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**Quick Start Guide for ATWILC3000  
on SAMA5D4-EK Android platform**

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## Prerequisites

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- **Hardware Prerequisites**
  - SAMA5D4EK board
  - Atmel WILC3000 evaluation board
  - Micro USB Cable (TypeA / MicroB)
  - USB to Serial Adaptor (for DBGU port)
- **Build Prerequisites**
  - Linux Host PC
  - Android Software Package

## Introduction

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This quick start guide describes how to integrate the Atmel WILC3000 evaluation board via SDIO for Wi-Fi and USART for Bluetooth in SAMA5D4EK Android platform. The following links also are available to get more information on Atmel wireless drivers, Android/Linux kernel and prebuilt images.

- Atmel Linux For SAM Site: <http://www.at91.com/linux4sam>
- Android4sam: <http://www.at91.com/android4sam/bin/view/Android4SAM/>
- Atmel ATWILC3000 Site: <https://github.com/atwilc3000>

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## 1. Introduction

The WILC3000 is a single chip IEEE 802.11 b/g/n RF, baseband, MAC, Bluetooth 4.0 and FM receiver optimized for low-power mobile applications. The WILC3000 utilizes highly optimized 802.11 – Bluetooth coexistence protocols. It provides multiple peripheral interfaces including UART, SPI, I2C and SDIO. This guide describes how to integrate the Atmel WILC3000 driver on the Android platform with the SAMA5D4EK board.

For more information on the SAMA5D4, visit <http://www.atmel.com/tools/sama5d4-ek.aspx>.

The latest WILC3000 driver and firmware are available on the following link:

<https://github.com/atwilc3000/driver>

<https://github.com/atwilc3000/firmware>

## 2. WILC3000 Linux Software Package

The latest WILC3000 is available on the [AtmelSmartConnect](#). Download the WILC3000 driver and firmware.

```
git clone https://github.com/atwilc3000/driver.git
git clone https://github.com/atwilc3000/firmware.git
```

For more information, visit the Github wiki pages: <https://github.com/atwilc3000/driver/wiki>

## 3. SAMA5D4EK Software Package

This chapter describes how to get the SAMA5D4EK Android SDK and build the images. The Android platform for AT91 is maintained at the [Android4Sam](#). See the following instructions to get the SDK and build images. This instruction is based on NAND flash boot mode.

### 3.1 Download Android source code

```
$ mkdir android4sam_v4.4_rc2
$ cd android4sam_v4.4_rc2
$ repo init -u git://github.com/Android4SAM/platform_sammanifest.git -b
  android4sam_v4.4_rc2
$ repo sync
```

### 3.2 Configure and build Android source code

```
$ . build/envsetup.sh
$ lunch sama5d4-eng
$ make
```

### 3.3 Generate Android image

```
$ mkubi_image -b sama5d4
```

Find **system\_ubifs-SAMA5D4-ANDROID-4.4.2\_r2.img** and **userdata\_ubifs-SAMA5D4-ANDROID-4.4.2\_r2.img** in the Android root directory if successful.

### 3.4 Download Kernel source code

```
$ git clone git://github.com/Android4SAM/linux-at91.git
$ cd linux-at91
$ git checkout -b linux-at91 Android4sam_v4.4_rc2
```

### 3.5 Configure and build

First copy the root directory in the Android source code directory.

```
$ cp -r <android-working-dir>/out/target/product/sama5d4/root <linux-working-dir>
```

Then, issue the following commands to build the kernel, modules and dtbs.

```
$ make mrproper
$ make ARCH=arm sama5_android_defconfig
$ make ARCH=arm CROSS_COMPILE=(path_to_cross-compiler/cross-compiler-prefix-) zImage
$ make ARCH=arm CROSS_COMPILE=(path_to_cross-compiler/cross-compiler-prefix-)
$ make ARCH=arm CROSS_COMPILE=(path_to_cross-compiler/cross-compiler-prefix-) dtbs
```

## 4. Flash images

Refer to [here](#) to flash prebuilt images and new images built with the Android and kernel source codes in the corresponding board.

### 4.1 Prebuilt images

The prebuilt images are provided in the [Android4Sam](#). Download the following demo package for NAND boot.

- SAMA5D4EK: Android-4.4.2\_r2-sama5d4-nandboot-rc2.tgz

For SAMA5D4EK board, push PB4 (RESET) while pushing PB3. Then, the boards go to boot mode to flash the prebuilt image. Run the batch file, **sama5d4\_nandflash.bat** in Windows. For Linux, run the script file like **sama5d4\_nandflash.sh**.

