Refactoring backlight and spi helpers in drm/tinydrm

OUTREACHY INTERNSHIP REPORT

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Outline

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- Backlight
- SPI
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About Me

- Round 15 (Dec 2017-Feb 2018) Outreachy intern
- Mentored by Daniel Vetter, Sean Paul and Noralf Trønnes to contribute to the drm subsystem.

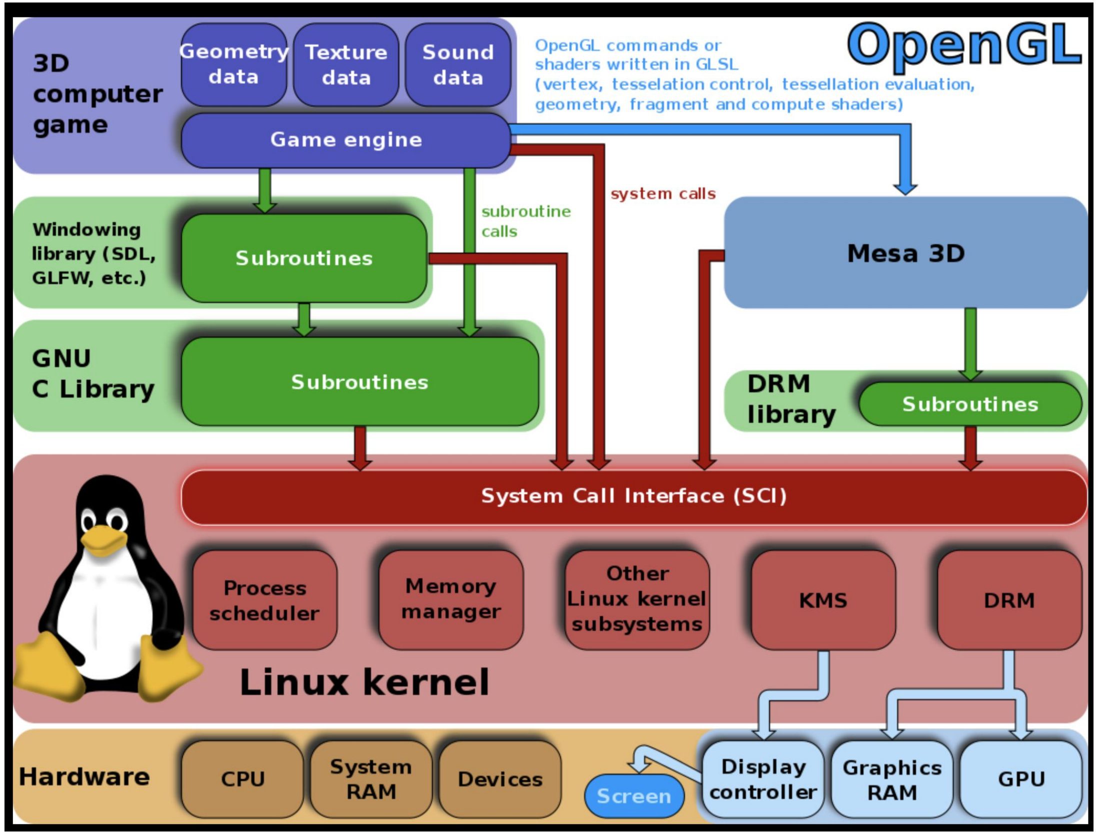
Project Goals

- Refactor Backlight and SPI helpers in drm/tinydrm
- Make the helpers less tinydrm specific and make them generic so that they can be used by other drivers

Introduction: DRM

- Direct Rendering Manager
- Subsystem of the linux kernel
- Exposes an API that user space programs can use to send commands and data to the GPU.
- Addresses limitation of fbdev: able to handle modern 3D accelerated GPU based video hardware

