

Multiple Booting Using NT Loader

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Introduction

This paper will show you how to boot directly into numerous operating systems (I have eight on one computer) using the Windows NT boot loader. If you want to dual boot with OS/2, you must use NT 3.51 Loader because HPFS has been dropped from NT4. However, LILO, the Linux Loader, does support HPFS and can be used to boot OS/2.

Specifically, one can boot directly into DOS without going through Windows 95/98 from the NT multiboot menu. In fact, other operating systems (apart from OS/2) can be added to this procedure given an understanding of the way the particular boot sequence works for the operating system.

One System

I have Windows 2000, Windows NT 4.0 Workstation, Windows 95, DOS 6.22 (with Windows 3.11, though this does not matter), and S.U.S.E. Linux 6.4, Linux Slackware 7, and Solaris 7 all installed on one machine. I installed DOS first, then Windows 95, then NT, then Windows 2000, and then Linux, though I'll attempt to explain how to "insert" another operating system so that you can do this in an arbitrary order.

My primary (bootable) partition is the first partition of the first hard drive (this is drive C:) which is FAT. I have each system on a separate partition, though this is not necessary--it is just easier for me to remember what's what and easier to backup and restore files in case of emergencies.

Drive C: therefore contains all of the startup files for all operating systems. A listing of all files (including hidden files) should contain at least the following NT system startup files:

BOOTSECT.DOS
BOOT.INI
NTDETECT.COM
NTLDR

If you have Windows 95 installed, then you should also have the following files if DOS was booted more recently than Win95:

IO.SYS
MSDOS.SYS
MSDOS.W40
WINBOOT.SYS

or the following files if Win95 was booted more recently than DOS:

IO.DOS
IO.SYS
MSDOS.DOS
MSDOS.SYS

If you have not installed Windows 95 yet, then you should just have the following DOS files:

IO.SYS
MSDOS.SYS

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Finally, I have a Linux boot sector file that points to the volume on which I have installed Linux (with LILO):

BOOTSECT.LNX

If you use Norton Speedisk, then add IO.SYS and MSDOS.SYS to the unmovable file list, or else you will no longer be able to boot DOS. Basically, DOS 6.x and before expect IO.SYS and MSDOS.SYS to be the first entries in the file list on the boot partition, but since DOS 7 doesn't care, Norton Speedisk doesn't care either. It will move them! And if this happens, DOS will panic! So be sure to make these files unmovable if this applies to you.

Required Conditions For Boot

1. The correct system files must be present with the required names.
2. The correct boot sector must be executed.

Steps Required

1. Make available separate Windows 95, DOS, and Linux boot sector files.
2. Edit BOOT.INI to add separate choices for Windows 95, DOS, Linux, and other operating systems you use.
3. Back up your Hard Disks. This is a very important step.
4. Make backups of the files BOOT.INI and BOOTSECT.DOS in the root of C: (BOOT.INI is hidden; BOOTSECT.DOS may be) if you already have NT installed.
5. It's not a bad idea to have a backup of your Linux lilo.conf file (usually /etc/lilo.conf) if you already have Linux installed.
6. Be sure you have BOOTABLE Windows NT Setup Diskettes (three diskettes). If not, run "winnt32 /o" from the installation CD to make them.
7. If you intend to install DOS, be sure you have a BOOTABLE DOS diskette that contains the SYS.COM program. You can also use this system to fix any problems you may introduce in error (you can restore BOOT.INI and BOOTSECT.DOS and start over).
8. If you intend to install Windows 95, be sure you have the Windows 95 installation disks or CD-ROM handy.
9. If you intend to install Linux, be sure you have your Linux boot/root disk(s) handy.
10. If you have not installed Windows 95 before but intend to, be sure that you can boot into DOS and Windows NT correctly before you do so.
11. If you have installed Windows 95, be sure you can boot into NT, Windows 95, and DOS (via Windows 95). If you can't reach DOS from Windows 95, you may need to add the line

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"BootMulti=1" to the "[Options]" section of MSDOS.SYS (do this from within Windows 95, to be sure you edit the right file).

