Section 2

Streaming

7 Introduction to streaming media

Introduction

Less than 10 years after its initial development, streaming joined the mainstream of communication media. The ubiquity of the Internet led many multimedia content owners to search for a way to deliver video content over an IP network. Video and audio are a more natural way to communicate than the text and images used for the first decade of the Internet. We only have to look at the overwhelming success of television. Combine live delivery over IP with video and audio and you have streaming.

The first multimedia applications used the Internet just for file transfer to the PC. Once the entire file had been downloaded, it could be played back locally, much like a CD-ROM. This is called download-and-play. True streaming is media content that is delivered to the viewer's media player in real-time. That means that it is transferred at the same rate as it is displayed. So a 10-minute clip will take 10 minutes to download over the network. There is no intermediate storage of the content between its origin and the player. The data is processed as it arrives at the player, and then discarded.

Three developments introduced this seed change in media delivery: the streaming server, advances in compression algorithms, and the improvements to the 'last mile.' Progressive Networks developed a way to control the delivery rate of a file, so that it could be transmitted in real-time. The ongoing developments in audio compression led to codecs that could deliver a reasonable quality music stream at 28 kbit/s. Alongside this evolution of the streaming architectures, the telcos and cable service providers were rolling out broadband Internet to the home. The cable modem and ADSL now could offer download speeds higher than 1 Mbit/s. The delivery of video over IP became a reality.

There have been many startups with innovative codecs but, from a plethora of technologies, the MPEG-4 standards are beginning to dominate. RealNetworks showed it was possible, and have developed a comprehensive range of products for producing, serving, and playing rich media content. Microsoft developed their Video for Windows multimedia platform into Windows Media –

focused now on the streaming of video and audio. It has strong support for integrated presentation graphics for the world of corporate communications. Apple came from the QuickTime multimedia world. A favorite for CD-ROM production, it was later extended to support streaming. It now offers support for a wide variety of media formats, from 3D to audio and video. Both Apple and RealNetworks now support the MPEG-4 standard.

All these products have developed from a background of the traditional rectangular picture that we know from film and television. The focus has been delivery to the PC, but that is not the only possible display.

The world of multimedia is expanding into new platforms, and finding new ways to use old platforms. The production community has requested international standards for the delivery of multimedia content unrestrained by the platform. MPEG-4 has been the outcome of this work. Interactive content can be authored for a whole range of platforms: hand-held wireless devices, games consoles, interactive television. The PC is just one of many means to view content.

MPEG-4 has broken away from the traditional methods of audio/video coding as a two-dimensional rectangular raster used by MPEG-1, MPEG-2, and the H.261 video-conferencing standard. MPEG-4 supports new types of media objects in addition to regular audio and video: three-dimensional (from virtual reality technology) and synthetic video and audio. It supports interactivity at the client and server-side. It is highly scalable and covers resolutions from a thumbnail size image suited to mobile wireless applications, to high definition for digital cinema.

Audio- and video-conferencing

Video-conferencing has much in common with streaming. Much of the streaming codec development started with the H.261 and H.263 video-conferencing standards. The latest, H.264, is called the advanced video codec (AVC). The real-time protocols also are shared by conferencing and webcasting. But there are also major differences. Video-conferencing demands very low latency so that natural conversations can be held; for webcasting the propagation delays and processing latencies are not important – if it takes 3 or 4 seconds for a live webcast to arrive it is of little concern. Another difference is the connection. Video-conferencing is peer-to-peer between at least two participants; in contrast, webcast streaming is server–client.

What are the applications of streaming?

Streaming media potentially can be employed wherever the CD-ROM or videotape previously has been used for content distribution. The initial applications very much followed the functions of the CD-ROM: training, corporate communications, marketing, and entertainment.

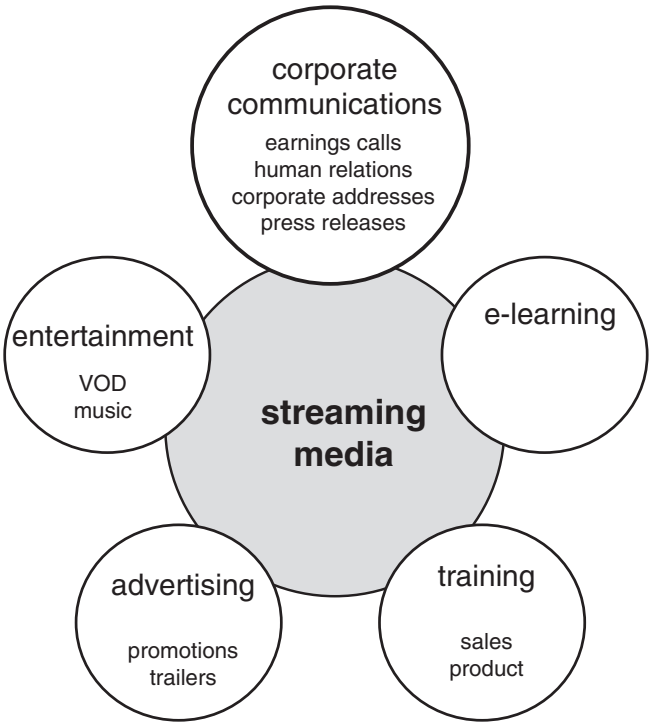

Figure 7.1 Streaming media applications.

