NSE

North Star Horizon Z80 Computer Emulator.

19th November 2013

TABLE OF CONTENTS

NSE APPENDICES

CPZ EMULATOR

IMAGES AND PRINTOUTS

1. INTRODUCTORY INFORMATION

1.1 Overview

NSE emulates the late 1970s to early 1980s North Star Horizon Z80 Computer.

NSE uses disk-image files which may contain any of North Star Computers' Disk Operating Systems of the period: North Star DOS (NSDOS), CP/M, UCSD Pascal, etc.

The original North Star Horizon in 1978 possessed a single-density floppy-disk-controller which used a single side of a 5-inch, 35-track, hard-sectored floppy disk with ten 256-byte sectors per track giving 88K of storage.

Later models used a double-density-controller which could access both sides of the disk and used 512-byte sectors giving 350K of storage. The double-density controller was not able to boot from a single-density disk but was able to read from and write on it.

Later again, hard-disk capability was added to the North Star Horizon.

NSE is constructed from two modules. The first module contains the 64K of RAM, a Z80 microprocessor emulator, and a display screen. There is also a monitor which emulates the operator's interaction with the hardware, such as inserting or removing floppy disks, and organizing the interaction between the host linux machine and the virtual Z80 machine. This first module is installed as a system library (or .dll) called libemu8bit_z80 and can be called by NSE or any other Z80-based emulator software, such as CPZ or CCS.

The second module consists of the North Star Horizon-specific components, such as the data and control ports of the serial and parallel I/O, the single and double-density floppy-disk controllers with their boot PROMS, and the fixed-disk controllers

A second Z80 CP/M emulator is included, called CPZ. This emulator is a virtual ICM CPZ-48000 single-board-computer. It uses disk-images which are virtual 8" disks, both single-density, single-sided and double-density, double-sided. This emulator also uses the same shared library, libemu8bit_z80, and is practically identical in usages and appearance as NSE.

1.2 ATTRIBUTIONS FOR OTHERS' CODE in NSE

NSE's Z80 emulation code pretty much comes from yaze, a CP/M emulator written by Frank Cringle. North Star specific amendments such as memory-mapped floppy-disk I/O, and a few other additions such as Mode 2 interrupt code were made by Jack Strangio.

NSE's Z80 disassembly code comes from Marat Fayzullin's 1999 DAsm code with some local alterations.

The rest of NSE cannot be blamed on anyone else but myself.
Jack Strangio, September 2013

1.3 THANKS

I have only the greatest appreciation for all those who have helped me in my rather idiosyncratic quest to write an emulator of the North Star Horizon. The Horizon was my first computer which took more than 40 hours to build during the course of several weeks in late 1978. The thousands of solder-joints literally burnt-out a new soldering iron. It says a lot for the quality of the instruction manual that most of the time I really had no idea what each step did but at the end (once my half-dozen wiring mistakes were fixed) I had assembled a computer which worked perfectly.

I'd like to mention a few of the people who have generously helped me:

Dave Dunfield, who gave me a lot of help in many different areas. Often, just the fact that a disk-image worked on his HORIZON.COM emulator and not on my NSE emulator showed me that I had to find yet one more bug. He also had quite a few North Star floppy disk-image files.

The Late Don Maslin, who got me started on the double-density floppy work by transferring a lot of data from my old 10-sectored disks to disk-image files.

Martin Brown, who helped me along the way with scanning old Disk-Controller manuals, without which I was more clueless than usual.

Howard Harte , whose regard for old computers means he has taken the trouble to maintain lots of North Star Manuals:

http://www.hartetechnologies.com/manuals/Northstar/

Bitsavers.org. (http://www.bitsavers.org/bits/NorthStar/). Thanks to them, there are still quite a few disk-image files around for the North Star Horizon.

Allison Parent, for indicating where I could get hold of information regarding the HD5X controller board.

1.4 SEE ALSO ...

The horizon.com emulator for MSDOS by Dave Dunfield at Dave's Old Computers Website (http://www.classiccmp.org/dunfield/index.htm).

Dave also has lots of stuff regarding the North Star Horizon and other old 8-bit computers from the 70's and 80's.

1.5 FLOPPY DISKS AND A HARD DISK SUPPLIED WITH NSE

Several floppy disks are supplied with NSE to get you up and going quickly. They are stored in the 'disks' subdirectory. These archive disks have been renamed to allow their uses to be self-explanatory. The original names are also given here.

HDCPM01.NSI	(was D03B01.NSI)	North Star CP/M Boot Disk for Hard Disks
HDOS22BOOT.NSI	(was D04B01.NSI)	North Star HDOS 2.2 Boot Disk
HDOS22REC.NSI	(was D07B01.NSI)	North Star HDOS 2.2 Inital Recovery Disk

Two hard-disks are also supplied as samples. They are SG5A-type hard disks storing 5 Megabytes, They have been pre-formatted and 'recovered'. On them are 5 CP/M virtual disks: CPMA, CPMB, CPMC, CPMD and CPME. When NSE is booted with the CP/M Boot Disk, it will take you to the A: directory on the first hard-disk on startup.

1.6 SCREEN VIEWS

(Note: Most of the screen images included in the User Guide do not render well on LCD screens. They look better in hard-copy.)

NSE is ncurses-based. When NSE starts it will look for a minimum console 25x80. Smaller screens will cause the program to abort with an error message.

(Fig 1, Page 8: HDOS running in 25x80 screen format.)

(Fig. 2, Page 9: CP/M Splash Screen with XDIR output)

NSE looks like a typical "green-screen" terminal of the 70's-80's period, in particular it will default to be a terminal which acts very similar to Televideo 925/ Soroc 120/ ADM3A terminals.

When you hit the default interrupt key (Shift-F3), you will be shown the "control console" terminal. This will display as an "amber screen" terminal.

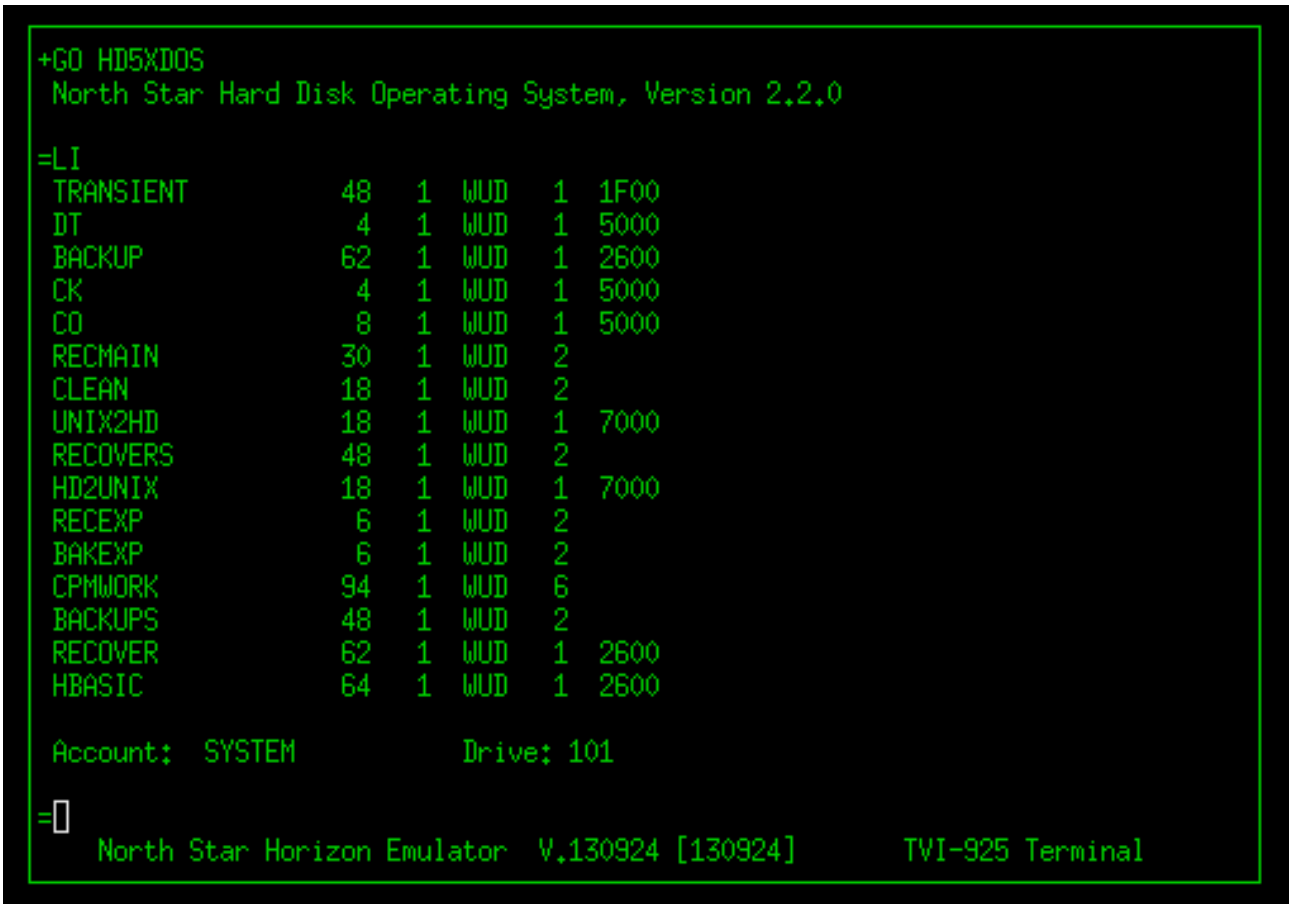
(Fig 3, Page 15: Monitor output from 'help' and 'mount).

To get back to the running emulator, type in the "go" command when you have finished with the control console.

