

VIRTUAL

U S E R ' S M A N U A L

CONNECTIX

INTRODUCTION

Compact Virtual™ 3.0 is an extension to Macintosh® Operating Systems 6 and 7. It allows compatible accelerated Macintosh Plus, SE, and Classic systems to use virtual memory. This addresses the problem that standard System 7 Virtual Memory (VM) is not compatible with such systems and that System 6 does not support Apple® VM at all. Compact Virtual also allows these systems to address large amounts of physical memory.

Using Compact Virtual, your Macintosh will be able to work with 16MB of application memory, or less if you prefer. It can do this either by extending a "normal" amount of RAM (4MB) using virtual memory, or directly addressing a "large" amount of RAM (more than 4MB) using enhanced 24-bit addressing techniques.

Virtual memory works by taking information which would usually be stored in RAM, and putting it in a file on your hard disk. This information is transparently retrieved from disk whenever it is required, giving the functionality of much more RAM than is actually installed on the machine.

Normally, virtual memory uses up hard drive space equal to the total size of application memory specified, regardless of the amount of physical RAM installed. However, Virtual's DiskSaver™ option enables you to create virtual memory using hard disk space equal to the application memory minus the physical RAM. So, for example, 6MB of application memory can be created using virtual memory on a Mac with 4MB of SIMM memory, using only a 2MB file on the hard drive.

This same product, Compact Virtual, also enables accelerated Mac Plus, SE, and Classic systems to address two and four megabyte SIMMs installed on compatible accelerator boards. This makes it possible for the first time to use up to 16MB of physical RAM on one of these systems as application memory. Since these systems are not able to use 32-bit addressing, Compact Virtual is the only way to address large amounts of physical RAM or virtual memory.

On many systems, motherboard RAM can be configured as a RAM disk. On systems with more than 4MB of accelerator board RAM, some of this memory can also be assigned to the RAM disk.

A different version of this product, Virtual 3.0, is available for use on Macintoshes based on the 68030 processor, Mac II with a PMMU, or accelerated LC.

SUMMARY

- Compatible with most accelerated Mac Plus, SE, and Classic systems.
- Creates up to 16MB of virtual memory.
- Can also address up to 16MB of physical memory (2 and 4MB SIMMs).
- Is fully compatible with System 6 and System 7 (24-bit addressing mode).
- Defragments 24-bit addressing to create nearly 12MB of contiguous application memory.
- DiskSaver feature only requires as much disk space as is needed to *extend* the physical memory.
- For compatible accelerator cards with more than 4MB RAM on board, allows RAM-based application memory of up to 16MB.
- Can create a protected non-volatile RAM disk with any motherboard RAM as well as any RAM over 4MB that is not used as application memory.
- Compatible with some 68030-based laptop computers using Mac Plus, SE, or Classic ROMs.

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GETTING STARTED

REQUIREMENTS

Compact Virtual 3.0 is designed to run on the Macintosh Plus, SE or Classic upgraded with compatible accelerator cards, or the 68030-based Outbound Portable™. Compact Virtual is compatible with System 6.0.2 or later. To use Compact Virtual, your Mac will need at least 1MB of RAM (4MB minimum recommended) and a hard drive with several megabytes of free space. It will also need a compatible processor upgrade ("accelerator board") which contains a Memory Management Unit (MMU). Usually this will mean a 68030 processor, though some 68020 boards can be equipped with the 68851 memory coprocessor (PMMU) which also contains an MMU. Accelerator boards based on the 68EC030 processor are *not* compatible with Compact Virtual, since they have no MMU. Many manufacturers offer upgrades from the 68EC030 to the 68030 processor for users who want to use Compact Virtual.

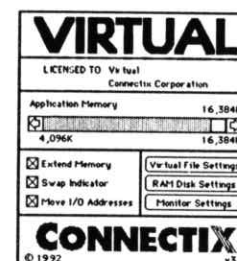
Connectix also produces another product, Virtual 3.0, for Macintoshes that come factory-equipped with the 68030 or 68040 processor. For example, if you have a Macintosh SE/30 or Classic II, you should use Virtual 3.0, instead of Compact Virtual 3.0. These two machines, while packaged in the "compact cases," are internally similar in design to the Macintosh II series computers. Virtual 3.0 is designed to work with the SE/30, Classic II, all Macintosh II series computers (including the original Mac II with PMMU upgrade), the Quadras, and the PowerBook 140 and 170. To run Virtual 3.0 on an LC computer, the machine must be upgraded with a 68030 or better accelerator board.

For readability, Compact Virtual 3.0 is described hereafter as "Virtual," but remember that you must have the right version, either Compact Virtual or Virtual for your system.

INSTALLING VIRTUAL

Virtual is simple to install. Just double-click the Virtual Installer on the original distribution diskette. The installer will then prompt you to fill in your name and organization. Click the OK button and Virtual will automatically be installed in the System Folder on the hard drive from which your Macintosh was last booted (the "current Startup Volume"). Any old versions of Virtual will be automatically replaced. After the installer is done you will get the "Virtual Successfully Installed" message.

Before Virtual can start to work, you should quickly check the configuration and then Restart. The following section tells you how to do this, and the subsequent Configuration section tells you how to optimize once you have Virtual running.



The Virtual Control Panel

CONFIGURATION

Once Virtual is successfully installed, you will probably want to adjust some of the default Control Panel settings. These are described here in the order they appear in the Control Panel.

SLIDE BAR

If you are using virtual memory (that is, your Mac has less than 16MB of RAM) and you have some more free space on your hard drive, you may want to start by increasing the slide bar setting.

A common misconception about virtual memory is that setting up a large amount of application memory will slow down the Macintosh. Actually, Virtual uses almost no processing time to keep track of open application memory which is not used by any application. More surprising is the fact that application memory used by applications which are not in the foreground (Open but not active) also uses up very little of the Mac's attention. You can therefore feel free to create a lot of application memory and fill it up with lots of small or medium-sized applications.

What does run slowly under virtual memory is a single very large application, which would not by itself be able to be opened without virtual memory, given the amount of RAM on your Mac. When these applications are in the foreground, your system may have to frequently swap information between the hard drive and RAM, in which case you will notice the Mac running sluggishly. Again, once these are pushed into the background, the fact that they are open will generally not affect performance.

Some Compact Macintosh accelerator boards can support up to 16MB of physical RAM (four 4MB SIMMs). Compact Virtual extends addressable memory, allowing the full 16MB to be used as application memory. Virtual's memory extension is accomplished in 24-bit mode so there are no compatibility issues related to 32-bit addressing.

If your accelerator board has 16MB of RAM you will not need to use virtual memory. In this case, the scroll bar in the control panel will determine how much RAM is used for application memory and how much is assigned to the RAM disk. You set the application memory with the scroll bar, and any additional RAM on the motherboard or the accelerator will be assigned to the RAM disk. For example, if you have 16MB on the accelerator and 4MB on the motherboard, and use the default scroll bar setting of 8MB, you will have a 12MB RAM disk ($16 + 4 - 8 = 12$). More details on how to configure the RAM disk are given in the next section and Appendix B.

If your accelerator has between 4 and 16MB (typically 8MB) the scroll bar range will still be 4 to 16MB. If you set the scroll bar below the amount of physical RAM installed, the remainder will be assigned to the RAM disk and no virtual memory will be created. If you set it equal to the amount of RAM installed on the accelerator board, no virtual memory will be created. A RAM disk will only be built if motherboard RAM is available. If you set the scroll bar for more than the amount of physical RAM installed, virtual memory will be used to create that amount of application memory, and a RAM disk would only be built if motherboard RAM were available.

Some accelerator boards require a simple upgrade to use the RAM disk – check with your manufacturer if you have problems. (See Appendix B – RAMDisk.)

SWAP INDICATOR

Click this check box if you want to turn on the Page Swap Activity Indicator. Sometimes Virtual has to read information from the hard drive into RAM. When this box is checked, a pixel in the upper left corner of your screen flashes whenever there is hard disk activity. This gives you feedback about

INITIAL CONFIGURATION

If you are using System 7, open the Control Panels folder in the System folder. Under System 6, choose Control Panels from the Apple menu. Select the Virtual Control Panel and open it.

Make sure the **Extend Memory** box is checked. This is necessary to enable Virtual.

Next, adjust the application memory size using the scroll bar in the Control Panel. On a Mac with 4MB physical RAM, the left edge of the scroll bar represents the memory you could have without using Virtual, 4MB. The right edge is the maximum virtual memory available, 16MB. We usually recommend that you start with the slide the bar in its default setting, 8MB. However, if you have less than 4MB free on your hard drive, you will need to start with a lower setting of virtual memory.

