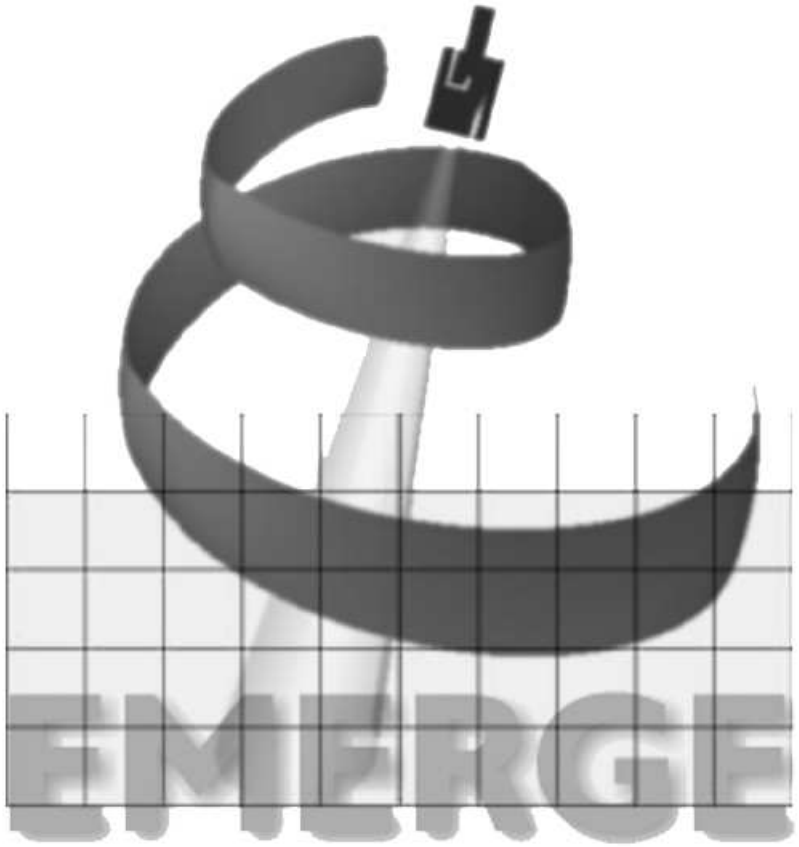


ESnet/MREN Regional Grid Experimental NGI Testbed

Who, Where, What, Why, How, and a little When

Tom DeFanti, Alan Verlo, Jason Leigh

Linda Winkler and John Jamison

October 4, 1999

EMERGE Sites

- **University of Chicago, to connect Center on Astrophysical Thermonuclear Flashes (FLASH)**
  - **FLASH is an ASCI Center with strong research connections to ANL, LANL, SNL, and LLNL**
- **University of Wisconsin-Madison, to connect to the Engine Research Center (ERC), Space Science and Engineering Center (SSEC), and Livny's Condor Lab in CS department**
  - **ERC and SSEC either currently work with Sandia, LLNL and LBNL, or are included in companion DoE NGI proposals for future collaboration. Livny is working with DoE high-energy physicists**

EMERGE Sites

- **The University of Illinois at Chicago to connect to the Electronic Visualization Laboratory (EVL)**
  - **EVL is part of the Data and Visualization Corridors (DVC) initiative, working with ANL, LLNL, Sandia and LANL, and also part of CorridorOne (C1)**
- **The University of Illinois at Urbana-Champaign to connect to the Center for Simulation of Advanced Rockets (CSAR)**
  - **CSAR is an ASCI Center**

The Two Basic Goals of EMERGE Year 1

- Achieve high network performance for some set of interesting applications (i.e., stress the network)
  - the instrumentation requirement is end-to-end network optimization
- Achieve guaranteed network performance for a set of interesting applications (i.e., QoS work)
  - the instrumentation requirement is verifying whether QoS is delivered

