Application Report
SPRAAT3–February 2008

Making a Cramfs File System Image

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ABSTRACT

This application report demonstrates how to build a compressed ROM file system (cramfs) file system image and add support for cramfs in the Linux kernel. The goal is to build a small file system that can be placed in Flash memory. Since cramfs is a read-only file system with limited size, it is mostly useful in embedded devices where there is a limited amount of storage and there is no need to write data back to the file system to be saved between reboots.

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1 Overview of cramfs

The cramfs is a read-only Linux file system designed to have a small footprint. The main difference between cramfs and a compressed image of a traditional file system is that the cramfs file system can be used without the need to decompress it first. This is accomplished by compressing the file system one page at a time, which allows for random read access. However, this also prevents writing to the file system.

There are some additional limitations to cramfs aside from the read-only attribute. The maximum file size in a cramfs file system is 16MB. The maximum size of the total file system is a little over 256MB. This is because the last file on the file system must begin before the 256MB mark but may extend past the 256MB mark.

2 Adding cramfs to the Linux Kernel and Building the Kernel Image

The following steps assume that you have already installed the DVEVM software packages to obtain the ARM Linux tool chain, the Linux support package, and the example RAM disk file system. If you have not done so, see the *DVEVM Getting Started Guide* (SPRUE66) before continuing.

For your embedded system to be able to use the cramfs file system image that you create, the Linux kernel used by your system must know how to read from the cramfs file system. This requires enabling the cramfs file system support in the Linux kernel configuration. There are multiple ways to edit the kernel configuration, but for this example, xconfig is used. This example assumes that you have made a copy of the default installed kernel tree (from the DVEVM packages) in the /home/user/workdir directory.

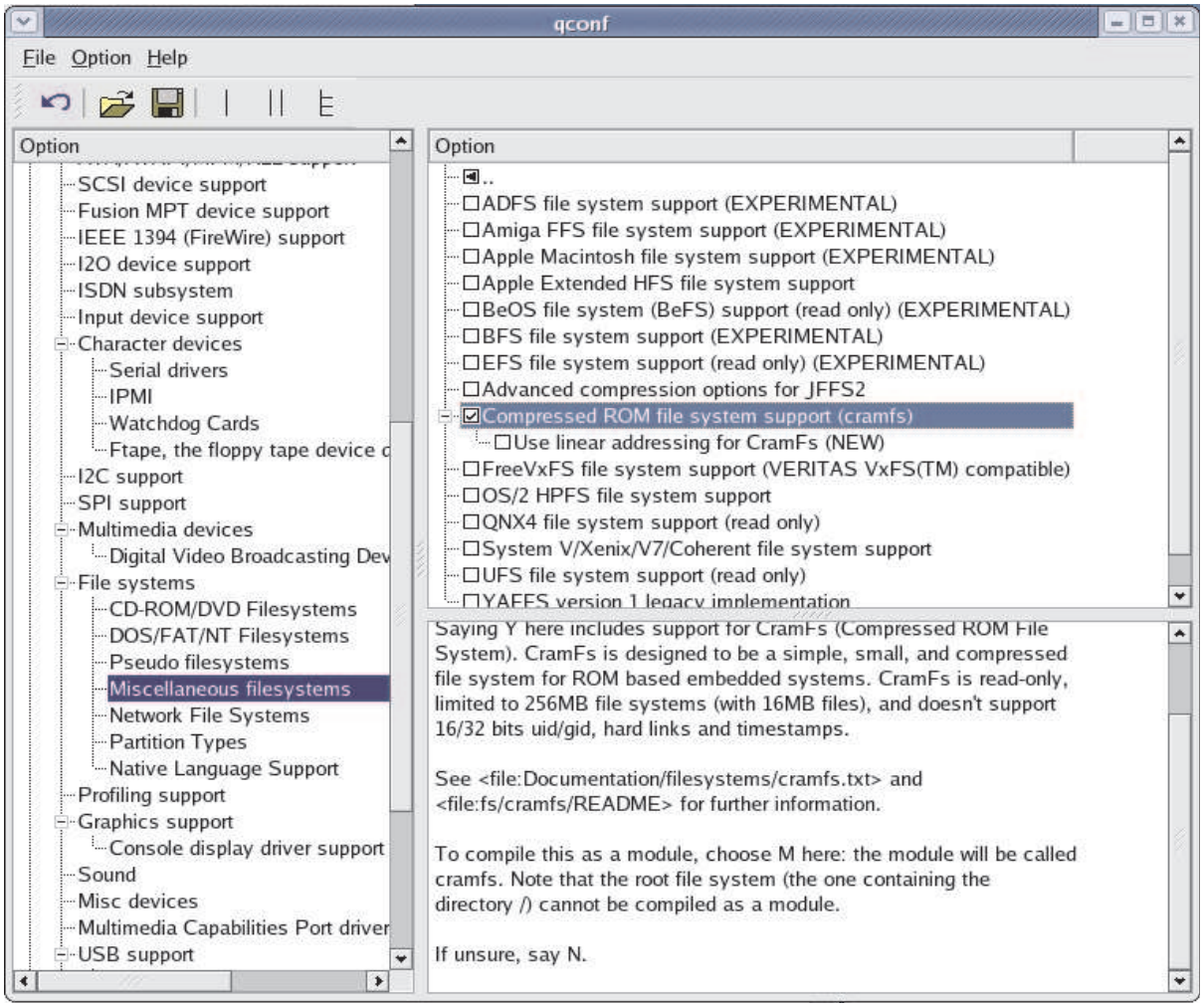
1. Change the directory to the base directory of the kernel tree:

```
host $ cd /home/user/workdir/ti-davinci
```

