Wi-Fi Network Controller Software Programming Guide

Introduction

This software programming guide describes the ATWINC1500 Wi-Fi Network Controller to build state-of-the-art Internet of Things (IoT) applications.

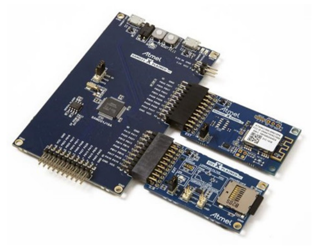
The following topics will be covered:

- How examples are organized.
- Target board information.
- Instruction for each example.

Prerequisites

- Hardware Prerequisites
  - SAM D21 Xplained Pro Evaluation Kit
  - ATWINC1500 extension (For more details, refer, user guide)
  - IO1 extension
  - Micro-USB Cable (Micro-A/Micro-B)
- Software Prerequisites
  - Atmel Studio 7.0 (For more details, refer, user guide)
  - Wi-Fi IoT Examples (for more details, refer to application notes)

Figure 1 SAM D21 XSTK Board Demo Setup



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1. How the Examples are Organized

This example package consists of several example codes and projects. The examples are organized in different level of codes to explain ATWINC1500 API usage – from basic Wi-Fi operations to advanced topics. These examples are categorized as:

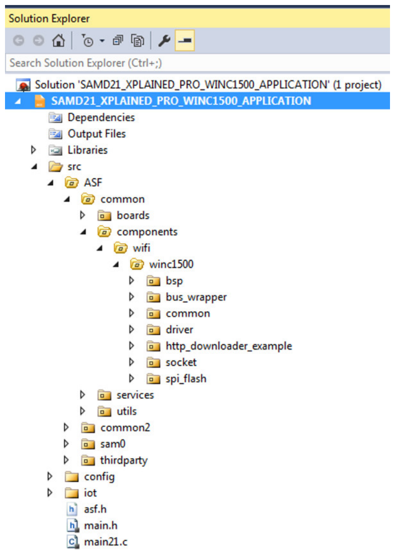
- Basic
- Protocol
- Advanced

2. Source Organization

There are some folders automatically allocated according to user configurations. The example source consists of `main.c` and `main.h`. The structure of application source codes is:

- ./src/ASF
  - All ASF modules' source code are located in this folder. You can select various modules with the ASF wizard and it will configure the content in this folder.
- ./src/config
  - This folder consists of configuration header files for the SAM D21 and extension boards.
- ./src/iot
  - Some protocol/advanced examples have this folder. It contains the source code of IoT protocols like HTTP, MQTT, etc.
- ./src/ASF/common/components/wifi/winc1500
  - This is the driver source folder of ATWINC1500 Wi-Fi module.

Figure 2-1. ATWINC1500 Application Solution Explorer



```
Solution Explorer
Search Solution Explorer (Ctrl+;)
Solution 'SAMD21_XPLAINED_PRO_WINC1500_APPLICATION' (1 project)
  SAMD21_XPLAINED_PRO_WINC1500_APPLICATION
    Dependencies
    Output Files
    Libraries
    src
      ASF
        common
          boards
          components
            wifi
              winc1500
                bsp
                bus_wrapper
                common
                driver
                http_downloader_example
                socket
                spi_flash
          services
          utils
        common2
        sam0
        thirdparty
      config
      iot
      asf.h
      main.h
      main21.c
```

Note: Some examples may have additional source files, but the structure is similar across the samples.

3. Basic Operation Code

This section explains the basic code for using the SAM D21 and ATWINC1500. These application API codes may differ according to the purpose of your actual application.

3.1 Basic Examples

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

- How to read the Chip ID (to identify WINC1500 H/W revision differences)
- How to set/get the MAC address of the Wi-Fi module
- How to start Wi-Fi in a specific operation mode, such as:
  - STA Mode (Station mode, known as a Wi-Fi client)
  - AP mode (Access Point mode)
  - P2P mode (Peer-to-Peer mode, also known as Wi-Fi Direct®)
- How to switch mode between STA, AP and P2P modes during the runtime
- How to scan an AP list that is nearby
- How to set Deep Sleep mode
- How to connect to a secure Wi-Fi using WEP/WPA/WPA2 security
- How to connect to an enterprise security network
- How to connect to a security WPS
- How to set packet monitoring
- How to get an RF signal status by reading the RSSI value
- How to set AP provision
- How to set HTTP provision

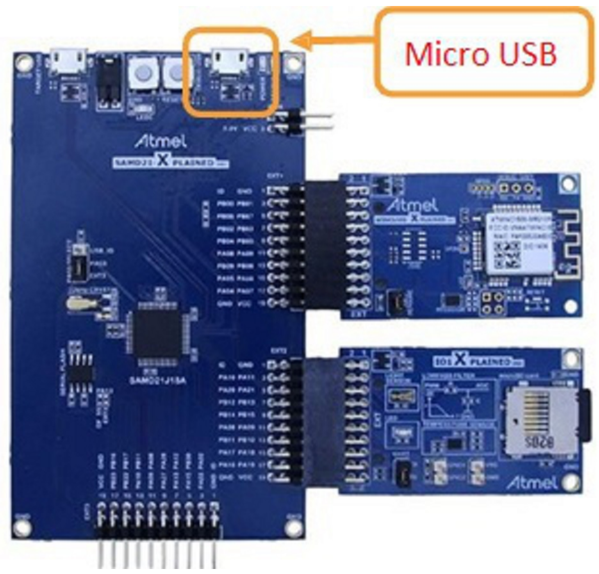
3.1.1 How to Read the Chip ID

This example demonstrates how to retrieve the chip information of the ATWINC1500 using the SAM D21 Xplained Pro board. This is a basic operation to identify which HW version is used.

It uses the following hardware requirement:

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

Figure 3-1. Get Chip ID Demo Setup



3.1.1.1 Execution

`main.c` - Initialize the ATWINC1500 and retrieve information.

1. Code summary.
   – `nmi_get_chipid()` function returns the chip ID of the ATWINC1500.
   – `nmi_get_rfrevid()` function returns the RF revision ID.

```
/* Display WINC1500 chip information. */
printf("Chip ID : \r\t\t\t%x\r\n", (unsigned int)nmi_get_chipid());
printf("RF Revision ID : \r\t\t\t%x\r\n", (unsigned int)nmi_get_rfrevid());
```

2. Build the program and download it into the board.
3. Start the application.

3.1.1.2 Get Chip ID Demo Console Log

Note: The succesful execution of the application provides the information in the console.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Chip ID : 1503a0
RF Revision ID : 1
Done.
```

Note: ATWINC1500 behavior and corresponding log messages can be different depending upon the revision.

3.1.2 How to Set/Get the MAC Address

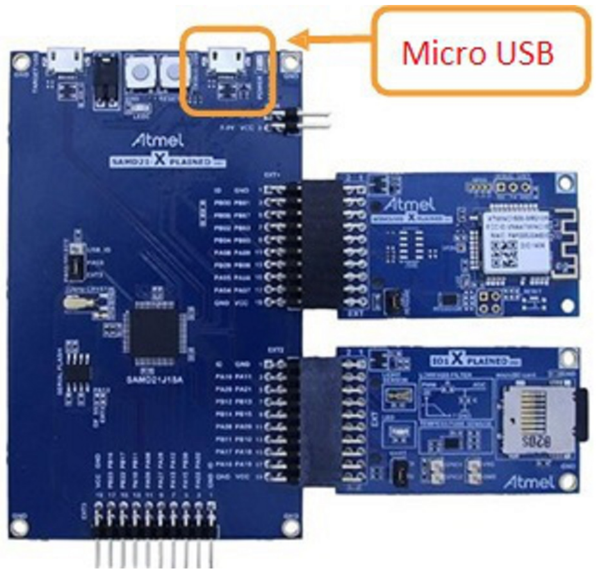
This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to retrieve the MAC address of the Wi-Fi module.

The example uses the following hardware:

- The SAM D21 Xplained Pro

- The ATWINC1500 on the EXT1 header

Figure 3-2. Demo Setup



3.1.2.1 Execution

Initialize the ATWINC1500 and retrieve information.

1. Code summary.
   – The MAC address is typically stored in the OTP-ROM. You can get it via the `m2m_wifi_get_otp_mac_address()` function.

```
/* Get MAC Address from OTP. */
    m2m_wifi_get_otp_mac_address(mac_addr, &u8IsMacAddrValid);
```

   – To set the user defined MAC address in the program memory, the `m2m_wifi_set_mac_address()` function is used. This API needs to be called whenever the system resets. This API overwrites the program memory MAC address, which is loaded from the OTP memory in the initialization process.

```
/** User define MAC Address. */
        const char main_user_define_mac_address[] = {0xf8, 0xf0, 0x05, 0x20, 0x0b,
0x09};
       /* Cannot found MAC Address from OTP. Set user define MAC address. */
    m2m_wifi_set_mac_address((uint8_t *)main_user_define_mac_address);
```

   – The API `m2m_wifi_get_mac_address()` is used to read the program memory MAC address. It is currently using by the WLAN device.

```
/* Get MAC Address. */
    m2m_wifi_get_mac_address(mac_addr);
    printf("%02X:%02X:%02X:%02X:%02X:%02X\r\n",
            mac_addr[0], mac_addr[1], mac_addr[2],
            mac_addr[3], mac_addr[4], mac_addr[5]);
```

2. Build the program and download it into the board.
3. Start the application.

3.1.2.2 Get MAC Address Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
OTP MAC Address : F8:F0:05:F2:5F:62
```

Note:

- The default MAC address is the MAC address in OTP ROM (One Time Programmable ROM).
- In this example result, you can see the OTP MAC address or USER MAC address.
- User Define MAC address: If you want to use a custom MAC address, set the user defined MAC address.

3.1.3 How to Get the Signal Status

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to check signal strength, such as RSSI.

It uses the following hardware:

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

Figure 3-3. Get the Signal Status Demo Setup

3.1.3.1 Execution

`main.c` - Initialize the ATWINC1500 and connect to the AP as a station mode.

1. Code summary.
   – Configure the below code in `main.h` for the AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID        "DEMO_AP" /* < Destination SSID */
#define MAIN_WLAN_AUTH        M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_PSK         "12345678" /* < Password for Destination SSID */
```

   – Connect the ATWINC1500 to the AP via the `m2m_wifi_connect()` function.

```
/* Connect to defined AP. */
    m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
                MAIN_WLAN_AUTH, (void *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – Call `m2m_wifi_req_curr_rssi()` to receive the RSSI.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    /* Request RSSI for the connected AP. */
    m2m_wifi_req_curr_rssi();
```

   – You can get the RSSI value when the `wifi_cb()` function is called with a `M2M_WIFI_RESP_CURRENT_RSSI` message.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_CURRENT_RSSI:
    {
    /* This message type is triggered by "m2m_wifi_req_curr_rssi()" function. */
    int8_t *rssi = (int8_t *)pvMsg;
    printf("RSSI for the current connected AP (%d)\r\n", (int8_t)(*rssi));
```

2. Build the program and download it into the board.
3. Start the application.

3.1.3.2 Signal Status Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Wi-Fi connected
Wi-Fi IP is 192.168.1.46
RSSI for the current connected AP (-37)
```

3.1.4 How to Run STA Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to behave as a station.

The example uses the following hardware:

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

Figure 3-4. Demo Setup

3.1.4.1 Execution

`main.c` - Initialize the ATWINC1500 and get the RSSI for the connected AP.

1. Code summary.
   – Configure the below code in `main.h` for the AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID        "DEMO_AP" /* < Destination SSID */
#define MAIN_WLAN_AUTH        M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_PSK         "12345678" /* < Password for Destination SSID */
```

   – Connect to the AP with the given information.

```
/* Connect to defined AP. */
    m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
                MAIN_WLAN_AUTH, (void *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – The `wifi_cb()` function is called with the `M2M_WIFI_RESP_CON_STATE_CHANGED` message and then it requests an IP address via the `m2m_wifi_request_dhcp_client()` function.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    switch (u8MsgType) {
    case M2M_WIFI_RESP_CON_STATE_CHANGED:
    {
        ...
    tstrM2mWifiStateChanged *pstrWifiState = (tstrM2mWifiStateChanged *)pvMsg;
    if (pstrWifiState->u8CurrState == M2M_WIFI_CONNECTED) {
        m2m_wifi_request_dhcp_client();
        ...
```

   – The `wifi_cb()` function is called with the `M2M_WIFI_REQ_DHCP_CONF` message and finally gets an IP address.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_DHCP_CONF:
    {
        ...
    uint8_t *pu8IPAddress = (uint8_t *)pvMsg;
    printf("Wi-Fi connected\r\n");
    printf("Wi-Fi IP is %u.%u.%u.%u\r\n",
            pu8IPAddress[0], pu8IPAddress[1], pu8IPAddress[2], pu8IPAddress[3]);
        ...
```

2. Build the program and download it into the board.
3. Start the application.

3.1.4.2 Station Mode Demo Console Log

Note: The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

3.1.5 How to Run AP Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to behave as an AP.

It uses the following hardware:

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

Figure 3-5. Demo Setup

3.1.5.1 Execution

`main.c` - Initialize the ATWINC1500 and act as an AP.

1. Code summary.
   – Configure the below code in `main.h` for AP information

```
/** Security mode Supported */
#define USE_WPAPSK        1 /* WPA/WPA2 PSK Security Mode*/
// #define USE_WEP            2 /* WEP Security Mode*/
// #define USE_OPEN         3 /* No Security or OPEN Authentication Mode*/
```

```
/** AP mode Settings */
#define MAIN_WLAN_SSID           "WINC1500_AP" /* < SSID */
#if (defined USE_WPAPSK)
#define MAIN_WLAN_AUTH           M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_WPA_PSK        "1234567890" /* < Security Key in WPA PSK Mode */
#elif (defined USE_WEP)
#define MAIN_WLAN_AUTH           M2M_WIFI_SEC_WEP /* < Security manner */
#define MAIN_WLAN_WEP_KEY        "1234567890" /* < Security Key in WEP Mode */
#define MAIN_WLAN_WEP_KEY_INDEX  (0)
#elif (defined USE_OPEN)
#define MAIN_WLAN_AUTH           M2M_WIFI_SEC_OPEN /* < Security manner */
#endif
#define MAIN_WLAN_CHANNEL        (M2M_WIFI_CH_6) /* < Channel number */
```

– In the `main()` function, initialize the AP mode configuration structure (`strM2MAPConfig`) as below. You can enable AP mode via `m2m_wifi_enable_ap function()`. Users may choose any one of the security methods according to their requirements.

