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## Getting Started Guide for ATWINC1500 Wi-Fi using SAM D21 Xplained Pro

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Atmel SmartConnect

### Introduction

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This getting started guide describes the Atmel® ATWINC1500 Wi-Fi Network Controller to build state-of-the-art Internet of Things (IoT) applications. The guide explains hardware information and how to install Atmel Studio (IDE), compile examples, and download ATWINC1500 firmware.

The following topics will be covered:

- How to get Atmel Studio (IDE) and install it
- Update new ASF package
- Target board information
- How to get weather client example project
- How to get log message
- How to download firmware and certificate

### Prerequisites

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- Hardware Prerequisites
  - Atmel SAM D21 Xplained Pro Evaluation Kit
  - Atmel ATWINC1500 extension
  - Atmel IO1 extension
  - Micro-USB cable (Micro-A / Micro-B)
- Software Prerequisites
  - Atmel Studio
  - Weather client example project source code



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## Icon Key Identifiers

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### INFO

Delivers contextual information about a specific topic.



### TIP

Highlights useful tips and techniques.



### TO DO

Highlights objectives to be completed.



### RESULT

Highlights the expected result of an assignment step.



### WARNING

Indicates important information.



### EXECUTE

Highlights actions to be executed out of the target.



# 1 Getting Started with Atmel Studio

## 1.1 Download and Install Atmel Studio 6.2

Atmel Studio 6 is the integrated development platform (IDP) for developing and debugging Atmel ARM® Cortex®-M and Atmel AVR® microcontroller (MCU) based applications. The Atmel Studio 6 IDP gives you a seamless and easy-to-use environment to write, build, and debug your applications written in C/C++ or assembly code.

Atmel Studio 6.2 is now available, adding advanced debugging features such as Data and Interrupt Trace, improved RTOS integration, and better ability to debug code that has been optimized.

With the introduction of Atmel Gallery and Atmel Spaces, Atmel Studio 6 further simplifies embedded MCU designs to reduce development time and cost. Atmel Gallery is an online apps store for development tools and embedded software. Atmel Spaces is a cloud-based collaborative development workspace allowing you to host software and hardware projects targeting Atmel MCUs.



Download and install Atmel Studio 6.2 from [http://www.atmel.com/microsite/atmel\\_studio6/](http://www.atmel.com/microsite/atmel_studio6/).

You can find the installed directory: C:\Program Files\Atmel\Atmel Studio 6.2.

## 1.2 Download and Install the latest ASF

Atmel Studio 6 is free of charge and is integrated with the Atmel Software Framework (ASF) — a large library of free source code with 1,600 ARM and AVR project examples. ASF strengthens the IDP by providing, in the same environment, access to ready-to-use code that minimizes much of the low-level design required for projects. Use the IDP for our wide variety of AVR and ARM Cortex-M processor-based MCUs, including our broadened portfolio of Atmel SAM3 ARM Cortex-M3 and M4 Flash devices.

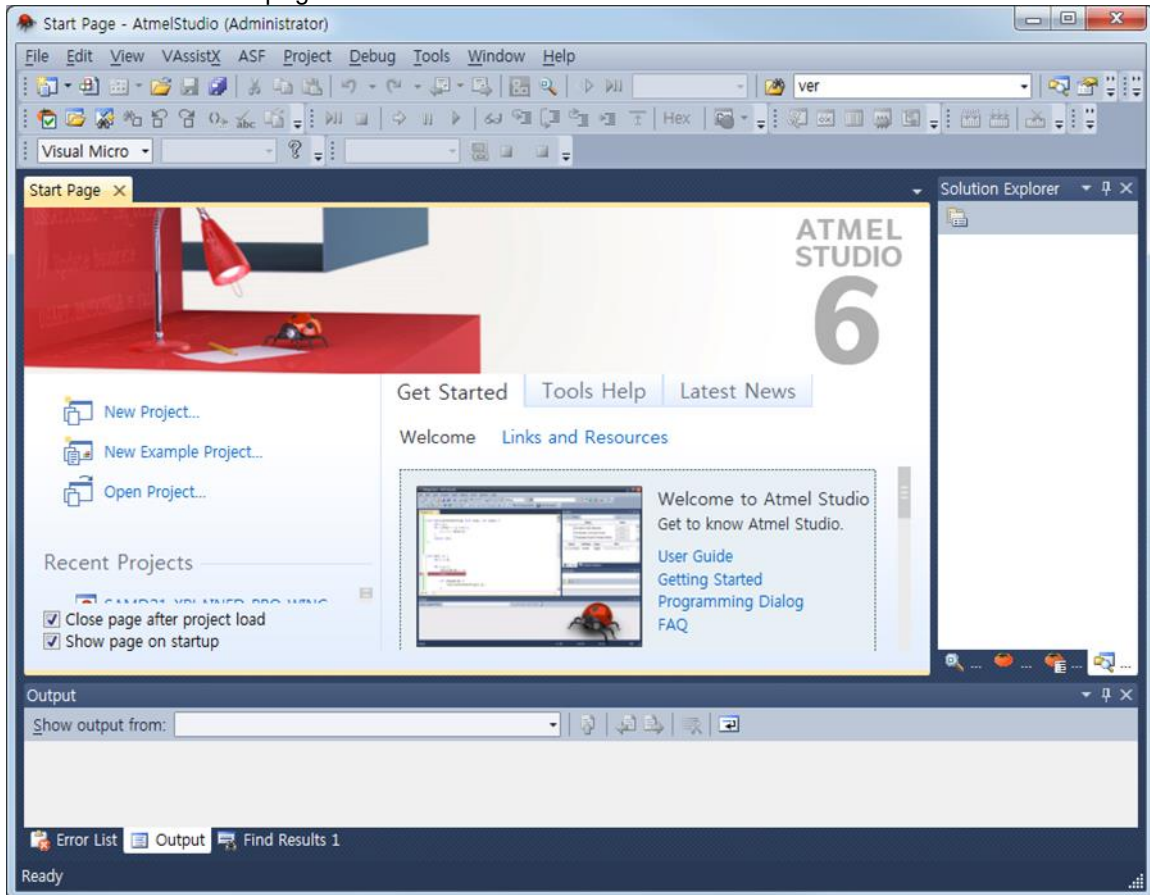
If the ASF version in your Atmel Studio is not the latest one you will be notified when Atmel Studio starts. The following procedure demonstrates how to update the ASF to the latest version. You can install other extensions in the list as well.

### 1.2.1 How to update Atmel Studio to the latest version

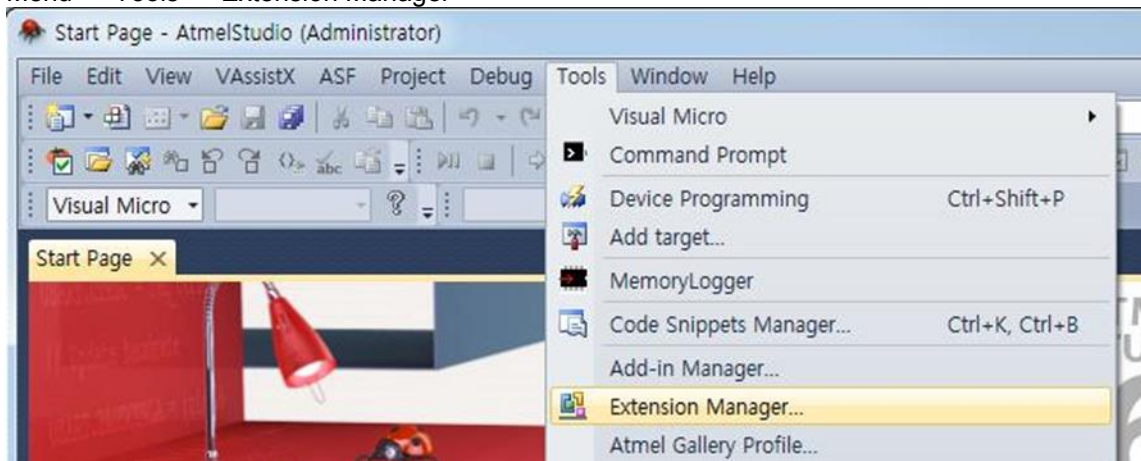
1. Run Atmel Studio 6.2.



