

# Android Custom Kernel/ROM design

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- I am a research grad student in Universiti Teknologi Malaysia, Skudai, Johor Bahru, Malaysia
- My current employer is International Islamic University Malaysia, Kuala Lumpur
- Research area - malware detection, narrowing on Windows executables
- Doing things on Android kernel and ROM due to some stories...

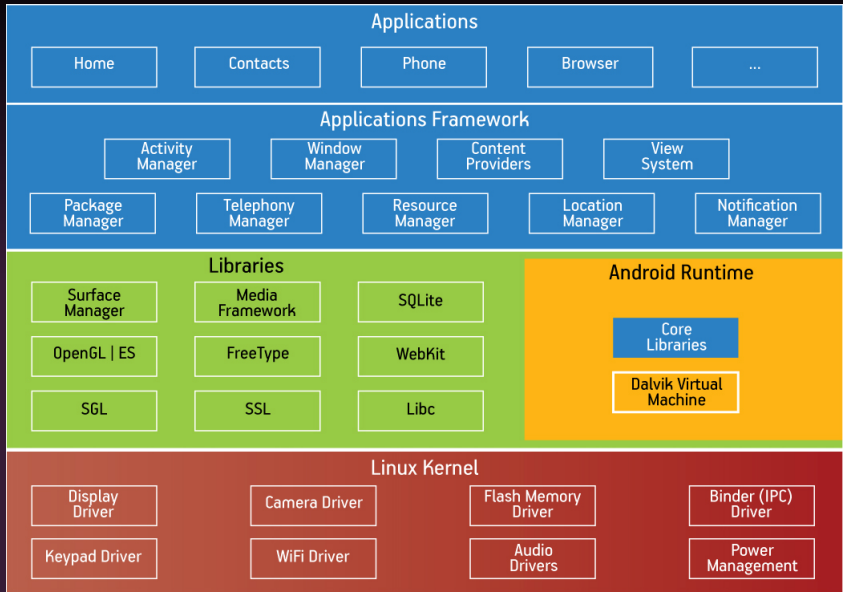


- Android is a mobile operating system
- Using *Linux* kernel
- Components for kernel are C language
- Components for interface are mostly C++ and Java

# Comparison between Android kernel and ROM

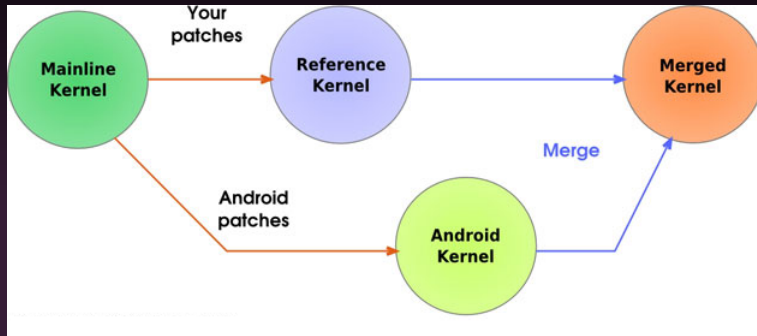
Kernel	ROM
GPL licensed	Apache licensed
Source code must be published	Source code is not compulsory to be published. Hence any modifications are not necessarily going back to the public

# Android structure



# Custom Kernel

# Android kernel vs Linux kernel



Source: [http:](http://eecatalog.com/embeddedlinux/2011/08/23/from-zero-to-boot-porting-android-to-your-arm-platform/)

[//eecatalog.com/embeddedlinux/2011/08/23/from-zero-to-boot-porting-android-to-your-arm-platform/](http://eecatalog.com/embeddedlinux/2011/08/23/from-zero-to-boot-porting-android-to-your-arm-platform/)

- Some are based from AOSP (Android Open Source Project) kernels - original source are from Google's git
- Some are based from CM (AOSP + Code Aurora Forum (CAF) commits)
- Some are based from other custom kernels which are based from two sources above



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  - Nexus 4 (codename: Mako)
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    - After I sold my Mako :)

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- Allow number of online/offline CPUs using many methods
- Allow many more TCP congestion methods

