
# Kernel Consolidation and Benefits for Snowball

**Andrea Gallo**

**Linaro TSC representative**
**Linux Chief Architect**

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# Credits
(in alphabetical order)

- Alessandro Rubini, GnuDD
- David Rusling, Linaro
- Linus Walleij, ST-Ericsson

# All Mistakes

- Myself ☺



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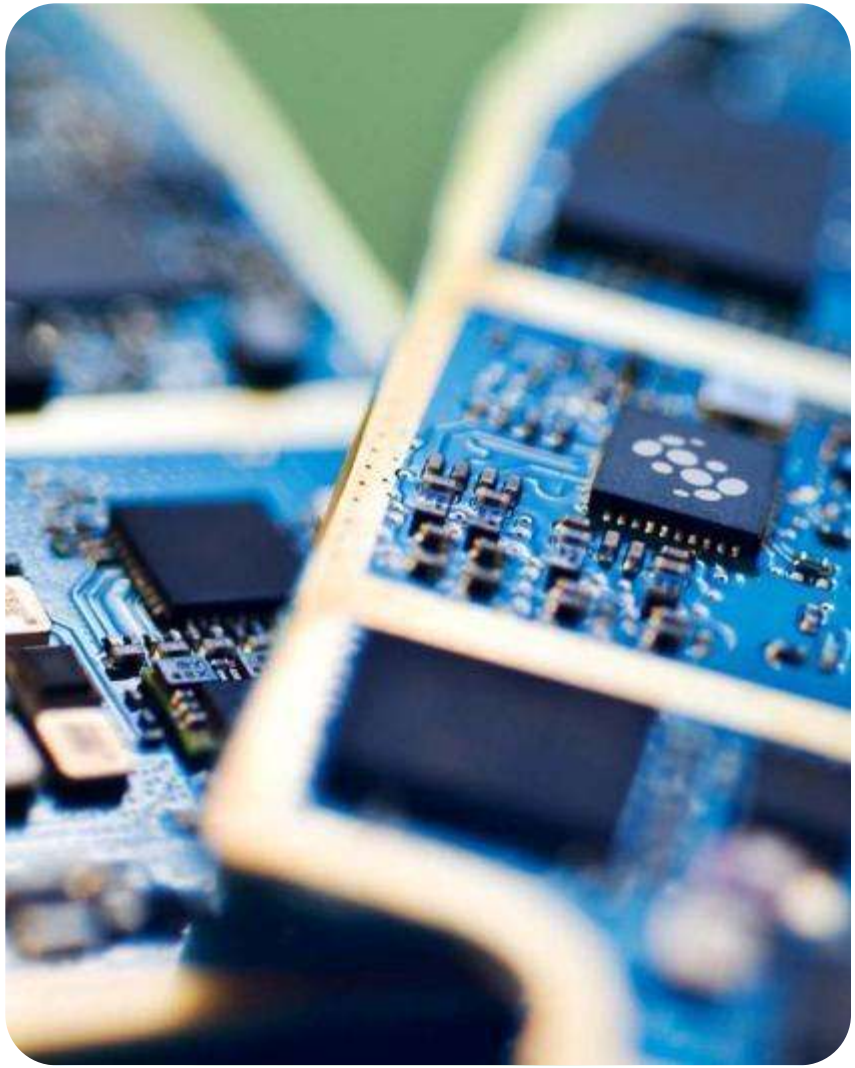
**One in three mobile phones powered by ST-Ericsson in 2010**

# A global leader in wireless technologies

Leading supplier of platforms and semiconductors for wireless devices

Fabless company supported by extensive semiconductor manufacturing experience and telecom heritage

Truly global with a workforce of more than 85% of employees in R&D



# Global presence


**A truly global company with a total of 6000 highly skilled engineers**

# Leading platform solutions

Nova™ BY ST-ERICSSON

**Highest performance application processors**

THOR™ BY ST-ERICSSON

**Industry-leading mobile broadband modems**

NovaThor™ BY ST-ERICSSON

**The most advanced and complete integrated application processor and modem platform family for smartphones and tablets**



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# Our approach – performance and flexibility

THOR BY ST-ERICSSON

**Leading thin modems for any device**

NovaTHOR BY ST-ERICSSON

**Best-in-class application processors with the latest broadband modems**

NovaTHOR BY ST-ERICSSON

**Integrated solutions for industry-leading bill of material and size with best performance in every tier**

**Full complement of connectivity and enhancements**

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# Highest-performance Application Processors

Optimized for mobile

Industry-leading mobile computing and multimedia performance and power

Nova™ BY ST-ERICSSON

28nm **A9600**

- A15 dual-core @ 2.5GHz with 20,000 DMIPS
- 20x graphics improvement* with Imagination Rogue
- Next level of power innovation

32nm **A9540**

- A9 dual-core @ 1.85GHz
- 3x graphics improvement*
- 2x Memory bandwidth
- Lower power through process & architecture innovation

45nm **A9500**

A9 dual-core @ 1.2GHz
20% graphics improvement*
45nm

* vs U8500

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# LTE, HSPA+ and TD

## LTE solutions for all markets

- The best multimode platforms in the industry
- Products tested and verified globally by top tier operators

**M700** 100/50 LTE | **M720** 100/50 LTE/HSPA+ | **M7400** 100/50 LTE/HSPA+/TD

## Industry leading HSPA+ solutions

- Extremely low power consumption and smallest platforms on the market
- World's first 21Mbps smartphone modem

**M570** 21/5,76 HSPA+ | **M5730** 21/5,76 HSPA+ | **M7300** 84/11 HSPA+/TD

## TD leadership

- State-of-the-art TD-HSPA modem powering numerous commercial products
- Pioneering TD-LTE solutions alongside LTE FDD

**M6718** 2,8/2,2 TD-HSPA | **M7300** 84/11 HSPA+/TD | **M7400** 100/50 LTE/HSPA+/TD



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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




