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Real Time Cinematic Effects on the PC

The 3dfx T-Buffer™



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Agenda

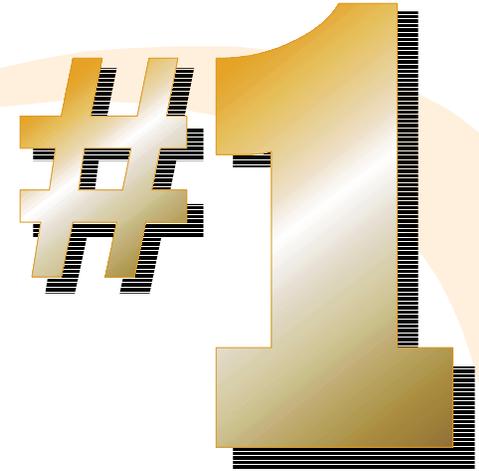
- Corporate Overview
- Technology Overview
- 3dfx Technology Innovation: T-Buffer
- Conclusion



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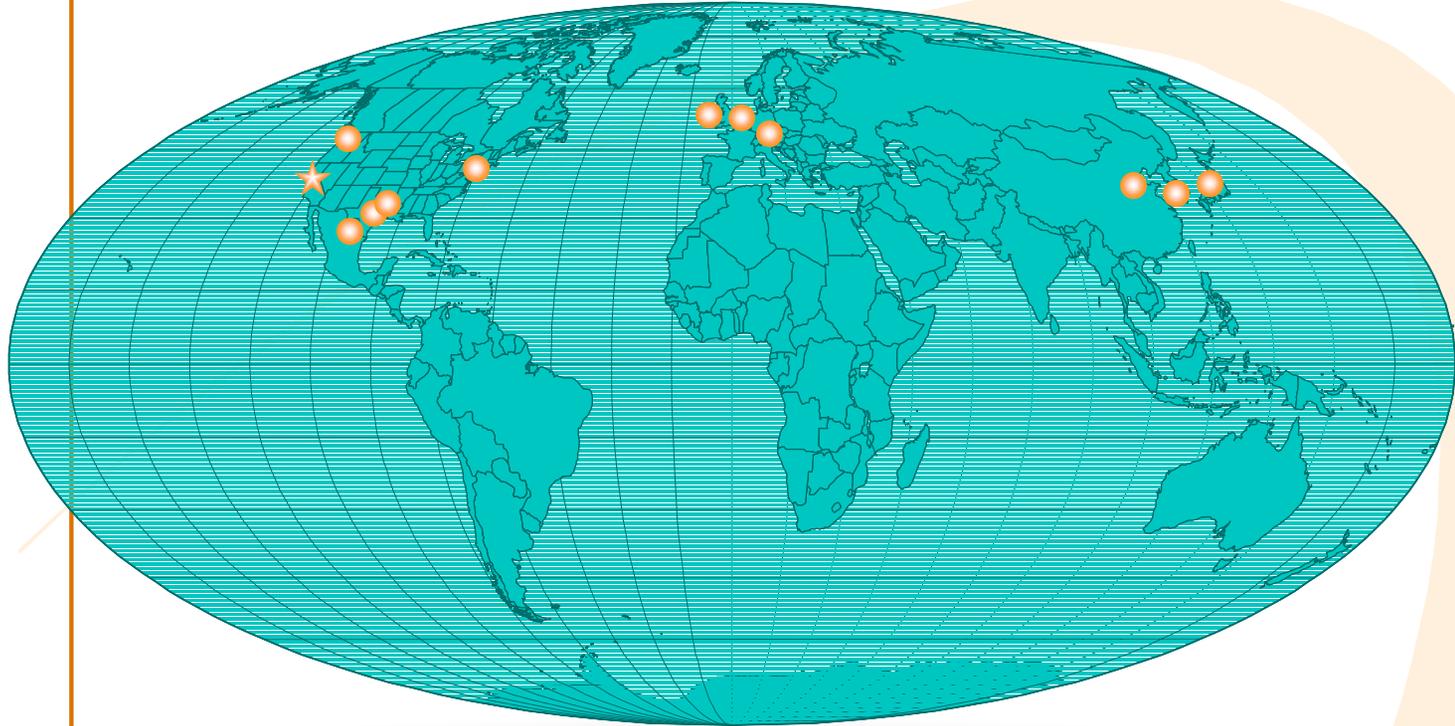
We Are . . .

- The most recognized PC graphics brand*
- The number one shipping retail graphics product**
- The number one fastest growing company in Silicon Valley***
- A branded technology company with worldwide distribution
- A vertically integrated company providing complete graphics solutions
- A leading supplier of integrated 2D, 3D and video graphics technology



