Getting Started with the NAS 782x Rapid Development Kit

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This guide explains how to implement a basic network-attached storage (NAS) system on the following Rapid Development (RDK) boards:

- NAS 7820 (order code NAS7820-AA RDK)
- NAS 7821 (order code NAS7821-AA RDK)
- NAS 7825 (order code NAS7825-AA RDK)

In the text these devices are jointly referred to as NAS 782x.

This guide also describes how to set up a wireless router/NAS demonstration system based on the NAS 7825.

The guide assumes that you are an experienced Linux software engineer who is familiar with similar devices and embedded systems.

The information in this document applies to single- and dual-SATA systems.

The RDK consists of:

- NAS 782x RDK board
- NAS 782x binaries
- Programming scripts
- Wi-Fi PCIe card and aerial (NAS 7825 RDK only)

To set up a NAS system, you:

1 Create a full network-attached storage (NAS) product based on the binaries we supply you, and the information in this document.

2 Run basic tests on the system to prove that the hardware and software are operational; for example, accessing web pages, copying files to shares, USB tests and similar.

3 Replace rootfs with your own binaries, using the information in this document and the programming scripts we provide.

4 Run tests to identify features that are not functional.

To set up a NAS 7825 wireless router/NAS demonstration, you:

1 Create a demonstration system using the information in this document.

2 Run the demonstration steps, as described in *NAS 7825 Router Demonstration Guide*.

To learn more about the NAS 7820, NAS 7821 or NAS 7825, see the relevant data sheet.

The installation CD contains sample complete NAS system software, including boot environment, kernel and rootfs. In this document, this is referred to as the *sample application*. The sample application is supplied in binary format ready for installation.

This guide covers the following topics:

- Equipment required for the NAS system
- Unpacking the sample application and installing it on the target hard disk drive
- Connecting the NAS 782x RDK board to a power supply and the host platform
- Setting up the MAC and IP addresses
- Running the sample application
- Installing your own root file system

Checking the Kit Contents

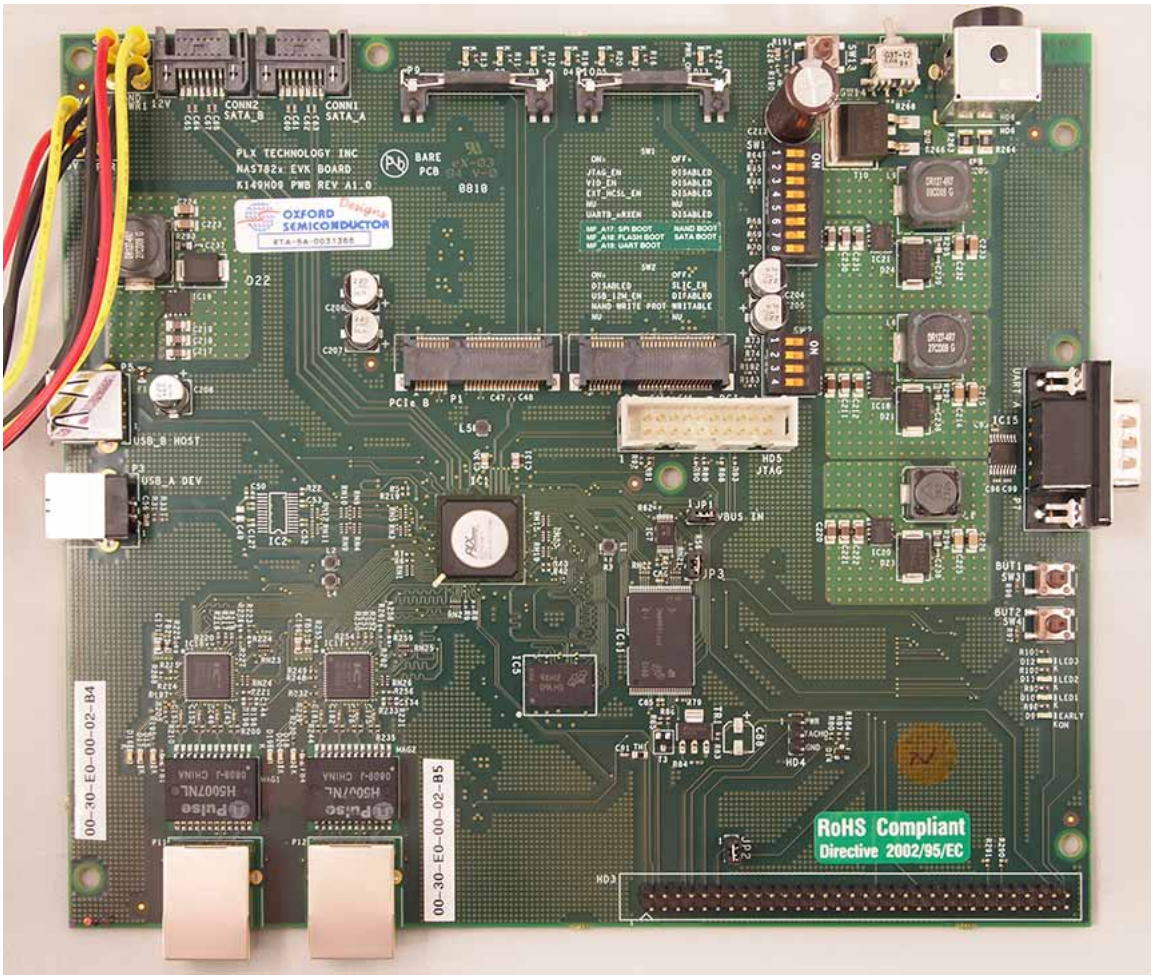
Before continuing, check the contents of the kit against the bill of materials supplied.

