ACTS Project AC052

Prospect

Project Title: **A Prospect of Multi-Domain Management in the Expected Open Service Market**

Title of the Deliverable:

D53A: Evaluation of the First Trial Phase

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Abstract: This document is an evaluation of the first trial phase in Prospect. The purpose of the trial was to test management services as subscription, accounting, integration of multimedia tools, different providers (two courses), to get feedback from end users, and finally to provide an evaluation (current document). The projects approach to the development cycles of multi-domain management systems is also evaluated. The evaluation of user applications is based on end user questionnaires, and external evaluators, and development cycles were evaluated by Prospect software designers.

Keywords: tele-education trial, management, evaluation, recommendations

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Executive Summary:

This deliverable describes the outcome of the efforts the Prospect project has invested in terms of practical set-ups for demonstration and evaluation purposes. The preparations for this trial are described in the deliverable D51A.

A tele-education service has been implemented with two examples of tele-education courses, to establish a realistic environment for evaluation of management of multi-domain, multi-provider networks.

The first tele-education environment is a self-study based application (it is a SQL course). It is accessed via the Internet to a server. The requirements to the user (student) equipment is just an ordinary PC with standard software, and Internet access. The application is applicable for a large amount of users who can access the course independent of each other.

The second tele-education environment is a combination of the lecture-, group work-, and self study-parts of the tele-education service. To subscribe to this tele-education environment, UNIX workstations with video and audio facilities are required; but the project committed itself to include the potential less costly PC platforms. The application is a virtual class room, and the number of simultaneous users is limited by the available bandwidth (in this trial about 15).

A management environment has been developed for both tele-education applications.

The purpose of Trial 1 was to test management services like subscription, accounting, integration of multimedia tools, different providers (two courses), and to get feedback from end users.

The evaluation procedure for user applications is based on end user questionnaires, and external evaluators, and development cycles were evaluated by Prospect software designers.

The evaluation of the tele-educational environment and the courses was based on questionnaires and narratives. Each day during the course the students provided feedback on their experiences. Also some evaluators participating only as supervisors provided their observations.

The evaluation of the course showed that the student were generally very satisfied with the virtual course environment. There are still problems with the multimedia tools not being stable which caused problems for the students.

The infrastructure connecting partners nationally as well as internationally was set-up manually. The approach was to establish and test first the international ATM links followed by the configuration and test of multicast routers and unicast IP routing. During the trials the unicast IP connectivity often broke down for several minutes. The problem always ceased with no intervention, and the reason for this was never concluded.

The international ATM network was provided by JAMES. The links were set-up manually; internationally by JAMES and nationally by the individual Prospect partners. The national connections consisted of ATM over SDH/PDH, E1 dedicated links and Basic Rate ISDN.

The evaluation of the service infrastructure was not conducted since it was not available at the time of the course.

The large amount of analysis, design, implementation and testing that was performed up to Trial 1 provided a valuable source of information for evaluating the projects initial approach to the development cycles of multi-domain management systems. This involved the assessment of the projects experiences with ORDIT requirements analysis, Jacobsen’s use cases, Rumbaugh’s Object Modelling Technique, OMG’s Interface Definition Language and ODP viewpoints.

The most important area for improvements are related to the integration of the tools. A better integration of the audio and video tools with the course environment and a “floor control system” (used for navigation within the tele-education environment) is needed. Some of this were planned but not implemented for the trial. There is also a need to improve the multimedia tools especially for the PC environment. Some better tools for co-operative work are also needed.

In the development cycle, advantages were found in using object oriented modelling techniques such as those of Rumbaugh and Jacobsen. Contrary to this, ODP viewpoints, while helpful in separating some design concerns, were not very suitable for iterative development cycles.

1. Introduction

Trial 1 is described in the previous deliverable, D51A: Operational Plan for the first trial. During week 11 and 12 1997 the trial has been executed. The results of the efforts are described in this deliverable.

A series of tests has been performed during the trial period. There are two parts of the trial: one deals with an off-line tele-education course using the Internet, and the other is a virtual class-room education situation using broadband telecommunications networks. Project external students have been involved in the trial, to provide the users perspective.

One course is applicable for Internet users. It was designed specifically to run on a server which the student may logon to on any time convenient for the user.

In the other course a virtual class-room is implemented. It was an objective to make the course situation as natural as possible. To realise this, existing applications was used, some had to be further developed. Since the pre-trials, especially the voice and the white board applications have been improved.

The students in the trial were placed in Berlin, London, Dublin, and Copenhagen. The teachers were in Copenhagen, and London.

It was the objective of the trial to gain experiences with tele-educational services, and especially with management facilities for such demanding courses. The results will be carried over to the next trial, scheduled for winter 1997-1998.

It was planned that the infrastructure and the applications should be integrated during week 11. On the IP level a static routed closed network was planned. A number of applications necessary for the tele-education service were used on both PC's and UNIX platforms (e.g. Netscape, vic, rat). Some efforts have been invested to include to also include PCs. Therefore the PCs must be equipped with relatively expensive video and audio hardware. In addition to this a large variety of software products was required to provide a satisfactory tele-educational environment that supports also PCs. Most of the software was actually newly developed. Some software modifications were done by the project.

The networks were continuously maintained. ATM, ISDN, APL. IP routers were configured according to a plan, developed by WP 3. The direct ATM-connection between Broadcom and TDK was not running. Therefore the IP routing was done via UCL.

The DSC cross-connects were set up at three sites, and the Network Level management system was able to set up and take down ATM cross connections at these sites. However, the VP connections available from the JAMES network was never switched through the DSC switches, in order not to take unnecessary risks of disturbing the tele-education trial.

The tele-education trial was evaluated using questionnaires by the end of the session. In addition the course was monitored by appointed supervisors.

In chapter 2 the tele-education courses are described. First the course environment is explained. Then an overview on the on-line ATM course and the off-line SQL course is given. Finally the tele-education facilities are described.

Chapter 3 explains the evaluation procedure. There are four categories of evaluation: requirement analysis versus system functionality, end user questionnaires, independent evaluators and experiences during design and implementation (with focus on principal problems).

The results of the evaluation are described in chapter 4. The end user feed back is summarised in the first section, containing evaluation of on-line lectures and self study, group work, and a general evaluation. Then the network and service infrastructure is evaluated, and finally experiences from development cycles are given.

The results of the evaluation of Trial 1 is given in the form of recommendations in chapter 5 for the tele-education services, the tele-education hardware and software, and the development cycles.

Appendix A contains the questionnaire for the designers/implementers is given. The end user feedback is in Appendix B, and the results of the two independent (project external) evaluators are in Appendix C.

The evaluation of management functionality will be included in deliverable D21B.

2. The TES Courses

2.1 The Tele-Educational Environment

A model describing the organisation of Prospect tele-educational courses has been developed, in order to illustrate how an Open-Service Market can be of benefit in the creation and operation of tele-education courses. It identifies the generic stages within a course and describes the forms of interaction between participants (tutors and students) and maps these interactions at the various stages of a tele-educational course onto possible communication/mediation mechanisms. Several forms of learning have been identified which the Prospect Teaching environment wishes to support. These learning forms are:

1. *Self Learning* - delivery of formatted course material for students own study.
2. *Lecture Presentation* - a one-to-many presentation by a tutor of course or organisational material.
3. *Exercises* - the facility to perform exercises either in groups or individually.
4. *Project work* - the development of sizeable projects using software outside the teaching environment.
5. *Discovery/Reference Search* - ability to locate and access background or supplemental learning material.
6. *Seminar / Class Discussion groups* - many-to-many communication between participants.
7. *Consultation* - private one-to-one communication between participants.

There is some overlap between these learning forms e.g. exercises, project work and discovery/reference search can be part of the self learning form, but all of the learning forms are listed here for completeness. To support the learning forms for the first Prospect trial, three partners acting as MMTS providers have implemented a multimedia tele-service each, providing both core and management services. The multimedia teleservices are briefly described as follows: *Video/audio conferencing service* - based on the MBONE tools VIC (video conferencing) and RAT (audio conferencing). This service supports conferencing via IP multicast routers and in Prospect management of subscription to the service and accounting of the use. *Hyper media service* - allows access to be provided to hypermedia information stored on a WWW server. *WebStore service* - 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:

Self study - individual work with web based course material including exercises and discovery/reference search. This paradigm is supported by the hypermedia and WebStore services.

Lecture - teacher to class presentation supported by the conferencing and hypermedia services.

Group work - discussions, exercises or project work performed by the students in groups. This paradigm can also include shared discovery/reference search. It is supported by conferencing, hypermedia and WebStore services.

Consultation - student to tutor consultation. Supported by video/audio conferencing and hyper media services.

In order to support these four paradigms the multimedia services are integrated into a tele-educational service (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.

These integrate the underlying multimedia tele-services and add some educational specific functionality to the service, including control of which learning paradigm to use, means for the teacher to present “slides” for the students and automatic correction of small exercises in the self study module. The functionality of the service changes during a course session, according to which of the learning paradigms is used. An example of the user interface for a student following a lecture can be found in figure a.

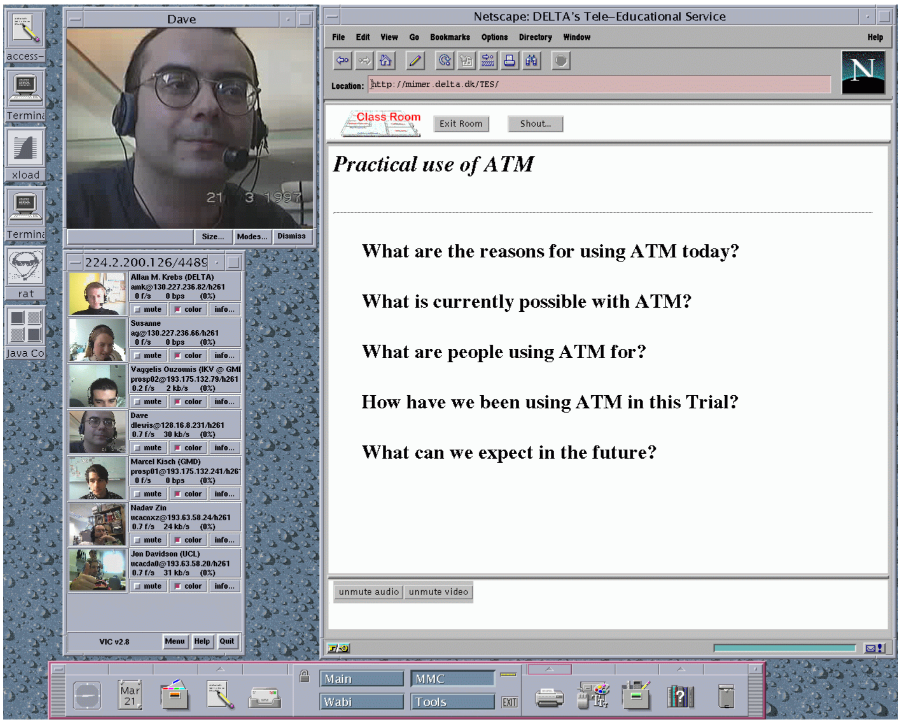


Figure A. A lecture in Trial 1.

2.2 The Tele-Education Courses

Two courses are provided for the first Prospect trial, both offered by the same TES provider, but developed by two different partners acting as tele-educational content providers.

2.2.1 Course 1: An Introduction to ATM

The course “An Introduction to ATM” provided as part of the Prospect trials includes both synchronous and asynchronous delivery methods. The duration of the course is four days with approximately three hours of teaching and studying each day. It consist of five lectures (one each day plus a plenary discussion at the end of the course), three self study modules and three group exercises with a follow-up discussion of the results. The different modules of the course are wrapped in a tele-educational environment which also includes course outline information, a database of participants with pictures and CVs, a WWW billboard supporting off-line discussions and a tea-room which participants can “visit” for informal “chats”. The lectures are performed by use of video/audio conference with use of a system to show slides on the participants web browsers. The self study modules are 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 thereafter returned to the teacher for correction. When the teacher has corrected the answers they are discussed in a conference with all the participants.

The outline of the course “An Introduction to ATM” can be found in table a.

Table A - ATM course outline

Tuesday 18th:	1300 - 1330(MET) 1200 - 1230(GMT)	Introduction *Class Room Lecture*
	(Self study)	"Background & The Switching Principle" *Self study module*
Wednesday 19th	1300 - 1345(MET) 1200 - 1245(GMT)	Exercise 1 : "Cell Switching" *Group room exercise*
	1400 - 1430(MET) 1300 - 1330(GMT)	ATM Adaptation Layer *Class Room Lecture*
	(Self study)	"ATM Adaptation Layer" *Self study module*
Thursday 20th	1300 - 1345(MET) 1200 - 1245(GMT)	Exercise 2 : "AAL" *Group room exercise*
	1400 - 1430(MET) 1300 - 1330(GMT)	Signalling overview (SAAL+UNI) *Class Room Lecture*
	(Self study)	"Signalling (NNI)" *Self study module*
Friday 20th	1300 - 1345(MET) 1200 - 1245(GMT)	Exercise 3: "Signalling" *Group room exercise*
	1400 - 1430(MET) 1300 - 1330(GMT)	Practical use of ATM *Class Room Lecture*
	1445 - 1515(MET) 1345 - 1415(GMT)	Plenary Discussion *Class Room Lecture*

2.2.2 Course 2: An Introduction to Relational Databases and SQL

This course is designed as a self contained, self-learning course. The course is for use by a large number of students (typically about 100 to 200 students concurrently accessing the course over a one month period). The course is presented in a sequence of modules each with a specific pedagogical goal and with self assessment questions to give feedback on the students understanding and comprehension. The multimedia course material integrates textual, graphical, animation and user interactions to provide as much student participation and stimulation as possible. The tutorial style questions in each module involve the student entering both free text answers (form based) as well as multiple choice questions. As the design of the course material is modular there are several “road maps” available which support differing profiles of educational experience and bias e.g. naive user, experienced user or database programmer. The idea is to provide various navigation paths through the modules based on the different level of knowledge of student groups. A teaching support service is also provided to facilitate any user queries or problems that may arise during self study activities. The teaching support service is also involved in correcting exercises submitted on-line and in providing feedback to the students. In order to provide further stimulation of the student in the educational course, student-student and student-tutor communication is facilitated by an integrated video conferencing, audio conferencing tools. To successfully put into practice the material presented on the course, access to live commercial databases are also facilitated. Such access provides a powerful means of reinforcing the principles and techniques presented in the course. This also provides a means of allowing the student to build large project based assignments, both individually and in group projects, which provide more focused practical experience for the students.

2.3 DELTA's Tele-Education Facilities

2.3.1 General Navigation

The "floor plan" and "tele port" window

After a user logged on to the system, part of the first page displays a floor plan of the course facilities. This floor plan is used to move from the hallway to another room.

