



**FLE Fusion uCLinux: NuHorizons Spartan3DSP-1800 Setup Guide  
January, 2009**



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**1. Change Log**

Revision	Description	Editor
1.0	Initial Release	SMS
1.1	Added note about USB Serial Cables	SMS



## **2. Introduction**

This document is intended to provide the reader with a step-by-step setup guide for configuring the Finger Lakes Engineering Fusion uCLinux onto the NuHorizons Spartan3-DSP1800 Evaluation Board.

The FLE Fusion uCLinux is based on the 2.4.31 uCLinux kernel, originally ported to the Microblaze architecture during R&D work at the University of Queensland.

The FLE Fusion uCLinux represents the combination of custom Microblaze IP, Xilinx Microblaze IP, Bootloader technology, uCLinux kernel technology, FLE auto-configuration technology, and the innovative development environment →FLE Fusion←.

Combining these technologies allows expert to inexperienced Linux developers the ability to harness the uCLinux O/S for developing robust and high performance embedded applications in a “straight forward” approach.

Bookmark [www.FL-ENG.com](http://www.FL-ENG.com) for more information on the FLE Fusion system.

### 3. What are we about to do?

Through this guide, we are going to begin a configuration process that will allow the uCLinux 2.4 kernel to be installed on the NuHorizons Spartan3-DSP1800 Eval Board. Once installed, it will be possible to demonstrate the following functions

- Intelligent bootload functions available through U-BOOT
- Demonstration of Video Capture and Video Display using the FLE Viper Video Technology
- 



**Before beginning, it is important the reader obtain the following hardware/software items and install them on a Windows XP/2000 host PC before continuing.**

#### Standard Required Items

- Xilinx ISE 10.1 and EDK 10.1
- NuHorizons Spartan3-DSP 1800 Evaluation Board
- Xilinx Impact USB JTAG Cable
- RS232 Female-to-Female Cable
- Monitor supporting at least 800x600 video display
- 10/100 Ethernet cable connected to a 'live' network
- Appropriate power supplies/etc

#### SP3E/Fusion Specific Required Items

- Install a local copy of the SolarWinds TFTP server (available on [www.fl-eng.com](http://www.fl-eng.com))
- Copy and unzip the FLE-NUHO-SP3DSP1800.zip project to the host PC
- Copy the bootme4linux.bin, uboot.hex, fpga.mcs files to the host PC (ex: c:/temp)

Once these items have been acquired/installed, proceed to the next section.

#### 4. Installing a TFTP Server

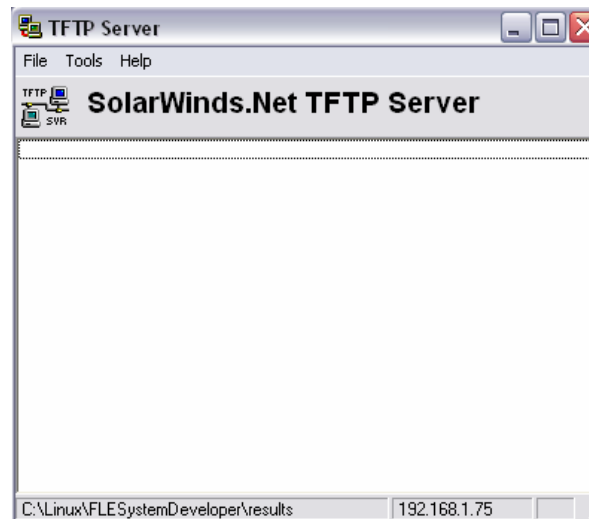
Before beginning, we need to ensure that the SolarWinds TFTP server is installed and configured properly. The TFTP protocol will be used to transfer the Linux O/S to the eval board and to allow demonstration of remote update functions.

Finger Lakes Engineering recommends the use of the FREE SolarWinds-TFTP. This is available on [www.fl-eng.com](http://www.fl-eng.com) on the Fusion Technology page.



**Depending on your local PC, you may need to disable/change the firewall settings to allow the eval board to access the TFTP server.**

Install the TFTP server and launch it from the Window's start menu. It should appear as follows.



The server must be configured for the path and permissions to allow the target hardware to retrieve the uCLinux O/S.

In order to do this, first select File→Configure.

Select the RootDirectory tab. Set the root directory to the location where the uboot.bin, bootme4linux.bin, and uboot.hex files exist.

Select the Security tab and ensure that Send AND Receive files is selected. This will allow the target hardware to access the RootDirectory.

