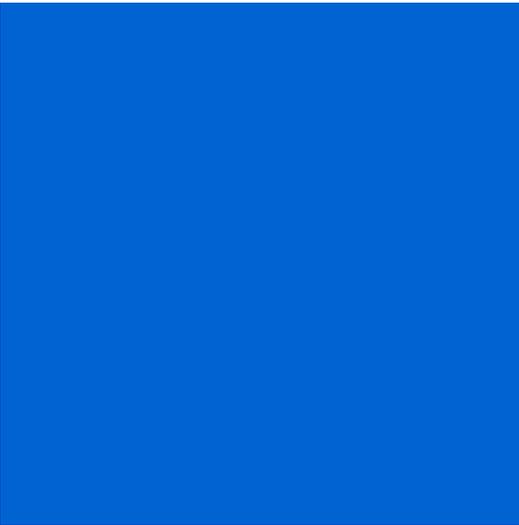


[Home](#)

# MAUI<sup>®</sup> Porting Guide

## Version 3.2



**RadiSys.**  
THE POWER OF WE

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# Chapter 1: Configuration Description Block

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The Configuration Description Block (CDB) contains specific information about your system configuration. This chapter explains what the CDB is, where the files are located, and how to modify, build, and test your CDB.



## Overview of the CDB

---

The Configuration Description Block (CDB) is one or more data modules that describe each device in your system. Applications read the CDB and adjust how they operate at run-time according to what devices are present and what capabilities each device has.

The CDB is central to the concept of application portability. Applications search the CDB data modules via the MAUI® CDB API. This API searches memory for all modules of type  $(5 \ll 8) + 1$ .

Each device in your system is represented by an entry in CDB. The entries are known as Device Description Records (DDR). DDRs begin with `dc.b` followed by a text string enclosed in quotes. When you customize the `cdb.a` file, you simply modify the `dc.b` lines, adding or subtracting lines as needed.

All DDRs do not have to be in the same CDB data module. CDB data modules may be linked and unlinked from memory as new devices, drivers, and descriptors are added and deleted from the system.

Each `dc.b` line is constructed in the same way:

```
dc.b "dev_type:device_name:parameters:",13
```

Each line begins with `dc.b`, then is followed by the DDR (a string that describes the device). The `,13` serves as the line terminator for each DDR. Following is a simple example of a CDB from an imaginary system that describes eleven devices:

```
psect cdb, (5<<8)+1, $8000, 200, 0, entry
org 0
entry:
dc.b      "0:sys:CP=\"PPC603\":OS=\"OS9000\":RV=\"2.0\":
          DV=\"2.1\":SR#12288,1:GR#512,128:",13
dc.b      "3:/gfx:AI=\"MAUI\":GR#2048,128:",13
dc.b      "4:/nvr:",13
dc.b      "5:/kx0/mp_xtkbd:",13
dc.b      "5:/m0/mp_bsptr:",13
dc.b      "9:/pipe:",13
dc.b      "20:/term:",13
dc.b      "20:/t1:",13
dc.b      "90:/mv:",13
dc.b      "91:/ma:",13
dc.b      "113:/sp0/lapb/x25:",13
```

```
dc.b "114:/r0:HD:",13
dc.b "1000:/win:",13
dc.b 0
ends
```

The following rules apply to DDR syntax and parameters:

- Each device in your system is represented by an entry. Each entry is a single line beginning with `dc.b` followed by the DDR inside quotation marks.
- DDR entries are delimited by a colon (:). Separate parameters in each entry are also delimited by colons.
- Parameters that contain quotes (string parameters) must include a back slash (\) preceding each quotation mark such as in the CP definition "PPC603" in the example below:

```
dc.b "0:sys:CP=\"PPC603\" :",13
```

- Each entry ends with the characters `,13` to denote an end of record.
- Though it is possible to have several devices of the same type in the system, each device must have a unique name. Names must be less than 80 characters long.
- If the parameter is numeric, it consists of a two character mnemonic part, pound sign (#), and the numeric part. The numeric part consists of one or more decimal values separated by commas. For example, a `GR#512,128` in the system device DDR (device 0) means that the system has a 512K bank of graphics accessible memory as color 128 (0x80). Optionally, this is followed by a comma character and another numeric parameter. The value comprises a variable length string of characters in the range 0x30 through 0x39.
- If the parameter is a string, it consists of a two character mnemonic part, an equal sign (=), and a string. `OS="OS9000"` indicates that the operating system is OS-9000. Within CDB source files strings are enclosed in quotation marks. Quotation marks in parameters are preceded by a back slash (\) to differentiate them from the closing quotation marks that follow each DDR entry.

- If the parameter is boolean (yes/no type), it is represented by two characters that indicate the particular system capability. For example, HD in the data channel DDR (device 114) stands for *hardware direct*. If the parameter is present, it indicates yes, there is a hardware direct connection. If the parameter is absent it indicates no, there is no hardware direct connection.

## Device Types, Device Names, Device Parameters

The ***Maui Programming Reference*** manual lists all the valid device types, device names, and device parameters. Use these descriptions as your reference for device description records when you build or modify a CDB. Device DDRs may appear in any order in the CDB, and parameters within a DDR may appear in any order. If a device type and name in a DDR does not include a specific parameter, the default values are assumed. If the device type and name has no default value listed for a parameter, you must supply the parameter value.

### Device Types and Names

Device types are a numeric assignment, for example, Device 3 is always a graphics device. A CDB may list more than one device of a given type, but each device must have a unique name. Names are arbitrary, but must be less than 80 characters long.

The System Description, device 0, is the only required DDR. It should appear at least once in one of the CDB data modules on the system. The format of the device name of the System Description is:

```
0:sys:parameters:
```

As this is not a physical device, the name is not preceded with a slash. On all other DDR entries, the device names are preceded with a slash as in the following example:

3 : /name:parameters:

When a device requires a protocol module, the name also includes the name of the protocol module directly following the name and preceded with a slash. An example of a device requiring a protocol module is a PS/2 mouse. The DDR entry for a mouse is similar to the following:

5 : /m0/mp\_bsptr:TY="ptr" :

## Example of the Source File

---

- cdb.a

```
psect cdb, (5<<8)+1, $8000, 200, 0, entry

org 0

entry:

dc.b "0:sys:CP=\"PPC603\":OS=\"OS9000\":RV=\"2.0\":DV=\"2.1\":SR#12288,1:\", 13
dc.b "2:/snd:", 13
dc.b "3:/gfx:AI=\"MAUI\":GR#2048,128:", 13
dc.b "5:/kx0/mp_xtkbd:TY=\"key\":", 13
dc.b "5:/m0/mp_bsptr:TY=\"ptr\":", 13
dc.b "9:/pipe:", 13
dc.b "20:/term:", 13
dc.b "20:/t1:", 13
dc.b "1000:/win:", 13
dc.b 0

ends
```

## Example of the Makefile

---

- makefile

```
# Makefile
*****
#* This makefile builds a MAUI CDB module
*****
#* Copyright 1995 by Microware Systems Corporation          **
#* Copyright 2001 by RadiSys Corporation                    **
#* Reproduced Under License                                **
#*                                                         **
#* This source code is the proprietary confidential property of Microware **
#* Systems Corporation, and is provided to licensee solely for documentation**
#* and educational purposes. Reproduction, publication, or distribution in **
#* any form to any party other than the licensee is strictly prohibited. **
*****

PORT      =    ../..
TRGTS     =    cdb

include $(PORT)/../make.com

ODIR      =    $(PORT)/CMDS/BOOTOBJS/MAUI
SDIR      =    .
OPTS      =    -to=$(OS) -tp=$(CPU) -k

$(TRGTS): DIRS $(ODIR)/$(TRGTS)
          $(COMMENT)

$(ODIR)/cdb : $(SDIR)/cdb.a
             $(CODO) $@
             $(CC) $(SDIR)/$*.a $(OPTS) -fd=$@
             $(FIXMOD0) $@

DIRS: .
      $(MAKDIR) $(ODIR)

_clean_purge: .
             $(CODO) $(ODIR)/cdb
             -$(DEL) $(ODIR)/cdb
```

## How to Modify the CDB

---

1. Create a directory *YOURPORT* for your ported files in:  
`MWOS/OS/CPU/PORTS`
2. Define and create a *CDB* directory. This directory is referred to in this chapter as *CDB* and assumes the pathname:  
`MWOS/OS/CPU/PORTS/YOURPORT/MAUI/CDB`
3. Using a text editor, modify the device list in the `cdb.a` file to reflect your configuration. Check that your CDB module follows these important rules:
  - Do not modify anything except the `dc.b` lines.
  - Do not modify the last `dc.b 0` line. This is the end-of-file marker.
  - At least one CDB module must include a system description DDR.
  - Your CDB may have more than one device of a given type.
  - Each device in the CDB should have a unique name.
  - Make sure every DDR line ends with a `,13`. This is the end-of-record marker.
  - Make sure you place a back slash (`\`) before each quote mark that appears inside the DDR. This does not apply to the quote marks that begin and end the DDR string.
  - Make sure the last lines of your file are:  
`dc.b 0`  
`ends`
4. Save the modified file in directory *CDB*.

## How to Build the CDB

---

1. Change directories to *CDB* directory

```
cd CDB
```

2. To make the new CDB module, type:

```
os9make
```

## How to Test the New CDB

---

Load the produced CDB data module(s) into your target's memory, use the MAUI CDB API calls to verify that all the relevant data can be retrieved from your CDB(s).

---

## Chapter 2: Graphics Driver Interface

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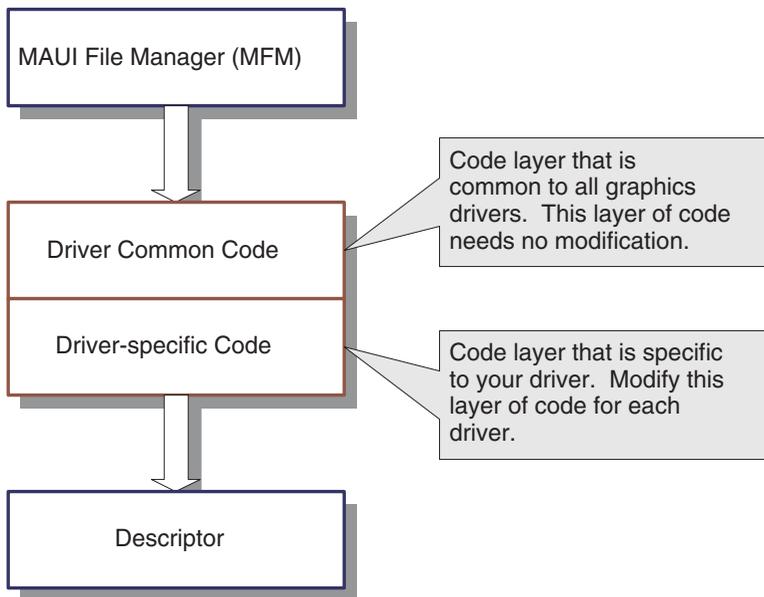
MAUI graphics drivers insulate applications from hardware differences in target systems. This chapter explains the graphics device capabilities; the relationship between the file manager, graphics driver, and descriptors; and how to build, modify, and verify your drivers.



# Overview of Graphics Driver Interface

MAUI graphics drivers interface between the graphics device and the MAUI file manager. The graphics driver contains all device-specific code so that MAUI applications and the MAUI APIs are insulated from hardware differences in the target system. The following figure shows the relationship between the MAUI file manager (MFM), graphics driver, and descriptor:

**Figure 2-1 MFM–Driver–Descriptor Relationship**



The graphics device driver consists of a common code layer and a device-specific code layer. All graphics drivers share the same set of common code, which provides functions and definitions needed by all drivers. Some of the common code is conditionally compiled for individual systems. The device-specific code handles all the functions and definitions unique to each device. When porting a graphics driver, modify the device-specific code in the sample driver to reflect the graphics device in your system.

The device descriptor is the handle used by applications to reference a device. The descriptor indicates the file manager, driver, and the driver initialization data required to access the device.

## Graphics RAM

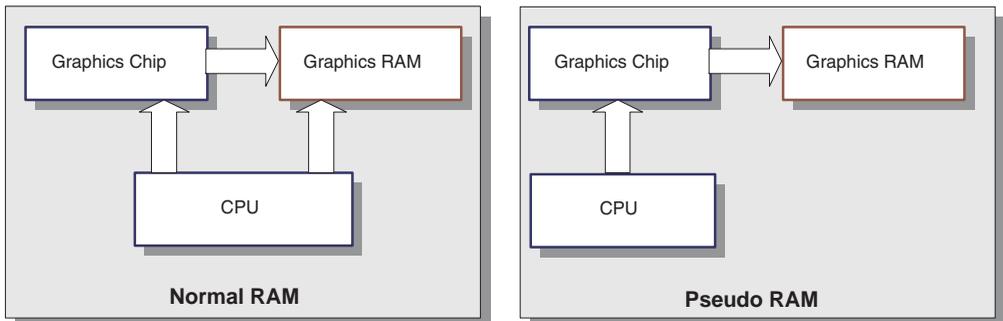
MAUI classifies graphics RAM as one of two types:

- Normal RAM (accessible by the CPU)
- Pseudo RAM (not accessible by the CPU)

For normal RAM, the CPU has direct access to the graphics RAM. For pseudo RAM, the CPU must access the graphics chip which, in turn, accesses the graphics RAM. This is determined by the chip or board manufacturer.

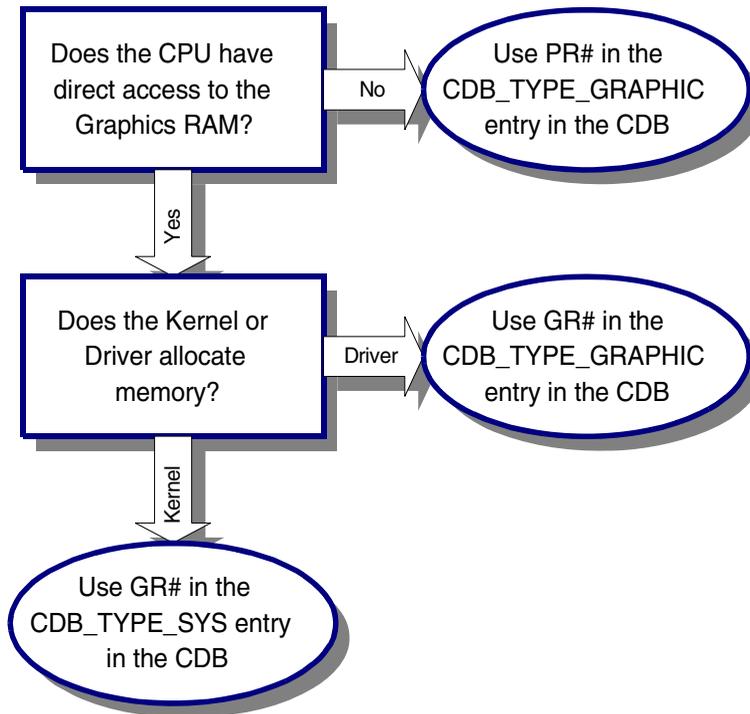
While normal RAM allows easier and normally faster access to the graphics RAM by the application, it draws the penalty of consuming CPU time for display memory updates. The following figure illustrates the two types of graphics RAM:

**Figure 2-2 Normal RAM and Pseudo RAM**



If your device uses normal RAM, the kernel or the driver may manage the memory. If the kernel manages the memory, it must be set up by the `sys_init` module or appear in the memory list in the `init` module (See **OS-9® Technical Reference** or **OS-9 for 68K Technical Reference**). The configuration of RAM is described in the CDB. Use the following decision tree to help you complete your CDB.

**Figure 2-3 RAM Allocation**

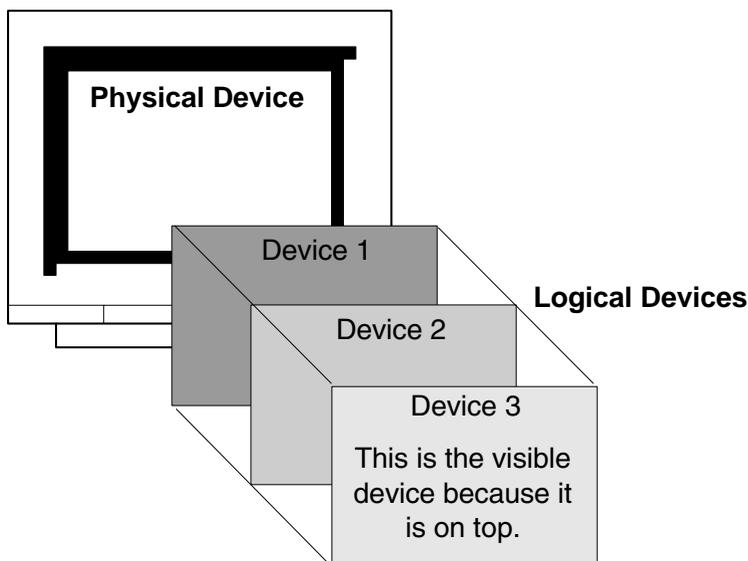


## Graphics Device

---

When a process opens a path to a physical device, a logical device is created for that process. There may be several paths open to the physical device at any one time, so multiple logical devices may exist. The logical device that is at the top of the logical device stack is the visible device as shown in the following figure:

**Figure 2-4 Physical and Logical Graphics Devices**



The physical device is simply the physical hardware that displays graphics such as a television, monitor, or LCD.

As each path is opened to the device with `gfx_open_dev()`, each path is given a logical device ID. Only the top-most logical device is visible.

A process may clone a logical device opened by another process by calling the function `gfx_clone_dev()`. When this function is called, the logical device is shared by both processes.

## Device Capabilities

---

One important function of your device driver is specifying the capabilities of the device. Graphics device capabilities are defined in a set of data structures within the `global.h` file. Written specifications for the sample drivers included with MAUI are located in the same directory as the source files.

A hardware specification is particularly valuable when writing your `global.h` file. Your specification may be different, but similar to the specifications of the sample drivers. Following are examples of the data structures that define device capabilities.

### GFX\_DEV\_CAP Device Capabilities

This data structure defines the set of display capabilities. The structure is defined as follows:

```
typedef struct _GFX_DEV_CAP {
    char *hw_type;                /* hardware type */
    char *hw_subtype;            /* hardware sub-type */
    BOOLEAN sup_vpmix;           /* supports viewport mixing */
    BOOLEAN sup_extvid;          /* supports external video */
    BOOLEAN sup_bkcolor;        /* supports background color */
    BOOLEAN sup_vptrans;        /* supports viewport transparency */
    BOOLEAN sup_vpinten;        /* supports viewport intensity */
    BOOLEAN sup_sync;           /* supports retrace synchronization */
    u_int8 num_res;              /* number of display resolutions */
    GFX_DEV_RES *res_info;       /* array of display resolutions */
    u_int8 dac_depth;            /* depth of DAC in bits */
    u_int8 num_cm;               /* number of coding methods */
    GFX_DEV_CM *cm_info;         /* array of coding methods */
    BOOLEAN sup_decode;          /* supports video decoding */
} GFX_DEV_CAP;
```

Following is an example of a `GFX_DEV_CAP` data structure of a driver, which supports standard VGA graphics chip set mode 12H and “X”-mode:

```
GFX_DEV_CAP gdv_dev_cap = {
    "VGA",          /* hardware type */
    NULL,          /* hardware sub-type name (filled in later) */
    FALSE,        /* supports viewport mixing */
    FALSE,        /* supports external video */
    FALSE,        /* supports backdrop color */
    FALSE,        /* supports viewport transparency */
    FALSE,        /* supports vport intensity */
    FALSE,        /* supports retrace synchronization */
    sizeof(gdv_res_info)/sizeof(*gdv_res_info), /* Num res_info */
    gdv_res_info, /* pointer to display resolution information */
    6,            /* depth of DAC in bits */
    sizeof(gdv_cm_info)/sizeof(*gdv_cm_info), /* Num cm_info */
    gdv_cm_info, /* pointer to coding method information */
    FALSE        /* supports video decoding into a drawmap */
};
```

This structure references two other structures `GFX_DEV_RES` `gdv_res_info` and `GF_DEV_CM` `gdv_cm_info` described below. Both of these are pointers to an array of structures of their respective types.

## GFX\_DEV\_RES Device Resolution

The `GFX_DEV_RES` structure provides a description of display setting/resolutions supported by the driver. The driver provides an array of `GFX_DEV_RES` structures describing each supported display setting. The first resolution defined in this data structure is the default resolution. This data is structured as follows:

```
typedef struct _GFX_DEV_RES {
    GFX_DIMEN disp_width;    /* width */
    GFX_DIMEN disp_height;  /* height */
    u_int16 refresh_rate;   /* refresh rate */
    GFX_INTL_MODE intl_mode; /* interlace mode */
    u_int16 aspect_x;       /* x aspect ratio */
    u_int16 aspect_y;       /* y aspect ratio */
} GFX_DEV_RES;
```

Following is an example of a `GFX_DEV_RES` data structure that defines two display resolutions:

```
GFX_DEV_RES gdv_res_info[] = {
    {640, 480, 60, GFX_INTL_OFF, 1, 1}, /* default mode 12H */
    {360, 480, 60, GFX_INTL_OFF, 1, 1} /* X-mode */
};
```

## GFX\_DEV\_CM Coding Methods

The `GFX_DEV_CM` data structure describes a coding method. The driver provides an array of `GFX_DEV_CM` data structures and contains an entry for each coding method supported by the graphics device. Coding methods are specific formats for graphic data. The first coding method entry is the default coding method, followed by additional supported coding methods. This data is structured as follows:

```
typedef struct _GFX_DEV_CM {
    GFX_CM coding_method;          /* coding method */
    BOOLEAN clut_based;           /* TRUE if CLUT-based */
    u_int16 dm2dp_xmul;           /* multiplier to convert X coordinate */
    u_int16 dm2dp_ymul;           /* multiplier to convert Y coordinate */
    u_int8 num_color_types;       /* number of color types */
    GFX_COLOR_TYPE *color_types; /* array of color types*/
} GFX_DEV_CM;
```

A CLUT-based coding method uses an index of colors called a Color Look-Up Table (CLUT).

Multipliers are used to convert values in the drawmap coordinate system to equivalent values in the display coordinate system. When the display resolution is different from the drawmap resolution the `dm2dp_xmul` and `dm2dp_ymul` values are other than 1. Following is an example of a `GFX_DEV_CM` data structure that defines two supported coding methods, 4bpp (16 colors) coding method for VGA mode 12H and 8bpp (256 colors) for 'X'-mode:

```
GFX_DEV_CM gdv_cm_info[] = {
    {GFX_CM_4BIT, TRUE, 1, 1, GDV_NUMCOLORS, gdv_valid_colors},
    {GFX_CM_8BIT, TRUE, 1, 1, GDV_NUMCOLORS, gdv_valid_colors},
};
```

## GFX\_DEV\_CAPEXTEN Extended Device Capabilities

As of MAUI 3.1 an extended or secondary device capabilities structure should be supported by all drivers. This data structure provides additional information about the display capabilities of the device. The structure is defined as follows:

```

typedef struct _GFX_DEV_CAPEXTEN {
    u_int16 version;           /* == sizeof(GFX_DEV_CAPEXTEN) used to
                               determine revision of struct */
    u_int16 num_modes;        /* Number of modes in mode_info */
    GFX_DEV_MODES *mode_info; /* Array of supported modes (maybe subset) */
    GFX_VPC vp_complexity;    /* Hint regarding supported viewport
                               complexity */
    GFX_VPDMC vpdmc_complexity; /* Hint regarding supported drawmap
                               viewport complexity */
} GFX_DEV_CAPEXTEN;

```

Following is an example of a `GFX_DEV_CAPEXTEN` data structure for the driver described above:

```

const GFX_DEV_CAPEXTEN gdv_dev_capexten = {
    sizeof(GFX_DEV_CAPEXTEN), /* Size/Version of structure, NEVER CHANGE */
    sizeof(gdv_dev_modes)/sizeof(*gdv_dev_modes), /* Number of modes */
    gdv_dev_modes, /* Mode info */
    GFX_VPC_ONE_EXACT, /* Supports only one viewport the
                        exact size of the display */
    GFX_VPDMC_LARGER /* Can display sub-drawmaps */
};

```

This structure references the structure `GFX_DEV_MODES` `gdv_dev_modes` described below. This is a pointer to an array of device modes structures which indicate compatible device resolution and coding method combinations supported by the graphics device.

