

FreeBSD 11 on Allwinner ARM Boards

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Summary

- ▶ ARM/SoC/SBC
- ▶ DTS/DTB
- ▶ Early support
- ▶ The last six month

Warning

- ▶ I am mostly a kernel noob
- ▶ I am an ARM noob

What is an SoC ?

- ▶ ARM does not manufacture processor
- ▶ SoC (System-On-Chip) companies buys IP from ARM
- ▶ Sometimes they also buy IP from other companies
- ▶ An SoC integrates a processor and peripherals



Single Board Computer

- ▶ SBC = Single Board Computer
- ▶ Generally from another company than the SoC one
- ▶ Integrates SoC and other chips (PMU, PHY etc ...)
- ▶ Also adds GPIOs, SD/MMC, ethernet connectors etc ...



FreeBSD

Allwinner

- ▶ Chinese SoC manufacturer
- ▶ Target cheap tablet and set-top box (VR headset too recently)
- ▶ Popular in SBC
- ▶ Documentation isn't that great



The Linux side

- ▶ Linux and Android SDK available from Allwinner
- ▶ Community kernel named linux-sunxi
- ▶ Mainline linux started support



The boot process

- ▶ Boot Rom load U-Boot SPL from SD/eMMC
- ▶ U-Boot SPL load main U-Boot binary
- ▶ U-Boot load ubldr from fat partition
- ▶ ubldr load DTB and kernel



DTS/DTB

- ▶ Data structure describing hardware
- ▶ Describe peripheral on SoC and devices on the board
- ▶ Either provided by manufacturer or the community
- ▶ Allwinner SDK uses FEL, not DTS



SoC DTS Example

```
#include "skeleton.dtsi"
...
/ {
...
    cpus {
        #address-cells = <1>;
        #size-cells = <0>;

        cpu0: cpu@0 {
            compatible = "arm,cortex-a7";
            device_type = "cpu";
...
        };
    };
...
    soc@01c00000 {
        compatible = "simple-bus";
        #address-cells = <1>;
        #size-cells = <1>;
        ranges;

        emac: ethernet@01c0b000 {
            compatible = "allwinner,sun4i-a10-emac";
            reg = <0x01c0b000 0x1000>;
            interrupts = <GIC_SPI 55 IRQ_TYPE_LEVEL_HIGH>;
            clocks = <&ahb_gates 17>;
            allwinner,sram = <&emac_sram 1>;
            status = "disabled";
...
        };
    };
};
```



Board DTS Example

```
/dts-v1/;
#include "sun7i-a20.dtsi"
#include "sunxi-common-regulators.dtsi"
...
/ {
    model = "Olimex A20-Olimex-SOM-EVB";
    compatible = "olimex,a20-olimex-som-evb", "allwinner,sun7i-a20";
    ...
};
&ahci {
    target-supply = <&reg_ahci_5v>;
    status = "okay";
};
...
&i2c0 {
    pinctrl-names = "default";
    pinctrl-0 = <&i2c0_pins_a>;
    status = "okay";

    axp209: pmic@34 {
        reg = <0x34>;
        interrupt-parent = <&nmi_intc>;
        interrupts = <0 IRQ_TYPE_LEVEL_LOW>;
    };
};
```



Support in FreeBSD 2013

- ▶ Work done by *ganbold@*
- ▶ A10 support added in January
- ▶ A20 support added in August
- ▶ Timer, UART
- ▶ Basic GPIO, watchdog and USB (ehci)
- ▶ Use custom DTS
- ▶ Cubieboard and Cubieboard2 SBC

Support in FreeBSD 2014

- ▶ Work done by *ganbold@* (again, thanks)
- ▶ EMAC (Fast Ethernet) support
- ▶ SMP enabled on A20



Support in FreeBSD 2015

- ▶ SD/MMC support by *Alexander Fedorov* and *pratiksinghal@*
- ▶ AHCI (SATA) support by *imp@*
- ▶ GMAC (Gigabit Ethernet) support by *loos@*



The Road to Generic ALLWINNER kernel and new SoCs

- ▶ Move to PLATFORM code
- ▶ Add pinctrl support
- ▶ Switch to Upstream DTS



Switching to Upstream DTS - Clocks

sys/boot/fdt/dts/arm/sun7i-a20.dtsi :

```
/ {  
  ...  
    SOC: a20 {  
      ...  
        ccm@01c20000 {  
          compatible = "allwinner,sun4i-ccm";  
          #address-cells = <1>;  
          #size-cells = <1>;  
          reg = < 0x01c20000 0x400 >;  
        };  
      ....  
    };  
};
```

- ▶ No *clocks* property on nodes

Switching to Upstream DTS - Clocks

Clocks in upstream DTS

```
{
    clocks {
        #address-cells = <1>;
        #size-cells = <1>;
        ranges;
        ...

        osc32k: clk@0 {
            #clock-cells = <0>;
            compatible = "fixed-clock";
            clock-frequency = <32768>;
            clock-output-names = "osc32k";
        };

        pll1: clk@01c20000 {
            #clock-cells = <0>;
            compatible = "allwinner,sun4i-a10-pll1-clk";
            reg = <0x01c20000 0x4>;
            clocks = <&osc24M>;
            clock-output-names = "pll1";
        };

        ...
    };
};
```



Switching to Upstream DTS - Clocks

- ▶ *mmel@* added clk,hwreset and regulator API
- ▶ *jmcneill@* added support for Allwinner clocks
- ▶ Now adding new Allwinner SoCs is just a matter of supporting the clocks

PMU and cpufreq

- ▶ Support for AXP209 and AXP813
- ▶ Most board correctly shutdown
- ▶ Generic cpufreq-dt was added by jmcneill@ (OP V1)

New SoCs added

- ▶ A31/A31s
- ▶ H3
- ▶ A83T
- ▶ A13 (-stable)
- ▶ A64 (should be easy to MFC)

New peripheral added

- ▶ I2C
- ▶ RTC
- ▶ HDMI
- ▶ Audio (analog and HDMI)
- ▶ A83T/H3/A64 Gigabit Ethernet
- ▶ Thermal Sensors (for most SoCs)
- ▶ OHCI
- ▶ ...

<https://wiki.freebsd.org/FreeBSD/arm/Allwinner>

Questions ?
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