Tele-education 18627

1. 0 INTRODUCTION

1. 1 Background of Tele-education

Tele-education has a long history beginning with systems like that for teaching children in Australian Outback, the British Open University and other such organizations. These built on the idea of correspondence courses where course materials are sent periodically by post and augmented the experience with broadcasts either on radio or on TV. The problem of student isolation was addressed partially through techniques such as telephone access or two-way radio links with teachers. At the end of 1980s, the vest majority of distance education throughout the worlds was still primarily print-based.

Technologies used for distance education are evolving from primarily ?? one-way?¦ technologies and applications such as computer aided learning, computer based training and computer aided instruction, to more ?? two-way?¦ technologies and applications such as computer mediated communications and computer conferencing systems for education. The significance of ?? two-way?¦ technologies is that they allow foe interaction between participant and tutors, and perhaps even more significantly amongst participant themselves. This development has allowed and in some senses force researches to look more closely at the impact of educational environment, on the students learning experience.

In the future, it is expected that the telecommunications-based technologies to become the primary means of delivery of distance teaching. The reasons for this are as follows:

„ h a much wider range of technologies are becoming more accessible to potential distance education participants

„ h the costs of technological delivery are dropping dramatically

„ h the technology is becoming easier to use for both tutors and learners

„ h the technology is becoming more powerful pedagogically

„ h education centers will find it increasingly difficult to resist the political and social pressures of the technological imperatives.

1. 2 The Emergence of Tele-education

Radical changes in the computing infrastructure, spurred by multimedia computing and communication, will do more than extend the educational system, that is revolutionize it. Technological advances will make classrooms mush more accessible and effective. Today, classroom education dominates instruction from elementary school to graduate school. This method has remained popular for a very long time and will probably persist as the most common mode of education. However, classroom education has its problems, that is the effectiveness decline with increase in the number of students per class. Other pressures affect the instructors, many of whom are not experts in the material they must teach, are not good ?? performers?¦ in class, or simply are not interested in teaching. The biggest limitation of the classroom instruction is that a class meets at a particular time in a particular place. This essentially requires all students and the instructors to collect in one spot for their specified period. But with the emerging technology, these problems can be overcome.

1. 3 Reasons for studying Tele-education

The current Tele-education systems that have been applied in some countries are generally of multipoint transmission technique. It is found that, this kind of transmission technique having several problems or defects. Mostly, problems raised during the application of the system. One of the significant problems raised is that, for the multipoint transmission, the signals or information transmitted by the sender do not completely received by the receiver. This problem is might be due to error that occurs during the transmission of the signals or information. Another problem is lag of transmission. For this case, the signals or information transmitted do not arrive at all the receiver at the same time, for example, the question raised by the lecturer might not received by the students at the same time and this is not a good environment for Tele-education system. Some receiver receives the signals earlier than the others and some later or even not receives at all. Therefore, it is important to study the Tele-education technology from time to time to overcome these problems so that the Tele-education system could provide a more effective way of learning environment.

In order to have a lecture from, for example, a very famous professor from other country would require him to come at our place. But the amount of money spent for paying him to give lecture would be very expensive and this also would cause troublesome for him. However, this problem can be solved with Tele-education system in which the professor does not need to go anywhere else to give his lecture. This would save a lot of expenses and time.

Another reason is that, in normal classes the learning process would not be very effective if the number of students in a class is very big. This is because the lecturer alone can not coordinate such a large class. With Tele-education system, one lecturer could deliver his lecture to as many students as possible effectively in a way that a large number of students from different sites having the same lecture at once.

1. 4 Purpose of Research

The purpose of this research is to study the current Tele-education system that has been applied in some countries. This study covers the background of Tele-education; that is its definition, the publications of Tele-education; that is any papers that discuss about Tele-education as a whole, the performance of applied Tele-education, and also the technology of Tele-education; that is its network architecture. But the main purpose of this study is to understand the Tele-education system that have been applied in another country and try to implement it in our country.

1. 5 Acronyms

ATM Asynchronous Transfer Mode

CCITT Committee Consultatif International Telegraphique et Telephonique

CPE Customer Premises Equipment

IP Internet Protocol

ISDN Integrated Services Digital Network

ISO International Standard Organization

JAMES Joint ATM Experiment on European Services

LAN Local Area Network

MAC Medium Access Control

Mbone Multicast Backbone

PC Personal Computer

POP Point-of-Presence

PVC Permanent Virtual Channel

QoS Quality of Service

RAT Robust Audio Tool

SLIP Serial Line Internet Protocol

TCP-IP Transmission Control Protocol – Internet Protocol

TES Tele-Educational Service

UI User Interface

VIC Video Conferencing Tool

VP Virtual Path

VPN Virtual Private Network

VSD Virtual Student Desktop

WAN Wide Area Network

WWW World Wide Web

XC Cross Connect

2. 0 METHOD OF INVESTIGATION

Since Tele-education is a very new technology that is popularly discussed today, it is quite difficult for me to find any books that discuss about Tele-education from the library. Therefore, the easiest and the fastest way to gather information relating this project is via the Internet. I have surfed and found many interesting sites that discuss about Tele-education. Besides surfing, I also have contacted several people who are involved in this area, Tele-education, by e-mail . But unluckily, this does not really help because most of them did not reply. Besides using the Internet, I also get the information for this project from the IEEE Database at the library of Universiti Telekom.

