

## MEMORANDUM

TO: Dr. William Decker  
National Science Foundation

FROM: Dr. Janet Poley  
President, ADEC

DATE: March 31, 2000

SUBJECT: NSF Proposal - Initial Answers to Questions

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Dear Bill:

The following are our initial answers to the questions you posed. Our team discussed the detailed reviewer comments in preparing the responses. We appreciate the time you and the reviewers took to assist us in strengthening our proposal. We are happy to provide any additional information you may require.

We agree with the proposal for establishing annual benchmarks, which will offer us the opportunity to incorporate new learnings into the goals establishment process for the coming year and the annual funding arrangement as you discussed with Don Riley.

The project team wanted to be certain also that we understand that it will not be possible to show educational impacts in year one. The technology, educational, cultural, management and support issues will all have somewhat different time lines, recognizing that they are interdependent.

### **1. Inclusion of Cooperative Extension Sites**

We agreed that this reviewer had a valid point in questioning Extension offices as sites for location of TAPS. We have a variety of Extension offices - a number now serve as distance learning centers and function as access points for learners. Our goal is to select sites most appropriate to achieving project goals. We also anticipate moving some TAPS throughout the project period. Several of the HBCUs to be involved want to test the technology in a mobile van where they can use the van as a learning center going from community to community.

Human resource development and capacity building are certainly issues for many HBCUs and tribal colleges. Partnering with 1862 institutions in a peer/mentoring role will be

advantageous for both institutions. (HBCUs can share knowledge and experience in working with underserved groups, while 1862s can share technical resources and networking skills needed to implement and sustain wireless satellite connections.)

Traditionally, HBCUs have targeted underserved and disadvantaged audiences in their educational outreach efforts. With minimal resources, these institutions have struggled against the odds to reach and serve isolated (technologically) rural and urban audiences. Clientele served by many HBCUs and tribal colleges may be hesitant to access services provided by Cooperative Extension due to past experiences of discrimination or lack of credibility on behalf of Extension in dealing with diverse groups. Therefore, site selection for the project must be inclusive of HBCU and tribal college sites as well as Cooperative Extension sites.

We will set up a site selection committee to establish the most appropriate locations to accomplish the objectives of the programs. In some states Cooperative Extension offices are learning centers and they may be an appropriate location for a tap. We will be very careful in analyzing how any site selected will impact the intended target audiences. We do anticipate that we will locate some of the TAPS in engineering and research facilities for the initial test prior to relocating them to locations at minority serving institutions and other appropriate learning centers. One team member noted that this isn't just a question of "last mile technology" - we are talking about "last mile educational delivery solutions."

We propose the following criteria for TAP site selection:

- \* Sites located in areas with highest concentration of have nots not currently being served through traditional university outreach.
- \* Sites with established relationships among grassroots organizations, public agencies, K-12 public schools, and other public universities and community colleges.
- \* Degree to which sites provide an important type of test location related to "last mile technology/last mile educational delivery."
- \* Degree to which sites focus on the intended project target audiences/institutions.
- \* Degree to which the location fosters organizational and human capacity building related to project objectives.
- \* Degree to which the overall project learnings will be significant - technologically, geographically, educationally, culturally, economically.

- \* Degree to which the location will foster long-term value for the learners, institution and project as a whole.

## 2. Dissemination Plan

As a number of the reviewers commented, ADEC is a very broad and deep organization. ADEC has been in business for 10 years and this is not the first network the organization has created, used and sustained for educational purposes. The ADEC analog satellite network includes 39 uplinks and nearly 2000 downlinks - many of the downlinks are now being converted to digital with assistance from the Department of Commerce. The organization has well established systems, is practiced and rehearsed for managing this project as well as widely disseminating the results including well-established and widely used webpages, monthly audio conferences, comprehensive listservs, regular interviews by the national media, quarterly meetings for the Board of Directors and Program Panel and an annual All ADEC meeting. In addition, the PIs proposed for this project speak and publish regularly. We anticipate a very active dissemination program. The culture of the ADEC consortium demands constant communication. This project is being placed in a national fishbowl and its possibility has already been widely discussed.

