TeraVision : a Platform and Software Independent Solution for Real Time Display Distribution in Advanced Collaborative Environments

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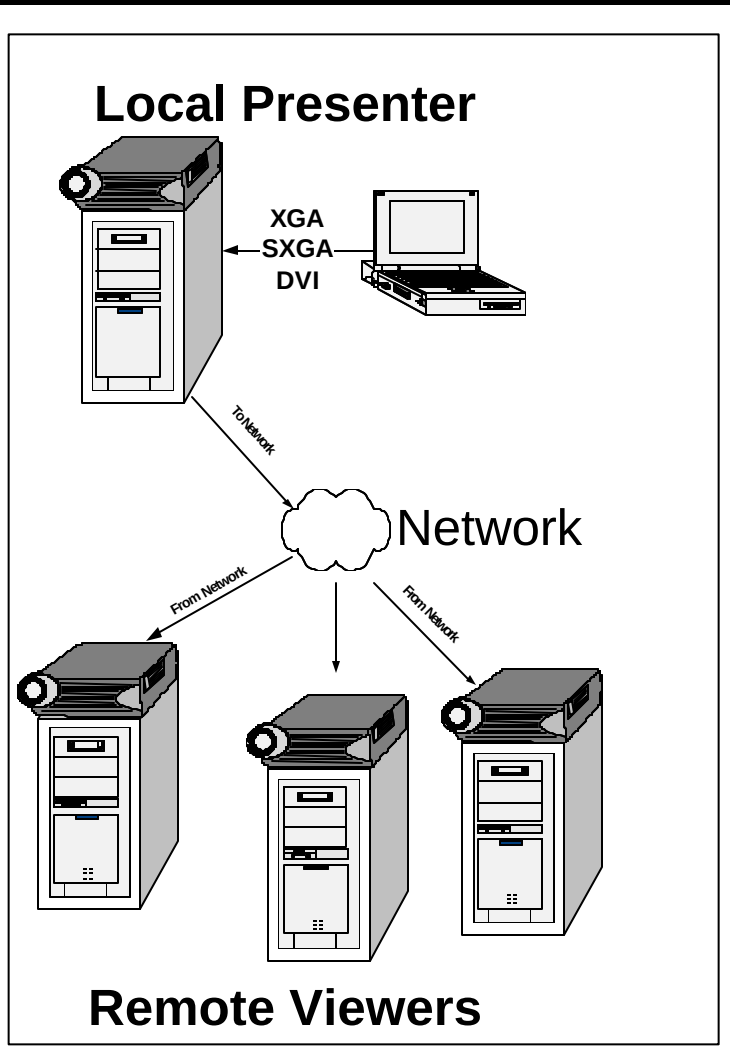
The Collaborative Continuum
5Ghz 40Mbps 802.11a
Wireless mobile
Plasma Touch screen
Persistent flip notes
Camera array for image based panorama
Passive stereo
VR display
Wireless tablet PCs +
cameras velcroed to wall
for private video or
persistent postits
Tiled display
(LCD tiles for high resolution,
or plasma screens)

Goals & Use Scenarios

- Docking Problem / Display Pushing Problem
- TeraVision Box (VBox)
- Plug laptop into VBox
- Plug output of an SGI Onyx or PC cluster into VBox



Advantages of Technique

- It does not require modification of the host visualization software;
- It is compatible with any hardware that can provide a standard VGA or DVI signal;
- It scales to large tiled-displays providing there are sufficient VBoxes and bandwidth to support VBox streams;
- Image generation is decoupled from image capture and transmission- hence the host graphics system can operate at optimal frame rates.

