

## AT17284: Proximity Cloud Based Smart Plug User Guide

### SMART ARM-based Microcontrollers

#### Introduction

This document introduces the Proximity cloud based Atmel® Smart Plug. It explains how to get the firmware code from Atmel Start, the source project structure and the APIs of Proximity Cloud Agent Library. It also describes the setup procedure and basic operations for a Proximity cloud based smart plug.

#### Features

- Proximity connectivity solutions with low footprint Agent library and SDK
- Getting started and setup procedure for Proximity cloud based smart plug
- Remote control and scheduled control with the Proximity cloud
- Device sensors data collection and UI for browsing historical data on graphs
- The Proximity Cloud Agent Main APIs

Figure 1. Atmel Smart Plug with Proximity Cloud



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# 1 Overview

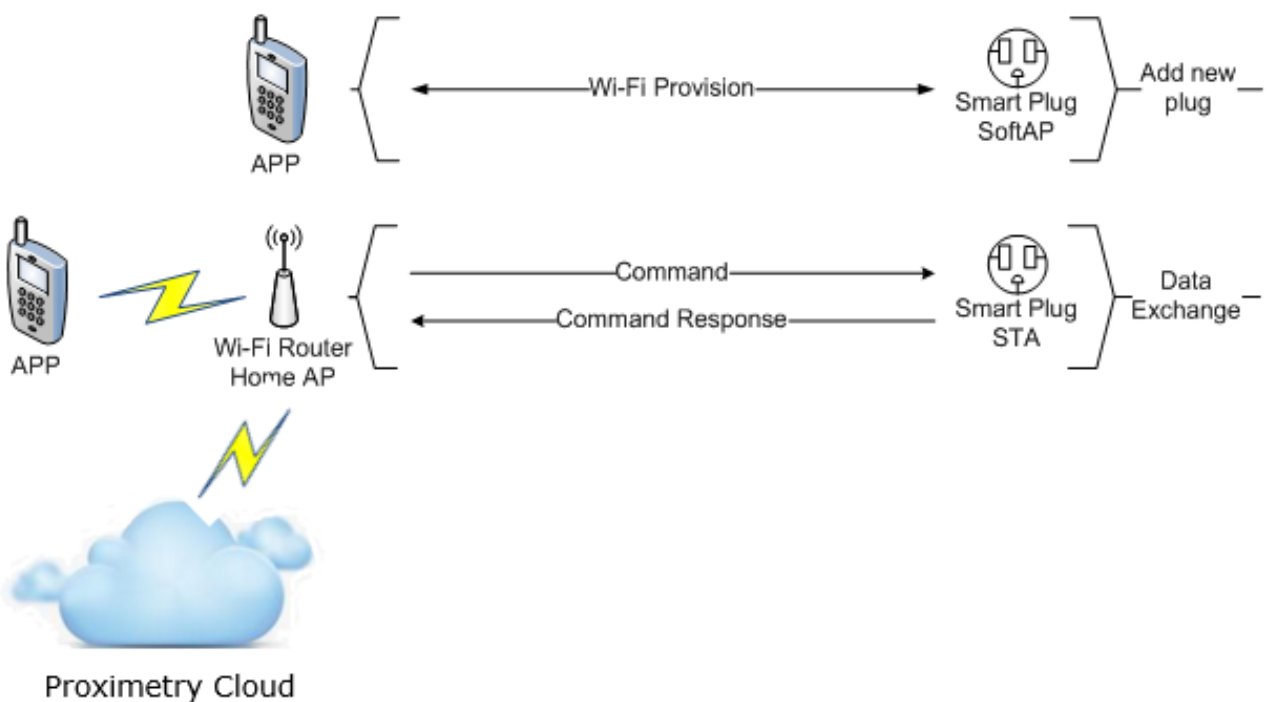
The Atmel smart plug is an IoT edge node from an IoT system level of view. It acts as a Wi-Fi® Access Point (AP) during initial setup and can be accessed and configured by the Android app, and will afterwards act as a connected node on the home Wi-Fi network.

In order to manage smart plug devices through Proximity, the users should first register a Proximity cloud account on the official Proximity website and then register the smart plug devices in the Proximity cloud.

After the smart plug has been assigned with a correct device activation code provided by Proximity and successfully connected to a Wi-Fi network, the smart plug device node can be found on the Proximity cloud account.

The smart plug work flow is shown in the figure below. This is a quite common setup for any IoT system design.

**Figure 1-1. Smart Plug Work Flow**

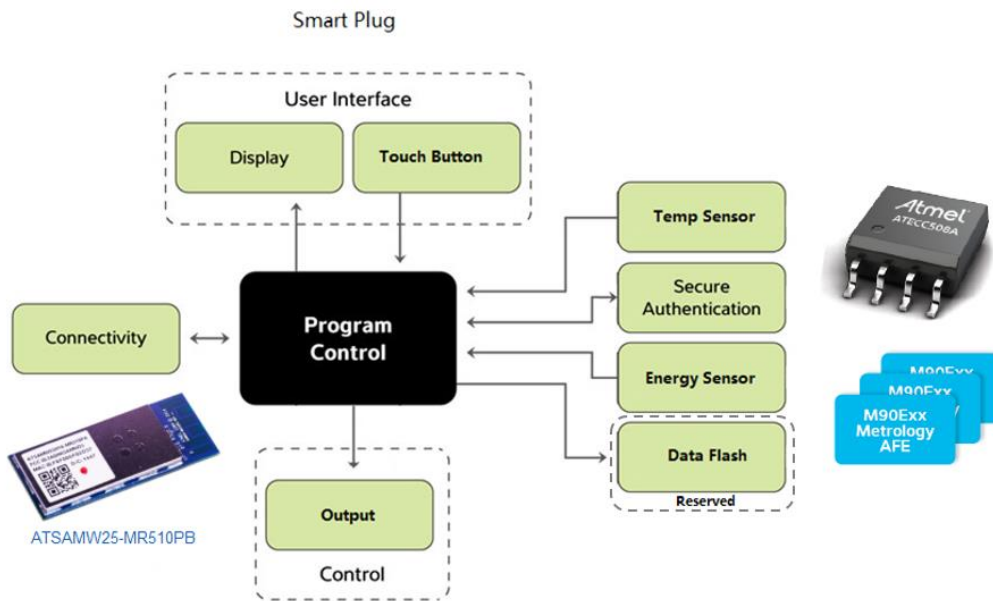


As shown in [Figure 1-1](#), there are two working stages. The first one is adding new plug stage, which is also known as provisioning stage. The second one is data exchange stage, in which the plug has been added into an existing Wi-Fi network and can be operated via the Android App and Proximity cloud. The Android App is mandatory in the Wi-Fi Provision stage. In the second stage, the users can either use the Android App or the Proximity cloud to communicate with the smart plug device. In this application note we will only focus on the operation through Proximity cloud.

## 1.1 Smart Plug Block Diagram

The smart plug usually works as an edge node in a typical IoT scenario. The block diagram of the smart plug is shown in [Figure 1-2](#).

**Figure 1-2. Smart Plug Block Diagram**



For more details about the smart plug operation, refer to the Atmel application note [AT15736: Atmel Smart Plug Getting Started Guide](#).

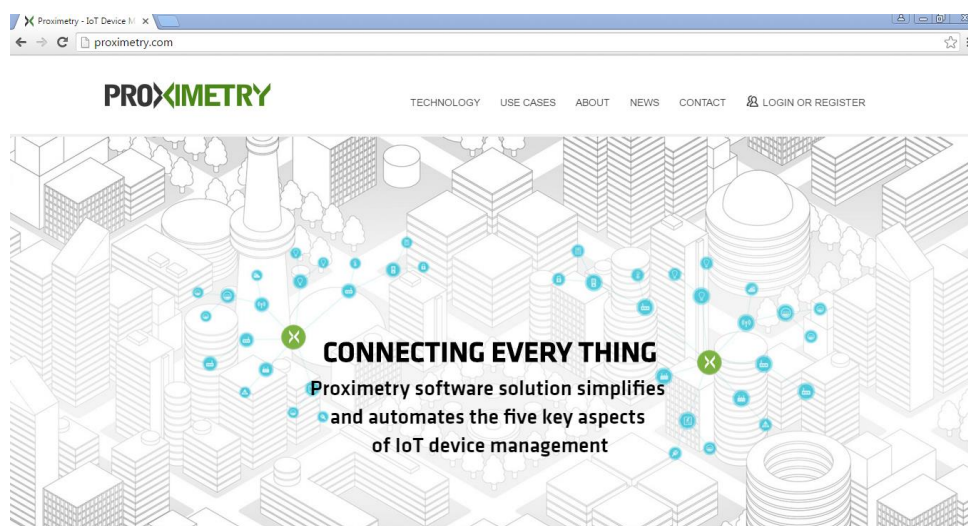
For more details about the smart plug hardware design, refer to the Atmel application note [AT16225: Atmel Smart Plug Hardware Design User Guide](#).

## 2 Proximity Cloud Account Registration and Activation

In order to manage the smart plug devices through the Proximity cloud, the users should first register an account for the Atmel cloud portal on the Proximity website. The Proximity cloud you registered must be linked to your smart plug devices, and will then allow controlling those device nodes from the cloud.

Open a Google Chrome\* window and navigate to [www.proximity.com](http://www.proximity.com) to start the registration process.

**Figure 2-1. Proximity Cloud Main Page**



Note: \*) Google Chrome is the only supported web browsers by Proximity cloud.

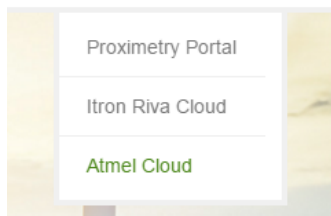
## 2.1 Proximity Cloud Account Registration

It just need to take a few steps to register a Proximity cloud account. First of all, users should get a valid e-mail address which it will be used to receive e-mail information sent from Proximity and validate the Proximity cloud account.

- On the Proximity website, go to Proximity Atmel Cloud login entrance to enter the account registration page

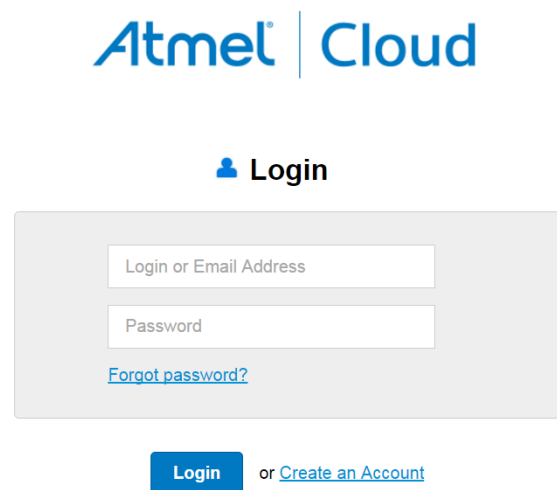
**Figure 2-2. Proximity Atmel Cloud Login Entrance**

 [LOGIN OR REGISTER](#)



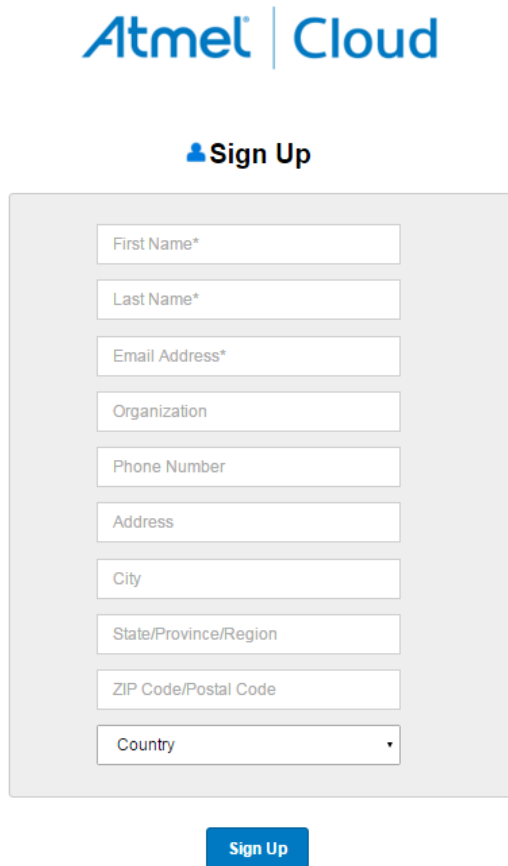
- Click on “Create an Account” to create a new Proximity cloud account

**Figure 2-3. Proximity Cloud Login Page**



- Fill in the blanks with all the necessary information especially a valid e-mail address

**Figure 2-4. Proximity Cloud Account Registration Page**



The image shows the 'Atmel | Cloud' logo at the top. Below it is a 'Sign Up' button with a person icon. The registration form is a light gray box containing several input fields: 'First Name\*', 'Last Name\*', 'Email Address\*', 'Organization', 'Phone Number', 'Address', 'City', 'State/Province/Region', 'ZIP Code/Postal Code', and a 'Country' dropdown menu. A blue 'Sign Up' button is located below the form.

