Microtronix Nios® II Linux® Distribution

Quick Start Guide

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This user guide provides information regarding the Nios II Linux Distribution. The following table shows the document revision history.

Document Revision History	
Date	**Description**
May 2004	Initial Release – Version 1.0
July 2004	Version 1.1
December 2004	Version 1.2

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Typographic Conventions

`Path/Filename`	A path/filename
`[SOPC Builder]$ <cmd>`	A command that should be run from within the Cygwin Environment.
`…sdk/<path>`	A file that is relative to the sdk directory.
`Code`	Sample code.
↩	Indicates that there is no break between the current line and the next line.

Table of Contents

Introduction

The Nios II Linux Distribution allows you to put together a Linux environment for your Altera® development board. This environment consists of a kernel configured for your SOPC system and a filesystem that can be mounted as the root directory. Once the environment has been created and loaded onto the development board, the users can then build applications for Nios II Linux and run them from the development board.

A set of example applications and their source are included in the Nios II Linux Distribution. The application source code can be built within a Nios II Linux application project and then transferred over to the Nios II Linux system via FTP or included within a Nios II Linux fileystem project. Please refer to the reference guide for more information.

For a more complete list of limitations and known bugs, please refer to the readme.txt file.

The purpose of this document is to guide you through getting a Nios II Linux system up and running on a target development board. This document will walk you through the process of creating a kernel and filesystem project. After both projects are created, you can then load the binary files representing the kernel and filesystem onto your development board and log into Linux. Once things are up and running, the Microtronix Nios II Linux Distribution Reference Guide included with the Nios II Linux Distribution will help guide you through other, more specific tasks.

Before You Begin

Hardware Requirements

- A development board. One of:
  - Altera Nios II Evaluation Kit (EP1C12 device)
  - Altera Nios II Development Kit, Cyclone™ Edition (EP1C20 device)
  - Altera Nios II Development Kit, Stratix™ Edition (EP1S10 or EP1S10ES device)
  - Altera Nios II Development Kit, Stratix Pro Edition (EP1S40 device)
- Please ensure that the following ports are connected to your PC using the appropriate cables:
  - ByteBlaster™
  - Ethernet
- After hooking up the cables, apply power to the board.

Software Requirements

The Nios II Linux Distribution requires the following software packages to be installed on the host system:

- Altera Quartus® II 4.2
- Altera Nios II Development Kit 1.1

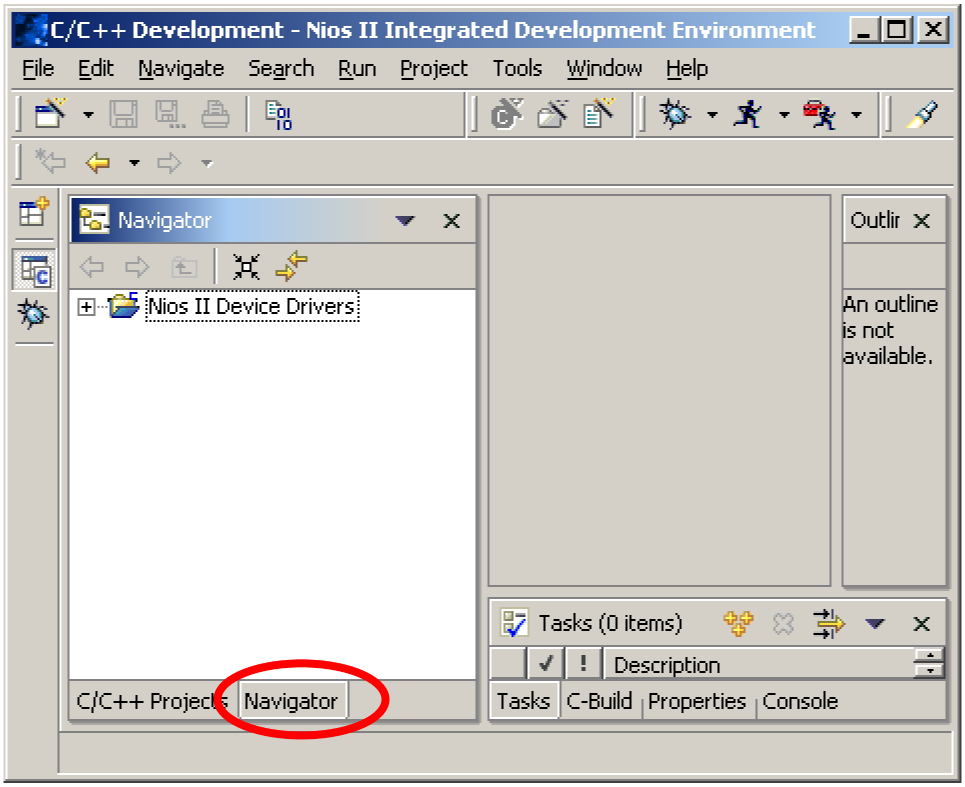
Starting Nios II IDE

This document deals with operations performed through the Nios II IDE. Currently, there are two prescribed methods of starting the Nios II IDE: through SOPC Builder or via the short-cut in the Start Menu.

For the purposes of this document, please start the Nios II IDE by:

1. Clicking the **Start** button within Windows
2. Click **Programs** -> **Altera** -> **Nios II Development Kit v1.1** -> **Nios II IDE**

After the IDE has started, be sure to switch to the navigator view by clicking on the **Navigator** tab at the bottom of the left windowpane in the IDE.


C/C++ Development - Nios II Integrated Development Environment
File Edit Navigate Search Run Project Tools Window Help
Navigator
Nios II Device Drivers
Outlir
An outline is not available.
Tasks (0 items)
Description
C/C++ Projects
Navigator
Tasks
C-Build
Properties
Console

PC Environment Notes

If you are using the ByteBlaster cable to connect to your development board, it is very important that it is first registered with the Quartus II Programmer tool. To do this:

1. Click **Tools** -> **Quartus II Programmer** in the menu bar.

2. When the Quartus II Programmer window appears,

    a. Click **Edit** -> **Hardware Setup** from the menu bar

3. If your ByteBlaster cable is not listed under the “Available hardware items” group, then click the **Add Hardware …** button. Select the appropriate cable and port in the dialog that appears and click **OK**.