Hardware Configuration

- 1.5GHz Pentium 4
- NetGear GA620 Gigabit Ethernet NIC
- Foresight I-RGB 75 – 1024x768 @ 60-75Hz
  – Max 120MB/s sustained transfer rate
- 32 & 64 bit PCI bus
  – 32 bit for Foresight
  – 64 bit for GigE NIC
- ATI Radeon 8500

Test Configuration

Windows 2000

Linux
Pentium 3- 933MhZ
Elsa Gloria III Quadra2 Pro

Software Implementation

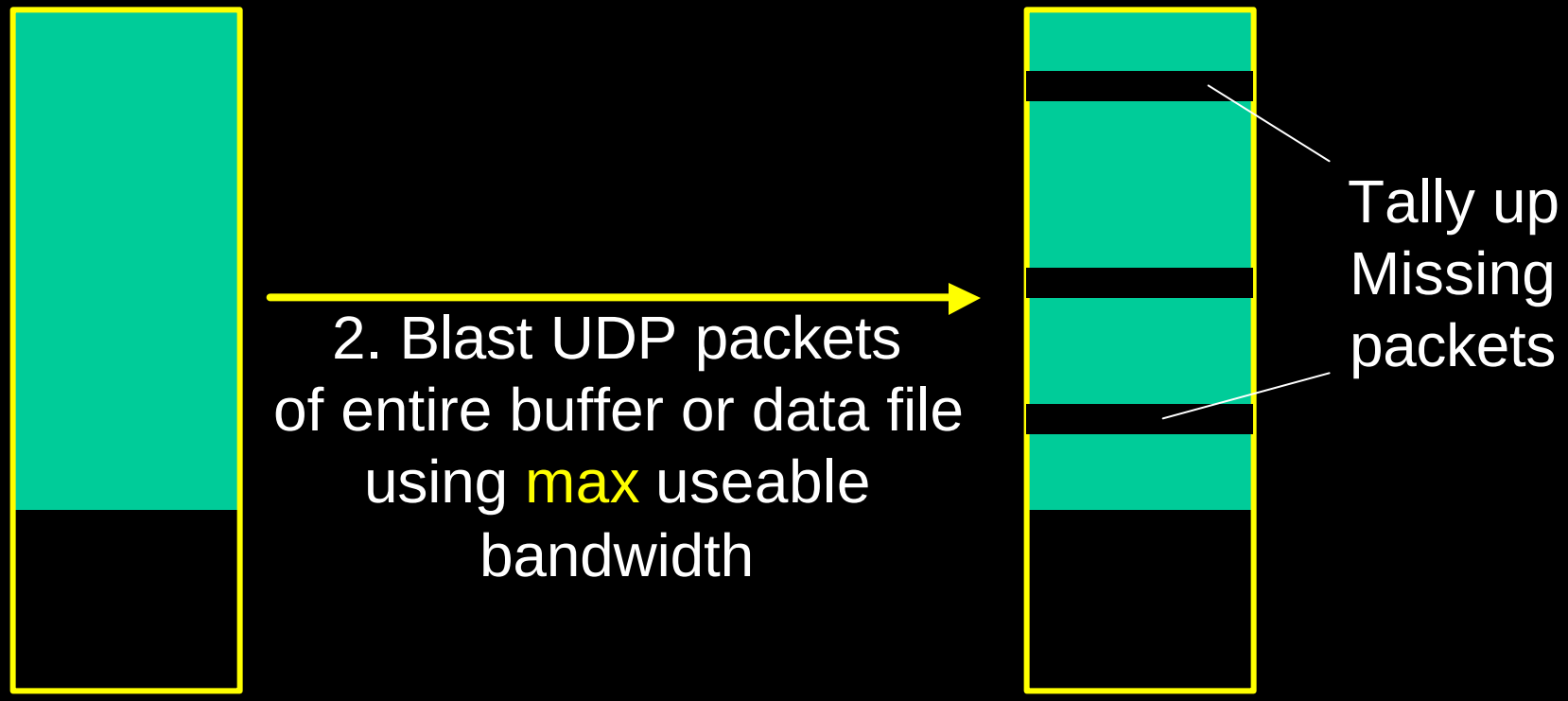
- Frame capture via DMA
- Write to NIC also via DMA
- Software synchronizes transmission on all source nodes & synchronizes receipt at destination nodes
  - Ie supports tiled displays
- Software synchronizes end-to-end transmission
  - Needed to prevent source from sending quicker than destination can receive
- Currently using TCP for image transfer
- Will switch to Reliable UDP for next implementation- especially for WAN