NAS 782x RDK Boards

The NAS 782x RDK board has two high-speed USB 2.0 ports (one host, P5; one device, P3) and two 10/100/1000 Ethernet ports (P11, P12). The PCIe bus has two mini PCIe connectors (P1, P2). The UART port (P7) offers serial debugging capability.

Figure 1 on page 3 shows a NAS 782x RDK board, with two SATA connectors. To connect the RDK board, use ports SATA A (CONN1), SATA B (CONN2), Ethernet A (P11) and USB B (P3).

Figure 1 NAS 782x RDK Board



You can configure the NAS 782x RDK board to boot from a number of sources. However, the system supplied boots from disk, with the root file system stored on the SATA hard disk drive.

You must obtain the hard disk drive separately.

Before powering up the board, note the key features of the NAS 782x shown in Figure 2 on page 4.

Figure 2 Principal Features of the NAS 782x RDK Board

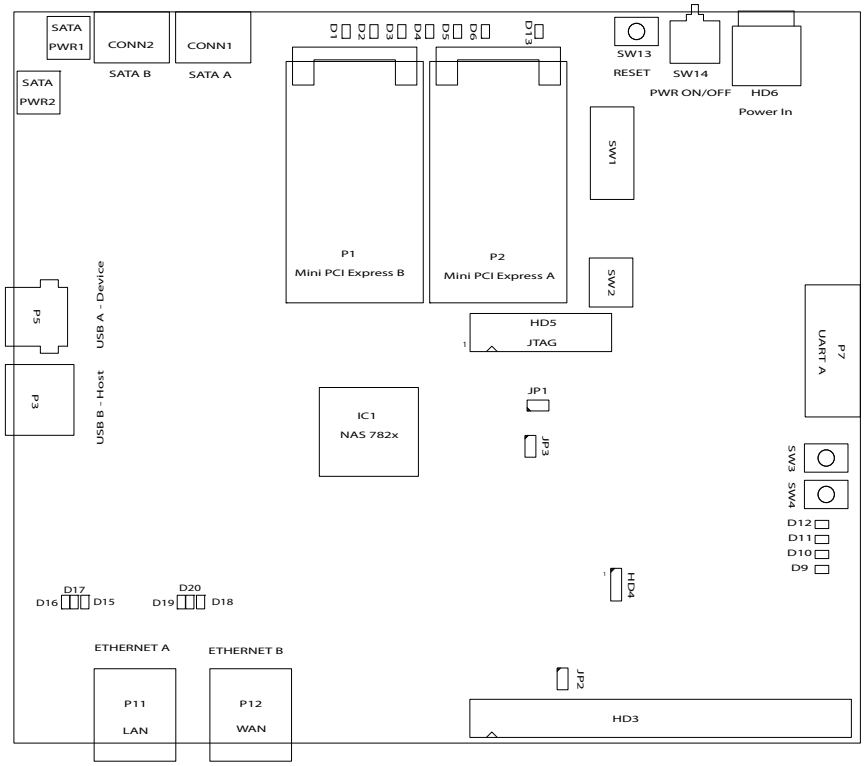
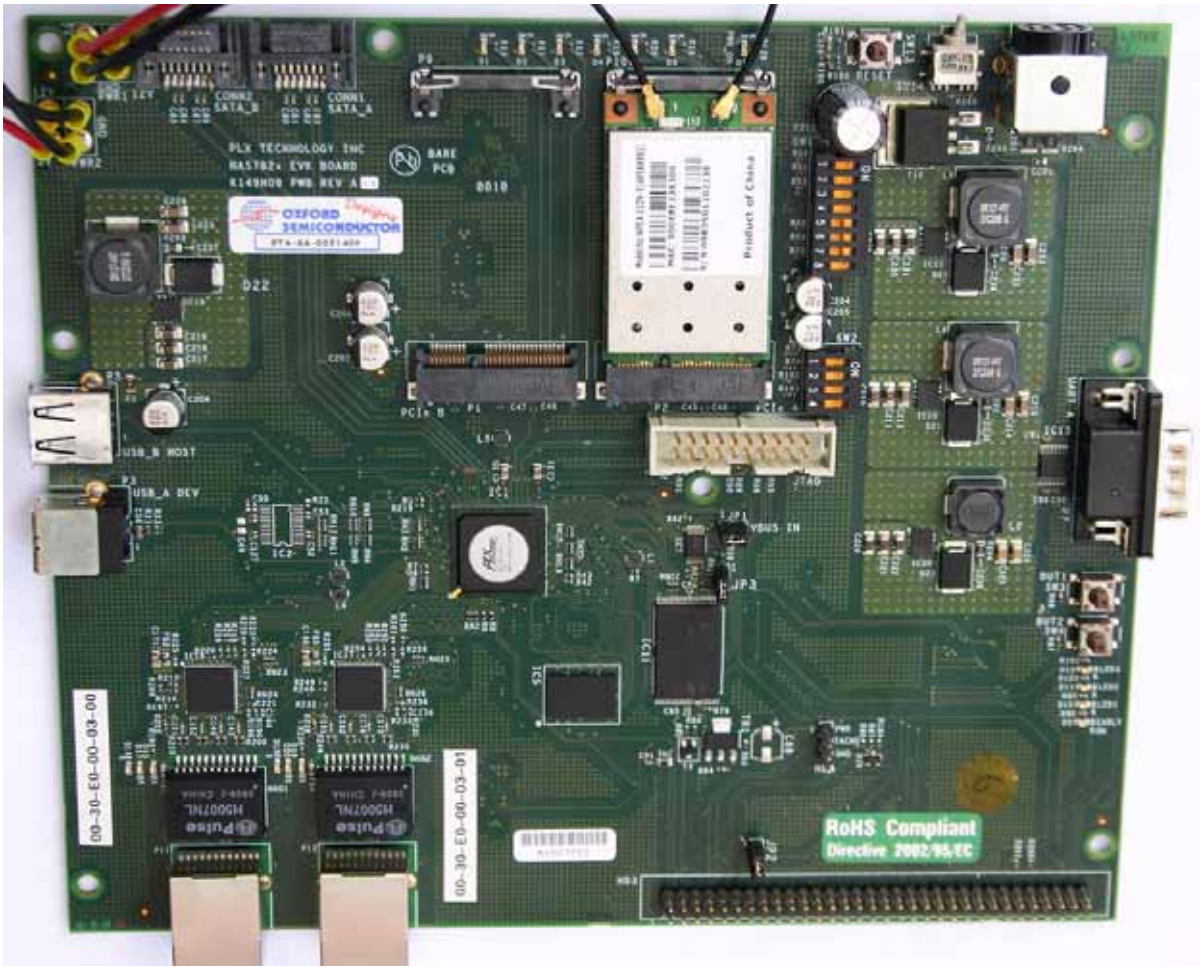


Figure 3 shows the NAS 7825 with the Wi-Fi card connected to the PCIe connector (P2).

Figure 3 NAS 7825 with Wi-Fi Card



The RDK board is supplied fitted with 128Mbytes of 16-bit DDR2 SDRAM and 128 Mbytes of NAND flash memory. The default configuration settings are:

- Jumpers JP1, JP2 and JP3 are fitted
- Switch SW1:
  - 1 off
  - 2 off
  - 3 off
  - 4 off
  - 5 on
  - 6 on
  - 7 on
  - 8 off

- Switch SW2:
  - 1 off
  - 2 off
  - 3 off
  - 4 off

For more information on the features of the board, see RDK Board Features on page 14.

