OMAP35X Linux Drivers Datasheet

SDO Productization

ABSTRACT

The Linux PSP consists of optimized peripheral device drivers for OMAP35X EVM integrated with the Linux 2.6.22 kernel to run on the ARM CORTEX-A8 core. The drivers enable rapid software development on the OMAP platforms and are provided in source form to facilitate portability on production hardware platforms. This document provides an overview and performance data for each of the drivers.

Contents

Features

OMAP 35X Linux Drivers

MAY 2008

- **Supported Devices**
  - **OMAP 35X**
- **Developed and Tested on OMAP3 EVM with ES 2.1 silicon**
- **Built with Linux Kernel version 2.6.22**
- **Compiled with CodeSourcery arm-2007-q3 tool chain**
- **ARM GNU/Linux Application Binary Interface (ABI)**
- **Support for U-boot 1.1.4**
- **Supported boot modes**
  - **OneNAND**
- **Ships with sample root file system based on Busybox 1.9.0**
  - **Ramdisk**
  - **NFS**
- **Display Sub System (DSS)**
  - **Supports display for VGA (480x640) resolutions using FBDEV and V4L2-based Video display drivers on LCD output.**
  - **Supports NTSC and PAL resolutions on TV output using V4L2.**
  - **The following features are supported through Linux FBDEV Interface**
    - **Supports VGA resolution on LCD and S-Video interface**
    - **Supports Display Panning**
    - **Supports programmable display modes (1, 2, 4, 8, 12, 16, 24 bits per pixel modes) on OSD**
    - **Supports Color Lookup Table for 1, 2, 4 and 8 bits per pixel modes.**
    - **Supports Mirroring**
  - **The following features are supported through Linux V4L2 Interface**
    - **Supports both the video pipelines**
    - **Supports NTSC-J, M and PAL-B, D, G, H, I ,N, PAL-M, PAL-N, PAL-Nc Standards on S-Video interface**
    - **Supports YUYV4:2:2, UYVY4:2:2, RGB565, RGB565X, RGB888 pixel formats on each of the video windows**
    - **Supports Rotation by 90,180 and 270 degrees**
    - **Supports Mirroring**
    - **Supports Upscaling from 1x to 8x and Downscaling upto 0.5x**
    - **Supports Transparency Color key (Source and Destination)**
    - **Programmable Video Color Space conversion YCbCr 4:2:2 into RGB**
    - **Supports Cropping**
    - **Supports alpha blending**
- **Audio**
  - **Advanced Sound Linux Architecture (ALSA)**
  - **Supports record and playback through TWL4030**
  - **Supports McBSP in slave mode and TWL4030 Codec in master mode.**
  - **Supports I2S McBSP data format**
- **Connectivity Drivers – (Ethernet, USB)**
  - **Supports SMSC9115 external Ethernet controller (via GPMC)**
    - **10/100 Mbps, Half and Full duplex**
    - **Auto-negotiation**
  - **Supports High Speed USB OTG Controller with mini-AB port**

- **Supports USB Host and Gadget mode of operations**
- **Support for USB2.0 Low, Full and High speed devices**
- **Supports Mass storage and HID class devices under host mode of operation**
- **Supports Mass storage, CDC and RNDIS classes under gadget mode of operation.**

- **Storage (MMC/SD, OneNAND, SLC NAND)**
  - **Supports OneNAND flash memory with big block access**
  - **Supports High-speed, High Capacity MMC (8-bit/4-bit/1-bit)**
  - **Supports High-speed, High Capacity SD (4-bit/1-bit)**
- **Serial (McSPI, UART, HS-I2C)**
  - **Supports McSPI interface to Touch Screen**
  - **Supports I2C interface to Audio codec.**
  - **Supports UART 1 interface for console.**
- **Power Management**
  - **Supports dynamic tick and tick suppression**
  - **Supports cpuidle framework with menu governor**
    - **MPU/Core retention and Off-mode**
    - **Smart Reflex in bypass mode.**
  - **Supports cpufreq framework with ondemand and performance governors**

- **Resizer**
  - **Supports resizing from 1/4x to 4x**
  - **Supports independent horizontal and vertical resizing.**
  - **Supports YUV422 packed data.**

- **Miscellaneous**
  - **Keypad**
  - **Touch screen**
  - **SDMA**
  - **PWM**
  - **GPIO**
  - **WDT**
  - **Timers**

1 Texas Instruments OMAP 35x Linux Drivers

1.1 Drivers Summary

The table below summarizes Linux driver support in the Linux PSP release *0.9.7* from TI:

Table 1. OMAP 35x Peripheral Driver Support

Peripheral	Description	Linux Driver Type	Section
Display Subsystem (DSS)	Enables display for graphics pipeline. Supporting VGA resolutions on LCD and TV out	FBDEV	2.1
	Enables display for Video pipelines for NTSC,PAL on TV out and VGA resolutions on LCD	V4L2	2.1
Audio (McBSP)	Audio Record and Playback	ALSA	2.2
Ethernet	Transmit/receive network data. Supports Auto negotiation with 10/100 Mbps link speed.	Netdev	2.3
USB 2.0 MSC Host	USB Mass Storage Class Host Driver	Block	2.4.3
USB 2.0 MSC Slave	USB Mass Storage Class Slave Driver	USB Gadget	2.4.4
USB 2.0 HID Host	USB Human Interface Device Host Driver	Input driver	2.4.6
USB 2.0 CDC Slave	USB Communication Device Class	USB Gadget /netdev	2.4.5
USB 2.0 RNDIS SLAVE	USB Remote Network Driver Interface Specification	USB Gadget /netdev	2.4.5
OneNAND	Flash Storage system	MTD Character and Block	2.5
MMC/SD	Interface to Multi Media Secure Digital cards	Block	2.6
UART	Serial Communication Interface	Character	2.7
I2C	Inter-IC Communication	Character	2.8
McSPI	Serial Peripheral Interface	Character	
SDMA	System DMA Engine	Linux DMA	
Power Management	Enables power management by supporting CPUIdle, CPUfreq, dynamic tick and Standard Linux clock framework	CPU Idle and CPUfreq Frameworks	2.10
Resizer	Enables upscaling to 4x and downscaling to 1/4x of input images.	Character	2.11

1.2 Limitations

This table summarizes the limitations in the PSP release version 0.9.7

Peripheral	Status	Use Case
USB 2.0 OTG	Feature not supported	USB On The Go. Supports HNP and SRP.
SDIO	Feature not supported	Wireless LAN , Bluetooth
DSS-DVI-D	Feature not supported	Display through DVI-D interface
DSS-Composite Video	Feature not supported	Display through Composite interface
Video Capture	Feature not supported	To capture Video data

Table 2. Feature Limitations

1.3 Documentation

The following documents are included in the driver package:

Document Name	Contents
ReleaseNotes.pdf	Release notes for the release.
UserGuide.pdf	UserGuide for the release

Table 3. List of documents

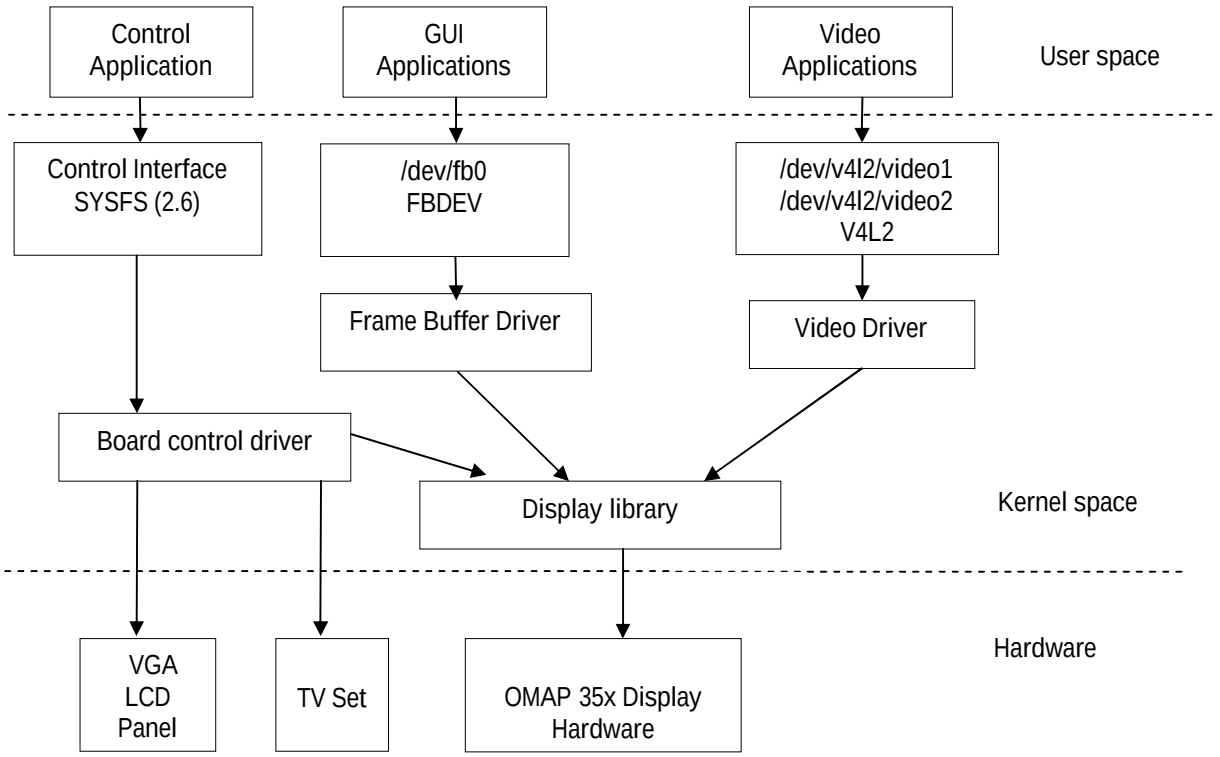
:

2 Linux Kernel Drivers

This section describes the OMAP Linux device driver features and performance data.

2.1 Video Display Driver

The video display driver for the OMAP 35x DSS peripheral consists of video driver, compliant with the V4L2 framework and frame buffer driver compliant with FBDEV framework. The device nodes for display driver are /dev/v4l/video1, /dev/v4l/video2 for video pipelines and /dev/fb0 for single graphics pipeline. Board Control Driver implements LCD and TV output software configurations. Display library implements abstraction layer for the Video Display Hardware.



2.1.1 DSS Display Driver Features

The driver supports the following features

- Buffer exchange mechanism supporting mmap'ed and user pointer exchange mechanisms.
- Supports static and modular builds.
- Display Panning, Mirroring and Color Map operations for the graphics pipeline.
- Windowing, Cropping, Rotation (90,180 and 270 degrees), Mirroring, Upscaling, downscaling for Video pipelines.
- Configuration of parameters such as height and width of display screen, bits-per-pixel, refresh rate, etc.
- Supports setting up of OSD and Video window destinations (TV or LCD) through sysfs
- Supports LCD backlight control through sysfs interface
- Supports alpha blending on Video2 and graphics pipelines.

