

Scalable VR



GTC 2014 : Mid-Tier VR: Cost Reducing the Cave by Embracing the GPU

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Some Content from Professor
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Ultimate Display

“The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal.”

-Ivan Sutherland Proceedings of IFIP Congress, 1965

Virtual Reality





Virtual Reality



Pixel density

Brightness

Dynamic Range

Lighting and Rendering

3D, Parallax

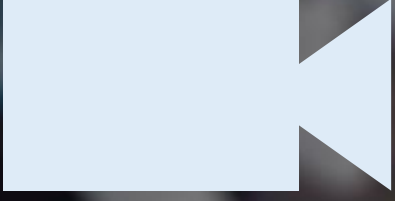
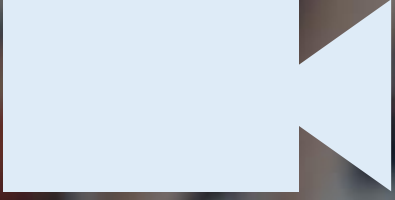
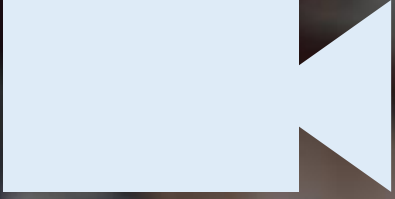
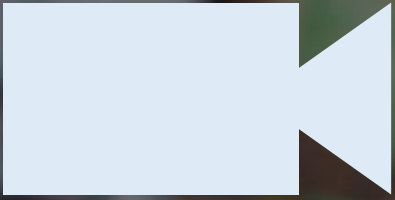
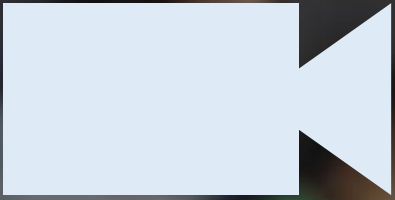
Becoming Ultimate

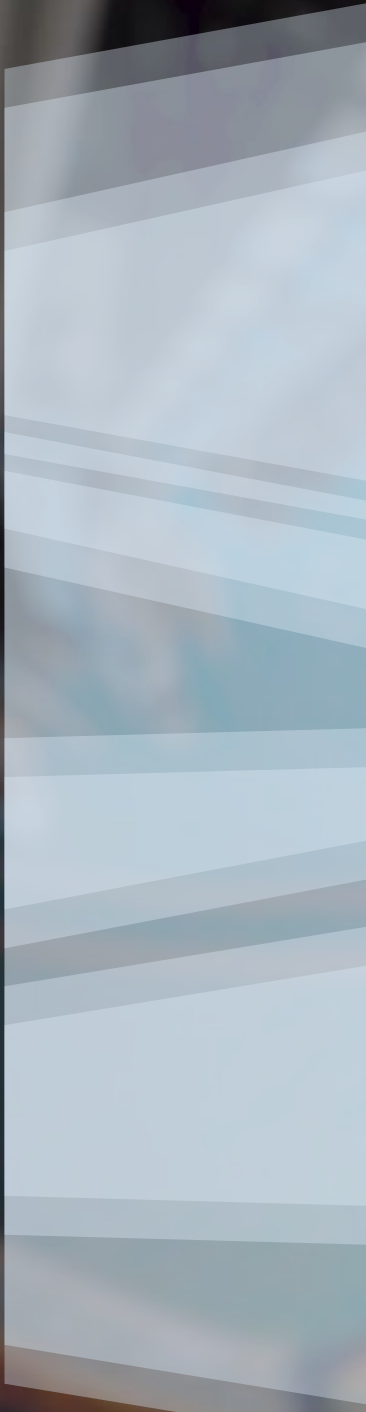
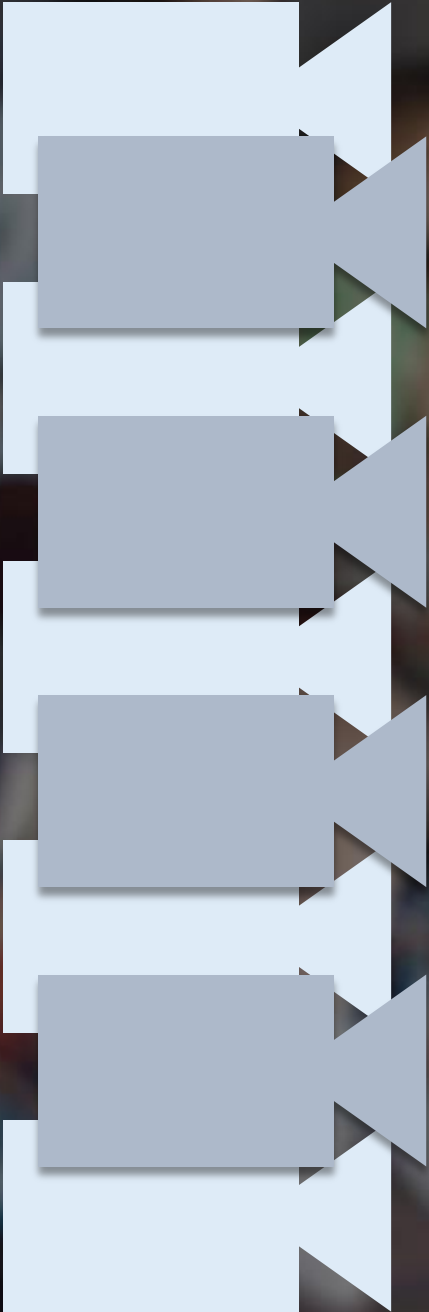