Equipment Required

To assemble a complete NAS system, you need the following equipment:

- PC running Linux Fedora Core 11 to 13

  Access super user privileges: use the **su** command with the appropriate root password. Install **xfsprogs** on the Linux host by entering **yum install xfsprogs**
- NAS 782x RDK board
- Programmed SATA disk(s)—see Programming a SATA Disk
- 12V power brick for the RDK board and SATA hard disk(s)
- SATA data cable(s) for the SATA hard disk(s)
- Ethernet cable (crossover cable if Ethernet 10/100 is used at both the host end and device end). A crossover cable is not required if a hub is used. For the NAS 7825 wireless router/NAS demonstration, you need two Ethernet cables
- 9 pin serial cable, crossover type

Programming a SATA Disk

Observe normal anti-static precautions throughout this procedure.

To program a SATA disk, you need the following items:

- A PC running Linux Fedora Core 9 or 10 with an internet connection. Ensure that the Ethernet card is recognized by the operating system
- For a single-SATA system: a spare SATA port on the Linux PC motherboard for connecting the SATA hard disk drive, or a USB to SATA bridge, that can be used to connect the SATA hard disk drive to the Linux PC
- For a dual-SATA system: you must programme both hard disks at the same time. Therefore you need one of the following:
  - Two spare SATA ports on your Linux PC motherboard
  - A single USB to dual-SATA bridge (configured in JBOD mode)
  - Two USB to single-SATA bridge boards
- Super user access through **su** or **sudo**

Unpacking and Installing the Sample Application

Before you unpack and install the sample application, ensure that the correct operating system is running and the hard disk drive is connected. The sample application software is supplied on the installation CD.

If you are using Gnome desktop, switch off **Auto-browse on mount** in the file manager.

You use the BASH command shell to unpack, install and build the application. This should make these instructions universal; GUI operating system options may vary.

To unpack and install the sample application:

1 To start a BASH command shell, use the operating system menu options (**Applications/System Tools/Terminal**) in Fedora.

2 To determine the name of the installation CD, use the **mount** command.

3 Within the BASH shell, copy the binaries onto your Linux PC (where ␣ is a space):

- For the NAS 7820 or NAS 7821, enter
  cp /media/*disk name*/782*n*-V*n.n.n*/Binaries/SDK-*n.n.n*-binaries.tar.bz2␣ .
  replacing *n* with **0** for a single-SATA system or with **1** for a dual-SATA system
- For the NAS 7825 wireless router/NAS demonstration system, enter
  cp /7825-demo-V*n.n.n*/Binaries/SDK-*n.n.n*-binaries.tar.bz2␣ .

The file is copied to your home directory on the hard drive.

4 To unpack the file, use the **tar** command. Use the syntax:

tar -xjf <*file name*>

This creates the **SDK_*n.n.n*-binaries** directory (where *n.n.n* represents the release version) containing installation scripts, pre-compiled boot-loaders, Linux kernel and a compressed root file system.

5 Change to the **SDK_*n.n.n*-binaries** directory.

6 To install the software, you must obtain super user privileges. To do so, run the commands with **sudo**.

On Linux, root is the system administrator with full control to administer and completely disable the system.

7 The installation scripts partition the disk, format the partitions and copy the software into the correct locations on the disk. To use them you specify the device node of the disk to be programmed.

To find details of the device nodes, disk drive device files and partitions for each of the attached disks, run the sudo /sbin/fdisk -l command with super user privileges.

Be very careful not to specify the device file of your system disk in the next command. **Ensure you do not install the software on your system disk.**

8 To install the sample application, type one of the following (where ␣ is a space and *version* is the version you want to assign to your build):

- For a single-SATA system:
  sudo␣./install-7820-fast.sh␣/dev/sdb␣"*version*"
- For a dual-SATA system:
  sudo␣./install-7821-raid1.sh␣/dev/sdb␣/dev/sdb␣"*version*"
- For a NAS 7825 wireless router/NAS demonstration system:
  sudo␣./install-7825-demo.sh␣/dev/sdb␣"*version*"

This creates a RAID 1 system. To change RAID mode use the NAS web interface; for more information, see GS-0078: *Getting Started with the NAS Web Interface*.

