Brillo / Weave Internals

Embedded Linux Conference Europe 2016

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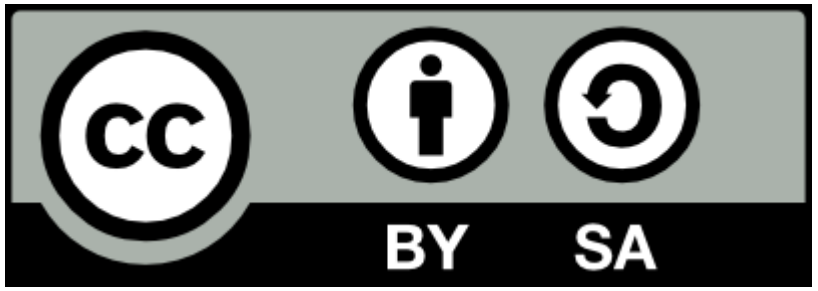
TM



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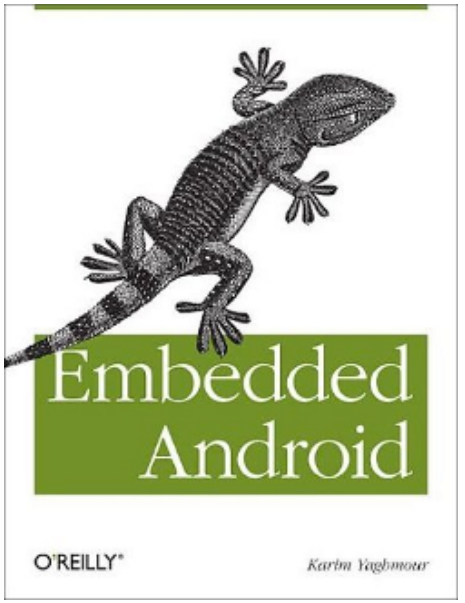
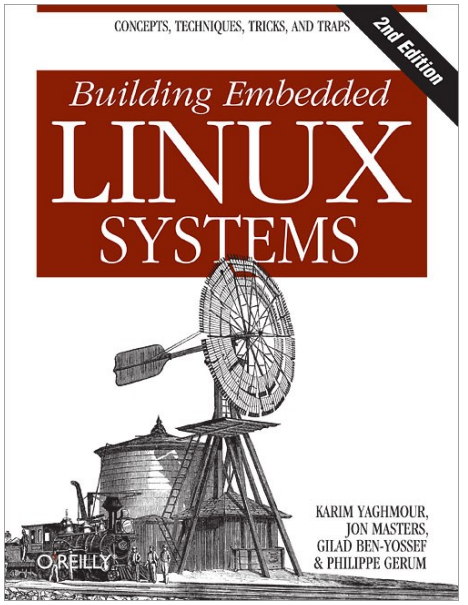
About

- Author of:





- Introduced Linux Trace Toolkit in 1999
- Originated Adeos and relayfs (kernel/relay.c)
- Training, Custom Dev, Consulting, ...

Agenda

1. A bit of history
2. Architecture
3. Source layout
4. Images
5. User-space
6. Services / Daemons
7. Weave
8. Example
9. Summing up

1. A bit of history

- Embedded Linux
- Android
- Headless Android
- Brillo

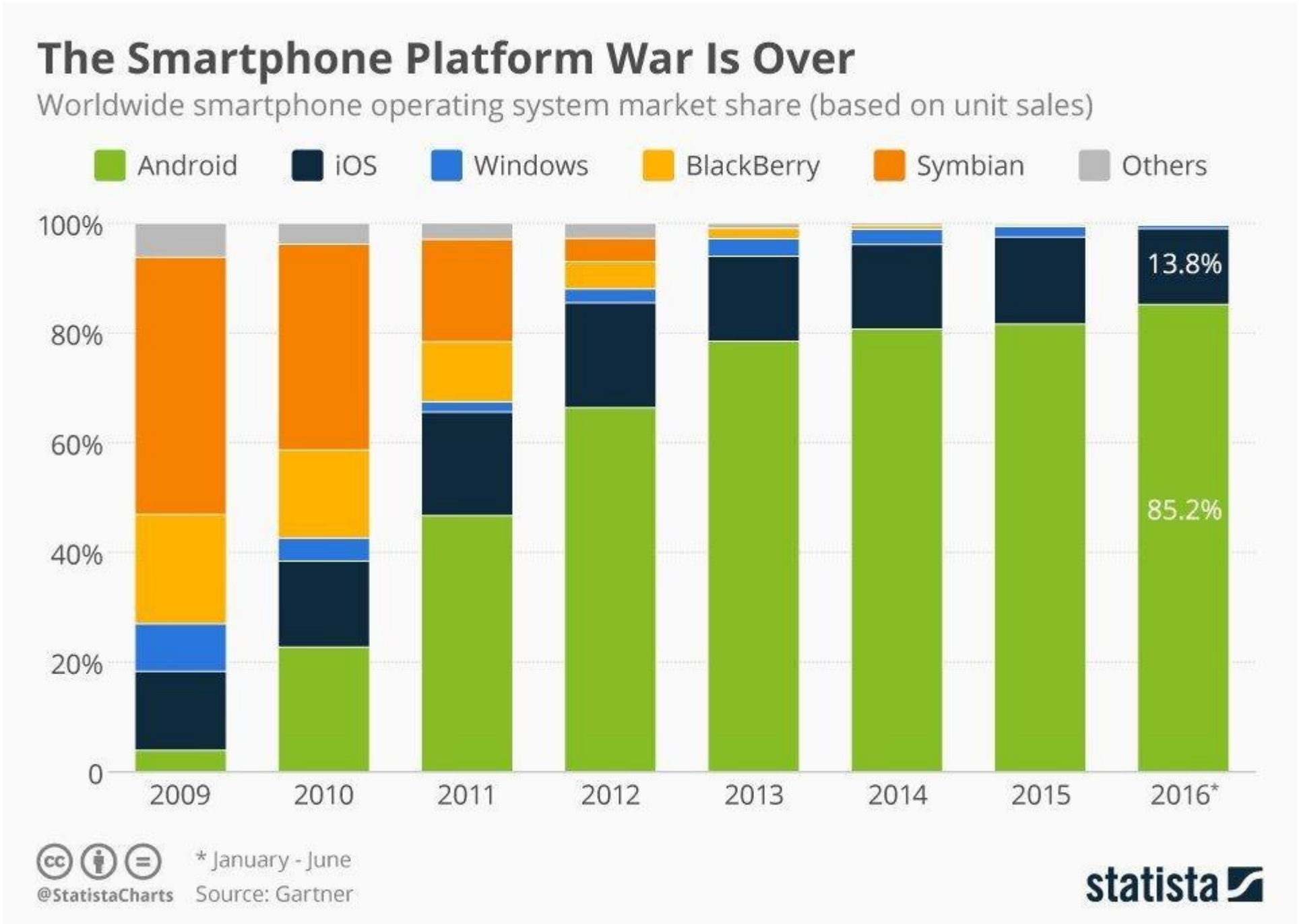
1.1. Embedded Linux

- A set of ad-hoc methods to package the Linux kernel with a (minimal) filesystem.
- FS content “to be determined” case-by-case
- APIs are specific to each device/build
- “Core software”:
  - BusyBox
  - U-Boot
  - GNU Toolchain
- Your flavor of:
  - glibc or uClibc or eglibc
  - yocto or buildroot or eldk or ltib or ptxdist or ...
- No serious UX framework

