



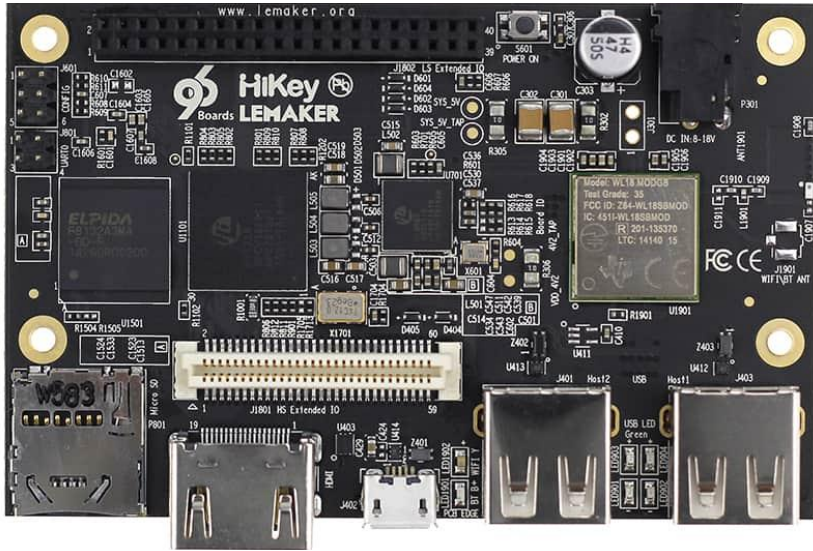
AOSP Devboards

Linux Plumbers Android Microconf 2017
[John Stultz](#) & Dmitry Shmidt



Now there are two: <https://source.android.com/source/devices>

HiKey



HiKey960



Hardware overview

HiKey

- HiSilicon Kirin 620 SoC
- 64bit ARM A53
- 8 Cores
- 1 or 2 GB RAM
- 4 or 8 GB eMMC
- Mali 450 (Utgard) Graphics
- USB2 Type A & USB-OTG
- [\\$100-120](#)

HiKey960

- HiSilicon Kirin 960 SoC
- 64bit ARM 4xA53 + 4xA73
- 8 core big.LITTLE design
- 3 GB RAM
- 32 GB UFS Storage
- Mali G71 (Bifrost) Graphics
- PCIe
- USB3 Type A & USB-C (USB2)
- 5GHz WiFi & BT 4.1
- [\\$240](#)

Remaining out-of-tree patches (4.14-rc)

HiKey

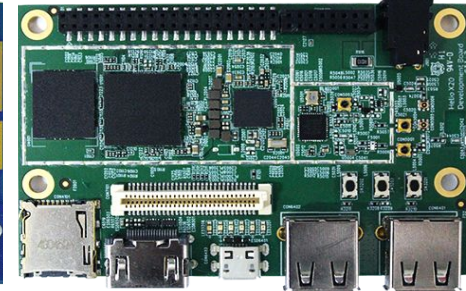
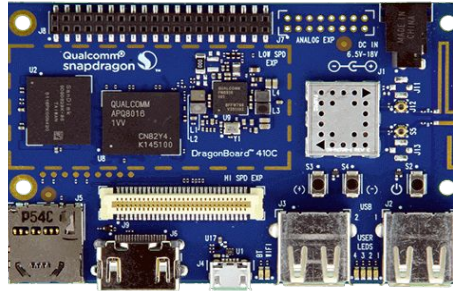
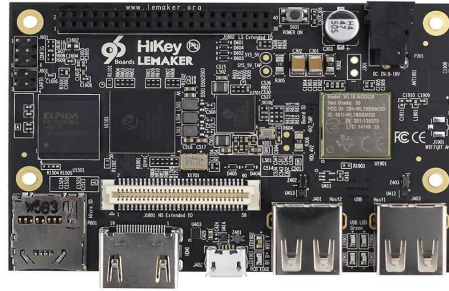
- Minor USB improvements
- ION ABI revert HACK
- Mali gpu

HiKey960

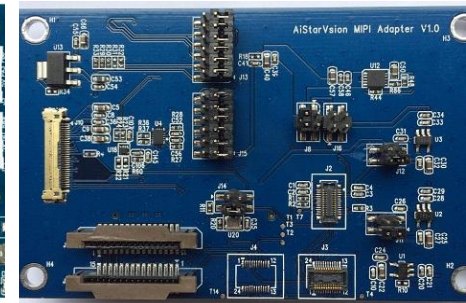
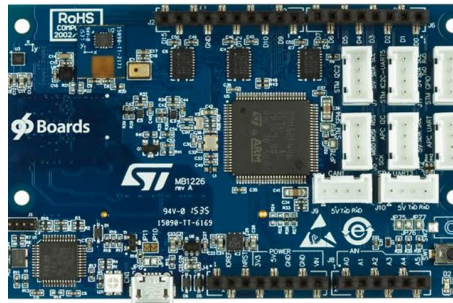
- regulators
- ufs
- mailbox
- cpufreq/thermal
- usb
- iommu
- drm driver
- dts
- Mali gpu
- ...