NSF sponsored meetings and workshops  
CAIDA  
Supercomputer Center Conferences  
EPScor Events  
American Academy of Sciences  
SigmaXi  
Internet2  
Wisconsin International Distance Teaching and Learning Conference  
EDUCAUSE  
National Learning Infrastructure Initiative  
Great Plains Network and other Regional Network Meetings  
Penn State National Leadership Institute on Distance Education  
Book Chapters  
Published Articles

ADEC is the most intensive user of electronic mail at the University of Nebraska-Lincoln and maintains multiple listservs, a highly trafficked website maintained at NCSU, frequently conducts major national videoconferences for purposes of disseminating results (i.e. April 13 ADEC is cooperating with EDUCAUSE in disseminating results of work done on ideal administrative systems for distance education programming)

A strength of this effort will be the dissemination efforts on behalf of participating partners. Also, a national superworkshop might be hosted in a major hub to share findings, strategies, and new teaching/learning paradigms resulting from this effort.

### **3. Cost Sharing**

The cost sharing is very substantial and our estimates are highly conservative. We apologize for an error on the budget sheet that contributed to lack of clarity on the part of at least one reviewer on this dimension. We agree that cost sharing in kind and dollars is an important indicator of institutional commitment. We will work very closely with the HBCUs, tribal colleges and Hispanic serving institutions on the issue of commitment and a sensible resourcing strategy in accordance with their needs. We know that for some of these institutions, both money and human resources are in short supply. They are also anticipating active participation in the implementation of this project and want to be a part of this collaborative research and development opportunity. The commitment was discussed at some length during the recent All ADEC meeting in Washington D.C. The tribal college representatives described their situations as did the HBCUs. HBCU commitment can be tested by the assignment of people to work on this project and participate in the training and on-ground development in both the educational programming and technology deployment.

We expect many non-project TAPS will be purchased and incorporated into this program - indigenous funds will be used for this purchase (this assumes initial successful deployment). This will substantially increase the member institution contribution, the Tachyon contribution and the ADEC management contribution. This also addresses in part the question of sustainability raised in question 12.

ADEC has developed a culture of sharing and contributions so this project is unlike some "artificial partnerships" ginned up to respond to a grant opportunity.

### **4. Tachyon Relations**

Tachyon is a partner and a provider. The project is not funding any Tachyon personnel. This project is not doing a marketing study nor developing Tachyon's business plan. Tachyon intends to make the bulk of its revenues from commercial customers. Participation in this project is a pro-bono effort in the 'old Internet' tradition of 'good works'. Tachyon believes that this technology could be of genuine value to rural and minority communities who would have no other alternative for net connections. In addition to extensive commercial activities, Tachyon is similarly active in a wide variety of international public service activities and has a dedicated manager responsible for supporting developing communities, for example, Tachyon's first international trials partners are the International Federation of Red Cross and Red Crescent societies, and the International Red Cross. Tachyon is hosting a comprehensive non-commercial directory of community networking projects worldwide. (see <http://www.tachyon.net/cnet/intro.html>)

In this case Tachyon is contributing in-kind services to this project at well below costs. For example:

- a. Tachyon's price for project participants for a Tachyon Access Point is \$2100 (below manufactured cost). Normal wholesale price is \$4200.
- b. Tachyon is contributing two (.5) FTE project personnel.
- c. Tachyon.net Commercial TCP/IP over satellite wholesale prices are normally \$350/mo for limited bandwidth. Project costs are \$200/mo. for greater experimental bandwidth.

## **5. Educational Applications and the Method for Measuring the Effectiveness of the Distance Learning Approach**

The project team appreciated the comments on this issue from two of the reviewers. While the perspectives varied - one advocated more of a "build it and they will come" perspective and the other suggested working closely with faculty and staff at the target institutions to evaluate learning impact. We also agree on the importance of having a clearly articulated evaluation strategy.

Pis Poley and McAlpin, both with Ph.D.s in education, will have the lead responsibility for this dimension. ADEC is working in partnership with Stephen Ehrmann, the lead developer of the Flashlight Evaluation program going into effect in institutions of higher education throughout the country. ADEC has also developed an online evaluation system for use by consortium members that includes an evaluation tutor and online evaluation development system. This project is called Distance Education Evaluation Program (DEEP) and is built around the principles for quality distance teaching and learning (see [http://www.adec.edu/admin/papers/distance-teaching\\_principles.html](http://www.adec.edu/admin/papers/distance-teaching_principles.html)). These tools will be very useful for developing application specific evaluation and validation processes, as well as developing longer term evaluation systems. We expect to establish a learner assessment evaluation oversight task force that will include Chere Gibson, University of Wisconsin; Connie Dillon, University of Oklahoma; Stephen Ehrmann, TLT Group; Tom Davis, Lac Courte Oreilles Ojibwa Community College; Caroline Brooks, University of Maryland-Eastern Shore; Lodis Rhodes, University of Texas; Randy Ross, Lincoln Indian Center and others as needed. Working with Poley and McAlpin, they will design the comprehensive evaluation strategy, including strategies for assessing learning achievements in settings where this project will work, training that can be used in individual and multiple settings, appropriate benchmarks and measurement systems for reporting results to NSF, consortium members and partners as well as others interested nationally and internationally. Consultancy contracts will be used for components of this work as appropriate. This strategy and its components will be designed so that reporting can be as open and transparent as possible with respect to the media attributes and

