Plan for Utilization of the FY2002/2003 FIRN Trust Fund Appropriation

8/22/02

Prepared at the request of FIRN management as a joint effort between staff from
The Council for Education Policy, Research and Improvement
and
Hayes Computer Systems

Executive Summary

The Florida Information Resource Network (FIRN) has been the primary data communications transport vehicle for the Florida Education System for over two decades. Now, as Florida undertakes the most aggressive education organizational change in over 150 years, this existing and proven K-20 element is in jeopardy of being eliminated due to economic conditions. Reductions in General Revenue appropriations to FIRN over the last two fiscal years, due to budget shortfalls, have severely reduced FIRN's ability to adequately address growth issues.

In an attempt to address critical performance issues caused by these reductions, the 2002 Legislative session appropriated $3.9 million in Trust Fund spending authority for enhancing user access. The Department of Education (DOE) has committed to provide cash for this Trust Fund appropriation. At the request of FIRN Management, CEPRI staff joined with Hayes Computer Systems staff in the preparation of a plan for the utilization of these trust fund resources.

This plan addresses both the overall improvements that are needed within FIRN and recommends the specific issues that need to be implemented with this FY2002/2003 trust fund appropriation. It identifies the most pressing educational needs in the new K-20 system, establishes criteria for the use of trust fund resources, identifies specific network enhancements in terms of access and transport bandwidth, network management needs, hub or nodal upgrades and the need to consider new services.

Specifically, this plan recommends:

- An eight step network improvement plan, designed to correct identified network operational deficiencies and provide relief to network traffic congestion,
- Experimentation with newer technology for the development of new services to education,
- Establishing network minimal standards for bandwidth connecting major users, and
- Identifies the need for continued support from DOE.

Based on all this research and associated cost estimates for deployment, there is sufficient trust fund spending authority in Fiscal year 2002/2003 to address all immediately required network enhancements; however, this will create a sizable recurring cost, which must be addressed in future fiscal years.

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I. Educational User Needs:

Over the past two years, CEPRI staff have spent time talking with users, meeting with Information Technology professionals in districts, colleges and universities, reviewing various surveys and comparing FIRN to other educational data networks. Hayes Computer Systems works continually with FIRN and its user community. As a result of this exposure, the following four items have been identified as priority issues:

1. Sufficient Access and Transport Bandwidth.
2. Network Support and Around-the-Clock Access
3. Provide Comprehensive Internet Content Filtering Capability
4. Enhance Network Capability with New Services

Each of these priority issues require a more detailed description:

1. Sufficient Access and Transport Bandwidth

Perhaps the greatest challenge for FIRN is to keep ahead of the insatiable demand for Internet access from schools, colleges and universities. In fact, most universities and some colleges have long since acquired their own separate Internet access capability, which runs in addition to that provided by FIRN, or in some cases, provides all of the educational entity needs in this area. Just keeping up with the growth demands in this area has been difficult. On almost all DOE and FIRN technology survey instruments, this need is echoed time after time. There are numerous critical sites throughout the K-20 system that must be addressed with enhanced network capacity. In many cases within the K-12 system, the school district has invested Public School Technology Funds and other funding toward enhancing the district infrastructure (ie: district Local Area Networks that connect schools and district facilities) for data communications between the district and schools. Once this has been accomplished, the district-school local area network likely has greater bandwidth capacity than the FIRN access link at the district. The net result is a bottle-neck of Internet traffic between FIRN and district resources. Community colleges have been forced to assume the access costs heretofore provided by FIRN and almost all SUS institutions have gone to separately acquired Internet access in order to meet campus demands. This plan must identify these critical locations, prioritize them for enhancement implementation and deploy the trust fund portion of the FIRN budget so as to maximize this specific funding toward efficient network access connectivity.

This network enhancement effort becomes more important as the implementation of new and enhanced statewide applications come into play. Specifically, the FASTER transcript tracking application continues to grow. Bright Futures scholarship application & tracking is soon to be enhanced by activity on the new state student financial aid system (SSFAD). FACTS implementation and full production status may never be fully realized, yet its deployment plans call for FIRN to be an integral part of its statewide delivery.

All of these issues have a direct impact on the educational entity FIRN access circuit bandwidth as well as the FIRN backbone bandwidth. Growth in Internet access and statewide applications usage will continue as Florida's student population increases and pressures to apply technology in education become more pronounced. Access to Internet-based and statewide applications will not be acceptable to the educational end-user community unless the service response is comparable to the levels they experience within their working domain and from exposure to similar access from home. This will require advanced planning for enhancing both access and backbone bandwidth.

A key issue is how to determine which circuits need attention? FIRN has no identifiable formal process or structure for performing network enhancements at present. In many instances, enhancements are made to those who are the most vocal. Other times, enhancements are made on based on end-user reports of congestion, supposition of network loading based on staff estimates and without measurable data. An established set of criteria needs to be in place that will identify when conditions warrant enhancements. Once this is in place, then all network components falling under such conditions must be prioritized and then implemented based on fiscal resources. This plan will make an attempt to set forth an initial set of criteria and utilize models for measuring conditions among the major FIRN end-users, in order to make optimal use of FY2002/2003 FIRN trust fund expenditures. Further, it will recommend network management capability to enhance these models and collect accurate data that may be used for future determination of needed network enhancements..

2. Network Support and Access to Support Resources

As more and more educational entities offer classes outside the prime work hours (Generally 8am-5pm EST, Monday through Friday) and expand their on-line course offerings, the availability of FIRN must transcend into a highly reliable level of 24 hours per day, 7 days per week usage (Usually referred to as 24/7 coverage). As bandwidth increases and more end-user become dependent on the network for selected features and access, this becomes a critical issue. Higher educational entities with evening classes cannot afford to have technology-delivered courseware and instructional materials unavailable. On-line students that are dependent on FIRN for access to certain data repositories will not tolerate network inaccessibility any time for an extended period. FIRN must address these changing needs with both a robust network design, redundant deployment of critical components and with sufficient expertise resources to address outages when (not if) they occur.

In order to accomplish the necessary level of network availability and support, FIRN must overhaul its network operations center (NOC) and the help desk function. With network component enhancements aimed at addressing increased bandwidth capacity throughout the network, 24/7 availability becomes a critical issue, as more and more end-users are becoming more dependent on any-time, anywhere services. The presentation and response to both information queries and reported service outages must be enhanced significantly. A major part of this overhaul will be having the NOC acquire and install capability for sensing and diagnosing various network component failures and the corresponding network outage. End-users now report that when they experience outages, the FIRN NOC only picks up on the problem when an end-user call comes in reporting inaccessibility. This is simply not good enough in today's technological environment. Credibility is gained when the end-user calls in an outage and the NOC responds with knowledge on the problem, a current status of problem resolution and a best estimate of how long corrective action will take.

Not only will the NOC need much improved eyes and ears over the entire network, but it needs to be expanded to reliable and efficient 24/7 coverage and be tightly-coupled with the help desk function. These two service elements need to be designed so that end-users make one phone call or e-mail and responses are generated in the form of:

- Acknowledging the performance inquiry or trouble report
- Posting a periodic status, if a immediate answering response is not produced, and
- Generating an appropriate answer or notice that the outage/problem has been resolved

This is especially true in gaining the support and acceptance of faculty. Current CEPRI reviews of K-12 data on technology usage show that very little technology is used in the actual delivery of instruction. One of the reasons for this is teachers have not experienced good reliability when they do attempt to use technology as a part of their teaching style. Only a robust infrastructure with a highly responsive support structure will change this image.

It will not be sufficient to address network bandwidth needs without simultaneously addressing these network management and support issues. This need must therefore be considered in this plan for appropriated trust fund usage. Item V. of this plan, prepared by Hayes Computer System, identifies the specific operational and management issues that must be addressed by FIRN.

In order to accomplish these operational and network management needs, FIRN must have a highly competent technical and operational staff. This is imperative for gaining the confidence of educational end-users. Whether done by filling FIRN vacancies or bringing in other personnel resources, it will not be possible to enact this plan without such resources. The current situation in FIRN, with vacancies in the network staff, will not afford an acceptable solution to this concern. A strong case can be made for having FIRN retain performing the network operations and management with state employees, in terms of the relationship among the users and for having staff with vested interest in education.

In September, 2001, CEPRI staff recommended that FIRN give strong consideration to having FIRN participate in the state SUNCOM effort to establish an IP-based Next Generation Network (NGN). It was deemed technically feasible for FIRN to migrate to a logical partition in such a new network, still retaining its dedication to education. Over the past year, this activity has not progressed. It is still feasible that one government network in Florida can be designed and deployed to address all needs, including those of education, however, the necessary activities to make this a reality have yet to be accomplished. It is therefore felt that education must proceed with needed FIRN enhancements. Such actions are absolutely mandatory in order to address performance and growth issues within FIRN. Qualified and competent support personnel are a key to success, even if in the future, FIRN does participate in any enhanced SUNCOM network offering.

The Internetworking Support Group (ISG) currently has 4 vacancies. It is **strongly recommended** that FIRN proceed immediately with filling these positions with candidates having the following background and experience:

- Two (2) highly experienced and capable network engineers, with appropriate technical degrees. Such employees must have experience in wide-area and local area network design and deployment. Their role and scope will be to continually monitor network performance, engineer enhancements as growth dictates or based on newer technology, research user trends and needs, implement new features when feasible and affordable, and oversee the planning and overall deployment of FIRN. Competent resources with this experience and background will require a high salary, most likely in the range of $70,000 - $90,000 annually

- Two (2) technicians with knowledge and expertise in wide-area and local area network operations and management. These employees will be responsible for the daily operation of FIRN and most importantly, in the proper recording of configuration and status information about the network and its components. It is anticipated that the salary requirements of these type employees will be in the range of $40,000 to $60,000.

The rational for two each in these critical positions is based first on the size of FIRN and the technical workload requirements in managing and keeping such a network reliable and feature-rich. Second, and perhaps even more important, these talents are in great demand. Keeping them properly filled will be an on-going challenge. Two FTE in each type position will be necessary in order to reasonably ensure that at least one of each position is in place at all times, thereby keeping the network institutional knowledge functional and intact.