96Boards.org

Vendor neutral hardware standard for developer boards

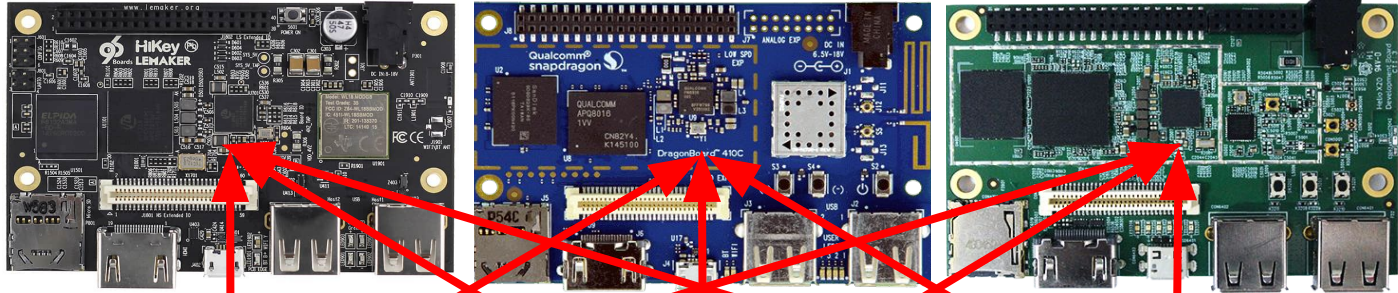


Allows ecosystem of peripherals that can be shared



96Boards.org

Vendor neutral hardware standard for developer boards



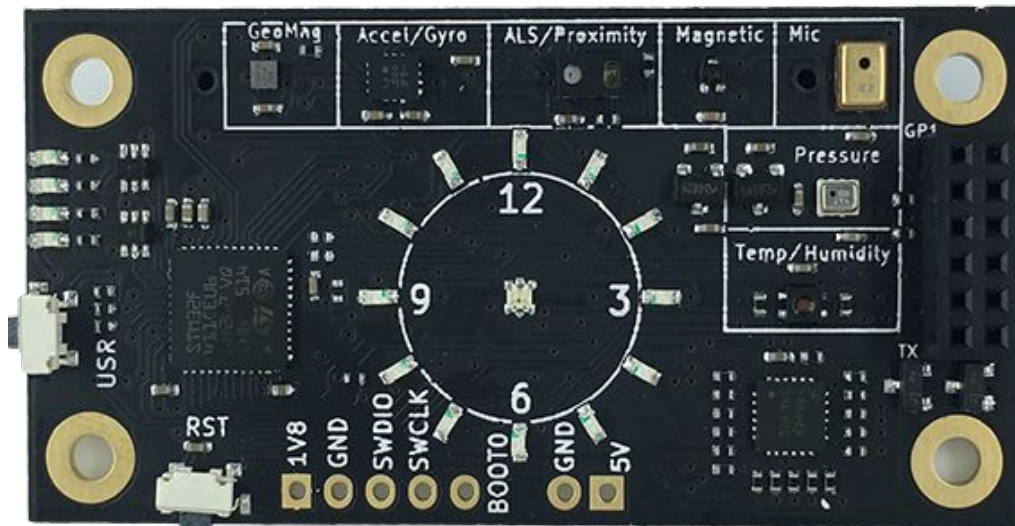
Allows ecosystem of peripherals that can be shared



Neonkey

Neonkey is certified 96Boards mezzanine: <https://source.android.com/source/devices#neonkey>