Once this is complete, proceed to the next step.



## **5. Downloading the FPGA Image**

For simplicity, exact details on how to use the Xilinx tool-chain are not covered in this document. It is assumed that the reader is familiar with the Xilinx ISE, EDK, and IMPACT tool.

Within the unzipped project fileset ,a file called FPGA-xxxxx.MCS should exist.

This file must be downloaded into the SPI FLASH located on the NuHorizons Spartan3-DSP board using the Indirect SPI Flash Programming method. Full details on this method can be found in the User Guide that is packaged with the Eval Board.

To program the MCS File follow these steps

- 1) Remove power from the Eval Board
- 2) Connect the JTAG cable to H3 (do not connect it to the slot near the dip switches)
- 3) Set the bootmode jumper H2 to be located between pins 2 and 3 (jtag mode)
- 4) Apply power and launch Xilinx Impact
- 5) Discover the JTAG chain and cancel out any file-browser boxes that may appear.
- 6) Impact should display a picture of the Xilinx SP3DSP1800 FPGA
- 7) Right click on the FPGA and select “Add SPI Device”
- 8) Locate the FPGA.MCS file using the file-browser box that will appear in step #7
- 9) Associate the FPGA.MCS file with the M25P128 Flash Device
- 10) Impact should now display the FPGA image with a small SPI Flash Image
- 11) Right click on the SPI Flash image and select the “PROGRAM” option
- 12) Programming may take 2-5 minutes
- 13) Once completed, change jumper H2 to be located between pins 1 and 2 (SPI mode)
- 14) Ensure that a valid serial link is connected between the PC and the Eval Board
- 15) Ensure that Hyperterminal is set to 115200,8,N,1 with NO Handshaking
- 16) Ensure that a PC monitor is connected to the Eval board
- 17) After completing these steps, power cycle the eval board and the new FPGA image should boot

Upon booting the FPGA image, the following text should appear in the Hyperterminal window.

```
*****  
***   Finger Lakes Engineering   ***  
***   www.FL-ENG.COM             ***  
*****  
  
Starting External RAM MemoryTest  
Running 32-bit test...PASSED!  
Running 16-bit test...PASSED!  
Running 8-bit test...PASSED!  
Clearing main memory...  
Press 'F' to enter the first-stage bootloader...  
Booting in 5  
Booting in 4  
Booting in 3  
Booting in 2  
Booting in 1  
Attempting to Direct Boot the User Application [0x00200000].....  
Application Appears Invalid!...HALTING!
```

Note that a 5-second boot countdown is shown. During the boot countdown, press the “F” key to enter the first-stage bootloader. This will allow downloading of the U-BOOT second stage bootloader.

Power cycle the board if you did not press the “F” key in time.

The boot menu will appear with only one option: Erase and download a U-BOOT image.

Select this option (option #1). This will erase SPI flash sections 8-11 (preserving the FPGA bitstream image).

After the erase cycle is complete, a prompt will appear to begin the ASCII hex file download. Goto the Transfer→SendTextFile option in hyperterminal and locate the uboot.hex file that was included in the zip package.

The download should take approximately 4 minutes. After ensuring that no transfer errors occurred, power cycle the Eval board and allow the boot countdown to occur without interruption. This will allow U-BOOT to launch.



**It has been observed that some USB<>SERIAL cables will drop data during the serial download process, causing file corruption of UBOOT. It is recommended to use a high quality USB<>SERIAL cable (such as those made by FTDI inc) or ideally a desktop PC with a true DB9 serial port).**

## 6. Configuring the Boot Environment

The first time U-BOOT starts, it is required to configure the Environment settings. The environment settings specify the network mode(s) that will be used to allow the Ethernet port to function.

At the U-BOOT prompt, type the command ‘printenv’ and press return.

A series of environment settings should appear similar to the list below.

```
FUSION> printenv
bootcmd=boot          (autoboot command function to call from the main menu)
bootdelay=10         (approximate number of seconds before uCLinux boot)
ethaddr=12:22:33:44:55:66 (mac address)
ipaddr=192.168.1.222  (target's static IP address)
serverip=192.168.1.190 (IP address of the HOST PC with the TFTP server)
gatewayip=192.168.1.1 (address of the network gateway)
netmask=255.255.255.0 (network submask)
ethact=eth0          (Ethernet adapter)
serialnum =FLE-15WESTMAIN-UNIT1 (unit serial number)
```

The settings ethaddr, ipaddr, serverip, gatewayip, and netmask must be setup for your local network. Make sure that the ipaddr is set for a UNUSED address on your network.