- Git knowledge
  - Knows at least how to clone, pull, push
  - Then reading git log.. (i'm using --pretty option)
  - Creating branch, reset to certain checkpoint/offset..  
resetting everything (git reset --hard)

# Git cloning the source

```
najmi@quds:~$ git clone https://android.googlesource.com/kernel/msm -b android-msm-hammerhead-3.4-l-preview
Cloning into 'msm'...
remote: Sending approximately 953.94 MiB ...
remote: Finding sources: 100% (3604873/3604873)
Receiving objects: 0% (14589/3604873), 4.63 MiB | 656.00 KiB/s
```



```

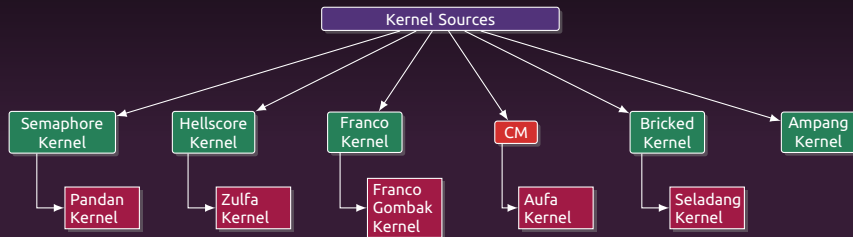
najmi@quds:~/cempaka-kernel$ git log --pretty=format:
'%Cred%h%Creset -%C(yellow)%d%Creset %s %Cgreen(%cr)%C(bold blue)<an>%Creset' --abbrev-commit
ba22633 - (HEAD, origin/cempaka-stable, cempaka-stable)
Cempaka v2.5 (11 days ago) <Muhammad Najmi Ahmad Zabidi>
acaaeea - Merge branch 'ElementalX-1.00-cm' of
https://github.com/flar2/ElementalX-N5 into cempaka-stable (11 days ago) <Muhammad Najmi Ahmad Zabidi>
039a263 - (elementalx/ElementalX-1.00-cm) Merge branch 'ElementalX-1.00' into ElementalX-1.00-cm
(12 days ago) <flar2>
cb7e4f0 - (elementalx/ElementalX-1.00) update defconfig (12 days ago) <flar2>
753de48 - msm-sleeper: use ex_max_freq (12 days ago) <flar2>
c5cc9d2 - Merge branch 'ElementalX-1.00' into
ElementalX-1.00-cm (2 weeks ago) <flar2>
8438630 - vibrator: change permissions again (2 weeks ago) <flar2>
e51fa2d - Revert "vibrator: change sysfs permissions" (2 weeks ago) <flar2>
9949aff - Merge branch 'ElementalX-1.00' into ElementalX-1.00-cm (3 weeks ago) <flar2>
cbee9fe - update defconfig (3 weeks ago) <flar2>

```

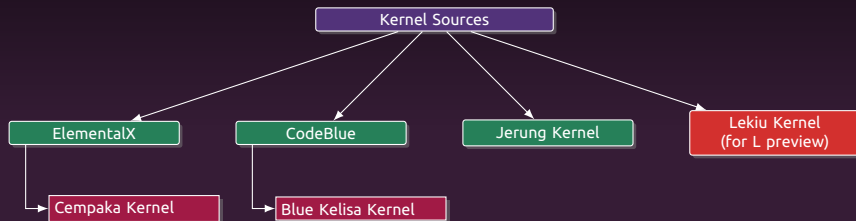
- Most of the developers' works are hosted on github
- Some use sourceforge's git and bitbucket's
- I prefer github because I am familiar with it

- 4.0 (Ice Cream Sandwich)
- 4.1 (Jelly Bean)
- 4.2 (Jelly Bean)
- 4.3 (Jelly Bean)
- 4.4 (KitKat)
  - 4.4.1
  - 4.4.2
  - 4.4.3
  - 4.4.4 (latest, as of now)

# My kernel projects for Nexus 4/Mako







# My Nexus 4/Mako Kernel Features

Kernel	Tap2Wake and S2S/S2W	Additional Governors	Additional Schedulers	Fast Charge	Multiboot (kexec)	Intelliplug	Advanced MPD
Aufa	X	X	X	X	X	X	-
Zulfa	X	X	X	X	X	X	-
Ampang	X	X	X	X	X	X	-
Franco Gombak	X	X	X	X	X	-	-
Seladang	X	X	X	X	X	-	X
Pandan	X	X	X	X	X	X	-

