ARM Reference Kernel of Tizen 3

MyungJoo Ham, Ph.D.
Tizen “System Domain” & “Base Domain” Architect

Samsung Electronics
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
What is “Tizen Reference Kernel”

- Kernel (& BSP) for Tizen Reference Devices

Yet Another BSP?

BSP Validated & Tested for the Reference Devices
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/Turbobooth …

- 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)
1. What is it?

2. Idea & Principle

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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: “dtc” → “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](http://www.devicetree.org/Main_Page)
• “Device Tree for Dummies” (eLinux)
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Tizen 3 Reference Kernel Overview
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`

  **Specific Functions**
  
  - `Crtc`
  - `Plane`
  - `Connector Encoder`
  - `drm_framebuffer`
  - `fb_info`
  - `Allocator`

  **Components**
  
  - `Crtc`
  - `Plane`
  - `Connector Encoder`
  - `drm_framebuffer`
  - `fb_info`
  - `Allocator`
Graphics

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

libdrm updated with Tizen 3
• Tizen Graphics Standard: DRM (Direct Rendering Manager) / Linux

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

Use Framebuffer (No DRM-KMS) + DRM-GEM
Memory Management 1/3

**Multimedia FW**
- XvImageSink

**Kernel / Core & Subsystem**
- V4L2
  - VB2
- UMM
  - DMABUF
- DRM Framework
  - XV Extension
  - X Video Drivers
  - EXA
  - Libdrm
  - 2D GPU backend
- EFL
  - Evas
  - PIXMAN
  - NEON
  - 2D GPU backend

**Kernel / Device Drivers (BSP)**
- Codec
- Camera
- Radio
- Display
- HDMI
- Virtual Display
- Post Processor (maybe relocated)
- G2D

**Open GL**
- GPU DDK (G3D)

* Images from MS Office clipart and Samsung
Memory Management 1/3

- **Kernel / Core & Subsystem**
  - V4L2
  - UMM
  - DRM Framework

- **Kernel / Device Drivers (BSP)**
  - Codec
  - Camera
  - Radio

- **Multimedia FW**
  - GStreamer
  - OpenMAX
  - Virtual Display

- **X Server**
  - XV Extension
  - X Video Drivers
  - EXA
  - Libdrm
  - 2D GPU backend

- **EFL**
  - Evas
  - PIXMAN

- **Open GL**
  - NEON
  - 2D GPU backend

- **Images from MS Office clipart and Samsung**

Being Heavily Updated for Better Performance & Lower Power. (Available in LKML as well)
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.