
WURCNET

Western University Research Consortium on *High Performance Computing and Networking*

**INTEGRATED DISTANCE
EDUCATION APPLICATIONS
SYSTEMS (IDEAS)**

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INTEGRATED DISTANCE EDUCATION APPLICATIONS SYSTEMS (IDEAS)

Proposal to CANARIE

Canadian Network for the Advancement of Research, Industry & Education
The Technology Development and Technology Diffusion (TD)² Program

Submitted by:

WurcNet Inc.

A Western University and Industry Research Consortium
on
High Performance Networking and High Performance Computing

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Integrated Distance Education Applications System (IDEAS)

A Proposal to
CANARIE Inc.

Presented on behalf of
WurcNet

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Executive Summary

Integrated Distance Education Delivery Systems (IDEAS) will integrate many of the distance education products available today into a single, easy to use architecture. It will be designed to meet the needs of all students: large groups, small groups and individuals; students who can attend classes during "normal" hours and those who must work around other situations; and students who are located close to a large educational facility as well as those who are geographically or situationally isolated. IDEAS will try to emulate for the distanced student the same experiences and access to facilities that they would have on the campus. The limitations of some communications networks (e.g., the plain old telephone system - POTS) and single video screens will be ameliorated by intelligent delivery of information to the end user terminal, with ultimate control of material residing with the end user through a very simple interface. Wherever possible, existing technology will be used and existing standards will be adhered to; some technology may be developed to "fill in the gaps" in existing technologies, but the major contribution will be the development of an easy to use, integrated solution to providing education to distanced students. IDEAS is a collaborate project with researchers at the University of Alberta, University of Calgary and AGT Ltd. Other WurcNet participants, commercial vendors and educational agencies have indicated interest in joining this project.

IDEAS will contribute to achieving the goals of CANARIE Inc. in a number of ways. First, it will provide a structure to integrate a number of network based products into an easy to use, multidimensional, digital distance education system. Secondly, it will develop a software interface which makes these products extremely easy to use. Thirdly, it will demonstrate to how technology will contribute towards a knowledge-based society by allowing individuals to improved their own knowledge base (education) from their own homes by accessing information and communicating with others.

The future economic payback is enormous. The cost of the adult education and training sector in Alberta is \$1.2 billion per year, roughly 10% of all government expenditures. In May 1993 the Alberta Provincial Treasurer announced an overall 20% reduction in funding over the next three years. This means a reduction of

approximately \$250 million in this sector alone. The Alberta government produced a discussion document *Adult Learning: Access Through Innovation* which states "the goal is to find innovative ways to increase access to learning opportunities and the responsiveness of Alberta's post-secondary system in the longer term." The resulting *Budget Roundtable Workbook* suggests among other things the expanded use of technology to support "distance learning opportunities to remote communities." A conservative estimate is that effective and efficient use of distance education could reduce overall costs to the post-secondary system by 10%. If IDEAS is as effective as we anticipate, the overall savings through the use of such a system in the post-secondary sector in Alberta alone would be \$120 million/year. This project will demonstrate that effective and cost efficient instruction can be delivered to the student in the home. Societally the payback is equally great, students will be able to access education when and where they wish without need to travel larger campuses.

At the end of the project, the following deliverables will be demonstrated:

- high speed, Internet connected classroom videoconferencing systems
- a Digital Store with an Intelligent Index
- a Digital Knowledge Warehouse with an Intelligent Digital Reference Librarian
- integrated computing facilities
- a prototype Distance Education Workstation
- a prototype Distance Education User Terminal
- an Integrated Control System

While the cost of the hardware for this system is, at this time, prohibitive for the individual learner, costs are coming down at precipitous rates and capabilities of consumer devices are improving equally quickly. The kind of system envisioned should be economically feasible for home use by 1997.

Table of Contents

	Page
Table of Contents	iii
List of Figures.....	v
List of Tables.....	vii
Executive Summary.....	viii
The Applicants	1
Technical Description	1
Classroom Videoconferencing System	2
Digital Store.....	3
Digital Knowledge Warehouse.....	3
Computing Facilities.....	6
Distance Education Workstation.....	7
Distance Education User Terminal.....	7
Integrated Control System	8
Technical qualifications of the participants and strategies employed.....	8
T. Craig Montgomerie Ph.D.....	8
Dr. Tom Keenan, I.S.P.....	9
Dr. Roger Pederson, Ph.D.....	9
Dr. David Collett.....	9
Mr. Doug Poff.....	9
Market Description.....	10
Commercial opportunities	10
Market potential.....	10
User needs	10
Overall economic benefits	11
Managerial Capability	12
Financial	12
Deliverables.....	14
Classroom Videoconferencing Systems.....	14
Digital Store/Intelligent Index.....	15
Digital Knowledge Warehouse/Intelligent Digital Reference Librarian.....	15
Computing Facilities.....	15