3. 0 BACKGROUND STUDY

3. 1 Definition of Tele-education

What is Tele-education? Before discussing about what Tele-education means, lets look at what distance learning is. This is because Tele-education and distance learning are very related to each other. Distance learning is the acquisition of skills and knowledge through electronic communications that allow student and instructor to be separate in either in time or space. The to

distance learning is ?? asynchronous learning?¦ which can be defined loosely as learning at different time. It is a highly flexible method of training because the sender and receiver do not need to be synchronized in space or time. But Tele-education is more than that of distance learning. In Tele-education, not only asynchronous but synchronous learning is also made possible. In other words, Tele-education is the evolution of distance learning.

As stated before, asynchronous learning environment is not real-time environment. It is a self-study-based application and is accessed via the Internet to a server. The requirement to the student is only an ordinary PC with standard software and Internet access. This application is applicable for a large amount of users who can access the course independent of each other. The combination of the lecture-part, group-work-part, and self-study-part is another type of Tele-education learning environment, which is synchronous learning. It is a real-time environment. In this environment, students and lecturers can interact with each other simultaneously.

Tele-education use the technology of video teleconferencing that allows two or more parties at different geographical area to interact with each other or to have learning process together. But people usually get confused whether video teleconferencing can be considered as Tele-education as well. Tele-education is actually different with video teleconferencing in a way that Tele-education usually involve a large number of people as compared to video teleconferencing, that is, it is in video teleconferencing many people use a single monitor to see other people at other area but in Tele-education, students have their own monitor that can be used not only to see their lecturer and colleagues but also to send and receive educational materials.

3. 2 Publications of Tele-education

There are many papers discussing about Tele-education. Most of these papers cover only the general or overall scope of Tele-education. The area of discussion on Tele-education can be summarized as the following:

„ h Tele-education service

„ h Content of Tele-education

„ h Network architecture

„ h performance of Tele-education

„ h operation and management of Tele-education

For Tele-education service, it describes about what multimedia tele-service and hyper media service is, and how it can be integrated into Tele-education service. It also describes about what Tele-education service facilitate. Content of Tele-education describes about the style or mode of Tele-education system, that is, what kind of education style used, and how the lecture notes or any materials delivered to all the students. For network architecture, it describes about the protocol used for the Tele-education system and its network infrastructure. Performance of Tele-education covers the performance of service of Tele-education and also the network performance. The description of these performances is from the customer point of view. For the operation and management of Tele-education, it describes about what should be taken into consideration in order to provide a well managed Tele-education service.

3. 3 Examples of Systems

From the study of materials gathered, there are generally three examples of Tele-education system that have been applied in the Europe and Canada. Those examples are:

„ h Tele-education NB

„ h Delta ‘ s Virtual College

„ h ACTS Project AC052 (RACE Project Report)

The purpose of looking into these examples is to try to understand what kind of Tele-education system is implemented, how Tele-education can be implemented, to know what are the requirements to implement it, and what considerations should be taken into consideration for implementing it.

3. 3. 1 Tele-education NB

Tele-education NB is implemented at the University of New Brunswick, Canada. The present physical network consists of three independent networks that operate on telephone lines;

„ h Voice

„ h SMART 2000 computer teleconferencing

„ h Computer Mediated Communications using NBNet

The SMART 2000 bridge for computer software sharing and audiographic teleconferencing is owned and operated by the Tele-education NB. This is

accessed by simple dial connections using ordinary telephone lines. This allows for the computer monitor at each site to show images created by users at the other sites. The software can be used like an elaborate electronic blackboard, overhead projector, or slide projector. In addition, it is being used for software sharing at multiple locations.

Data communications are transmitted over NBNet using a SLIP server which resides in a user friendly simple menu front-end created by Tel-education NB to permit easy access to NBNet and to facilities available. Students and teachers can access NBNet for uploading and downloading assignments and other course materials. A CD-ROM server is being set up at the central site and at the University of New Brunswick library for permitting access to different databases.

