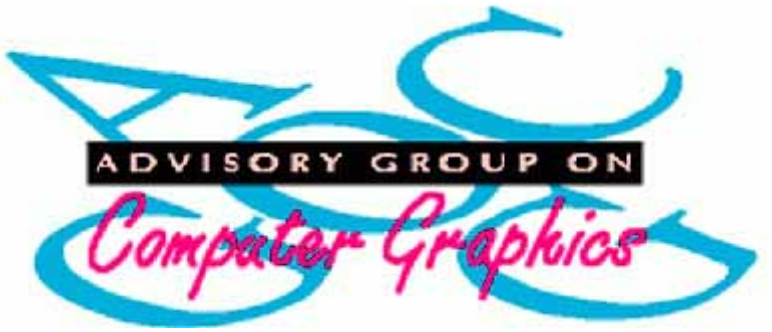

The Dos and Don'ts of Videoconferencing in Higher Education

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Contents

Acknowledgements

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Introduction

The aim of this document is to support those who wish to use videoconferencing in higher education.

Throughout the report, videoconferencing is taken as referring to “any activity which requires communication involving live video images being transmitted from one location to another”. In almost all applications, this also includes the transmission of audio and sometimes includes the transmission of data.

The authors recognise that this definition of videoconferencing is a very broad one, including activities that elsewhere may not be referred to as videoconferencing; e.g. videotelephony, TV-type broadcasting and surveillance. They have been included here because, in higher education, there seems to be an acceptance that all these diverse activities have a similar base and are usually referred to under the same umbrella heading of videoconferencing.

HOW TO USE THIS REPORT

This document is divided into 3 main chapters and has 5 appendices, a glos sary and bibliography.

Chapter 1 gives a general guide to using videoconferencing. It is intended to be of use to those thinking of using videoconferencing as well as those who are wanting to improve the facilities they already use. It will also be helpful for people who
offer a service to others.

Chapter 2 reviews the services (including networks and equipment) that are currently available and points to sources of further information.

Chapter 3 reports the results of a survey carried out specifically for this docu ment and describes the ways in which videoconferencing is currently being used in higher education, ways in which it is being funded, possible future uses and advice that existing users give to those who may be just starting out.

The Appendices form a very valuable reference resource and include:

- a summary of videoconference standards;
- a list of the main PC-based videoconferencing systems available with technical and other related information;
- a list of videoconferencing configurations currently used in higher education (from the survey) describing the equipment used in each case;
- a list of organisations (including higher education institutions) which have considerable experience and which are willing to be contacted;
- a copy of the questionnaire used in the survey.

The aim has been to cover as many potential problem situations as possible and the authors are aware that some areas have been covered in more detail than others as is not surprising in such a small project. The areas that have not been given so much

attention are probably those of satellite transmission (as opposed to detailed descriptions of some of the network possibilities) and large scale broadcasting generally. The authors suggest that those with spe cific queries in this area contact Ray Winders at The University of Plymouth (See Appendix 4) who offers services and advice.

Chapter 1 - Videoconferencing in Higher Education - How to get it right

This guide is based on a short project investigating videoconferencing within one specific application area — higher education. It refers to both the other chapters in this report and also draws on the experience of the HUSAT Research Institute in undertaking both research and consultancy work in the area of videoconferencing (largely in the commercial sector).

Structure Of This Chapter

The guide is designed to be useful and relevant for anyone wanting to succeed with videoconferencing in higher education. In order to address individual needs as closely as possible, it is important to differentiate between those who actually use or want to use videoconferencing in order to facilitate their work and those who provide a videoconferencing service for others to use (of course it is possible to be both a user and a provider of the service).

The intended readership of this report is those who would like to learn more about using videoconferencing in higher education. The reasons why you want to know more may be diverse and how you approach the subject will depend on where you are with it now.

The chapter is therefore written in two main parts:
The first provides information relating to videoconferencing that is divided into subject sections:

- Uses of videoconferencing
- Videoconferencing systems and methods of signal transmission (including networks)
- The videoconferencing environment (physical and social)
- Funding of videoconferencing
- Management of videoconferencing services.

The second part of the chapter attempts to provide guidance to individual readers which is dependent on where they are in the process now. This means that readers may want to go back to the chapter at a later date when their circumstances have changed. Each section of the second part of the chapter will refer the reader back to relevant sections of the first part. In addition, it will provide a perspective that is appropriate for individuals in each of the different situations described.

Part 1 SUBJECT SECTIONS

Uses of videoconferencing

According to the survey reported in Chapter 3, the general uses that higher education is currently making of videoconferencing are as follows:

- Personal communication
- Collaborative work
- Presentations
- Research (As a tool to aid research in other areas, e.g. astronomy and intensive testing and development of VC itself)
- Education (e.g. remote lecturing or demonstrating)
- Remote surveillance (e.g. keeping watch on cars in the car park)
- Entertainment (e.g. listening to remote radios, tapes and audio samples; pumping TV and radio programmes around the campus)
- Giving demonstrations to prospective students and visiting researchers
- "Just experimenting".

It is very important to be clear about what use you (or those using your service) will want to make of videoconferencing. The intended use will determine to a large extent what equipment and what physical environment will be required.

Where possible there should be a real communications need

Research has suggested that videoconferencing is very successful when there is a clear communication need that cannot easily be met using other media[1]. Tasks which generally are not likely to be suitable for videoconferencing (although there are documented exceptions)are:

- selling new ideas
- complicated tasks
- meetings involving interviewing
- influencing people
- tasks involving innovative interaction
- confidential meetings
- tasks which by their nature involve a high social component
- meetings involving a lot of paper
- highly controversial meetings

In higher education, at least with the facilities that are currently available, the different possible uses people might make of videoconferencing can be classified into 6 main types. The type of use will determine decisions about equip ment and environment. (If you want to

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[1] *ISSUE Project (1992 a) A Longitudinal Study of the use of Videoconferencing in 11 European Organisations. RACE Deliverable 65/HUS/DS/A/012/B1.*

use videoconferencing in ways that fall into more than one type, you may need to use more than one physical configuration.)

Informal personal communication (can be multipoint and can include collaborative working). There will normally be one individual at each site. It would not normally be necessary to arrange the communication in advance. It would be initiated by dial-up or over the SuperJANET network or similar. Communication would normally take place at the participant's desk.

More formal communication. This would usually have between 1 and 3 people at each end. (It may be multipoint and is less likely to involve collaborative working than the above.) Communication will usually be planned in advance with a fairly formal agenda. The facilities will be in or close to the normal work room.

Formal meeting capability. (May be multipoint and could in some circum stances be used for collaborative work.) This would normally be a dedicated studio situation. There could easily be up to 5 or 6 people at each site.

Multi-cast. Although this may include broadcast to group audiences it can involve broadcast to many individuals at their desks. (They may only be able to receive and not send.)

Formal 'lecture'/'demonstration'/'presentation' broadcast to a group or number of groups. There may be 1-way or 2-way audio/video or a combination.

Remote access to visual information. This category would include uses which do not necessarily involve personal communication at all, e.g. surveillance and monitoring of remote telescopes.

Videoconferencing systems and methods of signal transmission (including networks)

Choice of System

Physically, videoconferencing systems can be broadly classified into 4 main groups:

- Desk-top (including PC-based systems)
- roll-about systems
- studio-based systems
- TV-type broadcast systems.

Choice of Methods of Signal Transmission

Systems can operate using a variety of different methods of transmitting the audio and video signals, e.g. network, satellite, microwave etc.

As a general rule, small scale systems will use either the public telephone network (usually ISDN) or a network such as SuperJANET. Studio-based systems will usually use SuperJANET. Again, lectures/demonstrations given by TV-type broadcast can use SuperJANET but can also be well suited to satellite transmission.

Depending on the purpose of the communication and the capability of the system, the communication will be point-to-point, multi-point or onto many distributed communication. In point-to-point communication, there are only 2 locations involved. There is normally full two-way audio and video communication. In multi-point communication, more than two locations are linked simultaneously and each location involved can be seen and heard by all the other locations. Which location is viewed at any time depends on how the video-switching is achieved. With most systems capable of multi-point conferencing, it is only possible to view one distant location at a time although all locations can be heard. There are two ways of switching the video viewed on the monitor:

- voice activated (sound activated)
- manual (chairperson activated).

In voice activated switching, the video is switched to the location of the person talking (or making a noise). In manual switching, one person controls which location is shown on the monitor. (In both cases, the location being shown to the others can see the last location that was switched to their monitor.) It is suggested that unless there are task-related reasons for choosing manual switching, voice activated switching should be used.

One to many communication involves one location broadcasting to a number of others. Usually, there will only be cameras at the main location. Depending on the configuration, the 'receiving' locations may or may not be able to send audio signals, e.g. in a lecture situation, students at 'receiving' sites may be able to ask questions of the lecturer at the main location.

Codecs

The codec is a piece of equipment that encodes and decodes analogue/digital data to produce the final sound and picture. The codec can have a major influence on the quality of sound and picture. Consideration in the choice of codec are: interoperability, flexibility, cost, ease of upgrading, quality of transmission, supplier (other hardware preferences and terms, conditions etc).

Bandwidth

The bandwidth used affects the speed with which the signals can travel and this also influences the quality of sound and picture. Generally, the higher the bandwidth, the better the quality although compression techniques have im proved considerably and it is possible these days to have quite acceptable quality with fairly low bandwidth. The purpose of the communication will dictate the parameters of acceptable quality. Where the resolution of the picture needs to be very high or where full motion is required, for example, it may be worth ensuring that high bandwidths can be used.

The kind of system required will depend largely on the purpose of the video conference. The following table shows the likely configurations according to the main types of use of videoconferencing described on page 7.

Use	Likely Systems	Likely networks	Likely communication
Informal personal communication	Videotelephone, PC-based system	ordinary ‘phone network, ISDN telephone network	Usually point-to-point, 2-way audio/video and data transmission
More formal communication	Roll-about videoconference system	Usually ISDN telephone network	Usually point-to-point 2-way audio/video
Formal meeting capability	Studio-based videoconference system	SuperJANET and/or satellite	point-to-point or multi-point, 2-way audio and video
Multi-cast communication	PC-based system	SuperJANET (e.g. M-BONE)	Usually one to many distributed communication. Often one-way audio and video
Lecture/ demonstration	TV-type broadcast or studio-based system	SuperJANET/ satellite	Usually one to many. May be one way audio/video sometimes 2-way audio, one way video.
Remote access to visual information	PC-based or studio-based videoconference system	SuperJANET/ satellite	Usually point-to-point or one to many. Often video only

It is of course possible to mix configurations if there is sufficient compatibility of equipment. For example, if a seminar was taking place between two stu dios, it may at some point in the seminar be useful to bring in an expert from perhaps yet another institution. If he/she had a desk-top system that was com patible, they could join the seminar for a short while, thus maximising their use of time.

Additional Features

The ITU recommends a videoconference terminal must as a minimum include the following user interface modules (as well as a control module and a co dec.) At least - a camera, a screen monitor, a microphone, a loudspeaker, control keys and lighting controls (if not present in the screen).

The survey reported in *Chapter 3* gives details of additional facilities that some institutions have found useful.

The videoconferencing environment (physical and social)

Physical environment

What is appropriate in terms of the physical environment will depend on the purpose of the videoconference and on the kind of equipment that is being used.

Desk top — Hopefully, any system that is being used on the desk top will have been designed to accommodate most of the immediate environmental prob lems. There is not the opportunity to compensate on the desk-top to the extent that is possible in a studio. Things to be aware of are:

- Camera position — this may be fixed by the system, if not, the position ac knowledged to give the greatest chance of simulating eye contact is above the screen, in the centre and as close to the screen as possible.
- Glare — This may be a problem for you in seeing the image on your screen but also may be a problem for the camera so you may need to pay atten tion to the position of the system (preferably at 90 degrees to the win dow) or to the provision of suitable blinds. The lighting itself may also provide a problem and filters to tubes may need to be fitted.
- Lighting levels — Even if the system is designed to be used on the desk top and is therefore quite tolerant of a variety of different lighting levels, there does need to be adequate light provided for the cameras to be effective.
- Audio — It is difficult to achieve good quality audio even in specialised stu dios. Depending on the conditions this can require very careful attention in a desk top situation. Under some working conditions, it may be beneficial to use headphones if this is possible.

Roll-about — Again, roll-about systems are designed to be used in normal room environments but as in the desk-top situation, it pays to be aware of environmental considerations. If the quality is not as good as you expected, do not assume that the equipment is at fault before you have checked the environment.

Studio-based systems — If you are going to use large-scale videoconference rooms, they will need to be appropriately furbished. Most major suppliers and service providers are aware of the basic ergonomic recommendations for videoconference rooms. Some key points are listed below:

General feel

- Videoconferencing rooms should be designed to fit the needs of the culture of the organisation.
-

Position of participants

- The distance between participants and monitors should be between 4 and 6 times the vertical size of the screen. It can help if all participants are the same distance from the camera.

Seating

- Adjustable seats are recommended (for height) especially when a split screen technique is used.

Table shape

- There are not clear recommendations, there being advantages and disadvan tages with different shapes. Most commonly found are the semi-circular table, wedge-shaped table or a combination of both.

Decor

- The general decor on walls, floors and ceilings should not use saturated colour like shiny white or black. Any limitations which make it difficult for the camera and codec to work should be avoided.

Lighting

- Lighting levels should support the natural appearance of the participants and should enable them comfortably to read documents (on screen and hard copy).

Monitors

- Monitors need to be carefully positioned so that participants are able to see the image of people, text and graphics clearly.[2]
- The height of the horizontal axis should have the mean height of the speakers' eyes. The use of big screens is recommended for graphics representa tions.
- The monitors should be of dimensions which enable life-size images of the speaker to be portrayed.
-

Visual angle

- The horizontal visual angle of the main monitors should not exceed 60 de grees. The vertical visual angle for these monitors should be between 1 and 10 degrees.

Cameras

- If a spilt screen is used, 2 cameras will be necessary. Each camera will focus on half of the participants (3 max.).
- Cameras should be integrated into the general decor so that the room will be like a conference room and not a television studio.

Image size

- Large image size seems preferable to small image size (where possible natural size is recommended)[3].

Audio quality

- Attention should be paid to audio as well as video quality. The acceptance range in video quality is usually much broader than that of audio quality. Not being able to hear clearly can completely ruin a conference.

Video-Audio delays

- The unidirectional end to end delay should be as low as possible and in any case not greater than 250 ms. The delay becomes noticeable above 125 ms.

Ambient noise

- Assuming that the noise in the premises around the conference room is typically about 40 dB, the speech level transmitted by the room walls (and doors) should be less than 25 dB in order to ensure a high degree of privacy. An insulation of about 45 dB is therefore required assuming that the overall talking/listening levels into the rooms are around 70 dB.

Environmental conditions

- Temperature and humidity levels are important. The following recommendations are given assuming the equipment is on and participants in position.
  - Temperature range 20-22_ C (68-72_ F)

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[2] *McFarlane, R.E. and Nissen, R.J. (1982). Room design and engineering for two-way videoconferencing. In: Teleconferencing and electronic communications: Applications Technology and Human Factors (ED. Parker, LA. and Olgren. C.H.)*

[3] *Velthvijsen, A (1988). Human Factors in Teleconferencing. Twelfth International Symposium on Human Factors in Telecommunications. The Hague.*

- Relative humidity range 40%-55% [4]

TV-type broadcast — Attention will need to be paid to the environment of the room from which the lecture /demon stration is being broadcast. If possible, professional audio- visual expertise should be used. The environment in the room to which the broadcast is made will depend on things like the size of the audience and the equipment available.

Social environment

Videoconferencing is a relatively new communication medium, even now. Agreed protocols are still being formed concerning what is and is not socially acceptable behaviour. There are some guidelines which may help newcomers al though networks of users who have been communicating for some time will probably have derived their own behavioural ‘norms’.

- Consider what clothing will be worn. Avoid garish colours and stripes/polka dots.
- Respect the chairperson if there is one. More formal video conferences (particularly studio-based) work better if there is a chairman. Sometimes the chairman will even decide which image will be seen at which stage in the proceedings. Depending on the type of communication, this can sometimes be more effective than voice switching.
- If using voice switching, activate the microphone (or release mute') before speaking and remember to close microphones (or select ‘mute') after speaking unless the system is good enough to accommodate casual noises.
- When using the remote control for cameras, do not focus only on the speaker but provide a general overview of other participants as well.
- Do not disregard the common courtesies usually used in an equivalent face to face communication
- Always bear in mind any time constraints. (Time con straints are often less flexible in videoconferences than face to face communications and this requires discipline.)
- If someone new enters one site and is introduced to the others at that site, if it is appropriate, extend the introductions to let the other sites know who has just joined in.

[4] *McFarlane, R.E. and Nissen, R.J. (1982). Room design and engineering for two-way videoconferencing. In: Teleconferencing and electronic communications: Applications Technology and Human Factors (ED. Parker, LA. and Olgren. C.H.)*

Funding of videoconferencing

The survey in *Chapter 3* gives details of the ways in which current higher education videoconferencing is funded. There seems to be little in the way of general policy and much seems to depend on whether you belong to a 'chosen' institution. That is whether your institution has been one earmarked to benefit sooner rather than later from infra structure improvements and funding. Some end users have to pay for using videoconferencing facilities and others, once they have the necessary hardware and software (for desk-top, fairly inexpensive) can use what is then effectively a free service making videoconferencing more cost effective than a normal telephone call! The larger, broadcast TV type services can entail high costs but can also be very cost effective because of the numbers of students that can be reached. The funding picture as in almost all other aspects is very patchy in higher education.

There do not seem to be many attempts at co-ordinating videoconferencing services within a single institution as in the way for example Staff Development or Computer Services are co-ordinated. Perhaps this will come next. This approach would not necessarily lead to an overly centralised service — each department feels happy deciding when and which computer to buy next but knows that Computer Services is there to advise and co-ordinate. It also provides large scale services to all staff and students that smaller outfits would not be able to provide. The difference is that with videoconferencing, skills from many different current services would be re quired. This requires genuine co-operation and co-ordination in order to work well. See Subject Section: Management of Videoconference Services.

Management of videoconference services

One strategy for the implementation and management of a videoconference service is suggested here:

- Establish the need for videoconferencing
- Conduct a user requirements analysis
- Select appropriate systems/facilities
- Implement and manage the chosen system(s)
- Evaluate and act on the evaluation

The process can then begin again, depending on the results of the evaluation.

Other subject sections have dealt with details such as selecting appropriate systems. This section focuses on the implementation and management of the service and the evaluation process.

Implementation and management.

For successful implementation and management of a video conference service, the most important factor is probably communication. It will be necessary to ensure that communication is good between you and the following people:

- External service providers and suppliers
- Other management personnel
- Users/potential users.

Communication with external service providers and suppliers. Before deciding on external service providers or suppliers, consult with UKERNA as they may be able to help. Once you have made your decisions:

- Take responsibility for asking for what you want both be fore and after the contracts are signed.
- Negotiate terms and conditions, guarantees and support contracts.
- Arrange for supply, connection and testing alongside any room refitting taking place, taking into consideration any disruption this may cause.
- Take responsibility for initiating regular communication with the contacts you have.
- Take responsibility for feeding back to your service providers/suppliers: your complaints, your praise, new needs you have identified, areas you want to be informed about.

Communication with other management personnel This is probably the most difficult part of optimising your service. As described here there are many groups within any one institution who may be managing videoconferencing services or advising on videoconferencing. It is important that good communication mechanisms are developed between these groups. That is, groups such as:

- Audio-visual Services
- Computer Services
- Staff training and Development
- Network Development
- Library Services.

It may be that certain groups 'specialise', for example, Computer Services may specialise in PC based systems, Audio Visual Services may specialise in TV-type broadcast systems. If this is the case, make it clear to users and potential user perhaps through the newsletter. For the above and many other reasons, it can be very help ful for all groups concerned to produce a joint policy on videoconference use. Policy could be agreed on:

- the aims of videoconferencing within the institution. This should include current and planned availability of services, priorities of user groups, if any, with reasons given for these priorities.
- the best use of videoconferencing. This should include guidance on which kinds of task are suitable for video conferencing and which are not so suitable. If there are priorities operating for certain kinds of task, this should be made clear, along with reasons for the priorities and consequences of not respecting priorities (e.g. expanding the service unnecessarily or requiring very long reservation times).
- Charging end users/user groups for costs incurred in video conferencing. Whether or not there is a policy of charge-back will depend largely on the aims of video conferencing and how it is seen as a service. It must be made clear if there is a charge and if so, what the rates are.

Because of the growing convergence of IT and telecommunications, it is worth thinking about an institution-wide IT and telecommunications strategy so that long term planning can take place in a coherent fashion.

Communication with users and potential users This will need to be done in different ways at different times with different people.

General Announcement Whether or not you choose to an nounce “the arrival” of videoconferencing will depend on your own institution's culture and size. If there is such an announcement, it could be included in a newsletter, TV broadcast, demonstration, memo, e-mail or whatever is appropriate. If this is being done, remember to say:

- whether or not a pilot or experiment is being undertaken
- which users are the first target group(s) and why
- that videoconferencing technology is an additional tool and is not aiming to entirely replace face to face communications
- if the service is open to people outside the target group(s) and if so when
- who the contact point is for further information

Informing the first user groups At this stage, the first users should already be aware that videoconferencing is being introduced. (They should have been involved at stage 2 and possibly 3). It should be made clear to the users in what ways videoconferencing is seen as being a useful tool for them. Considerable effort will need to be put into providing adequate training and support and users need to be reassured that they will be receiving this.

