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OnRISC
User Manual
Edition: May 2014

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Contents

List of Figures

List of Tables

1. Introduction

1.1. OnRISC Family

The OnRISC is an ARM-based RISC industrial embedded computer family. The great variety of interfaces like LAN, CF, microSD, USB, CAN[1], I²C, serial interface and digital I/O makes it easy to connect various industrial devices to the OnRISC. New OnRISC device provide graphical display (VS-860 has built-in 8" LCD display and Alekto2 provides HDMI interface to attach an external monitor).

Compact dimensions and DIN Rail mounting capability make the OnRISC to a space saving and flexible mounting industrial computer. It is feasible to be installed even in space limited environments.

Due to RISC based architecture the OnRISC has very small power consumption, so fanless heat dissipation is possible. Working in an extended temperature range the OnRISC can be used under harsh industrial conditions. Therefore the OnRISC is downright designed for industrial automation. Refer to the Hardware Manual for exact characteristics.

The embedded computer runs full-featured Debian GNU/Linux on ARM operating system. With Debian's repository database it is easy to install and update the free software on the OnRISC. The OnRISC is capable to act directly as software development host, Web, Mail, Print and Database server or as desktop computer with X11 window manager and many more.

1.2. How to Read the Manual?

First of all the manual describes two different hardware architectures KS8695 based devices (Alekto, Alekto LAN, Alena) and OMAP3 based devises (VS-860, Alekto 2). For example the first group uses BIOS stored in a NOR flash, the second group uses in CPU built-in Boot ROM to boot from MMC card directly and so on. Hence you'll find Sections marked for KS8695 based devices or OMAP3 to highlight the differences.

Hardware Manual should be consulted first to understand, how the device is going to be powered. Section "Getting Started" will get you from power on till log on and basic network configuration. Section "Debian Maintenance Notes" describes how to search/install/remove Debian packages. Section "Network Services and Tools Provided by OnRISC" shows how to setup various network services like SSH, Apache, mail server etc.

Software development related sections are spread over the manual and touching different aspects of embedded software development for OnRISC devices. Section "Software Development" gives step-by-step instructions, how to setup development environment, get source code for the Linux kernel and programming examples. Section "Hardware API" gives overview of hardware interfaces and how they can be accessed in software. Sections "hwtest" and "hwtest-qt" describe test utilities. The source code of these utilities is a good starting point to see the topics described in "Hardware API" being used in practice. Section "Recommended Books" provides a list of books about Linux administration and programming.

Section "Buildroot" introduces another embedded Linux distribution built from scratch, that can be used instead of Debian.

[1] OnRISC Alena, Alekto2 and VS-860 devices

OnRISC Model	**Alekto**	**Alekto LAN**	**Alena**
CPU	ARM9 32-bit RISC CPU, 166MHz	ARM9 32-bit RISC CPU, 166MHz	ARM9 32-bit RISC CPU, 166MHz
RAM	64MB SDRAM	64MB SDRAM	64MB SDRAM
Flash Memory on Board	4MB	4MB	4MB
Serial Interfaces	2 x RS232/RS422/RS485	1 x RS232/RS422/RS485	2 x RS232/RS422/RS485 2 x RS232 only
CAN Interface on board	-	-	1 x
Digital I/O channels	8 x I/O channels	8 x I/O channels	4 x I/O channels 2 x Relays 2 x optically isolated inputs
CF-Slot (True IDE mode)	1 x (also accepts MicroDrives)	1 x (also accepts MicroDrives)	1 x (also accepts MicroDrives)
microSD-Slot	1 x internal slot	1 x internal slot	1 x internal slot
USB	2 x USB 2.0 as Host	2 x USB 2.0 as Host	2 x USB 2.0 as Host
Expansion Slot	MiniPCI-slot	MiniPCI-slot	MiniPCI-slot
Ethernet	2 x	5 x (WAN and 4 x LAN switch)	2 x
I^2C bus	1 x	1 x	1 x
RTC	1 x	1 x	1 x
Watchdog Timer	1 x	1 x	1 x
WLAN On/Off Button	-	1 x	-

Table 1: OnRISC Products Based on ARM9 KS8695 SoC

OnRISC Model	**VS-860**	**Alekto 2**
CPU	AM3517 (ARM Cortex-A8)	AM335x (ARM Cortex-A8)
RAM	256MB DDR2	256MB DDR2
Flash Memory on Board	N.A.	N.A.
Serial Interfaces	2 x RS232/RS422/RS485	2 x RS232/RS422/RS485
CAN Interface on board	1 x	1 x
Digital I/O channels	N.A.	8 x I/O channels
CFast slot	1 x	1 x
microSD-Slot	1 x internal slot	1 x internal slot
USB	2 x USB 2.0 as Host, 1 x as OTG	2 x USB 2.0 as Host, 1 x as OTG
Expansion Slot	Mini PCI Express	Mini PCI Express
Ethernet	2 x	2 x
I²C bus	N.A.	1 x
RTC	1 x	1 x
Watchdog Timer	1 x	1 x
Display	built in LCD	HDMI connector

Table 2: OnRISC Products Based on OMAP3 SoC

2. Getting Started

2.1. Connect to OnRISC via Serial Link

Connect the OnRISC to the serial port of your PC and start a terminal software (HyperTerminal, ZOC[2], minicom etc) with 115200,8,n,1 settings (no hardware/software handshake is needed. Set the terminal type according to Section 2.2). Insert a CF/microSD-card with one of the preinstalled systems (refer to Section 3). Power your OnRISC according to the Hardware Manual. You'll see Linux booting. After the boot procedure you'll be asked to log in. Two users are already added to the system: a super user (root) and an ordinary user (user). For the super user enter:

```
Debian login:  root
Password:  linux
```

For the ordinary user enter:

```
Debian login:  user
Password:  user
```

2.2. Terminal Type

Terminal type is defined in the environment variable `TERM` and is set to `TERM=linux` by default. The terminal type of your terminal application (HyperTerminal, ZOC, minicom etc.) should be set to the same type to interact correctly with the OnRISC console. If `linux` terminal type is not available in your software, `vt100` can be used instead. To do this add following line to the `~/.bashrc`:

```
export TERM=vt100
```

[2] www.emtec.com

2.3. Configure Network

Now you can configure network interfaces by editing `/etc/network/interfaces`. The IP addresses for `eth0`, `eth1` and `wlan0`[3] are statically assigned by default(see the Listing below).

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet static
        address 192.168.254.254
        netmask 255.255.255.0

# The secondary network interface
auto eth1
iface eth1 inet static
        address 192.168.253.254
        netmask 255.255.255.0

# The wireless interface
#auto wlan0
iface wlan0 inet static
        address 192.168.127.254
        netmask 255.255.255.0
        wpa-driver wext
        wpa-conf /etc/wpa_supplicant.conf
        post-up echo BLUE > /proc/vsopenrisc/leds
        post-down echo blue > /proc/vsopenrisc/leds
```

Listing 1: /etc/network/interfaces

`post-up` and `post-down` directives switch blue LED on and off signaling that wireless interface is up or down (KS8695 based devices only). The wireless interface `wlan0` will be configured with the `wpa_supplicant` utility (see Section 4.1).

Setup gateway and DNS server Assuming your router has IP address 192.168.254.1 the OnRISC will be configured in the following way:

1. change `eth0` section of `/etc/network/interfaces` file
   ```
   auto eth0
   iface eth0 inet static
   address 192.168.254.254
   netmask 255.255.255.0
   gateway 192.168.254.1
   ```
2. insert following line to the `/etc/resolv.conf`[4]
   ```
   nameserver 192.168.254.1
   ```

[3] to activate wlan0 uncomment the `#auto wlan0` line in `/etc/networking/interfaces`
[4] see `man resolv.conf` for explanations

3. execute `/etc/init.d/networking restart`

2.4. Start Programming

2.4.1. KS8695 based Devices

Connect to the OnRISC either via serial link or network and login as `user`. For the introduction some examples were prepared and placed under `/home/user/examples`. This folder contains following files:

- `ioctls.c` - LEDs, buzzer, reset push button and digital IO usage examples
- `ioctls2.c` - UART and network usage examples
- `rawsrv.c` - raw server application that transfers data from network to serial interface and vice versa
- `wdtimer.c` - Watchdog Timer example
- `onrisc.h` - OnRISC hardware API header file
- `Makefile` - the makefile to produce examples. Following targets can be created:
  - `all` - creates `ioctls`, `ioctls2` and `rawsrv` executables
  - `doc` - creates doxygen documentation in `doc` folder
  - `clean` - deletes executables
  - `distclean` - executes clean and in addition removes `doc` folder
- `onrisc.doxyfile` - doxygen configuration file

Execute `make` and you'll get three above mentioned executables (see Figure 1).

You can start with an `ioctls` example that reads and changes the LEDs (Power LED, WLAN LED etc.), reads the reset push button status and digital IO registers:

`./ioctls`

After that you'll see your LEDs blinking and explaining outputs on your terminal. For further information about software development for the OnRISC refer to Section 5.

2.4.2. OMAP3 based Devices

Log in into the desktop environment, open terminal and go to `/home/user/examples/qt-simple-window`. Execute:

1. `qmake`
2. `make`
3. `./simple`

You'll get a simple window with "Simple example" caption. For further information about software development for the OnRISC refer to Section 5.

```
user@debian:~/examples$ make
gcc -O0 -g3 -Wall ioctls.c -o ioctls
gcc -O0 -g3 -Wall ioctls2.c -o ioctls2
gcc -O0 -g3 -Wall rawsrv.c -o rawsrv
gcc -O0 -g3 -Wall wdtimer.c -o wdtimer
user@debian:~/examples$ ls -l
total 350
-rw-r--r-- 1 user user 349 Aug 27 14:32 CMakeLists.txt
-rw-r--r-- 1 user user 392 Aug 27 14:57 Makefile
-rwxr-xr-x 1 user user 68577 Aug 27 17:12 ioctls
-rw-r--r-- 1 user user 8865 Aug 27 14:54 ioctls.c
-rwxr-xr-x 1 user user 8568 Aug 27 17:12 ioctls.strip
-rwxr-xr-x 1 user user 91036 Aug 27 17:12 ioctls2
-rw-r--r-- 1 user user 3097 Aug 14 14:01 ioctls2.c
-rwxr-xr-x 1 user user 5352 Aug 27 17:12 ioctls2.strip
-rwxr-xr-x 1 user user 93286 Aug 27 17:12 rawsrv
-rw-r--r-- 1 user user 5682 Aug 14 14:01 rawsrv.c
-rwxr-xr-x 1 user user 8720 Aug 27 17:12 rawsrv.strip
-rw-r--r-- 1 user user 50619 Aug 14 14:01 onrisc.doxyfile
-rw-r--r-- 1 user user 2243 Aug 27 14:50 onrisc.h
-rwxr-xr-x 1 user user 61988 Jul 24 05:44 wdtimer
-rw-r--r-- 1 user user 1042 Aug 14 2008 wdtimer.c
-rwxr-xr-x 1 user user 3868 Jul 24 05:44 wdtimer.strip
user@debian:~/examples$
```

Figure 1: Compilation example

3. Software Configuration

The OnRISC comes with a preinstalled Debian GNU/Linux on ARM[5] operating system. The complete system image (see Section 3.7) provides necessary tools and services to start with application development, various services such as web and mail server, Samba server, etc. For office tasks it provides an X-Server with graphical desktop manager and some office software.

This image can be downloaded from our FTP server and can be copied to the CF/microSD card via `vsimgtool` utility or Win32 Disk Imager (see Appendix E.1) under MS Windows or via `dd` (see Appendix E.2).

Alternatively Buildroot (Section Section 10) can be used to create the root file system.

3.1. Booting from CF/microSD

3.1.1. KS8695 based Devices

There are two files placed under `/boot` directory on the complete image:

- `zImage` - kernel to boot
- `kparam` - kernel parameter

The OnRISC BIOS (refer to Section 8) is searching for these files to boot the system from an external medium (Mass storage devices, network etc.). Due to the fact that USB devices need more time to be detected it is recommended to increase the Start-Timeout value to at least 5 seconds (refer to 8.5). The kernel parameter will be described below:

root= parameter tells kernel from where to take the root filesystem. If this parameter is not supplied BIOS[6] defines it using the device name containing zImage. So if root filesystem is on the same device/partition as the kernel it is recommended not to define `root=` parameter.

Example:

Specifying `root=/dev/hda1` will mount `/dev/hda1` as root filesystem

Specifying `root=/dev/sda1` will mount `/dev/sda1` as root filesystem

If CF card is inserted into the internal CF-Slot and kparam doesn't supply `root=` parameter, `/dev/hda1` will be mounted as root filesystem

rootwait parameter tells kernel to wait till root device appears. This is important for booting from USB devices, because they will be detected much later than CF. This parameter is integrated into BIOS since version 2.0.

mem= parameter defines the amount of RAM that kernel can use. This parameter is integrated into BIOS since version 2.1, but it can be overridden in the `kparam`.

[5] http://www.debian.org/ports/arm/

[6] since BIOS version 2.1

3.1.2. OMAP3 based Devices

The system images for OMAP3 based devices have two partitions:

1. FAT partition having files need to initialize and boot the system (MLO, u-boot.img, uEnv.txt and uImage)
2. ext4 partition having Debian root file system

The OMAP CPU automatically loads x-loader (MLO) from the FAT partition and then the code in x-loader takes over and loads U-Boot[7] (u-boot.img), that takes care of Linux kernel (uImage). Please refer to this wiki for detailed information about OMAP boot process Bootloader Project.

3.2. Swapping and Logging

Due to the fact that the flash memory has a finite number of erase-write cycles it is very important to reduce them. Many applications use logging for information, recovery and debugging purposes, this can lead to frequent flash usage. There are several possibilities to avoid this:

1. use external HDD attached via USB and redirect swapping and logging to it
2. disable swapping[8] (remove swap entry in the `/etc/fstab`) and logging where it is possible
3. redirect the log stream via network

To redirect logged messages that need syslog edit /etc/syslog.conf and change all file destinations to network destinations (see the example). Change

```
*.=info;*.=notice;*.=warn;\
auth,authpriv.none;\
cron,daemon.none;\
mail,news.none -/var/log/messages
```

to

```
*.=info;*.=notice;*.=warn;\
auth,authpriv.none;\
cron,daemon.none;\
mail,news.none @192.168.254.84
```

for further information refer to the `syslog.conf` manpage. To receive the log messages under Linux you can use your existing syslog utility, for Windows you can use Kiwi Syslog Daemon[9] or any other Syslog daemon.

[7] http://www.denx.de/wiki/U-Boot
[8] To list swapping devices execute `cat /proc/swaps`
[9] www.kiwisyslog.com

3.3. Activating and Deactivating Services

Some services will be started as daemons at system startup and hence reduce the amount of free memory and increase the boot time. You can use one of the following options to deactivate the unused services at startup or start them only on demand:

- rename links under `/etc/rc2.d`[10] (see Table 3).
- use `sysv-rc-conf`[11] as graphical console program for the first method
- start the service over `inetd`[12]
- start manually via `/etc/init.d`

Disabled name	Enabled name
K09apache2	S91apache2
K77ntp	S23ntp
K80courier-authdaemon	S20courier-authdaemon
K80courier-mta	S20courier-mta
K80courier-pop	S20courier-pop
K80samba	S20samba
K80sqwebmail	S20sqwebmail
K84openvpn	S16openvpn

Table 3: Enable/disable services

3.4. udev

Since kernel 2.6.26.5 Complete Image uses udev[13] to create devices in `/dev` directory. The network interfaces are not bound to their MACs in order to be able to use only one system image on various devices[14]. To change this behavior in Debian 4.0 Etch uncomment following line in `/etc/udev/rules.d/z45_persistent-net-generator.rules`:

```
#KERNEL=="eth*|ath*|wlan*|ra*|sta*", DRIVERS=="?*",\
# IMPORT{program}="write_net_rules $attr{address}"
```

To change this behavior in Debian 5.0 Lenny change following line in `/etc/udev/rules.d/75-persistent-net-generator.rules:`

```
KERNEL!="eth*|ath*|wlan*[0-9]|msh*|ra*|sta*|ctc*|lcs*|hsi*",
\ GOTO="persistent_net_generator_end"
```

to

```
KERNEL!="ath*|msh*|ra*|sta*|ctc*|lcs*|hsi*",
\ GOTO="persistent_net_generator_end"
```

`/etc/udev/rules.d/custom.rules` has rules to create symlinks to I2C and RTC devices:

[10] For detailed information about filenames see `/etc/rc2.d/README` file
[11] http://sysv-rc-conf.sourceforge.net/
[12] see `man inetd`
[13] http://en.wikipedia.org/wiki/Udev
[14] All relevant settings were removed from `/etc/udev/rules.d/z25_persistent-net.rules` for Debain 4.0 Etch and from `/etc/udev/rules.d/70-persistent-net.rules` for Debian 5.0 Lenny

```
KERNEL=="rtc0", SYMLINK+="rtc"
KERNEL=="i2c-0", SYMLINK+="i2c"
```

3.5. Time Zone

The default time zone configured on the system image is Europe/London (GMT+0). BIOS operates with UTC time. So in summer time Debian's clock has one hour difference compared with the time shown in BIOS. It is normal behavior. Use `dpkg-reconfigure tzdata` to change the time zone in Debian according to your geographical position.

3.6. Create Swap File

Swap file can be created instead of creating a swap partition. To create it execute following steps:

1. create file with `count` being equal to the desired block size: `dd if=/dev/zero of=/var/swapfile bs=1024 count=131072`
2. `mkswap /var/swapfile`
3. add entry to the `/etc/fstab`: `/var/swapfile none swap sw 0 0`
4. reboot and check if `/var/swapfile` is used by looking at `/proc/swaps`