## GFX\_DEV\_MODES Device Modes

The `GFX_DEV_MODES` data structure is referenced by `GFX_DEV_CAPEXTEN` to indicate compatible device resolution and coding method combinations (modes) supported by the graphics device. This is ideally all of the supported modes, but can be a subset if there are too many. This data is structured as follows:

```

typedef struct _GFX_DEV_MODES {
    u_int16 res_idx; /* res_info index */
    u_int16 cm_idx; /* cm_info index */
    char *desc; /* Description of mode */
} GFX_DEV_MODES;

```

Following is an example of a `GFX_DEV_MODES` data structure that defines a set of coding method and display resolutions pairs:

```
GFX_DEV_MODES gdv_dev_modes[] = {  
    {0, 0, "640x480x4"},  
    {0, 1, "640x480x8"},  
    {1, 0, "360x480x4"},  
    {1, 1, "360x480x8"}  
};
```

Note that the `res_idx` and `cm_idx` fields are indexes into `GFX_DEV_CAP`'s `GFX_DEV_RES` `gdv_res_info` and `GF_DEV_CM` `gdv_cm_info` arrays, not pointers.



---

## Note

See the MAUI Programming Reference manual for complete description of each of the data structures.

---

## Compile State for Graphics Drivers

---

This section provides information regarding the compile state for MAUI graphics drivers, including the names of the driver files and the functions implemented within them.

### IOBLT and HWBLT Drivers

**Table 2-1 IOBLT and HWBLT**

| Compiled to User State   | Compiled to System State<br>(GDC_FE_SYSATE)   |
|--|---|
| <b>gdv_blt.c</b><br><br>_gdv_blt_drwmix<br><br>_gdv_blt_cpymix<br><br>_gdv_blt_pix<br><br>_gdv_blt_src<br><br>_gdv_blt_dst<br><br>_gdv_blt_ofs<br><br>_gdv_blt_mask<br><br>_gdv_blt_trans<br><br>_gdv_blt_exptbl | <b>gdv_fe.c</b><br><br>_os_ss_blt_drwmix<br><br>_os_ss_blt_cpymix<br><br>_os_ss_blt_pix<br><br>_os_ss_blt_src<br><br>_os_ss_blt_dst<br><br>_os_ss_blt_ofs<br><br>_os_ss_blt_mask<br><br>_os_ss_blt_trans<br><br>_os_ss_blt_exptbl |

## IOBLT Driver

**Table 2-2 Specific to IOBLT**

| <b>Compiled to User State</b>   | <b>Compiled to System State<br/>(GDC_FE_SYSATE</b>   |
|---|--|
| <p><b>gdv_copy.c</b></p> <p>    _gdv_ioblt_copyblk</p> <p>    _gdv_ioblt_copynblk</p> <p><b>gvd_draw.c</b></p> <p>    _gdv_ioblt_drawblk</p> <p>    _gdv_ioblt_drawhline</p> <p>    _gdv_ioblt_drawvline</p> <p>    _gdv_ioblt_drawpixel</p> <p><b>gdv_expd.c</b></p> <p>    _gdv_ioblt_expdblkc</p> <p>    _gdv_ioblt_expdnblk</p> | <p><b>gdv_fe.c</b></p> <p>    _os_ss_ioblt_copyblk</p> <p>    _os_ss_ioblt_copynblk</p> <p>    _os_ss_ioblt_copynblk</p> <p>    _os_ss_ioblt_drawblk</p> <p>    _os_ss_ioblt_drawhline</p> <p>    _os_ss_ioblt_drawvline</p> <p>    _os_ss_ioblt_drawpixel</p> <p>    _os_ss_ioblt_expdblkc</p> <p>    _os_ss_ioblt_expdnblk</p> |

## HWBLT Driver

**Table 2-3 Specific to HWBLT**

| <b>Compiled to User State</b>                              | <b>Compiled to System State<br/>(GDC_FE_SYSATE)</b>            |
|--|--|
| <code>hwblt.c</code><br><br><code>_gdv_hwbt_drawblk</code> | <code>gdv_fe.c</code><br><br><code>_os_ss_hwblt_drawblk</code> |

## Driver Code

---

MAUI graphics drivers consist of two types of code: common code that is already written for your driver, and device-specific code that you write. The common code makes up a large portion of the graphics driver and does not have to be modified. When porting a graphics driver, you modify the device-specific code in the sample drivers to reflect the capabilities of the graphics device in your system and implement the functionality it can support. The device-specific code consists of a number of files, of which some are required and others are optional, depending on your system. The following files are required in every graphics driver:

- `config.h` contains the definitions that control the configuration of the driver including the names of functions defined by the device-specific code.
- `drvvr.tpl` `os9make` “include” file.
- `global.h` contains the global definitions for the driver including device capabilities and prototypes.
- `hardware.c` defines functions that deal with the hardware device setup routines such as `init` and `terminate`.
- `hardware.h` contains hardware-specific definitions.
- `static.c` initializes and terminates static storage areas used by the driver.
- `static.h` contains the definitions for static storage areas available to the driver.
- `updtcpy.c` updates the display with queued changes and optionally synchronizes changes with vertical retrace.
- `vpdmap.c` sets a drawmap area to be displayed in the viewport.
- `vpdmpos.c` sets a position of the drawmap in the viewport.
- `vppos.c` sets a position of the specified viewport.

- `vprestak.c` restacks a viewport within the viewport stack.
- `vpsize.c` sets a size of the specified viewport.
- `vpstate.c` sets a state of the specified viewport to active or not active.

Several other files may be included in the device-specific code at your option. These files include:

- `dvbkcol.c` sets a background color for the display.
- `dvextvid.c` sets an external video on and off.
- `dvtran.c` sets transparent color.
- `dvvpmix.c` sets viewport mixing on and off.
- `iobl.c` enables driver-supported bit-BLT (using I/O registers).
- `hwblt.c` enables driver-supported bit-BLT (using H/W acceleration).
- `hwcur.c` enables a H/W cursor.
- `irq.c` defines interrupt service functions.
- `vpintens.c` sets an intensity of the specified viewport.

When modifying the driver code, you should organize your work to modify the files in this order:

1. Modify header files.
2. Modify required display functions.
3. Modify required viewport functions.
4. Modify optional functions.

## Device-Specific Code

Sample driver files are located in the directory:

```
MWOS/SRC/DPIO/MFM/DRVR/GX_SAMP
```

You can use these files as templates for building your own device-specific code.

## Where the Files are Located

---

MAUI is delivered with one directory of sample files and several complete drivers. The complete drivers are example drivers that you can modify to make your driver. The sample files contain instructions for building your own .h and .c files.

- MAUI standard header files are located in  
`MWOS/SRC/DEFS/MAUI`



---

### WARNING

These header files should never be modified by the user

---

- MAUI common driver code is located in  
`MWOS/SRC/DPIO/MFM/DRV/ GX_COMM`  
This directory is referred to as *common* throughout this chapter. Normally you should not need to modify files in this directory. If your implementation does have special requirements that necessitates modifying the common code, make a copy of the relevant file(s) to your driver specific directory and make your modifications there.
- The sample driver template files are located in:  
`MWOS/SRC/DPIO/MFM/DRV/ GX_SAMP`
- Depending on the software package purchased, other complete driver sources are found under:  
`MWOS/SRC/DPIO/MFM/DRV/ GX_*`

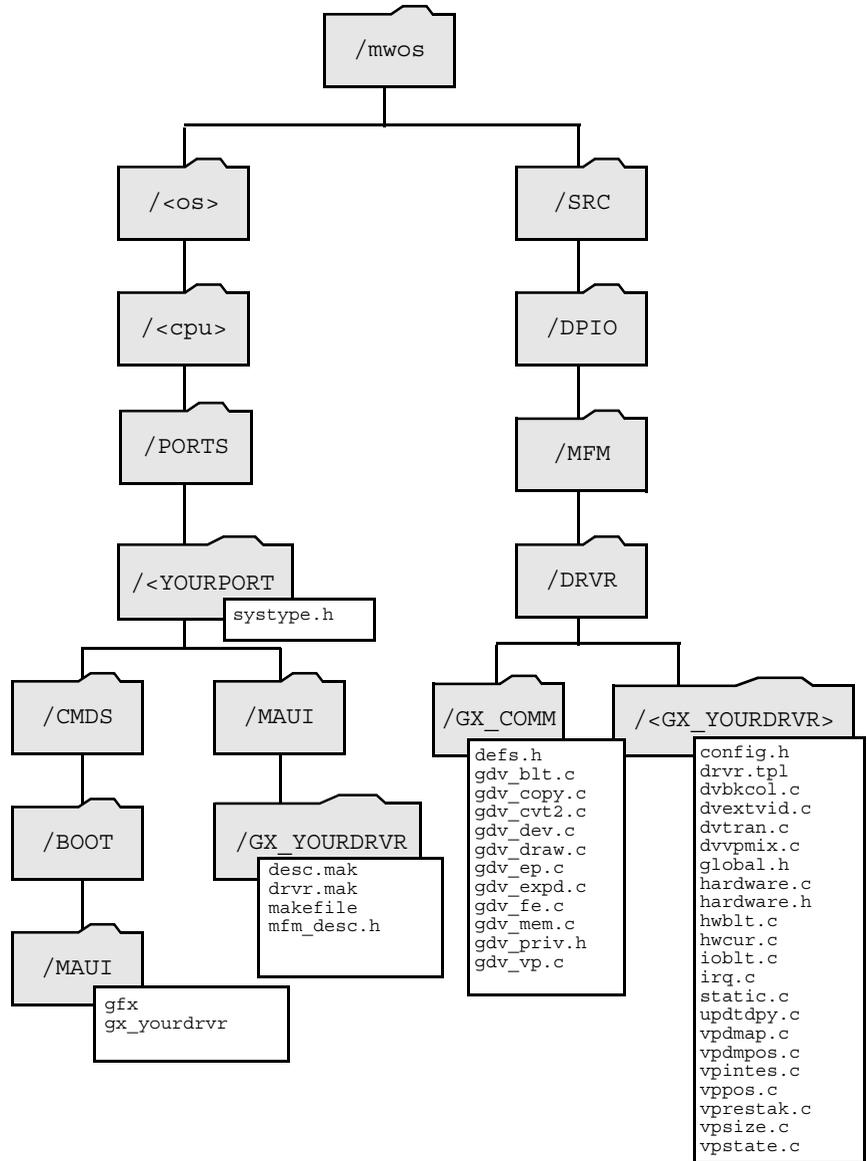
# How to Port Your Graphics Driver

---

## Create the directory structure for your port

Before beginning to port your graphics driver, you must create a directory structure to store your new files. That directory structure is shown on the next page in the figure **Directory Structure for Your Graphics Driver Port**.

**Figure 2-5 Directory Structure for Your Graphics Driver Port**



**Step 1.** Define and create a source directory. This directory is referred to in this chapter as *SOURCE* and assumes the pathname :  
MWOS/SRC/DPIO/MFM/DRVR/GX\_ YOURDRVR  
We recommend that the directory name start with “GX\_” followed by an uppercase descriptive name for your driver.

**Step 2.** Copy all of the files from:  
MWOS/SRC/DPIO/MFM/DRVR/GX\_SAMP  
into your new *SOURCE* directory. Verify that the following files are now in your *SOURCE* directory:

|            |            |
|------------|------------|
| config.h   | drvr.tpl   |
| dvbkcol.c  | dvextvid.c |
| dvtran.c   | dvvpmix.c  |
| global.h   | hardware.c |
| hardware.h | hwblt.c    |
| hwcur.c    | iobl.c     |
| irq.c      | static.c   |
| static.h   | updtcpy.c  |
| vpdmap.c   | vpdmpos.c  |
| vpintens.c | vppos.c    |
| vprestak.c | vpsize.c   |
| vpstate.c  |            |

**Step 3.** Define and create a ports directory. This directory is referred to in this chapter as *YOURPORT* and assumes the pathname:  
MWOS/OS/CPU/PORTS/YOURPORT

**Step 4.** Define and create a make directory. This directory is referred to in this chapter as *MAKE* and assumes the pathname:  
MWOS/OS/CPU/PORTS/YOURPORT/MAUI/GX\_ YOURDRVR

**Step 5.** Copy or create the following files in your *MAKE* directory :

|          |            |
|----------|------------|
| desc.mak | drvr.mak   |
| makefile | mfm_desc.h |

Here are examples of these files:

- `makefile`                    **Make both MAUI graphics descriptor and driver**

```
# Makefile
#####
#
#   Copyright 1996 by Microware Systems Corporation
#   Copyright 2001 by RadiSys Corporation
#
#               All Rights Reserved
#               Reproduced Under License
#
# This software is confidential property of Microware Systems Corporation, #
# and is provided under license for internal development purposes only. #
# Reproduction, publication, distribution, or creation of derivative works #
# in any form to any party other than the licensee is strictly prohibited, #
# unless expressly authorized in writing by Microware Systems Corporation. #
#
#####

#
# Conditionally call driver makefile automatically for BSP vs DEVKITS
#
if exists(drvr.mak)
DRVRMAKE = drvr.mak
else
DRVRMAKE =
endif

PORT      =    ../..
TRGTS     =    desc.mak $(DRVRMAKE)

include $(PORT)/../makesub.com

$(TRGTS):
    -$(MAKESUB) -f=$@

#####
```

- desc.mak **Make the MAUI graphics descriptor**

```

# Makefile
#*****
#* Makefile for MAUI Graphics Descriptors
#*****
#* Copyright 1996 by Microware Systems Corporation          **
#* Copyright 2001 by RadiSys Corporation                    **
#* Reproduced Under License                               **
#*                                                         **
#* This source code is the proprietary confidential property of **
#* Microware Systems Corporation, and is provided to licensee **
#* solely for documentation and educational purposes.  Reproduction, **
#* publication, or distribution in any form to any party other than **
#* the licensee is strictly prohibited.                    **
#*****
##### Add New Descriptor Names Here #####
#
TRGTS      =   gfx
DRVR       =   GX_YOURDRVR
USER_OPTS  =   -oln=gfx
#
#####

PORT       =   ../..
MAKENAME   =   desc.mak
include $(PORT)/../make.com

RDIR       =   RELS/DESC
ODIR       =   $(PORT)/CMDS/BOOTOBS/MAUI
SDIR       =   $(MWOS)/SRC/DPIO/MFM/DESC
DESCDIR    =   .

include $(SDIR)/desc.tpl

_purge_clean:
for TMP in $(TRGTS)
    -$(CODO) $(ODIR)/$(TMP)
    -$(DEL) $(ODIR)/$(TMP)
endfor

#####

```



```

#      ADDITIONAL_IFILES = $(IDIR)/yourfile.i
ADDITIONAL_IFILES =

# List additional libraries, required for the driver
# Example
#      ADDITIONAL_LIBS = -l=$(MWOS_LIBDIR)/yourlib.l
ADDITIONAL_LIBS =

# Include driver template
include $(MWOS)/SRC/DPIO/MFM/DRVR/$(DRVR)/drvr.tpl

# Additional build rules (required, if ADDITIONAL_IFILES
# flag is set
# Example
#      $(IDIR)/yourfile.i: yourfile.c $(DEPENDFILES)
#      $(COMPILE) yourfile.c

# you can use the following to change the revision # of the driver
# this is added to the end of the link rule in drvr.tpl
$(ODIR)/$(TRGTS): $(RFILES) $(MAKENAME)
    fixmod -ugua=a001 $@

#
#####

```

- `mfm_desc.h`      The MAUI graphics driver descriptor header  
(modify to reflect your descriptor settings)

```

/*****
**
* FILENAME : mfm_desc.h
*
* DESCRIPTION :
*
*   This file contains definitions for the MAUI device descriptors.
*
* COPYRIGHT:
*
*   This source code is the proprietary confidential property of Microware
*   Systems Corporation, and is provided to licensee solely for documentation
*   and educational purposes. Reproduction, publication, or distribution in
*   form to any party other than the licensee is strictly prohibited.
*
#ifndef _MFM_DESC_H
#define _MFM_DESC_H

#include "../systype.h"

/*****
/* Generic VGA Graphic Descriptor */
/*****
#if defined(MFM_DESC_GFX) || defined(gfx)

/*****
/* Descriptor's common portion (has to be present and set) */
/*****
#define MEM_COLOR 0x80
#define SHARE      TRUE          /* allow multiple open paths to */
                                /* the graphics device */
#define LUN        0            /* Logical unit number */
#define PORTADDR  0x00000000    /* Base address of hardware */
#define MODE      S_IREAD | S_IWRITE /* Device mode capabilities */
#define DRV_NAME   "gx_yourdrv" /* Driver name */

/*
* Base IRQ vector for OS-9000 is equal to 0x40. Therefore
* the resulting IRQ vector number to be set is 0x40 plus
* physical vector number.
*
* Note: if the driver do not support interrupts, both
* INTERRUPT_ENABLED and GDV_IRQ_EVNAME have to be set to
* zero (NULL).
*/
#define INTERRUPT_ENABLED 0 /* 0 - vertical interrupts disabled */
                          /* 1 - vertical interrupts enabled */

#define GDV_IRQ_NUM      0x40 /* IRQ vector number */
#define GDV_IRQ_PRIORITY 0 /* IRQ priority */

```

```

#define GDV_IRQ_EVNAME      NULL    /* IRQ event name (NULL if
none) */

/*****
/* Descriptor's specific portion (optional and driver-dependent) */
/*****
/* Definitions for the driver static storage (static.h) */
/* Add your own defines here */
#define MEM_BASE_ADDRESS    0xA0000
#define MEM_SIZE            0x10000

/*
 * for following GDV_HW_SUBTYPE definitions, see MFM/DRVR/XXX/static.h's
 * typedef enum { ... } HW_SUBTYPE;
 */
#define GDV_HW_SUBTYPE     VGA      /* Hardware sub-type */
#define GDV_HW_SUBNAME    "VGA_GENERIC" /* Hardware sub-type name */

#endif /* MFM_DESC_GFX */

#endif /* _MFM_DESC_H_ */

/*****

```

Step 6. Create the directory *YOURPORT*/CMDS/BOOTOBJS/MAUI. During the make process two object files are created and stored in MAUI:

- `gfx`                      Descriptor object
  - `gx_yourdrv`              Driver object
- This is typically a lower case version of the directory name in step 1.

Step 7. Verify your directory structure contains the correct files as shown in the figure [Directory Structure for Your Graphics Driver Port](#) on page 35.

## Common Source Files

The following files are located in the `GX_COMM` directory:

|                          |   |
|--------------------------|---|
| <code>defs.h</code>      | Global definitions file                   |
| <code>gdv_blt.c*</code>  | I/O and H/W Bit-BLT support common code   |
| <code>gdv_copy.c*</code> | I/O Bit-BLT support for copy operations   |
| <code>gdv_cur.c*</code>  | H/W cursor support common code            |
| <code>gdv_cvt2.c</code>  | Color conversion functions                |
| <code>gdv_dev.c</code>   | Common graphics device functions          |
| <code>gdv_draw.c*</code> | I/O Bit-BLT support for draw operations   |
| <code>gdv_ep.c</code>    | Entry point functions                     |
| <code>gdv_expd.c*</code> | I/O Bit-BLT support for expand operations |
| <code>gdv_fe.c*</code>   | Fast-entry-point functions                |
| <code>gdv_main.c</code>  | Main function for the driver              |
| <code>gdv_mem.c*</code>  | Graphics memory management functions      |
| <code>gdv_priv.h</code>  | Definitions private to the common code    |
| <code>gdv_vp.c</code>    | Viewport functions                        |

---

\* Optional files. Do not include in `drvr.tpl` if your driver does not support these functions.

## Device-specific Files

The following files are located in the *SOURCE* directory:

|                          |  |
|--------------------------|--|
| <code>config.h</code>    | Configures the capabilities of the driver and inclusion/exclusion of common code |
| <code>os9make</code>     | “include” file.  |
| <code>drvr.tpl</code>    | Backdrop color function  |
| <code>dvbkcol.c*</code>  | External video function  |
| <code>dvextvid.c*</code> | Transparent color function   |
| <code>dvtran.c*</code>   | Viewport mixing function   |
| <code>dvvpmix.c*</code>  | Global definitions   |
| <code>global.h</code>    | Hardware function  |
| <code>hardware.c</code>  | Definitions for hardware functions   |
| <code>hardware.h</code>  | H/W Bit-BLT support in driver  |
| <code>hwblt.c*</code>    | H/W cursor support in driver   |
| <code>hwcur.c*</code>    | I/O Bit-BLT support in driver  |
| <code>iobltd.c*</code>   | Interrupt service functions  |
| <code>irq.c*</code>      | Code to initialize/terminate static storage areas                                |
| <code>static.c</code>    | Definitions for static storage areas   |
| <code>static.h</code>    | Update display function  |
| <code>updtcpy.c</code>   | Viewport drawmap function  |
| <code>vpdmap.c</code>    | Viewport drawmap position function   |
| <code>vpdmpos.c</code>   | Viewport intensity function  |
| <code>vpintens.c*</code> | Viewport position function   |
| <code>vppos.c</code>     | Viewport restack function  |
| <code>vprestak.c</code>  | Viewport state (active/inactive) function  |
| <code>vpstate.c</code>   | Viewport size function   |
| <code>vpsize.c</code>    |  |

---

\* Optional files. Delete these files if not supported by your driver.

## Modify SOURCE Files

- 
- Step 1. Construct your `drvvr.tpl` file to include or not include the files marked \* depending on whether your driver supports those functions.
  - Step 2. Update your `drvvr.tpl` to reflect the changes made in step 1.
- 

### Modify the config.h file to reflect your system.

- 
- Step 1. Define `GDV_INCLUDE_MEM` only if your graphics driver must handle memory management. This must be done if the graphics memory is pseudo memory or it is not accessible by the CPU at the time the kernel does a memory search. It also has to be done, if graphics memory allocation should be on the specific boundary. Review [Graphics RAM](#) for a discussion of memory considerations.  
  
If the CPU can access the graphics memory, it is best to let the kernel handle memory management. See the ***OS-9 Porting Guide*** for more information about kernel memory management.
  - Step 2. Set `GDV_MEM_PREFIX` to the required size in bytes if the hardware requires a header at the beginning of drawmap memory for display. `GDV_INCLUDE_MEM` flag should also be set in this case.
  - Step 3. Set `GDV_MEM_POSTFIX` to the required size in bytes if the hardware requires a trailer at the end of drawmap memory for display. `GDV_INCLUDE_MEM` flag should also be set in this case.
  - Step 4. Define the `GDV_INCLUDE_CVT2_*` labels that match the color types required by the hardware. Delete all others.
  - Step 5. Define `GDV_FE_SYSSTATE` if fast entry points must execute in system state. If not, delete `GDV_FE_SYSSTATE`. This should only be defined if code in fast entry points perform privileged instructions or require system-state I/O access. Enabling this option adds the overhead of a context switch to all fast entry points.

- Step 6.** Define function names for `GDV_INIT_HW` through `GDV_UPDATE_DPY`. All values must be defined, although you normally use the default values. These are required functions.
- Step 7.** Define function names for `GDV_INIT_IRQS` through `GDV_GET_ATTRIBUTE`. Only include definitions for functions supported by your driver. These are optional functions.

Here is a brief description of each function.

- `GDV_INIT_IRQS` - Initialize interrupts
- `GDV_TERM_IRQS` - Terminate interrupts
- `GDV_INIT_DVATCH` - Initialize gfx device attachment
- `GDV_TERM_DVATCH` - Term gfx device attachment
- `GDV_INIT_VPATCH` - Initialize viewport attachment
- `GDV_TERM_VPATCH` - Terminate viewport attachment
- `GDV_SET_BKCOL` - Set backdrop color
- `GDV_SET_EXTVID` - Set external video on/off
- `GDV_SET_TRANSCOL` - Set transparency color
- `GDV_SET_VPMIX` - Set viewport mixing on/off
- `GDV_SET_VPINTEN` - Set viewport intensity
- `GDV_SET_ATTRIBUTE` - Set a device attribute
- `GDV_GET_ATTRIBUTE` - Get a device attribute

The prototypes for each of the functions may be found in `SRC/DPIO/MFM/DRVR/GX_COMM/defs.h`.