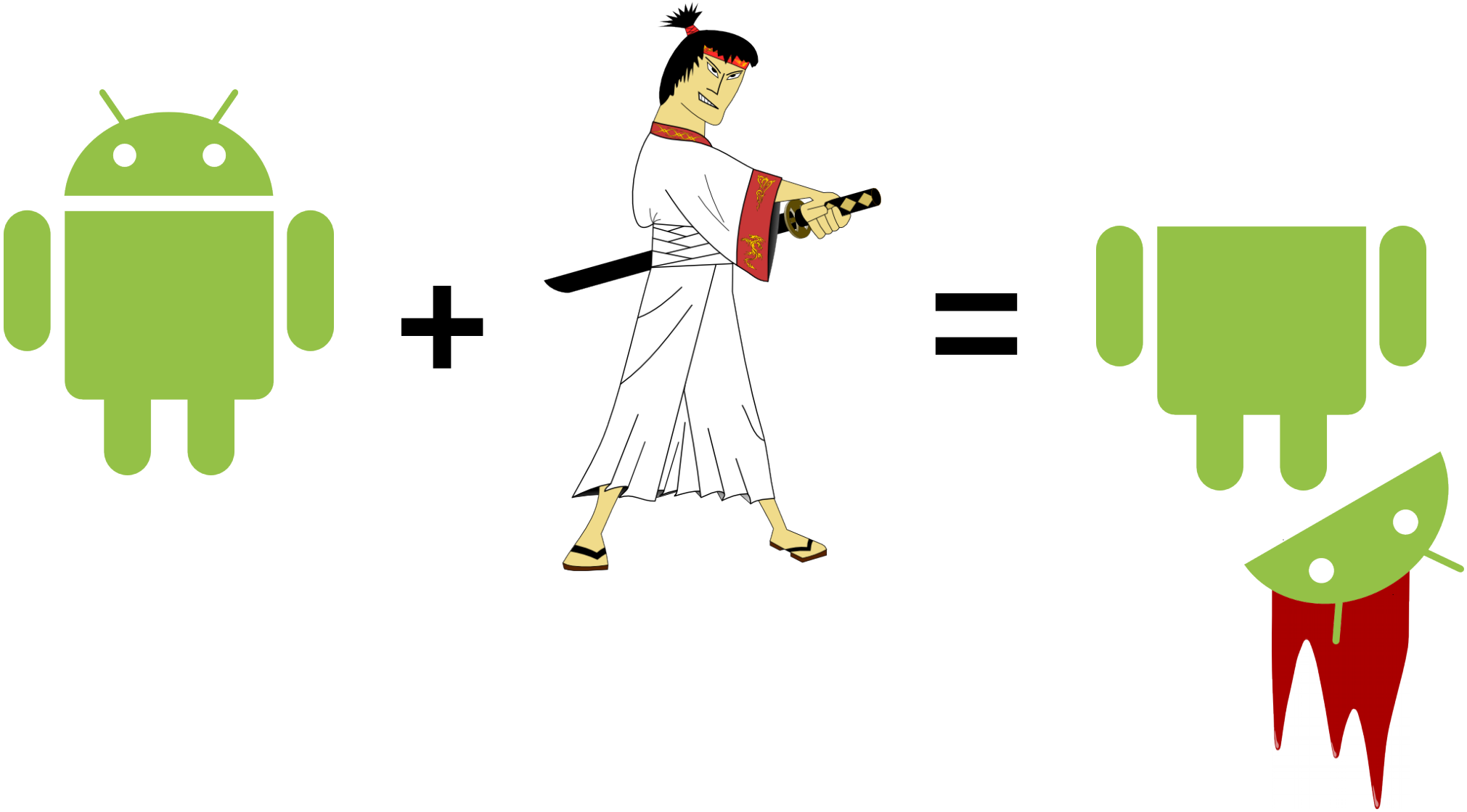
1.2. Android

- ... apart from its ubiquitous UX ...
- Fully-integrated IDE: Android Studio
- SDK/NDK
- ADB
- Fastboot
- Published, well-known, and very rich APIs
- A large and growing developer community
- And still we can use “embedded Linux” components:
  - GNU toolchain, BusyBox, u- boot, glibc, ...

An actual standardized dev. env. across all product lines


The Smartphone Platform War Is Over
Worldwide smartphone operating system market share (based on unit sales)
Android
iOS
Windows
BlackBerry
Symbian
Others
100%
80%
60%
40%
20%
0
13.8%
85.2%
2009
2010
2011
2012
2013
2014
2015
2016*
* January - June
@StatistaCharts
Source: Gartner
statista

1.3. Headless Android



1.4. Brillo / Weave

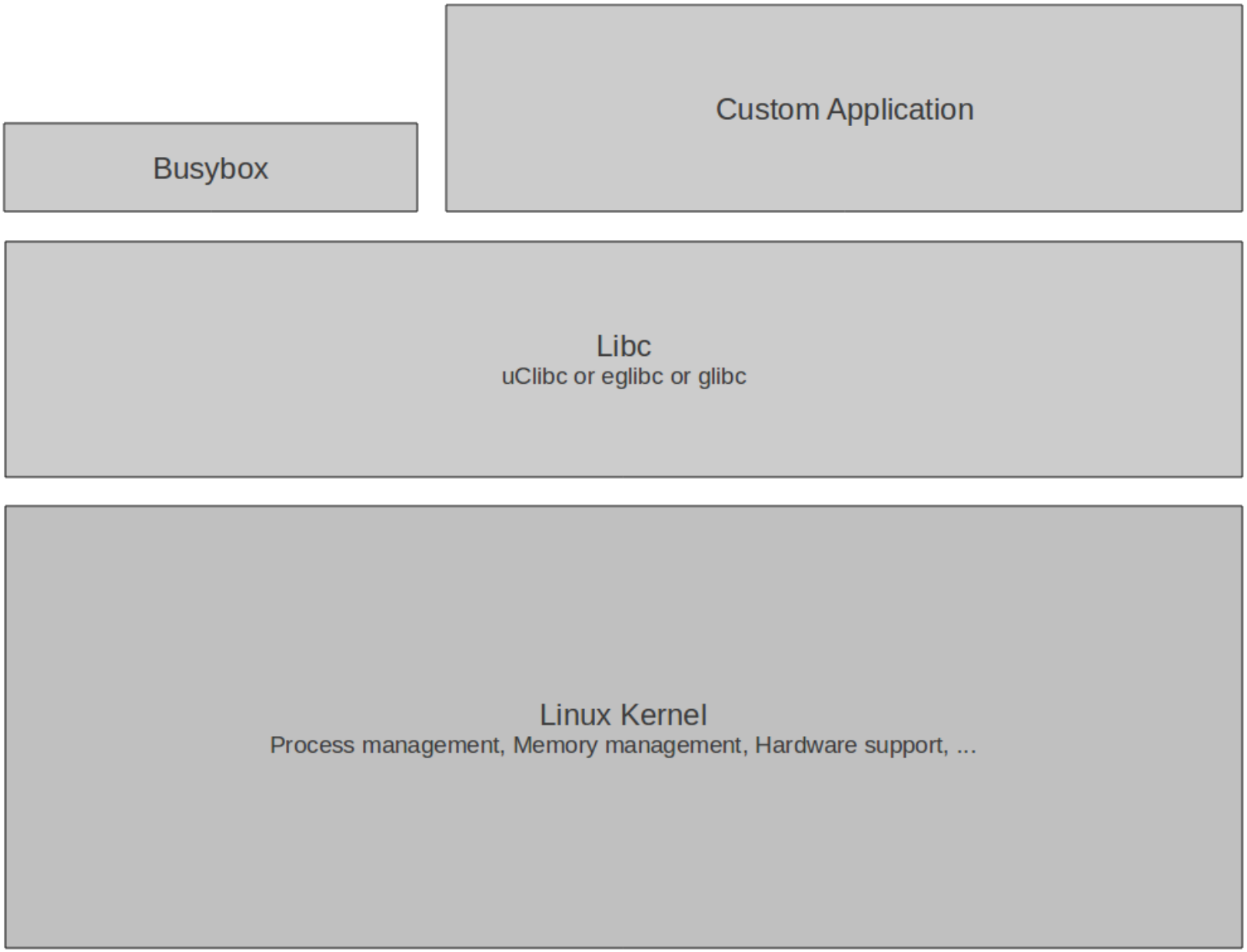
- Google platform for IoT*
- Based on Android
- Announced at Google I/O 2015
- Still not officially released
- Still under active development
- Need to sign up for developer preview on https://developers.google.com/brillo/
- Sources available from android.googlesource.com

