Linux内核的移植技术剖析

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今天的内容

- BSP的组成部分
- plat/mach各组件的实现
  - 内核节拍
  - 中断管理
  - 时钟
  - GPIO
  - DMA
  - IO内存映射
- 设备与资源
  - platform device、resource和plarform data
  - uart/spi/i2c等设备板级resource

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BSP的组成部分

- BSP作用
  - 为内核的运行提供底层支撑
  - 屏蔽与板相关的硬件细节

- 基本组成
  - 时钟tick（HZ）的产生
  - 系统中断控制的方法
  - GPIO、DMA、时钟资源的统一管理
  - 静态映射的IO内存
  - 设备的IO、中断、DMA等资源封装平台数据

ARM BSP的目录

- plat-xxx

linux-2.6/arch/arm/

plat-omap/
plat-pxa/
plat-s3c/
plat-s3c24xx/
plat-s3c64xx/
plat-stmp3xxx/

- mach-xxx

linux-2.6/arch/arm/

mach-s3c2400/
mach-s3c2410/
mach-s3c2412/
mach-s3c2440/
mach-s3c2442/
mach-s3c2443/
mach-s3c24a0/
mach-s3c6400/
mach-s3c6410/

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时钟节拍的产生

- sys_timer和timer_tick

```
static irqreturn_t s3c2410_timer_interrupt(int irq, void *dev_id)
{
        timer_tick();
        return IRQ_HANDLED;
}
static struct irqaction s3c2410_timer_irq = {
        .name           = "S3C2410 Timer Tick",
        .flags          = IRQF_DISABLED | IRQF_TIMER | IRQF_IRQPOLL,
        .handler        = s3c2410_timer_interrupt,
};
static void __init s3c2410_timer_init(void)
{
        s3c2410_timer_resources();
        s3c2410_timer_setup();
        setup_irq(IRQ_TIMER4, &s3c2410_timer_irq);
}
struct sys_timer s3c24xx_timer = {
        .init           = s3c2410_timer_init,
        .offset         = s3c2410_gettimeoffset,
        .resume         = s3c2410_timer_setup
};
```

系统中断管理

- irq_chip

```
static struct irq_chip s3c_irq_uart = {
        .name           = "s3c-uart",
        .mask           = s3c_irq_uart_mask,
        .unmask         = s3c_irq_uart_unmask,
        .mask_ack       = s3c_irq_uart_maskack,
        .ack            = s3c_irq_uart_ack,
};
static void __init s3c64xx_uart_irq(struct uart_irq *uirq)
{
        for (offs = 0; offs < 3; offs++) {
          irq = uirq->base_irq + offs;
          set_irq_chip(irq, &s3c_irq_uart);
          set_irq_chip_data(irq, uirq);
          set_irq_handler(irq, handle_level_irq);
          set_irq_flags(irq, IRQF_VALID);
        }
        set_irq_chained_handler(uirq->parent_irq, s3c_irq_demux_uart);
}
void __init s3c64xx_init_irq(u32 vic0_valid, u32 vic1_valid)
{
        set_irq_chip(irq, &s3c_irq_timer);
          ...
        for (uart = 0; uart < ARRAY_SIZE(uart_irqs); uart++)
          s3c64xx_uart_irq(&uart_irqs[uart]);
}
```

GPIO管理

gpio_chip和统一的gpio_xxx API

```
struct gpio_chip {
        int             (*request)(struct gpio_chip *chip,
                                unsigned offset);
        void             (*free)(struct gpio_chip *chip,
                                unsigned offset);
        int             (*direction_input)(struct gpio_chip *chip,
                                unsigned offset);
        int             (*get)(struct gpio_chip *chip,
                                unsigned offset);
        int             (*direction_output)(struct gpio_chip *chip,
                                unsigned offset, int value);
        void             (*set)(struct gpio_chip *chip,
                                unsigned offset, int value);
};
int gpio_request(unsigned gpio, const char *label);
void gpio_free(unsigned gpio);
int gpio_direction_input(unsigned gpio);
int gpio_direction_output(unsigned gpio, int value);
int gpio_get_value_cansleep(unsigned gpio);
```

