PetaLinux Implementation in GPAC 2.1

Revision 1.1
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Content

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History

Revision	Date	Author	Description
1.0	22.10.2014	W. Koprek	First version of the document.

References

[1] PetaLinux Wiki Page, http://www.wiki.xilinx.com/PetaLinux

Acronyms

Acronym	Full Name
FPGA	Field Programmable Gate Array
CSS	Cascading Style Sheet
PB FPGA	Piggy Back FPGA
BP FPGA	Backplane FPGA

1 Introduction

This document describes how the PetaLinux from Xilinx was adapted and ported to GPAC 2.1. It contains mainly implementation specific details. For more details about PetaLinux refer to documentation provided by Xilinx [1].

2 PetaLinux Implementation

2.1 File System

The PetaLinux file system consists of two parts. One is the romfs which is included in the image file of the linux installation. The second part is located on compact flash card of GPAC board.

2.1.1 Image File

Image file is generated from PetaLinux during compilation process of the kernel. The image file contains:

- Linux kernel – the compiled PetaLinux kernel with all modules necessary to boot and operate on GPAC board
- ROM filesystem – the romfs contains all files necessary for Linux booting and operation. This file system is created during linux booting and is loaded to RAM of the CPU.
- DTB file – the Device Tree Blob file is a binary version of DTS file. The DTB contains hardware configuration information necessary for booting and operation of the Linux.

2.1.2 The ROM Filesystem

The ROM files system (rofms) is included in the image file. When the Linux is booting it loads the romfs from image file and puts it in RAM. The files and folders can be modified in run time and are temporary. All modifications are lost after reboot of Linux.
The folder tree below presents the root folder of the romfs with some subfolders specific for the GPAC implementation.

```
\
 bin\
 dev\
 etc\
 home\
    www\
 init\
 lib\
 linuxrc\
 mnt\
    cf\
 proc\
 sys\
 tmp\
 usr\
 var\
```

2.1.3 Compact Flash Card

In addition to romfs the GPAC board provides external file system. This file system is stored on compact flash card which is connected to Virtex-5 FPGA by means of SystemACE chip – see figure 1.

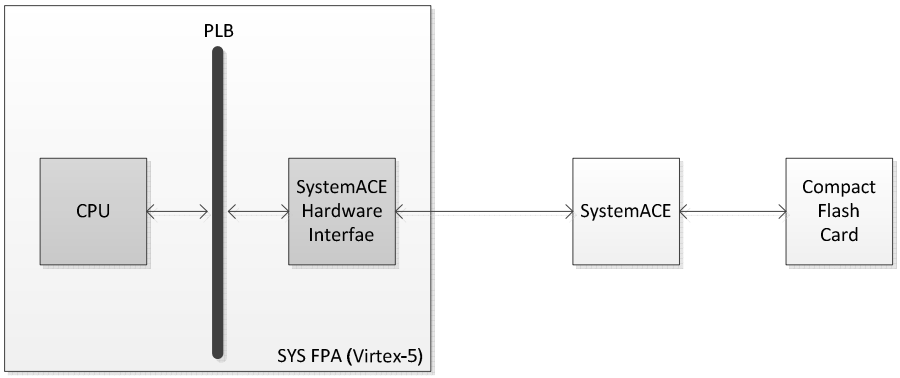

Figure 1. Connection of compact flash card to CPU on GPAC 2.1

The table 1 contains folder structure which is

Important: The compact flash card has FAT16 file system which only allows for 8.3 format of file names – maximum eight characters for the file name and up to three characters for the extension. Writing to compact flash card files with names violating this rule may lead to corruption of the file system on the card.

Table 1. Content of the compact flash card

\	Root folder mounted to \mnt\cf in Linux when Linux boots up.
\bin	Folder contains the image files for booting CPUs on GPAC
\image.elf	ELF file with Linux image.
\etc	Folder with configuration files for applications build in the Linux kernel
\fpga	Configuration files for FPGA chips. It contains bit streams for CFG FPGA, SEU FPGA, and .ace file for all other chips.
\cfg.bit	Configuration bit stream for CFG FPGA. It is used to program EEPROM of the CFG FPGA.
\seu.bit	Configuration bit stream for SEU FPGA. It is used to program either the SEU FPGA or EEPROM of the CFG FPGA.
\rev0	Folder contains ace files.
\rev0.ace	ACE file used by SystemACE chip to program SYS FPGA, BP FPGA, BPM1 FPGA, BPM2 FPGA, PB1 FPGA, and PB2 FPGA.
\rffe	Configuration files for EEPROM programming in various RFFEs
\usr	User specific Linux files. This folder is copied to \usr folder in romfs when the Linux boots up.
\www	Web server files. The conent of this folder is copied to \home\www\ folder in romfs when the Linux boots up. More details in section with web server implementation.
gpac.cfg	GPAC configuration file. See file description for details. Used by boot loader and Linux boot process.