### 4.2 Engineering images built with source codes

This section describes how to flash engineering images to the SAMA5D4EK board. If Android and kernel are successfully built, the following outputs are generated.

- <android-working-dir>/system\_ubifs-SAMA5D4-ANDROID-4.4.2\_r2.img
- <android-working-dir>/userdata\_ubifs-SAMA5D4-ANDROID-4.4.2\_r2.img
- <kernel-working-dir>/linux-at91/arch/arm/boot/zImage
- <kernel-working-dir>/linux-at91/arch/arm/boot/dts/sama5d4ek.dtb

All of outputs should be downloaded to the target board. Run the batch or script file as done with prebuilt image.

## 5. Bring up ATWILC3000

This section describes how to integrate the WILC3000 driver into the SAMA5D4EK Android platform. The patch file for the SAMA5D4EK is available in <https://github.com/atwilc3000/patch>. The following sections will briefly explain what to port the WILC3000 into the SAMA5D4EK Android platform.

## 5.1 Android: /device/atmel/sama5d4/BoardConfig.mk

The ATWILC3000 WLAN and Bluetooth are enabled in android with the following configuration in the BoardConfig.mk file.

```
BOARD_WIFI_VENDOR := atmel
ifeq ($(BOARD_WIFI_VENDOR), atmel)
    CONFIG_DRIVER_WEXT := y
    BOARD_WPA_SUPPLICANT_DRIVER := NL80211
    WPA_SUPPLICANT_VERSION := VER_0_8_X
    BOARD_WPA_SUPPLICANT_PRIVATE_LIB := lib_driver_cmd_nmc
    BOARD_HOSTAPD_DRIVER := NL80211
    BOARD_HOSTAPD_PRIVATE_LIB := lib_driver_cmd_nmc

    WIFI_FIRMWARE_LOADER := ""

    BOARD_WLAN_DEVICE := wilc3000

    WIFI_DRIVER_FW_PATH_STA := "AUTO"
    WIFI_DRIVER_FW_PATH_AP := "AUTO"
    WIFI_DRIVER_FW_PATH_P2P := "AUTO"

    BOARD_HAVE_BLUETOOTH := true
    BOARD_HAVE_BLUETOOTH_ATMEL := true
    SW_BOARD_HAVE_BLUETOOTH_NAME := wilc3000
endif
```

## 5.2 Android: /device/atmel/common/config/Android\_Copy.mk

```
PREBUILD_FIRMWARE := wilc3000

ifeq ($(PREBUILD_FIRMWARE), wilc3000)
    PRODUCT_COPY_FILES += \
        $(LOCAL_PATH)/wilc3000.ko:system/lib/modules/wilc3000.ko
endif
```

## 5.3 Android: /device/atmel/sama5d4/device.mk

The Bluetooth feature is enabled with the following configuration in the device.mk file.

```
PRODUCT_COPY_FILES += \
    frameworks/native/data/etc/android.hardware.bluetooth.xml:system/etc/permissions/android.hardware.bluetooth.xml \
    frameworks/native/data/etc/android.hardware.bluetooth_le.xml:system/etc/permissions/android.hardware.bluetooth_le.xml \
```

## 5.4 Android: /device/atmel/sama5d4/init.sama5-pda.rc

This file sets owner, group and also permission for the WLAN and Bluetooth like the following configuration.

```
insmod /system/lib/modules/wilc3000.ko
chown bluetooth net_bt_stack /dev/at_bt_pwr
#UART device
chmod 0660 /dev/ttyS1
chown bluetooth net_bt_stack /dev/ttyS1
```

The WPA supplicant is also configured with the following configuration for WLAN Station, AP and P2P mode.

```
service wpa_supplicant /system/bin/logwrapper /system/bin/wpa_supplicant -dd \  
-iwlan0 -Dnl80211 -c/data/misc/wifi/wpa_supplicant.conf \  
-O/data/misc/wifi/sockets \  
-e/data/misc/wifi/entropy.bin -g@android:wpa_wlan0  
class main  
socket wpa_wlan0 dgram 660 wifi wifi  
disabled  
oneshot  
  
service p2p_supplicant /system/bin/logwrapper /system/bin/wpa_supplicant -dd \  
-ip2p0 -Dnl80211 -c/data/misc/wifi/p2p_supplicant.conf \  
-e/data/misc/wifi/entropy.bin -N \  
-iwlan0 -Dnl80211 -c/data/misc/wifi/wpa_supplicant.conf \  
-O/data/misc/wifi/sockets \  
-g@android:wpa_wlan0  
class main  
socket wpa_wlan0 dgram 660 wifi wifi  
disabled  
oneshot
```

