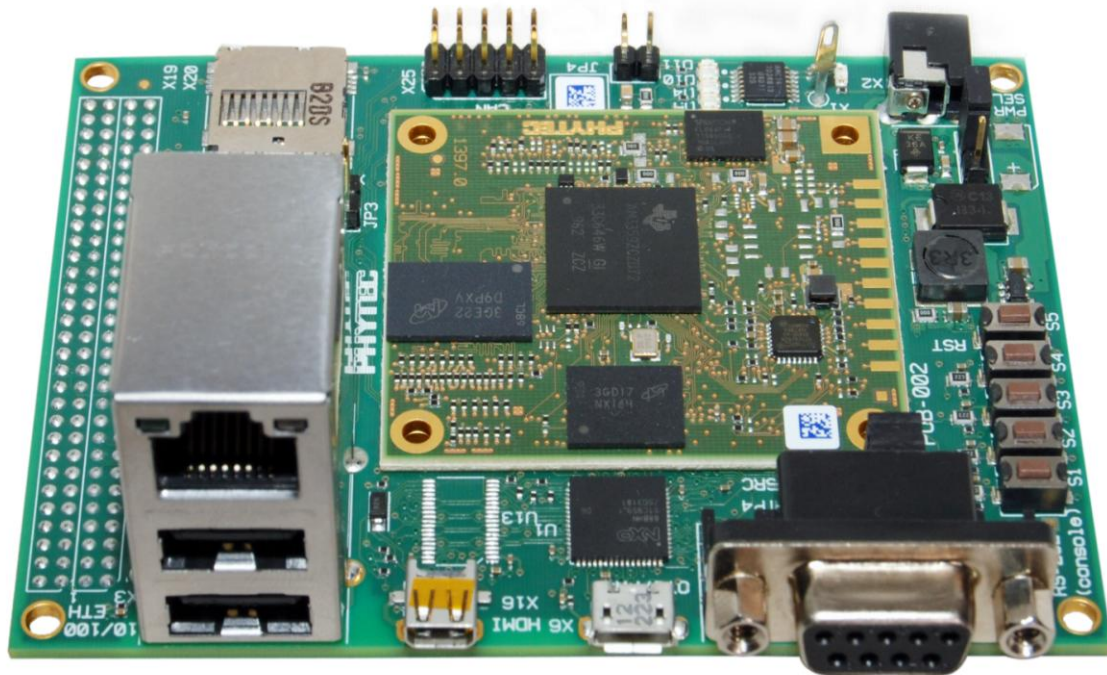


Cosmic Board for phyCORE-AM335x System on Module and Carrier Board

System Development User Manual for Linux



Product No	: PCL-051/POB-002
SOM PCB No	: 1397.0
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1. Prepare Host Environment:

In Order to follow this manual the host requires 32-bit Ubuntu, better go with LTS versions of Ubuntu. To install Ubuntu follow the link below.

<https://help.ubuntu.com/community/GraphicalInstall>

Ubuntu doesn't come with all the pre-requisite archives for the development, to prepare the host for development download the bash shell script which can be available from the link below. Download and execution steps of the script are as follows.

```
$ wget ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/tools/scripts/elinix_pkg.sh
$ chmod +x elinux_pkg.sh
$ sh elinux_pkg.sh
```

1.1 Configuring Services (TFTP, NFS)

1.1.1 Configuring TFTP

Installation of the TFTP Server is as follows; execute the command on Linux shell.

```
$ sudo apt-get -y install xinetd tftpd tftp
$ sudo vim /etc/xinetd.d/tftp
```

Add the following structure in /etc/xinetd.d/tftp file if it is not there or edit if it exists.

```
service tftp
{
    protocol = udp
    port = 69
    socket_type = dgram
    wait = yes
    user = nobody
    server = /usr/sbin/in.tftpd
    server_args = /var/lib/tftpboot -s
    disable = no
}
```

```
$ sudo service xinetd restart
```

Testing TFTP Server:

```
$ cp <file_name> /var/lib/tftpboot
$ sudo chmod +wr -R /var/lib/tftpboot
```

```
$ tftp localhost  
$ get <file_name>
```

If the same file is received without any error from the tftpserver then the tftp service is configured correctly.

