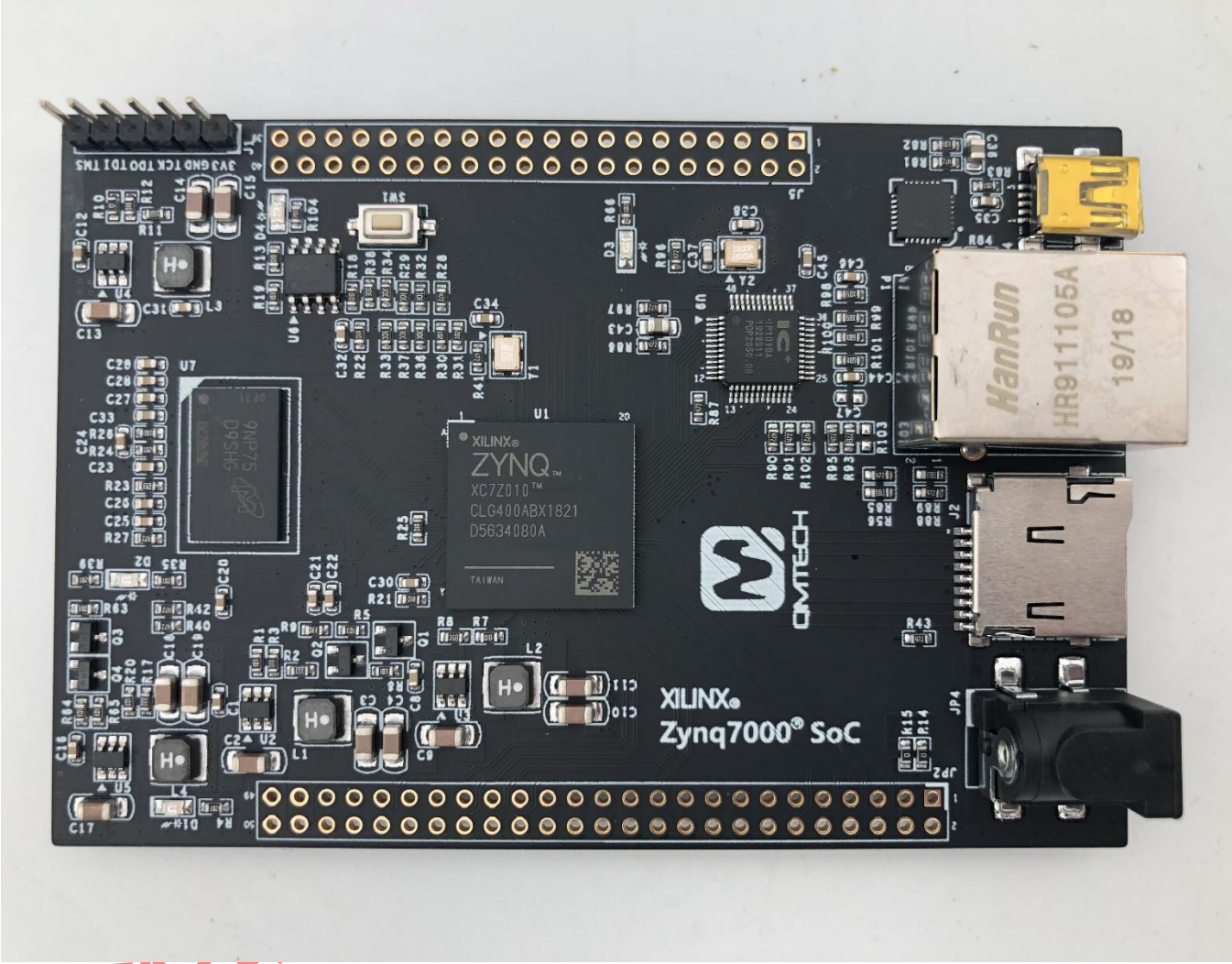
QMTECH ZYNQ XC7Z010 STARTER KIT

USER MANUAL



Preface

The QMTech® ZYNQ XC7Z010 Starter Kit uses Xilinx Zynq®-7000 device which integrates the software programmability of an ARM®-based processor with the hardware programmability of an FPGA, enabling key analytics and hardware acceleration while integrating CPU, DSP, ASSP, and mixed signal functionality on a single device. Consisting of single-core Zynq-7000S and dual-core Zynq-7000 devices, the Zynq-7000 family is the best price to performance-per-watt, fully scalable SoC platform for your unique application requirements.

For more information, updates and useful links, please visit QMTECH Official Website:

http://www.chinaqmtech.com

Table of Contents

1. Introduction

1.1 Document Scope

This user manual introduces the procedure to make the Linux environment running on the QMTECH ZYNQ XC7Z010 Starter Kit. The Linux environment mainly covers three parts: u-boot, Linux OS and file system. All of those parts are developed with Xilinx Vivado 2018.3 under Ubuntu 18.04 environment. The prerequisites before working with the Linux parts are shown as below:

1. Users have already installed the Vivado 2018.3 in Ubuntu. Preferred and verified version is Ubuntu 18.04.
2. Users have the basic knowledge about the usage of the Linux environment. Know how to use the cross-compile toolchain including arm-gcc-linux-, makefile, etc.

1.2 Preparation

Here lists some useful resources from the internet.

Below Xilinx Wiki offers everything necessary to customize, build and deploy Embedded Linux solutions on Xilinx processing systems. Tailored to accelerate design productivity, the solution works with the Xilinx hardware design tools to ease the development of Linux systems for Zynq®-7000 SoCs.

https://xilinx-wiki.atlassian.net/wiki/spaces/A/overview

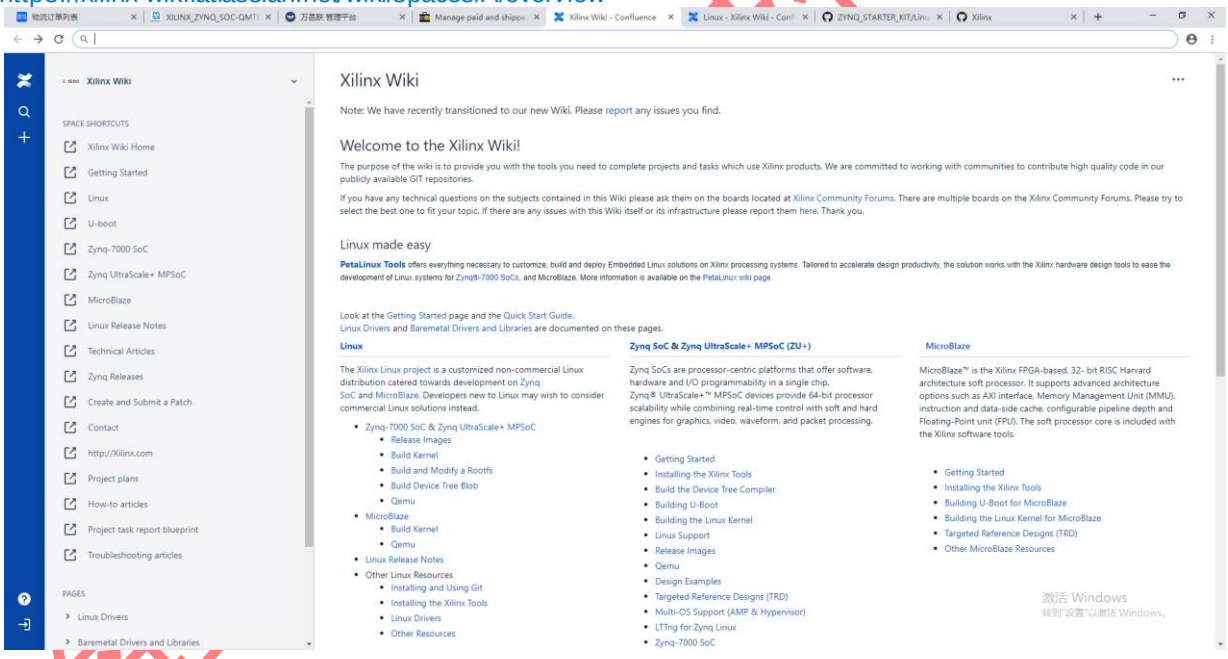


Figure 1-1. Xilinx Wiki

Below Github provides the official Xilinx Linux kernel and u-boot sources for Zynq®-7000 SoCs. QMTECH customized Linux kernel and u-boot sources are all from this repository: https://github.com/Xilinx

Below lists the linux source and u-boot Github source repository for QMTECH ZYNQ Starter Kit. Since these sources are already customized for the Starter Kit, users may download and build these sources directly. Nothing needs to be changed to make the Zynq XC7Z010 board running Linux environment.
https://github.com/ChinaQMTECH/ZYNQ_STARTER_KIT/tree/master/Linux
http://www.chinaqmtech.com/xilinx_zynq_soc

Since the customized Linux package is too large, users shall merge these five zip file into one and then unzip it.