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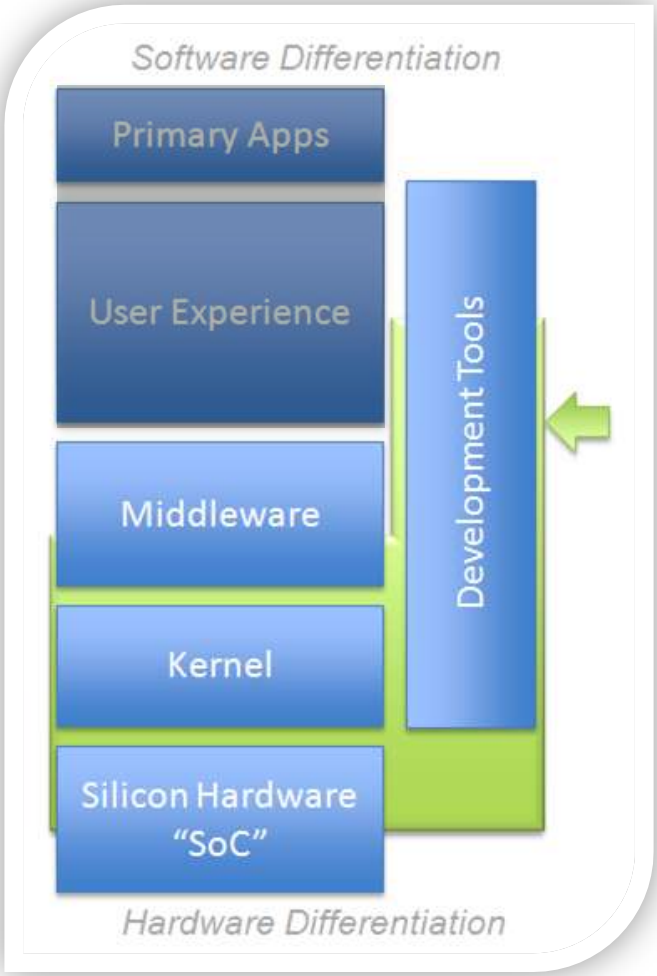
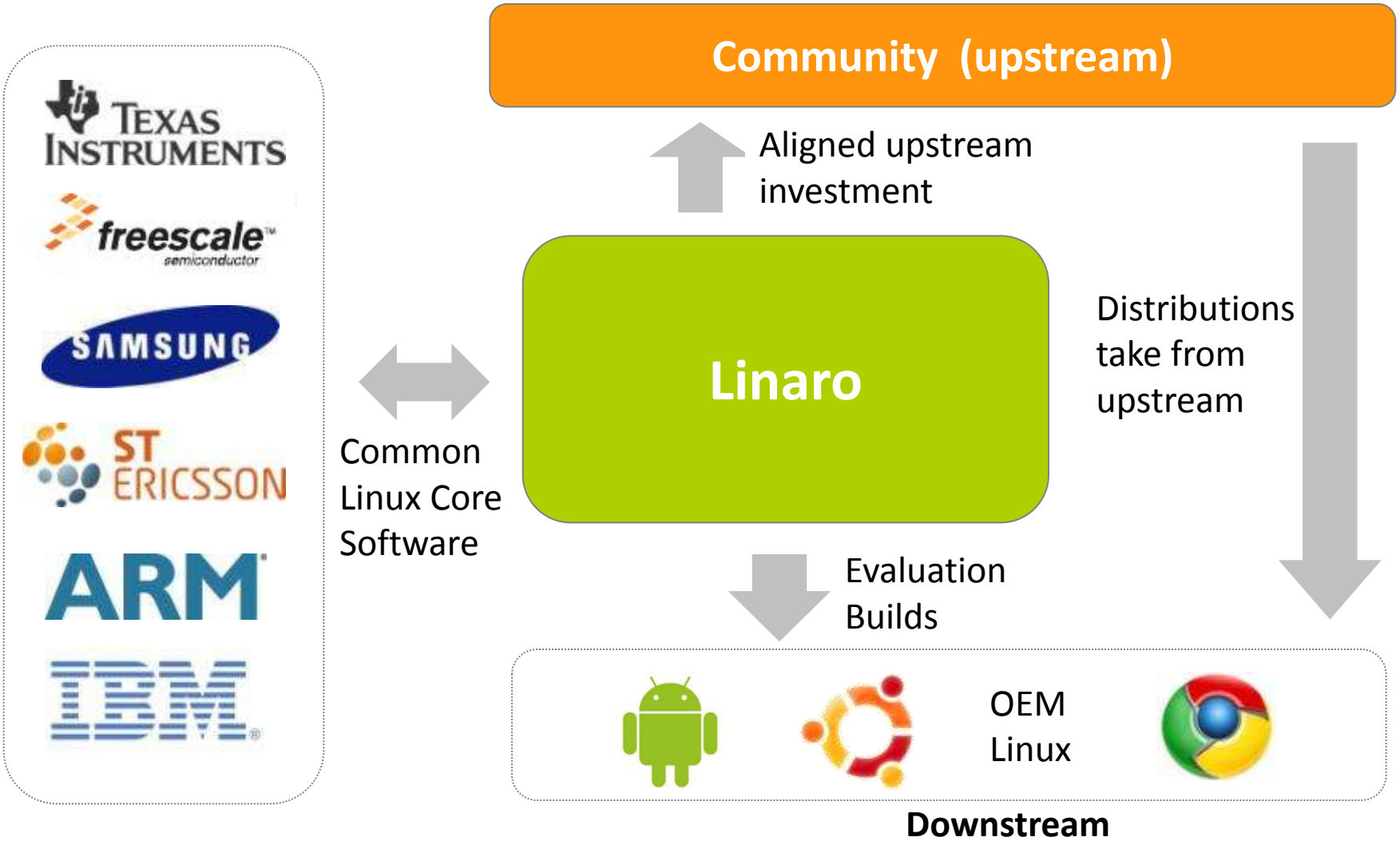
# What does Linaro do?




Linaro – NOT a distribution

- 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
  - Getting ready for A5
- Delivered upstream
  - Evaluation builds for key distributions – Android, Chrome, Ubuntu, Other Linux
  - Test & Validation framework for member SoCs

# Where does Linaro fit?



# Linaro in the top20 of contributors

**Most active 3.0 employers**

**By changesets**

| | | |
|---|---|---|
| (None) | 1111 | 13.1% |
| Red Hat | 882 | 10.4% |
| (Unknown) | 749 | 8.8% |
| Intel | 616 | 7.3% |
| Broadcom | 428 | 5.1% |
| Novell | 380 | 4.5% |
| IBM | 301 | 3.6% |
| Texas Instruments | 276 | 3.3% |
| (Consultant) | 223 | 2.6% |
| Freescale | 182 | 2.2% |
| Linaro | 170 | 2.0% |
| Samsung | 162 | 1.9% |
| Google | 150 | 1.8% |
| Wolfson Microelectronics | 142 | 1.7% |
| Fujitsu | 131 | 1.5% |
| Renesas Technology | 100 | 1.2% |
| Oracle | 82 | 1.0% |
| MiTAC | 80 | 0.9% |
| Nokia | 79 | 0.9% |
| (Academia) | 73 | 0.9% |

