phyCORE®-XScale/PXA270 Development Kit
(KPCM-027)
Loading a Linux Image (demo.img)

This Application Note provides instructions on how to start-up the phyCORE-PXA270, download U-Boot to the phyCORE-PXA270 and download a Linux image via TFTP server.

Please refer to the phyCORE-PXA270 and Development Board for phyCORE-PXA270 Hardware Manual for specific information on such board-level features as jumper configuration, memory mapping, and pinout.

The included Linux image (demo.img) was created using SYSGO ElinOS tools. This demo includes support for:

- MMC
- LCD Display
- Network (a web-server)
- USB Keyboard, Mouse, Memory-Stick
- IDE CF and Harddisk
- Realtime clock
- JFFS2 Filesystem
- sound (you can connect active loadspeakers to line out )

Please refer to the SYSGO ElinOS manual for more details regarding the included Linux image or for building a new image. demo.img is meant for demonstration purposes only and may not suite all customer development needs.
1 System Description

1.1 Hardware Description

The following PHYTEC hardware components are included in the phyCORE-PXA270 Basic Development Kit (part # KPCM-027-BASIC) and are necessary for completing the instructions in this application note:

- phyCORE-PXA270 (part # PCM-027-251EXMR)
- Development Board for phyCORE-PXA270 (PCM-990-P3)
- Interface Expansion Board (PCM-985)
- AC adapter supplying 12 VDC, 3.3A, center positive
- RS-232 null-modem cable
- cross-over Ethernet cable

1.2 System Requirements for loading Linux Image

This Application Note for the phyCORE-PXA270 requires a Linux host PC, the use of a terminal program on the host-PC, such as Komport or Minicom for Linux, together with TFTP services.

1.3 System Requirements for Loading U-Boot

The bootloader used for downloading the Linux kernel is the Universal Bootloader U-Boot. The bootloader is pre-installed on the phyCORE-PXA270 and resides in the on-board Flash memory from address 0 to 0x40000. If U-Boot needs to be re-installed (see section 2.2, “Downloading U-Boot”), a Windows based PC is required to use the Jflash utility for programming the phyCORE-PXA270.

A description of this Bootloader can be found at:
http://sourceforge.net/projects/u-boot/

1: You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA270 hardware and the host-PC.
2 Getting Started

Note: If the Bootloader is pre-installed on the phyCORE-PXA270, skip to section 2.3 and 2.4 for loading a Linux image.

2.1 Interfacing the phyCORE-PXA270 to a Windows Host-PC

- Copy the folder pC-PXA270 from the included Tools CD to the root of your PC.
- Connect the JTAG adapter's 20-pin flat-band cable to the pin connector X29 on the Development Board. Please make sure that pin 1 on the connector mates with pin 1 (which is marked red) on the cable.
- Connect the JTAG adapter to the LPT interface on your PC using a parallel cable.
- Connect the included 12 VDC power adapter to the power socket X1 on the Development Board.
- Connect the included RS-232 null-modem cable to an available COM port on your Windows PC and DB-9 (P1) of the phyCORE development board.
- Create a new HyperTerminal session, indicate the correct COM setting for your system and set the parameters as follows: Bits per second = 115200; Data bits = 8; Parity = None; Stop bits = 1; Flow control = None.
2.2 Downloading U-Boot

- Use the Windows Start button to open the Microsoft MS Command Prompt: `Start/Programs/Accessories/Command Prompt`.

- The following window should appear:

![Command Prompt window](image)

- Change directory to the location of `jflash` folder.
Start the Jflash program, which will load U-Boot, by typing `prog` at the command prompt and then pressing <Enter>. The `prog` batch file contains all the necessary command line options and the U-Boot file name. 

For all phyCORE-PXA270 units shipped prior to March 2006 the U-Boot file name was `u-boot.bin`. phyCORE-PXA270 SBC modules built in March 2006 or later are populated with an Intel J3 embedded Flash device and require use of a different U-Boot file. The file name has been changed to `u-boot_270_J3D.bin`. Make sure the correct U-Boot file name is used in the `prog.bat` file.

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• The batch file will invoke the **Jflash** program and show hardware recognition within the MS Command Prompt window. Please check to make sure that the **ACT** (Actual) and **EXP** (Expected) values of the recognized PXA270 device are the same and then press <Enter>.

![Command Prompt window](image1.png)

• After pressing <Enter>, the **PXA27x revision ??** should invoke in the MS Command Prompt window as below.

![Command Prompt window](image2.png)

• Press <Enter> again.

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• Upon successful download of the U-Boot, you should see the following errors. These errors may be caused by possible timing issues with the Jflash and may be ignored.

![Image of U-Boot command prompt]

The U-Boot utility has now been successfully downloaded and resides in the phyCORE-PXA270 on-board Flash memory from address 0 to 0x40000. Please verify that U-Boot executes correctly by viewing the serial output in the HyperTerminal window:
You are now ready to download the Linux demo image.