Tele-education NB also supports an on-line learning center with a file server located at Mount Allison University. Information of relevance distance education and the network in particular can be accessed there. In Tele-education NB, a special listserv is created for internal communications among different sites. As an integral part of the province’s electronic information highway, Tele-education NB is supporting the development of an open, distributed network, taking advantage of media available. The most widely used delivery modes are audio teleconferencing with SMART 2000, as well as videoconferencing. However, it is not limiting the network to any one technology, or suite of technologies. It is actively promoting experimentation and cooperation in the reception and delivery of courses using other software and media.

Tele-education NB placed routers in the Community College Campus in each region, and other sites in regions that do not have a college. Initially it operates using 56K connections and will move T1. SMART 2000 runs not only on regular telephone lines but also on LANs and WANs using Novell, TCP-IP and other telecommunication protocols. Tele-education NB are now experimenting with synchronous transmissions using the TCP-IP protocol on NBNet. The Picturetel videoconferencing units existing in province all are CCITT compatible.

Tele-education NB has provided the guidelines for selecting appropriate technology for its network as follows:

„ h The network shall experiment with different technologies and endeavor not to rely on any one technology or any supplier.

„ h Existing equipment and distance education sites in the province shall be integrated into the network wherever possible.

„ h The network shall establish computer teleconferencing and computer conferencing links among the sites, including access to electronic information highway and the Internet.

„ h Satellite delivery and reception capabilities and upgrading of sites to PC-based videoconferencing will be investigated for implementation in future.

„ h Other optional equipment may be placed in sites at the request of users and institutions such as MACs and CD-ROMs.

„ h The network should be compatible as much as possible with other provinces and regions.

3. 3. 2 DELTA’s Virtual College

Delta’s Virtual College is implemented in Denmark (Europe). It offers the opportunity for students to participate in desktop Tele-education from their homes or offices. This concept means that individual students participate in Tele-educational courses using a desktop computer online connected to a course provider.

The user interface is a common Web browser, that is, Netscape Web-browser, extended with loosely integrated audio and video tools. The educational environment applies the metaphor of a virtual college. The idea is that students access DELTA’s virtual college server when participating in a course. The user interface looks like the plan of a college. From the college hallway, the student can enter different rooms with different functions. Those rooms are:

„ h classrooms where on-line lectures and presentation take place,

„ h group rooms where on-line cooperative work takes place,

„ h studies where off-line study such as self-study material, exercises, slides from previous lectures, supplementary material and links to other sites on the Web take place,

„ h teacher offices where it is furnished with course administration tools,

„ h tea room where it is used for informal chat and social contact with fellow students during break.

The following figure, the “ floor plan”, illustrates those rooms:

Figure 1 : The floor plan

The goal of this virtual college is to integrate different modes of teaching and learning. This includes synchronous mode like on-line lectures and group exercises as well as asynchronous mode like interactive self study, participation and threaded bill board conferences and sharing of documents.

The virtual college is run primarily in a local network environment in order easily to monitor and control the students and technology. Then, when there are several countries participate, each sites are connected by the JAMES (Joint ATM Experiment on European Services) broadband network.

3. 3. 3 ACTS Project AC052 (RACE Project Report)

This is a big project on Tele-education. It covers the whole aspects that should be taken into consideration for implementing Tele-education in Europe such as service aspects, management aspects, network architecture, etc. In this project, there are several trials have been done in order to obtain an effective Tele-education system. The details of this will be discussed later throughout this report.

4. 0 CONSIDERATIONS

It is not easy to find materials or any papers reporting the architecture of Tele-education. Most of the materials found are basically discussing about

the general idea on what Tele-education system is, for example some papers discuss about the general system of a Tele-education service offered, its advantages over current educational environment, etc. However, I managed to find a very interesting material discussing about Tele-education as a whole, that is the ACTS Project AC052 (RACE Report Project). Therefore, I choose this report as my main reference in doing my study on Tele-education overall system description covering the architecture.

There are basically five main topics that are going to be discussed in quite detail regarding the Tele-education as a whole in this report. These main topics are:

„ h Tele-education service

„ h Tele-education content

„ h Network architecture of Tele-education system

„ h Performance of Tele-education service

„ h Operation and management of Tele-education service

4. 1 Tele-education Service

The multimedia tele-service provides both core and management services. The multimedia tele-services are briefly described as Video/audio conferencing service, which based on the MBONE (Multicast Backbone) tools VIC (video conferencing) and RAT (audio conferencing). Hypermedia service allows access to be provided to hypermedia information stored on a WWW server. The WebStore service is a managed WWW based multimedia

document store, which allows users to store and retrieve arbitrary documents (text, video, audio, etc.), using the well-known interface of the WWW. The management of the WebStore includes subscription, accounting and access control.

A mapping between the learning forms and the multimedia teleservices has resulted in a list of four basic paradigms:

a) Self-study

„ h Individual work with web based course material including exercises and discovery/reference search.