**By lines changed**

| | | |
|---|---|---|
| Novell | 162583 | 19.8% |
| (None) | 90119 | 11.0% |
| Broadcom | 76810 | 9.4% |
| Red Hat | 58262 | 7.1% |
| Intel | 43505 | 5.3% |
| (Unknown) | 27109 | 3.3% |
| Metzler Brothers Systementwicklung GbR | 23681 | 2.9% |
| Samsung | 23238 | 2.8% |
| Rising Tide Systems | 23090 | 2.8% |
| IBM | 22231 | 2.7% |
| Texas Instruments | 21130 | 2.6% |
| Freescale | 17270 | 2.1% |
| Brocade | 16587 | 2.0% |
| Realsil Microelectronics | 15868 | 1.9% |
| Wolfson Microelectronics | 14004 | 1.7% |
| (Consultant) | 13710 | 1.7% |
| South Pole AB | 12087 | 1.5% |
| Linaro | 11129 | 1.4% |
| Oracle | 9390 | 1.1% |
| Nokia | 7450 | 0.9% |

http://lwn.net/Articles/460826/

# Results so far

- Linaro Evaluation Builds for Android and Ubuntu based on latest kernel and Linaro innovations
- Established the ARM Linux SoC upstreaming process, resolving long term issues around upstreaming for ARM
- Delivering best ARM gcc toolchain in the industry on a monthly cycle
- Implemented Device Tree for ARM on member SoCs and upstreamed
- Set up Continuous Integration testing of key ARM kernel trees using LAVA framework on member hardware
- Delivered over 1000 patches in last 3 months alone – optimizations and frameworks upstreamed include sched-mc, libjpegturbo, QEMU, gdb on ARM, storage performance improvements and more
- Agreed approach for common kernel memory management framework with members, community and upstream maintainers, and started implementation
- Assembled world-class open source team, including kernel maintainers and subject matter experts to lead development of Linux on ARM in Linaro

**Do attend Arnd Bergman's session at 1.30pm**

***News From the ARM Architecture***



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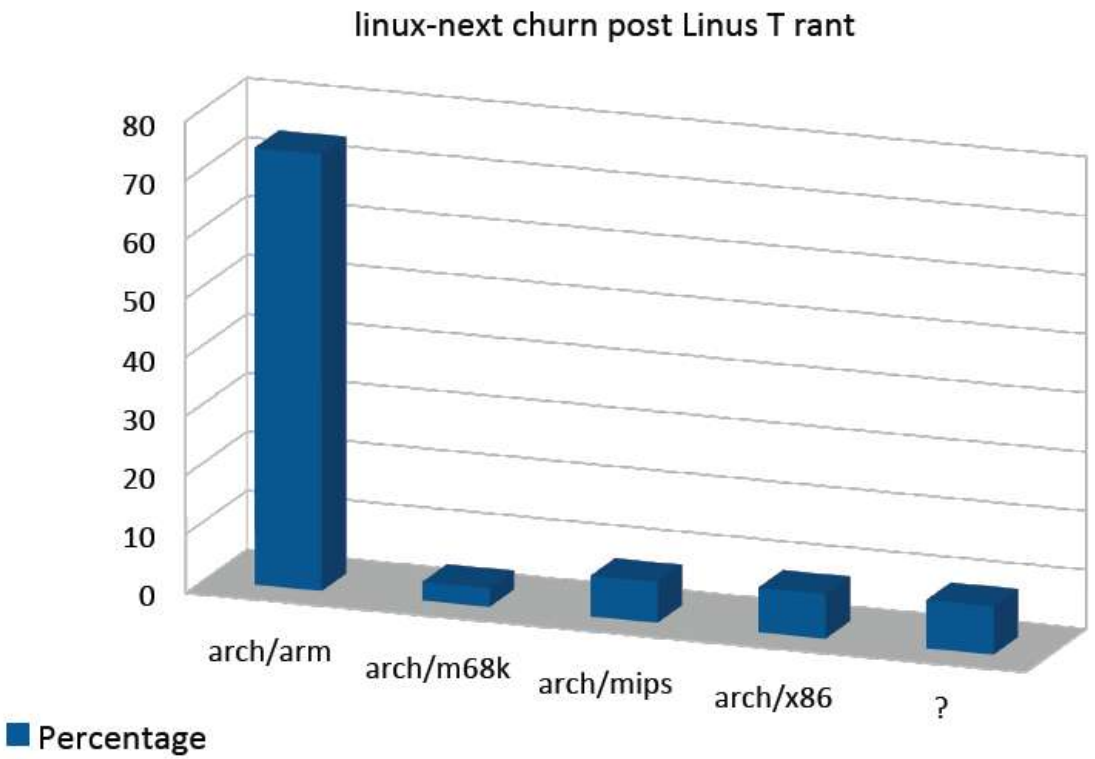
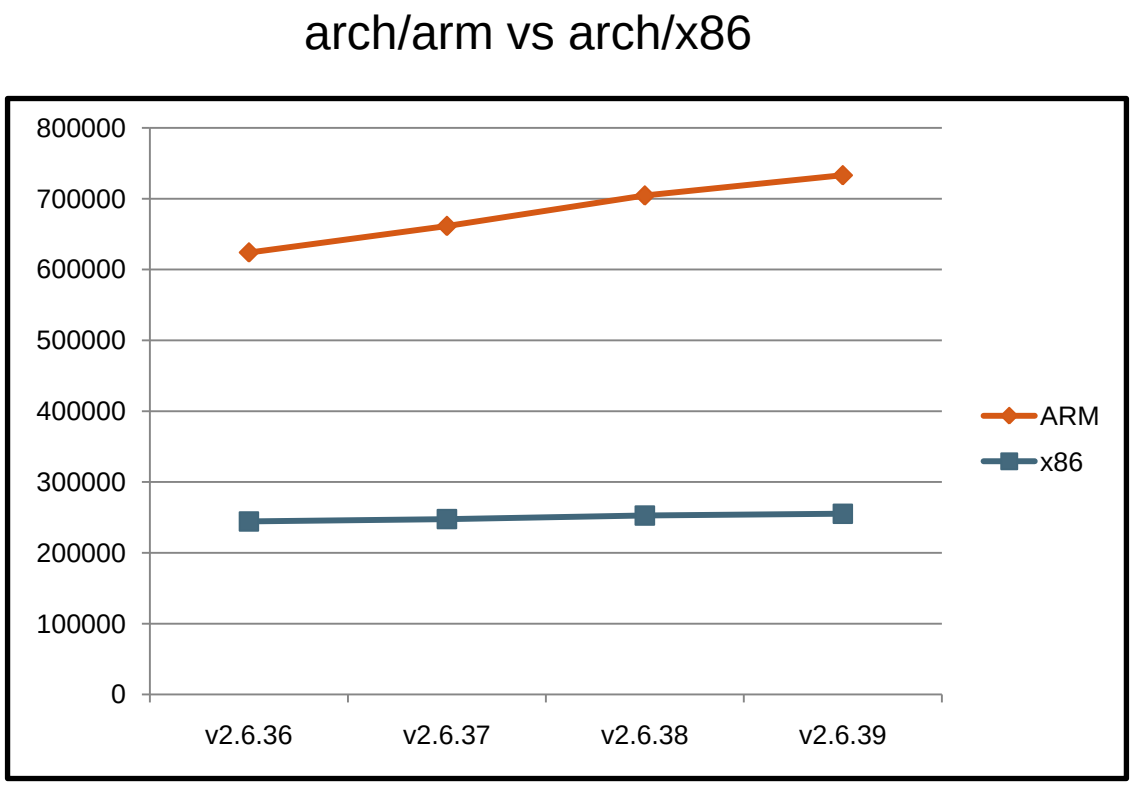
# March 2011

