

Birds Of a Feather Meeting

SC 2012

Agenda

- Introductions
- SAGE Community
- SAGE Developments
- SAGE Future
- Discussion



Introductions

- SAGE Research and Development Team


Jason Leigh


Luc Renambot


Maxine Brown


Sungwon Nam


Arthur Nishimoto

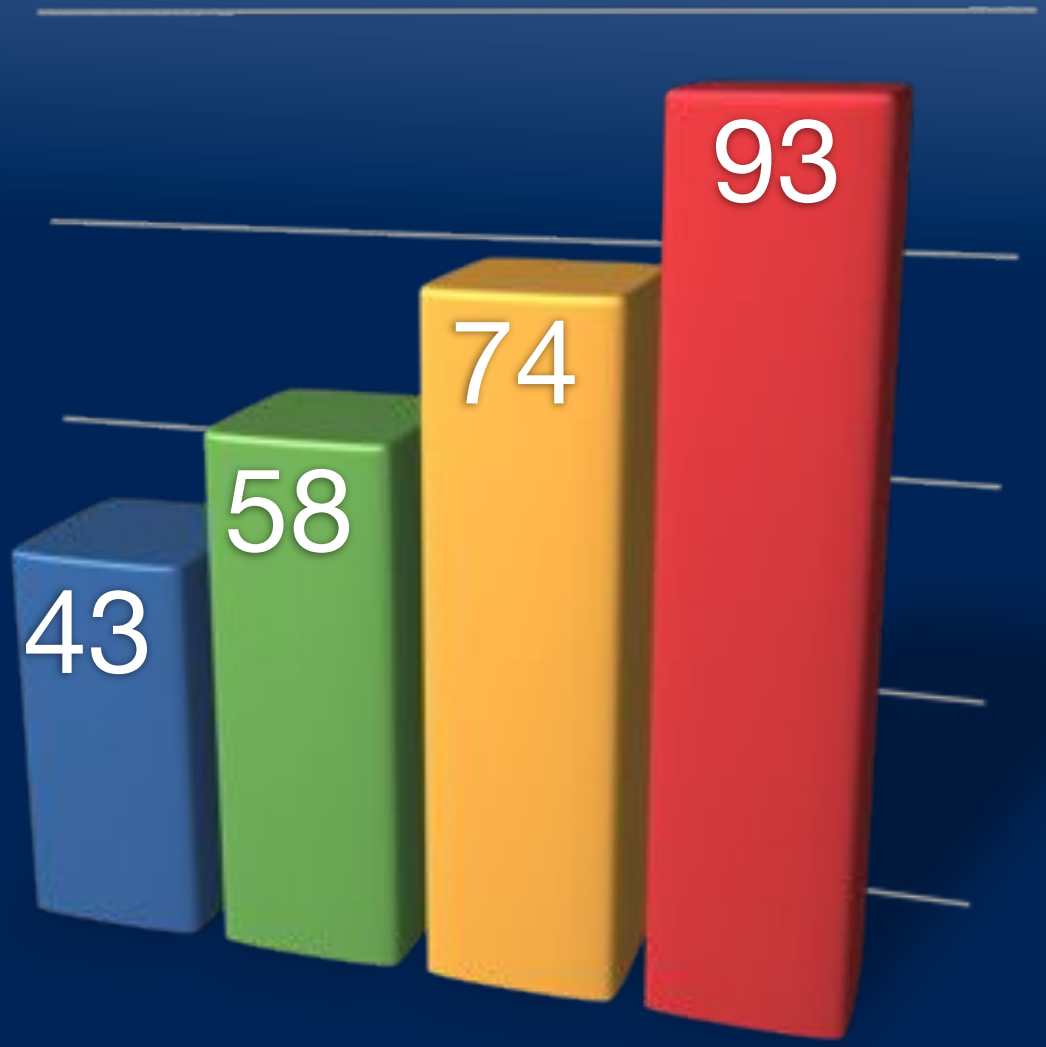
- SAGE Audience Participants
  (have audience introduce themselves)

What is SAGE?

