

# The Global Lambda Visualization Facility Supporting Advanced Visualization and Collaboration Research over Ultra High Speed Networks

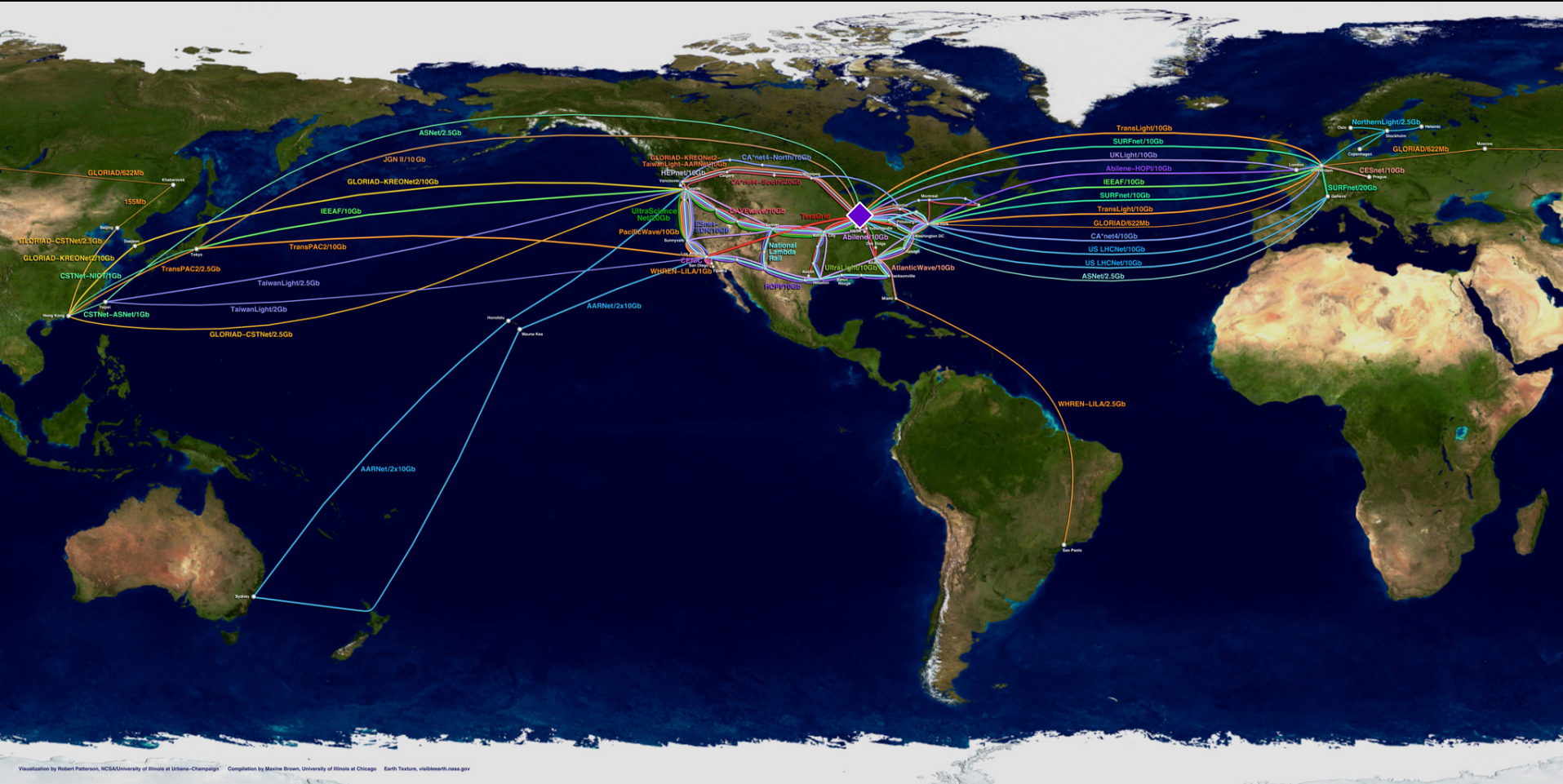
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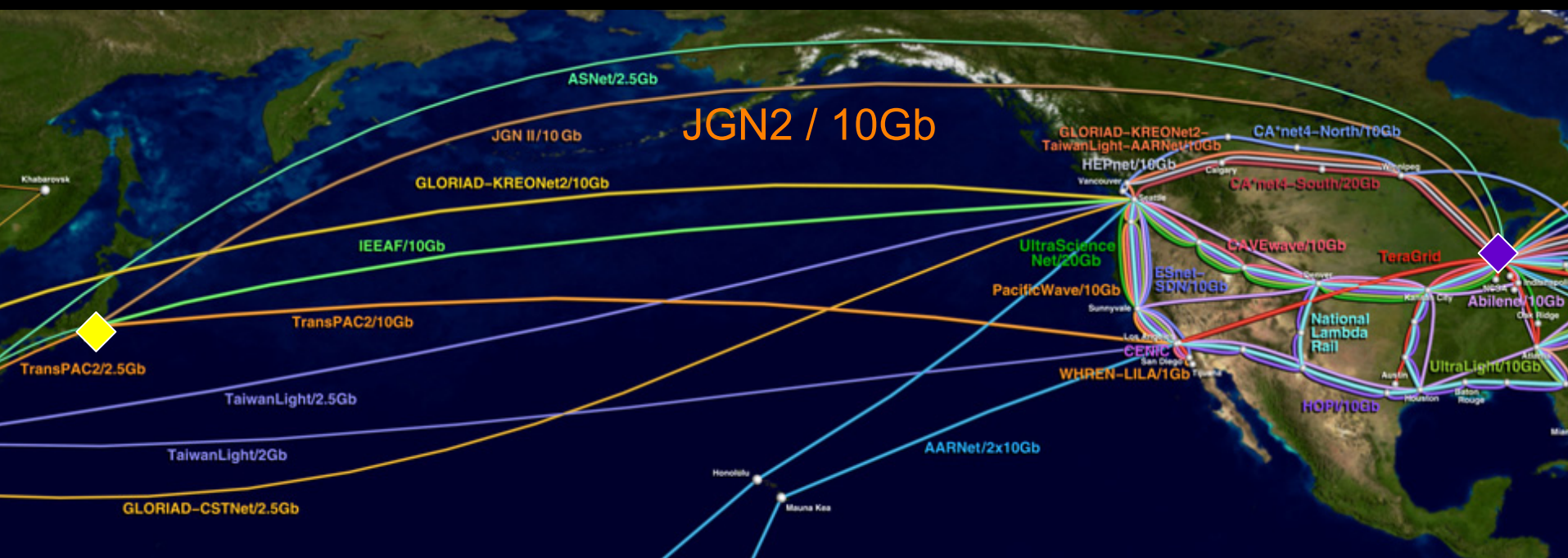


