GLSDK Datasheet DRA7xx 6.10.00.02

Contents

Read This First

All performance numbers provided in this document are gathered using DRA7xx Evaluation Module with ARM-15 running at 1176MHz and DDR3 configured at 532MHz unless otherwise specified.

About This Manual

This document provides a feature overview and performance data for each of the device drivers which are part of the **GLSDK 6.10.00.02 Release** package. This document should be used in conjunction with the release notes provided with the GLSDK package for information on specific issues present with drivers included in a particular release.

U-Boot Overview

Boot Modes Supported

Green colored box in the table below means that the particular boot mode is supported on the device in the release.

DRA7xx Supported Boot Modes

Boot Mode	DRA7xx Evaluation Module (EVM)
QSPI Flash	Yes
MMC/SD	Yes
eMMC Boot	Yes
UART Boot	No
NOR Flash	No
EMAC Boot	No
USB Boot	No

Note: These are supported boot modes in GLSDK 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 Features Supported

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	DRA7xx (Evaluation Module)
UART	Yes
Ethernet Download (TFTP)	Yes
MMC/SD	Yes
QSPI Flash	Yes

Memory Section Details

MMC/SD bootmode 1st Stage Memory Section on DRA7xx

Memory Section	Size(in bytes)
.text	44236
.data	2100
.bss	198404

- MMC/SD bootmode u-boot 1st Stage (MLO) size: 60724 bytes

MMC/SD bootmode 2nd Stage Memory Section on DRA7xx

Memory Section	Size(in bytes)
.text	172044
.data	8436
.bss	213216

- MMC/SD bootmode u-boot 2nd Stage (u-boot.img) size: 256104 bytes

Linux Kernel

Kernel Virtual Memory Layout

The default DRA7xx kernel configuration, uses following Virtual Memory laout:

```
[    0.000000] Memory: 1313544K/1566720K available (6507K kernel code, 540K rwdata, 2212K rodata, 353K init, 250K bss, 253176K reserved, 792576K highmem)
[    0.000000] Virtual kernel memory layout:
[    0.000000]     vector  : 0xffff0000 - 0xffff1000   (   4 kB)
[    0.000000]     fixmap  : 0xfff00000 - 0xfffe0000   ( 896 kB)
```

```
[    0.000000]     vmalloc : 0xf0000000 - 0xff000000   ( 240 MB)
[    0.000000]     lowmem  : 0xc0000000 - 0xef800000   ( 760 MB)
[    0.000000]     pkmap   : 0xbfe00000 - 0xc0000000   (   2 MB)
[    0.000000]     modules : 0xbf000000 - 0xbfe00000   (  14 MB)
[    0.000000]       .text : 0xc0008000 - 0xc088c094   (8721 kB)
[    0.000000]       .init : 0xc088d000 - 0xc08e5400   ( 353 kB)
[    0.000000]       .data : 0xc08e6000 - 0xc096d388   ( 541 kB)
[    0.000000]        .bss : 0xc096d394 - 0xc09abdfc   ( 251 kB)
```

Interrupt Latency Measurement

The following table gives interrupt latency measurements taken across 1001 measurement samples.

Interrupt Latency Measurement

Interrupt Latency (in micro seconds)	Number of samples (under 0% cpu load) (1001 total samples)	Number of samples (under 100% cpu load using hackbench `hackbench -P -l -1 -g 10`) (501 total samples)
TBD	TBD	TBD

Boot-time Measurement

Boot-time measurement was done using Grabserial tool(http://elinux.org/Grabserial). U-Boot environment variable `bootargs` is set to `'elevator=noop console=ttyO0,115200n8 root=/dev/mmcblk1p2 rw rootwait fixrtc omapdrm.num_crtc=2 consoleblank=0 cma=64M '`. In general kernel boot-up time alone is ~16 secs. The following table summarizes the boot-up cycle of different stages in QSPI boot mode.

QSPI Boot Cycle Measurement

Module	Stages	Time (sec)
UBoot		0.43
Kernel	Kernel load	3.46
	Kernel init	6.03
	Kernel init fs	7.04
Total Boot-time		**16.96**

Linux Kernel Drivers

This section provides brief overview of the device drivers supported in the Linux Kernel of the GLSDK release package.

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
Audio (McASP)	Audio Record and Playback	ALSA SoC	SDMA
Ethernet	Ethernet Network driver	Netdev	Internal DMA
USB1 DWC3(DRD)-SS/HS/FS/LS	DWC3 Device & xhci host controller driver	USB HCD/DCD	USB Internal DMA
USB2 DWC3(DRD)-HS/FS/LS	DWC3 Device & xhci host controller driver	USB HCD/DCD	USB Internal DMA
QSPI Flash/Controller Driver	Flash storage system	MTD Block	Not Supported
eMMC/SD/MMC	Interface to MultiMedia Secure Digital cards	Block	SDMA
UART	Serial Communication Interface	Character	Supported
I2C	Inter-IC Communication	Character	Not Supported
DSS	Display Subsystem driver	Platform driver	Internal DMA
VIP	Video IP driver	V4L2 Capture	VPDMA
VPE	Video Processing Engine driver	V4L2 Mem to Mem	VPDMA
CPUFreq	Supports multiple SoC operating levels for MPU(OPPs)	NA	None
RTC	Realtime clock	Character	None

ALSA SoC Audio Driver

This section an overview of the ALSA SoC audio driver features along with the throughput and CPU load numbers.

Introduction

DRA7xx 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.