„ h This paradigm is supported by the hypermedia and WebStore services.

b) Lecture

„ h Teacher to class presentation.

„ h Supported by the conferencing and hypermedia services.

c) Group work

„ h Discussions, exercises or project work performed by the students in groups. This paradigm can also include shared discovery/reference search.

„ h It is supported by conferencing, hypermedia, and WebStore services.

d) Consultation

„ h Student to tutor consultation

„ h Supported by video/audio conferencing and hypermedia services.

In order to support these four paradigms the multimedia services are integrated into a Tele-educational Services (TES) which provides both the core service and the management service functionality. The core Tele-educational service provides two user interfaces, one for the teacher and one for the students.

In Tele-educational service, each course, presented as part of Tele-educational service, would involve the rendering and seamless integration of audio, text, graphics/bitmaps and appropriate video segments, to suit the presentation of the course material. An educational service would also facilitate the interaction of course participants with one another in class discussions, as well as with the course tutor. In this way, a course tutor can guide debates on issues arising from course material and allow participants to exchange views and share experience. This interaction is very important, as participants need to be encouraged to learn both from the tutored course as well as from each other’s practical experience. This forum of discussion also supports the tutor in assessing feedback from the participants concerning the comprehension, benefit and effectiveness of a course for participants.

The educational service could also facilitate access to simulation environments and ‘ live systems’, which are parts of the participant’s course material. For example, it could provide access to specific commercial database information, which would be part of a Database Modeling course. In this way, access may be gained to systems and information, which would

otherwise not be available on the participant’s site. Course could be taken when the participant’s work schedules permitted. Similarly, participant/participant interaction could be scheduled flexibly. An educational service can be seen as incorporating several interaction (tele-services) and course presentation mechanism, for example, multimedia presentation tools conferencing, e-mail or notice board systems.

The following is an example of service layer used in the ACTS Project AC052:

Figure 2 : Service Layer

In the ACTS Project AC052, there are two Tele-educational courses offered as a trial of the management service. These courses are ” An Introduction to ATM ” and ” An Introduction to Relational Databases and SQL “.

4. 1. 1 An Introduction to ATM

The course includes both synchronous and asynchronous delivery methods. The duration of the course is three to four days with approximately three hours of teaching and studying each day. The course consists of five lectures, three self study modules and three group exercises with a follow-up discussion of the results. The different modules and modes of the course are conducted in a Tele-educational environment which includes course outline information, a database of participants with pictures and CVs, a WWW billboard supporting off-line discussions, access to a WebStore and a tea-room which participants can visit for informal chats.

The lectures are performed by using video/audio conference tools. A system was used to show slides on the participants web-browsers. The self study

modules contained web pages with information to read and small built-in exercises. The group exercises consist of a number of questions to be answered by the group and returned to the teacher for correction afterwards. When the teacher has corrected the answers they are discussed in a conference with all the participants.

In the first trial a shared editor was introduced for use in group exercises. The shared editor is a tool for synchronous collaboration on smaller texts, and is meant to complement the chat and whiteboard tools used in earlier trials. An illustration of the new shared editor can be found below.

In the second trial, a new floorcontrol-system for use during lectures as well as a complete new graphical design of the virtual learning environment was tested. The floorcontrol system was used by the teacher during lectures, to determine which students wanted to ask a question, and to mute or unmute the microphones and video cameras accordingly.

A new graphical design of the User Interface (UI) was introduced, in an attempt to create an even more homogenous UI. The floorplan metaphore was kept, but new images and controls where implemented throughout the environment.

4. 1. 2 An Introduction to Relational Databases and SQL

This course covered the theoretical principles of relational database technology as well as supporting the hands-on skills of using relational database language (SQL). Students took the course over a three day period, for two hours each day. At the beginning of the course a one hour lecture

outlined the objectives of the course and provided an introduction to the topics. The educational content comprised of text, graphics, and animation and was divided into four sections, consisting of a total of twenty one modules (a module typically being 1-5 pages). The course was made available via the Prospect Tele-educational environment.

On accessing the course, a separate courseware browser window was opened, called the Virtual Student Desktop (VSD). All student interactions with the courseware are facilitated via this VSD. The Tele-educational environment is also accessible by the student for conferencing and synchronous interaction. The VSD is rendered as a set of WWW windows, frames, tool bar and icons. All native WWW browser buttons are suppressed (hidden) so as not to distract the user from the main goal of education. A tool bar specially designed for educational use is provided by the VSD at the bottom of the screen. From this tool bar the student is able to contact tutors or fellow students (asynchronously), access external systems, as well as navigate and interact with the educational course material. Figure 3 illustrates a page from a module in the course, and shows the educational toolbar at the bottom of the screen and an index of the topics dealt with by this particular module in the course on the left hand side of the screen.