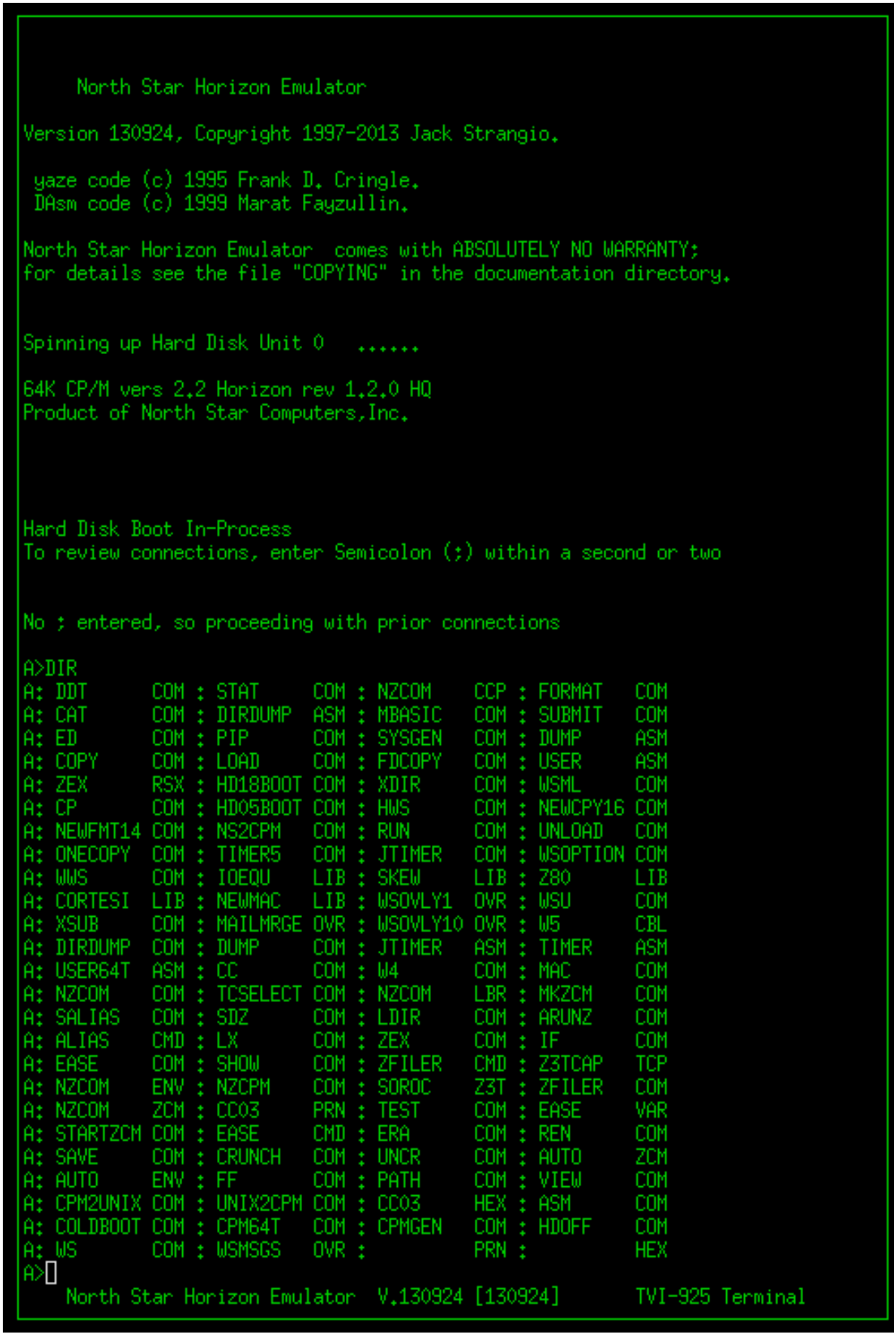
If you are using a GUI, an xterm even larger than 25x80 can be used. Personally, I usually use xterms of 64x140 characters.

(Fig 4, Page 10: WordStar running in high and wide screen format.)

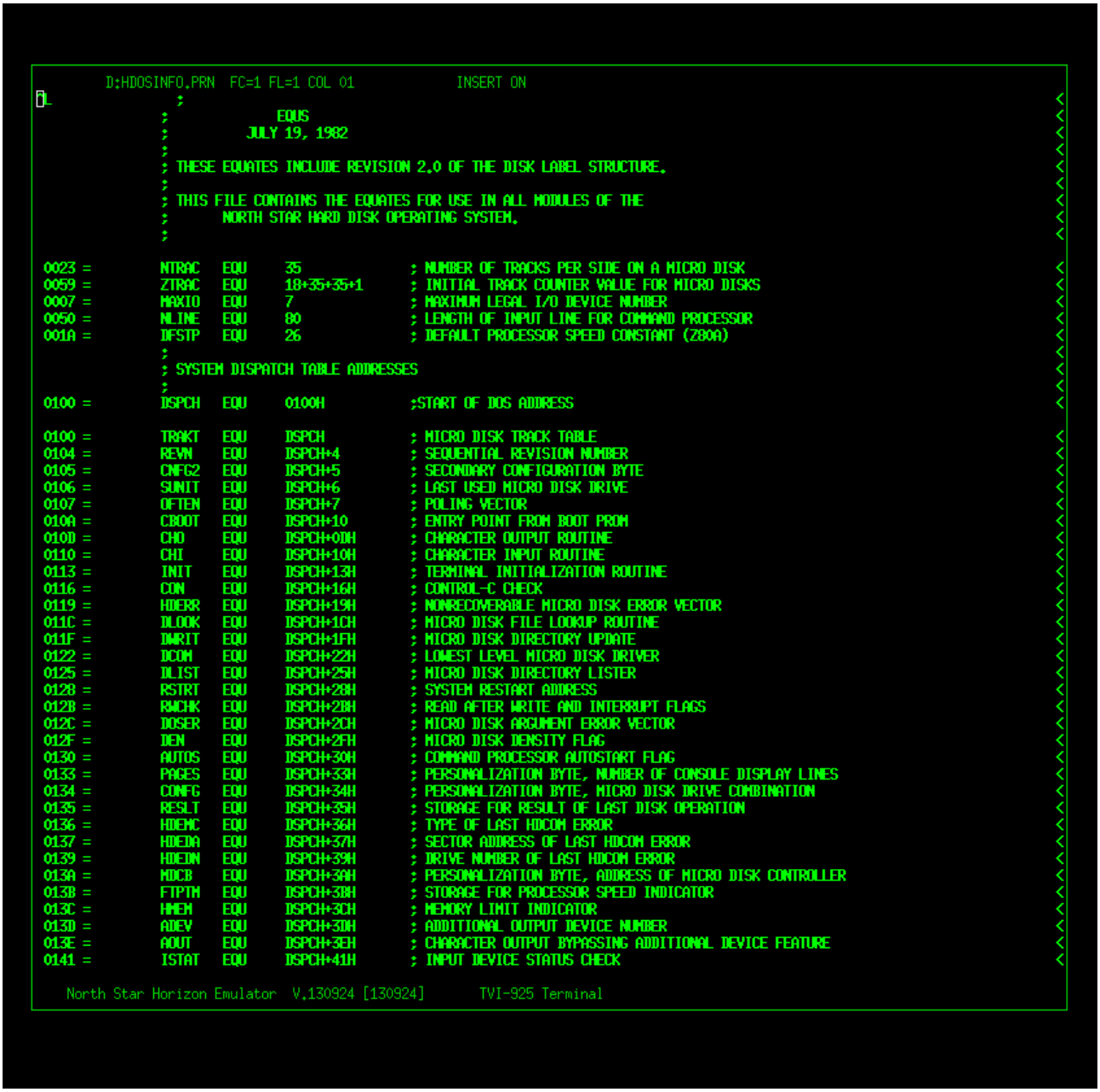
(Fig 5, Page 11: HDOS running in high screen format)



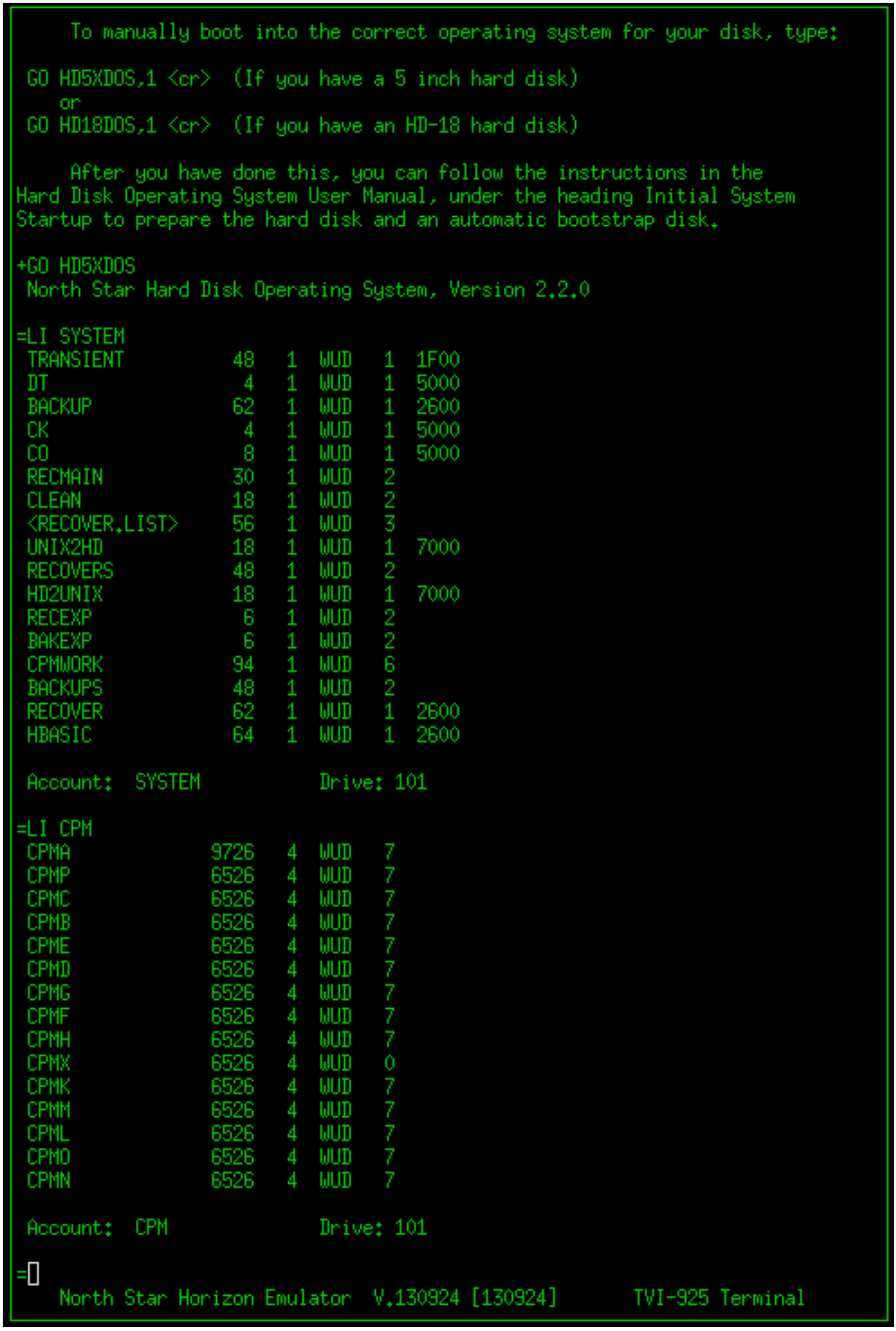
HDOS running in 25x80 character screen format. The status line at the bottom of the screen displays the Name of the emulator, then two version numbers: the first number is the latest commit date of the emulator code, the second number is the latest commit date of the emu8bit_z80 shared-library. The final part of the status line shows which of the terminal emulators has been selected.



NSE splash screen followed by CP/M running in a high screen format.



A custom-configured version of Word Star running in a high and wide screen format.



HDOS running in a high screen format.

1.7 NSE COMMAND-LINE START-UP OPTIONS

nse [-s] [-b floppy-disk-image-to-boot-from] [-c config-file] -w -h

-b <disk-image-to-boot>

Overrides the disk-image boot file named in the config-file.

-c <config-file>

Use an alternate config-file instead of the .nsdosrc file, the ~/.nsdosrc file or the'global' /etc/nse.conf file.

-s

Use the single-density controller.

Note that the North Star single-density controller was not able to boot double-density disks and vice-versa. You must use the -s option if you are going to boot from a single-density disk-image.

-w

Attempt to use a display width of 132 characters if the terminal is wide enough.

-h

Attempt to use a display height of 55 characters if the terminal is high enough.

1.8 NSE COMMAND-LINE STARTUP EXAMPLES:

nse -s -c nsdos.zzz -b nsdos51s.nsi

Start NSE using the single-density controller, booting from the nsdos51s.nsi disk-image file and using the nsdos.zzz configuration file.

nse -b nsdos52q.nsi

Start NSE using the double-density controller, booting from the nsdos52q.nsi disk-image file and using one of the default configuration files.

nse

Start NSE using the double-density controller, booting from the disk-image specified in the default configuration file.

