Accessing I2C devices with Digi Embedded Linux 5.2 example on Digi Connect ME 9210

Document History

Date	Version	Change Description
17/09/2010	V1.0	Initial entry/outline
24/02/2011	V1.1	Retested with latest patches
10/03/2011	V1.2	Need to add kernel config and Linux tests, pics of test setup

Table of Contents

1 Problem Description

Most Digi embedded ConnectCore modules or Digi Connect ME 9210 modules have integrated on chip I2C bus hardware. Typically these micro processors are used as I2C bus master, to access one or several external (or on module, or on development board) I2C devices.

I2C (also referred as *two wire interface*) is a bus with two signal lines:

SCL *serial clock line*

SDA *serial data line*

The master is driving the clock line, which can be stretched by slower slaves.

On the data line, the master addresses individual slaves by a 7-Bit (optional 10 bit) address. An additional bit is used to decide for read or write access to the connected I2C device. Talking about an 8- or 11 Bit address, it means device ID including read/write information. Specific I2C devices have pre-defined device ID = bus address. Equal devices can be hardware strapped to have a different ID.

The Linux kernel provides basic I2C bus driver and the interface to integrate hardware specific drivers for the local master. In order to communicate with remote I2C devices

you need to register chip specific drivers for those devices. E.g. you register an EEPROM chip driver with device ID = 17 or an external RTC with ID=0x68.

2 Requirements

To try the example in this document you need:

- Digi Connect ME 9210 mounted on Digi development board.
- Digi Embedded Linux (DEL) 5.2 or above development environment.
- You can get everything together in a Digi Linux JumpStart Kit
- You also need a I2C sample device, e.g. Dallas DS1307 I2C RTC

  (Alternatively use a Digi development board for 9P9360 or 9M2443, both have Dallas DS1307 RTC on board).

3 Hardware pin considerations

Digi Connect ME 9210 module pin out:

Pin	UART [All]	GPIO [ME/ Wi-ME]	GPIO [ME 9210]	Ext IRQ [ME/ Wi-ME]	Ext IRQ [ME 9210]	I2C [ME 9210]	SPI [ME 9210]	FIM [ME 9210]	CAN BUS [ME 9210]	Timer [ME 9210]	Other [All]
1											VETH+
2											VETH-
3-6	Positions Removed										
7	RXD	A3	GPIO[3]				DATA IN	PIC_0_GEN_IO[3]			
8	TXD	A7	GPIO[7]				DATA OUT			Timer Out 7 Timer In 8	
9	RTS	A5	GPIO[5]		3		CLK			Timer Out 6	
10	DTR	A6	GPIO[6]						PIC_CAN_TXD	Timer In 7	
11	CTS	A1	GPIO[1]		0			PIC_0_GEN_IO[1]			
12	DSR	A2	GPIO[2]		1			PIC_0_GEN_IO[2]	PIC_CAN_RXD		
13	DCD	A0	GPIO[0]				EN	PIC_0_GEN_IO[0]			
14											/RST
15											3.3V
16											GND
17		C4	GPIO[12]			SDA	CLK				RESET_DONE
18		C1	GPIO[9]	1	0	SCL					
19	Reserved										
20		C5	GPIO [13]				CLK			Timer Out 9	/INIT

We will use the standard UART for U-Boot and Linux console on serial Port P1, and use I2C from the signal rail P3:

Pin 15 3,3V <- connect to your I2C device 3,3V input pin ->

Pin 16 GND <- connect to your I2C device GND pin ->

Pin 17 I2C SDA (GPIO[12]) <- connect to your I2C device SDA pin ->

Pin 18 I2C SCL (GPIO[9]) <- connect to your I2C device SCL pin ->

This should work with the I/O selection switch SW3 to either GPIO or RS232.

4 Software Setup

For your convenience find all files and images compiled into the archive these instructions came with, you might want to skip this section. Find Archive Here.

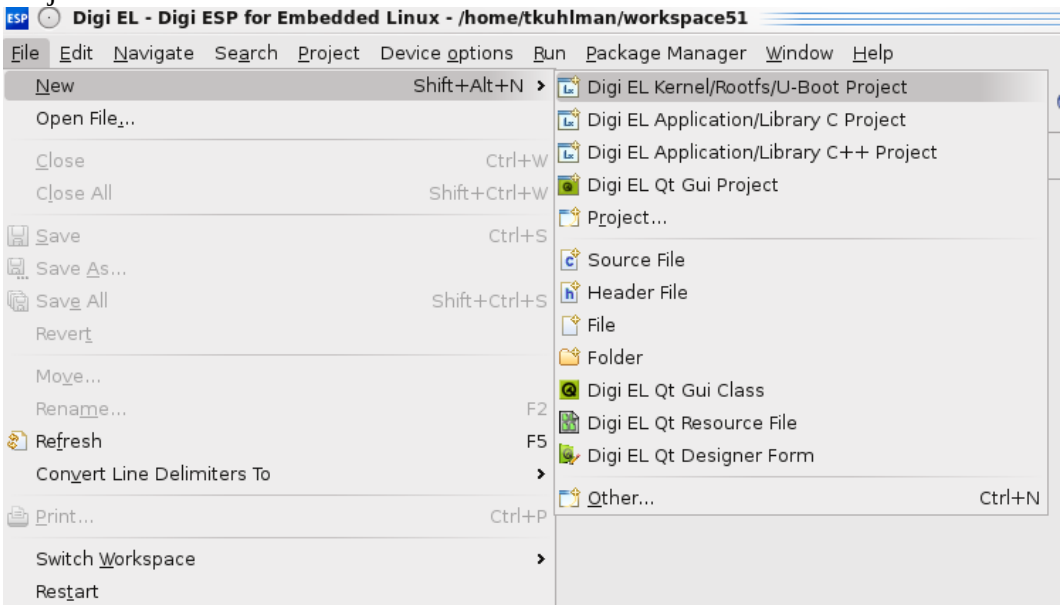
- Install Digi Embedded Linux (DEL) 5.2 or higher, apply latest patches with the Package Manager.