Figure 3 : page from module in the course

Overall the course comprised several different types of information: Administrative (i. e. how to use the course etc.); A database of (self contained) modules; Indexes or Roadmaps of specific courses through various modules; Evaluation Forms and a Case Study.

The roadmaps were important as the modules can be combined in several ways to satisfy the different requirements for different student objectives. Each roadmap corresponds to different learning objectives of the RDBMS course. Thus the roadmaps provide a means of re-using existing modules with as little redundancy as possible of educational material and administrative overhead.

A significant feature of the system was to provide direct access to a real ?? commercial?¦ RDBMS via the same interface as the educational course. The relational DBMS is seamlessly integrated into the student educational desktop. Thus the tool bar offered by the VSD contains an icon which allows students to issue SQL queries on a live database. The idea of this is to deliberately blur the distinction between the educational environment and the ?? target?¦ systems. This encourages students to ?? try out?¦ various parts of the course before attempting a larger project.

Another feature was the ability of the student to store references to distinct locations in the course material (bookmarks). Traditionally these are stored locally on the student?¦s machine. However this has disadvantages as students rarely use the same machine all the time. The VSD allows such bookmarks to be stored within the educational service and are thus (privately) accessible to an individual student at any time. Also if the student has logged off the course and logs back on, the VSD allows him/her the ability to resume at his/her most recent position or restart at the beginning.

Various forms of on-line tutorials are embedded into the course. ?? True or False?¦ and ?? Multiple Choice Questions?¦ are supported, with automatic

correction and notification of marks to the student. Form based (short unstructured text style) answers are also facilitated in some tutorials. In these cases the student answers are automatically delivered to course tutors for subsequent correction. Also integrated into the course are evaluation forms which, when completed, are automatically submitted and stored for later analysis by course tutors. The VSD provides buttons to contact other class members or to seek tutor assistance. Again, this is offered via WWW forms and integrated transparently with an email delivery system.

4. 2 Tele-education Content

There are several modes of educational interaction, which could be supported by a virtual theatre/study room. These would include lecture presentation, course material presentation and browsing, self-study, group work (shared application/work, class discussions, group presentations), consultation (tutor/participant, participant/participant), tutorial sessions, virtual coffee room/virtual lounge, and continuous assessment. There are also some other form of learning that have been identified. These forms of learning are:

„ h Self learning

„ h delivery of formatted courses material for students own study

„ h Lecture presentation

„ h a one-to-many presentation by the tutor of course or organizational material.

„ h Exercises

„ h the facility to perform exercises either in groups or individually

„ h Project work

„ h the development of sizeable projects using software outside the teaching environment.

„ h Discovery/Reference research

„ h ability to locate and access background or supplemental learning material

„ h Seminar/Class discussion groups

„ h many-to-many communication between participants.

„ h Consultation

„ h private one-to-one communication between participants.

There is some overtap between these learning forms. For example, exercises, project work, discovery/reference search can be part of the self-learning form, but all of learning forms are listed here for completeness.

It has been pointed out that not only should the different modes of teaching be supported in the Tele-educational environment but also the different styles of learning adopted by the students need to be supported. So for instance students who like to annotate their work or their course material should be facilitated in doing so. This is very much in the spirit of hypertext

origins of the WWW. Another point raised is that multimedia activity in the virtual classroom should be captured and associated with relevant course material. For instance, the teachers comments on a particular slide could be captured with the slide in question. Also the conversation of students working on group could also be recorded and stored with the exercise.

Course material could be presented as a hyper-document with the participant capable of navigating through the document or choosing the prescribed ordering of the presentation. In addition, the participant could also be given access to the more traditional learning material, for example, notes, books, etc. Course assignments could also be electronically submitted to promote fast feedback on performance. An important element of assignments and project work is the need to allow participants to co-operate in groups.

4. 3 Network Architecture of Tele-education System

From the application’s point of view, network operates as IP (Internet Protocol) network routing both multicast and unicast IP packets. Connection from network level to the Q-adapters managing the switches communicate via ISO stack over X. 25 links, but apart from this instances all network infrastructure is in support of IP traffic. This network structure connects seven sites.