If your Macintosh has more than 4MB of RAM, we still recommend starting the installation with the default setting of 8MB. You will probably increase it to 16MB later (see Configuration).

The SwapFile is where the information that is held in virtual memory is stored. When you first install Virtual, the SwapFile will be in your System Folder. If you are very short of disk space on your Startup Volume and have another, emptier drive, you may want to relocate the SwapFile to the other drive to get started (See Configuration).

Open the Memory Control Panel in System 7 or click the "General" icon in System 6's Control Panel. Check to make sure that your RAM Cache is either turned off, or set to a modest value (no greater than 128K). This will increase performance.

Finally, choose Restart from the Special menu to reboot your Macintosh. When your Mac restarts, you should see the successful loading icon indicating that Virtual has loaded.

If you see the Virtual icon with an X through it or an alert dialog, the system environment is not compatible. The conditions that could cause this are:

- 1) you have an out-of-date INIT for the accelerator (contact the manufacturer for the latest version),
- 2) you have the wrong version of Compact Virtual/Virtual for the machine,
- 3) you set an amount of virtual memory equal to the amount of memory that would be available for application memory if Virtual were not installed, (slide bar all the way to the left),
- 4) your accelerator board does not contain a 68030 or better processor (e.g. it has a 68000, 68020 or 68EC030), or is not a brand which is compatible with Compact Virtual,
- 5) your hard disk does not have enough disk space for the requested amount of virtual memory, or
- 6) a virus protection software or an INIT/Extension management utility is interfering with Virtual.

See the Troubleshooting section for details.



The Successful Loading and Not Loaded Icons

how much swapping is occurring when using virtual memory. Many users leave this box unchecked since it is only useful if you are particularly curious about how virtual memory works. (To read more about pages and page swapping, see page 22.)

MOVE I/O ADDRESSES

This option should normally be selected. If it is not selected, the size of any one application that can be opened is usually limited to no more than about 4MB.

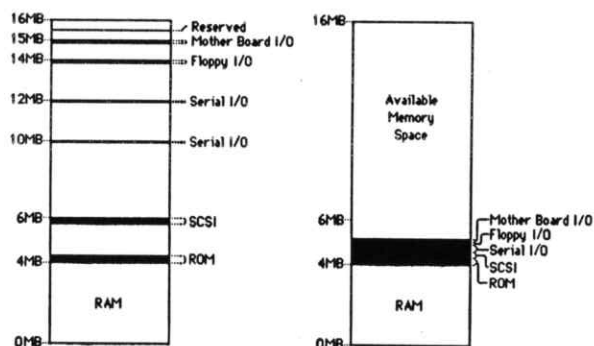
The RAM memory map (see below) of the Macintosh is fragmented by the addresses used for the ROMs and various other hardware devices. In the Plus, SE and Classic, the ROMs are addressed at the 4MB level and there are several other devices which fragment the memory between 4MB and 16MB. This fragmentation normally limits the size of the largest single application you can run under System 6 MultiFinder™ or System 7 Process Manager. These two environments will not assign fragmented memory to an application. For a Plus the limit is about 4.5MB. For the SE and Classic it is about 4MB.

When the **Move I/O Addresses** option is selected, Virtual eliminates most of this fragmentation. This option takes all predefined hardware I/O locations and moves them to a position on top of the ROMs. This can dramatically increase your largest unused block by creating nearly 12MB of contiguous application memory. This feature is optional because a small number of programs use "hard coded" addresses instead of looking up I/O addresses using low memory globals. These will not function properly with this option on.

When using System 6, you can run programs in fragmented memory space by running under Finder. Here, a single application will be assigned all of the memory in the machine. However, some limitations also apply in System 6 Finder, so the **Move I/O Addresses** feature is still recommended.

PRE-FRAGMENTED AND ENHANCED 24-BIT ADDRESS MAPS FOR THE COMPACT MACS

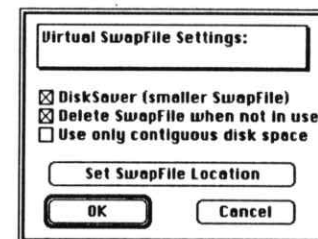
When you click on "Virtual" at the top of the Virtual Control Panel it will display a diagram of the 24-bit address maps. You can try this with the **Move I/O Addresses** option on or off to see the pre-fragmented and the enhanced memory maps.



Pre-fragmented and Enhanced 24-bit Address Maps

VIRTUAL FILE SETTINGS

Click the Virtual File Settings button in the Control Panel to open the Virtual SwapFile Settings dialog box. This dialog is used to configure the SwapFile.



The Virtual SwapFile Settings dialog

DISKSAVER

DiskSaver is an option that substantially reduces the amount of hard drive space Virtual requires. However, this can affect the system's performance. Use **DiskSaver** whenever hard drive space is limited, the amount of application memory required is not more than 50% larger than the amount of physical RAM installed, and the largest application to be used is not much larger than the amount of RAM free for use by applications (i.e. not required by the System).

In previous versions of Virtual, as well as in the standard System 7 VM, you need to allocate as much hard drive space for virtual memory as the *total* amount of application memory you want set up, regardless of the amount of physical RAM installed. With **DiskSaver** on, you will need only as much disk space as required to *extend* your memory. Virtual's **DiskSaver** option lets you use virtual memory with less hard disk space by not creating a copy of the information which is in RAM on the hard drive. This means, for example, that if you want 10 MB of virtual memory and already have 4 MB of RAM on the machine, you will only need 6 MB of disk space.

With **DiskSaver** off, Virtual can speed up the swap time when swapping out information from RAM to disk if that information has not been modified since it was brought up from the disk. In fact, it can swap in half the time if there is a disk image of the unmodified page, since it then does not need to write the information back onto the disk. This requires that Virtual be able to store all the information in application memory on the drive, regardless of whether it is in RAM. With **DiskSaver** on, you may notice more frequent disk access to retrieve information from the swap file. (See Appendix A – How Virtual Memory & Memory Extension Work for a more complete explanation.)

We recommend using **DiskSaver** when you want to extend memory a small amount, 10-50%, and only use applications which are small compared to the size of physical RAM installed. If you need even more memory or need to work with a large application, turn off **DiskSaver** and allocate the full amount of hard drive space to improve performance.

DELETE SWAPFILE WHEN NOT IN USE

It is not possible to delete the swap file when virtual memory is being used. However, when the **Delete SwapFile When Not in Use** option is selected, Virtual automatically deletes the swap file when virtual memory is not being used. Use this feature if you use virtual memory infrequently. Although it can save hard drive space, it will increase the time it takes to boot

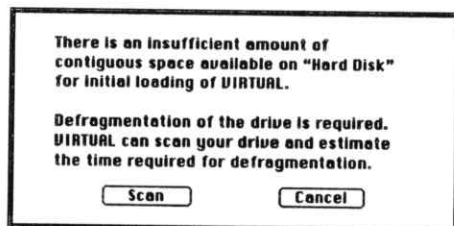
whenever your Mac has to create the swap file again. We do not usually recommend using this feature if you select the **Use Only Contiguous Disk Space** feature, as this may lead to a fragmented disk drive (see next section).

USE ONLY CONTIGUOUS DISK SPACE

When a large file is stored on the hard drive, the operating system will often break it into several smaller pieces to find space for it. When you first create your SwapFile (by installing Virtual), or increase its size (by adjusting the Control Panel slide bar and Restarting), Virtual can break up the SwapFile to fit it on such a fragmented disk. However, Virtual will work faster if the SwapFile is contiguous (see below), i.e. not broken into small pieces.

Note that contiguous disk space and contiguous RAM space are totally unrelated concepts. If you have a contiguous SwapFile on your hard drive, you may still have fragmented application memory, and vice versa.

When you select the **Use Only Contiguous Disk Space** option, Virtual will check the fragmentation on your drive before loading the SwapFile, whenever you initially install Virtual or increase its size. If Virtual finds enough contiguous space it proceeds to install without interruption. If Virtual finds there is simply not enough space, even fragmented, to load the SwapFile, it will notify you with a dialog box, and not load at all. If it finds enough space, but only in several fragments, it will ask you with the following dialog box if you want to create contiguous space, or load the SwapFile into several smaller fragments. Choosing to create contiguous space will increase the speed with which Virtual can work. Virtual will move information on your drive to create the necessary contiguous space and defragment the drive.



Contiguous Disk Space Alert dialog

To have Virtual estimate the time required to defragment your drive, click **Scan**. Virtual will then analyze your hard drive and estimate the time to create the necessary space. You will then be asked to choose between optimizing the disk space or using non-contiguous space with Virtual. Optimizing can significantly speed up the access and response time of virtual memory by keeping all of the virtual memory file together in one place on the disk.