delivery system attributes that can affect learning in different settings. The Smith and Dillon framework will guide this work, as will the Guiding Principles for Distance Teaching and Learning and the Distance Learning Evaluation Guide developed by the American Council on Education. One of the primary goals will be to assure that evaluation measures are sensitive to the cultural and contextual environments in which they will be used.

Local program development teams will include site coordinators, academic faculty (campus and field), as well as students to plan and evaluate training modules offered via the ADEC network.

The ADEC Guiding Principles for Quality Distance Teaching and Learning will serve as a guide in developing quality programs that can be shared across the network.

In addition to ongoing course evaluations by faculty, ADEC evaluation tools, (DEEP/Flashlight) will serve as primary vehicles for gathering data on learning effectiveness, usefulness of content, effectiveness of distance learning approaches and methodologies, factors on learner support, access to technology, etc. Program design and evaluation specialists will analyze this data and report findings to participating faculty and students. This data should be quite useful in revising course modules or planning for new initiatives.

## **6. Clarity on Internet2 and Other Partners**

The relationship between ADEC and Internet2 (UCAID, networks, institutions) is potentially symbiotic and very mutually beneficial. Besides overlapping memberships, both consortia are interested in meeting the educational goals of member institutions and learners who are no longer bound by place or time. The ADEC/Tachyon wireless network will provide I2 with a potential extension of I2 related applications into difficult-to-reach institutions, communities and geographic areas. This is especially true given the potential for being able to dynamically allocate bandwidth for selective uses.

The project will provide an important baseline of experience which Internet2 may use as it conceptualizes growth beyond the physical borders of a campus community. The project will strengthen relationships between the goals of the Internet2 and meeting the needs of HBCUs, tribal colleges and Hispanic serving institutions. It will provide Internet2 with experience from a rich population of distance education providers. ADEC will depend upon Internet2 for support in integrating related technologies into the project, help in developing applications consistent with the goals of Internet2, and in supporting the partnership with other Internet2 related organizations such as CAIDA, NLANR and the supercomputing centers.

ADEC is looking to NLANR and CAIDA for help in measuring and better understanding data traffic flow and network utilization. Delivering effective distance education will require a complete understanding of network performance and utilization issues, and CAIDA will be our source for needed tools and services. Of particular interest will be issues related to observing an Internet-provider and multi-organizational model involving the ADEC/Tachyon wireless network, in concert with Internet2 (vBNS and Abilene), and the web of commodity Internet providers. NLANR and CAIDA are natural partners in the ADEC project and both have indicated interest in collaboration on this project.

Collaboration with the San Diego Network Access Point (SD-NAP) is essential given that ADEC will rely on the NAP to manage its Internet traffic. As a gateway for managing the interconnection of IP transit networks, they will help ADEC establish and maintain connections with Internet1 and Internet2 services, host network switching and routing equipment and services, and help CAIDA/NLANR monitor ADEC network traffic.

**7. Explain "Other" Expenses, Travel Costs and Limited Detail in Item G.3.**

We anticipate that this project will be very travel intensive vis-a-vis work between and among the institutions and learning locations involved. We do not anticipate that any of the PIs will be looking at this as a source for travel support. All of the PIs have access to their own travel funds and we expect that they will travel, lead and speak using their own funds. We did not include these dollars in the matching money, but certainly could have. The travel funds will be used for training, technical assistance, workshops, travel for core project staff, supporting interns who will be working at locations such as the supercomputer centers and/or other institutional locations and to support their participation in regional and national dissemination activities. There will also be travel costs associated with formative and summative evaluation and assessment activities. While the consortium anticipates making maximum use of electronic communication means, as the borders shrink assessments are showing that demands for more travel accompanies the overall increase in communication. In terms of the limited detail in item G.3., the detail for these consultant services was inadvertently left out of the electronic proposal submission. They include a subcontract for Internet Traffic and Network Measurement Services anticipated potentially to be with UCAID, a network engineer contract and funding for the core institutions and their research and development work in networking, measurement, applications and services. The other category includes rent and utilities and a contingency. The details are now shown in the detailed budget comments.