Driver Features

The driver supports the following features:

1. Supports AIC3106 audio codec in ALSA SoC framework.
2. Sample rate support - 44.1 KHz and multiples of 44.1KHz for both capture and playback.
3. Supports audio in stereo mode
4. Supports simultaneous playback and record (full-duplex mode).
5. Supports mixer interface for the audio codec

Features Not Supported

1. OSS based applications, which use ALSA-OSS emulation layer, are not supported.
2. Synthesizer and midi interfaces are not supported.

Constraints

Supported System Calls

Refer ALSA project - the C library reference [1] (http://www.alsa-project.org/alsa-doc/alsa-lib/) for API calls.

Performance and Benchmarks

1. Access type - RW_INTERLEAVED
2. Channels - 2
3. Format - S16_LE
4. Period size - 64

Audio Capture

Sampling Rate (in Hz)	Throughput(bits/sec)	CPU Load (in %)
8000	352,585.00	0.13
11025	352,585.00	0.12
16000	352,585.00	0.12
22050	705,171.00	0.25
24000	705,171.00	0.24
32000	705,171.00	0.25
44100	1,410,341.00	0.53
48000	2,809,699.00	1.04

Audio Playback

Sampling Rate (in Hz)	Throughput(bits/sec)	CPU Load (in %)
8000	352,603.00	0.12
11025	352,603.00	0.12
16000	352,603.00	0.12
22050	705,205.00	0.24
24000	705,205.00	0.24

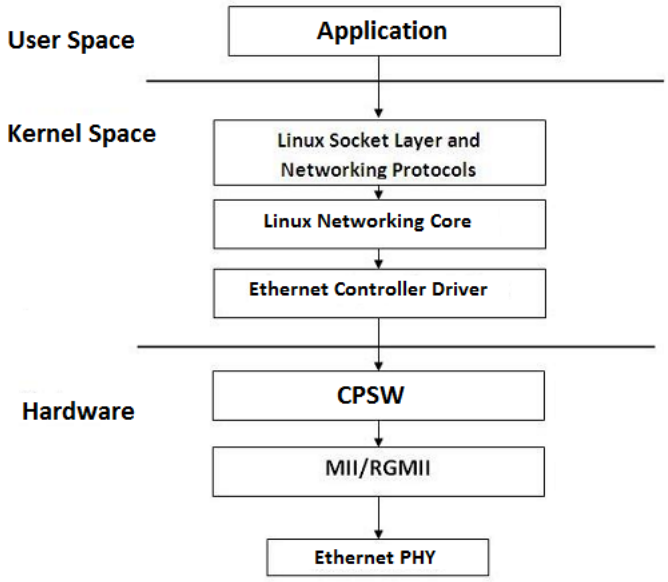
32000	705,205.00	0.25
44100	2,820,818.00	0.50
48000	2,820,818.00	0.98

Ethernet Driver

This section provides an overview of the Ethernet driver features along with throughput and CPU load numbers. Ethernet driver follows standard Linux network interface architecture.

Introduction

The Ethernet driver supports the Linux netdev interface.



Driver Features

The driver supports the following features:

1. 10/100/1000 Mbps mode of operation.
2. Auto negotiation.
3. Full duplex and half duplex mode of operation.
4. Linux NAPI support
5. Support for MII and RGMII interfaces to PHY
6. Operation of both external ports as independent network interfaces

```
* Enable CONFIG_ETHERNET through menuconfig (Menu Config->Device Drivers->Network device support & Menu config-> Networking support)
```

Features Not Supported

N/A

Supported System Calls

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

Performance and Benchmarks

TCP Performance

Ethernet Port0 TCP - 1000Mbps Mode Performance

TCP Window Size (in KBytes)	Bandwidth (without interrupt pacing, in Mbits/sec)	CPU Load (without interrupt pacing, in %)	Bandwidth (with interrupt pacing, in Mbits/sec)	CPU Load (with interrupt pacing, in %)
8	490	69	157	10

16	669	85	280	17
32	886	94	586	38
64	858	90	844	60
128	918	89	774	40
256	916	87	764	35

Note: The above data are obtained on DRA7xx EVM running @ 1176MHz.

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

- iperf version 2.0.5
- On PC Host invoke iperf in the server mode.

```
iperf -s
```

- On the DUT iperf is invoked in client mode (bi-directional traffic for 60 seconds).

```
iperf -c <server ip> -w <window size> -m -f M -d -t 60
```

- Interrupt pacing feature enabled with pacing interval set to 250usecs.

```
ethtool -C eth0 rx-usecs 250
```

- DUT is connected to a gigabit network.

UDP Performance

For UDP transmit performance, the iperf server instance is started on the PC and client is started from the DUT. Interrupt pacing for 250usecs interval was enabled

Ethernet Port0 UDP - Transmit Performance (MTU Size packets)

Bandwidth limit on send(MBits/sec)	Bandwidth measured by server (MBits/sec)	Jitter (milliseconds)	Lost Datagrams (%)	CPU Load (with interrupt pacing, in %)
302	302	0.066	0	26
511	511	0.030	0	33
733	733	0.028	0	46
881	811	0.017	8.1	55

For UDP receive performance, the iperf client instance is started on the PC and server is started on the DUT. Interrupt pacing for 250usecs interval was enabled.