If you do not select the **Use Only Contiguous Space** option, Virtual will not offer to create contiguous space. If it finds enough contiguous space it will use it. Otherwise it will automatically load a fragmented SwapFile.

If you use this speed enhancing feature, we recommend that you *deselect* (turn off) the **Delete SwapFile When Not in Use** feature. If you do not do this, whenever you turn off Virtual your

contiguous swap file space will start to fill up with fragments of other files and you will have to re-coalesce when you re-enable Virtual.

COALESCING FREE DISK SPACE

Contiguous space means that free space is not broken up into pieces scattered across the disk surface, but rather resides in one entire block. Creating and deleting files on a disk causes space on the disk to undergo fragmentation. This means that, although there may be many blocks of open space on the disk, all of which add up to a large amount of free space available, they are not together in one big block.

Free space coalescence will move files around on the disk. Before any files are moved, Virtual scans the disk to check for any pre-existing directory damage. Virtual uses the safest method of making space contiguous that we could devise: As each piece of any file is successfully moved, the disk directory is updated, meaning that you can back out of the process at any time and still avoid any loss of data. Typing a Command - period (`⌘ - .`) will do this, and can be used to quit a contiguous space-creation session that will take more time than you currently have.

However, even using conservative methods, there will be a large amount of disk activity. If the power were to go out while the utility was running, there would be a fair chance that the directory of the disk would be irretrievably damaged. For this and other reasons known only to Murphy, *we strongly recommend that you always back up your files before defragmenting!*

There are a few types of files which don't want their locations on the disk arbitrarily changed. These include some hard disk copy-protection schemes and sector defect-mapping software. If Virtual comes across a file it recognizes as not wanting to move, it will ask you whether you want to continue - doing so may necessitate re-installation of the offending software. Not letting Virtual move the file may make it impossible to coalesce enough contiguous free-space for the virtual memory size you requested, though this is not always true.

Please note that while Virtual can do a great job at creating the contiguous space it needs, it is not meant to replace commercial disk defragmenting tools. After using Virtual's contiguous space creation utility, files on the disk will be just as fragmented as they were before; only the free space you requested for Virtual is pulled together.

SET SWAPFILE LOCATION

Click the **Set SwapFile Location** button to specify where on your hard disk to store information held in virtual memory, i.e. where to put the SwapFile. When you first install Virtual, the SwapFile will be in the System Folder on the drive last used to boot the Macintosh (the "current Startup Volume").

If you have more than one drive, it is usually a good idea to put the SwapFile on the fastest drive. It is definitely not necessary to keep the SwapFile on the same drive as your System folder, applications, or the documents you plan to use. The SwapFile must, however, be on a drive which is available at the beginning of a Restart, not one produced by an INIT or a network utility.

RAM DISK

If your accelerator has its own RAM and you have additional memory on the original motherboard, this motherboard RAM can be used for a RAM disk. If your accelerator board has more than 4MB of RAM, you can also assign any RAM not used for application memory to the RAM disk.

The RAM disk is simply another mass storage device like your hard drive, where you can keep documents, applications and System files which you want to access when you use your Macintosh. Although it looks just like any other hard drive on your Desktop, it is special because data stored there can be retrieved much faster (more than ten times faster) than data kept only on a hard disk. This RAM disk feature is the same feature that Connectix's MAXIMA™ provides for Mac II series computers.

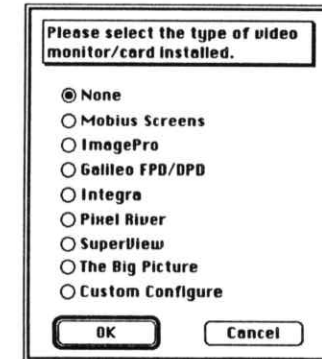
To create a RAM disk, click the RAM Disk Settings button in the Virtual Control Panel, and then the Install box in the dialog box that appears. Set the size of the application memory by adjusting the slide bar in the control panel. The amount of RAM not allocated to application memory plus any motherboard RAM (if the accelerator has its own memory) will be assigned to the RAM disk. For more details about configuring the RAM disk, see Appendix B.

Some accelerator boards require a simple upgrade to use the RAM disk – check with your manufacturer if you have problems. (See Appendix B – RAMDisk.)

MONITORS

Compact Macs can use external monitors if the accelerator card is equipped with a video card. To set the monitor type, click the Monitor Settings button in the Virtual Control Panel. This will open the Monitor Settings dialog box. Then, click the radio button corresponding to your monitor. When you restart the Mac, the primary monitor will be the external monitor. If you are not using an external monitor, you should select **None**.

Note: This is not applicable to users of large virtual screens like the Stepping Out™ screen extender utility. It only applies to hardware additions.



The Monitor Settings dialog

If you have a monitor that is not one of the choices, click the Custom Configure radio button. In the resulting dialog box, enter the starting memory location and length of address space specified by the manufacturer of your video interface card. Then click OK.

TROUBLESHOOTING

IS THIS THE CORRECT VERSION OF THE SOFTWARE?

Compact Virtual has been designed for Compact Macintosh systems (Plus, SE and Classic) with compatible accelerator boards. A different Connectix product, Virtual 3.0, is needed for the SE/30, Classic II, all Macintosh II series computers, Quadras, and the PowerBook 140 and 170. You can confirm that you are using the correct version for your machine by selecting the Virtual icon and choosing "Get Info" from the File menu. The version information should match the description of the machine on which you are using Virtual. Most compatible accelerator boards are sold bundled with Compact Virtual. If you did not get the software with your board it is possible you are trying to use it with a brand of accelerator board which is not supported. Contact the manufacturer or Connectix for details on compatibility.

VIRTUAL MUST BE INSTALLED FROM AN UNMODIFIED DISTRIBUTION DISKETTE.

The installation process customizes Virtual to work with your particular accelerator card. Virtual will load if you copy the Virtual extension onto another machine, but may disable itself if the new configuration is different. To install Virtual, you must run the installer from the original diskette. Do not erase or move the Virtual Installer – leave the disk locked so you can be sure it will always remain unmodified.

VIRUS DETECTION UTILITIES

Virus detection software is often designed to identify situations in which the system is modified. Virtual installation makes necessary changes to how the system starts up, so detection software may intercept and, depending on the level of protection set, stop or make Virtual loading incomplete. Often times, this occurs without notification from the detection software. Therefore, you should disable your virus detection utility as you install Virtual and start it up for the very first time. After Virtual is up and running, you may re-enable your virus detection utility.

IS THE VERSION OF THE ACCELERATOR SOFTWARE THE MOST CURRENT?

For almost every brand of accelerator card, you must also update to the very latest set of accelerator INIT/Extension software. Not having the most recent versions almost invariably leads to crashes during the boot process. Please contact your accelerator board manufacturer to receive the latest updates.

IS YOUR ACCELERATOR PRODUCT EQUIPPED WITH A 68030 PROCESSOR?

Virtual is compatible with most 68030 accelerator products. Virtual will not run if your accelerator board has a 68EC030 chip. Although this processor is based on the 68030, it does not contain the Memory Management Unit required for using virtual memory. If Virtual detects this condition, you will see the "Unrecognized Hardware Error" alert dialog. Many manufacturers offer an upgrade from the 68EC030 to the 68030 processor – contact your accelerator manufacturer for details.

INIT/EXTENSION MANAGEMENT UTILITIES

Many INIT or Extension management utilities do not properly turn Virtual on or off. Virtual loads extremely early in the boot process – before any extension manager and well before the Virtual loading icon appears. Do not use these utilities to disable Virtual. Instead, use the Virtual Control Panel, remove Virtual from the System Folder or hold down the tilde (~) or Escape key at Startup.

THERE IS NOT ENOUGH SPACE AVAILABLE ON THE HARD DISK.

After the Virtual SwapFile location has been selected, there must be enough room left on the selected disk drive for the virtual memory requested. When you are running your Macintosh, the information stored in the expanded virtual memory must have a place to reside. Instead of being stored in expensive RAM, this information is placed into a file on the hard disk drive.

If the DiskSaver option is selected, this file must be as large as the total application memory you set using the slide bar minus the amount of physical RAM installed. If the DiskSaver option is *not* selected, this file must be as large as the total application memory you set using the slide bar.

MY SYSTEM CRASHED.

Virtual is operating system and hard disk drive intensive. If your disk or system is already damaged, or you have a virus, the presence of Virtual may aggravate the situation. A system crash can be caused by many things but can generally be traced back to a problem with your System files or your file system.