A Worldwide Organization

World-class manufacturing and distribution facilities around the world

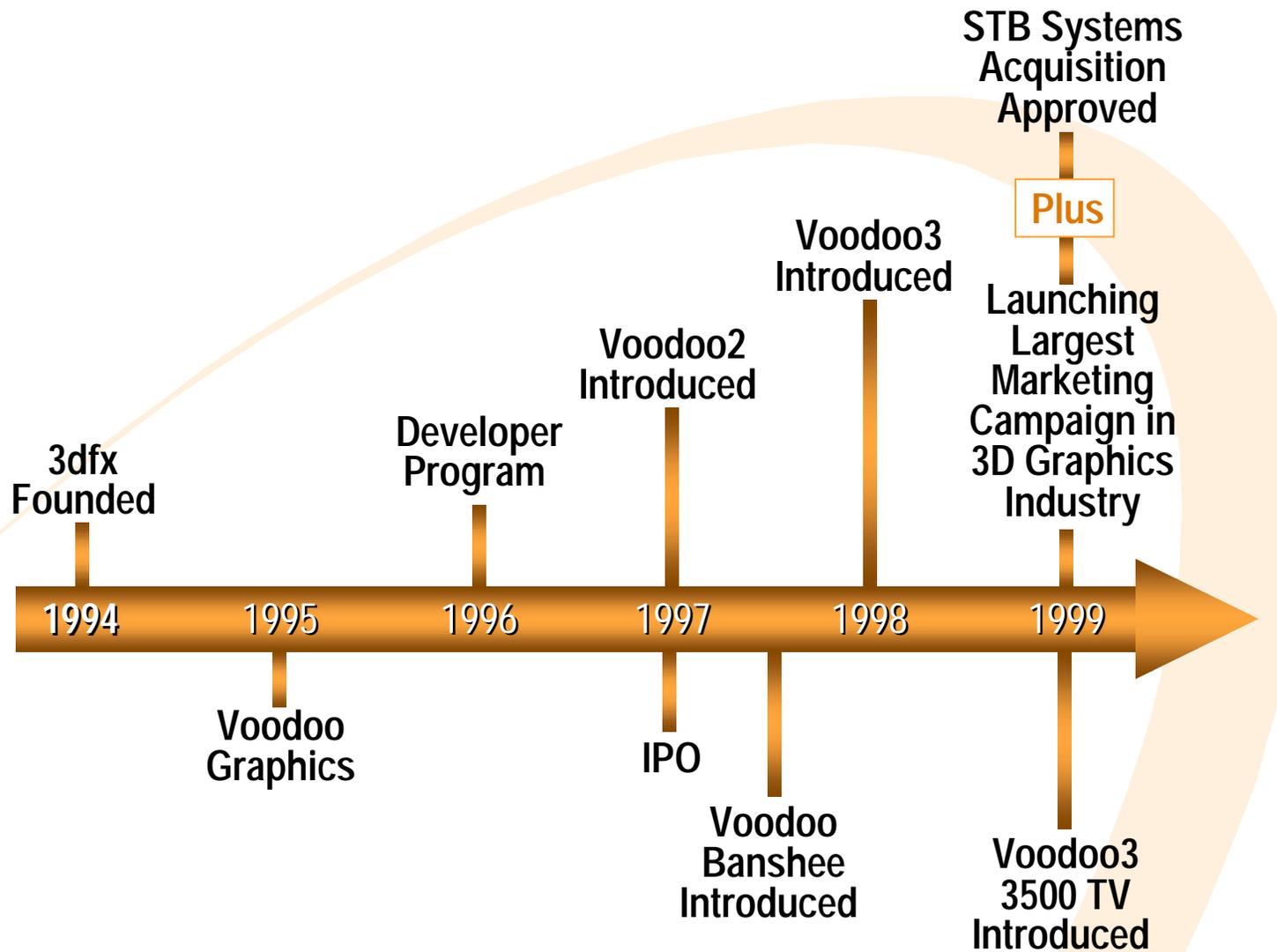


- Seattle, WA
- San Jose, CA
- Austin, TX
- Fort Collins, CO
- Richardson, TX
- Philadelphia, PA
- Juarez, Mexico
- Belfast, Ireland
- Paris, France
- London, England
- Tokyo, Japan
- Beijing, China
- Seoul, Korea



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A Little History . . .