```
/* Initialize AP mode parameters structure with SSID, channel and OPEN security
type. */
    memset(&strM2MAPConfig, 0x00, sizeof(tstrM2MAPConfig));
    strcpy((char *)&strM2MAPConfig.au8SSID, MAIN_WLAN_SSID);
    strM2MAPConfig.u8ListenChannel = MAIN_WLAN_CHANNEL;
    strM2MAPConfig.u8SecType = MAIN_WLAN_AUTH;

    strM2MAPConfig.au8DHCPServerIP[0] = 192;
    strM2MAPConfig.au8DHCPServerIP[1] = 168;
    strM2MAPConfig.au8DHCPServerIP[2] = 1;
    strM2MAPConfig.au8DHCPServerIP[3] = 1;
#if USE_WEP
    strcpy((char *)&strM2MAPConfig.au8WepKey, MAIN_WLAN_WEP_KEY);
    strM2MAPConfig.u8KeySz = strlen(MAIN_WLAN_WEP_KEY);
    strM2MAPConfig.u8KeyIndx = MAIN_WLAN_WEP_KEY_INDEX;
#endif
#if USE_WPAPSK
    strcpy((char *)&strM2MAPConfig.au8Key, MAIN_WLAN_WPA_PSK);
    strM2MAPConfig.u8KeySz = strlen(MAIN_WLAN_WPA_PSK);
#endif
    /* Bring up AP mode with parameters structure. */
    ret = m2m_wifi_enable_ap(&strM2MAPConfig);
    printf("AP mode started. You can connect to %s.\r\n", (char *)MAIN_WLAN_SSID);
```

2. Build the program and download it into the board.
3. Start the application.

3.1.5.2 AP Mode Demo Console Log

Note: The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
AP mode started. You can connect to WINC1500_AP.
Station connected
Station IP is xxx.xxx.xxx.xxx
```

Note: The ATWINC1500 supports AP mode operation with the following limitations:

1. Only one associated station is supported. After a connection is established with a station, further connections are rejected.
2. The device could not work as a station in this mode (STA/AP concurrency is not supported).

3.1.6 How to Run P2P Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to behave as a P2P device. P2P is also known as Wi-Fi Direct.

This demo uses the following hardware:

- The SAM D21 Xplained Pro
- The ATWINC1500 on the EXT1 header
- A Wi-Fi Direct or P2P supported WLAN device

Figure 3-6. P2P Mode Demo Setup

3.1.6.1 Execution

`main.c` - Initialize the ATWINC1500 and act as a P2P device.

1. Code summary.
   - Configure the below code in `main.h` for P2P information.

```
/** P2P device name. */
#define MAIN_WLAN_DEVICE_NAME    "WINC1500_P2P"
```

   - Set your device name which will be shown in the peer device.

```
/* Set device name to be shown in peer device. */
    m2m_wifi_set_device_name((uint8_t *)MAIN_WLAN_DEVICE_NAME,
strlen(MAIN_WLAN_DEVICE_NAME));;
```

   - Set to P2P mode with the channel number which is defined in `main.h`.

```
/* Bring up P2P mode with channel number. */
    m2m_wifi_p2p(M2M_WIFI_CH_6);
```

   - When your mobile device connects to the ATWINC1500, Wi-Fi callback will receive the `M2M_WIFI_REQ_DHCP_CONF` message.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    uint8_t *pu8IPAddress = (uint8_t *)pvMsg;
    printf("Wi-Fi connected\r\n");
    printf("Wi-Fi IP is %u.%u.%u.%u\r\n",
            pu8IPAddress[0], pu8IPAddress[1], pu8IPAddress[2], pu8IPAddress[3]);
```

2. Build the program and download it into the board.
3. Start the application.

3.1.6.2 P2P Mode Demo Console Log

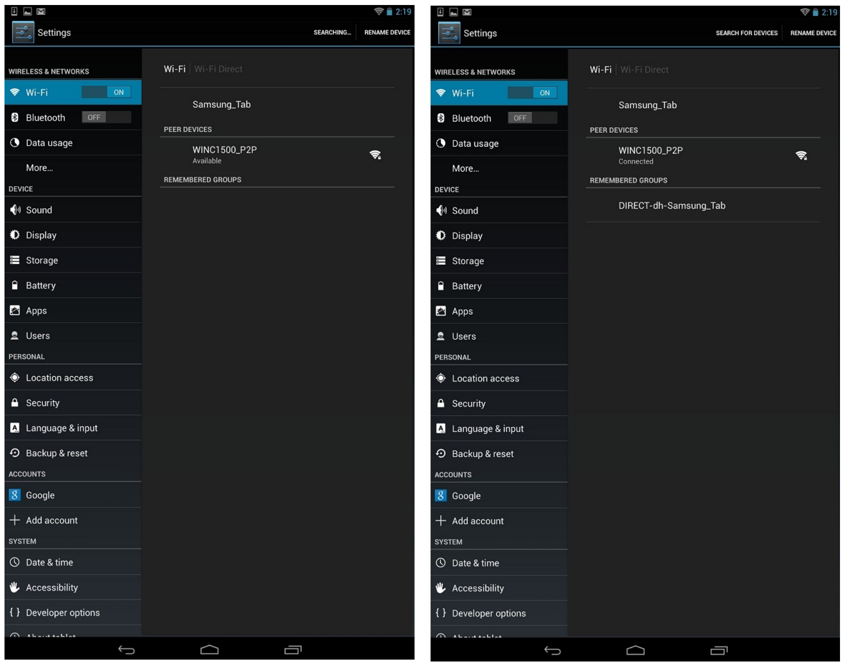
The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
```

```
P2P mode started. You can connect to xxxxxxx.
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

When running the P2P mode application in the ATWINC1500, open your smartphone's Wi-Fi Direct menu, then scan and connect to the ATWINC1500 device listed as a P2P device.

Figure 3-7. Mobile or P2P Device Connection



Note: The device can only operate as a Wi-Fi Direct device (Group Owner functionality will be supported in a future release).

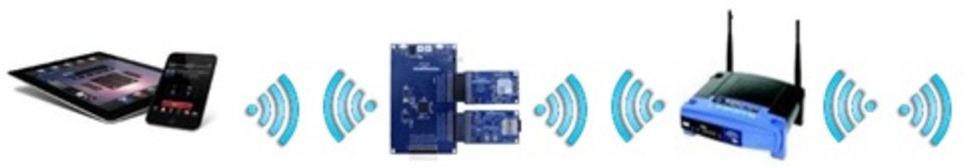
3.1.7 How to Change Modes

This example demonstrates how to use the ATWINC1500 with the SAM D21 Xplained Pro board as a station, and change it to AP or P2P mode.

It uses the following hardware:

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

Figure 3-8. Demo Setup



3.1.7.1 Execution

`main.c` - Initialize the ATWINC1500. By default, the device acts as station mode, then switches to AP mode or P2P mode. For details on each mode, refer to the MODE_STA, MODE_AP and MODE_P2P examples.

1. Code summary.

– Configure the below code in `main.h` for AP information to be connected.

```
/** Security mode Supported */
#define USE_WPAPSK        1 /* WPA/WPA2 PSK Security Mode*/
// #define USE_WEP            2 /* WEP Security Mode*/
// #define USE_OPEN        3 /* No Security or OPEN Authentication Mode*/

/** AP mode Settings */
#define MAIN_WLAN_SSID             "WINC1500_AP" /* < SSID */
#if (defined USE_WPAPSK)
#define MAIN_WLAN_AUTH             M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_WPA_PSK          "1234567890" /* < Security Key in WPA PSK Mode */
#elif (defined USE_WEP)
#define MAIN_WLAN_AUTH             M2M_WIFI_SEC_WEP /* < Security manner */
#define MAIN_WLAN_WEP_KEY          "1234567890" /* < Security Key in WEP Mode */
#define MAIN_WLAN_WEP_KEY_INDEX  (0)
#elif (defined USE_OPEN)
#define MAIN_WLAN_AUTH             M2M_WIFI_SEC_OPEN /* < Security manner */
#endif
#define MAIN_WLAN_CHANNEL          (M2M_WIFI_CH_6) /* < Channel number */
```

– Configure the below code in `main.h` for P2P information.

```
/** P2P mode Settings */
#define MAIN_WLAN_DEVICE_NAME        "WINC1500_P2P" /* < P2P Device Name */
#define MAIN_WLAN_P2P_CHANNEL        M2M_WIFI_CH_6 /* < P2P Channel number */
```

– In the `main()` function, it sets to AP mode first and changes to P2P mode after a little delay. For more details, refer to the “How to Run AP mode” example and the “How to Run P2P mode” example.

```
enable_disable_ap_mode();
nm_bsp_sleep(DELAY_FOR_MODE_CHANGE);
enable_disable_p2p_mode();
```

2. Build the program and download it into the board.
3. Start the application.

3.1.7.2 Mode Change Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
AP mode, start
AP mode, end
P2P mode, start
P2P mode, end
```

3.1.8 How to Scan APs

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to explain how to scan AP as a station.

It uses the following hardware:

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

Figure 3-9. Scan APs Demo Setup

3.1.8.1 Execution

`main.c` - Initialize the ATWINC1500 and scan AP until the defined AP is found.

1. Code summary.
   – Configure the below code in `main.h` for the AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID        "DEMO_AP" /* < Destination SSID */
#define MAIN_WLAN_AUTH        M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_PSK         "12345678" /* < Password for Destination SSID */
```

   – Request to scan for all channels.

```
/* Request scan. */
    m2m_wifi_request_scan(M2M_WIFI_CH_ALL);
```

   – The `wifi_cb()` function is called with the `M2M_WIFI_RESP_SCAN_DONE` message when scanning is done. You can get the number of found APs as mentioned. Review the scan result with a specific index by calling the `m2m_wifi_req_scan_result()` function untill it reaches the number of found APs.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_SCAN_DONE:
    {
    tstrM2mScanDone *pstrInfo = (tstrM2mScanDone *)pvMsg;
    scan_request_index = 0;
    if (pstrInfo->u8NumofCh >= 1) {
        m2m_wifi_req_scan_result(scan_request_index);
        scan_request_index++;
    }
```

   – The `wifi_cb()` function will be called again with the `M2M_WIFI_RESP_SCAN_RESULT` message. You can get the information of the AP for the specific channel number you gave. If the scan result is the same as the AP information in `main.h`, then device will connect to the AP.

```
sstatic void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_SCAN_RESULT:
    {
    tstrM2mWifiscanResult *pstrScanResult = (tstrM2mWifiscanResult *)pvMsg;
    uint16_t demo_ssid_len;
    uint16_t scan_ssid_len = strlen((const char *)pstrScanResult->au8SSID);
    /* display founded AP. */
    printf("[%d] SSID:%s\r\n", scan_request_index, pstrScanResult->au8SSID);
    num_founded_ap = m2m_wifi_get_num_ap_found();
    if (scan_ssid_len) {
    /* check same SSID. */
        demo_ssid_len = strlen((const char *)MAIN_WLAN_SSID);
        if((demo_ssid_len == scan_ssid_len) &&
        (!memcmp(pstrScanResult->au8SSID, (uint8_t *)MAIN_WLAN_SSID,
demo_ssid_len))) {
            printf("Found %s \r\n", MAIN_WLAN_SSID);
            m2m_wifi_connect((char *)MAIN_WLAN_SSID,
                        sizeof(MAIN_WLAN_SSID),
                        MAIN_WLAN_AUTH,
                        (void *)MAIN_WLAN_PSK,
                        M2M_WIFI_CH_ALL);
```

2. Build the program and download it into the board.
3. Start the application.

3.1.8.2 Scan APs Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
[1] SSID:DEMO_AP1
[2] SSID:DEMO_AP2
[3] SSID:DEMO_AP
Found DEMO_AP
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

3.1.9 How to Set Power Save Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to check the PS (Power Save) mode.

It uses the following hardware:

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

Figure 3-10. Power Save Mode Demo Setup

3.1.9.1 Execution

`main.c` - Initialize the ATWINC1500, set PS Mode and get the RSSI for the connected AP.

1. Code summary.
   – Configure the below code in `main.h` for the AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID        "DEMO_AP" /* < Destination SSID */
#define MAIN_WLAN_AUTH        M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_PSK         "12345678" /* < Password for Destination SSID */
```

   – Configure the below code in `main.h` for the Power Save mode you want to set.

```
/** PowerSave mode Settings */
#define MAIN_PS_SLEEP_MODE          M2M_PS_MANUAL /* M2M_NO_PS /
M2M_PS_DEEP_AUTOMATIC / M2M_PS_MANUAL */
```

   – In the `main()` function, set the Power Save mode as defined above.

```
/* Set defined sleep mode */
    if (MAIN_PS_SLEEP_MODE == M2M_PS_MANUAL) {
        printf("M2M_PS_MANUAL\r\n");
        m2m_wifi_set_sleep_mode(MAIN_PS_SLEEP_MODE, 1);
    } else if (MAIN_PS_SLEEP_MODE == M2M_PS_DEEP_AUTOMATIC) {
        printf("M2M_PS_DEEP_AUTOMATIC\r\n");
        tstrM2mLsnInt strM2mLsnInt;
        m2m_wifi_set_sleep_mode(M2M_PS_DEEP_AUTOMATIC, 1);
        strM2mLsnInt.u16LsnInt = M2M_LISTEN_INTERVAL;
        m2m_wifi_set_lsn_int(&strM2mLsnInt);
    }
```

– Connect to the AP with the given information.