- Step 8.** Define `GDV_MEM_TOP_BIT` if user-state process can not reference memory addresses with the most significant bit set (e.g. SuperH architecture). Every time driver common code allocates memory for the structure, which will be used by the API in user-state mode, it clears the most significant bit of the resulting pointer, if `GDV_MEM_TOP_BIT` is set. When `GDV_MEM_TOP_BIT` is not defined, no modification to the structure pointers is made. The most significant bit is set back when the driver common code has to deallocate the memory back to the system.

- Step 9. Define `GDV_PIXMEM_BNDRY` if allocations of and access to the graphics memory must be on a boundary. The value should indicate the required boundary size in bytes.
- Step 10. Define `GDV_INCLUDE_IOBLT` if I/O Bit-BLT support is required. If `GDV_INCLUDE_IOBLT` is defined, you must define the remaining entries in steps 10 through 15. If not defined, delete the following up to the `GDV_INCLUDE_IOBLT` flag and go to Step 17.
- Step 11. Define `GDV_IOBLT_WORDSIZ` as the size of each word in bytes. `GDV_IOBLT_WORDSIZ` is a restriction typically imposed by graphics hardware. It is the boundary (byte, word, longword, quadword, etc.) at which video buffer should be accessed. It is also the smallest segment of graphics RAM that must be read or written through the I/O port.
- Step 12. Define `GDV_IOBLT_WORDSFT` as the shift value derived from the `GDV_IOBLT_WORDSIZ` value. For example, if `GDV_IOBLT_WORDSIZ` is equal to 8 (video memory has to be accessed on 8-byte boundary), then `GDV_IOBLT_WORDSFT` is equal to 3 ( $1 \ll 3$  is 8).
- Step 13. Define `GDV_IOBLT_LINESIZ` as the maximum line size in bytes. `GDV_IOBLT_LINESIZ` is the size of the largest video buffer line, which IOBLT driver can store into internal data structure. This value should be large enough to hold the content of a video line of any dimension. For example, if IOBLT operations are to be performed on the video drawmap with the size 640x480x16bits/pixel, then `GDV_IOBLT_LINESIZ` should be set to  $640 * 16/8$ .
- Step 14. Set `GDV_IOBLT_GFXRAM` through `GDV_IOBLT_WRITE_PIX` to the names of the functions provided by the device-specific code. The default values are used in most cases.
- Step 15. Optionally define `GDV_IOBLT_OFFSETS` as the function to compute the odd and even offsets for interlace support.
- Step 16. Define `GDV_IOBLT_SEP_CHROMA`. This enables support of separate lumina and chroma sections of the drawmap.
- Step 17. Define `GDV_INCLUDE_HWBLT` if H/W Bit-BLT support is implemented. If `GDV_INCLUDE_HWBLT` is defined, you must define the remaining entries in steps 18 through 20.

- Step 18. Set `GDV_HWBLT_DRWMIX` through `GDV_HWBLT_DST` to the names of the functions provided by the device-specific code. The default values are used in most cases. These functions are required by the template.
- Step 19. Define `GDV_HWBLT_BCATCH` and `GDV_HWBLT_BCATCH` and in case driver-specific part of Bit-BLT attachment is specified (see also `GDV_BCATCH_SPECIFICS` in `static.h`). These functions are optional.
- Step 20. Set `GDV_HWBLT_DRAWBLK` through `GDV_HWBLT_GETPIXEL` to the names of the functions provided by the device-specific code. The default values are used in most cases. These functions are independent and should be set only in the case when the driver wants to support any of the correspondent Bit-BLT operations in H/W acceleration mode.
- Step 21. Define `GDV_HW_CURSOR` if H/W cursor is supported by the driver. If `GDV_HW_CURSOR` is defined, you must set the remaining entries in step 22. If not defined, delete the following and skip to the section “[Modify the global.h file to reflect your graphics device capabilities](#)”.
- Step 22. Set `GDV_CURSOR_CREATE` through `GDV_CURSOR_SET_POS` to the names of the functions provided by the device-specific code. The default values are used in most cases. These functions are required by the template.
-

## Modify the `global.h` file to reflect your graphics device capabilities

- 
- Step 1. Modify the `gdv_dev_cap` data structure. Please note, that two of its fields depend on the number of entries in the following data structures.



### Note

This and the following data structures are documented in the MAUI Programming Reference as well as an example in the **Device Capabilities** section of this manual.

- Step 2. Modify the `gdv_res_info` data structure.
- Step 3. Modify the `gdv_cm_info` data structure.
- Step 4. Modify the `gdv_dev_capexten` data structure. Please note, that one of its fields depends on the number of entries in the following data structure.
- Step 5. Modify the `gdv_dev_modes` data structure.
- Step 6. Prototype the functions you need for device-specific code in the `PROTOTYPE` area. This area is used to prototype functions that must be visible to multiple device-specific files.
- 

## Modify the `static.h` file to define your static storage areas.

Now it is time to define the device, logical unit and context specific static storage. You may not be able to completely define all the variables until you get further along with the port, make an attempt to define what you can now, and refine this file as the port proceeds. Steps 2 and 3 define the data per physical device. Step 4 defines the data per logical device. Step 5 defines the data per viewport. Step 6 defines the data per Bit-BLT context (define this structure only in case driver is going to support H/W accelerated Bit-BLT functions).

- 
- Step 1. Modify `HW_SUBTYPE` to define all the sub-types known by the driver. The descriptor determines the sub-type for a specific device. The driver uses this value to make run-time decisions based on the sub-type. This could be helpful, if the same driver has to support several subtypes of graphics controllers, that have a minor differences among each other (e.g. SVGA cards by the same manufacturer).
- Step 2. Modify `GDV_LU_SPECIFICS` with the variable names needed by the driver. This file is setup with the values in `GDV_LU_SPECIFICS_INIT` when the driver is initialized. Also the fields of this structure can be used as a global storage containing the current state of the physical device. This structure should include, but is not limited to the following:
- Address of each bank of graphics memory.
  - Address of groups or individual I/O registers.
  - Place holders for shadow contents of I/O registers.
- Step 3. Modify `GDV_LU_SPECIFICS_INIT` to include the values from the descriptor to compute the initializers. Minimize the number of definitions required in the descriptor to reduce its size.
- Step 4. Modify `GDV_DVATCH_SPECIFICS` to specify the device-specific members of the graphics device structure. This area is allocated and initialized when the graphics device is opened. This data structure should contain enough data to fully define the current state of the graphics device. The following considerations are important when modifying this file:
- The normal `GFX_DEV` and `GFX_DEV_SHARED` structures define the queued-up state of the device, not the current visible state. This allows the application to make any changes to the logical device, which is not on top and not visible, without affecting the physical device. All changes to the hardware will happen only after the device, which is on top, becomes visible and the “update display” function is called.

- The driver needs information about the current visible state whenever this logical device is put on top to set physical device operating mode properly.
- Each time you open the graphics device, a new path to the device is established and a new logical device structure is created. Each logical device maintains its own state so when it is put on top, the physical device should reflect all changes correctly. It is possible to use the `GDV_LU_SPECIFICS` structure to store the current state of the physical graphics device.

- Step 5. Modify `GDV_VPATCH_SPECIFICS` to specify the device-specific members of a viewport. This structure is allocated/initialized when the viewport is created. `GDV_VPATCH_SPECIFICS` maintains information about the current visible state of the viewport. This is similar to the requirements for `GDV_DVATCH_SPECIFICS`.
- Step 6. Modify `GDV_BCATCH_SPECIFICS` to specify the device-specific members of a Bit-BLT context. Define this structure only in the case when the driver is going to support H/W accelerated Bit-BLT functions. This structure is allocated/initialized when the Bit-BLT context is created. `GDV_BCATCH_SPECIFICS` maintains information about the current state of the H/W acceleration registers and provides additional storage per Bit-BLT context, which can be useful for implementing the H/W BLT layer.
- Step 7. Modify `GDV_CPATCH_SPECIFICS` to specify the device-specific members of a H/W cursor structure. Define this structure only in the case when the driver is going to support H/W cursors. This structure is allocated/initialized when the H/W cursor is created. `GDV_CPATCH_SPECIFICS` maintains information about the current state of the H/W cursor registers and provides additional storage per cursor, which can be useful for implementing H/W cursor.
-

## Modify the hardware.h file to reflect your system hardware definitions

---

- Step 1. Modify `hardware.h` to include all necessary hardware related definitions.
- 

## Modify the hardware.c file to initialize your hardware

---

- Step 1. Modify the `hardware.c` file with the following considerations:
- `dr_init_hw()` is called when the device is initialized. This function initializes the hardware and calls `gdv_create_mem_color()` to create a color of memory for each bank of graphics memory.
  - `dr_term_hw()` is called when the device is terminated. Be sure to return any resources allocated in `dr_init_hw()`.
  - `dr_show_topdev()` is called when the changes to the logical device stack have been made (device open/close/restack) in the common portion of the driver `GX_COMM` or when the “update display” function is called. This function updates the physical device state (operational mode, resolution, CLUT) according to the state of the top-most visible logical device in the stack (depending on how many resolutions and pixel depths the driver can support).
  - Different logical devices in the stack require different hardware mode settings. Plus, viewports in the viewport stack can have different CLUT palette settings. `dr_show_topdev()` decides what the current physical device state should be to match it with the top-most visible logical device and the palette of the top-most visible viewport associated with this logical device.

## Modify the static.c file to initialize and terminate static storage areas

---

- Step 1.** Define the function `dr_init_dvatch()`. This function is called when a device is opened. You do not need to allocate the space for the `GDV_DVATCH_SPECIFICS` structure, but you may allocate other structures and point to them from `GDV_DVATCH_SPECIFICS`. Be sure to initialize all members of `GDV_DVATCH_SPECIFICS`.
- If `GDV_INCLUDE_MEM` is defined in `config.h`, call `gdv_create_mem_shade()` to create a shade of memory for each color of graphics memory.
- If `GDV_FE_SYSSTATE` is NOT defined in `config.h`, then permit any address space, which is used to set the graphics device up (e.g. I/O registers). Memory will be permitted for the process which called an “open device” function.
- Step 2.** Define the function `dr_term_dvatch()`. This function is called when a device is terminated. Be sure to de-allocate any resources allocated by the `dr_init_dvatch()` function.
- If `GDV_INCLUDE_MEM` is defined, call `gdv_destroy_mem_shade()` to destroy any shades created in the `dr_init_dvatch()` function.
- If `GDV_FE_SYSSTATE` is NOT defined in `config.h`, make sure you protect any memory space which was permitted in `dr_init_dvatch()`. Memory will be protected from the process which called an “close device” function.
- Step 3.** Define the function `dr_init_vpatch()`. This function is called when a viewport is created. You do not need to allocate the space for the `GDV_VPATCH_SPECIFICS` structure, but you may allocate other structures and point to them from `GDV_VPATCH_SPECIFICS`. Be sure to initialize all of its members.
- Step 4.** Define the function `dr_term_vpatch()`. This function is called when a viewport is terminated. Be sure to deallocate any resources allocated by the `dr_init_vpatch()` function.

- Step 5. If `GDV_INCLUDE_HWBLT` is defined, implement `dr_init_bcatch()` function. This function is called when a Bit-BLT context is created. You do not need to allocate the space for the `GDV_BCATCH_SPECIFICS` structure, but you may allocate other structures and point to them from `GDV_BCATCH_SPECIFICS`. Be sure to initialize all of its members.
- Step 6. If `GDV_INCLUDE_HWBLT` is defined, implement `dr_term_vpatch()` function. This function is called when a Bit-BLT context is terminated. Be sure to deallocate any resources allocated by the `dr_init_bcatch()` function.
- 

## Modify the remaining display functions

---

- Step 1. Modify the display functions in the following files only if they are supported by your hardware.
- `dvbkcol.c` sets the background color for the display.
  - `dvextvid.c` sets external video on and off.
  - `dvtran.c` sets transparent color.
  - `dvvpmix.c` sets viewport mixing on and off.
- 

## Modify the remaining viewport functions

---

- Step 1. Modify the viewport functions in the following files. All of these functions are mandatory, and must be included.
- `updtcpy.c` updates the display with queued changes and optionally synchronizes changes with vertical retrace.

- `vpdmap.c` sets the drawmap area to be displayed in a viewport.
- `vpdmpos.c` sets the position of the drawmap in the viewport.
- `vppos.c` sets the position of the specified viewport.
- `vprestack.c` restacks a viewport within the viewport stack.
- `vpsize.c` sets the size of the specified viewport.
- `vpstate.c` sets the state of the specified viewport to active or not active.

**Step 2.** Modify the viewport functions in the following files only if they are supported by your hardware.

- `hwcur.c` enables driver-supported H/W cursor.
- `irq.c` defines interrupt service functions.
- `vpintens.c` sets the intensity of the specified viewport.

**Step 3.** Modify the following file only if either I/O BLT functions, or H/W BLT functions or both are supported by your hardware.

- `iobltd.c` enables driver-supported Bit-BLT (using I/O registers).
  - `hwbltd.c` enables driver-supported Bit-BLT (using H/W acceleration).
-

## How to Build your Graphics Driver

---

Step 1. Change directories to *MAKE* directory:

```
cd MWOS/OS/CPU/PORTS/YOURPORT/MAUI/GX_YOURDRV
```

Step 2. To make both the graphics driver and descriptor, type:

```
os9make
```

The makefile invokes `desc.mak` and `drvvr.mak`

To make only the graphics descriptor, type:

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

The `desc.mak` makefile builds the graphics descriptor and places it in the directory `YOURPORT/CMDS/BOOTOBS/MAUI`.

To make only the graphics driver, type:

```
os9make -f drvvr.mak
```

The `drvvr.mak` builds the graphics driver and places it in the directory `YOURPORT/CMDS/BOOTOBS/MAUI`.

---

## How to Test Your Driver

---

Run the demo programs included with MAUI on your target platform to test your driver. Demo program sources are located below the following directory:

`MWOS/SRC/MAUI/DEMOS`

Demo program objects are located in the following directory:

`MWOS/OS/CPU/CMDS/MAUIDEMO`



### Note

These demos are not designed to be a comprehensive test of the graphics driver.

---



---

## Chapter 3: Input

---

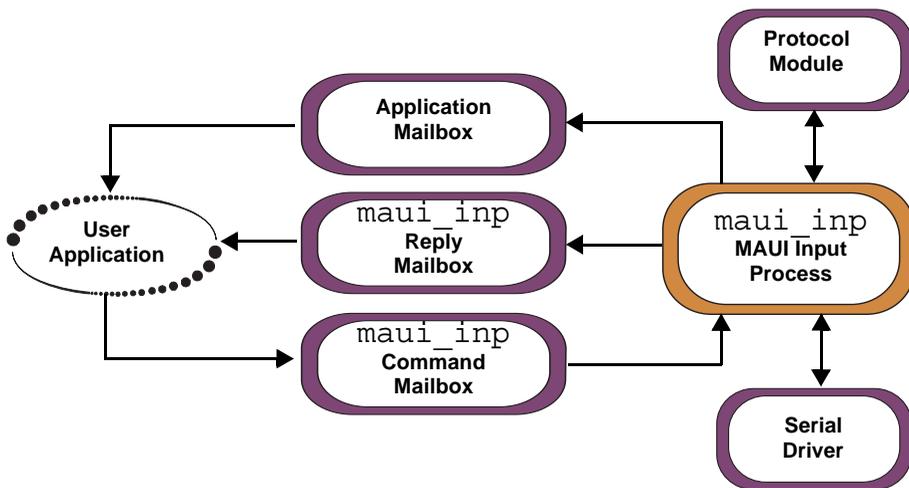
The MAUI Input System (MIS) provides an abstraction layer between the application and the raw serial output from the input hardware and their drivers. This abstraction layer insulates the applications from many of the hardware differences between target systems. The MIS provides key code translation, asynchronous messaging, pointer and key simulation, and device arbitration. This chapter explains how to build, modify, and verify MAUI Input Process Protocol modules.



## Overview

The MAUI Input System (MIS) consists of several components; the INP API, the MAUI Input Process (`maui_inp`), and the MAUI Input Process Protocol Modules (MPPMs). The `maui_inp` components, protocol modules, and the relationship to other components in a typical MAUI application are depicted in [MAUI Input Process System Diagram](#).

**Figure 3-1 MAUI Input Process System Diagram**



## Input API

The INP API handles all communication between the application and the `maui_inp` process. Although the communication between the API and `maui_inp` take place via messaging, this is transparent to the application. When each application initializes the INP API, the API creates a uniquely named Reply Mailbox. It then opens the `maui_inp` Command Mailbox and sends an `init` message to inform `maui_inp` that it is there. When an application opens an input device, the pathname specifies both the name of the serial device and protocol (MPPM) to use.

## MAUI Input Process

`maui_inp` provides routing, connection management, and message handling services. The `maui_inp` process is responsible for managing multiple applications, simultaneously using multiple input devices, with many different protocols. `maui_inp` monitors which applications are using the INP API and keeps track of which applications have open paths to which input sources. When data is received, the `maui_inp` process applies the appropriate protocol to the appropriate device, depending on which application has the focus for that device. When multiple applications open the same device with the same protocol, `maui_inp` also provides key reservation.

`maui_inp` is hardware and protocol independent. It uses MAUI Input Process Protocol Modules (MPPMs) to insulate it from hardware and protocol differences between ports.

When `maui_inp` starts, it creates a single Command Mailbox named `mp_mbox`. All messages from the INP API to `maui_inp` and the MPPMs are sent to this Command Mailbox. `maui_inp` replies to these messages via a Reply Mailbox that is created by the application's INP API.

## MAUI Input Protocol Modules

The MAUI Input Process Protocol Modules (MPPMs) provide the command control and response, as well as data interpretation. MPPMs are generally hardware independent (that is the job of drivers), but protocol dependent.

MPPMs are implemented as raw subroutine modules. In the interest of minimizing the overhead of calling MPPM functions, these modules are called directly without correcting the static or constant storage pointers. As such, they do not have any memory of their own. They operate completely on the stack of the process that calls them, in this case `maui_inp`. **Static and global variables are not allowed in MPPMs.** Use of variables that are not allocated on the stack can severely damage `maui_inp`'s internal data structures. If your MPPM requires persistent memory, include those variables in the `PMEM` structure.

OEMs are encouraged to take the basic MPPM examples, and modify them as appropriate for their input devices.



---

**WARNING**

Static and global variables are not allowed in MPPMs.

---

## Where the Files are Located

---

MAUI header files are located in:

```
MWOS/SRC/DEFS/MAUI
```



---

### WARNING

These header files should never be modified by the user.

---

There are several example source directories of MPPMs. Two basic MPPMs are:

```
MWOS/SRC/MAUI/MP/MP_KYBRD
```

```
MWOS/SRC/MAUI/MP/MP_MSPTR
```

MP\_KYBRD is example source code for a key device, specifically, a serial port connected to a VT100 terminal or communications program.

MP\_MSPTR is example source code for a pointer device, specifically a two-button Microsoft®-compatible type M mouse. See your release notes for a complete list and description of what protocol modules are included in your package. Depending on the type of your device (key or pointer), pick one of the example MPPMs as your starting point.

Within the above source directories are the following source files:

- `_key.h` port-specific header definitions.
- `init.c` initialize static memory and register processes.
- `mppmstrt.a` sub-routine entry point table.
- `procddata.c` interprets device data.
- `procmsg.c` process commands from `maui_inp`.
- `term.c` un-register processes.

## How to Port Your Protocol Module

---

The first step in porting to a new input device is to determine what kind of device is being ported. MAUI divides input devices into three classes, key devices, pointer devices and a hybrid (combination pointer and key) device.

A key device generates key symbol data. Examples include keyboards and remote controls.

A pointer device generates coordinate information, either absolute or relative. They may also have buttons. Examples include mice, joysticks, touchscreens, rollerballs, pens, and tablets.

The third class of device is a hybrid device. This device can generate both coordinate information and key symbol information.

### Porting a Key Device

For key devices, use the `MP_KYBRD` example located in the following directory:

```
MWOS/SRC/MAUI/MP/MP_KYBRD
```

### Create the directory structure for your port

Before beginning to port your protocol module, you must create a directory structure to store your new files.

- 
- Step 1. Define and create a source directory. This directory is referred to in this chapter as *SOURCE* and assumes the pathname:  
`MWOS/SRC/MAUI/MP/SOURCE`
- Step 2. Copy all of the files from:  
`MWOS/SRC/MAUI/MP/MP_KYBRD`  
into your new *SOURCE* directory. Verify the following files are now in your *SOURCE* directory:

|                          |  |
|--------------------------|--|
| <code>_key.h</code>      | port-specific header definitions.                |
| <code>init.c</code>      | initialize static memory and register processes. |
| <code>mppmstrt.a</code>  | sub-routine entry point table.                   |
| <code>procddata.c</code> | interprets device data.                          |
| <code>procmsg.c</code>   | process commands from <code>maui_inp.</code>     |
| <code>term.c</code>      | un-register processes.                           |

Step 3. Define and create a ports directory. This directory is referred to in this chapter as *YOURPORT* and assumes the pathname:

```
MWOS/OS/CPU/PORTS/YOURPORT
```

Step 4. Define and create a *MP\_YOURMPPM* directory. This directory is referred to in this chapter as *MP\_YOURMPPM* and assumes the pathname:

```
MWOS/OS/CPU/PORTS/YOURPORT/MAUI/MP_YOURMPPM
```

Step 5. Create the following file in *MP\_YOURMPPM*

```
makefile                                Make the MPPM

# Makefile
#*****
#* This makefile builds a MAUI Input Process Protocol Module
#*****
#* Copyright 1995 by Microware Systems Corporation                **
#* Copyright 2001 by RadiSys Corporation                          **
#* Reproduced Under License                                       **
#*                                                                 **
#* This source code is the proprietary confidential property of   **
#* Microware Systems Corporation, and is provided to licensee    **
#* solely for documentation and educational purposes. Reproduction, **
#* publication, or distribution in any form to any party other than **
#* the licensee is strictly prohibited.                           **
#*****

PORT      =    ../..

TRGTS     =    mp_kybrd

USER_OPTS =
USER_HEADERS =
USER_RFILES =
USER_LIBS =

include $(PORT)/../make.com
```

```

ODIR = $(PORT)/CMDS/BOOTOBSJS/MAUI
SDIR = $(MWOS)/SRC/MAUI/MP/MP_KYBRD
RDIR = RELS
IDIR = $(RDIR)/$(HOSTTYPE)

```

```
include $(SDIR)/../pmod.com
```

```

#
# Put USER_RFILES rules (if any) here
#

```

---

## **\_key.h**

This file defines the default settings for the protocol module.

For a key device, you normally only change the `DEV_CAP_*` definitions. These definitions are used to fill out the `INP_DEV_CAP` structure.

The `PMEM` structure is the static memory for the protocol module. It is allocated by `maui_inp` on behalf of the protocol module for each opened device. Extend this field if you have additional memory requirements.

## **init.c**

This file has two entry points, `mppm_initsize()` and `mppm_init()`. Normally, no changes are required in this file.

## **mppmstrt.a**

This assembly source file contains the subroutine module entry point table.




---

## **WARNING**

Do not modify `mppmstrt.a`

---

## procddata.c

This file contains the functions necessary to process raw data from the input device and build key and pointer messages.

`mppm_process_data()` is this file's only external entry point. This function is called whenever there is data to be processed.

For key devices, there is usually only one section to modify in `procddata.c`. That section parses the raw input data and translates that data into standardized key symbol data.

```
/* fill keybuf */
key =>(*buf)++;
(*buf_size)--;

/* do any required key translation */
switch (key) {
    case 0x7f: key= INP_KEY_CLEAR; break;
    case 0x80: key= INP_KEY_PLAY; break;
    case 0x81: key= INP_KEY_STOP; break;
    case 0x82: key= INP_KEY_PAUSE; break;
    case 0x85: key= INP_KEY_REWIND; break;
    case 0x86: key= INP_KEY_FASTFWD; break;
    case 0x88: key= INP_KEY_CUR_U; break;
    case 0x89: key= INP_KEY_CUR_D; break;
    case 0x8a: key= INP_KEY_CUR_R; break;
    case 0x8b: key= INP_KEY_CUR_L; break;
    case 0x91: key= INP_KEY_LASTCHAN; break;
    case 0x92: key= INP_KEY_EXIT; break;
    case 0x94: key= INP_KEY_STORE; break;
    case 0x99: key= INP_KEY_CHAN_U; break;
    case 0x9a: key= INP_KEY_CHAN_D; break;
    case 0x9c: key= INP_KEY_MENU; break;
    case 0x9d: key= INP_KEY_VIP; break;
    case 0x9e: key= INP_KEY_VDT; break;
    case 0xac: key= INP_KEY_VOL_U; break;
    case 0xad: key= INP_KEY_VOL_D; break;
    case 0xae: key= INP_KEY_MUTE; break;
    case 0xed: key= INP_KEY_RECORD; break;
}
```

Modify this section to parse and translate the data from your input device. The above example code is based on a remote that generates single-byte key data. Other remotes may require more translation. If you have more keys that require translation, you may wish to use a translation table rather than a `switch` statement.