With the current salary lapse in FIRN, having sufficient fiscal resources for this purpose in the current fiscal year is possible. The continuation of these resources must be made a priority for future fiscal years.

3. Provide Comprehensive Internet Content Filtering Capability

Federal law and rule now mandate that all K-12 Internet access must undergo a filtering process for both site access and content. Qualifying for e-rate funds from the Federal Universal Service Fund requires such filtering. For the past two school years, FIRN has offered filtering capability, at the district option, on a test and trial basis. FIRN has been able to prohibit access to inappropriate material on the Internet by utilizing an Internet filtering solution at each gateway to the Internet. In doing this, FIRN is in compliance with Children's Internet Protection Act (CIPA). Starting in July, 2002, the DOE has provided funds to FIRN so that a more permanent filtering capability may be implemented. While this is not an expense that may be considered in the allocation of the FY 2002/2003 trust fund appropriation, it is a factor that directly affects the enhanced network and must go hand-in-hand with actions to enhance the overall network bandwidth and its support capability.

A contract has been awarded to Secure Content Solutions (SCS) providers of the 8e6 filtering solution. FIRN is now completing the deployment phase of this change-over.

This solution is scalable and management flexible as well as cost effective. It allows for an unlimited number of workstations as compared to the previous solution, which was limited to 140,000 workstations. This solution is already installed and working at both Miami-Dade (3 years) and Hillsborough Public School Districts. An older version is in use at Brevard and Duval School districts.

4. Offer Enhanced Network Service Features and Capability

FIRN was created as strictly a data communications network for education. Over time, it has migrated with data communications technology and end-user needs, yet it still retains a primary focus on data communications. As technology disciplines merge and the lines between voice, data and video converge and grow blurred, FIRN will need to consider augmenting its services to accommodate a more sophisticated end-used community. This activity must be based on user needs and desires, with cost playing a major role. To date, there is no known pressing need to immediately expand into such services. FIRN has begun to survey users on the needs for enhance services. Results of such surveys need to be the primer toward positive actions in any expansion for new services.

Several areas are prime candidates for consideration in the evolution of FIRN services:

- **Internet 2 Access –** there is great interest in all segments of the education system in this venture. FIRN can play an important role in providing such access for all education and on a state-wide basis.

- **Video services –** for both educational instruction delivery and administrative purposes, video services will play a key role in educations usage of technology. Whether a viable video teleconferencing capability or using the network for streaming video into classrooms and labs, this discipline is one that FIRN must address in order to satisfy end-user demands.

- **Wireless Access –** The demands for education to match similar offerings that are prevalent in day-to-day society will require FIRN to support wireless access from various campus locations, as well as offering alternative wireless access from the traditional central FIRN connectivity locations. As wireless capability increases its reliability and its functionality, FIRN must be prepared to enhance its wireless support.

- **Voice over IP –** while this technology continues to lack full acceptance from end-users and is still experiencing voice quality issues when in high traffic situations, it does appear as a viable offering as more and more telecommunications facilities are deployed in IP environments. Also, certain applications involving both voice and data presentations make it a technology that FIRN should embrace.

Proviso language in the FY2002/2003 Appropriation act restricts the use of Trust Funds to bandwidth increases for additional school and classroom Internet connectivity. Specifically, this is issue I. 1., "Sufficient Access and Transport Bandwidth" above, but must also include issue I. 2., "Network Support and Access to Support Resources", in order to insure an efficient and effective delivery of services. Issue I. 3., "Provide Comprehensive Internet Content Filtering Capability", will be provided from other DOE funds. Issue I. 4., "Offer Enhanced Network Service Features and Capability", is really a combination of access disciplines and applications. In light of the intent of the proviso, it is felt that selected experiments in each of these areas would be appropriate, as any positive results will open new avenues of access for education.

While a large portion of the specific details of this plan will be limited to issues I. 1. and I. 2., the importance of enhanced service offerings cannot be ignored. The inter-relationship between bandwidth and support, filtering and new services must be approached in concert, as end-users will continually demand a full solution involving all of these 4 issues. Accordingly, this plan recommends some allocation of trust fund resources for experimentation in new services.

Recent events in the telecommunications industry will likely have an effect on FIRN and its ability to address the desires of its user community. The SUNCOM backbone OC-3 ring around the state is supplied by ITC Deltacom , which has declared Chapter 11 bankruptcy. The likewise declaration of bankruptcy by Worldcom will also possibly have an effect on FIRN through the SUNCOM provided services, as SUNCOM uses Worldcom for WATS, 800 and Frame Relay services. The SUNCOM contract with BellSouth for Internet Access services involves UUNET, a subsidiary of Worldcom, for traffic delivery to the appropriate Network Access Points (NAP's). It is not altogether clear how these actions will affect SUNCOM and FIRN. One can conjecture that the transport assets of these two companies continue to have value and currently play a major role in the function of the Internet. It is likely that these resources will be picked up by other industry organizations, but nothing concrete has come into play as of yet. Customers of both ITC Deltacom and Worldcom continue to receive services, according to agreements in place.

II. Criteria for applying trust fund monies to bandwidth

In light of the afore mentioned lack of standards and methodology in selecting when end-users need network resource enhancements, considerable effort has been spent in attempting to establish some formal procedure. This effort has focused on identifying elements of criteria that may be used in determining:

a) Those entities that require bandwidth adjustments, and
b) The priority of such adjustments.

For this plan, these criteria will be applied to the major FIRN users, i.e.; school districts, community colleges and universities. While there are a considerable number of access circuits dedicated to public libraries, CCLA, IFAS and others, these are generally lower in volume and from a brief survey, these users do not seem to experience the congestion noted by the larger educational delivery system entities. It should be noted that while dial-up services are not addressed in this effort, there is a need to evaluate their performance on a periodic basis.

Based on the lack of reliable network management data and records of configuration documentation that are not totally accurate, a decision was made to consider several sources on FIRN network performance in order to develop a selection method that is based on need and justified by the existing traffic patterns. Accordingly, the following are sources that have been candidates for being considered in building a case for bandwidth adjustments at specific sites and in network components:

1) FIRN End-user Survey of May 2001.
2) Ongoing evaluation of Multi Router Traffic Grapher (MRTG) performance reports.
3) Consultation with FIRN Internetworking Support Group (ISG) staff and submitted network enhancement requests.
4) Consideration of student population-to-instructional workstation ratios, compared to existing bandwidth.
5) Whether an educational entity has acquired an alternative Internet Service Provider (ISP) in addition to the FIRN connectivity.
6) Survey done by the Auditor General in the recent FIRN audit.
7) Results of the recent CISCO technical audit of hub performance.
8) Input from the FIRN Advisory Committee.

Data assembled and collected by CEPRI in another project to answer questions from DOE and the Legislature on how FIRN is being used and how much a replacement alternative to FIRN would cost education (Excel file “Budget-Appl-Master-v6.1-Final.xls” on the CEPRI server and shared with FIRN), were used extensively as a guideline and reference basis in preparing this report. This spreadsheet is a detailed accounting of the entire FIRN topology of access circuits, hubs and backbone circuits. In conducting research for this report, several areas of information within this reference spreadsheet and other FIRN ISG records of network topology reports came under question. Further, during a detailed review of the MRTG reports for annual traffic patterns, there were questions raised as to both configuration and traffic loads. It is not certain that the FIRN-deployed MRTG collection software is tuned properly. As there was no time for a comprehensive MRTG audit, best efforts were made to correct these data when such questions were raised. While most of these issues were resolved, there is still a lingering concern over the accuracy of the data used in preparing this report. It must be noted that this is the reason for using both a subjective analysis followed by the preparation of specific models in a best effort to both predict and verify the subjective findings.

During the course of research conducted for this report, several of these areas had to be removed from consideration:

- Specifically, with regard to item 6., the Auditor General was reluctant to share the results of their survey, prior to the audit of FIRN being published. Just prior to the delivery due date for this plan, the Auditor General's staff did provide CEPRI with a copy of their survey. In order to meet the time commitment, it was not feasible to factor this source into the draft deliverable. It will be possible to consider this source in any subsequent updates of this plan.

- In the case of item 7., the results of this effort do not contain performance data that is meaningful to this effort. The CISCO report is more of a marketing proposal for an upgrade rather than the expected technical audit of the hubs.

- And last, the FIRN Advisory Committee (item 8.) functions more in a needs and results mode and did not feel it appropriate to offer specific input. This report shall therefore concentrate on the five remaining items to form its recommendations.

Thus, this analysis and plan was based on the five remaining sources of FIRN network performance.

III. Detailed list of sites and conditions meeting these criteria

Attachment I, titled "*FIRN Major User Bandwidth Analysis & Criteria for Trust Fund Application*" represents a matrix of FIRN major users and the five considered criteria. Accordingly, it provided the basis for this plan. These five criteria for considering the use of Trust Fund appropriations may be identified by the column titles:

- FIRN May 2001 District Survey
- MRTG Analysis
- ISG View & Network Enhancement Requests

- Student Population Factor
- Alternative ISP Deployed

CEPRI staff preformed a subjective overview by considering data from each of these sources simultaneously and then identifying access circuits that needed immediate attention and those that would be next in line for attention when funding is available. The results of this overview may be found in Attachment I, under the column titled “FIRN Action Plans”, where the sub-column “Act” contains the value “X” for immediate attention or “N” for next-in-line consideration.

Columns titled “Student Population Factor” and “FIRN Plan Actions” in Attachment I have values derived from two models that were designed specifically for this plan. The purpose of these models is an attempt to give some measure of objectivity in prioritizing the results of the subjective overview. The following give a description of the basis and structure for each model:

1) Model to approximate justifiable access bandwidth based on student headcount population.