- Click on “Sign Up” button to finish the account registration process

You should receive an e-mail from Proximity shortly after and in the next section we will describe how to activate the registered Proximity cloud account.

## **2.2 Activate the Proximity Cloud Account**

After you have created an account through Proximity website, you should receive a confirmation e-mail.

- Open your e-mail to check the Proximity cloud account status. You should receive a confirmation e-mail as shown in [Figure 2-5](#).

**Figure 2-5. Confirmation E-mail from Proximity**

Thank you for signing up for the Proximity Portal!

Your account is awaiting for authorization. You will receive an account activation email soon.

If you haven't received an activation email within 24 hours of your registration please [contact us](#).

Sincerely,  
The Proximity Team

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- You should receive another e-mail some hours later with a Device Activation Code provided by Proximity

**Figure 2-6. Authorization Pass E-mail from Proximity**

Thank you for activating your account, and welcome to the Atmel Cloud!

Login/Email: [jjacj223@126.com](mailto:jjacj223@126.com)

Your Device Activation Code **000001d7da504e0029de656eb1365bd74543a58a2dee03253f6397a7fee2a49bb5e9844329**

Looking for more information? For any questions please [contact us](#).

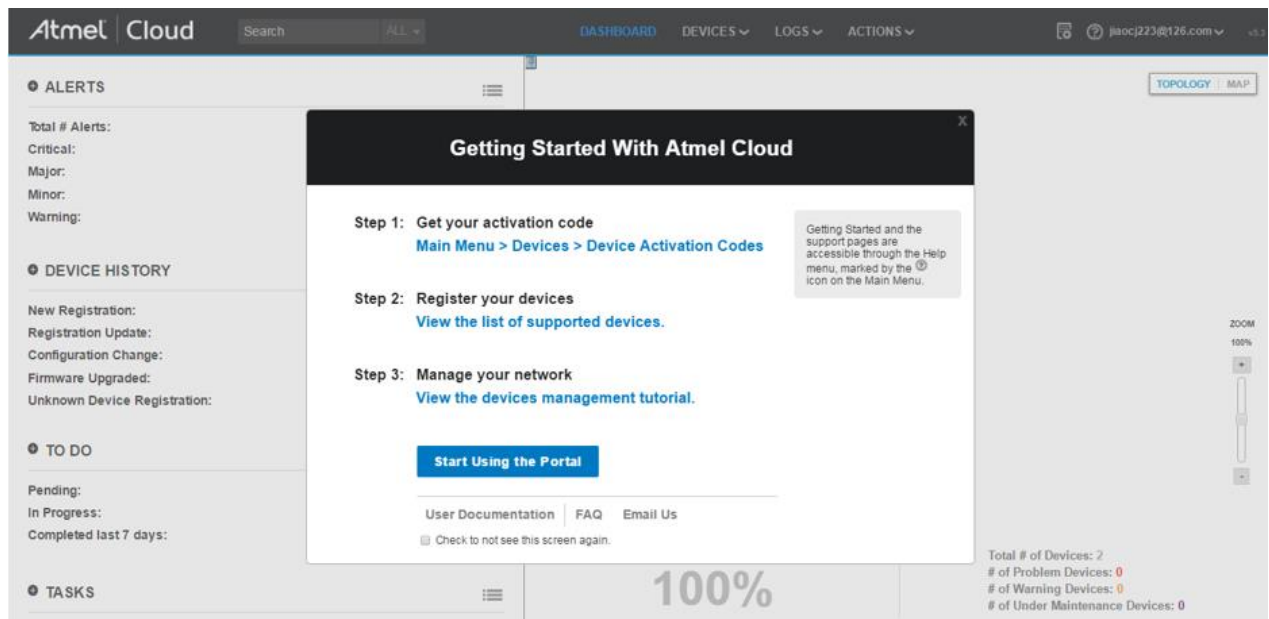
Sincerely,  
The Proximity Team

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**Note:** The Device Activation Code is used to connect Atmel Smart Plug device to your Proximity cloud account. Users should program the device activation code in the smart plug firmware. Each smart plug device should also contain a unique device activation code. For other device activation codes, you should create them through your Proximity cloud account.

- Log in to the Proximity cloud with your Proximity cloud account

Figure 2-7. Proximity Cloud Account Dashboard



Now you have successfully registered and activated your Proximity cloud account. Just close the popup window in the above figure and you are now on the Proximity cloud account dashboard page. As you haven't registered any smart plug device, you can't find any smart plug device information on this page.

### 3 Development Tools

The Proximity Cloud firmware for smart plug is based on Atmel Start ASFv4 instead of Atmel Studio ASFv3. Users can download the Proximity Cloud project source files from the Atmel Start website: <http://start.atmel.com/>.

To download or debug the firmware, the following development toolchain is used:

- **Atmel Studio 7:** Version: 7.0.634 - or above.
- **Atmel Start:** Users need to download the Proximity Cloud project from Atmel Start and then import it into Atmel Studio based project.
- Programming and debugging tool: **Atmel SAM-ICE™**.
- SAM-ICE Adaptor: a minimized (1.27mm pitch 10-pin header) adaptor for Atmel SAM-ICE. For more details, refer to **Atmel AVR®2033: SAM-ICE Adapter - Hardware User Manual**.

For more compatible development tools, refer to: <http://www.atmel.com/devices/ATSAMD21G18.aspx?tab=tools>



#### WARNING

The Atmel smart plug is designed as a real product reference design. To avoid electrical hazard, opening the case while powered by the AC input is strictly prohibited. Make sure that all connections are safe before connecting any development tools to the plug.



## 4 Getting Started with Proximity Cloud Project

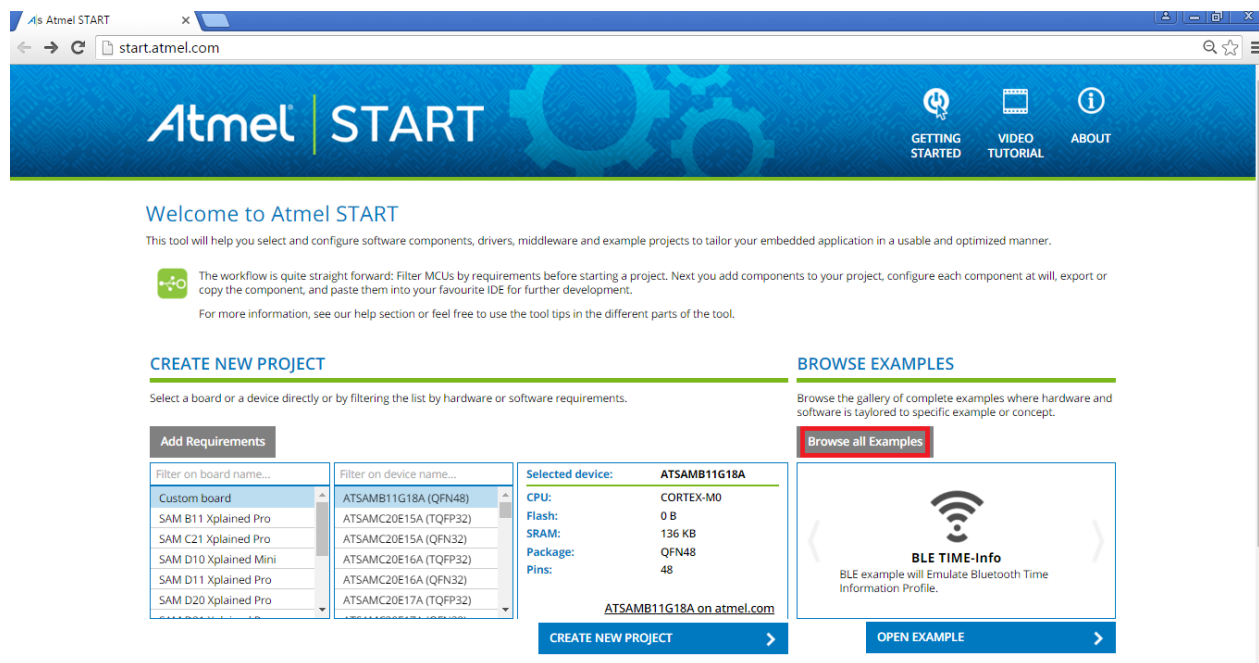
The Proximity cloud project for smart plug is already integrated in Atmel Start. Users just need to follow a few steps to download the Proximity cloud project from Atmel Start website. The Proximity cloud project is an .atzip file and can be imported into Atmel Studio 7.0. An Atmel Studio project will be created after the importing process finishes.

### 4.1 Download Proximity Cloud Project from Atmel Start

The Proximity cloud project for Atmel Smart Plug can be downloaded from the Atmel Start website. Follow the steps below to get the Proximity Cloud project source code.

