TI81XX PSP McSPI Driver User Guide

TEXAS INSTRUMENTS

TI81XX PSP McSPI Driver User Guide

Linux PSP

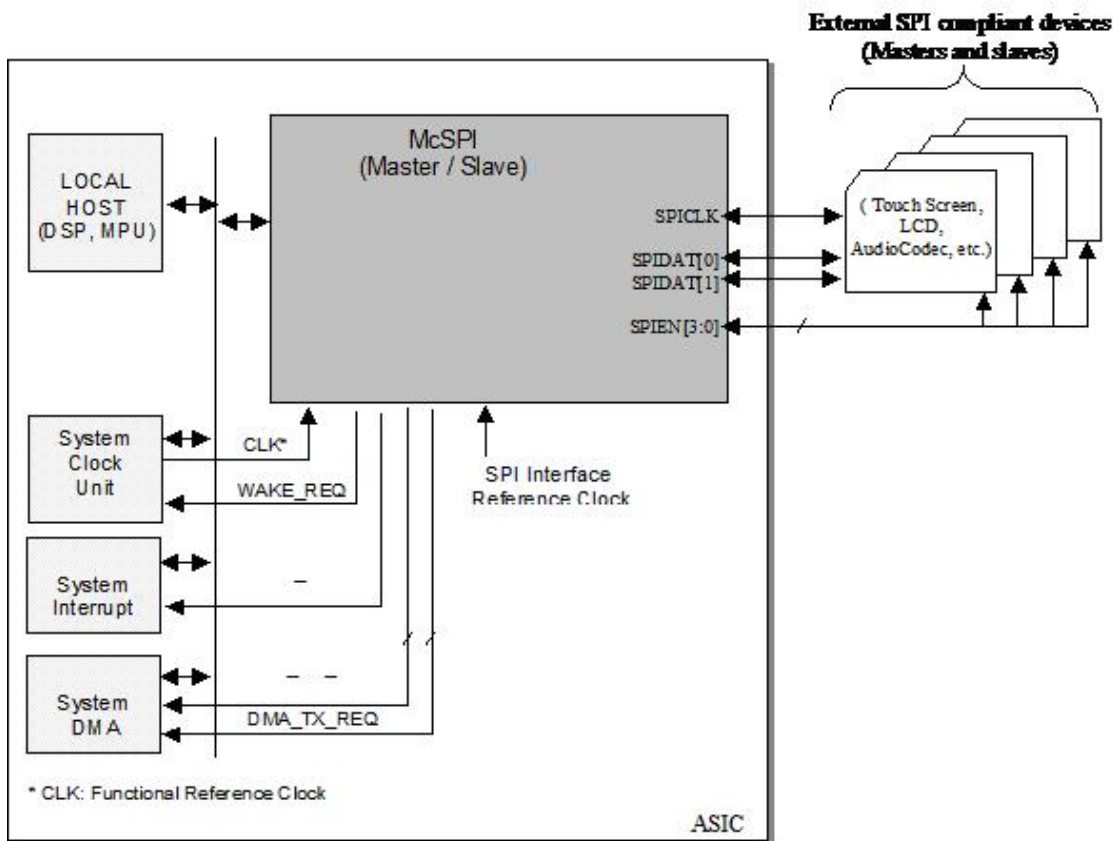**IMPORTANT**

TI81XX refers to TI816X, TI814X and TI813X.

Overview

Some of the features of an SPI interface are,

- Serial interface
- Synchronous
- Master-slave configuration (driver supports only master mode)
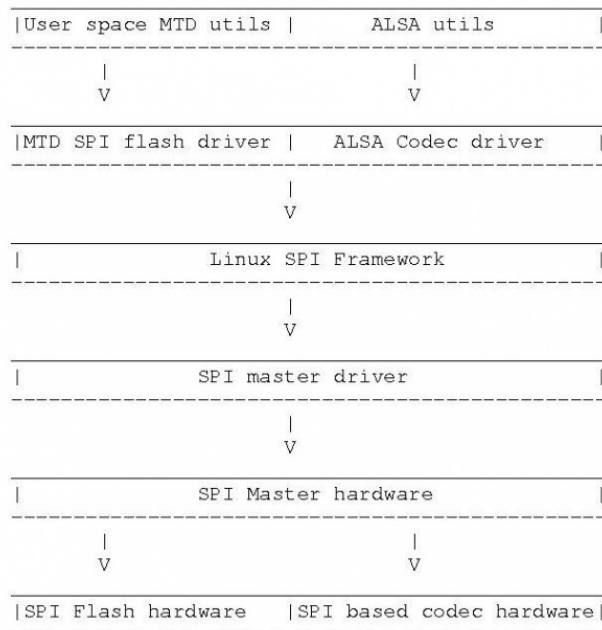- Data Exchange - DMA/PIO (driver supports only PIO mode)

SPI H/W Architecture

Note: This is just a reference block diagram, the actual SPI hardware might have more number of buses and also it might support more advanced features. For example, there are 4 McSPI controllers in TI814X and 1 in TI816X. Please refer the hardware TRM for the actual information. Information for TI814X is applicable for TI813X as well.