To transfer file through tftp between host and target follow steps listed below, configure the IP address for host by selecting the option Network Connection and modify the related option. The same can be done through command line interface by issuing the following command

```
$ ifconfig eth0 192.168.1.12 up
```

This will be used as server IP address. Note that IP for server and target should not be same

On Target side issue the same command with a different IP as below

```
$ ifconfig eth0 192.168.1.11 up
```

Configure the gateway address for target

```
$ route add default gw 192.168.1.1
```

Issue the tftp command to transfer the file

```
$ tftp -r <file_name > -g <server_ip>
```

Check the default gateway by command

```
$ route  
or  
$ /sbin/route -n
```

1.1.2 Configuring NFS Service

First step in NFS service configuration is to decide the path of a directory which is going to share the RFS. Here in this manual it has been taken as /nfsroot which is to be created by user by issuing the following command.

```
$ sudo mkdir /nfsroot
```

Edit the /etc/exports file and add the below line at the end of the file, save and close it
/nfsroot *(rw, sync, no_subtree_check, no_root_squash)

```
$ sudo gedit /etc/exports
```

To start the service with made changes issue the following commands on the terminal.

```
$ sudo exportfs -ra
```

```
$ sudo /etc/init.d/nfs-kernel-server restart
```

1.2 Partitioning Micro SD card in Ubuntu

Method 1: Using Graphical User Interface

Use the application Disk Utility in Ubuntu.

- Select Mass storage device
- Umount the volume
- Delete the partition
- Create the two partition boot and rootfs with *fat* and *ext3* support respectively
- Select the first *fat* partition and then select “edit partition” and mark it as bootable.

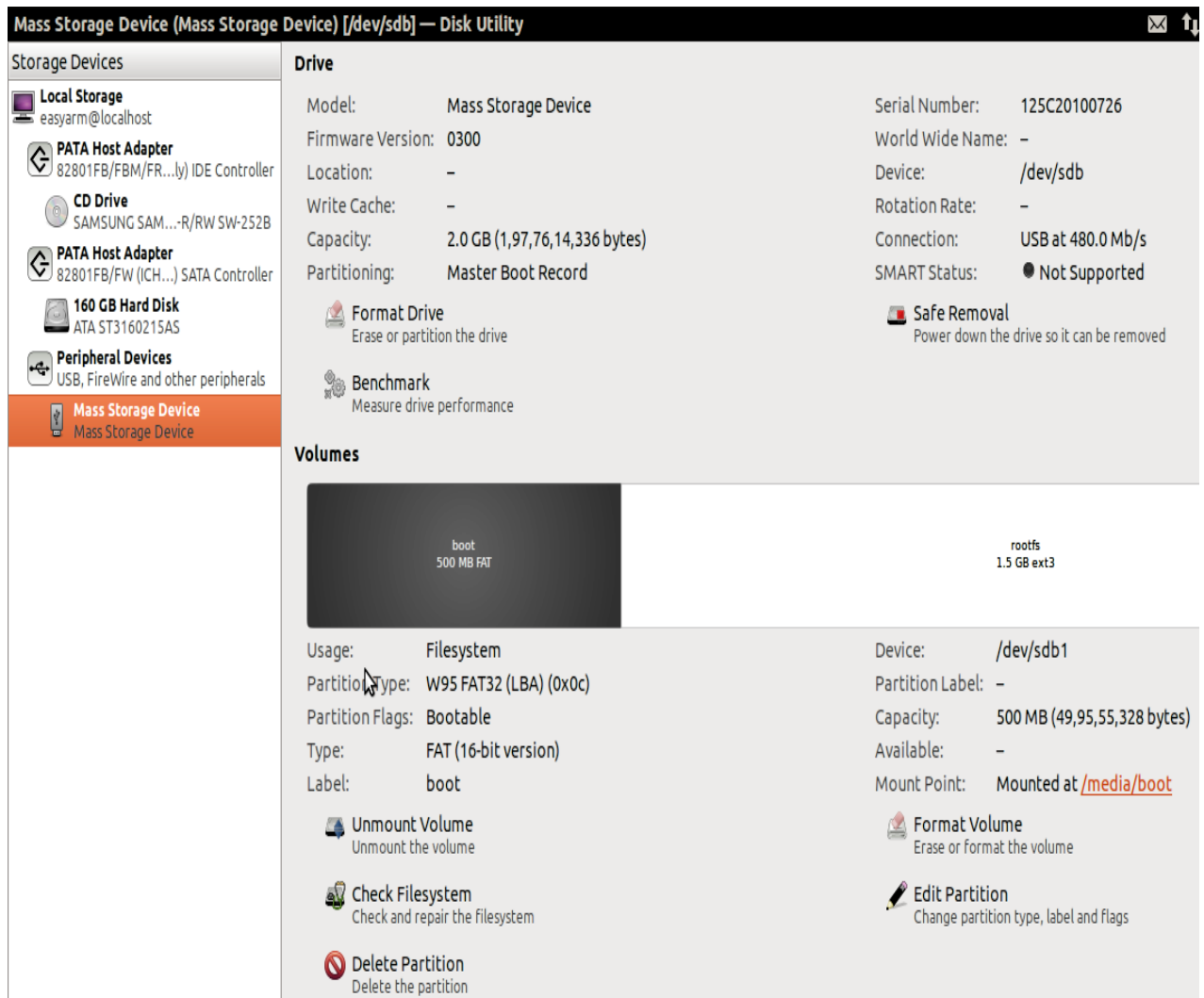


Figure 2. 11

Method 2: Using Command line interface

Download the script and follow the steps.

```
$ wget ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/tools/scripts/mkcard.sh
```

Change the mode of script

```
$ chmod 777 mkcard.sh
```

Insert the Micro SD card and issue the following command and check Micro SD card device interface

```
$ dmesg | tail
```

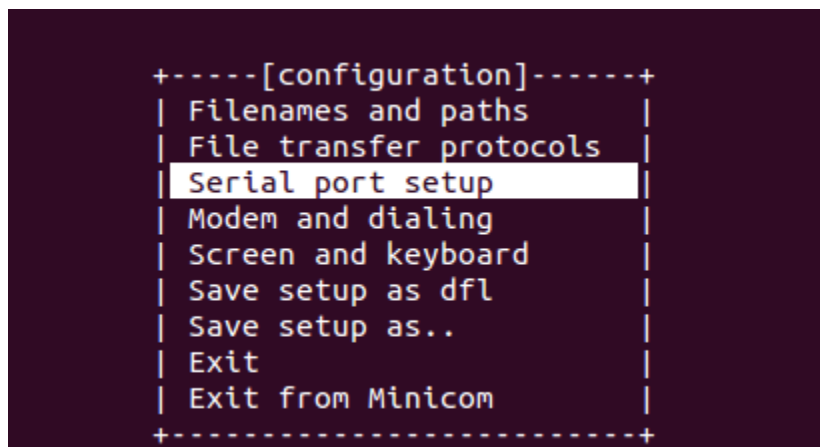
Execute the following script with that device interface like /dev/sda

```
$ sudo ./mkcard.sh /dev/sdx /* /dev/sdx is device interface name */
```

1.3 Setting Serial Console (Minicom)

```
$ sudo minicom -s
```

Select the option serial port setup from menu on terminal and press 'Enter'



```
+-----[configuration]-----+
| Filenames and paths          |
| File transfer protocols      |
| Serial port setup            |
| Modem and dialing           |
| Screen and keyboard         |
| Save setup as dfl           |
| Save setup as..             |
| Exit                         |
| Exit from Minicom           |
+-----+-----+-----+-----+
```

Figure 3.1

Using the options at left; make the setting as shown in the figure 3.2. For ex: Serial device - /dev/ttsyS0, first press 'A' the cursor blinks at the particular line then change the device name to /dev/ttyS0 and press 'ENTER'.

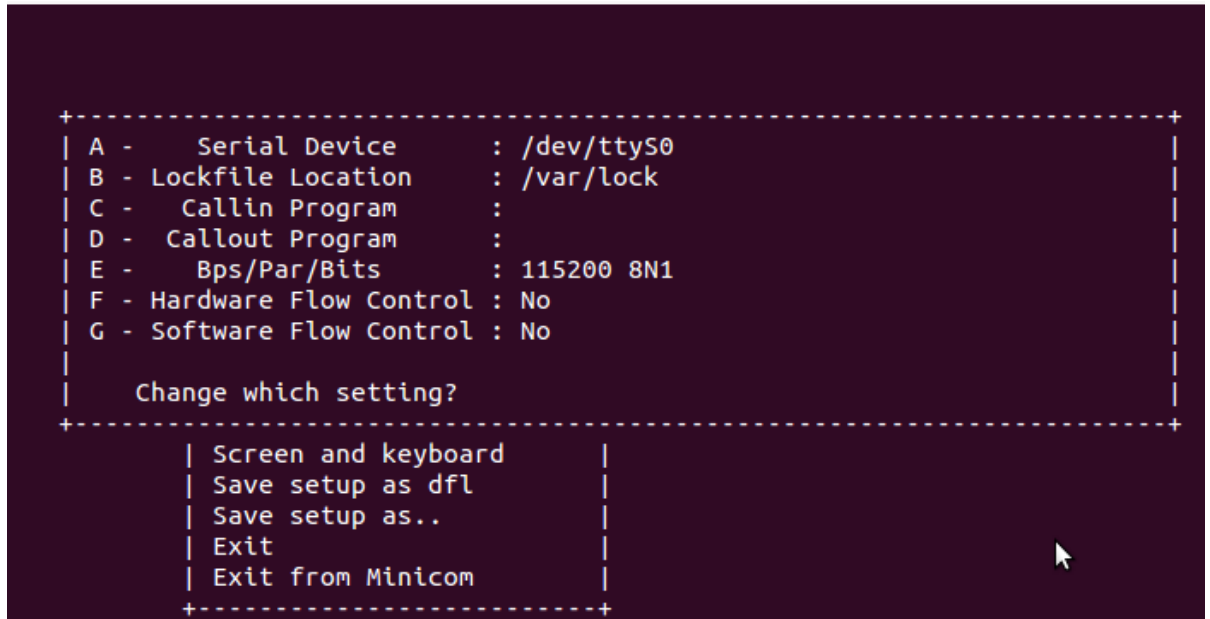


Figure 3.2

After making all changes like baud rate -115200, hardware control flow -No etc. that are required press 'ENTER' to come out from the screen, now the previous screen will appear.

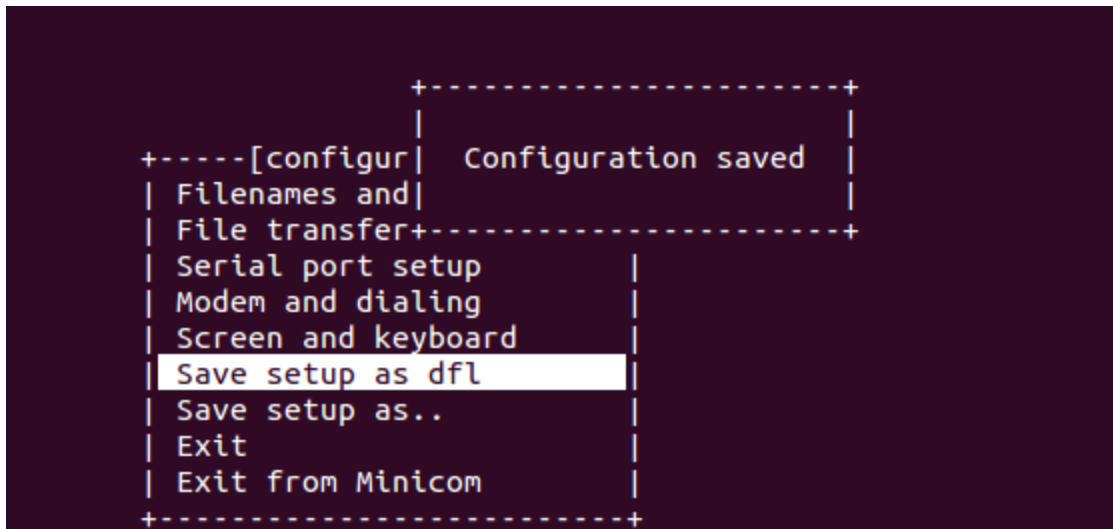


Figure 3.3

Now select the 'Save setup as dfl' it saves the setting as default.
Now select 'Exit'


```
+-----[configuration]-----+
| Filenames and paths          |
| File transfer protocols      |
| Serial port setup           |
| Modem and dialing           |
| Screen and keyboard         |
| Save setup as dfl           |
| Save setup as..             |
| Exit                       |
| Exit from Minicom          |
+-----+
```

Figure 3.4

It will take into 'minicom' the serial terminal.

1.4 Installing Toolchain

This section explains how to install prebuilt toolchain binaries on the Host. Whereas building of Toolchain is explained in buildsystem section.

1.4.1 Downloading the Toolchain:

Download the toolchain from the public ftp of PHYTEC from the link below.

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/tools/toolchain/arm-cortexa8-linux-gnueabi.tar.bz2>

1.4.2 Export the Toolchain to Shell Path:

Extract the toolchain that has downloaded in the above section to the HOME directory. For extracting the toolchain from GUI you can 'right click' on the toolchain and select 'Extract'. Same can be done from terminal issue the following

```
$ tar -xvf arm-cortex8-linux-gnueabi.tar.bz2
```

Now write a script that export the target Architecture and toolchain prefix as below.

```
$ vim env.sh
```

In the file add the following lines

```
#!/bin/sh
```

```
export PATH=$PATH:/home/<user>/<path to toolchain bin>
```

```
export ARCH=arm
```

```
export CROSS_COMPILE=arm-cortexa8-linux-gnueabi-
```

Save and exit from the editor. Execute the script by issuing

```
$. env.sh
```

Note: The command is “dot space env.sh”. Execute the above command for every new shell where you are trying to start compilation of Linux kernel or bootloaders.

Check whether the toolchain path is set or not by issuing

```
$ echo $PATH
```

Above command displays the entire paths that are added to Shell PATH variable separated by colon ‘:’. See if your path is printed on the terminal. If you are not able to see your toolchain path repeat the steps from the beginning of this section.

```
$ echo $PATH
```

2 Download prebuilt images:

This section gives the links to all the required binaries to boot the Cosmic-AM335x using the simplest method using Micro SD card. Partition your Micro SD card. Follow the Partitioning Micro SD card in Ubuntu section.

All the tested binaries are placed at the public PHYTEC ftp. Follow the links below to download the binaries.

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/images/MLO>

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/images/barebox.bin>

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/images/uImage>

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/images/root.ubi>

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/images/root.tgz>

3 Flashing binaries:

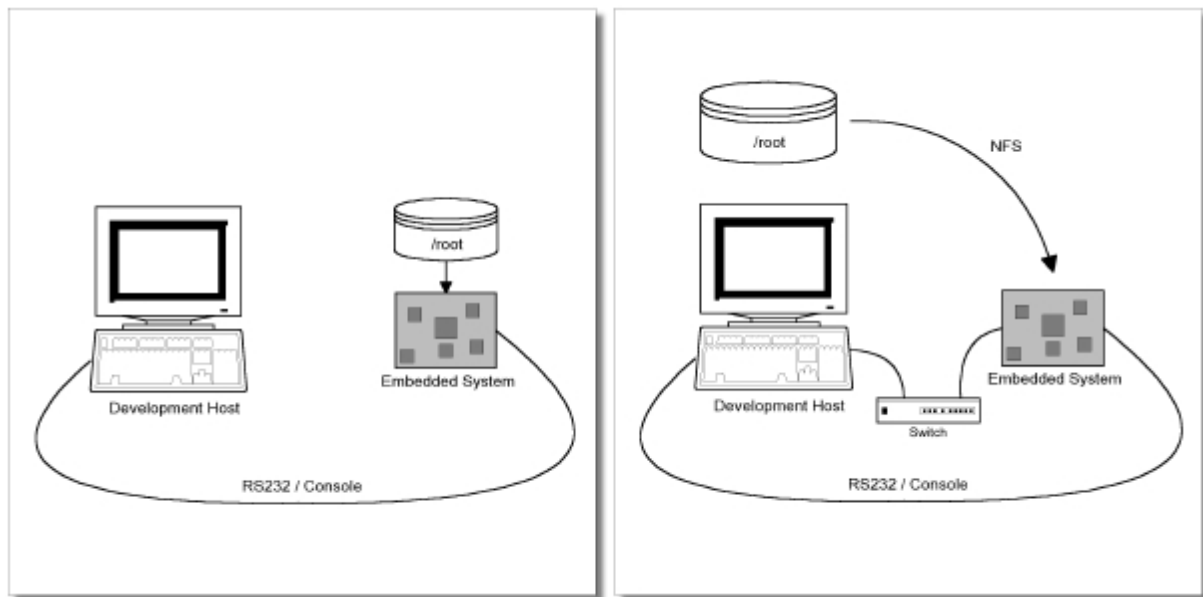


Figure 3.8

Figure shows two methods. The first method used to provide all needed components to run on the target itself. The Linux kernel image and the root file system image are persistent in the media the target features. This means the only connection needed is the serial cable to see what is happening on our target. This method is called standalone. This works after writing image into NAND which is explained later in Document.

The other method is to provide needed components via network. In this case the development host is connected to the Cosmic-AM3359 with a serial cable and via Ethernet; the embedded board boots into the bootloader, then issues a TFTP request on the network and boots the kernel from the TFTP server on the host. Then, after decompressing the kernel into the RAM and starting it, the kernel mounts its root CosmicBoard/root/ directory.

The latter one is especially for development purposes, as it provides a very quick turnaround while testing the kernel and the root file system. Other methods like Micro SD card and NAND have also been discussed.

3.1 Using Barebox bootloader:

3.1.1 Booting from Network:

Before using this method make sure that tftp & nfs-server is working fine. To test and configure refer section “Configuring Services (TFTP, NFS)” Copy the uImage (kernel image) and root filesystem into /var/lib/tftpboot & /nfsroot respectively.

On Host:

```
$ sudo cp uImage /var/lib/tftpboot  
$ sudo tar -xvf rootfs.tar -C /nfsroot
```

On Target:

You can check the targets network settings by running the following:

```
barebox@Phytec Cosmic-AM335x:/ devinfo eth0
```

The "ethaddr" variable is the MAC id of the target. This is a pre-programmed value which is read from the EEPROM and matches the sticker on the SOM. To modify any of the network settings, type:

```
barebox@Phytec Cosmic-AM335x:/ edit /env/network/eth0
```

You should see something similar to the following, modify the variables to specify your network configuration for ETH0:

```
ipaddr =###.###.###.###  
netmask=###.###.###.###  
gateway=###.###.###.###  
serverip=###.###.###.###
```

- **ipaddr:** A dedicated IP address for the SOM. This is crucial if TFTP will be used for updating the device's images at any point.
- **netmask:** Netmask for the network: typically 255.255.255.0. This is only necessary if the TFTP directory is located on another network.
- **gateway:** Gateway IP for the network. This is only necessary if the TFTP directory is located on another network.
- **serverip:** IP address of the host or another machine. "serverip" corresponds to where the TFTP directory, if it exists, is located.

Now specify the path of Linux kernel image and root filesystem via NFS.

```
barebox@Phytec Cosmic-AM335x:/ edit /env/boot/net
```

Make the changes as follows.

```
global.bootm.image="${path}/uImage"  
nfsroot="/nfsroot"
```

Once complete with file modifications exit the editor using **CTRL+D**. Save the environment.

```
barebox@Phytec Cosmic-AM335x:/ saveenv
```

Now reset the board & press ‘m’ for barebox menu & select option 3 to boot from network.

3.1.2 Booting from Micro SD card:

For partitioning the Micro SD card refer section [“Partitioning a Micro SD card in linux”](#)

Copy barebox.bin, MLO, uImage in first partition (boot) and Root file system in second partition (rootfs).

On HOST:

Insert the Micro SD card.

```
$ cp barebox.bin /media/boot  
$ cp MLO /media/boot  
$ cp uImage /media/boot  
$ sudo tar -xvf rootfs.tar -C /media/rootfs
```

On Target:

Insert the Micro SD card and make sure that the pins 3+4 of JP5 is shorted, Power On the board, press ‘m’ for barebox menu & select option 2 to boot from SD Card.

3.1.3 Booting from NAND:

If booting from SD Card start from here

```
barebox@Phytec Cosmic-AM335x:/ mkdir /mount  
barebox@Phytec Cosmic-AM335x:/ mount /dev/disk0.0 fat /mount/  
barebox@Phytec Cosmic-AM335x:/ erase /dev/nand0  
barebox@Phytec Cosmic-AM335x:/ cd /mount/  
barebox@Phytec Cosmic-AM335x:/mount/ cp MLO /dev/nand0.xload.bb  
barebox@Phytec Cosmic-AM335x:/mount/ cp barebox.bin  
                                          /dev/nand0.barebox.bb  
barebox@Phytec Cosmic-AM335x:/mount/ cp uImage  
                                          /dev/nand0.kernel.bb  
barebox@Phytec Cosmic-AM335x:/mount/ cp root.ubi /dev/nand0.root.bb
```

Remove the Micro SD card and make sure that JP5 is open, Power On the board, press ‘m’ for barebox menu & select option 1 to boot from NAND.

4 Preparing Cosmic-AM335x Bootloader & Kernel

This is required if board is not flashed with correct bootloader. Even you can skip to the flashing section if you want to use prebuilt images.

4.1 Preparing Cosmic-AM335x Barebox bootloader:

Note: Refer section 1.4 Installing Toolchain before going ahead.

Download the source of barebox version 2012.11.0 from the following link.

<http://barebox.org/download/barebox-2012.11.0.tar.bz2>

After getting the source copy it to working directory

```
$ cp barebox-2012.11.0.tar.bz2 ~/work  
$ cd ~/work
```

Extract the source here by following command

```
$ tar -xvf barebox-2012.11.0.tar.bz2
```

Go to extracted folder and issue the following command

```
$ cd ~/work/<directory path to source>
```

Download the patches for Cosmic-AM335x from the public ftp from the link below. Apply the patches.

```
ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/src/patches/barebox-2012.11.0/
```

Apply the patches one by one using following command. File name indicates the series how to apply the patches.

```
$ patch -p1 < <patch_file_name.patch> /* apply all patches one by one */
```

Cleaning all the binaries and other configuration files

```
$ make clean  
$ make distclean  
$ make pcm051lb_defconfig /* configuring the Barebox for target */  
$ make barebox.bin
```

If the compilation goes well you will find the files barebox.bin and barebox.bin in the source directory. If you experience any error act accordingly or post the errors at our forums you will get help accordingly.

4.2 Preparing Cosmic-AM335x Linux kernel:

Note: Refer section 1.4 Installing Toolchain before going ahead.

Download the source of Linux kernel version 3.2 from the following link.

<http://www.kernel.org/pub/Linux/latest/kernel/v3.x/linux-3.2.tar.bz2>

After getting the source copy it to working directory

```
$ cp linux-3.2.tar.bz2 ~/work  
$ cd ~/work
```

Extract the source here by following command

```
$ tar -xvf linux-3.2.tar.bz2
```

Go to extracted folder and issue the following command

```
$ cd ~/work/linux-3.2/
```

Download the patches for Cosmic-AM335x from the public ftp from the link below. Apply the patches.

```
ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/src/patches/linux-3.2/
```

Apply the patches one by one using following command. File name indicates the series how to apply the patches.

```
$ patch -p1 < <patch_file_name.patch> /* apply all patches one by one */
```

Cleaning all the binaries and other configuration files

Note: Before configuring & building the kernel copy PM firmware named **am335x-pm-firmware.bin** under **firmware** folder of the kernel source.

```
$ cp am335x-pm-firmware.bin ~/work/linux-3.2/firmware/  
$ make clean  
$ make distclean  
$ make pcm051lb_defconfig /* configuring the Kernel for target */  
$ make uImage
```

If the compilation goes well you will find the files zImage and uImage in arch/arm/boot directory. If you experience any error act accordingly or post the errors at our forums you will get help accordingly.

5 Compiling User-application:

Note: Refer section 1.4 Installing Toolchain before going ahead.

Make a helloworld program for target. Open file helloworld.c via command

```
$ gedit helloworld.c
```

Compile it with toolchain

```
$ arm-cortexa8-linux-gnueabi-gcc helloworld.c -o helloworld
```

Transfer it on target by tftp-server or by Micro SD card or USB

```
On target for tftp $ tftp -r helloworld -g <server_ip>and switch to minicom terminal and run  
For Micro SD/USB on Host $ cp helloworld /media/<partion name>
```

Insert the USB or MMC to target and switch to minicom terminal

It will display the device like sdb:sdb1 .Use that device for mounting.

```
$ mount /dev/sdb1 /mnt          (sdb1) is USB-device interface  
$ cd /mnt  
$ ./helloworld                /* it is dot slash
```

6 Compiling RFS with PTX-dist:

Download the PTX-dist packet from the following link:

```
$wget ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/buildsystems/ptxdist/ptxdist-2012.03.0.tar.bz2
```

Extract the above downloaded source

```
$ tar -xvf ptxdist-2012.03.0.tar.bz2
```

Go to downloaded folder

```
$ cd ptxdist-2012.03
```

Configure the packet

```
./configure
```

When the configure script is finished successfully, to compile run

```
$ make  
$ sudo make install
```

Download the toolchain from the public ftp of PHYTEC from the link below.

```
ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/tools/toolchain/arm-cortexa8-linux-gnueabi.tar.bz2
```

Extract the toolchain that has been downloaded. Issue following

```
$ tar -xvf arm-cortexa8-linux-gnueabi.tar.bz2
```

Download the PTX-dist BSP source from following link

```
ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/buildsystems/ptxdist/Cosmic-AM335x.PD13.0.0.tar.bz2
```

Extract the source

```
$ tar -xvf Cosmic-AM335x.PD13.0.0.tar.gz
```

Go to extracted folder

```
$ cd Cosmic-AM335x.PD13.0.0
```

Select the toolchain

```
$ ptxdist toolchain <path_of_toolchain_bin>
```

Start the build

```
$ ptxdist go  
$ ptxdist images
```

Check the images at `platform-phyCORE-AM335x/images/`

```
$ ls platform-phyCORE-AM335x/images/
```

7 Compiling RFS with Buildroot:

Download the Buildroot source from following link

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/buildsystems/buildroot/buildroot-2013.05.tar.bz2>

Extract the source

```
$ tar -xvf buildroot-2013.05.tar.bz2
```

Go to extracted folder

```
$ cd buildroot-2013.05
```

Configure the buildroot by issuing following command

```
$ make pcm051lb_defconfig
```

Compile the buildroot

```
$ make
```

Check the output files at output/images

```
$ ls output/images
```

8 Compiling RFS with Yocto:

Download the Yocto buidssystem source from following link

<ftp://ftp.phytec.de/pub/Products/India/Cosmic-AM335x/Linux/PD13.0.0/buildsystems/yocto/poky-danny-8.0.tar.bz2>

Before starting the build process install the necessary packages.

```
$ sudo apt-get install gawk wget git-core diffstat unzip texinfo build-essential chrpath libsdl1.2-dev xterm
```

Extract the source

```
$ tar -xvf poky-danny-8.0.tar.bz2
```

Go to extracted folder

```
$ cd poky-danny-8.0
```

Configure poky-danny-8.0 by issuing following command

```
$. ./oe-init-build-env
```

Then type the following command to get hob GUI interface.

```
$ hob
```

Then under “select machine” option select pcm051-bsp to build images for Cosmic-AM335x board.

To use hob refer the link given below.

<https://www.yoctoproject.org/documentation/hob-manual>

Check the output files at tmp/deploy/images

```
$ ls tmp/deploy/images
```