My personal start-up script is '/usr/local/bin/horizon' which runs a wide and high terminal showing 55 lines of 132 characters.

```
#!/bin/bash
#jvs script
# runs 'high and wide' NSE machine
mkdir -p /home/jvs/tmp/horizon 2> /dev/null
cd /home/jvs/tmp/horizon
xterm -geometry 140x64  \
  -title "North Star Horizon Emulator" \
  -e '/usr/local/bin/nse -w -h -c /home/jvs/.nsdosrc'
```

1.9 CONFIGURATION FILES

1.9 LOCATION OF CONFIGURATION FILES:

/etc/nse.conf

The system wide configuration file.

~/.nsdosrc

A user's default configuration file.

You can also use **.nsdosrc** as a program configuration file in the current working directory.

$PWD/.nsdosrc

1.10 PRECEDENCE OF CONFIGURATION FILES

NSE will look for a '.nsdosrc' file first in the current-working-directory. If it isn't found there it will look for it in the user's $HOME directory. It it still hasn't found a configuration file, it will look for the global configuration file '/etc/nse.conf'. The configuration file is a set of control console commands placed in a file at a pre-specified location. Generally, the most useful and specific file is the '.nsdosrc' file placed in the current working directory or in the user's home directory.

Because NSE depends on having certain information available at startup, less-specific files can be useful to make sure that the minimum required parameters are available if the working-directory or home-directory .nsdosrc files are non-existent.

For instance, a minimum global configuration file (/etc/nse.conf) could supply only the value of the interrupt key or maybe do the opposite in that it could remove the need for any user-level .nsdosrc files at all if it was properly set up to supply all relevant NSE information for all users.

1.11 GLOBAL CONFIGURATION FILE: /etc/nse.conf

A minimum system wide configuration file example:

```
#global config file for Northstar Horizon Computer emulator
# ( nse )
# lines beginning with '#' are commented out
#

#set CAPSLOCK on (NSDOS uses Upper case)
caps on

#Leave control console environment, begin execution of emulator
go
```

1.12 USER CONFIGURATION FILES: .nsdosrc

A more complex user-level configuration file in the current-working-directory. This is a copy of a real file:

```
### NSE Configuration File ###
#
# Debug Level - log DEV stuff
debug 4
#
log xlog
# Attach output devices
attach s2o /tmp/printout
attach plo /tmp/parlout

#==== interrupt is ` key
interrupt 60

caps on
delay off
# NorthStar floppies
mount 1 disks/hdcpm1.nsi
#mount 1 disks/jhd501.nsi
#mount 1 disks/D04B01.NSI
#mount 2 disks/D07B01.NSI

# North Star hard drives
mount 102 disks/SG5A-2.NHD
mount 101 disks/SG5A-1.NHD
# Begin emulation
go
```

2. THE CONTROL CONSOLE

The control console is used to do the nuts-n-bolts stuff behind the workings of the emulator, such as 'inserting' floppy disks, changing the CapsLock, altering the keyboard delay, altering which key will be used as the interrupt-key, etc.

2.1 help Show commands and brief synopsis of how they are used.

help <command> displays more information about <command

```
$>help
help        Display this text or give help about a command
?           Synonym for `help'
#           Display comment line
attach      Attach i/o device to a unix file
detach      Detach i/o device from file
debug       Set debug level
caps        Set 'Capslock' On/Off
terminal    Set Terminal Type
aread       Read an ascii unix file instead of keyboard
memory      Manipulate memory data
mount       Mount a unix file as a disk image
umount      Unmount disk image
delay       Set Hard-Disk Delay
log         Log debugging output to system file
screenlog   Log screen to system file
interrupt   Set user interrupt key
go          Jump-to/Continue N* DOS execution
reset       Cold Boot/Reset N* DOS execution
break       Set breakpoint address
trap        Set trap address where native code called
!           Execute a unix command
quit        Terminate nse
$>
$>
$>help mount
mount                       without arguments lists the mount table
mount [-r] <drive> <file>    mounts <file> as disk <drive> - a number
                             from 1-3 (floppies) or 101-102 (hard disks).
                            <file>  must contain a filesystem image.
                            If '-r' is used, then <file> is mounted as
                            READ-ONLY
$>
$>mount
  Floppy    1 is </u/1/northstar/WRK_CPMBOOT_DRI.NSI>
  Floppy    2 is   ** not mounted. **
  Floppy    3 is   ** not mounted. **
  Floppy    4 is   ** not mounted. **
  Hard Disk 1 is </u/1/northstar/30mb101.nhd>
  Hard Disk 2 is   ** not mounted. **
$>
$>mount 3 /tmp/075DISK.NSI
 FLOPPY 3, </tmp/075DISK.NSI> 87 K
$>
$>umount 3
  Floppy    3  </tmp/075DISK.NSI> now unmounted.
$>
```

2.2 attach Attach I/O device to a unix file.

attach <iodev> <file>

attach s2o /tmp/printout

Without arguments, attach lists the current attachments.

With arguments, attach attaches <iodev> to the <unix file>, where <iodev> is one of s2i, s2o, pli, plo. These are the North Star Horizon I/O interfaces where s2i = serial2-in, s2o = serial2-out, pli = parallel-in, plo = parallel-out.

2.3 detach Detach I/O device from file.

detach <iodev>

detach s2o

detach closes the unix file attached to <iodev>. See **attach**

2.4 aread Read in an ASCII unix file instead of keying in the characters from the keyboard.

aread <text file>

aread /tmp/program1

The linefeed character (0A H) is converted to a carriage-return character (0D H) automatically. Note that aread can supply 'keyboard' input faster than a lot of programs (e.g. Word Star) can handle gracefully.

2.5 caps Toggle 'Capslock' On/Off.

caps [on | off]
caps

When NSE starts, the capslock is 'Off'. NSDOS requires the capslock to be toggled on. This can be achieved either by the actual CAPSLOCK key or by the use of this command. I usually put the 'caps on' line in the configuration file.

2.6 delay Toggle a delay into the Hard-Drive Controller subsystem.

delay [on | off]
delay

The delay in the hard-drive subsystem will slow down the operation of the emulator. It is generally only used in a very few required places when the emulator outruns the user. e.g. when the system is looking for a ';' character to signal the need to edit CP/M Connections on the hard-drive and the emulator gets to the following prompt before the user can react.

The HDC delay should almost always be set to 'off'.

2.7 NSE DISK MANAGEMENT

2.7 mount Mount a unix file as North Star disk image.

mount
mount [-r] <drive> <file>

mount 1 /home/fred/cpm_22.nsi

mount without arguments merely lists the mount tables.

```
$>mount
   Floppy     1 is </u/1/northstar/WRK_CPMBOOT_DRI.NSI>
   Floppy     2 is   ** not mounted. **
   Floppy     3 is   ** not mounted. **
   Floppy     4 is   ** not mounted. **
   Hard Disk 1 is </u/1/northstar/30mb101.nhd>
   Hard Disk 2 is   ** not mounted. **
```

mount with arguments mounts <file> as N* DOS floppy disk <drive>.

The double-density controller can mount 4 floppy disks and two hard disks, but the single-density controller can only mount 3 floppy disks.

<file> must contain a North Star filesystem disk-image. If '-r' option is used, then <file> is mounted READ-ONLY. The '-r' option is not active with hard disks.

The unit numbers for floppy disks and hard disks follow the North Star HDOS convention. Units 1 to 4 are floppy disks, units 101 and 102 are hard disks.

2.8 umount Unmount a North Star disk-image.

umount <drive number>

umount 2

umount closes the file associated with disk drive <drive number> and frees the resources.

2.9 NSE DEVELOPMENT ASSISTANCE

2.9 memory Manipulate memory in the North Star Horizon virtual machine.

This subsystem has usage similar to CP/M 'DDT' or MSDOS 'DEBUG'

Commands:

Upper or lower case commands are accepted
<xxx> is required parameter
[xxx] is optional parameter

C <start address> <finish address> <start of compared block>
c 1a00 2000 2a00

Compare two equal-length blocks of memory. Only the bytes which are different will be displayed with location and values.

D [start address] [finish address]
d 0 12FF

Display the block of memory selected, showing bytes as hexadecimal and ASCII. If no start and end address specified, the command will continue for 100 H bytes from where it ended last.

E <start address>
E 2CFF

Examine/change values at memory locations. The operation is stopped when no new value is entered, just a plain 'enter'.

F <start address> <finish address> <fill byte>
f 1000 2000 55

Fill a block of memory with byte-value specified by <fill byte>.

H <value> <value>
h 1267 abcd

Hex arithmetic results of the addition of two values and the subtraction of the second value from the first value.

L [load address]
l 2a00

Load the file (previously specified by the 'N' command) into memory. If a load-address is not specified the file will be loaded into location 0000 H.

M <source start address> <source end> <destination>
M 4d00 5000 6d00

Move the block of memory specified by the block's start and end into memory beginning at the destination address.

N <file name>
N xtest.bin.bas

Change active file-name which specifies which unix file will be used for 'load' and 'write' operations.

Q

Quit from the memory subsystem back to the emulator's control console.

S <start address> <end address> "string"
S 0100 4fff "North Star"

Search for string delimited by quotes (") within memory block specified.

S <start address> <end address> byte.byte...
S 0100 4FFF 38.4F.4D.60

Search for a list of bytes specified in hex. and joined by dots.

W [number of bytes in hex]
w 5c00

Write to the disk file previously specified by the 'N' command. Write the number of bytes specified.

2.10 debug Set Debug Level.

debug [<hex level>]

debug c3

debug with a decimal numeric argument sets the debug level silently to the level specified. (0 = no debugging logged). debug Level is Set to C3H, using the bit-map values specified here:

Hexadecimal debug bit-values:

Bit 1	1	|	Bit 5	10
Bit 2	2	|	Bit 6	20
Bit 3	4	|	Bit 7	40
Bit 4	8	|	Bit 8	80

Thus debug level C3 is (bit 8) + (bit 7) + (bit 2) + (bit 1)

debug

debug with no argument displays the current bit-mapped level of debug logging to the **log** file, displays the current settings, then asks for a selection

```
$> debug

        1: Registers/Disassembly Display (01H): ON
        2: Motherboard I/O Display       (02H): ON
        3: Development Info Display      (04H): OFF
        4: Floppy Controllers Display    (08H): OFF
        5: Trap Function Display         (10H): OFF
        6: Hard Disk Controller Display  (20H): OFF
        7: Unix BIOS Emulation           (40H): ON
        8: Progress/Configuration Info   (80H): ON

          Select Toggle (or X to exit)    :
```

All output is sent to the **log** file (See 'log' below).

2.11 log — log the debug information to unix disk file.

log <file>

log xlog

sends debugging output to the specified unix file.

Take care, because the quantity of information sent to the log file can reach the maximum size (2 Gig in 32-bit systems, whole disk in 64-bit systems) within a fairly short time.

Unless you're doing development on the North Star Emulator itself, it probably will not be useful to use any debugging or logging at all.

2.12 screenlog — log the screen output to unix disk file.

screenlog <file>

screenlog screen-out

sends all output to the specified unix file. This can be handy if output scrolls off the top of the screen before you can read it.

2.13 break — Set a breakpoint address to stop the emulator and return to the control console prompt.

break <4-hex_digit address>

break 0a5c

2.14 trap — Set a trap address to stop the emulator, perform a user-specified unix operation, return to the emulator and continue.

trap <4-hex_digit address>

trap 2a00

A dummy function is included in the emulator source (trap.c) which merely prints the trap address and the register values. The trap function could be used to access parts of the host unix system or perform any other required operation.

2.15 PROGRAM FLOW CONTROL

2.15 go [new address] Start or continue North Star Horizon code execution.

2.16 reset Reset. Does a Cold Boot of North Star Disk System

2.17 quit Terminate NSE. Stop running, close files, close windows.

