embear

SOFTWARE MADE IN BERN

From Hardware to Linux

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When does the bringup start?

1. When the hardware arrives
2. During component evaluation
3. After the schematic is done

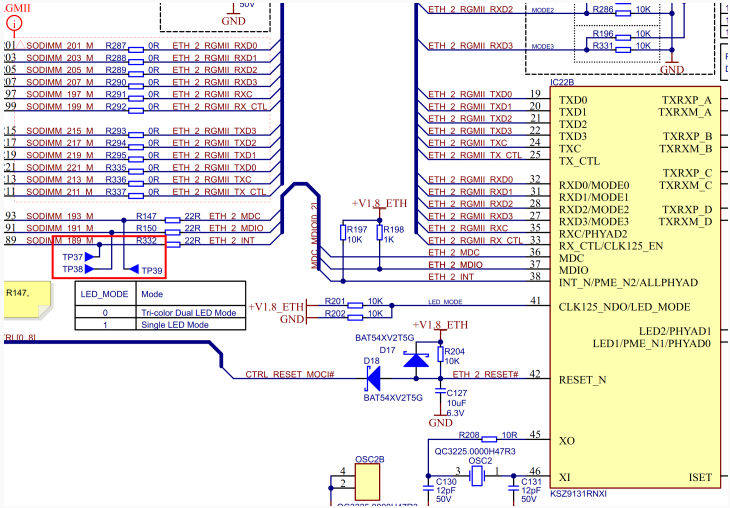
Image generated by ChatGPT 4o

Preparation

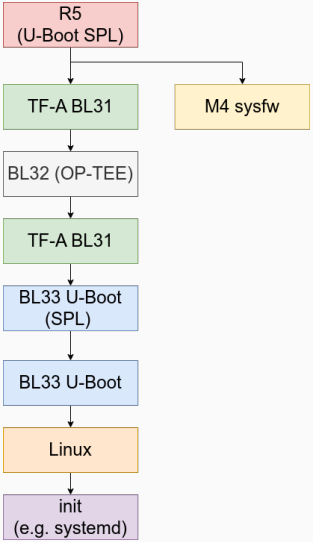
- Think about initial software load
- Do schematic review with HW team
- Write device trees
- Check the DRAM configuration
- Create an initial rootfs
- Create a CI/CD pipeline
- Refresh 1 week before HW arrives