- SAGE – Scalable Adaptive Graphics Environment
- Operating System software for organizing visualizations and information on scalable display walls to help researchers deal with problems of scale and complexity in their research.
- Specializes in streaming visualizations from remote rendering servers / supercomputers.
- Originally began with an NSF ITR grant (The OptIPuter) in 2002.

SAGE User Community

Growth of SAGE Sites Worldwide 2009-2012



SAGE User Community

93 Sites (49 U.S. and 44 Global)

SAGE User Sites 2012

Australia
- AARNet
- Australian National University
- CSIRO Discovery Center
- CSIRO Information and Communication Technologies, Marsfield
- Monash University – Caulfield
- Monash University – Clayton
- University of Melbourne
- University of Queensland

Belgium
- Katholieke Universiteit Leuven, IBBT

Brazil
- RNP (Brazilian R&E Network)
- University of Sao Paulo, Laboratory of Computer Architecture and Networks

Canada
- Ciena Networks (2)
- Communications Research Centre
- Simon Fraser University

China
- Beihang University, State Key Lab of Software Environment Dev.
- Chinese Academy of Sciences, Computer Network Information Center

Czech Republic
- Masaryk University, Laboratory of Advanced Networking Technologies (2)

Germany
- Braunschweig University of Technology, Institute of Computer and Network Engineering

India
- Monsanto Research Centre

Japan
- Cybernet Systems Co., Inc.
- Kyoto University National Institute of Advanced Industrial Science and Technology (AIST)
- National Institute of Information and Communications Technology (NICT), Koganei, Japan (3)
- NICT, Keihanna Research Center
- NTT Advanced Technologies Corp
- NTT Network Innovation Laboratories, Yokosuka
- Osaka University, CyberMedia Center

Korea
- Gwangju Institute of Science and Technology (GIST)
- Korea Institute of Science and Technology Information (KISTI)

Mexico
- Ensenada Center for Scientific Research and Higher Education (CICESE)

Netherlands
- SARA Computing & Networking Services
- SARA Collaboratorium
- University of Amsterdam, System and Network Engineering Research Group
- University of Amsterdam, e-BioScience Laboratory

New Zealand
- Victoria University of Wellington

Poland
- Poznan Supercomputing and Networking Center

Russia
- Russian Academy of Sciences, Science and Innovation Center
- Russian Academy of Sciences, Space Research Institute

Saudi Arabia
- King Abdullah University for Science and Technology (KAUST)

Taiwan
- National Center for High-performance Computing (NCHC)

United States
- Adler Planetarium & Astronomy Museum
- Argonne National Laboratory, Center for Nanoscale Materials (2)
- Argonne National Laboratory, Math and Computer Science
- Argonne National Laboratory, Transportation Research and Analysis Computing Center
- Calit2/U California, Irvine
- Calit2/U California, San Diego (6)
- Casa Familiar
- Case Western Reserve University, Kelvin Smith Library
- Extreme Networks
- Florida International University, Center for Internet Augmented Research & Assessment (CIARA)
- Lakota Technical Solutions Inc
- Louisiana State University, Center for Computation and Technology
- Monsanto (3)
- NASA Ames Research Center, Lunar Science Institute
- NASA Goddard Space Flight Center, Space Visualization Studio
- Naval Postgraduate School, CED3
- Naval Postgraduate School, MOVES
- Northwestern University, International Center for Advanced Internet Research (iCAIR)
- Purdue University, Envision Center for Data Perceptualization
- Rincon Research Corporation
- Sharp Laboratories of America
- South Metro Career Center
- Texas A&M University, Computer Science
- U.S. Geological Survey (USGS) Earth Resources Obs and Science
- UCD-Institute for Ultra-Scale Visualization
- UCSD-National Center for Microscopy and Imaging Research
- UCSD-Scripps Institution of Oceanography
- University of Hawaii, Center for Microbial Oceanography: Research and Education (2)
- University of Illinois at Chicago, ACM Student Chapter
- University of Illinois at Chicago (UIC), ACM Student Chapter
- UIC, Electronic Visualization Lab (EVL), Cyber-Commons
- UIC, EVL, Cyber-Commons 3D
- UIC Graham Clinical Performance Center
- UIC Innovation Center
- University of Illinois at Urbana-Champaign/National Center for Supercomputing Applications
- University of Michigan-Department of Atmospheric, Oceanic & Space Sciences
- University of Michigan, Digital Media Commons
- University of Michigan, School of Information
- University of Texas at Austin, Texas Advanced Computing Center (TACC)
- University of Washington
- Zoom Digital Signage