CLOCK管理

- 提供统一的clk_get、clk_put等API:
  - EXPORT_SYMBOL(clk_get);
  - EXPORT_SYMBOL(clk_put);
  - EXPORT_SYMBOL(clk_enable);
  - EXPORT_SYMBOL(clk_disable);
  - EXPORT_SYMBOL(clk_get_rate);
  - EXPORT_SYMBOL(clk_round_rate);
  - EXPORT_SYMBOL(clk_set_rate);
  - EXPORT_SYMBOL(clk_get_parent);
  - EXPORT_SYMBOL(clk_set_parent);

DMA管理

- 统一的DMA API支持：
  - int request_dma(unsigned int chan, const char * device_id);
  - void free_dma(unsigned int chan);
  - void enable_dma(unsigned int chan);
  - void disable_dma(unsigned int chan);
  - void set_dma_mode (unsigned int chan, unsigned int mode);
  - void set_dma_sg (unsigned int chan, struct scatterlist *sg, int nr_sg);

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IO内存静态映射

map_desc和iotable_init

```
static struct map_desc s3c_iodesc[] __initdata = {
        {
                .virtual        = (unsigned long)S3C_VA_SYS,
                .pfn            = __phys_to_pfn(S3C64XX_PA_SYSCON),
                .length         = SZ_4K,
                .type           = MT_DEVICE,
        }, {
         ...
        },
};

void __init s3c64xx_init_io(struct map_desc *mach_desc, int size)
{
       …
       iotable_init(s3c_iodesc, ARRAY_SIZE(s3c_iodesc));
       iotable_init(mach_desc, size);
}
```

platform_device和资源

- platform_device和resource

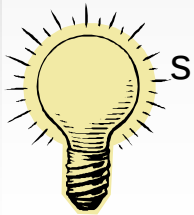
```
static struct resource smdk6410_smsc911x_resources[] = {
        [0] = {
          .start = 0x18000000,
          .end   = 0x18000000 + SZ_64K - 1,
          .flags = IORESOURCE_MEM,
        },
        [1] = {
          .start = S3C_EINT(10),
          .end   = S3C_EINT(10),
          .flags = IORESOURCE_IRQ | IRQ_TYPE_LEVEL_LOW,
        },
};

static struct platform_device smdk6410_smsc911x = {
        .name           = "smsc911x",
        .id             = -1,
        .num_resources = ARRAY_SIZE(smdk6410_smsc911x_resources),
        .resource       = &smdk6410_smsc911x_resources[0],
};
```

platform数据

- 提供与板相关的硬件设置数据

```
static struct smsc911x_platform_config smdk6410_smsc911x_pdata = {
        .irq_polarity  = SMSC911X_IRQ_POLARITY_ACTIVE_LOW,
        .irq_type      = SMSC911X_IRQ_TYPE_OPEN_DRAIN,
        .flags         = SMSC911X_USE_32BIT |
        SMSC911X_FORCE_INTERNAL_PHY,
        .phy_interface = PHY_INTERFACE_MODE_MII,
};
static struct platform_device smdk6410_smsc911x = {
        ...
        .dev = {
          .platform_data = &smdk6410_smsc911x_pdata,
        },
};
```



struct smsc911x_platform_config由对应设备的驱动定义，而platform_data则由驱动引用。

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SPI板级信息

spi_board_info

```
static struct spi_board_info __initdata jive_spi_devs[] = {
        [0] = {
                .modalias       = "VGG2432A4",
                .bus_num        = 1,
                .chip_select    = 0,
                .mode           = SPI_MODE_3,   /* CPOL=1, CPHA=1 */
                .max_speed_hz   = 100000,
                .platform_data  = &jive_lcm_config,
        }, {
                .modalias       = "WM8750",
                .bus_num        = 2,
                .chip_select    = 0,
                .mode           = SPI_MODE_0,   /* CPOL=0, CPHA=0 */
                .max_speed_hz   = 100000,
        },
};

spi_register_board_info(jive_spi_devs, ARRAY_SIZE(jive_spi_devs));
```

I²C板级信息

- i2c_board_info

```
static struct i2c_board_info i2c_devs0[] __initdata = {
        { I2C_BOARD_INFO("24c08", 0x50), },
        { I2C_BOARD_INFO("wm8580", 0x1b), },

#ifdef CONFIG_SMDK6410_WM1190_EV1
        { I2C_BOARD_INFO("wm8350", 0x1a),
          .platform_data = &smdk6410_wm8350_pdata,
          .irq = S3C_EINT(12),
        },
#endif
};

static void __init smdk6410_machine_init(void)
{
        ...
        i2c_register_board_info(0, i2c_devs0, ARRAY_SIZE(i2c_devs0));
        i2c_register_board_info(1, i2c_devs1, ARRAY_SIZE(i2c_devs1));
        ...
}
```