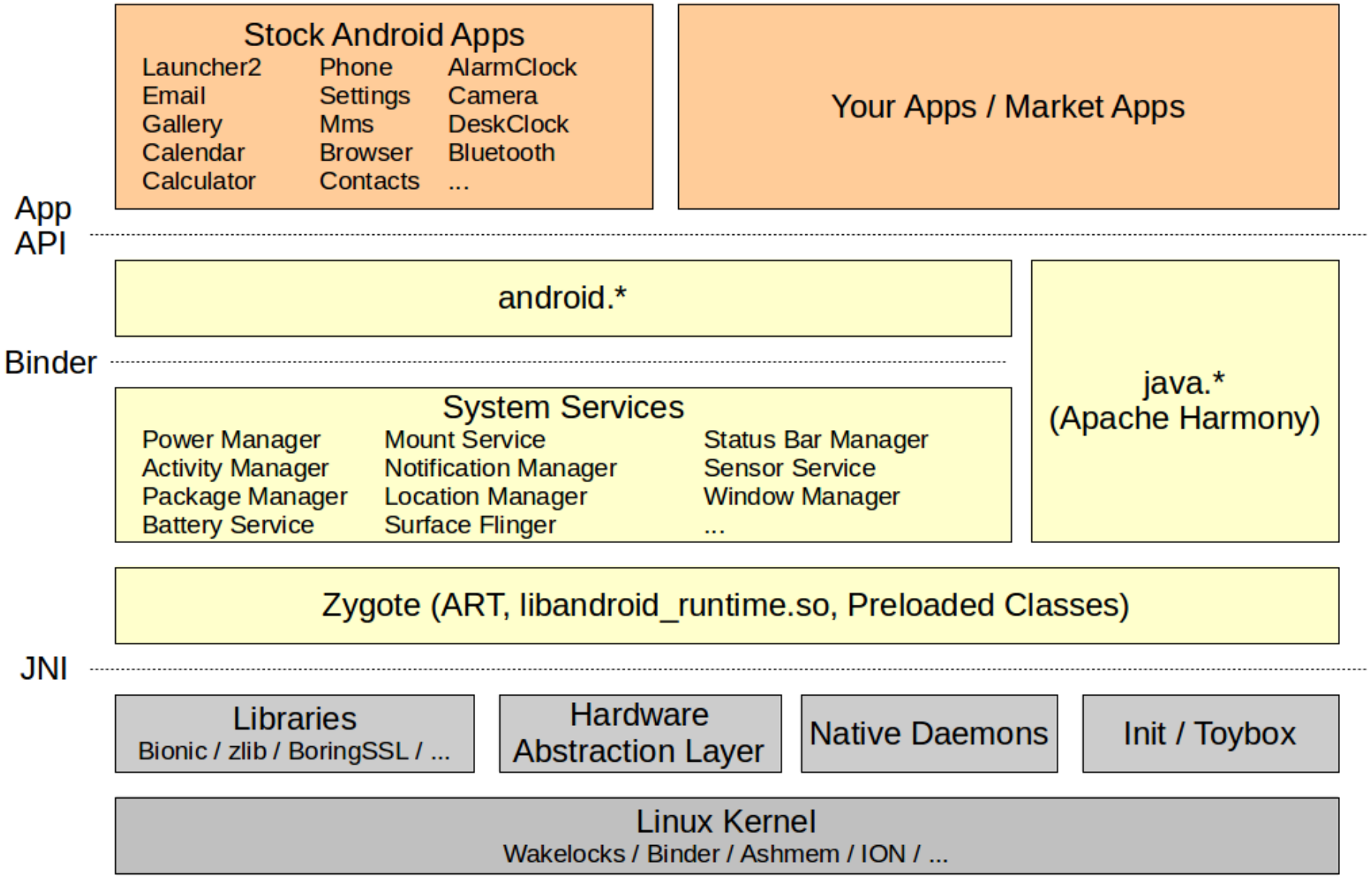
- Note:
  - This talk based on sources
  - This talk NOT based on developer preview or any information thereof :P

