DaVinci PSP 03.21.00.04 Device Driver Features and Performance Guide

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About This Manual

This document provides an overview and performance data for the device drivers which are part of the DaVinci Linux PSP package.

NOTE

For DA850/OMAP-L138/AM18xx EVM, the performance numbers have been recorded with cpuidle driver enabled and with cpufreq governor set to `userspace`.

If You Need Assistance

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Support Overview

Boot Modes Supported

The following table provides information on the boot modes supported in User Boot Loader (UBL). Green colored box in the table below means that the particular boot mode is supported on the device.

DaVinci Supported Boot Modes

Boot Mode	DM644x	DM6467	DM355	DM36x	DA830/OMAP-L137/AM17xx	DA850/OMAP-L138/AM18xx
SPI EEPROM						
SPI Flash						
NAND Flash						
NOR Flash						
I2C EEPROM						
MMC/SD						

NOTE

These are supported boot modes in PSP software, the actual hardware may support many more boot modes than shown here. Please refer to hardware documentation for list of all supported boot modes.

U-Boot Support

U-Boot is the defacto bootloader for Linux kernel on ARM. The following features of U-Boot are supported in this release:

U-Boot supported feature table

Feature	DM36x	DA850/OMAP-L138/AM18xx
UART		
Ethernet Download (TFTP)		
USB DFU		
MMC/SD		
SPI Flash		
NAND flash		
NOR Flash		
USB Mass Storage		

Device Driver List

The following table list the various device drivers supported and the device they are supported on. On detailed information on specific features or limitations of a pariticular driver, refer to the chapter catering to that driver in this document.

Peripheral Driver Support

Peripheral	Description	Linux driver type	DMA usage	Devices supported on
Audio (McASP)	Audio Record and Playback	ALSA SoC	EDMA3	DA850/OMAP-L138/AM18xx
Audio (McBSP)	Audio Record and Playback	ALSA SoC	EDMA3	DM36x
McBSP	Serial Communication Interface	Kernel API driver	EDMA3	DA850/OMAP-L138/AM18xx
EMAC	Ethernet Network driver	Netdev	EMAC Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
USB MSC Host	USB Mass Storage Class Host Driver	Block	USB Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
USB HID Host	USB Human Interface Device Host Driver	Input driver	USB Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
USB MUSB HCD	MUSB Host controller driver	USB HCD	USB Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
USB OHCI HCD	OHCI Host controller driver	USB HCD	USB Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
NAND Flash	Flash storage system	MTD Character and Block	Not Supported	DM36x, DA850/OMAP-L138/AM18xx
NOR Flash	Flash storage system	MTD Character and Block	Not Supported	DA850/OMAP-L138/AM18xx
GLCD	Graphical LCD driver	Frame Buffer	LCDC Internal DMA	DM36x, DA850/OMAP-L138/AM18xx
CLCD	Character LCD driver	Parallel port based driver	None	DA850/OMAP-L138/AM18xx
SPI Flash	Flash storage system	MTD Character and Block	EDMA3	DA850/OMAP-L138/AM18xx
MMC/SD	Interface to MultiMedia Secure Digital cards	Block	EDMA3	DM36x, DA850/OMAP-L138/AM18xx
UART	Serial Communication Interface	Character	Not Supported	DM36x, DA850/OMAP-L138/AM18xx
I2C	Inter-IC Communication	Character	Not Supported	DM36x, DA850/OMAP-L138/AM18xx
RTC	Real-time clock	Character	None	DM36x, DA850/OMAP-L138/AM18xx
Watchdog	Watchdog Timer	Miscellaneous	None	DM36x, DA850/OMAP-L138/AM18xx
SPI (/dev/spi)	Serial Peripheral Interface	Character	EDMA3	DM36x, DA850/OMAP-L138/AM18xx
SATA	Serial ATA Interface	Block	SATA Internal DMA	DA850/OMAP-L138/AM18xx
Video Port Interface (VPIF)	Video Display and Capture	V4L2 (Video for Linux version 2)	VPIF Internal DMA	DA850/OMAP-L138/AM18xx
VPBE and VPFE	Video Display and Capture	V4L2 (Video for Linux version 2)	Internal DMA	DM36x
Power Management	Linux drivers `cpuidle`, `cpufreq` and `Suspend-to-RAM`	Misc	None	DA850/OMAP-L138/AM18xx

Touchscreen	Drivers for TPS65070 and TSC2004	Input driver	None	DM36x, DA850/OMAP-L138/AM18xx

ALSA SoC Audio Driver

Abstract

This chapter provides details on ALSA SoC audio driver along with CPU load numbers.

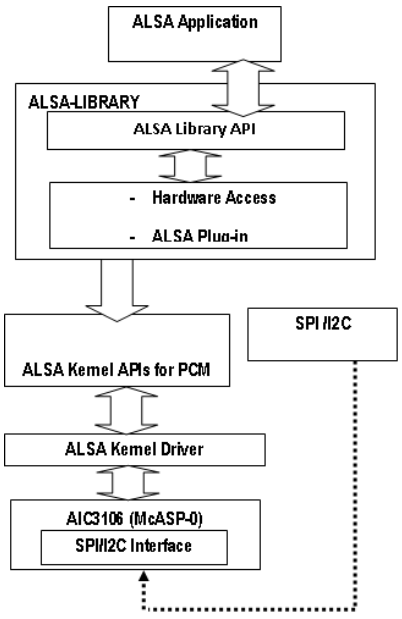
Introduction

DaVinci Audio driver complies to the Advanced Linux Sound Architecture (ALSA) System on Chip (SoC) framework (ASoC).

The ASoC framework splits an embedded audio system into three components:

- **Codec driver:** The codec driver is generic and hardware independent code that configures the audio codec to provide audio capture and playback. It should contain no code that is specific to the target platform or machine.
- **Platform driver:** The platform driver can be divided into audio DMA and SoC Digital Audio Interface (DAI) configuration and control. The platform driver only targets the SoC CPU and must have no board specific code.
- **Machine driver:** The ASoC machine (or board) driver is the code that glues together the platform and codec drivers. It can contain codec and platform specific code. It registers the audio subsystem with the kernel as a platform device.

Following architecture diagram shows all the components and the interactions among them:



Driver Features

1. The driver supports the following features:
2. Supports AIC3106 audio codec in ALSA SoC framework.
3. Multiple sample rate support (8 KHz, 44.1 KHz and 48 KHz commonly used) for both capture and playback.
4. Supports audio in stereo mode.
5. Supports simultaneous playback and record (full-duplex mode).
6. Start, stop, pause and resume feature.
7. Supports mixer interface for audio codecs.

Features Not Supported

1. Does NOT support OSS based applications using OSS emulation layer.
2. Driver will not work if built as module.

Constraints

- By default, codec is configured in master mode and McASP is used as slave. Testing of the audio sub-system is done in this configuration only.
- Configuration of playback and capture streams in different sampling rates is not supported.

Supported System Calls

Refer ALSA project - the C library reference [1] for API calls.