4. Click the **Close** button and exit Quartus II Programmer.

Walkthrough – Kernel Project

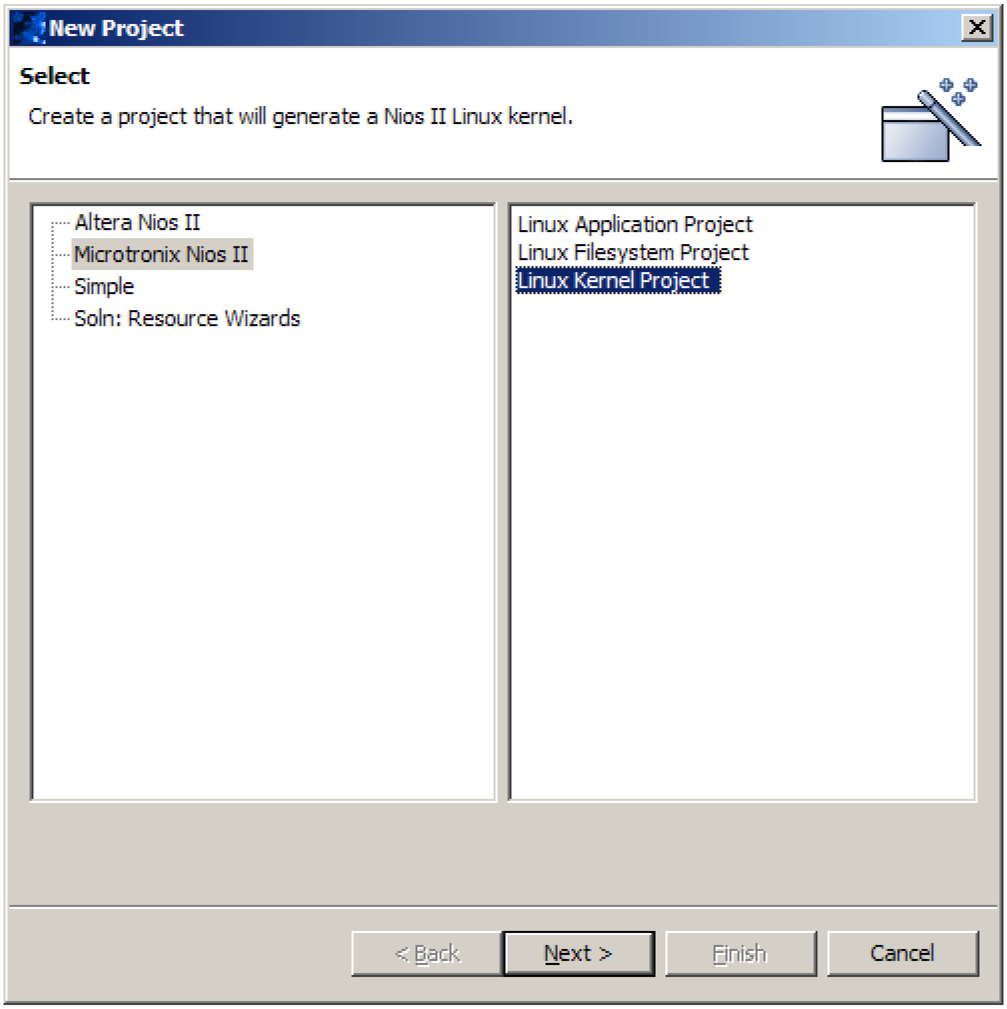
Creating a New Kernel Project

1. In the pull down menus within the Nios II IDE, Click **File** -> **New** -> **Project…**

2. Select the **Microtronix Nios II** item in the left pane

3. Select the **Linux Kernel Project** item in the right pane

4. Click **Next**



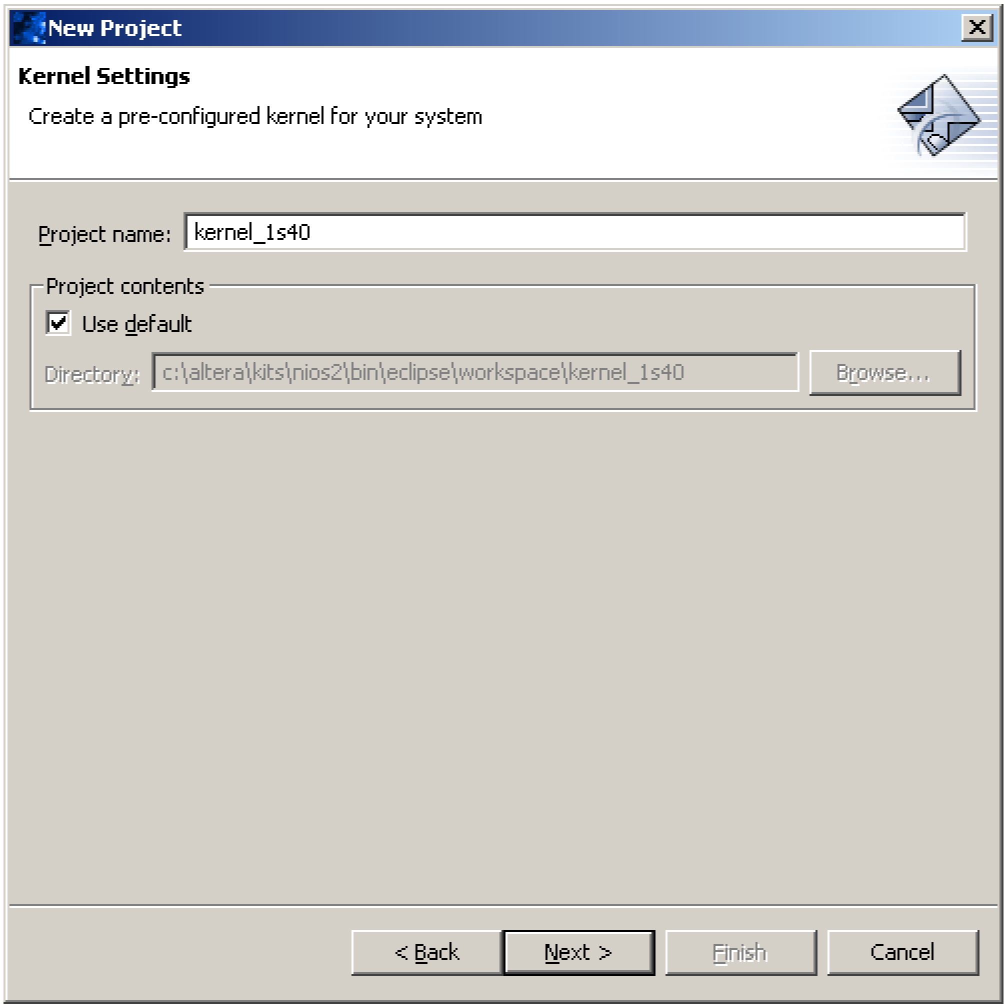
New Project

Select

Create a project that will generate a Nios II Linux kernel.

5. Give the project a unique name

6. Click **Next**



Kernel Settings

Create a pre-configured kernel for your system

Project name: kernel_1s40

Project contents

☑ Use default

Directory: c:\altera\kits\nios2\bin\eclipse\workspace\kernel_1s40

7. Click **Browse…**

8. Find the appropriate <system.ptf> file for your Quartus project

   a. The currently supported Quartus projects for this release can be found in the

   ```
   …altera\kits\nios2\examples\verilog\ ↵
       <board>\linux
   ```

   directory.