Distance Education Workstation.....	15
Distance Education User Terminal.....	15
Integrated Control System	15
Project Work Plan.....	16

List of Figures

Figure	Page
1 Integrated Distance Education Applications System (IDEAS).....	4
2 IDEAS Work Plan.....	17

List of Tables

Table	Page
1 IDEAS Proposed Budget.....	13
2 IDEAS Milestone Events.....	16

The Applicants

This project is a collaborative effort of the University of Alberta, the University of Calgary and AGT Ltd. The two universities are excellent research facilities with enviable records of transferring research to industry. AGT Ltd. is a major telecommunications provider with a significant research and development unit which can bring technological development to market.

The project leader is T. Craig Montgomerie, Ph.D. of the Department of Educational Administration at the University of Alberta. Dr. Tom Keenan, Dean of the Faculty of Continuing Education at the University of Calgary and Dr. Roger Pederson, Director of Research & Development, Marketing and Business Development of AGT Ltd. are acting as the major collaborative researchers from each of their organizations. A number of others have already indicated that they would like to become involved in this project including Dr. David Collett of the Department of Adult, Career and Technology Education at the University of Alberta and Mr. Doug Poff, Librarian and Manager Information Technology Services for the University of Alberta Libraries. A number of other researchers and graduate students are expected to become involved in this project.

Technical Description

It is proposed to develop a distance education system which integrates many of the products available today to meet the needs of all students: large groups, small groups and individuals; students who can attend classes during "normal" hours and those who must work around other situations; and students who are located close to a large educational facility as well as those who are geographically or situationally isolated. The system will try to emulate for the distanced student the same experiences and access to facilities that they would have on the campus. The limitations of some communications networks (e.g., the plain old telephone system - POTS) and single video screens will be ameliorated by intelligent delivery of information to the end user terminal, with ultimate control of material residing with the end user through a very simple interface. Wherever possible, existing technology will be used and existing standards will be adhered to; some technology may be developed to "fill in the gaps" in existing technologies, but the major contribution will be the development of an easy to use, integrated solution to

providing education to distanced students. Each of the major components of the proposed system is described below, while Figure 1 gives a schematic representation of IDEAS.

Classroom Videoconferencing System

The basic method of large group instruction will be based on videoconferencing. Videoconferencing allows the least impact on the traditional instructional format while encouraging more structured preparation and the use of high quality presentation graphics rather than chalk and blackboard presentations.

Requirements include:

- two-way interactive videoconferencing between classes.
- compressed video may be used, but it must be of a good enough quality to meet the needs of the learner.
- full duplex audio must be supported - audio must not be clipped by two people speaking at the same time.
- multiple receive classrooms must be able to link to one originating classroom
- multiple conferences must be able to share the network with dynamic linking
- automatic indication of a student question at another location with automatic switching and focusing on the student when the instructor is ready to answer the question
- instructor will have access to presentation alternatives such as:
 - still slide presentation
 - video presentation
 - computer presentation
- students will have access to computers in the receive classrooms which are connected to the same LAN as those in the originating classroom
- all interaction (video, audio, still, computer presentation) will be independently, digitally recorded and indexed to a common clock
- primary use of classrooms will be for synchronous instruction, but will have the ability to access the *Digital Store* for asynchronous replay of any lecture.

A system such a PictureTel System 4000 - Model 4235 could form the *Classroom Videoconferencing System*.