Ethernet Port0 UDP - Receive Performance (MTU Size packets)

Bandwidth limit on send(MBits/sec)	Bandwidth measured by server (MBits/sec)	Jitter (milliseconds)	Lost Datagrams (%)	CPU Load (with interrupt pacing, in %)
302	301	0.050	0.006	12
511	511	0.030	0.013	22
735	734	0.017	0.009	36
806	788	0.036	2.2	41

- iperf version 2.0.5
- For receive performance, on DUT, invoke iperf in server mode.

```
iperf -s -u
```

- For transmit performance, on DUT, invoke iperf in client mode.

```
iperf -c <server ip> -b <bandwidth limit> -f M -t 60
```

OMAPDRM/OMAPDSS (Display Subsystem Driver)

Introduction

The OMAPDRM internally uses OMAPDSS driver interface for configuration of panel drivers and the encoder interface(DPI/HDMI).

Menuconfig Option

```
Enable CONFIG_DRM_OMAP through (Menuconfig->Device Drivers->Graphics support)
```

```
Enable CONFIG_OMAP2_DSS_DRA7XX_DPI, CONFIG_OMAP5_DSS_HDMI, CONFIG_OMAP5_DSS_HDMI_DDC through (Menuconfig->Device Drivers->Graphics support->OMAP2+ Display Subsystem support)
```

```
Enable CONFIG_PANEL_TFCS9700 through (Menuconfig->Device Drivers->Graphics support->OMAP2+ Display Subsystem support->OMAP2/3 Display Device Drivers)
```

Source Location

```
drivers/gpu/drm/omapdrm/
drivers/video/omap2/dss/
```

Driver Features

OMAPDRM Display controller (DISPC)

DRM Plane Features:

- One Graphics (GFX) and Three Video pipelines (VID1, VID2, and VID3)
- Z-order, Alpha blending (Global, pre-multipled), Scaler and CSC

DRM CRTC Features:

- One TV and three LCD Overlay Managers
- Supports 1080p at 60Hz for all CRTCs

OMAPDRM Interfaces

HDMI Interface

- HDMI protocol engine
- HDMI 1.4 support

RGB Interface

- Supports 24bit LCD Fixed Resolution Panels

Features Not Supported

- Rotation/Tiler 2D
- Default BG color, Transparency and color Keys

Constraints

- Number of CRTCs must be passed either through bootargs or kernel config, which limits number of free DRM planes.

Supported System Calls

All libdrm APIs are supported.

QSPI Driver

Introduction

This chapter describes the QSPI platform driver & flash driver features and performance numbers (throughput and CPU load).

QSPI Platform driver feature

QSPI is a serial driver. Supports 4-Pin single read, 4-Pin single write & 6-Pin quad read. It implements only SPI_CORE mode & no support for memory mapped interface. Clock phase & polarity configured to mode-3 & functional clock programmed at 48MHz. There is no support for DMA data transfer.

The pointer to TI qspi hardware driver is drivers/spi/spi-ti-qspi.c

```
* Enable CONFIG_SPI_TI_QSPI through menuconfig (Menuconfig->Device Drivers->SPI support->DRA7xxx QSPI controller support)
```

QSPI Flash driver feature

Spansioin S25FL256S serial flash used on DRA7xx evm. The property of the flash are

- 256 Mbits (32 Mbytes)
- 256 or 512 Byte Page Programming buffer options
- 64KB erase sector size
- Normal, Fast, Dual & Quad

Linux mtd m25p80 used as serial flash device driver for s25FL256S. The driver layer exports API for device info read, sector erase, chip erase, data read & write. It creates the device node for user space access (example, /dev/mtd0)

The pointer to mtd m25p80 flash device driver is drivers/mtd/devices/m25p80.c

```
* Enable CONFIG_MTD_M25P80 through menuconfig (Menuconfig->Device Drivers->Memory Technology Device(MTD) support ->Self-contained
  MTD device drivers->Support most SPI Flash chips)
```

JFFS2 Filesystem Support

QSPI flash driver is mtd based block driver. Support to mount JFFS2 filesystem on /dev/mtd0. Validated to mount JFFS2 filesystem & performed basic file IO operations.

There is an exception on remounting the filesystem. It is known limitation in this release.

```
Erase the flash to mount JFFS2 filesystem
$flash_eraseall -j /dev/mtd0
```

```
Mount the serial flash
$mount -t jffs2 /dev/mtdblock01 /mnt/nor
```

```
Create a new file
$echo NewFileCreated > /mnt/nor/testfile.txt
```

```
Read the file
$cat /mnt/nor/testfile.txt
```

```
Delete the file
$rm /mnt/nor/testfile.txt
```

Performance Benchmark

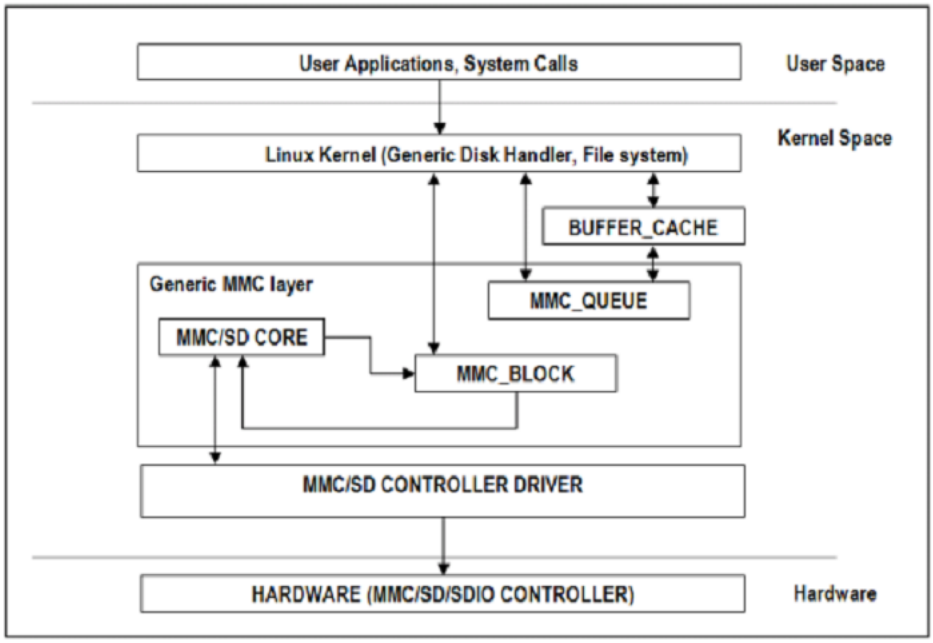
Not available for this release.

