Accelerated Development with Linaro

Infrastructure, Validation, and Optimization

Jim Huang (黃敬群)

Developer, **Linaro** : <jim.huang@linaro.org>

Developer, **0xlab** : <jserv@0xlab.org>

May 18, 2011

Agenda

- Infrastructure

  Linaro – Accelerating Product Development
  - Working Groups
  - Evaluation Builds
- Validation
- Optimization

Linaro

Open Source Revolution

- Billions of consumer devices rely on open source software
  - Google Android, Apple iOS, RIM, Windows Mobile, ...
- OEMs and ODMs want chip vendors to offer the best open source support for their SoCs and to avoid low level fragmentation speeding their time to market
  - Example: Qualcomm/QuIC
- This necessitates working together – kernel consolidation, aligned investment, defragmentation, aligned upstreaming, open source leadership

Linaro

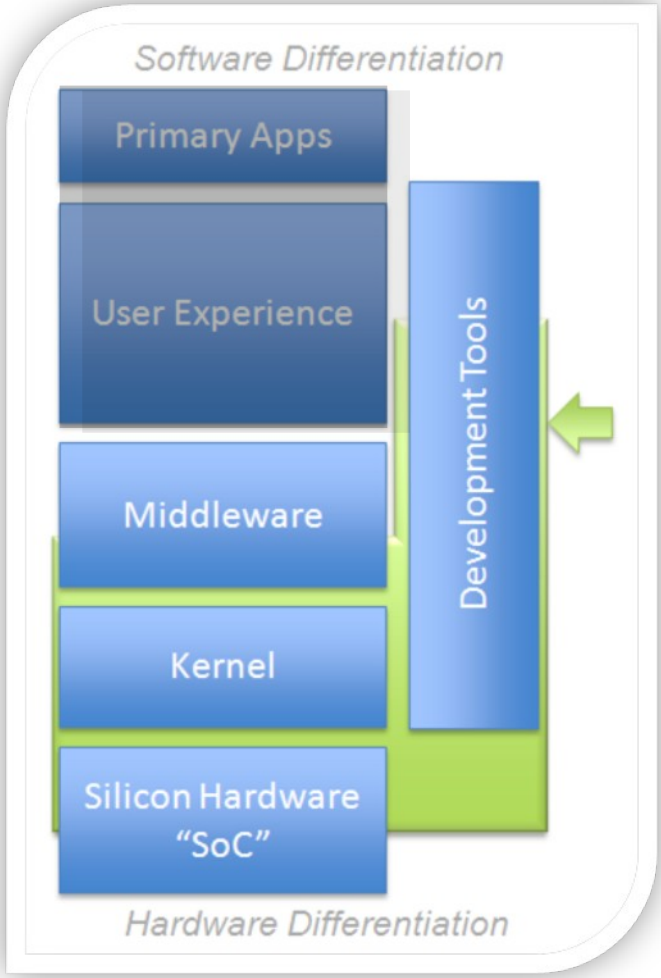
About Linaro

"to make it easier and quicker for ARM partners to deploy the latest technology into optimized Linux based products"

- Founded in June 2010
- Members align their open source strategy with Linaro
- Provides shared Leadership in open source

Linaro

What does Linaro do?



- Delivers a optimized code base
  - Kernel and vital middleware
  - Applied across all member SoCs
- Tools
  - Best compiler, debugger, profiler
- Enabled on the latest SoCs
  - Cortex A8, A9, & A15 processors
- Delivered upstream
  - Evaluation builds for key distributions – Android, Chrome, Ubuntu, Other Linux
  - Test & Validation framework for member SoCs