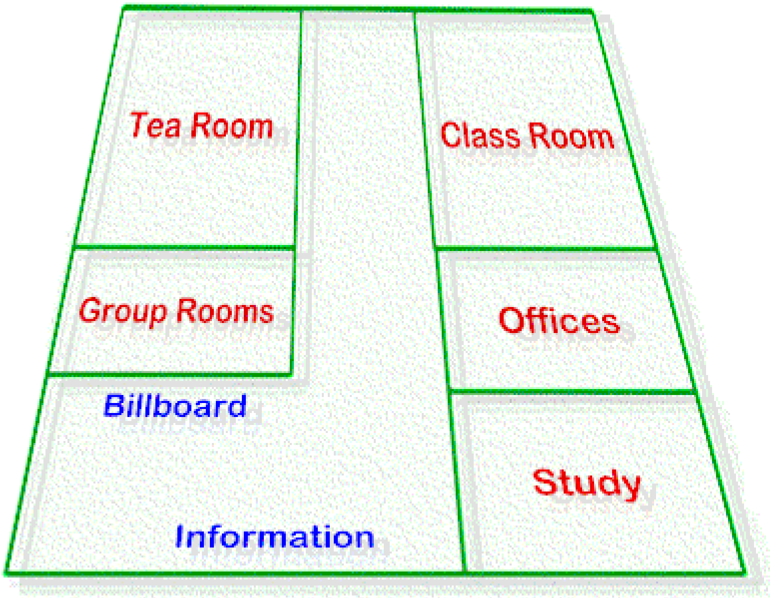


Figure 2. The floor plan with the course facilities.

Also on the top of the page, a small graphic and some buttons are displayed. The graphic is a small version of the floor plan, and will always display your current location. For instance, it will look like the example below, when you are using the "study".

Figure 3. The graphic that displays your current location.

This graphic can also be used as a button. When you click on it, a little window with the floor plan will appear, thus allowing you to "tele port" from one room to another, without having to step back to the hallway.

The "Exit Room" button

The "Exit Room" button will take you out of the room you are currently in, but it will not backtrace. That means if you have tele ported from an office to the study, "Exit Room" will not take you back to the office, but rather out to the hallway. Rooms can lead to "sub-departments", where from you can also return to the room. That means if you have entered the study, and then gone onwards to the self study modules, "Exit Room" will take you out to the main Study room.

2.3.2 The different rooms

The Tea Room

Here you can join in at discussions or informal meetings around different tables.

There are 6 tables - and each table has got it's own white board for sketching of ideas or just playing noughts & crosses.

The Class Room

Here the lectures takes places. Before a lecture starts, you can see who else is waiting for the lecture. When the lecture starts, slides will automatically be shown on you screen.

Group rooms

Here, up to six different groups can work on group exercises. Each group room will automatically be furnished with the tools necessary to solve the exercises. The group rooms are assigned by the teacher.

Offices

Here, the teachers offices are located. Choose the teacher you want to visit, and enter his offices. If he is in, you can have an audio/video conference. In the teachers offices there is also a white board.

The Study

In the study, you will find the self study material. You will also find references to material on the net, other references and you can review old lecture slides and group exercises. Here, you will also find evaluation forms and access to the WebStore.

Course Billboard

The billboard can be used to discuss subjects from the course with your fellow students - or ask questions, which both teacher and students can answer. The board will regularly be monitored by the teachers of the course.

Course Information

The information poster contains the time schedule from the course, descriptions and pictures of people participating in the course - both, students and teachers - as well as news and help pages.

2.3.3 Other facilities

The "Shout..." button

The shout button in the top-most control panel, allows you to send small written messages. If you want to transmit a message to everyone present in the course facilities use "<everyone>" as the recipient of your message. You can also choose a specific person as a recipient. Then only he or she will see the message. Messages sent using this facility, will popup in a little window on your screen - as long as you are in the course facilities.

The "Other Users In...." list

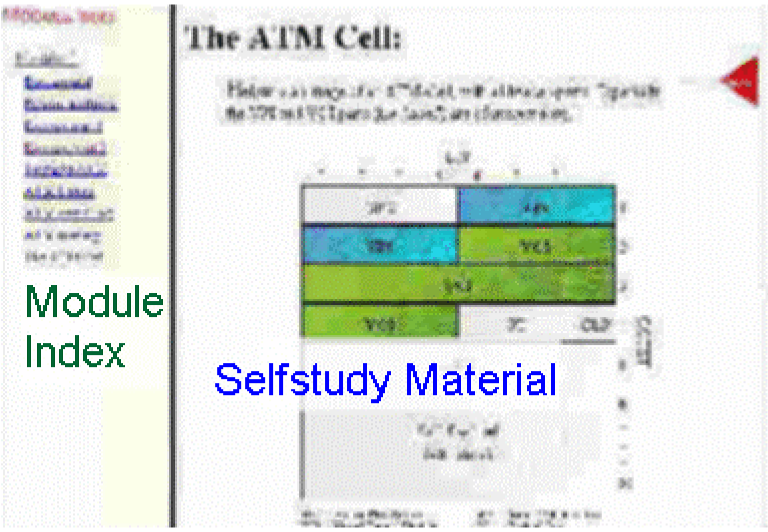
In some rooms, a list of other users in this room is available. Here, you can see who else is looking at the same material as you, and if you select a name, you get a small window, giving you the choice of either seeing some additional information on that person, writing a small message to him, or exiting the small window doing nothing.

The White boards

A general facility, available in offices, group rooms and at the tea-room tables, are white boards. These are shared white boards, i.e. everyone can see everyone else’s drawing.

2.3.4 The Self-study Modules

The Self-study module uses 2 HTML frames.



In the "Module index" area, you can see a table of contents and other links of the module. This area also contains a link to the "welcome"-page of the module. Checkmarks indicate pages you have already seen, and a red arrow marks the current page. Upon re-entering Self-study modules, the last page you visited will be automatically found and displayed.

In the "Self-study material" area, the material of the module is shown. In the bottom of each page here, you also find buttons which brings you to the next or the previous page. If there is more material, than can be shown on the page, a scroll-bar will appear in this area.

3. Evaluation Procedure

Objective assessment of the quality of a multimedia teleservice is a difficult task. On the one hand, several quality measurements exist, e.g. parameters like availability of the service and congestion in the network. On the other hand, the main goal of a teleservice provider is to meet the requirements and demands of its customers and users. But judgements of human users are often subjective. An appropriate way to overcome this problem is the development of questionnaires with specific questions.

A further problem is caused by the different skill levels of the end-users. A large number of users may have extensive experiences with computers and network services and may also have a profound knowledge of the internal design of telecommunications services. For others it may be first time they ever use such a service. In order to avoid misinterpretation of end-user comments, Prospect decided to define two user groups: users having a basic understanding of computers and networks, and experts with deeper insight in architecture and design of telecommunications services as well as basic knowledge of tele-teaching concepts.

The assessment of the Prospect tele-education service is merely based on interviews of users and experts. Additionally, experiences made during design and implementation of the service have been collected.

3.1 End-user questionnaires

Participants in the field trial were asked to fill in questionnaires, separate for students and administrators. Nearly all students and administrators answered the questions completely.

The purpose of these questionnaires was to have an evaluation of the virtual course environment from the students point of view. The students were asked to evaluate the course environment, the contents and presentation of the courses, and the tools (audio, video, white boards, WebStore, etc.).

In a separate event a number of management experts familiar with concepts like TMN, TINA, etc. were asked to evaluate the management part of the tele-services. The user interface of the tele-education service was trialed and some management scenarios were executed. The questionnaire the experts were asked to fill in covered areas like quality of the interface, e.g. ease-of-use, and the provided functionality. In addition, some questions asking for end-user requirements and future developments were included.

3.2 Reports of independent evaluators

Several experts with deeper knowledge of tele-education concepts followed the course and commented on course composition, on course content, and on the quality of the multimedia services used. Also future improvements and enhancements of course and services have been suggested.

3.3 Experiences made during design and implementation of the system

During design and implementation of the tele-services and their management components the project gained a lot of experience with modelling techniques, i.e. modelling notations and processes. The methodology used is described in document AC052/TCD/WP2/029 ("Prospect System Modelling Methodology for the Design of end-to-end inter-domain management services in the open service environment"). A questionnaire was developed in order to obtain information on, amongst others, the following issues:

- To what extent the WP2 methodology was followed in developing the individual parts of the Trial 1 system?
- In what way, if any, the process and notations actually used by developers varied from those prescribed by WP2?
- Which parts of the method actually used were found to be useful and effective and what parts were found less effective, and difficult to use?
- How useful were the techniques used when applied to the reuse of requirements, specifications and implementations?
- How could the methods and techniques used might be improved from a developer perspective?

All partners involved in the developing process filled in this questionnaire.

4. Evaluation

4.1 Tele-Education Courses

The end-user evaluation was organised with questionnaires and narratives. The first, the second and the fourth day each student was asked to fill in a questionnaire related to the activities performed that particular day. On the third day the student was asked to write a narrative giving a more free style feedback on their experiences from the trial. The student feedback is given in this chapter.

4.1.1 Evaluation of group work

Most of the people thought that their group work went on well, even if there has been a number of problems. To do group work with totally inexperienced people in unfamiliar surroundings is difficult. The general opinion about the group work facilities was good and the students were satisfied with the whiteboard and especially the audio communication. The quality of the video could be better.

Here are some of the problems the students experienced during the sessions:

- It took quite a long time to “find each other” and to get started with the assignment.
- It was quite easy to solve the simple assignments together but it was much harder to solve the tougher assignments.
- Working on-line is difficult, because the people in the group did not focus at the same things on the whiteboard. It can be difficult to explain things, when you are only using the whiteboard and the voice.
- It is more difficult to talk and explain on a computer screen and drawing with the mouse is not easy (the whiteboard facilities should be improved).
- When it becomes difficult to explain things to the other group members, people tent to solve the assignment themselves and they only start to corporate again when they have the solution. It is much easier to solve the assignment on paper locally.
- It would be useful to have an extra whiteboard to take notes on and to illustrate things.
- There should be links from the group room to the used books, so it would be easier to study the relevant pages during the group work.
- It is a good thing to maintain the same groups and this would improve the social relations. It takes longer time to build friendship on-line and there should be at most 4 people in a group.

4.1.2 Social relations

In distance education it is much harder to build up social relations and there is not the same amount of talking before and after the class. People do not get to know each other in the same way as they would do in a normal classroom. A combination of traditional education and distance education is preferable.

During the lecture it was easier to contact each other without disturbing the rest of the class and

the shout button was a good way to get in contact.

4.1.3 Lectures

A good thing about distance lectures is that you are not dependant of the physical surroundings and everybody can have a good for view on the teacher and the slides.

But when the video quality is too bad the teacher has no chance of getting feedback from the students, and it can be hard to sense if the students understand what the teacher is talking about. The same situation occurs among the students. When they can not see each other, it is easy to get the feeling to be the only one who do not understand the lecture, and to become afraid to ask questions. People do not want to interrupt the lecture by talking to the teacher. There should be another way to let the teacher know that someone want to ask a question. So the communication in the classroom is like a one-way communication.

When the teacher is showing slides it is very important that he points at the slide so the students has a better chance to follow.

It is more difficult to understand the lecture when the students can not see the teacher “live” and when the sound is a little noisy, it is very hard to concentrate. In general people have to be much more concentrated during the lecture and the maximum length of a lecture should be 30 minutes. The lack of not being physically present makes it much harder to cope with the lecture and it is hard to concentrate in front of a computer for a long time.

In distance education the students can be interrupted in their office during the lecture, etc. the phone is ringing or people can enter the office.

4.1.4 Self study

When you do self-study on the computer the animations and links are a very good way to improve the understanding. But if you have to read a lot of stuff on a computer screen, it is very hard to concentrate. There is two things that are very important with readability of texture:

- To many links can destroy the readability of the text and the size of type is also very important.
- A good idea could be to record some of the text on tape, so the students could listen instead (with the opportunity to play part of the tape again).
- The opportunity to get a quick answer on the assignments is a very good idea.

4.2 Network Infrastructure

4.2.1 Evaluation

Overview

The aim of the Trial 1 network infrastructure was to provide stable network interconnections for Trial 1 applications, as well as to be managed to some extent by the network management.

The Prospect Trial 1 network was quite complicated, connecting seven sites in four countries, and consisting of the following core components:

- seven Ethernet based LANs
- four ATM LANS
- four ATM Cross Connects
- eight static IP routes

- seven multicast routers
- two 2 Mbps leased lines
- 10 International ATM links (virtual paths)
- 1 basic rate ISDN link

figure 4 gives an overview of the network infrastructure, identifying the partners and countries involved, the inter-site connections mechanism and the trial network management domain model applied to the infrastructure in the trial.

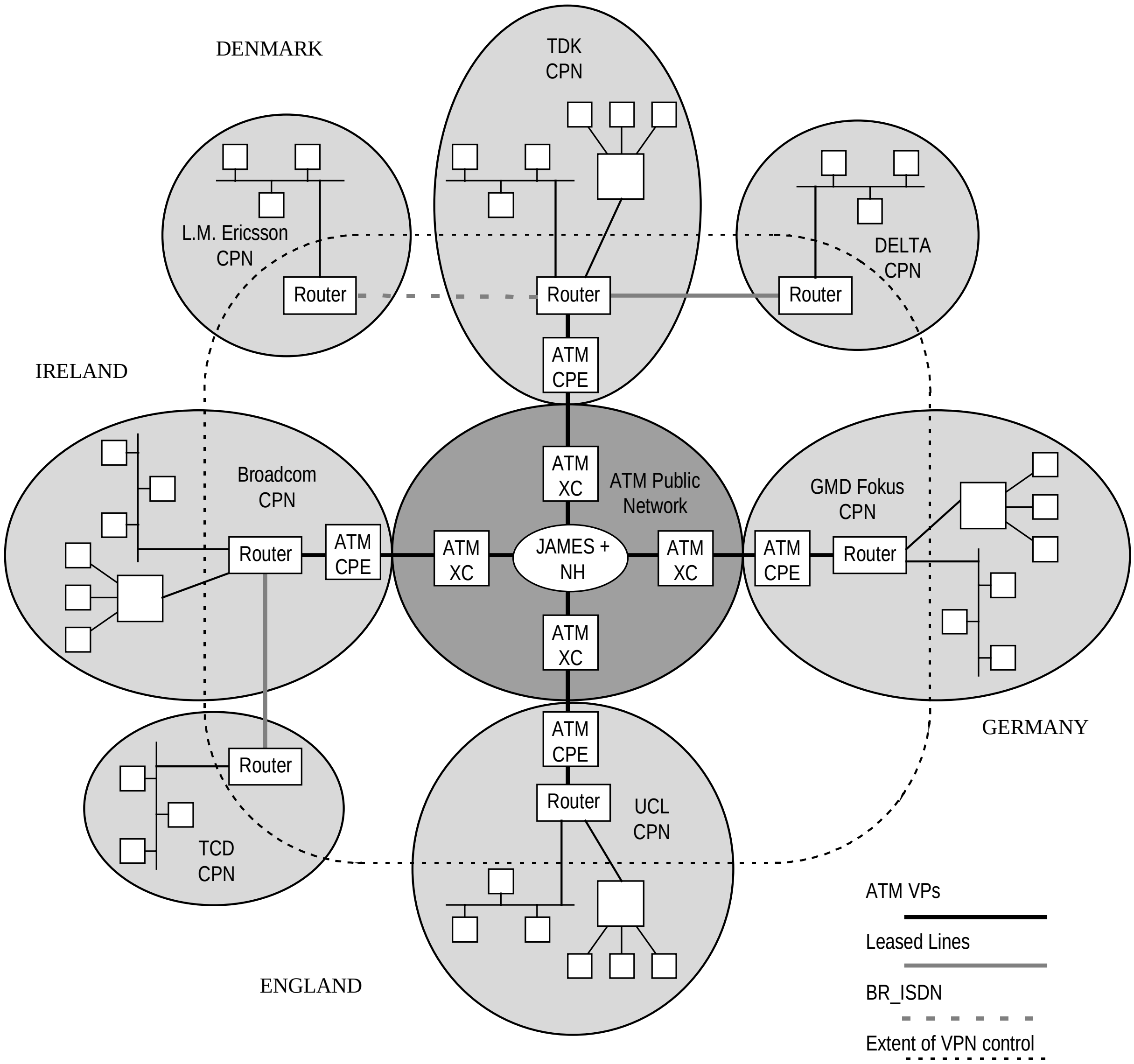


Figure 4. Trial 1 infrastructure and network management domain model

The network infrastructure used splits into the two following categories:

- network infrastructure operated and managed directly by Prospect partners
- network infrastructure operated by organisations not involved in Prospect, i.e. the JAMES project and the National Hosts (NH).

