

SWAP SPACE, SWAPPINESS & SWAP FILE IN LINUX

What is SWAP & how does it work?

Linux divides its physical RAM (random access memory) into chunks of memory called pages. Swapping is the process whereby a page of memory is copied to the preconfigured space on the hard disk, called swap space, to free up that page of memory. The combined sizes of the physical memory and the swap space is the amount of virtual memory available.

Swapping is necessary for two important reasons. First, when the system requires more memory than is physically available, the kernel swaps out less used pages and gives memory to the current application (process) that needs the memory immediately. Second, a significant number of the pages used by an application during its startup phase may only be used for initialization and then never used again. The system can swap out those pages and free the memory for other applications or even for the disk cache. You can run `vmstat` command to see swap details along with page in & page out.

```
# vmstat
```

However, swapping does have a downside. Compared to memory, disks are very slow. Memory speeds can be measured in nanoseconds, while disks are measured in milliseconds, so accessing the disk can be tens of thousands of times slower than accessing physical memory. The more swapping that occurs, the slower your system will be. Sometimes excessive swapping or thrashing occurs where a page is swapped out and then very soon swapped in and then swapped out again and so on. In such situations the system is struggling to find free memory and keep applications running at the same time. In this case only adding more RAM will help.

Swappiness:

The Linux 2.6 kernel added a new kernel parameter called swappiness to let administrators tweak the way Linux swaps. It is a number from 0 to 100. In essence, higher values lead to more pages being swapped, and lower values lead to more applications being kept in memory, even if they are idle. Kernel maintainer Andrew Morton has said that he runs his desktop machines with a swappiness of 100, stating that “My point is that decreasing the tendency of the kernel to swap stuff out is wrong. You really don’t want hundreds of megabytes of BloatyApp’s untouched memory floating about in the machine. Get it out on the disk, use the memory for something useful.”

One downside to Morton’s idea is that if memory is swapped out too quickly then application response time drops, because when the application’s window is clicked the system has to swap the application back into memory, which will make it feel slow.

The default value for swappiness is 60. You can alter it temporarily (until you next reboot) by typing as root:

```
echo 50 > /proc/sys/vm/swappiness
```

If you want to alter it permanently then you need to change the `vm.swappiness` parameter in the `/etc/sysctl.conf` file.

Using SWAP file as SWAP space in Linux:

Swap is a space on a disk that is used when the amount of physical RAM memory is full. When a Linux system runs out of RAM, inactive pages are moved from the RAM to the swap space.

Swap space can take the form of either a dedicated swap partition or a swap file. In most cases, when running Linux on a virtual machine, a swap partition is not present, so the only option is to create a swap file.

This tutorial was tested on Linux systems with Ubuntu 18.04 and CentOS 7, but it should work with any other Linux distribution.

How to add Swap File:

Follow these steps to add 1GB of swap to your server. If you want to add 2GB instead of 1 GB, replace 1G with 2G.

Create a file that will be used for swap:

```
# fallocate -l 1G /swapfile
```

If fallocate is not installed or if you get an error message saying fallocate failed: Operation not supported then you can use the following command to create the swap file:

```
# dd if=/dev/zero of=/swapfile bs=1024 count=1048576
```

Only the root user should be able to write and read the swap file. To set the correct permissions type:

```
# chmod 600 /swapfile
```

Use the mkswap utility to set up the file as Linux swap area:

```
# mkswap /swapfile
```

Enable the swap with the following command:

```
# swapon /swapfile -v
```

To make the change permanent open the /etc/fstab file and append the following line:

```
# vim /etc/fstab
```

```
/swapfile swap swap defaults 0 0
```

To verify that the swap is active, use either the swapon or the free command as shown below:

```
# swapon --show
```

```
NAME      TYPE  SIZE  USED PRIO
```

```
/swapfile file 1024M 507.4M -1Copy
```

```
# free -h
```

```
              total        used        free      shared  buff/cache   available
Swap:          1.0G          506M          517M Copy
```

How to adjust the swappiness value:

Swappiness is a Linux kernel property that defines how often the system will use the swap space. Swappiness can have a value between 0 and 100. A low value will make the kernel to try to avoid swapping whenever possible, while a higher value will make the kernel to use the swap space more aggressively.

The default swappiness value is 60 for older system & 30 for latest like RHEL 8 or CentOS 8. You can check the current swappiness value by typing the following command:

```
# cat /proc/sys/vm/swappiness
```

```
30
```

While the swappiness value of 60 or 30 is OK for most Linux systems, for production servers, you may need to set a lower value.

For example, to set the swappiness value to 10, you would run the following sysctl command:

```
# sysctl vm.swappiness=10
```

To make this parameter persistent across reboots append the following line to the /etc/sysctl.conf file:

```
# vim /etc/sysctl.conf
```

```
vm.swappiness=10
```

The optimal swappiness value depends on your system workload and how the memory is being used. You should adjust this parameter in small increments to find an optimal value.

How to remove Swap File:

If for any reason you want to deactivate and remove the swap file, follow these steps:

First, deactivate the swap by typing:

```
swapoff -v /swapfile
```

Remove the swap file entry /swapfile swap swap defaults 0 0 from the /etc/fstab file.

Finally, delete the actual swapfile file using the rm command:

```
# rm /swapfile
```

```
+++++
```