

**UNIVERSITY OF NATAL**

**MOVING TOWARDS INTERACTIVE VIRTUAL CLASSROOMS :  
Technological implications in establishing the first video conference  
distance learning facility at the University of Natal,  
with special emphasis on Music courses**

Research report submitted in partial fulfilment of the requirements of the  
Degree MA (Music Technology)

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## INTRODUCTION

This is an exciting time for the University of Natal as it starts to use a 'virtual classroom' to teach across distance. There has been a lot of discussion and debate about distance education – with some academics feeling that one cannot impart knowledge effectively using electronic media, while others feel that the only way to redress the gap that exists in South African education is through 'massification'.

This research article does not engage with these issues, but merely serves to document the establishment, and ongoing process, of setting up the facilities which will enable departments at the University of Natal to participate in teaching and learning using video conferencing.

Many organisations and individuals around the world have begun to use video conferencing for teaching – but it seems that no other institution has undertaken to teach a complex subject as Music using this medium. We therefore feel proud to be pioneers in establishing what must be a unique facility.

## 1. DIFFERENT METHODS USED FOR DISTANCE LEARNING INSTRUCTION

Traditional learning involves students and lecturer in the same physical space with the students turning up to lectures, listening, seeing and taking notes. The courses are time and location dependent.

As student numbers increase, personal interaction with tutors is reduced. Due to circumstances, many students find they have to work to pay for education, so opportunities for interaction with fellow students are also reduced. Students undertaking an Open Learning<sup>1</sup> programme have neither time nor location dependencies. Unless one is taking a course at the same time and progressing at the same pace, interaction with peers is extremely limited (Coventry, 1997).

Distance learning occurs when physical space prevents the tutor and student from meeting personally. Courses are location independent but not time independent, i.e. the courses are run at set times and should be completed within a specific time frame. Distant learners have even less opportunity to interact with peers and tutors. This is where introduction of new communication technologies such as video conferencing becomes important since, unlike receiving instruction and materials via the internet, satellite, radio, posted books or video tapes, face to face interaction with teachers and peers is possible.

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<sup>1</sup> Open Learning allows students to study materials based courses both on and off the campus at a place and time suited to the individual need (Bulman, 1998).

## 2. VIDEO CONFERENCING

The introduction of new communications technologies has begun to blur the boundaries between distance, open and traditional learning. While creating greater opportunities for peer and tutor interaction, video conferencing does not support open learning as students still have to register and attend classes at pre-set times and progress at a pace established by the course (Coventry, 1997).

“In its simplest form, video conferencing is the live connection of two or more people using some combination of video, audio and data for the purpose of communication...” (Myhrman & Eriksson, 1997).

Video conferencing is used to connect two or more locations using sophisticated technology. The heart of the system is a codec, an electronic device that transmits and receives the video signals that the class members will see on their television monitors (Galbreath, 1995). Video compression techniques are used to minimise the bandwidth by transmitting only the changes in the picture (<http://www.uiadho.edu>).

The term ‘video conferencing’ is sometimes confusing when it is used to refer to any ‘live interaction’ situation, ranging from satellite broadcast, internet and close circuit television. Some of these offer one-way video and two-way audio. More often, video conferencing is used to essentially describe systems where two or more people, situated at different locations, communicate with each other. More sophisticated systems allow simultaneous presentations to multiple sites with interaction.

Video conferencing offers many advantages over conventional face-to-face meetings, primary of these being reduction in costs. While suppliers market their systems based on annual travel savings, many corporations make the investment with other goals in mind – such as wanting employees to meet more often, share knowledge and to meet even when they cannot travel (Myhrman & Eriksson, 1997). There are many advantages for the educational sector, viz.:



- a) 'real time' contact between students and instructors or between students  
(<http://www.uidaho.edu>);
- b) supporting the use of diverse media (Reed & Woodruff, 1995);
- c) one tutor being able to teach the same material to separate groups of students at 2 or 3 campuses at the same time (Jones, 1996);
- d) enables connection with experts in other geographical locations (Reed & Woodruff, 1995);
- e) allows institutions to provide more courses;
- f) enables small numbers of students at distributed campuses to be joined together to form viable classes;
- g) enables institutions to provide specialist educational services to the wider community;
- h) it is an instrument to achieve access and equity goals;
- i) increases the opportunity to develop relationships with industry;
- j) Provides opportunities to develop national and international networks (Mitchell, 1997)

Video conferencing can be used to lecture a large audience or used for a point-to-point, individual desktop PC chat. Much more than just a way to reduce time and travel costs, it is convenient and is seen today as a strategic business tool that improves communication, speeds up decision making and increases efficiency. Many studies, including the undertaking at the University of Natal, indicate huge savings in travel costs, airfares, time and risk.

The 3 main types of video conferencing systems are:

- Small room video conferencing - designed primarily for small groups (1-12 participants) seated around a conference table (Woodruff & Mosby, 1996).
- Classroom video conferencing – using high quality components, codecs and an interface that allows all participants to be seen on the monitors.

(<http://www.uidaho.edu>)

- Desktop video conferencing – utilising a personal computer and video conferencing software. These are less expensive, offer limited resolution, and are most effective for individual use (Woodruff & Mosby, 1996).

Video conferencing is superior to other forms of distance teaching (such as satellite broadcast or telephone conferencing), in that communication is more effective. Learners and teachers can see and hear each other in real time and use conversation and body language to enhance communication. One very quickly adjusts to the lower resolution of compressed video and the slight delays in the audio, both caused by the information being compressed, transmitted and decompressed (Reed & Woodruff, 1995). “Interactive video conferencing is an effective tool that may be used in distance education settings. The system can be integrated into the distance education program with minimal adaptation to the curriculum and course...”

(<http://www.uidaho.edu/evo/dist11.html>).

For full two way audio and video communication, each site must have at least one video monitor, a video camera, microphone, speaker and a means of transmission between sites. While broadband satellite systems offer full-motion high quality video, the capital equipment, especially transmission is very expensive. Compressed video has become the method of choice, especially amongst the computer and telecommunication industry. This method of transmission depends on a telephone network, bringing with it low cost and the ability to dial up any other site as needed. Integrated Services Digital Network (ISDN) telephone lines have become essential to serious users of video conferencing. “Links can be made to any site, regardless of geographical location, provided it has access to ISDN and the same equipment and software at both ends” (Coventry, 1997).

“ISDN is now operating in 55 countries around the world and is becoming commonplace” (Cohen, 1998). Video conferencing has become so popular that 85% of Europe’s multinational corporations have today implemented it as the technology to communicate with branches, staff and employees around the world (<http://www.pictel.com>).

Video conferencing is being used for varied applications from telemedicine, where specialists in distant locations diagnose and offer advice to medical practitioners, to virtual court cases, where, in order to minimise cost and risk, the accused could be located at a remote site, possibly in the prison, while the case takes place in court (Whitby, 1998). International singer, Paul Simon, residing in the USA, recently asked if he could testify in the case involving Rev Allan Boesak, currently taking place in South Africa, through video conferencing (SABC TV news, 19.11.98).

### 3. SURVEY OF OTHER HIGHER LEARNING INSTITUTIONS USING VIDEO CONFERENCING FOR DISTANCE TEACHING

Video conferencing technology has become extremely popular and successful for the delivery of distance education programmes and many higher learning institutions and training organisations today offer courses via this medium. Hereunder are listed just a few.

In the USA, **Teleconference Training Associates** have been working with users of video conferencing and distance learning for the past six years. They also conduct workshops to assist users in designing content and presenting in this medium (<http://www.orednet.org.tta/>). **Illinois State University** has an emphasis on distance education, in particular on teachers' habits in using video conferencing (<http://www.convocom.org>). **Yale University** has five rooms, used for distance learning in a range of subjects, including telemedicine. **New York Institute of Technology** uses three computer-equipped classrooms interconnecting their three campuses, offering various graduate and undergraduate courses via video conferencing. **Boston University** uses video conferencing to teach graduate level courses to four United Technology Corporation sites, maximising the employee's quality time by eliminating the need to travel to the classroom (<http://www.picturetel.com/apps/applications/BostonU.html>). **Massachusetts Institute of Technology** School of Engineering and Management has created a System Design and Management (SDM) programme, comprising 11 students at 8 remote<sup>2</sup> corporate sites via video conferencing. The programme meets the needs of early- and mid-career engineers who don't have the luxury of spending time away from the workplace. Students can graduate with a full Master of Science degree in Engineering and Management. Students also hold weekly video meetings with professors and other students (<http://www.picturetel.com/apps/applications/MIT.html>).

**California Community Colleges** have recently invested \$3.2 million to bring together more than 1.3 million students, 16,000 faculty members and their 106 campuses using video conferencing (<http://www.pictel.com/press40.htm>).

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<sup>2</sup> A remote class/site/audience is used to identify the group of students or class receiving tuition at the far (receiving) end, where no lecturer is present.

In the UK, the **University of Brighton** is evaluating video conferencing as a learning tool while **Nottingham University School of Nursing** operates six studios connecting hospitals throughout Lincolnshire and Nottinghamshire, mainly for nursing education and tutorial support (<http://www.nottingham.ac.uk>). **The Royal Society of Medicine** recently installed a Sony video conferencing facility at its central London location to service the growing demand within the medical profession. It is used by doctors and healthcare workers (Lloyd, 1998). The Dental School at the **University of Bristol** uses video conferencing to reduce the load on the UK's 200 orthodontic consultants and cut waiting time for patients needing specialist dental advice. During a video call, the dental consultant views and discusses the patient's x-rays or even uses an intra-oral camera to send digital images (Lloyd, 1998).

The **University of Ulster**, Ireland installed video conferencing in 1990 to link three of its campuses (which are 32, 51 and 72 miles apart respectively) so administrative and academic staff could conduct cross campus meetings. Its teaching and learning use later took priority on the system where 20 students could be accommodated at each site (Abbott, Dallat, Livingston & Robinson, 1993).

**Tecnologico de Monterrey, Universidad Virtual**, Mexico, also keen to commence implementation of video conferencing in distance education, has a student doing research and completing her thesis for a Masters in Education on this topic (<http://www.ruv.itesm.mx>).

In Finland, the **Distance Education and Instructional Development Centre** teaches Art and Design courses via interactive TV and video conferencing (<http://www.uiah.fi/jedevries>).