9. Click **Open**

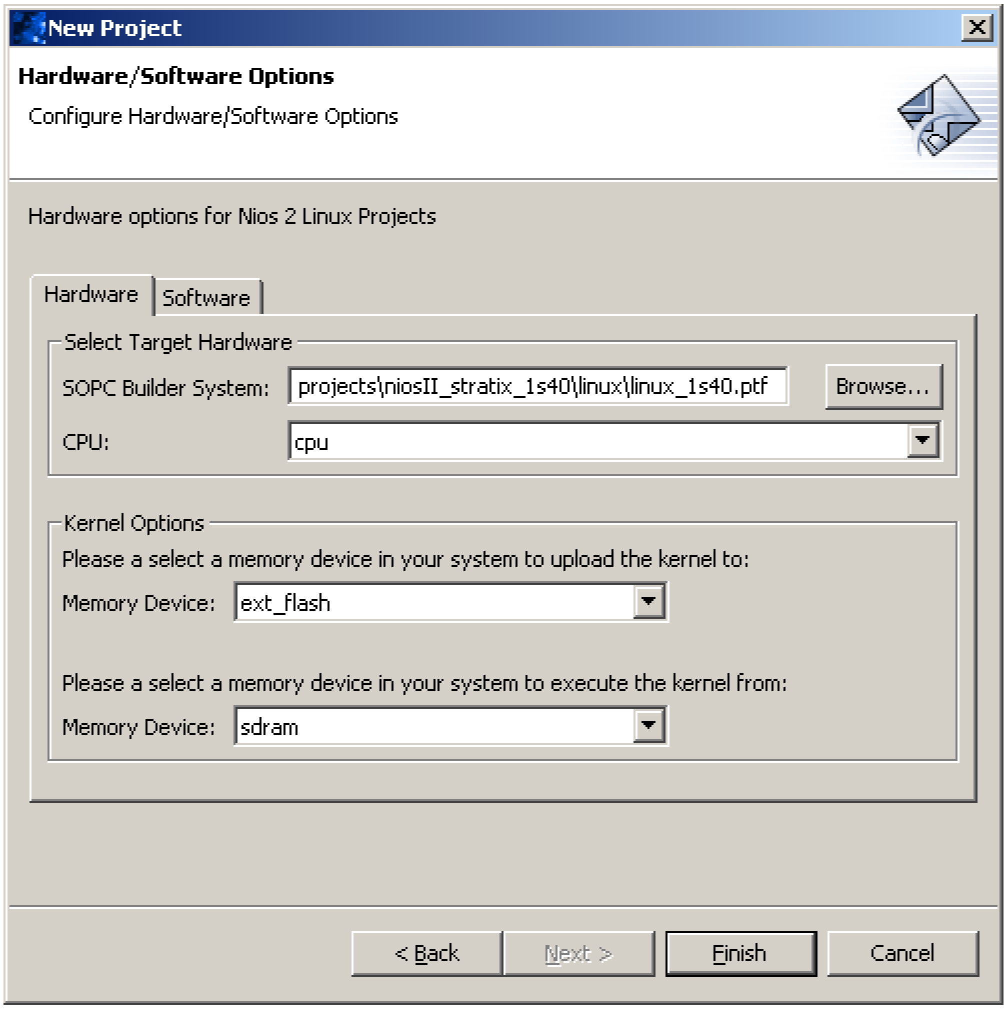
10. Double check that all the drop down boxes contain the correct values. An example configuration would be as follows:

    a. The **CPU** selected is "cpu"

    b. The "upload" device selected is "ext_flash"

    c. The "execute" device selected is "sdram"

11. Click **Finish**



New Project

Hardware/Software Options

Configure Hardware/Software Options

Hardware options for Nios 2 Linux Projects

Select Target Hardware

SOPC Builder System: projects\niosII_stratix_1s40\linux\linux_1s40.ptf

CPU: cpu

Kernel Options

Please a select a memory device in your system to upload the kernel to:

Memory Device: ext_flash

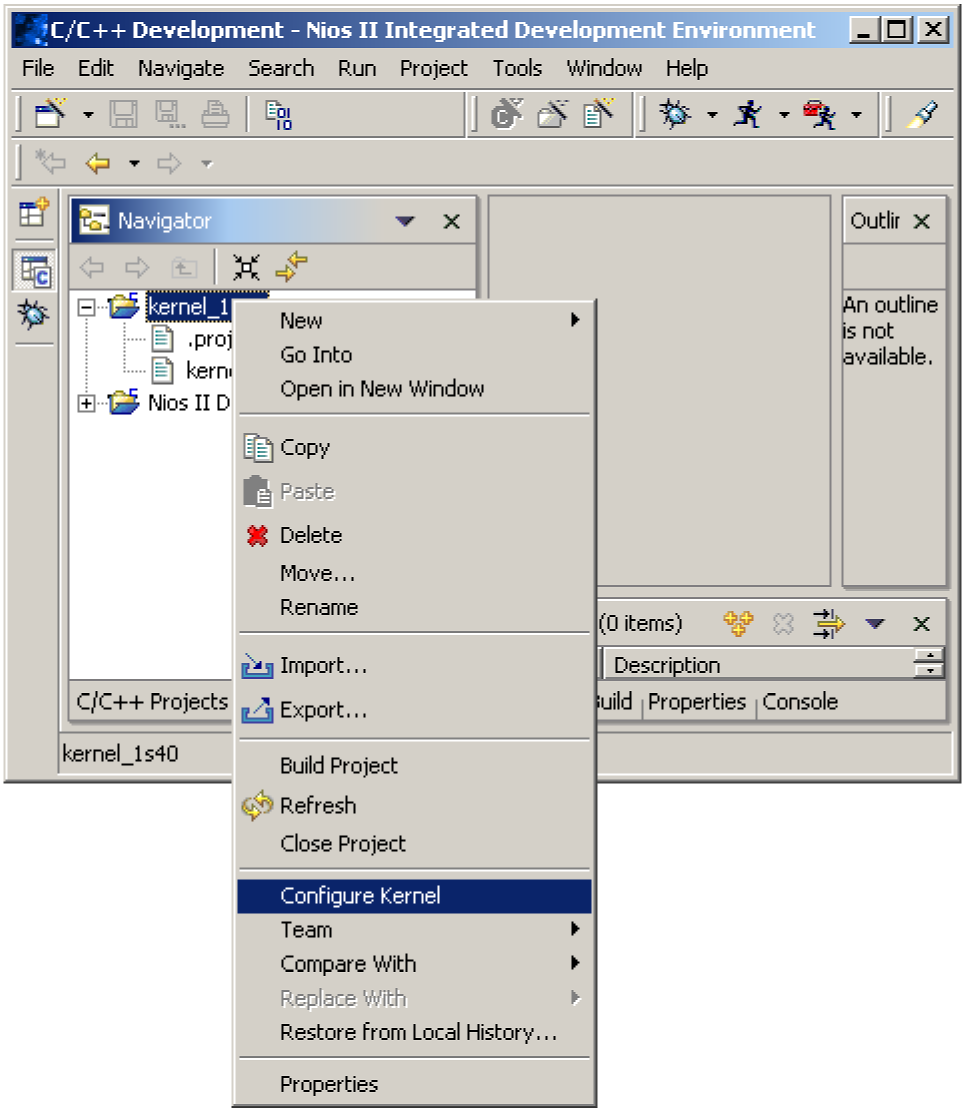
Please a select a memory device in your system to execute the kernel from:

Memory Device: sdram

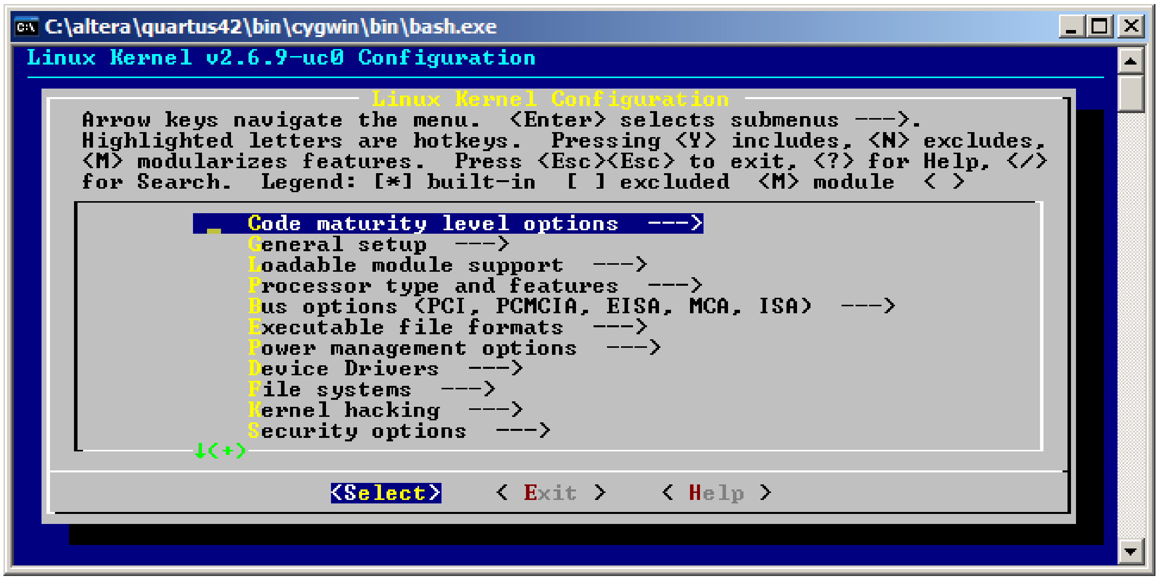
Configuration

1. In the **Navigator** view, right-click the created project.

2. In the drop down menu, click **Configure Kernel**



3. A DOS window will appear with the “Linux menuconfig” utility (this may take a few moments)



```
C:\altera\quartus42\bin\cygwin\bin\bash.exe
 Linux Kernel v2.6.9-uc0 Configuration
 ┌───────────────── Linux Kernel Configuration ─────────────────┐
 │  Arrow keys navigate the menu.  <Enter> selects 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  [ ] excluded  <M> module  < > │
 │ ┌──────────────────────────────────────────────────────────┐ │
 │ │           Code maturity level options  --->              │ │
 │ │           General setup  --->                            │ │
 │ │           Loadable module support  --->                  │ │
 │ │           Processor type and features  --->              │ │
 │ │           Bus options (PCI, PCMCIA, EISA, MCA, ISA)  ---> │ │
 │ │           Executable file formats  --->                  │ │
 │ │           Power management options  --->                 │ │
 │ │           Device Drivers  --->                           │ │
 │ │           File systems  --->                             │ │
 │ │           Kernel hacking  --->                           │ │
 │ │           Security options  --->                         │ │
 │ └──────────↓(+)────────────────────────────────────────────┘ │
 ├──────────────────────────────────────────────────────────────┤
 │                <Select>    < Exit >    < Help >              │
 └──────────────────────────────────────────────────────────────┘
```

4. Ensure that the correct development board is selected under **Processor type and features** -> **Platform**.

5. Browse around the kernel configuration options if you like, but the defaults should be fine, unless you are using an Altera Nios II Evaluation board.

   If you are using an Altera Nios II Evaluation board

   Turn off:

   - **Device Drivers** ->
     ATA/ATAPI/MFM/RLL support ->
     Enhanced IDE/MFM/RLL … support

   - **Device Drivers** ->
     Networking support ->
     Ethernet (10 or 100Mbit) ->
     SMC 91111 support

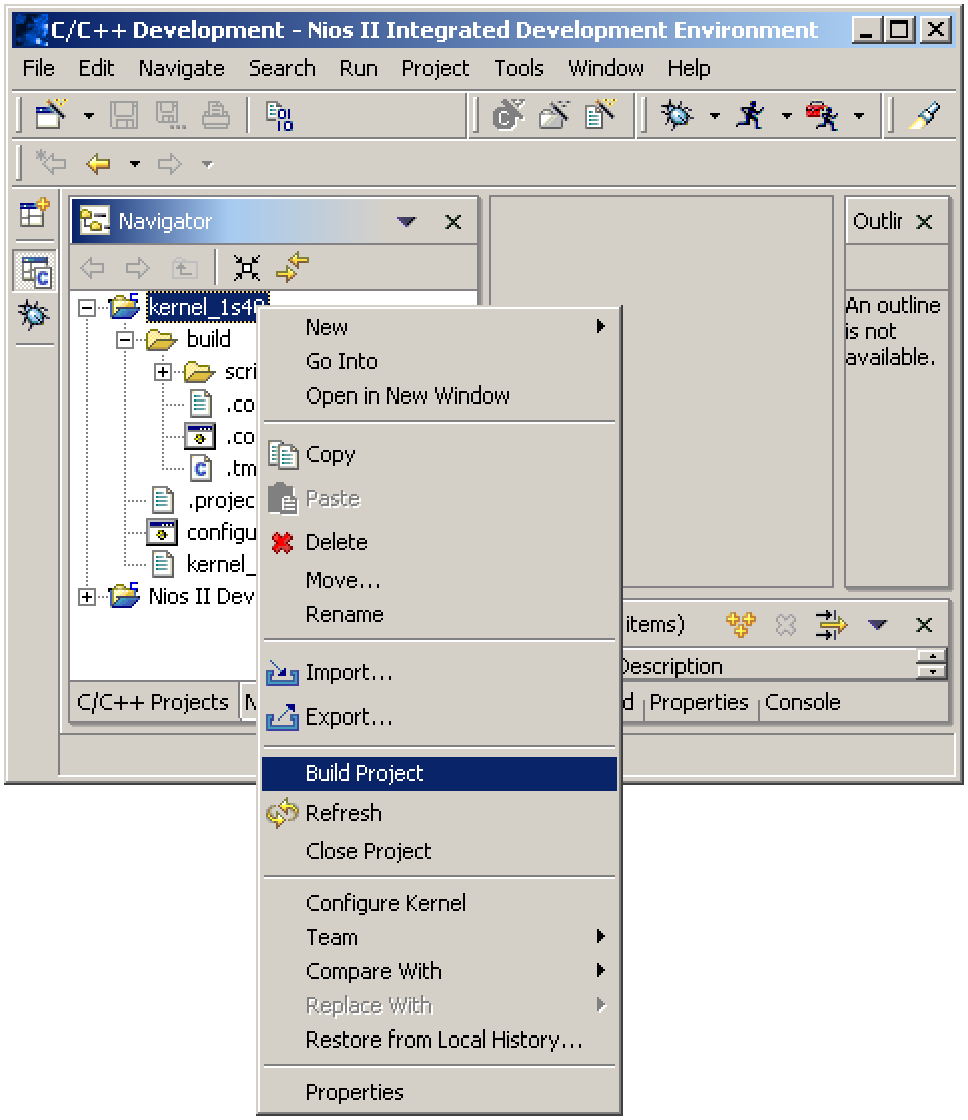
   Turn on:

   - **Device Drivers** ->
     Networking support ->
     Ethernet (10 or 100Mbit) ->
     MoreThanIP 10_100_1000 Emac support