# StarLight & Global Lambda Integrated Facility Optical Networking Infrastructure for Rapid Distribution of Large Scale Instrumentation Data



Visualization by Robert Patterson, NCSA/University of Illinois at Urbana-Champaign | Compilation by Maxine Brown, University of Illinois at Chicago | Earth Texture, vislabearth.nasa.gov





- August 2004 - JGN 2 established 10Gb link from Tokyo to Chicago
- July 2006 - NiCT and UIC sign MOU to formalize collaborations with Japanese research organizations







# The Global Lambda Visualization Facility was launched at iGrid 2005

- A single visualization demonstration that grew too big.
- EVL, UCSD, NCSA, USGS, SARA, GIST, KISTI, U of Chicago, Simon Fraser U, U Alberta

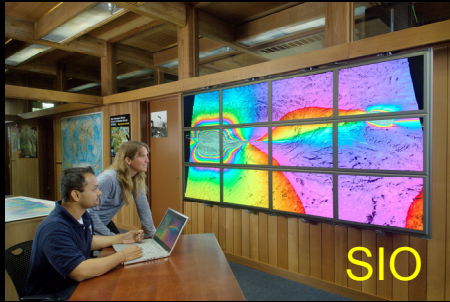
## **iGrid created the opportunity to:**

Create an international wide-area persistent / living **collaboratory** equipped with advanced visualization connected by GLIF:

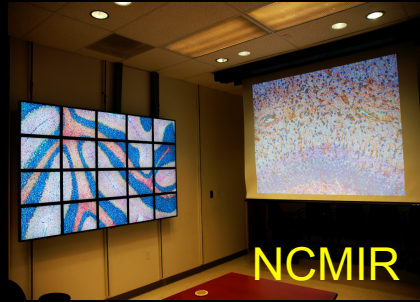
- Conducting **experiments in LambdaGrid remote visualization & collaboration**
- Providing **tutorials of international e-science visualization & collaboration capability** that can leverage advanced visualization over LambdaGrids.



