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Assignment 4

Unix like systems commonly use the term swapping to describe both the act of moving memory pages between virtual memory and disk, and the region of a disk the pages are stored on. [1] On Linux this can be implemented using a swap partition or a swap file. Red Hat, a multinational software company that contributes substantially to Linux, recommends using swap partitions. [2] In later versions of the Linux kernel swap files are about as fast as swap partitions. Although, it is limited by the fact that swap files should be allocated alongside each other in the file system. [1] Swappiness is a kernel parameter that is responsible for controlling the weight given to swapping out runtime memory, as opposed to dropping pages. The swappiness parameter can be set to values between 0 and 100. Higher values result in the kernel attempting to use swap space, while a low value results in swapping being avoided. The default value for swappiness is usually 60. [5] Linux uses a lazy swapper instead of swapping out the entire process. Linux only swaps a page into memory unless that page is needed, allowing it to avoid reading pages that will not be used, decreasing swap time and the amount of physical memory needed. Linux distinguishes between pages in memory and on disk by using valid or non-valid bits. Linux uses three level paging and the least recently used page replacement algorithm. [4] When using HHDs, one advantage of using swap partitions is the capability to place them on side by side HHD areas providing improved speed and throughput. On the other hand, a swap file can be placed on any file system, set to any reasonable size, and can be added or changed. That kind of adaptability is not possible with a swap partition without other tools that introduce more complexities. [1] Linux swap partitions perform TRIM operations by default when the underlying on-disk backing store supports TRIM, such as SSDs. [3] The Linux kernel supports many swap backends, as well as supporting backend priority. When there are multiple swap backends with the same priority, they are picked round-robin style, providing a performance increase permitted by the devices ability to be accessed in parallel. [1] Linux uses a linked list data structure and maintains a list of ‘vm_area_structs’. This list is searched whenever a page is to be found. The range of address, protection mode and the direction of growth are all also recorded. User mode is given 3GB of memory space and 1 GB is reserved for kernel mode. [4]

Microsoft Windows has supported paging since Windows 3.0. In this versions 3.x, a hidden file is created named ‘386SPART.PAR’ or ‘WIN386.SWP’ that is used as a swap file, usually called a page file in Windows. Moving or deleting this file causes an error message to appear on, a blue screen, the next time Windows is started. Windows 95, 98, and Me all use a similar file. The operating system automatically sets the size of the file and allows it to expand if necessary; size setting may be manually set. The Windows NT page file is named ‘pagefile.sys’. [1] When browsing the internet for Windows system tweaking one may come across articles advocating the disabling of the page file. Considering the consumer perspective reveals that this can be a highly opinionated topic. Some people believe that Windows is inefficient at using the page file, and if you have plenty of memory you should just disable it; you are forcing windows to keep everything in much faster RAM all the time. Contrary to this belief, your PC will not actually get

faster, because Windows will never page the application you are working with. Deleting the page file can also cause system problems; things like crashing applications and system crashes become more frequent if available RAM isn't kept in check be the user. Disabling the page file is simply a bad idea. [6] Pages are brought in the memory when they are needed. Eight pages are brought into memory at the same time, instead of being brought in one at a time. The working set model is used, which is the amount of memory currently assigned to a particular process; it contains the pages that are in main memory. Windows uses two level paging and uses the first in first out page replacement algorithm. [4] Windows can be configured to save the page file in free space on any available drive. Usually there needs to be a page file in the boot partition to allow for full memory or kernel dumps after system errors. [1] Microsoft has found the 'pagefile.sys' to be an ideal match for SSD storage. [3] Windows uses a tree data structure where each node is called a Virtual Address Descriptor (VAD). Nodes can be marked free, committed, or reserved. Windows can access up to 4GB of physical memory and allows each process to have its own 4GB logical address space by using paging. Both kernel mode and user mode are given 2GB each. [4]

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