- Linus Torvalds explicitely complained about
  - lack of coordination in the ARM community
  - unlimited growth, duplication and mess in the `/arch/arm` tree




From dirstat
Posted by
RMK Apr 14

# And look at the trend...



# Linaro volunteered to step in and help (1)

- ARM subarchitecture maintainers group
  - Arnd Bergman, Nicolas Pitre and Marc Zyngier
    with help from Thomas Gleixner and in sync with Russell King
  - Not limited to Linaro and not mandatory for non-Linaro ARM architectures

- The ARM Linux consolidation efforts fall into several areas:
  - Duplicate driver code - several versions of a device driver for shared IP
  - Duplicated infrastructure - several versions of similar infrastructure
  - Lack of infrastructure - many solutions that could be grouped in a common way
  - Code in the wrong place - kernel generic code that should more easily fit elsewhere in the kernel tree
  - Make each machine a single compile target and test it
    - one single kernel for current ST-Ericsson offerings, the ux500 kernel will boot on U8500, A9500 and U5500 platform as of the mainline kernel 3.0

# Linaro volunteered to step in and help (2)

- Ideal target: boot several ARMv7 SoC's using a single kernel image
- Required intermediate steps
  - Remove compile-time dependencies
  - Make each machine a single compile target and test it
    - we have one single kernel for current ST-Ericsson offerings, the ux500 kernel will boot on U8500, A9500 and U5500 platform as of the mainline kernel 3.0
  - Remove obstacles to cross-SoC single image - boot the same kernel on OMAP and Ux500 for example
    - Several device drivers unfortunately placed under the ARM architecture at arch/arm/* to be moved into the proper locations in drivers/*
  - Support Flattened Device Tree
    - Provide a system/machine topology description that will do for ARM what PCI Plug-N-Play can do for a desktop PC



