Using MPFM

Version 2.2

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Chapter 1: Overview of MPFM

The Motion Picture File Manager (MPFM) is a software extension to OS-9. Applications use MPFM to manipulate MPEG audio and video decoders. This software extension is implemented using the OS-9 file manager and driver structures. The following sections are included in this chapter:

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Introduction

The Motion Picture File Manager provides a set of functions that enables your application to play MPEG-1 and MPEG-2 movies. MPEG movies are delivered as synchronized audio/video data streams across a network. MPFM also provides the means to play MPEG audio files or video files that are not synchronized.

MPEG-1 and MPEG-2 files require different bandwidths. An MPEG-1 stream is delivered at the typical CD bandwidth of 1.4 Mb/second. MPEG-2 is typically delivered at bandwidths from 3 Mb/second and above. MPEG-1 decoders are limited to playing only MPEG-1 data. MPEG-2 decoders can handle both MPEG-1 or MPEG-2 data; however, MPEG-1 elementary streams must be wrapped in a MPEG-2 systems layer in order to be played in a system that employs a demultiplexing chip.

MPFM allows you to play MPEG-1 and MPEG-2 data in a hardware-direct mode, which means a demultiplexing chip is available in the system to parse the stream and deliver it to the MPEG decoders.

MPFM System Architecture

Device Access Restrictions

MPEG devices are typically non-sharable in that only one path may be open to the device at a time. However, a single process can open a path to the device and then fork a child process which inherits that path. This child process would also have complete access to the system.

Execution Classes

There are two classes of execution operation:

- **Synchronous**
- **Asynchronous**

Synchronous

Synchronous requests, when called by the application, complete their functions before returning. Unless otherwise indicated, the MPFM functions are synchronous.

Asynchronous

Asynchronous requests start the function and return to the application while the request is executing. Typically, the driver sends signals to the application to notify it of the operation's status. The asynchronous functions in the MPFM specification are `_os_ss_mv_play()` and `_os_ss_ma_play()` (play MPEG video and play MPEG audio).

Memory Architecture

For OS-9, the MPEG device RAM is an additional area of colored memory used by the MPEG decoder. When the MPEG system is not active, you may access this RAM for your own purposes. This RAM has a color of 0x90 and a priority of 0. Therefore, no “generic” or “system” memory requests are serviced from this area.

For More Information

OS-9 Insights, available from Microware, is a good resource book for information about memory color and allocation.

For program use, if any of this memory has been previously allocated, you must free all memory requested from this bank before using the MPEG I/O system. When the first path is opened to either the MPEG audio or MPEG video device, MPFM allocates the entire memory bank for itself, reserving it entirely for the MPEG system’s use. If the entire bank is not available, MPFM returns a `No RAM Available (EOS_NORAM)` error.

For OS-9 based systems, the system’s architecture dictates how this RAM is accessed. Consult the document specific to your hardware to determine its memory architecture.

Chapter 2: Playing MPEG Files

You can play MPEG files as synchronized audio/video, video only, or audio only. In this chapter you learn the steps needed to play an MPEG file and implement play controls. The following sections are included in this chapter:

- **Start MPEG Audio/Video Play**
- **Play Back Control Functions**
- **Synchronize Audio/Video Presentation**
- **MPEG Audio Presentation**

Start MPEG Audio/Video Play

Load/Play Data From External Devices

To play MPEG audio/video, the application has to perform the following operations:

1. Open a path to the specific MPEG audio/video device by issuing `_os_open()`.
2. Create a Motion Audio Map (MAM) or a Motion Video Map (MVM) according to the type and characteristics of the play requested using `_os_ss_ma_create()` or `_os_ss_mv_create()`.
3. Open a path to the network (such as `/rt0`) using _os_open().
4. Start the data delivery from the network using `_os_ss_readstream()`. You must set up the proper parameters in the SCB structure to select the video or audio stream to play (specifying the PID).
5. Set up the signals to be sent from MPFM by calling `_os_ss_ma_trigger()` and/or `_os_ss_mv_trigger()` if you wish to receive such signals.
6. Issue the specific play command. Audio/video play can be started in synchronous or asynchronous mode. This is discussed in the `_os_ss_mv_play()`/`_os_ss_ma_play()` function calls in the ***MPFM Programming Reference Guide***.

