What's DOS Do?

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http://www.sun.com/desktop/products/sunpci/

Introduction

When a user creates a SunPCi™ emulated drive, the user actually generates a virtual PC disk containing a fairly complete version of a DOS operating system. This paper discusses a little of the history, details and usage of that DOS operating system, Caldera DOS 7.01, which is bundled with every SunPCi bootable emulated disk image. This paper also details the SunPCi DOS utilities used in conjunction with the installation of Windows NT 4, Windows 2000, Windows XP, and Windows .NET/2003.

Note: Much of the information on DOS is the same for the installation of Win98, specifics on Win98 installation is not covered in this document.

For the remainder of this document, the Windows operating systems Windows NT 4, Windows 2000, Windows XP and Windows .NET/2003 will collectively be known as the **Windows NT Operating Systems.** This is to differentiate these Microsoft operating systems from previous Microsoft operating systems like Win95, and Win98 variants. The reason the Windows NT operating systems are grouped together is because the base kernel portions of the operating systems were significantly rewritten between Win98 and Windows NT 4.0. All of the major Windows operating systems after Windows NT 4 (e.g, Windows 2000, Windows XP and Windows .NET/2003) are all based on the same, rewritten kernel and thus, all basically the same type of operating systems (true multitasking, 32/64 bit, virtual memory managed).

What's DOS?

Whenever one starts a SunPCi session, the SunPCi software will cause the SunPCi hardware to start and boot as a regular PC would (a process known as Power On Self Test, or POST). The user will see the SunPCi X window flash, turn black and then some white text will appear (this is the POST). After that is complete, if the installed Windows NT Operating system is Windows NT 4.0, Windows 2000, Windows XP or Windows 2300, the following menu selection will appear:

```
Please select the operating system to start:

    Windows XXX
    Previous Operating System on C:

Use <up> and <down> to move the highlight to your choice
Press Enter to choose
```

The first selection (e.g., **Windows XXX**) is highlighted and the user can choose which of the Windows operating systems that they which to boot. The users selects the operating system by moving the up and down arrow keys until the desired operating system is highlighted and then boots that operating system by depressing the *select* key.

[**Note:** For those interested, this file is a hidden, system file named **C:\boot.ini**]

An interesting selection is at the bottom of the list : *Previous Operating System on C:*. If the user were to select this, in most circumstances DOS would then boot and then execute on the SunPCi hardware:

```
Starting DOS...

SunPCi Redirector Installed V1.1
HIMEM.SYS 2.3

Caldera OpenDOS 7.01
Copyright (c) 1976, 1997 Caldera, Inc.
```

```
All right reserved.

C:\>
```

[**Note:** There are cases where DOS will not boot. For instance, if the emulated disk had been formatted with the NTFS file system. Or, if the emulated disk had been converted to what's known as a "dynamic disk". Cases such as these, where the emulated disk cannot be booted to DOS, are typically the result of more sophisticated uses of SunPCi's emulated disks and is beyond the scope of this white paper].

So, what exactly is this DOS, anyway?

This Caldera OpenDOS 7.01 is a version of DOS (Disk Operating System), which was developed by Caldera in 1997. It is one of the many versions of DOS that are in existence today. Like all versions of DOS, it consists of a file system, memory manager, task manger and a set of utilities. Its lineage dates from the 1980's as it was the most popular operating systems to reside on PCs. In fact, DOS was **the** mainstream PC operating system until the appearance of Microsoft's Windows 95, which, in reality, was a version of Microsoft's DOS (MS-DOS) version 7.x plus a windows GUI. Microsoft's Windows ME contained MS-DOS version 8.0. In fact, in the current versions of Windows NT operating systems (this includes Windows NT 4.0, Windows 2000, Windows XP and Windows .NET/2003), there is a DOS emulation service (known as **ntvdm.exe**) which is provided by Microsoft to ease the transition of users from the Windows 95/98 operating system into the Windows NT operating systems. This **ntvdm** service will run DOS compiled/linked/built programs within the Windows NT environment.

Currently, there still is a strong community of users and supporters of "generic" DOS, or DR-DOS. The following table lists some of the more interesting and useful websites for DR-DOS.

Site	**Site Description/Contents**
www.drdos.com	The official DR-DOS website, maintained by the current company which distributes the licensed version of DR-DOS, DeviceLogics. Note that the lineage of DR-DOS started at Digital Research, through Novell, through Caldera, through Lineo and finally ending at DeviceLogics
www.drdos.net	An unofficial site, containing a good amount of background information and links for DR-DOS and other variations of DOS implementations
www.drdos.ws	Another unofficial DR-DOS site
www.freedos.org	The official site for the Open Source (GPL) DOS effort.
www.computerhope.com/msdos.htm	A site containing a very useful and fairly complete guide to MS-DOS commands and utilities

This is SunPCi DOS

For the remainder of this document, we will refer to Caldera DOS 7.0 as just DOS. This is the DOS which the SunPCi software employs for initial boot (before a Windows NT operating system has been installed) and for installation of a Windows operating system.

