

Video Streaming

a guide for educational development

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JISC

Video Streaming: a guide for educational development

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Click and Go Video

Video Streaming
a guide for educational development

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1.

An introduction

The rise of video streaming

The creation and use of digital web-based video is now open to non-specialist educators and even learners themselves. It has the potential of becoming a routine component of online education and e-learning. Although conventional (analogue) film and video have a long history in tertiary education, their widespread use was always limited by production costs and delivery difficulties. However production costs have now fallen with the emergence of high-quality, easy-to-use cameras and desktop video editing software aimed at the domestic market. Delivery has similarly been revolutionised by the growth of the web as an educational medium together with the rapid uptake of web-based video streaming technologies.

Streaming was pioneered by the RealNetworks company and now has competing versions from Microsoft, Apple and others. It is simply a method of making video, audio and other multimedia available relatively quickly via the Internet. Multimedia has been used on the web by educators almost since its inception, however earlier web-based formats took a long time to download (and used up considerable disk space on the viewer's computer). The advantage of streaming is that it can enable easier and more responsive on-demand access to multimedia resources. Perhaps even more exciting is the possibility of integrating video and audio with other web-based resources, for example communication and quiz tools. With streaming, video and audio become transformed from a method of delivering information to a focus of student and group activity.

How does video streaming work?

In order to play smoothly, video data needs to be available continuously and in the proper sequence without interruption. Until fairly recently, video had to be downloaded in its entirety to the computer before it could be played. With streaming, the file remains on the server. The initial part is copied to a buffer on the computer and then, after a short delay, starts to play and continues as the rest of the file is being pulled down. Streaming provides a steady method of delivery controlled by interaction between the computer and the server. The server regulates the stream according to network congestion and thereby optimises the presentation on the student's computer.

Educational possibilities and problems

From a learning and teaching perspective, the challenge for academics is how to use these new technologies in ways that are pedagogically appropriate and sensitive to their students' needs and the learning context. The choices with video streaming are intrinsically different from those of earlier video technologies. The main choice for developers at the moment is the crucial compromise between image quality and accessibility to remote users. On internal university and college networks and for users with *broadband* (high speed) connections, high quality full motion video can be delivered effectively, albeit usually in a small window. In these circumstances video streaming can fulfil at least the same role as conventional video tapes, the advantage of course being in distribution and flexibility. However when users, for example distance learning students, are connected via a modem – still by far the



most common means of access to online courses – the quality of the video image can be eroded. When network traffic is heavy, the already-small image may become jerky or fuzzy and sometimes freezes up completely, although the audio track is usually fairly reliable.

Does this mean, as some argue, that video streaming has no place in higher education, at least until all our remote students acquire broadband Internet access? An increasing number of academics are beginning to reject this view. They point to the ubiquity of streaming media on the web, particularly on entertainment and news sites, the increasing uptake of broadband as connection charges tumble, even the use of CD-ROMs to deliver streaming format resources to students with low speed access. However, perhaps the most fundamental issue these academics raise is the value of the moving image itself in education.

In contrast to the technological advances, research into the pedagogic uses and value of web video has lagged behind. Although the literature on educational uses of standard video (i.e. broadcast television and video tapes) may provide clues, as we suggest above, the nature of the video has itself changed as it cannot now be treated as a medium in isolation (Asensio, Strom, Young, 2001).

The JISC Click and Go Video Project (2000 – 2002)

The principles of this Guide are derived from the Click and Go Video Project, funded by JISC (Joint Information Systems Committee) under its Information Environment (IE) Programme. The project was originally set up under the JISC Distributed National Electronic Resource (DNER) 5/99 Learning and Teaching Development Programme from 2000 to 2002. The project set out to investigate the information, instructional material and framework required to enable the pedagogically sound use of moving image archives within a video-enriched learning environment. This included the integration of archived moving images, locally produced video and web resources together with asynchronous and synchronous communications tools. The project focused on the local technological, infrastructural and pedagogical barriers that inhibit the use of streaming media in teaching and learning. A particular element was to identify practical and resource-efficient strategies by making use of freely available streaming technologies that could automate the capturing, archiving and playback of streaming media.

The Click and Go Video Project philosophy

Streaming technology is maturing at a rapid rate but awareness, support and resources in institutions are falling behind. Before we can reach a critical mass of users engaged in building and exchange of media learning objects, there are still considerable barriers to be overcome with local technological implementation issues as well as in terms of gaining infrastructural and political acceptance. From a learning and teaching perspective, the challenge for educators is to progress to where they can think more about the pedagogic value of streaming delivery and less about controlling the technology. We need to get beyond the early adopters to the point where non-specialist educators can use and apply the technology themselves, as easily and as creatively as say Microsoft PowerPoint. Overcoming time and cost barriers will be crucial to a rapid take-up. Above all, the need is to provide an engaging and compelling learning environment to meet the rising expectations of learners and to demonstrate that streaming media can act as an enhancement rather than simply an embellishment of current teaching environments.

Project partners

Click and Go Video was a co-operative undertaking between four departments consisting of the Department of Information Systems at UMIST, Manchester Computing at the University of Manchester, the Learning and Teaching Unit at the Manchester Metropolitan University

and the Department of Management Learning at Lancaster University. The project also involved three case study departments: The Department of Textiles at UMIST, Manchester Royal Infirmary linked with the University of Manchester, and the Hospitality and Tourism Management Department at the Manchester Metropolitan University.

Learning from case studies

Through three case studies, the project has been able to identify different models for the adoption of streaming video in learning and teaching, reflecting the importance of image, interactivity and integration. The application of video streaming and building of content within each of these case studies was undertaken by departmental staff themselves, working with assistance and guidance from the project team.

The Click and Go Video information resource

An extensive period of investigation of streaming video technology, implementation and educational benefits was undertaken in parallel to the case studies. This has resulted in a rich set of information resources to provide help and guidance for academic and support staff and to stimulate and enhance understanding of video streaming production, delivery and pedagogy. The Click and Go Video web site (www.clickandgovideo.ac.uk) provides a *one stop shop* information point on video streaming practice and pitfalls. It has become a focal point to share examples of good practice including demonstration material with video streamed examples, guidelines and checklists to advise staff about implementation issues and to how to overcome practical difficulties. The site also incorporates an active discussion list addressing issues of pedagogy as well as implementation.

Building an educational community

Another of the main outputs of the project has been its highly successful workshop programme attracting a range of participants (UK and beyond) from academic, learning support and media support groups with a spread of awareness and expertise in using video. Initial workshops were aimed at a broad introductory coverage coupled with practical opportunities that evaluated examples of streaming video. (A virtual workshop made up of key instructional presentations is accessible through the web site.) The final workshop in July 2002 *Video Streaming: a new pedagogic approach* provided a highly inspiring and engaging exchange of ideas on the educational and community uses of video in learning and teaching. It demonstrated that institutions are eagerly looking for help and guidance in this particularly sparse area. Again the presentation videos from this workshop along with the results of the breakout sessions are all available on the web site.

Why have we produced this guide?

“Video, among other new technologies, offers education a challenge to rethink much of its methods and content, helping to tilt the balance away from teacher-centred instruction towards learner-centred study” Moss (1983:12).

As the project team reflected on our (not always successful) experiences through the case studies and discussed the issues with video streaming practitioners in workshops and at conferences, we realised we wanted to capture some of the current enthusiasm, practice and understanding. We are confident that streaming video is indeed within the reach of the average tertiary education teacher, that it can produce good educational outcomes and that it has the potential to underpin some of the wider changes educators often hope for. Goals may include richer and deeper learning, support for different learning styles, more *realistic* experiences, better access, more student-centred approaches and so on. However, we are also aware that this is not the first time enthusiasts have praised the potential of the moving image. There were peaks of passion in the fifties (educational film), sixties (educational television), seventies

(video tapes), eighties (interactive media), nineties (web-based media) and now (streaming media). Twenty years ago Moss felt that the challenge of video was “*part of a tide [for change] that is strong enough whether or not educators wish to reform*”. As we have seen right across the field of computer and media supported learning, educators actually have proved surprisingly resistant to *reform*, and video has actually made much less impact than, for example, the web.

We believe that one of the underlying problems is a lack of *literacy* to understand visual media as an educational resource. Students need an understanding of video as a *learning* medium rather than entertainment. Academics need to identify where video is appropriate for the learning event and design meaningful video-based learning experiences. Even subject disciplines ultimately may have to “*debate their representational practice*” (Deveraux and Hillman, 1995:3). Mixed up in this debate is a relentless advance in the video technology itself and as the technology (inevitably) improves, the parameters of the discussion themselves begin to change.

When we came to write this Guide we realised that this was the reason for academics being wary of video. It is not the difficulty of using the technology, or even of designing the learning materials and learning activities associated with them, but rather the tangled interplay between the various technical, pedagogical and infrastructure questions. This Guide is therefore simply an attempt to cut a rough path through the streaming video jungle. We hope you will be able to make the journey with us. We are sure that the goal is achievable and worthwhile.

The structure of the guide

The development of video streaming usually follows a logical sequence, starting with a consideration of the educational needs and completing with the delivery of the resource to students and an evaluation of learning outcomes. One of the interesting features of streaming video mentioned above however, is the compromise between image quality and deliverability over low speed connections. Therefore, the development cycle is often less a linear path and more like a *conversation* between educational objectives and technological possibilities and limits. For ease of use however, the Guide is presented as a linear sequence of stages:

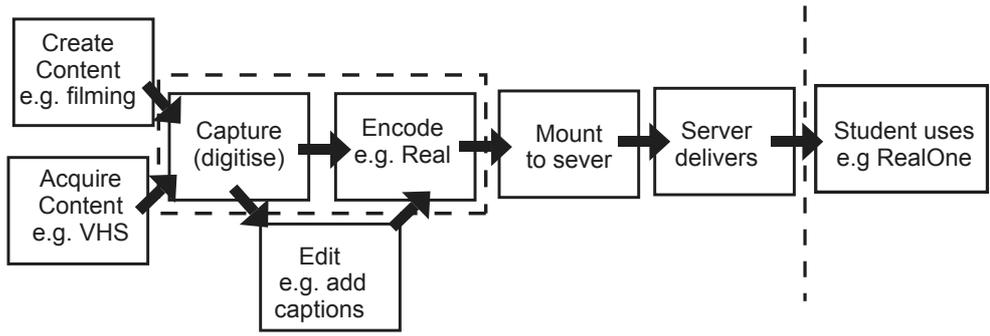


Fig 1.1 The streaming media development process

You will note, of course that in the Guide the discussion of pedagogical potential comes at the very beginning, and we make no excuses for that! ‘*Pedagogy comes first*’ is the rallying call of many educational developers. While this is not always quite true, technology – and we believe video streaming is a prime example – can enable new teaching and learning possibilities and broaden our repertoire of approaches, pedagogy should be uppermost in

our thoughts at all times. We have tried to capture and make explicit some of the fascinating pedagogical / technological conversation in the Decision Tool (see Section 3). Newcomers might want to try the Decision Tool first or read through the other Guide sections to acquire an overview of the subject before using it. We have also included a Section on the evaluation of streaming media. After all there is no point using all this technology unless we can find out if the students have actually learned anything from it!

Remember that the Guide works best alongside the Click and Go Video companion website *www.ClickandGoVideo.ac.uk* where you will find resources, links, examples and additional information we were unable to fit into this publication.

Clive Young and Jim Strom

2.

A learning and teaching perspective

From the magic lantern to video streaming

As the old cliché has it, ‘*an image is worth a thousand words*’. Moving images add authenticity and reality to the learning context, and can bring the course content *alive*. The moving image has long been a feature of education, from the earliest magic lanterns over a century ago to the latest web streaming technologies. Over the course of a century we have seen a succession of moving image technologies, film, television, videotapes, videodisks, digital desktop video, multimedia, CD-ROM, interactive TV and now web-based media. All were primarily developed for the entertainment sector then later found a place in education. The obvious feature all have in common is the ability to show the moving image to students. From the late eighties to the mid nineties however, the selling point for videotapes, videodisks, digital desktop video, multimedia, CD-ROM became the promise of *interactivity*. The *image* was still important, but was now overlaid with the idea that the user could have easier and more controllable access to the resource. In the mid nineties, the web reinforced further the ideas of accessibility and interactivity, but added a new element, *integration*. This referred to interlinking with other web materials including communication and collaborative tools. This changing emphasis on the *value* of video is partly a case of educators seeing a new technical opportunity, but as we will see later, also highlights the influence of prevalent pedagogical theory in interpreting, sometimes reinventing tools developed for other purposes.

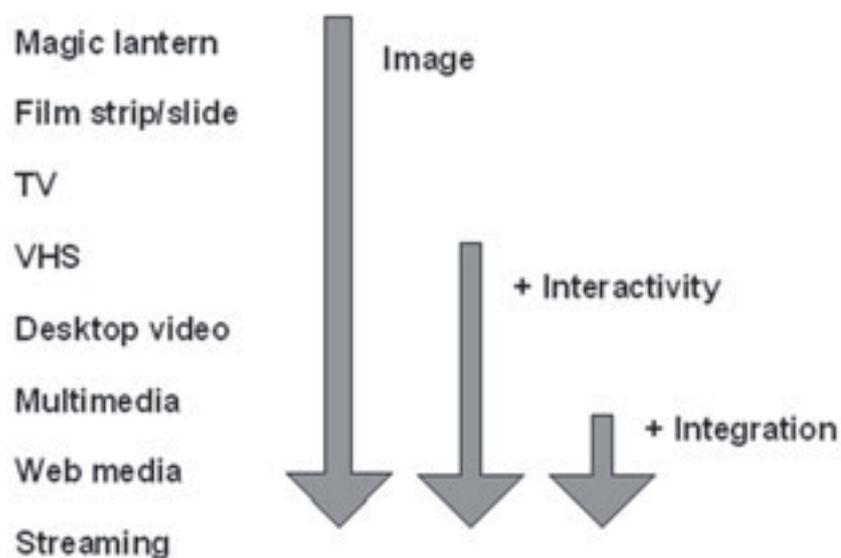


Fig 2.1 Features of moving image technologies

Young and Asensio (2002) describe this interplay of *image*, *interactivity* and *integration* as the Three 'I's Framework. As we shall see later in this Section, the Framework provides a useful methodology to analyse historical research ranging over many of the moving image technologies. It also provides a means of *unpacking* current practice and (see Section 3) underpins a Decision Tool to help develop and design educational resources using streaming video. We will start by examining each element of the Three 'I's Framework in turn.

The value of the image

As Jacques (1997) notes, images are a source of knowledge, persuasion and pleasure every bit as powerful as the written word. Duchastel and Waller (1979) observed that even static images when supplementing text attract attention, aid retention and recall and are explicative when verbal forms are not enough. Several researchers have made the connection between visual clues, the memory process and the recall of new knowledge (e.g. Shepard and Cooper, 1982, Mayer and Gallini, 1990). Even half a century ago, it was realised that the moving image, which at that time was mainly film, had a powerful contribution to make to education. In a pioneering study, Hoban (1951) conducted a meta-study of research on the pedagogic value of film going as far back as 1918. He found that the use of moving images could help the students to improve retention of concepts, facilitate thinking and problem solving and that it could be in some cases as good as an instructor in communicating facts or demonstrating procedures. The way in which sound and image can complement each other has also been well researched and is discussed later.

Moss (1983) remarks that video is different from other learning technologies, as it offers the advantage of using the sense of vision "*that powerful but neglected sense*" in new ways. A moving image can help the student to visualise a process or see how something works, moves or performs. It provides access to external worldviews, different forms of visual knowledge that can be archived and used for future generations. Goodyear and Steeples (1998) note that video can provide vivid descriptions to articulate tacit information and knowledge difficult to describe through text. Dale (1954) believed the moving image could balance the "*over-verbalisation*" he saw as endemic in education. Moss captures the radical mood often expressed by proponents of the moving image. He felt that "*video, among other new technologies, offers education a challenge to rethink much of its methods and content, helping to tilt the balance away from teacher-centred instruction towards learner-centred study*" (1983:12). Video indeed "*may offer inspiration to a minority because its ability to represent and stimulate ideas not readily expressed in written form*" (1983: 12). This could include what we would now term '*lifelong learners*' (e.g. working, retired, returning to study and work) and "*open up scholarship to wider, more dispersed and very different students that we have experienced before*" (1983: 110). Visually rich resources might perhaps bring more access, control and choice to the learning materials.

It is not only the visible explicit meaning of the moving image themselves that are important. Academic developers often refer to the motivational aspects of video; it seems to have an emotional resonance to the senses. Hempe (1999) refers to the strengths of video as visual demonstration, dramatisation, presenting visual evidence and making an *emotional* appeal. Images always carry hidden or semi-hidden messages such as narrative, emotion, authority, authenticity and symbolism. These may be more important and engaging than the explicit visual message itself. This is particularly relevant in video streaming, as one of the main concerns by academic developers is that of compromised visual quality. Does the value or quality-related message of a fuzzy, jerky image interfere with the educational message intended? Orton (2001) cites studies by Byron Reeves and Clifford Nass of Stanford University that even a slight mismatch between the audio and video tracks (a common problem in streaming) caused viewers to consider the material to be significantly "*less interesting, less pleasant, less influential*". The response of the Click and Go Video Project was not to retreat to this minimalist approach but to think about the appropriateness of the image for

'A picture is worth a thousand words - a video is worth more'
(practitioner)

'With video we can separate out the different skills components. We can break down what it is, a continuous process'
(practitioner)

the educational message it is carrying. Orton's reservations aside, a *talking head* supporting a slide presentation or a filmed interview, where the message is expertise and enthusiasm may not require the same level of quality and streaming may be quite appropriate. The same applies for other uses of video where the level of interaction and the activities associated with the video, may be far more important than the quality of the image itself.

The value of interaction

Given the educational potential of the moving image, it is not surprising that film and television had an impact on education, with some universities even building production studios. However, as Rosenberg puts it, "...the main reason why television did not become everyone's teacher was because it lacked the very essential quality of teaching: the ability to interact with the learner..."(2001:22). Thus, the advent of interactive video in the early eighties was met with some enthusiasm. "*The potential application of interactive video technology in educational and training fields is virtually unlimited.*", concluded a contemporary report sponsored by the UK Department of Industry (Duke, 1983:104). The key to interactivity was the linking of computers to video technology, initially video cassette recorders (VCRs) and videodisks, allowing control over the pace and direction of the video programme. This control enabled self-paced learning leading, according to Palmer (1987), not only to time saving and standardised results, but also distributed learning to a large numbers of students. *Interactivity* in the original sense was not confined to computer-human transactions but included:

- Access – availability of the material asynchronously and independent of location
- Choice – a library of materials to view *on-demand*
- Control – ability to start, stop, pause, skip and review material

Even with primitive early interactive video systems there was educational potential for searchable random access to previously linear video resources with facilities to freeze frame, forward and reverse and recognise multiple audio tracks. The materials could support more user-centred and independent modes of study. Some systems also allowed branching from decision points or tests along paths laid down when the programme was designed (Parsloe, 1985). In a series of meta-analyses of educational outcomes, Fletcher (1990) noted that interactive videodisk-based instruction fared much better overall than the computer-based instruction in the well-known study by Kulik and Kulik (1987). It was not until the early nineties that the combination of desktop digital video and CD-ROM enabled the high levels of control and integration with other computer-based learning materials we are familiar with today.

The rise of the web in the late nineties promised even greater access and choice but there was a price to pay. With video streaming, unlike earlier web multimedia, the user does not have to wait to download a large file before seeing the video or hearing the sound. Instead, the media is sent in a continuous stream and is played as it arrives. However, to do this, the images have to be compressed, leading to loss of image quality. Moreover, for most web users, the streaming video is limited to the data rates of the connection (for example, up to 56Kbps over a normal telephone line, on an average home modem) and the amount of other data traffic on the network. The result is that the video image, and in severe cases the soundtrack, can be seriously degraded. Most of these problems disappear if the user is on a local network (e.g. on campus) or has a broadband (high speed) connection. Nevertheless, one of the principal justifications of streaming media is its use in asynchronous, distance modes. Ironically the nature of the web as a distribution medium at the moment is also digital video's main limiting factor. This does not invalidate the use of streaming media in these circumstances, but means that the competing educational values of image and

'I went back to the beginning of a segment because I wanted to listen to it again. I skipped back and then carried on watching' (student)

'Some parts I actually watched several times...it was useful. It was very interactive' (student)

interactivity have to be carefully balanced.

