

ARM Reference Kernel of Tizen 3

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2014
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ARM Reference Kernel of Tizen 3

The background features a stylized illustration of a suspension bridge on the left, a city skyline in the middle, and a dark area with colorful confetti on the right. There are also several overlapping circles in shades of grey and yellow.

- 1. What is it?**
2. Idea & Principle
3. Design & Updates
4. Discussion

What is “Tizen Reference Kernel”

- Kernel (& BSP) for Tizen Reference Devices



BSP Validated & Tested for the Reference Devices

Image from seoz.com

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Need for “Tizen Reference Kernel”

- Distribute reference devices
- **Tizen-common kernel features & interface**
 - Basis for next-gen Tizen development
 - 1 KDBUS, User PM-QoS, PASS, DMABUF Sync FW, ...
 - 2 CMA, DRM-Exynos, Devfreq, Extcon, Charger-manager, LAB/Turboboost ...
- **Support Tizen Vendors!**
 - Well-known and well-written example.
 - Code basis for vendors.

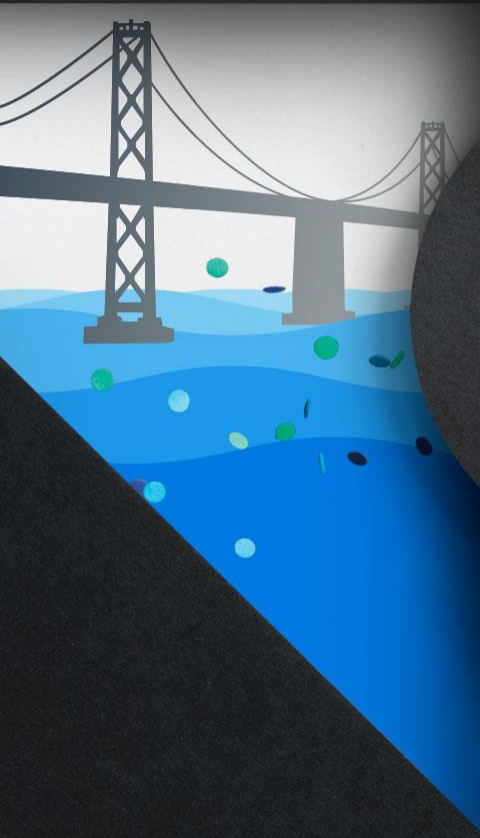
Previous Tizen ARM Reference Kernel (~2.2.1)

- **Linux 3.0.15**
 - Obsolete LTS. (Current: 3.4 & 3.10)
- **Support RD-PQ (Tizen 2) & RD-210 (Tizen 1 & 2)**
 - RD-PQ: Exynos4412
 - RD-210: Exynos4210 (Linux 2.6.36 for Tizen 1)
- **Not Good as Reference**
 - Too many backported features.
 - Too OLD! No LTS/LTSI support
 - Many kernel hacks & dirty patches
 - git history removed.
 1. Forked from production kernel.
 2. Hard to read

Status of Tizen 3 Reference Kernels

- **Two Reference Kernels: ARM / Intel**
- **ARM (armv7, aarch64)**
 - Linux 3.10.y
 - 3.10.33 @ 2014/05
 - Full git history.
 - armv6 support (Raspberry Pi) coming soon. (Thanks to Univ. of Warsaw)
 - Test & validation phase (integration test with userspace)
- **Intel (x86, x86_64)**
 - Linux 3.14.1
 - Recent ATOM SoC support merged @ 3.14
 - Test & validation phase (integration test with userspace)

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Mainline (kernel.org) Compliance 1/3

- **Subsystems from Mainline**
- **No {Forks, Staging, or Android-Kernel}**
- **Major Subsystems in ARM Reference**
 - Display Control / Buffer: DRM [GEM+KMS]
 - Multimedia: V4L2/VB2
 - IO Memory Allocator: CMA/IOMMU w/ buddy allocator
 - IO Memory Share: DMABUF
 - Charger: power-supply-class
 - Suspend-control: Non-opportunistic (original concept)
- **= x86 Reference**

Mainline (kernel.org) Compliance 2/3

- **Merge Tizen kernel subsystems into Mainline (upstream!)**
 - New Subsystems for Embedded Devices (Tizen devices)
 - Devfreq, Extcon, CMA, LCD-Panel, ...
- **Update Subsystems for Embedded Devices (Tizen devices)**
 - DRM, V4L2, Buddy-Allocator, SD/MMC, Regulator, Clock, ...

