OS-9 for Prospector P1100 Board Guide

Version 3.2

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This manual reflects version 3.2 of Enhanced OS-9 for StrongARM.

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Chapter 1: Installing and Configuring OS-9

This chapter describes installing and configuring OS-9 on the ARM Prospector/P1100 development board. It includes the following sections:

- **Development Environment Overview**
- **Requirements and Compatibility**
- **Target Hardware Setup**
- **Connecting the Target to the Host**
- **Building the OS-9 ROM Image**
- **Transferring the ROM Image to the Target**
- **Optional Procedures**

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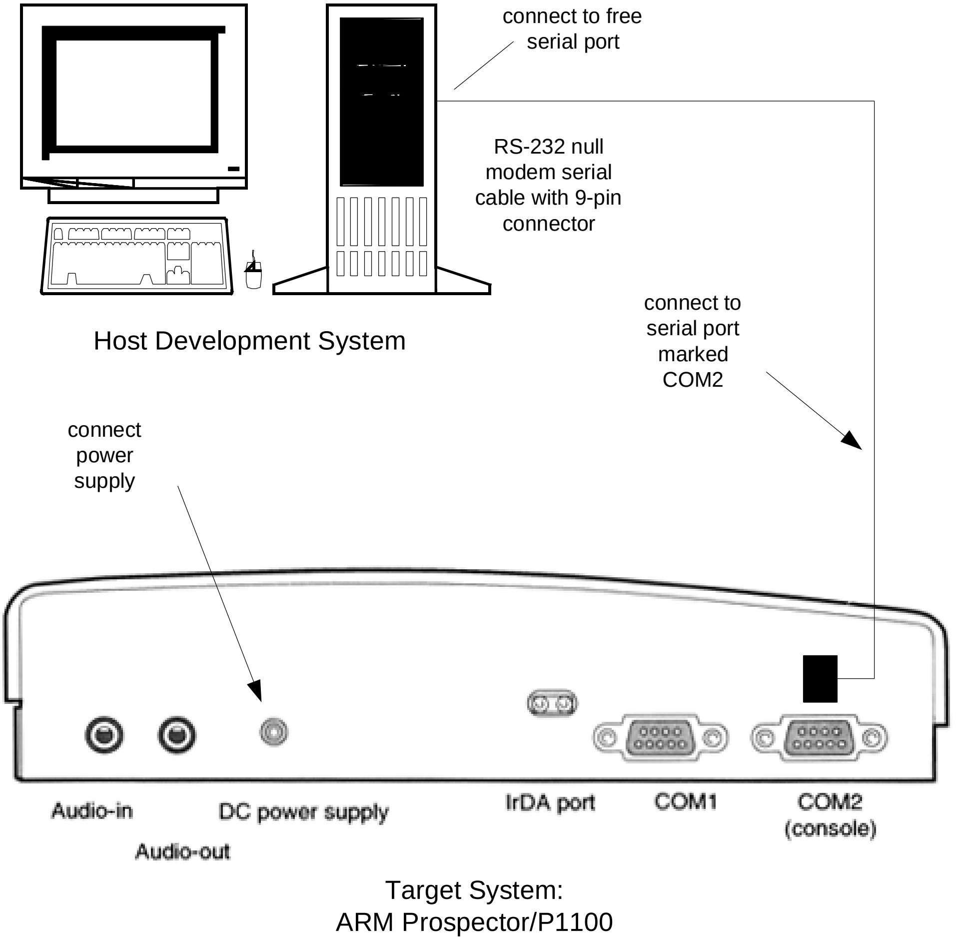
Development Environment Overview

Figure 1-1 shows a typical development environment for the ARM Prospector/P1100 evaluation board. The components shown include the minimum required to enable OS-9 to run on the Prospector.

Figure 1-1 Figure 1-1 ARM Prospector/P1100 Development Environment



Requirements and Compatibility

Note

Before you begin, install the ***Enhanced OS-9 for ARM*** CD-ROM on your host PC.

Host Hardware Requirements (PC Compatible)

Your host PC should have the following hardware:

- A CD-ROM drive
- A minimum of 150MB of free hard disk space (an additional 150MB of free hard disk space is required to install PersonalJava Solution for OS-9)
- At least 16MB of RAM
- One available RS-232 serial port, two ports if SLIP is to be used.

Host Software Requirements (PC Compatible)

Your host PC should have the following software installed:

- Enhanced OS-9 for ARM
- Windows 95/98/ME or Windows NT 4.0/2000 operating system
- A terminal emulation program. (For example, Hyperterminal, which comes with Windows)

Target Hardware Requirements

Your reference board requires the following hardware:

- Enclosure with power supply
- A RS-232 null modem serial cable

Java Hardware Requirements

Your reference board must have the following to run PersonalJava Solution for OS-9:

- 16MB of RAM
- 4MB of FLASH (Boot)
- LCD Display

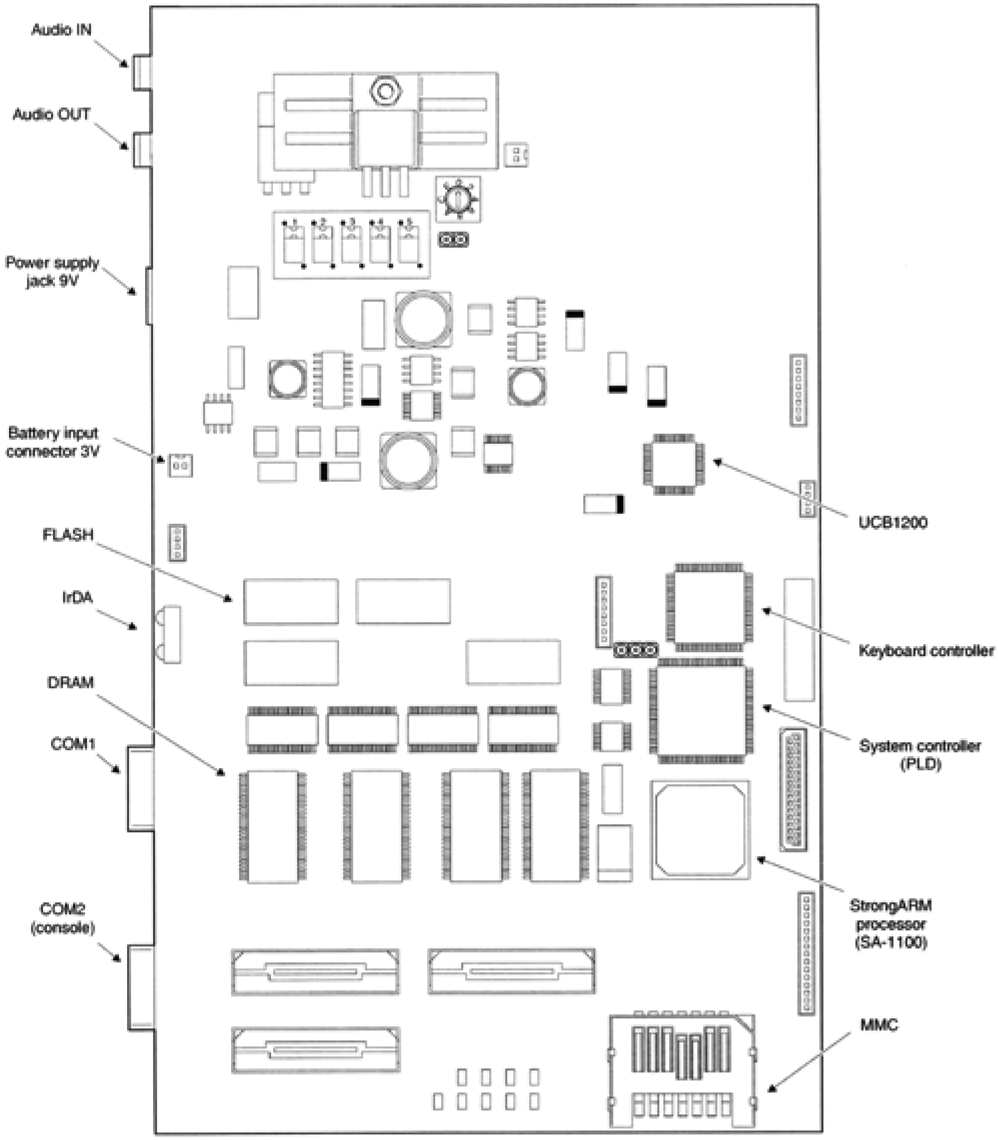
For More Information

The ARM ***Prospector/P1100 User Guide*** is provided by ARM Limited. You can download a copy of this document from `www.arm.com`.

Target Hardware Setup

Figure 1-2 provides an outline of the ARM Prospector/P1100 development board.

Figure 1-2 ARM Prospector Development Board



Configure Board Switch Settings

There is one switch setting to change for the Prospector/P1100 to run OS-9. It is DIL switch SW5, shown in **Figure 1-3**. **Figure 1-3** shows the DIL switch settings in their default positions. Leave the switches in their default positions until after you have burned the OS-9 ROM Image into Flash memory. After the OS-9 ROM image is in the Prospector's Flash, change the SW5 switch to the High position, as shown in **Figure 1-4**.