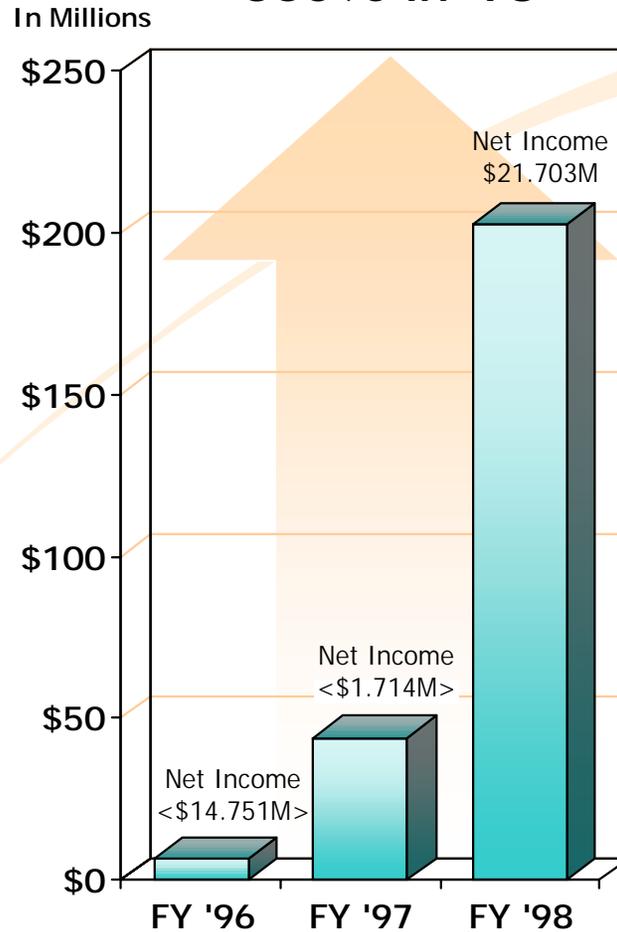




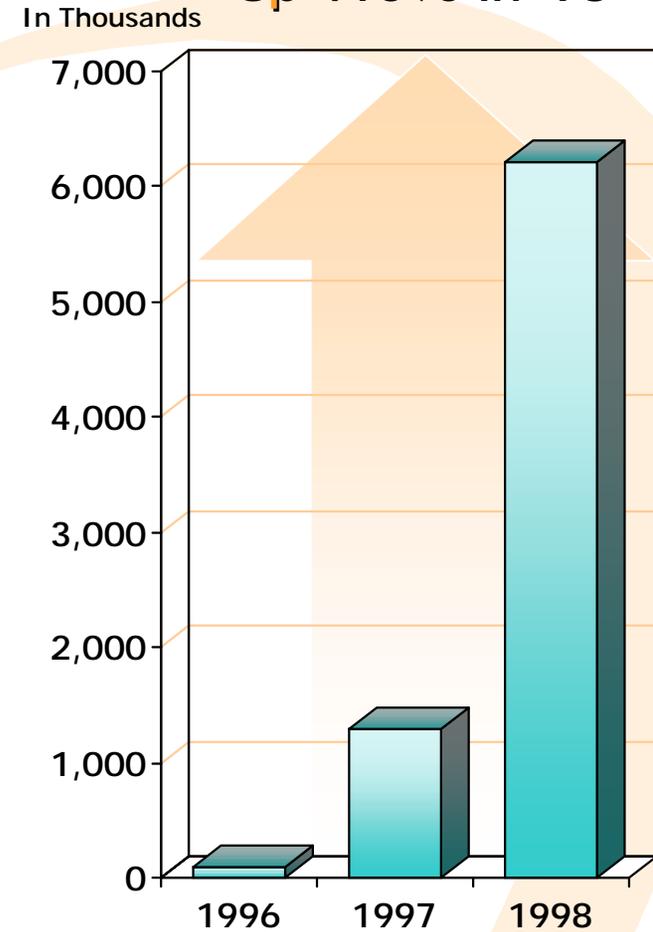
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A Look at Our Growth

