Software, Tools and Ecosystem

MPU Team

June 2016

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Agenda

- Hardware Support
- Evaluation Kits
- Development Tools
- Software Package
- Linux
- SAM-BA
- Third Parties' Solutions
- Reference Designs

Hardware Support

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Hardware Support

- **We provide for all our devices**
  - IBIS Models
  - BSDL Files
    - Boundary Scan Description File
- **For the latest Cortex-A5, we provide a Reference Layout for each package**
  - As optimized as possible, lowest number of layers
  - And we will do for the next coming boards
- **On-demand, we can review schematics and layouts**
  - Gerber files are useless, we need design files

Evaluation Kits

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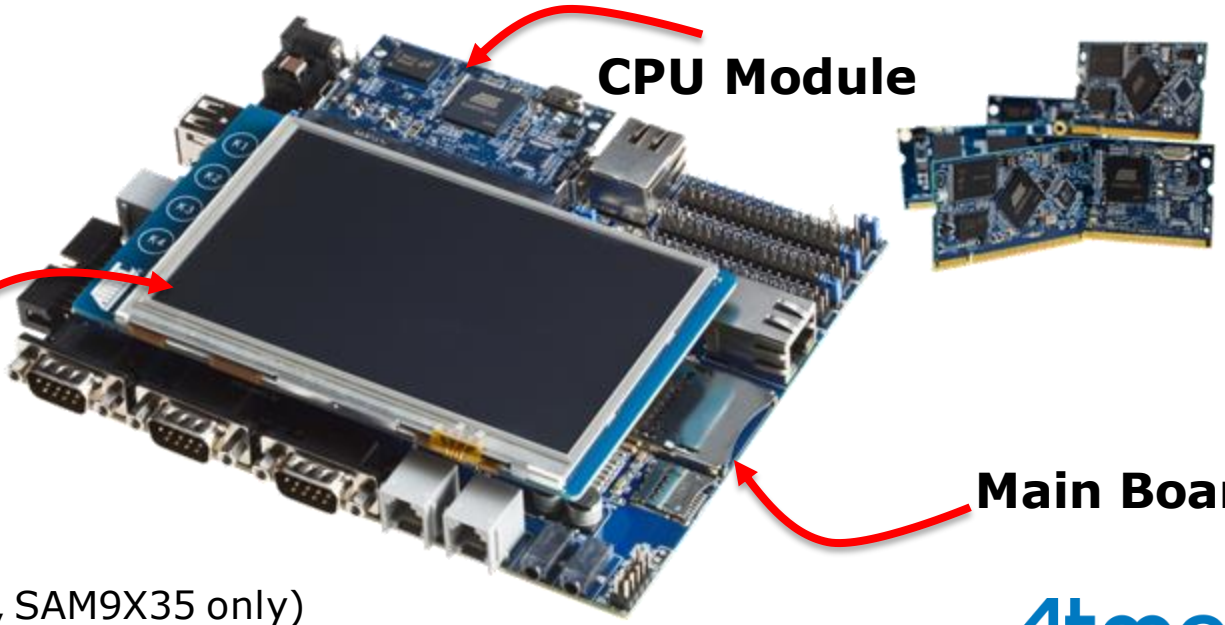
Evaluation Kits Policy

- **Fully-featured Evaluation Kits for the SAM9 products**
- **Moved to low-cost Xplained format for the Cortex-A5-based products**

- **All boards come with**
  - A detailed User Guide, including detailed schematics
  - Schematics and PCB Layout source files
    - Orcad/Allegro preferred for high-speed designs