The **Federal University of Santa Catarina**, Brazil, uses video conferencing to provide different courses for private and public organisations around the country. They offer two Masters courses using video conferencing (<http://www.uvirtual.eps.ufsc.br>).

In Australia, video conferencing has become a popular means of delivering higher education lectures and “over 30 of the 38 tertiary institutions in Australia now have video conferencing facilities...” (Mitchell, 1997). There are links from campuses offering nursing education directly to five different hospitals (Mitchell, 1977). **University of Western Sydney Macarthur**, conducts training programs in using video conferencing. **The Department for Employment, Training and Further Education (TAFE)**, a government-run agency successfully runs many classes to rural areas of South Australia via video conferencing. This allows many TAFE students, who are self-employed or who work full-time, to be able to complete their certificates and diplomas (<http://www.picturetel.com/apps/applications/south.html>).

The **University of Kalmar**, Sweden uses video conferencing for distance learning study centres in the country, mainly offering courses on Business English, Environment courses and presentation techniques (<http://www.mc.hik.se/EDIT/studion.html>).

To promote cultural integration within Europe, a video conference link was set up between schools in Denmark and Germany to extend contacts and exchange ideas. Their findings were that the central role of the teacher was de-emphasised and students began working together as a team (Sony Professional).

**University of Kobenhaven**, Denmark started a project 3 years ago with a link between the Mainland University and the department situated in Bjeorland, a remote island in the Baltic Sea. The original idea was to reduce the 2-hour ferry travel trip and lecturers living on the island could lecture to the Mainland University. The video conferencing and peripheral audio and video equipment enables any of the students to interact with any other remote location (Sony Professional USA).

Finland’s **Helsinki University of Technology (HUT)** launched its first video conferencing classroom in 1988, seating about 30 people. Lectures for the Master of Science programme,

approximately 14 hours per week, were delivered by video conferencing to four or five locations around Finland simultaneously (Salkunen, 1995).

In Canada, **Little Red River Board of Education**, with great distances to cover and a low student population, created the **KAYAS Cultural College**. It boasts being the first video conferencing college in the Western Hemisphere, bringing students in remote locations together. Courses offered include Native Studies, Adult Up-Grading and Computer Training (<http://www.picturetel.com/apps/applications/little.html>). **Queen's University** offers the Executive MBA degree through video conferencing from Ontario to a satellite campus in Ottawa. These classes are shared among 10 sites, with 2-8 students at each site. They hope to add students from the Pacific Rim and Bermuda this year. The students find the "virtual study groups very beneficial" (<http://www.picturetel.com/apps/application/queens.html>). **Malaspina University College** uses video conferencing to deliver short courses on community education, Fisheries and Aquaculture, Forestry and Resource Management to a distant campus site at Powell River, BC. (<http://www.mala.bc.ca>).

In South Africa, the **University of the Witwatersrand's Graduate School of Public and Development Management** has set up a classroom to teach both local<sup>3</sup> and remote sites. They find that straight lectures and individual exercises work well while activities involving many people do not (<http://www.wits.ac.za>). The **University of South Africa (UNISA) Bureau for University Teaching** has sites at their main campus at Pretoria which are linked to Durban, Pietersburg and Cape Town. The systems are used for both broadcast and live interaction between small groups of students and lecturers, who avoid travelling to the centres for discussion purposes (TAD Minutes, 1998). UNISA finds video conferencing "ideal for extending contact sessions with students" (<http://www.unisa.ac.za/dept/buo>). **Technikon Witwatersrand (TWR)** has 1,000 remote students receiving tutoring and on-the-job training on location. It uses

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<sup>3</sup> Local class/audience is used to identify the group of students or class from where the lecture is originated (and transmitted). The lecturer is present in this class and has face-to-face physical interaction with the local class.

a multi conference unit (MCU) to reach to 15 locations simultaneously, albeit switching to each site around the country for feedback (<http://www.saif.org.za/business/university.htm>).

The **University of Natal** started using video conferencing in 1995. It became a necessity in that its two campuses (Durban and Pietermaritzburg) are situated about 80 kilometres apart. While one of the initial considerations in setting up these facilities was distance teaching, the system was quickly booked up for administrative and academic meetings between the campuses. Linkages and conferences with other universities around the world are also undertaken frequently by the University's International Office; and the Human Resources Division finds it useful for conducting interviews with distant job applicants. It has also been used for special events.

A world-renowned speaker was invited to deliver the opening address at an international Chemistry conference hosted by the University of Natal in July 1998. However, this coincided with the opening of another important congress in the UK where he was also invited to speak. He chose to attend the South African event in person and made his presentation later that afternoon to the UK congress by video conference. The room had to be rearranged and especially set up to incorporate his various media.

The system is also used by the University's Medical Faculty. Later this year, specialists will use the system to observe and participate in an important medical operation due to take place at a Hospital in Cape Town.

Research indicates that the use of video conferencing is cost effective as, in the first year of usage, the estimated travel savings alone was greater than the capital and running costs of both the installed systems (<http://www.nu.ac.za>).



#### 4. HISTORICAL BACKGROUND AT THE UNIVERSITY OF NATAL

In February 1994, Professor Chris Ballantine enquired about the possibilities of 'tele-classing', i.e. teaching to a remote site. Professor Dale Cockrell, a music lecturer at the College of William and Mary had been invited to teach a course at UND in the summer. Due to scheduling difficulties and differences in academic terms, he suggested that he could teach the first half of the course from the USA via satellite uplink and come out to SA in the second half (Cockrell, 24.02.94). They were already teaching students on other continents using this methodology. He also suggested that, in order to foster international learning, complementary courses could be designed and taught from each side (Cockrell, 4.03.94).

The broadcast/satellite options were researched and found to be extremely expensive at the time. Furthermore, although the broadcast option offered 'full motion video', it did not provide immediate two-way interaction. The idea was put on hold temporarily.

Video conferencing, a relatively fairly new method of communication to South Africans at the time, was demonstrated at the Computer Faire in Johannesburg in April 1994. The systems utilised Integrated Services Digital Network (ISDN) telephone lines and while it seemed the ideal method to conduct distance teaching, the university had to wait until Telkom had made these lines available. Later in the year, once ISDN had been installed at the University, Sony South Africa loaned the University's Audio Visual Centre in Durban a video conferencing unit so they could try it out.

There were some initial difficulties with dialling in or out via the University's electronic telephone exchanges. Once this problem had been sorted out and the exchange configured, we succeeded in connecting to the UK. The lines later became fully functional between the University of Natal Durban (UND) and University of Natal Pietermaritzburg (UNP) campuses, and two Picture-Tel Venue video conference systems were budgeted for, purchased and installed on both campuses in 1996.

The initial intention was:

- a) To use the system to conduct meetings and conferences between staff of the two campuses in order to minimise time and costs spent in travel;
- b) To conduct meetings and conferences with other higher educational institutions nationally and internationally (as the University was now engaging in partnerships);
- c) To use the system for distance teaching and perhaps meet demands of lecturing to two classrooms (at UND and UNP) simultaneously. The advantages of video conferencing over satellite or broadcast options was that the system was easy to use, used a 'dial-up' facility (and therefore cheaper), and that it allowed for full 2-way communication.

Peripheral items were included and purchased together with the original system. These included:

- a visual presenter<sup>4</sup> for transmission of objects, printed material, transparencies and slides;
- a VGA computer input for users to directly connect their PC's and transmit computer generated presentations or documents;
- remote controllable camera operation – so that an operator could manipulate the pan, tilt and zoom of the cameras on either side;
- video playback/recording facilities – to play back video material or videotape meetings and conferences;
- a fax machine to transmit meeting minutes and documents that were too large or detailed to be placed on the visual presenter. The fax machine also doubles as a telephone in the event of equipment failure or emergency support being required.

The systems were installed at the Audio Visual Centre (UND) and the Department of Education (UNP). The Audio Visual Centres on both campuses were responsible for bookings, maintenance and technical support.

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<sup>4</sup> A visual presenter is an item similar to an overhead projector. It has a video camera with a zoom lens, which is able to pick up any object or printed matter placed on the surface. It has lights to illuminate objects as well as a backlight feature so that slides and transparencies may be used. The output is a video signal. A picture of a visual presenter may be found in Appendix A, picture 11.

The system was functional and immediately booked by user for meetings, especially international conferences. An Open Day was held to demonstrate video conferencing to staff on both campuses in February 1997 and the original idea of teaching through the system was once again raised. One of the attendees, the Music Department's Dr David Smith, caught onto the idea of using it for regular departmental teaching. This was followed up by Professor Jürgen Bräuninger who made more detailed enquiries such as whether the department would be charged for teaching a course this way, whether the room could accommodate enough students, as well as other logistical and technical questions (Bräuninger, 14.02.97).

## 5. THE OBJECTIVE – DEPARTMENT OF MUSIC

In May 1997, a meeting was held between the Head of the Department of Music, Professor Beverly Parker, Dr Smith and the Director of Audio Visual Centre, UND, to discuss video conferencing possibilities for the Department's *Music, Culture and History 1A and 1B* courses. It seemed an economical way of extending the boundaries, the intention being to conduct lectures from UND and enrol students to take these classes at UNP in 1998. Prior discussions had been held with the Dean: Faculty of Humanities at UNP, Professor Ron Nicholson, who was happy to allow UNP students to take courses in this way. Dr Veronica Franke, was also enthusiastic about teaching *Aural Perception* and *Music Theory 1A and 1B* via video conferencing to UNP students.

This would be in line with international trends to allow institutions to provide more courses, enable small numbers of students at distributed campuses to be joined together to form viable classes and to provide specialist educational services to the wider community (Mitchell, 1997). It would also fall within the University's Open Learning strategy to offer a wider range of courses and to promote collaboration between campuses (Bulman, 1998).