2.18 interrupt Set a user-selected 'interrupt' key.

interrupt <interrupt ascii value>

interrupt 1B

The value is written as two hexadecimal characters, thus '1b' is the ESCAPE key or '60' is the BACKTICK key.

This interrupt key is *additional* to the built-in key combination **Shift-F3**, which is always active.

2.19 ! Break out to unix shell.

! [<unix shell command>]

! ls /tmp

NOTE: *With this command, especially when using* ***!*** *without argument, NSE will continue running, it has not stopped.* ***But it will 'disappear' into the 'background'.***

! without any argument will appear to drop you back to the original unix shell you started from. You can perform any actions. This will continue until you exit the command-line shell in the usual unix ways; by entering Control-D or the 'exit' command at the shell prompt.

! followed by a unix command as its argument will drop you into the shell, perform the command, then wait for you to hit the 'ENTER' key, when you will be returned to the control console prompt.

3. HELPER PROGRAMS

3.1 NSE tools

3.1 **mkhd** (make hard-disk-image file)

mkhd is used to produce NSE hard-disk image files. The smallest of the images of the North Star 'standard' hard-disk types (as included in the HD5XTEST program) is 5 megabytes, the largest is 30 megabytes.

A typical example session with mkhd is shown (user input in **bold**):

```
nullius [jvs] /home/jvs/wrk/nse [dev*] > mkhd


                        === mkhd ===
                        Version  2.4

Prepares a "Standard" 5-inch Hard-Disk Imagefile for use with North Star
Horizon Emulator (nse) running HD5XDOS.

Disk-image sizes available range from 5 MB to 30MB.

No.      Type     Cylinders    Heads    Total Sectors   Capacity

 1       SG5A       153         4          9792         4.90 M
 2       TN5A       153         4          9792         4.90 M
 3       MS5B       306         2          9792         4.90 M
 4       RD5B       306         2          9792         4.90 M
 5       SG5B       306         2          9792         4.90 M
 6       TN5B       306         2          9792         4.90 M
 7      CM10E       612         2         19584         9.79 M
 8      MS10E       612         2         19584         9.79 M
 9      CM15C       306         6         29376        14.69 M
10      SG15C       306         6         29376        14.69 M
11      RD15C       306         6         29376        14.69 M
12      TN15C       306         6         29376        14.69 M
13      MS15D       480         4         30720        15.36 M
14      MS15E       459         4         29376        14.69 M
15      CM20E       612         4         39168        19.58 M
16      MS20E       612         4         39168        19.58 M
17      RD20E       612         4         39168        19.58 M
18      MS30D       459         8         58752        29.38 M
19      CM30E       612         6         58752        29.38 M
20      MS30E       612         6         58752        29.38 M
21      RD30E       612         6         58752        29.38 M


   Select ( '0' to exit) : 2


     Type: TN5A disk:   4.90 M capacity.   ---- Is that correct? Y

    creating disk-image type TN5A,  4.90 M.

    Enter file name for this disk: testdisk-1.nhd

Disk ImageFile:  /home/jvs/wrk/nse/testdisk-1.nhd    requested.


Disk ImageFile: '/home/jvs/wrk/nse/testdisk-1.nhd'   created OK.

Do you want to include the SYSTEM account and TRANSIENT file? (Y/n) y

Done.

nullius [jvs] /home/jvs/wrk/nse [dev*] >
```

I suggest the use of the .NHD extension for these North Star Hard-Disk Image files. This extension, like most, is probably already in use elsewhere but is unlikely to be confused with our usage.

3.2 **nshdls** (nshd list directory)

nshdls <North Star hard-disk-image>

nshdls disks/SG5A-1.NHD

nshdls displays lots of information from the file-entries in the North Star Hard Disk index. Because the position of the file-entries depends on a hash function, the directories always seem jumbled – this was a trade-off way back in the days of slow hard-disks.

3.3 **nshdbm** (nshd bitmap)

nshdbm <North Star hard-disk-image>

nshdbm disks/SG5A-1.NHD

nshdbm gives a slightly more compact set of information about the North Star Hard Disk index and also shows a graphical representation of the usage of the hard disk's file-space.

```
 /tmp/nse_120805/disks > nshdbm SG5A-1.NHD

          Bitmap and Directory for North Star Hard Disk Image "SG5A-1.NHD"  (4.896 Megabytes)

Total DIBs = 612 (maximum usable = 602, as also uses 1 DIB for System Track, 8 DIBs for File-Directory, 1 DIB for Test Track)
                           [ 1 DIB is 16 sectors unless a power-of-2 factor is applied ]


Dir    Dir             File            FileSize    Bytes  dib/dib    ndib0    ndib0     File  Type      File Type
Offset Type  Accnt  --  Name  -- Attr Sectors Blocks inLast Num/Sects Address Img_Offset  Type  Data      Description
_____________________________________________________________________________________________________________________
011A00  1    0001  CPMA           80    1562  3124    200    6  64     0020   00040000     7   0001.00  CP/M Virtual Disk File
012000  1    0001  TRANSIENT      80      24    48    200    4  16     0003   00006000     1   1F00.00  Executable, TypeData=GO
012A00  1    0001  CPMB           80    1562  3124    200    6  64     0084   00108000     7   0001.00  CP/M Virtual Disk File
013400  1    0001  DT             80       2     4    200    4  16     0005   0000A000     1   5000.01  Executable, TypeData=GO
014400  1    0001  BACKUP         80      31    62    200    4  16     0006   0000C000     1   2600.00  Executable, TypeData=GO
016E00  1    0001  CLEAN          80       9    18    200    4  16     0013   00026000     2   0010.00  HBASIC program
017000  1    0001  CK             80       2     4    200    4  16     0010   00020000     1   5000.01  Executable, TypeData=GO
017020  1    0001  CO             80       4     8    200    4  16     0011   00022000     1   5000.01  Executable, TypeData=GO
017400  1    0001  RECMAIN        80      15    30    200    4  16     0012   00024000     2   001D.00  HBASIC program
01A600  1    0001  RECOVERS       80      24    48    200    4  16     0014   00028000     2   002E.00  HBASIC program
01C400  1    0001  RECEXP         80       3     6    200    4  16     0016   0002C000     2   0003.00  HBASIC program
01CC00  1    0001  BAKEXP         80       3     6    200    4  16     0017   0002E000     2   0005.00  HBASIC program
01DE00  1    0000  SYSTEM         01       0     0    000    0   1     0000   00000000     0   0000.00  ACCOUNT directory entry
01DE20  1    0001  CPMWORK        80      47    94    200    4  16     0001   00002000     6   0000.00  CP/M Workfile
01E400  1    0001  RECOVER        80      31    62    200    4  16     001A   00034000     1   2600.00  Executable, TypeData=GO
01EC00  1    0001  HBASIC         80      32    64    200    4  16     001C   00038000     1   2600.00  Executable, TypeData=GO
01F200  1    0001  BACKUPS        80      24    48    200    4  16     0018   00030000     2   0030.00  HBASIC program


128 DIBs per line. 'S' = System, 'D' = Directory, 'X' = TestTrack, '.' = Unallocated, 'o' = Allocated, 'U' = Multiple Allocation

SooooooooDDDDDDDDoooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooo
oooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooo.....
................................................................................................................................
................................................................................................................................
................................................................................X
nullius [jvs] /tmp/nse/disks >
```

3.4 **nshdcp** (nshd copy file to unix)

nshdcp <North Star hard-disk-image> <Filename>

nshdcp SG5A-1.NHD HBASIC

nshdcp extracts a North Star HDOS file from the North Star Hard Disk image. The filename to be extracted is case-sensitive, although the huge majority of HDOS filenames are upper-case only.

3.5 unskew-hd-image

unskew-hdimage <North Star Hard Disk Image> <unskewed image file>
OR
unskew-hd-image <unskewed image file> <North Star Hard Disk Image>

unskew-hd-image SG5A-1.NHD image-plain-a

unskew-hd-image can be dangerous to your hard-disk image-files. **Be careful!** It will be used mainly if you are trying to resurrect portions of files which have been lost by removing the interleaving of the sectors and giving a flat file with everything in correct order.

3.6 nsfilecalc (calculate filesizes in terms of NSDOS 256-byte 'blocks')

ns*filecalc*

```
   nullius [jvs] /tmp/nse/disks > nsfilecalc

             North Star DOS/HDOS File-Size Calculator
                  copyright 2012 Jack Strangio

A North Star Floppy Disk file is restricted to a maximum length of 66
tracks on a DQ disk, or 660 sectors, 1320 blocks, 330 kilobytes.

A North Star Hard-Disk file is made from 'hunks' containing multiple
sectors.  These 'hunks' were originally so-named by North Star, but later
this name was changed to 'DIBs'.

Each DIB ('Data Incremental Block', similar to 'clusters', 'extents', etc.
in other operating systems) contains a multiple of 16 sectors.  There can be
a maximum of 128 DIBs per file.

Since this could really restrict the maximum size of a file, a power-of-2
factor can be applied to 16 giving 16, 32, 64, 128, or even up to 256 sectors
per DIB.  Consequently, it becomes possible to produce a file which can go up
to the maximum allowable file-size on a hard-disk: 65,535 blocks, 32,768
sectors or 16.384 megabytes.

Each file contains its own internal DIB-directory, which takes up the first
sector of the file itself.  Keep this 'loss' of the first file sector in
mind when creating your files on the hard-disk.  The Hard-Disk Directory (or
Index) merely tells HDOS where the file's first sector with its
DIB-directory is located upon the hard-drive.



 Bytes                                  (1)
 North Star Blocks (256-byte)           (2)
 Hard-Disk Sectors (512-byte)           (3)
 North Star DIBs ('clusters','extents')  (4)
 Kilobytes (1024 bytes)                 (5)
 Megabytes (1000x1024 bytes)            (6)


         Select Units: ('0' to quit)  6
                Enter Value wanted : 3

File is:  3072000 bytes, 12000 blocks, 6000 sectors, 94 DIBs, allocation factor = 4, 3000.0 KB

    HDOS Command Line:     CR FILENAME[[,ACCOUNT],DISK_UNIT]  12000  4


****    That size of file has unused sectors in the last DIB.    ****

      If all sectors of the last DIB were to be included, the file's size would then become:

          3079680 bytes, 12030 blocks, 6015 sectors, 94 DIBs, allocation factor = 4, 3007.5 KB

    HDOS Command Line:     CR FILENAME[[,ACCOUNT],DISK_UNIT]  12030  4

nullius [jvs] /tmp/nse/disks >
```

nsfilecalc will notify you whether the file-size you have requested will not completely fill a DIB. If there is unused space left in the allocated disk area you may, if you want, increase the size requested up to the end of the last DIB.

3.7 nsfd2u (copy NSDOS file from floppy-disk to unix)

nsfd2u <NSDOS disk-image>

nsfd2u D04B01.NSI

nsfd2u reads the files off a double-density North Star DOS disk image file and creates copies of those files in the unix file space.

The unix filenames will have the format of <Name of File>_<FileType>[_Go-Address]. The Go-address will only be used with a file of Type 1 (executable).

example 1.
The M5700 executable file is Type 1 and has a Go-Address of 5700 H; this has a unix file name of M5700_1_5700

example 2.
The BASIC program called OTHELLO is Type 2 (BASIC Program) and not being a executable Type 1 will have no Go-Address; this has a unix file name of OTHELLO_2

3.8 u2nsfd (copy file from unix to NSDOS floppy-disk)

u2nsfd <unix file> <NSDOS disk-image>

u2nsfd M5700_1_5700 MYDOSDISK.NSI

u2nsfd will copy a file from the unix file space onto a double-density North Star DOS disk image file.

