

**doc/VMM**

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# Chapter 1

## doc/VMM

### 1.1 VMM/doc/VMM.guide

```
VMM
(Virtual Memory Manager for Amigas with 68030 or 68040)
User's Guide
Version 2.1
$Date: 94/09/23 16:24:01 $
written by Martin Apel
email: apel@gypsy.physik.uni-kl.de
```

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### 1.2 VMM/doc/VMM.guide/COPYRIGHT

VMM is freely distributable. If you like to honour my efforts in developing VMM you can send me a gift, money, a postcard or maybe a registration of a program you have developed yourself.

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IMPORTANT NOTICE: This program is copyrighted by Martin Apel, but can be freely distributed, provided that the following rules are respected.

- No change is made to the program nor to the accompanying documentation
- The package is always distributed in its complete form.
- Every form of distribution is allowed and encouraged, but no fee can be charged for this program except for, possibly, the cost of magnetic media and/or disk duplication and shipping.
- Inclusion in PD software libraries such as Fish Disks is allowed, provided the fees charged for these disks are comparable with those charged by Fred Fish.
- The program cannot be distributed in any commercial product without the written consent of the author.

By copying, distributing and/or using the program you indicate your acceptance of the above rules.

## 1.3 VMM/doc/VMM.guide/INTRODUCTION

### 1. INTRODUCTION

Even on the A4000 equipped with 6 MB sometimes I longed for more memory or, as an alternative, for virtual memory. As the 68040 contains an MMU and I was interested in learning how it works, I decided to write a virtual memory manager for the Amiga myself. It emulates up to 128 MB in a user selectable amount of physical RAM. In version 2.1 VMM supports the 68030 and the 68040. Paging can be done either to a partition, a normal file or to a so-called pseudo-partition, which combines the speed of a partition with the flexibility of a file.

What does virtual memory mean ?

In a virtual memory environment the processor needs to be able to translate each address it operates on into a physical address. This translation is carried out in hardware by the memory management unit (MMU) for each memory access. Physical memory is split into page frames of equal size, VMM uses either 4 or 8 KB. It is possible for a page to be resident in memory or to be swapped out to harddisk. Whenever the processor tries to access a page that is swapped out, a pagefault occurs. VMM suspends the task causing the pagefault, fetches the corresponding page from disk and installs it somewhere in physical memory. When the page is in physical memory the task is allowed to resume. This process is carried out transparently, i.e. the task causing the pagefault has no knowledge of what happened. The only visible thing is that memory access time for that access has increased significantly. For further information how virtual memory works in general, see one of the following books:

Operating systems - Design and implementation  
Andrew Tanenbaum

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Prentice Hall

Operating system concepts  
Silberschatz, Galvin  
Addison Wesley

How does VMM achieve virtual memory management on the Amiga ?

Unfortunately the Amiga operating system has not been written to support virtual memory, so this program is kind of a hack. I tried to keep everything as system-friendly as possible, but there are certain situations when VMM might crash the system. This is not VMM's fault, but the thoughtlessness of the Amiga's developers regarding virtual memory.

VMM installs a standard memory list in ExecBase, so virtual memory will be handled just like other memory. VM is allocated only when the MEMF\_PUBLIC flag in the allocation is not set. Otherwise system data such as task control blocks and IORequests might be paged out, which would lead to failure. Code can NOT be put into virtual memory, because the DOS loader always requests memory with MEMF\_PUBLIC flag set. From V1.3 this mechanism has been extended to make non-behaving programs work together with VMM.