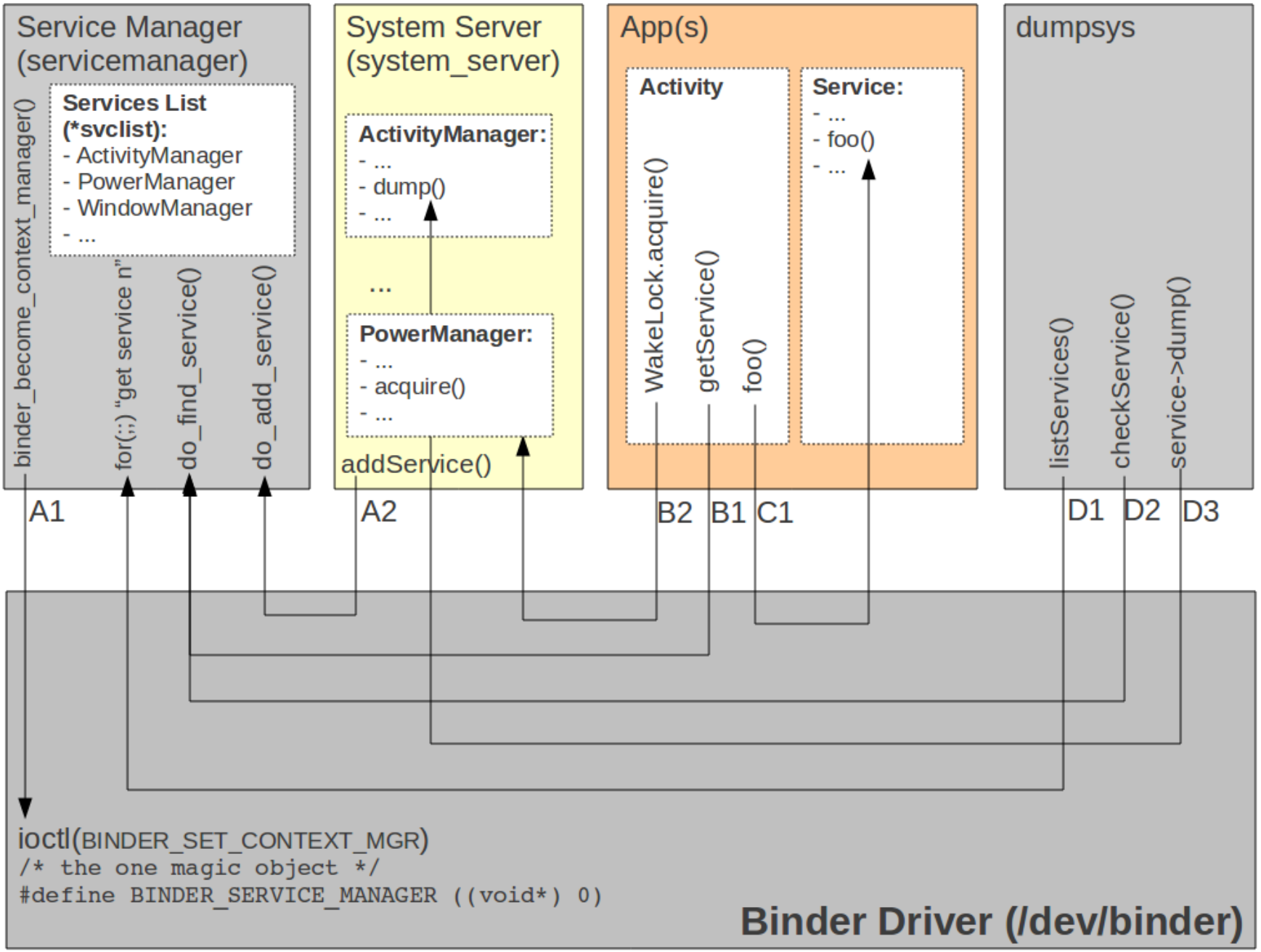
* New, hip way of talking about “Embedded Systems”, something that's been around for ~50+ years.

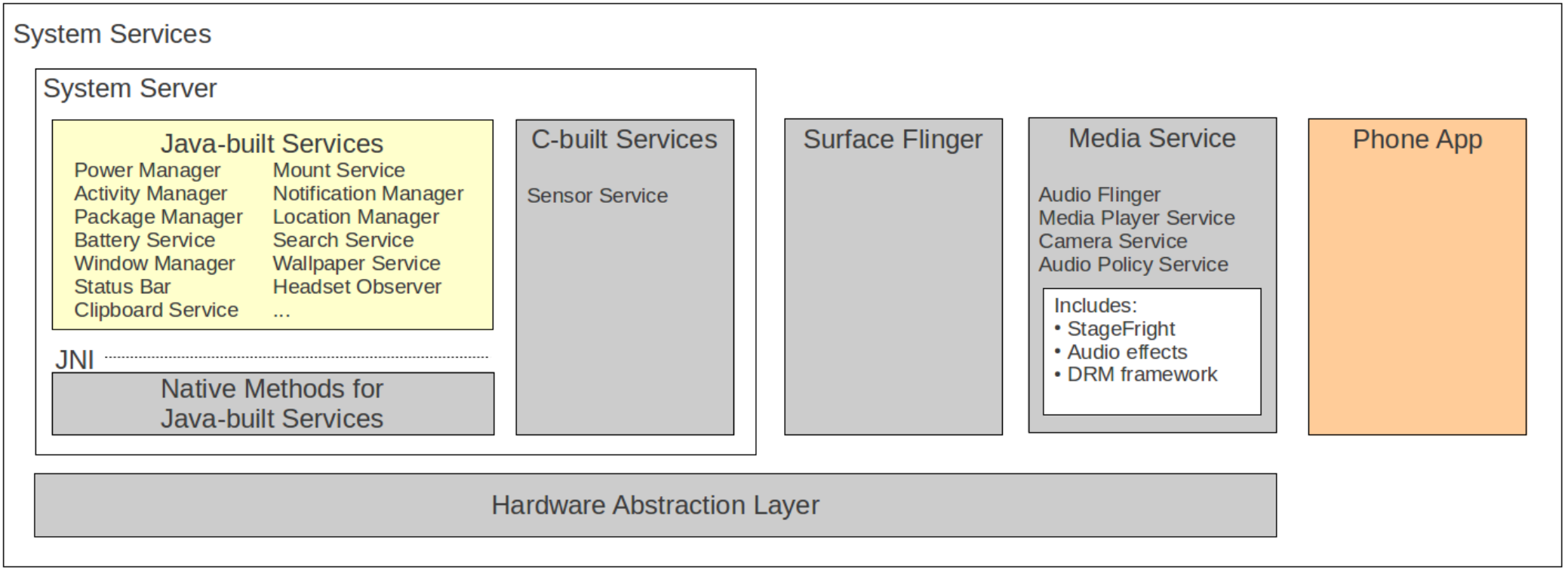
2. Architecture

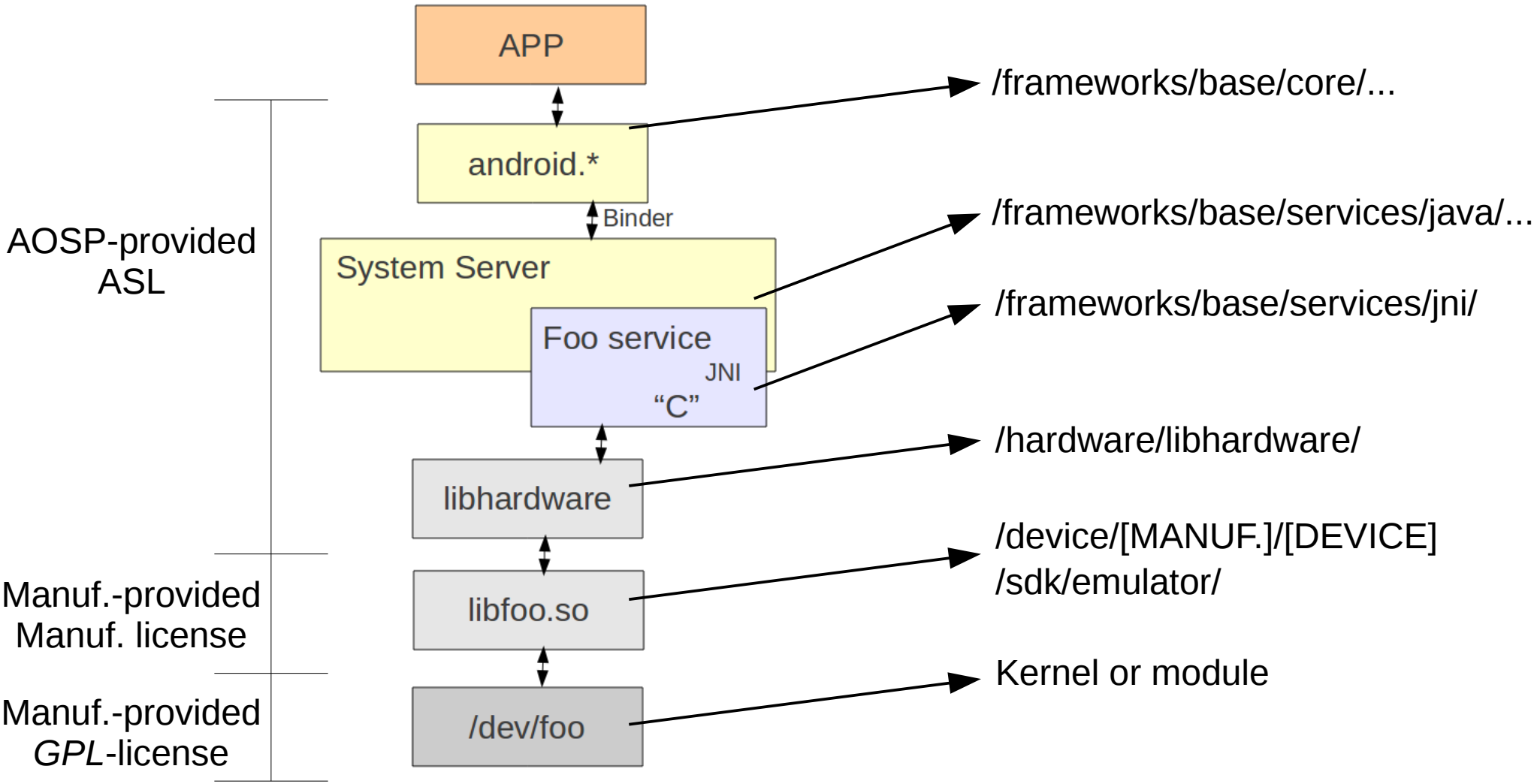
- Embedded Linux
- Android
- Binder
- System services
- HAL
- DBus
- Brillo
- Weave