12. If you have installed Linux, be sure you can start Linux (with LILO or via boot/root disks). Typically the only way to set this up initially is to have LILO write its boot information into that master boot record. (This means that it will come up BEFORE NT's boot loader. This is okay, because the procedure herein will unify things.)
13. It will help (but is not necessary) to have a hex dump program available (or you can use the NT DEBUG command) so you can look at the contents of the BOOTSECT files and verify their correctness.

Creating Boot Sector Files

What NT's boot loader uses to load any given operating system is a tiny bootstrap file that points it at the rest of the operating system's boot code. These files are pretty easy to create and maintain, given the right tools (and a fair amount of patience). For creating boot sector files, there are a couple of methods.

If you already have Windows 95 and Windows NT working, then the BOOTSECT.DOS file in the boot up directory (the root directory of the C: drive usually) is the Windows 95 Boot Sector file. (This is not the same as the DOS boot sector file.) If you have this file, back it up as BOOTSECT.W40 or BOOTSECT.W95 or some other name that you will remember as being the Windows 95 boot sector.

Now, in order to add DOS to the mix, you need a BOOTSECT.DOS that contains a DOS boot sector. The good news is that NT will make one for you. The bad news is that you have to go a fair way through the setup program for it to generate the BOOTSECT.DOS (which takes about 1 second). To do this, use your NT installation and setup disks/CD-ROM to Repair your NT boot files.

This file, BOOTSECT.DOS, is your DOS boot sector file. Save this file! You will want to copy the actual DOS BOOTSECT.DOS file because Windows NT will OVERWRITE the boot sector file if you reinstall it, because BOOTSECT.DOS is the default filename. So you can just copy this file to BOOTSECT.622 or some other name that you'll remember as being the actual DOS boot sector file.

Alternatively, if you're setting up a machine from scratch or you just haven't installed Windows 95 yet, and if you installed NT over DOS, then the BOOTSECT.DOS file in the boot up directory IS the DOS boot sector file.

Save this file! You will want to copy the actual DOS BOOTSECT.DOS file to a new file with a different name because Windows NT will OVERWRITE this boot sector file if you install or reinstall it, as BOOTSECT.DOS is the default filename. So you can just copy this file to BOOTSECT.622 or some other name that you'll remember as being the DOS boot sector file.

If you don't yet have a Windows 95 boot sector file (by backing one up in the process above), then there are a couple of ways to create one. First, if you have DOS and Windows NT installed, but have not installed Windows 95 yet, back up your DOS boot sector file (as described above) and run Windows 95 setup from DOS. Once this process completes, you'll probably need to repair your NT installation. When Windows NT setup finishes fixing your boot up files, copy the resulting

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BOOTSECT.DOS file to BOOTSECT.W40 or BOOTSECT.W95 or some other filename that you'll remember as being the Windows 95 boot sector file.

If you already have Windows 95 and Windows NT installed and you want to make a boot sector file specifically for Windows 95, then you can use Windows 95 sys.com to rewrite Windows 95's system files onto the Master Boot Record. Then you will need to install or reinstall Windows NT, and once it finishes installing, the resulting BOOTSECT.DOS file will be the Windows 95 boot sector file. Save it to BOOTSECT.W40 or BOOTSECT.W95 or some other filename that you will remember as being the Windows 95 boot sector.

Create The Linux Boot Sector File

If you've installed DOS, Windows 95, and Windows NT, and Windows 2000, then right about now your machine should load DOS (directly if you've installed the DOS boot sector file into your BOOT.INI file, or indirectly through Windows 95 otherwise), Windows 95, and Windows NT. (And, if somehow all of this didn't kill off LILO, then it will probably run LILO, and then run the NT loader. This is okay, too, for now.)