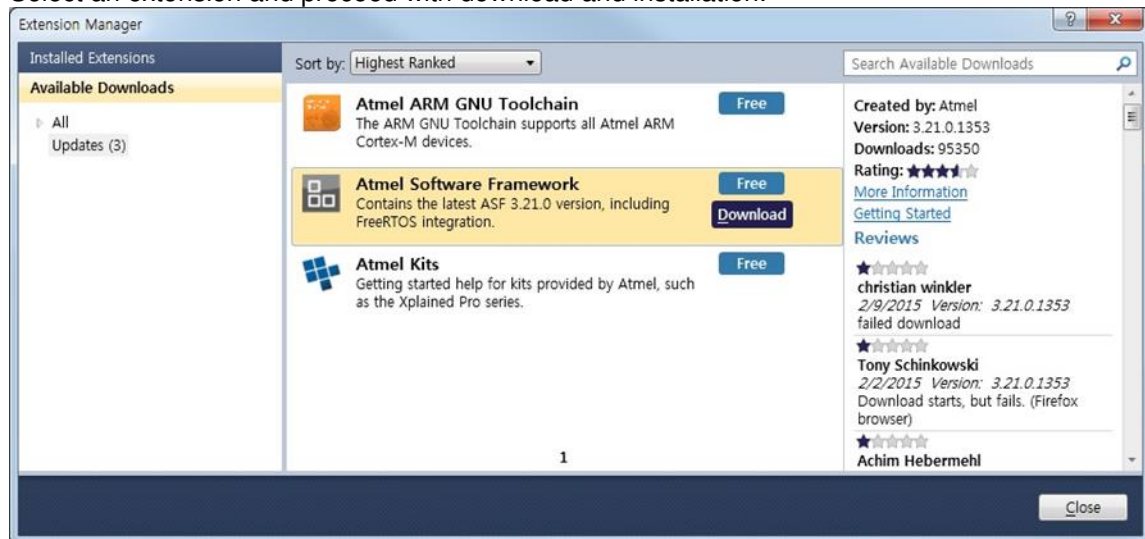
2. You can see the start page of Atmel Studio 6.



3. Update ASF to the latest version.  
Menu → Tools → Extension Manager



Available Downloads → Updates → Atmel Software Framework  
 Select an extension and proceed with download and installation:



#### TIPS

Restart Atmel Studio to take effect of the newly installed extension.

### 1.3 Download and Install the Latest ATWINC1500 Extension Package

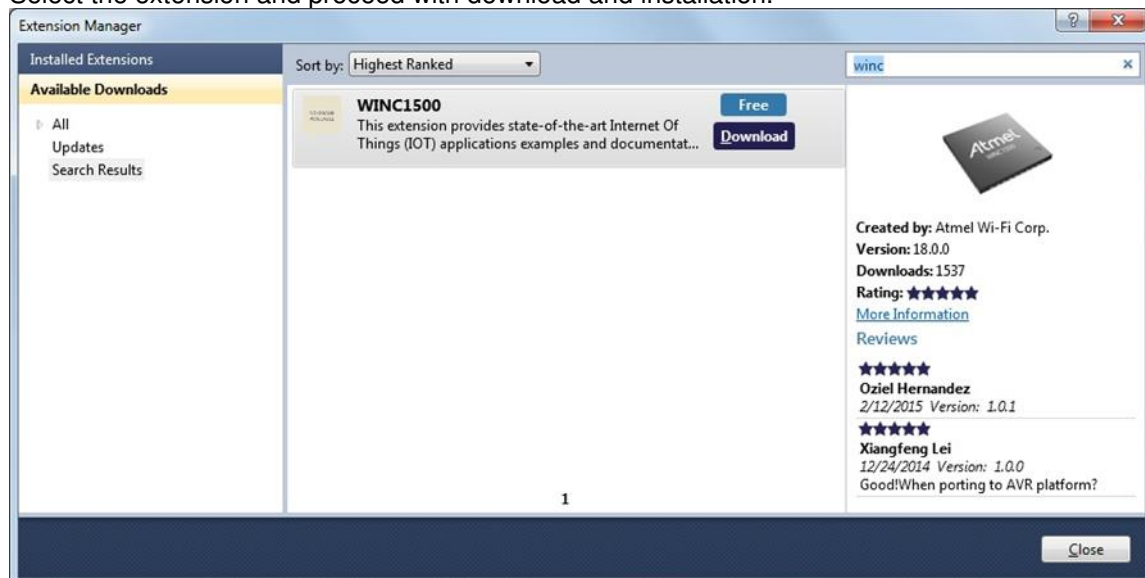
ATWINC1500 Extension package contains the ATWINC1500 software (latest firmware, Firmware update Tools, and Example projects).



#### TIPS

As an Atmel Studio Extension (.vsix file), which can be found on the Atmel Gallery web site (<http://gallery.atmel.com/>) or using the Atmel Studio Extension manager.

1. Atmel Studio → Menu → Tools → Extension Manager.
2. Input “winc” in the search window then you can find the ATWINC1500 extension.
3. Select the extension and proceed with download and installation.