## 1.4 VMM/doc/VMM.guide/INSTALLATION

### 2. INSTALLATION

VMM requires at least OS2.0 to run. There are two ways to install VMM on your system. There's an installer script provided which does all the necessary setup for you. Simply click on the icon from Workbench and it will guide you through the installation step by step. If you don't like to use the installer script, you can install VMM manually. You have to execute the following steps to do this:

There are two versions of the main program, one for a pagesize of 4 KB and one for 8 KB. You have to decide, which pagesize you want to use for paging. Generally a pagesize of 4 KB would be appropriate, but there might be cases (e.g. on some '040 cards for the A2000), which only work with 8K pages due to the MMU setup of special processor cards. If there's an MMU table already installed, you have to use the size used by that table. Otherwise the system will probably crash. Use the "ShowPageSize" program to find out which pagesize is possible for your system. When you have chosen which one to use, copy the corresponding executable into the L: directory and rename it to "VMM-Handler". Put VMM somewhere into your path or into WBStartup.

The developer files can be copied wherever you like or where your compiler expects them.

The first time you use VMM, you have to specify the parameters used for paging. This is done by simply clicking onto VMM's icon from Workbench or by starting VMM from the CLI. A sample configuration file "VMM.prefs" is provided which you can use as a starting configuration (paging device has still to be entered).

After you have set up your initial environment you may change the tooltypes of VMM to "CX\_POPUP=NO" to prevent VMM from displaying its window on startup. During runtime you can always invoke the window by

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either pressing VMM's hotkey (default: ralt rshift v) or by starting VMM a second time.

The following parameters can be specified when starting VMM. They can be entered from the CLI or as tooltypes from Workbench.

```
CX_POPUP=YES|NO
CX_PRIORITY=<n>
CX_POPKEY=<hotkey definition>
QUIT
```

This makes VMM quit if it is running

## 1.5 VMM/doc/VMM.guide/CHANGES

### 3. CHANGES

```
Changes from V1.0 to V1.1
Changes from V1.1 to V1.2
Changes from V1.2 to V1.3
Changes from V1.3 to V2.0
Changes from V2.0 to V2.1
```

## 1.6 VMM/doc/VMM.guide/To\_1\_1

There were quite a few changes / enhancements implemented since the release of V1.0.

- There was a bug, which caused VMM to page to the wrong disk on systems with hard disks with unit numbers other than zero.
- A dynamic memory allocation policy for page-frames is now implemented. This causes VMM to allocate a new page-frame on each pagefault if possible, thus reducing disk access. When memory is needed for other purposes, VMM will free its buffers and return memory to the public memory pool.
- Paging to a disk file is implemented now. Unfortunately it is quite slow due to the overhead of the AmigaDOS filing system.
- VMM should now run on all machines with a genuine 68040 processor without problems. It installs its own MMU table if necessary.
- The statistics window is font-sensitive now and gives more information about the paging process. Additionally a new program "VMMStat" is included, so you don't have to keep the statistics window open all the time.
- Up to 64 MB are now available for virtual memory.
- Two different program versions for pagesizes of 4 and 8 KB are available now.
- Disk access time is reduced by minimizing head motion of the paging



device.

## 1.7 VMM/doc/VMM.guide/To\_1\_2

- In V1.1 tasks were forbidden to allocate VM from a forbidden section for security reasons. This has been changed back to the behaviour of V1.0 because of problems with AdPro.
- A small program "ShowPageSize" has been added to determine which pagesize is possible on your system.
- Fixed a bug which caused strange errors when using a page-file with its path longer than 20 characters, or paging to a partition with the partition name longer than 20 characters. The path of the page-file can now be up to 80 characters, the name of the paging partition up to 40 characters.
- Maximum VM size has been increased to 128 MB as requested.
- A special library for giving VM only to dedicated programs has been added. It includes functions such as AllocVMem, FreeVMem and AvailVMem. See vmm\_lib.doc for details.