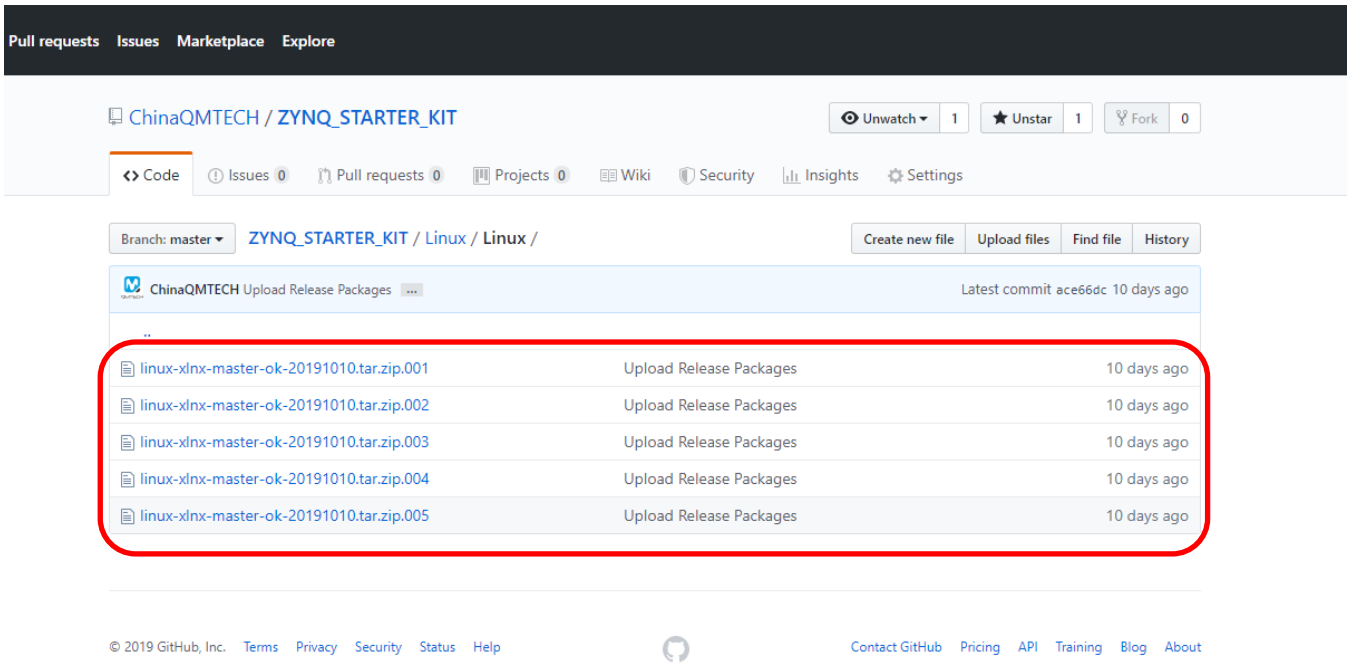


Figure 1-2. Customized Linux Packages

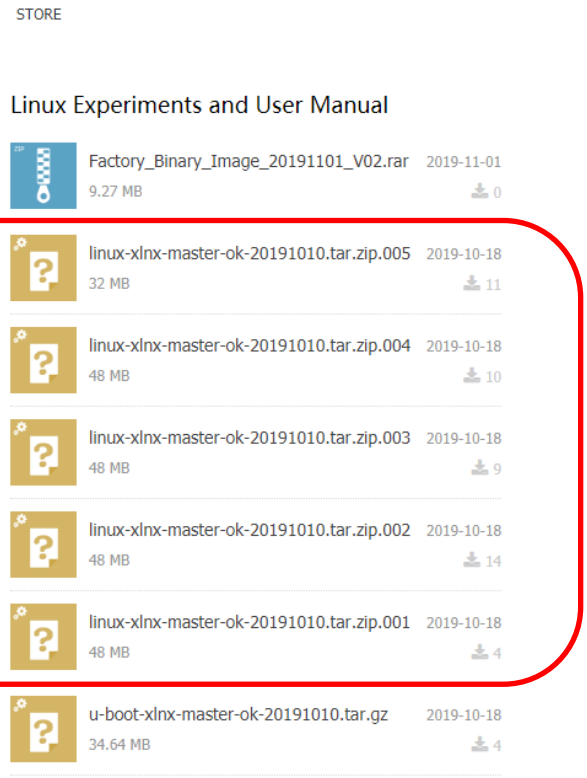


Figure 1-3. Customized Linux Packages

2. Getting Started

This chapter describes the detailed steps to create a customized Linux environment. Comparing to the existing ZYNQ development board e.g. Xilinx ZC702, there are many differentiations in the QMTECH ZYNQ Starter Kit. For example, there's only one 16bit width DDR3 memory chip connected to PS ARM core. And the ethernet interface no longer uses the GEM1, it uses GEM0 instead. Hence, the u-boot/ Linux device tree for the Starter Kit needs to be updated here.

2.1 Prepare the Linux Environment

Below image shows the example setup for the VMware virtual machine. Suggested size for the hard disk is 100GB because the Vivado takes so much storage space.