Parallel TCP from Chicago to Amsterdam (622Mbps Link)

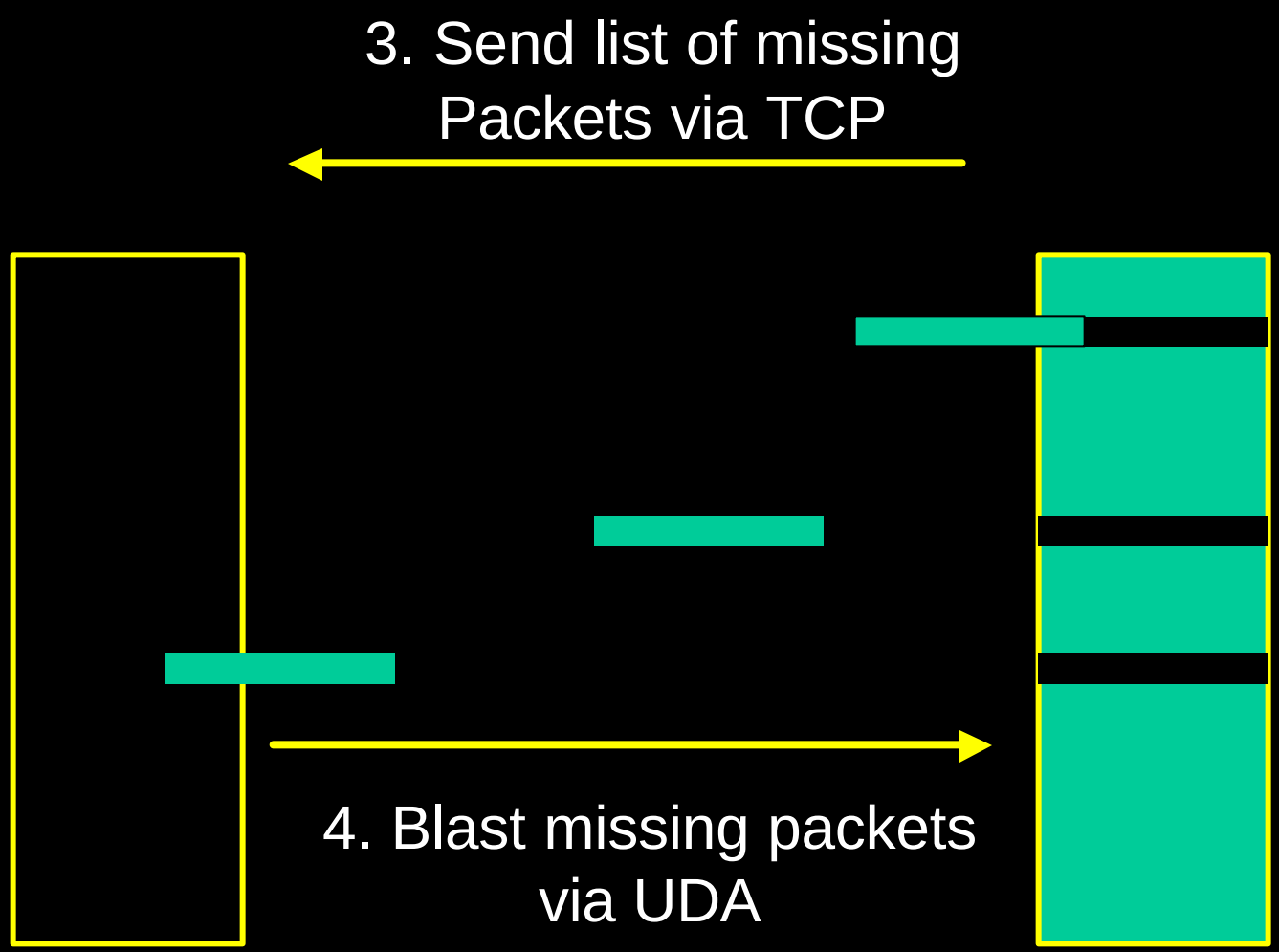
- Overcoming the Long Fat Network problem
- Basic strategy for GridFTP
- 290-300 parallel sockets – achieved 400Mbps
- Running 2 copies of the application – achieved a total of 550Mbps
- PTCP was practical for lower bandwidths, but the need to open several hundred sockets calls for a more precise solution.
- TCP performs incremental transmit window size and exponential backoff.
- For bulk data transfer over high speed almost-dedicated networks you want the opposite: exponential window size growth with incremental backoff.