## 1.8 VMM/doc/VMM.guide/To\_1\_3

- FreeMem now marks the freed pages as empty resulting in less paging on freeing memory. Unfortunately this breaks tools such as MungWall which writes to memory it hasn't allocated.
  - Fixed a bug which caused strange behaviour during disk IO using multiple units sharing the same device. This was probably responsible for some strange misbehaviours when rendering text and icons.
  - The statistics window is now "zoomable" to only the title bar indicating the amount of free VM. Position and initial status of the statistics window are configurable in VMMPrefs.
  - The preferences are now changeable while VMM is running. All parameters except the paging device/file, the page-file size and the position of the statistics window will be immediately changed by VMM.
  - An advanced section for memory allocation has been added to VMMPrefs. You can now determine the minimum size for VM allocations for PUBLIC and non-PUBLIC requests separately.
  - Reduced VMM's usage of signals on behalf of other tasks. There were problems with tasks that had all their signals already allocated.
  - The Wait function had to be patched in order to avoid problems with tasks which have a stack in VM.
-

- You can now exit VMM even if there's VM still allocated. In this case VMM will try to page in all this memory and set up the MMU tables accordingly, after which it will quit.
- Now writes out modified pages before it needs to, resulting in better average pagefault service times.
- Added a reset handler which inhibits a reset until paging currently going on has finished. This prevents the validate procedure after reset if you are paging to a file.
- Fixed a bug which caused VMM to hang when writing the first page to DMA-driven harddisks.
- Some minor changes and cleanups.

## 1.9 VMM/doc/VMM.guide/To\_2\_0

- VMM runs on the 68030. Consequently VMM40 has been renamed to VMM.
- Implemented so-called pseudo-partition, which look like a file but can be accessed with the speed of a partition.
- VMM is a commodity in V2.0 using a hotkey to display its GUI. Consequently the setup of V2.0 has changed a bit. VMM40 has been moved to L:VMM-Handler and VMM40Prefs is now simply called VMM. The VMM: assign and the StartVMM program have become obsolete.
- Hopefully fixed bugs having to do with paging to DMA devices (Patched CachePreDMA and CachePostDMA)
- The GUI has changed a bit to make room for some additionally needed gadgets.
- VMM now patches Workbench's title bar to include the amount of free VM. There's a configuration button to enable or disable this feature.
- Better exit handling if there's still VM allocated.
- Miscellaneous minor changes and bug fixes

## 1.10 VMM/doc/VMM.guide/To\_2\_1

- AvailMem now returns amount of free public memory if task is not permitted to use virtual memory.
  - Fixed a bug in the startup code which caused VMM to crash if the preferences file wasn't found. Now a requester is displayed.
  - Fixed a bug in the Installer script which caused the default configuration file not to be copied.
-

- Implemented a write buffer to write multiple pages to disk. Although this involves copying the pages to the buffer it generally results in a quite noticeable speed improvement.
- Deleted the memory option for paging to the largest available chunk since no-one ever seems to use it.
- Paging to a file is speeded up significantly by using additional buffers for the filesystem. FFS and OFS are very inefficient on seeking on long files. VMM installs as many buffers as are needed to keep the file list blocks of the paging file in memory. Other file systems such as the MSDOS filesystem don't need this.
- FreeMem now marks the freed pages as unused instead of invalid. Previously subsequent accesses to that range of memory resulted in a page-fault without any disk access but the overhead for page-fault handling.
- Corrected font calculation for statistics window.
- Improved error handling.
- Fixed a hard to find bug which could cause spurious crashes on 68030 systems with a 68882. I underestimated the amount of data which is pushed onto the stack during a context switch if the FPU is busy.
- Added support for external statistics displays. You can now write your own (possibly graphical) statistics output for VMM.
- Worked around a DOS bug which caused failure to use pseudo-partitions on partitions with the same volume and device name.

## 1.11 VMM/doc/VMM.guide/VMMPREFS

### 4. The preferences window

In order to enter all the settings that are needed for VMM to work, there's a nice GUI provided with the program. NEVER modify the configuration file generated by VMM by hand. If this file is not what it's supposed to be, VMM may crash or, even worse, use the wrong partition or the like. You can change the parameters of VMM while it is running except for a few, where it would be hard and unnecessary (in my opinion) to change them during runtime.