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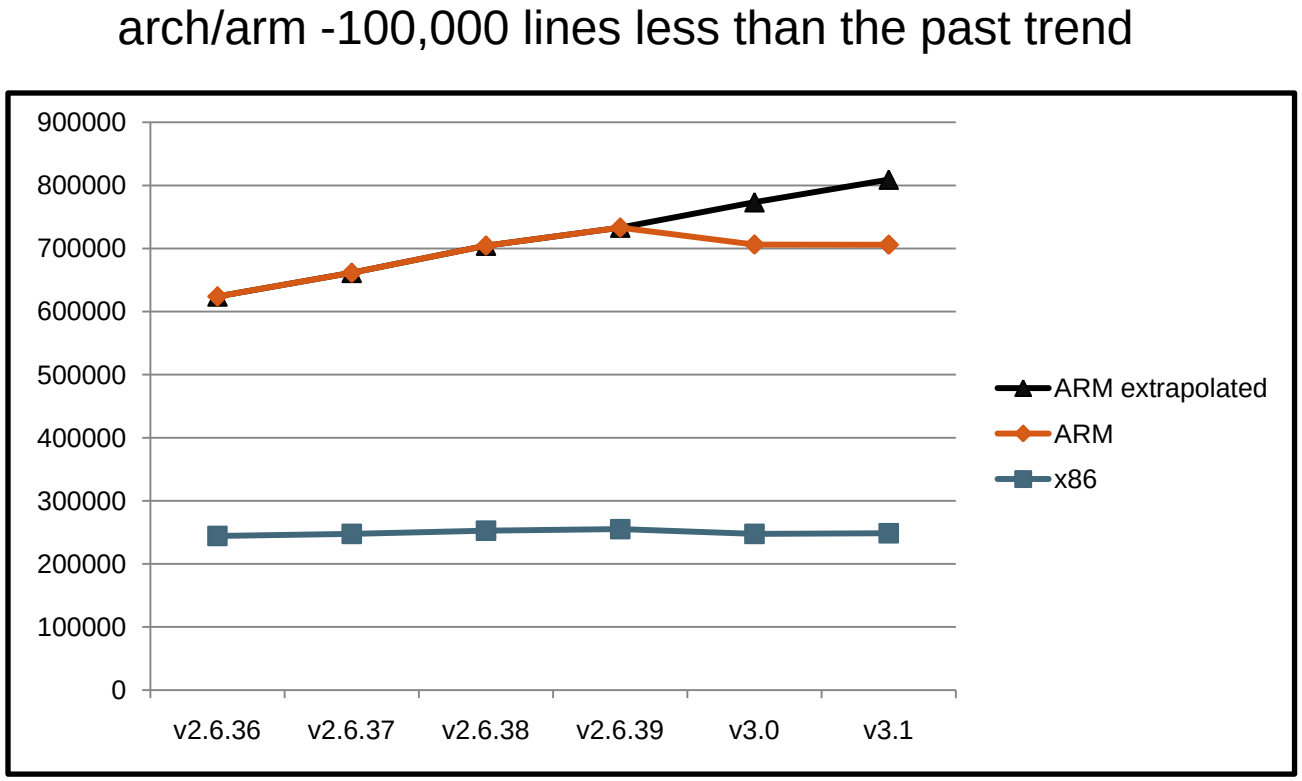
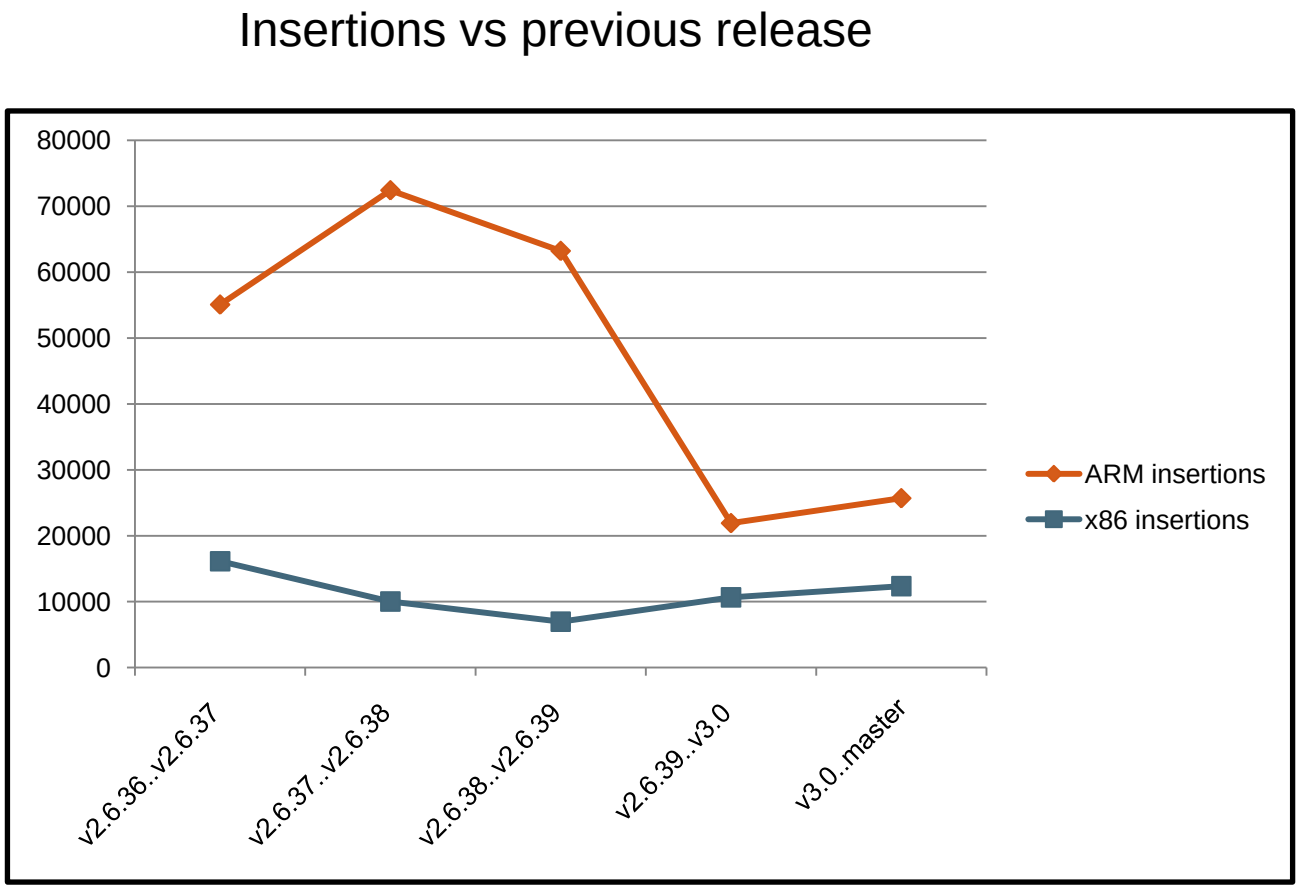
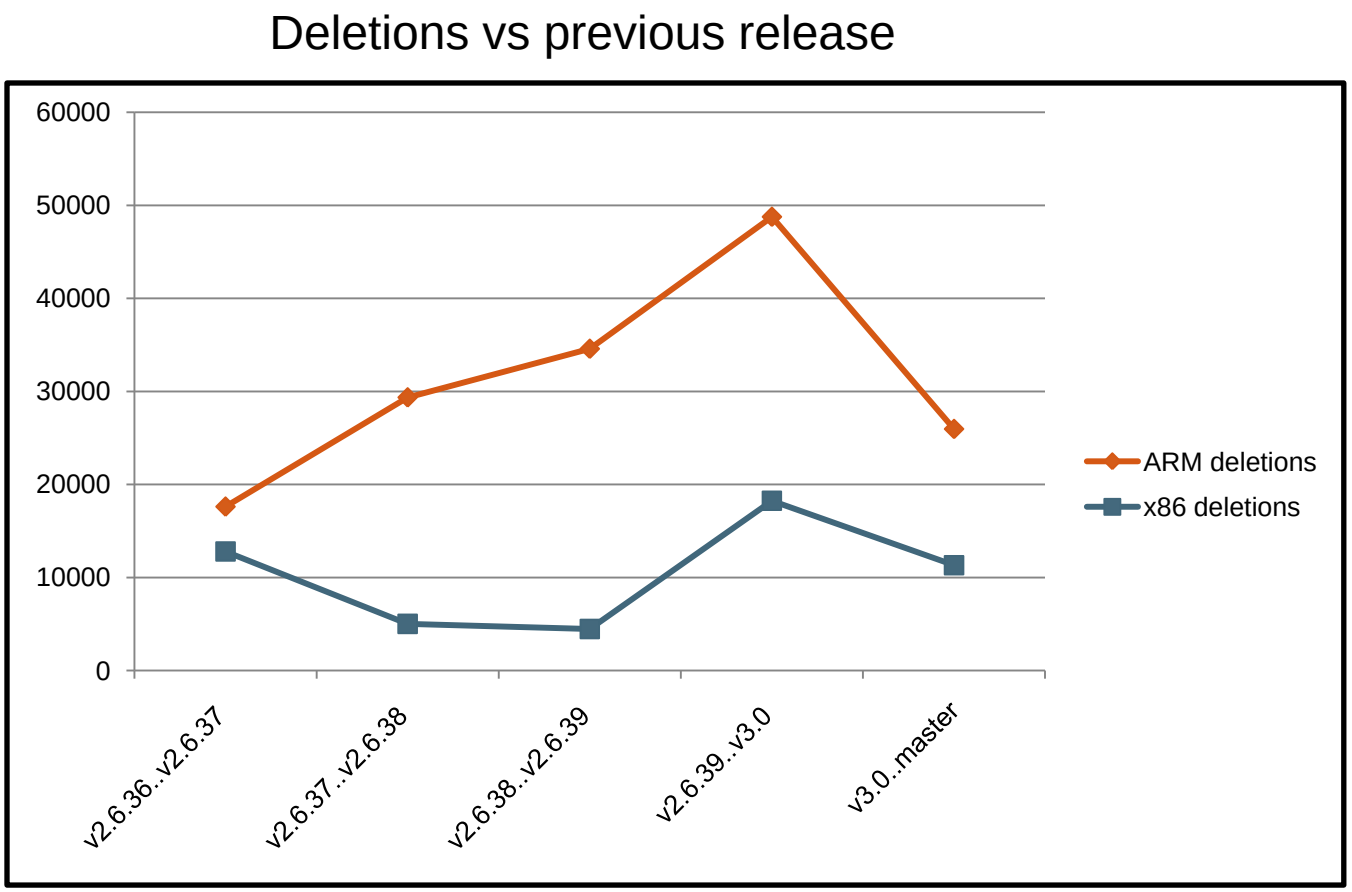
# Already a first inversion in the trend?



