

## **phyCORE®-XScale/PXA255 Development Kit (KPCM-022) Loading a Linux Image**

This Application Note provides instructions on how to start-up the phyCORE-PXA255, mounted on the PHYTEC Development Board, and how to download a Linux kernel via FF-UART RS-232 serial connection from a Linux-based machine.

Please refer to the phyCORE-PXA255 and Development Board for phyCORE-PXA255 Hardware Manual for specific information on such board-level features as jumper configuration, memory mapping, and pinout.

### **1 System Description**

#### **1.1 Hardware Description**

The following hardware is necessary for start-up of the phyCORE-PXA255:

- phyCORE-PXA255 (part # PCM-022-200E)
- Development Board for phyCORE-PXA255 (PCM-990)
- Interface Expansion Board (PCM-985)
- AC adapter supplying 12 VDC, 3.3A, center positive
- RS-232 null-modem cable
- cross-over Ethernet cable<sup>1</sup>
- host-PC running Linux

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<sup>1</sup>: You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA255 hardware and the host-PC.

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All PHYTEC hardware components are included in the phyCORE-PXA255 Basic Development Kit (part # KPCM-022-200E-B).

## **1.2 Software Description and Requirements**

This Application Note for the phyCORE-PXA255 requires the use of a terminal program on the host-PC, such as Komport or Minicom for Linux, together with TFTP services.

The Bootloader used for downloading the Linux kernel is the **Universal Bootloader U-Boot**. The Bootloader is pre-installed on the phyCORE-PXA255 and resides in the on-board Flash memory from address 0 to 0x40000.

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

## 2 Getting Started

### 2.1 Interfacing the phyCORE-PXA255 to a Host-PC

Downloading a Linux kernel over the Ethernet from a Linux host-PC to the phyCORE-PXA255/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 folder *Linux* from the included Tools CD to the root of your Linux machine.
- Open your terminal program of choice.
- Specify the correct serial interface settings for your system.
- Configure the terminal program to 115200 baud, 8 data bits, no parity, 1 stop bit, no hardware handshake.
- Connect the included null modem cable from the serial port on your host-PC to P1 on the Development Board.
- Connect the RJ-45 socket at X23 on the Development Board to the Linux-based host-PC using a cross-over Ethernet cable<sup>1</sup>.
- 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.
- Hit any key to stop tftpboot autoboot, as the environment settings for the target hardware must first be configured.

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<sup>1</sup>: You may also use a straight Ethernet cable connected to a hub to establish network connection between the phyCORE-PXA255 hardware and the host-PC.

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## 2.2 Configuring Environmental Variables

- At the **PCM022>** command prompt, enter the following environment variable command to view current settings:

```
PCM022> printenv
```

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 TFTP server (Linux machine) and phyCORE-PXA255 module. The values shown below are used as examples.

```
PCM022> setenv serverip 192.168.3.10
```

(IP address of your TFTP server)

```
PCM022> setenv ipaddr 192.168.3.11
```

(IP address of the module)

```
PCM022> setenv netmask 255.255.255.0
```

(net mask of the network system)

The MAC address of the SMSC91111 Ethernet controller at U7 has not been programmed into the EEPROM on the module. The PXA255 will read the contents of the EEPROM as FF:FF:FF:FF:FF:FF. U-Boot will use the MAC address given by the environment variable **ethaddr**.

