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A. Summary of Technical Activities

A.1. Euro-Link Network Status and Institutions

A.1.a. CERN

CERN is preparing a project proposal to the European Union (EU) for a high-speed research link between CERN and StarLight, in addition to the existing 155Mbps circuit that they plan to upgrade to 622Mbps by April 2002.

A.1.b. IUCC

Hank Nussbacher of IUCC is asking Euro-Link participants if they will allow the NOC to SNMP poll their routers to make the STAR TAP Weather Map <http://hydra.uits.iu.edu/startap-atm/> more informative. (See NOC Services, Section A.3.)

A.1.c. NORDUnet

Peter Villemoes reported that NORDUnet completed a tender for USA connectivity, to take effect July 1, 2001. NORDUnet will have a STM-4c (OC-12, 622Mbps) link directly between Stockholm and the Abilene PoP in New York, and 155Mbps from New York to STAR TAP in Chicago. KPNQwest is the provider. NORDUnet had considered connecting at 622Mbps to StarLight (peering with Abilene in Chicago), but was concerned that there

might not be sufficient Abilene capacity in Chicago for both NORDUnet and SURFnet. STAR TAP management is working with Internet2 to resolve this problem, and NORDUnet will seriously consider connecting to StarLight once the current Abilene situation is resolved.

A.1.d. Renater2

Peering between RENATER2 and the STAR TAP Router has been disrupted. Linda Winkler is investigating.

A.1.e. SURFnet

On March 5, 2001, SURFnet announced its upgrade plans for the coming year. July 1, 2001, SURFnet will close its New York PoP and bring two 622Mbps connections (one provided by Teleglobe and the other by Global Crossing) to the StarLight facility (710 N. Lake Shore Drive on Northwestern University's campus) in Chicago. On September 1, 2001, SURFnet will bring a 2.5 Gbps lambda connection from SARA to StarLight (provided by Teleglobe) in order to experiment with new types of technology for a completely optical Internet.

SURFnet is starting to build its PoP at 710 N. Lake Shore Drive. Equipment was shipped from the Netherlands, scheduled to arrive in Chicago at the end of May and/or beginning of June. Initially, SURFnet will have one Cisco 12008 router installed at StarLight, plus one Cisco 2620 for out-of-band access to the Cisco 12008. The 12008 will have OC-12c POS connections to both Teleglobe and Global Crossing, and an OC-12c ATM connection to STAR TAP. Between the 12008 and STAR TAP they will install a small ATM switch to access 6TAP. This will also involve a router dedicated to IPv6, which SURFnet will connect to a v6-exchange facility at the StarLight location as soon as it becomes available.

A.2. Engineering Services

A.2.a. StarLight/Abilene Connectivity

Tom DeFanti has started discussions with Internet2 (Heather Boyles, Steve Corbato and Guy Almes) about increasing Abilene bandwidth in Chicago for Euro-Link networks, either by bringing a second OC-12 circuit to Chicago and/or getting GigE connectivity directly to StarLight (bypassing the NAP). A meeting is scheduled May 29th in Chicago between STAR TAP and Internet2 to begin putting plans in place prior to the upcoming annual STAR TAP International Advisory Committee meeting at INET in June.

A.2.b. StarLight/STAR TAP Connectivity

STAR TAP is contracting for two OC-12 connections from StarLight to the Ameritech NAP. [Ameritech does not yet offer OC-48 service.] One of these OC-12s will be dedicated to SURFnet/Abilene traffic. The second link is to be shared by SURFnet (for non-Abilene traffic) and other NRNs that co-locate at 710. Ameritech assures us that these connections will be operational on July 1. [Note: Worst case, there is an OC-3 between 710 and the NAP that is operational and can be used.]