```
/* Connect to defined AP. */
    m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
                MAIN_WLAN_AUTH, (void *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

– The ATWINC1500 goes to Sleep mode automatically in `M2M_PS_DEEP_AUTOMATIC` mode. The ATWINC1500 will wake up upon any request/callback (Wi-Fi/SOCKET) and the host driver will allow the SoC to sleep again after handling the request. However, you must request sleep in the `M2M_PS_MANUAL` mode and the ATWINC1500 will go to sleep for the given period.

```
/* Request sleep mode */
if (gu8SleepStatus == MAIN_PS_REQ_SLEEP) {
    if (MAIN_PS_SLEEP_MODE == M2M_PS_MANUAL) {
        m2m_wifi_request_sleep(MAIN_REQUEST_SLEEP_TIME);
        gu8SleepStatus = MAIN_PS_SLEEP;
    }
}
```

2. Build the program and download it into the board.
3. Start the application.

3.1.9.2 Power Save Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
RSSI for the current connected AP (-xx)
```

3.1.10 HTTP Provision Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to start Provision Mode.

It uses the following hardware:

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

Figure 3-11. HTTP Provision Mode Demo Setup

3.1.10.1 Execution

`main.c` - Initialize the ATWINC1500 and start Provision Mode until one of the various APs is selected.

1. Code summary.

- Configure the below code in `main.h` for provision information.

```
#define MAIN_HTTP_PROV_SERVER_DOMAIN_NAME    "atmelconfig.com"
    #define MAIN_M2M_DEVICE_NAME                 "WINC1500_00:00"
```

- Start provision mode before the main loop.

```
m2m_wifi_start_provision_mode((tstrM2MAPConfig *)&gstrM2MAPConfig, (char
*)gacHttpProvDomainName, 1);
```

- When your mobile device sends configuration information, the `wifi_cb()` function will be called with the `M2M_WIFI_RESP_PROVISION_INFO` message and you can connect to the AP with the given information.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_PROVISION_INFO:
    {
    tstrM2MProvisionInfo *pstrProvInfo = (tstrM2MProvisionInfo *)pvMsg;
    printf("wifi_cb: M2M_WIFI_RESP_PROVISION_INFO.\r\n");
    if (pstrProvInfo->u8Status == M2M_SUCCESS) {
        m2m_wifi_connect((char *)pstrProvInfo->au8SSID, strlen((char *)pstrProvInfo-
>au8SSID), pstrProvInfo->u8SecType,
        pstrProvInfo->au8Password, M2M_WIFI_CH_ALL);
```

2. Build the program and download it into the board.
3. Start the application.

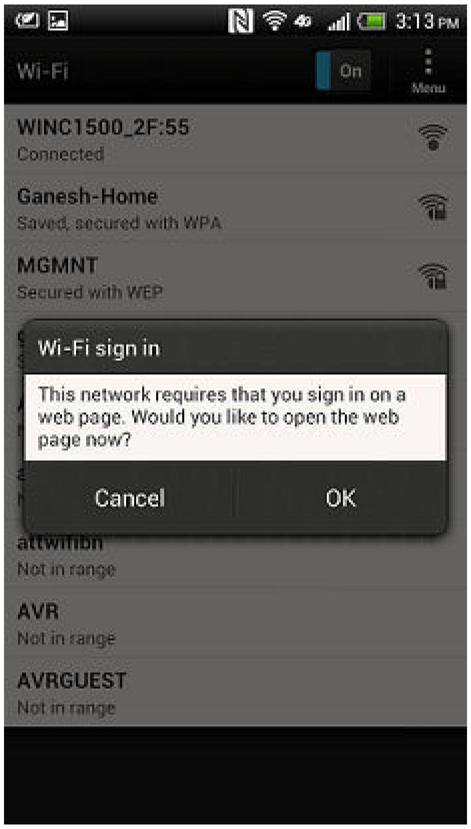
3.1.10.2 HTTP Provision Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Provision Mode started.
Connect to [atmelconfig.com] via AP[WINC1500_2F:55] and fill up the page.
```

1. Connect your mobile device to ATWINC1500 AP (ATWINC1500_xx:xx).

Figure 3-12. ATWINC1500 Provision AP



Wi-Fi

WINC1500_2F:55
Connected

Ganesh-Home
Saved, secured with WPA

MGMNT
Secured with WEP

Wi-Fi sign in

This network requires that you sign in on a web page. Would you like to open the web page now?

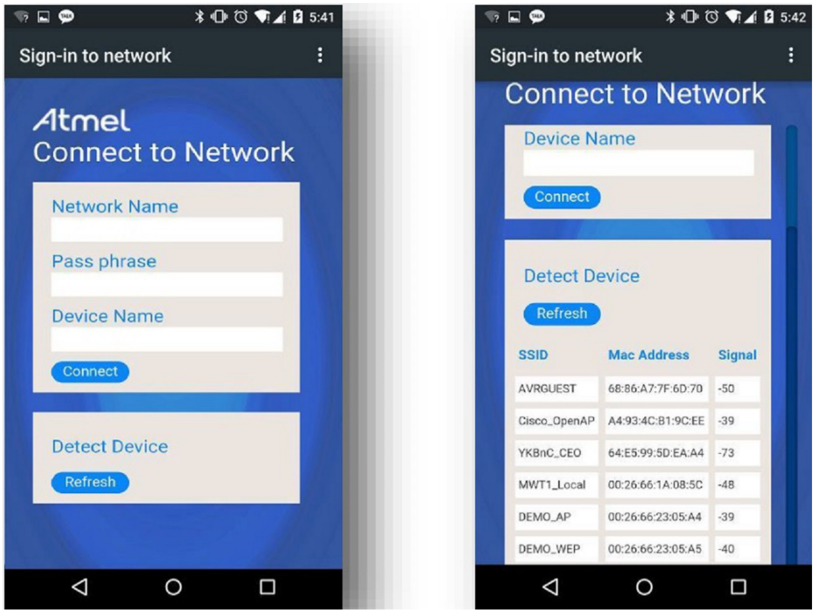
attwifibn
Not in range

AVR
Not in range

AVRGUEST
Not in range

2. Browse to (www.microchip.com) to setup the AP, populate the page, and then press Connect.

Figure 3-13. HTTP Provisioning Web Page



Sign-in to network

Atmel
Connect to Network

Network Name

Pass phrase

Device Name

Detect Device

Sign-in to network

Connect to Network

Device Name

Detect Device

SSID	Mac Address	Signal
AVRGUEST	68:86:A7:7F:6D:70	-50
Cisco_OpenAP	A4:93:4C:B1:9C:EE	-39
YKBnC_CEO	64:E5:99:5D:EA:A4	-73
MWT1_Local	00:26:66:1A:08:5C	-48
DEMO_AP	00:26:66:23:05:A4	-39
DEMO_WEP	00:26:66:23:05:A5	-40

3. ATWINC1500 will be connected to the AP that you configured.

```
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED: CONNECTED.
wifi_cb: M2M_WIFI_REQ_DHCP_CONF: IP is xxx.xxx.xxx.xxx
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED: DISCONNECTED.
wifi_cb: M2M_WIFI_RESP_PROVISION_INFO.
```

```
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED: CONNECTED.
wifi_cb: M2M_WIFI_REQ_DHCP_CONF: IP is xxx.xxx.xxx.xxx
```

Note: Refer to the HTTP Provision Mode application note for more details.

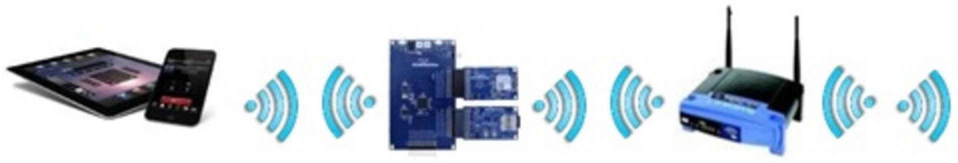
3.1.11 AP Provision Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to start Provision Mode.

It uses the following hardware:

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

Figure 3-14. AP Provision Demo Setup



3.1.11.1 Execution

`main.c` - Initialize the ATWINC1500 and start Provision Mode until one of various APs is selected.

1. Code summary.
   – Initialize the socket module and create the TCP server socket.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons((MAIN_WIFI_M2M_SERVER_PORT));
addr.sin_addr.s_addr = 0;
/* Initialize Socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
while (1) {
    m2m_wifi_handle_events(NULL);
    if (tcp_server_socket < 0) {
    /* Open TCP server socket */
    if ((tcp_server_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0)
    /* Bind service*/
    bind(tcp_server_socket, (struct sockaddr *)&addr, sizeof(struct sockaddr_in));
```

   – Enable AP mode before the main loop. (Refer to the “How to Run AP Mode” example.

```
/* Initialize AP mode parameters structure with SSID, channel and OPEN security
type. */
    memset(&strM2MAPConfig, 0x00, sizeof(tstrM2MAPConfig));
    strcpy((char *)&strM2MAPConfig.au8SSID, MAIN_WLAN_SSID);
    strM2MAPConfig.u8ListenChannel = MAIN_WLAN_CHANNEL;
    strM2MAPConfig.u8SecType = MAIN_WLAN_AUTH;
    strM2MAPConfig.au8DHCPServerIP[0] = 0xC0; /* 192 */
    strM2MAPConfig.au8DHCPServerIP[1] = 0xA8; /* 168 */
    strM2MAPConfig.au8DHCPServerIP[2] = 0x01; /* 1 */
    strM2MAPConfig.au8DHCPServerIP[3] = 0x01; /* 1 */

    /* Bring up AP mode with parameters structure. */
    ret = m2m_wifi_enable_ap(&strM2MAPConfig);
```