The 1st Three

Pixel density, Brightness, Dynamic Range







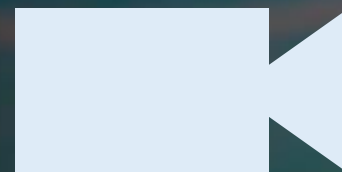
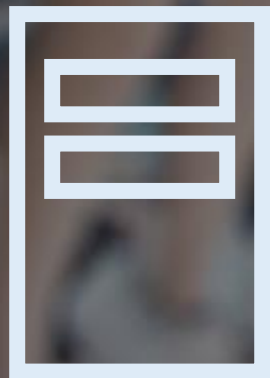
Holodeck on
the cheap



Details

How do drive that many displays?

Connectivity





QUADRO GRAPHICS SYNCHRONIZATION SOLUTIONS
NVIDIA Quadro Sync and G-Sync





EXPERIENCE TOTAL IMMERSION
NVIDIA® SURROUND TECHNOLOGY

NVIDIA SLI Mosaic Mode

AMD Eyefinity Technology

A group of people are on a boat with a large blue sail, sailing on a body of water. The scene is captured from a high angle, looking down at the boat and the water. The water is a deep blue, and the boat's hull is visible. The people are dressed in casual summer clothing. The overall atmosphere is bright and sunny.

The last two

Lighting and Rendering, 3D & Parallax





A group of people are sitting on a boat deck, looking out at a large body of water. In the background, a bridge is visible across the water. The scene is captured from a high angle, looking down at the people and the water. The text "3d & parallax" is overlaid on the image.

3d & parallax



Tracking

MPCDI



- Multiple Projector Common Data Interchange
- <http://www.vesa.org/vesa-standards/free-standards/>





What about
graphics
information?

A group of people are sitting on a boat, which has a blue canopy. The boat is on a body of water, and there are other boats visible in the background. The image is slightly blurred, giving it a candid, real-life feel.

The **real** problem

Tying it all together

Shipping Data



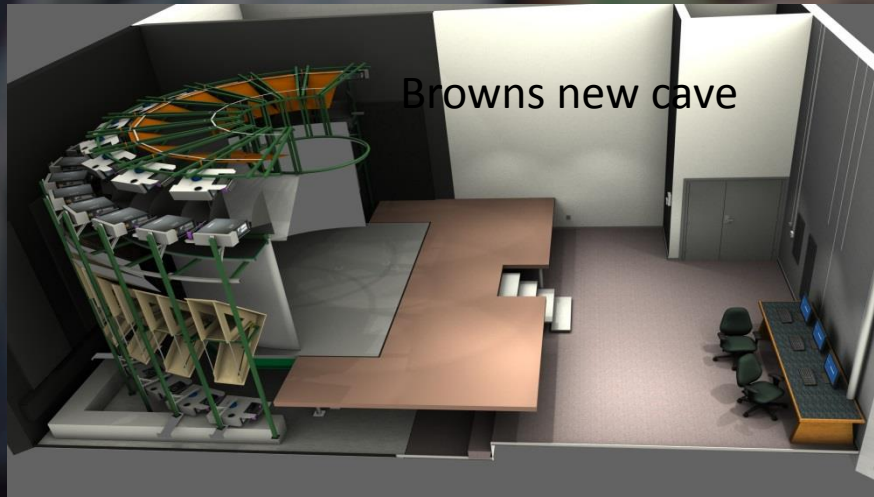
Open Problems

- Perspective corrected rendering
- Data synchronization
 - GPU Particles
 - Lighting
- Border conditions
 - SSAO
 - Lens effects
- Data transport (framebuffers)

A blurred background image showing a group of people running on a track. The image is out of focus, emphasizing the motion of the runners. The colors are muted, with a mix of blues, greys, and earth tones.