The aim of the logical network infrastructure is to provide stable network interconnections as well as to be managed to some extent by the network management, and to provide a working, broadband network infrastructure while also supporting an enterprise model suitable for multi-domain

environment. For the separate customer networks, each sites posses of LANs of Ethernet, or mixed ATM/Ethernet LAN technologies. For maximum efficiency of scarce international, broadband resources, only one site in each countries (that taking part in Tele-education system) are connected. The connection, internationally connected customer sites access the public network ATM service via an ATM cross-connect (ATM XC) providing ATM public network provider's Point-of-Presence (POP) in each of relevant countries. Each customer sites posses ATM Customer Premises Equipment (CPE) which is used to interconnect ATM public network with local routers. For the connection within the same country, it is performed via leased lines between routers at internationally connected customer sites and sites not connected to ATM public network provider. The ATM CPEs at internationally connected sites and routers at all customer sites managed by VPN (Virtual Private Network) provider. It is performed in concert with management of ATM public service by VPN provider to provide Intranet style connectivity between hosts on customer site LANs. This network is quite complicated because it connects seven sites in four countries and consisting of the following core components:

„ h Four ATM LANs

„ h Seven Ethernet based LANs

„ h Four ATM Cross Connects

„ h Eight static IP routes

„ h Seven multicast routers

„ h Two 2 Mbps leased lines

„ h Ten International ATM links (virtual path)

„ h One basic rate ISDN link

The following is the figure of logical network infrastructure:

Figure 4 : Logical Network Infrastructure.

The ATM infrastructure that represents ATM public network provider consists of a single ATM XC at each internationally connected sites. These XCs are interconnected by permanent VPs (Virtual Paths). The ATM CPE at each site based on one or more Fore System ASX-200 switches. It is employed as logically separate ATM LANs besides as providing ATM access between public network and routers at each site. The following is the figure of ATM configuration.

Figure 5 : ATM Configuration.

The IP configuration consists of routers at each connected sites being connected by Permanent Virtual Channel (PVC) running over VPs. The routing function at each site performed either by dedicated hardware router or by workstations running routing daemon software. Routing of multicast IP packets (used for multimedia conferencing applications) is not fully supported by most current IP routers, therefore, routing performed by multicast routing daemon (mrouteds) running on workstations. The mrouteds are interconnected by unicast IP tunnels, which can be used to be routed via routers together with all other unicast traffic. The IP tunnels between

mrouted at internationally connected sites used the second sets of VPs. This supports partition of multicast traffic from other unicast traffic and thus enables provision of more deterministic Quality of Service (QoS) for multimedia conferencing application.

For external infrastructure, the aim is to provide international ATM links between IP routers at the customer sites. Parallel VPs are used between each pair of sites; one for multicast routing and another one for unicast routing.

Figure 6 : The network configuration

Reflecting the contemporary trends in multimedia and information services, all software communication is over IP, including management system traffic. For the network infrastructures that are conducted at a single site, the requirement its network is fairly simple, requiring simply Ethernet connection to support IP communication between PCs and workstations. If the system includes the management of connections over IP switches, then the network infrastructure would include both a representative public network ATM cross connect and customer premises network ATM work-group switch (a FORE systems ASX200). These are connected and configured with multiple VPs to emulate a network with a larger number of nodes. IP routing functions in this network are provided by the SPARC workstations with ATM interface cards performing IP forwarding.

The following is the network configuration of this kind of network:

Figure 7 : Network configuration

For this network configuration, the TES Customer is able to request the set-up of a new connection to the TES provider. The TES provider then requested the VPN provider to do likewise. The VPN provider made a request to the Public Network Provider and Customer Premises Network Provider to ensure that the end-to-end IP/ATM connection was in place for the TES Customer. This is the goal for the configuration scenario.

One of the most important on an ATM network level management system is to provide end-to-end connectivity across constituent ATM network element, and so support the connectivity provisioning with fault management and quality of service features. Challenged by these requirements, a system that is able to set up ATM Virtual Paths and to correlate faulty conditions, determining how these fault effect the connectivity for each end user has been built. The following is the Network infrastructure of this system:

Figure 8 : Network infrastructure

The figure shows that all the network equipment is connected to one Ethernet hub, that is, the hub that acts as a backbone for one Public Network domain and two Customer Premises Networks. In reality, this hub could be partitioned into a number of internets that are inter-connected by routers, also known as the Internet.

For the network that is required to operate over six sites in four different countries, would require a much more comprehensive network infrastructure. This infrastructure consisted of an ATM VP service, leased lines, and the internal ATM and IP network infrastructure. The following is the example of this network infrastructure :

Figure 9 : Network infrastructure

4. 4 Performance of Tele-educational Service

4. 4. 1 Courses

There were two courses, both aimed at students with above average prior knowledge of computing and/or computer networks. The first, an introduction to SQL, was a self-study course, consisting mainly of modules of written text with assessments based on these. The second course, an introduction to ATM, was led by a tutor and involved varied methods of delivery, including lecture/seminar, individual study and group work. Students were therefore expected to interact both with one another and with the tutor. This course, too, included assessment modules.

Both of the courses were offered over a three-day period and students were expected to participate for three half days. Within this time, those taking the SQL course was able to pace their own study. On the ATM course, the students?¦ use of the different resources was timetabled and directed by the tutor. Time was divided between events, such as lectures, at which all students were expected to be present, and study time, during which they would work through a series of modules, with assessment associated with each one.