Figure 1-3 Default Switch Settings

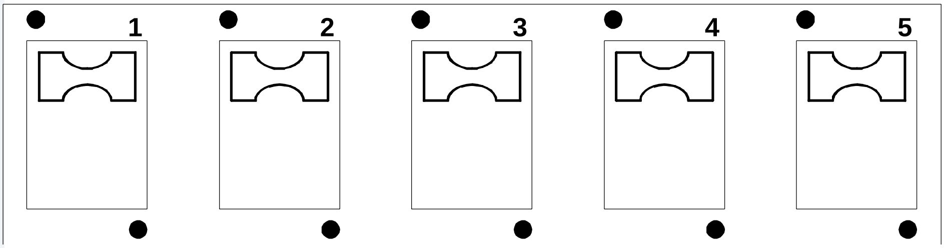
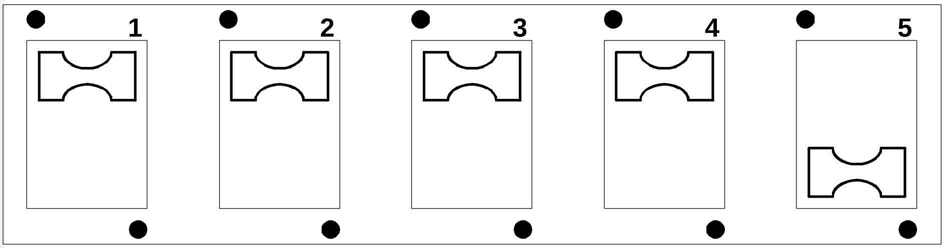


Figure 1-4 SW5 Switch Setting After Installing OS-9 ROM Image



Creating the OS-9 ROM image and burning it into the Prospector's Flash memory is described in the following sections of this manual.

Note

For detailed information about setting switches, refer to the ARM ***Prospector/P1100 User Guide*** supplied by ARM Limited. This manual can be downloaded from www.arm.com.

Connecting the Target to the Host

Step 1. Connect the target system to the host system using an RS-232 null modem serial cable with 9-pin connectors. For a description see **Figure 1-1**.

Step 2. On the Windows desktop, click on the `Start` button and select `Programs -> Accessories -> Hyperterminal`.

Step 3. Open Hyperterminal and enter a name for your session.

Step 4. Select an icon for the new Hyperterminal session. A new icon is created with the name of your session associated with it. The settings you choose for this session can be saved for future use. Click `OK`.

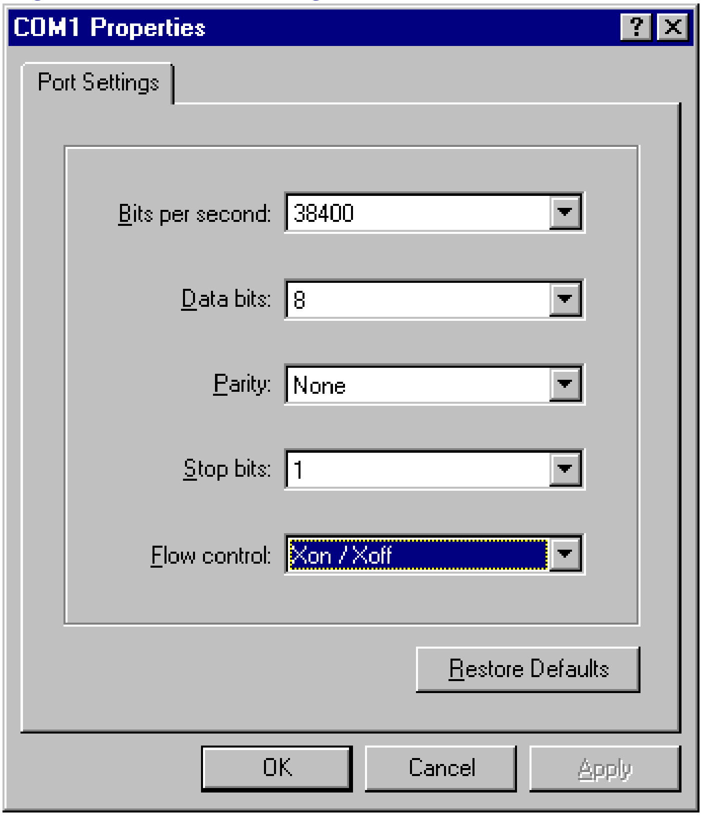
Step 5. In the **Phone Number** dialog, go to the **Connect Using** box, and select the communications port to be used to connect to the reference board.

The port you select must be the same port that you inserted the actual cable into. Click `OK`.

Step 6. In the **Port Settings** tab, enter the following settings (as shown in **Figure 1-5**).

```
Bits per second = 38400

Data Bits = 8

Parity = None

Stop bits = 1

Flow control = XON/XOFF
```

Figure 1-5 Port Settings



Step 7. Click OK. A connection should be established.

Note

If the word *connected* does not appear in the lower left corner of the window, select `Call -> Connect` to establish a connection.

Step 8. Apply power to the board. The ARM `boot Monitor >` prompt is displayed in the Hyperterminal window as well as on the target's LCD screen.

At this point your target system is running and a serial connection is established. Proceed through the following sections to create and load an OS-9 ROM image to the target system.

Building the OS-9 ROM Image

Overview

The OS-9 ROM Image is a set of files and modules that collectively make up the OS-9 operating system. The specific ROM Image contents can vary from system to system depending on hardware capabilities and user requirements.

To simplify the process of loading and testing OS-9, the ROM Image is generally divided into two parts—the low-level image, called `coreboot`; and the high-level image, called `bootfile`.

Coreboot

The coreboot image is generally responsible for initializing hardware devices and locating the high-level (or bootfile) image as specified by its configuration—for example from a FLASH part, a harddisk, or Ethernet. It is also responsible for building basic structures based on the image it finds and passing control to the kernel to bring up the OS-9 system.

Bootfile

The bootfile image contains the kernel and other high-level modules (initialization module, file managers, drivers, descriptors, applications). The image is loaded into memory based on the device you select from the boot menu. The bootfile image normally brings up an OS-9 shell prompt, but can be configured to automatically start an application.

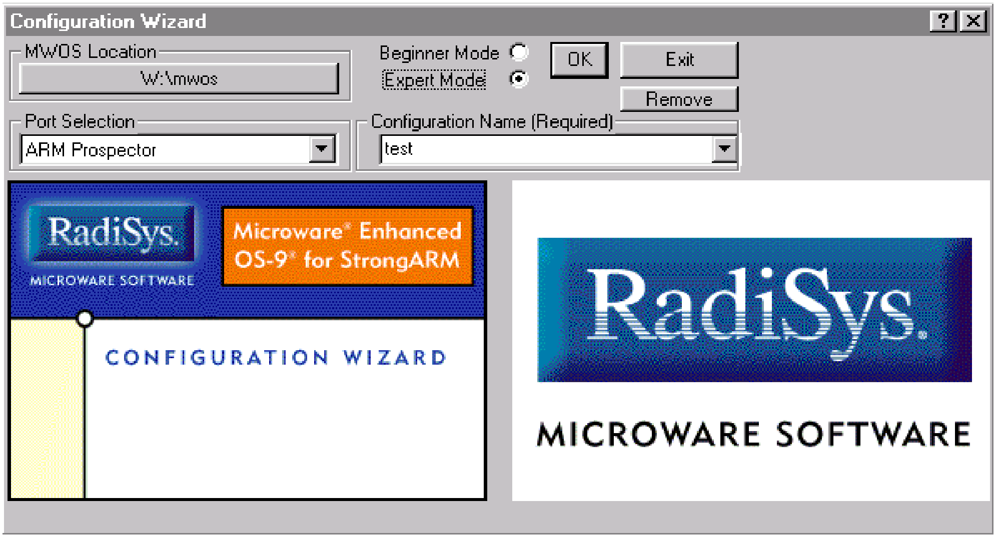
Microware provides a Configuration Wizard to create a coreboot image, a bootfile image, or an entire OS-9 ROM Image. The wizard can also be used to modify an existing image. The Configuration Wizard is automatically installed on your host PC during the Enhanced OS-9 installation process.

Using the Configuration Wizard

To use the Configuration Wizard, perform the following steps:

Step 1. From the Windows desktop, select `Start -> Programs -> RadiSys -> Enhanced OS-9 for ARM <ver> -> Configuration Wizard`. You should see the following opening screen:

Figure 1-6 StrongARM Configuration Wizard



Step 2. Select the path where the MWOS directory structure can be located by clicking the **MWOS location** button.

Step 3. Select the target board from the **Port Selection** pull-down menu.

Step 4. Select a name for your configuration in the **Configuration Name** field. Your settings will be saved for future use. This enables you to modify the ROM image incrementally, without having to reselect every option for each change.

Step 5. Select `Expert Mode` and click `OK`. The Main Configuration window is displayed. Expert mode enables you to make more detailed and specific choices about what modules are included in your ROM image.

Creating the ROM Image

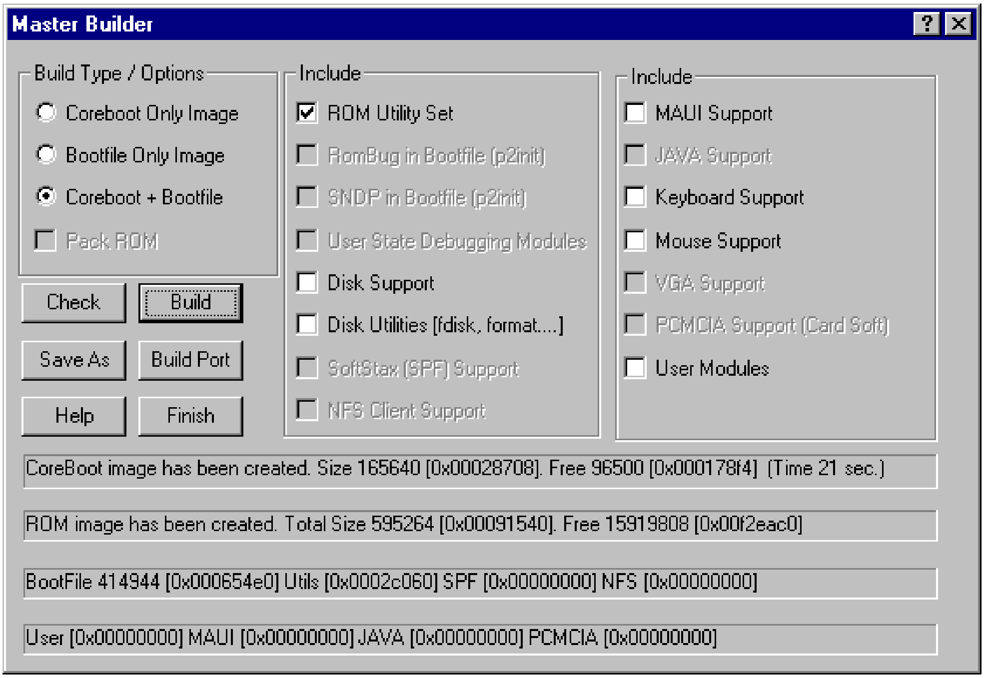
The ROM Image consists of the coreboot image (low-level system files) and the bootfile image (high-level system files). Together these files comprise the OS-9 operating system. The Configuration Wizard enables you to choose the contents of your OS-9 implementation. It also enables you to create individual coreboot and bootfile images, or combine them into a single file—called the ROM Image.