   – After your Android device is connected to the ATWINC1500 and sends the AP configuration, disable AP mode and connect to the AP with the given information.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    case SOCKET_MSG_RECV:
    {
        printf("Disable to AP.\r\n");
     m2m_wifi_disable_ap();
     nm_bsp_sleep(500);
     printf("Connecting to %s.\r\n", (char *)str_ssid);
     m2m_wifi_connect((char *)str_ssid, strlen((char *)str_ssid), sec_type, str_pw,
M2M_WIFI_CH_ALL);
```

– The `wifi_cb()` function is called with the `M2M_WIFI_REQ_DHCP_CONF` message and then receives an IP address.

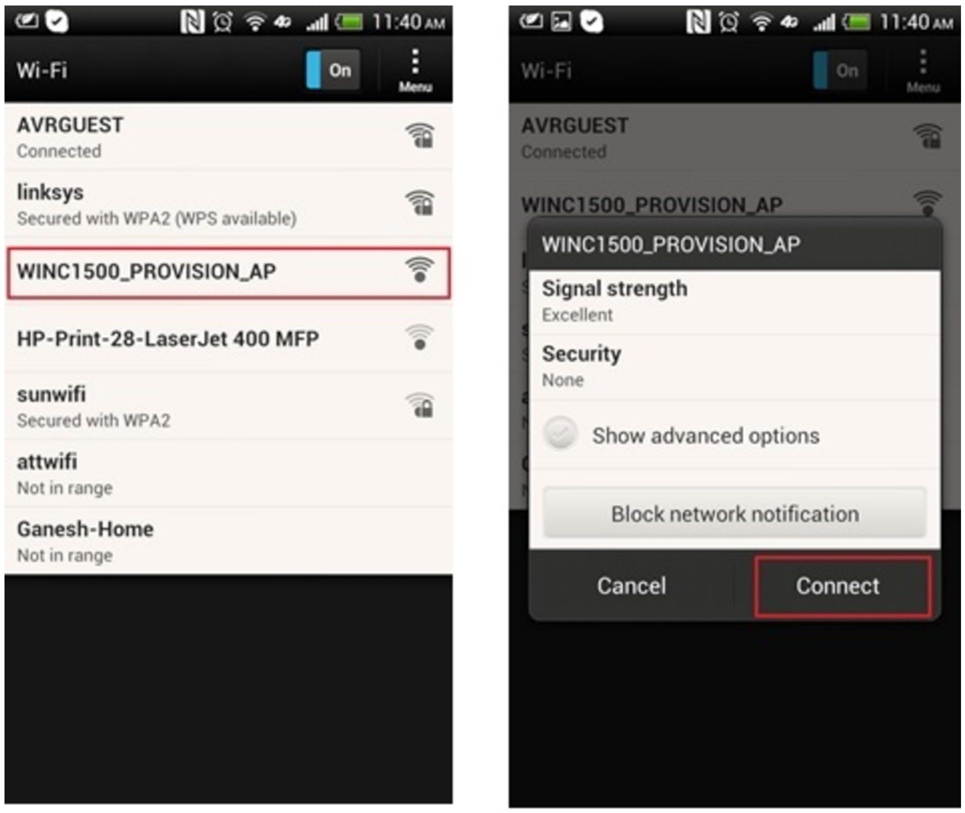
```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    uint8_t *pu8IPAddress = (uint8_t *)pvMsg;
    printf("Wi-Fi connected\r\n");
    printf("Wi-Fi IP is %u.%u.%u.%u\r\n",
            pu8IPAddress[0], pu8IPAddress[1], pu8IPAddress[2], pu8IPAddress[3]);
```

2. Build the program and download it into the board.
3. Start the application

3.1.11.2 Android App Connection Process

1. Install *provision_ap.apk* in the source package to your Android device. You can also build the Android application source and install it.
2. Connect your Android device to the ATWINC1500.

Figure 3-15. ATWINC1500 AP Connection

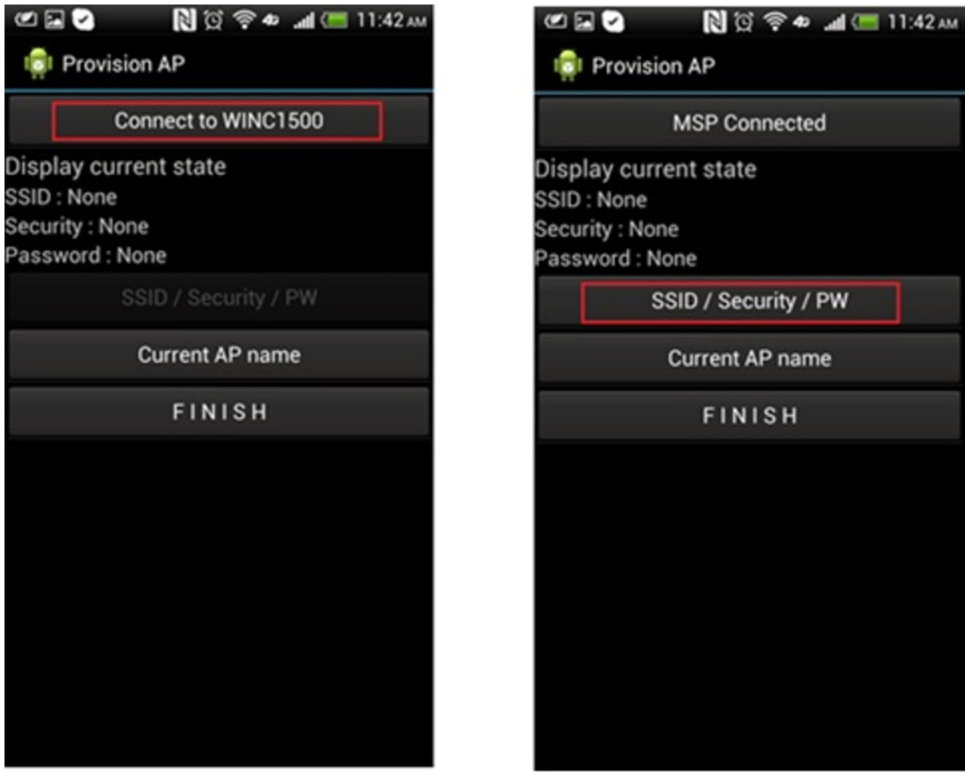


AVRGUEST
Connected
linksys
Secured with WPA2 (WPS available)
WINC1500_PROVISION_AP
HP-Print-28-LaserJet 400 MFP
sunwifi
Secured with WPA2
attwifi
Not in range
Ganesh-Home
Not in range

WINC1500_PROVISION_AP
Signal strength
Excellent
Security
None

3. Launch the Android application to configure AP, press the Connect button, and the SSID button will then be available.

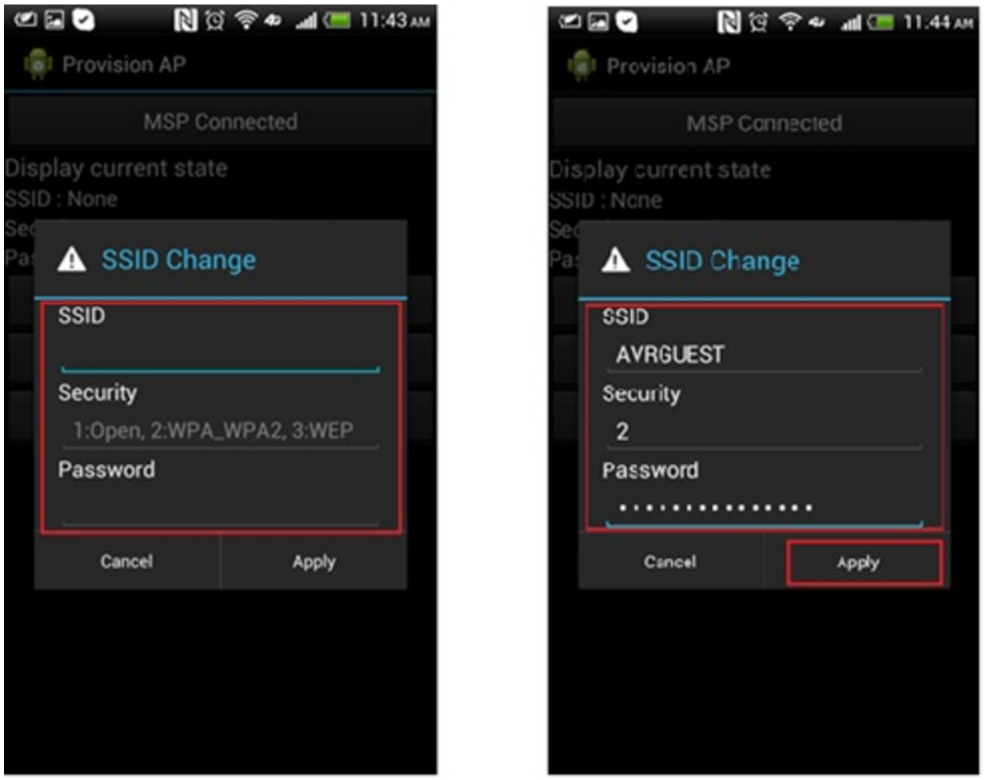
Figure 3-16. Connect to TCP Server and Enter Credentials



Display current state
SSID : None
Security : None
Password : None

4. Input the connection info, and then press the Apply button.

Figure 3-17. Entering AP Credentials



Display current state
SSID : None

SSID
Security
1:Open, 2:WPA_WPA2, 3:WEP
Password

SSID
AVRGUEST
Security
2
Password
•••••••••••••••

5. The ATWINC1500 will be connected to the AP you configured.

3.1.11.3 AP Provision Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
AP Provision mode started.
On the android device, connect to WINC1500_PROVISION_AP then run setting app.
(APP)(INFO)Socket 0 session ID = 1
socket_cb: Ready to listen.
Wi-Fi connected. IP is xxx.xxx.xxx.xxx
socket_cb: Client socket is created.
Disable to AP
Connecting to XXXXXX.
wifi_cb: DISCONNECTED
wifi_cb: CONNECTED
Wi-Fi connected. IP is xxx.xxx.xxx.xxx
```

Note: Refer to the AP Provision Mode application note for more details.

3.1.12 Connection to Security WPS

This example demonstrates how to connect the ATWINC1500 Wi-Fi device to AP with WPS Security with the SAM D21 Xplained Pro boad as the host MCU.

It uses the following hardware:

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

Figure 3-18. Demo Steup

3.1.12.1 Execution

`main.c` - Initialize the ATWINC1500 and connect to AP using WPS.

1. Code summary.
   Case 1: Push Button Method
   - To test the WPS button method, configure the WPS push button feature in `main.h` as below and use case 1 in the `main()` function.

```
/** WPS Push Button Feature */
#define MAIN_WPS_PUSH_BUTTON_FEATURE     true
```

```
/* Device name must be set before enabling WPS mode. */
m2m_wifi_set_device_name((uint8 *)devName, strlen(devName));
if (MAIN_WPS_PUSH_BUTTON_FEATURE) {
/* case 1 WPS Push Button method. */
    if (!gbPressButton){
        btn_init();
    }
}
```

- When pressing the SW0 button on the SAMD21, it will trigger WPS in the `btn_press()` function.

```
/* Connect to defined AP. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
                MAIN_WLAN_AUTH, (void *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

- The `wifi_cb()` will receive the `M2M_WIFI_REQ_WPS` message and it can connect to the AP with given information.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_WPS:
    {
    tstrM2MWPSInfo *pstrWPS = (tstrM2MWPSInfo *)pvMsg;
    printf("Wi-Fi request WPS\r\n");
    printf("SSID : %s, authtyp : %d pw : %s\n", pstrWPS->au8SSID, pstrWPS-
>u8AuthType, pstrWPS->au8PSK);
    if (pstrWPS->u8AuthType == 0) {
        printf("WPS is not enabled OR Timedout\r\n");
        m2m_wifi_request_scan(M2M_WIFI_CH_ALL);
        /* WPS is not enabled by firmware OR WPS monitor timeout.*/
    } else{
        printf("Request Wi-Fi connect\r\n");
        m2m_wifi_connect((char *)pstrWPS->au8SSID, (uint8)m2m_strlen(pstrWPS-
>au8SSID),
                    pstrWPS->u8AuthType, pstrWPS->au8PSK, pstrWPS->u8Ch);
    }
```

Case 2: PIN Method

- To test the WPS PIN method, configure the WPS PIN number and WPS push button feature in `main.h` as below and use case 2 in the `main()` function.

```
/** WPS PIN number */
#define MAIN_WPS_PIN_NUMBER              "12345670"
/** WPS Push Button Feature */
#define MAIN_WPS_PUSH_BUTTON_FEATURE     false
```

```
/* Device name must be set before enabling WPS mode. */
m2m_wifi_set_device_name((uint8 *)devName, strlen(devName));
if (!MAIN_WPS_PUSH_BUTTON_FEATURE) {
    /* case 2 WPS PIN method */
    m2m_wifi_wps(WPS_PIN_TRIGGER, (const char *)MAIN_WPS_PIN_NUMBER);
}
```

- When pressing the SW0 button on the SAMD21, it will trigger WPS in the `btn_press()` function.

```
/* Connect to defined AP. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
                MAIN_WLAN_AUTH, (void *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

- The `wifi_cb()` will receive the `M2M_WIFI_REQ_WPS` message and it can connect to the AP with the given information.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_WPS:
    {
    tstrM2MWPSInfo *pstrWPS = (tstrM2MWPSInfo *)pvMsg;
    printf("Wi-Fi request WPS\r\n");
    printf("SSID : %s, authtyp : %d pw : %s\n", pstrWPS->au8SSID, pstrWPS-
>u8AuthType, pstrWPS->au8PSK);
    if (pstrWPS->u8AuthType == 0) {
        printf("WPS is not enabled OR Timedout\r\n");
        m2m_wifi_request_scan(M2M_WIFI_CH_ALL);
        /* WPS is not enabled by firmware OR WPS monitor timeout.*/
    } else{
        printf("Request Wi-Fi connect\r\n");
        m2m_wifi_connect((char *)pstrWPS->au8SSID, (uint8)m2m_strlen(pstrWPS-
>au8SSID),
                        pstrWPS->u8AuthType, pstrWPS->au8PSK, pstrWPS->u8Ch);
    }
```

2. Prepare an AP that supports Wi-Fi Protected Setup (WPS).
3. Press the WPS button on the AP when using the WPS button method or enter the WPS PIN number in the AP setup menu and start the AP. (For more information, refer to AP product documentation.)
4. Run the application. Press the SW0 button on the SAM D21 when using the WPS button method. The ATWINC1500 will be connected to the AP automatically without security information.
5. Build the program and download it into the board.
6. Start the application.

3.1.12.2 WPS Mode Demo Console Log

Note: In the WPS button method, the following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
SW0 button pressed
Device is connecting using WPS Push Button option
Wi-Fi request WPS
SSID : xxxxxx, AuthType : x, PW : xxxxxxxx
Request Wi-Fi connect
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

Note: In the WPS PIN method, the following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Wi-Fi request WPS
SSID : xxxxxx, AuthType : x, PW : xxxxxxxx
Request Wi-Fi connect
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

3.1.13 Security with WEP/WPA

This example demonstrates how to connect the ATWINC1500 Wi-Fi device to AP with WEP or WPA security using the SAM D21 Xplained Pro board as the host MCU.

It uses the following hardware:

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

Figure 3-19. Demo Setup

3.1.13.1 Execution

`main.c` - Initialize the ATWINC1500 and connect to AP using WPS.

1. Code summary.

   Case 1: WEP Security Method

   - To test WEP security, modify `MAIN_WLAN_DEVICE_NAME`, `MAIN_WLAN_WEP_KEY_INDEX` and `MAIN_WLAN_WEP_KEY_40` or `MAIN_WLAN_WEP_KEY_104` in `main.h`.

   ```
   /** security information for Wi-Fi connection */
   #define MAIN_WLAN_DEVICE_NAME           "DEMO_AP" /**< Destination SSID */
   #define MAIN_WLAN_WEP_KEY_INDEX         1 /**< WEP key index */
   /**< 64 bit WEP key. In case of WEP64, 10 hexadecimal (base 16) characters (0-9
   and A-F) ) */
   #define MAIN_WLAN_WEP_KEY_40            "1234567890"
   /**< 128 bit WEP key. In case of WEP128, 26 hexadecimal (base 16) characters (0-9
   and A-F) ) */
   #define MAIN_WLAN_WEP_KEY_104           "1234567890abcdef1234567890"
   ```

   - When pressing the SW0 button on the SAM D21, it will trigger WPS in the `btn_press()` function.

   ```
   /** Security parameters for 64 bit WEP Encryption @ref m2m_wifi_connect */
   tstrM2mWifiWepParams wep64_parameters = { MAIN_WLAN_WEP_KEY_INDEX,
                                           sizeof(MAIN_WLAN_WEP_KEY_40),
                                           MAIN_WLAN_WEP_KEY_40};
   /** Security parameters for 128 bit WEP Encryption @ref m2m_wifi_connect */
   tstrM2mWifiWepParams wep128_parameters = { MAIN_WLAN_WEP_KEY_INDEX,
                                             sizeof(MAIN_WLAN_WEP_KEY_104),
                                             MAIN_WLAN_WEP_KEY_104};
   ```

   ```
   /* Case 1. Connect to AP with security type WEP. */
   m2m_wifi_connect((char *)MAIN_WLAN_DEVICE_NAME, strlen((char
   *)MAIN_WLAN_DEVICE_NAME),
        M2M_WIFI_SEC_WEP, &wep64_parameters, M2M_WIFI_CH_ALL);
   ```

   Case 2: WPA-PSK Security Method

   - To test WPA security, use case 2 in the `main()` function and modify `MAIN_WLAN_PSK` in `main.h`.