Supported IOCTLs

NA

Performance and Benchmarks

The performance numbers were captured using the following:

- Word length in bits = 16
- Number of channels per sample = 2

Audio Write Performance

Sampling Rate (in Hz)	CPU Load (in %)			
			DM365	DM368
	300 MHz	456 MHz	297 MHz	432 MHz
8000				
44100				
48000				

Audio Read Performance

Sampling Rate (in Hz)	CPU Load (in %)			
			DM365	DM368
	300 MHz	456 MHz	297 MHz	432 MHz
8000				
44100				
48000				

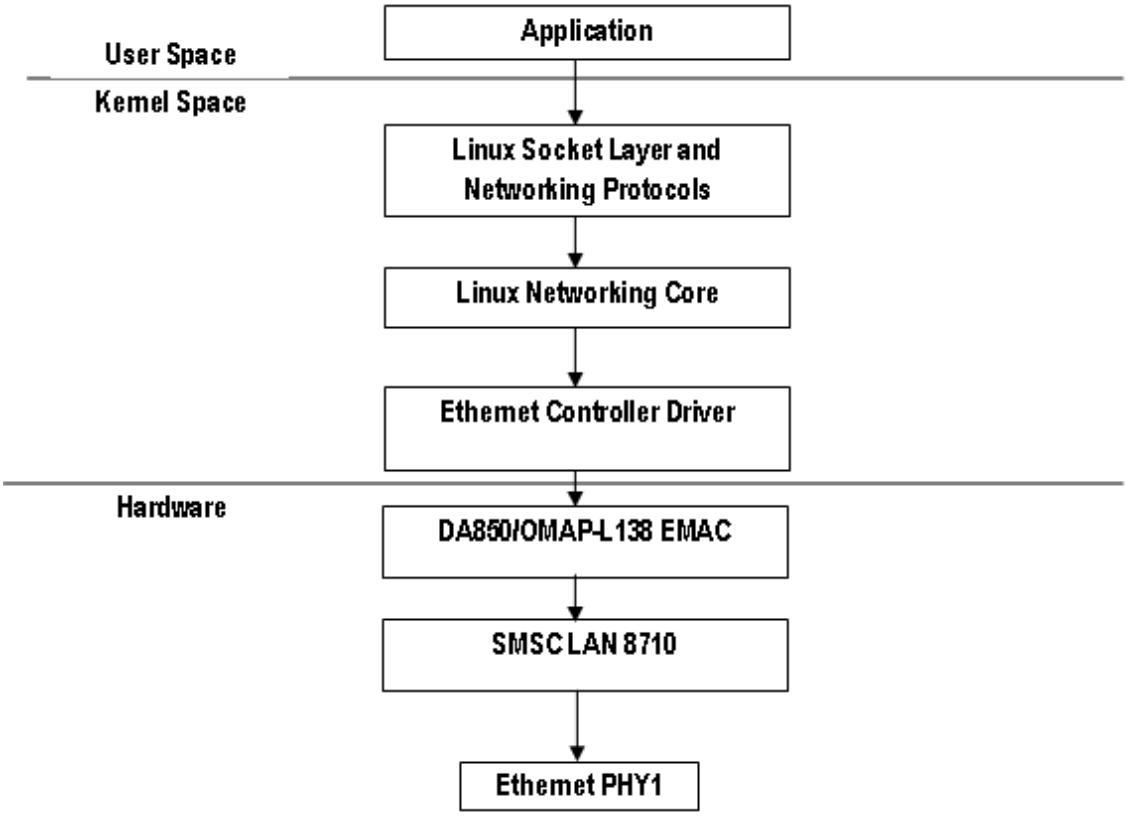
Ethernet Driver

Abstract

This chapter provides details on Ethernet driver along with throughput and CPU load numbers.

Introduction

The Ethernet driver supports the Linux netdev interface.



Driver Features

The driver supports the following features:

1. 10/100 Mbps mode of operation.
2. Auto negotiation.
3. Support for multicast and broadcast frames.
4. Promiscuous mode of operation.
5. Full duplex and half duplex mode of operation.
6. Linux NAPI support
7. Support for MII and RMII interfaces to PHY

Features Not Supported

NA

Constraints

NA

Supported System Calls

Supports the socket() and related system calls in accordance with Linux architecture.

Performance and Benchmarks

Ethernet 100Mbps Mode Performance

TCP Window Size(in KBytes)	Interval (in Seconds)	Transfer Rate MII PHY (in Mbps)				Transfer Rate RMII PHY (in Mbps)			
		DA850/OMAP-L138/AM18xx		DM365		DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
16	60	42.9		38.4	51.1			NA	NA
32	60	44.2		38.8	50.9			NA	NA
64	60	44.1		39.0	51.1			NA	NA
128	60	44.3		38.7	51.3			NA	NA

NOTES

RMII PHY support is available only on DA850/OMAPL138/AM18xx.

CPU load during the performance test is 100%

The performance numbers were captured using the iperf tool. Usage details are mentioned below:

- Server side command switch : "-s"
- Client side command : "-c <server ip> -w <window size> -d -t60". This starts bi-directional traffic to the server for a duration of 60 seconds.
- Iperf tool is run on the DUT1 in server mode and on DUT2 in client mode. Version 2.0.4 is used on both sides.
- Data captured here is for "iperf" in client mode.
- Cross cable is used to measure performance.
- Speed is set to 100Mbps

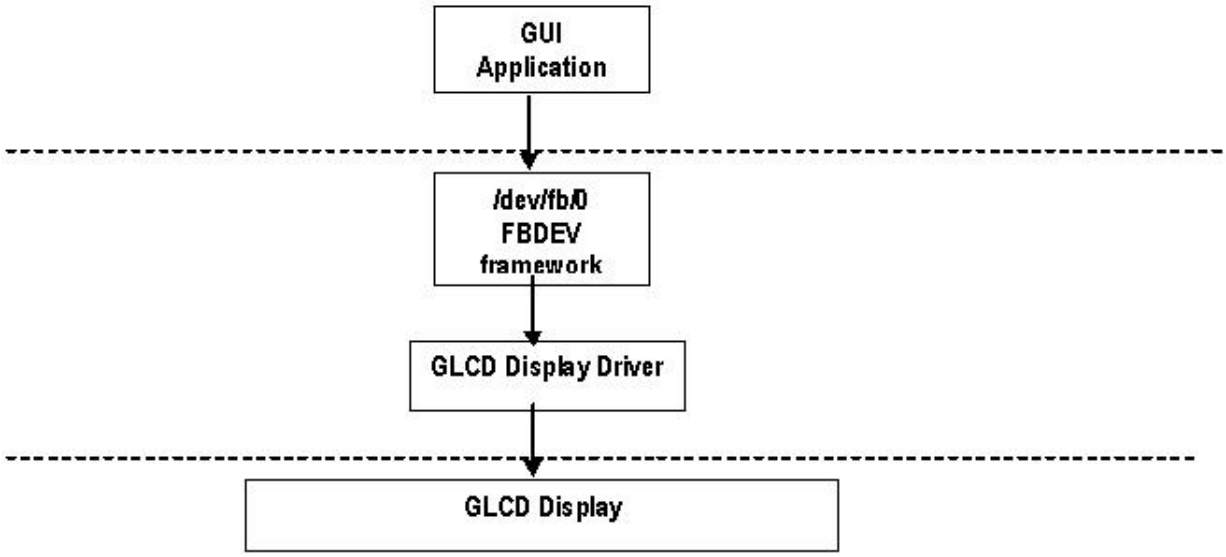
Graphical LCD (GLCD) Driver (DA850/OMAP-L138/AM18x)

Abstract

This chapter describes the GLCD driver architecture, driver features and performance numbers (throughput and CPU load).

Introduction

GLCD driver is based on Fbdev framework.



Driver Features

1. Supports QVGA display through Fbdev framework.
2. Supports display of RGB565 images.
3. Supports getting and setting the variable screen information.
4. Supports retrieving the fixed screen information.

