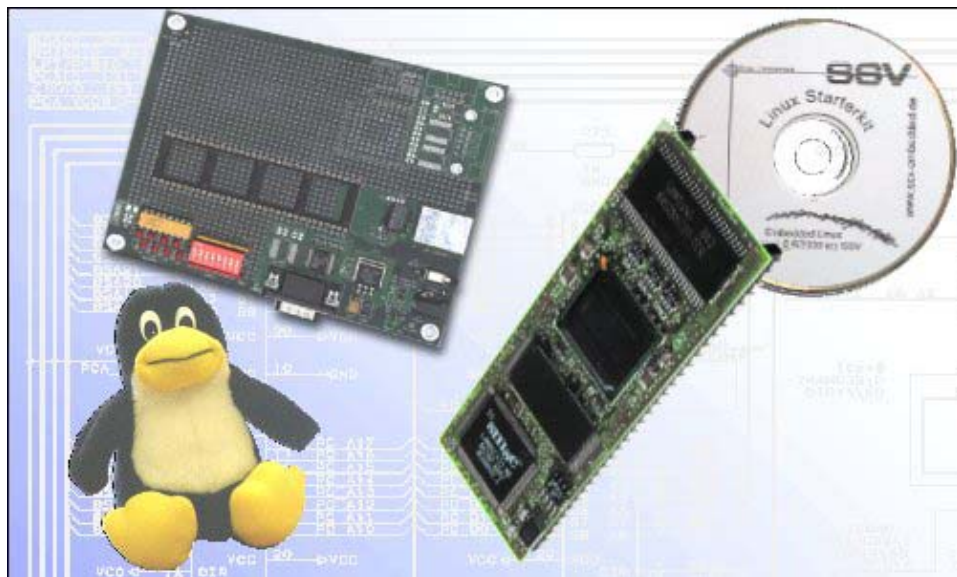


## DNP/2110 Linux Starter Kit: First Steps

The DIL/NetPC DNP/2110 starter kit contains everything you need to get started with your Intel PXA255 Xscale-based embedded networking application. The starter kit includes a DNP/2110 module with a pre-installed *U-Boot* boot loader and an embedded Linux, the evaluation board DNP/EVA2-SV (special version without ST16C2550 dual UART and the UART support chips – the DNP/EVA2 without additional UARTs is the DNP/EVA1 successor), power supply, serial interface (null modem) cable, a CD-ROM with software and documentation and a printed user manual for the first steps with the starter kit.



**Figure 1:** The DIL/NetPC DNP/2110 Linux Starter Kit

The starter kit CD-ROM comes with a full GNU cross tool chain for C/C++ software development. The binary files of this pre-build tool chain runs on a x86 Linux-based host (SuSE, Red Hat or other) and builds executable files for the Intel PXA255 Xscale 32-bit RISC microcontroller.

For using the DIL/NetPC DNP/2110 Embedded Linux Starter Kit you need a development system. The minimal configuration for this system is a Windows-based PC with the *HyperTerminal* terminal emulation program and a free COM port (COM1, COM2 or USB-based COMx) for the RS232 serial link between the DIL/NetPC DNP/2110 and HyperTerminal.

For using the Ethernet link, your PC needs an Ethernet adapter with 10 Mbps or 10/100 Mbps LAN interface. This environment allows web server programming (HTML pages, Java Applets) and Linux shell script programming. For using the GNU C/C++ cross tool chain, it is necessary to run Linux on the development system.

## The DNP/2110 Embedded Linux Starter Kit Key Features

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The DIL/NetPC DNP/2110 comes with a pre-installed U-Boot boot loader and an embedded Linux operating system. The DNP/2110 Linux consists of two main components: 1. the Linux kernel and 2. the root file system.

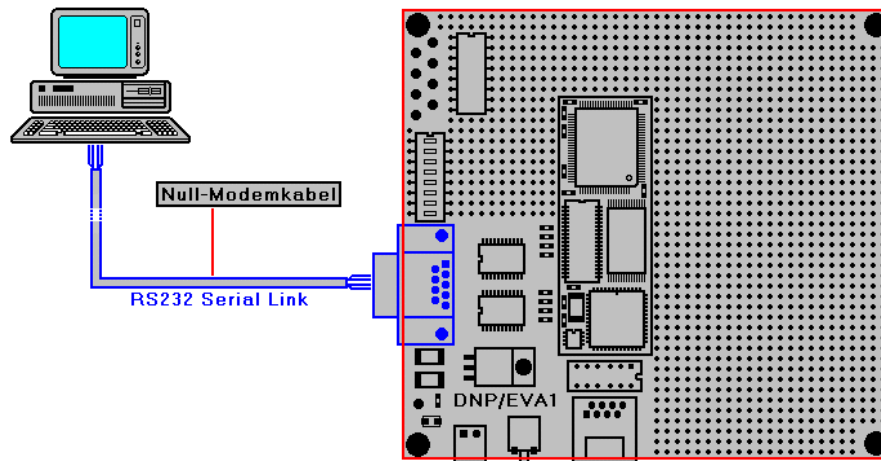
The DNP/2110 U-Boot boot loader allows the downloading of new Linux kernel versions and root file systems to the DNP/2110 RAM and Flash. This in-system programming feature can be used by a simple serial and Ethernet link between the development system and the DNP/2110.

- DIL/NetPC DNP/2110 with Intel 400 MHz PXA255, 16 Mbytes Flash and 16 SDRAM, 3.3 VDC Vcc
- U-Boot Boot Loader and Embedded Linux pre-installed in Flash memory
- Evaluation Board DNP/EVA2-SV (Special Version)
- Null modem Cable
- 110 VAC or 230 VAC to 5 VDC International Power Supply
- CD-ROM with User Manual and Hardware/Programmers Manuals
- Embedded Linux with Source
- GNU Cross Tool Chain for C/C++ Software Development for Linux-based PCs
- GNU *gdb* and *gdbserver* for Ethernet-based Remote Debugging
- Linux Remote Login with Telnet
- Web Server Setup Sample
- FTP Server Setup Sample
- Many Source Code Samples

## 1. Step: Cable for the Serial Link between the DNP/2110 and a PC

---

Set-up the serial link between the DIL/NetPC DNP/2110 Evaluation Board and your PC. Use a Null modem cable for this connection.

