# C. Project Description

## *C.1 Overview*

A significant challenge exists in widening the scope of impact of cyberinfrastructure (CI). We propose a pilot project within CIARA, The Center for Internet Augmented Research and Assessment, to be a new bridge between the existing disciplines and the CI community: CyberBridges. CyberBridges will create a new generation of scientists and engineers who are capable of fully integrating CI into the whole educational, professional, and creative process of diverse disciplines. CyberBridges will target minority students and faculty members, who otherwise would not be part of the excitement of CI.

The normative state is that CI research scientists (institutional information technology professionals with academic backgrounds) understand broadly applicable CI. The CI research scientists are active in communities that transfer computer science from the labs to the networks forming part of the National CI. They work hard to ensure that CI is in place to maintain low barriers for use of these technologies. Early adopter faculty members are excited to see potential benefits in their research domains, and as such become active in the communities that use CI. These faculty members are the exception. Previous efforts have tried to work with these early adopters to become evangelists for CI in entire domains of science. That work did not have a long or broad impact, as it depended on enthusiasm without a system for substantive rejuvenation. (Cambre 1991; Pournelle 1994).

CyberBridges is a system that will affect sustained transfer of CI knowledge, and as such will broaden the horizons for researchers and educators. The majority of faculty members do not see the applicability of CI for their own investigations. Their research requires a detailed understanding of their domain. Scanning other domains for possible benefit and collaborations, is often a desired activity, but too much of a time burden, and often the technical material is difficult to apply (Hazemi, etc. 1998). The research scientists are institutionally positioned to help faculty who need to use infrastructure, but lack topical expertise to explain how CI may be of benefit to faculty in their investigations.

This divide between faculty and the technical CI research scientist is so severe, that the full merits of CI are rarely realized due to the paucity of adoptions. CyberBridges seeks to integrate CI into research projects today, piloting a lifelong framework of understanding for tomorrow's faculty, to assess the effectiveness of CI, and to demonstrate an effective, academically grounded, institutional model of support.

The "collisions of ideas" that Bruce Alberts, President of the National Academy of Sciences and a member of the Boyer Commission identified as requisite to faculty and student success, is the core tenant of CyberBridges (Boyer Report, 1998, p. 11). CyberBridges is a framework for developing a workforce of scientists and engineers that will explore ways to advance their domains, aided by CI.

## *C.2 Research*

### C.2.a Hypothesis

The CIARA CyberBridges proposes that graduate students engaged in inquiry based learning activities can effect transfer of CI research and that this transfer will increase scientists' rates of discovery and create a CI empowered workforce.

### C.2.b Preliminary Research

We have engaged in experiments that lead us to be confident of the hypothesis put forward. These experiments did not have the rich matrix of support infrastructure that the CyberBridges project proposes, and as such the scope of impact was significantly less than the proposed effort. The experiments did allow us to look at the fundamental issues of graduate student effectiveness, faculty willingness, and usefulness of the research scientists. However, the rigorous assessment models developed as part of the CyberBridges process were not used for these preliminary experiments.

**First, an experiment conducted with maxillo-facial surgery.** . In the Puerto Rico BRIN project, IT research scientists worked to bring software expertise to a lab in order to adapt 3D volume reconstructions of infants with cleft palates and similar deformities. The goal was to use a High Performance Computing facility's (HPCf) VizRoom's capabilities together with the IT research scientists' computational resources to help with modeling and surgical planning. The experiment was largely successful. However, we feel that the rate of discovery could have been enhanced significantly with a partnership with a graduate student in his own domain. These experiments lead to a design point used in CyberBridges.

**Second, an experiment assistive technologies.** The Puerto Rico Assistive Technology Project is an NIH funded project through the National Institute of Disability and Rehabilitation Research. Its main focus is to provide all types of equipment and services that can be used to augment, maintain or improve the functional capabilities of people with disabilities. They wish to develop a resource capitalizing on the HPCf VizRoom capabilities, together with control and feedback technologies taken from OpenSource projects, which would bring to wheelchair-bound children with limited motion, a means to learn the control of their chairs in a simulated area rather then taking their first tentative strolls in the real-world. The intended clientele are children with various palsies, paresis or plegia, exclusively able to control their chairs through limited-motion apparatus such as joysticks, mouthpieces or head-controls. The work commenced with only the IT research scientists and has not significantly progressed. The need for a bridging between the domains was revealed. The assistive technology researchers and the IT research scientists do not share a technical vocabulary. The role of a graduate student, as proposed in CyberBridges would have significantly increased the rate of progress, and the CI skill set of the graduate students.

