# MIRNET ANNUAL REPORT

## JULY 1, 1998 – JUNE 30, 1999

## NSF ANI-9730330


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## REPORT NARRATIVE

The following provides a summary of primary accomplishments of the first year of funded activity under the NSF cooperative agreement ANI-9730330 and referred to in the remainder of this report as "MIRnet". A more detailed description of all project activities is provided on the MIRnet web sites referenced below.

(1) A 6 Mbps ATM service is established for transit of MIRnet traffic terminating at the STAR TAP facility in Chicago and at the M9 telecommunications station in Moscow. Telecommunications capacity is provided by Teleglobe from Chicago to Blaajberg, Denmark and by Russian provider Rascom, Inc. from Blaajberg to St. Petersburg and Moscow.

A $578,000 annual service contract has been executed between UTK and Teleglobe for service from Chicago to Blaajberg, Denmark. A $55,920 annual service contract is being finalized as this report is written with Ameritech for local STAR TAP connectivity. Current connectivity from the MIRnet link in Chicago to the STAR TAP is being provided by an OC-3 from Teleglobe. Similar contractual arrangements are made between Moscow State University and Rascom, Inc. for the Russian component of the link; funding is provided by Russian Ministry of Science and Technology.

From the STAR TAP, the MIRnet link in Chicago will take a DS-3 to the Excel POP on Michigan Avenue. This is the MIRnet POP in the USA. MIRnet takes a Teleglobe ATM service from the Excel POP to 60 Hudson in New York, NY. At that point it is inverse-muxed over three E1s. These E1s carry across the Atlantic and terminate in St. Petersburg. At St. Petersburg, the E1s are I-Muxed into a DS-3 and into an existing ATM switch that is jointly managed by Metrocom and Rascom. This switch is connected to a similar ATM switch at the M9 switch station in Moscow. A MIRnet switch and router is connected to this switch at M9. Moscow State University is connected to M9 via OC-3 ATM.

(2) The following equipment was installed by the US MIRnet team at Teleglobe facilities in Chicago:

(a) Cisco 7507 Router
(b) Cisco LS-1010
(c) Cisco 2511 Terminal Server
(d) Analog modem

(3) The following equipment was installed by the Russian MIRnet team at network facilities in Moscow:

Moscow
(a) Fore ASX-100
(b) Cisco 7507

(4) Both the MSU and UTK engineers have control access to the Chicago and Moscow based MIRnet equipment. With this joint effort, an ATM PVP was established between the two MIRnet ATM switches. This PVP is configured for 6 Mbps. A 4 Mbps PVC is configured within that PVP for IP traffic. That leaves 2 Mbps of available bandwidth for scheduled applications.

An Autonomous Systems Number (ASN) was procured and installed on the MIRnet link. This ASN is now being used to advertise access to the MSU network to all participants on the vBNS network. Other authorized Russian participants will be added in the early stages of the second year of the MIRnet project.

(5) With direct IP peering established between UTK and MSU via MIRnet, a video on demand IP stream was downloaded from UTK to MSU. The video used approximately 1.5 Mbps and was viewed successfully.

(6) Current monitoring of the MIRnet link is being performed by an HP OpenView station at UTK. Viewing station capabilities are being established at MSU. Problems on the link are reported to a technician on duty, 8:00 AM – 5:00 PM Eastern. Any problems outside of this time is reported to an on-call technician via a paging system.

Staffing is currently being developed to extend the UTK NOC to cover 7 x 24. This will be in place early in the second year of the MIRnet project.

(7) The utilization of the MIRnet link is monitored by the HP OpenView station. Over utilization of the of the link will be investigated and an action plan developed with the engineering and administrative groups of MIRnet.

A trouble ticketing system is being tested at this time. This system is being built using Remedy Action Request System (ARS) and will reside at UTK. The MSU members of the NOC will have direct access to the system to enter, update and monitor trouble ticket status.