2.1.2 Features Not Supported

The driver does not support the following features

- Rotation in 8 or less bits per pixel in color mode.
- Mirroring of RGB888 format images
- Composite out interface
- NTSC/PAL TV out for Fbdev driver
- Hardware cursor
- Gamma corrections
- RFBI(MIPI DBI Protocol)
- Serial display interface (DSI / SDI)
- Power management features - suspend, resume
- Setting rotation through bootargs on fbdev interface
- Linking of video pipelines
- DirectFB

2.1.3 Constraints

- Rotation of an RGB24-packed format image is not supported due to hardware limitations
- Wait for vsync not implemented in Fbdev driver.Application has to define and use it.

2.1.4 Kernel menu configuration

```
Device Drivers --->
      Multimedia devices--->
            <*> Video For Linux
            [*] Video capture adapters
                  OMAP2/OMAP3 V4L2 drivers --->
                        <*> Video out library
                        <*> Video out driver
                        [*] TV Out support
      Graphics Support --->
            <*> Support for frame buffer devices
            <*> OMAP frame buffer support (EXPERIMENTAL)
            <*> OMAP3 EVM VGA Display
```

2.1.5 Supported System Calls

Driver conforms to V4l2 and FBDEV framework.

V4l2: See http://v4l2spec.bytesex.org/v4l2spec/v4l2.pdf

FBDEV: See http://www.linux-fbdev.org/

2.1.6 Supported IOCTLs

2.1.6.1 FBDEV

Constant	Description
FBIOGET_VSCREENINFO	These I/O controls are used to query the variable screen info. This allows an application to query the display mode, including the color depth, resolution, timing etc.
FBIOPUT_VSCREENINFO	These I/O controls are used to set the variable screen info. This allows an application to query or change the display mode, including the color depth, resolution, timing etc.
FBIOGET_FSCREENINFO	This I/O control can be used by applications to get the fixed properties of the display, e.g. the start address of the framebuffer memory.
FBIOPUTCMAP	Sets up pseudo palette.
FBIOGETCMAP	Return the CMAP to the application.
FBIOPAN_DISPLAY	This I/O control is used to pan the display. It controls the portion of framebuffer memory that is visible. In general, the framebuffer dimensions in memory can be larger than the size of the display. This feature can be used in a GUI environment to support a "virtual desktop" larger than the physical display. However, it can also be used to support framebuffer "flipping." Flipping refers to the process of writing to a non-visible portion of framebuffer memory and then making it visible all at once
FBIO_BLANK	This I/O control is used to blank or unblank the frame buffer console.

2.1.6.2 V4L2

Constant	Description
VIDIOC_ENUMOUTPUT	Enumerate video outputs.
VIDIOC_ENUM_FMT	Enumerate supported formats by current decoder
VIDIOC_G_FMT, VIDIOC_S_FMT, VIDIOC_TRY_FMT	Gets or sets the data format, try a format.
VIDIOC_G_CROP, VIDIOC_S_CROP	Queries or selects the current cropping rectangle.
VIDIOC_QBUF, VIDIOC_DQBUF	Exchanges a buffer with the driver.
VIDIOC_QUERYBUF	Queries the status of a buffer.
VIDIOC_QUERYCAP	Queries device capabilities.
VIDIOC_REQBUFS	Initiates memory mapping I/O.
VIDIOC_STREAMON, VIDIOC_STREAMOFF	Starts or stops streaming I/O.
VIDIOC_CROPCAP	To get cropping parameters

CUSTOM IOCTLS:

Constant	Description
VIDIOC_S_OMAP2_MIRROR	Set the Mirroring.
VIDIOC_G_OMAP2_MIRROR	Gets the current mirroring status
VIDIOC_S_OMAP2_ ROTATION VIDIOC_G_OMAP2_ ROTATION	Sets / gets the rotation angle
VIDIOC_S_OMAP2_BGCOLOR VIDIOC_G_OMAP2_BGCOLOR	Sets /gets the background color
VIDIOC_S_OMAP2_COLORKEY VIDIOC_G_OMAP2_COLORKEY	Sets/gets the chosen transparent color key value
VIDIOC_S_OMAP2_CO LORKEY_ENAB LE,VIDIOC_G_OMAP2_COLORKEY_DI SABLE	Enable/Disable the chosen transparent color key
VIDIOC_S_OMAP2_COLORCONV VIDIOC_G_OMAP2_COLORCONV VIDIOC_S_OMAP2_DEFCOLORCONV	These are used to set/get the color conversion coefficients matrix. The VIDIOC_S_OM AP2_DEFCOLORCONV I/O control can be used to set the coefficients matrix to default values.

2.1.7 Performance and Benchmarks

Interface	Resolution	Display Frame rate (fps)
LCD	VGA	79.2
TV-OUT(S-Video)	VGA	10-30*

Table 4. DSS Performance

The performance numbers are captured using the following

- LCD Display- LS037V7DW01 from Sharp
- TV Display – OMAP EVM conected via S-Video to Sony Bravia LCD TV.
- *The frame rates on TV out are not consistent. They vary between 10-30 fps as each frame takes time between 33 to 100 msec. A MR has been raised in CQ for tracking this issue.

2.2 Audio Driver

2.2.1 Description

The OMAP audio driver is a char driver that supports audio operations over the McBSP/TWL4030 Codec. It is compatible with Advanced Linux Sound Architecture (ALSA) interface.

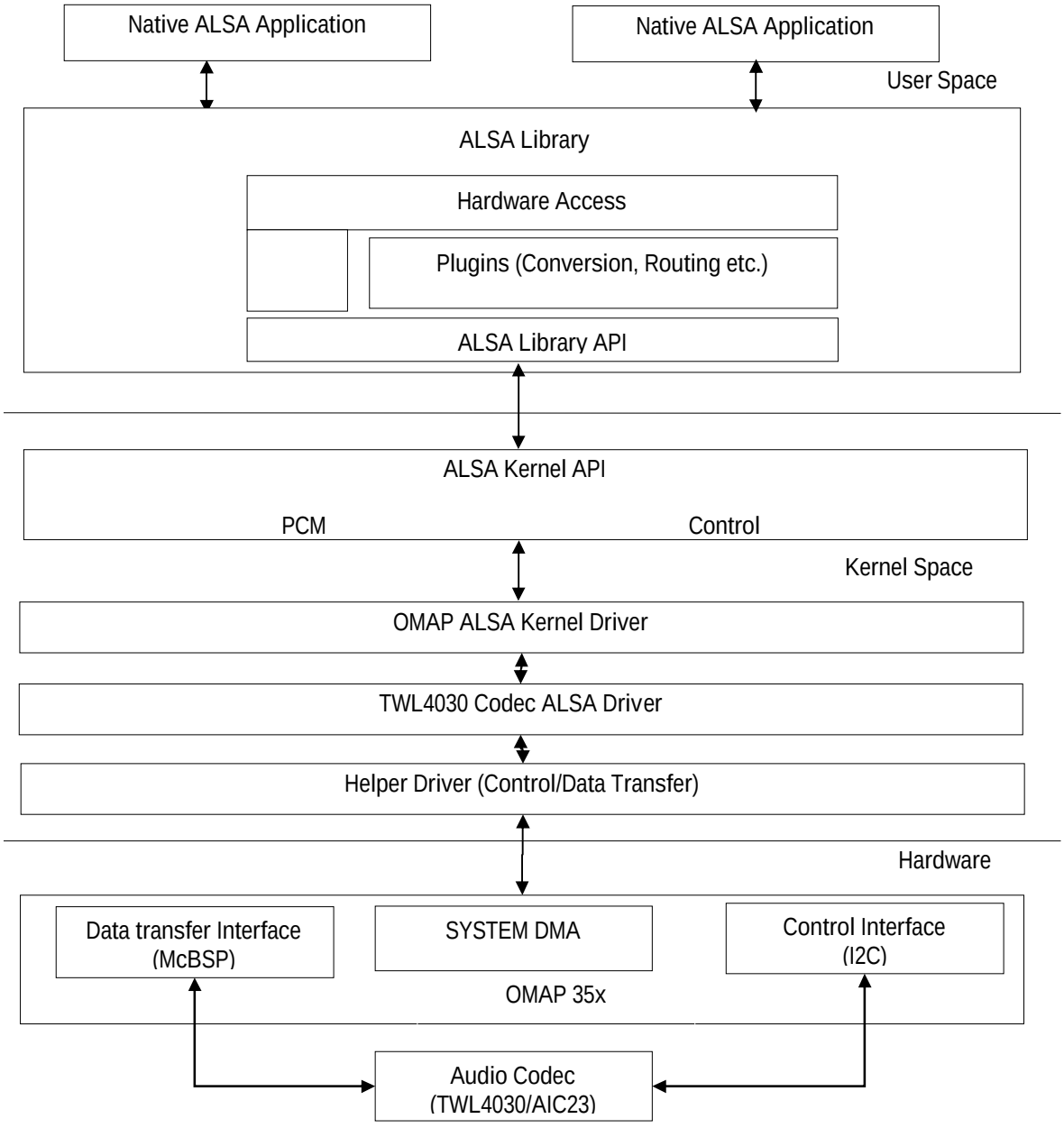


Figure 1. OMAP35X Audio Driver Architecture

2.2.2 Driver Features

The driver supports the following features –

- ALSA framework
- Record and playback capability in full duplex mode are supported for multiple sample rates(8KHz, 11.025KHz, 12KHz, 16KHz, 22KHz, 24KHz, 32KHz, 44.1kHz and 48kHz)
- I2S mode of operation.
- Mono and stereo modes. Audio channel set to stereo mode by default.
- 16/24 Bit little endian signed PCM data.
- Interleaved access mode
- McBSP works in slave mode and TWL4030 Codec in master mode.
- Start, stop and resume feature
- Mixer support.

2.2.3 Features Not Supported

- mmap and block transfer access modes have not been tested.
- Pause feature

2.2.4 Constraints

The Driver has the following constraints.

- McBSP can not be set as master when TWL4030 codec is used.
- Synthesizer and similar interfaces are not supported.
- Formats other than I2S.
- Opening of the same stream (Play/Record) multiple times is not supported
- OSS framework is not supported

2.2.5 Kernel Menu Configuration

```
Device Drivers --->
  Sound --->
     <*> Sound card support
     Advanced Linux Sound Architecture --->
          <*> Advanced Linux Sound Architecture
          <*> Dynamic device file minor numbers
          ALSA ARM devices --->
               <*> OMAP 35XX EVM ALSA driver
```

2.2.6 Supported System Calls

Refer http://www.alsa-project.org/main/index.php/Main_Page for API calls.

2.2.7 Supported IOCTLs

NA

2.2.8 Performance and Benchmarks

None

2.3 Ethernet Driver

2.3.1 Description

The Ethernet driver supports the Linux netdev Interface. The EMAC module SMSC911x is connected through the GPMC interface.