```
debian:~# cat /proc/swaps
Filename Type Size Used Priority
/var/swapfile file 131064 0 -1
```

3.7. Complete System Image

The complete system image contains lots of programs and libraries. It contains a development environment consisting of the gcc tool chain and vim-tiny text editor. Besides development tasks this image is designed to use the OnRISC as a server and/or desktop system to accomplish such tasks as mail server, web server, resource sharing and office tasks. For the latter window manager is installed to provide graphical desktop on the OnRISC.

3.7.1. Program Overview

The complete image provides among others the following utilities:

- Software Development
  - gcc
  - vim-tiny
- Network
  - ssh (server and client)
  - telnet (server and client)
  - vsftpd (server and client)

  - netcat
  - socat
  - Samba client and server
  - Apache2 web server
  - Courier mail server
  - NTP client and server
  - sredird RFC2217 server
- Desktop:
  - WindowMaker (KS8695 based devices) or XFCE (OMAP3 based devices) desktop
  - xdm server
  - AbiWord
  - dillo or netsurf web browser

3.7.2. GCC

GCC[15] development is a part of the GNU Project, aiming to improve the compiler used in the GNU system including the GNU/Linux variant. The GCC development effort uses an open development environment and supports many other platforms in order to foster a world-class optimizing compiler, to attract a larger team of developers, to ensure that GCC and the GNU system work on multiple architectures and diverse environments, and to more thoroughly test and extend the features of GCC.

3.7.3. Netcat

Netcat[16] is a featured networking utility which reads and writes data across network connections, using the TCP/IP protocol. It is designed to be a reliable "back-end" tool that can be used directly or easily driven by other programs and scripts. At the same time, it is a feature-rich network debugging and exploration tool, since it can create almost any kind of connection you would need and has several interesting built-in capabilities.

3.7.4. Socat

socat[17] is a relay for bidirectional data transfer between two independent data channels. Each of these data channels may be a file, pipe, device (serial line etc. or a pseudo terminal), a socket (UNIX, IP4, IP6 - raw, UDP, TCP), an SSL socket, proxy CONNECT connection, a file descriptor (stdin etc.), the GNU line editor (readline), a program, or a combination of two of these. These modes include generation of "listening" sockets, named pipes, and pseudo terminals.

[15] http://gcc.gnu.org/gccmission.html
[16] http://netcat.sourceforge.net/
[17] http://www.dest-unreach.org/socat/

3.7.5. Samba

Samba[18] is an Open Source/Free Software suite that has, since 1992, provided file and print services to all manner of SMB/CIFS clients, including the numerous versions of Microsoft Windows operating systems. Samba is freely available under the GNU General Public License.
To share an extra directory for users create this directory:

`mkdir /samba`

Edit `/etc/samba/smb.conf`:

```
[global]
workgroup = debian
netbios name = debianserver
server string = %h server (Samba %v)
log file = /var/log/samba/log.%m
max log size = 1000
syslog = 0
[SAMBA]
path=/samba
browseable=yes
writeable=yes
valid users = user
admin users = debian
```

Now you need to restart the samba to take the new changes effect:

```
/etc/init.d/samba restart
```

3.7.6. Web Server (Apache2.2)

The Apache HTTP Server Project[19] is an effort to develop and maintain an open-source HTTP server for modern operating systems including UNIX and Windows NT. The goal of this project is to provide a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards. Apache has been the most popular web server on the Internet since April 1996.
In addition to the Apache2 packages the openssl package is installed to enable a SSL certificate creation. Apache2 is already equipped with SSL certificate and is ready to accept https connections needed for example to configure mail server via webadmin tool (see 3.7.7) . To create your own certificate or to install the official certificate take a look at the following paragraph.

How to Configure SSL? To enable https connections, a SSL certificate must be created and then registered by the Apache2 web server:

1. `mkdir /etc/apache2/ssl/`
2. `openssl req $@ -new -x509 -days 365 -nodes -out /etc/apache2/ssl/apache.pem -keyout /etc/apache2/apache.pem`
3. `chmod 600 /etc/apache2/ssl/apache.pem`

[18] http://us3.samba.org/samba/
[19] http://httpd.apache.org/

4. `cp /etc/apache2/sites-available/default /etc/apache2/sites-available/ssl`
5. `ln -s /etc/apache2/sites-available/ssl /etc/apache2/sites-enabled/ssl`
6. ssl file must be changed:
```
NameVirtualHost *:443
<VirtualHost *:443>
SSLEngine On
SSLCertificateFile /etc/apache2/ssl/apache.pem
SSLCertificateKeyFile /etc/apache2/apache.pem
...
</VirtualHost>
```
7. to activate port 443 for https-Queries edit `/etc/apache2/ports.conf`. Add
`Listen 443`
8. activate SSL module:
`a2enmod ssl`
9. restart Apache:
`apache2ctl restart`

3.7.7. Mail Server (courier)

The Courier mail transfer agent (MTA)[20] is an integrated mail/groupware server based on open commodity protocols, such as ESMTP, IMAP, POP3, LDAP, SSL and HTTP. Courier provides ESMTP, IMAP, POP3, webmail and mailing list services within a single, consistent, framework. Individual components can be enabled or disabled at will. Courier now implements basic web-based calendaring and scheduling services integrated in the webmail module. Advanced groupware calendaring services will follow soon.
The mail server can be conveniently configured via web interface using courierwebadmin tool. It can be started with the following URL
https://*mail-server-address*/cgi-bin/courierwebadmin.
Execute webadmin-tool, setup server name and local domains under *Mail server name and local domains* menu. Then create a user:

`adduser --ingroup users testuser`
login as `testuser`
`cd /home/testuser`
`maildirmake Maildir` (this creates user's maildir folder structure)

Execute webmail-tool
https://*mail-server-address*/cgi-bin/sqwebmail
and log on. From now on one can send and receive e-mails.

3.7.8. NTP

NTP[21] is a protocol designed to synchronize the clocks of computers over a network to a common timebase (usually UTC).

[20] http://www.courier-mta.org
[21] http://www.ntp.org

Configuration Client For client configuration edit `/etc/ntp.conf` as follows:

```
### client:/etc/ntp.conf ###############
driftfile /var/lib/ntp/ntp.drift
# NTP-server in LAN
server 192.168.1.1
# Grant access from other NTP-server
restrict 192.168.1.1
# Grant access from localhost (ntpq -p)
restrict 127.0.0.1
# deny access for other peers
restrict default notrust nomodify nopeer
###############################################
```

Then restart ntpd.

Configuration Server For server configuration edit `/etc/ntp.conf` as follows:

```
### server:/etc/ntp.conf #######################
driftfile /var/lib/ntp/ntp.drift
# NTP-server
server ptbtime1.ptb.de
server ptbtime2.ptb.de
# Grant access from other NTP-server
restrict ptbtime1.ptb.de
restrict ptbtime2.ptb.de
# Grant access from localhost (ntpq -p)
restrict 127.0.0.1
# grant access for local network
restrict 192.168.1.0 mask 255.255.255.0
# deny access for other peers
restrict default notrust nomodify nopeer
#################################################
```

Then restart ntpd.

3.7.9. WindowMaker

Window Maker[22] is an X11 window manager originally designed to provide integration support for the GNUstep Desktop Environment. In every way possible, it reproduces the elegant look and feel of the NEXTSTEP[tm] user interface. It is fast, feature rich, easy to configure, and easy to use. It is also free software, with contributions being made by programmers from around the world. Window Maker includes compatibility options which allow it to work with other popular desktop environments, namely GNOME and KDE, and comes with a powerful GUI configuration editor, called WPrefs, which removes the need to edit text-based config files by hand

[22] http://www.windowmaker.info

3.7.10. Connecting to X-Window

The xdm manager[23] lets you connect to the X-Server. Following configuration issues should be considered to enable a remote access to the OnRISC:

- `#* #any host can get a login window`
  in `/etc/X11/xdm/Xaccess` should be uncommented
- `DisplayManager.requestPort: 0`
  in `/etc/X11/xdm/xdm-config` must be replaced with
  `! DisplayManager.requestPort: 0`

Xming[24] can be used to connect to the X-Server from MS Windows. After installation, execute XLaunch and configure the proper IP address. The configuration can also be saved. The saved XML-file can look as follows:

```
<?xml version="1.0"?>
<XLaunch xmlns="http://www.straightrunning.com/XmingNotes"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.straightrunning.com/XmingNotes XLaunch.xsd"
WindowMode="Windowed"
ClientMode="XDMCP"
XDMCPHost="192.168.1.66"
Display="0"
Clipboard="true"/>
```

3.7.11. AbiWord

AbiWord[25] is a free word processing program, similar to Microsoft® Word. It is suitable for a wide variety of word processing tasks.

[23] http://en.wikipedia.org/wiki/X_display_manager
[24] http://sourceforge.net/projects/xming
[25] http://www.abisource.com

4. Network Services and Tools Provided by OnRISC

The OnRISC can be accessed via Ethernet for remote usage and file sharing. For this purpose there are several services such as telnet, ssh and ftp installed and preconfigured. For WLAN configuration wpa_supplicant and wireless-tools are included in the distribution.

4.1. WLAN Configuration

Wpa_supplicant[26] is a WPA Supplicant for Linux, BSD, Mac OS X, and Windows with support for WEP, WPA and WPA2 (IEEE 802.11i / RSN). Supplicant is the IEEE 802.1X/WPA component that is used in the client stations. It implements key negotiation with a WPA Authenticator and it controls the roaming and IEEE 802.11 authentication/association of the WLAN driver.

4.1.1. Managed Wireless Network (Wpa_supplicant)

Wpa_supplicant uses `/etc/wpa_supplicant.conf` file for its configuration (see the Listing below).

```
ap_scan=1

# no encryption
network={
   ssid="TEST"
   key_mgmt=NONE
}
# WEP encryption
network={
   ssid="TESTWEP"
   key_mgmt=NONE
   wep_key0=xxxxxxxxxxxxxxxxxxxx
   wep_tx_keyidx=0
   auth_alg=SHARED
}
# WPA/WPA2 encryption
network={
   ssid="TESTWPA2"
   proto=WPA RSN
   key_mgmt=WPA-PSK
   pairwise=CCMP TKIP
   group=CCMP TKIP
   psk="xxxxxxxxxxxxxx"
}
```

Listing 2: /etc/wpa_supplicant.conf

WLAN interface is automatically configured on system's startup (see Section 2.3). To test the configuration just run:

`/etc/init.d/networking restart`

Wpa_supplicant can also be called manually to investigate configuration problems:

[26] http://hostap.epitest.fi/wpa_supplicant/

```
wpa_supplicant -iwlan0 -c/etc/wpa_supplicant.conf -dd -Dwext
```

Further information about configuring the WLAN interface can be taken from wpa_supplicant's manual page (`man wpa_supplicant`) .

4.1.2. Ad-hoc Wireless Network (wireless-tools)

To connect to another node with SSID "Node1" not using encryption execute following commands:

```
ifconfig wlan0 down
iwconfig wlan0 mode ad-hoc key off essid "Node1"
ifconfig wlan0 up
```

For WEP encrypted connection:

```
ifconfig wlan0 down
iwconfig wlan0 mode ad-hoc key restricted key [1] "some WEP key" essid "Node1"
ifconfig wlan0 up
```

See also iw

4.1.3. WLAN On/Off Button (Alekto LAN only)

OnRISC Alekto LAN provides a special button to enable/disable the WLAN adapter. Pressing the button will result in button LED going off and WLAN transmit power turning off, so no communication via WLAN is possible. Pressing the button for the second time will result in button LED going on and WLAN transmit power returning to the previous value, so WLAN data transfer is again possible. This functionality will be managed by `wland` service running on start up. The source code for `wland` service is available via our svn repository at http://svn.visionsystems.de/.

4.2. GSM Support

Using PCI Express Mini Card adapter described in the Hardware Manual you can attach a GSM card. The system was tested with following GSM/UMTS/HSPA cards:

- MC8775 (Sierra Wireless)
- MC8790/MC8705 (Sierra Wireless)
- F5521gw (Ericsson)

Following configuration files were prepared to use this functionality:

- /etc/network/interfaces (the PIN for your SIM-card will be configured there. See comments in the file)
- /etc/chatscripts/gprs (your provider's Access Point Name (APN) is stored here)
- /etc/ppp/peers/gprs

To activate a GSM connection configure proper PIN and APN. After that uncomment `auto ppp0` and restart networking service:

```
service networking restart
```

You can find the supported AT command reference[27] on the CD .

4.3. Bluetooth Support

The Bluetooth support is already integrated in the kernel. To use a USB Bluetooth adapter you'll need to install some additional software:

```
apt-get install bluetooth
```

To connect to the Bluetooth network access point (NAP) execute:

1. `hcitool scan`
   you'll get the list of available Bluetooth devices with their addresses
2. select the needed one and connect to it
   `pand -c <bdaddr>`
3. check `/var/log/daemon.log` to verify that the connection is established or execute
   `ifconfig -a`
   if you can see `bnep0` interface the connection is definitely established
4. set up the `bnep0` interface. For example:
   `ifconfig bnep0 192.168.10.1`
5. assuming the NAP has an address 192.168.10.2 try to ping it:
   `ping 192.168.10.2`

To set up the NAP execute:

1. edit `/etc/bluetooth/hcid.conf` and set the security option to auto:
   ```
   # Security Manager mode
   # none - Security manager disabled
   # auto - Use local PIN for incoming connections
   # user - Always ask user for a PIN
   #
   security auto;
   ```
2. execute `/etc/init.d/bluetooth restart` to activate the new configuration
3. `hciconfig hci0 piscan lm master`
   to enable authentication (required by MS Windows) execute:
   `hciconfig hci0 piscan auth lm master`
   the default passkey configured in `/etc/bluetooth/hcid.conf` is "1234"
4. `pand --listen --role NAP`
5. after the client has connected, the `bnep0` must be also set up

To connect to the OnRISC from MS Windows, use the on-board tools or the software supplied with the Bluetooth device. For the on-board tools:

[27] documentation/2130617_Supported_AT_Command_Reference-v2.4.pdf

1. select “Join a Personal Area Network”
2. search for the OnRISC
3. select it and try to connect. Enter “1234” as passkey
4. configure the network interface

4.4. Telnet

The telnet console can be accessed with following command:

`telnet ip address`

This connection can be used only for normal users, not for the super user. To execute super user commands login as user and then execute `su`. For further information see:

`man telnetd` or `man issue.net`

4.5. SSH

To access the OnRISC via SSH from Linux execute:

`ssh ip address`

To access OnRISC via SSH from Windows you need a ssh-client such as PuTTY[28]. To exchange files several tools could be used:

- scp (Linux) - secure copy tool
- pscp (Windows) - secure copy tool included in PuTTY distribution
- WinSCP[29] (Windows) - secure copy tool with graphical interface

For further information see:

`man sshd`

4.6. FTP

OnRISC provides vsftpd[30] as FTP-server. The files to be shared must be placed in `/home/ftp`. To access the files execute:

`ftp ip address`

The FTP-server is configured for normal user accounts created on the OnRISC, so login as user “user” with a password “user”. For access via graphical FTP-client following programs can be used:

- FileZilla (http://www.filezilla.de/)
- Firefox with FireFTP add-on (http://fireftp.mozdev.org/help.html)

[28] http://www.chiark.greenend.org.uk/~sgtatham/putty/
[29] http://winscp.net/eng/index.php
[30] http://vsftpd.beasts.org/

For further information see:

```
man vsftpd
```

4.7. RFC2217

Internal serial interfaces of the OnRISC can be made accessible over network via RFC2217 protocol. `ser2net`[31] is a daemon, that provides such functionality. On the client side (PC) you need either a virtual COM port driver or an application/library communicating RFC2217 directly. For MS Windows OS you can use the VScom driver of NetCom Mini[32].

The installation requires following components to be installed:

- RFC2217 driver and NetCom UPnP Manager (is bundled with the driver)
- `vsupnpd` (provided with our system images, enabled by default)
- `ser2net` (provided with our system images, disabled by default)

`ser2net` will be configured via special configuration file (default `/etc/ser2net.conf`). This file contains following information:

```
SIGNATURE:sign_vs:VScom NetCom:111S:(C) VS Vision Systems GmbH 2010:1
5000:telnet:0:/dev/ttyS1:115200 sign_vs
5001:telnet:0:/dev/ttyS2:115200 sign_vs
#5002:telnet:0:/dev/ttyS3:115200 sign_vs
#5003:telnet:0:/dev/ttyS4:115200 sign_vs
```

SIGNATURE is a string that will be sent on RFC2217 driver's request to identify the device. Don't change this setting. After that you'll find the per serial interface configuration strings in following format:

```
<TCP port>:<state>:<timeout>:<device>:<options>
```

In the example the `/dev/ttyUSB0` device will be used in RFC2217 mode (telnet), listens on TCP port 5000 and the timeout function is disabled.

`vsupnpd` daemon parses `/etc/ser2net.conf` file and extracts TCP port numbers. This information will be announced via SSDP broadcasts, so that NetCom UPnP Manager can find and install the serial interfaces. If OnRISC is behind a router and broadcasts are not allowed, you can manually add the device in the NetCom UPnP Manager. See NetCom Mini Manual for more details.

Please note that `ser2net` service is disabled by default. You need to activate using `sysv-rc-conf` (see Section 3.3).

[31] https://sourceforge.net/projects/ser2net/
[32] http://www.vscom.de/download/multiio/Windows7/driver/NCMini-Install-7z.exe

4.8. Socketcand

`socketcand` is a daemon that provides access to CAN interfaces on a machine via a network interface. The communication protocol uses a TCP/IP connection and a specific protocol to transfer CAN frames and control commands. The protocol specification can be found in `./doc/protocol.md`.[33]

The project provides Java API to develop your own client applications for `socketcand`. There is also a CAN sniffer software Kayak[34], that uses socketcand protocol, so that you can use OnRISC as a network based CAN sniffer at once.

Please note that `socketcand` service is disabled by default. You need to activate using `sysv-rc-conf` (see Section 3.3).

4.9. Other Possible Services

Other services such as Samba (see Section 3.7.5) or NFS could also be installed to share resources.

4.9.1. Samba

To install Samba execute:

`apt-get install samba`

To access your home directory from Windows, you must register the user in Samba:

`smbpasswd -a user`

For further information see:

`man samba`

4.9.2. NFS

To install the NFS-server execute:

`apt-get install nfs-kernel-server`

For further information see:

`man nfsd`

[33] https://github.com/dschanoeh/socketcand
[34] http://kayak.2codeornot2code.org/

5. Software Development

5.1. Environment

5.1.1. Compile your software directly on the OnRISC

You can start programming directly on the OnRISC. The toolchain is already installed and GCC compiler will be invoked in the same way it is done on a desktop Linux. To modify files you can use `vi` or some other editor. This method is preferred, if your software has many dependencies.

5.1.2. Cross-compile your software on the PC

KS8695 based Devices For more convenience you can also use a PC with Linux running on it. This can be either a directly installed Linux or Linux running in a virtual machine[35] for Windows users. For the compilation of your own applications outside of the OnRISC you'll need a cross-compiler[36] for the ARM platform. You'll find one on the CD. Depending on your Debian version you'll need the appropriate version:

1. `toolchain_gcc.4.2.2_libc.2.3.6.tar.bz2` for Debian 4.0 Etch
2. `arm-linux-gcc-4.3.2-gnueabi.tar.bz2` for Debian 5.0 Lenny[37]
3. `arm-linux-gcc-4.4.5-gnueabi.tar.bz2` for Debian 6.0 Squeeze

Please decompress one of these archives into the `/opt` directory of your PC. To install the toolchain for Debian 4.0 execute:

```
su
mount /dev/cdrom /mnt
cd /opt
tar -xvjf /mnt/development/toolchain_gcc.4.2.2_libc.2.3.6.tar.bz2
```

Add `/opt/arm-linux-gcc-4.2.2/bin` to your `PATH` environment variable:

```
export PATH=/opt/arm-linux-gcc-4.2.2/bin:$PATH
```

Following utilities prepent with `arm-linux-` will be available after extracting the files from the archive (refer to Table 14).

> Warning: please note that your software compiled for Debian 4.0 Etch can't be executed on Debian 5.0 Lenny without recompilation due to new ABI.

If you are developing on a 64-bit OS, please install all needed 32-bit libraries (zlib etc.), because toolchains were compiled for 32-bit OS.

[35] You can use free VM Software like VMWare Player www.vmware.com or VirtualBox www.virtualbox.org

[36] See http://en.wikipedia.org/wiki/Cross-compile for explanation

[37] EABI (http://en.wikipedia.org/wiki/EABI) interface is mandatory for new Debian versions. Debian 5.0 is the last version where you can choose between old ABI and EABI. The next version will be based only on the new interface.

OMAP3 based Devices Debian 7.0 will be supplied with OMAP3 based devices. It is based on an arm-linux-gnueabihf 4.7 toolchain. To install this toolchain on your development PC, you'll need to add emdebian repository. Add `deb http://www.emdebian.org/debian/ unstable main` to your `/etc/apt/sources.list`. Then execute as root:

```
apt-get update
apt-get install emdebian-archive-keyring
apt-get install gcc-4.7-arm-linux-gnueabihf g++-4.7-arm-linux-gnueabihf
apt-get install build-essential git debootstrap u-boot-tools
```

After installation you'll need to create symlinks for GCC and other tools:

```
ln -s /usr/bin/arm-linux-gnueabihf-gcc-4.7 /usr/bin/arm-linux-gnueabihf-gcc
ln -s /usr/bin/arm-linux-gnueabihf-gcov-4.7 /usr/bin/arm-linux-gnueabihf-gcov
ln -s /usr/bin/arm-linux-gnueabihf-g++-4.7 /usr/bin/arm-linux-gnueabihf-g++
ln -s /usr/bin/arm-linux-gnueabihf-cpp-4.7 /usr/bin/arm-linux-gnueabihf-cpp
```

If your software has dependencies on other libraries provided by Debian, it is recommended to use Debian 7 on your development host. You can get cross-compiled libraries via `xapt` (see this wiki[38] for more details).

Alternatively you can use Buildroot (refer to Section 10) as your development environment. This way you can develop applications with various dependencies like Qt, Boost, Gtk etc. directly on your development host.

5.1.3. Integrated Development Environment

For an Integrated Development Environment (IDE) following programs can be used:

- Eclipse (www.eclipse.org). See Appendix F for installation and configuration notes
- Vim[39] (www.vim.org)
- many more

For ease of creating Makefiles the CMake[40] utility can be used. For that purpose the `CMakeLists.txt` file was added to the examples directory. After installing CMake on your OnRISC directly or on your development host execute:

```
cd /home/user/examples
cmake .
```

After that the Makefile is created. This Makefile has the same targets as the original one.

[38] https://wiki.debian.org/EmdebianToolchain

[39] A good tutorial to start programming with Vim `http://heather.cs.ucdavis.edu/~matloff/ProgEdit/ProgEdit.html`

[40] www.cmake.org

5.2. Linux Kernel

5.2.1. From Subversion Repository or Archive (old kernels)

The OnRISC uses 2.6 series Linux kernel. The source code for one of these kernels can be obtained both from CD and from Subversion[41] repository at http://svn.visionsystems.de/. For the kernel archive on the CD execute:

```
su
mount /dev/cdrom /mnt
exit
cd /home/user/projects
tar -xvjf /mnt/development/linux-2.6.33-OnRISC.tar.bz2
```

To check out the repository to your development host execute:

```
svn co svn://svn.visionsystems.de/linux-2.6.33-OnRISC/trunk linux-2.6.33-OnRISC/trunk
```

After extracting the kernel sources from the archive or checking out the repository execute

```
cd linux-2.6.33-OnRISC/trunk
```

to get to the kernels source tree, where the main `Makefile` is placed.

To configure the kernel via text based graphical user interface Ncurses[42] library must be installed in the development version with all needed headers. After that execute:

```
make onrisc_ks8695_defconfig
```

```
make menuconfig
```

you'll see the following menu as shown in Figure 2. Change kernel configuration according to your needs and save the configuration. To compile the kernel execute:

`make`[43]

The compiled kernel image `zImage` will be placed under

```
arch/arm/boot/zImage
```

[41] http://subversion.tigris.org/
[42] http://www.gnu.org/software/ncurses/ncurses.html
[43] if your development host has more than one CPU core, you can use `make -j` to utilize all of you cores, that will accelerate the compilation process

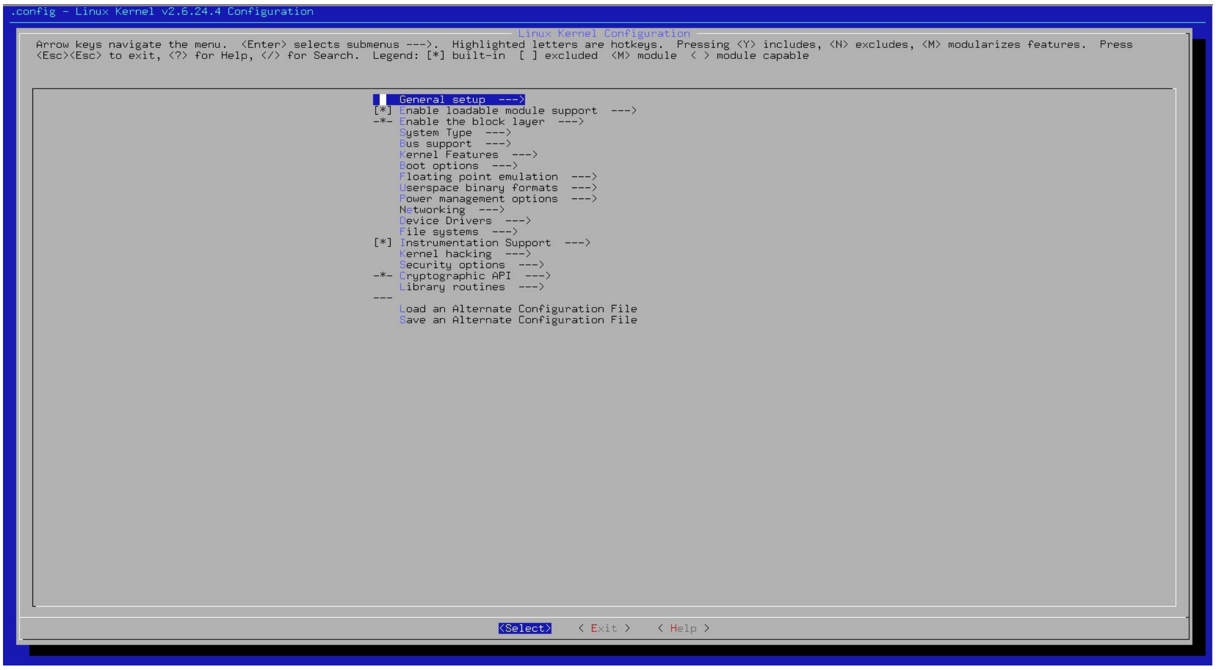


Figure 2: Kernel Configuration Menu

5.2.2. From Buildroot Repository

Since kernel version 3.0 there are no more Subversion repositories for Linux kernels on our server. Instead the patches will be maintained by our Buildroot repository . In order to compile the kernel you can either checkout our Buildroot repository and compile all components from toochain till kernel or you can use vskernel.sh script from our OnRISC_Software repository and the toolchain from our FTP server.

For the first way just follow the instructions in Section 10

For the second way checkout OnRISC_Software as described in Section 5.3, install toolchain and execute following steps:

1. `cd scripts`
2. `./vskernel.sh 3.0.4`
3. `export ARCH=arm`
4. `cd linux-3.0.4/`
5. `make`

5.2.3. Installation on OnRISC

KS8695 based Devices To start the OnRISC with new kernel do the following steps:

1. enter BIOS
2. enter “System Console”
3. configure IP address according to your network (for example 192.168.254.254)

4. execute `nc -l -p 5000 > /var/zImage` this will start Netcat listening on the port 5000
5. on your development host execute `netcat 192.168.254.254 5000 < arch/arm/boot/zImage`
6. after the data transmission mount your CF and copy new kernel
7. `mount /dev/hda1 /mnt`
8. `cp /var/zImage /mnt/boot`
9. `umount /mnt`
10. reboot the OnRISC

OMAP3 based Devices

1. extract the microSD card and insert into a card reader connected to your host PC
2. mount the first partition
3. copy `arch/arm/boot/uImage` to this partition
4. unmount
5. reboot

5.2.4. Install Kernel Modules

Linux kernel provides means to create installation package. The most portable packaging type is a tar package. After kernel compilation invoke:

```
make tar-pkg
```

This will create `linux-x.y.z.tar` file in the root of your kernel tree.

Copy this package to the OnRISC via `scp` and extract:

```
scp linux-x.y.z.tar root@192.168.254.254:/tmp
cd /
tar xf /tmp/linux-x.y.z.tar
```

You'll now get `/lib/modules/x.y.z` folder created. Remove unneeded files from `/boot` like `System.map-x.y.z` and `vmlinux-x.y.z` to save space.

5.3. Programming Examples Repository

Some programming examples were prepared to show/test the abilities of OnRISC hardware. The latest version of this software can be obtained from our repository by executing the following command:

```
svn co svn://svn.visionsystems.de/OnRISC_Software/trunk OnRISC_Software/trunk
```

This repository contains following folders:

- examples - some basic programming examples as described in Section 2.4 (KS8695)
- examples-gui - some basic examples for GUI programming. Each example has README file with compiling instructions and further info. Copy this folder to your OnRISC's Debian image, log in into XFCE, compile and run examples (OMAP3)
- hwtest - Hardware Test Utility enables the testing of OnRISC peripherals (KS8695) (see Section C)
- hwtest-qt - Hardware Test Utility with GUI enables the testing of OnRISC peripherals (OMAP3) (see Section D)
- installation - this folder provides files needed for Debian installation as described in Section (KS8695) 9

5.4. Setup Shared Source Directory

To avoid permanent copying the compiled files, you can share the examples folder on your PC via Samba. Assuming your PC has the IP address 192.168.254.253 and a valid user like "user" from group "user" registered in the Samba-server do:

- On the PC side
  - `cd /home/user`
  - `mkdir onrisc_examples`
  - copy all files from `examples` folder to `onrisc_examples`
  - edit as `su /etc/samba/smb.conf`. Add the `[onrisc]` share:
    ```
    [onrisc]
    comment=OnRISC programming examples
    path=/home/user/onrisc_examples
    browsable=yes
    writable=yes
    valid users=user
    ```
  - `/etc/init.d/samba restart`
- On the OnRISC
  - login as `user`
  - `mkdir onrisc_examples`
  - `su`

– `mount -t cifs -o username=user //192.168.254.253/onrisc /home/user/onrisc_examples`
– enter password
– `exit`
– `cd onrisc_examples`

Now you can edit and compile programs on the PC and execute them on the OnRISC.

5.5. Debugging

You have the possibility to debug your own applications with the `gdbserver`[44] on the target. To debug your application, start the server with the following command:

```
gdbserver :9000 /home/user/examples/ioctls
```

Make a connection to the server with the Insight[45] debugger:

```
arm-linux-insight ioctls
```

Go to the menu `Target Settings` (see Figure 3) and enter your destination data. Than you can get connected to the target with `Run\Connect to Target`. The rest of the debugging is up to you.

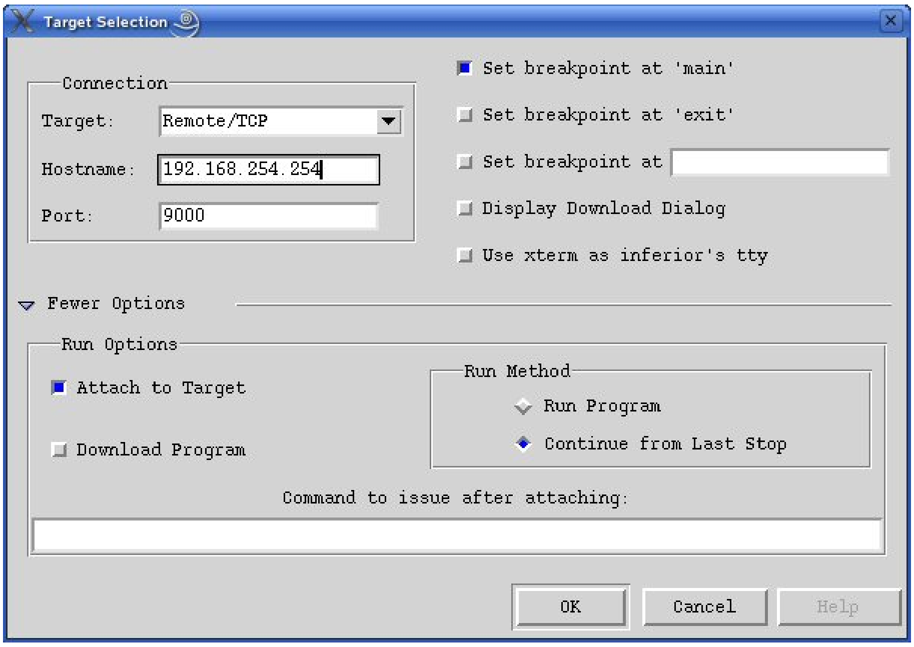


Figure 3: Insight: target selection

To get Insight download the source files and compile the code using the instructions given by the Insight developers in their FAQ (http://sourceware.org/insight/faq.php#q-2.2). In the case of OnRISC take the following steps:

```
host> ls
src/
```

[44] Please make sure to install `gdb` package: `apt-get install gdb`
[45] http://sourceware.org/insight

```
host> mkdir insight-arm; cd insight-arm
host> ../src/configure --target=arm-linux --program-prefix=arm-linux-
host> make
host> make install
```

You can also use Eclipse to debug your application (see Appendix F.2) .

5.6. Recommended Books

A list of books about Linux programming/usage and related topics:

- "The Debian Administrator's Handbook" by Raphaël Hertzog, Roland Mas (http://debian-handbook.info/)
- "Building Embedded Linux Systems, 2nd Edition " by Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, Philippe Gerum
- "Linux Device Drivers, Third Edition" by Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman (http://lwn.net/Kernel/LDD3/)
- "C: The Complete Reference" by Herbert Schildt
- "Dive Into Python 3" (http://getpython3.com/diveintopython3/)
- "Pro Git" by Scott Chacon (http://git-scm.com/book)

6. OnRISC Hardware API

KS8695 based Devices Such hardware as digital I/O, buzzer, serial interfaces will be controlled via IOCTL commands. These commands are defined in the `onrisc.h` header file. Almost all IOCTL commands are reflected in the `/proc`-filesystem (see Section 7).

To control the hardware the `/dev/gpio` device must be opened:

```
int fd;

fd = open("/dev/gpio", O_RDWR);
if (fd < 0)
  exit(-1);
```

Listing 3: Open `/dev/gpio`

Some examples for the OnRISC hardware are provided in the `examples/ioctls.c` and `examples/ioctls2.c`. For the usage in real applications see the source code of the Hardware Test Utility (`hwtest` provided on SVN repository).

OMAP3 based Devices Such hardware as digital I/O, serial interfaces, USB OTG will be controlled through sysfs GPIO entries. To simplify this task onrisctool.py (see Section Section B) provides a convenient access to these hardware from user space. A good starting point of how to access these interfaces from C/C++ and/or Python is the source code of hwtest-qt provided on SVN repository.

6.1. Digital I/O

6.1.1. KS8695 based Devices

The OnRISC provides up to 8 digital input/output channels, 2 optically isolated inputs and 2 relays[46]. The data direction for each I/O channel (not for optically isolated inputs or relays) can be independently set to input (bit value 0) or output (bit value 1). An interrupt for an input channel can also be independently enabled (bit value 1 enables interrupt, bit value 0 disables interrupt for the desired channel). The physical driver operates with 32mA for both high and low level. For digital I/O usage four registers are provided:

- data register - reflected in `/proc/vscom/gpio_data`
- data direction register - reflected in `/proc/vscom/gpio_ctrl`
- interrupt mask register - reflected in `/proc/vscom/gpio_irqmask`
- status register (read only) - reflected in `/proc/vscom/gpio_change`

In addition the interrupts will be counted for each pin.

Following IOCTL commands are defined in `onrisc.h` to control digital I/O:

- `GPIO_CMD_GET/GPIO_CMD_SET` - set/get data register value

[46] OnRISC Alekto provides 8 digital I/O channels only, OnRISC Alena provides 4 digital I/O channels, 2 optically isolated inputs and 2 relays

- `GPIO_CMD_GET_CTRL/GPIO_CMD_SET_CTRL` - set/get data direction register value
- `GPIO_CMD_GET_IRQMASK/GPIO_CMD_SET_IRQMASK` - set/get interrupt mask register value
- `GPIO_CMD_GET_CHANGE` - get status register value
- `GPIO_CMD_GET_CHANGES` - get interrupt count (reflected in `/proc/vscom/gpio_changes`)

The digital I/O driver also supports `select()` and `poll()` calls. To use this functionality the interrupt must be enabled for the desired pins.

To change the register values special structure and macros will be used (see the Listing below).

```
#define GPIO_BIT_0 0x01 // DIO0 or optically isolated input
#define GPIO_BIT_1 0x02 // DIO1 or optically isolated input
#define GPIO_BIT_2 0x04 // DIO2
#define GPIO_BIT_3 0x08 // DIO3
#define GPIO_BIT_4 0x10 // DIO4
#define GPIO_BIT_5 0x20 // DIO5
#define GPIO_BIT_6 0x40 // DIO6 or relay
#define GPIO_BIT_7 0x80 // DIO7 or relay

struct gpio_struct
{
  unsigned long mask;  // bits to modify
  unsigned long value; // value to set
};
```

Listing 4: GPIO struct

The following Listing shows how to change pins DIO0 and DIO2 to output and then read the control register back. To change the register direction `struct gpio_struct` is used because you need to specify what bits are going to changed and to what values (Lines 5-6). To read the register you only need to give `unsigned long` variable to the IOCTL command (Line 9).