(8) The MIRnet-HPIIS web site is in place and maintained on principal F&P servers in Knoxville (http://www.mirnet.org/) and in Moscow (http://www.friends-partners.ru/friends/mirnet/). The site was completely reengineered to utilize an underlying database for better site management and better end-user services. The technique (created for this project and other F&P activities) is documented at: http://www.friends-partners.org/friends/ourstory/newserver.html. In addition to standard project information, summary reports, contacts, etc., the site maintains a number of regularly updated services (updated by staff in Knoxville and in Moscow) about high performance networking; services include high performance network bibliography (currently published articles in the scientific literature), bibliography on Russian language high performance network materials, pointers to high performance network presentations on

the Internet, funding opportunities, and a glossary of networking terms. Most of the site is available in both English and Russian languages.

Several communications facilities have been established including a public MIRnet listserver (nearly 300 subscribers but not in active use yet), the MIRnet-ADMIN list (active list for MIRnet management) and the MIRnet-ENG list (active list for MIRnet engineering discussions). Web-based archives have been established for MIRnet-ADMIN and MIRnet-ENG. A chat room has been established for MIRnet but has been used thus far only for experimentation.

(9) In support of Article III, section F. of the cooperative agreement, the MIRnet team has researched and is in final stages of implementing the MIRnet Access and Scheduling System (MASS). This system will provide a fair and open means of scheduling high performance network service to as many U.S.-Russian research teams and their applications as possible. Recognizing the limited capacity of the MIRnet network and of the differing priorities of applications with regards to science, network research and potential of funding support, the system provides the following basic services:

(a) Enable end-user requests (via web-based interface) for differentiated class of service. While most MIRnet traffic will transit over a "best effort" PVC, the network will be configured to enable use of more carefully managed PVCs with which improved quality of service can be offered. In addition to the automated request system, MASS will enable requests for manually configured guaranteed PVCs, when necessary, and PVCs for other more general purposes such as 6-bone tunnels, etc. The system will allow for (indeed, encourage) users to provide immediate evaluation of service performance and reliability.

(b) Provide monthly reporting for all users (and all applications), indicating requested and actual usage.

(c) Provide means by which units of value can be related to consumption of network services. This capability combined with a growing base of actual usage data will better equip the MIRnet team to develop a cost-recovery plan for eventual financial sustainability.

(10) Promotional Efforts and Identification of Potential Users

(a) Promotional activities. Numerous presentations have been given during the past year (in US, Russia, Switzerland, Slovakia) to introduce the project to a wide audience of educators and network engineers. Additionally, the project has been advertised widely on the Internet and via a personalized mailing targeted to over 700 individuals with expressed or potential interest in the project.

A brochure is being prepared for printing now which will go to a much wider distribution of scientists and educators in the US and Russia.

(b) Initial Application Identification. Summaries of 20 initial US-Russia applications have been posted on the MIRnet web site at:

http://www.friends-partners.org/friends/mirnet/mirnet.applications/

(note: as of this date, the above URL is protected with username/password authentication because of pending MIRnet management review of applications)

(c) Initial Federal Users. In addition to continuing meetings with the National Science Foundation, several meetings have been held with personnel from NASA, US Department of Energy, and interested personnel from US Senator Frank Burns office (chair of senate telecommunications subcommittee). Purpose of meetings was to inform about MIRnet capabilities, to gauge potential interest and discuss possibilities of MIRnet to satisfy current needs for high performance applications.

(d) Russian travel. The most important travel during the first year was the three week trip to Moscow by the US leadership (G. Cole and J. Gipson) in October and November. This was the first face-to-face meeting between the entire US and Russian leadership of the MIRnet project and the first opportunity to discuss in detail the organizational policies, engineering issues and long ranging planning for the project. Meetings were held in person and by video-conference with academic centers and institutes throughout Moscow, St. Petersburg, and Novosibirsk. A protocol document was produced summarizing meetings, key decisions and outlining plans for the year. Serving as a key planning scheme for the project, the document is included in the appendix to this report.

Subsequent to this visit, Russian chief engineer K. Scherbatykh visited UTK to work with UTK network engineering staff.

During March, US co-investigator Cole spent three weeks in Russia visiting different cities involved in the Friends and Partners US-Russia Civic Networking Program. Lectures were presented about MIRnet as an enabling resource for scientific collaboration to various university groups. As Friends and Partners expands the US-Russian Civic Networking Program (to at least three new cities), there will be new opportunities to present the MIRnet project with applicant communities. The two projects together give opportunity to encourage development of high performance networking. F&P will continue efforts to increase awareness of the goals and services of MIRnet throughout the Russian academic community.