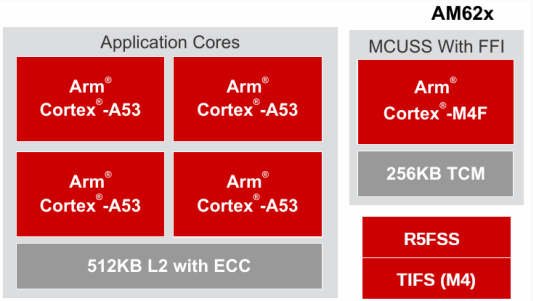
Image generated by ChatGPT 4o

Preparation



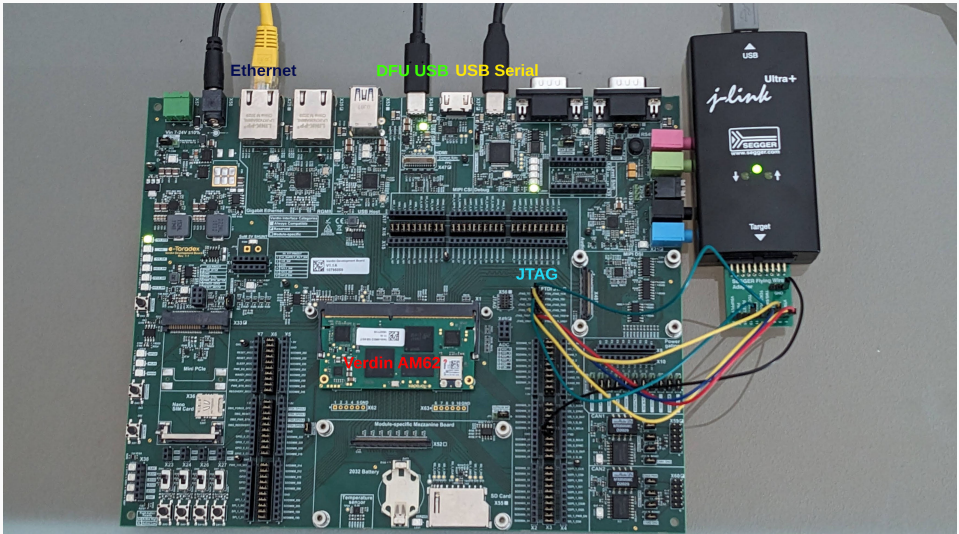
AM62 Boot Flow





TI AM62x Technical Reference Manual SPRUIV7B

Hardware Setup



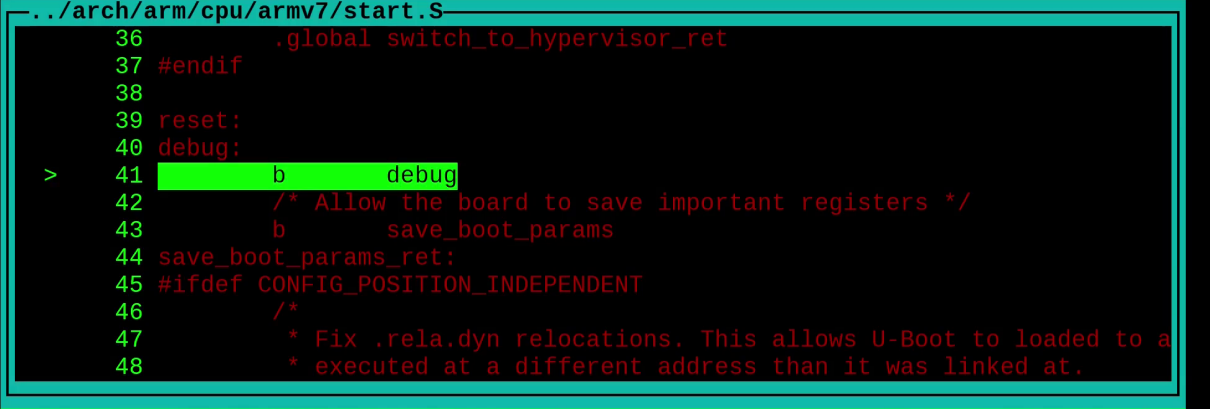
Resources

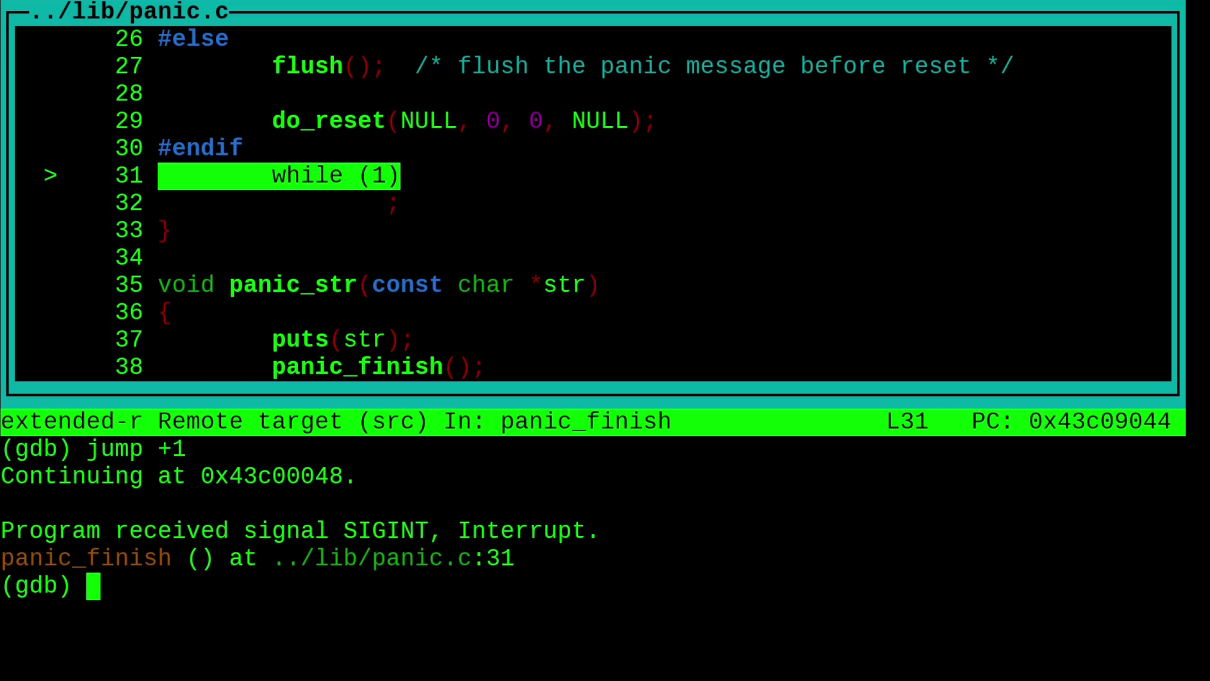
- Everything for the initial software load
- Serial port
- Power Supply
- Reference Manuals for the components
- Schematic of the board
- HW Layout of the board
- JTAG probe
- Multimeter
- Oscilloscope

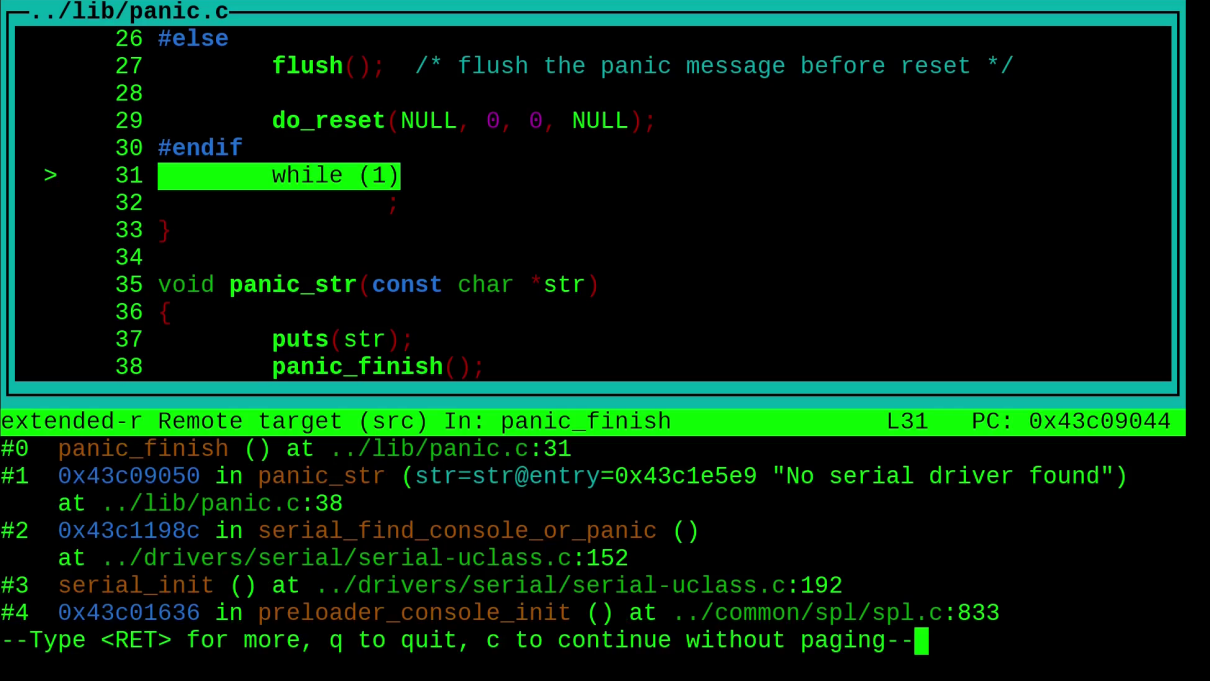
Image generated by ChatGPT 4o

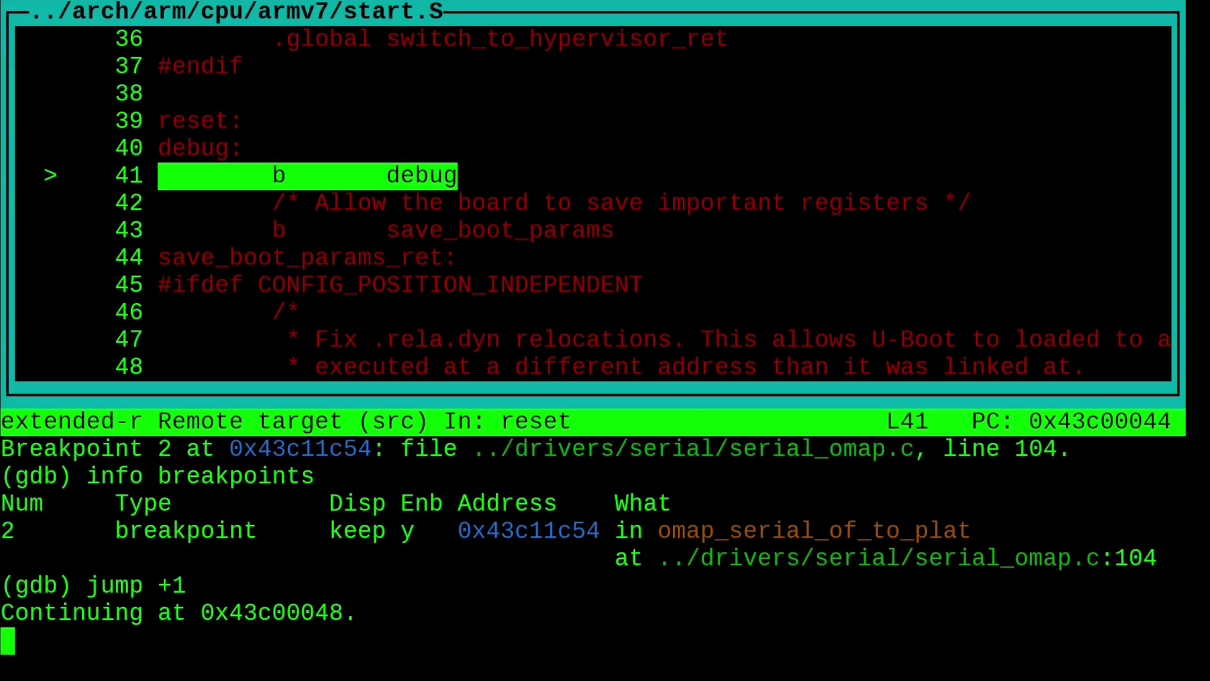
```
Load tiboot3
dfu-util 0.11

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2021 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to http://sourceforge.net/p/dfu-util/tickets/

dfu-util: Warning: Invalid DFU suffix signature
dfu-util: A valid DFU suffix will be required in a future dfu-util release
Opening DFU capable USB device...
Device ID 0451:6165
Device DFU version 0110
Claiming USB DFU Interface...
Setting Alternate Interface #0 ...
Determining device status...
DFU state(2) = dfuIDLE, status(0) = No error condition is present
DFU mode device DFU version 0110
Device returned transfer size 512
Copying data from PC to DFU device
Download        [=========================] 100%       303222 bytes
Download done.
DFU state(6) = dfuMANIFEST-SYNC, status(0) = No error condition is present
```