Only normal play forward mode is supported. Video and audio can be played at normal speed. After the play command is issued, the play starts at the first access unit in the incoming data stream for asynchronous play.

Play Back Control Functions

MPFM controls the MPEG decoders play back of the MPEG-1 and MPEG-2 streams. An MPEG audio/video decoder can play one multiplexed MPEG audio/video stream synchronously or asynchronously. The stream formats (PES packets or elementary streams) that can be accepted by a decoder depends on the hardware in the playback system.

Stop MPEG Play

When, during playback mode, the played MPEG stream ends, MPEG playback mode remains active. It is the application's responsibility to quit the playback mode. An application may quit the play upon receiving a signal from MPFM for any of the following events:

- A `sequence-end-code` (see ISO/IEC 13818-2 DIS recommendation) is encountered in the MPEG video stream being played.
- An `MPEG_program_end_code` (see ISO/IEC 13818-1 DIS recommendation) is encountered in the MPEG-2 program stream being played.
- An `iso_11172_end_code` (see ISO/IEC 11172-1 recommendation) is encountered in the MPEG-1 system stream being played.
- The MPEG decoder is out of data for a pre-specified period of time.

You can stop the play by issuing `_os_ss_ma_abort()` or `_os_ss_mv_abort()`. You can delete the play map (`MAM` or `MVM`) by using `_os_ss_ma_close()` or `_os_ss_mv_close()`. To close a path, use the call `_os_close()`.

When there are no more decoded pictures available from an MPEG video stream to display, the MPEG video decoder continues to display the last correctly decoded picture in the display window. The application controls the display window and defines whether or not to display this picture. The picture displays until the first new picture from the subsequent MPEG video stream is decoded and displayed.

Switch Streams

You can switch between MPEG video streams within a multiplexed stream. After switching to a new stream, the MPEG video decoder may not complete decoding the previous stream.

To switch video streams follow these steps:

Step 1. Abort the video stream by calling `_os_ss_abortstream()`.

Step 2. Abort the video play by calling `_os_ss_mv_abort()`.

Step 3. Change the parameters in the SCB structure to select a new stream.

Step 4. Start the new stream by calling `_os_ss_readstream()`.

Step 5. Start the video play be calling `_os_ss_mv_play()`.

Audio streams are switched in the same way, by calling the corresponding audio (`ma`) functions.

You decide whether or not to display the last-decoded picture from the previous stream (as a still picture) until decoded pictures from the new stream display. If you choose not to hold the decoded picture, you must code your application to explicitly turn the display off to blank out the last picture displayed. Otherwise, the last picture displayed continues to display until a new picture is displayed.

Synchronize Audio/Video Presentation

The ISO/IEC 13818 and ISO/IEC 11172 system streams contain time stamps relevant to the decoding and presentation of video pictures and blocks of audio samples. Some video access units have associated Presentation Time Stamps (PTS). A PTS indicates the time at which the associated decoded video picture or the block of audio samples should be presented to the user.

The audio and video PTS are both sampled from the encoder's system time clock, so the two streams have a common time stamp. Correct values of audio and video PTS are included in the data stream. The presentation of the audio and video presentation units should occur at the time indicated by the corresponding PTS (in terms of the system time clock). This results in precise synchronization of the audio and video when the stream is decoded.

It is possible for an MPEG video play to synchronize to an MPEG audio play, or vice versa. When both `_os_ss_ma_play()` and `_os_ss_mv_play()` are working with streams coming directly from the network, the application can send the streams to the MPFM sub-system in any order. The play function that receives data first from the network supplies the synchronization information for the other play function or you can group them together by setting the `syncpath` parameter to -2 for the first play function. MPFM does not start data retrieval from the network until both play commands are sent.

After issuing a play command, the decoding starts after a start-up delay. The length of this delay depends on the time required for the decoder's system clock to reach the time-stamp value of either video or audio at which the play is to start.