**Third, an experiment with architechture.** The initiative has failed to reach its desired affect due to that lack of faculty participation. Because no faculty member entered into a partnership

with a graduate student and the research scientist, the results were not as compelling as we believe they will be in a CyberBridges pilot.

**Fourth, an experiment with.** The ITR funded Metaverse Lab of UKy wishes to develop the tools and resources necessary to create a digital library, working with the collection of paintings, sculptures and pottery of the "Instituto de Cultura Puertorriqueña", an important repository of cultural artifacts in Old San Juan, Puerto Rico. In its initial stages, this project is exploring the use of visualization technologies, to capture and display three-dimensional objects. In its expected final development phase, the project would require the participation of students from CS but also from such fields as art history and fine arts, creating and managing a digital library of high-resolution objects representing the collection of this important Puerto Rican museum. When working with the investigators associated with the project, a substantial question arose regarding the final stages of the project. The academic value of the experience for the students seemed to be too diffused. The activities were couched as simple labor, rather than being designed as part of a scholastic-research program. The CIARA CyberBridges model changed the tone and tenor of the activity. New plans have been designed that use the CyberBridges model to couple the graduate students, faculty and research scientist in a way that provides learning experiences for the graduate students out of the active research program.

**Fifth, an experiment with astronomy.** Astronomy is an observational science that requires advanced instrumentation placed in the proper environment in order to do advanced, graduate-level research. FIU joined the SARA consortium in 1992 with the mission of building a remotely operated research-grade telescope at a dark site at Kitt Peak National Observatory. SARA became the first general purpose, remotely operated observatory at Kitt Peak in 1995. FIU first sponsored a SARA REU intern, and then she went on to become a graduate student in the physics department. She chose FIU because of the access to the SARA observatory and her interest in the quasar research we carry out here using SARA. In order to construct these experiments, the student and her faculty advisor defined a project with a CI scientist. The majority of the observations she used for her masters thesis were made using the SARA telescope remotely over the Internet. The application of the CI made possible the data-acquisition she needed to carry out her research. Her masters was awarded in 2001, and she continued to work on her Ph.D. here, expanding her masters work, and using the technical competency she gained to expand her and the faculty mentor's work.

**Sixth, an experiment with experimental nuclear physics.** A partnership between Dr. Pete Markowitz, graduate students and CI research scientists has allowed for efficient storage and retrieval of "large" data sets. The graduate students use the CI skills and knowledge they have developed as well as their knowledge of experimental nuclear physics to search for relatively infrequent scattering events, such as particular channels in strange quark electroproduction. Increases in networking and processing have let them to move data from national laboratories to their own laboratory. The combination of CI research scientist support and traditional faculty mentorship has allowed these students, and the research of the Dr. Markowitz to advance quantifiably.

### C.2.c Assessment

Measuring sub-project successes will fall under a number of rubrics. When a project is begun with a faculty member, a graduate student, and a CI research scientist, the first course of action will be to document the normative state. As the metrics for progress vary significantly by domain, this will be a highly customized activity, but fundamental to the operation of CIARA CyberBridges pilot. Different faculty members may choose to judge their progress in different ways even inside of domains. CyberBridges will document this, and then use it as a baseline. In a simple example, a faculty member might suggest that the number of peer reviewed journal articles that she publishes should be the metric for her success. CyberBridges will review the rate of publication for an appropriate amount of time (for example since being promoted from an assistant to associate professor.) This will be used as a normative measurement. The success of the CyberBridges pilot will then be an assessment of this metric. While there will be early indicators of the pilot's success, the nature of the change proposed will take longer to accurately assess.

The assessment of the scholastic and technological competency of CyberBridges will be assessed by an external review committee. The external review committee will be contracted to measure the pedagogy against best known practices, and the technology against the current work of the CI research community, as well as auditing the operations of the CyberBridges pilot. A report from the external reviewers will be included in the annual report to the NSF.