```
1  ...
2  struct gpio_struct gpio_val;
3  unsigned long val;
4
5  gpio_val.mask = (GPIO_BIT_0 | GPIO_BIT_2);
6  gpio_val.value = (GPIO_BIT_0 | GPIO_BIT_2);
7
8  ioctl(fd, GPIO_CMD_SET_CTRL, &gpio_val);
9  ioctl(fd, GPIO_CMD_GET_CTRL, &val);
10 ...
```

Listing 5: GPIO usage Example

6.1.2. Alekto2

Digital I/O in Alekto2 is made via TCA6416A I²C I/O expander. 8 I/O pins are divided in 3 groups (refer to Table 4). The direction (input/output) can be configured only for the whole group, i.e. if you set pin 0 from Group 0 to output, then pins 1-3 are also set to output.

You can set/get I/O status via onrisctool.py (refer to Section B.4)

Group nr.	Pins
0	0-3
1	4-5
2	6-7

Table 4: Digital I/O Groups

6.2. Buzzer for KS8695 based Devices

The OnRISC provides a buzzer for acoustic signaling. You can manipulate it via the IOCTL-calls or via the Proc-Filesystem. Following IOCTL commands are defined in the onrisc.h to control the buzzer:

- `GPIO_CMD_GET_BUZZER/GPIO_CMD_SET_BUZZER` - turn on/off the buzzer (reflected in `/proc/vscom/buzzer`)
- `GPIO_CMD_GET_BUZZER_FRQ/GPIO_CMD_SET_BUZZER_FRQ` - get/set the modulated signal delay. So that the buzzer will be turned on for the delay specified and the it will be turned off for the same delay and so on till this mode will be turned off (reflected in `/proc/vscom/buzzer_frq`)

6.3. LEDs for KS8695 based Devices

The OnRISC provides three configurable LEDs:

- red LED (power LED)
- blue LED (can be used to signal WLAN link)
- green LED (user LED)
- WLAN button LED (OnRISC Alekto LAN only)

Following IOCTL commands are defined in the onrisc.h to control the LEDs:

- `GPIO_CMD_GET_LEDS/GPIO_CMD_SET_LEDS` - get/set LED combination (reflected in `/proc/vscom/leds`)
- `GPIO_CMD_SET_LED_POWER` - turn on/off the power LED
- `GPIO_CMD_SET_LED_BLUE` - turn on/off the blue LED
- `GPIO_CMD_SET_LED_GREEN` - turn on/off the green LED
- `GPIO_CMD_SET_LED_BTN_WLAN` - turn on/off the WLAN button LED (OnRISC Alekto LAN only)

6.4. Serial Interfaces

6.4.1. KS8695 based Devices

RS232/422/485 mode switching The serial ports can operate in one of the three modes RS232, RS422 or RS485[47] (see Hardware Manual for electrical configuration issues). These modes will be controlled through the EPLD circuit. Following IOCTLS are to be used to switch the modes (alternative `/proc/vscom/epld_ttySx` entries can be used to switch RS modes. See Section 7):

- `TIOCGEPLD` - get EPLD mode
- `TIOCSEPLD` - set EPLD mode

These commands use the following structure to store the desired parameters:

```
struct epld_struct
{
  unsigned long port;
  unsigned long reg_shift;
  unsigned long value;
};
```

The field `value` can have one of the following values:

- `EPLD_RS232` - RS232 mode
- `EPLD_RS422` - RS422 mode
- `EPLD_RS485_ART_4W` - RS485 mode 4-wire transmit control by ART
- `EPLD_RS485_ART_2W` - RS485 mode 2-wire direction control by ART
- `EPLD_RS485_ART_ECHO` - RS485 mode 2-wire direction control by ART with echo
- `EPLD_RS485_RTS_4W` - RS485 mode 4-wire transmit control by RTS
- `EPLD_RS485_RTS_2W` - RS485 mode 2-wire direction control by RTS
- `EPLD_RS485_RTS_ECHO` - RS485 mode 2-wire direction control by RTS with echo
- `EPLD_CAN` - CAN mode
- `EPLD_PORTOFF` - shutdown the port

RS485 transmission control In RS485 the line driver for transmitting must be disabled (tri-stated) when the device does not send data. In a 2-wire configuration this is known as data direction change, with 4-wire it is called line contention. The following modes are provided by OnRISC:

- RTS: if this mode is set user software is responsible to turn transmitter on/off by toggling the RTS signal (RTS 1 turns sender on, RTS 0 turns sender off)
- ART (Automatic Receive Transmit): The sender will be automatically turned on/off by hardware. The turning off occurs after the stop bit was sent (recommended mode).

[47] See `include/asm/arch/serial.h` to see what EPLD capabilities each port has

RS485 receive control There are two modes to handle own transmitted messages in 2-wire mode:

- with echo (`EPLD_RS485_RTS_ECHO`, `EPLD_RS485_ART_ECHO`): both outgoing and incoming messages will be received by application
- without echo (`EPLD_RS485_ART_2W`, `EPLD_RS485_RTS_2W`): application receives only incoming messages

Baud rate generation interface The OnRISC provides full support for the 16C950 UART baud rate generation. This allows the user to use the serial interfaces with arbitrary speeds up to 3,6Mbit/s. To use this capability the current baud rate must be set to B38400 and the custom divisor to the negative value of the desired baud rate. In the source code below the baud rate will be set to 500000bit/s, so the custom divisor was set to -500000 (see the lines 26-39) and the current baud rate to 38400 (see the lines 41-66).

```c
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <sys/types.h>
4  #include <sys/time.h>
5  #include <sys/ioctl.h>
6  #include <sys/stat.h>
7  #include <unistd.h>
8  #include <termios.h>
9  #include <fcntl.h>
10 #include <linux/serial.h>
11 #include <string.h>
12
13 int main (int argc, char **argv)
14 {
15   int fd, ret;
16   struct termios ser_termios;
17   struct serial_struct ss_st;
18
19   fd = open("/dev/ttyS1", (O_RDWR | O_NOCTTY));
20   if(fd < 0)
21   {
22     perror("open");
23     return -1;
24   }
25
26   // set custom divisor to -500000 to achieve 500000bit/s
27   if (ioctl(fd, TIOCGSERIAL, &ss_st)<0)
28   {
29     perror("TIOCGSERIAL");
30     return -1;
31   }
32   ss_st.custom_divisor = -500000;
33   ss_st.flags |= ASYNC_SPD_CUST;
34
35   if (ioctl(fd, TIOCSSERIAL, &ss_st)<0)
36   {
37     perror("TIOCSSERIAL");
38     return -1;
39   }
40
41   // set baud rate to 38400bit/s to activate custom divisor
42   ret = tcgetattr(fd, &ser_termios);
43   if(ret <0 )
44   {
45     perror("getattr");
46     return -1;
47   }
48 ...
49   ret = cfsetispeed(&ser_termios, B38400);
```

```
  if (ret < 0)
  {
    perror("ispeed");
    return -1;
  }
  ret = cfsetospeed(&ser_termios, B38400);
  if (ret < 0)
  {
    perror("ospeed");
    return -1;
  }
  ret = tcsetattr(fd, TCSANOW, &ser_termios);
  if (ret < 0)
  {
    perror("getattr");
    return -1;
  }
...
  close(fd);
  return 0;
}
```

Every time the baud rate will be changed a special baud rate generation function will be invoked in the serial driver (`drivers/char/serial.c`) namely `serial16C950_get_divisors()`. This routine calculates appropriate values for the clock prescaler register (CPR), times clock register (TCR) and 16-bit divisor supported by 16C950 UART. If the routine couldn't find the appropriate values the baud rate 9600bit/s will be set. To disable this functionality comment the following definition in `drivers/char/serial.c`:

```
#define ENABLE_16C950_BAUD_GENERATION_FEATURES
```

6.4.2. OMAP3 based Devices

Serial interfaces on OMAP3 devices use FTDI USB-to-serial converter chips (FT2232D). Both ports appear in the system as /dev/ttyUSB0 and /dev/ttyUSB1. Two methods are provided to switch between RS232/RS422/RS485 modes (termination inclusive): via software[48] and via DIP-switch. Each port has its own DIP-switch named SW1 and SW2. Table 5 shows possible DIP-switch settings.

S1	S2	S3	S4	Mode
off	off	x	x	RS-232 Loopback Test
on	off	x	x	RS-232 MODE
on	on	on	off	RS-422 MODE
on	on	on	on	RS-422 MODE RxD +/- with 120 ohm Term
on	on	off	off	RS-485 Full Duplex Mode
on	on	off	on	RS-485 Full Duplex Mode RxD +/- with 120 ohm Term
off	on	off	off	RS-485 Half Duplex Mode without Echo
off	on	off	on	RS-485 Half Duplex Mode without Echo RxD +/- with 120 ohm Term

Table 5: Serial Modes (hardware switching)

[48] Refer to Section B.1 for software method.

6.5. CAN

SocketCAN provides access to CAN controller on all CAN capable OnRISC devices[49] (refer to Table 1). SocketCAN[50] is a set of open source CAN drivers and a networking stack contributed by Volkswagen Research to the Linux kernel. Formerly known as Low Level CAN Framework (LLCF).

6.5.1. CAN Interface Configuration

Special script `/etc/init.d/can_if`[51] is provided to setup `can0` interface. It is preconfigured to use `can0` at 1000000b/s. These settings are stored in the `CAN_IF` variable:

```
CAN_IF="can0@1000000,200"
```

To start the CAN interface issue:

```
/etc/init.d/can_if start
```

to stop CAN interface issue:

```
/etc/init.d/can_if stop
```

Further information regarding programming and configuration can be found on the SocketCAN's project site.

6.5.2. CAN Usage Examples

To send a CAN frame execute:

```
cansend can0 123#1234
```

To receive CAN frames execute:

```
candump can0
```

6.5.3. CANopen

It is possible to use CANopen[52] library from CanFestival[53] or any other open source or proprietary CANopen stack, that has SocketCAN support.

[49] The CAN interface and the fourth serial interface on OnRISC Alena are sharing the same connector. The EPLD must be switched to `can` before opening the CAN interface.
[50] http://elinux.org/CAN_Bus
[51] this script is maintained in this git repository: `http://gitorious.org/linux-can/can-misc`
[52] www.can-cia.org
[53] www.canfestival.org

6.6. I²C

I²C[54] (Inter-Integrated Circuit) is a multi-master serial computer bus. In the OnRISC integrated I²C controller is already supported by the mainline kernel. A good starting point on how to use I²C is the `hwtest` utility (see Section C.6). `test_LCD()` routine from `hwtest/module_i2c.c` shows how to communicate with an I²C device. Additional information can be found in the Linux kernel documentation `Documentation/i2c`. I²C platform device initialization is described in `Documentation/i2c/instantiating-devices`.

6.7. WLAN Button (Alekto LAN Only)

OnRISC Alekto LAN provides an additional button. By default this button is used to control WLAN card's transmit power. This button is just connected to GPIO line and will be controlled by `wland` service (refer to Section 4.1.3). To use it for other needs just disable the `wland` service. Following ioctl command for `/dev/gpio` is provided to get button's state:

`GPIO_CMD_GET_BTN_WLAN`

return value is `0` - for not pressed and `1` - for pressed.

6.8. Watchdog Timer

The OnRISC provides a watchdog timer[55] (WDT) that can work in intervals from 1 second to maximal 171 seconds. The access to the WDT occurs via `/dev/watchdog` device. After starting the WDT it should be turned off or reloaded after the critical part otherwise the system will reboot. Table 6 shows the most important IOCTLs to control WDT.

IOCTL	Description
`WDIOC_SETTIMEOUT`	set timeout and start the timer
`WDIOC_GETTIMEOUT`	get timeout
`WDIOC_SETOPTIONS`	enable (`WDIOS_ENABLECARD`) disable (`WDIOS_DISABLECARD`) the timer
`WDIOC_KEEPALIVE`	reload the timer

Table 6: Watchdog Timer IOCTLs

The WDT driver provides a special option called "Disable watchdog shutdown on close" to prevent stopping the timer on WDT descriptor close (see Figure 4). This is a compile-time option. It is deactivated by default, so you have to build your own kernel if you need it.

See `examples/wdtimer.c` for WDT usage example.

[54] http://en.wikipedia.org/wiki/I2C
[55] For further information see `drivers/watchdog/ks8695_wdt.c`

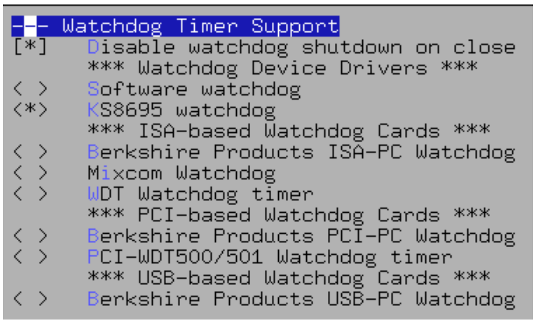


Figure 4: Watchdog Timer Support

6.9. Read Hardware Parameters like MAC Address, Serial Number etc.

6.9.1. KS8695 based Devices

Such parameters as MAC addresses, serial number etc. are stored in flash and can be accessed via special structure:

```
struct _param_hw                // v1.0
{
        byte pad[1];
        ushort szram;           // direct in MB
        ushort szflash2;
        ushort szflash1;        // direct in MB
        byte mac2[6];
        byte mac1[6];
        ushort biosid;
        char prddate[11];        // as a string ie. "01.01.2006"
        ulong serialnr;
        ulong hwrev;
        ulong magic;
} __attribute__ ((packed));
```

See `hwtest/hwtest.c->param_read_hw_params()` routine on how to read the parameters from flash.

6.9.2. OMAP3 based Devices

```
typedef struct _BSP_VS_HWPARAM     // v1.0
{
                ULONG Magic;
                ULONG HwRev;
                ULONG SerialNumber;
                CHAR PrdDate[11];     // as a string ie. "01.01.2006"
                USHORT SystemId;
                BYTE MAC1[6];
                BYTE MAC2[6];
                BYTE MAC3[6];
} BSP_VS_HWPARAM;
```

Use `onrisctool.py` without parameter and you'll get a list of all parameters stored in EEPROM.

6.10. Change Screen Resolution (Alekto 2 Only)

Alekto 2 supports tree resolutions:

- 640x480
- 800x600
- 1024x768 (default)

The resolution will be configured via kernel command line parameter `video`. Following values are accepted:

- 640x480@60
- 800x600@60
- 1024x768@60

This parameter will be configured in `uEnv.txt` located on the first partition. Example:

```
bootargs=video=da8xx_lcdc:1024x768@60
```

6.11. Built-in Touchscreen Calibration (VS-860 Only)

You can choose between two calibration methods:

- tslib[56] - suitable for Qt Embedded applications
- X11 evdev driver - as the name says suitable for X11

Tslib package provides ts_calibrate utility, to calibrate the touchscreen. New calibration values will be written to `/etc/pointercal`. Tslib requires following environment variables to use the touchscreen:

```
TSLIB_CALIBFILE=/etc/pointercal
TSLIB_CONFFILE=/etc/ts.conf
TSLIB_TSDEVICE=/dev/input/event1
```

Hwtest-qt utility provides special Python script (scripts/input_dev.py), that reads /proc/bus/input/devices and configures `TSLIB_TSDEVICE` together with Qt Embedded related environment variables.

X11 evdev driver will be calibrated via xinput_calibrator (must be started from X11 session). The calibration values will be stored in `/usr/share/X11/xorg.conf.d/10-evdev.conf`. Example:

```
Section "InputClass"
Identifier "evdev touchscreen catchall"
MatchIsTouchscreen "on"
MatchDevicePath "/dev/input/event*"
Option "Calibration" "28 999 988 41"
Driver "evdev"
EndSection
```

[56] https://github.com/kergoth/tslib

7. /proc-Extensions for the KS8695 based Devices

In the `/proc/vscom` directory reside several files to manipulate the OnRISC hardware:

- `epld_ttyS*` - configure serial driver e.g. rs232, rs422, rs485. For exact values execute `echo /proc/vscom/epld_ttySn` (n=1..4)
  For detailed description see 6.4
- `gpio_*` - set and read digital IO channels. For detailed description see 6.1
- `leds` - set and read LEDs values. For detailed description see 6.3
- `buzzer, buzzer_frq` - configure the buzzer. For detailed description see 6.2
- `reset` - reboot the OnRISC. To execute the hardware reset
  `echo 1 > /proc/vscom/reset`

Examples:

`echo 1 > /proc/vscom/buzzer`	turn buzzer on
`echo 0 > /proc/vscom/buzzer`	turn buzzer off
`echo 0x000001f4 > /proc/vscom/buzzer_frq`	this will activate the buzzer for 500ms and then deactivate it for 500ms and so on
`cat /proc/vscom/leds`	get the current LED status
`echo GREEN > /proc/vscom/leds`	turn the green LED on
`echo green > /proc/vscom/leds`	turn the green LED off
`echo rs422 > /proc/vscom/epld_ttyS2`	sets the mode of the second port to rs422
`echo 0x05 0x05 > /proc/vscom/gpio_ctrl`	set DIO0 and DIO2 to output

8. BIOS for KS8695 based Devices

BIOS (Basic Input Output System) lets you configure your OnRISC e.g. configure how to boot, set up date, time and so on. To get into the BIOS, press 'ESC' during the system start and you'll enter the following menu (see Figure 5).

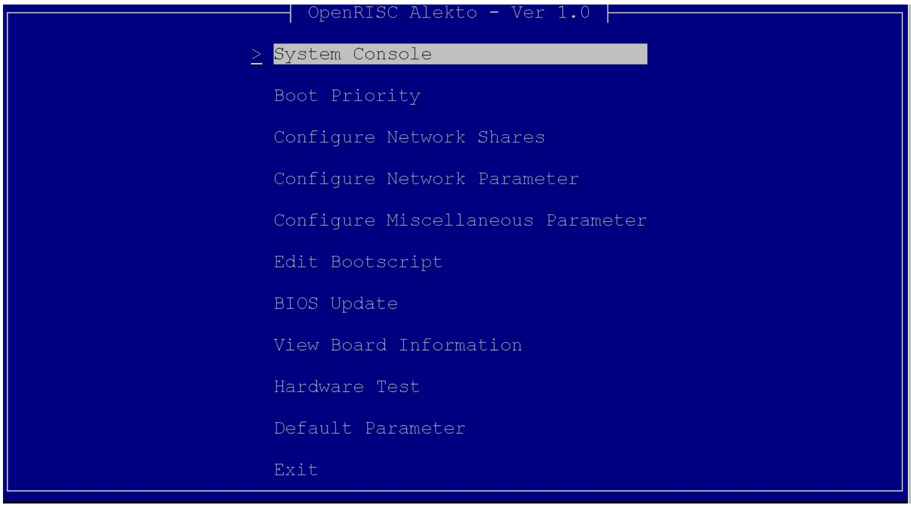


Figure 5: BIOS: main menu

To connect to the BIOS via Telnet press reset push button for a while till WLAN LED turns on and the following output appears (see Figure 6). Now you can connect to the BIOS via network by using the IP address specified under "Configure Network Parameter" (see 8.4).