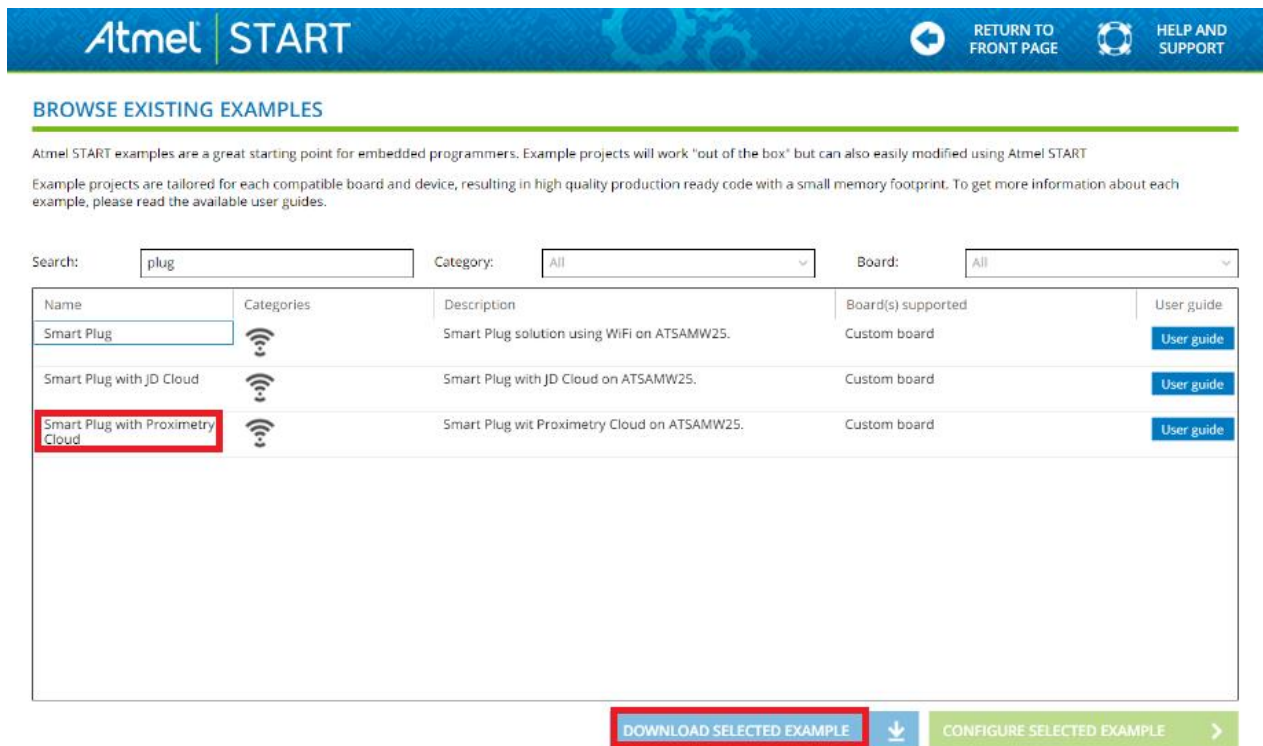
- Go to the [start.atmel.com](http://start.atmel.com) and double click on “Browse all Examples” button to get all the smart plug related project list

Figure 4-1. Atmel Start Main Page



- All the smart plug examples will be listed by typing “plug” in the search box

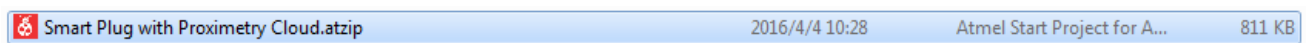
**Figure 4-2. Proximity Cloud Project on Atmel Start**



There are three projects related with smart plug devices: Smart Plug, Smart Plug with JD Cloud, and Smart Plug with Proximity Cloud. As we are using the Proximity cloud we will choose the Smart Plug with Proximity Cloud project. You can either download the project as an .atzip file by clicking on “DOWNLOAD SELECTED EXAMPLE” button or reconfigure the project by clicking on the “CONFIGURE SELECTED EXAMPLE” button.

- Download the project by clicking on “DOWNLOAD SELECTED EXAMPLE” and save it on your computer

**Figure 4-3. Proximity Cloud .atzip Project Downloaded from Atmel Start**



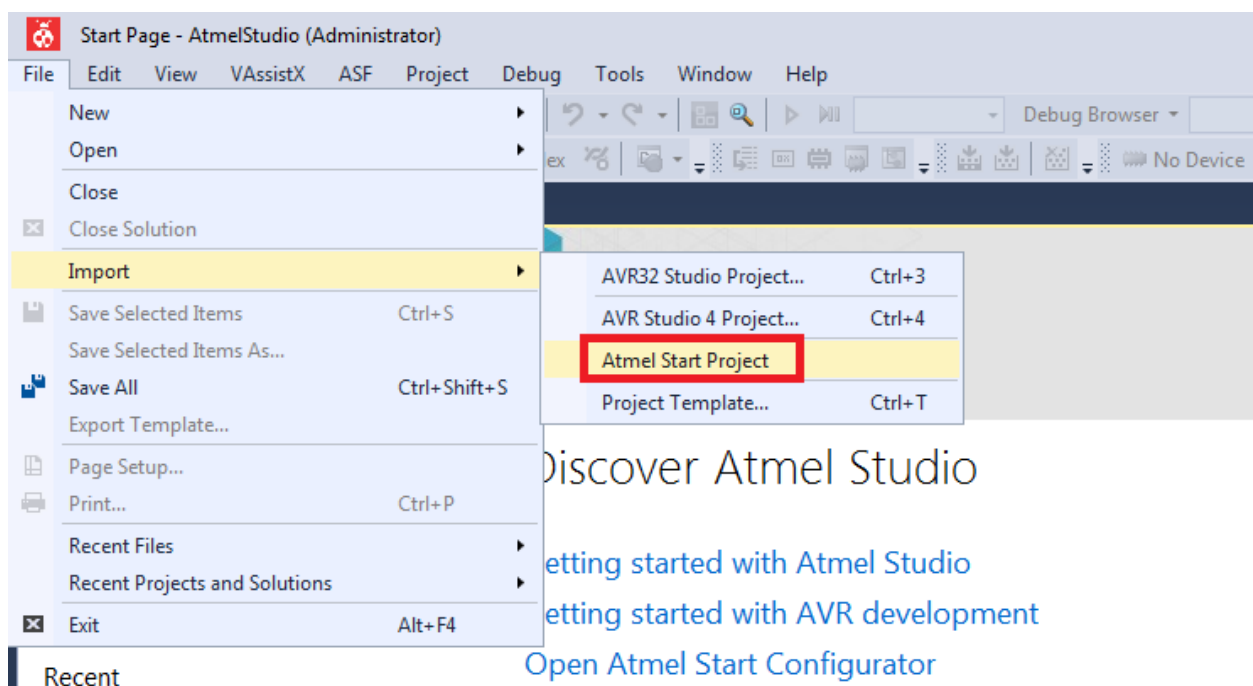
Now you get the Proximity cloud project from Atmel Start website and the default project name is "Smart Plug with Proximity Cloud.atzip".

## 4.2 Import Proximity Cloud Project into Atmel Studio 7.0

The Proximity Cloud project downloaded from Atmel Start can be imported into Atmel Studio 7.0 seamlessly. The users just need to open Atmel studio 7.0 and import the “Smart Plug with Proximity Cloud.atzip” into Atmel studio 7.0. The Atmel Studio will automatically extract all the project source files from the .atzip package and generate an Atmel Studio project.

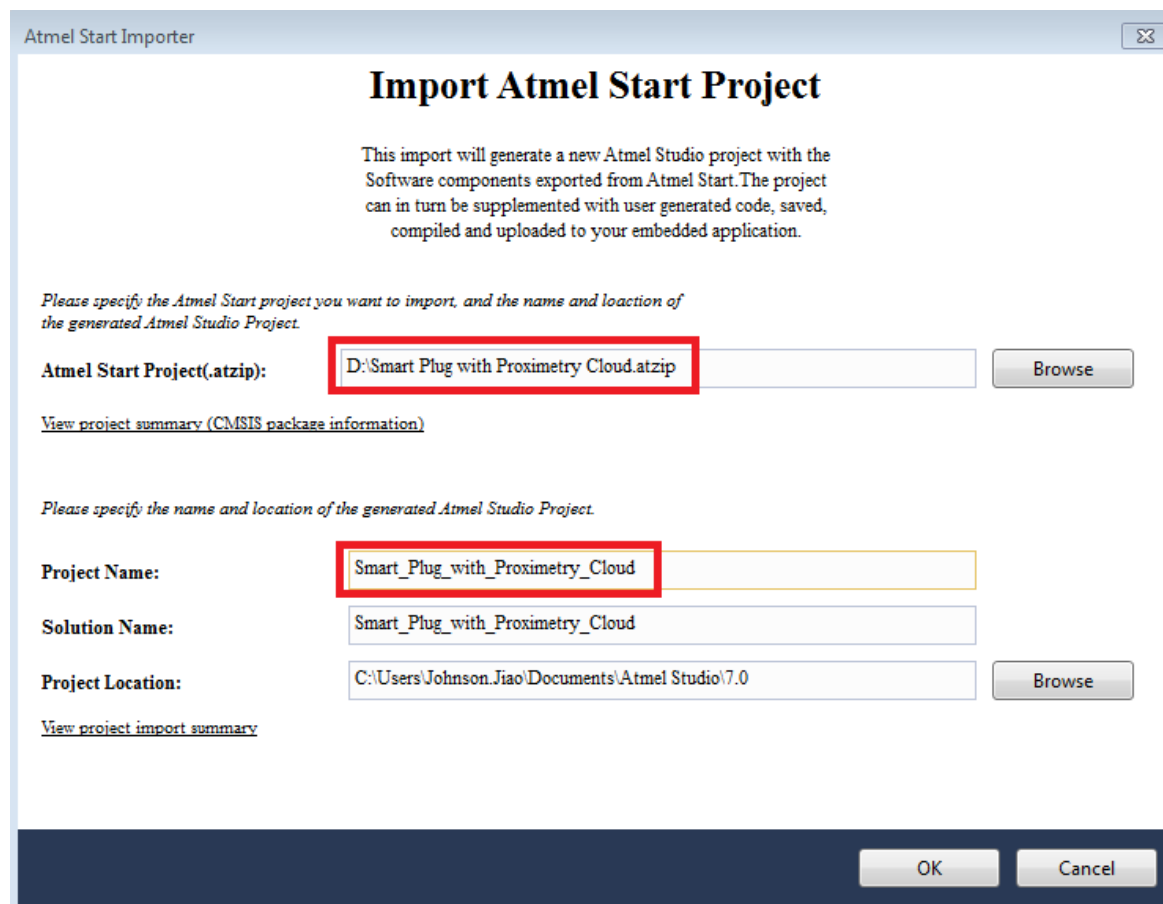
- Open Atmel Studio 7.0 and go to [File -> Import -> Atmel Start Project](#) menu

Figure 4-4. Import Menu on Atmel Studio 7.0



- Click on the “Browse” button to select the [Smart Plug with Proximity Cloud.atzip](#) file on your computer

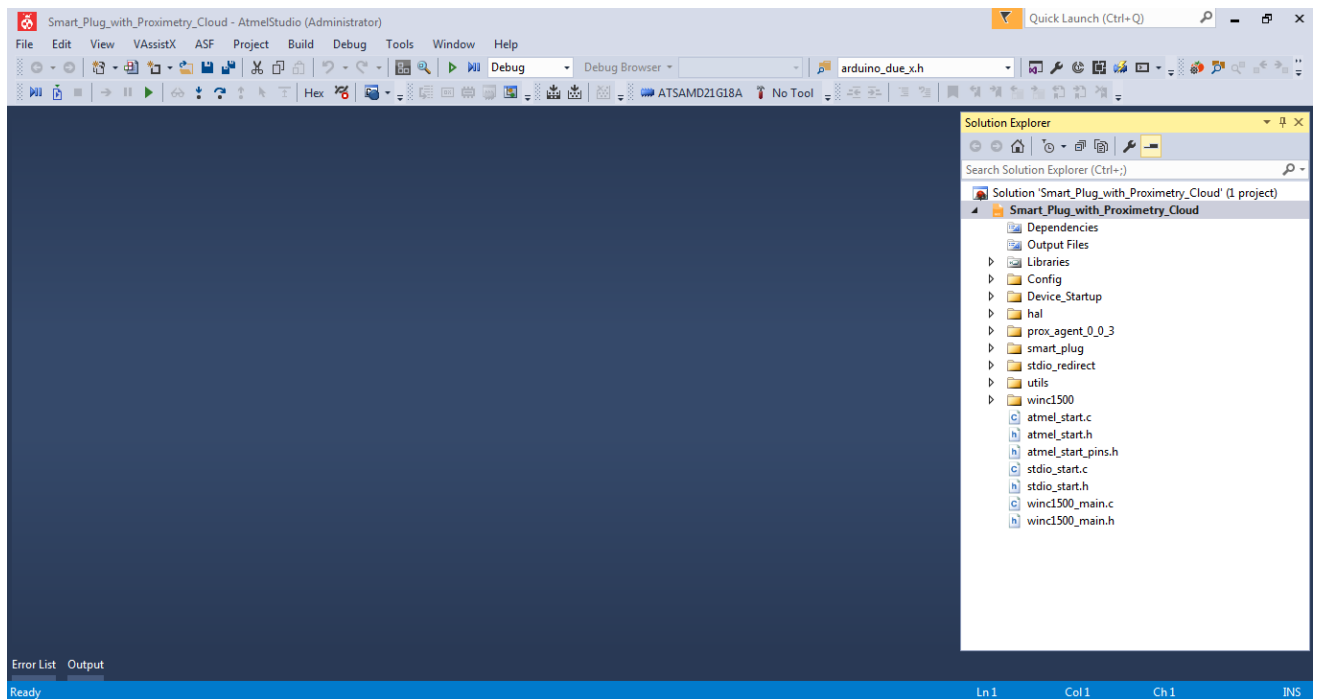
Figure 4-5. Import Atmel Start Project Wizard



You can modify the project name accordingly to replace the default project name.