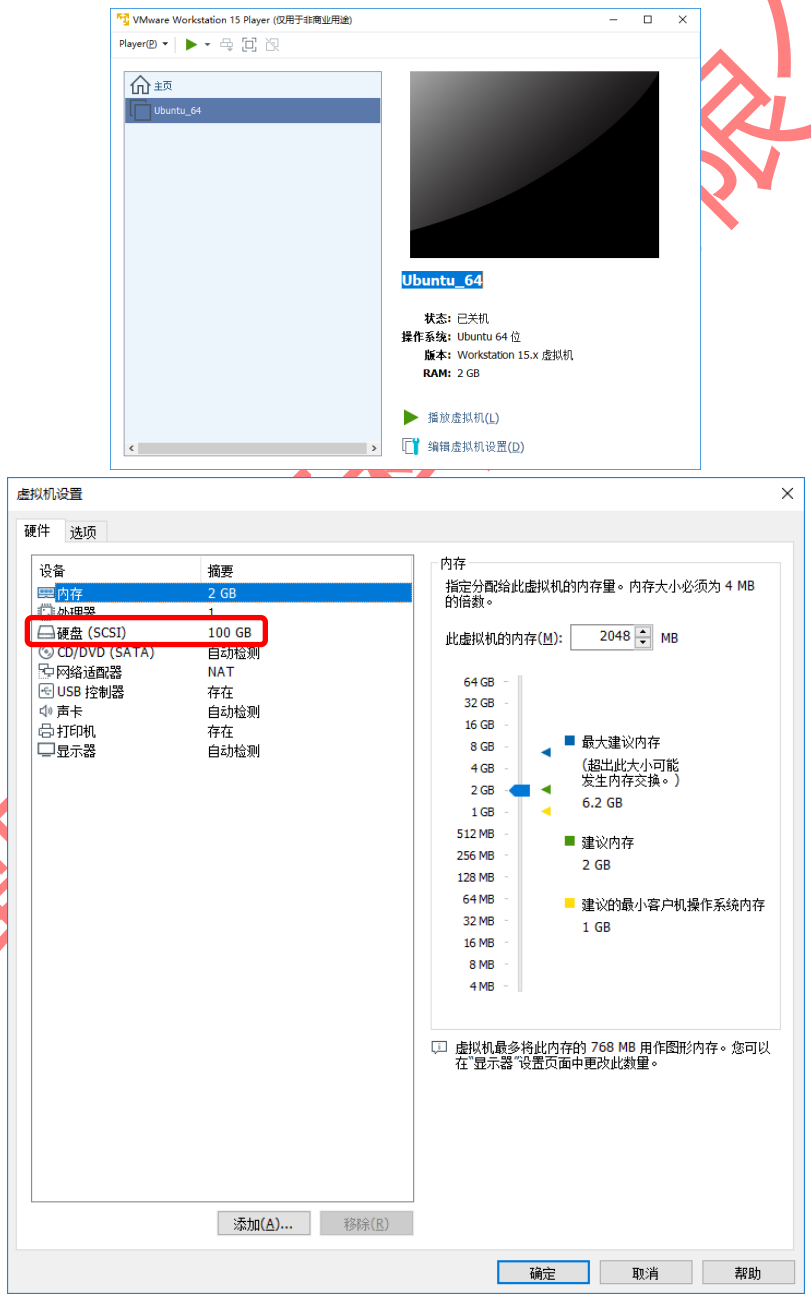


Figure 2-1. Virtual Machine Setup

Download the Xilinx Vivado 2018.3 Linux version from here. https://www.xilinx.com/support/download.html
Copy the installation package Xilinx_Vivado_SDK_2018.3_1207_2324.tar.gz into Ubuntu. And unzip the package and install it.

Below image shows the example Vivado installation directory. We could see all the cross compiler toolchain are available now.

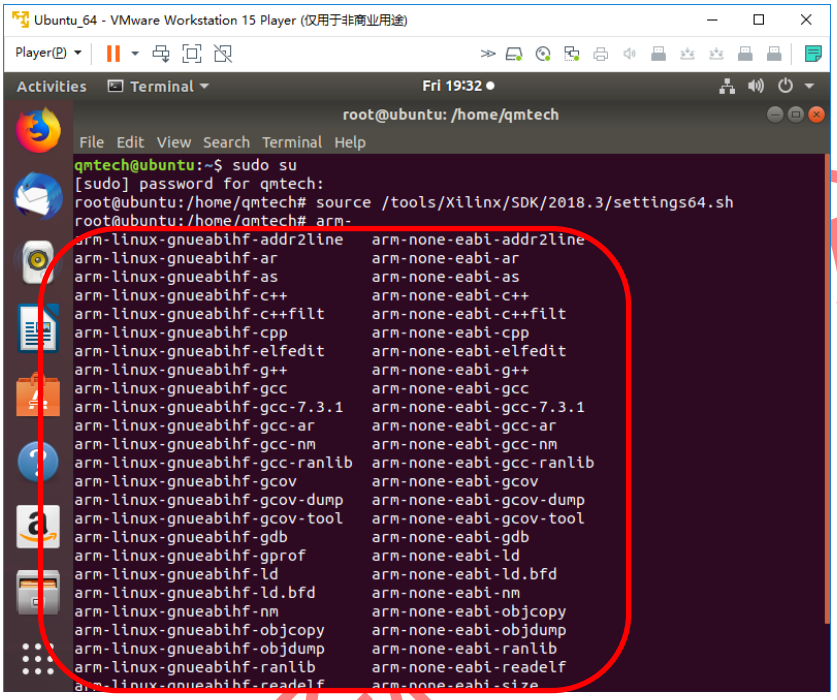


Figure 2-2. Vivado Installation

2.2 Steps to Customize the u-boot

The u-boot customization is based upon the Xilinx ZC702 development board. The first thing to do is to modify the u-boot/arch/arm/dts/zynq-zc702.dts. Below image shows the modified content for the customized QMTECH Starter Kit.

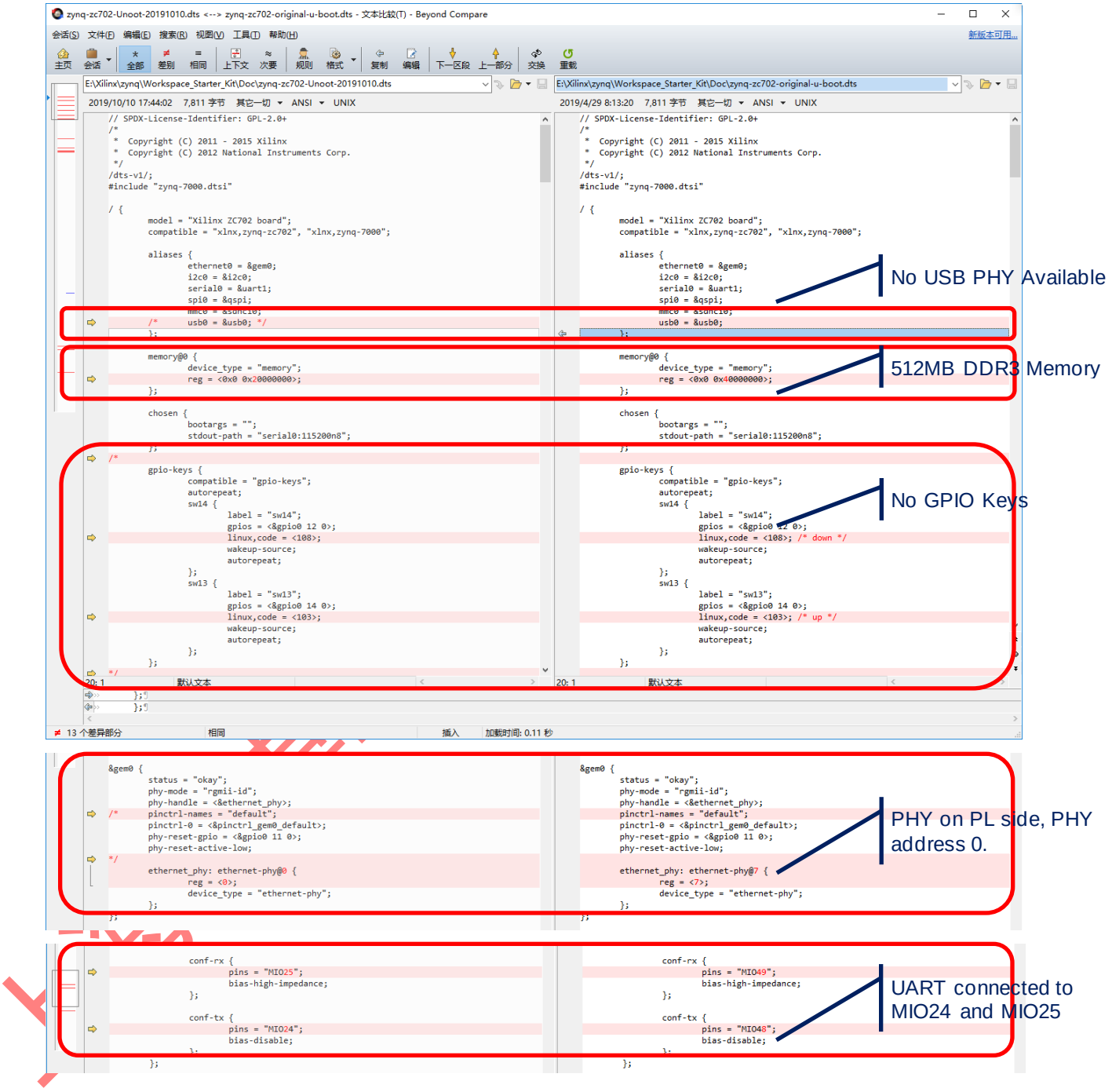


Figure 2-3. Modifications

Type command in the terminal: make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-zynq_zc702_defconfig. A new .config file will be generated.