Student population headcount is a common attribute across all education delivery systems. This effort attempts to calculate a fixed amount of FIRN access bandwidth on a per student basis. Though it is not entirely accurate and certainly can be improved upon with more thought and effort, it is felt this model has reached a level that can be used as an objective guideline in researching the major FIRN users need for access bandwidth. This model features two distinct factors:

a) a coefficient that approximates the percentage of time in a school day that instructional workstations are actually in use of the FIRN access bandwidth. This factor is calculated separately for K-12, colleges and universities and is recorded on Attachment I at the top of each delivery system tabulation, under the column titled “Student Population Factor”. It is denoted in the delivery system identifier row and the coefficient value is prefaced by the term “W/S IA Use”. It is derived from the ratio of actual school hours in a school day, times the best estimate for total use time in a school day, times the FIRN Internet access % factor derived as a result of the recent effort by CEPRI to determine how FIRN is being used by the delivery systems and what would it cost education if FIRN went away.

b) student population supported bandwidth is then calculated by using the headcount student population and the average of students per instructional workstation to determine the approximate number of workstations within an entity. The formula then is based on this approximation of workstations, using an average of 6 workstations per voice grade circuit capacity (an equivalent of 56k bits per second) to obtain acceptable response times in Internet access, times the W/S IA Use coefficient for a delivery system and normalized into megabits per second. While it is a rather crude approximation, it does have a surprisingly reasonable match with a great number of the bandwidth allocations in terms of Committed Information Rate (CIR) and from Multi Router Traffic Grapher

(MRTG) actual use measurements. This formula is defined on page 3 of Attachment I.

2) Model used to rank the entities selected for bandwidth enhancements based on subjective review of the five criteria.

The Attachment I column titled "*FIRN Plan Action*" has three sub-columns. The first, subtitled "Act", is the result of the afore mentioned subjective overview with the value indicating action and blanks means no action. In this column, a value of "X" means that subjectively, enhanced access bandwidth is now required. A value of "N" indicated that this entity will likely be ready for enhanced bandwidth soon, meaning next fiscal year (FY), or later this FY, should funds be available. The second sub-column, subtitled "Rank", is a calculated value of rank, based on the five criteria. The equation and its coefficient values are detailed on page 5 of Attachment I. The third sub-column, subtitled "Enhancement", is the abbreviated recommended action for access bandwidth enhancement at the corresponding educational entity.

Page 6 of Attachment I give a graphic overview of the FIRN backbone capacity and loading in a matrix format. This graphic was used to determine backbone elements needing more capacity.

Attachment II, titled *"FIRN FY2002/2003 Major User Bandwidth Analysis Priority Ranking & Cost Estimates"*, is the sorted priority rankings of those entities in the "X" and "N" category. This attachment also contains the estimate of recurring and non-recurring cost projections for bandwidth enhancement, hub requirements, network management and new service experiments. Attachment II should serve as the blueprint for using the Trust Fund appropriation to address the bandwidth portion of this plan. It is recommended that bandwidth orders be placed in the priority order as presented in Attachment II, thus enabling the validation of cost projections and applying the Trust Fund resources in a priority sequence.

Standard for Access Bandwidth Allocation: After developing these models and studying the result, it seems proper that FIRN establish a standard for bandwidth on access circuits that serve districts, colleges and universities. The following is set forth for consideration:

School Districts:	Each Florida school district shall be allocated local access bandwidth by FIRN that is equivalent to a T-1 circuit, or 1.544 million bits per second. Districts shall be allocated more bandwidth whenever the combination of MRTG data and bandwidth allocations based on student population exceed this initial level. Any deployment of additional district access bandwidth shall be contingent upon available funding for such purposes.
Post Secondary	Each public community college shall be allocated local access bandwidth by FIRN that is equivalent to a T-3

circuit or 45 million bits per second, with a committed information rate (CIR) of 6 million bits per second. Each state university shall be allocated local access bandwidth that is equivalent to a full T-3 circuit and full CIR.

One important question is whether the DOE will want to establish such a standard and also whether there is interest in having it applied to post secondary education. The initial deployment of the network did have such a standard. Over time, and based on the inability of FIRN to keep up with the needs in colleges and universities, this common thread among all educational entities unraveled. While it does have a significant cost impact, it also will be a visible issue in any K-20 system definition. Therefore, this plan includes such standards application and an estimated cost parameter is made a part of the recommended Trust Fund cost allocation in Section VI.

IV. HUB Operational and Management Evaluation

Based on Research by Hayes Computer Systems

Hayes Computer Systems (Hayes) was asked to examine the FIRN wide area network, identify any problems and recommend corrective action. The scope of this effort was not limited to just the Cisco hardware but was to encompass all aspects of the network. During the development of this section, Hayes utilized the results of the bandwidth analysis conducted by CEPRI staff. Hayes was also instructed not to limit its recommendations to working within existing FIRN methods and procedures, but to provide recommendations that would produce a highly reliable and efficient educational network.

Hayes Computer Systems assigned an engineer on site at FIRN for several days during the first weeks in August of 2002. Hayes engineers interviewed staff and customers of the FIRN network. Hayes resources also reviewed several documents prepared by Cisco Systems that had been presented to FIRN over the years.

Hayes was asked by FIRN management to start with a clean sheet of paper in creating our recommendations. Several realistic constraints were used:

1) Be as cost effective as possible. Wholesale replacement of the network would not be possible without additional funding. The recommendations that are

contained in this document recommend spending available dollars in a responsible manner.

2) Use conservative design principles so the network is stable and manageable.

3) Design the network in such a manner that it is easily understood.

During the initial visits, several issues regarding the FIRN network became apparent.

There are no performance goals evident. For the network to be managed correctly, performance goals must be in place in order to judge the operation of the network. This plan provides several goals that could be used to judge the network. It is not necessary for the exact numbers in the proposed goals be used, just that there are some objective standards in place that can be measured.

In order to measure these goals, effective network management solutions must be in place. The network management systems currently in place are not providing a meaningful view of performance. Part of the reason for this is the current staff shortage. Other network management requirements are not being accomplished in an effective manner. It would be useful to again consider the implementation recommended in the 1999 Cisco report.

There are still bandwidth demands that no amount of hardware or software will solve. Additional bandwidth is necessary in the network, however, throwing bandwidth at the network will not solve all of the problems until the operational and management issues are resolved.

Proposed Network Goals:

- The operation of the FIRN network should have performance goals similar to the following during normal operation:

    1) No more than 30ms latency between any two routers on the network.
    2) Sufficient bandwidth to carry the Internet traffic with less than 1% packet loss per minute on any link at peak times.
    3) Sufficient bandwidth such that the maximum sustained utilization of any link is no more than 80% over any 2 consecutive five minute intervals.
    4) Sufficient processing power on the router to keep the processor utilization under 60% over any 2 consecutive five minute intervals.

- During failure conditions, the network should have the following goals:

    1) Fail/Degrade in a predictable manner.
    2) Be recoverable to a useful level in no more than 2 hours and recoverable in total in 4 hours.

- Operational Goals:

1) Simplification of the network to make management and troubleshooting easier.
2) Create a network with an identifiable core whose job it is to move IP packets and an edge that is responsible for service adaptation and transformations.
3) Creation of an environment that allows peering with other network providers in an easy manner.
4) Provide written documentation, policies and procedures for operation of the network.

General Observations

There are several problem areas regarding the wide area network. They can be divided up into the following areas: Router Infrastructure; Network Management; Bandwidth between the Routers; The Bandwidth between the educational entities and FIRN. All of these areas must be addressed to ensure that FIRN operates properly.

It is recommended that the network be re-engineered in multiple steps since a wholesale replacement of this operational network is neither necessary, advisable nor cost effective. There will have to be additional hardware procured, but this may be done where and when it is needed and not as a wholesale replacement. Additional bandwidth will need to purchased or re-arranged on those links that are over capacity.

Improvement Plan

Step 1) Create a Network Management Infrastructure to manage the existing network. This is an important first step. Until this is accomplished, the network will continue to be run in a reactionary “fire-fighter” mode. Once such a management infrastructure is in place, information should be disseminated to the full staff and be available for any new members to review as they come onboard. A network Management Infrastructure will provide a baseline to measure performance now and as changes are implemented. Additionally, it will provide a safety net for disasters and tools to use for diagnosing network problems.

A) Create a system to automatically record and back up the router configurations and keep a historical log. Required for disaster recovery.
B) Create a web page with the IP addresses of all routers and other devices to facilitate connection to the devices
C) Keep network performance web pages (MRTG) up to date.
D) Synchronize clocks using NTP.
    i. The system clocks are not synchronized and GMT offset and EST/EDT is not set. This creates problems in correlating problems between routers.
E) Send log files to a centralized syslog server.
    i. Logging enabled only on Miam and Miam-GW at debug level to internal buffer.

   ii. No logging on other routers.
   iii. No routers sending logs to SYSLOG server.

F) Create a proactive network monitoring environment to stay ahead of the users. Page engineers when there is a critical outage.
G) Build a UNIX system using FREEBSD operating system. Install rancid for configuration backups. tftp repository for IOS archives. TACACS for user authentication. MRTG for network utilization reports. NEGIOS for proactive networking monitoring. A web page for Internal documentation and network management tools.
H) Create policies and procedures so that the network management solution is updated when changes are made.
I) Create policy that requires customers opening trouble tickets to be contacted on a regular basis while their ticket is being worked. Also require positive confirmation from the customer prior to a ticket being closed.
J) Continue to use existing trouble ticket system. Management should perform weekly review of active items to ensure that tickets are closed in a reasonable period of time.
K) Create a uniform naming scheme for the routers.
   i. Backbone routers are named inconsistently in the forward DNS, some spelled out like "Miami" and "Tampa", others abbreviated like "JKV" and "Orl", still others named after a university instead of city such as "UNF". Some are not obvious such as "DSB" and "DPS".
   ii. Many of the reverse DNS entries are missing. There seems to be entries for all the main distribution routers, but the core routers seem to be missing.
   iii. Recommend using a standard scheme like AT&T CLLI codes. Hostnames inside core routers sometimes embed the keyword "core", "BB" (backbone), "Border", and "GW" (gateway)-- it would be much clearer if they were named consistently.
L) Implementation of TACACS for username and password authentication on the router consoles. This will allow the following:
   i. Logging of user access to the routers
   ii. Revocation of access when an employee departs without wholesale changes to the network.
   iii. Limitation of which routers employees have access to.
   iv. Log changes that are made.