**8. Scientific Merit Versus Infrastructure Experiment - Proper Mix-Valuable Prototype and Learning Experience**

The project will facilitate research and will facilitate the ability to do research. A wonderful quote by Jonathan Turner, computer science professor from Washington University in St. Louis, in the March 28 Chronicle of Higher Education expresses this

relationship well in terms of the way this team is trying to approach the project: "When you're forced to grapple with some of the constraints of the real world, it leads you to more interesting research problems."

This project is action/applied research. We have an outstanding, diverse, multi-disciplinary team experienced in scientific research as well as infrastructure experimentation. Just by working together to develop this proposal over the past year, we have all developed more interesting ways to think about both research and practice.

The balance seems very appropriate and in line with the current NSF encouragement to address the issues this project attacks in a way that will absolutely result in interesting learnings that will impact the future of next generation networking for educational purposes.

## **9. Do We Have the Right Staff Involved?**

This project has outstanding staff involved and has the partnerships and relationships to draw upon nearly any technical resource required. The Internet2 institutions in the core partners and within the ADEC consortium represent a tremendous talent pool.UCAID has indicated their willingness to assist as a subcontractor and money is set aside in the budget for that potential. CAIDA, NLANR, the talents at the San Diego and Illinois supercomputer centers have outstanding expertise. At Tachyon we have Jeremy Guralnick, Tachyon's technical project manager. He is co-architect along with Brett Leida, MIT, of one of the most sophisticated QoS and network congestion management tools commercially available from an Internet protocol service carrier. Tachyon's engineering team is led by Bruce Carneal, who previously led software development and was directly responsible at Mentat for development of the TCP stack licensed and in use today by Sun Solaris, HP Unix, IBM, and Apple. Thomas Speranzi, Tachyon's Director of Installation services, prior to joining Tachyon led the installation team for Hughes Network Systems and is arguably responsible for more installations of this type than anyone else in the world. Michael Liebhold, Tachyon's project manager, has over 10 years experience in broadband applications research, most notably as Senior Scientist, Broadband Systems Research, Apple Computer, Inc. Advanced Technology Labs - 1984-1994.

The talents of the PIs are well articulated in the biographies, with the possible exception of Dan Cotton. Cotton founded the Distributed Environments for Active Learning (DEAL) laboratory at the University of Nebraska-Lincoln which assists faculty in the development of Internet-based active learning environments. Prior to coming to Nebraska to head Communication Information and Technology for the Institute of Agriculture and Natural Resources, he was Computer Coordinator for the Illinois Cooperative Extension Service where he led the development and organization of statewide computer networking and technology resources. He served as a consultant and partner to a consortium of rural

telephone companies bringing Internet services to rural Illinois and he assisted the National Center for Supercomputing Applications (NCSA) on several grant projects and in the development of an Internet-based agricultural production support system. He was a developer of PrairieNet, a community network located at the University of Illinois. Prior to Illinois, Cotton was Manager of Personal Computer Operations for the Missouri Cooperative Extension Service.

Additional ADEC resources include: Jeffrey M. Poley, a graduate of the University of Nebraska College of Engineering and School of Architecture and currently Technical Advisor for the American Distance Education Consortium. His experience includes purchase of satellite space segment, analysis of federal satellite telecommunications regulation, preparation of satellite ground station contracts and engineering analyses of satellite space segment capabilities. He has a thorough knowledge of the domestic fixed satellite service and broadcast satellite service inventory. Gary Atkins, Colorado State University, serves as Chief Engineer for ADEC and as Senior Engineer for the Office of Instructional Services at CSU. He was formerly the Chief Engineer for the National Technological University. His experience includes design, construction and management of analog and digital satellite ground segment. He has thorough knowledge of digital encoding and satellite technologies and the carriage of the Internet over geosynchronous earth orbit satellites.

#### **10. Have/Have Not Questions**

There are rural areas in almost every state with severe access problems. There is no such thing as have and have not states. This project as proto-type will clearly demonstrate some of the have and have not realities as compared to the hype and mythologies. A school may be only a mile beyond the reach of a modern central office to have very limited access capabilities. Where fiber exists, it often passes through but does not terminate in rural counties. According to a study published by Northwestern University:

- \* As many as 55.9% of U.S. counties have no dial-up Internet connectivity
- \* An additional 17% of U.S. counties have very limited connectivity (Shane Greenstein, Kellogg Graduate School of Management, Northwestern University)

The have/have not issues were of particular concern to this set of PIs long before it became popular. We will be happy to provide much more detail on this issue to any reviewer with continuing concerns about this question.