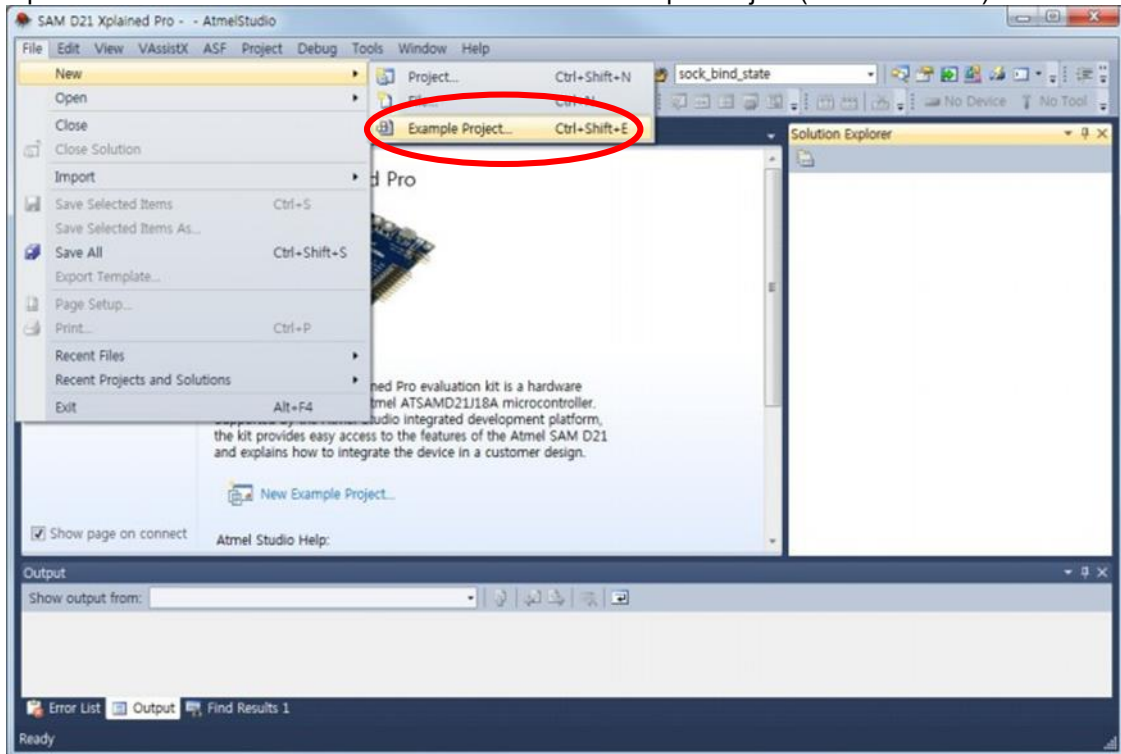




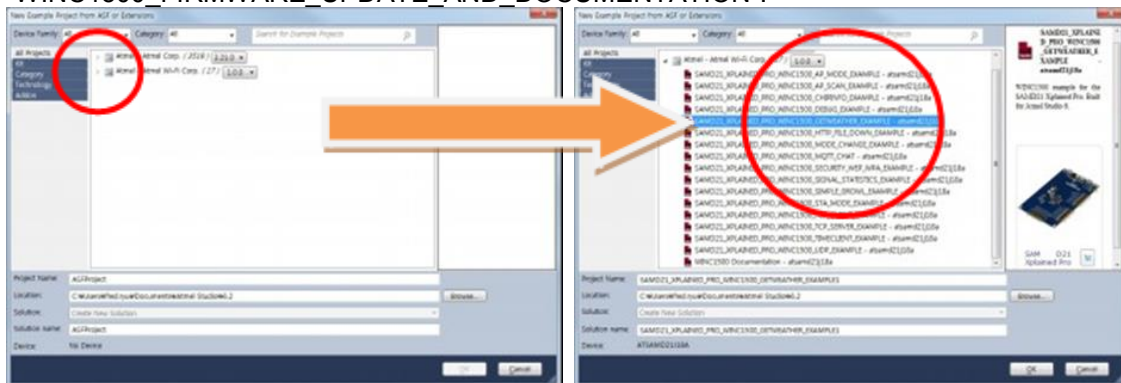
## TIPS

Restart Atmel Studio to take effect of the newly installed extension.

- Restart Atmel Studio.
- Open the Tools and Document via File → New → Example Project (Ctrl + Shift + E).



- Input "FIRMWARE" in the search window then you can find an example named like "WINC1500\_FIRMWARE\_UPDATE\_AND\_DOCUMENTATION".



This project contains documentation and tools to upgrade ATWINC1500 firmware to the specific version which is matched up with the Wi-Fi driver in example projects. It also contains documentation on how to run example projects in this extension.

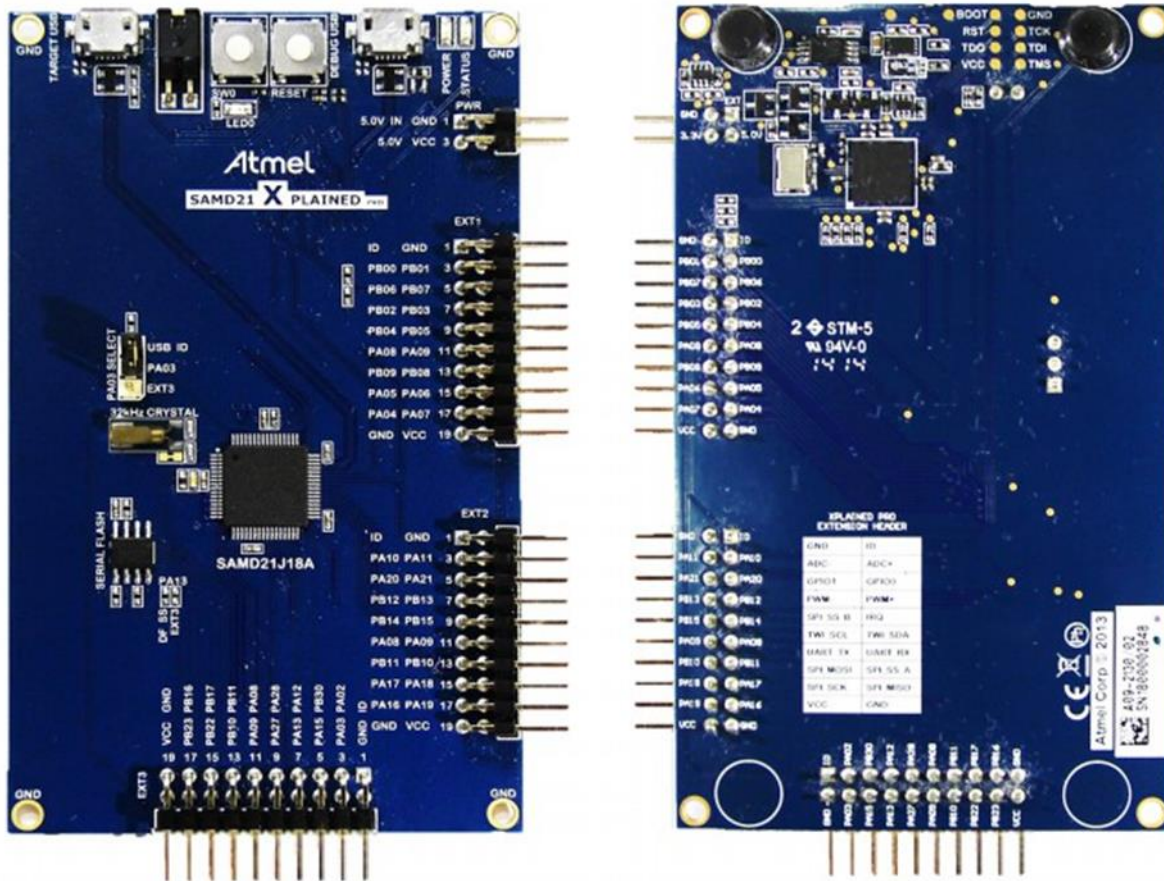


## 2 Getting Started with Atmel Hardware

This chapter introduces Atmel Evaluation Kits for testing IoT applications. The SAMD21 and the ATWINC1500 are essential but the IO1 and the OLED1 extension boards are optional.

### 2.1 Atmel SMART SAMD21-XPRO Evaluation Kit

The Atmel SAM D21 Xplained Pro evaluation kit is ideal for evaluating and prototyping with the Atmel SAM D21 ARM Cortex-M0+ based microcontrollers. Extension boards to the SAM D21 Xplained Pro can be purchased individually.



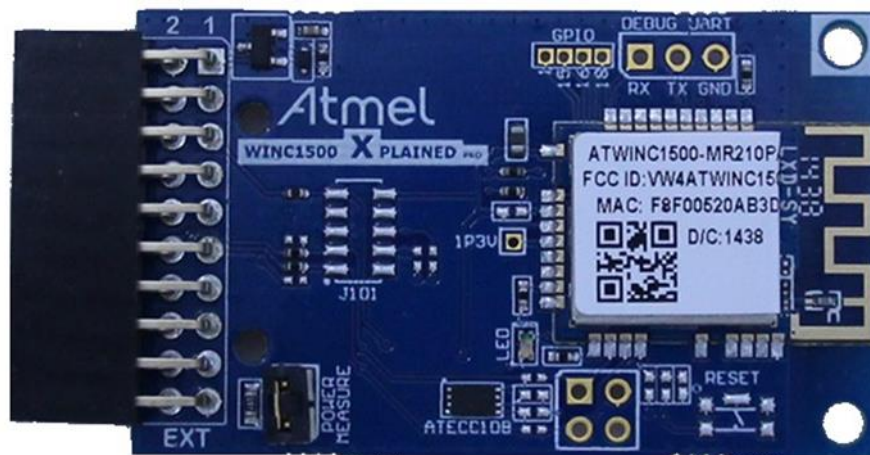
- SAMD21J18A microcontroller
- One mechanical reset button
- One mechanical user pushbutton (wake-up, bootloader entry, or general purpose)
- One yellow user LED
- 32.768kHz crystal
- USB interface, device and reduced host mode
- 8Mb Serial Flash
- Three Xplained Pro extension headers
- Embedded Debugger
  - Auto-ID for board identification in Atmel Studio 6.1
  - One yellow status LED

- One green board power LED
- Symbolic debug of complex data types including scope information
- Programming and debugging
- Data Gateway Interface: SPI, I<sup>2</sup>C, four GPIOs
- Virtual COM port (CDC)
- USB powered
- Supported with application examples in Atmel Software Framework

More detailed information about SAM D21: <http://www.atmel.com/tools/atsamd21-xpro.aspx>

## 2.2 Atmel SmartConnect ATWINC1500-XPRO Wi-Fi Extension Board

Atmel SmartConnect ATWINC1500 is an IEEE® 802.11 b/g/n IOT network controller SoC. It is the ideal add-on to existing MCU solutions bringing Wi-Fi and Network capabilities through SPI-to-Wi-Fi interface. The ATWINC1500 connects to any Atmel AVR or SMART MCU with minimal resource requirements. The ATWINC1500 most advanced mode is a single stream 1x1 802.11n mode providing up to 72Mbps PHY throughput. ATWINC1500 features fully integrated Power Amplifier, LNA, Switch, and Power Management. The ATWINC1500 provides internal Flash memory as well as multiple peripheral interfaces including UART, SPI, and I<sup>2</sup>C. The only external clock source needed for the ATWINC1500 is a high-speed crystal or oscillator with a wide variety of reference clock frequencies supported (between 12 – 32MHz). The ATWINC1500 is available in a QFN package.