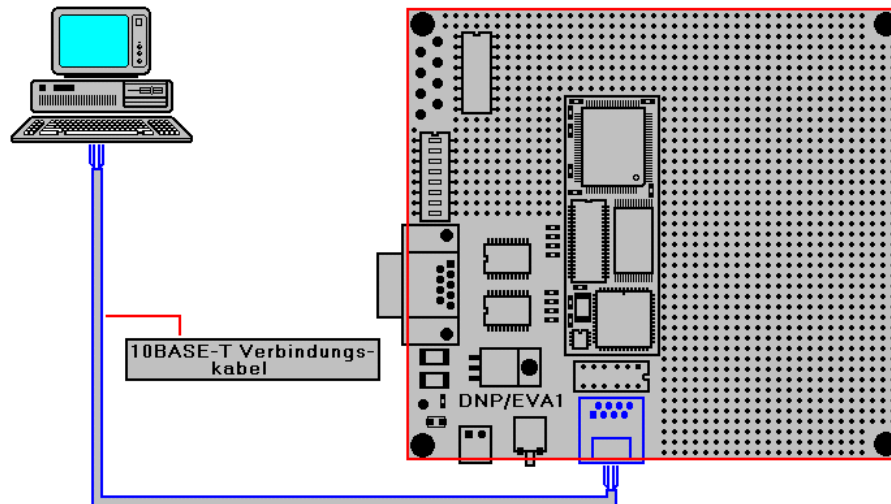


**Figure 2:** Serial Link between the DIL/NetPC Evaluation Board and the PC

Connect one end of the Null modem cable with a unused COM port of your PC. Make sure, that this PC COM port supports 115.200 bps.

## 2. Step: Cable for the Ethernet Link between the DNP/2110 and a PC

Set-up the Ethernet LAN link between the DIL/NetPC DNP/2110 Evaluation Board and your PC. Use an Ethernet cross-over cable for the first LAN connection.



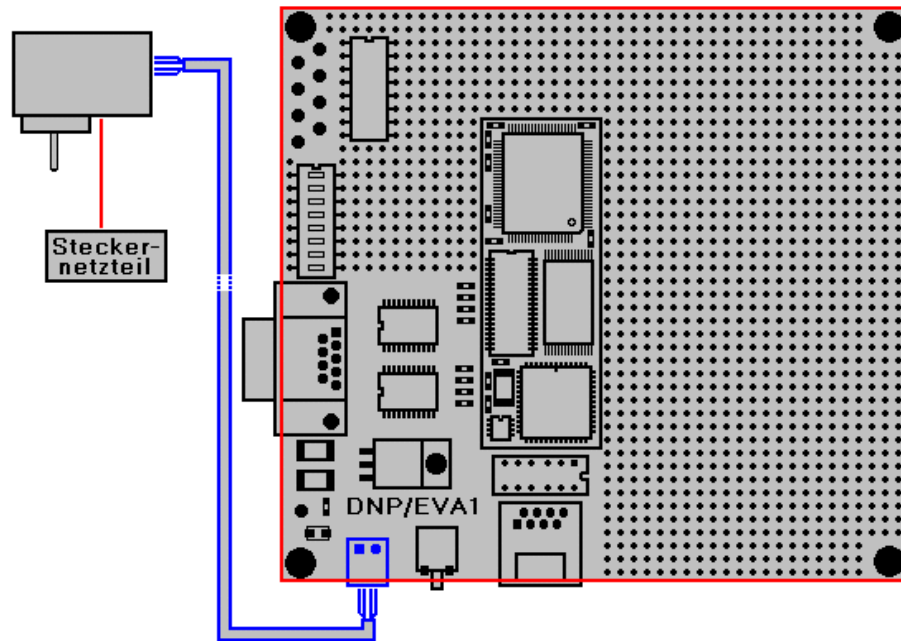
**Figure 3:** Ethernet Link between the DIL/NetPC Evaluation Board and the PC

**Please note:** The DNP/2110 comes with a default IP address of 192.168.0.126. Please make sure that your PC can work with the IP address range 192.168.0.x.

### 3. Step: Connect the Power Supply and Power-up the Starter Kit

---

Connect a 5 VDC power supply to DIL/NetPC Evaluation Board. Make sure, that the + voltage is within the center of power supply connector.



**Figure 4:** Power Supply for the DIL/NetPC Evaluation Board

**Please note:** Make sure, that all cable connections are OK. Then power-up the starter kit.

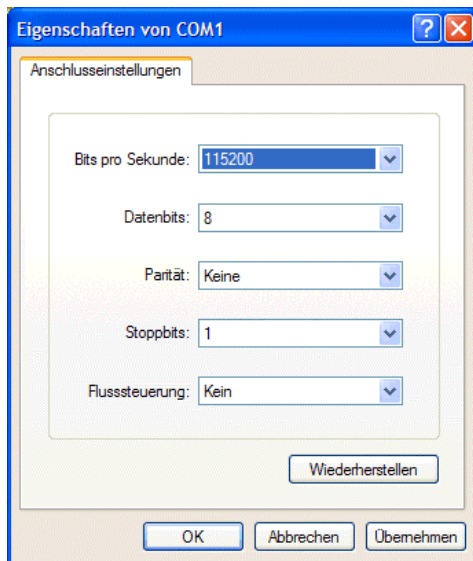
## 4. Step: Using the Serial Link with a Terminal Program

Run *HyperTerminal* on your Windows-PC, *minicom* or a similar simple terminal emulation program on your Linux-based PC.



**Figure 5:** Direct Connection Set-up with *HyperTerminal*

Set-up a direct connection with the parameters of Table 1. Make sure, that the PC COM port supports 115.200 bps.