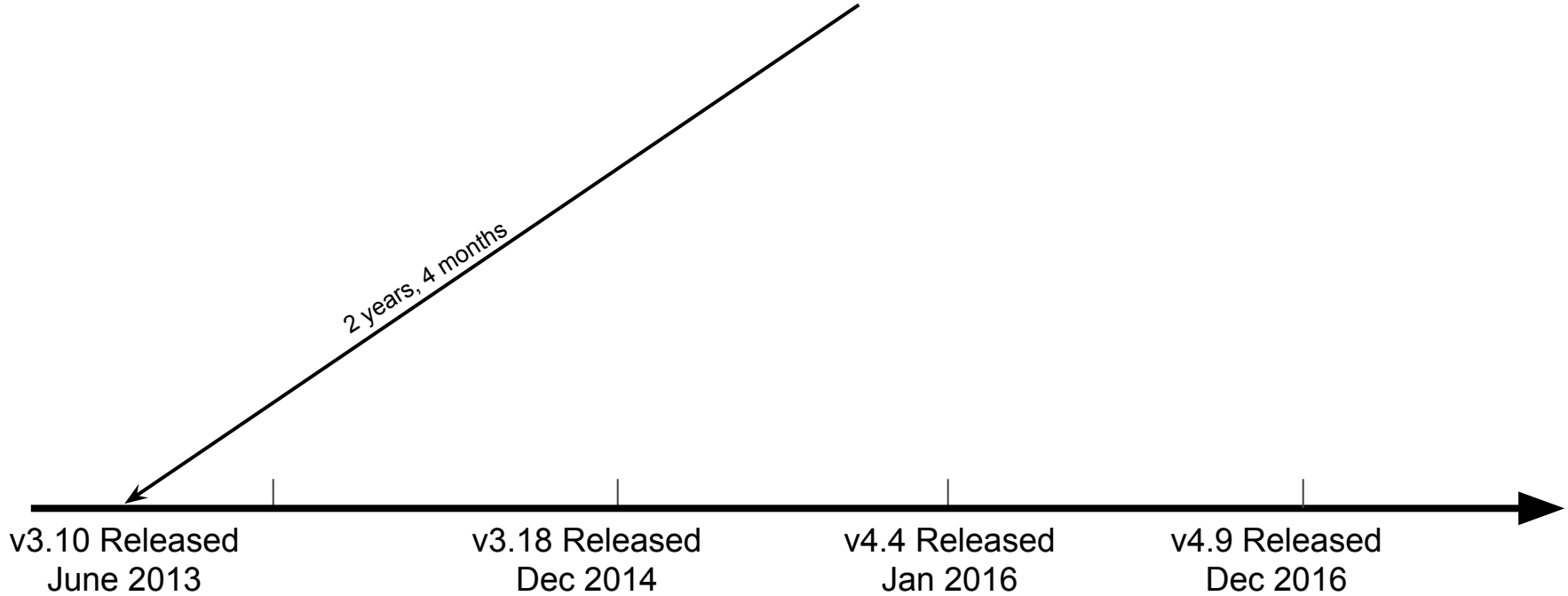
- CPU: STM32F11CE
- NOR Flash: 512 KB
- SRAM: 128 KB
- Pressure sensor: BMP280
- ARM Hall sensor: MRMS501A
- Temp/Humidity sensor: SI7034-A10
- ALS/Proximity sensor: RPR-0521RS
- LED driver with 15LEDs: LP3943
- Accel/Gyro+Geomagnetic sensors:
 - BMI160+BMM150
- 4 GPIO-driver LEDs
- I2C expansion
- GPIO (2 lines) expansion
- JTAG connector
- 96Boards LS Expansion connector