The SunPCi Emulated Disk

When a user creates a new SunPCi emulated disk, a choice is presented as to what should reside on the disk. In all cases (except for one), the SunPCi emulated disk creation utility will initially generate a disk which will be DOS bootable, even if a Windows operating system is selected to be automatically installed. This emulated disk is actually a single Solaris™ Operating System file, known as a *container* file, the contents of which look exactly like that of a PC disk image. That is, it contains such things as a boot block, master file table, partition information, etc. For these items to be existing on the "drive", the drive must be formatted. The SunPCi software will format the disk to a file system format known as FAT16, FAT being an acronym for File Allocation Table, and the 16 signifying that this version of FAT is based on 16 bit values. [There is a more recent version of FAT, known as FAT32, which is the same sort of file system, but based on 32 bit values rather than 16 bit values. Note that a FAT32 file system is completely incompatible with a FAT16 file system. That is, the software which recognizes and reads a FAT16 file system cannot recognize or read a FAT32 file system, and vice versa].

It should be noted that there are some limitations with the FAT16 file system, which were considered acceptable during the reign of DOS. Since the introduction of Win98 and the Windows NT operating systems, other files systems have been made available and have addressed these FAT16 limitations. These FAT16 limitations include:

- A maximum of 2 Gigabytes of disk space can be accessed, even if the emulated drive has was allocated with more than 2 Gigabytes. This is due to the fact that only 16 bit values are used for FAT16. If the users wishes to access/address more than 2 Gigabytes of disk space in a single partition, then the disk drive must be converted to another file system format (such as FAT32 or NTFS). However, if the file system is converted away from FAT16, DOS will no longer be able to boot that disk/file system. Note that this 2 Gigabyte restriction is due to the limitations of the FAT16 file system, and not a SunPCi restriction. That is, even on a real PC, if a hard drive was formatted FAT16, this restriction would apply.

- There is little , or no, recovery in the case of sudden Windows termination, either by user reset of the SunPCi session (e.g., not shutting down Windows before exiting the SunPCi process), a Windows crash (e.g., a Blue Screen of Death, or BSOD), or a power failure. Later file systems (such as NTFS) have better data recovery and redundancy. This doesn't mean that the FAT16 disk will always be unrecoverable in the event of a improper shutdown, but some data may be lost and the odds of recoverability are less than with a different file system type.

So, as the SunPCi process creates an emulated drive, the disk is formatted to FAT16, the necessary file system tables, information and blocks are written, and then a number of special files and directories are copied to the disk. Most of the files **are** DOS, and are executed when the disk is booted. Note that these are special system files and may be hidden from normal directory perusal techniques (i.e., they may not appear when using the "dir" command). Additionally, most of these files should not be modified, otherwise the resultant emulated disk may no longer be bootable. For Windows 95/98 and MS-DOS users, these files will be familiar, as these are standard DOS implementation boot files. These files include:

- ibmbio.com
- ibmdos.com
- command.com
- opendos.386
- config.sys – This is the DOS configuration file and contain parameters for DOS that are used upon boot
- autoexec.bat – This is the initial batch file which is executed upon boot. Some of its activities include:

    - sets the execution search path, used when a command is given at the DOS prompt
    - configures the DOS prompt (e.,g the **C:** string)
    - maps a series of network drives for convenience.
- dos directory – This contains most of the DOS utilities
- sunpc directory – This contains a set of SunPCi DOS utilities, which include
    - localize.exe
    - redir.sys – the SunPCi DOS network redirector which handles access to the Solaris file system from DOS
    - sunpcnet.exe – the SunPCi DOS network provider which maps drive letters to Solaris directories.

As noted above, since SunPCi DOS is closely related to all the other available versions of DOS, the DOS command set is quite similar to other versions of DOS. To find more information on the supported commands, type **help** at the DOS command prompt (once DOS has booted), or see the web site www.computerhope.com/msdos.htm for a good list and explanation of the more common DOS commands. Note that since this is Caldera DOS 7.01, the commands at the web site may differ slightly to those which are actually supported. Note that all commands and command arguments are case insensitive.