Step 2) Configure the existing routers to perform at their maximum potential and fix any configuration problems. This step can be performed in conjunction with step 1.

A) Remove NAT on all core boxes and push this function to the edge of the network.

i. NAT no longer appears to be in use on the PNSC, PNCY, ORLD and FTMY routers. On these routers NAT should be tuned off now.

ii. NAT is in use still on the TLHS, JCVL, GSVL, and DYBH routers. This needs to be pushed back to the access routers.

B) Standardization of router configurations to create a uniform environment.

i. Create uniform naming of Access Lists

ii. Removal of extraneous access lists and configuration parameters.

C) Remove policy routing.

i. This may not be possible with the present site filter. If not, policy routing should be minimized to improve performance and simplify the network.

D) Remove dynamic routing from links unless absolutely necessary.

E) Fix OSPF Problems

i. Routers are using the default OSPF divisor 10^8 to compute link cost, meaning that links faster than 100Mbps are represented as 100Mbps.

ii. Several OC3 ATM sub-interfaces have no bandwidth statement where OSPF thinks the bandwidth is 100Mbps (derived from physical OC3 and the divisor issue as discussed above). For example, a 6Mbps ATM PVC will be treated as a 100Mbps link in the OSPF shortest path calculations. This will cause OSPF to prefer to use some of the slower links causing additional congestion.

iii. The OSPF routing domain is broken into about 10 areas plus area zero in a logical manner, and these routers have meaningful Loopback0 addresses.

iv. Understanding the OSPF database is somewhat difficult as several routers have additional loopback addresses with higher IP addresses causing them to have OSPF router Ids different than Loopback0. This can be remedied using the OSPF router-id command. This will not improve performance, but will make it easier for engineers to understand this OSPF configuration.

v. In some places, OSPF area zero extends outside the core and distribution routers into the access routers such as from DYBH/Deland to DBCC. This is not recommended. Routing flaps that occur in area zero require routers on the entire network to re-compute OSPF tables.

F) In several places, an ATM sub-interface has a bandwidth statement value that is different from the vbr-nrt SCR, and sometimes they are different on both ends of the PVC.

i. For example: PNSC A6/0.2 bw=12Mbps, scr=20Mbps, TLHS A6/0.1 bw=6Mbps, scr=20Mbps. It is unclear whether these are typos or someone trying to skew the OSPF cost calculations to influence the link selection.

G) Remove dynamic routing redistribution into BGP.
    i. The BGP advertisements need to be cleaned up and made static. Static BGP advertisements are the preferred way to manage a network.
    ii. Redistribution of BGP into OSPF is also occurring and not recommended. The recommended method is to use IBGP to transfer reachablity inside the Autonomous system.

H) Implementation of IBGP in core. No IBGP peering is on the network today.

I) BGP peering sessions in several instances are being run across interfaces numbered in the private address space. Private address space is normally not used to span autonomous system boundaries. Private address space is kept under the control of one administrative organization.

J) AS 1 is configured in the BGP network. This is owned by GENUITY. It appears to be used in a peering session with UWF. Private AS numbers should be used if the organization you are peering with do not have officially assigned AS numbers from ARIN.

K) No standardization of loopback address allocation.
    i. Loopback0 addresses on distribution and core routers seem to be addressed as /32 from network 150.176.0.0/24. Several of the gateway locations have last octets in format .x0 (distribution) and .x (core), except for Pensacola which is reversed and has BGP enabled on the non-BGP router, and Miami which is different.

L) Standardize router software versions.
    i. The 7200 routers are using 5 different versions of IOS mostly in the 12.1E train. It is assumed that 12.1E is used instead of 12.1 to get the NBAR feature. Although not recommended, if NBAR is absolutely necessary, it may be better to run v12.2 mainline (Limited Distribution) instead of v12.1E (Early Distribution) since it has fewer bugs yet has the same memory requirements.
    ii. Presently, the MIAM-GW router is running image c7200-ik2s-mz.121-9.E.bin. This has a minimum recommended RAM memory of 128Mbytes, yet the router has only 96Mbytes.
    iii. Recommend upgrading the DRAM on JCVL and MIAM-GW routers to at least 128Mbytes.
    iv. Recommend upgrading all 15 7200s to the latest 12.2 mainline code. This should have many fewer bugs and provide consistency.

M) Recommend upgrading all 7200 routers to a minimum of 128MB memory and gateway 7200 routers to a minimum of 256MB memory.

N) Recommend removal of all buffer tuning parameters in conjunction with the software upgrade. After network operates using the default buffer statements, Cisco support should be consulted with if buffers appear to need modification.

O) NBAR (Network Based Application Recognition) is enabled on 3 routers: PNSC, ORLD-GW, and MIAM. This feature is still very buggy, consumes resources and should be removed.

P) Of the 15 distribution and core routers, about half were missing a VTY access-class to restrict TELNET access. This is a security problem and needs to be addressed.

Q) There may be a memory hardware problem on the PNCY router: *PC-BSB_7206VXR uptime is 5 weeks, 1 day, 5 hours, 59 minutes. System returned to ROM by processor memory parity error at PC 0x6101D1B8.*

R) Console logging to serial port is only disabled on 3 of the 15 routers.

S) Cisco 7206VXR routers have the configuration registers set to 0x2102 on some and 0x102 on others. The setting should be set to 0x2102 on all routers.

T) Several of the router image files have been renamed from the default, such as "7200_12.1.1E3_IP.bin" instead of "c7200-is-mz.121-1.E3.bin" making it impossible to determine the feature set from the IOS image name. Several images like the one above are very old and no longer even appear on the Cisco FTP archive site. The most recent 12.1E image for 7200 at present is 12.1(12)CE which has undergone many bug fixes since 12.1(1)E3.

U) The Cisco 7200 architecture backplane uses a right and left bus. Port adapter selection and slot location must be chosen consistent with the configuration guidelines appropriate for the given NPE (Network Processor Engine). The 7200 routers examined uncovered the following over capacity issues:

    i. GNVL (NPE200). Number of High Bandwidth PAs > 3 (4). Need to upgrade chassis to NPE300 or faster or remove one of the high bandwidth adapter
    ii. TAMP (NPE300). Left BUS PAs use > 600 points (740). Can fix by redistributing some port adapter load to right BUS.
    iii. MIAM-GW (NPE300) . Left BUS PAs use > 600 points (690) Right BUS PAs use > 600 points (690) The 7200 architecture does not support this configuration. May be able to either upgrade to larger router model and retain port adapters (75xx family or 6500 family use same PAs), or add second 7200 chassis and split load.
    iv. DYBH/DELAND (NPE200). High load on left bus, move some PAs to right bus. (left=330, right=0)
    v. PNCY (NPE300). High load on left bus, move some PAs to right bus. (left=420, right=0)
    vi. ORLD_GW (NPE300). Left bus at maximum capacity. (left=600, right=390)

vii. TLHS (NPE400). Both system busses are at maximum capacity. (left=600, right=600)

viii. See document "Cisco 7200 Series Port Adapter Installation Requirements" for further details. URL=http://www.cisco.com/univercd/cc/td/doc/product/core/7206/port_adp/config/3471in.htm

V) RAM memory split is unusual on Miami GW router. *"cisco 7206VXR (NPE300) processor (revision B) with 57344K/40960K bytes of memory"*. This needs to be further investigated.

W) ORLD-GW: interface ATM6/0.2 point-to-point description FIRN Miami-DSB Hub (Should read To MIAM-GW A4/0.1)

X) MIAM-GW: interface ATM4/0.1 point-to-point description FIRN Orl-OCPS Hub (Should read to ORLD-GW A6/0.2)

Y) Unused access lists in the routers must be removed.

Z) Point to point links in the core and distribution routers should be re-addressed to use global address space. This is especially true for the BGP peering routers. This will help in diagnosing problems using tools such as traceroute. At the current time, diagnosing problems that involve connectivity outside FIRN's network is nearly impossible using normal practices since the private address space is not allowed outside of the FIRN infrastructure.

Step 3) District router changes

A) District routers are running older versions of the Cisco IOS software. These routers should be upgraded to more recent versions of the software to close several security holes. They should all be a common level for better operation of the network.

B) A standardized naming convention should be implemented throughout the district routers to make management easier.

C) Cleanup of the router configurations including purging of unused access-lists and commands.

D) A near-term plan should be created to replace the older 2500 series routers with 1700 or 2600 routers. The 2500 routers are no longer being sold by Cisco and support is becoming more and more limited (support ending in 2004/2005 time frame). As a part of the on-going FIRN planning process, there should be a plan in place to upgrade portions of the network infrastructure on a regular basis. Should any trust fund resources remain unallocated, this plan could start when all other items have been deployed.

Step 4) Implement performance monitoring on the network

A) Collect netflow statistics for traffic analysis. Analysis should include source and destination flow information and types of traffic flows. Information will be used to base decisions on traffic policies as well and needs for additional capacity.

B) Implement a performance collection methodology to verify is network is meeting established goals. Collected performance data is essential for timely fault isolation, determining network degradation over time, as well as proactive monitoring and capacity planning.
C) Establish a methodology to collect network latency information between access points on network.
D) Procure 3 servers to be placed at the Tallahassee, Tampa and Miami gateway sites to collect data for the North, Central and Southern parts of the state. Procure an additional Server to combine the data from the three sites to create a unified view.

Step 5) Redesign of Miami-Gateway Node

Due to the high utilization in Miami, the router should be upgraded to a larger series of Cisco Router. Given the vendors current development emphasis, it is recommended that a Cisco 7600 series replace the existing 7200 series router. This router can be re-deployed to Gainesville where the router is overloaded now. The port adapters can be re-used in the new 7600 router. A Cisco 2950 switch will be used to provide Ethernet connectivity.