Putting Some numbers on the table With Examples and Implementation Detail

The spectrum...



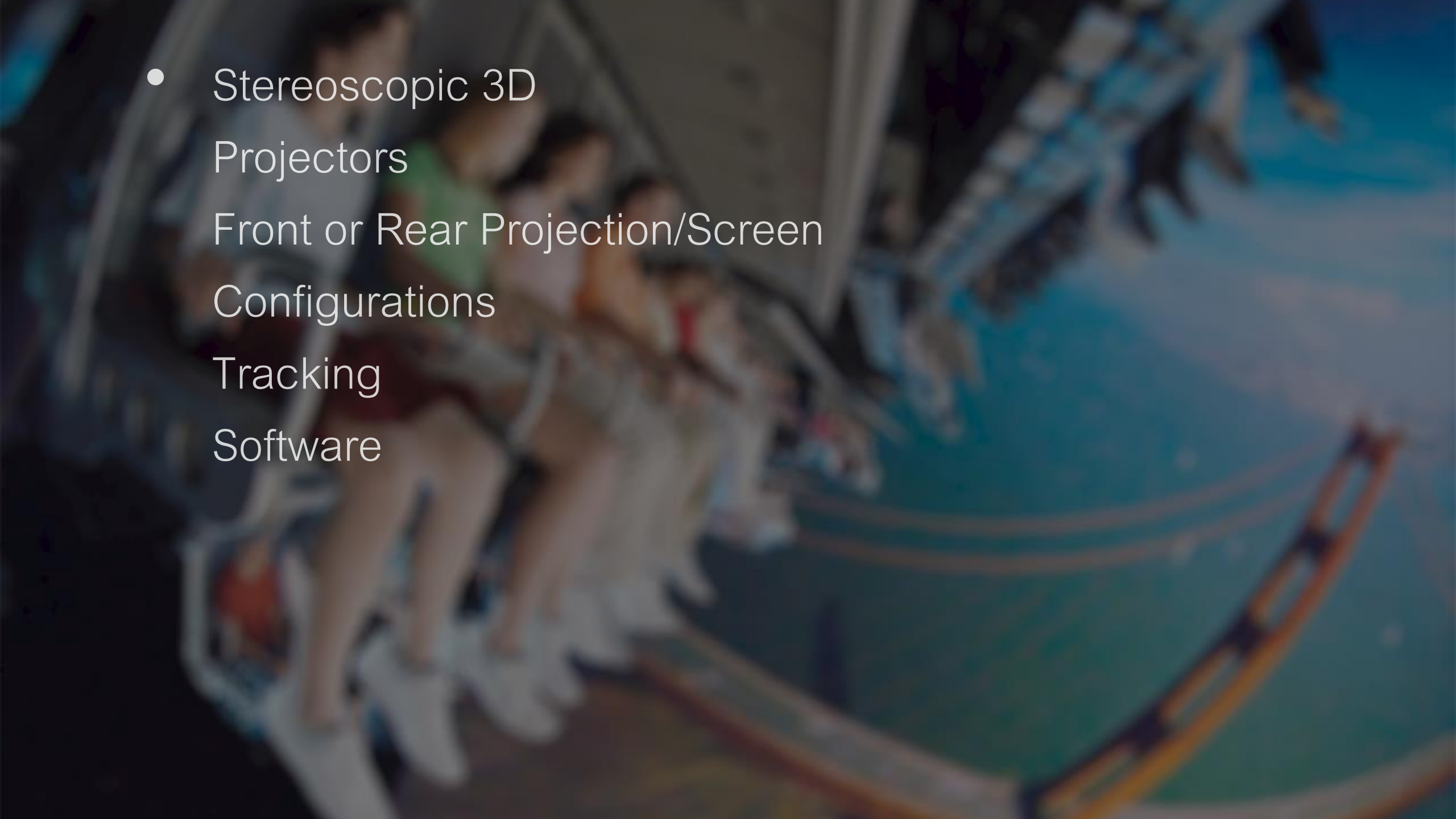
69 1920 1080P
120 hertz
projectors
Rear Projected
Camera Based
Tracking