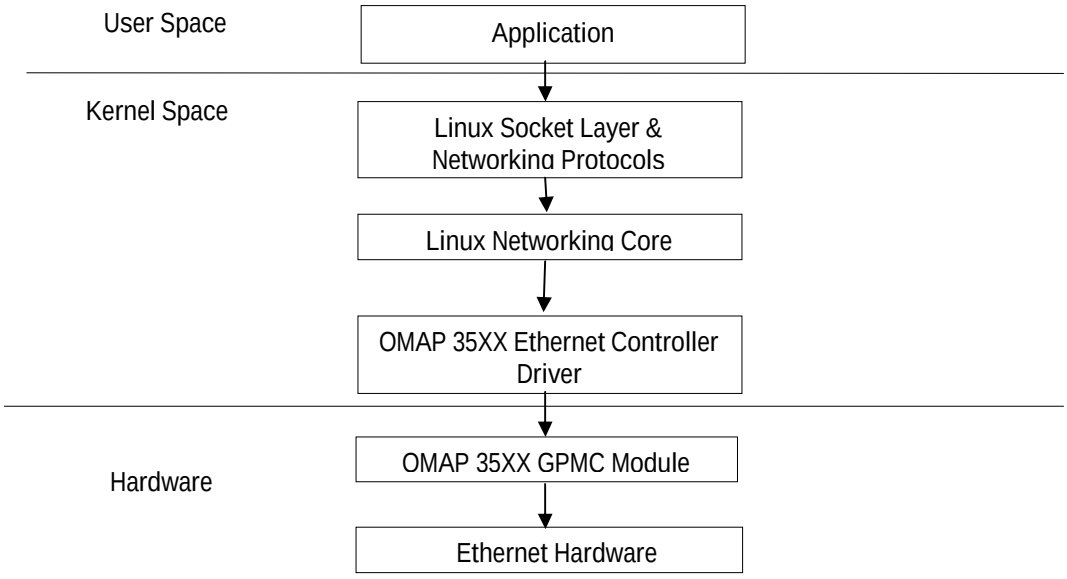


Figure 2. Linux Kernel Ethernet Driver

2.3.2 Features

The driver supports the following features.

- 10/100 Mbps speed.
- Auto Negotiation.
- Multicast and broadcast.
- Promiscuous mode.
- Full duplex and half duplex modes.
- Ethtool

2.3.3 Features Not supported

None

2.3.4 Constraints

- When built as module, rmmod operation can fail.
- Link might not be established if the peer doesn't enable autonegotiation.
- If "Power management Off mode" support enabled, the Ethernet driver is instable

2.3.5 Kernel Menu Configuration

```
Networking support --->
   [*] Networking support
    Networking options --->
       <*> Packet socket
       <*> Unix domain sockets
       [*] TCP/IP networking
       [*] IP: kernel level autoconfiguration
            [*] IP: DHCP support
Device Drivers --->
   Network device support --->
       [*] Network device support
   Ethernet (10 or 100Mbit) --->
       [*] Ethernet (10 or 100Mbit)
       <*> SMSC LAN9115 support for OMAP3EVM board
```

2.3.6 Supported System Calls

None

2.3.7 Supported IOCTLS

None

2.3.8 Performance and Benchmarks

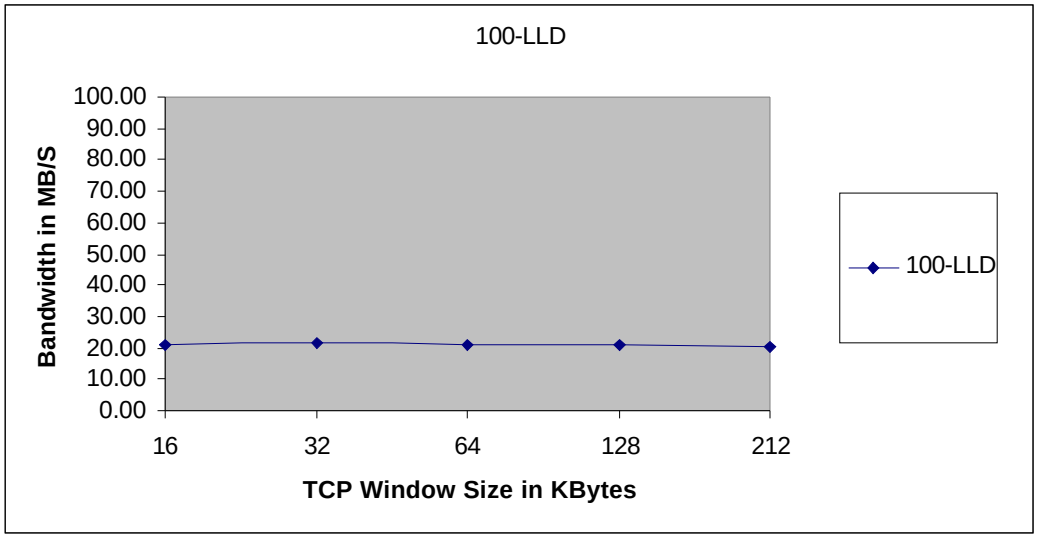


Figure 3. Ethernet-100- Performance

TCP window size in KBytes	Bandwidth Mbits/Sec	Transfer size in Mbytes	Interval in sec
16	21.2	310	60
32	21.45	304	60
64	20.8	297.7	60
128	20.85	294.9	60
208	20.5	291.0	60

Table 5. Ethernet-100- Performance

The Performance numbers were captured using the following

- server side command : “-s”
- client side command: "-c <server ip> -w<window size> -d -t60"
- iperf tool is run on DUT1 in server mode and on DUT2 in Client mode(v er1.7.0 is used on both sides)
- The Data captured here is for "iperf" in Client mode
- Cross cable is used to measure performance
- speed is set to 100Mbps
- Power Management is disabled

2.4 USB Drivers

2.4.1 EHCI/OHCI Controller

Current release doesn't support this feature.

2.4.2 USB OTG HS Controller

2.4.2.1 Description

The USB driver is implemented on top of Mentor IP version 1.4 as a communication driver and supports MSC, HID, Hub, CDC-Slave and RNDIS slave classes. HS DMA engine is used for both MSC-host and MSC-slave operations.

2.4.2.2 Driver Features

The Driver supports the following features.

- Host mode driver
  - Mass Storage Class (MSC) Host
  - Hub Class.
  - Human Interface Devices (HID)
- Slave mode driver
  - Mass Storage Class (MSC) Slave.
  - Communication Device Class (CDC)Slave support
  - Remote Network Driver Interface Specification (RNDIS) Slave support.

2.4.2.3 Features Not Supported

The following features are not supported by driver.

- USB Isochronous transfers support.
- USB OTG support.

2.4.3 USB-Mass Storage Class Host Driver

2.4.3.1 Description:

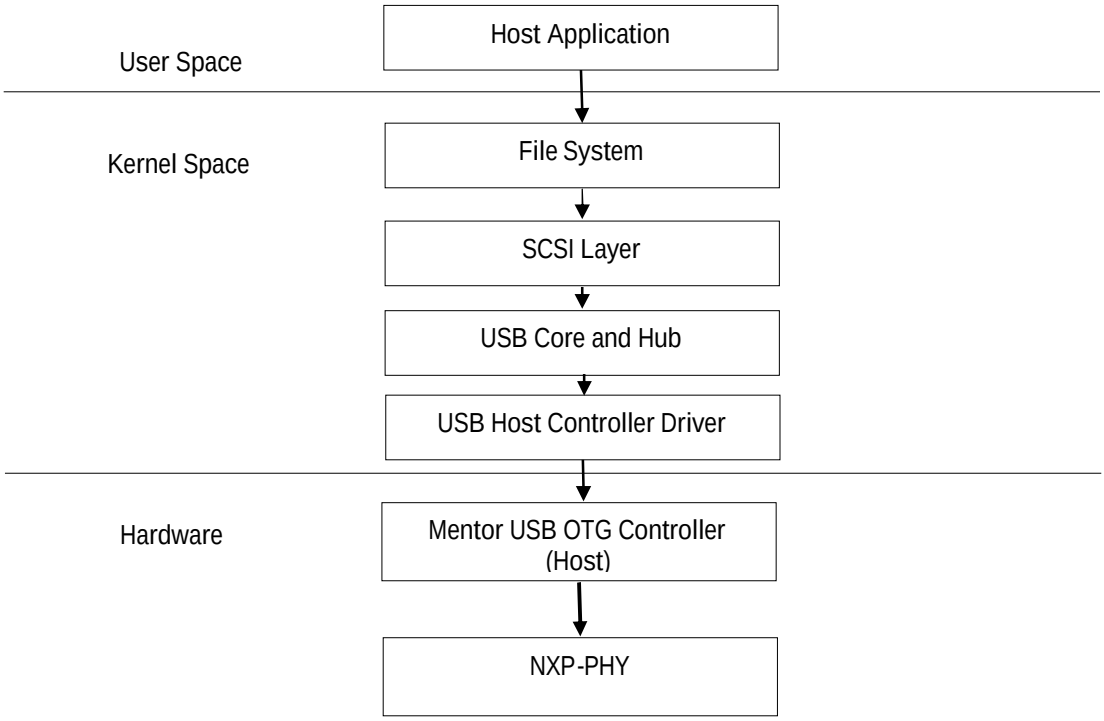


Figure 4. USB Mass Storage Class Host Driver

2.4.3.2 Driver Features

The Driver supports the following features.

- DMA and Interrupt mode

2.4.3.3 Features Not Supported

None

2.4.3.4 Constraints

- VBUS must be re-enabled after disconnect & reconnect of the MSC device.
- Few flash disks may not enumerate themselves if they do not respond to the PING points during CONTROL packet transactions.
- There is a limitation in the power that is supplied by the charge pump. If you notice VBUSERR messages in the system console, then connect a self powered USB hub and then attach the device to the hub.