```
Press 'Esc' to enter setup or 'Tab' for a bootlist
```

Figure 6: BIOS Prompt for Bootlist

8.1. System Console

Choosing this menu item, you'll get to the system console. To return to the main menu press 'Ctrl+D' or execute `exit` (see Figure 7). You can use the console to mount CompactFlash, copy the kernel (see 9.11), partition the disk and so on.

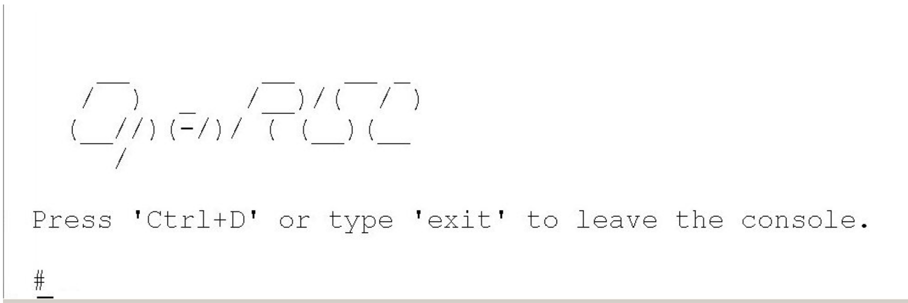


Figure 7: BIOS: System Console

8.2. Boot Priority

In this menu item you can change the boot priority (see Figure 8). You can choose between following sources:

- CompactFlash
- USB
- Network (Windows share, Samba)

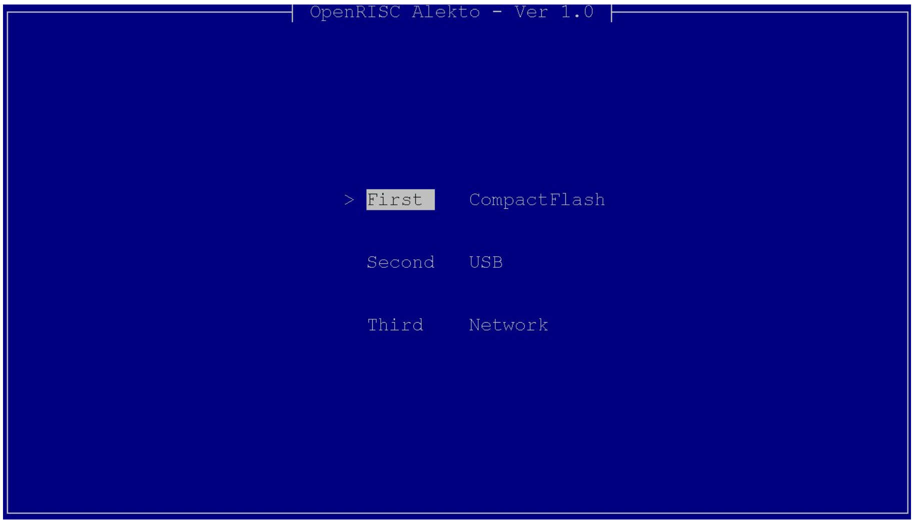


Figure 8: BIOS: Boot Priority

8.3. Configure Network Shares

Here you can configure a Windows share (SMB) to boot from (see Figure 9). To use this feature, you should set up following parameters:

- Type
- Server IP address
- Samba directory name
- User name
- Password

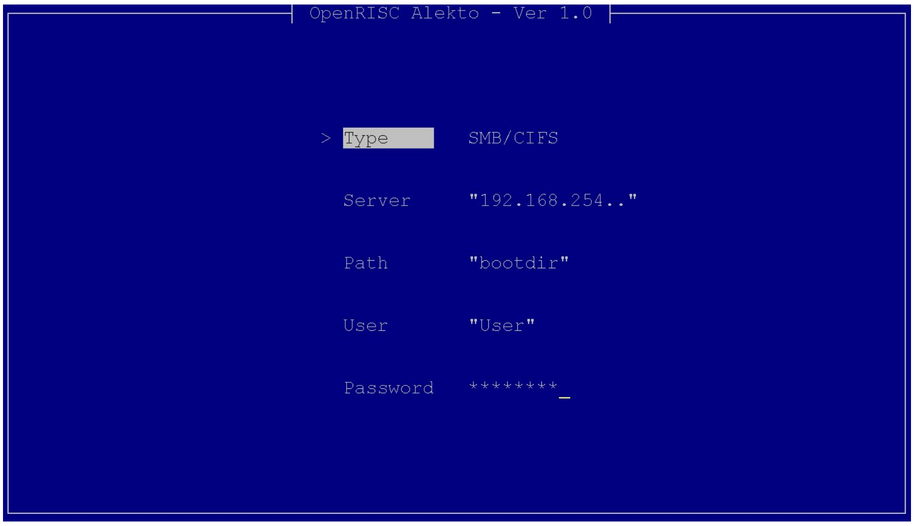


Figure 9: BIOS: Configure Network Shares

8.4. Configure Network Parameter

Here you can configure the network parameters (see Figure 10). You can choose between getting IP Address via DHCP or to assigning it statically. For the latter you should configure following parameters:

- IP Address
- Netmask
- Broadcast
- Gateway

Warning: please note that these network parameters are applicable only to BIOS not the system BIOS is booting.

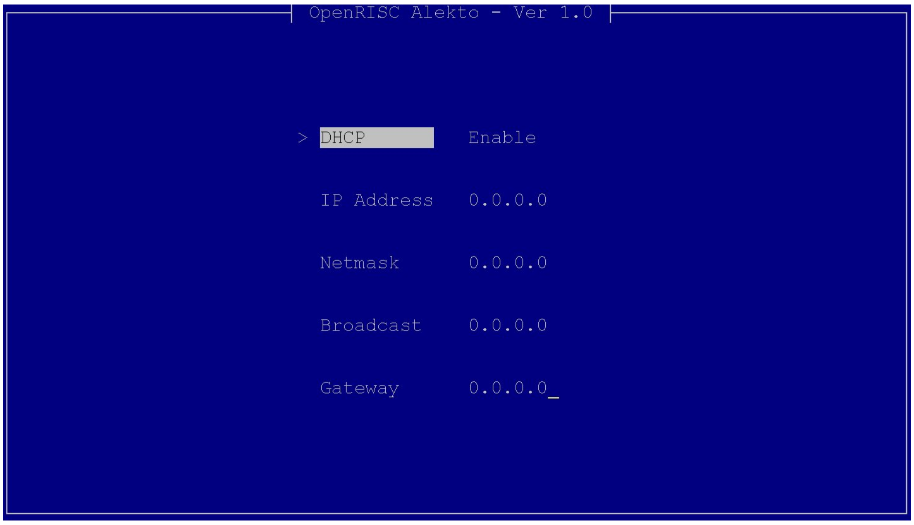


Figure 10: BIOS: Configure Network Parameter

8.5. Configure Miscellaneous Parameter

Following parameters can be set up here (see Figure 11):

- Date
- Time
- Start-Timeout[57] - the time in seconds during that the BIOS or bootlist could be accessed.
- Terminal Type (Console/Telnet) - emulation type to choose by terminal software such as Hyperterminal, ZOC etc while connecting via serial link or telnet. The OnRISC can emulate three types of terminals:
  - Linux
  - ANSI
  - VT100
- Password - BIOS protecting password

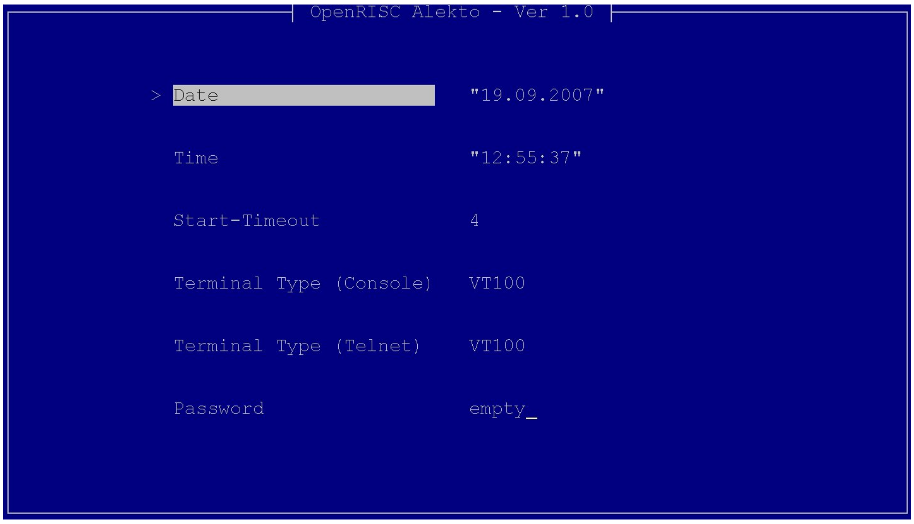


Figure 11: BIOS: Configure Miscellaneous Parameter

[57] for devices with internal microSD card reader the timeout should be set to at least 5 seconds

8.6. Edit Bootscript

The bootscript can be edited here (see Figure 12):

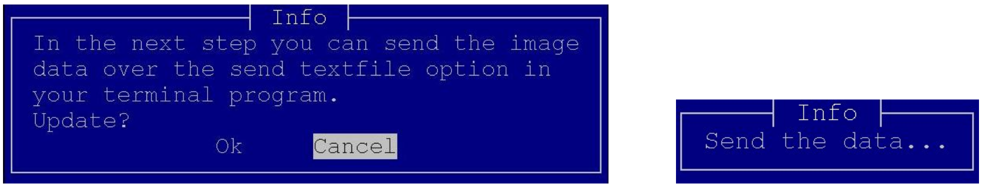
```
#!/bin/sh

#Insert your own bootscript here.
#It's called on every automatic startup (not in the bootmenu).
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
"/var/bootscript" line 1 of 3 --33%--
```

Figure 12: BIOS: Edit Bootscript

8.7. BIOS Update

BIOS update can be done either via serial connection or via network connection[58].



(a) Update prompt (b) Waiting for data

Figure 13: BIOS: Update

Update procedure via serial connection In the dialog shown in Figure 13a choose "Ok". "Send the data..." prompt appears (see Figure 13b). Select the appropriate *.b64 file and send it via the "Send Text File" functionality of your terminal software.

(a) Kernel (b) Filesystem

Figure 14: BIOS: Update (Images)

The *.b64 file consists of two files:

- Kernel - Linux kernel image (zImage)
- Cramdisk - filesystem image

After transmission you can choose between installing both kernel (see Figure 14a) and filesystem image (see Figure 14b) or only one of them.

Warning: do not power off or reset the OnRISC during the flashing of the images!!!

The last step is to reboot the system (see Figure 15).

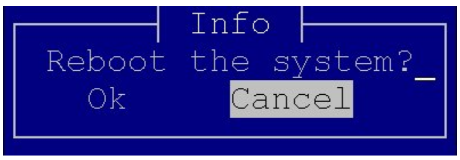


Figure 15: BIOS: Update (Reboot System)

[58]The network option is available since BIOS version 2.1

Update procedure via network connection Push the reset button till the WLAN LED is on. Send the appropriate *.b64 file via `netcat`[59] or `socat` (`socat` should be used if `netcat` closes connection as soon as the update image is transferred) as in the examples below:

```
netcat -w 600 192.168.254.254 23 < OnRISC-BIOS-2.2.bin.b64
```

or

```
socat -,ignoreeof TCP:192.168.254.254:23 < OnRISC-BIOS-2.2.bin.b64
```

As a result you'll see following output in your shell window (see Figure 16). The characters before this output are echo and terminal sequences for BIOS menu.