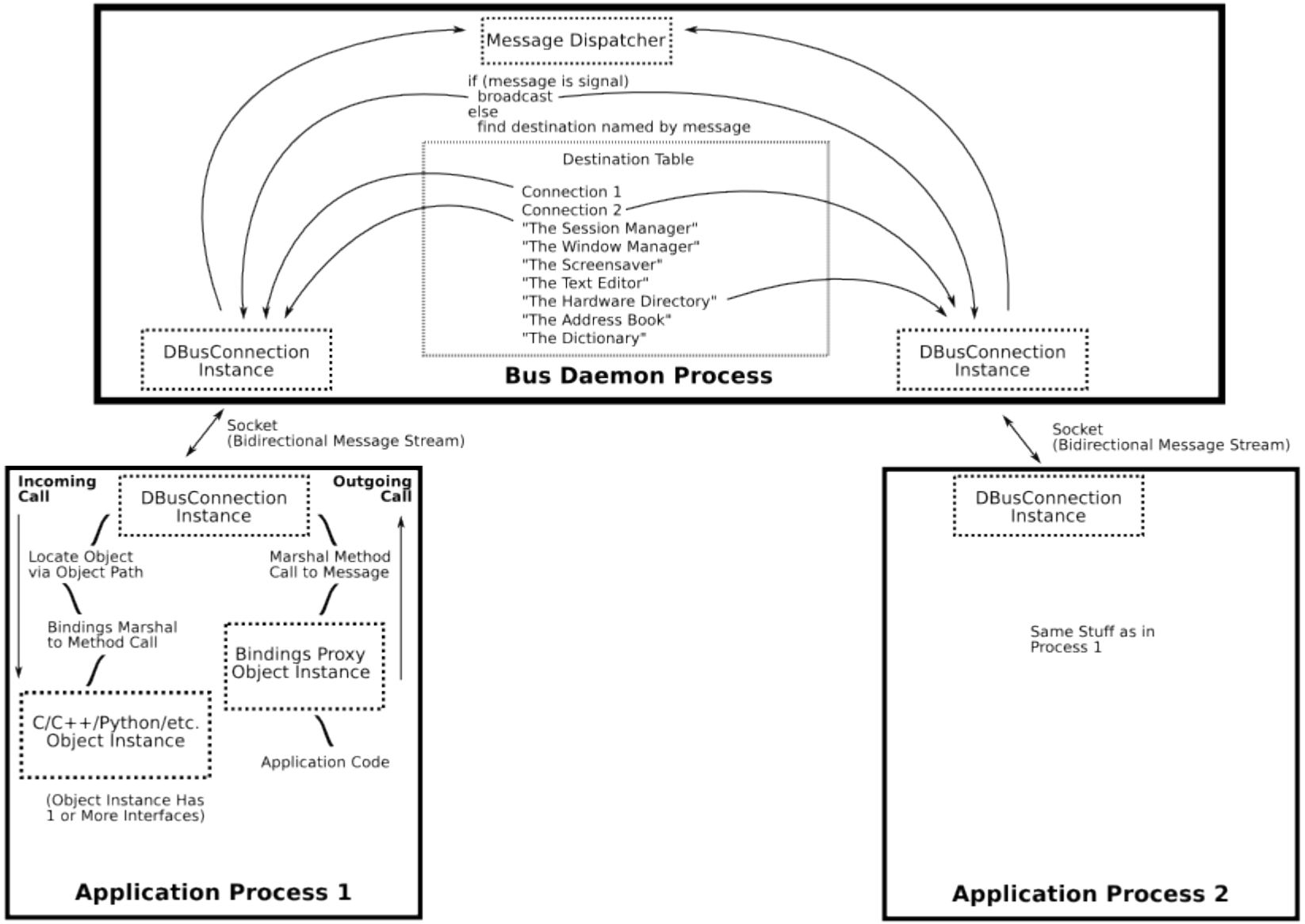

Custom Application
Busybox
Libc
uClibc or eglibc or glibc
Linux Kernel
Process management, Memory management, Hardware support, ...

