BIOS Pre-Processor

User Manual

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Chapter 1: Using the BIOS Pre-Processor™

This manual describes how to use the BIOS Pre-Processor™ with Sourcer® to create a detailed source listing of your computer's BIOS ROMs. The BIOS Pre-Processor identifies entry points and key data items and creates detailed comments. There are many applications for the BIOS Pre-Processor. For example, you might use it to:

- Change and add features to your BIOS.
- Clarify BIOS interfaces.
- Correct bugs and problems with your computer system.
- Simplify the basic functions of your computer system.
- Insure hardware and software compatibility.

Together, the BIOS Pre-Processor and Sourcer support the complex, non-structured programming typically found in BIOS implementations. For example, when used with the BIOS Pre-Processor, Sourcer:

- Determines major entry points and key data areas in ROM and RAM for any BIOS implementation.
- Automatically analyzes indexed call and jump instructions, marks each entry point, and creates an easy-to-read data table.
- Clearly identifies all subroutines, including nested subroutines and subroutines with multiple returns.
- Identifies subroutines that do not return to the caller.

- Inserts cross-references to make the BIOS listing easier to follow.
- Records external entry point cross-references at the end of the listing.

Installing the BIOS Pre-Processor

When you installed Sourcer, the BIOS Pre-Processor is automatically installed.

The BIOS Pre-Processor is not copy-protected, so you can make as many copies as you need for backup purposes. Be sure to read the license and warranty agreement at the end of this manual.

Generating a BIOS Listing

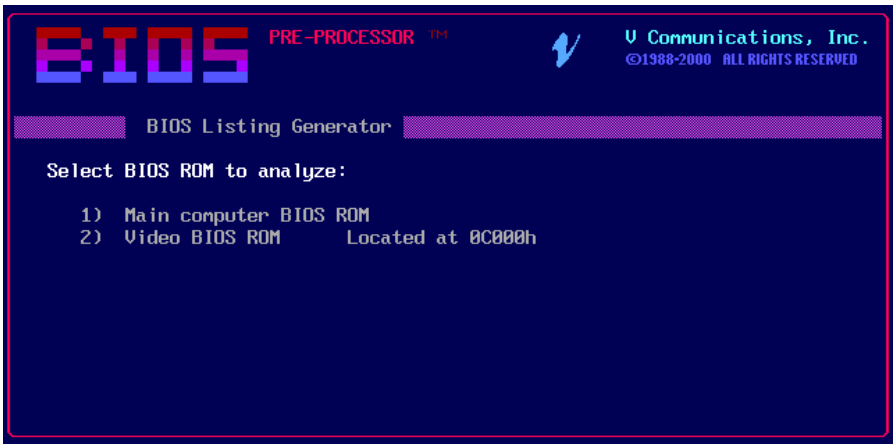
To run the BIOS Pre-Processor, change to the drive and directory in which you installed it. At the DOS prompt, enter:

runbiosp

The BIOS Pre-Processor determines what types of BIOS ROM your system has and lists them on the screen. In addition to the main BIOS ROM, it looks for video BIOS ROM and hard disk BIOS ROM. If it finds other, nonstandard BIOS ROMs, it labels them as unknown BIOS ROM.

Important: We recommend running BIOSP ***without*** a memory manager such as HIMEM, Memory Commander, QEMM, or 386MAX. In addition, for the best results, remove as many TSRs and device drivers as possible from the system. Any program that hooks interrupts could prevent the BIOS preprocessor from establishing all entry points into the selected BIOS. Some Memory Managers hide ROMs like QEMM's Stealth mode. You will get incorrect results if this type of memory manager is in use while processing the BIOS.