If all of this has totally wiped LILO from the picture at boot up, don't panic. Just boot Linux from your boot/root floppies with the boot option `mount root=/dev/hd?` (where `/dev/hd?` is the volume of your Linux installation--that is, the first partition of the first IDE volume would be `/dev/hda1`, or the third partition of the second SCSI volume would be `/dev/sdb2`, etc.). This should get you back into Linux with minimal hassle (all of Linux should still be there--it's just that LILO temporarily isn't around to boot it up!).

Once DOS, Windows 95, and NT boot okay, it's time to add Linux to the NT boot loader and to remove LILO from the Master Boot Record. The major trick here is to install Linux's boot information onto the super block of the volume on which Linux resides (usually LILO wants to write its information to the master boot record, and this won't work for our purposes).

Now, assuming that your LILO installation currently expects to be in the master boot record, this needs to be changed. The pertinent LILO information is in the `lilo.conf` file (again, usually in the `/etc` directory). So with your favorite editor, edit your `lilo.conf` file as follows: Replace the `boot=/dev/hd?` line that is currently there (probably `boot=/dev/hda`) with a line referring to the super block of the Linux volume (again, this would be `/dev/hdb1` for the first partition of the second IDE volume, or `/dev/sdb2` for the second partition of the second SCSI volume, etc.). At this point, since we're expecting LILO just to have to boot Linux, you might also want to comment out whatever menu options are for booting DOS (unless you work for the Department of Redundancy Department and want to have multiple ways to boot DOS and yet another choice at boot up!) Once you have made the appropriate changes, save the file and rerun `lilo` to update the boot information. Then remove LILO from the MBR. This should set up LILO to behave properly when next we launch it.

Once Linux is correctly installed (but not, at this point, bootable anymore), it's time to create the file that NT's boot loader will use to start up LILO. For this purpose, I recommend the shareware utility `BOOTPART`, which is designed exactly for this purpose. Running `BOOTPART` with no parameters should display all partitions on the machine and what file system they are formatted with. Then running `BOOTPART` with a partition number and a boot sector filename should create a new boot sector file (and possibly add it to your `BOOT.INI` file, but that's jumping ahead a bit). For this process, follow the instructions for `BOOTPART`, as the exact incantation may change somewhat from time to

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time and version to version. And when you do create the file, I personally recommend the filename BOOTSECT.LNX, but again, use whatever filename you will remember as being the boot sector for Linux.

Alternately, if you want to make the BOOTSECT.LNX file from within Linux, you can do it with the dd command:

```
dd if=/dev/hda? of=/mnt/c-drive/bootsect.lnx bs=512 count=1
```

where hda? is your boot partition in Linux and /mnt/c-drive is where your C: drive is mounted. Then, you can arrange LILO to write the boot sector to this file by setting the boot= parameter in /etc/lilo.conf:

```
boot = /mnt/c-drive/bootsect.lnx
```

Removing Lilo From MBR

The only complication to all of this is removing LILO from the Master Boot Record (MBR). To do this, you have to rewrite the MBR with the command:

```
fdisk /mbr
```

from Windows 95 or DOS. This will wipe out the master boot record, so you will have to use your NT installation disks/CD to repair NT's master boot record files.

Adding MS DOS To Boot.ini

Once you have all these boot sector files floating around, it's time to plug them into the NT loader. (Note: The following procedure can be used from any of the available systems; we used DOS. Be aware, though, that until NT is set up, there is no BOOT.INI file, so you need to have set up Windows NT by this point.) Also, the addition of items to the BOOT.INI file can be done in whatever order you want, but of course if a menu selection refers to a not-yet-created or invalid boot sector file, then your results will be less than favorable.

To get the correct system files (with the correct names), edit the BOOT.INI file (hidden and read-only) present in the bootup directory (probably the root of C:). You should have lines like the following:

```
[boot loader]
timeout=10
default=multi(0)disk(0)rdisk(1)partition(1)WINNT
[operating systems]
multi(0)disk(0)rdisk(1)partition(1)WINNT="Windows NT Version 3.51"
c:\bootsect.dos="Windows 95"
```

Edit the "c:\bootsect.dos" line and add a new line following it, as described in the boxes below.