### C2.e Learning sciences

The CyberBridges will fundamentally use "modeling" in instruction and learning. Mathematical modeling is a form of mathematical problem solving that produces solutions to complex and real, applied problems by creating theoretical representations of the real situation. In complex modeling situations, computer simulations of different ways of representing the mathematics are frequently generated. The inquiries that the CyberBridges fellows construct with their faculty advisors will model these connections. These depictions of the real situation frequently lead to underlying mathematical curve fitting, building of "wind tunnel" representations of the situation of the real problem, or the building of a real, scaled version of the objects of the problem. Technology permits teams of individuals, possibly in different locations and with different skills to enter into the work toward solution of the real problem. It is frequently a systems approach to solve a problem that requires the confluence of varied linked strategies. The Connected Mathematics and Core Plus curriculum projects are based on mathematical modeling as a fundamental teaching/learning strategy and provide two other examples of the potential of the modeling approach in teaching and learning. The COMAP project has demonstrated the effectiveness of modeling in problem solving in high school mathematics. The NCTM "Mathematics as Problem Solving" Standard conceptualizes mathematical modeling using the following diagram (1989, p.138):

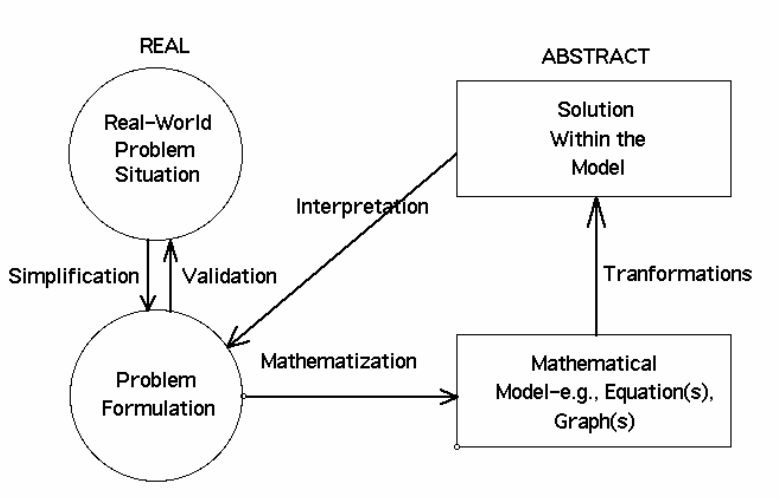


**Figure 1 Mathematical Modeling**

Research clearly indicates the high potential of the modeling approach for improving learning. Students learn best when the dynamic and developmental process of learning is guided by generalized principles applied to real-world problems or situations. Bruning, Schraw, and Ronning, (1995) highlight key themes relevant to teaching and learning found in cognitive psychology for, including the idea that learning is a *constructive process* and that meaningful learning is *contextual*. Learners are more highly motivated to learn when they can see that what they are learning is useful in their own lives. McCombs (1998) indicates that activities must encourage students to become personally and actively involved in their own learning. The modeling approach provides just such an atmosphere: an atmosphere in which students solve problems, make decisions, work with their peers, and pursue new learning as ideas evolve. We believe that graduate students constructing the models with faculty advisors and IT research scientists will provide the context, and the exploration of the inquiry will be an engaged - personal learning.

## *C.3 Implementation*

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### C.3.a Continuous Cross-Disciplinary Dialogue

The investigators have developed relationships with the CI research community, and are active in working groups that seek to form applications of CI research. The CIARA inquiry-based projects will be example applications of existing or needed CI research. The CIARA CI research scientists will work with existing CI researchers, and program officers to find matches between research interests and CIARA projects. These collaborations will assist CI researchers in understanding needs, and confusions in applying their work.