Digital Store

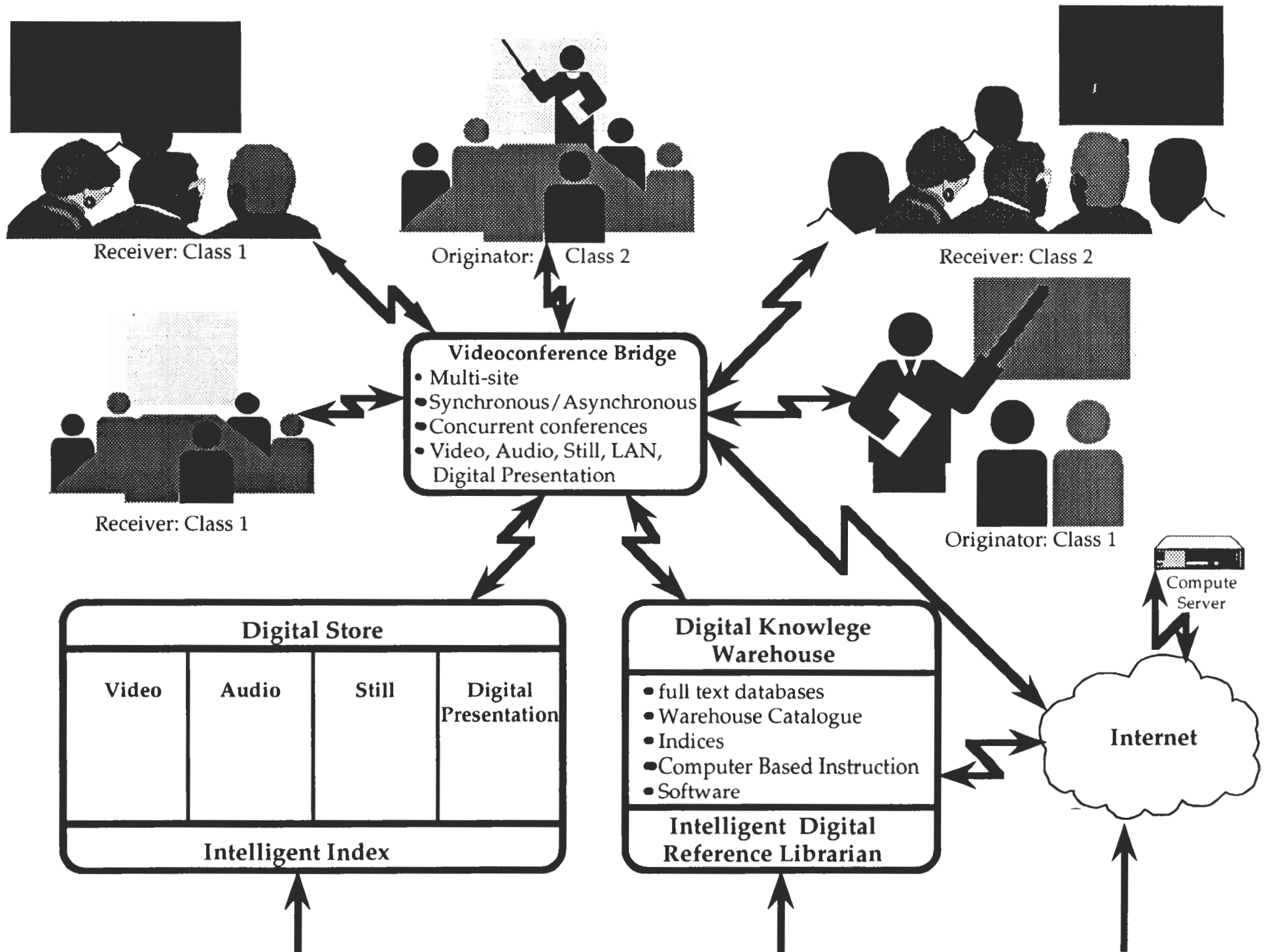
The *Digital Store* will allow material that had been delivered previously (probably as a synchronous videoconference) to be accessed later for asynchronous use. While material is recorded, electronic markers will be placed in the *Intelligent Index* which will allow it to synchronize the delivery of video, audio, still and digital material to the end user. Depending on the end user terminal and the speed of communications, the *Intelligent Index* will, upon demand from the end user, deliver fewer frames of video, less "rich" yet intelligible audio, and notify the client when a still or computer display was presented and transmit that upon command. The end user will be able to stop, back up and fast forward the instruction. They will also be able to print presentation graphics, notes and "class handouts" prepared by the instructor. Northern Telecom, ORACLE, Mentor and IBM have developed systems which provide "digital video on demand," the basic requirement for the *Digital Store*. The *Intelligent Index* will be one of the software products developed on this project.

Digital Knowledge Warehouse

The *Digital Knowledge Warehouse* will be a fully electronic library which is open 24 hours a day. The Warehouse will contain:

- library catalogs
- On-line Indices
- full text databases
- video archives
- archives of previous distance education classes
- video programming
- computer based instruction programs
- computer software
- access to other electronic information via the Internet

One of the major features of the *Digital Knowledge Warehouse* will be the *Intelligent Digital Reference Librarian*. This automated system will provide everything from "library Instruction" to helping the client find the appropriate sources for necessary information. A preliminary version of the *Intelligent Digital Reference Librarian* entitled *OnLine Access to Information (OLAI)* was developed by a team of professional librarians, instructional designers and programmers under the direction of the Principal Researcher using *Authorware Professional* during