Legacy formats

Before streaming media was developed, if you wanted to distribute a live broadcast to a multiple-site corporation, the main option was to rent a satellite transponder for the duration of the presentation. The cost for the distribution is not inconsiderable; in addition to satellite time, there is the rental of the uplink truck. The next problem is that most businesses do not have many television receivers. How many times have you taken a VHS tape home because it was the easiest way to view it?

The alternative for prerecorded content is the videotape cassette or CD-ROM. The tape is fine for linear programming (except for the just-mentioned lack of televisions), but is totally unsuited to random access. This was the strength of the CD-ROM. First, it can be played back on a PC, ubiquitous in the office. Second, the viewer could use interactive navigation, essential for applications like training.

The drawbacks with tape and CD are the duplication and distribution costs. There is also the delay while material is shipped out, so it always lacks the immediacy of a live broadcast.

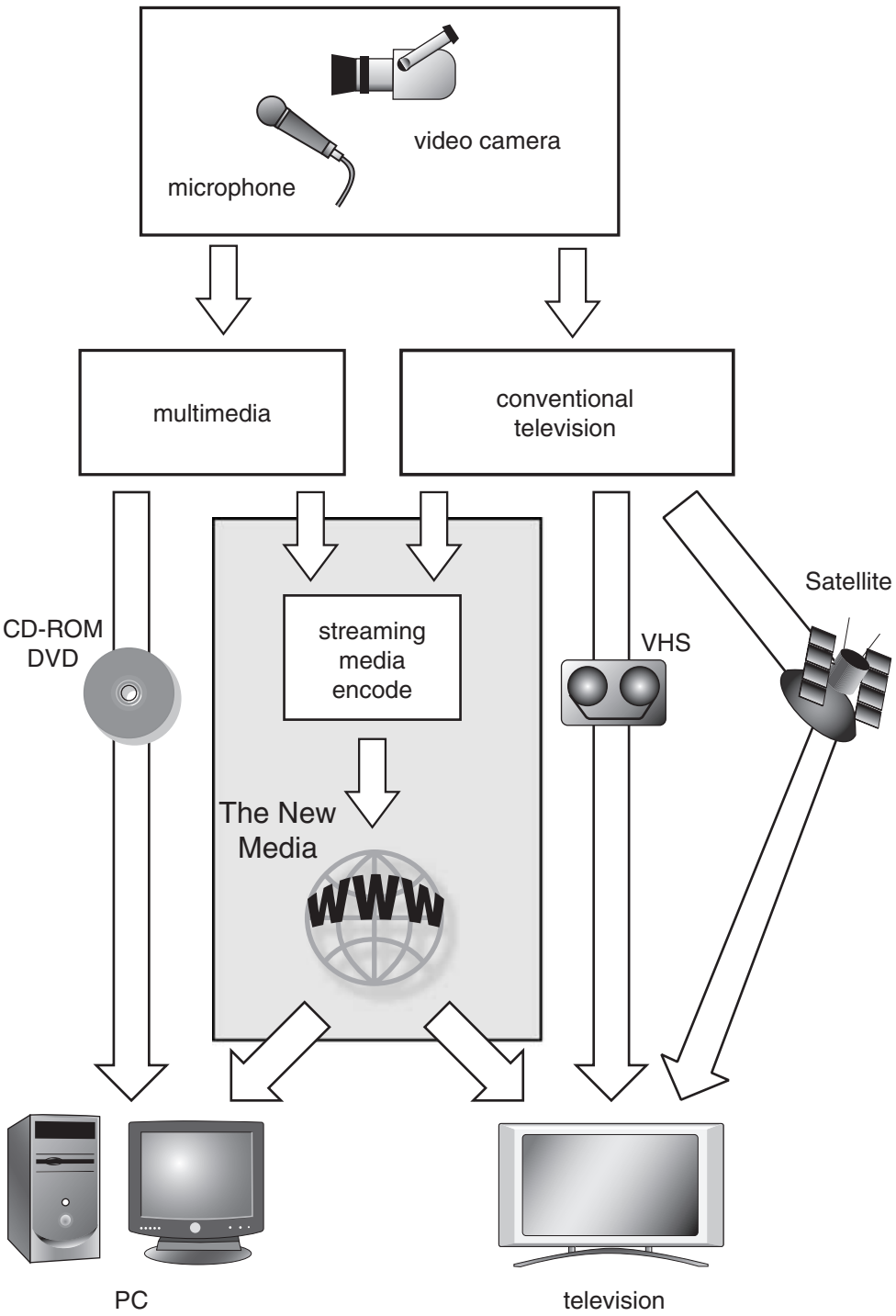

Figure 7.2 Streaming media as an alternative to videotape, satellite, and the CD-ROM.

The other form of distribution was on-demand. If you want a training presentation, you look up a suitable tape in a catalog and order a VHS tape for overnight delivery. When it arrives the next day, you preview the tape and find it is not what you want. Three days could elapse before you have the correct tape in your hand. With streaming media you can browse the online catalog, preview a clip, then once satisfied, download the stream. The whole procedure may have taken 15 minutes.

Which is the most productive? Which has the highest distribution costs? Streaming can replace the videotape cassette and courier, just as the PDF file has replaced the wait for a catalog in the mail.

If you were to adopt streaming, it is quite possible that the corporate wide area network can be used. If it does not have the capacity, the Internet infrastructure also can be used. One of the big advantages is that most of the audience can watch from their desktop PC. Home-workers or the field sales force can even dial up a company extranet server to watch on a laptop.

Corporate communications

Streaming opens up a whole new way to communicate. Until the advent of streaming, if a company executive wanted to communicate to the organization, the options were limited. A group e-mail could be sent out but it lacked impact, and would be buried in all the other messages. The alternative was to hire a conference facility in a suitable venue and make a stand-up presentation. Although effective, the cost of the latter option is considerable, both in time and money.

Using streaming media a webcast can be made from the CEO's office direct to all the staff, over the corporate WAN/LAN. The VP of Sales can address customers using the company extranet – the opportunities are endless.

The more natural feel of video and audio can be used as an adjunct to press releases, to give a more direct communication of important news. Investor relations can benefit greatly from streaming. It is becoming *de rigueur* to stream the quarterly earnings call.