   ```
   #define MAIN_WLAN_PSK     "12345678" /**< Password for Destination SSID */
   ```

   - Connect to the AP with the given information.

   ```
   /* Case 2. Connect to AP with security type WPA. */
   m2m_wifi_connect((char *)MAIN_WLAN_DEVICE_NAME, strlen((char
   *)MAIN_WLAN_DEVICE_NAME),
        M2M_WIFI_SEC_WPA_PSK, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
   ```

2. Prepare an AP that supports WEP and WPA/WPA2 Security and configure Wi-Fi Security. For more information, refer to the AP manufacturer's manual.
3. Run the application. If the device connected successfully, the IP address assigned by DHCP will be displayed on the terminal program.

3.1.13.2 WEP/WPA Security Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
```

```
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to XXXXXX.
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
```

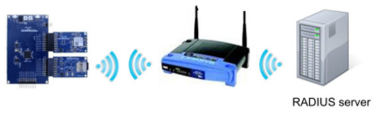
3.1.14 Connection to Enterprise Security Network

This example demonstrates how to connect the ATWINC1500 Wi-Fi device to AP with WPA/WPA2 enterprise security with the SAM D21 Xplained board as the host MCU.

It uses the following hardware:

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

Figure 3-20. Enterprises Mode Demo Setup



3.1.14.1 Execution

`main.c` - Initialize the ATWINC1500 and connect to an AP with WPA/WPA2 enterprise security.

1. Code summary.
   – Modify `MAIN_WLAN_802_1X_USR_NAME`, `MAIN_WLAN_802_1X_PWD` to the name and the password, respectively. Modify `MAIN_WLAN_DEVICE_NAME` to the wireless network name.

```
/** security information for Wi-Fi connection */
#define MAIN_WLAN_DEVICE_NAME           "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_802_1X_USR_NAME       "atmeluser" /**< RADIUS user account name */
#define MAIN_WLAN_802_1X_PWD            "12345678" /**< RADIUS user account
password */
```

   – Connect to the AP with the given information.

```
/* Connect to the enterprise network. */
m2m_wifi_connect((char *)MAIN_WLAN_DEVICE_NAME, sizeof(MAIN_WLAN_DEVICE_NAME),
     M2M_WIFI_SEC_802_1X, (char *)&gstrCred1x, M2M_WIFI_CH_ALL);
```

   – The `wifi_cb()` function is called with the `M2M_WIFI_RESP_CON_STATE_CHANGED` message and then it requests an IP address via the `m2m_wifi_request_dhcp_client()` function.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    switch (u8MsgType) {
    case M2M_WIFI_RESP_CON_STATE_CHANGED:
    {
    tstrM2mWifiStateChanged *pstrWifiState = (tstrM2mWifiStateChanged *)pvMsg;
    if (pstrWifiState->u8CurrState == M2M_WIFI_CONNECTED) {
        m2m_wifi_request_dhcp_client();
```

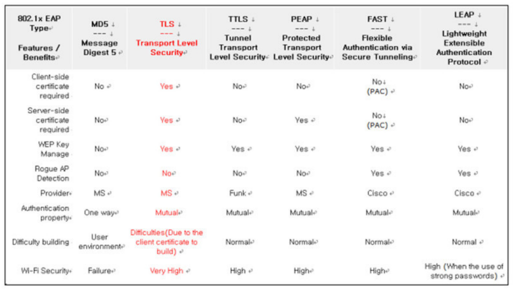
   – The `wifi_cb()` function is called with the `M2M_WIFI_REQ_DHCP_CONF` message and receives an IP address.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    uint8_t *pu8IPAddress = (uint8_t *)pvMsg;
    printf("Wi-Fi connected\r\n");
    printf("Wi-Fi IP is %u.%u.%u.%u\r\n",
            pu8IPAddress[0], pu8IPAddress[1], pu8IPAddress[2], pu8IPAddress[3]);
```

2. Prepare an AP that supports WPA/WPA2 enterprise security.You need to know following things before configuring RADIUS server settings in the AP. Ask your network administrator for this information and configure it in the AP.
   – User name
   – Password
   – Name of wireless network
   – Root certificate file
3. Download the root certificate generated from the previous step to the ATWINC1500 using the *RootCertDownload.bat* file.
4. Build and run the application. If the device connected successfully, the IP address assigned by DHCP will be displayed on the terminal program.

Note: For using the security enterprise network, the root certificate must be installed.

Figure 3-21. Supported 802.1x EAP (Extensible Authentication Protocol)



802.1x EAP Type / Features / Benefits	MD5 --- Message Digest 5	TLS --- Transport Level Security	TTLS --- Tunnel Transport Level Security	PEAP --- Protected Transport Level Security	FAST --- Flexible Authentication via Secure Tunneling	LEAP --- Lightweight Extensible Authentication Protocol
Client-side certificate required	No	Yes	No	No	No (PAC)	No
Server-side certificate required	No	Yes	No	Yes	No (PAC)	No
WEP Key Manage	No	Yes	Yes	Yes	Yes	Yes
Rogue AP Detection	No	No	No	No	Yes	Yes
Provider	MS	MS	Funk	MS	Cisco	Cisco
Authentication property	One way	Mutual	Mutual	Mutual	Mutual	Mutual
Difficulty building	User environment	Difficulties(Due to the client certificate to build)	Normal	Normal	Normal	Normal
Wi-Fi Security	Failure	Very High	High	High	High	High (When the use of strong passwords)

3.1.14.2 Enterprise Security Network Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
Connection successfully completed.
```

3.1.15 How to Set Packet Monitoring Mode

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to monitor all wireless data packets.

It uses the following hardware:

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

Figure 3-22. Monitoring Mode Demo Setup

3.1.15.1 Execution

`main.c` - Initialize the ATWINC1500 and then configure the monitoring parameters and start packet monitoring.

1. Code summary.
   - Set the below MAC address in the `main.c` that you want to monitor.

```
/** Source MAC address for monitoring. */
static const uint8_t SRC_MAC_ADDR[6] = {0xa4, 0xeb, 0xd3, 0xfc, 0x9f, 0x0d};
/** Destination MAC address for monitoring. */
static const uint8_t DST_MAC_ADDR[6] = {0xa4, 0xeb, 0xd3, 0xfc, 0x9f, 0x0d};
```

   - Register a monitoring callback function in the Wi-Fi initialization parameter. Activate one of two `memcpy()` functions in the `start_packet_monitoring()` function and call `m2m_wifi_enable_monitoring_mode()` function to start monitoring mode.

```
/* Initialize Wi-Fi parameters structure. */
param.pfAppMonCb = monitoring_cb; /* Register monitoring callback function. */
/* Start the packet monitoring. */
start_packet_monitoring();
```

```
void start_packet_monitoring()
{
    if (!monitoring_enabled) {
        wifi_monitor_conf.u8ChannelID    = M2M_WIFI_CH_1;
    wifi_monitor_conf.u8FrameType    = M2M_WIFI_FRAME_TYPE_ANY;
    wifi_monitor_conf.u8FrameSubtype = M2M_WIFI_FRAME_SUB_TYPE_ANY;
    /* memcpy(wifi_monitor_conf.au8SrcMacAddress, SRC_MAC_ADDR,
sizeof(SRC_MAC_ADDR)); */
    memcpy(wifi_monitor_conf.au8DstMacAddress, DST_MAC_ADDR, sizeof(DST_MAC_ADDR));
    m2m_wifi_enable_monitoring_mode(&wifi_monitor_conf, payload_buffer,
sizeof(payload_buffer), 0);
```

   - You can see the packet data in the monitoring callback function.

```
void monitoring_cb(tstrM2MWifiRxPacketInfo *pstrWifiRxPacket, uint8 *pu8Payload,
uint16 u16PayloadSize)
```

2. Build the program and download it into the board.
3. Start the application.

3.1.15.2 Monitoring Mode Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Packet monitoring started.
------------
Channel : 11
FrameType : 0xFF
FrameSubtype : 0xFF
```

```
Source MAC address : 00:00:00:00:00:00
Destination MAC address : 78:F7:BE:FA:92:5A
------------
monitoring_cb() MONITOR PACKET u8FrameType:0x00, u8FrameSubtype:0xD0
monitoring_cb() SRC MAC address : 00:26:66:1A:08:5C
monitoring_cb() DST MAC address : 78:F7:BE:FA:92:5A
monitoring_cb() MONITOR PACKET u8FrameType:0x00, u8FrameSubtype:0x50
monitoring_cb() SRC MAC address : 00:26:66:C6:00:2A
monitoring_cb() DST MAC address : 78:F7:BE:FA:92:5A
monitoring_cb() MONITOR PACKET u8FrameType:0x08, u8FrameSubtype:0x88
monitoring_cb() SRC MAC address : 00:26:66:1A:08:5D
monitoring_cb() DST MAC address : 78:F7:BE:FA:92:5A
...
```

4. Protocol Examples

This chapter describe protocol examples in detail. These protocol examples can also be used for IoT applications.

- UDP protocol example:
  – Client
  – Server
- TCP protocol example:
  – Client
  – Server
- NTP Time client – retrieves network time for the IoT application
- Send e-Mail – send email from an SMTP server
- Location client – get the current location of the network provider using HTTP

4.1 UDP Client

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to test the UDP socket.

It uses the following hardware:

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

Figure 4-1. UDP Client Demo Setup

4.1.1 Execution

`main.c` - Initialize the Wi-Fi module and test with the UDP server.

1. Code summary.
   – Configure the below code in `main.h` for AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                          "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                          M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                           "12345678" /**< Password for Destination
SSID */
#define MAIN_WIFI_M2M_PRODUCT_NAME              "NMCTemp"
#define MAIN_WIFI_M2M_SERVER_IP                 0xFFFFFFFF /* 255.255.255.255 */
#define MAIN_WIFI_M2M_SERVER_PORT               (6666)
#define MAIN_WIFI_M2M_REPORT_INTERVAL           (1000)
```

   – Initialize the socket module.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
```

– Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

– After the device is connected to the AP, create a TX socket in the main loop.

```
/* Create socket for Tx UDP */
if (tx_socket < 0) {
    if ((tx_socket = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
    printf("main : failed to create TX UDP client socket error!\r\n");
    continue;
    }
}
```

– Send data from the UDP client TX socket to the UDP server RX socket.

```
ret = sendto(tx_socket, &msg_wifi_product_main, sizeof(t_msg_wifi_product_main),
     0, (struct sockaddr *)&addr, sizeof(addr));
```

2. Build the program and download it into the board.
3. Start the application.

4.1.2 UDP Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
main: message sent
. . .
main: message sent
UDP client test Complete!
```

4.2 UDP Server

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to test the UDP socket.

It uses the following hardware:

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

Figure 4-2. UDP Server Demo Setup

4.2.1 Execution

`main.c` - Initialize the Wi-Fi module and test with the UDP client.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                       "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                       M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                        "12345678" /**< Password for Destination
SSID */
#define MAIN_WIFI_M2M_PRODUCT_NAME           "NMCTemp"
#define MAIN_WIFI_M2M_SERVER_IP              0xFFFFFFFF /* 255.255.255.255 */
#define MAIN_WIFI_M2M_SERVER_PORT            (6666)
#define MAIN_WIFI_M2M_REPORT_INTERVAL        (1000)
```

   – Initialize the socket module and create the UDP server socket.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – After the device is connected to the AP, create an RX socket and bind it in the main loop.

```

if (rx_socket < 0) {
    if ((rx_socket = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
        printf("main : failed to create RX UDP Client socket error!\r\n");
        continue;
    }
    /* Socket bind */
    bind(rx_socket, (struct sockaddr *)&addr, sizeof(struct sockaddr_in));
}
```

   – In the `socket_cb()` function, prepare a buffer to receive data.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    if (u8Msg == SOCKET_MSG_BIND) {
    recvfrom(sock, gau8SocketTestBuffer, MAIN_WIFI_M2M_BUFFER_SIZE, 0);
```

   – You can receive data in the `socket_cb()` function with the `SOCKET_MSG_RECVFROM` message when a client device sends data. (Use “UDP Client” example.)

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
    } else if (u8Msg == SOCKET_MSG_RECVFROM) {
    tstrSocketRecvMsg *pstrRx = (tstrSocketRecvMsg *)pvMsg;
    if (pstrRx->pu8Buffer && pstrRx->s16BufferSize) {
        printf("socket_cb: received app message.(%u)\r\n", packetCnt);
    /* Prepare next buffer reception. */
    recvfrom(sock, gau8SocketTestBuffer, MAIN_WIFI_M2M_BUFFER_SIZE, 0);
```

2. Build the program and download it into the board.
3. Start the application.

4.2.2 UDP Server Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
socket_cb: bind success!
socket_cb: received app message.(1)
. . .
socket_cb: received app message.(10)
UDP server test Complete!
```

4.3 TCP Client

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to test the TCP client.

It uses the following hardware:

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

Figure 4-3. TCP Client Demo Setup

4.3.1 Execution

`main.c` - Initialize the Wi-Fi module and test the TCP client.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                      "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                      M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                       "12345678" /**< Password for Destination
SSID */
#define MAIN_WIFI_M2M_PRODUCT_NAME          "NMCTemp"
#define MAIN_WIFI_M2M_SERVER_IP             0xc0a80164 //0xFFFFFFFF /*
255.255.255.255 */
#define MAIN_WIFI_M2M_SERVER_PORT           (6666)
#define MAIN_WIFI_M2M_REPORT_INTERVAL       (1000)
```

   – Initialize the socket module and register the socket callback function.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

– After the device is connected to the AP, create a TCP client socket and connect to server in the main loop.