Mainline (kernel.org) Compliance 3/3

- **Results**
 - Run Tizen with Vanilla Kernel!!! (kernel.org direct download)
 - Easy to Rebase
 - Kept rebased since 3.5-RCx to 3.10.y
 - → Easier maintenance.
 - Show Case for Vendors
 - A few exceptions
 - Modem support (not very clean...)
 - MHL (mobile HD link) W.I.P.
 - MFC, Camera-IP: proprietary firmware

Mainline (Das U-Boot) Compliance

- Same Principle with Tizen Kernel
- Upload New Features
- Update Features

- → Boot-Up Tizen Reference Device (RD-PQ) with Vanilla U-Boot and boot-up Tizen kernel/platform.
 - ✨ Show Case for Vendors

- **Tizen.org's U-Boot vs Mainline-U-Boot**
 - Better Performance (M0 binary download)
 - More M0 hardware debugging support

Linux Kernel. LTS? LTSI?

- We “Try” to support recent LTS/LTSI kernels.
- **Long-Term Stable (LTS)**
 - Maintained by Greg K.H.
 - Bugfixes for 2 years or longer.
 - Up to 2 LTS kernels at the same time.
 - Recent: 3.10.39 (2014/5/6)
- **Long-Term Stable Initiative (LTSI)**
 - Maintained by Greg K.H. and some manufacturers
 - Forked LTS for Industry. (LTS + Industry Patchset)
 - Longer support period.
 - Recent: 3.10.31-LTSI (2014/2/24)



Fully Utilize Device Tree

- **No Hardcoded Board/Machine File**
- **XML Description of Device “dts”**
 - Compile with DTC: “dts” → “dtb”
 - ➔ Smaller Size / Faster Boot
- **Single Tree for Multiple Devices**
- **Single Binary for Multiple Devices!!**
 - Enforce code reuse
 - Easier maintenance
- **Mandatory in Linux-ARM Mainline**
- http://www.devicetree.org/Main_Page
- “Device Tree for Dummies” (eLinux)

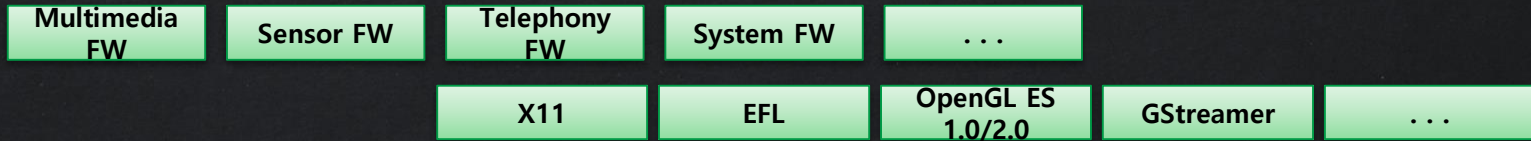
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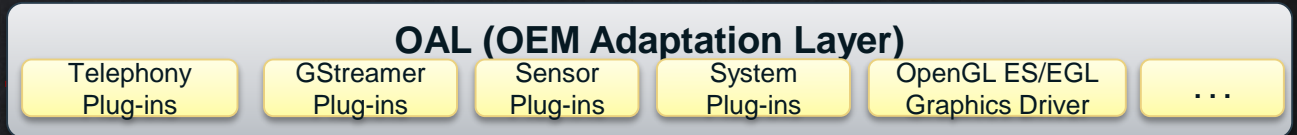
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Tizen 3 Reference Kernel Overview

