DRM(Direct Rendering Manager) of Tizen Kernel

Joonyoung Shim
jy0922.shim@samsung.com

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What is DRM

- DRM is not Digital Right Management

- Direct Rendering Manager
  - Kernel-level graphics device driver that support Direct Rendering Infrastructure.
  - Direct Rendering
    - An application communicates directly with graphics device driver
  - Display mode setting
  - Graphics memory management

Why DRM

- Can give display experiences similar to PC system

- However, why not use DRM until now
  - DRM was designed for PC
  - Embedded system
    - Low performance
    - No dedicated graphics memory
    - Not one graphics card but separated hardware devices
  - Linux framebuffer driver

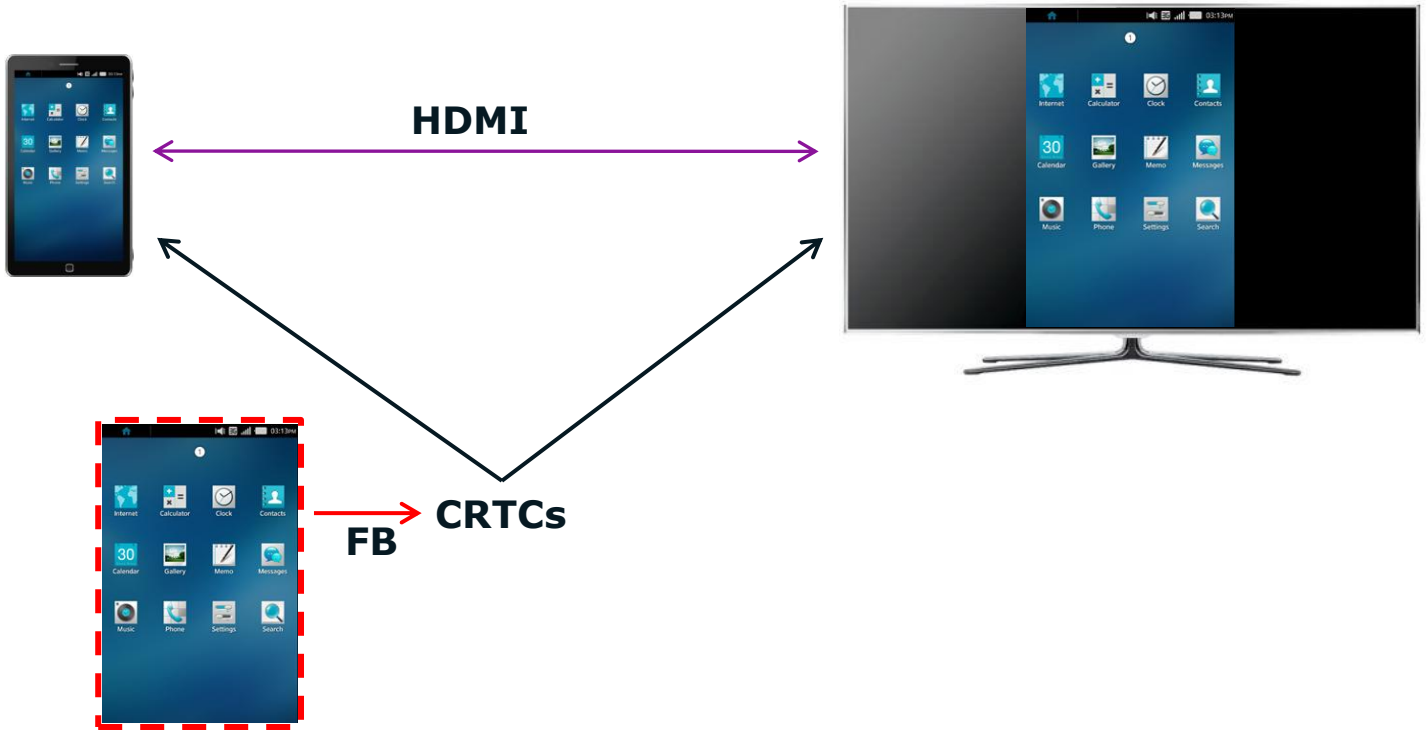
Why DRM

- Changed embedded environment
  - Powerful embedded SoCs
  - Requirements
    - Display hotplug & clone, extended mode
    - Unified memory management
    - Direct rendering
    - Varying device control with common interface
- So, we choose DRM for next

