

NeXTstation Mono headless operation

The problem

I have two NeXTstation Mono computers, but only one sound box and keyboard. Therefore, I wanted to prepare the second computer for operation without a local console ("headless operation"), i.e. enable the use of a serial terminal or access via Telnet.

The challenge

In principle, two problems had to be solved: Firstly, the NeXT computer is switched on using the keyboard, similar to Apple Macintosh computers; there is no physical power button. This obviously doesn't work without a sound box, so an alternative circuit is required.

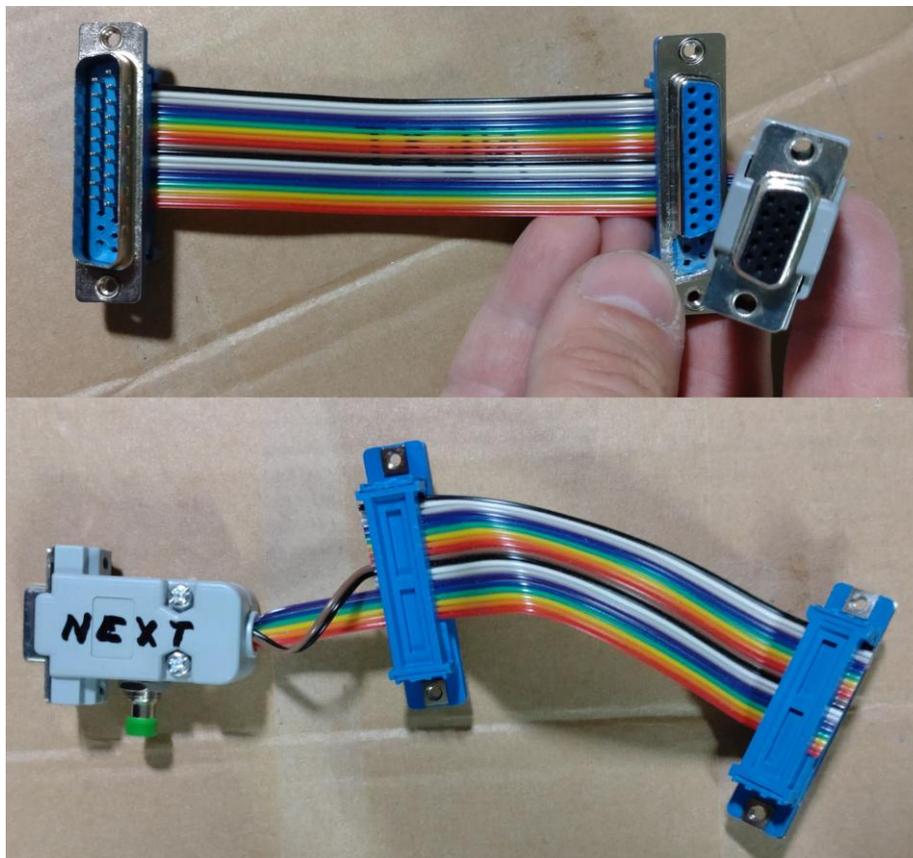
On the other hand, you need a suitable serial cable and an appropriate system configuration.

A monitor adapter and power button for the computer

The monitor adapter is easy to build, you just have to connect a VGA cable to the appropriate contacts on the 19-pin output to the sound box:

```
Next Pin 8 <----- Vsync -----> PC Pin 14
Next Pin 9 <----- HSync -----> PC Pin 13
Next Pin 10 <----- Video -----> PC Pin 1-3
Next Pin 13-19 <---- GND -----> PC Pin 5-10
```

The power button is implemented using a button with a 470 ohm resistor between contacts 6 (PWR SW) and 15 (GND). This starts the computer and displays the start messages on the VGA monitor.



A serial connection is required

Now a serial cable is required, i.e. a connection of the mini-DIN 8 socket on the NeXTstation with the normal 9-pin interface on the PC. The 68040-based NeXTstation uses RS-423/RS-232, while the predecessor (NeXTcube with 68030 processor) used RS-422 interfaces. Information on the pin assignment can be found on

http://www.asterontech.com/Asterontech/NeXT_68040_Serial_Console.html:

NeXT mini-DIN 8 (female):

```
8 7 6
5 4 3
2 1

1: DTR
2: DCD
3: TXD
4: GND
5: RXD
6: RTS
7: NC
8: CTS
```

Standard RS232 9-pin (female):

```
5 4 3 2 1
9 8 7 6

1: DCD
2: RXD
3: TXD
4: DTR
5: GND
6: DSR
7: RTS
8: CTS
9: RI
```

Of course, the connection to the PC must be a null modem cable, so the transmit and receive lines must be crossed (RX→TX and TX→RX). The status lines must also be crossed, so the correct wiring is as follows:

```
NeXT <----> RS232
1: DTR <----> 1: DCD
2: DCD <----> 4: DTR
3: TXD <----> 2: RXD
4: GND <----> 5: GND
5: RXD <----> 3: TXD
6: RTS <----> 8: CTS
7: Not Connected
8: CTS <----> 7: RTS
```

The hardware is now ready. Now the computer must be configured correctly, but there are a few pitfalls (the following description applies to ROM version .66)!