Increasing the user population. At some stage, you may wish to encourage new users to try videoconferencing. Simply announcing its availability does achieve this objective. More effective action includes the following:

- where possible, contact potential new users personally
- be realistic about the advantages and disadvantages of videoconferencing
- as far as possible, target potential users that have a real communication problem that your videoconferencing service could solve

Continuing information dissemination Set up appropriate mechanisms which will enable you to inform users (and potential users) of any changes that have been made to the service. service. If possible, use a mechanism allowing 2-way communication so that you can receive reactions to the news you give out, e.g, e-mail.

Provide adequate user support and training.(See page 23)

Manage the service day-to-day (See page 25)

Know who is using the service and for what. Make it your business to know who in your institution is using videoconferencing and what they are using it for. It is useful to gather this information for all the videoconferencing systems being used and not only your own.

Evaluation

At appropriate points in the life of the service it will be necessary to carry out an evaluation of videoconferencing in order to plan
future strategy/policy.

- use appropriate objective and subjective measures for eval uation
- evaluate in terms of goals produced and any new goals identified.
- identify any other organisational effects caused by videoconferencing

Conclusion

In summary, then, a videoconference service is likely to be successful if:

- there is a real need for videoconferencing
- the service matches the needs of the intended user groups
- the service is well managed providing adequate technical and user support
- the service is regularly evaluated so that it can respond to changing requirements or technology
- the evaluations are acted upon.

Part 2 - Where are you now?

Find which of the following statement(s) fits your situation best and use the appropriate section(s) of the guide.

If you are or want to be an end user:

- I have a need for videoconferencing but to my knowledge have no access to videoconferencing facilities. How do I find out if anything is available?
- I've got funding to start videoconferencing — where do I begin?
- I have access to videoconferencing facilities — how can I make the best use of them?
- I'm already videoconferencing. How can I make sure that I keep up to date with what's going on and make the best of the opportunities available?

If you are (or want to be) involved in providing / maintaining a service for end users:

- I can see the benefits of videoconferencing. People are start ing to ask me about it. How do I go about setting up a good service?
- We've just started to become involved with videoconferencing but don't know a lot about it. Things don't seem to be going as smoothly as we'd hoped. What can we do to improve things?
- We've been doing it for years. We think we've got things about right now. The people who use our service say that they are very pleased with what they get and we're still trying to improve and update the service. Is there anything else we can do?

I have a need for videoconferencing but to my knowledge have no access to videoconferencing facilities. How do I find out if anything is available?

This section will help you to get to the point where you will know if there is a readily available service that you can make use of or whether you will have to initiate something yourself.

If you have identified that potentially you have a require ment for videoconferencing, then you probably know who you might want to communicate with and at least some of the reasons you might want to communicate with thosepeople using a visual form of telecommunication. To be clear about your intended uses is very important because the kinds of system you will need to use will depend very much on what you want to use it for. The *Subject Section: Uses of Videoconferencing* will help to clarify exactly what you want to do with videoconferencing. When you are clear, reading the *Subject Section: Videoconferencing Systems and Methods of Transmission* will help you to determine what is appropriate for your needs.

Now that you are aware of the choices available and how they match your requirements, you can begin to find out if suitable systems already exist to which you might be able to gain access. Finding out which individuals in your institu tion have this information may be more difficult than you would think. Because of the history of videoconferencing, its diverse nature and the fact that it draws on technology from many different disciplines, there is no one model for the implementation and management of videoconferencing in higher education. You could start by contacting your Computer Centre, your Audio Visual Services Unit, your Library, your Staff Training and Development Unit or your Network Development Centre (or any of their equivalents). Reading *the Subject Section: Management of*

Videoconferencing Services will help you to identify the most likely individuals to help, depending on the kind of service you want.

You will probably now be in a position where you know:

- with whom you want to communicate
- what uses you have for videoconferencing
- which systems are the appropriate for you
- who in your institution provides videoconferencing services
- some other individuals who are using videoconferencing
- whether or not there is a suitable service available to you

If nothing suitable is available to you at the moment and you are sure that videoconferencing would be beneficial to you, you may either need to encourage one of the groups likely to be interested in providing a service to set one up or if what you need is within your own scope, see if you can find funding and technical support to provide your own service. Reading the *Subject Section: Funding of Videoconferencing* may help.

If you go further with videoconferencing, depending on which route you travel down, you may wish to consult an other of the sections in this part of the chapter.

Do	Don't
Be clear about what uses you have for videoconferencing	Use the first thing you hear about
Know at least some of the people (or groups) with whom you want to communicate	Assume that the professional service units will know all about videoconferencing
Choose to use a service that is suitable for your needs	
Find out as much as you can about the technology	
Find other people who use videoconferencing in the same way that you want to use it and learn from their experiences (even if they are at different institutions)	

I've got funding to start videoconferencing — where do I begin?

Presumably, to get the funding, you had to make a case so you will have an idea about:

- How you want to use videoconferencing e.g. for teaching, personal communication, research purposes or what ever it may be
- With whom you want to communicate
- The scale of videoconferencing you want to use (largely dependent on the above points)

However, there may have been changes since making the case so check these things out (*Subject Section: Uses of Videoconferencing*).

You will probably be more concerned though with the specific choice of equipment etc. and with any other consider ations that you should be making, e.g. optimising the envi ronment for videoconferencing. It will also be important to be clear about how much you want to do

yourself and when you want to call in the experts. You may also want to find out if there is any merit in co-operating with any other individuals or groups who are using videoconferencing locally. It will probably be useful to read the *Subject Sections: Videoconferencing Systems and Methods of Signal Transmission, The Videoconferencing Environment and Management of Videoconferencing Services.*

You should then be in a position to know:

- Specifically how you want to spend the funding
- What strategy you want to use in implementing and sup porting whatever systems you choose to use. This will include knowing:
- Which other individuals/groups you want to work with in order to get the service you want and
- What mechanisms you will use to communicate with those people

Do	Don't
Get the best service you can afford	Underestimate the importance of communicating well with those who can provide expertise
Get a service that is appropriate to your needs	Forget why you wanted to videoconference in the first place!
Use any expertise/advice that is available to you locally	Just look at the short term capital costs
Co-operate with other users if it is mutually beneficial	
Make the most of whatever is already available	
Ensure interoperability as far as possible	

I have access to videoconferencing facilities — how can I make the best use of them?

Check that the facilities match your needs
Before you do anything else, you will need to ensure that the equipment you have access to is actually appropriate for your needs. For example, a set-up designed to broadcast a lecture to groups of students around Britain will not help if what you want is to be able to discuss and edit graphical information with a colleague in Sweden. This may seem obvious but the term videoconferencing can encompass so many different technologies and working situations that being told "Sure, we've got videoconferencing facilities you can use — Just book a session with John and let him know who the other sites are" just is not enough. The first question is: Do you have a particular applica tion in mind? If so, you can check out whether the systems you have access to are appropriate by reading the *Subject Sections: Uses of Videoconferencing and Videoconferencing Systems and Methods of Signal Transmission*.

If you have been informed that there are facilities you can use and you would like to see if you have a suitable application, read the same subject section and find out exactly what is being offered. Then you will be able to identify whether or not you may have a need for that particular configuration.

Do you need supplementary equipment?
It may be that the facilities on offer are potentially useful for you but that to really make the most of them, you need some additional equipment, e.g. a document camera. It may well be

worth trying to ensure that videoconferencing is really useful rather than just an interesting new way of doing the same old things.

If there is a good match between what is on offer and your own needs then how can you make the most of videoconferencing?

Make sure there will be relevant people with whom you can communicate
One of the features of videoconferencing as with any form of distance communication, is that its success is dependent on having people with whom to communicate. Fax communication only really took off when there was a critical mass of users with compatible equipment. It can therefore help to encourage people with whom you would like to videoconference to look at the idea and to ensure that interoperability is taken into account if new equipment is being considered. It is also worth checking out who is currently using videoconferencing. There may be people you could already conference with. ***Chapter 1*** of this report gives information about institutions which currently use videoconferencing. It does not claim to be complete but is a useful source document.

Get adequate support

- Make it your responsibility to find out who to see if something goes wrong.
- Find out before you start how long it is likely to take if you need to get help during a conference session.
- Get training if you need it. Depending on what kind of facility you will be using, there may be some quite specialised interpersonal as well as technical skills required. Do not be afraid to admit that you need help.
- Find out where the main source of expertise is in your institution for your kind of application. For example if you are broadcasting lectures, Audio Visual Services may be a good place to get help. If you are using your personal computer to collaborate with remote colleagues using videoconferencing on a research project, Computer Services may have more useful information.
- Make sure you know the basic information like how to book the facilities.

Optimise your environment
In order to get the best out of the audio and video equipment you use in videoconferencing, it can be very worthwhile to pay attention to the environment in which it will be used. Depend ing on how you use videoconferencing, this may or may not be under your control. If it is not, it can still be worth requesting improvements to whoever is responsible. Details of environ mental requirements are given in the *Subject Section: The Videoconferencing Environment.*

Learn the 'etiquette' of using videoconferencing
Particularly for larger videoconferences or for multipoint conferences, the medium can demand a certain discipline in communication. For example, if voice switching is used to switch the view of the participating sites, it is important to keep very quiet unless you are actually talking to the camera (otherwise, everyone will see a picture of you instead of the person who is addressing the conference). Preparation for a videoconference can require more thought than a face to face meeting. It can even help to think about what clothes to wear — it can be very off-putting to watch a videoconference image of someone wear ing stripy shirts. PC-based systems tend to offer a more informal atmosphere and do not generally demand the disciplines of the larger set-ups. *The Subject Section: The Videoconference Environment* gives guidance on the social environment for videoconferencing.

At this stage, you will probably know:

- Whether or not the facilities you have been offered will actually be appropriate for your requirements (and what to do if they are not).
- Where the expertise is held at your institution relevant for your situation
- How to ensure you have adequate support
- How to optimise both the physical and the social environment for videoconferencing.

Do	Don't
Check the facilities are suitable	Use a system just because it is there. If it does not do what you really need, say so. There may be enough of you to justify an additional service
Make sure that you get the help that you need	
Think about the environment - particularly lighting and acoustics	
Pay attention to the fact that the social requirements of a videoconference can be different from a face to face meeting	
Ensure you have any additional equipment you might need to make use of the full potential of videoconferencing	

I'm already using videoconferencing. How can I keep up to date with what is going on and make the best of the opportunities available.

Communicate!
One of the best ways to keep up to date with what is going on is to talk to people! If you use a service provided by someone else, make sure that there are mechanisms for communicating easily with your service provider. You could perhaps encourage them to produce a newsletter for all their users if there is not one already.

If you use a small scale system which you run yourself, there are a number of ways you can keep yourself informed. One of the best is to keep in contact with other users even if you would have no other reason to contact them. You can help each other. (Appendices 3 and 4 of this report gives some limited information about other users of videoconferencing in higher education and some contact names and addresses.) Reading relevant sections of the daily press and the trade magazines can also help and if you have the time and the inclination, surfing the I nternet, World Wide Web etc. can be very informative. If no-one

seems to be interested in producing a newsletter, consider taking on the role yourself — at least that way, everyone would send you all the latest information!

User groups
Try joining a user group. If there is not one locally, think about setting one up. There are national and international bodies that include as part of their role information dissemination, e.g. the Telecommunication Users' Association and the European Teleconferencing Federation (see *Appendix 4)*.

If you are using videoconferencing on a small scale, it is worth contacting the groups that may be providing services for others if you have not already done so, e.g. Audio Visual Services, Computer Centre, Library, Staff Training and Development, Network Development etc. Let them know that you are using videoconferencing. They may ask if you would mind talking to new users about your experiences. The benefit for you is that the new users may be aware of the latest developments. Read the new users may be aware of the latest developments. Reading the *Subject Section: Management of Video conferencing Services* may help. If you are not familiar with the range of facilities that are on the market currently, see *Chapter 2* and *Appendix 2* of this report.

Do	Don't
Talk to others who are using or thinking of using videoconferencing	Become complacent - the field is moving so quickly at the moment that it pays to keep up to date
Talk to those who provide a service for other users	Attempt to do what you know is beyond your capability
Read what you can in the press and on electronic information media	
Join user groups, both locally and nationally/internationally	
Ask for information to be provided, e.g. local newsletter or set something up for yourself	

I can see the benefits of videoconferencing. People are starting to ask me about it. How do I go about setting up a good service?

Who do you want to serve and what will they want to do?
Research has shown that setting up a general videoconferencing service and then announcing it is available is not as effective as identifying a clear user population and a clear need to begin with. You may find that you can identify a number of potential user groups. They may have the same kinds of use in mind or they may want to use videoconferencing in different ways. Your own area of expertise will also have a bearing on the kind of thing you want to offer. A strategy for implementing and managing a service is offered in the *Subject Section: Managing Videoconferencing*

Building a 'do-it-yourself' videoconferencing system
In higher education far more than in industry, videoconferencing services are set up in a 'do-it-yourself' fashion. There is often the expertise and much of the equipment available as resources and it makes sense to use what is there rather than to purchase expensive off-the-shelf systems.

You need to be clear however about which components really can make the difference. For example, it is well worth taking time over the choice of codec and cameras. If these are good, it can be surprising what you can get away with. If you are setting up a 'studio' type situation it can also be well worth spending what can seem like a very large proportion of the budget on acoustics, e.g. a good echo canceller. It is always good to remember that if the video is poor, the quality of the conference goes down. If the audio is poor, the conference usually has to be cancelled.

When you know who you will be serving and with what kind of facility, you may want to buy either a complete system or components. There are now many manufacturers in the market place offering a whole range of services. Because the range is so great, some manufacturers/retailers actually split into different departments in order to market videoconferencing equipment. This is designed to be helpful but there are negative consequences for the customer. If you contact someone and ask to be sent literature on their videoconferencing systems, you may sent details of may be 2 or 3 different systems out of a total range of 11 or 12! Reading the *Subject Section: Videoconferencing Systems and Methods of Signal Transmission, Chapter 2* and *Appendix 2* of this report will help to give you an idea of the range of equipment that is available.

Building a studio
It may be that you do not need to provide a studio at all. If you are providing users with PC based or other office based equipment and are merely providing support for them, this will not be applicable. Likewise if you are involved with broadcasting lectures from a lecture theatre or for that matter broadcasting from an operating theatre then you may not be involved with building a studio although you may very well need to run a studio as well.

Much will depend on what space you have available and this will vary enormously from place to place. Some studios are little more than broom cupboards while others put some boardrooms to shame. What matters is that they are fit for their purpose, whatever that may be. Attention will need to be paid to the physical environment — the heating, lighting, acoustics and ventilation. More detailed information can be found in *Subject Section: The Videoconference Environment.*

Providing Support
Again, how much support you need to give and what form that will need to take will depend on what facilities are being offered. There are however some general requirements that are listed here ahead of the specific support recommended.

- Users will want to know what the procedures are in the case of a breakdown
- Users will want to know what the costs are and who is responsible for the costs at each stage of the operation
- It is helpful if a contact name can be provided for general enquiries or if enhancements or additional equipment etc. needs to be discussed at some future time
- Some sort of training or assistance will need to be made available if it is required.

Support for Desk Top / Roll-about Users
Some initial support may be required in the form of a short training session in the use of both the hardware and the software. It is possible that you could train up 'local experts' who could then take on that role with other future users in their department, group or geographical locality. Some guidance may need to be given about using the facilities; e.g. on a PC based system, how to make best use of any shared document facilities that may be used in conjunction with video/graphics windows.

Support for Studio Users
Technical back-up. Technical problems can and do happen with videoconference systems as with any technology and there needs to be a recognised procedure for recovery. This may just involve you or your colleagues or it may also involve outside agencies. Communication channels need to be proven and appropriate support contracts negotiated with any external support providers.

Training/instruction. Some new users seem to take to a studio without needing any assistance but often instruction can ensure that the facilities are used properly and that mistakes are avoided. It can be useful to have just a one-page user guide to remind users of the basics provided in a prominent position in the studio. This should provide guidance on how to work with multipoint conferences if there are multipoint facilities. Even if the system is usually operated by remote control, it is worth leaving instructions for hands on control of the equipment in the studio. In a survey of commercial videoconferencing studios, it was revealed that this might have saved the cancelling of an important conference. No-one could get the system to work and after everything had been tried, the meeting was cancelled. No-one tried the main controls because they did not know how to work them. All that had happened was that the batteries in the remote control unit had run out!

Support for Broadcast Users
Much of the support needed for broadcast users will be technical and it will include providing advice about 'programme making' This will normally mean that you have Audio Visual skills. Most users will expect you to know about appropriate lighting for example and will expect you to say if pre-recorded (therefore edited) material is more suitable than live. It will help if you can offer guidance on producing graphics/text for broadcast. The deterioration in resolution can mean that it is even more important that text and graphics are large enough and clear enough (e.g. sufficient contrast) to be legible.

It will help to provide some guidance for presenters of lectures to be broadcast. The following example of such guidance is taken from 'Notes to Presenters' supplied at the BRAIN (Bring Researchers on Advanced communications to Industry and Network operators) summer school:

1."With the emphasis on interaction through the link between Aveiro and Madrid, it is important to try to keep in mind the total audience for your talk. The feedback so far suggests that presentations which involve the two groups are the most effective. Some suggestions, for your consideration -

At the opening, please greet both groups separately; ask if you are clearly heard to both groups, and await a response; if there is no response, check again! During the talk, ask occasionally to both groups if they see clearly the slide, and be sure to get a reaction (especially from the remote site).

The emphasis of this point is on generation of feedback from the uadience, especially across the link. .....The result will be to make your talk more effective for both groups.

2.There are some limitations imposed by the video technology; those who are used to video/TV presentation will know more about this aspect.

It is important to stand in one position, without necessarily being 'stuck to the floor'(!); the camera cannot easily track rapid movement, so if you must move to a new location, do so slowly, and/or give some advance clue to the technicians (e.g 'I am now going to show a slide on the table')

The video lamp makes it difficult to see the audience before you, and there is a tendency to look at the material projected at the screen - the result is that you are not seen (on the video) to speak directly to the peole present. I suggest you have paper copies of slides/notes in front of you for reference, and that you for the most part ignore the screeen behind you, except for an occasional glance."

Support for other service providers
You may be in a position where you provide a service for other service providers. You may for example provide satellite facilities for other institutions or you may have a multipoint control unit which connects a number of different institutions simultaneously. You may have specialist facilities which other institutions share. Try to get feedback from those who use your service so that you can maintain the levels of support that you provide.

Day-to-day management
Another aspect to providing a service is the day-to-day management. Initiate mechanisms which will allow you to easily keep track of who is using which facilities for what purpose in which locations. It may be your responsibility to make sure rooms are clean and tidy and to check small details for example that the batteries in remote control units are charged (see training/instruction for studio users above).

Recognise the nature of higher education
There are significant differences between videoconferencing in higher education and videoconferencing in industry. In order to work effectively it may help to be aware of these differences. These remarks are not aimed at PC-based conferencing or dial-up ISDN but to studio-type situations where networks such as the SuperJANET ATM link are used. In most commercial organisations, the organisation has its own network. It conducts most conferences internally using that network alone. It can communicate with other organisations through standard gateways and uses agreed protocols for doing this. Where conferencing is taking place internally, those sites taking part all share things in common. They often have the equipment being used in common. They belong to the same organisation, they use agreed communication mechanisms, they share the same service centre, the share the same organisational model and use common terms. They share a group loyalty. This is taken for granted. When different universities communicate using videoconferencing over SuperJANET almost the only thing they have in common is the network. This can and inevitably will cause problems if it is not acknowledged. The effects of these problems can be minimised if everyone involved recognises and respects the powerful nature of autonomy in such a situation. Ground rules can be established so that it is not abused, therefore avoiding situations where one 'partner' can hold all the others to ransom sabotaging otherwise constructive communication. This will only be a problem while the facts of the

situation are unrecognised or ignored. Awareness can be all that is needed to resolve such difficulties.

The other way in which many educational institutions differ from commercial organisations is their funding base and this can affect cost justification of videoconferencing in higher education. As with many other new technologies, videoconferencing has had different benefits from those predicted. When word processing was first being marketed, one of the main selling points was that it would produce the 'paperless office' and that people who used word processors instead of typewriters would spend less money and trees on paper. Although most of us would not return to the days of the typewriter, there is no evidence of savings in terms of stationery costs! Videoconferencing is often sold as a way to reduce ever increasing travel and subsistence costs. Although there is some evidence that videoconferencing can help to reduce travel costs overall, this is not found to be the main financial benefit in industry. The real benefits seem to be in terms of increasing income rather than decreasing expenditure. Quality and speed of decision making is improved and in a commercial environment those elements can be vital. How important they are in terms of direct financial benefits in higher education may be questionable. For this reason, it is even more important to choose the intended applications care fully. Relying solely on cutting departmental travel budgets as an incentive for people to use the service, with few indirect benefits may be problematic.

Do	**Don't**
Be clear about who you want to serve and what those people want to do with the service	Take on more than your skills will allow
If you are building a system yourself, choose the components carefully - it may be better in the long run to buy a new camera than use the one that is lying around	Be tempted to set up a service that you think might be useful and then hope people will want to use it. Find out what is needed first
Think about the physical environment	Assume that if you ask manufacturers for information on videoconferencing that you will get details of all the systems they have.
Provide good quality support in an appropriate form.	Ignore feedback. Wherever possible, act on suggestions you get from users.
Develop a good relationship with any external service providers you are using. Negotiate adequate support contracts for yourself.	
Pay attention to the day-to-day management of the service.	
Be aware of the nature of organisational relationships in higher education	
Obtain feedback about your service in a way which is easy for users to give and easy for you to analyse.	