MMC/SD Driver

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 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. SPI mode of operation
2. PIO mode of operation
3. Card detect and Write protection features

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()
```

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.

EXT2 file system

SD - Write Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	17.42	4.28
262144	18.38	7.70
1048576	17.76	4.35
5242880	17.92	4.5

SD - Read Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	29.81	4.99
262144	29.84	4.71
1048576	29.33	4.56
5242880	29.86	4.9

The performance numbers were captured using the following:

- SD Card Sandisk Ultra 8G Class 10 SDHC card
- File System: ext2
- Partition was mounted with async option

VFAT file system

SD - Write Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	15.63	7.12
262144	15.87	7.46
1048576	15.83	7.6
5242880	15.79	7.28

SD - Read Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	29.03	5.91
262144	29.02	4.05
1048576	28.92	6.41
5242880	28.58	7.09

EMMC 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.

VFAT file system

EMMC - Write Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	10.26	4.95
262144	11.34	5.36
1048576	11.34	5.11
5242880	11.34	5.11

EMMC - Read Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	41.77	6.47
262144	41.58	8.74
1048576	41.66	7.08
5242880	41.64	7.64

The performance numbers were captured using the following:

- File System: ext4
- Partition was mounted with async option

EXT4 file system

EMMC - Write Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	11.48	4.2
262144	11.45	4.68
1048576	11.43	4.51
5242880	11.41	4.39

EMMC - Read Performance values

Buffer Size (in Bytes)	Transfer Rate (in MBytes/sec)	CPU Load (in %)
102400	49.2	8.05
262144	48.78	9.31
1048576	48.95	1.06
5242880	49.07	10.93

The performance numbers were captured using the following:

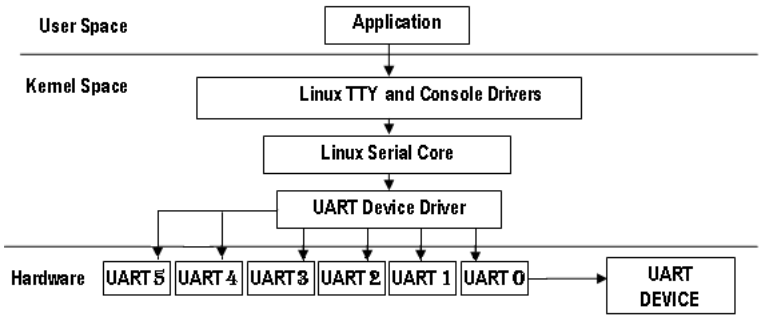
- File System: vfat
- Partition was mounted with async option

UART Driver

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/ttyOX(X=0-5)



Features Not Supported

- Hardware Flow Control

Features Supported

- DMA mode - please refer to GLSDK-6.10.00.02-Post-release-page (http://processors.wiki.ti.com/index.php/DRA7xx_GLSDK_6.10.00.02_Post-release_Updates#Post_Release:_Defect_Fixes_and_the_Patch_Updates) for UART-DMA support patches.

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

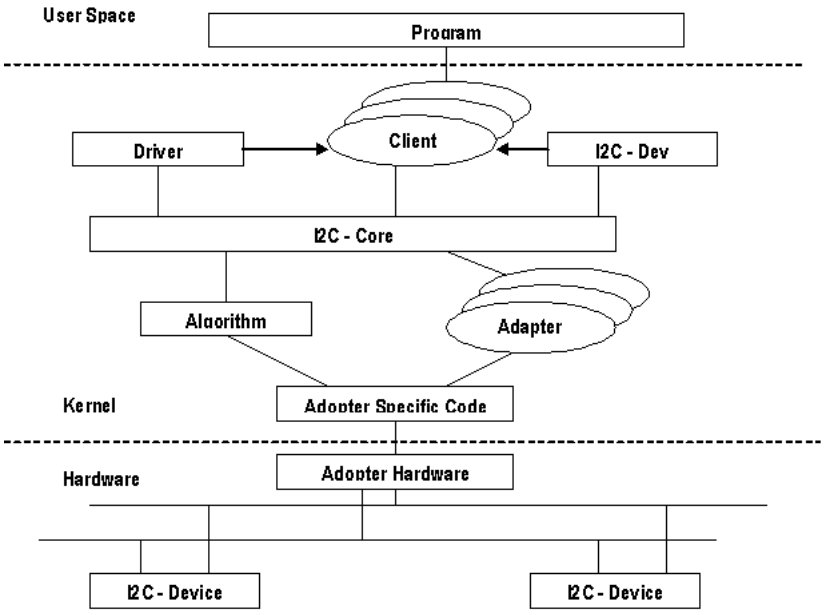
Performance and Benchmarks not available in this release.

I2C Driver

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

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_FUNCS	Gets the adapter functionality
I2C_RDWR	Combined R/W transfer (one stop only)

Performance and Benchmarks

Performance and Benchmarks not available in this release.

VIP Driver

Introduction

The Video Input Port (VIP) is a V4L2 based video capture driver.

Driver Features

- V4L2 Single planar ioctls supported.
- Supports MMAP and DMABUF buffering methods
- Multi instance capture support
- Simultaneous capture from multiple ports
- Configurable video interfaces via endpoint nodes in DT
- Supports descrete/embedded sync, 8/16/24 bit bus, YUYV and RGB format cameras
- Capture upto 60 fields/frames per second
- Selection of muxed cameras through device tree

Features Not Supported

Following features are not supported at this point of time.

- Inline Color Space Conversion support
- Inline Scaling support.
- Multi planar buffer support
- Runtime selection of cameras
- Media controller framework
- Multi channel CVBS camera capture

Constraints

- TI evm has a conflict between I2C signals and HDMI DDC.

Therefore, the sensor drivers which are controlled via I2C won't work when these pins are in HDMI DDC mode

Supported System Calls

- Standard V4L2 Capture ioctls
- No custom ioctls needed

Performance Benchmarks

The following performance benchmarks were measured on DRA7xx

- IRQ latency
  - The average IRQ latency of the interrupts to the VIP driver is measured as the time difference between a VPDMA list post and VIP ISR callback