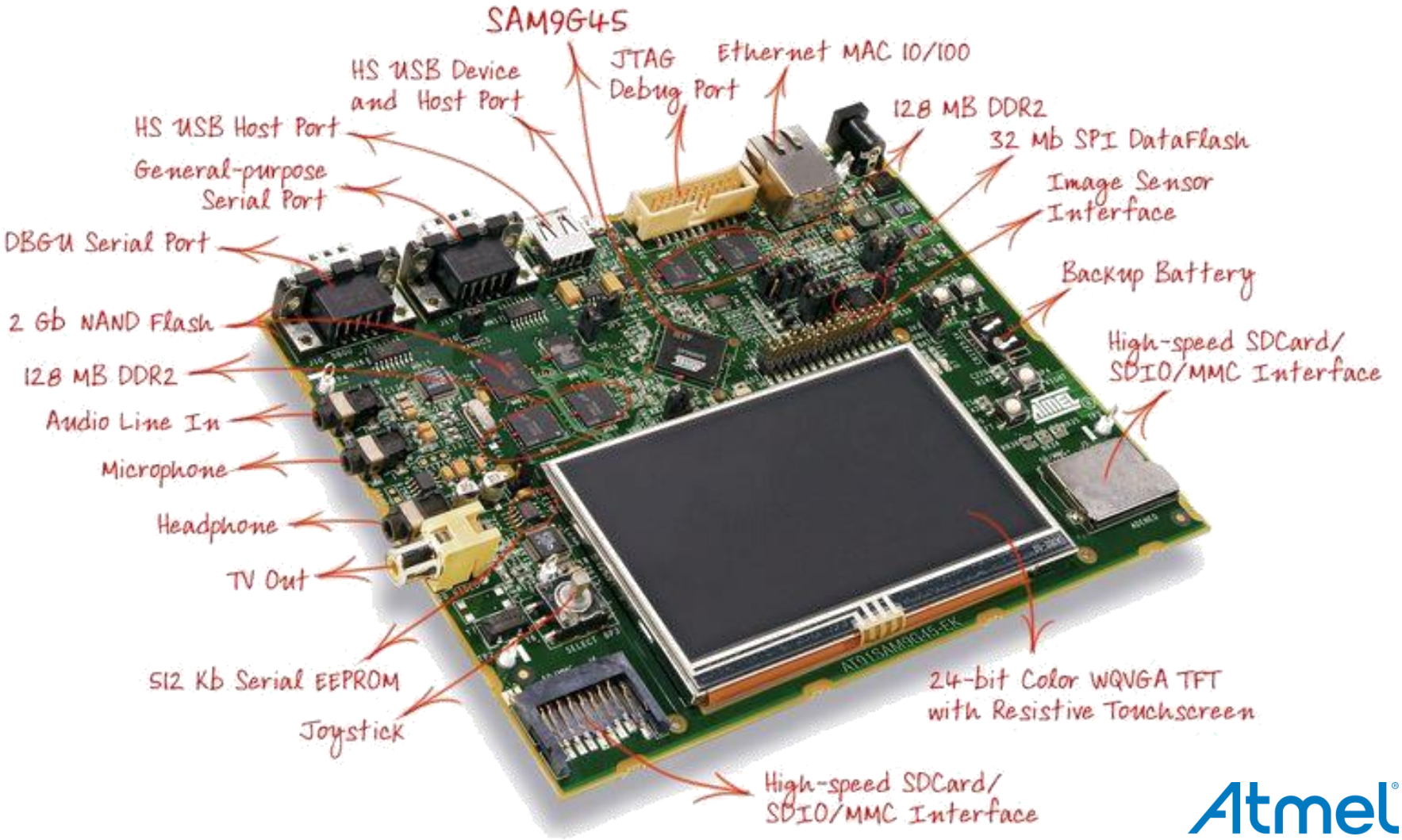
SAM9x5-EK

- **One Evaluation Kit for each Product**
  - 1 Main board
  - 1 CPU module
  - 1 Display Module (if making sense)
- **Production-ready CPU Modules are available from**
  - Cogent (US)
  - Embest (Asia)
  - Ronetix (EU)



Display Module
5” WVGA
(SAM9G15, SAM9G35, SAM9X35 only)