EMERGE Methodology

1. Identify initial application demonstration targets for these two classes of tests, and the machines that they will run on
2. Obtain detailed descriptions of these end-to-end paths, i.e. network maps
3. Characterize the paths via use of technology like pchar, ttcp, etc., with a view to fixing any immediate problems
4. Get in place low-level infrastructure for continuing to monitor these paths, e.g., NWS, as part of the Grid Services Package deployment
5. Create instrumented versions of the key applications, using Autopilot, NetLogger, whatever – then run them on the characterized paths

Measurement Tech/Apps Matrix

Network Measurement Apps, Tech, Who Matrix 23-Sep-99							
Tech\App	Type	UC to Labs	NU to ANL IM+	CAVERNsoft	Accessbot	Cactus	Techspert
pchar	admin	ye	ye	ye	ye	ye	Linda, Alan
netperf/ttcp	admin	ye	ye	ye	?	ye	Ian, Volker
netlogger	application	later	especially	ye	ye	ye	Ian, Ruth
netflow	admin/app	later	ye	ye	ye	ye	Mike, Randy
virtue/pablo/etc	application		later	later	later	later	Ruth
gloperf/NWS	application		ye	ye	ye	ye	Ian
LDAP	application		especially	ye	ye	ye	Ian
SQL database	application		later	ye	later	later	Ian
UDP traffic gen	admin		especially	ye	especially	ye	Alan
Application Tea		Linda Chuck Sellers (FTP mainly)	Mambretti Chen Ian, Lind	Jason, Andy Steve Tuecke Ian	Jason, Alan JJ, Tom Coffin Dan Sandin	Shalf Seidel	

Northwestern University
Status September 23, 1999

- **Northwestern University International Center for Advanced Internet Research (iCAIR)**
  - **iCAIR collaborates with UCAID/Abilene and MREN on QBone and related DiffSer issues**
- **Cisco 7507 delivered and installed**
- **Interactive Media+ (IM+) performance measurement plan designed**
- **Server implemented**
- **100baseT as well as ATM capability**
- **Ready to commence tests with ANL**

UIUC/NCSA

Status September 23, 1999

- The University of Illinois at Urbana-Champaign t connect to the Center for Simulation of Advance Rockets (CSAR)
  - CSAR is an ASCI Center
- 100Mb service to Michael Heath, CSAR
- Cisco 7507 on order
- Focus on:
  - Grid Services Package
  - NetLogger

University of Wisconsin/Madison

Status September 23, 1999

- University of Wisconsin-Madison, Engine Research Center (ERC), Space Science and Engineering Center (SSEC), and the Condor Lab in the CS department
  - ERC and SSEC either currently work with Sandia, LLNL and LBNL, or are included in companion DoE NGI proposals for future collaboration. CS is working with DoE high-energy physicists
- Cisco 7507 on order
- 100Mb service to
  - Christopher Rutland, ERC
  - Miron Livny, Computer Science Department (in collaboration with high-energy physics)

UIC/EVL

Status September 23, 1999

- **The University of Illinois at Chicago Electronic Visualization Laboratory**
  - **EVL is part of the Data and Visualization Corridors (DVC) initiative, working with ANL, LLNL Sandia and LANL, and also part of CorridorOne (C1)**
- **Cisco 7507s for EVL and STAR TAP on order**
- **100baseT and direct 155Mb ATM available in lab now**
- **12 students and several faculty/staff**
- **Strong interest from internationals to participate via STAR TAP**