The value of integration

Nelson rightly said in 1987 that “*the trouble with interactive media is that they all tend to be closed – objects that can’t be combined or viewed together (Whereas books can quote each other and lie open at once on the same desk).*” (1987: DM67). Although video can be used on its own, on the web it can be interlinked with slides, supporting texts, discussion boards, chat, resource links, self assessment quizzes and so on to form or as part of a **virtual learning environment**. This brings the possibility of designing novel learning experiences and ways of interacting with the media. The underlying assumption is that adding an additional *channel* of communication will increase the quality of communication itself. This notion is based on two theories that predate the web but support the use of several communication channels.

Multi-channel communication supporters claim that learning is effective when *cues* presented across channels are related or redundant (not in the negative sense but complementary or parallel). Thus Severin (1967) argues that multiple-channel communication is effective, but only when the cues have meaning. Thus when the stimuli for one channel provide reinforcement for the other, the quality of communication is improved (Hsia, 1971). The *dual code theory* also supports the effectiveness of multiple-channel communication, although the original work was concerned with the effects of audio plus video. Paivio (1971, 1991) argues that information that is supported by both aural and visual cues should increase recall and retention. In support of the audio and visual relationship, Mayer and Anderson (1991) have also shown that visual information helps to process and remember verbal information and vice versa.

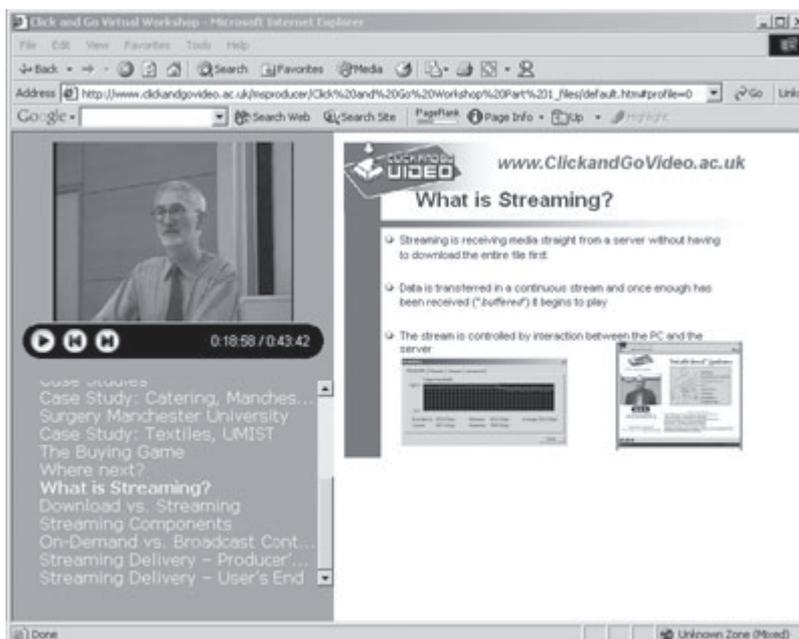


Figure 2.2 An example of video used alongside slides

With the opportunity of combining video with other interactive elements such as communication and assessment tools, learning environments can today be far richer than the multiple channel theorists could imagine thirty years ago. The impact of these new combinations of video and networked applications has still to be explored and evaluated. However, the studies describing multi-channel communication with traditional video may provide us with valuable clues. We know we have to at least ensure that the educational messages from the various components of the web environment are complementary and mutually supporting.

JISC defines the principal components of a **virtual learning environment** (VLE) as:

- support of online learning, including access to learning resources, assessment and guidance

- mapping of the curriculum into elements that can be assessed and recorded.

- tracking of student activity and achievement against these elements.

- online tutor support.

- peer group support.

- general communications, including email, group discussion and web access.

- links to other systems, both in-house and externally.” www.jisc.ac.uk

The pedagogic shifts

Film and video are often associated with a classic *instructional* or *transmission* pedagogic approach, though even writers from the fifties such as Hoban and Dale did not see the teacher as the only source of knowledge. Hoban (1951) even suggested that appropriate video material could be as good as the teacher in communicating facts or demonstrating procedures. In other words, the learning of facts or concepts is not dealt primarily by the teacher transmitting information, but as a result of the interaction between the student and the moving image. However, his approach to teaching is still reminiscent of the transmission model, in that the teacher still has control and choice over the resources and over the time and place for the learning to take place.

The rise of video cassette recorders in the late seventies that so inspired Moss, followed by digital *desktop* technologies that emerged in the late eighties and early nineties both enabled and were interpreted within more constructivism paradigms then gaining currency. Wetzal *et al* (1994) felt that “*the effectiveness of interactive video was related to its being a form of computer-based instruction*” and that this effectiveness in turn was explicable in terms of “*the greater interactivity and individualisation afforded by the variable control of pace and course of instruction, an active participation in advancement*” (1994:204). The constructivism approach claims that people construct their own understanding of the world, by generating their own individual *mental models* through experience. Interactivity, is therefore a key element within constructivism, in that control, choice and access over the learning resources and experiences enable the learner to actively construct her/his worldview.



Fig.2.3 example of a lecturer delivering information

This trend has become more pronounced with the emergence of video streaming in the late nineties. The current pedagogical challenge for educators using this medium seems to move beyond the mere instructional/transmission model, or even the commonly well-supported constructivism view, to encompass the collaborative, situated and conversational modes. The argument is that interactivity with the learning materials might not be sufficient to provoke a *meaningful* learning experience. Kearsley and Shneiderman (1998), referring to the concept of *engagement*, argue that students should be “*meaningfully engaged in learning activities through interaction with others and worthwhile tasks*”. Here the quality of interaction and engagement between the teacher, the students and the learning resources, is arguably more important to the learning experience than *interactivity* as perceived as an isolated individual cognitive process.

Engagement as described by Kearsley and Shneiderman clearly embodies a more social form of learning, in which the control over the learning resources is distributed and shared among the *learning community*. The ability to combine digital video seamlessly with other tools over the web offers an opportunity to move our concept from video as a purely presentational and instructional tool to video as a focus for student activity, collaboration and communication. Thus we can summarise these pedagogic shifts within the Three ‘I’s Framework in Table 2.1.

[Video] encouraged me to use the Internet and computers more’ (student)

Value	Technology	Locus of control	Pedagogic perspective
Image	Film, television, videotapes	Teacher	Transmission model
Image + interactivity	Videodisks, digital desktop video, multimedia, CD-ROM	Student	Constructivism model
Image + interactivity + integration	Web and streaming media	Distributed	Collaboration, contextualisation, community

Table 2.1 The Three 'I's Framework and underlying pedagogical perspectives

What do practitioners believe is the educational value of video?

The Click and Go Video Project was interested to know if there was any connection between the Three 'I's Framework approach to history and theory with the educational value of video as perceived by the participants of our workshops, dissemination events and website. About 100 current and potential users were asked to write down the different "values" they thought video had in education. These values suggested that the three categories of image, interactivity and integration indeed had a resonance in the way individuals conceptualised their current or planned use of video. Table 2.2 overleaf illustrates a selection of the thoughts expressed by the participants. We were surprised to find these divided fairly naturally into each of the Three 'I's values i.e. all of the values expressed could be mapped against one or more of the categories *image*, *interactivity* or *integration*.

If, as we suggest, ideas of *image* have been current longer than those of *interactivity* or *integration* we might expect participants to produce more responses relating to the value of image. Indeed in our ad hoc survey image-related responses outnumbered integration-related responses two to one, with interactivity somewhere in between.

Using the Three 'I's Framework as a practical tool

We believe, and this was supported by our survey described above, that academics often have very good ideas for educational use of video streaming, but often are not aware of the technical choices available to them, the issues around implementation and the feasibility of those ideas to create meaningful learning events for a specific student target. The pedagogical challenge faced by teaching staff and practitioners is the task of unpacking video to design learning events that are both educationally meaningful and feasible with the technical constraints of current streaming technologies. One problem is that the ability to combine digital video seamlessly with other tools, adds to the challenge of the academic developer.

As an analytical tool, the Three 'I's Framework image, interactivity and integration is intended to help teaching staff and practitioners with some of these decisions. It seeks to provide a way of unravelling the often complex ideas academics have for using video and provide a route to help the design and development of the resources themselves. The principles of the framework have been tested mainly on our experience with the work on the three distinctive case studies of the project: the Department of Textiles at UMIST, the Hospitality and Tourism Management Department at Manchester Metropolitan University and Manchester Royal Infirmary linked with the University of Manchester.

Image	Interactivity	Integration
Video is more appealing	Student ideally has control	Allows for dynamic presentations
Allows me to work outside the classroom	Students can re-wind, replay in their own time and at their own speed	Adds value to text
People take in more information when it is presented visually compared with text and voice alone	Ability to repeat / pause	Support for teaching and learning, not instead of
Able to see technical experts / examples / demonstrations	Can learn anywhere, anytime	Mix of media for students studying at a distance
Looks nice - may encourage those lazier users	Can select what is of use	To widen participants and address different learning styles
It grabs attention, it is new	To provide the personal <i>chemistry</i> between lectures and students that are remote	Video can work alongside lectures and compliment the students' module
A good way to get students ideas across without the need for writing	Students can view in confidence	Being able to split video into parts and relate to exercises
It adds to the entertainment value	Greater audience numbers can be reached	Integrating with web resources
Pictures can quickly give information whereas words can take longer	Greater access to learning for disabled students	Student support and feedback
Illustrate how theories/techniques can be applied in real life	Provides interactive teaching environment	Feedback to staff, etc.

Table 2.2 Examples of the 'value' of video in education as expressed by Click and Go Video workshop participants

Essentially the Three 'I's framework can be used as a way of linking what you want to do educationally with the practical utility of the technology to deliver those educational values. A way to start is to unravel what you think is the educational value of video itself, or in other words, your educational focus for using video. This can be illustrated by an analysis of the three case studies of the Click and Go Video Project. Clearly, each example has elements of all the three values we described earlier, but each emphasises one more than the other.



Fig.2.4 Hospitality video

- Hospitality** In this case, the lecturer wished to use video to introduce kitchen and cooking techniques. The resource was used on campus prior and subsequent to a practical session. The lecturer was concerned that the video should be able to capture the subtle colour changes that occur during cooking. From the perspective of the framework, we can see that the important aspect here was the *image*. Interactivity was less crucial, though the students could refer to the archive later. There was some integration with other online resources, particularly recipes, but again these are of secondary importance. The lecturer therefore concentrated on the production of the image, with much emphasis on high quality filming and lighting. The consequence is that the material was much less suitable for off-campus delivery.

- **Medical** Here the lecturer wished to produce a set of archive lectures, including slides, self-assessment quizzes and video content. The focus here was on the on-demand access to the resources, rather than the video image of the lecturer himself. The lecturer expected the students to be able to retrieve the archive video both on and off campus. Much of this case study focused on ensuring that students could *interact* successfully with the material.
- **Textiles** Video in this case aimed to support a Microsoft Excel-based simulation of retail buying that involved group work and negotiation skills. The lecturer wished to use the current classroom format simulation with remote students. Again, the video image quality was of much less consequence, as it only had to convey the enthusiasm and authenticity of the lecturer rather than carrying any significant detailed message itself. The key here was the *integration* of the video with Microsoft Excel and conferencing.

In these cases the Three ‘I’s framework enables us to determine the educational value of each of the streaming video elements. The importance of this is that it should help developers to make technical decisions.

Ideas for using video streaming with your students

Video can capture a subject, an object, a place or a process. The educational value that we give to video will be embodied in the use that we make of it with our students. Although the use of video for capturing live events, such as lectures, is probably the most widely used technique at the moment, the pedagogic strength of video is largely unrealised. The categories of use described in Table 2.3 are some examples of how streaming video is being used in universities and colleges. Goodyear and Steeples (1998) have already provided a typology of the different ways of representation of practitioner practice through video. Our categorisation of uses is more generic in scope and involves the videoing of subjects as well as places and objects. We have however, built on their criteria of uses that range from videoing a scripted/structured event to a more spontaneous/unstructured approach to video.

Each use of video that we describe points to some suggested educational benefits for the student. However in reality, these will largely depend on how video is actually embedded within the overall learning design of a specific course or programme. Educational video is not a type of incidental learning, the learning still needs to be organised as part of an externally guided, deliberate learning experience (Bates, 1984). You also need to consider that students have to be encouraged to take a positive view of video materials. Students are usually familiar only with passive forms of viewing television, and might expect to be merely entertained. It is essential therefore, that students are introduced to the benefits of educational video gradually, and encouraged to regard video as another valuable learning resource. One way of opening their eyes to the different potentials of video, and in supporting them in discovering new ones, is to actively involve the students in the video production process itself.

The control over planning, shooting and editing of video, does not need to be necessarily the task of the lecturer or practitioner. Students themselves can become involved in the actual process of planning and learning design, storyboarding, shooting, editing and encoding. Students can become more engaged and motivated with the subject matter, working collectively to share ideas and understanding. This is what is often called *participatory video* in which the students themselves can also take control of their own learning by becoming producers and reflecting on the effect of filming, on the subjects’ behaviour, and their own attitudes towards being filmed. Working with a camera can make students’ experiences more visible and accountable (Grimshaw, 2001); they can discover that video offers scope for more visually rich and imaginative forms of self-expression.



Fig.2.5 Medical video



Fig.2.6 Textiles video

'Apart from touch and smell. [Video] is the nearest we can get to being there' (practitioner)

As Moss rightly said: *“an enthusiastic mind can adopt to the challenge of an unfamiliar yet attractive mode of study”* (1983: 28) and we should add as well to *“unfamiliar yet attractive”* modes of teaching. As we have seen the pedagogic opportunities for video streaming are vast. However, as Moss remarked *“the rich colours of video’s roles in new patterns of distance learning have yet to be imagined, let alone brought into play”* (1983: 113). The following Sections in the guide aim to help the education developer to bring video into play, by providing advice to successfully design and implement video streaming learning events.



Fig.2.7 Students watching a streamed video together in a classroom

Mireia Asensio and Clive Young

	Description	Educational benefits
Talking head	The subject speaks to the audience or the camera. It is generally used for lecturing, or to provide a presentation or an overview. Video can give access to expert knowledge, for example, by bringing a virtual guest speaker into the classroom. This provides the opportunity to archive presentations to be retrieved on-demand.	Students can watch the presentations several times and use them for study revision. They can gain access to knowledge and insights from external speakers.
Events	Here the intention is to capture on video educational events such as a seminar, a workshop, or a conference for example to be archived as education and information resources.	These series of events, usually of restricted access, could be disseminated to the wider community of teaching staff, practitioners, students, researchers and to non academic audiences. Disseminating and sharing in this way would represent a step forward to the provision of a more inclusive form of education for all.
Instructional	This technique is used to show the process of doing something concrete, the procedures, the different stages. It is also used as a demonstration method to show experts and apprentices in practice.	Students can visualise an expert in practice performing a task difficult to describe or difficult to get access to. This can potentially support a situated approach to learning, where the students can benefit from observation without being there.
Simulation	Here the intention is to simulate an event such as a lab experiment where safety might be potentially at risk, or to engage in a role playing situation where the students can experiment with different roles and behaviours.	Students can watch a simulation of a lab experiment where lack of resources or time might be an issue. Equally by watching and analysing a simulation of a variety of role behaviours, students can gain greater retrospective insight on the issues at stake.
Think aloud	Here the subject is filmed as they engage describing their thoughts or actions. The subject can be on their own doing a video diary or can be prompted by the camera person for example as in the case of an interview.	This is an appropriate technique to capture the subject's reflection on the practice or experience and to transform an implicit and tacit action into explicit verbalisation. Students can express their reactions to the video, and discuss the experience as observers and interpreters.
Fly on the wall	In this type of use the camera is set up to capture an event in situ, an spontaneous event without script. This could include a group of students working together brainstorming ideas or engaging in decision-making.	This technique can be useful to observe and analyse an example of group dynamics in action. Video can help students to observe, analyse their own behaviour and prompt them to engage with the issues.
Real life	The purpose here is to capture an action that cannot be physically brought into the classroom. This might apply to any type of outdoor scene, a field trip, dance or linguistic samples.	Real life events can be observed, interpreted and discussed. Access to external knowledge and experience, can provide opportunities for knowledge transfer and for example increase awareness of cultural difference among distributed learning communities.



Fig 2.8.1 Talking head



Fig 2.8.2 Events



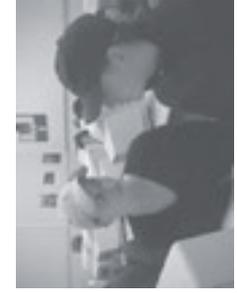
Fig 2.8.3 Instructional



Fig 2.8.4 Simulation



2.8.5 Think aloud



2.8.6 Fly on the wall



2.8.7 Real life

Table 2.3 Common uses of streaming video in education

3.

The Click and Go Video Decision Tool

Introduction

The development of streaming media resources for your students is undoubtedly rewarding. However, it is essential to have a clear pedagogic rationale for what you are trying to achieve. In addition, technical and implementation issues should also be considered at an early stage. As the various aspects of streaming media are sometimes confusing, we wanted to create a simple tool in order to help you make some key decisions that would ensure that your venture into streaming media was as risk-free and enjoyable as possible. *The Click and Go Video Decision Tool* has several stages. In *Stage 1*, you should make a clear educational proposal. Not only is this vital to an efficient development and design process but it will help communication with colleagues and technical/audiovisual staff. In *Stage 2*, a quiz asks you to think about your learning and teaching purpose in more depth. This will assist you to identify your Three 'I's educational focus. In *Stage 3*, we have a checklist to assist with some of the most frequent technical and implementation issues. *Stage 4* compares these with your Three 'I's educational focus. Finally in *Stage 5*, you are able to adjust your original educational proposal to take into account the issues raised from the previous stages. This should provide a sound foundation for your video project. We suggest you try to answer the questions in all four Stages. Some of the technical questions may be difficult to answer on your own, therefore we advise you to complete Appendix 1 to find out the responses from your institution, before you start substantial development work.

Stage 1. What is your educational purpose of streaming media?

Please answer the following four questions in the spaces provided:

1.1 Why do you want to use video as a medium?

1.2 What learning outcome(s) do you want to achieve using video?

1.3 Who is your audience?

1.4 Why do you want to stream video on the web (rather than on CD for example)?

1.5 After considering your answers, it is useful to bring your ideas together. We suggest writing a short proposal covering the main points you have considered.

Example: I intend to film a series of laboratory experiments for module E521. These will be linked directly to self-assessment quizzes and lecture notes within our virtual learning environment, WebCT. Students will use these to help integrate lab and lecture material and for revision purposes. I expect the student to watch the video as many times as needed before completing a self-assessment quiz. The quiz results will motivate the students to review the lecture notes.

Stage 2. The Three 'I's educational focus quiz

From the list below tick the statements that are closest to your ideal learning and teaching purpose. When you have finished, compare your ticked statements with their score and identify your main Three 'I's educational focus.

1. Students will have access to a web-based library of short video clips
2. Clips will be closely linked to web resources, background readings, etc.
3. Video will mainly be used to promote discussion, i.e. linked to a chat or discussion board
4. Colour definition in the video is very important (e.g. fine arts, textiles, catering)
5. Resources must be accessible via the web at any time
6. Video will be delivered within a virtual learning environment (e.g. Blackboard, WebCT, etc.)
7. Detailed 'screencams' (moving screenshots) will be provided to demonstrate software
8. Images need to convey high levels of detail (e.g. micrographs, X-rays)
9. Video resources can be browsed with facilities to start, stop, rewind, pause, etc.
10. Video clips will be linked to quizzes
11. Video needs to capture fine movements (e.g. dissections)
12. Material must be accessible from students' homes via a modem

Scores: 1 B, 2 C, 3 C, 4 A, 5 B, 6 C, 7 A, 8 A, 9 B, 10 C, 11 A, 12 B

If you scored a majority of As your focus is on **'Image'**

If you scored a majority of Bs your focus is on **'Interaction'**

If you scored a majority of Cs your focus is on **'Integration'**

If your scores are equal, please read all the focus areas that apply.

Image

It is important to you that the video captures colour, shape and texture as close as possible to the real thing. This will involve the production of detailed storyboard, a high quality camera, appropriate lighting and careful compression. Technical support might be needed and the detailed demonstration might require that the leading expert is intimately involved in the production stage. This type of video can be linked to other media tools and even integrated within a virtual learning environment. However, lower speed connections might compromise students' access from outside the campus, making high quality images not particularly appropriate for off-campus students. This might be a problem if the video is used to support collaborative learning or as a focus for online communication among distributed learners.

Interaction

On-demand access to the video resources is more important to you than high quality video. The focus here is the provision of user control and non-restricted access to a library of images, thus image quality can be compromised. It is expected that the students will be able to retrieve the archive of video resources both on and off campus. The level of interactivity built into the stream needs to be in accordance with the access bandwidth available to the students. Different streaming rates and/or interactive features may need to be provided depending on access limitations. One of the barriers to this is the local network infrastructure and its relationship with the outside world (firewalls, dial-in access, etc).

Integration

You find it important to link the video to other media and course tools. Video in this case is meant to be part of a wider learning environment, possibly embedded within your university's virtual learning environment or to support face-to-face lectures. The video image quality, though it might be important, is not essential to support student learning. Basic interactivity and easy access to the video is beneficial to the student but the main focus is that the video is well integrated with other networked media. The time taken to integrate different media into a production will vary according to the degree of integration sophistication and the resources available.

Stage 3. Technical and implementation issues

Now that you have decided what you would like to achieve educationally with your students it is time to check that it is feasible with your resources. From the list below, tick the statements that are closest to your situation. When you have finished, compare the issues raised in the ticked statements with the issues associated with your particular Three 'I's educational focus in Stage 4.

1. Some of my students will be accessing the videos from home.

Students at home will most likely have a slow Internet connection speed, which limits you to providing low quality video and audio. However, students using their own computer should have free access to install and maintain any software or hardware you require (e.g. media players, sound).

2. Some of my students will be accessing the videos on campus computers.

On-campus students will most likely have a fast connection speed, which allows higher quality video and audio. However, students have no control over the software or hardware (e.g. players, sound) on the machines and cannot install new features that you may require. You will need to know what software and hardware are on these campus computers or arrange for the appropriate software to be installed.

3. Some of my students will be accessing the videos from work.

Large companies will most likely have a fast connection speed, which allows you to provide higher quality video and audio. However, the students may not have administrative control over the software or hardware on the machines and cannot install new features that you may require (e.g. players, sound). Large companies are also more likely to have a *firewall* in place which blocks access to data such as videos. Your students will need to consult with the company's firewall administrator to get permission and configure the player's connection accordingly (e.g. using a proxy server).

4. My students have a diverse range of connection speeds.

RealNetworks and Windows Media offer technology that automatically detects the users' Internet connection speed and changes the delivered video quality to suit this. Alternatively, you may offer a choice of links to videos designed for different connection speeds but these take more time to create.

5. I am unsure which media player to choose.

The media player(s) you choose to deliver your video affects almost every stage of your media creation as they are not interchangeable (e.g. Windows Media does not play RealMedia). It is essential to choose your format early on to save you time and effort. The easiest way to choose is to find out which player your students use and examine whether this suits your institution. See Section 9 for other issues that may affect your decision. If you offer a choice of videos created for different media players, beware of the additional time involved.

6. All my students use the same Internet browser.

This rare situation means that the media you have created needs only to work in this browser. Once you have created your media and hyperlink, test that the link works in this browser.

7. My students use a variety of Internet browsers.

Some browsers need additional work to view certain media types (e.g. Netscape Navigator needs a plug-in to view Windows Media and a *Ramgen* pointer to view RealMedia). See Section 11 for more details. You should always test your media in as many browsers as possible.

8. Some of my students might not be able to hear sound.

Not everyone can automatically hear your video. The computer may not have a soundcard installed or there may be other problems that take time to rectify. Alternatively, a student might be deaf or hard of hearing. In these cases, you may wish to think of an alternative to the audio track such as a text transcript.

9. My video will be broadcast live.

Broadcasting your event live via the Internet rather than delivering the video on-demand at a later time has synchronous communication advantages. However, there is a greater risk of delivery failure if you do not plan well or have good equipment. It is worth considering your objectives and assessing whether an on-demand video will achieve these instead. For more information, see Section 13.

10. I do not have access to a server that can 'stream'.

Steaming videos do not normally run from the same server as your website. You will need to have access to a streaming server with your desired media format software on it (e.g. RealSystem Server, Windows Media Server). Your institution may have a streaming server you can use. Alternatively, you may buy one or hire space on one. See Section 10 for more details.

11. I intend for more than 10 students to watch the video simultaneously.

If your students are all watching a video at once (e.g. live or at a designated time) you need to be aware of the server and network issues this demand creates. Free versions of streaming server software may limit the number of simultaneous viewers (e.g. RealNetworks' free Helix Server has a maximum of ten viewers at once). This demand may also be too much for your institution's network, resulting in poor delivery speeds and quality. You should find out your maximum number of simultaneous users beforehand.

12. I do not have a camera, lights or a microphone.

These are the essential pieces of equipment for shooting a video (see Section 5). If you do not have the budget to purchase them, you may be able to borrow the equipment from an audiovisual department at your institution.

13. I do not have the equipment to turn the video on a camera into streaming video on the web.

You will need a reasonable quality computer with a capture card (see Section 6). Once you have this you will need software that captures the video from your camera, edits it and converts it into a streaming format. You can find free versions of nearly all this software. This Guide takes you through each of these stages. If you do not have the budget or the time for this process, your institution may have audiovisual support to help you or you may take it to an external media company.

14. I have one or more students with a disability.

The new Special Educational Needs and Disability Act (SENDA, 2001) amends the Disability Discrimination Act (1995) to include higher education. It means educators must make "*reasonable adjustments to prevent disabled students being placed at a substantial disadvantage*". This includes rich media such as streaming video. Videos should offer substitutes for the visuals (usually audio descriptions) or the audio (usually text-based transcripts).

15. I am a busy person.

Planning, shooting, editing and encoding videos can consume a good deal of time. You will need to free up time regularly to produce videos. A time saving method is to plan carefully and also to delegate tasks to support staff.

Appendix 1 is a more detailed technical and implementation survey, which we strongly recommend you to take away and fill in whilst you are still at the planning stage of the creation process.

Please continue overleaf to Stage 4 where you compare the issues raised above with your particular Three 'I's educational focus.

Stage 4. Comparing practical and educational requirements

This Stage will assist you to redefine your original proposal. To help you, we have summarised below some of the critical issues associated with each of the Three 'I's educational focus. Consider these issues in light of your original proposal in Stage 1 and the technical and implementation requirements ticked in Stage 3. This should give you a clearer picture of what is currently possible and highlight questions to be resolved. Each statement will direct you to the relevant sections in the Guide for advice.

Image

- High bandwidth needed (see Section 10)
- Good subject lighting (see Section 5)
- Subject filmed with video audience in mind (see Section 5)
- Microphones for audio (see Section 5)
- Quality capture card (see Section 6)
- Access to a good quality camera and tripod (see Section 5)
- Editing software (see Section 8)
- High quality encoding using the most suitable format for student access (see Section 9)
- Large window size to view detail (see Section 9)
- Producing high quality images may be time consuming (see Section 4)
- Audiovisual support (within your institution or out-sourced) can help but it may take extra time and/or money (see Section 4)
- Accessible alternatives to the visuals should be offered e.g. text, narrative (see Section 8)

Interaction

- Offer links to as many videos encoded for different connection speeds as possible (see Section 9)
- Offer as many media formats as possible, e.g. RealMedia, Windows Media (see Section 9)
- You will need access to all the development tools and resources (see Section 4)
- Building the additional tools will take additional time (see Section 4)
- Your institution may offer support for building these additional tools and resources (see Section 4)
- You should decide whether you will use technical assistance or to do it alone (see Section 11)
- You may need permission before you can use the other resources e.g. copyright (see Section 12)
- Good subject lighting (see Section 5)
- Accessible alternatives to the visual and audio should be offered e.g. text, narrative (see Section 8)

Integration

- Consider offering a variety of videos encoded for different connection speeds e.g. 56K, LAN (see Section 9)
- Alternatively, produce a single multi-bit rate stream covering a range of bandwidths (see Section 9)
- You will need access to technical skills to integrating other tools with video (see Section 4)
- Choose whether the integration of different media is to be done as an integral part of part of the editing or using a synchronisation tool e.g. SMIL, Microsoft Producer for PowerPoint 2002 (see Section 7)
- Consider what level of control you wish the student to have. Note a higher level of control such as *bookmarked hyperlinks* will require a faster connection (see Section 11)
- Accessible alternatives to the visual and audio should be offered e.g. text, narrative (see Section 8)

Please continue to the final Stage 5.

Stage 5. Revised proposal

After considering the practical issues raised in Stages 2, 3 and 4, you might want to amend or/and expand your original education proposal including this time as many details as possible.

Revised proposal example: I intend to film and edit a series of laboratory experiments for module E521 using the camera from the Audiovisual Department. I wish to learn how to edit myself and then ask Audiovisual to convert the films into a high quality image in a Windows Media streaming format. They will host the videos on their streaming server. I will ask the technical assistant how to link these films directly to self-assessment quizzes and lecture notes within our virtual learning environment, WebCT.

Students will use these videos to help integrate lab and lecture material and for revision purposes. I expect the student to watch the video as many times as needed before completing a self-assessment quiz. The quiz results will motivate the students to review the lecture notes. The students will need to use a campus computer lab or a networked study room which have high speed access and Windows Media players installed but they will have to bring their own headphones. However, I would like to see if this method could be used for distance students viewing from home. I will also try a series of still pictures, to see if it works as well. I am pretty sure one of my colleagues has used RealMedia video in WebCT, so there is a streaming server on campus and RealMedia players in the computer labs. I already know how to do the quizzes, but I am new to filming and editing so will need to free up some time to learn how to use the camera and software.

By now you should have determined what you would like to do with streaming media and you should have at least an overview of what is possible. The next stage is to find out in more detail how to go about the actual process of designing a learning event and creating your resources. The following chapters of the Guide will provide all you need to get started.

Sally Thornhill, Mireia Asensio, Clive Young, Jim Strom

4.

Planning your content

In Section 3, we introduced the Decision Tool to help you define your video educational project after considering the different technical and implementation issues. After you have established how you wish to use video, it is time to start planning what video material you will need and, if you require new content, what you will actually shoot.

In this Section we will focus on planning and shooting new video resources. If you have existing video you wish to use, for example on VHS tape, many of the suggestions regarding narrative, clips and storyboarding will still apply. Bear in mind though that what works in a sequential VHS format may be less effective as a digital web resource. The usual trick is to divide longer sequences into short sections of no more than a few minutes, then present the clips in a sequential menu. This makes it easier for web users to find the section they are looking for without having to fast-forward through long streams.

The planning stage is particularly important and you should expect to take at least as much time planning as shooting and producing. Note that filming or reusing existing video is not the only way of acquiring streaming resources. In Section 7 we will look at alternatives.

Narrative

Like conventional film and television, video streaming is all about telling stories, often described as *narrative*. Much of the planning stage involves making sure you capture all the visual components required to tell your story or, in educational terms, to help your students achieve the expected learning outcomes. You will need to film a number of **shots**. These can be edited together to form your narrative. In conventional film and television, editing is a very important and challenging task. A single sequential narrative displayed on a single screen has to engage and sustain the interest of the viewer over an extended time period. Moreover, from years of watching television and film, the audience has a very sophisticated *language* of relating and interpreting shots and edits. Viewers tend to associate and relate shots in a sequence. For example if we see a shot of a dog standing outside looking upwards followed immediately by a shot of a tree filmed from below, we make the connection that the dog is looking at the tree, even though the dog and the tree are not shown together.

What is special about streaming?

So how is video streaming different? Most importantly, unlike conventional film, the moving images are often displayed and used with other web resources such as web pages, slides, quizzes and discussion; all of which may both independently engage and inform the viewer but also work together to enhance the viewer's experience. Secondly, in digital media there is less emphasis on sequential narrative. Although shots are often edited together in narrative sequences or *clips*, streaming clips tend to be short, lasting a few minutes at most. This is partly due to the short attention spans of viewers when looking at computer screens. Brevity also helps usability and navigation; the student is expected to interact with the material e.g. browse, jump to any section, fast forward, pause, etc. This is why longer video sequences (i.e. over five minutes) are usually divided into smaller units. We have to think, therefore,

A **shot** is a continuous piece of film taken by one camera from one perspective.



Fig 4.1 A shot of a kitchen

of each short clip potentially being viewed in isolation and possibly in a different order than that intended by the author. There is also a pragmatic reason for relying on short clips. Even the most experienced video performers regularly fluff their lines and have to start shooting again! Keeping the sequence short speeds up filming and editing. This brings us to the practicalities of shooting video for streaming.

Scripts and storyboards

Planning for video can be compressed into two simple questions:

- What do you want to say? You may need a *script*.
- What do you want to show? You may need a *storyboard*.

Scripts

In education, even in a primarily visual medium such as video, the written and spoken word still tends to dominate and lecturers typically think it is important to “*get the words right*”. Text can be developed as a **script**. The process of writing a script will help to clarify the details of the shoot: who is involved, how long it might take, the likely location, supporting visuals and so on. Two other important reasons for having a good script are accessibility and bandwidth. Visually impaired people may not be able to see the visual images clearly (or indeed at all) and others may have a slow Internet connection speed where the video images are degraded although audio quality is usually maintained. In either case the audio track should be meaningful in itself or when supported by additional materials. Even if audio is not available or usable, a script can be used as the basis of a *text alternative*, which is the most common way of providing an accessible version of online media. From a developer’s point of view, scripts also give confidence to newcomers, although more experienced performers may prefer the spontaneity of improvisation. Scripts are ideal for audio-only situations but their disadvantage for video is trying to avoid obvious reading on-screen. This needs practice to look natural. Some situations do not need a script, for example: for *fly on the wall* sequences, an expert describing a familiar process or an interview. Shooting these one-off events, however, needs particular care and preparation, as they may be difficult to repeat. The camera has to be placed carefully and the subjects need to be aware of the limits of their movement so they do not stray off-screen. Interviews are a particularly simple and effective use of streaming. The viewer often clicks on a question from a list menu and sees how the expert answers it. Experts usually do not need scripts in this situation so their responses can be particularly relaxed and engaging.

Storyboard

As an aid to planning your production you may develop a **storyboard**. If the clip is to be used as part of an integrated learning environment, you may wish to make a note of what other components, graphics or interactions will make up the browser screen. If you are planning to do a lot of shooting in a single session, for example if you have borrowed a camera for a day, it may be worth also making up a shot list. This is a checklist of shots grouped in the easiest/quickest order for shooting (e.g. by location or participant), rather than the storyboard order in which they will eventually be displayed.

What shots do I need?

When deciding on which shots to use, go back to your objectives and think again about how and why the images will be used – you want to use as much material that you shoot as you can, so you will want to minimise wastage. The main issue is to show only what is essential to the learning process. Some questions you might want to consider for example are:



Fig 4.2 Reading a script to camera

A **script** is a detailed transcript including additional instructions and timings.

A **storyboard** is a sequence of text descriptions or sketches showing the layout of each shot.



Fig 4.3 A shot from a planned sequence

- What specific information or message do you want the shot to convey (stems from the educational objective)?
- How exactly will the shot help achieve this teaching purpose?
- Will it be of appropriate quality to convey the message? (See Section 3)
- Will the shot focus attention on the main message or is there distracting information?
- Does the shot give an idea of context (meaning, size, location, etc) of the subject or will this be given elsewhere?
- Does the shot have the proper amount of detail or is a close-up needed?
- How will the shot be related to other materials or activities?
- Will the shot convey the impression I want it to (i.e. are there any *hidden messages*)?

What about sequencing clips?

Some shots are likely to be sequenced together to form clips lasting from a few seconds to several minutes. You will want each clip to have its own narrative (remember they will be viewed individually). This brings us onto the traditional skills of video editing for linear storytelling. Although there are no strict rules it is advisable at least at the beginning to follow the *language* of editing mentioned below. The best way to learn is through experiment and by observing how television professionals film and edit material, particularly for educational programmes like documentaries and news shows.

Shooting video for streaming

How you actually shoot your subject depends on the subject and how you intend to use the video. After discussing a few general tips, this section mainly discusses a one presenter format, such as a lecturer in front of a class. The principle for shooting other scenes is much the same but the key to success is, as always, careful planning.



Fig 4.4 Lecturer presenting to a class

Here are a few general tips to consider

Composition: The classical way professionals achieve *balance* in a shot is by organising the components of a scene so that key elements, such as the horizon or the subject's eye line, fall along lines dividing the scene in thirds. This is why TV newsreaders and interviewees are usually shown off-centre. Also, vary as appropriate between *long* shots which are sometimes used to set the location or context, head-and-shoulders shots when people are talking and close-ups, e.g. of using lab equipment. Try using different camera angles and heights but avoid techniques that detract from the primary educational message. Remember that streaming images are quite small, so we may be looking at a video composition within a larger page composition. This may encourage you to use simpler shots.

Timing: Keep your shots as short as possible, really just long enough to convey the message comfortably. Avoid static shots of more than a few seconds. To convey a passage of time longer than the clip itself (e.g. the time taken to bake a cake), professionals use a trick called

cut-aways. They would show: the cake going into the oven, a general shot of the chef or the kitchen, then a shot of the cake coming out of the oven. If you are going to try this method, make sure you include some cut-aways on your shot list.

Movement: When subjects move, always maintain the same direction of movement from one shot in a sequence to the next.

User-orientation: When showing instructional clips, put the camera in the position of the student. Vary the closeness of the shots, e.g. head and shoulders, according to the detail required.

Preparing for filming

The Decision Tool in Section 3 takes you through the necessary stages to help you make the right choices. Before you begin filming you should be very clear about what your film intends to achieve. You must plan for the filming event as you may not have a second chance to capture the subject on film and if something goes wrong it can waste a great deal of time. Appendix 2 is a quick reference checklist for you to copy and take to every shoot.

Live broadcasts

If you are broadcasting the presentation live, detailed equipment and material preparation is critical. It is also useful, even for archived (*on-demand*) videos, that the presenter knows how the video will be used so that they can contextualise it e.g. by referring to the slides or other media that will be displayed alongside. Live broadcasts take a lot of planning to ensure nothing goes wrong. One essential stage is to advertise your event in advance so that you have an audience. You will also need to have all your material at hand in the compatible format to stream. There are a number of technical tests you will need to carry out to ensure you have a connection to stream from. On-demand video uses the same planning as a live broadcast but the recording can be edited afterwards should anything go wrong and you can often edit in additional material afterwards. Section 13 discusses the advantages, disadvantages and equipment needed for *live* broadcast.

Location

It is always useful to see the location and subject matter well in advance of the filming to familiarise yourself with the area, any extra equipment you may need, e.g. lighting, extension cables, and to allow yourself time to plan your shots in advance and experiment with different options.

Shooting the subject

Despite all the pre-production planning, the event to be filmed can be an unpredictable factor, especially if it is with a live audience. Remember that before you film anyone, you will need the subject to sign a consent form. Appendix 3 is a generic example of a release form that you may wish to use. This may be difficult to arrange if there is a large audience, so one option often adopted is to keep the cameras on the presenter(s) and explain to the audience that they will not be included in any shots.

Shooting for streaming

Shooting streaming video does not use the same techniques as mainstream (broadcast or video) filming. Due to bandwidth constraints, as described earlier, the films must be compressed for web delivery (see Section 9). People with lower bandwidths may see small video windows and a jerky picture. How do we reduce this problem? The following tips can be applied to most subject matter and aim to help you optimise filming for compression and

Depth of field is the range in a picture that appears to be in focus. It is controlled by the lens aperture (a hole which controls the amount of light that strikes the film). A smaller hole will produce a shorter depth of field.

web delivery. The majority of the tips are based on the notion that the streaming video and audio quality will be lower than that displayed on the camera screen. However, pre-existing material is unlikely to follow the tips we cover in this Section. Thus, whenever possible you should use film that has been produced with streaming media in mind, so that each shot is optimised for the best possible result once the film has been compressed.