6. Select **Exit** and then **yes** to save your configuration

Building

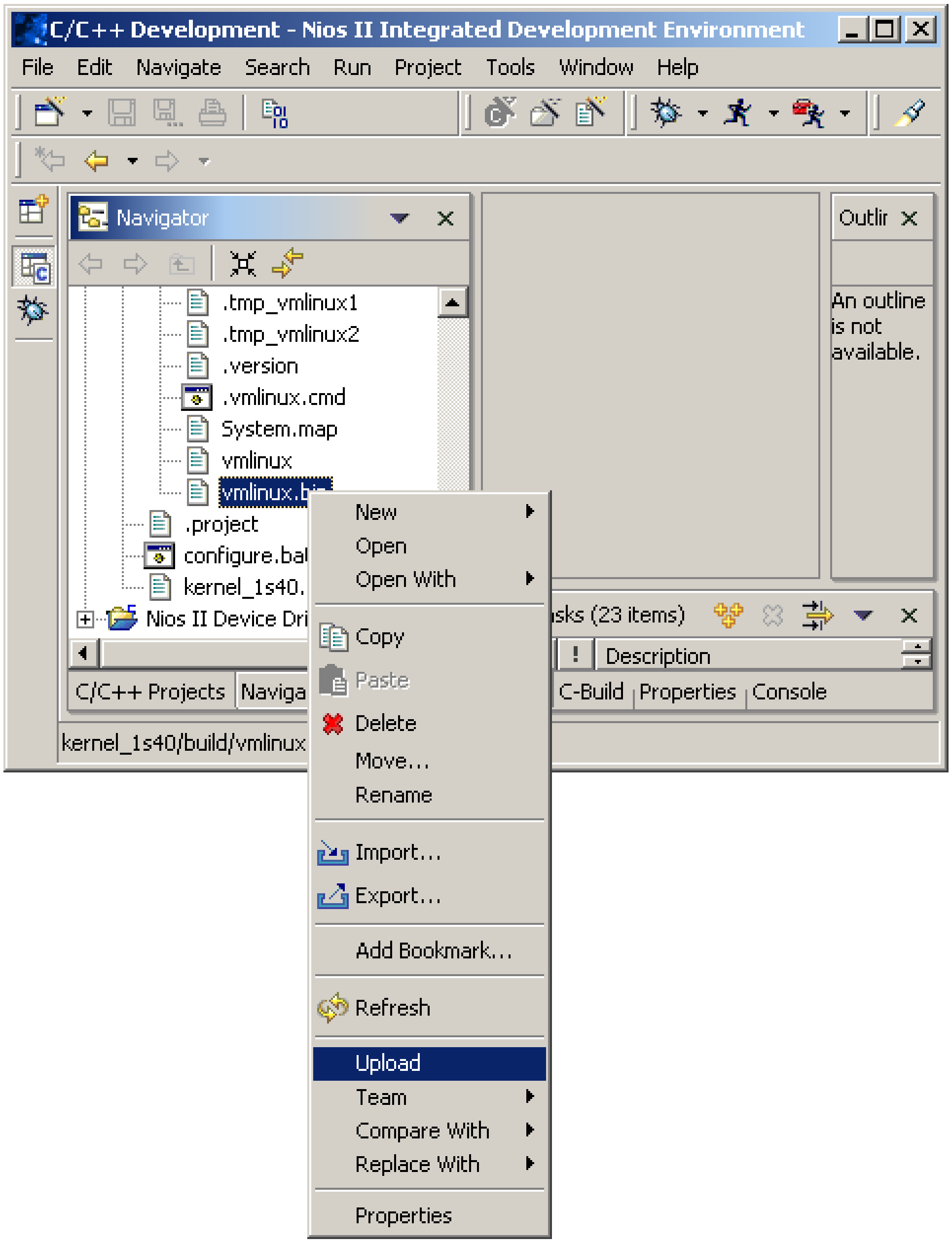
1. In the **Navigator** view, right-click the created project.
2. In the drop down menu, select **Build Project**
   a. The process of building the kernel project will take a while.



Loading the Kernel

1. Navigate to the kernel projects's ...**`build/vmlinux.bin`** file within the IDE

2. Right-click the file



3. In the drop down menu, select **Upload**

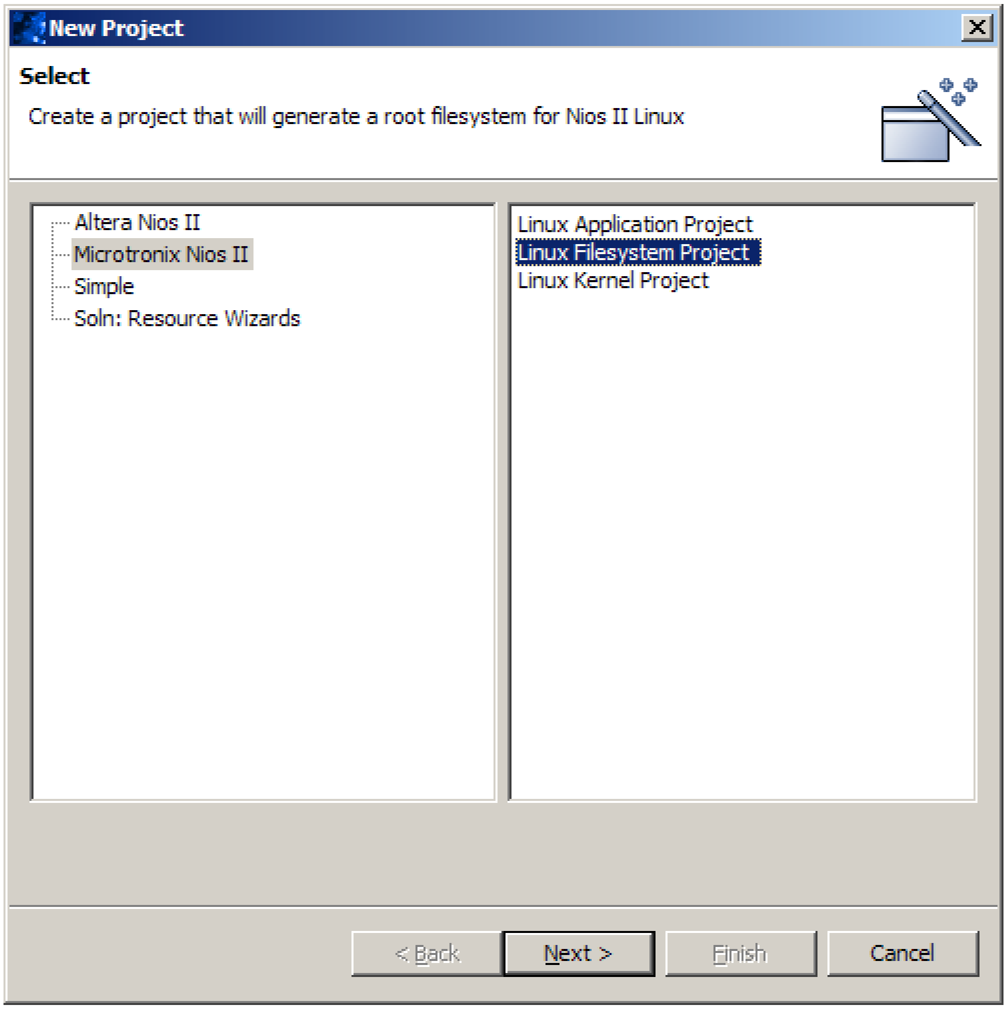
   a. The upload process will also take a little while.

Walkthrough – Filesystem Project

Creating a New Filesystem Project

In order to create a root filesystem image for your Linux system, you must create a new Nios II Linux Filesystem project:

1. Under the **File** menu in Eclipse, click **New** -> **Project**.
2. In the New Project selection wizard page, select the category **Microtronix Nios II** and choose **Linux Filesystem Project** for the project type. Click the **Next** button to continue on to the next wizard page.