### C.3.b Collaborative Proposal Writing

The early definition of individual CyberBridges projects will come from a one-page proposal document, collaboratively authored by the faculty member, and the CI research scientist. If the graduate student whom the faculty intends the fellowship for is known at that time, then the faculty will also be engaged in the authoring. The fellowship proposal will describe the nature of the domain specific problem and a particular inquiry into the problem that a graduate student can explore applicability of CI. These proposals are not meant to be prescriptive. The use of CI in the inquiry will be hypothetical. The graduate student will research and experiment to determine the veracity of the hypothesis. The one page document is meant to be a low enough barrier that many faculty members will explore fellowships early in their exploration of topics. These one-page proposals will also be used as a metric for Cyberbridge's pilot success. The number of faculty members that have been engaged enough to author a one-page proposal is a quantitative measurement of Cyberbridge's staff outreach.

The average length of the fellowships will be one semester. Particularly challenging projects will be funded for two semesters. The faculty advisory board will determine if certain fellowships should be renewed, but it is anticipated that this will not be routine.

### C.3.c Faculty review of proposals

The one-page proposals will be brought forward to a committee faculty, chaired by **Co-PI Dr. Chi Zhang**. The committee will evaluate the proposals based on the prospects for CI augmentation, the chance of being replicated and the scholastic suitability of the proposed inquiry. The faculty committees will ensure that the nature of the proposed research can hold up to peer review. The committee will rank the proposals and offer written critiques.

### C.3.d Normative assessment

The faculty members with accepted proposals will be asked to identify the graduate student who will be receiving the fellowships. The CIARA CI research scientist, with the graduate fellow and the faculty member, will document discipline specific metrics of success. Often these will be the same metrics used in tenure and promotion. There are often domain specific variants that will be taken into account. For example the rate of publications, the rate of discovery, and the success of presenting new work to peer review could be the metrics. The graduate fellow will use the agreed upon metric to establish a normative state document. This document might say that a particular faculty member has published 2.1 peer reviewed journal articles a year.

This normative document will be used at the conclusion of the fellowship period to explore potential changes. Every six months, the current and past projects will all be reviewed against the normative document. The CyberBridges pilot will publish all of these detailed assessment activities.

### C.3.e Nesting of Graduate Students in Lab

The graduate students will work with the CI research scientists to explore the challenge put forward in the one page proposal. This exploration will take place in a lab environment, where there are graduate students of various disciplines, all exploring applications of CI research into

their domains. This multi-disciplinary environment is a fertile space for cross fertilization of approaches and understandings. Under the tutelage of the CI research scientists the graduate flows will be engaged in a rich inquiry-based learning experience. The lab facilities and environments at FIU will offer a unique environment for multi-disciplinary exchange.

### C.3.f CI Scholastic Certification Program

The four CIARA CyberBridges fellowship program will have two requirements, the inquiry based project that will involve the faculty sponsor, and a course of study leading to a certificate in scientific networking and computing. The certification program will require three 3-credit courses. The courses will be drawn from the existing graduate catalog of courses, and a new seminar. The new seminar will be organized out of CIARA. The seminar will provide a solid foundation of understanding about how CI research takes place (Gelès, 2000), and how to be involved in the applications of it. While many faculty members today are not aware of NSF programs that have historically funded research and infrastructure programs, the graduate fellows in their careers as faculty members will have a rich understanding of the CI community.

For the certification program, one course might come directly from a Computer Science graduate course such as the Advanced Networking for e-Science course, or a course on Distributed Processing or Distributed & Concurrent Systems.

The CyberBridges certification program is supported by two senior personnel on the proposal. Co-PI Chi Zhang, an Assistant Professor of Computer Science at FIU, has incorporated Grid Computing into a graduate course at FIU. The course included 8 hours of lectures on Grid, and an exercise on "gridifying" a scientific computer program. In collaboration with Caltech engineers, he also conducted research on traffic measurement and analysis based on Cisco Netflow and NLANR PMA, over high-speed networks for high-performance scientific computing. Additionally, senior personnel Eric Johnson, who has a solid history with the advanced research and education community as well as supporting science applications and now teaches both beginners and advanced networking courses in the FIU School of Computer Science, will contribute to the course selection and development for CyberBridges.

This program is an important tool for institutions apart from FIU to directly benefit from CIARA's CyberBridges initiative. As the graduate fellows interview for post-doctoral positions, outside programs will be able to determine if such expertise could be beneficial for their departments. This will exponentially increase the scope of impact of CIARA. The combination of an inquiry-based learning program and the certification program will best prepare the next generation of scientists, engineers and educators to use and understand IT research.