We've just started to offer a videoconference service but don't know a lot about it. Things don't seem to be going as smoothly as we'd hoped. What can we do to improve things?

It really depends on what is causing the problems.

Technical problems
If there really are technical problems, then it is probably because of one (or more) of four factors.

Equipment/network failure. What you can do about this depends on how much you know technically yourself and what your contract is with any of the technical service providers involved. It is not always easy to isolate which part of the whole system is not functioning. It may be at the network level, any part of the videoconference system itself or at the interface between the two. One of the problems with the do-it-yourself approach is that, often, the system is made up of component parts supplied by a number of different manufacturers. On the other hand, if you have built the thing yourself, you will probably know it inside out and have a good idea of where to begin looking. (Don't forget to thoroughly document your work if this is the case — if you are out of the office on the day when there is a problem and only you know the system, you will not be too popular!)

Technical problems are still unfortunately quite common and the support provided by external agencies is not always what could be called ideal (See Chapter 3 of this report), so take the opportunity to tighten up on support provision if you get the opportunity, perhaps at an annual renewal of contract.

Something has been set up incorrectly. It is not that often that equipment actually fails. If something is not working, then it is likely that there has been a problem with setting up. Some equipment is very difficult to set up properly and often the manuals provided are not adequate. If you continue to have problems, try contacting others with similar equipment for advice (See *Appendices 3 and 4*) If you become a local expert with a particular piece of equipment, think about writing your own manual to make life a bit easier for others who have to grapple with difficult setting up procedures. Don't forget to let people know if you have got information available.

There is a technical problem that was not anticipated when the service was being planned. No matter how carefully you planned the implementation of your facilities, there may have been things that you were not able to predict. You may be able to compensate for the problem with a technical solution or there may be some procedural way to help the situation. For example, if the building carries noise much more than was anticipated and every time anyone goes by the studio the voice- switching system switches the picture to your site, it may be possible to provide sound proofing. If not, a procedural solution may be to tell your users to always use the 'mute' facility unless they are actually talking as part of the conference.

The equipment you have does not match the requirements of the people trying to use it. If you are having technical problems because the kit you have is just not able to do what your users want it to, you may be able to provide "add-on" equipment to satisfy the requirements, e.g. a document camera. If this is not possible, it may be worth actually starting again, doing a very detailed requirements analysis of the users who are currently trying to use your service. It may be that you can still use what you have but there may be a different "market" which needs to be tapped which has a need for the existing configuration. This is not the ideal way of working but quite quickly, a videoconference service which does

not meet the needs of those who are trying to use it will simply fall into disuse. It might help to read *Subject Sections: Uses of Videoconferencing and Videoconferencing Systems and methods of signal transmission.*

'People' problems

You may find that you have more 'people' problems than you have technical problems. Many of these problems can be eased by ensuring workable methods for communicating between groups (in addition to videoconferencing!). Some problems may be between different people in your own institution. Others may be between people in your institution and people in a completely different organisation. Where co-operation is required and is not happening or is not happening at an appropriate level, it can help to make shared goals explicit and agreed even if it might seem as though you are stating the obvious.

Do	Don't
Remember to document your work if you have taken a 'do-it-yourself' approach, so that you do not need to be involved every time thereis a problem	Panic. Be prepared and try to have some contingencies for unforseen problems, for example have audio back-up available
Ask for help if you need it	
Check that everything has been set up correctly. The actual equipment may be working even though it does not appear to be	
Be creative with problems that were not anticipated. If may be that non-technical solutions can compensate	
Ask your useres about the problems you perceive. How do they see them? What do they want?	

We've been doing it for years. We think we've got things about right now. The people who use our service say that they are very pleased with what they get and we're still trying to improve and update the service. Is there anything else we can do?

Be Visible

The most important thing you can do for the promotion of successful videoconferencing is to let people know that you exist! The chances are that you have had your share of problems and 'near misses'. What you definitely have is experience and that is what is needed by others who are just starting. During the survey reported in *Chapter 3* of this report, many institutions replied by saying that they were currently considering the implementation of videoconferencing and it was clear by their responses that they still had a lot to learn about the subject. It took the authors of this report a lot of time and effort to identify individuals within each organisation who were responsible for videoconferencing and still many have been missed. In an attempt to help those who would like to discuss videoconferencing with those who have had experience, there is a list of contacts in the *Appendix 4*. If you have experience and would not mind being contacted by those who are just beginning, you could contact someone who is listed in the Appendix and let them know. In this way, the network of users can expand. Currently, there are 'pockets' of networks of videoconference users. The pockets will eventually merge and hopefully this process will help. It may be that you not only have experience in providing a service for those in you institution but that you also provide a service for other institutions. If so, please inform groups such as the ETF as they will be able to point potential customers in your direction if it is appropriate to do so.

Continue to Collect Feedback
It is important not to be complacent when you have a successful service. Things change; new products become available and users' requirements change. Be open to criticism and see any feedback you get as an opportunity to improve. See *subject section 'Management of videoconferencing services'*.

Be willing to learn from others
It is tempting, particularly if you have been doing something for many years and also if you have been successful, to see all those who follow in your footsteps as somehow inferior. This is dangerous because there is then a tendency to assume you are right in all things and that by the very nature of things, you are senior and therefore do not need to listen. This is of course nonsense and not only leads to poor relationships but also prevents you from learning. Listen to those who are just beginning or who work in a different area of videoconferencing from yourself.

If you feel 'superior' and knowledgeable in your own field, it can also be tempting when working with other academics to automatically treat them as inferior, especially if they obviously know little about videoconferencing. Many of them will be eminent in their own area of expertise and will expect a certain amount of respect!

Do	**Don't**
Let people know you exist and have experience to share.	Assume you know it all.
Be willing to learn from others even if they are just starting out.	Be tempted to keep all our knowledge to yourselves
Keep up with the still changing technology	

Chapter 2 Videoconferencing Services - What is Available.

Structure of this chapter

This chapter will give an overview of the different kinds of services that are available in the market today to enable videoconferencing. The message that this chapter will convey is that the range of systems available is immense. Videoconferencing through one's own PC or Macintosh computer can be achieved without any financial investment in software, and a minimal outlay for hardware. On the other hand, the sky is the limit for the large 'room sized' systems, £50,000 can sometimes be a conservative estimate.

The chapter gives an overview of this range of systems, and talks about the applications that have already developed out of the technology. Some of the technical aspects are then covered, including a brief description of different networks and standards (which are covered in the appendices).

The different systems are then covered in two discrete sections; the PC integrated systems, and then the standalone equipment, incorporating desk-top and room sized systems. There is a special section devoted to CUSeeMe, the most prevalent video communication tool currently available.

Overview of currently available services

The videoconferencing market has developed into three distinct bands: the full studio systems offering near television quality and a number of ancillary facilities; the office systems based usually PC integrated, employing dial up circuits where available from 128-384kb/s; and the video telephony market which is being developed for both ISDN and standard telephone lines. At present the PC integrated videoconferencing seems to have stolen the march over the alternatives for a number of key reasons.

Firstly, they are low in cost, in fact the very basic systems, which can be integrated into one's existing PC, are free. There are a few different public domain videoconferencing alternatives, working in black and white, with no sound, with typical frame rates of about 10 fps. The most popular public domain software at the moment is CUSeeMe, which runs over a virtual Internet network known as the Mbone.

In addition the commercial PC integrated systems provide ancillary features to promote collaborative working, with the video component being just one of the contributing media. Most commonly file transfer facilities are augmented with shared viewing facilities of documents, in addition a shared whiteboard application will allow both parties to see annotations and changes made to the document. Some products allow the remote control of direct manipulation tools, so that editing of documents may take place even if only one party has the application.

It is usually a simply process to upgrade a standard PC into a videoconferencing tool. Minimum requirements are a 486 PC running Windows_ 3.0, or a Mac Quadra running system 7.0, most good systems run over an ISDN network. A video board is then slotted into the computer, a camera and telephone attached, and then the application can be launched.

Ovum, the London based market research company, has estimated that combined PC's and videotelephones, will provide more than £2 billion of revenue for telecommunications companies by the year 2000. It now seems that the key to the successful take up of the ISDN telecommunications networks, will to a large extent be the videotelephony market.

Already applications of this technology are becoming widespread. At the University of Wales, a project funded by the Welsh Office has give PC integrated videoconferencing facilities to GPs and patients throughout Wales. Using this system patients can call up their GP and obtain remote consultations. At present there are 14 such systems linked to dermatologists around the country. Page and Moy have been involved in a EC funded home shopping trial recently, and similar experiments are being carried out throughout Europe. A RACE (Research and Technology Development in Advanced Communications Technologies in Europe) project AREA (Access to Remote Expertise in Agriculture) is investigating the possibilities of providing remote consultations for farmers by viticultural experts via PC integrated videoconferencing (using the TELES system). The system also provide expert system assistance, and will be given free of charge with a possibility of being sponsored by chemical manufacturers, whose products will be recommended by the system, and the experts.

Broadcasting

Broadcasting to PC video Windows is also gaining momentum. IBM and CTN, a division of ITN are now broadcasting business television programs to 10 sites around Britain. Reuters have recently launched Reuter TV, a television window which sits embedded within the other financial and news information supplied by the company World-wide. This gives live television pictures to all subscribers of news stories, particularly affecting the financial markets.

Videotron have announced plans to provide PC uses in London business TV, financial data, travel information and desk-top videoconferencing, starting in January 1995.

Factors affecting videoconferencing uptake

A few years ago there was concern over a number of hurdles which needed to be overcome in order for the full potential of videoconferencing to be realised. Many of these have now been resolved including:

- The establishment of the H.320 standard for video codecs.
- The development of ISDN dial up service and consequent reduction in transmission costs.
- The improvement in compression techniques and subsequent improvements in audio and video quality.
- The establishment of ETSI standards, and creation of an integrated market in Europe.
- The evolution of video onto the desk-top with the introduction of multimedia terminals and enhanced user interfaces.

The key to the further development of videoconferencing lies with the convergence of ISDN and LAN with the existing PC based multimedia and video compression technology. Essentially this will give digital communications the effectiveness of personal meetings, the convenience of a telephone, and the power and facilities of a personal computer. In the UK

the growth of videoconferencing, particularly in the higher education domain, will rest upon the development of SuperJANET, the drive to provide useful bandwidth throughout the education network.

SuperJANET (Joint Academic Network) is the government funded project to link 100 British Universities. Videoconferencing equipment supplied by GPT Video Systems is planned to link up the first 50 universities by the end of this year. The network provides 140 Mb/s links, compared to the 2Mb/s links of Janet

Factors for consideration in the implementation of videoconferencing, are the networks and the standards.

Videoconferencing networks

For the networks the first step is ISDN, this was defined by the CCITT as:

> "A network, in general evolving from a telephony IDN, that provides end to end digital connectivity to support a wide range of services, to which users have access by a limited set of standard multipurpose user-network interfaces."

ISDN stands for "Integrated Services Digital Networks". It is basically the existing telephone network using existing but upgraded switches and wiring, but all digital, giving a bandwidth for a basic call of 64kbps. This increased bandwidth allows the transmission of high fidelity compressed audio, as well as the potential for video communication. It also, incidentally provides enhanced services.

Broadband ISDN (B-ISDN) refers to services that require channel rates greater than a single primary rate channel. B-ISDN services are usually categorised as

- Interactive
  - Conversational — videotelephony, videoconferencing
  - Messaging— electronic mail for video, images
  - Retrieval — teleshopping, news retrieval
- Distribution
  - With user control— teleadvertising, remote education
  - Without user control — electronic newspaper, TV distribution.

Videoconferencing over ISDN is governed by a set of CCITT standards which en sure interoperability. The main standard is the H.320, which encompasses most of the others. This specifies H.261 for video compression, H.221, H.230 and H.242 for communications, control and indication, the three G. standards for audio (711, 722 and 728) with a number of other ancillary standards. For full interoperability all of these standards should be complied with, and not simply the H.261 video compression standard as many equipment manufacturers would like one to believe.

In the UK ISDN lines can be installed and rented through both BT and Mercury.

SuperJANET
The Super Joint Academic Network, is an advanced high speed optical fibre network, being implemented by the academic community and BT. It currently provides three services; a high performance Internet service to all sites, and ATM (Asynchronous Transfer Mode) to some of the sites, and a video network to some of the sites. Access to the Internet and ATM

services is at 34 Mbps, but this is due to be upgraded. By 1997 there is talk of 600Mbps. Advice for connection to SuperJANET can be obtained from UKERNA (UK Education and Research Networking Association), the address of whom is appended to this document. At last count 57 universities were connected to the network, but only 14 of these have access to all three services.. These figures are expected to grow continually.

Standards
There are a number of internationally agreed standards covering all aspects of the technical processes involved in encoding and compressing video signals, mixing audio and video data, multiplexing this with other data, and transporting the signal through the network. These ensure compatibility between terminals from different manufacturers, they do not seek to ensure a degree of quality, but simply connectivity. A list of relevant standards with their definitions are incorporated into Appendix 1.

The EVE Program
Six leading European Telecommunications companies have formally agreed to co-operate in establishing a pan European videophone service. The initial members of the consortium were BT, Deutsche Bundepost Telekom, France Telecom, Norwegian Telecom, PTT Telecom Netherlands, and SIP Italy. The primary aims of this group is to raise the awareness of videotelephony, create a better understanding of the benefits to users, and to ensure that future developments of the technology comply to the existing standards.

PC integrated systems

There are currently more than 50 PC integrated videoconferencing products. This report could not possibly be fully comprehensive in its review of these products, as manufacturers are making new releases all the time. At the time of writing we know of at least two different products from a major telecommunications company and a video communications company that are due for release next month, incorporating videotelephony, shared whiteboard, file transfer, and address book facilities. With most new commercial videoconferencing products these ancillary features have almost become standard.

In business, multimedia technology, is expected to push a more versatile desk-top environment. Videomail could provide an easier to use replacement for text base e-mail, and databases could take the form of visual encyclopaedias. In the UK Telecom operators have emerged as the most active players in the multimedia market. A partnership has been formed between BT, Videologic and Motorola with the aim of developing multimedia semiconductors. Videologic will contribute VLSI silicon design while BT develop the Motorola Multimedia Communications chipset. The initial focus being on the development of the market for BT's PC integrated videophone. BT are working this technology in conjunction with their video on demand work, offering a dial up video service over existing phone lines.

Currently there are four platforms that offer full desk-top video.

- Intel based PCs with Microsoft's Video for Windows
- Apple Macintosh with QuickTime
- IBM's PS/2 with OS/2 multimedia presentation manager/2
- UNIX based workstations with X Windows

In order to have full videoconferencing, bandwidth is the main consideration. For store and forward applications like video mail, this is not a problem, but for real time audio and video communications, bandwidths of up to 6Mbps are required, even after compression.

Appendix 2 has descriptions of a selection of PC integrated videoconferencing products. This is simply to give an idea of the large range of systems currently available, but cannot possibly be all encompassing. Prices are listed when known, this also gives an indication of the range of possibilities. One of the most important price determinants is the interoperability, or compliance with standards. A system fully compliant with CCITT standards will cost several hundreds, or even thousands of pounds, less expensive systems should be used with caution.

Many people are gaining access to CUSeeMe, which requires no more than the Shareware application, an Ethernet connection with an IP (Internet Protocol) address and a camera. The software is free and provides video communication at up to 25 frames a second.

As a consequence the most prevalent form of video communication at the moment in higher education is by CUSeeMe, and growing.

CUSeeMe

CUSeeMe is a product developed by Cornell University in the USA. It provides audio and video images over the Internet, and runs on both the Macintosh and the PC. The main reason for it's popularity is that it is free and available from anonymous FTP (File Transfer Protocol) from ftp://gated.cornell.edu/pub/video/

All that is required to receive video images is:

- Macintosh platform only with a 68020 processor or higher, or a 386 PC
- System 7 and higher operating system, or Windows_ 3.1
- ability to set your monitor to 16grayscale
- an IP network connection
- MacTCP
- CU-SeeMe file

All that is required to send video is:

- The specifications to receive video mentioned above
- Video Spigot hardware (approximately £250.)
- Camera.
- Quicktime installed, or software to run Video for Windows_
- SpigotVDIG Quicktime component (driver) on disk.

It is also possible to run multipoint conferences using reflectors. A reflector is a Unix computer, running the reflector program, that enables multiparty conferencing. The CU-SeeMe Reflector was constructed out of necessity, there being no support in the Macintosh TCP/IP facilities for multicast. CU-SeeMe reflectors provide the ability to send multicast but not to receive.

CUSeeMe runs on the MBone, a virtual network that has been in existence since early 1992. It originated from an effort to multicast audio and video from meetings of the Internet Engineering Task Force. The MBone shares the same physical media as the Internet. It uses a network of routers (mrouters) that can support multicast. These mrouters are either upgraded commercial routers, or dedicated workstations running with modified kernels in parallel with standard routers. CUSeeMe complies with the H.261 standard for video encoding, but not with the full range of H.320 standards.

Videoconferencing Equipment

A number of companies are now producing a full range of videoconferencing products which encapsulate the full range of applications of the technology. Companies such as PictureTel have made a focus on the use of their products in the Higher Education domain.

PictureTel
Last year 70% of dial up videoconferences were with PictureTel equipment. It is therefore the market leader in its field. Their publicity material is full of endorsements from higher education establishments who have successfully used the PictureTel equipment. One of their systems is actually called the classroom system, with a 46 inch monitor, providing visibility for up to 30 students.

Their main suite of systems if the system 4000 family. There are five systems to choose from ranging from the model 20, a monochrome, desk-top system through to the model 800 boardroom system complete with single or dual 35 inch direct view monitors. The model 150 is the full colour desk top version, the 200 a compact office system, 400 a roll about system, whilst the 600 is a budget executive system, with a 25 inch monitor. All of these systems comply with the CCITT standards and full CIF video format.

PictureTel have produced a system called LIVEShare, which enables sharing and editing of applications in real time to be used in conjunction with their Live PCS100 PC integrated videotelephony product. The video frame rate is 10 or 15 frames per second, which is user configurable. The video component supports full CIF format, running under Windows.

VTEL
Have a complete range of office type systems. The VTEL 115 and 117 are designed for desk-top or tabletop applications, to run in conjunction with the Intel ProShare software, they run on a PC under Windows. The VTEL 125VP has a 25 inch screen, on a roll-about cabinet. The 127 is a 486 based PC running under Windows, but with a 27inch monitor, and sits on a roll-about cabinet. All conform to CCITT standards, and run on an ISDN telecoms network.

Their larger systems are the VTEL 227 with a 27 inch monitor and the VTEL 235 with the 35 inch monitor. With additional software these can also be used with document sharing, and shared whiteboard facilities.

Satelcom
Have produced a complete range of videoconferencing equipment which is due out later in 1994. They have a PC based system supplied in a kit to be used on an existing PC. The system runs on an ISDN link, and requires a 486 minimum PC. In addition they have a Macintosh version requiring a PowerMac 7100/AV or 8100/AV or a Quadra 840AV, with integrated software the system supports file transfer and document sharing.

Satelcom were due to release their C200 videoconferencing system, which is a roll-about system intended for small group meetings (3-4 people per location). It has a 21 inch monitor, runs over ISDN, and is compliant to all CCITT rec ommendations. This system retails at about £20,000. Two other systems make up the new Satelcom range; the C300 (a roll about system with a 28inch monitor, with an option for a 34 inch monitor), and the C600 which additionally allows interactive sharing of documents on a complementary second screen. These two systems run over ISDN, comply fully to CCITT standards and retail at approximately £22,000 and £33,000 respectively.

BT
BT have an array of videoconferencing services ranging from PC integrated systems through to large room based videoconferencing suites. Their entire range comply with H.320, H.261, G.711 and G728 standards, and all run on an ISDN network.

There are currently nine products in the BT videotelephony range;

They have their own videoconferencing centres (nine in the UK) which can connect to over 450 international videoconferencing centres World-wide. These centres incorporate extensive audio visual facilities. Their top of the range system is the VC5000 Dual Monitor System at about £30,000. These are designed to accommodate larger groups of people, in a conference room environment. The system has two screens plus a self view screen, so that visuals can be displayed in addition to face to face contact on the other screen.

For £10,000 less is the VC5000 Single monitor system, and for about £15,000 is their VC6000 system. This is a more compact alternative, and a true roll-about system.

BT have a range of desk top options including the VC7000 compact system, with a 10 inch screen. This is more like a telephone, with a handset, and numeric keypad. Their smallest system is the Presence unit, a collaborative venture between BT and Panasonic. This is a telephone with full motion and full colour video with a six inch colour LCD display. Running over ISDN, it will be available in February 1995 at approximately £2,500.

BT also produce the relate videophone which runs on the standard telephone network (non ISDN). This plugs into a standard telephone socket, but consequently has a reduced video quality (approximately 4 fps).

BT produce the PC Videophone comprising VC8000 multimedia commmunica tions card and video camera. It can be used in conjunction with other application software, to enable file transfer, simultaneous sharing of documents etc. This retails at approximately £3,500, and runs on ISDN networks.