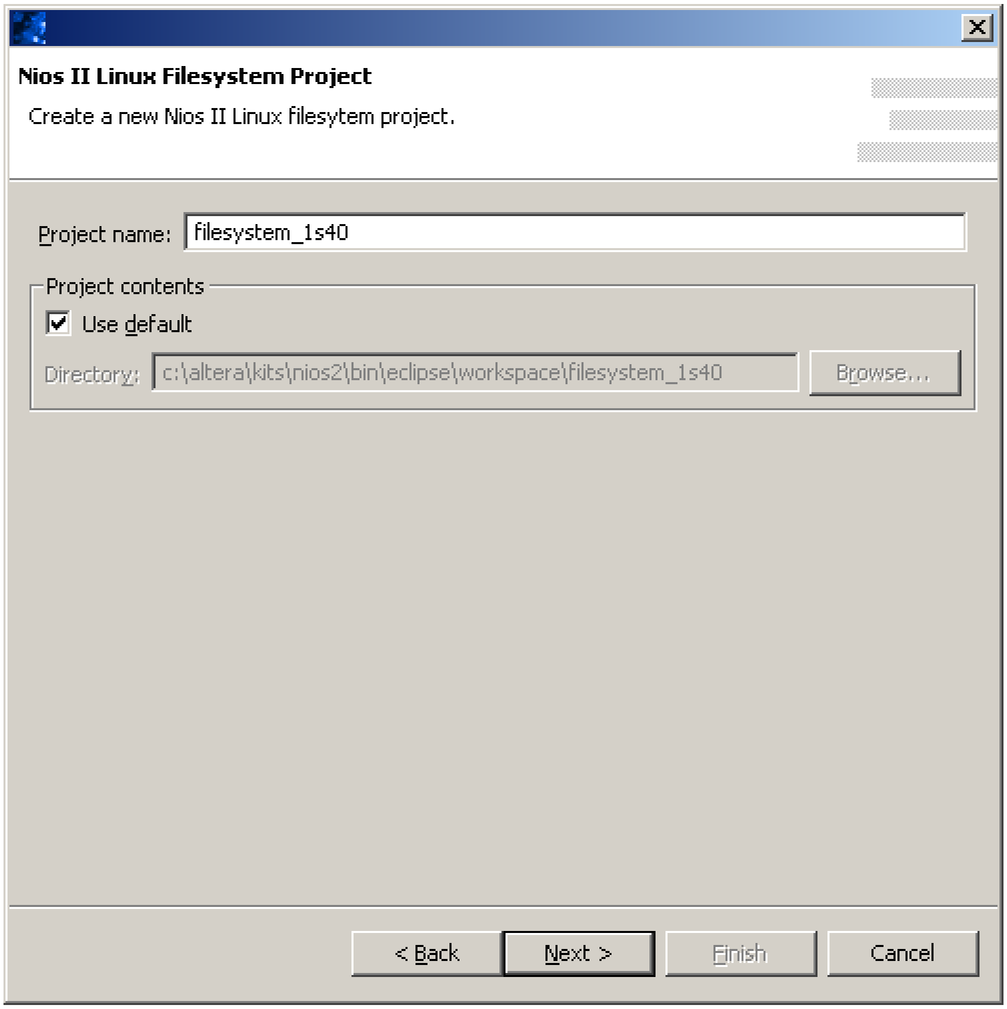


New Project

Select

Create a project that will generate a root filesystem for Nios II Linux

3. Give the filesystem project a name, and click the **Next** button to continue on to the next page.



Nios II Linux Filesystem Project

Create a new Nios II Linux filesytem project.

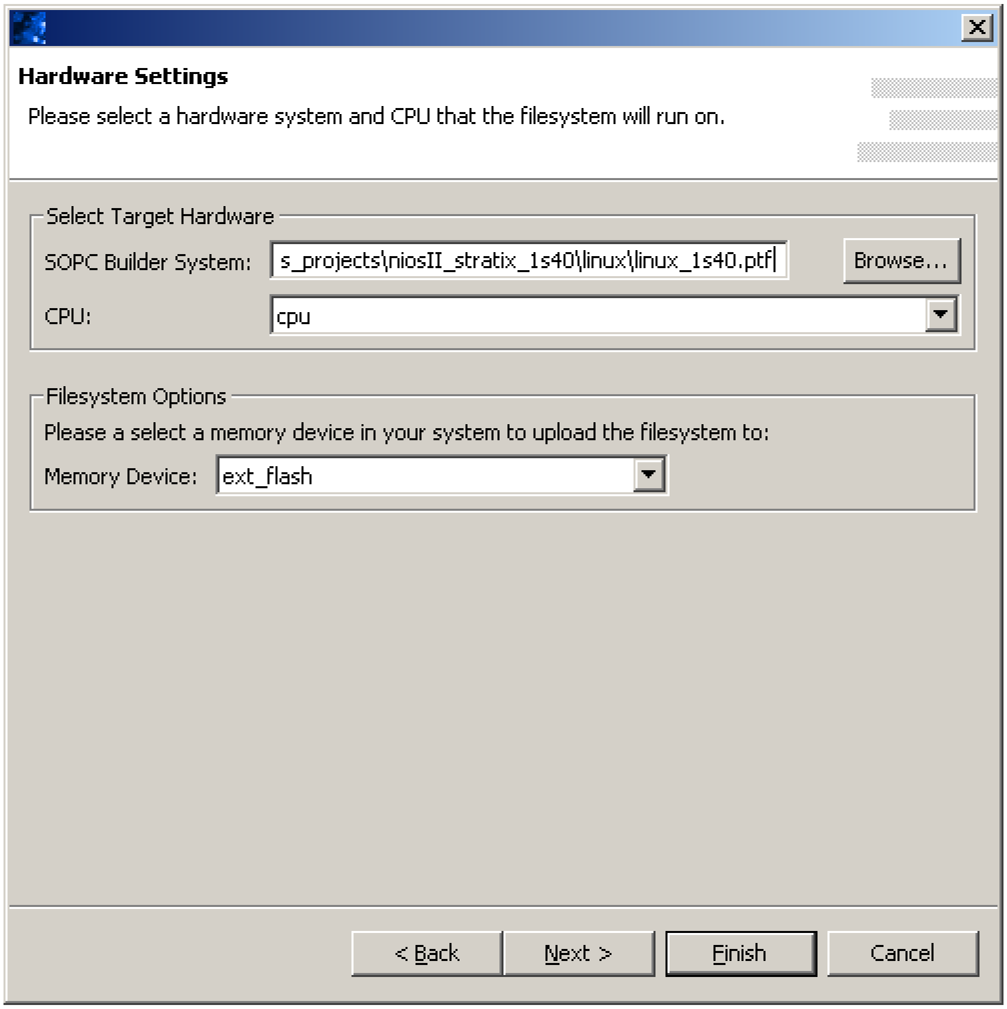
Project name: filesystem_1s40

Project contents

☑ Use default

Directory: c:\altera\kits\nios2\bin\eclipse\workspace\filesystem_1s40

4. Find the appropriate <system.ptf> file for your Quartus project
   a. The currently supported Quartus projects for this release can be found within the
      `…altera\kits\nios2\examples\verilog\ ↵`
      `<board>\linux`
      directory.
5. Use the **CPU** drop down box to select the CPU on which the system will run.
   a. For this example, **CPU** should be “cpu”.
6. Use the **Memory Device** drop down box to select the memory device to which the Linux filesystem image for your system will be uploaded.
   a. For this example, the **Memory Device** should be “ext_flash”.
7. Click the **Next** button to continue on to the next page.



Hardware Settings

Please select a hardware system and CPU that the filesystem will run on.