4. 4. 2 Students

There were 16 students on the more interactive of the two courses, the Introduction to ATM, and a similar number on the self-paced study course, An Introduction to SQL. All the students appeared to be experienced computer

users. This has to be accepted as necessary in a trial such as this , which takes place in the context of a research project which uses leading edge technology, some of it is still being tested. The prototypical nature of parts of the system may make unusual demands on the students, such as imposing unexpected delays. Having students who appreciate the difficulties may well be important. Having said this, it appeared that although they were knowledgeable about computers, these students were not experts in networked multimedia technology, and did need some initial training in the use of the software. This was given prior to the start of the course.

The courses were clearly directed at this target group, as their titles suggest. The students also stated that they had a genuine wish to learn the subjects being offered and that this was a major motivating factor. They were also paid for their participation, which may have helped improve their persistence when there were technical hitches.

4. 4. 3 System

The system used for the ATM course is described here. Those taking the SQL course used only those parts suited to self study. There are three main elements: audio, and video communications channels support a Tele-education system built on a web-browser base, but with considerable functionality added.

The audio tool, rat, allows participants to receive and transmit audio, to identify who is speaking, control the volume of incoming and outgoing audio streams. Since this tool was developed as a research platform, there are many extra features which the average end-user is not likely to use in an

application such as this one, for example, the facility to change the audio encoding scheme. The tool?¦s basic functionality is easy to learn and use.

The video tool, vic, also offers functionality suitable for its use as a platform for research into networked video. For the non-expert, however, the most important features are that multiple users can send and receive video simultaneously and that they can control some features of both display and capture/transmission (image size and frame rate are two examples). Video images can be displayed at various sizes from thumbnail image to CIF. Enlarging images does, however, involve creating a new window for each one.

Students access the Tele-education system via a web browser and navigate within it using hypertext links, buttons and active areas of images. Initial access is password protected and the system supports the notion of groups and hence, presumably of multiple classes and tutorial groups.

The interface is based on the metaphor of an educational institution, a building divided into rooms whose function most students will be able to predict from their real-life experience of education: classroom, tea room, hall, office, library and seminar room. Users are presented with an aerial view of the layout, in which the rooms are labeled. They gain access to a room by clicking on the appropriate part of this image. The resulting window sometimes maintains the metaphor but is more often mainly textual – a list of hypertext links, for example. Once “ in” a room, students have access to the resources they need for the part of the course they are taking.

As might be assumed from the description, the system is intended to support a mixed mode of course delivery, including lectures, group discussions and assignments, individual study, assessment with feedback. The existence of the office implies that students can also access relevant course administrative information. The Hall and tea rooms suggest that the intention is also to support less formal, social interactions.

4. 4. 4 Positive Findings

The courses both seemed to be appropriate for the target group. Students reported that they believed they had learned a considerable amount and felt they would retain the important points. The pacing of the study also seemed successful.

The tutor clearly had a sense that this was a real class in a real institution and made considerable efforts to generate a relaxed and positive atmosphere. Use of students?¦ names, and greeting them as soon as they logged in, contributed to this. This is no mean achievement, given the constraints. The tutor tended to refer to the environment as if it were a real place, arranging with students, for example, to “ meet in the tea room” or telling them to “ go to the library”. Whether the students shared this perception is less clear. This may be due to the short time available to become familiar with it. It would be interesting to see whether the environment would become more “ real” to the students over a longer course.

The room-based structure therefore seems to have been successful. The metaphor seems to have been well chosen, since students seemed to have

appropriate expectations of each “ room”. None of them appeared to have difficulty navigating between different rooms. Observation did show that some students had to scroll up and down repeatedly, however, when they were working on individual study texts. This seemed particularly to be the case where they found the material more difficult. Again, there was no sign that they were unsure of where to go or had difficulty in navigation.

In terms of course delivery, the trial showed that students experienced considerable variety in the ATM course (inevitably less so in the SQL course). Not only this, but the tutor seemed able to exploit the flexibility of the system and to direct the student to alternative areas of study from what had been planned originally, if necessary. One of the problems with distance education is that such flexibility can be harder to achieve than in a face-to-face situation, so this is promising and an interesting result of having different applications integrated in this way. It also has a pragmatic use: given technical problems in one area, it was possible to shift students to another activity quite easily.

Interactivity, both structured and casual was potentially considerable. The shared whiteboard used for group work was perceived by students as a good feature. It seemed, however, that they did not all realize at first that they could write and draw on it. Perhaps this should be pointed out in the introductory sessions, or the whiteboard should be accompanied by a short explanatory note. It would also be fair to say that this was not a long enough trial to assess usability of this part of the system.

