Agenda

Life of Android device kernels
“The Android Problem(s)”
... and their solutions.
Android Kernel Development Process
Project Treble & Kernel
Questions
Life of Android device kernels

- Stable Long Term Support
- Android Common
- SoC Kernel
- Device Kernel

Device Release → Device Update → Device Update → Device Update
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<th>The Android Problem(s)</th>
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<td>Shipping older kernels</td>
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<td>Manage multiple kernel versions</td>
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<td>Slower (non-existent) kernel updates</td>
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<td>Lack of automated continuous testing of latest kernels with Android.</td>
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Problem #1 & 2: Older & Multiple kernels

- Android Oreo: 3.18, 4.4 & 4.9
- Android Pie: 4.4.107+, **4.9.84+**, 4.14.42+
  - ~2 year delay.
- Android platform MUST continue work on following kernel versions.
  - 3.18, 4.4, **4.9**, 4.14, 4.19
Managed with testing

- **LKFT** tests of LTS, rc, android common...
- **kernelci** testing of android common kernels
- LTP improvements: syscall coverage, fixing breakage
- Pre-submit testing on Android kernels using “Cuttlefish”
- Testing from SoC vendors.
Problem #3: Slower (non-existent) kernel updates

- Major/minor kernel upgrade is still an issue with carriers and vendors alike.
- Android Oreo: Minimum kernel version defined and required.
- Android Pie: Minimum kernel version with LTS defined and required.
- Plan to continue moving the needle.
- Include LTS releases instead of Patches in security bulletin
  - “A bug is a bug is a bug”.
Problem #4 & 5: Lack of testing targets for Android

- None of the Android devices run mainline kernels.
- Problem for both Android & kernel developers.
- Large amounts of out-of-tree code.
  - Android common
  - Hardware support
Problem #6: Millions of lines of out-of-tree code

- Android common kernel
  - Many patches have been merged upstream or are now obsolete for v4.19
  - Android v4.19 kernel has about ~30 patches.
    - 83 files changed, 6474 insertions(+) and 173 deletions(-)
    - Numerous changes are dropped in v4.19 as a result of deprecation, user space alternatives and/or upstreaming.
  - Work yet to be upstreamed:
    - Binder priority inheritance, EAS, SDCardFS etc.
Problem #6: ...

- Upstreaming out-of-tree hardware specific code...

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(.. but more on this later)
Android kernel development Process updates

- Upstream first!

- Proactively report vulnerabilities and work w/ Upstream.

- Mainline, -next, -stable testing on ARM hardware.
  - Same done with Cuttlefish on emulated hardware.
Project Treble & Kernel

- **Vendor Interface (VINTF)**
  - Collection of versioned HAL interfaces
  - **Linux Kernel**
- **Generic System Image (GSI)**

**Framework Build**
Part of the Android build that is hardware-agnostic

**VINTF Implementation**
Part of the Android build that is aware of the hardware and implements the corresponding Vendor Interface (VINTF)

**Android Framework**

**HAL Interface**

**Applications**

**Vendor Implementation of HAL Interface**

**Linux Kernel**

**Hardware Components**
Platform vs Vendor Split

Vendor Implementation of HAL Interface
Make a “Generic” kernel possible for Android

GSI + GKI

Vendor Implementation of HAL Interface

Linux Kernel Modules for SoCs / Peripherals
How can we get there ...

- Kernel symbol namespaces
- Single compiler for Android
  - Both userspace and kernel.
- In-kernel ABI monitoring
More updates in Android MC

- Userspace low-memory killer
- Userdata checkpoints
- De-staging: Ashmem, Ion.
- DRM/KMS
- Updates on Android’s use of Device Tree.
- LVM, Android and resizable partitions.
Questions?