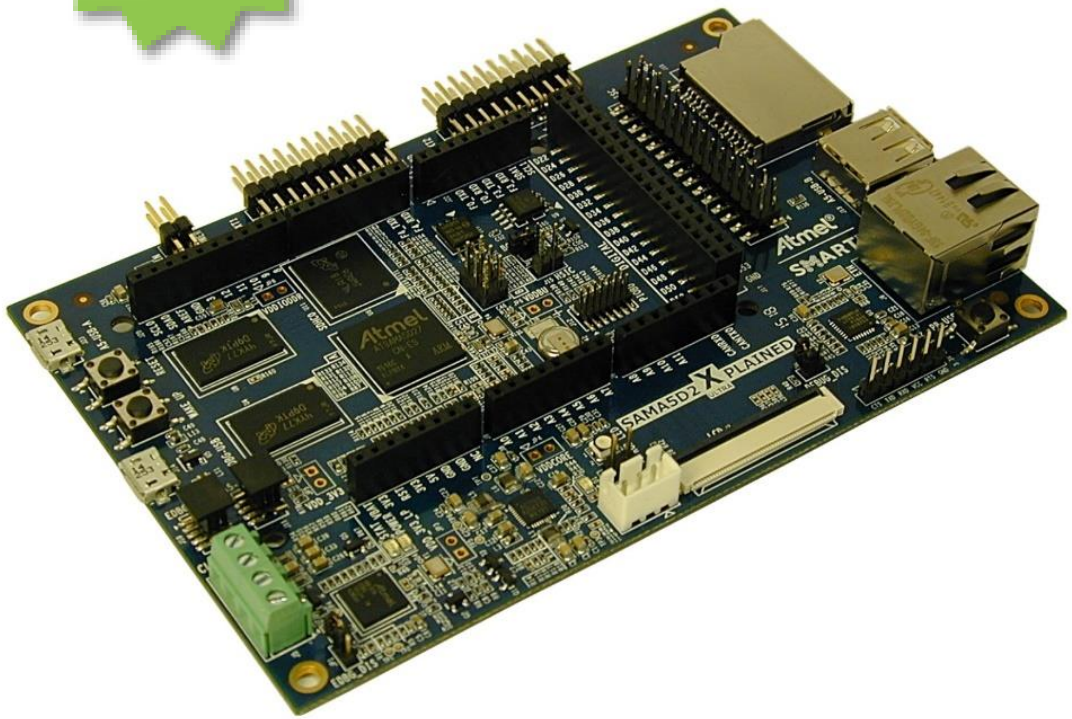
SAM9M10/G45-EK



SAMA5D2-XULT

6-layer PCB

$79

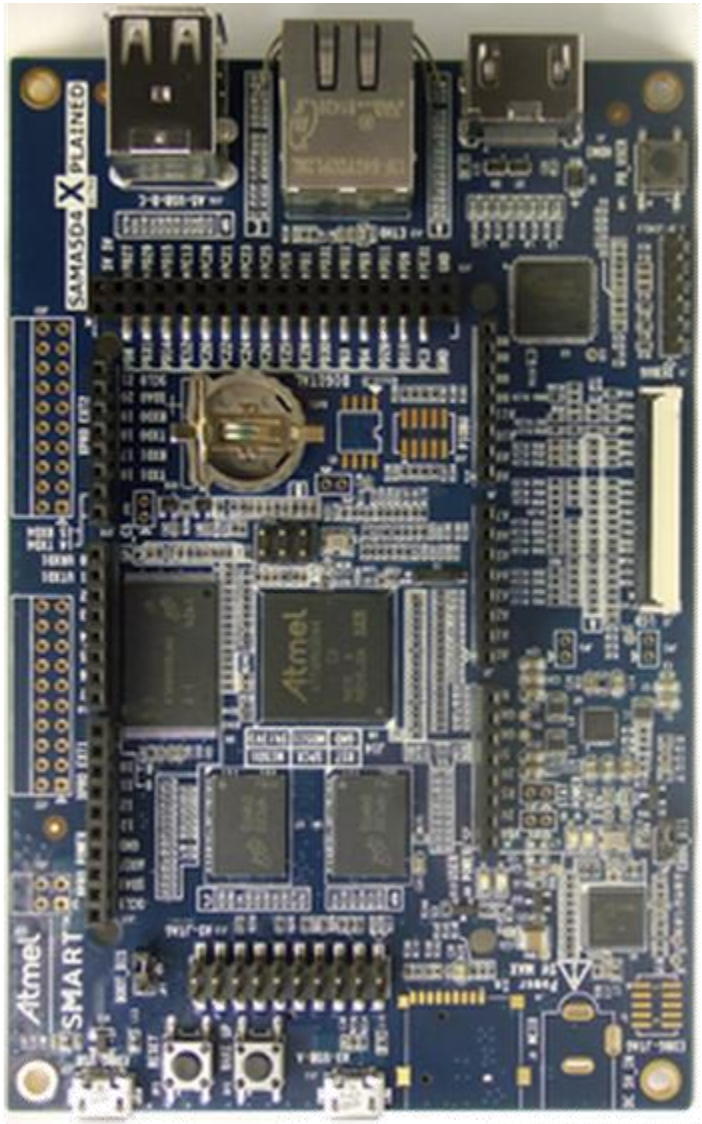


- 2x 2Gb DDR3L
- 4GB eMMC
- QSPI flash, EEPROM
- TFT LCD connector
- CMOS sensor camera connector
- Class D output
- 2x USB connectors
- 1 Fast Ethernet Phy
- 1 SD connector
- Active Semi PMIC
- Arduino Due R3 connectors
- Xplain connectors footprint

Ordering code ATSAMA5D2-XULT

Note : Current stock is mounted with SAMA5D27A-ES silicon

SAMA5D4-XULT



$99

- Core Running up to 600MHz
- 512MB DDR2
- 512MB SLC NAND
- TFT LCD connector
- HDMI connector
- SD/eMMC Socket
- MicroSD Socket
- CMOS sensor camera connector
- 3x USB connectors
- Ethernet PHY and Socket
- Active Semi PMIC
- Arduino Due R3 connectors
- Xplain connectors footprint

Extensions Boards

7” Capacitive (TM-7000)
Multitouch Touchscreen

Wi-Pi – WLAN module

4.3” Capacitive (TM4300B)
Multitouch Touchscreen

Digital Camera Module
(CAM8100-U)

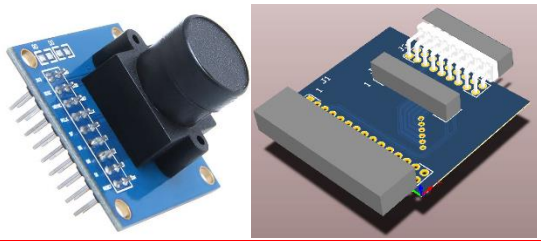
More to come…

Extensions Boards

- **Omnivision Sensor Modules that plug into the SAMA5D3x–EK**
  - Supporting VGA up to 5Mpix resolution
  - Limited availability requires marketing approval

