DRM (Direct Rendering Manager) of Tizen Kernel

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Contents

• What is DRM
• Why DRM
• What can we do
• How to implement
• Tizen kernel DRM
  – Exynos DRM driver
• Future work
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

HDMI

CRTCs

FB
Scenario: Extended mode

HDMI

CRTC

FBs
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

User
/dev/dri/card0

File operations

DRM

Exynos DRM

DRV
CRTC
Plane
Framebuffer
GEM

Subdrv
Encoder & Connector

Operation callback of manager

Exynos graphic devices driver

Display Controller
HDMI
Virtual Display
G2D

Buffer
fbdev

Hardware
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