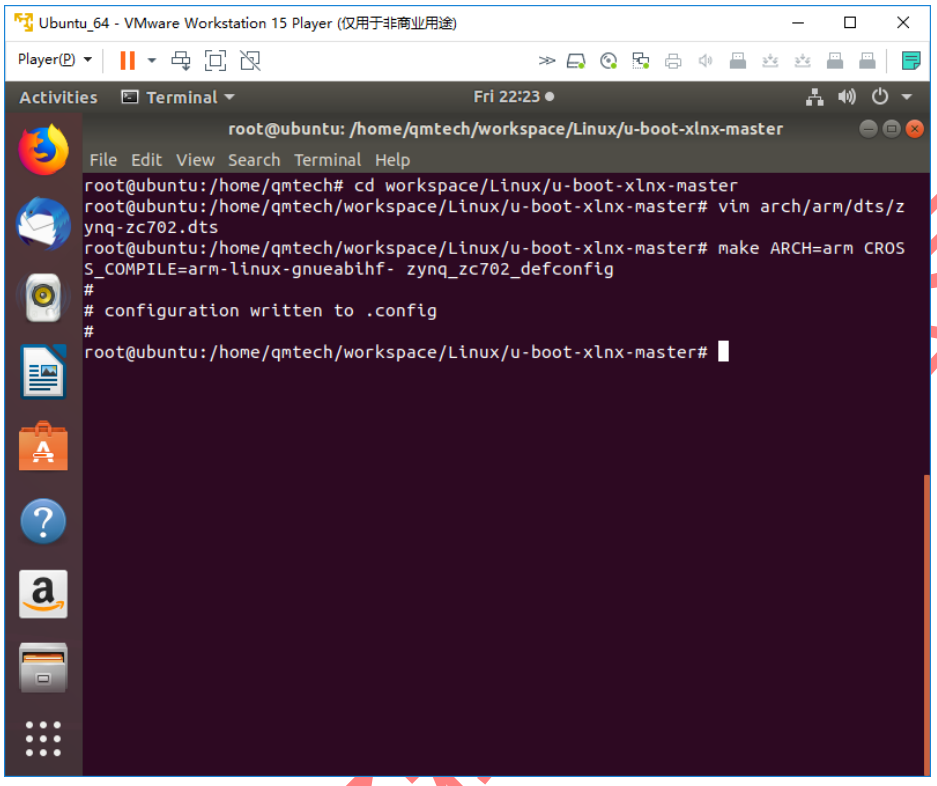
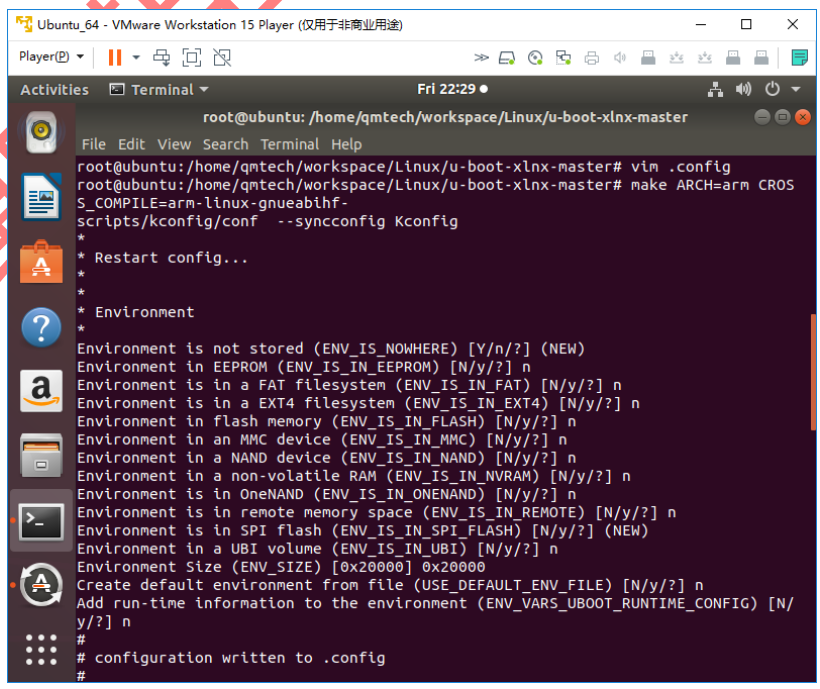


Figure 2-4. Make ZC702 Defconfig

Use edit tool Vim to edit the .config file. Comment below code line #CONFIG_ENV_IS_IN_SPI_FLASH = y. And replace CONFIG_BOOTCOMMAND="run distro_bootcmd" with CONFIG_BOOTCOMMAND="run bootcmd_xilinx". And then type this command in the terminal: make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-



Once the u-boot compilation is successfully finished, there's one file named as u-boot.elf will be generated. That's the target file needed for building a u-boot image running on ZYNQ SoC. Below image shows the content that generated in u-boot folder.

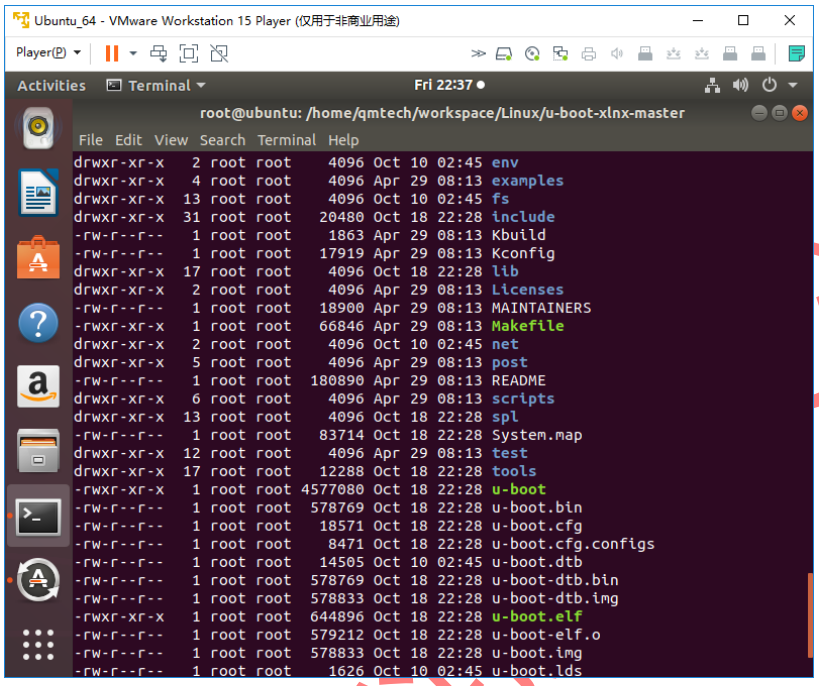
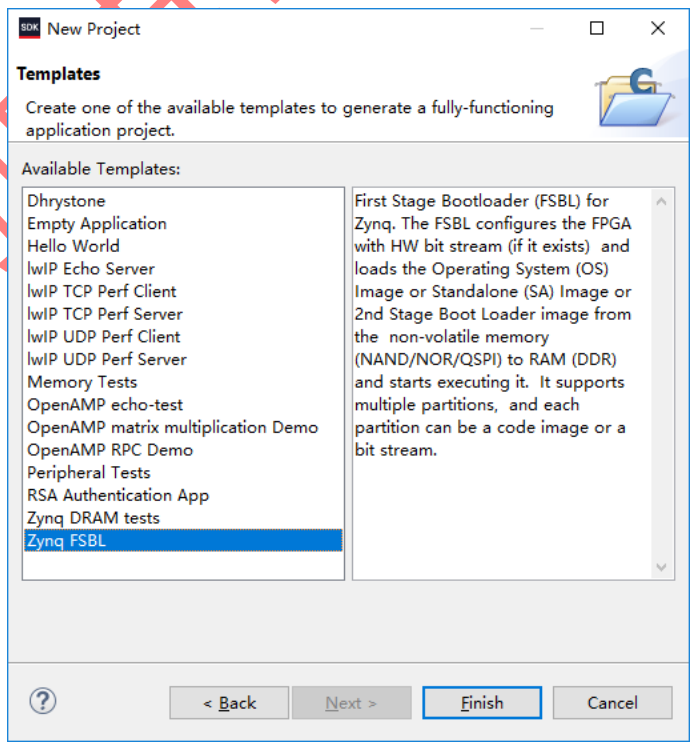