MACHINE_START

```
MACHINE_START(SMDK6410, "SMDK6410")
    /* Maintainer: Ben Dooks <ben@fluff.org> */
    .phys_io      = S3C_PA_UART & 0xfff00000,
    .io_pg_offst = (((u32)S3C_VA_UART) >> 18) & 0xfffc,
    .boot_params      = S3C64XX_PA_SDRAM + 0x100,

    .init_irq      = s3c6410_init_irq,
    .map_io      = smdk6410_map_io,
    .init_machine      = smdk6410_machine_init,
    .timer      = &s3c24xx_timer,
MACHINE_END
```

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范例：添加LDD6410板

- 修改Kconfig和Makefile：

Ø *linux-2.6.31/arch/arm/mach-s3c6410/Kconfig*

```
+       config MACH_LDD6410
+       bool "LDD6410"
+       select CPU_S3C6410
+       select S3C_DEV_FB
+       select S3C64XX_SETUP_FB_24BPP
+       help
+       Machine support for the LDD6410
+
        config MACH_SMDK6410
        bool "SMDK6410"
        select CPU_S3C6410
```

Ø *linux-2.6.31/arch/arm/mach-s3c6410/Makefile*

```
+       obj-$(CONFIG_MACH_LDD6410) += mach-ldd6410.o
        obj-$(CONFIG_MACH_SMDK6410) += mach-smdk6410.o
        obj-$(CONFIG_MACH_NCP) += mach-ncp.o
```

- 增加新板子的文件：

linux-2.6.31/arch/arm/mach-s3c6410/mach-ldd6410.c

文档与参考实例

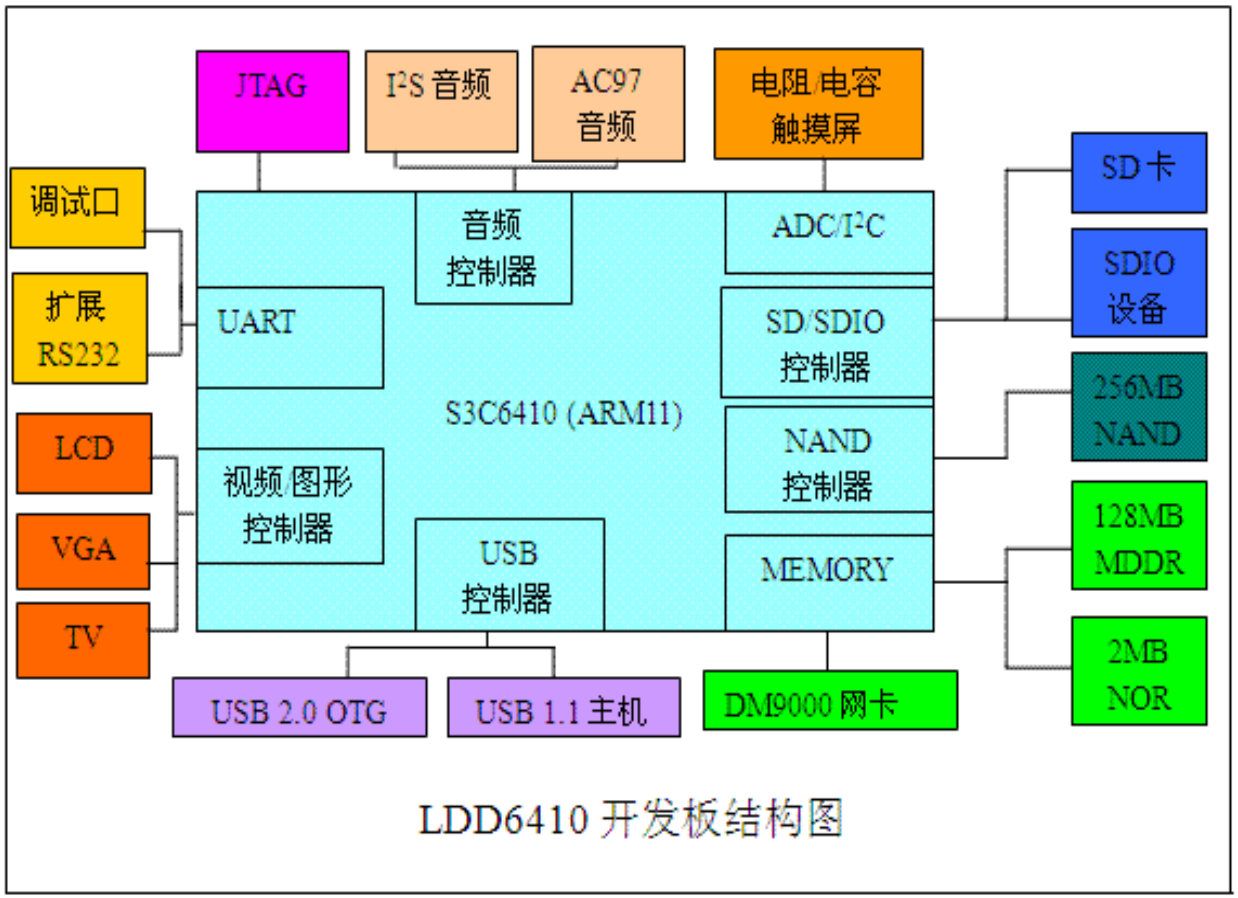
- Linux-2.6/arch/arm/
- http://code.google.com/p/ldd6410/
- http://code.google.com/p/ldd6410-2-6-28/
- 获取LDD6410源代码：