4.1 Configure U-Boot to include I2C commands

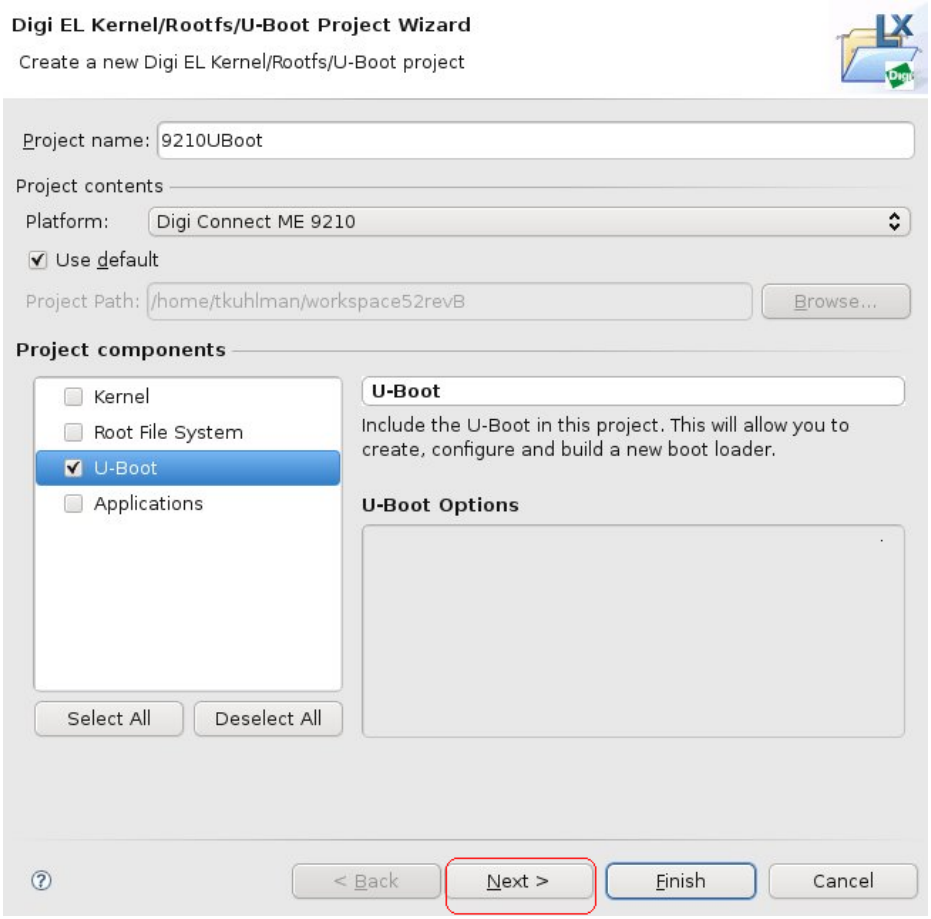
If you just want to access your I2C from Linux, you can skip this section. For testing your initial hardware connection to the I2C device and to check its ID or to modify the content of an I2C EEPROM having I2C features enabled in U-Boot might be useful.

4.1.1 Create U-Boot project for Digi Connect ME 9210

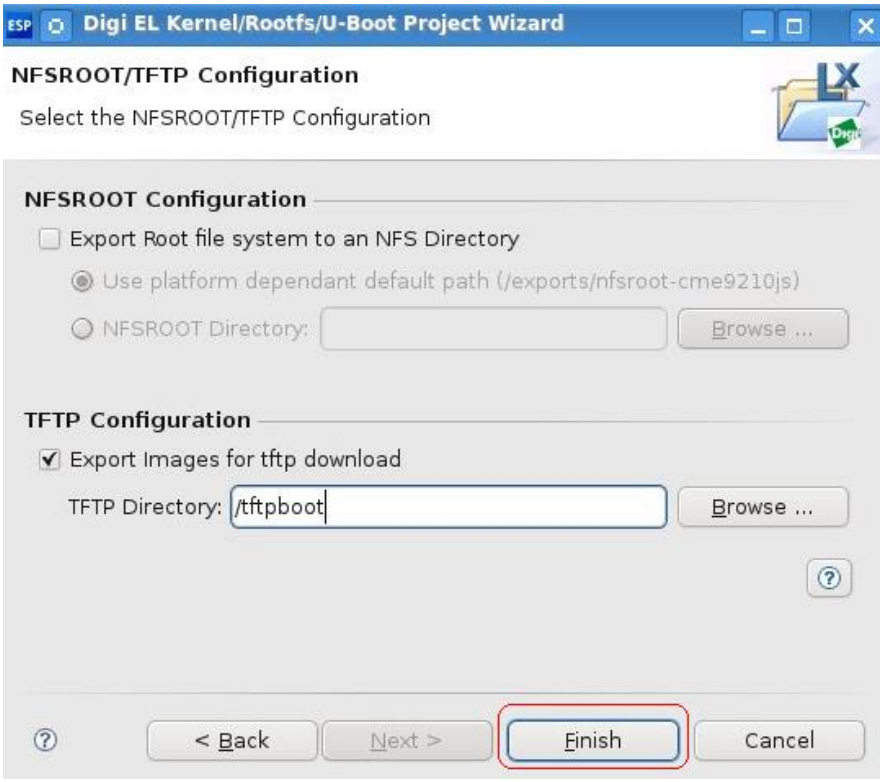
Open the Digi ESP, make sure you have the latest patches installed with the Package Manager. Create a new U-Boot project: File - > New -> Digi EL- Kernel/Roots/U-Boot Project.



Select appropriate project name and Digi Connect ME 9210 as platform with U-Boot as Project component:

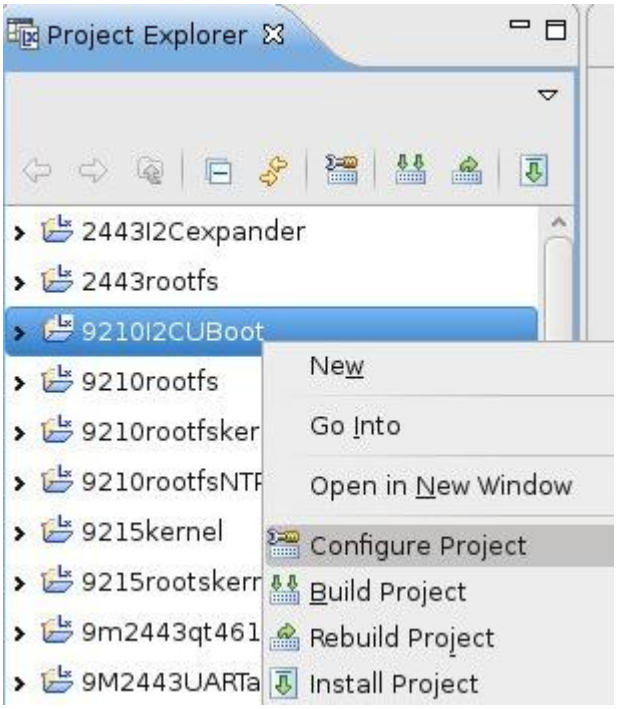


Click “Next” and select TFTP Configuration to /tftpboot, finally click “Finish” to create the project:

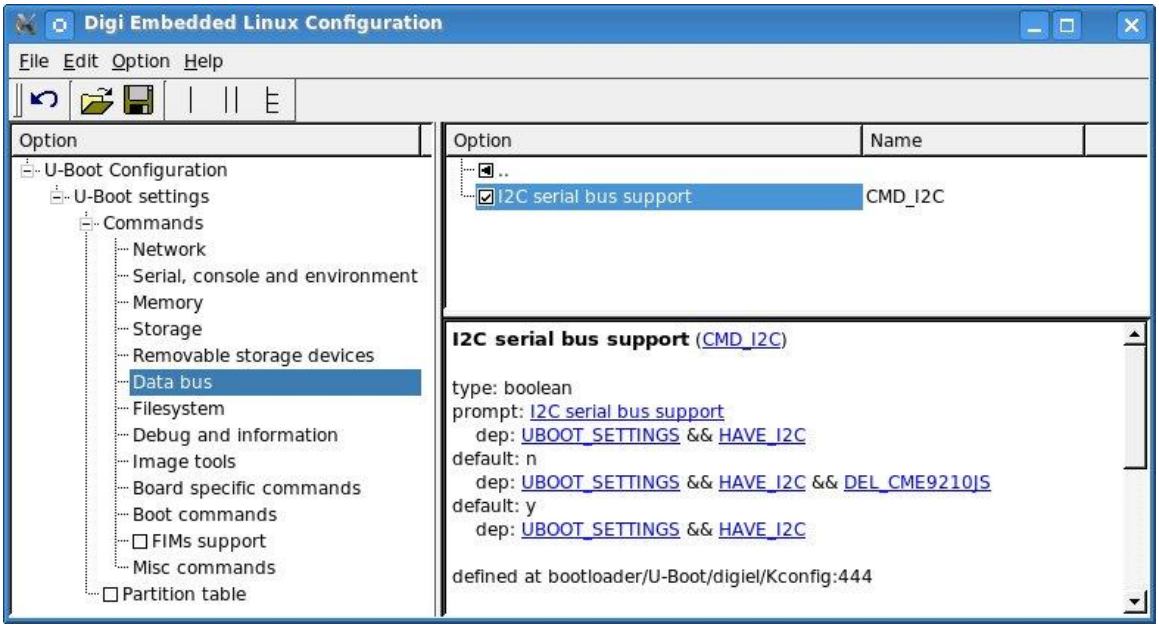


4.1.2 Configure and build the U-Boot to include I2C support

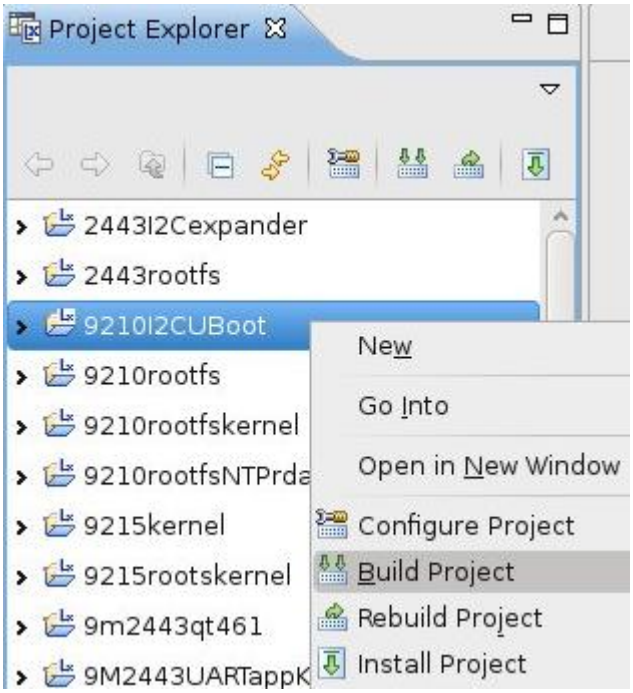
Select configure on the U-Boot project (e.g. right click -> configure):



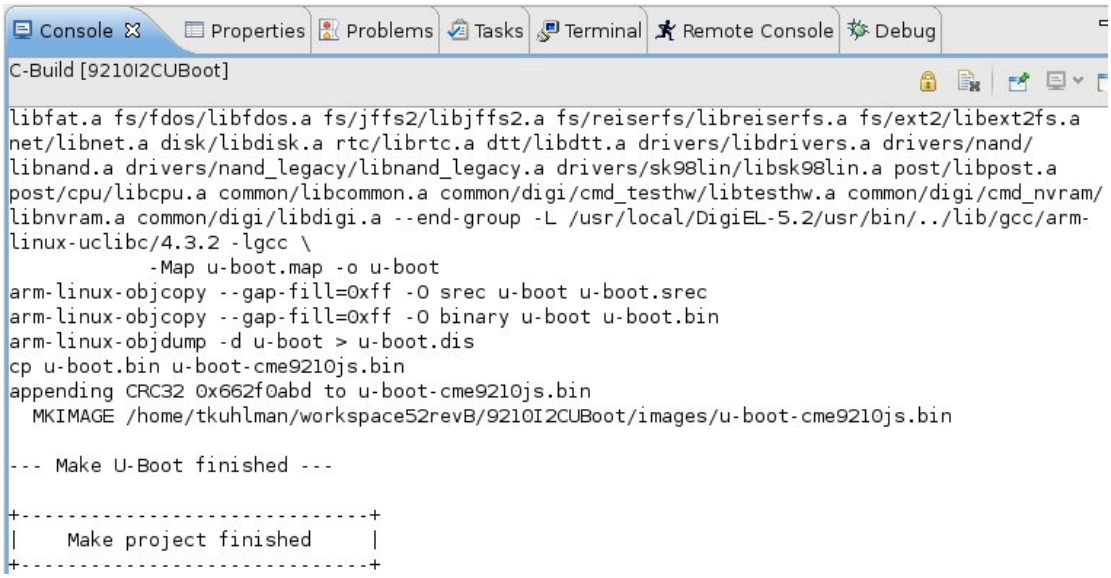
In Commands, select Data bus -> I2C to enable CONFIG_CMD_I2C:



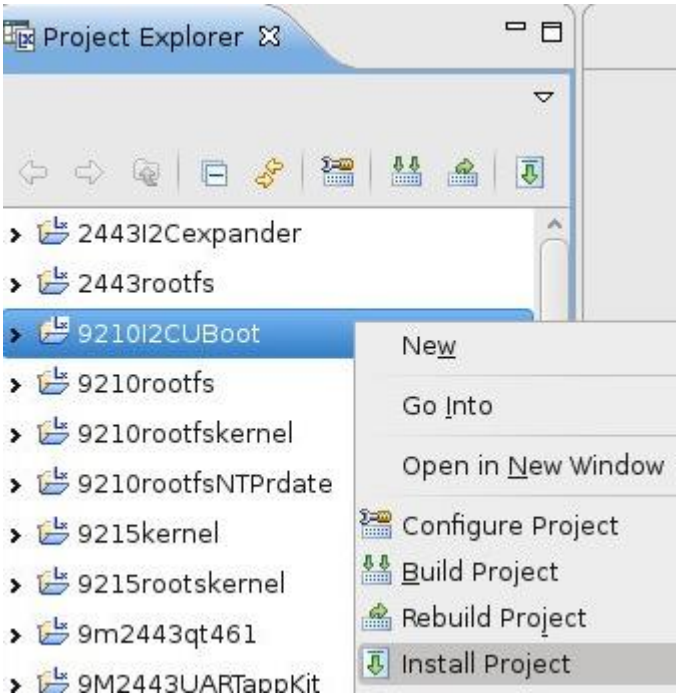
Save and Quit the configuration and build the U-Boot:



After the build finished:

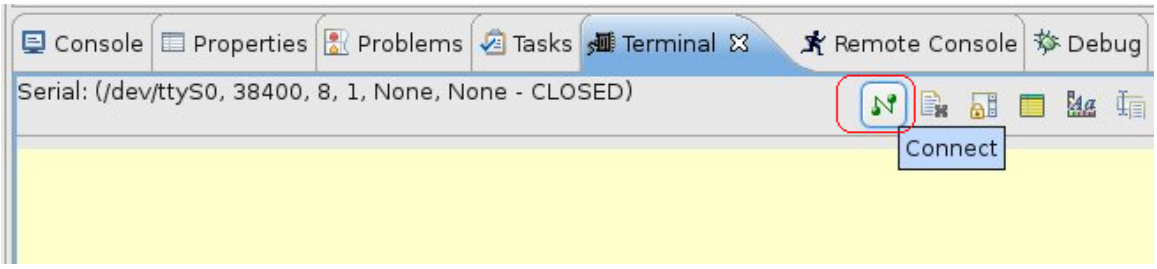


Install the binary into the /tftpboot directory:

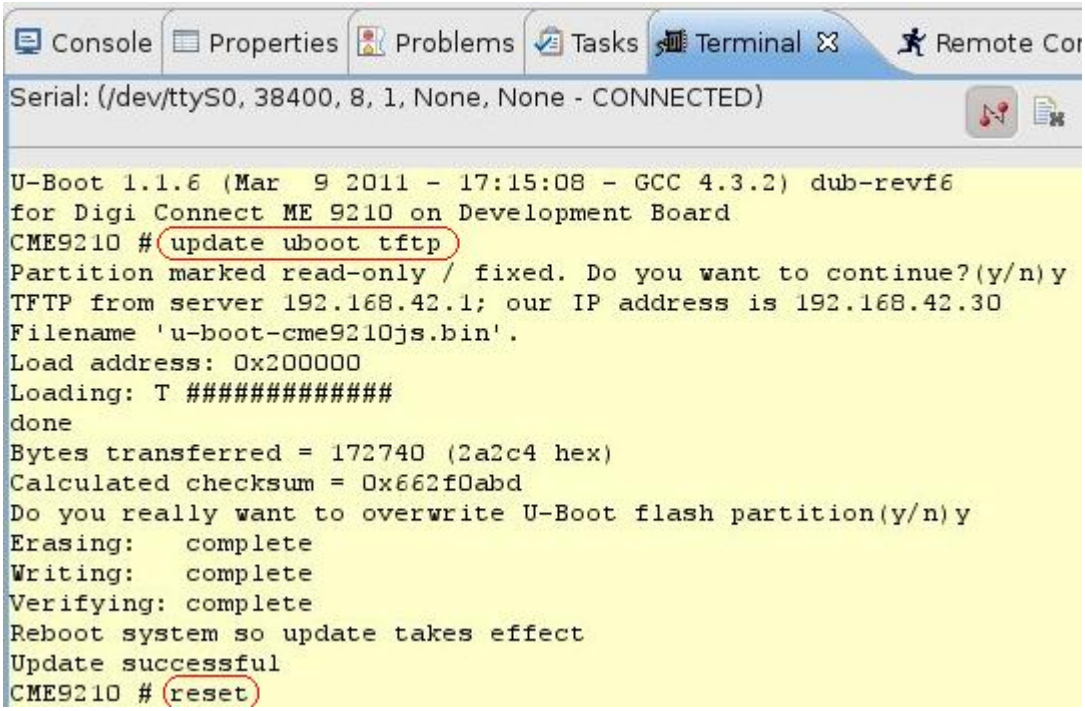


4.1.3 Program this U-Boot onto the module

Connect the Digi Connect ME 9210 via Ethernet and serial line to your development PC, make sure IP settings do match and serial 38400 8N1. Do a serial Terminal connection to the module:

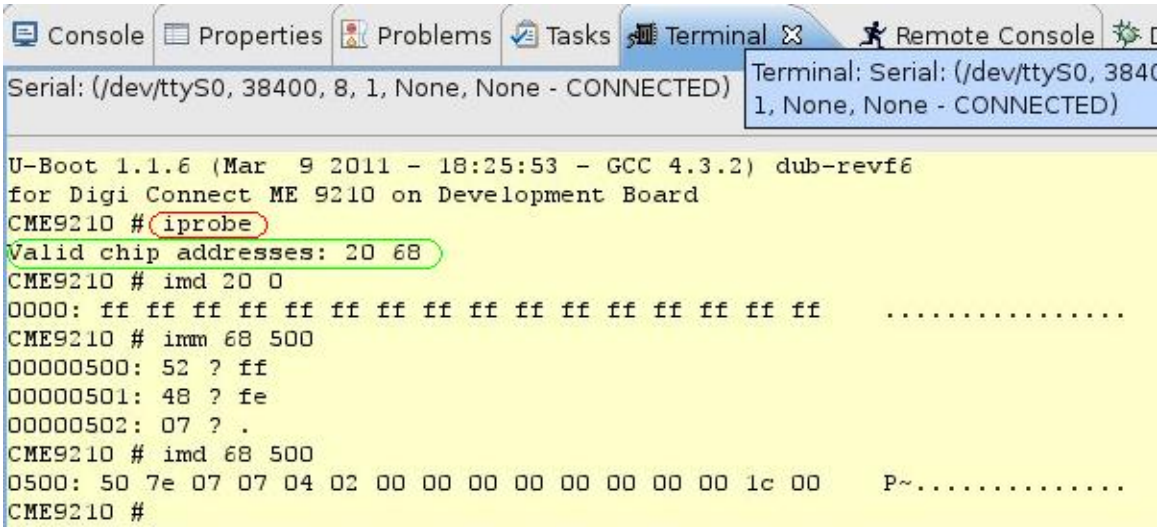


And update the U-Boot in flash with your custom U-Boot image, and reboot the firmware:

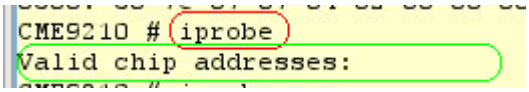


4.1.4 Testing I2C bus from U-Boot

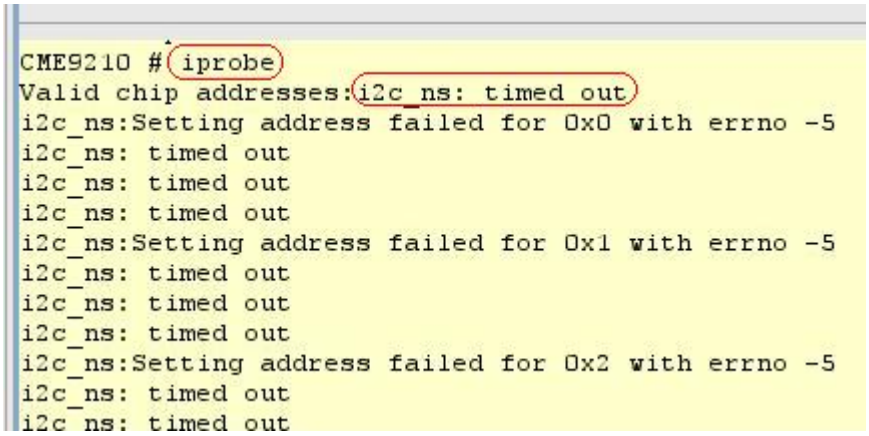
Now you can use the “iprobe” command to check for device or the “imm/imd” commands to modify connected I2C memory devices. Use the help command or the U-Boot command line reference to get more information about those commands.



If you are getting no chip addresses reported at all, you have not connected SDA/SCL correctly:

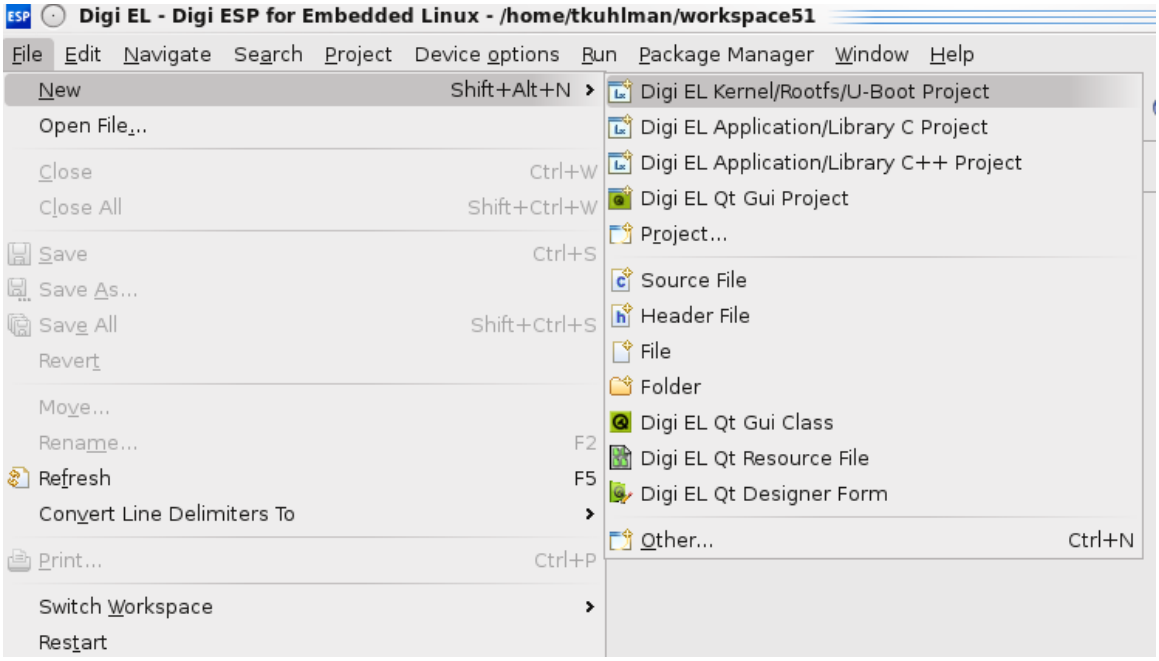


If you are getting timeouts, you have not connected GND/3.3V or the I2C pull up resistors need to be tuned:

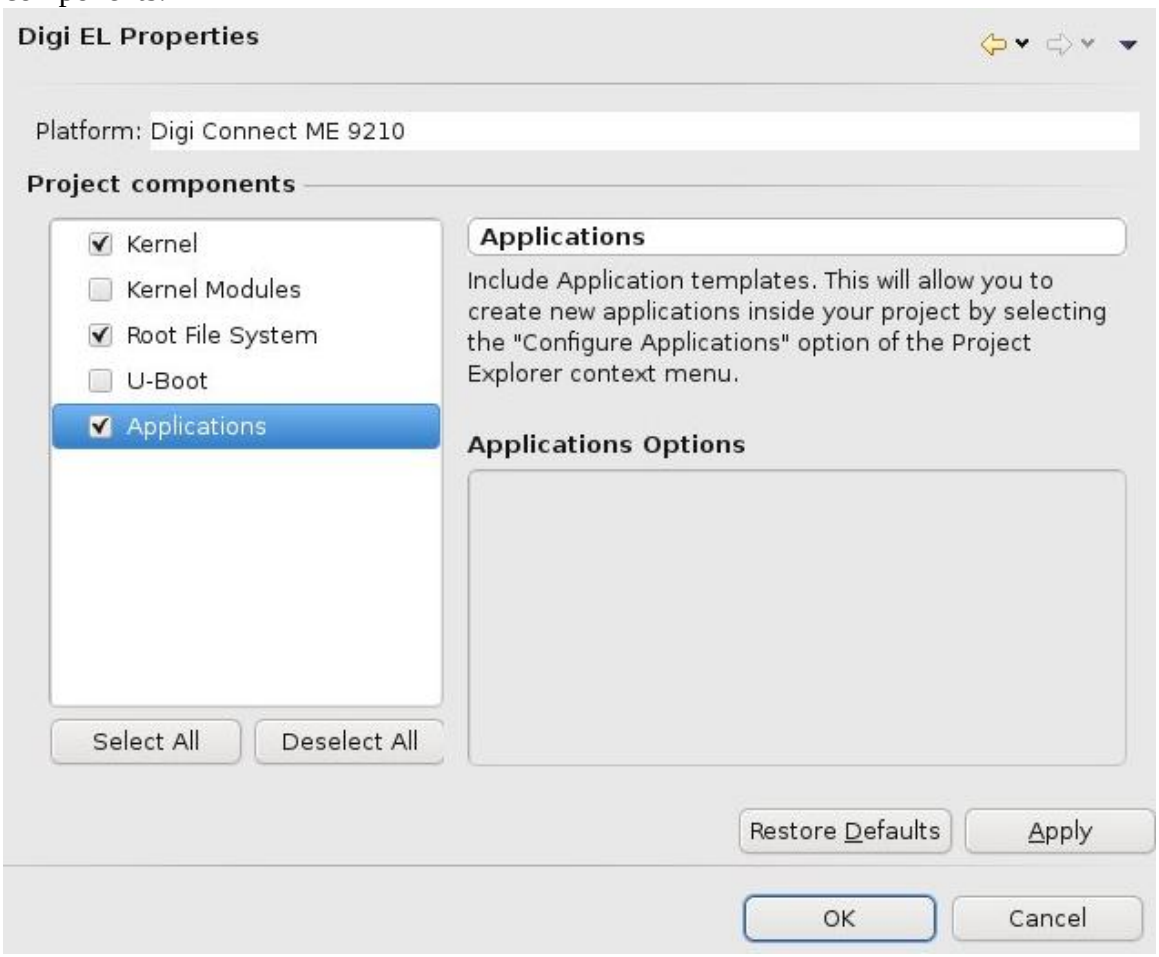


The output of iprobe can help you to determine under which device IDs you need to register the chip device drivers in Linux in the next section.

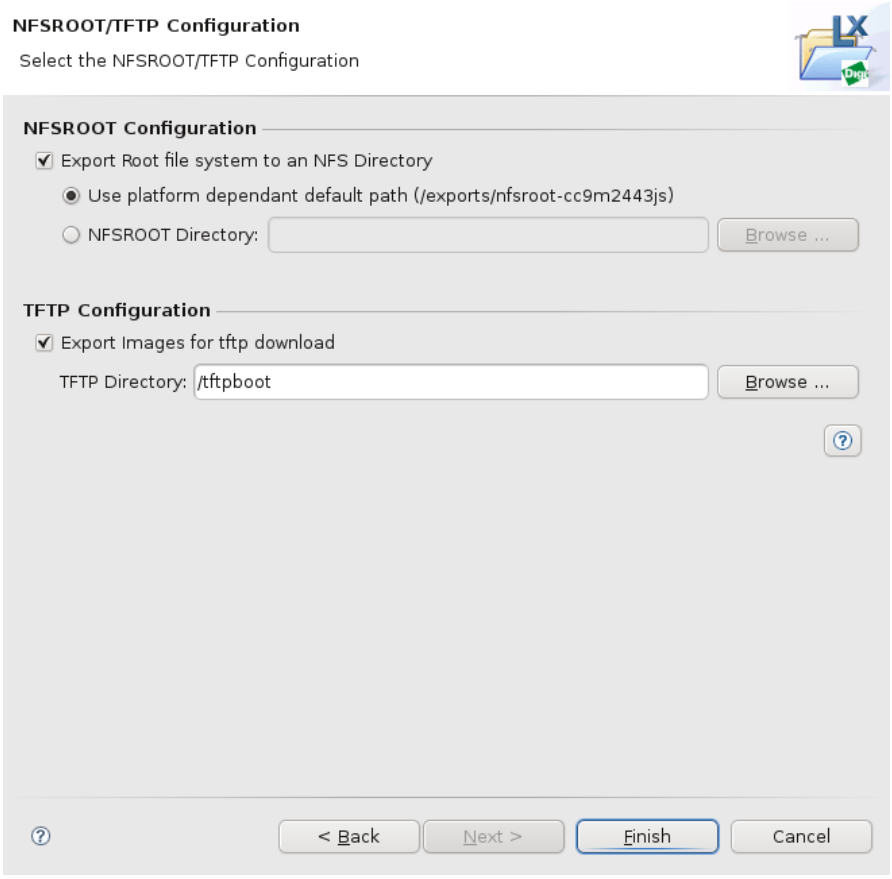
4.2 Create a new Digi EL Kernel/Rootfs/U-Boot Project



- Select Kernel and Root File System as project components:



- Select appropriate NFSROOT/TFTP Configuration



4.3 Patch support for your I2C device into the mach file

In the machine file $WORKSPACE/$YOURPROJECT/build/kernel/arch/arm/mach-ns9xxx/mach-cms9210js.c you need to register your device with your device ID, e.g. for Dallas RTC:

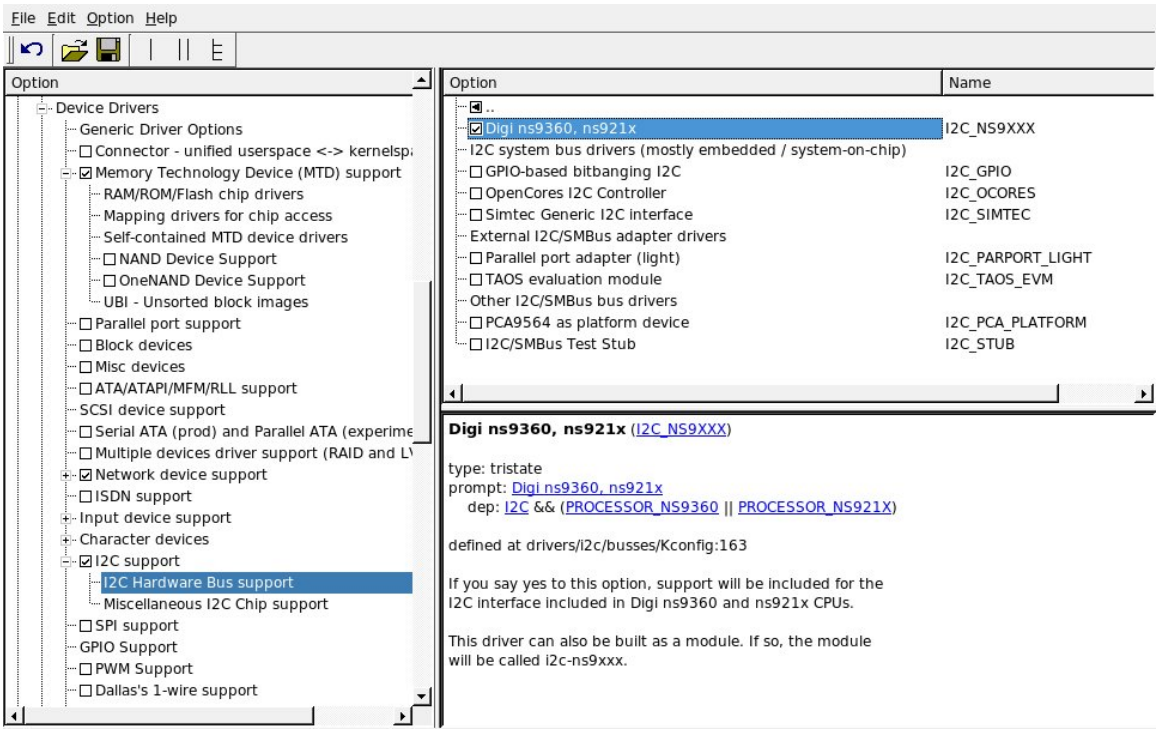
```
  /* I2C devices */
  static struct i2c_board_info i2c_devices[] __initdata = {
        {
+ #if defined(CONFIG_RTC_DRV_DS1307) || defined(CONFIG_RTC_DRV_DS1307_MODULE)
+               I2C_BOARD_INFO("ds1337", 0x68),
+ #else
                I2C_BOARD_INFO("device_name", address),
+ #endif
        },
  };
        /* I2C devices */
-       /*   <= uncomment this
        i2c_register_board_info(0, i2c_devices, ARRAY_SIZE(i2c_devices));
-       */  <= uncomment this
```