2.4.3.5 Kernel Menu Configuration

```
Device Drivers --->
    SCSI device support --->
      <*> SCSI device support
      [*] legacy /proc/scsi/support
      --- SCSI support type (disk, tape, CD-ROM)
      <*> SCSI disk support
     USB support --->
      <*> Support for Host-side USB
      --- Miscellaneous USB options
      [*] USB device filesystem
      [*] USB device class-devices (DEPRECATED)
      --- USB Host Controller Drivers
      <M> Inventra USB Highspeed Dual Role Controller Support
      <*> Use Builtin Controller
      --- OMAP 343x high speed USB support
     Driver Mode (USB Host) --->
      (X) USB Host
      [ ] Disable DMA (always use PIO)
      --- USB Device Class drivers
      <*> USB Mass Storage support
      --- USB Input Devices
      <*> USB Human Interface Device(full HID) support
      [*] HID input layer support
```

2.4.3.6 Supported System Calls

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

2.4.3.7 Supported IOCTLS

None

2.4.3.8 Performance Benchmarks

2.4.3.8.1 USB-MSC Host-DMA-Ext2 Performance

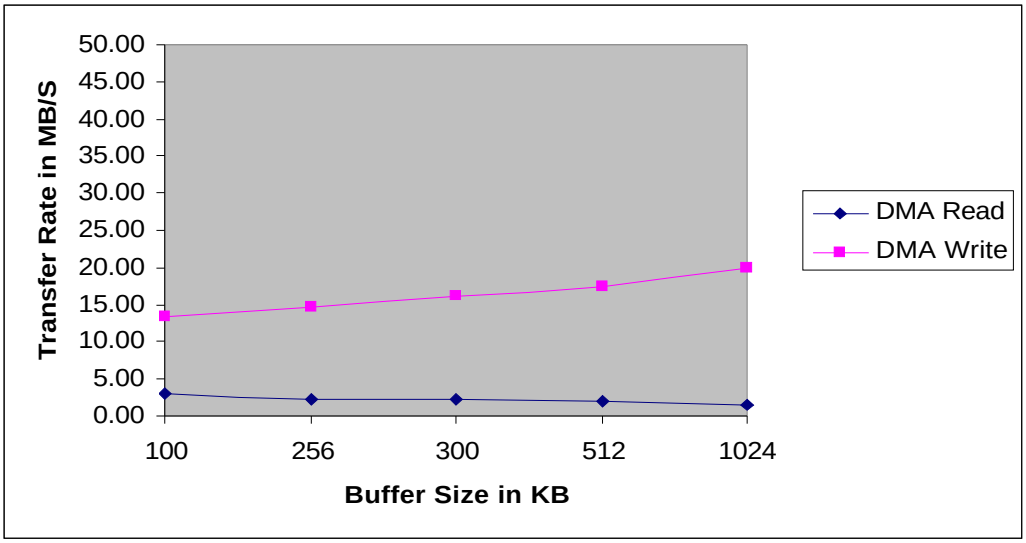


Figure 5. USB-MSC HOST-DMA-Ext2 Performance

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	3.01
250	100	2.29
300	100	2.20
500	100	2.10
1024	100	1.5

Table 6. USB-MSC Host-DMA-Read Performance values

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	13.5
250	100	14.6
300	100	16.2
500	100	17.3
1024	100	20.04

Table 7. USB-MSC Host-DMA-Write Performance values

The performance numbers are captured using the following

- Hard Disk: Western Digital, 60 GB
- File Format = Ext2

2.4.3.8.2 USB-MSC Host-DMA-Ext3 Performance

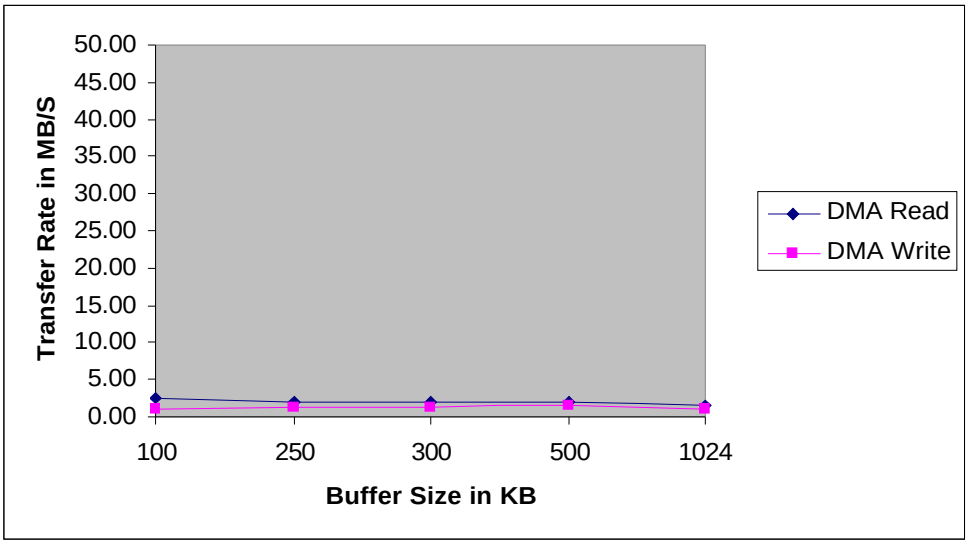


Figure 6. USB-MSC HOST-DMA-Ext3 Performance

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	2.53
250	100	1.97
300	100	2.01
500	100	1.98
1024	100	1.48

Table 8. USB-MSC Host-DMA-Ext3 Read Performance values

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	1.12
250	100	1.33
300	100	1.35
500	100	1.42
1024	100	1.04

Table 9. USB-MSC Host-DMA-Ext3 Write Performance values

The performance numbers are captured using the following

- Hard Disk: Western Digital, 60 GB
- File Format = Ext3

2.4.4 USB-Mass Storage Class Slave Driver

2.4.4.1 Description:

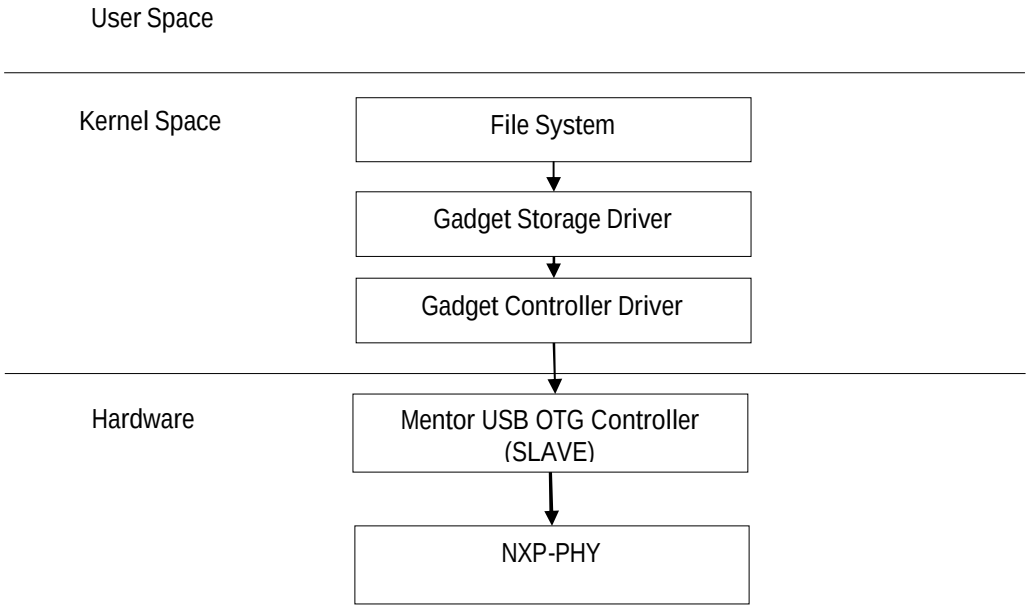


Figure 7. USB Mass Storage Class Slave Driver

2.4.4.2 Driver Features

The Driver supports the following features.

- DMA and Interrupt mode.
- File backed storage driver was tested with SD media as the storage medium.

2.4.4.3 Features Not Supported

None

2.4.4.4 Constraints

None

2.4.4.5 Kernel Menu Configuration

```
Device Drivers --->
 <*> Support for USB Gadgets
       USB Peripheral Controller (Inventra HDRC Peripheral(TI, ...))
       <M> USB Gadget Drivers
             <M> File-backed Storage Gadget
<*> Inventra USB Highspeed Dual Role Controller Support
<*> Use Builtin Controller
--- OMAP 343x high speed USB support
Driver Mode (USB Peripheral (gadget stack)) --->
[ ] Disable DMA (always use PIO)
```

2.4.4.6 Supported System Calls

NA

2.4.4.7 Supported IOCTLS

NA

2.4.4.8 Performance Benchmarks

2.4.4.8.1 USB-Slave-DMA- Performance

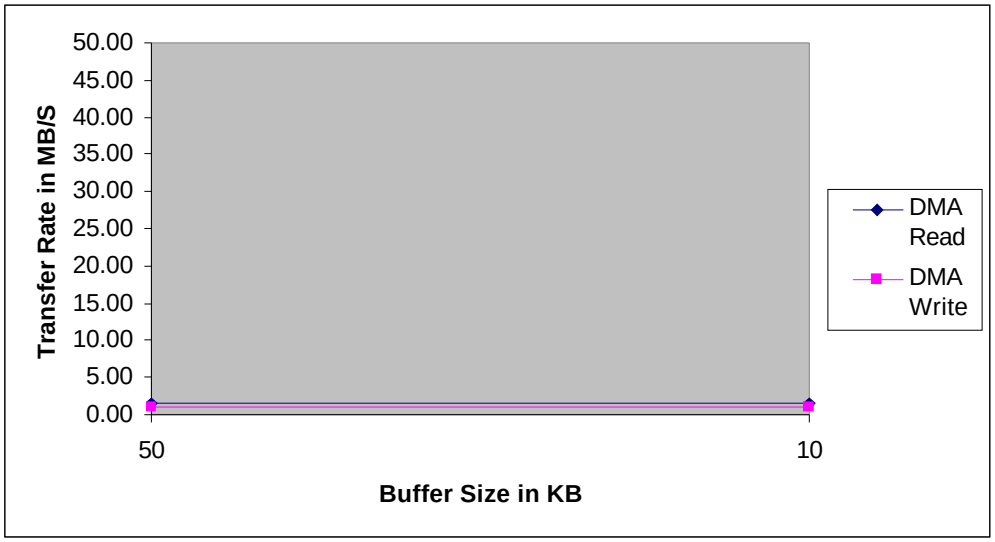


Figure 8. USB-SLAVE-DMA- Performance

Bytes Transferred (MB)	Number of files	Total Bytes Transferred (MB)	Data Rate (Mega Byte/sec)
50	20	1000	1.63
10	100	1000	1.39

Table 10. USB-Slave-DMA-Read Performance values

Bytes Transferred (MB)	Number of files	Total Bytes Transferred (MB)	Data Rate (Mega Byte/sec)
50	20	1000	0.9
10	100	1000	1.1

Table 11. USB-Slave-DMA-Write Performance values

The performance numbers are captured using the following

- MMC CARD: SanDisk ULTRAII 1 GB CARD
- File Format = VFAT

2.4.5 USB-CDC/RNDIS Slave Driver

2.4.5.1 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.

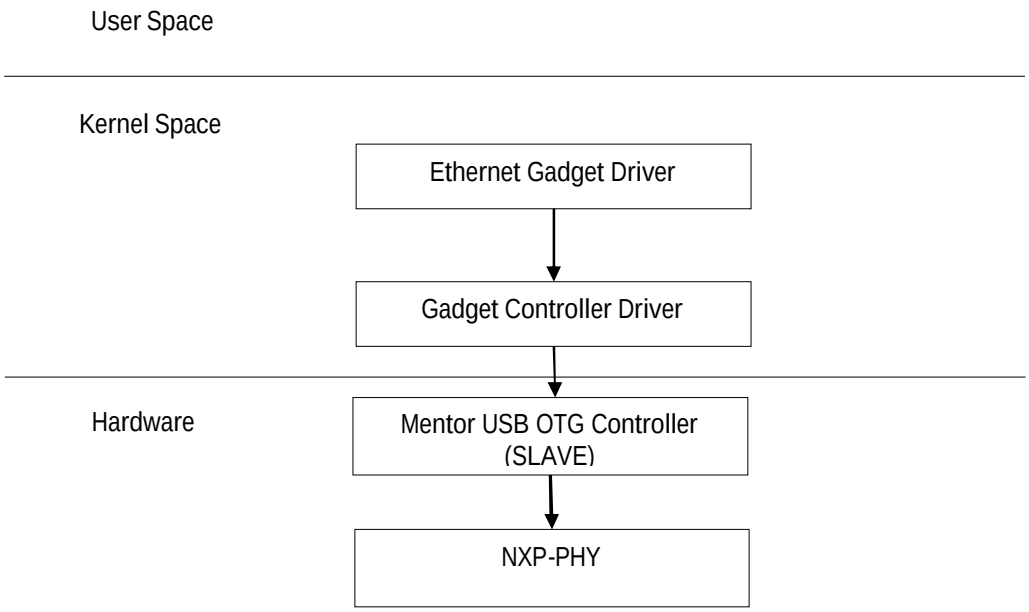


Figure 9. USB CDC/RNDIS Slave Driver

2.4.5.2 Driver Features

The Driver supports the following features.