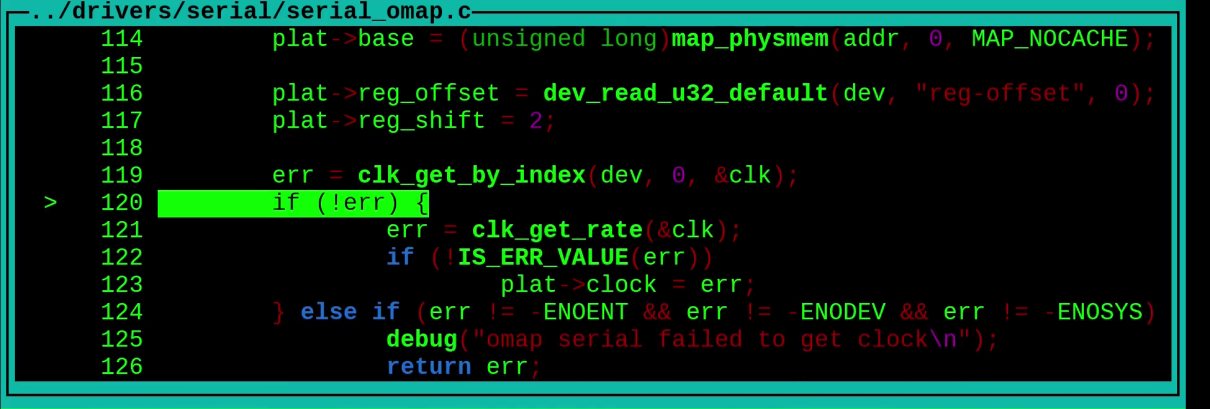
```
Welcome to minicom 2.9

OPTIONS: I18n
Port /dev/ttyUSB5, 16:00:21

Press CTRL-A Z for help on special keys
```


../arch/arm/cpu/armv7/start.S
36 .global switch_to_hypervisor_ret
37 #endif
38
39 reset:
40 debug:
> 41 b debug
42 /* Allow the board to save important registers */
43 b save_boot_params
44 save_boot_params_ret:
45 #ifdef CONFIG_POSITION_INDEPENDENT
46 /*
47 * Fix .rela.dyn relocations. This allows U-Boot to loaded to a
48 * executed at a different address than it was linked at.
extended-r Remote target (src) In: reset L41 PC: 0x43c00044
(gdb) jump +1
Continuing at 0x43c00048.


../lib/panic.c
26 #else
27 flush(); /* flush the panic message before reset */
28
29 do_reset(NULL, 0, 0, NULL);
30 #endif
> 31 while (1)
32 ;
33 }
34
35 void panic_str(const char *str)
36 {
37 puts(str);
38 panic_finish();
extended-r Remote target (src) In: panic_finish L31 PC: 0x43c09044
(gdb) jump +1
Continuing at 0x43c00048.
Program received signal SIGINT, Interrupt.
panic_finish () at ../lib/panic.c:31
(gdb)


../lib/panic.c
26 #else
27 flush(); /* flush the panic message before reset */
28
29 do_reset(NULL, 0, 0, NULL);
30 #endif
> 31 while (1)
32 ;
33 }
34
35 void panic_str(const char *str)
36 {
37 puts(str);
38 panic_finish();
extended-r Remote target (src) In: panic_finish L31 PC: 0x43c09044
#0 panic_finish () at ../lib/panic.c:31
#1 0x43c09050 in panic_str (str=str@entry=0x43c1e5e9 "No serial driver found")
at ../lib/panic.c:38
#2 0x43c1198c in serial_find_console_or_panic ()
at ../drivers/serial/serial-uclass.c:152
#3 serial_init () at ../drivers/serial/serial-uclass.c:192
#4 0x43c01636 in preloader_console_init () at ../common/spl/spl.c:833
--Type <RET> for more, q to quit, c to continue without paging--


../arch/arm/cpu/armv7/start.S
36 .global switch_to_hypervisor_ret
37 #endif
38
39 reset:
40 debug:
> 41 b debug
42 /* Allow the board to save important registers */
43 b save_boot_params
44 save_boot_params_ret:
45 #ifdef CONFIG_POSITION_INDEPENDENT
46 /*
47 * Fix .rela.dyn relocations. This allows U-Boot to loaded to a
48 * executed at a different address than it was linked at.
extended-r Remote target (src) In: reset L41 PC: 0x43c00044
Breakpoint 2 at 0x43c11c54: file ../drivers/serial/serial_omap.c, line 104.
(gdb) info breakpoints
Num Type Disp Enb Address What
2 breakpoint keep y 0x43c11c54 in omap_serial_of_to_plat
at ../drivers/serial/serial_omap.c:104
(gdb) jump +1
Continuing at 0x43c00048.