## BUDGET SUMMARY and BUDGET

(Available upon request.)

## WORK PLAN

The following describes MIRnet plans for FY 1999-2000 within the framework of the "Statement of Work" in the NSF-UTK cooperative agreement. Additional comments are provided in italics.

A. Furnish, operate, and maintain a direct connection for high-performance traffic between the vBNS and RBnet via the STAR TAP (Chicago) and the M9 telecommunication station (Moscow)

(a) Provide, at a minimum, a terrestrial 6 million bit per second (Mbps) Asynchronous Transfer Mode (ATM) permanent virtual path (VP) across the Ameritech, Teleglobe, and Rostelecom networks, terminating at the Ameritech Lucent switch in Chicago (STAR TAP) and the M9 station switch

*A primary goal of the second year's effort is to increase funding towards purchase of an E3 (34 Mbps) circuit for MIRnet. General strategy is to generate additional interest/demand for services while satisfying current requests through reliable service and, by offering differentiated classes of service to ensure good quality for critical applications – with special attention to needs of other federal research initiatives for which additional funding is likely.*

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(b) Implement and manage a Level 3 Internet Protocol (IP) service between Rbnet's HPIIS policy router in Moscow and the vBNS via the STAR TAP

*Additionally, install Ipv6 tunnel for requested experimentation.*

B. Provide coordinated network operation center (NOC), network information center (NIC) and user services support across the MIRnet-HPIIS link on a 24-hour per day, 7-day per week (24 x 7) basis

*24 x 7 NOC to be established/staffed at UTK during summer, 1999.*

C. Cooperate with STAR TAP and vBNS officials to ensure, to the extent supportable by prudent application of networking technology, that only approved institutions' traffic is permitted to use the high-performance connection

*At least until STAR TAP installs policy-based router, approach is to restrict access via router-based Access Control Lists (ACLs). The new MIRnet Access and Scheduling System (MASS) (to be completed during Q1) will produce and update ACLs in line with current approved scheduled requests for service. Decisions for access to the scheduling system (and thus to the network) will be made by MIRnet management working with NSF program officer and represented/documented in the MASS database system.*

1. Implement, maintain and update routing and switching configurations consistent with the Acceptable use Policies (AUPs) of RBnet and the vBNS

   *(see above statement about MASS)*

2. Update routing and switching hardware and system software as new capabilities become available

3. Document the AUP traffic segregation measures and procedures on the MIRnet-HPIIS web site (see item E. below)

   *Complete documentation for MASS (and how it maintains AUP traffic segregation) will be available by start of Q2. Additionally, an on-line and interactive "tour" of MASS will be provided for non-technical visitors.*

D. Monitor the performance and use of the MIRnet connection

1. Monitor appropriate traffic parameters (e.g., VP cell rate and IP flows) to manage the utilization of the MIRnet-HPIIS link and to assure high performance quality

   *Complete system for providing up-to-date statistics on network use and performance; also complete back-end MASS reporting system to provide regular updates to end-users on their scheduled and actual usage of MIRnet services.*

E. Cooperate with the vBNs and the National Laboratory for Advanced Network Research (NLANR) to develop testbed implementations and, as appropriate, production implementations of new versions of Internet networking protocols

1. Ipv6

   *Discussions have already been held with the 6bone group about an Ipv6 tunnel across MIRnet; interest also expressed by group in St. Petersburg, Russia for its use. Depending on exact need and readiness to use, a facility for carrying Ipv6 traffic will be provided early in this next year.*

2. Multicast and MBone

   *MIRnet engineering groups will continue work with other HPIIS institutions and with STAR TAP about providing multicast services.*

3. Resource reservation

   *While MIRnet networking groups will continue work with "traditional" tools and protocols for resource reservation (such as RSVP, DiffServ, etc.), the MASS system, by providing scheduled access to differentiated classes of service, will be of immediate and practical benefit to managing the initially small capacity of MIRnet.*

4. Cache services

E. Maintain a publicly-accessible MIRnet-HPIIS web site containing information about the MIRnet-vBNS high-performance connection and research and education collaborations that it enables