A.2.c. International Transit Network (ITN)

The STAR TAP CONNECT web page has been updated to include information about the International Transit Network, as well as Distributed STAR TAP and NAP connectivity (Ameritech provisioning) information. <http://www.startap.net/CONNECT/>

A.2.d. STAR TAP Router and Peering

STAR TAP engineers are preparing to install the new Juniper M5 Router in early May. The router will enable STAR TAP engineers to provide connecting networks with advanced services, such as line-speed forwarding, traffic filtering and sampling, MPLS, and Class of Service.

Euro-Link member networks will soon have an opportunity to peer with networks from Korea (KOREN/KREONet2), Ireland (HEAnet) and Brazil (FAPESP-ANSP, the Sao Paulo research network, and RNP, the national research network). Korea is preparing to connect to STAR TAP May 1. The Saõ Paulo/Brazil Foundation for the Advancement of Research (FAPESP) 155 Mbps link to Miami has been operational since December 2000. Connection to STAR TAP is still pending resolution of Cable & Wireless issues.

A.2.e. 6TAP

No updates to report.

A.2.f. STAR TAP NLANR Web Cache
No updates to report.

A.2.g. DiffServ
No updates to report.

A.3. NOC Services
The NOC is updating its network traffic tools to be compatible with the Juniper M5 Router to be deployed in May.

The NOC continues to seek permission from STAR TAP peers to gather host router network statistics for a planned STAR TAP animated traffic map. Despite NOC requests, STAR TAP (and Euro-Link) NRNs do not allow us to gather network statistics from their router. (Years ago we could get MRTG statistics from the Ameritech NAP, until they introduced a firewall.) Hank Nussbacher of IUCC is now talking to the NOC and Euro-Link participants to ask if they will allow SNMP polling to make the STAR TAP Weather Map <http://hydra.uits.iu.edu/startap-atm/> more informative. To date, IUCC and CERN have offered to comply. Jim Williams will bring this up as a discussion topic at the STAR TAP International Advisory Committee meeting at INET in June.

Sometime later this year, the NOC will be moving to a new enterprise-wide Trouble Ticket System. The likely candidate is Peregrine Systems, which will provide the NOC with more robust capability. In the interim, the NOC will be rolling out a temporary new system later this month, entitled Footprints. This system will provide increased functionality for tracking and escalating trouble tickets, increased accessibility to trouble tickets for those in TransPAC, STAR TAP and Euro-Link administration, and much more robust reporting. The NOC will be providing ticket summary updates on associated web pages.

Ongoing activities: The Global Research NOC is preparing to issue a regular, online newsletter in the next few months. John Hicks is working on adapting MIRnet-type traffic graphs for the Euro-Link and TransPAC projects.

B. Euro-Link Performance Analysis Tools

B.1.a. Network Monitoring Tools

Bandwidth Utilization Radar Map
EVL student Brenda Lopez is enhancing the iGrid 2000 STAR TAP network map, (which showed bandwidth utilization of networks participating in iGrid), to illustrate all country-to-country source and destination of packets arriving at STAR TAP/Euro-Link. This summer she plans to develop snapshots of network traffic spikes to STAR TAP/Euro-Link, rather than just previous history. The Map is currently not operational, and requires some modifications to the STAR TAP web site.

uCAN: unified Collaboratory for Analyzing Networks
EVL student Naveen Krishnaprasad started development of the unified Collaboratory for Analyzing Networks (uCAN) software, which will enable remote network researchers and application developers to collaboratively execute an application and monitor network utilization, as well as other application-specific parameters. uCAN will enable users to correlate, in real time, how the actions taken by an application directly impact the underlying networks, and vice versa. A network researcher could also alter router configurations, such as a router's queuing algorithm, to determine how it might improve application throughput. Estimated completion of a usable version is end of Spring 2001. The prototype currently allows users to initiate bandwidth measurement experiments and perform SNMP queries of routers.