There are four major parts in the configuration of VMM:

- Tasks / Programs
- Memory settings
- Statistics
- Miscellaneous

## 1.12 VMM/doc/VMM.guide/Tasks\_Gadget

Tasks / Programs list:

You can enter task or program names, which should be run either using VM or not. From V1.3 an advanced section has been added to VMM to make more detailed prescriptions about VM allocation possible. The details are explained in the following paragraph. A newly added task or program is entered with the currently displayed status of the "Use VM" gadget, i.e. "Use VM", "Don't use VM" or "Advanced", and can be modified afterwards. The name you enter can either be a task name, the name of a load file (without path), or even a normal AmigaDOS pattern to specify which entity is meant to be run with or without VM. The default behaviour is always presented first in the list, thus making the "VM by default" gadget in previous versions obsolete. There are additional buttons to move entries in the list, so you can group programs together. However the sequence of programs in this list does not influence the behaviour of VMM.

The advanced section has been implemented because there are programs which either always allocate memory with the public flag set or they allocate memory with the PUBLIC flag unset, where it must be set. To make these programs run together with VMM, you can tell VMM the minimum sizes to go into VM with the PUBLIC flag set or unset. If you enter a value into one of the string gadgets all requests with sizes larger than the given size will be allocated in VM, e.g. a value of 0 makes all allocations with the corresponding flag settings go into VM. The special value -1 will tell VMM that no allocation should go into VM for the corresponding flag setting. This is a bit difficult to explain, so I hope the following examples will make things clearer.

Example 1: A program allocates all its memory with the PUBLIC flag set and thus makes no use of VM.

Solution: Set the "Min public VM allocation" gadget to some value e.g. 200. You will have to try the actual value. If you enter 200, all requests smaller than 200 bytes with the PUBLIC flag set will go into PUBLIC memory, whereas all larger ones will go into VM. Enter 0 into the "Min non-public VM allocation" gadget to indicate all allocations with the PUBLIC flag unset should use VM.

Example 2: A program allocates system structures with the PUBLIC flag unset leading to crashes with previous versions of VMM.

Solution: Set the "Min non-PUBLIC VM allocation" gadget to e.g. 200 and the "Min PUBLIC VM allocation" gadget to -1. This way system structures, which are mostly well below 200 bytes, always go into PUBLIC memory.

The "Use VM" state corresponds to a -1/0 setting of the "Min PUBLIC"/"Min non-PUBLIC" gadgets. The "Don't use VM" state corresponds to a setting of -1/-1.

### 1.13 VMM/doc/VMM.guide/Memory\_Settings

This section determines the paging device and the configuration of memory used for paging.

Memory allocation  
Mem size used for paging  
Memory Type  
Swap medium  
Swap file size  
VM Priority  
Write buffer

### 1.14 VMM/doc/VMM.guide/MemType\_Gadget

Memory allocation for pageframes:

There are three policies for memory allocation:

- Largest: VMM allocates as much memory as possible on startup. There are certain problems in using this memory allocation scheme. I'm thinking about removing this option in future versions of VMM, because I think no-one really uses it. If you'd like this option to remain in future versions, send me a mail.
- Fixed size: VMM allocates as much memory as given by the memory size gadget on startup.
- Dynamic: VMM allocates and frees memory for page frames as required during run-time.

### 1.15 VMM/doc/VMM.guide/MemSize\_Gadget

Memory size:

For the fixed size memory allocation policy you can set the amount of memory used for page frames.

### 1.16 VMM/doc/VMM.guide/MemFlags\_Gadget

Memory type for pageframes:

This gadget determines the type of memory to be used for paging. Either FAST, CHIP or ANY can be selected. Normally CHIP memory is inhibited from being cached; also on the A4000 pageframes lying in CHIP RAM can't be cached. However on the A2000 with a 68040 card it might be possible that pageframes located in CHIP memory are cached, making it valuable to use CHIP memory as a paging buffer to acquire more cacheable RAM.