SAGE New Users 2011-2012

Some of the New SAGE Walls

				
Argonne National Laboratory, **Center for Nanoscale Materials**	Calit2, Vroom	**Case Western Reserve, Kelvin Smith Library**	Naval Postgraduate School, MOVES	UC Davis, **Institute for Ultra-Scale Visualization**

		
RNP, BRAZIL	Ciena, Demo Room, CANADA	SARA Collaboratorium, THE NETHERLANDS

SAGE New Users 2011-2012

Argonne National Laboratory, **Center for Nanoscale Materials**



SAGE New Users 2011-2012

Calit2 / UCSD, Vroom



SAGE New Users 2011-2012

Case Western Reserve, Kelvin Smith Library



SAGE New Users 2011-2012

Naval Postgraduate School, MOVES



SAGE New Users 2011-2012

UC Davis, Institute for Ultra-Scale Visualization



SAGE New Users 2011-2012

RNP, BRAZIL



SAGE New Users 2011-2012

Ciena, Demo Room, CANADA



SAGE New Users 2011-2012

SARA Collaboratorium, THE NETHERLANDS



SAGE Survey May 2012

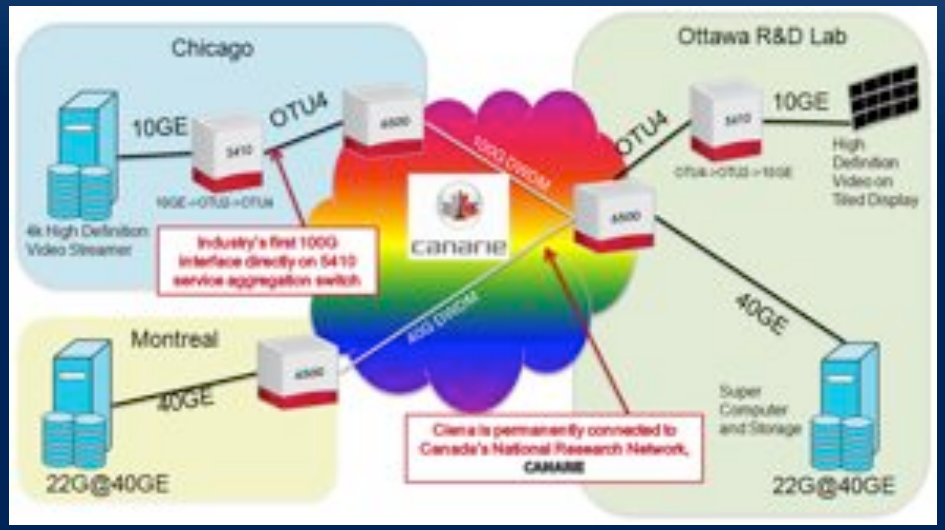
- 50% of SAGE users responded (40 responses)
- Users represent 50% US / 50 international
- Mostly university and labs
  - A few companies and non-profits (museums)
- Main focus: Collaborative workspace
- Usually more than 1 wall per institutions
  - 2-4: 35% , more than 4: 20%
  - Plan for more installations
- 50% in the 25-50 Mpixels
  - Plan for higher resolution
- Publications

Survey

- NSF, DOE and NASA funding in the US
  - Matching agencies for internationals
- 1-10 Gbps networks
  - 100 Gbps getting some interest
- Improvements
  - User interaction, HD video,
  - WAN Streaming
- SAGE application support for:
  - GIS, Office, video-conference, 3D models
  - ParaView, VisIt, …

Ciena 2011 Vectors Summit – Oct 2011

- Ciena worked with Northwestern/iCAIR and EVL to showcase optical networking, high-capacity transport and client interfaces.





- Visitors to Ciena's R&D facility in Ottawa watched e-science, high-definition visualization and computer science research applications utilizing 10/40Gbps Ethernet clients transported over a 100Gbps long-haul network provided by CANARIE.

U.S. / Brazil Demo – Aug 16, 2012

RNP (National R&E Network) Forum, Brasilia, Brazi

- Goal: To promote benefits of tiled displays for research and education to campuses in Brazil
- EVL/University Sao Paulo demo, transmitted via video to the Forum





- Educators asked to write proposals to RNP to borrow 2x2 SAGE systems – received 12 proposals, 3 selected. Two other institutions to build SAGE portals. By the end of the year, 6 institutions to have SAGE portals!

UltraGrid Demo – Oct 11, 2012

8K Ultra High Definition Digital Media Streaming Demonstration

- UltraGrid video/audio streaming software interoperates with SAGE.
- UltraGrid framework has new capabilities for video compression and processing using graphical processors and advanced protocols for distribution over networks.



- UltraGrid used JPEG compression at 2Gb/s, on-the-fly recompressed to DXT5-YCoCg compression at 6.5Gb/s and displayed the images on a high-resolution tiled-display walls using EVL's SAGE middleware

UltraGrid developed by SITOLA Laboratory, Masaryk University and CESNET, Czech Republic.

SuperComputing 2012

Architecture of OpenFlow-based failure avoidance for SAGE

JGN-X

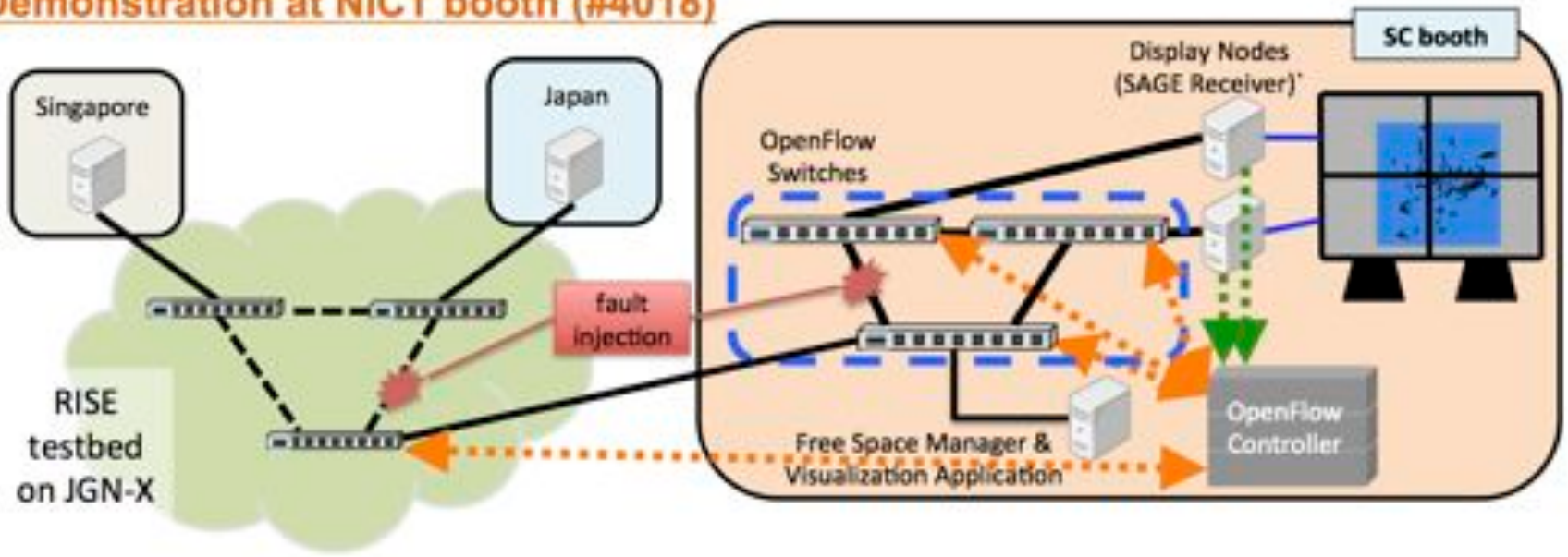
Osaka U

We propose a SAGE functionality that dynamically detects and avoids a network failure on a network link using OpenFlow, which allows to control network dynamically. The OpenFlow-based network failure avoidance functionality is composed of three functions.