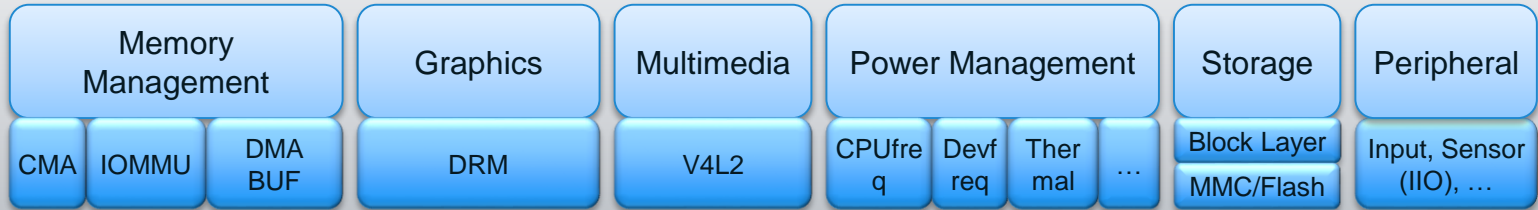
Core



Kernel

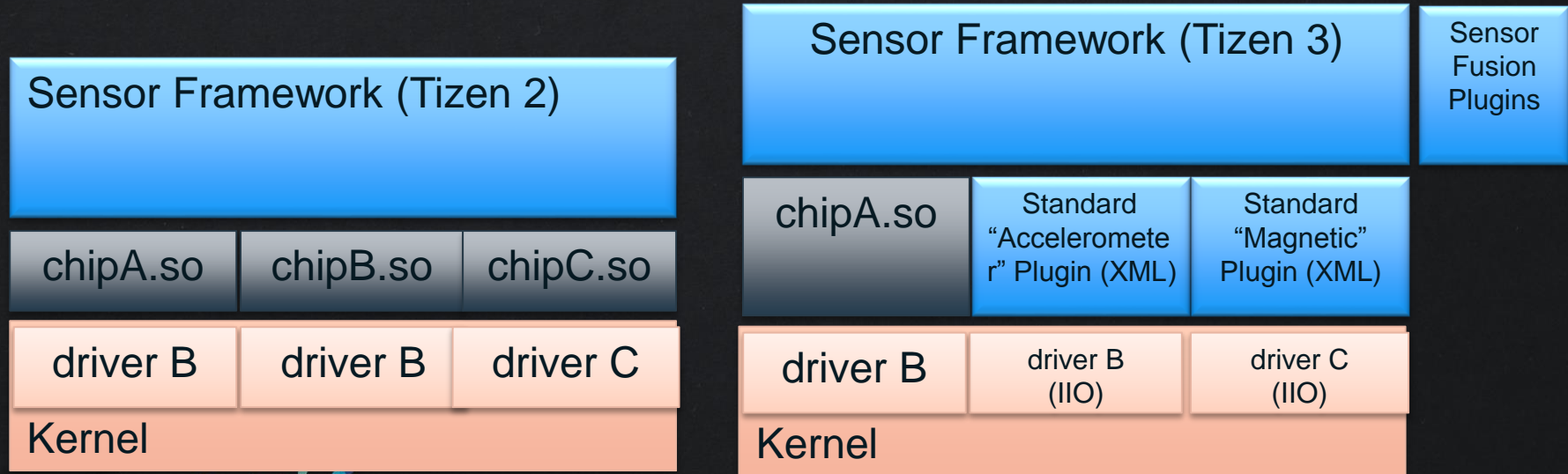


Kernel



Sensors: MAJOR REWORK!!!

- **No More Weird Plugins (.so) Required (still supported)**
 - Along with major rework in sensor framework + (real) sensor fusion.



EXTCON (External Connector)

- **Yet Another Weird Ad-hoc Kernel Hacks Removed**
- **Manage status of cable & ports**
 - A port with multiple cables (docks, multi-cables, ...)
 - A port with multiple modes (USB, HDMI, TA, ...)
 - 3.5pi: stereo, stereo+mic, stereo+mic+buttons, stereo+buttons, mono, ...
- **Compatible with Switch**
 - Android Switch drivers can be easily ported
 - Refer to Linux/Documentation (porting guide for switch driver)
 - Extcon drivers export both Switch and Extcon interfaces (compat mode)
- **In Reference Device**
 - MUIC (USB+HDMI+TA+DOCK+...)
 - 3.5Pi Jack

Charger

- **Charger Manager (/drivers/power/charger-manager.c)**
 - All needed by Tizen userspace are prepared
 - No OAL modification required
- **OR supply battery/charger interface with power-supply-class**
- **Use EXTCON for Cable-Input (MUIC in mobile)**
 - Switch class is no longer available in Linux.
- **Note: some SOC (state-of-charge) value is required for mobile profile. Unless, Tizen will assume that SOC is 0 → Shutdown!**