Tips for shooting

Shooting for streaming is always a trade off between quality and speed of connection. The following tips are aimed at reducing the amount of work the encoder must do and so keeping the file small and the stream faster:

- Keep the camera still – use a tripod (or improvise) to steady the camera. fashionable handheld techniques do not work for streaming!
- Use as little panning, tilting and zooming as possible. Movement makes additional work for the encoder and so will slow the stream.
- Concentrate on the presenter and cut out as much unnecessary background as possible but be prepared in case they suddenly move out of shot.
- Use a short **depth of field** to blur the background. A small amount will mean only your subject is in focus. This can be achieved by standing far away and zooming in on your subject or opening up your aperture.
- Lighting from the front is usually recommended to reduce the number of shadows. However creative side lighting, often seen in TV interviews, can work well.
- Be very aware of the audio levels during recording. If you have access to a *mixer* you can correct sound levels and integrate multiple microphones as the audio is being recorded.

The presenter

A presentation with a live audience - It is always a good idea to find out what delivery style the presenter uses before you start to film so that you can set up your equipment suitably. Ideally, for streaming media, the presenter should stay still. However, if the presenter usually paces about, it can be hard for them to remember to stand still. *Physical* reminders can help the presenter remain static, for example placing them behind a podium, making them sit or to be very safe, block them in an area with furniture that does not appear in shot. If there is a slide projection, keep it out of shot as the light from the projection can affect the automatic exposure settings of the camera. Be careful if the presenter has a tendency to point at the slides. Once presented on-screen, they may point one direction when the slides are on the opposite side.

Whilst you are in situ, it is worth gathering the extra *cut away* material that can be slotted in your clip during the editing stage. Ideally you will have planned out your whole video in the pre-production storyboarding stage and know what other shots you are looking for e.g. shots of an attentive audience (if you have their permission!).

A studio presentation - A good alternative to a live audience presentation is filming directly to camera in a studio setting. As well as the advantages of better eye contact, the production benefits of this are that mistakes can be re-shot, lighting can be easier, audio is improved and the presenter is easier to control. Many lecturers, however, find it difficult to perform if their movement is restricted and there is no audience to prompt them. Like actors, academic presenters can also *dry-up* when facing a camera. Unlike actors, however, presenters are usually not practiced in the art of reading a script to camera. One way around this is the use of bullet points either printed or displayed on a monitor immediately under the camera lens. This allows the lecturer more flexibility in their delivery but note that it takes some practice and do not expect to get it right first time. We may never be TV stars but just an afternoon in

front of the camera experimenting with tone and presentation style then analysing the output can vastly improve both performance and confidence.

Tips for the presenter

- If you are wearing a suit do not have the same colour shirt and jacket e.g. black shirt and black jacket as they smudge into one. Wear different plain colours.
- Try not to wear patterns, e.g. stripes, checks and comedy ties. Detail adds to the file size and is often lost anyway. Over-bright colours such as whites, blues and yellows may flare and distort the image.
- Try not to move too much. If you are a natural pacer, perch on a desk, sit down, or confine yourself to the width of your podium. If you must move, stand still afterwards to allow time for the pixels to resolve.
- Stand in front of a plain background, not the projection (you may need to reposition the podium). If the background is *busy* with wall switches, fittings and the like, consider hanging a backdrop – a plain sheet of cloth will do.
- Try to keep eye contact with the camera. Obviously this is hard when presenting to a live audience but acknowledging the web audience as you would a member of the live audience will help keep their attention. Some presenters do a specific *shot to camera* to welcome the virtual audience.
- Rehearse your script several times beforehand. If you still feel unnatural, try using bullet points rather than a script. This will keep your eye contact more natural and your voice will have its normal emphasis.

You may already be making a mental list of the equipment you will need to film new content. To help you start recording streaming video, Section 5 is devoted to recording equipment.

Sally Thornhill and Clive Young



Fig 4.5 A presenter talking to the viewer

5.

What equipment do I need?

This Section will focus on equipment you may need to film new video material yourself as it is perhaps the most complex option. Other material, which may be derived from screen capture recording or from previously produced film in VHS, is discussed in Section 7.

When filming your own material for video streaming you will need access to a basic production kit. This comprises of:

- Video camera
- Tripod
- Microphone
- Lights
- Capture card (see Section 6)
- Computer (see Section 6)
- Encoding software (see Section 9)
- Streaming server (see Section 10)

The type of equipment you will need really depends on the subject you intend to film. For example, if your film focuses on the *Image* (see Section 3) you will need to have a better quality capture card, good lighting etc. Other factors that may influence the equipment you will use is your budget and your location. Most of these factors should have been uncovered when working through the Decision Tool in Section 3.

Video camera

When buying a video camera it is important to understand the different formats available and choose a format that is most suitable for your needs. The two main formats are **digital** and **analogue**. The following definitions of digital and analogue, as described by Adobe, should help ground you in the fundamental difference between them.

*“**Digital:** representations consist of values measured at discrete intervals. Digital clocks go from one value to the next without displaying all intermediate values. All data that a computer processes must be digital, encoded as a series of zeroes and ones. Digital representations are approximations of analogue events. They are useful because they are relatively easy to store and manipulate electronically.”* (www.Adobe.com)

*“**Analogue:** is continuous. For example, clocks with hands are analogue—the hands move continuously around the clock face. As the minute hand goes around, it not only touches the numbers 1 through 12, but also the infinite number of points in between.”* (www.Adobe.com)

Digital format

Digital Video (DV) cameras are usually more expensive than the analogue alternative but produce higher quality images. As the image data is directly stored in digital format there is very little lost whilst capturing the recording onto your computer from a DV camera. If the camera has a **FireWire** connector (Figure 5.1 on the left) you can capture even higher quality material as it remains digital throughout the capturing process (see Section 6).



Fig 5.1 A FireWire capture card in a PC

FireWire is an interface standard for PCs and Macintoshes that permits the direct transmission of digital video/audio between equipment such as a DV camcorder and a computer. It is also used to describe the cables and connectors using this standard. Also known as *IEEE 1394* and *i-Link* by Sony.

The four main digital formats that you need to be aware of are:

- **MiniDV** - This is the highest quality camera format available in the consumer market. The small sized, reasonably priced cameras can produce very professional looking output (upwards of £700).
- **Digital 8** - Digital 8 video cameras produce almost the same high quality as MiniDV cameras. The cameras are larger in size but usually cheaper. Digital 8 cameras play the same tapes as analogue Hi-8 and so provide a good method of upgrading from Hi-8 analogue format to digital. Many Digital 8 cameras also offer the FireWire connection capability of MiniDV.
- **MicroMV** - Sony have recently introduced their new MicroMV digital format which they claim produces comparable results to MiniDV in 70% smaller cassettes.
- **Web Cameras (Webcams)** - A cheap webcam (approximately £40) connected directly to a computer can be used to stream live events. The software supplied with the cameras can often also capture video for storage. The main reason to choose this camera format is the cost but the quality is quite low. Webcams typically connect through the computer's **USB** serial port making them convenient to use. Depending on your subject, a webcam can be good enough. Streaming always degrades the quality of the video image so, in fact, cheap cameras can work reasonably well. FireWire webcams are now available which offer a higher **frame rate**. However, if you intend to use streaming regularly it is worth investing in a digital video camera. This gives you more freedom and, unlike a webcam, the film is stored to a tape making it easier to reuse the video at a later date.

Analogue format

Analogue cameras, the traditional format, are cheaper and bigger than digital cameras but quality is always lost when the video is being converted to digital from analogue via the capturing process.

- **VHS-C and S-VHS-C** - These are the large VHS cassettes that can be used in a home video recorder. Consequently the cameras are quite bulky. Existing video material is often in this format. The newer Super-VHS (*S-VHS*) format uses the same cassettes with slightly higher quality. As the quality of the streaming video is often quite low, the VHS and S-VHS format will often be adequate. Remember though, the quality drops each time a VHS tape is copied.
- **Hi8 and Standard 8** - The Hi8 format is an enhanced version of the Standard 8 format. These use smaller cassettes than VHS and so are less bulky to carry but the tape is not as durable and therefore is more likely to become damaged.

Tripod

A tripod is essential to reduce movement from the camera and therefore reduce the amount of work the encoder has to do. When buying a tripod, try it for smooth panning (side to side motion) and tilting (up and down motion). Although it is not recommended to pan or tilt when producing video for streaming, if it becomes necessary it needs to be smooth. Tripods can be expensive but reasonably priced (£40) own brands can be found.



Fig 5.2 A Philips Vesta webcam

For more details on Sony's MicroMV visit: www.ita.sel.sony.com/micromv/

USB (Universal Serial Bus) is an interface between a computer and peripheral devices (such as cameras, joysticks, keyboards, telephones, and printers). Using USB, a device can be added to your computer without having to add an adapter card or even turn the computer off.

Frame rate: The number of still images (video frames) shown within a specified time period; often represented as FPS (frames per second).

In the UK, where PAL (Phase-Alternating Line) is the video standard, the frame rate is 25 frames per second. The US and Japan, amongst others, uses NTSC (National Television Standards Committee) at 29.97 frames per second.

Microphone

Nearly all cameras have built-in microphones, the better ones being directional and wind-proof (to reduce background noise). In relatively peaceful surroundings a built in microphone can be enough but an additional microphone might be better in public places or if your subject is at a distance. The choice of microphone can be complicated. As with many decisions it depends on the intended use. If you need more than one microphone, a mixer may be needed to combine two or more audio input channels into one channel. The usual choices of microphones are:

- On-camera microphone - many cameras have a slot (*hotshoe*) for larger microphones
- Shotgun microphone - microphone on an arm you carry
- Tie-clip microphone - can be transmitted by radio or direct to the camera
- Hand-held microphone - radio or connected.

If any external microphone approach is used, the camera will have to be fitted with an external microphone input socket. It is also useful to be able to attach headphones to the camera to monitor the audio levels. You should record audio at the best possible quality (16-bit audio) and, where possible, use voice-overs that have been recorded especially.

Lights

Although modern cameras are quite good at dealing with poor light, many streaming video productions can be much improved by careful lighting. What looks fine by the human eye, or even in the camera's LCD screen, can look dark on a monitor. Whilst post-production editing can improve this slightly, extra lighting is nearly always preferable. The lights you need depend on what you intend to shoot. Lights can be placed in the slot (*hotshoe*) on top of most cameras (but beware if you planned to have an additional microphone there). As the lights point directly at the subject being filmed, it is important not to over expose them with too much brightness. Alternatively stand-alone lights can be purchased for a more varied lighting for under £100. A light in front and to either side of the subject can balance brightness and reduce any shadows.

A **diffuser** softens the light to avoid harsh shadows and glaring bulbs.

Studio lighting brollies usually come in gold, silver or white. Each colour produces a different type of light, e.g. gold light is warm.

Shadows can have an aesthetic purpose but can make extra work for the encoder. If the light is too intense and creates harsh shadows a **diffuser** may be needed. This diffusion can be as simple as bouncing the light off a wall. Walls are not very portable though and so a lighting umbrella (**studio brolly**) may be needed. These umbrellas attach to the light stand and can either bounce the softer light back or the light can shine through them. Brollies are also useful to prevent the lights from being too blinding when pointing at the subject.

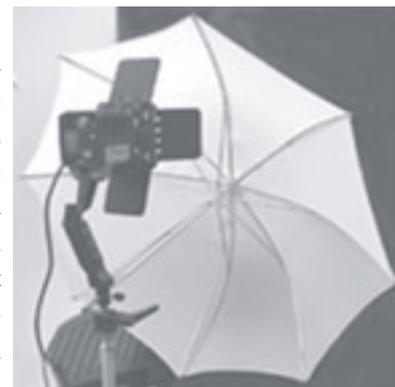


Fig 5.3 A studio light, stand and brolly

To learn more about capture cards and computers see Section 6. In Section 9 you will find useful information on software for encoding and Section 10 discusses the necessary streaming server requirements.

Sally Thornhill

6.

Capturing your video

The Process

This Guide is structured to follow the process you will go through when producing streaming video. This process is shown in the diagram below. After you have gathered all the material you wish to use, you will need to transfer it on to your computer. This is called **capturing**. Once the material is stored on your computer (*captured*) you can then manipulate it. The next stage is the editing process. This is the optional act of changing, shortening or merging video and/or audio clips to produce a preferred sequence. After you have your film sequence, you need to convert it into a suitable file format for streaming (such as .rm, .wm, .mov). This is known as **encoding** and will be covered in Section 9. Some software allows the capturing and encoding process to occur simultaneously and so capturing can also be confusingly referred to as encoding. After producing your streaming clip you need to place it on a *server* capable of streaming. We will talk more about servers in Section 10.

Capturing (also known as *digitising* and occasionally *encoding*) is the process of converting moving data from the source (e.g. camera) to a format on your computer. It can convert your analogue source (VHS, S-VHS) to digital or transfer digital information (MiniDV, Digital8) on your camera.

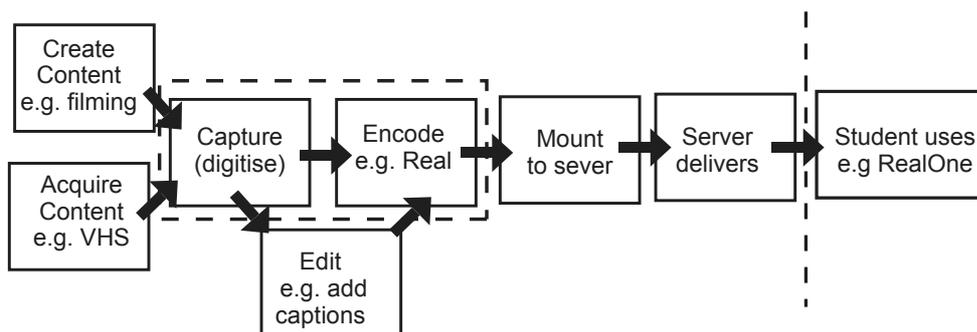


Figure 6.1 The media capture process

What computer hardware will you need?

As you get started in the streaming media creation process, you will need to make sure that your computer is powerful enough. Manipulating video demands a good processor and a lot of memory. It is recommended that you purchase the best hardware you can at the time. Analogue and digital capture have different requirements at the initial capture stage, but both will need the following for optimal quality:

- A high end PC (Intel or AMD processor) or Macintosh (G4/G5). The processor speed should be at least 1.2Ghz+ for the PC and 1Ghz+ for the Macintosh.
- At least 256MB RAM (512MB recommended).
- A large and fast hard disk drive, 80GBs+ is recommended, with a RPM (rotations per minute) of 7200+.
- A good quality graphics card also, with at least 32MB RAM. The graphics card can affect the quality you see on capture, for example some video cards do not support **video overlay** correctly and anything you capture will appear black on screen. Cards from ATI, Matrox or NVIDIA are popular.

1 hour of video equals approximately 12GigaBytes (GBs)

Video overlay is the placement of a full-motion video window on the display screen.

Archive means to capture for storage purposes and on-demand viewing.

Live means to capture and broadcast simultaneously.



Fig 6.2 MiniDV tapes

We suggest, always capture at the highest quality possible, as the results will be seen throughout all video streams.

www.pinnaclesys.com
www.viewcast.com
 These capture cards are also fully digital capable

Adobe Premiere is also covered in Section 8 – Editing

Rendering is outputting the final, edited version of a video to its final destination (file or external device).

The most vital part of the computer hardware will be the capture card itself, your choice of which will also vary depending on its primary use, either capture for **archive** or **live** broadcast.

Capturing from digital

When capturing video/audio from a digital device such as a MiniDV camcorder you will only need a FireWire capture card. These cards are inexpensive and readily available, nowadays coming as standard most PCs, and all Macintoshes. They allow a direct transfer of the video data to the computer without any loss of quality. A major benefit of this type of card is the ability on Windows 2000/XP or OSX to either capture video for archive or encode for a live broadcast. As both the source and the destination are digital, no conversion hardware is required and no quality loss is incurred. It is an inexpensive solution, which balances out against the higher cost of digital camera equipment.

Capturing from analogue

Analogue capture can work out more expensive. The process of converting an analogue source to digital requires more processing power than digital capture, although, this is offset by the final output quality. (Section 7 describes how to connect a VHS video recorder to a PC should you wish to convert an existing analogue VHS cassette to digital). If your main reason for capturing is to send the stream out immediately as, for example, a live broadcast to be watched by 56K modem users, then the input quality will not have a huge effect on the final output quality. Currently, popular choices for analogue capture cards are from Pinnacle Systems and Viewcast Corporation.

For archive-only capturing, products from Pinnacle are worth considering. Their range starts from low end TV capture cards up to very high end professional editing suite products. The mid-range capture card, currently the DV500 Plus, provides a good balance between cost, functionality and quality. In conjunction with the supplied Adobe Premiere, it allows full frame analogue video capture with very little, if any, loss of quality from the source. The card allows input and output connections over both composite and SVideo. This allows almost any analogue device to be attached. The DV500 Plus also has the ability to **render** a video out to an analogue device, such as a video cassette player, or to a digital device.

For live capture and broadcast, the Viewcast Corporations Osprey series performed well in testing (Live capture is discussed further in Section 13). The low-end Osprey 100, which is an analogue-only capture card, provides a reasonable quality capture at full frame if you have the processing power (1.3Ghz at least) and is very good value. It is also fully supported by streaming media applications such as RealNetworks' Producer and Windows Media Encoder. Again the mid-range product may be appropriate for the same reasons of cost versus efficiency. The Osprey 500 DV offers analogue and digital capture with hardware assisted encoding for Windows Media and RealMedia. The hardware assist greatly improves the output quality of a broadcast stream, bringing the video to broadcast quality over high speed network connections.

What software will I need?

Before you look at capture and encoding software itself, you need to make sure that your Operating System (OS) is up to the task. Video files, as mentioned, consume large amounts of hard drive space (about 200MB per minute of raw uncompressed AVI video).

For a PC based capturing system you will need an NT based operating system such as Windows XP or Windows.NET which will allow file sizes to reach Terabytes (TBs). Also their stability allows for a much faster and smoother working environment. Older systems, such as Microsoft Windows 95/98/ME, have a 4GB file limit. For video files, this would limit you to 18 minutes of full frame AVI capture.

Macintosh users will not experience this file limit problem. It is recommended however that you use at least OSX (10.x) or greater.

Capture software

There is a wide variety of cheap or free software available with the ability to capture. Also, many cameras include their own free capture software. Capture software usually has the ability to capture to AVI or MOV. These formats can then be converted to a streaming format using the target player's encoding software (see Section 9). Probably the most popular capture and editing software is Adobe Premiere. Available for PC and Macintosh, it allows Microsoft AVI or Apple MOV full frame capture and editing. Adobe Premiere's main strength for streaming media is its ability to save directly to any of the main streaming formats 'out of the box', such as Apple QuickTime, Windows Media, and RealMedia. Any other streaming **codec** can also be exported through the use of *plug-ins* which are distributed by the creator of the codec. This makes Premiere relatively future proof. Of course, product updates are released yearly. This and other products are covered in more depth in Section 8.



Fig 6.3 A screen capture of Adobe Premiere

NT – Microsoft New Technology Kernel

TB – 1024 GBs

Codec – COder / DECoder. A software device that allows a computer to either create or display a compressed media format.

Sally Thornhill and Paul White

7.

Alternatives to filming

This Guide mainly focuses on shooting new material for broadcasting on the web or streaming when the student demands it. This Section however, looks at the following alternative options you may choose to use when developing material for streaming:

1. Existing video material resources
2. Audio only
3. Screen capture software
4. Macromedia Flash

Existing video material resources

Instead of, or in addition to, making your own video you may decide to use existing video resources available on a VHS tape. Using existing video resources will save a lot of time and energy but, you do not have complete control of the content and usually the recording has not been shot with a streaming medium in mind. Therefore, it is unlikely to produce optimum results once it has been compressed. If you decide to use material that you did not create yourself you should also be aware of the copyright legality issues. These are covered in Section 12. Nevertheless, the benefits of using pre-existing material may overcome the drawbacks. Figure 7.1 below illustrates how to connect your video recorder to your computer to capture the VHS footage onto your computer.

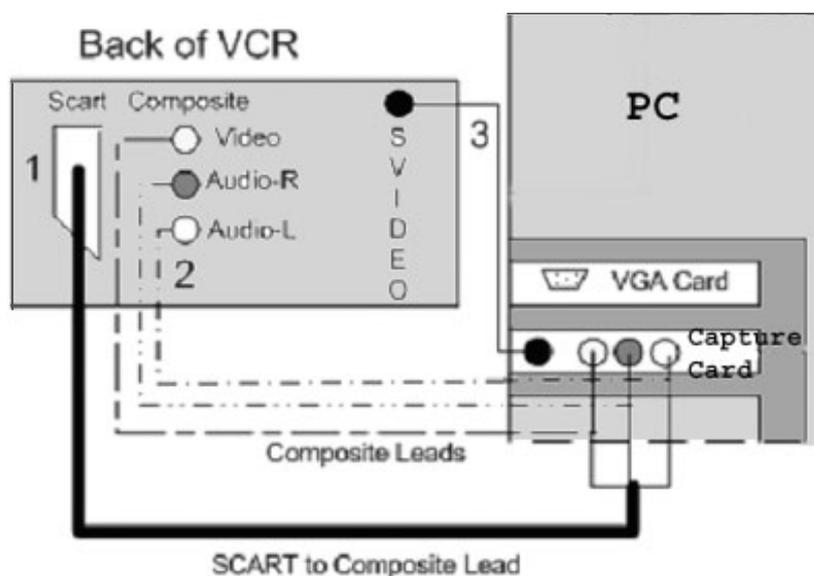


Figure 7.1 VCR Setup

It is quite simple to capture VHS footage to a digital format. The two basic ways are capturing it to your digital video camera and then transferring it as usual or capturing it straight to your PC. The first approach would provide you with a digital tape should this be your archival method. The second is quicker but you will need a suitable capture card (see Section 6). The first stage is to connect your video recorder to your capture device (camera or PC). If you take a look at your device, you will see that it uses one of the following connectors. Connecting any of these leads is a simple matter of matching point to point.

Connectors

1. SCART (*Syndicat des Constructeurs d'Appareils Radio Récepteurs et Téléviseurs*)

- SCART is a 20 pin connector used to connect television and video equipment. The SCART connector carries the video signal (in several formats) and audio. If the format at one end does not match the format at the other it can cause problems.
- The Euro AV (*Audio Visual*) SCART lead requires conversion to composite (phono) connector before it can be attached to the PC. This lead is easily obtained from any good audio visual suppliers.

2. Composite

- Composite Video leads are very common. The yellow cable is actually the composite cable (comprising the different information needed to form a picture). The red cable carries the right audio channel. The white cable carries the left audio channel (if you have a black cable, it is for mono). This is higher quality than standard transmitted television pictures (UHF). Composite leads are the most commonly used in analogue capture. The video quality over composite is not as good as SVIDEO or native SCART (i.e. SCART to SCART). SCART is not used widely in video capture.

3. SVIDEO

- SVIDEO provides the highest quality image when using analogue capture. Unlike composite which sends all the video data down one cable, SVIDEO splits the separate colour channels (red, green, blue), leading to a better colour balance.
- The SVIDEO cable transmits the video signal and so the red and white audio connectors from the composite cable will also be needed to transfer audio.

Once the video recorder has been connected, you must insert your cassette into the video recorder and find the starting point of the clip to be captured. If you decided to capture to a camera, you must also insert a cassette in that as well. If you chose to capture straight onto your PC you will need to open your capture software and have it ready to record. It is simply then a matter of pressing *play* on the video cassette recorder and *record* on your capture device. It is advisable to do a short initial test to see if the recording is working correctly. If you wish to store digital footage on VHS, the set up is the same except you press play on your camera or PC and record on your video cassette recorder.

Audio only

Although we have been mainly talking about video production, the audio of the clip is very often the most important channel of communication. Users very often continue to listen to the audio from a video clip whilst doing other things. In Section 2, we discussed educational reasons why a *talking head* may be appropriate but if your students do not have enough bandwidth, you may wish to reduce your lecture to just an audio clip or an audio clip with synchronised slides.

Recording audio at a professional level can take a good deal of equipment but sometimes you can produce audio that is good enough to be streamed with just the camera microphone. Audio with synchronised slides is a good compromise between video and audio. PresenterOne for RealOne and Microsoft Producer (see Section 11) are both free software packages that use a wizard to make it very simple to synchronise slides with an audio track.



Fig 7.2 SCART connector

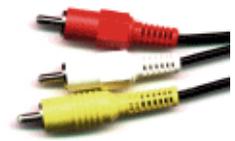


Fig 7.3 Composite connectors



Fig 7.4 SVIDEO connector

Audio Formats

As with video, audio has a number of formats which are designed for streaming and/or digital storage. RealNetworks and Microsoft use their own proprietary formats, RealAudio (RA) and Windows Media Audio (WMA) respectively. In comparison, Microsoft's WMA is the superior audio format, allowing greater compression for smaller file sizes while retaining quality. At 64Kbps, WMA allows CD quality. To obtain the same quality, RealMedia must use 96-128Kbps.

Both formats are designed specifically with streaming in mind, although they both can be used for storage purposes. MP3 (MPEG Layer 3) however, is probably the most well known of audio codecs. This format does allow streaming, but unlike RA and WMA, MP3 does not support multiple bit rate. This allows the stream to adapt to bandwidth fluctuations, for example a 64Kbps stream may be forced, due to network congestion, to only use 36Kbps. With VBR enabled, the stream would not stop or break-up, but instead would lower its quality to match the current bandwidth. In the case of MP3 the stream would stop altogether. MP3 was mainly designed to allow storage of large high quality audio in a small file. MP3 is now a relatively old technology. It is not as advanced as WMA for example, and quality at 64Kbps is not comparable.

By far the best format for storage archive is MPEG-2 AAC (*Advanced Audio Coding*). This format allows very high quality audio (including surround sound capabilities) at low bit rate, the optimal being 64Kbps. This format is used in DVD video for example and is also used in MPEG-4. As this technology is a licensable standard, it is being incorporated into other formats, such as MP3 Pro and QuickTime 6.

Screen capture software

Screen capture software can be used to produce videos that introduce new software, train new users on existing software, provide dynamic, visual online help and create active multimedia documentation. When demonstrating an on-screen procedure, capturing the activities on the screen (*screen capture*) can be very useful. This records everything that happens on your monitor, sometimes even visually indicating clicks of the mouse, to which a sound track can be added later. The only equipment required for this is a computer and the capture software.

Here are some examples of types of application this software can be used for*:

- Training, Education and Distance Learning - Capture, share and manage knowledge. Make and share how-to videos.
- Help Desk, Online Help, Help Systems - Handle error recording and reporting.
- Desktop Monitoring - Monitor desktop activities, process control and live content.
- Video and Voice Annotation - Annotate documents with voice and video for applications like CAD designs, medical images and web sites.
- Documentation - Preserve and archive desktop activities.
- Conferencing - Record, share and archive conference content.
- CAD and Simulation - Record and share animation, CAD designs, and annotation.

*adapted from:
www.TechSmith.com

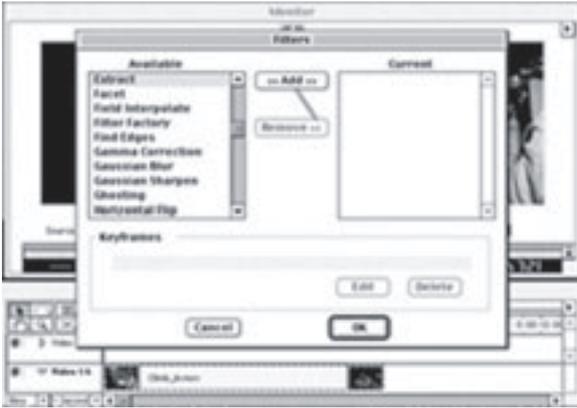


Fig 7.5 A captured screen after compression

When using screen capture software, you have to take certain considerations into account to optimise the recording. For example, the size of the area you are trying to capture will affect the frames per second at which the clip will play back. As the computer will be doing twice the work (running the application you are recording and the screen capture software itself), you will also need quite a fast machine to keep everything running smoothly. Alternatively, you may want to capture a smaller work area at a lower, and therefore jerkier, frame rate.

There are various screen capture software technologies available. However, most are designed to create Microsoft AVI files for playback from local machines rather than to be streamed. If you wish to stream these movies many of our filming tips in Section 5 still apply. For example, when the AVI file format is compressed into a streaming format, it is likely the window size will have been reduced. However, if you reduce your capture window too much, the student may not be able to distinguish the detail of the on-screen actions. It is therefore advisable to capture only small segments of the screen at a time, e.g. the area around where your mouse is clicking.

Screen capturing tips

If your movies have a slow frame rate, jerky mouse movements and slow background applications, the best solution is to use Windows 2000 or XP as your operating system, due to the better ability to multitask. Also, try turning off graphics hardware acceleration (this can be found in Control Panel, Display Properties, Advanced tab) which will increase frame rates dramatically. However, this will only work in Windows 2000 and XP.

Here are some more techniques you can use to improve your recordings:

- Set the colour depth to 256
- Reduce the resolution of the screen that is being recorded
- Reduce the recording frame rate
- Turn off all unnecessary background applications
- If possible, use a faster computer

Software Reviews

Of the software tested, we found TechSmith's Camtasia and Hyperionics HyperCam produced good results. They work in slightly different ways.

HyperCam is designed for local playback of video. It creates a high quality Microsoft AVI which can be edited and or dubbed in a third party package such as Adobe Premiere. Unfortunately, HyperCam requires quite a powerful computer and a very fast hard disk. On the other hand it is quite cheap (from £20) with a free trial version.

www.hyperionics.com

Lossless compression means that every single bit of data that was originally in the file is restored after the file is uncompressed. Unlike *lossy* compression which permanently deletes what it thinks is redundant information.

Flash is also referred to as Shockwave Flash (Shockwave being similar, but older, software from Macromedia).



Fig 7.6 A good educational example of Flash (see www.DissectionRoom.com)

Camtasia provides an ability to stream captured or live content directly from the desktop, as well as capture an AVI for local playback. It uses TechSmith's Screen Capture Codec (TSCC), optimised for recording computer screens, to produce perfect **lossless** videos of the desktop or any application running on it. Even though the files created are AVI in format, they can be streamed through RealMedia, Windows Media or QuickTime. Although the cost of Camtasia is relatively high (about £100), it comes with very useful features such as *Camtasia Producer*, for creating storyboards and editing your screen captures, and *DubIt*, which allows audio commentary to be overlaid onto the videos.



Macromedia Flash

Flash from Macromedia is very popular for drawing and animating graphics for the web and is sometimes used for educational animation. It can be used to create very dynamic, interactive web based presentations that Flash calls *movies*. This can amount to a film and a presentation in one. Choosing to create your movie in Flash means that the only equipment you will need is a computer and the Flash Software. However, it will take some time to become accustomed to all the functions of the software.

Quick-loading

Flash works on a progressive download streaming principle but does not need a streaming server. The initial information is downloaded and then the movie begins to play along the timeline stream you created. The main appeal of Flash is its capability to combine and manipulate objects to make interactive web-pages and presentations out of animations with astonishingly small file sizes that are quick to load.

Accessible

The movies are held in a .swf file format (ShockWave Flash) and need the user to have a Flash Player browser plug-in to view them though increasingly Flash can be exported to RealMedia and QuickTime. According to Macromedia, 98% of all European users have the Flash Player plug-in on their platforms (www.Macromedia.com). Most modern browsers supply a Flash Player and, if not, it is available as a free download. This accessibility means that Flash can be a very viable asset to a site. The new Flash Player 6 is also accessible to screen readers but currently only 7% of Europe use this version (www.macromedia.com, April 2002) and so Flash must still be treated with some caution to avoid discrimination against people with disabilities.

Compatibility

Apart from the Flash Player, Flash can be exported to a number of different formats:

- A Projector (.exe): No player is required but the file size is bigger
- Images (.gif .jpg .png).
- HTML: embeds a movie into a webpage for viewing in a browser.
- QuickTime: Flash's interactive benefits can be added to QuickTime movies. Buttons can be created to control the movie providing you have the QuickTime Player 5 or later.
- RealOne player: Flash version 2 is supported in RealOne player but to use later functions of Flash, such as ActionScript from Flash 4 you must use RealSystem Server 8 and later.

For more about Flash and RealMedia see:

<http://service.real.com/help/library/guides/realone/ProductionGuide/HTML/realpgd.htm>

Flash Tutorials

Macromedia changed Flash in quite a few ways for version 5, so if you are following a tutorial double check which version it is designed for.

- Using QuickTime in Flash Tutorial: www.ClickandGoVideo.ac.uk
- Real and Flash: www.ClickandGoVideo.ac.uk
- Flash 4 and 3 Tutorial by www.echoecho.com
- Becoming a Flash 5 Master by www.webmonkey.com
- A variety of specific Flash 4 & 5 tutorial subjects by www.iboost.com

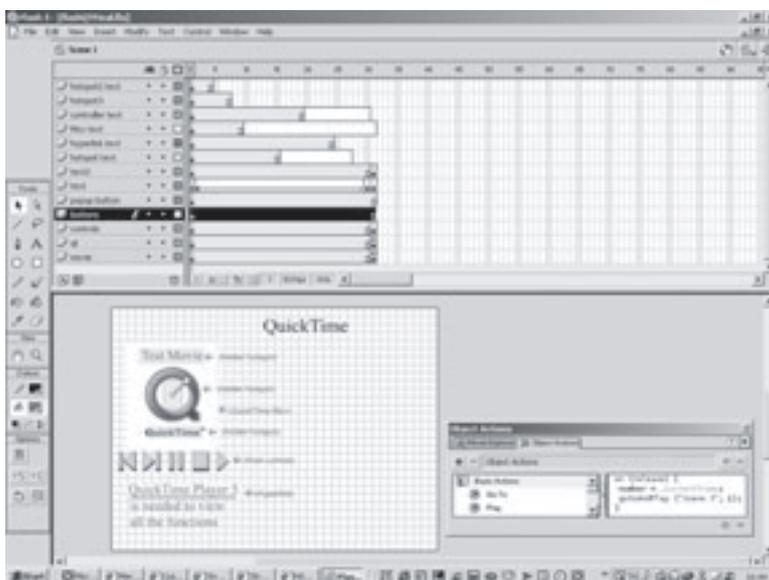


Fig 7.7 Macromedia Flash using a QuickTime movie

Paul White and Sally Thornhill

8.

Editing your material

Once you have captured your footage, you probably will need to edit the material. It may only be a matter of trimming off the beginning and end of your recording. Alternatively, it may involve removing whole scenes and reordering or even combining other clips from different sources. In this Section we will cover the software and techniques available to help you edit your video for streaming.

What is editing?

Editing is the act of altering, shortening or joining together video and/or audio sequences to form a more suitable sequence or narrative. *Raw* video footage is the video you take directly from the camera. This footage usually contains unusable video including mistakes, out-takes, sections with lots of camera shake and so on. Video editing allows you to extract the interesting material from the raw video. Live streamed video cannot be edited but can be integrated with other media in real time.

What makes a good clip?

Section 5 discusses some ideas for composing individual shots. Television audiences are accustomed to their attention being held by fast changing, multiple shots. Very often the presenter continues to talk whilst other relevant footage is slotted in. In an educational setting however, such fast editing may not be needed as the video is shown in the context of other educational resources and activities. Educational video can still be made more engaging and effective through careful editing. Despite having limited resources, educational aims can be achieved by using support material such as complementary clips, still shots and synchronised slides together with all the interaction capability that the web offers.

Including accessibility

During this editing stage it is possible for you to add in accessibility features, particularly captions. From September 2002, under the Special Educational Needs and Disability Act (*SEND*A), educational institutions must make “*reasonable adjustments*” to ensure that disabled students are not placed at a substantial disadvantage when accessing resources.

Editing tips for streaming

Editing video streaming should be kept to a minimum. To keep down the amount of work an encoder must do, you should keep the editing simple. Here are some practical editing tips for optimising your streaming video:

- **Save an original copy.** It is wise to save a relatively uncompressed format of your movie should you have to return to it. There are various high quality file formats you can use to store your video. The appropriate choice for you is a compromise of quality versus file size. Table 8.1 below shows the main examples of digital file format:

‘The problem is getting academic staff to believe that a video of a one hour lecture is even more boring than the original lecture was...they need to chop it up’ (practitioner)



Fig 8.1 Example of a brainstorm session clip

Format	Advantage	Disadvantage
Uncompressed AVI	Perfect reproduction of digital video and sound (Microsoft).	Requires huge amounts of hard drive space - 12GBs per hour of footage.
Uncompressed MOV	Perfect reproduction digital video and sound (Apple).	Requires huge amounts of hard drive space -12GBs per hour of footage.
MPEG-1	Small file size, compatible with most computer systems.	Poor quality reproduction in comparison to other formats.
MPEG-2	Very high quality reproduction, as used on DVD. Manageable file size at 9GBs for 1 hour at the highest bit-rate.	Although the bit-rate can be adjusted, MPEG-2 video quality does suffer as a result. It is designed for one purpose.
MPEG-4	Best all-round. Depending on bit-rate (150Kbps to 15000Kbps) it can produce almost uncompressed AVI quality at much smaller file sizes. Audio can also be compressed with little or no loss.	Many standards for MPEG-4 are emerging, such as solutions from Apple (QuickTime 6) and also the open source DivX. Both are very high quality and highly configurable.

Kbps- Kilobits per second
 Mbps- Megabits per second
 GB – Gigabyte
 MPEG – Motion Picture Experts Group

Apple QuickTime6 available at www.apple.com
 DivX MPEG-4 available at www.divx.com

Table 8.1 Digital video formats

- **File formats.** All of the file formats shown in Table 8.1 can be exported using standard editing packages, such as Adobe Premiere. There are no licensing implications when using these file formats for storage and backup. The emerging standard is MPEG-4 as it proves to be the best all round format and it can be edited within Adobe Premiere as an AVI.
- **Crop the film.** If you have the software, remove any unused screen space (*crop*). To make the video suitable for most codecs (see Section 6), ensure the new cropped dimensions are a multiple of four e.g. 320 x 240.
- **Reduce the picture size.** When saving your work, consider your streaming output. If you are working with Adobe Premiere it will automatically adjust the picture size to a suitable streaming format. The smaller the connection speed, the smaller the output movie. If you are using a simpler package like RealNetworks Producer, you may have to adjust the picture size manually.
- **De-interlace.** Films have been traditionally shot using interlacing, which is a method of layering alternative lines on the screen. Streaming video (or any desktop video) does not need interlacing and is improved without it. Digital editing software sometimes offers the ability to de-interlace a video. Also, some cameras have a *progressive scan function* which allows the camera to record the full frame information in each successive frame without any interlacing.
- **Do not use too many special effects.** Editing software usually offer lots of transitions and effects for video and audio (special effects make a **transition** from one clip to the next - such as fading or opening doors). Many are aesthetically dubious anyway, but all create extra work for the encoder. Most editors offer a simple fade function which can work well as a transition if necessary (e.g. to give the idea of a passage of time between shots).
- **Keep the clips short.** As mentioned in Section 4, clips should be kept short for the web to keep the viewer's attention span and to aid navigation. There is no

What are Transitions?
 "Clips from within a scene are often put end to end in what are called straight cuts. This creates the feeling that the scene is happening continuously. Often at the end of a scene we want to convey to the viewer a passage of time or place before starting the next scene. In order to achieve this effect we use Transitions"
 Ken Stone,
www.kenstone.net

prescribed length of time as it depends on the subject of the clip you are showing.

- **Black and white balance.** In some of the more professional editors (e.g. Adobe Premiere) you can change the spread of blackish pixels to be a single black colour or transform a spread of whitish pixels to a single white colour. This helps to reduce the amount of compression necessary without being too noticeable. Another method is by adjusting the *gamma* setting which will change the balance of white and black areas in your picture without affecting the overall brightness too much. Varying the amount of gamma correction changes the ratios of red to green to blue as well as the brightness.

Audio

- **Avoid background sounds such as music or talking.** Remember that many people will be listening through a computer's mono speaker. Do not use background sounds and always test your sound in mono.
- **Remove noise.** During the editing and encoding stage you may be able to use a filter to remove superfluous noise, such as background hums.
- **Enhance the audio signal.** Depending on how important your sound is and how well it was recorded, you may need to use a filter to boost the sound levels. This can be done using some of the more professional editors and encoders.

Video editing software

To edit your film, you will need to have editing software on your computer. Whilst free software (such as AIST's MovieXone) is very capable for many jobs, you may need to purchase some sophisticated software to deal with more advanced editing.