Summary

The range of videoconferencing options is immense. It is clear that videoconferencing can be achieved almost free of charge, or by the purchase of a system costing over £50,000. The selection of the system to suit one's individual requirements and budget is a personal choice, but one would do well to consider the Do's and Don'ts listed in the first section of this document. Manufacturers and suppliers will not always understand individual requirements, and have been known to not have the end users interests at heart.

The main manufacturers and products have been covered in this chapter, but there are many more systems in the market place, which may suit one's needs. The key factors to consider are price, compliance with standards, ancillary features, and support from the suppliers and/or manufacturers. All of these will interact with each other, and prioritisation of these is a personal decision.

Chapter 3 Survey of Users of Videoconferencing in Higher Education

INTRODUCTION

Design and distribution of the questionnaire

A questionnaire was designed to investigate the use of videoconferencing within higher education. Respondents were asked to give details of the equipment they are using, together with their opinions of that equipment. A picture of current usage patterns was obtained, along with predictions for future uses of the technology and advice for potential users of videoconferencing.

The questionnaire was distributed mainly in e-mail format. It was posted on a number of mailing lists concerned with human-computer interaction, multimedia products, flexible learning and staff development, in addition to AGOCG's own lists. Further responses were obtained from existing contacts (gained from HUSAT's many years of experience in this area) and from other candidates suggested by respondents.

What follows is not a statistical analysis; rather it is a summary of the responses.

A copy of the questionnaire is given in Appendix 5.

Number and source of responses

The majority of the 26 responses came from Computing, Psychology and Audio-Visual Departments within a wide range of UK Universities (including Manchester, Liverpool, Loughborough, York, Essex, Nottingham, Cardiff, Edinburgh, London and Plymouth). Other sources were UK and US manufacturers, and Universities in Australia and Finland.

The job titles of respondents included: Researchers, Lecturers and Professors; Sales and Marketing Directors and a large number of Computing staff (e.g. Heads of Computing, Senior Programmers, Graphics Managers, Systems Consultants, Multimedia Support Staff and Network Development Officers).

Their fields of interest were mainly in the areas of Computing and Advanced Communications (e.g. Programming, Networking, Asynchronous Transfer Mode (ATM), Integrated Services Digital Network (ISDN), Distributed Systems, Persistent Object Systems, Graphics, Multimedia and Image Processing]. There were also responses from those interested in higher education innovations, such as Distance Learning. and Telematics for Education and Training. Other specialist interests included Astronomy, Computer forensics and Diagrammatic interaction.

Equipment in use

Probably the most important point to make about the equipment currently in use is its sheer variety. A wide spectrum of manufacturers is represented, and the range and scale of configurations and locations for the equipment is considerable. This variety is particularly apparent when compared with the results of a similar survey conducted in the commercial

environment[5]. Several respondents gave permission for details of their videoconferencing equipment to be appended to this report. These are given in Appendix 3.

THE CURRENT PICTURE

Current uses of videoconferencing technology

Current uses of the technology (in order of popularity) are:

- Personal communication (technical and managerial meetings of all descriptions).
- Collaborative work (including distributed seminars and the control of projects across sites).
- Presentations.
- Research.
- Education.

A variety of other specialist uses are described below. In most cases, the equipment is being put to more than one use.

These uses were mainly the ones that were anticipated before the equipment was bought. Other comments included:-

- "That's what the funding bodies expected as well!"
- "If equipment exists which provides a facility, I will rapidly find uses for it."
- "I don't know what we anticipated; we just tend to use it because it's there."

Personal communications
The majority of personal calls are to colleagues and collaborators (who may be at same site, within the same organisation but at a different site, at other British Universities, or at other establishments abroad involved in the same work).

Topics discussed using a video medium tend to be of two distinct types:

- Subjects discussed by those who are using videoconferencing as a tool to aid communications activities such as contract negotiation, committee meetings, project management meetings and technical groups. In these cases the topics tend to be the same as would be discussed in person or via e-mail. Video does not really change the content of the conversation; it just helps "bring it alive".
- Topics pertinent to those who are researching and developing videoconferencing itself, and will therefore be discussing technical details of the technology (e.g. video and signal quality).

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[5] *ISSUE Project (1992 a). A Longitudinal Study of the use of Videoconferencing in 11 European Organisations. RACE Deliverable 65/HUS/DS/A/012/B1.*

Collaborative work
Collaborative work is mainly conducted with the academics and researchers, from within the same organisation to within numerous other HE and FE institutions world-wide. The uses to which videoconferencing is put overlap strongly with the personal uses described above (i.e. project management activities, technical project issues and the conducting of interviews). The distinguishing feature of collaborative work is the use of shared documents, graphics, etc.

For those involved in the development of the tools themselves [such as the development of new Multicast Backbone (MBONE) tools, for example] collaborative work takes place between academic institutions and manufacturing site, and between customers and suppliers.

Presentations
In this context, presentations are taken to mean the provision of information but not specifically as part of an educational course. Most of the respondents who use videoconferencing for this purpose have the capability to both send and receive presentations.

Recipients can be specific groups of students or customers, or can be "whoever's out there and wants to join in". Senders are usually lecturers, network customers, conference organisers, and people involved in Multimedia Integrated Conferencing for European Researchers (MICE) or the MBONE [e.g. members of the Internet Engineering Task Force (IETF)]. Again, however, senders can be essentially "anyone who wants to send material". The content of a presentation is obviously subject-dependent. In addition to the plethora of network-oriented conferences, users report having seen biomedical demonstrations and presentations on high energy physics and oceanography.

The majority of presentations incorporate pre-recorded material, which may be in a wide variety of formats, including:

- Pre-recorded video tapes showing demonstrations. It is possible to store these on Multimedia resource and to call them up
- by computer from any site where there is a modem/Ethernet connection to the resource.
- Time-delayed video replays
- Audio snippets
- Slide shows
- Vu-graphs
- Multimedia presentations

Research purposes
Again, videoconferencing is being used for two distinct research purposes:

- For intensive testing and development of videoconferencing itself (e.g. to investigate the many issues involving high
- bandwidth needs of desk-top conferencing; to develop standards such as MPEG4, etc.).
- As a tool to aid research in other areas. Videoconferencing is being used as an aid in the preparation of papers and
- proposals and "listen in" to seminars, workshops and conferences.

Fields of research interest include: high performance networks and distributed systems; image coding; persistent object systems; ATM communications; and Telematics applications.

In addition, psychologists are using videoconferencing to investigate its effects upon perception. Issues include:

> Understanding the relationship between evidence of visual behaviours and vocal communication.
>
> The development of effective psychological measures for differentiation of communications facilities.
> Studying dyadic interaction in negotiating tasks.

Educational purposes
Subjects taught using videoconferencing include:

- History
- History of Art
- Art and Design
- Business Studies
- Computing
- Human-Computer Interaction
- Physics
- Electronics
- Electrical Engineering
- Languages
- Adult Education
- Communal Politics
- The use of tools on the network (e.g. Concurrent CAD, Whiteboarding, FTP, etc.)
- Acupuncture
- Nursing
- Medicine (including Surgery which seems to be the most popular subject to be taught in this way).

One site is in the process of assessing the possible uses of videoconferencing for delivering IT related courses to the deaf community.

All existing configurations which are being used for educational purposes allow two-way audio and video. Teaching is mainly conducted one-to- distributed-groups or one-to-a-group. Less popular options are one-to-one and one-to-distributed-individuals. Other possibilities currently being employed are for “anyone who wants to join” and several-to-several. The number of sessions in a typical course tends to be in the region of 10-15 (or one session per term week).

Questions from students are principally dealt with by live interaction, mostly through a local ‘moderator’; or in some cases the teacher repeats the questions via a conferencing telephone. Students sometimes discuss their coursework in groups and then the representative of the

group tells the other participating groups about the results. However, there is usually no coursework which results specifically from the videoconferencing element of the course as such. The point was made that remote teaching complements rather than replaces traditional teaching techniques.

Users were asked about the inclusion of pre-recorded material in the lectures. Sources include a central 'image store' (laser disk) with still images and video clips. One respondent commented that whilst they do use pre-recorded video material to show special procedures, they prefer to be able to do as much as possible live (e.g. live demonstrations coming from clinical operating theatres).

Other uses
Other specialist uses of videoconferencing include:

- Tele-consultation in medicine.
- The assessment of the potential uses of videoconferencing for Small and Medium-sized Enterprises (SMEs).
- Remote surveillance (e.g. keeping watch on cars in the car park).
- Entertainment (e.g. listening to remote radios, tapes and audio samples; pumping TV and radio programmes around the campus).
- Giving demonstrations to prospective students and visiting researchers.
- "As a feed from remote locations to our TV studio. The composite picture is then sent by satellite." (For details of this set-up, see reference m in Appendix 3.)
- "Just experimenting".

Distance capability

In three cases, videoconferencing facilities are only available on the local Ethernet. Of the remaining respondents, half have international capability (via ISDN or the Internet) and the other half are operating on a wide area network (WAN). For example, a WAN links the SuperJANET video pilot sites. In some cases the WAN is potentially world-wide via 'protocol-converters' at University College London.

On some sites there is variable distance capability available: e.g. a local analogue part of the network operating within the campus; an analogue part of the visual network with wide area capability; and a digital part of the network which is national (via SuperJANET) and international (via ISDN).

Limit to the number of individual parties in a call

Often there is no theoretical limit to the number of individual parties in a call. Indeed, respondents report being able, for example, to run 5-site meetings with 26 participants and to relay a meeting of 200 people to 13 other sites. Some sites find it wise to set a practical limit of 5-6 sites for a multisite conference ('discussion'), whereas there is no need to set a limit for a 'broadcast' conference (one to many). Most users report being able to accommodate between three and six participants at each end (except, of course, in a teaching context, in which case there might be 80- 100 in a lecture theatre).

CU-SeeMe allows the reflector administration to set an upper limit at their discretion, whereas the MBONE does not seem to have an effective limit (e.g. the number of participants reached the 200 mark during the last shuttle flight).

Frequency and duration of use

A third of respondents are making daily use of their videoconferencing facilities, with most others using it at least 1- 2 times per week. Equipment that is used for educational purposes seems to be utilised at least once per week, with two studios reporting that they are in use for 70% of the time and 12-25 hours per week during term-time respectively.

The length of a typical call (presentation/ conversation/ lecture) clearly varies according to its purpose. A short conversation could last for less than ten minutes, whereas presentations may last all day and participation in a conference is likely to last for several days. The majority of calls, however, seem to fall within the range 15 minutes to 4 hours.

Importance attributed to the video link

Most users described the video link itself as “very important” or “essential”, especially for fast communication. Its role is obviously greatest when giving presentations and teaching, and helps to give context to slides, etc. Visual contact is also very useful during discussions.

However, it was pointed out that the video may be very valuable but it is not as important as good audio (although if the audio link is down, it is good to be able to see that there actually is someone sitting at the other end!). “Video aids understanding but without audio there is nothing to aid visually!” Greater importance was also given to the shared whiteboard than to the video link.

Associated facilities

Users were asked to give details of the associated facilities they use to accompany their videoconferencing. Examples are given below of some of the combinations of associated facilities in use. They are given in full, for interest. The letters in brackets are cross references to the example configurations given in Appendix 3.

- Document viewer, whiteboard camera, computer screen sharing (file transfer, fax available) (a).
- Shared whiteboard, shared application running (most useful bit!) (c).
- Fax being considered.
- Shared whiteboard acquired very recently — yet to be used in conjunction.
- Document sharing, file transfer, talk, video, sound, shared drawing, shared text documents.
- Sound, images.
- Document sharing, white board, file transfer, shared window applications, form filling, video image freeze-grab-and-transfer, two-way text conversations (g).
- Shared files, Concurrent CAD, whiteboard facilities.
- Whiteboard, conference management tools, access to the Scottish MICE NSC WWW server (h).
- Overhead projector, extra telephone, graphics (i).
- Whiteboard for document sharing, FTP, etc. (j).

- Shared whiteboard, Media on demand (record/playback tools), Format conversion (e.g. GSM-> DVI4), Session directory, File transfer/Gopher/ World-Wide Web, etc., IRC, "talk" (k).
- Document sharing, whiteboard facilities, file transfer, overhead projection, still and moving images from multimedia resource/store, etc. (l).
- Rostrum TV camera for samples, electronic graphics (m).
- Rostrum camera for documents, OHP, and 35 mm slides (n).

INSTALLATION AND SUPPORT

Installation procedure

One of the most marked differences between the use of videoconferencing within higher education and its use in the commercial sector appears to lie in the installation procedure adopted. In only three cases was the retailer or manufacturer solely responsible for the installation. Whilst a company might be called in to set up a specific piece of equipment (such as the codec or the echo canceller), the majority of the installation was done by the respondents themselves, either completely unaided (in 9 cases) or with the help of local experts.

In most cases the installation procedure was trouble-free (described as "a doddle", "a piece of cake", etc.).

However, some problems to watch out for include:

- Late delivery by the supplier.
- Working on a Windows_ installation with a retailer who is only familiar with the DOS version.
- Excessive length of time taken to provide a reliable ISDN service.
- Poor performance of the ISDN aggregator.
- Installation instructions which were vague and not comprehensive enough.
- Difficulties in installing some of the hardware in older models (e.g. SPARC 1).
- Difficulties in installing the analogue part of the network because there is no accepted standard.
- Problems in achieving an acceptable sound balance. Echo cancellers are particularly difficult to set up.
- Great problems in persuading BT to rent a line!

Identity and performance of personnel responsible for support

Support from manufacturer/retailer
Some were not in a position to comment because they had had little or no reason to call upon their maintenance contract so far. Most that had were very satisfied with what they deemed to be prompt, efficient service providing 'real' fixes (often consistently so over a period of several years). In several cases, the only problems to have occurred have been resolved through software upgrades.

However, criticisms included lack of resources (i.e. insufficient personnel to provide the required support) and the supplying of patches only when they are requested rather than when a bug has been found and fixed.

Most importantly, if you are offered hotline support, make sure you ascertain what is and is not included in the contract (e.g. engineer available on call out, telephone support only, etc.).

Largely self-supporting
Since budgets are limited, full service contracts are often no longer an option. If the fault is traced to a particular item of equipment then the manufacturer is called in, but it is usually down to the user to do a substantial amount of the first-line maintenance themselves.

Many of the Computing Services personnel provide their own support anyway, or call upon local expertise, since they are already running the machines. This seems to work well in most cases. There are "many willing and helpful experts on the doorstep" and because the support team are themselves users they tend to notice immediately when something goes wrong and can usually fix it or at least raise bug reports with the software authors. However, it is often difficult to find out what the problems are when an interruption occurs in the communication infrastructure.

Support can also be found via mailing lists such as:

mbone@isi.edu
rem-conf@es.net
jips-mbone-ops@noc.ulcc.ac.uk
cu-seeme-l@cornell.edu

This is rated as an excellent source of support. It is usually possible to find out the source of a problem and how to fix it within a few hours via e-mail.

It is worth noting that within the London Interactive Video Network (LIVENET) there are resident engineers; with SuperJANET, this is supported by the UK Education and Research Networking Association (UKERNA) who have contracts for maintenance.

Funding and cost-benefits

Running and capital costs

In cases where the videoconferencing equipment forms part of specific research projects, the running and capital costs are met by grants and occasionally by computer company sponsorship. However, very few respondents reported a single source for their funding. In most cases, the money is collected together from a variety of sources, such as operating and general equipment budgets, university funds and presentation charges. For example:

- "Network costs, the codec and the echo canceller are funded centrally [by the Joint Network Team (JNT) and UKERNA]; a substantial part of the audio-visual equipment is funded by the Technology in Learning and Teaching Programme (TLTP); and the remaining costs are met by the University."
- "Capital expenses are paid for by a special fund associated with the reorganisation of sites. Recurrent expenses are funded by the infrastructure budget."
- "Through Joint Information Systems Committee (JISC) grants and through the normal funding of the University Computing Service."

The MBONE is a volunteer effort and, as such, is not specifically funded (although the provision of SuperJANET is often centrally funded via top-slicing).

Payment for presentations

Users were asked about payment for the presentations and the communication time used.

Usually the university or commercial research department that hosts or transmits the presentation pays for it. Where the Internet is used, nobody "pays" as such; the cost is absorbed in the total bill for leasing the lines used to carry the Internet traffic. (This is a slight oversimplification as some Internet service providers charge on a volume basis, rather than a one-off charge for a leased line.)

Added value afforded by videoconferencing

The following benefits were identified:

- Travel savings (money, time and energy and organisational hassle).
- Immediate face-to-face meetings, with meetings between multiple sites being easier to organise since no travel is involved.
- It can be faster than using the telephone and provides a more natural meeting. If there is more than one person at each end then video helps the flow of information even more. At some sites it is (currently!) a free alternative to phone calls since the SuperJANET bandwidth is already paid for.
- Attending conferences remotely is instructive and saves a lot of air fares.
- Better quality teaching.
- For developers, it is a friendly user environment in which to look for troubles, anticipate additional uses, etc.
- It helps collaborative working; a shared whiteboard very useful for brainstorming.
- There is a great community out there waiting to be tapped into.

Value for money

Most users gave very firm positive answers to this question, especially when looking long term. For some it affords the opportunity for lots more communication which is effectively free as the bandwidth is already paid for. (It was pointed out that this question becomes academic in cases where there is no direct recharging for use.)

One respondent described how people had the opportunity to back out of LIVENET when it was re-designed at the beginning of 1994. New system was installed and, far from people backing out, the current use has increased to 1000 hours of teaching plus meetings, workshops, etc. In some cases the initial expense of the video network was justified on very specific grounds (such as the need to conduct teaching in the medium of the Welsh language).

However, others thought that videoconferencing is too expensive at present but has the potential to provide value for money in the future (although it is too early to say for sure). It is clear from the technical and usability problems cited later in this chapter that the promise is still to be delivered.

If the equipment is being used for educational purposes, it is essential that as many courses as possible take advantage of the facilities.

FUTURE USES

Potential uses for the future

Most users anticipate similar but much more widespread, regular use being made of videoconferencing technology on a world-wide basis in 1-5 years from now, with some seeing it being as ubiquitous as the telephone is today. In the fields of education, research and general purpose communications, there is a forecast for greatly expanded coverage beyond the boundaries of current projects and initiatives, together with the hope that the tools will be available close to the user (from his/her office) and cover a much wider area thanks to more affordable network technology.

Respondents anticipate:

- a much greater number of lectures using this medium, with the increased provision of remote teaching for those students who are sick;
- more classroom system links to lecture theatres for prestigious lectures;
- more distance learning (i.e. one-to-one tuition) as well as distance teaching;
- greater opportunity to share courses with other institutions;
- a greater number of meetings, training courses and conferences being made available using these tools, thus minimising travel;
- telecommuting from home on a greatly expanded scale.

Some specialist uses have also been identified, such as using videoconferencing as a medium for conducting and recording experiments and demonstrations in human-computer interaction, and for the remote use of overseas astronomical telescopes

To facilitate this more widespread use of the technology, respondents would want to see:

- much easier set-up procedures, with the systems integrated into academic networks;
- much easier control of the audio and much better interactivity;
- better picture quality, especially on desk-top systems;
- much greater use of network resources (e.g. multimedia servers, databases shared over networks, etc.).

Current limitations

Limiting factors which currently prevent the use of videoconferencing on this scale include:

- *Lack of other users*

Many sites with which respondents would like to communicate do not yet have videoconferencing equipment or access to ISDN, SuperJANET, etc.

- *Network issues*

At present, the general network infrastructure makes more widespread use difficult. There is a lack of bandwidth on JANET and SuperJANET to support sufficient simultaneous users and there are problems in linking ISDN to other networks.

- *Inadequate performance*

There were numerous reports that the tools in use are too unstable at present to support the predicted uses of the future. Video hardware and cameras are not bundled with most workstations yet, resulting in many users often being limited to audio and shared whiteboard. As one respondent commented, "videoconferencing is still a pretty new technology; it needs to mature a little more and prices need to come down a little."

- *Education issues*

There were complaints of a lack of adequate training in the use of videoconferencing for teachers and other employees. There seems to be little information currently available on the pedagogic aspects of distance teaching/learning. There also need to be changes in the philosophy of remote learning, which is currently grounded in the use of the one-way world of TV.

- *Lack of funding*

Setting up a videoconferencing system can be an expensive business and there is often no centralised resource within an institution for funding such ventures.

ADVICE FOR POTENTIAL USERS

Satisfaction with current set-up

Users were asked whether they were happy with their overall set-up and whether they would recommend what they have to other potential users. They were also asked if there were any extra facilities that they would like to see incorporated and whether they were indeed considering the purchase of any related equipment.

It seems that most respondents are basically happy with their current facilities, with well over 75% prepared to recommend what they were using. Specific factors which would influence these recommendations are listed below.

N.B. The letters in brackets refer to the example configurations given in Appendix 3.

- flexibility (e.g. because the combination of video and digital signal transmission allows the juggling of many parameters to
- arrive at any kind of video image possible) (d)
- suitability for distance education (i)
- cost-effectiveness (j)
- high potential (j)
- ease of use (k)
- high studio quality (n)

One respondent felt the equipment they were using was not yet stable enough to be recommended to others, but that videoconferencing could be a very useful communications tool once the bugs are ironed out.

For others there was not a simple answer to this question. While they would endorse some products, they were finding others to be redundant or too costly. Some felt that they were not in a position to make recommendations because their equipment has been largely determined (and funded) by outside bodies.