#### 5.5 Android: /hardware/atmel/sama5dx/Android.mk

```
modules := libagl gralloc hwcomposer audio liblights hardwareloader camera libbt wlan
```

#### 5.6 Kernel: /arch/arm/boot/dts/sama5d4.dtsi

The SAMA5D4EK supports USART DMA with adding the followings in the USART4 section.

```
atmel,use-dma-rx;  
atmel,use-dma-tx;
```

#### 5.7 Kernel: /arch/arm/configs/sama5\_android\_defconfig

The followings should be added in the sama5\_android\_defconfig to support WILC3000 via SDIO and Bluetooth via USART interface.

```
CONFIG_ATMEL_SMARTCONNECT=y  
CONFIG_WILC3000=m  
CONFIG_WILC3000_SDIO=y  
# Bluetooth device drivers  
CONFIG_BT_HCIBTUSB=y  
CONFIG_BT_HCIBTSDIO=y  
CONFIG_BT_HCIUART=y  
CONFIG_BT_HCIUART_H4=y  
CONFIG_BT_HCIUART_BCSP=y  
CONFIG_BT_HCIUART_LL=y  
CONFIG_BT_HCIUART_3WIRE=y
```

#### 5.8 Kernel: /drivers/net/wireless/Makefile, Kconfig

The followings should be added to build WILC3000 driver in kernel tree.

```
source "drivers/net/wireless/atmel/Kconfig"
```



```
obj-$(CONFIG_ATMEL_SMARTCONNECT) += atmel/
```

Create **atmel** directory in the wireless directory if not available. Then, copy the wilc3000 kernel driver into the **atmel** directory.

## 5.9 Kernel: wilc3000.ko

**Building** the kernel generates **wilc3000.ko** in the **{kernel-working-dir}/drivers/net/wireless/atmel/wilc3000**. It should be placed in the **{android-working-dir}/device/atmel/common/config/** to make new android images. Then, build Android to make new images.

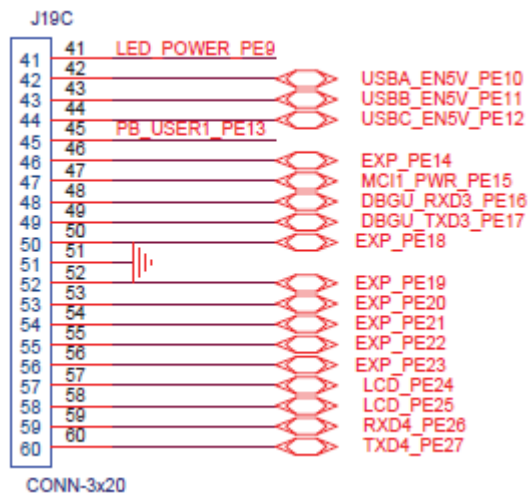
## 6. Hardware Consideration

This section shows how to connect the ATWILC3000 EVB to SAMA5D4EK for WiFi and Bluetooth. The ATWILC3000 should be connected to SAMA5D4EK via SDIO for WLAN and USART for Bluetooth.

### 6.1 Bluetooth

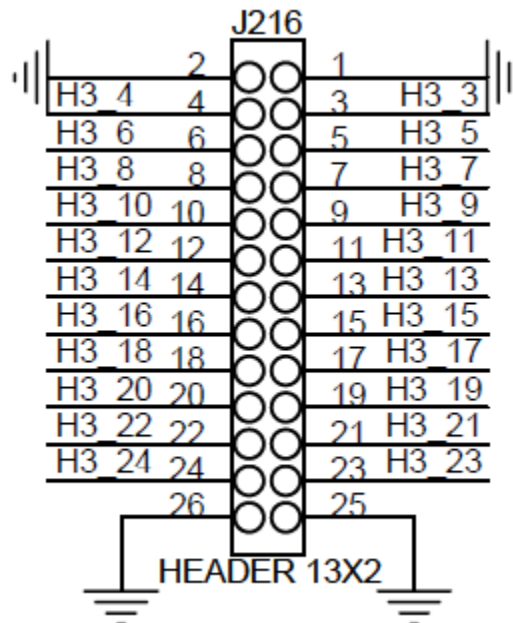
For Bluetooth, the USART4 of SAMA5D4EK is connected to the ATWILC3000 EVB. The following figure is I/O expansion, J19. The expansion, J19C has the TXD4 on pin 60 and RXD4 on pin 59.