The issues discussed and raised by Parker and Smith were:

- a) Lectures and Tutorials would take place 5 times a week, possibly on Tuesday at 10h40, Wednesday at 09h35, and Thursday at 08h40. Tutorials would be scheduled on Tuesday at 11h25 and Friday at 07h45. Detailed schedules would be supplied as soon as the 1998 timetable was ready.
- b) It was envisaged that enrolment figures would be between 25 – 30 and the rooms had to accommodate that number of students.
- c) There should be no dropouts on the calls during the lectures.
- d) No call charges were being billed to user departments in 1997 as 'internal' telephone lines were being used between the two campuses. They enquired if this would continue or whether departments would be expected to pay for call or rental costs in 1998.
- e) There did not seem to be a requirement for additional cameras but lecturers would need to use a document camera. Graphics and text needed planning. The advantage of the document

camera (or visual presenter) was that the lecturer would be able to write on paper instead of a chalkboard.

- f) It was imperative that good quality audio CD and Cassette playback facilities would have to be provided by Audio Visual Centre.
- g) It would be difficult to bring in an acoustic piano when needed so the Music Department would provide an electronic keyboard if required.
- g) There did not seem to be a need for an operator, as the lecturer, once shown how to operate the equipment, would do this himself or herself.

Smith would try and set up a simulated full-scale lecture sometime in July/August using all the elements, so that we could establish if there were any limitations or technical problems that would need attention. Ideally there should be a full class on both sides and perhaps some lecturers could go to Pietermaritzburg to participate from there. Due to equipment failure at UNP and scheduling difficulties, this did not materialise.

## **5.1 Technical Considerations**

Unlike most other courses, teaching music through video conferencing posed a unique challenge in that various media would be utilised almost on a daily basis. Investigations indicated that all known courses offered through video conferencing were straightforward lectures on business management-type subjects. A single microphone and camera were sufficient to transmit signals from the teacher to remote sites. The teacher was either in the same room with a small group of students or in a specially set up 'technical room' where there was no physical contact with students. Where students interacted with each other, single microphones and cameras were used. The course material for these, in most cases, made few technical demands, if any.

### **5.1.1 Audio Quality**

The issue of the quality of the audio signal, which would be crucial to a music teaching programme, had to be addressed. Transcending the quality limitations of the small video monitor speaker would require an amplifier with additional external speakers. The staff of the Music Department had to then satisfy themselves with the quality of the audio.

The video conferencing technical specifications indicated that since the video, audio and data signals shared the same line; there would be a compromise in audio fidelity. Video conferencing systems use codecs, which allow two-way 7kHz transmission on a 64kbs circuit, using the international G.722 standard. While this is perfectly adequate for voice, it could limit music quality. Audio delays could also occur because it takes about a second for the information to compress, travel and decompress. If the system is not properly configured, audio 'clipping' or echo could take place (Reed & Woodruff, 1995). Most systems have an 'echo canceller' – which samples the background noise of the room and attempts to reduce this noise. The Picture-Tel system specifications indicated that it transmitted audio in MONO at a bandwidth of between 50Hz and 7kHz. While this seemed to be inadequate, it was suggested that we go ahead and conduct some tests anyway.

We also looked at the possibility of adding 2 additional ISDN lines to the system and configuring them purely for transmission of high quality stereo audio. The video conferencing systems under evaluation did not make provision and this option would therefore require purchasing and installing stereo ISDN terminal adapters and audio interfaces at both ends, costing R75,700.00. There would also be additional costs for other peripheral equipment, telephone line rental<sup>5</sup> and call costs (should we decide to dial off campus).

### 5.1.2 Audio Feedback

Unlike a standard video conferencing system, where between 1 and 8 delegates sit around a table with a centrally placed boundary microphone<sup>6</sup> (usually positioned on the table), the students would be seated in a typical lecture-room configuration<sup>7</sup>. There would need to be full interaction between the lecturer and students at both sites, and all parties would listen to the music sources. It was important that there would be no audio feedback from the speakers through the system. Audibility of questions from students at the remote site is important and there may be times where the students interact with each other.

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<sup>5</sup> Although the telephone costs on campus are internal, the Audio Visual Centres have to budget for and pay installation costs and a monthly rental for each ISDN line.

<sup>6</sup> See Appendix A, picture 9

<sup>7</sup> See Appendix A, picture 6

### **5.1.3 Position of the Video Monitors**

Unlike in standard video conferencing, where delegates sit around a table facing a single video monitor, in this case both the students and the lecturer needed to see the remote class. If the monitor were situated on one side of the room where the lecturer would see the remote class, the UND class, seated with their backs to the monitor, would not be able to see the remote students. Tutors would also be using the visual presenter instead of overhead projectors or regular chalkboards, the output of which would be seen only on the monitors. This too would not be visible to the local students. It was felt that, rather than one, we should use two monitors. The lecturer would have to be positioned at an oblique angle as to see both classes and graphics as he/she teaches. At UND, the remote site would be visible on one monitor and graphics on another high-resolution monitor. At UNP, if there were only recipient students, the problem would not be as serious and the students would see the lecturer on one monitor and graphics on the other.

### **5.1.4 Positioning of the Video Cameras**

Placing the video cameras above or below the video monitors helps achieve eye contact as people tend to look at the monitor and image of the person rather than the camera (Coventry, 1997). At the remote site, where there would just be remote students, a single camera could be positioned on top of the monitor, facing the students. The local side would require rapid camera panning to see both the lecturer and students. It made more sense to use two video cameras, one trained on the students and the other on the lecturer. The camera for the students would be positioned on top of the monitor where the remote class would be visible. The camera focussed on the lecturer would have to be at a suitable position to the rear of the class.

## 5.2 Problems & Solutions

### 5.2.1 Venue and Student Numbers

In trying to figure out how the existing system, being used for conferences and meetings, could be adapted for teaching as well, a number of potential problems seemed evident. If we removed the table in the existing video conference room, we would only accommodate a maximum of 15 seated participants. While it was possible to move the system into AVC's Television Studio, situated just below the video conferencing room, where seating could easily be provided for 30 students, there would be the following consequences:

- a) The video conferencing system would need to be moved in and out of the studio on a daily basis. Considering the frequency of the lectures, and that the system was already heavily booked for meetings between centres, this was not a practical solution.
- b) The video conferencing system be moved into the TV studio permanently. This meant that all studio activities would cease. Confidentiality of meetings would be compromised due to the 'open design' of the TV Studio. This was also ruled out as a possibility.

It was therefore necessary for the University to purchase another system to be set up in a different venue that could accommodate 30 students. Installing expensive and complex equipment, with open telephone lines in a lecture theatre would pose obvious security risks. Bookings and technical support could also be a problem.

Facilities Management Group (FMG)<sup>8</sup> was requested to identify a secure room on UND campus that could accommodate 30 students. The room would have to be available from November 1997 for installation and tests. FMG proposed an office that was about to become available. Besides this posing a security risk, technical support and audio interference did not make this an ideal choice. UNP already had an unused room adjacent to their existing video conferencing room in the Department of Education, which, if modified, would be ideal.

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<sup>8</sup> FMG is the company that controls booking and manages the University's teaching spaces, as well as all building maintenance, alterations and associated work.



In Durban, the Audio Visual Centre was prepared to reorganise its Graphics and Photography sections and subdivide the existing Graphics area to create a room as the new teaching venue. A draft design was drawn up, carefully considering issues such as security, alarm system, seating, lighting and sound proofing. An estimate for the refurbishment was provided by FMG at R23,000.

The University's Custodial Services Division could only loan chairs and desks on a short-term basis. Since the room was not that large, using desks would seriously limit the numbers. A quote was obtained to purchase chairs with moulded writing tablets.

### **5.2.2 Call Dropout**

It was suggested that dedicated priority ISDN Telephone lines be allocated to the new video conference systems to prevent call dropout. The university's Telephone Services Department was alerted that once the lines had been assigned and configured, they should not be altered, as any dropout would seriously affect the teaching programme.

### **5.2.3 Charges**

The Telephone Services Department informed UND's Audio Visual Centre in May 1997, that it was likely that a flat rate of about R400 per month would be charged for calls between UND and UNP in 1998 and suggested that user departments budget for this (Peplow, 15.05.97). However, the University's Directors of Campus Affairs and Administration felt that, while it was appropriate for departments to budget, charging out to departments would be complex, unpopular and unwieldy. A simpler and more practical solution would be for the Audio Visual Centres on both campuses to budget for the full amount and offer the inter-campus services free to user departments (Trinder, 23.05.97).

As found at other universities, "in trying to mainstream Distance Education - if we charged for a room, it would make videoconferencing prohibitive" (Penn State University, 1997).

#### 5.2.4 Additional Equipment

Some means of providing multiple audio inputs was necessary. Extensive tests were done on the existing system and it was found that the single audio input, used by the desktop microphone was coupled with the camera signal, transmitting the picture of participants at the local site. This system did have other audio inputs, but these were coupled to additional video sources (such as the document camera or video player). Therefore audio signals plugged into those inputs meant switching and the associated video pictures became active rather than the camera. It seemed that the multiple audio signals should be fed into a mixer, the output of which could be sent to the microphone input using an impedance converter to change the line level signal into a microphone level signal. The problem with this was that the existing microphone with all its features, such as echo cancellation and noise reduction would be disabled. Either some modifications would have to be made or we would have to find a system in which the existing microphone as well as external inputs could be used simultaneously.

A good quality audio mixer, together with a CD player, audio cassette player, VCR, external speakers, amplifier and sufficient microphones to pick up the class would have to be purchased anyway.

A second camera was also necessary if one wished to have pictures of both the lecturer and the class. There were questions around whether the second camera could be controlled (by both the local and remote sites) and whether it could be patched into the system. Clearly these criteria would have to be carefully considered when evaluating the purchase of a second video conferencing system.

If the new system, in a new room was the considered option, rather than patching into the existing video conference systems, we should treat these new teaching venues separately and provide additional ISDN telephone lines permanently to them. There would be ISDN installation costs and one would have to investigate if there was spare capacity on the switchboard exchange.

Rather than provide all additional equipment at UND, from where the Music lectures would originate, it was felt that we ought to duplicate all pieces of equipment at both centres so that lectures could take place from either centre. There may be occasions when the lecturer would want to meet the UNP students in person and could lecture to the UND group via video conferencing on those days.