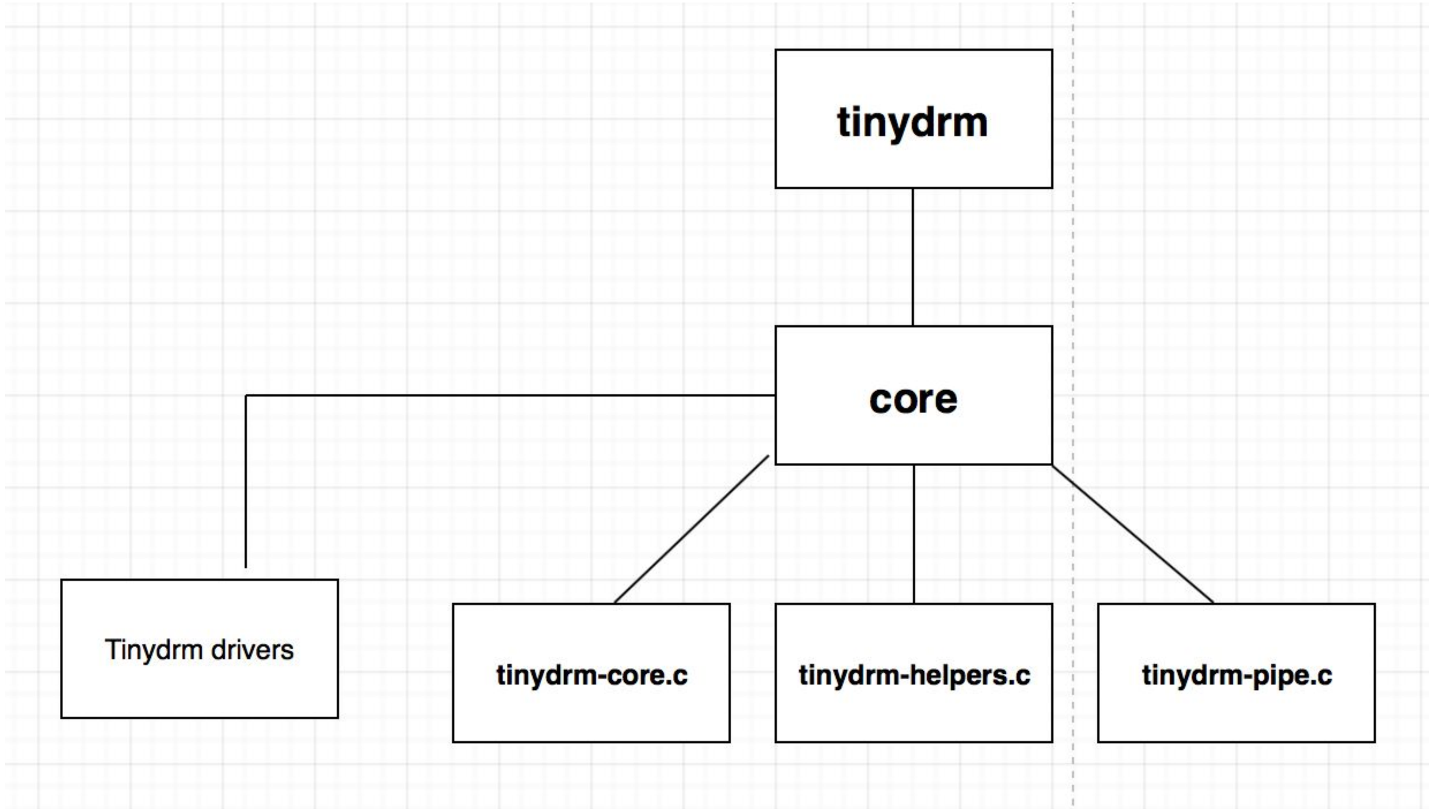
Introduction: DRM



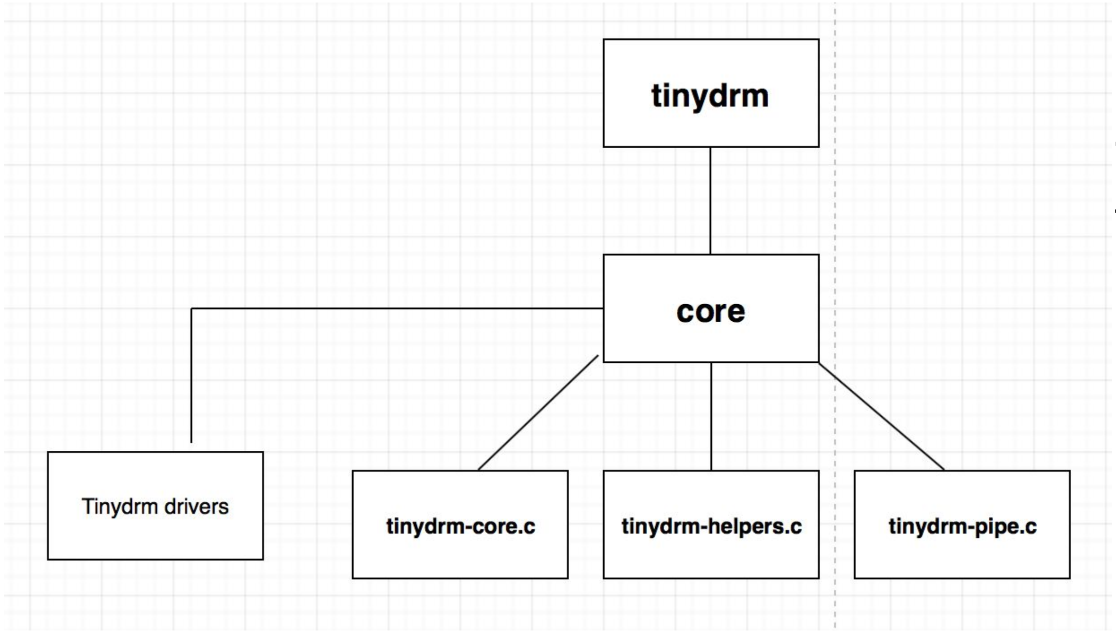
Introduction: Tinydrm

1. Driver helpers for very simple display hardware.
2. DRM drivers that are so small they can fit in a single source file.
3. helpers for MIPI Display Bus Interface (DBI) compatible display controllers
4. MIPI DBI implementation types:
   a. Motorola 6800 type parallel bus
   b. Intel 8080 type parallel bus
   c. SPI type with 3 options:

Introduction: Tinydrm



Introduction: Tinydrm



Task: Refactor and move helpers from tinydrm-helpers to general drm source code files so that they can be used by other drivers

Backlight

- Previously: Helpers present in tinydrm to find, enable and disable backlight
- The task: Backlight is used by other drivers in drm. Can we make the helpers general? Can we move them to video/backlight?
- During this process, I found that there was quite a bit of replicated code and different ways to enable and disable a backlight (different combinations of flags)