# GLVF Sites To-Date



SIO



NCMIR



USGS EDC



NCSA &  
TRECC



SARA



KISTI



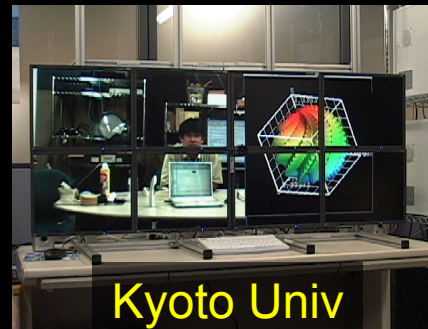
AIST



CALIT2



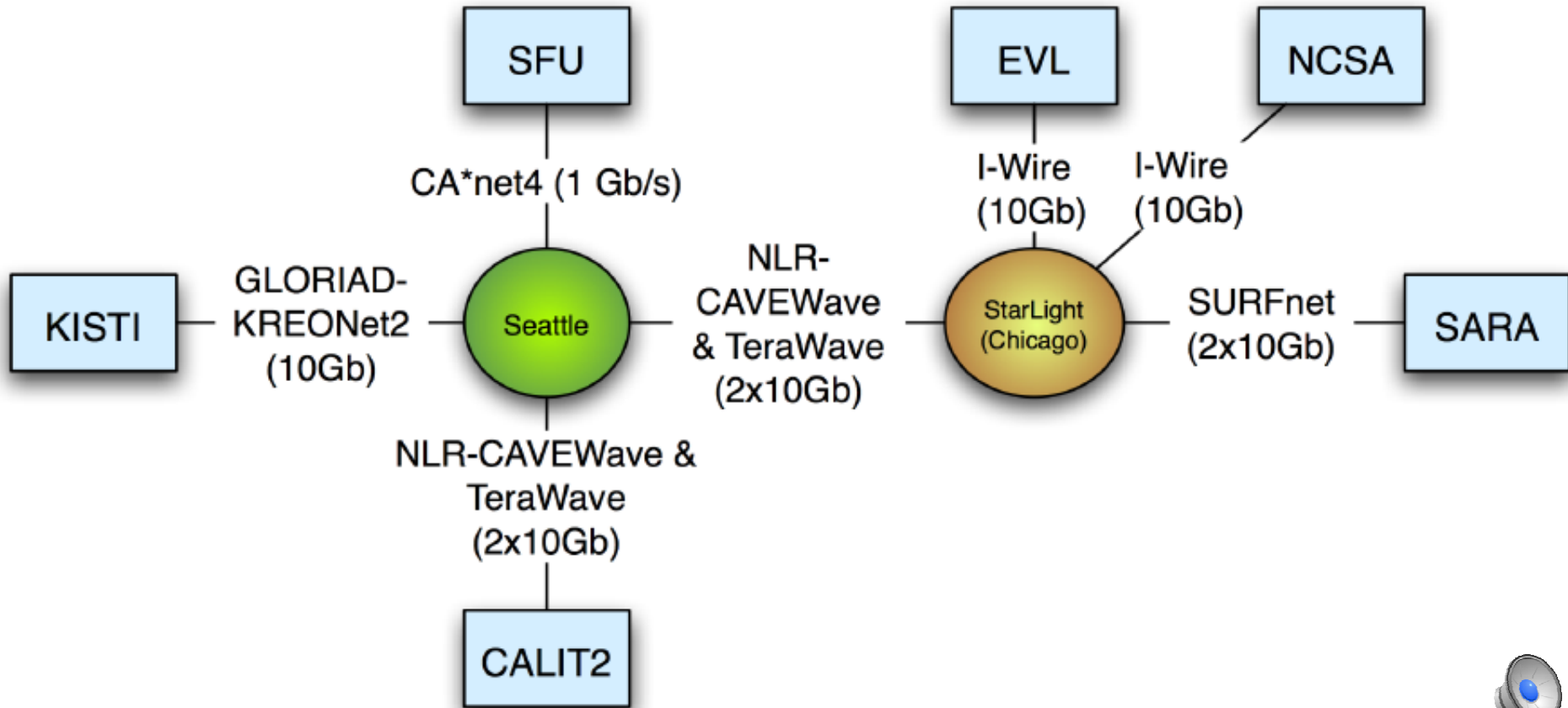
UIC



Kyoto Univ



# iGrid GLVF Connectivity



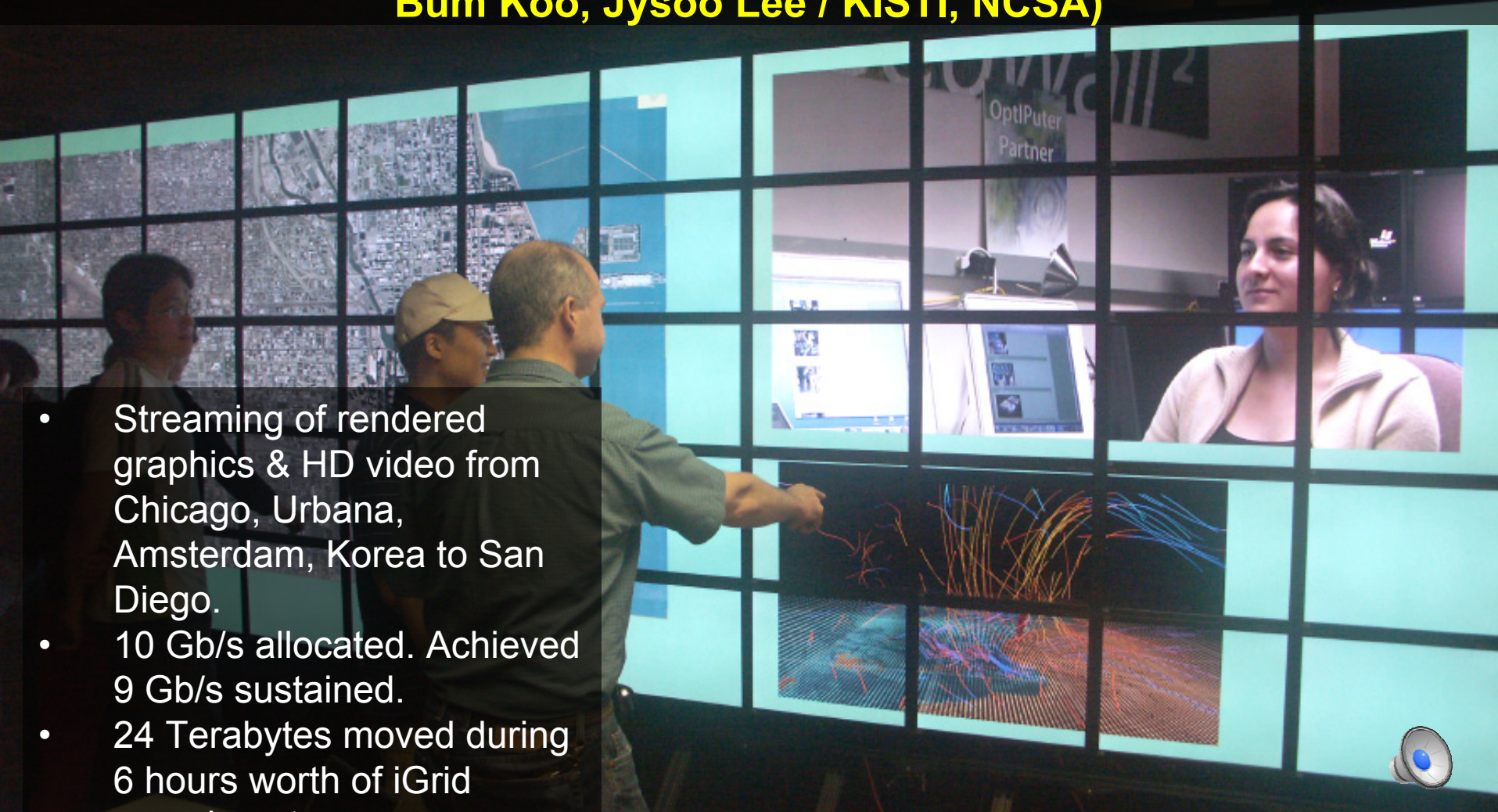


# OptIPuter

## Scalable Adaptive Graphics Environment (SAGE)

(EVL, SARA, Jaeyoun Kim, Sangwoo Han, and JongWon Kim/GIST, Gee Bum Koo, Jysoo Lee / KISTI, NCSA)

- Streaming of rendered graphics & HD video from Chicago, Urbana, Amsterdam, Korea to San Diego.
- 10 Gb/s allocated. Achieved 9 Gb/s sustained.
- 24 Terabytes moved during 6 hours worth of iGrid experiments.