# ARM: Reduced rate of insertions



# ARM: increased rate of deletions

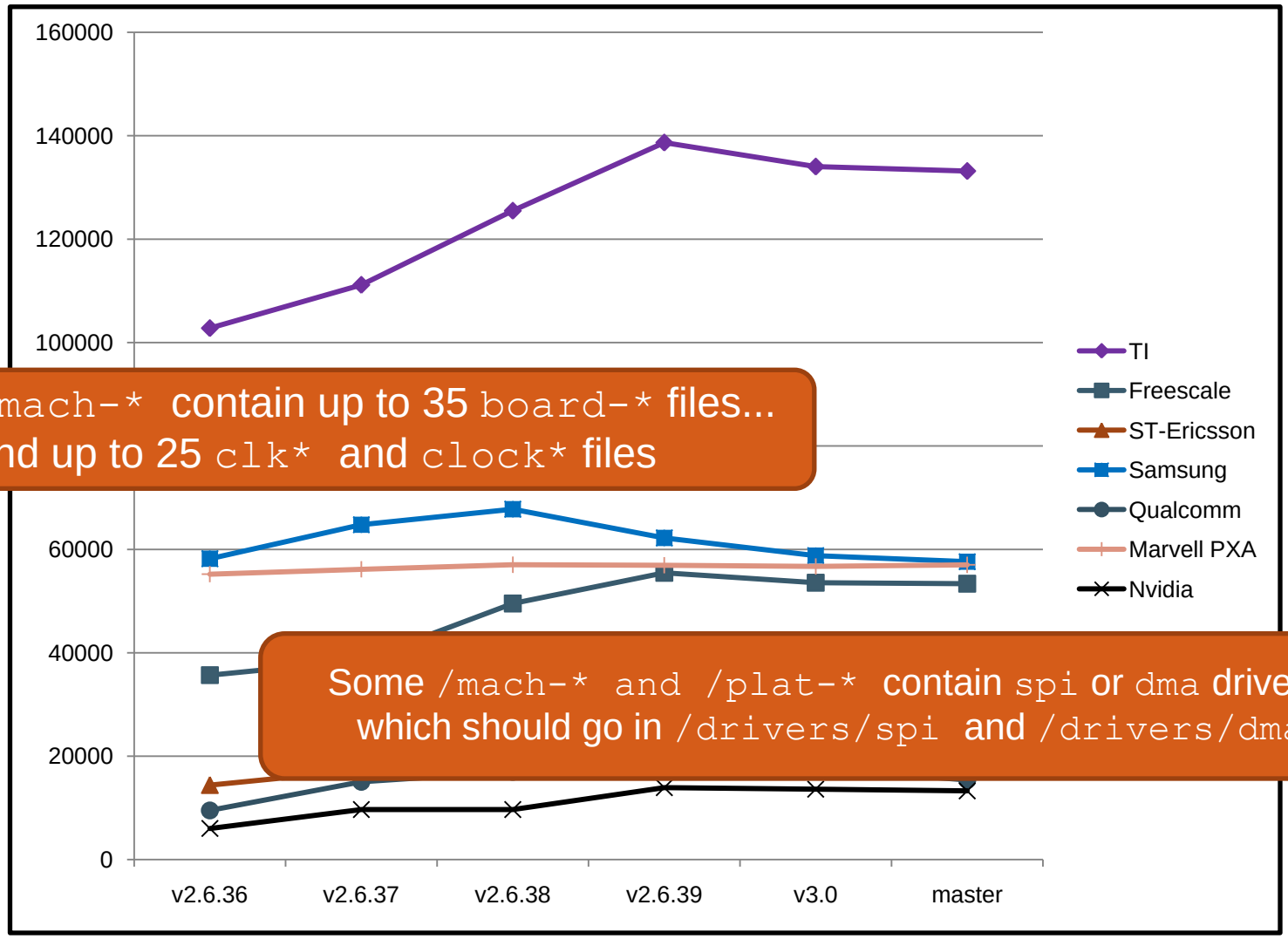


# Details by /arch/arm/

```
#!/bin/bash
function dometrics() {
    echo "TI LOC (OMAP variants, no DaVinci):"
    find mach-omap* plat-omap/ -type f -exec cat {} \; | wc -l
    echo "Freescale LOC (i.MX variants):"
    find mach-imx/ mach-mx* plat-mxc/ -type f -exec cat {} \; | wc -l
    echo "ST-Ericsson LOC (U300, Ux500, Nomadik):"
    find mach-nomadik/ mach-u300/ mach-ux500/ plat-nomadik/ -type f -exec cat {} \; | wc -l
    echo "Samsung LOC:"
    find mach-s5p* mach-s3c* plat-s3c24xx/ plat-s5p/ -type f -exec cat {} \; | wc -l
    echo "Qualcomm LOC:"
    find mach-msm/ -type f -exec cat {} \; | wc -l
    echo "PXA LOC (incl Marvell PXA):"
    find mach-pxa/ mach-mmp/ plat-pxa/ -type f -exec cat {} \; | wc -l
    echo "NVidia"
    find mach-tegra/ -type f -exec cat {} \; | wc -l
    echo "Marvell Orion (incl Dove, MV78xx0 and Kirkwood):"
    find mach-dove/ mach-kirkwood/ mach-mv78xx0/ mach-orion5x/ plat-orion/ -type f -exec cat {} \; | wc -l
    echo "ARM LOC:"
    find mach-integrator/ mach-versatile/ mach-realview/ mach-vexpress/ plat-versatile/ -type f -exec cat {} \; | wc -l
}

echo ""
echo "v2.6.36"
git checkout v2.6.36
dometrics
echo ""
echo "v2.6.37"
git checkout v2.6.37
dometrics
echo ""
echo "v2.6.38"
git checkout v2.6.38
dometrics
echo ""
echo "v2.6.39"
git checkout v2.6.39
dometrics
echo ""
echo "v3.0"
git checkout v3.0
dometrics
echo ""
echo "master/v3.1"
git checkout master
dometrics
```

# Size by /arch/arm/mach-* and /arch/arm/plat-*




Some `/mach-*` contain up to 35 `board-*` files...
and up to 25 `clk*` and `clock*` files

Some `/mach-* and /plat-*` contain `spi` or `dma` drivers,
which should go in `/drivers/spi` and `/drivers/dma`