2Mpix 5Mpix VGA 1Mpix

- **Also available for ISC-2-ARDUCAM**



Development Tools

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Tool Chains

- **Neither Studio nor MPLab support the MPUs**
- **Only third party tools or free tools do**
  - arm-gcc free tool chain from community though ARM
    - https://launchpad.net/gcc-arm-embedded
  - IAR EWARM
    - https://www.iar.com/
    - Free 30 days trial
  - ARM Development Studio DS-5
    - http://ds.arm.com/
    - Community Edition is available for free, supports Linux debug
  - Segger Embedded Studio
    - https://www.segger.com/embedded-studio.html
    - Formerly CrossWorks from Rowley Associates

Debug Probes

- **Atmel's SAM-ICE at about 100$**
  - Actually an Atmel-branded J-LINK
    - Locked on Atmel products
    - http://www.atmel.com/tools/ATMELSAM-ICE.aspx
- **J-LINK from Segger**
- **I-Jet from IAR**
- **And all the probes supporting the Cortex-A cores**

- **Our Xplained boards feature the EDBG**
  - EDBG stands for Embedded Debugger
  - Is programmed with CMSIS-DAP (Debug Access Protocol)
  - Could be re-programmed with the J-LINK software to gain in performance

Software Package

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Software Package Introduction

- **The Software Package is a bundle of examples showing how to use the peripherals**
  - Very convenient for hardware engineers willing to build up production test programs or to validate a board
  - More and more often re-used as-is by software engineers in their application
  - Re-used by our third parties for porting their RTOS and developing their drivers
- **The Software Packages are made of**
  - Peripheral Drivers
  - An example for each peripheral
  - A few middleware layers
    - USB, TCP/IP stack, Storage/File System, etc

List of Examples

- **getting-started**
  - Very basic example, including PIO, Interrupt, Console on USART
- **Basic peripheral examples**
  - adc, can, low_power_mode, pdmic, pmc_clock_switching, pwm, trc, tc_capture_wavwform, usart_fifo, usart_iso7816, usart_lin, usart_xdma, twi_eeprom, trrng, spi_salve, xdma, wdt, secumod
- **Crypto examples**
  - aes, aesb, icm, qspi-aesb, sha, tdes
- **Video and Audio examples**
  - lcd, isi, isc, classd, ssc_dma_audio
- **GMAC examples**
  - Gmac, gmac_lwip, gmac_uip_helloworld, gmac_uip_telnetd, gmac_uip_webserver
- **Memory examples**
  - ddram,qspi_flash, qspi_xip, nandflash_slc, nandflash_mlc, sdmmc_sdcard, spi_serialflash
- **USB examples**
  - usb_audio_looprec, usb_audio_speaker, usc_cdc_serial, usb_hid_aud, usb_hid_keyboard, usb_hid_mouse, usb_hid_transfer, usb_iad_cdc_aud, usb_iad_cdc_cdc, usb_iad_cdc_hid, usb_iad_cdc_msd, usb_mass_storage, usb_uvc_isc, usb_uvc_isi

Software Package Framework

- **Common framework for all MPUs**
  - Supports SAMA5D2 and SAMA5D4 right now
    - SAMA5D3 support is on-going, started porting the SAM9 as well
- **One single repository for all products**
  - Increases code re-use, no code duplication
  - Eases migration between different MPU products.
- **Top folders**
  - target/ : Chip & target support files
  - scripts/ : Templates for generators and build script (makefiles)
  - drivers/ : Source files for Drivers
  - examples/ : Source file for examples
  - samba_applets/ : Source file for Sam-BA 3.x applets

Some common modules

- **Definitions**
  - Header files
- **Initialization**
  - CStartup Code
  - Low Level Initialization
  - MMU & Cache Setup
- **System Management**
  - PIO Management
  - Clock Management
  - DMA Driver
  - External Memories
- **Debug**
  - Configurable Level of Trace

Software Package Features

- **All Software Package examples run with**
  - MMU and caches enabled
  - Management of cache coherency
- **All Software Package examples are thread-safe**
  - Gets them re-usable as is in customer's applications
- **One single repository for all the developments**
  - The drivers support features of all the products
  - Available through a github
    - https://github.com/atmelcorp/atmel-software-package
- **Includes all the SAM-BA memory applets**
- **The Software Package includes projects for**
  - gcc (makefiles)
  - IAR EWARM

Licensing Model

- **The Software Package License is BSD-like**
  - Similar to BSD, except it does not include the clause requiring to keep the license into the binary
    - Was inconvenient for sensible customers
- **The Software Packages are free of charge and can be reused by customers for commercial purposes**