Power Management

- **Recommendation For Tizen 3.0 or later**
 - Do not use DVFS (CPUfreq/Devfreq) min/max ABIs
 - PASS (Power-Aware System Service in Deviced) uses
 - Use (keep their standard ABIs for PASS)
 - CPUfreq & Devfreq (DVFS for non CPU devices if you have them)
 - Thermal FW
 - PASS gives hints to DVFS/Hotplug
 - based on the info from userspace.
 - based on the other kernel ABIs (e.g., Thermal)
 - highly configurable. (control knob of performance & power)

Graphics

- Tizen Graphics Standard: DRM (Direct Rendering Manager) /

Linux

DRM Common Framework

drm_mode_config

drm_fb_helper

GEM

Crtc

Plane

Connector
Encoder

drm_framebuffer

Crtc

Plane

Connector
Encoder

drm_framebuffer

fb_info

GEM

Allocator



Common

Specific

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Graphics

libdrm updated with Tizen 3

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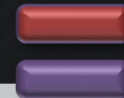
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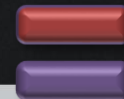
GEM

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Allocator

Questions from Embedded Vendors...
“What if SoC vendor supports FrameBuffer only?”

Use Framebuffer (No DRM-KMS) + DRM-GEM

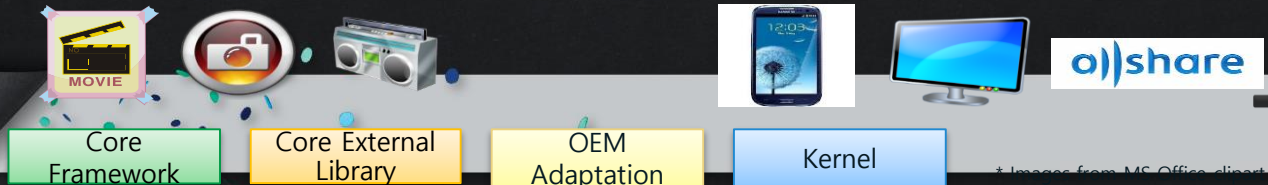
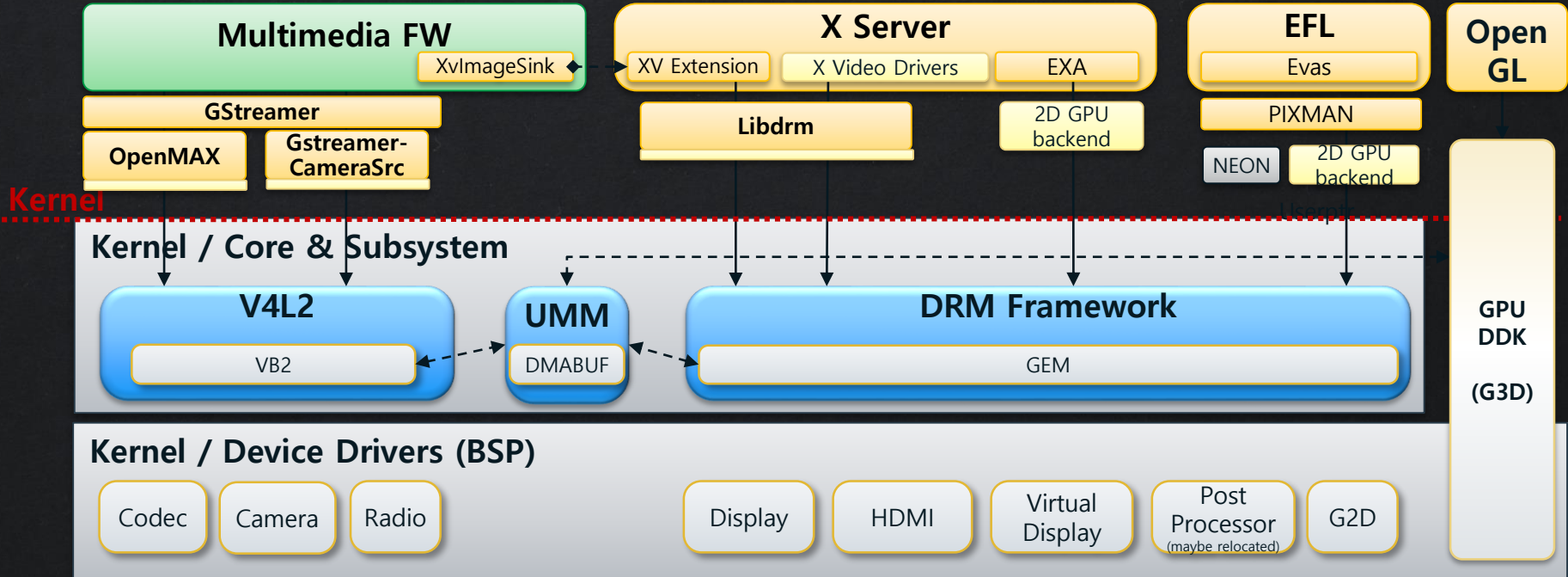