### **5.2.5 Technical Support**

While most video conferencing systems were fairly easy to operate, this particular application was complex and, while we initially discussed the possibility of lecturers being taught and operating the equipment themselves, it was felt that the lecturers may not be able to concentrate on delivering the lecture if they had to concern themselves with operating the equipment. The issue of technical support was therefore a crucial one. Both Audio Visual Centres had no spare capacity and were already understaffed. Added to this was the fact that the university was, at the time of implementation, undergoing a restructuring exercise where it hoped to downsize the number of staff on both campuses. Both heads of Audio Visual Centres would have to motivate this strongly to their respective superiors.

Other institutions also found technical support was necessary. At the University of Ulster, “technicians are located on all three sites and together they make it operational for users according to their booking arrangements” (Abbott et al, 1993).

### **5.2.6 Administrative Support**

While UND has a fully equipped music library, there was concern that the remote students may not have the necessary library facilities necessary to support the video conference lectures. There were also questions around the administration of tests/examinations and distribution of prepared materials. Smith suggested that, as the UNP library has some in-house listening facilities (5 or 6 cassette decks, 2 cubicles and a larger room with video equipment), pre-dubbed audio and video materials could be sent in advance to the library to be held and handled by the issue desk. The subject librarian would assume responsibility for the administration.

A proxy staff member or graduate assistant at the remote site (UNP, in this case) would have to be available to assist with general administration (reliability for handouts, assignments) and student queries. Consultation with lecturers could be solved by a combination of visits by lecturers, telephone and email (Smith, 16.05.97).

It was suggested that a tutor/reference person (perhaps a graduate assistant) be employed at the remote site. This person would co-ordinate the class, unlock the facility, hand out printed material (which would be sent by the lecturers in advance); collect assignments and provide some technical support. There was also concern about which faculty or department would appoint this person, especially since it seemed that the university could offer a range of courses across departments or faculties.

## **6. IMPLEMENTATION**

### **6.1 Tests**

The first test was conducted in May 1997 from UNP to UND. Passages of music from CD and cassette were played back and the UND site connected an amplifier and speakers to overcome the limitations of the video monitor speakers. While only in mono, the audio quality seemed quite acceptable. Tests would also need to be done from UND to UNP, as this would be the direction of the lectures and material. UNP would have to install an amplifier and speakers. Many of these subsequent tests had to be postponed as, close to the scheduled test times, the UNP system developed a series of problems with the system. No maintenance contract had yet been effected although the supplier was persuaded to send out extra boards and have their technical experts repair the system. Naturally this caused some anxiety amongst the staff who were concerned that similar mishaps could jeopardise their lectures. It seemed imperative that we implement a maintenance agreement, which offered rapid technical support.

Later tests, combining the audio inputs through a mixer, together with an external microphone caused impedance matching problems and did indeed defeat the echo-cancellation, causing feedback and low frequency rumble, which disturbed the clarity of music being transmitted. It also meant that channels had to be muted rapidly to avoid feedback.

### **6.2 Proposal**

While tests were still being conducted, in August 1997, the then Durban Principal, called for a proposal to purchase and install a second video conferencing system on both campuses. This was submitted in September 1997 (see section 6.5), together with a document highlighting why it was preferable to house the systems at Audio Visual Centres or close to them.

Technical staff would have to provide support and secretaries at both centres would need to receive and monitor bookings.

### 6.3 Evaluation of Systems:

A number of different video conferencing systems were evaluated and technical specifications scrutinised. In October 1997, we read of the success of the Sony Trinicom 5100 systems around the world, having just won the first prize at the American Teleconferencing Association (ITCA) as the best group video conferencing system. Sony systems had some unique and valuable features which would ideally suit our application:

- a) **MCU:** The system has a built in 4-way multi conferencing processor (MCU) and inverse multiplexer. These meant that, given sufficient lines, one could conference simultaneously with three other sites and view them all on a single split-screen monitor, browse by site (full screen), or select voice activated switching (full screen). Multipoint locations may exit a session without affecting the integrity of the call. On other systems, a multi-point bridge was offered as a very expensive optional extra. It was felt that MCU would be useful if ever we were to teach multiple sites simultaneously.
  
- b) **Dual monitor board:** On this system, by using the dual monitor board, two video monitors could be used. At the local class, students would see graphics on one and the remote class on the other. The remote site could switch between the lecturer and graphics, while observing the local class on the other monitor.
  
- c) **Whiteboarding<sup>9</sup>:** The whiteboarding function is standard – on other systems, where offered, this would cost more. This feature had to comply with the T.120 standard which allows for document conferencing between systems.

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<sup>9</sup> Whiteboarding is a document conferencing facility that lets multiple users simultaneously view and annotate a document with (electronic) pens, highlighters and drawing tools.

**d) Cameras:** Most competitive products would only allow control over one camera. With the Sony, two cameras could easily be plugged into the system and remote control and switching over both cameras was built into the software.

The cameras could also be set to auto track (follow) an individual in the room. This could be useful if lecturers moved around.

**e) Graphics:** The central processing unit contained an RGB input for still images created by any PC. Images could be saved on PCMCIA memory cards for later playout and transferred at 30+ images per second.

**f) Remote Controls:** The system is supplied with both a graphics tablet with a light pen and a hand-held remote to operate all functions, unlike other systems which use a standard infra-red control panel. "Few video conferencing systems offer true interoperability" (Miller, 1997) and therefore the system would have to comply to the H.320 standard, which allows a variety of video conferencing systems to communicate, thereby allowing users at one site to remotely control and switch the others. The tablet was useful for annotation and graphics.

**g) Video Compatibility:** The video conference system would have to be multi-standard, i.e. work across different world systems (NTSC, PAL or SECAM) without standards conversion. This was not perceived to be a problem as most available video conference systems were multi standard anyway, but it was important to check as there would be occasion to teach or receive instruction from different parts of the world.

**h) Reputation:** Sony systems were being used by many companies and educational institutions around the world for distance education, and over 70% of the video conferencing systems sold incorporated Sony components. Sony has a very good reputation in video industry with almost every TV studio using Sony equipment.

i) **Audio:** The Sony system had separate microphone and auxiliary audio inputs which could be combined (MIC + AUX) as needed without affecting the video signal. With other products, one had to switch inputs which meant that when the mike input was being used, the camera was live. Switching to auxiliary (to use external audio equipment) meant that the auxiliary video input was switched into the system and students could no longer see the 'live' camera.

j) **Support:** 24-hr technical toll-free support with remote diagnostics was offered in SA, and software upgrades could be downloaded via ISDN (at 64 KBPS).

Besides offering many additional features, the Sony systems were more competitively priced at almost a third lower than its competitors. It was therefore decided that two Sony Tricom 5100 units be purchased.

#### 6.4 Bookings

There are a number of issues that need to be considered when co-ordinating a video conference. These issues are pretty similar around the world. In a large institution, one has to deal with different departments when co-ordinating bookings, especially in the university's case where bookings have to be carefully and regularly co-ordinated between centres. This has a greater impact on UND where links are regularly made for overseas meetings and conferences. It is imperative to have a room co-ordinator. There are also other issues such as unrestricted telephone lines, who will pay for line charges, if an operator is required, etc. "You have to go through a lot of different areas to co-ordinate a videoconference (for example: parking issues, scheduling)" (Penn State University, 1997).

#### 6.5 Budget

A budget to purchase and install two video conference systems was proposed to the Deputy Vice Chancellor (Academic) in September 1997. This included capital equipment and ISDN installation costs. A further budget for the proposed annual running costs was also submitted.



Apart from the budgetary figures relating to capital expenditure, the idea of proposed rooms, technical backup, bookings, security of equipment, noise levels, furnishing and lighting were also addressed. Operating costs would be included in the 1998 Audio Visual Centres' budgets. To have the system operational by the start of the 1998 academic term meant that 'standard budgetary' procedures could not be followed, and financial approval had to be completed by December 1997 to allow for placement of orders, for proper tests to be conducted and the system to be commissioned.

## **6.6 Purchasing**

“While most educational organisations seem to prefer to buy equipment and then worry afterwards about operating costs, private companies are beginning to enter into both rental and lease agreements, to avoid high establishment costs” (Mitchell, 1977). The rental option was considered but it seemed to be more economical to purchase the capital equipment, which could be upgraded at a later stage, if necessary.

However, the University's budgeting process normally meant that while departments submitted estimates and proposals in about November of the preceding year, actual allocations only took place well into the new year. In order to have the equipment installed and functional by the start of term in 1998, special application was made to the Director: Administration to bypass the normal budgetary procedure.

This is easier in theory than in practice for a large university as ours has many bureaucratic processes and departments. Suffice to note, much pressure had to be brought on the university's finance, administration and central purchasing offices to obtain expenditure codes to place orders well ahead of the start of the first 1998 semester. Similar pressure had to be exerted on FMG to have the building alterations completed in time.

## 7. SETTING UP

The Audio Visual Graphics area was divided to create the new UND video conferencing training room. It had to be laid out in such a way that 30 chairs (with writing tablets) could be accommodated. A careful plan on paper was made so that seating arrangements did not obstruct the cameras or monitors.

The backdrop had to be carefully thought through as a busy background can have a distracting effect. Pale blue curtains were chosen as these have the least interfering effect and also create an impression of space and coolness. All 4 walls were draped in curtains to help with deadening acoustic reverberation. As one side of the room had windows, it was heavily lined to prevent external noise and to prevent any external (natural) light entering the room.

As was found in the other video conference room, additional fluorescent lighting was necessary in order for the cameras to pick up subjects better.

The room was modified by installing dry-partition walls over which new curtains were hung. Six new ISDN telephone lines were installed and the existing departmental alarm system had to be extended to include this room.

### 7.1 Modifications

The room had to be constantly modified, as certain problems became evident.

#### 7.1.1 More Monitors

Most video conference venues used for teaching use two monitors, one to display the incoming signal and the other for the outgoing (Coventry, 1997). When we started out, we had the monitors positioned in the front of the class off to one side. This resulted in Impey forgetting the remote students at times (Impey, 6.11.98). Smith (6.11.98) also was one of the first to use the system and found it difficult with no rear monitors. Two additional monitors were added with two positioned in front and two at the rear of the room. This was important so that the students

in the local class, looking forward, could see the lecturer, graphics on one monitor and the remote class on the other. Similarly, the lecturer would look above the heads of the local students to see the remote class and graphics. Signals would be looped from the front to rear monitors. The height of the monitors presented a problem and brackets were manufactured so that all video monitors could be suspended for better visibility. It was also necessary to purchase high resolution graphics monitors. The rear camera, trained on the lecturer, could be mounted in between the monitor brackets<sup>10</sup>.