```
Update BIOS
Receiving update file
................................................................................
................................................................................
................................................................................
................................................................................
................................................................................
Extracting binary images
Flashing image
Type:  Kernel
Size:  2012752
Version:  2.1
Date:  28.10.2008
O.K.
Flashing image
Type:  Cramdisk
Size:  1687552
Version:  2.1
Date:  28.10.2008
O.K.
BIOS updated.  The system will be restarted...
```

Figure 16: BIOS: Update via Network

[59] on some systems `netcat` binary is called `nc`. Windows version `nc.exe` is provided on the CD

8.8. View Board Information

Shows some board information (see Figure 17)

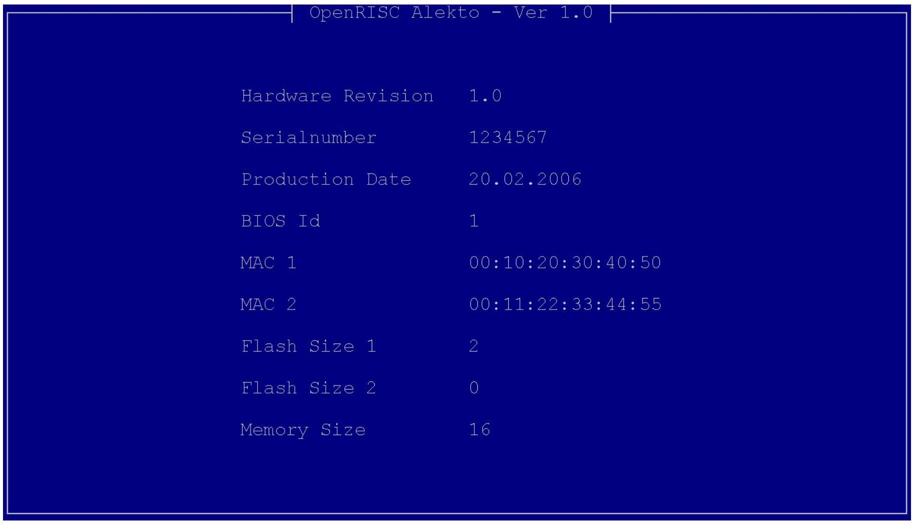


Figure 17: BIOS: View Board Information

8.9. Hardware Test

The `hwtest` program will be invoked for one cycle with the parameters listed in Table 7. For detailed information about `hwtest` refer to Appendix C.

`size`	4096	`modem`	
`cycles`	1	`sero`	/dev/ttyS1
`confirm`		`seri`	/dev/ttyS2
`serial`		`io`	
`net`		`buz`	
`gpio`		`led`	
`mpci`		`sleep`	1
`cf`		`testrtc`	
`i2c`		`eplddev`	/dev/ttyS1
`epld`		`eplddev`	/dev/ttyS2
`usb`		`usbmntdev`	/dev/sda1

Table 7: BIOS: hwtest parameters

8.10. Default Parameter

Sets all parameters to factory settings.

8.11. Exit

Leaves BIOS. If any parameters were changed, you'll be asked to save the changes.

9. Debian Installation

The installation of the Debian 5.0.3 Lenny[60] will be described in this section. The installation instructions for other Debian versions are similar with this one. Your system should meet the following requirements:

- BIOS 2.6 or later
- Serial Terminal (Emulation) at 115200bps, 8N1
- Installation source: CD/DVD-ROM on USB or Windows share (Samba)
- Installation target: CompactFlash card or USB Mass Storage device[61]

Due to the fact that OnRISC is not officially supported by arm-debian port there is no suitable kernel in the distribution. So you have to provide boot image files to the OnRISC to be able to start the Debian installer. These files (see the description below) can be downloaded from our SVN repository.

Generally two types of Debian installer are provided:

- CD-ROM Installer
- Network Installer

For Debian 4.0 Etch you'll find only CD-ROM Installer `etch/initrd.gz`. For Debian 5.0 Lenny both installer are supplied `lenny/initrd.gz-cdrom` and `lenny/initrd.gz-net`. The desired installer must be renamed to `initrd.gz` when copying to a mass storage device or Windows share. You can get the latest install DVDs at http://www.debian.org/distrib/

9.1. Preparing Boot Image Files

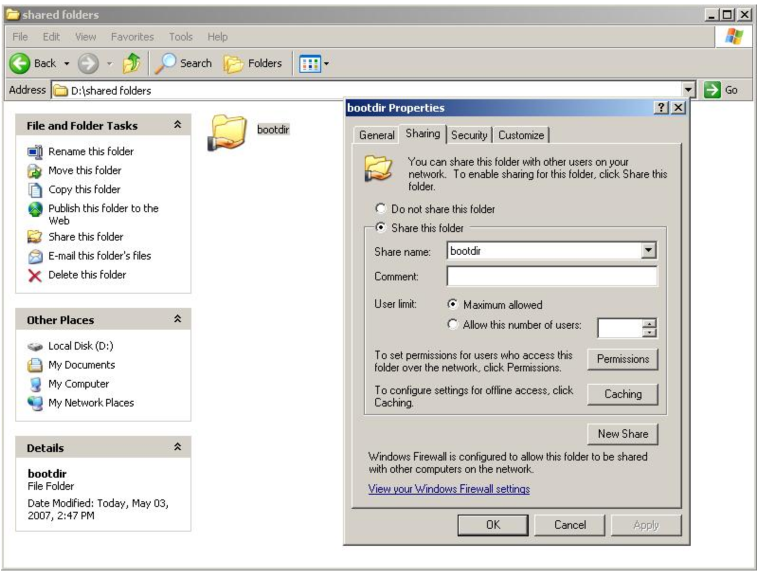
Copy the downloaded files to the root directory of your USB mass storage device. These files are:

- `initrd.gz` - RAM disk image with Debian Installer
- `zImage` - Linux kernel
- `kparam` - Kernel parameter like `root=/dev/ram` describing that kernel should use RAM disk as root filesystem (refer to Section 3.1.1)

Alternatively you can use a Windows share (Samba) (see Figure 18). It can be made in four steps:

1. create shared folder. For example D:\shared folders\bootdir (see Figure 18a)
2. copy the image files to this folder (see Figure 18b)
3. enter BIOS and set the Network Parameter (see 8.4)
4. configure your BIOS to access the network share directory (see 8.3)

[60] For detailed information about Debian Installation visit http://www.debian.org/releases/stable/arm
[61] 1GB or more recommended



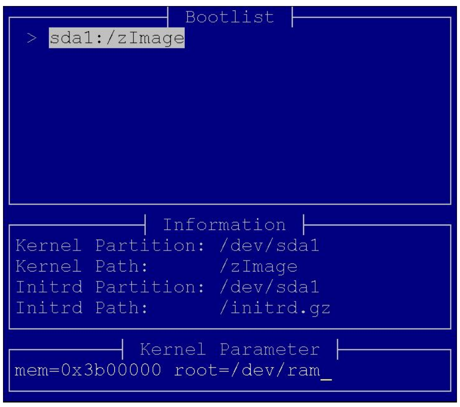
(a) Shared Folder Properties

(b) Boot Image Files

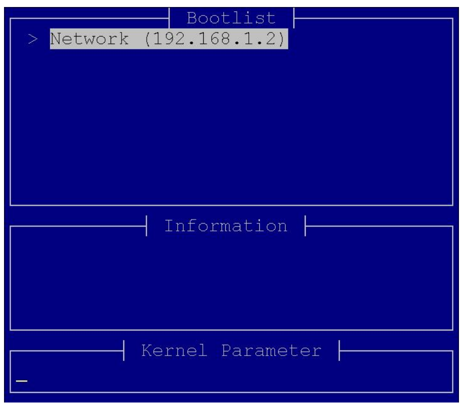
Figure 18: Windows Share

9.2. Starting Debian Installer

Exit BIOS and save changes if required. Press 'Tab' to access bootlist and choose USB Mass Storage Device (see Figure 19a) or Network (see Figure 19b). The Installer will be put into low memory mode (see Figure 20). Press 'Enter' and choose your country in the next dialog.



(a) Mass storage



(b) Windows share

Figure 19: Bootlist

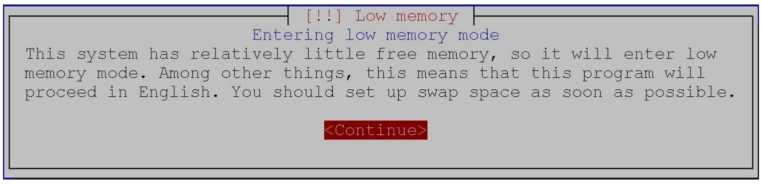


Figure 20: Low Memory Mode

9.3. Choosing CD-ROM

Debian Installer will try to find a device driver for your USB CD-ROM. This could fail as for Debian Etch installer. To select the device manually answer with 'No' (see Figure 21). In the second dialog say 'Yes' to manually select your CD-ROM module. In the third dialog select 'none'. In the fourth dialog press 'Enter' to select `/dev/cdrom` device file to access the CD-ROM. The Debian Installer will now scan your CD-ROM.

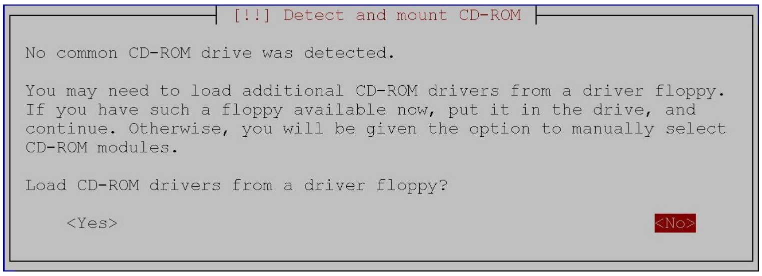


Figure 21: Detect and mount CD-ROM

9.4. Load Installer Components from CD

First you'll see a dialog with the statement that the kernel modules were not found (see Figure 22). It is due to the issue that all needed modules were compiled into the kernel. So answer with 'Yes'. Additional components will be loaded.

Figure 22: No Modules Found Warning

9.5. Network Configuration

In the next dialog the network configuration will be executed (see Figure 23). Choose the network interface to which the Ethernet cable is connected to. In the next two dialogs enter host and domain names.

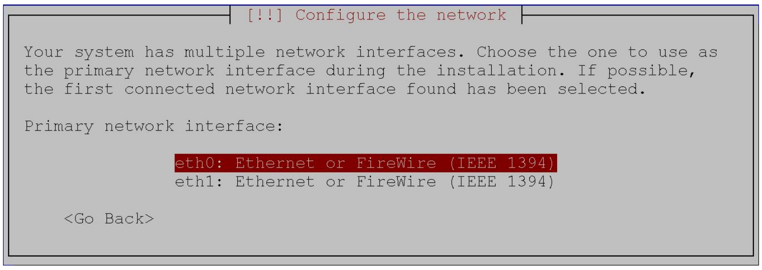


Figure 23: Network configuration

In the case of network installation you'll be asked to configure package mirror as in Figures 24 and 25.

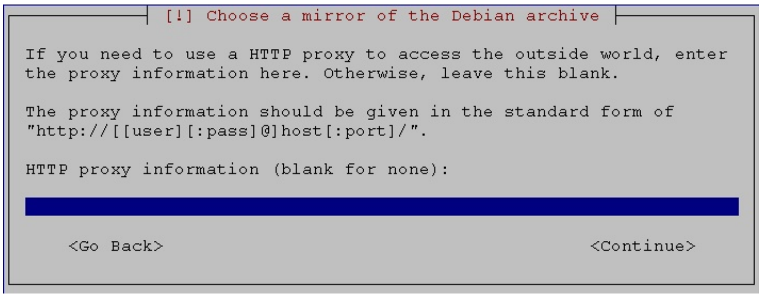


Figure 24: Proxy Configuration

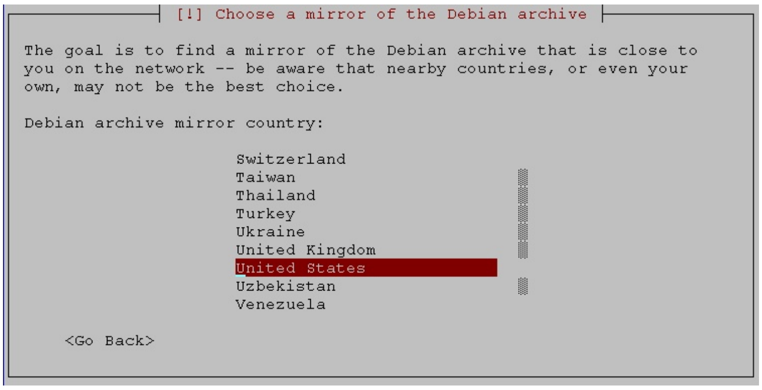


Figure 25: Mirror Configuration

9.6. Partition Disks

After scanning your target storage media, you'll be asked to continue with partitioning (see Figure 26). Answer with 'Yes'. In the second dialog select 'Guided - use entire disk' as in Figure 27.

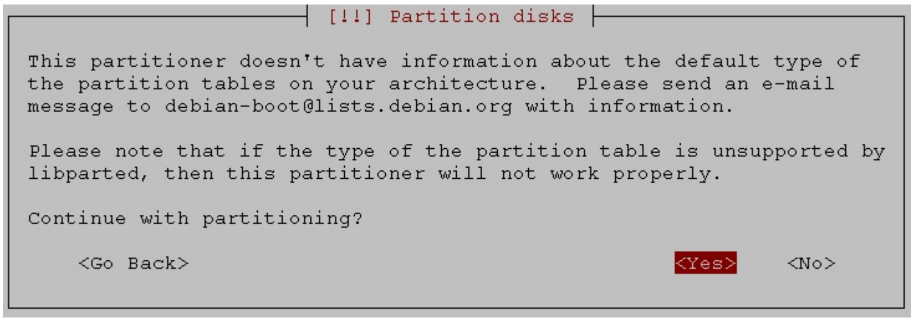


Figure 26: Partition Disks

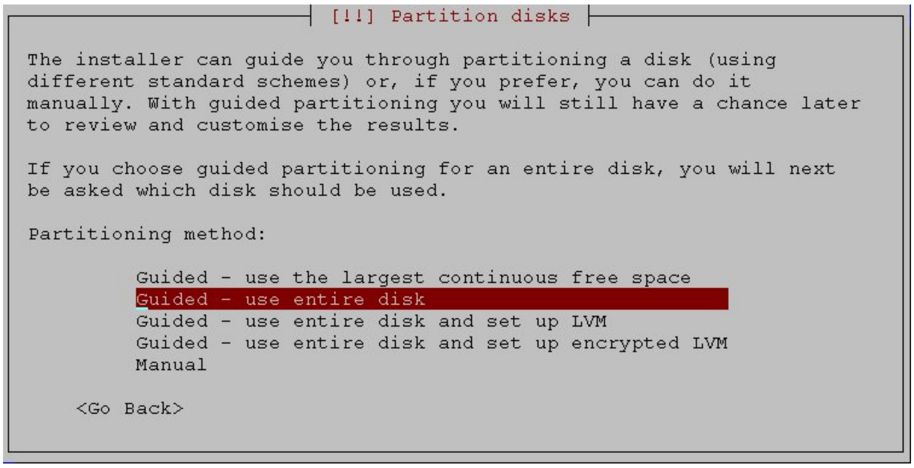


Figure 27: Partitioning Method

In the next dialog confirm your target disk and then select 'All files in one partition' scheme as in Figure 28.

Select 'msdos' for partition table type as in Figure 29

You'll get the following partition table as in Figure 30. It is very important that you leave swap partition during the installation. You can then change your partitions so you have only one partition and swap as a swap file (see Section 3.6). Select 'Finish partitioning and write changes to disk'. In the next dialog select 'Yes' to format both partitions.

After doing this select 'Finish partitioning and write changes to disk'. In the next dialog select 'Yes' to format both partitions.

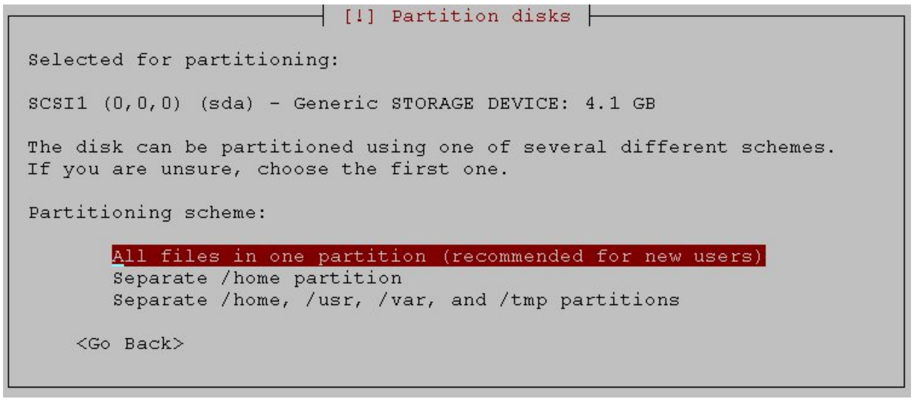


Figure 28: Partitioning Scheme

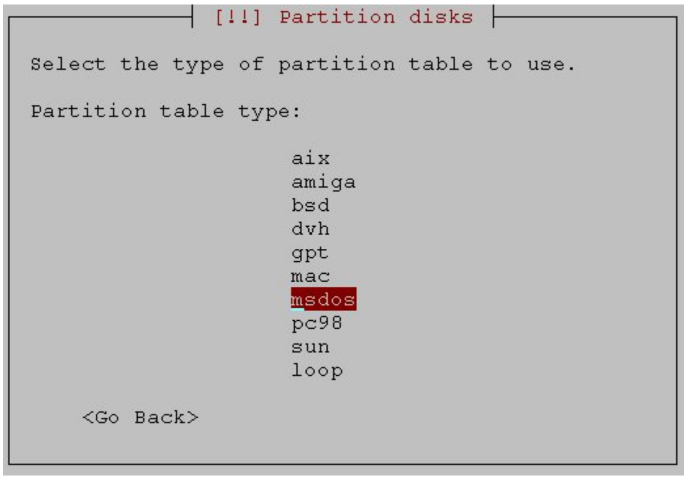


Figure 29: Partition Table Type

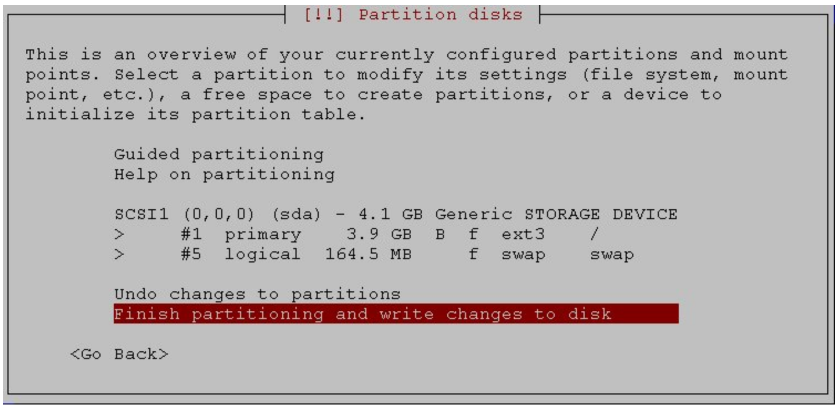


Figure 30: Partition Table

9.7. Setting Passwords

After partitioning the disks and setting up the clock, you'll be asked to set a password for 'root' and create a new user.

9.8. Install the Base System

As the OnRISC is not officially supported by Debian, there is no kernel shipped with the distribution. Answer with 'Yes', when you'll be asked to install without a kernel.

9.9. Configure the Package Manager

In the case of a CD-ROM installer you'll be asked if you want to download and install updates from a network mirror. The network mirror will be configured as described in Subsection 9.5. After configuring the package manager, you'll be asked to participate in the package usage survey.

9.10. Software Selection

In this dialog you can select which component groups will be installed on your system (see Figure 31).

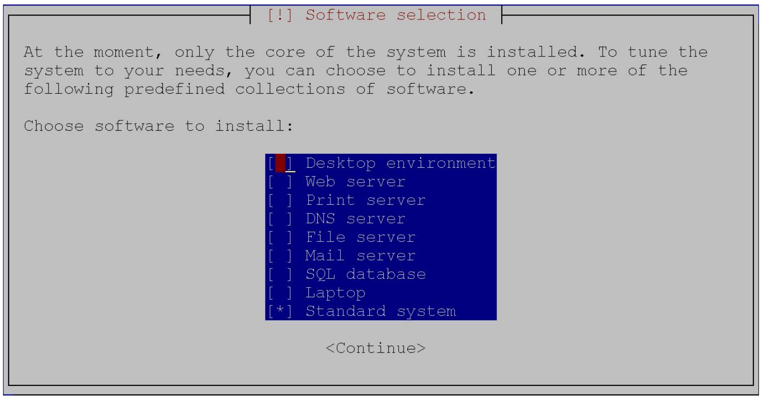


Figure 31: Software Selection

9.11. Finish the Installation

Due to the lack of the official support by Debian there is no boot loader (see Figure 32). After reboot, enter BIOS and go to the console. Mount the first partition:

```
mount /dev/hda1 /mnt
```

Copy zImage either from your host or USB mass storage device into the `/boot` directory and execute:

```
echo "mem=59M root=/dev/hda1" > /boot/kparam
```

Exit BIOS and enter the bootlist by pressing 'Tab'. You can now boot from `/dev/hda1`.
To enable the console port edit `/etc/inittab`, so that `tty1-tty6` are commented and `console` is configured for 115200bps:

```
...
# Note that on most Debian systems tty7 is used by the X Window System,
# so if you want to add more getty's go ahead but skip tty7 if you run X.
#
#1:2345:respawn:/sbin/getty 38400 tty1
#2:23:respawn:/sbin/getty 38400 tty2
#3:23:respawn:/sbin/getty 38400 tty3
#4:23:respawn:/sbin/getty 38400 tty4
#5:23:respawn:/sbin/getty 38400 tty5
#6:23:respawn:/sbin/getty 38400 tty6
# Example how to put a getty on a serial line (for a terminal)
#
T0:2345:respawn:/sbin/getty -L console 115200 linux
#T1:23:respawn:/sbin/getty -L ttyS1 9600 vt100
...
```

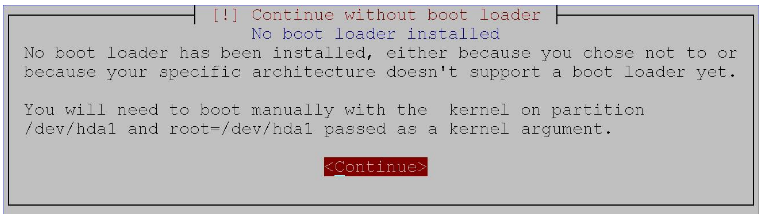


Figure 32: Continue without Boot Loader

10. Buildroot

Buildroot[62] is a set of Makefiles and patches that allows you to easily generate a cross-compilation toolchain, a root filesystem and a Linux kernel image for your target. Buildroot can be used for one, two or all of these options, independently. The benefits are:

- you don't have to supply the toolchain it will be built automatically
- you can choose between various file systems for your target image
- you can build a very small and quick booting system that suits your needs
- drivers compiled as modules will be automatically installed on your file system image
- many more

The distribution provided by VScom is configured to create a ready-to-run images for OnRISC and OpenNetCom systems. You'll get a minimal setup, that can run either form flash or mass storage device. A big variety of software can be then automatically added to your system using Buildroot repository.

10.1. Downloading

Subversion will be required to download and update the Buildroot distribution. Go to the desired project directory and execute the following command to get the latest version of Buildroot distribution:

```
svn co svn://svn.visionsystems.de/buildroot/trunk/buildroot-2010.08
```

10.2. Building the Image

After checking out the repository you can build the default image by issuing the following command:

```
make vscom_onrisc_defconfig && make
```

or

```
make vscom_opennetcom_defconfig && make
```

Buildrootwill start to automatically download needed packages and compile them. At the end of this procedure you'll find built images under:

```
output/images
```

The rootfs image can now be burned on to the target media.

[62] http://buildroot.org/

10.3. Copying the Created Image to the System

OpenNetCom You can copy the newly created image via RedBoot and console. This will require a special Service Board to interact with RedBoot. It is very important that write-protection jumper is set in order to protect RedBoot from getting corrupted. Please refer to OpenNetCom's user manual.

OnRISC You'll need to create a ext2 partition on your media (CF or microSD-card). Then insert your media in OnRISC and go to "BIOS->System Console" and execute following actions:

1. `OnRISC`: `nc -l -p 5000 | cat > /dev/hda1`
2. `PC`: `nc 192.168.254.254 5000 < output/images/rootfs.ext2`
3. `OnRISC`: `reboot`

This will copy ext2 image to the first partition of your CF card. For microSD-card just change `/dev/hda1` to `/dev/sda1`.

Type "root" to login to the system. No password is required.

10.4. Customizing the Image

Buildroot uses Kconfig[63] subsystem to manage the process of configuration just like Linux kernel does. Following bigger parts can be configured:

- `make menuconfig` - configures Buildroot: toolchain, rootfs, packages
- `make busybox-menuconfig` - configures BusyBox[64]
- `make uclibc-menuconfig` - configures uClibc[65]
- `make linux26-menuconfig` - configures Kernel

First place to look for choosing new packages is BusyBox configuration. If the package is not available there then it can be found in Buildroot itself if it was included into its repository.

You can specify a special script, that will be running before the file system image is built. In this script you can change your file system image via adding or modifying files. See following script, that copies device specific interfaces files: `target/devices/vscom/OnRISC/custom.sh`.

[63] en.wikipedia.org/wiki/Kconfig
[64] www.busybox.net
[65] www.uclibc.org

10.5. Compiling Your Own Software

There are following ways on how to get your software to be build and installed on the system using Buildroot:

- adding your software to the packages folder
- using generated toolchain to compile your software and then manually copying it either to fs/skeleton or output/target

The first way is described here Add packages. The second way is described here Using toolchain. See this article on how to override source directory Source directory override.

You can also use Buildroot together with Eclipse to develop your application Eclipse integration.

10.6. Using Your Own Kernel

If you have your own kernel or just want to use our 2.6.33 kernel, execute following steps:

1. disable automatic kernel compilation (BR2_LINUX_KERNEL)
2. copy your `zImage` to `target/device/vscom/OnRISC/`
3. execute `make` (your `zImage` will be installed to `output/target/boot/`)

10.7. Setup SSH Server

SSH server will be activated via the BR2_PACKAGE_OPENSSH variable. After copying the new rootfs image to the media, you'll see RSA/DSA keys will be created. By default password is required to login via SSH. You can configure the system in the following ways:

- define root password via `passwd root`
- change `sshd` behavior to accept empty passwords (set `PermitEmptyPasswords` to `yes` in `/etc/sshd_config`)

10.8. Getting Help

If you encounter any non-kernel related problems, you should get in contact with Buildroot community. As usual it is recommended to read the mailing list archives before asking questions on the mailing list.

A. Debian Maintenance Notes

A.1. Debian Package Management

Debian uses following utilities for the package management[66] :

- dpkg - the main package management program.
- APT - the Advanced Package Tool. It provides the `apt-get` program. `apt-get` allows a simple way to retrieve and install packages from multiple sources using the command line. Unlike `dpkg`, `apt-get` does not understand .deb files, it works with the packages proper name and can only install .deb archives from a source specified in `/etc/apt/sources.list`. `apt-get` will call `dpkg` directly after downloading the .deb archives from the configured sources.
- aptitude - a package manager for Debian GNU/Linux systems that provides a frontend to the apt package management infrastructure. `aptitude` is a text-based interface using the curses library, it can be used to perform management tasks in a fast and easy way.

To find a package execute:

`apt-cache search` *`pkg name`*

To view info such as version, dependencies, installed size etc. execute:

`apt-cache show` *`pkg name`*

To install packages execute:

`apt-get install` *`pkg1 pkg2`* `...` (su rights needed)

To update the list of package known by your system execute:

`apt-get update` (su rights needed)

To upgrade all the packages on your system

`apt-get upgrade` (su rights needed)

To remove packages from your system execute:

`apt-get remove` *`pkg1 pkg2`* `...` (su rights needed)

To install a package that is not contained in the repository download the *.deb file and execute:

`dpkg -i` *`pkg file name`* (su rights needed)

[66] for detailed information visit http://www.debian.org/doc/FAQ/ch-pkgtools.en.html

A.2. Keep a Track on Disk Usage

To get the list of all installed packages with its installed sizes execute:

```
dpkg-query -W -f'${Package}\t${Installed-Size}\t${Status}\n' | awk '/installed/ { print
$2 "\t" $1 }'
```

To estimate the file space usage execute:

```
du -h
```

To get a HTML output execute:

```
durep -w /tmp/web/
```

For detailed information see the manpages for `du` and `durep`.

To estimate free disk space execute:

```
df -h
```

B. onrisctool.py

OnRISC configuration utility provides following features to configure OMAP3 based devices:

- configure serial interfaces (RS232, RS422 etc.)
- configure OTG/CFast switching
- configure RTC
- configure digital I/O
- get EEPROM info
- set MACs from EEPROM

B.1. Configure Serial Interfaces

Both VS-860 and Alekto2 provide two UARTs working in RS232/RS422/RS485 modes. Invoking `onrisctool.py` without parameters will show which mode each port is configured to:

```
Port 1:  mode control:  DIP-switch
Port 1:  mode:  rs232
Port 2:  mode control:  DIP-switch
Port 2:  mode:  rs232
```

As one can see both port are configured in RS232 mode through DIP-switches. To switch the first port into RS422 mode execute:

```
onrisctool.py -t rs422 -p 1
```

All possible modes are show in the Table 8

Mode	Description
dip	DIP-switch settings are valid
loop	loopback mode
rs232	RS232
rs422	RS422
rs422-term	RS422 with termination
rs485-fd	RS485 full duplex
rs485-fd-term	RS485 full duplex with termination
rs485-hd	RS485 half duplex
rs485-hd-term	RS485 half duplex with termination

Table 8: Serial Modes (Software switching)

B.2. Configure OTG/CFast

Both VS-860 and Alekto2 use USB OTG port in two modes: OTG and CFast. The mode can be switched both via jumper and GPIO pin (software). The software settings “overwrite” the jumper. Executing `onrisctool.py` will show the status of hardware/software settings. Following output says, that the USB port is in OTG mode set over jumper:

```
OTG automatic mode:  OTG
```

You can switch to CFast via executing:

```
onrisctool.py -o cfast
```

If you then execute onrisctool.py without parameter you’ll see following output, indicating, that CFast mode is set via software:

```
OTG force mode:  CFast
```

B.3. Configure RTC

`onrisctool.py` lets you read the RTC directly and also write current system time to it.

Reading RTC:

```
onrisctool.py --readrtc
RTC read:  2013-06-03 12:44:47
```

Writing system time to RTC:

```
onrisctool.py --systohc
```

B.4. Configuring Digital I/O

As described in Section 6.1.2 Alekto2 provides 8 digital I/O pins. With `onrisctool.py` you can set direction and data.

Set direction “output” for the first group:

```
onrisctool.py -c out -g 0
```

Set pin 0 to 1:

```
onrisctool.py -m 0x01 -d 0x01
```

Set pin 0 to 0 and pin 1 to 1:

```
onrisctool.py -m 0x03 -d 0x02
```

B.5. Get EEPROM Info

`onrisctool.py` shows hardware related data like MACs, serial number etc. stored in EEPROM if called without parameters:

```
magic:  0xDEADBEEF
hw rev:  1.0
SerNum:  860102014
Prod date:  31.05.2013
SysId:  100
MAC1:  00:04:D9:8E:00:04
MAC2:  00:04:D9:8E:00:05
MAC3:  00:04:D9:8E:00:06
```

B.6. Setting LAN MACs from EEPROM

You can use in EEPROM stored MACs for internal LAN interfaces:

```
onrisctool.py --setlanmacs
```

Executing this command will set MAC1 and MAC2 to `eth0` and `eth1/usb0`.

C. hwtest

The test utility for the OnRISC hardware is provided in both BIOS and preconfigured Debian system images and consists of the following test modules:

- Network
- MiniPCI
- Serial
- GPIO
- CompactFlash
- I2C and RTC
- EPLD
- USB
- CAN
- WLAN Button

Three modes can be chosen for the test execution :

1. userless - executes all tests and shows the statistics at the end
2. fully interactive - the user has to acknowledge each test
3. half interactive - all of the automatic tests such as Network, MiniPCI, Serial, EPLD, USB, CAN and CompactFlash will be executed without user acknowledgment but GPIO and I2C would ask for the acknowledgment

The parameters can be specified in the command line or stored in the configuration file[67]. Without any parameter, the program will not execute any test. For the list of common parameters see Table 9.

For detailed information about options execute:

```
hwtest --help
```

[67]To use configuration file execute hwtest `--cfg=hwtest.conf`

`--cfg <file name>`	configuration file
`--cycles <number>`	number of test cycles. Default: infinite
`--size <bytes>`	test file size in bytes. Default: 1048576 bytes
`--mode <mode>`	`uless` for userless, `fint` for fully interactive, `hint` for half interactive. Default: `uless`
`--failstop`	stop testing after the first failure
`--verbose`	verbose output
`--net <params>`	network test module with its parameters
`--mpci <params>`	MiniPCI test module with its parameters
`--serial <params>`	serial test module with its parameters
`--gpio <params>`	GPIO test module with its parameters
`--cf <params>`	CompactFlash test module with its parameters
`--i2c <params>`	I2C and RTC test module with its parameters
`--epld <params>`	EPLD test module with its parameters
`--usb <params>`	USB test module with its parameters
`--can <params>`	CAN test module with its parameters
`--wlanbtn <params>`	WLAN button test with its parameters

Table 9: Common parameters and test modules

C.1. Network Test

Two interfaces must be connected with each other for the network test (either with a patch or crossover cable). A test file will be sent as raw Ethernet packets. To see the packet content use the `--verbose` flag. The size of the Ethernet packet (in bytes) can be defined with `--nblock` option. The delays between two packets will be defined with the `--ndelay` option (default 100000 microseconds).

Usage example:

`hwtest --cycles=1 --size=4096 --net --verbose`
executes the network test with a 4096 byte test file in verbose mode

C.2. MiniPCI Test

During the test `/proc/bus/pci/devices` will be searched for the presence of the WLAN card. If the WLAN card is found the name of the chip will be printed. After that, the WLAN environment will be searched for available participants.

Usage example:

`hwtest --cycles=1 --mpci`
executes the MiniPCI test

C.3. Serial Test

To test the serial port you will need a special null-modem cable. Following pinout will be used (see Table 10 and Figure 33 without USB-CAN connector):

TX	↔	RX
RX	↔	TX
RTS	↔	CTS, RI
CTS, RI	↔	RTS
DTR	↔	DSR, CD
DSR, CD	↔	DTR
GND	↔	GND

Table 10: Serial Test Cable Wiring

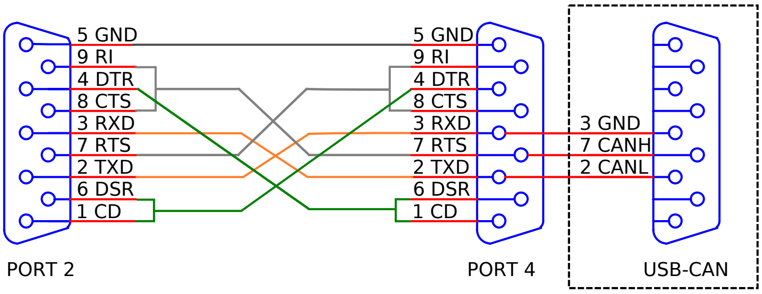


Figure 33: Serial Test Cable Wiring

The test file will be transferred from the first interface to the other and vice versa. This test can be also used to simultaneously test the serial and USB interfaces. To do this you must connect the USB port with the serial one using a USB-to-Serial adapter based on the FTDI chip. The serial test module has its own parameters `--seri` and `--sero` to configure the interfaces. With the `--sblock` parameter, the serial write block size can be configured. By default it is set to 64 bytes. The `--rtscts` option enables hardware handshake. The `--modem` option enables the test of the modem status pins.

Usage examples:

`hwtest --cycles=1 --size=4096 --serial --seri=/dev/ttyS1 --sero=/dev/ttyS2`
executes the serial test for on-board serial interfaces

`hwtest --cycles=1 --size=4096 --serial --sblock=200 --rtscts`
executes the serial test for default on-board serial interfaces (`/dev/ttyS1` and `/dev/ttyS2`) using hardware handshake and write block size of 200 bytes

`hwtest --cycles=1 --size=4096 --serial --seri=/dev/ttyS1 --sero=/dev/ttyUSB0`
executes the serial test using a USB-to-Serial adapter based on the FTDI chip

C.4. GPIO Test

The GPIO test module consists of following tests:

- IO test (will be activated with `--io` option)
- poll(), select() and interrupt functionality test (will be activated with `--poll` option)
- buzzer test (will be activated with `--buz` option)
- LEDs test (will be activated with `--led` option)

The I/O pins must be connected with each other for the IO test (using 4,7k resistors for example) (see Table 11). The optical isolated input channels will be connected to relays by Alena without any resistors(see Table 12).

DIO0	↔	DIO1				
DIO2	↔	DIO3		DIO2	↔	DIO3
DIO4	↔	DIO5		DIO4	↔	DIO5
DIO6	↔	DIO7				

Table 11: I/O Pin Connections for Alekto (left) and Alena (right)

DI0-G	↔	DO6-B
DI0-S	↔	DO6-C
DI1-G	↔	DO7-B
DI1-S	↔	DO7-C

Table 12: Optically Isolated Input Channels and Relays

Usage examples:

`hwtest --cycles=1 --gpio --io --poll --buz --led --mode=fint`
executes the complete GPIO test in full interactive mode

`hwtest --cycles=1 --gpio --io`
executes only the IO test in userless mode

C.5. CompactFlash Test

The CompactFlash test must be started from the BIOS or USB mass storage device, because the CF card must be unmounted. A test file will be written to the CF card during the test and then compared with the original one. After that, the test file will be removed from the CF card.

Usage example:

`hwtest --cycles=1 --size=4096 --cf`
executes the CompactFlash test with 4096 bytes big test file

C.6. I2C and RTC Test

A time stamp will be read from the Real Time Clock using I2C bus during the RTC test . The second time stamp will be read after the delay in seconds specified by `--sleep` option (default value is 1 second) and then compared. The test can be activated/deactivated with `--testrtc` and `--testlcd` options.

The LCD display (EAT123A-I2C) must be connected to the OnRISC for the I2C test. The program connects to the display and "O.K." string must be visible on the display.

Usage examples:

`hwtest --cycles=1 --i2c --testrtc --testlcd`
executes the RTC and LCD tests

`hwtest --cycles=1 --i2c --testrtc`
executes the RTC test only

`hwtest --cycles=1 --i2c --testlcd`
executes the LCD test only

C.7. EPLD Test

Each UART has its own EPLD to switch between RS232, RS422 and RS485 modes. Current configuration will be acquired and then switched to RS232 or RS422 depending on what the current configuration was. The EPLDs will be chosen using serial port devices configured in `--eplddev` option.

Example:

`hwtest --cycles=1 --epld --eplddev=/dev/ttyS1 --eplddev=/dev/ttyS2`
executes the EPLD test for both serial ports

C.8. USB Test

For USB test USB mass storage device should connected to the USB port. The device must be properly detected and mounted. `--usbmntdev` option defines which device to mount.

Usage examples:

`hwtest --cycles=1 --usb --usbmntdev=/dev/sda1`
executes the USB test for the first detected mass storage device

`hwtest --cycles=1 --usb --usbmntdev=/dev/sda1 --usbmntdev=/dev/sdb1`
executes the USB test for the first and the second detected mass storage devices

C.9. CAN Test

The CAN test will be made between the internal CAN interface and the VScom USB-CAN device. At first the USB-CAN sends one frame with the following data 0xDEADBEEF00000001, after internal interface receives this frame it send the same frame in return. There is only one parameter `--canpseed` to configure the CAN baudrate.

`hwtest --cycles=1 --can --canspeed=20000`
executes CAN test at 20Kbit/s

C.10. WLAN Button Test

WLAN Button test checks if WLAN button and WLAN button LED are functioning properly. Starting the test will let the WLAN button LED light on. The button must be pressed during the via –wbtimeout specified time slot. After pressing the button the LED will go off and the test is successful.

`hwtest --cycles=1 --wlanbtn --wbtimeout=5`

executes WLAN button test for 5 seconds

C.11. All-in-one Test for Alena

It is possible to test all serial ports, CAN and GPIO without reattaching the cables. Following components will be needed to make such a test:

- modified USB cable for USB-CAN (see Figure 34) so that GND and VCC wires will switched through relays and the outer GND is also isolated
- modified null-modem cable to connect PORT2, PORT4 and USB-CAN together (see Figure 33). Ports 1 and 3 will be connected with the same cable but without connector for USB-CAN
- special board for GPIO tests, that connects optically isolated inputs to bidirectional channels (see Figure 35)
- special `--canprod` flag must be activated to use this features

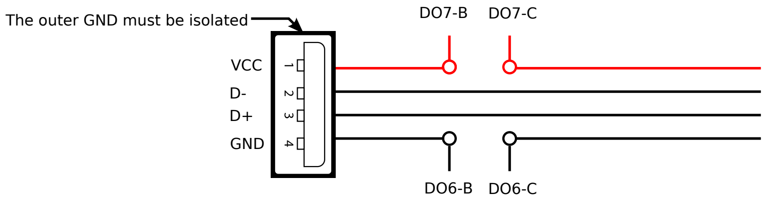


Figure 34: Modified USB cable

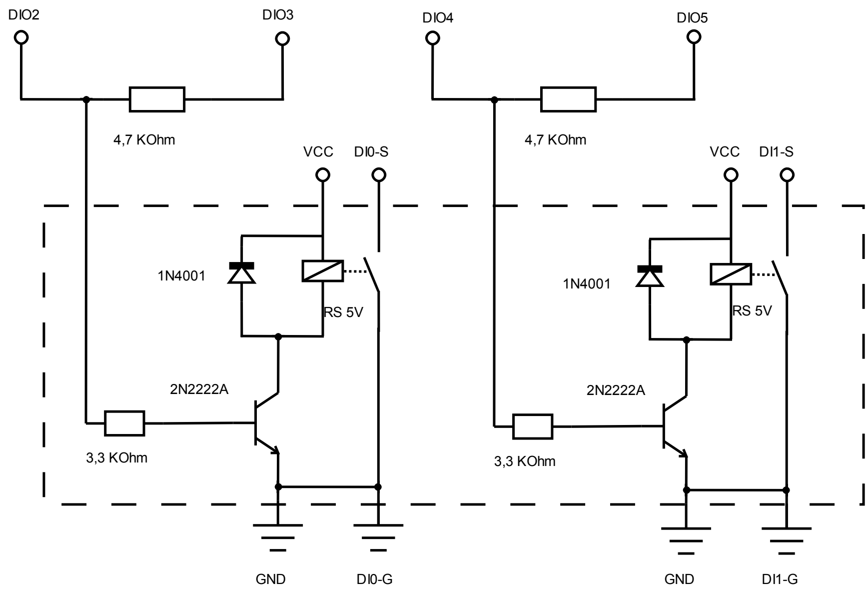


Figure 35: Special Board for GPIO Tests

Connect all components as described above. With the following command GPIO, CAN and serial tests will be executed:

```
hwtest --cycles=2 --size=4096 --can --canspeed=20000 --canprod --serial --seri=/dev/ttyS2
--sero=/dev/ttyS4 --gpio --io --poll
```

CAN test must be executed with low speed like 20000 bit/s, because the cable has no termination resistors. All other tests can be made without further modifications.

C.12. Build Notes

hwtest can be built either with GNU make or CMake. Both `Makefile` and `CMakeLists.txt` are supplied. The command line parameter parser was generated using GNU gengetopt[68]. To be able to generate the parser for changed options in `hwtest.ggo` one has to install GNU gengetopt tool.

[68] http://www.gnu.org/software/gengetopt/

D. hwtest-qt

Hwtest-qt provides various hardware tests in both console and graphical environment. To get GUI start `ghwtest-qt` instead of `hwtest-qt`. Hwtest-qt can be run using special configuration file. See `/etc/hwtest.conf` for example.