**Figure 6:** Parameter Set-up with *HyperTerminal*

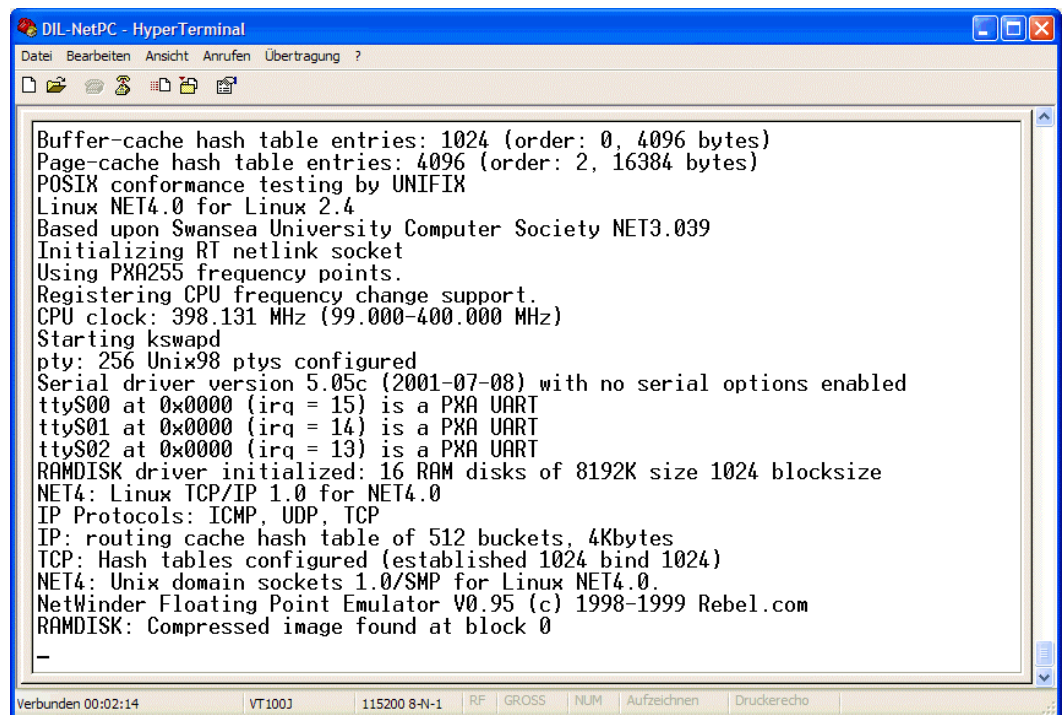
Parameter	Value
Speed	115.200 bps
Data Bits	8
Parity	None
Stop Bits	1
Protocol	No (Xon/Xoff, RTS/CTS or similar)

**Table 1:** Set-up Parameters for the Serial Link

## 5. Step: Power-up the DNP/2110 without RCM Jumper (RCM disabled)

Direct after power-up the DIL/NetPC DNP/2110 starts a automatic boot process from the on-board flash memory chip. This process consist of two steps:

1. Direct after power-up, the DNP/2110 runs the U-Boot boot loader program for some milliseconds. U-Boot initializes the hardware components (hardware init). **With RCM disabled** (please see the *DIL/NetPC DNP/2110 Hardware Reference Manual* for details), there is no U-Boot text message output over the DNP/2110 COM1 serial interface and no **bootdelay**-based<sup>1</sup> wait period. Direct after the hardware init, the U-Boot boot loader starts the Linux O/S image.
2. Linux takes control over the DIL/NetPC DNP/2110 hardware and runs all necessary processes for coming up to live.



```

Buffer-cache hash table entries: 1024 (order: 0, 4096 bytes)
Page-cache hash table entries: 4096 (order: 2, 16384 bytes)
POSIX conformance testing by UNIFIX
Linux NET4.0 for Linux 2.4
Based upon Swansea University Computer Society NET3.039
Initializing RT netlink socket
Using PXA255 frequency points.
Registering CPU frequency change support.
CPU clock: 398.131 MHz (99.000-400.000 MHz)
Starting kswapd
pty: 256 Unix98 ptys configured
Serial driver version 5.05c (2001-07-08) with no serial options enabled
ttyS00 at 0x0000 (irq = 15) is a PXA UART
ttyS01 at 0x0000 (irq = 14) is a PXA UART
ttyS02 at 0x0000 (irq = 13) is a PXA UART
RAMDISK driver initialized: 16 RAM disks of 8192K size 1024 blocksize
NET4: Linux TCP/IP 1.0 for NET4.0
IP Protocols: ICMP, UDP, TCP
IP: routing cache hash table of 512 buckets, 4Kbytes
TCP: Hash tables configured (established 1024 bind 1024)
NET4: Unix domain sockets 1.0/SMP for Linux NET4.0
NetWinder Floating Point Emulator V0.95 (c) 1998-1999 Rebel.com
RAMDISK: Compressed image found at block 0
-

```

**Figure 7:** Watch the Linux booting process with *HyperTerminal*

**Please note:** The U-Boot environment variable **bootdelay** doesn't influence the DNP/2110 boot process with RCM (Remote Console Mode) disabled.

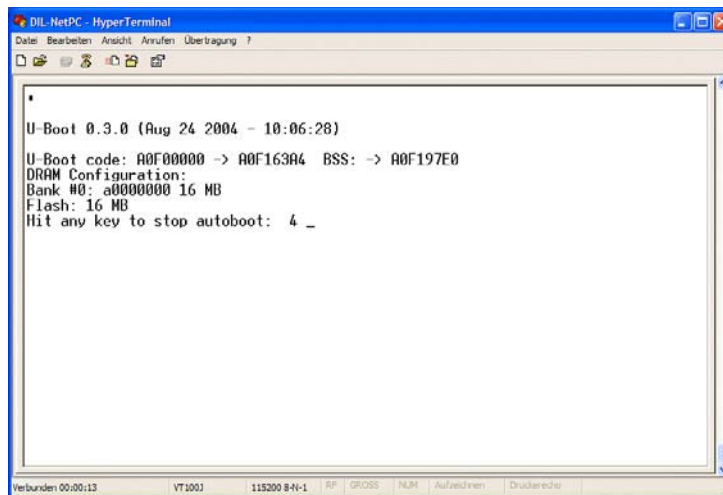
The DNP/2110 Linux supports a serial console. It allows running a Linux-based system in a headless configuration without a monitor or keyboard. Wait until the Linux boot process finish's. Then enter the user name **root**. This user name needs no password. Just hit the Enter key if the DNP/2110 Linux ask for a password.

<sup>1</sup> "**bootdelay**" is a U-Boot environment variable. The value defines a wait time before U-Boot starts the Linux operating system.

