National Science Foundation, Directorate for Computer Information Science and Engineering
Division of Advanced Networking Infrastructure & Research (ANIR)

NSF Cooperative Agreement No. ANI-9730202
September 2000 Quarterly Status Report

Submitted November 13, 2000

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A. Significant Results or Events in the Past Quarter

- IUCC research applications documented and appear on the Euro-Link web site
- iGrid 2000, an International Grid Application Research Demonstration, held in Yokohama, Japan
- iGrid 2000 activities documented and appear on the Euro-Link web site
- CERN and iCAIR conducted STAR TAP Router-enabled DiffServ QoS tests during iGrid 2000
- Chile's REUNA began passing traffic July 27
- China's CERNET established peering September 2
- Meetings held to plan STAR TAP International Transit Network
- Meetings held to plan Optical STAR TAP

B. Expected Results or Events in the Coming Quarter

- An NSF-convened Review Committee will evaluate the merits of the High Performance International Internet Services (HPIIS) program, notably the US/international scientific applications enabled, in order to recommend the program's continued support
- Upgrade of CERN's transatlantic and local loop from DS3 to OC3.
- Upgrade of RENATER2's transatlantic and local loop from DS3 to OC3.
- IUCC connectivity will change from satellite to fiber.
- Connection of Brazil's Sao Paulo Foundation for the Advancement of Research (FAPESP) network to STAR TAP.
- EVL scientists will run real-time demonstrations between Telecom 2000 in Israel, SC'00 in Dallas, SARA in Amsterdam, and EVL to showcase scientific collaboration over high-speed networks for Israeli scientists
- Will continue talks to establish STAR TAP ITN
- Will develop an equipment specification list to establish Optical STAR TAP (Star Light)
- Will release CAVERNsoft G2, version 1.2
- Will release a new CAVE simulator GUI to provide a graphical user interface for compiled CAVE Simulator applications

C. Summary of Technical Activities

C.1. Euro-Link Network Status and Institutions

C.1.a. CERN

CERN's Oliver Martin is talking to Ameritech in preparation of its 45Mb to OC-3/STM-1 upgrade scheduled for the end of November. Since provisioning changes will be difficult in Chicago until January, Martin was advised by Tom DeFanti to press Qwest to generate the appropriate paperwork. STAR TAP/Euro-Link pays for CERN's upgraded local loop.

Beginning August 6, CERN connectivity to STAR TAP was interrupted for two days due to an erroneously provisioned Ameritech ATM switch card. A card reboot fixed the problem. The problem affected performance to all the main North American academic networks, but did not affect commodity Internet connectivity via the transatlantic line. On August 16, CERN upgraded to a faster RSP on their backbone router.

CERN peering with the STAR TAP EMERGE (DiffServ) Router enabled CERN and iCAIR to conduct STAR TAP Router-enabled DiffServ QoS tests during iGrid 2000. See section C.2.e. Also, Jason Leigh of EVL started discussions with Harvey Newman at Caltech and Olivier Martin at CERN about using DiffServ to get better, more consistent performance on their link between Caltech and CERN. He is conferring with Joe Mambretti now to better understand their CERN/DiffServ tests.

During iGrid 2000, networked researchers at CERN remotely collaborated in two research application demonstrations (Distributed Particle Physics Research; Global Internet Digital Video Network). CERN peering with the STAR TAP EMERGE (DiffServ) Router enabled CERN and iCAIR to conduct STAR TAP Router-enabled DiffServ QoS tests throughout the event.

C.1.b. IUCC

Raphi Rom represents IUCC on the STAR TAP International Advisory Committee, replacing Danny Dolev.

EVL's Jason Leigh, Greg Dawe and Michael Lewis will attend Telecom 2000, November 6-9 in Tel Aviv, to showcase tele-immersive applications. Telecom 2000 is Israel's largest annual telecommunications conference. EVL was invited to participate at the request of the Israeli Ministry of Science's Jo van Zwaren, who wants universities in the IUCC network to acquire VR equipment for scientific collaborative research.

