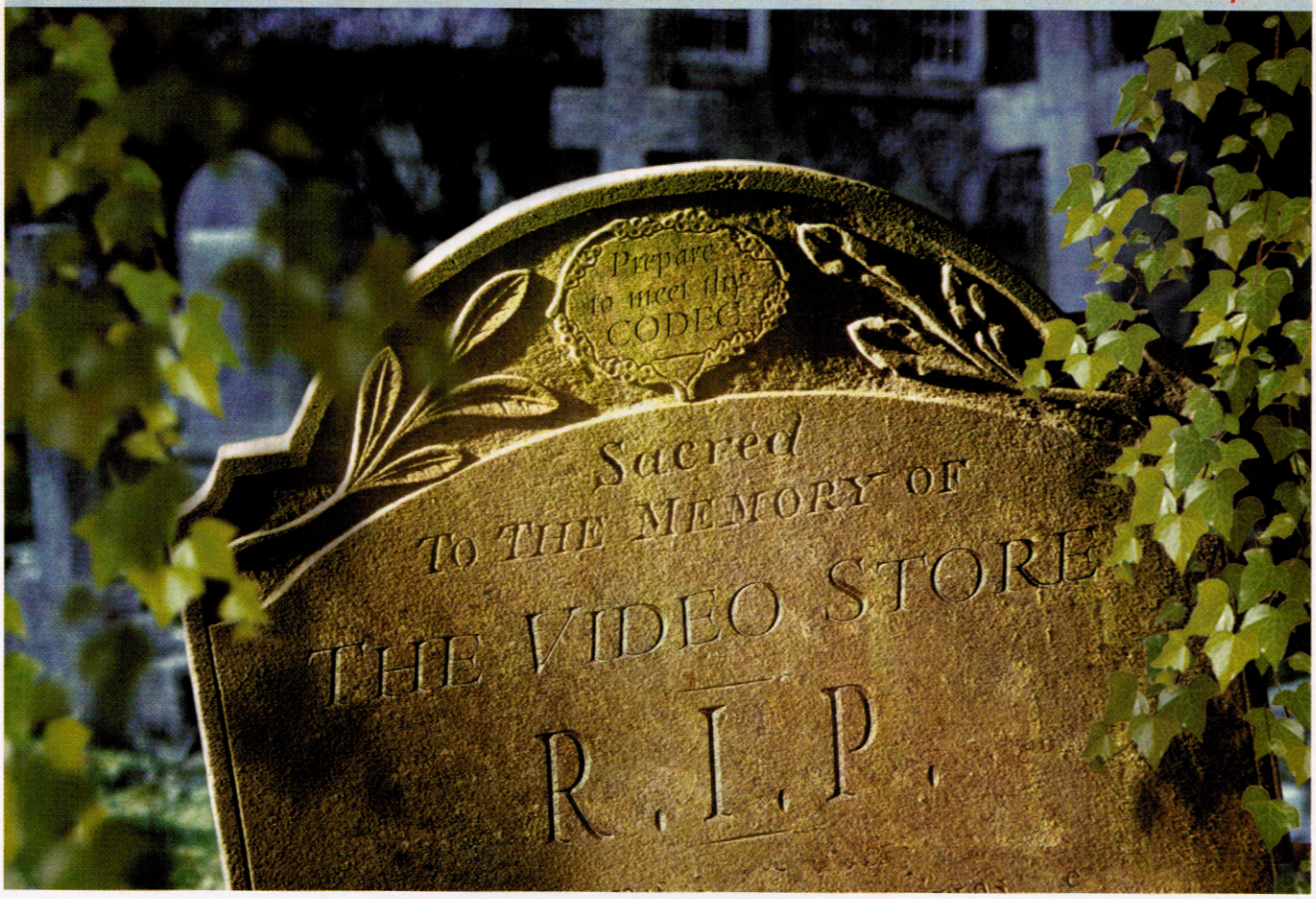

Goodbye to the video store

Streaming video: For too long, "video-on-demand" has promised more than it could deliver. But new ways are emerging for shrink-wrapping massive video files for delivery over the Internet