Creating the Bootfile Image

The default settings in the Configuration Wizard have been preset for optimum performance for the Prospector/P1100 evaluation board. To build the OS-9 ROM image, complete the following steps:

Step 1. Select `Configure -> Build Image`. The **Master Builder** dialog window appears, as shown in **Figure 1-7**.

Figure 1-7 Master Builder Dialog Window



Step 2. Configure your Master Builder options as shown in **Figure 1-7**.

Step 3. Click the Build button.

A file called `rom.S` is created in the following directory:

`MWOS\OS9000\ARMV4\PORTS\PROSPECTOR\BOOTS\INSTALL\PORTBOOT\`

This file, which represents the operating system for your target board, will be transferred to the target's Flash memory.

Note

You can modify the standard OS-9 ROM image by using the configuration wizard's Configuration Menu, or the buttons on the Configuration Toolbar. Some possible modifications are described in the **Optional Procedures** section.

Step 4. Click the Finish button.

Note

Clicking `Save As` after the build operation is optional; it enables you to rename and save the ROM image to a location of your choice.

Transferring the ROM Image to the Target

The following procedures describe transferring the OS-9 ROM image from the host system to the target system.

Note

An optional first step is to reset the baud rate on both the host and target systems. At the target's boot Monitor> prompt, type b <desired baud rate>. For example b 57600 sets the Prospector's baud rate to 57,600 Bits per second. Change the designated baud rate in your terminal emulation program. Make sure the two settings match. Your maximum download rate will depend on your terminal emulation program.

Step 1. Burn the image into the Prospectors application Flash.

Type l ("L") at the boot Monitor> prompt. The firmware will then delete the first entry in its application Flash and will then be ready to accept the OS-9 ROM image.

You will be prompted to type Cntr+C when your S-record (the OS-9 ROM image) is finished downloading.

Step 2. From the host system terminal emulation program, select the appropriate function to enable downloading of raw ASCII files to your connected serial port. In most emulation programs there is a menu selection called "send file".

Step 3. Navigate to the following directory in the emulation program's interface:

```
MWOS\OS9000\ARMV4\PORTS\PROSPECTOR\BOOTS\INSTALL\PORTBOOT\
```

Select the file rom.S and send it to the target.

If the Prospector is successful in getting the data, it will print out a `"."` for every block of data it processes. If there is an error, the program will print out some type of “buffer overrun” message. If this error occurs, you will likely have to reduce your baud rate at both the Prospector and terminal emulation programs. The `rom.S` file large, and takes time to burn. As long as dots (`"."`)are being written, the file is downloading.

Step 4. When the dots stop being written, type `cntl+C` and the Prospector will report back the Flash blocks it overwrote and the time it took to download.

The Prospector is now ready to boot up to an OS-9 prompt.

Note

If you changed the Baud rate at the beginning of this procedure, you must now reset the Prospector and terminal baud rate back to 38400.

Step 5. Reconfigure your board switch settings as described in the section **Configure Board Switch Settings** on page 12.

Step 6. Restart the target.

Step 7. Type the command `x` at the Prospector’s keyboard. This enables Prospector-specific commands. The prompt changes to the following:

```
[Prospector P-1100] boot Monitor >.
```

At the prompt type the following command:

```
g 0x04080000
```

This command jumps to the program point of the OS-9 image in its application Flash. Your LCD should change colors and fade as part of the Prospector's deinitialization sequence. A few seconds later, an OS-9 auto boot menu appears on the Prospector’s LCD screen and the console port.

Step 8. Allow the boot sequence to continue by itself or enter the `lr` command at your terminal window.

Optional Procedures

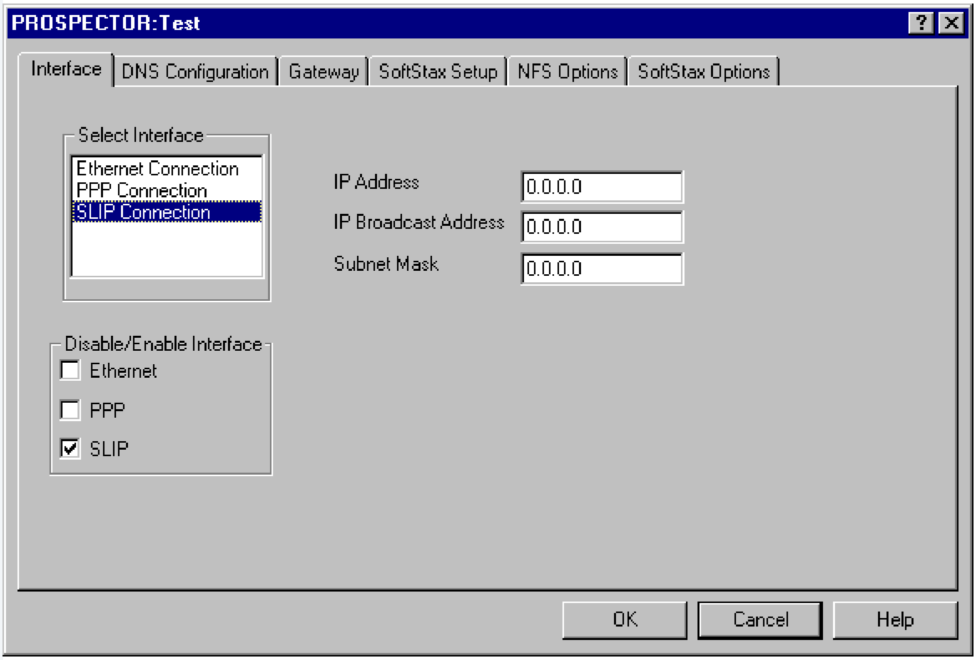
Network Configuration

One possible modification to the standard OS-9 ROM image is to enable networking if you want to establish a SLIP connection over the Prospector's serial port.

To configure your system for networking, complete the following steps:

Step 1. From the Wizard's main configuration window, select `Configure -> Bootfile -> NetWork Configuration`. The following dialog window should appear.

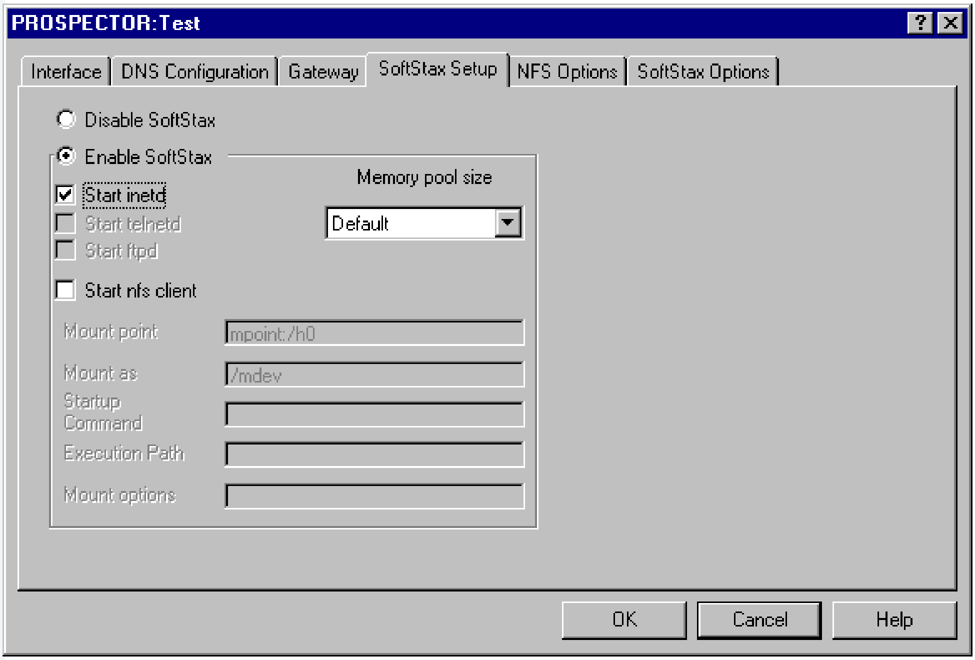
Figure 1-8 Network Configuration—Interface Tab



Step 2. Configure your system as shown in **Figure 1-8**. The **IP Address**, **IP Broadcast Address**, and **Subnet Mask** addresses must be obtained from your network administrator.

Step 3. Select the **SoftStax Setup** tab. The following dialog window should appear:

Figure 1-9 Network Configuration—SoftStax Setup Tab



Step 4. Configure your system as shown in **Figure 1-9**.