This evaluation is therefore split between experiences in these two areas, so that the resulting recommendations can be more clearly targeted.

4.2.1.1 Prospect partner infrastructure

Aim

The network infrastructure operated by project partners was primarily aimed at:

- providing unicast and multicast connectivity to other partner sites,
- offering manageable network elements to the network management systems being trailed.

Organisational Issues

The set-up and co-ordination of the network infrastructure was found to be a complex task. Close co-operation was required especially in the following areas:

- configuration to use and the testing of international ATM links
- configuration of multicast routers
- configuration of unicast IP routing

This was complicated by the fact that some partners operated several IP subnets and that some partners needed to provide routing services to other partners who did not have direct connectivity to all other partners.

In addition different partners operated different security mechanisms, some allowing full IP connectivity with strong password protection for hosts, while other partners used firewalls. This required careful configuration of firewalls to ensure that all the application traffic used in the trial was able to pass.

Set-up of connectivity

Setting up of connectivity between subnets and hosts was a time consuming operation, partly due to problems with JAMES and the NHs (see next section) and partly because routes to all other sites had to be entered manually, hence the need to good co-operation in exchanging routes to specific hosts and subnets.

One problem this presented was that it denied the use of ping to hosts inside the firewall, making quick connectivity checks more difficult.

Performance

Detailed performance measurements were not taken, principally because of a lack of easy to use tools and partly due to the complexities of running tests in parallel with user trials.

The multicast applications used gave a continuous measurement of the end-to-end loss experienced by audio and video traffic, and the former loss of audio quality was easily detected by the listener. Problems with these were usually remedied by users being asked to reduce the rate at which they were transmitting video. No detailed record of multicast tunnel usage measured against the load being imposed by conferencing applications was made.

Unicast IP performance was found to be problematic, with connectivity often appearing to disappear for several minutes at a time, though this tended to correct itself without external interference. This caused problems with the HTTP-based applications during the trial, manifesting itself as Web browsers halting temporarily. The reason for this has not been established with no pattern related to specific sites or links being established, though the resources that were allocated to this diagnosis were very limited. It is not known whether this problem was at the ATM level (though the multicast performance over parallel VPs did not exhibit the same behaviour), at the IP routing level or some combination of the two.

Some performance problems were also found in equipment where ATM traffic shaping was done. In particular performing ATM traffic shaping in a Fore S-Bus host adapter in a SPARC workstation that was performing multicast routing seemed to cause excessive cell loss in the adapter. Transferring the traffic shaping function to the ATM interface of the CISCO router resolved this problem.

In addition routing across ATM LANs was performed using PVCs rather than SVC (in this case using Fore's SPANS protocols) since it was suspected that the circuit set-up time might cause problems, though this was not determined conclusively.

Reliability

Though dedicated router boxes, e.g. CISCO routers, were found to be very reliable, where unicast and multicast routing functions were performed by UNIX workstations they were vulnerable to problems with system configuration or system failures experienced by such machines. Multicast was found to be slightly more robust to such outages since if alternative routes were available they were taken automatically, whereas the manually configured unicast routes did not do this.

Manageability

Management of partner infrastructure consisted of:

- configuring ATM PVCs on ATM LANs between JAMES access points and both routers and ATM XCs;
- configuring routing tables in unicast routers;
- configuring multicast tunnels between unicast routers;
- configuring IP routes to use the correct ATM PVCs to other sites;
- configuring routers to use leased lines or ISDN where needed;
- ensuring correct configuration of traffic shaping parameters for PVCs passing over JAMES;
- configuring ATM hosts to use ATM LAN interfaces to access the Trial 1 network.

Virtually all this configuration was performed manually, either by partner personnel or remotely by appropriately skilled people in other partners where partners were agreeable to this. There was no global mechanism to monitor the status of people at other partners' routers and switches, which sometimes proved problematic if local staff were not available and problems were being encountered in use of the network.

Recommendations

The following recommendations are proposed for Trial 2:

- a single source of information on the following should be kept consistent, up to date and free accessible by partners, e.g. on a WWW server.
- Partner operating firewalls should ensure that hosts inside the firewall operate some mechanism for easily checking connectivity, e.g. a telnet demon or a HTTP server listening on a specific port.
- Setting up and maintaining IP connectivity using manual routing is simplified by minimising the number of different subnets and hosts routed to, and preferably by using subnet routes where possible.
- The intermittent connectivity displayed by the international unicast IP links needs to be diagnosed and corrected.
- Appropriate measure should be taken to ensure the reliability of workstation based routers, i.e. either more stable and robust systems management and/or provision of pre-configured backup workstations.
- Mechanisms should be investigated to monitoring status of all partners' network elements remotely, either by providing suitable accounts and access right at all sites, or via SNMP, though here a suitable managing application would be required.

4.2.1.2 External Infrastructure

Aim

To provide international ATM links between IP routers at partner sites. Parallel VPs were used between each pair of sites, one for multicast routing, which was also subject to network configuration management by Trial 1 system, and one for unicast routing that was unmanaged.

figure 5 shows how these international ATM VPs were used in more detail.

figure 6 gives an overview of the Trial 1 network configuration.

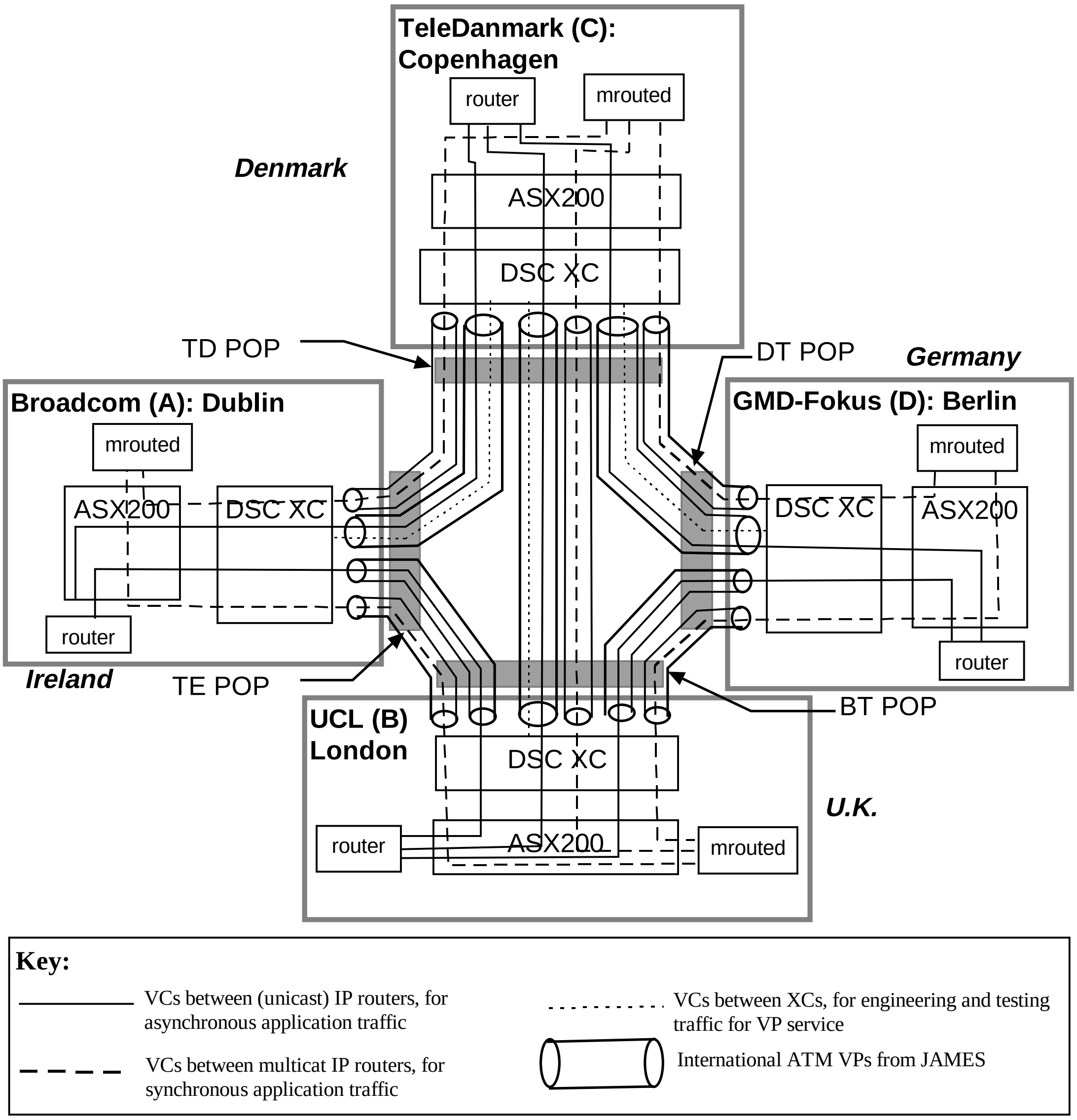


Figure 5. Use of international ATM VP in Trial 1

Organisational Issues

Many of the organisations problems experienced with users of JAMES have been at a very basic level of communicating information related to the tracking of provisioning of VPs and reporting and tracing of faults with VPs. What seems to be lacking is a common way of identifying VP that is used across users, JAMES partners and NHs. The current system uses the name of the project, the names of the end-points (user sites), the VP schedule and the VPI values in various combinations to identify a VP. This can prove ambiguous in communications between user, NH and JAMES partners when:

- more than one VP passes between any two sites for a single project
- VPI values are switched somewhere along the way
- a VP is requested with an interrupt in its schedule
- a VP is requested with a change in bandwidth scheduled in its life-time
- if point-to-multipoint VP were used

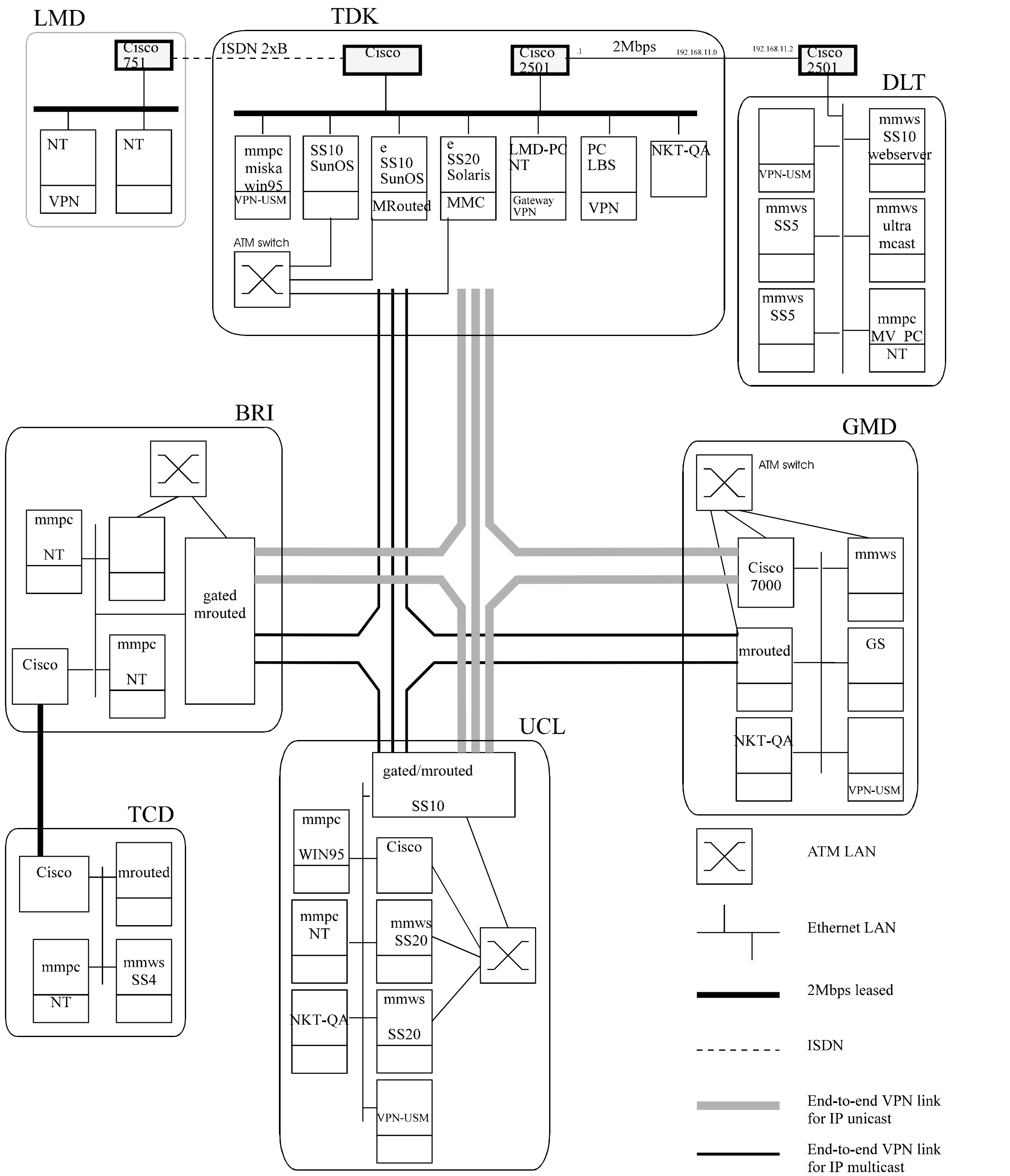


Figure 6. The Trial 1 network configuration.

