



SAGE

Scalable Adaptive Graphics Environment

***Electronic Visualization Laboratory***  
**University of Illinois at Chicago**

# SAGE is a middleware for driving ultra-high-resolution walls over high-speed networks



# What is SAGE ?

- SAGE – Scalable Adaptive Graphics Environment.
- **SAGE is software for organizing images, animations, and information on scalable display walls (*OptlPortals*) to help people deal with problems of scale and complexity in their data.**
- It specializes in streaming images from remote rendering servers / supercomputers
- Originally began with an NSF ITR grant (OptlPuter) in 2002.
  - Now supported by NSF STCI grant (OCI-0943558) through 2012 and King Abdullah University for Science and Technology (KAUST).

# New Approach

- Displays as “frame buffers” on the network
- Network as a bus between
  - Storage
  - Computing and rendering
  - Display resources
- Decoupling of rendering and display
- “10 Gbps rather than DVI to the display”

# SAGE: Design

- To see heterogeneous high-resolution datasets at a time
- To resize and reposition visualization windows on tiled displays
- To share remote visualization resources
- Collaboration on high-resolution display environment

# SAGE Applications

- Medias
  - Movie player
  - Image viewer
  - PDF viewer
- Desktop sharing
  - VNC
  - High-speed app
- Video capture
  - HD-SDI, HDMI capture card
  - iVisto
- Application extension
  - Paraview
- Custom applications
  - Animation playback
  - Flip book

# SAGE Application

- Application produces pixel buffers
- Stream
- Display

## Initialization

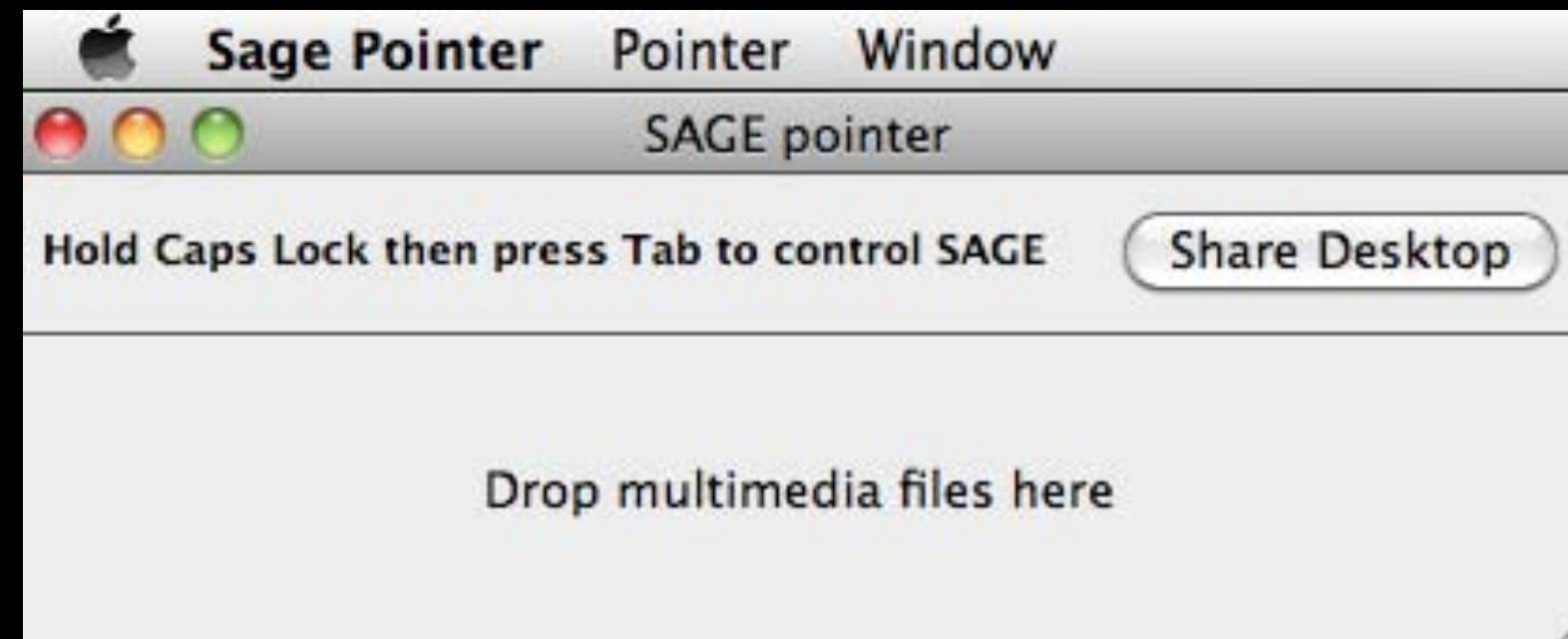
```
sailConfig scfg;  
scfg.cfgFile = "sage.conf";  
scfg.appName = "myapp";  
scfg.resX = 1024;  
scfg.resY = 768;  
scfg.colorDepth = 24;  
scfg.pixFmt = TVPIXFMT_888;  
scfg.rowOrd = TOP_TO_BOTTOM;  
sageInf.init(scfg);
```

