
Halium Documentation

Halium Documentation Contributors

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Porting Guide

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Welcome to the [Halium](#) porting guide. Halium is a collaborative project to unify the Hardware Abstraction Layer for projects which run GNU/Linux on mobile devices with pre-installed Android.

What is porting about - in a nutshell

Think of your device as a car. You have got a petrol car (Android). You want to put in an electric driven engine (target OS). In the garage you are told you can put in a diesel engine (e.g. Lineage OS). Fine, so your car is capable of exchanging the engine. Now you need to get all parts for your new engine (kernel, firmware, . . .), assemble them and build them into your car (porting). And because every car's chassis is different, you can not use the parts of a Ford to use with a Porsche. That's why every type of car needs its own engine (port). Got it?

2.1 First steps

This page contains the first steps you should take to start a Halium port.

2.1.1 Getting help

If you get stuck at any point during the porting process, we're here to help! You can contact us via the following support channels:

- IRC: #halium on Freenode
- Matrix: #halium:matrix.org
- Telegram: @halium

When you contact us, please use a pastebin service like pastebin.com to **pastebin the full log** of whichever step you are at. Also please point out which section of the documentation you're stuck on.

2.1.2 Pick an Android target device

If you're here, you probably already have a device in mind that you wish to port to. However, we still encourage you to port to devices that meet the following requirements:

Source availability Your device must have its Linux kernel source publicly available. The source code required to build LineageOS 12.1 or 14.1 must also be available. Both of these should be available if your device has a LineageOS 12.1 or 14.1 port, or a port of a LineageOS derivative based on these versions.

Kernel Halium currently requires a device with a Linux kernel version greater than or equal to 3.10.0. According to the [systemd v217 README](#), older device kernels are not compatible with systemd v217 or newer. You may learn your device's kernel version by finding "Kernel Version" in the About page of your Android settings. The kernel version can also be found in the `Makefile` at the top level of any Linux kernel source tree.

Some Halium distributions may use a kernel as old as 3.4, such as Ubuntu Touch.

RAM 1GB of RAM is sufficient to start most Halium distributions. 2GB or higher is recommended for a better end-user experience.

Storage 16GB of storage is required. Devices with less storage will likely not have enough space for a full Halium distribution.

It is unlikely that you will be able to build and run Halium if your device does not meet these requirements. Please *contact us* if you are unsure whether your device meets these requirements.

2.1.3 Collaborate

Head over to the [list of ports](#) and check if someone is already working on this device. If it is started, collaborate with those porters.

2.1.4 Document your target device

Head over to *How to contribute documentation* to learn about adding your device's information to our device overview. Adding your device will also lead you to looking at other Halium devices, some of which may have similar hardware to yours. You can use fixes made in similar devices to fix your own.

2.1.5 Set up your build device

Now you will need to install packages on the computer you wish to build Halium with.

Debian (Stretch or newer) / Ubuntu (16.04 or newer)

If you are on the amd64 architecture (commonly referred to as 64 bit), enable the usage of the i386 architecture:

```
sudo dpkg --add-architecture i386
```

Update your package lists to take advantage of the new architecture:

```
sudo apt update
```

Install the required dependencies:

```
sudo apt install git gnupg flex bison gperf build-essential \  
zip bzip2 curl libc6-dev libncurses5-dev:i386 x11proto-core-dev \  
libx11-dev:i386 libreadline6-dev:i386 libgl1-mesa-glx:i386 \  
libgl1-mesa-dev g++-multilib mingw-w64-i686-dev tofrodos \  
python-markdown libxml2-utils xsltproc zlib1g-dev:i386 schedtool \  
repo liblz4-tool bc lzip imagemagick libncurses5 rsync
```

Arch

If you have an amd64 installation of Arch, you need to add the `[multilib]` repository to your `/etc/pacman.conf`. This will allow you to install and run i686 packages. Please refer to 'Official Repositories/multilib' on the [Arch Wiki](#).

Install the `base-devel` package if you have not already.

Install the required dependencies from AUR:

```
git clone https://aur.archlinux.org/halium-devel.git && cd halium-devel && makepkg -i
```

Note: Arch uses Python 3 as its default `python`, which may cause some errors while building. Using a Python 2 virtualenv is highly recommended. Please refer to [‘Python/Virtual environment’ on the Arch Wiki](#) for instructions on setting up a Virtual Environment.

2.2 Get Halium source

Now that you have a target device selected and your build device ready, it’s time to get the sources for your target together. Let’s begin by initializing your source tree.

2.2.1 Initialize and download source tree

Make yourself a new directory to put your Halium source in:

```
mkdir halium && cd halium
```

This directory will be called `BUILDDIR` in the remaining part of the guide, when necessary, to avoid confusion.

If the target device has Android 7.1 or LineageOS 14.1 support, it’s recommended to select `halium-7.1`:

```
repo init -u https://github.com/Halium/android -b halium-7.1 --depth=1
```

If your device does not have Android 7.1 or LineageOS 14.1 support but has support for Android 5.1 or CyanogenMod 12.1, select `halium-5.1`

```
repo init -u https://github.com/Halium/android -b halium-5.1 --depth=1
```

`halium-7.1` is based on LineageOS 14.1

`halium-5.1` is based on CyanogenMod 12.1

Now that you have initialized the Halium tree (a shallow copy due to `-depth=1`), you can sync all repositories included in it. This will probably take a while as it downloads several GBs:

```
repo sync -c -j 16
```

In case you want to get the full repo history at some point in the future because you want to patch, contribute, etc. You can execute the following commands from the repository directory

```
git remote -v # The leftmost word is the remote name
git fetch --unshallow [remote_name]
```

2.2.2 Adding your device-specific source

Okay, so now you have the default manifest for Halium. This will enable you to download the basic Android sources used to build Halium, but you’ll need to find device-specific files. These enable the build system to make Android for your device.

If there’s any part for you to make a mistake on, this will be the one. Finding the files isn’t hard, but it might take you a couple of tries to get repo’s local manifest created correctly.

First, you'll want to find the repositories for your device on [LineageOS's GitHub organization](#). You can do this by typing your device's codename into the search box. You'll want the device repository, `android_device_[manufacturer]_[device]`. Take down this name, as you'll need it later.

There will be a `cm.dependencies` or `lineage.dependencies` file in that repository that will tell you all of the other repositories that your device is reliant upon. Keep this file around as you will need it in a little bit.

Navigate into your Halium directory and create the file `halium/devices/manifests/[manufacturer]_[device].xml`.

Paste the following into the file:

```
<?xml version="1.0" encoding="UTF-8"?>
<manifest>

</manifest>
```

We recommend cloning all of the repositories that you'll find in the next steps to a personal source archive (aka, fork or import them on GitHub), then adding those personal forks to the manifest. This will help you save and share your work later.

The Device Repository

Next, we'll fill the manifest with information. Start with your device repository. Create the following line between the `<manifest>` and `</manifest>` tags, replacing the information inside the square brackets with your own:

```
<project path="device/[manufacturer]/[device]" name="[repository name]" remote=
↳ "[remote]" revision="[revision]" />
```

Note: The `revision` attribute may be omitted if the default revision for this remote is the one that you wish to use.

If you're not sure of your remote, jump down to [Remotes](#).

Dependencies

Now create more lines like the previous, using the `cm.dependencies` or `lineage.dependencies` file you found earlier in your device repository. This file lists all of the other repositories that you need to build for your selected device. It's listed in a fairly straightforward way, so create a line for each of the entries in there using the following template:

```
<project path="[target_path]" name="[repository]" remote="[remote]" revision=
↳ "[revision]" />
```

The target path is found in the repository's name. The preceding "android" or "proprietary" is omitted and underscores are replaced with slashes. For example, `android_device_lge_bullhead` goes in `device/lge/bullhead`.

Vendor blobs

Vendor blobs go in the `vendor/` folder in your Halium source tree. You will need to find these in a repository or otherwise and add them to your source tree. Check if your device's vendor is listed in [TheMuppets' GitHub organization](#), then open the repository to see if your device's codename is inside on your desired branch.

If you are unable to find your device in TheMuppets, you will need to find another repository with the vendor files somewhere.

Remotes

A remote entry specifies the name, location (fetch) prefix, code review server, and default revision (branch/tag) for source.

You can create a remote by adding a `remote` tag to your manifest.

```
<remote name="aosp"
  fetch="https://android.googlesource.com"
  review="android-review.googlesource.com"
  revision="refs/tags/android-7.1.1_r25" />
```

Only the name, fetch, and revision attributes are required. The review attribute specifies a Gerrit Code Review server, which probably won't be useful for initial porting purposes.

For example, let's say that you have a bunch of repositories at `https://github.com/MyUserName/` and your desired branch name is `cm-14.1` in each. You would create a remote as follows and place it into your local manifest:

```
<remote name="mun"
  fetch="https://github.com/MyUserName"
  revision="cm-14.1" />
```

There are also some remotes available to you by default, though they differ between halium-5.1 and 7.1. The following tables will help you identify these. See more information on these remotes by viewing the top of `.repo/manifest.xml` in your initialized BUILDDIR.

halium-7.1

These remotes are available to you by default in halium-7.1:

Remote Name	Remote Description, URL
aosp	Android Open Source Project, https://android.googlesource.com
los	LineageOS, http://github.com/LineageOS
hal	Halium (link to GitHub root for legacy reasons), http://github.com
them	TheMuppets, http://github.com/TheMuppets
them2	TheMuppets (for some xiaomi vendor repos) https://gitlab.com/the-muppets

If you do not specify a remote, `aosp` is assumed.

halium-5.1

Remote Name	Remote Description, URL
phablet	Canonical Ubuntu Phone compatibility, https://code-review.phablet.ubuntu.com
aosp	Android Open Source Project, https://android.googlesource.com
cm	CyanogenMod, https://github.com/CyanogenMod
ubp	UBports (link to GitHub root for legacy reasons), https://github.com
halium	Halium (link to GitHub root for legacy reasons), https://github.com
ab2ut	Vendor blobs for UBports builds, https://github.com/ab2ut

If you do not specify a remote, `phablet` is assumed.

2.2.3 Sync

Now that you've got your manifest filled out, simply type the following to get all of your source (replace DEVICE with your device's codename):

```
./halium/devices/setup DEVICE
```

This will first link your manifest from Halium devices to `.repo/local_manifests/device.xml` and then sync all repositories. This can take a while as it will download up to 2 GB of sources. If you have a fast connection, you may set an extra `JOBS=[number]` environment variable at the beginning of the command to make more parallel downloading jobs. We generally recommend 12, which is the default.

2.2.4 Document

After following these steps, create an issue on the [Halium project management repository](#) to document your porting progress. Also create a pull request containing your manifest on the [Halium devices repository](#). You should link the manifest on Halium devices in your project management issue. Alternatively you can also use a link to the pull request, if the manifest was not merged already.

2.2.5 Next steps

Now that you've got your source tree downloaded, you can move on to the next page where we'll start to build it!

2.3 Build Halium

You've got all of your source downloaded, now it's time to start building!

2.3.1 Initialize

First we need to initialize the environment using the `envsetup.sh` tool. Enter `BUILDDIR` in a terminal and type:

```
source build/envsetup.sh
```

This will give you an output that looks like this:

```
including device/lge/bullhead/vendorsetup.sh
including vendor/cm/vendorsetup.sh
including sdk/bash_completion/adb.bash
including vendor/cm/bash_completion/git.bash
including vendor/cm/bash_completion/repo.bash
```

For Halium-5.1

We need to choose the target to build using the `lunch` command:

```
lunch
```

The output of this command will look something like this:

```
You're building on Linux
```

```
Lunch menu... pick a combo:
```

```
1. aosp_arm64-eng    4. aosp_mips-eng      7. cm_bacon-eng
2. aosp_arm-eng      5. aosp_x86_64-eng    8. cm_bacon-user
3. aosp_mips64-eng   6. aosp_x86-eng       9. cm_bacon-userdebug
```

```
Which would you like? [aosp_arm-eng]
```

Here you need to choose your device `cm_[your device]-userdebug`, for example if you wish to build for the OnePlus One you would type `cm_bacon-userdebug` or 9.

For Halium-7.1

The `breakfast` command is used in LineageOS 14.1 and above (and therefore halium-7.1) to set up the build environment for a specific device. It is easy to use. Simply ensure that you're in `BUILDDIR` and run the following:

```
breakfast [codename]
```

Breakfast will attempt to find your device, set up all of the environment variables needed for building, and give you a summary at the end. You don't need to worry about any of this, unless it fails.

2.3.2 Modify the kernel configuration

Halium uses `systemd` as the init system. This requires various specific kernel configurations.

To check which config options needs to be adjusted we use `mer-kernel-check` utility provided by `mer-hybris`:

```
git clone https://github.com/mer-hybris/mer-kernel-check
cd mer-kernel-check
./mer_verify_kernel_config <path to kernel configuration>
```

If you don't know the path to your kernel config run `grep "TARGET_KERNEL_CONFIG" device/<VENDOR>/<CODENAME>/BoardConfig.mk`. It should be in `arch/arm/configs/<CONFIG>` or `arch/arm64/configs/<CONFIG>` depending on the architecture of your device.

Todo: Mention that the config parameters `CONFIG_IKCONFIG` and `CONFIG_IKCONFIG_PROC` need to be set to `y`, otherwise Halium wont boot (or add them to the check script)

2.3.3 As of systemd 233 the 3.4 kernel needs to have a patch in order to boot (tmpmnt not being created)

Due to changes introduced in `systemd` 233, specifically <https://github.com/systemd/systemd-stable/commit/e187369587b1c6a5f65a12e7ec0bf7844905d014#diff-091b5e8286ba9db94f3958b92eb3653a> is causing issues in many 3.4 kernels due to `fstat` not returning the correct value. A simple one line patch to the kernel will address this. See https://github.com/ubports/android_kernel_google_msm/pull/5/commits/1ad88b041787d8ce8407a021271ef1031e95cba6

2.3.4 Include your device in fixup-mountpoints

Fixup-mountpoints replaces the aliases of block device nodes in `/dev/block/by-name` with their literal nodes under `/dev/block`. This prevents issues caused by `by-name` not being populated by `systemd`.

First check if the codename of your device is already included in the `<BUILDDIR>/halium/hybris-boot/fixup-mountpoints` script.

If it's not already included, you will need to add it. Your device should be running LineageOS or another ROM where you can get root access over ADB.

1. Find the `fstab` file for your device. For my Moto G5 Plus, this was `fstab.qcom` in `device/motorola/potter/rootdir/etc`
2. Enable adb root access
3. Create the skeleton for your device in `fixup-mountpoints`, right before the `*`):

```
"[codename]")
    sed -i \
        [replacements, one per line]
        "$@"
    ;;
```

4. For every line in `fstab` where the type is not `auto`, `emmc` or `swap`, run `readlink -f [src]` on the target device over ADB. `[src]` is the leftmost column in `fstab`.
5. Write all of our replacements, one for every mountpoint. Here's the bones of one:

```
-e 's [src] [return] ' \
```

Replace `[src]` with what you input into `readlink` and `[return]` with what it returns. The space after `[return]` is important. The build fails without it.

Note: Be careful to ensure that your indentation is the same as other devices! The `"[codename]")` line should be indented by four spaces, and everything below it should be indented as shown.

2.3.5 Building the `system.img` and `hybris-boot.img`

Halium will use the `mkbootimg` tool for creating the boot image. In most cases it is not on the local harddisk, so it can be built by issuing:

```
mka mkbootimg
```

To build the `system.img` and `hybris-boot.img` - required for Halium - use the following commands:

```
export USE_HOST_LEX=yes
mka hybris-boot
mka systemimage
```

Note: If you use `make` and not `mka` it is recommended to set `-j[num]` to do parallel building, which reduces build time. Replace `[num]` with the number of threads in your system plus 2.

If you get any errors, jump down to [Documented errors](#). Otherwise, continue on to [Next steps](#).

2.3.6 Documented errors

If you receive errors while building Halium, check the following documents to see if there is a documented solution.

Common kernel build errors

These are the `hybris-boot` build errors most commonly seen in the Halium community. If you have found and fixed a new error, please document the steps that you have taken to fix it.

Implicit declaration of 'kvfree'

If you receive something similar to the following error:

```
../../../../../../../../kernel/[...]/[...]/security/apparmor/apparmorfs.c: In function 'aa_
↳simple_write_to_buffer':
../../../../../../../../kernel/[...]/[...]/security/apparmor/apparmorfs.c:110:3: error:
↳implicit declaration of function 'kvfree' [-Werror=implicit-function-declaration]
kvfree(data);
```

Apply the patch `nick kvfree()` from apparmor.

'kuid_t' (sdcards, cgroup) error

Example of the error:

```
../../../../../../../../kernel/lenovo/msm8916/kernel/cgroup.c:2138:37: error: invalid
↳operands to binary != (have 'kuid_t' and 'kuid_t')
if (current != task && cred->euid != tcred->uid &&

../../../../../../../../kernel/lenovo/msm8916/kernel/cgroup.c:2139:18: error: invalid
↳operands to binary != (have 'kuid_t' and 'kuid_t')
cred->euid != tcred->suid)
```

Set `CONFIG_USER_NS` to `n` in your `defconfig`.