- 10/100 Mbps speed.

2.4.5.3 Features Not Supported

The following features are not supported by driver.

- Flood ping at the maximum packet size of 64K

2.4.5.4 Constraints

None

2.4.5.5 Kernel Menu Configuration

```
Device Drivers --->
<*> Support for USB Gadgets
      USB Peripheral Controller (Inventra HDRC Peripheral(TI, ...))
      <M> USB Gadget Drivers
            <M> Ethernet Gadget
            [*] RNDIS support (EXPERIMENTAL) (NEW)
<*> Inventra USB Highspeed Dual Role Controller Support
<*> Use Builtin Controller
--- OMAP 343x high speed USB support
Driver Mode (USB Peripheral (gadget stack)) --->
[ ] Disable DMA (always use PIO)
```

2.4.5.6 Supported System Calls

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

2.4.5.7 Supported IOCTLS

None

2.4.5.8 Performance Benchmarks

None(Could not be captured due to a known issue on bidirectional traffic).

2.4.6 USB-Human Interface Device Driver

2.4.6.1 Description

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

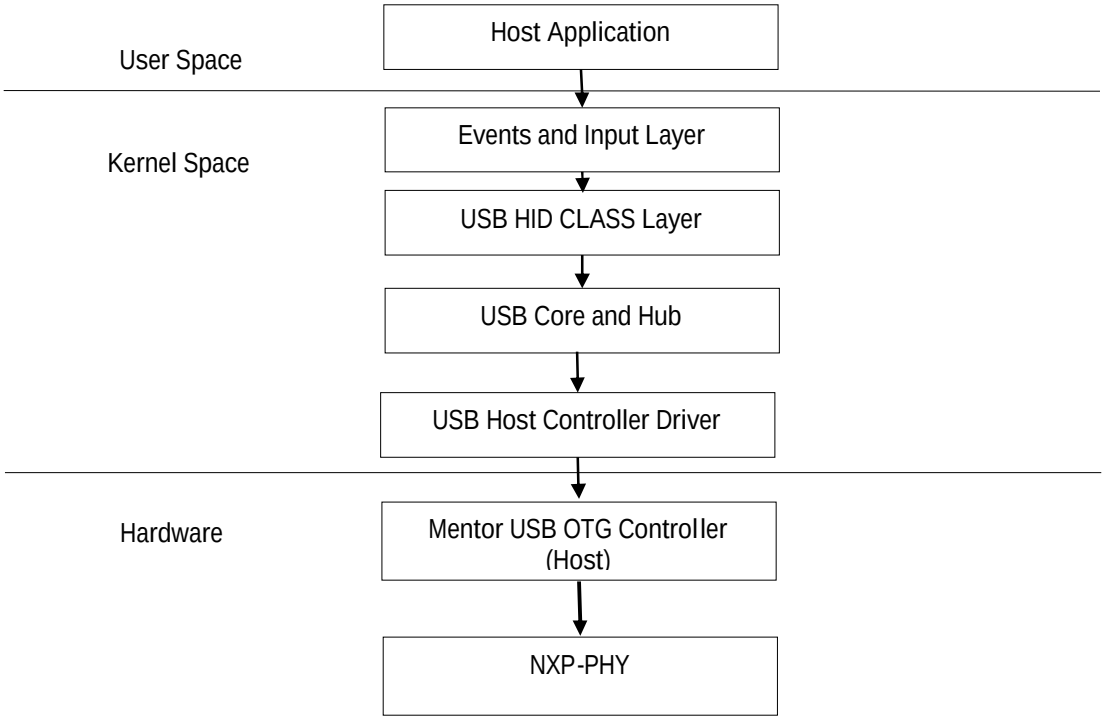


Figure 10. USB Human Interface Device Driver

2.4.6.2 Driver Features

- USB Mouse and Keyboards that conform to the USB HID specifications

2.4.6.3 Features Not Supported

None

2.4.6.4 Constraints

None

2.4.6.5 Kernel Menu Configuration

```
Device Drivers --->
      SCSI device support --->
      <*> SCSI device support
      [*] legacy /proc/scsi/support
      --- SCSI support type (disk, tape, CD-ROM)
      <*> SCSI disk support
USB support --->
      <*> Support for Host-side USB
      --- Miscellaneous USB options
      [*] USB device filesystem
      [*] USB device class-devices (DEPRECATED)
      --- USB Host Controller Drivers
      <*> Inventra USB Highspeed Dual Role Controller Support
      <*> Use Builtin Controller
      --- OMAP 343x high speed USB support
      Driver Mode (USB Host) --->
      (    X) USB Host
      [ ] Disable DMA (always use PIO)
      --- USB Input Devices
      <*> USB Human Interface Device(full HID) support
      [*] HID input layer support
```

2.4.6.6 Supported System Calls

None

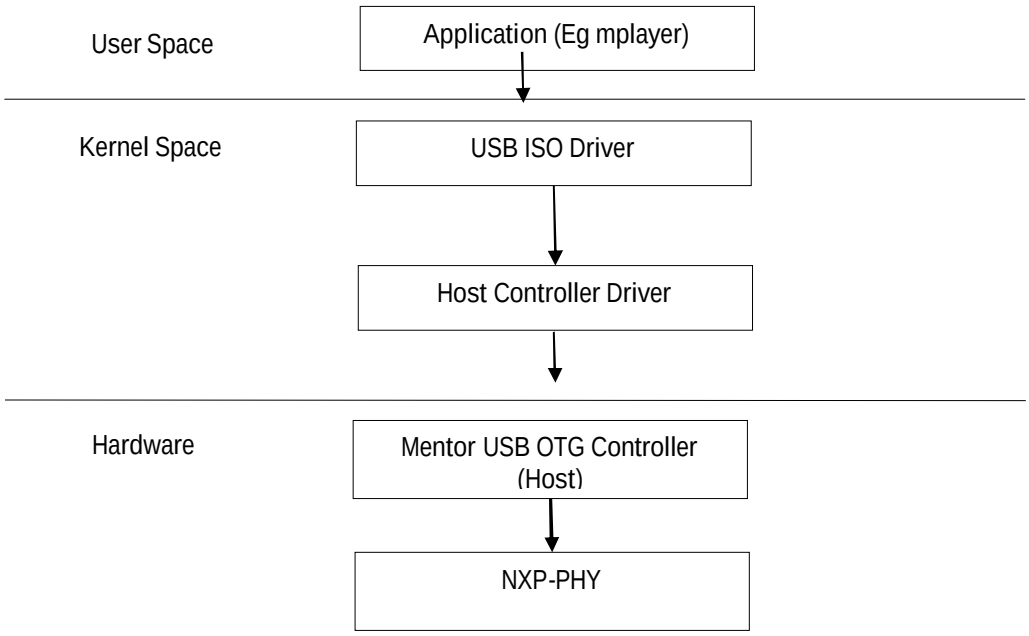
2.4.6.7 Supported IOCTLS

None

2.4.6.8 Performance Benchmarks

None

2.4.7 USB-ISO Driver



2.4.7.1 Driver Features

- USB Audio and video class are supported.

2.4.7.2 Features Not Supported

None

2.4.7.3 Constraints

None

2.4.7.4 Kernel Menu Configuration

```
Device Drivers --->
   Sound --->
    <*> Sound card support
       Advanced Linux Sound Architecture --->
       <*> Advanced Linux Sound Architecture
       USB devices --->
      <*> USB Audio/MIDI driver
      USB support --->
       <*> Support for Host-side USB
       --- Miscellaneous USB options
       [*] USB device filesystem
       [*] USB device class-devices (DEPRECATED)
       --- USB Host Controller Drivers
       <*> Inventra USB Highspeed Dual Role Controller
     Support
       <*> Use Builtin Controller
       --- OMAP 343x high speed USB support
        Driver Mode (USB Host) --->
        (X) USB Host
        [ ] Disable DMA (always use PIO)
```

2.4.7.5 Supported System Calls

None

2.4.7.6 Supported IOCTLS

None

2.4.7.7 Performance Benchmarks

None

2.5 OneNAND/Nand Driver

2.5.1 Description

The OneNAND/Micron Nand driver is implemented as a block driver, compliant with the standard MTD driver. The OneNAND/Micron Nand driver creates the device nodes for user space access (/dev/mtdblock0, /dev/mtdblock1, etc.)

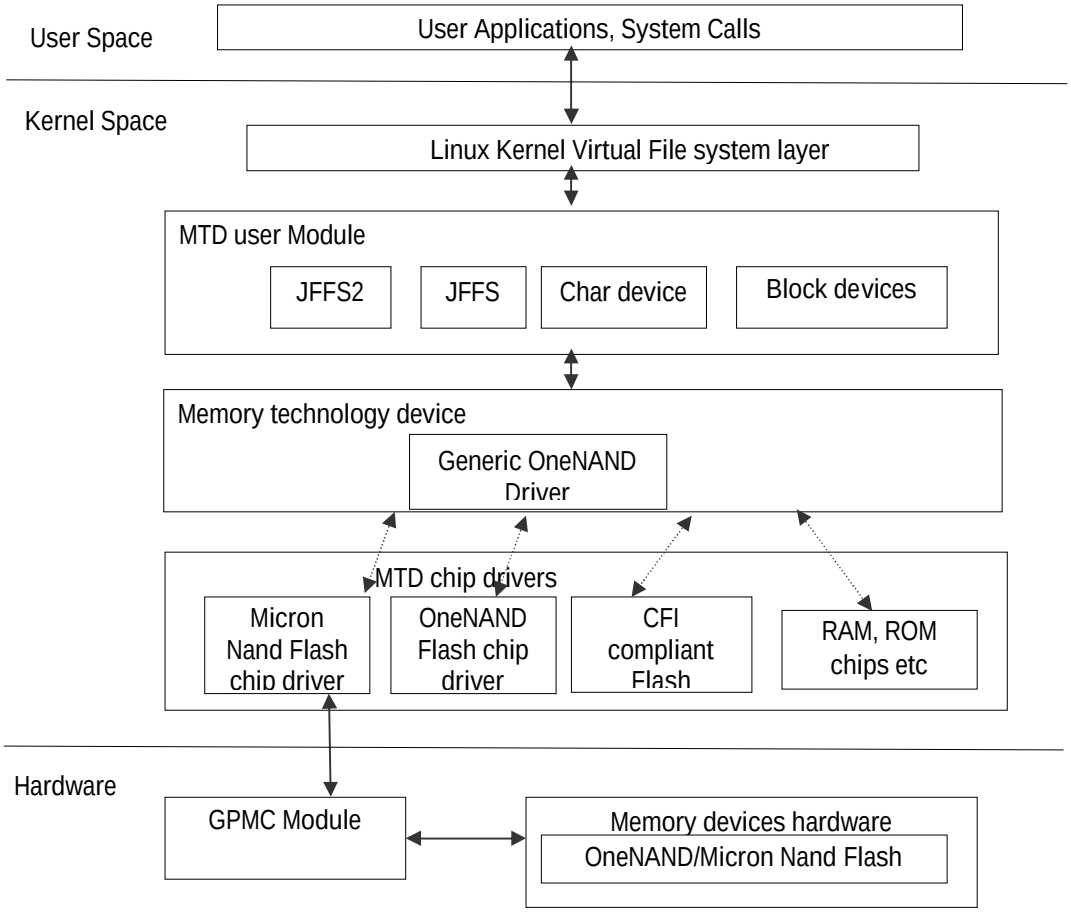


Figure 11. Linux Kernel NAND Driver

2.5.2 Driver Features

The driver supports the following features.