The three functions implemented on OpenFlow

- Network failure detection
- Topology understanding
- Packet forwarding configuration

Demonstration at NICT booth (#4018)




CAVE2



CAVE2 displaying the latest Mars Curiosity data from NASA.



Prof. Andrew Johnson (University of Illinois at Chicago) teaches his Visual Analytics class in CAVE2.



CAVE2 shows the future of science and scientific visualization to the general public during Chicago Ideas Week.



Khairi Reda, an EVL research assistant and computer science PhD candidate, uses the CAVE2 to fly through a close-up of a glass fissure computed in a 5-Million atom molecular dynamics simulation. Visualization by Reda, Aaron Knoll and Michael Papka of the Argonne Leadership Computing Facility (ALCF) at Argonne National Laboratory. Simulation and data provided by Kenichi Nomura and Priya Vashishta of University of Southern California. EVL OmegaLib software is used to display the 3D model in CAVE2



Individuals standing in the CAVE2 interactively fly around a 3D representation of Mars, originally created by EVL graduate Robert Kooima with data from the NASA Mars Global Surveyor and Viking missions, and fly through star data from the European Space Agency Hipparcos mission. Kooima's Electro software is used to display the 3D model in CAVE2.



Khairi Reda, an EVL research assistant and computer science PhD candidate, shows this visualization of a balls-and-sticks model of a molecular chemistry dataset to fellow students in EVL's CAVE2 virtual- reality environment. The clouds represent the density of electrons around atoms. Chemistry models and simulation data provided by Aslihan Sumer, Juliuis Jellineck and Michael Papka of the Argonne Leadership Computing Facility (ALCF) at Argonne National Laboratory. EVL OmegaLib software is used to display the 3D model in CAVE2.



Cultural Heritage visualization in CAVE2. Displayed is a 3D panorama of Luxor in Egypt. Images were captured by Tom DeFanti and Dan Sandin at UC San Diego, CALIT2.

SAGE Development Update

- Updates
- New features
- Survey Results

SAGE: Website

- New site rebuilt
- Adding more content in the coming weeks



- *Google group* for support
  - https://groups.google.com/d/forum/sagecommons

SAGE: Distribution

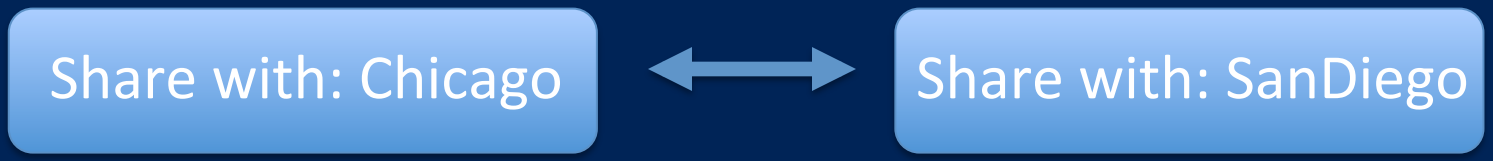
- RPM v.3.3.8 binary
  - OpenSuse 12.1
  - 64bit version
- Source code released
  - svn://iridium.evl.uic.edu/sage2012
  - Open check-out
  - A few branches
    - Audio work with UCSD
    - Stereo 3D extension

SAGE: Linux Distribution

- Live bootable CD base on openSUSE 12.1, containing:
  - openSUSE 12.1 distribution
  - sage v3.3-8 RPM
- all the SAGE dependencies
- an 'extras' directory containing:
  - Latest NVIDIA drivers
  - Latest Myrinet 10G ethernet drivers
  - Latest Blackmagic drivers and MediaExpress application

Document Sharing

- Drag-and-drop documents between walls
- Copy the document to the remote wall
- Start the application
  - Movies, Images, PDF, VNC
- Support multiple destinations
  - Sync'd playback in the work



Audio work

- Audio Server (SAM)
- Streaming audio API
  - Media player (mplayer)
  - HD capture (Blackmagic card)
- Written using:
  - RTP data transport
  - Qt framework
  - OSC messaging
- Development led by UCSD/Calit2 Sonic Arts Group