Revenue Growth 360% in '98



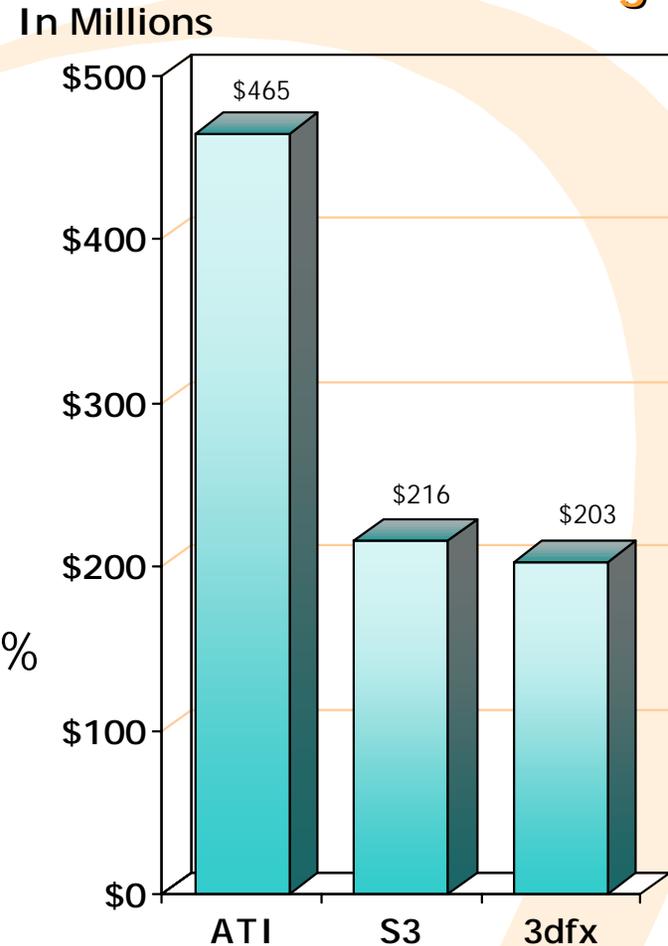
Unit Shipments Up 410% in '98





3dfx Market Position

1998 Desktop Revenue Ranking



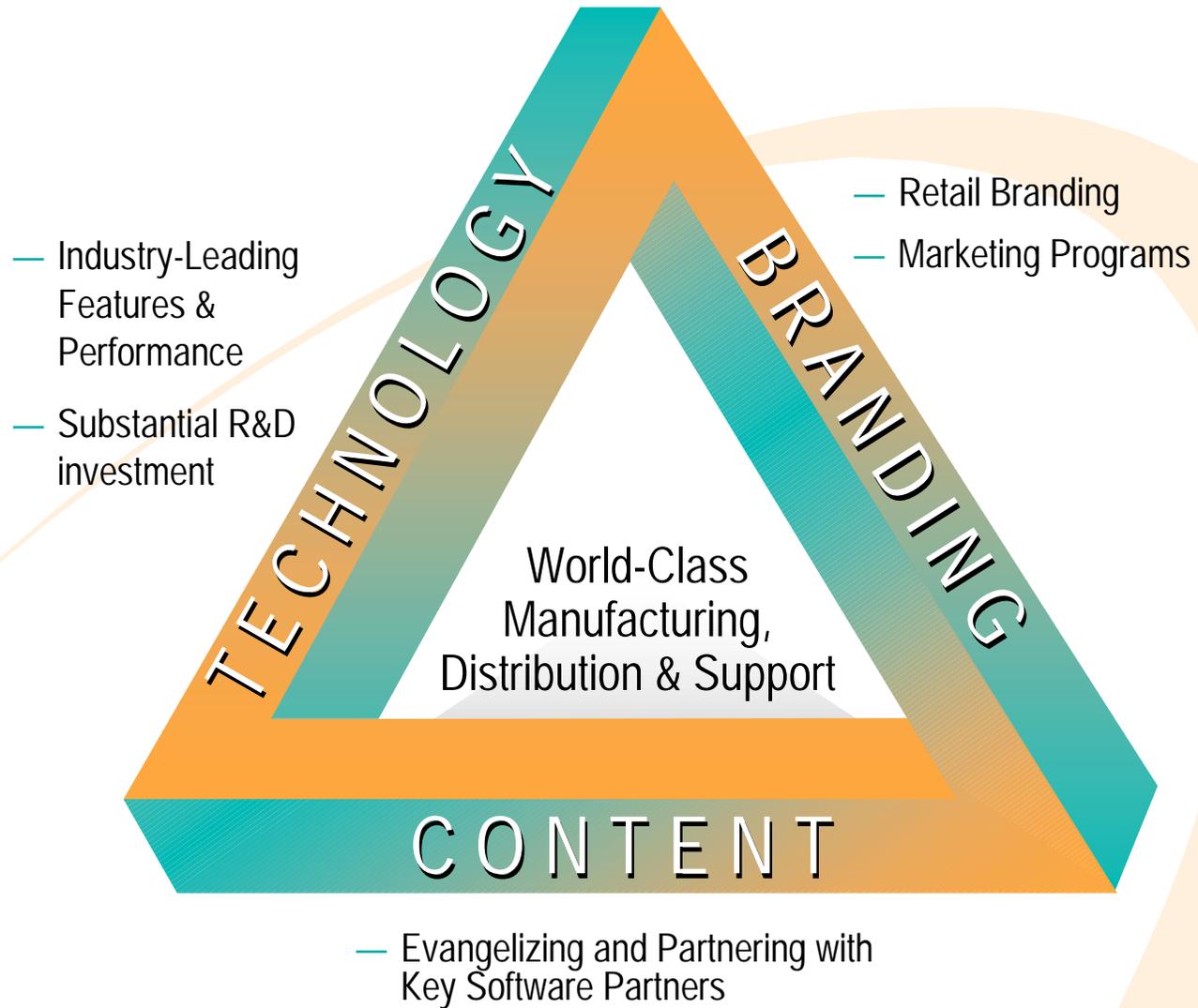
— No.1 retail graphics product since Voodoo Graphics launch in 1996

— No. 3 in desktop graphics revenue in 1998

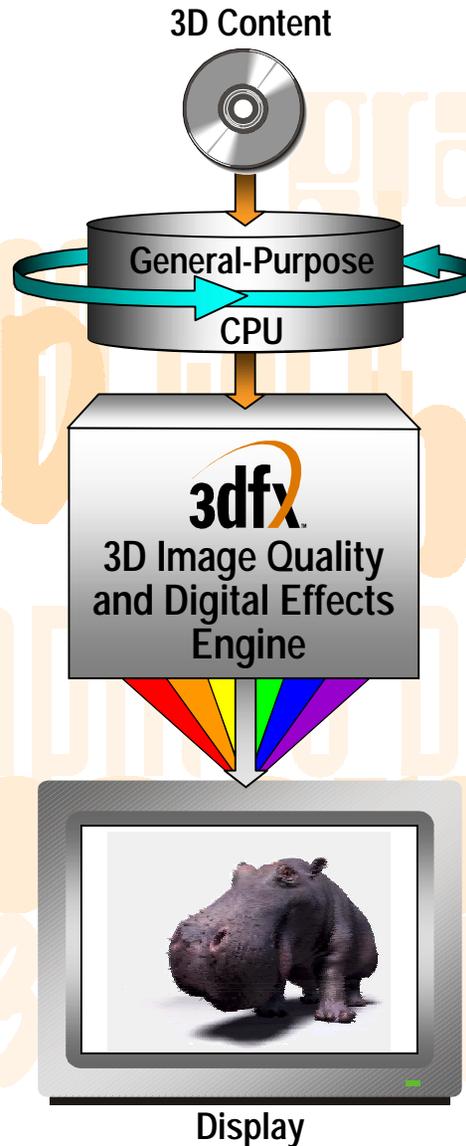
— Electronic News - top graphics suppliers for May '99

○ - ATI 29%, 3dfx 27%, nVidia 23%

3dfx Model for Success



What is a 3dfx Graphics Accelerator?



General-purpose horsepower
"Something for everyone"
Productivity applications are done here

The 3dfx graphics subsystem renders 3D images and adds special effects
Consumers buy 3dfx accelerators for cool special effects and stunning image quality
Real-time special effects similar to those done by Digital Hollywood are done here