Check your file system by using a program from Apple called **Disk First Aid** (DFA) which can be found on one of the Apple floppy disks. DFA looks at your hard drive's directory structure checking it for any loose connections or problems. When DFA is done, it will present its findings which are usually something like "Finished, No repair necessary" or if something is wrong, a box will be presented prompting for appropriate action.

The easiest way to fix your system files is to start up the system software Installer program. Select the type of system you are using from the items on the left and select Install. The Installer updates your system files and *completes other low level maintenance which will not occur if you just copy the files over onto the drive*. It will not affect your installed fonts or desk accessories. Refer to the Macintosh Reference Guide if you need more information about installing system software. Finally, run a current virus eradicator to make sure that your system is clean. After this procedure is completed, you should have one clean happy Mac so restart it and get back to work.

We have found that the vast majority of intermittent crashes can be avoided just by running the Installer, Disk First Aid, and a virus eradicator. Please try these on your system.

TIPS ON USING VIRTUAL

While using Virtual, keep in mind the following tips:

WHEN IN SYSTEM 6, USE MULTIFINDER

Virtual and MultiFinder seem made for each other, and most users will find that MultiFinder helps them get the most out of their expanded workspace. Without MultiFinder, some applications actually exhibit degraded performance due to inefficient use of very large memory partitions. MultiFinder can therefore improve responsiveness as well as increase utility. (System 7 is always in an environment which is similar to MultiFinder.)

TILDE (~) KEY AT STARTUP

Even after the Virtual software is installed, disabling Virtual's operation is easy. Just hold down the tilde key (~) at startup. If you decide that you don't normally want Virtual to load during the boot process, you can uncheck the "Extend Memory" box on the control panel, or remove it from the System Folder (or "hide" it in a sub-folder within the System Folder).

You can use the tilde key trick whenever you suspect that there is a problem running a particular application under virtual memory – it's easy to try running it with Virtual disabled. Also, remember to check whether the version of your application is compatible with your system software.

When you hold down the tilde key, you may often also want to bypass the loading of MultiFinder, and start up with the Finder instead. To do this, hold down the Command key (and the Command key only) during system startup. For System 7 users, you may disable all your extensions by holding down the shift key during system startup.

DON'T QUIT APPLICATIONS (UNTIL YOU HAVE TO),

The first instinct of almost all new users of MultiFinder and System 7 when they have finished with a program is to quit; an automatic, almost knee-jerk reaction for the "Command-Q" key. By not quitting an application when you finish, not only is it quickly available in the future (starting an application up can be a time consuming operation on a Mac), but more importantly you do not fragment memory. The tendency for memory to become fragmented and less usable is one of the most frustrating aspects of the current release of the Mac's system software. So unless you are absolutely sure you won't be needing the program again, just switch back to Finder (by selecting it under the Apple menu), then, instead of quitting, start up your next application.

DON'T WORRY ABOUT FREE DISK SPACE

Once Virtual is installed and running, the amount of space still available on your disk is accurately reflected in the folder or disk information windows. You don't need to worry about keeping extra space free on the disk for Virtual to use (Virtual has already reserved its space by creating the Virtual SwapFile). Also, if you have plenty of free space on your disk, don't worry about setting the amount of virtual memory as large or larger than you are ever likely to need: Having excess virtual memory will not slow down the machine when using MultiFinder, it will just provide more capacity if you should ever need it.

DON'T USE VIRTUAL MEMORY FOR HUGE DISK CACHES OR RAM-DISKS

Use of a RAM Cache can actually slow down the machine when Virtual is enabled. The RAM cache works by storing frequently used disk sectors in RAM memory. With Virtual, infrequently used RAM memory is stored on the disk. By using both, disk sectors can be stored twice on the disk, and thus can slow down operation. Therefore, turn the RAM cache off, or keep it at reasonable size (no greater than 128K) to avoid this penalty. Disk caches are not necessarily undesirable, since as long as their memory (or any memory, for that matter) is accessed frequently enough, it will not be swapped out to disk, but will retain its place in RAM and have the desired effect.

USING MORE THAN ONE DISK DRIVE

If you have more than one fast hard disk attached to your computer, you may find it advantageous to put the Virtual SwapFile on another drive than the one you use for your applications. Then, when you're running an application, the heads on the application's hard drive will tend to hover right over the application program, while the heads on the drive with Virtual tend to hover over the SwapFile. This can minimize head travel, and (if the drives are comparable in access time) maximize speed. Use the "Set SwapFile Location" button in the Virtual File Settings dialog to set the file's location. (Note: The same is NOT true if you have another volume which is just a different "partition" of your hard disk. This can in fact slow things down more than necessary by maximizing head travel!)

CAUTIONS

REAL-TIME APPLICATIONS

Programs which depend upon real-time response may not work as desired in a virtual memory environment. The most common examples are **sound** and **animated video** programs which may "stutter" as disk accesses are performed from virtual memory. Real-time feedback or control systems dependent upon guaranteed-minimum or very fast response times should also not be run in a virtual environment. While Virtual behaves just like RAM memory, it is not always as fast. Fortunately Compact Virtual allows you to address large amount of real RAM as well. If you are using a real-time application and need more than 4MB of memory, find out if your accelerator card is compatible with 4MB SIMMs. If so, you should probably invest in four 4MB SIMMs.

PROGRAMS WHICH SEEM TO HAVE PROBLEMS

There are a very few applications which don't run when loaded into the memory space above the ROMs (the major applications are MacWrite* 4.5 and 5.0, while MacWrite II works just fine). MultiFinder and System 7 Process Manager fill memory from the top down, so if the memory size is kept at or below 4 megabytes, or if several other programs are loaded before such an application (such that the application loads into memory below the ROMs), these programs will behave normally. Some other programs will not work when the system allocates more than 4 MB of memory or with getting fragmented memory. The premier example is Microsoft* Word, which will work fine under MultiFinder, but not under Finder if Virtual is set to more than 4 MB.

Some programs may seem to be slow (especially at startup or when performing some particular function) while running under Finder with virtual memory. A common problem is that when given a huge block of memory, some programs grab and initialize or move sections of memory across the entire block. When running in RAM, this process takes just a few tenths of a second, but running

under virtual memory, it can take much longer. (FileMaker® is a prime example of this problem, sometimes taking many minutes to boot under Finder.) Using MultiFinder can entirely eliminate this problem – run the application under MultiFinder (when possible set its memory allocation to an amount less than the amount of RAM actually in your machine). See the section on MultiFinder Tips for how to set this value. This can dramatically increase performance.

SETTING THE APPLICATION MEMORY SIZE

Don't automatically bump the "Application Memory Size" (the memory allocation given to a program running under MultiFinder) way up. We have found that many applications work best when they are given just the "Suggested Memory Size" shown in the "Get Info" box (this is especially true of scanning applications). Allocate more memory only when necessary.

THRASHING SITUATIONS

Very occasionally, you may find yourself in a situation where the disk seems to be doing non-stop accesses, and your Macintosh is unresponsive (although the cursor will still move on the screen). This process can continue for some time (a minute or more) before things calm down. If at all possible, its best not to interrupt the Mac in this state, but let it work it out. If the thrashing seems persistent, try reducing the size of the partition allocated to the program in MultiFinder. Some programs seem to generate such situations more than others, and often it is just one particular operation in that application.

COMMONLY ASKED QUESTIONS

After you use Virtual for a while you will probably have a few questions.

WHAT IS THE DIFFERENCE BETWEEN MAXIMA AND COMPACT VIRTUAL?

Compact Virtual takes the best features of Virtual and MAXIMA to provide a single solution for accelerated Compact Macs.

MAXIMA is a RAM disk and memory extension utility for Macintosh SE/30, Mac II series, PowerBook (140 and 170) and Quadra computers. It provides an enhanced 24-bit addressing mode (up to 14MB addressable memory) for computers with 8 or more megabytes of memory. Compact Virtual provides virtual memory in an enhanced 24-bit addressing mode (up to 16MB) for accelerated Compact Macs. In addition, Compact Virtual incorporates all of the 24-bit mode features of MAXIMA (RAM disk and memory extension).

WHY CAN'T I SET MORE THAN 16 MEGABYTES? IT'S JUST DISK SPACE, ISN'T IT?

Although the Motorola 68000 family uses 32-bit addressing, the Compact Macs cannot use 32-bit addressing because of the software built into their ROMs (not "32-bit clean") and can use only the lower 24 bits for address information. (This is true even though the accelerator board's 68030 chip has a 32-bit address bus). For Compact Macs, this means that only 2²⁴ addresses can be used, which is equivalent to 16 megabytes. Compact Macintoshes are only compatible with the less powerful 24-bit addressing modes in System 6 and System 7.

UNDER "ABOUT THE FINDER..." MY LARGEST UNUSED BLOCK IS SMALLER THAN IT SHOULD BE.