IT SOUNDS like the movie addict's ultimate fantasy: a TV-mounted set-top box that taps the film libraries of Hollywood's big studios. A film buff could peruse thousands of titles spanning dozens of genres, from enduring classics to the latest blockbuster releases. After deciding what to watch, viewers would enter a password, confirm credit-card details, then sit back as 5.1-channel surround-sound video streams from a remote web server into a home-theatre system in their living room.

Too good to be true? For the moment, yes. Bespoke video-on-demand is at least three years away. But the difference now is that Movielink—a recently formed joint venture between MGM, Paramount, Sony, Universal and Warner Bros—is preparing a collective library for just such a service. The venture intends to serve up an almost unlimited selection of films over the Internet—and, eventually, through a web-connected set-top box.

There is only one problem: the current scheme for converting an average two-hour epic into a digital file results in about five gigabytes of data—equivalent to five billion letters of the alphabet (ie, close to a billion words in English). With each byte comprising eight binary digits (or "bits"), a typical movie contains no less than 40 billion bits of data. Trying to stuff that many zeros and ones through the copper lines that link most homes to the Internet—even via a broadband DSL (digital subscriber line) or cable modem connection—would take all day. If there is ever going to be a profitable online video service, content creators in Hollywood and elsewhere must figure out how to squeeze those hefty film files through narrow digital pipelines.

That is where "codecs" (compression/decompression algorithms) come in. These are sophisticated, and often proprietary, mathematical formulae that can quickly scrunch hours of digital video and determine where best to make nips and tucks unnoticeable to a viewer. The end result is a compact digital file.

One of the most prevalent codecs is MPEG-2. Established by the Moving Picture Experts Group in 1994 as a standard for digital television, MPEG-2 governs DVDs, satellite TV and digital cable content. This requires a minimum transmission rate of two megabits per second for video scenes with little movement in them and up to 80 megabits per second for action scenes, so there is little hope of sending MPEG-2 video to homes using even the fastest of Internet connections available today—which, at best, barely break the one megabit per second barrier.

More muscle needed

Yet, if the future is indeed "anytime anywhere" video-on-demand, as digital-media buffs suggest, then Movielink, Intertainer and other online film sites will require a codec with many times the compression muscle of MPEG-2. The demand for such a codec is spurring a feverish race ▸▸

"The consumer-electronics makers cannot afford to lose the battle for the set-top box."

between developers all angling to create the *de facto* compression/decompression standard for online video delivery.

There are the established organisations, such as RealNetworks, Microsoft and Apple, each with a video-playing software product (ie, "media player") that exploits the firm's own proprietary codec. With 29m users, RealNetworks hopes to propagate its popular RealPlayer beyond the desktop and into set-top boxes, cell phones, PDAs (personal digital assistants), and anywhere it imagines full-motion video might be feasible. Microsoft is closing in on RealNetworks with its Windows Media Player that is now reckoned to be on some 13m personal computers. Apple's QuickTime comes third with 8m users.

It is the upstarts, however, who are better positioned to rule the future of video-on-demand. For instance, the latest iteration of the Moving Picture Expert Group's standard, MPEG-4, is honed to function smoothly on consumer-electronics devices, which gives it an advantage over Microsoft, RealNetworks and Apple, whose algorithms are better suited for the beefier microprocessors inside desktop PCs. And there are a handful of others, including Pulsent, On2, and DivxNetworks, each hawking their own video codecs to content creators and electronics manufacturers, convinced that their technology is the best for the job.