../drivers/serial/serial_omap.c
114 plat->base = (unsigned long)map_physmem(addr, 0, MAP_NOCACHE);
115
116 plat->reg_offset = dev_read_u32_default(dev, "reg-offset", 0);
117 plat->reg_shift = 2;
118
119 err = clk_get_by_index(dev, 0, &clk);
> 120 if (!err) {
121 err = clk_get_rate(&clk);
122 if (!IS_ERR_VALUE(err))
123 plat->clock = err;
124 } else if (err != -ENOENT && err != -ENODEV && err != -ENOSYS)
125 debug("omap serial failed to get clock\n");
126 return err;
extended-r Remote target (src) In: omap_serial_of_to_plat L120 PC: 0x43c11c8e
(gdb) p addr
$1 = 41943040
(gdb) n
(gdb) n
(gdb) n
(gdb) p err
$2 = -19
(gdb)

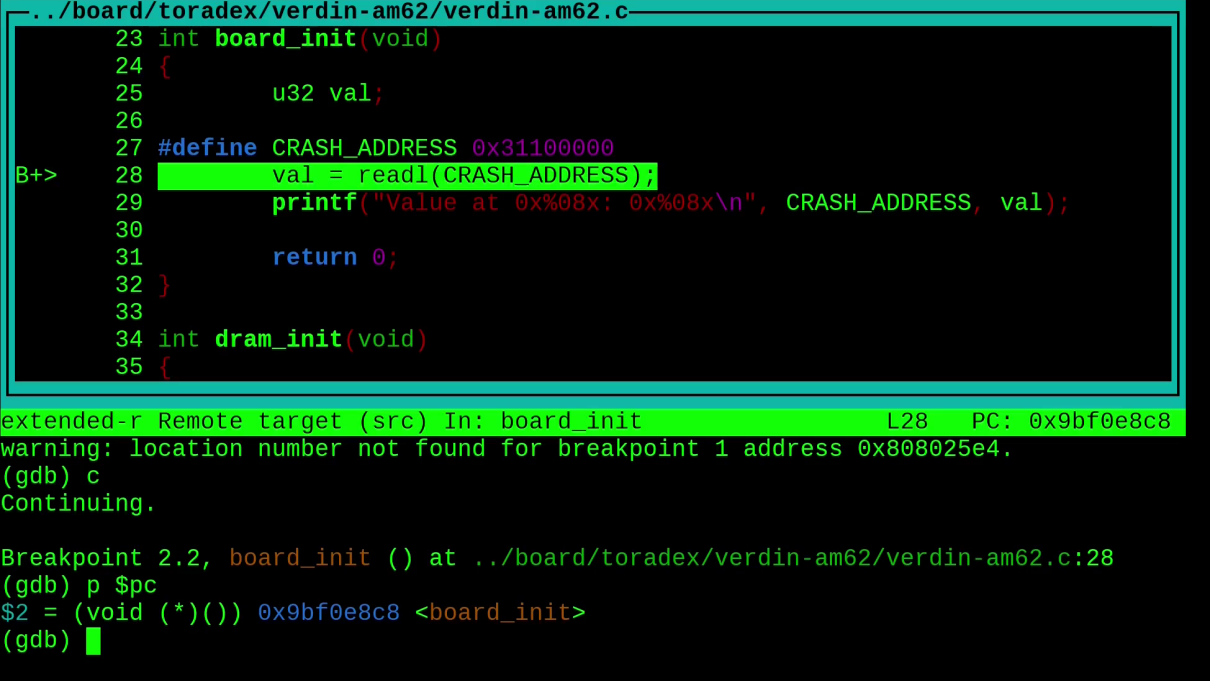
Bootloader Debugging

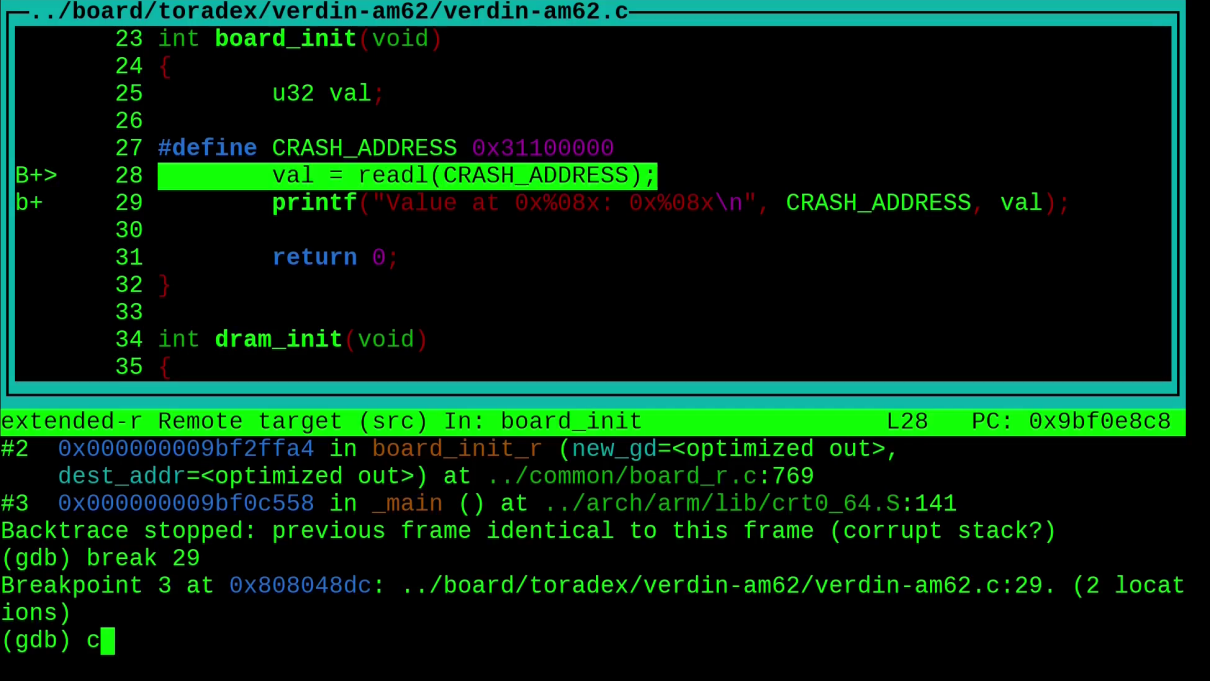
Fix R5 SPL Device tree

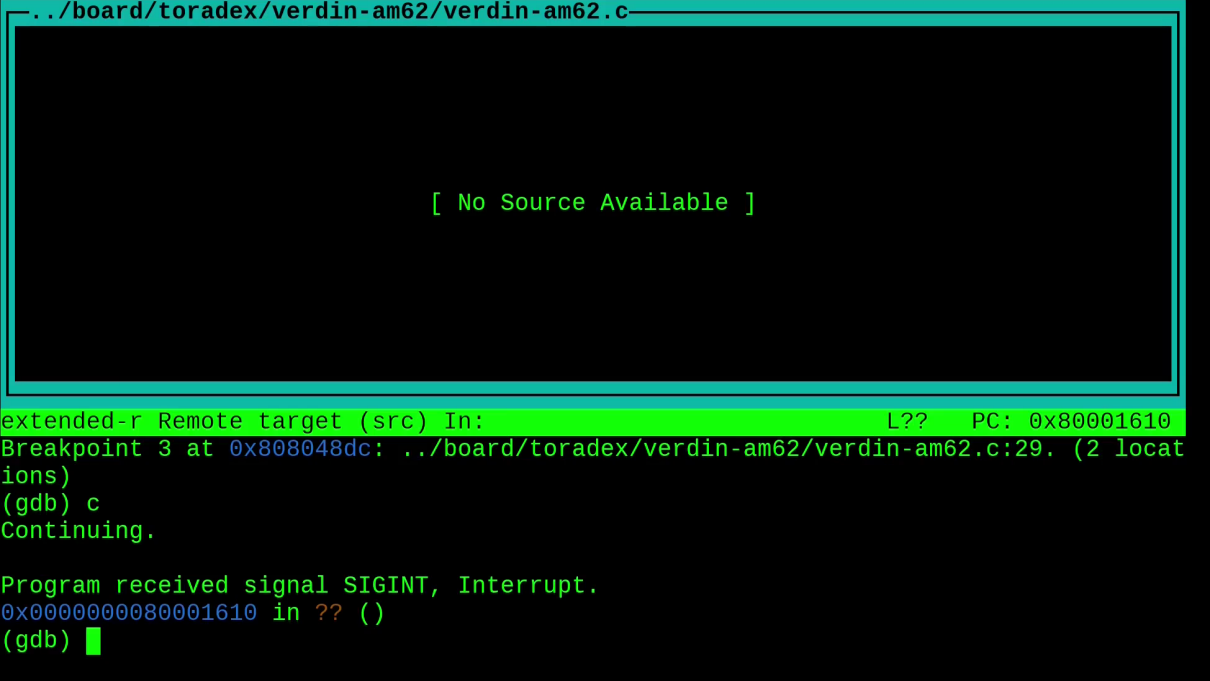
```
--- b/arch/arm/dts/k3-am625-verdin-r5.dts
+++ a/arch/arm/dts/k3-am625-verdin-r5.dts
     /* We require this for boot handshake */
     status = "okay";
 };
-
-&k3_clks {
-     status = "disabled";
-};
```

```
I/TC: SYSFW ABI: 3.1 (firmware rev 0x000a '10.0.4--v10.00.04 (Fie17:25:24 [80/2187]
I/TC: HUK Initialized
I/TC: Primary CPU switching to normal world boot
INFO:    BL31: Preparing for EL3 exit to normal world
INFO:    Entry point address = 0x80080000
INFO:    SPSR = 0x3c9

U-Boot SPL 2024.07-00691-ge497b84f81ac (Jul 29 2024 - 17:23:25 +0200)
SYSFW ABI: 3.1 (firmware rev 0x000a '10.0.4--v10.00.04 (Fiery Fox)')
SPL initial stack usage: 1904 bytes
Trying to boot from DFU
################################################DOWNLOAD ... OK
Ctrl+C to exit ...
Authentication passed
Authentication passed


U-Boot 2024.07-00691-ge497b84f81ac (Jul 29 2024 - 17:23:25 +0200)

SoC:   AM62X SR1.0 HS-FS
DRAM:  1 GiB
Unhandled Exception in EL3.
x30            = 0x0000000080001308
x0             = 0x000000009bf0e800
```

```
../arch/arm/lib/relocate_64.S
       18  *
       19  * This function relocates the monitor code.
       20  * x0 holds the destination address.
       21  */
       22 ENTRY(relocate_code)
B+>    23         stp     x29, x30, [sp, #-32]!   /* create a stack frame */
       24         mov     x29, sp
       25         str     x0, [sp, #16]
       26         /*