Features Not Supported

1. WAITFORVSYNC ioctl not supported.
2. Panning not supported.
3. Brightness and color control ioctls not supported.

Constraints

1. Driver doesn't support double buffering.

Supported System Calls

`open(), close(), read(), mmap(), ioctl()`

NAND Driver

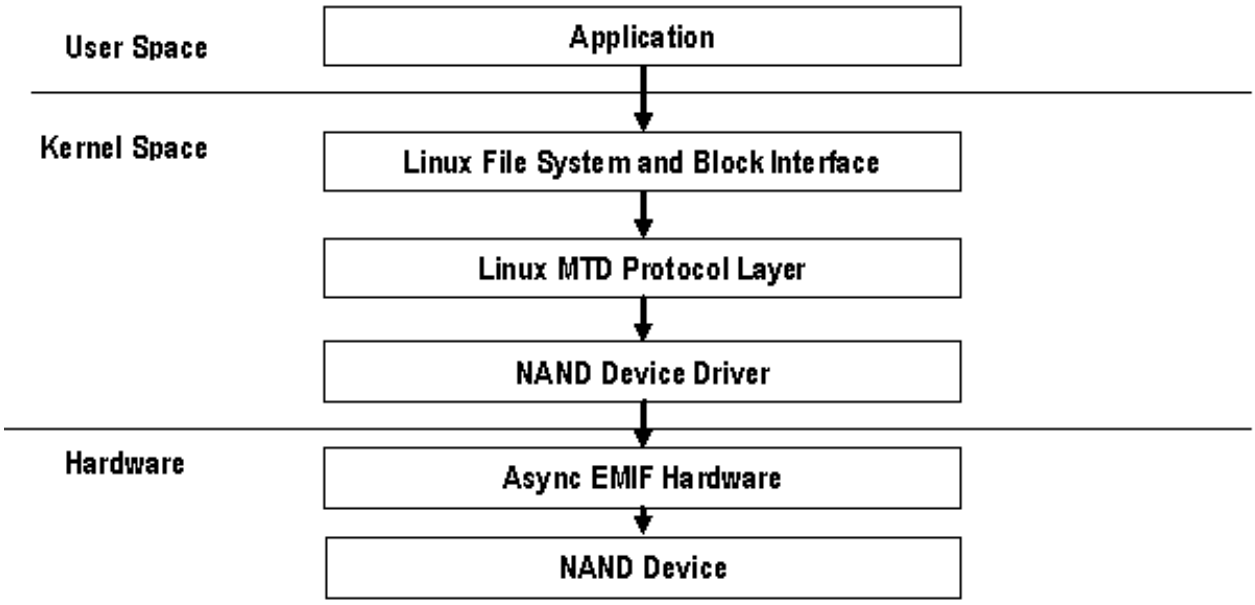
Abstract

This chapter describes the NAND flash driver architecture, driver features and performance numbers (throughput and CPU load).

Introduction

The NAND driver is implemented as a character and block driver, compliant with the Linux MTD subsystem interface. It supports various NAND Flash chips (see file `drivers/mtd/nand/nand_ids.h` in Linux kernel sources) The NAND driver creates the device nodes for user space access (/dev/mtdblock0, /dev/mtdblock1, /dev/mtd0,/dev/mtd1 and so on.).

This figure illustrates the stack diagram of NAND flash driver in Linux.



Driver Features

The driver supports the following features:

1. JFFS2 file system support
2. Supports Read, Write and Erase
3. Bad Block Management
4. Polled mode of transfer
5. Small Block (512 bytes), Big Block (2K & 4K bytes), SLC NAND

Features Not Supported

1. `flash_eraseall` with `-j` option fails. Please use without `-j` option

Constraints

None

Supported System Calls

Supports the system call support proivided by Linux MTD interface viz. `open()`, `close()`, `read()`, `write()`, `ioctl()`

Performance Benchmarks

NAND Write performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	1.50	1.97	0.52	0.68	99.46	99.08	99.81	99.87
256	100	1.54	2.0	0.52	0.69	99.33	99.33	99.93	99.91
512	100	1.54	1.99	0.52	0.68	99.91	99.01	99.93	99.93
1024	100	1.55	2.01	0.52	0.68	99.81	99.67	99.79	99.75
5120	100	1.53	2.01	0.52	0.68	99.27	99.02	99.68	99.65

NAND Read performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	0.24	0.30	0.09	0.11	100	100	100	100
256	100	0.24	0.30	0.09	0.11	100	99.99	100	100
512	100	0.24	0.30	0.09	0.11	100	100	100	100
1024	100	0.24	0.30	0.09	0.11	100	99.99	100	100
5120	100	0.24	0.30	0.09	0.11	99.96	99.99	100	100

The performance numbers are captured using the following:

1. NAND PART Number: Micron MT29F4G08AAC
2. File System = JFFS2
3. NAND partition was mounted with async option.

NOR flash Driver

Abstract

This chapter describes the NOR flash driver architecture, driver features and performance numbers (throughput and CPU load).

Introduction

The NOR flash driver is implemented as a character and block device driver, compliant with the Linux MTD subsystem architecture. It supports various CFI compliant NOR flash chips. The NOR flash driver creates the device nodes for user space access (/dev/mtdblock0, /dev/mtdblock1, /dev/mtd0,/dev/mtd1 and so on.).

Driver Features

The driver supports the following features:

1. JFFS2 file system support
2. Supports Read, Write and Erase
3. Polled mode of transfer

Features Not Supported

None

Constraints

None

Supported System Calls

Supports the system call support proivided by Linux MTD interface viz. `open(), close(), read(), write(), ioctl()`

Performance Benchmarks

NOR Write performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100			NA	NA			NA	NA
256	100			NA	NA			NA	NA
512	100			NA	NA			NA	NA
1024	100			NA	NA			NA	NA
5120	100			NA	NA			NA	NA

NOR Read performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100			NA	NA			NA	NA
256	100			NA	NA			NA	NA
512	100			NA	NA			NA	NA
1024	100			NA	NA			NA	NA
5120	100			NA	NA			NA	NA

NOTE

NOR driver support is available only on DA850/OMAPL138/AM18xx.

The performance numbers are captured using the following:

1. NOR PART Number: Intel PC28F640P30T85
2. File System = JFFS2
3. NOR partition was mounted with async option.

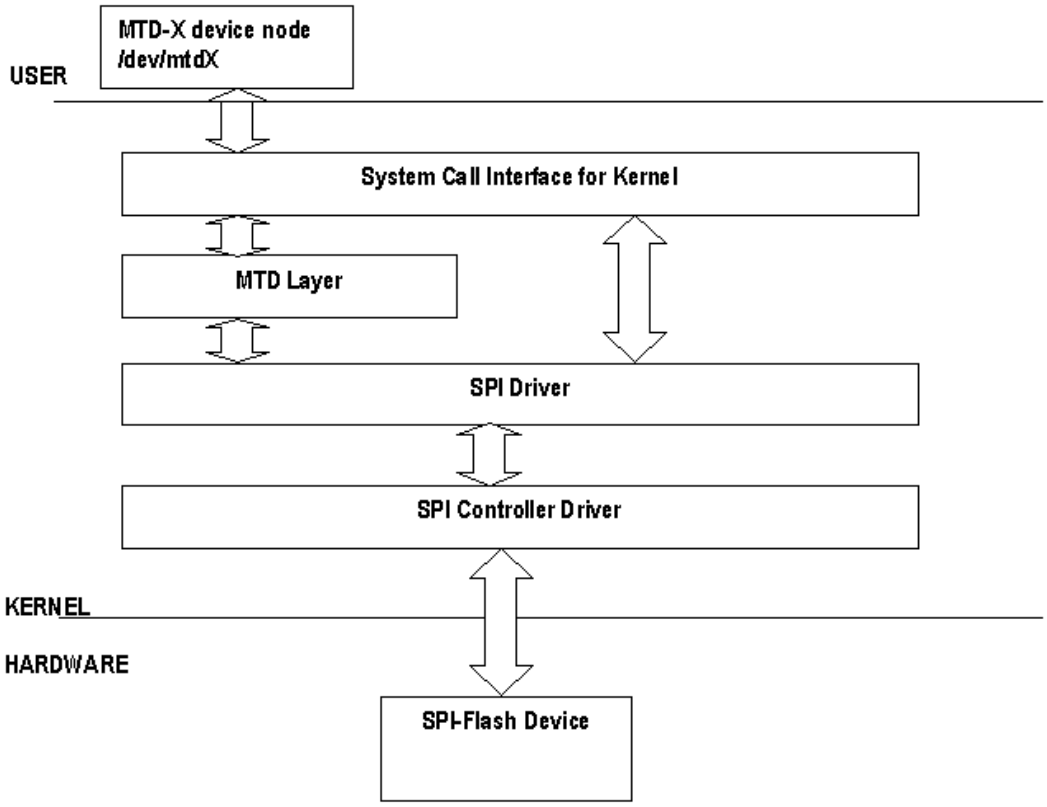
SPI Flash Driver

Abstract

This chapter describes the SPI flash driver architecture, driver features and performance numbers (throughput and CPU load).