- JFFS2 file system.
- OneNAND has been divided into 5 partitions:
  - 512 KB read only partition for X-Loader
  - 1920 KB read only partition for U-Boot.

  - 128 KB read only for environment variables.
  - 5 MB read/write partition for Linux.
  - Remainder for file system and others (read/write).
- Big block size access

2.5.3 Features Not Supported

- OneNAND driver can not be built as a kernel module.

2.5.4 Constraints

None

2.5.5 Kernel Menu configuration

```
Device Drivers --->
   Memory Technology Devices --->
     <*> MTD concatenating Support
     <*> MTD partitioning Support
     [*] Command line partition table parsing
     <*> Direct char device access to MTD devices
     <*> Caching block device access to MTD devices
     <*> OneNAND device support >
          <*> Verify OneNAND page writes
          <*> OneNAND on OMAP2 support
File systems --->
    <*> Second extended fs support
    <*> Ext3 journalling file system support
     [*] Inotify file change notification support
     [*] Inotify support for userspace
     [*] Quota support
     <*> Quota format v2 support
     [*] Dnotify support
     Pseudo filesystems --->
     [*] /proc file system support
     Miscellaneous filesystems --->
     <*> Journalling Flash File System v2 (JFFS2) support
     [0] JFFS2 debugging verbosity (0 = quiet, 2 = noisy)
     [*] JFFS2 write-buffering support
```

2.5.6 Supported System Calls

open(), close(), write(), read(), fwrite(), fread(), ioctl()

2.5.7 Supported IOCTLs

Table 12. List of NAND IOCTLs

Constant	Description
MEMGETINFO	Get layout and capabilities .
MEMERASE	Erase flash blocks .
MEMWRITEOOB	Write out-of-band (OOB) info (ECC).
MEMREADOOB	Read out-of-band (OOB) info (ECC).
MEMLOCK	Lock flash blocks to disallow changes .
MEMUNLOCK	Unlock flash to allow changes.
MEMGETBADBLOCK	Check whether the specified block is bad .
MEMSETBADBLOCK	Set block as bad.

2.5.8 Performance and Benchmarks

None

2.6 MMC/SD Driver

2.6.1 Description

The MMC controller provides an interface to external MMC cards using MMC specification V4.0. Communication between the MMC controller and MMC card(s) is performed by the MMC/SD protocol. The MMC driver is implemented as a block driver. It creates the device nodes for user space access (/dev/mmcblockp1, /dev/mmcblockp2, etc.).

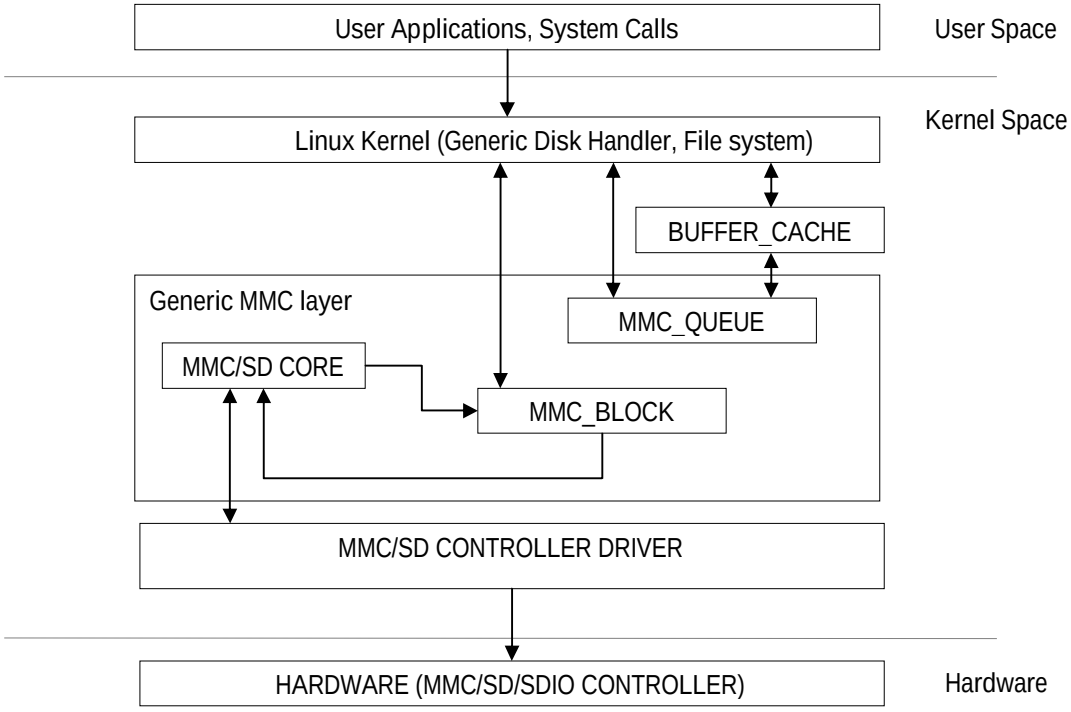


Figure 12. Linux Kernel MMC Driver

2.6.2 Driver Features

The driver supports the following features

- MMC/SD native protocol command/response set.
- Single / Multiple block data transfers
- Linux file systems and generic MMC layer abstract details of block devices (MMC).
- High-speed(SDv1.1) , High Capacity SD(SDV2.0) cards.
- Support for MMCV4.X(MMCPlus)
- Support for 1 /4 /8 bit modes

- Auto detect of card
- DMA for data transfer operations.

2.6.3 Features Not Supported

- SDIO functionality has not been tested.

2.6.4 Constraints

- MMC/SD cards should not be removed when the mount operation is in progress. If it is removed data integrity is not guaranteed.

2.6.5 Kernel Menu Configuration

```
Device Drivers --->
   <*> MMC/SD Card Support-->
      [ ] MMC Debugging
      [ ] Allow unsafe resumes ( DANGEROUS)
      ---MMC/SD Card Drivers
      <*> MMC block device driver
      --- MMC/SD Host controller Drivers
      <*> TI OMAP3430 Multimedia Card Interface Support
      <*> TI OMAP3430 MMC1 Support
      < > TI OMAP3430 MMC2 Support
      [*] OMAP SDIO Support
      [ ] Use SDIO card in non-dma mode
```

2.6.6 Supported System Calls

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

2.6.7 Performance and Benchmarks

2.6.7.1.1 SD-DMA-Ext2 Performance

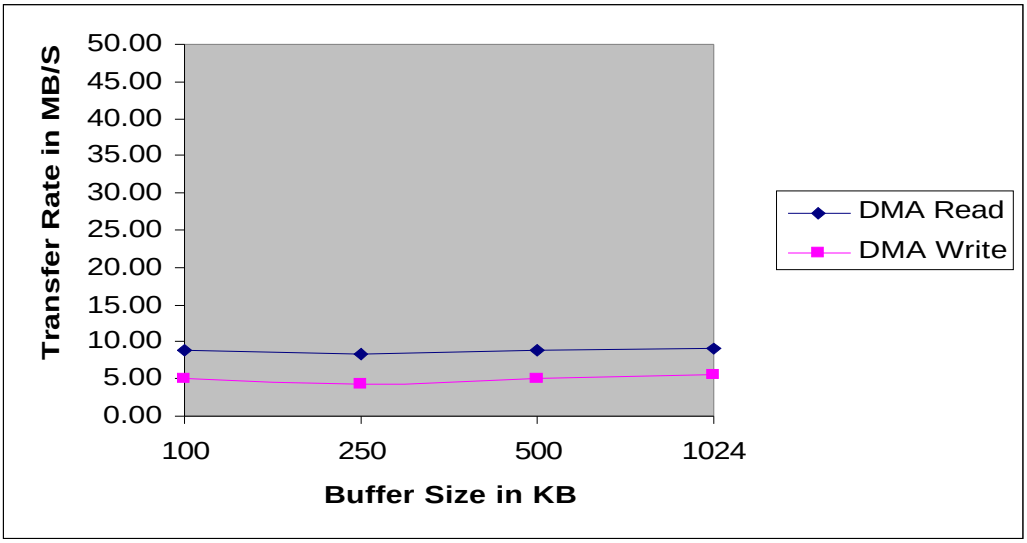


Figure 13. SD-DMA-Ext2 Performance

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	8.91
256	100	8.43
512	100	8.85
1024	100	9.01

Table 13. SD-DMA-Read Performance values

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	4.98
256	100	4.41
512	100	5.01
1024	100	5.49

Table 14. SD-DMA-Write Performance values

The performance numbers are captured using the following

- SD CARD: Panasonic 4GB High capacity CARD
- File Format = Ext2

2.6.7.1.2 SD-DMA-VFAT Performance

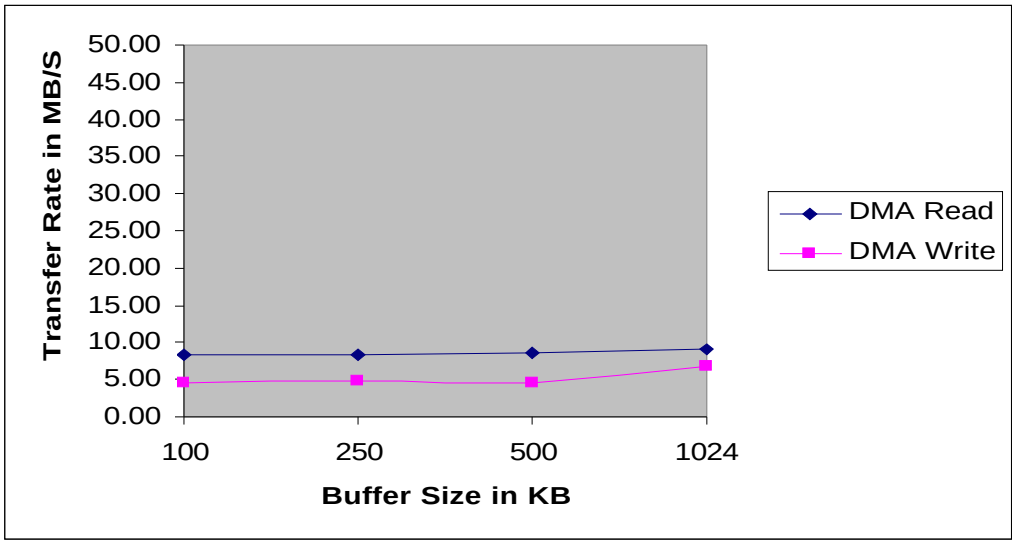


Figure 14. SD-DMA-VFAT Performance

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	1.88
256	100	1.89
512	100	1.90
1024	100	1.91

Table 15. SD-DMA-Read Performance values

Buffer size (Bytes)	Total Bytes Transferred (MB)	Transfer Rate (MB/s)
100	100	1.38
256	100	1.39
512	100	1.33
1024	100	1.34

Table 16. SD-DMA-Write Performance values

The performance numbers are captured using the following

- SD CARD: Panasonic 4GB High capacity CARD,
- File Format = VFAT

2.7 UART Driver

2.7.1 Description

The UART driver is implemented as a serial driver, and can be accessed from user space as /dev/ttyS0. The UART Library is the module that abstracts the OMAP 2x-3x UART hardware. The OMAP 3x UART controller contains three UART's which can be used for different types of applications. All accesses to the UART hardware are done th rough this library. The UART Library has helper routines that are used by UART driver.