720P Single
Projector 120
hertz Front
Projected, Kinect



| | Eye | 1998 Cave | 2014 Cave | Reality Deck 2 | iPhone 4 | 24" desktop |
|-------------------|-----------|------------|------------|----------------|------------|-------------|
| Res [arc-min] | 1 | 4 | 1 | << 1 | 1 | 1-2 |
| Stereo | Yes | Yes | Yes | No | No | No |
| Contrast [levels] | 100-1000 | 10-100 | 100-1000 | 100-1000 | 100-1000 | 100-1000 |
| Color [levels] | 100-1000 | 10 | 100-1000 | 100-1000 | 100-1000 | 100-1000 |
| Dynamic range | 10^{10} | 10^{1-2} | 10^{2-3} | 10^{4-5} | 10^{3-4} | 10^{3-4} |
| Horiz FOV [°] | ±90 | ±135 | 360 | 360 | ±2 | ±15 |
| Vert FOV [°] | ±45 | +45, -135 | +75, -180 | ±30 | ±4 | ±12 |

- Stereoscopic 3D
Projectors
Front or Rear Projection/Screen
Configurations
Tracking
Software



Stereo Scopic 3d

Active:

is very accessible today because of the big TV 3d boom – High end systems from Wolfoni, Monster 3d (rf based etc) Though less then 20% transmisssion. RealD and DepthQ offer Pi Cells that are excellent also – lets use use passive glasses on user. DLP Link – reduce contrast...

Passive is a good compromise for large group viewing experience Vendors include:

Infinitec (requires color processing and 6 color so special whhels) == can get special products directly from Infinitc for NEC PA Series (with SDT Stacking Built in) Wavelenth based

Polarization – Linear or Circular – off angle viewing issues can buy from many sources such as Berezin.

Omega Filters – no color processing, wave length separated , worth experimenting with.

Projectors: Lots of Options but...

Active 3d

720p 120 hertz DLP Projectors, IR or DLP Link 500 lumens
\$500 dollars, Optoma , Vivitek, NEC etc

1080P ST BenQ with 720P 120 Hertz Benq \$1200.00 (.5)
throw 2k lumens

UST .34 Throw 720P 120 Hertz NECu310W \$1500.00 3k
lumens

Optoma TW865-NL 6k lumen 720P 120 hertz \$4k dollars (3d
Sync on board)

Digital Projection, Christie, Barco/Projection
Design/LG/Panasonic

Lower End 10k-60k for 1080P 120 Hertz -- Price will come
down – 442x DLP Chipset controller out...

Barco will offer 120 Hertz 4 megapixel in the F50 at very
competitive pricing in the Summer. F35AS3d opened up
market below 60k per projector.

Christie, Barco offer 120 Hertz stereoscopic 3d at 4k.

Quality and
expectations should
be kept in line with
“you get what you
pay for”

Rear gives best Image, but it is very expensive in terms of Space!

Recent Optical Product advances provide Ultra Short Throw for higher Lumen projectors good for caves .19 throw 100 inch image from 31 inches away!



Rear Projection screens tend to be expensive

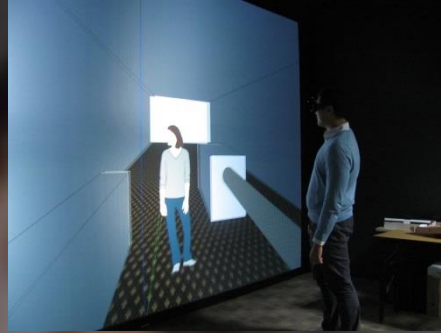
Front Projection can be network gryo paint, screen goo, Screen Innovations RP flexible, Barco and Stewart offer the Finest materials. Barco can model and change screen density to optimize contrast!

Flat dual use whiteboard/vr system



3 projector
1080P UST
Laser
Phosphor

Flat Disney (\$100k no software)



Curved Disney 5 F35AS3d



Articulated



10 projectors

10 wuxga
projectors

CornerCave --
worldviz

2 UST Projectors



Christie HoloStation

Barco OSV – Rear
Projection Cube based
seamless walls

Mechdyne Flex etc

Tracking

Low End Kinect, Use Multiple?

Practical Good Systems Optitrack(5k minimum), Vicon,
PhaseSpace, ART(10k)

This is an area where the COST NEEDS to come down..

Software

Home Brew use Unity Engine, Panda, Unreal, Crytek on single computer

Distributed Rendering are being made available through many vendors

TechViz, Eon Reality, WorldViz, Mechdyne all offer packages that solve many issues – distributed rendering, 3difying apps etc.

Solution for under 20k recipe

2 NEC/Optoma UST projectors DLP based

1 5k Optitrack systems

Use Unity

1 K5000, i7

SDT Tools.