## 6. Step: Power-up the DNP/2110 with RCM Jumper (RCM enabled)

The DIL/NetPC DNP/2110 boot sequence with RCM enabled is similar to the boot procedure with RCM disabled. Only the first step is different:

1. The DNP/2110 runs the U-Boot boot loader program. This software shows a wait message over the DNP/2110 COM1 serial interface if **RCM is enabled** (please see the *DIL/NetPC DNP/2110 Hardware Reference Manual* for details). It is possible to interrupt the boot process and switch to the U-Boot command line interface. Just hit a key of your terminal emulation program.
2. Without interruption the U-Boot boot loader starts a Linux O/S image after the wait period from the DNP/2110 flash memory.



```

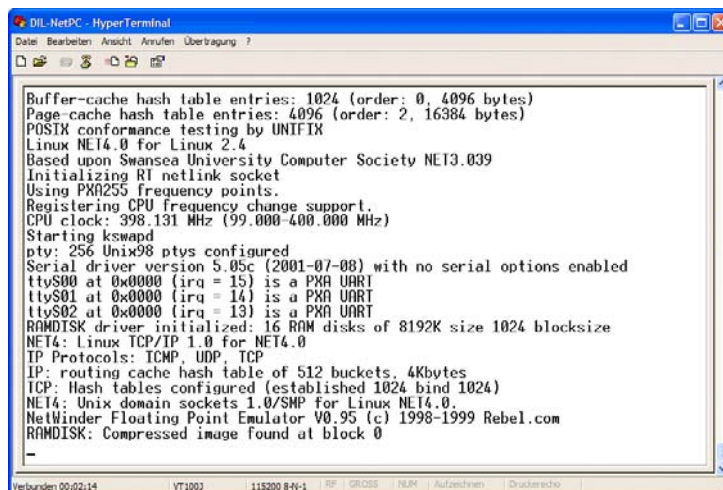
U-Boot 0.3.0 (Aug 24 2004 - 10:06:28)

U-Boot code: A0F00000 -> A0F163A4 BSS: -> A0F197E0
DRAM Configuration:
Bank #0: a0000000 16 MB
Flash: 16 MB
Hit any key to stop autoboot: 4 _

```

**Figure 8:** U-Boot wait message

**Please note:** The U-Boot command line interface allows you to change the wait time of the first step. Please see the U-Boot environment variable **bootdelay** for details.



```

Buffer-cache hash table entries: 1024 (order: 0, 4096 bytes)
Page-cache hash table entries: 4096 (order: 2, 16384 bytes)
POSTIX conformance testing by UNIFIX
Linux NET4.0 for Linux 2.4
Based upon Swansea University Computer Society NET3.039
Initializing RI netlink socket
Using PX0255 frequency points.
Registering CPU frequency change support.
CPU clock: 398.131 MHz (99.000-400.000 MHz)
Starting kswapd
pty: 256 Unix98 ptys configured
Serial driver version 5.05c (2001-07-08) with no serial options enabled
ttyS00 at 0x0000 (irq = 15) is a PXA UART
ttyS01 at 0x0000 (irq = 14) is a PXA UART
ttyS02 at 0x0000 (irq = 13) is a PXA UART
RAMDISK driver initialized: 16 RAM disks of 8192K size 1024 blocksize
NET4: Linux TCP/IP 1.0 for NET4.0
IP Protocols: ICMP, UDP, TCP
IP: routing cache hash table of 512 buckets, 4Kbytes
TCP: Hash tables configured (established 1024 bind 1024)
NET4: Unix domain sockets 1.0/SMP for Linux NET4.0.
NetWinder Floating Point Emulator V0.95 (c) 1998-1999 Rebel.com
RAMDISK: Compressed image found at block 0
-

```

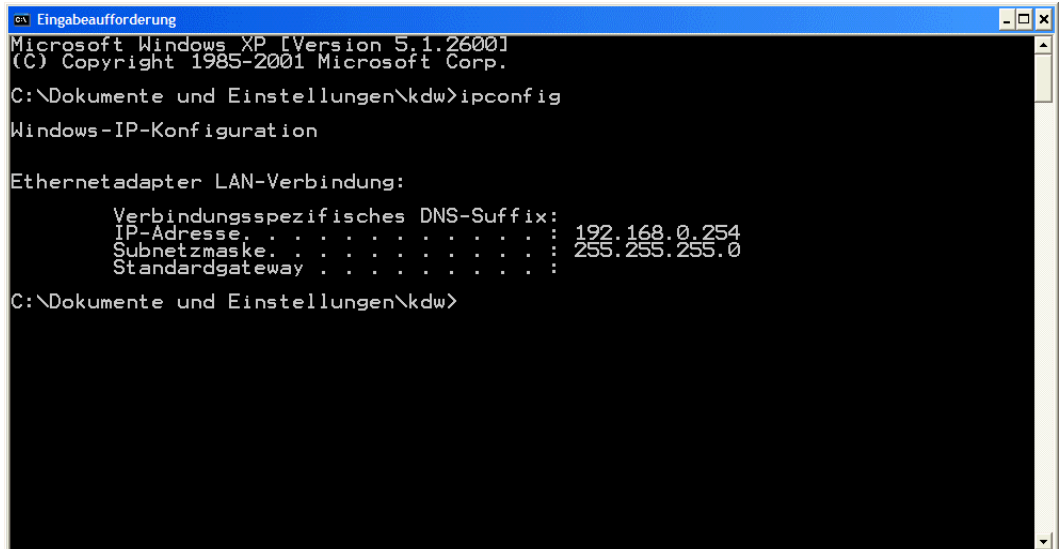
**Figure 9:** Linux booting process after the U-Boot boot delay