Figure 1 SAMA5D4EK I/O Expansion



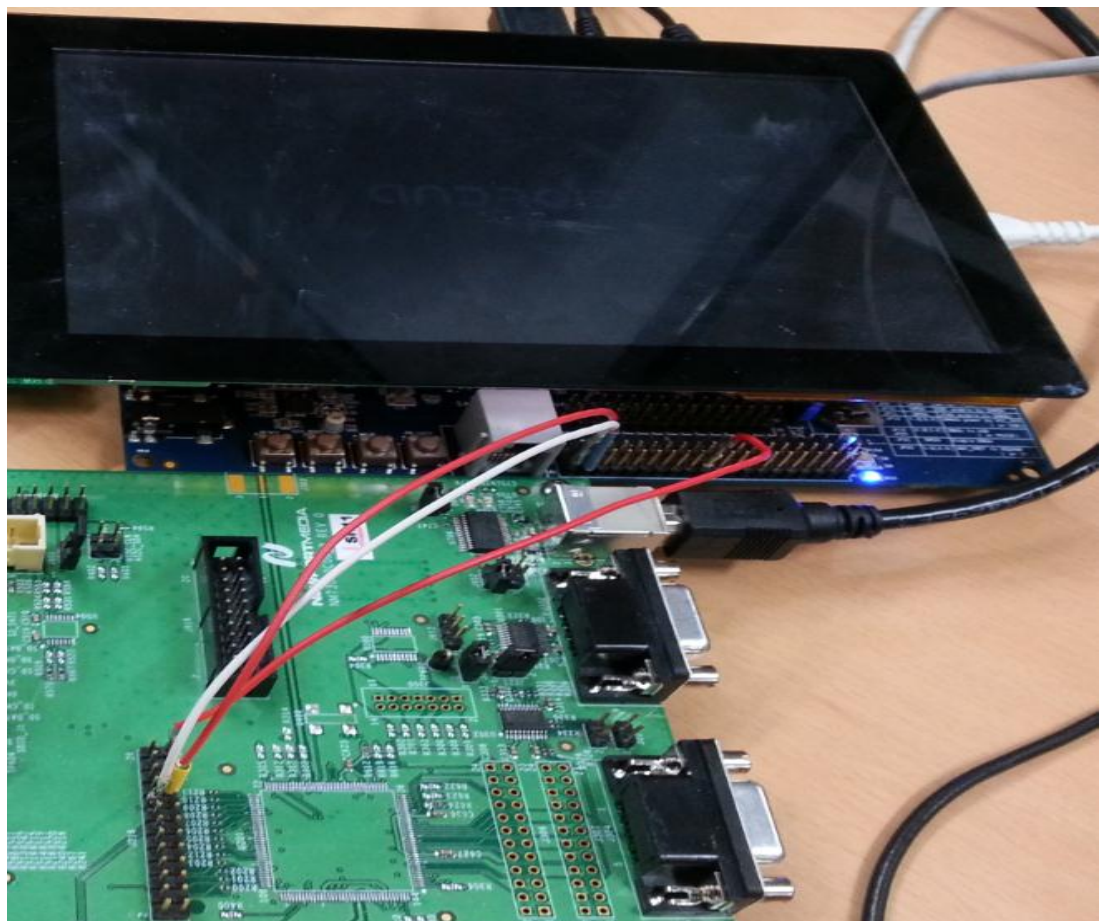
The TXD4 on the SAMA5D4EK should be connected to the RXD on the ATWILC3000 EVB, J216 pin18. In contrast, the RXD4 on the SAMA5D4EK should be connected to the TXD on the ATWILC3000 EVB, J216 pin19. Make sure open J227, J805 and J901 on ATWILC3000 EVB before running the Bluetooth. The USART should be closely connected.

Figure 2 ATWILC3000 EVB J216



The following is real picture for the Bluetooth connection via USART4 in SAMA5D4EK board.