3dfx closes the gap between real-life imagery and computer-generated graphics



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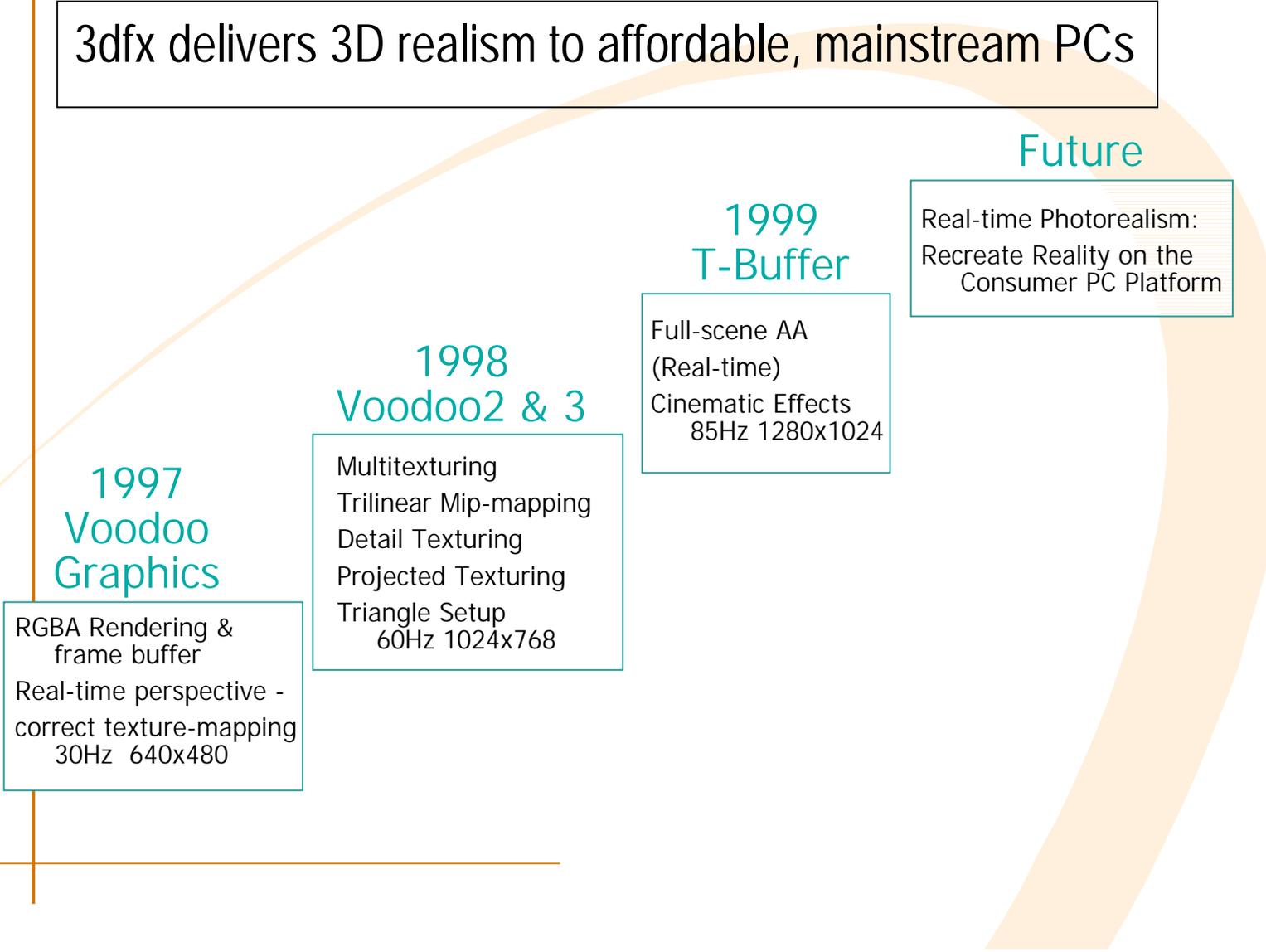
Technology Overview



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3dfx Breakthroughs for Mainstream PCs

3dfx delivers 3D realism to affordable, mainstream PCs



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

Multitexturing
Trilinear Mip-mapping
Detail Texturing
Projected Texturing
Triangle Setup
60Hz 1024x768

Full-scene AA (Real-time)
Cinematic Effects
85Hz 1280x1024

Real-time Photorealism:
Recreate Reality on the Consumer PC Platform



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Immersive 3D: Suspension of Disbelief

- The viewer must perceive an image as realistic to become immersed in the content
- Inconsistent image quality or visual artifacts will jar the viewer from his/her immersed state
 - Poor 3D experience
- Useful digital effects must offer consistent image quality and frame rate without artifacts like:
 - Aliasing “jaggies”
 - Polygon popping
 - Inconsistent frame rate
 - Strobed animation



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Introducing

3dfx T-Buffer™ Technology!



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T- Buffer™:

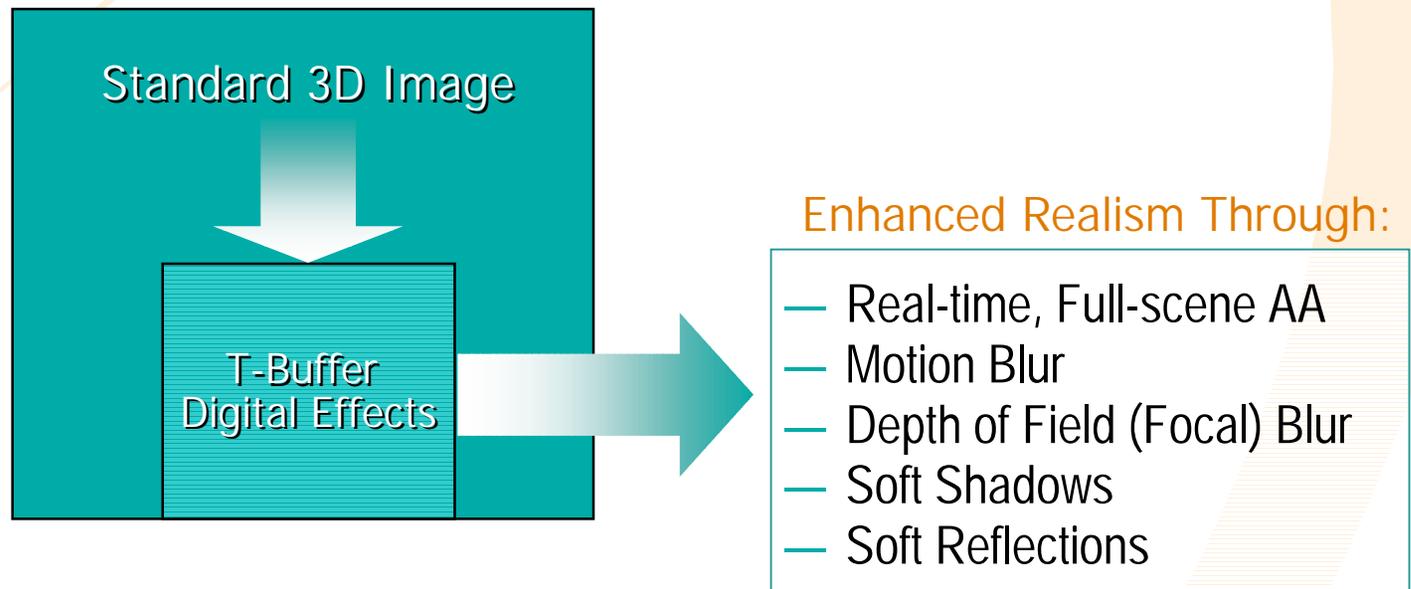
The Problem It Solves

- The T-Buffer solves the general problem of aliasing in computer graphics
- Aliasing is the under-sampling of a source image that causes errors in the image finally drawn on the computer screen
- Under-sampling artifacts occur in:
 - Space: jaggies and pixel popping
 - Time: strobed or stuttered motion
 - Focus: lack of realistic peripheral blur

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





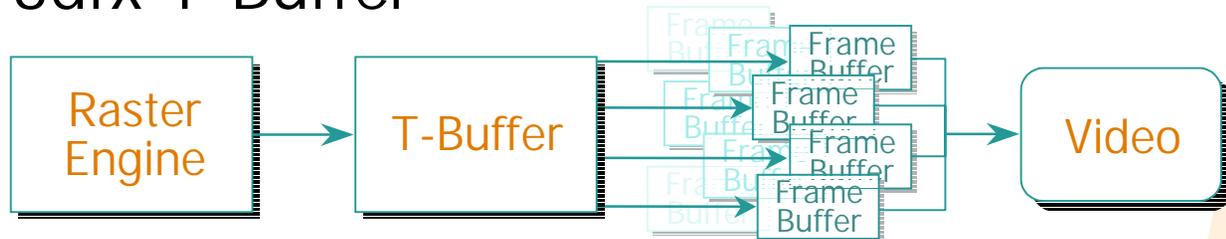
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What Is It?

Conventional PC Accelerator



3dfx T-Buffer™



— Special rendering and video architecture

- Accumulates multiple renderings

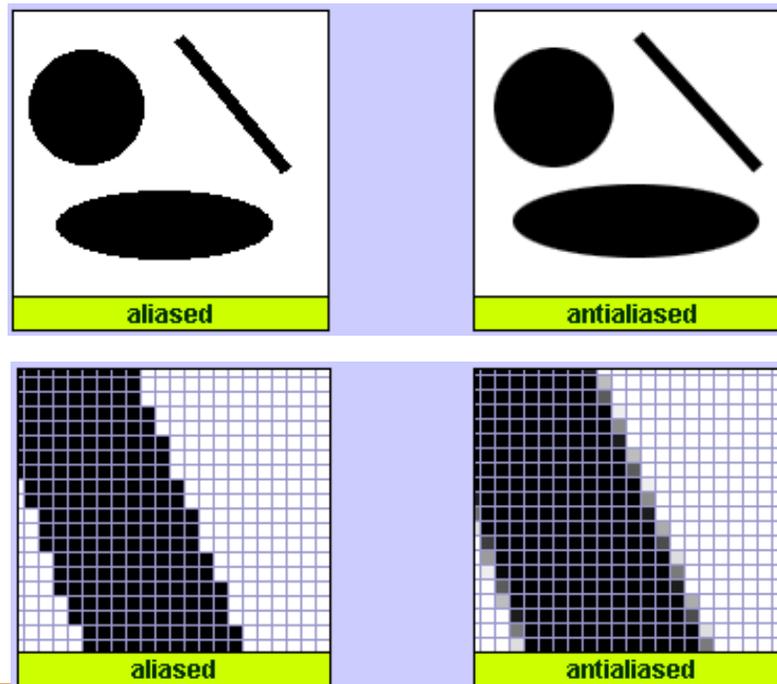


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T-Buffer™ Benefit: Full-Scene Spatial Anti-Aliasing

- Full-scene "AA" has long been 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
- Full-scene AA dramatically improves the quality of any digitally-generated 3D image





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Other AA Techniques Don't Deliver

— "Edge" AA

- Software hack implemented to improve synthetic benchmark scores in 3D Winbench98
- Very CPU intensive: **slow performance** and completely unplayable in games
- API modifications required: scene markers
- Latency/playability problems

— "Oversampling" AA

- Simply renders the 3D scene at increased resolution and then filters down
- Significant compatibility problems
- Slow performance



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Full-Scene Spatial AA Images





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Spatial AA Demo



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Motion Blur Image



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* Image Copyright The Association For Computing Machinery



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Motion Blur Image





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Motion Blur Video



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T-Buffer™ Benefit: Depth Of Field Blur (Focal AA)