Introduction

SPI Flash driver is implemented as block driver and compliant with standard MTD driver. It supports various flash devices. The SPI driver creates device node for user space access (example, /dev/mtd1).



Driver Features

- DMA and PIO modes are supported.

Features Not Supported

None

Constraints

None

Supported System Calls

Supports the system call support proivided by MTD interface viz. `open(), close(), read(), write(), ioctl()`

Performance Benchmarks

Performance numbers will be provided later

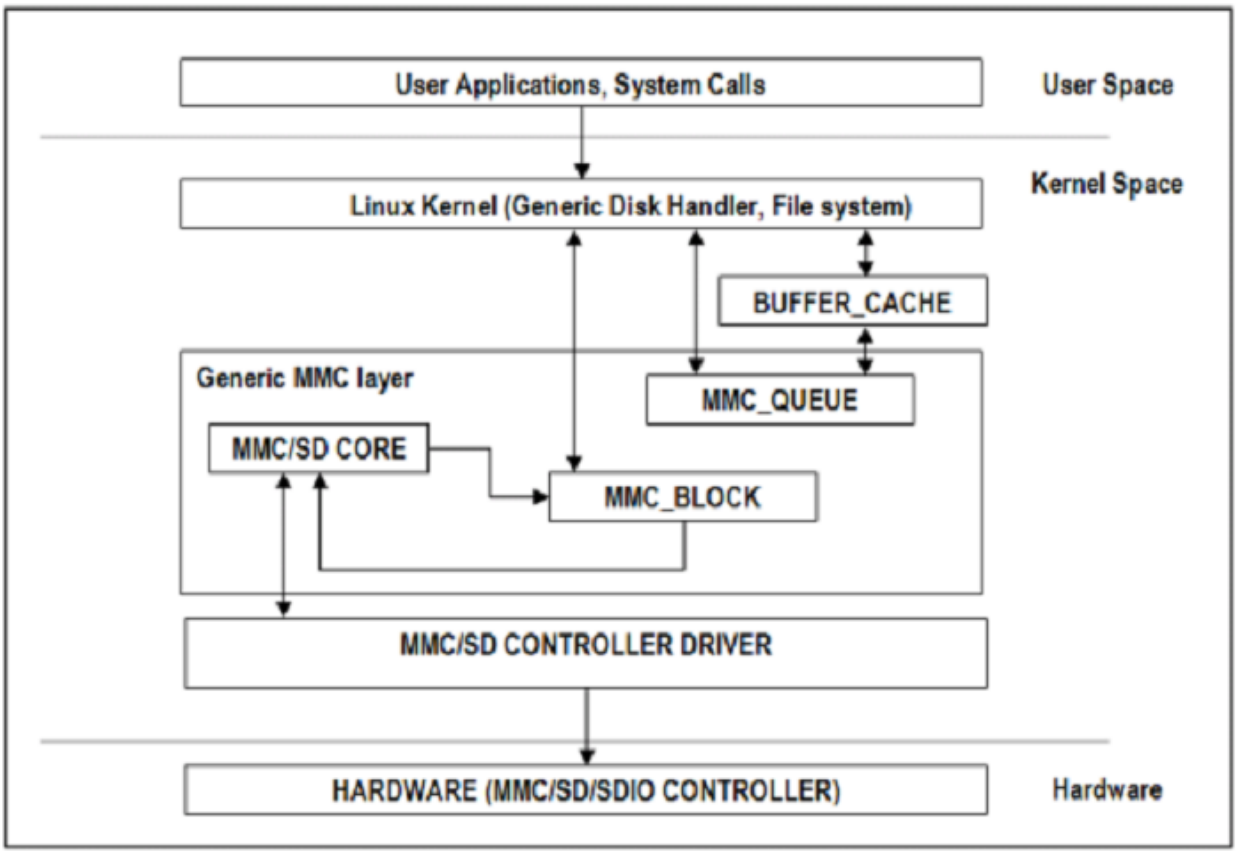
MMC/SD Driver

Abstract

This chapter provides details on MMC/SD driver along with throughput and CPU load numbers.

Introduction

The MMC controller provides an interface to external MMC cards that follow the MMC specification v4.0. The MMC driver is implemented as a block driver. Block device nodes(such as /dev/mmcblockp1, /dev/mmcblockp2) are created for user space access.



Driver Features

The driver supports the following features:

1. MMC/SD native protocol command/response set
2. Single/multiple block data transfers
3. Linux file system and generic MMC layer abstract details of block devices (MMC)
4. High-speed (SDv1.1) and High Capacity (SDv2.0) cards
5. Support for 1/4 bit modes
6. Support for card detect and Write protect features
7. DMA and polled mode for data transfer operations

Features Not Supported

1. Support for 8-bit mode of operation.
2. SDIO - WLAN support
3. SPI mode of operation

Constraints

1. MMC/SD cards should not be removed when the mount operation is in progress. If done so, data integrity cannot be guaranteed.

Supported System Calls

`open(),close(),read(),write()`

Supported IOCTLs

None

Performance and Benchmarks

IMPORTANT

The performance numbers can be severely affected if the media is mounted in sync mode. Hot plug scripts in the filesystem mount removable media in sync mode to ensure data integrity. For performance sensitive applications, umount the auto-mounted filesystem and re-mount in async mode.

The performance numbers were captured using SDHC Card (SanDisk, 8GB)

Performance using EXT2 file system

Write performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	3.21	3.05	4.67	4.45	42.97	41.27	33.17	23.36
256	100	3.14	3.12	4.44	4.63	40.19	40.85	30.66	24.20
512	100	3.15	3.24	4.39	4.51	42.25	41.94	30.55	23.92
1024	100	3.17	3.14	4.57	4.36	41.29	42.13	31.58	23.33
5120	100	3.10	3.18	4.37	4.37	41.85	41.95	29.98	23.33

Read performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	10.01	9.98	10.60	10.77	27.86	28	30.03	20.94
256	100	9.99	9.97	10.61	10.77	26.88	26.21	29.42	23.13
512	100	9.98	10.04	10.60	10.73	28.29	27.59	30.40	22.52
1024	100	9.91	10.02	10.60	10.73	28.92	27.15	29.73	22.52
5120	100	10.01	9.96	10.58	10.77	29.01	29.15	30.96	22.34

Performance using VFAT file system

Write performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	2.79	3.22	4.29	4.58	44.46	50.12	50.84	39.91
256	100	2.94	2.75	4.45	4.63	48.15	43.74	52.68	40.40
512	100	2.84	2.88	3.37	4.62	46.86	44.83	40.33	39.85
1024	100	2.81	2.87	4.45	4.68	46.81	47.69	53.05	40.36
5120	100	3.08	3.28	4.61	4.65	51.38	48.94	54.53	40.26

Read performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	9.74	9.71	10.22	10.42	30.18	31.60	35.90	42.74
256	100	9.65	9.66	10.21	10.40	33.92	31.09	33.37	26.29
512	100	9.66	9.61	10.22	10.42	34.53	33.82	36.66	27.33
1024	100	9.71	9.64	10.21	10.42	32.34	32.44	35.31	20.41
5120	100	9.73	9.68	10.20	10.41	33.02	32.41	37.31	26.60

