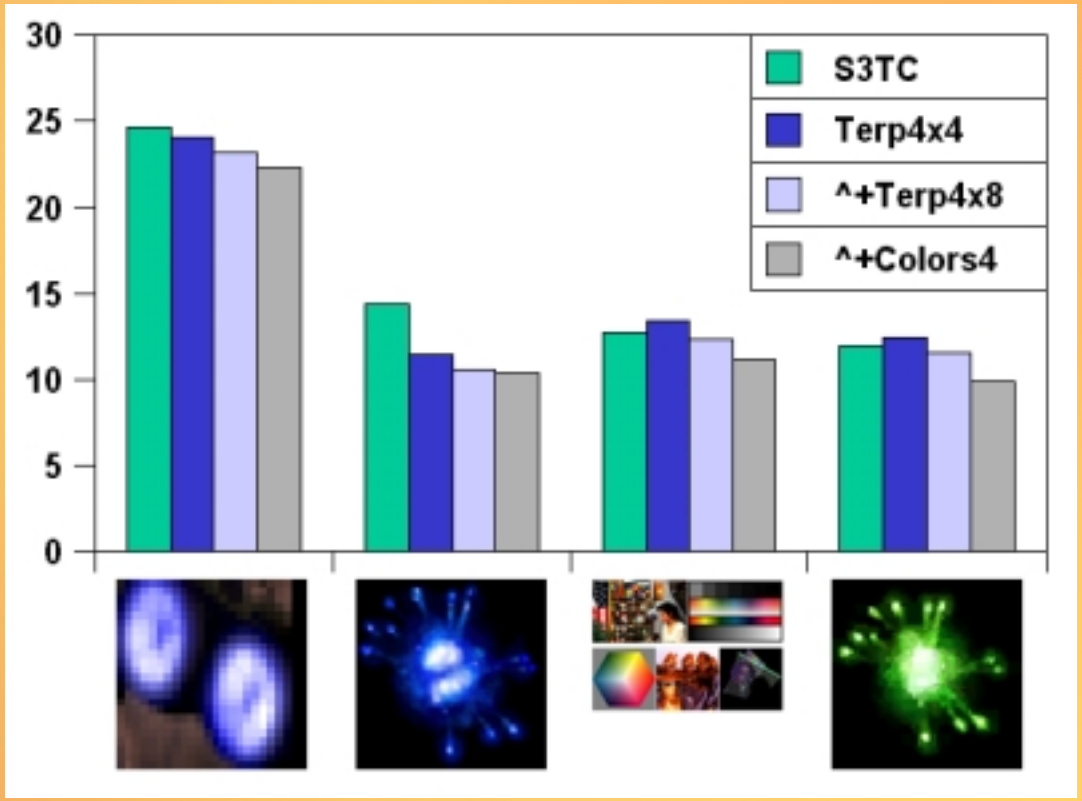
FXT1™: Texture Compression

What FXT1 delivers that other texture compression doesn't

- **Highest possible image quality**
  - Multiple algorithms used for every image to deliver most precise reproduction of original artwork
- **Best compression ratio for textures with more than single bit alpha**
  - FXT1 uses 4 bpt compression for textures even with multi-bit Alpha channels -- reduces storage requirements by 1/3
- **Free**

FXT1™: Texture Compression

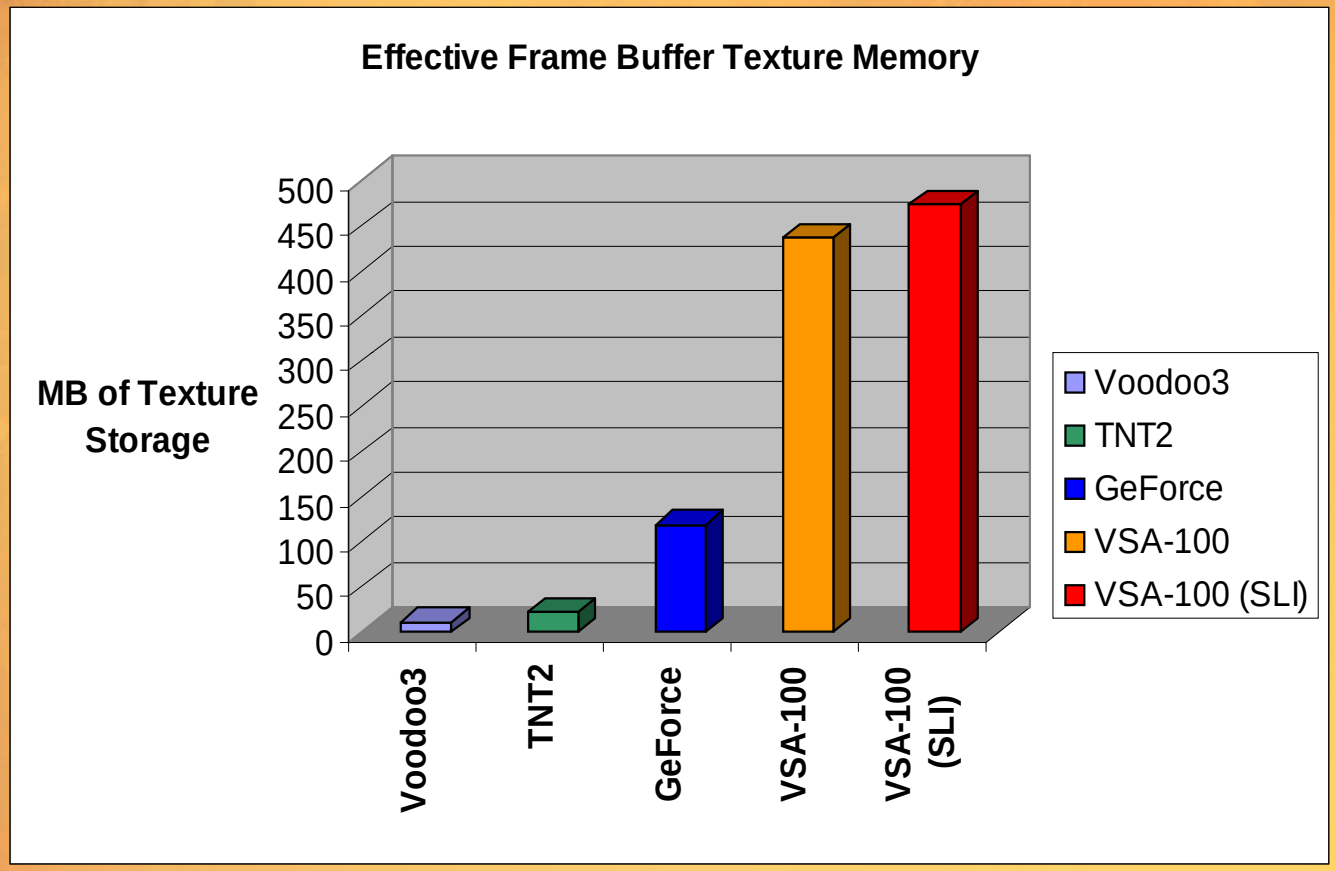
How does it compare to S3TC™?