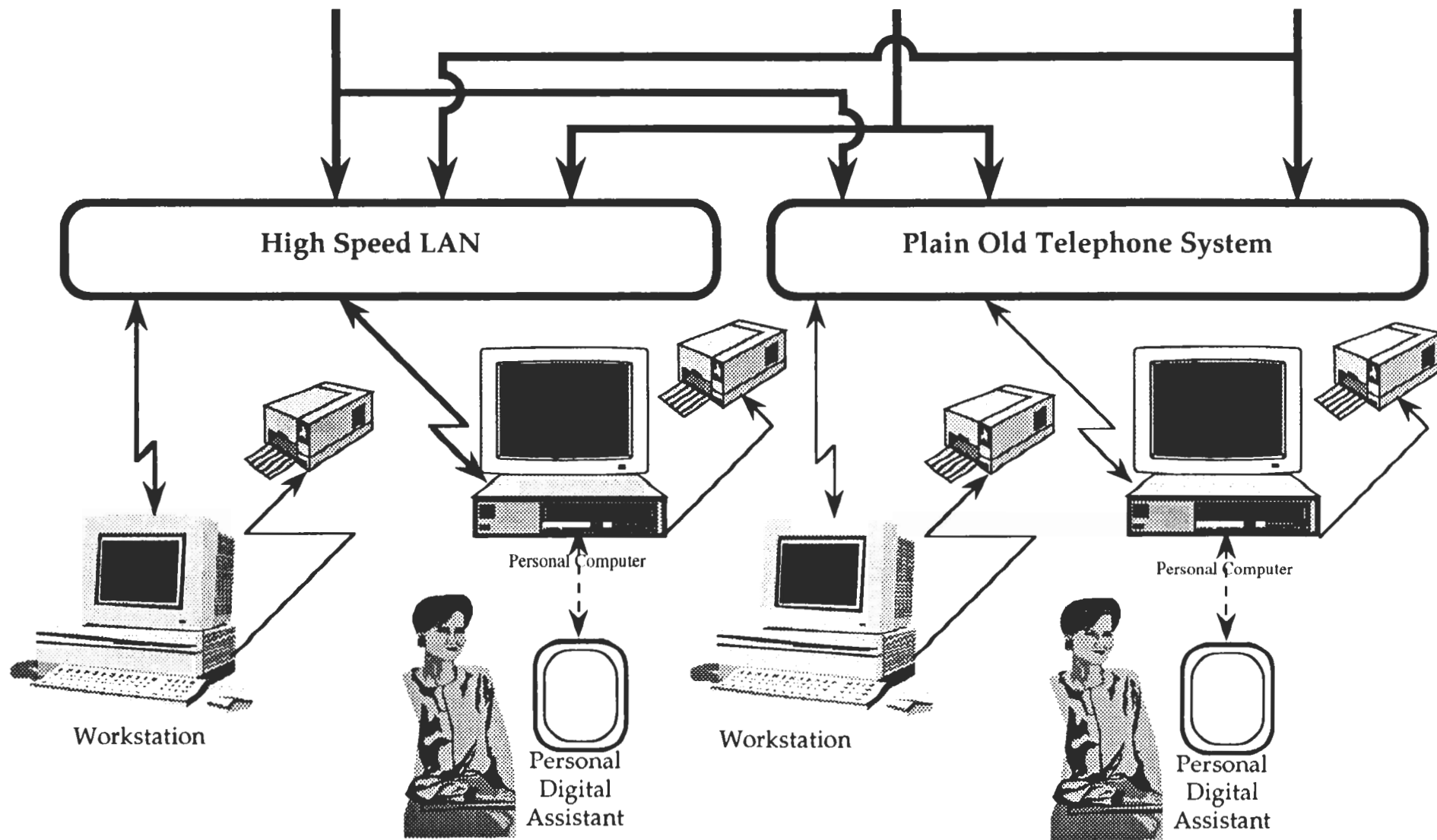
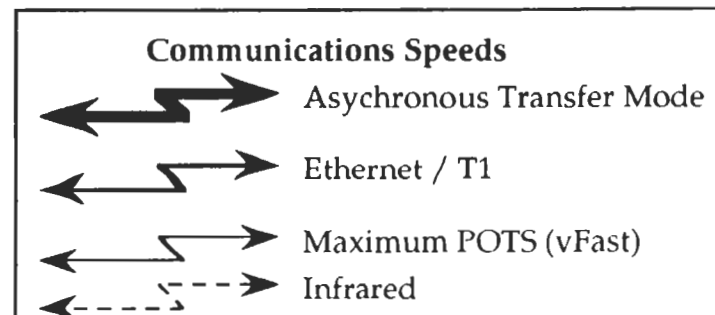


Figure 1
Integrated Distance Education
Applications System (IDEAS)

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1989 - 1991. When required, the *Intelligent Digital Reference Librarian* will connect the client to a "real" reference librarian via person to person videoconference, electronic chat, computer conference or electronic mail.