Firmware class error

Example of the error:

```
../../../../../../../../kernel/lenovo/msm8916/drivers/base/firmware_class.c: In function '_
↳request_firmware':
../../../../../../../../kernel/lenovo/msm8916/drivers/base/firmware_class.c:1226:38:
↳warning: passing argument 2 of 'fw_load_from_user_helper' from incompatible pointer
↳type
error, forbidden warning: firmware_class.c:1226
```

Set `CONFIG_FW_LOADER_USER_HELPER` to `y` in your `defconfig`.

ECRYPTFS error

Example of the error:

```
../../../../../../../../kernel/lenovo/msm8916/fs/ecryptfs/file.c: In function 'ecryptfs_
↳readdir':
../../../../../../../../kernel/lenovo/msm8916/fs/ecryptfs/file.c:130:16: error: assignment_
↳of read-only member 'actor'
buf.ctx.actor = ecryptfs_filldir;
```

Apply ‘patch ecryptfs to fix a build error’ from bullhead.

‘Undefined reference to pidns_operations’ on Linux 3.4

The implementation of PID Namespacing was incomplete in the Android kernel 3.4, causing the following error:

```
fs/built-in.o:namespaces.c:ns_entries: error: undefined reference to 'pidns_operations
↳'
```

To fix this issue, apply the patch [Finish implementation of PID namespace](#)

‘struct perf_cpu_context’ has no member named ‘unique_pmu’

This is caused by an incomplete merge of a few changes in some 3.4 kernels:

```
../../../../../../../../kernel/fairphone/msm8974/kernel/events/core.c: In function 'perf_cgroup_
↳switch':
../../../../../../../../kernel/fairphone/msm8974/kernel/events/core.c:379:13: error: 'struct_
↳perf_cpu_context' has no member named 'unique_pmu'
if (cpuctx->unique_pmu != pmu)
```

To fix this issue, apply [perf: Clarify perf_cpu_context::active_pmu usage by renaming it to ::unique_pmu](#)

‘PROC_PID_INIT_INO’ undeclared here (not in a function)

Somehow, the implementation of the /proc filesystem is incomplete in some 3.4 kernels:

```
../../../../../../../../kernel/fairphone/msm8974/kernel/pid.c:81:15: error: 'PROC_PID_INIT_INO'
↳undeclared here (not in a function)
.proc_inum = PROC_PID_INIT_INO,
```

Add the following line after all of the other `#include` lines in the file `kernel/user_namespace.c` similar to https://github.com/Halium/android_kernel_lge_hammerhead/commit/5754614eb43dea44a99e54898e3b83d4d96d8b83

```
#include <linux/proc_fs.h>
```

POSIX_ACL not supported in 3.18 backport

Example of the error:

```
/home/florian/halium-7.1/kernel/huawei/angler/fs/ext4/inode.c: In function 'ext4_
↳setattr':
/home/florian/halium-7.1/kernel/huawei/angler/fs/ext4/inode.c:4717:2: error: #error_
↳POSIX_ACL not supported in 3.18 backport
#error POSIX_ACL not supported in 3.18 backport
```

Set `CONFIG_EXT4_FS_POSIX_ACL` to `n` in your `defconfig`.

Common system build errors

These are the `systemimage` build errors most commonly seen in the Halium community. If you have found and fixed a new error, please document the steps that you have taken to fix it.

signapk.jar missing

```
error: 'out/host/linux-x86/framework/signapk.jar', needed by 'out/target/product/
↳kenzo/obj/APPS/TimeService_intermediates/package.apk', missing and no rule to make_
↳it
```

All APKs and Java libraries should be removed from the Makefiles in `vendor/[manufacturer]/[device]` and `device/[manufacturer]/[device]`. The setup script will take care of this for you normally. In case you want to do it manually, simply commenting them out is enough, but you can remove them entirely. An example of these changes can be found at [remove APKs on Lyudmila17/android_device_motorola_athene](#).

Also check the vendor folders of your dependencies.

Undefined or missing bluetooth headers

```
*TODO: example*
```

Some devices requires bluetooth when compiling, which aren't synced for default by Halium. This can be fixed adding LineageOS's repo to the device manifest:

... to the device manifest:

```
<project path="system/bt" name="android_system_bt" remote="los" revision="cm-14.1" />
```

HYBRIS_BOOT_PART and HYBRIS_DATA_PART

```
find: `device/*/generic': No such file or directory
find: `device/unknown': No such file or directory
find: `device/android': No such file or directory
halium/hybris-boot/Android.mk:67: ***** /boot appears to live on_
↳ERROR: *fstab* not found
halium/hybris-boot/Android.mk:68: ***** /data appears to live on_
↳ERROR: *fstab* not found
halium/hybris-boot/Android.mk:71: *** There should be a one and only one device entry_
↳for HYBRIS_BOOT_PART and HYBRIS_DATA_PART.
```

Make sure you run the commands [here](#) before trying to build. The Makefile depends on the environment set up immediately before by `envsetup.sh`; so if running in a build environment such as Emacs, be sure to set your compile command to something like “`source build/envsetup.sh && breakfast [codename] && make [target]`”

Flex locale error

```
[ 19% 2365/12156] Lex: checkpolicy <= external/selinux/libsepol/cil/src/cil_lexer.l
FAILED: /bin/bash -c "prebuilts/misc/linux-x86/flex/flex-2.5.39 -o/home/peter/docs/
↪devel/halium.amami/out/host/linux-x86/obj/STATIC_LIBRARIES/libsepol_intermediates/
↪cil/src/cil_lexer.c external/selinux/libsepol/cil/src/cil_lexer.l"
flex-2.5.39: loadlocale.c:130: _nl_intern_locale_data: Assertion `cnt < (sizeof (_nl_
↪value_type_LC_TIME) / sizeof (_nl_value_type_LC_TIME[0]))' failed.
Aborted (core dumped)
```

This seems to be a problem with locales and the prebuilt flex. You can avoid this by using the flex installed on your host:

```
export USE_HOST_LEX=yes
make systemimage
```

Missing bison error

```
[ 1% 322/20069] Yacc: checkpolicy <= external/selinux/checkpolicy/policy_parse.y
FAILED: /bin/bash -c "prebuilts/misc/linux-x86/bison/bison -d -v --defines=/home/
↪builder/workdir/out/host/linux-x86/obj/EXECUTABLES/checkpolicy_intermediates/policy_
↪parse.h -o /home/builder/workdir/out/host/linux-x86/obj/EXECUTABLES/checkpolicy_
↪intermediates/policy_parse.c external/selinux/checkpolicy/policy_parse.y"
/bin/bash: prebuilts/misc/linux-x86/bison/bison: No such file or directory
```

The error message is very misleading here. The issue stems from the bison shipped with halium-7.1 at prebuilts/misc/linux-x86/bison/bison being 32-bit only, with the host system lacking 32-bit compatibility.

The fix is to install 32-bit support for Ubuntu via:

```
sudo dpkg --add-architecture i386
sudo apt-get update
sudo apt-get install libc6:i386 libncurses5:i386 libstdc++6:i386
```

If your error is not in this list, please [contact us for help](#).

2.3.7 Next steps

Now that you have `hybris-boot.img` and `system.img` built, let's install them along with the reference rootfs to test functionality.

2.4 Install Halium

At this point, you've set up your build device, downloaded all of the sources for device enablement, and built `hybris-boot.img` and `system.img`. Now, we'll walk you through installing your build along with a distro.

2.4.1 Fully halium-integrated distributions

You may choose any of the following distributions to install with the scripts and sources provided by Halium. We recommend you start with the Halium reference rootfs for testing.

Halium reference rootfs

Once you have built the system.img from the android tree, you can download and install the rootfs using the `halium-install` script from the [halium-scripts](#) repository.

Install hybris-boot.img

First, boot your device into its bootloader. This is normally done by holding Power+Volume Down, but it can be different on each device.

Next, simply execute the following command:

```
fastboot flash boot [path/to/]hybris-boot.img
```

If you're in `BUILDDIR`, `hybris-boot.img` will be located at `out/target/product/[codename]/hybris-boot.img`.

Install hybris-boot.img on Samsung devices

Samsung devices cannot be flashed using fastboot. Instead, the device needs to be brought into "Download Mode". This can be achieved in two ways:

1. By manually by pressing Vol-Down, Home and Power button until the green warning text appears. Then press Vol-Up as instructed.
2. By issuing the command:

```
adb reboot download
```

Once in download mode the necessary tool depends on platform:

On Windows, proceed with the Odin flashing tool which takes image files wrapped in `tgz` format.

On Linux, use the Heimdall flashing tool. Heimdall, when used in command line mode, can handle plain `.img` files.

On recent devices, only newer versions of Heimdall should be used. Ubuntu's ppa holds an older version of Heimdall. Do not use this. Instead, build it from source:

```
git clone https://github.com/Benjamin-Dobell/Heimdall.git
```

For building instructions, consult the [README](#).

Note: Often you will find instructions on Samsung ROMs saying that you need to obtain a PIT file before flashing a device. This is not required and could in fact soft-brick your device. The PIT file is the partition table and is only required when repartitioning. This is normally not necessary and using downloaded PIT files is risky.

Heimdall will always reboot by default after flashing. Using the `--no-reboot` option will leave the connection in a strange state. Therefore, after flashing a `.img` file it is not possible to immediately push a second one. Also, Heimdall is incapable of rebooting directly into recovery mode.

The command for flashing is:

```
heimdall flash --BOOT hybris-boot.img
```

Install rootfs and system.img

- Download the halium reference rootfs from [bshah's personal server](#).
- Get the halium-install script from the [JBB's repository](#).
- Bring the device into recovery mode and run:

```
./halium-install -p halium <path to rootfs tarball> <path to android system.img>
```

If you have trouble getting this to work, use the `-v` option to get verbose output.

Debugging

Now that you have this installed, move on to [Debug Halium](#) to test your port's functionality.

Plasma mobile

In order to install [Plasma mobile](#) you perform basically the same steps as for the [Halium reference rootfs](#). This section only highlights the relevant differences.

Install rootfs and system.img

Use the plasma mobile rootfs. Download the latest version from here: <https://images.plasma-mobile.org/rootfs/>.

If you have a "CAF" device (Code Aurora Forum), then you must use the rootfs from here: <https://images.plasma-mobile.org/caf-rootfs/>. Generally speaking, if it is a Qualcomm device and it is not a Nexus, then it is CAF.

Debugging

Instead of connecting with `root` you use `phablet`:

```
ssh phablet@10.15.19.82
```

Todo: Make sure phablet password is set either by using `chroot` from recovery or `halium-install` from [JBBgameich](#).

For general debugging tips refer back to reference rootfs instructions. Some plasma mobile specific tips are below.

Todo: Document PM specific debug instructions. Some lose notes copied from irc log:

- run `test_XYZ` with `sudo`
 - `pgrep kwin_wayland`
 - `journalctl | grep simplelogin`
-

2.4.2 Halium-modified distributions

These distributions require changes to the source or use different scripts than those provided by Halium. We recommend you only try these after your build tests correctly with the reference rootfs.

Todo: Distributions like Ubuntu Touch and LuneOS go here. Links to their respective documentation should be sufficient, but please place them inside the toctree above.

2.5 Debug Halium

The following subsections should help you through the porting process.

Keep in mind, every port is a bit different. You might be following this from top to bottom and even skip steps. Or, you might end up going back and forth between the sections while you improve your port.

2.5.1 Early Init

Hybris-boot offers a telnet service that you can use to debug the very early init of your port. This service will be exposed if the Halium system has failed to boot for any reason.

Determining if this is needed

While bringing the USB network interface up, the boot image will write a few debug messages. These debug messages are communicated via a clever hack of resetting the serial number of the usb connection.

The steps in detail are:

- Execute this command to watch the changes in the usb serial number:

```
while : ; do lsusb -v 2>/dev/null | grep -Ee 'iSerial +[0-9]+ +[^\ ]' ; done | uniq
```

- Boot your newly built image
- Watch the output of the lsusb command above. It will put out lines like this:

```
iSerial          3 01234567
iSerial          3 Mer Debug setting up (DONE_SWITCH=no)
iSerial          3 Mer Debug telnet on port 23 on usb0 192.168.2.15 - also_
↔running udhcpd
```

If you get a line similar to the last two above, Telnet is running. Continue to the next section to debug it.

If you instead get the line GNU/Linux devices on rndis0 10.15.19.82, the system has booted successfully. Move to *Logging in* to continue your debugging.

Debugging via telnet

- **Determine the name of the usb network device on your desktop:** `dmesg | tail`. You're looking for a line similar to this:

```
[ 1234.123456] rndis_host 1-7:1.0 enp0s20f0u7: renamed from usb0
```

- In this example shown above, `enp0s20f0u7` is the usb network device name. Use this for the USBNETWORK below
- Check if the usb network device has a MAC address assigned:

```
$ ip address show dev USBNETWORK
6: USBNETWORK: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default_
↳qlen 1000
link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff
```

If it shows the link/ether address `00:00:00:00:00:00` as shown above, you will have to manually assign the MAC address:

```
ip link set USBNETWORK address 02:01:02:03:04:08
```

You can set any MAC address you want, it just needs to be a valid MAC address.

- Configure usb networking:

```
sudo ip address add 192.168.2.1 dev USBNETWORK
ip address show dev USBNETWORK
sudo ip route add 192.168.2.15 dev USBNETWORK
ping -c 2 192.168.2.15
```

- Connect with telnet: `telnet 192.168.2.15`

Now you have terminal access to the system running from `initramfs`. The first command to run once you're logged in is `cat diagnosis.log` to see if it has any hints.

Forcing debug mode

If the device simply reboots when trying to boot and does not bring up telnet, you may build and use the `hybris-recovery.img` file to attempt to force a shell to come up. To do this, set up your build tree and issue the following command:

```
mka hybris-recovery
```

The file will be in the standard `$OUTDIR`. Simply flash it in the same way you did for `hybris-boot.img`.

Common errors

The device reboots after leaving hybris-recovery

If your device reboots after you leave `hybris-recovery` by running `echo continue > /init-ctl/stdin`, there could be something wrong with your `lxc` container. Try the following in the `hybris-recovery` shell to disable it for the moment:

```
TERM=linux HOME=/root PATH=/sbin:/bin:/usr/sbin:/usr/bin:$PATH chroot target/ /bin/
↳bash
systemctl disable lxc@android
systemctl mask lxc@android
exit
echo continue > /init-ctl/stdin
```

You should then be offered SSH. See [Logging in](#) for more details.

Bootloop: “Too many levels of symbolic links” when leaving hybris-boot

```
systemd[1]: Failed to determine whether /sys/fs/cgroup is a mount point: Too many
↳levels of symbolic links
systemd[1]: Failed to mount cgroup at /sys/fs/cgroup/systemd: NO such file or
↳directory
systemd[1]: Freezing execution.
```

There’s a patch on hammerhead kernel from Linus Torvalds you need to apply: [Fix /proc/<tid>/fdinfo/<fd> file handling](#).

The device reboots with hybris-recovery

There are several cases in which telnet will not be exposed, such as when the device fails to load the kernel or initramfs, or when an in-kernel driver decides to cause a kernel panic very early. In this case, the phone will almost immediately reboot when it starts, even when using `hybris-recovery`. You may be able to *read the previous boot’s kernel message buffer*. Please have that ready and *contact us for help*.

None of these describe my issue

You may be able to *read the previous boot’s kernel message buffer*. Please have that ready and *contact us for help*.

2.5.2 Logging in

Once booted, the reference rootfs will offer an SSH connection that you can use to run tests or otherwise debug the system. Before you’re able to sign in, though, you will need to change the root user’s password.

To change the root user’s password, reboot into TWRP and get access via `adb shell`. Then, perform the following commands:

```
mkdir /a
mount /data/rootfs.img /a
chroot /a /bin/bash
. /etc/environment
passwd
```

You will be prompted to change the password. Once finished, clean up:

```
exit
umount /a
rmdir /a
sync
```

You may now reboot your device into Halium.

Once your device is booted, you should see that you have a new network interface again. Look at the output of `ip link show`, the name will be e.g. `enp0s29u1u1`. `rndis0` is not working on most kernels. Assign it a fake MAC address (if the default one is all 00s) and an IP of 10.15.19.100:

```
ip link set <devicename> address 02:11:22:33:44:55
ip address add 10.15.19.100/24 dev <devicename>
ip link set <devicename> up
```

(continues on next page)

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Once finished, you should be able to do the following to log **in**:

```
ssh root@10.15.19.82
```

2.5.3 Add udev rules

You must create certain udev rules to allow some tests access to the hardware.

There are 2 different ways to do this:

On the device:

Log in on the device, run the following command, replacing [codename] with your device's codename:

```
cat /var/lib/lxc/android/rootfs/ueventd*.rc | grep ^/dev | sed -e 's/^\/dev\/' |  
↪awk '{printf "ACTION==\"add\", KERNEL==\"%s\", OWNER=\"%s\", GROUP=\"%s\", MODE=\"  
↪%s\"\\n\", $1, $3, $4, $2}' | sed -e 's/\\r//' >/etc/udev/rules.d/70-[codename].rules
```

Now, reboot the device.

