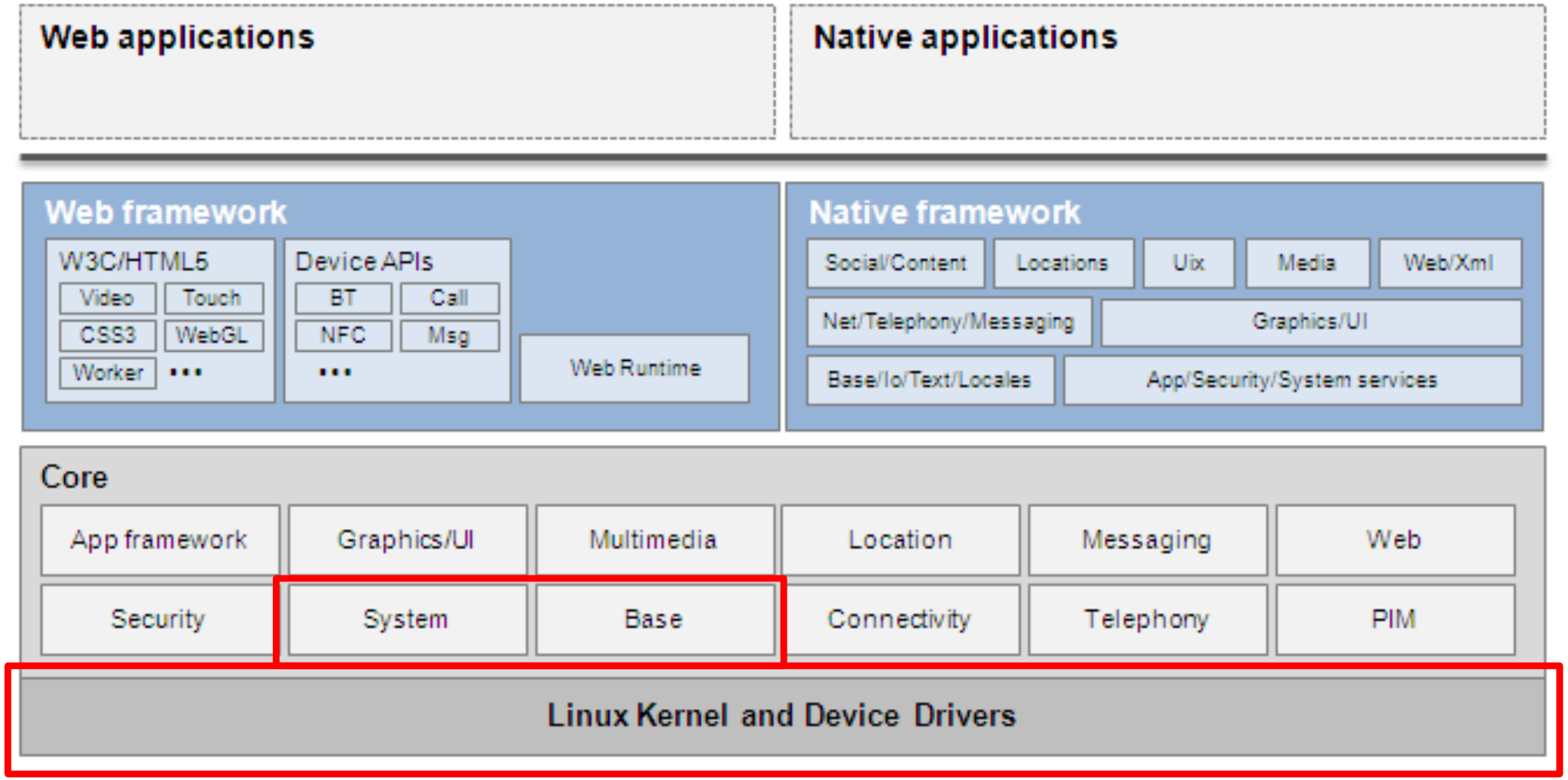
Tizen Kernel & System Frameworks for Vendors and Enthusiasts

(Tizen 2.1+)

SW센터 S/W Platform Team

함명주 책임

Tizen Overview (2.x)



Target Audience

- Vendors & Enthusiasts
  - 새 제품/보드에 Tizen을 돌려보기
    - Tizen BSP / Device Porting
  - 새 부품이 Tizen을 지원하도록 하기
    - Device Driver for Tizen
  - Linux System Programming 실습(?)
    - Core daemon/library 개발
    - Tizen “Hacking”
    - Tizen Reference Device의 활용
      - RD-210 (Galaxy S2 HD) / RD-PQ (Galaxy S3 3G) / …

Contents

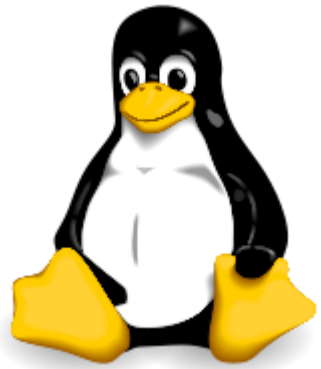
- Tizen Kernel
  - Graphics, Multimedia, Memory Management
  - Power Management
  - Other Peripherals
- Core Daemons
- OEM Adaptation Layer (OAL)
- Future Development

Linux Kernel

- Linux Kernel Mainline (https://git.kernel.org/cgit/linux/kernel/git/torvalds/linux.git/)
  - Stable: Linux 3.9: 2013/4/29 (3.9.6: 2013/6/13)
  - Dev: Linux 3.10 RC6: 2013/6/15

- MAINTAINERS
  - Directory / File 별 Mainline 관리자
  - 관련 Patch의 Review 및 Integration 책임을 지고
  - 상위 Maintainer (보통 상위 Directory)에 정리된 patchset을 보냄
  - 최종 Maintainer: Linus Torvalds

- LongTerm Stable (LTS): 3.0 / 3.4
  - Stable release이후 최소 2년간 bugfix support 됨.

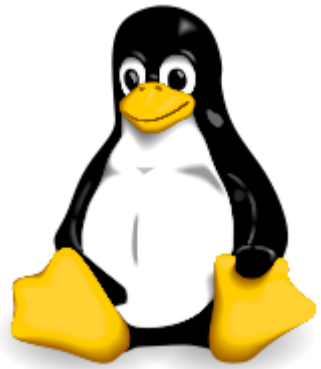


Linux Online (2008). "Linux Logos and Mascots". Retrieved 11 August 2009.

Tizen Kernel

- Tizen 1.0 Reference Kernel: Linux 2.6.36
- Tizen 2.x Reference Kernel: Linux 3.0
- Next-Tizen Reference Kernel: Linux 3.10?
  - Released soon at Tizen.org (2013.7.?)

- Linux Kernel Version에 크게 구애 받지 않음.
  - 개별 제품별로 다른 버전 사용 가능



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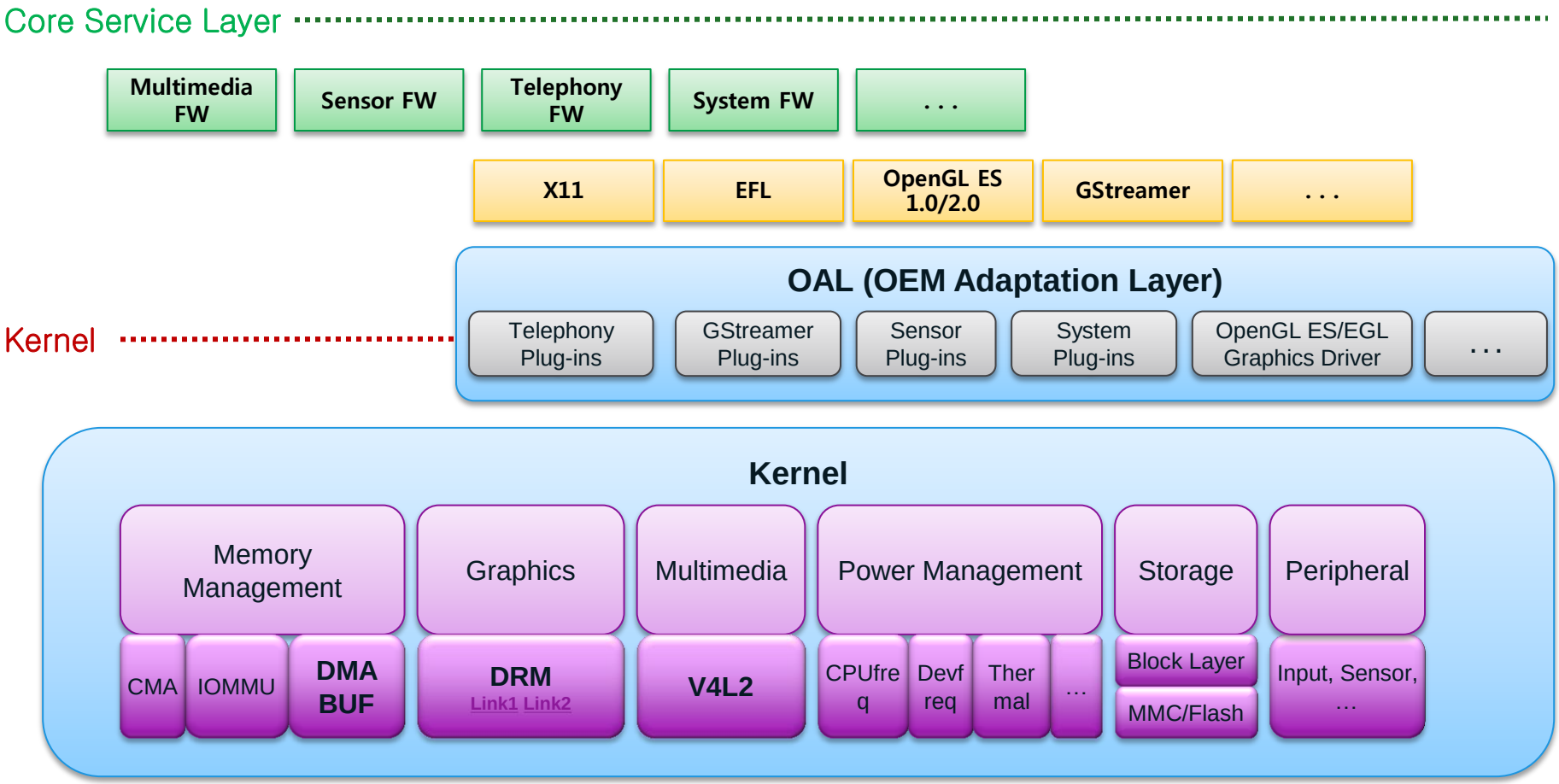
Tizen Kernel Principles

- Use Mainline Features / Follow Mainline Policy
  - No “Tizen-Kernel Patch”
    - Easy porting w/ vanilla
    - Low maintenance cost (kernel upgrade)
  - Device driver interface: mainline 표준 사용.
    - Graphics: DRM, Camera & Codec: V4L2, Touchscreen: input/touch, Image post process: DRM, Sound: ALSA, Bluetooth: BlueZ, …
    - 몇 가지 해결 안된 부분 (표준 구현 안됨 / 표준 구현 중): 3D GPU, Telephony, NFC.
    - 비표준 interface 추가 최소화. 특히 userspace에서의 직접 제어를 위한 interface open은 사용하지 않음.
  - 사용된 device driver들을 mainline에 upstream해두는 것을 추천함.
    - 추후 재사용이 용이함.