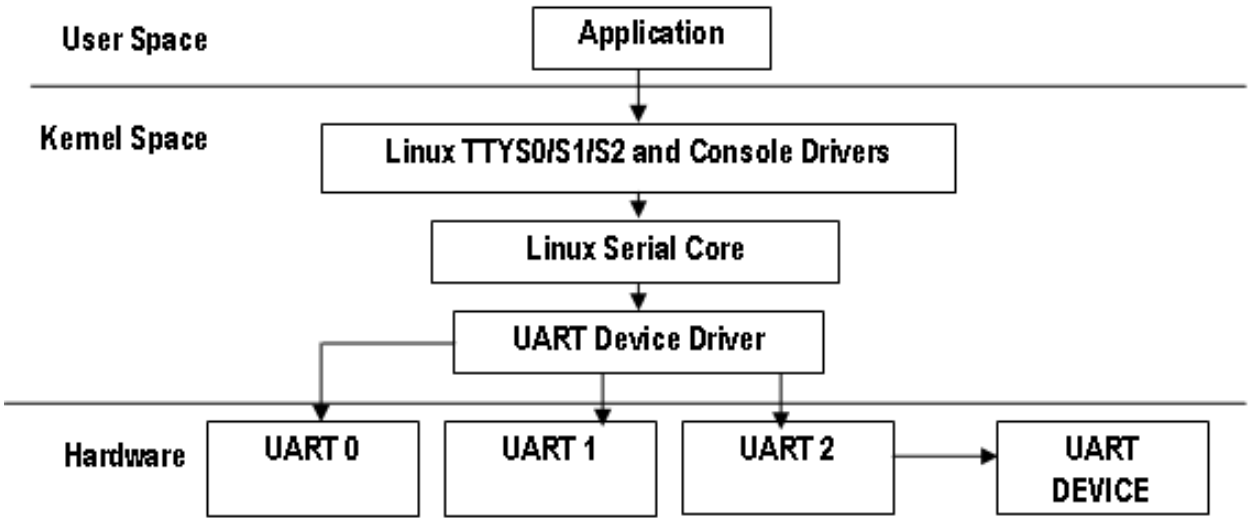
UART Driver

Abstract

This chapter provides details on UART driver.

Introduction

The UART driver is implemented as a serial driver, and can be accessed from user space as /dev/ttyS2.



Driver Features

The driver supports the following features:

1. Only UART2 is physically available on EVM board

Features Not Supported

- None

Constraints

None

Supported System Calls

`open(),close(),read(),write(),ioctl()`

Supported IOCTLs

Constant	Description
TIOCGSERIAL	Gets device parameters from the UART (example, port type, port num, baud rate, base divisor, and so on.
TIOCSSERIAL	Sets UART device parameters (example, port type, port num, baud rate, base divisor, and so on)

Performance and Benchmarks

None

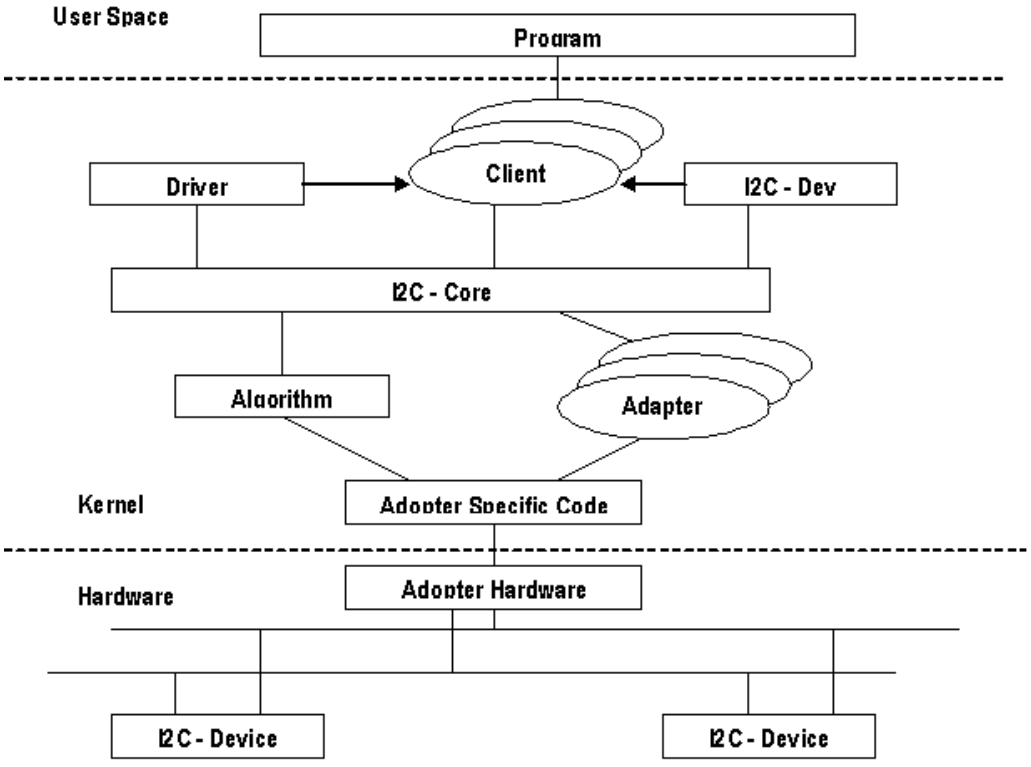
I2C Driver

Abstract

This chapter provides details on I2C driver.

Introduction

The I2C peripheral is compliant with the Philips Semiconductor I2C-bus specification version 2.1. The I2C driver is implemented as a serial driver. The I2C driver can be accessed from the user space as /dev/i2c/0.



Driver Features

The driver supports the following features:

1. 7-bit addressing mode
2. Fast mode
3. Interrupt mode

Features Not Supported

1. 7-bit and 10-bit addressing combined format is not supported
2. DMA mode is not supported

Constraints

- None

Supported System Calls

`open(),close(),read(),write(),ioctl()`

Supported IOCTLs

Constant	Description
I2C_SLAVE_FORCE	Changes slave address. Slave address is 7 or 10 bits. This changes the address, even if it is already considered.
I2C_TENBIT	7- or 10-bit address. (Value = 0 for 7 bits; value != 0 for 10 bits.)
I2C_FUNCS	Gets the adapter functionality
I2C_RDWR	Combined R/W transfer (one stop only)

Performance and Benchmarks

None

EDMA Driver

Abstract

This chapter provides details on EDMA driver along with throughput and CPU load numbers.

Introduction

The EDMA controller handles all data transfers between the level-two (L2) cache/memory controller and the device peripherals. On DA850/OMAPL138 EDMA has 2 CC instances where as the other SoCs have one instance. Each EDMA instance supports up to 32-dma channels and 8 QDMA channels. The EDMA consists of a scalable Parameter RAM (PaRAM) that supports flexible ping-pong, circular buffering, channel-chaining, auto-reloading, and memory protection. The EDMA allows movement of data to/from any addressable memory spaces, including internal memory (L2 SRAM), peripherals, and external memory.

The EDMA driver exposes only the kernel level API's. This driver is used as a utility by other drivers for data transfer.