Figure 3 ATWILC3000 to SAMA5D4EK via USART4

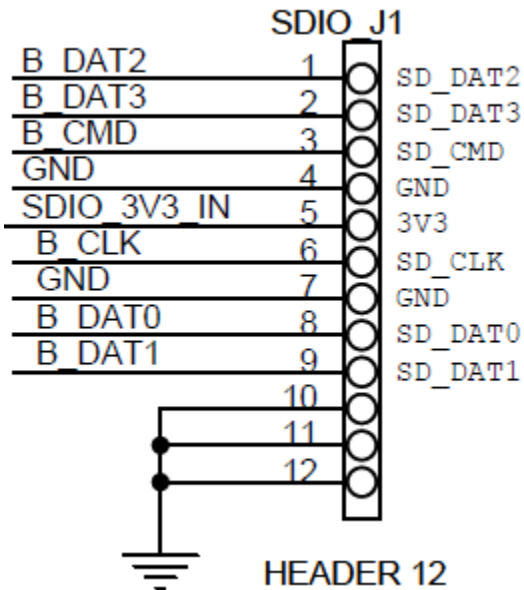




## 6.2 WiFi

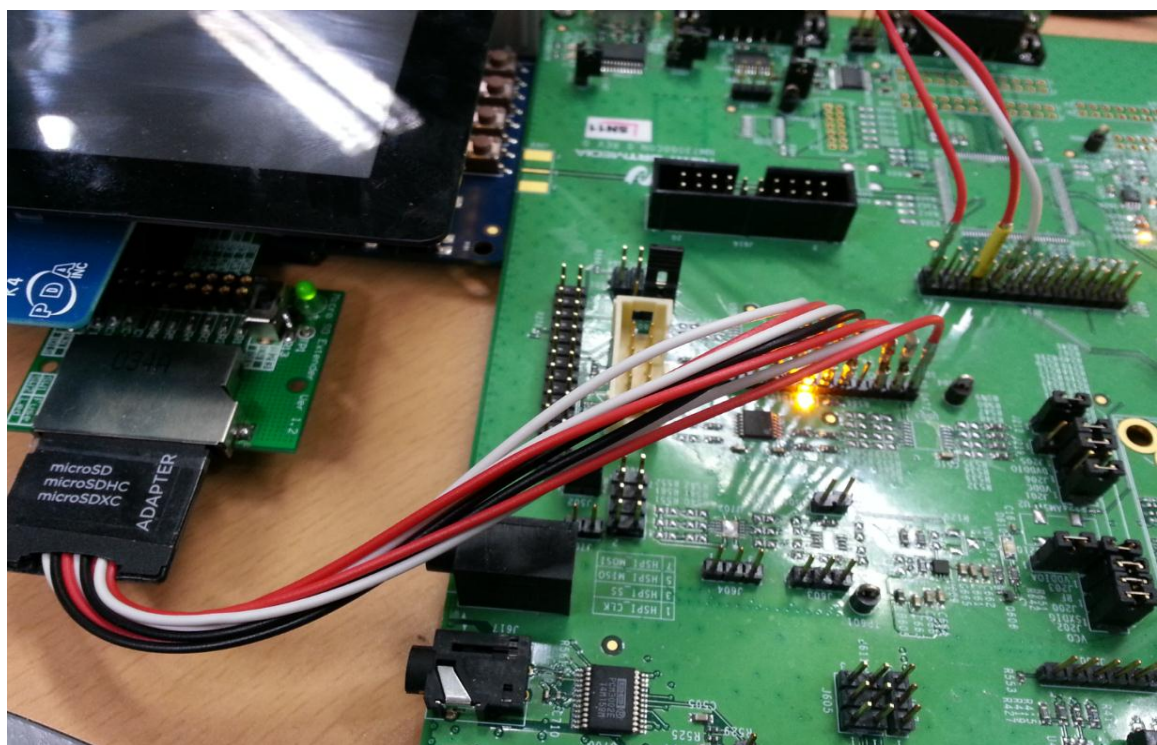
For the WLAN, the MCI1 MicroSD socket J14 on the SAMA5D4EK should be connected to the SDIO\_J1 on the ATWILC3000 EVB. The following figure is the SDIO\_J1 pin on the ATWILC3000.

Figure 4 ATWILC3000 SDIO\_J1 Pin



The SD\_DAT0 to SD\_DATA3 should be connected to support SDIO 4-bit mode. In addition, SD\_CMD, SD\_CLK and GND should be connected to the SAMA5D4EK board. The following is real picture showing how to connect ATWILC3000 EVB to SAMA5D4EK for SDIO interface. The Micro SD socket is recommended like the following picture.

Figure 5 ATWILC3000 to SAMA5D4EK via SDIO



## 7. Conclusion

This Quick Start Guide described how to integrate the Atmel WILC3000 Combo driver in the Android platform with SAMA5D4-EK board.

## 8. Revision history

Doc. Rev.	Date	Comments
XXXXXA	11/2014	Initial document release
	11/2014	Add wilc3000 Bluetooth
	2/2015	Update the contents

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