## 7. Step: Check the IP Address of your PC

---

Make sure that your PC is using the right IP address for the Ethernet-based TCP/IP communication with the DIL/NetPC. Use 192.168.0.1 or 192.168.0.254 for your PC and 192.168.0.126 for the DNP/2110.



```
Eingabeaufforderung
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
C:\Dokumente und Einstellungen\kdw>ipconfig

Windows-IP-Konfiguration

Ethernetadapter LAN-Verbindung:

    Verbindungsspezifisches DNS-Suffix:
    IP-Adresse. . . . . : 192.168.0.254
    Subnetzmaske. . . . . : 255.255.255.0
    Standardgateway . . . . . :

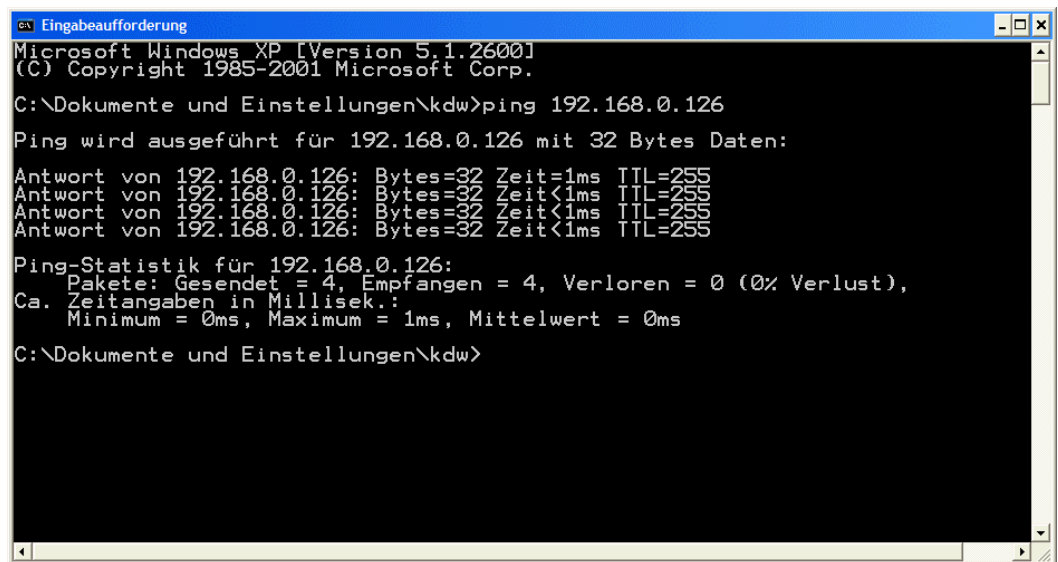
C:\Dokumente und Einstellungen\kdw>
```

**Figure 10:** Windows-PC IP address check with *ipconfig*

Talk to your network administrator if you have problems with the IP address understanding.

## 8. Step: Check the Ethernet-based TCP/IP Communication

Check the Ethernet-based TCP/IP communication between the DNP/2110 and the PC with a simple *ping* command.



```
Eingabeaufforderung
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Dokumente und Einstellungen\kdw>ping 192.168.0.126

Ping wird ausgeführt für 192.168.0.126 mit 32 Bytes Daten:

Antwort von 192.168.0.126: Bytes=32 Zeit=1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255
Antwort von 192.168.0.126: Bytes=32 Zeit<1ms TTL=255

Ping-Statistik für 192.168.0.126:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0 (0% Verlust),
Ca. Zeitangaben in Millisek.:
    Minimum = 0ms, Maximum = 1ms, Mittelwert = 0ms

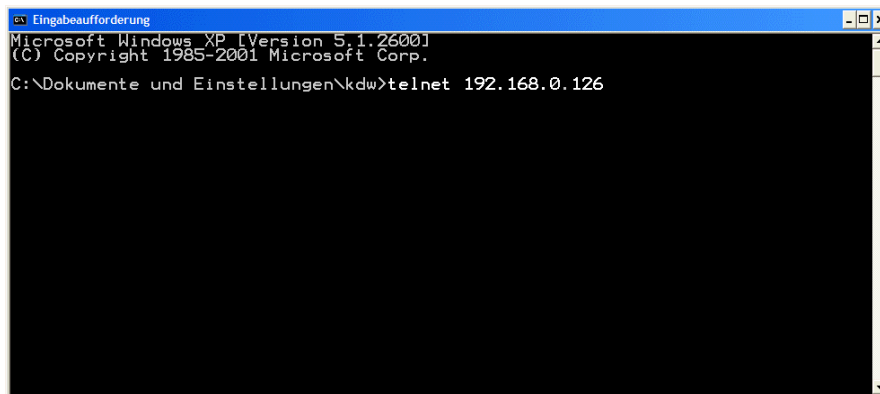
C:\Dokumente und Einstellungen\kdw>
```

**Figure 11:** Windows-PC TCP/IP communication check with *ping*

First check the cable connections and then the IP addresses if your *ping* doesn't work.

## 9. Step: Using a Telnet Connection

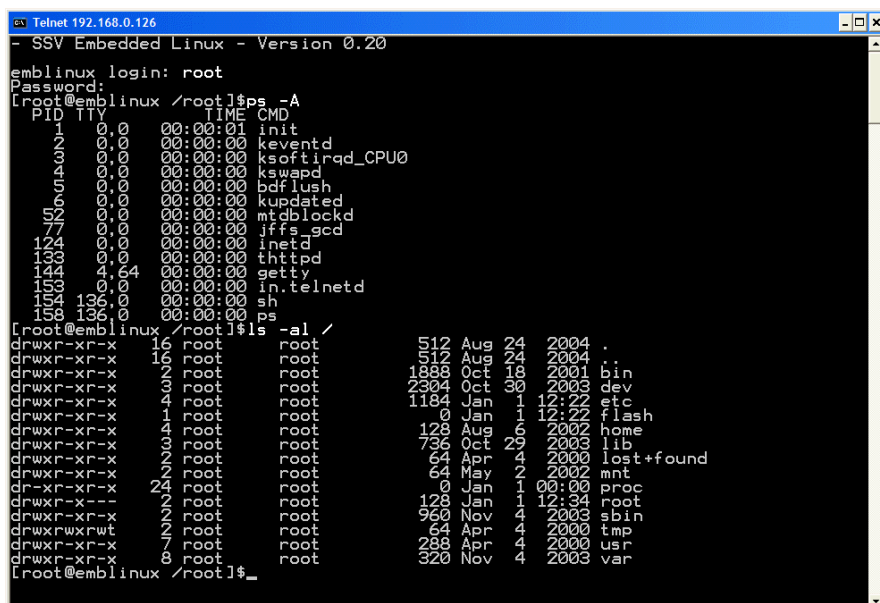
Run a Telnet client program on your PC with the IP address of the DNP/2110. You can use a Telnet session for remote entering Linux commands.



**Figure 12:** Run the Windows telnet client program

Wait until the DNP/2110 Linux ask you for a user name. Please enter the user name **root**. This user name needs no password. Just hit the Enter key if the DNP/2110 Linux ask for a password.

**Please note:** The DNP/2110 Linux comes with *BusyBox*. All Linux command lines commands are implemented in *BusyBox*. *BusyBox* combines tiny versions of many common UNIX utilities into a single small executable. It provides replacements for most of the utilities you usually find in GNU *fileutils*, *shellutils*, etc. The utilities in *BusyBox* generally have fewer options than their full-featured GNU cousins; however, the options that are included provide the expected functionality and behave very much like their GNU counterparts. *BusyBox* provides a fairly complete environment for any small or embedded system.



