

Debugging Embedded Linux Systems: Locate Device Driver Source Code

Debugging Embedded Linux Training Series [Part 5]

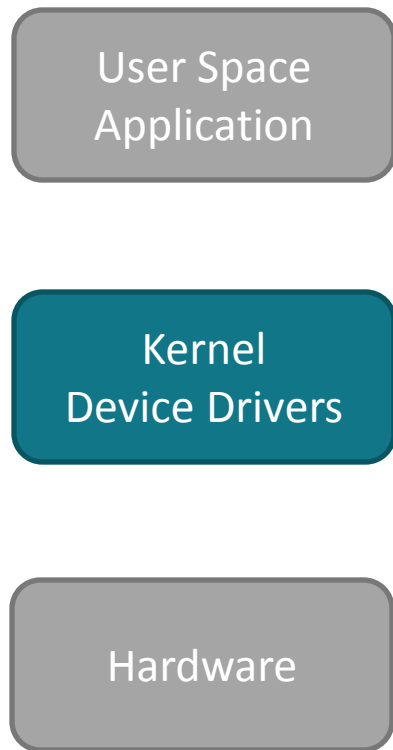
Debugging Embedded Linux Training Series

- Part 1: Linux/Kernel Overview
- Part 2: Kernel Logging System Overview
- Part 3: printk and Variations
- Part 4: Dynamic Debug
- **Part 5: Locate Device Driver Source Code**
- Part 6: Understand Kernel Oops Logs

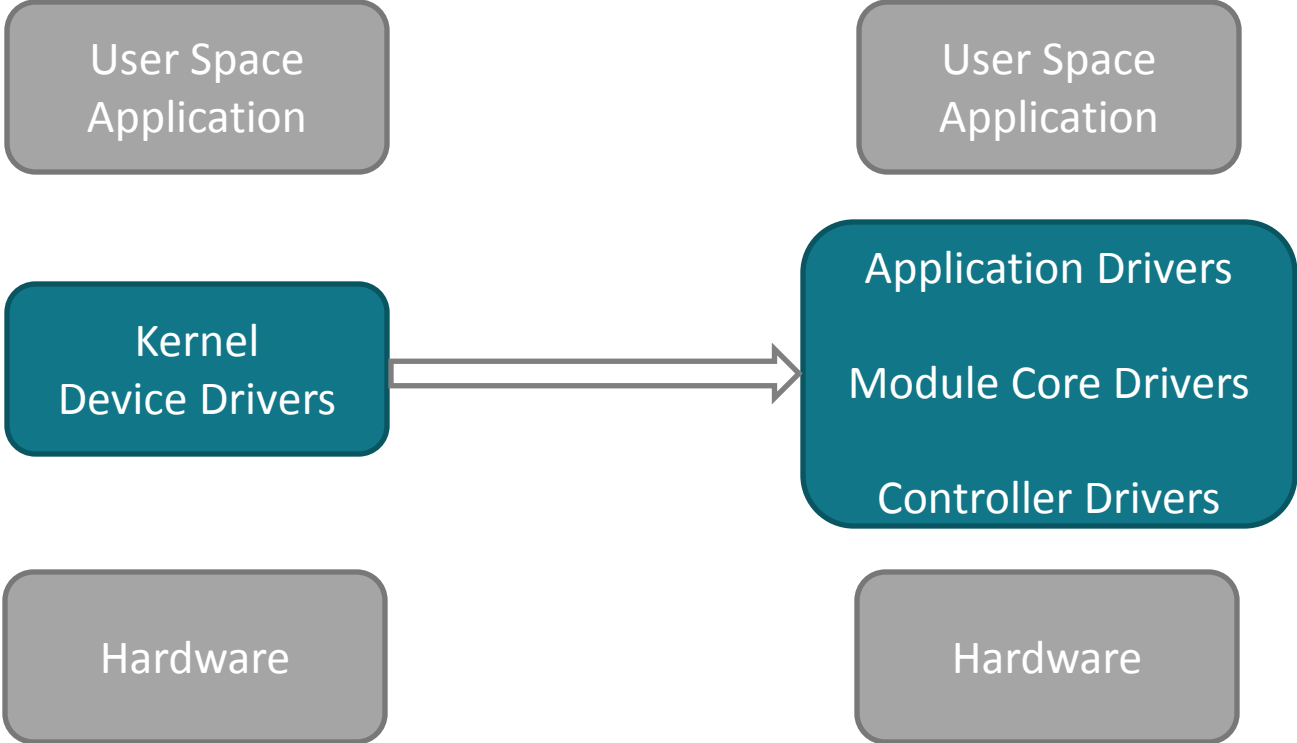
Agenda

- Device Driver Architecture Overview
- How Does the Kernel Load a Driver?
- How to Locate a Device Driver?
- Case Study