Tizen Kernel Overview



More at http://source.tizen.org/documentation/porting-guide

DRM Link1: http:// elinux.org/images/7/71/Elce11_dae.pdf
DRM Link2: http://download.tizen.org/misc/media/conference2012/wednesday/ballroom-c/2012-05-09-1330-1410-the_drm_(direct_rendering_manager)_of_tizen_kernel.pdf

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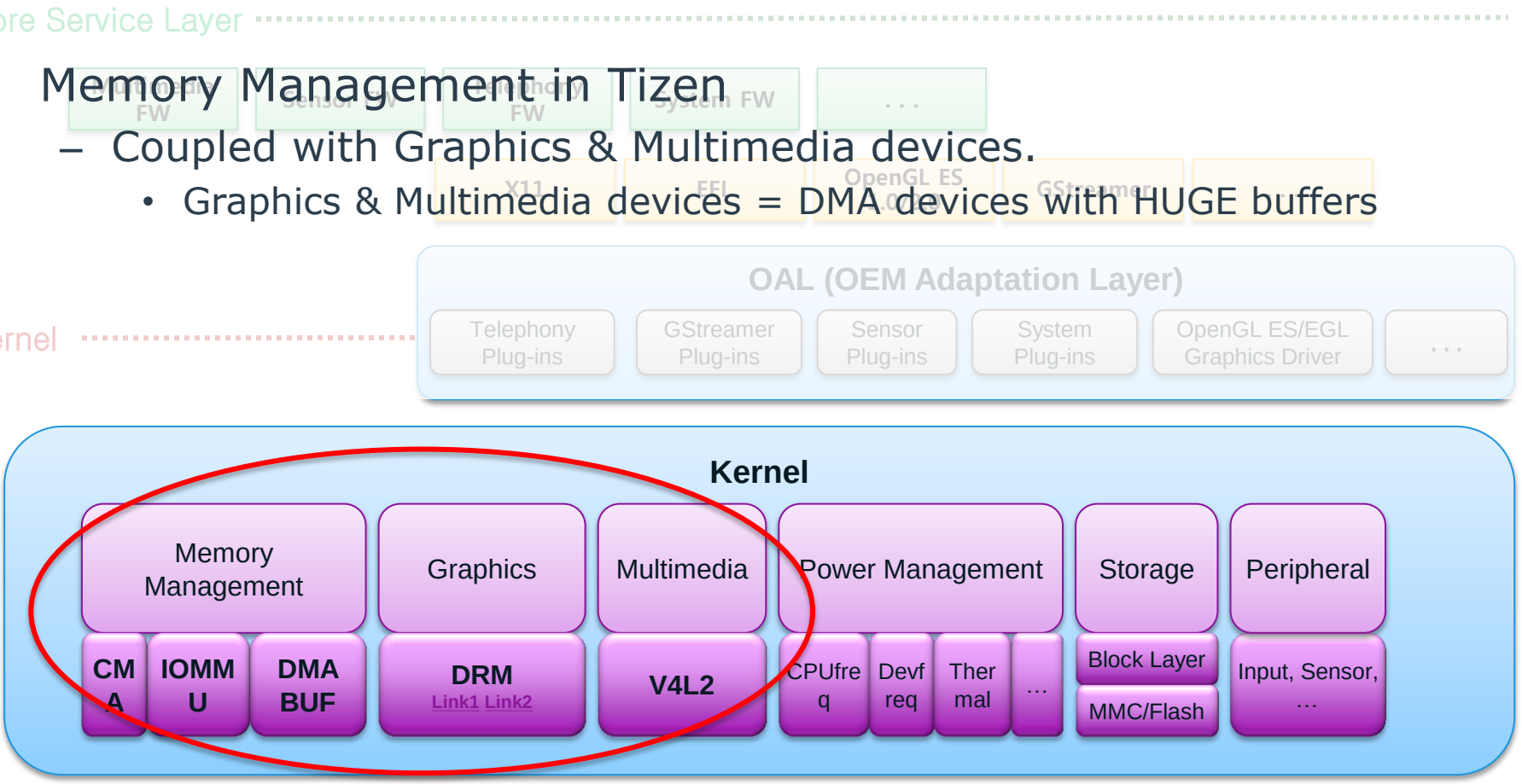
Tizen Kernel Overview

- Memory Management in Tizen
  - Coupled with Graphics & Multimedia devices.
    - Graphics & Multimedia devices = DMA devices with HUGE buffers



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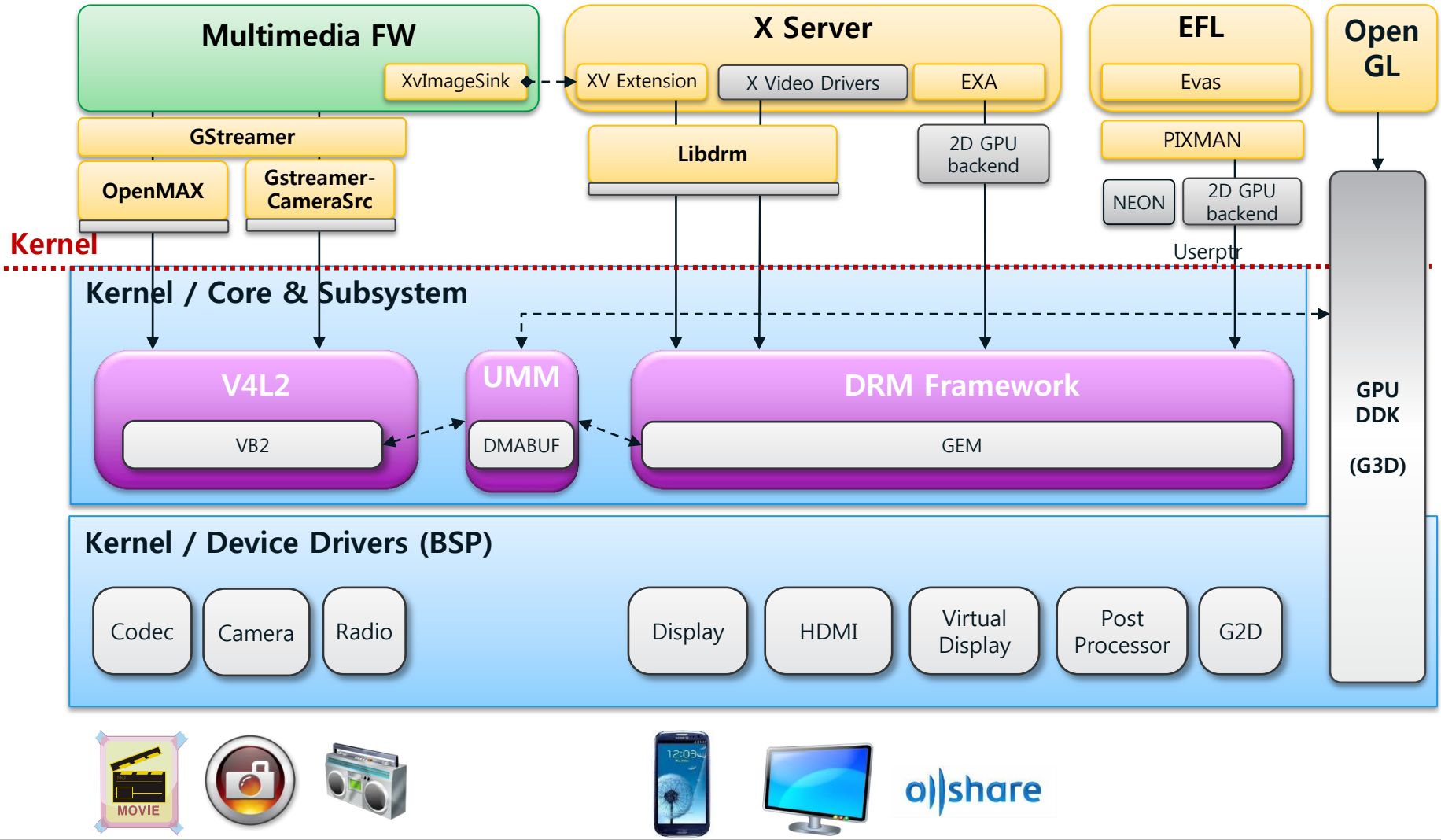
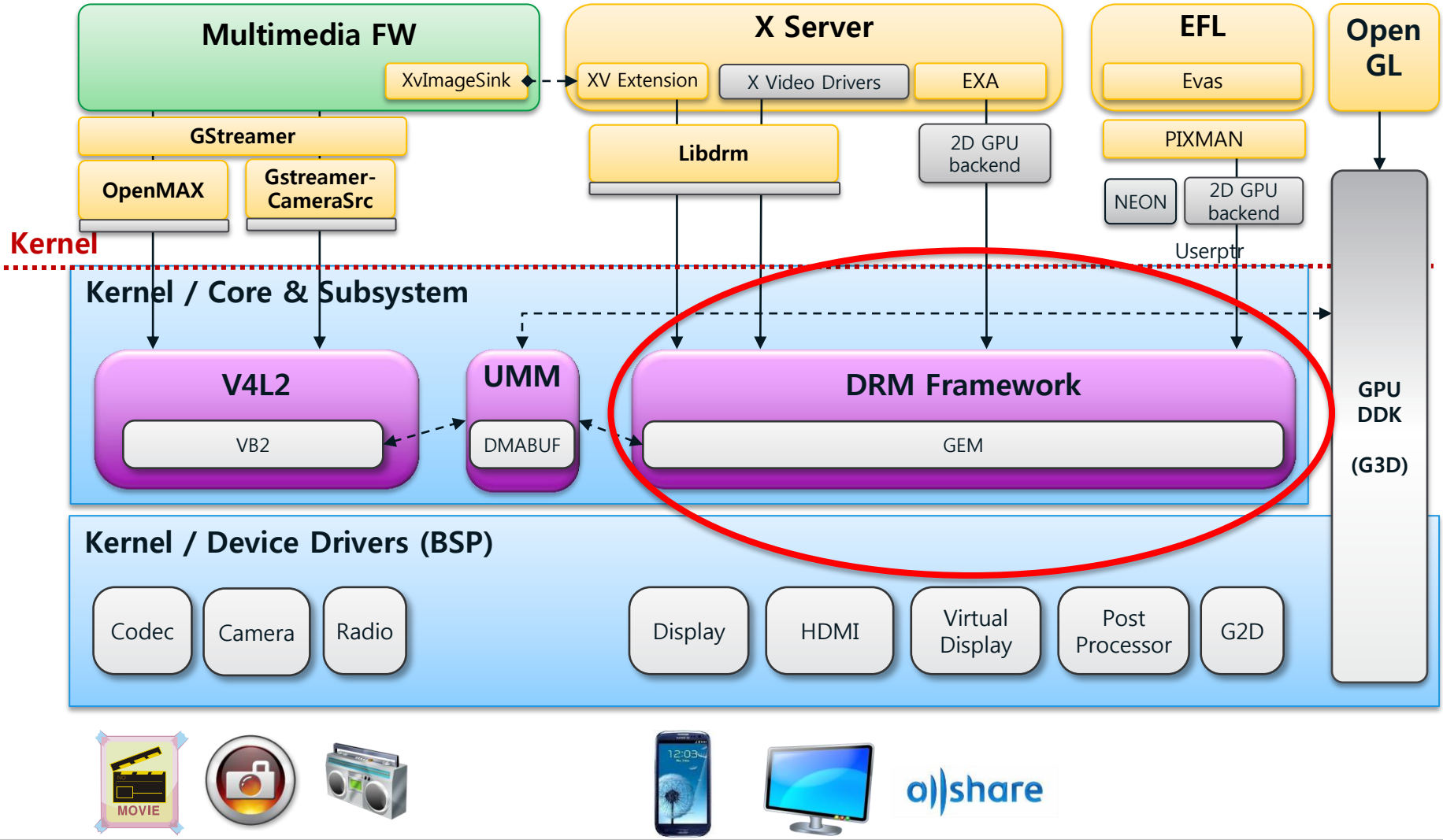