MeeGo OEM Linux

Linaro – NOT a distribution

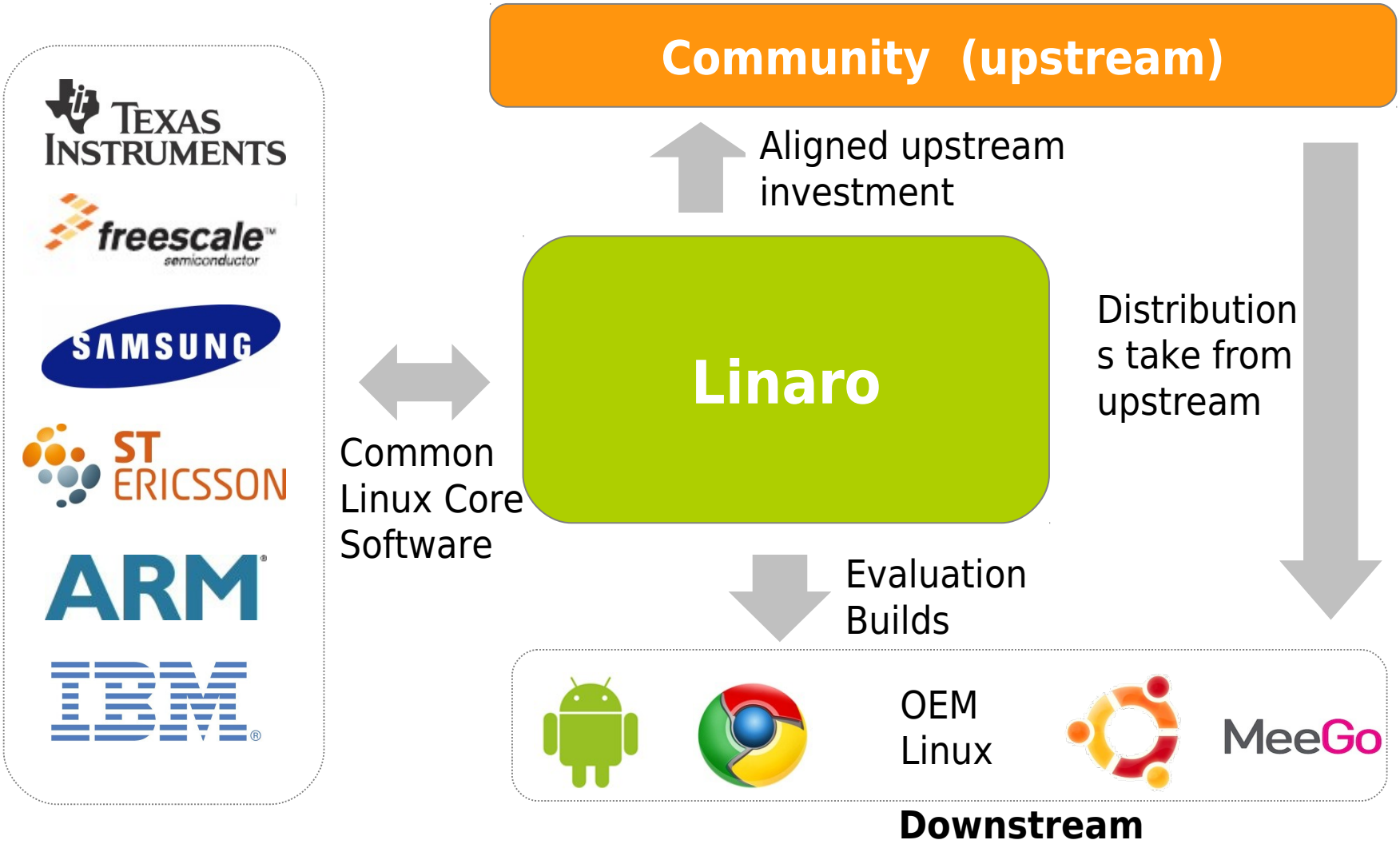
Linaro

- Infrastructure

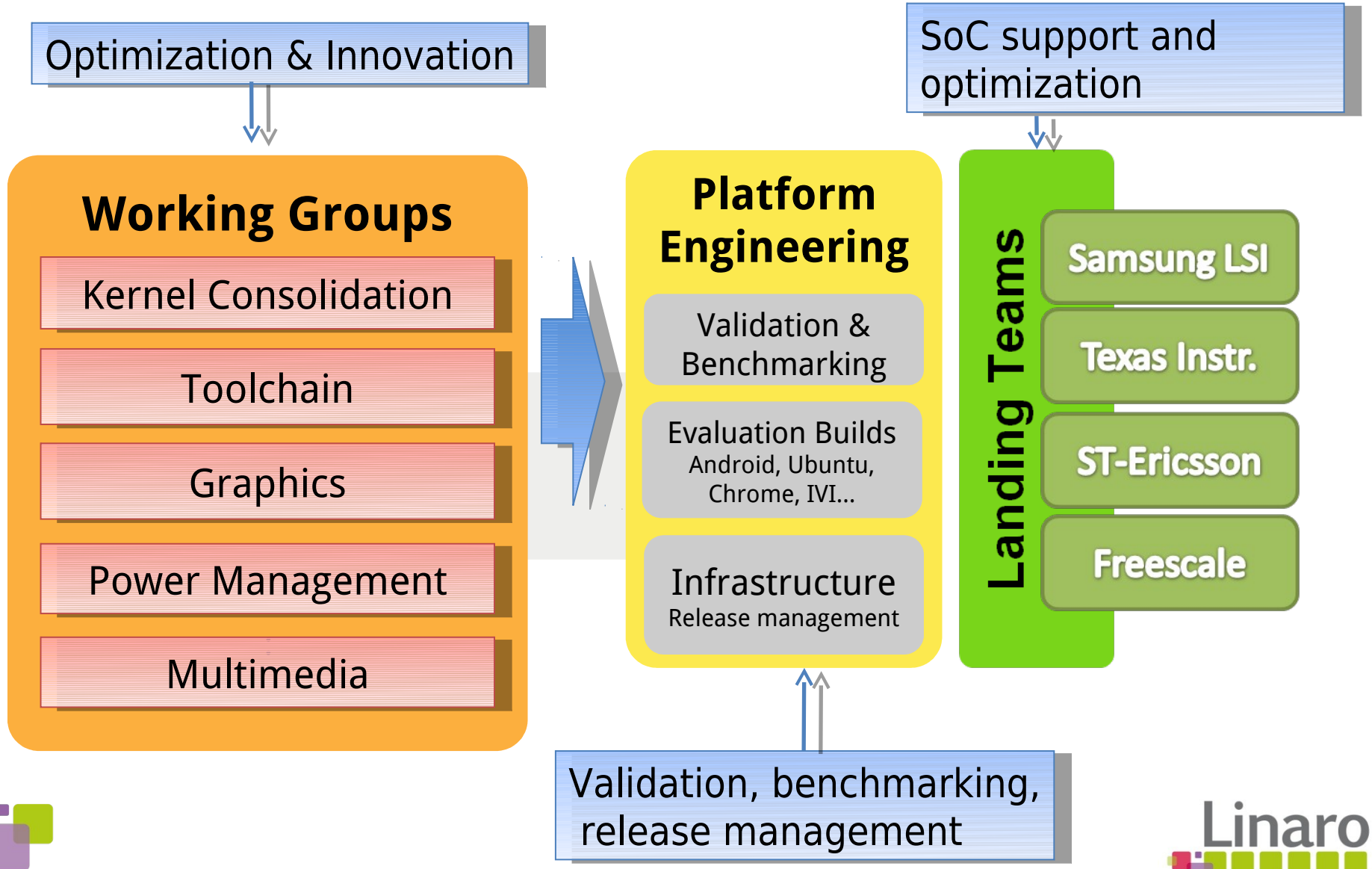
  Linaro – Accelerating Product Development
  - Working Groups
  - Evaluation Builds
- Validation
- Optimization

Linaro

Where does Linaro fit?

