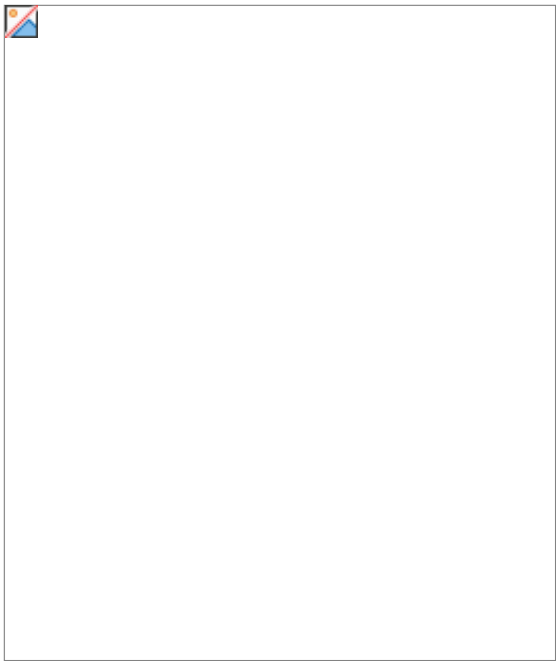


QuickTime Technical Backgrounder

QuickTime™ is a revolutionary extension to Macintosh system software that provides exciting new capabilities to all Macintosh developers. It is a new architecture for the integration of dynamic data types—such as sound, video and animation— that will stimulate new directions in personal computing for years to come. Just as QuickDraw is a standard part of Macintosh system software that allows applications to integrate graphics in a consistent, mainstream fashion, QuickTime will become a standard part of Macintosh system software that will empower applications to integrate dynamic media in a consistent, mainstream fashion.

Apple Media Integration

Apple believes that "multimedia," or media integration, as we prefer to call it, is a natural extension of the personal computer we know today. Our goal is to extend the power of Macintosh computers and *all* applications to take advantage of dynamic data types, not just a subset of specially-classed machines or special applications. The integration of these new data types will provide our customers with powerful new tools for communication, more closely approximating the richness of the world in which we live.

We also believe in providing capabilities for both "passengers" and "pilots." In other words, we want our users to not only be able to view other people's information ("passengers"), but create their own information at their desktop ("pilots") in a simple, straightforward fashion.

All of this requires tight hardware and software integration. One example of this is sound integration. By providing sound playback system software and hardware in every Macintosh computer we make, Apple can be sure that if someone adds a voice annotation to a document, they can send it to anyone with any-model Macintosh, and that person can play back that sound without additional hardware. This tight integration is required if these new data types are going to become true data types in the sense that PICT—a format for the storage and exchange of graphics documents on the Macintosh— images are today.

Essential QuickTime Messages

1. QuickTime raises the bar for personal computing
It would be unthinkable for a developer to ship an application today that didn't support the basic cutting, copying, and pasting of PICT images. With QuickTime, that least-common denominator will be raised to include support for dynamic data. QuickTime provides breakthrough functionality for all applications, and will be used not only to extend current applications, but create entirely new classes of applications that we can only guess at today.

2. QuickTime provides immediate benefits for millions of customers
QuickTime version 1.0 works with all color-capable (68020 or later) Macintosh computers running system software 7.0 or 6.0.7 with at least 2 MB of memory, which means that millions of Macintosh owners using applications that support QuickTime can take advantage of these capabilities right away. QuickTime also builds on familiar Macintosh metaphors (e.g. cut and paste) that make it simple for users to work with these new data types.

3. QuickTime provides growth without disruption
QuickTime-compatible applications can take advantage of new functionality without having to modify their applications through extensible and replaceable modules called "components". Developers are already at work creating new components that will expand the offerings to QuickTime-compatible applications.

4. QuickTime sets cross-platform standards for dynamic data exchange
QuickTime's Movie file format is a robust cross-platform container for dynamic data. Apple will publish the full specifications for this format, and is encouraging developers doing cross-platform development (e.g. Windows 3.0) to use the Movie file format for their dynamic data.