On the host:

Alternatively, if you want to create the file with the udev rules on your “host” machine you can run the following command inside your halium folder, replacing [codename] with your device's codename:

```
cat out/target/product/[codename]/root/ueventd*.rc | grep ^/dev | sed -e 's/^\/dev\/' |  
↪awk '{printf "ACTION==\"add\", KERNEL==\"%s\", OWNER=\"%s\", GROUP=\"%s\", MODE=\"  
↪MODE=\"%s\"\\n\", $1, $3, $4, $2}' | sed -e 's/\\r//' > 70-[codename].rules
```

You can then use either `ssh` or `adb push` to push the file to the right location:

SSH:

```
cat 70-[codename].rules | ssh 10.15.19.82 'cat > /tmp/udev.rules'  
ssh 10.15.19.82  
sudo cp /tmp/udev.rules /etc/udev/rules.d/70-[codename].rules
```

ADB: Reboot into recovery. If your rootfs is mounted at `/data/halium-rootfs/` you can push it with:

```
adb push 70-[codename].rules /data/halium-rootfs/etc/udev/rules.d/
```

Send upstream:

In order for other users to be able to use the udev rules send a pull request to the lxc-android repository. Similar to: <https://github.com/Halium/lxc-android/pull/12/files>

2.5.4 Wifi

Enabling Wi-Fi hardware

Qualcomm

Wifi is fairly easy to get going on most Qualcomm devices. The following should enable your device's Wi-Fi hardware:

```
echo 1 > /dev/wcnss_wlan
echo sta > /sys/module/wlan/parameters/fwpath
```

Errors

If the first command line fails with `/dev/wcnss_wlan: Bad address`

This is not an error condition; don't get put off — try the second command.

If `/sys/module/wlan` is missing (not found)

Try to load the `wlan` kernel module first:

```
insmod /system/lib/modules/wlan.ko
```

If `insmod` fails with `Required key is not found`, you could temporarily disable all the `CONFIG_MODULE_SIG**` options in your `defconfig` and then re-build `hybris-boot` (or `halium-boot`) and `system.img`. **Beware: this disables kernel module signatures (a security feature) — consider fixing it later.**

If `insmod` fails with `Invalid module format`, then you need to ensure that you build your `hybris-boot` (or `halium-boot`) and `system.img` with the same kernel configuration (e.g. perhaps you forgot to re-install `system.img` after disabling kernel module signatures above, it contains kernel modules).

Broadcom bcmdhd

It is recommended to build Broadcom drivers as a module since that will ensure use of the device's MAC address.

In the kernel `defconfigs`, make sure these settings are set:

```
CONFIG_MODULES=y
CONFIG_BCMDHD=m
```

Then add this to your device's `init.rc` file, it's recommended to set this in early stages to avoid race condition with network manager (on `post-fs-data` is a good place for this):

```
insmod /system/lib/modules/bcmdhd.ko
```

Testing Wi-Fi functionality

You may run the following command to see if your Wi-Fi hardware has come up:

```
nmcli d
```

Your device should show up as `wlan0` and have a state of "Disconnected" when it is ready. At that point, run the following command to enter an interface that you can use to connect to Wi-Fi:

```
nmtui
```

Once you are connected to Wi-Fi, try pinging an Internet device:

```
ping 8.8.8.8
```

If all of this is successful, you have successfully brought up your Wi-Fi hardware. If not, check your device's *Logcat* for possible errors.

Common errors

Kernel 3.10 ping: socket: Permission denied

This error is most common on devices which shipped with Linux kernel 3.10. To resolve it, apply the following patches:

1. Introduce the `SECURITY_ANDROID_GID_CAPABILITIES` option
2. Select `SECURITY_ANDROID_GID_CAPABILITIES` when enabling paranoid network
3. Enable the `CONFIG_SECURITY_ANDROID_GID_CAPABILITIES` option

2.5.5 Lights

Lights is one of the simple parts to get going in Halium.

Tests

```
test_lights
```

The device's light should start flashing now.

2.5.6 Graphics

Graphics is an essential part of Halium. Halium uses libhybris to make Android's bionic based hardware adaptations layer usable with glibc systems.

Tests

Here is some tests to test the graphics stack

```
EGL_PLATFORM=hwcomposer test_hwcomposer
```

```
test_egl
```

```
test_egl_config
```

```
test_glesv2
```

Todo: Add tests using more heavy graphics applications using Wayland (mir)

Common errors

EGL_BAD_SURFACE

If these tests fail but some others succeed (lights, vibrator, Wi-Fi), you may need software which is built for Code Aurora Forum’s Android for MSM (generally nicknamed “CAF” for short) rather than AOSP.

If this is the case, you’ll encounter errors similar to the following in *Logcat*:

```
W Adreno-GSL: <gsl_ldd_control:475>: ioctl fd 8 code 0xc0140933 (IOCTL_KGSL_TIMESTAMP_
↳EVENT) failed: errno 22 Invalid argument
W Adreno-GSL: <ioctl_kgsl_syncobj_create:2984>: (9, 1, 62845) fail 22 Invalid argument
W Adreno-EGLSUB: <SwapBuffers:1339>: gsl_device_3d_add_fence_event failed
W Adreno-EGL: <qeglDrvAPI_eglSwapBuffers:3890>: EGL_BAD_SURFACE
```

On the reference rootfs, you can get this software from the Halium repository by running the following commands:

```
. /etc/environment
echo "deb http://repo.halium.org/caf xenial main" >> /etc/apt/sources.list.d/halium-
↳caf.list
apt-get update
apt-get dist-upgrade
```

Non-reference distributions will need to provide software which is compatible with CAF Android trees.

Reading pm4 microcode failed

This error may appear in *Logcat* when running these tests:

```
kgsl kgsl-3d0: |_load_firmware| request_firmware(a330_pm4.fw) failed: -2 ... kgsl_
↳kgsl-3d0: |adreno_init| Reading pm4 microcode failed a330_pm4.fw
```

To resolve this, toggle `CONFIG_FW_***LOADER` in your kernel config.

test_hwcomposer failure on aarch64 device with armhf rootfs

On an armhf only rootfs, `test_hwcomposer` will fail despite doing the above on 64-bit devices running kernel 3.18.

To work around the issue, apply [this patch](#) to your device’s kernel repository.

2.5.7 Vibrator

Vibrator is one of the simple parts to get going in Halium, and is often used as to goto test to check if libhybris linker works as expected.

Tests

```
test_vibrator
```

The device should now vibrate

2.5.8 Debugging the Android userspace

Debugging the Android userspace

lxc-android

lxc-android is the container in which the Android userspace is running. You can check that it is started with the following command:

```
systemctl status lxc@android
```

LXC needs some kernel config to make sure it runs correctly. Check that you have all the needed options by running the following command on the device:

```
lxc-checkconfig
```

All option except `User namespace` need to be the green word *enabled*. If one of the options is a yellow *missing* or a red *required*, then you need to change the kernel config, rebuild `hybris-boot` and check the status again.

Note: I was getting the following error, which I didn't understand: `lxc-start: utils.c: mkdir_p: 254 Invalid argument - failed to create directory '/sys/fs/cgroup/net_cls//lxc/android'` It appears like LXC is expecting some functionality that doesn't work yet in Linux 3.4. Counter-intuitively I had to disable the following functionalities in the `defconfig` to make it work:

```
CONFIG_NET_CLS_CGROUP=n  
CONFIG_NETPRIO_CGROUP=n
```

Logcat

Logcat is a tool that reads the Android user space logs. This includes all services that should be running in Halium. You can run it at any time with the following command:

```
/system/bin/logcat
```

For radio (Wi-Fi, GSM, LTE) logs, you can add a flag:

```
/system/bin/logcat -b radio
```

If you're not able to run this command for any reason (for example, because you're running an `armhf` rootfs on an `arm64` device), you can try to run it inside the Android container via `lxc-attach`:

```
lxc-attach -n android -- /system/bin/logcat
```

You may similarly use this to run any binary inside the Android system. Simply replace the command after the two dashes.

dmesg

Even though Android logs do not normally end up in `dmesg`, early initialization of Android and kernel output ends up here:

```
dmesg
```

strace

For cases where the log files do not reveal sufficient detail, a `strace` can be helpful. This is how you get a `strace` for the example of `test_hwcomposer`:

```
EGL_PLATFORM=hwcomposer strace test_hwcomposer
```

backtrace

Another debugging technique is to investigate the backtrace when a program crashes. This is how you get a backtrace for the example of `test_hwcomposer`:

```
EGL_PLATFORM=hwcomposer gdb test_hwcomposer
```

This will start the interactive debugger `gdb`. At the prompt of `gdb` you enter `run`. Now the program is executed and you wait for it to crash. Then you enter `bt full`. This will give you the full backtrace of what the program was trying to execute at the moment of the crash.

In order to make the backtrace most useful you want to ensure that you have debug symbols installed for the program you are debugging.

Firstly, let's fix the `PATH` variable which is currently missing `/sbin` on the reference rootfs:

```
export PATH=$PATH:/sbin
```

Secondly, do install debug symbols for `libc`:

```
apt install libc6-dbg
```

Thirdly, install whichever package contains the debug symbols for the program in question. Typically it is in a package with a name similar to the one containing the program and ending in `-dbg`. For the example of `test_hwcomposer` you want:

```
apt install libhybris-dbg
```

If `gdb` reports “(no debugging symbols found)”, then you are still missing debug symbols, look further for the relevant package.

Todo: Document the debugging of `libhybris`: <https://wiki.ubuntu.com/Touch/Core/UbuntuDebugAndroid>

Todo: Document how to deal with firmware partitions.

For example `xLeEco Le Max2`, codename “x2” has a firmware partition where the vendor blobs are stored. Initially `lxc@android` would not start. The resolution was roughly:

- no need for a vendor blobs repository in the manifest

- determine firmware partition name
- ensure fix-mountpoints takes it into account
- reflash android to ensure the blobs are in the partition
- reflash halium

See <http://logs.nslu2-linux.org/livelogs/halium/halium.20180430.txt>

2.5.9 USB Network tethering

It is possible to connect the device to the internet via usb network tethering. This can be helpful when you haven't gotten Wi-Fi working (yet).

The instructions below assume you're running Ubuntu >=16.04. Earlier versions of Ubuntu or other distributions will probably work similarly if `iptables` is installed.

You need three things:

- The name of your computers network device which connects to the internet. You can check `ip link` to determine this. Likely it is something like `wlan0` or `eth0`. We'll call this `[INTERNET]`.
- The name of your computers usb network device which connects to the "rndis" network. This is the same as described for the *telnet debugging access*. We'll call this `[USBNETWORK]`.
- Lastly, you need your computers IP address on this network. If you are connecting with *telnet* then this is `192.168.2.1`. If you are connecting with *ssh* then this is `10.15.19.100`.

With this information you run the following commands:

```
sudo sysctl net.ipv4.ip_forward=1
sudo iptables -t nat -A POSTROUTING -o [INTERNET] -j MASQUERADE
sudo iptables -A FORWARD -m conntrack --ctstate RELATED,ESTABLISHED -j ACCEPT
sudo iptables -A FORWARD -i [USBNETWORK] -o [INTERNET] -j ACCEPT
```

Now, run the following command as root on your device:

If you're in `initrd` debug (*telnet*):

```
route add default gw 192.168.2.1
```

If you're in the real rootfs (*ssh*):

```
ip route add default via 10.15.19.100
```

Then try `ping 8.8.8.8` from the phone. The pings should go through.

To add an DNS server on your device, edit `/etc/resolv.conf` and add the line `nameserver 8.8.8.8`. This is NOT the recommended way to add a nameserver on Debian, but it works reliably when you can't depend on other options. Your changes will be overwritten on reboot, so you will need to perform them again.

You should now be able to `ping debian.org` and generally have internet access on the device.

2.5.10 Reading kernel logs

To find out what happened during an unsuccessful boot you can check the kernel log files. These can usually be retrieved after rebooting the device into another, working system. Generally, your recovery image will be the "working system".

Linux kernel <=3.4

Until Kernel 3.4, Android developers created a driver that the Linux kernel may use to store its kernel message buffer in a special persistent location in RAM. This information is preserved over a reboot but not a hard power cycle (such as holding the power button or powering off). This location is preserved to the system in `/proc/last_kmsg`

To use `last_kmsg` to debug problems in your port, do the following:

1. Boot your newly built image
2. Wait for it to fail
3. Reboot the device into a working system.
4. Retrieve the kernel log with `adb shell cat /proc/last_kmsg > ~/last_kmsg`
5. Read `~/last_kmsg` and find out what went wrong

If you aren't able to find these files, ensure that the following configs are set in your kernel config:

```
CONFIG_ANDROID_RAM_CONSOLE=y
CONFIG_ANDROID_RAM_CONSOLE_ENABLE_VERBOSE=y
```

Linux Kernel >3.4

After Kernel 3.4, most Android vendors have used the upstream `pstore` and `ramoops` drivers to store kernel logs after a panic.

You can get these logs by following these steps:

1. Boot your newly built image
2. Wait for it to fail
3. Reboot the device into a working system.
4. Find and retrieve the logs from `/sys/fs/pstore/console-ramoops`. The file may be named slightly differently, but will be in this directory.

If you aren't able to find these files, ensure that the following configs are set in your kernel config:

```
CONFIG_PSTORE=y
CONFIG_PSTORE_CONSOLE=y
CONFIG_PSTORE_PMSG=y
CONFIG_PSTORE_RAM=y
```

Most devices require that the kernel panics in order to offer these logs. You can cause a kernel panic by running these commands as root:

Warning: Yes, these commands really do cause a kernel panic. Don't run them on your production machine.

```
echo 1 > /proc/sys/kernel/sysrq
echo c > /proc/sysrq-trigger
```

2.5.11 References

The hybrid-boot image is based on work from the Sailfish OS and the [Sailfish Hardware Adaptation Development Kit porting guide](#) contains valuable tips.

2.6 Distribution

2.6.1 Reference rootfs

To make development and porting easier the halium team provides the reference rootfs. It is based on Ubuntu 16.04 and includes the following:

- systemd
- lxc
- lxc-android
- libhybris
- ofono
- ofono-scripts

This reference rootfs is built using the live-build tool. Documentation on how you can build it locally using rootfs-builder is available at <https://github.com/halium/rootfs-builder/tree/ubuntu>

2.6.2 Deployment

There are various parts which need to be deployed on the device:

- boot.img
- rootfs
- udev rules
- lxc container configuration
- system.img
- vendor.img (for newer devices)
- android ramdisk

boot.img

The boot.img is based on [hybris-boot](#). This boot.img is built inside the android tree.

boot.img has really simple functionality: Mount the data partition, and the rootfs.img inside to /target,

```
mount $DATA_PARTITION /data
mount /data/rootfs.img /target
```

and switch to the target rootfs and run the init (systemd)

```
exec switch_root /target $INIT --log-target=kmsg &> /target/init-stderrout
```

rootfs.img

The rootfs is provided by the distribution in tar.gz format. The installation tool extracts the contents and puts them into the ext2 or ext4 rootfs.img. This rootfs.img will be mounted by the hybris-boot later on.

Following are the minimal requirements of the such a rootfs

- systemd as the main init
- lxc

Depending upon required functionality, you may need

- ofono (for calling and mobile data)
- libhybris
- NetworkManager
- Pulseaudio

udev rules

The rootfs.img contains the udev rules. They are device specific and generated from the udevd*.rc file from the device tree. Instructions for getting these rules installed can be found at [Add udev rules](#).

You can either,

- a) copy them to /lib/udev/rules.d/ during the initial installation of the rootfs or
- b) deploy all the supported udev rules in /usr/lib/lxc-android/, and have a systemd service to copy the device udev rule before starting udev service.

lxc container configuration

This is most important bit. It starts the android init. This is required to start the android binary daemons etc.

There are two parts of the lxc container configuration:

- config
- pre-start.sh

They are provided at : <https://github.com/Halium/lxc-android/blob/master/var/lib/lxc/android/>

The configuration file specifies the following options:

- lxc.rootfs
- lxc.network.type
- lxc.devtydir
- lxc.tty
- lxc.pts
- lxc.arch
- lxc.cap.drop
- lxc.pivotdir (deprecated)
- lxc.hook.pre-start

- `lxc.init_cmd`
- `lxc.aa_profile` (optional, only for distribution using apparmor)
- `lxc.autodev`

The pre-start hook is used to extract and configure the android rootfs before booting into it.

system.img and vendor.img

These are the android libraries and the vendor binary blobs. They are generated by building the android tree and they are deployed to the userdata partition at installation time.

Android rootfs

The android rootfs is provided by halium. It is generated by the android build system. The android rootfs contains what is usually contained inside the initrd of android's boot.img. This is extracted by the android lxc container's pre-start hook before starting the container. It is located at `/system/boot/android-ramdisk.img`.

2.6.3 Startup sequence

- fastboot starts the kernel and loads the initrd
- initrd mounts the userdata partition and rootfs.img from it
- After mounting rootfs.img it will start the systemd init from the rootfs
- The rootfs is expected to mount the `/system`, `/vendor` and other android mount points before `local-fs.target`
- After the `local-fs` target, the lxc container is started
- lxc pre-start hook will bind mount the mounted android partitions inside the android rootfs
- Once the android container is started the host system will start `udev` and other system daemons
- At this point the scope of halium is over and userspace services like `sddm`, `mir`, `lipstic` etc can be started

2.7 About this chapter

In this section, we want to gather information about

- The exact hardware built into our phones and tablets
- The status of ports, that is:
 - Which OS is available in what version and to which degree of functionality
 - Which kernel is available? What drivers are used for what part?
 - Where are the sources for all this? What is their license?
- Where can we reuse drivers/kernel patches/backports?

2.7.1 Where should I put my information?

The documentation has a logical structure so that every specific group of devs we are trying to help here can access the info that is meant for them without having to read the other parts.