Select Target Hardware

SOPC Builder System: s_projects\niosII_stratix_1s40\linux\linux_1s40.ptf

CPU: cpu

Filesystem Options

Please a select a memory device in your system to upload the filesystem to:

Memory Device: ext_flash

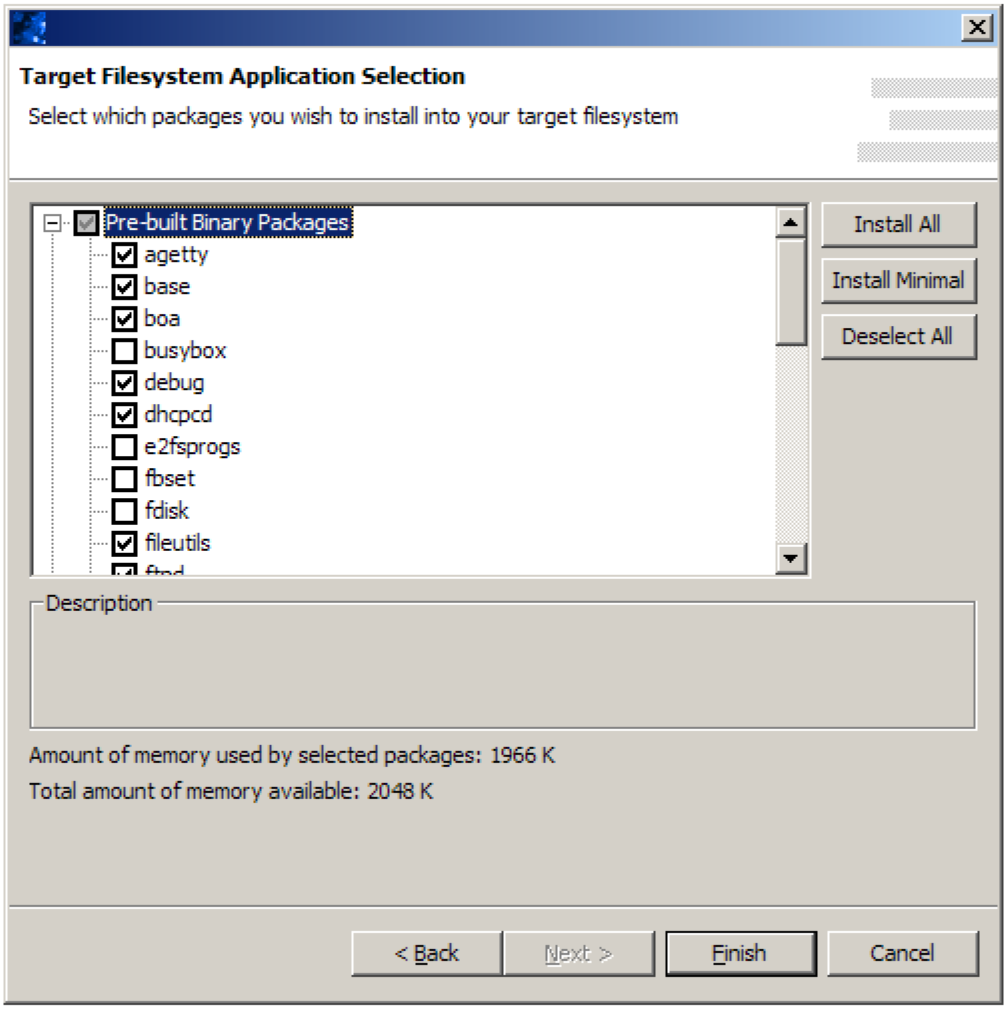
8. The next wizard page allows you to select which applications are to be included in the filesystem image.

    a. Applications will be listed under two categories: Pre-built Binary Packages and Installable Workspace Projects. Pre-built Binary Packages include common Linux applications that have been pre-built for a Nios II Linux system. The Installable Workspace Projects category will list custom applications that are already present in your Eclipse workspace.

    b. For the purposes of this example walkthrough, click the **Install Minimal** button to select only the necessary packages.

    c. Please also enable: agetty, boa, dhcpcd, ftpd, inetd, init, ping, route, and telnetd. These will be useful for demonstration purposes.

9. Click **Finish**.



Target Filesystem Application Selection

Select which packages you wish to install into your target filesystem

- ☑ Pre-built Binary Packages
  - ☑ agetty
  - ☑ base
  - ☑ boa
  - □ busybox
  - ☑ debug
  - ☑ dhcpcd
  - □ e2fsprogs
  - □ fbset
  - □ fdisk
  - ☑ fileutils
  - ☑ ftpd

Description

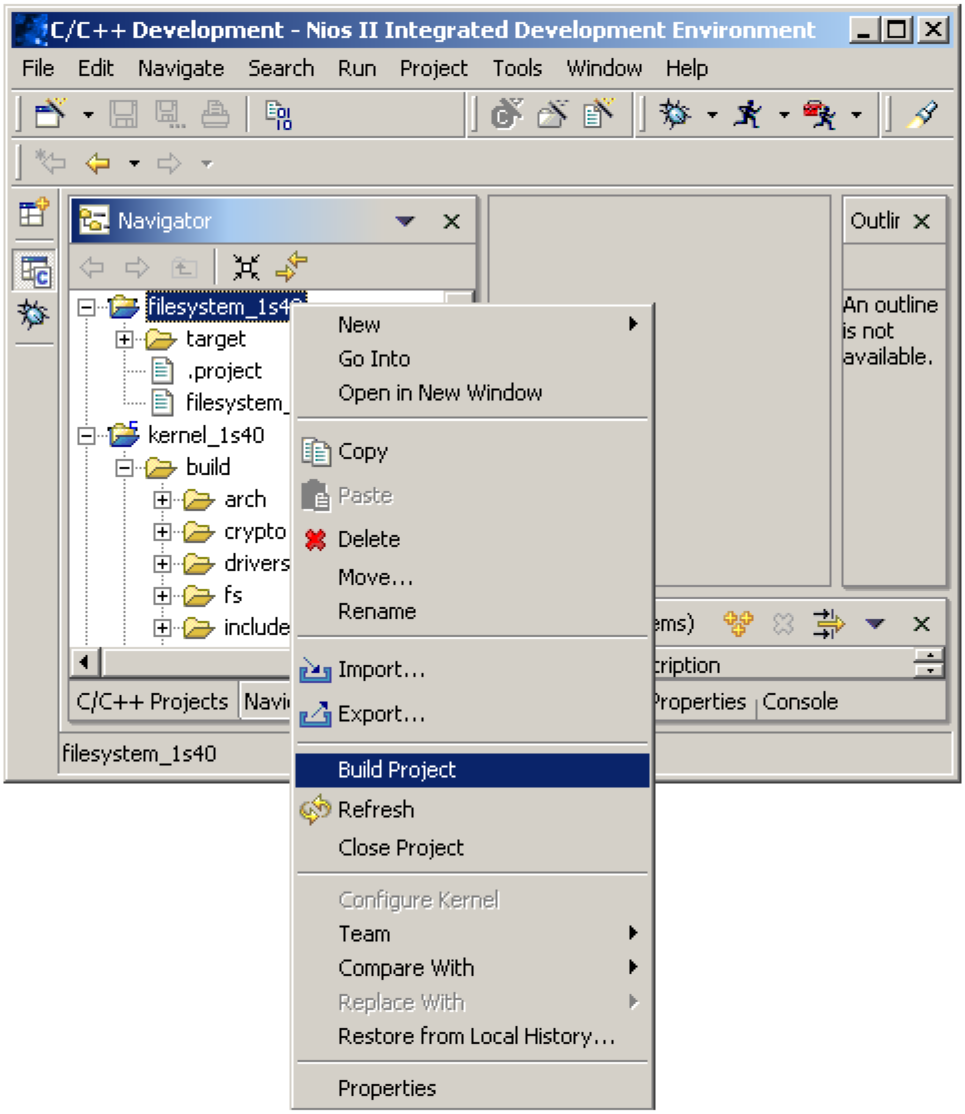
Amount of memory used by selected packages: 1966 K

Total amount of memory available: 2048 K

Building

Once the filesystem project has been created, a …`target/` directory tree will exist under the project's folder. This directory tree reflects the structure and content of the filesystem image that will be built, and includes all the pre-built binaries and associated files you selected during the project creation process. To build a filesystem image from the target/ directory tree:

1. Right-click on the filesystem project's name in your Eclipse Navigator and select **Build Project** in the context menu that appears.