  svn checkout ***http***://ldd6410.googlecode.com/svn/trunk/ ldd6410-read-only

  svn checkout http://ldd6410-2-6-28.googlecode.com/svn/trunk/ ldd6410-2-6-28-read-only

华清远见

演示板LDD6410的结构



LDD6410 开发板结构图

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演示板LDD6410的实物(Android)

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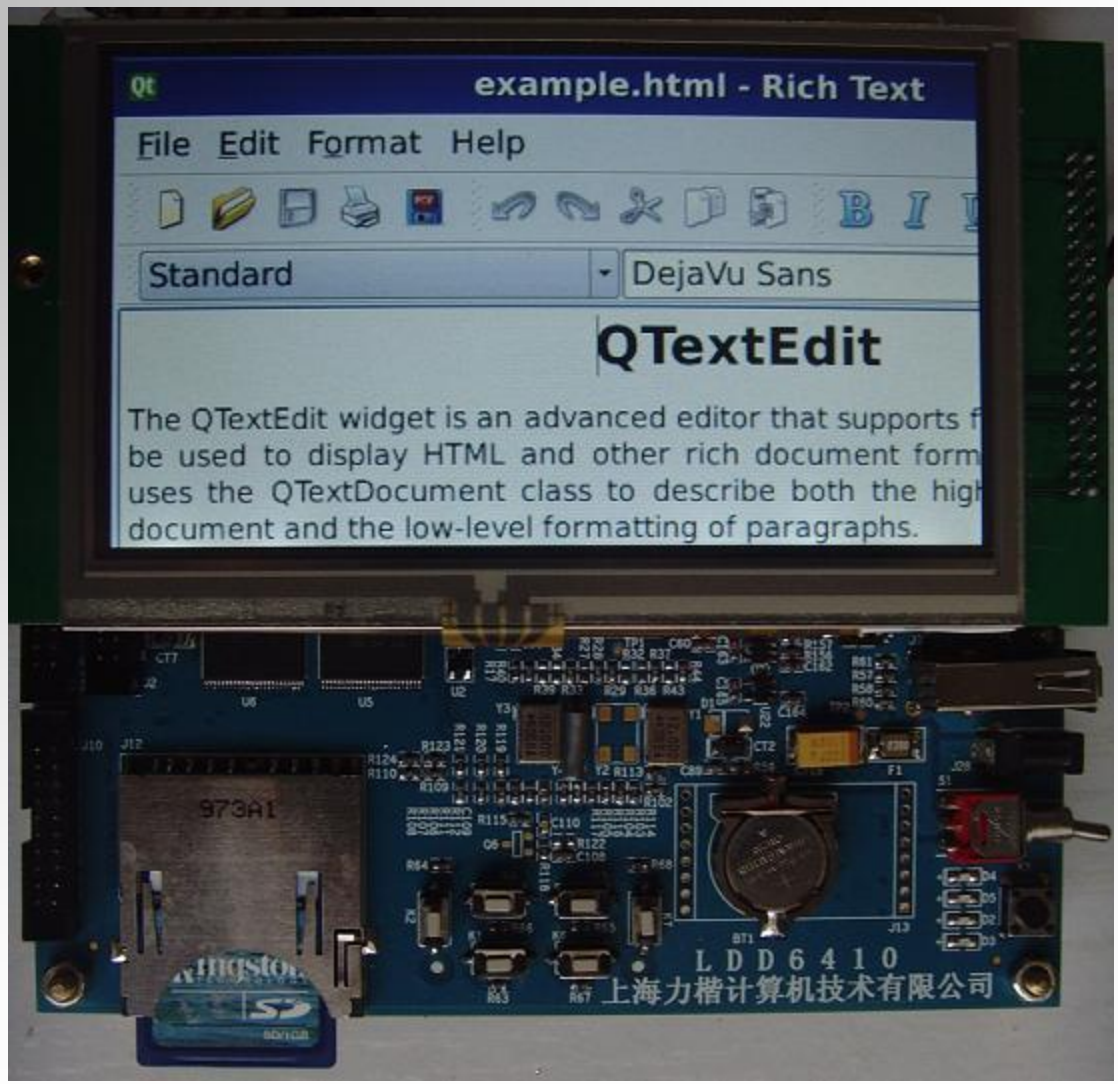
演示板LDD6410的实物(QT)