**Figure 13:** Using Linux commands within a Telnet client window

## 10. Step: Check the DNP/2110 Embedded Web server

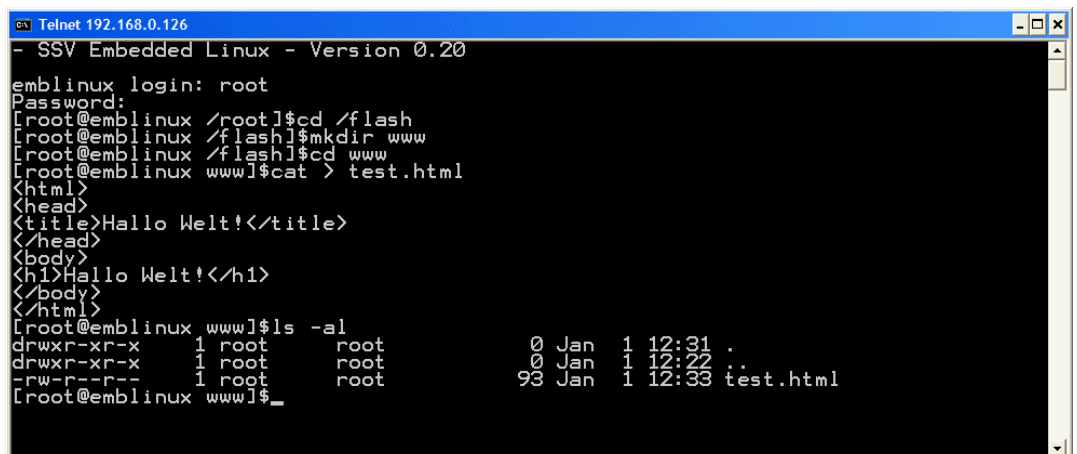
The DIL/NetPC DNP/2110 default Linux configuration comes with a pre-installed embedded Web server. The object storage space (HTML pages, pictures, CGI programs, Java Applets, ...) for this Web server is located within the DIL/NetPC DNP/2110 flash memory.

Setup a Telnet session with root user rights from your PC to the DIL/NetPC DNP/2110 (see “9. Step: Using a Telnet Connection” if necessary). Enter the following command lines within this Telnet session:

```
cd /flash
mkdir www
cd www
cat > test.html
<html>
<head>
<title>Hallo Welt!</title>
</head>
<body>
<h1>Hallo Welt!</h1>
</body>
</html>
```

CTRL-D (*CTRL-D stops the Linux cat command*)

This command lines create a HTML file `/flash/www/test.html` within the DIL/NetPC DNP/2110 flash memory with the German version of “Hello World”.



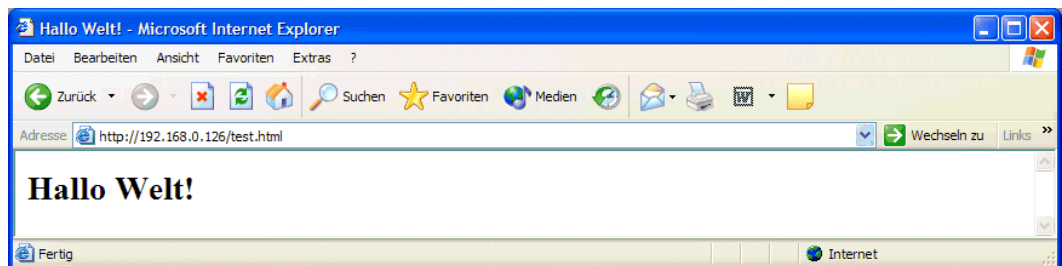
```

Telnet 192.168.0.126
- SSV Embedded Linux - Version 0.20
emblinux login: root
Password:
[root@emblinux /root]#cd /flash
[root@emblinux /flash]#mkdir www
[root@emblinux /flash]#cd www
[root@emblinux www]#cat > test.html
<html>
<head>
<title>Hallo Welt!</title>
</head>
<body>
<h1>Hallo Welt!</h1>
</body>
</html>
[root@emblinux www]#ls -al
drwxr-xr-x  1 root  root    0 Jan  1 12:31 .
drwxr-xr-x  1 root  root    0 Jan  1 12:22 ..
-rw-r--r--  1 root  root   93 Jan  1 12:33 test.html
[root@emblinux www]#_

```

**Figure 14:** Create a HTML file within a Telnet session

Run your PC Web browser and access the HTML file `test.html` with your browser. Use the URL `http://192.168.0.126/test.html`. This URL assumes, that your DNP/2110 is using the IP address 192.168.0.126 for the Ethernet LAN interface LAN1. Change this IP address if necessary.



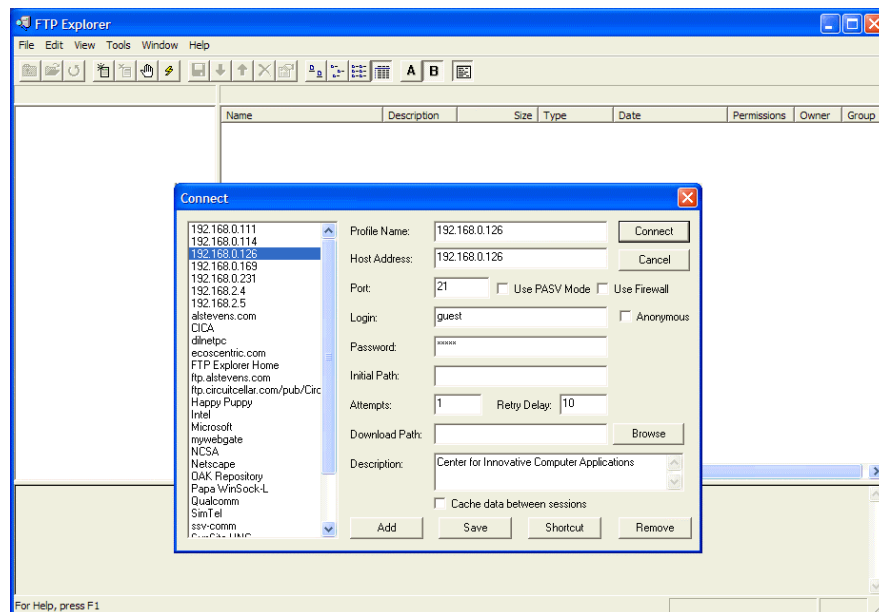
**Figure 15:** Check the Embedded Webserver with *Internet Explorer*

**Please note:** `/flash/www` is the default directory for the DNP/2110 embedded Web server. Please restart the DNP/2110 Linux after the creation of `/flash/www/test.html` and before the first access with a Web browser. The DNP/2110 embedded Web server look out for `/flash/www` at boot time. If this the directory `/flash/www` at boot time does not exist, the DIL/NetPC DNP/2110 embedded Web server works with the RAM disk-based directory `/usr/local/www`.