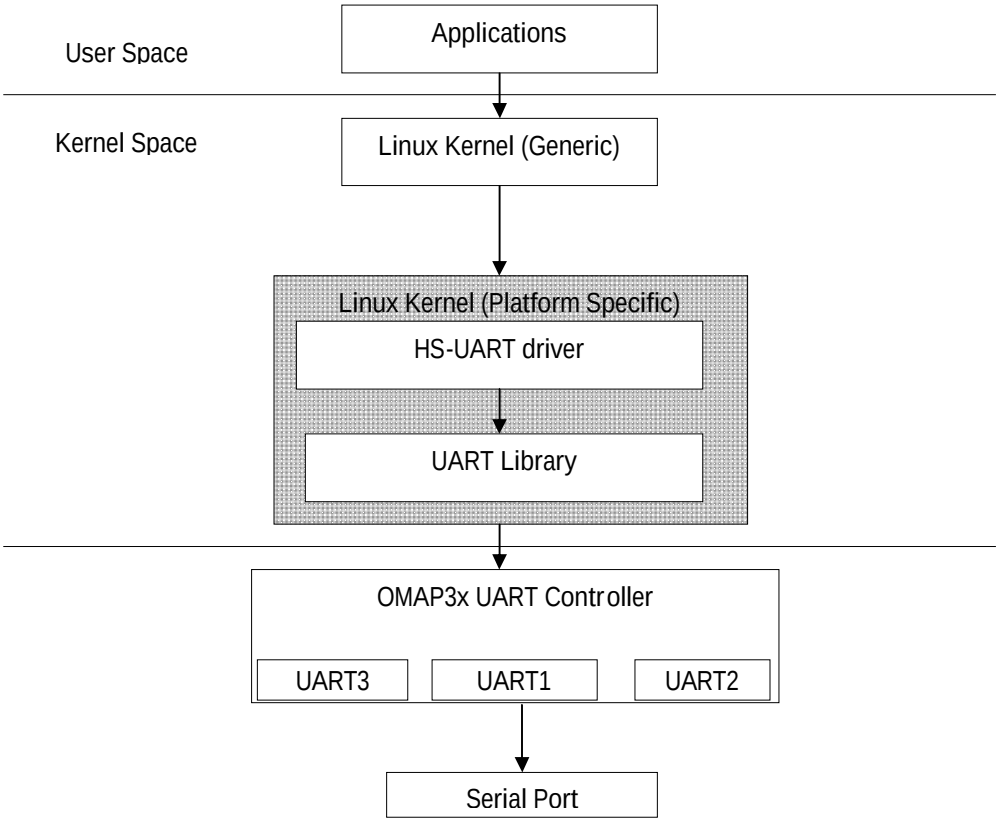


Figure 15. Linux UART Driver

2.7.2 Driver Features

The driver supports the following features.

- UART 1 instance.
- Standard speeds are 110, 300, 1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600, and 115200 bit/s.
- UART software flow control
- UART hardware flow control.

- Console UART shall be configured with the following parameters - 115200 baud rate, 8 bit data, no parity and 1 stop bit.

2.7.3 Features Not Supported

None

2.7.4 Constraints

None

2.7.5 Kernel Menu Configuration

```
Device Drivers --->
    Character devices --->
          Serial drivers --->
         <*> 8250/16550 and compatible serial support
          [*]Console on 8250/16550 and compatible serial port
         (32) Maximum number of 8250/16550 serial ports
                (4) Number of 8250/16550 serial ports to register at
runtime
          [*] Extended 8250/16550 serial driver options
          [*] Support more than 4 legacy serial ports
                [*] Support for sharing serial interrupts
                [*] Autodetect IRQ on standard ports(unsafe)
                [*] Support RSA serial ports
System Type --->
   TI OMAP Implementations --->
         Low-level debug console UART (UART1) --->
```

2.7.6 Supported System Calls

open(), close(), read(),write(), Ioctl()

2.7.7 Supported IOCTLs

Constant	Description
TIOCGSERIAL	Get device parameters from the UART (e.g. port type, port num, baud rate, base divisor , etc.)
TIOCSSERIAL	Set UART device parame ters (e.g port type, port num, baud rate, base divisor, etc.)

Table 17. Supported IOCTLs

2.7.8 Performance and Benchmarks

None

2.8 I2C Driver

2.8.1 Description

The I2C peripheral is compliant with the Philips Semiconductor I2C-bus specification version 2.1. The I2C driver is implemented as a serial driver which supports high speed and full speed clients on the same HS-I2C bus.

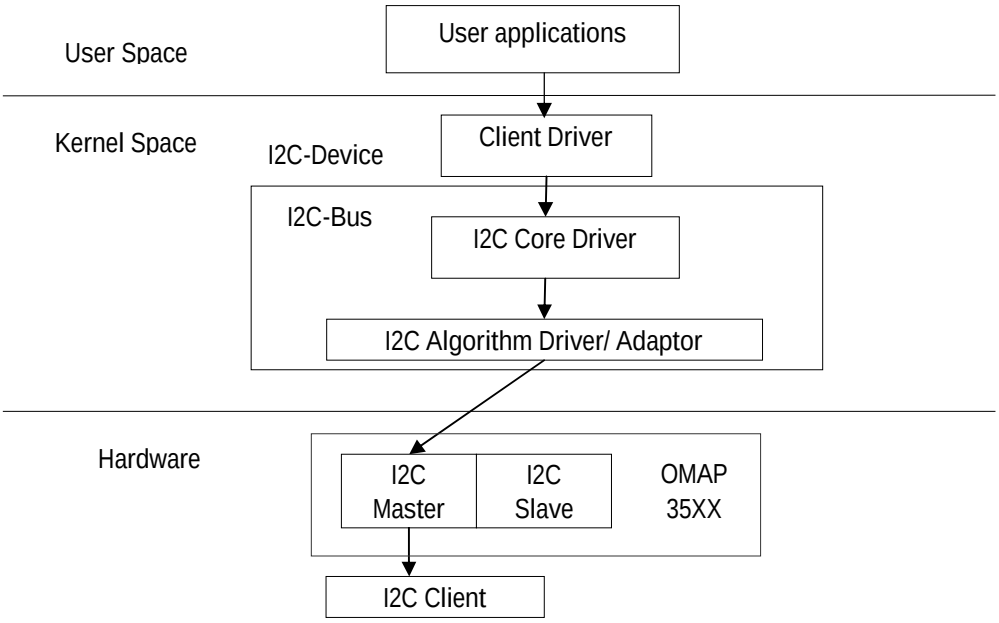


Figure 16. Linux Kernel I2C Driver

2.8.2 Driver Features

The driver supports the following features.

- 7-bit addressing mode.
- 10 –bit addressing mode.
- Fast mode up to 400 Kbps.
- High speed mode up to 3.4 Mbps
- DMA mode.
- Cancel of pending read and write operation

2.8.3 Features Not Supported

None

2.8.4 Constraints

- HS operations will be successful only if the client is HS capable and the adapto r is High Speed capable.
- Co-existence of HS and Fast I2C clients on a bus in which there is a HS master is subject to the hardware requirement of having a bridge between the I2C buses on which the clients reside. That part of the bus where the FS devices r eside must be separated from the area where the HS clients reside.

2.8.5 Kernel Menu Configuration

```
Device Drivers --->
 I2C support --->
      <*> I2C device interface
 I2C Hardware Bus Support --->
      <*> OMAP HS I2C bus controller
```