The University of Alberta spent \$2,336,000 in 1993 to convert to an Internet-accessible integrated library system (Data Research Associates) which provides access to the three million volume University Library collection as well as Telnet access to the approximate 400 library catalogs on the Internet. Installation in 1993 includes a 500-node local area network, a RS/6000 Z39.50 database server with CD PLUS citation database search software, 2 ARIEL document delivery stations (Internet-based high resolution Fax), and AVISO automated interlibrary lending software. The Library is currently formulating a research project with CD PLUS Technologies AGT Ltd., and Hughes Aircraft to develop a digital library services component to their Remote Consultative Network (RCN) workstations technology. This technology, currently being tested for remote medical consultation, will be extended to provide real-time reference consultation between students and distance education librarians, and digital document delivery services. Production implementation of the RCN technology will involve redesign to function in a high bandwidth TCP/IP network environment.

The University of Calgary has recently contracted to purchase a similar Internet-accessible automated library system.

Computing Facilities

Distanced students will have 24 hour access to the same computer facilities they would have on the campus:

- electronic mail
- electronic chat
- computer conferencing (both synchronous & asynchronous)
- person to person videoconference (such as the PictureTel PCS 100, Northern Telecom's VISIT or Cornell University's CU-See-Me)
- access to specialized software
- access to compute cycles
- access to computer consulting and technical support.

Both Universities already support these systems and with the WurcNet project, this access improves greatly.

Distance Education Workstation

Instructors and students may be relatively expert computer users and may have a multimedia workstation (e.g., IBM PC 486 with Windows Multimedia, Silicon Graphics "Indy" or Macintosh Quadra 840AV). Systems such as the PictureTel PCS 100 allow such system with added hardware such as still image projectors and video cameras to originate distance education programming. Connection to a high speed network will allow high quality presentations to be presented synchronously to distanced students. Such workstations could also be used to convert a synchronous real time lectures into an asynchronous multimedia instruction module. Consultants, reference librarians and instructors will also use these workstations for one-to-one videoconference consulting with distanced students.

Distance Education User Terminal

Many distance education clients will have little or no technical expertise. They will wish to access material in their own home either at the same time the class is taught (synchronously) or later (asynchronously). This is where the use of extremely sophisticated technology can be used to hide the technology itself from the user. The video recorder industry found that the best way to get the unsophisticated user to program the video recorder was to give step-by-step instructions to the user on the screen while the user responded through a hand held "clicker" which uses an infrared channel to communicate with the video recorder.

We propose to develop a more sophisticated yet easier to use interface for the distance education student. A high powered yet relatively inexpensive multimedia computer (e.g., the Macintosh TV) will be the display screen (and the intelligence) while a Personal Digital Assistant (such as the Newton QuickTime PDA) will be the "clicker." Infrared communications between the Newton and the Macintosh is already available. The PDA will always show a series of buttons which the user can select with a stylus to control the educational programming. Buttons will only be displayed on the PDA when they can be used. For example, Pause, Fast Forward, and Rewind buttons will show at all times on the PDA when an asynchronous program is being displayed. If the instructor being displayed on the screen discusses

something on a slide, an icon will show up on the screen and on the PDA which will allow the user to display the slide. When the slide is displayed, two buttons will show up on the PDA, one to print the screen and a second to switch back to a view of the instructor.

Students will also be able to use the Computer or the PDA to communicate via electronic communications with the instructor or other students. The computer will also be able to link to the University LAN to access the *Digital Knowledge Warehouse*, the Internet or other computing facilities.

Integrated Control System

The development of an integrated control system to make the *Integrated Distance Education Application System* as easy to use as possible will be a major task in this research project.

Technical qualifications of the participants and strategies employed

The two universities are excellent research facilities with enviable records of transferring research to industry. AGT Ltd. is a major telecommunications provider with a significant research and development unit which can bring technological development to market.

The researchers are uniquely qualified to undertake this project. Dr. Montgomerie, Dr. Collett and Dr. Keenan have each been involved in distance delivery for over ten years. Each have used a number of different technologies in their distance delivery.