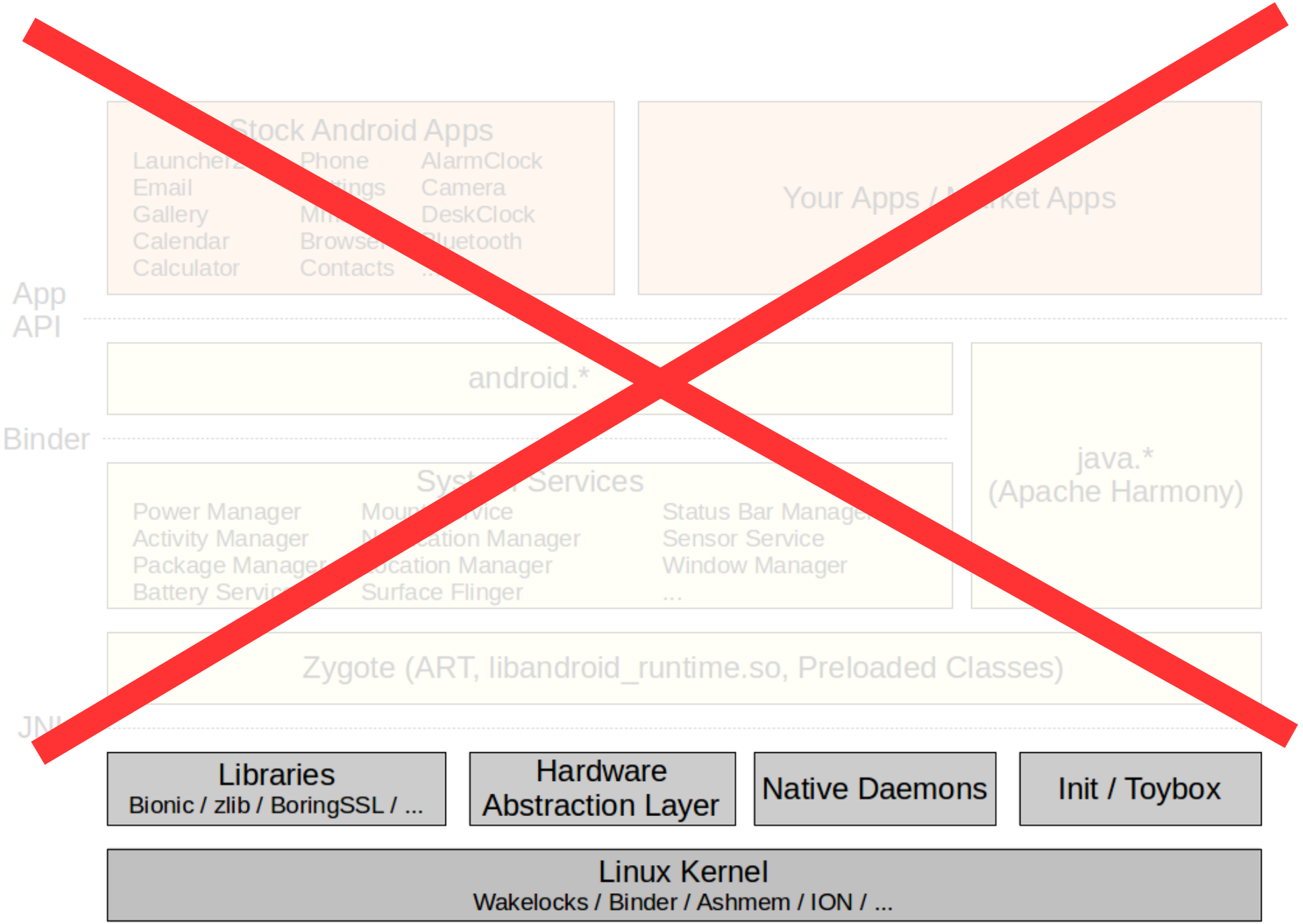

Stock Android Apps
Launcher2 Phone AlarmClock
Email Settings Camera
Gallery Mms DeskClock
Calendar Browser Bluetooth
Calculator Contacts ...
Your Apps / Market Apps
App API
android.*
Binder
System Services
Power Manager Mount Service Status Bar Manager
Activity Manager Notification Manager Sensor Service
Package Manager Location Manager Window Manager
Battery Service Surface Flinger ...
java.*
(Apache Harmony)
Zygote (ART, libandroid_runtime.so, Preloaded Classes)
JNI
Libraries
Bionic / zlib / BoringSSL / ...
Hardware Abstraction Layer
Native Daemons
Init / Toybox
Linux Kernel
Wakelocks / Binder / Ashmem / ION / ...


Service Manager
(servicemanager)
Services List
(*svclist):
- ActivityManager
- PowerManager
- WindowManager
- ...
binder_become_context_manager()
for(;;) "get service n"
do_find_service()
do_add_service()
System Server
(system_server)
ActivityManager:
- ...
- dump()
- ...
...
PowerManager:
- ...
- acquire()
- ...
addService()
App(s)
Activity
WakeLock.acquire()
getService()
foo()
Service:
- ...
- foo()
- ...
dumpsys
listServices()
checkService()
service->dump()
A1
A2
B2
B1
C1
D1
D2
D3
ioctl(BINDER_SET_CONTEXT_MGR)
/* the one magic object */
#define BINDER_SERVICE_MANAGER ((void*) 0)
Binder Driver (/dev/binder)


System Services
System Server
Java-built Services
Power Manager
Activity Manager
Package Manager
Battery Service
Window Manager
Status Bar
Clipboard Service
Mount Service
Notification Manager
Location Manager
Search Service
Wallpaper Service
Headset Observer
...
JNI
Native Methods for Java-built Services
C-built Services
Sensor Service
Surface Flinger
Media Service
Audio Flinger
Media Player Service
Camera Service
Audio Policy Service
Includes:
• StageFright
• Audio effects
• DRM framework
Phone App
Hardware Abstraction Layer


APP
android.*
Binder
System Server
Foo service
JNI
"C"
libhardware
libfoo.so
/dev/foo
/frameworks/base/core/...
/frameworks/base/services/java/...
/frameworks/base/services/jni/
/hardware/libhardware/
/device/[MANUF.]/[DEVICE]
/sdk/emulator/
Kernel or module
AOSP-provided
ASL
Manuf.-provided
Manuf. license
Manuf.-provided
GPL-license


Message Dispatcher
if (message is signal)
broadcast
else
find destination named by message
Destination Table
Connection 1
Connection 2
"The Session Manager"
"The Window Manager"
"The Screensaver"
"The Text Editor"
"The Hardware Directory"
"The Address Book"
"The Dictionary"
DBusConnection Instance
Bus Daemon Process
DBusConnection Instance
Socket
(Bidirectional Message Stream)
Socket
(Bidirectional Message Stream)
Incoming Call
DBusConnection Instance
Outgoing Call
Locate Object via Object Path
Marshal Method Call to Message
Bindings Marshal to Method Call
Bindings Proxy Object Instance
C/C++/Python/etc. Object Instance
Application Code
(Object Instance Has 1 or More Interfaces)
Application Process 1
DBusConnection Instance
Same Stuff as in Process 1
Application Process 2