  - A zero sized list post would generate IRQ immediately
  - When measured across 1002 samples, the average interrupt latency is 15.94 us
  - Peak IRQ latency is 138 us
  - For all the following latencies, IRQ latency is not considered
- Capture latency
  - average capture latency is the time taken by the driver to make the buffer available for the userspace
  - It is calculated as the time difference between the IRQ and the time where DQBUF ioctl returns
  - This would vary based on the size of the captured buffer
- Capture display latency
  - Average capture latency is the time difference between the time a buffer was captured and the time when it was given for display
  - This is the total latency between end of the capture frame and start of display frame

Following table shows latencies for different capture sizes

Capture display performance on DRA7xx

Capture size	Capture latency	Capture Display latency
720x240 60fps	40us	Display latency not available
1280x720 30 fps	57us	Display latency not available

- multi instance capture latency
  - Following table shows latencies for for multi instance capture scenario
  - Here, four different VIP ports are used to capture from LVDS cameras
  - All the captures are at 1280x720 YUYV format at 30fps

VIP driver Capture latency multi-instance

Capture thread	Number of samples	Average capture latency
LVDS cam1	2115	54.61us
LVDS cam2	2114	57.51us
LVDS cam3	2116	54.21us
LVDS cam4	2111	51.72us

VPE Driver

Introduction

Video processing Engine(VPE) is a V4L2 Mem to Mem driver. It supports video operations such as scaling, colour space conversion and deinterlacing.

Driver Features

Video processing Engine(VPE) supports following formats for scaling, csc and deinterlacing:

- Supported Input formats: NV12, YUYV, UYVY
- Supported Output formats: NV12, YUYV, UYVY, RGB24, BGR24, ARGB24, ABGR24
- Inline Scaling supports
- Horizontal up-scaling up to 8x and Downscaling up to 4x using Pre-decimation filter.
- Vertical up-scaling up to 8x and Polyphase down-scaling up to 4x followed by RAV scaling.
- V4L2 M2M Multiplanar ioctl() supported.
- Multiple V4L2 device context supported.

Features Not Supported

- Following formats are not supported : YUV444, YVYU, VYUY, NV16, NV61, NV21, 16bit and Lower RGB formats are not supported.
- Passing of custom scaler and CSC coeffficients through user spcase are not supported.
- Only Linear scaling is supported without peaking and trimming.
- Deinterlacer does not support film mode detection.

Constraints

- VPE functional clock is restricted to 152Mhz due to HW constraints.

Supported System Calls

- Standard v4l2 m2m ioctls

USB Driver

This section gives an overview of the USB DWC3(XHCI) controller driver features supported/not supported, constraints and performance numbers.

DWC3(XHCI) USB controller

The DWC3 (XHCI) based controller supports following features

- USB1: SuperSpeed (SS) USB 3.0 Dual-Role-Device (DRD) subsystem with integrated SS (USB3.0) PHY and HS/FS (USB2.0) PHY
- USB2: High-Speed (HS) USB 2.0 Dual-Role-Device (DRD) subsystem with integrated HS/FS PHY

Features Not Supported

- OTG support (HNP/SRP)

Features Supported

- USB Host mode.
- USB Peripheral mode
- USB DRD mode (Dual Role Device)

USB Configuration

For USB configuration selection please refer to USB General Guide Linux (http://processors.wiki.ti.com/index.php/USB_General_Guide_Linux_v3.8#Linux_USB_Stack_Architecture)

Driver Features

The driver supports the following features

DRD (Dual Role Device) support

The DRD (Dual role device) support enable the each instance of controller to configure either as "Host" or "Device" mode. Refer to User's Guide for more details how to configure the controller into DRD mode.

Host mode support

Host Mode

Host Mode Feature	Supported
HUB class support	Yes
Human Interface Class (HID)	Yes
Mass Storage Class (MSC)	Yes
USB Video Class (UVC)	Yes
USB Audio Class (UAC)	Yes

USB Mass Storage Class Host Driver

Constraint

None

Supported System Calls

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

Supported IOCTLS

None

Performance Benchmarks