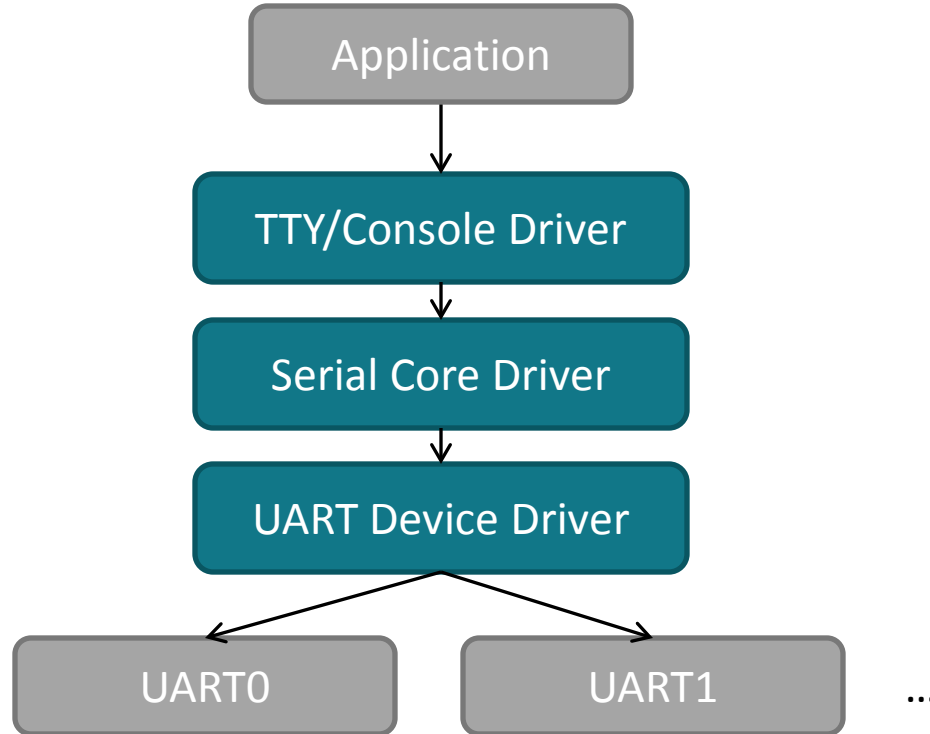
Device driver architecture overview



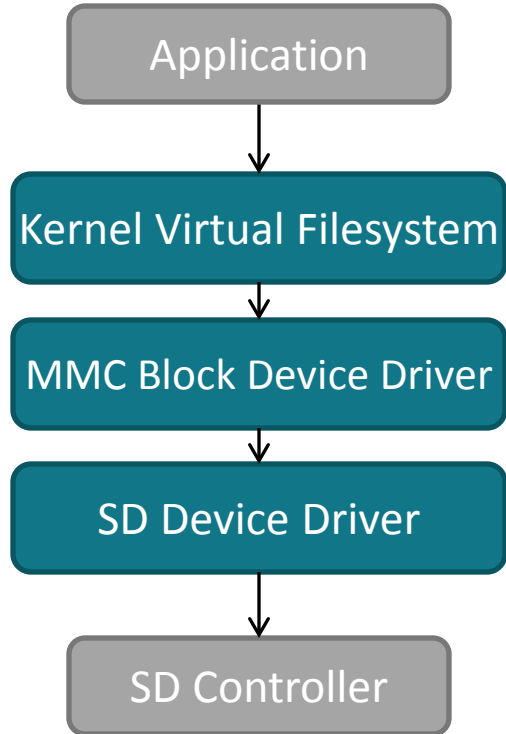
Device driver architecture overview



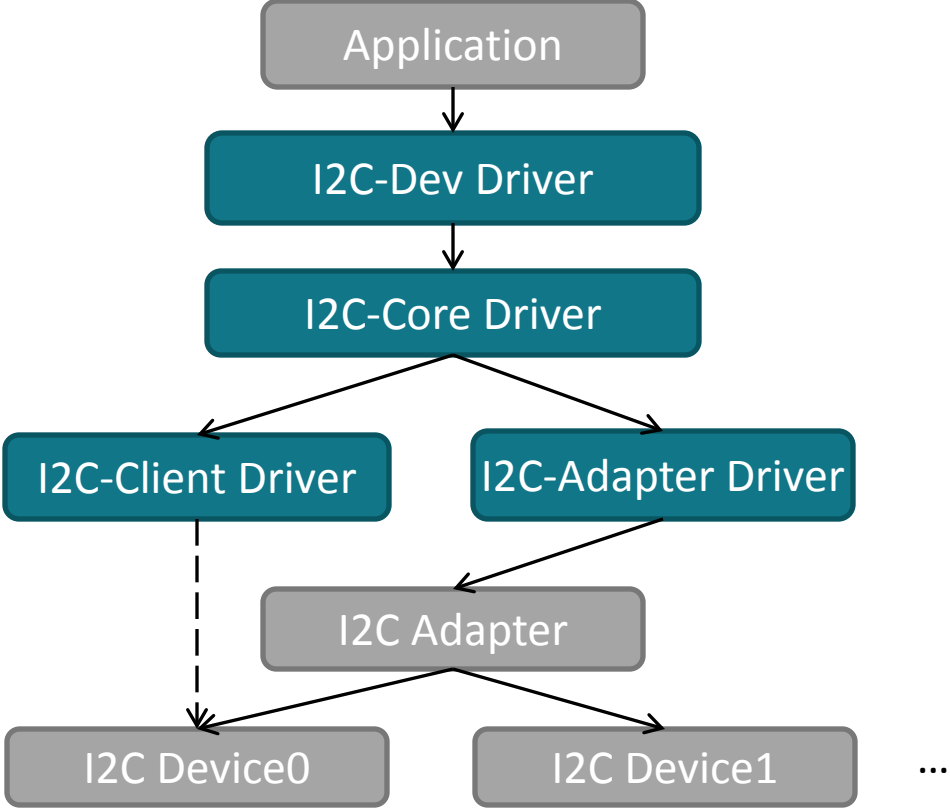
Example: UART



Example: SDIO



Example: I2C



Problem

- Each driver module has a common application and core drivers.
- Kernel has many controller drivers to support multiple platforms.
- Only one controller device driver is used for a specific system.
- How do I find the controller device driver for my platform?

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- Each driver module has a common application and core drivers.
- Kernel has many controller drivers to support multiple platforms.
- Only one controller device driver is used for a specific system.
- How do I find the controller device driver for my platform?