Stock Android Apps
Launcher
Email
Gallery
Calendar
Calculator
Phone
Settings
Camera
DeskClock
Browser
Contacts
AlarmClock
Bluetooth
Your Apps / Market Apps
App API
android.*
java.*
(Apache Harmony)
Binder
Power Manager
Activity Manager
Package Manager
Battery Service
Surface Flinger
Sensor Service
Window Manager
Zygote (ART, libandroid_runtime.so, Preloaded Classes)
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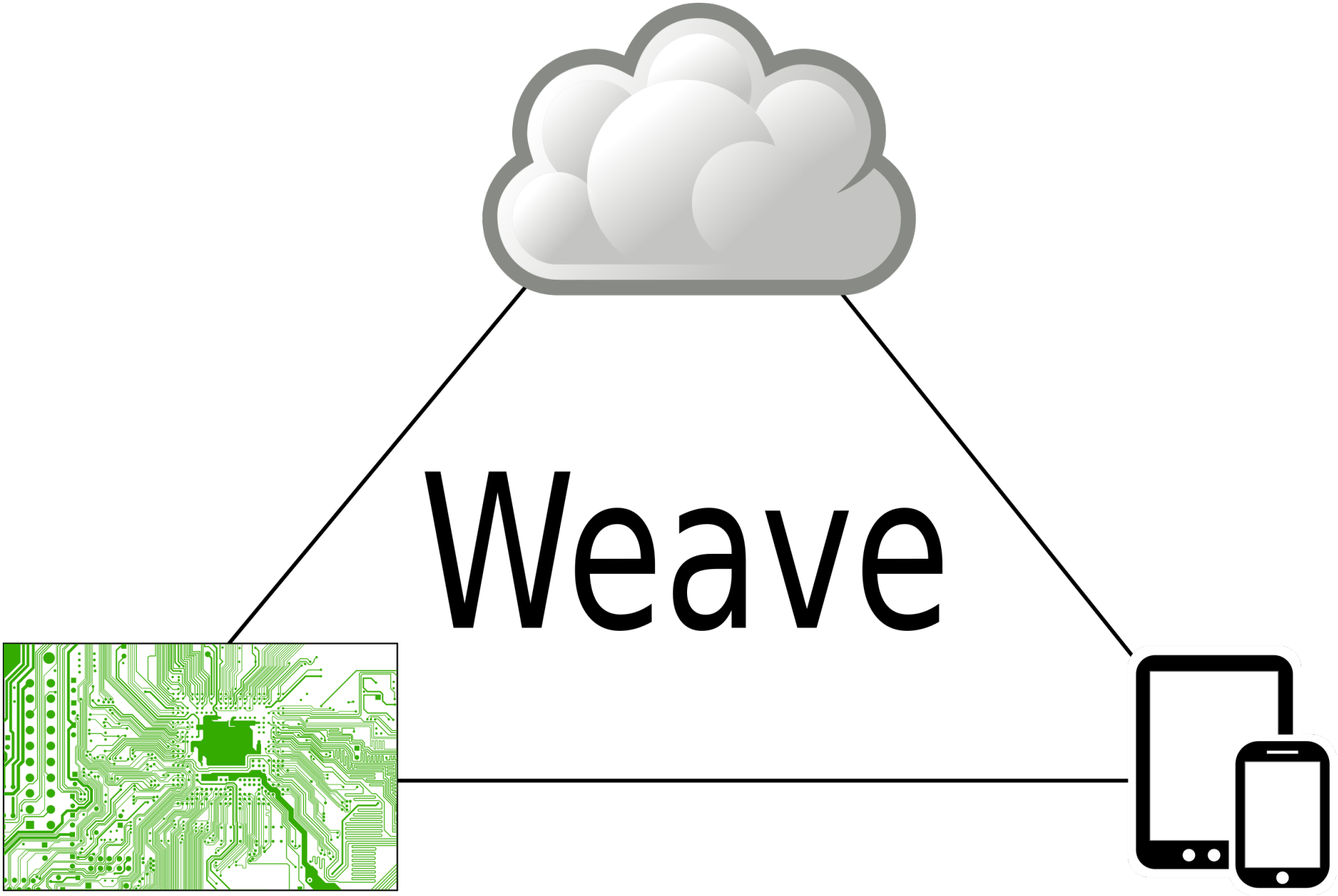

Weave

3. Source layout

- Getting the sources
- Brillo top level
- Removed from Android top level
- Gone from external/
- New to external

3.1. Getting the sources

- Same project repo as Android:

  android.googlesource.com
- Different manifest file
- Using “repo”:

```
$ repo init -u https://android.googlesource.com/brillo/manifest
$ repo sync
```

3.2. Brillo top level

bionic	C library replacement
bootable	Reference bootloader
build	Build system
device	Device-specific files and components
external	Copy of external projects used by AOSP
frameworks	Native system services and libraries
hardware	Hardware support libs
libnativehelper	JNI helpers
prebuilts	Prebuilt binaries
product	“Products” running on Brillo
system	Embedded Linux core
tools	Brillo Development Kit

3.3. Removed from Android top level

art
cts
dalvik
dvelopers
development
docs
frameworks/base and more
libcore
ndk
packages
pdk
sdk
system/vold and more
tools/external

3.4. Gone from external/

adt-infra
android-clat
androidplot
ant-glob
antlr
apache-commons-math
apache-harmony
apache-http
apache-xml
blktrace
bouncycastle
caliper
cblas
ceres-solver
chromium-libpac
chromium-trace
chromium-webview
cmockery
conscrypt
crcalc
dagger2
deqp
dexmaker
dlmalloc
dng_sdk
doclava
donuts
drm_gralloc
drm_hwcomposer
droiddriver
dtc
easymock
eclipse-basebuilder
eclipse-windowbuilder
eigen
emma
esd
eyes-free
fdlibm
fio
fonttools
freetype
fsck_msdos
gemmlowp
giflib
glide
google-fonts/carrois-gothic-sc
google-fonts/coming-soon
google-fonts/cutive-mono
google-fonts/dancing-script
google-tv-pairing-protocol
googletest
gptfdisk
guava
guice
hamcrest
harfbuzz_ng
hyphenation-patterns
ipsec-tools
jacoco
jarjar
javasqlite
javassist
jcommander
jdiff
jetty
jhead
jline
jmdns
jsilver
jsmn
jsoncpp
jsr305
jsr330
junit
junit-params
kernel-headers
ksoap2
libavc
libdivsufsort
libdrm
libedit
libexif
libhevc
libmojo
libmpeg2
libmtp
libnfc-nci
libnfc-nxp
libpcap
libphonenumber
libpng
libusb
libusb-compat
libutf
libvncserver
libvorbis
libvterm
libxml2
libyuv
littlemock
lld
ltrace
marisa-trie
markdown
mdnsresponder
mesa3d
messageformat
mmc-utils
mockftpserver
mockito
mockwebserver
mp4parser
mtpd
nanohttpd
nanopb-c
naver-fonts
netcat
netperf
neven
nfacct
nist-pkits
nist-sip
noto-fonts
oauth
objenesis
okhttp
opencv
opencv3
owasp/sanitizer
parameter-framework
pdfium
piex
ppp
proguard
regex-re2
replicaisland
rmi4utils
robolectric
roboto-fonts
scrypt
seccomp-tests
sfntly
skia
sl4a
slf4j
smali
snakeyaml
sqlite
srtp
svox
tagsoup
testng
tcpdump
timezonepicker-support
v8
vboot_reference
vixl
vogar
vulkan-validation-layers
webp
webrtc
xmlwriter
xmp_toolkit
zopfli
zxing