Next steps

- **Merge with Harmony, to be investigated**
- **Raise the re-use and abstraction levels with an actual I/O SubSystem/Device Driver model**
- **Align the configuration with Linux**
- **Open repository to customers for them to contribute**
  - Reverse patches for fixing bugs or for adding features

Linux Solutions

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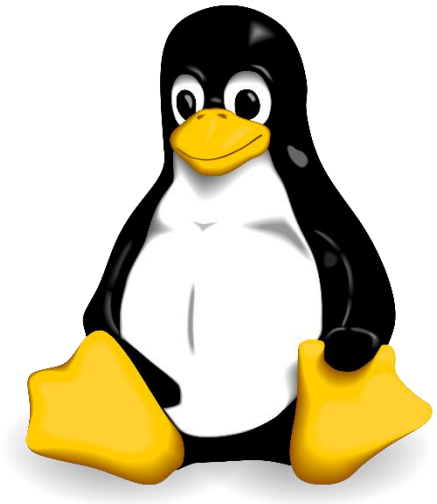
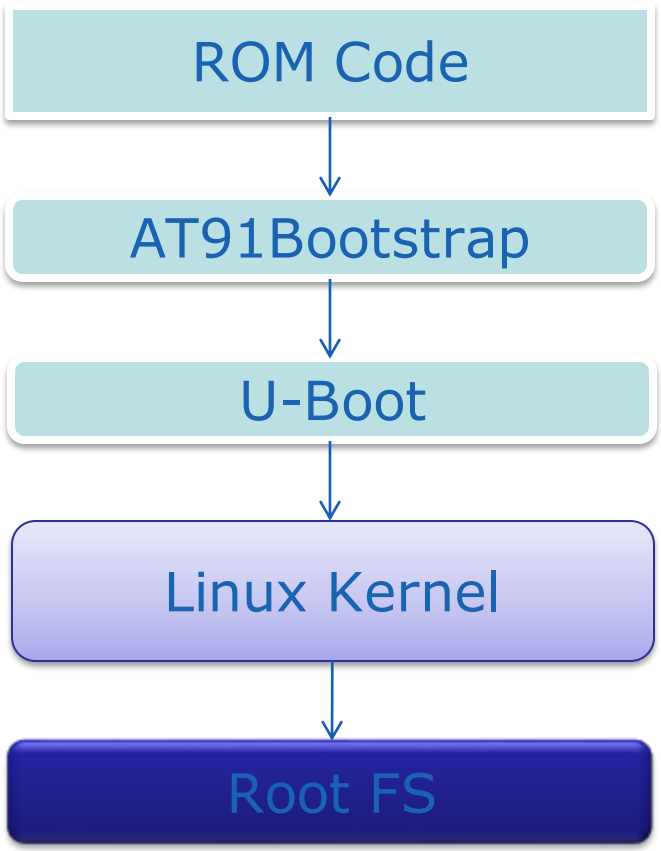
Linux on MPUs

- **Linux solutions are available on MPUs**
  - All our developments are mainlined since 2006
- **Based on several open source projects**
  - AT91Bootstrap
    - AT91 is the former name of the product line
  - U-boot
  - Linux kernel
  - Buildroot
  - Yocto
- **Linux4SAM.org is made to ease our customer's life**
  - A non-branded Web site with all links and all procedures to rebuild all the Linux distributions



What's Linux made of?

- **AT91Bootstrap**
  - 2nd level boot loader
- **U-Boot**
  - Universal boot loader for Linux solutions
- **Linux kernel**
  - Drivers
  - Device Tree
- **Root File System**
  - Either Buildroot or Yocto
  - Contains applications and libraries



Linux4SAM.org

Linux & Open Source related information for AT91 Smart ARM Microcontrollers

Search

Print

LINUX4SAM

- Software tools
- AT91Bootstrap
- U-Boot / barebox
- Linux Kernel

Open source solutions

- Yocto Project
- Buildroot

BOARDS

- SAMA5D2 Xplained
- SAMA5D3 Xplained
- SAMA5D4 Xplained
- Older boards

FAQ

- FAQ updates by Boards
- FAQ updates by Components

USEFUL LINKS

- AT91SAM Community
- ATMEL
- Linux4SAM on GitHub
- Atmel | Linux newsletter

Linux4SAM » WebHome

Fork me on GitHub

Welcome to Linux4SAM

Welcome to the main starting point for Linux OS on SAM products. Its aim is to centralize information about Linux kernel and open source projects on ATMEL AT91 Smart ARM-based Microcontrollers (aka SAM).

Our goal is to be an interface with open source projects that include AT91 support. We do not want to duplicate information but to link as much as possible to good resources available on the Web.

Keep an eye on this website as it has been designed for instant update. We will try to make it live with the open source community and update AT91SAM information in those pages. To keep yourself informed, add WebRss or WebAtom feeds in your usual news reader.