Ryan Jones, who tracks media and entertainment strategies for the Yankee Group, a consultancy based in Boston, believes that Microsoft and RealNetworks will lead the way on the PC, mainly because they have reliable systems for stemming piracy. But gathering around the computer in the study to view the latest Star Wars sequel is unrealistic. "Consumers want the movie experience in their living room," Mr Jones insists. That is exactly what those developing the newest video codecs are counting on. Mr Jones believes that the first step will be the evolution of the set-top box—the device that decodes the cable or satellite feed for displaying on TV—into a competitive consumer-electronics product.

Such a trend will turn the movie, video and TV businesses upside down. Currently, the design of set-top boxes is largely in the hands of the cable-TV operators, who want to control the kind of content accessible over their networks, such as pay-per-view (they choose the movie, you choose the time). Eventually, however, the cable providers will find themselves ceding control over the set-top box to consumer-electronics manufacturers such as Matsushita, Sony and Philips, on the one hand, and to content creators, on the other. Why? Because both the technological and market forces will simply overwhelm them. As a result, the set-top box will handle video-on-demand from any number of providers. Users will then access the content they wish to see using an Internet-like "browser" displayed on their TV screens. Eventually, film studios will rent or sell new films direct to the public.

The implications of such a trend: declining influence of the movie-distribution chains that hold sway over when and where new films are released; few video stores outside large urban areas; and dwindling attendances at cinemas everywhere. Cable providers will get their cut in the form of payment for opening their networks to third-party content.

Meanwhile, the set-top box will replace the VCR—the greatest single product the consumer-electronics industry ever produced, and one which, at its peak, generated half the industry's sales and three-quarters of its profits. That is why the consumer-electronics makers cannot afford to lose the battle for the set-top box.

One codec or many?

For codec makers, the aim will be to become the standard means for compressing all those thousands of movies that will be streamed into millions of homes. Doing so could make one company (or, in the case of MPEG-4, one consortium of patent holders) very wealthy.

Today, it is still not clear whether a single codec will emerge as the prevailing standard—just as MP3 reigns over the audio world. Nor is it yet clear whether future set-top boxes will become more like a PC, with their own microprocessors and built-in software to juggle multiple codecs. The answer could come when some media mogul—say, Jim Ramo, the boss of Movielink—chooses a single codec to compress all his company's content. That would oblige set-top-box makers to build compatible devices, rendering all other codecs instantly obsolete.

In the meantime, few are hanging around for that day to arrive. Instead, codec firms, envisaging an imminent gold rush, are spending millions promoting themselves to content providers and electronics companies. These, in turn, are hoping to avoid the blunders made by the music industry when it failed to embrace the money-spinning potential of MP3 until it was too late.

At the moment, MPEG-4 has a head start in the race to become the prevailing codec for streaming digital video. In essence, MPEG-4 is a set of technical specifications that define a patented process for compressing and decompressing video. Because nearly 90% of Internet users connect over a dial-up line, the previous version of the codec, MPEG-2, would quickly clog the pipes. MPEG-4 tackles this problem by slashing the bandwidth requirements to as little as 40 kilobits per second—some 50 times leaner than MPEG-2—while preserving clarity. At higher bit rates, MPEG-4 manages near-DVD quality.

The trick MPEG-4 uses to render crisp video without hogging bandwidth is a process known as "object-based compression". Previous MPEG schemes simply divided each video frame into a grid, then tagged each block with a unique data signature. MPEG-4 begins with this strategy but takes compression a step further. Instead of capturing the sum total of each frame, MPEG-4 considers separate regions within the picture and decides how to handle them on the fly. For example, if the background between two consecutive frames remains unchanged, while the foreground varies, MPEG-4 will compress the static background and treat the image as a still picture. As MPEG-4 streams video over a network, static backgrounds are sent once, reserving bandwidth for dynamic parts, which have to be compressed and retransmitted as they shift positions.