T. Craig Montgomerie Ph.D.

Dr. Montgomerie is an Associate Professor in the Department of Educational Administration at the University of Alberta with research interests in the application of technology to education. He is currently seconded to the Office of the Vice President (Research) as Research Coordinator, Telecommunications Initiatives. In the 1970s, Dr. Montgomerie developed an integrated, interactive "front end" to a complex series of statistical programs. In 1981 Dr. Montgomerie developed the support system which allowed students in the Master of Educational Administration Extended Campus Program to access the on line ERIC database and

communicate with graduate assistants on campus to obtain library and other support. As technology has improved this system has been improved to include features such as computer based library instruction and access to the on line catalog.

Dr. Tom Keenan, I.S.P.

Dr. Keenan is Dean of the Faculty of Continuing Education at the University of Calgary. He holds degrees from Columbia University (New York, NY) in computer science and adult education. He is the Technology Correspondent for CBC Television's *Midday* and CBC Newsworld's *Canada Live* programs.

Dr. Roger Pederson, Ph.D.

Dr. Pederson is the Director of Research & Development, Marketing and Business Development of AGT Ltd. One of the initiatives of AGT Research and Development is the development and exploitation of technology to enhance the delivery of education for K-12 through Adult Learning and Life-long education.

Dr. David Collett

Dr. Collett is a professor in the Department of Adult, Career and Technology Education at the University of Alberta. His major area of teaching and research is Distance Education. Dr. Collett is the director of the distance learning initiative which allows instructors in Post Secondary Institutions in Alberta and British Columbia to achieve a B.Ed. primarily within their workplace.

Mr. Doug Poff

Mr. Poff is a Professional Librarian and Manager of Information Technology Services (ITS) for the University of Alberta Libraries. ITS focuses its work in three areas:

1. development of electronic library services infrastructure for the University community;
2. extending electronic library initiatives to twenty other Edmonton libraries through development of a city-wide library consortium: NEOS – Networking Edmonton's Online Systems;
3. developing Internet information server initiatives with other institutions – Alberta Health Knowledge Network with the University of Calgary to provide

health related electronic library services to post-secondary, hospital, government and individual practitioners in Alberta – involving commercial partnerships with database vendors, telecommunications companies and software developers.

Market Description

Commercial opportunities

While a number of distance education products exist or are under development, there is no product which is aimed at integrating all aspects of distance education under a single easy to use facility. The commercial opportunity for such a system is great. Further, such a system will increase the market for existing commercial systems because educational institutions and students can see how they fit into education's "big picture." IDEAS has the potential to be in the right place at the right time

Market potential

Education is one of the largest markets in the world. With the move to life-long learning the potential is growing. The market for distance education (i.e. serving all distanced students) is growing at a phenomenal rate. The demand is that educational institutions must teach more students with the same, or reduced, staff and physical plant. Equally, education must be available where and when the learner needs it. Finally, educators constantly express their own demands to continue to provide quality instruction. Clearly, the only way to come close to meeting all these needs is through a quality, integrated distance education system. The IDEAS technology is applicable from elementary through postgraduate education, in adult "life long" education and in workplace training.

User needs

Distance education students are interested in learning, usually with the intention of improving their economic position. They are not interested in experimenting with technology, rather they complain that technology gets in the way of their learning. IDEAS is designed to allow them to use very sophisticated technology without knowing they are doing so. The ultimate design criteria is that IDEAS must be as easy to use as is the on-screen programming of a VCR using a hand held "clicker."

Overall economic benefits

The future economic payback is enormous. The cost of the adult education and training sector in Alberta is \$1.2 billion per year, roughly 10% of all government expenditures. In May 1993 the Alberta Provincial Treasurer announced an overall 20% reduction in funding over the next three years. This means a reduction of approximately \$250 million in this sector alone. The Alberta government produced a discussion document *Adult Learning: Access Through Innovation* which states "the goal is to find innovative ways to increase access to learning opportunities and the responsiveness of Alberta's post-secondary system in the longer term." The resulting *Budget Roundtable Workbook* suggests among other things the expanded use of technology to support "distance learning opportunities to remote communities." A conservative estimate is that effective and efficient use of distance education could reduce overall costs to the post-secondary system by 10%. If IDEAS is as effective as we anticipate, the overall savings through the use of such a system in the post-secondary sector in Alberta alone would be \$120 million/year. This project will demonstrate that effective and cost efficient instruction can be delivered to the student in the home. Societally, students will be able to access education when and where they wish without need to travel to larger campuses.