2.7.2 Why is this important?

Halium is trying to reduce the workload for different OS teams by developing a common base. The deepest root in all of the OS systems, even the official ones, is the kernel, which is based upon the linux mainline kernel. For Halium to work, certain features need to be implemented into this kernel, for example the ability to use lxc.

Therefore it is of great interest to us to have a kernel for each device that has all the needed parts. The sense behind mainlining is that **you only care about the specific hardware you are working on**. All other features that are implemented by other people will just be handled mainline and if your code is mainline too, upon a kernel update, you can just use the new one with new features from other people, without having to reimplement your driver into this new kernel. So if e.g. lxc is updated or apparmor and we are working on an older kernel, at some point the rootfs we are working with will require this new version and we need to do all the implementation of our work to a new kernel.

By documenting things **that will never change** like the hardware built into a phone, the kernel version a driver was mainlined, or general mainline status of hardware parts, we reduce the risk to document something that will change before it is ever looked at.

On the other hand, comparing the hardware of devices shows, that many parts are used across manufacturers, so many drivers may, at least partially, be cloned.

With documenting these things at a central point, we may make connections easier visible and by this enable kernel devs or newcomers to write/modify drivers and mainline them.

For our porters, we can gather info about available ROM versions, where the sources and proprietary blobs (if available) are located, and perhaps what challenges/problems may occur if any are known already.

2.7.3 Who is this for?

This sub section of the documentation is meant for

- **porters** as a first quick reference about the status for certain hardware parts (drivers) and whole devices (custom kernels & OSes)
- **community members** who want to help by documenting
- **kernel devs** as a reference which hardware is in what device, if there are open source drivers or where the official drivers are located

2.8 Device Overview

These pages detail devices that

- (A) **have a running Halium Image**
- (B) **had a Halium image in the past**
- (C) **users want to see ported**

All of these should only be document in the exact same way here and **only an overview shall be given on this page** everything that goes into more detail should please be posted on a device specific sub page!

2.8.1 Codename - Template Device

//Disclaimer: Please remove everything that is just part of this template and not actually about the device before submitting this into the official wiki, thank you! //

Here only one or two sentences. What makes the device special? Is it a reference device?

Status

Halium

Of course we are mainly interested in Halium status. Therefore please state

- Is someone already working on Halium for this device? If YES: link to repositories of **device specific files** (usually github repos called “android_device_manufacturer_codename”) and **device kernel** (usually a repo beginning with “androidkernel”) and name authors if possible (perhaps link to their github profile)
- Is Halium working for this device? If YES: Name the android base version (5.1 or 7.1) and everything you know about the actual status (what’s working, which rootfs, ...)

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS placeholder device page placeholder	an-droid_device_placeh	android_kernel_placeholder based on vX.Y.Z	?	?
Ubports placeholder device page placeholder	an-droid_device_placeh	android_kernel_placeholder based on vX.Y.Z	?	?

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

Write whether something that is needed for the device is mainline already (switch the version in the heading for what’s recent when you write this). This means **device tree source files (.dts) as well as single drivers** (for example only the wifi driver).

Cyanogemod based kernels (LOS & UBP)

If other kernels exist, just make up headlines with a name that describe the origin (Cyanogemod, LineageOS, UBports, Canonical, ...) and which is the underlying mainline version. Afterwards describe what’s been improved or altered and if possible why or what is still missing.

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#).

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the xda-developers forum) and document it

Useful Resources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.2 dream2lte - Samsung Galaxy S8+

The Samsung Galaxy S8+ (shortened to S8+) are Android smartphones produced by Samsung Electronics as part of the Samsung Galaxy S series. The S8+ was unveiled on 29 March 2017 and directly succeeds the Samsung Galaxy S7 Edge.

Status

Halium

Halium 7.1 is **WIP**. Ported by [Ivan Semkin](#).

Distributions

Distribution	Device Specific Files	Device Common Files	Kernel	What works	What doesn't work
dream2lte on XDA	universal8895/android_device_samsung_dream2lte	universal8895/android_device_samsung_dream2lte	universal8895/android_kernel_samsung_universal8895 based on v4.4.79	see device page	see device page
dream2lte on Halium projectmanagement	universal8895/android_device_samsung_dream2lte	vanyasem/android_device_samsung_dream2lte	vanyasem/android_kernel_samsung_universal8895 based on v4.4.79	see device page	see device page

Kernel & Hardware

Cyanogemod based kernels (LOS & UBP)

Both **Halium** and **LOS** share a **common base** which is Cyanogenmod. However, the Halium kernel was patched with Halium-specific edits.

Device Specifics

Guides

Unlocking the bootloader will permanently set your device's KNOX to 0x1, which will disable Knox-related functionality even if you re-lock your device later.

The device doesn't have fastboot, you need to flash it using [Heimdall](#).

To unlock the bootloader enable `OEM Unlock` setting in Developer Options of your ROM.

In order to launch download mode, with the device powered off, hold `Volume Down + Bixby + Power`.

In order to launch recovery, with the device powered off, hold `Volume Up + Bixby + Power`.

Useful Resources

- [Repo Manifest](#)
- [TWRP for Samsung Galaxy S8+](#)

2.8.3 Bullhead - Nexus 5X

This is supposed to become one of our **reference devices**.

Status

Halium

Halium is being worked on for this device. You can find the sources in the table below.

Todo: Add the manifest for Bullhead

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Bullhead on LineageOS Wiki	LineageOS/android_device_ige_bullhead	LineageOS/android_kernel_ige_bullhead v3.10.73	?	?

Kernel & Hardware

Mainline Kernel (4.13rc4 as of writing)

There is **no device tree source** (dts) file in the mainline kernel, neither for the device itself nor for the underlying SoC (MSM8992). The general support for Nexus 5X and Nexus 6 landed with 4.10, according to a [Phoronix article](#) about Kernel 4.10 ARM support. There is also a [short slideshow](#) by Jeremy McNicoll about the initial and ongoing mainlining process.

LOS 14.1 Android Kernel (3.10.73)

Unclear whether security bug fixes are implemented into this kernel (long term 3.10 kernel @ kernel.org has version 3.10.107).

Device Specifics

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#). For now check the LOS device page linked in the table above.

2.8.4 Cedric - Motorola Moto G5

The Moto G5 is a mid-range phone, with a few variants. It has multiple factors that are different for each variant: - XT number - 2GB or 3GB RAM - 16GB or 32GB Internal Storage - Single SIM or Dual SIM

Todo: Document some other device variants.

Status

Maintainership

Who	What	GitHub	XDA-Developer	Other Links
Olivier	Initial documentation	reivilibre	LambdaPerl	n/a
nift4	More docs	nift4	nift4	http://nift4.tk

Halium

Halium porting for this device is centered around Ubuntu Touch. There are only a few bugs left.

GitHub: <https://github.com/halium-on-cedric>

Telegram: <https://t.me/noandroidoncedric>

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Unofficial LineageOS 14.1 (GitHub User: Wzedlare)	android_device_motorola_cedric 14.1	android_kernel_motorola_msm8937 14.1 based on v3.18.49	Every-thing	Nothing
Unofficial LineageOS 15.1 (GitHub User: Sohamlad7)	android_device_motorola_cedric 15.1	android_kernel_motorola_msm8937 15.1 based on v3.18.100	Almost-every-thing	USB tethering (can be fixed tho)
Unofficial LineageOS 16.0 (GitHub User: Sohamlad7)	android_device_motorola_cedric 16.0	android_kernel_motorola_msm8937 16.0 based on the newest 3.18	Almost-every-thing	Audio for Wfd & Camera problems
Unofficial LineageOS 17.1 (GitHub User: Sohamlad7)	android_device_motorola_cedric 17.1	android_kernel_motorola_msm8937 17.1 based on the newest 3.18	Almost-every-thing	Camera problems

Kernel & Hardware

Mainline (v4.16-rc7 as of writing, 2018-03-31): Not Mainline

There is no device tree source (dts) file in the mainline kernel, neither for the device itself nor for the underlying SoC (MSM8937). Consult the table below for status on other hardware. There is some progress here (boots pmOS but no touch, no USB, no network): <https://github.com/Hacker1245/linux-1>.

Kind	Component	Progress
Chipset/SoC	MSM8937 (msm8937.dts)	Not mainline yet. No known work yet.
GPU	Adreno 505	YES, mainline
Image Sensor (Front)	OV5695 (5 MP)	TODO
Image Sensor (Back)	IMX258 (13 MP)	TODO

Other hardware still needs research.

Unofficial LineageOS 15.1 Android Kernel (3.18.100)

Note: the 3.18.x branch of the Linux kernel has been marked as End-Of-Life (EOL).

Available at:

- Device Tree: https://github.com/Wzedlare/android_device_motorola_cedric/tree/lineage-15.1
- Kernel: https://github.com/Wzedlare/android_kernel_motorola_msm8937/tree/lineage-15.1
- Vendor Blobs: https://github.com/Wzedlare/android_vendor_motorola_cedric/tree/lineage-15.1

Unofficial LineageOS 14.1 Android Kernel (3.18.49)

I have included this, despite being less updated than the LOS15.1 version, as it (LOS 14.1) is what I use on my phone today.

Available at:

- Device Tree: https://github.com/Wzedlare/android_device_motorola_cedric/tree/cm-14.1
- Kernel: https://github.com/Wzedlare/android_kernel_motorola_msm8937/tree/cm-14.1
- Vendor Blobs: https://github.com/Wzedlare/android_vendor_motorola_cedric/tree/cm-14.1

Motorola Kernel Sources (?.?.???)

As used on the XT1676 devices. Not sure about the version, would have to check.

<https://github.com/MotorolaMobilityLLC/kernel-msm/releases/tag/MMI-NPP25.137-15>

Other devices have a different set of sources from Motorola. Research may be required if someone is interested in locating them.

Device Specifics

Guides

Unlocking the bootloader

To unlock the bootloader, you have to provide a code to Motorola's online service who will warn you that your warranty will be void before giving you an unlock code.

Be sure to back up your stock image if you want to return to it, as Motorola do not provide images for this device, despite there being a friendly-looking 'stock ROMs' section on their developer site.

Once your device is unlocked, your boot photograph will be replaced by a warning with hard-coded text over the top of it. You can change the boot photograph but the white text will always remain, so you need to use a boot photograph with white in the correct region to prevent this from being visible.

Warning: There have been reports of hard-bricking devices by restoring stock, relocking the bootloader and updating through Motorola channels. Consult xda-developer threads about this issue if this concerns you. (If you don't intend on returning to stock, this is likely not a concern.)

Todo: TODO provide a nice link to help users unlock their bootloader

Access the bootloader

When your device is turned off: Hold down the Volume-Down button whilst you hold down the Power button. Within a few seconds, you should be greeted by the bootloader menu.

Use Volume-Up and Volume-Down to choose between the choices (such as 'Start', 'Recovery', 'Restart Bootloader', amongst others) and press Power to activate your choice.

Developer Info

The XT1676 had [segmentation faults](#) with a particular (kernel?) configuration under LineageOS 14.1 and other custom Android versions. Investigation may be required to track down the cause and solution in the event that the Halium porting effort runs into it again. Update: Solved.

Useful Resources

Todo: Provide some useful resources here.

2.8.5 Chaozu - BQ Aquaris U

Here only one or two sentences. What makes the device special? Is it a reference device?

Status

Halium

A port for **Halium 7.1 is being worked on** by LNJ2 and JBBgameich. See the [Halium project management issue](#) for chaozu.

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS placeholder device page placeholder	an-droid_device_placeholder	android_kernel_placeholder based on vX.Y.Z	?	?
Ubports placeholder device page placeholder	an-droid_device_placeholder	android_kernel_placeholder based on vX.Y.Z	?	?

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

Write whether something that is needed for the device is mainline already (switch the version in the heading for what's recent when you write this). This means **device tree source files (.dts) as well as single drivers** (for example only the wifi driver).

Cyanogemod based kernels (LOS & UBP)

If other kernels exist, just make up headlines with a name that describe the origin (Cyanogemod, LineageOS, UBports, Canonical, ...) and which is the underlying mainline version. Afterwards describe what's been improved or altered and if possible why or what is still missing.

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#).

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the [xda-developers forum](#)) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.6 Deb - Nexus 7 (2013 GSM)

This should probably **also work for the Wifi edition (flo)**.

Status

Halium

Halium 7.1 is working for this device thanks to [doniks](#). There is a detailed log by doniks in the [ubports forums](#) and a [halium/projectmanagement issue](#). The sources are linked in the forum post.

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS 14.1 info page	android_device_asus_flo	android_kernel_google_msm based v3.4.0	?	?

Kernel & Hardware

Mainline Kernel (4.13rc4 as of writing)

Most of the drivers is already mainlined. Check [John Stultzes kernel](#) below for what is missing.

The "John Stultz" almost mainline Kernel (4.11 latest)

John Stultz from Linaro has been working some time on getting everything for the Nexus 7 mainline and the most promising candidate to try on this device should be [one of his kernel branches](#). The 4.10 branch is just 23 commits different from mainline! See here a [post from John on the mainlining effort](#).

LOS 14.1 Android Kernel (3.4.0)

Unclear whether security bug fixes are implemented into this kernel (long term 3.4 kernel @ kernel.org has version 3.4.113).

Canonical's Ubuntu Touch Kernel (3.4.0 based)

This is listed because it used the kernel backports to integrate newer drivers in the original vendor kernel which might be usefull in some cases. It can be found [here](#).

Device Specifics

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#). For now check the LOS device page linked in the table above.

2.8.7 Flo - Nexus 7 (2013 Wifi only)

This is not being worked on right now, however it's the most mainline phone besides the N900 AFAIK.

Status

Halium

There are currently no effort to get Hallium to work on Flo directly although there is work being done to port it to the [Nexus 7 \(2013 LTE\)](#) aka [deb by user doniks](#). There seem to be cases were images work on both phones which should be the case since deb is flo with additional mobile network capabilities.

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS 14.1 info page	an-droid_device_asus_flo	android_kernel_google_msm based v3.4.0	?	?

Kernel & Hardware

Mainline Kernel (4.13rc4 as of writing)

Most of the drivers is already mainlined. Check John Stultzes kernel below for what is missing.

The "John Stultz" almost mainline Kernel (4.11 latest)

John Stultz from Linaro has been working some time on getting everything for the Nexus 7 mainline and the most promising candidate to try on this device should be [one of his kernel branches](#). The 4.10 branch is just 23 commits different from mainline!

LOS 14.1 Android Kernel (3.4.0)

Unclear whether security bug fixes are implemented into this kernel (long term 3.4 kernel @ kernel.org has version 3.4.113).

Canonical's Ubuntu Touch Kernel (3.4.0 based)

This is listed because it used the kernel backports to integrate newer drivers in the original vendor kernel which might be usefull in some cases. It can be found [here](#).

Device Specifics

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#). For now check the LOS device page linked in the table above.

2.8.8 FP2 - Fairphone 2

The Fairphone 2 is the smartphone made with highest priority for fair production worldwide (AFAIK) and extremely easy to repair (compared to other phones), This makes this a great candidate for a reference device ;-)

Status

Halium

There are reports of Halium running on the device [here](#), however the locations of the sources are unknown to the author at the moment.

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Ubports 15.04 (Android 5.1 base) device page	an-droid_device_fairphonefp2	an-droid_kernel_fairphone_fp2 based on v3.4.0	?	?

Also there is an [official page](#) by the manufacturer dedicated to list more.

Kernel & Hardware

Mainline (4.13rc4 as of writing)

There is no device tree source inside the mainline kernel specific to the FP2. However, the underlying SoC is present (MSM8974).

UBports kernel (3.4.0 base)

This is probably taken from the Fairphone sources directly and patched with the Ubuntu Touch specific stuff, need to check this further to be sure...

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar.

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the xda-developers forum) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.9 Hammerhead - Nexus 5

This is one of our **reference devices** and is besides the Nexus 7 2013 (flo) one of the best mainlined smartphones out there.

Status

Halium

Halium is **working on this device as version 5.1**. You can find the kernel at [Halium/android_kernel_lge_hammerhead](#) and the device tree at [Halium/android_device_lge_hammerhead](#).

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS 14.1 device page	Lin-eageOS/android_device_lge_hammerhead	Lin-ageOS/android_kernel_lge_hammerhead based on v3.4.0	?	?
UBports 15.04 (Android 5.1 base) device page	UB-ports/android_device_lge_hammerhead	UB-ports/android_kernel_lge_hammerhead based on v3.4.0	?	?

Kernel & Hardware

Mainline (4.13rc4 as of writing)

Main **device tree source (dts)** is available at [qcom-msm8974-lge-nexus5-hammerhead.dts](#), inside the latest mainline kernel but how far the functionality goes exactly is unknown. The general support for Nexus 5 landed with 4.9 according to [phoronix](#).

Cyanogenmod based kernels (LOS & UBP)

Both **UBports(UBP)** and **LOS** share a common base which is Cyanogenmod. However the Ubports kernel received some patches from the **backports project** ([backports on github](#) and the [official wiki](#)) whereas the LOS kernel has a few more manual commits.

Device Specifics

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#). For now check the LOS device page linked in the table above.

2.8.10 Herolte - Samsung Galaxy S7

The Samsung Galaxy S7 is a lightweight, powerful handset with an impressively crisp screen, and good look and feel. As with Samsung devices in general, the process of building and flashing ROMs has its peculiarities compared to devices of other makes. This page should help overcome the challenges they might otherwise present.

(Note: This page is still under construction.)