- Cleaned this up, made it more modular by encapsulating it into a backlight_enable and backlight_disable functions

Backlight

THEN

- tinydrm/helpers
  - Usage:

```
if (ddata->backlight) {
ddata->backlight->props.power =
FB_BLANK_UNBLANK;
backlight_update_status(ddata->backlight);
 }
```

(ENCAPSULATE THIS IN backlight_enable)

NOW

- video/backlight/backlight.c

Separate function for enabling and disabling backlight

- static inline int backlight_enable(struct backlight_device *bd)
- static inline int backlight_disable(struct backlight_device *bd)
- Usage: `backlight_enable(ddata->backlight);`

Backlight

THEN

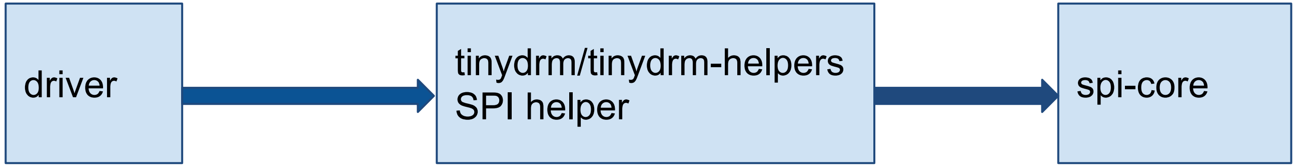
- tinydrm/helpers
  - struct backlight_device *tinydrm_of_find_backlight(struct device *dev)
  - **Usage:** mipi->backlight = tinydrm_of_find_backlight(dev);

NOW

- video/backlight/backlight.c
  - struct backlight_device *of_find_backlight(struct device *dev)
  - **Usage:** mipi->backlight = of_find_backlight(dev);