QuickTime Features

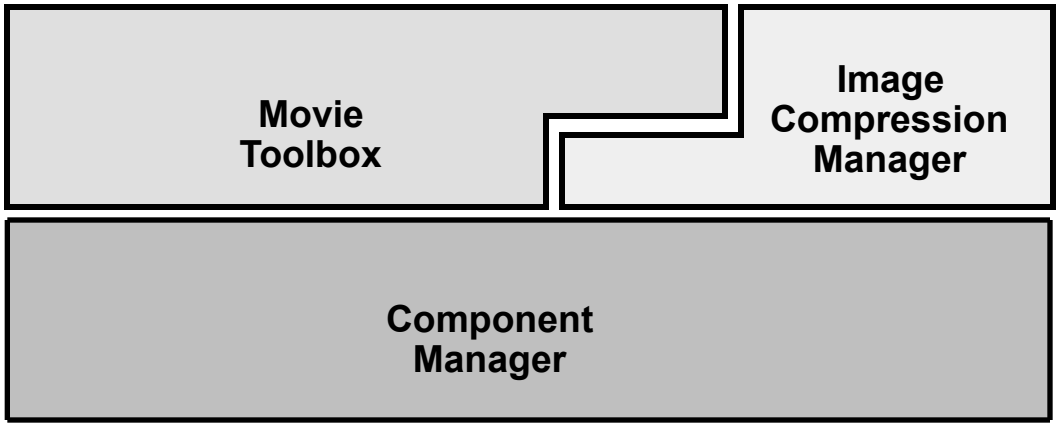
QuickTime consists of four major components: System software, File formats, Apple Compressors, and Human Interface standards

System Software	1. Movie Toolbox: creation, editing, & playback of movies 2. Image Compression Manager: shields applications from compression algorithm details 3. Component Manager: shields applications from external device details (e.g. digitizer cards)
File Formats	1. Movie: new file format for dynamic data 2. PICT Extensions: compression and preview support
Apple Compressors	1. Photo Compressor 2. Animation Compressor 3. Video Compressor 4. Graphics Compressor
Human Interface	1. Standard Movie Controller 2. Extended Standard File Dialog Box with Preview 3. Guidelines for compression, capture, and more.

The following section explores each piece in greater detail.

1. System Software

QuickTime system software consists of three major pieces:



Movie Toolbox

The Movie Toolbox is a set of high-level system software services that make it easy for applications to incorporate support for movies in their applications. On average, application developers have been able to incorporate movie playback in their applications within a matter of just a few days using the capabilities of the Movie Toolbox.

Image Compression Manager

The Image Compression Manager (ICM) shields applications from the intricacies of compression and decompression through device and algorithm-independent services. The ICM allows developers to take advantage of numerous compression schemes (e.g. MPEG, Group 3 fax) in their applications, without having to make modifications each time. This ensures that QuickTime-compatible applications will always have access to the best available compression technology. Details of display such as clipping, scaling, crossing screens, and fast dithering are supported automatically via the ICM. With QuickTime's fast dithering scheme, you can author a movie in 24-bits, and play it back in 8, 16, or 24-bits with the same playback speed.

Component Manager

The Component Manager allows external resources (e.g. digitizer cards, VCRs, system software extensions) to register their capabilities with the system at run-time. In version 1.0 of QuickTime, Apple will define a class of components for video digitizer cards, compression schemes, and timing clocks, among others. Before QuickTime, any application that wanted to support digitizer cards, for example, would have to write custom software for every digitizer they wished to support, and change that software every time the hardware changed. With QuickTime, hardware is transparent to applications. The application merely makes a request to the Component Manager for "a digitizer card with X capabilities" and the Component Manager takes care of locating and communicating with components of that type. In this way, applications can support new hardware without modification.

2. File Formats

Movie

The term "Movie" refers to *all* dynamic data. For example, a movie could be a presentation slide show, or a dynamic bar chart of data, or a graph of lab data over time. The Movie file format is a container for this dynamic data. A movie contains groups of homogeneous data, called tracks. A simple movie might contain a video track and a sound track, of any compression type. QuickTime takes care of synchronizing these tracks when the Movie file is played. The description of the data is separate from the data itself, which allows for multiple edits or versions of the data without duplicating the content each time.

