



## **Progress report (Q1-08)**

### **Scalable displays as network drivers: Partnership in the OptIPuter project.**

#### **Participants:**

Prof. B. A. Pailthorpe, Dr. N S Bordes, Dr. D Green, C. Willing, D. Kosovic, UQ;  
Dr. J Young, QUT; J Bell, CQU. Students: Jonathon White, Imran Saed, Tony Gill.

#### **International Partners:**

CalIT2, UCSD: Prof. Larry Smarr, Dr. Tom Defanti; EVL, UIC: Dr. Jason Leigh.

### **1. Description**

This project sought to build a new, high capacity computer display - an OptiPortal - at UQ-VisLab (co-located with the UQ HPC Unit) that would be the highest capacity in Australia: 36 Mega-pixels (compared to regular desktops with 1-2 Mpixel). It is part of the US OptIPuter project<sup>1</sup>, “A Powerful Distributed Cyberinfrastructure to Support Data-Intensive Scientific Research and Collaboration”. It is led by Larry Smarr, Director of the California Institute for Telecommunications and Information Technology, CAL(IT)-2<sup>2</sup>. The OptiPortal displays are low-cost, scalable computer displays based on tiled arrays of LCD panels driven by PC graphics clusters.

### **2. Construction**

The physical system is a tiled LCD display, with associated PC graphics systems and network manager. A simple mechanical frame (80:20 Al alloy extrusions) supports and aligns the array of LCD displays. Summer student intern, Jonathon White, did the CAD drawing, liaised with the SPS Mechanical Workshop at UQ who machined special components; he then constructed the systems in our lab. The display currently is a 4x4 array of LCD panels, with narrow bezels for edge-to-edge tiling. Each LCD screen is 1920 x 1200 pixels, with a total image size of 7680 x 4800 pixels, or 36 mega-pixels. Each PC drives 4 screens, via a pair of dual DVI output graphics cards. Due to cost savings thus far, we foresee how to expand the display to > 50 Mpixels presently.

Chris Willing configured the PC cluster and the software, SAGE<sup>3</sup>. It is the open source API and software suite that drives the display from a PC linux graphics cluster. Thus the display acts as a wall-sized desktop. Currently it supports linux image viewers and movie players and an enhanced VNC viewer for remote desktop display. Running commentary on the constructions with photos is shown at our vislab website<sup>4</sup>. There also is a live HD and H.321 feed into the Access Grid APAG Virtual Venue. That has casually generated quite a bit of awareness, with many tours requested (we are conducting ~ 3/day at time of writing).

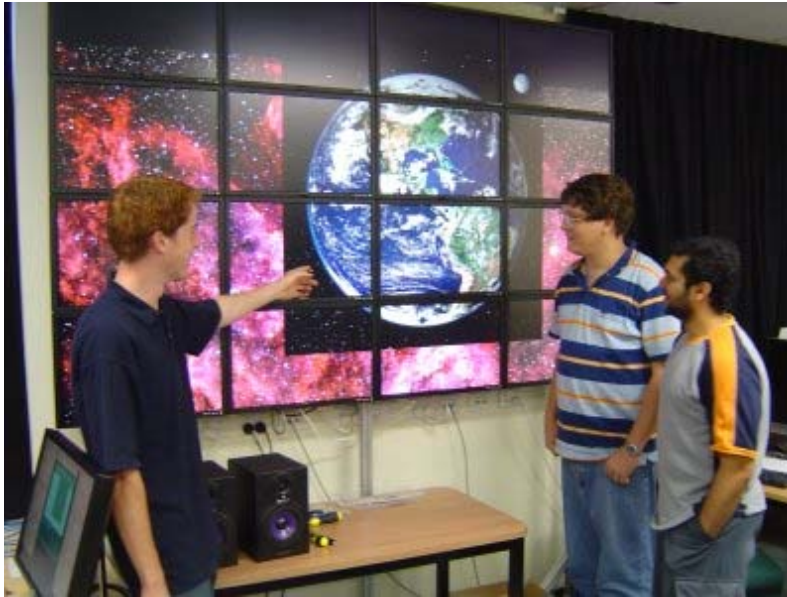
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<sup>1</sup> [www.optiputer.net](http://www.optiputer.net)

<sup>2</sup> [www.calit2.net](http://www.calit2.net)

<sup>3</sup> [www.evl.uic.edu/cavern/sage/index.php](http://www.evl.uic.edu/cavern/sage/index.php).