       27          * Copy u-boot from flash to RAM
       28          */
       29         adrp    x1, __image_copy_start          /* x1 <- address bits [
       30         add     x1, x1, :lo12:__image_copy_start/* x1 <- address bits [
extended-r Remote target (src) In: relocate_code                L23   PC: 0x808025e4
Breakpoint 1 at 0x808025e4: file ../arch/arm/lib/relocate_64.S, line 23.
(gdb) jump +1
Continuing at 0x8080002c.

Breakpoint 1, relocate_code () at ../arch/arm/lib/relocate_64.S:23
(gdb) p/x gd->relocaddr
$1 = 0x9bf0a000
(gdb) add-symbol-file a53/u-boot 0x9bf0a000
```


../board/toradex/verdin-am62/verdin-am62.c
23 int board_init(void)
24 {
25 u32 val;
26
27 #define CRASH_ADDRESS 0x31100000
B+> 28 val = readl(CRASH_ADDRESS);
29 printf("Value at 0x%08x: 0x%08x\n", CRASH_ADDRESS, val);
30
31 return 0;
32 }
33
34 int dram_init(void)
35 {
extended-r Remote target (src) In: board_init L28 PC: 0x9bf0e8c8
warning: location number not found for breakpoint 1 address 0x808025e4.
(gdb) c
Continuing.
Breakpoint 2.2, board_init () at ../board/toradex/verdin-am62/verdin-am62.c:28
(gdb) p $pc
$2 = (void (*)()) 0x9bf0e8c8 <board_init>
(gdb)


../board/toradex/verdin-am62/verdin-am62.c
23 int board_init(void)
24 {
25 u32 val;
26
27 #define CRASH_ADDRESS 0x31100000
B+> 28 val = readl(CRASH_ADDRESS);
b+ 29 printf("Value at 0x%08x: 0x%08x\n", CRASH_ADDRESS, val);
30
31 return 0;
32 }
33
34 int dram_init(void)
35 {
extended-r Remote target (src) In: board_init L28 PC: 0x9bf0e8c8
#2 0x000000009bf2ffa4 in board_init_r (new_gd=<optimized out>,
dest_addr=<optimized out>) at ../common/board_r.c:769
#3 0x000000009bf0c558 in _main () at ../arch/arm/lib/crt0_64.S:141
Backtrace stopped: previous frame identical to this frame (corrupt stack?)
(gdb) break 29
Breakpoint 3 at 0x808048dc: ../board/toradex/verdin-am62/verdin-am62.c:29. (2 locat
ions)
(gdb) c


../board/toradex/verdin-am62/verdin-am62.c
[No Source Available]
extended-r Remote target (src) In: L?? PC: 0x80001610
Breakpoint 3 at 0x808048dc: ../board/toradex/verdin-am62/verdin-am62.c:29. (2 locat
ions)
(gdb) c
Continuing.
Program received signal SIGINT, Interrupt.
0x0000000080001610 in ?? ()
(gdb)