For the RTC example you can also use the patch attached with:

```
cd /usr/local/DigiEL-5.2/kernel/linux/arch/arm/mach-ns9xxx
patch -p0 <mach-cme9210js.patch
```

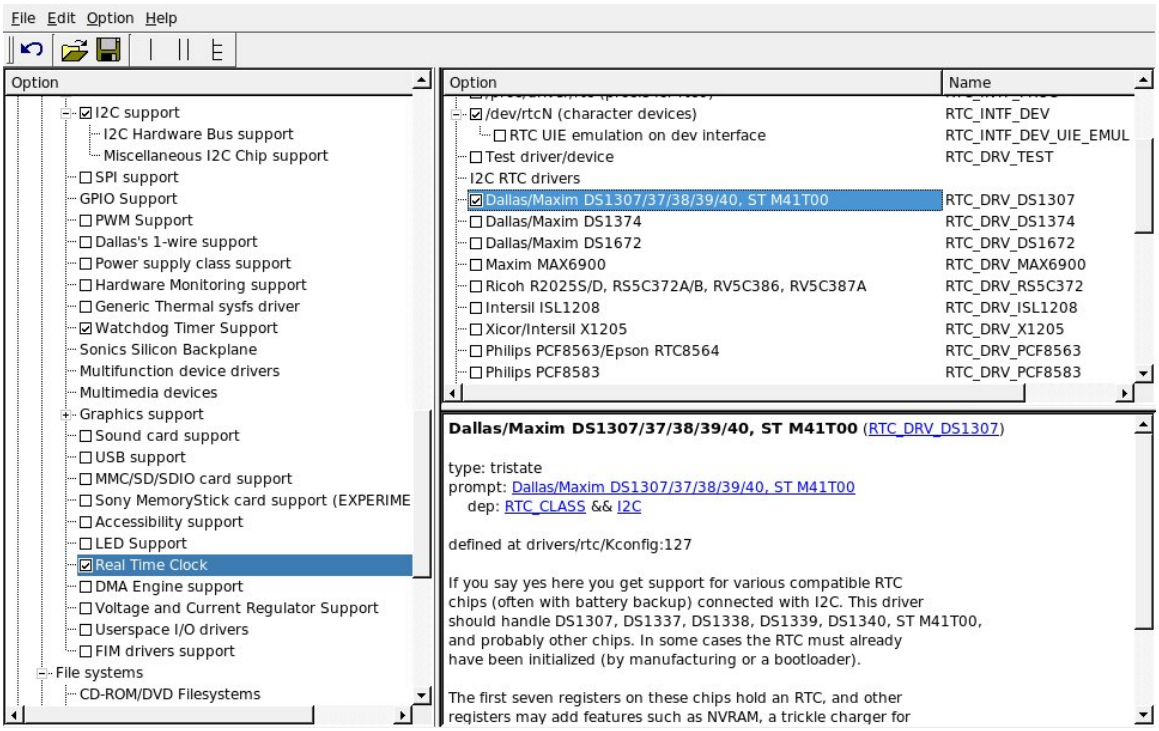
4.4 Configure the kernel for I2C

Open the Kernel config. In the Device drivers section, select I2C support and Digi ns9360, ns921x support:

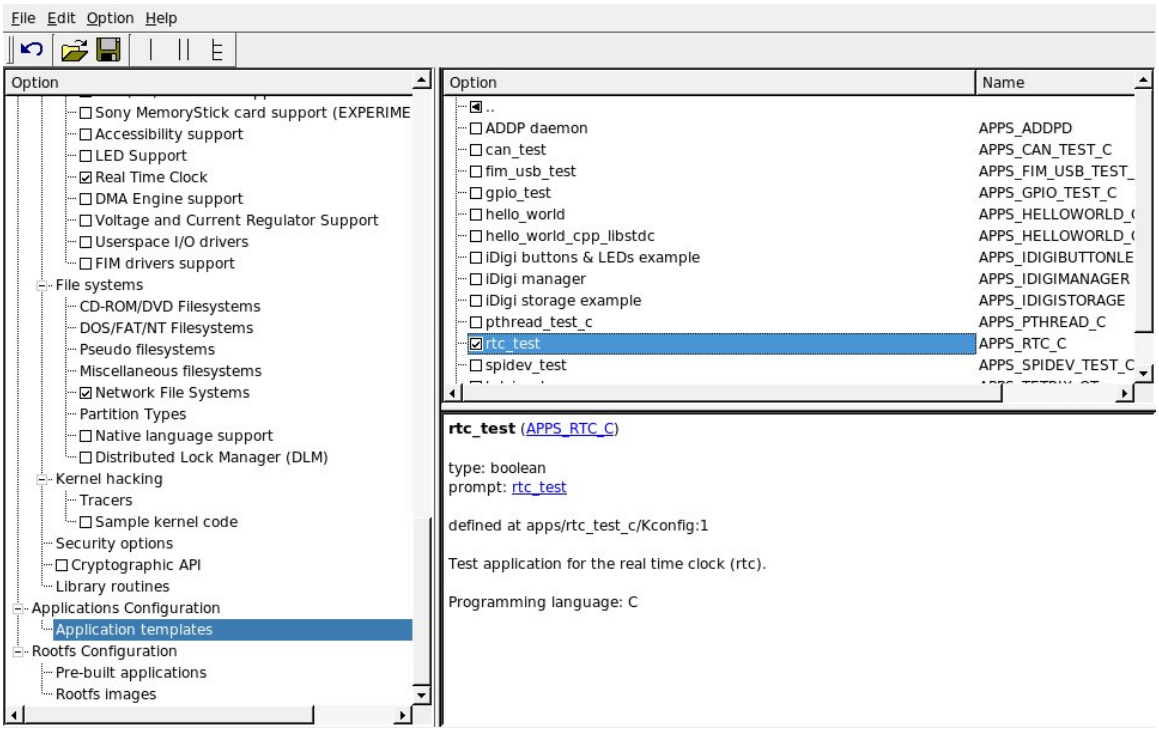


Enable support for your I2C device, e.g. to enable support for Maxim DS1337 I2C RTC, either search the kernel config (Edit->Find) or select and enable Real Time Clock and

Dallas/Maxim DS1307/37 support, this will create /dev/rtc:



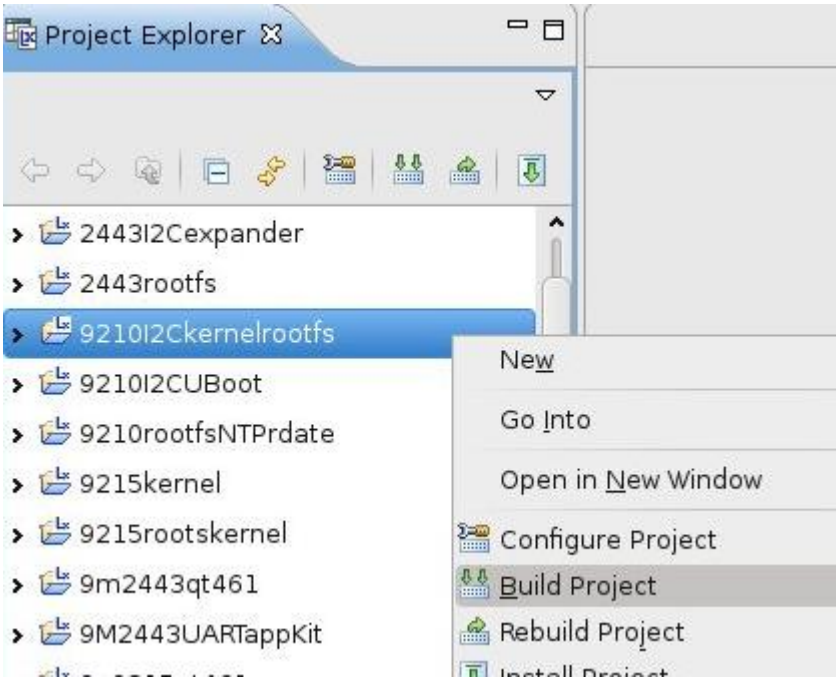
Configure rootfs with Application template -> rtc_test:



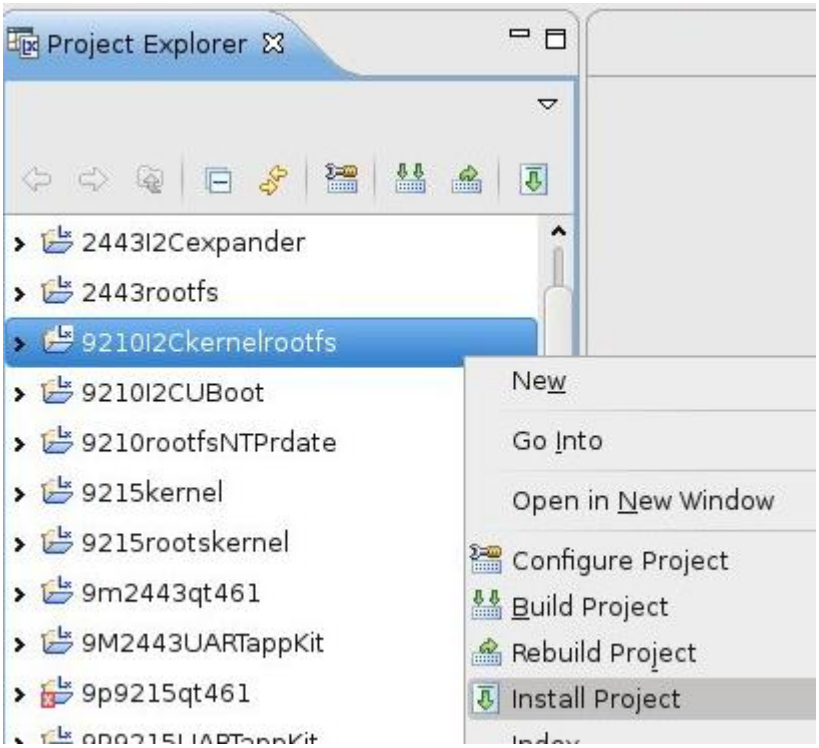
So rtc_test will work, as well as hwclock. However if clock is not detected, system might not boot sometimes, if the driver is statically linked in.

4.5 Built the kernel/rootfs project

Build the project from the project explorer (right mouse button):



Install the project from the project explorer:



5 Hardware Setup

- Turn off the development board.
- Connect the power cable.
- Plug the Connect ME 9210 or ConnectCore module to the development board.
- Connect Ethernet between development board and your development PC or switch (for updating firmware).
- Connect a serial null modem cable (pins 2 and 3 crossed) to your host computer (e.g. COMA is the CONSOLE). Plug the cable into Serial Port 1 (P1) of the Digi development board.
- Connect your external I2C device with SDC/SLA/GND/3.3V as indicated in section 3.
- Power on the Connect ME 9210 dev board

6 Testing from Linux

Run the new built kernel and rootfs on module (e.g. update the images into flash built in section 4.5 “update linux tftp; update rootfs tftp;dboot linux flash”, or boot with NFS-root: “dboot linux tftp”).

During boot up you should notice message from your selected I2C device driver, e.g.:

```
rtc-ds1307 0-0068: rtc core: registered ds1337 as rtc0
```

And from the I2C bus driver:

```
i2c-ns9xxx i2c-ns9xxx: NS9XXX I2C adapter
```

Run the I2C device test applications specific to your device, or access the device file directly, e.g. for the Dallas RTC:

```
# hwclock
# rtc_test
# rtc_test --help
```