* Images from MS Office clipart and Samsung

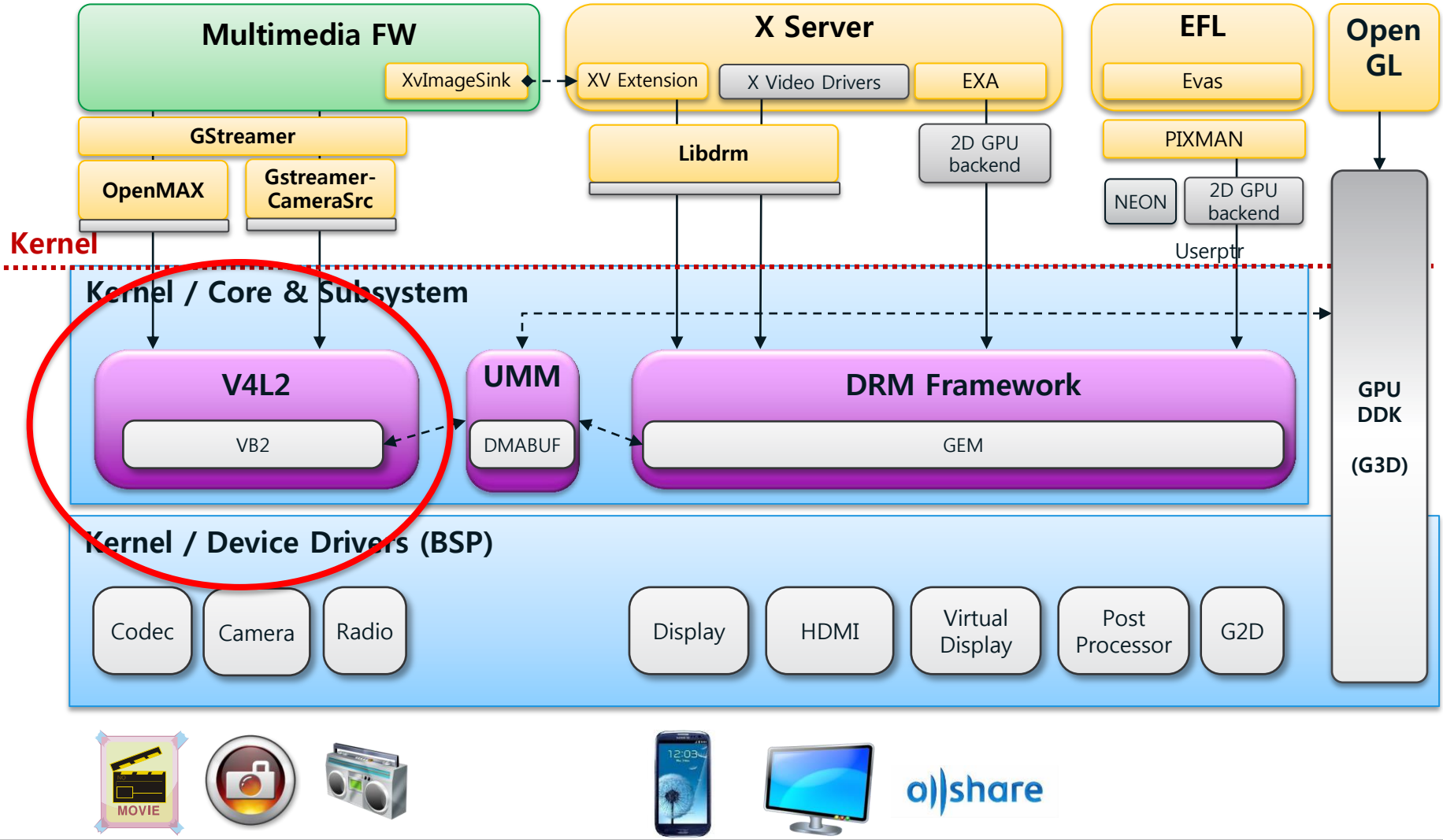
Tizen Kernel MM, Graphics (DRM)



Core Framework | Core External Library | OEM Adaptation | Kernel

* Images from MS Office clipart and Samsung

Tizen Kernel MM, Multimedia (V4L2/VB2)



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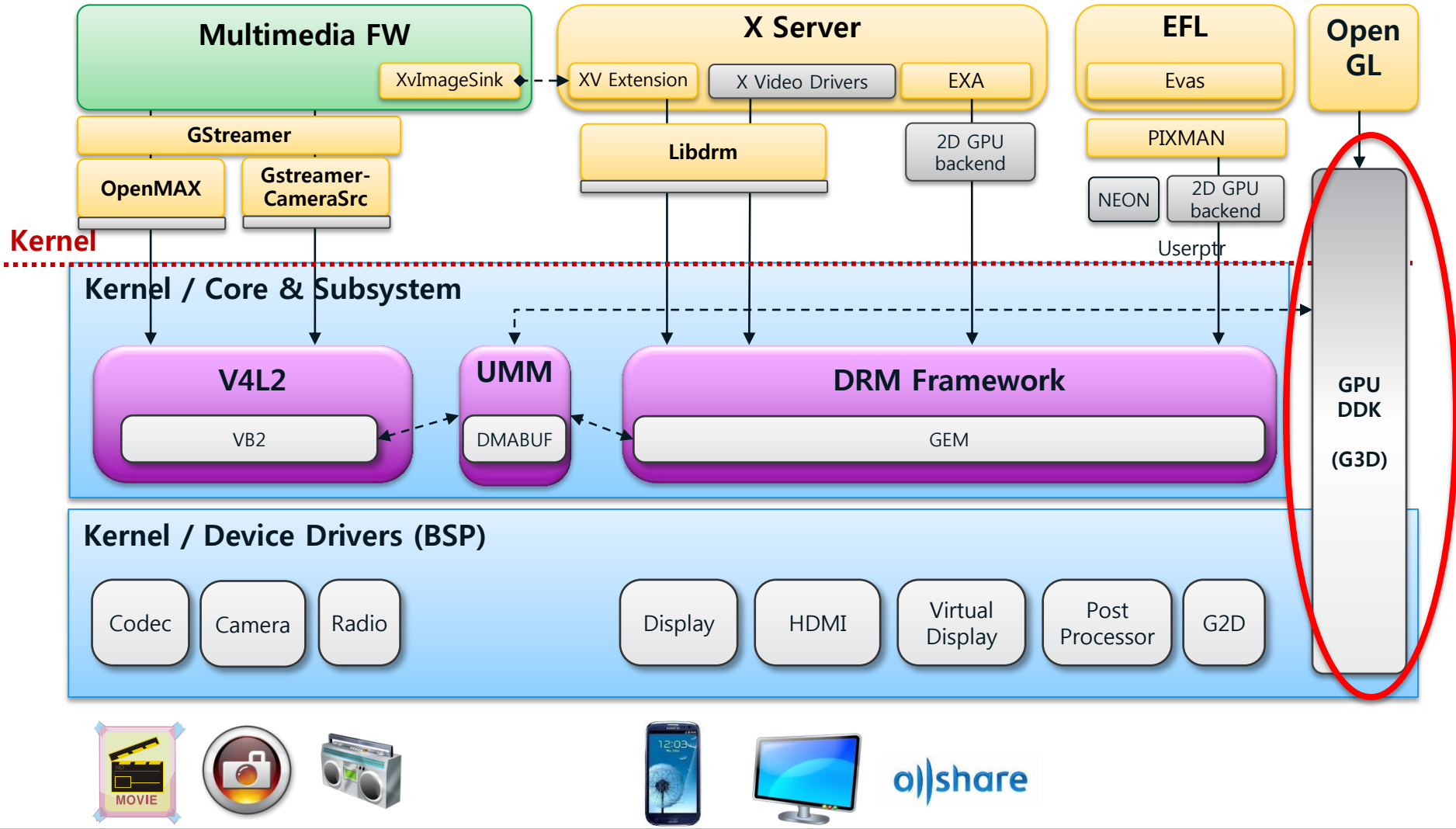
* Images from MS Office clipart and Samsung

Tizen Kernel MM, OpenGL/G3D-GPU

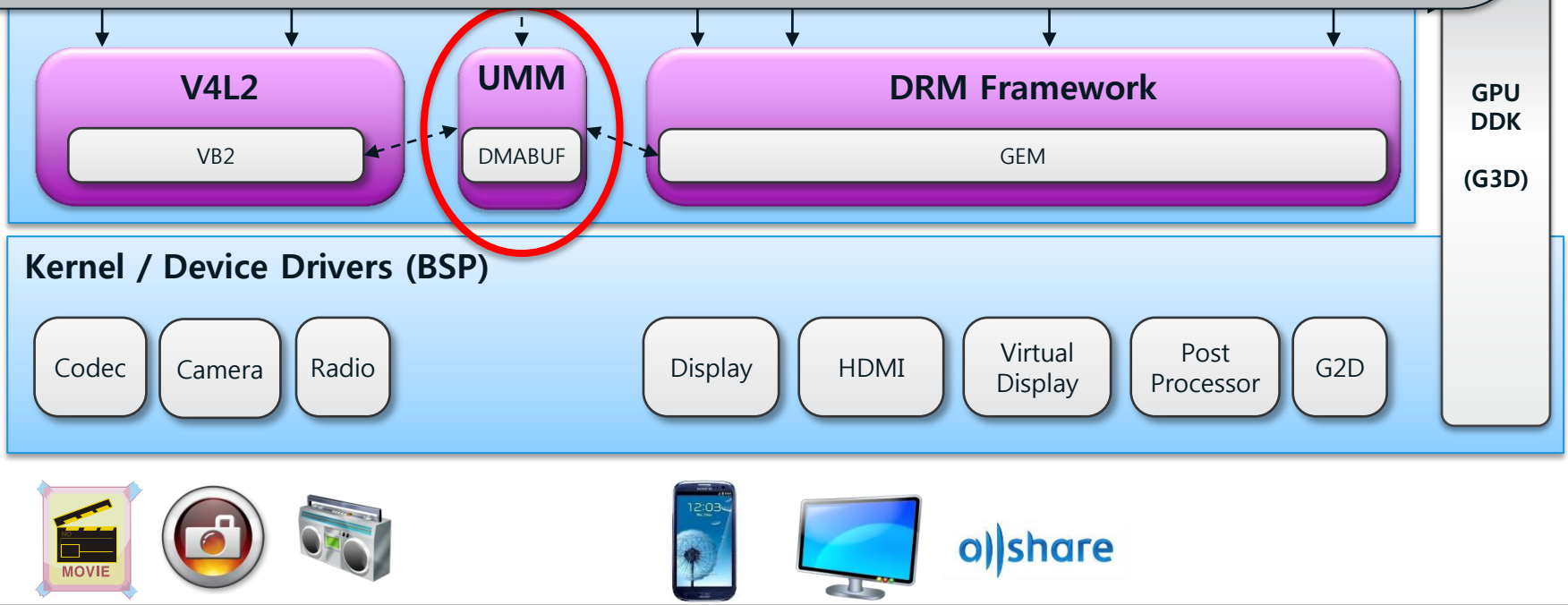


* Images from MS Office clipart and Samsung

Tizen Kernel MM, UMM

UMM (Unified Memory Management) DMABUF = “Tizen Standard Buffer”

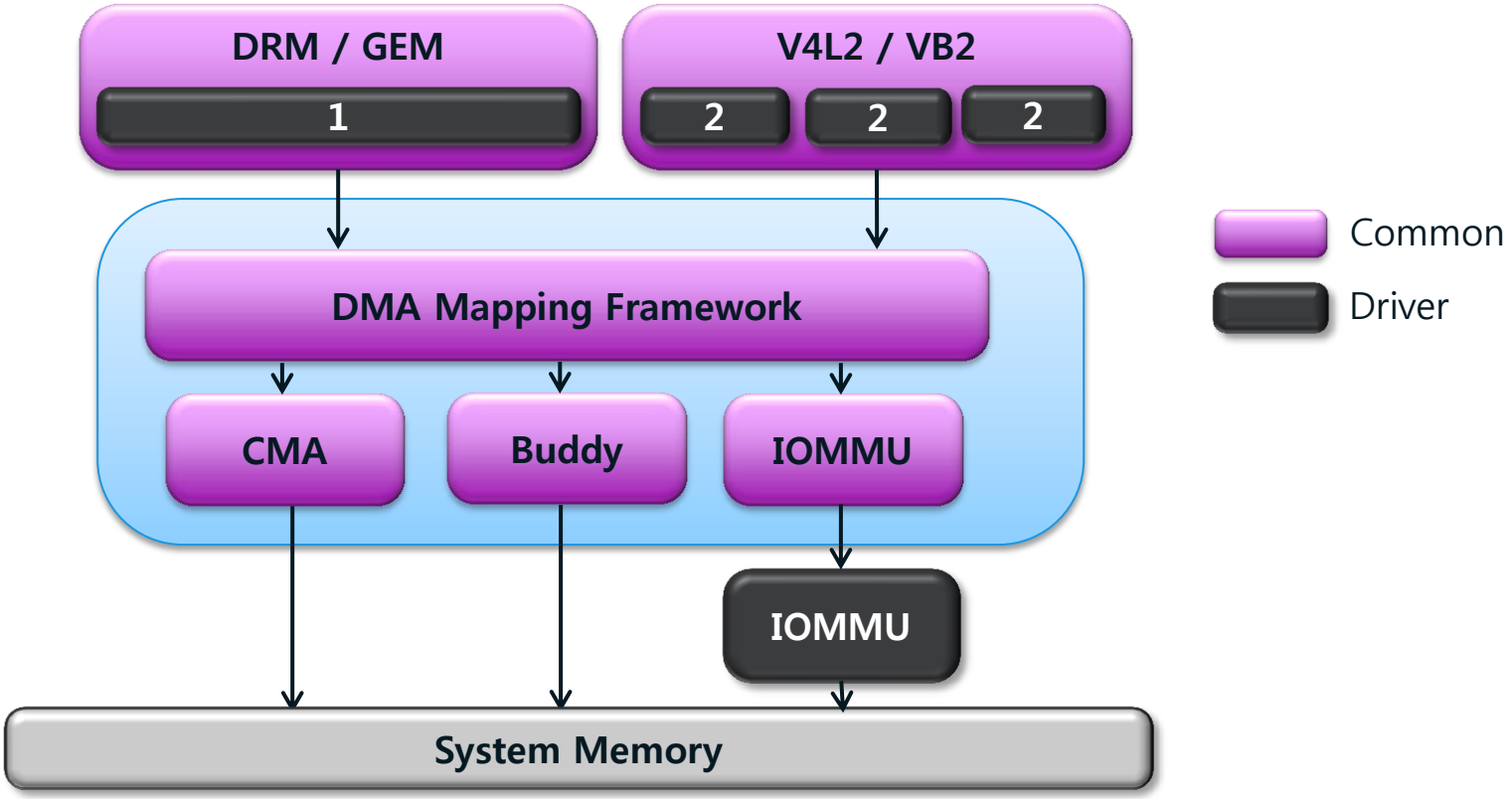
- Buffers 공유기능 제공
  - DRM, V4L2, GPU-Custom 사이의 호환성 제공
  - Memcpy없는 Buffer 전달.
  - Userspace에의 안전하고 효율적인 Buffer 공유