In summary, the reviewer alluding to this mentioned Idaho and Montana. Idaho and Montana certainly do have issues with respect to large technologically underserved areas. For example, Montana has the highest DTH satellite percentage in the nation. The poorest counties in the United States are in Nebraska in the rural/remote part of the state.

The have/have not question is multi-variant and increasingly well studied. The PI team, Core Institutions and ADEC partners know the on-ground realities in every part of the United States. That is where most of us first developed our interests in technology and one of the reasons we have developed this proposal. The project expects to evaluate the performance of a wide variety of applications in a wide variety of community situations using a scientific process for assessing the media/delivery system attributes via-a-vis learning.

## **11. Asymmetric Media and Latency-Conversational and Interactive Uses of the Network**

Two reviewers, maybe more, are seriously concerned about the viability of asynchronous media of this type (downlink vs. uplink speeds). They argue that this may contribute to have and have not differences by effectively denying the same to both providers and consumers. They also argue about the effects of latency and impacts on conversational or interactive uses of the network.

While fully symmetric bandwidth services may have considerable appeal from a philosophic or 'religious' perspective, this project makes no assumptions. Rather, the explicit goals of the project are to investigate and scientifically quantify applications bandwidth requirements for a broad range of different constituent communities. These results are expected to lead to more precise recommendations on how to provision Internet Protocol (IP) services on extremely valuable geostationary satellite capacity.

There are some additional constraints limiting Tachyon.net services to 256kbits/sec. from a users' terminal. Although the radio on the Tachyon terminal is capable of operating at speeds as high as 1 mbit/sec, system performance has been limited by the FCC license, and by explicit interpretation of international treaties between the U.S., Mexico (joint operator of Tachyon's satellite with Loral corporation) and Canada. (The legal tenant of the adjacent geostationary satellite position). Canada argued before the commission that a 'hotter' Tachyon signal could theoretically spill over into their currently vacant orbital position.

Packet latency has traditionally been a prohibitive obstacle to providing interactive TCP/IP services over Geostationary satellites. Ordinarily, slow start, selective acknowledgment, and window size have been problematic. Tachyon's engineering team has made a number of technical breakthroughs enabling very high performance interactive TCP/IP services over generic KuBand satellites. The system is active and available across North America and Europe. A test terminal is currently installed at the ADEC facilities and is a live demonstration of very high quality Internet access - indistinguishable from a high performance terrestrial link. Note: Because of its direct connection to an Internet backbone, Tachyon.net actually offers very superior service compared to a terrestrial connection that may be oversubscribed at a central office at ratios from 10:1 to 100:1

(typical of many T1 or DSL connections). Tachyon.net also offers superior performance client to server: Where there may be as many as 19 routing hops across a network between client and server, Tachyon.net will provide practically a direct client connection to servers hosted on or near the Abilene backbone. Additionally, Tachyon has demonstrated excellent capability to carry voice over IP (although this service may be outside the scope of this project.)

The technical latency problem has been solved but there may be a perception of an ergonomic problem i.e. some people are initially uncomfortable experiencing tiny latencies in interpersonal conversations, i.e. international telephone calls. AT&T has a research base that shows that this is not a significant barrier and it is experienced comfortably in international phone calls after people respond to and get comfortable with the slight delay. People demonstrate the same or even more initial concern when video cameras are brought into the environment. Humans are very adaptable.

With regard to the Internet, there are some inherent advantages to using satellite - IP multicasting is a good example This is the basis for most business telecommunications networks, but this doesn't have high bandwidth interactivity which this project will provide.

Finally, BW symmetry is NOT the most limiting variable to full participation of minority communities in the Internet world (see Global Access to Learning: Gender, Poverty and Race , Janet Poley in Higher Education in an Era of Digital Competition)

## **12. Enduring Value Reached.....What Happens When Seed Funding Gone.....**

The question of "enduring value" was partially addressed above. However, the more complete answer to that question cannot be provided until later in the project. It would be foolish to consider the enduring value of this effort as only related to the location and continued use of the TAPs and the network. It is expected that this project will be a major vehicle for determining some very significant things about teaching and learning using technology, including a study of media and delivery system attributes in relationship to the knowledge base about the factors helping and hindering learning. The human resource development dimensions at the HBCUs, Hispanic serving institutions and tribal colleges if well accomplished will be significant. Also, it is expected that if we build it and they come, there will be a significant shift of existing resources in this direction.