2.8.6 Supported System Calls

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

2.8.7 Supported IOCTLs

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

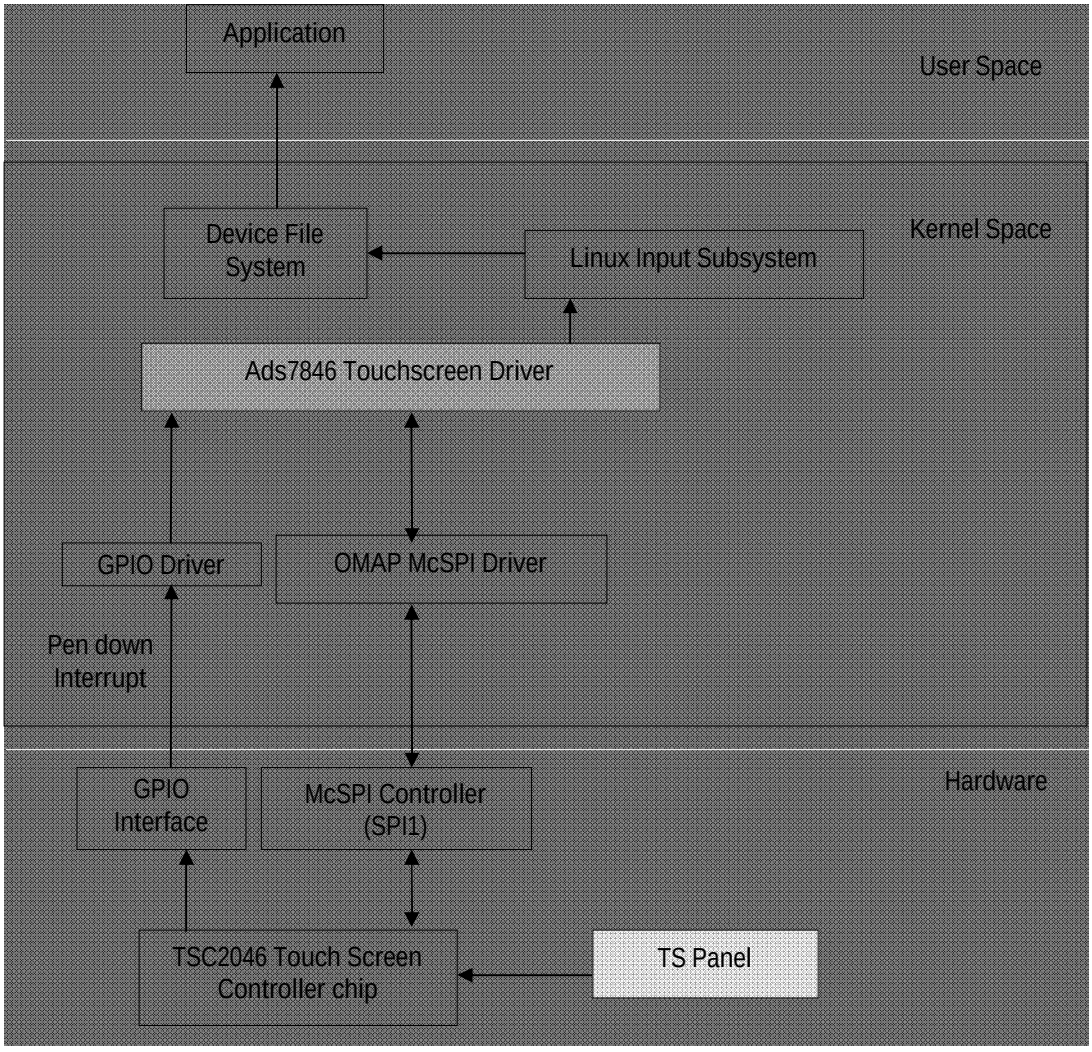
2.8.7.1 Performance and Benchmarks

None

2.9 Touch screen driver

2.9.1 Description

The OMAP processor includes a built in McSPI controller that inter faces with the ads7846 touchscreen controller chip. The ads7846 uses GPIO interface for sending interrupts on pen down. The touchscreen driver makes use of the McSPI interface to read the coordinates x, y and touch pressure z after receiving interrupt from ads7846.



2.9.2 Driver Features

- Uses the interfaces provided by the McSPI driver for the communication with the touchscreen controller chip.

- Provides the functionality as expected by the Linux input subsystem in order to notify the touchscreen events to user space.
- Uses GPIO interface for pen down/up interrupts.

2.9.3 Features Not Supported

None

2.9.4 Constraints

- Drag and draw operations are too slow on ES2.1 silicon.

2.9.5 Kernel Menu Configuration

```
          Device Drivers --->
             Input device support --->
                 <*> Event interface
                     [*] Touchscreens --->
                         <*> ADS7846/TSC2046 and ADS7843 based
touchscreens
```

2.9.6 Supported System Calls

None

2.9.7 Supported IOCTLS

None

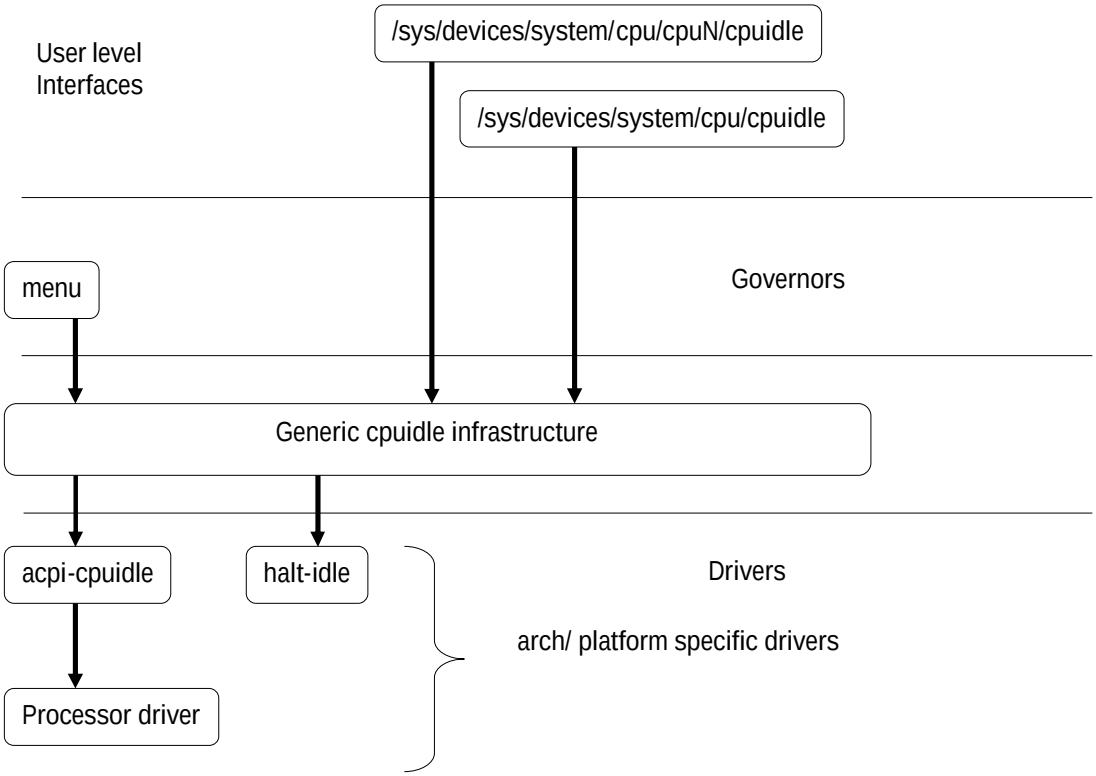
2.9.8 Performance and Benchmarks

NA

2.10 Power Management Driver

2.10.1 Description

OMAP35x silicon provides a rich set of power management features. The features include the Clock control at module level, multiple power domains, scalable voltage domains and support for transitioning power and voltage domains to retention/off. The driver adheres to the standard Linux frameworks.



2.10.2 Driver Features

The driver supports the following features

- The CPU Idle framework with MPU and Core transition to the Retention and OFF states
  - Support for 'menu' governor
- Dynamic-tick framework
- Low level API for controlling clock, DPLL, power domain and voltage.
- Supports dynamic voltage and frequency scaling using ‘cpufreq’ framework. Only kernel space ‘ondemand’ governor is supported.

2.10.3 Features Not Supported

- Suspend and Resume
- SmartReflex

2.10.4 Constraints

NONE

2.10.5 Kernel Menu Configuration

```
CPU Idle --->
      CPU idle PM Support -->
            [*] CPU idle PM Support
            --- Governors
            < > 'menu' governor

Power Management Options --->
      [*] Power Management support
      [ ] Legacy Power Management API (DEPRECATED)
      [ ] Power Management Debug Support
      [*] Driver model /sys/devices/.../power/state files
(DEPRECATED)
      < > Advanced Power Management Emulation
          OMAP power management options  --->
               Choose Voltage Scale method (Voltage Scale via Smart
Reflex in bypass)  --->
                  [*] Voltage scale via smart reflex in bypass
               VDD1 OPP(MPU-500Mhz/DSP-360Mhz (OPP3)) --->
                  [*] MPU-500Mhz/DSP-360 Mhz(OPP3)
               VDD2 OPP (L3 166Mhz(OPP3)) --->
                  [*] L3 166Mhz (OPP3)
               [*] Enable MPU Off in suspend/resume and cpuidle
               [*] Enable OFF mode for 3430
              [*] Enable CORE off in cpuidle
               [*] OMAP3430 enable H/W supervised transition for clock
domains
               [*] Enable automatic power domain control
               [*] Disable h/w supervised control of EMU clock domain
```

2.10.6 Supported System Calls

NA

2.10.7 Supported IOCTLS

NA

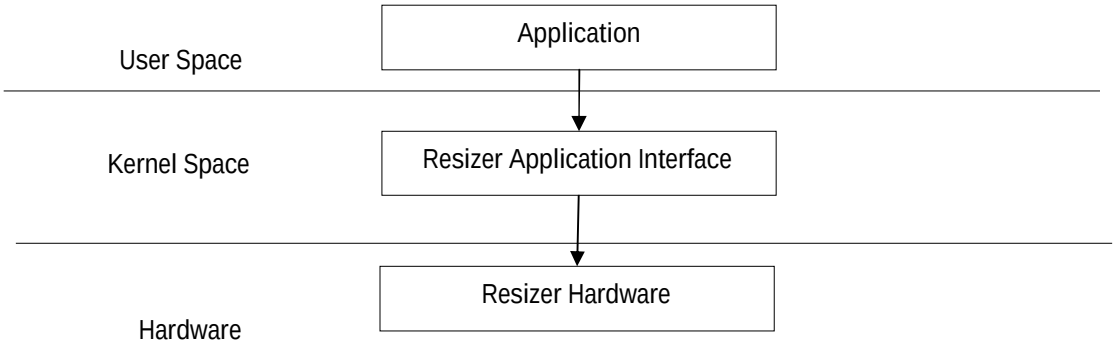
2.10.8 Performance and Benchmarks

NA

2.11 Resizer Driver

2.11.1 Description

OMAP35x Resizer module supports upscaling and downscaling. It resizes YUV422 image and stores output image in the RAM. The following figure shows the block diagram of resizer module.



2.11.2 Driver Features

The driver supports the following features

- Resizes input frame stored in RAM and stores output frame in RAM.
- Supports resizing from 1/4x to 4x.
- Supports independent horizontal & vertical resizing.
- Supports YUV422 packed data.
- Supports driver allocated and user provided buffers.

2.11.3 Features Not supported

The driver does not support the following features

- Resizing with multiple channels
- Resizing with color separate data
- Modular driver build.

2.11.4 Constraints

- All input,ouput addresses and pitch must be 32 bytes aligned.
- Output image size cannot be more than 2047x2047
- Output width must be even.
- Output width must be 16 byte aligned for vertical resizing.
- The horizontal start pixel must be within range 0-15 for color interleaved and 0-31 for color separate data.

2.11.5 Kernel Menu Configuration

N/A

2.11.6 Supported System Calls

open(), close(), ioctl(),mmap(),munmap().

2.11.7 Supported IOCTLS

Constant	Description
RSZ_S_PARAM	Set the Resizer driver parameters
RSZ_G_PARAM	Get the Resizer driver parameters
RSZ_RESIZE	Starts the resizing process
RSZ_QUERY BUF	Request physical address of buffers allocated by RSZ_REQBUF
RSZ_REQBUF	Request to allocate buffers

2.11.8 Performance and Benchmarks

Resize operation	Time taken in ms
Upscale to 4x	2.319
Downscale to 1/4x	4.151

Appendix A

U-Boot Overview

Description

The U-Boot bootloader in this release is based on open-source version U-Boot 1.1.4. U-Boot 1.1.4 is executed at reset and loads the O/S kernel into DDR2 memory.

U-Boot for oneNAND:
In this case U-Boot resides in OneNAND memory, along with X-loader. At Power reset, X-Loader is executed, which is responsible for loading the U-Boot from ONE-NAND to DDR2 memory. U-Boot then gets executed from DDR2.

The U-Boot is responsible for the following functions:

- Initializes the OMAP EVM hardware
- Provides boot parameters to the Linux kernel
- Starts the Linux kernel
- Uploads new binary images to memory via serial port or Ethernet