The Movie file format is a cross-platform file format. Apple is publishing the full specifications of the file format , and is encouraging third-parties doing cross-platform development to use the file format as a container for exchanging dynamic data.

The Movie file format also has provisions for posters (still frames which represent the movie for printing) and previews (short clips that represent the movie when previewing), which give application developers additional flexibility.

The Movie file format is also extensible: Apple will continue to extend the file format with additional track types. Apple is defining two tracks in the first release of QuickTime: video and sound.

The Movie file format will have full Clipboard and Scrapbook support, which means that users can cut and paste Movies as simply as they cut and paste text and PICT images today.

PICT extensions

Apple is extending the PICT file format in two ways: 1. image compression, and 2. previewing. Users will be able to compress a still image using any compression scheme registered with the Component Manager, and play back or "decompress" that still image using any existing, unmodified application, as long as the QuickTime extension is in the System Folder. With preview support, applications will be able to save a small 4-5 K "thumbnail" of the picture along with the image itself. This will allow users to quickly browse through still image libraries (e.g. using the preview version of the standard file dialog box in QuickTime).

3. Compressors

In QuickTime, version 1.0, Apple is providing a basic set of software compression/decompression schemes that meet a range of compression needs for still images, animation, and video. These schemes are designed to playback with reasonable performance from hard disk on any color-capable Macintosh. These compression schemes are a built-in feature of every color-capable Macintosh, much like LocalTalk. New software or hardware-based compression/decompression schemes can be added to the system by merely adding a

component file to the System Folder. The basics of each Apple compressor is listed below, and more detail can be found in the accompanying paper "Compression Details."

Photo Compressor
Apple is the first personal computer company to implement the JPEG (Joint Photographic Experts Group) compression scheme as a standard part of the operating system for high-quality still image compression. JPEG is designed to compress full-color images and typically gives compression ratios in the range of 10:1 to 25:1 with no visible picture degradation. Apple's implementation of JPEG complies with the ISO (International Standards Organization) baseline standard, and is a lossy scheme—a compressor in which image data is lost every time the compression is performed—(i.e. some picture information is lost).

Animation Compressor
Apple's animation compressor employs a compression algorithm based on run-length encoding principles to compress computer-generated sequences from 1-32 bits in depth. The algorithm supports both lossless and lossy modes. Compression ratios vary widely based on content. The Animation Compressor displays animations at acceptable speeds on low-end Macintoshes, and allows complex animations to be previewed on a Macintosh without first having to lay them off to videotape one frame at a time.

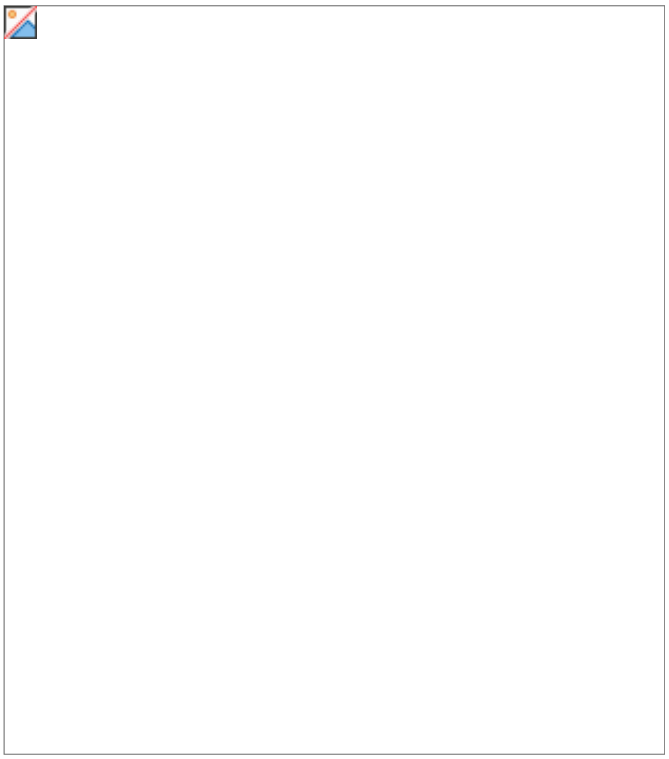
Video Compressor
Apple's Video Compressor employs an image compression method developed by Apple. This compression scheme allows digitized video sequences to decompress from a hard disk or CD-ROM in real-time with no additional hardware on any color-capable Macintosh. Compression ratios typically range between 5:1 and 25:1. An average movie compressed with this scheme could play back at 15 frames-per-second at 160x120 pixels on a Macintosh IIsi, although the scheme is by no means restricted to this size.