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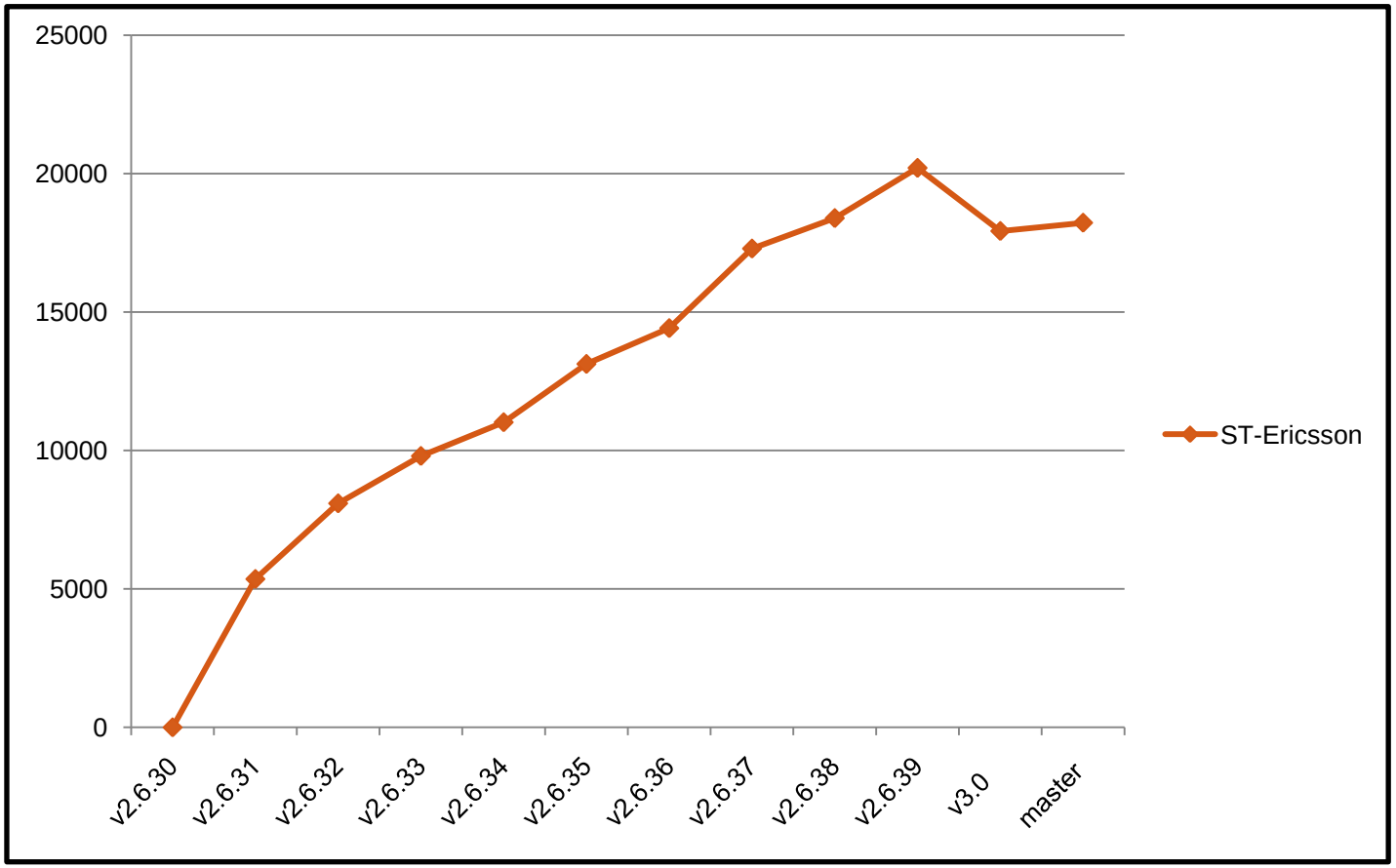
# Size from ST-Ericsson



# ST-Ericsson supported SoC's and boards

- U300 — Ericsson legacy
- Nomadik 8815 — STMicroelectronics legacy
- Ux500 — dual Cortex A9 family U8500, U5500, A9500

- S338 ref design
- Nomadik NHK-15
- HREF-500
- S5500 ref design
- A9500 Snowball SDK and PDK



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# ST-Ericsson targeting code reuse since ever

- `arch/arm/common/vic.c`
  - Extended the number of IRQ sources in the PL190
  - Reused existing code and added ST vendor ID for specific init only
- `drivers/spi/spi-pl022.c`
  `drivers/tty/serial/amba-pl011.c`
  `drivers/mmc/host/mmci.c`
  - Common ancestry of STn8810 and U300
  - ST-Ericsson NHK8815, U300, U8500, U5500
  - ST Microelectronics SPEAr 3xx and 6xx
  - ARM RealView and ARM Versatile
  - NXP LPC32XX
- `drivers/mfd/stmpe.c`
  `drivers/gpio/stmpe-gpio.c`
  `drivers/misc/input/keyboard/stmpe-keypad.c`
  - Added the stmpe as an extended gpio range, reuse ethernet and touch screen controller drivers as is without additional changes
- `drivers/net/ethernet/smsc/smsc911x.c`
  - Used in Snowball as is

# ST-Ericsson own contributions within Linaro

- Global GPIO clean-up by Linus Walleij
  - `plat-nomadik, mach-u300, mach-ks8695, mach-davinci, mach-ep93xx, mach-ixp2000, mach-lpc32xx, mach-lpc32xx, plat-pxa, mach-pnx4008, mach-sa1100`
- Creation of a pincontrol and a pinmux subsystems by Linus Walleij
  - `drivers/pinctrl/core.c`
    `drivers/pinctrl/pinmux.c`
    `drivers/pinctrl/pinmux-u300.c`
    `include/linux/pinctrl/machine.h`
    `include/linux/pinctrl/pinctrl.h`
    `include/linux/pinctrl/pinmux`
- Alignment to hwspinlock instead of proprietary hw semaphore API's by Mathieu Poirier
  - `drivers/hwspinlock/u8500_hsem.c`



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# Benefits to ST-Ericsson customers


**http://www.igloocommunity.org**

# Enabling the next killer apps

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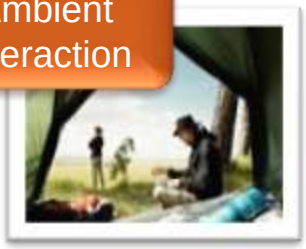
Ambient Interaction