The CyberBridges pilot project will also engage the heterogeneous faculty of Florida International University. This engagement will consist of an open dialogue facilitated by the faculty investigators, with the full support of university administrators. This dialogue will foster CyberBridges fellowship proposals and projects from any discipline on campus ranging from the physical sciences to the humanities. Each project will be faculty led, and taken on as a result of the dialogue with CI research scientists.

The research scientists will schedule one-on-one meetings with faculty members who have expressed interest. At this meeting the research scientist will bring relevant CI to the faculty member. If the faculty member sees a potential benefit to their research at the time, then the research scientist will work with the faculty member to author a one-page CIARA CyberBridges fellowship proposal.

### C.3.g Case study package

The graduate fellows will work with the CIARA CyberBridges research scientists and the faculty advisors to author a case study package. This package will contain all of the assessment data, the domain specific challenge and history of the inquiry, and the technologies employed. The case study package will be detailed so that others can use it in the domain of the graduate fellow and faculty member to replicate the inquiry. The case study package will represent examples across the disciplines for applications of CI research.

"Best Practices" white papers have been useful conveying to large communities how to employ applications of CI research in video conferencing (Gemmil, etc 2003). The case study packages will be submitted to peer reviewed journals for publication. The full case studies will also be available on line. The case studies will be a reference that is technically accessible to the domains that they arrive out of. An inquiry, based in the humanities, will result in a case study package that is easily understood by other humanists. The case studies will themselves be mechanisms to effectively transfer CI research into the domains, in a widely available and applicable form.

## *C.4 Community Engagement and Participation*

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### C.4.a Continuous Dialogue

The CIARA CyberBridges presentations to faculty department meetings and the brown bag lunches will foster an environment of continuous dialogue. The FIU faculty communities will be engaged creatively to understand applications of CI research. This environment will be a fertile space for multi-disciplinary research to be initiated. The open exchange will be a model for institutions that replicate the CIARA CyberBridges.

### C.4.b Student outreach

The graduate fellows will present their work with CI research to their peers. The graduate fellows will work with their peers to present the role of CI research to undergraduate classes. Having graduate students that are knowledgeable about a topic, acting as role models for undergraduate students, has proven to be effective in minority serving institutions (Stearns and Snyder 2002 ) Through the outreach work of the CIARA fellows, a large community will be engaged in reaching out to the student community. In disciplines that have not effectively appealed to minorities, we believe that CI research may offer a new perspective as to the excitement in those fields. By having role models convey their enthusiasm in using CI research in the humanities or physical sciences, the opportunity for impact is significant. (IBID 2002)

### C.4.d Culture changing nature of work

The CIARA CyberBridges is asking faculty members to look at CI in a new way. To see it not as simply a tool that is used in a predetermined manner, but as a domain of research itself. The goal is to change the culture of the faculty at FIU into one that sees working with technology as collaboration, rather than simply an application. The difference is profound. The systemic nature of CI results in non-iterative change, which confounds faculty who are used to the iterative pace of discovery in other disciplines. This recognition of the dynamic of CI research and the desire to collaborate will affect the culture. The notion of infrastructure being a barrier to participation will no longer have a death grip on the creativity of the faculty. This shift will result in scientists, engineers, and educators who are fully integrating CI into their professions.

## *C.5 Related and Leveraged Work*

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### C.5.a AMPATH

FIU's University Technology Services group has created with NSF funding the AMPATH international research network serving South and Central America, the Caribbean and Mexico, as well as a variety of US research programs in the region. This program is aided by the presence in the Miami area of one of only five Tier-1 Network Access Points (NAP) in the US. Over the last two years, FIU has developed an international, high-performance research connection point in Miami, Florida, called AMPATH (AMericasPATH). One of AMPATH's goals is to enable wide-bandwidth digital communications between the Abilene network and ten National Research and Education Networks (NRNs) in South and Central America, the Caribbean and Mexico, as well as a variety of US research programs in the region.