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## 1.17 VMM/doc/VMM.guide/SwapMedium\_Gadget

Swap medium:

There are three possible mediums where to page to:

- Paging to a partition: When clicking on the 'Select' gadget you will be asked for the partition you want to use for paging. If you select a partition for paging for the first time, VMM will ask you if you really want to overwrite that partition, so you need not worry about destroying the wrong partition.
- Paging to a file: When clicking on the 'Select' gadget you will be asked for a filename used for paging.
- Paging to a so-called pseudo-partition: Pseudo-partitions are files which use a contiguous block on your harddisk. As such they can be listed, viewed and deleted just like normal files. VMM creates this kind of file for you and can access it using device commands yielding the speed of paging onto a partition while still using a file. If the file already exists VMM checks its consistency upon startup so you need not worry about VMM overwriting part of your partition.

Pseudo-partitions currently work only on FFS volumes with a blocksize of 512 bytes. Because pseudo-partitions need contiguous blocks on your harddisk and FFS stores the root block in the middle of a partition, a pseudo-partition cannot be larger than half the size of the volume it resides on.

A sentence of warning has to be spoken here: This is a very DANGEROUS option. If there is a bug in the code creating and maintaining the pseudo-partition, VMM has the potential of destroying your partition. However, I've thoroughly tested this feature and never had any problems with it.

This parameter and the following page file size will not be updated until the next start of VMM. It would be very hard and unnecessary to switch page files during runtime.

## 1.18 VMM/doc/VMM.guide/FileSize\_Gadget

Filesize:

This gadget determines the size of the paging file or pseudo partition.

This parameter and the previous swap medium will not be updated until the next start of VMM. It would be very hard and unnecessary to switch page files during runtime.

## 1.19 VMM/doc/VMM.guide/MemPri\_Gadget

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VM priority:

Here you can select, when VM will be allocated. Exec searches through all memory lists in a priority order with normal FAST memory usually at priority 30, CHIP at -10. So if you want to allocate VM first, you have to select a value larger than 30; if you want to use normal fast memory first, but VM before CHIP memory, you have to select a value between -10 and 30. Dynamic memory allocation works best with VM priority being the highest in the system. Otherwise all physical memory will already be taken and VMM has to page all virtual memory into a small buffer, because it cannot enlarge it anymore.

## 1.20 VMM/doc/VMM.guide/WriteBuffer\_Gadget

Write buffer:

From V2.1 VMM uses a write buffer in order to be able to write out several pages in one go. This results in a considerable speedup because it reduces disk seek times and overhead for I/O handling. With the write buffer gadget the amount of memory dedicated to buffering pages going out to disk can be determined. Setting this to 0 disables write buffering. Specifying an amount of 100 to 200 K for this should suffice for nearly all situations.

## 1.21 VMM/doc/VMM.guide/Stat\_Gadget

Statistics:

Statistics of the paging process can be displayed in a small window or just in a titlebar. If the titlebar is used, only available VM and PUBLIC fast memory is displayed. You can switch between the two displays using the zoom gadget. The display also contains a close gadget. Clicking on it will cause the statistics window to be closed. Note that this behaviour is different from previous versions (before 2.0). You can set the position of the window/titlebar and the initial state.

## 1.22 VMM/doc/VMM.guide/Misc\_Settings

Hotkeys:

There are two additional hotkeys to enable or disable allocation of virtual memory during runtime. The hotkey descriptions have to follow the commodities rules for hotkey descriptions. The popup hotkey can only be specified via commandline or tooltypes (according to commodities setup).

Minimum VM allocation

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To speed up the AllocMem routine which is heavily used by the whole system, VMM doesn't allocate VM for requests smaller than the size given here. This saves AllocMem the overhead of looking into a hash table to find out if the current task is allowed to use VM. Setting this to zero will effectively cause VMM to look into its hash table on every AllocMem. A value of 100 to 200 is reasonable.

Don't cache Zorro II RAM:

On some Amigas with a 68040 card you have to disable the caching of RAM in the range of 0 to \$00ffffff (Zorro II addressing range).