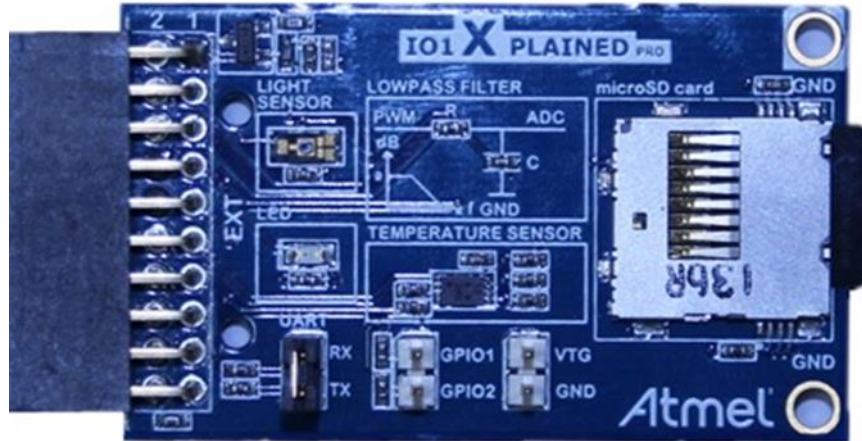
- IEEE 802.11 b/g/n (1x1) for up to 72Mbps
- Integrated PA and T/R Switch
- Superior sensitivity and range via advanced PHY signal processing
- Wi-Fi Direct, station mode and Soft-AP support
- Supports IEEE 802.11 WEP, WPA2 Security Enterprise
- On-chip memory management engine to reduce host load
- 4Mb internal Flash memory with OTA firmware upgrade
- SPI as host interfaces
- TCP/IP protocol stack (client/server) sockets applications
- Network protocols (DHCP/DNS)
- Secure TLS stack
- WSC (wireless simple configuration WPS)
- On-Chip Network Stack to offload MCU
  - Integrated Network IP stack to minimize host MCU requirements

- Network features: TCP, UDP, DHCP, ARP, HTTP, SSL, and DNS

More detailed information about ATWINC1500: <http://www.atmel.com/devices/ATWINC1500.aspx>

## 2.3 Atmel IO1-XPRO Sensor Extension Board

Atmel IO1 Xplained Pro extension board is a generic extension board for the Xplained Pro platform. It connects to any Xplained Pro standard extension header on any Xplained Pro MCU board. The extension board utilizes all functions on the standard Xplained Pro extension header to further enhance the feature set of Xplained Pro MCU boards.



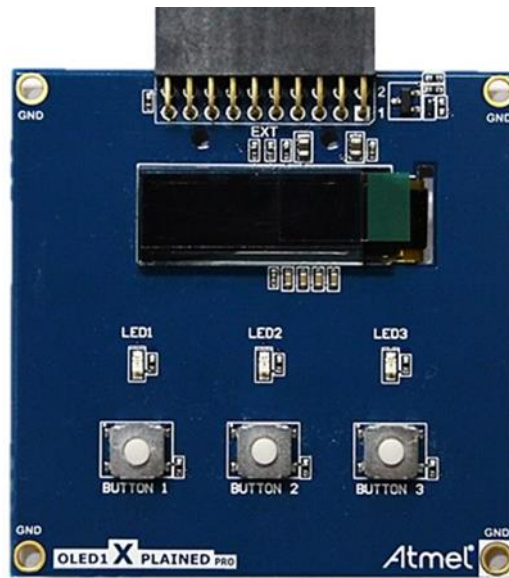
- microSD card connector
  - 2GB microSD card included
  - Accessed with SPI interface
- PWM
  - LED control
  - PWM → Low pass filter → ADC
- ADC
  - PWM → Low pass filter → ADC
  - Light sensor
- UART
  - Loopback interface via pin header
- TWI
  - AT30TSE758 Temperature sensor with EEPROM
- Xplained Pro hardware identification system

More detailed information about AT IO1:

[http://www.atmel.com/images/atmel-42078-io1-xplained-pro\\_user-guide.pdf](http://www.atmel.com/images/atmel-42078-io1-xplained-pro_user-guide.pdf)

## 2.4 Atmel OLED1-XPRO Display Extension Board

Atmel OLED1 Xplained Pro is an extension board to the Atmel Xplained Pro evaluation platform. The board enables the user to experiment with user interface applications with buttons, LEDs, and a display.



- UG-2832HSWEG04 monochrome OLED display
  - 128 x 32 Pixels
  - Controlled by 4-wire SPI interface, up to 100MHz
- Three LEDs
- Three mechanical push buttons
- Xplained Pro hardware identification system

More detailed information about Atmel Oled1 Xplained Pro:

[http://www.atmel.com/images/atmel-42077-oled1-xplained-pro\\_user-guide.pdf](http://www.atmel.com/images/atmel-42077-oled1-xplained-pro_user-guide.pdf)



## 3 Getting Started with ATWINC1500 IoT Examples

This chapter introduces ATWINC1500 IoT examples and describes how to run an example on the SAM D21 board.

### 3.1 Organization of ATWINC1500 IoT Examples

All these examples are included in the ASF package and there are various IoT examples using Wi-Fi module.

#### 3.1.1 Basic Examples

These examples describe basic Wi-Fi operation in 'how-to' manner:

- How to read chip ID (to identify ATWINC1500 H/W revision)
- How to set debug message level
- How to get MAC address of the Wi-Fi module
- How to start Wi-Fi in specific operation mode, such as:
  - STA Mode (Station mode), AP mode (Access Point mode), and P2P mode (client mode)
- How to switch mode among STA, AP, and P2P modes during the runtime
- How to scan APs nearby
- How to set deep sleep mode
- How to connect to secure Wi-Fi with using WEP/WPA/WPA2 security
- How to connect to enterprise security network
- How to connect to security WPS
- How to set packet monitoring
- How to get RF signal status by reading RSSI value
- How to set AP provision
- How to set HTTP provision

#### 3.1.2 Protocol Examples

After basic code examples, the user may be interested in how to send and receive network packets. Here are protocol examples that can be extended for IoT application.

- UDP protocol example
- TCP protocol example
- NTP Time client – retrieve network time for IoT application
- MQTT protocol client example
- Send email – send an email from SMTP server
- Location client – get the current location of the network provider using HTTP

#### 3.1.3 Advanced Examples

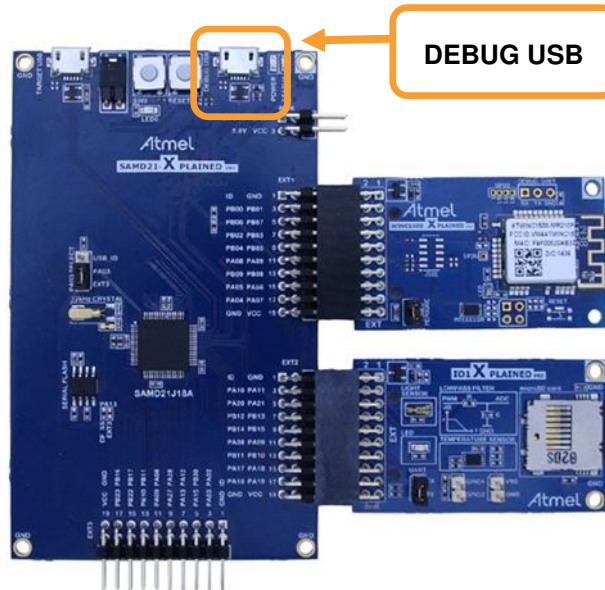
These examples demonstrate more complex functions like:

- Growl client – demonstrates using RESTful API over SSL (essential for IoT application)
- MQTT Chat client – demonstrate how to send and receive IoT information using MQTT protocol
- Weather client – get the current weather information of the network provider and utilize the IO1 sensor device
- Wi-Fi serial - useful for chatting or controlling a remote device
- OTA Firmware Upgrade – ATWINC1500 Firmware upgrade via OTA server
- SSL connection - Set up an SSL connection

## 3.2 Connect the Board

Connect the ATWINC1500 Wi-Fi module to the SAM D21 as shown in the figure.

