

# Transparent Storage Expansion With TimesTwo™ A Technical Overview



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## **Transparent Storage Expansion With TimesTwo™**

### **A Technical Overview**

Bigger applications, bigger files, and more data create a constant need for more disk space, but continually upgrading storage devices is an expensive proposition for the typical Macintosh user. During the past few years, a number of file compression utilities have emerged to help with this problem, but while these products have been continually improved, none provides the transparent expansion of storage space most users want. This paper looks at Golden Triangle's TimesTwo (patent pending) product and explains its new approach to transparent storage expansion.

#### **File Compression: Making Space by Shrinking Files**

File compression products use lossless compression algorithms to reduce file sizes by approximately 50%, effectively doubling the speed of modem transfers or doubling the space on a storage disk. Originally developed to cut modem transfer costs or reduce the number of floppy disks needed to distribute files, file compression has become a common method of increasing disk storage space for all users.

With products like Compact Pro or StuffIt, users manually select individual files or groups of files and compress them inside archive files. Once inside compression archives, individual compressed files are no longer visible in the Finder. Users must manually compress and decompress files by opening and closing archives.

Other products such as AutoDoubler use System Extensions that automatically activate the compression utility when files are saved or opened from other application programs, so that file compression and decompression occurs automatically and requires no user intervention.

Whether or not the file compression is automatic, however, there are several drawbacks to using a technology designed for working with *individual* files as a solution designed for increasing storage space for *all files*. Basically, compressing files means introducing another level of interaction between the application program and the Macintosh operating system, and it creates an artificial environment for the user:

- Compression and decompression with archive files requires constant user intervention.

- Files must be decompressed before they can be recognized and used by the application that created them.
- A decompression utility must be distributed with compressed files for those who don't own the compression product.
- Compressed file sizes don't represent the file's real, usable size, so users must always calculate whether they have enough disk space to store and use a decompressed a file. (Automated compression utilities attempt to make themselves more user-transparent by presenting compressed files in the Finder with their normal, uncompressed sizes, while showing the actual amount of total disk space remaining. However, doing this involves playing tricks with the Finder, and makes compression utilities highly vulnerable to any change in the Mac's operating system.)
- All compressed files are converted to a different creator type by the compression program. Some compression programs replace the file's native icon with their own icon. Users can no longer double-click on a compressed file's icon to launch the application that created it—double-clicking launches the compression program instead.
- In changing file creator types, compression can trigger virus-detection programs, and compression utility developers have had to create work-around solutions to this problem.
- Compressed files can't be properly recovered by file-recovery programs, because they don't have the right creator types and the data is compressed.
- File compression utilities won't compress the System Folder (because changes to those files' creator type would render them inoperable), so a whole area of the disk with a high potential for space savings is ignored.
- Constant, automated packing and unpacking of individual files creates disk fragmentation much more quickly than normal file storage, so storage performance degrades more quickly.

## **TimesTwo: Making Space by Expanding Disks**

Rather than operating on files or placing an extra layer of complexity between a program and its files, TimesTwo implements compression at the disk driver level. It

creates a logical disk twice the size of the original disk, and then compresses the storage blocks assigned by the Macintosh File Manager so that twice as many of them will fit on the same disk.

As a result, the user, the Finder, the Macintosh operating system and all application programs “see” a disk that is twice as large as it was before. Files aren’t compressed at all, so their sizes remain constant, their creator types aren’t changed, and users continue to work with them as before.

This approach removes the complexity and artificiality from compression. For example:

- TimesTwo doesn’t operate on files, so files don’t have an artificial storage size that must be doubled before the file can be used, and they don’t have a different creator type that renders them useless to the program which created them.
- File recovery programs still see the same files, so recovering them is no problem.
- TimesTwo doesn’t introduce an extra level of file manipulation and complexity between the primary application and the Mac’s file management operations.
- TimesTwo doesn’t play any tricks with the Finder, so it remains fully compatible with system software upgrades.
- An unpacking utility isn’t required when the disk is distributed, because the expanded logical disk map is part of the disk.