Common

Specific

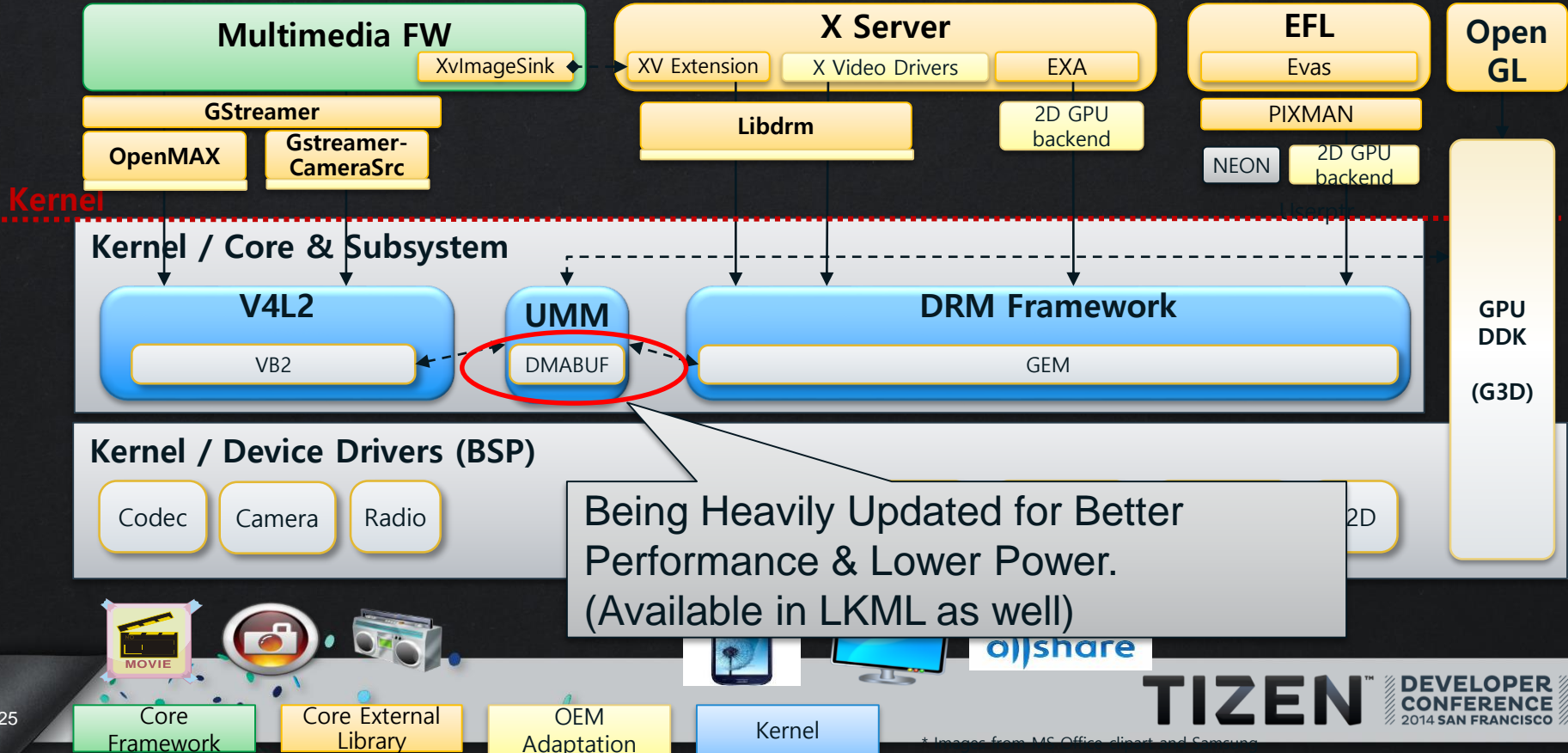
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Memory Management 1/3