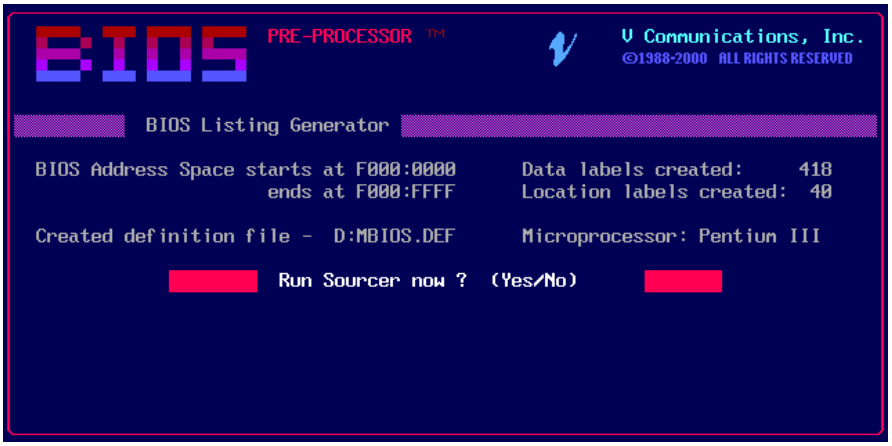
The BIOS Pre-processor screen appears similar to:



Press the number corresponding to the type of BIOS ROM for which you want to generate a listing. For example, to generate a listing of your system's main BIOS ROM, press 1.

The BIOS Pre-Processor analyzes the BIOS you selected and creates a BIOS definition file describing it. It reports the beginning and ending addresses of the BIOS address space, the number of data labels created, number of location labels created, the microprocessor type, and the name of the BIOS definition file.

The resultant screen may appear similar to:



The BIOS Pre-Processor assigns a different definition file name to each type of BIOS ROM as shown in the following table.

BIOS ROM Type	Definition File Name
Main	MBIOS.DEF
Video	VBIOS.DEF
Hard disk	HBIOS.DEF
Unknown	UBIOS.DEF

To run Sourcer and create the BIOS listing, press **Y**. The Sourcer Main Menu appears. For information about setting Sourcer options, see the *Sourcer User's Manual*.

Note: If you are running the BIOS Pre-Processor from a diskette, instruct Sourcer to write the output file to a different diskette drive. The output file will not fit on the BIOS Pre-Processor diskette.

Press G to generate the BIOS listing. The BIOS listing file has the same name as the BIOS definition file and the extension .LST. For example, the main BIOS listing has the filename MBIOS.LST. For information about reading the BIOS listing, see the *Sourcer User's Manual*.

Depending on the system speed most 200 Mhz machines and faster will often need less than 10 minutes to process the BIOS. If you are running under Windows, it may take longer. Since Windows will reduce the quality of results, we recommend running directly from a DOS or Windows 95/98 boot prompt.

The main BIOS will normaly generate large listings. The size of the generated listing file often exceed 4 MB, depending on the Sourcer options you set. To reduce the file length by as much as half, be sure to set up Sourcer to output tabs (the default setting) instead of spaces.

Large BIOS ROMs

For large 128K BIOS ROMs, like those used on the IBM PS/2, a different approach is used to get the best results. First remove any memory manager like HIMEM and EMM386 from

CONFIG.SYS. From the directory where Sourcer is installed, run:

BIOSP

Select the main BIOS ROM from the menu, but do not run Sourcer yet. Re-install the memory manager and reboot. At the Sourcer directory, enter:

COPY MBIOS.DEF BIOS.DEF

SR BIOS

This will then generate the best possible listing for the PS/2 system ROM. Remember, you cannot use a memory manager that hides the BIOS ROMs, like QEMM stealth and NetRoom.

Generating BIOS Source Code

To generate BIOS Source code from the BIOS listing file, when the Sourcer control panel appears, press **F** to select ASM output. Be sure to select the correct target assembler to match your assembler and set the associated "**+**" option for byte match. For more information, see the *Sourcer User's Manual*.

Reassembling BIOS Source Code

In rare cases your assembler may flag an error when you reassemble BIOS source code created by Sourcer. In most cases, you can correct errors by editing the BIOS definition file. For instructions, see the *Sourcer User's Manual*.