Four monitors were also supplied to the remote class, with the two in front showing the local class on one and the lecturer on the other. As switching takes place, the local class is replaced with graphics.

### **7.1.2 Audio Routing**

All audio signals – microphones, CD player, audio cassette deck, video player and provision for an electronic keyboard are fed into an audio mixer. The output of the mixer is fed into an amplifier and speakers so that the local class can clearly hear all audio signals.

The video conferencing unit has ‘far’ and ‘near’ audio outputs which are normally fed into the 2 channels of a video recorder so that a session may be taped. These audio signals were also routed into the mixer so that the far end channel may be raised to hear signals emanating from the remote site clearly. Faders on the channels carrying the local microphones and the ‘near’ signal were not raised to prevent feedback. The mixer has two pre-fade auxiliary send busses – one was used to route signals into a video recorder (for taping of sessions) and the other, to send the local microphone signals and the audio sources to the remote site. The remote site’s audio is configured in a similar way.

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<sup>10</sup> See Appendix A, picture 7

### 7.1.3 Multiple Microphones

Picking up audio from the class was one of the important components of the system. This had to be done unobtrusively yet at the same time providing clarity. Microphones had to be sensitive enough and situated to pick up participants, wherever they were seated in the room.

Unlike the Picture-Tel system which used a dedicated boundary microphone on the table with the audio output routed to the video monitor, the Sony system used a single speaker box which doubled as an omni-directional microphone.

Multiple microphones needed to be connected to audio mixing desks on both sides and routed to a pre-fade bus for onward transmission to the remote site. Similarly the microphone signals from the far end would be routed into the normal channels of the mixer for the local site to hear.

A variety of microphones were tried out in the room. These included condenser dynamic, PZM and lapel microphones from Beyer and Shure.

The specifications of the Beyer MC834 (shown on the right) indicates a wide frequency range, natural response and high signal-to-noise ratio. This condenser cardioid microphone picked up ambient sound well but lacked the clarity required.

MC 834

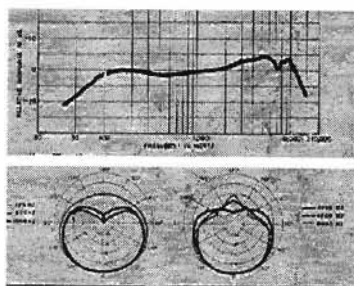


- FEATURES:**
- Wide frequency range, natural response
  - Exceptional signal-to-noise ratio and high SPL capability
  - Transformerless output
  - Switchable 10 and 20 dB attenuation plus 3 position low frequency roll-off
  - Price/performance ratio

- APPLICATIONS:**
- For vocals, piano, strings, brass, percussion, overheads sampling and voice overs

- SPECS:**
- Transducer type: Condenser
  - Frequency response: 20 - 20,000 Hz
  - Polar pattern: Cardioid
  - Nominal output impedance: 180 Ω
  - Max. SPL: 130/140/150 dB
  - Sensitivity: 20 mV/Pa

The Shure SM58 (below) is a good all round versatile dynamic microphone which has good frequency response. It is also competitively priced. It provided good clear sound, but one had to turn up the gain quite high, adding ambient noise. Due



to their physical size, they also were visible on camera.



Even expensive high end microphones such as AKG's C535, C414 and C1000 were tried. The C414B condenser (right) has an excellent reputation as a studio recording microphone. It delivered exceptional clarity, low internal noise and a very flat on-axis response. It has four selectable polar patterns to tailor response, switchable pre-attenuation pads and two bass filter settings to suppress unwanted low frequency components. However, it is an expensive microphone and beyond what our budget would allow.



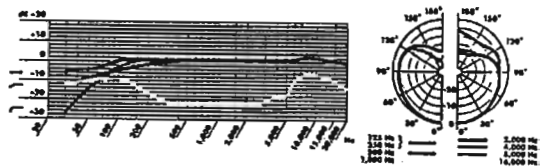
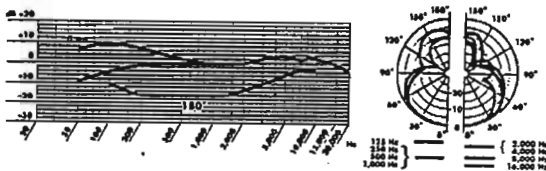
AKG's distributor also made available the C1000S and C535EB condenser microphones (below) for us to experiment with. Both provided a clear open sound, had high sensitivity but were also reasonably expensive. We found that they emphasised the high frequencies, especially between 7 and 12kHz.



**C1000S**  
**FREQUENCY RANGE:** 50Hz to 20kHz  
**POLAR PATTERNS:** cardioid, hypercardioid with PPC 1000 mounted  
**SENSITIVITY:** 6mV/Pa  
**IMPEDANCE:** 200Ω  
**EQUIVALENT NOISE LEVEL:** 19dB-A  
**MAXIMUM SPL FOR 0.5% THD:** 137dB  
**SIZE:** 1.3" dia. x 8.7"  
**NET/SHIPPING WEIGHT:** 9.7 oz./1.8 lbs.



**C535**  
**FREQUENCY RANGE:** 20Hz to 20kHz  
**POLAR PATTERN:** cardioid  
**SENSITIVITY:** 7 mV/Pa (-43dBV)  
**IMPEDANCE:** ≤200Ω  
**S/N RATIO:** 73dB  
**MAXIMUM SPL FOR 1% THD:** 137dB SPL  
**SIZE:** 1.8" dia. x 7.2"  
**NET/SHIPPING WEIGHT:** 1.7 lb.





AKG's C921CM (left) is called a hanging microphone, commonly used to mike choirs or used in theatres and in television studios for audience pickup. The specifications indicate a wide acceptance angle which can cover a wide stage area. It has a cardioid polar pattern and only picked up certain sections of the room clearly, meaning we would have to use many of them in a single room to obtain decent coverage.

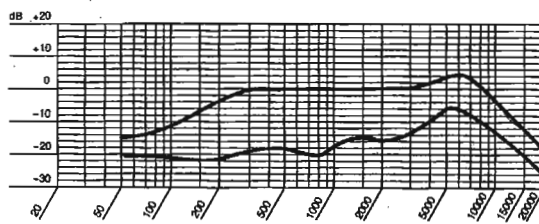
We found that the best results came from the inexpensive C400BL miniature condenser boundary microphones from AKG (right). Its frequency response has been designed for optimum intelligibility of



6. Specifications	C 400 BL	C 400 BL-1
Type:	Self-polarized condenser microphone	
Polar pattern:	Hypercardioid	
Frequency range:	150 to 10,000 Hz	
Sensitivity at 1000 Hz:	50 mV/Pa	
Impedance:	200 Ω	200 Ω (with B 20)
Recommended load impedance:	≥ 2 KΩ	
Max. SPL for 1% (3%) THD:	95 (107) dB SPL	
Signal/noise ratio re 1 Pa (A-weighted):	35 dB (50 dB)	
Supply voltage:	9 VDC to 57 VDC 9 VDC	
Current consumption:	< 2 mA	
Connector:	3-pin XLR	Three-sided 1/8" mono jack plug
Cable length:	2 m (7 ft)	1.5 m (5 ft)
Size:	42 x 23 x 12 mm (1.6 x 0.9 x 0.5 in.)	
Net weight:	3.5 g (0.2 oz.) (without cable and connector)	

EU Conformity  
This product conforms to EN 50082/1

6.1. Frequency Response



speech maximum gain-before-feedback. Because it is inconspicuous - it is one of the smallest boundary microphones available (42 x 23 x 12mm) - it is commonly used on desks and tables as well as in theatre, where it can be mounted on the stage floor or on sets. Their physical size meant that they could not be seen on camera. These microphones can also be repainted to blend in with the colour of the surface.

Boundary microphones are usually mounted on some flat surface, thereby turning the entire surface into the pickup area. We suspended three microphones from the ceiling<sup>11</sup> and found they work just as well in this position. The possibility of battery failure was an important consideration in choosing the microphones and the mixer.

<sup>11</sup> See Appendix A, picture 8

The microphones had to be capable of being phantom-powered from the mixing desk (which also had to have phantom powering capabilities). These microphones were so sensitive that they picked up all kinds of extraneous noises. Their cables had to be isolated from the air-conditioning ducting and the microphones had to be lowered as the air pressure from the air-conditioning grilles caused distortion. However, the noise from the air-conditioning still presents a problem and other options are presently under investigation. Air-conditioning cannot be switched off during lectures (as had been hoped) due to the capacity of the room. A fourth microphone is mounted on a lectern when required.

#### **7.1.4 Cables**

Video signals had to be looped from the front to the rear monitors. The rear camera and monitors were situated over 10 metres away from the front monitors and processor unit. The systems used component (Y/C) cables and local suppliers could only supply 5 metre long cables. It was suggested that short Y/C cables be used. These terminated in 'break out' boxes so that 2 composite cables for luminance and chrominance would interconnect the boxes at either end. This was an expensive solution as one set was required for each monitor. It was arranged that these cables be especially manufactured by Sony.

#### **7.1.5 Lectern**

Initially the lecturers wanted free space at the front of the classroom to give them freedom of mobility. However, one of the lecturers pointed out that he had nowhere to place his notes and therefore required a lectern. One was placed in the room temporarily but it was decided to build a desk on which to place the visual presenter and speaker. A raised section would be built on one side of the desk to serve as a lectern.

One was manufactured in the department - but as it took up too much space and prevented movement, it was not used. Instead two trapezoidal tables were purchased and the lectern retained. When not in use, they could be moved to one corner of the room. The tables were also

more versatile in that they could be rearranged as needed when the room was used for tutorials and other meetings.

#### **7.1.6 Acoustic Interference/Noise Levels**

Lecturers would, from time to time, play loud passages of music to illustrate certain points and to allow the students to listen to sections of music critically. As the training room adjoined other offices in another department, there were complaints that the loud music interfered with meetings taking place there. Occupants expressed their irritation by banging on the wall, much to the dissatisfaction of the music lecturer. It was clear that some form of acoustics treatment had to be applied to prevent this interference.