CIARA will leverage FIU's **networking** expertise and its membership in the International Virtual Data Grid Laboratory (iVDGL) through its AMPATH research network activities. FIU will use ITR advances in human-to-human collaboration tools to hold joint workshops, and implement Grid computing testbed projects between our universities and FIU's immediate iVDGL and Grid collaborators including University of Florida and California Institute of Technology, as well as the State University of Rio de Janeiro (UERJ).

### C.5.b The Partnership in Academic Communities (PAC) in Excellence

Our research at FIU during the past nine years with grades 7-12 "at-risk" students of an urban public school district clearly indicate the strong potential that instructional technology used in mathematics and science contexts has in improving the academic success rates of this population. Recent national reports have indicated a continuing major problem of student drop out which particularly impacts underrepresented, minorities (National Center for Educational Statistics, 1999; Frase, Kaufman, & Klein, 1999). Schools often fail to address the special circumstances including community, economic, family, ethnic, and racial status that characterize students at risk to drop out (Natriello, McDill, & Pallas, 1990).

CIARA's CyberBridges will serve a similar profile of graduate students. This work will be leveraged to allow us to design a nurturing environment for the CyberBridges graduate students,

and a scholastic program tailored to this demographics' needs. The PAC program conclusions design and operational elements of CIARA's CyberBridges are:

1. PAC program students are more able to work together collaboratively and systematically.
2. PAC program students are often more willing to take risks, to experiment and try out possibilities.
3. PAC program students tend to be more persistent in their pursuit, when the interest or challenge is there to make it worthwhile.

In this proposal, we would like to develop an active learning framework that seeks to establish a tight coupling of the research materials and projects for research scientists, faculty members and graduate students. **Sr. Personnel Eric Johnson** will be the designated manager for this component of the activity. He will base development on improvement with respect to the quality of education measured in terms of efficiency of instruction, effectiveness of pedagogical techniques, and the quality of testing and assessment.

### C.5.b CHEPREO

Florida International University (FIU), together with partners at Florida State University (FSU), the University of Florida (UF), and the California Institute of Technology (Caltech), in cooperation with the National Science Foundation, is in the midst of creating and operating an interregional Grid-enabled Center for High-Energy Physics Research and Educational Outreach (CHEPREO[1]) at FIU. The CHEPREO project is lead by Pete Markowitz in the FIU Department of Physics and Heidi Alvarez who is the Co-PI responsible for the development and support of cyberinfrastructure for CHEPREO as well as the administrative lead of this complex collaboration funded by multiple directorates and offices of the NSF. The CHEPREO team continues to make outstanding contributions in the development of the CMS experiment at CERN while equally engaged in educational outreach efforts at the high school, undergraduate and graduate level. CyberBridges will build on this expertise in collaborative techniques between science and CI guided by educational techniques that have been developed over the last two years in support of CHEPREO.

### C.5.b International Research Network Connections (IRNC)

Discovery may start in isolation, but grows through discourse and collaboration. Throughout the Americas, geographically distributed researchers, students, and instruments need a seamless cyber-infrastructure to inquire and discover collaboratively. The CISE-SCI IRNC[2] funded program at FIU, WHREN (Western Hemisphere Research and Education Networks) addresses the existing and future needs for improved North American (especially U.S.)–South American connectivity and LILA (Links Inter-connecting Latin America) specifically focuses on the need for connectivity through new links. The WHREN-LILA senior personnel led by CyberBridges Co-PI Ibarra bring their international domain science and CI breadth of knowledge as well as their collaborations to bear on the CyberBridges model. This foundational support can be tapped in a broader expansion of CyberBridges in the future to include important international graduate

[1] www.chepreo.org
[2] http://whren.ampath.net/

student and faculty collaborations spanning the Americas, adding a rich nascent international dimension to CyberBridges.

## *C.6 Project and Management Plans*

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### C.6.a Project Structure

The CIARA will be responsible for the outreach programs (department meeting presentations, brown bag lunches, fellows undergraduate lectures, and conferences), soliciting fellowship proposals, administering the graduate certification program, and providing the IT tools and expertise for the structured inquiry projects. There will be one faculty board of solicitation review for both institutions, and one reporting and external audit functionality. The project is structured so that each graduate fellow will have a faculty advisor (typically their thesis advisor and one research scientist advisor.)