```
Setup : Western Digital HDD (500GB) connected to usb1 or usb2 port.
```

USB - ext2 File System Performance

USB Host File write (Ext2) Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	USB1(SS)		USB2(HS)	
		MB/sec	cpu load (%)	MB/sec	cpu load (%)
100	100	33.73	8.61	33.54	8.58
256	100	34.65	9.97	33.77	9.08
512	100	34.65	9.8	33.75	8.33
1024	100	33.76	8.79	34.31	8.43
5120	100	33.18	11.30	33.06	8.59

USB Host Read (Ext2) Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	USB1(SS)		USB2(HS)	
		MB/sec	cpu load (%)	MB/sec	cpu load (%)
100	100	107.16	12.57	34.76	5.79
256	100	98.20	7.91	35.46	5.57
512	100	92.02	16.59	35.71	5.16

1024	100	86.08	10.8	35.57	6.09
5120	100	95.64	16.16	35.71	6.98

USB - VFAT File System Performance

USB Host File write (VFAT) Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	USB1(SS)		USB2(HS)	
		MB/sec	cpu load (%)	MB/sec	cpu load (%)
100	100	33.97	14.50	28.09	13.90
256	100	52.66	21.91	27.39	13.55
512	100	51.21	21.21	26.87	12.60
1024	100	52.40	22.16	27.50	13.22
5120	100	52.69	21.05	27.47	12.60

USB Host Read (VFAT) Performance values

Buffer Size (in KBytes)	Total Bytes Transferred (in MBytes)	USB1(SS)		USB2(HS)	
		MB/sec	cpu load (%)	MB/sec	cpu load (%)
100	100	86.31	11.57	31.46	04.87
256	100	86.44	15.32	31.26	04.96
512	100	88.88	11.11	31.71	06.09
1024	100	87.94	12.38	31.71	06.09
5120	100	88.84	17.65	31.64	06.66

USB Peripheral mode Support

NCM Gadget Support

The NCM(Network control Model) 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

Supports default DMA mode.

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.

USB NCM Gadget Performance

```
   Setup : EVM as client and Linux Host PC as server
command at EVM: iperf -c <linux host ip_adr> -w <8|16|32|64|128>K -t 60 -d
```