Show VM in WB title

After receiving many requests to patch the Workbench title bar in order to reflect the amount of free virtual memory I finally implemented this. As this patch is a bad hack (patches SetWindowTitles() and compares the string title to "Amiga Workbench" or "AmigaOS 3.1") I decided to make it configurable. That's what this button is for.

## 1.23 VMM/doc/VMM.guide/PROC\_DIFFS

### 5. 68030 VS. 68040

There are certain differences in the 68030 and 68040 implementation. First, on the 68030 VMM (nearly) always installs its own MMU table. This is because most 68030 machines either don't use the MMU at all or they have it set to a different pagesize. This means that Enforcer does not work on the 68030 together with VMM. It uses a pagesize of 256 bytes. From V2.1 I have added a small hack which causes the machine to reload the kickfile after a crash if you are using a softkicked A3000. This feature is not documented anywhere but has been proposed by Mike Sinz.

## 1.24 VMM/doc/VMM.guide/PROBLEMS

### 6. PROBLEMS

Commodore defined the MEMF\_PUBLIC flag for the AllocMem function a long time ago, when no-one knew what this would mean in future. The result is that either people allocated all their memory with the MEMF\_PUBLIC flag set or they ignored it and never set it at all. The first way doesn't hurt VMM, but it prevents the corresponding program from using virtual memory. The second alternative is worse. There are a lot of programs, which allocate messages or IORequests on the stack, which might produce a failure in a virtual memory environment. Such programs can be forbidden to use virtual memory using the preferences program, otherwise spurious crashes may result. If you

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are considering writing programs which might benefit from virtual memory, you should read the file "VMProgGuideline" to see what should be avoided in a virtual memory environment.

Caching programs such as FastCache or PowerCache should be disabled from using virtual memory (doesn't make sense to give virtual memory to a caching program, does it?). The same applies to all programs that patch the BeginIO vector of the paging device. When using disk caching programs, the file system tasks probably have to be disabled from using VM, too.

Programs which use the Access Fault Trap Vector such as Enforcer have to be run before VMM, otherwise Enforcer will flag all pagefaults as invalid memory references.

## 1.25 VMM/doc/VMM.guide/TROUBLESHOOTING

### 7. TROUBLESHOOTING

Question: Program "X" doesn't use virtual memory. Why?

Answer: "X" might always allocate memory with the MEMF\_PUBLIC flag set. Use the "advanced" section to enable this program to use VM.

Question: VMM crashes with my configuration. How do I find out which program behaves badly?

Answer: Set the default allocation to "Don't use VM" and move the memory slider to a low position, so there are many pagefaults, if VMM runs. Then enable virtual memory for each task in your system one after another. This way you can see, when the system crashes first. You can disable VM for the task producing the crashes then.

Question: VMM sometimes hangs when accessing a partition using the same device as the paging partition. Why?

Answer: You probably have a harddisk using DMA transfers with the mask parameter for the filesystem set wrong. You have to use either HDToolbox or edit your mountlist to change the value of the mask parameter for all partitions on the paging device. If you don't know what the mask parameter means, simply set it to 0xfffffe, limiting transfers to the lower 16 MB. This error should not occur anymore from V2.0. If it still does, please send me a mail.

Question: My disk-caching program doesn't work even if disabled from using VM. Why?

Answer: Some programs patch code executed by other tasks. E.g. DynamiCache patches the BeginIO vector of cached devices, so that all memory allocation for cache buffers is done not by DynamiCache, but by the filesystem task. If this is a problem, the tasks executing the patched code (here: DH0, DH1,...) have to be disabled from using VM. For a problem regarding the copyback cache of PowerCache see section Known bugs.