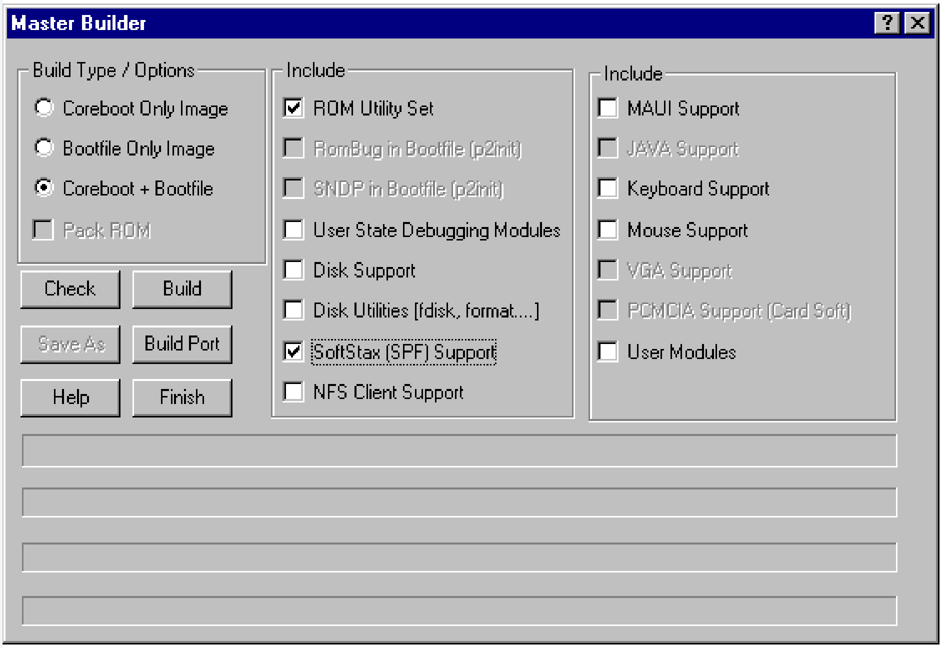
Step 5. Leave the other **Network Configuration** options at the default settings. Click `OK`.

Note

Other **Network Configuration** options can be changed in this dialog according to your specific requirements and your network.

Step 6. Select `Configure -> Build Image`. The **Master Builder** dialog window appears.

Figure 1-10 Master Builder Dialog Window



Step 7. Configure your Master Builder options as shown in **Figure 1-10**.

Step 8. Click the **Build** button.

A file called `rom.S` is created in the following directory:

`MWOS\OS9000\ARMV4\PORTS\PROSPECTOR\BOOTS\INSTALL\PORTBOOT\`

This file, which represents the operating system for your target board, will be transferred to the target's Flash memory.

Step 9. Click the **Finish** button.

Note

Clicking `Save As` after the build operation is optional; it enables you to rename and save the ROM image to a location of your choice.

Chapter 2: Board-Specific Reference

This chapter contains information that is specific to the ARM Prospector/P1100 P-Series development system. The development system includes an INTEL SA-1100 microprocessor. It includes the following sections:

- **Boot Options**
- **The Fastboot Enhancement**
- **OS-9 Vector Mappings**
- **GPIO Usage**
- **Port Specific Utilities**

For More Information

For general information on porting OS-9, see the ***OS-9 Porting Guide.***

Boot Options

Following are the default boot options for the reference board. You can select these by hitting the space bar when the Now Trying to Override Autobooters message appears on the console port when booting.

You can configure these booters by altering the `default.des` file at the following location:

```
MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/ROM
```

Booters can be configured to be either menu or auto booters. The auto booters automatically try and boot in order from each entry in the auto booter array. Menu booters from the defined menu booter array are chosen interactively from the console command line after getting the boot menu.

Booting from Flash

When the `romcnfg.h` has a ROM search list defined, the options `ro` and `lr` appear in the boot menu. If no search list is defined, N/A appears in the boot menu. If an OS-9 ROM Image is programmed into Flash, the system can boot and run from Flash.

`ro`	ROM boot—the system runs from the Flash bank.
`lr`	load to RAM—the system copies the ROM Image from Flash into RAM and runs from there.

Booting over Serial Communications Port via kermit

The system can down-load a ROM Image in binary form over its serial communication port at 57600 using the kermit protocol. The speed of this transfer depends of the size of the image. If the transfer is successful, a dot is shown for every block of data processed. The communications port is clearly marked and located on the side of the development board.

`ker`	Kermit boot—The ROM image is sent via the kermit protocol into system RAM and runs from there.

Restart Booter

The restart booter allows a way to restart the bootstrap sequence.

q	Quit—quit and attempt to restart the booting process.

Break Booter

The break booter allows entry to the system level debugger (if one exists). If the debugger is not in the system the system will reset.

`break`	Break—break and enter the system level debugger rombug.

Example Boot Session

```
OS-9 Bootstrap for the ARM (Edition 65)

Now trying to Override autobooters.

Press the spacebar for a booter menu


BOOTING PROCEDURES AVAILABLE ---------- <INPUT>

Boot embedded OS-9 in-place ----------- <bo>
Copy embedded OS-9 to RAM and boot ---- <lr>
Load bootfile v ----- <ker>
Enter system debugger ----------------- <break>
Restart the System ------------------ <q>

Select a boot method from the above menu: lr

Now searching memory ($04040000 - $04ffffff) for an OS-9000
Kernel...

An OS-9 kernel was found at $040c0000
A valid OS-9 bootfile was found.
$
```

The Fastboot Enhancement

The Fastboot enhancements to OS-9 provide faster system bootstrap performance to embedded systems. The normal bootstrap performance of OS-9 is attributable to its flexibility. OS-9 handles many different runtime configurations to which it dynamically adjusts during the bootstrap process.

The Fastboot concept consists of informing OS-9 that the defined configuration is static and valid. These assumptions eliminate the dynamic searching OS-9 normally performs during the bootstrap process and enables the system to perform a minimal amount of runtime configuration. As a result, a significant increase in bootstrap speed is achieved.

Overview

The Fastboot enhancement consists of a set of flags that control the bootstrap process. Each flag informs some portion of the bootstrap code that a particular assumption can be made and that the associated bootstrap functionality should be omitted.

The Fastboot enhancement enables control flags to be statically defined when the embedded system is initially configured as well as dynamically altered during the bootstrap process itself. For example, the bootstrap code could be configured to query dip switch settings, respond to device interrupts, or respond to the presence of specific resources which would indicate different bootstrap requirements.

In addition, the Fastboot enhancement's versatility allows for special considerations under certain circumstances. This versatility is useful in a system where all resources are known, static, and functional, but additional validation is required during bootstrap for a particular instance, such as a resource failure. The low-level bootstrap code may respond to some form of user input that would inform it that additional checking and system verification is desired.

Implementation Overview

The Fastboot configuration flags have been implemented as a set of bit fields. An entire 32-bit field has been dedicated for bootstrap configuration. This four-byte field is contained within the set of data structures shared by the ModRom sub-components and the kernel. Hence, the field is available for modification and inspection by the entire set of system modules (high-level and low-level). Currently, there are six bit flags defined with eight bits reserved for user-definable bootstrap functionality. The reserved user-definable bits are the high-order eight bits (31-24). This leaves bits available for future enhancements. The currently defined bits and their associated bootstrap functionality are listed below:

B_QUICKVAL

The `B_QUICKVAL` bit indicates that only the module headers of modules in ROM are to be validated during the memory module search phase. This causes the CRC check on modules to be omitted. This option is a potential time saver, due to the complexity and expense of CRC generation. If a system has many modules in ROM, where access time is typically longer than RAM, omitting the CRC check on the modules will drastically decrease the bootstrap time. It is rare that corruption of data will ever occur in ROM. Therefore, omitting CRC checking is usually a safe option.

B_OKRAM

The `B_OKRAM` bit informs both the low-level and high-level systems that they should accept their respective RAM definitions without verification. Normally, the system probes memory during bootstrap based on the defined RAM parameters. This allows system designers to specify a possible RAM range, which the system validates upon startup. Thus, the system can accommodate varying amounts of RAM. In an embedded system where the RAM limits are usually statically defined and presumed to be functional, however, there is no need to validate the defined RAM list. Bootstrap time is saved by assuming that the RAM definition is accurate.

B_OKROM

The B_OKROM bit causes acceptance of the ROM definition without probing for ROM. This configuration option behaves like the B_OKRAM option, except that it applies to the acceptance of the ROM definition.

B_1STINIT

The B_1STINIT bit causes acceptance of the first init module found during cold-start. By default, the kernel searches the entire ROM list passed up by the ModRom for init modules before it accepts and uses the init module with the highest revision number. In a statically defined system, time is saved by using this option to omit the extended init module search.

B_NOIRQMASK

The B_NOIRQMASK bit informs the entire bootstrap system that it should not mask interrupts for the duration of the bootstrap process. Normally, the ModRom code and the kernel cold-start mask interrupts for the duration of the system startup. However, some systems that have a well defined interrupt system (i.e. completely calmed by the sysinit hardware initialization code) and also have a requirement to respond to an installed interrupt handler during system startup can enable this option to prevent the ModRom and the kernel cold-start from disabling interrupts. This is particularly useful in power-sensitive systems that need to respond to “power-failure” oriented interrupts.

Note

Some portions of the system may still mask interrupts for short periods during the execution of critical sections.

B_NOPARITY

If the RAM probing operation has not been omitted, the `B_NOPARITY` bit causes the system to not perform parity initialization of the RAM. Parity initialization occurs during the RAM probe phase. The `B_NOPARITY` option is useful for systems that either require no parity initialization at all or systems that only require it for “power-on” reset conditions. Systems that only require parity initialization for initial “power-on” reset conditions can dynamically use this option to prevent parity initialization for subsequent “non-power-on” reset conditions.

Implementation Details

This section describes the compile-time and runtime methods by which the bootstrap speed of the system can be controlled.

Compile-time Configuration

The compile-time configuration of the bootstrap is provided by a pre-defined macro (`BOOT_CONFIG`), which is used to set the initial bit-field values of the bootstrap flags. You can redefine the macro for recompilation to create a new bootstrap configuration. The new over-riding value of the macro should be established by redefining the macro in the `rom_config.h` header file or as a macro definition parameter in the compilation command.