In the Miami distribution node, the existing I/O controller with the Fast Ethernet port will need to be replaced with an I/O controller with a Gigabit Ethernet port. This is required to increase the speed of the connection between the 2 routers. A Gigabit Port Adapter will not work since the bandwidth points would be above the 600 allowed on the system bus.

It was brought to our attention that rack space might be limited in the Miami machine room. This needs to be addressed to ensure that the new equipment can fit. It is also important to inspect the electrical facilities at the Miami location. The new Cisco 7600 router uses 220volt power and the existing electrical connections and the existing UPS may need to be upgraded.

Step 6) NPE Upgrades

Replace NPE in Gainesville 7200 with the NPE from the Miami-GW Router. This will fix the backplane bandwidth issue in Gainesville.

Based on the 8/14/2002 CPU utilization study provided by FIRN, the following CPU upgrades should be made. For clarification, the NPE in a Cisco 7200 series router is the CPU.

Replace the existing NPE-300 in the ORL-Border router with an NPE-400.
Replace the existing NPE-300 in the MIA-distribution router with an NPE-400.
Replace the Jacksonville NPE-225 with NPE-300 from Orlando.
Replace the Deland NPE-200 with the NPE-300 from Miami.

If this step is approved, the Memory upgrade in the Jacksonville router that is requested in Step 2 can be deleted.

Step 7) Bandwidth Additions to educational institutions and Backbone

The recommendations that are listed in CEPRI portion of this plan (detailed in Attachment II) should be made. Specific recommendations made by CEPRI for bandwidth enhancements that require hardware considerations are listed below:

A) Miami OC-3 Internet addition: An additional Cisco Flexwan card and an OC-3 Packet over SONET card must be purchased for the Miami Core Router.
B) Orlando DS-3 Internet Addition: An additional Cisco PA-T3+ card will need to be purchased and installed in the right bus.
C) Pensacola DS-3 Internet Addition: An additional Cisco PA-T3+ card will need to be purchased and installed in the right bus.
D) Dade School Board bandwidth Upgrade. Upgrade connection to their district from Fast Etherent to Gigabit Ethernet. There is no cost associated on FIRN's part, but there may be cost associated on the School Boards part.

Step 8) Ingress bandwidth additions

There are two aggregation points on the network, which are overloaded today.

A) The Miami distribution Frame connection that has 58 T1 circuits attempting to come into 1 DS –3 circuit. A DS-3 circuit is equivalent to 28 T1 circuits. This is a problem area. It is our recommendation that an additional T3 circuit for aggregation be purchased and the existing circuits be split among the 2 connections. There is an existing T3 port available on the Miami Distribution router that can be used for this purpose.
B) The Tampa ATM connection is very close to capacity. There is currently 157mpbs of sustained cell rate being assigned to this OC-3. The maximum speed of an OC-3 without over commitment is 155mbps. The burst assigned to this circuit is approximately 225mbps. It is our recommendation that an additional OC-3 ATM circuit be purchased and the customers be divided among the 2 connections. An additional PA-A3-OC3SMI card will need to be purchased.
C) It is recommended that the Frame Relay circuits used for aggregation in Jacksonville and Gainesville be monitored closely to determine if additional capacity is needed in these areas.

Step 9) Network simplification/redesign

After all of these steps are taken, the FIRN network should be re-examined. It is our belief that a simplification of the network should take place. The recommendations and methods to get beyond this point are beyond the scope of this paper.

Step Deployment Timeframe Estimates

It is Hayes belief that Steps 1, 2, and 3, the network management, existing router configuration changes, and the district router configuration changes can be done in a 30-60 day time frame given sufficient staffing. Step 4, the performance monitoring could also be started in this time frame.

Hayes believes that it would be best to have steps 1, 2, 3 and 4 done in large part before other changes are made so that a baseline can be formed. This would allow the measurement of the impact other changes have on the network.

Step 5 and 6, The Miami node upgrade and the NPE upgrades around the state could be performed within a 90 day window. It would depend on availability of maintenance windows for network outages. It might also be best to implement the Miami re-configuration during the Christmas break so as to cause the least amount of disruption.

Steps 7 and 8 can be done within a 90 day time frame also.   This is dependant on circuit availability and coordination with the local phone companies.

V. Recommendations for Plan Execution:

1) It is strongly recommended that FIRN deploy network enhancements by executing the proposed improvement plan and each step as propose herein.

- While implementation of Steps 1 and 2 will not solve many of the performance complaints that are being experienced on the network, they will provide a foundation for future performance improvements. They will make the network manageable and clean up problems that may be masking other problem areas.

- Step 1 has minimal capital outlay costs. Step 1 can be done without affecting any part of the network and should be done prior to changes in step 2 and 3. This is so changes in step 2 and 3 can be accurately monitored and measured.   It is the recommendation of Hayes Computer Systems that FIRN perform steps 1, 2 and 3 regardless of how FIRN proceeds.

- All of the bandwidth enhancements, as referenced in Step 7 and detailed in Attachment II, should be deployed.

- The steps have recurring and non-recurring expense requirements, but as presented in Section VI., it is estimated that all may be accomplished within the Trust Fund appropriation. In the opinion of CEPRI and Hayes, these actions must be taken for FIRN to continue to exist as a highly reliable and efficient educational network.

- This plan is not a static solution to the evolution of FIRN. The long term design review (as proposed in step 9) should be taken to seriously evaluate how the network could be modified to make it more efficient.

2) Experiments in new services will be a vital part of the network’s ability to keep up with both technological changes and user expectations and needs. Planned experiments, as proposed herein should be intimidated the FY, and continued as a functional entity of overall network support.

3) FIRN and DOE should consider bandwidth standards for major users, as proposed herein, and decide if it is to be enacted. Further, it is felt the models derived for this plan and as presented in Attachment I, represent a reasonable start in having measurable data for determining network enhancements. These concepts should be retained, refined and included in the overall FIRN network management portfolio.

4) The DOE must recognize the implications of the significant Trust Fund recurring costs that this plan produces. A commitment for continued support, whether as trust fund or general revenue, must be secured at the highest levels of the department.

VI. Cost estimates for addressing these issues and needs with Trust Fund monies.

Attachment II, Page 4, titled *"FIRN Plan Cost Estimates for Trust Fund Allocations"*, gives the detailed cost estimates of each type action recommended in this plan. While the research into necessary actions and cost estimates were made in a fashion that would permit a staged implementation over multiple fiscal years, the total estimate of costs was within the Trust Fund appropriation for FY 2002/2003. Thus, this plan features performing all recommended actions with the current appropriation.

The following table gives a summary of these cost projections and estimates:

FIRN Trust Fund Expenditure Plan for FY2002/2003

Network Element	**Recurring Cost**	**Non-Recurring Cost**
Network Bandwidth:		
Immediate Access Bandwidth Enhancements	$ 236,162	$ 2,593
Next-in line Access Bandwidth Enhancements	$ 248,375	$ 1,710
Backbone Bandwidth needs	$1,053,268	-0-
Bandwidth Subtotal	$1,537,805	$ 4,303
Hub Equipment & Network management:		
Step 1-Network Management	-0-	$ 7,900
Step 2-Router Performance	-0-	$ 965
Step 3-District Routers	-0-	-0-
Step 4-Performance monitoring	-0-	$ 17,200
Step 5-Redesign Miami Node	-0-	$ 80,549
Step 6-NPE Updates	-0-	$ 15,912
Step 7-Bandwidth additions	-0-	$ 32,640
Step 8-Ingress bandwidth	$ -0-	$ 6,800
Hub & Network Management Subtotal	-0-	$ 161,966
New Service - Proposed Experiments:		
Internet 2 Access	$ 247,240	$ -0-
Video Services	$ 2,500	$ 36,000
Wireless Access	$ 3,000	$ 50,000
Voice over IP	$ 1,200	$ 5,000
New Service Experimentation Subtotal	$ 253,940	$ 91,000
Apply Access Standard to Higher Education:		
Re-assume community college DS-3 cost	$ 836,000	$ -0-
Establish DS-3 at each SUS institution	$ 806,073	$ -0-
TOTAL PLAN ESTIMATE	**$3,433,818**	**$ 257,270**

ATTACHMENT I

FIRN Major User Bandwidth Analysis & Criteria for Trust Fund Application

08/14/2002

Educational Entity	Current Connecting Bandwidth		FIRN May 2001 District Survey	MRTG Analysis Avg of Annual Weekly Peaks in Xmbps (done 07/02)	ISG View and Network Enhancement Requests	Student Population Factor-2001/2002 Population-Bandwidth in X mbps		Alternative ISP Deployed (Named if so)	FIRN Plan Actions Act..Rank…Enhancement….		
School Districts	**Circuit**	**CIR**				W/S IA Use	0.109				
ALACHUA	100mb MAN	100		6.5		29599	8.147				
BAKER	T-1	1.5		1.5		4490	1.236		N	3.8239	Add 2nd T-1
BAY	100mb	100		5		26033	7.165				
BRADFORD	T-1	1.5		1.5		4096	1.127				
BREVARD	T-3	9		15	Y, +6m	71718	19.739		X	5.7159	Increase CIR +6m
BROWARD	T-3	30	Congestion Reports	30	Y, up to 35m	262027	72.119		X	5.904	Increase CIR +10m
CALHOUN	T-1	1.5		1.3		2212	0.609				
CHARLOTTE	T-1	1.5		0.9		17302	4.762	Cable & W"less			
CITRUS	2 T-1's	3	Congestion Reports	3.2		15221	4.189		N	4.8717	Install fracT-3 w/4m
CLAY	2 T-1's	3	Congestion Reports	3.65	Y, fT-3 w/ 4m	29013	7.985		X	6.8658	Install fracT-3 w/4m
COLLIER	T-1	1.5		1.1	Y, 2nd T-1	36475	10.039	Sprint(Primary)	N	9.7628	no action
COLUMBIA	T-1 & T-3	3	Congestion Reports	0.2		9560	2.631				
DADE	100mb	100		90		374806	103.159		N	2.0351	Add New T-3
DESOTO	T-1	1.5		1.7	Y, 2nd T-1	4714	1.297		X	3.8809	Add 2nd T-1
DIXIE	T-1	0.128		1.65		2264	0.623				
DUVAL	10mb	10		1.3	Y	126919	34.932	AT&T BrdBnd			
ESCAMBIA	10mb	10		3.5	Y, up to 100mb	44648	12.289	Cox			
FLAGLER	T-3	6		3.1		7144	1.966				
FRANKLIN	2 T-1's	3		3		1442	0.397				
GADSDEN	T-1	0.256		1.45		7431	2.045		N	5.234	Add 2nd T-1
GILCHRIST	T-1	44.2		1.4		2669	0.735				
GLADES	T-1	1.5		0.2		1099	0.302				
GULF	T-1	1.5		1.7		2218	0.610				
HAMILTON	T-1	1.5		1	Y, full T-1	2152	0.592				
HARDEE	T-1	1.5	Congestion Reports	1.1		4782	1.316		N	1.3329	Add 2nd T-1
HENDRY	T-1	1.5		0.7		7584	2.087				
HERNANDO	T-1	0.128	Congestion Reports	1.7		17939	4.937		X	7.3291	Add 2nd T-1
HIGHLANDS	T-1	1.5		1.65	Y	11303	3.111		X	5.9763	Add 2nd T-1
HILLSBOROUGH	~~OC-3~~	~~6~~	Congestion Reports	6	Y, +3m	169682	46.702		X	11.284	Increase CIR +3m
HOLMES	2 T-1's	3	Congestion Reports	2.3		3537	0.973				
INDIAN RIVER	2 T-1's	3		3.5	Y, fT-3 w/ 4m	15417	4.243		X	6.3552	Install fracT-3 w/4m
JACKSON	100mb	100		1.8		7311	2.012				
JEFFERSON	100mb MAN	100		17*		1709	0.470				