## Streaming

```
rgbBuffer = sageInf.getBuffer();  
memcpy(rgbBuffer, data, size);  
sageInf.swapBuffer();
```

# Personal Interaction

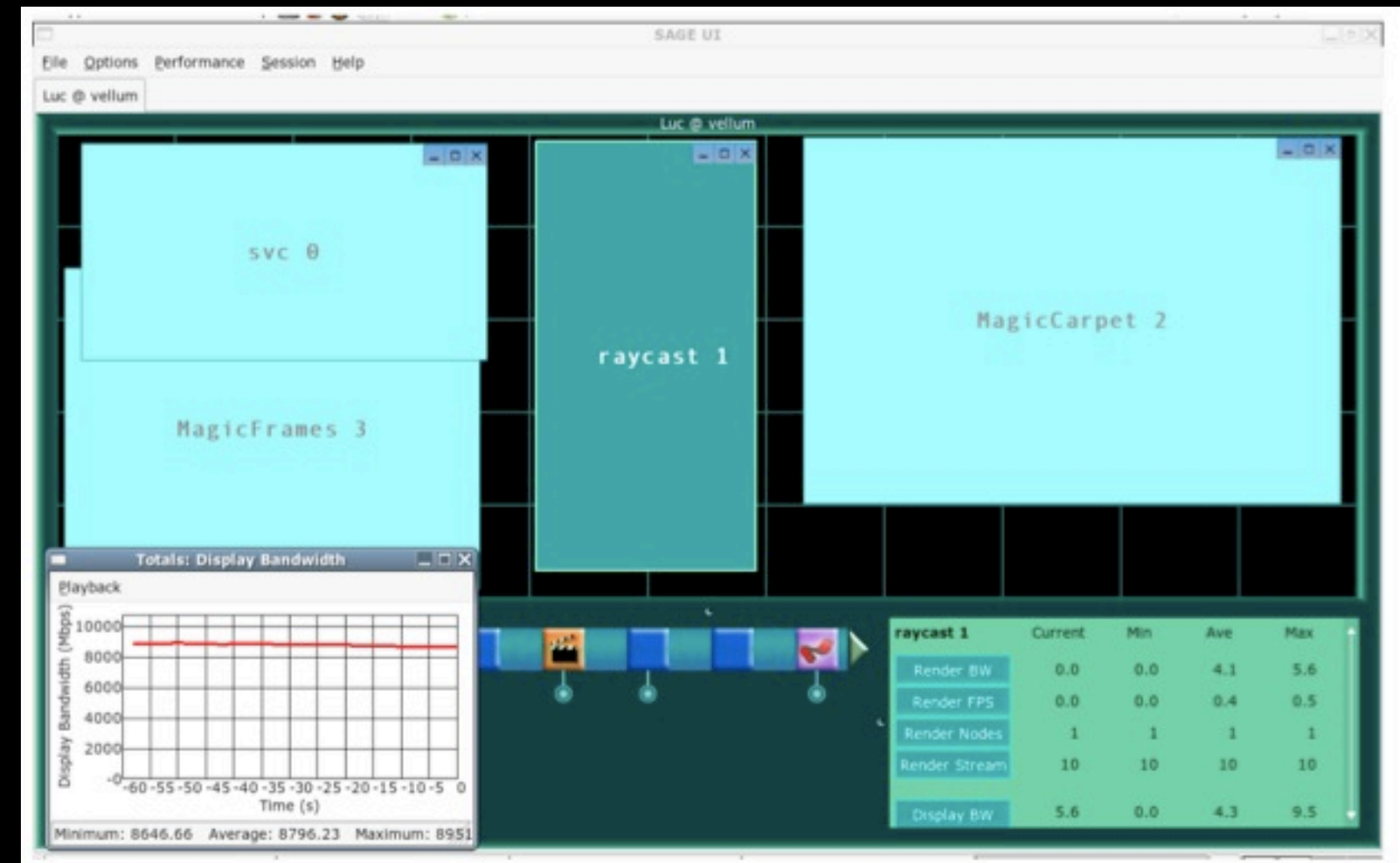
- Small application for every laptop user
- Capture keyboard and mouse events
- Enable desktop sharing through VNC
- Drag-and-drop of multimedia files onto the display
  - from desktop or web browser
  - pictures, videos, PDFs