The `rom_config.h` header file is one of the main files used to configure the ModRom system. It contains many of the specific configuration details of the low-level system. Below is an example of how you can redefine the bootstrap configuration of the system using the `BOOT_CONFIG` macro in the `rom_config.h` header file:

```
#define BOOT_CONFIG (B_OKRAM + B_OKROM + B_QUICKVAL)
```

Below is an alternate example showing the default definition as a compile switch in the compilation command in the makefile:

```
SPEC_COPTS = -dNEWINFO –dNOPARITYINIT –dBOOT_CONFIG=0x7
```

This redefinition of the `BOOT_CONFIG` macro results in a bootstrap method that accepts the RAM and ROM definitions without verification, and also validates modules solely on the correctness of their module headers.

Runtime Configuration

The default bootstrap configuration can be overridden at runtime by changing the `rinf->os->boot_config` variable from either a low-level P2 module or from the `sysinit2()` function of the `sysinit.c` file. The runtime code can query jumper or other hardware settings to determine what user-defined bootstrap procedure should be used. An example P2 module is shown below.

Note

If the override is performed in the `sysinit2()` function, the effect is not realized until after the low-level system memory searches have been performed. This means that any runtime override of the default settings pertaining to the memory search must be done from the code in the P2 module code.

```
#define NEWINFO
#include <rom.h>
#include <types.h>
#include <const.h>
#include <errno.h>
#include <romerrno.h>
#include <p2lib.h>

error_code p2start(Rominfo rinf, u_char *glbls)
{
    /* if switch or jumper setting is set… */
    if (switch_or_jumper == SET) {
        /* force checking of ROM and RAM lists */
        rinf->os->boot_config &= ~(B_OKROM+B_OKRAM);
    }
    return SUCCESS;
}
```

OS-9 Vector Mappings

This section contains the vector mappings for the OS-9 Prospector/P1100 implementation of the SA1100.

The ARM standard defines exceptions 0x0-0x8. The OS-9 system maps these 1-1. External interrupts from vector 0x6 are expanded to the virtual vector range shown below by the `irq1100` module.

Note

Vectors can be virtually remapped from a ROM at physical address 0 and into DRAM at virtual address 0. This speeds interrupt response time and is enabled by defining the first cache list entry as a sub 1 Meg size.

Table 2-1 and **Table 2-2** show the OS-9 IRQ assignments for the target board.

Table 2-1 IRQ Assignments and ARM Functions

OS-9 IRQ #	ARM Function
0x0	Processor Reset
0x1	Undefined Instruction
0x2	Software Interrupt
0x3	Abort on Instruction Prefetch
0x4	Abort on Data Access
0x5	Unassigned/Reserved

Table 2-1 IRQ Assignments and ARM Functions (continued)

OS-9 IRQ #	ARM Function
0x6	External Interrupt
0x7	Fast Interrupt
0x8	Alignment error

Table 2-2 IRQ Assignments and Processor-Specific Functions

OS-9 IRQ #	SA11X0 Specific Function (pic)
0x40	GPIO[0] Edge Detect (IRQ Input from the board’s PIC.)
0x41	GPIO[1] Edge Detect
0x42	GPIO[2] Edge Detect
0x43	GPIO[3] Edge Detect
0x44	GPIO[4] Edge Detect
0x45	GPIO[5] Edge Detect
0x46	GPIO[6] Edge Detect
0x47	GPIO[7] Edge Detect
0x48	GPIO[8] Edge Detect
0x49	GPIO[9] Edge Detect
0x4a	GPIO[10] Edge Detect

Table 2-2 IRQ Assignments and Processor-Specific Functions (continued)

OS-9 IRQ #	SA11X0 Specific Function (pic)
0x4b	OR of GPIO edge detects 27 - 11
0x4c	LCD controller service request
0x4d	UDC service request (0)
0x4e	SDLC service request (1a)
0x4f	UART service request (1b) (SP1)
0x50	UART/HSSP service request (2)
0x51	UART service request (3) (SP3)
0x52	MCP service request (4a)
0x53	SSP service request (4b)
0x54	DMA controller channel 0
0x55	DMA controller channel 1
0x56	DMA controller channel 2
0x57	DMA controller channel 3
0x58	DMA controller channel 4
0x59	DMA controller channel 5
0x5a	OS timer 0
0x5b	OS timer 1

Table 2-2 IRQ Assignments and Processor-Specific Functions (continued)

OS-9 IRQ #	SA11X0 Specific Function (pic)
0x5c	OS timer 2
0x5d	OS timer 3
0x5e	One Hz clock tick
0x5f	RTC als alarm register
0x60	GPIO[11] Edge Detect (the vector 0x4b OR is broken out here to make each one distinct)
0x61	GPIO[12] Edge Detect
0x62	GPIO[13] Edge Detect
0x63	GPIO[14] Edge Detect
0x64	GPIO[15] Edge Detect
0x65	GPIO[16] Edge Detect
0x66	GPIO[17] Edge Detect
0x67	GPIO[18] Edge Detect
0x68	GPIO[19] Edge Detect
0x69	GPIO[20] Edge Detect
0x6a	GPIO[21] Edge Detect
0x6b	GPIO[22] Edge Detect
0x6c	GPIO[23] Edge Detect

Table 2-2 IRQ Assignments and Processor-Specific Functions (continued)

OS-9 IRQ #	SA11X0 Specific Function (pic)
0x6d	GPIO[24] Edge Detect
0x6e	GPIO[25] Edge Detect
0x6f	GPIO[26] Edge Detect
0x70	GPIO[27] Edge Detect

Table 2-3 shows the target board PIC functions.

Table 2-3 PIC Functions

OS-9 IRQ #	Function (Board Pic)
0xb1	RESERVED
0xb2	RESERVED
0xb3	RESERVED
0xb4	RESERVED
0xb5	IRQ CAN1
0xb6	RESERVED
0xb7	PCMCIA slot 0 Ready/IRQ
0xb8	RESERVED
0xb9	UCB 1200
0xba	SMC 91C94 Ethernet

Table 2-3 PIC Functions (continued)

OS-9 IRQ #	Function (Board Pic)
0xbb	RESERVED
0xbc	PCMCIA Card A detect
0xbd	RESERVED
0xbe	Board Switch
0xbf	IRQ SSP
0xc0	IRQ BAT FAULT

Note

Fast Interrupt Vector (0x7)

The ARM4 defined fast interrupt (FIQ) mapped to vector 0x7 is handled differently by the OS-9 interrupt code and can not be used as freely as the external interrupt mapped to vector 0x6. To make fast interrupts as quick as possible for extremely time critical code, no context information is saved on exception and FIQs are never masked. This requires any exception handler to save and restore its necessary context if the FIQ mechanism is to be used. This requirement means that a FIQ handler's entry and exit points must be in assembly, as the C compiler will make assumptions about context. In addition, no system calls are possible unless a full C ABI context save has been done first. The OS-9 IRQ code for the SA11X0 has assigned all interrupts as normal external interrupts and the user must re-define a source as an FIQ to make use of this feature.

GPIO Usage

Table 2-4 shows GPIO usage of the target board in an OS-9 system.

For More Information

See the ***Intel StrongARM SA-1100 Microprocessor Developer's Manual*** for available alternate pin functions.

Table 2-4 GPIO Usage of the Board

GPIO	Signal Name	Direct	Description
GPIO0	`/IRQ`	Input	Falling edge interrupt from external peripheral
GPIO1	`SWITCH`	Input	External signal to wake processor up during sleep mode.
GPIO2	`GREEN3`	Output	LCD Green bit 3 in 16 bit color mode=20
GPIO3	`GREEN4`	Output	LCD Green bit 4 in 16 bit color mode
GPIO4	`GREEN5`	Output	LCD Green bit 5 in 16 bit color mode
GPIO5	`RED0`	Output	LCD Red bit 0 in 16 bit color mode

Table 2-4 GPIO Usage of the Board (continued)

GPIO	Signal Name	Direct	Description
GPIO6	RED1	Output	LCD Red bit 1 in 16 bit color mode
GPIO7	RED2	Output	LCD Red bit 2 in 16 bit color mode
GPIO8	RED3	Output	LCD Red bit 3 in 16 bit color mode
GPIO9	RED4	Output	LCD Red bit 4 in 16 bit color mode
GPIO10	SSP_TXD	Output	SSP Port transmit
GPIO11	SSP_RXD	Input	SSP Port Receive
GPIO12	SSP_SCLK	Output	SSP Port Clock
GPIO13	SSP_SFRM	Output	SSP Port Frame
GPIO14	CTS1	Input	CTS SA1100 uart 1 (not needed)
GPIO15	RTS1	Output	RTS SA1100 uart 1 (not needed)
GPIO16	CTS2	Input	CTS SA1100 uart 2 (not needed)
GPIO17	RTS2	Output	RTS SA1100 uart 2 (not needed)
GPIO18	CTS3	Input	CTS SA1100 uart 3 (not needed)

Table 2-4 GPIO Usage of the Board (continued)

GPIO	Signal Name	Direct	Description
GPIO19	RTS3	Output	RTS SA11X0 uart 3 (not needed)
GPIO20	LED0	Output	SMD LED D3 on board
GPIO21	LED1	Output	SMD LED D2 on board
GPIO22	LED2	Output	SMD LED D1 on board
GPIO23	IRDA ON	Output	0 IRDA On, 1 IRDA Off
GPIO24	LED4/PNL_ENA	In/Out	External GPIO on J7, P38, Panel Enable
GPIO25	LED5	In/Out	External GPIO on J7, P36
GPIO26	LED6	In/Out	External GPIO on J7, P34
GPIO27	LED7	In/Out	External GPIO on J7, P32

GPIO Interrupt Polarity

When GPIOs are used as interrupt sources, the `_PIC_ENABLE()` function will set default polarity to rising edge (GRER) along with enabling the interrupt at the SA11X0 PIC. If falling edge is required, software must assert the appropriate bit in the GFER and negate the corresponding bit in the GRER.