Status

Halium

Halium 7.1 can be built for the Samsung Galaxy S7, although not everything works as of writing.

Building Halium 7.1 for the Galaxy S7 is a straightforward process. It is well described in the [UBPorts porting guide](#) and the [Halium porting guide](#), but you should also consult the [LineageOS guide](#). For those wishing undertake this endeavor, some words of advice:

- Read the guides and familiarize yourself with the process before starting.
- Secure the necessary resources beforehand, including a PC to do the development work on and a good USB cable.
- Download and install the necessary resources before starting.
- Check and record the details of your device (version, hardware, the currently installed OS and its version)
- Completing a successful build is the easy step. Installing, configuring, debugging and fixing issues is the demanding part. However, anyone with a fair amount of patience and the ability to read and follow a slightly above average cooking recipe should manage to build, install and get the system up and running. Making everything work is different question.

For convenience, links to some of the important resources mentioned in the guides are also gathered at the bottom of this page, along with other useful/potentially useful resources not mentioned there.

Good luck!

Distributions

The following table is somewhat lacking, but a good start.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS for Samsung Galaxy S7 wiki page	android_device_samsung_universal8890	android_kernel_samsung_universal8890 based on v3.18.14	?	?
Halium and Ubports device port page	Same as above	android_kernel_samsung_universal8890 based on v3.18.14	Graphics, screen rotation, WiFi, lights, sound, vibration.	Bluetooth, phone, sms, gps, camera, video.

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

(To be completed...)

Cyanogemod based kernels (LOS & UBP)

(To be completed...)

Device Specifics

Guides

[Building Lineage OS for the S7](#)

[The UBPorts Porting Guide](#)

[The Halium Porting Guide](#)

[Detailed account of one porter's porting process for Ubuntu Touch to the S7, including valuable extra links and tips](#)

[Device port discussion thread for the S7 on Github](#)

Developer Info

In order to flash a custom recovery or boot image, the Samsung Galaxy S7 has to be put into download mode. Simultaneously press the home button, volume-down button and power button until the blue screen appears. Then confirm download mode by pressing the volume-up button.

Switching of the device when in the download mode can be done by simultaneously pressing the volume-down button and the power button until the device switches off.

After flashing a custom recovery, entering custom recovery from the power-off state is done by simultaneously pressing the volume-up button, the home button and the power button until the Samsung boot logo appears, then IMMEDIATELY releasing all buttons.

If at some point the device does not boot at all from the power off state, no matter how long you press the power button, try this:

- First enter the download mode as described above.
- Then switch completely off, also as described above.
- Now, you should once more be able to either boot normally or boot into recovery, whichever you wish.

Useful Resources

[GSMARENA full phone specifications for Samsung Galaxy S7](#)

[Wikipedia entry on Samsung Galaxy S7](#)

[Firmware for Samsung Galaxy S7 at Sammobile.com](#)

[Stock firmware for Galaxy S7 at Firmware Home](#)

[TWRP recovery for Samsung Galaxy S7](#)

[Fix 'kernel is not Seandroid enforcing' problem](#)

[Videoguide 'kernel is not Seandroid enforcing' problem](#)

2.8.11 H815 - LG G4

The LG G4 is a mobile handset featuring a 5.5 in 1440p display, a snapdragon 808 hexacore processor and 3 GB RAM, 32 GB internal storage with the option to expand to 2TB. The micro USB port doubles as HDMI out.

Status

Halium

Halium works on this device although not all features are functional as of writing. The device is currently being worked on by [Ari Börde Kröyer](#).

The Halium version is 7.1 and the kernel is version 3.10.84. The device boots into the Ubports Ubuntu Touch 32 bit rootfs.

What works: Graphics (including screen rotation), wifi, audio, sensors, and sms are all working. Audio in calls is currently not functional, although it is possible to place and receive calls.

Distributions

Overview of available distributions and the status of these, as well as corresponding sources.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LG G4 (h815) on LineageOS Wiki	LineageOS/android_device_lge_h815 LineageOS/android_device_lge_g4-common proprietary_vendor_lge	android_kernel_placeholder based on vX.Y.Z	?	?
Uports device page: none as yet	abkro/android_device_lge_h815/tree/halium-7.1-ut abkro/android_device_lge_g4-common/tree/halium-7.1-ut Vendor blobs: see above.	abkro/android_kernel_Graphics,Screen based on v3.10.84	Graphics, Screen rotation, wifi, audio, sensors, sms	Camera, audio in calls

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

—

Cyanogemod based kernels (LOS & UBP)

—

Device Specifics

Guides

[LOS device page.](#)

Developer Info

Once the device has been unlocked, TWRP recovery has been installed and you have flashed the device, reflashing has to be done as follows, using adb:

Enter TWRP recovery Wipe as necessary Connect to host pc by USB cable Enter directory on host where your boot image resides Input command: 'adb push <your_boot_image> /sdcard/Download/' On the device: Select 'install', navigate to directory /sdcard/Download, choose 'Image', select the file, select 'Boot', swipe to flash.

For flashing system image and rootfs, follow instructions in the relevant guide.

2.8.12 krillin - BQ Aquaris E4.5

This device is besides having a smaller display almost identical to the Aquaris E5 so maybe images are interchangeable.

Status

Halium

There is no one working on bringing Halium to this device AFAIK.

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Ubports 15.04 (Android 5.1 base) device page	?	?	?	?
Unofficial LineageOS 13 device page	Pablito2020/android_dev	Pablito2020/android_kernel_bq_krillin based on 3.10.49		some problems with SMS

Kernel & Hardware

Mainline (4.13rc4 as of writing)

There is no Mediatek MT-6582 device source tree present inside the mainline kernel yet.

Canonical's kernel (3.4.67 based)

The [kernel from canonical](#) especially saw some backporting. AFAIK with this kernel every feature except radio worked.

Pablito2020 unofficial LOS kernel (3.10.49 based?)

This kernel (linked in table) seems to be more recent and is said to work completely with a CM13 base.

Device Specifics

Guides

Entering Fastboot & Recovery Mode

For BQ Aquaris E4, E4.5, E5 and E6, assuming *device is off*:

Hold *Power* button + *Volume Up* button until menu pops up

Boot Mode Selection: Navigate with *Volume Up* and select with *Volume Down*

Entering Recovery: Press *Volume Up* to access menu Navigate with *Volume* buttons and select with *Power* button.

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the [xda-developers forum](#)) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.13 land - Xiaomi Redmi 3S/Prime

land - Xiaomi Redmi 3S/Prime is a entry-level phone with aggressive development on XDA Forums. The Prime variant has a fingerprint sensor and 3Gb RAM

Status

Halium

Halium 7.1 is **WIP**. Ported by [rupansh](#) and [sridhardv](#).

Distributions

Distribution	Device Specific Files	Device Common Files	Kernel	What works	What doesn't work
Unofficial LineageOS 14.1 Tree by hyper team	HyperTeam/android_device_xiaomi_land	HyperTeam/android_device_xiaomi_land	HyperTeam/android_kernel_xiaomi_msm8937 based on v3.18.31	see device page	see device page
land on Halium projectmanagement	rupansh/android_device_xiaomi_land	rupansh/android_device_xiaomi_land	rupansh/android_kernel_xiaomi_msm8937 based on v3.18.31	see projectmanagement issue	see projectmanagement issue

Kernel & Hardware

CAF based

The kernel is based off CAF's kernel (Though it has some LineageOS specific patches)

Device Specifics

Guides

Unlocking the bootloader WILL void the warranty for this device.

To unlock the bootloader, you need to get the permission from Xiaomi.

Press Volume Down + Power Button to enter fastboot mode.

Press Volume Up + Volume Down + Power button to enter recovery mode.

Developer Info

Unlocking bootloader is cancerous for Xiaomi devices.

Usefull Resources

- [TWRP for Xiaomi Redmi 3S/Prime](#)

2.8.14 mako - Nexus 4

As all Nexii rather good support of sources.

Status

Halium

Work in progress.

Sources:

- [Kernel](#)
- [Device](#)
- [Vendor](#)

What works:

- Halium boots with reference rootfs
- LED
- Vibrator
- Wifi
- Buttons
- Graphics
- Battery

What doesn't work (or isn't tested yet):

- Audio
- Camera

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Mako on LineageOS Wiki	Lin- eageOS/android_device_ige_mako	Lin- eageOS/android_kernel_ige_mako based on v3.4.0	?	?
Ubports 15.04 (Android 5.1 base) device page	?	?	?	?

Kernel & Hardware

Mainline (4.13rc4 as of writing)

No exact device tree source (dts) for mako so far. But a general dts for the underlying SoC (APQ8064) is available and also used for other specific dts'ses (e.g.) Nexus 7)

LineageOS kernel (3.4.0 based)

TODO

Canonical's Ubuntu Touch kernel (3.4.0 based)

Available [here](#).

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the LOS device database.

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the xda-developers forum) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.15 Nicki - Sony Xperia M

Xperia M is very weak, especially by today's standards. But it runs Halium. Somehow.

Status

Halium

There is an ongoing port of Halium for Nicki that [Konrad Dybcio](#) is working on. Halium-7.1 branch builds with LOS 14.1 sources. Halium rootfs can be flashed using [halium-install](#) by JBB, yet /data partition is too small (2 gigs) to fit a plasma mobile rootfs. This can be worked around by changing `IMAGE_SIZE=2G` to for example `IMAGE_SIZE=1.7G` for pm in `halium-install/functions/distributions.sh`.

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS	<code>an-droid_device_sony_nicki</code>	<code>an-droid_kernel_sony_msm8x27</code> based on v3.4.0	Everything(afaik)	Nothing
Halium Reference Rootfs	<code>ewen-tual/halium_device_sony_nicki</code>	<code>ewen-tual/halium_kernel_sony_msm8x27</code> based on v3.4.0	See projectmanagement issue	Everything else
Ubports	Not yet	Not yet	Nothing, even putting rootfs on the device (not enough space)	Everything

Kernel & Hardware

Mainline

Not present

Cyanogemod based kernels (LOS & UBP)

Kernel version is v3.4.0.

Device Specifics

Guides

Special boot modes

Fastboot: With the device powered off, while holding Volume Up, connect the USB cable to the computer. The LED should turn blue.

Flashmode: With the device powered off, while holding Volume Down, connect the USB cable to the computer. The LED should turn green. Then you can go back to the stock rom using [Androxyde's Flashtool](#). Last sure to be working with nicki version of Flashtool was 0.9.18.6, newer versions could fail.

Recovery (ONLY on android custom kernels): On boot, press Volume Down when the LEDs start lighting up. This only works with a working boot image. If there is none, you can flash twrp to boot partition first and use it to reboot into recovery.

Second Recovery: To boot to the FOTA Recovery follow recovery instruction, but press Volume Up instead.

Developer Info

With hybris-boot only way to access TWRP is to flash it as boot.

Useful Resources

- [halium-install](#) from JBB

2.8.16 oneplus3 - OnePlus 3(T)

The OnePlus 3 (also abbreviated as OP3) is a smartphone produced by OnePlus. It was revealed on June 14, 2016. The OnePlus 3 is the first OnePlus device to not be part of the invite system, which OnePlus had used for its last three devices to regulate flow with inadequate manufacturing for the inevitable high demand.

The OnePlus 3T (also abbreviated as OP3T) is a smartphone made by OnePlus. It is the successor to the OnePlus 3 and was revealed on 15 November 2016. It is an incremental update to the company's flagship phone being released only 6 months later.

Status

Halium

Halium is **working on this device as version 7.1**. Ported by [Nelly Simkova](#), [Ivan Semkin](#) and [Marius Gripsgard](#)

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
oneplus3 on LineageOS Wiki	Lin- eageOS/android_device_oneplus3	Lin- eageOS/oneplus3d_kernel_oneplus_msm8996 based on v3.18.31	see device page	see device page
oneplus3 on Halium projectmanagement	Hal- ium/android_device_oneplus3	Hal- ium/oneplus3d_kernel_oneplus_msm8996 based on v3.18.31	see device page	see device page

Kernel & Hardware

Cyanogenmod based kernels (LOS & UBP)

Both **Halium** and **LOS** share a **common base** which is Cyanogenmod. However, the Halium kernel was patched with Halium-specific edits.

Device Specifics

Guides

Unlocking the bootloader doesn't void the warranty.

To unlock the bootloader enable `OEM Unlock` setting in Developer Options of your ROM and run `fastboot oem unlock` command while in download mode.

In order to launch download mode, with the device powered off, hold `Volume Up + Power`.

In order to launch recovery, with the device powered off, hold `Volume Down + Power`.

Also, be sure to check the [LineageOS device info for oneplus3](#)

Useful Resources

- [Repo Manifest](#)
- [TWRP for OnePlus 3\(T\)](#)

2.8.17 PME (Perfume) - HTC 10

In 2015, HTC released the HTC One M9 smartphone, which was praised for its design, but criticized for being too similar to its predecessor, the HTC One (M8). To address the shortcomings of the M9, HTC released another new phone that year with a new design and hardware: the HTC One A9. The design of the HTC 10 is somewhat of a mix of the M9 and the A9

Status

Halium

Halium is **working on this device as version 7.1**. Ported by [Ivan Semkin](#) and [Marius Gripsgard](#)

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
PME on LineageOS Wiki	LineageOSandroid_device_htc_pme	LineageOSandroid_kernel_htc_msm8996 based on v3.18.31	see device page	see device page
PME on Halium projectmanagement	Halium/android_device_htc_pme	Haliumandroid_kernel_htc_msm8996 based on v3.18.31	see device page	see device page

Kernel & Hardware

Cyanogemod based kernels (LOS & UBP)

Both **Halium** and **LOS** share a **common base** which is Cyanogenmod. However, the Halium kernel was patched with Halium-specific edits.

Device Specifics

Guides

HTC allowed users to officially unlock phones without S-Off. Links provided below

This device has 2 modes for fastboot: `bootloader` (white background) and `download` (dark background). You have to use `download` mode in order to flash/wipe anything. AFAIK `bootloader` mode is only used to check its status and for emergency purposes.

In order to launch recovery, you have to boot into `download` mode first (Power + Volume Down), then select `reboot to bootloader`, and only then `boot to recovery` mode.

Also, be sure to check the [LineageOS device info](#) for PME

Developer Info

TWRP's BusyBox for the device is partially broken. Thus stock rootstock might fail to install Halium properly. I suggest using [JBB's alternative installation script](#).

Useful Resources

- [Repo Manifest](#)
- [Official HTC Unlock guide](#)
- [TWRP for HTC 10](#)

2.8.18 rolex - Xiaomi Redmi 4a

A Snapdragon 425 (MSM8917) budget phone from Xiaomi released in 2016 that is great on its own. Comes with MIUI 8 (Marshmallow), upgradeable to MIUI 9 (Nougat).

It has 2GB LPDDR3 RAM, 16GB/32GB eMMC storage.

An updated version of this device Redmi 5a (riva) was released in 2017. Both are basically the same, and share device trees and kernels. So anything that applies to 4a should as well apply to 5a

Status

Halium

Halium 7.1 is **WIP**. Ported by areyoudeveloper(Tea)

Distributions

Distribution	Device Specific Files	Device Common Files	Kernel	What works	What doesn't work
Unofficial LineageOS 14.1 Tree by murali	muralivi-jay/android_device_xiaomi_rolex	NA	Nick89786/android_kernel_xiaomi_rolex based on v3.18.140	see device page	see device page
rolex on Halium projectmanagement	areyoudevel-oper1/android_device_xiaomi_rolex	NA	areyoudevel-oper1/android_kernel_xiaomi_rolex based on v3.18.140	see projectmanagement issue	see projectmanagement issue

Kernel & Hardware

The kernel is based off nick's kernel (though it has some halium specific patches).

Device Specifics

Guides

Unlocking the bootloader WILL void the warranty for this device.

To unlock the bootloader, you need to get the permission from Xiaomi. Takes around a week or two. [Official Guide](#).

Press Volume Down + Power Button to enter fastboot mode.

Press Volume Up + Power button to enter recovery mode.

Useful Resources

[TWRP XDA Link](#)

2.8.19 T00F/T00J - Asus Zenfone 5

Here only one or two sentences. What makes the device special? Is it a reference device?

Status

Halium

Halium 7.1 is being worked on by [Ilya Bizyaev](#) and as of august 2017, he's got a **working x86 rootfs and LXC container** but test seem to fail. Here are [Device files](#) and [kernel](#). The local manifest has the following form

```
<manifest>
  <remote name="zf" fetch="http://github.com/zenfone-legacy" revision="refs/heads/cm-14.1"/>
  <project name="Halium/android_device_asus_T00F" path="device/asus/T00F" remote="hal" />
</manifest>
```

(continues on next page)

(continued from previous page)

```
<project name="Halium/android_kernel_asus_T00F" path="kernel/asus/T00F" remote="hal
↪"/>
<project name="proprietary_vendor_asus" path="vendor/asus" remote="zf"/>
<project name="android_external_stlport" path="external/stlport" remote="los"/></
↪manifest>
```

There is an issue in halium/projectmanagement for the T00F.

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Hammerhead on LineageOS Wiki < https://wiki.lineageos.org/devices/hammerhead >'	an-droid_device_placeholder	an-droid_kernel_placeholder based on vX.Y.Z	?	?

Kernel & Hardware

Mainline (version TODO)

TODO

Cyanogemod based kernels (LOS & UBP)

If other kernels exist, just make up headlines with a name that describe the origin (Cyanogemod, LineageOS, UBports, Canonical, ...) and which is the underlying mainline version. Afterwards describe what's been improved or altered and if possible why or what is still missing.