Use the following commands to configure these values.

```
setenv ipaddr A.B.C.D
setenv gatewayip E.F.G.H
setenv netmask I.J.K.L
setenv serverip M.N.O.P
```



**Open a DOS shell and type “ipconfig /all” to see the host PC’s ip, gateway, and netmask. Use the same GATEWAY and NETMASK for the eval board as your local PC uses.**



**Note that the serverip must be the IP address of the PC running the SolarWinds TFTP server. The IP address is visible in the lower right hand side of the SolarWindows TFTP GUI.**

After issuing the above commands, enter the command saveenv

The ‘saveenv’ configuration will preserve the settings in the flash memory associated with U-BOOT.

The U-BOOT should respond by saying the environment has been updated.

The final step for configuring the eval board is to transfer the uCLinux kernel into flash memory.





Upon completion, type the command `spi_writekernel` to copy the kernel into flash memory. This will erase the SPI Flash sectors 12-35 and transfer the kernel into the SPI Flash.

Once this is completed, power cycle the EVAL Board and allow the Linux Operating System to boot.

## 8. uCLinux Kernel Startup

Launching the uCLinux kernel will display a ‘verbose’ set of startup messages. An example startup log has been captured and key details are highlighted for clarity.

### Starting.....



#### *Message showing the version and build date of the kernel*

```
Linux version 2.4.31-uc0 (steve@FLE-DUALA) (Built by FLE Fusion with mb-gcc version 3.4.1)
Compile# 1234 On 07-10-2007 12:58:12
Overlaying U-BOOT Command Arguments
<FLEconsole=ttyS0,2400 ethaddr=00:51:23:9a:de:F1 ifconfig='eth0 192.168.1.123 netmask
255.255.255.0 up' sn=aaa>
```



#### *MAC Address specified in U-BOOT Environment*

```
Extracted MacAddress [0:51:23:9a:de:f1]
Bank(0) Start=524288 End=528383 Bootmap_pages=1
On node 0 totalpages: 4095
zone(0): 4095 pages.
zone(1): 0 pages.
zone(2): 0 pages.
CPU: MICROBLAZE
CPU: Enabling ICACHE
CPU: Enabling DCACHE
Console: xmbserial on UARTLite
Calibrating delay loop... 30.41 BogoMIPS
```



#### *Total system RAM available for use*

```
Memory: 15MB = 15MB total
Memory: 11060KB available (1101K code, 4544K data, 52K init)
Dentry cache hash table entries: 2048 (order: 2, 16384 bytes)
Inode cache hash table entries: 1024 (order: 1, 8192 bytes)
Mount cache hash table entries: 512 (order: 0, 4096 bytes)
Buffer cache hash table entries: 1024 (order: 0, 4096 bytes)
Page-cache hash table entries: 4096 (order: 2, 16384 bytes)
POSIX conformance testing by UNIFIX
Linux NET4.0 for Linux 2.4
Based upon Swansea University Computer Society NET3.039
Nulling protocol families
Initializing sock SLAB cache
Initializing skbuff SLAB
Registering sockets 1
Initializing RT netlink socket
```



### ***Configuration of the FLE Ethernet MAC Core***

Probing For Microblaze Ethernet Cores.....  
Set RX Buffer @ 0x801d0804  
Set TX Buffer @ 0x802d0804  
FLE EMAC: Configured <64> Transmit Buffers  
FLE EMAC: Configured <64> Receiver Buffers  
Finger Lakes Engineering EMAC Assignment-->0:51:23:9a:de:f1  
eth0: Finger Lakes Engineering EMAC: Using DMA Buffer Mode.  
eth0: Located Ethernet PHY at address 15  
eth0: Finger Lakes Engineering EMAC #0 at 0xC0000000 mapped to 0xC0000000, irq=2  
eth0: id 2.28{; block id 154, type 241  
NET4: Linux TCP/IP 1.0 for NET4.0  
IP Protocols: ICMP, UDP, TCP  
IP: routing cache hash table of 512 buckets, 4Kbytes  
TCP: Hash tables configured (established 512 bind 1024)  
NET4: Unix domain sockets 1.0/SMP for Linux NET4.0.  
devfs: v1.12c (20020818) Richard Gooch (rgooch@atnf.csiro.au)  
devfs: boot\_options: 0x0