Port Specific Utilities

The following port specific utility is included:

- `pflash`
- `ucbtouch`

pflash

Program Strata Flash

Syntax

```
pflash [options]
```

Options

`-f[=]filename`	input filename
`-eu`	erase used space only (default)
`-ew`	erase whole flash
`-ne`	don't erase flash
`-r`	program resident flash (default)
`-p0`	program PCMCIA slot 0
`-p1`	program PCMCIA slot 1
`-ncis`	don't emit cis for PCMCIA flash cards
`-b[=]addr`	specify base address of flash (hex) for part identification (replaces -r,-p0,-p1)
`-s[=]addr`	specify write/erase address of flash(hex) defaults to base address)
`-u`	leave flash unlocked
`-i`	print out information on flash
`-nv`	don't verify erase or write
`-q`	no progress indicator

Description

The pflash utility allows the programming of Intel Strata Flash parts. The primary use will be in the burning of the OS-9 ROM image into the on-board flash parts at U25/U26. This allows for booting using the lr/bo booters and allows for booting with out a PCMCIA card. The `pflash` utility also can be used to burn OS-9 ROM images into Intel Value Series PCMCIA cards, which internally use StrataFlash parts. This allows for booting using a PCMCIA slot and the f0 booter.

ucbtouch

Print Raw Values at Set Sample Rate

Syntax

```
ucbtouch <>
```

Description

The `ucbtouch` utility prints the raw x,y and pressure values at a set sample rate.

Press the touch screen and observe the output on your console. The utility is helpful in determining whether your touch screen is connected properly.

Example

```
$ ucbtouch
Touch[00000]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=329 Y=322
Touch[00001]: Touch=0x30c3 X1=00329 Y1=00325 P= 28 X=330 Y=326
Touch[00002]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00003]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00004]: Touch=0x30c3 X1=00329 Y1=00319 P= 29 X=330 Y=320
Touch[00005]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00006]: Touch=0x30c3 X1=00329 Y1=00327 P= 28 X=330 Y=328
Touch[00007]: Touch=0x30c3 X1=00329 Y1=00321 P= 28 X=330 Y=322
Touch[00008]: Touch=0x30c3 X1=00329 Y1=00321 P= 29 X=330 Y=322
Touch[00009]: Touch=0x30c3 X1=00329 Y1=00322 P= 28 X=330 Y=323
Touch[00010]: Touch=0x30c3 X1=00329 Y1=00319 P= 28 X=0 Y=0
Touch[00011]: Touch=0x30c3 X1=00328 Y1=00321 P= 28 X=-1 Y=2
Touch[00012]: Touch=0x30c3 X1=00329 Y1=00315 P= 28 X=0 Y=-4
Touch[00013]: Touch=0x30c3 X1=00329 Y1=00322 P= 29 X=0 Y=3
```

Appendix A: Board-Specific Modules

This chapter describes the modules specifically written for the target board. It includes the following sections:

- **Low-Level System Modules**
- **High-Level System Modules**

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Low-Level System Modules

For More Information

For a complete list of OS-9 modules common to all boards, see the ***OS-9 Device Descriptor and Configuration Module Reference*** manual.

The following low-level system modules are tailored specifically for the ARM Prospector/P1100 platform. The functionality of these modules can be altered through changes to the configuration data module (`cnfgdata`). **Table A-1** provides a list and brief description of the modules.

These modules can be found in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/ROM`

Table A-1 Board-Specific Low-Level System Modules

Module Name	Description
`cnfgdata`	Contains the low-level configuration data.
`cnfgfunc`	Provides access services to cnfgdata data.
`commcnfg`	Inits communication port defined in cnfgdata.
`conscnfg`	Inits console port defined in cnfgdata.
`io1100`	Provides polled serial driver support for the low-level system.
`portmenu`	Inits booters defined in the cnfgdata.
`romcore`	Board specific initialization code.

Table A-1 Board-Specific Low-Level System Modules (continued)

Module Name	Description
`splash`	Provides way to init LCD screen with a compressed image.
`tmr1_1100`	Provides low-level timer services via time base register.
`usedebug`	Inits low-level debug interface to RomBug, SNDP, or none.

The following low-level system modules provide generic services for OS-9 Modular ROM. **Table A-2** provides a list and brief description of the modules.

These modules can be found in the following directory:

`MWOS/OS9000/ARMV3/CMDS/BOOTOBJS/ROM`

Table A-2 Generic Services Low-Level System Modules

Module Name	Description
`bootsys`	Booter registration service module.
`console`	Provides console services.
`dbgentry`	Inits debugger entry point for system use.
`dbgserve`	Provides debugger services.
`excption`	Provides low-level exception services.
`flshcach`	Provides low-level cache management services.

Table A-2 Generic Services Low-Level System Modules (continued)

Module Name	Description
`hlproto`	Provides user level code access to protoman.
`llbootp`	Booter which provides bootp services.
`llip`	Provides low-level IP services.
`llslip`	Provides low-level SLIP services.
`lltcp`	Provides low-level TCP services.
`lludp`	Provides low-level UDP services.
`llkermit`	Booter which uses kermit protocol.
`notify`	Provides state change information for use with LL and HL drivers.
`override`	Booter which allows choice between menu and auto booters.
`parser`	Provides argument parsing services.
`pcman`	Booter which reads MS-DOS file system.
`protoman`	Protocol management module.
`restart`	Booter which cause a soft reboot of system.
`romboot`	Booter which allows booting from ROM.
`rombreak`	Booter which calls the installed debugger.
`rombug`	Low-level system debugger.

Table A-2 Generic Services Low-Level System Modules (continued)

Module Name	Description
`sndp`	Provides low-level system debug protocol.
`srecord`	Booter which accepts S-Records.
`swtimer`	Provides timer services via software loops.

High-Level System Modules

The following OS-9 system modules are tailored specifically for the ARM Prospector/P1100 board. Unless otherwise specified, each module is located in a file of the same name in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS`

CPU Support Modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/CMDS/BOOTOBJS`

`kernel`	The kernel provides all basic services for the OS-9 system.
`cache`	Provides cache control for the CPU cache hardware. The cache module is in the file `cach1100`.
`fpu`	Provides software emulation for floating point instructions.
`ssm`	The System Security Module provides support for the Memory Management Unit (MMU) on the CPU.
`vectors`	Provides interrupt service entry and exit code. The vectors module is found in the file `vect110`.

System Configuration Module

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/INITS`

`dd`	Descriptor module with high level system initialization information.
`nodisk`	Same as init, but used in a disk-less system.

Interrupt Controller Support

This module provides extensions to the vectors module by mapping the single interrupt generated by an interrupt controller into a range of pseudo vectors which are recognized by OS-9 as extensions to the base CPU exception vectors.

For More Information

The mappings are described in **Chapter 2**.

`irq1100`	P2module that provides interrupt acknowledge and dispatching support for the SA1100 pic.

Real Time Clock

`rtc1100`	Driver that provides OS-9 access to the SA1100 on-board real time clock.

Ticker

`tk1100`	Driver that provides the system ticker based on the SA11X0 Operating System Timer.

Generic IO Support modules (File Managers)

These files are located in the following directory:

`MWOS/OS9000/ARMV3/CMDS/BOOTOBJS`

`ioman`	Provides generic io support for all IO device types.
`scf`	Provides generic character device management functions.
`rbf`	Provides generic block device management functions for OS-9 specific format.
`pcf`	Provides generic block device management functions for MS-DOS FAT format.
`spf`	Provides generic protocol device management function support.
`mfm`	Provides generic graphics device support for MAUI.
`pipeman`	Provides a memory FIFO buffer for communication.

Pipe Descriptor

This file is located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/DESC`

`pipe`	Pipeman descriptor that provides a RAM based FIFO which can be used for process communication.

RAM Disk Support

This file is located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/DESC`

`ram`	RBF driver which provides a RAM based virtual block device.

Descriptors for Use with RAM

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/DESC/RAM`

`r0`	RBF descriptor which provides access to a ram disk.
`r0.dd`	Same as r0 except with module name dd (for use as the default device).

Serial and Console Devices

This file is located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/DESC`

sc1100	SCF driver which provides serial support the SA11X0's SP1 and SP3 ports when configured as UARTS.

Descriptors for Use with sc1100

`ms0`	
`term1/t1`	Descriptor modules for use with sc11X0 and SP1. Board header:J7 Default Baud Rate:19200 Default Parity:None

Default Data Bits:8

Default Handshake:Software

`term3/t3`	Descriptor modules for use with sc11X0 and SP3. Board header:J2 Default Baud Rate:115200 Default Parity:None Default Data Bits:8 Default Handshake:Software

`scllio`	SCF driver that provides serial support via the polled low-level serial driver.

Descriptors for use with scllio

`vcons/term`	Descriptor modules for use with scllio in conjunction with a low-level serial driver. Port configuration and set up follows that which is configured in cnfgdata for the console port. It is possible for scllio to communicate with a true low-level serial device driver like io1100, or with an emulated serial interface provided by iovcons.

`scur8hc007`	SCF driver that provides serial support.

Descriptors for use with scur8hc007

`k0`

`kx0`

`m0`

Network Configuration Modules

`inetdb`

`inetdb2`

`rpcdb`

`sps10`

`sps11`

ucb1200 Support Modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/SPF`

`spucb1200`	SPF driver that supports the on-board Phillips ucb1200 chip. This device communicates to the SA11X0 over SP4 using MCP. The `spucb1200` will work with UCB1100, ucb1200, and ucb1300 devices.

Descriptors for Use with spucb1200

`ucb`	SPF descriptor module that provides access to ucb1200.

Maui Graphical Support modules

These files are located in the following directory:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR/CMDS/BOOTOBJS/MAUI`

`gx_sa1100`	MFM MAUI driver module with support for the board's LCD panel.

Descriptors for Use with gx_sa1100

`gfx`	MFM MAUI descriptor module for the board's LCD.
`sd_ucb1200`	MFM MAUI driver module that provides PCM/mu-law sound support via the ucb1200.