If you have a multi-byte input packet, you can find an example of how to deal with incomplete packets in `procddata.c` of `MP_MSPTR`.

## **procmmsg.c**

This file contains all the functions necessary for processing messages from `maui_inp`.

`mppm_process_msg()` is this file's only external entry point. `mppm_process_msg()` routes a message to the appropriate function (listed next) based on the command code found in the `cmd_msg->any.dcom.cmd` variable.

```
static error_code cmd_get_dev_cap();
static error_code cmd_get_dev_status();
static error_code cmd_set_ptr_pos();
static error_code cmd_set_sim_meth();
static error_code cmd_set_ptr_limit();
static error_code cmd_set_msg_callback();
static error_code cmd_set_msg_mask();
static error_code cmd_release_key();
static error_code cmd_reserve_key();
static BOOLEAN cmd_check_keys();
```

Usually, the only function you need to modify is `cmd_check_keys()`. Modify this function to return `TRUE` for key ranges present on the device.

## **term.c**

This file contains the functions for terminating the use of this protocol module. The two entry points are `mppm_term()` and `mppm_detach()`. Normally, no changes are required for this file.

## Porting a Pointer Device

For pointer devices, use the `MP_MSPTR` example located in the following directory:

```
MWOS/SRC/MAUI/MP/MP_MSPTR
```

### Create the directory structure for your port

Before beginning to port your protocol module, you must create a directory structure to store your new files.

---

**Step 1.** Define and create a source directory. This directory is referred to in this chapter as *SOURCE* and assumes the pathname:

```
MWOS/SRC/MAUI/MP/SOURCE
```

**Step 2.** Copy all of the files from:  
`MWOS/SRC/MAUI/MP/MP_MSPTR`  
 into your new *SOURCE* directory. Verify the following files are now in your *SOURCE* directory:

|                          |  |
|--------------------------|--|
| <code>_key.h</code>      | port-specific header definitions.                |
| <code>init.c</code>      | initialize static memory and register processes. |
| <code>mppmstrt.a</code>  | sub-routine entry point table.                   |
| <code>procddata.c</code> | interprets device data.                          |
| <code>procmmsg.c</code>  | process commands from <code>maui_inp</code> .    |
| <code>term.c</code>      | un-register processes.                           |

**Step 3.** Define and create a ports directory. This directory is referred to in this chapter as *YOURPORT* and assumes the pathname:

```
MWOS/OS/CPU/PORTS/YOURPORT
```

**Step 4.** Define and create a *MP\_YOURMPPM* directory. This directory is referred to in this chapter as *MP\_YOURMPPM* and assumes the pathname:

```
MWOS/OS/CPU/PORTS/YOURPORT/MAUI/MP_YOURMPPM
```

## Step 5. Create the following file in *MP\_ YOURMPPM*

```

makefile                                Make the MPPM

# Makefile
#*****
#* This makefile builds a MAUI Input Process Protocol Module
#*****
#* Copyright 1995 by Microware Systems Corporation                **
#* Copyright 2001 by RadiSys Corporation                          **
#* Reproduced Under License                                       **
#*                                                                 **
#* This source code is the proprietary confidential property of   **
#* Microware Systems Corporation, and is provided to licensee    **
#* solely for documentation and educational purposes. Reproduction, **
#* publication, or distribution in any form to any party other than **
#* the licensee is strictly prohibited.                           **
#*****

PORT      =    ../..

TRGTS     =    mp_msptr

USER_OPTS =
USER_HEADERS =
USER_RFILES =
USER_LIBS =

include $(PORT)/../make.com

ODIR      =    $(PORT)/CMDS/BOOTOBS/MAUI
SDIR      =    $(MWOS)/SRC/MAUI/MP/MP_MSPTM
RDIR      =    RELS
IDIR      =    $(RDIR)/$(HOSTTYPE)

include $(SDIR)/../pmod.com

#
# Put USER_RFILES rules (if any) here
#

```

### \_key.h

This file defines the default settings for the protocol module. Modify the `DEV_CAP_*` definitions to reflect the capabilities of your device. These definitions are used to fill out the `INP_DEV_CAP` structure.

Modify the `PMEM` structure if you have additional memory requirements. The `PMEM` structure is the static memory for the protocol module. It is allocated by `maui_inp` on behalf of the protocol module for each opened device.

Modify `NUM_IMSG` based on the number of messages that can be queued. This is usually `(DEV_CAP_PTR_BUTTONS+1)`.

Modify `NUM_PKT_BUF` based on the size of a data packet. In the `MP_MSPTTR` example, this is three bytes because the mouse generates three byte packets. This definition is used to determine the size of `pktbuf` in `PMEM`.

## **init.c**

This file has two entry points, `mppm_initsize()` and `mppm_init()`. Normally, no changes are required in this file.

## **mppmstrt.a**

This assembly source file contains the subroutine module entry point table.



---

### **WARNING**

Do not modify `mppmstrt.a`!

---

## **procdta.c**

This file contains all functions necessary to process raw data from the input device and build key and pointer messages.

`mppm_process_data()` is this file's only external entry point. This function is called whenever there is data to be processed.

First modify the section that builds a complete mouse packet in the packet buffer. Modify this section to synchronize and packetize the raw data from your input device.

```

/*****
**
* build a mouse packet in the packet buffer
*****/

/* If on 1st byte of packet, advance 1 byte at a time
until we get a good start byte (bit 6 set to 1) */
if (pmem->pktcnt == 0)
{
    while (*buf_size && !(*(*buf)&1<<6))
    {
        (*buf)++;/* advance buffer pointer */
        (*buf_size)--;/* decrement buffer counter */
    }
}

/* fill pktbuf */
while (*buf_size && pmem->pktcnt < 3)
{
    pmem->pktbuf[pmem->pktcnt++] = *(*buf)++;
    (*buf_size)--;
}

/* if the packet is not complete, leave until it is */
if (pmem->pktcnt < 3)
{
    *inp_msg = NULL;/* don't send a msg yet */
    return SUCCESS;
}

```

The next section decodes the button and coordinates data from the packet. Modify this section to decode your data packet into button and coordinate information.

```

/*****
* decode the mouse data packet
*****/

/* save off the old position */
old_x = status->ptr_cur.x;
/* compute the new position */
status->ptr_cur.x += (int8)((pmem->pktbuf[0] << 6)
    & 0xc0) | (pmem->pktbuf[1] & 0x3f));
/* keep it in bounds */

```

```
LIMIT (status->ptr_cur.x, status->ptr_min.x,
        status->ptr_max.x);
/* compute the real change */
new_x_delta = status->ptr_cur.x - old_x;

/* save off the old position */
old_y = status->ptr_cur.y;

/* compute the new position */
status->ptr_cur.y += (int8)(((pmem->pktbuf[0] << 4)
        & 0xc0) | (pmem->pktbuf[2] & 0x3f));
/* keep it in bounds */
LIMIT (status->ptr_cur.y, status->ptr_min.y,
        status->ptr_max.y);
/* compute the real change */
new_y_delta = status->ptr_cur.y - old_y;

/* grab the new button state */
new_button_state = ((pmem->pktbuf[0] >> 5) & 1)
        | ((pmem->pktbuf[0] >> 3) & 2);
button_change = status->button_state ^ new_button_state;
status->button_state = new_button_state;
```

## procmmsg.c

This file contains all functions necessary for processing messages from `maui_inp`.

`mppm_process_msg()` is this file's only external entry point.

`mppm_process_msg()` routes a message to the appropriate function (listed below) based on the command code found in the `cmd_msg->any.dcom.cmd` variable. For pointer devices, functions in this file usually do not need modification.

```
static error_code cmd_get_dev_cap();
static error_code cmd_get_dev_status();
static error_code cmd_set_ptr_pos();
static error_code cmd_set_sim_meth();
static error_code cmd_set_ptr_limit();
static error_code cmd_set_msg_callback();
static error_code cmd_set_msg_mask();
static error_code cmd_release_key();
static error_code cmd_reserve_key();
static BOOLEAN cmd_check_keys();
```

## term.c

This file contains functions for terminating the use of this protocol module. The two entry points are `mppm_term()` and `mppm_detach()`. Normally, no changes are required in this file.

## How to Build Your Protocol Module

---

Step 1. Change directories to *MP\_YOURMPPM* directory:

```
cd MP_YOURMPPM
```

Step 2. To make the protocol module, type:

```
os9make
```

---

## How to Test Your Protocol Module

---

Use the Input API to exercise the protocol module.

### Testing Key Devices

Verify that `inp_check_keys()` returns true for all keys on the device.  
Verify that each key returns the proper key code.

### Testing Pointer Devices

Verify the protocol module responds correctly to events such as simultaneous movement and button presses.

## Input Protocol Module Entry Points

---

MAUI Input Process Protocol Modules (MPPMs) have seven entry points. This section describes each entry point and their responsibilities.

### Summary of MAUI Hardware-Layer Functions

**Table 3-1** contains a list of all MAUI hardware-layer functions.

**Table 3-1 MPPM Entry Point Functions**

| Function                         | Description   |
|----------------------------------|---|
| <code>mppm_attach()</code>       | attaches a device.  |
| <code>mppm_detach()</code>       | detaches a device.  |
| <code>mppm_init()</code>         | initializes a device.                                       |
| <code>mppm_initsize()</code>     | gets the protocol module's static memory size requirements. |
| <code>mppm_process_data()</code> | interprets device data.                                     |
| <code>mppm_process_msg()</code>  | processes command messages.                                 |
| <code>mppm_term()</code>         | terminates device.  |

## Location of MAUI Hardware-Layer Functions

MAUI hardware-layer functions are located in the files shown in [Table 3-2](#).

**Table 3-2 Location of MPPM Entry Points**

| Function                         | File Name                |
|----------------------------------|--------------------------|
| <code>mppm_attach()</code>       | <code>init.c</code>      |
| <code>mppm_detach()</code>       | <code>term.c</code>      |
| <code>mppm_init()</code>         | <code>init.c</code>      |
| <code>mppm_initsize()</code>     | <code>init.c</code>      |
| <code>mppm_process_data()</code> | <code>procddata.c</code> |
| <code>mppm_process_msg()</code>  | <code>procmmsg.c</code>  |
| <code>mppm_term()</code>         | <code>term.c</code>      |

## mppm\_attach()

Attaches to a Device

---

### Syntax

```
#include <mppm.h>
error_code mppm_attach(MP_DEV *mp_dev);
```

### Description

`mppm_attach()` notifies a protocol module that a new device has been opened.

`mppm_attach()` is called when an application calls `inp_open_dev()`.

### Parameters

`mp_dev` points to the data structure that represents an opened input device path.

### Direct Errors

`SUCCESS (0)` if no error occurred.

### See Also

`inp_open_dev()` (See *MAUI Programming Reference Manual*)

`MP_DEV`

## mppm\_detach()

Detaches Device

---

### Syntax

```
#include <mppm.h>
error_code mppm_detach(MP_DEV *mp_dev);
```

### Description

`mppm_detach()` notifies the protocol module that an application has closed the input device. `mppm_detach()` is called by `maui_inp` when an application calls `inp_close_dev()` or `inp_term()`.

`mppm_detach()` releases any reserved keys for the calling application before closing the device.

### Parameters

`mp_dev` points to the data structure that represents an opened input device path.

### Direct Errors

SUCCESS (0) if no error occurred.

### See Also

MSG\_CLOSE\_DEV (See *MAUI Programming Reference Manual*)

MSG\_INP\_TERM (See *MAUI Programming Reference Manual*)

[MP\\_DEV](#)

## mppm\_init()

Initializes Static Memory

---

### Syntax

```
#include <mppm.h>
error_code mppm_init(MP_MPPM *mppm,
    void *mem_buf, size_t mem_size);
```

### Description

`mppm_init()` initializes the protocol module's static memory `mem_buf`. `mppm_init()` is called by `maui_inp` after `maui_inp` allocates the amount of memory specified by `maui_initsize()`.

### Parameters

|                       |   |
|-----------------------|---|
| <code>mppm</code>     | points to a data structure that points to the device and protocol module.   |
| <code>mem_buf</code>  | points to the protocol module's static memory. <code>mem_buf</code> is allocated and attached to <code>mppm</code> by <code>maui_inp</code> . |
| <code>mem_size</code> | contains the size of the protocol module's static memory as returned by <code>mppm_initsize()</code> .  |

### Direct Errors

`SUCCESS(0)` if no error occurred.

### See Also

`inp_init()` (See *MAUI Programming Reference Manual*)

`mppm_initsize()`

`MP_MPPM`

## mppm\_initsize()

### Gets Static Memory Requirements

---

#### Syntax

```
#include <mppm.h>
error_code mppm_initsize(MP_MPPM *mppm,
    size_t *mem_size);
```

#### Description

`mppm_initsize()` returns the protocol module's static memory size requirements in `mem_size`. This call also sets the protocol module's compatibility level in the `mppm` structure.

`mppm_initsize()` is called by `maui_inp` upon receipt of a `MSG_INP_INIT` message.

#### Parameters

|                       |   |
|-----------------------|---|
| <code>mppm</code>     | points to a data structure that contains information on the static memory space required. |
| <code>mem_size</code> | contains the size of the protocol module's static memory.                                 |

#### Direct Errors

OS-9/OS-9000 error code or `SUCCESS(0)` if no error occurred.

#### See Also

[mppm\\_init\(\)](#)

`MSG_INP_INIT` (See *MAUI Programming Reference Manual*)

[MP\\_MPPM](#)

## mppm\_process\_data()

Interprets Device Data

---

### Syntax

```
#include <mppm.h>
error_code mppm_process_data(MP_MPPM *reply_mppm,
    u_char **buf,
    size_t *buf_size,
    MSG_MBOX_ID *mbox_id,
    INP_MSG **reply_msg);
```

### Description

`mppm_process_data()` receives raw data from the SCF device in `buf`, then returns standardized key and pointer messages in `reply_msg`.

### Parameters

|                       |  |
|-----------------------|--|
| <code>mppm</code>     | points to the current device and protocol module static memory associated with the data.   |
| <code>buf</code>      | points to the buffer where the raw data is stored. <code>buf</code> is updated to the next unprocessed byte at the conclusion of this call.                                    |
| <code>buf_size</code> | contains the number of bytes of data available for processing. <code>buf_size</code> is updated with the number of unprocessed bytes remaining at the conclusion of this call. |
| <code>mbox_id</code>  | is set to an alternative mailbox ID if the message in <code>reply_msg</code> needs to be redirected (for example, key reservations).   |

`reply_msg`

the `maui_inp` process forwards the message to the application's mailbox if this pointer is not NULL.

### Direct Errors

OS-9/OS-9000 error code or `SUCCESS(0)` if no error occurred.

`EOS_UNFINISHED` returned when `mppm_process_data()` needs to be recalled to complete a task.

`EOS_READ` returned when there is an error interpreting incoming data.

### See Also

`INP_MSG` (See *MAUI Programming Reference Manual*)

`MP_MPPM`

`MSG_MBOX_ID` (See *MAUI Programming Reference Manual*)

## mppm\_process\_msg()

### Processes Command Messages

---

#### Syntax

```
#include <mppm.h>
error_code mppm_process_msg(MP_MPPM *mppm,
    MP_DEV_MSG *cmd_msg,
    MP_DEV_MSG **reply_msg);
```

#### Description

`mppm_process_msg()` processes all device command messages.

#### Parameters

|                        |   |
|------------------------|---|
| <code>mppm</code>      | points to the current device and protocol module static memory associated with the message. |
| <code>cmd_msg</code>   | points to a structure containing the device command message.                                |
| <code>reply_msg</code> | if not set to <code>NULL</code> when this function returns, it points to the reply message. |

#### Direct Errors

`OS-9/OS-9000` error code or `SUCCESS (0)` if no error occurred.

`EOS_MAUI_BADACK` returned when command code is not understood.

#### See Also

[MSG\\_GET\\_DEV\\_CAP](#)  
[MSG\\_GET\\_DEV\\_STATUS](#)  
[MSG\\_SET\\_PTR\\_POS](#)  
[MSG\\_SET\\_SIM\\_METH](#)  
[MSG\\_SET\\_PTR\\_LIMIT](#)  
[MSG\\_RESERVE\\_KEY](#)  
[MSG\\_RELEASE\\_KEY](#)  
[MSG\\_SET\\_MSG\\_MASK](#)

```
MSG_SET_MSG_CALLBACK  
MP_DEV_MSG  
MP_MPPM
```

## mppm\_term()

Terminates Process

---

### Syntax

```
#include <mppm.h>
error_code mppm_term(MPPM *mppm);
```

### Description

`mppm_term()` is called by `maui_inp` upon receipt of a `MSG_INP_TERM` message.

### Parameters

|                   |  |
|-------------------|--|
| <code>mppm</code> | points to the current device and protocol module static memory associated with the data. |
|-------------------|--|

### Direct Errors

OS-9/OS-9000 error code or `SUCCESS (0)` if no error occurred.

### See Also

`MSG_INP_TERM` (See *MAUI Programming Reference Manual*)  
[MP\\_MPPM](#)

## Functional Data Reference

---

This section gives a detailed reference for each of the data types in this interface. These are the only data types defined and recognized by this interface.

**Table 3-3 Data Structures/Data Types**

| <b>Name</b>             | <b>Description</b>              |
|-------------------------|---------------------------------|
| <a href="#">MP_DEV</a>  | Input device path/mailbox data  |
| <a href="#">MP_MPPM</a> | Device and protocol module data |

## Syntax

```
#include <mppm.h>
typedef struct _MP_DEV
{
    u_int32 sync_code; /* syn code - _MP_DEV_SYNC */
    MP_PROC *proc; /* owner proc */
    MP_DEV *proc_next_dev; /* proc linked list */
    MP_MPPM *mppm; /* device and pmod */
    MP_DEV *mppm_next_dev; /* mppm linked list */
    MSG_MBOX_ID app_mbox_id; /* mbox to send msgs */
    INP_DEV_ID device_id; /* ID to return in PTR */
    /* and KEY messages */
} MP_DEV;
```

## Description

This data structure represents an opened input device path and is seen by the Input API as `MP_DEV_ID`.

## See Also

`INP_DEV_ID` (See *MAUI Programming Reference Manual*)

`MP_DEV_ID`

`MP_PROC_ID`

`MSG_MBOX_ID` (See *MAUI Programming Reference Manual*)

`MSG_INP_TERM` (See *MAUI Programming Reference Manual*)

`MP_MPPM`

## MP\_MPPM

### Device and Protocol Module Data

#### Syntax

```
#include <mppm.h>
typedef struct _MP_MPPM
{
    u_int32 maui_inp_compat_level; /* maui_inp level */

    /* owner info */
    MP_DEV *mp_dev_head; /* current mbox */
    MP_MPPM *next; /* next mbox */
    MP_MPPM *prev; /* previous mbox */

    /* raw device info */
    path_id dev_path; /* device path id */
    char dev_type; /* device type */
    char dev_name[INP_MAX_DEV_NAME];
        /* device name */

    /* protocol module info */
    u_int32 pmod_compat_level; /* pmod level */
    mh_com *pmod_head; /* pmod module header */
    char pmod_name[INP_MAX_DEV_NAME];
        /* pmod name */
    void *pmod_mem; /* pmod static mem */
    void *pmod_functable; /* pmod entry points */
} MP_MPPM;
```

#### Description

This data structure represents each unique combination of device path and protocol module. MPPMs use this structure to find their static memory space (`pmod_mem`).

#### See Also

INP\_MAX\_DEV\_NAME (See *MAUI Programming Reference Manual*)

MP\_DEV

## Message reference

---

This section provides a complete reference for each of the command and reply messages handled by `mppm_process_msg`.

**Table 3-4** `mppm_process_msg`

| <b>Command</b>                    | <b>Description</b>            |
|-----------------------------------|-------------------------------|
| <code>MSG_CHECK_KEYS</code>       | checks for existence of keys. |
| <code>MSG_GET_DEV_CAP</code>      | gets device capabilities.     |
| <code>MSG_GET_DEV_STATUS</code>   | gets device status.           |
| <code>MSG_RELEASE_KEY</code>      | releases a reserved key.      |
| <code>MSG_RESERVE_KEY</code>      | reserves a key for a process. |
| <code>MSG_RESTACK_DEV</code>      | restacks an input device.     |
| <code>MSG_SET_SIM_METH</code>     | sets pointer simulation mode. |
| <code>MSG_SET_MSG_CALLBACK</code> | sets message callback.        |
| <code>MSG_SET_MSG_MASK</code>     | sets message write mask.      |
| <code>MSG_SET_PTR_LIMIT</code>    | sets pointer limit.           |
| <code>MSG_SET_PTR_POS</code>      | sets pointer position.        |

## MSG\_CHECK\_KEYS

Checks if Key Exists

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_CHECK_KEYS
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_CHECK_KEYS */
    wchar_t min_key; /* first key symbol to */
                  /* reserve */
    wchar_t max_key; /* last key symbol to reserve */
} MSG_CHECK_KEYS;
```

### Syntax Reply Structure

```
typedef struct _MSG_CHECK_KEYS_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_CHECK_KEYS_REPLY */
    BOOLEAN present; /* return TRUE if all present */
    error_code error; /* return error code */
} MSG_CHECK_KEYS_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_check_keys()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

### See Also

`inp_check_keys()` (See ***MAUI Programming Reference Manual***)

`MSG_COMMON_MPCMD`

`MSG_GET_DEV_CAP`

`BOOLEAN` (See ***MAUI Programming Reference Manual***)

## MSG\_GET\_DEV\_CAP

Gets Device Capabilities

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_GET_DEV_CAP
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_GET_DEV_CAP */
} MSG_GET_DEV_CAP;
```

### Syntax Reply Structure

```
typedef struct _MSG_GET_DEV_CAP_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_GET_DEV_CAP_REPLY */
    INP_DEV_CAP cap; /* device information */
    error_code error; /* return error code */
} MSG_GET_DEV_CAP_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_get_dev_cap()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

### See Also

`inp_get_dev_cap()` (See *MAUI Programming Reference Manual*)

`INP_DEV_CAP` (See *MAUI Programming Reference Manual*)

`MSG_COMMON_MPCMD`

## MSG\_GET\_DEV\_STATUS

Gets Device Status

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_GET_DEV_STATUS
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_GET_DEV_STATUS */
} MSG_GET_DEV_STATUS;
```

### Syntax Reply Structure

```
typedef struct _MSG_GET_DEV_STATUS_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_GET_DEV_STATUS_REPLY */
    INP_DEV_STATUS status; /* device information */
    error_code error; /* return error code */
} MSG_GET_DEV_STATUS_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_get_dev_status()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

### See Also

`inp_get_dev_status()` (See *MAUI Programming Reference Manual*)

`INP_DEV_STATUS` (See *MAUI Programming Reference Manual*)

`MSG_TYPE_MPCMD`

## MSG\_RELEASE\_KEY

Releases a Reserved Key

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_RELEASE_KEY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_RELEASE_KEYS */
    wchar_t key; /* first key symbol to */
                /* release */
} MSG_RELEASE_KEY;
```

### Syntax Reply Structure

```
typedef struct _MSG_RELEASE_KEY_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_RELEASE_KEYS_REPLY */
    error_code error; /* return error code */
} MSG_RELEASE_KEY_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_release_key()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

`EOS_MAUI_NOTRESERVED` returned when the key is not currently reserved.

`EOS_MAUI_NOHWSUPPORT` returned when the specified key is not supported by the hardware.