The installation script expects to see all of the above line complete. The system does not run unless the correct strings are given here.

Setting up the NAS 782x RDK Board

This section explains how to connect the NAS 782x RDK board to the host PC and how to obtain MAC and IP addresses, assuming that the board is configured and correctly powered up.

Connecting to a Linux Host

Figure 4 shows the cabling for the NAS 782x RDK board when attached to two SATA hard disk drives.

Figure 4 NAS System Setup with NAS 782x RDK Board

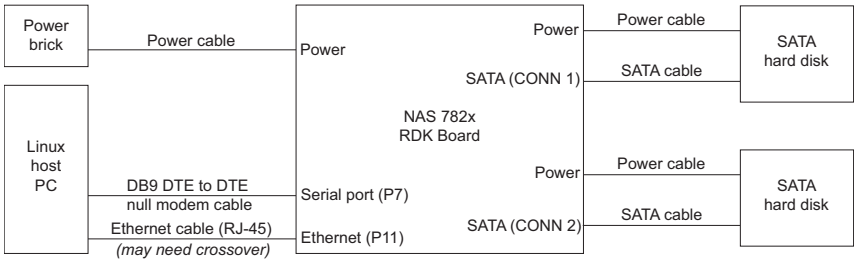
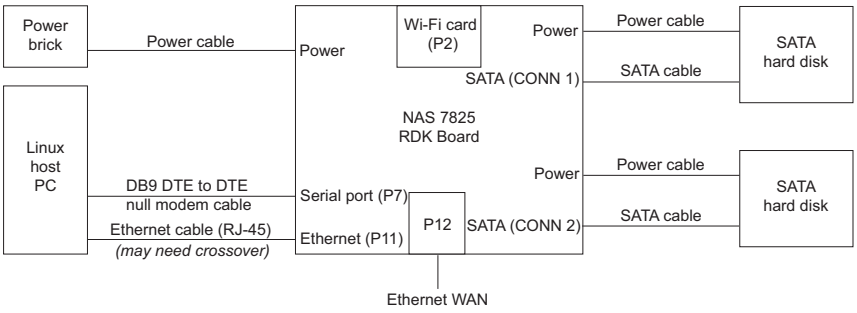


Figure 5 shows the cabling for the NAS 7825 wireless router/NAS demonstration, when attached to two SATA hard disk drives.

Figure 5 NAS 7825 Demonstration System Setup



Observe normal anti-static precautions throughout this procedure.

To connect the NAS 782x RDK board to a Linux host:

1 Use a SATA cable to connect the SATA hard disk to CONN1 on the RDK board. For a dual-SATA system, use a second SATA cable to connect the SATA hard disk to CONN2 on the RDK board.

2 Use an Ethernet cable to connect the host PC directly (or using a hub or switch) to the Ethernet interface (P11). Use a crossover cable if Ethernet 10/100 is used at both the host end and device end.

3 Use the 9 pin serial cable to connect the Linux host PC to the device serial port (P7P3).

4 Connect a disk drive power cable to the SATA hard disk.

5 Connect the power supply to the power connector (HD6).

6 Start a serial console and set access for Serial Port 0, as described in Appendix A Starting a Serial Console and Setting Access for Serial Port 0.

7 To see debugging data output on the serial port, turn on the power.

8 Having established that the software is running and that debug output can be observed, turn off the power to the board.

The next steps are Setting up the MAC Address and Setting up the IP Address.

For the next steps for a NAS 7825 wireless router/NAS demonstration system, see *NAS 7825 Wireless Router/NAS Demonstration Guide*.

Setting up the MAC Address

The Ethernet MAC address is stored on a disk when the disk is programmed, and is set to its default value. It is stored in the environment variables controlled by **U-Boot** and passed to the Linux kernel when it is run. **U-Boot** has a primitive terminal interface that is available for a brief time during the boot process. You use this interface to change the MAC address.

To prevent problems when you have multiple Ethernet devices (such as two NAS systems) on the same network, you must give each device a different MAC address.

The correct MAC address for your device is shown on a sticker on the device.

To change the MAC address manually, use the serial connection to the NAS 782x RDK board. Follow the steps below:

1 Start a serial console and set access for Serial Port 0, as described in Appendix A Starting a Serial Console and Setting Access for Serial Port 0.