2. Launch the Linux kernel configuration utility:

```
host $ make ARCH=arm CROSS_COMPILE=arm_v5t_le- xconfig
```

3. Check the Compressed ROM file system support (cramfs) box to enable the cramfs file system support in the Linux kernel under Device Drivers → File systems → Miscellaneous filesystems.



4. Continue configuring your kernel as needed for your system. For an example on making the smallest kernel possible, see *Building a Small Embedded Linux Kernel Example* (SPRAAH2).
5. Build the Linux kernel image with the following command:

```
host $ make ARCH=arm CROSS_COMPILE=arm_v5t_le- uImage
```

3 Downloading and Installing Required Tools

The mkcramfs tool must be installed on your host Linux workstation to create the cramfs file system image. If you do not have the mkcramfs installed on your host system, you can obtain the latest version of the tool at http://sourceforge.net/projects/cramfs. After downloading the tools, in this example the tools are downloaded to the /home/user directory, you can perform the following steps to compile and install the tools.

1. Untar the following tools package:

```
host $ cd /home/user/

host $ tar xzf cramfs-1.1.tar.gz

host $ cd cramfs-1.1
```

2. Compile the tools

```
host $ make
```

   This creates the mkcramfs and cramfsck utilities. You can install both, but in most cases, only the mkcramfs utility is necessary.

3. Install the tools

   Since the Makefile does not have an install section, you have to install the utilities. This can be done by copying the tools to the /usr/bin directory.

```
host $ cp mkcramfs /usr/bin/

host $ cp cramfsck /usr/bin (optional)
```

4 Creating a cramfs File System Image

Although this section is not dependent on the previous section, it is assumed that you have already installed the DVEVM software on the Linux host machine according to the steps outlined in the *DVEVM Getting Started Guide* (SPRUE66).

To save time, a RAM disk is provided with the DVEVM ARM Linux software tool chain; use this as a base for your cramfs file system image. It is located under:

```
<tool chain install directory>/pro/devkit/arm/v5t_le/images
```

Note: Later releases of the DVSDK software package provide the sample RAM disk file system image at <dvsdk install dir>/<PSP dir>/bin

In this directory, the RAM disk file is called ramdisk.gz (about 2.1MB gunzipped). In run time, it occupies about 6.3MB in DDR. This file system contains some unnecessary utilities for this project, but is appropriate for a typical embedded system. The following steps demonstrate how to use this example file system to generate a cramfs file system image.

1. Copy the example initial RAM disk to a temporary location:

```
host $ mkdir –p /mnt/def_cd

host $ cp <tool chain install
dir>/pro/devkit/arm/v5t_le/images/ramdisk.gz /mnt/def_cd

host $ cd /mnt/def_cd
```

2. Mount the example initial RAM disk image:

```
host $ gunzip ramdisk.gz

host $ mkdir ram0

host $ mount ramdisk ram0 –o loop
```

3. Modify the example initial RAM disk. You can add new applications or files at this point. For a more detailed example on how to add a new application, see *Building a Small Embedded Linux Kernel Example* (SPRAAH2). For this example, a simple shell script is added to print *Hello World!!!* on start-up.

```
host $ vi ram0/etc/init.d/hello.sh


Add the following 2 lines into the hello.sh file:

#!/bin/sh

echo "Hello World!!!"


host $ chmod +x ram0/etc/init.d/hello.sh

host $ cd ram0/etc/rc.d/rcS.d

host $ ln –s ../init.d/hello.sh S50hello

host $ cd /mnt/def_cd
```

4. Create a cramfs image of the file system:

```
host $ mkcramfs ram0 cramfs.image
```

5. Un-mount the example initial RAM disk:

```
host $ umount ram0
```

5 Summary

This application report demonstrates how to create a cramfs image of a file system called cramfs.image. With this information, you can flash this image into the Flash memory on your board and use it as an initial ramdisk image (initrd) for the kernel you built in Section 2. For more information on flashing the kernel and cramfs file system images to the Flash on your board, see *Building a Small Embedded Linux Kernel Example* (SPRAAH2).

6 References

- *DVEVM Getting Started Guide* (SPRUE66)
- *Building a Small Embedded Linux Kernel Example* (SPRAAH2)

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