This situation is especially complicated when the JAMES partners and the NH in a country are the same organisation. What is clear however is that projects, as "customers" of JAMES, really need end-to-end service and support, i.e. they want a single interface to the service that covers both JAMES and the NH. Though this is an aim of JAMES, it does not seem to be working very well. Project partners find they often have to contact their JAMES representative and the NH to find out the status of a link. JAMES does not seem very proactive in chasing the status of links set up and fault tests and keeping the project representative informed, even when both bodies are within the same organisation, thus encouraging user to chase this information directly themselves.

For instance users may be told that new links "should be up" but still have to wait several days to get confirmation and VPI details from the NH. It is felt that both the JAMES partners and the NH will greatly benefit from trying to examine the problems and attempt solutions to such end-to-end configuration, fault and performance management while still able to do so in a collaborative framework.

In addition, faults once reported may be rectified quickly, but often the cause and solution are not noted and made available end-to-end, so many people in the chain regard the fault as "one of those things". This makes detection of recurring faults and measurements of operational performance very difficult to do.

Set-up of connectivity

The mechanism for doing this was cumbersome, involving filling in a Technical Framework document that was faxed to a JAMES representative who then disseminated details to other JAMES partners. This process was therefore very slow, with some links only being set-up days or even weeks after the requested date. When enquiring about the reason for this it seemed mostly due to problems in communicating between JAMES partners and between JAMES and the National Hosts.

Performance

No detailed performance measurements where made of the international ATM links, apart from course grained IP level measurements (using ping) to confirm that the VPs had been set up to the correct bandwidths. In at least one case a VP was found to have the incorrect bandwidth using this technique, which was corrected by JAMES once the part of the link that was incorrectly programmed had been corrected.

Reliability

There were few reliability problems with the ATM links, and these usually were due to problems in the National Hosts rather than the JAMES portions of the network. In one case a leased line also failed and had to be fixed by the national host.

Manageability

No direct management of the JAMES or NH networks was possible.

Recommendations

The following recommendations are proposed for Trial 2:

JAMES should introduce a global VP link identifier, used in all communication between users, JAMES partners and the NHs. This would provide a common reference that would be beneficial in the following ways, among others:

- Identifying in TFDs different periods of time and different bandwidth that are regarded as being used for the same VP by the user. Ideally this would mean the same VPI value was offered to the user for this VP link over any changes.
- VP links being provisioned could be unambiguously referred to when trying to trace the progress of the order (important to avoid confusion where other links already exist for the same project or site).
- Faults on specific VPs can be reported in an more unambiguous manner than currently, by referring to such VP identifiers. This would be useful not only between JAMES users and JAMES, but also between JAMES co-ordinators and individual JAMES partners, between JAMES partners and NHs and, where local problems might need to be addressed, between individual NH/JAMES

partners and users. Using a global identifier for VP links would also make it easier to assign trouble ticket identifiers to a specific VP and track it identification and resolution across different administrative domains.

- In co-ordinating performance experiments across multiple domains (see next section)

This point has now been acknowledged by JAMES and amendments to procedures are under way.

Other recommendations are:

- JAMES and the NH should co-ordinate more closely so that a better end-to-end service can be provided to the projects that use this network.
- Project partners should ensure they have the capability to test international ATM links via a remote ATM loopback, as well as to measure, even roughly, the bandwidth provided by this loopback.

4.3 Experiences from Development cycles

The experiences on the design and implementation of the Trial 1 system presented here are based on the results to the questionnaire in appendix A and on discussions at an implementers review meeting. This evaluation is presented following the structure of the questionnaire, i.e. by stages of the development process.

4.3.1 Analysis stage

The following were noted about the use of the ORDIT technique in the analysis stage:

- Partner's did not use ORDIT in a consistent way, with some not applying at all. It was therefore found very difficult to compare the results between partners due to the different approaches taken.
- The objective of trying to apply ORDIT to existing services, e.g. MMC, was not clear.
- ORDIT was found however useful in understanding the design.
- Problems observed in using ORDIT in that different partners used different level of abstraction for responsibilities, obligations, resources and activities.
- Some experience with ORDIT had been positive especially in moving designs used for previous projects into ones for the trial, i.e. in understanding the changes in user requirements.
- Though ORDIT did seem useful for identifying activities that could find some mapping to high level scenarios, it did not generate many useful results in terms of resources that could be used in an analysis model.

Concerning the general enterprise mode, the split between service and management was not clear, and seemed to cause confusion.

High level scenarios between roles identified in ORDIT and the stakeholder entities where generally found to be useful tools for analysis and a good mechanism for forwarding requirements into the design stage.

Some requirements were implicitly included through the adoption of the model from the TINA service architecture, the NMF SMART Business Process Model and system designs from the RACE II PREPARE project.

In the Trial 1 development phase of the project the, initial requirements were not revised to reflect changes made during the later design stages.

4.3.2 Design Stage

It was found that understanding the justification for the designs of the information models being presented between partners, particularly of the TINA based components, was very difficult. It was generally felt that there was a lot of problems in mapping from the TINA design specification in terms of information and computational viewpoints to a specification for implementation. It was also noted that this split in viewpoints did not always assist in the development of good object oriented design. Since implementers did not know the reasoning behind the details of the computational and information viewpoint design, there was a tendency not to trust its validity, an impression compounded when perceived errors in design were found. This was caused primarily by the difficulty in clearly mapping between the computational and information viewpoints.

Message trace diagrams based on use cases were generally felt to be useful, especially for aiding common comprehension of a design, though they were not sufficient for this by themselves. There was some desire to have further details (e.g. operation parameters) to be specified more clearly on these figures.

The use of OMT was also seen as beneficial though the lack of suitable CASE tools made maintaining these diagrams (as well as the message trace diagrams) laborious.

IDL was also found to be useful and expressive in defining interfaces (at least when compared to GDMO). When using IDL, a better convention for including other IDL files was required and stronger version control was seen as essential.

Some discussion took place of how the behaviour description of IDL could be better used. Though it was felt that better use could be made of this, some more formal structure of this field was not seen as solving all our problems since they were restricted to the behaviour of a specific operation, interface or module, and some over-arching view was always needed to describe behaviour that spanned these boundaries.

It was observed that the use of IDL tended to make the clients simpler to implement at the expense of the server.

It was also generally agreed that IDL structs should always be kept shallow, deep structs caused lots of implementations problems.

4.3.3 Integration and testing

It was found that generating detail Test Design Specifications (TDS) was actually useful in the design of the system. This was taken as an indication that the design was incomplete before reaching the test stage. Part of this was leaving the specification of the possibly values of IDL strings until the test states and naming convention documents were drawn up.

It was noted that the TDSs that were produced did not cover the testing of exceptions and that exceptions were not well addressed in the current design. It was felt that designers could benefit from some general guidelines on how to design exceptions, especially when interactions occurred across long chains of objects.

5. Recommendations (for improvements/additions)

5.1 Tele-Education Services

The tele-educational experience from Trial 1 serves also as input to the requirements document for Trial 2, and D21B. The following is a destillation of the main points. The evaluation stems both from user feedback to questionnaires and from a set of evaluators who observed Trial 1.

5.1.1 Tools

Audio was generally working well, but a few times the connections were unstable. Also the RAT panel still gives erroneous or conflicting information on the PCs.

Video quality was not perceived as being sufficient. Especially the participants missed a larger and more synchronised picture of the teacher during lectures. Screens with only 256 colours tend to flicker. It would be nice if the TES system could automatically detect screens with this few colours and start VIC in an appropriate mode.

The shout tool was frequently used and was felt to be a good supplement to audio/video communication. However, it would probably be better when all messages were printed to a fixed message window that will be brought on top each time a message arrives.

Shared whiteboards were used extensively by the participants, but should be enhanced in different ways. The facilities to point were not sufficient; each student should be given a default pointer that can display continuous mouse-movements (furthermore it was mentioned that it is difficult to control movements with the mouse carefully enough). Maybe better pointers should be supplemented with other tools for focusing attention to particular parts of a page. It was also mentioned that each participant could be given an additional whiteboard where personal notes and sketches can be put on, but only if such a whiteboard can serve its purpose better than pen and paper.

5.1.2 Contact between participants

Participants feel that there is little social contact with other students. This has the consequence that students get afraid of interrupting lectures with questions and that they appear to be quite inactive initially in groupwork. It was suggested that the very first session in a course should be devoted to just getting acquainted with the tools and the other participants.

The participants still find it difficult to figure out what is really going on during a course - even though there are cues build in to the course environment about who is where. In a few cases it took a long time before it was detected that some machine had failed and in one lecture the teacher did not discover that nobody could see that he was flipping slides; it could help to introduce indicators that show that everybody has reached a common stage. Likewise, during lectures the students found it difficult to figure out how much the other students understood, and this also made them afraid of interrupting for asking questions.

A nice feature in real life discussions is that people can immediately split into smaller groups if they desire. This was not possible in the Trial 1 course, where the participants in each group were determined in advance.

More careful control should be exercised over the communication tools. In lectures there should be a default mode where the teacher’s image is displayed in high quality. If somebody asks a question, this image should change to the questioner. Group work could similarly use a timer to switch between participants as long as nobody says anything, and change to “video follows audio” when people start to discuss. Furthermore it would be a good idea to introduce a faster mechanism for interrupting the teacher than using the shout button.

5.1.3 Concentration

The participants felt that it was difficult to concentrate. There were many reasons for this. In general people felt it was difficult to concentrate in front of a screen - it would be nice if especially pages in the self-study modules could be printed out, so that the binding to the screen could be loosened a bit. There was also too much background noise in some of the offices - people entered and left the office or the telephone rang.

5.1.4 Miscellaneous

In group exercises there should be more links to course material that has already been presented. However, this may cause other problems, since the course facilities are structured like a building where you enter and leave rooms. Using links to already presented material may call for a go-back mechanism like those found in web-browsers.

The font size should be increased in many parts of the self-study modules.

5.2 Tele-Education Hardware/Software

The requirements for end-user hardware/software is that the tele-educational system can run on 'high-end' standard PC and UNIX systems with standard operating systems (for PC's this means Windows95 or NT).

5.3 Development cycles

The following recommendations were made as a result of the evaluation of the approach taken to the Trial 1 development:

- The approach of centring the development of new functionality and system integration around use case should be maintained
- Separate information and computational viewpoints should not be used for the design stage, instead a single object-model of the system should be the media for designing and evolving the various systems and components in Trial 2. Viewpoints could still be used if a final ODP style description of the systems developed is required.
- ORDIT may be used where individual partners find the technique useful, but it is not an aim to generate a complete ORDIT specification of all Trial 2 systems, nor is it a requirement to use ORDIT in generating an analysis object model that should form the basis of the design.
- Where possible CASE tools should be used to draw and maintain at least the graphical components of the design.
- The use of TDSs needs to be strengthened, but with more of the configuration information involved being present at the design stage.
- Better guidelines for the naming of IDL interfaces and the inclusion and structure of IDL files is required.

6. Conclusion

The approach to Trial 1 were a number of pre-trials. Each pre-trial focused on a specific area of the entire trial. The complexity of the Trial 1 network, together with applications of which many were prototypes, suggested a phased approach. This solution proved to be mandatory for the degree of success of Trial 1. Many problems were discovered during these pre-trials (e.g. the first pre-trial showed, that the audio tools needed substantial improvement).

The phased approach will also be applied for Trial 2.

Our experiences with operation of the networks proves the importance of continuous monitoring of individual links and the necessity of very stable routing machines.

The general feedback from students related to the virtual classroom was very positive. They liked the concepts and found it easy to navigate in this environment. A few suggestions were provided. A better integration of the audio and video tools in the virtual classroom is needed. Also better aids for controlling these tools, like a floor control system, should be developed. Especially the group work part of the course showed some shortcomings. Therefore some better cooperation tools to support the shared whiteboard are needed.

Since all communication was established manually, and not by any management system, it is not possible to conclude the management part of Trial 1 based on the two tele-educational situations.

Preparations for Trial 1 gave extensive experience on development cycles of multi-domain management systems. The approach taken is seen as an evolving one and this experience is also being disseminate through the NIM-G1 guideline titled “A Methodology for Design of Inter and Intra Domain Management Systems”. The evaluation gives us some insight into the usefulness of techniques as the ORDIT requirement analysis, Jacobsen’s use cases, Rumbaugh’s Object Modelling Technique, OMG’s IDL and ODP viewpoints. Definite advantages were found in using object oriented modelling techniques such as those of Rumbaugh and Jacobsen. However, ODP viewpoints, while helpful in separating some design concerns, were not found very suitable for the iterative development cycle needed for these systems.

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Abbreviations

ATM	Asynchronous Transfer Mode
CMIP	Common Management Information Protocol
TES	Tele-Education Service
IP	Internet Protocol
CORBA	Common Object Request Broker Architecture
CPN	Customer Premises Network
ORDIT	Organisational Requirements Definition

Appendix A. Questionnaire for the Design Implementers

A.1 Introduction

This questionnaire is intended to elicit from those involved in the various stages of developing the Trial 1 infrastructure, their experiences with notations and processes used during this development. As a base line the methodology described by WP2 in document AC052/TCD/WP2/029 (Prospect System Modelling Methodology for the Design of end-to-end inter-domain management services in the open service environment) is used. The questionnaire is intended to obtain information on, amongst others, the following issues:

- To what extent the WP2 methodology was followed in developing the individual parts of the Trial 1 system.
- In what way, if any, the process and notations actually used by developers varied from those prescribed by WP2.
- Which parts of the method actually used were found to be useful and effective and what parts were found less effective, and difficult to use.
- How useful were the techniques used when applied to the reuse of requirements, specifications and implementations.
- How could the methods and techniques used be improved from a developer perspective.

A.2 Questionnaire

The questionnaire contains sections on all the stages of development of Trial 1 systems, though obviously only information on the stages where you had direct experience need be filled in. Please feel free to add any additional comments you may think to be of interest concerning the notation and methodology used at any point in the development. Please bear the following additional points in mind when completing the questionnaire:

- Answers and comments should only relate to the components stated in the context section. If a response covers several different components, then please indicate which comments apply to which components.
- Where providing comments on the methodology used it would be very useful if you could refer to deliverables or internal documents containing the results of any work being commented on.
- The quantitative questions (e.g. how many use cases, etc.) may be regarded as optional. This is useful information but we would rather have this form returned before the UCL implementors meeting than being delayed by people having to dig up this information.

A.2.1 Context

A.2.1.1 Name and Partner Code

Please provide name and partner ID:

A.2.1.2 Components and/or Systems Developed

Please provide details of the Trial 1 components referred to in this response, e.g. DSI, Subscription management, QA etc, together with the phases of the development of that component in which you were involved, e.g. all stages, analysis only, implementation only. If you we involved in the development of different components with resultantly different experiences you may find it easier to fill in a different questionnaire for different components:

A.2.1.3 Tools used

Please provide details of any CASE or other automated tools made use of in the development process:

A.2.2 Requirements Analysis

A.2.2.1 Use of ORDIT

If you did not use the ORDIT method for requirements analysis please go to the next section.

Was ORDIT used primarily to provide input to common project working documents, or where they also used internally for requirements analysis?

Was ORDIT the only method used in requirements analysis, if not please specify other techniques used?

What problems, if any, were encountered in generating the descriptions of roles, responsibilities, obligations, activities and resources?

How many of each of the following were present in your ORDIT description: roles, responsibilities, activities and obligations (Optional)?

A.2.2.2 Enterprise Model

Was an explicit Enterprise Model description used primarily to provide input to common project working documents, or where they also used internally for requirements analysis?

In what combination of terms was the Enterprise Model expressed; i.e. terms such as stakeholders and their relations; ORDIT roles, responsibilities, obligations, activities, resources; enterprise objects in OMT or other notations?

How, if at all, did the resources arrive in the ORDIT description map to objects in the enterprise model?

How many, if any, explicit enterprise objects were present in your enterprise model (Optional)?

A.2.2.3 High Level Scenarios

Were scenarios used primarily to communicate the analysis and design decisions with other partners, or were they also used in designing components internally?

Which types of entity were used in the definition of scenarios, e.g. roles, stakeholders, other?

How many high level scenarios were generated for your requirements(Optional- but preferred)?

A.2.2.4 Non-functional Requirements

Did non-functional requirements, e.g. those impose by performance or technology constraints, affect the functional requirements, and if so in what way?

A.2.2.5 Re-use of Requirements

Where all aspect of the requirements drawn up from scratch or where some derived from other sources, and if so which, e.g. requirements from previous requirements or standards?

A.2.2.6 Revision of Requirements

Was the ORDIT model revised after the design had begun and if so to what extent?

Was the Enterprise Model revised after the design had begun and if so to what extent?

Were the Scenarios revised after the design had begun and if so to what extent?

How consistent were the ORDIT description, Enterprise Model description and scenarios with what was actually implemented?

A.2.3 Design

A.2.3.1 Use of Informational and Computational Viewpoints

Were the informational and computational viewpoints used primarily to communicate your design to other partners, or where they used for internal designs also? If not what other design documentation approaches were adopted?

Describe the differences between the information and computational viewpoints as used in your design.

What notations were used for each viewpoint?

How were these two viewpoint kept consistent in your design?

How many different information and computational objects were present in the design (optional)?

A.2.3.2 Use of Use Cases

Were use cases used primarily to communicate your design to other partners, or where they used for internal designs also? If not what other design documentation approaches were adopted?

How many use cases were generated for your design (optional)?

What were the entities present within the use cases, i.e. the entities between which messages were passed?

A.2.3.3 Reuse of Design

Were any part of your design reused from else where, and if so from where, e.g. TINA, NMF, and in what form was the reuse part presented, e.g. ODP viewpoints?

A.2.3.4 Revision/Refinement of Design

How many revision were made to the design? What were the primary reasons for the changes?

How were revision to the design handled in terms of changes to documentations and informing other partners?

A.2.4 Implementation

A.2.4.1 Implementation Platform Used

A.2.4.2 Use of Engineering Viewpoint

Was the engineering viewpoint used primarily for communication with other partners or was it used internally in the design process?

How was the engineering viewpoint used in your design?

What notation was used for expressing the engineering viewpoint?

A.2.4.3 Mapping Design to Implementation

How many implementation classes were generated for this implementation (please indicate how many of those were automatically generated from interface definitions?

How were implementation objects mapped from information and computational objects?

A.2.4.4 Use of Platforms

Which platforms and additional services were involved in your implementation?

Please comment on any specific problems with the platforms concerned?

A.2.5 Testing and Integration

A.2.5.1 Use of TDSs

Were TDSs used as the basis for integration tests either internally or with other partners?

How many separate test cases were generated for you tests?

How were the tests initialised?

How were the tests monitored?

How was successful completion of the test verified?

Please discuss the major practical problems you faced when performing integration tests with components from other partners.

A.2.6 Other Comments

Please provide any comments or additional information that you think might be interesting for the drawing up of notations and method for use in Trial 2.

Appendix B. End User Feedback

B.1 Evaluation of on-line lectures and on-line selfstudy (Tuesday)

B.1.1 Was it in any sense more difficult to participate in the lecture?

How was your experience with the lecture parts of the course?

Was it in any sense more difficult to participate in the lecture (compared to a classroom lecture)?

Eamon :

There were a number of problems getting the software and comms links set up for the first tele-educational session.

If a problem occured in a traditional classroom (e.g. say the overhead projector did not work) then at least all the students would know what was going on, and it might be possible to fix the defective equipment (e.g. put a new bulb in the projector). With tele-education we do not have similar self-sufficiency and are depending on software/telecoms companies to fix problems which can lead to delays.

Because of the amount of co-ordination necessary with tele-education, it is not easy to use alternatives. In a traditional classroom we could just move to another room.

Therefore for tele-education it is absolutely critical that all the technology and comms links must work together flawlessly. Problems that do occur are severely compounded by the distributed locations of the students.

Susanne :

I think that a classroom lecture would have been more interesting because there might be some kind of dialogue between the student and the teacher. Here it feels like a show and nobody are asking questions. I would definitely prefer to have a teacher or at least a video of the teacher talking about the material. The small videopicture isnt enough...

Jon :

To a certain extent. Getting used to communicating using headset at first.

Poor quality audio (at times) was anonoying.

Kelvyn :

Participation was easy once the relevant tools were started. Integration of the VIC and RAT tools with netscape could have been better. In the sense that physical travel to the classroom is not necessary, then this approach is much easier. The 'slides' could be seen by all and reviewed later (no visibility problems which sometimes arises when at the back of a physical class room. Multiple windows to view background notes on-line during the lecture would have been helpful (akin to viewing previous notes).

Michael M :

Yes a little, felt a little more self concious about speaking or asking questions.

Michael M ?? :

Initially yes. There was a certain novalty to all of the equipment, so that for a while the actual material was very much secondary to the educational aspect of the exercise. Perhaps a 'warm-up' session could combat this.

Otto :

The lecture was too short. The teacher just read the text on the screen. So a waste of time for all.

Stanley :

I wasn't here tuesday

Vaggelis :

The first day was not a typical day, due to some technical problems occured at the initial phase. Although, I believe that the potential end-user of this application should be computer - litarate.

Therefore, for a normal end-user no computer literate Yes it will be rather difficult to participate.

B.1.2 Change of behaviour compared to your normal behaviour in a classroom

How was your experience with the lecture parts of the course?

How did your behaviour change compared to your normal behaviour in a classroom?

Eamon :

Assume I walked into a classroom for the first lecture in a series.

Assume I arrived a few minutes early and there were other students there and we all waited for the lecturer. Normally I and the other students would talk and introduce us to each other.

With tele-education, this do happen, but not to the same amount. When you speak, sometimes no-one replies and other times too many people reply.

Susanne :

In an ordinary classroom I would never send messages to the other students. Its probably due to lack of "control" from the teacher. I feel less involved and feel no need to ask questions. In a classroom I would be able to see if my fellow students understand the information or if they are as confused as I am. Here its a problem - its more difficult to ask questions because you dont know if you are wasting the other students time.

Jon :

It was more difficult to concentrate with background noise (my end).

Kelvyn :

The experience of the lecture was closely related to a real classroom environment. What was additionally useful was the ability to pass notes via the 'shout' tool without disturbing the others. The ability also to mute the audio and video tools is double-edged: on the one hand it gives freedom to view notes, drink coffee and interact with others locally without disturbing the other students in the lecture; on the other hand cocentration could be worsened for the same reasons. There is not the discipline of a physical classroom where the lecturer can see and hear if you are not comcentrating. For motivated lectures such as these, this is not a problem. For less motivated students, it could be.

Michael M :

Didn't ask as many questions. Also didn't chat to my classmates/ ask them to expalin something I didn't understand.

Michael M ?? :

More reluctant to ask questions. Initially it can be quite intimidating to participate especially with the video camera present.

Otto :

I did not take notes, but maybe this was only due to the fact that all the inforantion presented was on the screen, which to me means that II can return to it anytime.

Stanley :

I wasn't here tuesday

Vaggelis :

In general, you loose the sense of the classroom and you have to be concentrated on the audio-visual transmission of the lecture. Some events that will be occurred during the lecture inside of your office can move your attention from the lecture (e.g. telephones).

B.1.3 Concentration

How was your experience with the lecture parts of the course ?

Was it harder to concentrate in the tele-education sessions than during normal classroom sessions ?

Eamon :

Yes

In a normal classroom you will have a certain number of distractions - someone arriving late, a pencil dropping on the floor, even the noise of students leaning against furniture. etc.

With tele-education, (assuming you do it in a room where other people are present), you have two sets of distractions - the local ones of the other people in the room (similar to those in a normal classroom), and then the distrations of the distributed students ("My Netscape Window has disappeared, "Teacher - I cannot hear you", "the slides are slow to appear on my screen").

The fact that I wore headphones means the local distractions were diminished (though not eliminated).

Susanne :

I had a hard time keeping concentrated during the session. You are sitting alone looking at some slides. Its more or less like watching television....

Jon :

See above.

Kelvyn :

See comments above. The multiplicity of windows and small screen can be distracting, where the actions to mute the audio tool and call up/dismiss video windows can be troublesome where the windows overlap. Also background interference in the local environment - where there are others not involved in the class - can affect concentration.

Michael M :

No, not really

Michael M ?? :

Initially, yes. Also, with a lot of users speaking, it is difficult to keep track of what is going on. Perhaps smaller groups could combat this difficulty.

Otto :

Yes, the flickering of pictures of the other participants was anoying. I prefer to have all faces up constantly.

Stanley :

I wasn't here tuesday

Vaggelis :

Yes, I think that it is very difficult to concentrate, especially during the self study section because of the monitor and the reflection from it. I think that there are phycological reasons for no being so concentrated.

B.1.4 Time-limit for a Tele-Education lecture

How was your experience with the lecture parts of the course?

What do you think should be the time-limit for a tele-education lecture?

Eamon :

1 Hour.

I think the use of multiple formats to deliver the tele-educational (lecture, self-study, group-work) is excellent.

Susanne :

Half an hour at the time and then a 5 minutes break.

Jon :

45 minutes

Kelvyn :

Due to the difficulties of eye-strain, 1 hr lectures would be preferable.

Although in theory one is free to take a break at any time, due to the freedom the tools give, some structure as to formal breaks would have been useful during the whole session.

Michael M :

About half an hour

Michael M ?? :

20 min to 30 min per lecture module. This would allow for the assimilation of material and perhaps an opportunity to look up some references.

Otto :

I have no idea based on just one example. To me, this one was to long, but that was more because of the way it was performed (as commented on above)

Stanley :

I wasn't here tuesday

Vaggelis :

I think that one and a half hour is a good limit for tele-education. In this time interval, should be included the self study time and the collaboration with other students-participants. I also think that a break would have been useful.

B.1.5 Interaction with the teacher during the Tele-Education lectures

How was your experience with the lecture parts of the course ?

How was the interaction with the teacher during the tele-education lectures ?

Eamon :

None!

Susanne :

There wasnt much interaction at all.

Jon :

ok

Kelvyn :

The audio tools were very useful. The video tool was of somewhat lesser utility. A faster frame rate would be required for the video tool to be a really useful adjunct, so that lip-sync could be attained.

It was easy to make questions, but perhaps rather than simply interjecting during the lecture, some tool for signalling to the lecturer that you want to ask a question would be helpful - the electronic equivalent of putting one's hand up in class - . The shout command could do this, but is perhaps a little distracting to the lecturer. In a later lecture session, it was clear that a whiteboard would have been useful both to the lecturer and the students.

Michael M :

Ok, would be better if you could signal the teacher that you wanted to ask a question. Perhaps an electronic version of sticking up your hand!

Michael M ?? :

Pretty minimal. Again, this was augmented by the technical difficulties we experienced.

Otto :

None. Unless you think of the introduction of the participants. This part was very quick, and did not give the participants a chance to read or speak. So I have no idea about who the others are (except thata I can look their cv's up later.

Stanley :

I wasn't here tuesday.

Vaggelis :

Very good. Of cource there were some technical problems, like bad audio quality or bad video quality. I think that audio is a critical point in such interaction compared to the video conferencing.

B.1.6 Did you try to contact the teacher in his office?

How was your experience with the lecture parts of the course?

Did you try to contact the teacher in his office?

Eamon :

No.

Susanne :

No, I didnt try to contact the teacher even though I had problems understanding the material. I didnt even consider the possibility.

Jon :

no

Kelvyn :

Not during this session.

Michael M :

No, due to technical difficulties

Michael M ?? :

No. We incorporated technical difficulties in this area at Broadcom.

Otto :

No. The intent was as far as I was told to browse around. But I did not feel the need to enter group rooms or office (since I had no business there).

Stanley :

I wasn't here tuesday

Vaggelis :

No I have n't.

B.1.7 Was the selfstudy motivating on a computer?

How was your experience with the selfstudy parts of the course ?

Was the selfstudy more motivating on a computer compared to selfstudy using a book?

Eamon :

Imagine if the self-study pages were printed out and bound together in a book. I think the differences between using this book and the on-line version are:

- The animation is nice (and educational)
- Being able to receive immediate corrections for the answers to questions is very useful.
- I distinctly do not like to read lots (hundreads) of pages of text off the screen - I would much rather read a proper book for that (e.g. Reading the ITU standard on Wednesday).
- One suggestion - as opposed to a "page" metaphor for the screen, would it not be better to have the idea of a "educational canvas", which is just a pane, and all the educational material appears in it, and hence the student does not have to "turn the page" to on - instead the "canvas" is built up with more material.

Susanne :

I get more tired reading on the screen than reading a book. So it wasnt that motivating.

Jon :

No, there is something less satisfying about reading from a computer screen.

Kelvyn :

The on-line self-study module was more motivating than a book due to the sense of participation given by the on-line question/answer session. Also the animations were helpful. These comments apply to the self-study modules as introductory material, where they are very good. A book however is a more convenient medium I feel for portability, re-reading and digesting aterial. Moreover, as sources of reference for further study, access on-line to the libraries of information on the Internet make it a more convenient medium.

Michael M :

Yes, the animated diagrams are great. The helped visulaise what was being descriped, so it wasn't as easy to get lost.

Michael M ?? :

Somewhat more motivating when the animations were accompanying the text. However, in some areas the computer material is more concise than that of a book, which can be limiting. Perhaps, if each point in the notes led to a link with a more thorough explaination.

Otto :

No. There wer too many acronyms already on the first page. I know that they were links to detailed in formation, but high-lighted acronyms spoil the reading of the text, because you violate the rules of good uder interface design.

Stanley :

I wasn't here tuesday

Vaggelis :

In general, you can not read more than 10-20 minutes continuously, because you can not concentrate more than that time. The content was OK and the appearence was also OK. Additionally, the reading material was for 10-15 minutes reading.

B.1.8 Experience with the selfstudy

How was your experience with the selfstudy parts of the course?

Did you experience any problems?

Eamon :

No - after a little getting used to it, then it worked very well.

Susanne :

I think one problem is that you dont know your fellow students and its much more difficult to asks questions to somebody you dont know and cant talk to face-to-face.

I felt a distance to the rest of the students.

Jon :

Problem swith resizing netscape and font size. Ok though, once sorted.

Kelvyn :

No major problems were encountered.

Michael M :

Not with the self study modules. Module 2 was very heavy as the ITU doc was large. Would have been better if it was broken up into smaller chunks.

Michael M ?? :

No the self-study section was fine.

Otto :

The RAT sound was always giving error, which Allan can testify to from the number of SHOUTS I sent him.

Stanley :

I wasn't here tuesday.

Vaggelis :

Some technical problems (e.g. bugs, bad sound quality, not enough bandwidth some times for transmitting good video quality). Another main problems was the degree of integration between netscape and rat and vic. I think that an integrated approach should be much more conveniant.

B.2 Evaluation of social aspects and of working on-line in groups (Wednesday)

B.2.1 Interaction and cooperation with the other group members

How was your experience with the groupwork part of the course?

How was the interaction and cooperation with the other group members?

Nadav :

This was a very interesting experience.

It is actually possible to discuss a group project.

Eamon :

Susanne :

We were only two persons in my group and I think the interaction and cooperation went quite well, though it takes some time to get to know each other and to find out how to solve the questions.

Jon :

Generally very good - audio was a problem but this aside the whiteboard proved very useful.

Kelvyn :

Initial coordination was a little disorienting, but that soon passed.

Interaction via the audio tool was good. Again the slowness of the video frame rate inhibited the usefulness of that tool for establishing really useful visual interaction. On the positive side, I found group interaction effective and relatviely easy within these constraints. The combination of the whiteboard and audio tool made cooperation quite effective.

Where there was a definite structure and problem to solve, with plenty of 'hints' in the text, the work went quite well. Where there was less structure, then the deficiencies of the interaction became more obvious, as coordination as what to do next became more difficult interaction being practically limited to an audio conference.

Michael C :

Pretty good.

Michael M :

Pretty good. I worked with Ina and Stanley in Group 1.

I think it was a good idea to keep the group sizes small, it is easier to confer on matters.

Otto :

Audio communication was ok. The video connection is not relevant since you are only seeing the persons face, not what he is pointing at (or who is writing on the whiteboard).

The cooperation is very difficult because you are not looking at the same things.

Stanley :

Sound was a little chuppy.

Video I would not recomment to anyone.

Whiteboard worked but not convincing.

Vaggelis :

I think that the interaction and cooperation with the other groups was excellent. Except from some technical problems (e.g echoes and bad audio quality) all member of group really enjoyed it.

B.2.2 Did you have to change your normal groupwork routines?

How was your experience with the groupwork part of the course?

In what way did you have to change your normal groupwork routines?

Nadav :

It was more similar to a telephone conversation than a face-to-face group work (i.e., the video and shared tools are still far behind the audio tool).

Eamon :

Susanne :

Its harder to make drawings to explain what you mean and you dont have the bodylanguage to tell you if your fellowstudent understands what you say.

Jon :

Because of audio problems/problems with other people's browsers we often had to use alternative methods for communicating our ideas, which was made all the more difficult if you did not know whether the others had heard/seen what you had said/written.

Kelvyn :

The video tool refresh rate was too slow for practicality. Consequently the main tool for interaction was audio and secondarily the whiteboard.

However a difficulty was the fact that the routing table windows were not integrated into the hiteboard, so work through these windows had to be verbally described. In general the whiteboard in such sessions could benefit from more integration with other sources of information provided. The pointer tool was most useful here.

Whereas in a physical meeting, posture and gesture is very important in group interaction, this was not really available. A barrier to interaction was thus put in place. Generally however the roupwork was satisfying even within these limitations.

Michael C :

A lot more carefull to wait your turn when speaking.

Michael M :

One difficulty I found was in the submission of the answers.

It was difficult to establish who should send the answers.

Otto :

This was not a group work. It was each person trying to study the tables to try to find his own solution, and then presenting this to the others. Only in the end was there a cooperation beacuse two persons had different (but equally good) solutions.

Stanley :

Normally I do not wait so much, and it's possible to speak more than one at the same time allmost without informationloss.

Vaggelis :

Human interatcion is a very important aspect of cooperation. But for technical matters you can alsways find something interesting from the interatcion. In general:

1. I have n't used the phone to ask something

2. I did n't move to find someone

3. The matterial was always there waiting me (by cliking on hyperlinks)

4. No paper on my desktop

5. Reusable notes in electronic format.

B.2.3 Interaction and cooperation with the other group members

How was your experience with the groupwork part of the course?

How was the interaction and cooperation with the other group members?

Nadav :

The whiteboard helped a lot. But it was more the description given by voice which enabled colaboration.

Eamon :

Susanne :

The sound was alright and it was a big help that we could talk to each other and at the same time sketch on the figures to make sure that we were talking about the same thing. A videoconnection would have made it even better....

Jon :

whiteboard was very useful if a little cluttered.

Kelvyn :

The whiteboard tool proved not to be as convenient as hoped. It was easier in the end to do working locally on paper and describe things verbally to the other members of the group. The whoteboard was thus used as a secondary support tool for illustration of thoughts rather than the primary tool for cooperation, which was the audio link. Again the video was a nice additional input, but not essential to the work done.

For the third question the shout tool was useful to summon help from the lecturer who helped us through the question.

Michael C :

Common whiteboard is useful in explaining your ideas.

Michael M :

The white-board was a good idea. I think this idea could be augmented by incorporating along side the whiteboard, a sratch-pad area for each member of the group which the other members could also see that way, answers could be correlated more clearly. However, the white-board was very useful.

Otto :

Very badly. Drawing on the white board with a mouse is impossible. It is impossible to erase your own drawings, only the last one drawn, irrespective of who drew it.

Also having to click on the rat whenever you wanted to say something, and then clicking on a netscape window to look up things is tedious.

You may wonder why I just didn't turn on the unmute permanently: This would make it impossible to see who is talking right now because all names would be high-lighted, that's why!

Stanley :

The communication via whiteboard seams to be a good way of handling technical information.

Vaggelis :

1. White board facility can really improve cooperation
2. Content material was always there, well organised
3. Teacher - student interaction was possible
4. Good level of integration during the cooperation phase

B.2.4 The information board

How did you experience your contact with your fellow students during the course (compared to a traditional course)?

How did the information board help to improve the social relations among students?

Nadav :

I was curious to read some details about my fellow groupmates.

Eamon :

Susanne :

Since a lot of CVs are missing its hard to get information on the fellowstudents. It would also be nice if there was a common standard for the CVs in relation to the subject we are studying. I couldnt find any information about my groupmembers experience with networking and transmission.

Jon :

No - just told me about course times.

Kelvyn :

It was helpful to have some background on the others initially. However Social relations between students was not particularly improved, beyond this.

Use of the news facility to provide some structure as to where we should gather when first arriving might have been helpful.

Michael C :

Could see who everyone was.

Michael M :

It was handy to get some background information on the participants. For instance oyu could see at what level people already were versed in the material.

Otto :

I had no time to use it, and I am not sure why I should use it. I am here to take a course in ATM, and I expect direct communications from the teacher.

Stanley :

There's nothing on it, so what can I say?

Vaggelis :

In general not in social relations, but it help us to share figures and comments and to get a common consensus during the problem solving process.

B.2.5 The bulletin board

How did you experience your contact with your fellow students during the course (compared to a traditional course)?

How did the bulletin board help to improve the social relations among students?

Nadav :

Have not used it yet.

Eamon :

Susanne :

In my group we were asked to look on the questions about interactive television and we had a discussion while sitting in the tea-room.

Jon :

Did not visit.

Kelvyn :

Pros: The ability to make (relatively) considered and constructive comments to the group not generally feasible through the ephemeral audio conversations.

Use of this feature was limited at the time of writing, but was picking up. Given time, the bulletin board may well have helped to foster a sense of ownership and contribution to the site on behalf of the students. This is because no other part of the site (apart from the tearoom to an extent) gives a free forum to the students.

Michael C :

Got a bit of a discussion going.

Michael M :

Useful for facilitating discussions within the group.

Otto :

I had no time to use it, because of severe problems with the equipment/communication software (rats). I am not sure why I should use it. I am here to take a course in ATM, not read messages on a billboard.

Stanley :

It's a good place to talk about technical stuff.

Vaggelis :

Unfortunetely I have not used the billboard. I did not have the time. Technical problems delayed us for 25 minutes and then we had to catch up the time in order to solve the exercises.

B.2.6 The tea-room

How did you experience your contact with your fellow students during the course (compared to a traditional course)?

How did the tea-room help to improve the social relations among students?

Nadav :

Have not used it yet. Some of us had a small chat in the group room while waiting for others to join (or sort out some technical problems).

Eamon :

Susanne :

We didnt have much time to talk about more social related stuff while sitting in the tea-room. It would be nice if you had time to talk to the fellow students about things that are not related to the studies.

Jon :

Did not visit.

Kelvyn :

Use of the tea room was restricted by lack of formal breaks, when the natural place to gather would have been this room, and its use could be combined with a real coffee break. This could have been a result of our unfamiliarity with the environment and the trial nature of the course: not all the tools working.

One of the best features here was some indication of who was present. In the rooms where this was present it was useful: wandering around the web site can be a lonely business, with no concept of where people are, or if they are there at all. The tea room facility for seeing who is present was thus helpful. An extension to see what people are at what tables (and a post of what they the declared conversation topic - eavesdropping) might add to the feeling of a social gathering.

The whiteboard is a nice idea. Execution is a little clumsy however: esp the delete function. An erasor would have been useful.

Michael C :

Didn't use it.

Michael M :

I did not use the tea-room.

Otto :

I had no time to use it, and I am not sure why I should use it. I am here to take a course in ATM, not chat.

Stanley :

I was there a few times but nobody elese were around and there were no tea.

It would help if i.e. tables with people around them were a diff. color.

Vaggelis :

Due to time limitation, I have not used the tea room. In general, I 've noticed that the people left the session when the lectures finished. So, I dont think that someone actually used the tea room for social relations.

B.2.7 Which facility improved the social relations best?

How did you experience your contact with your fellow students during the course (compared to a traditional course)?

Which facility in the tele-education environment did improve the social relations among students best?

Nadav :

The audio tool for sure. The video has a strong potential but it is too slow at the moment.

Eamon :

Susanne :

Grouproom and tearoom.

Jon :

The group session was generally very good. A fun way of tackling the questions.

Kelvyn :

The RAT tool was the most useful as it was the most natural to use. By contrast the video tool was helpful in fostering a sense of being in a 'place' with others, but its practical utility in problem solving was more limited.

The group sessions as a whole, i.e. the group rooms, were a useful mechanism for forcibly initiating interaction. The freedom of the audio tool was most important here in improving social relations. THe relatively unsophisticated 'shout' messaging system was curiously helpful too in passing 'notes' between individuals.

Michael C :

Group audio conferences.

Michael M :

I would say the audio facility. The video facility was very impressive, however, it tends to make one feel self-conscience. I think once you have established the video link, a reduced frame rate (but not static) was a lot more comfortable to deal with. The audio link affords you the necessary communication required for the particular problem. It was a lot easier to concentrate on the actual exercise when the video was not such a dominant aspect. I think the video is more pertinant in the establishment of the conversation. Once established, it's nice to have and to call up. I think, however, that this might not necessarily apply for another type of conference, but for the lectures and group work, it could be distracting.

Otto :

Audio. Static video (e.g. .gif pictures) of the other participants would be sufficient.

Stanley :

Well.... I think that the fact that you can see, talk, draw and type things to one-another at the same time.

Vaggelis :

1. Whiteboard
2. Audio conference

B.3 General evaluation (Friday)

B.3.1 Video quality

How was the quality of the video in the course?

Nadav :

What bothered me is not the quality but the speed of update.

Eamon :

Poor! The frame rate was too low. Either no video at all should be used or else high bandwidth is needed. The video this week definitely did not add much to the course.

Susanne :

The quality could be better, but compared to a situation with no picture this was fine.

Jon :

Frame rate was too poor for the video to be of much use in judging others' gestures/body language. Functionally equivalent to a still of the person in question.

Kelvyn :

The video frame rate used was insufficiently rapid to have a true impression of visual interaction. lipsync and the ability to make simple (and polite) gestures would have imporoved the video interaction.

However my impression is that the video tool is not of primary importance in a course such as this, where the focus is on the presented materials and where the audio is an invaluable tool for instant queries and feedback.

Michael V :

I think that the video quality is ok, but it will be nice, if the small video pictures at the screen, could be in double size. That will brings the student closer to each other - a social dimension.

Michael M :

Good, not important really as it was enough to know that a certain person was there.

Otto :

Not good, it created problem all the time.

Stanley :

Slow but pixelwise it was okay when you enlarged them.

Vaggelis :

B.3.2 Audio quality

How was the quality of the audio in the course?

Nadav :

The quality was good. The problems were usually due to local setting of volume. I find the audio satisfactory to this stage of the technology.

Eamon :

Mostly very good. I could hear Allan very well during his lecture. Dave's audio during his lecture was slightly choppy - and not as clear.

It is uncomfortable wearing headphones for very long periods (therefore it is a good idea to limited lecture periods to say an hour).

Susanne :

The audio got too much chopped up in pieces and it made it quite hard to obtain a real conversation. Also the delay in time make it a bit difficult to talk to each other.

Jon :

Quite poor at times - I could hear very little some people.

This caused problems in the group work.

Kelvyn :

The audio quality was generally acceptable. It was noted that when too many video sources were transmitting, the quality of the audio went down appreciably. Also there was at times a noticable but small delay experienced, with faint echoes. However this is not a major criticism, as the audio was comparable with a telephone audio conference.

Michael V :

The quality of the audio is ok. Some times with ecco, and small fall outs, but generally ok.

Michael M :

Generally ok, can break up badly sometimes. Also could use some regulating on volume as some people would be load and others would be faint.

Otto :

Reasonable.

Stanley :

Pretty good.

Vaggelis :

B.3.3 Navigation facilities

What do you think about the navigation facilities in the course environment (the course browser (Netscape), the audio, the video, the white board)?

Nadav :

The virtual space is a nice metaphore. The thing is that we got used to navigation in a certain way (i.e., on html documents on the web) and the self study module did not comply with these "standards" which made things a bit problematic.

Eamon :

I have spent the past 20 minutes filling in detailed responses to all these questions except one - and clicked submit. A message appeared saying all fields must be filled in with a hyperlink to return to the form.

When I returned to the form All the text I had filled in was lost - I am not impressed.

Yesterday I filled in detailed responses on the evaluation form, and before I could click "Submit" Netscape crashed and everything I wrote was lost. This is *very* annoying.

Susanne :

When the technical part is working I find the facilities very useful. The whiteboard is really useful in situations where you have to explain something to each other. Audio and video gives you a feeling of getting to know the people that you wouldnt have using f.x only the "Shout"-facility. The metaphor of a virtual "Course-facility" is very good.

Jon :

I was quite impressed witht the feel of the browser and the a/v frontend. It could be improved by integrating these further.