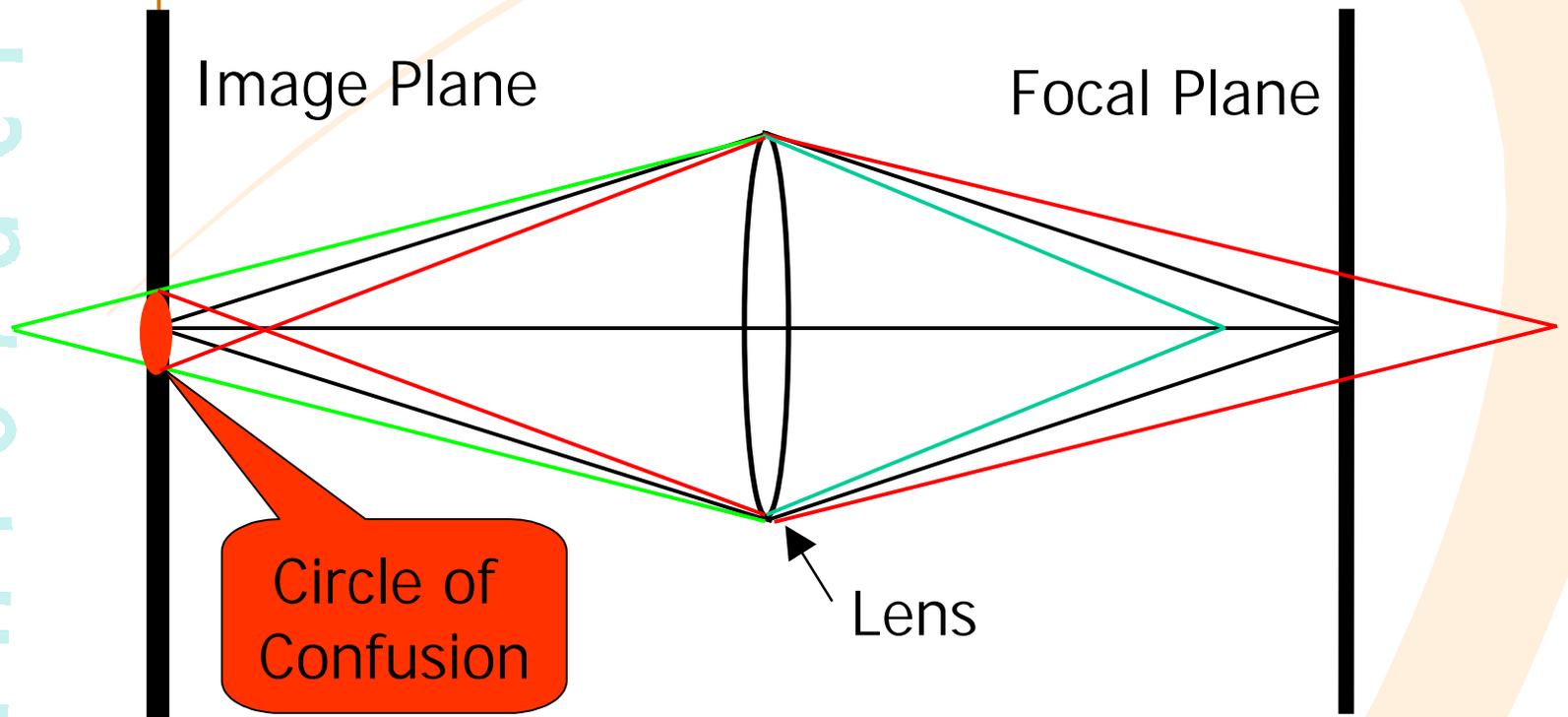
— Depth of Field (DOF) blur simulates the blurring of objects at varying distances from the focal point of a lens (like a camera or your eye)

— DOF blur 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 gets blurred

Depth of Field, Some Theory

For a given lens aperture and focal plane, objects at the focal plane are in focus on the image plane (the black lines), objects behind and in front of the focal plane are in focus in front of and behind the image plane (red and green lines) and are out-of-focus on the image plane





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Depth Of Field Image

Foreground focus



Background focus





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T-Buffer™ Benefit: Soft Shadows

- Soft Shadows show the effect of area lights that create a “soft” edge on real shadows
- Soft Shadow benefits:
 - Significantly enhances realism
 - Hard shadow edges, such as those created only with Stencil Buffers, look artificial