Figure 2-5. U-boot Compilation

Copy the u-boot.elf file into Windows system. E.g. put it into the folder Project04_Uboot. Then open the project Project04_Uboot. Make sure the compilation of this project brings no error and then Launch SDK.

Click **[File]→[New]→[Application Project]** to create a new project named as **fsbl**. Select the Zynq FSBL as the project template.



The fsbl project will be automatically compiled and then right click the project folder. Select Create Boot Image:

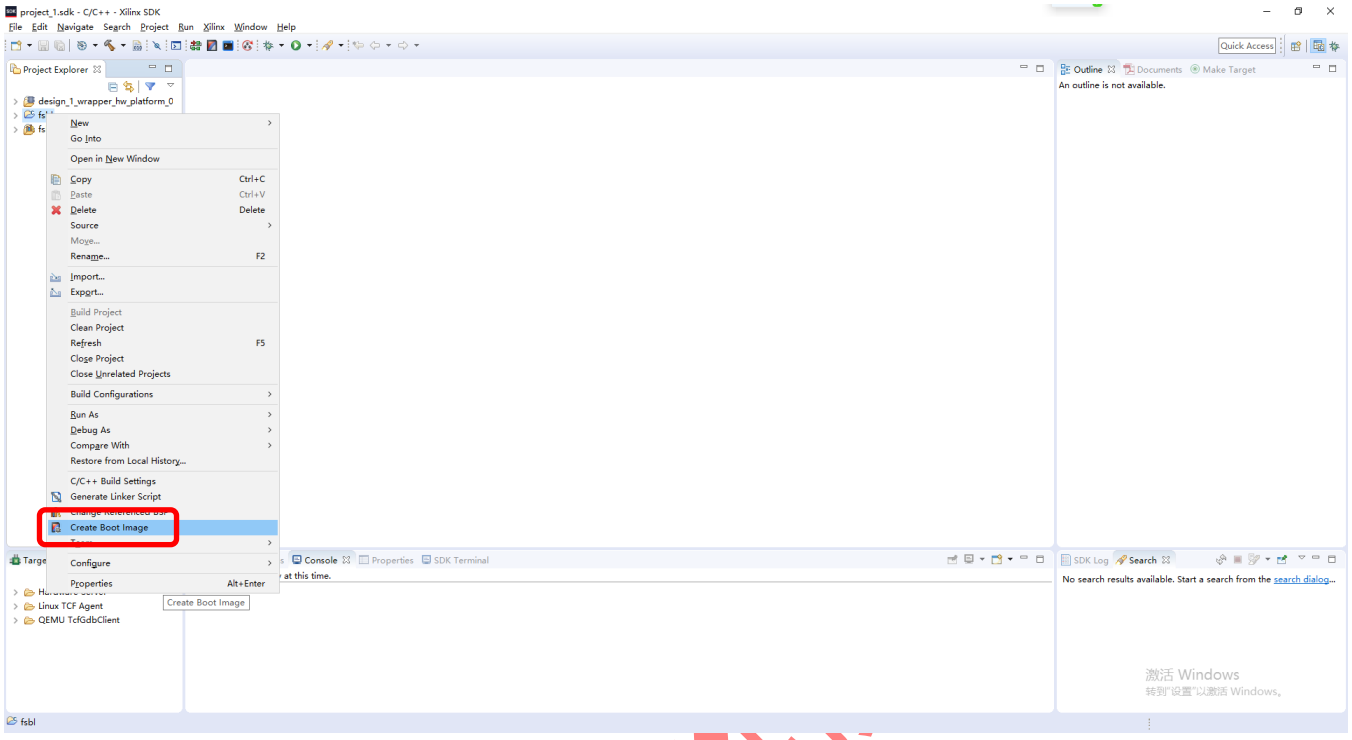
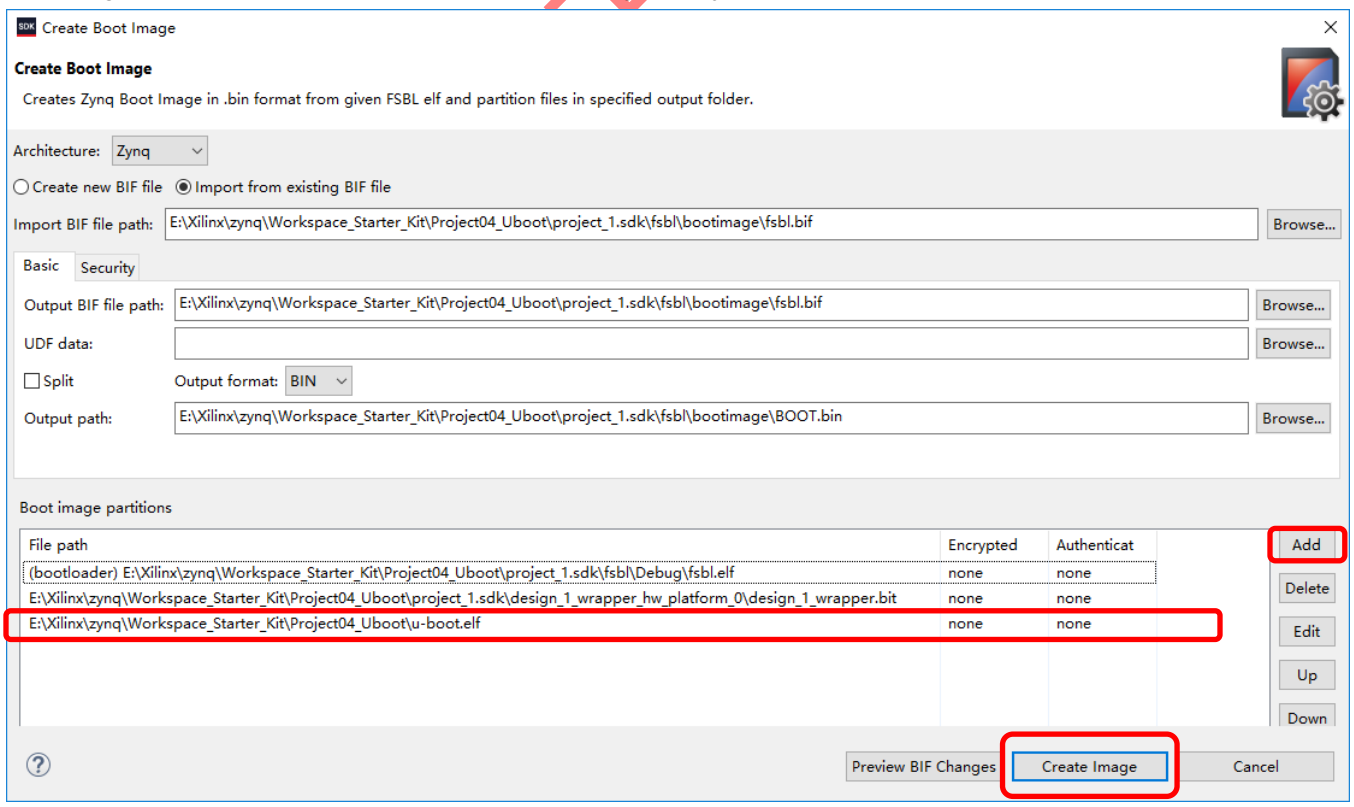


Figure 2-6. Create Boot Image

Choose the u-boot.elf when adding the Boot image partitions. Then click the Create Image button to generate the BOOT.bin which could be running directly on the ZYNQ SoC.