A spectrum analyser was used to identify the level of the interference and the frequency responses. It was found that low frequencies, in the range 125 – 500Hz were the most audible. Drilled acoustic tiles, measuring 400mm x 400mm x 25mm were glued on both sides of the wall and painted. This did not totally isolate the sound but lessened it to an acceptable degree. Low frequencies, especially around 250Hz, were still audible, being transmitted via the building structures, floor and ceilings.

#### **7.1.7 Lighting**

Smith (6.11.98) made use of slides in his lectures and found that the lights could not be dimmed. Switching them off would produce better visual results, but meant that students could not take notes. As dimmers would introduce audio interference, the lighting system was modified so that different banks of lights could be switched off as required.

#### **7.1.8 Air-conditioning**

The air-conditioning ducts feeding the new video conferencing room were connected to a plant that served the Graphics area, with a single temperature control. Due to the size of the room, when full, the temperature rose to an uncomfortable level and had to be lowered. However, this



decreased the temperature in the Graphics area, making it uncomfortable for its occupants. The system was later split with separate temperature controls for each area.

Of concern is the noise level of air from the air-conditioning ducts, which is picked up by the suspended microphones. This also has an effect on the video conferencing echo-cancellation circuits. FMG were asked to budget for and modify the system so that the room can be air-conditioned from Audio Visual Centre's central plant for greater efficiency, while at the same time bringing down the noise level to below NC30.

## 8. THE RESULT

In my research, I found that we experienced the same problems and derived similar results as others around the world that use video conferencing equipment for teaching and learning.

Lectures did take place, albeit to just 2 students at UNP during the first and second semesters. Apparently more students would have liked to take this course but were not able to as the UND and UNP timetables were not 'synchronised'. It is hoped that cross campus timetables will come into effect in 1999. This problem is not unique to the University of Natal. As the leader for the European Union project, Manfred Wissel quickly found out, "Timetables in both schools must, of course, be carefully synchronised" (<http://www.prosony.trinicom/videoconference.html>).

Professor Ballantine commented that "as a first attempt, the course is a success" (Ballantine, 14.05.98). Some of the problems he identified were the poor sound quality at the far end (due to UNP not having installed audio equipment timeously); audio levels and feedback at UND (later resolved by re-routing the audio signals) and the absence of good playback facilities at UNP (Ballantine, 14.05.98).

Ms Tatum Robinson, a student at UNP found that receiving music lectures via video conferencing in the second semester was very good. She had no problems with participating in the extended classroom and would not mind taking more courses using this method. The only problem she experienced was poor sound (echo) at times. This was caused by high audio levels at UNP, which was not controlled as there is no technician to operate the system. UND's technician had to switch audio sources and adjust audio levels to compensate. This again pointed to the need to have a system operator. Robinson highlighted that advertising at UNP was poor as she only saw one poster advertising this course and also stated that the time tables between UND and UNP conflicted (Robinson, 1998).

Dr Franke, who taught *Aural Perception* and *Music Theory 1A and 1B*, found the experience very good and would certainly like to continue using the system for future teaching. She will also

conduct the end of year examination in the video conferencing room so that the UNP students may be able to simultaneously listen to the pieces of music. She was only concerned about the audio quality for the UNP students (Franke, 1998).

There have been times, especially during software upgrades to our telephone switchboard, when the lines were not operational. UND's Telephone Services technicians were not able to assist with these technical issues and an off-campus technician (from Siemens) had to be called in to reconfigure the ISDN lines. This issue was again raised with Telephone Services, since lectures cannot be rescheduled due to down time. A permanent solution is awaited.

The technician responsible for the room reported that toward the beginning of the second semester, the room was at capacity and additional students had to stand. He was concerned that the student numbers may increase in 1999 (Murugan, 8.09.98). This issue was raised with Parker and Trinder since the Audio Visual Centre would have to make alternate plans early enough for costs to be factored into the 1999 budget. The centre would also have to acquire additional space, which impacts on other areas of its operation. Parker's response was that it seems that the 1999 first semester class would be as large as the 1998 one but this number would decrease in the second semester (Parker, 9.09.98). Bawa suggested that if the class grew to larger than 30 on either side, we would not use video conferencing as a delivery method and the numbers would justify a lecturer travelling to UNP to give the lecture personally (Bawa, 12.09.98).

The lecturers felt that, even if the size of the class did not increase, it was a large number for which the room was too small (Impey, 6.11.98), that the room was already quite full and more space would assist the learning process (Ballantine, 6.11.98). Their concerns were that if the class grew and the room did not, the programme may have to be abandoned as it would be virtually impossible to travel to UNP 5 times a week for half a day at a time (Smith, 6.11.98). Ballantine (6.11.98) argued that just considering travel costs alone, it would be cheaper to expand the room. This was again raised with Bawa and Trinder.

The Music Department only uses the system once a day - so there is spare capacity for other departments who wish to make use of the system for teaching. The Division of Tertiary Education (DTE) has just started teaching students at UNP via video conferencing and at present, the system is also being used for other conferences and meeting.

## 9. CONCLUSIONS AND FUTURE POSSIBILITIES

One of the classes taught this year by the Music Department was *Music Culture and History 1A*, "Popular and Traditional Music – Africa and Beyond". The course was split into various modules, each 4 – 5 sessions on the different musics of Africa. West African and Central Africa (Professor Christopher Ballantine), South Africa (Dr Angela Impey), North Africa (Dr David Smith) and the Diaspora (Professor Darius Brubeck). It has not been easy to conduct a proper study on the learning advantages of remote students due to the small numbers at UNP. One of the students who took the class, Tatum Robinson (1998) felt that it was exciting to receive instruction through this medium and she would certainly do so again.

Ballantine (6.11.98) was initially enthusiastic to make use of video conferencing and was overwhelmed by the technology. He described the experience as "a quantum leap in the delivery of education". He was impressed at how well the system works and hoped that this method of teaching would expand to other students. Initially he found the transmission delay "off-putting", where he was not sure if the remote class had heard him, but he quickly adjusted. The biggest problems were the provision of CD's and hardware for the remote students. Options such as provision on the web, CD shuttles, etc. would be explored.

Impey (6.11.98) found the use of video conferencing an exciting prospect and, as the subjects being taught were potentially popular courses, she thought the system had exciting future possibilities. She would also consider using it for exchanges with overseas music departments and to participate in conferences that the departmental staff could not attend.

Many organisations that use video conferencing have found that it improves the delivery of educational services and can be powerful and effective when used appropriately by trained staff and when students are properly supported. It also creates the opportunity for dialogue over distance between teachers and learners or between learners. Coventry's (1997) findings also indicate that "video conferencing has great potential for learning in Higher Education...the only inhibiting factors are probably cultural and not technological".

Similar to the study conducted by Myhrman & Eriksson (1997), we also found that the whole project can fail “if there is no ‘pusher’ (a person that pushes the rest of the employees to use the system through a burning interest for the technology).” Mitchell (1997), in his article on critical success factors in educational video conferencing, speaks about the importance of obtaining senior executive support in the planning stage, and identification and support of champions and early adopters in the pilot stage.

Murrell (1998) believes that to use video conferencing just to add numbers to a classroom can be just as impersonal as lecturing a large classroom where there is little interaction with the entire class.

Coventry (1997) highlights some of the mistakes that one, engaged in teaching via video conferencing can easily make:

- a) Failure to acknowledge remote participants and leaving them out of discussion. Teachers should involve both (or all) sites equally. Establishing interpersonal rapport and giving the remote students enough feedback will make them feel part of the local class. Sometimes teachers forget about the remote students in favour of the local class. They will need to think of the camera as another student. Murugan (1998) suggests that teachers can make the remote students feel that they are in the same venue by asking them if they understand the subject matter. Body language and voice quality (pitch, tone, volume, pauses and pace) of the teacher is also important. Having individual or team reports, presentations and feedback can also help. Teachers can arrange time for individual contact with distant students during the class, at a specified time or by email or telephone. Impey (6.11.98) put her students at ease by asking questions and stopping for interaction from the remote class.
- b) Lack of interpersonal skills. Depersonalisation can take place due to lack of physical contact. Learners see teacher as an object on a screen. Teachers should learn to know students’ names and address them directly. Teachers should engage the students. Doing a reverse lecture, i.e.

going to other sites to broadcast from will also give the teacher an opportunity to personally interact with the remote students. Ideally there should be a session that brings everyone at all sites together. Students should also be introduced to each other and be given some time for inter-group interaction.

- c) Not sending materials in advance for students to use. They felt that written materials such as readings, outlines and worksheets should be distributed well in advance. Used properly, they will capture the student's attention, and free them from note taking. Students often want the slides as handouts. This was also not seen as a problem for the music courses as an employee at UNP was employed for this purpose (Smith, 6.11.98).
- d) Simply transferring one's teaching style or method to a 'virtual classroom' and assuming that it will work as well as it does in a conventional classroom. Watching someone talk on a video screen for a long period of time can become monotonous. Teachers using video conferencing have the advantages of using readily available media, which will greatly assist in making a more interesting presentation. Murugan (1998) suggests that teachers avoid talking too fast and avoid rapid motion. Unlike the large screen format of a conventional overhead projector, visuals and transparencies would have to be redesigned as they are now displayed on a smaller video screen. Careful consideration has to be given to text size, font and colour. Lecturers are also not as free to move around as they do in lecture theatres. Impey (6.11.98) agreed that one has to use a different style of teaching.
- e) Not paying sufficient attention to audio quality. Coventry (1997) indicates that if sound is poor, the learning process will be interfered with. Good quality audio was seen as a crucial component of the music course, both by students and teachers.
- f) Not planning who will operate the equipment at the remote location, having no technical support and therefore concentrating on equipment operation rather than delivery of a lecture. Where the lecture is straightforward, it is possible for teachers to operate the equipment themselves. However, teachers using complex equipment, such as our music lecturers, are not

able to operate the various items of equipment, adjust audio levels and switch the cameras while concentrating on teaching. The Audio Visual Centre at UND motivated for, and provides a technical operator who is present at all times to operate the equipment and attend to any problems that may occur. Parker (27.11.98) reported that the technician's "assistance made it easier to deliver a lecture by video than in the classroom where we have to organise our own sound". Ballantine (6.11.98) "found the technicians offered a wonderful service." "When dealing with different media, one has to concentrate and good technical backup is essential and appreciated" (Impey, 6.11.98). "Although we can operate all the media – we do so every day, we do make a lot of use of different media and try and cram in as much in the time available" (Smith, 6.11.98). Smith made use of the visual presenter, slides, tape, video and CD's often, and, while he was anxious at the beginning, he found technical support necessary.