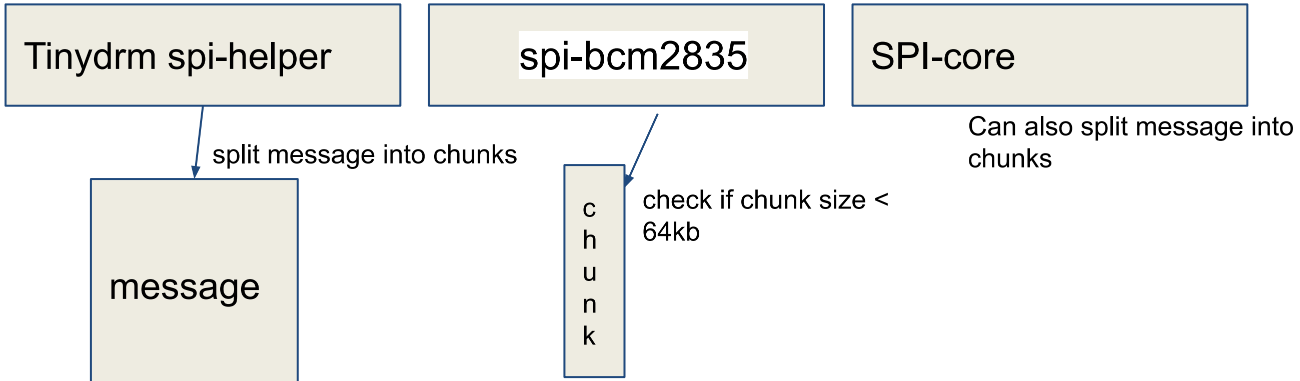
SPI

- SPI: Interface bus - send data between microcontrollers and small peripherals (eg. shift registers, sensors, and SD cards.
- In Tinydrm: Helpers for device drivers to communicate with spi.



SPI

- **Goal: as part of my overall goal of refactoring, remove redundant chunk splitting in tinydrm spi helpers.**
- Consider DMA transfers directly between the SPI hardware and a memory buffer
- The problem, we want to be able to send large >64kB buffers in one go to SPI.
- Tinydrm splits the buffer into max_dma_len chunks to spi-bcm2835 because drivers/spi/spi-bcm2835.c - has an upper bound check on dma transfer length (64KB) in bcm2835_spi_can_dma()
- Goal: 1) we want to remove splitting of buffer into small chunks in the tinydrm spi-helpers. This is because we want to leave it to the spi core to handle.


Tinydrm spi-helper
spi-bcm2835
SPI-core
split message into chunks
message
chunk
check if chunk size < 64kb
Can also split message into chunks

SPI

The solution

- Remove chunk splitting in tinydrm_spi_transfer in tinydrm-helpers and split the buffer in the driver (bcm2835)
- The spi core will split a buffer into max_dma_len chunks for the spi controller driver to handle.
- Remove the upper bound check on dma transfer length in bcm2835_spi_can_dma().