### Indirect Errors

`mppm_process_msg()`

**See Also**

`inp_release_key()` (See *MAUI Programming Reference Manual*)

`MSG_TYPE_MPCMD`

`MSG_RESERVE_KEY`

## MSG\_RESERVE\_KEY

Reserves a Key for a Process

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_RESERVE_KEY
{
    MSG_COMMON_MPCMD dcom;
        /* dcom.cmd = CMD_RESERVE_KEY */
    wchar_t key; /* key symbol to reserve */
} MSG_RESERVE_KEY;
```

### Syntax Reply Structure

```
typedef struct _MSG_RESERVE_KEY_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
        /* CMD_RESERVE_KEYS_REPLY */
    error_code error; /* return error code */
} MSG_RESERVE_KEYS_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_reserve_key()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

`EOS_MAUI_ISRESERVED` returned when key is already reserved.  
`EOS_MAUI_NHWSUPPORT` returned when the protocol module does not support key reservation. Most often because the device does not have keys.

### Indirect Errors

`mppm_process_msg()`

**See Also**

`inp_reserve_key()` (See *MAUI Programming Reference Manual*)

`MSG_COMMON_MPCMD`

`MSG_RELEASE_KEY`

## MSG\_RESTACK\_DEV

### Re-stack an Input Device

---

```
#include <mpm.h>
```

#### Syntax Command Structure

```
typedef struct _MSG_RESTACK_DEV {
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = CMD_RESTACK_DEV */
    INP_DEV_PLACEMENT placement; /* placement in stack of */
    /* devices */
    MP_DEV_ID ref_dev_id; /* reference device */
} MSG_RESTACK_DEV;
```

#### Syntax Reply Structure

```
typedef struct _MSG_RESTACK_DEV_REPLY {
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
    /* CMD_RESTACK_DEV_REPLY */
    error_code error; /* return error code */
} MSG_RESTACK_DEV_REPLY;
```

#### Description

This message instructs `maui_inp` to change the placement of the logical input device `dcom->dev_id` within the current stack of logical devices. The following table shows how placement and `ref_dev_id` specify the new position. The Reference Device column indicates when the `ref_dev_id` is applicable. If successful, this device returns `SUCCESS`.

**Table 3-5 Value of Placement in MSG\_RESTACK\_DEV**

| Value of Placement | Reference Device | New Position            |
|--------------------|------------------|-------------------------|
| INP_DEV_FRONT      | Not applicable   | In front of all devices |
| INP_DEV_BACK       | Not applicable   | In back of all devices  |

**Table 3-5 Value of Placement in MSG\_RESTACK\_DEV (continued)**

| Value of Placement | Reference Device        | New Position                     |
|--------------------|-------------------------|----------------------------------|
| INP_DEV_FRONT_OF   | MP_DEV_ID<br>ref_dev_id | In front of device<br>ref_dev_id |
| INP_DEV_BACK_OF    | MP_DEV_ID<br>ref_dev_id | In back of device<br>ref_dev_id  |

### Direct Errors

EOS\_MAUI\_BADID is returned when the ID specified by dcom->dev\_id or ref\_dev\_id is not valid.

EOS\_MAUI\_BADVALUE is returned when placement value is not valid.

EOS\_MAUI\_DAMAGE is returned when maui\_inp has detected inconsistencies in internal data structures.

### Indirect Errors

None

### See Also

inp\_restack\_dev() (See *MAUI Programming Reference Manual*)

[MSG\\_COMMON\\_MPCMD](#)

## MSG\_SET\_SIM\_METH

Sets Simulation Mode

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_SET_SIM_METH
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_CURSOR_SIM */
    INP_SIM_METH sim_meth; /* simulation mode */
    GFX_DELTA speed; /* X/Y speed for simulation */
    wchar_t button_map[INP_MAX_BUTTONS];
                          /* button to key mapping */
} MSG_SET_SIM_METH;
```

### Syntax Reply Structure

```
typedef struct _MSG_SET_SIM_METH_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_CURSOR_SIM_REPLY */
    error_code error; /* return error code */
} MSG_SET_SIM_METH_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_set_sim_meth()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

### See Also

`inp_set_sim_meth()` (See *MAUI Programming Reference Manual*)

`GFX_DELTA` (See *MAUI Programming Reference Manual*)

`INP_CUR_SIM` (See *MAUI Programming Reference Manual*)

`INP_MAX_BUTTONS` (See *MAUI Programming Reference Manual*)

`MSG_COMMON_MPCMD`

`MSG_GET_DEV_STATUS`

## MSG\_SET\_MSG\_CALLBACK

Sets Message Callback

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_SET_MSG_CALLBACK
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_MSG_CALLBACK */
    void (*callback)(const void *msg);
                          /* pointer to callback */
                          /* function */
} MSG_SET_MSG_CALLBACK;
```

### Syntax Reply Structure

```
typedef struct _MSG_SET_MSG_CALLBACK_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd =
                          /*CMD_SET_MSG_CALLBACK_REPLY */
    error_code error; /* return error code */
} MSG_SET_MSG_CALLBACK_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_set_callback()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

[mppm\\_process\\_msg\(\)](#)

### See Also

`inp_set_callback()` (See *MAUI Programming Reference Manual*)

[MSG\\_COMMON\\_MPCMD](#)

## MSG\_SET\_MSG\_MASK

Sets Message Write Mask

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_SET_MSG_MASK
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_MSG_MASK */
    u_int32 write_mask; /* Message write mask */
} MSG_SET_MSG_MASK;
```

### Syntax Reply Structure

```
typedef struct _MSG_SET_MSG_MASK_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd =
                          /* CMD_SET_MSG_MASK_REPLY */
    error_code error; /* return error code */
} MSG_SET_MSG_MASK_REPLY;
```

### Description

This message sets the message write mask and then passes the message to the protocol module via `mppm_process_msg()` when the application calls `inp_set_msg_mask()`.

### Direct Errors

None

### Indirect Errors

`msg_set_mask()` (See *MAUI Programming Reference Manual*)  
[mppm\\_process\\_msg\(\)](#)

### See Also

`inp_set_msg_mask()` (See *MAUI Programming Reference Manual*)

`MSG_COMMON_MPCMD`

## MSG\_SET\_PTR\_LIMIT

Sets Pointer Limit

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_SET_PTR_LIMIT
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_PTR_LIMIT */
    GFX_POINT ptr_min; /* minimum position for the */
                      /* pointer */
    GFX_POINT ptr_max; /* maximum position for the */
                      /* pointer */
} MSG_SET_PTR_LIMIT;
```

### Syntax Reply Structure

```
typedef struct _MSG_SET_PTR_LIMIT_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_PTR_LIMIT_REPLY */
    error_code error; /* return error code */
} MSG_SET_PTR_LIMIT_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `ind_set_ptr_limit()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

### See Also

`inp_set_ptr_limit()` (See *MAUI Programming Reference Manual*)

`GFX_POINT` (See *MAUI Programming Reference Manual*)

`MSG_COMMON_MPCMD`

`MSG_GET_DEV_STATUS`

## MSG\_SET\_PTR\_POS

Sets Pointer Position

```
#include <mppm.h>
```

### Syntax Command Structure

```
typedef struct _MSG_SET_PTR_POS
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_PTR_POS */
    GFX_POINT position; /* New position */
} MSG_SET_PTR_POS;
```

### Syntax Reply Structure

```
typedef struct _MSG_SET_PTR_POS_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                          /* CMD_SET_PTR_POS_REPLY */
    error_code error; /* return error code */
} MSG_SET_PTR_POS_REPLY;
```

### Description

This message is passed directly to the protocol module via `mppm_process_msg()` when an application calls `inp_set_ptr_pos()`.

The protocol module is responsible for formatting the reply.

### Direct Errors

None

### Indirect Errors

`mppm_process_msg()`

**See Also**

[inp\\_set\\_ptr\\_pos\(\)](#) (See *MAUI Programming Reference Manual*)

[GFX\\_POINT](#) (See *MAUI Programming Reference Manual*)

[MSG\\_COMMON\\_MPCMD](#)

[MSG\\_GET\\_DEV\\_STATUS](#)

## MSG\_BADACK\_REPLY

Replies to Bad Messages

---

```
#include <mppm.h>
```

### Syntax Reply Structure

```
typedef struct _MSG_BADACK_REPLY
{
    MSG_COMMON_MPCMD dcom; /* dcom.cmd = */
                        /* CMD_BADACK_REPLY */
    error_code error; /* return error code */
} MSG_BADACK_REPLY;
```

### Description

This message is returned by a protocol module with an error code of `EOS_MAUI_BADACK` when the protocol module does not understand the command code.

### Direct Errors

`EOS_MAUI_BADACK` returned when a command code was not understood.

### Indirect Errors

None

### See Also

[MSG\\_COMMON\\_MPCMD](#)

## Message Data reference

---

This section gives a detailed reference for each of the data types in `mp.h`.

**Table 3-6 Message Data Reference Structures**

| Structure                       | Type             | Description                                       |
|---------------------------------|------------------|---|
| <code>MP_DEV_CMD</code>         | Enumerated       | Message command codes                             |
| <code>MP_DEV_ID</code>          | Data             | Input Device ID                                   |
| <code>MP_DEV_MSG</code>         | Data Structure   | Union of all messages                             |
| <code>MP_MBOX_NAME</code>       | Defined Constant | Name of the <code>maui_inp</code> command mailbox |
| <code>MP_MBOX_REPLY_NAME</code> | Defined Constant | Format string for reply mailbox                   |
| <code>MP_PROC_ID</code>         | Data             | Input Process ID                                  |
| <code>MSG_COMMON_MPCMD</code>   | Data Structure   | Common section of all messages                    |
| <code>MSG_TYPE_MPCMD</code>     | Defined Constant | Message type code                                 |

**MP\_DEV\_CMD****Message Command Codes****Syntax**

```

#include <mppm.h>
typedef enum
{
    CMD_INP_INIT,                /* Register a process */
    CMD_INP_INIT_REPLY,        /* Reply to CMD_INP_INIT */
    CMD_INP_TERM,              /* Un-register a process */
    CMD_INP_TERM_REPLY,        /* Reply to CMD_INP_TERM */
    CMD_OPEN_DEV,              /* Open an input device */
    CMD_OPEN_DEV_REPLY,        /* Reply to CMD_OPEN_DEV */
    CMD_CLOSE_DEV,             /* Close an input device */
    CMD_CLOSE_DEV_REPLY,       /* Reply to CMD_CLOSE_DEV */
    CMD_RESTACK_DEV,           /* Re-stack an input device */
    CMD_RESTACK_DEV_REPLY,     /* Reply to CMD_RESTACK_DEV */
    CMD_SET_MSG_MASK,          /* Set message write mask */
    CMD_SET_MSG_MASK_REPLY,    /* Rply 2CMD_SET_MSG_MASK */
    CMD_CHECK_KEYS,            /* Check if keys exist */
    CMD_CHECK_KEYS_REPLY,      /* Reply to CMD_CHECK_KEYS */
    CMD_GET_DEV_CAP,           /* Get device capabilities */
    CMD_GET_DEV_CAP_REPLY,     /* Reply 2CMD_GET_DEV_CAP */
    CMD_GET_DEV_STATUS,        /* Get device status */
    CMD_GET_DEV_STATUS_REPLY,  /* Reply to CMD_GET_DEV_STATUS */
    CMD_RELEASE_KEY,           /* Release a reserved key */
    CMD_RELEASE_KEY_REPLY,     /* Rply 2 CMD_RELEASE_KEY */
    CMD_RESERVE_KEY,           /* Reserve key for process */
    CMD_RESERVE_KEY_REPLY,     /* Rply 2 CMD_RESERVE_KEY */
    CMD_SET_MSG_CALLBACK,      /* Set message callback */
    CMD_SET_MSG_CALLBACK_REPLY, /* Reply to CMD_SET_MSG_CALLBACK */
    CMD_SET_SIM_METH,          /* Set pointer sim mode */
    CMD_SET_SIM_METH_REPLY,    /* Reply to CMD_SET_CURSOR_SIM */
    CMD_SET_PTR_POS,           /* Set pointer position */
    CMD_SET_PTR_POS_REPLY,     /* Reply 2 CMD_SET_PTR_POS */
    CMD_SET_PTR_LIMIT,         /* Set pointer limit */
    CMD_SET_PTR_LIMIT_REPLY,   /* Rply CMD_SET_PTR_LIMIT */
    CMD_BADACK_REPLY,          /* Reply to bad messages */
} MP_DEV_CMD;

```

**Description**

This enumerated type defines the device message command codes.

## MP\_DEV\_ID

Input Device ID

---

### Syntax

```
#include <mppm.h>
typedef void * MP_DEV_ID;
```

### Description

This data type defines a caller process ID and is returned in MSG\_OPEN\_DEV\_REPLY.

### See Also

MSG\_OPEN\_DEV (See *MAUI Programming Reference Manual*)

**MP\_DEV\_MSG**

## Union of All Messages

**Syntax**

```

#include <mppm.h>
typedef union _DEV_MSG
{
    MSG_INP_INIT                inp_init;
    MSG_INP_INIT_REPLY         inp_init_reply;
    MSG_INP_TERM               inp_term;
    MSG_INP_TERM_REPLY         inp_term_reply;
    MSG_OPEN_DEV               open_dev;
    MSG_OPEN_DEV_REPLY         open_dev_reply;
    MSG_CLOSE_DEV              close_dev;
    MSG_CLOSE_DEV_REPLY        close_dev_reply;
    MSG_RESTACK_DEV            msg_restack_dev;
    MSG_RESTACK_DEV_REPLY      msg_restack_dev_reply;
    MSG_SET_MSG_MASK           set_msg_mask;
    MSG_SET_MSG_MASK_REPLY     set_msg_mask_reply;
    MSG_GET_DEV_CAP            get_dev_cap;
    MSG_GET_DEV_CAP_REPLY      get_dev_cap_reply;
    MSG_GET_DEV_STATUS         get_dev_status;
    MSG_GET_DEV_STATUS_REPLY   get_dev_status_reply;
    MSG_SET_PTR_POS            set_ptr_pos;
    MSG_SET_PTR_POS_REPLY      set_ptr_pos_reply;
    MSG_SET_SIM_METH           set_cursor_sim;
    MSG_SET_SIM_METH_REPLY     set_cursor_sim_reply;
    MSG_SET_PTR_LIMIT          set_ptr_limit;
    MSG_SET_PTR_LIMIT_REPLY    set_ptr_limit_reply;
    MSG_RESERVE_KEY            reserve_key;
    MSG_RESERVE_KEY_REPLY      reserve_key_reply;
    MSG_RELEASE_KEY            release_key;
    MSG_RELEASE_KEY_REPLY      release_key_reply;
    MSG_CHECK_KEYS             check_keys;
    MSG_CHECK_KEYS_REPLY       check_keys_reply;
    MSG_SET_MSG_CALLBACK       set_msg_callback;
    MSG_SET_MSG_CALLBACK_REPLY set_msg_callback_reply;
    MSG_BADACK_REPLY           badack_reply;
    MSG_COMMON_MPCMD           any;
} MP_DEV_MSG;

```

**Description**

This union defines a generic reference to all input device command messages. See the message reference for details of these messages.

## MP\_MBOX\_NAME

Name of maui\_inp's Command Mailbox

---

### Syntax

```
#include <mppm.h>  
MP_MBOX_NAME
```

### Description

This constant defines the name of the `maui_inp` command mailbox.

## MP\_MBOX\_REPLY\_NAME

Format String for Reply Mailbox

---

### Syntax

```
#include <mppm.h>  
MP_MBOX_REPLY_NAME
```

### Description

This constant defines the format string for the reply mailbox.

## MP\_PROC\_ID

Inputs Process ID

---

### Syntax

```
#include <mppm.h>
typedef void * MP_PROC_ID;
```

### Description

This data type defines a caller process ID and is returned in MSG\_INP\_INIT\_REPLY.

### See Also

MSG\_INP\_INIT (See *MAUI Programming Reference Manual*)

## MSG\_COMMON\_MPCMD

Common Section of  
Control Messages

---

### Syntax

```
#include <mppm.h>
typedef struct _MSG_COMMON_MPCMD
{
    MSG_COMMON com;          /* common section of all */
                           /* messages */
    MP_DEV_CMD cmd;         /* Command code of message */
    MP_DEV_ID dev_id;       /* ID of device */
} MSG_COMMON_MPCMD;
```

### Description

This data structure defines the common header at the beginning of all command and reply messages. A message must have this header to be understood by `maui_inp` and its protocol modules.

### See Also

[MP\\_DEV\\_CMD](#)

[MP\\_DEV\\_ID](#)

`MSG_COMMON` (See *MAUI Programming Reference Manual*)

## MSG\_TYPE\_MPCMD

Message Type Code

---

### Syntax

```
#include <mppm.h>  
MSG_TYPE_MPCMD
```

### Description

This constant defines the type code for all command messages.

---

## Chapter 4: Sound Driver

---

MAUI sound drivers enable applications to operate independent of hardware differences in target systems. This chapter explains the sound device capabilities, the relationship between the file manager, sound driver, and descriptors, and how to build, modify, and verify your drivers.



## Overview of Sound Driver Interface

---

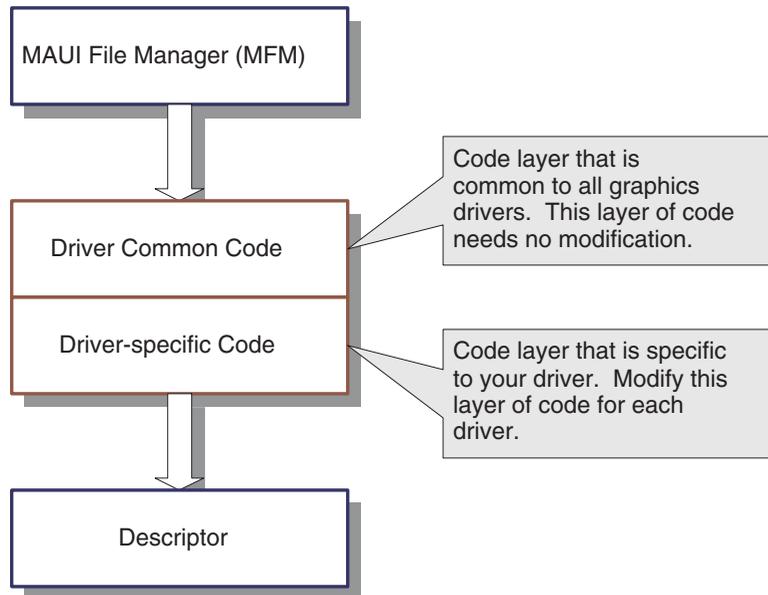
The Sound Driver Interface:

- provides a set of primary entry points, GetStat sub-functions, and SetStat sub-functions through which MAUI applications can control the sound driver.
- is a dual-ported I/O (DPIO) driver that uses the multimedia file manager (MFM). This allows the driver to work under both OS-9 and OS-9000.

The sound driver is sharable (multiple paths may be open to it at the same time). This enables multiple play and record paths, but not concurrent play and record. The Sound Driver Interface is accessible by MAUI applications and directly controls the operation of the sound driver

MAUI sound drivers interface between the sound device and the MAUI File Manager. The sound driver contains all device-specific code so that MAUI applications and the MAUI APIs can operate independent of the hardware in any system. The following figure shows the relationship between the file manager, sound driver, and descriptor:

**Figure 4-1 MFM, Driver, Descriptor Relationship**



The sound device driver consists of a common code layer and a device-specific code layer. All sound drivers share the same set of common code, which provides functions and definitions needed by all drivers. Some of the common code is conditional to allow individual customization of each port. The device-specific code handles all the functions and definitions unique to each device. When porting a sound driver, modify the device-specific code in the example drivers to reflect the sound device in your system.

The device descriptor is the handle used by applications to reference a device. The descriptor indicates the file manager, driver, and the driver's initialization data required to access the device.

## Device Capabilities

One important function of your device driver is identifying the capabilities of the device. Sounds device capabilities are defined in a set of data structures within the `global.h` file. A specification is particularly valuable when writing your `global.h` file.



---

### For More Information

Look in the directory holding the sample drivers for an example of a written specification for the sample sound driver included with MAUI.

---

## Driver Code

---

MAUI sound drivers consist of two types of code: common code that is already written for your driver, and device-specific code that you write. The common code makes up a large portion of the sound driver.

The simplest and most successful method of developing device-specific code when porting a sound driver is to modify the device-specific source code in an existing sample driver. Your modifications reflect the capabilities and requirements of the sound device in your system.

The device-specific code consists of a number of files, of which some are required and others are optional, depending on your system. The following files are required in every sound driver, although it is possible to change their names:

- `abort.c` contains hardware specific code, if any, to abort a play or record.
- `config.h` contains the definition that controls the configuration of the driver including the names of functions defined by the device-specific code.
- `cont.c` contains hardware specific code to continue a play or record after a pause.
- `drvrv.tpl` `os9make` “include” file.
- `gain.c` contains hardware specific code to modify both input and output gain.
- `global.h` contains the global definitions for the driver including device capabilities and prototypes.
- `hardware.c` defines functions that deal directly with the hardware device such as `init` and `term`, and any register modification.
- `hardware.h` contains hardware-specific definitions.
- `irq.c` contains interrupt service functions.
- `path.c` contains hardware specific code, if any, for opening and closing a device.

- `pause.c` contains hardware specific code to pause a play or record.
- `signal.c` contains hardware specific code, if any, for the `_os_ss_sendsig()` functionality.
- `static.h` contains the definitions for static storage areas available to the driver.

The following files may be included or excluded depending on whether play and/or record functionality is needed. These files are:

- `play.c` contains hardware specific code to play sound samples.
- `record.c` contains hardware specific code to record sound samples.

When modifying the driver code, you should organize your work to modify the files in this order:

1. Modify the header files; `config.h`, `global.h`, `static.h`, `hardware.h`, and `mfm_desc.h`.
2. Modify `hardware.c` to access the device hardware.
3. Modify `play.c`, `record.c`, and `irq.c` as required.
4. Modify `gain.c`, `abort.c`, `pause.c`, and `cont.c` as required.
5. Update `drvvr.tpl` to reflect any file name changes.

## Device-specific Code

This provides specific details for modifying the device-specific code. Within each of these files, some functions are required and some are optional.

Sample driver files are located in the directory:

```
MWOS/SRC/DPIO/MFM/DRVVR/SD_SAMP
```

You can use these files as templates for building your own device-specific code.

## Where the Files are Located

---

MAUI sound driver source is delivered with one directory of sample files and one complete example driver. You may either modify the example driver or the sample files to make your driver. The sample files contain instructions for building your own .h and .c files.

- MAUI Standard header files are located in  
MWOS/SRC/DEFS/MAUI



---

### WARNING

These header files should never be modified by the user

---

- MAUI common sound driver code is located in:  
MWOS/SRC/DPIO/MFM/DRV/SD\_COMM  
This directory is referred to as *common* throughout this chapter. Normally you should not need to modify files in this directory. If your implementation does have special requirements that necessitates modifying the common code, make a copy of the relevant file(s) to your driver specific directory and make your modifications there.
- MAUI example driver source is located in:  
MWOS/SRC/DPIO/MFM/DRV/SD\_CS
- The sample driver template files are located in:  
MWOS/SRC/DPIO/MFM/DRV/SD\_SAMP

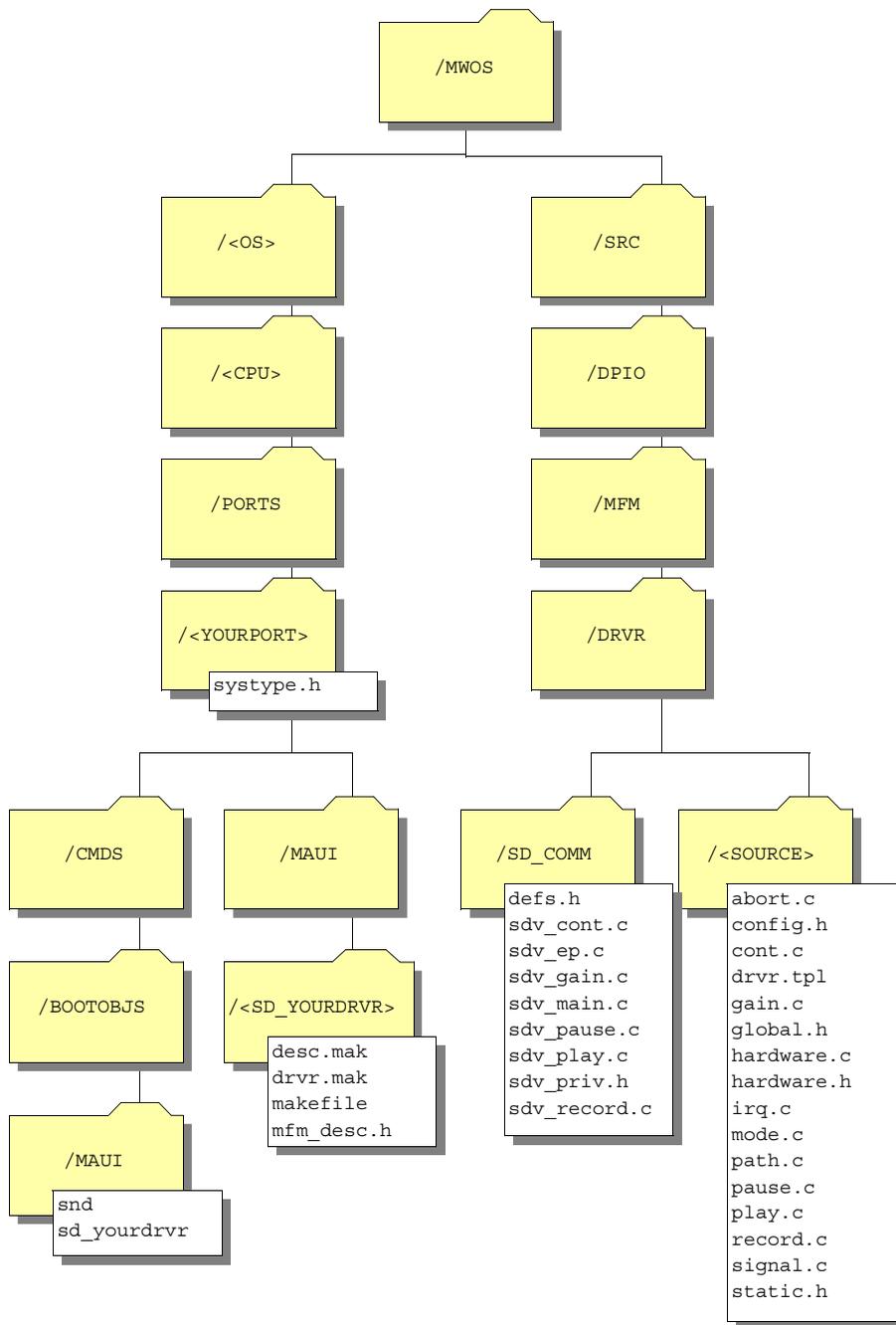
# How to Port your Sound Driver

---

## Create the directory structure for your port

Before beginning to port your sound driver, you must create a directory structure to store your new files. That structure is shown in [Figure 4-2 Directory Structure for Your Sound Driver Port](#)

**Figure 4-2 Directory Structure for Your Sound Driver Port**



- Step 1.** Define and create a source directory. This directory is referred to in this chapter as *SOURCE* and assumes the pathname :  
`MWOS/SRC/DPIO/MFM/DRVR/SD_YOURDRVR`  
It is recommended that the directory name start with “SD\_” followed by an uppercase descriptive name for your driver.
- Step 2.** Copy all of the files from  
`MWOS/SRC/DPIO/MFM/DRVR/SD_SAMP`  
into your new *SOURCE* directory. Verify that the following files are now in your *SOURCE* directory:
- ```
abort.c
config.h
cont.c
drvr.tpl
gain.c
global.h
hardware.c
hardware.h
irq.c
path.c
pause.c
play.c
record.c
signal.c
static.h
```
- Step 3.** Define and create a ports directory. This directory is referred to in this chapter as *YOURPORT* and assumes the pathname:  
`MWOS/OS/CPU/PORTS/YOURPORT`
- Step 4.** Define and create a make directory. This directory is referred to in this chapter as *MAKE* and assumes the pathname:  
`MWOS/OS/CPU/PORTS/YOURPORT/MAUI/SD_YOURDRVR`  
We recommend that this name match the one in step 1.
- Step 5.** Copy or create the following files in *SD\_YOURDRVR*
- ```
desc.mak          drvr.mak
makefile          mfm_desc.h
```

Here are examples of these files:

- desc.mak                    Make the MAUI sound descriptor

```
# Makefile
#####
#   This makefile will make the MAUI Sound descriptors#
#####
#* Copyright 1996 by Microware Systems Corporation          **
#* Copyright 2001 by RadiSys Corporation                   **
#* Reproduced Under License                               **
#*                                                        **
#* This source code is the proprietary confidential property of **
#* Microware Systems Corporation, and is provided to licensee **
#* solely for documentation and educational purposes. Reproduction, **
#* publication, or distribution in any form to any party other than **
#* the licensee is strictly prohibited.                   **
#####

#### Add New Descriptor Names Here #####
#                                     #
TRGTS  =   snd snd10
DRVR   =   SD_YOURDRVR
#                                     #
#####

PORT   =   ../..
MAKENAME=desc.mak
include $(PORT)/../make.com

RDIR   =   RELS/DESC
ODIR   =   $(PORT)/CMDS/BOOTOBJS/MAUI
SDIR   =   $(MWOS)/SRC/DPIO/MFM/DESC
COMMDIR =   SD_COMM
DESCDIR =   .

include $(SDIR)/snddesc.tpl

_purge_clean: nulltrg
    $(CODO) $(ODIR)/snd
    -$(DEL) $(ODIR)/snd
    $(CODO) $(ODIR)/snd10
    -$(DEL) $(ODIR)/snd10

#                                     #
#####
```

- `drvvr.mak`      **Make the MAUI sound driver**

```
# Makefile
#*****
#* Makefile for Maui CS4231 Driver
#*****
#* Copyright 1996 by Microware Systems Corporation          **
#* Copyright 2001 by RadiSys Corporation                   **
#* Reproduced Under License                               **
#*                                                         **
#* This source code is the proprietary confidential property of **
#* Microware Systems Corporation, and is provided to licensee **
#* solely for documentation and educational purposes. Reproduction, **
#* publication, or distribution in any form to any party other than **
#* the licensee is strictly prohibited.                   **
#*****

#### Put Driver Names and Options Here #####
#
TRGTS  =   sd_yourdrvvr
DRVVR  =   SD_YOURDRVVR

#DEBUG =   -g
DEBUG  =

#
#
#####

PORT   =   ../..
MAKENAME=drvvr.mak
include $(PORT)/../make.com

ODIR   =   $(PORT)/CMDS/BOOTOBSJS/MAUI
RDIR   =   RELS/DRVVR
IDIR   =   $(RDIR)/$(HOSTTYPE)
DESCDIR =   .

# Place user defines here. See the bottom of config.h in the driver
# source directory for the list of defines value for this driver

USR_DEFINES = -dPIO -dXCTL_CONTROL -dPCI_I82378

include $(MWOS)/SRC/DPIO/MFM/DRVVR/$(DRVVR)/drvvr.tpl

#
#
#####
```

- **makefile**                    **Make the MAUI sound descriptor and the MAUI sound driver**

```
# Makefile
*****
#* Call makefiles to build sound driver and descriptor
*****
#* Copyright 1997 by Microware Systems Corporation
#* Copyright 2001 by RadiSys Corporation
#* Reproduced Under License
#*
#* This source code is the proprietary confidential property of
#* Microware Systems Corporation, and is provided to licensee
#* solely for documentation and educational purposes. Reproduction,
#* publication, or distribution in any form to any party other than
#* the licensee is strictly prohibited.
*****

MWOS    =    ../../../../..
TRGTS   =    desc.mak drvvr.mak
ALL_TRGTS=p603
MAKENAME=makefile
include $(MWOS)/MAKETMPL/makesub.com

$(TRGTS):    notarget
              $(MAKE) -f $@ $(MAKEOPTS) TARGET=$(TARGET) $(SUBTRGT)

notarget:    .
              $(COMMENT)

#                                     #
#####
```

- **mfm\_desc.h**                    **The MAUI sound descriptor header file**

```
/******
**
* FILENAME : mfm_desc.h
*
* DESCRIPTION :
*
*   This file contains definitions for the MAUI device descriptors.
*
* COPYRIGHT:
*
*   This source code is the proprietary confidential property of Microware
*   Systems Corporation, and is provided to licensee solely for documentation
*   and educational purposes. Reproduction, publication, or distribution in
*   form to any party other than the licensee is strictly prohibited.
**
*/
```

```

#ifndef _MFM_DESC_H
#define _MFM_DESC_H

#include "../systype.h"

#define I82378_NCFG_ADDR    ISA_IOBASE        /* Non-Configured I82378 base */
#define BOARD_CFG_REG_ADDR BOARD_CFG_REG     /* Board Configuration register
*/

/*****
**
* CS4231A Sound Descriptor
*****
*/
#if defined(MFM_DESC) && (defined(snd) || defined(snd10))

#define SHARE                TRUE            /* Path sharing flag */
#define LUN                  1              /* Logical unit number */
#define PORTADDR             (ISA_IOBASE+0x830) /* Base address of hardware */
#define MODE                 S_IREAD | S_IWRITE

#define DRV_NAME              "sd_cs"

/* for SD_COMM/defs.h */
#define SDV_HW_SUBTYPE       CS4231A        /* Hardware sub-type */
#define SDV_HW_SUBNAME      "CS4231A"     /* Hardware sub-type name */

#if defined(snd)
#define SDV_IRQ_NUM          5              /* IRQ number */
#else /*snd10 */
#define SDV_IRQ_NUM          10             /* IRQ number */
#endif

#define SDV_IRQ_PRIORITY     5              /* IRQ priority */
#define SDV_DMA_PLAY_CHAN    6              /* DMA Channel for Playback */
#define SDV_DMA_RECORD_CHAN  7              /* DMA Channel for Capture */

/* for SD_CS/static.h */
#define SDV_TRANSFER_SIZE    (500*64)     /* This is the Maximum transfer size -
make divisible by 16 */

#endif /* MFM_DESC_SND */

#endif /* MFM_DESC_SND */

#endif /* _MFM_DESC_H */

```

- Step 6. Define and create the directory *YOURPORT*/CMDS/BOOTOBJS/MAUI. During the make process two object files are created and stored in MAUI:
- `snd` descriptor object.
  - `sd_yourdrv` driver object. This is typically a lower case version of the directory name in step 1.
- Step 7. Verify your directory structure contains the correct files as shown in **Figure 4-2 Directory Structure for Your Sound Driver Port**.

## Common Code Source Files

The following files are located in the `SD_COMM` directory:

- `defs.h` primary definition file which ties together all the other definition files.
- `sdv_abort.c` common abort functions.
- `sdv_cont.c` common continue functions.
- `sdv_ep.c` entry point functions.
- `sdv_gain.c` common gain functions.
- `sdv_main.c` main function for the driver.
- `sdv_pause.c` common pause functions.
- `sdv_play.c` common play functions.
- `sdv_priv.h` definitions private to the common code.
- `sdv_record.c` common record functions.

## Device-specific Source Files

The following files are located in the `SOURCE` directory:

- `abort.c` abort play or record function.
- `config.h` configures the capabilities of the driver and inclusion/exclusion of common code.
- `cont.c` continue play or record functions.

- `drvvr.tpl`      `os9make` “include” file.
- `gain.c`          gain control functions.
- `global.h`        global definitions.
- `hardware.c`      hardware function.
- `hardware.h`<sup>\*</sup>    definitions for hardware functions.
- `irq.c`<sup>†</sup>          interrupt service functions.
- `path.c`          hardware Open and Close functions.
- `pause.c`        pause play or record functions.
- `play.c`<sup>‡</sup>        optional hardware play functions.
- `record.c`<sup>\*\*</sup>      optional hardware record functions.
- `signal.c`        hardware `sendsig` and `release` functions.
- `static.h`        definitions for static storage areas.

## Modify the *SOURCE* files you need

- 
- Step 1. Delete the optional files in your *SOURCE* directory, if your driver does not support the corresponding function.
- Step 2. Update your `drvvr.tpl` to reflect the deletions, if any, made in step 1.
- 

\*. The example `sd_cs` sound driver has additional hardware definition files that are not depicted in this list. These could have gone into `hardware.h` instead, but were included by `hardware.h` to preserve their original integrity. If you make similar extensions, remember to update `drvvr.tpl`.

†.Optional files. Delete these files if not supported by your driver.

‡.Optional files. Delete these files if not supported by your driver.

\*\*.Optional files. Delete these files if not supported by your driver.

## Modify the config.h file to reflect your system.

---

- Step 1. Define function names for `HW_ABORT_PLAY` through `HW_TERM`. All values must be defined, although you normally use the default values. These are required functions.
  - Step 2. Define function names for `HW_INIT_IRQS` through `HW_RECORD_SET_MODE`. Only include definitions for functions supported by your driver. These are optional functions.
- 

## Modify the global.h file to reflect your system.

---

- Step 1. Modify the initializer for the `sdv_gain_cap` array to match the gain capabilities of your driver.
  - Step 2. Modify the initializer for the `sdv_cm_info` array. Show the data structure with a detailed explanation of each member.
  - Step 3. Modify the initializer for the `sdv_sample_rates` array to include all supported sample rates.
  - Step 4. Modify the initializer for the `sdv_channel_info` array to include all supported number of channels.
  - Step 5. Modify the initializer for the `sdv_dev_cap` data structure. Show the data structure with a detailed explanation of each member.
  - Step 6. Modify the initializer for the `sdv_status_gain` array. Include one entry for each device that is controllable on your system.
  - Step 7. Modify the initializer for the `sdv_mix_lines` array.
  - Step 8. Prototype the functions you need for device-specific code in the `PROTOTYPE` area. This area is used to prototype functions that must be visible to multiple device-specific files.
-

## Modify the `static.h` file to define your static storage areas.

This task may be difficult to perform at this time because the variables that must be defined here may not be known yet. Make an attempt to define them now, and refine this file as the port proceeds.

---

Step 1. Modify `SDV_LU_SPECIFICS` with the variable names needed by the driver. This file is setup with the values in `SDV_LU_SPECIFICS_INIT` when the driver is initialized. This structure should include, but is not limited to the following:

- Address of groups or individual I/O registers.
- Place holders for shadow contents of I/O registers.

Step 2. Modify `SDV_LU_SPECIFICS_INIT` to include the values from the descriptor to compute the initializers. Minimize the number of definitions required in the descriptor. The objective there is to use a few definition in the descriptor to compute a larger number of entries in the `lustat`.

---

## Modify the `hardware.h` file to reflect your system hardware definitions

---

Step 1. Modify `hardware.h` to include all necessary hardware related definitions.

---

## Modify the hardware.c files to initialize your hardware

---

Step 1. Modify the `hardware.c` file with the following considerations:

- `hw_init()` is called when the device is initialized.
- `hw_term()` is called when the device is terminated.
- Be sure that `hw_term()` returns any resources allocated in `hw_init()`.

## Modify the play.c, record.c, and irq.c files to support play and/or record

---

Step 1. Modify the `play.c` file with the following considerations:

- `hw_play_enable()` is called at the start of a play to enable the decoding of sound samples.
- `hw_play_disable()` is called at the conclusion of a play to disable the decoding of sound samples.
- `hw_play_set_mode()` is called to set the hardware mode and IRQ handler for the sound data in the sound map.

Step 2. Modify the `record.c` file with the following considerations:

- `hw_record_enable()` is called at the start of a record to enable the encoding of sound samples.
- `hw_record_disable()` is called at the conclusion of a record to disable the encoding of sound samples.
- `hw_record_set_mode()` is called to set the hardware mode and IRQ handler for the sound data in the sound map.

Step 3. Modify the `irq.c` file with the following considerations:

- `hw_init_irqs()` must be modified to enable interrupts.
  - `hw_term_irqs()` must be modified to disable interrupts.
  - `hw_isr()` is the entry point for all sound driver interrupts. This function must be modified to read the appropriate status register, act on the interrupt, and clear the interrupt.
- 

## Modify the remaining control functions

---

Step 1. Modify the following control functions only if they are supported by your hardware. If they are not supported, delete the source file and point the function in `config.h` at a function that simply returns `EOS_UNKSV`. Make sure that the inclusion or exclusion of these files are represented in the device capabilities (`global.h`) and the makefile template (`drvtr.tpl`).

- `abort.c` contains the hardware specific code to abort a play or record.
  - `cont.c` contains the hardware specific code to continue a play or record after a pause.
  - `gain.c` contains the hardware specific code to modify both input and output gain.
  - `pause.c` contains the hardware specific code to pause a play or record. This driver simply stops the timer to pause both play and record.
-

## Modify the remaining device-specific functions

---

- Step 1. Modify the following device-specific functions only if your hardware has specific requirements. These functions are normally handled completely in the sound driver common code. Normally the these device-specific functions simply return `SUCCESS`.
- `signal.c` contains any, if any, hardware specific code for enabling and disabling “send signal on device idle”. Normally this is not necessary.
  - `path.c` contains any, if any, hardware specific code to be called when the device is opened or closed. normally this is not necessary.
-

## How to Build your Sound Driver

---

Step 1. Change directories to *SD\_YOURDRVR* directory:

```
cd MWOS/OS/CPU/PORTS/YOURPORT/MAUI/SD_YOURDRVR
```

Step 2. To make both the sound driver and descriptor, type

```
os9make
```

The `makefile` invokes `.desc.mak` and `drvvr.mak`.

To make the sound descriptor, type:

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

The `desc.mak` makefile builds the sound descriptor and places it in the directory `YOURPORT/CMDS/BOOTOBS/MAUI`.

To make the sound driver, type:

```
os9make -f drvvr.mak
```

The `drvvr.mak` builds the sound driver and places it in the directory `YOURPORT/CMDS/BOOTOBS/MAUI`.

---

## How to Test your Driver

---

Run the sound demo programs included with MAUI to test your driver. Demo program source is located in the following directory:

```
MWOS/SRC/MAUI/DEMOS/SND
```

Demo program objects are located in the following directory:

```
MWOS/OS/CPU/CMDS/MAUIDEMO
```

There are two demo programs:

- `auplay` attempts to play `.au` and `.wav` sound files. Success depends on the capabilities of the sound hardware. `auplay` has many options. Execute `auplay` with a parameter of `-?` or `-h` to get on-line help.
- `aurecord` attempts to record `.au` and `.wav` sound files. Success depends on the capabilities of the sound hardware. `aurecord` has many options. Execute `aurecord` with a parameter of `-?` or `-h` to get on-line help.

These are not complete tests, but should enable you to verify basic functions.



---

# Chapter 5: How to Configure a System for MAUI

---

This chapter describes how to configure a MAUI enabled system. It includes the following sections:

- **Overview of MAUI Object Modules**
- **Selecting a MAUI System Driver**
- **Using the Configuration Wizard for MAUI**
- **Advanced Wizard Configuration**



## Overview of MAUI Object Modules

---

MAUI is highly modular and configurable, enabling system developers to make design decisions that trade off between size, speed, and functionality. This section describes the objects that make up MAUI and the considerations for configuring a MAUI enabled system.

### Common MAUI modules

- `MWOS/OS/CPU/CMDS/BOOTOBS/mfm`  
MAUI File Manager. Required for the CDB, MSG, SND, and GFX APIs.
- `MWOS/OS/CPU/CMDS/BOOTOBS/maudev`  
MAUI Device Descriptor. Required for the CDB and MSG APIs.
- `MWOS/OS/CPU/CMDS/BOOTOBS/mauidrvr`,  
`MWOS/OS/CPU/CMDS/BOOTOBS/mauidrvr_lock`, or  
`MWOS/OS/CPU/CMDS/BOOTOBS/mauidrvr_filter`  
MAUI System Driver. Required for the CDB and MSG APIs. There are three different versions of this driver. Each has the same module name but different file names. See the [Selecting a MAUI System Driver](#) section for a full description of each:
  - `mauidrvr` - Default/recommended version. The smallest, fastest, most secure version of the three. The mailbox format is not run-time compatible with the other two versions.
  - `mauidrvr_lock` - Supports queue locks that are compatible with old statically linked MAUI MSG applications.
  - `mauidrvr_filter` - Supports queue locks and the deprecated `msg_set_filter()` call. This is the largest, slowest, least secure version of the three.
- `MWOS/OS/CPU/CMDS/BOOTOBS/maui_inp`,  
`MWOS/OS/CPU/CMDS/BOOTOBS/MON/maui_inp`, or  
`MWOS/OS/CPU/CMDS/BOOTOBS/MON/maui_inl`

**Input daemon.** Required by the `INP` API. Only include this module on the system if `INP` or `WIN` API support is required. The Input daemon uses the `MSG` API, so it requires `mfm`, `mauidev`, and `mauidrvr`. There are three different versions of the Input daemon:

`maui_inp` - Default version. Requires `maui` shared library module

`MON/maui_inp` - Debug version. Requires `maui` shared library module. Includes a command line option to print status and debug information.

`MON/maui_inl` - Statically linked debug version. Does not require the `maui` shared library module.

- `MWOS/OS/CPU/CMDS/BOOTOBS/maui_win` or `MWOS/OS/CPU/CMDS/BOOTOBS/MON/maui_win`

**Window daemon.** Required by the `WIN` API. Only include this module on the system if `WIN` API support is required. The Window daemon uses the `INP` and `MSG` APIs, so it requires `mfm`, `mauidev`, `mauidrvr`, and `maui_inp`. There are two versions of the Window daemon:

`maui_win` - Default version. Requires `maui` Shared Library module.

`MON/maui_win` - Debug version. Requires `maui` Shared Library module. Includes code to print debug messages.

- `MWOS/OS/CPU/CMDS/maui` or `MWOS/OS/CPU/CMDS/mt_mai`

**MAUI Shared Library module.** This module is normally present on MAUI systems, but is not required if all MAUI applications link to the static MAUI libraries, `maulib.l/maulib.il`, instead of `maui.l/maui.il`. While the MAUI Shared Library module is large, linking all MAUI applications against `maulib.l/maulib.il` instead of `maui.l/maui.il` makes each of those applications larger (including any required daemons such as `maui_win` and `maui_inp`). Sometimes this results in an even larger footprint. In addition, statically linking MAUI applications does not provide as

much compatibility with future versions of MAUI.

There are two versions of the MAUI Shared Library. Each has the same module name but different file names:

`maui` - Non-Threaded version. This is smaller and faster, but does not supported “connections” from threaded MAUI applications.

`mt_maui` - Threaded version. This version can accept “connections” from both threaded and non-threaded MAUI applications.

## Port-Specific Objects

The port-specific module names described below are common, but not absolute or fully inclusive.



---

### For More Information

Port-specific MAUI modules are described in each appropriate OS-9 Board Guide.

---

## Configuration Description Blocks

There may be one or more Configuration Description Block (CDB) modules on a system. Via the CDB API, they appear to the application as a single Configuration Description Block string. CDB modules can have any name, since what defines them as CDB modules is a module type/attribute of 0x501. The primary module is usually (but not always) called `cdb`. This module contains the `CDB_TYPE_SYSTEM` entry and any devices that are in all board configurations.

Other devices can be listed in separate CDB modules so they can be easily added or removed from a system. For example, you might create separate CDB entries for the mouse and touch screen, and then configure the wizard to load these along with the descriptor, drivers, and protocol modules as appropriate.

## Graphics Devices

Graphic device modules typically consist of a descriptor and driver. A common descriptor name is `gfx`, but `osd`, `vga` and `lcd` are often used as well. By convention, graphics drivers have a prefix of `gx_`, followed by a name descriptive of the device. Graphic devices use the `mfm` file manager.

MAUI supports multiple graphics devices on a system. It is also possible that more than one descriptor may exist in memory for a particular graphics device. The various descriptors might select different default resolutions or specify some other configurable attribute of the device.

## Sound Devices

Sound device modules typically consist of a descriptor and driver. The most common descriptor name is `snd`. By convention, sound drivers have a prefix of `sd_`, followed by a name descriptive of the device. Sound devices use the `mfm` file manager.

MAUI supports multiple sound devices on a system. It is also possible that more than one descriptor may exist in memory for a particular sound device. The various descriptors might select different defaults or specify some other configurable attribute of the device.

## Input Devices

Input devices consist of a MAUI Input Protocol Module and an associated device descriptor and driver. In the configuration wizard, sometimes the input device descriptor and driver are configured as part

of the “core OS”, such as with serial ports. For input devices that are solely used by MAUI (e.g. a touch screen), they are configured within the MAUI screens of the Wizard.

The MAUI Input devices use the MAUI Input Process (`maui_inp`) to read a “normal” OS-9 input source, such as a serial port. `maui_inp` is not affected by what file manager or driver supplies the data as long as it supports `_os_open()`, `_os_close()`, `_os_gs_ready()`, `_os_sendsig()`, and `_os_read()`. Some protocol modules may require additional `setstat/getstat` support.

Like MAUI Graphic Drivers, the names of MAUI Input Protocol Modules are not fixed. By convention, they have a prefix of `mp_`, followed by a name indicating the protocol they support. Microware provides the following standard MAUI Input Protocol Modules.



## Note

Not all MAUI Input Protocol Modules are included in all packages.

|                        |   |
|------------------------|---|
| <code>mp_bsptr</code>  | Three Button Bus/PS2 Mouse  |
| <code>mp_hamp</code>   | Hampton Communications Touch Screen Format                              |
| <code>mp_keyptr</code> | Example Combination Key/Pointer Device                                  |
| <code>mp_kybrd</code>  | Generic VT100 Serial Keyboard   |
| <code>mp_msptr</code>  | Two Button Serial Mouse   |
| <code>mp_phptr</code>  | Touch Screen CD-i Mouse   |
| <code>mp_phrem</code>  | Philips Remote Control - In some OEM packages as a source code example. |
| <code>mp_pskbd</code>  | Raw PS2 Keyboard  |
| <code>mp_sakpad</code> | StrongArm/SideKick 16 Button Numeric Keypad Example                     |
| <code>mp_ssptr</code>  | SmartSet Touch Screen Controllers by Elo Touch Systems, Inc.            |

|                         |                               |
|-------------------------|-------------------------------|
| <code>mp_t328ads</code> | Motorola MC68328ADS Touchpad  |
| <code>mp_ucb1200</code> | UCB1200/1300 Touch Screen     |
| <code>mp_usbkbd</code>  | USB Keyboard                  |
| <code>mp_xtkbd</code>   | Generic XT/Scan Code Keyboard |

## Demo Objects

Demo objects include examples, demos, and their assets. The demo objects described below are located in the following directory:

`MWOS/OS/CPU/CMD5/MAUIDEMOS`

Their sources are located below `MWOS/SRC/MAUI/DEMOS`. All of these demos use the MAUI Shared Library module (`maui` or `mt_mau`). Readme files located with the demo sources indicate other dependencies.

**Table 5-1 MAUI Demos**

| Demo                  | Description                      |
|-----------------------|----------------------------------|
| <code>Aloha</code>    | Text and input demo              |
| <code>Auplay</code>   | Playback AU and WAV sound files  |
| <code>Aurecord</code> | Record AU and WAV sound files    |
| <code>Cdbval</code>   | CDB validation                   |
| <code>Fcopy</code>    | Graphics copying demo            |
| <code>Fdraw</code>    | Graphics drawing demo            |
| <code>Gxdevcap</code> | Print graphic device information |
| <code>Hello</code>    | Graphic text demo                |

**Table 5-1 MAUI Demos**

---

|                             |   |
|-----------------------------|---|
| <code>Inp</code>            | Input demo                                |
| <code>Jview</code>          | Display JPEG images                       |
| <code>Msginfo</code>        | Displays information about a MAUI mailbox |
| <code>Msgwrtr/Msgrdr</code> | Messaging demo                            |
| <code>Sfont</code>          | Display a UCM font                        |
| <code>Showimg</code>        | Display IFF image                         |
| <code>Windraw</code>        | Window API block drawing demo             |
| <code>Winink</code>         | Window pen/inking drawing demo            |
| <code>Winmgr</code>         | Demo window manager daemon                |

---

## Aloha

## Text and input demo

---

### Syntax