While the cost of the hardware for this system is, at this time, prohibitive for the individual learner, costs are coming down at precipitous rates and capabilities of consumer devices are improving equally quickly. The kind of system envisioned should be economically feasible for home use by 1997.

For CANARIE and telecommunications providers IDEAS will increase the use of the telecommunications networks. It will drive a demand for more bandwidth and will provide high connect times. Since students will now be taking courses at home or in the workplace, they will no longer be restricted to courses offered locally. They will want the best course, whether it is offered in their own community or in a different country. Educational Institutions which realize this potential will benefit from developing courses for distance delivery, and telecommunications providers will benefit from toll revenue and the sale of IDEAS products.

Managerial Capability

The project coordinator has managed a number of large research and software development projects. AGT and the two Universities of Alberta and Calgary have committed resources to Distance Education (the University of Alberta is advertising for a distance education project coordinator at this time).

Both universities have offices which deal with technology transfer. The three partners have been working together on developing the WurcNet proposal for over six months and have agreed in principle to negotiate a full technology transfer agreement when this project is funded. AGT Ltd. sees the opportunity for commercial benefits through marketing IDEAS. The two Universities see economic benefits from licensing the product, but mainly from being at the leading edge of the development of distance education courses and moving more strongly into the distance education marketplace.

Financial

Both universities have committed funds to alternative delivery methods for distance education. The University of Alberta has set aside \$250,000 for the purchase of distance education equipment, staffing of a distance education unit, and delivery costs. The University of Calgary similarly has allocated \$276,000 from the Program Initiatives Fund. In both these cases, the funding is for production rather than research and development. AGT has made a commitment to assist the development and delivery of innovative distance education programs, and has specifically allocated \$20,000 in "in-kind" support for this project. Negotiations have begun with Apple Canada, IBM Canada and the Alberta Distance Learning Centre to obtain their support for the project. Funding from CANARIE Inc. will allow the partners to pursue the integration of a number of existing distance education technology into a pedagogically sound delivery system.

Table 1 presents the proposed Budget for the Project.

Table 1
IDEAS Proposed Budget

Capital Equipment	New \$	In-kind
4 videoconferencing rooms (1 large & 1 small at each University)	\$300,000	
1 Videoconferencing Bridge (6 port)	\$80,000	
1 Digital Store	\$25,000	
2 Distance Education Workstations	\$30,000	
2 Personal Computers	\$8,000	
2 Personal Digital Assistants	\$2,800	
1 Journal/Full Text RS/6000 Database server c/w Z39.50 search software from CD PLUS.		\$245,000
2 ARIEL Internet-based document delivery Fax-4 stations		\$13,000
AVISO automated interlibrary lending software		\$8,000
Network database licensing (yearly)		\$130,000
CDP Database Server Upgrade to RS/6000 to allow 10 additional concurrent user licenses	\$13,000	
Silver Platter Electronic Reference Library CD ROM Database Server	\$28,000	
Subtotal	\$486,800	\$396,000

Table 1 (continued)
IDEAS Proposed Budget

Operating	New \$	In-kind
AGT consulting/design		\$20,000
Release Time for Researchers	\$10,000	
Support for two Graduate Assistants (12 months each)	\$30,000	
Travel	\$5,000	
Programming	\$20,000	\$10,000
Secretarial	\$10,000	
Office supplies, printing, etc.	\$2,000	
Subtotal	\$77,000	\$30,000
University Overhead 30% of Personnel	\$23,100	\$3,000
Total	\$586,900	\$429,000
Consortium Contribution	\$293,450	\$386,100
Requested CANARIE Inc. Contribution (50% New \$, 10% In Kind)	\$293,450	\$42,900

Deliverables

This project is estimated to take approximately one year to complete. The following will be complete one year after the contract is completed.

Classroom Videoconferencing Systems

The classroom videoconferencing systems will be used to demonstrate to staff at the two universities that quality instruction can be delivered economically to large

groups who are distanced from each other, and that a group can asynchronously access a previously recorded class. This is certainly NOT a new use of technology.

Digital Store/Intelligent Index

At the end of the project, it will be demonstrated how video, audio, still, and computer graphics can be stored in a form that they are easily retrievable at a later time and location to allow a student to receive and control a reconstructed lesson.

Digital Knowledge Warehouse/Intelligent Digital Reference Librarian

At the end of the project, it will be demonstrated that a student will have easy access to the same kind of information which is accessible to students on campus through the *Digital Knowledge Warehouse*. A prototype of the *Intelligent Digital Reference Librarian* to assist students find information will be completed.

Computing Facilities

At the end of the project distanced students will have seamless access to the computing resources of the Universities through a single, easy to use interface.