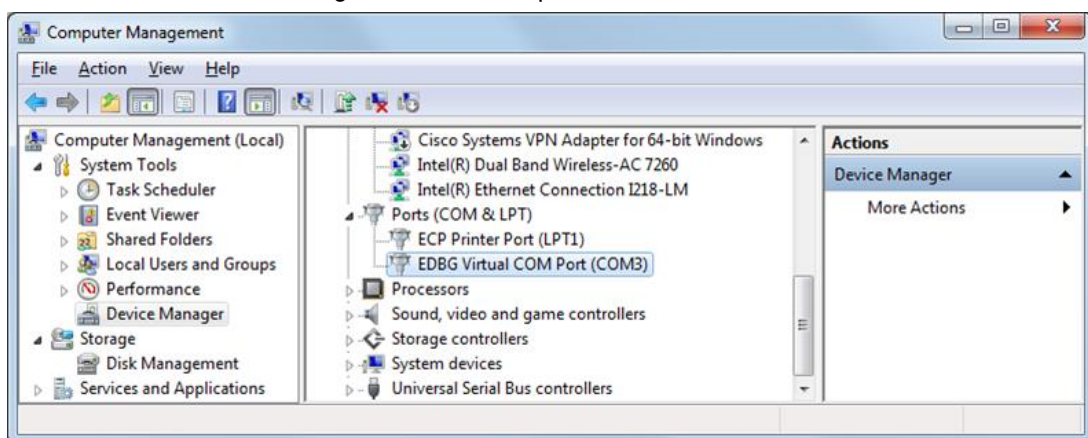
The ATWINC1500 Wi-Fi module comes with a Wi-Fi software API. The purpose of this API is to provide an abstraction of the binary protocol used between the host processor and the ATWINC1500 Wi-Fi module while keeping an easy and reliable solution to add wireless capabilities to any user application. This software is based on the Atmel Software Framework (ASF) and is configured to use an ATWINC1500 Wi-Fi module on EXT1 by default. Note that switching to another extension port (EXT2 or EXT3) is possible by modifying a configuration file.



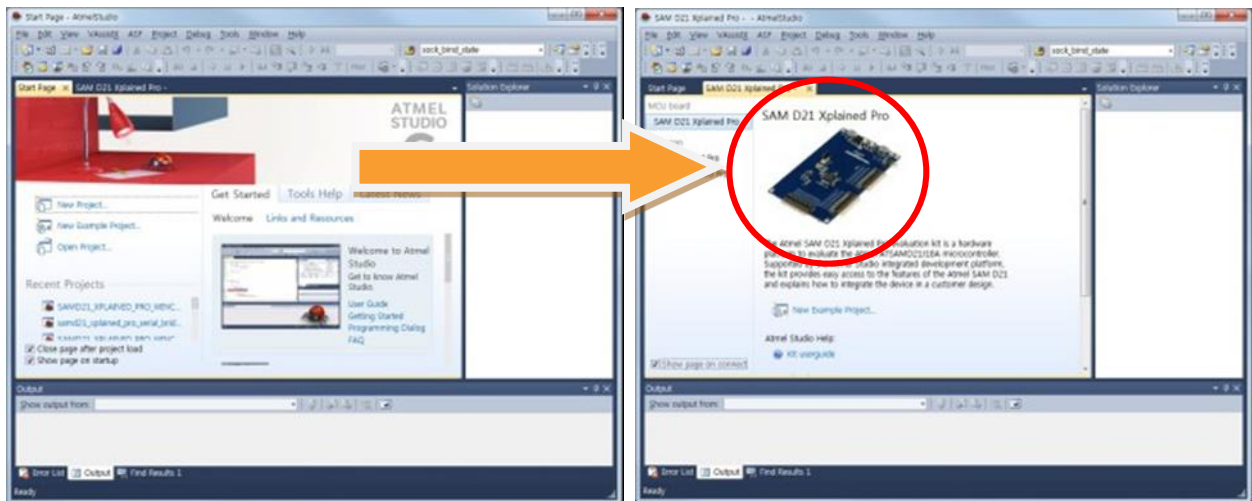
### WARNING

Connecting several ATWINC1500 Wi-Fi modules is possible but not supported by the provided Wi-Fi Software API.  
For this getting start guide the ATWINC1500 Wi-Fi module will remain connected on EXT1.

Connect the DEBUG USB port on the SAM D21 to your PC using a Micro-USB cable. The SAM D21 will be visible in the Windows® Device Manager with its COM port.



Atmel Studio may detect your device automatically and show a proper page.



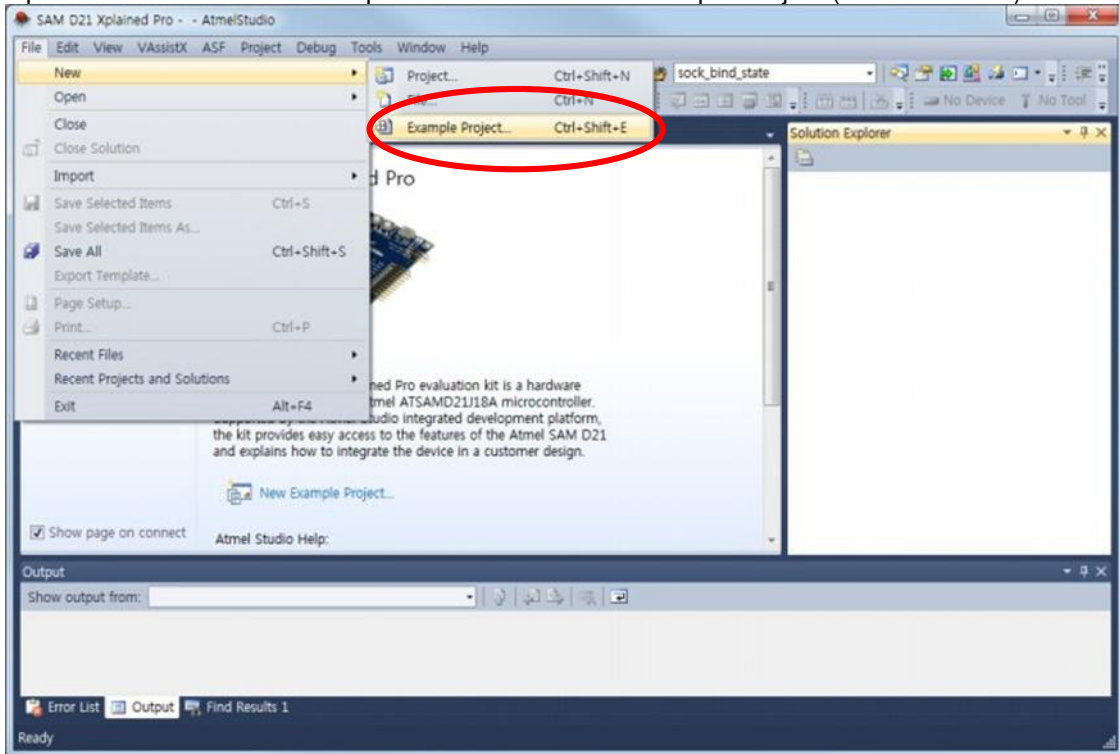
### 3.3 How to Get Weather Client Example Project