Bootloader Debugging

Enable USB power domain

```
--- a/board/toradex/verdin-am62/verdin-am62.c
+++ b/board/toradex/verdin-am62/verdin-am62.c
 #define CRASH_ADDRESS 0x31100000
+   puts("Get USB device\n");
+   usbss_node = ofnode_path("/bus@f0000/dwc3-usb@f910000");
+   device_find_global_by_ofnode(usbss_node, &usbss_dev);
+   puts("Get power domain controller and turn it on\n");
+   power_domain_get_by_index(usbss_dev, pd, 0);
+   power_domain_on(pd);
+
    val = readl(CRASH_ADDRESS);
    printf("Value at 0x%08x: 0x%08x\n", CRASH_ADDRESS, val);
```

```
INFO:    Entry point address = 0x80080000                    17:19:31 [15/1972]
INFO:    SPSR = 0x3c9

U-Boot SPL 2024.07-00695-gc0d6521d0692 (Jul 29 2024 - 17:14:57 +0200)
SYSFW ABI: 3.1 (firmware rev 0x000a '10.0.4--v10.00.04 (Fiery Fox)')
SPL initial stack usage: 1904 bytes
Trying to boot from DFU
################################################DOWNLOAD ... OK
Ctrl+C to exit ...
Authentication passed
Authentication passed


U-Boot 2024.07-00695-gc0d6521d0692 (Jul 29 2024 - 17:14:57 +0200)

SoC:   AM62X SR1.0 HS-FS
DRAM:  1 GiB
Get USB device
Get power domain controller and turn it on
Value at 0x31100000: 0x01100020
Core:  148 devices, 31 uclasses, devicetree: separate
MMC:   mmc@fa10000: 0, mmc@fa00000: 1
Loading Environment from MMC... Reading from MMC(0)... OK
In:    serial@2800000
```

Bootloader Debugging

PHY Debugging

```
Verdin AM62 # md.l 0x31100000 1
31100000: 01100020                    ...
Verdin AM62 # mdio list
mdio@f00:
5 - TI DP83867 <--> ethernet@8000000port@1
7 - Micrel ksz9131 <--> ethernet@8000000port@2
Verdin AM62 # mii read 5 2
FFFF
# TI PHY-ID = 0x2000
Verdin AM62 # mii read 0 2
2000
```

Bootloader Debugging

Fix PHY Address

```
--- a/arch/arm/dts/k3-am625-verdin-wifi-dev-u-boot.dtsi
+++ b/arch/arm/dts/k3-am625-verdin-wifi-dev-u-boot.dtsi
&cpsw3g_phy0 {
-   reg = <5>;
+   reg = <0>;
};
```

Flash U-Boot

U-Boot Commands

```
setenv ipaddr 192.168.1.1; setenv serverip 192.168.1.254

mmc partconf 0 1 1 1; mmc bootbus 0 2 0 0
mmc dev 0 1

tftp ${loadaddr} verdin-am62/tiboot3.bin
mmc write ${loadaddr} 0x0 0x400
tftp ${loadaddr} verdin-am62/tispl.bin
mmc write ${loadaddr} 0x400 0x1000
tftp ${loadaddr} verdin-am62/u-boot.img
mmc write ${loadaddr} 0x1400 0x2000
```

Useful U-Boot Commands

Check register values

```
help
# Dump/Modify memory/registers
md [.b, .w, .l, .q] address [# of objects]
mw [.b, .w, .l, .q] address value [count]
# Access Ethernet PHYs
mii info / mii dump / mii read / mii write
# Access MMC devices
mmc info / mmc dev / mmc part / mmc read / mmc write
```

Useful U-Boot Commands

Check U-Boot Status/Load Images

```
# Check e.g. relocation address / device tree address
bdinfo
# Print/Modify U-Boot/Linux device tree
fdt addr / fdt print / fdt list
# Print information about U-Boot drivers
dm tree/ dm list
# Load files
tftpboot / load / ls
# Boot to image
bootm / bootz /booti
```

Boot to Linux

Boot Command

```
setenv fdt_addr_r 0x80000000; \
setenv bootargs \
'root=/dev/ram waitroot console=ttyS2,115200n8'; \
setenv ipaddr 192.168.1.1; setenv serverip 192.168.1.254; \
tftp $kernel_addr_r verdin-am62/Image.gz; \
tftp $fdt_addr_r verdin-am62/k3-am625-verdin-wifi-dev.dtb; \
tftp $ramdisk_addr_r verdin-am62/ramdisk.u-boot; \
booti $kernel_addr_r $ramdisk_addr_r $fdt_addr_r
```

Boot to Linux

Consider earlycon

```
setenv fdt_addr_r 0x80000000; \
setenv bootargs \
'root=/dev/ram waitroot console=ttyS2,115200n8
↪   earlycon=ns16550a,mmio32,0x02800000'; \
setenv ipaddr 192.168.1.1; setenv serverip 192.168.1.254; \
tftp $kernel_addr_r verdin-am62/Image.gz; \
tftp $fdt_addr_r verdin-am62/k3-am625-verdin-wifi-dev.dtb; \
tftp $ramdisk_addr_r verdin-am62/ramdisk.u-boot; \
booti $kernel_addr_r $ramdisk_addr_r $fdt_addr_r
```

```
[    0.000000] OF: reserved mem: 0x0000000080000000..0x000000008007ffff (51[0/2640]
[    0.000000] Reserved memory: created DMA memory pool at 0x000000009db00000, sizB
[    0.000000] OF: reserved mem: initialized node r5f-dma-memory@9db00000, compatil
[    0.000000] OF: reserved mem: 0x000000009db00000..0x000000009e6fffff (12288 KiB0
[    0.000000] OF: reserved mem: 0x000000009e800000..0x000000009fffffff (24576 KiB0
[    0.000000] NUMA: No NUMA configuration found
[    0.000000] NUMA: Faking a node at [mem 0x0000000080000000-0x00000000bfffffff]
[    0.000000] NUMA: NODE_DATA [mem 0xbfdcf9c0-0xbfdd1fff]
[    0.000000] Zone ranges:
[    0.000000]   DMA      [mem 0x0000000080000000-0x00000000bfffffff]
[    0.000000]   DMA32    empty
[    0.000000]   Normal   empty
[    0.000000] Movable zone start for each node
[    0.000000] Early memory node ranges
[    0.000000]   node   0: [mem 0x0000000080000000-0x000000008007ffff]
[    0.000000]   node   0: [mem 0x0000000080080000-0x000000009dafffff]
[    0.000000]   node   0: [mem 0x000000009db00000-0x000000009e6fffff]
[    0.000000]   node   0: [mem 0x000000009e700000-0x000000009e7fffff]
[    0.000000]   node   0: [mem 0x000000009e800000-0x000000009fffffff]
[    0.000000]   node   0: [mem 0x00000000a0000000-0x00000000bfffffff]
[    0.000000] Initmem setup node 0 [mem 0x0000000080000000-0x00000000bfffffff]
[    0.000000] cma: Reserved 32 MiB at 0x00000000bcc00000 on node -1
[    0.000000] psci: probing for conduit method from DT.
```

```
Starting kernel ...

[    0.000000] Booting Linux on physical CPU 0x0000000000 [0x410fd034]
[    0.000000] Linux version 6.9.10 (eichest@eichest-laptop) (aarch64-linux-gnu-gc4
[    0.000000] KASLR disabled due to lack of seed
[    0.000000] Machine model: Toradex Verdin AM62 WB on Verdin Development Board
[    0.000000] earlycon: ns16550a0 at MMIO32 0x0000000002800000 (options '')
[    0.000000] printk: legacy bootconsole [ns16550a0] enabled
[    0.000000] efi: UEFI not found.
[    0.000000] OF: reserved mem: 0x0000000080000000..0x000000008007ffff (512 KiB) 0
[    0.000000] Reserved memory: created DMA memory pool at 0x000000009db00000, sizB
[    0.000000] OF: reserved mem: initialized node r5f-dma-memory@9db00000, compatil
[    0.000000] OF: reserved mem: 0x000000009db00000..0x000000009e6fffff (12288 KiB0
[    0.000000] OF: reserved mem: 0x000000009e800000..0x000000009fffffff (24576 KiB0
[    0.000000] NUMA: No NUMA configuration found
[    0.000000] NUMA: Faking a node at [mem 0x0000000080000000-0x00000000bfffffff]
[    0.000000] NUMA: NODE_DATA [mem 0xbfdcf9c0-0xbfdd1fff]
[    0.000000] Zone ranges:
[    0.000000]   DMA      [mem 0x0000000080000000-0x00000000bfffffff]
[    0.000000]   DMA32    empty
[    0.000000]   Normal   empty
[    0.000000] Movable zone start for each node
[    0.000000] Early memory node ranges
```