```
/* Open client socket. */
if (tcp_client_socket < 0) {
    if ((tcp_client_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
    printf("main: failed to create TCP client socket error!\r\n");
    continue;
}
/* Connect server */
ret = connect(tcp_client_socket, (struct sockaddr *)&addr, sizeof(struct
sockaddr_in));
```

– Connect, send and recv operations will be executed sequentially in the `socket_cb()` function.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
...
case SOCKET_MSG_CONNECT:
    {
        if (pstrConnect && pstrConnect->s8Error >= 0)
            send(tcp_client_socket, &msg_wifi_product, ...);
    }
    ...
    case SOCKET_MSG_SEND:
    {
        recv(tcp_client_socket, gau8SocketTestBuffer, ...);
    }
    ...
    case SOCKET_MSG_RECV:
    {
        tstrSocketRecvMsg *pstrRecv = (tstrSocketRecvMsg *)pvMsg;
        if (pstrRecv && pstrRecv->s16BufferSize > 0) {
            printf("socket_cb: recv success!\r\n");
            printf("TCP Client Test Complete!\r\n");
        }
    }
```

2. Build the program and download it into the board.
3. Start the application.

4.3.2 TCP Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
socket_cb: connect success!
socket_cb: send success!
socket_cb: recv success!
TCP Client Test Complete!
```

4.4 TCP Server

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to test the TCP server.

It uses the following hardware:

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

Figure 4-4. TCP Server Demo Setup

4.4.1 Execution

`main.c` - Initialize the Wi-Fi module and test the TCP server.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                          "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                          M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                           "12345678" /**< Password for Destination
SSID */
#define MAIN_WIFI_M2M_PRODUCT_NAME              "NMCTemp"
#define MAIN_WIFI_M2M_SERVER_IP                 0xFFFFFFFF /* 255.255.255.255 */
#define MAIN_WIFI_M2M_SERVER_PORT               (6666)
#define MAIN_WIFI_M2M_REPORT_INTERVAL           (1000)
```

   – Initialize the socket module.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – After the device is connected to the AP, create a TCP server socket and bind it in the main loop.

```
if (tcp_server_socket < 0) {
/* Open TCP server socket */
    if ((tcp_server_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        printf("main: failed to create TCP server socket error!\r\n");
        continue;
    }
/* Bind service*/
    bind(tcp_server_socket, (struct sockaddr *)&addr, sizeof(struct sockaddr_in));
}
```

   – Five operations (bind/listen/accept/recv/send) will be executed sequentially in the `socket_cb()` function.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
    case SOCKET_MSG_BIND:
    {
        tstrSocketBindMsg *pstrBind = (tstrSocketBindMsg *)pvMsg;
        if (pstrBind && pstrBind->status == 0)
            listen(tcp_server_socket, 0);
    }
    case SOCKET_MSG_LISTEN:
    {
    tstrSocketListenMsg *pstrListen = (tstrSocketListenMsg *)pvMsg;
    if (pstrListen && pstrListen->status == 0)
        accept(tcp_server_socket, NULL, NULL);
    }
    case SOCKET_MSG_ACCEPT:
    {
        tstrSocketAcceptMsg *pstrAccept = (tstrSocketAcceptMsg *)pvMsg;
        if (pstrAccept) {
            tcp_client_socket = pstrAccept->sock;
            recv(tcp_client_socket, gau8SocketTestBuffer, ..., 0);
        }
    }
    case SOCKET_MSG_RECV:
    {
        tstrSocketRecvMsg *pstrRecv = (tstrSocketRecvMsg *)pvMsg;
        if (pstrRecv && pstrRecv->s16BufferSize > 0)
            send(tcp_client_socket, &msg_wifi_product, ..., 0);
    }
    case SOCKET_MSG_SEND:
    {
        printf("socket_cb: send success!\r\n");
        printf("TCP Server Test Complete!\r\n");
        printf("close socket\n");
    }
```

2. Build the program and download it into the board.
3. Start the application.

4.4.2 TCP Server Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxxsocket_cb: bind
success!
socket_cb: listen success!
socket_cb: accept success!
socket_cb: recv success!
socket_cb: send success!
TCP Server Test Complete!
close socket
```

4.5 NTP Time Client

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to retrieve time information from the time server.

It uses the following hardware:

- The SAM D21 Xplained Pro

- The ATWINC1500 on the EXT1 header

Figure 4-5. NTP Time Client Demo Setup

4.5.1 Execution

`main.c` - Initialize the socket and get the time from the NTP server.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                                "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                                M2M_WIFI_SEC_WPA_PSK /**< Security
manner */
#define MAIN_WLAN_PSK                                 "12345678" /**< Password for
Destination SSID */
```

   – Initialize the socket module and register socket callback function.

```
/* Initialize Socket module */
socketInit();
/* Register socket handler, resolve handler */
registerSocketCallback(socket_cb, resolve_cb);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – After the device is connected to the AP, create a UDP socket and bind it in the main loop.

```
if (udp_socket < 0) {
    udp_socket = socket(AF_INET, SOCK_DGRAM, 0);
    if (udp_socket < 0) {
    printf("main: UDP Client Socket Creation Failed.\r\n");
    continue;
    }
/* Initialize default socket address structure. */
addr_in.sin_family = AF_INET;
addr_in.sin_addr.s_addr = _htonl(MAIN_DEFAULT_ADDRESS);
addr_in.sin_port = _htons(MAIN_DEFAULT_PORT);
bind(udp_socket, (struct sockaddr *)&addr_in, sizeof(struct sockaddr_in));
```

   – Initialize the socket module and send an NTP time query to the NTP server in the `resolve_cb()` function

```
static void resolve_cb(uint8_t *pu8DomainName, uint32_t u32ServerIP)
{
    ...
if (udp_socket >= 0) {
        addr.sin_family = AF_INET;
        addr.sin_port = _htons(MAIN_SERVER_PORT_FOR_UDP);
        addr.sin_addr.s_addr = u32ServerIP;

        ret = sendto(udp_socket, (int8_t *)&cDataBuf, ...);
    }
```

   – Receive the NTP time from the server and convert it in the `socket_cb()` function.

```
static void resolve_cb(uint8_t *pu8DomainName, uint32_t u32ServerIP)
{
    ...
if (udp_socket >= 0) {
        addr.sin_family = AF_INET;
        addr.sin_port = _htons(MAIN_SERVER_PORT_FOR_UDP);
        addr.sin_addr.s_addr = u32ServerIP;
        ret = sendto(udp_socket, (int8_t *)&cDataBuf, ...);
    }
```

– Parse the time from the received server response.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
    case SOCKET_MSG_RECVFROM:
    {
        /* printf("socket_cb: socket_msg_recvfrom!\r\n"); */
        tstrSocketRecvMsg *pstrRx = (tstrSocketRecvMsg *)pvMsg;
        if (pstrRx->pu8Buffer && pstrRx->s16BufferSize) {
            uint8_t packetBuffer[48];
            memcpy(&packetBuffer, pstrRx->pu8Buffer, sizeof(packetBuffer));
            ...
            uint32_t secsSince1900 = packetBuffer[40] << 24 |
                                     packetBuffer[41] << 16 |
                                     packetBuffer[42] << 8 |
                                     packetBuffer[43];

            /* Now convert NTP time into everyday time.
             * Unix time starts on Jan 1 1970. In seconds, that's 2208988800.
            * Subtract seventy years. */
            const uint32_t seventyYears = 2208988800UL;
            uint32_t epoch = secsSince1900 - seventyYears;
        /* Print the hour, minute and second. GMT is the time at Greenwich
Meridian. */
            printf("socket_cb: The GMT time is %lu:%02lu:%02lu\r\n",
                        (epoch  % 86400L) / 3600,           /* hour (86400 equals
secs per day) */
                        (epoch  % 3600) / 60,               /* minute (3600 equals
secs per minute) */
                        epoch % 60);                        /* second */
```

2. Build the program and download it into the board.
3. Start the application.

4.5.2 NTP Time Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
m2m_ip_resolve_handler : DomainName pool.ntp.org
socket_cb: The GMT time is xx:xx:xx
```

Note: If the server connection is unstable, it may not operate normally.

4.6 SMTP Send Email

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to send email for an SMTP server.

It uses the following hardware:

• The SAM D21 Xplained Pro

- The ATWINC1500 on the EXT1 header

Figure 4-6. SMTP Send Email Demo Setup

4.6.1 Execution

`main.c` - Initialize the chip and send an email.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                        "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                        M2M_WIFI_SEC_WPA_PSK /**< Security manner */
#define MAIN_WLAN_PSK                         "12345678" /**< Password for Destination
SSID */
#define MAIN_SENDER_RFC                       "<sender@gmail.com>" /* Set Sender Email
Address */
#define MAIN_RECIPIENT_RFC                    "<recipient@gmail.com>"  /* Set Recipient
Email Address */
#define MAIN_EMAIL_SUBJECT                    "Hello from WINC1500!"
#define MAIN_TO_ADDRESS                       "recipient@gmail.com" /* Set To Email
Address */
#define MAIN_FROM_ADDRESS                     "sender@gmail.com" /* Set From Email
Address */
```

   – Initialize the socket module and register socket callback function.

```
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, resolve_cb);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – After the device is connected to the AP, try to connect to the SMTP server. Once connected, the smtpStatehandler will be executed sequentially until the socket status become SocketComplete.

```
if (gu8SocketStatus == SocketInit) {
if (tcp_client_socket < 0) {
    gu8SocketStatus = SocketWaiting;
    if (smtpConnect() != SOCK_ERR_NO_ERROR) {
            gu8SocketStatus = SocketInit;
    }
}
} else if (gu8SocketStatus == SocketConnect) {
    gu8SocketStatus = SocketWaiting;
    if (smtpStateHandler() != MAIN_EMAIL_ERROR_NONE) {
        ...
    }
} else if (gu8SocketStatus == SocketComplete) {
    printf("main: Email was successfully sent.\r\n");
    close_socket();
}
```

   – Connect to the socket and receive data following the SMTP status.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
case SOCKET_MSG_CONNECT:
    {
        if (pstrConnect && pstrConnect->s8Error >= SOCK_ERR_NO_ERROR)
            recv(tcp_client_socket, gcHandlerBuffer, ..., 0);
    }
    ...
    case SOCKET_MSG_RECV:
    {
        switch (gu8SmtpStatus) {
            case SMTP_INIT:
                ...
            case SMTP_HELO:
                ...
            case SMTP_AUTH:
                ...
            case SMTP_AUTH_USERNAME:
                ...
case SMTP_AUTH_PASSWORD:
                ...
            case SMTP_FROM:
                ...
            case SMTP_RCPT:
                ...
            case SMTP_DATA:
                ...
            case SMTP_MESSAGE_DATAEND:
                ...
        }
    }
```

2. Build the program and download it into the board.
3. Start the application.

Note:

- For using Gmail, the root certificate must be installed. For more details about downloading the root certificate, refer to the "Atmel-42417-SAMD21-ATWINC1500-Platform_Getting_Started_Guide" document.
- If the server connection is unstable, it may not operate normally.
  Limitations:

  1. Email is sent to only one recipient.

  2. Only plain text email is supported.

4.6.2 SMTP Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
Host IP is xxx.xxx.xxx.xxx
Host Name is smtp.gmail.com
Recipient email address is recipient@gmail.com
main: Email was successfully sent.
```

4.7 Location Client

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to get the location of the network provider.

It uses the following hardware:

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

Figure 4-7. Location Client Demo Setup

4.7.1 Execution

`main.c` - Initialize the ATWINC1500 and get location information.

1. Code summary.
   - Configure the below code in `main.h` for AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                    "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                    M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                     "12345678" /**< Password for Destination
SSID */
```

   - Configure the HTTP client.

```
configure_http_client();
```

   - Get the default config data and specify user configuration. Then the `http_client_init()` and `http_client_register_callback()` functions execute sequentially.

```
static void configure_http_client(void)
{
    ...
    http_client_get_config_defaults(&httpc_conf);

    httpc_conf.recv_buffer_size = 256;
    httpc_conf.timer_inst = &swt_module_inst;
    httpc_conf.user_agent = "curl/7.10.6";

    ret = http_client_init(&http_client_module_inst, &httpc_conf);
    if (ret < 0) {
        while (1) {
        } /* Loop forever. */
    }

    http_client_register_callback(&http_client_module_inst, ...);
}
```

   - Initialize the socket module and register socket callback functions.

```
socketInit();
registerSocketCallback(socket_cb, resolve_cb);
```

   - Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   - After the device is connected to the AP, an HTTP request will be sent.

```
static void wifi_callback(uint8_t msg_type, void *msg_data)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    {
        http_client_send_request(&http_client_module_inst, ...);
    }
```

– 4 operations will be executed sequentially.

```
static void http_client_callback(...)
{
    switch (type) {
    case HTTP_CLIENT_CALLBACK_SOCK_CONNECTED:
        printf("Connected\r\n");
        break;
    case HTTP_CLIENT_CALLBACK_REQUESTED:
        printf("Request complete\r\n");
        break;
    case HTTP_CLIENT_CALLBACK_RECV_RESPONSE:
        if (data->recv_response.content != NULL) {
            if (json_create(...) == 0 && json_find(...) == 0) {
                printf("Location : %s\r\n", loc.value.s);
            }
        }
        break;
    case HTTP_CLIENT_CALLBACK_DISCONNECTED:
        printf("Disconnected reason:%d\r\n", data->disconnected.reason);
        ...
    }
}
```

– The first sequence begins with the socket connection. After the request completes, the third sequence will be executed and you can retrieve the location data.

2. Build the program and download it into the board.
3. Start the application.

Note:

- If the disconnect reason is equal to -ECONNRESET(-104), it means the server disconnected your connection due to the keep alive timeout. This is normal operation.
- This example obtains the location of your network provider, not your current position.
- If the connection with the location client server is unstable, the response may not be as expected.

4.7.2 Location Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
Connected
Request complete
Received response 200 data size 178
Location : {latitude},{longitude}
Disconnected reason:-104
```

5. Advanced Examples

This chapter describes complex or advanced examples in detail.