Whenever you assemble a system BIOS source code file generated by Sourcer, the following warning may appear:

```
10000                seg_d  ends
BIOS.ASM (xxx)  Warning A4102:  Segment near (or at) 64K
                                                  limit
```

Check the ending offset of the generated code. If it is any number other than 10000, compare the Sourcer generated listing

with the assembler listing to find where they differ. With the Byte Match feature enabled, the output in almost all cases will be identical to the original.

If an undefined symbol error occurs, it usually indicates a section of data may have been incorrectly processed as code. This creates reference that doesn't exist. Check the item's definition in the BIOS listing file, and then update the BIOS definition file to force the area to be data. For instructions, see the *Sourcer User's Manual*.

Once the assembly process is complete, you will need to use a special linker/locator to convert the object file into a binary file to burn into an EPROM. The standard linkers from Microsoft and Borland are NOT capable of making these binary files. One company who produces a suitable linking locator is Phar Lap Inc., in Cambridge MA. Contact them at 617-661-1510 for more information about their LinkLoc product.

Using the BIOS Definition File with Sourcer

You can use the BIOS definition file created by the BIOS Pre-Processor as input to Sourcer. For example, you might edit the BIOS definition file and then use Sourcer to create a BIOS source code file. The BIOS Pre-Processor stores comments for all four types of BIOS ROM in a single remarks file named BIOS.REM. To link these comments with your BIOS definition file, you must rename the BIOS definition file to BIOS.DEF before using it with Sourcer. For example if you used the BIOS Pre-Processor to analyze your system's main BIOS, enter the following command at the DOS/Windows prompt:

rename mbios.def bios.def

To run Sourcer with the BIOS definition file, enter:

sr bios

For more information, see the *Sourcer User's Manual*.

Chapter 2: Advanced Topics

The best method for analyzing a BIOS is to run the BIOS Pre-Processor and Sourcer on the system with the BIOS you want to analyze. Chapter 1 explains this method.

If the system is not working, is unavailable, or has insufficient memory to run Sourcer, you can generate a BIOS listing from a binary file of the BIOS. It is recommended that you do not reassemble the generated output, since a few problems will be encountered as described later. If you want to make a change to the BIOS after analyzing it, you can use our Patcher program PATCH included with Sourcer.

Analyzing Files with a Non-Zero Starting Offset

If the BIOS you want to analyze has a starting offset other than zero, you must change the segment:offset range in section 2 of the definition file. Refer to the *Sourcer User Manual*, Virtualization information in the Advanced Topics chapter.

Capturing a Binary BIOS File

To capture the BIOS image into a binary file, use an EPROM programmer or, if the system is operating, use DEBUG. Name the file BIOS.BIN to allow automatic linking of comments in the BIOS.REM file.

To use DEBUG, you must known the exact size and location of the BIOS. The following example shows DEBUG commands for saving a 64K system BIOS starting at address F000:0000 into a file named BIOS.BIN.

```
 -n  BIOS.BIN  Set the file name and optional
path
 -rbx              Set the bx:cx register pair
for the total
 BX  0000         number of bytes to write
(10000)
 :1
 -rcx              Set cx to the lower 16 bits
of the
 CX  0000         number of bytes to write into
the file
 :0
 -wF000:0000   Write data from the specified
address
 -q            Quit
```

Generating and Editing the BIOS.DEF file

If possible, run the program BIOSP.EXE on the system with the BIOS you want to analyze. BIOSP obtains important information such as interrupt entry points and data areas specific to the BIOS under analysis. If you cannot run BIOSP on the system you want to analyze, then run it on a similar system. BIOSP creates a Sourcer definition (DEF) file that you can use to run Sourcer with the binary file. Rename the generated definition file to BIOS.DEF.

You must edit the BIOS.DEF file to instruct Sourcer to load the BIOS.BIN file and to adjust the segments within the definition

file. For a complete description of definition files, see the *Sourcer user's manual*.