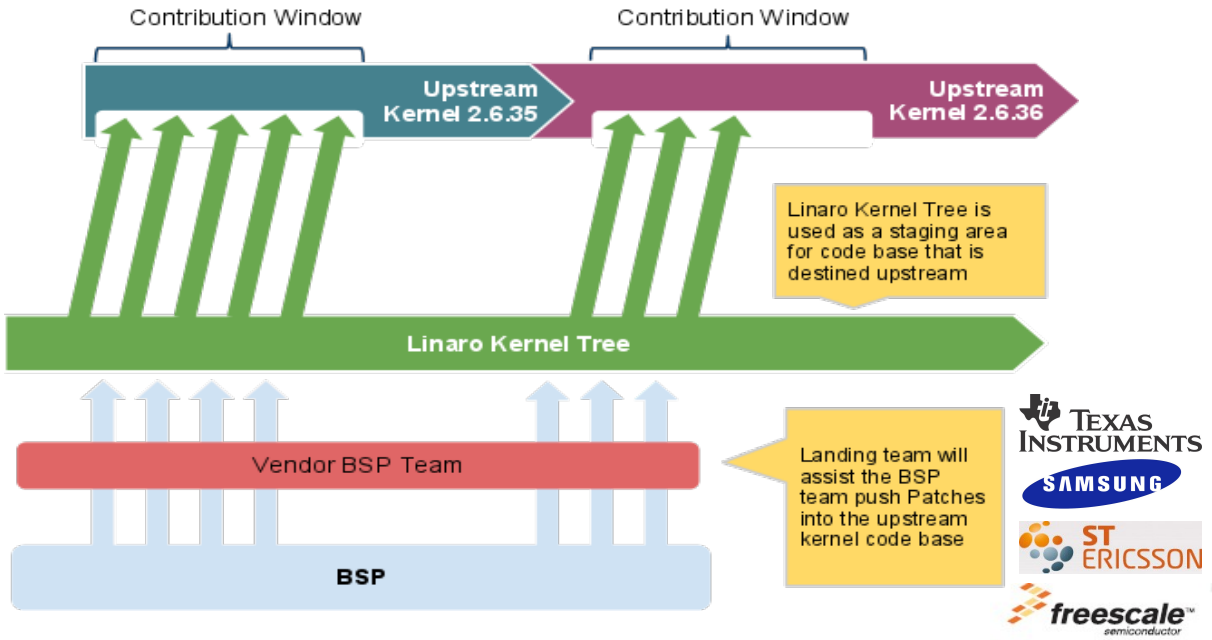


Engineering units



Working with Linaro

- Linaro kernel becomes members most advanced
- Vendor BSP and Linaro landing team engineers work together
- Get latest software on latest SoCs with upstream support



Linaro

WGs: Alignment, Optimization, Leadership

- Aligned investment: boot, power mgmt, Float, kernel...
- Open source Leadership
- Latest software on latest HW

Optimization & Innovation

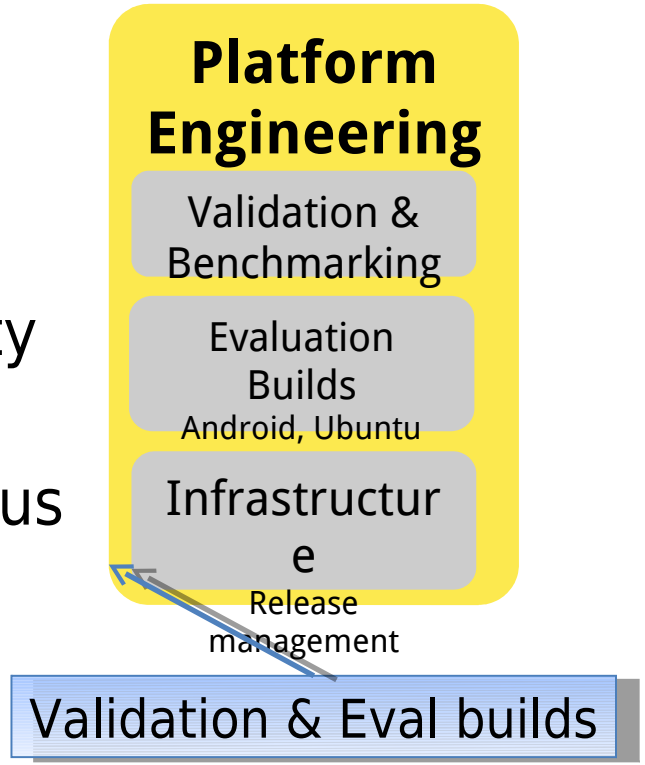
Working Groups

- Kernel Consolidation
- Toolchain
- Graphics
- Power Management
- Multimedia

Linaro

Linaro eval builds & test farms

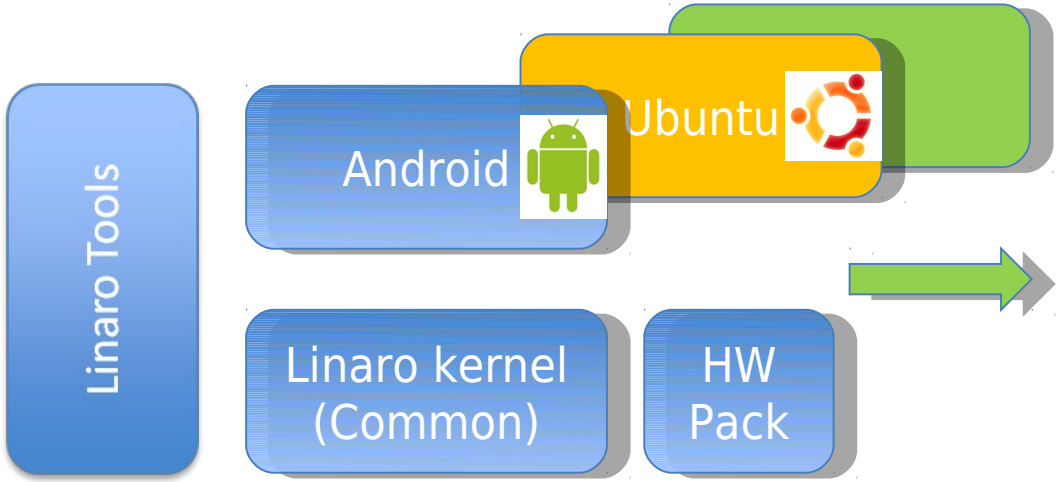
- Linaro evaluation builds push latest software into distributions
- Validation test farms monitor improvements in software quality
- Benchmarking ensures continuous improvements in performance

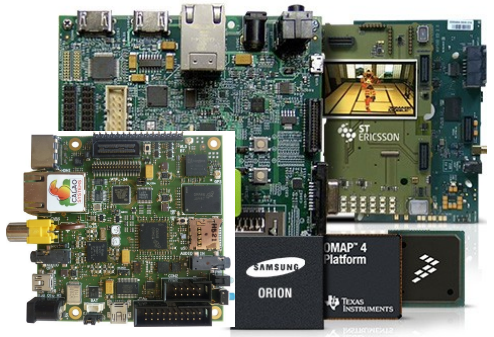


Linaro

Linaro Evaluation Android Build

- Reduced TTM with streamlined integration
- Increased optimisation and benchmarking
- Validation on multiple hardware





Early Android for latest member hardware with Linaro optimisations

Test & Validation farm Benchmarking

Evaluation Builds

- Builds of key distributions incorporating Linaro's technology
- Initial Evaluation builds (11.05)
  - Android 2.3 Gingerbread
  - Ubuntu 11.04