Core Framework | Core External Library | OEM Adaptation | Kernel

* Images from MS Office clipart and Samsung

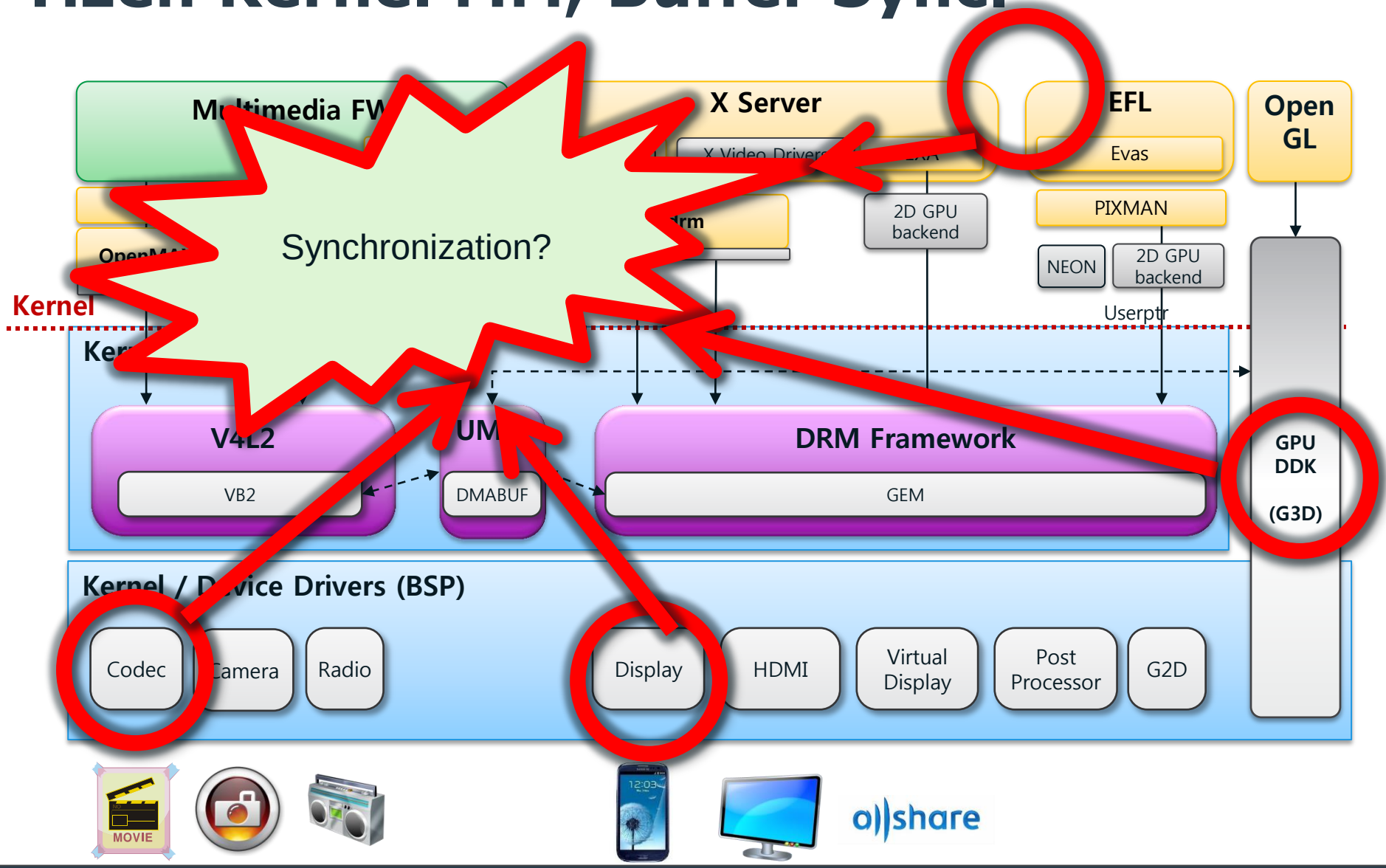
Tizen Kernel MM, UMM
DMA Mapping API @ Tizen Reference



1: "Exynos-DRM" provides unified device address space for all DRM devices

2: Each V4L2 device has its own device address space

Tizen Kernel MM, Buffer Sync.



Core Framework | Core External Library | OEM Adaptation | Kernel

* Images from MS Office clipart and Samsung

Tizen Kernel Memory Management
Buffer Synchronization

- TGL (Tizen Global Lock) @ Tizen 2.x
  - … Let userspace handle the issue …
  - Kernel patch required.

- Sync Framework (Google)
  - Jun, 2012. Resources w/o DMABUF (similar with TGL)

- KDS (Kernel Dependency System, ARM)
  - May 2012 / DMABUF-compatible

- **DMA Fence Framework (Canonical/TI/Samsung)**
  - Aug 2012 / DMABUF-compatible
  - Jun 2013 / DMABUF-Sync Framework (Samsung)

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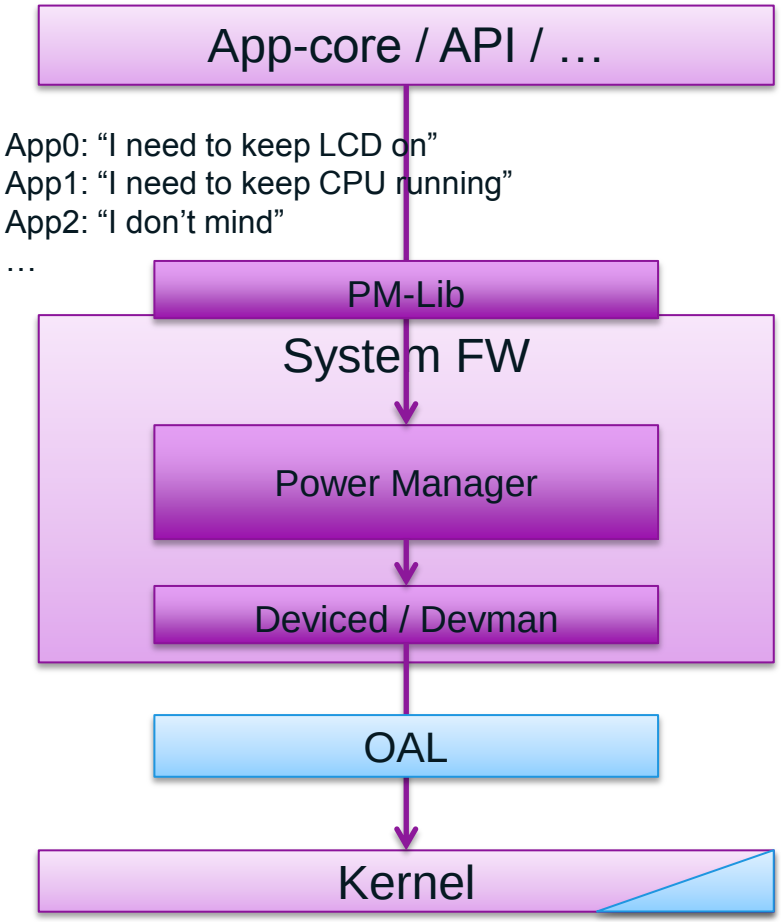
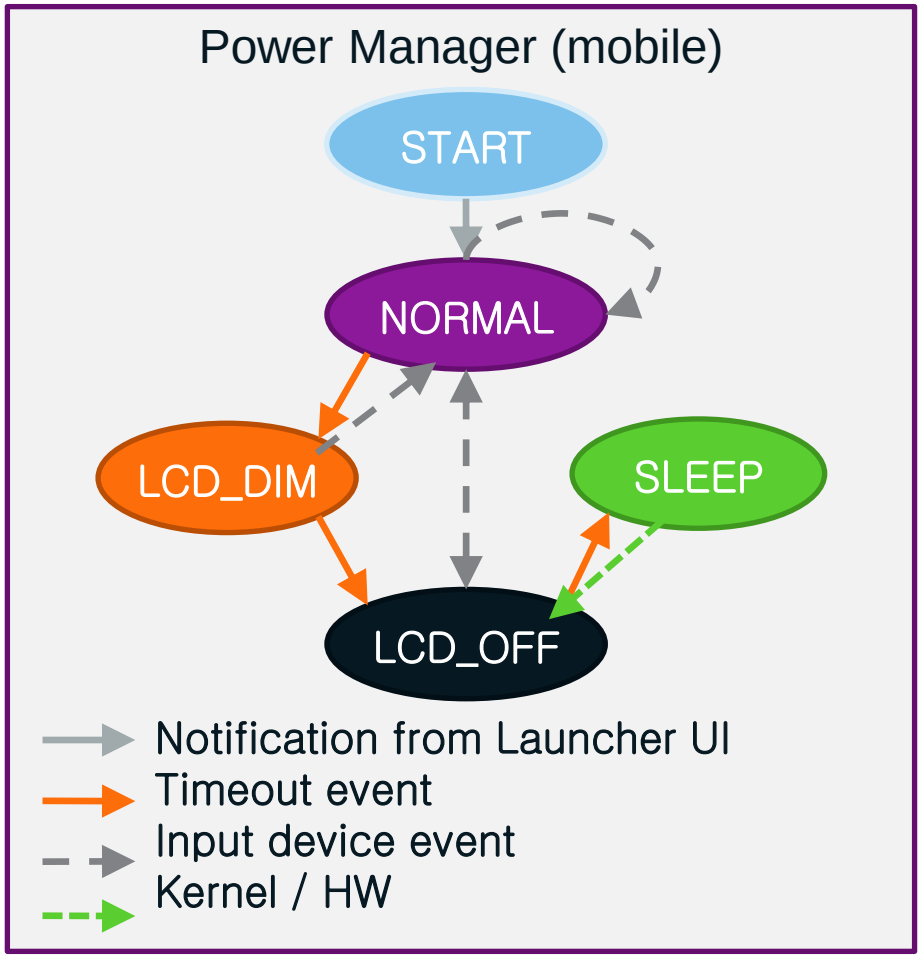
Power Management: System Overview (Tizen 2.x)