- Set the value of **ethaddr** to the MAC-ID address on the serial number sticker on phyCORE-PXA255 module (example values shown below):

```
PCM022> setenv ethaddr 00:50:C2:32:AE:92
```

- Set the boot arguments to be passed to the Linux kernel as described below. Copy and paste the **bootargs** argument from the *Bootargs.txt* file, located in the *Linux* folder on the PHYTEC Tool-CD, into the terminal. Example **ip** addresses shown, be sure to edit these numbers to match your settings, all arguments **must** be in one line:

```
setenv bootargs root=/dev/mtdblock2 rw
ip=192.168.3.11:192.168.3.10:192.168.3.11:255.255.255.0::eth0:
mem=64M console=ttyS0,115200n8 ide0=0xf6000000,0xf6000800
ide1=0xf7000000,0xf7000800
```

- Save environment settings with the following command:  
**PCM022> saveenv**
- Print the environment variables to double-check your settings:  
**PCM022> printenv**

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

```
bootdelay=3
baudrate=115200
ethaddr=00:50:C2:32:AE:9D
filesize = 1000000
netmask = 255.255.255.0
ipaddr = 192.168.3.11
serverip = 192.168.3.10
bootargs=root=/dev/mtdblock2 rw
ip=192.168.3.11:192.168.3.10:192.168.3.11:255.255.255.0::eth0:
mem=64M console=ttyS0,115200n8 ide0=0xf6000000,0xf6000800
ide1=0xf7000000,0xf7000800
stdin=serial
stdout=serial
stderr=serial
```

**Environment size: 383/1020 bytes**

## 2.3 Downloading the Linux Kernel and File System

- The following command loads the kernel binary into RAM, starting at address 0xA3000000:

```
PCM022> tftpboot a3000000 phylmage
```

Download is indicated by a status bar in the terminal window and will take several seconds, depending on the speed of your system.

Please note that a "**Warning! MAC addresses don't match**" message will appear in the terminal window. This can be ignored. The reason for the message is that the hardware MAC address depends on the corresponding value stored in the EEPROM connected to the SMSC91111 Ethernet controller. Upon delivery, the MAC address is **not** programmed into the EEPROM, so memory content is FF:FF:FF:FF:FF:FF, which does not match the MAC-ID on the module. U-Boot will use the MAC address entered into environmental variable **ethaddr**, as described above.

- Erase the required Flash memory area, sector 1-8, in bank #1 (0x40000 – 0x23FFFF) by entering the following command:

```
PCM022> erase 1:1-8
```

You will see a sector-by-sector erase of the specified Flash sectors in the terminal window.

- Copy the kernel from RAM address 0xA3000000 to Flash memory area 0x40000 – 0x240000 with 0x1FFFFF length:

```
PCM022> cp.b a3000000 40000 1FFFFF
```

The copy process will take up to a minute, depending on the speed of your system. Once the image is copied, a "**Copy to Flash... done**" or similar message should appear in the terminal window.

- The following command loads the file system, *lu.jffs2*, into RAM starting at address 0xA3000000:

```
PCM022> tftpboot a3000000 lu.jffs2
```

Likewise, load of the file system can take about 30 seconds, depending on the speed of your system.

- Erase Flash memory area, sector 9-127, in bank #1 (0x240000 – 0x2000000).

```
PCM022> erase 1:9-127
```

You will again see a sector-by-sector erase of the specified Flash sectors in the terminal window.

- Back at the command prompt, copy the file system from RAM address 0xA3000000 to Flash memory area 0x240000 – 0x2000000 with 0x1FFFFFF length.

```
PCM022> cp.b a3000000 240000 1000000
```

Copying the file system from RAM to Flash will take about ten minutes given the 16 MByte file size.

## 2.4 Booting from on-board Flash

- Set the **bootcmd** variable to boot the kernel image from Flash memory 0x40000. Upon a reset the Linux kernel will boot from Flash.

```
PCM022> setenv bootcmd bootm 40000
```

```
PCM022> saveenv
```

- To boot the kernel from Flash through the Minicom terminal program without resetting the target hardware, enter the following command:

```
PCM022> bootm 40000
```

- Successful kernel start-up will return a boot-up message in the terminal window showing the complete system configuration information. At the end of these initialization messages you will find the Linux login prompt. For the Login type **root** and simply press <Enter> for password:

```
Login: root
```

```
Password: 'press <Enter>'
```

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.