The following is a compiled review (in alphabetical order) of some of the more popular free or relatively cheap digital video editing packages.

Adobe Premiere (around £480) has long been the industry standard for the Macintosh and PC video market, due to its combination of cost and capabilities. It can be overwhelming for the beginner but for streaming video it has a lot to offer with its direct FireWire support, CleanEZ 5 encoder and export options for the Web (HTTP), RealMedia and Windows Media. Premiere can take beginners through the steps but there is an advanced option for more versatility. Premiere also includes an audio mixer and 20 audio filters to help process your audio.

AIST MovieXone 1.0 is a free complete package for video production including tools for editing video, animation, audio. Transitions and effects are also included. PCPlus (Aug 2001) concluded *"It does provide a foundation in the practice and principle of video-editing as good as anything we've seen...8 out of 10"*.



Fig 8.2 MovieXone

Microsoft Windows Media Encoder is a free production tool that converts both live and pre-recorded audio, video, and computer screen images to Windows Media Format for live and on-demand delivery. It only has limited editing capability such as adjusting sound or colour levels and adding author details.

A free trial download of Premiere is available from: www.adobe.com

MovieXone is a free download from www.aist.com

Windows Media Encoder is available as a free download from www.microsoft.com

Pinnacle Studio Basic for RealVideo is a free software download. It lets you edit digital video files and export to RealMedia. It supports FireWire cards but limits the resolution to 320x240 pixels and a target audience of only two.

Pinnacle Studio DV 7 (around £77 including FireWire card) offers standard DV editing: trimming and arranging your clips, adding titles, scene transitions, music, narration, special effects and more. It comes with a FireWire Card and can export to RealVideo8 and Windows Media format.

Microsoft Producer for PowerPoint 2002 is a free software download. It has limited editing capabilities but it does simplify the process of making rich-media presentations. For more information see Section 11.

Flickerfree Video Framer for RealVideo (around £60) allows you to digitize and edit your video using a multi-track timeline and transition effects. It can create basic RealVideo directly or export your video as an AVI.

ULead's VideoStudio 6.0 (around £69) is quite an intuitive interface that allows scrolling titles, 3D effects, filters, motion overlays and extensive audio options. It is good for beginners as it takes you through the steps but can be restrictive for the more advanced. VideoStudio is often bundled with DV cameras.

Vegas Video LE 3.0 by Sonic Foundry is a free, streamlined version of Vegas Video 3.0, Sonic Foundry's professional digital video and audio editing system. You can mix audio and video using multiple tracks, perform fast edits, apply effects and transitions, and hear and see the results in real-time.

Audio Editing

Many of the video editing packages above also edit audio. It is commonplace within editing systems for the recording to be split up into video and audio channels where they can be worked on in synchronisation or split apart and the picture and sound used separately. For example, in Adobe Premiere if you require an audio track only, you are able to unlink the video and audio track and then delete the video track altogether leaving just the audio track to work on.

If you want a package purely for editing audio, Sound Forge 6 (around £300) by Sonic Foundry is perhaps the industry standard audio editor. It includes a set of audio processes, tools and effects for recording and manipulating audio. This application can record and edit audio, process effects, and encode in Windows Media and QuickTime but not RealMedia which uses Sound Forge XP Studio 5.0 (around £60). There are many other free, shareware and low-cost alternatives available on the web.



Fig 8.3 Pinnacle RealVideo



Fig 8.4 Ulead's VideoStudio

A free trial download of VideoStudio and Media Studio is available from: www.ulead.co.uk

Sally Thornhill

9.

Encoders and players

Encoding

Once you are happy with your recording and have done any editing you feel necessary, it is time to produce the final file format for streaming delivery.

When creating streaming video, it is important to *optimise* the file for the speed of the connection of the viewer. Students viewing a streaming media file over a 28.8K modem link would get the best results when that file is optimised for a 28.8kKbps delivery speed. Equally, on university campuses, although we can still receive the 28.8Kbps stream, we would see and/or hear the best results for a file optimised for network LAN speed (10,000Kbps). It is possible to create streaming files that can be streamed over several different speeds (called *SureStream* in RealMedia and *Intelligent Streaming* in Windows Media). This enables the same video file to be viewed on-campus as well as off-campus. Files made to be streamed over a single speed can also be pulled from a normal web server but files created to be streamed over multiple speeds can only be streamed from a streaming media server. This is because the streaming media server is specifically designed to determine the speed of the connection and to stream the file at the optimum speed.

To optimise your recording you must *encode* it. Encoding has two purposes: compression for web delivery and saving in a suitable video file format. How you encode your video depends on two main questions:

1. What media player will be used (e.g. Windows Media Player, RealOne media player)? The main media player choices will be discussed later in this Section.
2. What Internet connection speed will be available? (Section 10 discusses connection speeds further.) There is usually the option of delivering different quality of streams to users with different connection speeds.

These questions, as well as other technical issues, are covered in the Decision Tool (Section 3 and Appendix 1). Once you know the answers to these questions, you can decide how you wish to encode your video.

Encoding for compression

Compression is vital for video that is delivered via the web. If the file size is too large, the image and/or sound quality will be very poor if viewable at all. The average digital video size is 4MB (4000KB) for 1 second of AVI. Few computers can handle that many megabytes per second. The average home 56K modem user may only receive 34Kbps (around 4KB per second). Compression therefore has to reduce the file size of your video and/or audio for more effective delivery out to the user.



Fig 9.1 RealNetworks' Realsystem



Fig 9.2 Microsoft's Windows Media



Fig 9.3 Apple's QuickTime

- **Window size**

During the encoding stage there is often the option to specify the frame (*window*) size of the video. This can also be done in the editing stage. In a sense, this is the first stage of compression. It is very rare to see video over the web at the same frame size used when it was captured. Reducing the window size reduces the amount of data in the video and so the file size. It is for this reason that video produced for slower connection speeds usually has a smaller window size than faster connections. Many software packages offer default frame sizes when you choose different connection speeds.

- **Codecs**

The next method of compression within encoding is to apply a **codec** to the video and/or audio. Codecs generally work by removing unnecessary visual and audio data from the file to reduce the amount of data sent.

Saving in a suitable file format

The encoding process also results in files being saved in a file format that is suitable to be played back by the chosen player (**architecture**). Different multimedia architectures offer different features and options, and store data in different file formats. QuickTime, RealVideo, and Windows Media are examples of streaming media architectures.

Both RealNetworks (*SureStream*) and Windows Media (*Intelligent Streaming*) offer the opportunity to encode just once for multiple connection speeds (*multi bit rate*). This is as an alternative to producing individual encodings for each speed and letting the user choose. To open and view these file formats, the student must have the correct player installed on their computer.

What software will my students need?

The main formats in streaming video are currently RealNetworks' RealMedia, Microsoft's Windows Media, and Apple's QuickTime. Each of these has different advantages and disadvantages which will be discussed below.

When selecting a streaming format various issues need to be taken into consideration. You will need to know who your target audience(s) are and whether your chosen format can accommodate them. For example, QuickTime is free and supports a wide range of operating systems, but if your audience is connected via a modem, they are likely to be reduced to watching a slide show without audio, far removed from the fast moving video creation you intended. The Decision Tool in Section 3 takes you through more of these considerations. Table 9.1 at the end of this section shows some of the advantages and disadvantages of using each player.

The Main Players

RealNetworks, Microsoft and Apple use their own **proprietary format** for encoding and serving media. This situation is the same for the media players. In an ideal world you might expect to view any content on any player. Content generated by one supplier's encoder is generally only viewable through that supplier's player. (However, RealNetworks' new Helix platform promises that any of the three main formats can be streamed from their server.) There may also be a version incompatibility between players and content. For example, content encoded with the latest version of a supplier's encoder may turn out to be not viewable by earlier versions of the player. This problem occurs with versions of RealOne Player and Windows Media Player. In short, you have to make a choice at an early stage as to what player you intend your students to use and develop compatible material for.

Codec – COder / DECoder. A software device that allows a computer to either create or display a compressed media format.

Architecture is a term for the group of software components that creates, stores, and plays back multimedia content. An architecture may contain things such as encoders, codecs, file formats, server software and browser plug-ins.

Proprietary format is when your web browser cannot read a document without the assistance of another software program, often called a plug-ins. These include RealMedia, Windows Media, QuickTime, Flash, PDFs.

To open a proprietary software file your browser needs software which decodes that file (plug-in). Browsers usually come with a set installed (such as Flash, WM Player) but for others you must first download and install them to work with your browser. They will then automatically load each time the browser encounters that proprietary file.

As we will show you next, your choice of player can have a lot of impact on the experience your students achieve when viewing material. Each player has benefits over the other. Unfortunately there is no best option as it depends on costs, the material itself, how your students are connected and how you want to integrate material.



RealNetworks

RealNetworks' products are fully SMIL (Synchronised Multimedia Integration Language) compatible, and are designed for various types of content to be integrated together within the player. There are two sides to this approach, one being that no matter what operating system the user views your content on it will appear and operate the same way within the player. The disadvantage of this approach is that content is limited to the file compatibility of RealOne (the new RealPlayer). For example, you cannot currently include Microsoft PowerPoint presentations in their original format. They must be converted to images such as JPEG or GIF.

RealNetworks have recently launched their ninth platform version *Helix*. Helix is the new media delivery system from RealNetworks. It consists of several components, the encoder Helix Producer, the Helix Universal Server, and Helix Universal Gateway. The *basic* versions of these are free but very limited in their capabilities. For more information on the server see Section 10.

Helix Producer Basic will encode your recording into a streaming format but limits the multiple bit-rate encoding to three connection speeds. (The full *Plus* version can be purchased for about £150 and offers a more features.) Helix Producer not only encodes the recording into RealVideo format but it can also create synchronised multimedia presentations for playback within the RealOne player. Helix Producer also has the ability to capture and broadcast directly from a FireWire source, which keeps the quality high and the connection of devices simple.



Windows Media

At the other end of the scale, Windows Media Player is designed to be embedded and controlled from other sources, such as an HTML page, or Java/VBScript commands. The main advantage of this approach is the ability to control and link all web-compatible sources of media. This is extended considerably by all browsers having support for *plug-in* modules which extend their capabilities and compatibilities. Of course there is a downside. As this software is designed by Microsoft, it is intended to work at its best with other Microsoft products. This limits its compatibility with other operating systems and non Microsoft browsers.

Windows Media Encoder 7.1 is a free encoder tool that allows you to convert both live and pre-recorded audio/video into Windows Media format for live and on-demand delivery. However, watch out for the new Windows Media 9 range which is currently in a beta-testing format but the full version will be launched soon. A Microsoft press release recently announced these changes, "*July 15, 2002 - Microsoft Corp. today announced the official name for its next-generation digital media platform, Windows Media 9 Series. ... Showcasing new versions of Windows Media Player, a new streaming server, new audio and video compression, a new encoder and a new software development kit, Windows Media 9 Series will offer a dramatically improved playback experience, unmatched audio and video quality, and the most complete platform for enabling a whole new range of digital media solutions.*"

There are numerous improvements from version 8 of RealNetworks' products.

A full breakdown can be found here:
www.realnetworks.com/products/media_creation.html

Keep abreast of Windows Media developments at:
www.microsoft.com/windows/windowsmedia/default.asp

Apple QuickTime

Apple QuickTime has the ability to display various synchronised media within its player through SMIL, and also be controlled externally when embedded into a web page. However, it does not have the same level of functionality as RealNetworks' player or Windows Media Player.



Unlike Windows Media and RealMedia, the QuickTime Pro encoder must be purchased for about £20 however it does provide more features than the other two. QuickTime Pro also provides simple editing, basic effects, and import/export of many types of media. For streaming live events Apple has produced the free *Broadcaster* encoding software. However, it is only available on Macintosh platforms. One major benefit for QuickTime when it is used in its native Macintosh environment or on a Windows based PC is its compatibility within numerous types of web browser. (Table 9.1 summarises each player's compatibility with systems and file formats.)

So which player should you use?

Windows Media

Advantages

- Free: All Microsoft developed video applications are freely available and unrestricted in use
- Good integration abilities, such HTML embedding and Visual Basic support
- Encoder application is wizard-based for ease of use
- Overall high quality video and audio from 128Kbps upwards

Disadvantages

- Poor audio quality when streaming with video at modem speeds
- Users require Microsoft's Internet Explorer to view embedded media
- Streams can only be viewed on Microsoft Windows or Macintosh computers
- Needs a plug-in to be compatible with Netscape
- Requires a Microsoft Windows Server to host streams

RealMedia

Advantages

- Helix Producer Basic version is free with good support on operating systems
- The most widely used streaming format
- Helix Universal Server can stream all the three main formats (Windows Media, QuickTime, RealVideo)
- Excellent quality at modem streaming rates. For most situations, the best quality streaming available
- **SMIL** support

Disadvantages

- Cost: Extended encoding features (e.g. Helix Producer Plus) must be paid for
- Slow updates to the format

SMIL -Synchronised
Multimedia Integration
Language (see Section
11)

Apple QuickTime

Advantages

- Extremely high quality video reproduction at a fast Internet connection speed (1000Kbps+)
- Player can view a wide range of media formats
- SMIL support
- Support 360° panoramas and 3D objects

Disadvantages

- Requires a bought-in package (e.g. QuickTime Pro, Adobe Premiere) to create Apple MOV files on PC systems
- Poor quality footage below 1000Kbps when real-time streaming

Player	Compatibility	File Formats	Browser Compatibility	Availability
Windows Media Player	All Windows, Mac OS 8.1/9.x, Mac OSX, Pocket PC, Solaris, HP HandHeld, Casio Palm, Compact Palm	ASF, WMV, WMA, WAV, AVI, MPEG-1, MPEG-2, MP3, MPEG-4	Internet Explorer 5.0 +, Netscape 4 + (additional plug-in needed), Mozilla (with Netscape plug-in)	www.windowsmedia.com FREE
RealOne	All Windows, Linux, Mac OSX, Pocket PC, Solaris	RM, RA, RealPix, RealText, MPEG-1, MPEG-2, MPEG-4, AVI, SMIL	Internet Explorer, Netscape, Mozilla, Opera, Various Linux browsers	www.realnetworks.com FREE Option for <i>Plus</i> version at cost
Apple QuickTime	All Windows, All Macintosh	MOV, MPEG-1, MPEG-3, AVI, SMIL + others	Internet Explorer, Netscape, Mozilla	www.apple.com/quicktime FREE Option for <i>Pro</i> version at cost

Table 9.1 Player compatibility

Once you have a suitably encoded video in your desired file format, you are ready to upload it to a streaming server. This will be discussed in Section 10.

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10.

Serving streaming media

No matter which format you have chosen, now that you have your streaming media files you will require a server to deliver them to your students.

Your current web servers are able to store and send audio, video files in a standard download manner. Also, end user applications such as RealNetworks' player or Windows Media Player will **pseudo stream**, or start to play the partially downloaded file on detection it is coming from a web server. This is an acceptable way to begin testing streaming media but if you intend to use it seriously, a better solution is to use a dedicated streaming server application. As you may expect, pulling media files down from a web server is not as sturdy as using a streaming server. For example you lose the ability to fast forward the streaming clip and critically, you lose the ability for the stream to automatically adjust to the bandwidth.

There are many other reasons why a streaming server is beneficial. Some of the most important are: the ability to protect your intellectual property (the file is never downloaded), users can interact with the stream (fast forward, rewind immediately into the stream), live broadcasting becomes possible and you have far more control over who has access to your video/audio etc.

What hardware will I need?

Depending on the format you have chosen, different options are available to you. However a generic streaming server would require the following:

- **1GHz+ processor.** A dual processor or greater based system would provide the best performance and increase the computers multitasking abilities which will be taxed.
- **1GB+ RAM.** In most cases multiple services such as FTP, Web server, and live stream handling will be placed on the machine. Low memory will deplete the server's efficiency dramatically.
- **Large storage capacity.** Numerous choices are available, but we recommend that a **RAID** system should be employed. The main reasons for this are, RAID allows smaller drives (e.g. 100GB) to be linked as one drive and mirrored for backup very quickly within the server. This is a huge cost saving when storage is concerned. Also RAID systems have a very fast drive access and throughput, a huge benefit on servers dealing with multiple tasks involving video and other media.
- **Network connectivity.** There is no point having a fast server if your connection will not support it. Depending on your location, choosing the fastest option you have available as bandwidth is vital. For example: 10/100Mbps **Ethernet**, Gigabit Ethernet or xDSL connection.

Pseudo-streaming, allows the audience to access the file via a network, such as the Internet, while the media file is still in the process of downloading. Unlike true streaming, pseudo streaming makes a copy of the file on the user's computer.

A streamed video or audio is never *copied* to the users machine, it is constantly controlled from the server.

In all cases, use the best available resources you have at the time.

RAID – Redundant Array of Inexpensive Disks. RAID can be made up of IDE (Ultra or Serial ATA) or SCSI. IDE being cheaper, SCSI being faster.

Ethernet is the main technology to implement local area networks (LAN).

What software will I need?

All the major streaming formats offer server side software that controls access and distribution. This software will need to be run on a server platform with the appropriate choice of operating system, i.e. Linux, MS Server. This part of the guide will be based on the capabilities and compatibilities of each of the three main server options.

RealNetwork's server



RealNetworks' server software (RealSystem Server) has matured over many years and has become a very stable, fast and user-friendly platform. It has full remote administration capabilities and is very secure. It supports:

- Microsoft Windows NT/2K/XP/.NET
- All *flavours* of Linux
- FreeBSD
- Solaris

Installation and configuration of RealSystem Server is straightforward and very customisable, allowing it to fit within an already existing service, i.e. a web server or other streaming service. It also supports streaming of Apple QuickTime, both archive and live streaming.

The major disadvantage to using RealSystem Server is cost. However, the new Helix Universal Server, which replaces the RealSystem Server, claims to reduce your costs by supporting all the three main streaming formats: Windows Media, QuickTime, RealVideo as well as MPEG-1, MPEG-2, MP3 and MPEG-4. You can download a free *basic* version of the Helix Universal Server software that limits you to 10 simultaneous users viewing streams. This free licence lasts for 12 months. For testing purposes, this is more than adequate and will allow you to run various stress and compatibility tests on your server. However, the costs arise when you wish to move over the 10 user limit to up to 10,000 as the full versions cost approximately £3500 - £5000. The Server has a *caching* ability that leads to greater performance when dealing with large amounts of streams from a single server. In addition, it has the ability to stream to all types of media enabled devices, such as palmtops and mobile phones.

Both RealNetworks (*SureStream*) and Windows Media (*Intelligent Streaming*) offer multiple bit rate encoding. This is the ability to encode a single file that can be streamed out to clients at different data rates according to their access bandwidth. The server will automatically select the appropriate encoding suited to the client's bandwidth when the connection is made. If the connection becomes congested, the server drops to a lower encoding rate. Once the congestion is gone, the connection will return.

Microsoft Windows Media Server



Unlike the RealNetworks offering, Media Server is not a standalone product, but comes bundled with Windows 2000/.NET Server. If you already have either of these servers in place, the cost of implementation is minimal and is a worthwhile investment of a small amount of time. Bear in mind, that Media Server will only run on a Windows Server. A major advantage though is the ability to stream to over 3,000 users per Media Server without incurring licensing costs. Windows Media Server is, like RealNetworks, a fast and efficient platform although your media files are not quite as secure. This does not mean that your server can be accessed or attacked through Windows Media Server. Your server, its services and files are protected and cannot be tampered with. However, applications have been written that allow users to record the stream as it comes down from the Media Server but these are not widespread and relatively rare in use.

Current pricing for all Real products is available from www.realnetworks.com

All streaming solutions support RTP (Real Time Protocol – pseudo streaming) and RTSP (Real Time Streaming Protocol)

For more information on Real's Server Basic visit:

www.realnetworks.com/products/server/index.html

http://docs.real.com/docs/rn/howto/helix_gateway_cfg_guide_v7-21.pdf

Apple QuickTime Streaming Server / Darwin Streaming Server

QuickTime Streaming Server is a Macintosh-only based solution. For Macintosh infrastructures it offers a wide range of streaming file compatibility, including standard MOV, MP3, MPEG-4 and Shockwave Flash, to over 4,000 users per server.

QuickTime's major selling point is the quality of footage that can be produced using its Sorenson encoding protocol. For example, most major film companies will release movie trailers onto the Internet in this format due to its high quality reproduction.