New Phones, Old Kernels



2015 Nexus devices
(Oct 2015)



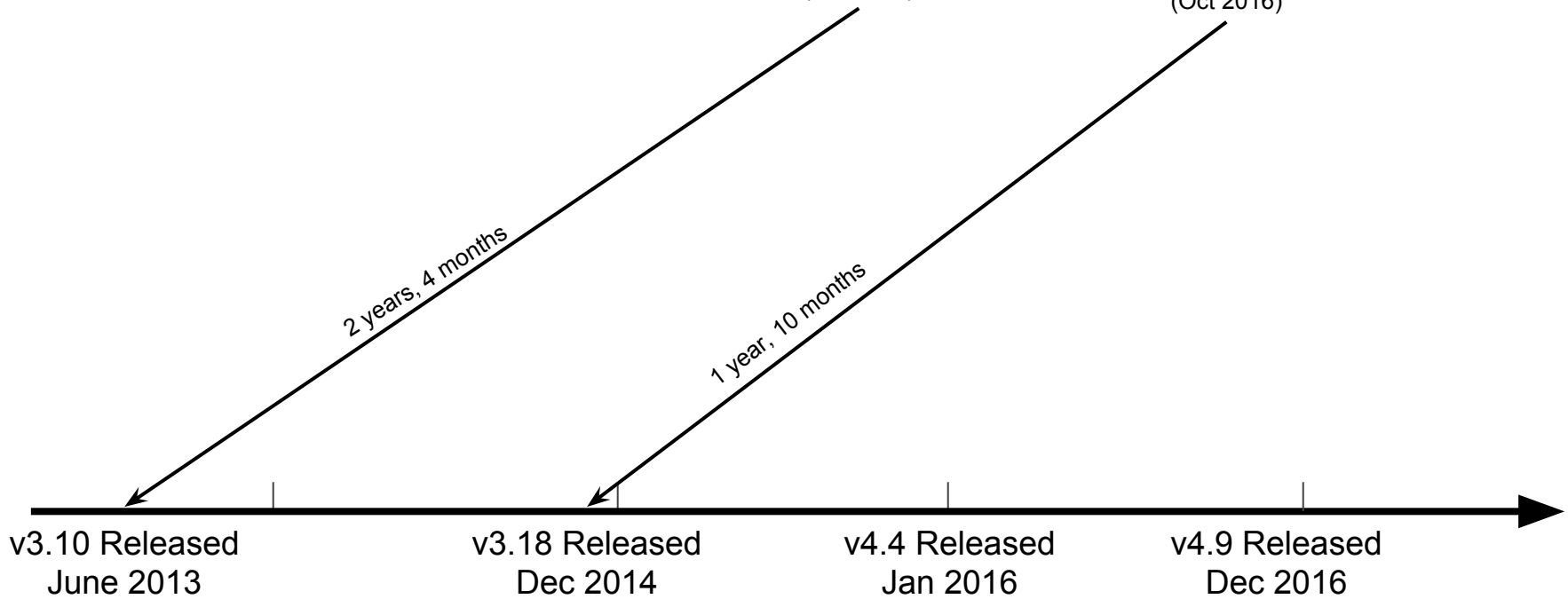
New Phones, Old Kernels



2015 Nexus devices
(Oct 2015)



2016 Pixel Phone
(Oct 2016)



New Phones, Old Kernels



2015 Nexus devices
(Oct 2015)



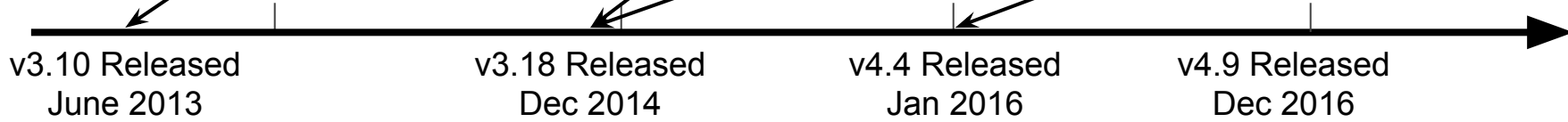
2016 Pixel Phone
(Oct 2016)



Early 2016 Flagship
(Mar 2016)



Early 2017 Flagship
(April 2017)