Distance Education Workstation

At the end of the project a single interface will be demonstrated which will allow someone at a *Distance Education Workstation* to deliver distance instruction, redesign captured videoconference lessons to be used as multimedia instruction and to communicate with distanced students to provide consulting services.

Distance Education User Terminal

At the end of the project a prototype Distance Education User Terminal interface will be demonstrated which will allow a student who is distanced from the Universities to access instruction either synchronously or asynchronously. A PDA will allow the student complete control over all aspects of the lesson with virtually no technical knowledge.

Integrated Control System

At the end of the project an Integrated Control System for the production and delivery of Distance Education will be demonstrated.

Project Work Plan

Figure 2 provides a PERT chart of the proposed work schedule. Milestone dates are shown in Table 2. All times are based upon an expectation that the contract will be completed February 1, 1994.

Table 2 IDEAS Milestone Events	
December 1, 1993	Proposal sent to CANARIE Inc.
February 1, 1994	Contract Completed
February 1, 1994	Begin evaluation of alternative technologies for trial
February 2, 1994	Design of human interface specifications begins
February 23, 1994	Prepare equipment tenders
April 26, 1994	Tenders awarded
May 10, 1994	Equipment Installed
May 11, 1994	Begin testing and modifying Prototypes
August 30, 1994	Begin trials of IDEAS with "real" subjects
December 21, 1994	Begin Final Report
Jan. 31, 1995	Announce availability of IDEAS version 1.0
Jan. 31, 1995	Present Final Report

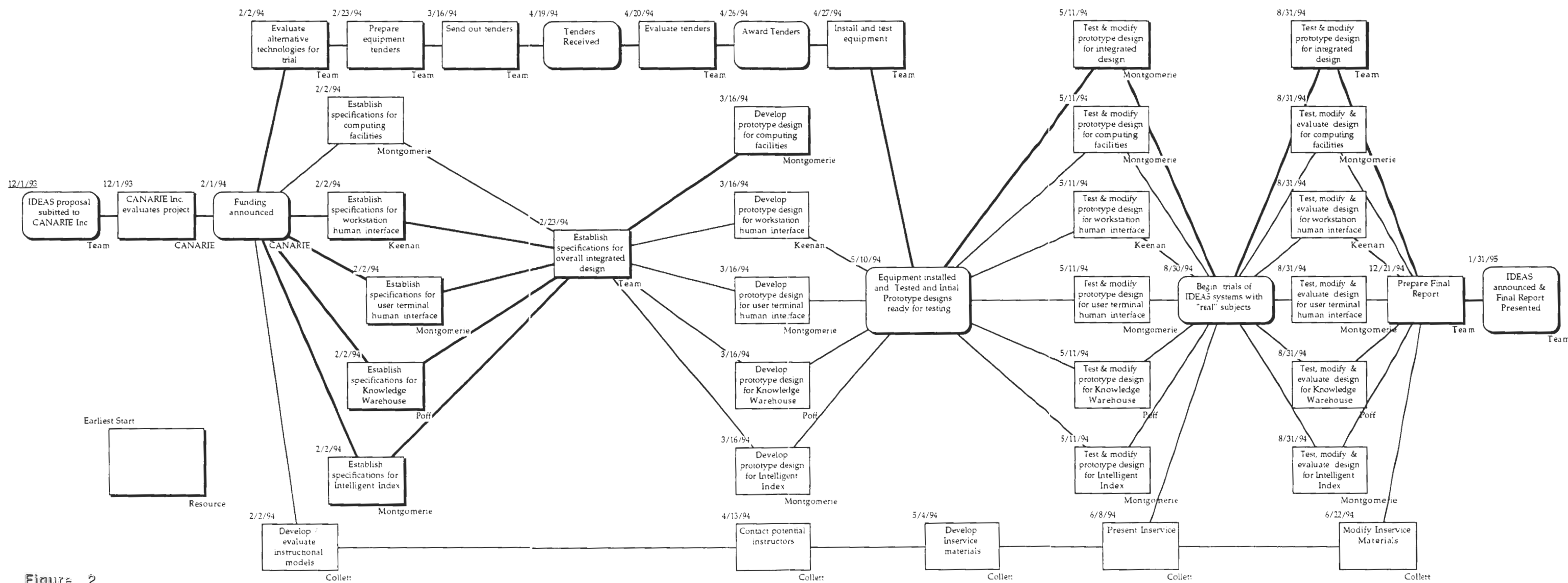


Figure 2
 Integrated Distance
 Education Applications System
 (IDEAS)