```
hwtest-qt -qws -c /etc/hwtest.conf
```

If you want to execute the tests in parallel:

```
hwtest-qt -qws -c /etc/hwtest.conf --parallel-exec
```

Please see `hwtest-qt --help` for further options.

D.1. Controller Area Network Test

CAN test requires USB-CAN device attached to one of the USB ports[69]. Connect internal CAN interface with USB-CAN via CAN cable and execute:

```
hwtest-qt -qws --test-can --cani=can1 --cano=can0
```

D.2. UART Test

Connect both internal serial ports via null-mode, cable and execute:

```
hwtest-qt -qws -test-serial --seri=/dev/sertest0 --sero=/dev/sertest1
```

D.3. Network Test

Connect both LAN insteraces via patch cable and execute:

```
hwtest-qt -qws --test-network --neti=eth0 --neto=usb0
```

D.4. RTC Test

```
hwtest-qt -qws --test-rtc
```

D.5. WLAN Test

WLAN test scans for available WLAN hosts (iw wlan0 scan). At least one AP must be running and antenna must be attached.

```
hwtest-qt -qws --test-wlan
```

[69] You'll need a slcan tools to bring USB-CAN up. See VSCAN SocketCAN FAQ

D.6. Bluetooth Test

Bluetooth test needs an active Bluetooth device like headset, Bluetooth dongle etc. to find during the scan.

```
hwtest-qt -qws --test-bt
```

D.7. Disk Test

Insert CFast card and execute:

```
hwtest-qt -qws --test-disk --drive=/dev/sda
```

D.8. Touch Test

If you start ghwtest-qt and you can precisely touch the buttons, then touch controller is functioning properly. You can calibrate it by executing

```
ts_calibrate
```

D.9. SIM-card Test

You'll need a 3G card and a SIM-card For Ericsson F5521gw execute:

```
hwtest-qt -qws --test-simcard --cardmodel=F5521gw --cmdport=/dev/ttyACM0
```

For Sierra Wireless creates /dev/ttyUSBx devices, so according to where external FTDI devices are connected the port numbering can differ. Please refer to dmesg, to see what ports were assigned to Sierra Wireless card and calculate an offset. If numbered from /dev/ttyUSB0 the command port is /dev/ttyUSB3

```
hwtest-qt -qws --test-simcard --cardmodel=mc8790 --cmdport=/dev/ttyUSB3
```

D.10. Button Test

For button test the user will be prompted to press buttons on the front panel from left to right, skipping the first button (power button).

```
hwtest-qt -qws --test-btn
```

D.11. Audio Test

Insert earphones into the left connector and execute:

```
hwtest-qt -qws --test-audio
```

You'll hear a woman voice saying “Front left”

E. Managing System Images

System images provide 1:1 copy of the Debian OS installed on a CF/microSD card. The image has the size of a medium being used to produce the system image. For KS8695 based devices it is ca. 2GB and for OMAP3 based devices ca. 4GB. In the case of OMAP3 based devices a special utility **`raspi-config`**[70] is provided to automatically enlarge partition/file system to the real physical size of a medium, i.e. if you burn the image to a 8GB card, it will occupy only 50% of the medium, after executing **`raspi-config`** whole 8GB will be at your disposal. To expand the root partition start raspi-config and select "expand_rootfs" in the menu as show in Figure 36 and exit. The root partition expanding runs in two stages: at first the partition will be enlarged and after a reboot the file system will be enlarged too.

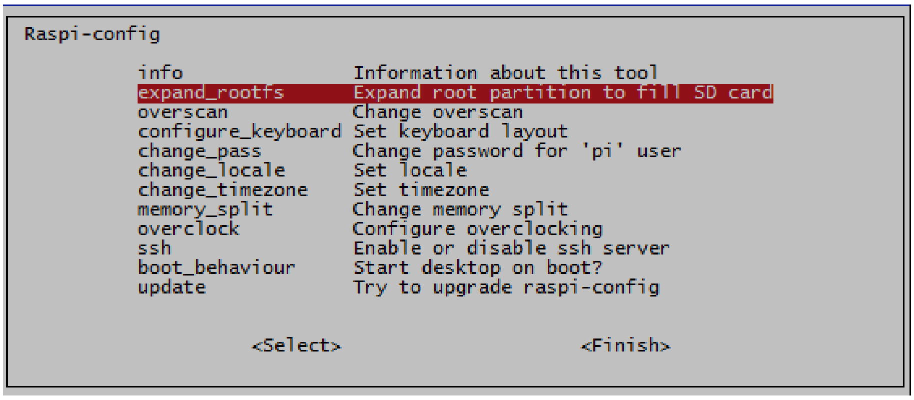


Figure 36: Expand Root Partition

E.1. VS Image Tool: VSImgTool

VSImgTool[71] was developed to make/copy images from/to the flash drives connected to a Windows host. This utility can make the whole image or only part of it. Refer to Table 13 for parameters.

Warning: please note that you must have administrator privileges to properly execute VSImgTool.

`--list`	list available flash drives with their size in bytes
`source destination`	copy image from source to destination
`source destination custom_size`	copy only part of the image from source to destination

Table 13: VSImgTool call parameters

The is also an open source tool with GUI named Win32 Disk Imager[72] to accomplish the same task (see Figure 37).

[70] `raspi-config repository`
[71] VSImgTool can be found on the CD under `tools` or on our FTP server
[72] http://sourceforge.net/projects/win32diskimager/

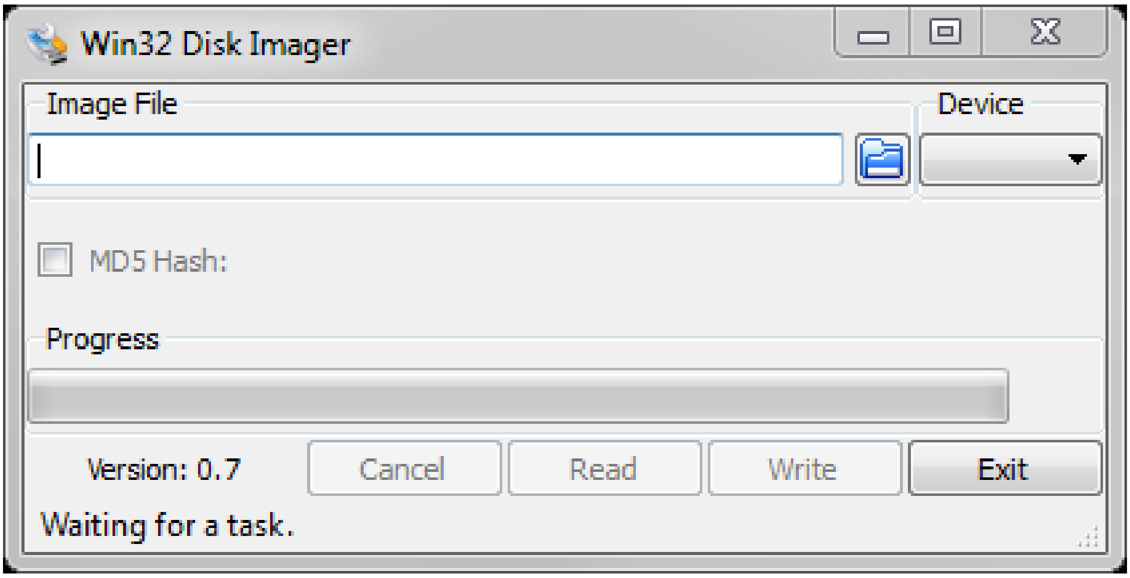


Figure 37: Win32 Disk Imager

E.1.1. Burn System Image to CF/microSD Card

1. Insert CF/microSD card in your card reader and execute
   `vsimgtool --list`
   you should see the similar output:
   ```
   >vsimgtool.exe --list
   VSImgTool 1.0
   Available devices:
   PhysicalDrive2 Size:  1024450560 bytes
   ```
2. to copy the complete image to the CF/microSD card on the PhysicalDrive2 execute
   `vsimgtool.exe 26082008_etch_complete.bin PhysicalDrive2`
   you should see the following output:
   ```
   >vsimgtool.exe 26082008_etch_complete.bin PhysicalDrive2
   VSImgTool 1.0
   Image source:  26082008_etch_complete.bin
   Size:  1008451584 bytes
   Removable destination:  PhysicalDrive2
   Size:  1024450560 bytes
   The data on the destination will be lost.  Are you sure you want to continue?  [yes/no]
   >
   ```
3. answer with "yes" and the copying process will begin
4. at the end of the copying process you should see the elapsed time and the size of the burned/-copied image

If your CF/microSD card has bigger capacity than the system image, you can just insert it in the card reader and change the partition with some partition manager like Gparted[73] on your Linux host.

[73] http://en.wikipedia.org/wiki/Gparted

E.1.2. Make An Image From CF/microSD Card

```
vsimgtool drive_name image.bin
```

where *drive_name* is the name showed by `vsimgtool --list`.

For 256MB and 512MB CF/microSD cards there are two custom sizes prepared:

`vsimgtool PhysicalDrive2 image.bin 256`
will copy exactly $244 \cdot 1024 \cdot 1024 = 255852544$ bytes

`vsimgtool PhysicalDrive2 image.bin 512`
will copy exactly $488 \cdot 1024 \cdot 1024 = 511705088$ bytes

`vsimgtool PhysicalDrive2 image.bin 519192576`
will copy exactly 519192576 bytes

E.2. dd

E.2.1. From Host PC

To copy a system image to a CF/microSD card using your host PC just download the required system image from our FTP server and extract the *.bin file (for example to `/home/user/`).

If USB card reader is used the CF/microSD could be found under `/dev/sdx` devices (for example `/dev/sda`, `/dev/sdb` etc). If CF card is attached to IDE channel then CF card could be found under `/dev/hdx` (for example `/dev/hda`, `/dev/hdb` etc). Please note, that the system images are complete images of a CF/microSD card not of the single partition and must be applied to the device like `/dev/sda` and not `/dev/sda1`.

For the example below it will be assumed that the CF/microSD card is assigned to `/dev/sda` device and the system image is `27032008_etch_complete.bin`:

```
su
dd if=/home/user/27032008_etch_complete.bin of=/dev/sda bs=4096
```

To create an image from the CF/microSD card execute following:

```
dd if=/dev/sda of=/home/user/image.bin
```

E.2.2. Directly From OnRISC (KS8695 based Devices)

The procedure is the same as with PC with a small difference, that the system image has to be copied on some removable medium (USB drive) and then mounted on OnRISC to `/mnt` from within BIOS. So that the dd command looks as follows (for microSD card):

```
dd if=/mnt/27032008_etch_complete.bin of=/dev/sda bs=4096
```

E.3. Working with Partitions

It is also possible to write/extract only one partition at file system level. The advantage: you can write this partition even to a smaller medium. Please refer to this project FSArchiver

F. Eclipse

F.1. Installation Notes

Eclipse is an open source community whose projects are focused on building an extensible development platform, runtimes and application frameworks for building, deploying and managing software across the entire software life cycle. In Debian run:

```
apt-get install eclipse
```

to install it. Additionally you'll need to download and install Java 2 SDK or Java 2 JRE from Sun Microsystems[74]. It can happen that Eclipse doesn't find Java binary, in this case execute:

```
eclipse -vm java
```

To get working with C projects you'll need the CDT[75] plug-in to compile and debug your software for the OnRISC.

If you'd like to checkout Kernel or examples from our Subversion repository, use doxygen etc. you could also find these plug-ins as useful:

- Subclipse (subclipse.tigris.org)
- Gengetopt Eclipse (ggoeclipse.sourceforge.net)
- CMake Editor(www.cthing.com/CMakeEd.asp)

[74] java.sun.com/javase
[75] http://www.eclipse.org/cdt/

F.2. Debugging

Assuming your OnRISC has IP address 192.168.1.66. Start your `ioctls` executable on the OnRISC with following command:

```
gdbserver :9000 ioctls
```

On the PC side:

- open `examples` project (the .project and .cdtproject file are already created)
- Select Run->Debug
- Double click Embedded debug (Native). After that you'll get new configuration entry
- select the project corresponding to yours (see Figure 38)
- select C/C++ Application to `ioctls`
- choose Debugger tab (see Figure 39)
- GDB debugger: `arm-linux-gdb`
- choose Commands tab (see Figure 40)
- 'Initialize' commands: `target remote 192.168.1.66:9000`
- 'Run' commands: `c`
- Apply
- Debug

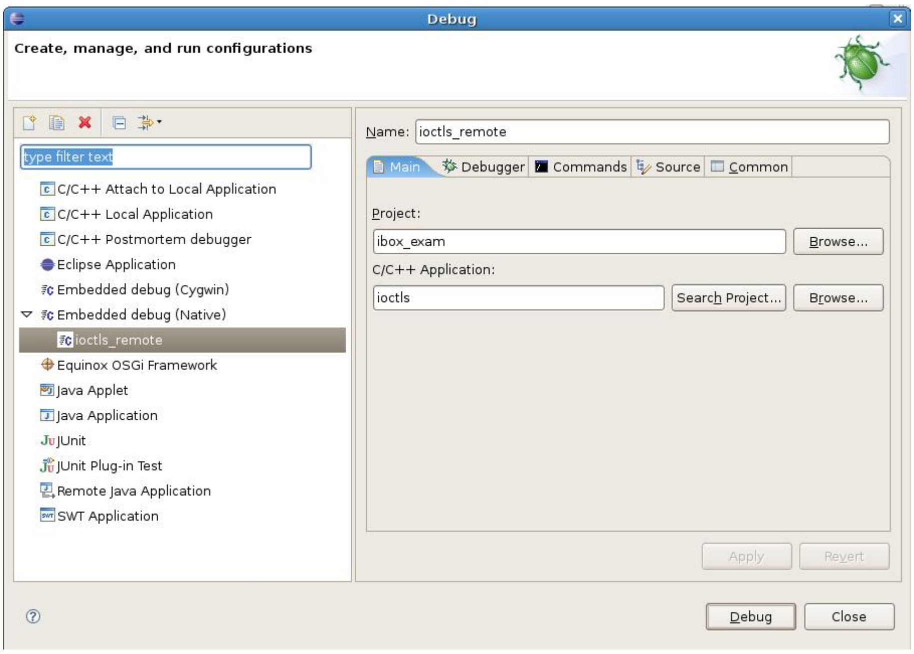


Figure 38: Eclipse debug: Main tab

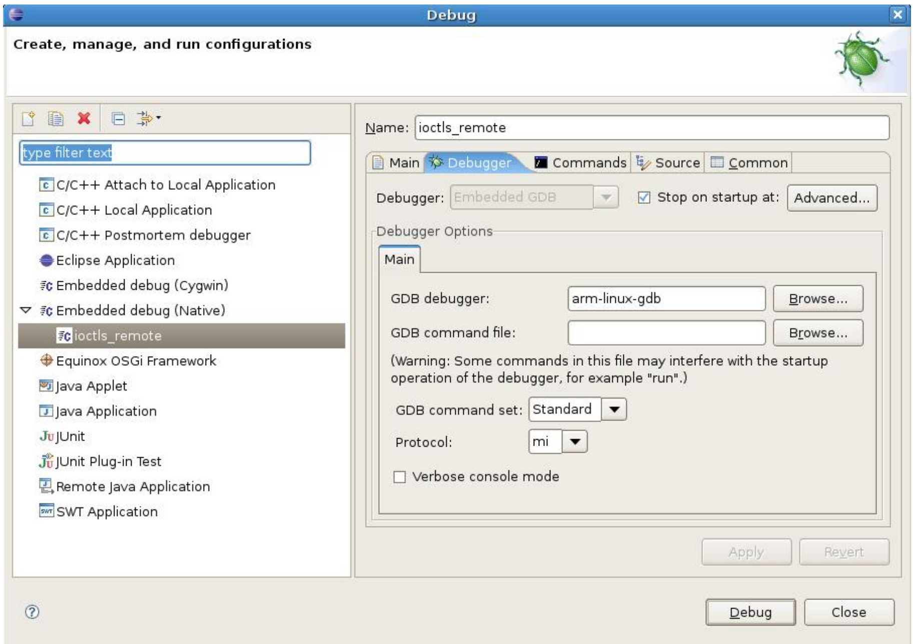


Figure 39: Eclipse debug: Debugger tab

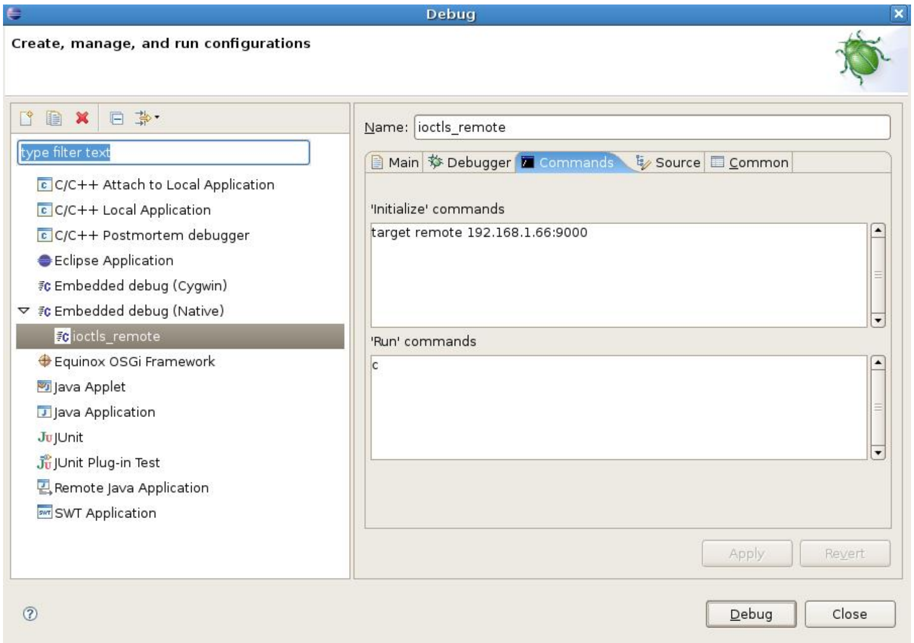


Figure 40: Eclipse debug: Commands tab

G. Cross-Compiler Tools

Name	Description
ar	Creates and updates static library files
as	Assembler
g++	C++ compiler
cpp	C preprocessor
gcc	C compiler
ld	Linker
nm	Lists symbols from object files
objcopy	Copies and translates object files
objdump	Displays information about object files
ranlib	Generates indexes to archives (static libraries)
readelf	Displays information about ELF files

Table 14: Toolchain items

H. Frequently Asked Questions (FAQ)

There is dedicated website http://faq.visionsystems.de to handle the FAQ concerning OnRISC and other products provided by VScom. The customer question will be posted to the support team for approval and if approved appears in the corresponding category.

Index