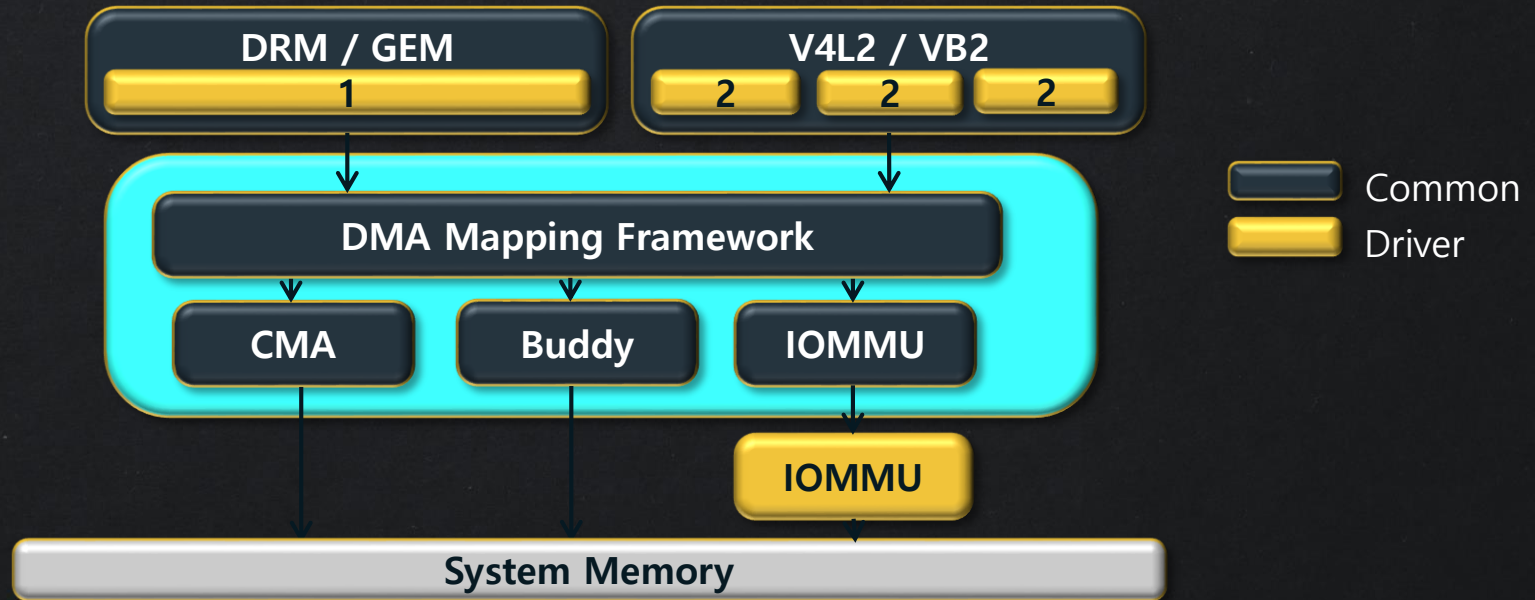
* Images from MS Office, diigo, and Samsung

Memory Management 1/3



Memory Management 2/3

- UMM (Unified Memory Management)



Memory Management 3/3

- **Incoming Features**
 - DMABUF Synchronization Framework
 - Adaptive IOMMU TLB
 - Reduced TLB Misses
 - Integrated Cache Operations
 - No More Userspace Cache Operations
 - Reduced Cache Operations
- **Better Power-Performance Efficiency**
- **Upstreaming at the same time.**

Multimedia

- **Camera**
 - V4L2 + Default Gstreamer Plugin
or
 - HAL + Gstreamer Plugin
- **Video Codec**
 - OpenMX IL Interface (for GstOpenMax)
- **Sound Codec**
 - ALSA

Recap...