Driver Features

The driver supports the following features:

1. Request and Free DMA channel
2. Programs DMA channel
3. Start and Synchronize with DMA transfers
4. Provides DMA transaction completion callback to applications
5. Multiple instances of EDMA driver on a single processor

Features Not Supported

1. QDMA is not supported.
2. Reservation of resources (channels and PaRAMs) for usage from DSP is not supported.

Constraints

None

Supported System Calls

None

Supported IOCTLs

None

Performance and Benchmarks

NA

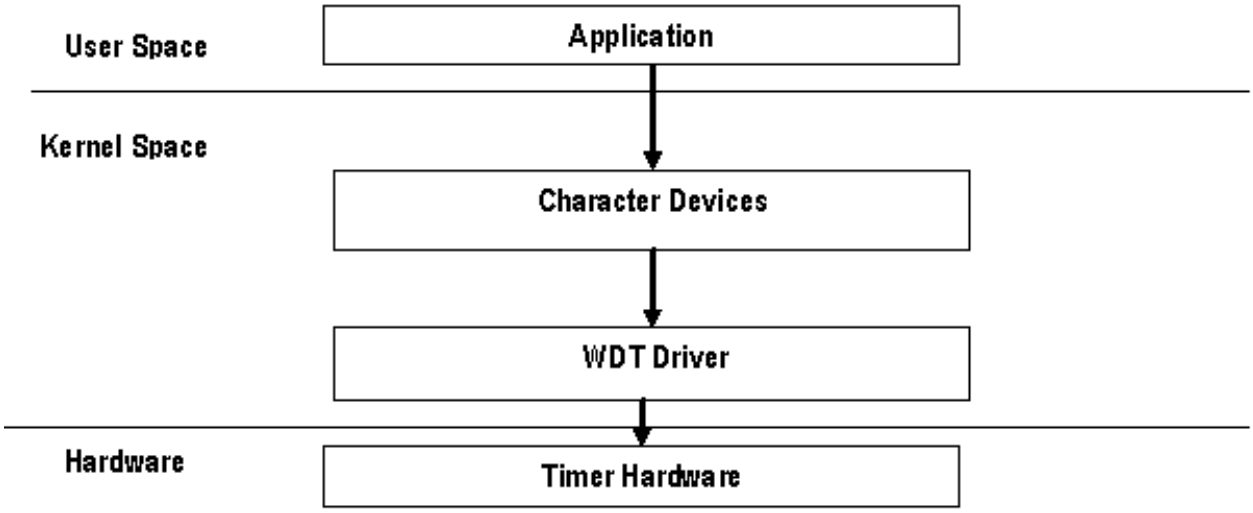
Watchdog(WDT) Driver

Abstract

This chapter provides details on Watchdog timer driver.

Introduction

DaVinci SoCs have a 64-bit watchdog timer which can be used to reset the hardware in case of a software fault. Once the /dev/watchdog is opened, it will reboot the system unless a user space daemon resets the timer at regular intervals within a certain timeout period. The WDT driver is registered as a misc device. Default timeout of this driver is 60 seconds.



Driver Features

The driver supports the following features:

1. Supports IOCTLs to set/get the timeout value, ping the watchdog & query the watchdog structure info.
2. Driver can be built as a loadable module and inserted dynamically.

Features Not Supported

- None

Constraints

1. Once /dev/watchdog is opened, closing it doesn't disable the watchdog

Supported System Calls

`open(), close(), write(), read()`

Supported IOCTLs

Constant	Description
WDIOC_GETSUPPORT	This ioctl returns "struct watchdog_info", which tells what the device can do
WDIO_KEEPALIVE	This ioctl can be used to notify the watchdog timer that the user space application is alive
WDIO_SETTIMEOUT	Watchdog timeout or margin can be dynamically changed using this ioctl
WDIO_GETTIMEOUT	This ioctl returns the present watchdog timeout period in seconds

Performance and Benchmarks

None

USB Driver

Abstract

This chapter provides details on OHCI and MUSB drivers along with throughput and CPU load numbers.

This chapter describes the USB (EHCI and MUSB) driver architecture, features supported/not supported, constraints and performance numbers.

OHCI Controller

Driver Features

The driver supports the following features

1. Human Interface Class (HID)
2. Mass Storage Class (MSC)
3. Hub Class
4. USB Video Class (UVC)
5. USB Audio Class (UAC)

Features Not Supported

All other classes not mentioned in the "Supported Features" section.

MUSB OTG controller

Description

The MUSB driver is implemented on top of Mentor OTG IP version 1.8 which supports all the speeds (High, Full and Low (host mode only)). On DA850/OMAP-L138, MUSB uses CPPI 4.1 DMA for all the transfers on other devices CPPI 3.0 DMA is used.

Driver Features

The driver supports the following features

Host Mode

1. Human Interface Class (HID)
2. Mass Storage Class (MSC)
3. Hub Class
4. USB Video Class (UVC)
5. USB Audio Class (UAC)

Gadget mode

1. Mass Storage Class (MSC)
2. USB Networking - RNDIS/CDC

Features Not Supported

- OTG
- Modular support for host/device mode.

USB Mass Storage Class Host Driver

Driver Features

The driver supports the following feature

1. DMA mode
2. PIO mode

Features Not Supported

None

Constraint

None

Supported System Calls

`open(), close(), read(), write(), ioctl()`

Supported IOCTLS

None

Performance Benchmarks

IMPORTANT

For Mass-storage applications, the performance numbers can be severely affected if the media is mounted in sync mode. Hot plug scripts in the filesystem mount removable media in sync mode to ensure data integrity. For performance sensitive applications, umount the auto-mounted filesystem and re-mount in async mode.

USB MSC (MUSB) Host mode DMA EXT2 File System Performance

USB-MSC MUSB Host-DMA-Write Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	9.49	12.24	9.93	13.07	99.0	99.7	97.66	97.28
500	100	9.35	11.18	10.02	13.11	99.9	98.15	98.39	95.79
1024	100	10.22	12.67	10.09	13.12	99.5	99.6	98.00	93.68
5120	100	9.71	10.96	10.02	13.06	97.4	99.69	97.82	96.42

USB-MSC MUSB Host-DMA-Read Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	13.98	18.54	12.61	16.00	94.6	94.87	95.84	85.41
500	100	14.02	17.23	12.71	16.11	94.39	94.75	97.96	86.95
1024	100	14.17	17.71	12.5	15.92	94.75	94.75	97.39	85.91
5120	100	11.73	15.69	12.38	15.67	98.45	96.14	98.60	85.38

The performance numbers are captured using the following.

1. Hard disk: USB Western Digital HDD
2. File format: ext2

USB MSC (MUSB) Host mode DMA VFAT File System Performance

USB-MSC MUSB Host-DMA-Write Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	8.17	9.59	6.5	8.38	90.9	86.20	95.07	87.61
500	100	7.73	9.72	6.53	8.52	90.9	82.95	94.98	87.12
1024	100	7.51	9.70	6.55	8.44	92.7	84.61	95.78	87.13
5120	100	7.68	9.44	10.87	8.75	90.7	82.44	96.31	89.72

USB-MSC MUSB Host-DMA-Read Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)				CPU Load (in %)			
		DA850/OMAP-L138/AM18xx		DM365	DM368	DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
100	100	13.91	15.78	11.13	13.83	92.71	89.26	96.33	91.56
500	100	13.86	15.65	11.14	13.94	93.15	88.92	96.74	91.45
1024	100	16.24	16.64	11.08	14.18	93.18	89.52	96.34	91.03
5120	100	13.11	14.03	10.87	13.99	94.9	95.23	96.31	93.39