- Exostite Cloud Application
- Growl client – demonstrates using RESTful API over SSL (essential for IoT application)
- HTTP client file downloader application
- IoT temperature and Qtouch sensor demo application using an Android app
- MQTT Chat client – demonstrate how to send and receive IoT information using the MQTT protocol
- OTA Firmware Upgrade – ATWINC1500 Firmware upgrade via OTA server
- PubNub Cloud application
- SSL Client connection – Set up an SSL Client connection
- SSL Server connection – Set up an SSL Server connection
- 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

For a customer's IoT application, these examples are useful for how to use ATWINC1500 APIs and implement a feature for an IoT application.

5.1 Exosite Cloud

This section will demonstrate how to connect the SAM W25 Xplained PRO board to cloud backend services such as Exosite.

Thef ollowing topics will be covered:

- Hardware overview for both SAM W25 Wi-Fi module and SAM W25 Xplained PRO evaluation board
- How to connect to Exosite Cloud
- How to create a dashboard to visualize the data
- How to build and execute the Exosite demo

It uses the following hardware:

- The SAM W25 Xplained Pro
- The IO1 Xplained Pro extension on the EXT1

5.1.1 Execution

`main.c` – Initialize the board, connect to an Exosite Cloud and update the temperature details to the cloud.

The SAM W25 module now should be in AP mode and be listed as a Wi-Fi network with the same name as shown in the below image (Atmel_SAMW25_XX:XX). Notice that the last two bytes of the MAC address are appended to the SSID. Simply connect your PC/smartphone to the module in AP mode.

```
#define MAIN_M2M_DEVICE_NAME    "Atmel_SAMW25_00:00"
```

Note: Once connected, open your favorite web browser at the following address http://atmelconfig.com and provide the required Network Name (SSID) and Passphrase (device name can be blank) fields of the Wi-Fi AP the SAM W25 is supposed to connect to.

Enter your SSID and Passphrase. Now your SAM W25 module is provisioned and connected to the provided Wi-Fi AP.

Now that the SAM W25 is connected to the AP with internet connectivity, it will immediately connect to the Exosite messaging service and will start sending temperature and light data.

For this application, you can start with the `main.c` file.

The above file has all the code needed to perform the system initialization by controlling components such as UART, buttons, LEDs, BSP, temperature sensor, Wi-Fi driver and socket.

The WiFi initialization and other configurations to be done before the super loop function `for(;;system_sleep())`:

```
/* Initialize WINC1500 Wi-Fi driver with data and status callbacks. */
    param.pfAppWifiCb = wifi_cb;
    ret = m2m_wifi_init(&param);
    if (M2M_SUCCESS != ret) {
        DEBUG(DEBUG_CONF_WIFI "m2m_wifi_init call error!(%d)" DEBUG_EOL, ret);
        while (1) {
    }
    }
    m2m_wifi_set_sleep_mode(M2M_PS_AUTOMATIC, 1);

    /* Initialize socket. */
    socketInit();
    registerSocketCallback(http_client_socket_event_handler,
http_client_socket_resolve_handler);
    /* Connect using stored SSID and Password. */
    m2m_wifi_default_connect();
     ap_exosite_connection_state = MAIN_CHECKING_AP_INFORMATION;
    for(;;system_sleep())
    {
        /* Handle pending events from network controller. */
        ret = m2m_wifi_handle_events(NULL);
```

The first step is to initialize the Exosite client module by calling function `Exosite_example_init().` This function receives one parameter, which is a function pointer to call back the http module. The role of this function is to initialize a timer_module for the http_module and also initializes the http_module. Add the following code just before the `for(;;system_sleep())` inside the `main()` function.

```
/* Initialize Exosite. */
exosite_example_init(main_http_client_callback);
```

`main_http_client_callback()` will be registered by `Exosite_example_init()` and will receive and process all socket events. This function can be located in the `main.c` file or in a separate file as below:

```
/** brief Callback to get the Data from socket.*/
    static void main_http_client_callback(struct http_client_module *module_list, int type,
                                            union http_client_data *data)
    {
        Switch(type)
        {
            case HTTP_CLIENT_CALLBACK_SOCK_CONNECTED: break;
            case HTTP_CLIENT_CALLBACK_REQUESTED: break;
            case HTTP_CLIENT_CALLBACK_RECV_RESPONSE: break;
            case HTTP_CLIENT_CALLBACK_DISCONNECTED: break;
        }
    }
```

Register the callback function for the sockets by calling the following function in `main()`:

```
/* Initialize socket. */
socketInit();
registerSocketCallback(http_client_socket_event_handler, http_client_socket_resolve_handler);
```

The above function receives two parameters. The first one is a function pointer to deliver socket messages from the socket. The other one is a function pointer that is used for DNS resolving functions. The two parameters are located in `http_client.h`.

```
/**
 * \brief Event handler of socket event.
 *
 * \param[in]  sock            Socket descriptor.
 * \param[in]  msg_type        Event type.
 * \param[in]  msg_data        Structure of socket event.
 */
void http_client_socket_event_handler(SOCKET sock, uint8_t msg_type, void *msg_data);

/**
 * \brief Event handler of gethostbyname.
 *
 * \param[in]  domain_name     Domain name.
 * \param[in]  server_ip       Server IP.
 */
void http_client_socket_resolve_handler(uint8_t *domain_name, uint32_t server_ip);
```

In order to send the data from the temperature and light sensors on the IO1 to the Exosite cloud, the function `exosite_example_read_and_write()` must be used.

```
/* publish the temp measurements every interval */
if (tick_counter_check_timer())
{
    Char send_buf[100]; int dTemp = 0;
    int dLight = 0;

    /* prepare to sensor data in the I/o1 Board */ io1_board_prepare_to_get_info();
    dTemp = io1_board_get_temperature(); dLight = io1_board_get_lightvalue();
    sprintfsend_buf,"degree=%d&voltage=%d", fintbdTemp, fintbdLightb;
    if( exosite_example_read_and_write(send_buf, (char*)p_board_info->cik))
    ...
}
```

The function sends the data to the cloud continuously in regular intervals.

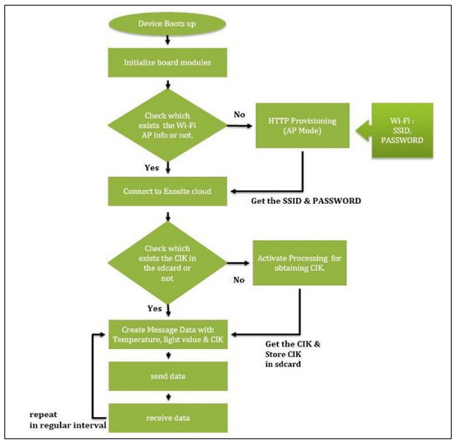
In order to receive the response messages from Exosite, the `main_http_client_callback()` function must be used.

```
/** brief Callback to get the Data from socket. */
static void main_http_client_callback(struct http_client_module *module_list,
                                        int type, union http_client_data *data)
{
    case HTTP_CLIENT_CALLBACK_RECV_RESPONSE:
    parsing_http_response_data( data->recv_response.response_code,
    data->recv_response.content,
    data->recv_response.content_length);
    break;
}
```

Then you can add the relevant code to process the received messages without the `parsing_http_response_data()` function.

Note: This function is required to receive the CIK from Exosite.

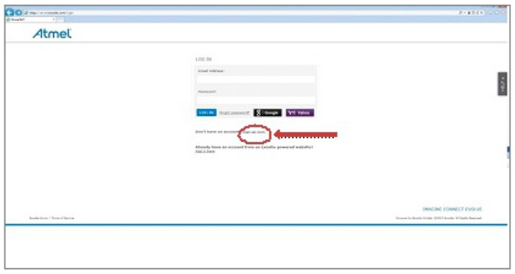
Figure 5-1. Exosite Application Flow Chart


Device Boots up
Initialize board modules
Check which exists the Wi-Fi AP info or not.
No
HTTP Provisioning (AP Mode)
Wi-Fi : SSID, PASSWORD
Yes
Connect to Exosite cloud
Get the SSID & PASSWORD
Check which exists the CIK in the sdcard or not
Activate Processing for obtaining CIK.
No
Yes
Create Message Data with Temperature, light value & CIK
Get the CIK & Store CIK in sdcard
send data
repeat in regular interval
receive data

5.1.2 How to Set the Exosite Cloud to View the Published Data

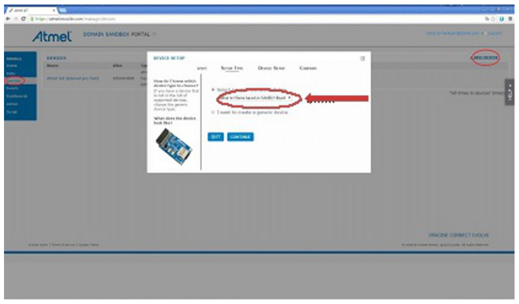
1. Open a free account on the Exosite Portal.
   - Go to the Exosite Portal web site http://atmel.exosite.com
   - Click on “Create an Account” and then log in

   Figure 5-2. Atmel Exosite Login Page

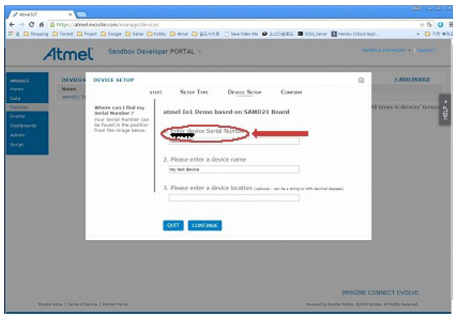
2. Register your device and input your device serial number on the I/O1 extension.
   - You can see the device setup window (see below).
   - Select Device -> ADD DEVICE -> Atmel I/O1 Demo based on the SAM W25 Board.

     Figure 5-3. Atmel Exosite Add Device

   - Populate the S/N written on the back of I/O1 Xplained Pro.

Figure 5-4. Atmel Exosite Add Device Details



DEVICE SETUP

Where can I find my Serial Number ? Your Serial number can be found in the position from the image below.

atmel Io1 Demo based on SAMD21 Board

1. Enter device Serial Number

[redacted]

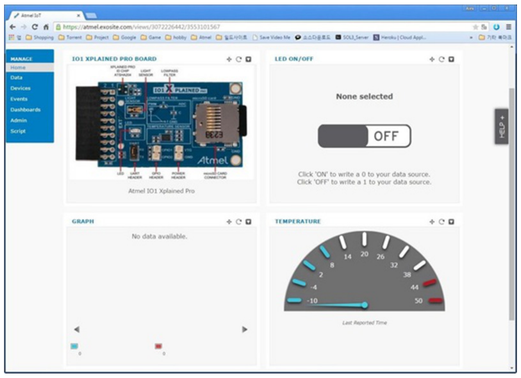
2. Please enter a device name

my test device

3. Please enter a device location (optional - can be a string or GPS decimal degrees)

3. The DashBoard of my device will be shown.

   Figure 5-5. Atmel Exosite Device Update



5.2 HTTP File Downloader

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to download the file in the SD card connected to the IO1 Xplained Pro board.

It uses the following hardware:

- The SAM D21 Xplained Pro
- The ATWINC1500 on the EXT1 header
- The IO1 XPRO board on the EXT2 header

Figure 5-6. HTTP File Downloader Demo Setup

5.2.1 Execution

`main.c` – Initialize the ATWINC1500 and download the file from the URL.

1. Code summary.
   – Configure the below code in `main.h` for the AP connection information.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                          "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                          M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                           "12345678" /**< Password for Destination
SSID */
```

– Configure the HTTP URL file to be downloaded into the SD card.

```
/** Content URI for download. */
#define MAIN_HTTP_FILE_URL        "http://www.atmel.com/Images/Atmel-42502-
SmartConnect-WINC1500-MR210PB_Datasheet.pdf"
```

– Configure the HTTP client.

```
configure_http_client();
```

– Get the default config data and specify the user configuration. The `http_client_init()` and `http_client_register_callback()` functions execute sequentially.

```
static void configure_http_client(void)
{
    ...
    http_client_get_config_defaults(&httpc_conf);

    httpc_conf.recv_buffer_size = MAIN_BUFFER_MAX_SIZE;
    httpc_conf.timer_inst = &swt_module_inst;

    ret = http_client_init(&http_client_module_inst, &httpc_conf);
    if (ret < 0) {
    while (1) {
    } /* Loop forever. */
    }
    http_client_register_callback(&http_client_module_inst, http_client_callback);
}
```

– Initialize the socket module and register socket callback functions.

```
socketInit();
registerSocketCallback(socket_cb, resolve_cb);
```

– Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

– After the device is connected to the AP, an HTTP request will be sent.

```
static void wifi_callback(uint8_t msg_type, void *msg_data)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    {
        start_download();
    }
```

```
static void start_download(void)
{
    ...
    /* Send the HTTP request. */
    printf("start_download: sending HTTP request...\r\n");
    http_client_send_request(&http_client_module_inst, MAIN_HTTP_FILE_URL,
HTTP_METHOD_GET, NULL, NULL);
}
```

– Four operations will execute sequentially. The files are stored in the SD card when they are received by the HTTP request and callback.