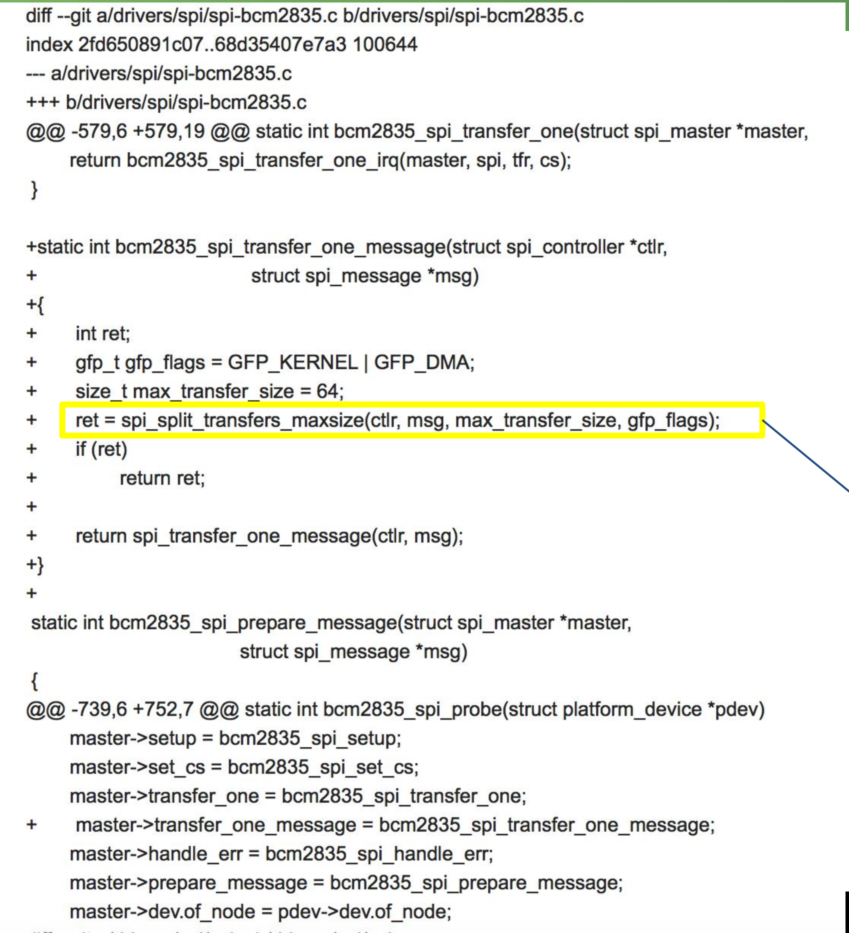
SPI

Remove the DMA length checking in spi-bcm2835.c

```
diff --git a/drivers/spi/spi-bcm2835.c b/drivers/spi/spi-bcm2835.c
index f35cc10772f6..0dcc45f158b8 100644
--- a/drivers/spi/spi-bcm2835.c
+++ b/drivers/spi/spi-bcm2835.c
@@ -365,19 +365,6 @@ static bool bcm2835_spi_can_dma(struct spi_master *master,
        if (tfr->len < BCM2835_SPI_DMA_MIN_LENGTH)
                return false;

-       /* BCM2835_SPI_DLEN has defined a max transfer size as
-        * 16 bit, so max is 65535
-        * we can revisit this by using an alternative transfer
-        * method - ideally this would get done without any more
-        * interaction...
-        */
-       if (tfr->len > 65535) {
-               dev_warn_once(&spi->dev,
-                             "transfer size of %d too big for dma-transfer\n",
-                             tfr->len);
-               return false;
-       }
-
```

SPI



```
diff --git a/drivers/spi/spi-bcm2835.c b/drivers/spi/spi-bcm2835.c
index 2fd650891c07..68d35407e7a3 100644
--- a/drivers/spi/spi-bcm2835.c
+++ b/drivers/spi/spi-bcm2835.c
@@ -579,6 +579,19 @@ static int bcm2835_spi_transfer_one(struct spi_master *master,
        return bcm2835_spi_transfer_one_irq(master, spi, tfr, cs);
 }

+static int bcm2835_spi_transfer_one_message(struct spi_controller *ctlr,
+                                            struct spi_message *msg)
+{
+       int ret;
+       gfp_t gfp_flags = GFP_KERNEL | GFP_DMA;
+       size_t max_transfer_size = 64;
+       ret = spi_split_transfers_maxsize(ctlr, msg, max_transfer_size, gfp_flags);
+       if (ret)
+               return ret;
+
+       return spi_transfer_one_message(ctlr, msg);
+}
+
 static int bcm2835_spi_prepare_message(struct spi_master *master,
                                        struct spi_message *msg)
 {
@@ -739,6 +752,7 @@ static int bcm2835_spi_probe(struct platform_device *pdev)
        master->setup = bcm2835_spi_setup;
        master->set_cs = bcm2835_spi_set_cs;
        master->transfer_one = bcm2835_spi_transfer_one;
+       master->transfer_one_message = bcm2835_spi_transfer_one_message;
        master->handle_err = bcm2835_spi_handle_err;
        master->prepare_message = bcm2835_spi_prepare_message;
        master->dev.of_node = pdev->dev.of_node;
```

“bcm2835_spi_transfer_one_message” in spi-bcm2835.c calls the helper spi_split_transfers_maxsize before calling spi_transfer_one_message
to split the message into smaller chunks to be able to use dma.

Split the message into <64KB chunks

Conclusion

- Current state: The backlight patches have been accepted but the spi patches were still being discussed
- Refactored backlight and spi helpers
- Learned a lot about the linux kernel.
- Learned how to collaborate with people and communicate effectively.

QUESTIONS ?