```
command at Host: iperf -s
```

USB NCM Gadget Performance values - Client

TCP Window Size(in KBytes)	Interval (in Seconds)	(dra7xx) Mbps
16	60	9.58
32	60	17.16
64	60	28.85
128	60	119.3

The cpu load is 35% for 128K window size, for 16K, 32K, 64K the cpu load is 2%.

Power Management

Introduction

DRA7xx provides a rich set of power management features. The features include Clock control at module level, multiple power and voltage domains etc. It also provides the typical power consumption observed for different scenarios.

Active clocks

Following gives a list of clocks that are known to be active at boot time.

Modules with active clocks

Name	Instances
ADC_TSC	NA
CPSW	1
ELM	NA
EMIF	1,2
GPIO	1-8
GPMC	1
LCD	1
MCASP	2,3,6&7
MAILBOX	1-16
OCMC	1,2&3
RTC	1
TIMER	1,2,5,6
TPCC	1
TPTC	NA
UART	0-5
USB	1,2,3&4

Lock Frequency of various PLLs

IP	Frequency (MHz)
MPU	As per OPP (1000/1176)
IPU	212.8
DSP	600
IVA	388
SGX	425
L3	266
DDR	532

MPU DVFS (CPUFreq)

CPU is not loaded evenly during execution. This provides an opportunity to save power by adjusting/scaling voltage and frequency based on the current cpu load. A set of frequency and voltage is called an OPP (Operating performance Point) which are arraived at during silicon characterization and are guaranteed to be working combination for desired performance.
As per Data Manual, DRA7xx supports following OPP for MPU: OPP_NOM, OPP_OD and OPP_HIGH

- In GLSDK Kernel, only OPP_NOM and OPP_OD are enabled as the OPP_HIGH is applicable to the Dra7xx high speed (superset) devices only.

Power Measurement

This section indicates the power measured for all power rails at OPP_NOM in different scenarios/use-cases. Power measurements are done using FTDI (FT2232HL - I2C over USB) module on DRA7xx EVM Rev E1 - ES 1.0.

1) At kernel Prompt - no application is running @ OPP_NOM

Device	Bus(V)	Sense Res(uV)	Current(mA)	Power(mW)
VDD_DSPEVE	1.07	332.55	332.55	353.21
VDD_MPU	1.06	231.9	231.9	245.34
DDR_CPU	1.35	1249.88	249.98	336.08
VDDA_1V8_PLL	1.8	325.83	32.59	58.37
VDD_GPU	1.06	403.73	201.87	213.72
VUSB_3V3	3.3	16.55	1.66	5.45
VDDS18V	1.81	847.58	84.76	152.85
VDD_SHV	3.28	31.58	31.58	103.34
CORE_VDD	1.04	1176.3	588.15	609.14
VDD_IVA	1.06	31.45	15.73	16.64
DDR_MEM	1.35	620.05	124.02	166.61
VDDA_1V8_PHY	1.99	1032.75	103.28	205.2
Total Power	2465.95 mW			

2) Dual AV decode and dual display @ 1080p@30fps, at OPP_NOM (using Userspace governor)

Device	Bus(V)	Sense Res(uV)	Current(mA)	Power(mW)
VDD_DSPEVE	1.07	334.9	334.9	355.69
VDD_MPU	1.06	258.65	258.65	273.77
DDR_CPU	1.35	1700.53	340.11	457.76
VDDA_1V8_PLL	1.8	335.8	33.59	60.16
VDD_GPU	1.06	420.53	210.27	222.63
VUSB_3V3	3.3	16.58	1.66	5.46
VDDS18V	1.81	1041.16	104.12	187.83
VDD_SHV	3.28	43.58	43.58	142.58
CORE_VDD	1.04	1362.68	681.34	706.99
VDD_IVA	1.07	163.65	81.83	86.89
DDR_MEM	1.35	1426.73	285.35	383.32
VDDA_1V8_PHY	1.99	1140.03	114.01	226.42
Total Power	3109.5 mW			

3) V4L2Capture with loopback display on HDMI 1080p video @30fps, at OPP_NOM

Device	Bus(V)	Sense Res(uV)	Current(mA)	Power(mW)
VDD_DSPEVE	1.07	335.45	335.45	356.31
VDD_MPU	1.06	265.93	265.93	281.45
DDR_CPU	1.35	1682.28	336.46	452.74
VDDA_1V8_PLL	1.8	325.78	32.58	58.37
VDD_GPU	1.06	432.7	216.35	229.13
VUSB_3V3	3.3	16.7	1.68	5.5
VDDS18V	1.81	1035.58	103.56	186.83
VDD_SHV	3.28	28.25	28.25	92.48
CORE_VDD	1.04	1398.98	699.49	726.05
VDD_IVA	1.06	34.33	17.17	18.17
DDR_MEM	1.35	1158.13	231.63	311.2

VDDA_1V8_PHY	1.99	1146.08	114.61	227.61
2945.84 mW				

Filesystem

The filesystem is built using the yocto build system. More information on the build system refer to Building_Yocto_Filesystem (http://processors.wiki.ti.com/index.php/DRA7xx_GLSDK_Software_Developers_Guide#Building_Yocto_Filesystem)

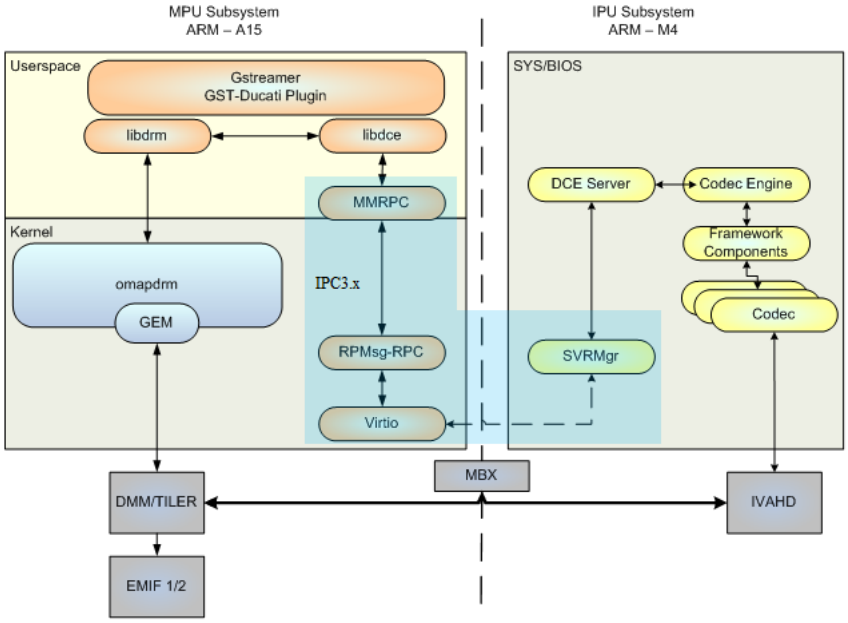
Filesystem information

System initialization	**System V**
Compressed filesystem size	347MB
Uncompressed filesystem size	1.1GB

Multimedia

Introduction

Multimedia consist of hardware accelerated video decoder(IVAHD). IVAHD subsystem is used for video decoding/encoding through libdce interface.



Supported Codecs

MJPEG decoder - version 01.00.12.01
H264 decoder - version 02.00.15.01
MPEG4 decoder - version 01.00.14.01
VC1 decoder - version 01.00.00.13
MPEG2 decoder - version 01.00.14.01
MPEG4 Encoder - Version 01.00.02.01
H264 Encoder - Version 02.00.08.01

Supported Playback Application

GStreamer version 0.10 with following display sinks:

- waylandsink
- kmssink

Viddec3test: application that demonstrates viddec3 API usage for video decode and display (using KMS).

Features Not Supported

TBD

Constraints

TBD

Performance Benchmarks

IVAHD performance on DRA7xx

Stream Resolution	IVAHD load	FPS	M4 Load	Opp Frequency
CIF	73%	392	35%	**IVAHD at 532MHz** **IPU at 212MHz**
720p	89%	121	16%	
1080p	82%	70	10%	

- Performance is calculated using the proprietary video decoder application (viddec3test)

Graphics

SGX544-MP2

Introduction

The SGX544-MP2 is a multicore (dual-core) evolution of the PowerVR® SGX544 GPU from Imagination Technologies. The 3D graphics processing unit (GPU) accelerates 3-dimensional (3D) graphics applications and 2-dimensional (2D) composition operations.

Driver Features

The following specifications are supported on the platform:

- OpenGL ES 1.0
- OpenGL ES 1.1
- OpenGL ES 2.0
- EGL 1.4

Features Not Supported

The following specifications are not supported on the platform:

- OpenVG
- OpenGL ES 3.0

Performance Benchmarks

The following performance benchmarks were measured on DRA7xx with LCD as the only connected display and DRM/KMS as the display backend.

GLBenchmark 2.5 performance on DRA7xx

Benchmark	Test Number	FPS
GLBenchmark 2.1 Egypt Classic ETC1 - C16Z16	2000000	161
GLBenchmark 2.5 Egypt HD ETC1 - C24Z24MS4	2500003	38
GLBenchmark 2.5 Egypt HD ETC1 - C24Z16 Fixed timestep	2500005	33
GLBenchmark 2.5 Egypt HD ETC1 - C24Z16	2501001	40
GLBenchmark 2.5 Egypt HD PVRTC4 - C24Z16	2501101	41
GLBenchmark 2.5 Egypt HD ETC1->565 - C24Z16	2501401	40

GLBenchmark 2.5 Vertex throughput on DRA7xx

Benchmark	Test Number	Mtriangles/sec
Triangle throughput: Textured 888 - C24Z16	2500301	80.74
Triangle throughput: Textured 888 - C24Z16 Vertex lit	2500401	67.22
Triangle throughput: Textured 888 - C24Z16 Fragment lit	2500501	65.17

GLBenchmark 2.5 pixel throughput on DRA7xx

Benchmark	Test Number	FPS	MTexels/sec

Fill rate 888 - C24Z16	2500101	52	1274

Wayland

Introduction

Wayland is a protocol that specifies the communication between the display server (called Wayland compositor) and its clients. The Wayland protocol is essentially only about input handling and buffer management. The handling of the input hardware relies on evdev in Linux, and similar components in other operating systems. The initial implementation, chiefly libwayland-server, libwayland-client, libwayland-EGL and the reference implementation Weston are published under the MIT License.

It is widely regarded as a replacement for the X Window System.

The GLSDK 6.10.00.02 release supports **Wayland/Weston version 1.3**.

Wayland API documentation

The documentation from the Wayland project can be accessed here [[2] (http://wayland.freedesktop.org/docs/html/)] X server does not support dual display with LCD and HDMI on DRA7xx.

Default supported clients

The list of clients and instructions on running them can be referenced from DRA7xx_GLSDK_Software_Developers_Guide#Running_weston_clients

Performance Benchmarks

Performance benchmarks have not been run for this release.

GC320

Introduction

GC320 graphics processing unit (GPU) IP defines a high-performance 2D raster graphics core that accelerates the 2D graphics display on a variety of consumer devices. Addressable screen sizes range from the smallest cell phones to HD 1080p displays. GC320 has two 64 bit AXI bus interfaces to interact to the HOST processor or the MPU. GC320 Hardware is enabled using Native Linux driver. The userspace comprises of bltsville interface as defined here (http://graphics.github.io/bltsville/).

Driver Features

- Blit – Composition of multiple sources to a destination image namely, alpha Blend, overlay, overlap, clip
- Filter – High quality scaling (up/down) 3, 5, 7, 9 tap filters
- Multi-image format support and color conversion (YUV and RGB space)
- Multi source blending: Supports up to 8-source blending

Features Not Supported

- 8-bit color index (palette)

Constraints

- Supports only single planar buffer (all the components of the color should be in a single buffer Eg. RGB, YUV)
- Does not support dma_buf yet

Supported Interfaces

- Kernel Driver:
  - open() - Opens the device
  - close()- Closes the device
  - ioctl() - Accepts commends from userspace
- Bltsville Userspace:
  - bv_map() : Supplies a buffer to compositor
  - bv_blt(): Performs the operation
  - bv_unmap(): Relinquishes the buffer
  - bv_cache(): Performs the cache operation if required

Performance Benchmarks

Performance numbers DRA7xx 1GB RAM

Test Case	DRA7xx (MPix/s)
RGBA24 to RGBA24	657.89

RGBx24 to RGB16	887.27
RGBx24 to RGB16 with dithering	889.13
RGBA24 to RGBA24 with non-interpolated scale up	176.32
RGBA24 to RGBA24 with non-interpolated 3/4 scale	112.09
RGBA24 to RGBA24 with non-interpolated half scale	96.79
RGBA24 src1over RGBx24 to RGBx24 with global alpha	442.75
RGBA24 src1over RGBx24 to RGBx24 with local alpha	445.80
RGBA24 src1over RGBA24 to RGBA24 with global alpha	444.75
RGBA24 src1over RGBA24 to RGBA24 with local alpha	447.10
RGBA24 src1over RGBA24 to RGBA24 with non-interpolated scaling	178.63
RGBA24 src1over RGB16 to RGB16 with global alpha	667.09
RGBA24 src1over RGB16 to RGB16 with local alpha	667.41
RGBA24 src1over RGB16 to RGB16 with dither with global alpha	667.86
RGBA24 src1over RGB16 to RGB16 with dither with local alpha	668.98
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale up	187.62
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale down half	120.08
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale down third	98.88
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale up and dither	187.38
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale down 3/4 and dither	120.01
RGBA24 src1over RGB16 to RGB16 with non-interpolated scale down half and dither	98.73
RGB16 to RGB124	814.36
NV12 to RGBx24.	481.58
YUYV to RGBx24	598.54

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1. switchcategory:MultiCore=

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