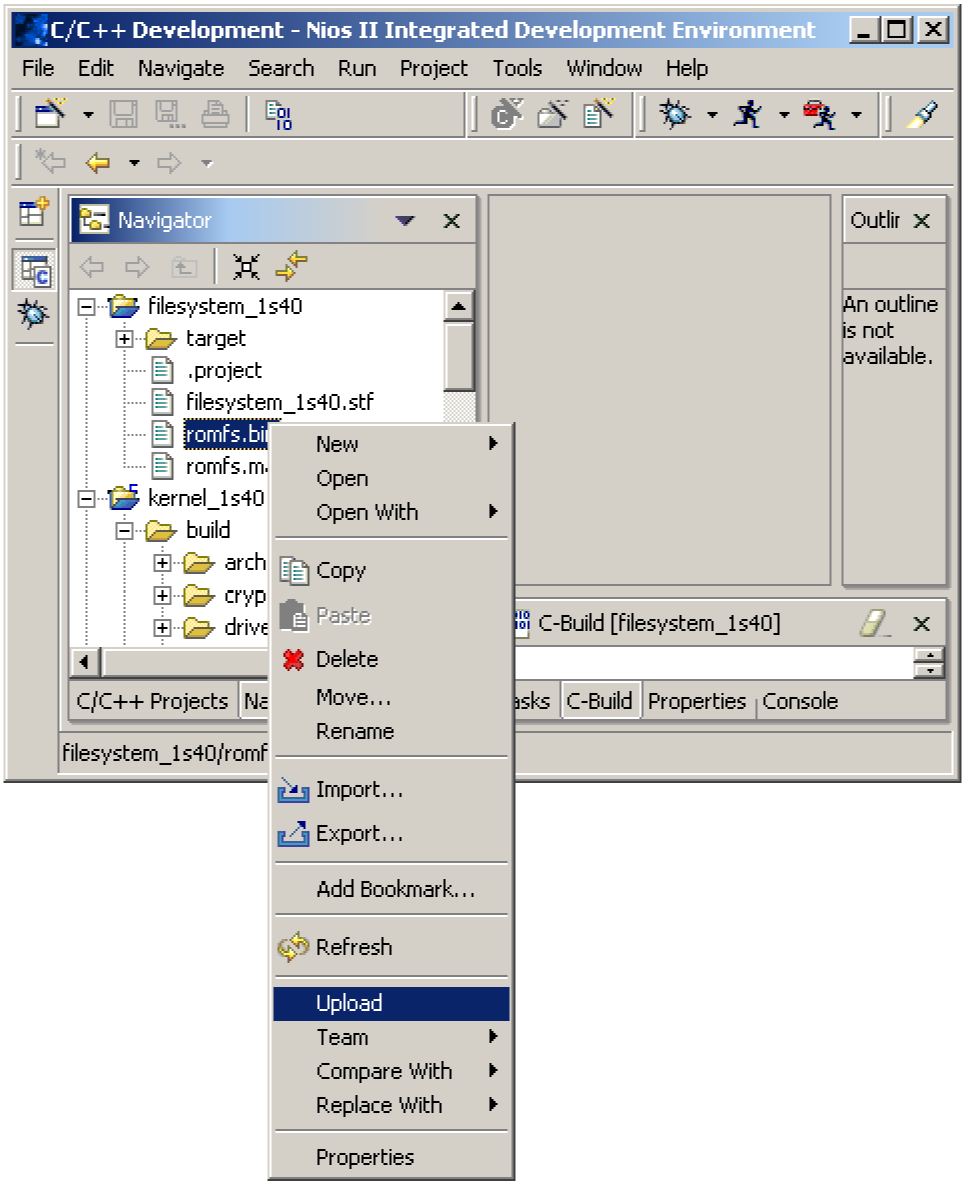


2. After the project builds, a file named `romfs.bin` should appear under the filesystem project's folder. This is the filesystem image file.

Loading the Filesystem

Once the filesystem project has been built, a file named **`romfs.bin`** should appear under the filesystem project's folder. This is the filesystem image file. To load the filesystem image to the board:

1. Right-click on the **`romfs.bin`** file in your Eclipse Navigator and select **Upload** from the context menu that appears.



Starting up Nios II Linux

In order to start running Linux on your Nios II target board, the **`.sof`** file for a Nios II Linux compatible Quartus project must be uploaded. The following example uses the **`.sof`** included with the Nios II Linux Distribution.

1. From the menu bar, click **Tools** -> **Quartus II Programmer**
2. Ensure that your hardware is setup properly (please refer to the **PC Environment Notes** section of this document for more information)
3. Select Add File and locate the **`.sof`** file for the Quartus project that you have been building the kernel and filesystem against.
4. Click Open. You will get an information message from the Quartus II Programmer. Click OK.
5. Enable the Program/Configure box.
6. Click Start.
7. Once the **`.sof`** file is finished loading onto the development board, you can connect to the development board using the nios2-terminal program (which uses the JTAG UART). This can be accomplished by issuing the following command in a Nios II SDK shell:

   ```
   [SOPC Builder]$ nios2-terminal
   ```

   You can now log into the Nios II Linux system through your terminal window.

Miscellaneous

To login, use the username **`nios`** and the password **`uClinux`** (note the capitalization of the "C", the password is case sensitive).

If you wish to enable network support you can do so either manually or with dhcp (assuming you selected the appropriate applications when you built your filesystem project).

To manually configure your IP address run the following command:

```
# ifconfig eth0 <IP address> netmask <netmask>
```

where `<IP address>` and `<netmask>` are valid parameters for your local network. Alternately, if DHCP is available, you can configure your IP address by running the following commands:

```
# mkdir /var/dhcpc

# dhcpcd -NRY &
```

If you are using DHCP to configure your IP address, use ifconfig to obtain the address assigned by the server.

The board is setup with an ftp daemon, telnet daemon, and a small webserver. Once you've enabled network support, you can try connecting to the board via these 3 protocols.

The mount utility included with the filesystem project is capable of NFS-mounting. To mount an NFS share run the following command:

```
# mount -t nfs __.__.__.__:<dir> <mount point> -n ↩
     -o nolock,rsize=4096,wsize=4096
```

(Where __.__.__.__ is the IP address of the NFS server, <dir> is the directory of the NFS share, and <mount point> is mount point on the development board's filesystem to use).

Note

Please remember to review the readme.txt file included with this package for any last minute updates to the documentation.