General RUDP Algorithm

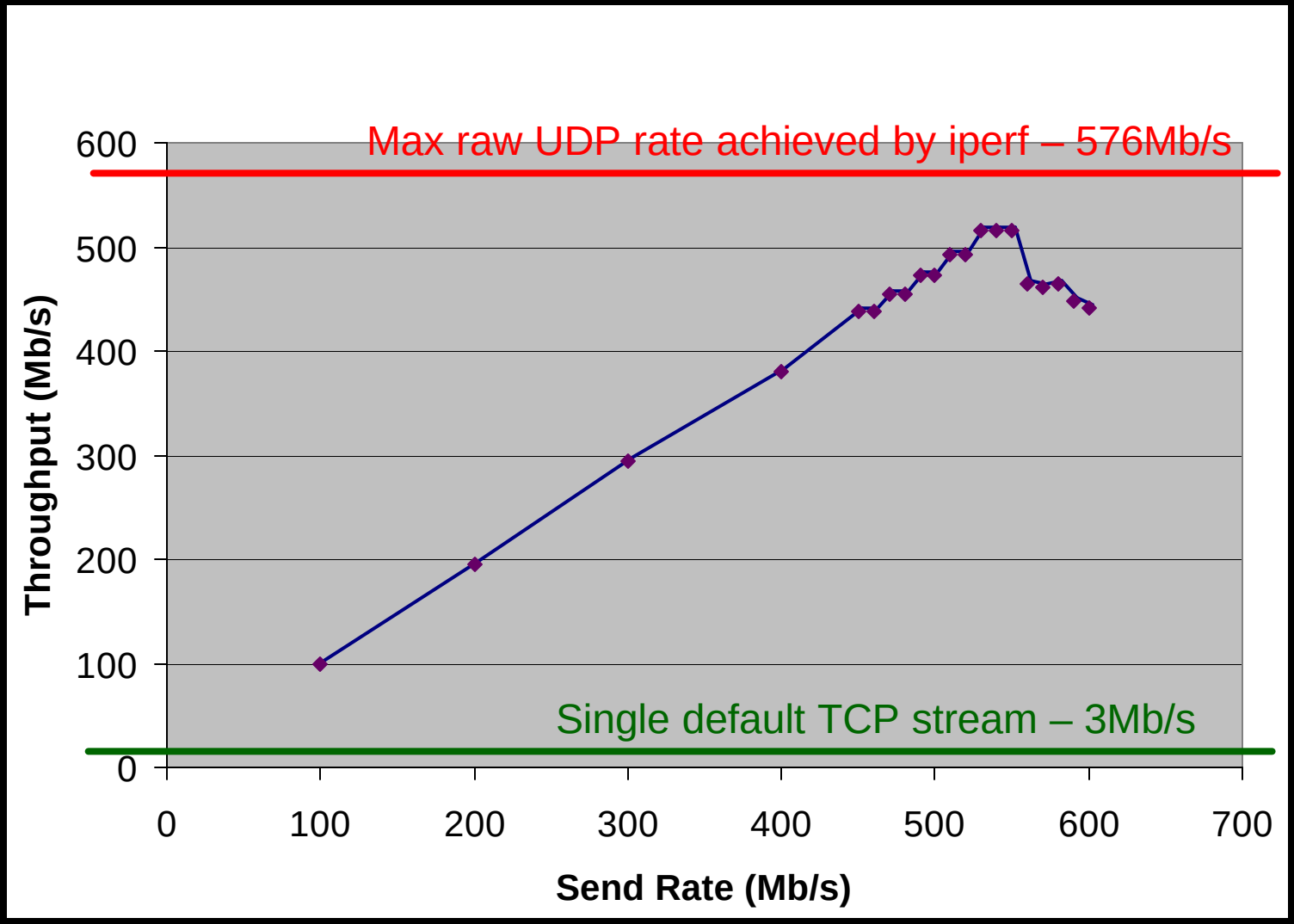
1. Use a network probe (like netperf or iperf) to estimate Maximum useable UDP bandwidth