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LAFAYETTE	10mb	10			2.9		1030	0.283				
LAKE	2 T-1's	3			1.7	Y, fT-3 w/ 4m	30626	8.429		N	5.1937	Install fracT-3 w/4m
LEE	T-1	1.5			1.2		60661	16.696	Sprint	N	14.663	Evaluate ISP Usage
LEON	100mb MAN	100			17*		31802	8.753				
LEVY	T-3	0.512			2.3		6253	1.721				
LIBERTY	T-1	1.5			1.4		1321	0.364				
MADISON	T-1	5			17*		3439	0.947				
MANATEE	~~OC-3~~	~~6~~			4		38250	10.528	Time Warner	N	2.1319	Increase CIR+3m
MARION	2 T-1's	3			3.95	Y, to 10m MAN	39319	10.822		X	6.9802	Install MAN @6m
MARTIN	2 T-1's	3			2.5	Y	16790	4.621		N	2.6485	Install fracT-3 w/4m
MONROE	T-3	6			1		9266	2.550				
NASSAU	T-1	1.5			0.6		10435	2.872				
OKALOOSA	T-1	1.5	Congestion Reports		0.1		30858	8.493				
OKEECHOBEE	T-1	1.5	Congestion Reports		1.6		6916	1.904		X	6.2522	Add 2nd T-1
ORANGE	100mb	100			25	Y	156905	43.185				
OSCEOLA	T-3	9			7.5	Y, +6m	37744	10.388		N	3.1543	Increase CIR +3m
PALM BEACH	T-3	44.2	Congestion Reports		11		159862	43.999				
PASCO	~~OC-3~~	~~6~~			5	Y, +3m	52632	14.486		X	4.6972	Increase CIR +3m
PINELLAS	~~OC-3~~	~~9~~	Congestion Reports		9	Y, +3m	114251	31.446		X	6.994	Increase CIR +6m
POLK	~~OC-3~~	~~6~~			3.5		81163	22.339	BBN Planet			
PUTNAM	T-3	0.064	Congestion Reports		3.95		12629	3.476		X	4.3638	Increase CIR to 6m
ST. JOHNS	2 T-1's	3	Congestion Reports		2.25	Y, fT-3 w/ 4m	20918	5.757		N	3.7255	Install fracT-3 w/6m
ST. LUCIE	T-3	4	Congestion Reports		6.1		30552	8.409		X	5.2228	Increase CIR +3m
SANTA ROSA	T-3	3			3	Y, to fT-3	23228	6.393		X	5.131	Increase CIR+3m
SARASOTA	~~OC-3~~	~~9~~			8	Y, +3m	37048	10.197		X	3.1496	Increase CIR+3m
SEMINOLE	T-3	9			7.5	Y, +6m	62718	17.262		X	4.1016	Increase CIR+6m
SUMTER	T-1	1.5			1.3		6378	1.755		N	2.1965	Add 2nd T-1
SUWANNEE	T-1	1.5			1.3	Y, full T-1	5797	1.596		X	4.0735	Add 2nd T-1
TAYLOR	T-1	1.5			1.5		3629	0.999				
UNION	T-1	1.5			1.5		2130	0.586				
VOLUSIA	100mb	100			12.5		62339	17.158				
WAKULLA	100mb MAN	100	Congestion Reports	17*			4680	1.288				
WALTON	T-1	1.5			1.5	Y, 2nd T-1	5968	1.643		X	5.0951	Add 2nd T-1
WASHINGTON	T-1	1.5	Congestion Reports		1.35		3373	0.928		N	1.0766	Add 2nd T-1
DEAF/BLIND							717					
DOZIER/OKEEC	T-1						419					
FAU LAB SCH							478					
FSU LAB SCH							1409					
FAMU LAB SCH							515					
UF LAB SCH							1197					
TOTAL K-12							2500161					

ATTACHMENT 1

NOTE: **W/S IA Usage**={(7.5 school hours per day)/24 hours per day)*(the K-12 survey average factor for instructional workstation usage=68.3%)*(the FIRN Internet access % factor for K-12=51.09%)
Bandwidth per student is based on the statewide average of 3.7 students per workstation and 6 workstations per 56kbps voice grade channel over the access link, multiplied by the W/S IA Usage coefficient
Bandwidth per student ={(((FTE headcount/3.7)/6)*56k)/1mbps}*W/S IA Usage Coefficient for the delivery system
***** MAN shared access - indistinguishable

Community Colleges					W/S IA Use	0.140				
Brevard	T-3	6	7.5		26,017	3.045		X	2.6059	Increase CIR+3m
Broward	T-3	6	2	Y	49,090	5.745				
Central Florida	100mb-MAN	100	Not measured		17,294	2.024				
Chipola	100mbps	100	7.8		5,082	0.595				
Daytona Beach	T-3	6	5.2		29,671	3.472		X	0.5139	Increase CIR+3m
Edison	OC-3	6	5.9		19,245	2.252		X	0.3648	Increase CIR+3m
FCCJ	T-3	6	0.1		55,349	6.477	BellSouth			
Florida Keys	T-3	6	3		3,766	0.441				
Gulf Coast	100mbps	6	3.5		21,634	2.532				
Hillsborough	OC-3	6	5.2		44,579	5.217		X	2.8494	Increase CIR+3m
Indian River	not serviced		0		40,306	4.717	Sprint			
Lake City	T-3	6	5.5		5,954	0.697		X	0.0358	Increase CIR+3m
Lake-Sumter	not serviced		0		5,946	0.696	Earthlink			
Manatee	OC-3	6	4.64		16,359	1.914		N	-0.881	Increase CIR+3m
Miami-Dade	T-3	6	0.01		106,888	12.508		?		Take out?
North Florida	T-3	9	1.7		3,536	0.414				
Okaloosa-Walton	T-3	6	3		12,660	1.482				
Palm Beach	T-3	6	0		38,903	4.553	FDN			
Pasco-Hernando	OC-3	6	5		10,864	1.271		N	0.0543	Increase CIR+3m
Pensacola	T-3	6	5.5	Y, +3m	22,420	2.624		X	1.3861	Increase CIR+3m
Polk	OC-3	6	4.5		17,336	2.029		N	-0.883	Increase CIR+3m
St. Johns	T-3	6	2.4		8,723	1.021				
St. Petersburg	OC-3	6	2.8		49,717	5.818				
Santa Fe	100mbps	100	6.5		21,437	2.509				

Seminole	T-3	6	1.7		22,678	2.654	Sprint			
South Florida	T-3	6	1.5		8,004	0.937				
Tallahassee	OC-3	6	4		21,873	2.560		N	-0.86	Increase CIR+3m
Valencia	T-3	6	5		52,526	6.147	BellSouth.net	X	2.0293	Increase CIR+3m
TOTALS					737,857					
				CC-Stud/WS	11					

NOTE: Some community colleges use FIRN only as a alternative or back-up and have their own ISP arrangement

W/S IA Usage={(12 college hours per day)/24 hours per day)*(the estimated college average use factor for instructional workstation usage=75%)*(the FIRN Internet access % factor for community colleges=37.21%)

Bandwidth per student is based on the statewide average of 11 students per workstation and 6 workstations per 56kbps voice grade channel over the access link, multiplied by the W/S IA Usage coefficient

Bandwidth per student ={(((FTE headcount/11)/6)*56k)/1mbps}*W/S IA Usage Coefficient for the delivery system

Universities

					WS IA Use	0.328				
UF	100mbps	100	5.2	Y	46599	54.921	Quest & GRU			
FSU	MAN	5	1.5		35462	41.795	Sprint			
FAMU	MAN	5	0.45		12317	14.517	Sprint			
USF	100mbps	100	43.5	Y	37535	44.238	BBN Planet			
FAU	T-3	6	0.75		23537	27.740	BellSouth			
UWF	100mbps	100	22		9145	10.778				
UCF	T-1	0.256	0.01		35967	42.390	BellSouth			
FIU	T-1	0.256	1.5		31802	37.481		X	28.817	Eval Usage
UNF	T-1	1.5	1.5		13137	15.483	BellSouth	X	12.322	Eval ISP
FGCU	100mbps	100	6.6		4237	4.994				
TOTALS					249738					
				SUS Stud/WS	2.6002728					

NOTE: Most SUS institutions have their own Internet access circuit and use FIRN as an alternative & back-up