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LDD6410配套软件

- *U-BOOT*
- *Linux 2.6.28.6(附带Android补丁）*
- *Android*
- *Qt/Embedded*
- *大量开发学习案例*

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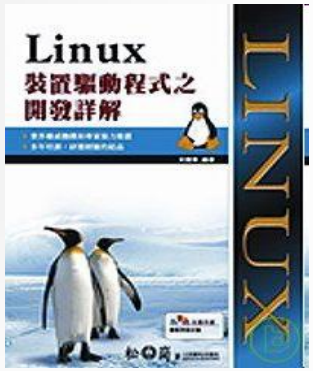
华清远见

Linux设备驱动开发详解

- 主要出发点：
  - 力求用最简单的实例讲解复杂的知识点，以免实例太复杂搅浑读者（驱动理论部分）
  - 对Linux设备驱动多种复杂设备的框架结构进行了全面的介绍（驱动框架部分）
  - 更面向实际的嵌入式工程，讲解开发必备的软硬件基础，及开发手段（调试与移植部分）
  - 提供讨论与交流平台（华清远见，www.linuxdriver.cn）



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筹备出版中——Linux设备驱动开发详解第2版

- 主要出发点
- 开发LDD6410 SAMSUNG S3C6410开发板，所有实例均可在该板上直接运行和学习
- 全面升级为Linux 2.6.28.6内核，对Linux内核最新API和驱动子系统架构的变化进行介绍
- 对第一版中部分知识点进行整理和重新讲解
- 删除过时内容
- 新增大量内容：
  - SPI主机和设备驱动
  - ALSA SoC架构驱动
  - USB 设备控制器／gadget驱动／USB OTG驱动
  - 内核移植（BSP构建与开发）
  - Android驱动
  - 驱动分层思想
  - 驱动分离思想

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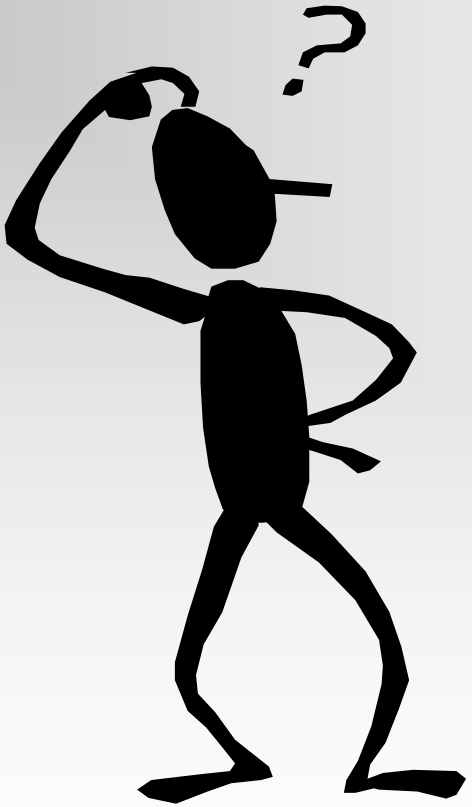
让我们一起讨论！



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谢谢！