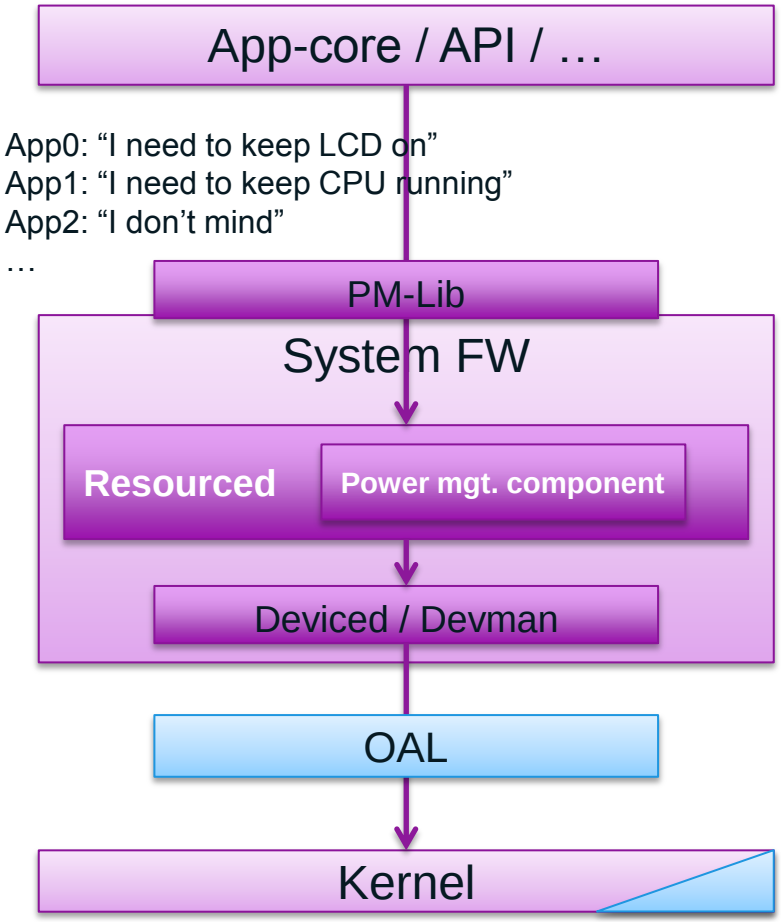


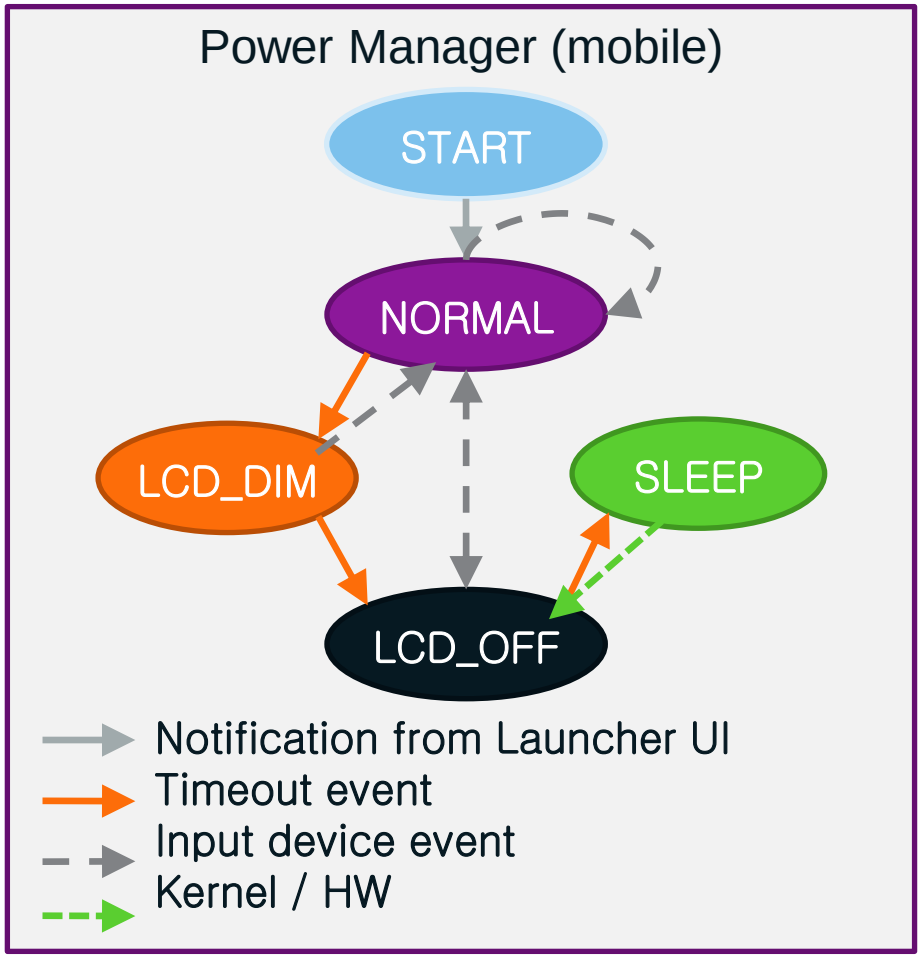


주의: Kernel에서는 Android wake-lock과 같은 Opportunistic sleep을 사용하지 않음
Userspace(Power Manager) 에서 직접 sleep에 들어갈 것을 요구해야 함

* Tizen 3.0부터 Device Control이 Deviced로 억세스 경로가 통합되어 Deviced를 사용함. 2.x에서는 Power Manager에서 Devman Library를 통해 직접 Kernel의 Device Node 접근 가능.

Power Management: System Overview (Tizen 3.0)





Resourced 내에 자원 관리를 위한 Component (e.g., OOM)들이 Consolidate & Merge 되었음.

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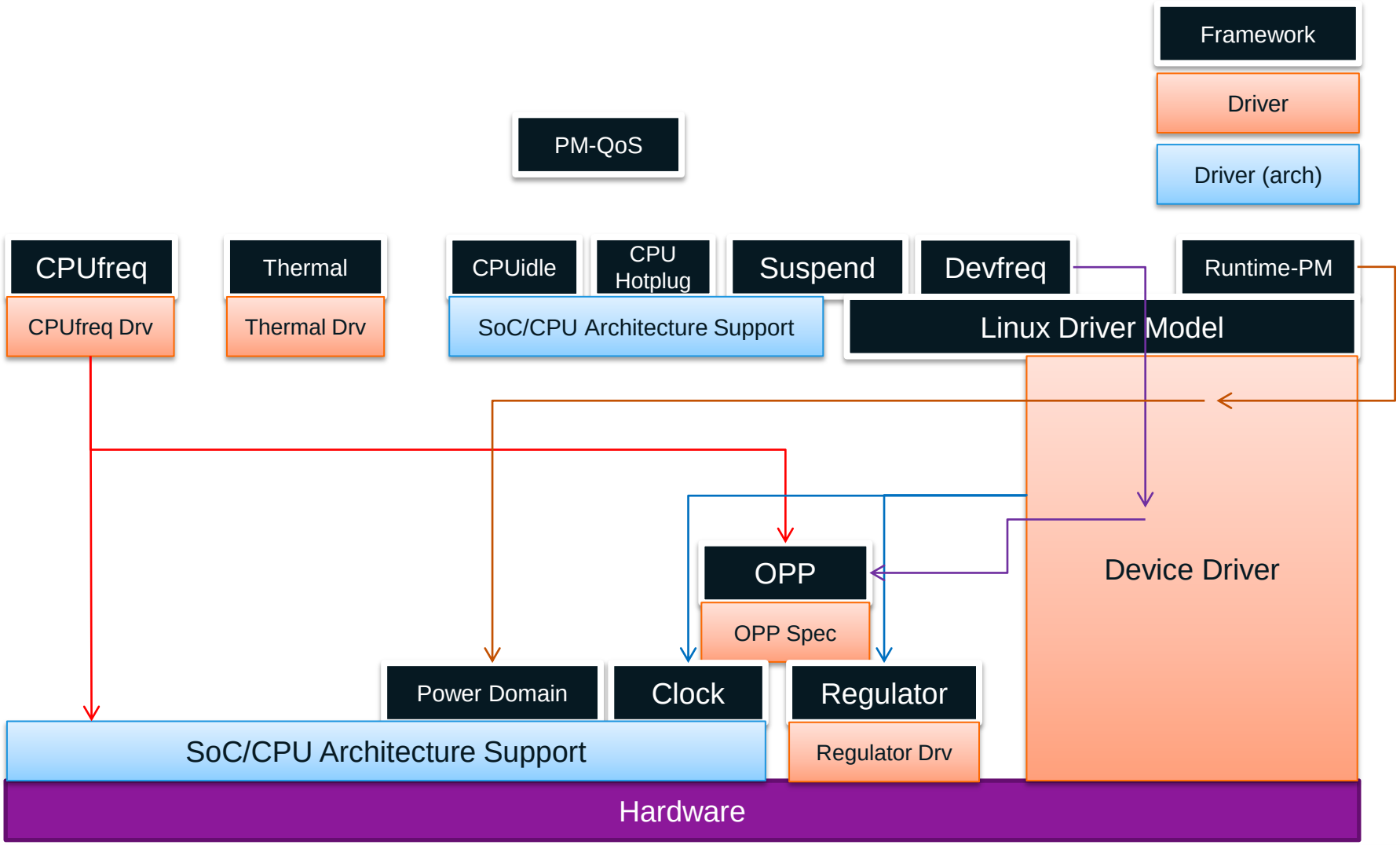
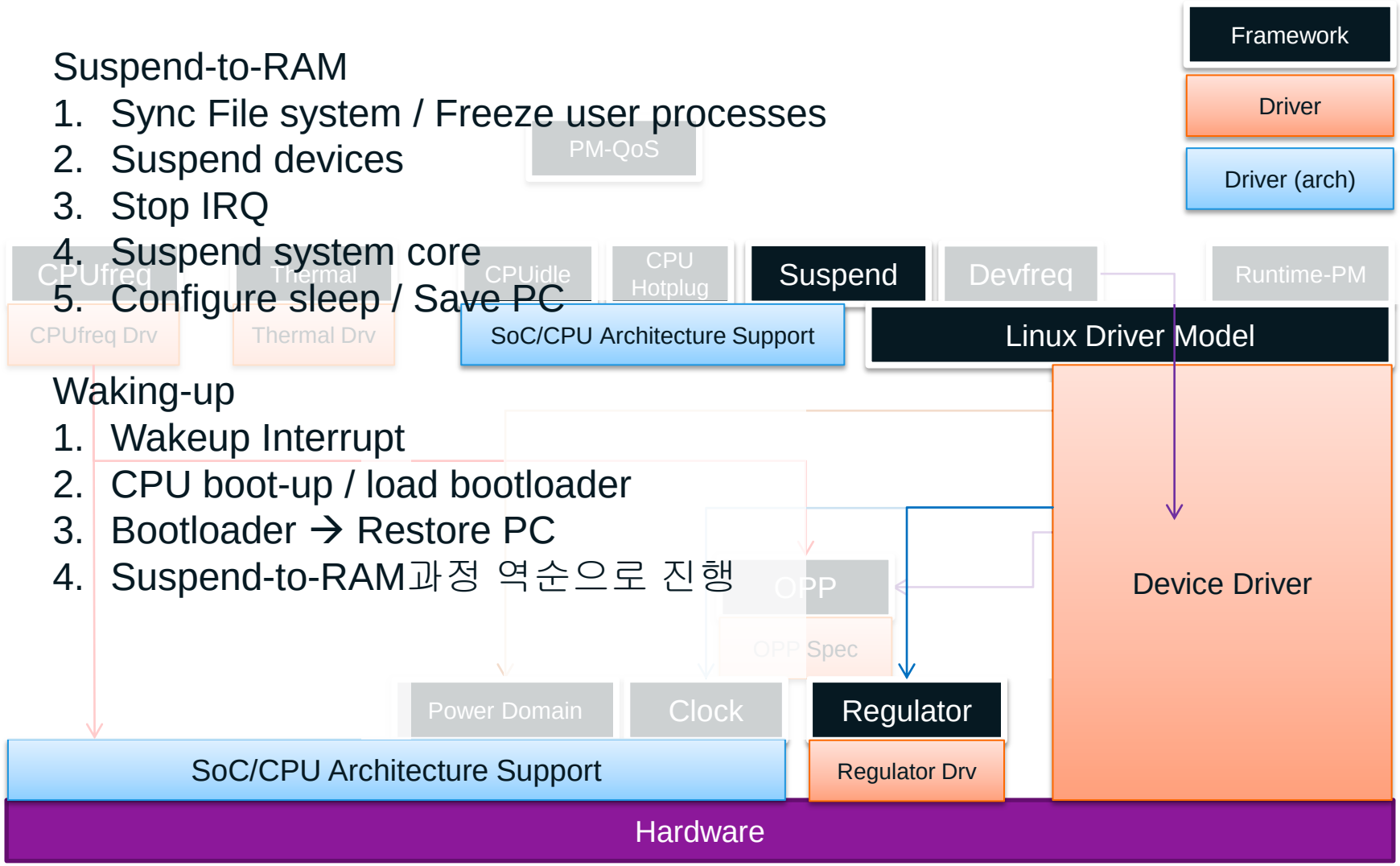
Power Management: Kernel Overview