Boot to Linux

Working Boot Command

```
setenv bootargs \
'root=/dev/ram waitroot console=ttyS2,115200n8
↪   earlycon=ns16550a,mmio32,0x02800000'; \
setenv ipaddr 192.168.1.1; setenv serverip 192.168.1.254; \
tftp $kernel_addr_r verdin-am62/Image.gz; \
tftp $fdt_addr_r verdin-am62/k3-am625-verdin-wifi-dev.dtb; \
tftp $ramdisk_addr_r verdin-am62/ramdisk.u-boot; \
booti $kernel_addr_r $ramdisk_addr_r $fdt_addr_r
```

Linux Driver Debugging

sysfs paths

```
# What we have
ls /sys/class/drm/
version
# What we expect
ls /sys/class/drm/
card0 card0-DSI-1 version
```

Linux Driver Debugging

kernel log

```
dmesg |grep mipi
[   2.232727] mipi-dsi 0-000e.0: Fixed dependency cylce(s) with
 ↪  /bus@f0000/i2c@20000000
[  12.687477] mipi-dsi 0-000e.0: deferred probe pending:
 ↪  (reason unknown)
```

Linux Driver Debugging

Which driver do we use?

```
&dsi_bridge {
  panel_mipi_w552946aba: panel@0 {
    compatible = "wanchanglong,w552946aba";
  };
};
```

drivers/gpu/drm/panel/panel-ilitek-ili9881c.c

```
static const struct of_device_id ili9881c_of_match[] = {
  { .compatible = "wanchanglong,w552946aba" }, { }
};
```

Linux Driver Debugging

Printk Debugging

```
--- a/drivers/gpu/drm/panel/panel-ilitek-ili9881c.c
+++ b/drivers/gpu/drm/panel/panel-ilitek-ili9881c.c
@@ -1281,6 +1281,9 @@ static int ili9881c_dsi_probe(struct
 ↪  mipi_dsi_device *dsi)
   struct ili9881c *ctx;
   int ret;
+  dump_stack();
+  pr_info("%s - %s:%d\n", __func__, __FILE__, __LINE__);
   ctx = devm_kzalloc(&dsi->dev, sizeof(*ctx), GFP_KERNEL);
   if (!ctx)
     return -ENOMEM;
+  pr_info("%s - %s:%d\n", __func__, __FILE__, __LINE__);
```

```
nted 6.9.10 #12
[   12.677338] Hardware name: Toradex Verdin AM62 WB on Verdin Development Board (
DT)
[   12.684930] Workqueue: events_unbound deferred_probe_work_func
[   12.690853] Call trace:
[   12.693320]  dump_backtrace+0x90/0xe8
[   12.697052]  show_stack+0x18/0x24
[   12.700425]  dump_stack_lvl+0x74/0x8c
[   12.704140]  dump_stack+0x18/0x24
[   12.707502]  ili9881c_dsi_probe+0x30/0x248
[   12.711637]  mipi_dsi_drv_probe+0x20/0x2c
[   12.715696]  really_probe+0xbc/0x29c
[   12.719318]  __driver_probe_device+0x78/0x12c
[   12.723720]  driver_probe_device+0xd8/0x15c
[   12.727951]  __device_attach_driver+0xb8/0x134
[   12.732442]  bus_for_each_drv+0x88/0xe8
[   12.736320]  __device_attach+0xa0/0x190
[   12.740201]  device_initial_probe+0x14/0x20
[   12.744431]  bus_probe_device+0xac/0xb0
[   12.748308]  deferred_probe_work_func+0x88/0xc0
[   12.752882]  process_one_work+0x148/0x29c
[   12.756950]  worker_thread+0x2fc/0x40c
[   12.760751]  kthread+0x110/0x114
standard input
```

Linux Driver Debugging

Where is my function?

```
./scripts/faddr2line vmlinux mipi_dsi_drv_probe+0x20/0x2c
mipi_dsi_drv_probe+0x20/0x2c:
mipi_dsi_drv_probe at drivers/gpu/drm/drm_mipi_dsi.c:1299
```

```
[
[   12.727951]  __device_attach_driver+0xb8/0x134
[   12.732442]  bus_for_each_drv+0x88/0xe8
[   12.736320]  __device_attach+0xa0/0x190
[   12.740201]  device_initial_probe+0x14/0x20
[   12.744431]  bus_probe_device+0xac/0xb0
[   12.748308]  deferred_probe_work_func+0x88/0xc0
[   12.752882]  process_one_work+0x148/0x29c
[   12.756950]  worker_thread+0x2fc/0x40c
[   12.760751]  kthread+0x110/0x114
[   12.764029]  ret_from_fork+0x10/0x20
[   12.767887] ili9881c_dsi_probe - drivers/gpu/drm/panel/panel-ilitek-ili9881c.c:
1285
[   12.776091] ili9881c_dsi_probe - drivers/gpu/drm/panel/panel-ilitek-ili9881c.c:
1302
[   12.783966] ili9881c_dsi_probe - drivers/gpu/drm/panel/panel-ilitek-ili9881c.c:
1309
[   12.791762] ili9881c_dsi_probe - drivers/gpu/drm/panel/panel-ilitek-ili9881c.c:
1317
[   12.809387] mipi-dsi 0-000e.0: deferred probe pending: (reason unknown)
[   12.816180] platform 2b300050.target-module: deferred probe pending: (reason un
known)
[   12.824120] platform 30200000.dss: deferred probe pending: (reason unknown)
:
```

```
    9
    8 ›       pr_info("%s - %s:%d\n", __func__, __FILE__, __LINE__);
    7 ›       ret = of_drm_get_panel_orientation(dsi->dev.of_node, &ctx->orientat#
    6 ›       if (ret) {
    5 ›       ›       dev_err(&dsi->dev, "%pOF: failed to get orientation: %d\n",
    4 ›       ›       ›       dsi->dev.of_node, ret);
    3 ›       ›       return ret;
    2 ›       }
    1
 1317 ›       pr_info("%s - %s:%d\n", __func__, __FILE__, __LINE__);
    1 ›       ctx->panel.prepare_prev_first = true;
    2
    3 ›       ret = drm_panel_of_backlight(&ctx->panel);
    4 ›       if (ret)
    5 ›       ›       return ret;
    6
    7 ›       pr_info("%s - %s:%d\n", __func__, __FILE__, __LINE__);
    8 ›       drm_panel_add(&ctx->panel);
    9
   10 ›       dsi->mode_flags = ctx->desc->mode_flags;
   11 ›       dsi->format = MIPI_DSI_FMT_RGB888;
   12 ›       dsi->lanes = 4;
```