Given this, once booted, DOS is actually a full-fledged operating system and can be used as such. Batch files may be edited and executed much as they could be on other versions of DOS (or even on a Windows NT Operating System), the only restrictions being those normally associated with DOS (e.g., FAT16 limitations, device limitations, etc.) as well as the fact that there is no basic graphics support for SunPCi DOS. However, the more adventurous DOS user will find that this DOS can be expanded and various drivers can be experimented with, such as FAT32 support, direct CDRom support, and other driver/device support. However, once a DOS installation has been modified beyond that supplied by the SunPCi DOS installation, the SunPCi engineering team can not support that modified DOS.

The SunPCi Windows Installer (setupXXX)

One of the only other DOS program that a SunPCi users is likely to run is one of the SunPCi Windows installer programs. These are set of special DOS programs which are designed to install specific versions of Windows operating systems.

Note: This document does not cover the installation of Win95 or Win98 and its variants.

The following is a list of the setup programs for each of the Windows NT operating system:

Windows NT Operating System	SunPCi Setup Program (/opt/SUNWspc3)
Windows NT 4.0 (and server variants)	./drivers/winnt/setupnt.exe
Windows 2000 (and server variants)	./drivers/win2k/setupw2k.exe
Windows XP	./drivers/winxp/setupwxp.exe
Windows .NET/2003	./drivers/winnet/setupnet.exe

The reason for a specific setup program for each Windows NT operating system is because with each major release of a Windows NT operating system, Microsoft changed their setup

procedure (which is manifested in programs called **winnt.exe** and **winnt32.exe** on the Microsoft installation CD). Accordingly, the SunPCi versions of the setup program must be modified as well.

Why Can't We Use Microsoft's Setup Program?

A very common user mistake is to try and use the setup program (**winnt.exe** or **winnt32.exe**) that is provided by Microsoft on their operating system installation CD to install a Windows NT operating system on a SunPCi installation, much as one would install on a regular PC. This type of installation will always result in the **0x7B (INACCESSIBLE_BOOT_DEVICE)** Blue Screen Of Death (BSOD)[1], just after the installation reboots after copying all of the files from the CDRom. This is because the SunPCI hardware requires special drivers (known as Boot Class Drivers) that must be loaded as soon as the Windows NT operating system boots. These Boot Class Drivers will perform all of the PC-like disk I/O on the emulated disks. These drivers are **not** in the normal Microsoft distribution (i.e., on the Microsoft operating system installation CD) and the normal Microsoft distribution does not make any provisions for loading these special type of drivers. Therefore, if an installation is attempted whereby these SunPCi Boot Class Drivers are not the first ones installed, the Windows NT operating system will not be able to read the emulated disk, and the Windows NT system will stop with the **0X7B** BSOD, because, as the message indicates, the boot device couldn't be read (it was inaccessible).

The SunPCi SetupXXX Program

So, the typical user will create an emulated disk, formatted with FAT16 and with DOS installed. The next step is usually to install a Windows NT operating system. The user then places the Microsoft Operating System Installation CD into the Solaris Operating System CDRom and then boots the emulated disk to the DOS prompt. At this point the user then will **cd** to the appropriate driver directory under the mapped **F:** drive and invoke the **setupXXX.exe** program. The complete syntax for execution is:

setupXXX <optional_switches>

The setup program will:

1. Create a log file in **C:\ntsetup.log** which will log all of the installation (and subsequent upgrade and update) activities. This is an ASCII text file and can be perused using any windows text editor. Note that if the user moves, deletes or modifies this file, no backup copy is maintained. It is merely a log and is used only as a source of possible debug information.
2. Perform a verification check on the installation media (either CD or a specified solaris path) to insure that the correct operating system is being installed with the correct installation media. For example, the setup program **setupwxp.exe** will check the installation media to make sure that the Windows XP installation files exist. If this check fails, the setup program will post a message and exit

There are a number of options that are available to the advanced user of the setup programs. All options can be seen by invoking the setup program with a **/?** option. We list these options (and an undocumented helpful option) below:

[1] For more details on Windows BSOD's, see the SunPCi white paper "The Blue Screen Of Death (BSOD) Primer".