### ***Transfer of the ROM Filesystem, from within the kernel image, into RAM***

MicroBlaze auto-config ram probe(0x803d1a24,1781760,4): 1b3000 at 803d1a24  
Creating 1 MTD partitions on "RAM":  
0x00000000-0x001b3000 : "Romfs"  
RAMDISK driver initialized: 16 RAM disks of 4096K size 1024 blocksize



### ***Start low-level driver to access flash Memory***

Initialzing FLE Parallel Flash MTD Driver  
Attaching to MTD Layer:  
Detected Region [0] At Base 0x0 Blocks=1  
Detected Region [1] At Base 0x20000 Blocks=32  
Detected Region [2] At Base 0x420000 Blocks=78  
Detected Region [3] At Base 0xde0000 Blocks=15  
Detected Region [4] At Base 0xfc0000 Blocks=1  
Detected Region [5] At Base 0xfe0000 Blocks=1  
Adding partitions.



### ***Mapping 6 Flash memory partitions into the kernel space***

Creating 6 MTD partitions on "28F128":  
0x00000000-0x00020000 : "UBOOT"  
0x00020000-0x00420000 : "KERNEL"  
0x00420000-0x00de0000 : "JFFS2"  
0x00de0000-0x00fc0000 : "MISC"  
0x00fc0000-0x00fe0000 : "CONFIG"  
0x00fe0000-0x01000000 : "UBOOTENV"

***Initializing the JFFS2 Flash Memory Filesystem Driver***

JFFS2 version 2.1. (C) 2001 Red Hat, Inc., designed by Axis Communications AB.

uclinux[mtd]: RAM probe address=0x803d1a24 size=0x1b3000

uclinux[mtd]: root filesystem index=8

Starting kswapd

Microblaze UARTlite serial driver version 1.00

ttyS0 at 0x40600000 (irq = 1) is a Microblaze UARTlite

VFS: Mounted root (romfs filesystem) readonly.

Freeing init memory: 52K

Mounting proc:

Mounting var:

Populating /var:

Running local start scripts.

Mounting /etc/config:

Populating /etc/config:

flatfsd: Created 6 configuration files (591 bytes)

Setting hostname: uclinux-auto

Setting up local IP interface 127.0.0.1

***Formatting and/or Mouting the Flash Filesystem onto JFFS2 Partition (may take 20 seconds the first time this is launched)***

Mounting Flash Filesystem

Launching FLE AutoInit Process

***Launching the FLE AutoInit Process to synchronize the Kernel with the U-BOOT environment***

Starting FLE U-BOOT AutoInit Process...

Binding to [/dev/mtd6]

Calling [/bin/ifconfig eth0 192.168.1.123 netmask 255.255.255.0 up]

Calling [/bin/route add default gw 192.168.1.1 eth0]

Overwriting the resolv.conf with the gateway address.

***Start the process that will auto-launch tftp,telnet,ftp access***

Starting inet daemon

***Login prompt for the operating kernel (username=root and password=root)***

FUSION login:



## **9. Exploring the uCLinux O/S**

Congratulations on successfully configuring and loading the Linux O/S.

At this stage, all settings are now resident in Flash Memory.

In this section, we will explore some basic functions of the FLE Fusion uCLinux environment.

First, login as username root and password root to arrive at the '#' prompt. This '#' is the standard uCLinux shell prompt (similar to DOS in windows).

Type 'ls' and press return to see the directory contents of the filesystem.

```
bin  etc  fle  lib  proc  tmp  var  
dev  flash  home  mnt  sbin  usr
```



## **10. Conclusion**

This tutorial has hopefully guided the user through the process of configuring the NuHorizons Spartan3-DSP Eval board with the FLE Fusion Linux Reference package.

After successfully completing the configuration, the FUSION Linux system will boot and perform an image capture and display demonstration.

Thank you for following this tutorial.

## **11. Appendix**

Finger Lakes Engineering - FLE's Main Website for all FLE, Free-From-FLE, and FUSION materials  
<http://www.fl-eng.com>

NuHorizons – Worldwide distributor of Xilinx Components, Training, and Materials  
<http://www.nuhorizons.com>

Xilinx – Website for Xilinx Corporate  
<http://www.xilinx.com>

University of Queensland – uCLinux Microblaze Original Port  
<http://www.cs.uq.edu.au/~jwilliams/mblaze-uclinux/index.html>

uCLinux main website  
<http://www.uclinux.org>

U-Boot main website  
<http://www.denx.de/wiki/Uboot>