2.3 Steps to Customize the Linux OS

The Linux OS customization is based upon the Xilinx ZC702 development board. The first thing to do is to modify the linux\arch\arm\boot\dts\zynq-zc702.dts. Below image shows the modified content for the customized QMTECH Starter Kit.

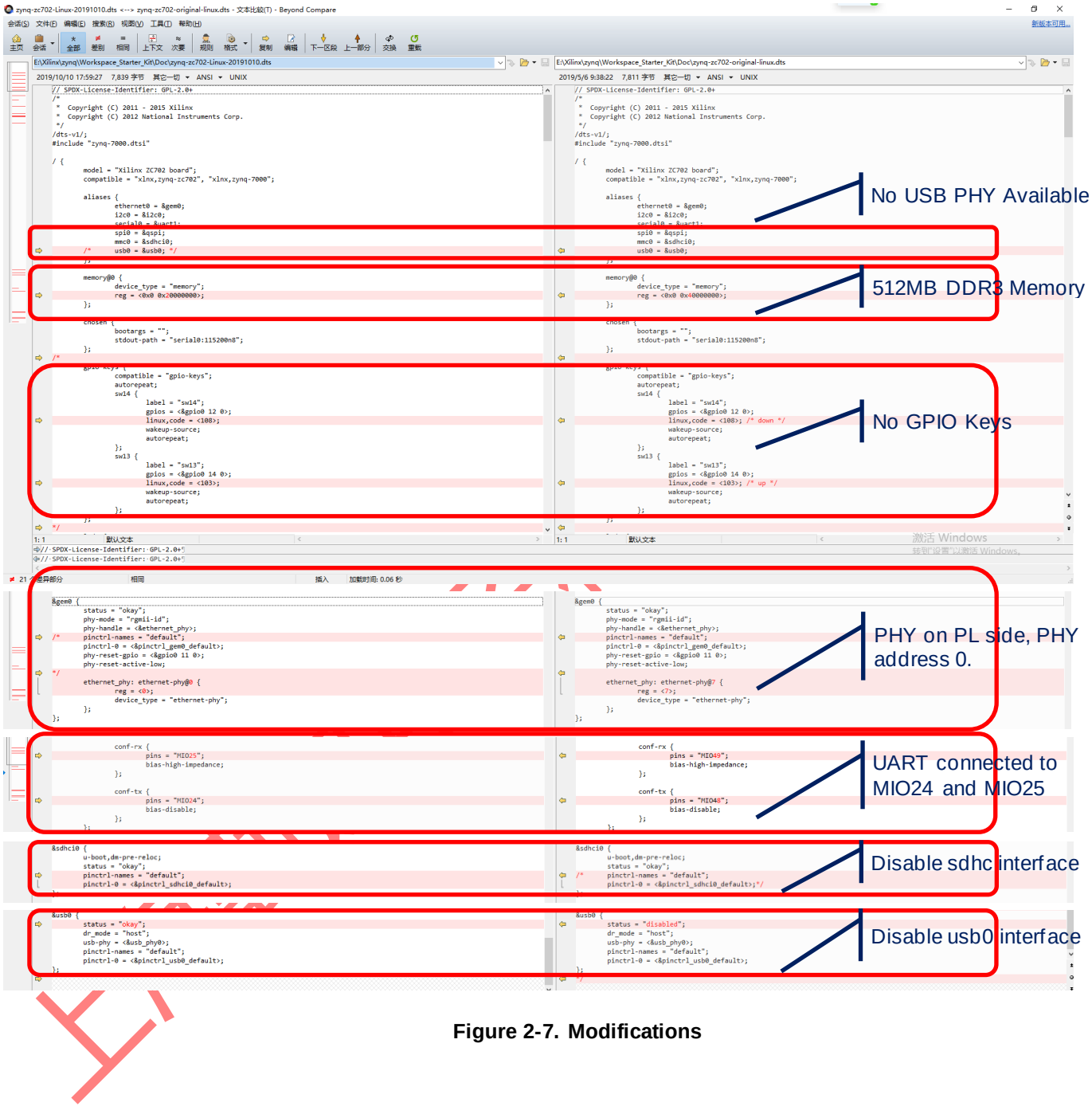


Figure 2-7. Modifications

Then type command in terminal window. make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- xilinx_zynq_defconfig. A .config file will be generated.

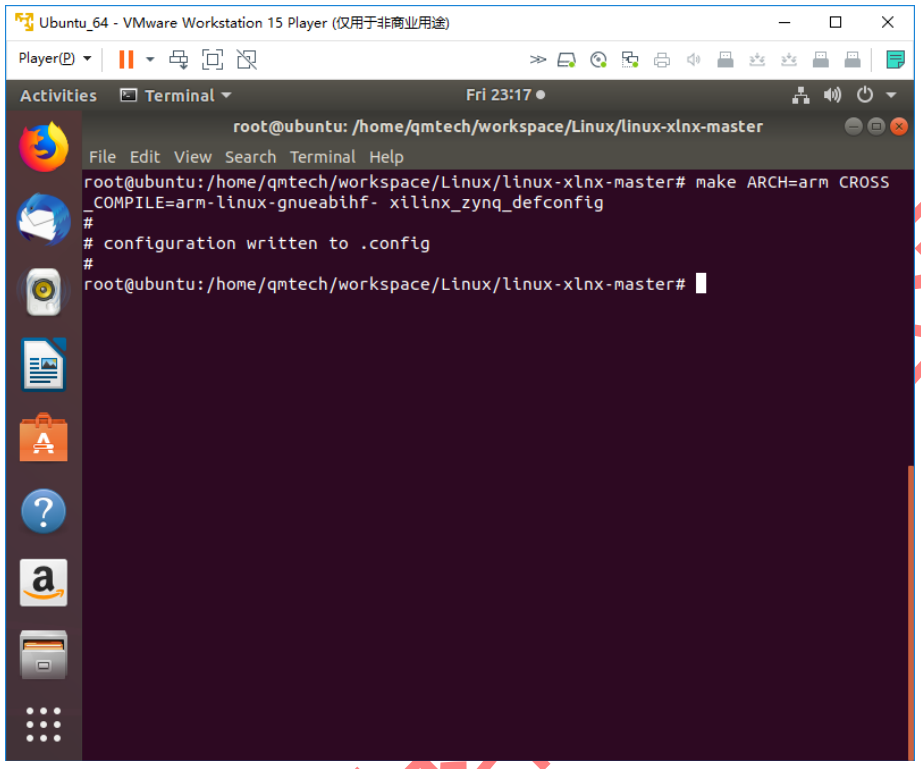


Figure 2-8. Make ZC702 Defconfig

If users want to change some configuration in the .config, users may open the configuration menu in a graphical way by typing command make ARCH=arm menuconfig.

Then type below command in the terminal window to start compile the Linux OS: make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- UIMAGE_LOADADDR=0x8000 uImage

In the process, linux-xlnx/arch/arm/boot/Image and linux-xlnx/arch/arm/boot/zImage are created. The Image file is the uncompressed Linux kernel image and the zImage file is a compressed kernel image which will uncompress itself when it starts.