Graphics Compressor
The Graphics Compressor also employs an image compression method developed by Apple. It provides lossless compression of 8-bit images and is ideal for compressing both still images, such as those created in painting applications, and 8-bit movies. The Graphics Compressor differs from the Animation Compressor, which can also compress 8-bit data, in that the Graphics Compressor gains compression at the expense of decompression speed. A movie compressed with the Graphics Compressor will usually be half the size of an Animation Compressor (RLE) movie, but at approximately half the *maximum* playback rate.

4. Human Interface

Just as Apple specified human interface guidelines for the original Macintosh that provided consistency between applications for dealing with graphics, Apple is doing the same with QuickTime for dynamic media. In QuickTime 1.0, Apple is specifying several standard human interface elements:

Standard Movie Controller



The movie controller is a system software component that provides a consistent way of controlling movies. The standard controller allows a user to:

- adjust sound volume
- play or stop a movie
- get an indication of where in the movie you are
- interactively jump and scroll around the movie
- step-forward and step-reverse through the movie
- select and cut, copy, or paste portions of movies

Standard File Dialog with Preview

The extended standard file dialog box is another standard system call that allows applications to invoke a dialog box (e.g. for the Open... menu item) that includes a preview window for still images and movies.

Recommendations in Sample Utilities
In addition to these standard elements, Apple is releasing human interface guidelines for areas such as capture, compression, and editing. These guidelines are contained in the standard QuickTime documentation for developers.

QuickTime 1.0

QuickTime is available to both developers and customers via the following methods:

Developers
Developer's can order the QuickTime Developer's Kit through APDA (Apple Programmers and Developers Association). The toolkit sells for $195 (U.S.) and contains over 800 pages of printed documentation and a CD-ROM with the following:

- QuickTime Extension
- Picture and Movie utilities
- XCMDs
- Sample code and sample drivers
- Sample content

QuickTime version 1.0 is available for licensing to Macintosh developers to include with their new QuickTime Savvy products. Hardware or software products that take advantage of QuickTime are considered QuickTime Savvy.

Customers
Future versions of QuickTime will be packaged and sold as part of future versions of System 7. In addition, Apple USA will make the QuickTime system extension available to customers in January for a nominal shipping and handling charge. In the interim, the QuickTime extension will be available in the United States via electronic bulletin boards such as AppleLink®, CompuServe and America Online.

Apple will also be releasing the QuickTime Starter Kit in the spring through reseller channels. The kit contains the QuickTime extension, utilities for capturing, compressing, and trimming movies and still images, a CD-ROM of clip content (video, animation, photos), and sample applications for browsing through the application possibilities of QuickTime.

Applications

Macintosh developers are already incorporating QuickTime functionality into their next-generation products. Here's a short sampling of what they're doing:

1. Mainstream applications (e.g. word processors, spreadsheets, databases)

- Compress and display high-resolution still images
- Annotate documents with audio or video notes
- Cut and paste Movie files
- Playback movies with standard controller
- Save dynamic data (e.g. a presentation slide show) into the Movie file format
- Dynamic help systems

2. Exploring the boundaries of the architecture

- Developing new plug-in compression schemes (e.g. fax, motion JPEG, DVI, and more)
- Creating truly international products that adapt to the native OS language (e.g. French, Spanish, Kanji)
- Adding transitions, filters to movie data

3. New application categories

- Videoconferencing and store-and-forward video mail
- Low-cost movie editing
- Dynamic CD-ROM magazines
- and much more...

An Industry Perspective

In 1984, Apple Computer, Inc. created a commercially successful phenomenon called the Macintosh computer that paved the way for the integration of graphics into mainstream applications. In 1991 we delivered both System 7 and QuickTime, which together will provide a platform for a whole new generation of applications, and extend the capabilities of the mainstream applications we use every day. We look forward to exploring the future with you.