## **How TimesTwo Improves Macintosh File Storage**

To better understand TimesTwo’s unique solution to storage expansion, a brief overview of file storage on the Macintosh is in order. In the Macintosh operating system, there are three functions that handle the storage of files on a disk:

- The *disk driver* and the initialization package used to format the disk organizes every disk into 512-byte physical storage blocks and then informs the File Manager about the number of blocks available.
- The *File Manager* uses information from the disk driver to create and maintain a logical disk map. When a disk’s space is viewed by an application program or the Finder, the space showing is the current state of the logical disk as provided by the File Manager.
- The *SCSI Manager* is the interface between the disk driver and the physical disk. It controls the physical writing and reading of blocks on the disk.

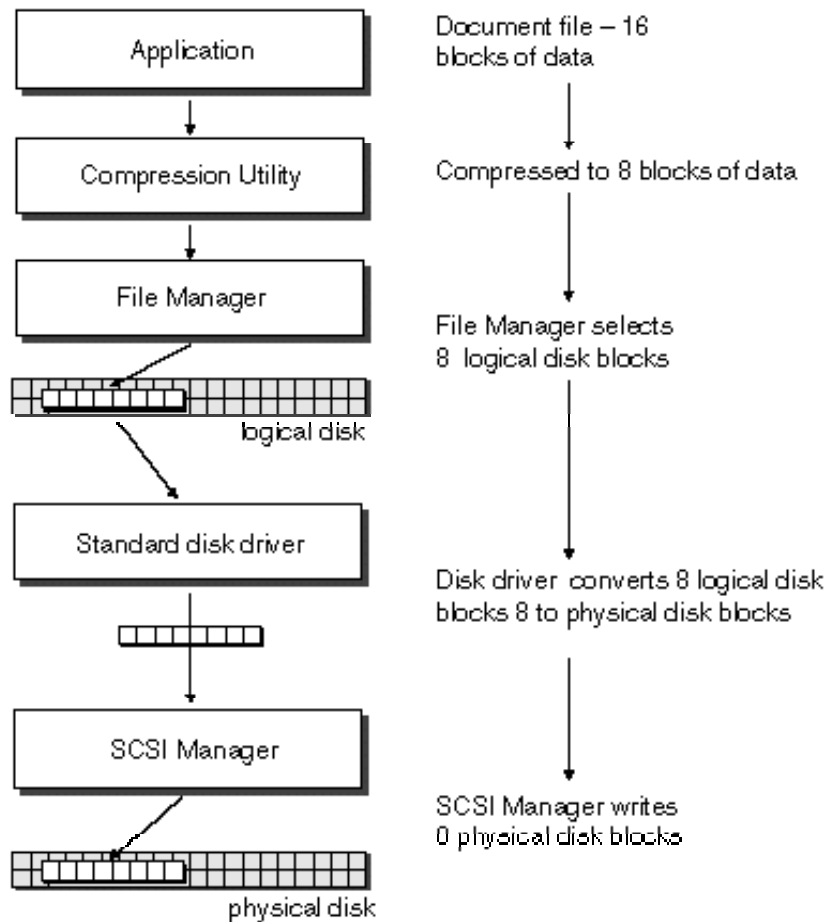
## **Saving Files on a Normal Mac**

When an application (a word processor, spreadsheet, etc.) saves a file to the disk, it tells the File Manager how much information is to be saved and the folder in which it is to be stored. The File Manager allocates space by selecting blocks on the logical disk map, and then tells the disk driver to write the disk blocks to the logical disk. The driver in turn translates that request into a physical location on the disk and then tells the SCSI Manager to record the individual blocks on the physical disk. (Figure 1.)

***Figure 1. Saving to a normal Macintosh disk.***

## Saving Compressed Files

With an automated compression solution like AutoDoubler, the application program hands off file-saving to the compression utility. The compression utility changes the file's creator type and compresses it, and then asks the File Manager for a smaller amount of space. The File Manager assigns logical blocks of space, passes them to the disk driver, which translates the request into a physical disk location and tells the SCSI Manager to write the blocks to the disk. (Figure 2.)