The point was made that recommendations would depend on the potential users' situation and the uses they anticipated for videoconferencing. For example, a site with a low bandwidth Internet connection and no money to lease private lines will be limited in the technology they can use effectively.

However, a variety of problems and deficiencies, some of which were of a technical nature while others were concerned with the usability of the system.

Problems identified

Technical problems

- Sound quality is not always provided to acceptable levels (noise and rumble are unacceptable). Some tools (such as vat and maven) are particularly subject to sound break-up.
- CU-SeeMe needs improvement in the areas of audio support and colour. It would also beneit from some recording/playback tools, akin to the media-on- demand software for the MBONE.

- MBONE audio/video synchronisation needs improvement.
- Incompatibility between different components. For example, PictureTel does not interface with BT bridge equipment.
- PictureTel demonstrates poor resolution, especially for document sharing and computer screen sharing.
- Jerky video motion is sometimes annoying.
- Projection of vu-graphs by way of a video camera is not acceptable.

Usability issues

- Significant propagation delay (in the use of PictureTel) makes verbal interjection awkward.
- The non-colinearity of monitor and camera will mean that eye-to-eye contact is not complete.
- Inadequate preparation by speakers is still a problem.
- CU-SeeMe makes it easy for novice users to break the Internet for everyone. User education is the only effective countermeasure to date.
- Users would like to see easier control systems to handle different cameras and resources. The digital systems are not as flexible as the analogue systems and we would like to see development to give this level of flexibility of interaction. The digital system are more formal as there are time delays, which tend to kill spontaneity.

Extra facilities required

- Computer application sharing.
- Desk-top office systems, either standalone or PC-based (to supplement PictureTel which is installed in a dedicated videoconferencing room).
- Document viewer.
- Proper dedicated videoconferencing room.
- A small occasional studio (to supplement the existing videoconferencing studio).
- Split screen.
- ISDN compatibility.
- Better conference control tools (floor control, etc.).
- Remote control of camera pan and zoom. (N.B. This is incorporated into the ES f- 2-f software — which is very clever — but it is rather limited.)
- Video boards for some HP PCs, and some cameras to suit.
- Better cameras.
- Faster link to Internet (currently 57.6K).
- Faster networks with guaranteed bandwidth.
- MCU and PBX.
- Large SPARCstation with FDDI interface to replace current MBONE router.
- Large digital servers for multimedia resources.
- More compact and cheaper workstations.
- Cheaper codecs.
- The possibility to run remotely (Windows_ or Mac) programs in Vis-A-Vis- program (i.e. the ability to use Vis-a-Vis to connect from distant locations to the server.)
- 3D.

Facilities considered to be superfluous

The majority of respondents found none of their facilities to be superfluous, making regular use of most of the features available to them. One user found their video mixer to be superfluous and another found that they were not making much use of the shared drawing application. The split screen facility was falling into disuse at a third site because of the need to keep moving the cameras around in order to set it up.

The point was made that document sharing is often better done by fax and computer screen sharing is better done using computer network technology.

Two-way text conversation can often seem unnecessary, considering you are already in verbal contact.

Specific pieces of advice

- Practise! Even institutions which have been using the technology for several years admit that they are still learning and still do not get it right all of the time.
- Think very carefully about your requirements and your intended uses of the technology.
- Try to see systems in operation to decide which matches your need.
- Be clear about the distinction between desk-top and full screen techniques and the difference between conferencing and distance teaching.
- Be aware of the kind of image you will be dealing with on a day-to-day basis (because although the Information Superhighway will offer substantially increased bandwidth, there is still going to be a lot of traffic and this will affect transmissions).
- Consider whether you really need a moving picture. In many cases a digital camera or scanner connected to a computer will suffice. Still pictures give quite a lot information and shaking heads are sometimes annoying (especially in an ISDN connection).
- Decide in advance on the protocols of use which will allow the equipment to be integrated into your work environment. For example:-
-
    - Is it going to be on all the time?
    - Who will the cameras be pointed at?
    - What sort of control will they require over the images they transmit?

- Get the best facilities you can afford from the beginning, making sure that every link in the chain has adequate performance. A good sound system is especially important.
- Proprietary set-ups are more robust than customised ones, unless you like “tinkering”!
- If multicasting a lecture make sure that you set your gear up at least a day in advance, test all the connections, get a stable platform for the camera (which should be a decent video camera with zoom lens) and most importantly get decent audio set up (lots of microphones near the speakers/audience and a mixer unit between them and the workstation).
- Wait. In the case of ISDN-based systems, wait until the standards and compatibility issues have been sorted out and the technology (mainly software) is more stable.
- Use Macintoshes; in the long run they save money and effort.
- Have face-to-face meetings as well, especially at the start.
- Voice switching takes a little getting used to but is excellent.

- Check out all of the video server software very carefully before buying. Most of the video conferencing software is badly done.
- Watch the software cost and the video board being used; it can get very expensive.
- Make sure the software runs on several network platforms. TCP/IP over Ethernet, T1, and FDDI infrastructures should be a norm. If it only uses ISDN don't use it. Tests show that ISDN is late and too slow to be of any help in a high speed image network.
- Look for cross platform software — workstation to PC connect is the best.
- Give careful consideration to the quality of the display. Many monitors and data projectors have a poor quality picture. No matter what the tests say, the only display you can watch for hours without getting sore eyes is non-radiating, non-pulsar Activ-Matrix or Electro-luminens displays. Unfortunately these displays are too expensive and too small at the moment.
- Get in touch with people who have been using the facilities (see Appendix 4 for possible contacts).
- PC-based videoconferencing is a compact solution; but when there are, say, eight different cards inside the PC, real problems start to occur. Compact often means risky.
- Bear in mind that videoconferencing over a wide area (e.g. the Internet) is experimental, and you may be treading on an awful lot of people's toes by broadcasting high bandwidth video on public networks.
- Try it to learn something about new options for yourself and your organisation. But do some reading about what others have done and see how their models might apply to you and what you want to do. Do learn from others and don't assume that your plans or needs are unique!
- The best is yet to come!

Further Reading

Glossary

Appendices

Further Reading

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Glossary

Note: The Cray Communications Pocket Book Collection provided several of these explanations and definitions.

ADPCM
Adaptive DPCM (where DCPM is differential PCM, transmitting value differences, and adaptive means dynamically adjusting parameters to the data stream).

ATM
Asynchronous Transfer Mode networks (based on packet switching). A mode of data transfer in which units of data are not time-related to each other.

B-ISDN
Broadband ISDN. A communication channel having a bandwidth greater than a voice-grade channel 1 and therefore capable of higher-speed data transmission.

CBT
Computer-based training.

CCD camera
Charged Couple Device camera.

CCIR
International Radio Consultative Committee.

CCITT
International Telegraph and Telephone Consultative Committee. A standards body concentrating on definition of European Communications Standards.

CELP
Code Excited Linear Prediction. The most common vocoder technology in use today, which uses "codebooks" to quantise the input signal. The CELP algorithm provides excellent speech quality and is well suited for tele-conferencing.

CIF
Common source Intermediate Format.

CODEC
An item of equipment containing an encoder and a decoder. A device which performs the dual function of encoding two-way analogue data and two-way digital data into analogue data.

DARPA
Defense Advanced Research Project Agency.

DMA channels
Dynamic Memory Addressing.

DSP
Digital Signal Processor.

DVI
Digital Video Interactive (Trade Mark of the Intel Corporation).

ETF
European Teleconferencing Federation.

Ethernet
A LAN transmission network utilising a bus structure, first produced by Xerox in the USA, later adopted by both DEC and Intel as well. This was later adapted to create the IEEE 802.3 and ISO 8802-3 standards.

ETSI
European Telecommunications Standards Institute. Membership is open and there are currently 135 member organisations including national administrations, public network operators, manufacturers, users and research bodies.

FDDI
Fibre Distributed Data Interface. A token passing ring network specification developed by ANSI, implementing dual optical fibre rings. The network operates at 100Mbps and can be up to 100 kilometres in length.

fps
Frames per second.

FTP
File Transfer Protocol. A protocol from the Internet Protocol Suite which provides transfer of files between two dissimilar machines.

H.320
A series of audio visual communications recommendations which were ratified by the CCITT in December 1990. The aim of the series, which applies to audio visual communications over 56/64 Kbps to 2.048 Mbps channels, is to ensure videoconferencing systems and video terminals will interconnect across any network. H.320 is an umbrella standard encompassing a series of recommendations, including:

H.221 (frame structure for a 64-1920Kbps channel);

H.230 (frame synchronous control and indication signals);

H.242 (systems for establishing communications between audio visual terminals using digital channels up to 2 Mbps);

H.261 (visual coding for transmission over 56/64-2048 Kbps digital channels);

G.711 (3.5 kHz narrowband audio specification for 48-64 Kbps channels);

G.722 (7 kHz wideband audio specification for 48-64 Kbps channels);

G.728 (3.5 kHz audio specification for 16 Kbps channels).

HDTV
High definition TV (e.g. 1125 or 1250 lines).

HTTP
HyperText Transfer Protocol.

IEEE
Institute of Electrical and Electronic Engineers. An American Institute responsible for developing and publishing many communications standards.

IETF
Internet Engineering Task Force. Part of the organisation that develops Internet standards.

Internet
A vast community of computers, distributed around the world, which share common protocols (TCP/IP).

IP
Internet Protocol.

ISDN
Integrated Services Digital Network. Basically the existing telephone network using existing but upgraded switches and wiring, but all digital, giving a bandwidth for a basic call of 64 kbps. This increased bandwidth allows the transmission of high fidelity compressed audio, as well as the potential for video communication.

ISO
International Standards Organisation.

JANET
Joint Academic NETwork.

JBIG
Joint Broadcasting Information Group. Generates standards for binary image compression (e.g. faxes).

JISC
Joint Information Systems Committee (of the Higher Education Funding Councils of England, Scotland and Wales). Responsible for funding SuperJANET.

JNT
Joint Network Team. Forerunner of UKERNA.

JPEG
Joint Photographic Experts Group. Generates standards for still image compression.

LAN
Local Area Network. A system for intercommunication between computer terminals, PCs and related equipment operating within the same general area.

LIVENET
London Interactive Video Network. A hybrid network combining analogue and digital communications, with gateways to ISDN, SuperJANET, Internet and satellite.

MAN
Metropolitan Area Network. A geographically extended high-speed LAN designed to interconnect users within a city or metropolitan area.

MBONE
Multicast Backbone. A virtual network that has been in existence since early 1992. Originated from an effort to multicast audio and video from meetings of the IETF. Shares the same physical media as the Internet. MBONE today is used by several hundred researchers for developing protocols and applications for group communication. It is a co-operative, volunteer effort.

MCU
Multipoint Conferencing Unit.

MHEG
Multimedia and Hypermedia information coding Experts Group. Generates standards for multimedia data (such as integrating stills, video, audio, text, etc.).

MICE
Multimedia Integrated Conferencing for European Researchers. Co-ordinated by University College London, this project aims to provide a multi-way integrated conferencing service between a number of European pilot sites, and link them to the appropriate communities in the US.

MPEG
Moving Picture coding Experts Group. Generates standards for digital video and audio compression.

NetBIOS
Network Basic Input/Output System. A network communication system operating on MS/DOS PC networks.

NTSC
(US) National Television System Committee - TV standard.

ODA
Office Document Architecture. Defines the structure of complex documents for interchange between systems in an OSI environment. It also provides for the creation, change, consolidation and management of documents using screens or printers as necessary for input and output (ISO 8613/CCITT T.411-T.418).

OSI
Open Systems Intercoynnection. The term defined by the International Standards Organisation as a basis for standards to enable different vendor systems to interwork without modification.

OSPF
Open Shortest Path First.

PAL
Phase Altering Line. The TV standard in much of Europe which uses YUV colour space (i.e. Y luminance, 1.3 MHz chrominance components U, V).

PBX
Private Branch Exchange. PCM Pulse Code Modulation. An encoding technique for digitising analogue voice signals (used, for example, with CD audio).

PDH
Plesiochronous Digital Hierarchy.

PNO
Public Network Operator

POTS
Plain Old Telephone System.

PSTN
Public Switched Telephone Network.

QCIF
Quarter Common source Intermediate Format.

QuickTime
Produced by Apple, QuickTime is a set of protocols that allow a Mac or a PC running Windows to use a single interface to create/display/manipulate movies that contain digitised video, sound, text, etc.

RIFF
Resource Interchange File Format.

RIPE
Réseaux IP Européens. Co-ordinator of the Internet community in Europe. Operational since 1989. A RIPE Network Co-ordination Centre in The Netherlands provides Internet management functions, network software and documentation.

RTP
Real Time Protocol. A transport protocol for audio/video data that is being developed by the Audio/Video Transport working group of the Internet Engineering Task Force.

SDH
Synchronous Digital Hierarchy.

SGML
Standard Generalised Mark-up Language (mark-up metalanguage - ISO 8879).

SMDS
Switched Multimegabit Data Service.

SuperJANET
A national high performance network supporting UK education and research. It currently provides three services: a high performance IP service to all connected sites, an ATM service to a sub-set of the connected sites and a video network to the ATM sites. Super VGA High resolution VGA often 800X600 pixels and 256 colours with faster scanning rate. S-Video Separate-video (also known as Y/C) in which the luminance and chrominance information of a video signal are carried on separate wires.

T1
A digital communications path operating at 1.544 Mbit/sec.

TCP/IP
Transmission Control Protocol/Internet Protocol. Two main network communication protocols, part of the Internet Protocol Suite.

TLTP
Technology in Learning and Teaching Programme (run through UCOSDA).

Token Ring
A LAN transmission network utilising a ring structure. The most common form is IBM Token Ring. This network type is detailed by the IEEE 802.5 and ISO 8802-5 standards.

TUA
Telecommunications Users Association.

UDP
User Datagram Protocol.

UKERNA
UK Education and Research Networking Association. A company that has been set up to manage the networking programme for the UK higher education and research community.

VADPCM
Variable rate ADPCM compression.

VESA
Video Electronics Standards Association.

VGA
Virtual Graphics Adapter. Standard 640X480 resolution PC monitor configuration.

WAN
Wide Area Network. A network which uses public or private circuits to link terminals, PCs and computers over long distances that also often allows some user choice in destination. Following the implementation of routers, bridges and gateways, many LANs are becoming WANs, but more typically networks such as X.25 are classed as WANs.

WWW
World Wide Web.

Appendix 1: List of relevant standards and definitions

H.320
This is the ITU (formally the CCITT) standard covering the technical requirements for narrow-band visual telephone services. Video processing and transmission is now governed by a group of three main standards (H.261, H.221 and H.242) which fall under the umbrella standard H.320. It defines the types of terminal and the transmission mode that can be used. H.320 stipulates that a terminal must be capable of supporting video communications with both 64kbit/s B channels in parallel or with each other independently. The 3 'satellite' standards relate to the coding, decoding, control and synchronisation of the video elements of a multimedia transmission, with three other standards defining the audio path, G.728, G.722 and G.711. It is anticipated that Recommendation H.320 will be extended to a number of Recommendations each of which would cover a single videoconferencing or videophone service (narrow-band, Broadband, etc.). However it is felt that because all of the standards would have so much duplication of wording, and as the points of divergence have not been settled, for the time being it is convenient to treat all the text in a single Recommendation.

The service requirements for visual telephone services are presented in Recommendation H.200/AV.120-Series; video and audio coding systems and other technical set aspects common to audiovisual services are covered in other Recommendations in the H.200/AV.200- Series.

H.261
This is the ITU recommendation for audiovisual Services at p x 64 kbit/s. It describes the video coding and decoding methods for the moving picture component of audiovisual services at the rate of n x 64 kbit/s, where n is in the range 1 to 30. This is for two way live transmissions such as video conferences and videotelephony. For video telephony, a bit rate of 384kbits/s has become the norm. The standard defines the compression algorithms that are to be used, the two picture formats that can be used as a source for the video encoder, and the ways in which the output from the encoder is formatted. The picture input format required by H.261 is known as the Common Intermediate Format (CIF).

This standard is intended for carrying video over ISDN - in particular for face-to- face videophone applications and for videoconferencing. Videotelephony is less demanding of image quality, and can be achieved for n=1 or 2. For videoconferencing applications (where there are more than one person in the field of view) higher picture quality is required and n must be at least 6.

There are actually two picture formats defined within H.261; CIF (Common Intermediate Format) has 288 lines by 360 pixels/line of luminance information and 144 x 180 of chrominance information; and QCIF (Quarter Common Intermediate Format) which is 144 lines by 180 pixels/line of luminance and 72 x 90 of chrominance. The choice of CIF or QCIF depends on available channel capacity - eg QCIF is normally used if n<3.

The actual encoding algorithm is similar to (but incompatible with) that of MPEG. Another difference is that H.261 needs substantially less CPU power for real-time encoding than MPEG. The algorithm includes a mechanism which optimises bandwidth usage by trading picture quality against motion, so that a quickly-changing picture will have a lower quality

than a relatively static picture. H.261 used in this way is thus a constant-bit-rate encoding rather than a constant-quality, variable-bit-rate encoding.

H.221
The methods by which synchronisation of audio and video are achieved are specified in H.221. The standard defines how a transmission should be subdivided into subchannels so defining the order in which packets of encoded H.261 video are interleaved or multiplexed with the audio.

It offers several advantages:

It takes into account Recommendations G.704, X.301/I.461, and so it may allow the use of existing hardware and software.

It can be used in multipoint configurations, where no dialogue is needed to negotiate the use of a data channel.

It provides a variety of data bit-rates (from 300 b/s up to almost 2 Mb/s) to the user.

Closely related to H.261 & H.242 and in fact supersedes H.220

Products complying to the standard include codecs from BT, GPT, PictureTel and VideoTel.

H.242
This specifies the protocols that are to be used to establish how communications between two terminals with differing capabilities should signal the facts to each other so that they can negotiate the highest level of performance. A number of applications utilising narrow (3 kHz) and wideband (7 kHz) speech together with video and/or data have been identified, including high quality telephony, audio and videoconferencing (with or without various kinds of telematic aids), audiographic conferencing, with other applications emerging all the time

To provide these services, a scheme is recommended in which a channel accommodates speech, and optionally video and/or data at several rates, in a number of different modes. Signalling procedures are required to establish a compatible mode upon call set-up, to switch between modes during a call and to allow for call transfer.

All audio and audiovisual terminals using G.722 audio coding and/or G.711 speech coding or other standardised audio codings at lower bit rates should be compatible to permit connection between any two terminals. This implied that a common mode of operation has to be established for the call. The initial mode might be the only one used during a call or, alternatively, switching to another mode can occur as needed depending on the capabilities of the terminals. Products complying to this recommendation include codecs from BT, GPT, PictureTel, VideoTel & others.

G.711
ITU standard for Pulse Code Modulation (PCM) of voice frequencies

G.721
ITU standard for audio encoding.

F.700
ITU standard for Audiographic, Videotelephony and Videoconference service standards. The individual recommendations are as follows:

F.711 Audiographic Conference Teleservice for ISDN

F.720 Videotelephony Services General

F.721 Videotelephony Teleservices for ISDN

F.722 Videotelephony Services General

F.730 Videoconference Service General

F.732 Broadband Videoconference Services

F.740 Audiovisual Interactive Services (AVIS)

CIF
This specifies how the results of digitising video signals should be presented to the encoder. This is needed because of the different scan frequencies and framing rates used by the TV standards (525 lines at 60 fps for NTSC and 625 lines at 50 fps for PAL). The TV frame is converted from the linear raster scan of the input TV signal to a two dimensional array of picture elements, The result is a compromise between the NTSC and PAL standards. The standard also defines a lower resolution format, quarter CIF, which has half the number of pixels per line and lines per frame. The use of Q-CIF in a video encoder is now mandatory according to H.261, while full CIF is optional.

JPEG
This is the compression Standard for continuous-tone still images. JPEG stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard. The standard is designed for compressing either full-colour (24 bit) or gray-scale digital images of "natural" (real-world) scenes. JPEG does not handle black-and-white (one bit/pixel) images, nor does it handle motion picture compression.

JPEG is "lossy", meaning that the image you get out of decompression isn't quite identical to what you originally put in. The algorithm achieves much of its compression by exploiting known limitations of the human eye, notably the fact that small colour details aren't perceived as well as small details of light- and-dark. Thus, JPEG is intended for compressing images that will be looked at by humans. If you plan to machine-analyse your images, the small errors introduced by JPEG may well be a problem for you, even if they are invisible to the eye.

MPEG
The Moving Pictures Experts Group (MPEG) meets under the auspices of the International Standards Organisation (ISO) to generate standards for digital video and audio compression.

In particular, they define a compressed bit stream which implicitly defines a decompressor. The MPEG group usually meet at the same time as the JPEG, JBIG and MHEG groups. However, they are different sets of people with few or no common individual members and they have different charters and requirements. JPEG, as already described, is for still image compression, JBIG for binary image compression (e.g. faxes) and MHEG is for multimedia data standards (such as integrating stills, video, audio, text, etc.)

MPEG 1 has been devised and is in three parts: video, audio and systems, where the last part provides for the integration of the audio and video streams with the proper time stamping to allow synchronisation of the two. The MPEG 1 standard is available as ISO CD 11172. MPEG has the potential for higher compression rates than H.261 (because of support for frame interpolation between frames, not just extrapolation) and it will also provide a standard for higher resolution images.