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to receive weather information from a weather server. It uses the following hardware:

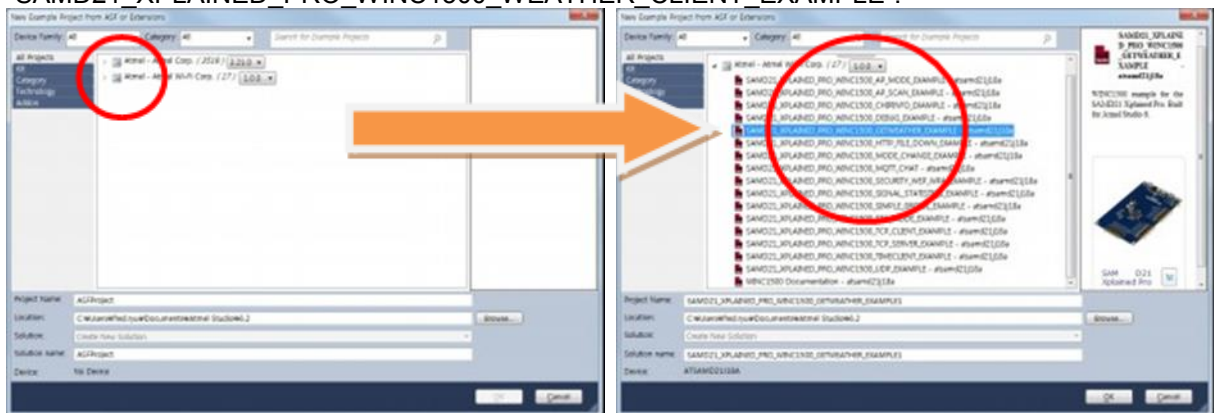
- The SAM D21 Xplained Pro
- The ATWINC1500 on EXT1 header
- The IO1 on EXT2 header
- A wireless access point
- A mobile device (for provisioning)



1. Open the Weather client example via File → New → Example Project (Ctrl + Shift + E).

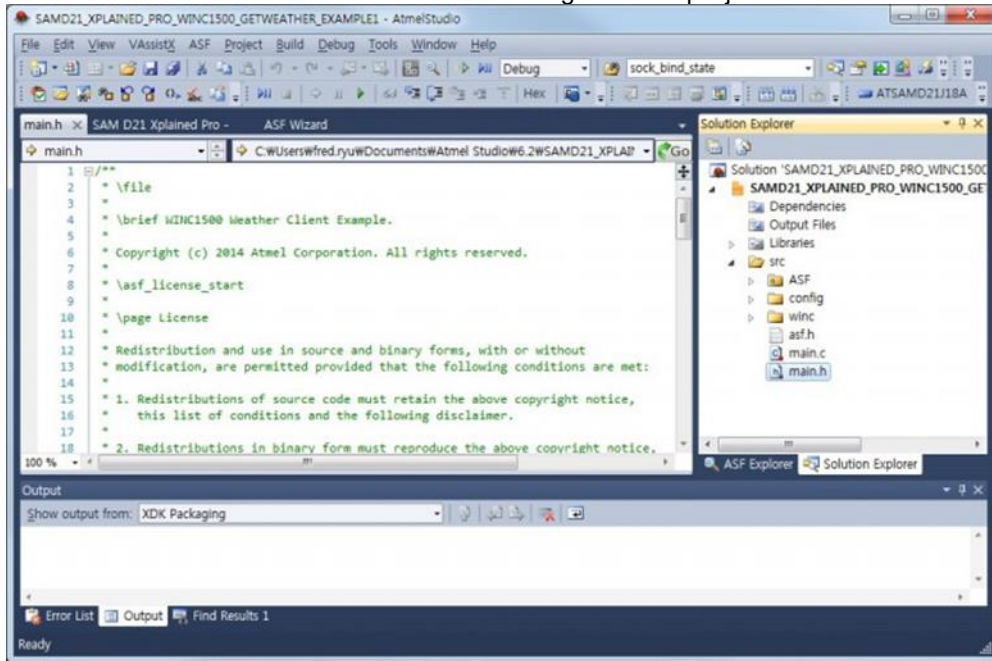


2. Input "WEATHER" in the search window then you can find an example named like "SAMD21\_XPLAINED\_PRO\_WINC1500\_WEATHER\_CLIENT\_EXAMPLE".





- Press the OK button then Atmel Studio will bring over the project source code of the example.



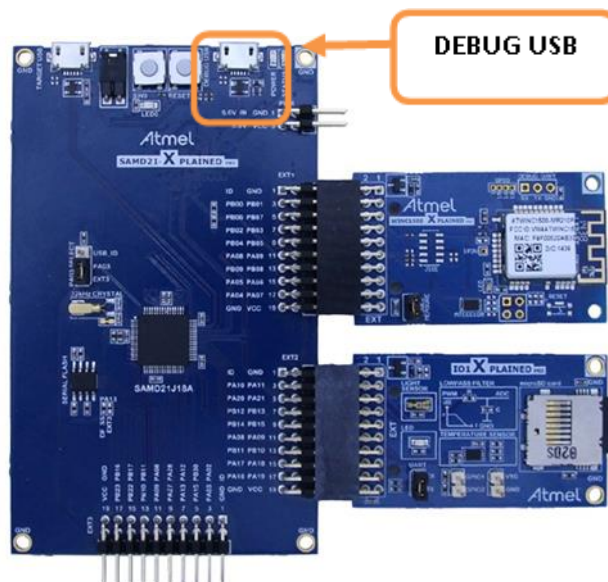
### 3.4 How to Build and Execute

This guide demonstrates how to build an example and execute it on the SAM D21 Xplained Pro.

- Build the solution (F7) and ensure you get no errors.



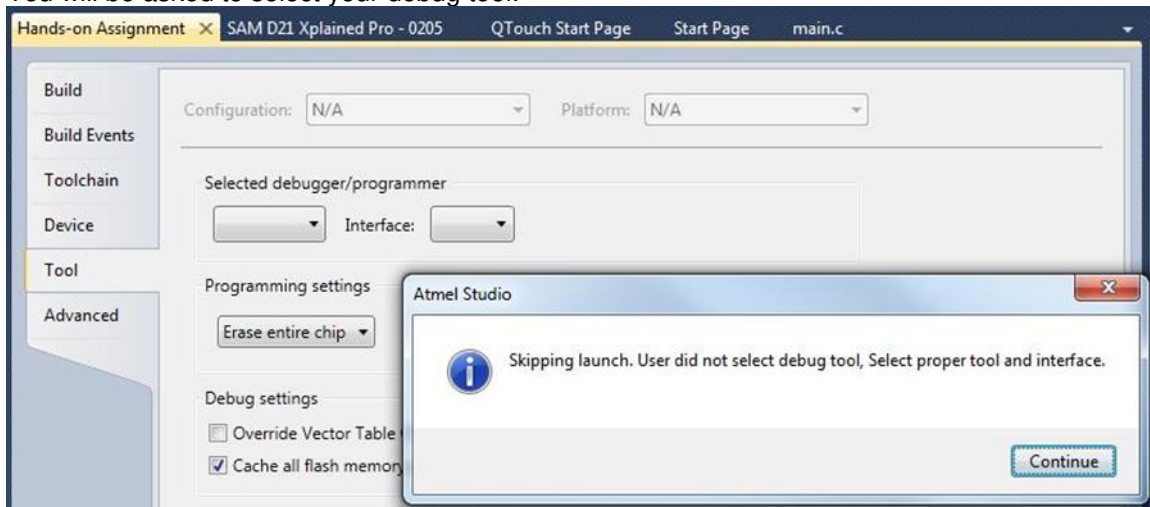
- Connect the ATWINC1500 Wi-Fi extension and the IO1 extension to the SAM D21 Xplained Pro as displayed below:



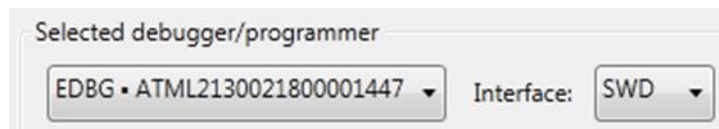
- Connect the SAM D21 Xplained Pro board to your PC using DEBUG USB connector.
- Program the application by clicking on the Start Debugging and Break icon.