First, let's see how the kernel finds it...

How does the kernel bind a driver to a device?

- The tie: *compatible*
- Both drivers and DT nodes define the *compatible* property.
- Kernel binds a driver to a device if their compatible string matches.

How does the kernel bind a driver to a device?

- The tie: *compatible*
- Both drivers and DT nodes define the *compatible* property.
- Kernel binds a driver to a device if their compatible string matches.

.../dts/am33xx.dtsi

```
usb: usb@47400000 {  
    compatible = "ti,am33xx-usb";  
    ...  
}
```

drivers/.../musb_am335x.c

```
static const struct of_device_id  
am335x_child_of_match[] = {  
    { .compatible = "ti,am33xx-usb" },  
    { },  
};  
MODULE_DEVICE_TABLE(of, am335x_child_of_match)
```

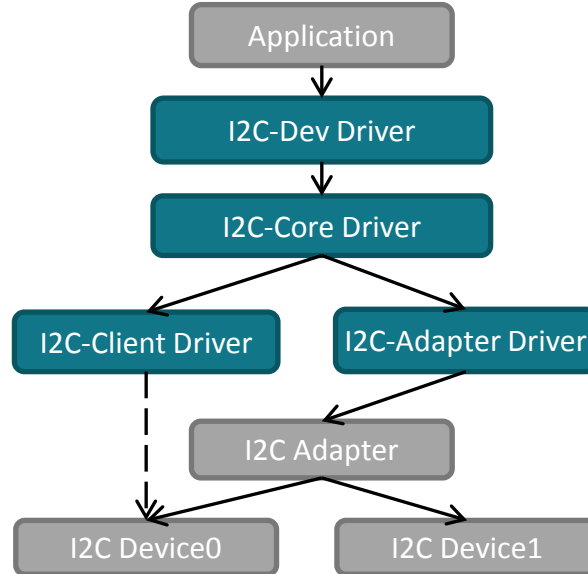
How to locate a device driver?

