PetaLinux Tutorial+Demo

For Avnet Zynq ZedBoard

What are PetaLinux Tools?

1. PetaLinux Tools are a tool-chain or a framework to develop customised Linux distribution for Xilinx SoC FPGA
2. PetaLinux Tools is based on the Yocto Project
3. PetaLinux is built on top of Xilinx Yocto Layers
4. Ships with XSCT and other Xilinx tools necessary for distribution development and deployment
5. Provides Board Support Packages (BSP) for Xilinx evaluation boards
6. Executes complex Yocto scripts and build process through simple commands
7. Abstracts complexities of Yocto Project from the user

Downloading and Installing PetaLinux

1. Download PetaLinux Installer from the following weblink :

   https://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/embedded-design-tools.html

2. Install the Board Support Package (BSP) corresponding to the Zynq 7000 SoC or the Zynq Ultrascale+ MPSoC from the same weblink: https://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/embedded-design-tools.html
3. BSP is essential to configure the kernel as per the underlying hardware
4. BSP describes the hardware and various features supported by the hardware
5. The Petalinux Tools installation guides detail the whole procedure for installing and using Petalinux.
6. Each Petalinux version comes with its own updated installation guide

PetaLinux - Installation Files - 2019.1

PetaLinux 2019.1 License and copyrights info (TAR/GZIP - 81.63 MB)

MD5 SUM Value : 002da213e5efb98f2a295b2135898d1f

PetaLinux 2019.1 Open Components Source Code (TAR/GZIP - 6.25 GB)

MD5 SUM Value : ec81867ff96211c9b887c5ea69e8e79d

PetaLinux 2019.1 Installer (TAR/GZIP - 7.14 GB)

MD5 SUM Value : f43b15fb25d5cc0026c2e44518f5ac29

ZCU102 BSP (BSP - 599.56 MB)

MD5 SUM Value : 2189911c4ac9c33f170cdced96472ba7

ZCU104 BSP (BSP - 1.27 GB)

MD5 SUM Value : 7565ebe8e94a08575bbda8a9942feba1

ZCU106 BSP (BSP - 1.26 GB)

MD5 SUM Value : a07155319c32fb3d29e051719ae9fb25

ZED BSP (BSP - 100.2 MB)

MD5 SUM Value : aad0d0e4576a562bbeaa547330164b52

sstate cache (TAR/GZIP - 32.84 GB)

MD5 SUM Value : 5a977150ee4ea4ebbf6b6c2aa1aafe11

README for state-cache (TAR/GZIP - 595 bytes)

MD5 SUM Value : 8f9131de963a5f21e6289ca1bc4a8c51

PetaLinux Installation Commands

● For this demo, we use Petalinux2018.3 as an example

To install PetaLinux Tools under ~/Petalinux2018.3, execute the following commands in your home directory :

$ mkdir -p ~/Petalinux

● Change to the installer download directory and execute the following command which will install PetaLinux tools in the Petalinux2018.3 folder created by you :

$ ./petalinux-v2018.3-final-installer.run ~/Petalinux

● Provided all the dependencies for the installation are available in the system, the installation should be smooth process

● All PetaLinux installer dependencies can be found in that versions installation guide

● Installation guide for PetaLinux 2018.3 can be found at the following weblink :

https://www.xilinx.com/support/documentation/sw_manuals/xilinx2018_3/ug1144-petalinux-tools-reference-guide.pdf

Creating a Project

- Type the following command wherever you wish to create the PetaLinux project post-installation :

  $ source <path-to-installed-PetaLinux>/settings.sh

- This imports the environment variables necessary for executing PetaLinux specific commands into the shell environment

- Create a basic project template by typing in the following command :

  $ petalinux-create --type project -s <path-to-bsp> --name <PROJECT NAME>

OR **$ petalinux-create --type project --template <PLATFORM> --name <PROJECT NAME>**

- **-s** refers to source of the BSP of the evaluation board
- **--template** specifies the Xilinx SoC platform which is being used(ex. Zynq)

Configuring a Project

- Configure the project as per the hardware designed in Vivado:

  $ petalinux-config --get-hw-description = <PATH-TO-HDF/DSA-DIRECTORY>

- It will pop-up a blue menu-config screen in which system configuration has to be done

- The **petalinux-config** command configures the general system behaviour such as :

  1. Source of U-Boot (provided by Xilinx or external source)
  2. Source of Kernel (provided by Xilinx or external source)
  3. Ethernet MAC address
  4. Type of Root Filesystem (INITRAMFS , NFS etc.)

- Many other things such as name of boot image file, baud rate for serial connection etc. can be specified here

- The **petalinux-config** command takes 5-10 minutes to complete execution

- The **petalinux-config** essentially configures the files which would be eventually built by PetaLinux using **petalinux-build**

Configuring the Kernel

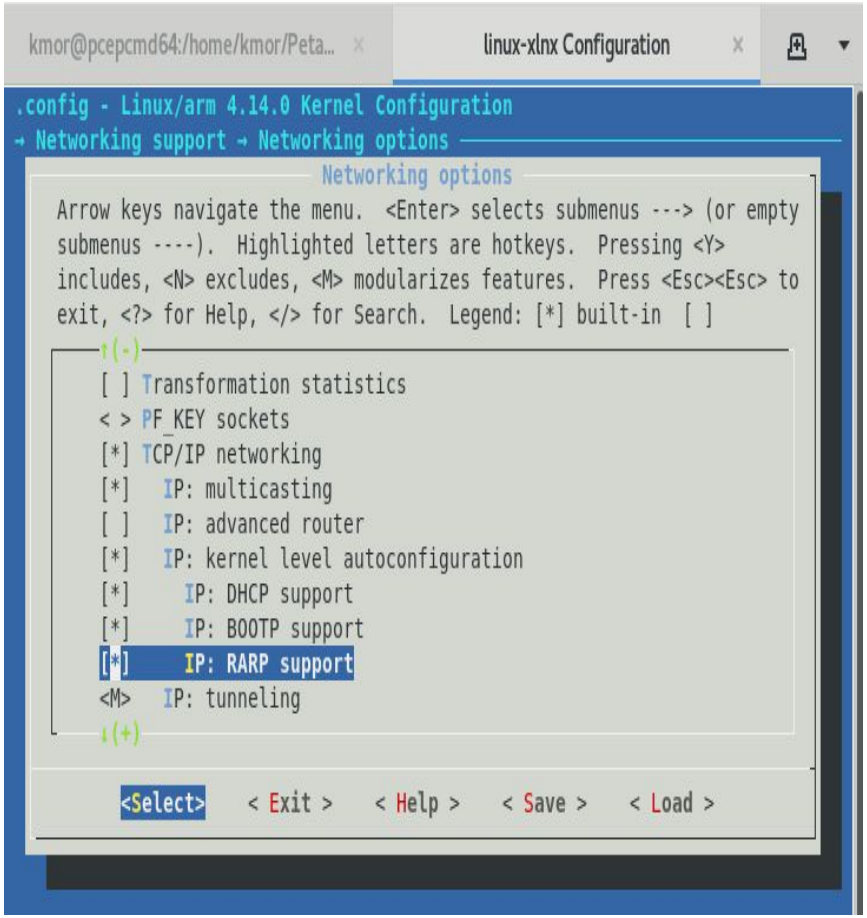
- The Linux kernel in use for the demo is the kernel provided by Xilinx
- Configuration of kernel by the user is not mandatory as a default configuration of kernel is done by PetaLinux using the BSP
- One can Configure the kernel after the **petalinux-config** command has done executing by typing the following command in project directory :

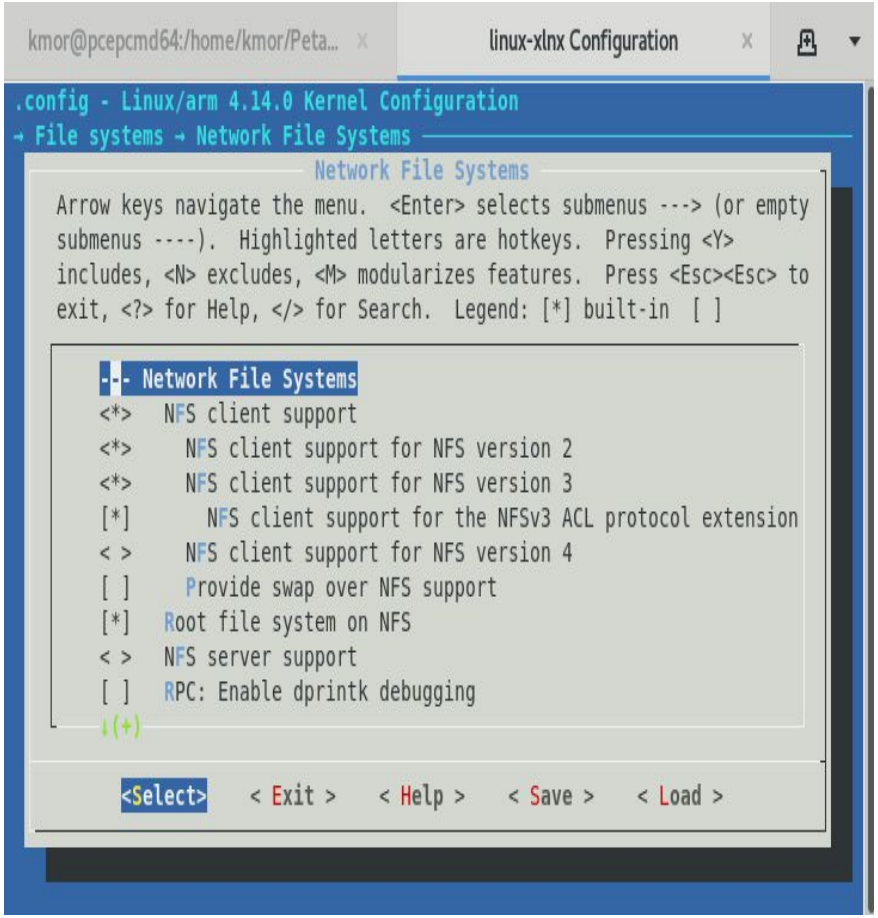
  $ petalinux-config -c kernel

- This command also takes 5-10 minutes to execute before a menu-config screen pops up
- Here, one can configure the kernel by adding/removing features as one wants
- More features associated with kernel means a large kernel file requiring a lot of memory space
- One should also ensure that conflicting features are not activated as it affects build process (**dropbear** and **ssh** for example)
- For this demo, for TFTP booting and NFS root filesystem we activate :

  1. IP : TCP/IP , DHCP, BOOTP, RARP support
  2. NFS : NFS Client support for NFSv2 or NFSv3 (depending on the NFS version which you are using)

- Other config commands include : **petalinux-config -c u-boot, petalinux-config -c rootfs**


kmor@pcepcmd64:/home/kmor/Peta...
linux-xlnx Configuration
.config - Linux/arm 4.14.0 Kernel Configuration
→ Networking support → Networking options
Networking options
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
↑(-)
[ ] Transformation statistics
< > PF_KEY sockets
[*] TCP/IP networking
[*] IP: multicasting
[ ] IP: advanced router
[*] IP: kernel level autoconfiguration
[*] IP: DHCP support
[*] IP: BOOTP support
[*] IP: RARP support
<M> IP: tunneling
↓(+)
<Select> < Exit > < Help > < Save > < Load >


kmor@pcepcmd64:/home/kmor/Peta...
linux-xlnx Configuration
.config - Linux/arm 4.14.0 Kernel Configuration
→ File systems → Network File Systems
Network File Systems
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
--- Network File Systems
<*> NFS client support
<*> NFS client support for NFS version 2
<*> NFS client support for NFS version 3
[*] NFS client support for the NFSv3 ACL protocol extension
< > NFS client support for NFS version 4
[ ] Provide swap over NFS support
[*] Root file system on NFS
< > NFS server support
[ ] RPC: Enable dprintk debugging
↓(+)
<Select> < Exit > < Help > < Save > < Load >

Building the PetaLinux Project

- After configuration of the files is done, it is time to build the project and generate output products
- To build the project, execute the following command in project directory :

  $ petalinux-build

- This command generates this step generates a device tree binary **DTB** file, a **First Stage Bootloader(FSBL)**, **U-Boot**, the **Linux kernel** FIT image, and compressed **root filesystem** . Finally, it generates the necessary boot images :

1. **BOOT.BIN** : A binary file which is responsible for loading the FPGA bitstream, the FSBL and the U-Boot.
2. **Image.ub** : Contains compressed kernel and device tree

- **petalinux-build** command uses BitBake to build the output products
- BitBake is a core component of the Yocto Project and is used by the OpenEmbedded build system to build images.
- BitBake is a generic task execution engine that allows shell and Python tasks to be run efficiently
- BitBake is a build engine that uses the recipes provided to it, to perform specific tasks.

Conclusion

1. PetaLinux Tools is easy to download and Install
2. It is easily configurable with HDF and Bitstream generated by Vivado
3. It is easy to use out of the box
4. Anyone can use it to develop a distribution for their Zynq 7000 or Zynq Ultrascale+
5. It is a good point to start understanding Linux distribution development
6. PetaLinux Tools a good point to start understanding Linux boot process

Thank You!
Questions?