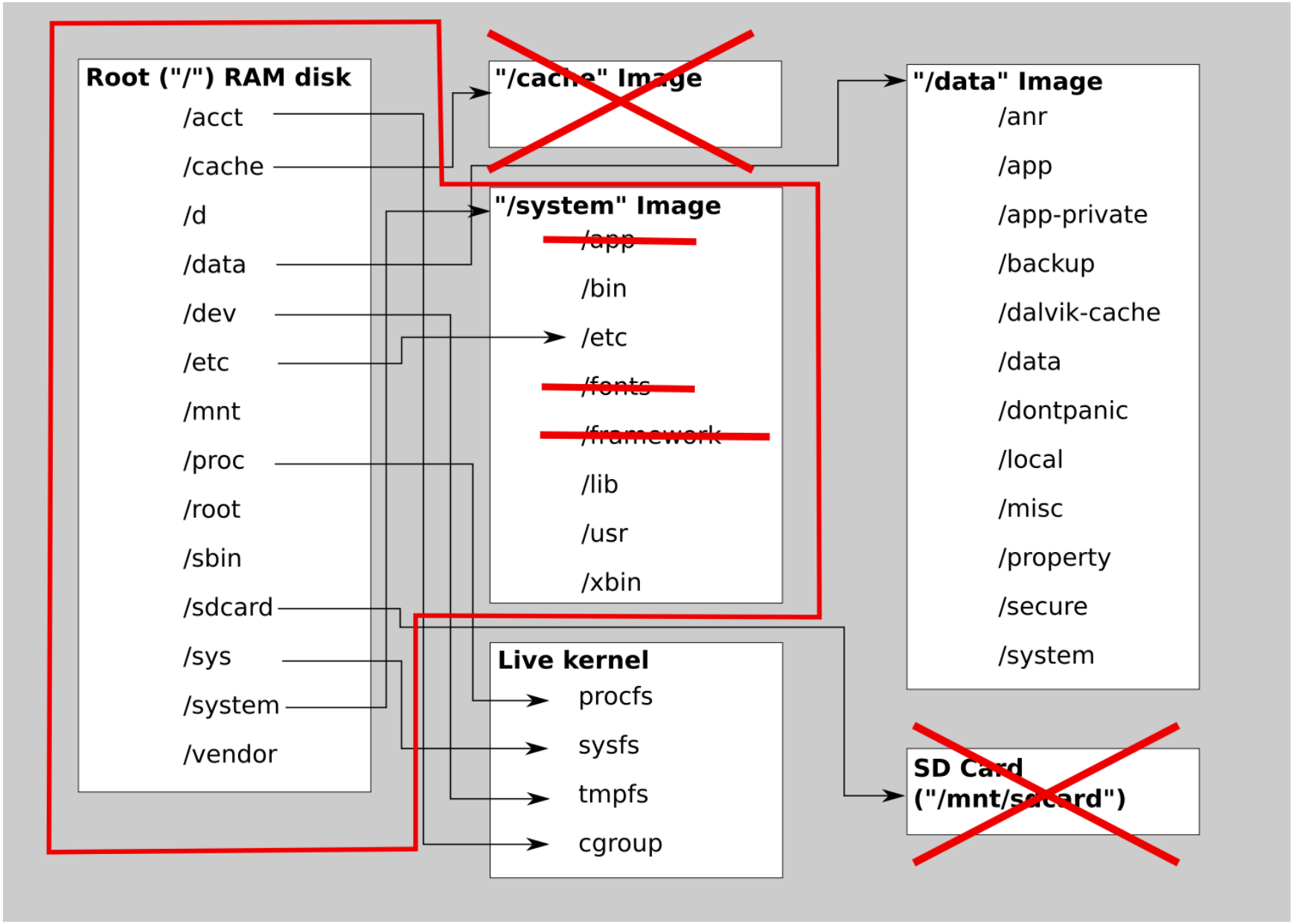
3.5. New to external/

bvb	Brillo Verified Boot
chromite	Tools to build Chrome OS
gentoo	
libdivsufsort	lightweight suffix array construction algorithm library
lzop	LZO compression tool

4. Images

- AOSP x86 32-bit:
  - 5.1M out/target/product/generic_x86/cache.img
  - 1.3M out/target/product/generic_x86/ramdisk.img
  - 1.3G out/target/product/generic_x86/system.img
  - 12M out/target/product/generic_x86/userdata.img
  - 551M out/target/product/generic_x86/userdata-qemu.img
- Brillo x86 64-bit:
  - 6.2M out/target/product/brilloemulator_x86_64/boot.img
  - 36K out/target/product/brilloemulator_x86_64/partition-table.img
  - 158M out/target/product/brilloemulator_x86_64/system.img
  - 201M out/target/product/brilloemulator_x86_64/userdata.img
  - 551M out/target/product/brilloemulator_x86_64/userdata-qemu.img

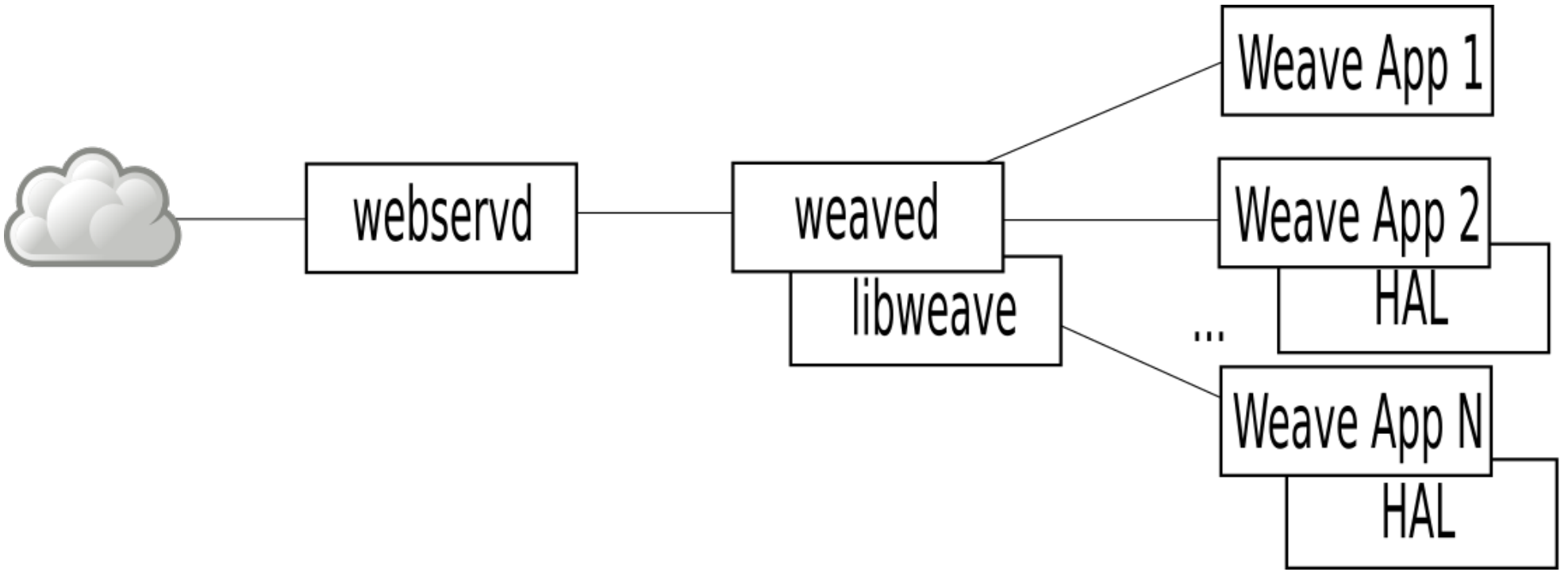
5. User Space


Root ("/") RAM disk
/acct
/cache
/d
/data
/dev
/etc
/mnt
/proc
/root
/sbin
/sdcard
/sys
/system
/vendor
"/cache" Image
"/system" Image
/app
/bin
/etc
/fonts
/framework
/lib
/usr
/xbin
Live kernel
procfs
sysfs
tmpfs
cgroup
"/data" Image
/anr
/app
/app-private
/backup
/dalvik-cache
/data
/dontpanic
/local
/misc
/property
/secure
/system
SD Card
("/mnt/sdcard")

6. Services / Daemons

- dbus-daemon
- servicemanager
- avahi-daemon
- keystore
- nativeperms
- peripheralman
- sensorservice
- wpa_supplicant
- brilloaudioservice
- metrics_collector
- metriscsd
- perfprofd
- tlsdated
- tpm_managerd
- trunksd
- update_engine
- weaved
- webservd
- shill
- firewalld
- dhcpd

7. Weave


webservd
weaved
libweave
Weave App 1
Weave App 2
HAL
...
Weave App N
HAL

8. Example

9. Summing Up

- Cool use of AOSP
- The “new standard” Embedded Linux distro?
  - Yocto
  - Buildroot
- Work in progress
- Nice move to Binder (instead of DBus)
- Clear cloud component

Thank you ...

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