This is a side effect of pre-fragmented memory. This value represents the size of the largest single block available, not the total remaining memory. There is more memory available, but it resides in smaller blocks (probably above the 4MB level.) Because high memory fills first, it is not unusual to be able to open several applications before the Largest Unused Block size starts to decrease. You may use the **Move I/O Addresses** option to reduce pre-fragmentation and create nearly 12MB of contiguous memory.

VIRTUAL SEEMS MUCH SLOWER ON MY MACHINE THAN ON MY FRIEND'S MACHINE. WHAT AM I DOING WRONG?

Virtual's performance is dependent upon the access and transfer speeds of your hard disk drive. Those of you who made the investment in a fast, high capacity drive should find that your investment has paid off well. The amount of real memory is also of critical importance, and the more the better.

WHY DO I STILL SEE "OUT OF MEMORY" MESSAGES WHEN I HAVE 16 MEGABYTES OF MEMORY?

Under MultiFinder or the Process Manager, you only allocate a portion of the available memory to any particular application. See the **Tips on Using MultiFinder/Process Manager** section on page 17 to learn how to increase these values.

I STILL SEE "NOT ENOUGH MEMORY" ERRORS WHEN I TRY TO START APPLICATIONS, BUT I KNOW I HAVE LOTS OF UNUSED MEMORY LEFT! WHAT GIVES?

This is not a problem associated with Virtual – it also happens when using physical RAM. Not unlike disk space, memory becomes fragmented. The operating system is not able to relocate entire applications to coalesce free space in memory. After enough time, the zones are broken down into increasingly smaller pieces. The largest free block remaining is shown in the "About the Finder..." window. You can sometimes recover more space by closing two programs which appear next to each other in order in this window, but at some point it is usually best to restart the machine. This will clear the memory fragmentation problem.

I AM RUNNING FINDER IN SYSTEM 6 (SO ONE APPLICATION RECEIVES ALL THE MACHINE'S MEMORY) AND I STILL CAN'T DECLARE ONE HUGE ARRAY (OR MAKE THE ONE HUGE PICTURE) I NEED FOR PROCESSING.

The extended memory created by Virtual is *pre-fragmented*; that is, there is not one continuous chunk of memory, but there are at least two (or more) chunks which add up to the total installed memory. Some applications will not be able to take advantage of all the memory due to this fragmentation. You may use the **Move I/O Addresses** option to reduce pre-fragmentation and create nearly 12MB of contiguous memory.

HOW MUCH DOES MY MACHINE SLOW DOWN WHEN USING VIRTUAL MEMORY?

There is no fixed answer to this question. There is usually very little performance degradation until the foreground application starts to actively use almost as much memory as is installed in your machine during any given second. When this happens, the number of page swaps required starts climbing quickly, and the performance decreases. How rapidly this occurs is very dependent on the particular application you are running. Theory can give us a worst-case answer (more than 1000 times slower) but in any real-world practice, this situation simply never occurs. The only real answer to the question is to try it, and see whether the performance decrease on any particular application warrants temporarily running without virtual memory. For moderate size applications running under MultiFinder, the speed decrease is usually below the threshold of perceptibility.

It is important to understand that applications open in the background have very little affect on the performance of the foreground application. The key parameter is the amount of memory required by the foreground application versus the amount of RAM not used by the System.

WHERE'S MY BEEP?

On some systems that are using System 6, the "Simple Beep" sound often fails to function when using Virtual. If your machine lacks a simple beep sound, scroll the window on the Virtual distribution diskette to find a utility called "Simple Beep Installer" and double click. Follow the instructions to add a Virtual-compatible simple beep to your system folder. Finally, reboot the system before using the new beep.

TIPS ON USING MULTIFINDER/PROCESS MANAGER

*The following is intended to summarize and complement the **Macintosh Reference** included with your Macintosh.*

DIFFERENCES BETWEEN MULTIFINDER AND THE PROCESS MANAGER

Under System 6, you have a choice between using Finder or MultiFinder. Using Finder, you can only open one application at a time, and this uses all the application memory which is available. Under System 6 MultiFinder, you can open and manage multiple programs at the same time, although only one can be in actual use.

Under System 7, you do not have an option because the Process Manager is always on. It is similar in function to MultiFinder. (Unfortunately, under both System 6 and System 7, the file management system is known as "the Finder" which is not the same thing as the optional System 6 Finder).

HOW TO ALLOCATE SPACE UNDER MULTIFINDER/PROCESS MANAGER

When using MultiFinder or System 7, the "Get Info" box (which appears after you have selected an application and chosen "Get Info" under the Finder's "File" menu) has two new fields. The editable box (Application Memory Size) lets you select how much of memory you would like to allocate to this particular application when it is running under MultiFinder or Process Manager.

Using System 6, we have found it to be a good idea (*important!*) to increase the partition that Finder itself receives when running under MultiFinder. Select the Finder in the System Folder and choose "Get Info" from the File menu. Increase the Finder's Application Memory Size from 160K to 320K (or higher, if you do a lot of Finder operations). This enhances file duplication, copying, etc. As an example, if you copy onto a 800K floppy disk and you have set the Finder's memory size to 1024K, the Mac may not have to "swap" the information. You do not need to set the size for the System 7 Finder because it is done automatically by the system software.

It is also a good idea to set slightly larger size partitions for some applications. A value too small can limit the utility of the application, while too high a value might force excessive and unnecessary virtual memory activity. Don't automatically set huge memory partitions for each application, but experiment to find the best setting for you. It takes some time to break the old mind-set of conserving memory to adopt one of conserving your time and effort.

DON'T QUIT PROGRAMS (UNTIL YOU HAVE TO).

To avoid memory fragmentation, don't quit programs until you find yourself getting low on memory. Who knows? Maybe you'll need the application later in the day (or the week!). Many applications will let you close all their windows, and can be almost transparent until needed. Starting up an application is often one of the most time-consuming tasks involved in using it, and not quitting will keep the number of starts required to a minimum.

When you are looking to free up a block of memory to start another program, check the "About the Finder..." selection under the Apple menu. Not only do you have to clear out enough space to load the new program (as specified in its "Get Info" box), but the blocks which you empty must be adjacent. "About the Finder" shows the current size allocated to each block, but also displays the programs in the order of their relative positions in memory.

SOME PROGRAMS MUST BE LOADED IN SPECIAL AREAS.

The most common example here is Microsoft Excel prior to version 2.2, which must run in the lowest 1 megabyte of memory. MultiFinder knows about some of these exceptions, and tries to reserve these zones until they are required, but sometimes you can have lots of memory available and still not be able to load a program. If you use an older version of Excel, you may want to start it first (even if you don't need it right away) just to have it reserve its place.

A few applications may exist which don't like running in memory above the ROMs (the expanded memory workspace). If you find such a program, you can try loading it only after several other applications are up and running, so it will be loaded into lower memory (memory normally fills from the top down).

USE THE APPLE MENU (SYSTEM 6) OR APPLICATION MENU (SYSTEM 7) TO SWITCH BETWEEN APPLICATIONS

When you have a lot of applications open, it is often much faster to switch to another application by selecting it from under the Apple menu (System 6) as opposed to cycling through all open applications by clicking on the icon in the upper right corner of the screen. Use the Application menu to switch to another application when using System 7.

Function keys and Command-key equivalents can really speed and ease the task of getting around when lots of windows are open. For example, if you are in the Finder and the desktop is hidden by a large window which prevents you from clicking on a Floppy disk you just inserted, use the Command-O key combination (this will open the last item selected, which should be the disk you just inserted). Similarly, if you can't drag a diskette to the trash, try option-Command-E to accomplish the same end. There are lots of shortcuts like this, and many more can be programmed or assigned using third-party function-key software.

WHEN POSSIBLE, AVOID ARBITRARY MOVING AND RESIZING OF WINDOWS

Every time you move or resize a window and expose other applications running underneath, all of the windows newly exposed have to be updated. Usually this is no big deal, but sometimes (especially when you are running lots of applications at the same time) under virtual memory, each application must swap itself in, update any small window zone just exposed, and swap itself back out again – the process becomes time-consuming. After a little practice, it is easy to learn how to set up your windows on the screen to minimize this problem. Use large windows to hide less frequently used applications in the back. Try to keep the right edge of your main display clear to have access to your disks and the trash when doing Finder operations. Use function keys or the Apple menu to switch between applications.

When using System 7, you can also select "Hide Others" from the Application menu and hide all the background windows. Connectix's HAND-Off™ II product provides an "Auto-Hide" function which automatically hides all the windows from applications that are not being currently used.