Lower bar is better

With 4 different techniques used to compress each image, FXT1™ provides the most accurate image reproduction as measured by Root Mean Square error of each encoding algorithm

Frame Buffer Advantage



- Effective texture memory is frame buffer memory remaining after setting frame buffer to highest bit depth at 1024x768, double-buffered with Z, using 32-bit or 32-bit compressed textures.

VSA-100™ Summary

- **Breakthrough features and performance for the mainstream PC**
  - Scalable Architecture
  - Real-Time Full Scene HW Anti-Aliasing
  - T-Buffer™ Digital Cinematic Effects
  - Leadership Fill Rates
  - FXT1™ Texture Compression
  - The First Giga-pixel board!!
- **The Best Out Of Box Experience In Years**

And Now,
The New Products

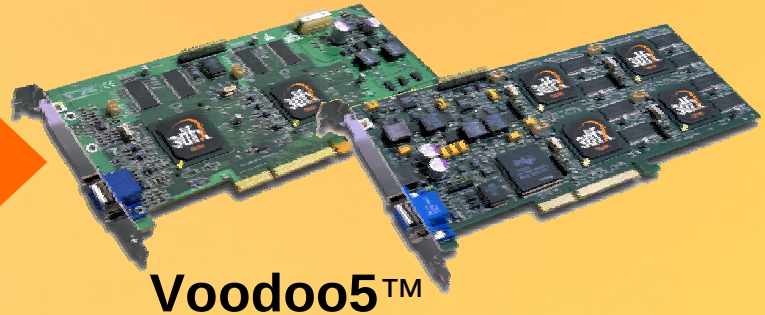
The New VSA-100™ Board Products

8 to 32 Chips

QUANTUM3D

"professional"

Dual to Quad Chip



Voodoo5™
"gaming enthusiasts"

Single Chip

Voodoo4™
"mainstream consumers"

3dfx Interactive

Voodoo4™ 4500 AGP & PCI

- Single 3dfx VSA-100™
- 32 MB graphics memory
- 2 pixels per clock rendered
- 333 - 367 megapixels/sec
- ~$179 US

Voodoo5™ Product Line

- Multi chip product line
- Programmable scan line interleaving
- Real-Time Full-Scene Anti-Aliasing
- T-Buffer™ Digital Cinematic Effects
- Insane fill rates
  - 667 to 1.47 megapixels/sec

Voodoo5™ 5000 PCI

- Real-Time Full-Scene Anti-Aliasing
- T-Buffer™ Digital Cinematic Effects
- 32 MB dual chip SLI
- 4 pixels per clock rendered
- 667 - 733 Megapixels/sec
- ~$229 US

Voodoo5™ 5500 AGP

- Real-Time Full-Scene Anti-Aliasing
- T-Buffer™ Digital Cinematic Effects
- 64 MB dual chip SLI
- 4 pixels per clock rendered
- 667 - 733 Megapixels/sec
- ~$299 US

Voodoo5™ 6000 AGP

- Real-Time Full-Scene Anti-Aliasing
- T-Buffer™ Digital Cinematic Effects
- 128 MB quad chip SLI
- 8 pixels per clock rendered
- 1.33 - 1.47 Gigapixels/sec
- ~$599 US

Quantum3D AAlchemy™

- Ultimate image quality and scalability to serve the visual simulation and training markets
- 8 to 32 chip VSA-100™ SLI configurations
- Up to 2 GB video memory with over 100 GB/sec memory bandwidth
- Up to 3.2 billion 32-bit, 4-sample AA pixels/sec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