Descriptors for Use with sd_ucb1200

`snd`	MFM MAUI descriptor module for ucb1200 sound functions.

MAUI configuration modules

`cdb`	MAUI configuration data base module.
`cdb_ptr`	Serial mouse configuration data base module.
`cdb_touch`	Touch screen configuration data base module.

MAUI protocol modules

`mp_bsptr`	Bus mouse protocol module.
`mp_kybrd`	Keyboard protocol module.
`mp_msptr`	Serial mouse protocol module.
`mp_ucb1200`	ucb1200 protocol module.
`mp_xtkbd`	XT Scan Code keyboard protocol module.

For More Information

The MAUI drivers are described in more detail in Appendix B: MAUI Driver Descriptions.

Appendix B: MAUI Driver Descriptions

This chapter provides MAUI driver descriptions. It includes the following sections:

Prospector Objects

This package provides object-level support for the ARM Prospector/P1100 reference board. The port directory is at the following location:

`MWOS/OS9000/ARMV4/PORTS/PROSPECTOR`

MAUI objects

`cdb`	Lists the devices on the system.
`mp_msptr`	Serial mouse protocol module.
`mp_ucb1200`	Touch screen protocol module for the UCB1200.
`gfx` and `gx_sa1100`	LCD graphics descriptor and driver.

GX_SA1100 LCD Graphic Driver Specification

This section describes the hardware specification of the StrongARM SA11X0 LCD driver (named `gx_sa1100`) and descriptor (named `gfx`). The hardware sub-type defines the board configuration. This specification should be used with the MAUI Graphics Device API.

Board Ports

This driver is used in the following ports.

The Prospector board uses a Sharp LQ0804V2DS01 with a 480x640, 8 or 16 bpp LCD panel.

The GraphicsClient board typically uses a Sharp LQ64D341 18 bpp color (16 used), TFT, with a resolution of 640x480 single panel. This panel is connected to the GraphicsClient with one of several possible cables:

- 8 bpp - most common to date
- RGB 565 - next most common
- RGB 655
- RGB 556

Note

ADS has shipped several other LCD panels, usually simply modifiying the device descriptor, using timing values from ADS, is sufficient to supopport these other panels.

The SideArm board can support an LCD panel, but does not typically ship with one. For this reason the SideArm port does not build this driver. If the user did connect a LCD panel to this board, simply copy the makefiles from one of the other ports into the SideArm port.

Device Capabilities

Information about the hardware capabilities is determined by calling `gfx_get_dev_cap()`. The hardware sub-type defines the board configuration. This function returns a data structure formatted as shown in **Table B-1**. See GFX_DEV_CAP for more information about this data structure.

Table B-1 gfx_get_dev_cap() Data Structure

Member Name	Description	Value
`hw_type`	Hardware type (embedded in driver)	SA1100 LCD Controller
`hw_subtype`	Hardware subtype (embedded in descriptor)	The Prospector, like the Graphicsclient, supports 8 or 16 bit color LCD
`sup_vpmix`	Supports viewport mixing	FALSE
`sup_extvid`	Supports external video as a backup	FALSE
`sup_bkcol`	Supports background color	FALSE
`sup_vptrans`	Supports viewport transparency	FALSE
`sup_vpinten`	Supports viewport intensity	FALSE
`sup_sync`	Supports retrace synchronization	FALSE

Table B-1 gfx_get_dev_cap() Data Structure (continued)

Member Name	Description	Value
`num_res`	Number of display resolutions	1
`res_info`	Array of display resolution information	See Display Resolution table
`dac_depth`	Depth of the DAC in bits	12
`num_cm`	Number of coding methods	1
`cm_info`	Array of coding method information	See Coding Methods table
`sup_viddecode`	Supports video decoding into a drawmap	FALSE

Display Resolution

The display resolution is configured by the descriptor and can be changed to support LCD panels of different sizes. The driver is only designed to support one resolution at a time. That resolution is specified by the descriptor. Modify the `DEFAULT_RES` macro in `mfm_desc.h` to change the resolution. If you change the resolution, you must also change all of the LCD timing fields as well.

Table B-2 Display Specifications

Board	Width	Height	Refresh Rate	Interlace Mode	Aspect Ratio X:Y
Prospector	640	480	0*	`GFX_INTL_OFF`	1:1
Graphics-Client	640	480	0*	`GFX_INTL_OFF`	1:1

*Refresh rate is determined by timing specified in descriptor. The devcap is not automatically update to reflect this.

Coding Methods

The coding method is also configured by the descriptor and can be changed to support b/w and color LCD panels. The coding method can be selected in the descriptor by simply specifying the coding method in the `DEFAULT_CM` macro in `mfm_desc.h`.

This driver was verified on the Prospector evaluation board with an 8-bit cable, and a GraphicsClient with both a 8-bit and 565 cables. The maximal coding method supported by SA11X0 LCD Controller is 16 bpp.

Table B-3 Coding Method Description

Board	Coding Method	CLUT Based	X,Y Multipliers	Palette Color Types
Prospector, and Graphics-Client w/8 bit cable	`GFX_CM_8BIT`	TRUE	1,1	GFX_COLOR_RGB
Prospector and Graphics-Client w/16 bit cable	`GFX_CM_565`, `GFX_CM_655`, `or` `GFX_CM_556`	FALSE	1,1	NA
No Public Hardware reference available	`GFX_CM_4BIT`	TRUE	1,1	GFX_COLOR_RGB

Viewport Complexity

The driver supports one active viewport at a time. The application can create multiple viewports and stack them. The viewport must be aligned with, and the same size as the display. Display drawmaps must be the same size as the viewport.

Memory

Applications are expected to request graphics memory from the driver. The driver allocates memory from the system as needed. It requests this memory from color 0x80. This memory (specified in the init module) is located at the bottom of 16 MB DRAM address space and is marked as non cached.

Location

This driver's source is located in:

`SRC/DPIO/MFM/DRVR/GX_SA1100`

This driver's makefiles are located in:

`OS9000/ARMV4/PORTS/PROSPECTOR/MAUI/GX_SA1100`, and

`OS9000/ARMV4/PORTS/GRAPHICSCLIENT/MAUI/GX_SA1100`

This directory contains the makefiles and descriptor header file to build the descriptor(s) and driver(s) (not all packages include driver source) for the StrongARM reference platform. This directory contains:

`makefile`	Calls each of the other makefiles in this directory
`drvr.mak`	Builds the driver
`desc.mak`	Builds the descriptor(s)
`mfm_desc.h`	Defines values for all modifiable fields of the descriptor(s)

Build the Driver

The driver source is located in `SRC/DPIO/MFM/DRVR/GX_SA1100`. To build the driver, use the following commands:

```
cd OS9000/ARMV4/PORTS/PROSPECTOR/MAUI/GX_SA1100
os9make -f drvr.mak
```

Build the Descriptor

To build a new descriptor, modify `mfm_desc.h`, and use the following commands to compile:

```
cd OS9000/ARMV4/PORTS/PROSPECTOR/MAUI/GX_SA1100
```

```
os9make -f desc.mak
```

To build both the driver and the descriptor you can specify `os9make` with no parameters.

SD_UCB1200 Sound Driver Specification

This section describes the hardware specifications for the Philips UCB1200 driver `sd_ucb1200`. The hardware sub-type defines the board configuration. This specification should be used in conjunction with the MAUI Sound Driver Interface.

This driver works in conjunction with the spucb1200 driver.

Device Capabilities

Information about the hardware capabilities is determined by calling `_os_gs_snd_devcap()`. This function returns a data structure formatted as in the following table. See `SND_DEV_CAP` for more information about this data structure.

Table B-4 Data Returned in SND_DEV_CAP

Member Name	Value	Description
`hw_type`	UCB1200	Hardware type
`hw_subtype`	UCB1200	Hardware sub-type
`sup_triggers`	`SND_TRIG_ANY`	Supported triggers
`play_lines`	`SND_LINE_SPEAKER`	Play gain/mix lines
`record_lines`	`SND_LINE_MIC`	Record gain/mix lines
`sup_gain_cmds`	`SND_GAIN_CMD_MONO`	Mask of supported gain commands
`num_gain_caps`	`2`	Number of `SND_GAIN_CAP`s

Table B-4 Data Returned in SND_DEV_CAP (continued)

Member Name	Value	Description
`gain_caps`	See Gain Capabilities Array	Pointer to `SND_GAIN_CAP` array
`num_rates`	30	Number of sample rates
`sample_rates`	See Sample Rates	Pointer to sample rate array
`num_chan_info`	1	Number of channel info entries
`channel_info`	See Number of Channels	Pointer to channel info array
`num_cm`	3	Number of coding methods
`cm_info`	See Encoding and Decoding Formats	Pointer to coding method array

Gain Capabilities Array

The following tables show the various gain capabilities for the Philips UCB1200. This information is pointed to by the gain_cap member of the SND_DEV_CAP data structure. See SND_GAIN_CAP for more information about this data structure. This driver allows control of following individual physical gain controls:

Table B-5 Individual Gain Controls

SND LINE SPEAKER	Output Attenuation
SND LINE MIC	Microphone Gain

The following tables detail the various individual gain capabilities:

Table B-6 Speaker Gain Enable

Member Name	Value	Step	HW	Level	Comments
lines	SND_LINE_SPEAKER	0-3	31	-69 dB	default_level
sup_mute	TRUE	4-7	30	-66.8 dB	
default_type	SND_GAIN_CMD_MONO	8-11	29	-64.7 dB	
default_level	SND_LEVEL_MAX	12-15	28	-62.5 dB	
zero_level	SND_LEVEL_MIN	...	...	...	
num_steps	32	112-115	3	-6.5 dB	
step_size	216	116-119	2	-4.3 dB	
mindb	-6900	120-123	1	-2.2 dB	
maxdb	0	124-127	0	0.0 dB	zero_level

Table B-7 Mic Gain Enable

Member Name	Value	Step	HW	Level	Comments
lines	SND_LINE_MIC	0-3	0	0 dB	zero_level
sup_mute	FALSE	4-7	1	0.7 dB	
default_type	SND_GAIN_CMD_MONO	...	...	...	...
default_level	SND_LEVEL_MAX	64-67	16	11.3 dB	default_level
zero_level	SND_LEVEL_MIN	...	...	...	...
num_steps	32	112-115		20.4 dB	
step_size	70	116-119	29	21.1 dB	
mindb	0	120-123	30	21.8 dB	
maxdb	2250	124-127	31	22.5 dB	

Sample Rates

Following is an abbreviated list of the supported sample rates for the UCB1200. Below is a formula to derive valid sample rates:

sample_rate = 11981000/(32 * i), where 8 < i < 128

This information is pointed to by the `sample_rates` member of the `SND_DEV_CAP` data structure.