Edit the definition file as follows:

1. Add the following lines in section 1 of the definition file. Insert these lines just before the Analysis options line. Begin each line in column 1.

```
Begin segment          = 7FF0
Keep segments          = DEF
Input filename         = BIOS.BIN
Analysis options . . .
```

   The first line instructs Sourcer to load the file at segment 8000h in the available RAM area. The second line forces Sourcer to only use the range definitions in section 2. The third line instructs Sourcer to load the file BIOS.BIN.

   If the system on which you are running Sourcer does not have EMS memory available, you might not have enough available main memory for Sourcer to load the file. Free additional memory or change the file load address. For example, a BIOS that is 64K or less can be loaded at 9000h. To do this, change the Begin segment line to 8FF0h. In step 3, below, use 9000 instead of 8000 as the segment value.

2. If the BIOS.DEF file was not created from the BIOS you want to analyze, the data and entry points at the end of section 3 are incorrect. Search for all entries in section 3 that have a segment C000 or above. If you know the valid address for these items, replace the address with the correct address of the item or remove the line altogether.

   You might want to run Sourcer once without the data and interrupt entry points, and determine the actual addresses from the first listing. In this case, you can edit the definition file and run Sourcer again. Until you define the actual data and interrupt entry points, Sourcer will not always separate code and data in a BIOS. For more information, see "Analyzing Binary BIOS Files without using BIOSP" next.

3. In section 2, each line that references the BIOS ROM must be updated with the real load memory address. For example, if the three def lines appear:

```
begin      end      default   seg  seg
   seg:off       off       ds   es type size

0040:0000 00FF 0040 0040 data use16
E000:0000 FFFF 0040 0040 auto use16
F000:0000 FFFF 0040 0040 auto use16
```

   These are changed to:

```
begin      end      default   seg  seg
   seg:off       off       ds   es type size

0040:0000 00FF 0040 0040 data use16
E000:0000 FFFF 0040 0040 auto use16
          Mem=8000:0
F000:0000 FFFF 0040 0040 auto use16 Mem=9000:0
```

   This instructs Sourcer to virtualize the loaded ROM memory image at 8000h to a virtual address starting at E000:0h.

4. Make sure that the BIOS.DEF, BIOS.BIN, and BIOS.REM files are in the same subdirectory. Run Sourcer by entering the following command at the DOS prompt:

   SR BIOS

5. Review the Sourcer listing. You might need to make further refinements the BIOS.DEF file and run Sourcer again

Analyzing Binary BIOS files without Using BIOSP

If the binary file of the BIOS exists and you cannot run the BIOS Pre-Processor on the system you want to analyze, there is no way to automatically identify the interrupt entry points. For a clear and understandable listing, the entry points are usually necessary. You can try and determine them if BIOSP cannot be run on the system.

Most system BIOS ROMs have a table of offsets near the end of the BIOS. If you can locate this table, you can use it to create a

list of entry points to add to the BIOS.DEF file. There is no consistent location for this table, and it is built different ways depending on the manufacturer and version.

The most common table is a group of offsets for interrupts 0 to 1Ch. On AT class systems, offsets for interrupts 70h to 77h may follow it. Some BIOS ROMs start the table at interrupt 5 rather than 0, and some older BIOS ROMs use doubleword pointers within the table. There is no standard layout. If the interrupt vector table from the machine can be viewed, you may be able to confirm these offsets with the entries in the ROM table.

POST Codes

Many system BIOS ROMs generate POST (Power-On-Self-Test) codes as a diagnostic aid for the manufacturer. The BIOS typically writes these codes to an I/O port to show the progress of the code within the BIOS. Unfortunately, the ports and codes used for this purpose are not consistent. Even different versions of a BIOS from the same manufacturer will typically use different ports and codes.

Sourcer will identify ports used for the post code as "POST checkpoint". The following table lists ports used by some common system BIOS ROMs.