Supporters of the new Video on CD MPEG 1 standard include Philips (co-developer of the original audio CD); JVC (developer of the VHS video-tape standard); PC maker Commodore International; and Korean consumer electronics giants Samsung and Goldstar.

MPEG 2 is similar to MPEG 1, but includes extensions to cover a wider range of applications. It is designed to handle applications (e.g. video on CD) that need higher-quality playback. MPEG 2 supports CCIR 601 resolutions, but it requires transmission rates above 4 Mbps, as opposed to the 1 to 3 Mbps that MPEG 1 requires. It also requires a lot more processing time to encode the source video signal.

The primary application targeted during the MPEG 2 definition process was the all- digital transmission of broadcast TV quality video at coded bit-rates between 4 and 9 Mbit/sec. However, the MPEG-2 syntax has been found to be efficient for other applications such as those at higher bit rates and sample rages (e.g. HDTV). The most significant enhancement over MPEG-1 is the addition of syntax for efficient coding of interlaced video (e.g. 16x8 block size motion compensation, Dual Prime, etc.).

The MPEG 2 Audio Standard supports low bit-rate coding of multichannel audio, supplying up to five full bandwidth channels (left, right, centre, and two surround channels), plus an additional low frequency enhancement channel, and/or up to seven commentary/multilingual channels. It extends the stereo and mono coding of the MPEG-1 Audio Standard to half sampling-rates (16 kHz, 22.05 kHz, and 24 kHz), for improved quality for bit- rates at or below 64 Kbits/s per channel. The MPEG 2 Systems Standard specifies coding formats for multiplexing audio, video and other data into a form suitable for transmission or storage.

MPEG 3 targeted HDTV applications with sampling dimensions up to 1920 x 1080 x 3 Hz and coded bit-rates between 20 and 40 Mbit/sec. It was later discovered that with some (compatible) fine tuning, MPEG 2 and MPEG 1 syntax worked very well for HDTV rate video.

MPEG 4 Work on a new initiative for very low bit-rate coding of audio-visual programs has been approved by unanimous ballot of all national bodies of ISO/IEC JTC1. This work began in September 1993 and is now in the application identification phase. It is scheduled to result in a draft specification in 1997. When completed, the MPEG-4 standard will enable a whole spectrum of new applications, including interactive mobile multimedia communications, videophone, mobile audio-visual communication, multimedia electronic mail, remote sensing, electronic newspapers, interactive multimedia databases, multimedia videotex, games, interactive computer imagery, sign language captioning.

Since the primary target for these applications is a bit-rate of up to 64 kbit/s at good quality, it is anticipated that new coding techniques allowing higher compression than traditional techniques may be necessary.

X.400

This is the ITU standard for the exchange of multimedia messages by store-and- forward transfer. The aim of the X.400 standards is to provide an international service for the exchange of electronic messages without restriction on the types of encoded information conveyed. Work on X.400 began in 1980 within ITU and resulted in the publication of the 1984 Recommendations, which still forms the basis of many of the products available today. Since then ITU formed a collaborative partnership with ISO for the further development of the technology and published technically aligned text in 1988 (1990 in ISO) for the first major revision of X.400.

Message handling technology is complex; as well as the sheer technical difficulties involved, as a global service it has had to take account of political, commercial, legal, and historical realities. Some issues which are dependent on national telecommunications regulation are not covered by the International Standards and are addressed by national standards.

The relatively poor penetration of X.400 messaging has been caused by a variety of factors. The heavy investment in developing 1984 products has lead to considerable resistance to change, regardless that global interconnectivity is severely constrained in 1984 products, and that 1984-1988 interworking degrades the quality of service offered. Paradoxically it is the attempt to recoup the investment in 1984 products which is impeding the introduction of 1988 products that are essential for a highly functional global messaging service.

IP Multicast

IP multicasting is the transmission of an IP datagram to a host group, which is a set of zero or more hosts identified by a single IP destination address. A multicast datagram is delivered to all members of a destination host group. The membership of the host group is dynamic. A host group may be transient or permanent. Multicasting of this nature is essential to optimise bandwidth usage for multiparty conferencing applications.

RTP

A Transport Protocol for Audio and Video Conferences and other Multiparticipant Real-Time Applications

Services typically required by multimedia conferences are playout synchronisation, demultiplexing, media identification and active-party identification. RTP is not restricted to multimedia conferences, however, and other real-time services such as data acquisition and control may use its services.

QuickTime
This is Apple Computer's file format for the storage and interchange of sequenced data, with cross-platform support.

A QuickTime movie contains time based data which may represent sound, video or other time-sequenced information such as financial data or lab results. A movie is constructed of one or more tracks, each track being a single data stream.

A QuickTime movie file on an Apple Macintosh consists of a "resource fork" containing the movie resources and a "data fork" containing the actual movie data or references to external data sources such as video tape. To facilitate the exchange of data with systems which use single fork files, it is possible to combine these into a file which uses only the data fork . It is possible that QuickTime could become a computer-industry standard for the interchange of video/audio sequences.

RIFF
RIFF (Resource Interchange File Format) is a family of file structures rather than a single format. RIFF file architecture is suitable for the following multimedia tasks: Playing back multimedia data Recording multimedia data Exchanging multimedia data between applications and across platforms.

Appendix 2: A selection of currently available PC integrated videoconferencing products.

AT&T TeleMedia Connection
Provider: AT&T Global Information Solutions.
Description: Video/Audio/Tools over ISDN running on a PC.
Requires a386 or higher, 8MB RAM, VGA with VESA feature connector, Microsoft Windows 3.1+, ISDN adapter or telephone.
Price:About £3500 including camera.
Multipoint: Yes (application sharing for point-to-point only).
Collaboration Features: Whiteboard, Application Sharing of Windows applications, File transfer.

BVCS (Bitfield Video Conferencing System)
Provider: Bitfield OY
Description: Video/Audio over ISDN, LAN and other networks. Bitfield provides a set of application programming interfaces for Windows (as a Dynamic Linked Library) and DOS, allowing video applications to be integrated into existing systems.
Platforms: PC
Requirements: Microsoft Windows 3.1+, video overlay board.
Multipoint: No

Cameo Personal Video System
Provider: Compression Labs Inc.
Description: Video over Switched 56, ISDN, and Ethernet. Audio requires ISDN or Analog phone line. Computer-based version of the AT&T VideoPhone 2500. An external image processor unit and attached video camera encodes and passes data to an ISDN board. The performance is relatively slow, but the system is aimed at low-end requirements rather than full-blown videoconferencing.
Platforms: Apple Macintosh
Requirements: System 7 or higher, QuickTime, ISDN card for ISDN use, analogue telephone or speakerphone.
Price: about £2000 with camera.
Multipoint: No
Collaboration Features: File Transfer.

CommunicatorIII
Provider: EyeTel Communications Inc.
Description: Video/Audio/Tools over Switched 56, ISDN, T1, Ethernet, or Token Ring.
Platforms: PC
Requirements: Novell Netware 3.11+, 386SX or higher, 4 MB RAM, Super VGA w/256 colours and feature connector, Microsoft Windows 3.1+, audio input/output, 5 MB hard disk space.
Price: About £5000, includes camera, microphone, speakers, CODEC and video capture board. Optional motion estimation
board $995.
Multipoint: Yes
Collaboration Features: Whiteboard, File transfer.

Communique!
Provider: InSoft
Description: Video/Audio/Tools over ISDN, Frame relay, FDDI, SMDS, Ethernet, ATM.
Platforms: Sun SPARCstation, HP9000 Series 700, DEC Alpha AXP (running OSF/1), RS6000.
Requirements: Video card and camera.
Price: About £600
Multipoint: Yes
Collaboration Features: Shared Whiteboard, Shared Applications, Shared Writeboard, File Transfer, Groupware Tools.

Connect 918
Provider: Nuts Technologies
Description: Video/Audio/Tools over Analog, Switched 56, ISDN, or Ethernet.
Platforms: Macintosh, PC.
Requirements: 386 AT or higher, 2 ISA slots, VGA/SVGA monitor, Microsoft Windows 3.1+, 8MB RAM.
Price: About £2000 - £3500 depending on ISDN or LAN options.
Multipoint: Yes (up to 3 parties).
Collaboration Features: Whiteboard, Screen sharing.

DECspin (DEC Sound Picture Information Network)
Provider: Digital Equipment Corporation
Description: Video/Audio using standard network protocols. DECspin uses packetized audio and video to allow for desktop teleconferencing. DECspin uses standard networking protocols (TCP/IP and DECnet) along with either hardware or software compression of digitized audio and video.
Platforms: DEC
Requirements: DECstation 5000, ULTRIX 4.3 or higher, TURBOchannel, DECmedia hardware (DECvideo,DECaudio), XMedia Tools Runtime license, 24-32MB memory, 500MB - 1GB disk storage.

Desktop Videoconferencing
Manufacturer: Fujitsu Networks Industry
Description: ISDN-based desktop videoconferencing for MS Windows. It combines simultaneous screen sharing and remote control of live applications with real time pointing, writing and annotation files. It uses Novell Netware software to enable these ancillary collaborative features, over a LAN or WAN network.
Platforms:PC running under Windows
Minimum requirements: 4Mb RAM, VGA monitor, Winodws 3.0 or higher
Multipoint: Yes up to eight participants
Collaborative features: Application screen scharing,remote control, file transfer, clipboard transfer

ES+F2F (Electronic Studio's Face 2 Face)
Provider: Electronic Studio
Description: Video/Tools over ISDN, Analog, Ethernet. Audio requires ISDN or Analog phone line. A package which allows two way desktop video conferencing with text and image exchange. The people involved in the conference can see and interact with the same document, highlighting areas of a diagram, for example, which are also highlighted on the recipient's screen. Speeds of 15 fps are achievable without compression hardware. Appletalk and ISDN networks are supported.
Platforms: Macintosh
Requirements: Apple Communications Toolbox, video capture board.
Price: £1000
Multipoint: No
Collaboration Features: Text and image exchange.

InPerson

Provider: Silicon Graphics
Description: Video/Audio/Tools over Analog, Ethernet. A conference includes a shared whiteboard and a "shared shelf" for visual file transfer. Platforms: InPerson runs on any SGI platform with graphics. For machines without video hardware, a static image is used instead of live video. For machines without audio hardware, the InPerson whiteboard can be used with an analog phone line for voice. Bandwidth usage for video is dependent on the resolution selected as well as the amount of motion in the video scene. The formula for determining maximum required bandwidth for each participant is...
video height * video width * frame rate * 1.4 = kbits / second
For instance, video with 160x120 resolution, at 15fps, consumes approximately 400 kbits/sec. This is the maximum amount of data bandwidth used for just the video for a single participant. Actual bandwidth used may be less if there's not much motion in the video scene. InPerson uses multicasting for audio in conferences with more than two participants. Unicast networking is used for a two-person conferences. InPerson uses an early draft of RTP, a transport protocol for audio/video data that's being developed by the Audio/Video Transport working group of the Internet Engineering Task Force. IETF is part of the organization that develops Internet standards. Will InPerson run over Ethernet? Will InPerson run over ATM? Will InPerson run over FDDI? InPerson will run over each of these networks as they use standard TCP/IP networking protocol. If the network topology doesn't support multicasting, then the size of the conference may be limited. InPerson was designed to operate within at least an Ethernet bandwidth and network topology. While InPerson is limited by available network bandwidth, there is no support to take advantage of additional (greater than 10 Mbit) bandwidth. This support will be available in a future release. The additional bandwidth will allow for more simultaneous conferences as well as conferences with a greater number of participants.
Requirements: No additional hardware needed.
Price: About £350
Multipoint: Yes
Collaboration Features: Text, image, 3D model sharing. Whiteboard can include graphics, as well as text and images. Sharing 3D models are not currently supported in the whiteboard, except as image "snapshots" of the model. InPerson also includes a "shared shelf" for visual file transfer between participants in a call.

INTERVu

Provider: Zydacron, Inc. Description: Video/Audio/Data over IsoEthernet (802.9), ISDN, Switched 56, or V.35/RS366.
Platforms: PC
Requirements: 386 or higher, Microsoft Windows 3.1 or higher.
Multipoint: Yes
Collaboration Features: File Transfer, runs most collaborative software already on the market (i.e. talkshow, vis-a-vis, person to person, farsite, terminal, carbon copy, proshare, etc.)
It operates at fixed frame rates of 15fps at CIF and 30fps at Q-CIF. INTERVu is completely CPU independent. Future plans to come out with a multiplatform product capable of 20(fixed) fps at Full CIF.

InVision
Provider: InVision Systems Corp.
Description: Video/Audio/Tools over ISDN, Switched 56, Ethernet, FDDI, Frame Relay, Token Ring, ATM.
Platforms: PC
Requirements: 386 or higher, Microsoft Windows 3.1+.
Price: About £700
Multipoint: No
Collaboration Features: Whiteboard, Shared Clipboard.

IRIS
Provider: SAT
Description: Video over ISDN. A hardware/software package which allows bilateral desktop video conferencing. Compressed colour video is carried over ISDN, and audio over a normal voice telephone channel. JPEG compression is done in hardware.
Platforms: Macintosh
Requirements: Macintosh II or Quadra, Planet ISDN board, 4MB RAM.
Price: £5000-£6000.
Multipoint: No

IVS (Inria Videoconference System)
Provider: RODEO Project, INRIA Sophia Antipolis, France.
Description: Video/Audio over the Internet. ivs is an integrated audio/video conferencing tool used in RIPE and Internet remote conferencing research. A window is presented to the user giving a couple of menus, one for selecting a video encoding and one for selecting an audio encoding. At the bottom of the window a list of participants in the conference is presented and whether each of them is broadcasting audio or video or both. By clicking on the buttons next to these labels you can either hear the audio through the loud speaker or pop up another window showing the video image. The video is encoded using a H.261 software codec. Output from the encoder is approximately 30 kbyte/s. The audio stream can be encoded with either PCM (64 kbit/s), ADPCM (32 kbit/s) or VADPCM (variable rate ADPCM) compression.
Platforms: Sun SPARCstation, HP9000, DECstation 5000, SGI Indigo.
Requirements: A workstation with a 1, 4, 8 or 24 bit screen depth. Multi-host conferences require kernel support for multicast IP extensions (RFC 1112). Video frame grabbers supported are VideoPix, SunVideo or Parallax boards for SPARCStations, RasterOps board for HP stations, IndigoVideo or GalileoVideo boards for SGI IRIS Indigo and Indy

workstations, or the VIDEOTX board for DEC stations. No special hardware apart from the workstation's build-in audio hardware is required for audio. Requires a camera compatible with the video board.
Price: Free, by anonymous ftp from ftp://zenon.inria.fr/rodeo/ivs.
Multipoint: Yes
Collaboration Features: None

MacMICA
Provider: Group Technologies
Description: Video/Audio over Appletalk networks. Conferencing system which provides multipoint, real-time interactive conferencing between multiple workstations over Appletalk networks.
Platforms: Macintosh
Multipoint: Yes

MMDC
Manufacturer: ISI
Description: Runs on Sparcs over the DSI network (ST-1.5). It's a video conferencing tool used in research.

Nevot

Manufacturer:Henning Schulzrinne, hgs@research.att.comAT&T BL
Platform: Sun (SunOS), Silicon Graphics, DEC Ultrix (soon)
Description: The network voice terminal (NEVOT) allows audio-capable workstations to participate in audio conferences across local and wide area networks. Features: compatible with NVP (network voice protocol) as used by 'vat' (LBL) and VT (ISI) compatible with 'vat' native packet format upward compatible with 'vat' session protocol versions for: Sun SPARCstation; SGI Indigo (4D Series); Personal DECstations [soon] GUIs: XView; Motif [in progress]; curses; dumb terminal can serve as gateway for protocol and encoding translation network transport protocols: TCP; unicast/multicast UDP; ST-2 several independent concurrent conferences, each with different encoding and compression DES-based voice encryption (U.S. only) audio encodings: 64 kb/s (u- law PCM); 32 kb/s G.721 ADPCM (Sun only); 32 kb/s Intel DVI; 24 kb/s G.723 APDCM (Sun only); 4.8 kb/s LPC codec each site can use different audio encodings playback and recording of AIFC and .snd audio files extensive statistics and tracing facilities arbitrary voice packet length, which may differ for each site lost packet and silence substitution setable audio buffer occupancy configurable adjustment mechanisms for playout delay, VU meter, silence detector and automatic gain control redefinable session identifier string with variable substitution
Price: Free

Ntv
Provider: Peregrine Systems
Description: Video/Audio/Tools over Ethernet and Token Ring.
Platforms: PC
Requirements: 386 DX/25 or higher, 4MB RAM, Microsoft Windows 3.1+ or Windows for Workgroups, Network connection,
Video capture board, Audio capture board, Camera, Microphone, Speakers.
Multipoint: Yes
Collaboration Features: Application sharing of Windows-based applications.

NV (Network Video)
Provider: Xerox/PARC
Description: NV provides video over the Internet. It is commonly supplemented with VAT (Visual Audio Tool) and WB (Whiteboard) for full-featured video/audio conferencing and collaboration. nv is a videoconferencing tool that transmits video images across an internet using UDP/IP. Images maybe sent point-to-point or can be broadcast to a large number of receiving stations using multicast IP. It is widely used in the DARPA remote conferencing research effort.
An X window with a list of video sources is presented to the user and video images to be viewed can be selected by clicking with a mouse on the label of the appropriate sending station.
The picture is built up using a slow-scan method which means that only the changes between each frame are broadcast. Typically frame refreshes happen at about 2 to 5 frames per second. Both PAL and NTSC video standards are supported.
No specialist hardware is required for receiving the video image. If video images are to be transmitted using nv then a VideoPix framegrabber (available from Sun Microsystems) and a video camera are required. There is no integrated audio support.
Platforms: Sun SPARCstation, DECstation 5000 and Alpha, SGI, HP9000, IBM RS6000.
Requirements: All platforms require a camera that is compatible with the video capture hardware. Sun/SunOS 4: Parallax, PARCVideo, VideoPix, X11. Sun/SunOS 5: SunVideo, VideoPix, X11. DEC 5000/Ultrix: PIP, X11; DEC Alpha/OSF 1: J300,X11; SGI/Irix 5: SGI VL (Indy, Galileo), X11. HP9000/HPUX: VideoLive, X11. RS6000/AIX: IBM VCA, X11.
Price: NV, VAT, and WB are all free and available by anonymous ftp
Multipoint: Yes
Collaboration Features: None

PCS100

Manufacturer: PictureTel
Description:PC integrated videoconferencing running under Windows. To be used in conjunction with LIVEShare software to enable whiteboard, and colaborative working, as well as file transfer. Runs on ISDN network, compliant with all ITU standards
Platforms: PC
Requirements: 386 or above, Microsoft Windows 3.1, SVGA or VGA monitor, 4 MB RAM(8MB recomended).
Multipoint: No
Collaboration features: whiteboard, file transfer, application sharing.

Person To Person
Provider: IBM
Description: Video/Tools over Analog, ISDN, Ethernet, or Token Ring. Audio requires separate ISDN or Analog phone line. Person To Person/2 is a two way videoconferencing system which incorporates a shared "chalkboard" window. This is a shared, interactive workspace that shows the same information on everyone's screen. The chalkboard can mirror any OS/2 application window, or can be loaded with bitmaps or scanned images. The chalkboard can be annotated, and each participant can see the other's mouse pointer. The next most important facility is EClip which, as the name suggests, connects the system clipboards of all the participants of a P2P EClip. This means that anyone can pass just the right information to a colleague using the clipboard commands found in most applications. The data comes in just the right format, instantly and without extra training.
Compressed digital video and graphics are carried either over ISDN, or over a Token Ring or Ethernet LAN using NetBIOS. There is an option to carry video over a physically separate analogue video link. Voice is carried over the telephone system. There are several other facilities in P2P that each play their part. File Transfer like a minimalist e-mail system, lets you pass groups of files to colleagues. Talk is a shared minute-taking tool, like the chat programs you may have seen but with the addition of date, time and author stamps that make the transcript useful when the virtual meeting is over.
Platforms: PC
Requirements: 386SX minimum, OS/2 2.x or Microsoft Windows 3.1+, 8MB memory, ActionMedia II hardware. Camera.
Price: £195 (educational discount available)
Multipoint: Yes
Collaboration Features: Whiteboard, File transfer, Talk window, Shared clipboard.

Personal Viewpoint
Provider: ViewPoint Systems
Description: Video/Audio/Tools over Analog, Switched 56, ISDN, Ethernet, Token Ring.
Platforms: PC
Requirements: Microsoft Windows 3.1+, VGA graphics, 1 available slot.
Price: About £1000 without camera, £1500 with camera.
Multipoint: Yes
Collaboration Features: Whiteboard, File transfer.

PICFON
Provider: Specom Technologies
Description: Video/Audio over Analog and ISDN phone lines. PC-based video telephone system which uses a 14.4 kbit/s modem. Video is captured and compressed using the CAPICOM board and transmitted using the PICFON card.
Platforms: PC
Requirements: 386 or higher, 4MB RAM, 40MB hard disk, DOS 5.0 or higher, camera.
Multipoint: Yes (maximum of 3 parties).
Collaboration Features: Still-image sharing.

PictureTel Live PCS 100
Provider: PictureTel
Description: Video/Audio/Tools over Switched 56, ISDN.
Platforms: PC
Requirements: 386 or higher, 2 ISA slots, Microsoft Windows 3.1+.
Price: About £4000
Multipoint: Yes (maximum of 16 parties).
Collaboration Features: Whiteboard, File Transfer, Screen sharing.