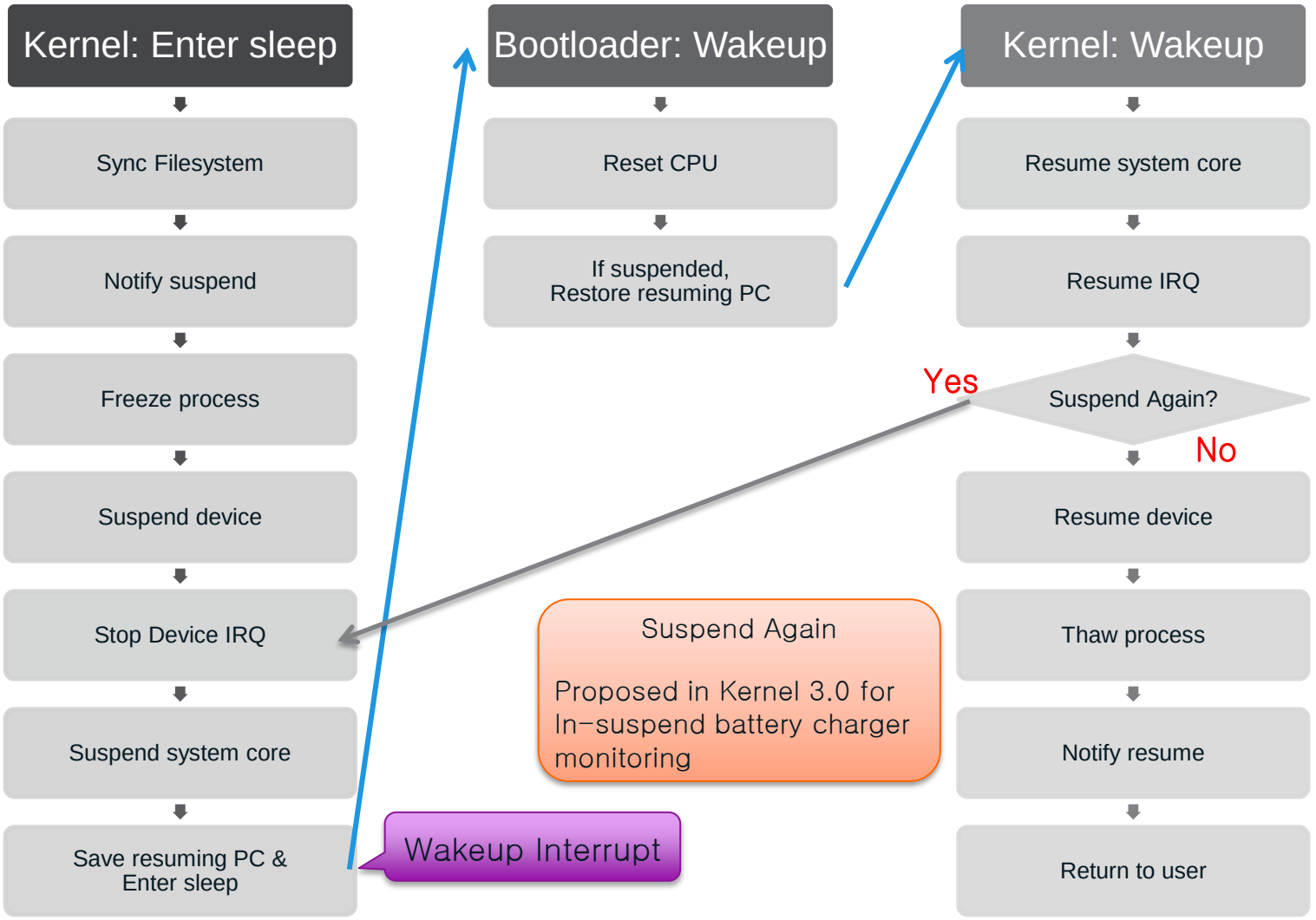
Power Management: Suspend

Suspend-to-RAM
1. Sync File system / Freeze user processes
2. Suspend devices
3. Stop IRQ
4. Suspend system core
5. Configure sleep / Save PC

Waking-up
1. Wakeup Interrupt
2. CPU boot-up / load bootloader
3. Bootloader → Restore PC
4. Suspend-to-RAM과정 역순으로 진행



Power Management: Suspend (detail)



More info: http://platform.sec.samsung.net/system/Linux/kernel/power/

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Other Peripherals

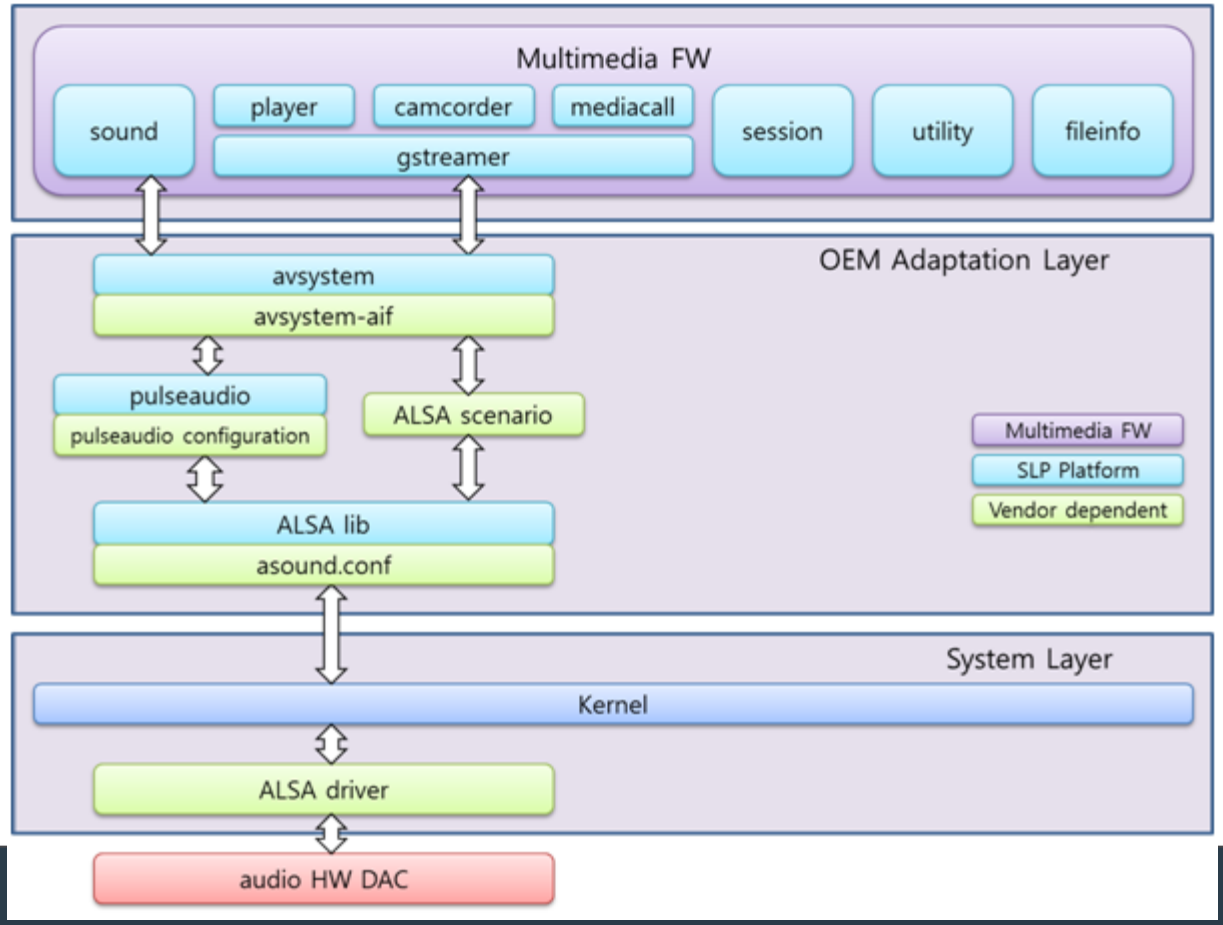
- 기본적으로는 OAL을 통해 Deviced (3.0)/Devman (2.1)이 요구하는 Callback이 모두 채워지면 됨
  - E.g., adaptation/ap_samsung/device-manager-plugin-exynos

- Battery/Cable과 관련하여 OAL이 요구하는 I/F 제공 Kernel subsystem:
  - Charger-manager (battery / charger)
  - Extcon (external connector: cable 관리. MUIC/3.5-pi 등)
  - 다른 subsystem이나 개별 device driver node에 의한 제공도 가능
    - Charger-manager 대신 일반 power-supply-class를 이용해도 됨. (기능을 모두 재구현 해야 함)
    - Extcon을 쓰지 않고 custom sysfs node를 만들어 사용하여도 동작에는 문제 없음. (e.g., "jack")

More on OAL: https://wiki.tizen.org/wiki/Porting_Guide
More on Charger-Manager: http://platform.sec.samsung.net/system/Linux/drivers/power/charger_manager.pptx
[Linux]/Documentation/power/charger-manager.c
[Linux]/drivers/power/charger-manager.c
More on Extcon: http://platform.sec.samsung.net/system/Linux/drivers/extcon/
[Linux]/Documentation/extcon/porting-android-switch-class
[Linux]/drivers/extcon/*

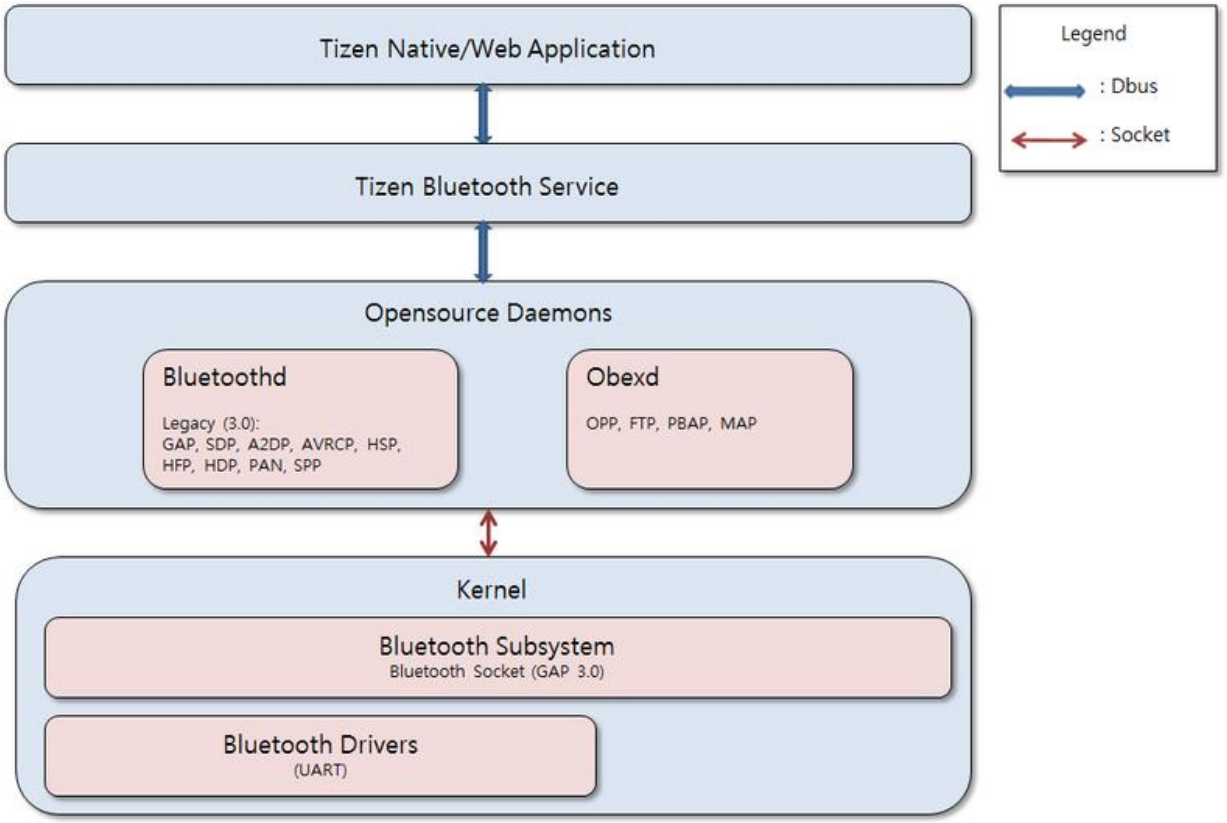
Other Peripherals: Sound

- Tizen은 ALSA Scenario (www.alsa-project.org) 을 사용함.
  - ALSA 표준에 맞춰 hardware plugin 및 device driver 작성.
- https://wiki.tizen.org/wiki/Porting_Guide#Audio