At UNP, as the video conferencing room is situated in another building, users fetch a key from the Audio Visual Centre, turn on the equipment and operate it themselves. This lack of technical support sometimes leads to poor audio quality (Robinson, 1998). Fortunately, one technical support person (at either end) is able to resolve most problems. Coventry (1997) concurs that "there is justification for support personnel to maintain and run the equipment and leave the lecturers free to concentrate on the learning process." She further states that technology is still evolving and there is a "need for specialised technicians who understand the technology.....it would be an added burden on lecturers if they were to maintain the equipment and get the best out of it" (Coventry, 1997).

After hours technical support is also provided at UND (and not at UNP) primarily so that, should the user experience difficulties, the session does not have to be abandoned. It is possible that some lectures will take place in the evenings in future (Bulman, 1998) and the issue of remuneration for the technician is currently being investigated with the preferred option being a combination of overtime pay and flexitime.



- g) Failure to set rules and expectations at the start of the class. This problem was not encountered as the courses taught were part of the University curriculum.
- h) Not starting or stopping on time, making it tedious on participants and inconveniencing other users. This too was not a problem as the classes were within the University's scheduled lecture periods. A booking schedule was provided by the Music department well in advance and co-ordinated with the central booking officer.
- i) Not making use of the media and not structuring materials such as transparencies to conform to the 'video' convention. Teachers should not be afraid to use other media such as video tapes. They enhance a lecture and add visual interest. Video format works on a 4:3 ratio and visual materials have to be structured accordingly. Larger fonts and certain colours work well for text and graphs and one would need to prepare materials in advance. Smith (6.11.98) considered the size of the text and checked with the UNP students if they could see materials clearly. Impey (6.11.98) used the visual presenter for text she would have written on a blackboard. Sessions can also be videotaped and played back for students who have missed the lecture or for revision. The Music lecturers at UND made use of virtually all the media available to them, with some using more than one medium at once, e.g. showing slides while playing music (Smith, 6.11.98).
- j) No co-ordination of time tables at different centres. This was perceived to be the major hindrance to this particular distance teaching exercise. In 1997, it was anticipated that we would have 20 students at UNP. As the campus timetables were not "synchronised", it resulted in many students not being able to take the classes. The University executive were alerted at the start of the year and "gave an assurance that it would receive priority in 1998" (Ballantine, 6.11.98). Smith (6.11.98) said "the course could be optimised by having a common time table between the UND and UNP campuses".

In an attempt to offer some assistance to users on these and other issues, a section is being created on the UND Audio Visual Centre's home page to offer some general video conferencing

guidelines (<http://www.und.ac.za/und/avc>). This is not meant to be prescriptive, but draws on common experiences around the world. We have also included a small section on the technical specifications of our systems and are in the process of developing a booking form that can be downloaded or electronically submitted.

The University of Natal's video conference site/s have also been listed with international booking agencies, thereby making it easier for other like institutions to network with the University of Natal.

Perhaps sometime soon, we will eventually realise the initial request for a cross-continent teaching system and teachers on other continents can teach our students, with our teachers teaching theirs, without leaving 'home' and disrupting one's other activities. Staff and students can participate in conferences, interact and have seminars with foreign students via video conferencing.

Already, auto-tracking cameras are available. The Sony 5100 has Automatic Target Tracking (ATT), where the camera memorises certain colours and brightness and tracks a subject with those features. If the subject almost goes off screen, the camera performs a pan/tilt action so that the subject is placed in the centre of the screen. Picture-Tel offers a software upgrade called "Limelight" which makes use of voice tracking and moves the camera to the person who speaks the loudest. V-Tel has just brought out "Smart Track" which uses two cameras - one to automatically find the location of the speaker's voice while the other stays on the previous speaker. Once the shot is found, the software switches to the new speaker (du Plessis, 1998).

It takes some getting used to the speed of transmission, which affects the quality of our video pictures. No doubt, ISDN will soon give way to faster ATM networks, which will then be replaced by others....and picture quality will no longer be a distraction.

Some studies have shown that students prefer the 'electronic classroom' at a local site rather than having to travel to a learning centre or central campus (Bates, 1992). Coventry (1997) concludes

that “the success of video conferencing will lie in the people communicating, not the technology.”

Video conferencing is just but another method of delivery and will not alone solve the problem of educating the masses. As has been found elsewhere in the world, it works best for people in industry who wish to further their education. Small groups of students can take classes and interact with their tutors and peers by video conferencing. A combination of video conferencing and internet technology ought to be employed - notes and information can be emailed or posted on web pages, students can join computer news or discussion groups, and for more individual attention, students can email their tutors - as is being done by the Music Department (Impey, 6.11.98).

The educational justification for two-way video conferencing comes from increasing teacher and student ratios by sharing teachers between sites, through a reduction travel in costs and allowing greater access to quality teaching regardless of geographical location (Coventry, 1997).

## GLOSSARY OF TERMS

- **Algorithm** : a step-by-step problem solving procedure. Transmission of compressed video over a communications network requires sophisticated compression algorithms. Most video conferencing systems offer both propriety and standard compression algorithms.
- **Application** : The specific use of a technology to accomplish a task. Often used when referring to software programs that perform a specific task, such as word processing, database management, or graphics.
- **Audio track** : The section of a videodisc or tape that contains a sound signal. A system with two audio tracks can utilise either two independent sound tracks or stereo sound.
- **Bandwidth** : the amount of information that can be transmitted in an information channel or the frequency range of a given transmission method. In video systems, this value is expressed in MHz, and the higher the quality of the signal, the greater the bandwidth required. High bandwidth video conferencing means that the picture and sound will be clear.
- **Baud** : The commonly used unit of speed that describes the rate at which binary data is transmitted. One baud is approximately equal to one bit per second. Common baud rates are 300, 1200, 2400 and 9600 bps (bits per second).
- **Baud rate** : Term used to measure data transfer rate. Baud rate is equivalent to bits per second at low speeds, e.g., 300 baud is the same as 300 bps. At higher speeds the bits per second is greater than the baud rate, since one baud can be made to represent more than one bit.
- **Bit** : Acronym for Binary digit. The smallest unit in computer data handling (either a zero or a one, yes/no, on/off.) equal to one binary decision. A computer's processing capability is usually measured by the number of bits that can be handled at one time.

- **bit rate** : The digital equivalent of bandwidth.
- **BNC** : A connector commonly used with coaxial cables. Receives all R, G, B, H-Sync and V-Sync information, as well as composite video through one cable.
- **bps** : bits per second (lower case is significant). A measure of how fast some device communicates, usually in thousands of bits per second (Kbps) or millions of bits per second (Mbps). The number of bits passing a point per second. The transmission rate for digital information.
- **BPS or Bps** : (8-bit) byte per second (upper case is significant).
- **BRI - basic rate interface (ISDN)** : User interface to the public ISDN network. Contains three digital signals over a single pair of copper wire: 2 voice (B) channels at 64 Kbps and one signal (D) channel that operates at 16 Kbps. (e.g. voice and fax on a single pair of wires).
- **Byte** : A unit of computer memory (developed by IBM) used to store numeric or character information. Bytes of 8 bits normally reflect either 1 character or 2 numerals.
- **Cable** : Wires used to distribute audio, data, video and power.
- **camera presets** : Allows the programming of pre-defined camera angles into a video conferencing system.
- **Card** : A computer board with printed circuitry and components that is plugged into the computer's system board to provide special functions or features.
- **CD** : Compact Disc. Also referred to as compact audio disc. A 4.75 inch optical disk that contains information encoded digitally in the CLV format.

- **Channel** : One of the two stereo sound signals, identified as left and right, in video or audio discs. Also, a high-speed optical fibre or metal pathway between the host computer and the controllers of the peripheral devices.
- **Codec** : **Coder-Decoder**. Video conferencing hardware that codes the outgoing video and audio signals and decodes the incoming signals. Prior to transmission, the codec converts analogue signals to digital signals and then compresses these digital signals for transmission. Incoming audio and video must be decompressed and converted from digital back to analogue.
- **Compatible** : Term for different hardware devices or software formats that can be utilised together without modification.
- **component video** : The original elements of a colour picture, including the red, green, blue, and sync information. Regarded as visually superior to composite video.
- **composite video** : The complete colour television picture information including luminance, chrominance, blanking, and sync signals encoded into one signal.
- **Compressed video** : when a vast amount of information in a normal TV transmission is squeezed into a fraction of its former bandwidth by a codec, the resulting compressed video can be transmitted more economically over a smaller carrier. Some information is sacrificed in the process, which may result in diminished picture and sound quality.
- **computer graphics** : Visual images produced by a computer. Graphics standards for IBM-compatible PC's include CGA, EGA, VGA, and XGA.
- **computer interface** : A device used to convert the computer video signal to a standard analogue RGB signal to be used by a standard display device.

- **Data** : A common term used to indicate any raw facts, numbers, letters, and symbols that describe or refer to any elements, such as images, objects, ideas, or conditions. Basic components of information that can be computer processed.
- **data rate** : The rate or speed at which data is transmitted.
- **delivery system** : The computer and media hardware components used to deliver a multimedia or interactive video program. Delivery systems range from a videodisc player with an on-board microprocessor, a monitor and a keypad to a personal computer, more than one monitor and a variety of peripheral devices such as a mouse, printer, a CD-ROM, and so on.
- **Desktop video conferencing** : video conferencing on a personal computer. Appropriate for small groups or individuals. Often include document sharing. Low cost.
- **Display** : A screen that electronically presents characters, numbers, graphics or other information transmitted from the personal computer. Also, to show text and graphics on a monitor.
- **Document sharing** : a feature supported by many desktop video conferencing systems that allow participants at both ends of a video conference to share applications, view and jointly edit the same computer document or any text or graphic file.
- **Echo cancellation** : the process of eliminating acoustic echo in a video conferencing room.
- **Feedback** : The reinforcement of correct responses or the correction of errors by the computer system or instructor. Also, the negative reinforcement in an audio system.
- **Field** : In a video system, all of the odd-numbered or even numbered lines that, when interlaced sequentially, comprise a frame of video.