The /WIN95 and /WIN95DOS switches cause NTLDR to rename the DOS and Windows 95 system files back and forth so that the correct names are used with the operating system selected (If you have not noticed, look at the hidden files in the root of C: when running DOS and Windows 95. Under Windows 95, the DOS files are renamed IO.DOS and MSDOS.DOS; under DOS, the Windows 95

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files are renamed WINBOOT.SYS and MSDOS.W40; IO.SYS and MSDOS.SYS belong to the 'current' operating system.).

Note that the /WIN95 and /WIN95DOS switches are only recognized by NTLDR version 3.51. The NTLDR from versions 3.5 and earlier won't recognize these switches, so the renaming won't take place.

You have also requested that Windows 95 be booted using the boot sector in the file BOOTSECT.W40, while DOS is booted using BOOTSECT.DOS, which is what all of this furious creation of boot sectors was about.

Adding Linux To Boot.ini

Again, be aware that there is no BOOT.INI file until after you install NT, so make sure that NT is running before you attempt this section.

Adding the Linux boot sector file (BOOTSECT.LNX or whatever name you created it with using BOOTPART) should be trivial. In fact, BOOTPART has an option that will add the Linux option to your BOOT.INI file for you. Or, if you want to edit the exact message (such as "Slackware Linux", etc.) you can just add the line

```
c:\bootsect.lnx="Slackware Linux"
```

Either way, this should bring Linux into the picture. Then, when you select your new Linux option, it should fire up LILO with the LILO options you set up previously.

Repairing NT or 2000 Installation

How to repair your NT bootup files (from Microsoft Knowledge Base articles Q102793 and Q104429).

Note Be sure you have a bootable "NT Setup Disk 1" before starting. After executing "SYS" and before booting setup, NT cannot be booted.

1. Be sure that the last system you ran from the hard disk was DOS (to ensure the proper files are replaced in step 3 below). THIS IS IMPORTANT! To be sure, you may want to boot DOS via Windows 95 before continuing.
2. Boot DOS from the bootable diskette that contains the MS-DOS program SYS.COM (and the program fdisk if you are going to remove LILO from your Master Boot Record).
3. If you have LILO installed in the Master Boot Record, use the following command to remove it:

```
FDISK /MBR
```

4. From the bootable disk in drive A, use the following command to remove the Windows NT boot sector:

```
SYS C:
```

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You should receive a "System Transferred" message. SYS.COM replaces the partition boot sector, which loads NTLDR, with an MS-DOS boot sector that loads MSDOS.SYS and IO.SYS. SYS.COM also replaces IO.SYS, MSDOS.SYS, and COMMAND.COM in the root of C:. This is why DOS should have been the last system run from the hard disk (so that the files named MSDOS.SYS, etc. are the DOS versions, not the Windows 95 versions). Note If you last ran Windows 95, you will overwrite the Windows 95 versions.

5. Reboot the system with the Windows NT Setup Disk number 1 in drive A.
6. When prompted with "To repair a damaged Windows NT Version 3.51 installation, press R", enter R for Repair. Follow the prompts, answering questions regarding the hardware configuration with what is reasonable for your system.
7. Setup will eventually prompt with the following repair options in a box:

```
[x] Inspect registry files
[x] Inspect startup environment
[x] Verify Windows NT system files
[x] Inspect boot sector
Continue (perform selected tasks)
```

Alter the options so that only the last one, "Inspect boot sector" is checked. Then choose "Continue". (The "Inspect boot sector" option used to be called "Verify boot files".)

8. When setup prompts "If you have the Emergency Repair Disk, press ENTER", you may hit ESC to locate the "previous" (i.e., your working copy) of NT. You do not need the Emergency Repair Disk, though you may use it (it does not matter; setup is not going to use it).
9. Setup will replace the DOS boot sector with the NT boot sector, and store the DOS boot sector in BOOTSECT.DOS. It will then tell you to reboot your system.