- Click on the “OK” button to create an Atmel Studio project from the .atzip file

**Figure 4-6. Atmel Studio Project Created from .atzip File**



Now the Proximity cloud project from Atmel Start has successfully imported in Atmel studio 7.0 and the Atmel Studio project is created.

## 5 Firmware Architecture

The reference design firmware runs on the ATSAMD21G18 MCU embedded in the ATSAMW25 module - performing the following tasks:

- Wi-Fi connectivity – ATWINC1500 driver
- Security – ATECC508A driver and software AES
- Communication protocol and logical control
- Sensor control:
  - Energy measurement – ATM90E26 driver
  - MCU internal temperature sensor
- Touch Button - QTouch® PTC library
- LED indicator – Wi-Fi status and On/Off status
- Proximity Cloud Agent – Communicating with Proximity Cloud

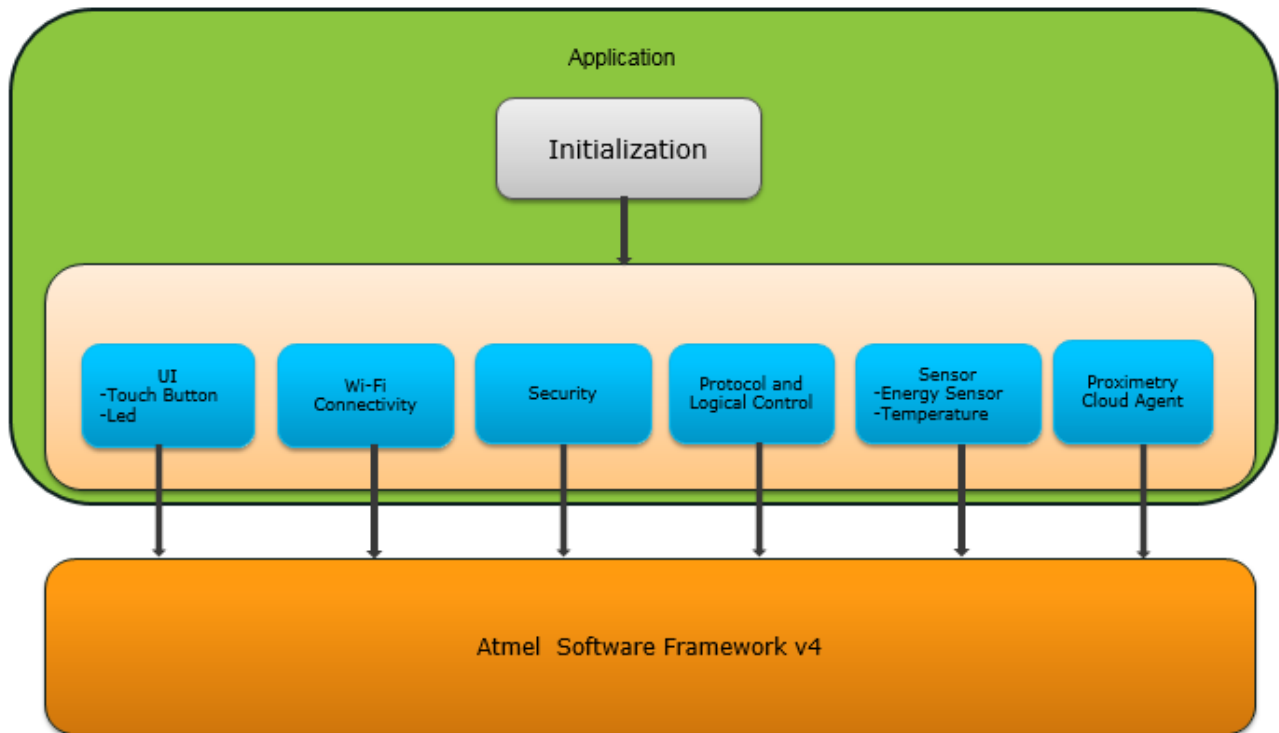
As the firmware does not use an RTOS, all these function blocks are running in an endless loop after the initialization functions have been called. Depending on different requirement, the function blocks are called at predefined intervals.

The application layer timer is based on the ARM® Cortex®-M0+ SysTick timer. It's initialized to generate a 1ms interrupt and a millisecond tick is incremented in its interrupt handler. The other application layer timers are derived from this tick.

The low level drivers are based on Atmel Start and users need to be familiar with Atmel Start code styles. A quick understanding of Atmel Start can be found on this Link:

<http://start.atmel.com/static/help/index.html?GUID-0E128A71-D76F-4FFC-8049-6D31238B672D>.

**Figure 5-1. Smart Plug Firmware Structure**



## 5.1 Wi-Fi Connectivity

The smart plug Wi-Fi function is based on the Atmel industry-leading low-power 2.4GHz IEEE® 802.11 b/g/n Wi-Fi ATWINC1500 SoC (embedded inside the ATSAMW25 module). It provides an integrated software solution with application and network services (integrated TCP/IP stack).

For more details about the Wi-Fi firmware development, refer to [Software Programming Guide for SAM W25 Xplained Pro](#) and [ATWINC1500 Wi-Fi Network Controller - Software Design Guide](#).

## 5.2 Security

Security is an integrated part of the smart plug reference design, as it is a key design factor for any IoT application. Both a hardware crypto device and software crypto library are used to achieve the desired security features. The same security functions are also implemented on the Android app side (provisioning stage) to allow them to communicate with each other.

### 5.2.1 Hardware Crypto Engine

[Atmel CryptoAuthentication™](#) device ATECC508A is used to perform high-speed public key (PKI) algorithms: ECDH (Elliptic Curve Diffie-Hellman) key agreement and ECDSA (Elliptic Curve Digital Signature Algorithm). This offloads many heavy operations from the MCU, leaving more cycles for the application. The ATECC508A crypto device also has a secure hardware-based cryptographic key storage and cryptographic countermeasures, which are more secure than software-based key storage. For more information about ATECC508A driver support, refer to <http://www.atmel.com/tools/CryptoAuthLib.aspx>.

Also note that the ATECC508A should be provisioned and/or personalized in production before it's used in a final product. For more detail, refer to the application notes below:

- [ATECC Production Provisioning Guide](#)
- [ATSHA204A and ATECC508A Personalization Guide](#)

Note: The SN of the ATECC508A included in the SAMW25 module is different with normal commercial devices. Contact Atmel technical support channel for more information.

### 5.2.2 Software Crypto Library

Besides the hardware crypto engine, a software crypto library is also included to perform the AES algorithm. In the smart plug reference design, the AES-128 CBC mode is used to encrypt and decrypt the data. A third-party library LibTomCrypt from <http://www.libtom.net/> is used for this purpose.

## 5.3 Sensor Control

The smart plug includes two sensors; one is an energy measurement sensor (ATME90E26), while the other is the internal temperature sensor of the SAM D21 MCU.

The ATM90E26 is a high-performance energy metering device that is accessed by the MCU via a UART interface. It is used to measure real-time output current, voltage, power, and accumulated electrical energy output by the smart plug. Check more about ATM90E26 usage in application note: <http://www.atmel.com/Images/Atmel-46102-SE-M90E26-ApplicationNote.pdf>.

The temperature sensor is integrated with the MCU ADC peripheral. It is easy to read the ADC result and calculate the temperature. Read more about this temperature sensor in the ATSAMD21G18 datasheet.

## 5.4 QTouch PTC Library

The MCU (ATSAMD21G18) embedded in the ATSAMW25 module is equipped with a PTC (peripheral touch controller) module. Due to the autonomous operation, the PTC uses very little CPU resources and provides high quality touch performance. Atmel provides the QTouch PTC library to support code development, making it easy to add a touch button to the smart plug design.

For more about touch application based on the PTC, refer to:

- <http://www.atmel.com/tools/QTOUCHLIBRARYPTC.aspx>

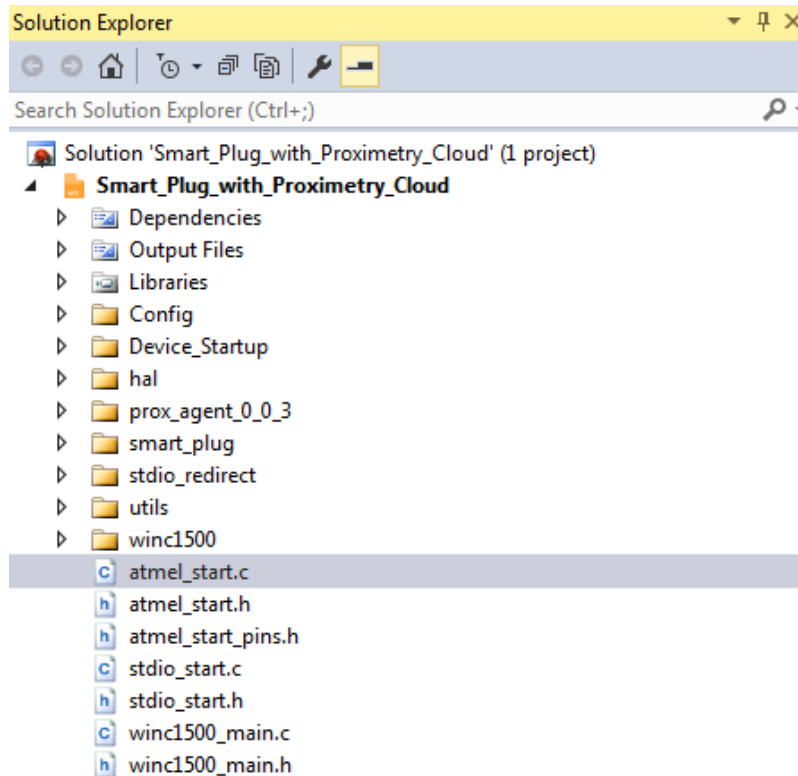
## 5.5 Proximity Cloud Agent

Proximity provides a library named libampagent.a to access Proximity Cloud. The library implements a lot of interfaces that can be used to initialize and set up communication with the Proximity cloud. The users can use the related interfaces to register the smart plug device with a valid device activation code in Proximity cloud. After the communication channel is successfully set up, the smart plug device can write to or read from Proximity cloud through the Proximity Cloud Agent.