PictureWindow
Provider: BBN
Description: Video/Audio over the Internet.
Platforms: Sun SPARCstation.
Requirements: Sun SPARCstation (1,1+,2,IPX,10), 8 bit color or grayscale frame buffer, 24MB memory, SunOS 4.1.1 or later with IPC_SHMEM option, OpenWindows 2.0 or higher or X11 R4 or higher with an 8-bit PseudoColor visual, VideoPix card.
Price: About £350 software only, £1000 with VideoPix and camera.
Multipoint: Yes
Collaboration Features: None

ProShare
Provider: Intel
Description: Video/Audio/Tools over ISDN.
Platforms: PC
Requirements: 486/33 or higher, 8MB RAM, 7MB hard disk space, DOS 3.3 and Windows 3.1+, VGA resolution or higher, 2 ISA slots.
Price: About £1800
Multipoint: No
Collaboration Features: Whiteboard.
Notes: Current whiteboard supports OLE but does no allow application sharing yet. Future versions will support H.320.

PSVC (Paradise Software Video Conferencing)
Provider: Paradise Software, Inc.
Description: Audio/Video/Tools over ISDN, Ethernet, ATM.
Platforms: Sun SPARCstation
Requirements: Parallax XVideo/PowerVideo boards, SunOS 4.1.3 or Solaris 2.3, OpenWindows 3.x, 1MB disk space, 16MB
memory, 16 MB swap.
Price: About £700 (without any hardware)
Multipoint: Yes
Collaboration Features: Whiteboard, Video Mail, Screen Capture.
Notes: Support for HP 700 series, Motif forthcoming.

SD

Manufacturer:Van Jacobson Lawrence Berkeley
Platform: Sun SPARCstation + SunOS 4.1.x + IP Multicast extensions, X windows
Description: This is a session director. It lists all the audio/video conferences available on the Internet. Information about each conference (what it is, who created it, when it starts and finishes, which address and conferencing protocol it uses) is presented to the user.
When the user selects the desired conference from the list, the appropriate tool is started (eg. nv or vat) with the correct address and port number for that conference.
A facility for creating conferences is provided and these conferences can be limited to being site-wide, region-wide, or global. This is currently achieved by setting the time-to- live on the broadcast packets. This tool is being developed as part of the DARPA remote conferencing research effort.
Future plans: Ongoing development of the tool and underlying protocols.
Available from: ftp.ee.lbl.gov
Price: Free

ShareView 3000
Provider: ShareVision
Description: Audio/Video/Tools over Analog phone line.
Platforms: Macintosh
Requirements: System 7.01 or higher, 4MB RAM, 2 NuBus slots.
Price: About £3000
Multipoint: No
Collaboration Features: Whiteboard, Document sharing.

ShareVision
Manufacturer: ShareVision
Description: Desktop videoconferencing and real-time document sharing over POTS (Plain Old Telephone System) lines for Macintosh

ShowMe
Provider: SunSolutions
Description: Video/Audio/Tools over the Internet. ShowMe is a computer conferencing tool. Virtually any information that would be presented or recorded in a conference room can be interactively presented to that same group from the desktop using this software.
ShowMe supports global workgroups connected via any TCP/IP based local or wide are network. Conferees can import information from their desktop such as slide presentations, documents, graphs, images, and spreadsheets onto ShowMe's shared conference board, and then augment their verbal discussion visually and interactively using ShowMe's on-screen markers to gesture or mark-up the information. With the Active Window feature you can make changes to your applications and then pop these changes onto the ShowMe conference board for further discussion. Voice is carried over the normal telephone network.
ShowMe was released in September 1992.
Platforms: Sun SPARCstation
Requirements: Solaris 2.3 or later, X11 R5, OpenWindows 3, 1 SBUS slot, SunVideo board, SunMicrophone.
Price: ABout £2500, including SunVideo board and camera. Educational discount available.
Multipoint: Yes, with and without IP Multicast.

Collaboration Features: Whiteboard, Application Sharing for X11 R4/R5-based applications and Wabi 1.0 supported MS
Windows applications.

Slate
Manufacturer: BBN
Platform: UNIX workstations
Description: Slate provides real-time conferencing and multimedia electronic mail on UNIX workstations. Slate allows shared access of documents (images, desktop publications) in real time. It's all based around a mail system so that there's a natural archival system for the various sorts of media being shared.
Future plans: Investigations into the use of (Internet-compatible) videoconferencing facilities within Slate are proceeding at BBN.
Price: Slate is available to educational sites (at least in the US) at $100 a license (site licenses are also available).

TeleView 1000C
Provider: VCC (Video Conferencing Communications, Inc.)
Description: Video over Analog phone lines.
Platforms: PC
Price: About £3000 includes boards and software.

TELES.VISION

Manufacturer: TELES GmbH, Berlin
Platform: PC running under Windows
Description: In 1991 TELES claimed that the TELES. VISION system was the only PC-integrated videoconferencing system on the market. In runs over an ISDN link, or across an ethernet connection, and provides some collaboration features.
Requirements: 486 with 8Mb RAM, running under Windows 3.0 or later.
Multipoint: Yes, up to 15 particpants
Collaboration features: Shared files, shared views.

VAT
Manufacturer:Van Jacobson Lawrence Berkeley Laboratory University of California Berkeley.
Platform: Sun SPARCstation, SunOS 4.1.x + IP Multicast extensions, X windows
Description: vat is an audio-conferencing tool which supports both point-to-point and broadcasting of audio using multicast IP. This tool is extensively used in the DARPA remote conferencing research effort. A window is presented to the user showing a list of names of all the participants of the conference. The tool allows you to set the gain on the microphone and loudspeaker. You can select whether the audio received goes to the loudspeaker or headphones. You can select individual members of the conference and either setup a side-conversation with them or block out the audio coming from that station.
Different audio encodings are supported: pcm 64Kb/s 8-bit u-law encoded 8KHz PCM idvi 32Kb/s Intel DVI ADPCM gsm 16Kb/s GSM lpc1 18Kb/s Linear Predictive Coder lpc4 8Kb/s Linear Predictive Coder vat can act as a filter between these different formats.
Encryption of audio data using DES is supported, thought there is no automatic way of propagating/generating the encryption key.

Future plans: Work is underway on U.S. Federal Standard 1016 4800 bit/s CELP (a very low bandwidth codec that could be run over 9600 baud dial-up SLIP links).
Price: Free

VC7000
Provider: Tandberg Telecom
Description: Video/Audio. Videoconferencing system and document transmission system. Conforms to H.261 coding. Audio is synchronised to full motion video.
Platforms: PC

VCI/oem
Manufacturer:VistaCom
Platform: PC
Description: VCI/oem is a set of H.261 video codec boards for the OEM (original equipment manufacturer) market, designed for use over a number of different network types with bandwidths from 56 kbit/s up to 2 Mbit/s. A JPEG compression option is available.
The basic video codec consists of two PC/AT bus boards. Six additional boards are available for various networks interfaces. There is a development kit, called CDS-261/100, which consists of one set of all codec boards, one fully assembled and tested codec in a standalone chassis, development software and technical manuals. A 3-day course is also available.
The products were released in October 1992.

VicPhone
Provider: VIC Hi-Tech Corporation
Description: Video/Tools over Analog, ISDN phone lines or Ethernet. Audio can be sent over the same analog line with a voice-modem. No additional line required for voice over ISDN.
Platforms: PC
Requirements: 486/33 or faster, 16-bit ISA bus, Microsoft Windows 3.1+, VGA board with feature connector, 9.6 - 28.8 modem or network, CCD camera (NTSC,PAL,S- VIDEO).
Price: About œ450, includes video capture/display card,videoconferencing software and additional multimedia video/audio capture/edit/playback features.
Multipoint: Point-to-point modem operations, Multi-point LAN/WAN operations.
Collaboration Features: Shared image/document workspace with mutual chalkboard, file transfer, text chat window.

VidCall
Provider: MRA Associates Inc.
Description: Video/Tools over Analog, ISDN, Ethernet, Token Ring. Audio requires separate phone line or voice/data modem to send voice and video over one telephone line.
Platforms: PC
Requirements: 386/33 (486 recommended), 2M disk space, 4 MB RAM, VGA graphics, Microsoft Windows 3.1+ or Windows NT, Microsoft mouse, video capture board (compatible with many boards including Video For Windows compatible boards), MNP/V.42 modem (14.4+) or Windows compatible LAN, WAN, TCP/IP network, still or motion camera.
Price: About £50, includes software for two stations and documentation.
Multipoint: Point-to-point modem operations, Multi-point LAN/WAN operations.
Collaboration Features: Whiteboard, Image sharing and annotation.

VISIT Video
Provider: Northern Telecom Inc.
Description: Video/Tools over ISDN or Switched 56. Audio requires separate ISDN or Analog phone line. Desktop videoconferencing via switched-56 or ISDN for Apple Macintosh and IBM PC. It integrates desktop video conferencing, screen sharing, electronic voice mail.
Platforms: PC, Macintosh.
Requirements: PC: 386 minimum and hard drive, Microsoft Windows 3.1+, AT-bus expansion slot, DOS 5.0 or greater, 8MB RAM (12 MB RAM max on ISA PC, 16MB or more possible on EISA w/ memory re-mapping), 256-color VGA board and color monitor (Super VGA w/ thousands of colors support recommended). Mac: Macintosh II family or other NuBus-equipped Apple computer, NuBus expansion slot, System 7 or greater, 8MB RAM, Color monitor. Camera included with product.
Price: About £4000
Multipoint: No
Collaboration Features: Whiteboard, File transfer.

Vivo320
Provider: Vivo Software, Inc.
Description: Video/Audio/Tools over ISDN.
Platforms: PC
Requirements: 486 66-MHz PC, Microsoft Windows 3.1.
Price: About £1500, includes MovieMan video capture card and digital camera, Logitech mircrophone, IBM WaveRunner
ISDN card, hands-free speaker, privacy earpiece, and Vivo320 software.
Multipoint: Yes, using H.320 compliant MCU (Multi-point Conferencing Unit).
Collaboration Features: Document Sharing
(Databeam's FarSite 2.0 collaboration software included), Image Presentation and markup.

VS1000
Provider: Mentec International Ltd.
Description: Video/Audio. Videoconferencing system for MS Windows. A codec card, screen window update card and camera
are required.
Platforms: PC
Requirements: Microsoft Windows.
Price: £10,000

The information included in appendices 1 and 2 has been primarily collated from manufacturers publicity material. However in order to be as complete as possible, some of the summaries have been derived from sources on the World Wide Web.

These surveys can be accessed at the following addresses;
http://www2.ncsu.edu/eos/service/ece/project/succeed_info/dtvc_survey/products.html
http://cui_www.unige.ch/OSG/MultimediaInfo/mmsurvey/

Appendix 3: Examples of Equipment Currently in Use

Tabulated below are some examples of videoconferencing configurations currently in use (derived from the survey described in Chapter 3).

DESCRIPTION OF EQUIPMENT	LOCATION
(a) PictureTel System 4000 Model 400	Videoconferencing room
(b) Silicon Graphics & SuperJANET	
(c) SunSparc IPX workstations, SunSparc ZX workstations. Sun Multimedia upgrade kit (board + video camera). Sunworks ShowMe video conferencing suite.	Offices
(d) Hardware (All x2): Panasonic Camcorder VHS-C NVG1 Panasonic VTR NVF75-HQ Panasonic Digital AV Mixer WJ-AVE5 Sony Trinitron 14" TV/Monitor Finlux black design 32" TV/Monitor Mac IIvx RasterOps 24MXTV Image Grabbing Board Apple 16" Monitor Software: Mediagrabber (by RasterOps) ES f-2-f (by Electronic Studios) Timbuktu Pro (Faralon) Aspects (Group Technologies)	Experimental suite
(e) Software bundled on SGI Indy machines.	Office and a shared laboratory.
(f) GPT 261A Video Codec	AV Unit in Medical School
(g) BT VC8000 hardware with Olivetti's PCC software - runs over ISDN.	In 3 offices around the city
(h) Sun workstations (IPC, SPARCclassic, SPARCstation 5, SPARCstation 1) with Parallax Powervideo with FORE SBA-200 TAXI ATM interfaces with VideoPix with SunVideo using MBONE tools nv, vat, ivs, wb, mmcc, nevot, nt using Paradise Software Video Conferencing (PSVC) using InSoft Communique	Offices
(i) Vis-A-Vis Windows + DOS versions on 486 Dx 33 PC + TCP/IP + modem + Sony QM-1251 Data projector	Auditorium.
(j) DEC Alpha 300LX, AV300, Communique!, (SD, NV, VAT, WB), DECSpin.	Own office.

(k) Sun SPARCstation IPC/IPX running MBONE software and applications. Silicon Graphics Indy running MBONE applications. Apple Macintosh (various) running CU-SeeMe. IBM PC clone running CU-SeeMe. N.B. The Indy comes with a built-in camera. None of the other machines have cameras.	Various offices and laboratories.
(l) GPT codecs operating to H261 standard and ASCEND Multiband Units permitting operating at a range of bit-rates (2 Mbps on ATM video Network of SuperJANET; 128 - 768 Kbps on ISDN). VC7000 Videophone operated at 128 Kbps over ISDN. ISDN cards in PCs operating at 64-128 Kbps. SUN workstation (UNIX) with video cards operating over Ethernet link to Internet. This is a desk-top type workstation running as part of MICE. This uses a variable bit-rate according to availability on the Internet. HP 725/75 Workstation (UNIX) with Bitfield codec operating up to 2 Mbps operating over SMDS in the IP network on SuperJANET.	A variety of rooms and teaching space It is linked through a visual network based on LIVENET-2. This network has outlets in laboratories, lecture theatres, seminar rooms and clinical operating theatres.
(m) PictureTel PCS100TM on IBM PC. (Used on trial - now awaiting updated equipment) Now evaluating BT coco derivatives	TV Studio and Office. Two ISDN lines are linked to the TV Studio with an extension to the office Videoconferencing terminal moved as required.
(n) BT VC-4100 over 384 kb Kilostream to five studio sites.	Videoconferencing studio. Runs on an extensively used Welsh network.

Appendix 4: Useful Contacts

Note: Much of the explanatory material for the contacts is taken from publicity information on the National Hosts for the ACTS Programme.

UKERNA (UK Education and Research Networking Association)
UKERNA is a company that has been set up to manage the networking programme for the UK higher education and research community and has taken over the staff and resources of the former Joint Network Team, which managed the programme for the past 15 years. This programme has gained an international reputation for both innovation and for delivering high quality services and support to the research community. It is recognised as one of the most advanced in the world and includes the JANET and SuperJANET networks. UKERNA's remit is to continue and expand the already well-established networking programme and to bring the benefits to wider communities. UKERNA has a well established close working relationship with the UK research community, including the IT research sector, and with the funding bodies and government departments that support the community.

For more information contact:

Liaison Desk
UKERNA
Atlas Centre
Chilton, Didcot,
OXON OX11 OQS

Tel: 0235 445517
Fax: 0235 446251
E-mail: Liaison-Desk@ukerna.ac.uk

SuperJANET

SuperJANET forms part of the UK's higher education and research networking programme funded principally by the Higher Education Funding Councils of England, Scotland and Wales via their Joint Information Systems Committee (JISC).

SuperJANET is a national high performance network supporting UK education andresearch. It currently provides three services: a high performance IP service to all connected sites, an ATM service to a sub-set of the connected sites and a video network to the ATM sites. Access to the IP and ATM services is at 34 Mbps; developments are in progress to upgrade the ATM network to 155 Mbps. The network uses SMDS and PDH/SDH network services provided by BT, supplemented by other facilities such as 34 Mbps leased lines and dark fibre links. SuperJANET is connected to the European PNO ATM Pilot.

SuperJANET's primary role is to provide stable, high quality network services to meet the requirements of the UK university and research community. In addition, it is able to support network research and development activities to the extent that those activities are compatible with, and do not disrupt, the service provision to the wider user community. All use will be governed by the JANET and SuperJANET Acceptable Use Policy.

Technical information
Users gain access to the IP service via the local-area network (LAN) (e.g. Ethernet or FDDI) that serves the user's site. The LAN is connected to SuperJANET via a router with a high performance interface, the type of interface required depends on the type of SuperJANET access selected (e.g. SMDS, PDH link or dark fibre).

Access to the SuperJANET ATM network is via equipment on the user's site (e.g. an ATM switch or host computer) equipped with an ATM interface that is linked to the appropriate SuperJANET ATM switch. The type of interface required depends on the type of access selected (e.g. PDH or SDH link, dark fibre).

Access to the video network is via a video codec on the users site linked to the appropriate SuperJANET video switch via a 2 Mbps channel provided as a leased line or via the ATM network.

UKERNA will advise on the most suitable type of connection and the equipment required for that connection.

User community
SuperJANET has a large and growing user community. 60 institutions are currently connected of which 57 are universities and 2 are major national research laboratories. The network provides access to four national supercomputer centres and several other national research facilities.

A major expansion programme has recently been launched which is expected to increase the total number of organisations connected to more than 110 over the next three years, including all UK universities. It is expected that a growing number of organisations outside the university sector will connect to the network over the same period.

For more information contact:

Liaison Desk
UKERNA
Atlas Centre
Chilton, Didcot,
OXON OX11 OQS
WWW ttp://www.ja.net/SuperJANET/SuperJANET.html

Tel: 0235 445517
Fax: 0235 446251
E-mail: Liaison-Desk@ukerna.ac.uk

NORTHERN INFORMATICS APPLICATIONS AGENCY LTD
Based on initiatives from the Universities of Newcastle and Northumbria the Northern Informatics Applications Agency (NIAA) has been created to become the focus for telematics developments that will give the Northern Region of the UK a leading competitive advantage both nationally and internationally in the application of broadband communications and information services.

By stimulating and co-ordinating the creation of a Regional data network which is also a testbed for developing and piloting services and applications, the NIAA is providing an open forum in which suppliers and customers can co-operate for mutual advantage.

One of the primary objectives of the initiative is to co-ordinate the integration of a region-wide communications infrastructure as well as an associated programme of applications. This is being achieved by the integration of existing regional and national networks together with selective in-filling of the gaps. For example, the SuperJANET network is providing a core network of broadband-width services and is being interfaced with networks from utilities, Tecs and Business Links. Other large businesses in the region are also offering to integrate their communications networks into the regional infrastructure.

The objective is not only to provide excellent regional facilities but to make the region a key node on the world wide network.

User Community
The Northern Region covered by the NIM comprises the area of the five counties of Cleveland, Cumbria, Durham, Northumberland and Tyne and Wear. Costs

For more information contact:

Chris Drew
Northern Informatics Applications Agency,
Northumbria House, Regent Centre,
Gosforth, Newcastle, NE3 3PX.
Tel: 091 284 3151
Fax: 091 284 0378
E-mail: CHRIS.DREW@Newcastle.ac.uk

INTREPID (The IBC Network Trans-European Pilot Interoperability Demonstrator)
A RACE funded project, INTREPID, aims to provide a broadband infrastructure connecting users in two objective one regions of Europe, addressing issues with respect to interoperability and Quality of Service, and expanding the trials and user community across the network.

The INTREPID consortium comprises MARI (Northern Ireland) Limited, University College Dublin, the University of Ulster at Jordanstown and Mentec Picturecom Ltd. The trials are currently in the areas of tourism, educational teleworking and education multimedia database access tools.

Description of facility
INTREPID operates at the national and international level, linking networking facilities at the local level to the BT SMDS and the Dublin Metropolitan Area Network.

In Northern Ireland this will be done by connecting to the UK academic network SuperJANET or directly to BT SMDS, and thus connecting through to the ATM node in London. In Ireland the Metropolitan area network will be connected to the Telecom Eireann ATM Node.

Connectivity to the ATM pilot will provide opportunities to interwork with other broad band islands in Europe and carry out interoperability experiments across INTREPID.

Access to the service will be either via SuperJANET or via a direct connection to BT SMDS (UK) or the Dublin Metropolitan Area Network (Ire).

For more information contact:

Patricia Jones
MARI (Northern Ireland) Limited
Bridgewood House, Newforge Lane
Belfast, BT9 5 NW
Tel: 0232 669500
Fax: 0232 669800
E-mail: jones@mari.co.uk

INTTELEC
The INTTELEC user group, co-ordinated by LEDU and MARI (Northern Ireland) Ltd is comprised of actors selected from LEDU's client base of nearly 7000 small and medium sized business enterprises (SMEs).The ten SMEs selected for the INTTELEC user group are geographically dispersed throughout Northern Ireland, an area of approximately 5,500 square miles.
The current user group consists of three common interest groups (ClG) working in Printing & Publishing, Training & Education, and Information Technology & Telematics. They have

identified opportunities to work together for common business objectives in diverse markets by communicating and working at a distance.

For more information contact:

Stuart McLean (LEDU) Tel: 0232 491031
LEDU House, Fax: 0232 691432
Upper Galwally, E-mail: 100336,2311(Compuserve)
Belfast, BT8 4TB

Garry McMullan Tel: 0232 669500
MARI (Northern Ireland) Ltd, Fax: 0232 669800
Bridgewood House, Newforge Lane E-mail: mcmullan@mari.co.uk
Belfast, BT9 5 NW

Queen's University Belfast

The host facility at Queen's University is partitioned into two areas of interest. The first of these concerns the interconnection of Computer Supported Collaborative Working (CSCW) and Multimedia applications over an ATM enterprise LAN, and the interconnection of Wireless LANs using an ATM switch. This is supported by the DSP & Telecommunications Research Group. The second area of interest involves distributed and/or high performance computing and networking applications. This is supported by the Parallel Computer Centre.