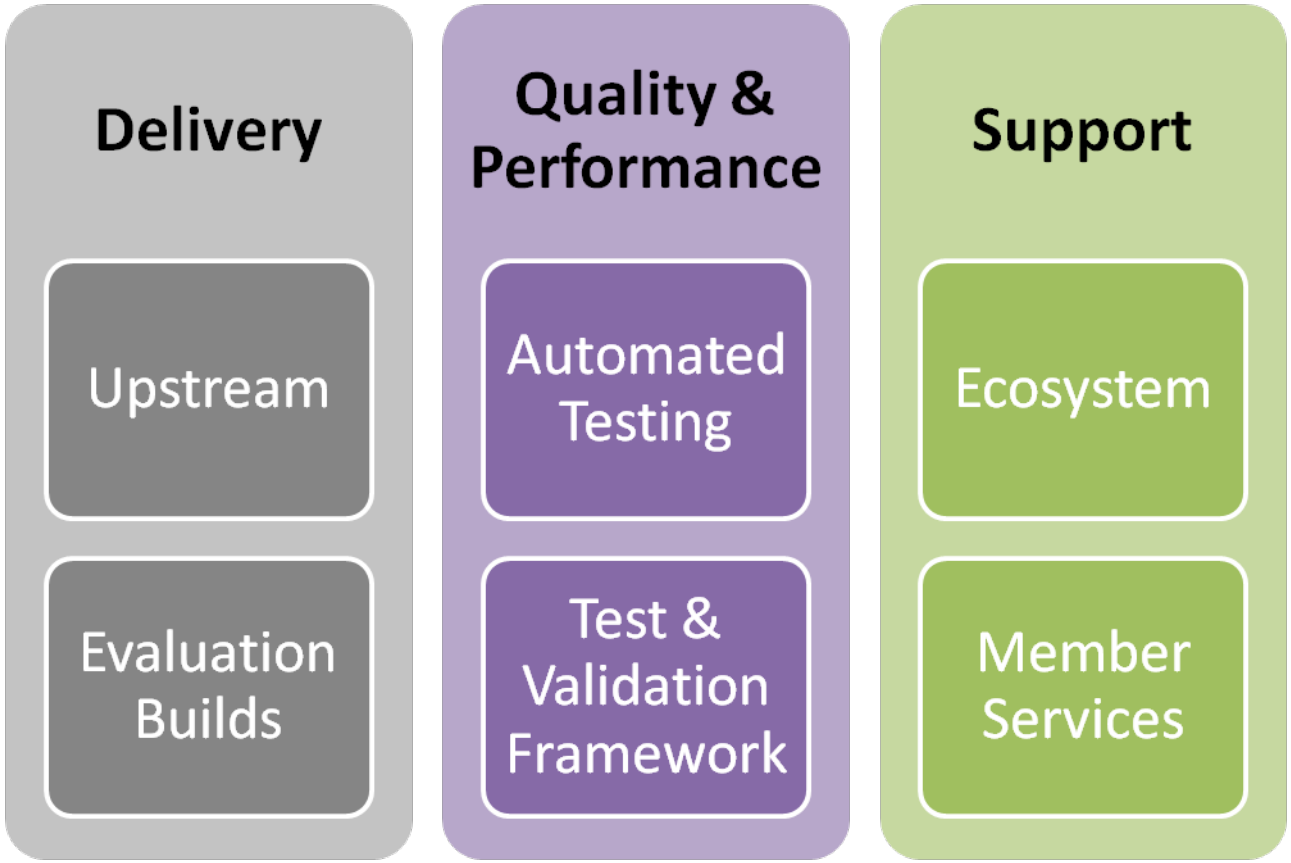
Linaro

Benefits of Evaluation Builds

- Demonstrate the output of the working groups
- Real-life product-quality distributions for Linaro performance and regression testing
- Closer to understanding and delivering tangible deliverables that shorten the TTM
- Serve as basis for OEM/ODM commercialization
- Validate members silicon and reference designs
- Attract distribution owners to Linaro
- Attract a wider community audience

Linaro

Linaro 2011



Linaro

11.05: Working Group Deliverables

- Toolchain
  - Produce the best all-round v7 GCC compiler
    - EEMBC DENBench/ConsumerBench, SPEC CPU2006
  - linaro-gcc 4.5 & 4.6, linaro-gdb 7.2, cortexstrings 1.0
  - ARM-enhance/port qemu, libunwind, ltrace, gold, libgc
- Kernel
  - Linaro Linux and Linaro Android trees
  - Devicetree evaluation kernels
  - GPU and MM implementation guidelines
- Power Management
  - Standard ARM-enhanced management mechanisms
  - Hotplug, thermal and clock/regulator tree common interfaces
  - Allow custom engines to encode policies
    - Tools to demonstrate interfaces and debug behaviors

Linaro

11.05: Working Group Deliverables

- Multimedia
  - A multimedia optimization workbench
  - ARM-enhanced JPEG and VP8 decoding
  - OpenMAX-standardized components
  - Free content for benchmarks and testing
- Graphics
  - OpenGL ES backends for Cairo, Skia, meegotouch-compositor, chromium-wm and compiz
  - Work with vendors and upstream to document a common ARM-standard acceleration framework

Quality & Performance

- Open source code has limited testing as it is created
- Linaro needs to quantitatively measure its performance & quality over time
  - Benchmarks
  - Power consumption under system loads
  - System stability
- Linaro engineering needs improved tools
  - Smoke testing
  - Regression testing
  - Automated testing with real distributions

Linaro

- Infrastructure

  Linaro – Accelerating Product Development
  - Working Groups
  - Evaluation Builds
- Validation
- Optimization

Linaro

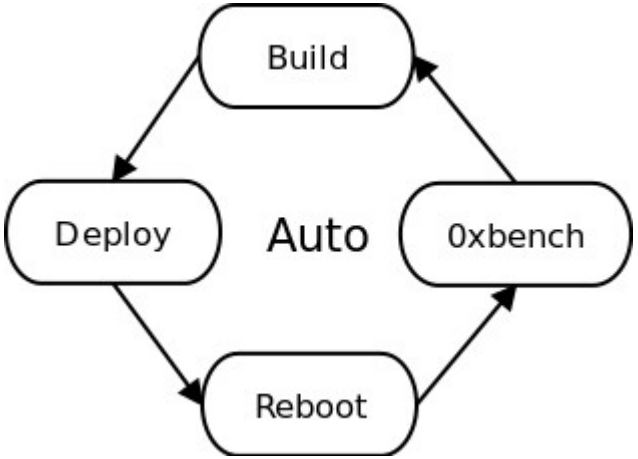
Linaro Test & Validation

- We have started to develop our test & validation farm to benefit members & our own engineering
- Populated by member hardware
- Goals
  - Linaro 11.05
    - Running automated daily builds and smoke tests
    - Running daily benchmarks
    - At least 2 member boards
  - Linaro 11.11 and beyond
    - Automated performance tests on release and daily builds
    - Automated stability tests
    - Hardware from all members
    - Web dashboard available