MPEG Audio Presentation

The MPEG audio decoder reconstructs audio from the MPEG audio data. It generates an output for each of the left and right channels. Audio may be multiplexed with video in a synchronized MPEG data stream or may be encoded as an audio-only MPEG data stream.

Chapter 3: Display Control Functions

MPFM provides functions to control the video display of your MPEG motion video. The following functions are included in this chapter:

- **Basic Display Control**
- **Special Video Control**
- **Frame-Rate Conversion**

Basic Display Control

Play and Show

The command you use to begin MPEG play is `_os_ss_mv_play()` and `_os_ss_ma_play()`. These commands begin playing an MPEG stream. To display the MPEG video on the display screen, use the call `_os_ss_mv_show()`.

Hide

You can clear the display window by using the function call `_os_ss_mv_hide()`. The content of the display window becomes black: R,G,B = 16,16,16. The MPEG file currently playing continues to decode but is not displayed until `_os_ss_mv_show()` is called again.

After the blanking is turned off, the selected part of the decoded picture is again visible in the display window. If a video sequence is not played back immediately after issuing the command, blanking is turned off at the vertical synchronization that occurs immediately before the presentation of the next decoded picture. See the `_os_ss_mv_hide()` functions for details.

Stop

To stop decoding and displaying the MPEG video, use the calls `_os_ss_ma_abort()` and `_os_ss_mv_abort()`. Unlike the hide command, the abort command stops decoding the MPEG stream.

Set the Border Color

When playing an MPEG stream that was encoded at less-than-full-screen size, you can set the color of the border surrounding the MPEG video. Border color is set using the function call `_os_ss_mv_bcolor()`. The border color is expressed as an RGB value. The value of each RGB component is between 16 and 235. For example, an RGB value of 16,16,16 is black; while 235,235,235 is white.

Special Video Control

Anti-taping

MPFM contains three functions that control MPEG video anti-taping. These functions are useful only if the hardware contains anti-taping hardware.

Before turning on the anti-taping functions, you must configure the anti-taping hardware. This is accomplished with the function call `_os_ss_mv_at_config()`. To configure the anti-taping hardware you must know the following information:

- Path to the MPEG video decoder
- Authentication key
- Length of the authentication key
- Configuration string
- Length of the configuration string

After configuration, anti-taping is switched on and off by using the functions `_os_ss_mv_at_on()` and `_os_ss_mv_at_off()`.

Closed Captioning

If your hardware provides closed captioning functions, and the MPEG audio/video stream contains closed caption data, your application can control the display of closed caption data on the screen. This function depends on the user's TV set being capable of decoding the closed captioning data.

The MPFM driver strips the closed caption data out of the data stream and communicates to the NTSC/PAL encoder to insert the closed-caption data into line 21 of the analog video output, to be interpreted by the TV or display.

The call `_os_ss_mv_cc_on()` switches the closed caption encoding on. The call `_os_ss_mv_cc_off()` switches the closed caption encoding off.

Frame-Rate Conversion

MPEG video may be encoded at various frame rates. The frame rate is the number of pictures per second of video. Films are often recorded at a frame rate of 24 frames per second (fps). NTSC video is recorded at 30 fps, and PAL and SECAM video is recorded at 25 fps. The MPEG encoded video maybe encoded at any of those standard frame rates.

After decoding, reconstructed pictures are available at the picture rate at which they were encoded. The pictures are displayed in the full motion plane at a display rate of 25 fps (PAL) or 30 fps (NTSC).

A frame-rate conversion from the coded picture rate to the required display rate is applied by the MPEG video decoder hardware. Conversion is supported for each picture rate allowed in the full motion system. The conversion is only in a temporal direction, without any effect on picture size in terms of pixels and lines. Since NTSC and PAL have different picture and screen sizes, the aspect ratio of the picture may be affected when playing an NTSC-encoded video on a PAL TV set, or a PAL-encoded video on an NTSC TV set.

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Product Discrepancy Report

To: Microware Customer Support

FAX: 515-224-1352

From:_____

Company:_____

Phone:_____

Fax:_____Email:_____

Product Name: MPFM

Description of Problem:

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Host Platform_____

Target Platform_____

RadiSys.

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