Kelvyn :

I felt that the site was well laid out with definite areas for particular types of interactions. I was impressed by the facility in the tea room and class room for indicating who was where. In this sense too the video/audio conference tools gave this information, albeit rather slowly as the tools took a while to start up. In this context it might have been better to have the option of joining into the conference or not when certain rooms were entered.

The problem was not so much with navigation as with locating individuals. The shout tool provided a mechanism for asking where a person currently was, but it would have been nice to have had a locate tool generalising the feature in the tea room. Also an indication of which table individuals were sat at would have been nice.

The whiteboard tool could have been improved with regard to dragging and dropping information from other sources and better interaction. (An indication of what each person is doing on the white board).

Finally, it would have been of benefit to have had multiple windows for reviewing the lecture slides and self-study modules when engaged on the groupwork. It was necessary to leave the room (and the conference) on these occasions.

Michael V :

Ok.

Michael M :

Poor, netscape was okay but th whiteboard could do with improvement.

Otto :

Lousy, you were only able to to one thing at a time.

Stanley :

The audio and video should be totally integrated in Netscape or the host app. one choose.

Vaggelis :

B.3.4 Mixture of lectures, groupwork and selfstudy

How did you find the mixture of lectures, groupwork and selfstudy in the course?

Nadav :

The ATM course was a bit too difficult for a layman in communication like myself. The material given was not enough to solve the problems in the self-study work. I must say the that SQL module is far better in terms of presentation and coherence. I would like to participate in a course which is presented in this level and combined with lectures and groupwork.

Eamon :

Very good. I particularly liked the "teleporting".

Susanne :

The intended mixture of different activities looked good. I think that its very important (in longdistance education) to make variation in the course. This way you ask the students to inter-act and not just expect the teacher to give them all the facts.

Jon :

This was a nice idea: lectures were not too long, but group work was marred by problems with audio and lack of clarity in some of the questions. The self-study was a touch too technical, but I think I got the gist of what was going on.

Kelvyn :

The lectures were excellent. I feel the toolset is best suited to this kind of structured learning environment: the primary visual focus on the material being presented in the browser, with audio explanations. Here the difficulties with the video were not so important.

The group work being less structured depended more on the audio and video, and here the quality of video hampered interaction, as the visual clues present in 'normal' conversations could not be derived from it, and more emphasis had to be placed on the audio. It was sometimes awkward to freeky have a conversation without the visual clues as to the reactions of the others, or to work out when a person had finished speaking. Although the group work was potentially the most interesting aspect, it was also perhaps disappointing in practice due to these technical aspects.

The selfstudy modules were perhaps a little too advanced compared with the introductory nature of the lectures. The self-testing exercises were useful feature. More lectures perhaps would have been better to provide more in-depth coverage of the material before tackling the self-study.

This is however a question of balance in this case rather than a comment on the technology.

Michael V :

Ok.

Michael M :

Good, it would have been to easy to get lost in some of the self study modules if they were lectures.

Otto :

Ok.

Stanley :

Normally it's a good thin, but here I think selfstudy on screen is to hard for my eyes (I could'nt scale the text) but the slideshow with speak and groupwork in small groups 3-4 pers. works fine.

Vaggelis :

B.3.5 Effectiveness of Tele-Education course

Did you find the tele-education more effective, compared to education in a classroom?

Nadav :

I am not so sure it is more "effective". One thing is sure, though, it makes education more available and it is a good way of cutting the costs of conferences and workshops for example.

Eamon :

I think a classroom course would be better, and to be honest think in the future it will remain so.

However, tele-education could be more cost effective and good for a variety of reasons (could how many more courses).

Susanne :

I have to admit that my knowledge of ATM would have been higher if I had followed a traditional course. This is due to a lot of factors.

1. The technical problems make it difficult to go through the selvstudy material and reading a lot of information on the computer is not so good. I would suggest a manual on paper for getting the needed information.

2. The material seemed suited for people already working a lot with data-transmission and people that are used to the expressions (acronyms). I really felt lost some times - and in traditional education I would just have asked the person sitting next to me, if I had a question - but who should I ask here?

3. I think that some of the questions in the selfstudy part were too difficult compared to the knowledge we could get during the course. So all in all I got less out of it than in an ordinary classroomsession.

Jon :

No. interaction on a face-to-face basis is a lot more comfortable - at present there are too many technical barriers to make the tele-education comparable to classroom based education. More fundamentally, I find in-depth study (eg. some of the self-study modules) from a computer screen inherently less comfortable than from a book.

Kelvyn :

The technical difficulites during the course inevitably affected impressions of the effectiveness of the course. When things were running, I found the lecture material generally as effective as could be expected during a classroom lecture.

More work (and better video tools) are required for the group work, and for some topics it is hard to see how interaction could be acheived. A programming course for example would need a better tool than the white-board for editing code interactively, as well as a more sophisticated tool for compiling and running the program. Other areas again such as engineering topics are such that physical meeting simply cannot be avoided.

The bulletin board and the tea-room are useful features for discussion among the students that the brevity of the course did not allow us to exploit fully. Doubts were expressed whether this could really replace 'real' conversations among students, but it would be unfair to say that an effective compromise could not be acheived in a longer trial with better video and whiteboard tools.

In conclusion, I would compare it less with the experience of a course delivered in a real class room than with learning achieved non-interactively currently through the Internet libraries or on-line discussion news-groups, bulletin-boards and email. Compared to these the course was very much more effective.

Michael V :

I think so.

Michael M :

Self study was more effective, but the lectures not really.

Otto :

No, definitely not.

Stanley :

No but at least as effective.

Vaggelis :

B.3.6 The Tele-Education environment

Did you like the tele-education environment?

Nadav :

Yes, I think it is going in the right direction. I am sure that the technical problems will be solved soon and than we will have to get used to this additional kind of interaction.

Eamon :

There were simply too many technical problems!

Susanne :

Basicly the idea is good - and I believe that it will be even better when you implement some of the things that were discussed in the last session. How to show that you want to talk etc.

As Ive said before - I find the metaphor of a virtual building good because it makes you feel more like moving between the different facilities.

Jon :

It was fun:- though mainly for its novelty value.

Kelvyn :

The experience was certainly interesting, the technical problems aside.

These latter problems with the tools certainly reduced the enjoyment, but it is certainly an experience I would be willing to repeat.

Michael V :

Yes, wery much.

Michael M :

Yes, wouldn't mind doing it again if it was more automated.

Otto :

For dedicated purposes, yes. Generally, no.

Stanley :

Being a grafic designer I have to think that there's something left to wish for.

Vaggelis :

B.3.7 Comparison with normal course, what misses most?

What did you miss most compared to a normal education course?

Nadav :

It would be nice if an assistant was assigned to each group which help in the material when the group is stuck without an idea how to continue the exercise.

Eamon :

There is a major difference between being presnet in a room with the teacher and other students, compared to using multimedia tools.

Susanne :

The feeling of belonging to a group. Here I felt that nobody would really care if I showed up or not.

Also the bodylanguage of the teacher and the other participants.

I find the last thing very important. If somebody stop transmitting video (mute it) they can leave the room or be doing something else than listening. The same thing would take a lot of nerve in a normal course.

Smalltalk is never the same on writing ...

Jon :

The fluidity of social interaction.

Kelvyn :

Video quality sufficient to express the normal human codes for interest, puzzlement and boredom. This would have given a better sense of 'presence' during the course.

Michael V :

The social contact, with the other student and "one to one" relations.

Michael M :

Social interaction, we had problems with the tearoom. It would have been nice to participate more in discussions/conversations off the main conference more.

Otto :

Speed. Things are to slow here. There is only one thread of thought available at any time.

Stanley :

Real social contact. Tea in the Tearoom. Seeing other parts of the world or at least the country. Going out with my fellow students.

B.3.8 General impression about the Tele-Education course

What is your general impression about the tele-education course?

Nadav :

It is quite encouraging that research is been done in this area.

Keep up with the good work!!

Eamon :

There is still alot of work left to do to get the technology working.

The concept is good and has alot of potential.

It would have been better to conduct the trial after the technology had been tested, so that the trial would be looking at tele-education itself, instead most of the time this week was spent trying to get

all the hardware/software/comms working.

Susanne :

I think it could be very good but it depends too much on a technology that right now is quite new and not stabil enough to facilitate a complex trial as this. I have had a very good time here - thougt I have been using a lot of time waiting for lectures, groupwork etc. I think there are a lot of possibilities in this kind of education - I look forward to hear about the evaluation 7 April.

Jon :

It certainly has potential to fulfil a certain role within the broad field of education.

Kelvyn :

General impression is that the idea is interesting, but the available toolset was not sufficiently powerful, for whatever reason, to fully exploit the potential. Without this I have my doubts as to whether complex material requiring sophisticated interaction can be taught through this medium. I understand that the paricular audio, visual and whiteboard tools are only very loosely coupled with the course server, so it would be interesting to see what was possible with better video.

On the positive side, the school-building layout of the site and the provision of dedicated conference facilities for formal and informal discussion were interesting.

Michael V :

Wery positive, but i have to swith back in danish, for more detail.

For mig er der ingen tvivl om at videokonferencer via Internettet/Intranettet er fremtidens mødeform - som seriøst alternativ til den fysiske tilstedeværelse. Det gælder i.f m. distancearbejde og kommende hjemmearbejdspladser, konferencer/mødeaktiviteter og som her i.f.m. undervisning. Generelt synes jeg at projektet / kurset er forløbet godt. Jeg er imponeret over den tekniske kvalitet, selvom der selvfølgelig har været små skønhedsfejl, med nedbrud og som følge heraf forsinkelser.Periodiske billed og lydudfald, ekko etc. Hvad angå den pædagoiske og kursusmæssige indfalds vinkel, har dette efter min opfattelse fungeret fint.Dette ikke mindst i forhold til de virituelle fascilliteter, såsom klasseværelse, grupperum the rum etc. Underviseren har fungeret godt og har generelt haft et godt overblik over undervisningssituationen,omend det kan være vanskeligt at holde styr på alle kursister samtidigt, når teknikken gør at nogle falder ud. Dette stiller langt større krav til underviseren / mødelederen, herunder planlægning og struktur, ikke mindst opfølgning på de kursister, som af den ene eller anden grund i perioder ikke har været tilstede eller hørt efter. Set udfra en brugersynsvinkel, med alm. forudsætninger i forhold til computere, er opstartsprocedure, procedure ved fejl eller nedbrud, efter min opfattelse ikke bruger venlige nok. Dette vil som jeg ser situationen, være den største barriere for at få almindelige mennesker til at deltage i video konferencer. For at imødekomme disse barrier, bør der udvikles en konference værktøjsbjælke, indeholdende ikoner med de respektive procedurer, som vi kender det for Microsoft og andre programudbydere.

Alt i alt har det været spændende at deltage, og jeg stiller gerne op til andre ekperimenter, eller input / tilbagemeldinger i forholdt tilprojektet.

Med venlig hilsen Michael Vilebæk - Tele Danmark Hovedkontor / HPSUK

Teglholmsgade 1, 0900 København C

Tel. 80 80 80 80 / bil 20 12 50 68 - Fax 65 25 50 68

Michael M :

Okay, it is quite good some of the technical issues/problems need to be sorted out.

Otto :

Not good enough. I didn't learn anything useful. But I am perhaps not the target audience. Yet, the course was called: An introduction to ATM!

Stanley :

For updating people or teaching people a small amount of material and to discuss simple problems I feel it is a good tool.

Vaggelis :

B.4 Results of the narrative evaluation

B.4.1 MichaelM

Firstly I was thoroughly impressed with the idea of tele-education and I think it has enormous potential. I am currently undertaking a taught masters degree which involves me driving approx 160 miles twice a week. A system like this would be a great help for my situation, in that if a portion of the syllabus material was available in this format, I would be afforded exposure to the relevant material and be better able to utilise my time lost in travelling. However, I would not wish it to totally replace a classroom situation. I am also involved in teaching and I see tremendous merit in this type of system ... especially in Adult education.

However, I found some aspects of the set-up somewhat distracting. I think the audio aspect is one of the strongest tools available in the system. With the technology which was utilised, I was disappointed that it was not integrated into the self-study parts of the course, which, in and of themselves, were very good. The material was point based. I think in addition to the statement on screen, if the user was afforded a mechanism to click on a point and have an audio description stating the point and perhaps further clarifying it, the user would get a better appreciation of the material and also, the user could maintain a higher level of concentration. I think this could also be extended to the lectures and after a series of points had been competed, a period of interaction with the actual lecture could take place where she/he could further clarify a point, or have students ask as the lecture proceeds and not an open-loop system where the whole lecture takes place and afterwards questions are raised.

I thought the animations which accompanied the self-study were excellent and again could have been utilised more in the lectures and again could have been augmented by accompanying audio.

I found the video at first difficult to deal with. Suddenly you are confronted with your own image and several other people you are not familiar with. It was very distracting at first. Also, there is a certain novality to the video aspect of the set-up which can be quite distracting. A situation occurred where we were asked to stop the transmission of video, however, the pictures stayed static on screen. I found this a lot more comfortable and was able to concentrate more on the actual material being taught. From then on I reduced the frame-rate of my own picture and was better able to concentrate on the lecture. I also liked the control over such aspects as frame rate, size of shot, volume, etc.

We were unfortunate in Broadcom with the technical difficulties we experienced. However, I appreciate the difficulties involved. Also, compressing all of the aspects into four days was a lot to take in at once and I think a better evaluation could be achieved over a longer period of time, where you can digest the material and the environment in which you are working.

Socially I don't think that this system would be of benefit if it was not accompanied by standard teaching methods. However, it would allow for people who are intimidated by classroom situations in that it affords them a certain distance but yet exposure to the relevant material.

Intellectually, I think it is a good mechanism of teching, but again I think it does require some aspect of classroom interaction.

On the whole I think this system has enormous potential as a companion to conventional teaching meachanisms. I would not, however, wish to see it attempt to replace it altogether.

It was a pleasure (despite the technical difficulties encountered) to participate in this evaluation. I am grateful, as both a student and teacher, to have been aforded an opportunity to see this technology as it evolves. I this it is an excellent system, and would look forward to seeing some refinements in it's implementation.

Best Regards,

Michael McCarthy,

Waterford Institute of Technology.

B.4.2 Nadav

It's only recently that I've started thinking about this tele-education thing, mainly because of this experience (i.e., the experiment). I am still not quite sure how I feel about it. In general I am quite optimistic about the technological revolution we are going through - but I would not very easily dismiss the warnings people have been signaling about the eddect of these changes on our society.

Basically I think that tele-education is a complementary tool. I think it would be good at higher levels of education. I can hardly imagine that kids at school would learn basic maths by "conferencing" with others. I mean that the basic education is probably best given on a one-to-one, face-to-face basis.

I do believe, that at university level, or general education we have quite a number of benefits. I can imagine virtual classes and colaborating learning environments quite soon actually. I do fear, however, that this is going to split society even further in therms of those who can afford this luxus and those who can not. On the one hand people will find education much more available - but those people would be fewer.

The technical problems are soon to be resolved - I am quite confident in that. What we should concebtrate on, really, is how to adopt to the new situation socially speaking.