SPI Driver Architecture


```
                SPI Driver Architecture

|User space MTD utils |      ALSA utils          |
------------------------------------------------
         |                       |
         V                       V

|MTD SPI flash driver |   ALSA Codec driver      |
------------------------------------------------
                        |
                        V

|              Linux SPI Framework               |
------------------------------------------------
                        |
                        V

|              SPI master driver                 |
------------------------------------------------
                        |
                        V

|              SPI Master hardware               |
------------------------------------------------
         |                       |
         V                       V

|SPI Flash hardware   |SPI based codec hardware|
------------------------------------------------
```

TI8168/TI8148 EVM does not contain a SPI based audio codec. The reference to 'SPI Codec' above are meant to serve as an example.

SPI Support

- SPI could be disabled/enabled from the following location during menuconfig

```
Device Drivers  --->
      [*] SPI support  --->
         <*>   McSPI driver for OMAP24xx/OMAP34xx/TI81XX
```

- Enable W25X32 SPI flash support. This step is mandatory if for using root file-system on SPI flash.

```
Device Drivers  --->
  <*> Memory Technology Device (MTD) support  --->
       Self-contained MTD device drivers  --->
          <*> Support most SPI Flash chips (AT26DF, M25P, W25X, ...)
          [*]   Use FAST_READ OPCode allowing SPI CLK <= 50MHz (NEW)
```

Loadable Module Support

- Incase if you want to build the drivers as modules, use <M> instead of <*> during menuconfig while selecting the drivers (as shown below). For more information on loadable modules refer Loadable Module HOWTO [1]

```
Device Drivers  --->
      [*] SPI support  --->
         <M>   McSPI driver for OMAP24xx/OMAP34xx/TI81XX

Device Drivers  --->
```

```
<*> Memory Technology Device (MTD) support  --->
      Self-contained MTD device drivers  --->
          <M> Support most SPI Flash chips (AT26DF, M25P, W25X, ...)
          [*]   Use FAST_READ OPCode allowing SPI CLK <= 50MHz (NEW)
```

- This step applies if the drivers are built as modules, all of the below commands are run from Linux command line,
  - Do "make modules" to build the McSPI driver and SPI Flash driver as module. The module should be present in "drivers/spi/omap2_mcspi.ko" and "drivers/mtd/devices/m25p80.ko".
  - Copy the ".ko" files to the target
  - In the target command prompt, load the driver using "insmod <module_name.ko>"
  - Following sequence should be used during insertion and removal of modules

Module insertion sequence

```
insmod omap2_mcspi.ko
insmod m25p80.ko
```

Module removal sequence'

```
rmmod m25p80.ko
rmmod omap2_mcspi.ko
```

Validating SPI Support

- Use the MTD interface provided for SPI flash on the EVM to validate the SPI driver interface. The below step copies 8KiB from /dev/mtd1 partition (u-boot env) to /dev/mtd3 partition and reads the 8KiB image from /dev/mtd3 to a file and checks the md5sum. The md5sum of test.img and test1.img should be same.

```
cd /tmp
dd if=/dev/mtd1 of=test.img bs=8k count=1
md5sum test.img
flash_eraseall /dev/mtd3
cp test.img /dev/mtd3
dd if=/dev/mtd3 of=test1.img bs=8k count=1
md5sum test1.img
```

Proc Interface

The /proc/mtd kernel interface is a status interface. A lot of useful information about the partitions created after inserting modules can be found in the /proc/mtd file.