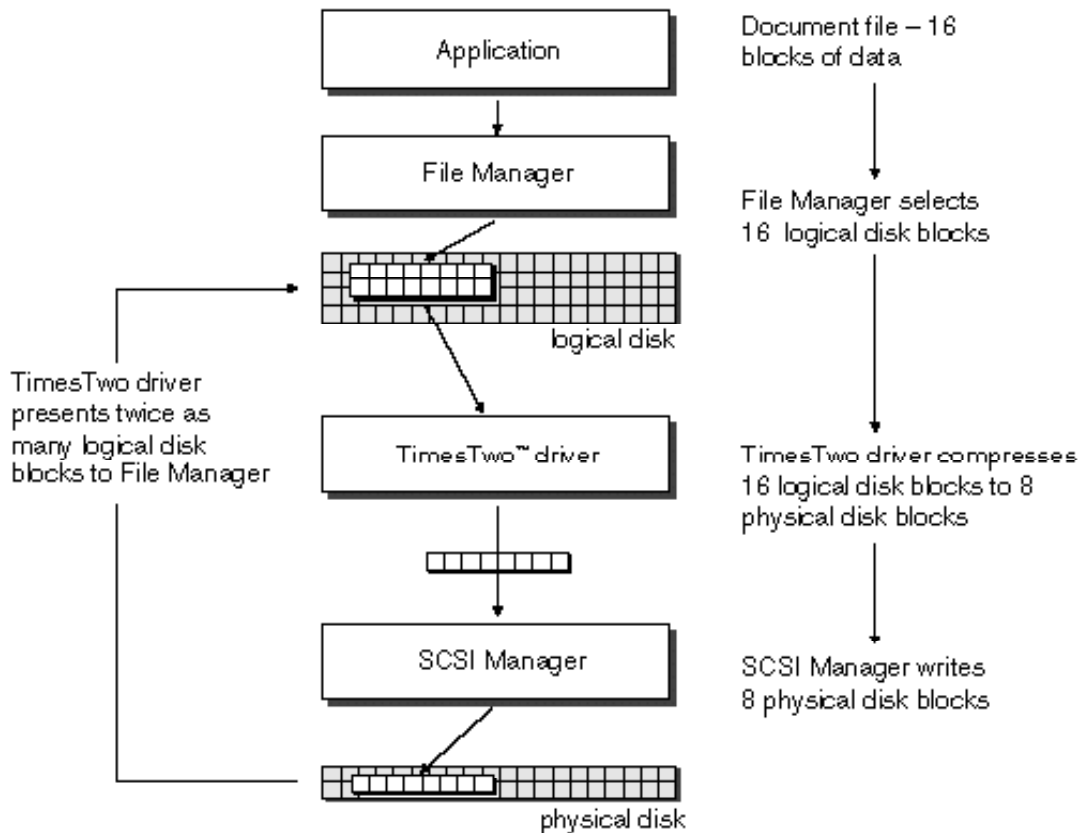
**Figure 2. Saving to a disk with file compression.**



### Saving Files with TimesTwo

TimesTwo replaces the standard disk driver for any disk. It presents twice as many physical storage blocks as the normal disk driver would present, so the File Manager creates a logical disk map that is twice as large, and application programs “see” twice as much disk space as they normally would.

When an application saves information to a TimesTwo disk, the File Manager allocates blocks for it on the logical disk, just as on a normal Mac, except the logical disk is twice as large. Then, the TimesTwo driver compresses the disk blocks to a reduced size. Since the blocks have been compressed to a smaller size, the SCSI manager can write many more logical blocks to the same-sized physical disk. (Figure 3.)



**Figure 3. Saving to a TimesTwo disk.**

## **Transparent Storage Expansion**

All application programs rely on the information supplied by the Macintosh File Manager. Because TimesTwo simply gives the File Manager different information to work with, all interactions between applications and the File Manager are undisturbed. As far as file-recovery programs, virus checkers, productivity programs or the Finder are concerned, everything works the same except there is twice as much disk space as before.

In contrast, file compression utilities create an artificial environment of different file creator types and file sizes that aren't what they seem to be in the Finder. All compressed files must be unpacked by the compression utility before they can be used normally. Compression utilities that alter file size or disk space information in the Finder may well become incompatible with future versions of the Macintosh operating system. Frequent compression and decompression as files are used increases disk fragmentation far more rapidly than saving and opening normal files.

By operating at a level below that used by all application programs, TimesTwo eliminates problems associated with changing files themselves. File icons, sizes, and creator types remain the same as they would on a normal Mac, so files can be opened, saved, used, recognized and recovered just as they would on a normal Mac. Users get twice the disk space without any of the problems associated with file compression.