xilinx.sys	Xilinx configuration file used by SystemACE to find the default configuration .ace file

2.2 Loadable GPAC Kernel Module for Synchronous Applications

2.3 Linux Applications and Services

2.3.1 telnet

The GPAC Linux provides telnet server. This standard program allows remote access to the system.

2.3.2 ftp

The FTP server running on GPAC Linux allows access to both romfs and CF card file system. The FTP client can read and write any file from GPAC.

Note: Files written to romfs will be lost after Linux reboot. Files written to CF card (folder /mnt/cf) will stay there permanently.

2.4 Linux Configuration and Update

2.4.1 Hostname

The Ethernet interface of the Linux is configured to DHCP. It supports DHCP server with dynamic DNS. The dhcp client in GPAC sends request with its own hostname included in options field. The GPAC hostname can be forwarded by the dhcp server to local dns server in order to bind the GPAC IP address to its name. The hostname of GPAC is configurable and it is stored in gpac.cfg file in CF card. The configuration line for hostname in gpac.cfg consists of key word 'hostname' followed by '=' character and the hostname. It may look like below:

```
hostname=ipc1361
```

where the 'ipc1361' string can be set to any hostname.

2.4.2 MAC address

Each GPAC board has fixed MAC address which is taken from the PSI pool of MAC addresses. The MAC address cannot be modified. It is stored in 1-Wire EEPROM of GPAC board. Each GPAC board should have green sticker with the MAC address on the left SFP cage. This MAC address is passed to Linux boot process to configure the Ethernet interface.

Important: Do not use Ethernet interface in GPAC boards which have no green sticker with MAC address on the left SFP cage.

2.4.3 Updates

The firmware and software running in GPAC 2.1 can be updated remotely using ftp client. All configuration files are stored on the CF card. Any update of the firmware or software is done by copying corresponding file from client host to the CF card of the GPAC. The ftp can be used to update:

- firmware of CFG FPGA and SEU FPGA (bit files in folder /fpga)
- firmware of application specific FGPA chips, namely SYS FPGA, BP FPGA, BPM1 FPGA, BPM2 FPGA, PB1 FPGA, PB2 FPGA (ace file in folder /fpga/rev0)
- Linux kernel and ROM file system (file /bin/image.elf)
- Binaries and configuration of user applications for Linux
- Web server documents
- GPAC configuration

Important: When files are copied from client ftp to GPAC CF card over Ethernet they are first buffered in RAM of GPAC board and then the FTP server on GPAC writes the data to CF card. The Ethernet transfer is faster than the CF card interface. Therefore when the ftp transfer is finished the file transfer to CF card may still run. Wait a few seconds before switching off GPAC board after uploading of large files to CF card.

3 Built-in User Applications

All applications described in the following sections are compiled as a stand-alone executables which exist as independent files stored on CF card in folder \usr\bin. All these files are copied during Linux boot to \usr\bin folder in romfs. Each file can be update separately by uploading new version to CF card using FTP.

3.1 goahead – Web Server

Table 2. File structure of the web server.

\	Root folder of the web server which is located in \home\www folder of the Linux file system.
cgi-bin\	Contains shell scripts executed on the server side which can be called from a web browser.
css\	Cascading Style Sheets (.css) files contain definition of the look and formatting of the web documents.
doc\	Folder with documentation files stored in pdf format and displayed in the web browser in the same format.
images\	Graphical files included in the web documents.
include\	Folder contains include files which are small parts included in the web documents. These files are used to generate dynamically a web document on the server side.
js\	JavaScript files. These files are included in web documents and executed on the client side.
index.html	Default web documents which is loaded when no file is

	specified in the url address.
favicon.ico	The default icon displayed in the web browser.

3.2 mrd, mwr – Memory read/write

3.3 progrffe – Programming EEPROM of RFFEs

3.4 xc3sprog – Firmware update in CFG and SEU FPGA

3.5 gpacsrv – GPAC data server for user applications