2 Power on the NAS 782x RDK board. As the system boots, a two-second countdown is displayed. Press any key in the serial terminal window during this countdown period to gain access to the **U-Boot** terminal interface.

3 To set the MAC address, type the following (all on one line), replacing 0x*nn* with the digits of the MAC address shown on the sticker:

setenv bootargs console=ttyS0,115200 root=/dev/md1 mac_adr=0x*nn*, 0x*nn*, 0x*nn*, 0x*nn* 0x*nn*, 0x*nn*, elevator=cfq

For example, a MAC address of 00 30 E0 00 01 71 is entered as:

setenv bootargs console=ttyS0,115200 root=/dev/md1 mac_adr=0x00, 0x30, 0xE0, 0x00, 0x01, 0x71, elevator=cfq

4 Save this to disk using the **save** command, then reboot the system using the **reset** command.

5 Now you need to set up the IP address.

Setting up the IP Address

When powering up, the software attempts to define the IP address using a number of mechanisms:

- If a static address is defined, this address is always used
- When an Ethernet link is available, the system uses DHCP client to obtain an address from a DHCP server
- If a DHCP server is not available, the system uses a zero conf address and tries to establish whether this address is in current use. When it finds an address that is not being used by another device, it assumes that address

You usually change the Ethernet address using the web user interface. Alternatively, you can change the address using the serial console to log in to the NAS as follows:

1 Start a serial console and set access for Serial Port 0, as described in Appendix A Starting a Serial Console and Setting Access for Serial Port 0.

2 Let the start-up data run through until the message **OXNAS login** appears.

3 To log in to the NAS, enter user **root**, password **root**.

4 To edit the network settings file **/var/oxsemi/network-settings**, use **vi**.

5 If there is not a DHCP server on the network, in the **network-settings** file, change the line

network_mode=dhcp to **network_mode=static**

6 To set the IP address, change the **static_ip** and **static_msk** lines as required. The **static_msk** line is defined as follows:

Mask	static_mskline value
255.0.0.0	static_msk=8
255.255.0.0	static_msk=16
255.255.255.0	static_msk=24

7 Save the changes to the **network-settings** file, then exit **vi**.

8 To restart the network interfaces, type:

/etc/init.d/network_control.sh restart

Samba Shares

The NAS 782x system is created with a share called PUBLIC (standard share, standard performance).

Additional standard shares can be automatically created and mounted through the web pages. For more details, see Accessing the Web Pages.

You can manually create and mount fast shares based on a script that is stored on the NAS 782x system. To do so:

1. Log in to the NAS and enter user **root**, password **root**.
2. Run the script to create and mount the share by typing one of the following:
   - For a single-SATA system: **/etc/create_fast_share.sh**
   - For a dual-SATA system: **/etc/create_fast_share_raid.sh**

   This creates a fast share called FAST.
3. You can create additional fast shares by typing one of the following:
   - For a single-SATA system: **/etc/create_fast_share_example.sh** <*share_name*>
   - For a dual-SATA system: **/etc/create_fast_share_raid_example.sh** <*share_name*>

   replacing *share_name* with the name you want.

Accessing the Web Pages

The RDK kit contains a web server that provides configuration pages.

You can access these using a standard web browser, either by typing the following URL in the browser's location bar:

http://*<IP address of the unit>*

or by using the default device name oxnas:

http://oxnas

Some of the pages require authorized access; the default access is:

user name: **admin**

password: **123456**

For more information, see GS-0078: *Getting Started with the NAS Manager*.

Halting the System

To stop the system, type **halt** in the console window.

Installing Your Own Root File System

You can install your own root file system in preference to the one supplied.

Your root file system must include the following features:

- Contain the kernel modules from the supplied **modules.tar.bz2** file
- Contain the supplied firmware **gmac_copro_firmware** file. The location of the firmware file depends on how you are handling kernel events for firmware loads. For hotplug based systems, the location is typically **/usr/lib/hotplug/firmware**; for udev based systems, the location is typically **/lib/firmware**
- Load any needed modules during boot, this typically includes the GMAC (network) driver and USB support

Example BusyBox /etc/inittab lines to load the GMAC and USB drivers are:

::sysinit:/sbin/modprobe gmac mac_adr=$mac_adr

::sysinit:/sbin/modprobe ehci-hcd

::sysinit:/sbin/modprobe usb-storage

You must create your root file system as a bzip2 compressed tar file called **rootfs.arm.tar.bz2**.