Port Number	Type of System
80h	IBM AT and most clones
84h	Compaq
280h	Some clones
300h	Some EISA based systems
680h	IBM PS/2 (MCA bus)
1080h	Some EISA based systems

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Chapter 3: Troubleshooting

This chapter suggests actions you should take to correct problems you encounter while running the BIOS Pre-Processor. If you encounter a problem while reassembling generated code, see "Reassembling BIOS Source Code" in Chapter 1.

General Problems

This section describes problems that occur without BIOS Pre-Processor warning messages.

Cannot Access BIOS Pre-Processor

The file BIOSP.EXE must be in the current directory or on the current diskette.

Screen is Difficult to Read or the Color Changes

If you are using a CGA card with a composite monochrome monitor, enter the following command at the DOS prompt:

```
mode bw80
```

If you are using an EGA or VGA adapter that is not fully IBM-compatible, start BIOS Pre-Processor with the -v command line option. (This option turns off color changes.) For example:

```
runbiosp -v
```

You can set the -v option in your DOS environment by entering the following command at the DOS prompt:

```
set vcom=-v
```

If your system does not support one of the IBM display standards, insure ANSI.SYS is loaded in your CONFIG.SYS file before you start the BIOS Pre-Processor. Also, enter the following command at the DOS prompt:

```
set vcom=-n1
```

BIOS Pre-Processor Messages

This section lists each BIOS Pre-Processor message (in numerical order) and give suggestions for correcting problems.

File is Corrupt

This indicates the BIOSP file is damaged. Try loading the BIOSP.EXE file directly from the installation diskette.

Message B-1: Remove RAM resident programs for improved results.

The BIOS Pre-Processor cannot create an accurate BIOS entry map, because RAM-resident routines have bypassed most or all interrupts. Temporarily remove these routines and run the BIOS Pre-Processor again. (An easy way to remove these routines is to boot your system from your original DOS diskette.)

Message B-2: System not IBM or 100% IBM compatible.

The BIOS Pre-Processor cannot locate the BIOS interrupt vector table it uses to determine entry points. The BIOS may not be 100% IBM compatible, thus the BIOS listing you generate may not be completely accurate. For the best results, remove all RAM-resident programs and run the BIOS Pre-Processor again. (See message B-1.)

Message B-3: BIOS address range may be wrong.

As it analyzed your system's BIOS ROM, the BIOS Pre-Processor determined a nonstandard address range for the BIOS. The address range appears in the BIOS Pre-Processor screen and in the BIOS definition file. If you determine that the address range is incorrect, enter the correct range in the range definitions section (section two) of the BIOS definition file. For

more information about the definition file format, see the *Sourcer User's Manual*.

Message B-4: Cannot open file:

The BIOS Pre-Processor cannot open the specified file. Check whether a read-only file with the same name exists and remove it.

Message B-5: Output file disk operation failed.

Use the DOS CHKDSK utility to check whether the disk is functioning correctly.

Message B-6: Disk full.

Remove files to create enough disk space for the BIOS definition file.

Message B-7: Canceled using Escape.

This message appears when you press **Esc** to quit the BIOS Pre-Processor. The BIOS Pre-Processor does not create a BIOS definition file before quitting.

Message B-7: Remove memory manager for improved results.

Many memory managers alter bytes in the actual BIOS and redirect interrupts to alternate handlers. The BIOS Preprocessor will generate results of what appears in memory, not what is actually in the BIOS ROM. Removing the memory manager will produce significantly better results. A few memory managers also "hide" the BIOS ROMs. For example, QEMM's stealth mode does this, making it impossible to analyze the systems BIOS ROM.

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Appendix A: About BIOS the Pre-Processor

How the BIOS Pre-Processor Works

To locate the interrupt entry points into the BIOS, the BIOS Pre-Processor analyzes interrupt vectors and locates the BIOS interrupt load table. Even if Terminate and Stay Resident (TSR) programs have changed interrupts, the BIOS Pre-Processor usually locates correct entry points to the BIOS ROM.