A Year Ahead



2015 Nexus devices
(Oct 2015)



2016 Pixel Phone
(Oct 2016)

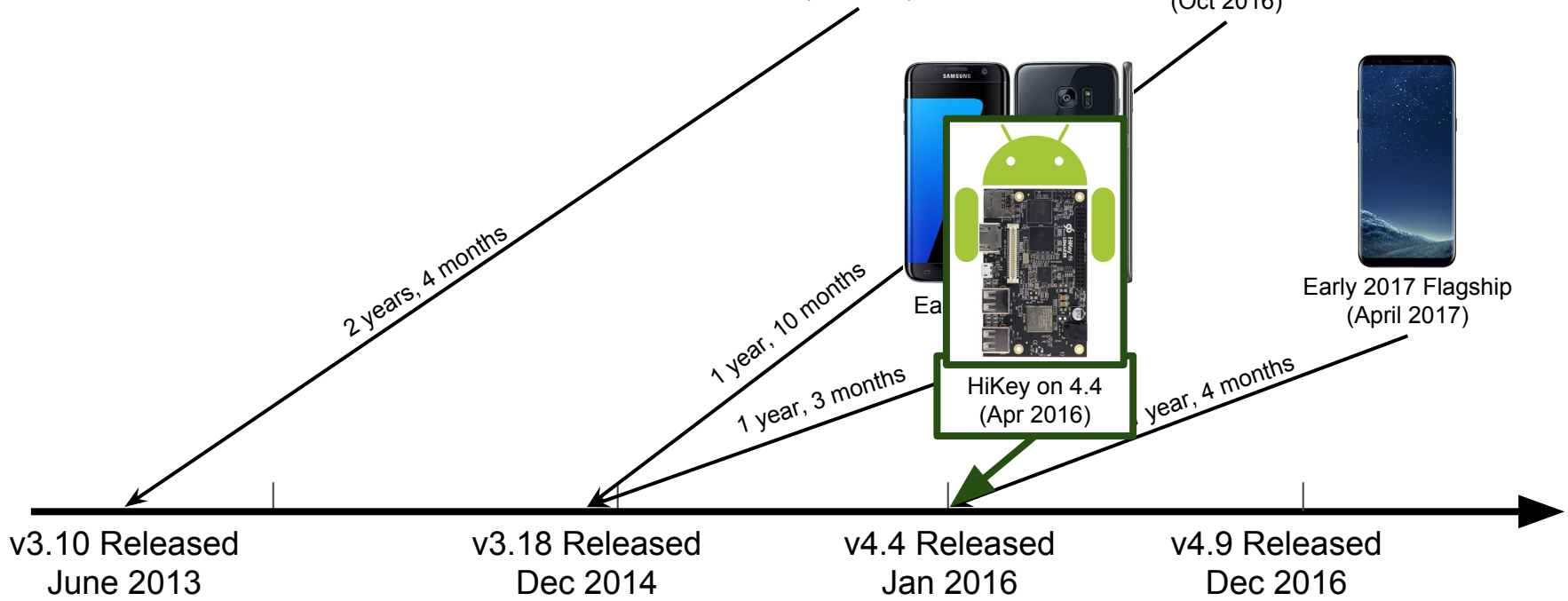


Ear

HiKey on 4.4
(Apr 2016)



Early 2017 Flagship
(April 2017)



A Year Ahead



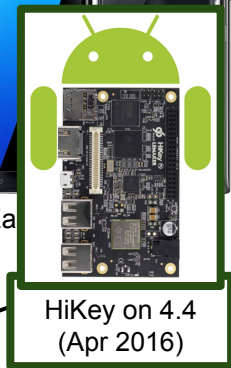
2015 Nexus devices
(Oct 2015)



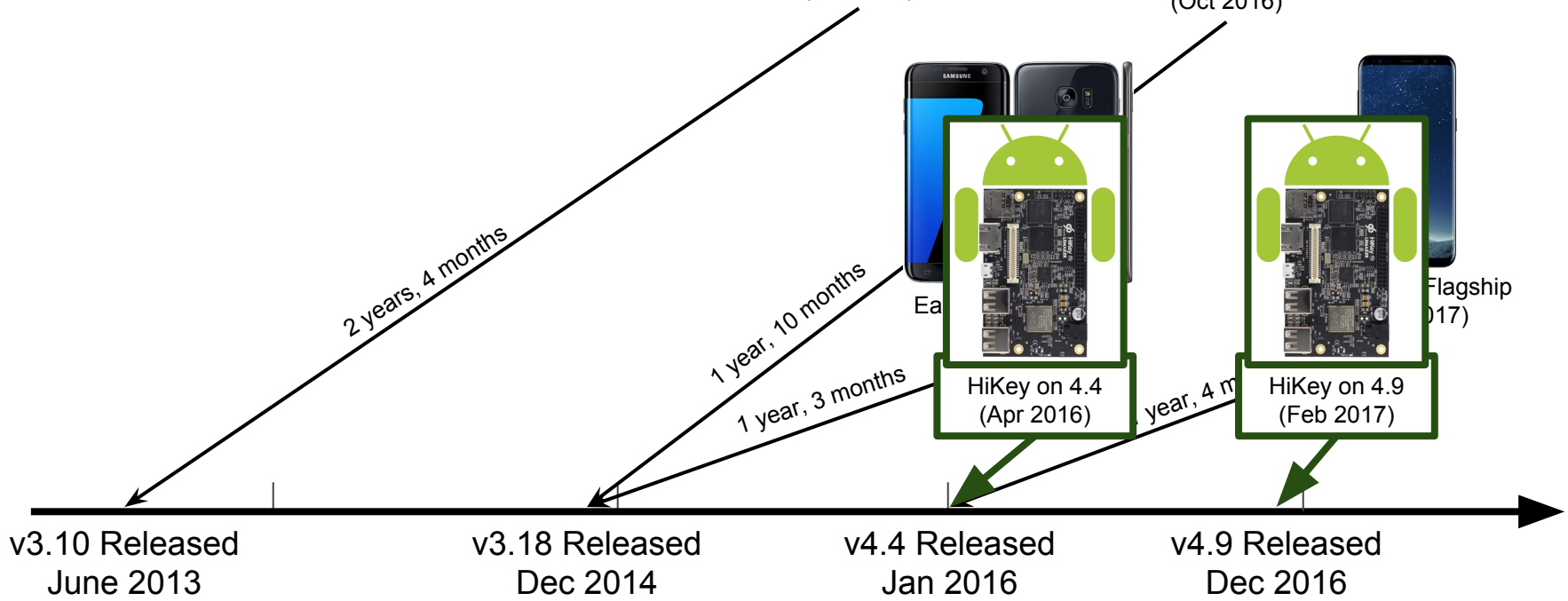
2016 Pixel Phone
(Oct 2016)