5. You will be asked to select your debug tool:



6. Select EDBG and SWD (Serial Wire Debug) as Interface.



7. Click again on the Start Debugging and Break icon:

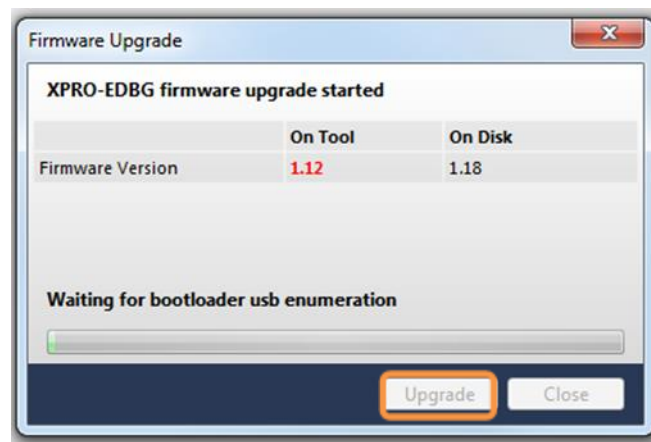


8. The application will be programmed in the SAM D21 embedded flash and breaks at main function. Click on continue to execute the application:



## RESULT

You may be asked to upgrade your EDBG firmware. If so, click on Upgrade button:



## WARNING

Upgrade operation may take a few minutes, **wait** for the operation to complete.



## RESULT

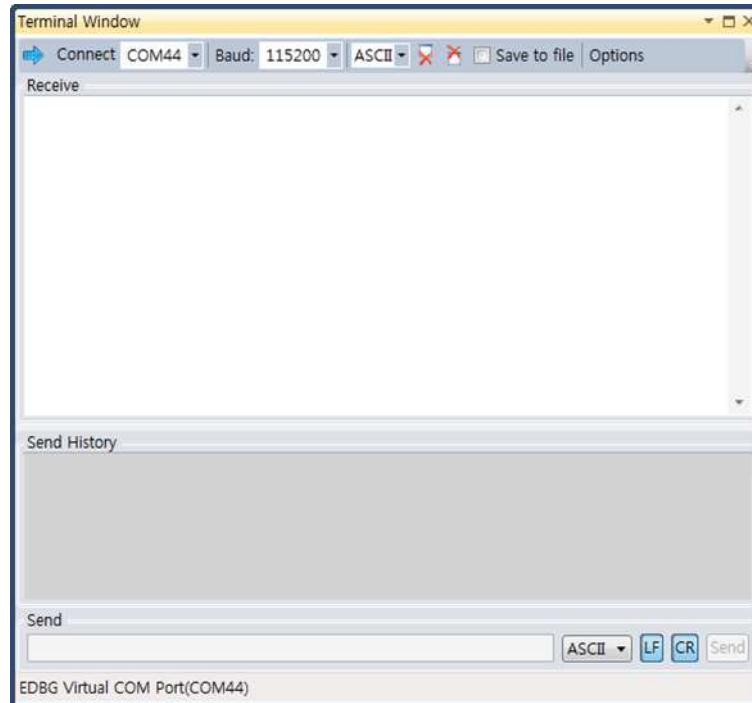
The example is now programmed and running.

Open the SAM D21 EDBG DEBUG USB serial COM port, with the following settings:

- 115200 bauds
- 8 bit data
- No parity
- One stop bit
- No flow control

Open a serial terminal tool to see the result. You can use your preferred serial terminal, such as PuTTY, Tera Term, etc. You can also use terminal window plug-in in Atmel studio. You can install it through below menu. (Menu → Tools → Extension Manager.)

Connect to the device.



## RESULT

The following information will be displayed on the terminal window.

```
-- WINC1500 weather client example --  
-- SAMD21_XPLAINED_PRO --  
-- Compiled: xxx xx xxxx xx:xx:xx -  
Provision Mode started.  
Connect to [atmelconfig.com] via AP[WINC1500_08:CA] and fill up the page.
```

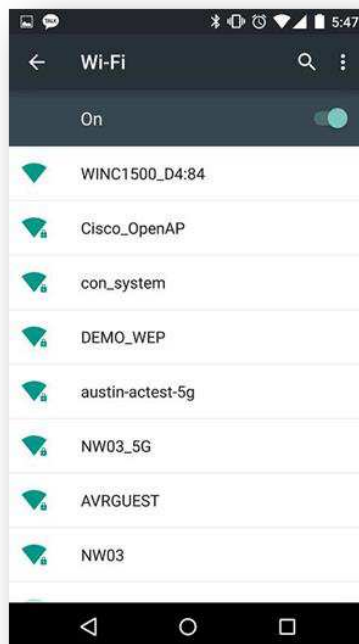
## 3.5 Provisioning

As seen in the log message, the device is waiting for provisioning. In this stage, the ATWINC1500 device will running as AP mode, waiting for user setup a credential for desired Access Point to use.

Some examples have this kind of provision function while some are not. It depends on the scenario of demo purpose.

### 3.5.1 To set up a desired AP

1. Connect your mobile device to ATWINC1500 in Wi-Fi Setting.



2. Browse the webpage (atmel.com) for setting AP, fill up the page then press Connect button.





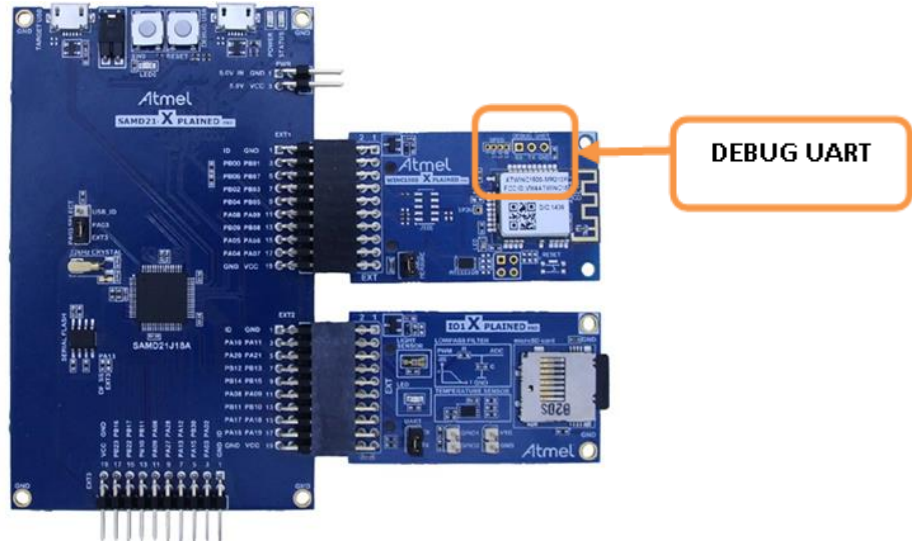
3. Then ATWINC1500 will run as a client and will connect to the AP which you selected (the mobile device will be disconnected from your ATWINC1500).
4. After the network is online, the device will communicate with the weather server. The weather info will be shown on the terminal window.

```
Wi-Fi IP is xxx.xxx.xxx.xxx
wifi_cb: M2M_WIFI_RESP_PROVISION_INFO.
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
Host IP is 144.76.102.166
Host Name is openweathermap.org
City: Seoul
Temperature: 20.63
Weather Condition: sky is clear
```

**WARNING**

It may not be operated normally if the server connection is unstable.

## 4 How to Debug ATWINC1500 Wi-Fi Firmware



ATWINC1500 Xplained Pro board provides UART interface for debugging. You can connect the ATWINC1500 Xplained Pro board to your PC using a USB-to-Serial device and a debug USB connector to get firmware debug information.