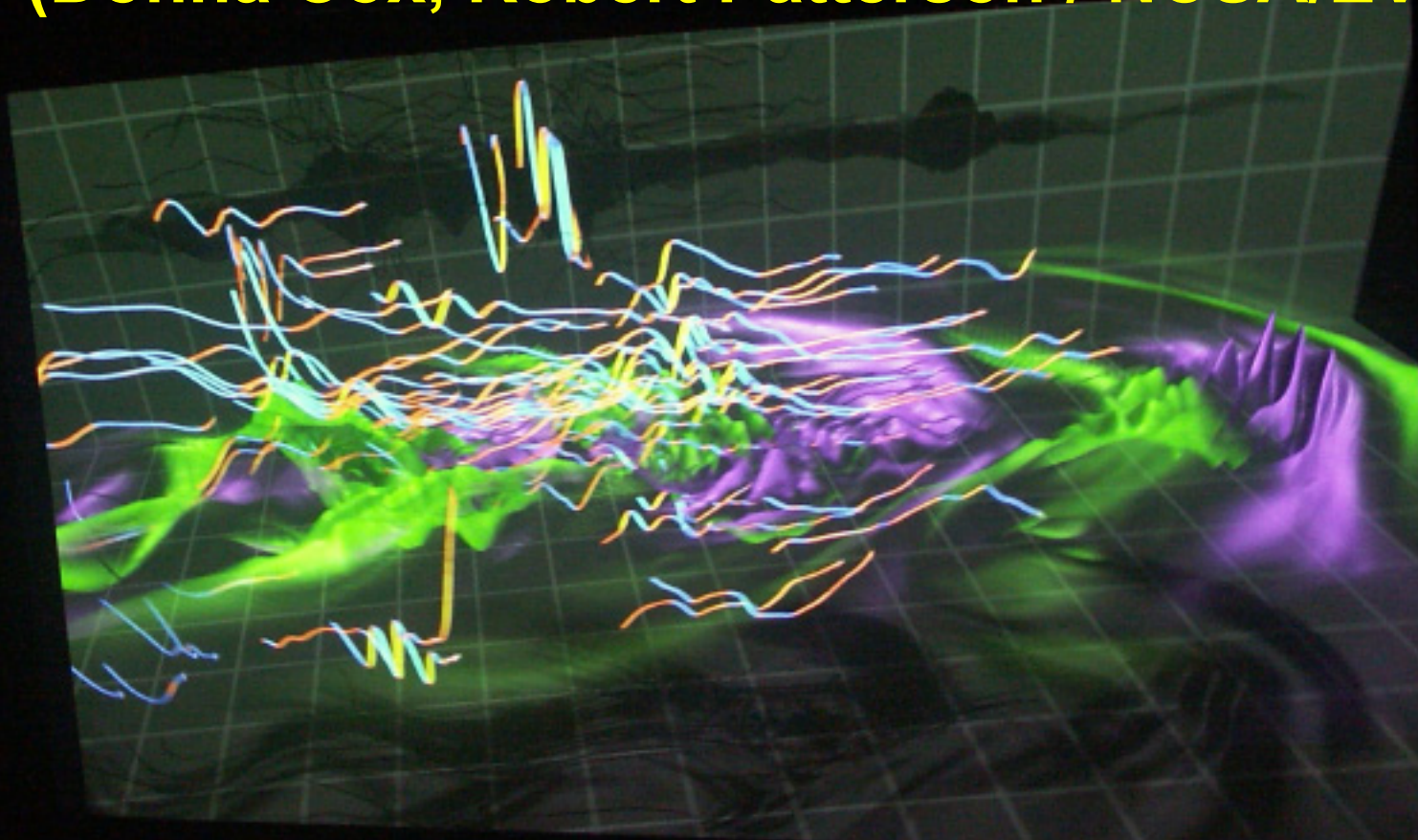




# Bplayer / SAGE

## HD Stereo Visualization Streaming

(Donna Cox, Robert Patterson / NCSA/EVL)



- NCSA disk movie player extended with SAGE to enable streaming.
- Streamed 2 x 1920x1080 at 15 frames per second.
- 1.4 Gb/s





# The Solutions Server

Brian Corrie / Simon Fraser University

Pierre Boulanger / University of Alberta



- Media LightPath Project
- Use UCLP for advanced visualization
- Simulation steering (Solutions Server) in Alberta streaming data to Vancouver to render and stream visualizations to San Diego using SGI VizServer Product.

- 600Mb/s over local area
- But only 200Mb/s over test lightpath
- And 20Mb/s to iGrid #@#^\$!
- Attributed to insufficient tuning of end-systems