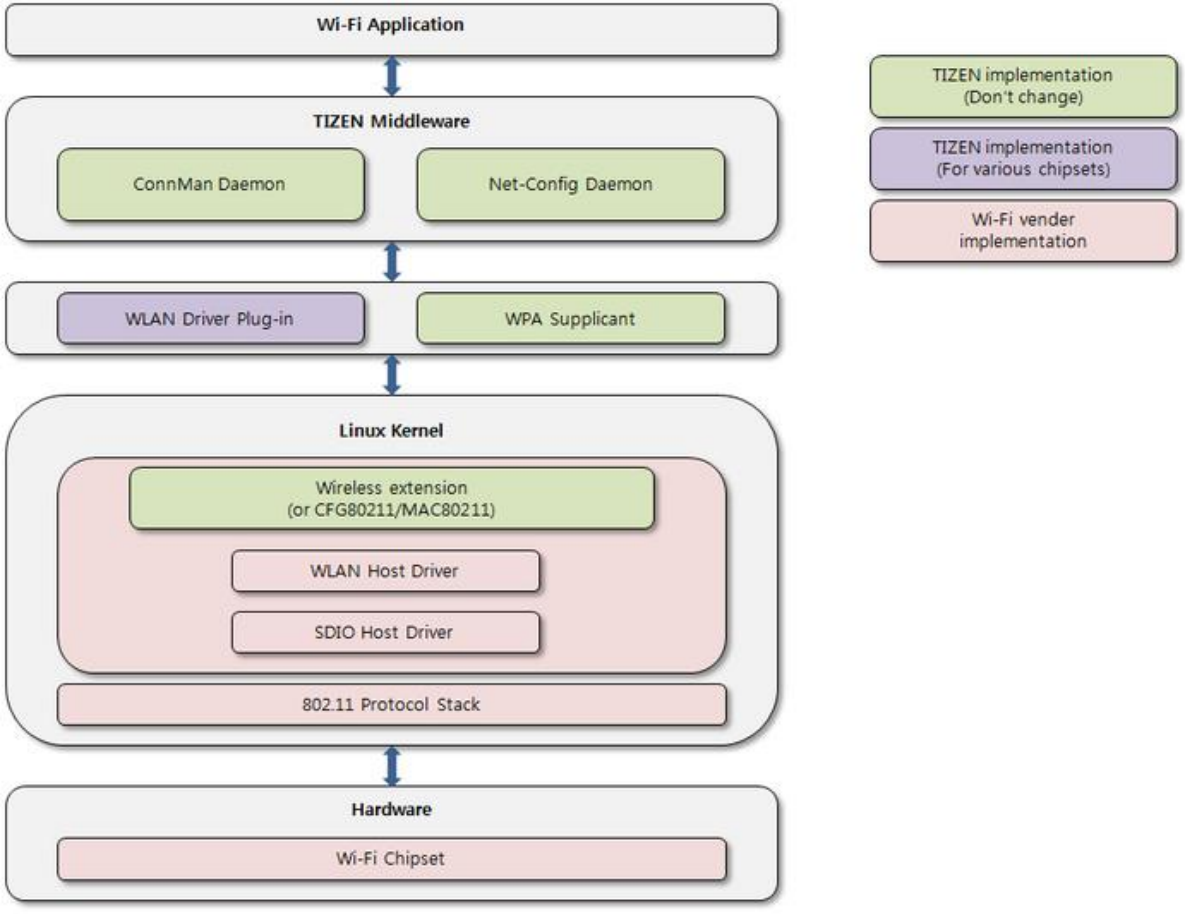
Other Peripherals: BlueTooth

- Tizen은 Bluez(www.bluez.org)을 사용함
- https://wiki.tizen.org/wiki/Porting_Guide#Bluetooth



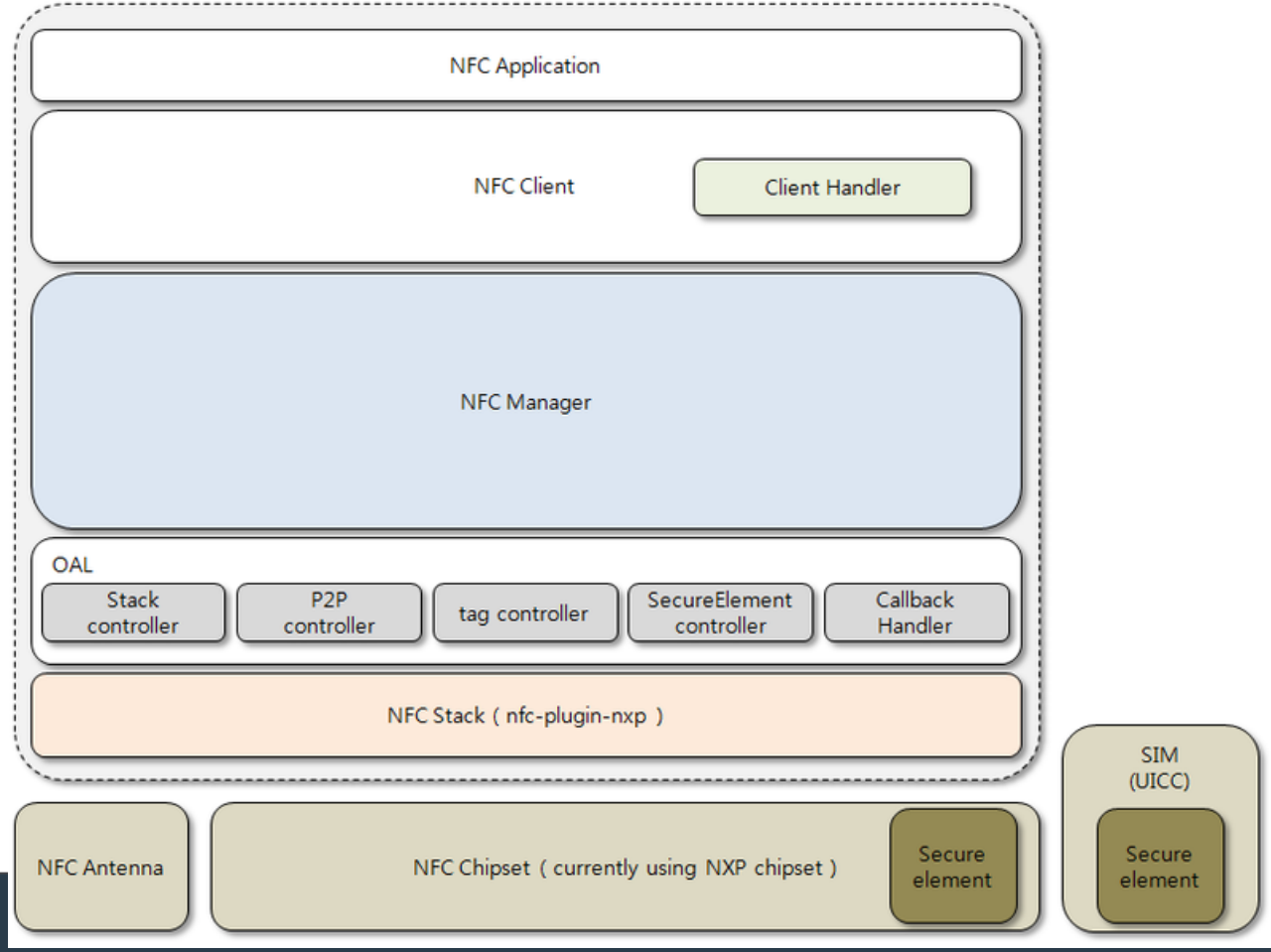
Other Peripherals: WiFi

- Tizen은 wpa-supplicant를 사용함.
- https://wiki.tizen.org/wiki/Porting_Guide#WLAN



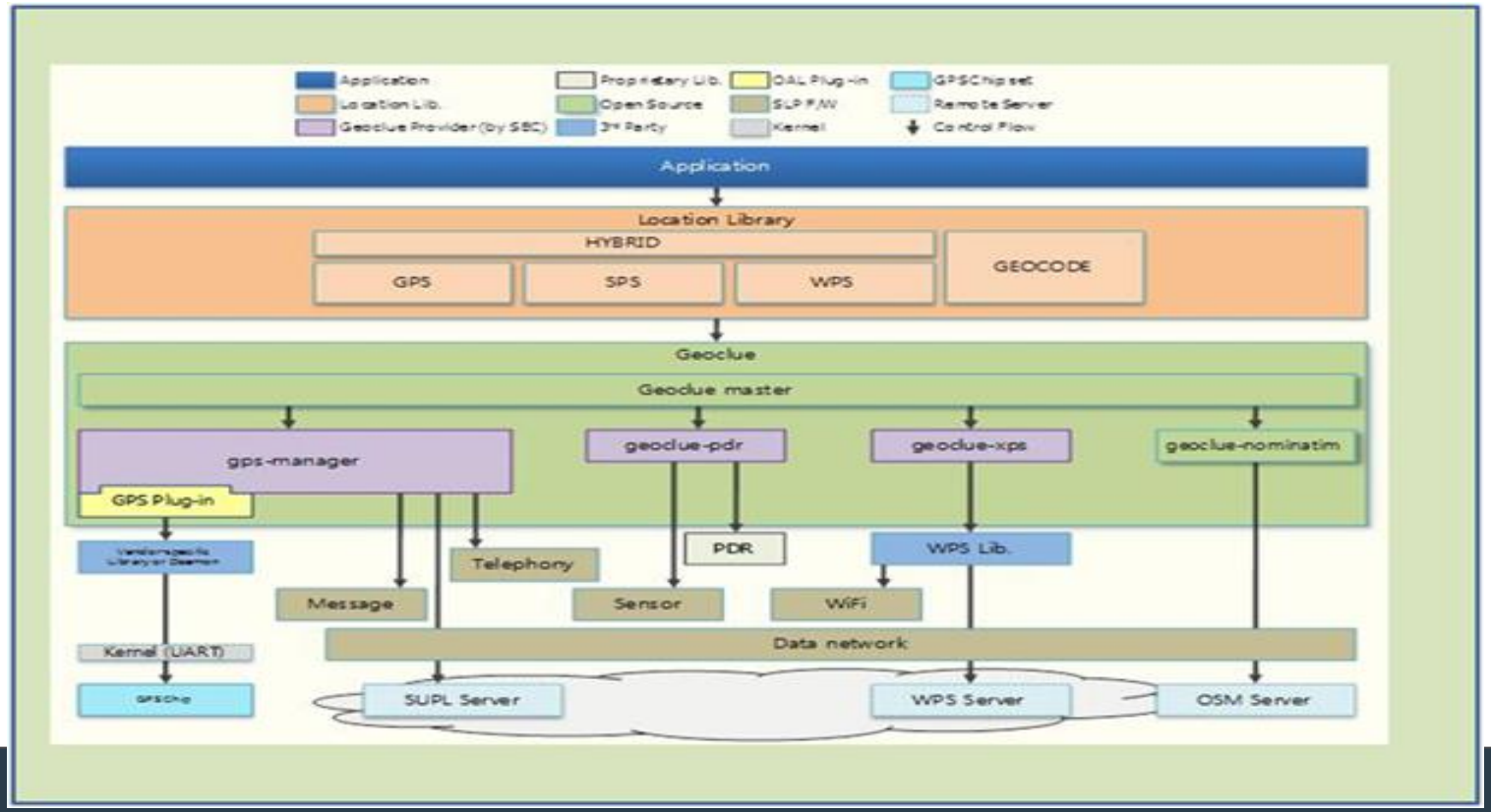
Other Peripherals: NFC

- 현재는 Tizen 자체 custom이며 libnfc 패키지 내에 OAL 함수를 구현해야 함. (이후 NEARD로 교체될 예정)
- https://wiki.tizen.org/wiki/Porting_Guide#NFC



Other Peripherals: Location (GPS)

- Tizen은 Geoclue를 사용함.
- WiFi/Telephony 나 기타 센서들은 기본 Tizen library를 사용하여 Tizen framework를 억세스 함 (별도 porting 불필요).
- GPS는 GPS Plug-in을 통해 Kernel GPS driver (보통 UART interface 사용)를 사용함. (OAL 함수 구현)