If the above filename format (as in nsfd2u) is used for the North Star DOS filename in the unix file space, then the file will be added to the NSDOS disk directory complete with Type attributes and Go-Address if applicable. If the NSDOS directory already has a file of the same name, the new file will replace the earlier file.

If the above filename format is not used, the file-type defaults to Type 0 (undefined). This can then be altered using the TY command in NSDOS:

TY <filename> <File-Type> [Go-Address]

3.9 compact

compact <NSDOS disk-image>

compact MYDOSDISK.NSI

compact will 'compact' a North Star DOS disk image file. It will act similar to a defragmenting of the disk-image file by moving all files towards the beginning of the disk, eliminating any unused space between the files where previously deleted files once were.

3.10 nsfdls (NS floppy-disk list directory)

nsfdls *<NSDOS disk-image>*

nsfdls MYDOSDISK.NSI

nsfdls lists the directory of the floppy-disk image file in the same format as the LI in NSDOS.

3.11 mkfs.ns

mkfs.ns [-s] <disk-image filename>

mkfs.ns -s MYSSSDDISK.NSI

mkfs.ns creates an empty North Star DOS formatted floppy-disk image. It can produce either single-sided, single-density disk-images (88K) or double-sided, double-density disk-images (350K). The default size is 350K, if you use the '-s' option an 88K disk-image is produced. The first 8 characters of the filename are used as the disk-label.

3.12 ni & li

ni and li are small unix scripts for manipulating the .nsdosrc configuration file in the user's current-working-directory.

ni is used for editing the .nsdosrc file, it will use whatever text-editor is set in the user's environment. **li** is used to list the current .nsdosrc file

3.13 jdz80 (Z80 disassembler)

jdz80 is a slightly improved version of Marat Fayzullin's 1999 DAsm, in which relative jump destination addresses are calculated and displayed rather than just displaying the relative jump offsets.

3.14 OTHER TOOLS

3.14 cpmtools

Life is simpler with cpmtools-2.7 (or later) which can be obtained from most linux repositories. This set of utilities can be used to copy files directly between North Star CP/M disk-images and the unix/linux file space. It will be necessary to add the following disk definitions to the cpmtools config-file **diskdefs** which is usually at /etc/cpmtools/diskdefs.

```
diskdef nsfd
  seclen 512
  tracks 70
  sectrk 10
  blocksize 2048
  maxdir 64
  skew 5
  boottrk 2
  os 2.2
end
```

```
diskdef nshd4
  seclen 512
  tracks 512
  sectrk 16
  blocksize 4096
  maxdir 256
  skew 0
  boottrk 0
  os 2.2
end
```

The added disk-definitions will enable cpmtools to understand the North Star CP/M disk

formats, both the floppy-disk images and the larger CP/M Virtual Disk Images on the hard disk. (Note that you will need to copy the hard-disk CP/M Virtual Disk image-file off from the hard disk image-file by using the **nshdcp** program before you can start to use the cpmtools with it.)

The utilities in cpmtools include:

`cpmls`	list files in the North Star CP/M disk-image
`cpmcp`	copy files to and from the North Star CP/M disk-image
`cpmrm`	delete files from the North Star CP/M disk image
`mkfs.cpm`	prepare stub disk for CP/M. In my experience, this does not work properly. Instead, use mkfs.ns to produce an NSDOS disk then FORMAT it for CP/M.

3.15 **hdos2u** (File in HDOS)

hdos2u is a HDOS utility to copy a file on a North Star Hard Disk to the unix filesystem while running HDOS. All unix filenames will be considered all lower-case, HDOS filenames will be considered upper-case.

3.16 **u2hdos** (File in HDOS)

u2hdos is a HDOS utility to copy a file on the unix filesystem to a North Star Hard Disk while running HDOS. All unix filenames will be converted to lower-case, HDOS filenames considered upper case.

3.17 **cpm2unix** (File in CP/M)

cpm2unix is a CP/M utility to copy a file on a North Star Hard Disk CP/M virtual-disk image to the unix filesystem while running CP/M. All unix filenames will be considered all lower-case, HDOS filenames will be considered upper-case.

3.18 **unix2cpm** (File in CP/M)

unix2cpm is a CP/M utility to copy a file on the unix filesystem to a North Star Hard Disk CP/M virtual-disk image while running CP/M. All unix filenames will be converted to lower-case, CP/M filenames considered upper case.

3.19 **screenlog**

screenlog is not a tool as such but a record of NSE's output.

4 VARIOUS.

4.1 OTHER FILES REQUIRED

Various floppy-disk image files:

These are available from various sources. Most of them have a .nsi extension.

4.2 COMPILING LIBRARIES REQUIRED

The linux libraries required are libpthread, libncurses and libpanel. Some linux distros include libpanel with ncurses.

4.3 VARIOUS USEFUL MANUALS

Most of the manuals are available from http://www.hartetechnologies.com/manuals/Northstar/ or from http://itelsoft.com.au.

Probably the most useful are:

North Star DOS Rev 5
North Star BASIC Version 6
North Star Horizon Emulator (NSE) User Guide (this manual)
North Star Hard Disk Operating System Manual
North Star CPM 2.2 Manual
North Star CPM 2.2 Preface to the Addendum
North Star CPM 2.2 Addendum

These are all included in the 'documentation' directory

4.4 BUGS

I feel I have got most bugs out which makes NSE very usable. (After all, it's my usual day-to-day CP/M system.) But there are still a few to go, apart from the things that could be done to make NSE not quite so rough-edged. Please inform me of any that you discover. Email me at: jackstrangio@yahoo.com

4.5 TODOs

Choice of a third or fourth terminal other than the TV-925 and the Lear-Siegler ADM-3A.

More realistic emulation of Parallel I/O.

4.6 AUTHOR and SUPPORT

Jack Strangio <jackstrangio@yahoo.com>

Website: http://itelsoft.com.au

5. INSTALLATION AND INITIAL SETUP OF HDOS AND CP/M. SESSION PRINTOUTS

Before we start to make NSE, we need a few things. First make sure you have the **gcc** compiler, also **make** and then some libraries which are libncurses, libpanel and libpthread. These will be found easily when you start up your software package manager. Just make sure they show as installed on your system. If not, select the required packages and hit 'install'. Most of this stuff is included in most modern distros. You probably won't need to get anything that you haven't got already.

You will also need to be able to run sudo or as the root user. This is to install the **emu8bit_z80.h** header file into the /usr/includes directory and to install the **libemu8bit_z80.so** shared library (DLL) in the /usr/lib directory. Alternatively, you could alter the Makefiles in the source directory and in the emu_lib subdirectory and locate these files in a place of your own choosing.

Compilation.
First we download the source-files tarball and extract to a directory of our choice. Then cd to that directory and type in 'make install':

```
nullius [jvs] /tmp/nse > make install
```

```
After a some lines of output, you will be asked for your password to enable
sudo's root-privileges so that you can install the shared library to /usr/lib
and the executables to /usr/local/bin.

[sudo] password for jvs:

 Once the screen output stops, 'nse' and 'cpz' should be ready.
```

If you want to use the emulators, just change directory to either 'cpz' or 'nse' and run the emulators by entering their names at the CLI prompt. There will be usable disks supplied in the 'disks' subdirectories for experimentation and the configuration files '.nsdosrc' and '.cpzrc' set up to use those.

If we want larger or different hard-drive images for NSE, we'll need some hard-disks, so we'll run mkhd once or twice (but it's only shown once here).

```
nullius [jvs] /tmp/nse > mkhd

                         === mkhd ===
                         Version  2.4

Prepares a "Standard" 5-inch Hard-Disk Imagefile for use with North Star
Horizon Emulator (nse) running HD5XDOS.

Disk-image sizes available range from 5 MB to 30MB.

No.      Type     Cylinders    Heads    Total Sectors   Capacity

 1       SG5A       153         4          9792         4.90 M
 2       TN5A       153         4          9792         4.90 M
 3       MS5B       306         2          9792         4.90 M
 4       RD5B       306         2          9792         4.90 M
 5       SG5B       306         2          9792         4.90 M
 6       TN5B       306         2          9792         4.90 M
 7      CM10E       612         2         19584         9.79 M
 8      MS10E       612         2         19584         9.79 M
 9      CM15C       306         6         29376        14.69 M
10      SG15C       306         6         29376        14.69 M
11      RD15C       306         6         29376        14.69 M
12      TN15C       306         6         29376        14.69 M
13      MS15D       480         4         30720        15.36 M
14      MS15E       459         4         29376        14.69 M
```

```
15      CM20E       612         4         39168        19.58 M
16      MS20E       612         4         39168        19.58 M
17      RD20E       612         4         39168        19.58 M
18      MS30D       459         8         58752        29.38 M
19      CM30E       612         6         58752        29.38 M
20      MS30E       612         6         58752        29.38 M
21      RD30E       612         6         58752        29.38 M


   Select ( '0' to exit) : 1

     Type: SG5A disk:   4.90 M capacity.   ---- Is that correct? Y

    creating disk-image type SG5A,  4.90 M.

    Enter file name for this disk: hard_disk_1.nhd

Disk ImageFile:  /tmp/nse_120805/hard_disk_1.nhd    requested.

Disk ImageFile: '/tmp/nse_120805/hard_disk_1.nhd'   created OK.

Do you want to include the SYSTEM account and TRANSIENT file? (Y/n) y

Done.
```

OK. Now using a text editor of some kind prepare a config file called '.nsdosrc'. It doesn't have to be fancy, as long as it tells NSE where to find its HDOS floppies or hard disks. One is supplied with the source files. It should look something like this:

```
#   .nsdosrc - nse startup configuration file

#==== interrupt is ` key
interrupt 60

caps on
delay off

attach s2o /tmp/out_serial2
attach plo /tmp/out_parallel

# NorthStar floppies
##### N* CP/M
#mount 1 disks/HDCPM01.NSI
##### N* HDOS
mount 1 disks/HDOS22BOOT.NSI
mount 2 disks/HDOS22REC.NSI
# North Star hard drives
mount 101 hard_disk_1.nhd
mount 102 hard_disk_2.nhd

go
```

Now we're ready to run NSE with our own disks for the first time. Type into your terminal or xterm the command './nse'