# SAGE User Interface

- Creation of a simple user interface that provides interaction with SAGE
- SAGE UI:
  - All of the SAGE applications appear in the launcher area
  - Operations: resize, move, z-ordering, start, kill
- Application performance monitoring information



# SAGE Widgets

- Applications can define UI widgets
- Overlaid on application window
- Used for direct interaction on the wall
- Shared by all the users
- File browser for pictures, videos, PDFs
- Automatic layout of content
  - grid, tiles, free form



# 40 SAGE OptIPortals in 2009, 12 new in 2010

<p><b>Australia</b></p> <ul style="list-style-type: none"> <li>• AARNet</li> <li>• Australian National University</li> <li>• CSIRO Discovery Center</li> <li>• CSIRO Information and Communication Technologies, Marsfield</li> <li>• Monash University – Caulfield</li> <li>• Monash University – Clayton</li> <li>• University of Melbourne</li> <li>• University of Queensland</li> </ul> <p><b>Canada</b></p> <ul style="list-style-type: none"> <li>• Ciena Networks</li> <li>• Simon Fraser University</li> </ul> <p><b>China</b></p> <ul style="list-style-type: none"> <li>• Chinese Academy of Sciences, Computer Network Information Center</li> </ul> <p><b>Czech Republic</b></p> <ul style="list-style-type: none"> <li>• Masaryk University, Laboratory of Advanced Networking Technologies (2)</li> </ul> <p><b>Germany</b></p> <ul style="list-style-type: none"> <li>• Braunschweig University of Technology, Institute of Computer and Network Engineering</li> </ul> <p><b>India</b></p> <ul style="list-style-type: none"> <li>• Monsanto Research Centre</li> </ul> <p><b>Japan</b></p> <ul style="list-style-type: none"> <li>• Knowledge Graphics Technologies (KGT), Inc.</li> <li>• Kyoto University</li> <li>• National Institute of Advanced Industrial Science and Technology (AIST)</li> </ul>	<ul style="list-style-type: none"> <li>• National Institute of Information and Communications Technology (NICT), Koganei, Japan</li> <li>• Osaka University, CyberMedia Center</li> </ul> <p><b>Korea</b></p> <ul style="list-style-type: none"> <li>• Gwangju Institute of Science and Technology (GIST)</li> <li>• Korea Institute of Science and Technology Information (KISTI)</li> </ul> <p><b>Mexico</b></p> <ul style="list-style-type: none"> <li>• Ensenada Center for Scientific Research and Higher Education (CICESE)</li> </ul> <p><b>Netherlands</b></p> <ul style="list-style-type: none"> <li>• SARA Computing &amp; Networking Services</li> <li>• University of Amsterdam, System and Network Engineering Research Group</li> <li>• University of Amsterdam, e-BioScience Laboratory</li> </ul> <p><b>New Zealand</b></p> <ul style="list-style-type: none"> <li>• Victoria University of Wellington</li> </ul> <p><b>Russia</b></p> <ul style="list-style-type: none"> <li>• Russian Academy of Sciences, Science and Innovation Center</li> <li>• Russian Academy of Sciences, Space Research Institute</li> </ul> <p><b>Saudi Arabia</b></p> <ul style="list-style-type: none"> <li>• King Abdullah University for Science and Technology (KAUST)</li> </ul> <p><b>Taiwan</b></p> <ul style="list-style-type: none"> <li>• National Center for High-performance Computing (NCHC)</li> </ul>	<p><b>United States</b></p> <ul style="list-style-type: none"> <li>• Adler Planetarium &amp; Astronomy Museum</li> <li>• Argonne National Laboratory, Center for Nanoscale Materials</li> <li>• Argonne National Laboratory, Transportation Research and Analysis Computing Center</li> <li>• Calit2/Univ. of California, Irvine</li> <li>• Calit2/Univ. of California, San Diego (4)</li> <li>• Florida International University, Center for Internet Augmented Research &amp; Assessment (CIARA)</li> <li>• Louisiana State University, Center for Computation and Technology</li> <li>• NASA Goddard Space Flight Center, Space Visualization Studio</li> <li>• Northwestern University, International Center for Advanced Internet Research (iCAIR)</li> <li>• Purdue University, Envision Center for Data Perceptualization</li> <li>• Rincon Research Corporation</li> <li>• Sharp Laboratories of America</li> <li>• Texas A&amp;M University, Computer Science</li> </ul>	<ul style="list-style-type: none"> <li>• UCSD-National Center for Microscopy and Imaging Research</li> <li>• UCSD-Scripps Institution of Oceanography</li> <li>• University of Hawaii, Center for Microbial Oceanography: Research and Education</li> <li>• University of Illinois at Chicago, Electronic Visualization Lab (2)</li> <li>• University of Illinois at Urbana-Champaign/National Center for Supercomputing Applications</li> <li>• University of Michigan-Department of Atmospheric, Oceanic &amp; Space Sciences</li> <li>• University of Michigan, Digital Media Commons</li> <li>• University of Michigan, School of Information</li> <li>• University of Texas at Austin, Texas Advanced Computing Center (TACC)</li> <li>• University of Washington</li> <li>• US Geological Survey (USGS) Earth Resources Observation and Science</li> </ul>
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# **SAGE Application Domains**