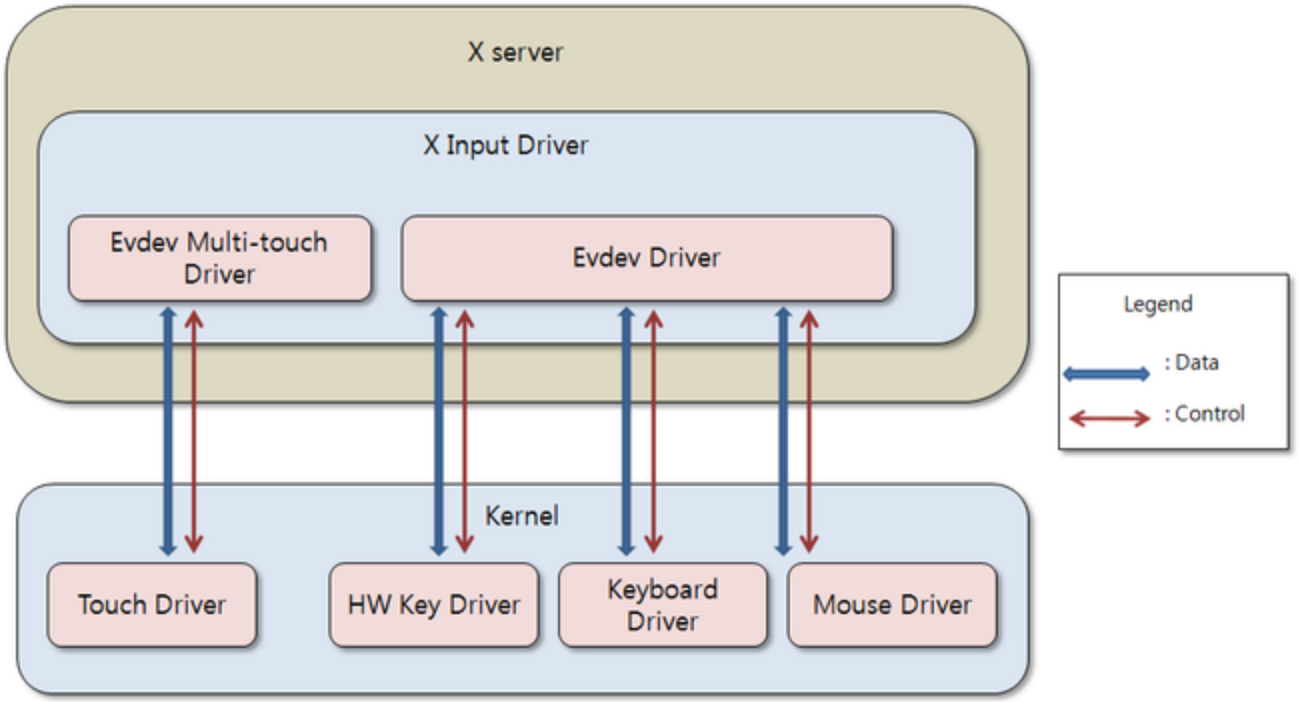


Other Peripherals: Telephony

- Tizen Telephony Framework를 위한 Telephony plugin 내에 OAL 함수 구현을 하여 Driver 제어를 함.
  - Plugin이 지원하는 기능:
    - Voice / Video call
    - Supplementary service control, USSD
    - Packet data connection handling
    - Network Information (such as signal strength)/registration
    - SMS transport
    - SIM/USIM services such as PIN code checks and read/write/delete of SIM/USIM resident data
    - SIM Application Toolkit mechanism(s)
    - Sound control
  - Plugin 예제: framework/telephony/tel-plugin-dbus-tapi.git
  - Intel CMUX 방식도 지원함. (kernel mux)

Other Peripherals: Input

- X Window System의 Input기능을 사용함.
- Userspace 측에서는 X input driver (주로 evdev) 를 이용해 kernel의 touchscreen, HW key, mouse 등의 device에 접근.



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Core Daemons (Tizen 3.0)

- Systemd (booting & daemon management)

- Deviced
- Resourced
  - (deviced/resourced: 기존 power-manager, devman, system-server, … 등이 consolidation됨)

- DBUS
  - 기존 Vconf 대폭 축소

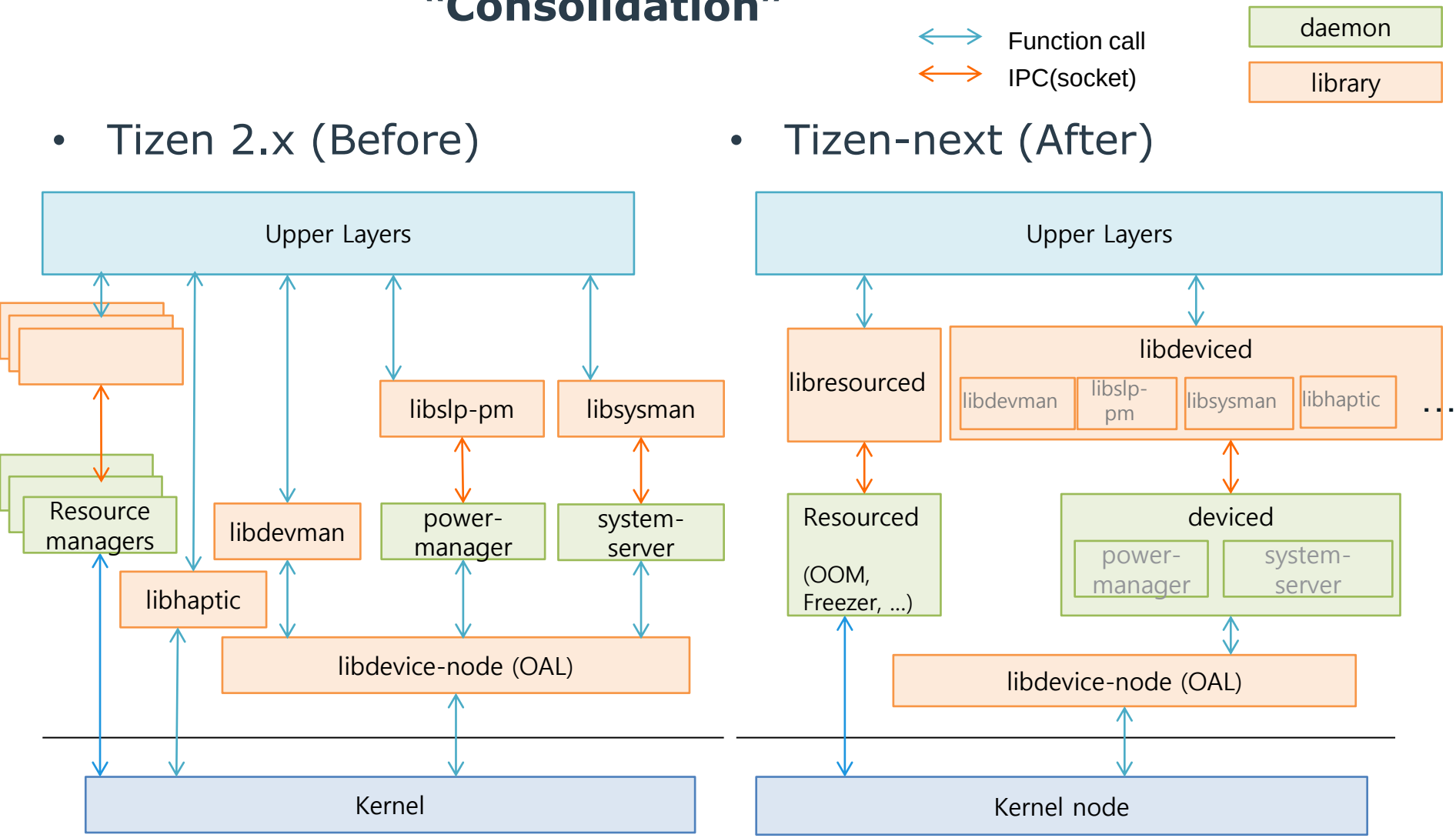
* Tizen.org 에서 3.0 개발 현황 review 가능함.

Systemd in Tizen

- From Tizen 2.1
- Sysvinit의 대체
- Service/Daemon 간의 dependency를 파악하여 동시에 start시켜 더 빠른 부팅을 가능하도록 함.
- Service/Daemon 의 runtime 감시 및 관리
  - 예) 동작 중 update에 의한 kernel reboot의 필요성 감소

Deviced & Resourced in Tizen

"Consolidation"



- Tizen 2.x (Before)

System Framework(As-is)

- Tizen-next (After)

System Framework(To-be)

DBUS, IPC in Tizen

- Tizen 2.x: IPC with VCONF → DBUS
  - VCONF: “Registry”. Not for IPC.
  - Ease of Development & Code Maintenance
    - Build dependencies between IPC peers
- Tizen-next: DBUS → KDBUS
  - Performance!

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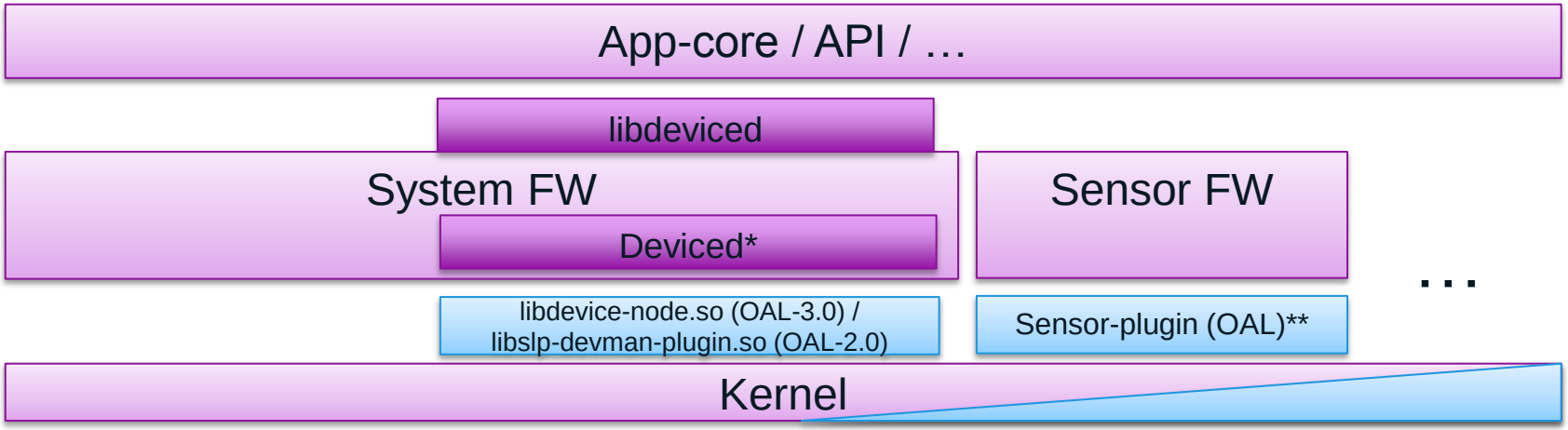
OEM Adaptation Layer (OAL)

- 각종 kernel node의 위치 및 사용방법 지정
- 참고:
  - Tizen 2.0/adaptation/*
    - System FW관련 부분:
      - Tizen 2.0/adaptation/ap_samsung/device-manager-plugin-exynos
      - Tizen 2.0/adaptation/intel_mfld/device-manager-plugin-mfld-blackbay
    - Alsa (sound) 관련 부분:
      - Tizen 2.0/adaptation/devices/alsa-scenario-*
    - …
- [ ] 부분이 vendor가 porting을 위해 채워 넣어야 하는 부분임.



* Tizen 3.0부터 Deviced로 억세스 경로가 통합됨. 2.x에서는 system server이며, system server (daemon)을 통하지 않고 devman library를 통해 OAL device node를 직접 억세스할 수 있음
** Subject to consolidation.

OEM Adaptation Layer (OAL)

- Example with system F/W (device manager / deviced) OAL.
  - Adaptation/ap_samsung/device-manager-plugin-exynos/src/device_manager_plugin_exynos.c

```
static OEM_sys_devman_plugin_interface devmanp;
EXPORT_API const OEM_sys_devman_plugin_interface *OEM_sys_get_devman_plugin_interface()
{
      devmanp.OEM_sys_get_display_count = &OEM_sys_get_display_count;
      devmanp.OEM_sys_get_backlight_min_brightness = &OEM_sys_get_backlight_min_brightness;
      . . .
      return &devmanp;
}
```

```
/* devman_plugin_intf.h */
typedef struct {
      int   (*OEM_sys_get_display_count) (int *value);
      int   (*OEM_sys_get_backlight_min_brightness) (int index, int *value);
      . . .
} OEM_sys_devman_plugin_interface;
const OEM_sys_devman_plugin_interface *OEM_sys_get_devman_plugin_interface();
```

  - https://wiki.tizen.org/wiki/Porting_Guide#System_OAL

- X graphics/input, OpenGL, ALSA, Gstreamer 및 기타 표준제정이 되어있는 component의 plugin은 해당 표준 plugin format을 사용.

Contents

- Tizen Kernel
  - Graphics, Multimedia, Memory Management
  - Power Management
  - Other Peripherals
- Core Daemons
- OEM Adaptation Layer (OAL)
- Future Development

Ongoing Development in Kernel+System

- 현재 Linux 3.10+로 Upstream 진행하는 New Feature의 지원 @ Tizen 3.0 Platform + Tizen Reference Kernel
  - Power Management, Low/Out-of-Memory, Peripheral, Sensors, Device-Tree (Single-Binary Multi-Device), …
  - Easy & Efficient DMA-CPU Synchronization & Cache Operation
  - Full V4L2 Support
- System Daemon/Library Consolidation
- Analysis Tool for Tizen Developers
  - For All: Native Apps, Web Apps, Frameworks, Kernel
  - Performance, Power, Memory, Security Analysis

TIZEN™

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

Additional Information

- Tizen.org, “Tizen Porting Guide”
- Collaboration Summit: Tizen Kernel Memory Management

- kernel/linux-3.10.git at Tizen.org will be very helpful.
  - “The Real Reference Tizen Kernel”