**Table :** Features of the custom kernels (at least from what I remember)

# My Nexus 5/Hammerhead Kernel Features

Kernel	Tap2Wake and S2S/S2W	Additional Governors	Additional Schedulers	Fast Charge	Multiboot (kexec)	Intelliplug	Advanced MPD
Cempaka	X	X	X	X	X	X	-
Blue Kelisa	X	X	X	X	X	X	-
Jerung	X	X	X	X	X	X	-
Lekiu	X	X	X	X	not yet	-	-

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# MultiROM capabilities

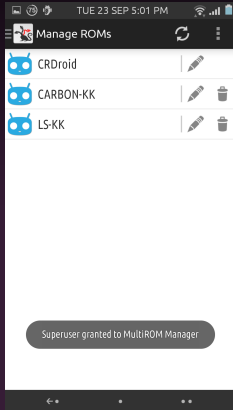


Figure : List of ROMs

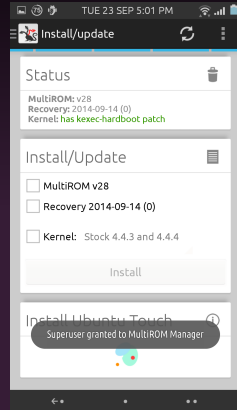


Figure : MultiROM settings

# Kernel configurations



Figure : Using trickster to tune the kernel parameters, by sysfs interfacing

# I/O scheduler selector

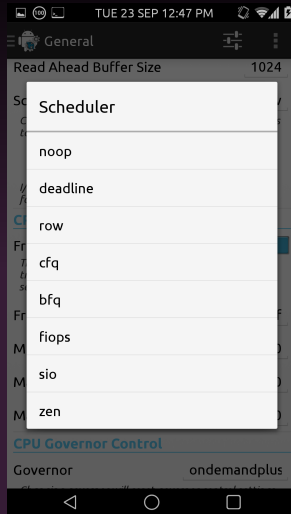


Figure : Using trickster to select preferred I/O scheduler

# CPU governors

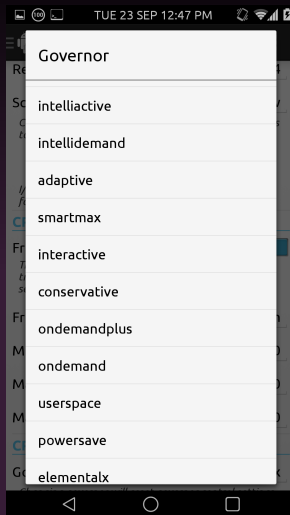


Figure : Using trickster to select preferred CPU governors

# How to compile Android kernel?

- Use desktop PC (Mine is i3, 16GB RAM, Ubuntu 14.04 LTS)
- Only works on 64-bit Linux
- Use cross compiler.. GCC for ARM
- Cross compiling in this case means compiling ARM kernel image on x86 (x64) based machine
  - Default kernel sources somehow cannot use latest (bleeding edge) GCC (as for now 4.10). Need some patches to allow that.



- Use “patch” command by downloading intended patch from other source manually
- Use “git cherry pick” command

# Patch

```
wget -c https://github.com/engstk/l-preview/commit/8c203729fc0d4479b790408de2ac464745cc7769.patch
--2014-09-24 23:53:24--
https://github.com/engstk/l-preview/commit/8c203729fc0d4479b790408de2ac464745cc7769.patch
Resolving github.com (github.com)... 192.30.252.130
Connecting to github.com (github.com)|192.30.252.130|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [text/plain]
Saving to: '8c203729fc0d4479b790408de2ac464745cc7769.patch'
```

```
[ <=>
```

```
2014-09-24 23:53:26 (59.6 KB/s) - '8c203729fc0d4479b790408de2ac464745cc7769.patch'saved [20146]
```

```
najmi@quds:~/lekiu-lprev-kernel$ patch -Np1 -i 8c203729fc0d4479b790408de2ac464745cc7769.patch
patching file arch/arm/Kconfig
Hunk #1 succeeded at 2213 (offset 1 line).
patching file arch/arm/boot/compressed/head.S
patching file arch/arm/configs/hammerhead_defconfig
patching file arch/arm/include/asm/kexec.h
patching file arch/arm/kernel/machine_kexec.c
patching file arch/arm/kernel/relocate_kernel.S
patching file arch/arm/mach-msm/include/mach/memory.h
patching file arch/arm/mach-msm/lge/devices_lge.c
patching file arch/arm/mach-msm/restart.c
patching file include/linux/kexec.h
patching file kernel/kexec.c
```