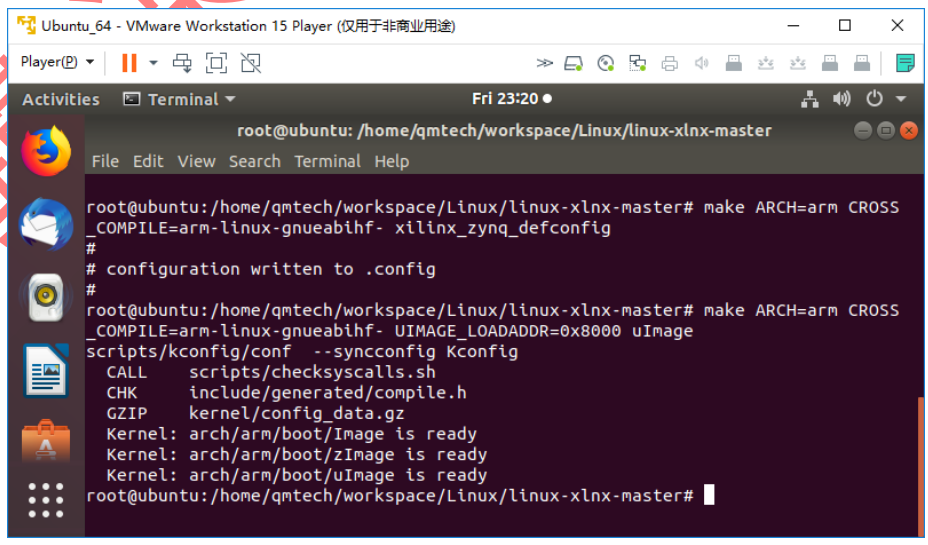


Figure 2-9. Compilation

Since the device tree also needs to be updated, users need to type command `make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- dtbs` in the terminal window. A zynq-zc702.dtb will be generated in folder:

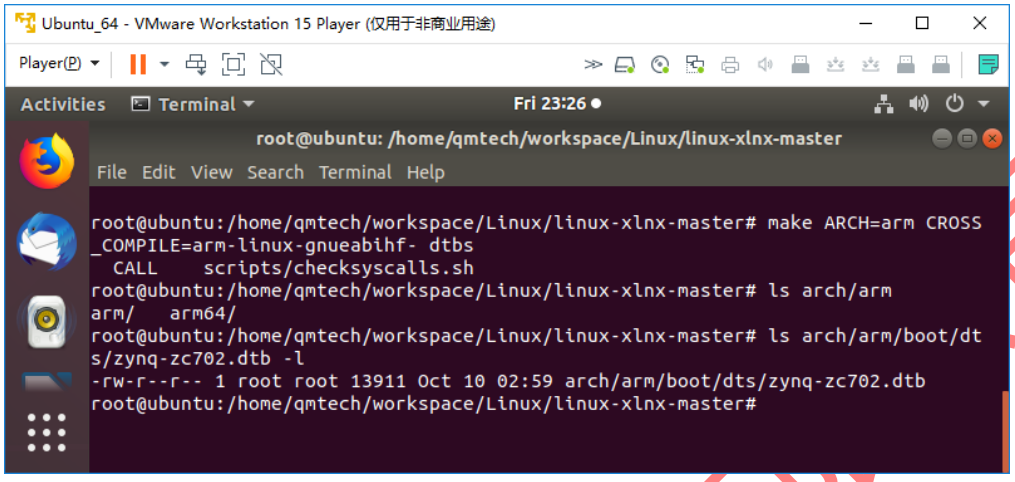


Figure 2-10. Update Device Tree

2.4 Steps to Make the File System

Users shall download the file `arm_ramdisk.image.gz` from below Xilinx Wiki and copy it into Ubuntu.

https://xilinx-wiki.atlassian.net/wiki/spaces/A/pages/18842473/Build+and+Modify+a+Rootfs

And then follow the modification guide shown in the above Xilinx Wiki.

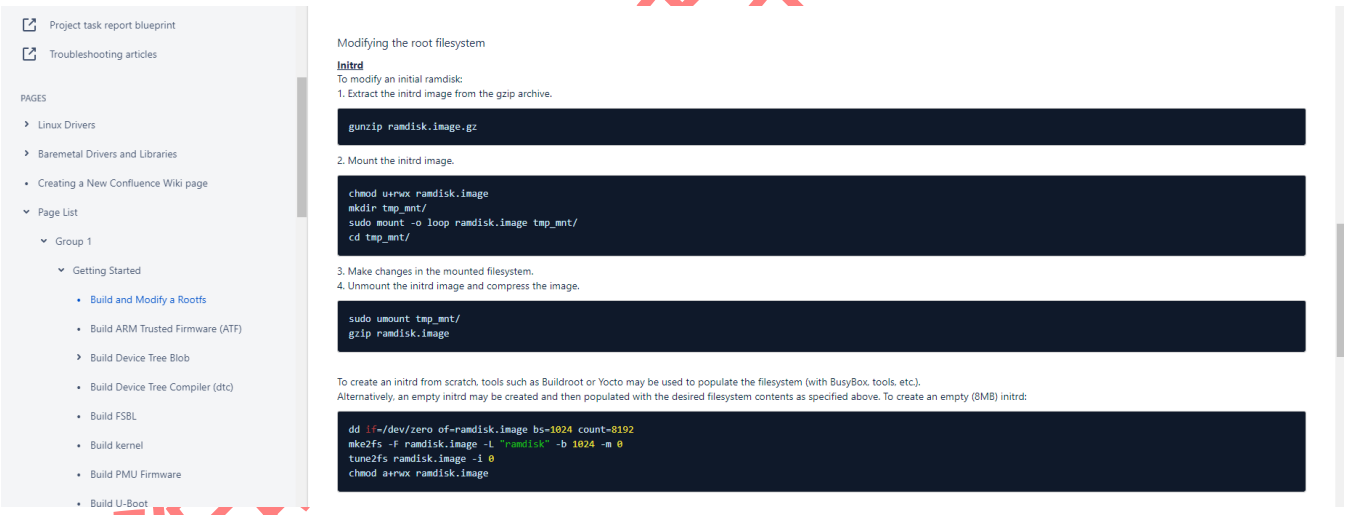


Figure 2-11. File System Modification

2.5 Test the Ethernet Under Linux Environment

Copy all the generated files into micro SD card. And make sure some rename needs to be done for file like: zync-zc702.dtb to devicetree.dtb. And then insert this micro SD card into the Starter Kit's card slot.

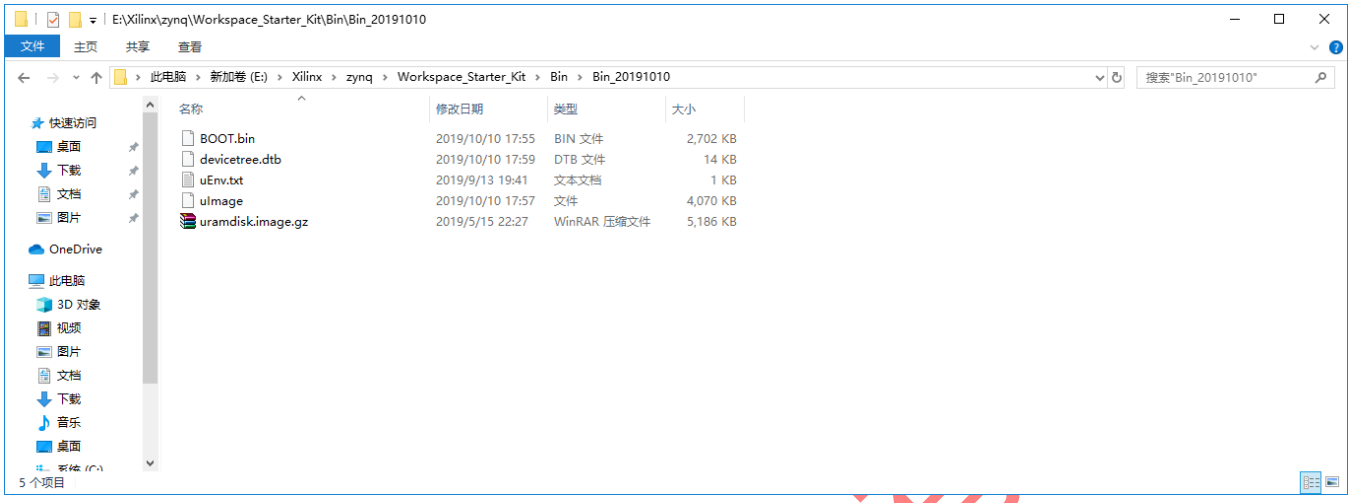


Figure 2-12. Factory Binary Image

Power on the Starter Kit and below log will be displayed on the terminal tool:

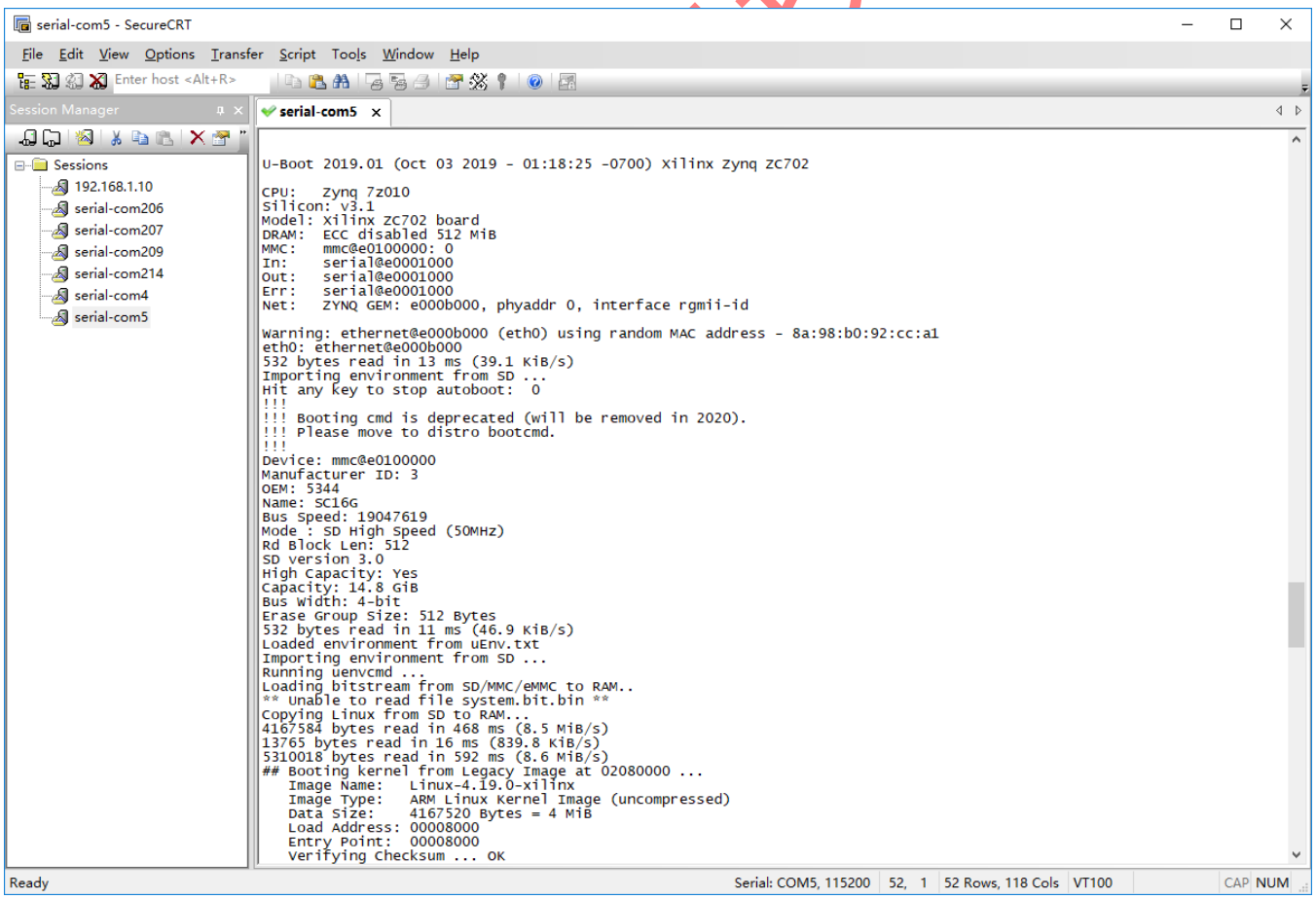


Figure 2-13. Log Info

Make sure the ethernet cable is connected to the router and QMTECH Starter Kit. Once the Linux OS successfully runs, users may type below ethernet test related commands to check the status of ethernet interface.

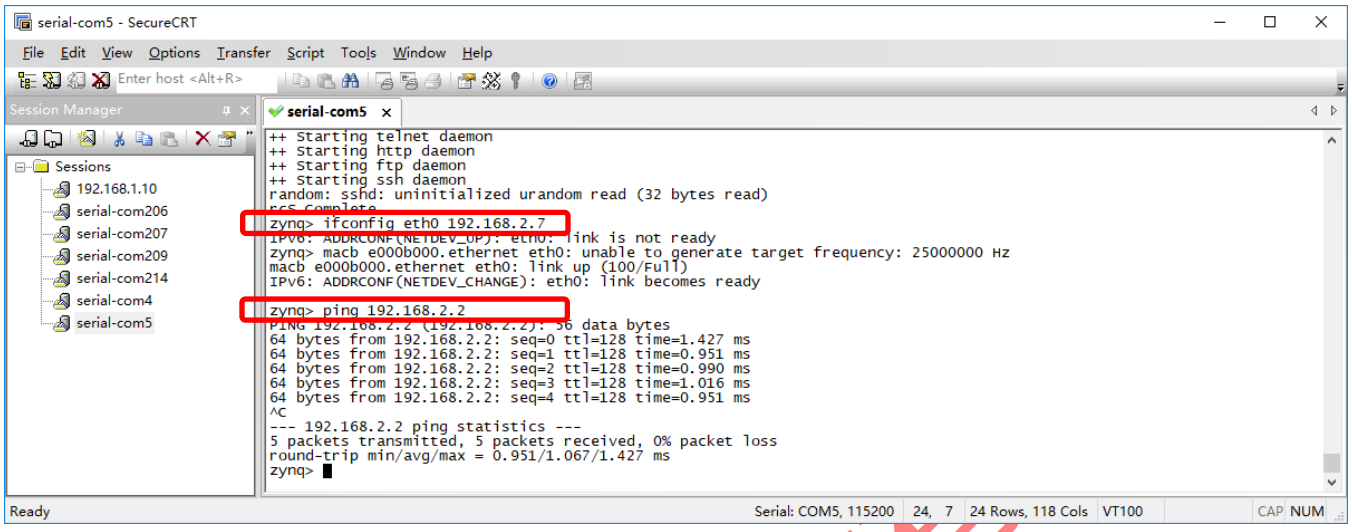


Figure 2-14. Echo Test under Linux

3. Reference

[1] ug585-Zynq-7000-TRM.pdf
[2] ds187-XC7Z010-XC7Z020-Data-Sheet.pdf
[3] ug865-Zynq-7000-Pkg-Pinout.pdf
[4] MT41K256M16TW-107:P.pdf
[5] tps563201.pdf
[6] IP101GA_2018-11-27.PDF

4. Revision

Doc. Rev.	Date	Comments
0.1	01/11/2019	Initial Version.
1.0	03/11/2019	V1.0 Formal Release.