- **Frame** : A single, complete picture in a film recording or video. A video frame consists of two interlaced fields of either 525 scan lines (NTSC) or 625 scan lines (PAL/SECAM). Film runs at 24 frames per second.
- **Full duplex audio** : Two-way audio simultaneously transmitted and received without any interference or “clipping”. A common feature of room based video conferencing systems.
- **Full motion video** : equivalent to broadcast television video with a frame rate of 25 fps. Images are sent in real-time and motion is continuous.
- **H.320 standard** : Suite of ITU (International Telecommunications Union) video conferencing standards for use over switched digital standards such as ISDN, T1 and Switched 56. Is a widely used video compression standard that allows a wide variety of video conferencing systems to communicate.
- **Half-duplex audio** : two-way audio is transmitted and received in turn (rather than simultaneously) so that only one site can speak at a time.
- **Hardware** : In computing, the electronic and mechanical components used for processing information. Any equipment that comprises the computer system.
- **Hz** : abbreviation for Hertz, a measure of frequency in cycles per second. Used to express the frequency of an electrical signal or event.
- **ISDN** : Acronym for Integrated Services Digital Network. Telecommunications service by which high-quality data, video, audio, and still images are transmitted by one universal network. Essentially a digital network that will provide seamless communication of voice, video, and text between individual desktop video conferencing systems and group video conferencing systems. Type of digital telephone service available in two speeds -128 KBPS



basic-rate interface (BRI) and 1.54 Mbps primary-rate interface (PRI). ISDN is expected to replace current telephone lines.

- **Kbps (kilobits per second):** Unit of data that can be transferred over a connection. One Kbps equals 1,000 bits per second or 1,000 baud.
- **Mbps (megabits per second) :** One Mbps equals 1,000,000 bits per second or 1,000,000 baud.
- **Media :** Used as a more modern term for audio-visual aids. Frequently thought of as mass communication such as newspapers, magazines, or televisions. Refers to the agency transmitting the message or the format of the stored image.
- **megabyte (MB/Mbyte) :** 1 million, or 1,048,576 bytes or characters.
- **Menu :** A list or display of available options that can be selected from the video conference set-up screen.
- **Monitor :** Device for viewing the output from a computer.
- **multipoint control unit (MCU) :** Device that links three or more point-to-point video conferencing systems into a multipoint conference.
- **multipoint video conference :** video conferencing with more than two sites at a time. Video bridge is used for the connection.
- **multiple media :** Using more than one type of media at the same time.

- **Multimedia** : Combining different elements of media (text, graphics, audio, still images, animation, motion video) for display and control from a personal computer.
- **NTSC** : Acronym for National Television System Committee. The television standard for the US, administered by the Federal Communications Committee (FCC). Also used in Canada and Japan. The number of scanning lines in the luminance signal (Y) is set at 525, and the field frequency is 60 Hz. 30 frames are transmitted per second. This system features excellent black-and-white television compatibility.
- **PAL** : Acronym for Phase Alternation by Line. The standard colour system used throughout western Europe, except in France. PAL-M is the standard system in Brazil. The PAL system uses 625 scanning lines and a field frequency of 50 Hz. 25 frames are transmitted per second. Compatibility with black-and-white television is maintained, but the circuitry is rather complicated.
- **PC** : Referring to computers (hardware and/or software) that are compatible with the IBM Personal Computer standard.
- **Peripheral** : External devices controlled by the computer, e.g., keyboard, printer, mouse, etc.
- **point-to-point video conference** : video conferencing between two sites.
- **presentation software** : Includes software packages which allow a presenter to create, capture, manipulate, and/or control images, text, sound, and animation for the purpose of visual display.
- **presentation support** : Audio and visual accompaniment to a speaker's presentation.
- **Processing** : The manipulation of data from one state to another.

- **real time** : The transfer of data that returns results so quickly in actual time that the process appears to be instantaneous.
- **Resolution** : Number of pixels (or dots) per unit of area, measure in number of pixels wide by the number of pixels high that can be displayed on the screen or output to film. More pixels per unit of area produce a higher resolution giving more detail in the display of an image.
- **Room-based video conferencing** : video conferencing using sophisticated high quality components, sophisticated codecs and feature-rich interfaces to suit large groups.
- **SECAM** : Acronym for Sequential Couleur avec Memoire (sequential colour with memory). The TV system used in France and throughout the Eastern Block Republics. This system employs 625 scanning lines and the field frequency is 50 Hz. The number of frames per second is 25. Compatibility with black-and-white television is slightly inferior to PAL, however the circuitry is less complicated.
- **Software** : The programs, routines, subroutines, languages, procedures, and other non-hardware information used in a computer system.
- **SVGA** : Super Video Graphics Array. refers to a computer signal that is higher than the standard VGA resolution of 640 pixels by 480 lines with 16 or 256 colours. SVGA graphics cards may output resolutions such as 1024 x 768, 1280 x 1024, 1600 x 1200 pixels or higher, with 16.7 million colours displayed.
- **S-Video** : A video signal type where the luminance and chrominance (Y/C) components are transmitted separately resulting in a high quality displayed image. S-VHS and High-Band 8mm (Hi8) formats are typically referred to as S-Video signals.

- **T.120** : ITU standards for document conferencing over different transmission standards. A system needs to be T.120 compatible to document conference with other T.120 video conferencing systems.
- **Telecommunications** : Communication transmitted via telephone lines from one computer terminal system to another.
- **Teleconferencing** : A meeting or conference in which video, audio, or data are shared by geographically separated persons using various telecommunications methods.
- **VCR/VTR** : video cassette/tape recorder. Allows recording or viewing of video tapes using normal, still, slow motion, and fast forward speeds.
- **Video** : Visual or picture information. A process of recording and transmitting information that is primarily visual, by translating moving or still images into electrical signals. These signals, which typically include audio signals, can be broadcast (live or pre-recorded) using high-frequency carrier waves, or sent through cable on a closed circuit.
- **Video bridge** : computerised switching system which allows for multipoint video conferencing.
- **Video conferencing** : communication across long distances with video and audio contact that may also include graphics and data exchange.
- **Video compatibility** : Ability of computers and projection units to transmit and receive data, to read and/or project various video tape standards such as NTSC, PAL, SECAM and S-VHS.

- **Whiteboard** : Document-conferencing function that lets multiple users simultaneously view and annotate a document with pens, highlighters and drawing tools. Advanced whiteboard programs handle multipage documents and provide tools for delivering them as presentations.

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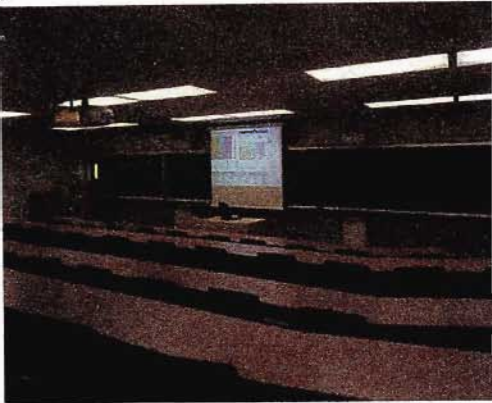
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## Appendix

1



### Stanford University, USA

Video conferencing room, using lateral conference tables, video projection and single teacher lectern/podium.

2



### Stanford University, USA

Video Conference Room fitted with front video projection and individual chairs with writing tablets.

3



### Auckland Institute of Technology Videoconference Centre, New Zealand

Typical video conference room set up, using single 72cm video monitor and an electronic white board.



4



**University of Natal, Durban**

First video conferencing system at the University of Natal. Accommodates 2 - 10 people and mainly used for meetings and conferences. Equipped with a visual presenter, VHS VCR and fax/telephone.

5



**University of Natal, Pietermaritzburg**

UND student's view of Music students at the UNP Video Conferencing Training Room receiving instruction from Durban.

6



**Training Room, University of Natal, Durban**

Students in a video conferencing teaching session.

7



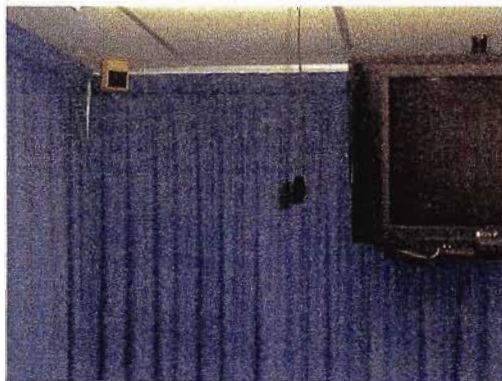
**Training Room, University of Natal, Durban**  
A teaching session in progress

8



**Training Room, University of Natal, Durban**  
Teacher's view of the video conference room.

9



**Training Room, University of Natal, Durban**  
One of the suspended miniature boundary microphones used to pick up audience responses unobtrusively.

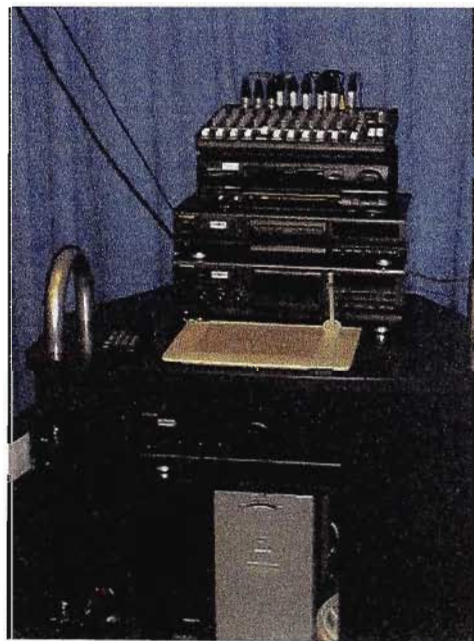
10



**Video Conference Room, University of Natal, Durban**

Selection committee conducting an interview with an applicant in Australia via video conferencing.

11



**Training Room, University of Natal, Durban**

Audio equipment and video conferencing hardware.

12



Visual Presenter, used for projecting slides, negative film, transparencies and hardware.