B.1.b. Network Performance Studies for European/US Collaborative Art Project
EVL co-director Dan Sandin is assisting in the development of Yggdrasil, a script-based, authoring environment for networked VR applications by EVL PhD candidate Dave Pape. This tool will allow non-programmers to create effective, behavior-rich art and science virtual-reality environments. Sandin is extending the library for behaviors, performing network performance tests and developing applications. In coming months, Dan will supervise EVL student Joseph Tremonti in the development and execution of network performance tests to Austria, and later Sweden, Hungary and The Netherlands, in anticipation of the Ars Electronica Center's Festival in Austria, September 1-6. [http://www.aec.at] (See Section D, Collaboration Activities)

B.1.c. High Bandwidth Transmission Over Long Distance Networks

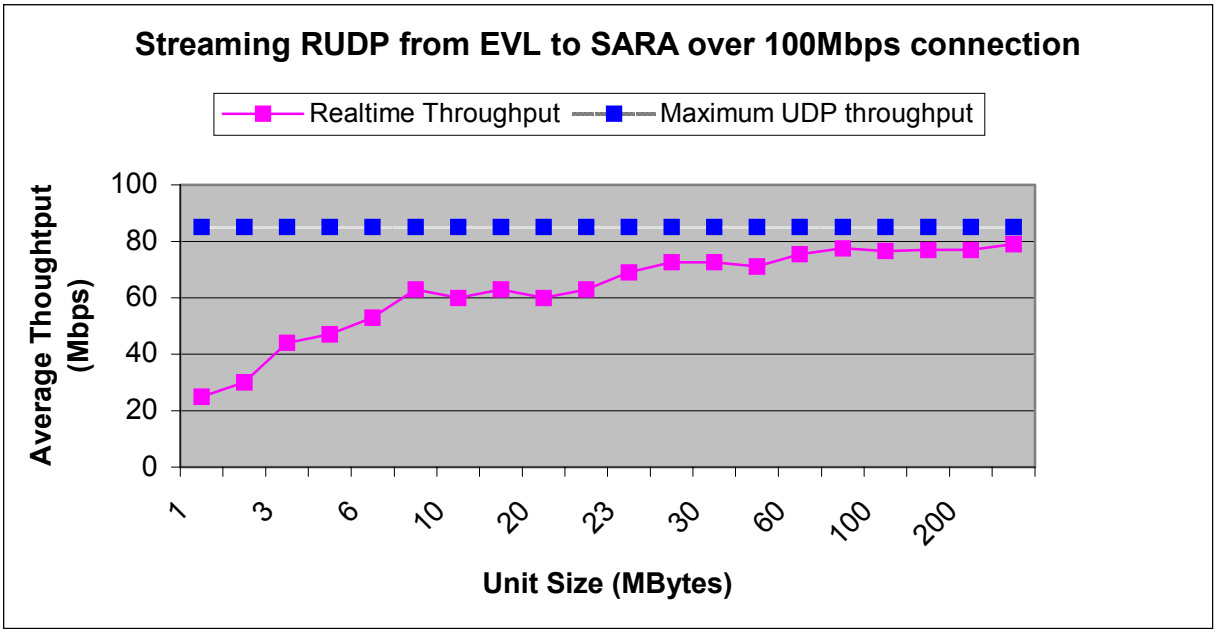
Parallel Socket Experiments

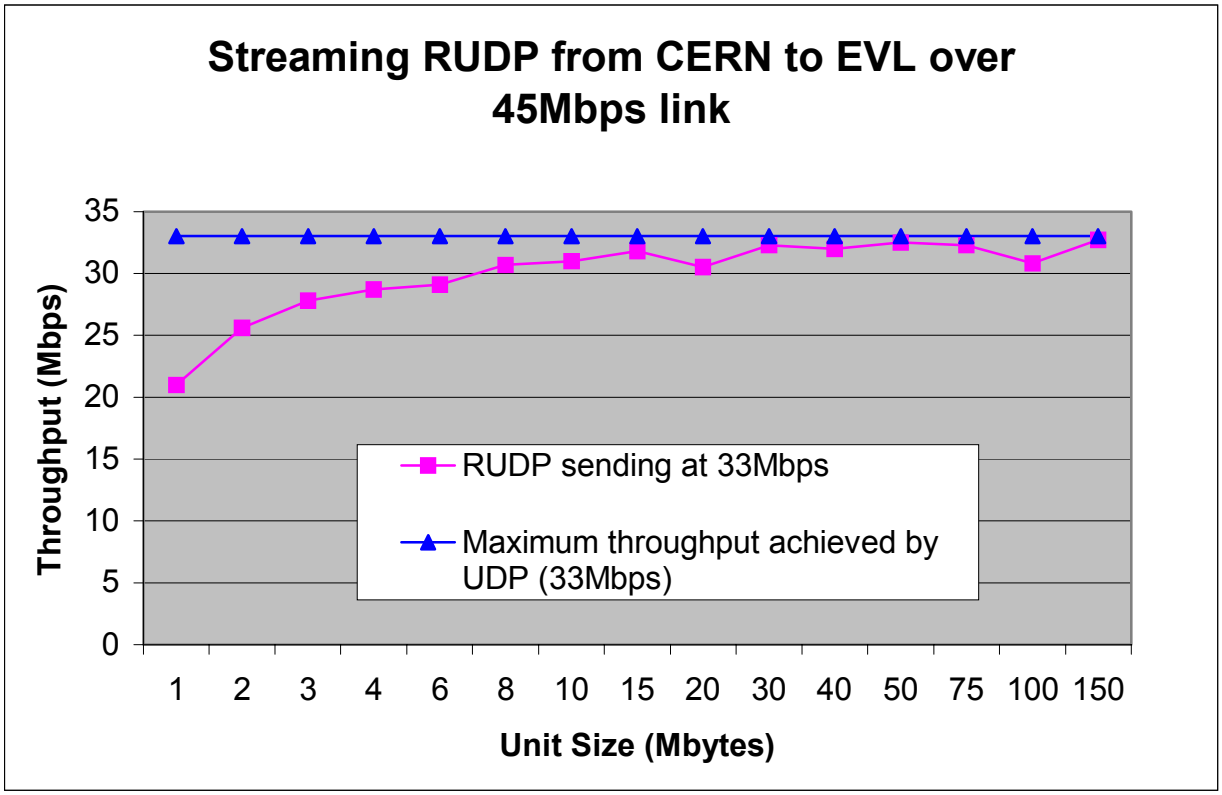
Jason Leigh and student Atul Nayak, in network performance studies with SARA in The Netherlands, were getting between 32-80Mbps throughput doing parallel TCP experiments over SURFnet's 155Mbps link. They have been unable to achieve 80Mbps throughput consistently; throughput appears to average at 32Mbps. They are working with UIC's National Center for Data Mining (NCDM) to incorporate codes to attempt to predict the number of parallel sockets that need to be opened for optimal throughput.

Reliable Blast UDP (RUDP)

Jason Leigh and student Eric He has improved and extended their RUDP algorithm. Performance has increased as a result of algorithm improvement. The extension now allows for smaller transmission buffer sizes. This is useful if a reliable **streaming** protocol is desired. Results below show the performance trade-off between using smaller buffer sizes and obtainable throughput from sending large data streams from EVL to SARA (the Ethernet card had a limit of 100Mbps although the link from EVL to SARA is 155Mbps). The Blue colored line is the maximum achievable throughput via UDP (approximate 85Mbps). The graph shows that for very large buffer sizes, bandwidth utilization can be as high as 80Mbps. This is good news for bulk data transfer applications that have really massive amounts of data to ship from one place to another. We have not been able to achieve this degree of stability with parallel TCP. The bad news is that if you want to incrementally stream the data so that you can use it as it comes along, performance will suffer. However, we are developing ways around this.