General RUDP Algorithm (cont)



RUDP from Chicago to Amsterdam (622 Mb/s Link) transmitting 100MB



Performance

- Raw capture frame rate (1024x768x32bit) : 33-35fps via DMA from card to memory
- Max achieved GigE bandwidth from Windows to Linux test – 300Mb/s (optimization needed here-have been able to achieve 900Mb/s in the past in Linux to Linux LAN tests)
- This reduced our display frame rate to 15fps.
- Max remote display frame rate achieved by optimized Linux to Linux streaming (1024x768x24bit) – 30fps

ToDos

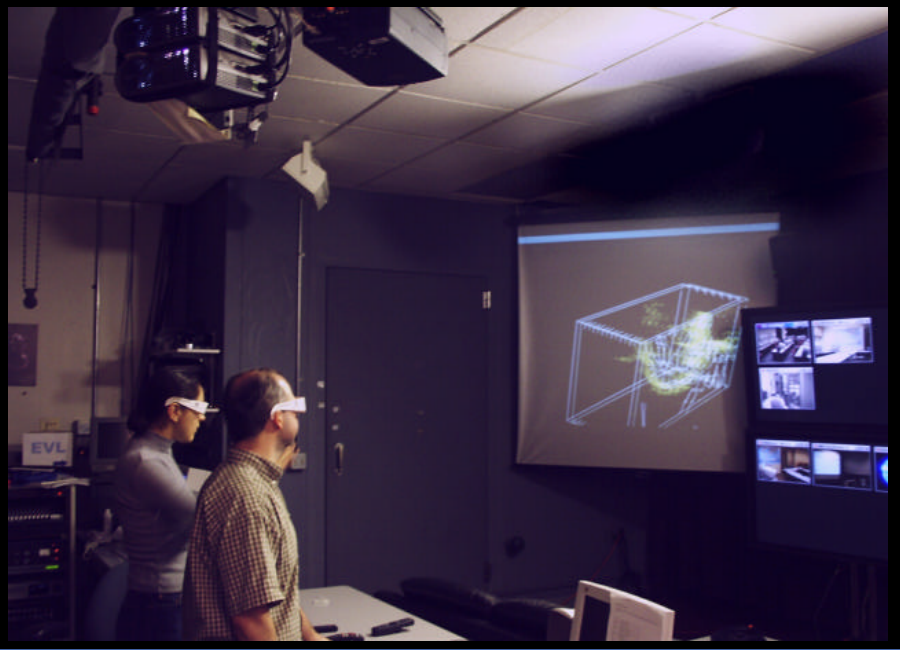
- Bottleneck currently in Windows networking
- Need to apply RUDP for highspeed end-to-end transmission over WAN
- Need to make TeraVision symmetric to allow bi-directional transfer
- Each stream takes 500Mb/s – so reflectors cannot be used for distribution to multiple sites
- Reliable multicasting is needed
- Examine hardware codecs to reduce bandwidth, if necessary

ToDos

- To increase resolution:
  - Foresight I-RGB 200 – 1600x1200 @ 75Hz, 1280x1024 @ 85Hz
- Problem: 1280x1024x32bitx30fps ~ 1Gb/s
  - PCI bandwidth is 1Gb/s
  - 64 bit PCI is 4Gb/s – 64bit Foresight cards are being planned
  - Future??? PCI-X – 8Gb/s, 3GIO/PCI-3 – 48Gb/s