In the limited time it was also not easy for students to establish relationships. The system and the way the tutor used it did encourage students to get to know one another since, for example, one of the first activities for students was to upload their CVs and pictures and to browse through those of other students.

The level of concentration appeared to be high. Naturally, as in a classroom, there were moments when students?¦ attention moved away from the subject of study but these were not frequent. Interestingly, they usually stayed at the workstation but moved to another activity such as reading e-mail. The students observed “ live” appeared to maintain concentration despite considerable background noise and other potential distractions. This is not a surprise, since other computer-based teaching and learning trials have drawn similar conclusions – but it is another promising feature.

At best, the material with which the students were engaged appeared well designed for delivery on a computer screen. The information was “ packaged” into manageable chunks and was visually stimulating. Diagrams, colour and animation were used effectively, and the layout was clear and appealing. As the next section suggests, however, not all of the written material was so suitable for this method of presentation.

Feedback was given to students both by the tutor, during discussions (for the ATM course), and as a result of assessments done at the end of each module. Students appeared to take these assessments seriously and were observed to return to the relevant part of the notes when unsure or when they had given an incorrect answer. The scope of this evaluation did not

extend to assessing the course design or the assessment methods, but it is worth mentioning that the regular assessment seems to have been a successful feature of the course.

Awareness of other students is something that is hard to achieve in distance education. Interestingly, with the audio channel left open during private study periods, it appeared that students experienced something similar to working in a library with other students around them. They were able to hear conversations and could have asked questions if they needed to. The potential disadvantage is that the additional background noise might interfere with concentration. It would probably be worth investigating whether the availability or otherwise of the audio channel makes a difference to students.

4. 5 Operation and Management of Tele-education Service

A vital element of any service is the reliability, configurability and administration of that service. In order to ensure success of an educational service from both the participants?¦ and tutor?¦s perspectives, the delivered service must be well managed and monitored. It is crucially important to realize the software and procedures necessary to manage and deliver Tele-educational services over broadband networks.

Four basic principles for successful teaching in a virtual classroom environment have been identified as

„ h media richness,

„ h interaction,

„ h timely responsiveness and

„ h organization of materials.

Media richness and interaction mechanisms can be satisfied by the educational services described earlier. The organization of course materials and the insurance of timely response by systems, participants and tutors are goals of the management service. During the delivery of a course, there is a significant mass of material presented to participants as well as a high degree of interactive responses amongst participants. Unless this mass of materials is organized and interaction controlled, participants can become confused and disillusioned. Proper maintenance and management of the dissemination of material must be put in place to provide an effective learning environment. Segregation of material, both between and within course modules should also be supported. The strategy of ?¦participant-paced?¦ learning is important so as to ensure that the class moves through the modules of a course together in order for the interactions to be meaningful.

Timely responsiveness has also been identified as a key requirement for Tele-education. Thus access to course material, as well as other participants and tutors, should be reliable and timely. To achieve successful operation of the tele-educational service, participant (on-site) software should be configurable for a wide range of computing environments. Also participation of the class members should be manageable e. g. course registration, controlling access to class discussions, automatic collection/distribution of

assignments and projects etc. The on-line management system should provide the range of services as required by each course leader.

5. 0 CONCLUSION

Tele-education system is a very new emerging technology. It has been applied in Europe and Canada, and is still under study in order to improve it from time to time.

From this project, it is known that Tele-education is a revolution of distance learning in which distance learning basically only provides asynchronous learning environment. But Tele-education has improved it by providing both asynchronous and synchronous learning environment.

After studying all the materials found for this material, it was found that Tele-education is not easy to implement. This is because there are a lot of things need to be considered before implementing such as what kind of network structures available, what kind of service can be provided by network service provider, what is the most suitable network for interconnection among the involved sites, etc. Another reason is that, after implementing it, there need to have several trials on the service to look at its efficiency which would take a long time.

In general, it can be concluded that Tele-education is becoming popular as the emerging of multimedia technology. Its advantages that could overcome the problem in current learning environment also has made it a preferable way of learning process.

6. 0 REQUIRED EQUIPMENT AND MATERIALS

The following are the equipment or materials needed for the completion of this project in third semester :

a) Opnet software (Sun workstation)

– used to perform simulation

b) TV Conferencing System with;

i. ISDN Interface

ii. H324 TV Conferencing Interface

iii. Small TV camera

iv. Speaker (stereo)

„ h this is required for some experiment purposes on Tele-education system

c) Satellite System with;

i. Antenna (2. 6 m)

ii. RF receiver (C-band)

iii. 2 Mbps TV conferencing Interface

iv. ISDN (2B+D) Interface

– Still under study/discussion

7. 0 SCHEDULE OF PLANNING (Timetable)

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