University of Chicag

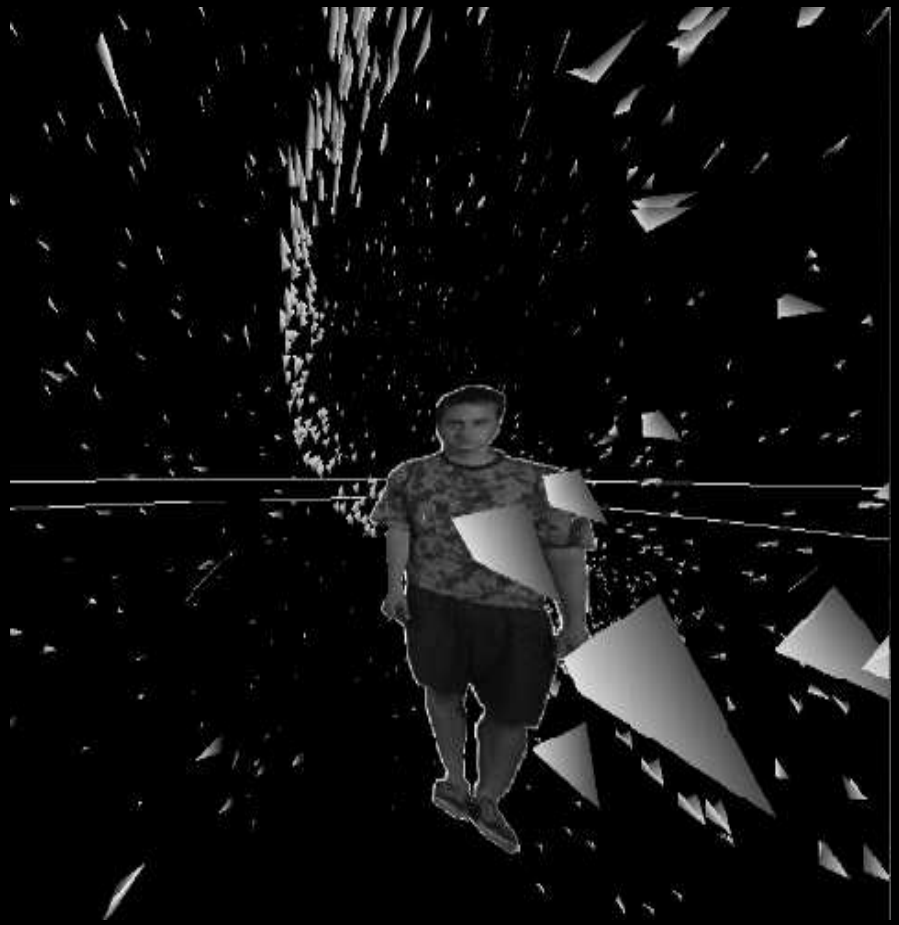
Status September 23, 1999

- University of Chicago, to connect Center on Astrophysical Thermonuclear Flashes (FLASH)
  - FLASH is an ASCI Center with strong research connections to ANL, LANL, SNL, and LLNL
- 100Mb service to Robert Rosner, FLASH Center
- Cisco 7507 on order
- Focus first on improving effective transfer rates to DoE labs

EMERGE "Deep Tech" Meeting October 7

- Linda Winkler, Leader
  - Bill Jensen, UW-Madison
  - Ala Verlo, UIC/EVL
  - Ron Rusnak, Noam Freedman and Kay Sandacz, UChicago
  - Tim Ward, Northwestern
  - Tony Rimovsky, NCSA/UIUC
- Goal: set up the 7507's on MREN PVC's

Streaming Video and Audio



Streaming Video and Audio

- High frame rate
  - 15 frames per second
  - 30 fields per second (at half vertical resolution)
- High quality Video – Medium quality Audi
  - Video Motion JPEG compression scheme with variable quality factor to deal with bandwidth
  - Audio fixed at 8KHz sampling rate and Mono
  - Minimum requirements: 8 Mb/sec
  - UDP/IP with out of order correction