The pilot project will offer four semester long fellowships. Each fellowship will start with a normative analysis, then an inquiry project, followed with a case study package. In addition, each fellow will be required to successfully complete the certification program. Failure to complete the terms of the fellowship will result in a suspension of the fellowship. The inquiry-based project does not have to meet any prerequisite of success, rather thoroughness. The fellows are further required to participate in two undergraduate lectures on CI research in the domain, and one Case study conference.

The operational milestones of CyberBridges will come from the execution of the fellowship activities, and the annual assessment of the delta from the past normative states. CIARA will have at least 4 more case study packages, and an updated assessment from all past projects. After the years of the project, an institutional assessment report will be authored examining broader impacts.

### C.6.b Management Structure

The PI, Heidi Alvarez will direct the activities in CIARA for CyberBridges. In the center role, she will convene that faculty review panel, chaired by co-PIs Julio Ibarra and Chi Zhang. The review panel will consist of faculty members nominated by the chairs, and approved by the FIU Vice President for Research, George Dambach. Ibarra is the FIU Executive Director of the AMPATH project, CIARA as a Type II State of Florida Center, and other advanced networking infrastructure activities for FIU including his role as PI of the International Research Network Connections (IRNC) award from CISE-SCI for the Western Hemisphere Research and Education Network-Links Interconnecting Latin America (LILA) project. Furthermore, he will manage the external review process. External consultants will be engaged to annually review the progress of CyberBridges and further ensure academic integrity.

The PI, Heidi Alvarez, is the operational director of CIARA at FIU. She will manage the research scientists associated with the center. The PI will also biannually report the activities of the center to the faculty advisory board. The fellowship disbursements will also be managed out of CIARA under Alvarez's guidance.

Co-PI Zhang's general research areas are computer networks and distributed systems, with focus on high-performance computing. He is enthusiastic about bringing domain-specific computing problems into computer science research. He will be engaged in the continuous cross-discipline dialogue, and will work together with graduate students and domain specific-faculty in the inquiry-based projects, beginning with his role as chair of the RFP selection board. The projects will produce research papers publishable in scholarly journals. He will also teach a course in the fundamentals of Grid Computing for the certification program.

**C.6.c Advisory Committees**

The CyberBridges advisory committee will consist of eight faculty members that will represent a broad range of domains. The committee will have senior and junior faculty members. The committee will annually work with the outside consultants to ensure the IT research being proposed by the CIARA research scientists is applicable and current.

**C.6.e Schedule and milestones**

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| September 1, 2005 | Project starts |
| | Weekly brown bag lunches commence for entire project |
| | Weekly meeting with rotating faculty departments begin for entire project |
| October 15th, 2005 | Solicitation for fellowship posted |
| December 3rd 2005 | Faculty committee selects four fellowships |
| January 8th, 2006 | CIARA fellowship program begins |
| May 2006 | Case studies published |
| June 2006 | CIARA Conference & Solicitations posted |

**C.6.f Sustaining the project beyond the funded period**

The long-term vitality of the CIARA is dependent on the success of the Cyberbridge's graduate fellows. The assessment rubrics are in place to demonstrate a return on investment to the various disciplines. The CIARA is not proposing a budget for infrastructure - that is a responsibility of projects and the institutions. CIARA is pioting a system for using graduate fellowships to increase the rate of discovery and improve the CI skill set of faculty and studenrs. The research scientists are an essential part of the CIARA system. The faculty participants will determine the longevity of CIARA. If the faculty sees a significant return on investment, they will secure support for the fellowships and the research scientists. There are clear and direct funding mechanisms to ensure that CIARA operates beyond the length of NSF support. The same factors would lead to other institutions adopting the CIARA model. Both of these outcomes depend on CIARA's success.

CIARA is poised to succeed. The investment is directed primarily to graduate fellowships. They are the next generation of scientists, engineers and educators who will be nurtured in their explorations of IT. The methodology for fostering, inquiry based learning is sound (Bransford etc 1999), the IT research is compelling (Joy, Kennedy et al. 1999), the need is significant across the disciplines (Atkins, etc 2003) so CIARA has a mandate and a means to effect long-lasting change.