Switch syntax	Action	Comments
/s:<source_path>	Specify the path for the Windows Installation media.	• The **default** for this path is **R:\cdrom\cdom0** which is the CDRom • Do not use the **i386** name in the path • Make sure that if this is a path to a solaris directory which contains the contents of a Windows installation CD, that all files and directories on the installation CD must be copied into this directory, with their original filenames and directory names.
/t:<temp_drive>	Windows drive letter which is to contain the temporary setup files.	• The **default** is **C:** • As part of Windows installation, the installation files are copied from the installation media to a set of temporary directories on the target machine. If there is insufficient room on the **C:** drive, then the user can optionally specify another drive to use (note that the only choice is **D:)**
/i:<inf_file>	Path for an alternate **DOSNET.INF** (Windows installation .inf file)	• The **default** is **DOSNET.INF** • This file is the main .inf file used in the installation of Windows. Casual modification of this file will result in a bad Windows installation. This should be only used by advanced users of Windows installation.
/u:<script_file>	Path for an alternate **SUNCPINT.INF** file (SunPCi installation .inf file)	• The **default** is **SUNPCINT.INF** • This file is the main .inf files used in the installation of all SunPCi specific drivers and services. Casual modification of this file will result in a bad Windows/SunPCi installation. This should only be used by advanced users of Windows installation.
/r:<oem_path>	Path for an alternate **OEM** installation directory	• The **default** is **OEM** • This is the specification of the directory which contains all SunPCi specific drivers and services which will be installed on the Windows operating system. Casual modification of this path will result in a bad

		Windows/SunPCi installation. This should only be used by advanced users of Windows installation
/server	Install NT4 Server	• The **default** is "install NT 4 Workstation" • When specified, this will instruct **setupnt.exe** that it is to install Windows NT 4 Server.
/NTFS:<size>	Convert the boot disk to NTFS prior to installation (undocumented).	• The **default** is "no conversion" • If **<size>** is specified, it can have the following values: o **2-9**. This implies that the boot partition will be expanded to the specified number of Gigabytes and formatted to NTFS. Thus, if the switch **/NTFS:5** is specified and the emulated drive was created at least 5 Gigabytes large, after installation, the **C:** partition will be 5 Gigabytes large and formatted NTFS. Note that, in this example, if the emulated drive is larger than 5 Gigabytes, the remainder of the emulated disk will appear as an unformatted partition. o **MAX**. This implies that the entire emulated disk will be converted to NTFS. o **<nothing>**. If no number is specified and if the string **MAX** is not specified, then the entire emulated disk will be converted to NTFS (i.e., acts as if **MAX** was specified).

The SunPCi Network Provider (sunpcnet)

The intent of SunPCi DOS is that it is to be used as a facilitator for installation of Windows Operating Systems, through the use of the **setupXXX** family of SunPCi Windows installation programs. However, one of the more interesting SunPCi DOS applications is **sunpcnet**. This is the SunPCi DOS network provider which maps drive letters to various Solaris directories. By default, the **autoexec.bat** does some of these mappings automatically when DOS is booted. These are:

- **F: -> /opt/SUNWspci3**. This mapping is actually made to the environment variable **$SUNPCIIIHOME**, which is defined in the Solaris script **/opt/SUNWspci3/bin/sunpci.** This mapping is used when installing a Windows operating system as the **F:** drive points to the location of the SunPCi Windows Installation program (**setupXXX** – see below), as well as to the location of all of the SunPCi specific Windows binaries.

- **R: -> /**. This mapping is known as the "root" mapping and is used primarily during installation as the access point for the CDRom drive (**/cdrom/cdrom0**).

- **H: ->** ~. This mapping is to the user's home directory, as specified by the environment variable **$HOME**.

These are the only drive letter mappings that occur by default for DOS. Once a Windows operating system has been installed and booted, these mappings are no longer valid. Thus, the drive letters **F:, R:**, and **H:** would then be available for mapping in the booted Windows operating system.

Obviously, when running DOS, the user can map (or unmap) any drive letter by invoking **sunpcnet** manually. The command format is:

sunpcnet <command>

where **<command>** is the **sunpcnet** command. A helpful command is **/help**, which lists the valid **sunpcnet** commands. One of the more useful command is the **use** command. This command will map (and unmap) drive letters to any valid Solaris path.

To add a drive letter, the command is:

sunpcnet use <drive_letter>: <solaris_path>

Thus, if the user wanted to map drive **X:** to **/export/home/emmy/graduation**, the syntax is:

sunpcnet use X: /export/home/emmy/graduation

Warning: Since DOS commands are case-insensitive, and since Solaris Operating System paths are case-sensitive, if there exists multiple paths that differ only in case, it is not clear which path will actually get mapped.

To delete a mapping, the syntax is:

sunpcnet use <drive_leteter> /d

Can't Boot DOS!

A common question comes up – "What happened? – I can't boot DOS anymore!" This always occurs after the user has converted the file system on his boot disk to something other than FAT16, such as to FAT32 or NTFS and the user attempts to boot DOS in order to examine their boot drive without having to actually boot that drive. While FAT32 and NTFS file systems are superior in performance and recovery to FAT16, the problem is that Caldera DOS cannot recognize, and therefore cannot read, any file system except for FAT16. If a user wishes to examine their emulated boot drive, but not have to boot the installed Windows operating system, there are a number of alternatives.

