

System Run Level

A run level is a preset operating state on a Unix-like operating system.

A system can be booted into (i.e., started up into) any of several runlevels, each of which is represented by a single digit integer. Each runlevel designates a different system configuration and allows access to a different combination of processes (i.e., instances of executing programs).

There are differences in the runlevels according to the operating system. Seven runlevels are supported in the standard Linux kernel (i.e., core of the operating system). They are:

0 - System halt; no activity, the system can be safely powered down.

1 - Single user; rarely used.

2 - Multiple users, no NFS (network filesystem); also used rarely.

3 - Multiple users, command line (i.e., all-text mode) interface; the standard runlevel for most Linux-based server hardware.

4 - User-definable

5 - Multiple users, GUI (graphical user interface); the standard runlevel for most Linux-based desktop systems.

6 - Reboot; used when restarting the system.

By default Linux boots either to runlevel 3 or to runlevel 5. The former permits the system to run all services except for a GUI. The latter allows all services including a GUI.

In addition to the standard runlevels, users can modify the preset runlevels or even create new ones if desired. Runlevels 2 and 4 are usually used for user defined runlevels.

The program responsible for altering the runlevel is `init`, and it can be called using the `telinit` command. For example, changing from runlevel 3 to runlevel 5, which allows the GUI to be started, can be accomplished by the root (i.e., administrative) user by issuing the following command:

telinit 5

Booting into a different runlevel can help solve certain problems. For example, if a change made in the X Window System configuration on a machine that has been set up to boot into a GUI has rendered the system unusable, it is possible to temporarily boot into a console (i.e., all-text mode) runlevel (i.e., runlevels 3 or 1) in order to repair the error and then reboot into the GUI. The X Window System is a widely used system for managing GUIs on single computers and on networks of computers.

Likewise, if a machine will not boot due to a damaged configuration file or will not allow logging in because of a corrupted `/etc/passwd` file (which stores user names and other data about users) or because of a forgotten password, the problem can be solved by first booting into single-user mode (i.e. runlevel 1).

The `runlevel` command can be used to find both the current runlevel and the previous runlevel by merely typing the following and pressing the Enter key:

```
/sbin/runlevel
```

The `runlevel` executable file (i.e., the ready-to-run form of the program) is typically located in the `/sbin` directory, which contains mostly administrative tools and which by default is not in the user's `PATH` (i.e., the list of directories in which the system searches for programs). Thus, it is usually necessary to type the full path of the command as shown above rather than just the name of the command itself.

The default runlevel for a system is specified in the `/etc/inittab` file, which will contain an entry such as `id:3:initdefault:` if the system starts in runlevel 3, or `id:5:initdefault:` if it starts in runlevel 5. This file can be easily (and safely) read with a command such as `cat`, i.e.,

```
cat /etc/inittab
```

As an alternative to `telinit`, the runlevel into which the system boots can be changed by modifying `/etc/inittab` manually with a text editor. However, it is generally easier and safer (i.e., less chance of accidental damage to the file) to use `telinit`. It is always wise to make a backup copy of `/etc/inittab` or any other configuration file before attempting to modify it manually.