IGRID 2002

- IGRID – International Grid meeting to demonstrate aggressive network applications (www.startap.net/igrid2002)
- Demonstrate VBox by streaming passive stereo over 2.5G StarLight connection from Chicago to Amsterdam
- AGAVE – Access Grid Augmented Virtual Environment
- GeoWall Consortium (www.geowall.org)



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Visualization and Digital Imaging Lab, Univ. Minnesota- Duluth

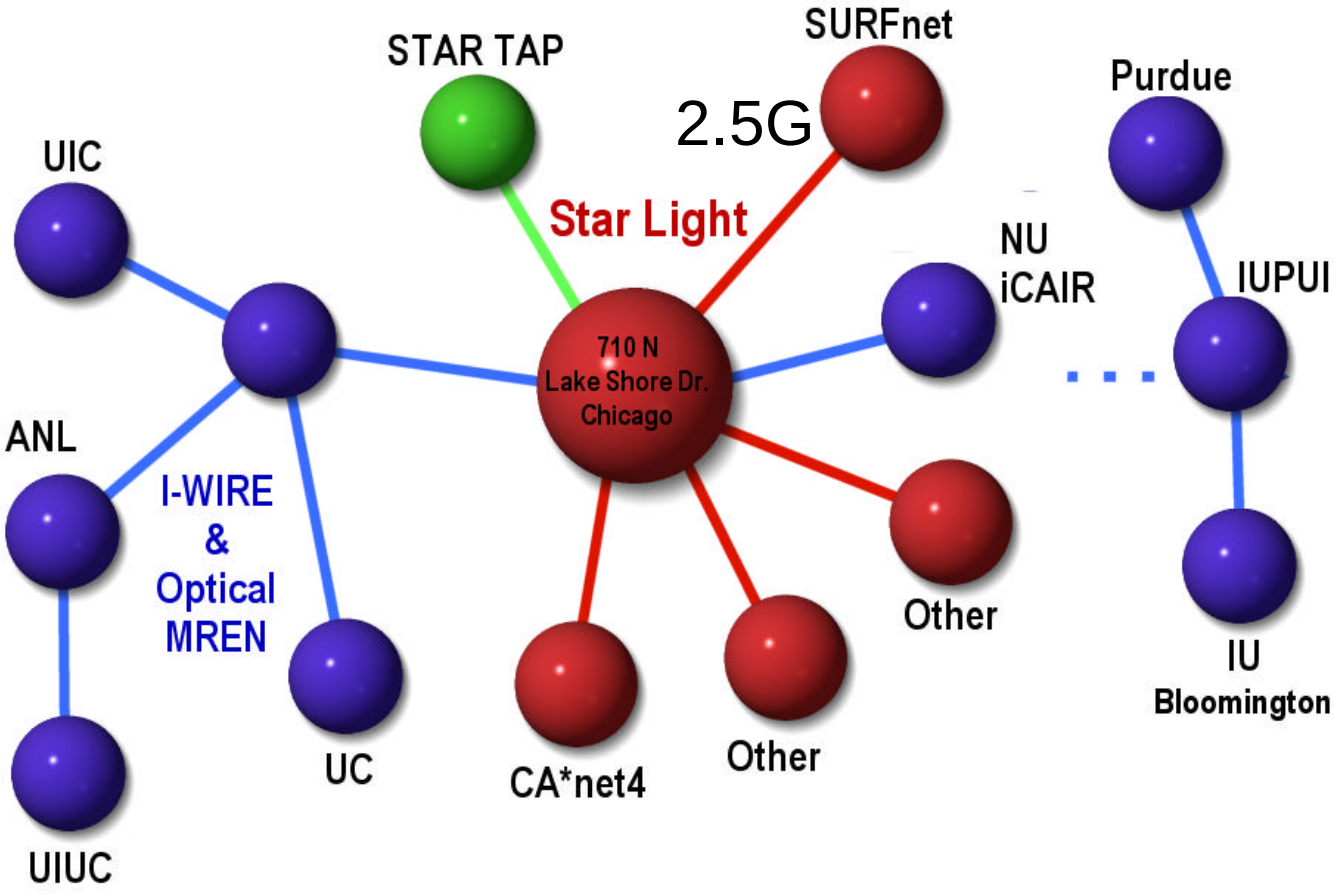
Dept. of Computer Science and Mathematics, Fond Du Lac Tribal and Community College

Northern Arizona Univ.