Apple also supply a free PERL-based server called Darwin for the following operating systems:

- Red Hat Linux 7.1
- Solaris 8 (SPARC)
- Windows NT Server 4.0/Windows 2000 Server

Darwin is not a very user-friendly server system. Being script-based, all configuration has to be done from within text documents and the PERL setup needs to be done by an experienced administrator. However, like its counterpart on the Macintosh, it offers a wide range of compatible streaming files and can stream to 2,000 or more users.

Remember, at low bit-rates, Apple QuickTime does not fare well against Windows Media or RealMedia. At 512Kbps and below, both the other solutions look and sound far superior, but at high connection speeds of 1000Kbps or greater QuickTime's quality is superior. This is due to the design of the codec and its intended target audience.

How much bandwidth will my network need?

Bandwidth and the capacity of your network are vital for effective video streaming. The quality of the output stream will depend greatly on your own and your students' bandwidth. Your server must have enough bandwidth available to cope with the demands made on it or else your students will experience a very poor quality playback i.e. fragmented or jerky images, broken sound and possibly total loss of connection.

The students' bandwidth also has to be considered and your streams have to be encoded to suit your target audience (see Section 9). Remember, encoding for a LAN stream e.g. over a fast university network, and then sending out to students to watch at home over a 56K modem will swamp their connection in seconds and prove un-viewable.

Connection speeds

Table 10.1 shows typical connection speed (*bit rates*) during average conditions for different bandwidths. It also shows the typical use of each bandwidth. As you have probably experienced, bandwidth can fluctuate depending on conditions, e.g. at times when the Internet is in demand it can be difficult to view any media. Also, you must also consider how many students are likely to access your stream and ensure enough bandwidth is available. Even 56K modem streams can add up to Mbps if you advertise your stream to a wide audience.



QuickTime Streaming Server Specifications:

Power Mac G4,
Macintosh Server G4,
Power Mac G4 Cube,
iMac,
Macintosh Server G3 or
Power Macintosh G3

128MB of physical RAM
(512MB recommended
for professional
streaming)

Mac OS X Server 10.1

1GB of hard disk space

Bandwidth describes how fast data flows on a communications path at a given time. If this path were a tube, then bandwidth would denote how wide the pipe was and therefore much data could flow through it at once.

BT Openworld have a Macromedia Flash simulation of video at different connection speeds:
www.btopenworld.com/broadband/pro20

Connection Speeds

Unlike file sizes, which are measured in Kilobytes (“KB”) and Megabytes (“MB”), network data is in Kilobits (“Kb”) and Megabits (“Mb”). The rule to remember is that there are 8 bits in a byte. For example: when people talk of a “56K modem”, they mean a modem that will receive downstream a maximum of 56Kbps (Kilobits per second) and not a modem which can receive a 56KB (kilobyte) in one second.

Connection Type	Typical use	Maximum bandwidth	Typical Video Bandwidth
28.8Kb Modem	Quite old	28Kbps	16-20Kbps
56Kb Modem	Home users	56Kbps	34Kbps
ISDN	Small business	64-128Kbps	45-80Kbps
256Kb xDSL/Cable	"Broadband"	256Kbps	225Kbps
384Kb xDSL/Cable	"Broadband"	384Kbps	350Kbps
512Kb xDSL/Cable	"Broadband"	576Kbps	450-500Kbps
10Mbps Ethernet (LAN) 100Mbps Ethernet 1000Mbps Ethernet	On campus / business	10Mbps 100Mbps 1000Mbps	9Mbps 90Mbps 950Mbps

Table 10.1 Bandwidth

Connection speed terminology

When talking about faster connection speeds, you may come across a lot of jargon that describes how you are connected to the Internet. We will now look at a few of the more common terms.

Broadband. There is a common belief amongst video streaming enthusiasts that many of the challenges of the technology will be solved when students replace modems with *broadband*. But what does broadband mean? Although *broadband* is commonly used, it has not been defined as an actual delivery speed. Currently, it is generally considered to be between 512Kbps and above. The Government Office of the e-Envoy explains, “*Broadband services offer significantly faster data rates, enabling the delivery of services such as high-speed Internet access and video-on-demand. Higher bandwidth can also facilitate ‘always on’ connection to the Internet. But the term broadband is often used to describe a very wide set of technologies, offering data rates that are orders of magnitude apart.*”*

*www.e-envoy.gov.uk

In the Government report ‘*UK online: the broadband future*’ (February 2001) the Government set a new target – “*for the UK to have the most extensive and competitive broadband market in the G7 by 2005*”. In this report they distinguished between:

- **Higher bandwidth** - services provided at speeds greater than 384Kbps.
- **Current generation broadband** - services provided at speeds of 2Mbps and over.
- **Next generation broadband** - services provided at speeds of 10Mbps and over.

In the UK there are two main options for broadband Internet access at home:

- **Cable modem** - which connects the home PC to the fibre optic network, e.g. NTL broadband.
- **ADSL** - which uses the existing telephone network, e.g. BT Openworld which operates within approximately 5.5km of the local exchange. (Source NTL **)

**www.ntl.com

For more details about broadband, a copy of the Government report '*UK online: the broadband future*' is available online at: www.e-envoy.gov.uk/publications/reports/broadband/index.htm

ISDN (ISDN2e). Integrated Systems Digital Network is a set of standards for digital broadcast over ordinary telephone lines as well as over other media. For more information, there is a good tutorial online at www.ralphb.net/ISDN/intro.html

DSL. Digital Subscriber Line is a technology for delivering high-bandwidth information over ordinary telephone lines. xDSL refers to different variations of DSL, such as ADSL, SDSL and VDSL

LAN. Local Area Network is a network that connects computers within a geographically small region, often just one building (for example, within a campus).

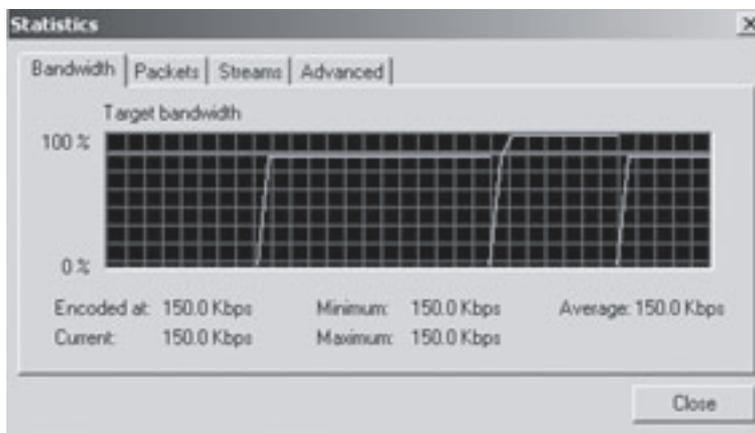


Fig 10.1 RealNetworks' SureStream delivery.

Paul White and Sally Thornhill

11.

Presenting your content

Introduction

Once you have captured, edited and possibly encoded all the material you need, it is time to think about how you intend to present the video clips to your audience. As we have seen in Section 9, the major products offer various options to combine video, sound and other resources such as Microsoft PowerPoint within, or external to, the player. Clearly this offers many pedagogical opportunities to integrate the moving image, not only with slides but real-time chat, discussion boards, quizzes and other web-based resources. Nowadays these are often delivered via a virtual learning environment (VLE) as can be seen in Fig 11.1 below. In this example the video image is embedded in the left hand window with the slides on the right. Both video and slides are synchronised and both have interactive control buttons. Thus clicking back to slide 10 will bring up the appropriate section of video, or fast forwarding the video will cause the slides to catch up. The user can also navigate using the menu of **bookmarks** on the left of the video image. This is also synchronised. In the bottom left corner are the communication tools (in this case List, Discussion Board, Chat and HyperMail) together with links to other course and departmental resources. Thus in this single example we can see elements of *image*, *interactivity* and *integration* as mentioned in Section 2.

Examples of rich media are available on the Click and Go Video web site. www.ClickandGoVideo.ac.uk

Bookmarks are a list of headings within the player that the student can use to skip forward and back to a particular section within the video.

Microsoft NetMeeting videoconferencing software is free with Windows or downloadable from www.microsoft.com

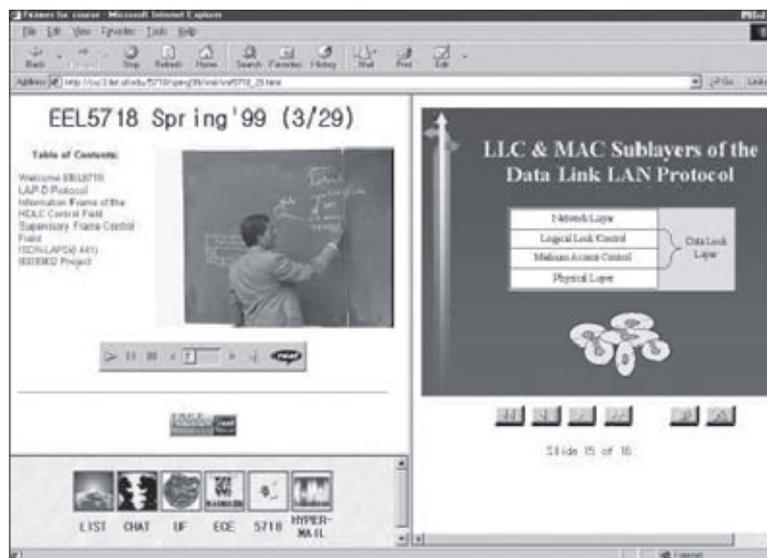


Fig 11.1 Video supported by slides, discussion and chat within WebCT. Prof.Latchman, University of Florida (www.ufl.edu)

How do I present my video?

Technically, this can vary from quite simple video clip links to quite complex (in design and technical terms) integrated layouts like the one above. These will require varying degrees of technical skills. A summary of the main options is given in Table 11.1, with a guide to the technologies below.

What you can do	Tools you can use
A clip and media player controls embedded within a web page	HTML or HTML generators (e.g. FrontPage, Dreamweaver), RealNetworks' Producer, Windows Media Encoder (WM), Microsoft Producer (WM), Discreet Media Cleaner (QT)
A link to a pop-up clip from a web page (e.g. a video clip or an audio clip)	As above
A clip with synchronised slides (e.g. Microsoft PowerPoint with video and audio)	HTML, Microsoft Producer (WM), PresenterOne for RealOne (Real), SMIL (Real and QT), HTML + TIME (WM)
A clip with synchronised slides, hyperlinks and bookmarks (e.g. web addresses or email addresses)	As above
A clip with synchronised slides, hyperlinks, bookmarks and communication tools (e.g. live chat, discussion forums)	HTML / HTML+TIME, Microsoft Producer with HTML (WM), SMIL 2.0 Code within RealOne Player (Real)
A clip with synchronised slides, hyperlinks, bookmarks, communication tools and shared software (e.g. a Microsoft Word document)	HTML with Windows Media and NetMeeting ActiveX plugin (WM)

Table 11.1 Some options for displaying streaming video

Embedding clips with HTML

You may play a video file from a web page by creating a simple text hyperlink on the page using a text editor or an application like Microsoft FrontPage or Macromedia Dreamweaver. When the user clicks on the hyperlink, the appropriate player opens up as a separate application and the user can view the media file as it streams from the server. The very simplest option is when you are streaming from a normal web server. You create a link `My Real File`. Creating a link to a streaming server is slightly more complex. A link to a Windows Media streaming server looks like `` and for a RealServer ``.

The letters to the left of the “//” refer to the protocol being used to control the stream - “mms” and “rtsp” (for a normal webpage the protocol is “http”). Unfortunately, Netscape Navigator cannot interpret this protocol properly for either file type. There are two options: use something called the *ramgen* pointer (which comes on a RealSystem Server) or create a simple auxiliary text file.

To use the *ramgen* option, say to run a RealMedia clip that will work in Netscape, you must create a special `http://` web address link in the following format that links to the RealMedia file: `Click me</`

For more on HTML+TIME see www.microsoft.com

Microsoft Windows Media Home Page: www.windowsmedia.com

a> You replace the *[text and brackets]* above with RealNetworks' server location, port number and filename for your RealMedia file. Thus the actual link will look something like this ` Click me ` Note the port connection to the server (8080) also needs to be specified.

Ramgen is a pointer within an Internet address (URL) to redirect HTTP calls to the RealNetworks' server as RTSP calls. The alternative to Ramgen is to create a .ram redirection file (the equivalent in Windows Media is .asx). You may want to create a .ram/.asx file, for example if you need to define a pseudo-stream from a CD-ROM. The .ram file redirects the server to the location of the media clip and provides the protocol for dealing with the file. The .ram or .asx files are simple text files that can be located anywhere on the web server. Links on the web page should be pointed at the .asx or .ram. However, before you begin to panic, it is actually much easier than it seems. Both of the *wizards* in Windows Media and RealNetworks' Producer help you to create the HTML code as well as the appropriate .asx or .ram file.

Synchronised slides and video

There are several options open to developers for producing more complex, integrated media. One of the most important is **SMIL** (Synchronised Multimedia Integration Language, pronounced "smile", currently version 2.0) a HTML-like World Wide Web Consortium (W3C) specification markup language which enables simple authoring of multimedia presentations that integrate streaming audio and video with images, text or any other media type. It does this by dividing the different media components into separate files and streams, then displaying them together on the user's computer as if they were a single multimedia stream. For example, SMIL is commonly used for delivering audio and video together with a slide presentation and perhaps links to handouts. Current desktop versions of QuickTime player and RealNetworks' player support SMIL. Microsoft have developed an alternative, SAMI (Synchronised Accessible Media Interchange), similar to SMIL, but supported only by Microsoft products, including Windows Media Player. Internet Explorer 5.5 (or later) also supports a protocol called HTML+TIME based on the SMIL 2.0 specification. Both SMIL and SAMI are easy-to-learn HTML-like languages, and authors often write SMIL and SAMI presentations using a simple text-editor. It is possible that the two formats will eventually merge.

How to SMIL

Within the code you can define the metadata, the presentation layout and the media files you need to access together with their synchronisation timings. SMIL provides a time-based synchronised environment to stream audio, video, text, images and animation. A SMIL file (with a .smi extension) defines the layout and sequencing of the media clips. Sequential (`<seq>`) and parallel (`<par>`) tags allow you to specify that clips should be played either one after another or at the same time.

Using a SMIL file to control a presentation means that a slide stream can be run in parallel with a presenter's video stream, scrolling or ticker text can appear and live links to other web pages or media can be built in. RealNetworks have added some extensions of their own to the SMIL standard and have defined two additional data types:

- RealPix (with a .rp extension) allowing you to stream a sequence of graphic images as a series of JPEGs and to control the timing
- RealText (with a .rt extension) allowing you to provide a stream of scrolling or tickertape text (text scrolling across horizontally)

Below is a simple example of a basic SMIL file:

```
<smil>
<head>
<meta name="example" content="example smil file" />
<meta name="author" content="click and go video" />
<layout>
<root-layout background-color="black" width="655" height="400"/>
<region id="VideoWindow" top="5" left="5" width="200" height="160"/>
<region id="Presentation" top="5" left="210" width="440" height="330"/>
<region id="Link" left="5" top="170" width="200" height="200"/>
</layout>
</head>
<body>
<par>
<ref region="Link" src="Weblink.txt" />
<seq>



</seq>
<video region="VideoWindow" src="Video.rm"?duration=0:30.00"/>
</par>
</body>
</smil>
```

The **<meta>** tags apply **metadata** to the SMIL file whilst the **<root-layout>** tag defines the properties of the presentation window. The **<region>** tags specify the areas (exact distance from the top and the left of the original window and the width and height of the new area) for images and video to be displayed by the player. The **** / **<video>** tags specify which files are to be placed in the defined regions. For best playback results, put the SMIL file and any GIFs, JPEGs and Macromedia Flash on your web (HTTP) server and the audio/video files that you wish to stream on your streaming server. The output layout produced from the above code would look something like:

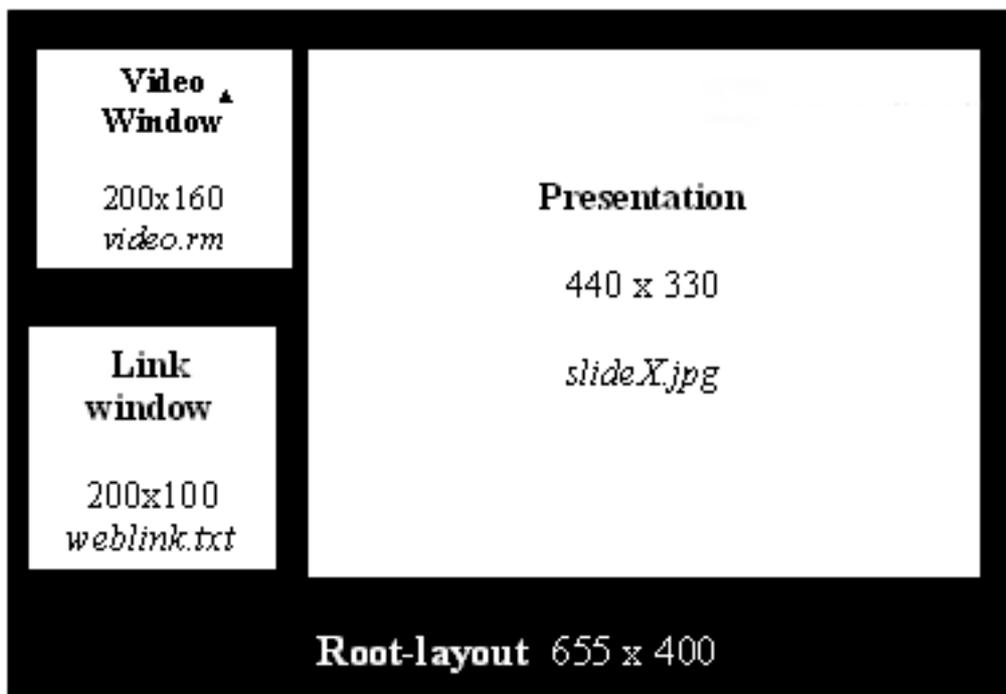


Fig 11.2 The layout created by the SMIL code shown above

Metadata - "Meta is a prefix that in most information technology usages means 'an underlying definition or description.' Thus, metadata is a definition or description of data" (Whatis.com)

Grins Editor for RealOne (around £250) is an authoring environment for creating, editing and maintaining streaming media documents that are targeted directly to the RealOne player. This includes support for the three-pane player environment and SMIL 2.0 authoring capabilities. www.realnetworks.com/products/editorpro/index.html

SMIL has many advantages and creation possibilities, such as:

- A combination in real-time of many different types of file, such as video, audio, text, images and Macromedia Flash in real-time.
- Your original content remains intact. You do not need to edit and merge clips into a single streaming file. To make any changes you simply need to edit the SMIL file.
- You have complete control over how your presentation is displayed, i.e. its layout and the timing in which events occur, such as slide changes, audio track change or the start of an animation.
- You can use different files from different locations. SMIL uses links, much in the same way as HTML, to locate clips or other such files.
- A major advantage is to be able to offer different presentations dependant on your users. For example, different languages, either through audio soundtracks or subtitles. You can also define bandwidth usage, e.g. the more bandwidth your user has, the more complex you can make the presentation.

There are several software programs available that assist in the creation of SMIL presentations. RealNetworks endorse products such as **Grins** 2.0 (www.oratrix.com). However, you do not really need to purchase software to create SMIL. As it is a mark-up language, you nearly need a text editor.

Presentation software

If the joys of SMIL seem intimidating, fortunately here are two easy-to-use alternatives.

Microsoft Producer for PowerPoint 2002

Windows Media Player does not contain the functionality for displaying rich media from within itself. Instead, Windows Media Video (WMV) files are embedded into a web page and controlled via HTML. This allows any web-based compatible media to be synchronised with the video/audio file of your choice. A disadvantage of this approach is the complexity of creating such presentations. To help the user in creating online presentations, Microsoft has released *Microsoft Producer for PowerPoint 2002*. This free application synchronises your video media with Microsoft PowerPoint,

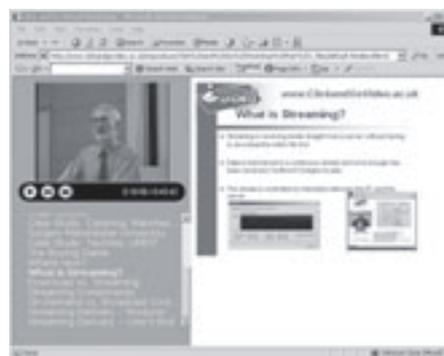


Fig 11.3 Example of a Microsoft Producer presentation

HTML, images, audio and also other video sources. This is a very capable *wizard*-based package, although you will need to have Microsoft Windows 2000 or XP and have Office XP installed. Your end users require the latest version of Internet Explorer (version 5+) to view your content and ideally need the latest Windows Media Player codecs. This raises a general problem. In university contexts it can be difficult to persuade computer lab administrators to keep streaming players up-to-date.