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar. For this device this can be pulled from the [LOS device database](#).

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the [xda-developers forum](#)) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.20 Titan - Moto G 2014

Here only one or two sentences. What makes the device special? Is it a reference device?

Status

Halium

A port to **Halium 7.1 is being worked on** by [Walid Hammami](#). The according Halium/projectmanagement issue can be found [here](#).

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS placeholder device page placeholder	an-droid_device_placeh	android_kernel_placeholder based on vX.Y.Z	?	?
Ubports placeholder device page placeholder	an-droid_device_placeh	android_kernel_placeholder based on vX.Y.Z	?	?

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

Write whether something that is needed for the device is mainline already (switch the version in the heading for what's recent when you write this). This means **device tree source files (.dts) as well as single drivers** (for example only the wifi driver).

Cyanogemod based kernels (LOS & UBP)

If other kernels exist, just make up headlines with a name that describe the origin (Cyanogemod, LineageOS, UBports, Canonical, ...) and which is the underlying mainline version. Afterwards describe what's been improved or altered and if possible why or what is still missing.

Device Specifics

Guides

This should be populated with guides how to get into different boot modes and similar. Maybe this can be pulled from the [LOS device database](#).

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the xda-developers forum) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.21 Vegeta / Vegetahd - BQ Aquaris E5 / BQ Aquaris E5HD

The family of Aquaris E5 devices by BQ are all called vegeta + a special suffix (there is an E5 HD so it's vegetahd for example). However, the hardware is "the same" only in the versions E5 (vegeta) and E5 HD (vegetahd). The newer E5 4G (vegetalte) <devices/vegetalte> which has an LOS 14.1 image is a completely different System and does not share the same hardware. However, the *BQ Aquaris E4.5 (krillin)* is basically the same and maybe it's images will work with minor changes.

Status

Halium

There has been no effort to get Halium onto this device so far.

Distributions

The following entries are just a placeholder, exactly as this sentence.

Distribution	Device Specific Files	Kernel	What works	What doesn't work
UBports 15.04 (Android 5.1 base) device page	?	?	?	?

Kernel & Hardware

Mainline (4.13rc4 as of writing)

There is a very rudimentary device tree source file inside kernel 4.13rc4 at `dts/mt6589-aquaris5.dts`. This still needs a lot of work.

Canonical's Ubuntu Touch kernel (3.4.67 based)

This kernel can be found at [bq/aquaris-e5](#)

Device Specifics

Guides

Entering Fastboot & Recovery Mode

For BQ Aquaris E4, E4.5, E5 and E6, assuming device is off :

Hold *Power* button + *Volume Up* button until menu pops up

Boot Mode Selection: Navigate with *Volume Up* and select with *Volume Down*

Entering Recovery: Press *Volume Up* to access menu Navigate with *Volume* buttons and select with *Power* button.

Developer Info

Some devices show strange behaviour of some kind, try to find this (for example in the xda-developers forum) and document it

Usefull Ressources

If anything might be usefull but didn't fit above you can just throw in some links here.

2.8.22 Xiaomi Redmi 2/Prime (wt88047)

Xiaomi Redmi 2 smartphone was launched in January 2015. The phone comes with a 4.70-inch touchscreen display with a resolution of 720 pixels by 1280 pixels at a PPI of 312 pixels per inch.

Status

Halium

A port for Halium 7.1 is being worked on by [Abhishek Mudgal](#)

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
WT88047 on LineageOS Wiki	LineageOSan-droid_device_wingtech_wt88047	LineageOSan-8047d_kernel_wingtech_msm8916 based on v3.10.49	see device page	see device page

Kernel & Hardware

Mainline (vX.Y.Z as of writing)

Write whether something that is needed for the device is mainline already (switch the version in the heading for what's recent when you write this). This means **device tree source files (.dts) as well as single drivers** (for example only the wifi driver).

Cyanogemod based kernels (LOS & UBP)

Both **Halium and LOS share a common base** which is Cyanogenmod. However, the Halium kernel was patched with Halium-specific edits. Currently only kernel flags in `lineageos_wt88047_defconfig` were altered.

Device Specifics

Guides

Bootloader for wt88047 comes pre unlocked.

Flash hybris-boot as a boot image from fastboot.

In order to launch recovery, do press "Power + Volume Down + Volume UP"

Also, be sure to check the [LineageOS device info for WT88047](#)

Developer Info

This device is mostly open and has no weird behaviour

Useful Resources

- [Repo Manifest](#)
- [TWRP for Xiaomi Redmi2/Prime](#)

2.8.23 Yuga - Sony Xperia Z

There exists basic mainline kernel support added by Sony. This possibly could become a reference device.

Status

Halium

There is a **working Halium 7.1** port made by [LNJ](#) and here is the according [Halium project management issue](#).

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Yuga on LineageOS Wiki	LineageOS/android_device_sony_yuga	LineageOS/android_kernel_sony_apq8064 based on v3.4.113	everything	

Kernel & Hardware

Mainline (v4.15-rc9 as of writing)

The kernel will start and there is already UART and USB debugging implemented for this device. There also has been worked on riva, which is used for connectivity like WiFi, Bluetooth and FM, but there is no documentation of what really works.

LineageOS kernel (v3.4.113)

This is just the original Sony kernel with some security fixes, updates and back ports. Unfortunately the LTS has ended, so 3.4.113 is the last version.

Device Specifics

Guides

You can always get into fastboot by holding the power button and the volume up button until the device vibrates three times, then only press the volume up button and you'll get into fastboot. If you use a LineageOS/CyanogenMod boot image you can also press volume up or down, when the LED turns pink on startup.

I always had to flash TWRP to the boot partition to get into the recovery again. Currently I don't know if there is any way to get into the recovery in a simpler way.

Developer Info

There's no strange behaviour, except the way to get into fastboot or recovery.

Useful Resources

[TWRP for yuga \(only up to v3.0.2\)](#)

2.8.24 Taoshan - Sony Xperia L

The device is quite weak to run Halium. But it should be possible.

Status

Halium

A port for Halium 7.1 is being worked on by [Jonatan Hatakeyama Zeidler](#). Halium 7.1 builds, but does not install using `halium-install` due to TWRP BusyBox issues. Using `halium-install` from JBB the halium reference rootfs can be installed, but it does not seem to start.

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
LineageOS	Lin- eageOS/android_device_sony_nuos	Lin- eageOS/android_kernel_asus_msm8916 based on v3.4.0	Everything	Nothing
Halium Reference Rootfs	jon- nius/android_device_sony_nuos	jon- nius/android_kernel_asus_msm8916 based on v3.4.0	Installation	Does not boot
Plasma Mobile	jon- nius/android_device_sony_nuos	jon- nius/android_kernel_asus_msm8916 based on v3.4.0	Building images	Installation (/data is too small)
UBPorts	None	None	Porting not yet started	Everything

Kernel & Hardware

Mainline

I don't know if something that is needed for the device is mainline already.

Cyanogemod based kernels (LOS & UBP)

Kernel version is 3.4.0.

Device Specifics

Guides

Special boot modes

- **Fastboot:** With the device powered off, while holding Volume Up, connect the USB cable to the computer. The LED should turn blue.
- **Recovery:** On boot, press Volume Down when the LEDs start lighting up. This only works with a working boot image. If there is none, you can flash twrp to boot partition first and use it to reboot into recovery.
- **Second Recovery:** To boot the FOTA Recovery, press Volume Up instead. This seems to be equal to Recovery.

Developer Info

After flashing hybris-boot, recovery can not be accessed anymore. Therefore follow these steps to install halium rootfs:

- Enter Fastboot
- Flash [TWRP image](#) to recovery and boot partition
- Reboot into TWRP on boot
- From TWRP reboot into Recovery
- In TWRP mount data partition
- Clone [halium-install from JBB](#) (the official one does not work)
- Edit functions/core.sh and change rootfs size to 1G (data partition has only 1.6 GB)
- Run halium-install with halium rootfs image and system.img
- Enter Fastboot
- Flash hybris-boot image to boot partition using fastboot

Usefull Resources

- [halium-install from JBB](#)

2.8.25 Z00L - Zenfone 2 Laser

The Zenfone 2 Laser is a group of mid-range Android smartphones, released in August 2015, with a number of different region-specific configurations. The Zenfone 2 Laser comes with either a 5", 5.5" or 6" display, with either 720p or 1080p resolutions. Chipsets range from a 1.2GHz quad-core Snapdragon 410, to a 1.7GHz octa-core Snapdragon 616, with each device having either 2GB or 3GB of RAM and 8GB, 16GB or 32GB internal storage. All devices are capable of holding a microSD card up to 128GB and have dual-SIM capability. Cameras comes in either 8MP or 13MP and batteries range from 2400mAh to 3000mAh.

Status

Halium

A port for Halium 7.1 is being worked on by [Aayush Gupta](#)

Distributions

Distribution	Device Specific Files	Kernel	What works	What doesn't work
Z00L on LineageOS Wiki	Lin- eageOS/android_device_asus_z00l	Lin- eageOS/android_kernel_asus_msm8916 based on v3.10.108	see device page	see device page
Z00L on Halium projectmanagement	Hal- ium/android_device_asus_z00l	Hal- ium/android_kernel_asus_msm8916 based on v3.10.108	see device page	see device page

Kernel & Hardware

Mainline (v3.10.108 as of writing)

Everything required is already patched in kernel source and is fully upstreamed. Patches from CAF and Linux are also merged already.

Cyanogemod based kernels (LOS & UBP)

Both **Halium** and **LOS** share a **common base** which is Cyanogenmod. However, the Halium kernel was patched with Halium-specific edits. Currently some kernel flags and additional patches were used.

Device Specifics

Guides

Special boot modes

Recovery: With the device powered off, hold Volume Up + Power. On the next screen (fastboot mode) use Volume Down to scroll to “RECOVERY” and then press Power to select.

Download: With the device powered off, hold Volume Up + Power.

Developer Info

This device is completely open and has no weird behaviour

Useful Resources

- [TWRP for Z00L](#)

2.8.26 How to document

Purpose

This table is meant for 2 purposes:

- (A) give porters a **quick status reference** what has already been done in regard of Halium to a specific device or what the starting conditions are
- (B) make hardware visible for **kernel team** to see there may be a possibility of a **common drivers base** for multiple devices

Table Format

Please use the following where the formatting is not obvious:

1. First Row ‘Device’ is Manufacturer + Device Name and **links to the devices sub page**
2. Second Row ‘Codename’ is the official Codename as stated inside the Android/Ubuntu Touch/Lineage sources

3. Third Row 'Halium status' is a very short description like 'working fully' or 'boot loop' with the base version attached so e.g. with halium 5.1 base: 'working fully - 5.1'
4. All following Hardware Rows **should link to a detail page about every chip**
5. If you **only have the labels from chips available** just set them inside 'label' perhaps someone else knows more details (most common for cameras, see Nexus 4 example below)
6. **Kernel Version Please fill this one only when there is an existing Halium image!**

Getting the Info

- Search **Wikipedia** for your device, a good starting points are the articles that compare [smart phones](#) or [tablets](#)
- Search the [xda-developers forum](#)
- Connect to your device via adb (assuming you have some kind of Android on your phone/tablet) and search for infos using getprop or similar
- Search for **teardowns** and scan the images for readable chips and try to find out what each one does (you may of course do a teardown on your own) good starting points for this are iFixit or Youtube Videos that show how to repair/tear down a device
- Search the [LineageOS device database](#) for your devices codename.
- Please **write down your sources somewhere and link to them below the table or in the device's sub page**

2.8.27 Devices

Device	Code	Hardware status	Kernel	SoC	CPU	GPU	RAM	Storage	Connectivity	Camera Front	Camera Back	Battery	Sound	Touch screen	Display	Navigation	Sensors	Other
OnePlus 5	pluees	Halium porting started	4.4	Qualcomm Snapdragon 835	4.0 GHz	Adreno 540	8GB LPDDR4	Storage	Connectivity	Sony IMX371	Dual Camera with Sony IMX398 (wide angle) + Sony Exmor IMX350 ("telephoto")	Battery	Sound	Touch screen	Display	Navigation	Sensors	Other
Samsung Galaxy S8+	dream	Halium 7.1 WIP	4.4	Samsung Exynos 9895	3.3 GHz	Mali-G71 MP20	4GB LPDDR4	Samsung UFS 2.1	Bluetooth, Wi-Fi, NFC, FM, GPS, IR, Proximity, Accelerometer, Gyro, Barometer, Light, Proximity, Light, 11160-	Sony Ex-RS (8MP)	Sony Ex-RS (12MP)	3300mAh	Qualcomm WCD9341	Touch screen	Super AMOLED	GPS, GLONASS, BDS, e-GALILEO	Proximity, Light, 11160-	Other: AFEM-9066, Avago AFEM-9053, Silver, AFEM-9069
Samsung Galaxy S8	dream	Not working	4.4	Samsung Exynos 9895	3.3 GHz	Mali-G71 MP20	4GB LPDDR4	Samsung UFS 2.1	Bluetooth, Wi-Fi, NFC, FM, GPS, IR, Proximity, Accelerometer, Gyro, Barometer, Light, Proximity, Light, 11160-	Sony Ex-RS (8MP)	Sony Ex-RS (12MP)	3000mAh	Qualcomm WCD9341	Touch screen	Super AMOLED	GPS, GLONASS, BDS, e-GALILEO	Proximity, Light, 11160-	Other: AFEM-9066, Avago AFEM-9053, Silver, AFEM-9069

2.8. Device Overview

Sources

Since there are no sub pages yet, gathering links for the examples here:

OnePlus 5

- [Oneplus 5 iFixit teardown](#)
- [Oneplus 5 Wikipedia](#)

Samsung Galaxy S8+

- [Samsung Galaxy S8+ iFixit teardown](#)
- [Samsung Galaxy S8+ GSMArena](#)
- [Samsung Galaxy S8+ DeviceSpecifications](#)
- [Samsung Galaxy S8\(+\) Website](#)

Samsung Galaxy S8

- [Samsung Galaxy S8 iFixit teardown](#)
- [Samsung Galaxy S8 GSMArena](#)
- [Samsung Galaxy S8 DeviceSpecifications](#)
- [Samsung Galaxy S8\(+\) Website](#)

Shift 5.1

- [Shift 5.1 iFixit teardown](#)

Wiko Pupl 4G

- [Pupl 4G iFixit teardown](#)

Nexus 5

- [Nexus 5 iFixit teardown](#)
- [Nexus 5 Wikipedia](#)
- [Nexus 5 Slideshare on Snapdragon 800](#)

Nexus 5X

- [Nexus 5X iFixit teardown](#)
- [Nexus 5X Wikipedia](#)

Oneplus One

- [Oneplus One iFixit teardown](#)
- [Oneplus One Wikipedia](#)

Nexus 4

- [Nexus 4 iFixit teardown](#)
- [Nexus 4 Wikipedia](#)
- [Nexus 4 Kernel @ launchpad](#)

Fairphone 2

- [Fairphone 2 iFixit teardown](#)
- [Fairphone 2 UBP dev info page](#)
- [Fairphone 2 Wikipedia](#)
- [Fairphone 2 Kernel Makefile @ github/UBP](#)

Nexus 7 (2012)

- [Nexus 7 2012 iFixit teardown](#)
- [Nexus 7 2012 Wikipedia](#)

Nexus 7 (2013) Wifi-only = flo

- [Nexus 7 2013 iFixit teardown](#)
- [Nexus 7 2013 Wikipedia](#)

BQ Aquaris E4.5

- [Aquaris E4.5 Wikipedia](#)

HTC 10

- [HTC 10 Wikipedia](#)
- [HTC 10 GSMArena](#)
- [HTC 10 DeviceSpecifications](#)
- [HTC 10 iFixit](#)
- [HTC 10 LOS](#)
- [HTC 10 Website](#)

Asus Zenfone 2 Laser (Z00L)

- [Asus Zenfone 2 Laser Z00L LOS](#)

Xiaomi Redmi2/Prime (wt88047)

- [Xiaomi Redmi 2/Prime GSM-Arena](#)
- [Xiaomi Redmi 2/Prime Fonearena](#)
- [Wingtech Wt88047 LOS](#)

OnePlus 5

- [OnePlus 3 Wikipedia](#)
- [OnePlus 3T Wikipedia](#)
- [OnePlus 3 GSMArena](#)
- [OnePlus 3T GSMArena](#)
- [OnePlus 3 DeviceSpecifications](#)
- [OnePlus 3T DeviceSpecifications](#)
- [OnePlus 3 iFixit teardown](#)
- [OnePlus 3\(T\) LOS](#)
- [OnePlus 3 Website](#)
- [OnePlus 3T Website](#)

Xiaomi Redmi 3s/Prime

- [Redmi 3s Website](#)

Xiaomi Redmi 4A

- [Redmi 4A Website](#)
- [Redmi 4A GSMArena](#)

Samsung Galaxy S7

- [Samsung Galaxy S7 GSMArena](#)
- [Samsung Galaxy S7 Exynos DeviceSpecifications](#)
- [Samsung Galaxy S7 SD820 DeviceSpecifications](#)

LG G4

- [LG G4 GSMArena](#)
- [LG G4 DeviceSpecifications](#)

2.9 Hardware and kernel enablement

This page is meant as an overview of

- **What Hardware may be inside a smart phone**
- **Which of those parts need a kernel driver** = probably all
- **What is eachs components current status?** = mainline(since)/wip/blob

Please be aware that mainlining is A PROCESS so sometimes “mainline” doesn’t mean the same for two chips. However we will use the term in this overview as in “the chip is being mainlined beginning with kernel v.xx) and a detailed overview shall be given on a sub page or an external reference.