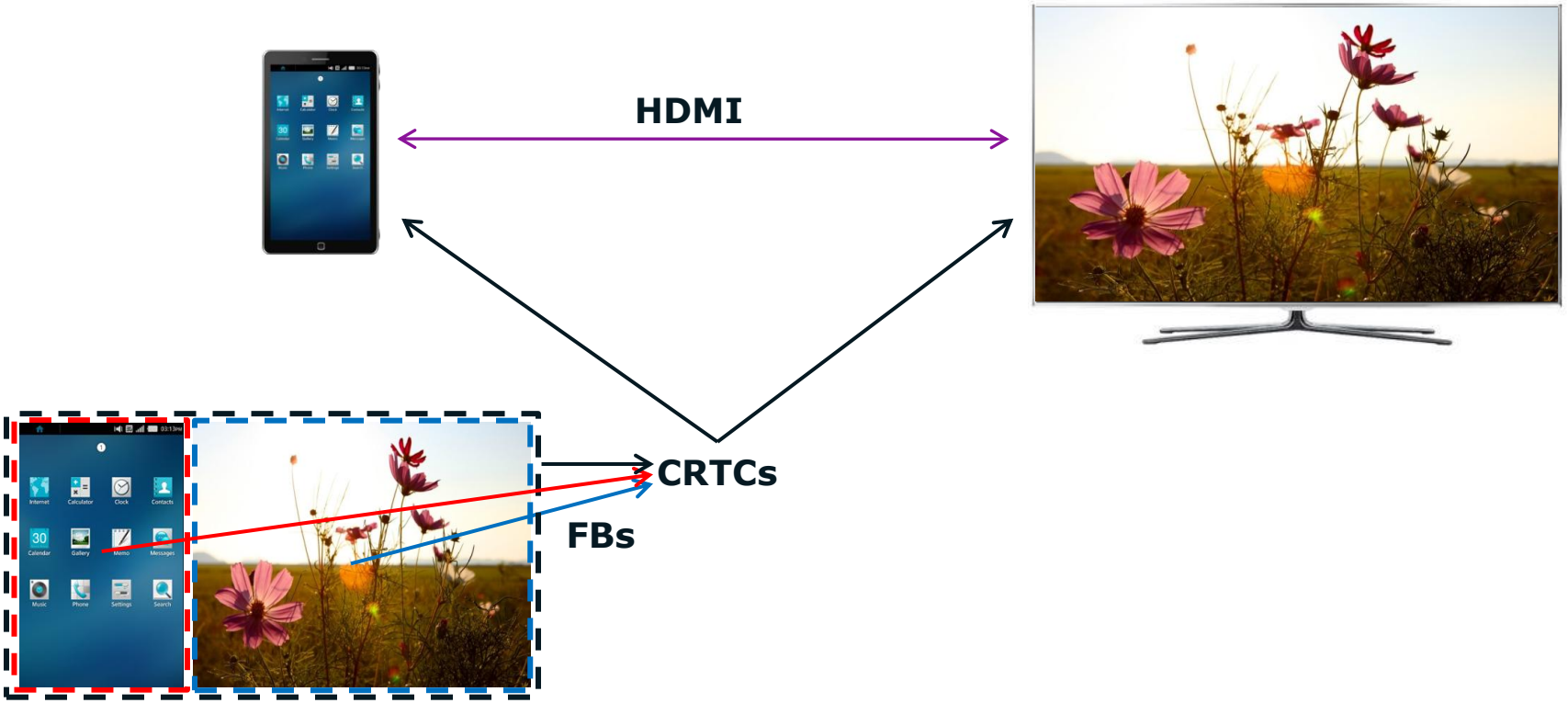
What can we do

- Export image data from buffer to the screen
  - Generic display pipeline
    - Buffer → CRTC → Output → Monitor
- Flexible environments with multiple displays
  - Smart Phone and Digital TV
    - LCD and HDMI
  - Possible modes
    - Clone mode (Duplicate display)
    - Extended mode (Dual display)

Scenario: Clone mode



Scenario: Extended mode



How to implement

- Use common DRM core
  - GEM framework
    - For buffers
  - Kernel mode setting
    - To control CRTCs and outputs
- Implement hardware specific parts
  - Wrapper common DRM core
  - Support each different devices driver

DRM of Tizen kernel

- Tizen supports several processors
- However, the current version supports Exynos SoCs

- Need Exynos specific DRM driver!

Exynos DRM driver

- DRM driver to support graphics hardware of Exynos SoCs
- First ARM SoC graphics driver to use the Direct Rendering Manager
- Merged into the mainline linux 3.2 kernel first
- linux/drivers/gpu/drm/exynos