*Continuing improvements and constant updates to the MIRnet-HPIIS web site will be made throughout the next year. More of the site will be translated into the Russian language and new mirroring software installed to automate maintenance of mirror locations in the US and Russia. Specific new emphases during the next year include:*

- *completion of an interactive multi-media "tour" of MIRnet introducing the project, explaining concepts of high performance networking, describing important applications, etc. This portion of the site is to be geared particularly towards the public and to efforts to better publicize the existence and capabilities of MIRnet.*
- *completion of system for reporting statistical information about performance as well as graphic description of scheduled usage of MIRnet.*
- *media-interesting "success stories" about MIRnet applications and use – with engineering-relevant information available and linked to the stories [note: discussions on-going about printed publication describing project and success stories]*
- *new "current awareness" system to be added to MIRnet to enable automated targeting of new information to subscribers based on their specified interests. This service is a part of the recent transition of the MIRnet site (along with all Friends & Partners services) to an underlying database model. Increased work is planned on providing information services about all HPIIS projects and relevant high performance networking issues to the larger HPIIS community.*

1. Include up-to-date international collaboration information, points of contact, engineering information links, documentation and mailing lists to facilitate additional collaboration and experience-sharing;

2. Include up-to-date summary statistical information about the performance of the MIRnet international connection

3. Document MIRnet-HPIIS success stories through up-to-date web pages with proposals, detailed technical requirements, and results;

F. In concert with the methodologies developed by the NLANR Distributed Applications Support Team (DAST), provide consultative user services supporting the use of MIRnet-HPIIS for high-performance computing and communications applications. Provide web-based front-end tools and direct user support to access differentiated network services

*In addition to increasing collaboration with other HPIIS institutions (and network groups such as DAST) on current research into network resource allocation, connection classes, etc., the MIRnet team will complete and fully document the MASS system by which end-users will be use web-based front-end tools to schedule different classes of service for their needs. While*

*projected use of MASS is initially tied to production of Access Control Lists for network access to differentiated classes of service only, use of the system can be explored in concert with other network access and reservation schemes.*

1. Resource allocation mechanisms

2. Application-workstation-network 'tuning' for enhanced performance

and, as development objectives, make best effort to provide

3. Pre-configured connection classes

4. Dynamic call establishment mechanisms

A summary of key activities for the second year of MIRnet activity include:

(1) stabilization of MIRnet service and plans in place for 24x7 network monitoring and trouble shooting; implementation of shared trouble-ticketing system as well as shared responsibilities for monitoring network status and resolving network problems. (network seen as stable and reliable during Q1)

(2) completion of and transition to MIRnet Access and Scheduling System (MASS) for allowing user-based scheduling of network service. Also, complete back-end reporting system to provide regular information to end-users about their scheduled and actual usage of network services. (system completed and in operation during Q1)

(3) increasing awareness and use of MIRnet and its service offerings to US and Russian scientific/educational communities (including government groups, potential corporate partners, scientific associations) through distribution of quality literature, increased Internet visibility, presentations at appropriate meetings, contact with media (as "success stories" emerge). (initial letter and brochure to be distributed widely at beginning of Q2)

(4) establishment, as part of overall user services program, necessary working groups to deal with specific technical, policy and other issues. Possible directions of the group activities:

- standards, protocols, hardware and software related to video-conferencing;
- supercomputing and data visualization;
- remote instrumentation and control.

Support groups with listservers (and web-based and searchable archives) web-based information services, etc. (initial working groups established by mid-Q2)

(5) establishment of Senior Advisory Board to make policy and other advisory recommendations to the central operative management team. Consider mix of leadership from industry, government, scientific associations, other HPIIS projects, etc. (advisory board established by end of Q2)

(6) establishment of Technical/Engineering Advisory Board, to advise the network operations centers on engineering issues. (Q2)

(7) securing funding to organize first annual MIRnet meeting to which interested scientists, educators, engineers, etc. are to be invited. (meeting should be held in Q4)

(8) completion of system for presentation and automated update of performance statistics and scheduled network usage on MIRnet web sites. (Q1)

(9) securing funding from potential MIRnet users to increase capacity of MIRnet services. (Q4)

(10) supporting increased number of user applications.