**Collaborative, Networked, Interactive, Real-Time,  
Ultra-High-Resolution, Streaming...**

# CineGrid: Movie Production

... to research, develop, and demonstrate networked collaborative tools for the production, use, preservation, and exchange of very-high-quality digital media over photonic networks.



The Disney demo at Disney Studios, October 13, 2010

# Disaster Response and Recovery

... planning routes for evacuation, medical aide, etc.



USGS Katrina data on EVL LambdaVision

# Higher Education



Classes in EVL Cyber-Commons



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# Entertainment – Paint Program, Video Games



EVL Cyber-Commons  
20-foot Canvas

EVL Cyber-Commons  
Video Games





# Financial

... to monitor and analyze real-time financial data and place trades



Financial analyst using EVL Cyber-Commons (Photo: Ratko Jagodic)



Bloomberg Terminal is used in financial industry

# High-Definition Video Teleconferences and Data Sharing



SAGE Visualcasting



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# Homeland Security – Incident Command

... used to plan security for President Obama's 2009 inauguration



USGS briefs former Interior Secretary Dirk Kempthorne and now Secretary Ken Salazar on National Mall security

# Geoscience

... CoreWall, a stratigraphic correlation, core description, and data visualization system



EVL's desktop CoreWall display

Core analysis on EVL Cyber-Commons

# Geoscience

... Project Endurance, Antarctica frozen lake data



Analyzing data on EVL Cyber-Commons



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# Marketing – Information Kiosk