Es



Flagship
(2017)



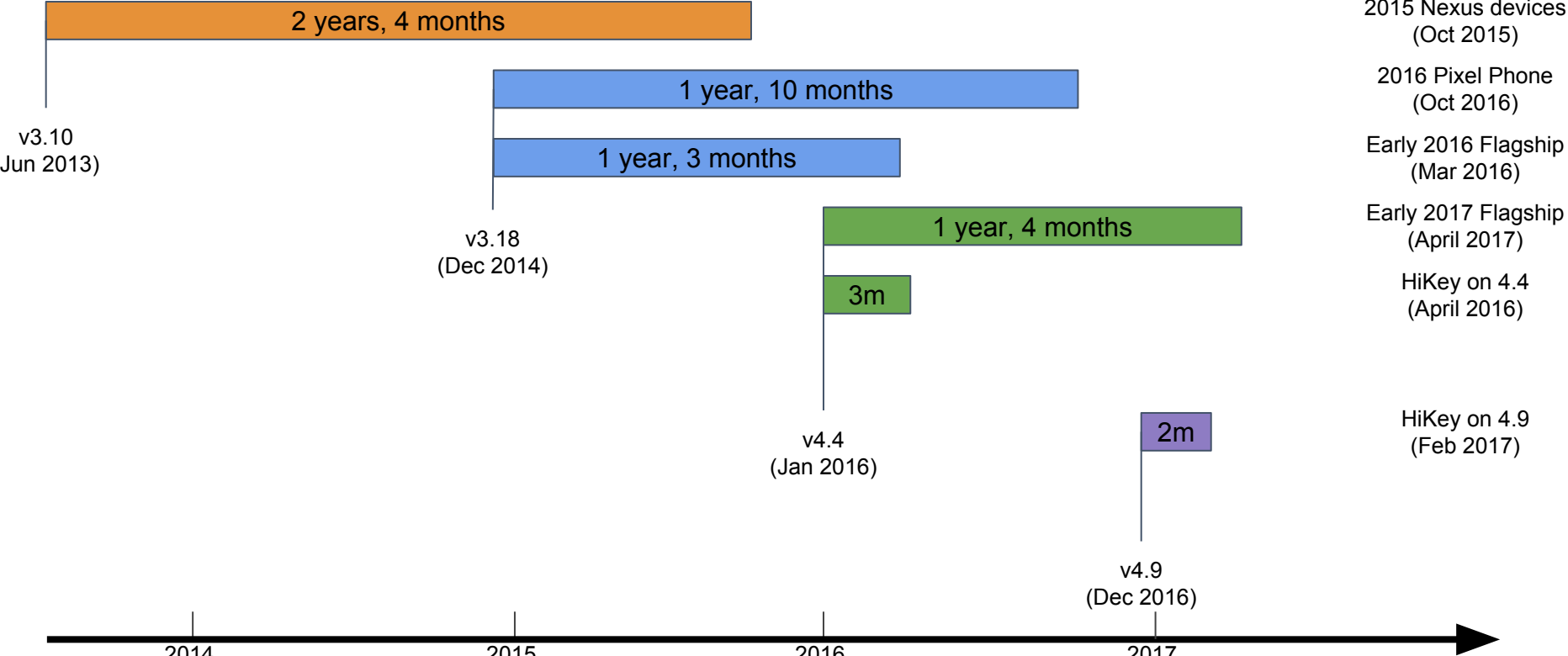
v3.10 Released
June 2013

v3.18 Released
Dec 2014

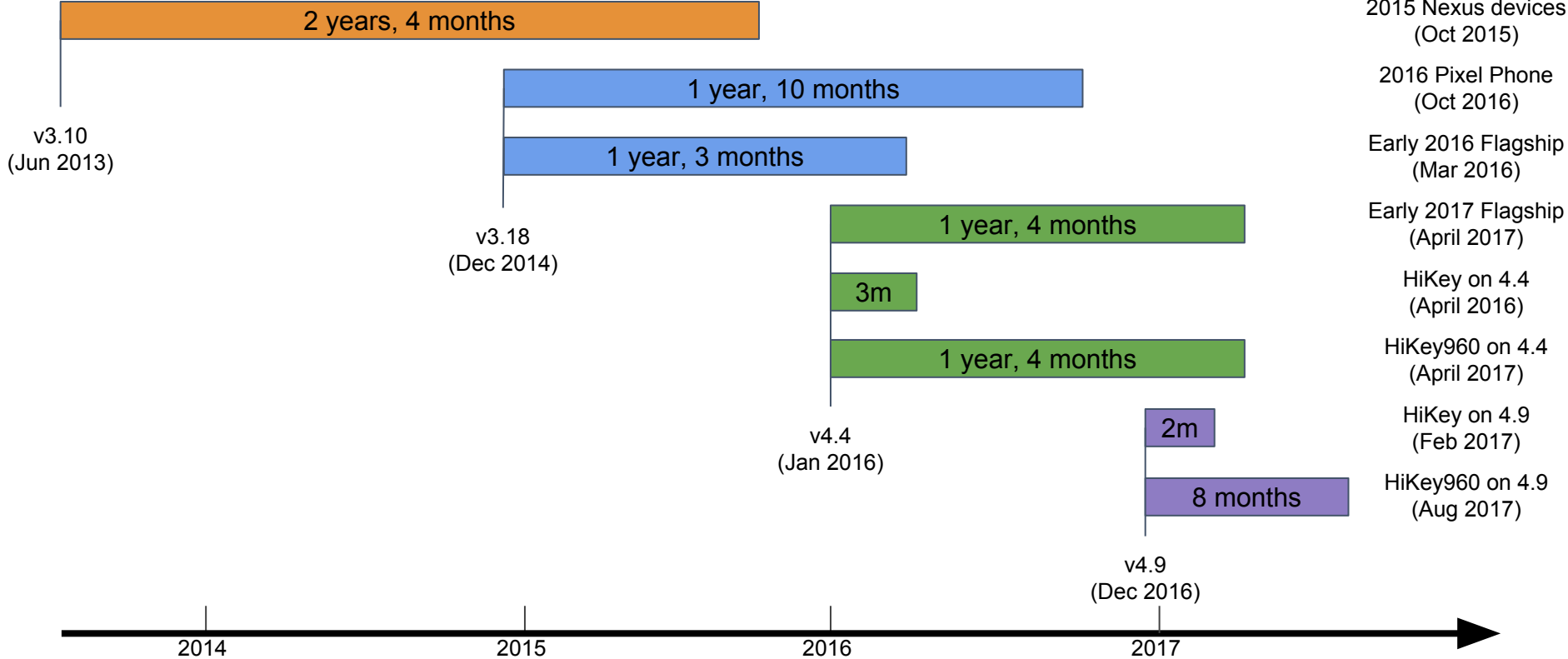
v4.4 Released
Jan 2016

v4.9 Released
Dec 2016

Kernel/Device Release Latencies



Kernel Release Latencies





Benefits to Android Devs

- Inexpensive Android development board
- Amount of board-specific patches is small
- Helps development of new Kernel features
 - Android Verity
 - Hibernation
 - Sdcardfs
 - SELinux
- Validation of Kernel patches / -stable updates
 - Wide range of supported kernels
 - Example: 3.18, (4.1), 4.4, 4.9
- Development of Android runtime libraries
 - Wide range of supported kernels

Benefits to Android Devs (cont)

- Development of new Bootloader features
 - UEFI bootloader is provided in source
 - Boot to RAM
- Development and Support of new Hardware modules
 - Display boards
 - Camera modules
 - Sensor modules (ex: Neonkey sensorhub)
 - Connectivity modules
- Use of overlay manager to support various hardware configurations
- Testing
 - Manual
 - Automation



Upstream Testing

Have a AOSP target that can run mainline kernels.

- LKFT efforts (previously covered)
- Weekly manual testing every mainline -rc release w/ HiKey
- Manually testing mainline ~daily during merge window
 - Small enough patchset that rebase-bisection isn't bad

Found and reported numerous regressions against upstream (SELinux, drm, binder, ipv6 networking, etc)

Also reported a number of issues that AOSP needs to address to work with upstream kernels (New SELinux policies, dma_buf fences, ION destaging ABI break)

Recent efforts

Bring-up and validation of android-4.9 kernel tree

HiKey960 migration to v4.9

Transition to Generic Linux Bluetooth HAL (hikey & hikey960)

Parameterized EAS PowerHAL to make it shared/reusable

Migration to new mali driver, which works w/ dma-buf fence SYNC_FILE interface

Gralloc binderization & migration to opensource gralloc on hikey960

Migration to Android O

INPROGRESS: libION/Gralloc support for old and new (4.12+) ION ABIs

INPROGRESS: Hibernation proof-of-concept support on HiKey

Direction forward

Utilize HiKey as arm64 target for lots of upstream and LTS testing

HiKey960 upstreaming

UEFI transition(hikey960), updates & improvements (A/B, ?)