Boot a Different Disk

One simple solution is to create another emulated disk **and** install a windows operating system that understands the converted file system. This is important, as not all Windows operating systems will understand FAT32 and NTFS. In fact, to make things worse, there are actually 2 types of NTFS file systems: NTFS 4, used by all Windows NT operating systems and NTFS 5, introduced by Windows 2000. This last note is particularly significant since Windows NT 4.0 cannot recognize nor read (nor boot) an NTFS 5 file system. However, Windows 2000/XP can

boot and recognize NTFS4 file systems. Note further, that Win98 cannot recognize, nor read (nor boot) any type of NTFS file system. The SunPCi User's Guide contains a table that summarizes which Windows Operating System supports which type of file system.

With these restrictions in mind, the user can continue and install the appropriate Windows operating system on that new emulated disk and then attach, as the **D:** drive, the converted disk drive. Now the user can access that converted disk drive, and all the files, without having to boot that converted drive.

Boot NTFS-DOS

As noted frequently above, the problem with DOS is that it only recognizes FAT16 file systems. However, there is a third party product which the SunPCi team uses regularly which allows DOS to recognize, boot, mount and read/write NTFS file system disks. This third party software is called **NTFSDOS Professional** and is sold by www.sysinternals.com. This is a special set of DOS drivers and applications that, when used in conjunction with Caldera DOS, can recognize and read SunPCi emulated disks which have been converted to NTFS. In fact, the SunPCi Engineering team uses this software (and the technique described below) to aid in debug and development of the SunPCi package.

The process consists of generating special boot floppies which contains the NTFSDOS software as well as Caldera DOS. Once these special boot floppies have been created, the user boots the SunPCi disk image with the floppy inserted into the floppy drive. The SunPCi hardware (if properly configured) will boot the floppy first, rather than the emulated disk. Once the floppy boots, the NTFSDOS program will be activated and will run and mount the emulated disk, usually ask device **D:**. Once mounted, the user can use all of the usual DOS commands to effect any changes necessary to the SunPCi emulated drive.

To generate these floppies:

1. install **NTFSDOS Professional** on a SunPCi Windows installation
2. create the NTFSDOS floppies as per the instructions supplied with **NTFSDOS Professional**
3. copy the contents of **C:\sunpc** to the floppy (e.g., **A:\sunpc)**
4. create the directory **DOS** and copy some of the DOS utilities from **C:\DOS**. Remember that there is a limited amount of spaced on the floppy, so the user will not be able to copy the entire contents of **C:\DOS.** A suggested list includes:
    a. HIMEM.SYS
    b. EDIT.COM
    c. ATTRIB.EXE
    d. XCOPY.EXE
    e. MOVE.EXE
    f. XDIR.EXE
    g. FIND.EXE
    h. MORE.COM
5. modify **config.sys** on the floppy to include **redir.sys** and **himem.sys** as devices as follows:

```
shell=a:\command.com /P /E:1024
files=30
buffers=20
```

```
stacks=9,256
device=a:\sunpc\redir.sys
device=a:\dos\himem.sys
lastdrive = z
```

6. modify **autoexec.bat** on the floppy to include **A:\sunpc** and **A:\DOS** in the execution search path as follows:

```
@echo off
a:\sunpc\sunpcnet use f: $SUNPCIIHOME
path=a:\;a:\dos;a:\sunpc
sunpcnet use r: /
sunpcnet use h: ~
prompt $p$g
rem
rem run ntfs pro
rem
ntfspro
```

An example of the NTFSDOS boot sequence:

```
Starting Windows 98...

SunPCi Redirector Installed V1.1
HIMEM.SYS 2.3

NTFSDOS Professional Edition
NTFS File System Driver for DOS, v3.12
Copyright (C) 1999-2000 Winternals Software LP
http:///www.winternals.com

You have specified your time zone as GMT+00:00.
GMT time is 2003/2/19 06:53
Local time is 2003/2/19 06:53

Warning: You are mounting a Windows 2000 volume (v3.1)
Using drivers from NT 4.0
Mounting NTFS partition at 0x80:1 as drive D:
Going resident. . .
A:\>
```

Conclusion

This has shown that the bundled SunPCi DOS is a fairly fully complete operating system unto itself and can be used much like a version of Win98, but without the graphics. Additionally, some details into some specific DOS utility programs, specifically the SunPCi Windows installer programs have been detailed.