Linux Driver Debugging

What backlight driver do we use?

```
/ {
  backlight_dsi_panel: backlight_dsi_panel {
    compatible = "pwm-backlight";
    pwms = <&epwm1 0 5000000 0>;
  };
};
&dsi_bridge {
  panel_mipi_w552946aba: panel@0 {
    compatible = "wanchanglong,w552946aba";
    backlight = <&backlight_dsi_panel>;
  };
};
```

Linux Driver Debugging

Is my driver enabled?

```
zcat /proc/config.gz |grep BACKLIGHT
CONFIG_BACKLIGHT_CLASS_DEVICE=y
CONFIG_BACKLIGHT_PWM=m
```

Linux Driver Debugging

It works!

```
ls /sys/class/drm/
card0 card0-DSI-1 version
cat /sys/class/drm/card0-DSI-1/status
connected
cat /sys/class/drm/card0-DSI-1/modes
720x1280
```

Useful Linux Filesystems

Sysfs

```
# sysfs - kernel subsystem information
/sys/
# Trigger actions
echo 1 > /sys/bus/pci/rescan
# Navigate in the device tree
/sys/firmware/devicetree/base/
# Decompile dtb if necessary
/sys/firmware/devicetree/fdt
```

Useful Linux Filesystems

Debugfs

```
# debugfs - kernel debug information
/sys/kernel/debug/
# Example clock tree
cat /sys/kernel/debug/clk/clk_summary
# Example pinctrl
cat /sys/kernel/debug/pinctrl/44e10800.pinmux/pins
```

Useful Linux Filesystems

Procfs

```
# procfs - process information
/proc
# Example memory mapping
cat /proc/iomem
000f4000-000f42ab : pinctrl-single
0f910000-0f9107ff : f910000.dwc3-usb dwc3-usb@f910000
0fa08000-0fa083ff : fa00000.mmc mmc@fa00000
```

Useful Linux Tools

Shell

```
# Access memory/registers
devmem2 <address> [type] [data]
# Access PHY registers
phytool <read/write> <interface>/<addr>[:page]/<reg> [value]
# Get/set ethernet interface settings
ethtool <interface>
# Check connectivity
ping <ip>
# Check display settings
modetest
```

Useful Linux Tools

Shell

```
# Test network
iperf3 <-c/-s> [ip]
# Test CPU performance
coremark2
# Stress CPU and memory
stress-ng
# Test RAM stability
memtester
```

Summary

- Get involved as early as possible
- Work with the HW team, not against them
- Be prepared when the HW arrives
- Perhaps some of the methods shown will help you

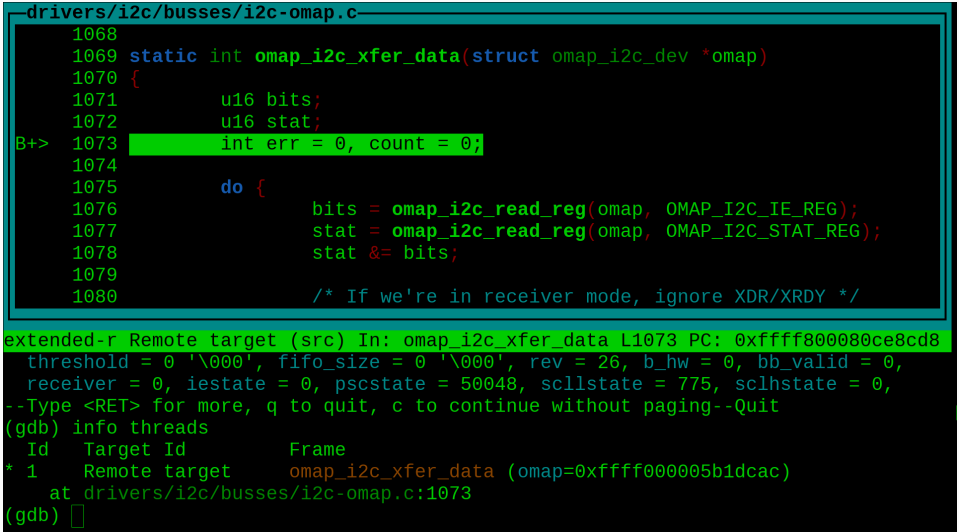
Image generated by ChatGPT 4o

Questions

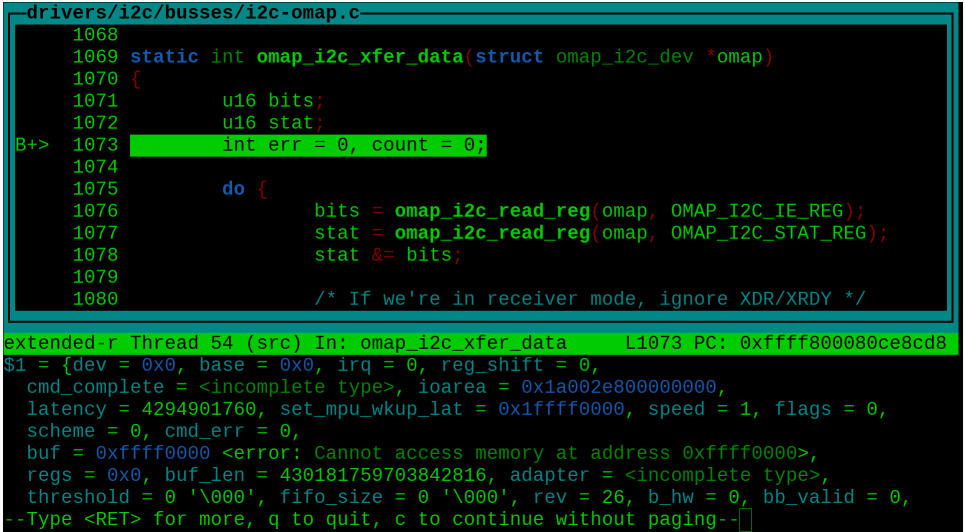
- Information: www.embear.ch
- Module: www.toradex.com

Image generated by ChatGPT 4o

Linux Debugging - JTAG



Linux Debugging - KGDB



Linux Debugging

Bootargs

```
setenv bootcmd 'setenv bootargs nokaslr rodata=off
 ↪  sysrq_always_enabled=1 kgdboc=ttyS3,115200 $bootags'
```

Questions

- Information: www.embear.ch
- Module: www.toradex.com

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