Distance learning

Distance learning, often called e-learning, takes a big step forward when you can add video and audio content. One problem that distance learning has always suffered from is a high drop-out rate. In the past it has been limited to communication via e-mail and the telephone. Streaming now presents the opportunity to add video to help to convey facts and information in a far more compelling way. Video can help the student relate to the tutors, giving a boost to the success rates of the courses.

Product and sales training

This is rather different from distance learning, in that it is more likely to be aimed at a group of staff or customers, as opposed to the one-to-one interaction of e-learning. For product training, streaming can replace the traditional slide presentation with a rich media show – slides, video audio, and text – plus the opportunity for interactivity with web meetings. Of course it could also be a one-to-one training session – the boundary between e-learning and e-training is blurred.

Advertising

Many surveys have shown that streaming media users spend more online, so they are suitable targets for Internet-delivered advertising. Streaming ads are one step further than the banner ads of the web page. The technology has to be applied with care. Viewers will not be pleased if the result of a stalling download is a commercial for a loan they do not want.

One of the first major applications for advertising was the movie trailer. Streaming is an obvious vehicle, offering on-demand video teasers for upcoming films. The music business has also adopted streaming as part of interactive rich media promotions for new albums.

Entertainment

In some circles streamed entertainment has gained notoriety after the blatant abuses of intellectual property rights practiced by peer-to-peer content distribution systems like Napster. The widespread distribution of entertainment calls for an industrial-strength rights management solution to protect the potential revenues. Entertainment did get off to a slow start. Who wants to pay to watch a jerky, fuzzy video over a dial-up modem? The advent of broadband to the home changes all that. With high-performance content delivery networks and ADSL or a cable modem, the viewer can now watch at a quality that is comparable to VHS. Pay-per-view becomes a viable proposition.

The streaming architecture

There are four components to a streaming architecture:

- Capture and encoding
- Serving
- Distribution and delivery
- Media player

Capture and encoding take the raw audio and video from the microphone and camera and process them into a compressed computer file. These files are then stored on a content server, which has special software that can control the real-time delivery of the stream.

The distribution channel connects the server to the player. This may involve many interconnected networks and cache servers. The network may be anything from a local area network to the Internet. Distribution can use digital rights management (DRM) to protect intellectual property.

The media player, usually a plug-in to a web browser, receives the stream and decompresses back to regular audio and video, where it can be displayed on the PC.