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## 1.26 VMM/doc/VMM.guide/TECHNICAL\_DES

### 8. TECHNICAL DESCRIPTION

VMM consists of three tasks, enabling the statistics window invokes a fourth. The first one is the VM\_Manager, which takes care of deciding which task is allowed to use VM, initializing everything and so on. The PageHandler does the paging, when a pagefault has occurred. The Prepager causes pages to be locked in memory, when IO has to be carried out to or from VM using the paging device. Most of the effort has not been invested into getting the paging to run, but to make the system use VM correctly under all circumstances. Unfortunately Commodore hasn't invested much thought into the definition of the MEMF\_PUBLIC flag, so quite a few system functions had to be patched. I have tried to keep VMM as system-friendly as possible, but I had to make a few assumptions, which are not documented. The worst one is that I had to patch the Switch function, which changes a task from running state into the ready or wait state. This means that VMM might not run in future versions of the OS, though I don't think Commodore will be changing much in such low level code.

Commodore also didn't state anything about using non-public memory inside Forbid/Permit or Disable/Enable. Causing a pagefault inside a forbidden/disabled section is dangerous, because paging results in task switching. Memory which should be freed inside such a section is freed when this section is completed.

Currently the number of faults in progress plus the number of tasks using VM for their stack must not be more than 20 at any moment.

#### The VM\_Manager process

The VM\_Manager starts up all other tasks and initializes most data. It also handles the quit request by the user. Each time AllocMem is called, VMM has to decide whether the requesting process is allowed to use VM. The first time a task/process allocates memory, a message is sent to the VM\_Manager, which decides if usage of VM is permitted. Subsequent requests by the same task are dispatched quickly using a hash table. The manager process also handles all messages generated by pressing a hotkey or using the Exchange program.

#### The PageHandler task

All paging is handled asynchronously by the page handler. When a fault occurs, the parameters for such a fault are put into a so-called trap-struct by the trap-handling code. This structure is then sent to the pagehandler. The pagehandler chooses a page to be evicted and possibly writes out a modified page first. The so-called second-chance algorithm is used for choosing a page to be evicted. When this process is finished, the required page is read in. When the read has been successfully completed, the faulting task is signalled to continue its computation. During IO to the paging device other tasks are permitted to run and eventually cause other pagefaults, which are handled immediately.

It will sometimes look as if VMM is paging a lot. To reduce page-fault service time, VMM tries to write out modified pages before it really needs to. This reduces the average service-time quite a

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bit. Sometimes VMM will write out pages without benefit, because they are modified later on. Though VMM might use the paging device more than other VM programs do, this makes programs using VMM running quicker most of the time.

#### The Prepager task

In the process of writing VMM I have detected some cases, in which IO to the paging device is requested, e.g. to another partition living on the same physical device as the paging partition. As the paging device itself must never block for a pagefault, this has to be prevented. All IO to the paging device (except that from the pagehandler) is examined for usage of virtual memory. If it uses VM, the corresponding pages are copied to a temporary buffer, the IO is carried out using that buffer, the pages are copied back if needed and the process requesting IO is permitted to continue.

#### The statistics task

The statistics task is only created, if statistics are enabled. Every second it prints a few lines about usage of virtual memory and the number of pagefaults occurred so far.

#### Patches to system functions

The following Exec functions are patched by VMM: Switch, AddTask, Wait, AllocMem, FreeMem, AvailMem, CachePreDMA and CachePostDMA. On 68030 system ColdReboot is also patched to restore the original MMU table before reset.

Additionally the BeginIO function of the paging device is patched. The Switch, Wait and AddTask functions had to be patched because the stack may be in virtual memory. To prevent pagefaults while in supervisor mode (task-switching), the stack is replaced by a temporary stack large enough to contain all registers pushed onto the stack during a context switch. When the task is re-launched, the original stack is used again.

## 1.27 VMM/doc/VMM.guide/VMM\_LIBRARY

### 9. VMM.LIBRARY

A library has been added to the VMM distribution as requested by some people. It contains functions for AllocVMem, FreeVMem, AvailVMem, AllocVVec and FreeVVec. When the library is first loaded, the VMM pagehandler is automatically installed. Only programs using the function calls of vmm.library will get virtual memory. If you wish to use vmm.library and the standard way of getting VM, you have to use VMM just like before. Currently the pagehandler is not terminated when the library is expunged. A doc file for the library functions in Autodoc format is included.