Find the matching compatible string!

Case study: AM335x I2C subsystem (1)

```
$ ls -F drivers/i2c/
```

```
algos/          i2c-core.c  i2c-mux.c      i2c-stub.c  muxes/  
busses/        i2c-core.h  i2c-slave-ee- Kconfig  
i2c-boardinfo.c i2c-dev.c   i2c-smbus.c    Makefile
```



Case study: AM335x I2C subsystem (1)

```
$ ls -F drivers/i2c/
```

```
algos/          i2c-core.c  i2c-mux.c      i2c-stub.c  muxes/
busses/         i2c-core.h  i2c-slave-eprom.c Kconfig
i2c-boardinfo.c i2c-dev.c   i2c-smbus.c    Makefile
```

```
$ ls -F drivers/i2c/busses/
```

```
i2c-acorn.c      i2c-eg20t.c  i2c-octeon.c   i2c-sis5595.c
i2c-ali1535.c    i2c-elektor.c i2c-omap.c     i2c-sis630.c
i2c-ali1563.c    i2c-emev2.c  i2c-opal.c     i2c-sis96x.c
i2c-ali15x3.c    i2c-exynos5.c i2c-piix4.c    i2c-st.c
i2c-amd756.c     i2c-gpio.c   i2c-parport.c  i2c-stu300.c
i2c-amd756-s4882.c i2c-highlander.c i2c-parport.h i2c-tiny-usb.c
i2c-amd8111.c    i2c-hix5hd2.c i2c-parport-light.c i2c-taos-evm.c
i2c-at91.c       i2c-hydra.c  i2c-pasemi.c   i2c-tegra.c
i2c-au1550.c     i2c-i801.c   i2c-pca-isa.c  i2c-uniphier.c
...              ...          ...            ...
```

Case study: AM335x I2C subsystem (2)

am33xx.dtsi

```
i2c0: i2c@44e0b000 {
    compatible = "ti,omap4-i2c";
    ...
};
i2c1: i2c@4802a000 {
    compatible = "ti,omap4-i2c";
    ...
};
i2c2: i2c@4819c000 {
    compatible = "ti,omap4-i2c";
    ...
};
```

am335x-evm.dts

```
&i2c1 {
    lis331dlh: lis331dlh@18 {
        compatible = "st,lis331dlh", "st,lis3lv02d";
        ...
    };
    tsl2550: tsl2550@39 {
        compatible = "taos,tsl2550";
        ...
    };
    tmp275: tmp275@48 {
        compatible = "ti,tmp275";
        ...
    };
    tlv320aic3106: tlv320aic3106@1b {
        compatible = "ti,tlv320aic3106";
        ...
    };
};
```


Case study: AM335x I2C subsystem adapter

am33xx.dtsi

```
i2c0: i2c@44e0b000 {  
    compatible = "ti,omap4-i2c";  
    ...  
};
```

Case study: AM335x I2C subsystem adapter

am33xx.dtsi

```
i2c0: i2c@44e0b000 {  
    compatible = "ti,omap4-i2c";  
    ...  
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*omap4-i2c"' {} \;
```

Case study: AM335x I2C subsystem adapter

am33xx.dtsi

```
i2c0: i2c@44e0b000 {  
    compatible = "ti,omap4-i2c";  
    ...  
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*omap4-i2c"' {} \;
```

```
./drivers/i2c/busses/i2c-omap.c:                .compatible = "ti,omap4-i2c",
```

Case study: AM335x I2C subsystem - tlv320aic3106 codec

am335x-evm.dts

```
&i2c1 {  
    tlv320aic3106: tlv320aic3106@1b {  
        compatible = "ti,tlv320aic3106";  
        ...  
    };  
};
```