Linaro

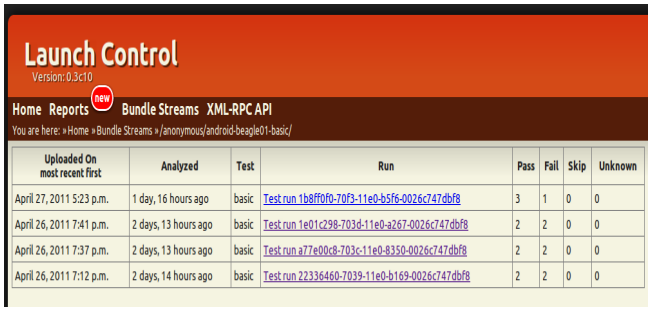
Automated Validation for Android

Android benchmark running on **LAVA**.
Automated Validation flow includes from deploy, then reboot, testing, benchmark running, and result submit.



Android support on LAVA
https://wiki.linaro.org/Platform/Validation/LAVA

```
Android related commands in LAVA:
 * deploy_linaro_android_image
 * boot_linaro_android_image
 * test_android_basic
 * test_android_monkey
 * test_android_0xbench
 * submit_results_on_host
```



https://code.launchpad.net/~linaro-validation/lava/trunk

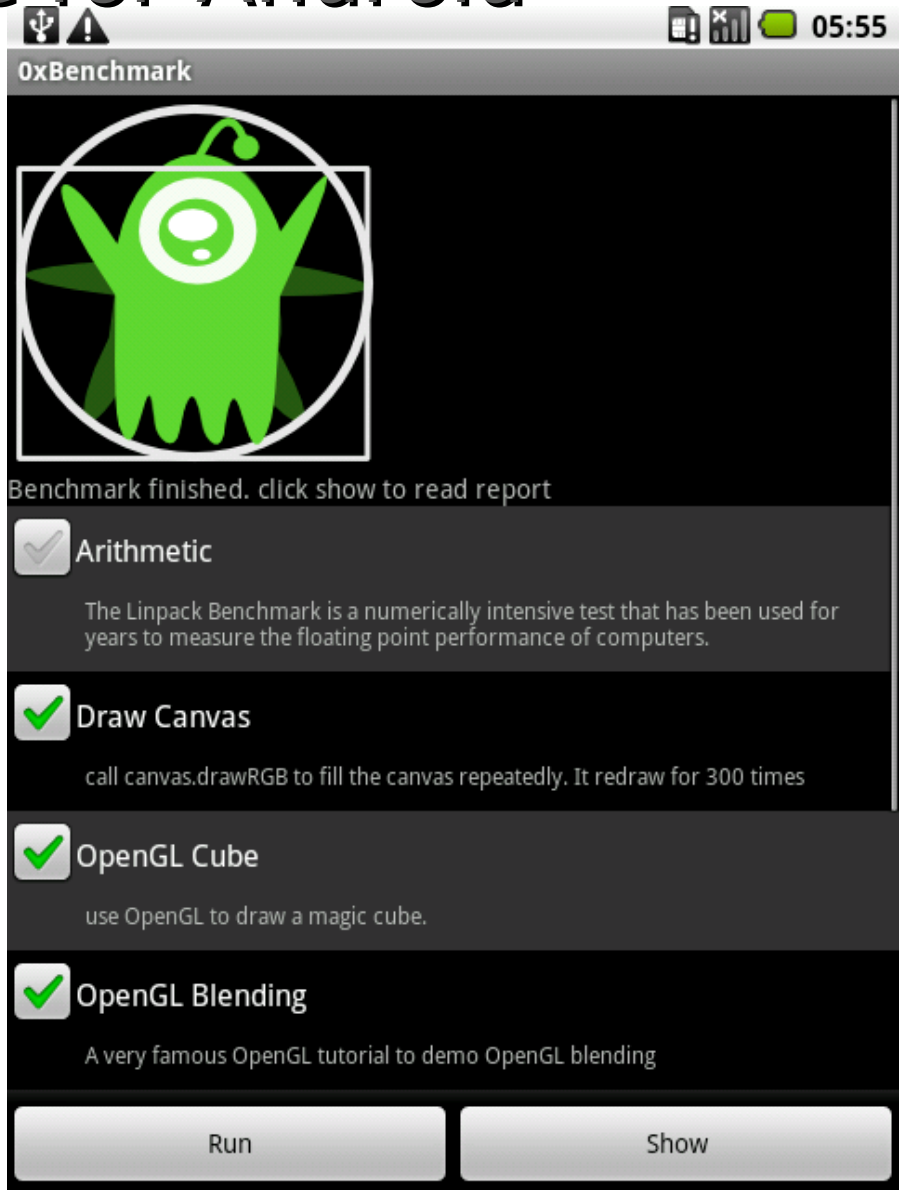
Reference hardware:
Beagleboard xM
Pandaboard

https://wiki.linaro.org/JeremyChang/Sandbox/LavaAndroidValidation
Android-dev branch:
lp:~jeremychang/lava/android-support

Linaro

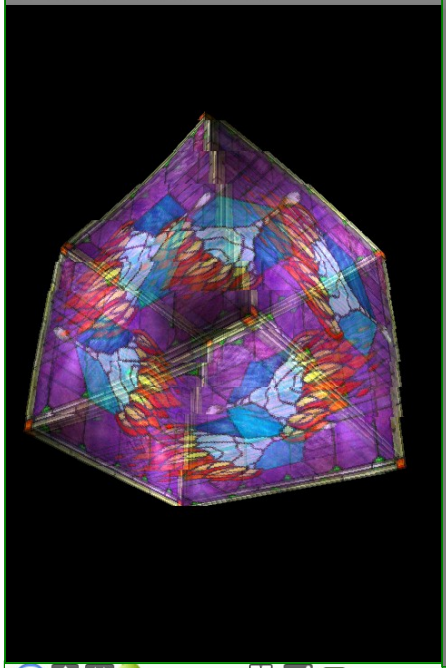
0xbench: comprehensive open source benchmark suite for Android

- A set of system utilities for Android to perform comprehensive system benchmarking
  - Dalvik VM performance
  - OpenGL|ES performance
  - Android Graphics framework performance
  - I/O performance
  - Connectivity performance
  - Micro-benchmark: stanard C library, system call, latency, Java invocation, ...