## 6 Source Code Structure

From Section 0 of this user guide, the .atzip Proximity Cloud project downloaded from Atmel Start can be imported in Atmel Studio 7.0 and finally an Atmel Studio project will be created as shown in Figure 6-1.

Figure 6-1. Proximity Cloud Project on Atmel Studio



The source code structure of Proximity cloud project is as below:

- **Libraries:** The Proximity Cloud Project Library. There are three libraries in the Proximity cloud Project: libm, libsamd21\_touch\_gcc.a, and libampagent.a.
  - **libm:** default math library for each Atmel Start project
  - **libsamd21\_qtouch\_gcc.a:** library for QTouch operation, provided by Atmel
  - **libampagent.a:** library for communicating with Proximity Cloud, provided by Proximity
- **Config:** Configuration files for different peripherals and components. Users can find all the MCU peripheral configuration files under the “Config” directory. Take the hpl\_adc1\_v120\_config.h as an example, it represents the configuration file for ADC peripheral.
- **Device Startup:** The samd21g18a\_flash.ld is the default device link file for the samd21g18a chip. By default, the firmware will be downloaded into the flash address with offset at 0x0.
- **hal:** Hardware Abstraction Layer for Different Peripherals. The hal directories contain four sub-directories; hpl, hri, include, and src. The directories and files are auto generated if the users try to create an Atmel Start based project. Once a peripheral is selected and configured properly through Atmel Start webpage, the corresponding hpl and hri files and directories will also be created automatically.
  - **hpl:** hal proxy layer
  - **hri:** hal register interface
  - **include:** include files for hal
  - **src:** source files for hal



- [prox\\_agent\\_0\\_0\\_3](#): Proximity Cloud Agent Library and Interfaces.
  - [libampagent.a](#): Proximity Cloud Agent Library
  - [amp\\_agent.h](#): This file exposes all the interfaces to communicate with the Proximity cloud
  - [prox\\_agent\\_config.h](#): This file mainly defines the cloud server address and port information and pre-defined activation code
- [smart plug](#): The smart plug main directory contains main source files needed for UI, crypto, energy sensor, QTouch, Proximity Agent, etc. The main function is contained in file `main_samd21_prox.c`.
- [winc1500](#): ATWINC1500 Wi-Fi BSP. The ATWINC1500 Wi-Fi BSP is located in the directory `winc1500`. It contains all interfaces/drivers to communicate with the ATWINC1500 from the SAM D21.

## 7 Proximity Cloud Connectivity Based on Smart Plug

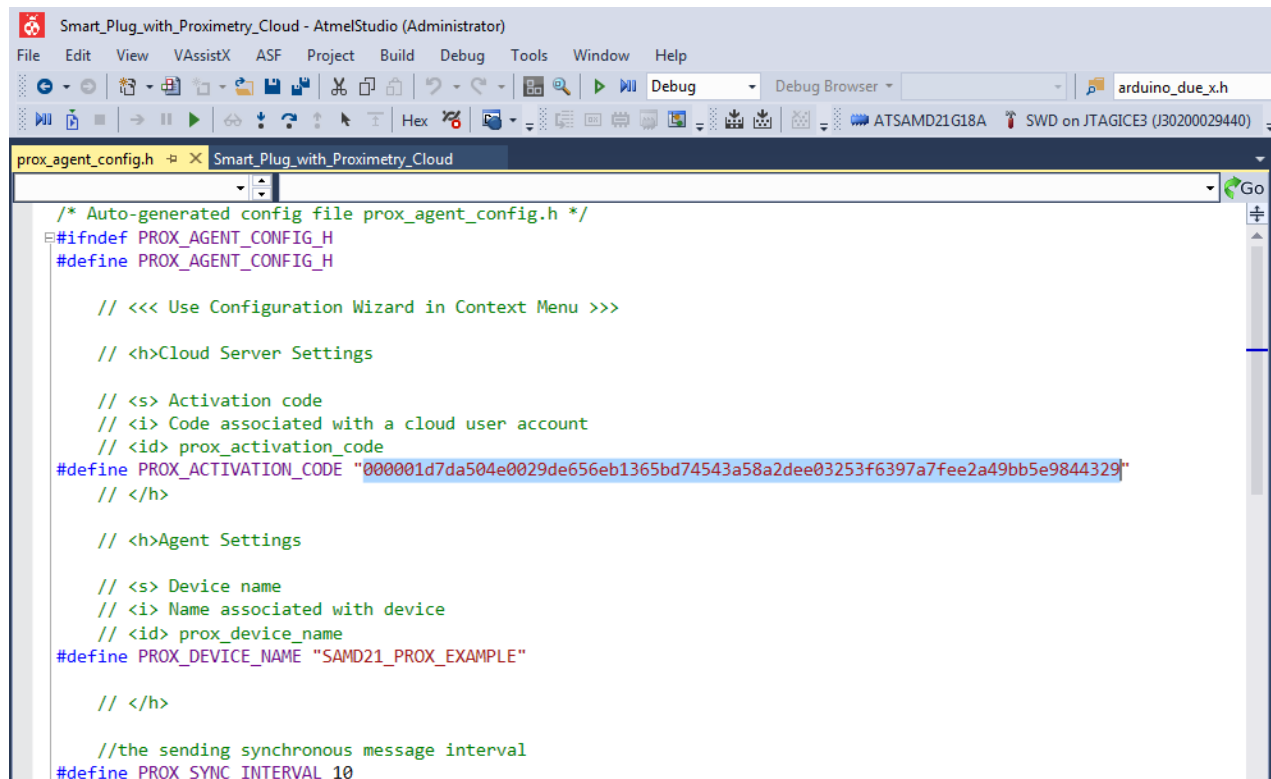
There are several steps to register a smart plug device in Proximity cloud. After the smart plug firmware has been programmed with a valid device activation code and configured by Android App to connect with a Wi-Fi router, the users can view the registered smart plug device information through the Proximity cloud.

Follow the steps below to register a smart plug device in Proximity cloud.

### 7.1 Register Smart Plug Device in Proximity Cloud

- On the `Smart_Plug_with_Proximity_Cloud` project, open the `prox_agent_config.h` file and replace the device activation code received in your e-mail

**Figure 7-1. Programming Device Activation Code in Smart Plug Firmware**



```

/* Auto-generated config file prox_agent_config.h */
#ifndef PROX_AGENT_CONFIG_H
#define PROX_AGENT_CONFIG_H

    // <<< Use Configuration Wizard in Context Menu >>>

    // <h>Cloud Server Settings

    // <s> Activation code
    // <i> Code associated with a cloud user account
    // <id> prox_activation_code
#define PROX_ACTIVATION_CODE "000001d7da504e0029de656eb1365bd74543a58a2dee03253f6397a7fee2a49bb5e9844329"
    // </h>

    // <h>Agent Settings

    // <s> Device name
    // <i> Name associated with device
    // <id> prox_device_name
#define PROX_DEVICE_NAME "SAM21_PROX_EXAMPLE"

    // </h>

    //the sending synchronous message interval
#define PROX_SYNC_INTERVAL 10
  
```

- Save the file, recompile the project, and program the firmware into the smart plug device
- Power on the smart plug and configure the smart plug device to connect to a Wi-Fi router through the android smart plug app



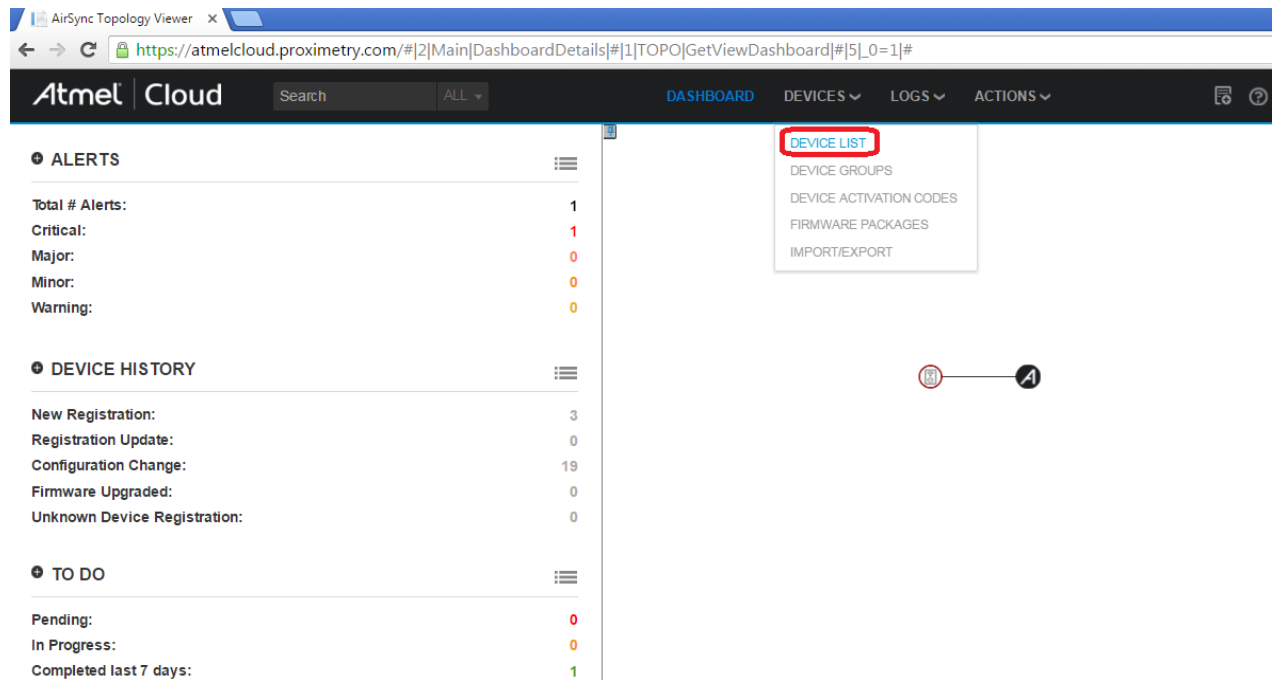
Now the smart plug device has registered into the Proximity cloud.

Note: Users should refer to AT15736: Atmel Smart Plug Getting Started Guide to setup the smart plug to connect to a Wi-Fi router.

## 7.2 View Smart Plug Device Information through Proximity Cloud Account

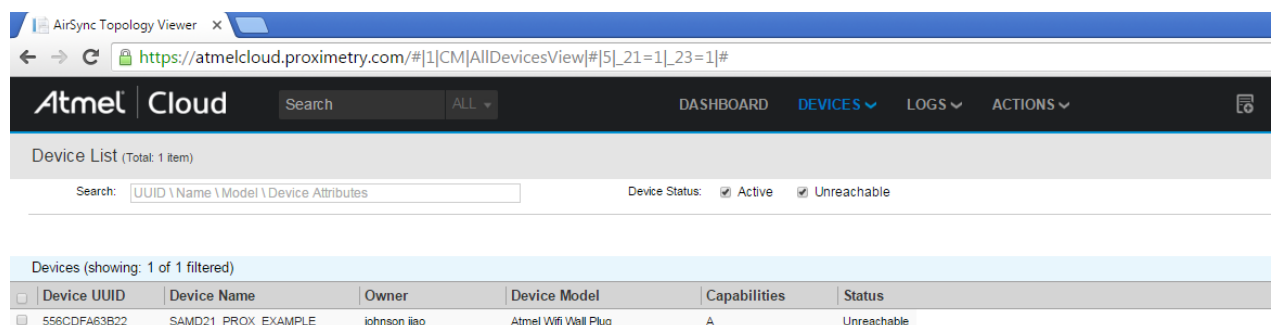
- Wait until the smart plug connects to a Wi-Fi router, log in to the Proximity cloud with your account through: [www.proximity.com](http://www.proximity.com).

