AVR32005: AVR32 AP7 How to add a custom board to Buildroot

32-bit AVR® Microcontrollers

Application Note

Features

- **Adding a custom board to the Buildroot configuration system**
- **Creating a default Buildroot board configuration**

1 Introduction

This application note describes how a custom target board can be added to the Buildroot build system. A custom board is useful if you intend to use Buildroot in combination with your own design.

The custom board can contain board specific kernel patches and the Buildroot configuration file for this board can enable a default selection of packages. This eases the recreation of the root file system for a custom board.

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2 Creating a custom board

In this application note the *atngw100-base* board is used as an example to implement a custom board. This approach has the advantage that it can be used as a template and it only contains, as the name implies, a basic setup for the NGW100 board.

All files needed are located in the directory *target/device/Atmel/atngw100-base*. To start a new board create a new directory in *target/device/Atmel* and name it after your board. After that copy all files and directories in *atngw100-base/* to this directory.

These files and directories are discussed in the next chapters.

2.1 Linux® configuration

The kernel needs a valid configuration for your board. This configuration is stored in the kernel sources in the *.config* file. The file *linux-2.6.25.10.config* in your new board directory is such a configuration file. It will be copied to the kernel sources when you initiate a build for your board. The version may vary according to the last kernel release. Rename the file to fit your kernel version.

- Change *2.6.25.10* to your kernel version

If you do not want to use this configuration, configure the kernel and copy the *.config* file to your board directory. Rename it as described earlier. To run the kernel configuration within Buildroot run:

```
make linux26-menuconfig
```

You also have the possibility to use a default kernel configuration shipped with the kernel source. To use this you have to change the Buildroot configuration:

```
Kernel  --->
  Kernel type (linux (Advanced configuration))  --->
  Linux Kernel Configuration  --->
    Linux Kernel Configuration (Run make <custom>_defconfig)  --->
    (yourboard_defconfig) make custom_defconfig
```

The kernel sources are loaded from the official website (http://ftp.kernel.org). The official release may not include all AVR®32 specific changes and might need a patch. In addition the board setup code for the Linux kernel, which is specific for each board, may be included in this patch.

All kernel patches must reside in the *kernel-patches/* directory under your board directory in order to let Buildroot automatically apply them. The patches are applied in an alphabetical order. So if you need to follow a specific sequence, name the patches appropriately.

2.2 Busybox configuration

Busybox is a set of common Linux tools such as *ls*, *cat* and *echo,* which are combined into one binary to reduce size. More information is available on http://www.busybox.net.

To select the tools that you want on your target system, a configuration file is needed. The file *busybox.config* in your board directory is such a configuration for Busybox. Edit this file to add/remove tools from Busybox.

To run the Busybox configuration within Buildroot run:

```
make busybox-menuconfig
```

This command will overwrite the Busybox board configuration in the board target directory.

NOTE: exit with *Ctrl* + *c* will not copy the config file.

2.3 Target file system

Your target board needs a root file system. A skeleton for the root file system is available in the directory *target_skeleton/* in your board directory. Here you can add new directories and files. The files and directories here will be copied to the root file system. File attributes such as the group id (gid) or permissions you set here will be ignored.

In order to set file attributes and to create special files the file *device_table.txt* exists. Here you can modify the attributes of existing files and directories or add new ones. It is also possible to create special files like device files or fifo's.

The reason of having a *device_table.txt* file is that you can build the whole target root file system as normal user and thus do not have to switch to root. A short documentation about editing the *device_table.txt* file is included in the same file.

2.4 Board Makefile

In the file Makefile.in change the path to your board directory, remove ATNGW100_BASE from BR2_TARGET_AVR32_ATNGW100_BASE and replace it with your board name. Do the same with ATNGW100_BASE_PATH. Unless you did not change the name/directory of *target_skeleton* and *device_table.txt* no further changes are needed here.

```
ifeq ($(BR2_TARGET_AVR32_ATNGW100_BASE),y)
ATNGW100_BASE_PATH=target/device/Atmel/atngw100-base
TARGET_SKELETON=$(ATNGW100_BASE_PATH)/target_skeleton
TARGET_DEVICE_TABLE=$(ATNGW100_BASE_PATH)/device_table.txt
endif
```

3 Adding a board to the configuration system

In order to make a new board visible and selectable in the Buildroot configuration system it must be added as an entry in a configuration file. The file of interest is *target/device/Atmel/AVR32_Config.in*. In this file an entry is needed to make your board selectable from the menu.

Open the file *AVR32_Config.in* and copy the entry for the NGW100 base board to make a new insertion right after it. Make sure that the entry is between the labels choice and endchoice.

```
config BR2_TARGET_AVR32_ATNGW100_BASE
        bool "Atmel AVR32 basic network gateway board support"
        depends BR2_at32ap7000
```