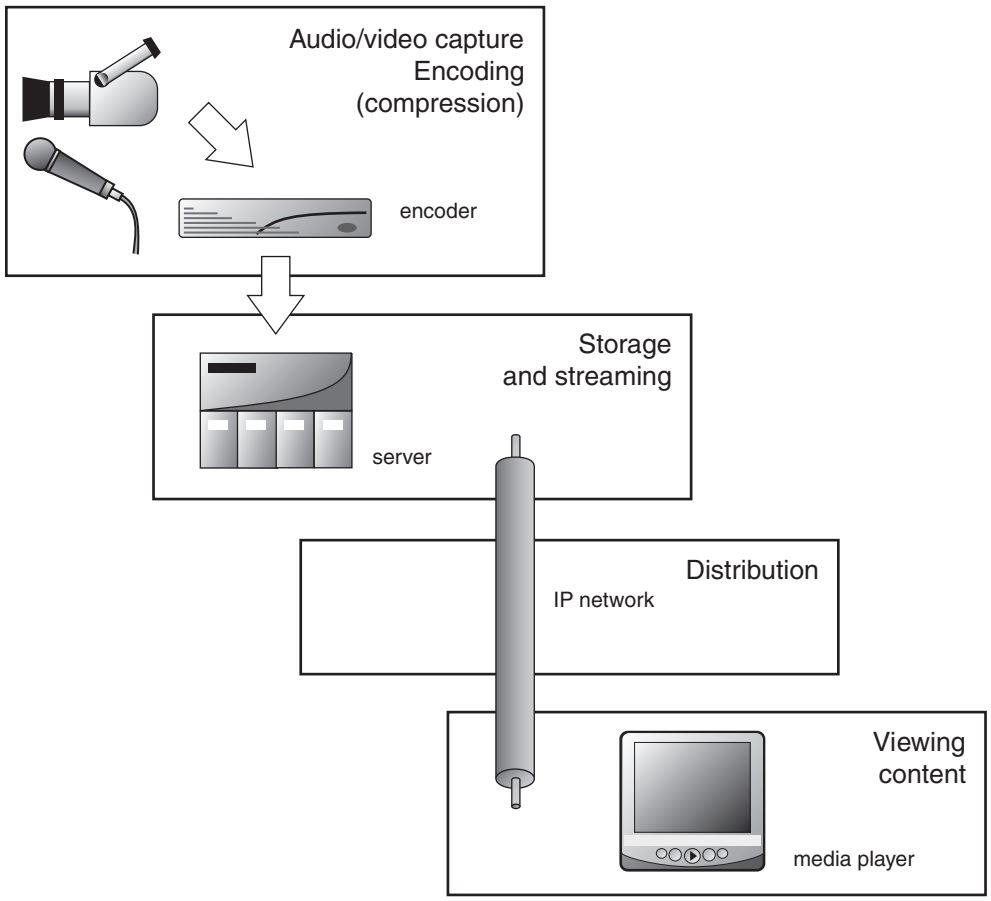

Figure 7.3 The four stages of streaming.

Capture and encode

The capture and encode processing takes regular audio and video signals in a television format and converts them to a streaming file. There are a number of stages to this:

- Capture to computer file format
- Compress the media data
- Packetize data with hints or index

A straight video signal cannot be handled by software until it is in a compatible format, typically AVI. A video capture card installed in the capture workstation converts analog or digital video and audio into the AVI format. The card most likely also scales down the picture size to one-quarter of the original resolution. This gives a data rate that can be handled easily by the processor and ease the storage requirements for the final file.

The compression algorithm is embedded in a software application called a compressor-decompressor, or *codec* for short. The compressed takes the raw audio/video file and reduces the data rate to match the bandwidth available for streaming. The decompressor is found in the media player, and renders the data stream back to audio and video. The encoder also wraps the data with special hint or index metadata that the server uses to control the real-time delivery. Note that the compression and stream wrapping do not necessarily have to be from the same software vendor. As an example, QuickTime can wrap many different codecs, with Sorenson being one.

Serving

The encoded file is uploaded to a server for delivery out to the network. The server is a software application, like a web server, rather than the physical server hardware. A streaming server is more than just a fancy file server, it controls in real-time the stream delivery – this is what sets it apart from similar products like the web server.

Streaming versus download

Downloading was the normal way to receive files over the Internet. We are used to requesting a web page, then waiting an indeterminate period while all the files for the page are downloaded to the web browser for rendering. The recall of a page places no special requirements for the network bandwidth. A high bandwidth network will allow rapid delivery; conversely, a large file will be delivered slowly over a narrow band network (28 kbit/s). The process is