2.9.1 How to use this Overview

If you are trying to document the parts of a new or incomplete documented device the chips should all be listed in the *Device Overview* and on each devices sub page.

Every hardware part should be listed on this page in it’s category (connectivity, sensors, ...) and link to a **detailed sub page** with further info if possible **while only open source status should be presented here**.

Also in the tables below, it would be very useful to know with which kernel version certain drivers were mainline so please try to take the time to **document the kernel version of each’s components mainlining success**

Where to find software status

How to find all hardware related data is documented on the Devices Overview. However, it’s not that trivial to find out if there is an open source (or even mainlined) driver of the specific component. Essentially, you need to search [the linux kernel](#) and drivers should be inside the folder *drivers/*. **Always keep in mind that abbreviations are used** e.g. qcom instead of Qualcomm.

There are many ways to search for specific drivers. I’ll need to tinker a little bit or ask around to find out which way works best. All ways shall be listed below

1. You can for example manually browse the mainline kernel by clicking on ‘browse’ there, then navigate to the ‘tree’ section and then click yourself through the drivers folder
2. You can search linux kernel mailing lists like [the linux-arm-kernel archives](#) for specific hardware
3. For **Qualcomm SoCs** there is a community driven [qualcomm mainlining wiki](#) as is for **Allwinner @ sunxi mainlining**
4. You can also look into [kernel changes on kernelnewbies.org](#)
5. Wicket from the Maemo community also has a short [list of devices](#) and their status pages.

SoC support @ Device Tree Source (dts) folder

Modern ARM devices should have their own **device tree** inside the mainline kernel. For a really good reference check out ‘[Device Tree for Dummies](#)’ by Thomas Petazzoni from [Free Electrons](#). Also from Thomas Petazzoni is the great [ARM-soc-checklist](#) (they really produce stunning docs there)

For all ARM based smart phones and tablets this should be inside

```
root/arch/arm/boot/dts/
```

or if your device is using a 64-bit (arm64) processor (e.g. BQ Aquaris M10) all files are sorted by manufacturer inside

```
root/arch/arm64/boot/dts/
```

2.9.2 System Components

System-on-Chips (SoC)

Device specific dts

Please only include SoCs that are used inside any smart phone/tablet and have a smart phone/tablet *.dts file.

Manufacturer	SoC	Board	Main-line(since)	file	armhf/arm64
Qualcomm	APQ8064	Asus Nexus 7	since 4.6	qcom-apq8064-asus-nexus7-flo.dts	armhf
Qualcomm	APQ8064	Sony Xperia yuga	? is inside 4.12-rc2	qcom-apq8064-sony-xperia-yuga.dts	armhf
Qualcomm	MSM8974	LG Nexus 5	? inside 4.12-rc2	qcom-msm8974-lge-nexus5-hammerhead.dts	armhf
Qualcomm	MSM8974	Sony Xperia Honami	? inside 4.12-rc2	qcom-msm8974-sony-xperia-honami.dts	armhf

Here, we directly see what is the benefit of these tables -> The Qualcomm MSM8974 SoC is already mainlined and there are several boards one can use as a reference to e.g. **write a fairphone2.dts** with the purpose to one day mainline it! Also, the APQ8064 SoC is used inside Nexus 4 as well. . .

General dts

Below are gathered mainlined SoCs and Smart phones/Tablets that use it but do not have a device-specific *.dts yet.

Manufacturer	SoC	arch	Devices
		armhf	Smartphones/Tablets
Qualcomm	APQ 8060	armhf	HP TouchPad, HTC Jetstream, HTC Amaze 4G, HTC Vivid, HTC Raider 4G, Le Pan II, LG Nitro HD, Pantech Element, Samsung Galaxy S II X (SGH-T989D), Samsung Galaxy S II LTE, Samsung Galaxy S II Skyrocket, Samsung Galaxy S Blaze 4G, Samsung Galaxy Tab 7.7 LTE, Samsung SGH-i577 Galaxy Exhilarate, Sony Xperia ion
Qualcomm	APQ 8064	armhf	Asus PadFone 2, HTC Droid DNA, HTC J Butterfly, LG Optimus G, Nexus 4, Oppo Find 5, Pantech Vega No.6, Pantech Vega R3, Sharp Aquos Phone Zeta (SH-02E), Sony Xperia UL, Sony Xperia Z, Sony Xperia ZL, Sony Xperia ZR, Xiaomi MI-2, Panasonic P-02E,ZTE Nubia Z5,ZTE Nubia Z5 Mini
Qualcomm	APQ 8074	armhf	?
Qualcomm	APQ 8084	armhf	Samsung Galaxy S5 LTE-A (Korea), Samsung Galaxy S5+, LG G3 Cat.6, Samsung Galaxy Note 4 LTE, Samsung Galaxy Note Edge, Amazon Fire HDX 8.9, Motorola Moto MAXX, Motorola Droid Turbo, Nexus 6, Inforce IFC6540, Samsung Galaxy Note 4 Duos
Qualcomm	MSM 8660	armhf	HTC Evo 3D (CDMA), HTC Rezound, LG Connect 4G, LG Optimus LTE LU6200, Pantech Vega Racer, Pantech Sky LTE EX, Pantech Burst, LG Lucid, Samsung Galaxy Note, Xiaomi MI-One (CDMA2000 for China Telecom)
Qualcomm	MSM 8960	armhf	Asus Transformer Pad Infinity (3G/4G version), BlackBerry Z10, BlackBerry Classic HTC Droid Incredible 4G LTE, HTC Evo 4G LTE, HTC One X (North America), HTC One XL, HTC Windows Phone 8X, Samsung Ativ S, LG Mach, Motorola Atrix HD, Motorola Droid Razr M, Motorola Droid Razr HD, Motorola Razr HD, Motorola Droid Razr Maxx HD, Nokia Lumia 820, Nokia Lumia 920, Nokia Lumia 925, Nokia Lumia 1020, Panasonic Eluga Power, Qualcomm Snapdragon S4 Plus MSM8960 MDP/S, Samsung Galaxy S III (select versions), Sharp Aquos Phone sv (SH-10D), Sharp Aquos Phone Zeta (SH-09D), Sony Xperia GX, Sony Xperia TL, Sony Xperia SX, Sony Xperia V, Toshiba Regza Phone (T-02D), ZTE Grand Era LTE, ZTE Grand X LTE,[75] ZTE V96, Huawei Ascend P1 LTE, Kyocera Hydro Elite C6750, Nokia Lumia 928, Nokia Lumia 822, Nokia Lumia 810, Sony Xperia T LTE, LG Lucid 2, LG Optimus F7, LG Optimus F5, LG Spectrum 2, LG Optimus VU II, BlackBerry Q10, Huawei Premia 4G, ZTE Vital, ZTE Avid 4G, ZTE Flash, Dell XPS 10, LG Escape, LG Optimus LTE II, Kyocera Hydro XTRM, Kyocera Torque, BlackBerry Porsche Design, Pantech Discover, Pantech Perception, Pantech Flex, Pantech Vega PTL21, Xolo LT900, Kyocera Torque SKT01
Qualcomm	MSM 8974	armhf	?

Useful sources:

- [Wikipedia list of Qualcomm SoCs with devices using them](#)
- [Wikipedia list of Tegra SoCs and devices using them](#)

GPU

There is sadly only a very short list of open source driver projects, mainly [Etnaviv](#) which is for Vivante GCxxx embedded GPUs and [Freedreno](#) for Adreno GPUs (there was also once [lima](#) for mali GPUs, however it seems more or less abandoned, although just recently there was news that someone from AMD is trying to rewrite it as [mesa-lima](#)).

Qualcomm's Adreno

- Adreno 320

- Adreno 330
- Adreno 418

Wireless Connectivity

WiFi + (x)

- Broadcom BCM4339 (inside **mainline** 4.11.2 @ /arch/x86/platform/intel-mid/device_libs/platform_bcm43xx.c also perhabs @/drivers/net/wireless/broadcom/b43)
- Qualcomm QCA6174
- Qualcomm WCN3680 (inside **mainline** 4.11.2 @ /drivers/net/wireless/ath/wcn36xx)
- Qualcomm WCN3680B (inside **mainline** 4.11.2 @ /drivers/net/wireless/ath/wcn36xx)
- Murata SS2908001
- AzureWave AW-NH665
- Qualcomm Atheros WCN3660 (inside **mainline** 4.11.2 @ /drivers/net/wireless/ath/wcn36xx)
- Skyworks SKY85709

Mobile

- Qualcomm WTR1605L
- Qualcomm WTR3925
- Avago ACPM7800
- Avago ACPM-7251
- Qualcomm MDM9215M

NFC

- NXP 65N04
- Broadcom 20793S

Sound

this is probalby located @ /sound/soc/codecs

- Qualcomm WCD9320
- Qualcomm WCD9330
- Qualcomm WCD9310
- Realtek ALC5642 (not inside 4.11.2 but alc5623)

Sensors

Touch

probably at `/drivers/input` and than `../mouse` or `../touchscreen`

- synaptics e.g has a driver in 4.11.2 @ `/drivers/input/mouse`

Orientation & Acceleration

this means gyroscopes, accelerometers, compasses and GPS, probably inside `/drivers/iio/`

- InvenSense MPU-6515
- Asahi Kasei AK8963
- InvenSense IDG-2020
- ST Microelectronics LSM330DLC
- InvenSense MPU-6050 (inside **mainline** 4.11.2 @ `/include/linux/platform_data_invensense_mpu6050.h` & `/drivers/iio/imu/inv_mpu6050/`)
- Broadcom BCM4751 (general inside **mainline** 4.11.2 @ `/arch/mips/bcm47xx/`)

Peripherals

Charging & Power Management

- Texas Instruments BQ51013B
- Texas Instruments BQ24192 (not inside 4.11.2 but similar stuff @ `/include/linux/power/`)
- Qualcomm PM8921
- Qualcomm PM8821
- Qualcomm PM8941 (inside **mainline** 4.11.2 @ `/arch/arm/boot/dts/qcom-pm8941.dtsi` & `/drivers/input/misc/pm8941-pwrkey.c` & `/drivers/video/backlight/pm8941-wled.c`)
- Qualcomm PM8841 (inside **mainline** 4.11.2 @ `/arch/arm/boot/dts/qcom-pm8841.dtsi`)
- Qualcomm QFE1100
- Qualcomm PMI8994 (inside **mainline** 4.11.2 @ `/arch/arm/boot/dts/qcom/pmi8994.dtsi`)
- Qualcomm SMB1358

Slimport

- Analogix Semiconductors ANX7808 e.g. @ mako kernel 3.4: `root/drivers/misc/slimport_anx7808` **mainlined** @ 4.11.2: `root/drivers/gpu/drm/bridge/`

2.9.3 How to test a new kernel

There is some [nice documentation](#) by Simon Raffener at his blog how to boot a new kernel in Ubuntu Touch (Mediatek devices only!) once for testing.

Todo: Add info about this on Android/Others

2.10 How to contribute documentation

DISCLAIMER: this is still a work in progress and some parts are missing, however this will change soon and you can use it as it is for now

Okay, we'll assume that you want to help in other ways than donating, bug reporting/testing, translating or organizing/moderating but instead want to document.

Why is this useful? If you have device x at home and want to have a working UBports (Ubuntu Touch)/Plasma Mobile/Halium image but there is no developer out there right now who wants to take on this project you might think *I'll just post a request in the forum, I can't do anything anyway* but **that's wrong**. If you gather information about **software support (Cyanogenmod/Lineage OS/Android images and Kernels available)** what **Hardware is inside exactly**. You have already done the first steps and some dev might think he/she gives it a quick look.

If you now compare the exact hardware with existing, ported devices you **may find that most/some of the hardware is already supported on another device**. If this is the case, you can go a step further and try to find out where exactly in the code these hardware parts are mentioned and if they are also included in the so called 'mainline' linux kernel.

You think this sounds hard and as if you need dev skills? We will try to help you take this steps without any starting knowledge!

For all those who read this but have a little more knowledge about some step/want to use different editors or tools to get to the end: This guide will only show one way and no alternatives at all for better clarity for beginners (for example, you can edit this wiki with many editors but we will recommend typora for now). There will also be nothing about github accounts, pull requests or anything but rather an approach that inexperienced users can do themselves. And one final thing, some points are simplified to a great extent so don't take anything too literal!

2.10.1 Check for existing Halium work

1. Check the [Device Overview](#) page to see if your device has already been inserted

1. If it is **inside the list** BUT has no image for download available based upon Halium, see if the entry has all points covered or if info is missing. Also check the device specific sub page and the hardware parts' sub pages if there is some info that has not been inserted yet. Even if all those exist, the info has been gathered, perhaps something has changed since then?
2. If it is **NOT in the list**, continue to the next section

2.10.2 Download templates and files

1. Getting the current wiki & templates for all sites we want to create

Head over to [this documentation's GitHub repository](#), click on the green button **download or clone** and select *Download ZIP* from the drop down and unpack it in a folder of your choice and move to the folder "supplementary/devices". Inside there are a few files of interest for us:

- **index.rst** here we will insert a quick list of the status of the device and link to a new device specific sub page we will create
- **devicetemplate.rst** this will be our device template, that means we will copy this file, rename it to match our device name and fill the specific info about it

You can open each of these in a multitude of editors but the simple **gedit** which is pre-installed on Ubuntu suffices.

If we will go deeper later on, we might have to create chip-specific sub pages as well and edit the ‘Hardware and Kernel Enablement’ page but don’t worry about this for now.

2.10.3 Edit device-overview

1. Open up your browser of choice and head over to the *Device Overview* again. You can use this for reference while editing it locally on your PC and also there is some useful links there that may lead you to the places where you find info about your device without opening it yourself.
2. Also open index.rst in gedit
3. Then, just fill in the voids in the editor. Once finished you can save your work send in your changed index.rst to docu@ubports.com THIS MAIL ADRESS NEEDS TO BE FIXED!
4. Wait until someone merged it into the official wiki

Note: Alternatively, you can also create a github account, fork the wiki and create a pull request once you have edited everything you wanted in your branch. How this is achieved will be documented in a future post. But it is not that hard, you can find a quick interactive intro for git [here](#) (it will take ~15 minutes)

2.10.4 Create device documentation

Todo: create reference-device.rst

1. Open up your browser and head over to the *template for device specific pages*. This will again be our reference and may provide some useful links as well.
2. Also open up the **devicetemplate.rst** file with your editor and directly save-as *Your-Device-x.rst* so you always change the correct file and not the template.
3. Now look into the showcase and try to gather as much info about your device in the same style, save your work and submit in the same way as in step 3.

Okay, by now you may have noticed it’s not that hard, it’s just a lot of work to do this. You may also notice that if info is gathered in a centralized manner, devs may save lot’s of time!

2.10.5 Check hardware enablement

So this needs a very short intro: Every chip you might imagine that is inside your device needs a driver. This driver needs to be inside the so called *kernel* which is the core of every Android/GNU linux system. There is the **mother of all kernels**, the so called *mainline kernel* which is worked on by thousands of people all over the world.

If all code (= all drivers) needed to run a device is inside this mainline kernel, it will stay there and other people will also take care about not destroying anything when a new version is developed and we can just use every new version that comes along. This kernel changes, sometimes in very radical steps which is why a driver that was once included in a custom kernel, let’s say kernel 3.4-mydevice can’t just be copied to 4.11 into the same directory. If we stick to

a custom kernel, our little team needs to put all the new, sometimes radical changes into our custom kernel which is much more work on much fewer shoulders in comparison to mainlining our little device specific code.

The biggest issue however is not that the kernel changes but rather **that manufacturers include code that cannot be read or changed by us (legally)** (so called proprietary *blobs*). Which is why we are often stuck at older kernel versions. BUT the **community is often developing alternative free and open source drivers** to replace these blobs. At a certain point, it is possible to ‘suddenly’ run a device with a new kernel (for example the Nexus 7 2013 is step-by-step mainlined by John Stultz and others). **Our porting devs cannot watch the kernel all the time so we as community can try to check which hardware is supported how well.**

Also, we can link to older, working kernels and where inside of them the specific drivers sit. Some day someone might have the time to take a look and then only needs to look up the paths we provide instead of searching themselves.

So what to do:

1. Open up your browser and head over to the *Hardware and kernel enablement* page.
2. Open up the same page in your editor (**supplementary/hardware-enablement.rst**)
3. Insert missing info and submit your changes
4. If you find a part without its own subpage, you might want to create one. Head to the next step for that.

2.10.6 Create pages for undocumented hardware

Todo: add component_template.rst

If there is no sub page for a certain hardware component (e.g. a Wifi + Bluetooth chip) you can also create a new hardware component sub page from the template. Just open up the *New-component-template.rst* file, save as *Your-component.rst*, fill with info and submit to the docs team.