Overall, MPEG-4 incorporates 23 different mathematical profiles. These enable users to adapt its algorithms to operate on a variety of devices, including pocket PCs and set-top boxes. Despite that, Mr Jones reckons that other, newer codecs could win the battle to rule the set-top box. The reason is MPEG-4's tough licensing terms. Anybody wanting to integrate MPEG-4 into a particular video streaming device must pay stiff royalties to a group of 23 companies, which together own several hundred related patents.

Between them, the consortium members have established an independent licensing body called MPEG LA to hammer out royalty agreements between MPEG-4's patent holders and the companies hoping to use the codec. Larry Horn, vice-president of licensing and business development at MPEG LA, explains that the licence is non-exclusive, giving any

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firm the right to negotiate a royalty deal.

The terms of those agreements, however, are still up in the air. Initially, MPEG LA introduced a scheme that would require companies employing MPEG-4 in their technology to pay a 25 cents royalty for every machine with a copy of the codec incorporated, plus a "per use" fee of two cents an hour. In other words, if a viewer watched a video encoded in MPEG-4 from CNN's website, the news network would have to pay patent holders a royalty. Although the proposed amounts were small, MPEG LA made no allowance for differing content types, free or otherwise. If, for example, tens of millions of people suddenly began downloading a two-minute video clip of the World Trade Centre collapse, the ensuing royalties would bankrupt CNN within days.

Following an uproar from the industry, MPEG LA reworked its royalty arrangements. In July 2002, Mr Horn announced a modified structure that places annual caps on certain types of content usage. Other features include an option for media firms and electronics manufacturers to pay a one-time licensing fee, a per-subscriber charge, or a pay-by-the-minute rate. The last would value a downloaded copy of "Black Hawk Down" at about five cents.

Too little, too late?

Many in the industry believe that MPEG LA's final licensing terms could still suffocate innovation. Apple was forced to delay the release of the latest version of its QuickTime player (version 6.0), which incorporates MPEG-4. Initially, it declared the licensing terms too onerous. Apple relented once MPEG LA revised its terms. Douglas McIntyre, head of On2 Technologies, a software company based in New York that has developed a codec called VP5, has been one of the most vocal critics. His company recently posted a tome online, criticising MPEG LA's strategy point by point. "It is a move by a few very large companies to dominate a market and fix prices," says On2.

Mr McIntyre and others are counting on MPEG LA's draconian licensing rules to steer content creators and electronics firms towards an array of other video codecs. Anybody in the business of using video compression is bound to consider MPEG-4 as well as codecs from RealNetworks, Microsoft and Apple, admits Mr McIntyre. But he points out that other codecs work as well, if not better, and come

with fewer licensing strings attached.

On2's own VP5 technology is one of several emerging codecs that provide potential users with a serious alternative. Streaming at 400 kilobits per second, about half the speed of a DSL connection, VP5-encoded video looks almost as good as images from a DVD. The company guards its compression technique jealously, but Mr McIntyre attributes most of the work to pre- and post-processing tools. These are methods for manipulating digital files before the video is compressed and after it is decoded. To that end, VP5 scrutinises data rates, making on-the-fly adjustments to image softness, colour tone, and pixel size. But with debts of more than $100m, On2 has been seeking new partners. It recently announced a deal to use its codec in chips for set-top boxes and mobile telephones produced by Texas Instruments.

Then there is Jordan Greenhall, a former executive of MP3.com, who amassed a wealth of experience as a broker of "content deals" for that renowned audio portal. Mr Greenhall now heads DivXNetworks of San Diego, California, which is marketing a video codec that aims to reproduce the experience of being in a cinema. DivX began as a cult movement when Jérôme Rota, a computing and digital-video guru, wrote the codec in 1999 to help him crunch graphics. Word spread, and soon DivX video appeared Napster-like on file-sharing networks around the world. So far, more than 12m copies of DivX have been downloaded, and thousands of (mostly pirated) full-length feature films, television shows, music videos, and pornographic movies are circulating the Internet encoded in this popular format.