W/S IA Usage={(18 university hours per day)/24 hours per day)*(the estimated university average use factor for instructional workstation usage=90%)*(the FIRN Internet access % factor for universities=48.64%)

Bandwidth per student is based on the statewide average of 2.6 students per workstation and 6 workstations per 56kbps voice grade channel over the access link, multiplied by the W/S IA Usage coefficient

Bandwidth per student ={(((FTE headcount/2.6)/6)*56k)/1mbps}*W/S IA Usage Coefficient for the delivery system

HUBS

FGCU	Y
FIRN-TLH	Y
Hayes Internet GW	Y
Deland	OK
Gainesville	MAN to save $
Mayo	Y,2nd T-1
Miami-BB	

ATTACHMENT 1

Orlando-BB	Awaiting up'gds
Panama City	OK
Tampa	up'dg access
Tallahassee-BB	Y, up IMT-GNV
Marianna	
Ft. Myers	OK
Jacksonville	OK
Miami-Dis	At capacity
Orlando-Dis	
Platka	
Pensacola	OK
Tallahassee-Dis	
Tallahassee-NWRDC	

Internet Gateways

Pensacola	T-3	44.2	40	
Tampa	OC-3	45	28	U,IG to 90mb
Orlando	2 T-3's	90	44	
Tallahassee	OC-3	45	43	U, to 90m
Miami	OC-3	155	150	

Development of FIRN action plans and ranking - three columns of information are used:

Act A value of "X" indicates a subjective evaluation for immediate attention to bandwidth enhancements. "N" means plan for attention.

Rank A formula intended to rank all of the subjective candidates

Coefficients are:		
	2001 Survey	no entry = 0
		entry = .5
	MRTG Review	0 if below CIR
	(Annualized)	1 if within 20%
		2 if equal CIR
		3 if over CIR
	ISG Rec	0 if no rec
		1 if rec
	MRTG vs St BW	1 if M below S
		2 if within 20%
		0 if M above S
	Differential Ratio	equals (Student supported bandwidth-CIR)/(MRTG Measaured Bandwidth)

The equation is then:

Thus, **Rank** = (2001 Survey) + (MRTG Usage Review) + (ISG Rec) + (MRTGvsSbw) + Differential Ratio

Enhancement An abbreviation of the specific action nesessary to enhance bandwidth to the educational entity

ATTACHMENT 1

MRTG Backbone Views																	
Values are in the format of MRTG Annual Usage - CIR from FIRN Map																	
Nodes - Col is FROM, Row is TO	Deland	Gainesville	Mayo	Miami-BB	Orlando - BB	Panama City	Tampa	Tallahassee - BB	Marianna	Ft Myers	Jacksonville	Miami-Dis	Orlando - Dis	Palatka	Pensacola	Tallahassee - Dis	Tallahassee - NWRDC
Deland													**16-15CIR**	0.3-6CIR			
Gainesville					0.2-12CIR		3.5-6CIR	**20-25CIR**			**4-6CIR**						
Mayo																	
Miami-BB					3-15CIR		**18-20CIR**					**80-100CIR**					
Orlando - BB							2-15CIR					6-15CIR	45-100CIR				
Panama City								3-6CIR							**9-12CIR**		
Tampa		**5-6CIR**						6-15CIR		**10-12CIR**		10-20CIR	2-15CIR				
Tallahassee - BB							7-15CIR								6-15CIR	35-100CIR	0.35-?CIR
Marianna						4.5-?CIR											
Ft Myers							6.6-12CIR					6.5-15CIR					
Jacksonville		**4.2-6CIR**						**10-12CIR**						3-6CIR			
Miami - Dis										6-15CIR							
Orlando - Dis	**18-15CIR**	3.5-12CIR															
Palatka																	
Pensacola						7-12CIR		5-15CIR									
Tallahassee - Dis		**15-25CIR**				3-6mb					**10-12CIR**						
Tallahassee - NWRDC								4.5-155CIR									
Color Codes:				Within 60-80% of CIR capacity, consider for "N" upgrades													
				Within 80-100% of CIR capacity, consider for "X" upgrades													

ATTACHMENT II

FIRN FY2002/2003 Major User Bandwidth Analysis Priority Ranking & Cost Estimates

08/20/2002

Educational Entity	Current Connecting Bandwidth		FIRN May 2001 District Survey	MRTG Analysis Avg of Annual Weekly Peaks in Xmbps (done 07/02)	ISG View and Network Enhancement Requests	Student Population Factor-2001/2002 Population-Bandwidth in X mbps		FIRN Plan Actions Act..Rank........Enhancement...			Estimated Annual Recurring Cost Increase	Estimated Non-Recurring Costs
School Districts	**Circuit**	**CIR**				W/S IA Use	0.109					
FY 2002/2003 Recommended Actions:												
HILLSBOROUGH	~~OC-3~~	~~6~~	Congestion Reports	6	Y, +3m	169682	46.702	X	11.284	Increase CIR +3m	$ 3,000.00	$ 267.45
HERNANDO	T-1	0.1	Congestion Reports	1.7		17939	4.937	X	7.3291	Add 2nd T-1	$ 6,007.56	$ -
PINELLAS	~~OC-3~~	~~9~~	Congestion Reports	9	Y, +3m	114251	31.446	X	6.994	Increase CIR +6m	$ 3,000.00	$ 267.45
MARION	2 T-1's	3		3.95	Y, to 10m MAN	39319	10.822	X	6.9802	MAN@6m	$ 5,747.64	$ 1,010.00
CLAY	2 T-1's	3	Congestion Reports	3.65	Y, fT-3 w/ 4m	29013	7.985	X	6.8658	Install Frac T-3w/ 4m	$ 17,283.84	$ -
INDIAN RIVER	2 T-1's	3		3.5	Y, fT-3 w/ 4m	15417	4.243	X	6.3552	Install Frac T-3 w/ 4m	$ 33,320.04	
OKEECHOBEE	T-1	1.5	Congestion Reports	1.6		6916	1.904	X	6.2522	Add 2nd T-1	$ 6,993.00	$ -
HIGHLANDS	T-1	1.5		1.65	Y	11303	3.111	X	5.9763	Add 2nd T-1	$ 7,329.00	
BROWARD	T-3	30	Congestion Reports	30	Y, up to 35m	262027	72.118	X	5.9039	Increase CIR +10m	$ 21,120.00	
BREVARD	T-3	9		15	Y, +6m	71718	19.739	X	5.7159	Increase CIR +6m	$ 6,240.00	
ST. LUCIE	T-3	4	Congestion Reports	6.1		30552	8.409	X	5.2228	Increase CIR +3m	$ 3,552.00	
SANTA ROSA	T-3	3		3	Y, to fT-3	23228	6.393	X	5.131	Increase CIR+3m	$ 3,552.00	
WALTON	T-1	1.5		1.5	Y, 2nd T-1	5968	1.643	X	5.0951	Add 2nd T-1	$ 8,017.20	
PASCO	~~OC-3~~	~~6~~		5	Y, +3m	52632	14.486	X	4.6972	Increase CIR +3m	$ 3,000.00	$ 267.45
PUTNAM	T-3	0.1	Congestion Reports	3.95		12629	3.476	X	4.3638	Increase CIR to 6m	$ 13,692.00	
SEMINOLE	T-3	9		7.5	Y, +6m	62718	17.262	X	4.1016	Increase CIR+6m	$ 10,080.00	
SUWANNEE	T-1	1.5		1.3	Y, full T-1	5797	1.596	X	4.0735	Add 2nd T-1	$ 11,197.20	
DESOTO	T-1	1.5		1.7	Y, 2nd T-1	4714	1.297	X	3.8809	Add 2nd T-1	$ 14,721.60	
SARASOTA	~~OC-3~~	~~9~~		8	Y, +3m	37048	10.197	X	3.1496	Increase CIR+3m	$ 3,960.00	$ 267.45
Subtotals											$ 181,813.08	$ 2,079.80
Enhancements for Future Fiscal Years or if Funds Available												
LEE	T-1	1.5		1.2		60661	16.696	N	14.663	Eval ISP	$ -	
COLLIER	T-1	1.5		1.1	Y, 2nd T-1	36475	10.039	N	9.7628	no action	$ -	
GADSDEN	T-1	0.3		1.45		7431	2.045	N	5.234	Add 2nd T-1	$ 10,436.04	$ -
LAKE	2 T-1's	3		1.7	Y, fT-3 w/ 4m	30626	8.429	N	5.1937	Install Frac T-3w 4m	$ 27,966.00	
CITRUS	2 T-1's	3	Congestion Reports	3.2		15221	4.189	N	4.8717	Install Frac T-3w/ 4m	$ 35,464.92	$ 500.00
BAKER	T-1	1.5		1.5		4490	1.236	N	3.8239	Add 2nd T-1	$ 7,164.00	
ST. EOHNS	2 T-1's	3	Congestion Reports	2.25	Y, fT-3 w/ 4m	20918	5.757	N	3.7255	Install Frac T-3w 6m	$ 16,766.40	
OSCEOLA	T-3	9		7.5	Y, +6m	37744	10.388	N	3.1543	Increase CIR +3m	$ 8,160.00	
MARTIN	2 T-1's	3		2.5	Y	16790	4.621	N	2.6485	Install Frac T-3w 4m	$ 16,248.00	
SUMTER	T-1	1.5		1.3		6378	1.755	N	2.1965	Add 2nd T-1	$ 16,090.80	