Case study: AM335x I2C subsystem - tlv320aic3106 codec

am335x-evm.dts

```
&i2c1 {  
    tlv320aic3106: tlv320aic3106@1b {  
        compatible = "ti,tlv320aic3106";  
        ...  
    };  
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tlv320aic3106"' {} \;
```

Case study: AM335x I2C subsystem - tlv320aic3106 codec

am335x-evm.dts

```
&i2c1 {  
    tlv320aic3106: tlv320aic3106@1b {  
        compatible = "ti,tlv320aic3106";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tlv320aic3106"' {} \;
```

```
./sound/soc/codecs/tlv320aic3x.c:      { .compatible = "ti,tlv320aic3106" },
```

Case study: AM335x I2C subsystem - lis331dlh

am335x-evm.dts

```
&i2c1 {  
    lis331dlh: lis331dlh@18 {  
        compatible = "st,lis331dlh", "st,lis3lv02d";  
        ...  
    };  
};
```

Case study: AM335x I2C subsystem - lis331dlh

am335x-evm.dts

```
&i2c1 {  
    lis331dlh: lis331dlh@18 {  
        compatible = "st,lis331dlh", "st,lis3lv02d";  
        ...  
    };  
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*lis3\((31dlh\|lv02d\)'"' {} \;
```


Case study: AM335x I2C subsystem - lis331dlh

am335x-evm.dts

```
&i2c1 {
    lis331dlh: lis331dlh@18 {
        compatible = "st,lis331dlh", "st,lis3lv02d";
        ...
    };
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=*lis3\(31dlh\|lv02d\)'"' {} \;
```

```
./drivers/misc/lis3lv02d/lis3lv02d_i2c.c: { .compatible = "st,lis3lv02d" },
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

```
<found nothing> ???
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

```
<found nothing> ???
```

```
$ find . -name '*.c' -exec grep -nH '"tsl2550"' {} \;
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

```
<found nothing> ???
```

```
$ find . -name '*.c' -exec grep -nH '"tsl2550"' {} \;
```

```
drivers/misc/tsl2550.c:27:#define TSL2550_DRV_NAME      "tsl2550"  
drivers/misc/tsl2550.c:441:    { "tsl2550", 0 },
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

```
<found nothing> ???
```

```
$ find . -name '*.c' -exec grep -nH '"tsl2550"' {} \;
```

```
drivers/misc/tsl2550.c:27:#define TSL2550_DRV_NAME      "tsl2550"  
drivers/misc/tsl2550.c:441:    { "tsl2550", 0 },
```

```
$ grep -nC5 '"tsl2550"' drivers/misc/tsl2550.c
```

Case study: AM335x I2C subsystem - tsl2550

am335x-evm.dts

```
&i2c1 {  
    tsl2550: tsl2550@39 {  
        compatible = "taos,tsl2550";  
        ...  
    };  
};
```

```
$ find . -name '*.c' -exec grep -H '\.compatible.*=.*tsl2550"' {} \;
```

```
<found nothing> ???
```

```
$ find . -name '*.c' -exec grep -nH '"tsl2550"' {} \;
```

```
drivers/misc/tsl2550.c:27:#define TSL2550_DRV_NAME      "tsl2550"  
drivers/misc/tsl2550.c:441:    { "tsl2550", 0 },
```

```
$ grep -nC5 '"tsl2550"' drivers/misc/tsl2550.c
```

```
...  
440 static const struct i2c_device_id tsl2550_id[] = {  
441     { "tsl2550", 0 },  
442     { }  
443 };  
444 MODULE_DEVICE_TABLE(i2c, tsl2550_id);
```


Summary

- The link between device and driver: *compatible*
- Search in kernel source code for the compatible string, which is defined in the device node and DTS file.

For more information

- Processor SDK Training Series:
<http://training.ti.com/processor-sdk-training-series>
- Debugging Embedded Linux Training Series:
<http://training.ti.com/debug-embedded-linux-training-series>
- Processor SDK Linux Getting Started Guide:
http://processors.wiki.ti.com/index.php/Processor_SDK_Linux_Getting_Started_Guide
- Download Processor SDK Linux for Embedded Processors:
<http://www.ti.com/processorsdk>
- For questions about this training, refer to the E2E Embedded Linux Community Forum: <http://e2e.ti.com/support/embedded/linux/f/354>



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