Figure 7-2. Proximity Cloud Account Dashboard



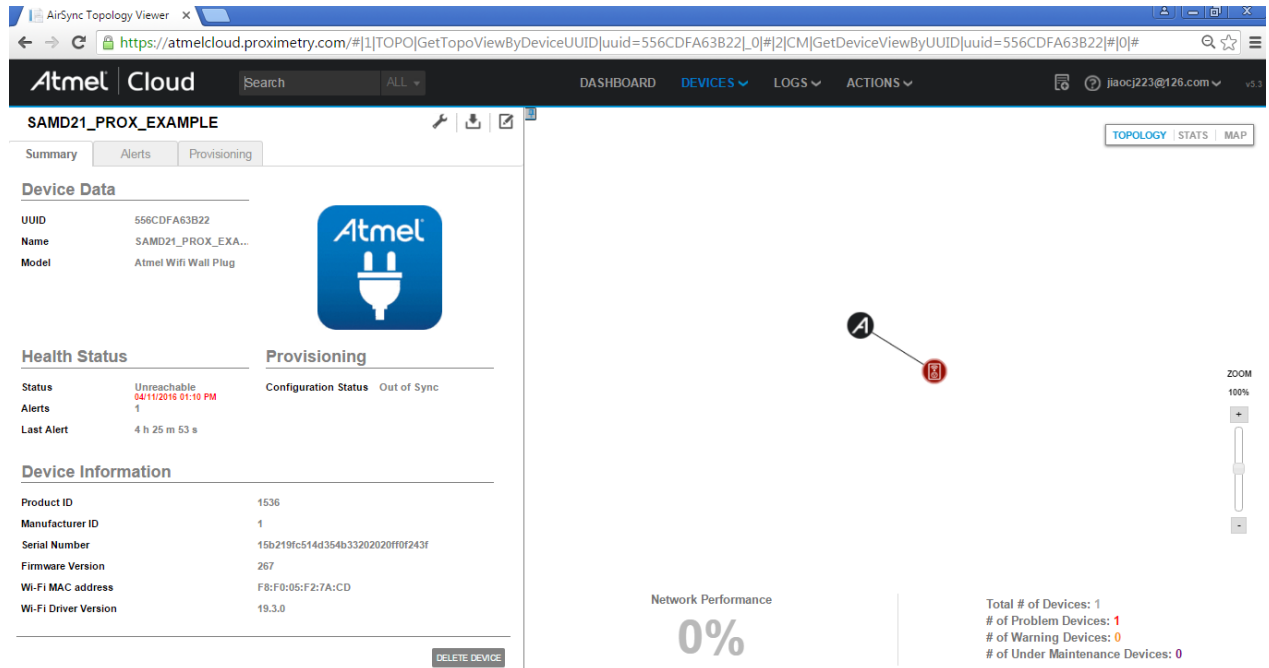
- Select DEVICES->DEVICE LIST to view the registered smart plug device

Figure 7-3. Smart Plug Device List



- Double click “SAMD21 PROX EXAMPLE” to get more detailed information about this device node

**Figure 7-4. Smart Plug Device Detail Information**



## 8 Proximetry Cloud Usage and Operations

The Proximetry cloud provides several ways to manage and operate the registered smart plug devices. We will introduce Proximetry cloud operations and usage and show how to manage the registered smart plug devices.

Proximetry cloud operations Include:

- Device activation code operations
- Device List operations
- Device Group operations

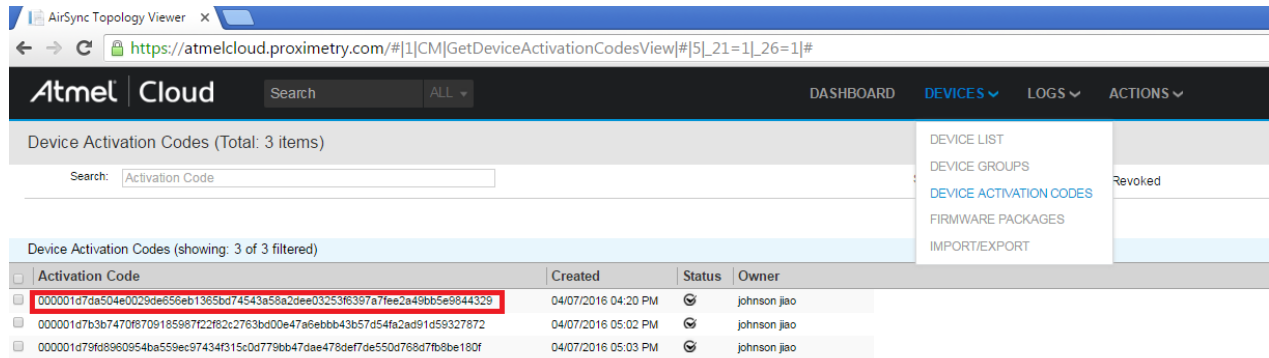
Proximetry cloud device control:

- Smart Plug device On/Off control
- Smart Plug device scheduled control

### 8.1 Device Activation Code Operations

The device activation code provides the only connection between your Proximetry cloud account and the smart plug device. You need to program a correct device activation code in the smart plug firmware in order to connect to your Proximetry cloud. Log in to the Proximetry cloud with your registered account, and then navigate to [DEVICES -> DEVICE ACTIVATION CODES](#) to get the device activation code list as shown in [Figure 8-1](#).

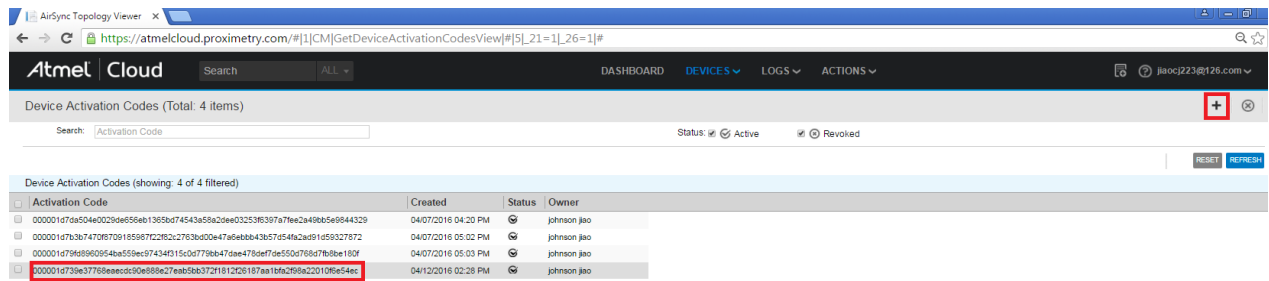
**Figure 8-1. Device Activation Code List**



A device activation code list will show up. Note that there is a default device active code created by Proximity when your Proximity account was created for the first time.

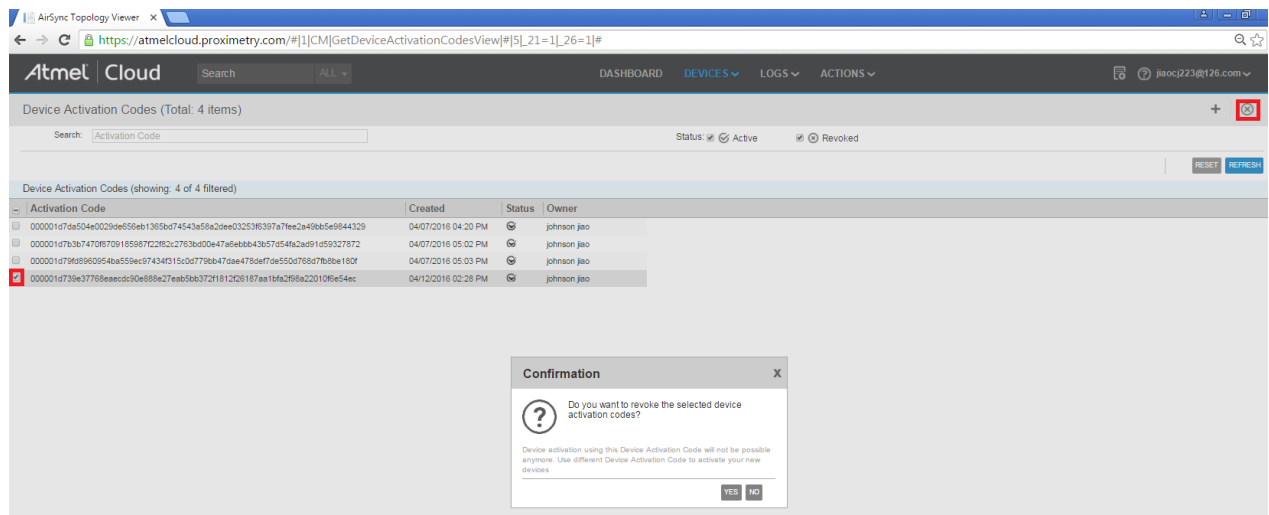
- Click on the “+” icon on the top right to add a new device activation code

**Figure 8-2. Adding a Device Activation Code**



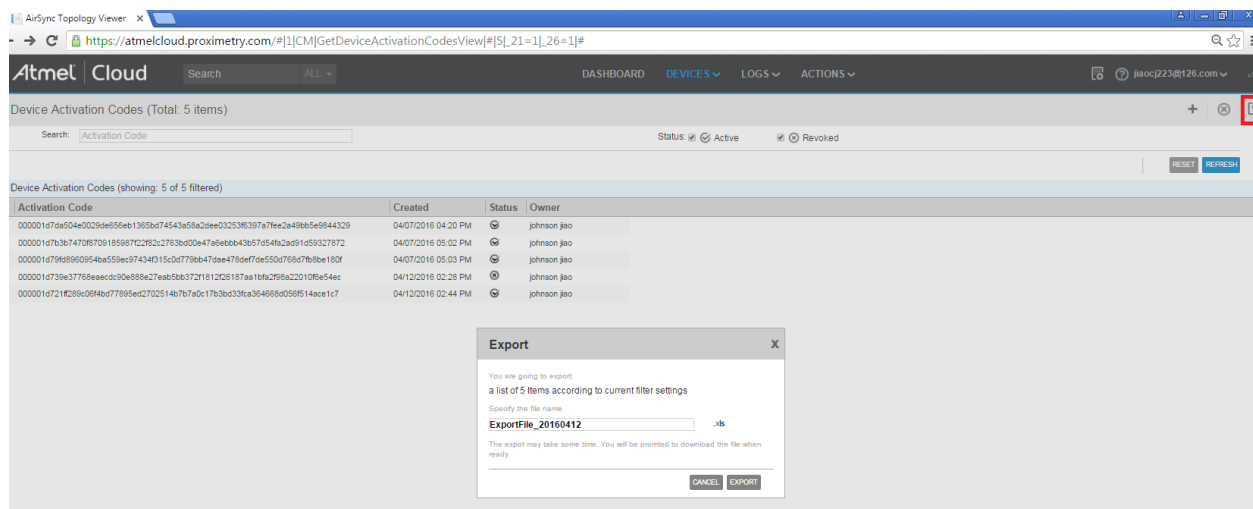
- Click on the “X” icon on the top right to delete a device activation code. Once it is deleted, it can’t be recovered and the deleted device activation code can’t be used any more.