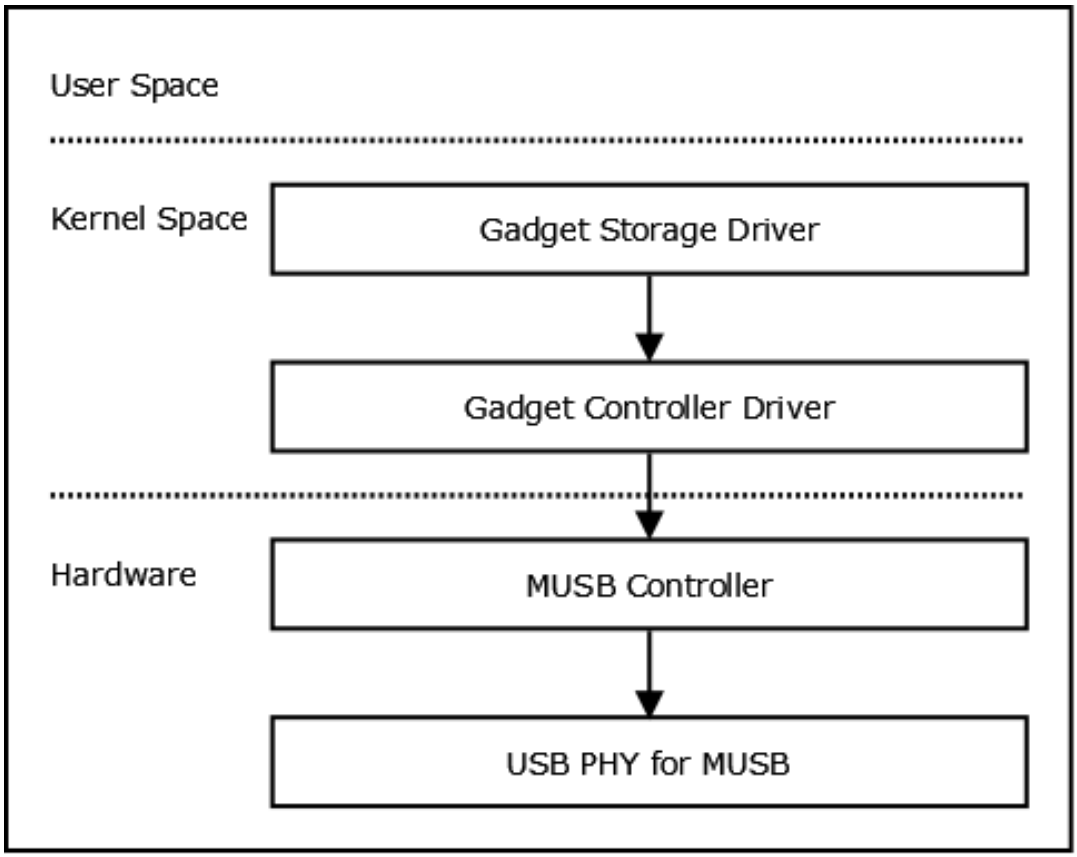
The performance numbers are captured using the following.

1. Hard disk: Western Digital USB HDD
2. File format: VFAT

USB Mass Storage Class Slave Driver

Description

This figure illustrates the stack diagram of the system with USB File Storage Gadget driver



Driver Features

The driver supports the following feature

1. DMA mode
2. PIO mode
3. File backed storage driver was tested with SD media as the storage medium

Features Not Supported

- Modular support

Constraint

None

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

USB Slave-DMA Performance

USB Slave-DMA-Write Performance values

Bytes Transferred (MB)'MicroSD Trascend as storage device'	Number of files transferred	Total Bytes transferred (MB)	DM3850/OMAP-L138/AM18xx		DM365	DM368
			300 MHz	456 MHz	297 MHz	432 MHz
500	1	500	2.63	3.125	1.28	8.9

USB Slave-DMA-Read Performance values

Bytes Transferred (MB)'MicroSD Trascend'as storage device'	Number of files transferred	Total Bytes transferred (MB)	DM3850/OMAP-L138/AM18xx		DM365	DM368
			300 MHz	456 MHz	297 MHz	432 MHz
500	1	500	6.25	9.25	1.56	9.6

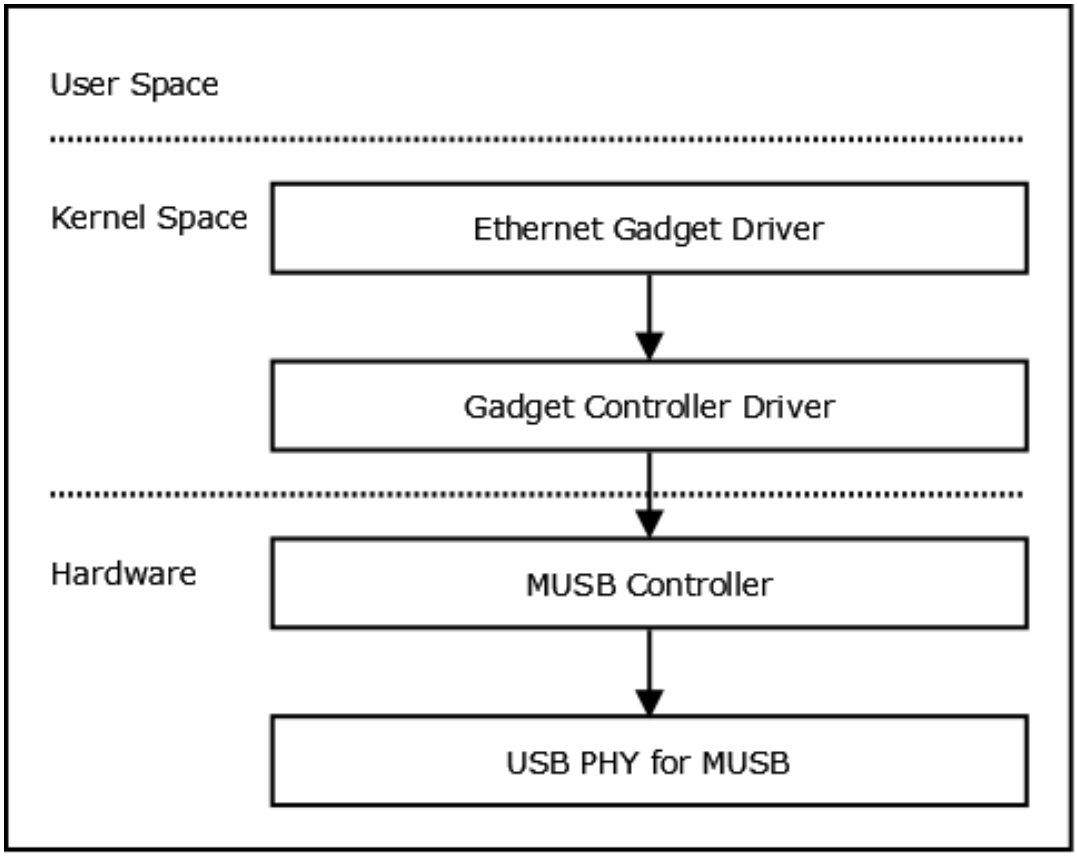
The performance numbers are captured using the following.

1. For OMAPL138 - SATA Western Digital 500GB HDD (Model-WD5001AALS) Used as storage device
2. For DM36x - Storage device used is MMC/SD card(Sandisk-8GB)
3. File format: vfat on Windows XP

USB CDC/RNDIS Slave Driver

Description

The CDC RNDIS gadget driver that is used to send standard Ethernet frames using USB. The driver will create an Ethernet device by the name usb0.



Driver Features

The driver supports the following feature

1. DMA mode
2. PIO mode
3. 10/100 Mbps speed.

Features Not Supported

None

Constraint

None

Supported System Calls

`open(), close(), read(), write(), ioctl()`

Supported IOCTLS

None

Performance Benchmarks

Performance benchmarks were collected using the Iperf tool and default options were used to collect the throughput numbers.

DA850/OMAP-L138

USB CDC-DMA Performance

USB CDC-DMA Performance values - Client

TCP Window Size(in KBytes)	Interval (in Seconds)	Bandwidth (Mbits/Sec)			
		DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz
16	60	34.7	42.8	31.1	41.1
32	60	34.9	42.8	31.0	41.9
64	60	34.0	42.7	31.2	42.1
128	60	34.2	42.9	31.1	42.1

USB RNDIS-DMA Performance

USB RNDIS-DMA Performance values - Client

TCP Window Size(in KBytes)	Interval (in Seconds)	Bandwidth (Mbits/Sec)			
		DA850/OMAP-L138/AM18xx		DM365	DM368
		300 MHz	456 MHz	297 MHz	432 MHz
16	60	28.7	35.3	26.3	34.8
32	60	28.6	35.1	26.1	34.7
64	60	28.5	35.2	26.1	35.5
128	10	28.4	35.4	26.3	35.4

USB Human Interface Device (HID) Driver

Description

The event sub system creates /dev/input/event* devices with the help of mdev.