UI Cleanup



Stereo 3D format

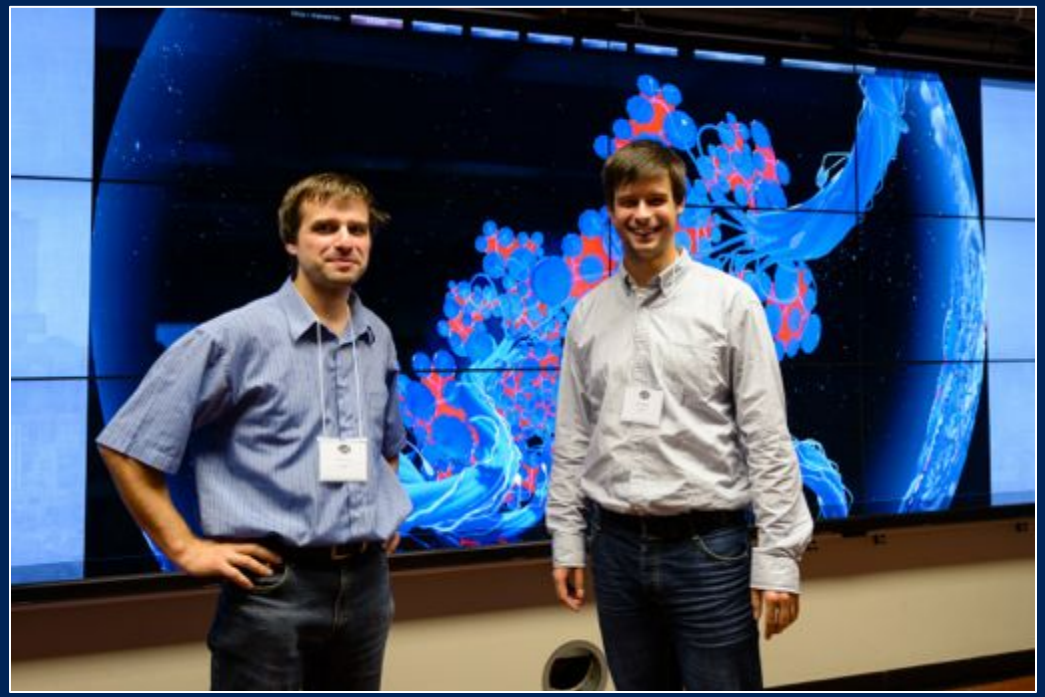
- New pixel format : PIXFMT_RGBS3D
- Left and right pixel next to each other



  - 6-byte format RGB
- Stereo recombination done on display side
  - GLSL Shader
  - For now: interleaving (passive stereo)
  - Allows for repositioning and upscaling
- MPO and JPS 3D file formats supported

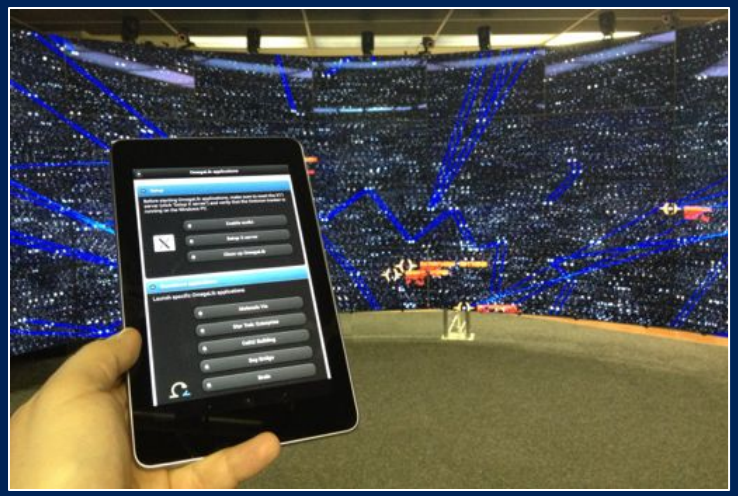
Added more DXT formats

- New DXT formats
- PIXFMT_DXT5 and PIXFMT_DXT5YCOCG
- Used by UltraGrid
- GLSL shader