Table B-8 Sample Rate (Hz)

2948	3941	4926	5942	6933
7966	8914	9852	10697	11700
12910	13866	14976	15600	17828
18720	19705	20800	22023	23400
24960	26743	28800	31200	34036
37440	41600	46801	53486	62401

Number of Channels

The following table shows the different supported number of channels for the Philips UCB1200. The first entry in the table is the default number of channels. This information is pointed to by the `channel_info` member of the `SND_DEV_CAP` data structure.

Table B-9 Number of Channels

Channels	Description
1	Mono

Encoding and Decoding Formats

The following table shows the supported encoding and decoding formats for the Philips UCB1200. The first entry in the table is the default format. This information is pointed to by the `cm_info` member of the `SND_DEV_CAP` data structure.

Table B-10 Encoding and Decoding Formats

Coding Method	Sample Size	Boundary Size	Description
`SND_CM_PCM_ULAW`	8	2	8 bit u-Law commanded
`SND_CM_PCM_SLINEAR` `SND_CM_LSBYTE1ST`	16	4	16 bit Linear (two's complement) little endian
`SND_CM_PCM_SLINEAR`	16	4	16 bit Linear signed (two's complement) big endian

SPUCB1200 driver for the UCB1200 Codec

This document describes the hardware specifications for the Philips UCB1200 driver. This is an SPF driver and works with the UCB1100, UCB1200, and UCB1300.

Capabilities

The UCB1200 is capable of controlling a microphone/speaker, input/output telecommunications lines, resistive style touch screen, and 16 General Purpose Input/Output lines. This driver currently can only control the touch screen, and general purpose input/output lines. The microphone/speaker can be controlled with a MAUI Sound driver called `sd_ucb1200`. No driver has been written for the telecommunications part of the UCB1200.

Descriptors

Table B-11 lists the UCB1200 descriptors.

Table B-11

Name	Function
`ucb`	UCB1200 Chip Initialization
`ucb_audio`	Not Implemented
`ucb_touch`	Touch Screen
`ucb_gpio`	Control GPIO Lines
`ucb_telecom`	Not Implemented

UCB

Opening the /ucb device will perform basic chip initialization. Normally this is not necessary, unless another driver is written to control part of the UCB1200 functions. This is the case for audio. The MAUI Sound driver `sd_ucb1200` will open /ucb to perform chip initialization. In this way, the MAUI Sound driver play audio and this driver can control the touch screen at the same time.

Audio

This portion of the driver is not implemented since the MAUI Sound driver `sd_ucb1200` already exists. `sd_ucb1200` and this driver can co-exist.

Touch Screen

This portion of the driver controls the touch screen operation. When pressure is applied to the touch screen, a hardware interrupt is raised, and this driver's interrupt service routine will execute. A system state alarm, then, will fire at regular intervals to sample data from the touch screen. When pressure is removed, the alarm stops. This mechanism leaves the UCB1200 in a low power state until the user presses the touch screen. The alarm rate can be controlled in the `ucb_touch` descriptor.

Each sample contains an x, y coordinate as well as pressure information. The data is formatted into a six byte packet as defined in the table below. Each packet contains 10 bits of x, 10 bits of y, and 8 bits of pressure information.

Table B-12 Touch Screen Descriptor Data

Byte number	Description
0	sync code - 0x80
1	header: bit 1: pendown bit 2: penup bit 3: penmove (may occur with pendown or penup)
2	bits 0..2: high 3 bits of x bits 3..6: high 4 bits of pressure bit 7: 0
3	bits 0..6: low 7 bits of x bit 7: 0
4	bits 0..2: high 3 bits of y bits 3..6: low 4 bits of pressure
5	bits 0..6: low bits of y bit 7: 0

GPIO

This section of the driver has basic GPIO line control, where lines 0..9 are connected to a 7 segment display or LED. Each line can be controlled with an `_os_write()` call. (Refer to the UCBHEX program in the TEST directory.)

Telecom

This portion of the driver is not implemented.

Supporting Modules

Before this driver can be used, the following modules must be in memory: `spf`, `sysmbuf`, `mbinstall`. `mbinstall` must also be run before use.

MP_UCB1200 MAUI Touch screen Protocol Module

This document describes the function of the `mp_ucb1200` protocol module, as well as a high level discussion of the touch screen driver and calibration application.

Overview

The protocol module converts the driver raw data into a `MAUI_MSG` structure. In this way, applications can remain somewhat ignorant of the details of the hardware since it deals with the MAUI Input layer. In this protocol module, the raw hardware data is converted into screen coordinates. In addition, some data filtering occurs to reduce the amount of erroneous data that the touch screen hardware can produce.

Data Format

The touch screen driver sends a 6 byte packet that contains `x`, y, and pressure information. The exact format of this packet is described in the spucb1200 driver.

Data Filter

This protocol module filters the data coming from the hardware in an attempt to reduce erroneous data. Two methods are implemented: data point averaging and low pressure point removal. The first method will average the last two points received from the driver. The data point will lag slightly behind the current position, then, but the average will reduce erroneous data points produced by the hardware. The second method throw out data points where the pressure below a certain threshold. It seems that extremely light touches will cause the data to become erratic, although the exact pressure threshold is hardware dependent.

Raw Mode

An application can put this protocol module in a "raw" mode where data points are not filtered, averaged, or converted to screen coordinates. That is, the data from the hardware is passed directly up to the application.

The application can put this protocol module in a "raw" mode by calling: `inp_set_sim_meth(inpdev,RAW_MODE)`. After calibration, the program will need to put the protocol module back in NATIVE mode by calling: `inp_set_sim_meth(inpdev,DEFAULT_SIM_METH)`. There is a sample touch screen Calibration Application in the `TOUCH_CAL` directory.

When the protocol module is taken out of "raw" mode, it will try to read new calibration data points from the ucb1200.dat data module. After the data is read from the module, it is no longer needed.

cdb.touch

The touch screen can be registered with MAUI by loading the `cdb.touch` module in memory before any programs using input are started. This will specify the spucb1200 as the driver, `cdb.touch` as the descriptor, and `mp_ucb1200` as the protocol module.

Compile Time Options

Table B-13 shows compile time options used to control the default calibration settings and also the screen size. These options can be specified with a value in the `mp_ucb1200` makefile to modify the defaults.

Table B-13 Compile Time Options

Name	Purpose
`SCREEN_WIDTH`	Screen Width in Pixels
`SCREEN_HEIGHT`	Screen Weight in Pixels

Table B-13 Compile Time Options

Name	Purpose
DEFAULT_CALIBRATION_X	Left Calibration Hardware Point
DEFAULT_CALIBRATION_Y	Top Calibration Hardware Point
DEFAULT_CALIBRATION_WIDTH	Width of Screen In Hardware Points
DEFAULT_CALIBRATION_HEIGHT	Height of Screen In Hardware Points
JITTER_THRESHOLD	Minimum Pixel Change Required Before Points are Reported to the Application.
NUM_PTS	This allows you to choose how many successive data points to average in order to produce less erroneous screen coordinate data to the application. The default is 2, and valid choices are 1, 2, 4, 8, 16.
MIN_PRESSURE	Any pressure point less than this value will be ignored. This is another way to reduce erroneous data. This represents the 8 bit pressure value we get from the driver. The default is 40.

Calibration Application

There is a sample calibration application located in the `$(MWOS)/SRC/MAUI/MP/MP_UCB1200/TOUCH_CAL` directory. This application, called `touch_cal`, will present a text message on the screen as well as points for the user to press. After the points are pressed, the protocol module `mp_ucb1200` will be updated with the new calibration information.

Assumptions/Dependencies

1. A Window Manager must be running before this application will operate.
2. A font module must be present to run the demo. `default.fnt` is the default module, or you can specify one on the command line.

3. `touch_cal` will open the first `CDB_TYPE_REMOTE` device in the cdb.

Command Line Options

`-f[=]<outfile>`	Specifies the filename of the calibration information module. This program will write the calibration information to this filename if it is specified. The file contains the calibration information as a data module, thus allowing the information to be stored on disk, nv RAM, flash, etc. for use the next time the hardware is rebooted.
`-c`	This option only works if `-f` is specified. This will cause the calibration program to run only if the filename specified with `-f` is not present.
`-m=<font module>`	Specifies the font module to use for displaying the text message on the screen.

Coordination with Protocol Module

The protocol module `mp_ucb1200` and the touch screen application `touch_cal` work together to provide the calibration functionality. `touch_cal` must first open the touch screen device, and then must set it into Raw Mode. After the user selects each calibration point, `touch_cal` computes the average of them. These averaged hardware points (as well as the screen resolution) are then stored in a data module called `ucb1200.dat.` When the input device is taken out of Raw Mode, the protocol module will link to `ucb1200.dat` and update itself with the new calibration information.

Compiling

The makefile for touch_cal exists in the `$(PORTS)/MAUI/MP_UCB1200/TOUCH_CAL` directory.