... outdoor SAGE Wall at NICT headquarters, Konganei

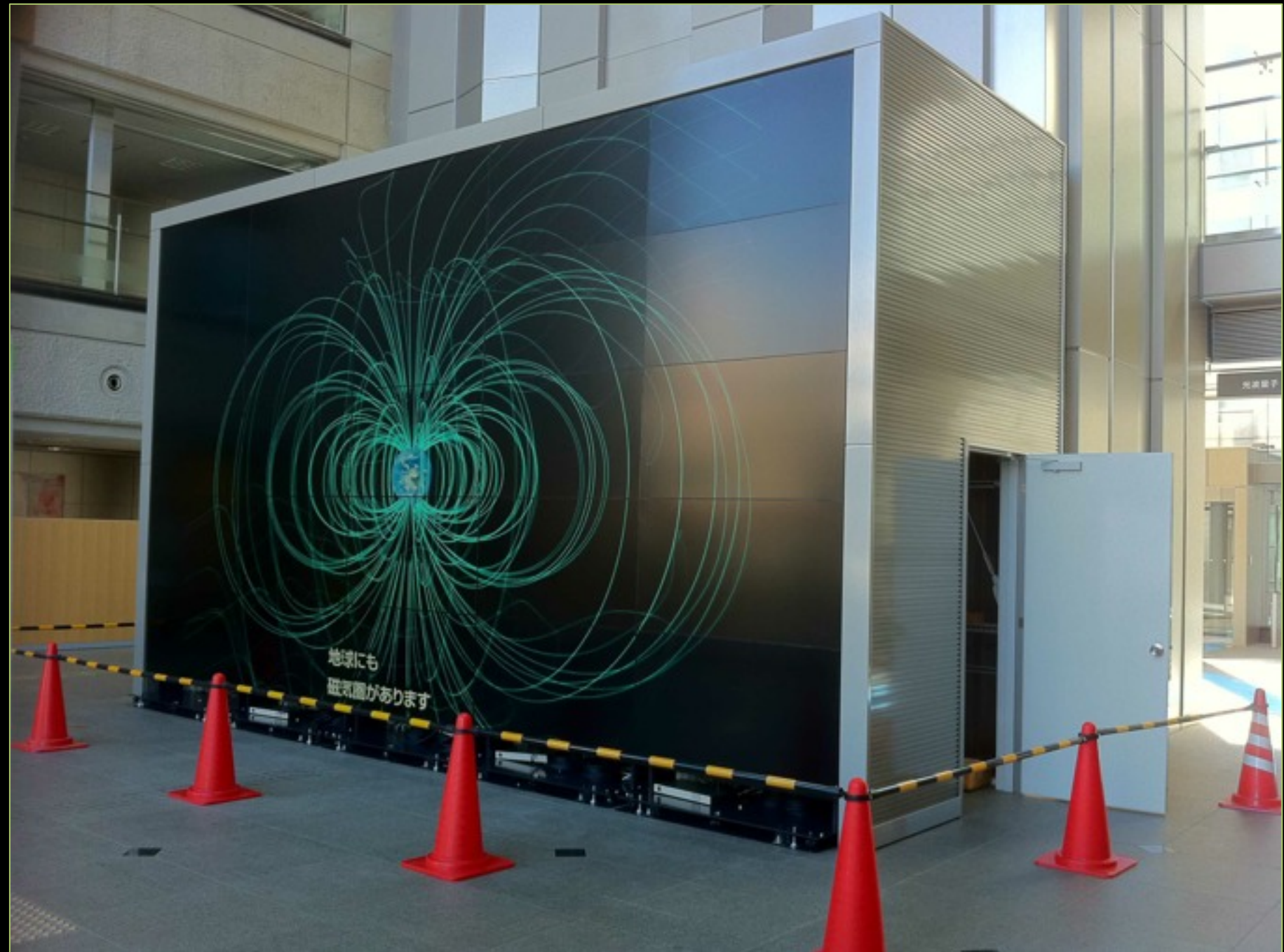


Photo courtesy of Shinji Shimojo, NICT

# Medical

... digital operating room integration is the surgeon's gateway to digital medical information



BrainLab



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# BioMedical Research

... for analyzing electron microscopy images



UCSD National Center for Microscopy and Imaging Research



# Tele-Medicine

... for remote teaching and remote consultation



EVL remote surgery demo for Clinical Robotic Surgery Association, 2009

# Museums

... to teach the general public about how scientists work



Adler Planetarium's Space Visualization Laboratory and Moon Wall

# Precision Agriculture

... for agricultural bioengineering



Monsanto Research Centre Bangalore



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# Public Policy

... to monitor and analyze geo-political data, etc.



Al Gore's office

# The Future

... tiled display rooms!



Sharp develops a gigantic 156 Multi-Screen display System for total immersion