Place the rootfs.arm.tar.bz2 file in the **SDK_*n.n.n*-binaries directory**.

The installation script uses this tar file in preference to the supplied system.

Programming a SATA Disk

To program a SATA disk:

1 Re-connect the disk to the PC

2 Change to the SDK_*n.n.n*-binaries directory

3 To install the software, you must obtain super user privileges. To do so, run the commands with **sudo**.

On Linux, root is the system administrator with full control to administer and completely disable the system.

4 The installation scripts partition the disk, format the partitions and copy the software into the correct locations on the disk. To use them you specify the device node of the disk to be programmed.

To find details of the device nodes, disk drive device files and partitions for each of the attached disks, run the sudo /sbin/fdisk -l command with super user privileges.

Be very careful not to specify the device file of your system disk in the next command. **Ensure you do not install the software on your system disk.**

5 To install the sample application, type one of the following (where ␣ is a space):

- For a single-SATA system:
  sudo␣./install-7820-fast.sh␣/dev/sdb␣"*version*"
- For a dual-SATA system:
  sudo␣./install-7821-raid1.sh␣/dev/sdb␣/dev/sdb␣"*version*"

The installation script expects to see all of the above line complete. The system does not run unless the correct string is given here.

You do not need to set the MAC address again. You can now reconnect the disk to the board, boot the system and continue as follows:

- Examine the boot process for any warnings or errors
- Access your web pages and ensure they are working as expected
- Check other features for correct operation

RDK Board Features

This section describes the major features on the RDK board. For further details see the relevant schematics supplied on the installation CD.

Jumpers and Switches

The RDK board has various jumpers, buttons and switch banks used to configure and control its operation (see Figure 2 on page 4):

- JP1—normally fitted. This jumper allows the USB_A interface to monitor the VBUS signal. If the USB-A interface is not required, you can remove this jumper to allow the use of MF_A10 on the expansion interface
- JP2—normally fitted. This jumper provides access to LED2 on MF_A9. If this LED is not required, you can remove the jumper to allow use of MF_A9 on the expansion interface
- JP3—normally fitted. Provides access to button BUT2. If this button is not required, you can remove this jumper to allow use of MF_A11 on the expansion interface

- SW1—see the table below .

SW1 Switch	Setting	Effect
1	On	JTAG enable
	Off	JTAG disabled
2	On	Not used
	Off	
3	On	When an external HCSL clock generator is fitted, On enables the device, Off disables it
	Off	
4	On	Not used
	Off	
5	On	Enable UART A receiver
	Off	Disable UART A receiver so the UART SIN pin can have an alternative function
6	On	SW1[8:6] = MF_A[19:17] 0xx—boot from UART 100—boot from SATA fallback to NAND 101—boot from SATA fallback to SPI 110—boot from NAND 111—boot from SPI Note that the settings given here are correct: the details printed on Revision A1.0 RDK boards are incorrect.
	Off	
7	On	
	Off	
8	On	
	Off	

- SW2—see the table below

SW1 Switch	Setting	Effect
1	On	Loopback SLIC clocks enabled
	Off	Loopback SLIC clocks disabled
2	On	Not used
	Off	
3	On	NAND flash write-protected
	Off	NAND flash write-enabled
4	On	Not used
	Off	

- SW3—button BUT1. Button connected to MF_B6
- SW4—button BUT2. Button connected to MF_A11 when JP3 is fitted
- SW5—global reset button
- SW14—RDK board power on/off switch

LEDs

There are the following general LEDs:

- D13—yellow LED that illuminates to indicate the presence of +12V on the board
- D9— yellow LED that indicates a boot from SATA is in progress. When the output is tristate this glows dimly
- D10 (LED1)—yellow LED driven by MF_B11. When the output is tristate this glows dimly
- D11 (LED2)—yellow LED driven by MF_A9 when JP2 is installed. When the output is tristate this glows dimly
- D12 (LED3)—yellow LED driven by MF_B7 When the output is tristate this glows dimly

The following Mini PCIe A LEDs are used by plug-in mini PCIe wireless cards:

- D4—green LED connected to LED_WPAN# on mini PCIe connector
- D5—green LED connected to LED_WLAN# on mini PCIe connector
- D6—green LED connected to LED_WWAN# on mini PCIe connector

The following mini PCIe B LEDs are used by plug-in mini PCIe wireless cards:

- D1—green LED connected to LED_WWAN# on mini PCIe connector
- D2—green LED connected to LED_WPAN# on mini PCIe connector
- D3—green LED connected to LED_WLAN# on mini PCIe connector

There are the following Ethernet A LEDs:

- D15—yellow activity light
- D16—orange 10/100M link mode
- D17—green 1G link mode

There are the following Ethernet B LEDs:

- D18—yellow activity light
- D19—orange 10/100M link mode
- D20—green 1G link mode

Interfaces

The RDK board has the following interfaces:

- HD6—main 12V power supply for the RDK board. All operating voltages are derived from this source, including power for SATA disk drives
- Two mini PCIe sockets (P1 and P2). These only support the primary PCIe functions. The UIM, USB and SMDAT interfaces are not supported
- A USB 2.0 host interface (P5)
- A USB 2.0 device interface (P3)
- Two SATA interfaces (SATA_A on CONN1, SATA_B on CONN2). Power for these interfaces is delivered by flying leads from PWR1 and PWR2
- A single RS232 550 compatible UART port (P7) for serial download and debugging. This interface only supports SIN and SOUT. There is no hardware flow control. The interface is configured as a DTE so a standard null modem cable is required to connect to a standard PC serial port
- Two RJ45 Gbit Ethernet ports (ETHA on P11 and ETHB on P12)
- HD3 provides access to the MFIO pins. For use as an expansion header 12V, 5V, 3.3V and GND are also provided. For details, see the RDK board schematics
- JTAG interface on HD5. For pin definitions, see the table in Fan Tachometer Header
- A fan tachometer interface is provided on HD4. For pin definitions, see the table in Fan Tachometer Header

JTAG Header

The following table details the pin allocations for the JTAG header.

Pin Number	Function	Pin Number	Function
1	VCC3V3	11	GND
2	VCC3V3	12	GND
3	JTAG reset (MF_B0)	13	TDO (MF_B0)
4	GND	14	GND
5	TDI (MF_B3)	15	nRESET (output)
6	GND	16	GND
7	TMS (MF_B2)	17	NC
8	GND	18	GND
9	TCLK (MF_B1)	19	NC
10	GND	20	GND

Fan Tachometer Header

The following table details the pin allocations for the fan tachometer header.

Pin Number	Function
1	Power (PWM speed controlled)
2	Tacho (feedback from the fan to the NAS 782x)
3	GND

Using MFIOs

The NAS 782x RDK board provides 50 MFIOs, which are multiplexed for a variety of uses. Each MFIO pin has primary, secondary and tertiary functions, selectable under software control. For more information on MFIO use, see the relevant layout guidelines document for your device.

Revision Information

The following table lists the revisions of this document.

Version	Date	Modification
3.00	August 02 2010	Includes NAS 7825 wireless router/NAS details
2.00	July 28 2010	Updated Unpacking and Installing the Sample Application, Samba Shares, Installing Your Own Root File System
1.00	June 16 2010	Terminology changed from evaluaiton kit to RDK
0.60	June 08 2010	Includes dual-SATA build details
0.50	April 20 2010	Addition of Samba Shares
0.20	March 08 2010	First publication

Starting a Serial Console and Setting Access for Serial Port 0

This appendix describes the procedure for starting a serial console and setting access permission for Serial Port 0.

You must have root privileges to access serial port device nodes.

The procedure is as follows:

1 Start a BASH command shell using the operating system menu options (**Applications/System Tools/Terminal** in Fedora).

2 To access super user privileges, use the **su** command with the appropriate root password.

3 Use the **chmod** and **cu** commands to allow all users access permission for Serial Port 0 (**/dev/ttyS0**) and to start a serial console. Enter the following:

su -c "chmod a+rw /dev/ttyS0"

4 To start the console, do one of the following:

- Enter **cu -l /dev/ttyS0 -s 115200**
  where the – s (speed) option sets the baud rate and the – l (line) option sets the serial port to use
- Enter **minicom**

5 If the system response to the **cu** command is

bash:cu: command not found

you must download the file **uucp-1.07-12.i386.rpm** (or later) from one of the Fedora mirror sites.

When you have downloaded the file, install it from the BASH shell with super user privileges by typing:

rpm –i uucp-1.07-12.i386.rpm

The file works as soon as the installation has finished. You can now start a serial console and set access for Serial Port 0 as described above.

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