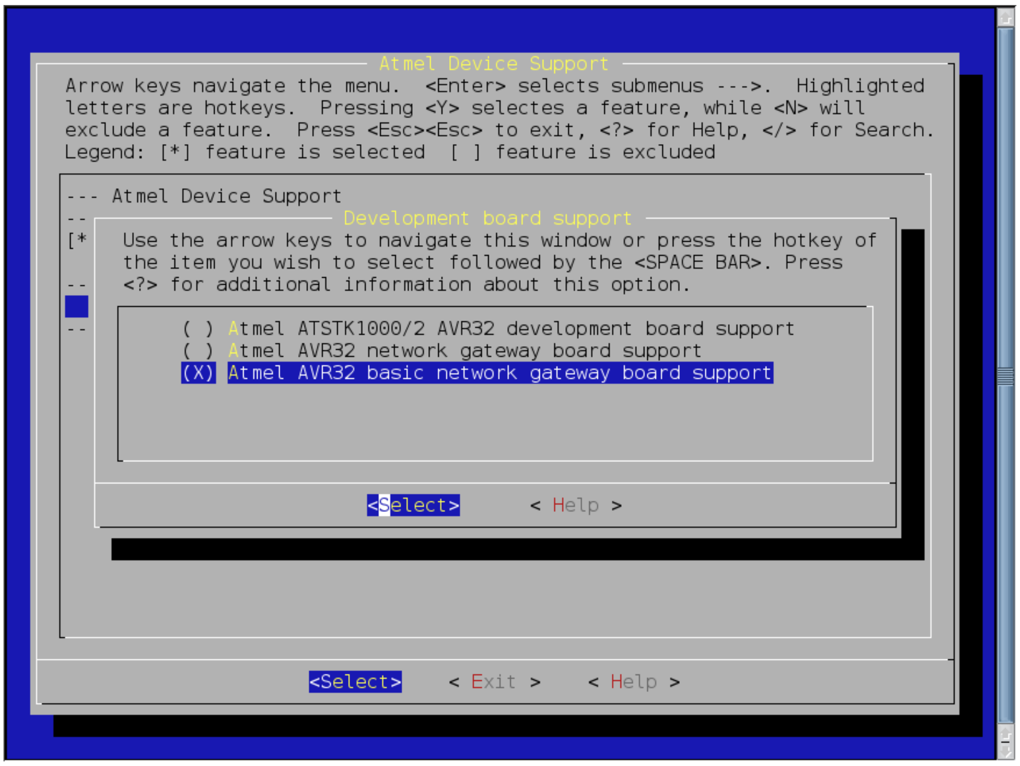
```
select BR2_PACKAGE_LINUX
help
  Very simple configuration for the Atmel AVR32 Network
  Gateway Board.
```

Now edit the entry:

- Replace BR2_TARGET_AVR32_ATNGW100_BASE with your Buildroot board name (something like BR2_TARGET_AVR32_YOUR_BOARD_NAME; make sure it is the same name as in chapter 2.4).
- Add a description for the menu entry after bool.
- Depending on the device that is mounted onto your custom board, add the correct target device after depends. Supported devices are listed in the same file as configuration options.
- It is mandatory to enable the Linux package with "select BR2_PACKAGE_LINUX".
- Add a detailed board description after the help attribute if you like. This description appears in the menu system as help message.

  The board is now available in the menu under "Board Support Options -> Atmel Device Support -> Development board support". It will be shown in the development board support list as shown in Figure 3-1.

Figure 3-1. Board selection in the Buildroot configuration



```
Atmel Device Support
Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted
letters are hotkeys.  Pressing <Y> selectes a feature, while <N> will
exclude a feature.  Press <Esc><Esc> to exit, <?> for Help, </> for Search.
Legend: [*] feature is selected  [ ] feature is excluded

--- Atmel Device Support
    Development board support
    Use the arrow keys to navigate this window or press the hotkey of
    the item you wish to select followed by the <SPACE BAR>. Press
    <?> for additional information about this option.

        ( ) Atmel ATSTK1000/2 AVR32 development board support
        ( ) Atmel AVR32 network gateway board support
        (X) Atmel AVR32 basic network gateway board support

              <Select>      < Help >

        <Select>    < Exit >    < Help >
```

Last step is to edit the file *target/device/Atmel/Config.in*. The BR2_BOARD_NAME configuration parameter needs the correct board name. The name has to be the directory in target/device/Atmel in which the custom board files are located.

```
config BR2_BOARD_NAME
        string
        …
        default "atngw100-base" if  BR2_TARGET_AVR32_ATNGW100_BASE
```

The example above reflects only the relevant part of the BR2_BOARD_NAME configuration in the Config.in file. Other boards are replaced by "…". Copy the last line and add it right after it. Replace "atngw100-base" with your board directory and BR2_TARGET_AVR32_ATNGW100_BASE with your Buildroot board configuration.

After these steps your custom board is integrated in the Buildroot build system. The only thing left to do is to enable your board in the configuration.

4 Creating a Buildroot configuration

When you build an image for a board you typically run *make atngw100_defconfig* or a similar command depending on the board. Refer to the application note *AVR32003 Buildroot for AVR32* for more information. This command copies the specified configuration file to the file *.config* and runs a check to see if the configuration is sane. After that you can make additional selections by running *make menuconfig*. To benefit of this feature for your board you have to create a board default configuration file.

Run *make atngw100-base_defconfig* to get a basic configuration loaded from which you can start to make your own. Other configurations are also possible but they will, most likely, have many things configured that you probably will not need. Now run *make menuconfig* to alter the settings. To activate your board go to the menu entry described in chapter 3.

Select packages and edit all options to your needs. When you are finished leave the configuration system and save your settings. Copy the .config file to the directory target/device/Atmel/<your board name> and name it after your board with a *_defconfig* extension at the end of the file name. Now it is possible to run *make your_board_name_defconfig* and Buildroot loads your default settings.

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