How And Why It Works

When you are done and reboot, you will get the Windows NT boot loader menu (that starts out at the top of the screen with "OS Loader V4.0") with (at least) these choices:

```
"Windows NT 3.51"
"Windows 95"
"DOS 6.22"
"Linux"
```

and when you select a choice, you will then see one of the following messages on the screen (depending on which system you select):

```
"NTDETECT V1.0 Checking Hardware"
"Starting Windows 95..."
"Starting MS-DOS..."
"LILO..."
```

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When you start the system, the first sector of the active disk partition is loaded into memory and executed. This sector is called the "boot sector" and is physically located "outside" of the FAT file system on drive C: (for a more comprehensive discussion, see the Microsoft Knowledge Base article Q101787, "General Information on Starting Multiple Operating Systems"). If you can boot Windows NT, then the boot sector is the "Windows NT boot sector", which loads and runs the program NTLDR, which presents the multiboot menu.

When MS-DOS was installed, it put its own boot sector in that loads IO.SYS. When Windows NT was installed, it overwrote MS-DOS's boot sector with its own (the Windows NT boot sector) after copying the MS-DOS boot sector to a file called BOOTSECT.DOS in the root of C:. When you selected "MS-DOS" from the NT boot menu, Windows NTLDR would run BOOTSECT.DOS, which would load IO.SYS, and MS-DOS would boot.

When Windows 95 was installed, it left the Windows NT boot sector in place, but overwrote BOOTSECT.DOS with its own boot sector (the "Windows 95 boot sector") which also loads IO.SYS. Windows 95 also wants to install its own IO.SYS and MSDOS.SYS, which conflicts with the MS-DOS versions. So it renames MS-DOS's IO.SYS and MSDOS.SYS to IO.DOS and MSDOS.DOS.

Since MS-DOS and Windows 95 each expect their system files to be *.SYS, their respective IO.SYS and MSDOS.SYS files must be renamed back and forth as the two systems are booted. Therefore:

After booting Windows 95, MS-DOS's IO.SYS and MSDOS.SYS become IO.DOS and MSDOS.DOS. After booting MS-DOS, Windows 95's IO.SYS and MSDOS.SYS become WINBOOT.SYS and MSDOS.W40. The Windows 95 IO.SYS will perform this renaming when you select "Previous version of MS-DOS", but apparently uses an internal loader to perform the equivalent of the MS-DOS boot sector.

NTLDR will also perform the renaming (with the /Windows 95 and /Windows 95DOS switches) but still needs an external BOOTSECT file to boot MS-DOS.

You can verify which boot sectors are in which file by examining the files with a hex dump program (or use the NT command "DEBUG"). Look at the first few bytes and also at the last few bytes for the following strings:

```
First Bytes
Last Bytes
Operating System
MSDOS5.0
IO SYS MSDOS SYS
DOS
MSDOS5.0
NTLDR
NT
MSWIN4.0
WINBOOT SYS
Win95
```

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Using NT Debug To View Bootsect Files

1. Open a console window under NT.
2. Change the current directory to the root of C:.
3. Enter the command "debug bootsect.dos" (or "debug bootsect.w40").
4. At the "-" prompt, enter the command "d 100 L 100" to see the first half of the file.
5. At the "-" prompt, enter the command "d 200 L 100" to see the second half of the file.
6. At the "-" prompt, enter the command "q" to quit back to the command prompt.

More Information

For a good explanation of the NT BOOT.INI file, consult article Q102873 in the Microsoft Knowledge Base. For an explanation of setting up MS-DOS for use with Windows NT, see Q102793 and Q104429 in the Microsoft Knowledge Base. For details on creating an NT boot floppy, consult article Q119467 in the Microsoft Knowledge Base. For details on adding an IDE hard drive to a SCSI installation of Windows NT, consult article Q133491 in the Microsoft Knowledge Base. For details on setting up FreeBSD with Windows NT, see www.devious.com/freebsd/, a page by Scott Storkel.