After determining the BIOS entry points, the BIOS Pre-Processor locates key data areas and determines their length. It then inserts the interrupt information and the data items into the BIOS definition file.

Next, the BIOS Pre-Processor determines the length of the BIOS ROM and stores it in the BIOS definition file. In some systems, the BIOS repeats at two or more different addresses. When the BIOS Pre-Preprocessor detects duplicate addressing, it assigns the higher address range to be processed and ignores the duplicate BIOS at the lower address range. It changes any references to the lower address range to refer to the higher address range.

The BIOS Pre-Processor also stores comments in a BIOS remarks file and links them to items in the BIOS definition file. Sourcer inserts these comments into the BIOS listing.

BIOS Pre-Processor Files

File name	Description
RUNBIOSP.BAT	Batch file that runs the BIOS Pre-Processor program.
BIOSP.EXE	BIOS Pre-Processor program file.
BIOS.REM	BIOS remarks file.

BIOS Pre-Processor Specifications

Memory Requirement:
512 Kb minimum.

Computers Supported:
IBM PC, XT, AT, and PS/2; IBM-compatible systems; and compatible 8088 through 80486, Pentium to Pentium III, K6 (and varients).

Instruction Sets:
8088/8086, 8087, V20/V30, 80186/80188, 286, 287, 386, 387, 486, and Pentium, Pentium II, Pentium III (no SMID instructions).
Supports all 286 and later CPUs in real and protected modes.

Input File Type:
BIOS ROM up to 128 Kb.

Output:
BIOS definition file for creating BIOS listing or source code file with Sourcer.

Symbols:
Includes key ROM areas, related RAM areas, and major entry points.

Appendix B: Product Support & Update Policy

Customer Support

If you have a problem with the BIOS Pre-Processor, gather the following information before contacting V Communications Customer Service:

- Program version, and serial number. Both appear on the diskette label and in the upper right corner of the screen when you are running the BIOS Pre-Processor.
- Computer name and model number.
- Printed portion of the Sourcer BIOS listing showing the problem if the problem is in the output file.

Contact Customer Service at the telephone number or address listed on the back of the title page at the beginning of the manual.

Product Update Policy

Registered BIOS Pre-Processor users can purchase a software update for major new releases for a nominal fee. For update information and fees contact Customer Service.

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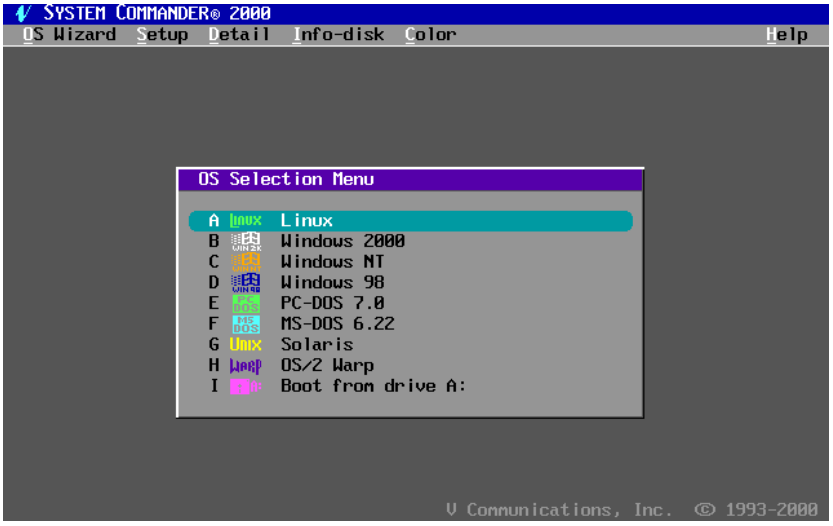
Appendix C: V Communications Products

V Communications produces a number of high performance products for the PC. See our Web site for all of our current products. Additional details on all our products also appear when running SRIN, using the *V Communications Information* selection.