DivXNetworks, founded recently by Mr Rota and Mr Greenhall to take advantage of the codec's grassroots success, has raised $11.6m in these difficult times for venture capital. Its latest codec, DivX 5.0, is said to be particularly good at preventing "tearing", a playback error that occurs when the software cannot "render" the video for display at the same pace that it is being decompressed and fed into the media player. The overload appears as a frayed line across the middle of the frame. Similar to VP5, DivX 5.0 massages the decompressed video to prevent tearing, dropped frames and other glitches.

Objects beat blocks

One of the newest video-compression tools comes from Pulsent, a Silicon Valley start-up that has toiled for the past four years in self-imposed secrecy. The company claims that its "stealth team of scientists" is developing a codec that breaks the 20-year paradigm of "block-based" compression techniques. Pulsent's chief executive, Adityo Prakesh, is cagy about the specifics. But his company is not without cash, having raised $33.5m from private investors.

According to Mr Prakesh, the Pulsent codec identifies objects on the screen as unique entities. Whereas block-based compression and object-oriented codecs slice up backgrounds and foregrounds into grids, the Pulsent approach actually pinpoints real-world items in the frame—such as a person, tree or building—and processes each element separately to optimise the playback's performance. Mr Prakesh believes that his firm's codec will revolutionise video compression—so much so that he is pumping money into the development of a chip that can encode and decode files in real-time using the Pulsent algorithms. The aim is to get the chip into set-top boxes for video-on-demand services.

It is difficult to verify Pulsent's claims. Experts and rivals are curious but tentative. It is still too early to know which codecs will endure. At this stage, the strategy for most is to get their product into the marketplace and build their brand. That is not the case with Emmett Plant, a 25-year-

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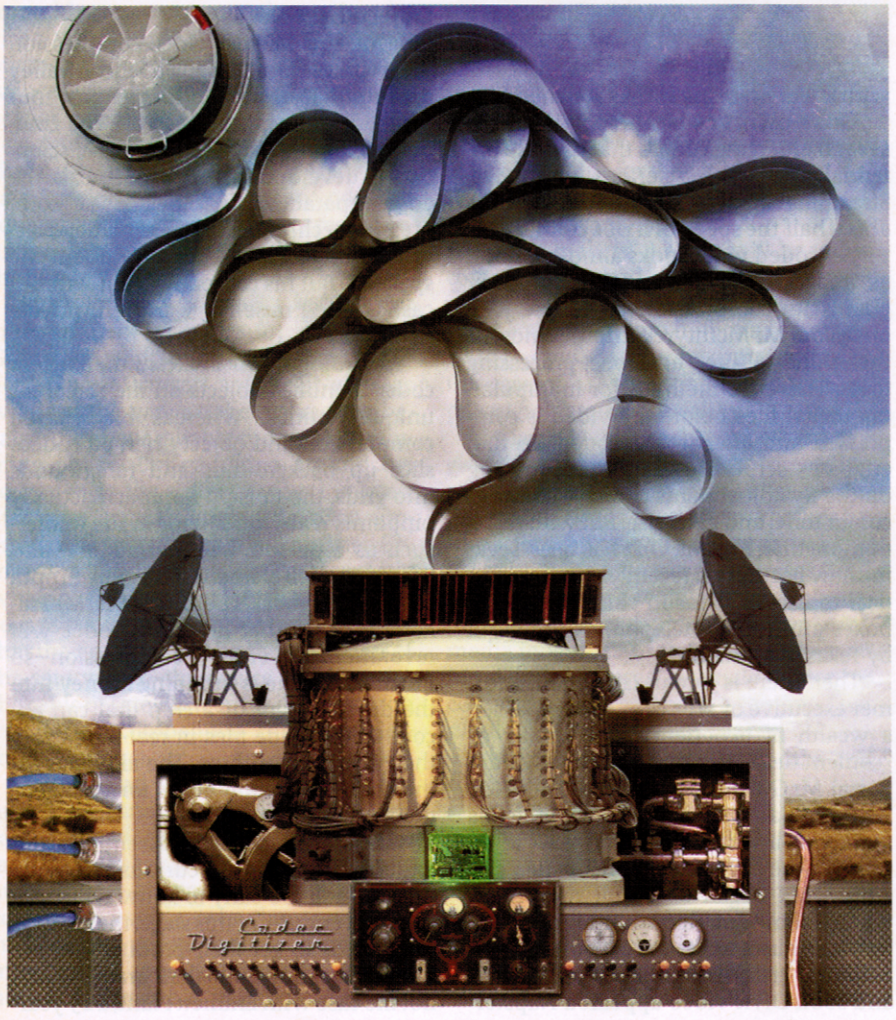
old former Unix engineer who heads a non-profit organisation called Xiph.org Foundation that is developing open-source solutions for multimedia. Mr Plant surveys the codec scramble from above the fray. Surviving mostly on donations, Xiph.org is developing an open-source video codec called Tarkin. What really defines the success of a codec, Mr Plant believes, is its ease of use, adaptability and popularity. He argues that the average consumer wants something that looks and sounds good, and does not care how the film is compressed.