2.11 Scope of Halium

Halium’s scope primarily consists of 2 parts:

1. Halium’s Android is a minimal Android distribution designed to run within an LXC container. It will provide a set of interfaces to let the host of the LXC container utilize Android’s HAL to communicate with the hardware of Android-based smartphones. These interfaces come in 3 forms:
 1. Native Android interfaces. In this category, the interface is used either unmodified or with only the standard libhybris wrapper. For example, this includes rild’s socket, Audio HAL (dlopen’ed directly), and WiFi HAL (a standard libhybris wrapper).
 2. Libhybris compat layer. Usually used to wrap Android C++ interfaces, contains some logic, and has its counter-part compiled in the Android tree. An example is the *HWC2 compat layer* in libhybris.
 3. Custom interfaces. This will contain more than a compat layer and may have quite deep integration within Android code. We would like to reduce this kind of interface as much as possible to reduce our workload, especially those doing deep modification to Android. An example would be the Ubuntu Touch’s camera interfaces, which consists of *camera compat layer*, *custom media compat layer*, and deep modifications to Android’s libmedia¹.

¹ The modification makes changes to audio handling of libmedia to make video recording accept audio from Pulseaudio via UNIX domain socket. This is tightly integrated with how qtubuntu-camera works. See https://github.com/ubports/android_frameworks_av/compare/1516fdb...c66dd36

2. Halium's middleware is a set of software, libraries, and Linux kernel modules which talk to the interfaces in (1.). It is mostly distro and toolkit agnostic. For example, this includes [pulseaudio-module-droid](#), but will not include [qtubuntu-camera](#) (the client of the aforementioned camera interface, as it's tied to Qt). Halium may not be upstream of most of the middlewares. Thus, most of the time we'll just maintain the minimal patch(es) that make them work in Halium-based environment.

Halium will primarily be a source-only distribution. Downstream distributions (such as Plasma Mobile or Ubuntu Touch) can modify the Android distribution for their needs. The modified Android can then be built and provided as part of their distribution. For example, Ubuntu Touch adds [platform-api](#) and additional kernel parameters to enable AppArmor, then provides Android images as part of its OTA update model.

Halium will provide the reference rootfs to demonstrate how to integrate Halium into distributions and help porters develop their port. It'll contain the common middlewares and enough testing tools to help determine if the port is likely to work in more full-blown distributions or not. A reference repo, which is primarily used to build the reference rootfs, will also be provided. Downstream distributions can use this repo but are not required to.

2.11.1 Reference-implementation only components

There are components which require tight integration with distributions, for example:

- Deployment tools
- Initramfs tooling
- Scripts used in Linux userspace for the boot sequence (systemd units, init.rc scripts, etc.)

We understand that every distribution has its own requirements for these tools, so they are not enforced. We provide reference implementations of each of these which may or may not be used by downstream distributions. For example:

- Deployment tools: [Halium-install](#)
- Initramfs: [Hybris-boot](#) or [Halium-boot](#)
- Boot sequence scripts: [lxc-android](#)

2.12 Related projects

There are a number of other free software projects to provide a *Linux experience* for mobile devices. Some of these projects are actively working on moving to Halium. All of them are kindred spirits in the quest for Linux on mobile. Not the least, they have valuable resources available at their respective sites about porting to mobile devices.

2.12.1 LuneOS

[LuneOS](#) is based on Open webOS and webOS OSE. It is provided by the WebOS Ports team. The system has its legacy in projects by Palm, HP and LG. It is a continuation of Palm/HP's webOS that was used in 2009-2011 in various phones and tablets. The project is fully open source and can be build completely from scratch. LuneOS developers are actively contributing to Halium, even though only the minimal Android image from Halium is being used currently. LuneOS actively uses the Yocto Project build system and builds their kernels with GCC provided by Yocto.

2.12.2 Plasma mobile

[Plasma-mobile](#) is based on the Plasma shell, developed by the KDE community. Plasma mobile is available on Halium.

2.12.3 postmarketOS

PostmarketOS is based on Alpine Linux. It has a selection of multiple phone interfaces. A main difference to Halium is that postmarketOS targets upstream kernels. This brings the advantage of more up to date software. It has the disadvantage that device drivers which are only available as binaries for old kernels can not be used.

2.12.4 SailfishOS

Sailfish OS is based on the Mer Project. The user interface is developed by Jolla and not open source. The technical architecture should be largely compatible with Halium.

2.12.5 Ubuntu Touch

Ubuntu Touch is based on Unity 8 and is developed by UBports. It is the continuation of the earlier Ubuntu Touch project from Canonical. UBports is actively working on making their future releases available on Halium.

2.12.6 Others

There are more projects that share similar goals and/or similar tools and might have valuable resources. A few shout outs: LineageOS, MaruOS, Neo900, Purism Librem 5, Replicant, Tizen.

2.13 Planning

2.13.1 Linux kernel + Android + Libhybris common base

Introduction

Overall idea is, This stack includes,

- Linux kernel
- Android HAL
- Sensors
- Camera
- RILd
- Libhybris
- Android HAL interfaces like Audiofingerglue and droidmedia
- Build system and scripts
- GPS - AGPS from Mozilla
- Pulseaudio
- Media codecs
- oFono
- Way to distribute updates and images (way to install) (that's debatable)
- Systemd? (Upstart can handle user-level service initialization: See Ubuntu Touch)

This stack doesn't include the,

- Qt
- No Qt would be best, most platforms are very strict on the version they depend on
- Wayland
- KWin hwcomposer platform
- Plasma
- Unity
- Mir
- Lipstick
- Gecko
- Applications
-

Action Points

- See if there are any conflicting requirements and how best to resolve them. For eg. Ubuntu touch needs apparmor patches in kernel, while Sailfish doesn't.
- Decide what the stack will contain and make a short summary of the whole thing.
- Decide how the lxc/container should be setup (img file like ubuntu or in rootfs like sailfish)
- Decide what will be the default method to accrue android, build our own or take vendors and modify that (both would be best here in my opinion)
- What infrastructure we will need for this? What are options?
- Fork https://github.com/mickybart/gnulinix_support / make pull requests?
- Find all kernel features systemd requires, maybe fork mer-kernel-check to automatically check kernel configs
- Fork <https://github.com/ubports/ubports-installer> for cross platform installations
- Fork ubp-5.1 && ubp-7.0
- Common support for Multirom :) YES PLEASE I don't think Multirom is maintained anymore, but we can fork it can continue it ; There's already a fork with active developers: <https://github.com/multirom-dev>
- Please let's move away from android recovery update method (it does not fit us) (Boot from sdcard using efdroid at least for testing, so write images to sdcards?)
- Document all the things! YES! We need that badly

2.13.2 REVIEW ONCE THEN MOVE UP - bshah

What this base consists of? Or what is our "products"?

- AOSP source tree (LineageOS)
- Collection of Device Repos (similar to Cyanogenmod)
- Prebuilt and ready-to-integrate android images
- Reference packaging of libhybris and co. for the distributions / developers

- Reference binary images of this stuff
- Tool to flash the images
- Documentation on how to integrate the AOSP base with Linux system (this is most important.. Basically everything we create needs to be documented from start)
- Common config system?

What I would expect from this is a minimal booting android with libhybris, and all the libhybris tests pass

What is the lifecycle of port?

- Porting team decides upon target (or someone suggests it)
- We create android device and vendor tree or “fork” it from LineageOS/CM/AOSP/whatever
- Integrate our changes required for libhybris etc
- CI builds image and publishes them

Distributions (Plasma Mobile, UBports, Mer etc)

- Distributions picks up this new packaging if they are using our reference packaging for userspace (Linux) parts, otherwise they build their own packages.
- Along with rootfs generated from side of Distribution, they use the android IMG from the port lifecycle. (kernel depends on splitting / not splitting android and kernel)

2.13.3 The Stack - proposal

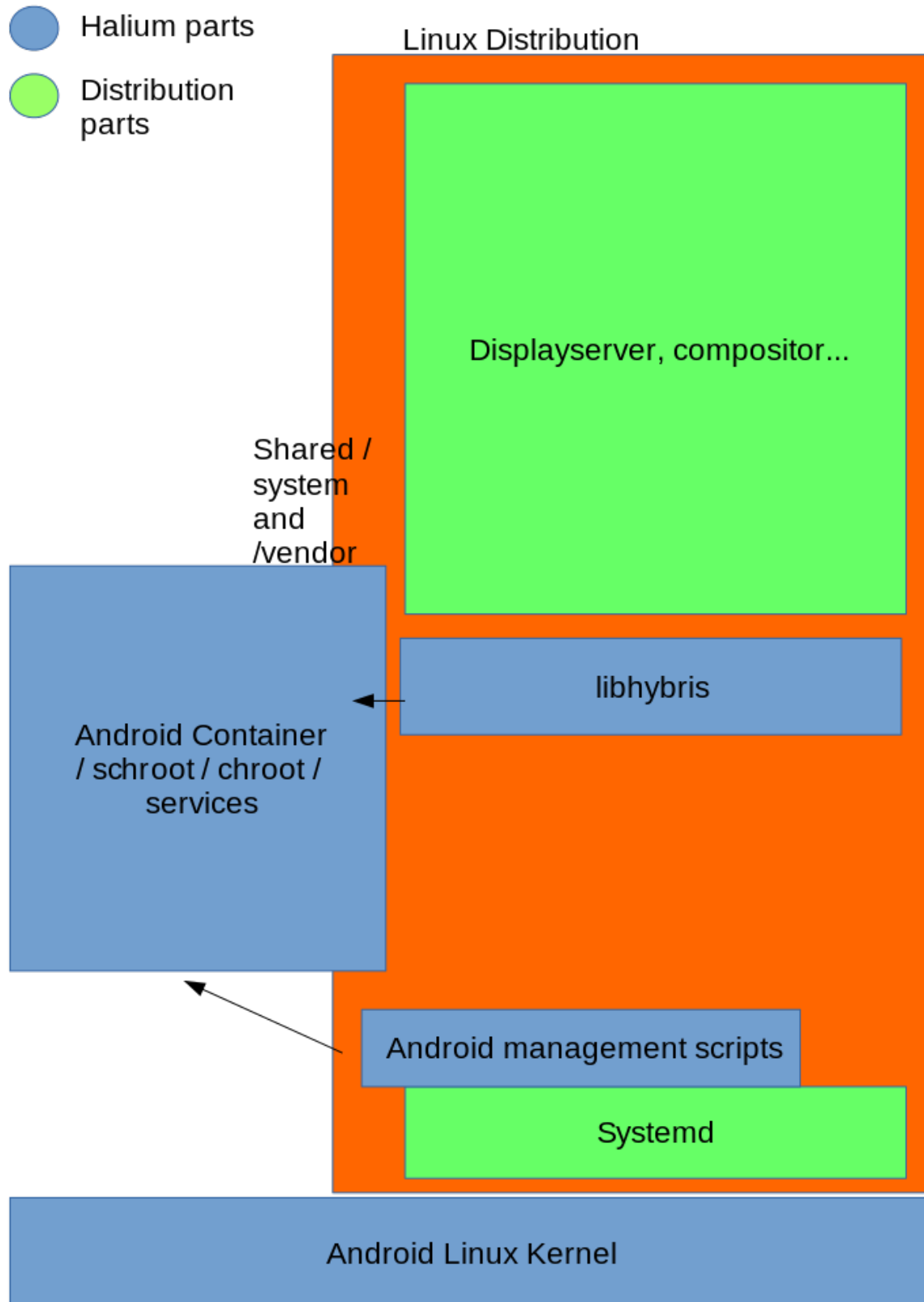
The system is running on a android manufacturer linux kernel, IF the device is mainlined, it can run mainline linux kernel

(Initramfs?)

Systemd start's up the system and the android HAL, which runs either in a schroot, container, or directly on the system.

Graphic output, camera and other sensors are managed by libhybris.

The linux distribution running with this stack can either use packages of libhybris etc. offered by us, if it's compatible, or build it's own



Some random links

- http://www.webos-ports.org/wiki/Halium_Considerations
- <http://merproject.org/meetings/mer-meeting/2017/mer-meeting.2017-04-19-08.00.txt>
- <http://merproject.org/meetings/mer-meeting/2017/mer-meeting.2017-04-19-08.00.log.html>

Mer-meeting takeaway

Jolla guys potentially interested but too early to commit to this. We need a proper proof-of-concept to show mer could run on top. Sailfish OS community devs of course anyone is welcome.

Jolla was concerned about how our things work with the ODMs way of things. This may not be a problem for community projects like ubports, plasma, et. al. but especially for Jolla since they're dealing straight with the ODMs. Something to take into account when we build our infrastructure. We should make it as flexible as possible so that this would work with them also.

2.13.4 Initial halium creator script (locusf rambling)

1. Plug in phone, run adb, which pulls in needed binaries from /system
2. builds halium kernel + the boot selection (still wondering what this could be)
3. boot selector then fetches/runs the actual os inside some runtime (container/switch_root up to debate)

Halium kernel means both the actual kernel + middleware needed in order to have a common libhybris base from the running android system

2.14 Development

2.14.1 Development plan/outline:

Goal: being able to adb shell / telnet / SSH into the GNU/Linux system where you can run tests related to android hardware enablement and they work out of the box.

Reference device(s): Nexus 5, OnePlus one, Nexus 5X (It will be interesting to see how easy it makes it for Ubuntu Touch once Halium works for this device).

Reference rootfs: Ubuntu ARM or ArchLinux ARM or Debian ARM or Fedora ARM (Requirement: systemd as main init system)

2.14.2 Initial development (stage 0, libhybris):

- [] Fork the Android source tree with libhybris patches
- [] Bring continuous integration system up to build the android image
- [] Start with the basic rootfs (ubuntu 16.04)
- [] Build and integrate the libhybris (upstream) to the base rootfs

- [] Create publishing infrastructure for the distribution of the android image and rootfs
- [] At this point it's fine if not all tests "pass" but they should at least run.

2.14.3 Hardware enablement (stage 1):

- [] After stage 0 we will have a system to work on where we are able to run the `libhybris` tests and get the logs required, in this stage we can pick random hardware component and get it working
- [] At end of this stage, Halium is "ready" for distributions

2.14.4 Device enablement (stage 2):

- [] During this stage we will have most of the infrastructure ready for including new devices, so this is the time to go wild ;-)

Tests: We need to write tests that can run in our reference rootfs to make it easier to spot problems, we need both direct tests that live in `android` and tests that use `libhybris`.

Automated tests: These tests will run after each CI build to ensure the builds that comes out of our build servers are working. (@UBports has some tests we can use for this)

2.14.5 Future ideas

- [] Common upstream msm kernel for all devices
- [] Common sets of qcom drivers
- [] All qcom devices to caf
- [] Freedreno for mainlined devices
- [] Backport 5.1 and 6.0 kernel driver required by 5.1 and 6.0 blobs
- [] Upstream the Android N port of `libhybris` from UBports fork
- [] Common place to put device configs for userspace (not talking about android device configs here, but the config each OS uses to configure different parts)
- [] Create a *translator* that converts common configs to OS specific configs
- [] Possibly something to "update" kernel from distribution packaging. I remember @micky-bart/gnulinux_support has something around that.
- [] Create a sandbox env to test *only* the hal and `libhybris`

2.15 Documentation Todo

This is an automatically generated page of all of the "todo" items in this documentation. If you're looking to help us out, feel free to take some on!

Todo: Mention that the config parameters `CONFIG_IKCONFIG` and `CONFIG_IKCONFIG_PROC` need to be set to y, otherwise Halium wont boot (or add them to the check script)

Halium Documentation

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/build-sources.rst`, line 66.)

Todo: Document the debugging of libhybris: <https://wiki.ubuntu.com/Touch/Core/UbuntuDebugAndroid>

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/debug-build/debug-android-userspace.rst`, line 86.)

Todo: Document how to deal with firmware partitions.

For example xLeEco Le Max2, codename “x2” has a firmware partition where the vendor blobs are stored. Initially `lxc@android` would not start. The resolution was roughly:

- no need for a vendor blobs repository in the manifest
- determine firmware partition name
- ensure fix-mountpoints takes it into account
- reflash android to ensure the blobs are in the partition
- reflash halium

See <http://logs.nslu2-linux.org/livelogs/halium/halium.20180430.txt>

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/debug-build/debug-android-userspace.rst`, line 89.)

Todo: Add tests using more heavy graphics applications using Wayland (mir)

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/debug-build/graphics.rst`, line 28.)

Todo: Distributions like Ubuntu Touch and LuneOS go here. Links to their respective documentation should be sufficient, but please place them inside the toctree above.

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/install-build/index.rst`, line 28.)

Todo: Make sure phablet password is set either by using chroot from recovery or halium-install from [JBBgameich](#).

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/install-build/plasma-mobile.rst`, line 22.)

Todo: Document PM specific debug instructions. Some lose notes copied from irc log:

- run `test_XYZ` with `sudo`
- `pgrep kwin_wayland`
- `journalctl | grep simplelogin`

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/porting/install-build/plasma-mobile.rst`, line 27.)

Todo: Add the manifest for Bullhead

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/devices/bullhead.rst`, line 15.)

Todo: Document some other device variants.

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/devices/cedric.rst`, line 12.)

Todo: TODO provide a nice link to help users unlock their bootloader

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/devices/cedric.rst`, line 170.)

Todo: Provide some useful resources here.

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/devices/cedric.rst`, line 197.)

Todo: Add info about this on Android/Others

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/hardware-enablement.rst`, line 259.)

Todo: create reference-device.rst

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/how-to-document.rst`, line 53.)

Todo: add component_template.rst

(The [original entry](#) is located in `/home/docs/checkouts/readthedocs.org/user_builds/halium-docs/checkouts/latest/supplementary/how-to-document.rst`, line 84.)