USING "ABOUT THE FINDER..." TO ITS BEST ADVANTAGE

The "About the Finder..." selection under the Apple menu can help analyze your patterns of memory usage. Selecting it brings up a bar chart which displays the memory currently allocated to each running application. The dark section of the bar shows how much memory is actually being used,

while the light section shows how much "spare room" is still available. When the light section gets small or non-existent, you can expect to see "Out of memory" messages coming soon in that application. That's the time to shut it down and give it more memory (using the "Get Info" box described above).

Remember that the "Total Memory" shown in the window represents the total pool of memory available to all applications (which you can divide up between applications using the "Get Info" box while running MultiFinder or Process Manager), while the "Largest Unused Block" represents the largest possible space that could be given to the next application to start up (this memory space will not be given to any programs which are already running unless you shut them down, adjust their size, and restart them).

INITS/EXTENSIONS LOADED BEFORE VIRTUAL WILL BE LOCKED INTO RAM

System Extensions are normally loaded in alphabetical order. To speed system startup and to maximize the amount of pages available for swapping, Virtual normally tries to load first, but any extension which loads into high static memory before Virtual loads will be granted full-time RAM; other extensions will be subject to being swapped out with the rest of memory, based on their frequency of use. You can use this feature to reserve memory for time-critical applications, or to help make otherwise obstinate extensions functional.

TO START USING MULTIFINDER (SYSTEM 6 ONLY)

The easiest way is to use the "Set Startup..." feature under the "Special" menu in Finder. You may also select the applications you want to load upon restart (highlight them before selecting "Set Startup"). If the applications you want to start are not all in the same folder (and so cannot all be selected at once), you may either drag them to the same folder, or after starting MultiFinder, go through and start the applications one by one. "Set Startup" will then let you choose to bring up all of the running applications after restarting.

COMMAND KEY TO BYPASS THE USE OF MULTIFINDER AT STARTUP (SYSTEM 6 ONLY)

In System 6, if you have MultiFinder selected at restart, but want to start up in the Finder instead, hold down the Command key (and the Command key only) before MultiFinder is loaded in the boot process. This trick is especially helpful when you have a number of applications set for startup which you want to bypass loading, or if you have disabled the use of Virtual, and don't have enough memory to load many applications otherwise.

REGISTRATION

So that Connectix can continue to keep you informed of new Virtual developments and provide you with quality customer and technical assistance, please take the time to fill in and mail the enclosed registration card. Please also make a note of the registration number on the card and write it on the inside cover of this manual for future reference.

ABOUT YOUR SOFTWARE LICENSE

You are licensed to use this product on a single system at a time. This means, for example, that you are welcome to take your external hard drive home from work and use the product on a machine there. However, you may not install multiple copies of Virtual on different CPUs. If you do so you may find that some of these copies will be non-functional. In particular, only one copy of each registered product will run on any network at any one time.

The legitimate owner of a software product is entitled to make a back-up, or archival, copy of the original distribution disk. However, you may not make any other copy of Virtual and give or sell it to a colleague, as this is a violation of the copyright.

If you need multiple copies of Virtual, please contact Connectix for information about our quantity pricing. Substantial discounts are available for quantities of ten or more.

APPENDIX A - HOW VIRTUAL MEMORY & MEMORY EXTENSION WORK

This section is only for those who have some curiosity how their new virtual memory software and memory extension software work. An understanding of these concepts is in no way necessary to enjoy the benefits of Virtual.

VIRTUAL - MAINFRAME TECHNOLOGY ON A PERSONAL COMPUTER

Virtual memory has been used for many years on mainframe and minicomputers, but Virtual on the Macintosh really represents the first time true virtual memory has been available to every program running under a popular personal computer operating system.

GENERAL CONCEPT

When we want to expand the working memory space of a computer (to add more storage locations at which the computer can address to be read or written with values) we have a wide choice of what kind of storage to add. There are lots of different ways to store information, all the way from very fast static RAM, to DRAM, to hard disks, to floppy disks, to tape storage, to writing things down on a piece of paper, and then the user later having to type it back in.

Normally a distinction is made between directly addressable locations, like RAM memory, and Input/Output (I/O) devices, like disk drives. Virtual memory works by blurring this distinction. Instead of adding expensive DRAM to expand memory, we can allocate some part of an alternate storage device - create a file on the hard disk - and use that file to store the information in our expanded memory space.

Later, when the computer is running, special hardware (provided by the CPU's MMU) detects every access to any location in this expanded virtual memory space. First it checks to see whether the information is already stored somewhere in real DRAM memory. If so, the proper current address of that information (called the physical address) is applied to the memory hardware, and the memory responds with the appropriate value requested. Note: the physical address (where the requested information actually resides) may not be the same value as the "logical" address (which is the location that the CPU thought the information had been stored). This represents a translation of addresses, and is called "remapping" an address from one location to another. Tables accessible to the MMU keep track of the latest translation values; a large fraction of the time, the MMU can perform this address translation lookup for the CPU in less than one-half clock cycle, which means that there will be no delay caused by the translation process.

Sometimes the requested location is not anywhere in the semiconductor memory, but is instead stored out on the hard disk. If this is the case, the processor saves its state on the stack, and looks for a zone of memory which it doesn't think will be needed for a while (perhaps one that hasn't been used much). It takes the information from that zone and writes it out to the hard disk, so it can use the space just vacated to read in the information which is stored out on disk. After the requested information has been retrieved from the disk, the address translation tables are altered so that the information appears to be at the "logical" address where the CPU originally sought it. The processor is then free to restore its state from the stack and resume execution just where it left off. When it tries to access that information again, this time the information will be in DRAM.

Given a sufficiently fast hard disk, and sufficiently intelligent virtual memory management software (to minimize the number and frequency of swaps necessary) virtual memory performance can approach that of DRAM for many types of applications. This is because the vast majority of

operations the computer performs are sequential in nature, and accesses to memory don't jump around in a totally arbitrary manner, but tend to progress across zones or clumps of memory. In the worst case, if every access to memory resulted in an access to the disk file, the computer would proceed at a snail's pace; more than a thousand times slower than normal. However, for the vast majority of real-world applications, this situation simply never occurs.

A PAGE SWAP

One standard method of minimizing the overhead of swapping locations in from external storage is to group a whole bunch of locations together into a unit called a "page." After all, if we just requested an access to a particular location, there is a good chance we will need to access the location right after it in the near future. And besides, when we read from the disk it's lots faster to read several consecutive locations than it is to retrieve information a byte here and a byte there. The term "Page Swap" then refers to the action of writing one page out to disk to free up space in order to read another page back into memory. Common page sizes are 256, 512, 1K, 2K, 4K, and 8K blocks. Virtual uses a fixed, 4K page size.

DEMAND PAGING

There are several methods of determining the best time to swap a page. One of the most obvious, (and a method often having excellent performance) is to swap a page only when it is needed. This is called "Demand Paging," since the page is retrieved on demand.

An alternative approach is the "Working Set" theory. Here, the page management software attempts to figure out what pages are likely to be used in the near future, and swaps those pages in *before* they are needed. For example, if you just shifted under MultiFinder to a different application, the software might swap in all of that application, rather than just the pages which were needed on demand. This can have both positive and negative effects; if you just popped into the application to do a quick copy, you could find yourself waiting to swap in a lot of pages you are never going to use. It is easy for the software to "outsmart" itself. On the other hand, while running that application, you may not have to wait for any further page swaps.

Virtual uses the Demand Paging approach, which means that it will effectively load up only those sections of an application that you use. The first time you use a new function or pull down a menu, there may be a brief pause while code for that function is loaded. But thereafter, any subsequent use should find the code already loaded and ready for execution. It will keep just those sections of those programs you most need and use in memory.

PSEUDO LEAST-RECENTLY-USED ALGORITHM

To do this, the software uses what has been called a pseudo Least-Recently-Used function. Every time you use any memory location on any page, extra hardware in the MMU remembers the page that has been accessed. In addition, if the location is modified, that information is stored as well. (The amazing thing is that all of this information can be continually updated with virtually no degradation in performance!) When it comes time to do a page swap, the computer looks through all the pages, and just selects the one which hasn't been used in the longest time – the Least Recently Used page. As time goes on, all of the frequently used information stays in memory, while infrequently used information spends most of its time on the disk.

We can speed things up even more by taking into account whether a page has changed at all while it has been in memory. If no information on the page has changed, we can save ourselves some time by not bothering to write that page out to disk – the information already stored on the disk is the same as that in memory. Since the time to do a disk write is almost half of what it takes to do a page swap, we can increase our page swap performance by nearly a factor of two if we preferentially select pages which have not been modified. This is the reason that the Virtual SwapFile occupies the full size of the requested memory size on the disk, instead of just the amount needed to supplement the real memory in your machine up to the requested memory size – the extra space is used to store the image of every page in memory, in case that page remains unchanged.