Open the ATWINC1500 DEBUG USB serial COM port, with the following settings:

- 115200 bauds
- 8 bit data
- No parity
- One stop bit
- No flow control

Open a serial terminal tool to see the result. (ATWINC1500 Wi-Fi Firmware Debug information.)

```
(1)Chip ID = 1502b1
(1)Flash ID = c21320c2, Size = 4 MBit
(1)Working Image offset = 0x3000 Rollback = 0x40000
(2)(M2M)(Efuse) successfully loaded from bank 1.
(2)EFUSE:MAC
(2)(M2M)MAC_ADDR = F8:F0:05:20:AE:BF
(3)NMI M2M SW VERSION 18.0
(3)NMI MIN DRV VERSION 18.0
(3)Built at Jan 19 2015 23:48:51
(3)___ROM_FIRMWARE___
(4)(M2M)LOAD SEC
(6)(M2M)1000 400 2f000 2fc00 38000
(7)(M2M)Wifi Connect
(7)(M2M)SSID : NW01
(7)(M2M)AUTH : WPA-Personal
(7)(M2M)PSK : nmisemi2
(8)(M2M)Channel : 256
```

Wi-Fi driver version and  
Firmware version

## 5 How to Download New ATWINC1500 Firmware

As Wi-Fi host driver is coupled with ATWINC1500 firmware, you have to match up the firmware version with the Wi-Fi host driver version. You can check these versions via firmware debug message when the device is booted up.

### 5.1 Download Firmware

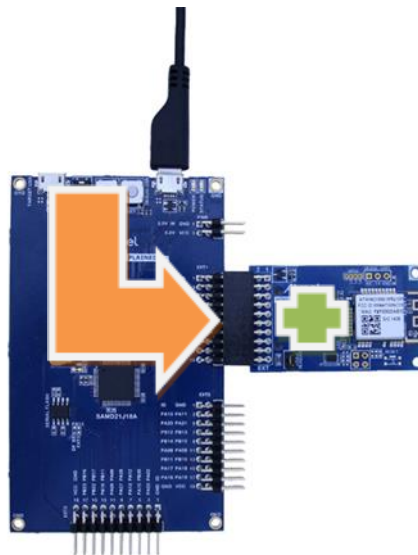
This section demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to upgrade firmware of the ATWINC1500 Wi-Fi module. This is a basic operation to download firmware. It uses the following hardware:

- The SAM D21 Xplained Pro
- The ATWINC1500 on EXT1 header

Connect the SAM D21 (DEBUG USB PORT) to the USB port on your PC.



**WARNING** Do not connect SAM D21 VIRTUAL COM PORT via terminal program.



#### STEP1: Build and run the Serial Bridge application on the SAMD21 Board.

1. Open “SAMD21\_XPLAINED\_PRO\_WINC1500\_FIRMWARE\_UPDATE” project via File → New → Example Project. (Refer to Section [3.3 How to Get Weather Client Example Project](#)) This project supports serial bridge function on SAMD21.
2. Build the program and download it into the board.
3. Start the application. The application is now ready to download ATWINC1500 firmware.

#### STEP2: Firmware update to the ATWINC1500 Board.

1. Go to “WINC1500\_FIRMWARE\_UPDATE\_AND\_DOCUMENTATION” project directory. (Refer to Section [1.3 Download and Install the Latest ATWINC1500 Extension Package](#))
2. Launch the batch file.  
`\src\samd21_xplained_pro_firmware_update.bat`



## RESULT

SUCCESS firmware download. The following information will be displayed on the command window.

```
SAMD21 flashing script: please connect edbg and power up the board.
Firmware check OK
Chiperase completed successfully
Firmware check OK
Programming completed successfully.
Mode UART
Can not find image_builder path...
Downloading Image...
*****
* >Programmer for WINC1500 SPI Flash<      *
*      Owner:  Atmel Corporation           *
*****
>>Init Programmer
Detecting ports...
EDBG Virtual COM Port(COM4)
(APP)(INFO)WINC1500 Serial Bridge Found
Avail port COM4
1 of ports found

. . .

>Start erasing...
Done
#Erase time = 4.633000 sec
>Start programming..
Done
#Programming time =6.661000 sec

Image downloaded successfully.

>>This task finished after 11.42 sec
OK
#####
##                                     ##
##          #####      ###      #####      #####      ##
##          ##      ##  ##  ##  ##      ##  ##      ##  ##
##          ##      ##  ##  ##  ##      ##      ##      ##
##          #####  ##      ##  #####      #####      ##
##          ##      #####      ##      ##      ##      ##
##          ##      ##      ##  ##      ##  ##      ##
##          ##      ##      ##  #####      #####      ##
##                                     ##
#####
Downloading ends successfully
```





## RESULT

FAILED firmware download. The following information will be displayed on the command window.

```

SAMD21 flashing script: please connect edbg and power up the board.
Firmware check OK
Chiperase completed successfully
Firmware check OK
Programming completed successfully.
Mode UART
Can not find image_builder path...
Downloading Image...
*****
* >Programmer for WINC1500 SPI Flash<      *
*      Owner:  Atmel Corporation           *
*****
>>Init Programmer
Detecting ports...
EDBG Virtual COM Port(COM4)
(APP)(ERR)[nm_bus_port_detect][567]Failed to find any COM ports
0 of ports found
(ERR)Failed To intilize programmer
Fail

#####
##                                     ##
##          #####      ###      ####  ##          ##
##          ##          ## ##      ##      ##          ##
##          ##          ##  ##      ##      ##          ##
##          #####      ##      ##      ##      ##          ##
##          ##          #####      ##      ##          ##
##          ##          ##      ##      ##      ##          ##
##          ##          ##      ##      ####  #####          ##
##                                     ##
#####

```

If you see a failed message, you must check if your device is assembled correctly.



## WARNING

You must check the terminal program. Do not connect SAM D21 VIRTUAL COM PORT via terminal program.



Retry firmware download again.

## 5.2 Download Certificate File

You need a certificate to set up a TLS connection and ATWINC1500 Firmware contains some root certificate files. This guide demonstrates how to download certificate files. It is similar to Firmware download.

It is assumed that you already have your “**Test\_Root.cer**” file.

### STEP1: Build and run the Serial Bridge application on the SAMD21 Board.

1. Connect the SAM D21 (DEBUG USB PORT) to the USB port on your PC and run “SAMD21\_XPLAINED\_PRO\_WINC1500\_FIRMWARE\_UPDATE” project. (Refer to Section [5.1 Download Firmware](#))  
The application is now ready to download certificate files.

### STEP2: Download certificate files to the ATWINC1500 Board.

1. Go to “WINC1500\_FIRMWARE\_UPDATE\_AND\_DOCUMENTATION” project directory. (Refer to Section [1.3 Download and Install the Latest ATWINC1500 Extension Package](#))
2. Go to \src\firmware\Tools\root\_certificate\_downloader\crt. You can find some cer files in the directory. (FreeRadius\_Root.cer, NMA\_Root.cer, PROWL\_Root.cer, Radius\_Root.cer)  
Copy your “**Test\_Root.cer**” file. (FreeRadius\_Root.cer, NMA\_Root.cer, PROWL\_Root.cer, Radius\_Root.cer, **Test\_Root.cer**)
3. Modify the bat file as below. Find the “RootCertDownload.bat” file in \src\firmware\Tools\root\_certificate\_downloader\debug\_uart.

```
root_certificate_downloader -n 5 NMA_Root.cer PROWL_Root.cer RADIUS_Root.cer  
FreeRADIUS_Root.cer Test_Root.cer -port 0
```

or

```
root_certificate_downloader -n 1 Test_Root.cer -port 0
```

4. Launch the batch file.  
\src\samd21\_xplained\_pro\_certificate\_update.bat



### RESULT

SUCCESS certificate download. The following information will be displayed on the command window.

```
...  
Start erasing...  
Done  
#Erase time = 0.047000 sec  
>Writing the certificate to SPI flash  
>Start programming..  
Done  
#Programming time = 0.093000 sec  
Done  
All certificates have been downloaded
```

If you see a failed message, you must check if your device is assembled correctly and retry downloading again.