You should now have a black screen and a '+' prompt. Enter 'GO HD5XDOS' and then 'GO TOTREC,1”

```
                    HDOS Initial Boot Procedure

This floppy disk supplied from North Star contains two different HDOS
operating systems: one for 5 inch hard disks and one for the HD-18 hard disk.
The names of these files are HD5XDOS and HD18DOS, respectively.
     To manually boot into the correct operating system for your disk, type:

 GO HD5XDOS,1 <cr>  (If you have a 5 inch hard disk)
    or
 GO HD18DOS,1 <cr>  (If you have an HD-18 hard disk)

     After you have done this, you can follow the instructions in the
```

```
Hard Disk Operating System User Manual, under the heading Initial System
Startup to prepare the hard disk and an automatic bootstrap disk.

+GO HD5XDOS
 North Star Hard Disk Operating System, Version 2.2.0

=ML
 TRANSIENT          48   1  WUD   1  1F00

 Account:  SYSTEM           Drive: 101



 TRANSIENT          48   1  WUD   1  1F00

 Account:  SYSTEM           Drive: 102


=GO TOTREC,1

              TOTAL RECOVER FROM FLOPPY DISKS
                    NORTH STAR COMPUTERS, INC.
                         VERSION 1.1.0

This program erases all files and accounts on the hard disk.
Is this what you want?: Y
YES or NO, please
: YES

Hard disk drive # :101

Reading skip table from sector 2
Skip count given    = 0
Creating directory at sector 128
Reading disk label from sector 0

Constructing disk label as:
Auto load and execute pathname = TRANSIENT,SYSTEM,101
Major disk structure revision level = 1
Minor disk structure revision level = 0
Disk size = 9776 usable sectors
Sectors reserved for destructive testing = 16
DIB (Hunk) size = 16 sectors
Directory size = 128 sectors
Directory address = 128
.............................
Creating SYSTEM account
Initialization complete

       Listing to :
                    1. Terminal
                    2. Printer (Device #1)
                    3. Other printer

        Selection : 1

Recover directory from floppy disk in drive # : 2

                    1. Recover all accounts
                    2. Specify accounts
                    3. Specify exceptions

        Selection : 1

Assuming SYSTEM account already there
Allocated space for file TRANSIENT,SYSTEM :        48 blocks
Allocated space for file DT,SYSTEM :               4 blocks
Allocated space for file BACKUP,SYSTEM :           62 blocks
Allocated space for file CK,SYSTEM :               4 blocks
Allocated space for file CO,SYSTEM :               8 blocks
Allocated space for file RECMAIN,SYSTEM :          30 blocks
Allocated space for file CLEAN,SYSTEM :            18 blocks
Allocated space for file RECOVERS,SYSTEM :         48 blocks
Allocated space for file RECEXP,SYSTEM :           6 blocks
Allocated space for file BAKEXP,SYSTEM :           6 blocks
Allocated space for file BACKUPS,SYSTEM :          48 blocks
```

```
Allocated space for file RECOVER,SYSTEM :          62 blocks
Allocated space for file HBASIC,SYSTEM :           64 blocks

.............
 13 files found on the recover list

Recovered    48 blocks to file TRANSIENT,SYSTEM                *COMPLETED*
Recovered     4 blocks to file DT,SYSTEM                       *COMPLETED*
Recovered    62 blocks to file BACKUP,SYSTEM                   *COMPLETED*
Recovered     4 blocks to file CK,SYSTEM                       *COMPLETED*
Recovered     8 blocks to file CO,SYSTEM                       *COMPLETED*
Recovered    30 blocks to file RECMAIN,SYSTEM                  *COMPLETED*
Recovered    18 blocks to file CLEAN,SYSTEM                    *COMPLETED*
Recovered    48 blocks to file RECOVERS,SYSTEM                 *COMPLETED*
Recovered     6 blocks to file RECEXP,SYSTEM                   *COMPLETED*
Recovered     6 blocks to file BAKEXP,SYSTEM                   *COMPLETED*
Recovered    48 blocks to file BACKUPS,SYSTEM                  *COMPLETED*
Recovered    62 blocks to file RECOVER,SYSTEM                  *COMPLETED*
Recovered    64 blocks to file HBASIC,SYSTEM                   *COMPLETED*
You may remove the disk from drive 2
File recovery completed.  Thank you for waiting.
 North Star Hard Disk Operating System, Version 2.2.0

=ML
 TRANSIENT          48   1  WUD   1  1F00
 DT                  4   1  WUD   1  5000
 BACKUP             62   1  WUD   1  2600
 CK                  4   1  WUD   1  5000
 CO                  8   1  WUD   1  5000
 RECMAIN            30   1  WUD   2
 CLEAN              18   1  WUD   2
 RECOVERS           48   1  WUD   2
 RECEXP              6   1  WUD   2
 BAKEXP              6   1  WUD   2
 BACKUPS            48   1  WUD   2
 RECOVER            62   1  WUD   1  2600
 HBASIC             64   1  WUD   1  2600

 Account:  SYSTEM           Drive: 101

 TRANSIENT          48   1  WUD   1  1F00

 Account:  SYSTEM           Drive: 102
```

Right. Now we have two hard-drives up and running. Now, let's make a CPM Virtual disk file. This one 'CPMA' will be 3MB (12030 256-byte blocks) in size, and we're going to put it on our second hard drive (unit 102). Since this size file is much larger than a file we can make with an allocation factor of one, we need to make our allocation factor '4'. The helper program **nsfilecalc** does all the working out for us.

```
=CR CPMA,102 12030 4
```

That's done. Let's have a look, and there's the new large file on hard-drive 2.

```
=ML
 TRANSIENT          48   1  WUD   1  1F00
 DT                  4   1  WUD   1  5000
 BACKUP             62   1  WUD   1  2600
 CK                  4   1  WUD   1  5000
 CO                  8   1  WUD   1  5000
 RECMAIN            30   1  WUD   2
 CLEAN              18   1  WUD   2
 RECOVERS           48   1  WUD   2
 RECEXP              6   1  WUD   2
 BAKEXP              6   1  WUD   2
 BACKUPS            48   1  WUD   2
 RECOVER            62   1  WUD   1  2600
 HBASIC             64   1  WUD   1  2600

 Account:  SYSTEM           Drive: 101

 CPMA            12030   4  WUD   0
 TRANSIENT          48   1  WUD   1  1F00

 Account:  SYSTEM           Drive: 102
```

Having got HDOS running, quit NSE by hitting **Shift_F3** or our own (`) interrupt key to take us out of the green-screen emulator window and into the amber-screen control console window. Then enter '**quit**' at the amber control console prompt to take us back to the unix command-line. Now we edit our '.nsdosrc' file to comment out the HDOS disks and uncomment the CP/M disk so that we will boot into CP/M instead.

```
<some lines above deleted>

# NorthStar floppies
##### N* CP/M
mount 1 disks/HDCPM01.NSI
##### N* HDOS
#mount 1 disks/HDOS22BOOT.NSI
#mount 2 disks/HDOS22REC.NSI
# North Star hard drives
mount 101 hard_disk_1.nhd
mount 102 hard_disk_2.nhd

go
```

And start NSE again. This time you will enter the CP/M installation setup. Because there is not yet any connection between HDOS and CP/M, you will immediately fall into the connection-setup process. Normally you need to switch on the disk-delay in the config file to give you enough time time to hit the (;) key before you are presented with the A> prompt on boot-up. Make sure you put in a connection for the floppy as well as for the hard-disk A: drive, or you will find yourself at an A> prompt but no files to play with, as they are still only on the floppy and you have no way of reaching them. I usually set the floppy in unit 1 as I: and the floppy in unit 2 as J: but do what you feel works for you. I tend to use large (30MB) hard disks with as many 2-3 MB CP/M virtual disks as possible, but leaving at least two drive-letters free for floppies: say 14 large virtual drives and 2 floppy reaching your maximum allowable of 16 CP/M drives.

```
64K CP/M vers 2.2 Horizon rev 1.2.0 HQ
Product of North Star Computers,Inc.


Hard Disk Boot In-Process
To review connections, enter Semicolon (;) within a second or two

----- Current Connections in WorkFile: CPMWORK
----- ENTER A CONNECTION or T=To HDOS or S=SAVE or X=EXIT?
I:,1
```

Note above how the floppies are allocated: <CP/M drive letter> plus colon (:) plus comma (,) plus <floppy drive number>

```
----- Current Connections in WorkFile: CPMWORK
I:,1
----- ENTER A CONNECTION or T=To HDOS or S=SAVE or X=EXIT?
A:CPMA,102
```

Note above how Virtual Disks are allocated: <CP/M drive> plus colon (:) plus <HDOS file name>.

(Don't forget that the HDOS filename has *three* components:
<filename> plus <account name> plus <drive number>.
In the case above, we are using the filename “CPMA”, we're leaving out the default “SYSTEM” account name, and we're noting that the file is on the second hard disk which is HDOS unit number “102”).

```
----- Current Connections in WorkFile: CPMWORK
A:CPMA,102
I:,1
----- ENTER A CONNECTION or T=To HDOS or S=SAVE or X=EXIT?
```

```
S

A>I:PIP A:=I:*.*

COPYING -
-CPMD01
ASM.COM
CAT.COM
[ some filenames omitted ]
WSML.COM
WSMSGS.OVR
WSOVLY1.OVR
WSU.COM
XSUB.COM

A>CAT
Name    Ext Bytes   Name    Ext Bytes   Name    Ext Bytes   Name    Ext Bytes
-CPMD01        0K ! DIRDUMP ASM   20K ! HDOFF   COM    4K ! USER    ASM    8K
ASM     COM    8K ! DIRDUMP COM    4K ! LOAD    COM    4K ! USER64T ASM    8K
CAT     COM    4K ! DUMP    ASM    8K ! MBASIC  COM   24K ! WS      COM   16K
COLDBOOTCOM    4K ! DUMP    COM    4K ! ONECOPY COM    4K ! WSML    COM   16K
COPY    COM    4K ! ED      COM    8K ! PIP     COM    8K ! WSMSGS  OVR   28K
CPM64T  COM   16K ! FORMAT  COM    4K ! STAT    COM    8K ! WSOVLY1 OVR   36K
CPMGEN  COM   16K ! HD05BOOTCOM   32K ! SUBMIT  COM    4K ! WSU     COM   16K
DDT     COM    8K ! HD18BOOTCOM   32K ! SYSGEN  COM    4K ! XSUB    COM    4K
32 File(s), occupying 364K of 2996K total capacity
223 directory entries and 2632K bytes remain on A:
A>
```

From here on in the future, you can boot directly into the A: drive and have tools to work with.

NECESSARY DOCUMENTATION

The underlying system for CP/M on the North Star Hard Disk is the North Star Hard Disk Operating System. CP/M disks are merely virtual disks composed of files within the North Star Hard Disk Operating System.

To understand the HDOS file system you will need a copy of the **North Star Hard Disk Operating System Manual.**

You will most probably need some documentation regarding the CP/M Operating System to refresh your memory, and for those who weren't familiar with CP/M previously it will seem relatively familiar due to the ubiquity of Microsoft's MSDOS in more recent years

Get a copy of the **North Star CP/M 2.2 Manual** for the usage of the CP/M utilities.

A copy of the **North Star CP/M 2.2 Preface** together with the **North Star Addendum to the CP/M 2.2 Preface** is necessary to explain the usage of CP/M with the North Star Hard Disk Operating System and gives more details on the preparation of the CP/M Virtual Disks within the North Star HDOS file system. The helper program **nsfilecalc** can help in working out the parameters of the Virtual Disk files.

All of the manuals mentioned here can be found in the 'documentation' subdirectory. Also they are online. They can be found on my website and on other websites.

APPENDIX A.

HOW TO ENABLE NSDOS AND CP/M TO USE THE SECOND HARD DRIVE ON HD5X CONTROLLER

NOTE: The two North Star boot disks supplied with NSE have been adjusted so that the second hard drive is already configured in. This **may not** be the case with other boot disks.

1. NSDOS

I discovered that the 'NSDOS for HARD-DISK version 2.20' master disk (archive disk : D04B01.NSI) is configured by default to use only the first hard-disk. Then by logging the path of the flow in the hard-drive initialisation code I saw that an incorrect port-number for the second hard-drive was being used. (0xFF in place of 0x70).

I found that to use two hard-drive units, we need to enable use of second hard-drive by replacing an 0xFF byte at 0504H in memory by 0x70 (base port for second hard-drive in controller). If we load HD5XDOS into memory at 5000H then the relevant byte to alter is at 5404H.

Bytes 0503H & 0504H then become 60H & 70H. We also need to 'restore' the second hard-drive using the TOTREC software.

I did intend to remove that set of SYSTEM-account software on the second hard-drive, but it wasn't worth the effort. (Disk space is cheap). And besides, the **mkhd** program can install the SYSTEM account and the TRANSIENT program for you.