Real-time collaboration between Jason Leigh at Israel's Telecom 2000, and EVL student Chris Scharver at the SC'00 Alliance booth in Dallas, Texas, will take place November 8, from 6-8 PM (Tel Aviv time). Leigh will attend the Franco-North Carolinian-Israel Workshop on Distance Learning via Broadband Internet, at Tel Aviv University,

November 6-7. The Israeli Ministry of Science, the French Ministry for Foreign Affairs, and the North Carolina Israel Partnership are organizing the workshop.

STAR TAP is multicast peering with IUCC.

IUCC peering with the STAR TAP was intermittently unavailable during July, due to satellite errors.

Note: Subsequently (in late October), due to US State Department recommendations that Americans not travel to Israel due to Israeli/Palestinian conflicts, Leigh, Dawe and Lewis did not attend the conference but sent EVL VR equipment and remotely taught the Israelis how to use it. This will be reported in the Euro-Link November report.

C.1.c. NORDUnet

Tom DeFanti, Maxine Brown, Mark Ellisman (UCSD), Bill St. Arnaud (CANARIE), Kees Neggers (SURFnet), David Williams (CERN) and Peter Villemoes (NORDUnet) were speakers at NORDUnet 2000, in Helsinki, Finland, September 28-30 <www.csc.fi/nordunet2000/>.

At iGrid 2000, networked researchers at Sweden's Royal Institute of Technology remotely collaborated in two research application demonstrations (Steering/Vis Finite-Difference Code; Global Internet Digital Video Network).

C.1.d. RENATER2

Renater2 has a DS-3 into STAR TAP and has ordered an upgrade to OC-3.

C.1.e. SURFnet

On August 7, SURFnet upgraded its New York to STAR TAP connection to 155 Mbps.

Networked researchers from the Academic Computing Services Amsterdam (SARA) and SURFnet remotely collaborated in two research application demonstrations during the iGrid 2000 event (Architectural Linked Immersive Environment; Global Internet Digital Video Network).

C.1.f. DANTE

During iGrid 2000, DANTE networked researchers from Germany's Fraunhofer Institut Graphische Datenverarbeitung (Darmstadt), Albert-Einstein-Institute (Potsdam), Konrad-Zuse-Zentrum fur Informationstechnik (Berlin), High Performance Computing Center Stuttgart, and Brandenburg University of Technology at Cottbus remotely collaborated in four research application demonstrations.

On April 11, as the first instance of the "STAR TAP International Transit Network (ITN)," CA*net3 carried DANTE's Ten-155 pan-European research network traffic from New York to STAR TAP in Chicago. On April 13, this link was temporarily shut down until DANTE provisioned more bandwidth for its connection to CA*net (currently 10 Mbps). This is still under consideration by DANTE management.

C.1.g. BELNET

On July 15, Jan Torreele of Belgian National Research Network (BELNET) requested information on connecting to STAR TAP, and was advised by Tom DeFanti to submit a proposal to Steve Goldstein. Belgium intends to dedicate the full 45Mbps to research traffic. Initially wants to connect through a DS-3 from New York. The connection is pending; the proposal to NSF is forthcoming.

C.2. Engineering Services

C.2.a. STAR TAP International Transit Network (ITN)

STAR TAP ITN is a new service currently being developed by STAR TAP, CANARIE and Internet2 to facilitate connectivity among international National Research Networks (NRNs) that now connect to one of the coasts of North America. Meetings were held in July and August 2000 to discuss relevant issues. Internet2/Abilene intends to enable their ITN service in October.

C.2.b. STAR TAP Router Peering

New STAR TAP Router peers include Russia's MIRnet [http://www.friends-partners.org/friends/mirnet/home.html], which began passing traffic June 13, Chile's REUNA [http://www.reuna.cl], which began passing traffic July 27, and China's CERNET [http://www.cernet.edu.cn/], which established peering September 2. On October 2, an updated STAR TAP logical map was distributed to S. Goldstein, L. Winkler, I. Foster and J. Jamison. Current Peering Matrix information is at [http://www.startap.net/ENGINEERING/].

C.2.c. 6TAP

Due to limited rack space, v4 addressing/global routing, and out-of-band management issues at the 6TAP, Marc Blanchet moved 6TAP PC servers to CANARIE premises. He will replace them with the route servers after testing is complete.

The iGrid 2000 "Advanced Networking for Telemicroscopy" demonstration between UCSD and Osaka University successfully showcased its end-to-end IPv6 connectivity. UCSD peered over IPv6 with vBNS, ESnet, and APAN.

In late June, Linda Winkler installed a 6TAP 6to4 Cisco router to the STAR TAP rack, to enable networks without native IPv6 support to STAR TAP to participate in the 6TAP project.

C.2.d. STAR TAP NLANR Web Cache

The STAR TAP NLANR web cache computer was experiencing some instability and is being repaired. Its serial port will also be enabled for out-of-band access.

C.2.e. DiffServ

Joe Mambretti reports that iGrid 2000 demonstration, the "Global Internet Digital Video Network (GiDVN)," showcased DiffServ-enabled media streaming between iCAIR (International Center for Advanced Internet Research) in Chicago and CERN in Switzerland, using the STAR TAP DiffServ EMERGE Router and Euro-Link. (iCAIR is part of the EMERGE activity.)

iCAIR and CERN, with support from STAR TAP and APAN, established a testbed that linked CERN and iCAIR to Yokohama. A variety of experiments were conducted, involving mgen UDP flows, with BE baseline streams and contending traffic streams, and with measurements for throughput, delay and jitter. Because of the limited number of routers available, the full EMERGE model was not implemented. Instead, the CERN iGrid link was established as a dedicated broadband 5 Mbps PVC. A constant UDP flow was established with a Poisson distribution of 2.4 Mbps, which was preserved because of the a) ingress control b) link control and c) congestion control at the APAN-JP NOC and the network control points established for iGrid. The delay results showed a desirable consistency. On a scale of 100ms, equal service was delivered to every part of the flow. Jitter variations (closely clustered average jitter of 1.65 ms) resulted from variations in flow source. The success of these tests has led to plans for a more complex series of experiments. (Another set of DiffServ-based experiments for the GiDVN was conducted by the APAN group in Korea in conjunction with collaborators at Korean universities.)

See http://www.evl.uic.edu/cavern/EMERGE/ and http://www.icair.org/inet2000

C.3. NOC Services

The NOC continues to seek permission from STAR TAP peers to gather host router network statistics for a planned STAR TAP animated traffic map.

On the last day of iGrid 2000 demonstrations, Litton CAMVision systems were used to send a broadcast-quality, edited half-hour program from the iGrid booth to University of Washington, then bridged to community-access educational cable TV in the Seattle area. The NOC plan to post it online by Sept 29; still pending. http://www.indiana.edu/~video/igrid2000/home.html#litton

The NOC generated the following video services for the iGrid 2000 event, described at http://www.indiana.edu/~video/igrid2000/home.html#litton

- Interactive and multicast broadcast-quality videoconferencing—Litton Network Access Systems CAMVision-2 MPEG/IP codecs were used to provide broadcast quality interactive and streaming video from the iGrid floor. Highlights included multicast to Litton equipped Internet2 sites; and first live IP-based, trans-Pacific

distribution to commercial cable television audiences in the Seattle area, and rebroadcast on the Research Channel to reach direct broadcast satellite viewers across the US.
- Point-to-point H.323 videoconferencing—In cooperation with Wire One, 30fps at 384/512/768kbs utilizing Polycom Viewstation 512 systems.
- Streaming video—Disseminated collaborative demonstrations to Internet2 and Internet1 communities utilizing streaming video. IBM Content Manager VideoCharger was used for high-quality 1.5Mbps multicast MPEG1 and Real for commodity-quality webcast.

Doug Pearson reported all services "worked well," and a video is expected to be available at the above URL. Researchers running the Distributed Simulation Analysis, Telemicroscopy, CyberCAD, and Blue Window Pane II applications utilized the H.323 videoconferencing systems to communicate with their home-based collaborators during setup and throughout the course of the demonstrations.

The STAR TAP Router Proxy and the Syslog Monitor are both accessible from <http://noc.euro-link.org/noc.html>. They can also be found at <http://hydra.uits.iu.edu/~transpac/proxy/> and <http://palpatine.ucs.indiana.edu/sysmon-startap/>, respectively. The Router Proxy allows users to submit 'show' commands to the STAR TAP router; the user selects the router and a command, and the output is displayed in a separate frame. This allows Euro-Link peers to check routing configurations on the STAR TAP router, and help them troubleshoot problems as well. The Syslog monitor automatically watches system logs of network components, and reports significant events via email to NOC operations and engineering; individuals can view and search current and past syslogs from the STAR TAP router.

C.4. Euro-Link Performance Analysis Tools

C.4.a. Network QoS of Real-Time Multimedia

QoSIMoTo (QoS Internet Monitoring Tool) [www.evl.uic.edu/cavern/qosimoto] is available on the web for IRIX and Linux.

C.4.b. Network Monitoring

CAVERNsoft G2 is available on the web; see [http://www.evl.uic.edu/cavern/cavernG2/].

C.4.c. Low Latency State Transmission Over Long Distance Networks

No updates to report at this time.

D. Accomplishments

D.1. iGrid 2000

The iGrid 2000 event during INET 2000 in Yokohama, Japan, July 18-21 was an overwhelming success. It featured 24 high-performance collaborative research applications from 14 regions around the world. iGrid connected to the JGN, the WIDE Project Network (in cooperation with NTT, TTNet and PNJC), APAN and the APAN/TransPAC (100 Mbps) link to STAR TAP. A debriefing session following the third day of demonstrations yielded no negative comments or reports of technical failure. A special web page for iGrid 2000 that provides application descriptions, schedules and SNMP information appears at <http://www.startap.net/igrid2000/>.

D.2. Dante

No updates to report at this time.

D.3. Euro-Link Applications

Active US/European collaborations utilizing high-performance research networks have been documented for CERN, IUCC, NORDUnet, Renater2, and SURFnet. They appear at http://www.euro-link.org/APPLICATIONS/

D.4. Meetings Attended

September 27-30, 2000. Tom DeFanti and Maxine Brown of EVL attended NORDUnet 2000 in Helsinki, Finland <http://www.csc.fi/nordunet2000/program.phtml>. DeFanti gave a presentation "The Global Grid;" Brown presented "Global Tele-Immersion Applications." Also represented at NORDUnet 2000 were Bill St. Arnaud (CANARIE), Kees Neggers (SURFnet), Peter Villemoes (NORDUnet) and David Williams (CERN). DeFanti,

Brown, St. Arnaud, Neggers and Williams had meetings on our future "Star Light" project, as both SURFnet and CERN are interested in installing wavelengths across the Atlantic Ocean.

September 14, 2000. Tom DeFanti, Joe Mambretti, Andy Schmidt, Linda Winkler, Alan Verlo, Oliver Yu, Akihiro Tsutsui, Cliff Nelson and Ameritech's Anthony Haeuser met to discuss 1.) status of dark fiber available between UIC/Goldberg, NU campuses and Bell Nexxia, 2.) co-location space available at Ameritech, and 3.) I-WIRE and MREN (STAR LIGHT) plans for GigE, 10GigE, DWDM/CWDM.

September 7, 2000. Bill St. Arnaud, Rene Hatem (CANARIE), Charlie Catlett, Linda Winkler, Bill Nickless (ANL), Cliff Nelson (UIC ADN), Tom DeFanti, Alan Verlo, Akihiro Tsutsui, Oliver Yu, Jason Leigh (EVL) met at EVL to discuss Optical STAR TAP. Discussion included goals, and hardware, middleware and fiber needs.

August 2, 2000. Networking people from STAR TAP, TransPAC, Internet2 and CANARIE met to discuss the issues and procedures for an International Transit Network (ITN).

July 16, 2000. Tom DeFanti, Maxine Brown and Laura Wolf met with SURFnet's Kees Neggers to discuss SURFnet's DWDM network, now under construction, and future plans to connect it to STAR TAP and Canada.

July 17, 2000. Annual meeting of the STAR TAP International Advisory Committee met in Yokohama, Japan. Minutes posted to http://www.startap.net/ABOUT/MEETINGS.html

D.5. Publications

Luc Renambot, Henri E. Bal, Desmond Germans, Hans J.W. Spoelder, "CAVEStudy: An Infrastructure for Computational Steering in Virtual Reality Environments," Proceedings of the Ninth IEEE International Symposium on High Performance Distributed Computing," Pittsburgh PA, August 2000, pages 57-61, IEEE Computer Society Press.

K. Park, Y. Cho, N. Krishnaprasad, C. Scharver, M. Lewis, J. Leigh, A. Johnson, "CAVERNsoft G2: A Toolkit for High Performance Tele-Immersive Collaboration," To appear in the Proceedings of the Symposium on Virtual Reality Software and Technology 2000, October 22-25, 2000, Seoul, Korea.

Y. Zhou, T. Murata, T. DeFanti, "Modeling and Performance Analysis Using Extended Fuzz-Timing Petri Nets for Networked Virtual Environments," IEEE Transactions on Systems, Man and Cybernetics (SMC), to appear. [http://www.euro-link.org/PUBLICATIONS/Yi_CollabVirtualEnv_IEEE.pdf]

Y. Zhou, T. Murata, T. DeFanti, and H. Zhang, "Fuzzy-Timing Petri Net Modeling and Simulation of a Networked Virtual Environment – NICE," Institute of Electronics, Information and Communication Engineers (IEICE) Transactions in Japan (Special Section on Concurrent Systems Technology), to appear. [http://www.euro-link.org/PUBLICATIONS/FuzzyTiming_IEICE_Murata_June00.pdf]

Jason Leigh, Maggie Rawlings, Javier Girado, Greg Dawe, Ray Fang, Muhammad-Ali Khan, Alan Cruz, Dana Plepys, Daniel J. Sandin, Thomas A. DeFanti, "AccessBot: An Enabling Technology for Telepresence," INET 2000 Proceedings, The 10th Annual Internet Society Conference, 18-21 July 2000, Yokohama, Japan, CD ROM. http://www.evl.uic.edu/cavern/papers/Inet2000AccessBot.pdf

Tomoko Imai, Zhongwei Qiu, Sowmitri Behara, Susumu Tachi, Tomonori Aoyama, Andrew Johnson, Jason Leigh, "Overcoming Time-Zone Differences and Time Management Problem with Tele-Immersion," INET 2000 Proceedings, The 10th Annual Internet Society Conference, 18-21 July 2000, Yokohama, Japan, CD ROM. [http://www.startap.net/images/timezone.pdf]

D.6. Software Releases

CAVERNsoft G2, version 1.1 [http://www.evl.uic.edu/cavern/cavernG2/].
QoSIMoTo (QoS Internet Monitoring Tool) [www.evl.uic.edu/cavern/qosimoto].

E. Collaboration Activities

- Working with SARA in The Netherlands to experiment with an EVL-designed packet-level Forward Error Correction scheme.
- Beginning discussions with Harvey Newman at Caltech and Olivier Martin at CERN on DiffServ tests.
- Ongoing with SARA in Amsterdam. The upgrading of Saranav to CAVERNsoft G2 is complete. The first virtual walk-through of architect Rem Koolhaas' IIT design was demonstrated by Jason Leigh and student Chris Scharver, June 2, at SARA.

F. Problems

No significant problems were encountered this quarter.

G. Any Proposed Changes in Future Plans

No changes to date.

H. Summary of Award Expenditures (July-September)

Euro-Link Expenditures – Year 2			
Itemized Expenses	**Year 2 Budget**	**Current Quarter Expenses**	**Year 2 to Date**
Salaries and Fringe Benefits	228,112	73,436	85,232
Travel	50,000	1,088	3,615
Computer Equipment and Supplies	50,000	22,373	22,373
Subcontracts/Services (Ameritech and Indiana U.)	327,821	0	50,000
Other (HPIIS services to NRNs)	1,600,000	0	1,600,000
Indirect Costs	167,621	42,232	63,978
Total Expenditures	**2,423,554**	**139,129**	**1,825,198**

Euro-Link Expenditures – Cumulative			
Itemized Expenses	**Year 1 Spent**	**Year 2 to Date**	**Cumulative (Years 1+2) Spent**
Salaries and Fringe Benefits	212,923	85,232	298,155
Travel	50,000	3,615	53,615
Computer Equipment and Supplies	100,000	22,373	122,373
Subcontracts/Services (Ameritech and Indiana U.)	96,780	50,000	146,780
Other (HPIIS services to NRNs)	1,600,000	1,600,000	3,200,000
Indirect Costs	159,221	63,978	223,199
Total Expenditures	**2,218,924**	**1,825,198**	**4,044,122**