Questions, feedback, patches and enhancement are the way open source communities live. Go to LinksToCommunities page for a natural way to interact with material presented on this website.

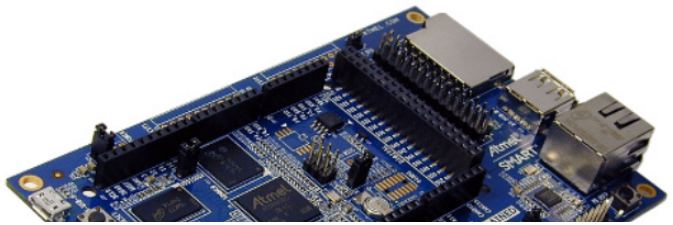
Latests News

Atmel | Linux newsletter NEW

Check our latest Linux newsletter and learn what's going on with Atmel | Smart ARM microcontrollers in Linux communities.

Linux4SAM 5.3 demo directory NEW

New demo available for all SAMA5 Xplained boards. Based on updated



Our Linux Policy

- **Mainline**
  - All developments are published in the different open source projects
    - For the kernel
      - Stable release: www.kernel.org
      - Development: https://git.kernel.org/cgit/linux/kernel/git/torvalds/linux.git/
- **That's what our customers expect**
  - In order to benefit from support, reviews, maintenance of these projects by the open source communities
  - "You benefit from millions lines of code, please give away your tiny modification"
- **Atmel in Linux Mainline**
  - 12 official Maintainers
  - ~250-350 posts/month on lkml (Linux Kernel Mailing List)

Licensing Model

- **GPL license**
  - Linux kernel
  - GNU tools
  - Several applications in your system
- **LGPL license**
  - Mostly for libraries
  - C library
  - QT Library for instance
- **BSD-like license**
  - AT91Bootstrap
- **The license I choose (even proprietary)**
  - My application (even using libc of course)
  - My own library

Open Source Initiative

Real Time Linux

- **Preempt_RT enables the Real Time extensions of the Linux kernel**
  - Never really tested, but partners of ours did it
- **Xenomai steps real time up in the kernel**
  - AT91 product family is supported, but never tested

- **Comparisons and benchmarks for SAM9 products are available on Linux4SAM**

Fast Boot

- **Frequent question from the field**
  - As Linux kernel boots in about 10 seconds
- **Excellent paper and labs from Free-Electrons is available on their Web site**
  - http://free-electrons.com/doc/training/boot-time/
  - Made on SAMA5D3

What about Android solutions for MPUs?

- **As our products do not embed any graphic accelerations, they are not really suited for Android, except**
  - For small screen, when graphics can be managed by software
  - For headless Android, if customers expect to benefit from the Android communications and/or audio frameworks

- **An Android port is available on the SAMA5 products**
  - Distribution on demand, if business is worth and if the application does not require a full blown Android

Linux Next steps

- **SAM9 Revival coming soon**
- **Linux4SAM Update**
- **More applications and demos**
- **Looking at microchip.com/linux**
  - Would definitely show Microchip's commitment to provide Linux solutions
  - Could align all Linux solutions in the company