```
aloha [<opts>]
```

### Description

The aloha demo displays a message on the screen. When a key on the input device is pressed, the program exits.

### Options

```
-f[=<filename>      filename - select alternate font  
file.
```

### Requirements

default.fnt must be loaded into memory unless an alternative font file is specified, maui\_inp must be running on the system, and gfx and mfm must be in memory.

### Example

```
$ aloha
```

```
$ aloha -f=bold13.fnt
```

## Auplay

## Play AU and WAV sound files

### Syntax

```
auplay [<opts>] <file list>
```

### Description

Plays audio files that are in the .wav or the Sun Microsystems .au formats.

### Options

- a Async (play while reading next chunk, default: Sync)
- al Async with linked soundmaps (not compatible with -k or -p)
- b[=]<size> size of the two read buffers in K bytes (default: 375)
- c print device Capabilities and quit
- g[=]<line-1>[,<line-n>]:<l>[,<r>]
 

Set left and right gain for <line-1...n>. If <r> is not specified, <l> is used as a mono specifier. 'R' or <l> resets the lines. The option may be repeated for different sets of <line>s. <line> codes are:

|   |         |  |
|---|---------|--|
| 0 | VOLUME  | Master output level                          |
| 1 | BASE    | Base level of all output lines               |
| 2 | TREBLE  | Treble level of all output lines             |
| 3 | SYNTH   | Synthesizer input                            |
| 4 | PCM     | Output level for the audio (CODEC, PCM) line |
| 5 | SPEAKER | Output level for the PC speaker              |
| 6 | LINE    | Input level for the line in jack             |

|    |        |   |
|----|--------|---|
| 7  | MIC    | Input level for the microphone in jack        |
| 8  | CD     | Input level for CD in jack                    |
| 9  | IMIX   | Recording monitor level (output of rec input) |
| 10 | OMIX   | Loopback of output to input level             |
| 11 | ALTPCM | Output level of alternative codec device      |
| 12 | RECLEV | Global recording level setting                |
| 13 | IGAIN  | Input gain control                            |
| 14 | OGAIN  | Output gain control                           |
| 15 | LINE1  | Generic mixer line one                        |
| 16 | LINE2  | Generic mixer line two                        |
| 17 | LINE3  | Generic mixer line three                      |

Other special values:

|              |     |  |
|--------------|-----|--|
| 99           | ALL | Selects all devices  |
| -i           |     | just print Info about the audio files, don't play  |
| -k[=]<ticks> |     | kill/abort play in <ticks> (implies -s but acts like FINISH, not compatible with -p) (default: 0=none) |
| -l[=]<num>   |     | number times to loop individual soundmaps (default 0)  |
| -o[=]<dev>   |     | specify alternative Output sound device (default: /snd)  |
| -p[=]<ticks> |     | pause interval in ticks (implies -s but acts like FINISH, not compatible with -k) (default: 0=none)    |
| -r[=]<r>     |     | override the files sample Rate (samples per second)  |
| -s           |     | print device Status info   |
| -u           |     | force signed 8-bit PCM data to Unsigned  |
| -v           |     | verbose - prints more info   |

## Requirements

A sound descriptor, sound driver, and mfm must in memory.



### Note

The Sound Driver Interface only supports WAV type 0x39 files, it does not support WAV type 0x11 files.

## Example

```
$ aplay 0.au
Open 0.au
smap->err_code = 000:000
_os_ss_sndsig() generated the correct signal

$ aplay -i 0.au
Open 0.au
smap->coding_method = SND_CM_PCM_ULAW (0x1)
smap->num_channels = 1
smap->sample_size = 8
smap->sample_rate = 8000
time estimate: 0.12 seconds

$ aplay -s

*****
****Device Status****
*****
status->status = 0x0
status->play_pid = 0
status->record_pid = 0
    SND_LINE_MIC
        SND_GAIN_CMD_MONO
        gain->param.mono.m = 0x40
    SND_LINE_VOLUME | SND_LINE_SPEAKER
        SND_GAIN_CMD_MONO
        gain->param.mono.m = 0x7f
```

```
$ auplay -g99:127 0.au  
Open 0.au  
smap->err_code = 000:000  
_os_ss_sndsig() generated the correct signal
```

## Aurecord

## Record AU and WAV sound files

### Syntax

```
aurecord [<opts>] <filename>
```

### Description

Records audio files to the .wav or the Sun Microsystems .au formats.

### Options

|                                    |   |
|------------------------------------|---|
| -b[=]<size>                        | size of the two read buffers in K bytes (default: 375)  |
| -c                                 | print device Capabilities and quit  |
| -e[=]<f>[,<r>[,<d>]]               | encoding Format, Rate, Depth (default 1,8000,8) where <f> is:<br>1 = SND_CM_PCM_ULAW<br>2 = SND_CM_PCM_ALAW<br>3 = SND_CM_PCM_SLINEAR<br>4 = SND_CM_PCM_ULINEAR<br>5 = SND_CM_ADPCM_G721<br>6 = SND_CM_ADPCM_G723<br>7 = SND_CM_ADPCM_IMA<br><r> is the sample rate (samples per second) and <d> is the bit depth (eg. 8,16,32) |
| -f[=]<type>                        | format file as <type> (default 0) where <type> is:<br>0 = AU_FILE_TYPE_SND<br>1 = AU_FILE_TYPE_WAVE   |
| -g[=]<line-1>[,<line-n>]:< >[,<r>] |   |

Set left and right gain for <line-1...n>. If <r> is not specified, <l> is used as a mono specifier. 'R' or <l> resets the lines. The option may be repeated for different sets of <line>s. <line> codes are:

|    |         |   |
|----|---------|---|
| 0  | VOLUME  | Master output level                           |
| 1  | BASE    | Base level of all output lines                |
| 2  | TREBLE  | Treble level of all output lines              |
| 3  | SYNTH   | Synthesizer input                             |
| 4  | PCM     | Output level for the audio (CODEC, PCM) line  |
| 5  | SPEAKER | Output level for the PC speaker               |
| 6  | LINE    | Input level for the line in jack              |
| 7  | MIC     | Input level for the microphone in jack        |
| 8  | CD      | Input level for CD in jack                    |
| 9  | IMIX    | Recording monitor level (output of rec input) |
| 10 | OMIX    | Loopback of output to input level             |
| 11 | ALTPCM  | Output level of alternative codec device      |
| 12 | RECLEV  | Global recording level setting                |
| 13 | IGAIN   | Input gain control                            |
| 14 | OGAIN   | Output gain control                           |
| 15 | LINE1   | Generic mixer line one                        |
| 16 | LINE2   | Generic mixer line two                        |
| 17 | LINE3   | Generic mixer line three                      |

Other special values:

99 ALL           Selects all devices

-i[=]<dev>           specify alternative Input sound device  
(default: /snd)

-m                   mono instead of stereo

|                |  |
|----------------|--|
| -r             | replace existing file  |
| -s[=]<kbytes>  | size limit of capture in K bytes (default: no limit)                                 |
| -t[=]<seconds> | time limit of capture in seconds (default: no limit) note: -t has precedence over -s |
| -v             | verbose - prints more info   |

## Requirements

A sound descriptor, sound driver, and mfm must in memory. A file system to store the recorded file.



### Note

The Sound Driver Interface only supports WAV type 0x39 files, it does not support WAV type 0x11 files.

## Example

```
$ aurecord -c

*****
****Device Capabilities****
*****
devcap->hw_type = 'UCB1200'
devcap->hw_subtype = 'UCB1200'
devcap->sup_triggers = 0xf
    SND_STATUS_ANY
    SND_TRIG_START
    SND_TRIG_FINISH
devcap->play_lines = 0x21
    SND_LINE_VOLUME | SND_LINE_SPEAKER
...

$ aurecord -t10 -f=1 test.wav
```

**Cdbval****CDB validation****Syntax**

```
cdbval [<opts>]
```

**Description**

Cdbval checks for errors in CDB modules. If no options are not specified, cdbval uses the CDB API to validate each entry in all CDB modules in memory.

**Options**

|                        |  |
|------------------------|--|
| <b>-d</b>              | Dump all CDB data in system memory. This is useful to see what order the CDB data will appear in to an application.  |
| <b>-p</b>              | Print out registered device type information.  |
| <b>-s=&lt;name&gt;</b> | Validate the general structure of the CDB module <name> in memory (bypassing the CDB API) and exit. This test is useful if errors occur when running cdbval which might be caused by things like invalid characters or a missing NULL terminator, etc. |

**Example**

```
$ cdbval
Total DDRs found      : 8
Total warnings found : 0
Total errors found   : 0

$ cdbval -s=cdb_pskbd

General structure validation:

Module "cdb_pskbd":
Total DDRs found      : 1
Total errors found   : 0
```

```
$ cdbval -d=cdb
0:sys:CP="ARMV4":OS="OS9000":RV="1.1":SR#15360,1:
3:/gfx:AI="MAUI":GR#1024,128:
1000:/win:
2:/snd:
9:/pipe:
20:/term:
5:/kx0/mp_pskbd:TY="key":
5:/ucb_touch/mp_ucb1200:TY="ptr":
```

## Fcopy

## Graphics copying demo

---

### Syntax

```
fcopy [<opts>]
```

### Description

Fcopy exercises a block copy operation from a source drawmap to a destination drawmap. A portion of one image will be copied into the drawmap of another image. Fcopy expects three image modules to be in memory:

```
fun.<CM>  
travel.<CM>  
mwlogo.<CM>
```

where <CM> is the supported coding method. The images can be found in MWOS\<<operating system>\<hardware platform>\ASSETS\IMAGES.

### Options

`-t[=]<seconds>`                      number of seconds for the demo to run.

### Requirements

A working MAUI environment. Gfx and mfm must be in memory.

### Example

```
$ fcopy  
16183 random images in 10 seconds
```

```
$ fcopy -t=3  
Using timeout of 3 seconds  
4930 random images in 3 seconds
```

**Fdraw****Graphics drawing demo****Syntax**

```
fdraw [resolution index] [<opts>]
```

**Description**

Draws blocks of random size and random color in a random location on the screen for about 15 seconds unless a timeout value is specified.

**Options**

|  |  |
|--|--|
| <code>-t[=]&lt;seconds&gt;</code>        | number of seconds for the demo to run. |
| <code>-cm[=]&lt;coding method&gt;</code> | coding method index                    |

**Requirements**

A working MAUI environment. Gfx and mfm must be in memory.

**Example**

```
$ fdraw
10684 boxes of random size and color in 10 seconds

$ fdraw -t=3 -cm=0
Using timeout of 3 seconds
Using coding method index = 0
3213 boxes of random size and color in 3 seconds
```

## Gxdevcap

## Print graphic device information

---

### Syntax

```
gxdevcap
```

### Description

Gxdevcap looks in the CDB for each graphics device name and prints all information about each graphics device's capabilities, including resolutions and coding methods supported.

### Requirements

A working MAUI environment. Gfx and mfm must be in memory.

### Example

```
$ gxdevcap

Device number = 1
Device name = /gfx
scavr: SmartIO ID      : 0x4017
scavr: Device Type     : 0x3585
scavr: Device Version  : B(0x42)
scavr: lustat Version  : B(0x42)
Hardware type = SA1100 LCD Controller
Hardware subtype = GraphicsClient 8-Bit Color LCD
Supports viewport mixing = FALSE
Supports external video = FALSE
Supports backdrop color = FALSE
Supports viewport transparency = FALSE
Supports viewport intensity = FALSE
Supports retrace synchronization = FALSE
Supports video decoding = FALSE
DAC depth = 12

Resolution 0:
    Size = 640x480
```

```
Refresh rate = 0
Interlace mode = GFX_INTL_OFF
Aspect = 1x1
```

Coding method 0:

```
Name = GFX_CM_8BIT
ByteOrder = Big
BitOrder = Little
Depth = 8
Align = 16
X Multiplier = 1
Y Multiplier = 1
CLUT based = TRUE
Num Color Types = 3
Color Types = (GFX_COLOR_RGB, GFX_COLOR_YUV,
GFX_COLOR_YCBCR)
Extension size = 16
Modes supported = 1
    res_idx: 0  cm_idx 0      NO DESCRIPTION
Viewport complexity = 2 (GFX_VPC_ONE_EXACT)
Viewport Drawmap complexity = 2 (GFX_VPDMC_EXACT)
```

## Hello

## Graphic text demo

---

### Syntax

```
hello [<opts>]
```

### Description

"Hello MAUI demo..." is displayed on the graphics device for ten seconds then exits.

### Options

|                                    |  |
|------------------------------------|--|
| <code>-f[=]&lt;filename&gt;</code> | specifies an alternate font file. default.fnt is used by default |
|------------------------------------|--|

### Requirements

A working MAUI environment. Gfx and mfm must be in memory.

### Example

```
$ hello
```

```
$ hello -f=myfont.ucm
```

## Syntax

```
inp [mboxname] [<opts>]
```

## Description

Inp displays input from an input device on the standard error path. If no input device is specified, inp will use the first device of type CDB\_TYPE\_REMOTE found in the CDB module.

If a pointer device is used, messages will be displayed when the cursor position is changed or buttons are pressed. Select both buttons simultaneously or press ^C to quit the application.

If a key input devices is specified, messages will be displayed for each key selected. Press ^C to quit the application.

## Options

|   |  |
|---|--|
| <code>-i=&lt;input device name&gt;</code> | specifies an alternative input device name. By default, inp will use the first device of type CDB_TYPE_REMOTE found in the CDB module. |
|---|--|

## Requirements

Maui\_inp must be running on the system.

## Example

```
$ inp -i=/ucb_touch/mp_ucb1200
Opening device '/ucb_touch/mp_ucb1200'
Send signal to 'inp' to end test
Expected device id 0xc89df018
+-----+
Device type:  +++ Pointer +++  Device ID:
0xc89df018
```

```
| Sub-type: 0x4
|                               INP_PTR_MOVE
| Button changed: 0
| Button status 0 (0x0)
| New position (417,176)
| Simulating keysym: INP_KEY_NULL (0x0)
+-----+
Device type:  +++ Pointer +++  Device ID:
0xc89df018
| Sub-type: 0x1
|                               INP_PTR_DOWN
| Button changed: 1
| Button status 1 (0x1)
| New position (417,176)
| Simulating keysym: INP_KEY_NULL (0x0)
+-----+
Device type:  +++ Pointer +++  Device ID:
0xc89df018
| Sub-type: 0x2
|                               INP_PTR_UP
| Button changed: 1
| Button status 0 (0x0)
| New position (417,176)
| Simulating keysym: INP_KEY_NULL (0x0)
+-----+
```

## Jview

## Display JPEG images

### Syntax

```
jview <file_name> [<opts>]
```

### Description

Jview uses the MAUI JPEG API to display either a single or sequential JPEG images found either in the current directory or the current module directory.

### Options

|                           |  |
|---------------------------|--|
| file_name                 | Either a JPEG image file in the current directory or in the module directory or a file in the current directory that holds a list of JPEG image file names specified one per line. |
| c<num_colors>             | Number of desired colors (default is 256)  |
| C<value>                  | Coding method number in dev_cap (default is 0)   |
| F                         | Use fade-in and fade-out effect (default - no fade); note that fade effect is only available in CLUT-based coding methods.   |
| m                         | Monochrome mode  |
| r<value>                  | Resolution number in dev_cap (default is 0)  |
| q<quality_level>          | Quality level, 1 thru 3, where 3 is default and highest quality.   |
| s<numerator><denominator> | Scale (1:1, 1:2, 1:4, 1:8 are supported); for example, s12 means scale 1:2.  |
| S                         | Slide mode (assumes that a file list is used)  |
| T<value>                  | Display time in seconds (default is 3 seconds)   |

|          |                     |
|----------|---------------------|
| V        | Verbose debug mode  |
| x<value> | x offset coordinate |
| y<value> | y offset coordinate |

## Requirements

Working MAUI graphics environment and JPEG images.



---

### Note

This is a user-contributed demo provided due to the high demand for a JPEG viewer, and has not been verified by RadiSys. There may be memory leaks or other problems with this code.

## Example

```
$ jview image.jpg q2 s12  
  
$ jview image.jpg m x10 y10 T5  
  
$ list file_list  
image.jpg  
image2.jpg  
$ jview file_list S T6 F
```

## Msginfo

## Displays information about a MAUI mailbox

---

### Syntax

```
msginfo [<opts>] <mboxnames ...>
```

### Description

Msginfo prints information about mailboxes in memory. It has command line options to either "dump" the content of the mailbox on the screen or decode messages stored in the mailbox.

### Options

|     |                            |
|-----|----------------------------|
| -d  | Dump contents              |
| -dd | Attempt to decode messages |

### Requirements

A working MAUI environment with maudev/mauidrvr.

### Example

```
$ msginfo -d app_mbox
Mailbox status for 'app_mbox'
  number of entries : 50
  free entries : 50
  message size : 20
  link count: 3
```

## Syntax

```
msgwrtr
```

## Description

This demo shows the use of the message functions using a mailbox. When the write process, 'msgwrtr', is executed, the process creates a mailbox, then initiates the read process, 'msgrdr'. The two processes then pass messages to each other through the mailbox.

When executed, this demo does the following:

1. The message write process will write 1001 messages in the mailbox.
2. While the write process is writing, the read process will read messages from the mailbox. If the mailbox becomes full a diagnostic will be printed and go on.
3. When the read process receives a message of type MSG\_DONE, it will display the number of messages read. This should indicate 1001 messages read.
4. Both the read and write processes then terminate.

This demo is capable of showing the use of a filter routine attached to a mailbox. To enable the use of the filter routine simply define the FILTER environment variable. The filter will simply print out the message "filter!" and accept the message. To enable the installation of the filter do the following before running msgwrtr:

```
$ setenv FILTER x
```

## Requirements

A working MAUI environment with msgwrtr and msgrdr in memory.

## Example

```
$ msgwrtr
MAUI Fatal(7|7): 10:28 detected in msg_write.
mbox full retrying
status.name app_mbox
status.num_entries 50
status.free_entries 0
status.entry_size 20
status.link_count 1
status.write_mask 0xffffffff
status.filter 0x0
status.filter_data 0x0
...
Wrote 1001 messages
Waiting for child to finish
Read 1001 messages
```

**Sfont****Displays a UCM font****Syntax**

```
sfont <opts>
```

**Description**

Sfont displays a UCM font on a graphics device. Default.fnt will be displayed unless an alternative font is specified.

**Options**

|                      |   |
|----------------------|---|
| -i                   | print information about font.                                 |
| -f[=]<modulename>    | reads font from <modulename> otherwise 'default.fnt' is used. |
| -a                   | displays ['a',..., 'z'] and ['A',..., 'Z'].                   |
| -n                   | displays ['0',..., '9'].                                      |
| -s                   | displays ['!',..., '~'].                                      |
| -au                  | displays ['A',..., 'Z'].                                      |
| -al                  | displays ['a',..., 'z'].                                      |
| -r1 or -r2           | displays [32,127] or [32,255] range of chars.                 |
| -rs[=]<n>            | specifies display resolution <n>.                             |
| -m[=]<n>             | specifies coding method <n>.                                  |
| -x[=]<x_start>       | display starting at <x_start> coordinate.                     |
| -y[=]<y_start>       | display starting at <y_start> coordinate.                     |
| -p[=]<padding>       | display characters with <padding>.                            |
| -ur[=]<start,end>    | displays characters within <start,end> range.                 |
| -us[=]"string"       | displays "string" of characters.                              |
| -uf[=]<file_on_disk> | displays content of the file <file_on_disk>.                  |

- |                                  |  |
|----------------------------------|--|
| <code>-cb[=]&lt;index&gt;</code> | sets font background color to <index> value. |
| <code>-cf[=]&lt;index&gt;</code> | sets font foreground color to <index> value. |

## Requirements

A working MAUI environment with a graphics device.

## Example

```
$ sfont
Press return to quit.

$ sfont -f=bold13.fnt
Press return to quit.

$ sfont -us="hello" -f=bold13.fnt
Press return to quit.
```

**Showing****Display IFF image**

---

**Syntax**

```
showing [filename]
```

**Description**

Showing displays an IFF image file for about 10 seconds. The image filename must be included on the command line.

**Options**

|          |                        |
|----------|------------------------|
| filename | Specifies an IFF image |
|----------|------------------------|

**Requirements**

A working MAUI environment. Gfx and mfm must be in memory.

**Example**

```
$ showing fun.c8
```

## Windraw

## Window API block drawing demo

### Syntax

```
windraw <x> <y> <w> <h> <demo> <mbox>
```

### Description

Windraw is an example of a windowing program. This program is similar to fdraw except it uses the WIN API to draw blocks in a window.

### Options

|      |   |
|------|---|
| x    | starting x coordinate                                 |
| y    | starting y coordinate                                 |
| w    | width of window to create                             |
| h    | height of window to create                            |
| demo | 1 - draws random rectangles<br>2 - draws random lines |
| mbox | MAUI mailbox name                                     |

### Requirements

A working MAUI environment. Gfx and mfm must be in memory. Maui\_win must be in memory or in the execution directory. Maui\_inp and winmgrdemo (filename winmgr) must be running.



### Note

On some platforms the priorities of maui\_inp and winmgrdemo need to be higher than the default (128). Set the priority using the '^' character. e.g.