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## 1.28 VMM/doc/VMM.guide/EXT\_STATS

### 10. EXTERNAL STATISTICS

From V2.1 it is possible to write your own statistics display program. You can add graphical output and additional computations such as average page fault rate and so on. There's an include file describing the message structure you have to send to VMM to acquire status information. See that include file for further information. If you write a nice program you can send it to me and I might include it in the next release.

## 1.29 VMM/doc/VMM.guide/KNOWN\_BUGS

### 11. KNOWN BUGS

As far as I know there are no major bugs in VMM. However there is one minor bug which still has to be corrected. If a task is removed via `RemTask` from another task and it uses virtual memory for its stack, the `TrapStruct` is currently not released. Commodore recommends not to call `RemTask` on another task and it isn't done very often in real programs. One possibility is to prevent the task that allocates the stack for such programs from using virtual memory.

It can happen that VMM cannot startup due to lack of memory. In this case it should bring up a requester stating this fact. If the requester cannot be created, there will be no message at all indicating the reason of failure. This is due to a bug in `EasyRequestArgs`, as there is no way to find out if the requester was successful or not. In future OS versions (if there will be any) this should produce a recoverable alert.

There's a strange phenomenon in conjunction with `console.device`. When you open a new CLI window, sometimes the cursor remains ghosted although the window is activated. Activating another window and then the new console window again will activate the cursor. The 'CON' task seems to allocate its stack in VM and that produces the problem. If you disable 'CON' from using VM this problems disappears.

There's a bug in conjunction with the copyback mode of `PowerCache`. It causes file contents to be garbled. This is rather a bug in `PowerCache` than in VMM. In the current version of `PowerCache` (37.115) there's are two choices: either you have to turn off the copyback cache of `PowerCache` or you have to set the mask (in `HDTtoolbox`) for all partitions on the paging device to `0xffffffff` (limits accesses to lower 256 MB). I hope this will be fixed in future versions of `PowerCache`.

If you decide to open the statistics window when VMM is already running by invoking the GUI with the hotkey it can happen that `VMM_Manager` displays an error message saying "Not enough memory". Despite this fact the statistics window is opened. I didn't want to fix this in this release because it requires a rather large change in the code which I want to be thoroughly tested before release.

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I have been reported problems with GVP cards. Though I have done a lot of debugging for this case I haven't been able to track this down yet. The only thing I can say is that VMM works flawlessly on these cards if the data cache is turned off.

## 1.30 VMM/doc/VMM.guide/BUG\_REPORTING

### 12. BUG REPORTING

If you wish to report a bug or propose an enhancement to VMM please use the bug-report form which can be found in this archive. I frequently cannot answer questions because I don't know which version of VMM people are referring to, which hardware they use and so on. This is the reason the bug-report form is important for me. You can find my address under Miscellaneous.

## 1.31 VMM/doc/VMM.guide/FUTURE\_PLANS

### 13. FUTURE PLANS

There are several features I want to include in future versions of VMM such as:

- Support to use virtual memory for code segments / seglists.  
I have done a few experiments in this area and the results seem quite promising. It is not yet in a state which can be released to the public and as such will be incorporated in the next release.
- Improve dynamic memory model under low memory conditions

I include a list of working programs and of programs with problems in this documentation (based on data you send me). Please keep on sending me your experiences.

## 1.32 VMM/doc/VMM.guide/ACKNOWLEDGMENTS

### 14. ACKNOWLEDGMENTS

I would like to thank the following people for ideas, improvements and beta-testing of VMM (in alphabetical order).

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I also want to thank all those people who sent me mail with wishes and bug reports. Without them VMM wouldn't work as well as it does.

## 1.33 VMM/doc/VMM.guide/MISCELLANEOUS

### 15. MISCELLANEOUS

I would be glad to hear from you, if VMM works on your machine, what programs have difficulties in running with VMM. If you report a bug PLEASE use the bug-report form which can be found in this archive. Because most bugs seem to be very hardware dependent I need your configuration data to find out what happens.

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