## 11. Step: Check the DNP/2110 FTP server

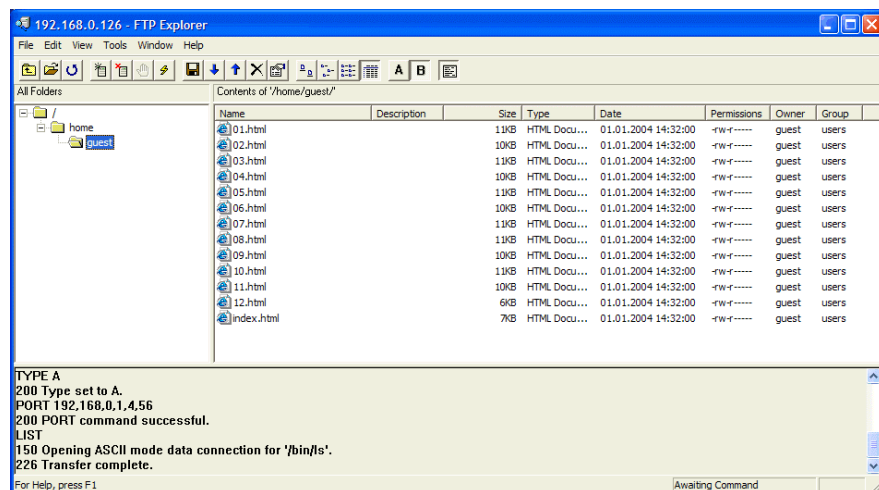
The DIL/NetPC DNP/2110 Linux comes with a pre-installed FTP server. This server allows the file transfer between a PC and the DNP/2110.

Run a FTP client program on your PC system. Set the session parameters for your FTP client to “IP address: **192.168.0.126**, user name: **guest**, password **guest**”. The DNP/2110 default directory for the FTP user name guest is **/home/guest**. This directory is located within the DNP/2110 RAM disk.



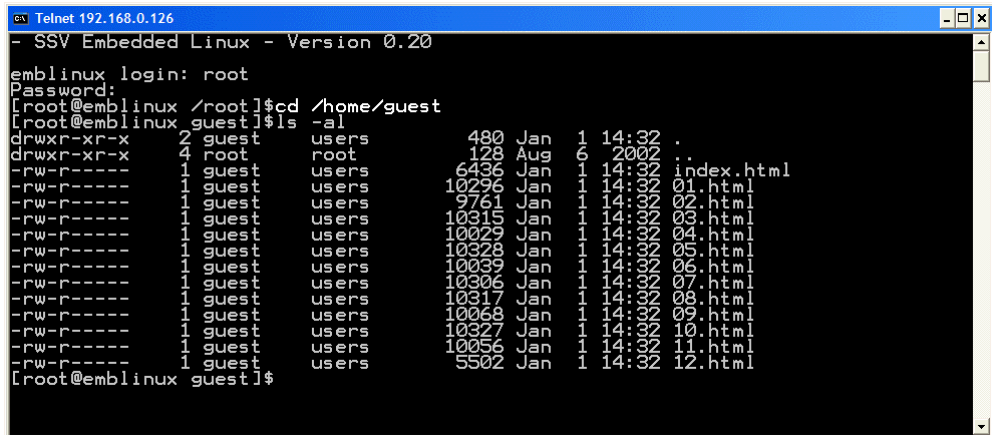
**Figure 16:** Set the session parameters for a FTP client program

Connect your FTP client with the DIL/NetPC DNP/2110 FTP server. Please watch the DNP/2110 default FTP directory. Transfer some files from your PC to the DIL/NetPC DNP/2110. The DNP/2110 stores this files in the DNP/2110 default FTP directory.



**Figure 17:** Transfer some files to the DNP/2110

Check the new files with a Telnet session. Move to the DNP/2110 default FTP directory `/home/guest` within your Telnet session.



```
emlinux login: root
Password:
[Root@emlinux /root]$cd /home/guest
[Root@emlinux guest]$ls -al
drwxr-xr-x  2 guest  users      480 Jan  1 14:32 .
drwxr-xr-x  4 root   root       128 Aug  6 20:02 ..
-rw-r----- 1 guest  users     6436 Jan  1 14:32 index.html
-rw-r----- 1 guest  users    10296 Jan  1 14:32 01.html
-rw-r----- 1 guest  users     9761 Jan  1 14:32 02.html
-rw-r----- 1 guest  users    10315 Jan  1 14:32 03.html
-rw-r----- 1 guest  users    10029 Jan  1 14:32 04.html
-rw-r----- 1 guest  users    10328 Jan  1 14:32 05.html
-rw-r----- 1 guest  users    10039 Jan  1 14:32 06.html
-rw-r----- 1 guest  users    10306 Jan  1 14:32 07.html
-rw-r----- 1 guest  users    10317 Jan  1 14:32 08.html
-rw-r----- 1 guest  users    10068 Jan  1 14:32 09.html
-rw-r----- 1 guest  users    10327 Jan  1 14:32 10.html
-rw-r----- 1 guest  users    10056 Jan  1 14:32 11.html
-rw-r----- 1 guest  users     5502 Jan  1 14:32 12.html
[Root@emlinux guest]$
```

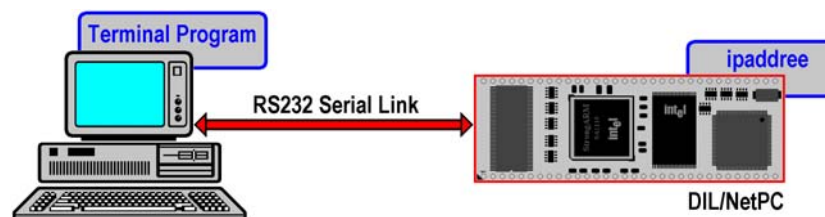
**Figure 18:** The new files within `/home/guest`

## 12. Step: Change the DNP/2110 Factory-Set IP Address (ipaddree usage)

Every device connected to an IP network must have a unique IP address. This address is used to reference the specific unit.