Sample session:

```
 North Star Hard Disk Operating System, Version 2.2.0

=ML
 TRANSIENT          48   1  WUD   1  1F00
 DT                  4   1  WUD   1  5000
 BACKUP             62   1  WUD   1  2600
 CK                  4   1  WUD   1  5000
 CO                  8   1  WUD   1  5000
 RECMAIN            30   1  WUD   2
 CLEAN              18   1  WUD   2
 <RECOVER.LIST>     56   1  WUD   3
 RECOVERS           48   1  WUD   2
 RECEXP              6   1  WUD   2
 BAKEXP              6   1  WUD   2
 CPMWORK            94   1  WUD   6
 BACKUPS            48   1  WUD   2
 RECOVER            62   1  WUD   1  2600
 HBASIC             64   1  WUD   1  2600

 Account:  SYSTEM           Drive: 101

=LI HDUNIT2,102

 Type: 125   Drive: 102   Sector:     2   Hard Disk Drive Not Found

=DH 0500-050F
 0500  C3 24 05 60  FF 00 00 00   28 00 03 00  01 00 08 07

=LF HD5XDOS,1 5000

=DH 5400-540F
 5400  C3 24 05 60  FF 00 00 00   28 00 03 00  01 00 08 00

=DS 5404
 5404 FF= 70

=SF HD5XDOS,1 5000

=
```

(Reboot here)

```
 North Star Hard Disk Operating System, Version 2.2.0


=LI HDUNIT2,102
 CPM-A:           4096   4  WUD   7
 CPM-B:           4096   4  WUD   7

 Account:  HDUNIT2          Drive: 102

=ML
 TRANSIENT          48   1  WUD   1  1F00
 DT                  4   1  WUD   1  5000
 BACKUP             62   1  WUD   1  2600
 CK                  4   1  WUD   1  5000
 CO                  8   1  WUD   1  5000
 RECMAIN            30   1  WUD   2
 CLEAN              18   1  WUD   2
 <RECOVER.LIST>     56   1  WUD   3
 RECOVERS           48   1  WUD   2
 RECEXP              6   1  WUD   2
 BAKEXP              6   1  WUD   2
 CPMWORK            94   1  WUD   6
 BACKUPS            48   1  WUD   2
 RECOVER            62   1  WUD   1  2600
 HBASIC             64   1  WUD   1  2600

 Account:  SYSTEM           Drive: 101



 CPM-A:           4096   4  WUD   7
 CPM-B:           4096   4  WUD   7

 Account:  HDUNIT2          Drive: 102

=DH 0500-050F
 0500  C3 24 05 60  70 00 00 00   28 00 03 00  01 00 08 07

=
```

2: CP/M

In a similar manner to HDOS, the CP/M floppy disk master is also configured to use just the first hard-drive.

In this case, we don't have the easy method of doing the required changes within the emulator itself. You will need to find a hex editor, such as my own 'uddt' or similar, so that the bytes within the floppy disk-image can be altered.

In the CP/M disk (archive disk: N2212_64.NSI), there will be 60H, FFH bytes at positions 1AC03H and also at 20F08H from start of floppy-disk image.

Change the bytes at 1AC04 and at 20F09 from FFH to 70H. Save the new values to disk-image.

APPENDIX B.

REPLACE THE COMMAND-LINE UNDERLINE IN HDOS 2.2.0 WITH A BACKSPACE

In the days of the Teletype, we made do with a back-arrow or underline instead of the destructive backspace which we are more comfortable with nowadays. It's a bit of a shock to the system when we have to go back to the 'bad old days' of the command-line underline.

METHOD ONE

Change the define in the nse.h file so that the variable WANT_DESTRUCTIVE_BACKSPACE is set to TRUE. This is the default for NSE.

METHOD TWO

This patch will change both the backspace and the underline to the destructive backspace, if you want to fix just the underline then only adjust the byte at XX1B H. If you only want the backspace to be fixed then just change the byte at XX1F H, as shown below.

Using a hex editor, load the D04B01.NSI floppy-disk file.

Change the two bytes at 3E1B H and at 3E1F H to point to the Control-H code at 3E5F H by changing the value of the byte at 3E1B H to 43 H and the value of the byte at 3E1F H to 3F H.

ALTERNATE METHOD 2

Boot into NSDOS using the D04B01.NSI floppy-disk image file. Then follow as shown in the session below: (user input in **bold**)

```
+GO HD5XDOS
 North Star Hard Disk Operating System, Version 2.2.0

=LF HD5XDOS,1 5000

=DH 7410-741F
 7410  C1 24 E6 7F  FE 40 28 5A   FE 5F 28 CD  FE 7F 28 C9

=DS 741B
 741B CD= 43

=DS 741F
 741F C9= 3F

=SF HD5XDOS,1 5000

=
```

DO SIMILAR FOR THE 'TRANSIENT' PROGRAM ON THE HARD-DISK

Load the TRANSIENT file into RAM at 6F00 H : 'LF TRANSIENT 6F00'.

Alter the bytes required as in Alternate Method 2. They will be in the same locations.
(NOTE: Some versions of the TRANSIENT file will have the positions at 751B H and at 751F H.)

'SF TRANSIENT 6F00' back into its usual place on the disk.

APPENDIX C.

NORTH STAR HARD-DISK DATA FORMAT

DATA LAYOUT ON HARD DISK.

A hard-disk drive is actually a set of spinning disks (or platters). For each platter there are two heads, one above and one below the platter. Thus a hard-disk drive with two platters has four heads, and each head reads and writes on a separate 'surface'. Because all the heads are moved as a single unit from track to track on the platters, the set of tracks being read from is called a 'cylinder', so, in this case, there would be four tracks within each cylinder.

STRUCTURE OF SINGLE TRACK

Each North Star hard disk track consists of 16 sectors. Each sector has its own set of data fields. As the platter spins the disk-drive electronics supply pulses which specify when the first sector of the set of 16 sectors is reached by the read/write head (the index pulse), and when the start of each sector begins(the sector pulse). The index pulse is not retained by the North Star Hard-Disk Controller, but the sector pulse is latched on and is turned off by the Hard-Disk Controller itself.

STRUCTURE OF THE WRITTEN DISK SECTOR

When the sector-pulse is received from the hard-drive by the hard-disk controller, the controller waits a short period then begins sending a stream of zero bytes (00 H). This is to cushion variations in speed of the physical drive. After a enough time has passed, a Sync Byte (01 H) is sent to the hard drive to signify the actual start of the data to write on the disk sector.

The first set of real data written is the Sector-Label Header field, this is a set of nine bytes which identify which sector is being written. This information is later used when reading the disk, to ensure that the data being read is from the sector desired and not another sector.

The next data field contains the 512-bytes of data or program we want to store.

The last data field contains CRC information to ensure that the data has been written cleanly. If the data read back from the disk-sector does not match the store CRC value, there has been corruption of the data.

STRUCTURE OF THE SECTOR-LABEL HEADER FIELD

Example:

PHY	CYL	HED	LSl	LSh	STl	STh	CRC	CRC~
05	0C	83	BD	04	B0	04	09	F6

In typical North Star Computers fashion, the sector ID label is not that as suggested by Shugart in the ST506 protocol, but one which was designed by North Star themselves. However there are similarities.

Byte 1:PHYSICAL SECTOR

The lower 4 bits (Bits 0-3) are used to specify the physical sector on the track. The physical sector is the one calculated by skewing the reads to improve reading/writing speeds. The physical sector is calculated by adding 8 to the ODD logical sectors: logical sector 1 is at physical sector 9, logical sector 15 is at physical sector 7.

Bits 4 and 5 contain the 2-bit overflow of the CYLINDER byte (Byte 2) which then gives the CYLINDER byte a total of 10 bits which allows a maximum of 1024 cylinders

Byte 2:CYLINDER

This byte plus the extra 2 bits specified in Byte 1 allow 1024 cylinders.

Byte 3:Surface (Head Number)

The lower 3 bits are used to specify which head is selected.
The high bit (Bit 7) may used to specify whether the sector is write-protected or not.

Bytes 4 - 5: LOGICAL SECTOR NUMBER

These bytes contain the logical sector-number on the hard-drive. This number may differ from the physical sector number because of the skewing described above.

Bytes 6 - 7: SHIFTED TRACK NUMBER

These bytes contain the logical sector-number on the drive modulo 16. This can be thought of as either the disk-address of sector 0 on the track, or the 12 bits of the track number shifted up 4 bits. This supplies the physical sector address quite simply by adding the PHYSICAL sector in Byte 1 to this up-shifted track number.

example: (In hex numbers as it makes it easier to see.)

Logical sector : 04BD H
Track Number : 004B H
Shifted Track : 04B0 H
PHYSICAL : 05 H

Physical Sector: 04B5 H

Byte 8:CRC SUM

This byte contains the lower 8 bits of the total obtained by adding all 7 previous bytes.

Byte 9:CRC BYTE COMPLEMENT

This byte contains the complemented CRC byte. (The sum of Byte 8 and Byte 9 is always FF H)

FURTHER EXAMPLE:

PHY	CYL	HED	LSl	LSh	STl	STh	CRC	CRC~
25	52	80	CD	DE	C0	DE	40	BF

Physical Sector: 5 (From Bits 0-3 of PHY)

Cylinder : 52 H (From CYL) + 0200 H (From Bits 4 & 5 of PHY) = 0252 H = 594 (Dec.)

Head : 0 (From Bits 0-2) of HED

Logical Sector : DECD H = 57037 (Dec.)

Physical Sector: 5 (From PHY) + DEC0 H (From Shifted Track) = DEC5 H = 57029 (Dec.)

CRC : 25 H + 52 H + 80 H + CD H + DE H + C0 H + DE H = 440 H = 40H

CRC~ : 40 H complemented = BF H (or BF H + 40 H = FF H)

APPENDIX D.

NSE's HARD-DISK IMAGE FILE STRUCTURE

The hard-disk image structure's size varies according to the number of sectors which were in the original physical hard disk.

The sectors are laid out as in physical sectors, rather than logical sectors. This means the sectors in the disk-image are interleaved, just as they are on the physical disk. There is an unskewing utility in the nse_tools directory, but I don't think this would ever be used by most users of NSE.

NOTE: Validation that the file is truly a North Star Emulator hard-disk image as of NSE, version 0.54 depends solely on the presence of the North Star 'magic' bytes (00 H, FF H) at the start of the first sector of the hard disk image-file. This first sector is North Star's "Hard Disk Label" and contains much information about the size and layout of the hard disk.

If the two validation bytes are not found, NSE will not mount the file at all. While this means that a hard disk image file may become unusable very occasionally, it serves to guard against unwanted accidental damage to other types of files. If warranted, further tests for disk image validity may be included in later versions of NSE.

For producing NSE hard-disk image files of the 'standard' hard disks used by North Star Computers, see under NSE Tools, **mkhd.**

APPENDIX E.

SUBDIRECTORIES AND OLD OPERATING SYSTEMS LIKE NSDOS AND CP/M

A problem with using modern operating systems like Windows and Unix with primitive operating systems like NSDOS and CP/M is that the primitive operating systems know nothing at all about modern subdirectories, and so are unable to read them. As a consequence we are forced to using Virtual Disks which those old operating systems *can* read.

That is why you will get a 'I can't read this floppy' type of disk-error from NSDOS if you try to read files directly from Windows or Unix. How do you mount or read them? You need to move a file into a virtual disk-image and then mount that desired virtual disk-image in one of the emulated floppy-drives as in:

```
mount 4 /home/jvs/dl/DBase2.nsi
```

while in control console mode (the amber-screen). Don't forget that unix/Linux is case-sensitive.