```
$ maui_inp ^255 <>>>/nil &
```

```
$ winmgrdemo ^201 <>>>/nil &
```

## Example

```
$ windraw 10 10 100 100 2 mbox1
```

```
$ windraw 200 200 50 50 1 mbox2
```

## Winink

## Window pen/inking drawing demo

---

### Syntax

```
winink <x> <y> <w> <h> <mbox>
```

### Description

Winink is an example of a windowing program that opens a window that the user can ink in.

### Options

|      |                            |
|------|----------------------------|
| x    | starting x coordinate      |
| y    | starting y coordinate      |
| w    | width of window to create  |
| h    | height of window to create |
| mbox | MAUI mailbox name          |

### Requirements

A working MAUI environment. Gfx and mfm must be in memory. Maui\_win must be in memory or in the execution directory. Maui\_inp and winmgrdemo (filename winmgr) must be running.



### Note

On some platforms the priorities of maui\_inp and winmgrdemo need to be higher than the default (128). Set the priority using the '^' character. e.g.

```
$ maui_inp ^255 <>>>/nil &
```

```
$ winmgrdemo ^201 <>>>/nil &
```

### Example

```
$ winink 50 50 100 100 mbox1
```

**Winmgr****Demo window manager daemon****Syntax**

```
winmgrdemo [<opts>]
```

**Description**

Winmgr is an example of a window manager program.

**Options**

|             |   |
|-------------|---|
| -b[=]<n>    | Background color. Valid values for <n>:<br>0 = black, 1 = white, 2 = medium grey, 3<br>= dark grey, 4 = dark blue   |
| -c[=]<idx>  | Coding method index for graphics device   |
| -g[=]<name> | Specifies an alternative graphic device<br>name which overrides the graphics<br>device specified in the CDB module. |
| -r[=]<idx>  | Resolution index for graphics device  |
| -s          | Draw stipple background pattern   |
| -v          | Prints verbose more info  |

**Note**

To resolve a module name conflict the winmgr module has been renamed to winmgrdemo, but the filename is still winmgr so the bootlists would still work.

**Requirements**

A working MAUI environment. Gfx and mfm must be in memory. Maui\_win must be in memory or in the execution directory. Maui\_inp must be running.



---

**Note**

On some platforms the priorities of `maui_inp` and `winmgrdemo` need to be higher than the default (128). Set the priority using the '^' character. e.g.

```
$ maui_inp ^255 <>>>/nil &
```

```
$ winmgrdemo ^201 <>>>/nil &
```

**Example**

```
$ winmgrdemo ^201 <>>>/nil &
```

## Selecting a MAUI System Driver

---

MAUI Version 3.1 or greater includes the MAUI System Driver, which implements the `MSG` and `CDB` functionality.

### MSG Support

To close a stability hole in the original design of MAUI Messaging (`MSG`), MAUI 3.1 re-implemented messaging as a system state service via a driver. By making messaging part of the OS-9 IO system, MAUI can now detect abnormal application termination via `SS_CLOSE`. This enables automatic cleanup of mailboxes opened by the application. In addition, the `MSG` API was extended to enable applications to request notification when other applications, which use the `MSG` API, terminate. For example, `maui_inp` can now determine if an application using the `INP` API, which uses the `MSG` API, quits without calling `inp_term()`, which calls `msg_term()`. This allows the application to return memory allocated on behalf of that application.

There is additional overhead to call a driver instead of directly running the message code. This can be partially offset by the driver making faster system calls from system state. To do this, however, the driver must execute entirely in system state, which interferes with the continued support of the `msg_set_filter()`.

### CDB Support

MAUI Version 3.1 moved the `CDB` from user state application code to the MAUI System Driver. This corrected a hole in the original design that allowed small windows where the systems module directory could change while the application searched for `CDB` modules. This also resulted in a speed improvement because of fewer system calls and less copying of system state structures for accessing in user state.

All versions of the MAUI System Driver have the same `CDB` implementations.

## MAUI System Driver Versions

MAUI provides the following versions of the MAUI system driver:

- `mauidrvr`
- `mauidrvr_lock`
- `mauidrvr_filter`

The three versions of the driver allow the selection of different messaging implementations by installing different versions of the driver.

### The `mauidrvr` Driver

The standard version of the MAUI System Driver, `mauidrvr`, is the smallest and fastest of the three. It does not support `msg_set_filter()` so it can execute 100% in system state. This results in a size savings. This also enables the MAUI System Driver to make accelerated OS calls (speed savings) directly into the kernel as well as remove the old semaphore calls (speed and size savings) that protected the message queues.

This version of the MAUI System Driver is not compatible with pre-MAUI 3.1 statically linked applications, which expect all parties accessing the message queue to use semaphore queue locking. Pre-MAUI 3.1 binaries that linked with the MAUI Shared Library (`maui.l/maui.il`) are still compatible because those applications will attach to a current MAUI Shared Library Module (`maui`), which uses the MAUI System Driver.

### The `mauidrvr_lock` Driver

The second version of the MAUI System Driver, `mauidrvr_lock`, does not support `msg_set_filter()`, but does provide queue locking via semaphores. This allows the continued use of old versions of statically linked MAUI binaries on a system. This version is both larger and slower than the standard MAUI System Driver because of the additional semaphore code. This version of the driver is not considered

as “secure” as the standard driver because the message queue memory is permitted for write access by the old application binaries in user state.

## The `mauidrvr_filter` Driver

The third version of the MAUI System Driver, `mauidrvr_filter`, is the largest, slowest, and least secure of the three versions. However, it is the most compatible with prior versions of MAUI. This version supports both `msg_set_filter()` and queue locking via semaphores. To maintain compatibility with earlier version of MAUI, the `read`, `readn`, `peek`, `peekn`, and `flush` functions have to execute in user state when a filter function is active. This required that the application be permitted both read and write access to the memory containing the message queues. This leaves the message queues vulnerable to errant or malicious data accesses by applications, which could result in lockups and other unpredictable behavior. In addition, because parts of the driver code now execute in user state, the accelerated system state OS calls, plus full semaphore locking of the message queues, is required.

Extreme care should be exercised when implementing filter functions. Filter functions are intended only for inspection of the message data in the queue. Activity in the filter function should be kept to a minimum. The filter function must not attempt to modify the messages in the queue. Programming errors or abnormal termination of an application while executing a filter function can cause damage to message queue and the other processes using that message queue.

The filter function should not make function calls or cause the application to block or abort. While the filter function is called, MAUI locks the message queue of the mailbox, blocking all other applications attempting to access the message queue. Delays or failures in the filter function can impact the stability of other applications accessing the message queue.

Unless there is a specific need for compatibility with pre-MAUI 3.1 binaries that were statically linked, it is recommended that you use the `mauidrvr` version of the driver.

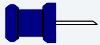
# Using the Configuration Wizard for MAUI

This section describes using the OS-9 configuration wizard to configure your software system for MAUI.

- Step 1. Start the configuration wizard by selecting **Start -> Programs -> Microware -> <Product Name> -> Microware Configuration Wizard** from your Windows development system. Select **Advanced Mode** and click **OK**. The configuration wizard executable is located in `mwos\DOC\BIN\os9p.exe` on your Windows development system.

**Figure 5-1 Configuration Wizard Starting Window**





---

**Note**

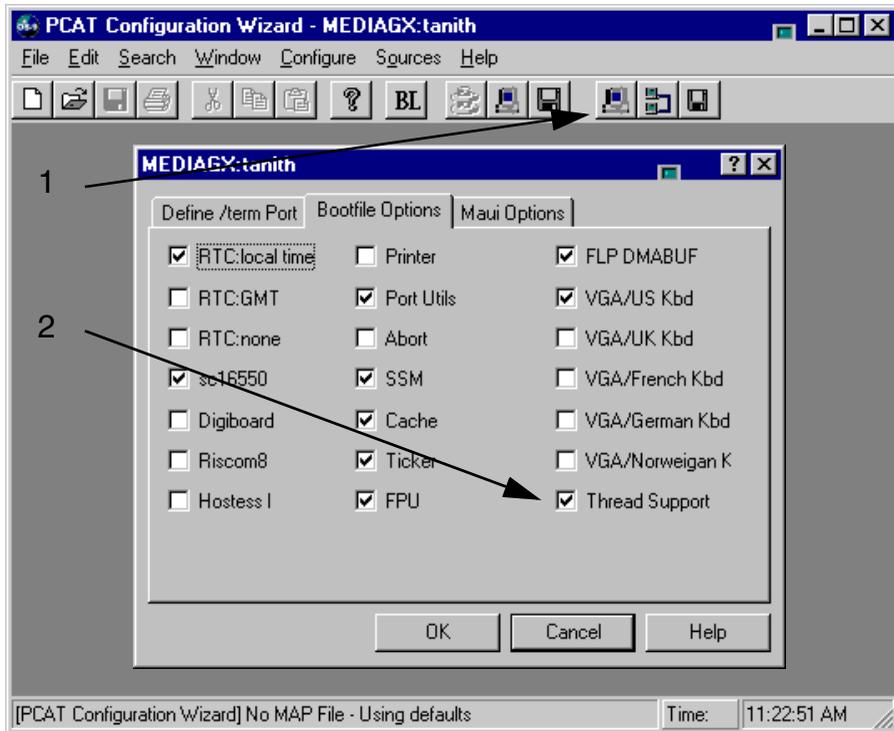
This section assumes that you are familiar with the configuration wizard and can build an OS-9 system that boots your target hardware to an OS-9 shell prompt on one of the serial ports. This information is provided in the appropriate OS-9 Board Guide.

---

- Step 2. Choose your bootfile options by pushing the **Configure Systems Options** button on the toolbar shown by arrow 1. Select the **Bootfile Options** tab.

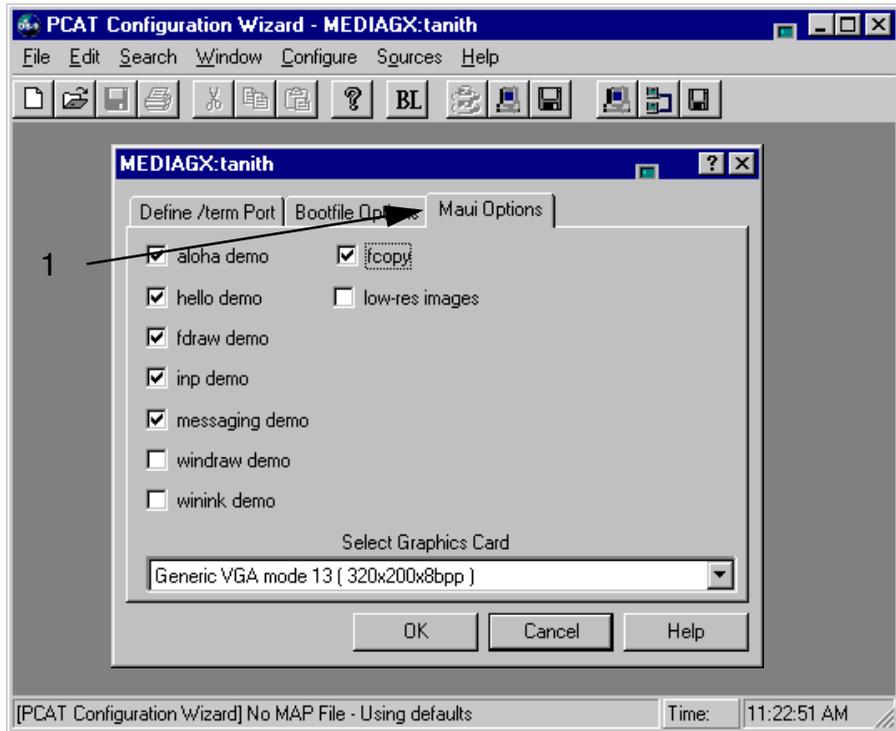
If the target system must support threaded applications, check the **Thread Support** box shown by arrow 2. Clear this box if you do not require thread support. This option selects the appropriate C and MAUI shared library modules. Thread support has a slightly larger footprint and some operations may run a little slower.

**Figure 5-2 MAUI Bootfile Options**



Step 3. Select the **MAUI Options** tab shown by arrow 1.

**Figure 5-3 MAUI Options**

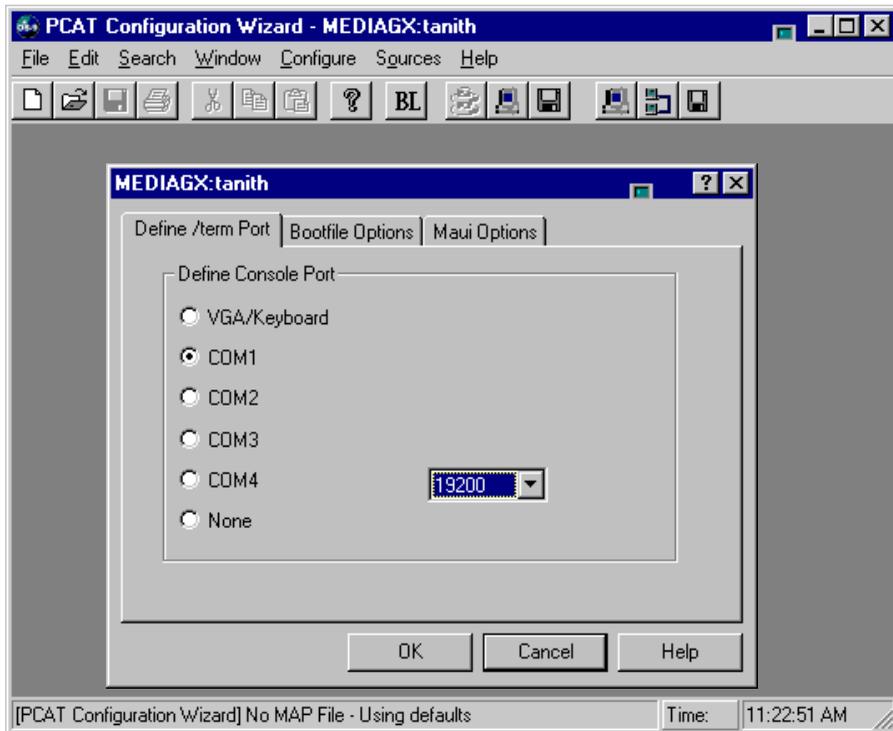


This screen varies depending on the specific port you are working with. Refer to the object module descriptions in the previous section and the appropriate OS-9 Board Guide for descriptions of these options. In this example, you can select the version of the graphics driver to use and what demos to load.

Some systems (for example the PCAT and Sandpoint) boot by default with a command console on the VGA/Keyboard rather than a serial port. An active shell on the same port as used by `maui_inp` can cause

conflicts. It is recommended that when using MAUI on these systems, you switch the Console Port to one of the serial ports. To set the Console Port, select the **Define /term Port** tab.

**Figure 5-4 Setting the Console Port**

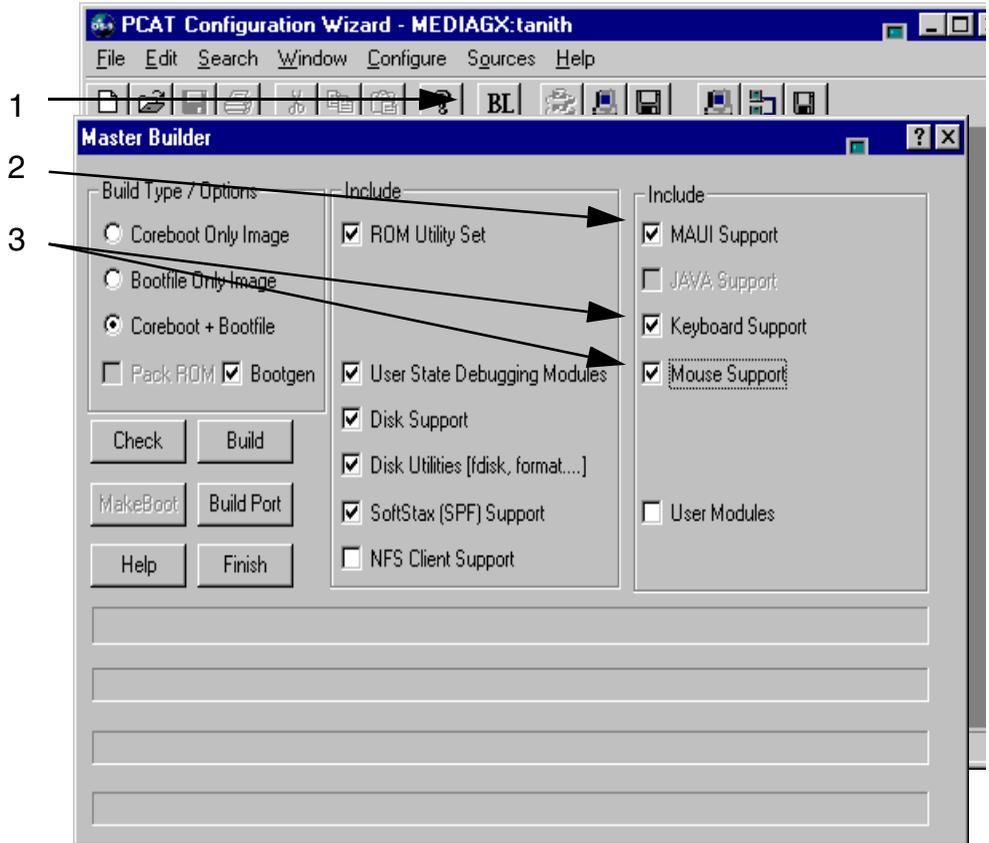


For instance, the screen dump below has selected COM1 rather than the default VGA/Keyboard for the command shell. This allows MAUI applications uncontented access to the scan code keyboard.

Step 4. Click **OK** and close the window.

Step 5. Select the **Build Images** button from the toolbar shown by arrow 1.

**Figure 5-5 Master Builder Window**



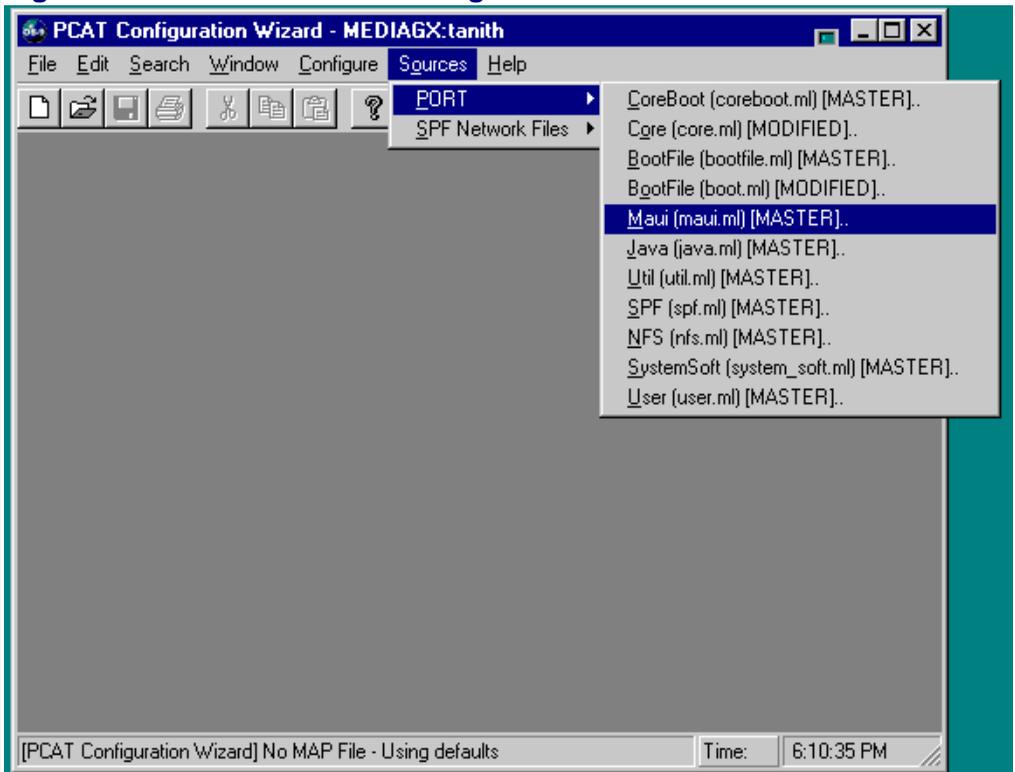
The Master Builder window is displayed. Here you select which components to enable on the system. Select the MAUI Support check box (shown by arrow 2) as well as any other boxes that may be appropriate for the device (shown by arrow 3). Again the specific selections may differ between ports.

Step 6. Click the **Build** button. For advanced MAUI settings, see the [Advanced Wizard Configuration](#) section.

## Advanced Wizard Configuration

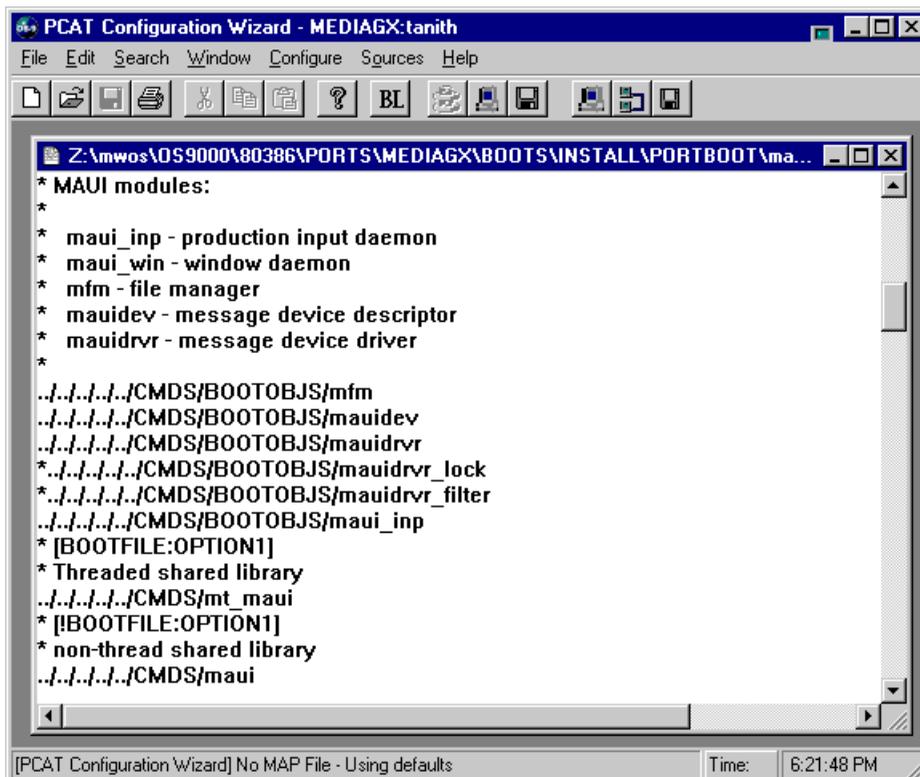
The Advanced Mode of the Wizard provides convenient access to the file lists used to build the boot images. The MAUI file list is called `maui.ml` and can be accessed by selecting **Sources -> Port -> Maui** from the configuration window menu.

Figure 5-6 MAUI Advanced Configuration



This selection opens a text editor window for editing the MAUI file list.

**Figure 5-7 Editing the MAUI File List**



A “\*” in the first column denotes a comment, which is ignored. Comment lines that contain bracketed items such as “\* [BOOTFILE:OPTION1]” are used by the wizard to find and select files based on the options selected in the Wizard configurations screens.

By removing and adding comment symbols “\*”, a developer has absolute control of what MAUI objects are placed in the boot image. This includes changing file selections that are not controllable from the Wizards graphic user interface, such as which `mauidrvr` or `maui_inp` to use.



MICROWARE SOFTWARE

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