## *C.7 Broader Impacts of Proposed Activity*

The smallest impact of CIARA's CyberBridges will be a change in the way that the largest Hispanic minority-serving institution in the continental U.S. views cyberinfrastructure. The CIARA project represents an inclusion in the CI research community of benefits. Where CI has raised the tide, not all vessels have been lifted. CIARA will bring the benefits to domains and groups that have yet to realize the fantastic impact. Over the pilot year, CIARA will include underrepresented groups supported in areas of national importance. CyberBridges will impact the faculty doing research and teaching today, and the faculty of the future. This impact alone is significant to the U.S. society.

The CIARA model will likely have a much larger impact. Institutions across the country support CI by investing in systems specialists and IT support staff. The application of CI is limited to the vision of institutional information technology plans. There is a great divide between these plans, and the needs of the faculty. A successful CIARA, shown through the emphasis on assessment, will profoundly affect the national models for CI. When institutions can effect more efficient CI transfer by investing closer, in graduate students, rather than farther, in systems analysts, to institutional missions, a substantial impact will occur. The re-focusing on institutional expenditures from tangential technology support functions, to synchronous fellowships will have profound impact on the effectiveness of our inquiries today, and the creativity and effectiveness of generations to come.

## *C.8 Results from Prior NSF Support*

Heidi Alvarez: (ANI-0123388): **AMPATH Workshop to Identify Areas of Scientific Collaboration between the US and the AMPATH Service Area, April 15-17, 2001** (ANI-0220176): **First AMPATH International Conference, Valdivia, Chile, April 12, 2002** (ANI-0215434) **AMPATH StarLight Rio Grid Workshop, held February 7-8, 2002** Newman and Alvarez worked with RNP Brazil to test COJAC application for HEP visualization. **STI - AMPATH Collaborative Research and Education Operational and Functional Support**, Co-PI for AMPATH (ANI-0231844) funded September 12, 2002, ongoing. Co-PI for (ANI-6188654) **AMPATH Workshop, Miami, January, 2003: Fostering Collaboration and Next Generation Infrastructure.** Results are available now at www.ampath.fiu.edu **. Inter-Regional Grid-Enabled Center for High Energy Physics Research and Educational Outreach at FIU (CHEPREO)** Co-PI Award #0312038 was made on 09/29/03 and the first report was accepted March, 2004. Results to date are available at www.chepreo.org. **Pan American Advanced Studies Institute in Mendoza, Argentina May 2005; Grid Computing and Advanced Networking Technologies for e-Science** Co-PI Awarded # 0418366, OISE | Americas Program funded August, 2004. The program is available at www.ciara.fiu.edu/pasi. **SCI/IRNC: WHREN (Western Hemisphere Research and Education Networks): Increasing the Rate of Discovery and Enhancing Education across the Americas** Co-PI Award #0441095 was made as a Co-operative agreement on January 1, 2005. Preliminary information is available at http://www.ciara.fiu.edu/whren_kickoff/irnc_kickoff_05.htm .

Julio Ibarra: (ANI-0123388): AMPATH Workshop to Identify Areas of Scientific Collaboration between the US and the AMPATH Service Area, April 15-17, 2001 Report. (ANI-0220176): First AMPATH International Conference, Valdivia, Chile, April 12, 2002 Report. (ANI-0215434). STI - AMPATH Collaborative Research and Education Operational and Functional Support, PI for AMPATH (ANI-0231844) funded September 12, 2002, ongoing. PI for (ANI-6188654) AMPATH Workshop, Miami, January, 2003: Fostering Collaboration and Next Generation Infrastructure. The workshop results can be found at www.ampath.fiu.edu and show a robust agenda, informative presentations, and a very well rounded participant list. Pan American Advanced Studies Institute in Mendoza, Argentina May 2005; Grid Computing and Advanced Networking Technologies for e-Science PI Awarded # 0418366, OISE | Americas Program funded August, 2004. Program available at www.ciara.fiu.edu/pasi . SCI/IRNC: WHREN (Western Hemisphere Research and Education Networks): Increasing the Rate of Discovery and Enhancing Education across the Americas PI Award #0441095 was made as a Co-operative agreement on January 1, 2005. Preliminary information is available at http://www.ciara.fiu.edu/whren_kickoff/irnc_kickoff_05.htm