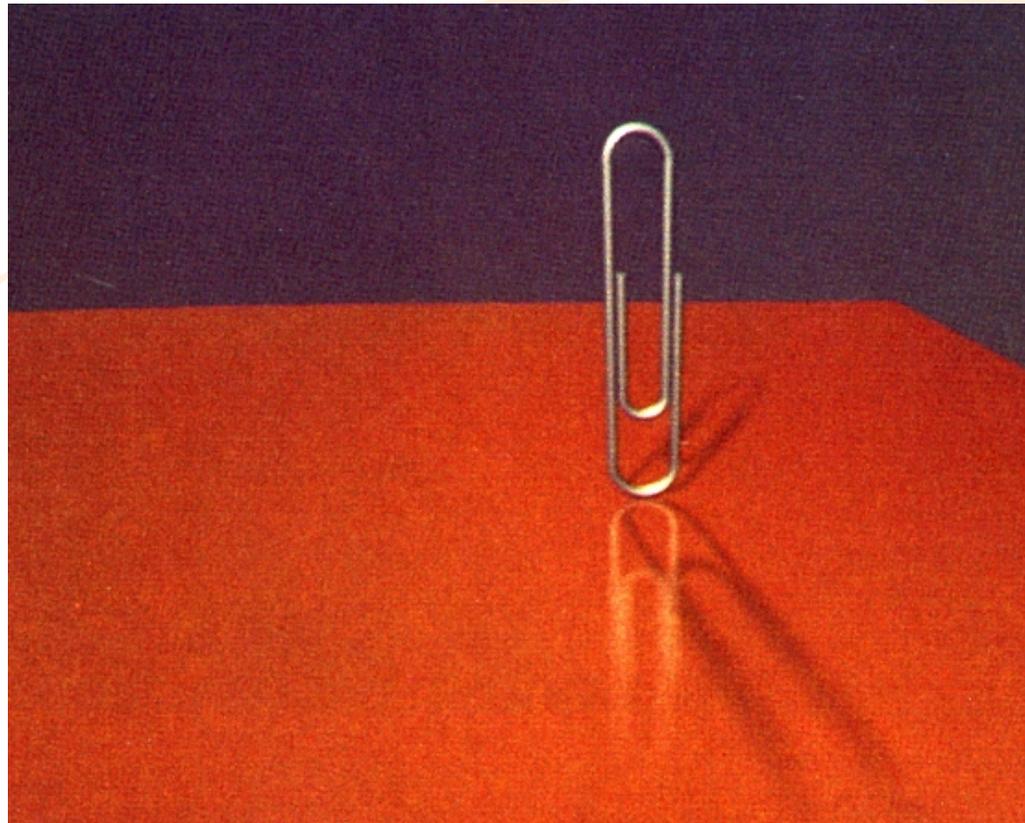


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Soft Shadows Image

Note the realistic fuzziness of the paper clip's shadow



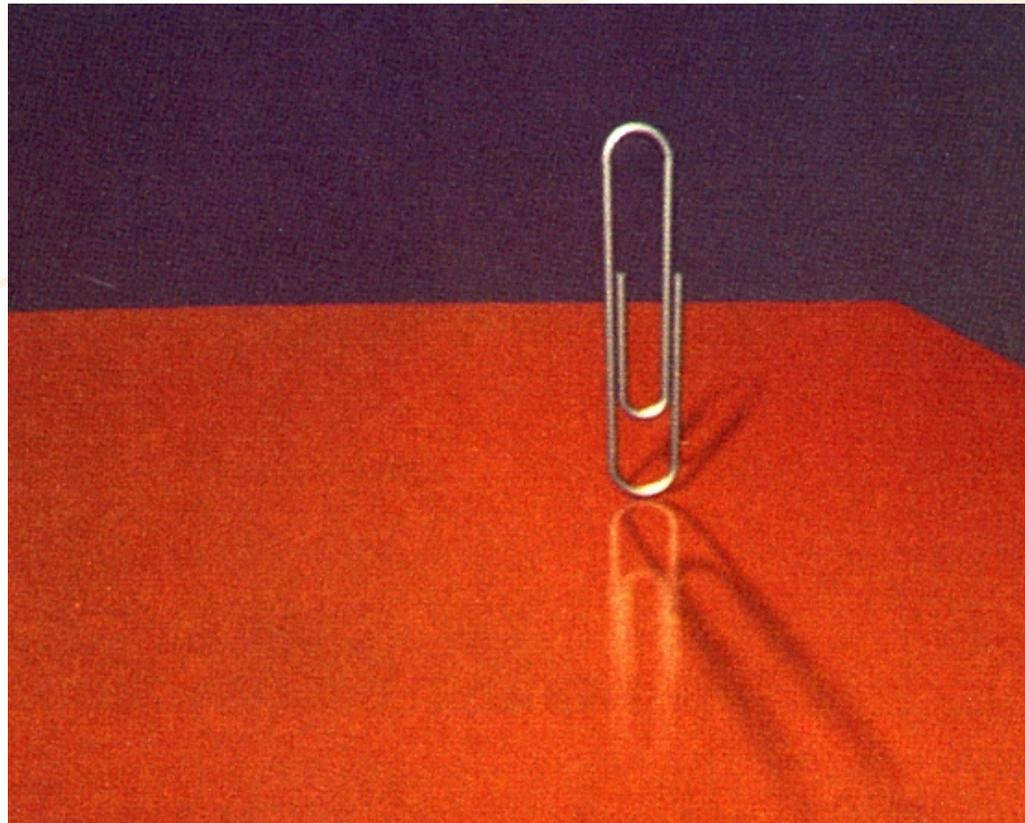


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Soft Reflections Image

Soft reflections deliver a realistic reflection from real-world surfaces



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T-Buffer Demo



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Developer Testimonials

— “3dfx has always taken the lead in delivering compelling features to the gaming community without compromising performance. The T-Buffer technology will allow us to deliver yet another major leap in visual quality at the usual raging-on frame rates from 3dfx.”

- Scott Cronce, vice president of technology, Electronic Arts

— “Today’s games heavily rely on the ability to differentiate themselves through their intelligent use of 3D graphics and graphics effects. This will become more apparent in the future. While frame rate and resolution are important to running smoothly and delivering crisp images, the digital effects that 3dfx enables will greatly improve our ability to create immersive gameplay. We intend to use this new technology from 3dfx to its fullest.”

- Malcolm Johnson, director of technology, Lucas Arts

— “Epic Games is known for it's innovative games and special effects. Motion blur and depth of field are cinematic effects employed by the film industry for years. The ability to achieve real-time effects such as these on a consumer graphics product is exciting indeed. Unreal Tournament will look amazing with full-scene anti-aliasing.”

- Tim Sweeney, director of technology, Epic Games



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Conclusion



T-Buffer™ Effects: Vital For Realism

- Spatial AA: highly noticeable, especially in fine details
- T-Buffer™-enabled effects introduce important subtleties to 3D content that greatly enhance realism
- Once experienced, these effects are indispensable
- The T-Buffer™ technology provides these effects with the consistency of image quality required to maintain the viewers' immersive experience

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The 3dfx T-Buffer™: Delivers Cinematic Effects To Mainstream PCs

- Proprietary 3dfx technology
- Generates highest-quality pixels
- First mainstream PC implementation of true full-scene spatial AA
 - Real-time
 - Application and API “ignorant”
- First mainstream PC implementation of additional digital effects:
 - Motion Blur
 - Depth of Field Blur
 - Soft Shadows
 - Soft Reflections
- Available in affordable, mainstream 3dfx products this Fall
 - Concurrently available in advanced configurations from Quantum3D



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Presentation Credits

- T-Buffer Emulation Demo System
 - Quantum3D Mercury System
- Images
 - Kodak, Pixar / Disney
 - Mango Grits
 - The Association For Computing Machinery
- T-Buffer White Paper
 - Mace Labs
- T-Buffer Demo
 - 3dfx Voodoo Porting Group