The system configuration for operation without a local console (headless operation)

The first hurdle is in the boot PROM, which is basically the BIOS of the NeXTstation. Normally, no serial terminal is active here. To change this, a local console (sound box, keyboard and monitor) is required.

When the system starts (when the message "Testing System" appears on the screen), press the <Command_Right><μ> keys to access the Boot PROM menu. Then select the configuration menu with the <p> command and set the following parameters:

```
boot command: sd
DRAM tests: yes
perform power-on system test: no
    sound out tests: no
    SCSI tests: no
    loop until keypress: no
    verbose test mode: no
boot extended diagnostics: no
serial port A as alternate console: no
```

This is where the first trap lies: you must not select “yes” in the last menu item (to put the system console on serial port A). Otherwise the machine will hang during the boot process (at the latest on the login screen) with a “kernel page fault” or similar problems.

```
NeXT Mach (blacksun.ganymed.de) (ttya)

blacksun.ganymed.de login: unexpected kernel page fault failure
trap: type 0x410 fcode 5 rw 3 faultaddr 0x0
trap: pc 0x4017252 sp 0x16bdf0 sr 0x2018
trap: cpu 0 th 0x400f690 proc 0x10125268 pid 172 pcb 0x400f81c
traceback: fp 0x1107ee8c
called from pc 0x04085824 fp 0x1107eeb8 4-args 00000a00 040614ba 040e6f14 101242
04
called from pc 0x0407cff4 fp 0x1107eec4 4-args 00000a00 1107eef4 040491c4 00000a
00
called from pc 0x040491c4 fp 0x1107eef4 4-args 00000a00 00000003 1107eef2 000000
03
called from pc 0x040331ac fp 0x1107ef64 4-args 1107ef26 00000003 10117c0c 000000
03
called from pc 0x04031e4a fp 0x1107ef94 4-args 000f9fdc 00000000 00000003 000000
00
called from pc 0x04031da6 fp 0x1107efb4 4-args 000f9fdc 00000003 00000000 000000
ac
called from pc 0x040a562c fp 0x1107eff4 4-args 00000002 00000005 00000000 000000
00
called from pc 0x04001eaa fp 0x0400fd40 4-args 0400fd08 1107d000 040b437a 000000
02
last fp 0x400fd40
panic: (Cpu 0) MMU invalid descriptor during table walk
NeXT ROM Monitor 2.5 v66
panic: NeXT Mach 3.3; Mon Oct 24 13:56:37 PDT 1994; root(rcbuilder):mk-171.9.obj
2/RC_m68k/RELEASE_M68K

panic>
```

To actually load the operating system, enter the following command at the PROM prompt:
bsd(0,0,0)sdmach

The boot process can be observed on the VGA screen, the output will look similar to the following screen.

```
NeXT Mach Operating System
NeXT ROM Monitor 2.5 v66
NeXT Mach 3.2; Mon Oct 18 21:57:41 PDT 1993; root(rcbuilder):mk-149.30.15.obj-2/RC_m68k/RELEASE_M68K

FPU version 0x40
physical memory = 20.00 megabytes.
available memory = 17.92 megabytes.
using 126 buffers containing 0.98 megabytes of memory
fc0 at 0x2114100
Sony MPX-111N as fd0 at fc0 slave 0
SCSI 53C90A Controller, Target 7, as sc0 at 0x2114000
IBM OEM 0662S12 Rev 3 30 as sd0 at sc0 target 0 lun 0
Waiting for drive to come ready

Disk Label: Disk
Disk Capacity 1003MB, Device Block 512 bytes
Generic SCSI Device as sg0 at sc0 target 7 lun 7
Generic SCSI Device as sg1 at sc0 target 7 lun 7
Generic SCSI Device as sg2 at sc0 target 7 lun 7
Generic SCSI Device as sg3 at sc0 target 7 lun 7
en0 at 0x2106000
en0: Ethernet address 00:00:0f:00:c2:67
IP protocol enabled for interface en0, type "10MB Ethernet"
dsp0 at 0x2108000
np0 at 0x200f000
sound0 at 0x200e000
root on sd0

Mon May 31 13:04:14 PDT 1999
Checking disks
/dev/rsd0s: file system clean: skipping check
Faking root mount entries
en0: netmask set to 255.255.255.0
lo0: address automatically set to 127.0.0.1
Setting hostname to myhost
Reinitializing nmserver's network portion
The network is disabled or your computer isn't connected to it.
/usr/etc/mech_swapon: swapping on /private/vm/swapfile.front
Cleaning up: /etc/nologin ptys floppy devices editors /tmp /Net.
Starting early daemons: syslogd.
Starting RPC and network services: portmapadd net default: gateway 192.168.68.1
```