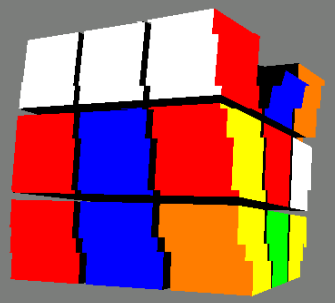
上午 9:40

com.nea.nehe.lesson08.Run



上午 9:40

Kubench



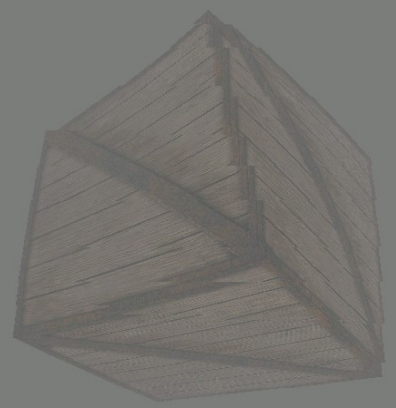
下午 12:47

org.zeroxlab.benchmark.Report

```
==================================
Linpack
----------------------------------
Mflops/s :38.24873895068384
Norm Res :1.71006733926878 94E14
Precision:2.220446049250313E-16
==================================
Draw Canvas
----------------------------------
Round 0 fps = 60.802593
Round 1 fps = 60.398632
Round 2 fps = 60.753338
Average: fps = 60.0
==================================
Draw Circle
----------------------------------
Round 0: fps = 59.725266
Round 1: fps = 59.512
Round 2: fps = 58.708412
Average: fps = 58.666668
==================================
```

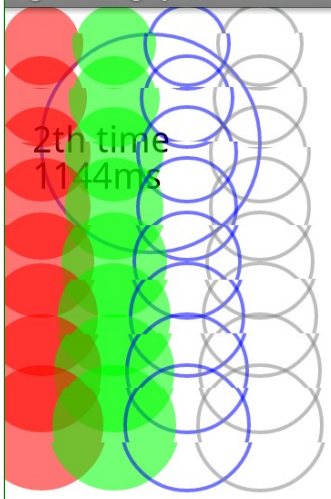
上午 9:41

com.nea.nehe.lesson16.Run



上午 9:38

org.zeroxlab.graphics.DrawCircle



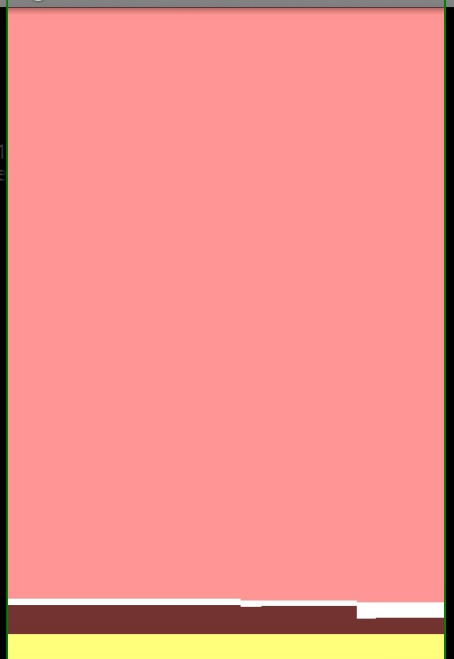
下午 12:46

org.zeroxlab.benchmark.TesterGC

```
Stretching memory:
    binary tree of depth 16
*Total memory:3612640 bytes
*Free  memory:738576 bytes

Creating:
    long-lived binary tree of depth 1
    long-lived array of 125000 double
*Total memory:8003552 bytes
*Free  memory:3327960 bytes

Create 37448 trees of depth 2
- Top down: 1481msecs
- Bottom up: 1328msecs
Create 8456 trees of depth 4
- Top down: 1319msecs
- Bottom up: 996msecs
Create 2064 trees of depth 6
- Top down: 799msecs
- Bottom up: 776msecs
Create 512 trees of depth 8
- Top down: 957msecs
- Bottom up: 808msecs
52 bytes          rees of depth 8
    down: 957msecs
    Bottom up: 808msecs
Total memory:8003552 bytes
*Free  memory:2901808 bytes

Completed in 10413ms
```