General Products

System Commander® - *Any operating system. Any time. Automatically! - Includes Partitioning.*



System Commander 2000 provides many additional features over prior System Commander versions. It adds automatic partitioning with the OS Wizard. Simply select which OS you

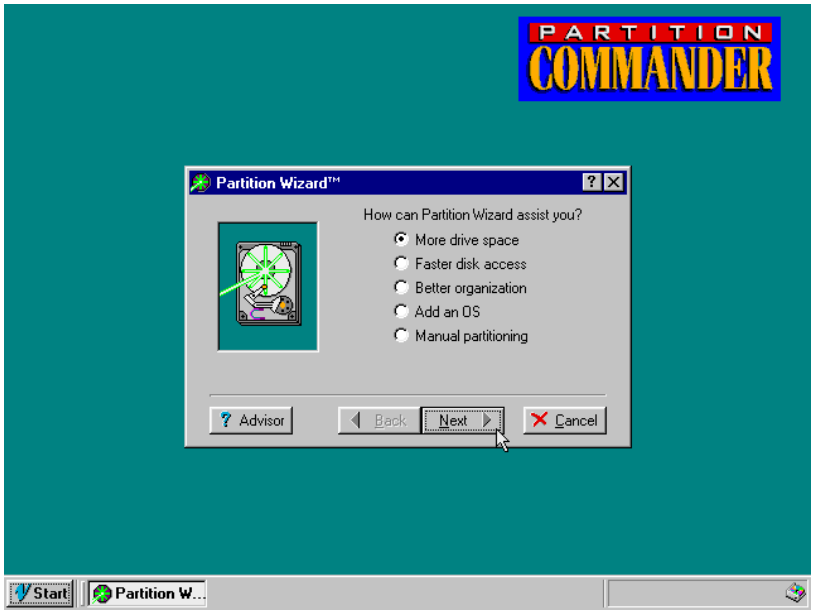
plan to install, and OS Wizard will scan your system to find the best configuration. It can automatically resize existing partitions, create and format a new partition.

System Commander 2000 also offers full manual partitioning with create, delete, resize, validate, conversion, and other key functions. You will also enjoy the new graphics style options and universal mouse support.

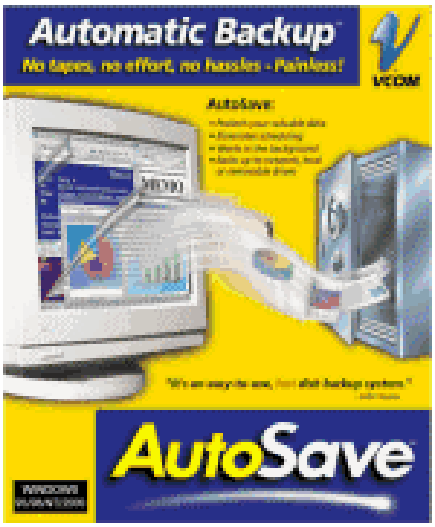
Bundled with the packaged System Commander 2000 are free copies of TurboLinux and Sun's StarOffice.

Partition Commander® - *Automatic Partitioning!*

The most advanced partitioning product available! With our exclusive Partition Wizard™ easily gain more disk space, move unused space on a drive from one drive letter to another, optimize disk usage, and much more.



Partition Commander® even makes manual partitioning operations easy with complete GUI operation – no painful and risky FDISK to hassle with. Provides safe and easy Create, non-destructive resize, delete, copy, move, and FAT to FAT32 conversions and back.



AutoSave™ - *Automatic Backup! No tapes, no effort, no hassles, Painless!*

AutoSave works in the background to automatically save your work files to an alternate location, such as another hard disk, network drive, or removable media like zip, jazz, LS120, or Orb. No scheduling required, since AutoSave works silently in the background, backing up your work files shortly after you create or modify them.

AutoSave works on Windows 95/98/NT/2000.