# git cherry pick

```
najmi@quds:~/lekiu-lprev-kernel$ git fetch codeblue
remote: Counting objects: 1073, done.
remote: Compressing objects: 100% (422/422), done.
remote: Total 1073 (delta 698), reused 974 (delta 649)
Receiving objects: 100% (1073/1073), 1.09 MiB | 443.00 KiB/s, done.
Resolving deltas: 100% (698/698), done.
From https://github.com/engstk/l-preview
+ 3043028...647125f code_blue-l -> codeblue/code_blue-l (forced update)
+ 59063dc...647125f code_blue-l-beta -> codeblue/code_blue-l-beta (forced update)

najmi@quds:~/lekiu-lprev-kernel$ git cherry-pick 8c203729fc
[test cf6f160] Implement kexec-hardboot by. All work done by @Tassadar
Author: franciscofranco <franciscofranco.1990@gmail.com>
11 files changed, 350 insertions(+), 7 deletions(-)
```

- Since kernel sources are GPL, if you publish your release, you **MUST** publish your source codes
- People can view your codes/modifications or borrow/use them anyway they want, and they need to publish them as well

# Custom ROMs

- Custom ROMs are either AOSP or CM
- AOSP and CM ROM source are out there, many creative people do modifications on these sources
- Popular custom ROMs with relatively awesome team members and support many devices
  - CyanogenMod
  - Carbon ROM
  - Liquid Smooth
  - Paranoid Android (PA)
  - Mahdi ROM
  - AOKP

- Sources and modifications are updated in gerrits
- Cherry pick is also possible



**Figure :** Liquid Smooth ROM, running Cempaka Kernel



**Figure :** Carbon ROM, running Blue Kelisa Kernel



- ROMs are using “repo” command to sync all changes from the upstream
- Updates are based from the repositories defined in the manifest file

# Repo sync

```
najmi@quds:~/rom/aicp$ repo sync
remote: Counting objects: 3, done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 3 (delta 0), reused 3 (delta 0)
Unpacking objects: 100% (3/3), done.
From https://github.com/AICP/platform_manifest
 9ee1fc3..d607bb2  kitkat    -> origin/kitkat
project .repo/manifests/
Updating 9ee1fc3..d607bb2
Fast-forward
 default.xml | 2 +-
 1 file changed, 1 insertion(+), 1 deletion(-)

Fetching project platform/packages/apps/Provision
Fetching project CyanogenMod/android_hardware_ti_wpan
Fetching project omnirom/android_packages_wallpapers_PhaseBeam
Fetching project platform/external/tinymce
.....
remote: Counting objects: 12, done
remote: Finding sources: 100% (12/12)
remote: Total 12 (delta 0), reused 12 (delta 0)
remote: Counting objects: 12, done
Unpacking objects: 100% (12/12), done.
From https://android.googlesource.com/platform/external/eigen
```



## Example of extra features in custom ROMS

- Hover
- PIE
- Halo
- Customization of date display



Figure : PIE

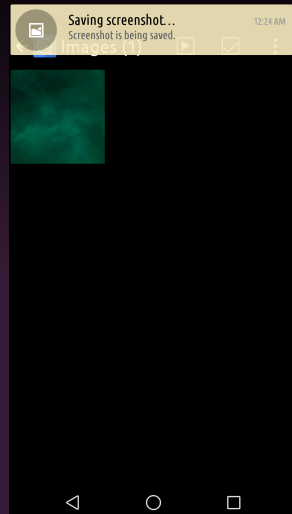


Figure : Hover

END

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