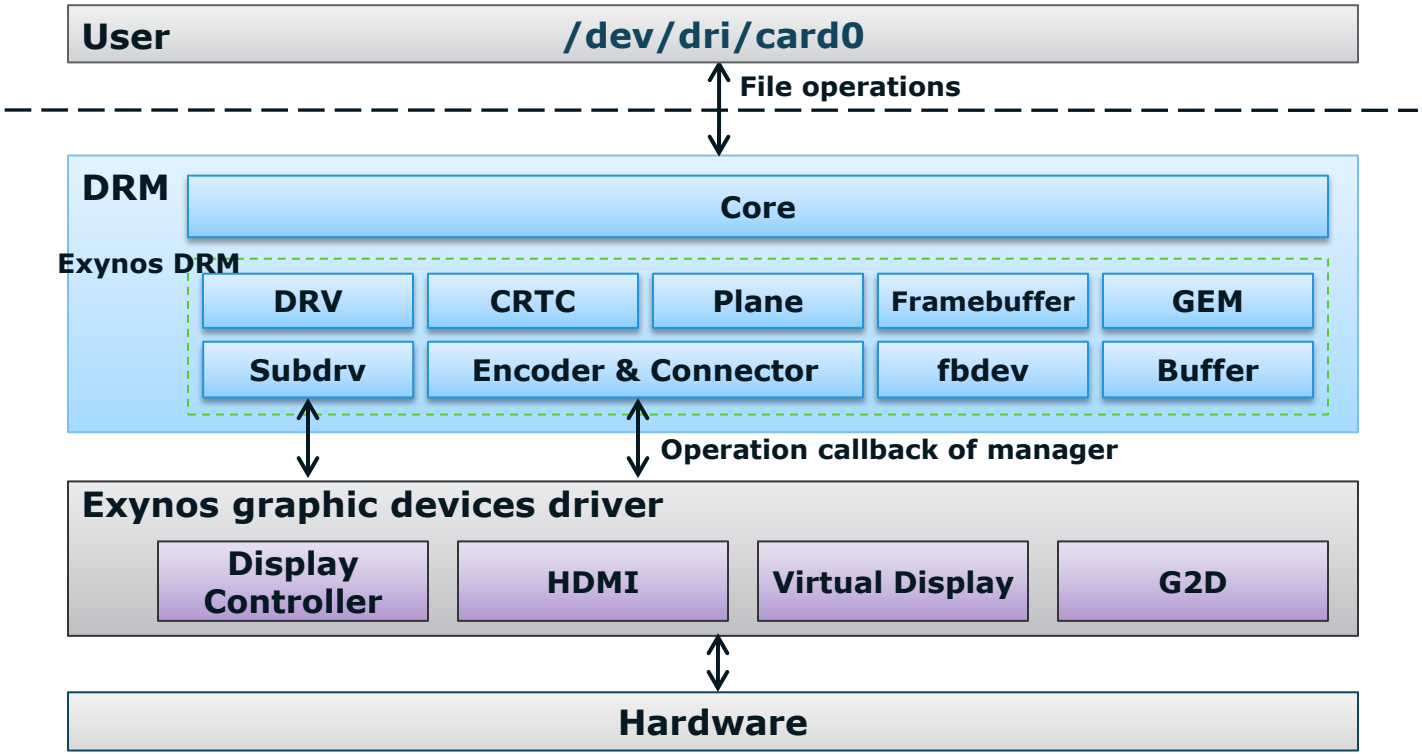
Features

- KMS(Kernel Mode Setting)
- GEM(Graphics Execution Manager)
- Fbdev(linux framebuffer)
- Specific ioctls
- Pageflip
- HDMI hotplug

Exynos graphics devices

- Display controller
  - Transfer image data in system memory to external LCD interface
- HDMI
  - HDMI v1.3 / v1.4
- G2D
  - The 2D graphic accelerator that supports Bit Block Transfer
- Virtual display device
  - Provide virtual display to user
  - Can be used for wireless display

Architecture



KMS (Kernel Mode Setting)

- A method for setting display resolution, frequency and depth in the kernel space
- Can change mode without X server reloading
- Include framebuffer and output management code

- KMS in the Exynos DRM
  - CRTC used commonly
  - Encoder and Connector with hardware specific callbacks
  - Plane support (control multiple window layers)
  - Default FB and user FB

GEM (Graphics Execution Manager)

- Developed by Intel to manage graphics memory
- Memory allocation and freeing
- Command execution
- Share graphics memory by multiple applications

- Exynos SoCs do not have dedicated graphics memory
  - Implement buffer management
  - Memory type
    - Physically Continuous memory
    - Physically Non-Continuous memory

SUB driver

- DRM is not aware of graphics devices driver
  - Each graphics device driver registers sub driver data
  - Exynos DRM driver manages sub driver data to linked list
  - Sub driver data must be registered when Exynos DRM driver is probed

- Manager
  - The interface to communicate with graphics devices driver
  - Delivered to Encoder and Connector
  - Operation callback functions

Future work

- Support more Exynos graphics devices
  - Rotator
  - Post processor
  - G3D
- Update features
  - IOMMU support
  - DMA-buf support
  - HDMI / Plane update

- The updating patches will be posted to dri-devel ML

References

- http://dri.freedesktop.org/wiki
- http://www.x.org/wiki/Development/Documentation/HowVideoCardsWork
- https://wiki.archlinux.org/index.php/KMS
- http://www.kernel.org/doc/htmldocs/drm.html
- http://elinux.org/images/7/71/Elce11_dae.pdf

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