ATTACHMENT II

MANATEE	~~OC-3~~	~~6~~		4		38250	10.528	N	2.1319	Increase CIR+3m	$ 3,000.00	$ 267.45
DADE	100mb	100		90		374806	103.159	N	2.0351	Install New T-3	$ 56,220.00	
HARDEE	T-1	1.5	Congestion Reports	1.1		4782	1.316	N	1.3329	Add 2nd T-1	$ 7,665.00	$ 500.00
WASHINGTON	T-1	1.5	Congestion Reports	1.35		3373	0.928	N	1.0766	Add 2nd T-1	$ 7,102.44	
Subtotals											$ 212,283.60	$ 1,267.45
Community Colleges						W/S IA Use	0.140					
FY 2002/2003 Recommended Actions												
Hillsborough	OC-3	6		5.2		44,579	5.217	X	2.8494	Increase CIR+3m	$ 3,000.00	$ 267.45
Brevard	T-3	6		7.5		26,017	3.045	X	2.6059	Increase CIR+3m	$ 5,472.00	
Valencia	T-3	6		5		52,526	6.147	X	2.0293	Increase CIR+3m	$ 5,472.00	
Pensacola	T-3	6		5.5	Y, +3m	22,420	2.624	X	1.3861	Increase CIR+3m	$ 5,472.00	
Daytona Beach	T-3	6		5.2		29,671	3.472	X	0.5139	Increase CIR+3m	$ 5,472.00	
Edison	OC-3	6		5.9		19,245	2.252	X	0.3648	Increase CIR+3m	$ 2,520.00	$ 10.00
Lake City	T-3	6		5.5		5,954	0.697	X	0.0358	Increase CIR+3m	$ 5,472.00	
Subtotals											$ 32,880.00	$ 277.45
Enhancements for Future Fiscal Years or if Funds Available												
Pasco-Hernando	OC-3	6		5		10,864	1.271	N	0.0543	Increase CIR+3m	$ 2,520.00	$ 10.00
Tallahassee	OC-3	6		4		21,873	2.560	N	-0.8601	Increase CIR+3m	$ 2,520.00	$ 10.00
Manatee	OC-3	6		4.64		16,359	1.914	N	-0.8805	Increase CIR+3m	$ 3,000.00	$ 267.45
Polk	OC-3	6		4.5		17,336	2.029	N	-0.8825	Increase CIR+3m	$ 5,472.00	
Miami-Dade	T-3	6		0.01		106,888	12.508	?		Take out?	$ -	
Subtotals											$ 13,512.00	$ 287.45
Universities						WS IA Use	0.328					
FY 2002/2003 Recommended Actions												
FIU	T-1	0.3		1.5		31802	37.481	X	28.817	Evaluate Usage	$ -	
UNF	T-1	1.5		1.5		13137	15.483	X	12.322	Evaluate ISP Traffic	$ -	
Backbone Circuits												
FY 2002/2003 Recommended Actions									**% of Use**			
Deland-Orlando/Dis	DS-3	15		16				X	1.0667	Increase CIR+5m	$ 10,560.00	$ -
Miami/BB Gateway	OC-3	155		150				X	0.9677	New OC-3 w/ 155m CIR - based on current cost	$ 586,920.00	
Miami/BB-Tampa	DS-3	20		18				X	0.9	Increase CIR+5m	$ 10,560.00	
Orlando/BB Gateway	DS-3	90		76				X	0.8444	Install New DS-3	$ 94,200.00	
Tampa-Ft Myers	DS-3	12		10				X	0.8333	Increase CIR+3m	$ 14,844.00	
Tampa-Gainesville	DS-3	6		5				X	0.8333	Increase CIR+3m	$ 15,384.00	
Tallahassee/Dis-Eacksonville	DS-3	12		10				X	0.8333	Increase CIR+3m	$ 19,164.00	
Eacksonville-TLH/BB	DS-3	12		10				X	0.8333	Increase CIR+3m	$ 19,164.00	

ATTACHMENT II

Gainesville-Tallahassee/BB	DS-3	25		20				X	0.8	Increase CIR to 30m	$ -	
Miami/BB-Miami/Dis	OC-3	100		80				X	0.8	?	$ -	
Subtotals											$ 770,796.00	$ -
Enhancements for Future Fiscal Years or if Funds Available												
Pensacola Gateway	DS-3	45		35				N	0.7778	New DS-3 w/ 45m CIR - based on current cost	$ 165,240.00	
Pan City-Pensacola	DS-3	12		9				N	0.75	Increase CIR+3m	$ 12,360.00	
Gainesville-Jacksonville	DS-3	6		4				N	0.6667	Increase CIR+3m	$ 9,120.00	
TLH/Dis-Gainesville	DS-3	25		15				N	0.6	Increase CIR to 30m	$ -	$ -
Subtotals											$ 186,720.00	$ -
Sum of Immediate Attention (X) Items:											**$ 985,489.08**	**$ 2,357.25**
Sum of Next Round (N) Items:											**$ 412,515.60**	**$ 1,554.90**
Contingency-10%											**$ 139,800.00**	**$ 391.22**
TOTAL Items											**$ 1,537,804.68**	**$ 4,303.37**

Assumption: Any backbone within 80% of CIR from MRTG needs immediate attention. Within 60% of CIR needs planned attention

ATTACHMENT II

FIRN Plan Cost Estimates for Trust Fund Allocations

		Recurring Cost	Non-Recurring Cost
Cost Parameters:			
Bandwidth Estimates:			
Identified immediate entity access bandwidth enhancements	Districts	$ 199,994.39	$ 2,287.78
	Colleges	$ 36,168.00	$ 305.20
	Universities	$ -	$ -
Subtotal		$ 236,162.39	$ 2,592.98
Identified next-in-line entity access bandwidth enhancements	Districts	$ 233,511.96	$ 1,394.20
	Colleges	$ 14,863.20	$ 316.20
	Universities	$ -	$ -
Subtotal		$ 248,375.16	$ 1,710.39
Backbone bandwidth enhancements	Immediate	$ 847,875.60	
	Next Round	$ 205,392.00	
Total Bandwidth (Immediate & Next Round) Subtotal		$ 1,537,805.15	$ 4,303.37
Hub Equipment & Network Management Requirements:			
Step 1 Costs			
Network Management Station	DL320 1.2GHZ, 1GB RAM, 2 18GB Disks		$ 3,100.00
Installation+Training	40 hours labor (installation + Training)		$ 4,800.00
	***This pricing is from Compaq Web site		
	***FIRN may already have acceptable machine		

ATTACHMENT II

Subtotal			$	7,900.00
Step 2 costs				
TLH-FIRN-Dis_7206VXR	Upgrade NPE-400 from 128MB to 320MB Memory	256MB Module	$	207.00
JKV-DPS_7206VXR	Upgrade NPE-225 from 64 to 192MB Memory	128MB Module	$	95.00
Miami-DSB_7206VXR_Core	Upgrade NPE-300 from 96 to 512MB Memory	2 * 256MB Module	$	378.00
TLH-FIRN_BB_7206	Upgrade NPE-300 from 160 to 256MB Memory	128MB Module	$	95.00
Orl-OCPS-Border_7206VXR	Upgrade NPE-300 from 160 to 256MB Memory	128MB Module	$	95.00
Tampa-GW_7206	Upgrade NPE-300 from 160 to 256MB Memory	128MB Module	$	95.00
	***This is pricing using Kingston 3rd party memory			
Subtotal			$	965.00
Step 3 costs				
	No equipment needed		$	-
Step 4 costs				
Collector Nodes	DL320 1.2GHZ, 1GB RAM, 2 18GB Disks	3 nodes	$	9,300.00
Consolidation Node	DL320 1.2GHZ, 1GB RAM, 2 18GB Disks	1 node	$	3,100.00
	Labor (installation and training)	40 hours	$	4,800.00
	***Pricing from Compaq Web Site			
Subtotal			$	17,200.00
Step 5 costs				
Miami-DSB_Border	Cisco 7600 Router+2PS+2 Flexwans		$	74,378.41
	Cisco 2950 Switch	WS-C2950G-24-EI	$	1,696.60
	GBIC * 4	WS-G5483=	$	1,074.40
Miami-DSB_Dist	7200 Gigabit Ethernet I/O Controller	C7200-I/O-GE+E	$	3,400.00
	*** Requires 220V power **Need to verify UPS			
	*** Reuses existing Miami Port Adapters			
Subtotal			$	80,549.41
Step 6 costs				
Orl-OCPS-Border	Upgrade to NPE-400	NPE-400+256MB	$	7,956.00

ATTACHMENT II

Miami-DSB_Dist	Upgrade to NPE-400	NPE-400+256MB		$ 7,956.00
	***Trade-in on NPE-225 and NPE-200 not reflected			
	***Price reflects State Contract Price for Cisco			
Subtotal				$ 15,912.00
Step 7 costs				
	See CEPRI Portion of this Plan			
Miami-DSB_Border	Flexwan Card	WS-X6182-2PA		$ 10,200.00
	Packet over Sonet Card	PA-POS-OC3SMI		$ 5,440.00
Orl-OCPS-Border	T3 Card	PA-2T3+		$ 8,500.00
Pens-UWF-GW	T3 Card	PA-2T3+		$ 8,500.00
	***Price reflects State Contract Price for Cisco			
Subtotal				$ 32,640.00
Step 8 costs				
Miami-DSB-Dist	no hardware required			
Tampa	ATM Card	PA-A3-OC3SMI		$ 6,800.00
	***Price reflects State Contract Price for Cisco			
Subtotal				$ 6,800.00
Total Hub Cost estimate - all steps				$ 161,966.41
New service experiments	Internet 2 - Connection fee and circuit cost for statewide access for all education		$ 247,240.00	
	Video Services - f T-3 and Video server for sreaming tests + video teleconferencing multi-conference switch		$ 2,500.00	$ 36,000.00
	Wireless Access - Wireless access test at one high landline cost connection - includes tower lease, RF licenses, TxRx equipmemt & Interfaces		$ 3,000.00	$ 50,000.00
	Voice over IP - handsets and network access & switching equipment		$ 1,200.00	$ 5,000.00
Subtotal			$ 253,940.00	$ 91,000.00

ATTACHMENT II

Applying Access Standard to Higher Education					
Re-assume CC DS-3 access cost	T-3 to each main campus	$	836,000.00		
Standard for SUS main campus	T-3 at 10 campus locations	$	806,073.12		
TOTALS		**$**	**3,433,818.27**	**$**	**257,269.78**
Combined Total - all aspects of the plan:				**$**	**3,691,088.04**
Unallocated Trust Fund Spending Authority:				**$**	**208,911.96**