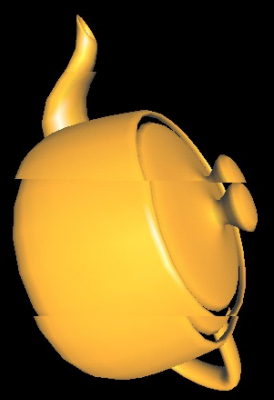
上午 9:38

org.zeroxlab.benchmark.TesterCanvas



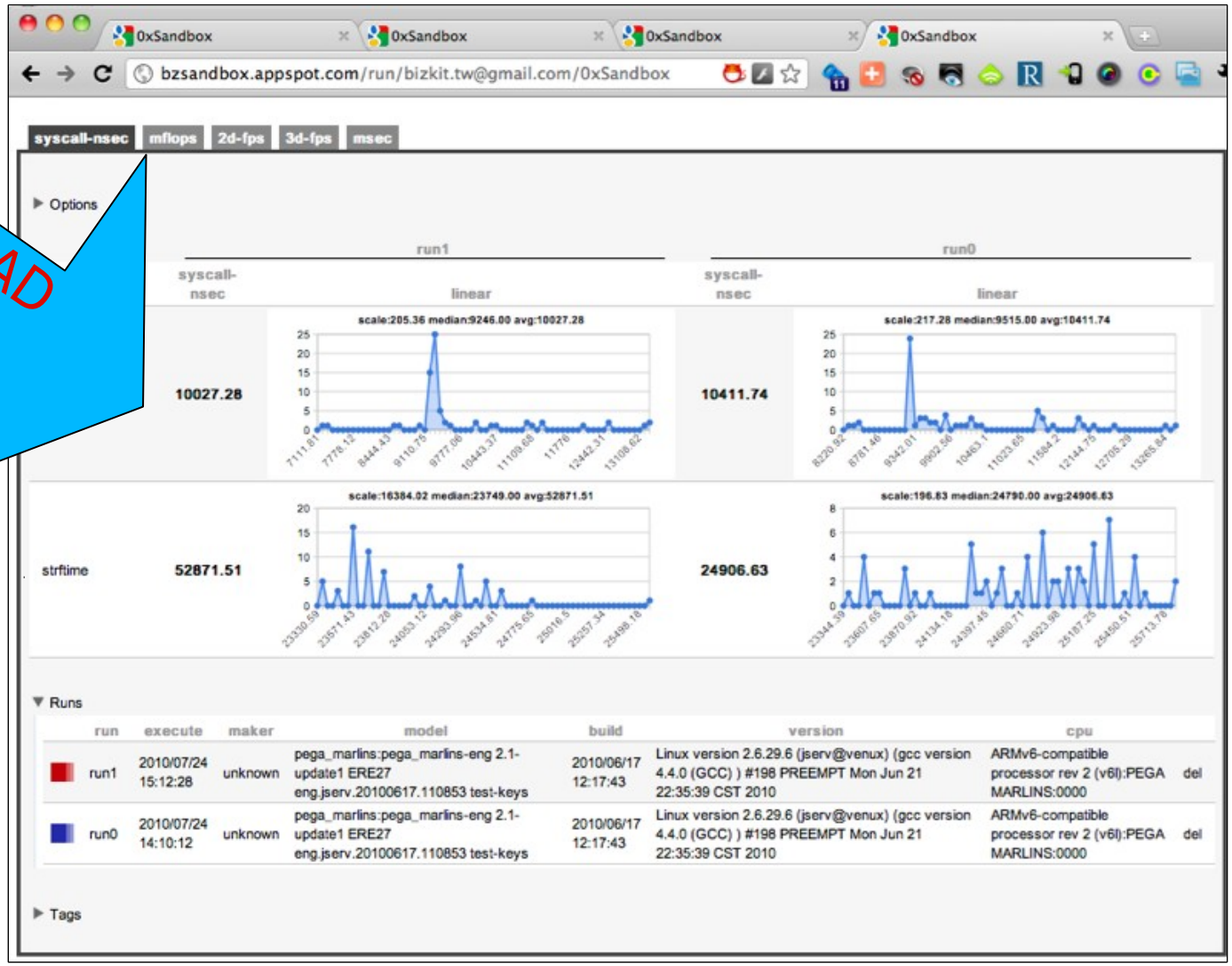
上午 9:43

org.itri.teapot.TeapotES



Collect and Analyze results in the cloud

UPLOAD



Linaro

Sikuli - testDialer.sikuli

File View

G1.test.sikuli | testDialer.sikuli

```
def setUp(self):
  click( <image> )
  wait( <image> ) # wait until the app appears

def tearDown(self):
  click( Home )
  untilNotExit( <image> ) # wait until the app disappears

def testA(self):
  type("1234\n")
  sleep(2)
  click( Menu )
  click( End call )

def testB(self):
  click( Home )
```

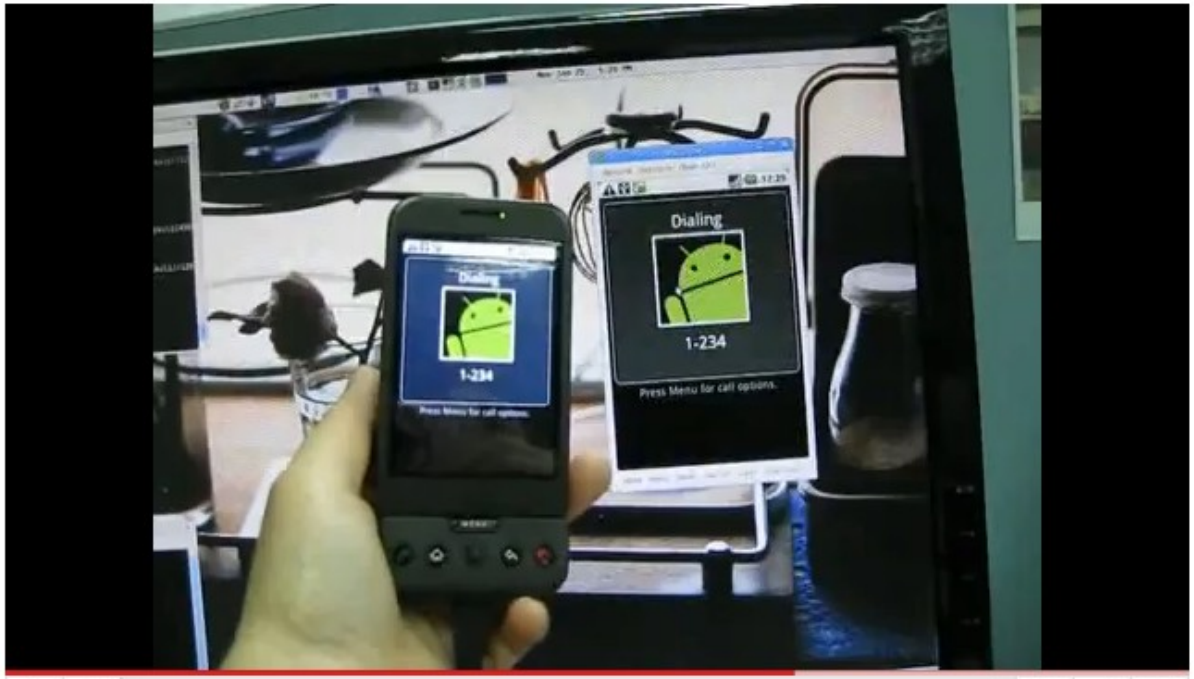
Message | Test Trace

```
0 matches found
capture: java.awt.Rectangle[x=0,y=0,width=1920,height=1080]
1 matches found
[sikuli] click 1 times
[sikuli] click on (1676,585) BTN: 16, MOD: 0
capture: java.awt.Rectangle[x=0,y=0,width=1920,height=1080]
1 matches found
[sikuli] click 1 times
[sikuli] click on (1424,702) BTN: 16, MOD: 0
Finished: 27.457 seconds
[sikuli] FileAction.toggleUnitTest
```

Line: 97, Column: 19

Dial out a phone call in Android by Sikuli

icedventilatte 10 videos Subscribe



0:22 / 0:33 360p

Like + Add to Share Embed 2,660

icedventilatte | January 25, 2010 | 1 likes, 0 dislikes

it's Android Dev Phone + a java application called Screencast. It can allow you to see G1 screen on local machine.
http://code.google.com/p/androidscree...
1. write a very basic unit test
2. testDialer: dial out 1234, then hang up
3. press Run from Sikuli IDE editor