### 2.3 Interfacing the phyCORE-PXA270 to a Linux Host-PC

Downloading a Linux kernel over the Ethernet from a Linux host-PC to the phyCORE-PXA270/Development Board combination (also referred to as target hardware) requires use of a terminal program, such as Minicom or Komport, and the TFTP networking service installed and activated.

- Copy the Linux demo image `demo.img` from the included Tools CD to your TFTP directory on your Linux machine.
- Connect the included RS-232 null-modem cable to an available COM port on your Linux PC and DB-9 (P1) of the phyCORE Development Board.
- Connect the RJ-45 socket at X23 on the Development Board to the host-PC using a cross-over Ethernet cable\(^1\).
- Open your terminal program of choice.

\(^1\): You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA270 hardware and the host-PC.
• Configure the terminal program to 115200 baud, 8 data bits, no parity, 1 stop bit, no hardware handshake.

• Connect the included 12 VDC power adapter to the power socket X1 on the Development Board. In the terminal window, you will see U-Boot startup messages attempting to tftpboot over the network once power is applied to the target hardware.

U-Boot 1.1.3 (Jan 28 2006 – 17:27:52)

U-Boot code: A1FE0000 –> A2004B60 – BSS: –> A20394F0
RAM Configuration:
Bank #0: a0000000 64 MB
Flash: 32 MB
Hit any key to stop autoboot: 3

• Hit any key to stop tftpboot autoboot, as the environment settings for the target hardware must first be configured.
2.4 Downloading a Linux Image

- After stopping the autoboot you should see the following in your Minicom window:

```
U-Boot 1.1.3 (Jan 28 2006 - 17:27:52)
U-Boot code: A1FE0000 -> A2004B60- BSS: -> A20394F0
RAM Configuration:
 Bank #0: a0000000  64 MB
 Flash: 32 MB
 Hit any key to stop autoboot:  0
PCM027>
```

- At the `PCM027>` command prompt, enter the following command to view the current environment variable settings:

```
PCM027> printenv
```

**Note:**
A complete list of currently supported U-Boot commands is displayed after entering "help" in the command line.

- Configure U-Boot environmental variables using the following commands:

  **Note:**
  Be sure to enter the IP address specific to your network. The values shown below are used as examples.

```
PCM027> setenv serverip 192.168.3.10
(IP address of your TFTP server)
PCM027> setenv ipaddr 192.168.3.11
(IP address of the module)
PCM027> setenv netmask 255.255.255.0
(net mask of the network system)
```
• Set the boot arguments to be passed to the Linux kernel by modifying the `bootargs` argument from the `bootargs.txt` file, located in the `Linux_Image` folder on the PHYTEC Tool-CD. The IP values must match the settings made in the previous step. Copy the entire `bootargs` variable from the `.txt` file. All arguments must be in one line before copying to be pasted into the terminal window.

```
bootargs devfs=mount mem=64M rw rootfstype=tmpfs
root=/dev/ram
ip=192.186.3.11:192.168.3.10:192.168.3.1:255.255.0.0::eth0:
   console=ttys0,115200n8
```

**Note:**
In order to ensure proper execution of this demo you must set the IP address for the phyCORE-PXA270, the netmask, and the gateway IP. The bootargs variable sets these values. The network setup for this example was:

- **IP** = 192.168.3.11,
- **netmask** = 255.255.255.0,
- **tftpserver** = 192.168.3.10,
- **gateway** = 192.168.3.1

• Enter `setenv` in the command prompt in the terminal window and paste the bootargs variable into the terminal window, as shown below.

```
PCM027> setenv bootargs devfs=mount mem=64M rw
   rootfstype=tmpfs root=/dev/ram
   ip=192.186.3.11:192.168.3.10:192.168.3.1:255.255.0.0::eth0:
      console=ttys0,115200n8
```

• Disable the autostart with the following command:

```
PCM027> setenv autostart no
```

• Save environment settings with the following command:

```
PCM027> saveenv
```
• Erase the flash with the following command
  
  **PCM027> erase 1:1-127**
  
  Erase Flash Sectors 1-127 in Bank # 1 Erasing sector 1 ... ok.
  Erasing sector 2 ... ok.
  Erasing sector 3 ... ok.
  Erasing sector 4 ... ok.
  Erasing sector 5 ... ok.
  ...
  Erasing sector 127 ... ok.