Streaming Video and Audio

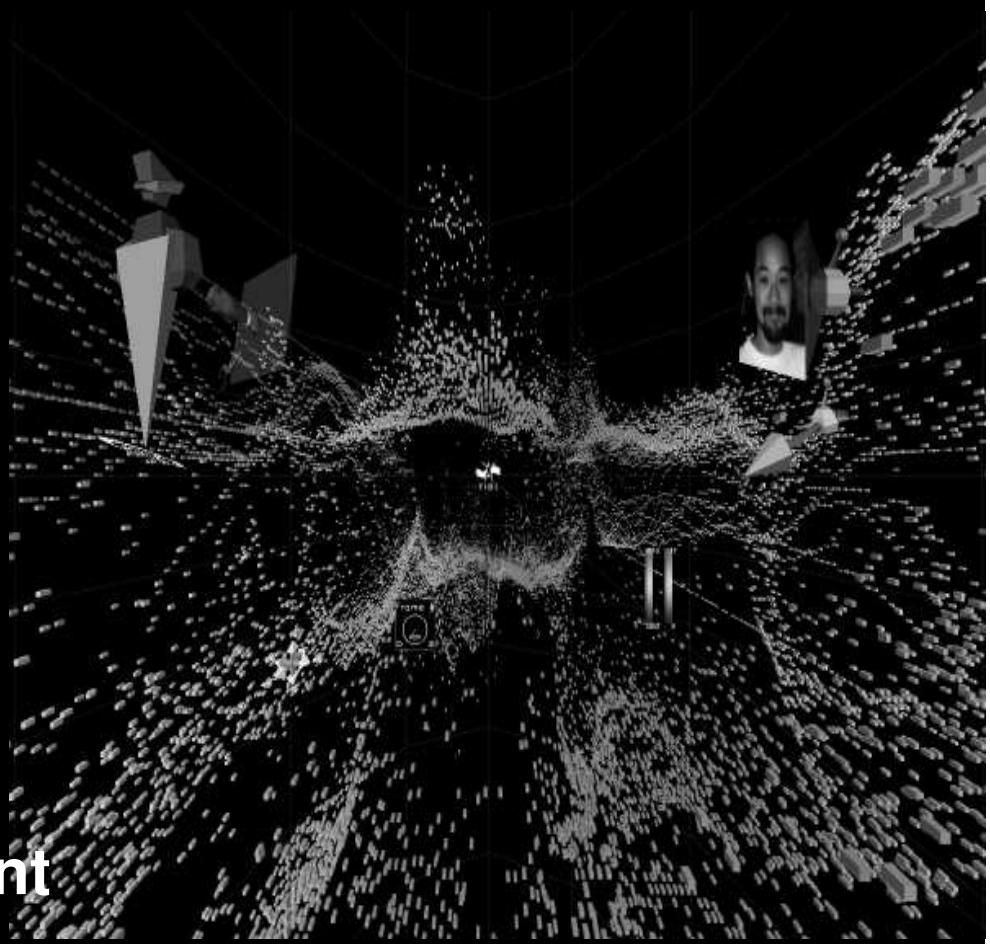
- Low latency strategy
  - Two frames (60ms) or two fields (30ms) plus network latency >=10ms
  - Dedicated SGI O2s to send/recv audio/video
  - JPEG compression chip for real-time compression
  - High speed ATM network card or 100Base
- Network measurement
  - Lost packets
  - Out of order packets

Next Phas

- Optimize code to reach 30 frames/sec or higher resolution
- Instrument with NetLogger

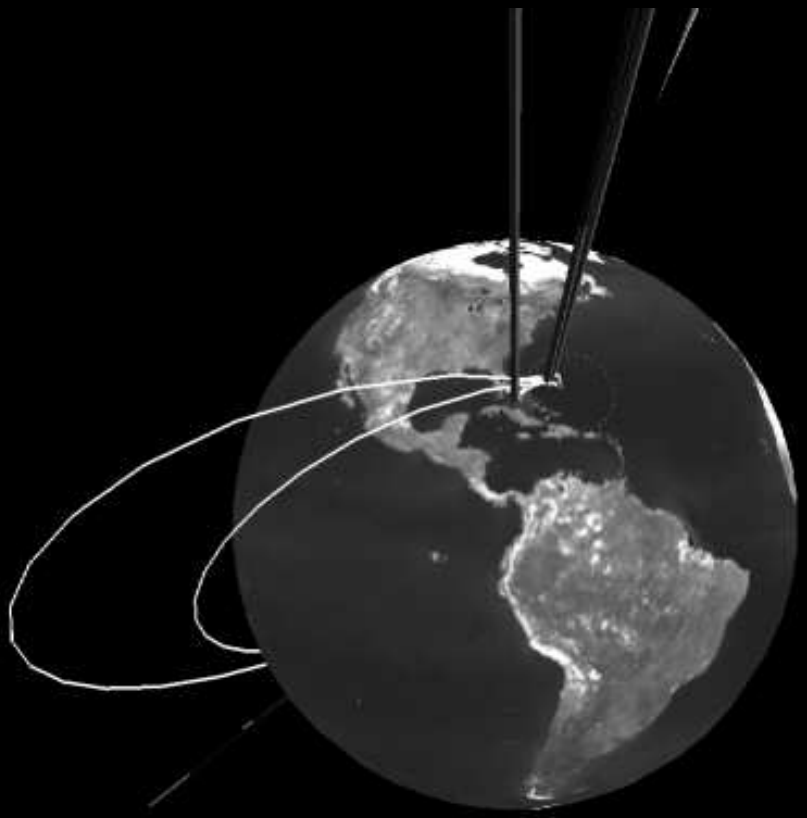
CAVERNsoft and GlobusIO

- GlobusIO will include Netlogger instrumentation
- Developing New CAVERNsoft G2 in GlobusIO
- Incorporate DiffServ via Globus Architecture for Reservation & Allocation (GARA) QoS API
- Upgrade Tele-Immersive Data Exploration environment (TIDE) to G2



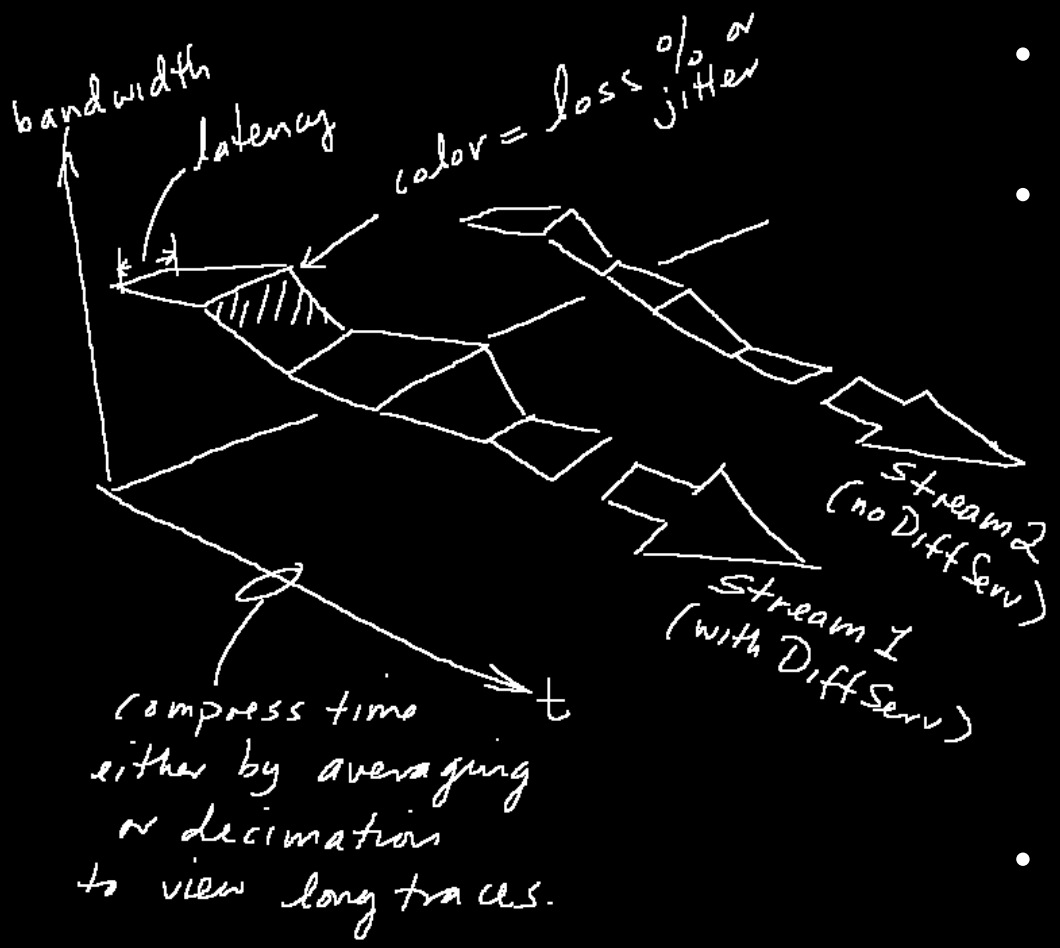
Tele-Immersive Data Exploration environment

CAVE Collaborative NetLogger Visualizer



- **Goal: Develop generic visualizer for NetLogger-format data in VR**
- **Build on SC'98 visualization of incoming and outgoing BW between sites in Japan, Chicago, Australia, Tokyo & Orlando**

Next Phas

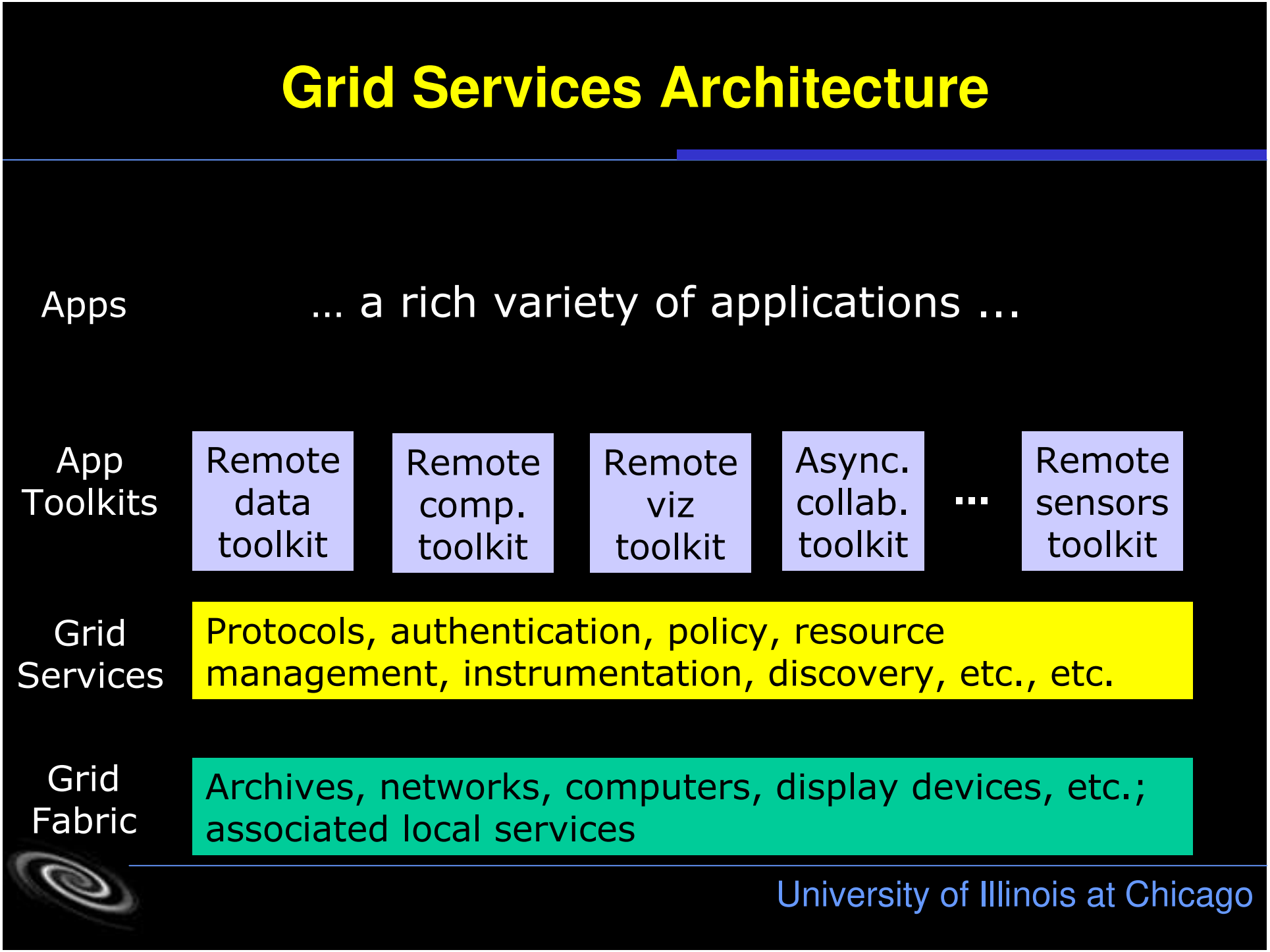


- **Goal: Apply more information visualization techniques**
- **Demo and deploy a first version at CorridorOne Campaign in Nov 1999**
- **Test over EMERGE with QoS enabled (and later STAR TAP)**

Grid Services Package--The Basic Idea as expressed in the EMERGE Proposal

- Deploy standard infrastructure across sites participating in EMERGE
  - Provide maximum capabilities to applications
  - Increase what can be "taken for granted" when developing applications
  - Reduce deployment burden at sites
- For example
  - Authentication, resource discovery, resource management, instrumentation, ….
- Call this a "Grid Services Package"

Grid Services Architecture



Grid Service Package Statu

- Core services
  - Authentication/authorization--PKI (GSI--done)
  - Resource management (reserve/allocate bandwidth, perhaps other things) (GARA--demo underway)
  - Instrumentation (discussions underway)
  - Directory service (publish/query selected information) (MDS--Done)
  - Others? (suggestions?)

Forward Error Correction Scheme for Low-Latency Delivery of Data

- Transmit redundant data to enable error detection and correction at much lower latency than TCP detection and retransmission
- Thus improve quality of streamed vide and audio

Next Phas

- Design media-independent forward error correction algorithms by using traditional error correcting codes
- Implement algorithm using UDP in GlobusIO