The DIL/NetPC DNP/2110 is automatically assigned an IP address on DHCP-enabled networks as it is DHCP-enabled by default. If DHCP doesn't work (i.e. no DHCP server available), the DNP/2110 takes a default IP address.

The factory-set value for this default IP address is **192.168.0.126**. The network mask for this address is **255.255.255.0**. You can change this IP address over a RS232-based serial link with the help of program, called **ipaddree**.

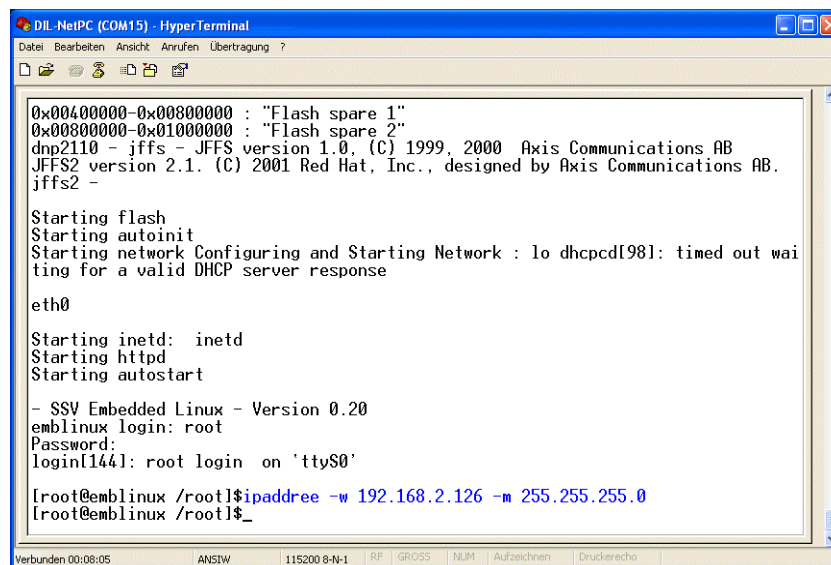


**Figure 19:** Environment for `ipaddree` usage

Use a serial console and enter the user name **root**. This user name needs no password. Just hit the Enter key if the DNP/2110 Linux ask for a password. Then execute the following command:

```
ipaddree -w 192.168.2.126 -m 255.255.255.0
```

“ipaddree” is the name of a command-line IP setup tool. “192.168.2.126” is a IP address. Use the IP address of your choice for your set-up on this position. “255.255.255.0” is a network mask. Use a valid network mask for your IP address.



```
DIL-NetPC (COM15) - HyperTerminal
Datei Bearbeiten Ansicht Anrufen Übertragung ?
0x00400000-0x00800000 : "Flash spare 1"
0x00800000-0x01000000 : "Flash spare 2"
dnp2110 - jffs - JFFS version 1.0, (C) 1999, 2000 Axis Communications AB
JFFS2 version 2.1. (C) 2001 Red Hat, Inc., designed by Axis Communications AB.
jffs2 -
Starting flash
Starting autoinit
Starting network Configuring and Starting Network : lo dhcpcd[98]: timed out waiting for a valid DHCP server response
eth0
Starting inetd: inetd
Starting httpd
Starting autostart
- SSV Embedded Linux - Version 0.20
emblinux login: root
Password:
login[144]: root login on 'ttyS0'
[root@emblinux /root]$ipaddree -w 192.168.2.126 -m 255.255.255.0
[root@emblinux /root]$_
```

**Figure 20:** Serial console with `ipaddree` command line



Reboot the DNP/2110. The new IP address and network mask is valid after the next boot process if no DHCP server available or if DHCP doesn't work. Check the new IP address with a *ping*.



```
Eingabeaufforderung
C:\>ping 192.168.2.126
Ping wird ausgeführt für 192.168.2.126 mit 32 Bytes Daten:
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Antwort von 192.168.2.126: Bytes=32 Zeit<1ms TTL=64
Ping-Statistik für 192.168.2.126:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0 (0% Verlust),
    Ca. Zeitangaben in Millisek.:
        Minimum = 0ms, Maximum = 0ms, Mittelwert = 0ms
C:\>
```

**Figure 21:** Check the new IP address with *ping*

**Please note:** Don't forget to change the IP address of your PC to 192.168.2.1 or similar.

## Appendix 1: U-Boot Boot Loader Command Overview

The user interface to U-Boot consists of a command line interpreter (CLI), much like a Linux shell prompt. When connected via a serial line you can interactively enter commands and see the results. The following table shows the available U-Boot commands for the DIL/NetPC DNP/2110.

Command	Function
autoscr	run script from memory
base	print or set address offset
bdinfo	print Board Info structure
bootm	boot application image from memory
bootp	boot image via network using BootP/TFTP protocol
bootd	boot default, i.e., run 'bootcmd'
cmp	memory compare
cp	memory copy
crc32	checksum calculation
echo	echo args to console
erase	erase FLASH memory
flinfo	print FLASH memory information
go	start application at address 'addr'
help	print online help
iminfo	print header information for application image
loadb	load binary file over serial line (kermit mode)
loadc	load binary file over serial line (ymodem-c mode)
loadg	load binary file over serial line (ymodem-g mode)
loads	load S-Record file over serial line
loop	infinite loop on address range
md	memory display
mm	memory modify (auto-incrementing)
mtest	simple RAM test
mw	memory write (fill)
nm	memory modify (constant address)
printenv	print environment variables
protect	enable or disable FLASH write protection
rarpboot	boot image via network using RARP/TFTP protocol
reset	perform RESET of the CPU
run	run commands in an environment variable
saveenv	save environment variables to persistent storage
setenv	set environment variables
sleep	delay execution for some time
tftpboot	boot image via network using TFTP protocol and env variables ipaddr and serverip
version	print monitor version
?	alias for 'help'

**Table 2:** U-Boot Command Overview

## Helpful Literature

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Intel PXA255 Processor: Developer's Manual (Intel Order Number 278693-001)  
Intel PXA255 Processor: Data Sheet (Intel Order Number 278780)  
Intel PXA255 Processor: User's Manual (Intel Order Number 278796)  
DIL/NetPC DNP/2110 Hardware Reference Manual (SSV Starter Kit Item)

## Contact

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## Notes to this Document (DNPSK17-FirstStepsE.Doc)

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1.00	15.12.2004	First Version	KDW

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