- **Removed weird kernel hacks**
 - External ports/cables
 - Sensors
 - Chargers
 - Updated DRM
 - ...
- **Updated for better performance & efficiency**
 - Memory management (DMABUF and its friends)
 - Power-Aware System Service (userspace helper for kernel PM)

Recap...

- **Removed weird kernel hacks**

- External ports/cables
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Of Course...
That is not ALL!

64bit Support (AARCH64)

- **Kernel Ready (dev/aarch64 in linux-3.10.git of Tizen.org)**
 - For Fast Models (ARMv8 Versatile Express Board)
- **Fixing incompatible packages in Tizen.org (~1000)**
 - Remaining build errors: ~50.

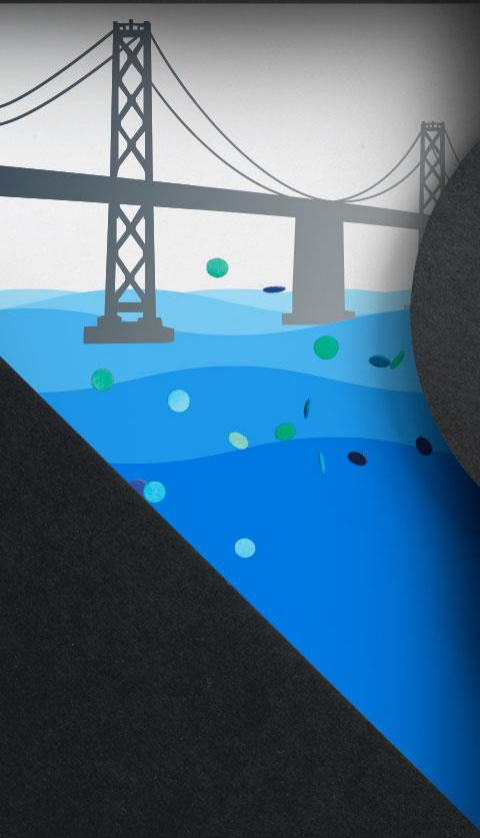
```
Packages (2014/5/23)
Success: 796
Failed: 24
Unresolvable: 25
```

- Created test AARCH64 Tizen platform image. (5/12)
https://build.tizen.org/project/show?project=devel%3Aarm_toolchain%3AMobile%3AMain
- **x86_64: Done**

Supported Devices with “linux-3.10.git in tizen.org”

- **Official**
 - RD-PQ (a.k.a. M0 or TRATS2), the official Tizen mobile reference
- **Not Official**
 - Odroid X2
 - Odroid U3
 - Gear2
 - RD-210 (a.k.a. U1HD or TRATS), previous official reference
- **Some other Exynos4 and Exynos5 boards supported with the vanilla.**
- **Experimental**
 - ARMv8 Versatile Express (for Fast Models)
- **Out-of-tree**
 - ARMv6 for Raspberry Pi

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Update Tizen Reference Kernel Version?

- **Which LTS/LTSI to Use?**

- “The most recent LTS, 4 months before major Tizen version release”

- 1 As of 2014.5., Linux 3.10

- 2 Intel IA Reference: Linux 3.15

For 3.0, LTS/LTSI won't be supported.

Intel is also going to support LTS/LTSI from the next version.

- Keep the high code quality for easier rebase (e.g., 3.10 → 3.16)

- **LTS→LTSI conversion?**

Tizen for Smaller Devices (<128/256?)

- **Minimize Hardware Reservation**
 - CMA + IOMMU
- **Minimize Kernel Size**
 - [Trivial but important] “.config” Consolidation
 - 1 We need to publish “minimized .config” for Tizen 3
 - Appended DTB (no/minimized board/machine files)
- **UcLinux for NO-MMU?**
 - UcLinux has been poorly maintained recently
 - 1 No new devices/Linux to support
 - After porting, it seems to work but no real benefit (for MMU devices)
 - 1 Virtually no memory saving
 - 2 Userspace might suffer from inefficient memory usage.