Another problem that worries me is that of content quality. Once broadcasting your ideas is becoming fast, cheap and easy (hence, more available) there is a danger that people will use it for wrong purposes. I am not saying that this should be control - I am a strong suporter in free (at least in two senses) on the web.

However, if we are not carefull we could find only one encyclopedia available : MS-encarta :-) We need opinion diversity and this is something that could be in danger once you have a few groups controling tele-education resources (i.e., tele-education service providers). We want no monopoly on education.

I guess, those worries can be easily dismissed (e.g., tele-education is making it more available to spread different ideas, and more easy - therefore, enhancing opinion diversity and not reducing it). My answer to this is that we should look positively about those technologies and in a suspicious and caucious way at the same time.

Enough of this. Bye.

B.4.3 Otto

Let me tell you a little about my expectations wrt. teleducation.

In my normal environment, I would be sitting at my desk in the office (or in a meeting room there). I started up the tele-education because I wanted to learn some new stuff. E.g. I am only interested in the course, not the other participants. Therefore I have no interest in entering the team room participating on the bulletin board. I want my instructions to come directly form the teacher to me. I don't want to hang around his office (where he necer is anyway). Thats why I use the shout button a lot. This is my cry for attention.

Also I find that video is like tresspassing. I want to sit here and be at easy, and not being looked at.

Video communication is also confusing. The flickering of pictures distracts the eye, and the information content in it is negligible. Still pictures of the other participants would be just as good.

What I would rather have, would be pictures of what the member of my group are poiting at,like I would be able to in a real meeting. I know that there are small arrows on the whiteboard, but I don't know which is which, and it is only possible to point to tings on the board not the other texts that are needed (think of the routing example: pointing to the rows would have completerd the exercise in no time).

Furthermore drawing with a mouse is impossible, so you give that up immediately. And you cannot erase what you (or others) have written.

Technically there is also a problem that the constant redrawing of the whiteboard is confusing and takes a long time, so nobody knows when to interact.

Audio, however, works excellent, when you first get the habit of speaking up. I find this as the most interesting aspect of the group exercises. We can actually solve problems by talking to each other.

As for the class room teaching, I find it difficult to sit and listen to someone speaking and only seeing static "overhead foils". The pointer mechanism shoould be used more frequently, and I should be allowed to look up information other places (hot-links or self study material) while the teacher murmurs on. As it is now I feel locked in an inactive mode, and therefore not really listen.

The self study material should be much more interesting to read. I don't like to read screen after screen of text (in too small a font by the way). Hot-links don't necessarily help, if they are just there to hide more text. The "help" aspect should be the guiding priciples when using hot-links, not acces to reference material. And the hot-links should be on all occurrences of the word in the text, not only the first time.

Exercises in the self study material broke every rule of good conduct in human interface. E.g: You made 3 errors ! - in large font and bold. The use of read and green text in error messages is misleading, and the messages in themselves were not clear. I had to try out several combinations of answers until the message went away, and then I had forgotten what was now the correct answer.

Funny enough, if you want to go back to the explanatory text in the middle of the completion of the exercise, all your answers are gone when you return, so you have to start all over.

But, all in all this has been fun. I didn't really learn anything about ATM though, I have just been gessing a lot.

Keep up the good work.

B.4.4 Stanley

Pretty much what I can say was said in our last group conversation.

All in all I feel that this media is good in an education situation, one teacher several students, you can ask questions and get an emediate response, you can use Svideo and Swhiteboard where S stands for slow.

The normal group conversation or ping pong conversation is however a very complex thing that is not suited for the media the way it looks today.

My overall feeling is positive and that this is still hounted by beginner problems.

B.4.5 Susanne

I am very interested in the possibilities that are in the use of longdistance education. Participating in this trial was a perfect opportunity to see if my predudices were true.

I can see a social problem studying this way. I think it might be okay if you are sitting together with a few other people so you can talk about all the stuff that you are learning about. Sitting all by yourself is difficult especially with all the technical problems that we have experienced here. I was never really sure if the problems were general or only experienced by me. Sitting by yourself could result in people not participating at all in the groupdiscussion and thereby not getting involved in the studies, and it takes a lot of efford to try to get to know each other.

But as an alternative not to get the education I think that long distance learning is very good - if the technical part works.

Groupwork is okay - but I would prefer (as we have done it here) that the groups remain the same. That way you get to know the other students a little bit! The groups should not be to big - maximum 4 persons and just a little introduction on how to do the work in a way that let everybody give their opinions. Working in groups give you a feeling that you know somebody and that is nice. You have somebody to say hello to when you arrive the next day.

B.4.6 Jon

As james drifted into consciousness, he had the vaguest sensation that something was amiss. Slowly rubbing his eyes, he surveyed the contents of his brightly lit room searching for the cause of this mental itch. The fact that his mouth felt like it had been stuffed with cotton wool by an over enthusiastic dental nurse suggested to him that his problem was somehow alcohol related, so he resolved to drag himself out to the kitchen and sort himself with a couple of pills and a coffee. His legs, however, appeared to have other ideas and had independently conspired to keep him exactly where he was.

This was not good. James lay and mused the nature of his moblity-related predicament, wondering whether he should pursue his desire to get up, when without warning he felt himself being hauled from under the covers as if by some invisible force and dragged toward, er, the bathroom.

James suspected that class was going to be an unusual experience, but he was not quite ready for what was to occur that day. By now he had ascertained that the best way to get something done was, generally, to think about it approximately 30 seconds before he wished it to happen, and then kind of hope for the best. "Not unreasonable,", he thought (being a well adjusted lad) "but disconcerting and a little awkward, none the less." He had been looking forward to this class - a totally new subject and a refreshing change from the usual mundane activities of his class.

This, however, was made all the more interesting by the fact none of his usual class mates turned up and that their replacements were... well, far from fluid in either speech or action. Somewhat puzzled but far from flummoxed, james determined to just see what happened.

The teacher arrived and soon things got under way. James was impressed by the presentation of slides on the overhead projector, but his concentration was not always as good as it could have been. "Hmmm, a rather technical subject", he thought, but with a bit of extra effort he was able to keep up for the duration which, thankfully, was not too long.

After the lecture the teacher had assigned James to a group somewhere else in the building, which seemed spookily unfamialiar, considering that he had been in attendance for over three years now. Undetered, he decided to venture off toward the group room by himself, and after having taken the odd wrong turning, (inexplicably finding himself back at the college gates on more than one occasion) james eventually found his way to the meeting place.

The room was empty, but a few heads popped around the door from time to time, and quickly disappeared before he could say anything. Eventually a couple of others came and settled down at a table. James quickly established that he was involved in some sort of communication problem but could not figure out whether it was his eyes and ears that were at fault (his apparent hangover had yet to subside) or whether the others had similar handicaps. However, after several abortive attempts it became clear that these obstacles could be rounded by using all means available to them, and though progress was slow, and the end of the class James felt that the group had actually achieved something, in terms of solving the problems they were set and also in getting to know one another in such unusual circumstances.

Pleased with his experience of a rather unusual day, james drifted out of the classroom with the others, when a message came over the loud speaker about some forms that had to be filled in and sent back to the teacher. James inspected the "Hmm, it seems that my unusual experiences are not alcohol related after all and have, in actual fact been engineered by a group of evil scientists as part of a terrible experiment in thought control. "Evaluation forms, eh? I'll show them." A wry smile grew into a wicked grin, "It's payback time..." :-)

Appendix C. Evaluation Reports from Appointed Evaluators

C.1 Dr. Andreas Zekl, IBM Germany, Learning Technology

I participated in the trial from March 17 - 19. March 17 was a preparation day, the trial started at March 18 with a short lecture and a self study session. In the following I will describe my impression of the tools and the whole environment concerning technical, social and pedagogical aspects.

The management tool (TESP-MUAP):

Because of technical problems the management tool was not fully integrated in the trial. It is rather difficult to say anything about the underlying network management. It would be useful to involve a network specialist in the next trial. But the direct and easy configuration of the network environment is important for the acceptance of such a tele-education environment.

The user interface of the management application wasn't really satisfying. Problems with the fonts caused the problem that you couldn't read what was filled in into the fields. This occurred on a UNIX machine. This problem does not exist on Windows 95 machines. But to be platform independent, this problem has to be fixed.

There are several possible improvements of the GUI:

1. There is no indicator that the application is working. Therefore if you have a slow network connection, you don't know if the application has crashed or is still working.

2. In many cases there are no selection menus, so you have to remember e.g. a customer name you typed in on a previous page.

3. Result and Action windows should be replaced by one message window where all the messages are displayed. For the moment you get one or two message windows that indicate that your transaction is finished. So you have to click OK once or twice before going on to the next step.

4. Often there is no update of the field entries after an transaction that changed data.

5. The naming of buttons display/modify is not clear nor consistent. It would be better to open a field by double-clicking on the item and there you are allowed to modify the entries. Then you can press OK or cancel if you don't want to change anything.

6. A finished operation should automatically lead to the next logical page in an operation sequence. For instance, you create a new customer, and after finishing the operation you are still on the page where you entered the customer data. It would be better to finish the operation, send an OK message to the message window and then return to the page where further customers can be created.

7. Sometimes you have entry fields where you have to insert a customer name, then you have to press a button to display the possible groups for this customer. It would be better to have a selection list to choose the customer out of a list of all existing customers, then automatically in a parallel list all possible groups for this customer are displayed and you can make your choice by using the mouse.

8. No help or only a too short help message is available in the current version of the application.

9. Some parameters are not yet clearly defined or are ambiguous. It should be checked if really all the parameters are needed.

10. Sometimes the application is really not self-explaining. Button naming is not clear, e.g. BAR, when a user authorisation is withdrawn.

11. Not always happens what you expect the application to do, e.g. after having finished an operation you normally don't expect that you have to press back to continue your input.

The lectures:

Automatic foil switching done by the teacher works fine. Only pages with complex animation are still not loaded while the teacher is already explaining the content. Perhaps it would be useful to give a feedback to the teacher whether all students can see the current foil. The audio quality was absolutely sufficient. There was a problem with colour palette shifting caused by different colour palettes in the video and in the foils shown by Netscape.

First we had all 12 participants shown in parallel in small video windows. The performance for that is not sufficient. Then we had one larger video window which periodically switched from one to another. It would be better to show the teacher while the teacher speaks and switch to a student if he has a remark. If nobody is talking, e.g. while doing an exercise, there might be a periodical switch to get an overall impression of the situation in the virtual classroom.

The video quality should be improved, so that the video is a real added value. For the moment there is no big difference showing a still image of the one speaking and the video transmission. Students can send messages, this always opens a small message window. In my opinion it would be more useful to have one permanent message window, where all the messages are displayed and which is automatically brought to the front when a new message arrives.

There was a little bit of a confusion after finishing the lecture, when the students should go to the self study course. The message window could also be used to display such information, because if the teacher just says something, this information might get lost. The shout button to send a message is very important. It would be useful to have another button which immediately attracts the teacher’s attention. It might take too long to open the message window, to choose a receiver and then send the message to the teacher that you want to ask something. This could also be done by speaking, but then you would have a chaos in the virtual classroom such as in a real classroom.

The control widget for setting the right to speak should be improved. So far, the teacher gives the right to say something. As I already mentioned it is necessary to have a button which immediately signals the teacher that you want to say or ask something.

My overall impression is that this kind of lecture can work very well, after the teacher and the students gained a little bit experience with this new technique.

The self study modules:

I had a look at all four modules of the ATM course. Not all course modules are yet finished. Navigation is very easy because the well know Netscape browser is used as interface. So it is a good interface for all kinds of different target groups with different computer background. The course is developed in HTML/Java(script). There are still some problems in using audio with this software. This is a problem of JAVA which should be solved in new releases of the JAVA language. But in the courses I’ve seen it is no disadvantage that there is no audio.

Gif animations were used to explain technical processes. This is very good to illustrate the functionality of e.g. the packet flow in a network. The animation can be repeated, also step by step. The exercises are very good, because there is a different feedback for each possible answer.

The possibility to make annotations to a graphic before answering a question is a good way to improve interactivity. The possibility to directly access on-line resources in the Internet to check possible answers is a good simulation of the working situation in more and more jobs today. This example shows that it is possible to build such courses in the same quality as with authoring systems like Toolbook, Authorware or IconAuthor. But it has also shown that the development effort is about the same. The developers sometimes needed one or two days for one page (because of JAVA programming and building animations).

Doing such a self study module is much more intensive than following a classroom course, so after about 45 minutes you need a pause. I assume that more than four hours of self study at the computer is not possible. The maximum duration for a mixture of tele-education lectures, groupwork and selfstudy has to be found out in further trials with a statistical significant amount of students.

It is important to have a large monitor with a sufficient font size, if not it is really hard to read a lot of pages at the monitor.

Groupwork using the whiteboard application:

Currently, it is not visible who has joined a workgroup. It is possible to see that while using the audio tool, but this should be a feature independent from the audio tool. It seemed to be rather difficult for the students to use the whiteboard. The usability is very good, but there was confusion who will write or paint something on the whiteboard and when. So perhaps it would be good to assign different colours to different students. I think a group video conference between the group members would be an ease for this work.

Groupwork is an important part of this tele-education environment, but neither teachers nor students are yet used to that kind of technique. It might take some effort until people become acquainted with these new ways of collaborative work.

Tearoom:

The tearoom was not used during the first two days of the trial. The tearoom is important for the social contacts between students in a class. But I don't yet know if this works.

The virtual university building:

Navigation is really easy and intuitive in this environment which contains class, study, grouprooms, offices, tearoom, information, billboard and hallway.

Final Summary:

If it will be possible to overcome the technical problems and to improve the video quality by the use of new technologies and more powerful networks, then that environment is a good possibility for effective distributed learning. My recommendation is to have a few more trials with as many students as possible, including students with different technical and social background. It would also be interesting to make a survey how the acceptance would be to pay for such a service in comparison to traditional classroom courses.

C.2 Berit Thaysen, Copenhagen Business School.

The tele-educational system is split into three parts:

- On-line, students participate in a common educational session, everybody can see eaach other and talk to each other, it is required that all students are present at the same time.
- Group facilities, students can work together using a common white board, it enables immediate feedback from other students.
- Advanced selfstudy material, the material has a hierarchical structure, this gives both a quick overview and easy access to detailes, the animations are very good, and the system provides automatic check of answers to questions.

Some experiences from the trial are given below:

- Often the students behaved as if they were alone, they did not contact the other students and it took a long time to start working together.
- Sometimes both students and the teacher forgot that they were in an educational situation and were distracted by other incidents like a telephone ringing or a collegue entering the room.
- The teacher had to spend too much time on starting a session (calling the students) and on helping to solve technical problems.
- The teacher had less feeling with the students than in a traditional educational situation.
- It requires considerable effort to get used to this kind of teaching and learning.

Conclusions:

- It is time consuming to develop educational material.
- Disciplin is very important, both for planning the course and for conducting it.
- The student must be independent and active to gain some benefits from this type of course.
- It is necessary to know how people communicate in order to improve the cooperation between students.
- The system is very vulnerable for technical problems.