Arizona State Univ.

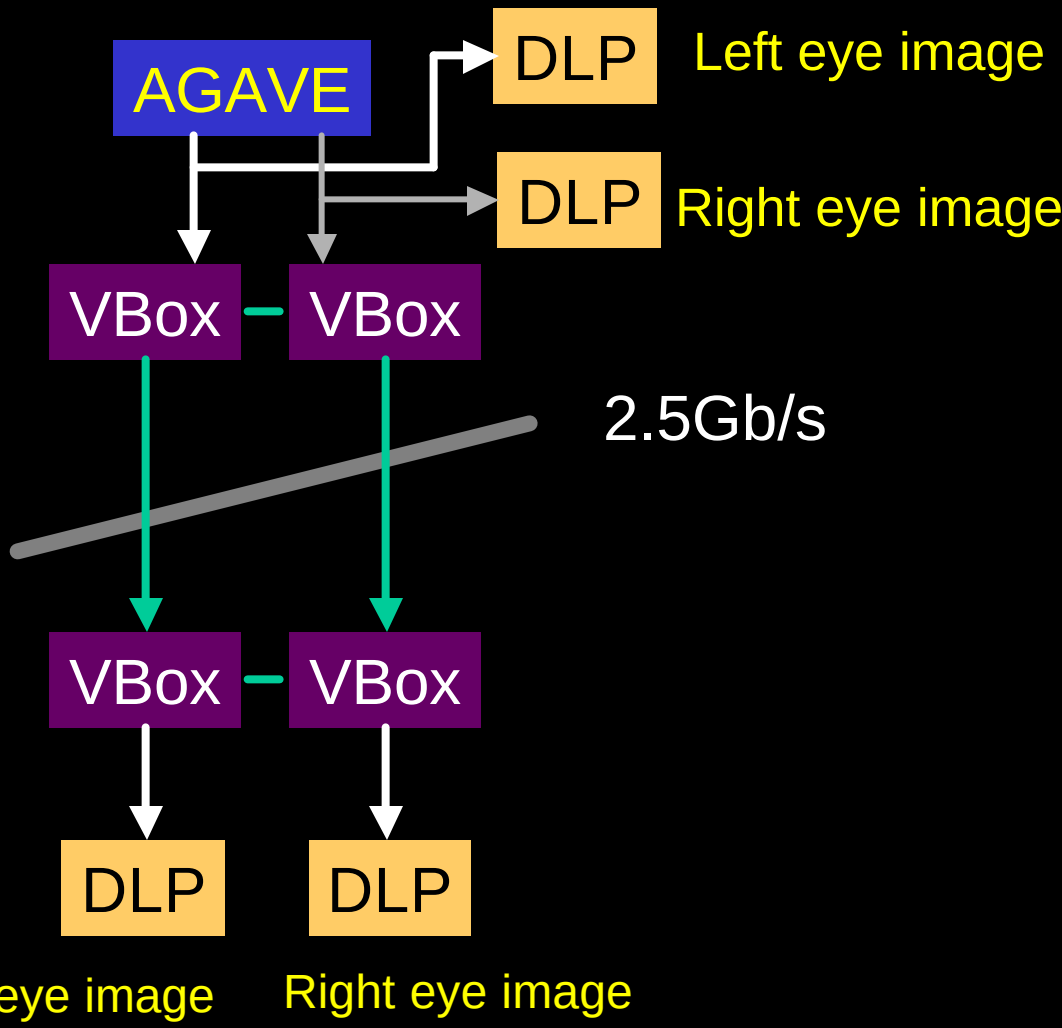
STARLIGHT SM

The Optical STAR TAP SM



Chicago

Amsterdam



For More Info

- www.evl.uic.edu/cavern/continuum
- www.evl.uic.edu/cavern/agave
- www.geowall.org