In the next step, the serial terminal must be activated in NeXTstep. To do this, edit the file `/etc/ttys`:

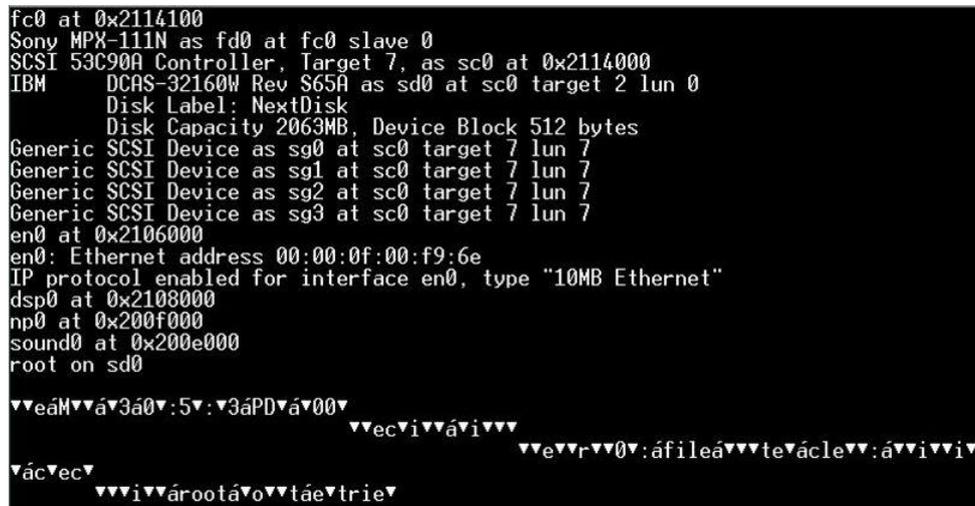
```
# If you want to enable getty's on the "a" serial port, change the
# "off" entry to "on" in exactly one of the "ttya", "ttyfa", or
# "ttydfa" entries. This same caveat applies for the "b" port.
#
# If you do not want to start the window server by default, you can
# uncomment the first entry and comment out the second.
#
# console "/usr/etc/getty std.9600" NeXT on secure
b/NextStep/WindowServer onoption="/usr/etc/getty std.9600" secure ...
-> uncomment this: ttya "/usr/etc/getty knj.9600" vt100 on secure
ttya "/usr/etc/getty std.9600" unknown off secure
```

You can then shut down the system. The next time you start it, you can omit the local console; you should be able to operate it using a serial terminal.

Headless use

The computer starts when you press the button on the VGA adapter. You can continue to follow the system messages on the local VGA screen and on the serial terminal. After a while, the login prompt should appear, and at the same time the login screen will appear on the VGA screen. You can now log in as any user of the system.

The second trap lurks in this step: The console must be set to 9600bps/7 bit. During the boot process, the word length setting (7 or 8 bit) does not matter. However, the operating system expects 7 bit mode, otherwise wrong characters appear on the screen as you can see below.



```
fc0 at 0x2114100
Sony MPX-111N as fd0 at fc0 slave 0
SCSI 53C90A Controller, Target 7, as sc0 at 0x2114000
IBM DCAS-32160W Rev S65A as sd0 at sc0 target 2 lun 0
Disk Label: NextDisk
Disk Capacity 2063MB, Device Block 512 bytes
Generic SCSI Device as sg0 at sc0 target 7 lun 7
Generic SCSI Device as sg1 at sc0 target 7 lun 7
Generic SCSI Device as sg2 at sc0 target 7 lun 7
Generic SCSI Device as sg3 at sc0 target 7 lun 7
en0 at 0x2106000
en0: Ethernet address 00:00:0f:00:f9:6e
IP protocol enabled for interface en0, type "10MB Ethernet"
dsp0 at 0x2108000
np0 at 0x200f000
sound0 at 0x200e000
root on sd0

▼▼eáH▼▼á▼3á0▼:5▼:▼3áPD▼á▼00▼
▼▼ec▼i▼▼á▼i▼▼▼
▼▼e▼▼r▼▼0▼:áfileá▼▼te▼ácle▼▼:á▼i▼▼i▼
▼ác▼ec▼
▼▼i▼▼árootá▼o▼▼táe▼trie▼
```

Access via Telnet should also be possible, but logging in as "root" is usually blocked. You therefore need another user account to log in and can switch to the root user using `su` if necessary.

Once the work is finished, the computer can be shut down by entering `halt -p` (this usually requires root permissions).