• Load the file `demo.img` from your tftp server into RAM at address a3000000:
  
  **PCM027> tftpboot a3000000 demo.img**
  
  Using MAC Address 00:50:C2:32:A1:20
  TFTP from server 192.168.3.10; our IP address is 192.168.3.11
  Filename 'demo.img'.
  Load address: 0xa3000000
  Loading: #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  #################################################
  done
  Bytes transferred = 4487814 (447a86 hex)

• Copy the demo image into the flash. This will take a couple minutes:
  
  **PCM027> cp.b a3000000 40000 450000**
  
  Copy to Flash... done
Set the environment variable `bootcmd` to copy image from flash at address 0x40000 with length 0x450000 into ram and boot from ram at 0xA3000000.

```
PCM027> setenv bootcmd cp.b 40000 a3000000 450000;bootm a3000000
```

Re-enable autostart

```
PCM027> setenv autostart yes
```

Saving Environment to EEPROM...

```
PCM027> saveenv
```

Print the environment variables to double-check your settings:

```
PCM027> printenv
```

Environment variables that appear in the terminal window should be similar as follows (`ipaddr` and `serverip` and are example values):

```
printenv
bootdelay=3
baudrate=115200
ethaddr=00:50:C2:48:55:A4
bootfile=uImage
bootcmd=cp.b 40000 a3000000 450000;bootm a3000000
bootargs=devfs=mount=mem=64M rw rootfstype=tmpfs
root=/dev/ram
ip=192.168.3.11:192.168.3.10:192.168.3.1:255.255.255.0::eth0:
console=ttyS0,115200n8
filesize=447a86
fileaddr=A3000000
netmask=255.255.0.0
ipaddr=192.168.3.11
serverip=192.168.3.10
autostart=yes
stdin=serial
stderr=lcd
stdout=serial

Environment size: 418/1020 bytes
PCM027>
```
Now you have successfully downloaded the kernel and file system over a tftp Ethernet connection into RAM, copied the Linux kernel and file system from RAM into Flash, and set the environment variables to automatically boot the kernel from Flash upon a reset.

- Reset the module with the following command:
  
  PCM027>Reset

- While U-boot is checking the image checksum you see the following:

  ## Booting image at a3000000 ...
  
  Image Name:   Multi-File Image
  Created:      2005-11-30  14:32:54 UTC
  Image Type:   ARM Linux Multi-File Image (gzip compressed)
  Data Size:    4487750 Bytes =  4.3 MB
  Load Address: a0008000
  Entry Point:  a0008000
  Contents:
  Image 0:   994819 Bytes = 971.5 kB
  Image 1:  3492918 Bytes =  3.3 MB
  Verifying Checksum ... OK
      Uncompressing Multi-File Image ... OK

  Starting kernel ...

  Caution!
  Don't use the "flash_eraseall" comand or any JFFS2 commands. If you do so, you will corrupt the "demo.img" inside the flash. If the demo.img is corrupted, you will get an DATA CRC error when U-boot is checking the image checksum. You will also see a checksum error if the image was not copied to the correct memory space.

- You should see the Linux image boot up in the Terminal window, this takes a couple minutes to complete. Please see a portion of the output below:

  Linux version 2.6.12.6-elinos-218 (kilb@obelix) (gccversion 3.4.4 (ELinOS V4.0 3.4.4-11 2005-10-23)) #1 Wed Nov 30 15:11:41 CET 2005
  .
  .
  .

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ELinOS Netconfig 4.0-14
=======================

Checking if network driver installed: found unconfigured interface eth0

Interface configuration
=======================
Enter an IP-Address for this machine [192.1.1.1]:

To begin the demo, you have to setup the IP address, the netmask, and the gateway IP.

- Enter the IP address of the phyCORE-PXA270 at the prompt and then y for yes as prompted, for our demo we use IP Address 192.168.3.11:

  Enter an IP-Address for this machine [192.1.1.1]:
  Your input was 192.168.3.11, is this ok (y/n)? [y] y

- Enter the netmask for the phyCORE-PXA270, for our demo we use 255.255.255.0 and then y for yes as prompted:

  Enter the netmask for this machine [255.255.255.0]:
  Your input was 255.255.255.0, is this ok (y/n)? [y] y

- Enter the default route for the phyCORE-PXA270, for this demo we use 192.168.3.1, and then y for yes as prompted.

  Enter the default route for this machine [192.168.3.1]:
  Your input was 192.168.3.1, is this ok (y/n)? [y] y
The web server should now execute and output the following to the Terminal window:

```
Executing </sbin/ifconfig eth0 192.168.3.11 netmask 255.255.255.0>...
eth0: link down
Executing </sbin/route add default gw 192.168.3.1>...
Netconfig done.
```

```
BusyBox v1.00 (2005.10.23-16:29+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.

%rdy000000
```

```
===================================================================
== Welcome to the Codeo Development Environment!                  ==
=====================================================================

===================================================================
== Welcome to the X Demo Project!                                  ==
== This demo provides a small X-Server, which directly operates on a framebuffer device. ==
== To start the demo application, please enter:                    ==
== # startx                                                        ==
== Note: Since there are no fonts installed with this demo, the application may complain about missing fonts. You can safely ignore these messages for this demo. ==
```

```
# eth0: link up, 100Mbps, full-duplex, lpa 0x41E1
```

**Note:**
At this time PHYTEC does not have an X-Server demo. You can connect to the webserver on the board via a webbrowser.
Open an Internet browser and enter the IP address of your phyCORE-PXA270. For this example we have used IP address **192.168.3.11**. You will see the Linux web server in the browser as below: