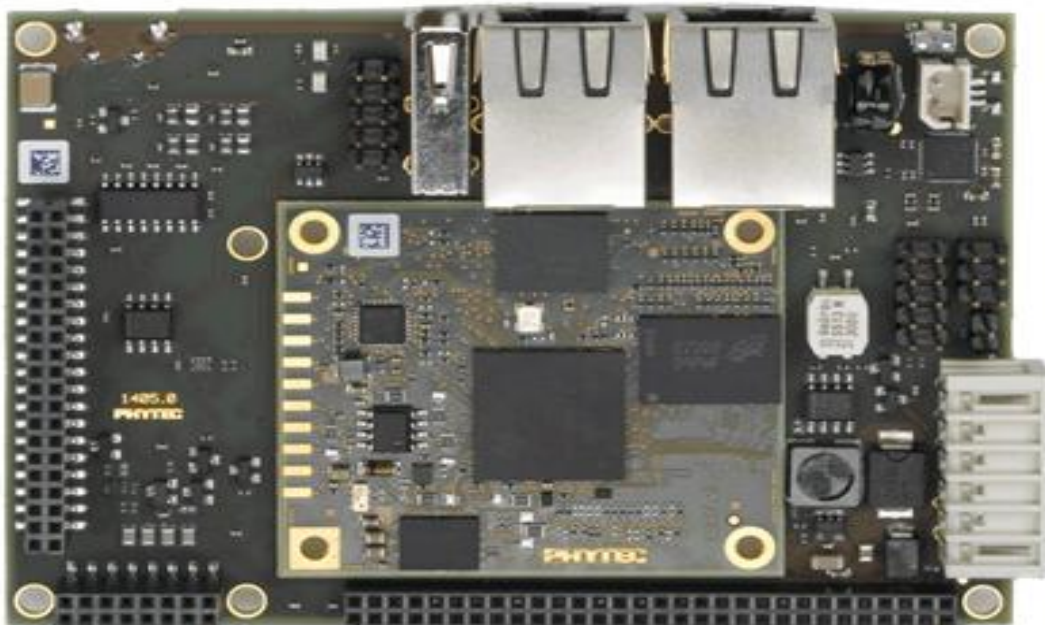


PhyBOARD-WEGA-AM335x

System Development User Manual for Linux



Release 1.0
February, 2014

In this manual copyrighted products are not explicitly indicated. The absence of the trademark (™) and copyright (©) symbols does not imply that a product is not protected. Additionally, registered patents and trademarks are similarly not expressly indicated in this manual.

The information in this document has been carefully checked and is believed to be entirely reliable. However, PHYTEC Embedded Pvt. Ltd. assumes no responsibility for any inaccuracies. PHYTEC Embedded Pvt. Ltd. neither gives any guarantee nor accepts any liability whatsoever for consequential damages resulting from the use of this manual or its associated product. PHYTEC Embedded Pvt. Ltd. reserves the right to alter the information contained herein without prior notification and accepts no responsibility for any damages that might result.

Additionally, PHYTEC Embedded Pvt. Ltd. offers no guarantee nor accepts any liability for damages arising from the improper usage or improper installation of the hardware or software. PHYTEC Embedded Pvt. Ltd. further reserves the right to alter the layout and/or design of the hardware without prior notification and accepts no liability for doing so.

© Copyright 2014 PHYTEC Embedded Pvt. Ltd, Koramangala Bangalore.

Rights - including those of translation, reprint, broadcast, photomechanical or similar reproduction and storage or processing in computer systems, in whole or in part - are reserved. No reproduction may be made without the explicit written consent from PHYTEC Embedded Pvt. Ltd.

	India	Europe	North America
Address:	Phytec Embedded Pvt. Ltd #16/9/C 3rd Floor 3rd Main 8th Block Opp: Police Station Kormangala Bangalore-560095	PHYTEC Technologie Holding AG Robert-Koch-Str. 39 55129 Mainz GERMANY	PHYTEC America LLC 203 Parfitt Way SW, Suite G100 Bainbridge Island, WA 98110 USA
Ordering Information:	+91-80-40867046 Sales@phytec.in	+49 (800) 0749832 order@phytec.de	1 (800) 278-9913 sales@phytec.com
Web Site:	http://www.phytec.in	http://www.phytec.de	http://www.phytec.com

Table of Contents

1. Prepare Host Environment:.....	4
1.1 Configuring Services (TFTP, NFS).....	4
1.1.1 Configuring TFTP	4
1.1.2 Configuring NFS Service	5
1.2 Partitioning Micro SD card in Ubuntu	6
1.3 Setting Serial Console (Minicom).....	7
1.4 Installing Toolchain.....	9
1.4.1 Downloading the Toolchain:	9
1.4.2 Export the Toolchain to Shell Path:	10
2 Download prebuilt images:	10
3 Flashing binaries:	10
3.1 Using Barebox bootloader:	11
3.1.1 Booting from Micro SD card:.....	11
3.1.2 Booting from NAND:.....	12
4 Preparing phyBOARD-WEGA-AM335x Bootloaders.....	13
4.1 Barebox bootloader:	13
4.2 Preparing phyBOARD-WEGA-AM335x Linux kernel:	14
5 Compiling User-application:.....	16
6 Compiling RFS with PTX-dist:	17
7 Compiling RFS with Buildroot:.....	19
8 Compiling RFS with Yocto:.....	20

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/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/tools/scripts/elinux_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 bellow commands on Linux shell.

```
$ sudo apt-get -y install xinetd tftpd tftp
$ sudo mkdir /var/lib/tftpboot
$ 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 /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

Host-Side Setup:

```
$ sudo ifconfig eth0 192.168.1.12 up
```

This will be used as server IP address.

Note: IP for server and target should not be same.

Target-Side Setup:

```
$ 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 service 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.

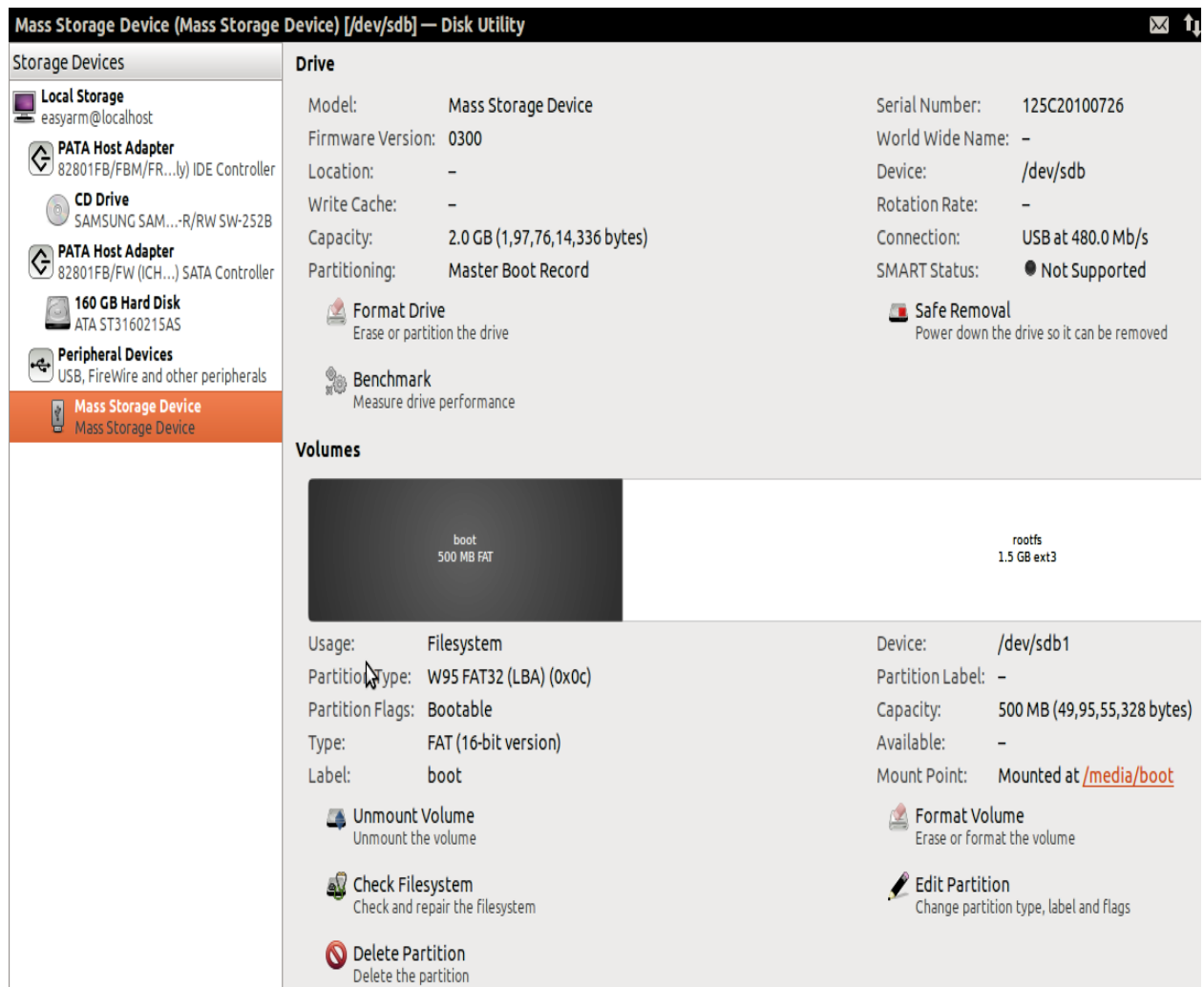


Figure 1.1

Method 2: Using Command line interface

Download the script and follow the steps.

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/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 sh 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'

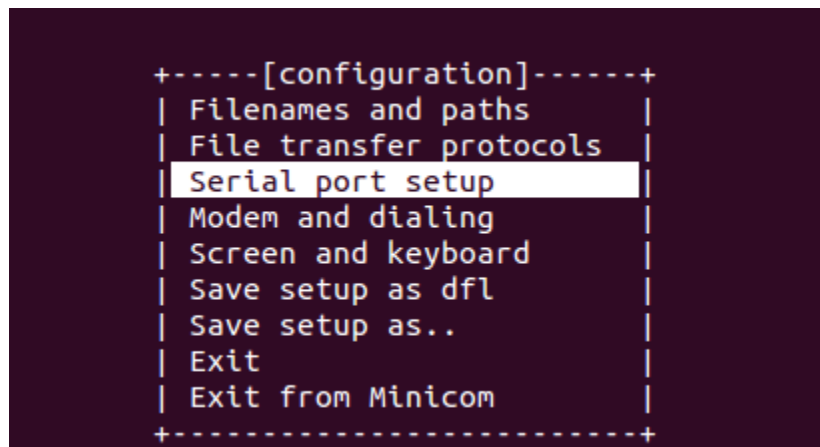


Figure 1.2

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

```

+-----+
| A -   Serial Device       : /dev/ttyS0
| B - Lockfile Location    : /var/lock
| C -   Callin Program     :
| D - Callout Program      :
| E -   Bps/Par/Bits       : 115200 8N1
| F - Hardware Flow Control : No
| G - Software Flow Control : No
|
| Change which setting?
+-----+
| Screen and keyboard
| Save setup as dfl
| Save setup as..
| Exit
| Exit from Minicom
+-----+

```

Figure 1.3

After making all changes like baud rate 115200, **hardware control flow NO** by pressing the keyword 'F' etc. that are required press 'ENTER' to come out from the screen, now the previous screen will appear.

```

+-----+
| Configuration saved
+-----+
| [configur]
| Filenames and
| File transfer+-----+
| Serial port setup
| Modem and dialing
| Screen and keyboard
| Save setup as dfl
| Save setup as..
| Exit
| Exit from Minicom
+-----+

```

Figure 1.4

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 1.5

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 buidsystem section.

1.4.1 Downloading the Toolchain:

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

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/tools/toolchain/arm-cortexa8-linux-gnueabihf.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-gnueabihf.tar.bz2
```

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

```
$ vim env.sh
```

In this 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-gnueabihf-
```

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.

2 Download prebuilt images:

This section gives the links to all the required binaries to boot the PhyBOARD-WEGA-AM335x using 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/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/images/MLO
ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/images/brebox.bin
ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/images/uImage
ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/images/root.ubi
ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/images/root.tgz
```

3 Flashing binaries:

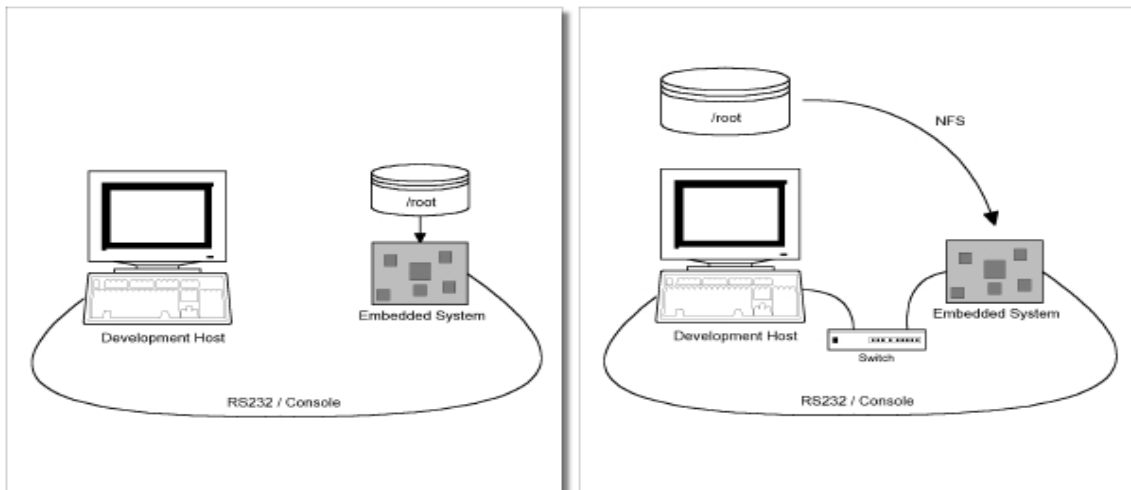


Figure 3.1

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. 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 **PhyBOARD-WEGA-AM335X** 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 **PhyBOARD-WEGA/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.

3.2 Using Barebox bootloader:

3.2.1 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 extract the 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 root.tgz -C /media/rootfs
```

On Target:

Insert the Micro SD card, Power On the board.

Interrupt the auto boot by pressing any key to get barebox prompt.

Edit the config file do the modifications in below config file.

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ edit env/config
```

```
global.boot.default=mmc
```

Ctrl + d to save the file and exit.

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ saveenv
barebox@Phytec phyBOARD-WEGA-AM335x:/ reset
```

Now, The Board will boot from MMC.

Note: If you experience any error act accordingly or post the errors at our “forums” you will get help accordingly.

3.2.2 Booting from NAND:

If booting from NAND start from here, copy below images into SD Card boot partition.

```
$ cp barebox.bin /media/boot
$ cp MLO /media/boot
$ cp uImage /media/boot
$ cp root.ubi /media/boot
```

On Target, Insert the Micro SD card, Power On the board. Interrupt the auto boot by pressing any key to get Barebox prompt.

Give below commands to copy images into NAND.

If boot directory doesnot exist, start from here

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ mkdir boot
barebox@Phytec phyBOARD-WEGA-AM335x:/ mount /dev/disk0.0 /boot
```

If boot directory exists, start from here

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ cd boot
barebox@Phytec phyBOARD-WEGA-AM335x:/boot/ cp MLO /dev/nand0.xload.bb
barebox@Phytec phyBOARD-WEGA-AM335x:/boot/ cp barebox.bin /dev/nand0.barebox.bb
barebox@Phytec phyBOARD-WEGA-AM335x:/boot/ cp uImage /dev/nand0.kernel.bb
barebox@Phytec phyBOARD-WEGA-AM335x:/boot/ cp root.ubi /dev/nand0.root.bb
```

Edit the config file do the modifications in below file.

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ edit env/config

global.boot.default=nand
```

Press Ctrl + d to save the file and exit.

```
barebox@Phytec phyBOARD-WEGA-AM335x:/ saveenv
barebox@Phytec phyBOARD-WEGA-AM335x:/ reset
```

Remove the Power Cable and SD card. And Power up The Board. Now The Board will boot from NAND.

Note: If you experience any error act accordingly or post the errors at our "forums" you will get help accordingly.

4 Preparing phyBoard-WEGA-AM335x Bootloaders

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 Barebox bootloader:

Note: Refer section 1.4 Installing Toolchain before going ahead.

Download the source of barebox version 2013.11.0 from the following link.

```
http://barebox.org/download/barebox-2013.11.0.tar.bz2
```

After getting the source copy it to working directory

```
$ mkdir ~/work  
$ cp barebox-2013.11.0.tar.bz2 ~/work  
$ cd ~/work
```

Extract the source here by following command

```
$ tar -xvf barebox-2013.11.0.tar.bz2
```

Go to extracted folder and issue the following command

```
$ cd ~/work/barebox-2013.11.0
```

Create a directory with the name "patches" in the extracted barebox-2013.01.0 directory.

```
$ mkdir patches  
$ cd patches
```

Execute bellow command in patches directory

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/src/patches/barebox-2013.11.0/patches/*
```

Go to the barebox-2013.11.0 top directory and run quilt command.

```
$ quilt push -a
```

All the patches will apply one by one using above command.

Cleaning all the binaries and other configuration files

```
$ make clean
$ make distclean
$ make pcm051_mlo_defconfig /* configuring the Barebox for target */
$ make /* MLO will generate */
$ make pcm051_defconfig
$ make /* barebox.bin will generate */
```

If the compilation goes well you will find the files barebox.bin and MLO in the source directory.

Note: If you experience any error act accordingly or post the errors at our “forums” you will get help accordingly.

4.2 Preparing phyBOARD-WEGA-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.

```
https://www.kernel.org/pub/linux/kernel/v3.0/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/
```

Create a directory with the name "patches" in the extracted barebox-2013.01.0 directory.

```
$ mkdir patches
$ cd patches
```

Execute bellow command in patches directory

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/src/patches/linux-3.2/patches/*
```

Go to the linux-3.2 top directory and run quilt command.

```
$ quilt push -a
```

All the patches will apply one by one using above command.

Cleaning all the binaries and other configuration files

```
$ make clean  
$ make distclean  
$ make pcm051_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.

***Note:** 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

By using TFTP - Server:

```
On Host   : $ cp helloworld /var/lib/tftpboot
On Target : $ tftp -r helloworld -g <serverip>
           $ ./helloworld
```

By using USB:

```
On Host   : cp helloworld /media/<partition name>
```

Insert the USB to target and switch to minicom terminal

It will display the device like sda, sda1. Use that device for mounting.
To find device interface, type **dmesg | tail** command...

```
On Target :
           $ mount /dev/sdb1 /mnt           /* (sda1) is USB-device interface */
           $ cd /mnt
           $ ./helloworld                 /* it is dot slash */
```

By Using SD-Card:

```
On Host : cp helloworld /media/boot
```

Insert the Micro SD card to target and switch to **minicom** terminal
It will display the device like mmcblk0p1. Use that device for mounting.

```
On Target :
           $ mount /dev/mmcblk0p1 /mnt     /* (mmcblk0p1) is SD-Card 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/phyBOARD-WEGA-AM335X/Linux/PD14.0.0/buildsystems/ptxdist/ptxdist-2013.01.0.tar.bz2
```

Extract the above downloaded source

```
$ tar -xvf ptxdist-2013.01.0.tar.bz2
```

Go to downloaded folder

```
$ cd ptxdist-2013.01.0
```

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.

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/Linux/tools/toolchain/arm-cortexa8-linux-gnueabihf.tar.bz2
```

Extract the toolchain that has been downloaded. Issue following command

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

Download the PTX-dist BSP source from following link

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/buildsystems/ptxdist/phyBOARD-WEGA-AM335X-PD14.0.0.tar.bz2
```

Extract the source

```
$ tar -xvf phyBOARD-WEGA-AM335X-PD14.0.0.tar.bz2
```

Go to extracted folder

```
$ cd phyBOARD-WEGA-AM335X-PD14.0.0
```

Select the toolchain

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

Start the build

```
$ ptxdist go
```

It will take some time to compile. Once it compiled give the bellow command to generate images

```
$ ptxdist images
```

Check the images in platform-phyBOARD-WEGA-AM335x/images/

```
$ ls platform-phyBOARD-WEGA-AM335x/images/
```

7 Compiling RFS with Buildroot:

Download the Buildroot source from following link

```
$ wget ftp://ftp.phytec.de/pub/Products/India/PhyBOARD-WEGA--AM335x/Linux/latest/buildsystems/buildroot/buildroot-2013.11.1.tar.bz2
```

Extract the source

```
$ tar -xvf buildroot-2013.11.1.tar.bz2
```

Go to extracted folder

```
$ cd buildroot-2013.11.1
```

Configure the buildroot by issuing following command

```
$ make pcm051_defconfig
```

Compile the buildroot

```
$ make
```

Check the output files in output/images

```
$ ls output/images
```

8 Compiling RFS with Yocto:

Download the Yocto buildsystem source, from following link below

```
$ wget ftp://ftp.phytec.de/pub/Products/India/phyBOARD-WEGA-AM335X/buildsystems/yocto/poky-danny-10.0.0.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-10.0.0.tar.bz2
```

Go to extracted folder

```
$ cd poky-danny-10.0.0
```

Configure poky-danny-10.0 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 **phyBOARD-WEGA-AM335x** board.

To use hob refer the link given below.

```
https://www.yoctoproject.org/documentation/hob-manual
```

Check the output files in tmp/ deploy/images

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