Results from performing the same experiment from EVL to CERN are also shown below. Since the bandwidth to CERN is lower, RUDP achieved results similar to our former parallel TCP technique. However it is expected that as CERN's bandwidth increases it will suffer similar predictability problems using parallel TCP, as is the case with SARA. RUDP is now being incorporated into the CAVERNsoft toolkit and tested between PCs over a LAN Gigabit Ethernet connection.





C. Accomplishments

C.1. Meetings

April 27, 2001. Tom DeFanti gave a presentation to the Computer Science Department at Northwestern University on, "StarLight: Optical Switching for the Global Grid." Maxine Brown and Laura Wolf, as well as others from EVL, met with Ian Foster and his staff about SC Global, a major international event at SC'2001 in Denver in November.

April 24-27, 2001. Dan Sandin of EVL visited Umeå University in Stockholm, Sweden. He attended the Umeå Forum, gave a presentation entitled "Interaction Design in the CAVE," and participated in the "Life in Networked Society" panel. Sandin visited Umea's HPC2N lab and presented a talk on the latest networking research at EVL. He met with Umeå's Kenneth Homlund to discuss setup for the upcoming tele-immersive art event in conjunction with the Ars Electronica Center festival in Austria in September. Sandin conducted a real-time, collaborative test between EVL and HPC2N. He intends to develop an on-going persistent collaborative relationship. Sandin also spoke at the Tools for Creativity Studio at the Interactive Institute of Sweden, another partner in the Ars Electronica event. (See Section D.)

April 22, 2001. Tom DeFanti attended the UCAID Board of Trustees meeting in Washington DC, where he spoke with Doug Van Houweling, Heather Boyles and Steve Corbató about upgrading Abilene's 622 Mb link to Chicago, primarily to accommodate SURFnet and other internationals, such as NORDUnet or CERN, as well as MREN customers, as bandwidth increases. It was decided that we would hold a meeting in Chicago to discuss this issue, as well as share information on future plans under non-disclosure. For Internet2, this involves Abilene evolution and a next generation backbone network as well as DTF. For STAR TAP, it involves information on Star Light. The meeting is set to occur on May 29 at EVL.

April 19, 2001. Olivier Martin of CERN visited EVL and toured the StarLight facility in downtown Chicago. Met with Tom DeFanti, Maxine Brown and Joe Mambretti about a possible high-speed research link between CERN and StarLight, in addition to the existing link CERN plans to upgrade to 622Mbps by March/April 2002.

April 17, 2001. Joe Mambretti hosted an OMNInet technical meeting at Northwestern University. OMNInet, the Optical Metropolitan Network Initiative network, is co-located with StarLight at the 710 facility. Tom DeFanti, Maxine Brown, Jason Leigh, Linda Winkler, Alan Verlo and Andy Schmidt attended.

C.2. Publications

No new publications to report.

C.3. Software Releases

No new software upgrades or releases.

D. Collaboration Activities

A team from EVL deployed an ImmersaDesk in Valparaiso, Chile as part of REUNA's "Science, Culture and Education over Internet2 Networks" meeting, April 4-6. Real-time, tele-immersive collaborative demonstrations between Chile, University of Illinois at Chicago and University of Michigan featured geological earthquake data and medical models. REUNA director Florencio Utraras invited EVL to showcase tele-immersive virtual reality to stimulate interest among the Chilean scientific community for future collaborations with North America and Europe via the REUNA link to STAR TAP.

EVL's Dan Sandin is organizing a large, shared VR environment for the Ars Electronica Festival, September 1-6, 2001, in Austria. Participants include artists from Hungary's C3 [http://www.c3.hu/], The Netherlands' V2 [http://www.v2.nl/], The Interactive Institute of Sweden [http://www.interactiveinstitute.se/], and the United States (UIC, Chicago and SUNY, Buffalo).

Working with SARA in The Netherlands to do network performance studies over long, fat networks using various transmission techniques (TCP, UDP, FEC, RUDP).

EVL is working with CERN on RUDP tests. EVL is talking to CERN about DiffServ tests.