FROM ANOTHER VIEWPOINT

If all of this seems confusing, an alternative viewpoint on the whole virtual memory process is to imagine that the entire memory space of the computer has been moved from RAM out to the hard disk. Then a very fast, intelligent hardware disk cache is set up in memory accessible to the CPU, so that frequently used disk sectors (pages) are the only ones kept in RAM. The net effect of this process would be very close to the implementation of virtual memory.

MOVING BEYOND FOUR MEGABYTES

Getting the operating system to recognize and use more than 4 megabytes of memory on a Mac Plus, SE or Classic is one of the major features of Virtual. Even a short time ago, 4 megabytes must have seemed like an enormous memory capacity for a personal computer, but it has already become a significant (even severe) limitation for some applications (especially in a MultiFinder environment). To get extra memory space and maintain compatibility with the 24-bit addressing scheme of the original Macintosh, extra memory space has to be pulled from somewhere else in the existing "memory map" of the computer. Otherwise, we could not expand the address space without adding more address bits, and then patching all applications and system code to expect more bits in each and every address. 24 bit addressing means 2^{24} different addresses can be generated ($2^{24} = 16,777,216$, commonly abbreviated as 16 megabytes).

On the Mac Plus, SE or Classic, Apple chose to allow 4MB for application RAM and use parts of the remaining 12MB for addressing various devices like the SCSI ports, floppy drive, etc. However, the actual addresses used in this area represent less than 1% of the available space so, by carefully mapping the applications around these special addresses we can recover almost all this space.

Once we have made more address space available, we still need to make applications recognize that although more space is available, it is not all available in one continuous chunk (otherwise, when an application requests more memory it might try to take over the space allocated to the SCSI hardware valid slot card, or even the ROMs). Fortunately, the original memory management system of the Macintosh was defined such that it is possible to make some zones of memory unavailable for use. Virtual marks occupied zones as unavailable from the moment more memory space is allocated, and so programs (which are used to dealing with locked, unavailable zones) bypass these memory areas, treating them just as if they were already in use for another purpose.

FOR DEVELOPERS

Virtual is transparent for the vast majority of applications. A small subset may require an intimate knowledge of the machine's memory map for efficiency of performance or alternate bus master use.

APPLE'S VIRTUAL MEMORY STANDARDS

Apple has proposed a set of standard calls for those drivers or programs which must deal with a non-unity memory mapping environment. This standard includes calls to determine page size, to temporarily lock and unlock zones of memory, and to communicate the logical-to-physical address translation to the host program. Virtual conforms to Apple's Virtual Memory standards.

APPENDIX B - RAM DISK

If your accelerator has its own RAM and you have additional memory on the original motherboard, this motherboard RAM can be used for a RAM disk. If your accelerator board has more than 4MB of RAM, you can also assign any RAM not used for application memory to the RAM disk.

The RAM disk is simply another mass storage device like your hard drive, where you can keep documents, applications and System files which you want to access when you use your Macintosh. Although it looks just like any other hard drive on your Desktop, it is special because data stored there can be retrieved much faster (typically more than ten times faster) than data kept only on a hard disk. This RAM disk feature is the same feature that Connectix's MAXIMA provides for Mac II series, SE/30, Powerbook (140 and 170) and Quadra computers.

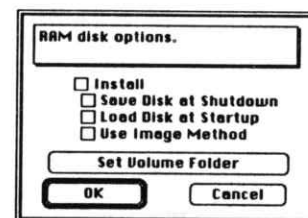
The RAM disk can be easily configured to function like an ordinary hard disk. Its Volume Folder makes it possible to store or revise files on the RAM disk and restore that information later when you come back and turn on the computer. The Volume Folder is a just a specific folder on your hard disk which stores the entire contents of the RAM disk when the computer is turned off. By selecting the two options, **Save Disk at Shutdown**, and **Load Disk at Startup** the information in the RAM disk will automatically be saved in the Volume Folder on your hard drive during periods when the Mac is shut down and copied back into the RAM disk when you turn it back on.

Even if you do not set up a Volume Folder, the contents of the RAM disk will survive Restarts and system crashes as long as power is not interrupted. The Volume Folder is only needed to preserve information when the machine is unpowered (shutdown) – a state in which RAM forgets all stored information. The RAM disk works just like a hard drive – if you save the information to the RAM disk before the crash it should still be there when you start up again. However, if you lose power, you will lose any changes to information on the RAM disk since the last Shutdown.

If the RAM disk contains a System and Finder, it will *automatically* be used as the Startup Volume. This means that the Macintosh will boot using information stored in RAM which can significantly cut boot time. Do *not* use "Select Startup Device" from the Control Panel to designate the RAM disk as the startup volume.

INSTALLING THE RAM DISK

Click the RAM disk Settings button in the Control Panel to open the RAM disk Options dialog box. This dialog is used to configure the RAM disk.



The RAM Disk Options dialog

To enable the RAM disk, click the Install check box. To set the size of the RAM disk, use the Virtual Control Panel's scroll bar. The RAM on the main logic board and any RAM on the accelerator board which is not being used for application memory will be used to make the RAM disk.

RAM DISK OPTIONS

SAVE DISK AT SHUTDOWN

LOAD DISK AT STARTUP

You can configure the RAM disk to automatically be copied to the Volume Folder on your hard drive whenever you Shutdown. You do this by selecting the **Save Disk at Shutdown** feature. Similarly, you can cause the RAM disk to be automatically restored from the hard drive when you startup by selecting the **Load Disk at Startup** feature.

This means that you can come in mornings, startup your machine and find your RAM disk just as you left it when you shutdown the night before – same files, same settings, same open folders. This makes its operation and use much more like a hard disk than a traditional, volatile RAM disk. You need to select *both* **Save Disk at Shutdown** and **Load Disk at Startup** if you want to preserve and restore the contents of the RAM disk when you Shutdown and Restart.

The first time you turn on these options, hold down the Command key and select “Restart” or “Shutdown” from the Special Menu. This will transfer a copy of the RAM disk into the Volume Folder on your hard disk. This may take a while, since initially the entire contents of the RAM disk must be copied to the hard disk. But this only happens the first time. After that, whenever you do a Shutdown or Restart, only the information which has changed will be copied, so the process will usually be much faster. After the machine has restarted, you can see a new folder on your hard disk which has the same name as whatever you have called the RAM disk. This is the Volume Folder.

When you use the Load Disk at Startup feature, you can actually boot from the RAM disk. If the Volume Folder contains a System and Finder, the RAM disk will *automatically* be used as the Startup Volume. Do *not* use “Select Startup Device” from the Control Panel to designate the RAM disk as the startup volume.

The Load Disk at Startup feature can also be used to copy any folder to the RAM disk at Startup. Use the Set Volume Folder button which folder is copied on to the RAM disk (see Set Volume Folder section).

USE IMAGE METHOD

If your RAM disk is nearly full and contains numerous files (more than 200) the Image Method can substantially increase the speed of the copying at Shutdown and Startup.

The “Use Image Method” box in the RAM Settings dialog changes the way files are stored in the Volume Folder. This is a feature you may wish to ignore until you have used Virtual for a while. If it is selected, a full “bit-image” of the RAM disk is copied into a file called RAM disk Image in the Volume Folder, rather than the usual file-by-file copy.

However, if the RAM disk is fairly empty, this can increase the time it takes to start up and shut down as well as use unnecessary hard drive space. This is because all the memory allocated to the RAM disk gets copied, whether or not files are stored in it.

Some INITs and Extensions (e.g. Master Juggler, Disk Express and ON Location) require that the Image Method be used. These products depend upon “file numbers” of files on a disk, and the “file number” on the RAM disk can change with each Shutdown/Restart using the Normal (HFS) Copy Method. Using the Image Method, even file numbers are preserved.

SET VOLUME FOLDER

Click the Set Volume Folder button to specify where on your hard disk the entire contents of the RAM disk volume are stored while the computer is turned off. Use the standard directory dialog box to open the folder you want to designate as the Volume Folder. Then click the Use this Directory button at the top of the dialog box.

The name of your particular Volume Folder will always be the same as the name of your RAM disk. You can change the name of the RAM disk just like any other drive. But if you do so, it is very important that also change the name of the Volume Folder. Otherwise, if you have the Save Volume Folder option on, Virtual will create a new folder in which to store the contents. Likewise, if you change the name of the Volume Folder, you should change the name of the RAM disk.