Accordent's PresenterOne Basic for RealOne

As RealNetworks launch the new Helix platform, RealPresenter is replaced by *PresenterOne for RealOne*. It is free authoring software that enables you to create streaming web-based presentations for the RealOne player. Using the *wizard* it is quite straight forward to add and synchronise audio and video to Microsoft PowerPoint slides. The free basic version has

For more information on these and RealNetwork's other products and services visit www.realnetworks.com/products/media_creation.html

limited capabilities such as only producing up to 15 minutes of streaming video. The Standard Edition is around £300 and if you wish to distribute presentations live you will also need PresenterOne Live (around £1300). To use PresenterOne your system will need the free Helix Producer Basic which converts live feeds or existing audio and video files into streaming RealMedia files (see Section 9).

For more information see:
www.realnetworks.com/products/producer/basic.html and
www.realnetworks.com/products/presenterone/index.html

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12.

Copyright issues

As discussed in Section 7, if you did not create the material resources yourself you must get permission to use it from the person who controls the rights.

Who owns the copyright?

In the UK a person's work is automatically copyrighted. As a result there is no copyright-free material, whether there is a copyright statement © or not. However some material may have had its rights waived or the rights may have expired. Particularly relevant to video is that a person's own image is also their property. Thus, if you wish to film someone you should have them sign a release form. We have produced a release form template which you may use. This can be found in Appendix 2 as well as downloaded from www.ClickandGoVideo.ac.uk.

Does copyright still apply on the Internet?

The 1988 Act has made protection of work “*technology neutral*” so that recording the moving picture is still *a film* no matter what medium it is on. “*Under UK law, it makes no difference how the work is stored or published, copyright law still applies.*” (Source: www.copyrightservice.co.uk/copyright/copyright_questions.htm) Computer programs are also protected as literary works.

Education and off-air recording of broadcast materials

Section 34 (1) of the 1988 Copyright, Designs and Patents Act gives educational institutions the right to record off-air for educational purposes any radio & television broadcasts and cable programmes without infringing copyright. In addition to this, a certified licensing scheme is in place for members of educational institutions.

Recording for educational purposes

The Educational Recording Agency (ERA- www.era.org.uk) administers a licensing scheme on behalf of (among others): BBC (TV & Radio), Channel 4, Channel 5 and ITN. The ERA Licence allows members of educational institutions to make recordings of broadcast materials by ERA members (either at work or at home) for bona fide educational purposes. This Licence includes feature films and advertisements. Most educational establishments in the UK hold an ERA Licence.

Many cable and satellite broadcasts originate outside the UK and are made and transmitted by non-ERA members. Since there is no licensing scheme for these broadcasts, Section 35(1) of the 1988 Act allows recording for educational purposes.

The ERA Licence allows:

- Recording, playing back and copying (including transferring from an analogue to a digital medium) of broadcast materials for educational purposes is allowed. These purposes include the delivery of educational objectives to registered

To find out if your establishment does hold an ERA Licence you can contact The ERA on era@era.org.uk

students of the educational establishment, but not performances to audiences who pay, or for entertainment, or to promote the institution.

- Extracts from broadcasts can be recorded, compilations of extracts from different programmes can be made, recorded programmes can be edited (as long as the recording is not adapted, e.g. by substituting another soundtrack).
- Copies of recordings can be made, as long as they are not sold or hired out.
- Copies can be lent to students provided that they use them only for educational purposes. (Many universities advise against this, since it is difficult to control the use that students might make of copies of recordings.)
- Commercially bought or hired tapes or videos cannot be copied under the terms of the ERA Licence. It must be the version that was originally broadcast e.g. on television.

Recordings made under the ERA Licence must be labelled with the date and title of each recording, together with the statement “*This recording is to be used only under the terms of the ERA License*”.

Video and online courses

It is very unclear where legislation stands on how recorded video, e.g. a television show, can be used as part of an online course by an educational establishment. Current thinking is leaning towards allowing such recordings to be used within an online course for which students must be registered. Thus broadcasting the video to the wide world is prevented. If you are in doubt you should always seek permission from the owner of the material.

Paul Jackson and Sally Thornhill

Copyright Further Resources:

The British Universities Film and Video Council (BUFVC - www.bufvc.ac.uk) will supply copies of any TV broadcast on terrestrial television since 1st June 1998 to establishments holding an ERA Licence.

The UK Copyright Service:
www.copyrightservice.co.uk

The 1988 Copyright, Designs and Patents Act:
www.hmso.gov.uk/acts/acts1988/ukpga_19880048_en_1.htm

13.

'Live' broadcasting

This Guide mainly focuses on the process used to produce streaming media for **on-demand** viewing. In this Section we will examine the process you face if you decide to choose to broadcast your event **live**.

On-demand: videos which are available as an archive library on a server, for students to access when they wish.

Live: video which is fed to a server as it is recorded, rather than being pre-recorded and accessed later

The advantages of live capture

- The opportunity for extending the reach of your event (typically a lecture) to a much greater audience is probably the most common reason for the use of live broadcasts. For example, you would be able to lecture to numerous classes in various universities or bring distance learning to individuals who are unable to attend the live event.
- Streamed live events can include two-way communication. For example, the student can communicate with the lecturer as the broadcast takes place through the use of live text chat.
- It is also possible to archive your event for future reference while simultaneously streaming it. The output encoded by the computer is merely recorded to the hard drive for access later.

The disadvantages of live capture

- Unlike on-demand video streams, much more planning and rehearsing is needed for live broadcast. Planning your shots through a storyboard is still a good approach to ensure the narrative flow of your presentation (see Section 4).
- You will also need a fast connection (512Kbps+) from wherever you are planning to broadcast. This will need to be tested finally beforehand.
- Depending on the size of your audience and the amount of bandwidth they have available, you must have enough network capacity available to cope with demand. As mentioned in Section 10, if you have a large target audience, and not enough bandwidth, your server will be swamped and your live broadcast will greatly reduce in quality.
- One very important tip: if it is at all possible, you should always have a backup encoding machine that you can turn to should disaster strike. This is especially true if you are broadcasting an important or prestigious event.

How to set up your equipment to broadcast live

As well as the camera, tripod, lights and microphone discussed in Section 5, you will also need the following technical equipment. The diagram below shows how the equipment is connected (Figure 13.1).

Live encoding software

To stream a live broadcast you will again need a piece of encoding software. It is best to use either Windows Media Encoder or RealNetworks' Producer in these situations as they are the most capable and are specifically designed for this purpose.

Streaming server software

As mentioned in Section 10 you will need server software capable of accepting a live stream. Again, both Windows Media Server and RealSystem Server can handle live streams. Windows Media Server can accept Windows Media streams from both PCs and Macs. RealNetworks' new Helix Universal Server accepts Real, QuickTime and Windows Media streams from either PCs or Macs.

Hardware

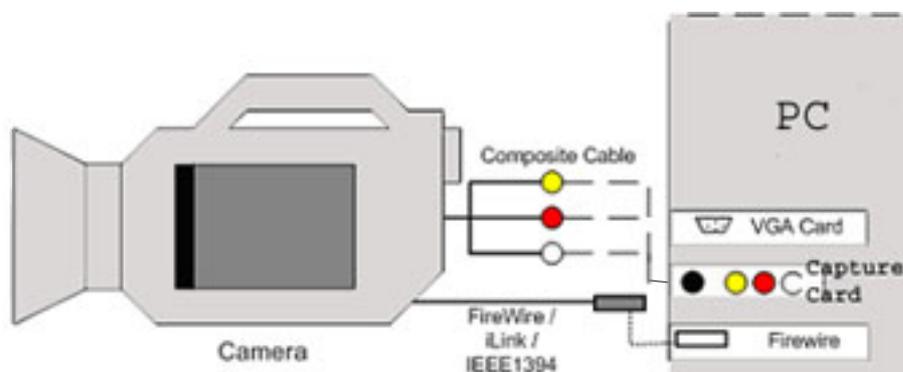
Unlike capture cards for on-demand delivery, live capture requires different technology. These capture cards range from standard TV viewing cards, which are cheap and readily available, all the way up to the high end, Osprey capture cards. These types of cards are used if your source (e.g. camera, video cassette player) uses an analogue connection. However, if you plan on using Windows Media on a PC or Mac in conjunction with a digital camera, you can use FireWire to connect your camera for streaming. This will produce a very high quality input to the computer and will also be cheaper.

Fast Connection to and from the streaming server:

Any Internet connection speed from ADSL upwards (512Kbps +) should produce a reasonably quick and stable stream to your server. However, you will need far more bandwidth coming out from the server. A LAN connection (such as JANET) to a fast network infrastructure is the most desirable.

With analogue connections, connecting a device such as a camera for live streaming is very similar to the connection of a video cassette player (see Section 7). You will need either composite connections (red and white are Audio, yellow is video) or SVIDEO (video only) to connect to the capture card. From this point the only configuration required is that of the encoding software itself which varies depending on the product.

Digital connections are even more straightforward. You will need either a PC running Windows 2000, Windows XP, .NET variant or Apple Macintosh with a video connection through FireWire. Both audio and video information is sent down this single cable with no loss of quality.



Paul White

JANET is a private, government funded network for education and research. All further and higher education organisations are connected to JANET as are all the Research Councils. (www.ja.net)

Figure 13.1. Attaching your camera to your computer for live capture

14.

Evaluating the educational benefit

This Section provides advice on how to evaluate educational video streaming initiatives. We propose an evaluation approach, which was used within the Click and Go Video Project. This approach involves a number of principles and a framework as a basis for ensuring that the greatest contribution and benefits are gained from the evaluation. The methodology you might choose depends on the criteria deemed important for the evaluation of your particular video streaming event. Finally, we give some suggestions on how to feed the results obtained from the evaluation into the development of video learning events.

What is evaluation and why do we need to evaluate?

Evaluation is used primarily to assess the impact on learning and teaching of an educational event and to identify the factors that promote or hinder learning for the individual. As such, evaluation is considered to be an essential element in educational design.

Understanding the pedagogical impact of initiatives in Information and Communication Technologies (ICT), such as video streaming learning events, is a difficult task due to the numerous variables involved. The data derived from careful evaluation can identify and demonstrate the effectiveness of a given video streaming event.

Proposed evaluation principles and framework*

The following evaluation framework includes a number of criteria for evaluation, which can be negotiated and agreed with all the partners involved on the development of video streaming resources.

Evaluation principles

Effective evaluation approach is based on three key procedural principles:

- **Collaborative.** The evaluation should include and be organised in conjunction with all those who are involved in the development, implementation and use of video streaming.
- **Integrated.** The evaluation methodology should ideally be integrated throughout the development and implementation stages of the video materials.
- **Formative.** The evaluation should generate feedback throughout the whole process.

The evaluation should provide useful information at three levels:

- **Personal** - insights that contributes to the self-development of each of the individuals involved in the project.
- **Local** - insights that are of value to the course providers and institutions.
- **Global** - insights that are of interest to policy makers, researchers and educators.

*The framework was originally developed by Murray Saunders and Joan Machell as part of the Delta funded project JITOL and is described in Neurope Lab Occasional Papers - NL/6/93 JITOL evaluation Toolset - version 2

It is important to consider the diversity of views held amongst the people involved in a project. For example, some might focus on learning processes; others might be interested in the technology itself. All these assumptions need to be made explicit in order to reach agreement. Equally, it is important to consider the specific context of the learning experience being evaluated, the nature of the interactions that take place and, last but not least, the learning outcomes.

Evaluation framework

In evaluation it is useful to have shared understanding and to reach a consensus on the type of criteria that will provide the kind of information considered the most relevant for those involved, including the project sponsors. We suggest the following criteria headings:

Enabling criteria

These are those criteria that relate to preparation and design, organisation and administration, availability and distribution of resources, etc. Some examples of the kind of things that could be included are: clarity of goals or intentions, ease of access to resources, understanding by participants of what is required, etc.

For example, in all three Click and Go Video Project case study trials we have used the following enabling criteria:

- clarity of purpose and goals of the programme
- access to technology
- technical support to lecturers
- flexibility of access to technology (from home, campus)

Process criteria

Process criteria relate to the actual experience and process of both being involved with and participating in a given video streaming learning event. Examples are: availability of support, amount and kind of interaction, levels of perceived satisfaction and enjoyment, participants' perceptions of the learning environment, etc.

In evaluating the Click and Go Video case study trials we used the following process criteria:

- friendliness and usability of the interface
- understanding of technical barriers
- usefulness of support and archived material
- learner control (issues of self-pace, attention span and boredom)
- motivation
- interactivity with the learning material
- learning benefits
- perceptions of the lecturer or tutor within the video streaming environment

Outcome criteria

Those criteria to examine the learning outcomes of a video streaming event. Examples of the kind of criteria that might be useful here include: effects or impact on participants and/or involved institutions, skills, competencies and insights acquired by those involved, status or nature of knowledge used, etc.

As an example, in one of the Click and Go Video case studies the following criteria was suggested:

- technical flexibility and access to all
- understanding of technical choice and appropriateness
- learner control
- interactivity
- ability to integrate experience from video streaming into own professional learning
- understanding of the pedagogical opportunities and constraints
- greater appreciation of the value of streaming video to lecturers and students
- better exploitation of the potential of streaming video technology in medical education

Methodology

The resources available for the evaluation and, more importantly, the criteria that are decided as important for the evaluation of the video streaming event, might indicate a methodology for collecting data. In addition, there should be congruence between the methodology used for the evaluation and the theory of learning upon which the video streaming learning event is either explicitly or implicitly based. It is, for example, perhaps not appropriate to administer tightly structured questionnaires to those using video streaming as part of a self managed, learner-centred educational programme or course. This might be less insightful than simply asking students (for example, through interviews or focus groups) what they did, why they did it, how they did it and what their feelings are about the whole thing, etc.

It is often useful to take an *action research* approach where all partners are encouraged to collect data and analyse their own contribution and experience. During the Click and Go Video evaluation we included face-to-face interviews with all the partners involved in order to provide an insight on the initial ideas, expectations and concerns at the early stages of the evaluation as well as their observations, concluding remarks and final thoughts at the final stages. A short questionnaire was used to help the case studies representatives to describe what they wanted to do educationally. This assisted the technical, pedagogical and evaluation team to better understand the specific needs and variations across the three case studies. These completed questionnaires contributed to the discussion of the evaluation criteria and methodology. In the light of the criteria suggested, the methods chosen collaboratively to evaluate the educational benefit involved the use of one to one face-to-face interviews and open ended questionnaires with students.

Feeding the evaluation results to the development of video streaming

We strongly suggest analysing the data and reporting to the team (i.e. during the ongoing process of the evaluation) and not merely at the end of the activity. It is nonetheless, towards the end, useful to do an analysis and synthesis of all the data and information collected throughout the evaluation and to write a final report that examines the results obtained from the three perspectives identified, i.e. the personal, local and global.

Both formative and summative reports should examine the results obtained in the light of the initial criteria proposed for the evaluation and make judgements about the extent to which each criterion has been met. The relationship between the criteria met and the results obtained will point to the learning benefit obtained. A critical feature of the evaluation might be the identification of contextual and unexpected factors that influence both the results obtained

and the learning gains observed. The identification of factors such as unpredicted barriers to access to the technology can inform future trials and applications of the planning and use of video streaming. In summary, it is essential that the findings reach everyone and that they are shared and discussed with all those involved in a regular basis. To ensure that findings and suggested improvements are taken up, you might find it useful to develop a process that will ensure that evaluation actively feeds into the design and implementation of future video steaming development.

Vivien Hodgson, Maria Zenios and Mireia Asensio

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Section 14

Evaluation Framework Murray Saunders and Joan Machell, Delta funded project JITOL. Neurope Lab Occasional Papers - L/6/93 JITOL evaluation Toolset - version 2

Appendix 1.

Technical and implementation survey

To save you time and effort later, it is important that you are fully aware of your technical situation with regards to your institution and your students at the planning stage. In addition to completing the Click and Go Video Decision Tool in Section 3, we recommend you use the following checklist and find out the answers to the questions before starting your video project:

1) Will the majority of your students be watching the videos from *on-campus* or *off-campus*? (please tick one)

on-campus – continue to question 2

off-campus – skip to question 3

2) What procedure is in place to ensure software versions are kept up-to-date on public computer clusters? (please state)

3) What is the average Internet connection speed from this location? (please circle one)

Slow (modem)	Medium	Fast (LAN)
--------------	--------	------------

4) Which media player(s) will be used by your students? Please state which version. E.g Windows Media 7

Windows Media RealNetworks QuickTime Other Please state _____

5) Which browsers are available to your students? Please state which version. E.g. Internet Explorer 5

Internet Explorer Netscape Opera Other Please state _____

6) Can the students' machines play sound? (please tick one)

Yes – the machines have soundcards and speakers

Yes – but the students will need headphones

No – there is no soundcard on the machines

7) Is there a firewall or any other other security issues blocking access to videos? (please tick one)

No

Yes Please state _____

8) Will the video be broadcast live? (please tick one)

Yes

No

9) Do you have access to a Streaming Server? If you do, what software is licensed on it? (please tick one)

- RealSystem
- Windows Media
- QuickTime
- Other streaming server
- No streaming server (please state below how you intend to deliver your stream)

10) How many viewers can the network capacity and streaming licence handle at once? (please state)

11) Is there anyone else in your institution using up the streaming network or licence? (please tick one)

- Yes No

12) How will you free up the time needed to plan, shoot, edit and encode the videos? (please state)

13) Have you got access to filming equipment you will need for streaming videos? (please tick)

- Camera
- Microphone
- Computer
- Software

If you did not tick any of the above questions, how do you intend to get the equipment?

14) Is there any audiovisual support available to help with filming and equipment? (please tick one)

- Yes No

15) Is there any technical support staff available to aid you with streaming questions? (please tick one)

- Yes No

Sally Thornhill

Appendix 2.

Checklist for taking on location

Date: ___ / ___ / ___

Location:

Subject:

Equipment

- Camera
- Fully charged battery(ies)
- Power lead
- Video tapes
- Spare Video tape
- Tripod
- External microphone
- Light, stand and any diffuser
- Release forms
- Parcel tape
- Extension leads
- Conversion plugs -audio- phono to jack; large stereo jack to small jack
- Conversion plugs -video- composite to s-video
- Disabled screensaver on your computer
- Presenters material digitised

Checks

- Camera angles
- Position.
- Comfortable place for camera-person
- Lighting
- Sound
- Ambient sound such as slamming doors, trains, etc
- Power source location
- Internet connection (IP address: _____)
- All your equipment links together and works
- Does the subject move or stay still?

The Subject

- Wearing plain dark colours
- Perched on a desk
- Sitting down
- Podium
- In front of a plain background

Shooting tips

- Keep the camera still - use the tripod (or improvise) to steady the camera
- As little panning, tilting and zooming as possible
- Concentrate on the presenter and cut out as much unnecessary background as possible but beware in case they suddenly move out of shot
- Lighting from the front is usually recommended to reduce the number of shadows, however some experts believe more creative side lighting can be beneficial

Sally Thornhill

Appendix 3.

Release form

Name (Please print): _____

I consent and agree that <your institution>, its employees or agents have the right to take photographs or record video of me (and/or my property) and to use these in any and all media and for educational purpose only.

I do hereby release to < your institution >, its agents and employees all rights to use this work in print and electronic form. I waive any rights, claims or interest I may have to control the use of my identity or likeness in the photographs and agree that any uses described herein may be made without compensation.

I am at least 18 years of age, have read and understand the foregoing statement, and am competent to execute this agreement.

Unless otherwise stated, your name and contact details will be kept confidential.

Name: _____

Date: _____

Email: _____

Address: _____

Tel. no: _____

Witness for < your institution >: _____



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