Development Tools

Sourcer - *The #1 Commenting Disassembler*

Sourcer creates detailed commented source code and listings from executable files and memory. PC Magazine says, "Sourcer is the best disassembler we've ever seen!" Sourcer can process COM, EXE, and SYS files, device drivers, and ROM or RAM. A built in data analyzer and code simulator identifies segments and separates code from data. It even links up data references across segments. Sourcer provides detailed comments on interrupts and subfunctions, I/O ports, and more. It also determines the necessary assembler directives. The disassembly quality is so high, that most programs can be reassembled and have a binary file identical to the original. It includes a definition file facility to include your own comments and descriptive labels. Sourcer supports 8088 through 80486, Pentium, Pentium Pro, Pentium II, Pentium III, MMX

instructions, and math coprocessor instruction sets and handles both 16 and 32 bit code.

Windows Source - *Disassembly Pre-Processor*

Windows Source with Sourcer disassembles Windows EXEs, DLLs, and VxDs. It inserts the actual Windows API names, imports and exports to dramatically improve your understanding of the generated assembly listings. It also helps in exploration of undocumented window APIs. Windows Source comes with a complete set of utilities, including the ability to examine a program's resources and extraction of API lists for current and future releases of Windows.

Windows Source handles Windows 3.x, Windows 95/98, Windows NT/2000, and OS/2 file formats. This includes 32-bit VxDs, DLLs, EXEs, and both 32-bit type executables, PE and LX formats.

BIOS Pre-Processor - *BIOS Source Code Generator*

The BIOS Pre-Processor augments the power of Sourcer by providing the only way to obtain accurate, legal listings of any BIOS (Basic Input/Output System) ROM. It identifies entry points with detailed in-line comments, explains functions and subfunctions, and registers for those functions. It also identifies key data areas. The BIOS Pre-Processor provides highly descriptive labels such as "video_mode" and "int_9_keyboard". And best yet, the BIOS Pre-Processor is fully automatic!

Appendix D: Reference Materials

BIOS

Personal System/2 and Personal Computer BIOS Interface Technical Reference. IBM Corporation, 1988. To order contact IBM Corporation, PO Box 2009, Racine, WI 53404; 800-465-1234. (Order number 68X2341).

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Chappell, Geoff. ***DOS Internals***. Reading, MA: Addison-Wesely Publishing Company, Inc., 1994.

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Schulman, Andrew; Michels, Raymond; Kyle, Jim; Paterson, Tim; Maxey, David; Brown, Ralf. ***Undocumented DOS, 2nd Edition***. Reading, MA: Addison-Wesley Publishing Co. Inc. 1994.

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Brown, Ralf; Kyle, Jim. ***PC Interrupts, 2nd Edition***. Reading, MA: Addison-Wesley Publishing Co. Inc. 1994.

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Highly Recommended!

van Gilluwe, Frank; ***The Undocumented PC, 2nd Edition***. Reading, MA: Addison-Wesley Publishing Co. Inc. 1997.

Instruction Sets and Microprocessors

Hummel, Robert. ***The Processor and Coprocessor***. Emeryville, CA: Ziff-Davis Press, 1992.

Intel i486 Programmer's Reference Manual. Intel Corporation, 1990. To order contact Intel Corporation, PO Box 58130, Santa Clara, CA 95052; 800-548-4725. (order number 240486-001)

Pentium Processor User's Manual, Volume 3: Architecture and Programming Manual. Intel Corporation, 1993. To order contact Intel Corporation, PO Box 58130, Santa Clara, CA 95052; 800-548-4725. (order number 241430-001)

Video Systems

Sutty, George & Blair, Steve. ***Advanced Programmer's Guide to Super VGAs***. New York, NY: Simon & Schuster, 1990.

Richard Ferraro. ***Programmer's Guide to the EGA and VGA Cards, 3rd Edition.*** Reading, MA: Addison-Wesley Publishing Co. Inc. 1994.

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