SAM-BA

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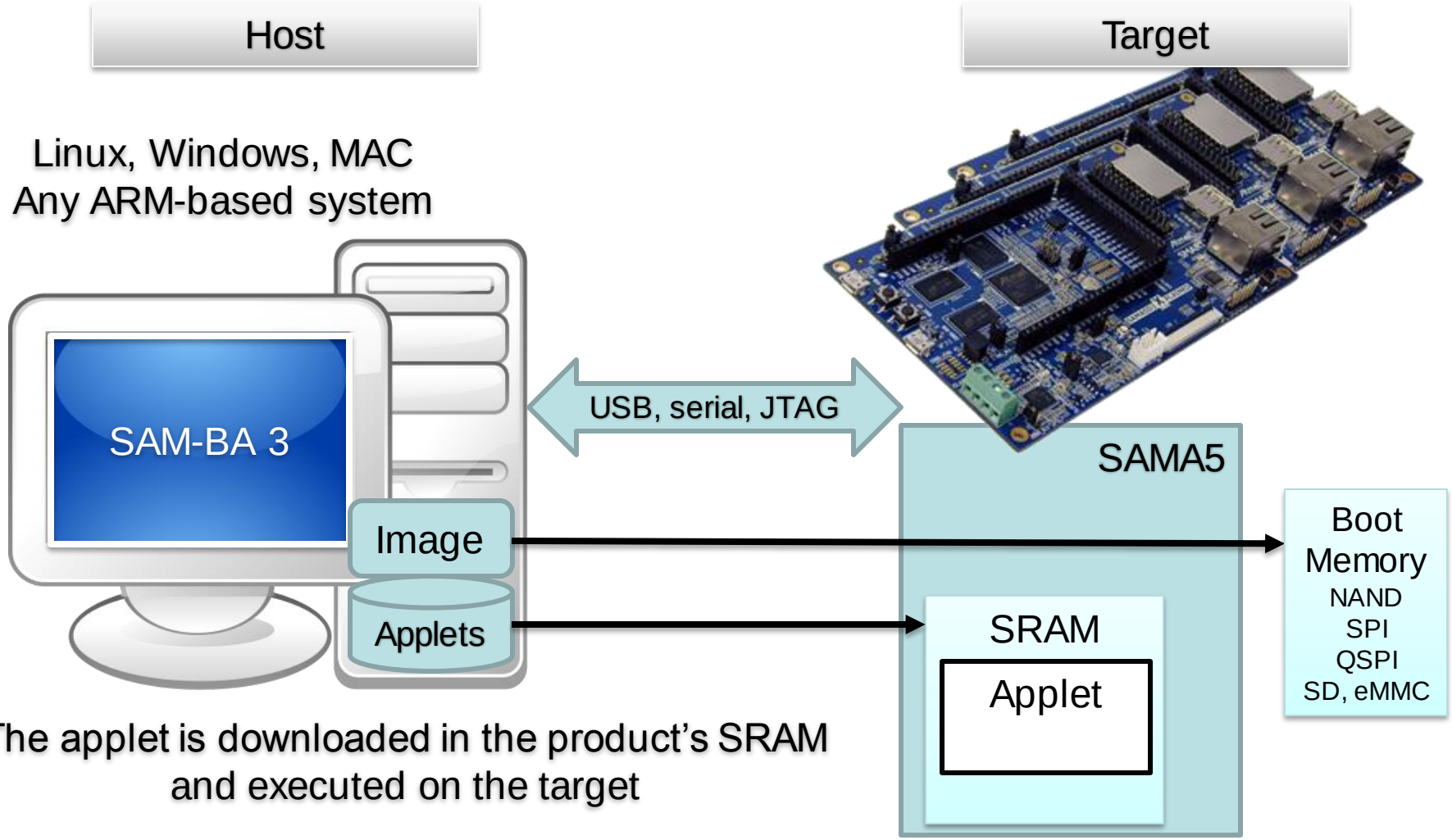
SAM-BA is an In-System Programming Tool

- **SAM-BA stands for SAM Boot Assistant**
- **SAM-BA is made of**
  - The SAM-BA Monitor embedded in the ROM Code of our products
  - The SAM-BA Tool running on a host computer
- **SAM-BA is used during the manufacturing process**
  - Although more than welcome during development/debug
  - And used by the FAEs for programming the demos
- **SAM-BA Monitor is present on all the ARM products designed in Rousset**
  - ARM7, Cortex-M3, Cortex-M4, Cortex-M7, ARM9, Cortex-A5

Secure SAM-BA

- **Secure SAM-BA has been introduced with the Secure Boot on the SAMA5D3**
- **Secure SAM-BA is made of 2 executables**
  - Secure SAM-BA Cipher for encrypting the boot application
    - The only one manipulating customers' keys
  - Secure SAM-BA Loader for downloading the encrypted application
    - Destined to be given to the customers' OEM, does not manipulate any keys, only encrypted files
- **The ROM Code (in Secure Mode) downloads the boot application in Embedded SRAM, authenticates it and decrypts it before starting it**
- **Secure SAM-BA is distribution-limited**

SAM-BA Applets offers flexibility



SAM-BA 3 Distribution

- **SAM-BA 3.1.1 is available on the Web**
  - http://www.atmel.com/tools/atmelsam-bain-systemprogrammer.aspx
- **SAM-BA 3.1.1 Sources are GPLv2**
  - https://github.com/atmelcorp/sam-ba
- **SAM-BA 3.1.1 applets sources are open**
  - https://github.com/atmelcorp/atmel-software-package/tree/master/samba_applets
- **Secure SAM-BA 3.1 is distribution-limited**
  - Provided under NDA, should be approved by the marketing
  - Its installation requires a license
    - Distributed through a PGP connection
    - Locking the tool on the user's computer
- **The Secure Plugin will be distribution-limited**

Third Parties' Solutions

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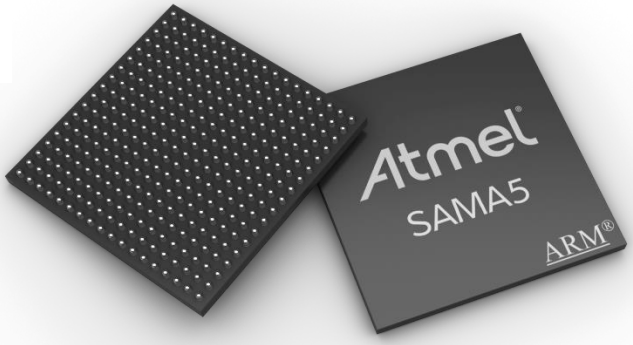
Wide Ecosystem