Mr Plant compares Tarkin to Linux, the open-source operating system that has revitalised the Unix community and become a serious alternative to Windows. Linux got a foothold among computer-science students, who were looking for a cheap way to learn programming and downloaded the free operating system. Later, as companies recruited the students as software engineers, Linux infiltrated the corporate world and took over many of the more important server duties there.

Xiph.org sees Tarkin following a similar path. The idea is that as more and more programmers download the codec for use in video playback devices, they will make continual improvements to its freely accessible software. Mr Plant contends that an open-source project such as Tarkin is more likely than a commercial project to produce a high-quality codec, because the motivation behind such volunteer groups is not profit but performance.

Whether Tarkin—or any other new codec technology—succeeds will depend not only on the ingenuity of mathematicians devising the new algorithms for compressing video data and the talents of the marketing people who are seeking to build the brand. Equally important will be getting the backing of those who control the means of delivery: the cable companies. Without a conduit into the home, content providers are stymied. Most cable operators have already made big investments to add digital cable and high-speed Internet services to their networks. Providing for video-on-demand means spending millions more.

Fortunately, a short cut is in development at CableLabs, an industry R&D consortium that includes AOL Time Warner, AT&T Broadband, and Comcast. The project, known as OpenCable, will establish a cable transmission standard analogous to the Internet protocol that will allow set-top boxes from any manufacturer to work with any cable system and swap movies, games and multimedia content. The devices would incorporate an array of features, including Internet capabilities and browsing software, to make possible video-on-demand services.



Avoiding music's mistakes

But first, content creators must agree on a method to encode their content for Internet delivery. At present, nobody is sure what form that will take. Will there be one principal codec, such as VP5, MPEG-4 or DivX, handling content and powering the majority of set-top boxes? Or will there be an array of codecs scrunching video that is encoded in a variety of formats?

That is not important, according to Mr McIntyre. He cites KaZaA, a piece of software that allows enthusiasts to swap video content over the Internet in a Napster-like fashion but even more anonymously. Already, 62m users have downloaded the KaZaA software. At any given moment, some 800,000 people are said to be sharing media files this way. As high as they are, those numbers will be minuscule, declares Mr McIntyre, if Hollywood and others waste any more time quibbling over formats, or fretting over copyright infringements.

In May, KaZaA announced that it would have to shut its doors because it could not find the cash to defend itself against the barrage of lawsuits filed by the studios. Will big media ever learn? When Napster went down, Morpheus, LimeWire and Audiogalaxy quickly filled its shoes. Consumer demand for content is not going to wait for the studios to sort out their gripes. Even if KaZaA disappears, its success proves that very soon video codecs will do for movies what MP3 did for music. Then it will be too late to persuade consumers to pay for a service they can get for nothing. ■