Web Interface for UI Control

- Room getting more and more complex
  - Lots of devices
  - Different protocols (serial, OSC, scripts, …)
- Tool to build web interface
  - *Sabi.js*
  - HTML5 / JQUERY / Javascript
  - Mobile and desktop web



  - http://renambot.lakephoto.org/software/sabi-js/

SAGE Current Projects

- SAGE Next
  - easy to use, single PC, cloud-based, media based
- OmegaLib + SAGE
  - Parallel rendering streaming
  - Omicron device library
- Remote collaboration: distributed media creation
  - Working with NTT Network Innovation Labs and UCSD
  - Audio with UCSD/Calit2 Sonic Arts
  - Support for media creation
  - Web interface for UI control

SAGE*NEXT*

- Hardware trend towards multi-processing in a single node.
- Multi-core CPUs, multi-GPUs make single machine can drive tiled-display walls.
  - EVL's 20 foot-wide, 8K by 2K display wall is driven by a single machine.
- But OS is not designed for multi-user collaborative environments provided by large display walls.

SAGE*NEXT*

- Optimized to run on 1 PC via multi-user, multi-core aware resource scheduling.
- Compatible with legacy SAGE streaming applications.
- Enables Cloud applications – e.g. Google services.
- Custom native applications
  - Qt toolkit

Desktop sharing



PDF viewing



Google maps



WebGL



Plugins (apps)



Organization



OmegaLib



- OmegaLib is middleware to ease the development of applications for virtual-reality systems.
  - Display system scalability
  - Support for a wide range of input peripherals (controllers, motion capture systems, touch surfaces)
  - Integration with third-party higher-level toolkits such as VTK and Open Scene Graph
- Open-source:
  - *http://code.google.com/p/omegalib/*

OmegaLib as Pixel Generator

- OmegaLib application
  - Parallel rendering
- SAGE back-end
  - Offscreen rendering
  - SAGE streaming
- Streams stereo-3D content to SAGE
- OmegaLib window in a SAGE workspace
- Example: large-scale 3D model rendering

SAGE Future

- Continue to push the SAGE model
- Pursuing new funding, such as:
  - NSF Big Data
  - NSF PFI (Partnership for Innovation)
  - NSF S2I2 (Software Infrastructure for Sustained Innovation)
- Building targeted environments for specific domains, such as:
  - Hybrid tiled-display/VR middleware
  - High-resolution Genomics environment (GenoSAGE)

SAGE Future
Hybrid 2D/3D Environments

- VR and SAGE collaboration space
- CAVE2™ System
  - 2D and 3D can be mixed
- Seamless transition between SAGE world (2D, collaboration support, media files, …) and stereo-3D VR world for large datasets and scientific visualization

SAGE Future
OmegaLib + SAGE

- Collaborative 2D space with stereo-3D windows
  - no tracking, limited interaction
- Seamless switch to full VR environment
  - Large-scale visualization
  - User-centered perspective
  - Full interaction
- How to architect middleware
  - API, interaction, interfaces, …

SAGE Future

GenoSAGE



GenoSAGE preliminary prototype of high-density genomics visualizations will enable researchers to view, compare and analyze hundreds to thousands of genome sequences

SAGE Future

GenoSAGE



Conceptual mock-up of GenoSAGE illustrating how research groups can collaboratively analyze large volumes of genomic data, compare multiple high-density visualizations, and relate genome sequences to other data types.

Thank You

The Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago receives major support for SAGE from the National Science Foundation, award #OCI-0943559.

EVL receives additional support from King Abdullah University for Science and Technology, NTT Network Innovation Lab, and Sharp Laboratories of America







SHARP LABORATORIES OF AMERICA

evl electronic visualization laboratory

SAGE

www.sagecommons.org

Discussion

- Comments
- Q&A

SAGE Future
GenoSAGE

- Development of techniques for visualizing large-scale genomic data in scalable resolution display environments
- GenoSAGE is a proposed prototype data visualization tool to enable the comparative analysis of thousands of sequenced genomes at multiple, integrated, levels of detail – whole genomes, gene regions and nucleotide sequences – in one view.
- NSF Big Data grant