Linaro

- Infrastructure

  Linaro – Accelerating Product Development
  - Working Groups
  - Evaluation Builds
- Validation
- Optimization

Linaro

Android Platform Team

https://wiki.linaro.org/Platform/Android

- Scope
  - Provide Linaro optimized builds of the Android software stack
  - Help consolidate and improve the Android ecosphere
  - Extend Android validation
- Goals
  - Reduce ODM/OEM time-to-market
  - Upstream Linaro optimizations

11.05 Accomplishments

- 25 patches sent upstream, 9 merged
  - Merged Sample
    - bionic: Add ARM optimized strcpy()
    - libpng: use GCC visibility to reduce shared library size
    - Allow building toolchain without target gdb alternatively.
  - Accepted Sample
    - libpixelflinger: Add ARM NEON optimized scanline_t32cb16
      - Dramtically improve boot animation performance

https://review.source.android.com/#dashboard,1002471

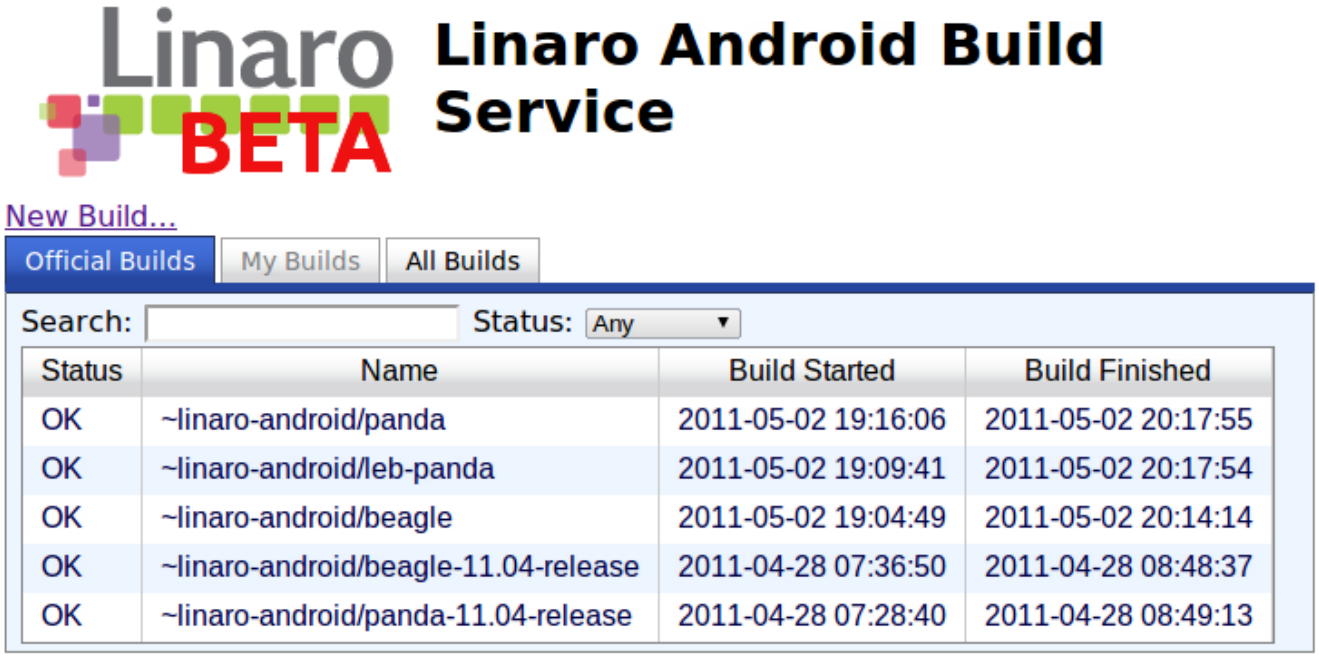
Development Aspects

- ARM specific optimizations
  - multi-core for bionic libc, dalvik, skia, blitter, RenderScript, WebKit, etc.
- Figure out hotspot for further improvements and and apply strong validation
- SoC vendor HAL/enhancement consolidation=
- code size, performance, debugging facility, introducing latest technologies
  - Recompiled by Linaro Toolchain for Android (2011.04), skia obtains 10% performance gain. Up to 150% for specialized routines

Linaro

11.05 Accomplishments

- Created daily Android builds



Status	Name	Build Started	Build Finished
OK	~linaro-android/panda	2011-05-02 19:16:06	2011-05-02 20:17:55
OK	~linaro-android/leb-panda	2011-05-02 19:09:41	2011-05-02 20:17:54
OK	~linaro-android/beagle	2011-05-02 19:04:49	2011-05-02 20:14:14
OK	~linaro-android/beagle-11.04-release	2011-04-28 07:36:50	2011-04-28 08:48:37
OK	~linaro-android/panda-11.04-release	2011-04-28 07:28:40	2011-04-28 08:49:13

Released 11.04 Panda-LEB build

https://android-build.linaro.org/builds/~linaro-android/leb-panda/

Linaro

How Linaro delivers value

- Linaro provides a common platform for member SoCs and Linux distributions
  - Enables SiP, Distribution, OEM, ODM to focus on value add rather than common core code
- Multiplier effect of multiple member resources working on common code base
- Access to test & validation framework
- Support and services
- **Faster time to market for end products**

Linaro

Roadmap

- Work with distributions to become the enablement channel for member SoCs
- Work with ARM to deliver open source support for Cortex A15
- Continue to work on ARM generic SoC optimization including toolchain support, NEON and SMP issues
- Support new market segments
  - DTV/STB, Server

Benefits to everyone

- SoC Vendors
  - Linaro makes Linux BSPs easier to create and support
  - Ability to accelerate TTM for new products through working inside Linaro before SoC release
- Distributions
  - Linaro enables rapid support for multiple SoCs for new distribution versions
- OEM/ODM
  - Software and tool reuse between projects
  - Faster TTM
- Carriers & Segment Leaders
  - Linaro enables a standardized ARM Linux core for segment specific distributions (mobile, STB, embedded etc.)

Linaro

Summary

- Linaro is a not for profit software engineering company owned by ARM, IBM and SoC vendors
  - Delivers core Linux technology for ARM SoCs
  - Faster product TTM through better integration of ARM with upstream & distributions
  - Members get significant advantages of belonging to Linaro: Multiplier effect, latest software on latest SoCs, defragmentation & happy customers

Linaro

www.linaro.org