# Varrier Auto Stereo Conferencing (Dan Sandin / EVL)



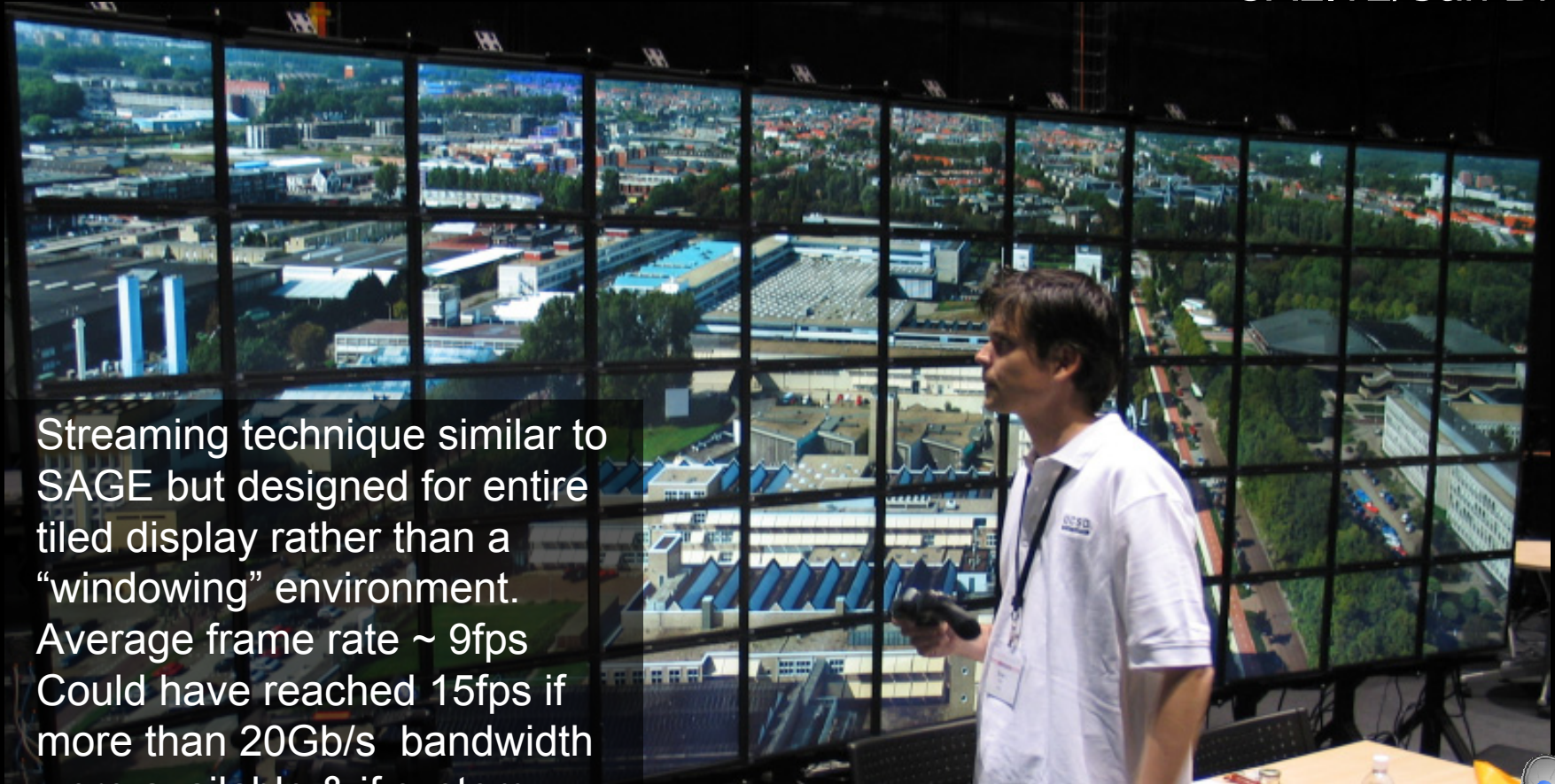
- See 3D without wearing glasses.
- Exceptional solution for 3D video conferencing.
- 2 x 640 x 480 cameras.
- 220Mb/s streamed bi-directionally.
- Same technique can be used to stream view dependent images on-demand.
- Focuses graphics power on where the user is looking.





# Technology for Optical Pixel Streaming (Bram Stolk, Paul Wielinga / SARA)

Visualization World Record 20 Gb/s from SARA/Amsterdam  
CALIT2/San Diego



- Streaming technique similar to SAGE but designed for entire tiled display rather than a “windowing” environment.
- Average frame rate ~ 9fps
- Could have reached 15fps if more than 20Gb/s bandwidth were available & if system limits don't get in the way.





# Collaborative Visualization poses a good upperbound to stress network requirements

Type of Flow	# Flows	Bandwidth per flow	Latency sensitive	Jitter sensitive	Reliability requirement	Burstiness	Message size	Protocol
Audio stream	1 per user	Low 1Mbps	yes	yes	med	constant	small	UDP-based
HD video conference stream	1 per user	Med to High 25Mbps to 1.5Gbps	yes	yes	med	constant	small to med	UDP-based
Application Stream	1 - 100 per application*	High 1 to 2.5 Gbps	yes	variable	high	app dependent	large	TCP-based
Annotations / Static Content	1-10 per user	Low 1Mbps	no	no	high	one burst	small	TCP-based
Control channel	1 per rendering node + 1 per display	Low 64Kbps	no	yes	high	short burst	small	TCP-based
Synchronization channel	1 per rendering node + 1 per display	Low 1Mbps	yes	yes	high	constant	small	TCP-based
SAGE UI	1 per user	Low 64Kbps	no	no	high	short burst	small	TCP-based
VNC streams	1 per user	Low 1 Mbps	yes	yes	high	small burst	small	TCP-based



# Thank You

- [www.evl.uic.edu/cavern/glvf](http://www.evl.uic.edu/cavern/glvf)