**MEMS**
Barometer
Magnetometer,
Accelerometer
3D gyroscope

**Dual-Core Processor**
ARM Cortex-A9

Immersive gaming

**Multimedia**
3D graphics
HD video

Augmented Reality

Ultra-responsive user Interfaces

**Battery operated**
USB powered

**Full Connectivity**
GPS, Bluetooth,
WiFi,
USB, HDMI

SNOWBALL

**Full HD Camcorder**
Up to 20Mpix cameras

Location-based services

*MOST FEATURES, SMALLEST FOOTPRINT*

IGLOO

**Igloo** – a **powerful open source community** for mobile innovation to facilitate and support collaboration

Computer Vision

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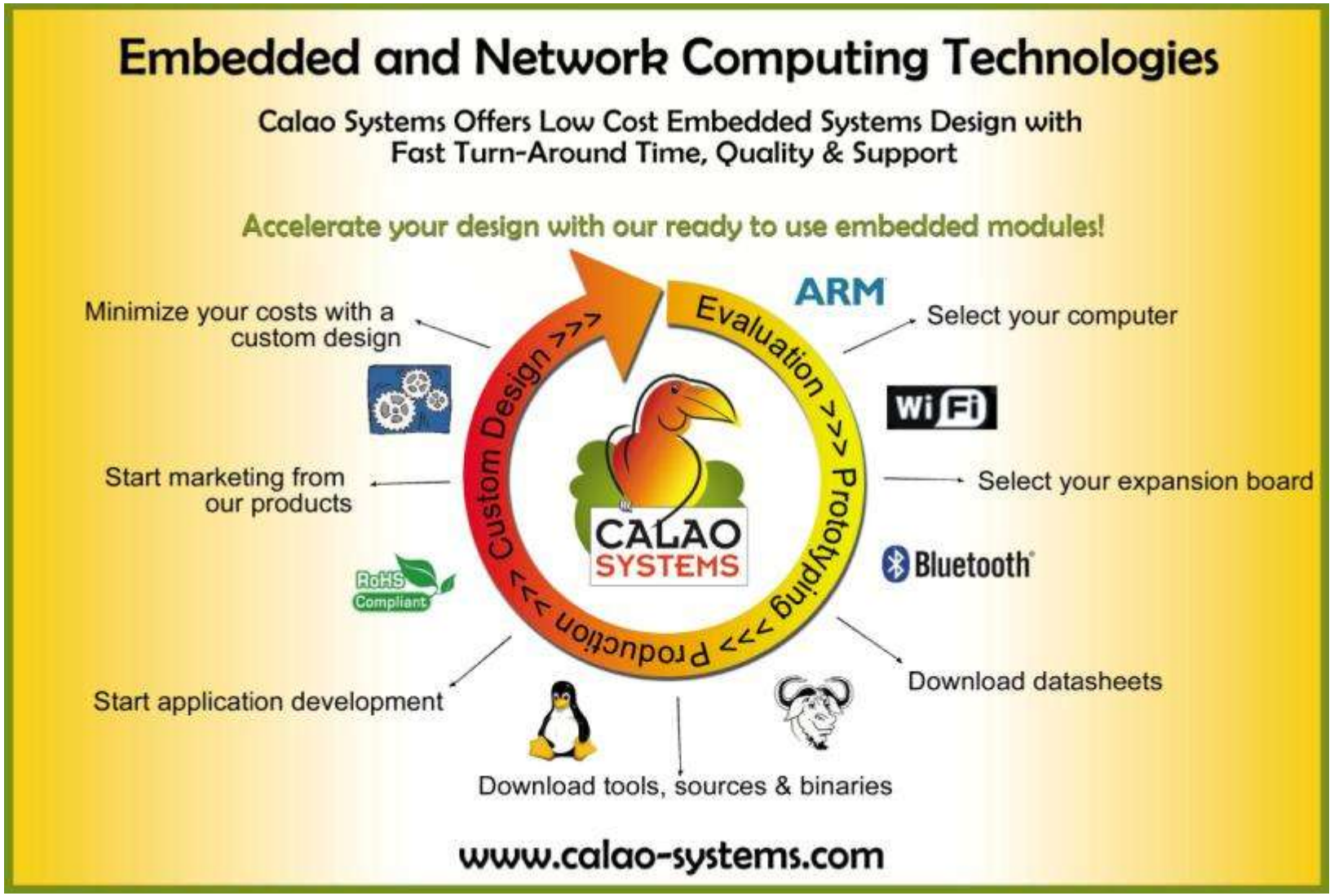
# Snowball SDK vs PDK

| Differentiating FEATURES | SNOWBALL-SDK | SNOWBALL-PDK |
|---|---|---|
| CPU/DDR2 | Dual A9, 2x1GHz/ 8Gb | Dual A9, 2x1GHz/ 8Gb |
| On board eMMC | 4GB | 8GB |
| Extension connectors | Foot print | YES |
| MEM Sensors | - Barometer<br>- Magnetometer<br>- Accelerometer<br>- 3D gyroscope | - Barometer<br>- Magnetometer<br>- Accelerometer<br>- 3D gyroscope |
| Connectivity | WiFi, BT | WiFi, BT |
| GPS | YES | YES |
| USB operated | Yes if battery operated | Yes if battery operated |
| Battery operated | YES | YES |
| Professional tool | Ethernet , JTAG and MIPI DEBUG | Ethernet , JTAG |
| Usable in Product | NO | YES |
| Small size | YES (85x85) | YES (85x85) |
| Target Price | ~$200 | ~$300 |

# Igloo Hardware Partners



# Igloo Software Partners

## Movial Designs, Develops and Delivers

Movial Corporation
Porkkalankatu 20
FI-00180 Helsinki

www.movial.com

## Precision Engineering Support for IGLOO

### Support Services

- Consulting Services
- Android Services
- MeeGo Services
- Ubuntu Services
- Qt Services
- Training & Support

### UX Design Services

- User Experience Design
- Performance optimization
- Interaction Design
- Research and Testing
- Audiovisual Design

### Application Integration

- Internet browsing
- Media player
- Flash 10 Services
- AIR 2.5 Services

MOVIAL



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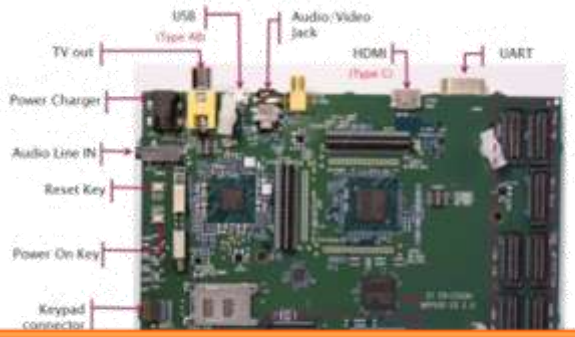
# Snowball evolutions and customer products




Maximize Code reuse and avoid new patch sets
Same code base on all platforms

→ Kernel Consolidation and Device Tree


http://www.smartkeitai.com/wp-content/uploads/2011/09/toshiba-at200-tablet-550x438.jpg

http://www.forecaconsulting.com/u/images/usenet.jpg http://ietindia.in/images/domotics_b.jpg



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# Removing Entry Barriers

Nova BY ST-ERICSSON

- Snowball is production-grade
- Linaro is providing Android and Ubuntu builds
- Igloo is supporting developers
- Customers can focus straight away on their own ***VALUE CREATION*** and ***PRODUCT DESIGN***


Snowball – unleash your creativity

**http://www.igloocommunity.org**

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