Technical Information

The CSCW/ Multimedia/ WLAN facility consists of a two ATM switches connected via an 8Mbps E2 line. One local switch then connects to the DV2 SuperJANET connection. A number of Sun and PC-based workstations are directly connected to each switch via a TAXI interface and internal ATM cards. TCP/IP is supported throughout the configuration, while direct ATM encoded video is available locally at each switch (using ML5). It is also intended to connect two Wireless LAN (WLAN) base stations to one of the switches. it is anticipated that the WLANs will conform to WlNDATA's FreePort architecture which supports 8Mbps Ethernet in the 2.4Ghz and 5.8 GHz frequency bands (downlink & uplink respectively); other WLAN connections will be considered .

The Distributed / High Performance Computing facility consists of 8 SGI Indy workstations, each with 64MB RAM, 1 GB disc and R4400 processor. All workstations are connected by a local ATM switch via a TAXI interface and internal ATM cards. The local ATM switch then connects to the DV2 SuperJANET connection. TCP/IP is supported throughout this configuration.

For more information on CSCW/Multimedia/WLANs contact:

Dr. A. Marshall Tel: 0232 245133 ext. 4248
Dept. Electrical & Electronic Engineering, Fax: 0232 667023
Queen's University, E-mail: A.Marshall@ee.qub.ac.uk
Belfast, BT9 5AH.

For more information on Distributed/High Performance Computing contact:

Dr. R. F. Rankin Tel: 0232 245133 ext. 3819
Parallel Computer Centre
Queen's University, E-mail: R.Rankin@Queens-Belfast.ac.uk
Belfast, BT9 5AH.

HD THAMES LTD.
HD Thames is an SME independent production company, created by former members of Thames Television in 1992, to explore new opportunities in multimedia, broadcast and non-broadcast.

As an independent producer the company has substantial experience of cost-effective production (including the particular problems of using prototype equipment) and the creation and management of multi-national high technology operations.

For more information please contact Ian Martin or Paul Kafno at:
HD Thames Ltd. Tel: 0181 614 2965
Teddington Studios, Fax:0181 614 2955
Broom Road, Teddington Lock,
Middlesex, TW11 9NT.

Mercury One-2-One/Cable and Wireless/Ericsson Radio Systems
The vision of Mercury One-2-One is to lead the market for personal communications, satisfying people's needs for affordable, convenient and reliable telecommunications in the home, at work and on the move. Cable and Wireless have telecommunications interests throughout the world. In the UK, they are the principal shareholder of Mercury Communications Ltd, a fixed PSTN operator. Ericsson is a leading international supplier of telecommunications equipment and is a market leader in the area of mobile communications.

The first stage of the Mercury One-2-One network, implemented mainly with Ericsson supplied equipment, was switched on in September 1993. By mid October 1994, the network provided access to 30% of the UK population, representing about 16 - 17 million people. Mercury One-2-One will provide coverage to 90% of the UK population by the end of the decade.

For more information contact:
Dr Alan Marsh Tel: 0181 214 2233
Mercury One-2-One, Fax: 0181 905 1671
Imperial Place,
Borehamwood, WD6 1EA.

Yorkshire Cable (with University of Bradford)
Yorkshire Cable is a rapidly expanding cable operator with coverage of the major conurbations of Bradford, Halifax, Wakefield, Barnsley, Sheffield, Rotherham and Doncaster. They have established a productive collaboration with the University of Bradford in both originating new network services and in initiating research into the 'radio over fibre' environment for personal communications.
Yorkshire Cable offer a wide range of entertainment and telecommunications services which include the following.

- 47 TV channels (many in NICAM stereo)
- 32 FM radio channels (including the University of Bradford broadcasting station 'RAMAIR')
- 30 channels of digital music (DMX)
- Residential and business analogue telephony
- ISDN30 and DASS telephony
- 2 Mbps and 34 Mbps leased data services (G703)
- 64 kbps and Nx64 kbps leased data services (X21 and G703)

Among other new services to be introduced in the near future are:

- Centrex
- ISDN2

The network is also configured to support interactive TV, a facility which will be commissioned shortly, while a wide range of cell-based services are also the subject of feasibility studies. Immediate future planning covers the availability of full data (Internet) multimedia service supporting E-Mail, Home Shopping and Banking as well as educational and information services.

For more information contact:

Kevin Truby
Engineering & Operations Manager
Yorkshire Cable Communications Ltd
Mayfair Business Park,
Broad Lane,
Bradford, BD4 8PW.

Tel: 0274 828282
Fax: 0274 828400
E-mail: Kevin@truby.demon.co.uk

EUROBELL

Eurobell was one of the first independent telecommunications companies to enter the deregulated UK market. It owns and operates a franchise in the Horley-Crawley- Gatwick area south of London which includes London Gatwick airport.

The Eurobell commercial facility comprises Cable TV distribution and digital telecommunications networks built in the last two years using state-of-the-art technologies. Both networks share a ring topology using optical fibres. A good cross section of both residential and business users are connected.

The cable TV facility offers almost 40 channels to its subscribers. The digital telecommunications network offers telephony, ISDN and other advanced services For more information contact:

Peter Woodward
Eurobell Ltd

Tel: 0293 400 444
Fax: 0293 400 440
E-mail: 100325.605@compuserve.com

BT Laboratories Futures Test-Bed

The BT Laboratories Futures Test-Bed is being developed as a test-bed for R&D activity into multimedia information services and broadband networks. The network will provide a broadband capability to 600+ desks in the Advanced Applications and Technologies Department and will provide a basis for work in fields as diverse as fibre- optics, networks, network management, multimedia databases, information engineering, services and applications (including business, medicine, education, library of the future, shopping and entertainment).

The network will include a single mode optical fibre backbone carrying switched 155MBit/s ATM. It will provide an Ethernet segment (10MBit/s) to every desk, with 155MBit/s ATM where required for higher bandwidth applications. A wide range of servers or terminal equipment can be connected to the network via an appropriate interface card. Optical fibre technology will be exploited on part of the network to provide much greater bandwidths (GBit+) and free application developers from concerns over bandwidth limitations.

The Futures Test-Bed has a link to SuperJANET (currently SMDS) to facilitate joint research with Universities on applications, networks and network management.

For more information contact:
Steve Sim Tel: 0473 642041
Applications Research, Fax:0473 637400
BT Development and Procurement, E-mail: sim_s_p@bt-web.bt.co.uk
Advanced Applications and Technologies Department,
Martlesham Heath,
Ipswich, IP5 7RE.

Rutherford Appleton Laboratory
The Rutherford Appleton Laboratory (RAL) supports the entire UK academic community with scientific skills and facilities. It provides a wide range of support services for scientific, commercial and industrial applications, serving more than 7000 different users.

Videoconferencing
Videoconferencing is one of the many facilities available. RAL is one of 14 sites on the UK's pilot ATM network and this is the backbone of an active videoconferencing network using H.320 codecs.

Videoconferencing capability is available from a number of rooms, ranging from a video booth through regular meeting rooms up to a full 200-seater lecture theatre equipped with three video projectors. The kernel of the video conferencing system is located next to the Atlas Video Facility; this provides a flexible interface between the video conferencing system and many types of computer and video source: Unix workstations, personal computers, video disks and most videotape formats.

RAL also uses the MBONE system over Internet and is currently installing ISDN video conferencing equipment. Bridges between all these various video conferencing domains are being developed to allow the maximum inter-connectivity and allow flexible conference structures, with groups, individuals, computer sources and video sources to be used simultaneously.

Satellite Ground Terminal
The satellite ground terminal is operated by RAL's Advanced Communications Unit. In the past it has mainly been used to access European Communications Satellites (ECS) satellites. It is a Ku-band station with a manually steered 3-metre dish. The terminal can be used to access satellites giving European coverage or satellites providing transatlantic links.

The terminal operates in the 12-13/14 GHz frequency range. It has a solid-state transmitter amplifier. Transmission is digital with bit rates up to 8 Mbps possible. Transmissions may be continuous or burst mode (for packet transmission).

For more information on RAL Support Services contact:
Terry Mawby Tel: 01235 445787
Rutherford Appleton Laboratory, Fax: 01235 445147
Chilton, Didcot, E-mail: tpm@inf.rl.ac.uk
Oxon, OX11 OQX.

For more information on RAL Videoconferencing contact:
Chris Osland Tel: 01235 445733
Atlas Video Facility, 01235 446565 (message)
Atlas Centre, Fax: 01235 446626
Rutherford Appleton Laboratory E-mail: Chris.Osland@rl.ac.uk

For more information on the RAL Satellite Ground Terminal contact:

Prof. John Burren
Advanced Communications Unit
Rutherford Appleton Laboratory
Chilton, DIDCOT
Oxon, OX11 OQX

Tel: 01235 446671
Fax: 01235 445753
E-mail: John.Burren@rl.ac.uk

BBC

Digital broadcasting facilities

The BBC is the national public service broadcaster in the UK. It operates two national television networks and five national radio networks. It not only makes and schedules programmes, but also runs a network of point-to-point contribution links and broadcasting transmitters. Through its Research and Development Department the BBC keeps in the forefront of technology.

The BBC is collaborating with other broadcasters in Europe to look at the possibility of digital audio broadcasting (DAB) by satellite. It is considering starting a pilot digital terrestrial broadcasting service in London towards the end of 1995, with a view to offering a public service in 1997. A limited satellite DAB service is expected to be provided in mid-1995 using an Inmarsat satellite.

Optical fibre transmission

The BBC expects to be able to offer access to digital highways or unequipped optical fibres between some of its studio centres in London and elsewhere in the UK forming parts of its contribution and primary distribution networks. Digital highways will use the synchronous digital hierarchy (SDH) of ITU Recommendations G.707, 708, 709 operating at the STM-16 rate of 2.48 Gbit/s on single-mode optical fibre.

R&D TV and HDTV production facilities

The BBC R&D Department at Kingswood Warren (30 km south of the centre of London) has a small studio and recording suite equipped for TV and HDTV production and post-production. These facilities are suitable for the production of short test sequences and demonstrations.

The TV studio is equipped with 1250-line HDTV cameras and 625-line cameras, lighting and some scenery. 625-line and HDTV signals can be recorded on professional quality digital recorders. Post-production facilities include editing and captioning. Programme output is normally on tape, but satellite links can sometimes be set up with advance notice for live events.

For more information contact:

Andrew Oliphant
BBC Research & Development Department,
Kingswood Warren, Tadworth,
Surrey, KT20 6NP.

Tel: 0737 836657
Fax: 0737 836665
E-mail: andrew.oliphant@rd.eng.bbc.co.uk

Sony Broadcast & Professional - Viewing Facilities
Sony Broadcast and Professional is a major supplier of broadcast equipment throughout Europe. It houses a large, well established, R&D facility which is developing new ideas and techniques for use by the broadcast industry and professional video users. With that aim, the facility uses a network of computers and video equipment to allow complex image processing to be explored and the results displayed as well as developing high performance gate arrays to the latest available specifications.

The viewing facility is capable of showing standard and high definition pictures recorded on a number of formats to be displayed on a 4 metre screen. The facility allows up to 24 people to be seated in a small cinema-like environment.

For more information contact:
Mr J Wilkinson
Sony Broadcast & Professional,
Jays Close, Basingstoke,
Hants, RG22 4SB.
Tel: 0256 483330
Fax: 0256 810950
E-mail: jhw@adv.sbc.sony.co.jp

University of Plymouth
For advice on satellite services:

Ray Winders
University of Plymouth,
The Hoe Centre, Notte Street,
Plymouth, Devon, PL1 2AR.
Tel: 0752 233635/9
Fax: 0752 233638

Cambridge University
For advice on the use of echo cancellers:

David Hurworth
Technical Manager, Audio Visual Aids,
Cambridge University,
Cambridge.
Tel: 0223 334392

University College London - Multimedia Support and Communications Centre
Connection to:

- ISDN (128 Kbps and 384 Kbps)
- SuperJANET ATM Video network
- Satellite

Dr D. G. Jameson (Gordon)
Audio Visual Centre,
Windeyer Building, Cleveland Street,
London W1P 6DB.
Tel: 0171 380 9320
Fax: 0171 580 0995
E-mail: g.jameson@ucl.ac.uk

Alternative contacts:
Mr Nick Leach
E-mail: n.leach@ucl.ac.uk

Mr Piers O'Hanlo
E-mail: piers@cs.ucl.ac.uk

University of Edinburgh

Graeme Wood
Computing Services,
The University of Edinburgh,
James Clerk Maxwell Building,
Mayfield Road,
Edinburgh, EH9 3JZ.

Tel: 0131 650 5003
Fax: 0131 650 6552
E-mail: Graeme.Wood@ucs.ed.ac.uk

Part of the: Scottish MICE National Support Centre For multimedia conferencing support:
E-mail: mice-nsc-scotland@ed.ac.uk
WWW http://mice.ed.ac.uk/mice/

Loughborough University of Technology

For enquiries about the MBONE:

Jon Knight
Department of Computer Studies
Loughborough University of Technology,
Loughborough,
Leicestershire, LE11 3TU.

Tel: 01509 228225
Fax: 01509 211586
E-mail: J.P.Knight@lut.ac.uk

Martin Hamilton
Department of Computer Studies
Loughborough University of Technology,
Loughborough,
Leicestershire, LE11 3TU.

Tel: 01509 222799
Fax: 01509 265393
E-mail: martin@mrrl.lut.ac.uk

University of Manchester Computing Centre

Janusz Lukasiak
University of Manchester Computing Centre,
Oxford Road,
Manchester, M13 9PL.

Tel: 0161 275 6007
Fax: 0161 275 6040
E-mail: J.Lukasiak@mcc.ac.uk

University of Liverpool

Dr. J. S. Morgan (Steve
Computing Services Department,
The University of Liverpool,
P.O. Box 147,
Liverpool, L69 3BX.

Tel: 051-794-3746
051-794-3719 (for messages)
Fax: 051-794-3759
E-mail: J.S.Morgan @ UK.AC.LIVERPOOL

University of York

Leon Watts
HCI Group,
Department of Psychology,
University of York,
York, YO1 5DD.

Tel: 01904 433186
Fax: 01904 433181
E-mail: law4@tower.york.ac.uk
WWW: http://www.york.ac.uk/~law4

Motion Media Technology Limited

Stephen Maudsley
Motion Media Technology Limited,
Horton Hall, Horton Hill, Horton,
Bristol, BS17 6QN.

Tel: 01454 329115 (Direct)
01454 313444 (Switchboard)
Fax: 01454 313678
E-mail: stevem@mmtech.co.uk
or: market@mmtech.co.uk

SuperJANET Sites and Service Access

SITE	***ACCESS METHOD***	***SuperJANET SERVICES***
Aberdeen University	SMDS	IP network
Aston University	MAN (2x34 Mbps)	IP network
Bath University	SMDS	IP network
Birmingham University	PDS/SDH, SMDS	IP, ATM and video networks
Bradford University	SMDS	IP network
Bristol University	SMDS	IP network
British Library Doc. Supply Centre	SMDS	IP network
Brunel University	SMDS	IP network
Cambridge University	PDH/SDH, SMDS	IP, ATM and video networks
Cardiff University	PDH/SDH, SMDS	IP, ATM and video networks
Cranfield University	SMDS	IP network
Daresbury Laboratory	PDH/SDH, SMDS	IP, ATM and video networks
Dundee University	SMDS	IP network
Durham University	SMDS	IP network
East Anglia	MAN (1x8 Mbps)	IP network
Edinburgh University	PDH/SDH, SMDS	IP, ATM and video networks
Essex University	SMDS	IP network
Exeter University	SMDS	IP network
Glasgow University	PDH/SDH, SMDS	IP, ATM and video networks
Heriot-Watt University	SMDS	IP network
Hertfordshire University	SMDS	IP network
Imperial college	PDH/SDH, SMDS	IP, ATM and video networks
Kent University	SMDS	IP network
Kings College London	SMDS	IP network
Lancaster University	SMDS	IP network
Leeds University	PDH/SDH, SMDS	IP, ATM and video networks
Leicester University	SMDS	IP network
Liverpool University	SMDS	IP network
Loughborough University	SMDS	IP network
London School of Economics	MAN (1x34 Mbps)	IP network
Manchester University	PDH/SDH, SMDS	IP, ATM and video networks
Manchester Metropolitan University	SMDS	IP network
Newcastle University	PDH/SDH, SMDS	IP, ATM and video networks
Nottingham University	PDH/SDH, SMDS	IP, ATM and video networks
Nottingham Trent University	MAN	IP network
Oxford University	SMDS	IP network
Oxford Brookes University	SMDS	IP network
Plymouth University	SMDS	IP network
Queen Mary and Westfield College	SMDS	IP network
Queen's University Belfast	PDH/SDH	IP, ATM and video networks
Reading University	SMDS	IP network

Royal Postgraduate Medical School	MAN(Dark fibre)	IP network
Rutherford Appleton Laboratory	PDH/SDH, SMDS	IP, ATM and video networks
Sheffield University	SMDS	IP network
Sheffield Hallam University	SMDS	IP network
Southampton University	SMDS	IP network
St Andrews University	SMDS	IP network
Staffordshire University	SMDS	IP network
Stirling University	SMDS	IP network
Strathclyde University	MAN (1x34 Mbps)	IP network
Surrey University	SMDS	IP network
Sussex University	SMDS	IP network
Swansea University	SMDS	IP network
Teesside University	SMDS	IP network
ULCC	MAN, SMDS	IP network
Ulster University	4xSMDS	IP network
UMIST	MAN (Dark fibre)	IP network
University College London	PDH/SDH,SMDS	IP, ATM and video networks
Warwick University	SMDS	IP network

Appendix 5: Questionnaire

Below is a copy of the questionnaire which formed the basis of the survey described in Chapter 3

N.B. The format of the questionnaire has been changed to save space (extra lines removed etc.) but the content remains the same.

Job Title:

Main field of interest:

What equipment do you use for videoconferencing? (Please give details of the make, model, hardware and software, etc., if
known.)

Where is it situated? (e.g. In your office, in a videoconferencing room, etc.)

Who installed your equipment?

Retailer
Manufacturer
Local expert
Yourself

Was the installation procedure acceptable to you? Please explain.

Who supports your equipment? (Where would you go if it went wrong?)

How do you rate this support?

Excellent
Good
Adequate
Poor

Please explain your rating.

Which uses do you have for this equipment?

Personal communication
Presentations
Education
Research
Collaborative work
No use yet
Other

Is this what you anticipated? Please explain.

If you use videoconferencing equipment for personal communications then...

What added value does videoconferencing give you?

To whom do you talk?

What are the destinations for the majority of your video calls?

What topics do you usually discuss using a video medium?

What is the limit to the number of individual parties in a call?

How important is the video link in your videotelephony calls?

Have you found your videoconferencing equipment to be useful? (If not, why not?)

What associated facilities do you have to accompany your videotelephony? (e.g. document sharing, file transfer, etc.)

If you use videoconferencing equipment for presentations (i.e. providing information but not specifically for higher education purposes) then...

Do you receive or send presentations?

If you send presentations, who is the recipient?

If you receive presentations, who sends them?

What is the typical content of a presentation?

Apart from the video, what other media are used in the presentations?

Who pays for the presentations and the communication time?

Do the presentations incorporate pre-recorded material? If so, in what form?

If you use videoconferencing equipment for educational purposes then...

Which subjects are taught in this way?

Is the teaching conducted?

one to one
one to distributed individuals
one to a group
one to distributed groups
other...

Does your configuration allow?

two-way audio and video
two-way audio, one-way video
one-way audio, two-way video
one-way audio, one-way video
other...

How many sessions constitute one typical course?

How are questions from students dealt with (e.g. pre-written, asked "live", etc.)?

How is coursework, if any, dealt with?

What additional media are used (e.g. video, graphics, blackboard, etc.)?

Do lectures incorporate any pre-recorded material? Please explain.

If you use videoconferencing equipment for collaborative work then...

With whom is the work conducted?

What type of work is carried out?

Do you have any associated tools for use with the video communication (e.g. shared files, whiteboard facilities, etc.)?

If you use videoconferencing equipment for research purposes then...

What is your field of research?

How do you use your videocommunications?

If you do not yet use your videoconferencing equipment then...

What will you be using it for?

When will you start to use it? Please explain.

If you have any other use for videoconferencing technology...

What do you use it for (e.g. remote surveillance, watching TV, etc.)?

For all current uses.....

What is the distance capability of your videoconferencing equipment (e.g. local area, wide area, etc.)?

Do you find that the video medium provides value for money?

How often do you use your equipment?

How long is a typical call (presentation/ conversation/ lecture)?

Are you happy with your overall set up? (e.g. What extra facilities would you like to see incorporated? Are there things you cannot
do which you would like to be able to do?)

Which facilities do you find to be superfluous for your purposes? Please explain.

Would you recommend what you have to others? Why?

How are the running/capital costs funded?

From your experiences, is there any advice you would give somebody who was considering the use of videoconferencing
technology?

Potential uses for the future

How do you expect to be using videoconferencing technology in 1 year/5 years from now?

What are the limitations in your existing equipment that prevent you from using it in this way at the moment?

Are you considering the purchase of any related equipment? If so, what?

Please add any other comments or feelings about videoconferencing equipment and technology that you do not feel have been
covered in the questionnaire.