Driver Features

The driver supports the following feature

1. DMA mode
2. PIO mode
3. USB Mouse and Keyboards that conform to the USB HID specifications

Features Not Supported

None

Constraint

None

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

NA

USB Isochronous Driver

Description

USB camera, speaker and mic uses isochronouse transfers. USB Video Class (UVC) is used by most of the USB cameras to capture image.

Driver Features

The driver supports the following feature

1. DMA mode
2. PIO mode
3. Support for USB Audio and video class(UVC class)

Features Not Supported

None

Constraint

None

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

NA

USB OTG Driver

Description

MUSB controller on DaVinci supports USB On The Go (OTG). OTG protocol enables runtime role switch between USB host and device. This is achived using Session Request Protocol (SRP) and Host Negotiation Protocol (HNP). OTG driver is tested with OPT (OTG Protocol Tester).

Driver Features

The driver supports the following feature

Features Not Supported

OTG

Constraint

None

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

NA

SATA

Description

SATA peripheral is AHCI Ver.1.1 spec compliant peripheral. It supports SATA1 (150MBps) and SATA 2 (300MBps) speeds over one SATA port. Port Multiplier support is available in the SATA controller. The controller can support drives upto UDMA-133 speeds.

Driver Features

Registers as a SCSI controller with the Linux SCSI Subsystem. SATA devices get registered as SCSI devices and can be accessed as "/dev/sd{*}" devices.

- Port Multiplier support
- CD/DVD support

Driver Features Not Supported

None.

Constraint

None

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

SATA - ext2 File System Performance

SATA - Write Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)		CPU Load (in %)	
		300 MHz	456 MHz	300 MHz	456 MHz
100	100	23.17	26.26	98.46	98.25
500	100	23.92	25.78	98.64	98.28
1024	100	23.67	25.84	97.98	97.54
5120	100	23.60	25.82	97.76	98.28

SATA - Read Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	Transfer Rate (in MBytes/sec)		CPU Load (in %)	
		300 MHz	456 MHz	300 MHz	456 MHz
100	100	39.61	41.57	98.88	98.81
500	100	38.84	41.79	99.25	98.01
1024	100	39.82	41.66	99.25	99.60
5120	100	39.70	40.75	98.88	99.22

The performance numbers are captured using the following.

1. SATA HDD - Seagate Baracuda 7200 RPM 500GB drive
2. File format: ext2

Video Port Interface (VPIF)

Abstract

This chapter provides details on Video Port Interface (VPIF) used for video display and capture.

Description

This section describes the Video Port Interface (VPIF) is a Linux V4L2 driver. It uses v4l2-subdev interface to interact with the encoders and decoders. On DA850/OMAP-L138/AM1808 EVM, VPIF channel 0 and channel 1 are used for capture and channel 2 is used for display. Channel 0 takes in composite input and Channel 1 is for S-Video input. There are 2 TVP5146 decoders interfaced, one for each channel. Channel 2 is used for output. One ADV7343 encoder is connected to it and output is either Composite or S-Video depending on the output type chosen.

Driver Features

1. Supports Composite Video input and output
2. Supports S-Video input and output
3. Supports V4L2 driver model for video planes
4. Supports NTSC and PAL standards
5. Supports SBGGR8 and NV16 color formats for capture and NV16 color format for display.

Driver Features Not Supported

1. Framebuffer (fbdev) interface is not supported.
2. Raw Capture is not supported
3. VBI data on display and capture is not supported
4. HD resolutions are not supported

Performance Benchmarks

Video Display Performance

Resolution	Frame Rate				CPU Load (in %)			
			DM365	DM368			DM365	DM368
	300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
NTSC(720x480)	30	30			0	0		
PAL(720x574)	25	25			0	0		
720P	NA	NA			NA	NA		
1080I	NA	NA			NA	NA		

Video Capture Performance

Resolution	Frame Rate				CPU Load (in %)			
			DM365	DM368			DM365	DM368
	300 MHz	456 MHz	297 MHz	432 MHz	300 MHz	456 MHz	297 MHz	432 MHz
NTSC(720x480)	30	30			26	22.5		
PAL(720x574)	25	25			24	19		
720P	NA	NA			NA	NA		
1080I	NA	NA			NA	NA		

NOTE

The above performance numbers are based on application which does mmap buffer allocation mechanism.

McBSP

Description

Multi-channel Buffer Serial Port (McBSP) peripheral is primarily used for serial data transfer like in the case of audio interfaces. McBSP supports DMA mode of transfer and hence is suitable for real-time audio applications. The McBSP driver provides APIs to the programmer to control McBSP.

Driver Features

1. The driver is an API driver.
2. Supports multiple instances of the peripheral.
3. Supports master transmitter and slave receiver operation.
4. Supports multi-channel selection mode of operation.
5. Supports configuration of word length, frame length, sample frequency.

Driver Features Not Supported

Slave transmitter, master receiver combination.

Constraint

The test setup consists of Interposers connecting two EVMs with the necessary connections wired. Using this setup, the maximum frame length that has been tested is 32. Beyond this the test results are not stable.

Supported System Calls

NA

Supported IOCTLS

NA

Performance Benchmarks

NA

VPFE V4L2 Driver

Description

The Video Port Front End Driver is the Video capture interface for the DM3X device for capturing the video data through the VPFE interface. The interface supports both RAW Bayer and processed YUV, and stores the data into the DDR using the internal DMA. The port is capable of both storing the data as-is without processing using only CCDC or process it midway using IPIPE hardware.

The Driver conforms to the V4L2 Media Controller Framework interface with CCDC, Previewer, Resizer H3A and AEW being the core Media entities in the VPFE IP, and MT9P031, TVP7002 and TVP514X being the external Media entities. The driver is operable in two modes - mainly continuous where the data captured is synchronously stored in the DDR and in Single shot mode where the input and the output is the DDR.

For more information visit: Writing_V4L2_Media_Controller_Applications_on_Dm36x_Video_Capture

Driver Features

1. Supports Media Controller Framework
2. Supports Suer pointer exchange and memory mapped buffers
3. Single Shot and Continuous mode operations
4. Supports DV_PRESETS for HD modes.

Driver Features Not Supported

1. NV12 buffer format is not supported
2. Resizer-B as a seperate node is not supported
3. IOCTL on IPIPE for setting format(s_format) and config (s_config) has to be issued as both private IOCTL and V4l2.
4. Single shot driver supports queuing one buffer at a point of time. Does not yet support multiple buffer queuing.

Performance Benchmarks

Video Capture Performance on VPFE

Driver	Resolution	Frame Rate		CPU Load (in %)	
		DM365	DM368	DM365	DM368
Resizer Single Shot	720x480 to 1280x720	113	158		
Resizer Single Shot	1280x720 to 720x480	43	60		
Resizer Single Shot	1280 x 720 to 1920 x 1080	43	60		
Resizer Single Shot	1920 x 1080 to 1280 x 720	26	26		
Previewer Single Shot	720 x 480, format=YUYV	76	106		
Previewer Single Shot	1280 x 720 format=YUYV	28	40		
Previewer Single Shot	1920 x 1080 format=YUYV	12	18		
Previewer + Resizer	720x480 to 1280 x 720 format=YUYV	76	106		
Previewer + Resizer	1280x720 to 720x480 format=YUYV	28	40		
Previewer + Resizer	1280x720 to 1920x1080 format=YUYV	28	40		
TVP514X + CCDC	NTSC	30	30		
MT9P031 + CCDC	720P	26	26		
CCDC	1080P	31	31		
MT9P031 + CCDC + Previewer	720P	26	26		
MT9P031 + CCDC + Previewer	1080P	31	31		
MT9P031 + CCDC + Previewer + Resizer	720P	26	26		
MT9P031 + CCDC +Previewer + Resizer	1080P	31	31		

NOTE

The above performance numbers are based on application which does user pointer buffer allocation mechanism.

References

[1] http://www.alsa-project.org/alsa-doc/alsa-lib/

Article Sources and Contributors

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