The command assumes that the disk-image you have downloaded the disk-image from the web (or wherever) is in /home/jvs/dl.

If you then enter just plain 'mount' at the control console-prompt you should get a mount-table display something similar to this:

```
$>mount
 Floppy     1 is </tmp/nse-64_120205/disks/HDCPM01.NSI>
 Floppy     2 is  ** not mounted. **
 Floppy     3 is  ** not mounted. **
 Floppy     4 is </home/jvs/dl/DBase2.nsi>
 Hard Disk 1 is </tmp/nse-64_120205/disks/SG5A-1.NHD>
 Hard Disk 2 is </tmp/nse-64_120205/disks/SG5A-2.NHD>
$>
```

A second point to consider: NSDOS and CP/M are two entirely different operating systems. If you try to read a CP/M disk image with NSDOS (or vice-versa) you won't get what you might be expecting:

[Using CP/M. NSDOS floppy disk mounted in G:]

```
A>DIR G:
G: ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^@
G: ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^@
G: ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^@
G: ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^ : ^^^^^^^^ ^^^@
G: ^^^^^^^^ ^^^@
A>
```

Here CP/M is looking at the area on the virtual disk where it is expecting to find a valid CP/M file-directory. However, on a NSDOS disk, that CP/M directory is nowhere to be found. Whatever is at the expected position on the disk will show up as gibberish. A similar problem occurs in

the reverse case, when you are looking at a North Star CP/M disk with NSDOS. But in this case, because North Star CP/M came later than NSDOS, North Star were able to format their CP/M disks such that valid data is produced when you try to use LI on a North Star CP/M disk.

[Using NSDOS. CP/M floppy disk mounted on drive 2]

```
+LI 2
CP/M 2.2   0    0 D   0
QUAD.CAP   0    0 D 112
DISKETTE   0 1400 D   0
CPM FROM   0    0 D   0
NORTH *    0    0 D   0
STAR       0    0 D   0
--------   0    0 D   0
-SYSTEM-   4   32 D   6
-TRACKS-   4   32 D   6
BIOS       4    8 D   6
USER       8    2 D   6
CPM CCP    9    8 D   6
CPM BDOS  13   14 D   6
--------   0    0 D   0
DIR.SEC1  20    2 D   3
DIR.SEC2  25    2 D   3
DIR.SEC3  21    2 D   3
DIR.SEC4  26    2 D   3
--------   0    0 D   0
CPM DATA   0    0 D   7
DATASEC1  22    2 D   7
DATASEC2  27    2 D   7
DATASEC3  23    2 D   7
PRESS RETURN TO CONTINUE
DATASEC4 284  135 S  46
....     135    0 S  32
+
```

To get a better idea of the two operating systems' idiosyncracies, grab the user manuals for each one from a website and have a rummage though them.

CPZ EMULATOR

The Inter Continental Microsystems' CPZ-48000 single-board computer from around 1982 was quite advanced for its day. It was designed as a base system with 'personality boards' (daughter-circuitboards) which took over the interfaces between different peripherals, such as serial printers, parallel printers, 5" floppy drives, 8" floppy drives, etc. The CPZ emulator can deal with most of the everyday operation of the CPZ-48000 and runs up to 4 eight-inch floppy drives. These drives simulate an 8" double-sided double-density floppy. On track 0, side 0, the sectors are formatted to be 26 sectors of 128 byes, all the rest of the tracks on both sides are formatted to 16 sectors of 512 bytes. This gives a total of about 1.2megs per disk.

The disk image is laid out as follows: each track is allocated 8K (16x512), whether filled with 26 sectors of 128 bytes, or 16 sectors of 512 bytes. The disk-image is built up of Track0, side 0; followed by Track 0, Side 1; then Track 1, Side 0; Track 1, Side 1, etc.

```
                                 Side 0                                                      Side 1
Track  0:   S S S S S S S S S S S S S S S S S S S S S S S S S S          DD  DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD
Track  1:   DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD              DD  DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD

   Tracks Omitted ........

Track 75:   DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD              DD  DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD
Track 76:   DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD              DD  DD DD DD DD DD DD DD DD DD DD DD DD DD DD DD
```

Because the disk-image is laid out regularly, the unix cpmtools can be used quite well to copy files to and from disk-images, using the cpmtools disk_defs supplied with the two emulators. Append the disk_defs supplied to the file /etc/cpmtools/diskdefs using any suitable text editor.

System tracks: With the CPZ disk-images, the system tracks take up Track 0, Side 0 plus one other track. If the disk is single-sided the systems tracks are Track 0, Side 0 and Track 1, Side 0. If the disk is double-sided, the systems tracks are Track 0, Side 0 and Track 0, Side 1.

The CPZ-48000 software distinguishes between the various disk formats by inspecting the byte at 7EH on Track 0, Side 0, Sector 1. (The first sector on the disk.) The byte values signify:

DE   double-density 512-byte sectors single-sided

DC   double-density 512-byte sectors double-sided

E5   single-density 128-byte sectors single-sided

E7   single-density 128-byte sectors double-sided

The identification byte is used or implemented by the CPZ-specific programs:

1. Formatting programs:

DSKFMT - Formats single/double-sided 8" floppies with 26x128-byte sectors per track

FMT512 - Formats single/double-sided 8" floppies with 16x512-byte sectors per track, except for Track 0, Side 0 which has 26 128-byte sectors.

DSKTST & DSKT512 - checks single & double-density disk sectors for errors.

2. Other programs which write at the raw-sector level:

COPY512 - Copies a complete disk.

SGEN512 - Writes system tracks to double-density (512-byte sector) tracks.

CPZ CP/M Master disk Files

Note that some of these will not work or will work differently when using the CPZ emulator.

From CPZ-48000 System Disk Explanatory Pages written September 15 1982:

Disk File Explanation 9-15-82

This document describes the contents of your CP/M system disk.

1. *ASM.COM - This is the normal CP/M assembler. It only assembles 8080 code.*

2. *BASIC.COM - This is a public domain basic written by Gordon Eubanks for his Thesis. This Basic is UNSUPPORTED.*

3. *BOOT.ASM - This is your secondary bootstrap source file used to load your CP/M 2.2 deblocked operating system. You will use this file any time you need to make any changes in your bios file and when you rebuild your operating system tracks. See the User's Guide provided.*

4. *CHA-BAUD - This program allows you to change the baud rate of the A channel I/O port. The default baud rate for Channel A = 9600 Baud when the system is first brought up. CHA-BAUD will allow you to change it.*

5. *CONVERT.COM - This program is used to convert lower case letters to upper case letters in the label field and instruction field before using the ZASM.COM assembler. This program will check the balance of quoted strings and if an imbalance is found, will mark the source file with a @ character. Program syntax is as follows:*
   CONVERT [filename.ext] <cr>

6. *COPY512.ASM and COPY512.COM - This program copies single-sided or double-sided deblocked 512-byte double-density disks for backup. This program checks the target disk to see if it matches the source disk before the copy operation takes place. If the two disks do not match, then an error message is given and the program restarts at the beginning. Improper disk means source disk is double-sided 512 byte, target disk is a single-sided disk, for example.*

7. *DDT.COM - This your CP/M Dynamic Debugger Program. This program does not support Z80 instructions.*

8. *DISKDEF.LIB - Library file for generating disk definition tables as explained in the Alteration Guide.*

9 *DSKFMT.ASM and DSKFMT.COM - This program formats disks in single-density IBM 3740 standard, or double-sided, single-density.*

10. *DSKT512.ASM and DSKT512.COM - This program checks 512-byte diskettes for errors. This is a read-only disktest program.*

11. *DSKTST.ASM and DSKTST.COM - This program checks single-density diskettes for errors. This is a read-only disktest program.*

12. *DUMP.ASM and DUMP.COM - Example program supplied by Digital Research.*

13. *ED.COM - This is your CP/M context editor.*

14. *EXTRACT.COM - This program allows you to list source code from a .PRN file by using a Starting and Ending label in your program. This saves you from having to list your whole file just to get at a small area if you need to debug. Syntax is as follows:*

EXTRACT [filename] <first label> <second label> <cr> where:
filename = name of file with extension .PRN assumed
first label = starting label
second label = ending label

15. *FMT512.ASM and FMT512.COM - This program formats diskettes in either single-sided or double-sided 512-byte x 16 sectors. Track 0, Side 0 is always single-density 128-byte sectors for single-sided or double-sided disks.*

16. *GUESS.COM - This is a small computer game written in assembly language.*

17. *IOEQU.LIB - This file is used in conjunction with TURBO.ASM during assembly time.*

18. *LOAD.COM - Used to load .HEX files into .COM files for running in CP/M's TPA space.*

19. *MOVCPM.COM - This file is used to create a system image file which is used to rebuild your CP/M operating system. Do not destroy this file, as it is the only file which allows you to change your system memory size. See the CP/M User's Guide for further instructions.*

20. *NEWMAC.LIB - This is a collection of MACRO's which are used in some of the support programs provided on this diskette.*

21. *PIP.COM - This the CP/M interchange program.*

22. *RUN.COM - This is the runtime package used with the BASIC.COM program. This program is likewise NOT suported.*

23. *SETTIME.COM - Program used to set the 'REAL TIME CLOCK' date and time. This program is used with the auto start feature of CP/M if you set the AUTOTIM equate true in the BIOS file.* ** **CPZ will NOT change the system clock** **

24. *SGEN512.ASM and SGEN512.COM - This program is used to place your CP/M operating system onto the first two tracks of your diskette. This file will check to see if you are trying to place the wrong system type onto the wrong diskette type. You can not place a double-sided operating system onto a single-sided diskette. This program is only used to place systems onto 512-byte diskettes. It will not work with single-density disks. (See SYSGEN.COM)*

25. *SKEW.LIB - This is another MACRO file used with some of the support programs provided on this diskette.*

26. *STAT.COM - This is your CP/M status program.*

27. *STRIP.COM - This program will tear down a .PRN file back into an .ASM file. It is mainly provided so that in the event that you should lose a source file, but you have the .PRN file, you can reasonably recover back to your source file level. This package does not remove everything, such as macro expansions, but at least it may be of some help. Syntax is as follows:*

STRIP [filename1] [filename2] <cr>
where .PRN is assumed for filename1,
and .ASM is assumed for filename2.

28. *SUBMIT.COM - Your CP/M submit program.*

29. *SYSGEN.COM - Your CP/M sysgen program. This file only works on single-density diskettes.*

30 TIME.COM - This program is used to display the date and time at the console. Options include: TIME<cr> to display the date and time and return to CP/M.
TIME P <cr> causes the date and time to display until any key is pushed to abort.

31. TURBO.ASM - This your BIOS file for CP/M 2.2 for use with the Intercontinental Micro Systems Corp. CPU board. See the User's Guide for more details.

32. TURBO.LIB - This file contains the macros for generating a BIOS which uses extended memory as a Memory Disk. See the User's guide for more details.

33. WORM.ASM and WORM.COM - This program is an M1 memory check program used to check memory for proper operation.

34. XDIR.COM - This program displays a sorted disk directory with file sizes displayed in kilobytes.

35. XSUB.COM - This your CP/M extended submit program.

36. Z80.LIB - This is a macro file containing Z80 instructions for use with Digital Research's MAC macro assembler.

37. ZASM.COM - This a Z80 assembler used to assemble most of the support programs. The syntax for this assembler closely follows that of the CP/M assembler with some exceptions as noted in the ZASM users guide.