SPECIAL KEYS FOR USE WITH THE RAM DISK

COMMAND KEY AT RESTART

Hold down the Command key while selecting Restart from the Special menu to force copying the contents of the RAM disk to the Volume Folder on your hard disk. You should use this combination whenever you wish to update the contents of the Volume Folder without shutting down the machine.

You can also use this combination to preserve the contents of the RAM disk if you have not yet created a Volume Folder on the hard disk.

Do not hold the Command key down after the Restart chime as this reinitializes the RAM disk (see the next section).

COMMAND KEY AT STARTUP

Hold down the Command key at Startup to re-initialize the RAM disk and force copying from the Volume Folder into the RAM disk (if any). If the RAM disk becomes corrupted for any reason, or if you wish to load files from a new Volume Folder, use this combination to place a fresh copy of the Volume Folder onto the RAM disk.

Under normal circumstances, the RAM disk knows the times it is necessary to copy itself to or from the Volume Folder, and most users should never worry about tricks to force a copy.

OPTION KEY

If any folder on the RAM disk contains both a System and a Finder, hold down the option key at Startup to prevent the RAM disk from loading as the Startup disk. Use this special key when you want to start up from a hard disk instead of the RAM disk. The RAM disk will still load.

THE MINUS (-) KEY

Hold down the Minus, or dash key (-) at Startup to disable all RAM disk features. When you use this special key, Virtual will still load at Startup; only the RAM disk features will be disabled. The RAM disk can also be disabled by unchecking the Install check box in the RAM Disk setting dialog box.

If you do not want Virtual to load, hold the tilde key at Startup, uncheck the Extend Memory check box in the Virtual Control Panel, or remove Virtual from your System Folder.

A FEW CAUTIONS

POWER INTERRUPTIONS

Whether or not you use the Volume Folder feature, any information on the RAM disk will always be erased by an unexpected power interruption. In this case your last "backup" will be the last version saved on the Volume Folder of the hard disk. Because information is only written to the Volume Folder upon an orderly transition to the power-off state (shutdown), someone tripping over your power cord would erase all your progress not only since your last save, but since your last shutdown! For especially critical information or material which took a lot of time to generate, consider periodically dragging a copy to a hard disk or to a backup floppy. If you are in the habit of leaving your machine running for days at a time, it is a good daily practice to select "Restart" while holding down the Command key. This will copy the contents of the current RAM disk into the Volume Folder. Do not, however, drag files directly into the Volume Folder to be "sure" they get saved. The normal Save Disk at Shutdown process can erase any information "saved" in this fashion.

If you crash, you should always use the "programmer's keys" on the side of the Macintosh to restart; turning off the power will kill the RAM disk, but just pressing the reset key will not.

ABOUT THE VOLUME FOLDER

The Volume Folder is just a folder which stores the entire contents of the RAM disk volume. Therefore the contents of the two look identical. This means that if the Volume Folder on the hard disk or any folder within it is opened up, it becomes *virtually indistinguishable* from the folder of the same name on the RAM disk. It is easy to drag a program or file into the wrong folder without realizing it – for example, putting a file into the hard disk's folder instead of on the RAM disk. Then at shutdown, the copy on the hard disk would be eliminated since *only* the contents of the RAM disk are preserved in the Volume Folder, and anything else is removed. For this reason, the Volume Folder and every folder in it is closed on the hard disk any time the files are automatically copied to or from the RAM disk.

There is normally no reason to open the Volume Folder on the hard disk. If you do so, you must pay extra-special attention to which folder and file belongs to which disk, and remember that at shutdown it is just as if you *replaced the entire contents* of the Volume Folder with whatever is on the RAM disk at that time.

The other potential problem occurs when the contents of the Volume Folder will not all fit on the RAM disk. This may occur as the result of the RAM disk being re-sized to make the memory for applications bigger. If this happens, the message "RAM disk full – Copying Halted" appears in the "Welcome to Macintosh" box. This is potentially a hazardous situation – if you now re-size the RAM disk, and try to start again, *only* the information which actually made it onto the RAM disk will remain on the hard disk! For this reason, the RAM disk will not automatically become the Startup Disk when the copy process is incomplete – this gives you a choice of either unmounting the RAM disk (so the files on the hard disk will not be altered at shutdown) and resizing the drive so there *will* be enough space; or of picking and choosing what elements you *do* wish to keep on the RAM disk. You may have to re-copy the entire contents of some folders back up to the RAM disk, since not every item in every folder made it onto the RAM disk by the startup process. Remember to change the information on the RAM disk, not the information in the Volume Folder if you choose this path, because whatever is in the Volume Folder will be replaced by whatever is in the RAM disk as of the next shutdown. Due to these serious side effects, an alert box will appear whenever the copy-up process is incomplete.

OTHER PRODUCTIVITY TOOLS

Connectix offers a full line of productivity products for the entire range of Macintosh computer systems. For more information, please call Connectix at 800/950-5880 (International 415/571-5100), fax 415/571-5195, AppleLink or America On Line at "CONNECTIX" or on the CompuServe Macintosh Forum (GO "MACAVEN").

MAXIMA

For Mac II series, SE/30, PowerBook (140 and 170) and Quadra computers, MAXIMA is software that extends 24-bit mode memory access to as much as 14 megabytes of application memory without using 32-bit addressing. MAXIMA maximizes your RAM investment for System 6 or 7 in 24- or 32-bit addressing modes.

MAXIMA uses any installed RAM beyond 14 MB to create a powerful non-volatile RAM disk that survives system crashes, Restarts, and shutdowns. The RAM disk can be used to reduce boot time, accelerate many routine operations, and speed up memory intensive applications.

MC73 PMMU

The original 68020-based Mac II requires this Motorola 68851 Paged Memory Management Unit (PMMU) in order to run MAXIMA, Connectix's Virtual, or System 7.0 VM, unless the Mac II has been upgraded with a 68030 or 68040 processor. The Mac II has a motherboard socket specifically designed for this memory coprocessor. The MC73 PMMU includes the current (Mask 73) version of the processor, a grounding strap, and a detailed installation manual.

OPTIMA

OPTIMA is an INIT which allows Macintosh systems to operate in 32-bit mode under System 6.0. OPTIMA/32 is the version that allow access of up to 32 megabytes of contiguous application memory, while OPTIMA/128 extends this range to 128MB. OPTIMA can create a 32-bit RAM disk with any memory not allocated to application memory. It is not compatible with MultiFinder or System 7, and requires 32-bit clean applications with the same restrictions as MODE32.

MODE32

MODE32 enables Mac II, IIx, IIcx, and SE/30 systems to use System 7 32-bit addressing. MODE32 creates the same 32-bit addressing that is standard on the Mac IIsi, IIfx, and LC and puts the 32-bit addressing buttons back into the Memory control panel. Using 32-bit mode allows direct access of up to 128 Megabytes of physical RAM or one Gigabyte of virtual memory.

MODE32 is now available for use worldwide through a special distribution agreement between Apple Computer and Connectix.

HAND-OFF II

HAND-Off is a complete Finder enhancement solution to simplify launching applications and opening documents. It gives you fast, easy file access while increasing your overall productivity. Its SuperMenu feature (System 7 only) makes your Apple menu hierarchical so that you can open, launch, or view any file, application, document, Control Panel or alias. HAND-Off II's Pop-up Launch Menu lets you open any file or group of files with a single mouse stroke from anywhere. Application Substitution eliminates the "Application Not Found" error message and allows you to substitute a compatible application.

HAND-Off II's other features help speed up processing by automatically providing optimal environment set-up. Automatic Color Depth Switching speeds up screen redraws by changing color depth and sound levels to your pre-selected settings whenever you switch applications. HAND-Off's AutoHide feature (System 7 only) eliminates window clutter by automatically hiding all windows except the ones that your current application is using.

THE MACINTOSH MEMORY GUIDE

PRINTED EDITION

The Macintosh Memory Guide is a reference guide which provides a simple explanation of memory and how to get the most out of your Macintosh. It provides a detailed description of how memory works on the Macintosh computer. Other topics include RAM, virtual memory, enhanced and extended memory addressing, 24-bit and 32-bit addressing and memory fragmentation.

The Macintosh Memory Guide includes a complete reference section on memory requirements and configurations for all Macintosh models, including LaserWriters.

ELECTRONIC EDITION

The Macintosh Memory Guide HyperCard stack is a HyperCard-based version of the popular Macintosh Memory Guide. This HyperCard stack includes all the detailed information found in the Macintosh Memory Guide as well as a glossary that lets you click on a word to bring up more information on related topics. The Macintosh Memory Guide HyperCard Stack also creates information order forms for Connectix products which you can send by regular or electronic mail services.

To obtain your copy of the Macintosh Memory Guide at no charge, please call, fax, or send Connectix your name, company, address and phone number.