- Design and perform an experiment to compare this FEC-UDP versus TCP
- Test over EMERGE and STAR TAP with and without DiffServ
- Test FEC effectiveness in streaming media-motion JPEG, MPEG4

Modeling TI Data Flows Using Petri Nets

Goal: Predict Tele-Immersive applicatio behavior based on network topology usin

- High-Level Fuzzy-timing Petri Nets
- Design/CPN as modeling & simulation tool

Sub-Goals for Modelin

- TCP and UDP protocols
- Network connection
- Tele-Immersion data flows at CAVERNsoft and application layers

Current Work

- Modeled
  - UDP tracker data, TCP world-state data, TCP model data
- Evaluating current TCP & UDP Petri Net models
  - Locally within EVL and Between EVL and SARA
- Collected data using CAVERNsof clients/server
  - 1 to 5 clients (model allows variable topologies)
  - 4 minutes to simulate 10 seconds with 2 clients on SPARC Ultra 1
  - UDP 64 bytes (size of avatar tracking data)
  - TCP 64, 1K, 1M, 10M (state and model data)
- Input to Petri Net Model
  - Latency curve between each pair of sites

Next Phases

Winter ‘99

- Audio and video streaming data
- Model the AccessBot connection between EVL and DC
- Modeling network connections at IP layer

Spring ‘00

- CAVERNsoft / Application layer modeling

In Summary

EMERGE plans to:

- **Build a DiffServ testbed infrastructure**
  - Add to the existing MREN network
- **Implement DiffServ**
  - Purchase suitable DiffServ-capable routers
- **Control DiffServ**
  - Use the Grid Services Package
- **Apply DiffServ**
  - Collect and distribute application toolkits
- **Understand DiffServ**
  - Model, monitor and measure applications

EMERGE WEB Site:

www.evl.uic.edu/cavern/EMERGE