Reference Designs

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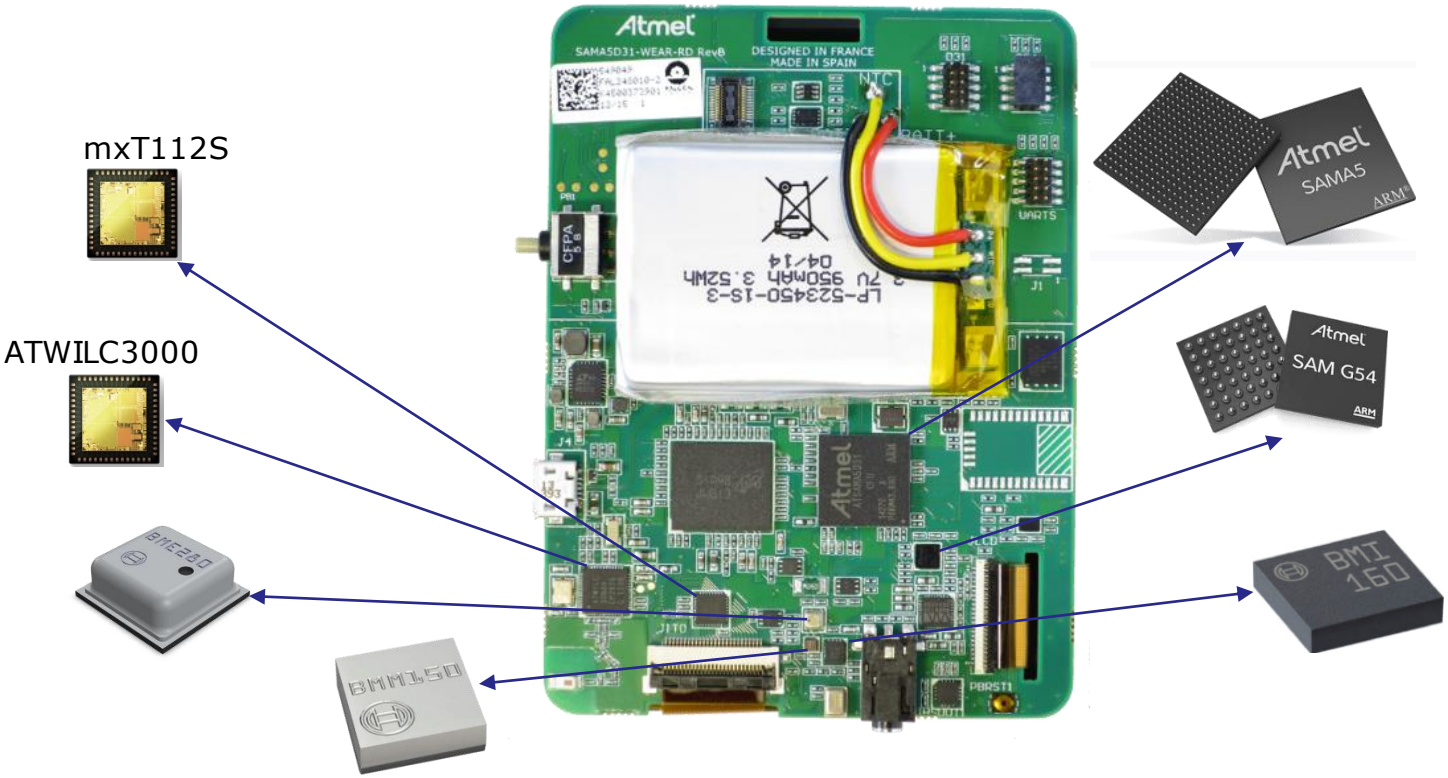
Smart Badge

- **Technologies Demonstrator**
- **Features**
  - SAMA5D3 @500MHz + Micron LPDDR2/eMMC Combo
  - Sensor Hub – SAMG54 + Bosch Sensors
  - Connectivity – WILC3000 WiFi/BT
  - Maxtouch – mXT112 + Display 320x480
- **Running**
  - The Bosch sensor fusion algorithms
  - Linux 3.18 + WILC3000 BT Stack + Android KitKat
  - Android Apps interacting with an Android Mobile phone

High Constrained Design

- **10-Layers with laser vias (in BGA pad and also buried)**
- **0.5mm pitch BGA, 0.11mm track width & spacing**
- **Designed for high speed and signal integrity**
  - Controlled impedance and bus length matching



Summary

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Summary

- **MPUs offer includes**
  - Evaluation Kits and hardware services
  - Tools, IDE and Debug probes
  - Software packages
  - Linux Distributions
  - Programming Tool – SAM-BA
- **A large ecosystem completes the offer for customers to improve their Time-To-Market**
- **A few reference designs might help you opening customers' door**

Thanks for listening

- Any questions?