<sup>4</sup> [www.vislab.uq.edu.au/research/optiputer/](http://www.vislab.uq.edu.au/research/optiputer/)



QCIF's new *Optiportal* display<sup>4</sup>. From left: Jonathon White (SPS, UQ Honours student), Doug Kosovic (ITEE, UQ) and Imran Saed (SPS, UQ PhD student); Chris Willing, who led the team, is absent from photo. The tiled display uses *SAGE* to show 4k x 4k satellite images (Feb'08). The 17<sup>th</sup> screen, on the left, hosts the control interface.

### 3. Applications

Initial users, in first weeks of operation, are drawn from satellite imaging (Landsat, MODIS, SLATS – Prof. Stuart Phinn, UQ, PhD student Tony Gill; DNRMW) of Queensland landcover (tree over- and under-story evergreen foliage cover, seasonal grasses, bare soil). The next two user groups are: astronomical (A/Prof Michael Drinkwater, UQ; ausVO – NCRIS5.10) and microscopy (Drs. Brad Marsh & Ben Hankamer, IMB) imaging. Thus we can show 4k x 4k CCD camera images, as above, HD and 3k x 1k movies, etc. We also can show natively the 3D Orion movie that BAP (and ~50 others) produced for the Jan 1, 2000 opening of the new (digital) Hayden Planetarium in New York (cf. amnh.org) – that system was essentially a “starship simulator” since it employed a fly-through of a 3D model of our galaxy derived from NASA, Goddard mapping of star positions. Previously no display, at all, was available locally to view such scientific images natively.

We currently are attempting to show a 300+ Megapixel Digital Elevation (DEM) model of Australia at 90m resolution, derived from space shuttle radar altimetry (SAR) – this is composite image is a single 40+ GByte file. It requires us to use the *JuxtaView* distributed memory image render, since normal software cannot handle such large files – Jonathon currently is figuring out how to drive that software.

User interaction is the next challenge: one does not easily, or usefully, drag a mouse across 8,000 pixels. We are investigating pointers, wands, 3D mice (spaceball, etc), inexpensive 3D games controllers, etc.

### 4. Funds

\$50k was approved by QCIF, towards costs of equipment – construction thus far has cost ~\$35k. We anticipate that a larger display (>50 mega-Pixels) can be built with remaining funds. Matching funds were provided from BAP research accounts at UQ (~\$10.6k), to cover the student intern salary (Nov'07 – Feb'08).

We are considering now dedicated network facilities for the OptIPortal, building on our DataGrid installed in 2007. Currently, networking of the cluster is mediated via a simple network switch connected to the normal campus network. Experience at U. Melbourne and

AARNet (see below) has shown that a network link via dedicated Customer Premises Equipment (CPE) directly to AARNet3 is required for successful participation in multi-site OptIPortal collaborations. It is possible that QCIF resources could be connected directly to AARNet3, without having to share with regular campus network traffic.

## 5. Others

QCIF is now informed, by Larry Smarr and Tom Defanti, that we are a member of the OptiPlanet project, as it is called – the multi-national extension of the NSF Optiputer project, which now is nearing the end of its life. Chris Willing, currently on R/L in the US, will visit the calIT2 team on Feb 11-12.

Melbourne VC, Glynn Davis also met Larry Smarr during his August 2007 visit. Thus U Melb. Built a \$500,000+ theatre-sized display (est 92 M-pixel) that was opened on Feb 16, amongst much media coverage, by deputy PM Gillard and Vic Premier Brumby, as part of a *US-Australia Leadership Dialogue* meeting in San Diego. We waited, and we were beaten to the mark. Melbourne, not Brisbane, now claims the #1 computer display in Australia. The difference is that our project was bottom-up, while theirs was top-down. Ours is dramatically lower cost and technically superior, since it uses better software and is supported by a stronger skills base, due to our background in Access Grid and tiled displays.

### About the OptIPuter project

- from the OptIPuter<sup>1</sup> website:

“The OptIPuter<sup>1</sup>, so named for its use of **Optical** networking, **Internet Protocol**, **computer** storage, processing and visualization technologies, is an emerging infrastructure that tightly couples computational resources over dedicated optical networks using the Internet Protocol”. OptiPortal displays are the user endpoints in this distributed system, the largest of which at UCSD is 200 Mega-pixels.

The OptIPuter’s mission is to enable scientists to explore very large, remote, data objects in a novel interactive and collaborative fashion, which is impossible on today’s shared internet. We are doing this by developing a radical LambdaGrid architecture (cf. nlr.net), which shows great promise for enabling a number of this decade’s e-science shared information technology facilities. The research agenda involves the design, development and implementation of the OptIPuter -- a tightly-integrated cluster of computational, storage and visualization resources, linked over parallel dedicated optical networks across campus, metro, national, and international scales. The OptIPuter runs over 1-10Gbps lambdas, with advanced middleware and network management tools and techniques to optimize transmissions so distance-dependent delays are the only major variable.