- Use /proc/mtd to get information on how many partitions are currently configured by the kernel's flash driver.

```
target$ cat /proc/mtd
```

You should see output similar to:

```
target$ cat /proc/mtd
dev:    size    erasesize  name
mtd0: 00020000 00020000 "U-Boot-min"
mtd1: 00240000 00020000 "U-Boot"
mtd2: 00020000 00020000 "U-Boot Env"
mtd3: 00440000 00020000 "Kernel"
mtd4: 0c820000 00020000 "File System"
```

```
mtd5: 03120000 00020000 "Reserved"
```

Porting to custom hardware

- `drivers/spi/omap2_mcspi.c` implements **core SPI** master functionality.
  - This file is generic hence should not modify it.
- Board specific **customizations** are available in `arch/arm/mach-omap2/board-ti8168evm.c` and `arch/arm/mach-omap2/board-ti8148evm.c`
- Modify device array `ti8168_evm_spi_info` (for TI816X) or `TI8148_evm_spi_info` (for TI814X) to change information on **slaves connected** to SPI. When adding new slave devices, ensure that `num_chipselect` member of the platform data is updated for the corresponding SPI master.
  - Each member is of type `spi_board_info` defined in `include/linux/spi`. Each element of the device array represents one slave device.
    - `modalias` used to match slave device to slave driver. Note that this is **not** the SPI master driver. Each slave needs to have its own driver. Example, SPI flash will have a MTD driver, SPI codec will have an ALSA driver etc.
    - `platform_data` used by slave driver
    - `controller_data` used by SPI master driver for slave specific information (of type `omap2_mcspi_cs`). This is used to take care of specific requirements for communicating with a given slave.
    - `bus_num` Bus number identifies the SPI controller instance to which the SPI slave is connected. Numbering starts with '1'. Hence should use 1 for the first SPI controller. Please check the EVM schematic to identify the bus number to which your SPI slave is connected. On TI816X and TI814X EVM, it is the first SPI controller to which the SPI flash is connected.
    - `chip_select` chip select number for this SPI slave (0 on TI81XX EVMs)
    - `max_speed_hz` SPI bus speed.
- Ensure all pins required for SPI operation are **muxed** correctly (especially if using GPIO for CS)

Supporting SPI Flashes

- To modify partition layout on SPI flash following structure has to be modified in arch/arm/mach-omap2/board-ti8168evm.c and arch/arm/mach-omap2/board-ti8148evm.c

```
struct mtd_partition ti816x_spi_partitions[] = { /* For TI8168 EVM */

                (or)

struct mtd_partition ti8148_spi_partitions[] = {  /* For TI8148 EVM */

    /* All the partition sizes are listed in terms of NAND block size */
    {
        .name       = "U-Boot",
        .offset     = 0,    /* Offset = 0x0 */
        .size       = 64 * SZ_4K,
        .mask_flags = MTD_WRITEABLE,    /* force read-only */
    },
    {
        .name       = "U-Boot Env",
        .offset     = MTDPART_OFS_APPEND,   /* Offset = 0x40000 */
```

```
        .size       = 2 * SZ_4K,
    },
    {
        .name       = "Kernel",
        .offset     = MTDPART_OFS_APPEND,   /* Offset = 0x42000 */
        .size       = 640 * SZ_4K,
    },
    {
        .name       = "File System",
        .offset     = MTDPART_OFS_APPEND,   /* Offset = 0x2C2000 */
        .size       = MTDPART_SIZ_FULL,     /* size = 1.24 MiB */
    }
};
```

- SPI Flash information is available in following structure in file *arch/arm/mach-omap2/board-ti8168evm.c* (for TI816X) and *arch/arm/mach-omap2/board-ti8148evm.c* (for TI814X). This structure should be modified to support a SPI flash. The example structure given here supports most of the SPI flashes, check **drivers/mtd/devices/m25p80.c** for support for the new SPI flash. The string constants **.modalias** and **.type** depend on device names provided in the slave driver (in our case m25p32.c). The **.type** string here selects W25X32 SPI flash, which has to be modified in case of new SPI flash.

```
struct spi_board_info __initdata ti816x_spi_slave_info[] = { /* For TI8168 EVM */


                        (or)


struct spi_board_info __initdata ti8148_spi_slave_info[] = { /* For TI8148 EVM */


    {
        .modalias    = "m25p80",
        .platform_data  = &ti816x_spi_flash,
        .irq         = -1,
        .max_speed_hz   = 75000000,
        .bus_num     = 1,
        .chip_select    = 0,
    },
};


const struct flash_platform_data ti816x_spi_flash = { /* For TI8168 EVM */


            (or)


const struct flash_platform_data ti8148_spi_flash = { /* For TI8148 EVM */


    .type       = "w25x32",
    .name       = "spi_flash",
    .parts      = ti816x_spi_partitions,
    .nr_parts   = ARRAY_SIZE(ti816x_spi_partitions),
};
```

- Check if **drivers/mtd/devices/m25p80.c** support the new SPI flash. If it is not supported then the new SPI flash device information has to be added to the m25p_ids[] list.

References

[1] http://tldp.org/HOWTO/Module-HOWTO/

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