drm_hwcomposer

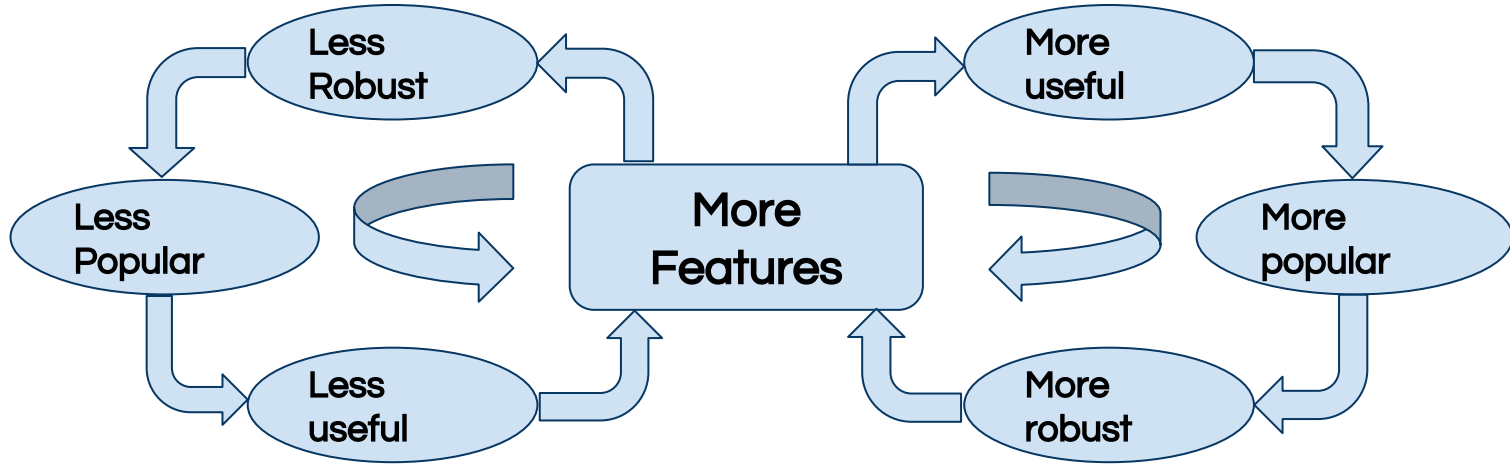
android-4.14 bringup and validation

Proving ground for upstream EAS

Improved treble implementation

Upstream DT fragments/overlay solution

Virtuous and Vicious Dev. Board Circle



- When dev. board becomes more useful for community, more people will use it and more people will fix issues. To do this we need to add more features.
- Adding more features will add more problems making the board less popular and therefore less useful.
- We want right circle to “spin” quicker than left one.
- Dialectic law: transition from quantity to quality.

AOSP pain points

Devboards aren't really mobile devices (no panel, touch, baseband, etc)

Devboards aren't "product" level targets internally, so AOSP changes break them fairly often.

Support Effort/Load (bugs/feature requests):

- HiKey: ~240 over 2 years
- HiKey960: ~ 60 over 0.5 years
- ~1 issue every 3 days

Mali blobs make us dependent on ARM for continued support of hardware

No real space for developing shared/common HALs (cross-project dependencies avoided)

Very difficult process to add/update project trees

Community pain points

Support multiple older kernels (v3.18, v4.4, v4.9, v4.14)

Difficult to develop clean solutions that cross all those points.

Example: `drm_hwcomposer` HWC2 implementation needs changes in v4.10+

Still need something for v3.18, v4.4 kernels

Android Sync/dma-buf fence transition, ION ABI changes, etc have been difficult

Would be nice if upstream efforts provided better migration paths



LMG
Mobile

Other Work

Generic Build

- Kconfig based
- Supports multiple devices/architectures from single build system
(db410c, db820c, nexus7, qemu-x86_64, qemu-aarch64, raspi3, etc)
- Need more community involvement

Work on open-graphics stack

(mesa3d, gbm_gralloc, drm_hwcomposer, libdrm)

Questions/Discussion

Anyone outside of Linaro/Google finding this helpful/useful?

Price vs Power preference?

Upstreaming board support takes a frustratingly long time!

Multiple boards (and supporting multiple kernels) is hard to scale!

Still not getting to the point where we're really pushing some of the advanced Android functionality upstream (offloaded sensor collection, wifi/bt scanning, etc).

Standard Kernel interfaces for Android are becoming a smaller issue than standard bootloader interfaces for Android (Reboot reason, dtb handling, fastboot flashing, secure boot, A/B updates, etc). Some work going on in UEFI, but with limited resources.

Thank you!

Questions: John Stultz <john.stultz@linaro.org>