**Figure 8-3. Deleting a Device Activation Code**



- Click on the export icon as shown in Figure 8-4 to export all the device activation code to a file

**Figure 8-4. Exporting Device Activation Code in Batch**

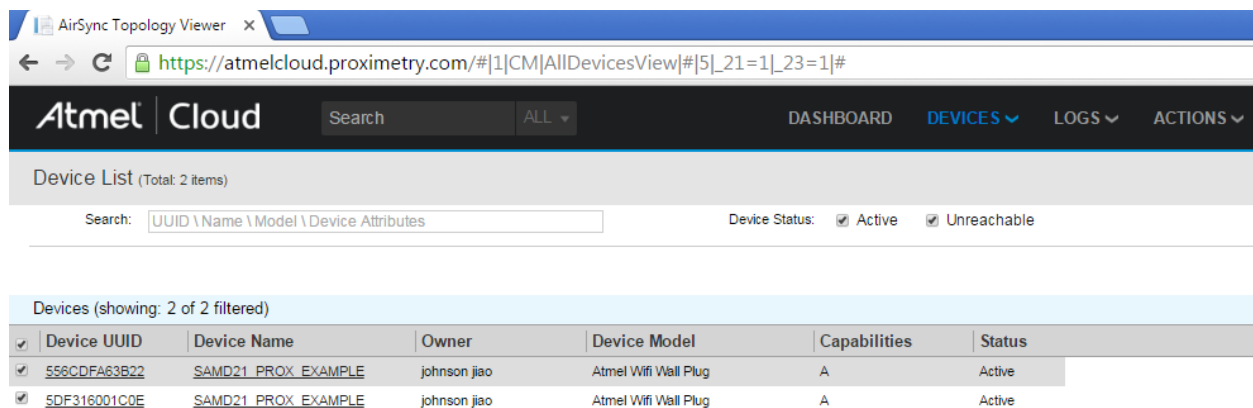


In mass production, each device will need a unique device activation code. Figure 8-4 provides a convenient way to export all the device activation codes in batch to a file. Note that you should click the “+” to create enough device activation codes first.

## 8.2 Proximity Cloud Device List Operations

The users can get the smart plug device list under the Proximity Cloud Account by clicking on menu “DEVICE-> DEVICE LIST”. Go to “DEVICE-> DEVICE LIST”.

**Figure 8-5. Proximity Cloud Device List**



In Figure 8-5 there are two smart plug devices in the list. Each device is assigned with a Device UUID. This UUID is automatically created by Proximity Cloud when a device is registered.

- Double click on the Device UUID or Device Name to view the device's detailed information

Figure 8-6. Proximity Cloud Device Detail Information

The screenshot displays the 'Atmel Cloud' interface for a specific device. At the top, there's a header with the 'Atmel Cloud' logo, a search bar, and a dropdown menu set to 'ALL'. Below the header, the device name 'SAMD21\_PROX\_EXAMPLE' is shown with icons for settings, download, and share. A tabbed interface includes 'Summary' (selected), 'Alerts', and 'Provisioning'. The 'Device Data' section lists: UUID (556CDA63B22), Name (SAMD21\_PROX\_EXA...), and Model (Atmel Wifi Wall Plug), accompanied by a blue Atmel plug icon. The 'Health Status' section shows the device is 'Active' with a timestamp '19 m 2 s'. The 'Provisioning' section shows 'Configuration Status' as 'In Sync'. The 'Device Information' section lists: Product ID (1536), Manufacturer ID (1), Serial Number (15b219fc514d354b33202020ff0f243f), Firmware Version (267), Wi-Fi MAC address (F8:F0:05:F2:7A:CD), and Wi-Fi Driver Version (19.3.0).

- The users can also check a specific device node and click on the delete icon on the top right to delete a specific device

Figure 8-7. Deleting a Proximity Cloud Device Node

The screenshot shows the 'Atmel Cloud' interface with the 'DEVICES' tab selected. The top navigation bar includes 'DASHBOARD', 'DEVICES' (selected), 'LOGS', and 'ACTIONS'. The user profile 'jiaocj223@126.com' is visible. The 'Device List (Total: 2 items)' section has a search bar, device status filters (Active, Unreachable), and a 'Delete Devices' button. A table lists two devices. The first device, with UUID '556CDA63B22' (highlighted with a red box), is named 'SAMD21\_PROX\_EXAMPLE', owned by 'johnson jao', and is an 'Atmel Wifi Wall Plug' with status 'Active'. The second device has UUID '5DF316001G0E' and is also 'Active'. A red box highlights the delete icon (trash can) in the top right corner of the device list area.

Device UUID	Device Name	Owner	Device Model	Capabilities	Status
556CDA63B22	SAMD21_PROX_EXAMPLE	johnson jao	Atmel Wifi Wall Plug	A	Active
5DF316001G0E	SAMD21_PROX_EXAMPLE	johnson jao	Atmel Wifi Wall Plug	A	Active

- Select the device nodes you want to operate and click on the configuration icon on the top right to perform a specific task based on the selected nodes

**Figure 8-8. Proximity Cloud Device Configuration**

The screenshot shows the Atmel Cloud dashboard. At the top, there's a navigation bar with 'Atmel Cloud', a search bar, and tabs for 'DASHBOARD', 'DEVICES', 'LOGS', and 'ACTIONS'. Below this, a 'Device List (Total: 2 items)' section is visible. It includes a search bar, a 'Device Status' filter (Active, Unreachable), and a 'Group Configuration Change' button. A table lists the devices:

Device UUID	Device Name	Owner	Device Model	Capabilities	Status
556CDA63B22	SAMD21_PROX_EXAMPLE	johnson jao	Atmel Wifi Wall Plug	A	Active
5DF316001C0E	SAMD21_PROX_EXAMPLE	johnson jao	Atmel Wifi Wall Plug	A	Active

One or more device node can be selected each time. A new window will pop up as shown in [Figure 8-9](#).

**Figure 8-9. Group Configuration Change Panel**

The screenshot shows the 'Group Configuration Change' panel. It has a title bar with a close button. Below the title bar, there's a section for 'Available configuration parameters' with three tabs: 'Product Info', 'Wi-Fi Configuration', and 'On/Off'. The 'Product Info' tab is selected, showing 'Schedule' and 'Alerts Config'. To the right, a message states 'This operation will affect 2 devices' and a table lists the affected devices:

Device UUID	Device Model
556CDA63B22	Atmel Wifi Wall Plug
5DF316001C0E	Atmel Wifi Wall Plug

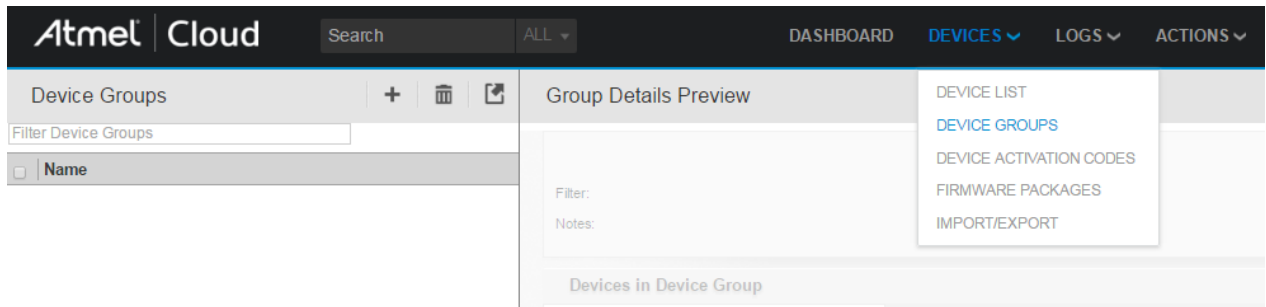
At the bottom, there are 'CANCEL' and 'SAVE' buttons. A note at the bottom left states '\* device restart required'.

The users can see the Wi-Fi configuration information, perform the ON/OFF operation, and set some schedule on the smart plug device, etc. We will introduce the ON/OFF and schedule operation later.

### 8.3 Proximity Cloud Device Group Operations

Smart plug devices can be arranged as a device group in the Proximity cloud for better management. Go to "DEVICES"->"DEVICE GROUPS" to create a device group and assign devices to a group.

**Figure 8-10. Proximity Cloud Group Operation Main Page**



- Click on the “+” icon to add a new group. Enter the group name and click on “NEXT” button to continue.

**Figure 8-11. Adding a New Device Group in Proximity Cloud**

- Click on the “+” button to define the Filter Condition

**Figure 8-12. Add New Device Group Wizard**

The screenshot shows the 'Add New Device Group' wizard with three steps: 1. Basic Group Information, 2. Group Filters, and 3. Summary. The 'Filter Condition' dialog is open, titled 'Define Filter Condition'. It prompts the user to 'Define filtering criteria for a Device Group'. The 'Parameter' is set to 'Model', the 'Operator' is '=', and the 'Value' is a list of device models. 'Atmel Wifi Wall Plug' is selected and highlighted with a red box. The 'Relation' is set to 'AND'. Buttons for 'CANCEL', 'OK', 'PREVIOUS', and 'NEXT' are visible.

There are a lot of Atmel device models listed in the Proximity cloud. The smart plug device model name is “Atmel Wifi Wall Plug”.

- Follow the wizard and click on the “NEXT” button and a new group will be created

**Figure 8-13. New Device Group with Two Smart Plug Device Nodes**

The screenshot shows the Atmel Cloud interface. On the left, there's a 'Device Groups' sidebar with a search bar and a list of groups. The main area shows 'Group Details Preview' for a group named 'Atmel Smart Plug'. The filter is set to 'Model = Atmel Wifi Wall Plug'. Below this, there's a table titled 'Devices in Device Group' with columns: Device Name / Device Type / Device UUID, Device UUID, Name, Device Model, Capabilities, and Status. Two devices are listed, both with the name 'SAMD21 PROX EXAMPLE' and model 'Atmel Wifi Wall Plug', both with status 'Active'.

Device Name / Device Type / Device UUID	Device UUID	Name	Device Model	Capabilities	Status
✓	556CDA63B22	SAMD21 PROX EXAMPLE	Atmel Wifi Wall Plug	A	Active
✓	SDF316001C0E	SAMD21 PROX EXAMPLE	Atmel Wifi Wall Plug	A	Active

Now you have created a group containing two smart device nodes.

## 8.4 Smart Plug ON/OFF Control

Smart Plug devices can be controlled to be ON/OFF status through the Proximity cloud. The following steps show how to control the ON/OFF action on smart plug devices.

- Go to the device list table and double click on the name (SAMD21 PRO EXAMPLE) of the first smart plug device. A new window will pop up as shown in [Figure 8-14](#).



**Figure 8-14. Smart Plug Detail Information**

The screenshot shows the Atmel Cloud interface for device SAMD21\_PROX\_EXAMPLE. The left sidebar contains tabs for Summary, Alerts, and Provisioning. The main content area is divided into several sections: Device Data (UUID: 556CDA63B22, Name: SAMD21\_PROX\_EXA..., Model: Atmel Wifi Wall Plug), Health Status (Status: Active, Configuration Status: Out of Sync), Device Information (Product ID: 1536, Manufacturer ID: 1, Serial Number: 15b219fc514d354b33202020f0f243f, Firmware Version: 267, Wi-Fi MAC address: F8:F0:05:F2:7A:CD, Wi-Fi Driver Version: 19.3.0), and Smart Plug Control. A network topology diagram is shown on the right, and a 'Network Performance' section displays '100%'. The interface also includes a search bar, navigation links (DASHBOARD, DEVICES, LOGS, ACTIONS), and a user profile dropdown.

- Click on Provisioning panel, then focus on “On/Off” sub-panel, click “EDIT” button to change the ON/OFF status, and click on “SAVE” button to make the ON/OFF action active.

**Figure 8-15. Smart Plug ON/OFF Control through Proximity Cloud**

The screenshot shows the Atmel Cloud interface for device SAMD21\_PROX\_EXAMPLE, with the Provisioning tab selected. The 'On/Off' sub-panel is active, showing a dropdown menu with 'On' and 'Off' options. The 'On' option is currently selected. Below the dropdown, there is a 'Schedule' sub-panel. At the bottom of the Provisioning panel, there are 'CANCEL' and 'SAVE' buttons. A network topology diagram is shown on the right, and a 'Network Performance' section displays '100%'. The interface also includes a search bar, navigation links (DASHBOARD, DEVICES, LOGS, ACTIONS), and a user profile dropdown.

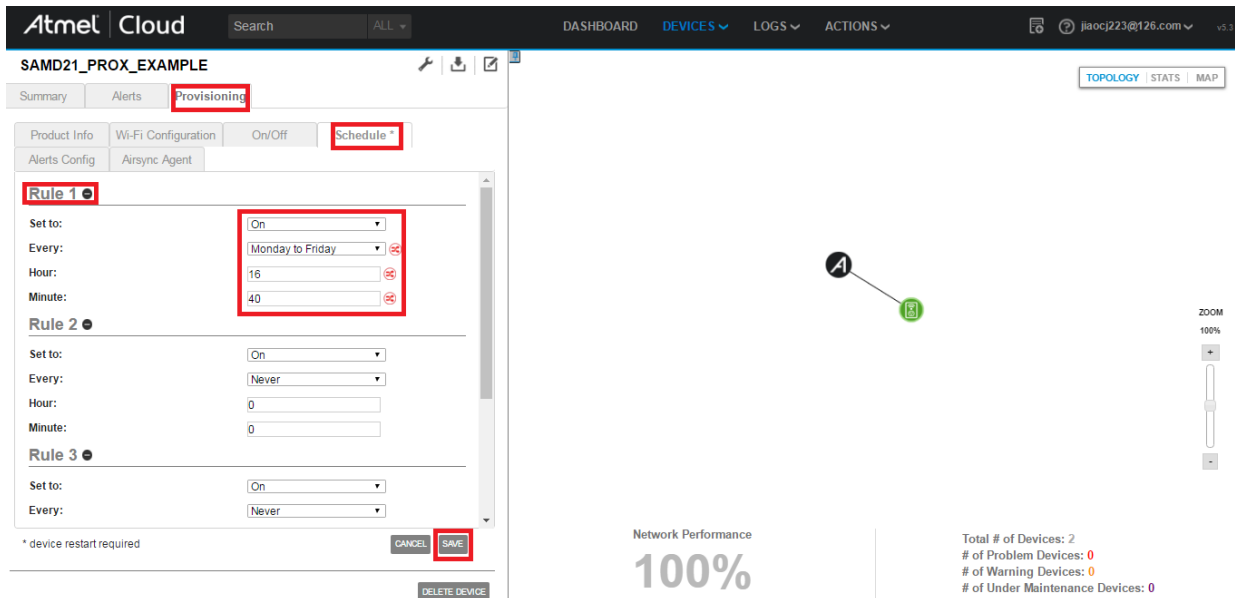
The smart plug device will be in ON/OFF status immediately according to the selection.

## 8.5 Smart Plug Scheduled Control

The scheduled control through the Proximity cloud is similar with the ON/OFF control.

- Go to the device list table, double click on the name (SAMD21 PRO EXAMPLE) of the first smart plug device. A new window will pop up as shown in [Figure 8-14](#).
- Click on Provisioning panel, then focus on “Schedule” sub-panel, click “EDIT” button to set the scheduling task, and click on “SAVE” button to make the schedule active

**Figure 8-16. Scheduled Control through Proximetry Cloud**



As shown in Figure 8-16, totally four scheduled tasks can be set from Rule1 to Rule 4. In each Rule, the status can be set to ON/OFF, and the time interval can refer to “Every” item from Monday to Sunday. The “Hour and Minute” decide the ON/OFF schedule time.

For example, if we set the “Set to” as “On”, “Every” as “Monday to Friday”, “Hour” and “Minute” are “16” and “40”, it means that the smart device plug will be in “On” status in time 16:40 from Monday to Friday.

## 9 Proximetry Cloud APIs introduction

The Proximetry Cloud Agent provides a lot of APIs to access the Proximetry Cloud. We will describe some basic Proximetry APIs which helps us to understanding the communication process between the smart plug device and the Proximetry Cloud.

- Proximetry Agent Initialization

```
prox_agent_socket_init(void); // initialize a UDP socket to communicate with Proximetry Cloud
prox_agent_init(void); // Proximetry Cloud Agent Initialization
```

These two functions are invoked only when the smart plug is in station mode and connected to a Wi-Fi router. After the Android App has successfully configured the smart plug to connect to a Wi-Fi router, the Proximetry Agent can be initialized.

- Callback APIs to communicate with Proximetry Cloud

```
prox_agent_param_changed(amp_param_t *param); // This function is invoked by the Proximetry Agent Library, as a callback, when a configuration parameter has been changed from the Cloud service.
```

```
prox_agent_send_msg(uint8_t *data, uint16_t size); // Agent utilizes this routine to send message, Proximetry Cloud Server address and port number are defined in prox_agent_config.h
prox_agent_time_ms(void); // get the current time in ms
```

```
prox_agent_stats_update(void); // This routine is invoked periodically by the Proximetry Agent Library to send statistics to the Cloud
```

- Proximetry Sync task run every one second

```
amp_agent_sync_task(); // sync task run every one second to perform Agent functionality
```

For more Proximetry cloud related APIs, the users can refer to the smart plug project source codes.

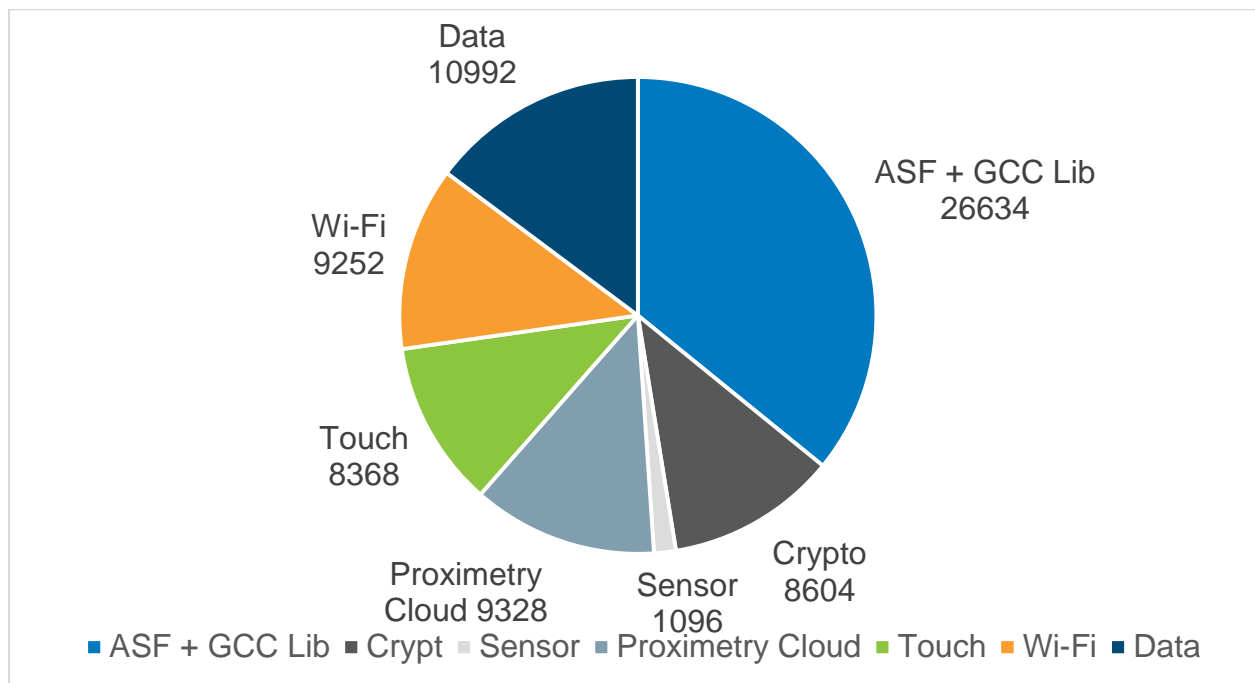
## 10 Memory Footprint

Here is the Proximity cloud smart plug project overall memory size generated in Atmel Studio 7 with GCC optimization option set to -o1.

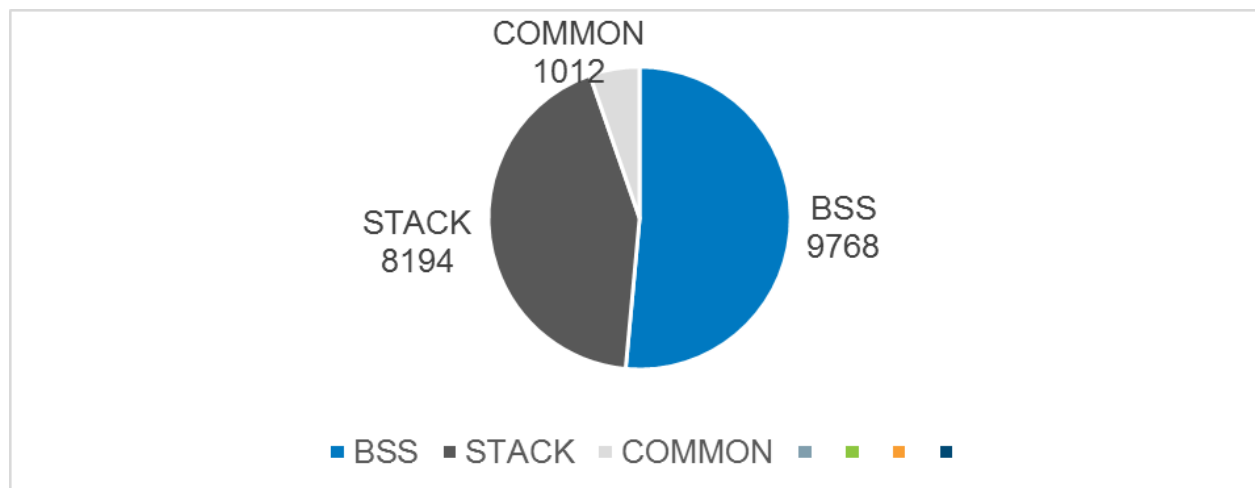
- Program Memory Usage: 96840 bytes, 36.8% Full
- Data Memory Usage: 20004 bytes, 61.0% Full

Figure 10-1 and Figure 10-2 show the memory usage grouped by the smart plug function blocks.

**Figure 10-1. Flash Memory Footprint [Byte]**



**Figure 10-2. SRAM Memory Footprint [Byte]**



## 11 Revision History

Doc Rev.	Date	Comments
42724A	4/2016	Initial document release.



**Atmel Corporation** 1600 Technology Drive, San Jose, CA 95110 USA T: (+1)(408) 441.0311 F: (+1)(408) 436.4200 | [www.atmel.com](http://www.atmel.com)

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