```
static void http_client_callback(...)
{
    switch (type) {
    case HTTP_CLIENT_CALLBACK_SOCK_CONNECTED:
        printf("Connected\r\n");
        break;
    case HTTP_CLIENT_CALLBACK_REQUESTED:
    printf("Request complete\r\n");
    break;
    case HTTP_CLIENT_CALLBACK_RECV_RESPONSE:
        printf("http_client_callback: received response %u data size %u\r\n",
                (unsigned int)data->recv_response.response_code,
                (unsigned int)data->recv_response.content_length);
        if ((unsigned int)data->recv_response.response_code == 200) {
            http_file_size = data->recv_response.content_length;
            received_file_size = 0;
        }
        if (data->recv_response.content_length <= MAIN_BUFFER_MAX_SIZE) {
            store_file_packet(data->recv_response.content, data-
>recv_response.content_length);
        }
        break;
    case HTTP_CLIENT_CALLBACK_RECV_CHUNKED_DATA:
        store_file_packet(data->recv_chunked_data.data, data-
>recv_chunked_data.length);
    case HTTP_CLIENT_CALLBACK_DISCONNECTED:
        printf("Disconnected reason:%d\r\n", data->disconnected.reason);
        ...
    }
}
```

   – The first sequence begins with the socket connected. After the request completes, the third sequence will be executed and the file header is followed by the file data.

2. Build the program and download it into the board.
3. Start the application.

Note:

- If the disconnect reason is equal to -ECONNRESET(-104), it means the server disconnected your connection due to the keep alive timeout. This is normal operation.
- If the server connection is unstable, it may not be operate normally.

5.2.2 HTTP File Downloader Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
This example requires the AP to have internet access.

init_storage: please plug an SD/MMC card in slot...
init_storage: mounting SD card...
init_storage: SD card mount OK.
main: connecting to WiFi AP DEMO_AP...
wifi_cb: M2M_WIFI_CONNECTED
wifi_cb: IP address is xxx.xxx.xxx.xxx
start_download: sending HTTP request...
resolve_cb: www.microchip.com IP address is xxx.xxx.xxx.xxx

http_client_callback: HTTP client socket connected.
http_client_callback: request completed.
http_client_callback: received response 200 data size 1147097
store_file_packet: creating file [0:WINC1500-MR210PB_Datasheet.pdf]
store_file_packet: received[xxx], file size[1147097]
...
store_file_packet: received[1147097], file size[1147097]
store_file_packet: file downloaded successfully.
main: please unplug the SD/MMC card.
main: done.
```

5.3 Growl Notification

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro.

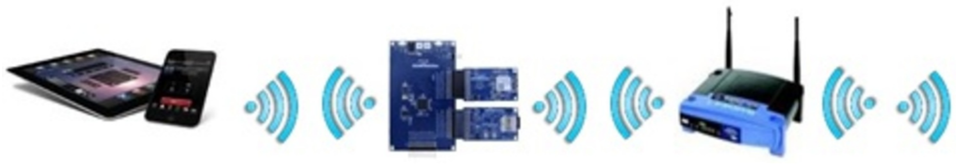
This example transmits a notification from the ATWINC1500 device (based on a certain trigger) to a public remote server which in turn sends it to a phone application.

The initiated notification from the ATWINC1500 device is directed to a certain subscriber on the server. The supported applications are PROWL (for iPhone notifications) and NMA (for ANDROID notifications).

It uses the following hardware:

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

Figure 5-7. Demo Setup



5.3.1 Execution

`main.c` - Initialize growl and send notification message.

1. Code summary.
   – Configure below code in `main.h` for your account.

```
/** Growl Options */
#define PROWL_API_KEY            "6ce3b9ff6c29e5c5b8960b28d9e987aec5ed603a"
#define NMA_API_KEY              "91787604ed50a6cfc2d3f83d1ee196cbc30a3cb08a7e69a0"
```

   – Get the MAC address and set the device name with the MAC address.

```
m2m_wifi_get_mac_address(gau8MacAddr);

set_dev_name_to_mac((uint8_t *)gacDeviceName, gau8MacAddr);
set_dev_name_to_mac((uint8_t *)gstrM2MAPConfig.au8SSID, gau8MacAddr);
m2m_wifi_set_device_name((uint8_t *)gacDeviceName, ...);
```

   – Start provision mode.

```
m2m_wifi_start_provision_mode((tstrM2MAPConfig *)&gstrM2MAPConfig,
            (char *)gacHttpProvDomainName, 1);
```

   – When your mobile device sends the configuration information, the `wifi_cb()` function will be called with the `M2M_WIFI_RESP_PROVISION_INFO` message and you can connect to the AP with the given information.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_PROVISION_INFO:
    tstrM2MProvisionInfo *pstrProvInfo = (tstrM2MProvisionInfo *)pvMsg;
    if (pstrProvInfo->u8Status == M2M_SUCCESS) {
    m2m_wifi_connect((char *)pstrProvInfo->au8SSID,
        strlen((char *)pstrProvInfo->au8SSID),
        pstrProvInfo->u8SecType,
        pstrProvInfo->au8Password, M2M_WIFI_CH_ALL);
    }
```

   – After the device is connected to the AP, initialize the growl key and execute the message handler.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    ...
    NMI_GrowlInit((uint8_t *)PROWL_API_KEY, (uint8_t *)NMA_API_KEY);
    growl_send_message_handler();
    }
    ...
}
```

– The notification message will be sent through the below function.

```
static int growl_send_message_handler(void)
{
    ...
    NMI_GrowlSendNotification(NMA_CLIENT, (uint8_t *)"Growl_Sample",
        (uint8_t *)"Growl_Event", (uint8_t *)"growl_test", NMA_CONNECTION_TYPE);
    return 0;
}
```

2. Build the program and download it into the board.
3. Start the application.
4. Connect your mobile device to ATWINC1500 AP [WINC1500_08:CA].
5. Browse to the webpage (www.microchip.com) to setup AP, populate the page, then press Connect.
6. The ATWINC1500 will be connected to the AP that you entered.
7. The Growl message will be sent.

This example supports sending GROWL notifications to the following servers:

- PROWL for iOS push notifications (https://www.prowlapp.com/)
- NMA for Android push notifications (http://www.notifymyandroid.com/)

In order to enable the GROWL application (for sending notifications), you need to set your own API key to represent your account. Create your own by:

Create an NMA account at http://www.notifymyandroid.com/ and create an API key. Copy the obtained key string in the file `main.h` in the NMA_API_KEY macro as follows:

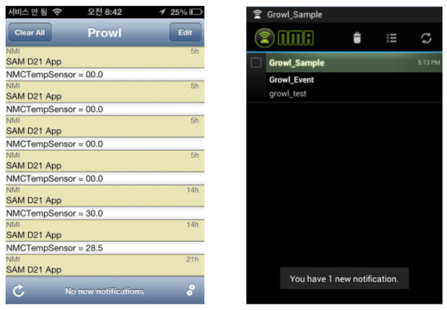
- #define NMA_API_KEY "f8bd3e7c9c5c10183751ab010e57d8f73494b32da73292f6"

Create a PROWL account at https://www.prowlapp.com/ and create an API key. Copy the obtained API key string into the file `main.h` in the macro PROWL_API_KEY as follows:

- #define PROWL_API_KEY "117911f8a4f2935b2d84abc934be9ff77d883678"

Note: For using growl, the root certificate must be installed.

Figure 5-8. Launch the Growl or NMA application to receive notification



NMI 5h
SAM D21 App
NMCTempSensor = 00.0
NMI 5h
SAM D21 App
NMCTempSensor = 00.0
NMI 5h
SAM D21 App
NMCTempSensor = 00.0
NMI 5h
SAM D21 App
NMCTempSensor = 00.0
NMI 14h
SAM D21 App
NMCTempSensor = 30.0
NMI 14h
SAM D21 App
NMCTempSensor = 28.5
NMI 21h
SAM D21 App

Growl_Sample 5:13 PM
Growl_Event
growl_test

You have 1 new notification.

5.3.2 Growl Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Provision Mode started.
Connect to [atmelconfig.com] via AP[WINC1500_XX:XX] and fill up the page.
Wi-Fi connected
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
send Growl message
Growl CB : 20
```

5.4 IoT Temperature and Qtouch Sensor Demo

The purpose of this demo is to connect various kinds of sensors to your home network using a Wi-Fi access point and remotely access the sensors' information via an Android device.

A sensor typically implements a basic discovery system where UDP broadcast frames are sent each second to advertise the sensor presence on the network. The Android App can then detect such packets and communicate with the sensor to receive the sensor data stream.

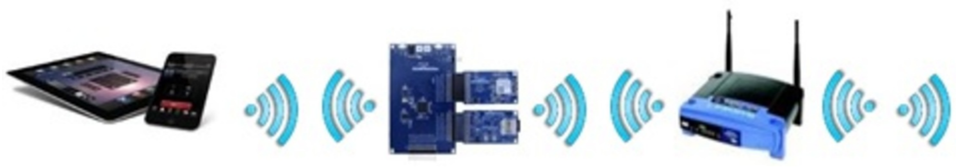
These are implemented in a similar way and use a similar communication protocol with the Android application. Both can work at the same time and report sensor information to the same “Atmel IoT Sensor” Android application.

It uses the following hardware for Temperature Sensor Demo:
- The SAM D21 Xplained Pro
- The ATWINC1500 on EXT1 header
- The IO1 XPRO board on the EXT2
- The QT1 XPRO board on the EXT1 and EXT2

It uses the following hardware for Qtouch Sensor Demo:
- The SAM D21 Xplained Pro
- The ATWINC1500 on the EXT3 header
- The QT1 XPRO board on the EXT1 and EXT2

Note: Qtouch mutual capacitance QT1 XPRO board needs to be connected to EXT1 and EXT2 header together.

Figure 5-9. IoT Demo Setup



5.4.1 Execution

`main.c` - Initialize the board, connect to an AP and communicate using the Android App.

- Configure AP SSID in `demo.h` for the *Temperature Sensor Demo*.

```
#define DEMO_WLAN_AP_NAME    "WINC1500_MyAP"// Access Point Name.
```

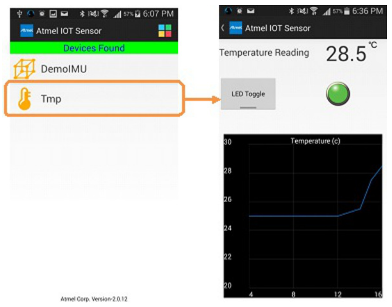
- Configure AP SSID in `demo.h` for the *Qtouch Sensor Demo*.

```
#define DEMO_WLAN_AP_NAME    "WINC1500_TOUCH_MyAP"// Access Point Name.
```

- **Note:** Refer to the HTTP provision mode application note for more details.

Once your sensor Wi-Fi module is provisioned, connect your Android device to the same Access Point and open the Atmel IoT Sensor Application. Your sensor will display on the Android application's main screen as shown below:

Figure 5-10. Demo Android App



By tapping on the sensor's name, you will be able to access the real time data flow. In the case of a temperature sensor, you can see the real time temperature data in the graph. The "LED Toggle" button toggles the LED status. A green or red light next to the "LED Toggle" button gives the current status of the LED.

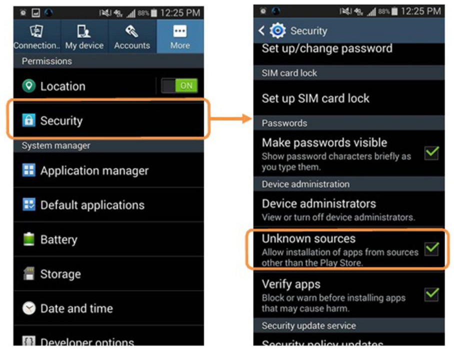
Note: If your Android device is not connected to the same Access Point as the sensor, you will not be able see any device.

5.4.2 Install the IoT Sensor Android Application

To Install the IoT Sensor APK located in the android_app folder of your ASF project, do the following:

- Connect your Android device to your Windows laptop
- Open the start menu and double click on "Computer"
- Your phone will be listed under the "Portable Devices" list
- Open and browse the existing folders
- Locate the "Download" folder, then simply drag and drop the provided "Atmel_IOT_Sensor_v2.10.18.apk" application
- Go to your Android phone settings and allow unknown application sources

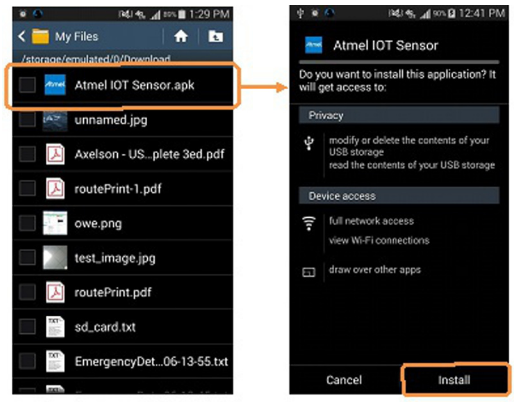
Figure 5-11. Android App Install Settings



- Open your favorite file browser like "MyFiles" (available on Google market for free)

- Go to your “Downloads” folder
- Click on the Atmel IoT Sensor Application file (APK)
- Press the “Install” button

Figure 5-12. Install Android App


1:29 PM
My Files
/storage/emulated/0/Download
Atmel IOT Sensor.apk
unnamed.jpg
Axelson - US...plete 3ed.pdf
routePrint-1.pdf
owe.png
test_image.jpg
routePrint.pdf
sd_card.txt
EmergencyDet...06-13-55.txt
12:41 PM
Atmel IOT Sensor
Do you want to install this application? It will get access to:
Privacy
modify or delete the contents of your USB storage
read the contents of your USB storage
Device access
full network access
view Wi-Fi connections
draw over other apps
Cancel
Install

5.4.3 Demo Console Log

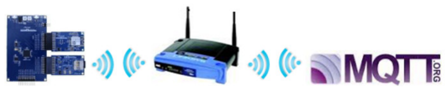
5.5 MQTT Chat

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to chat using the MQTT protocol.

It uses the following hardware:

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

Figure 5-13. MQTT Chat Demo Setup



5.5.1 Execution

`main.c` - Initialize the board, connect to an MQTT broker and chat with other devices.

1. Code summary.
   – Configure the below code in `main.h` for the MQTT broker and AP information to be connected.

```
/* Chat MQTT topic. This is only demo User can create their own topic*/
#define MAIN_CHAT_TOPIC "atmel/sample/chat_demo/"
/** A MQTT broker server which was connected.
 * test.mosquitto.org is public MQTT broker.*/
static const char main_mqtt_broker[] = "test.mosquitto.org";

/** Wi-Fi Settings */
#define MAIN_WLAN_SSID        "DEMO_AP" /* < Destination SSID */
#define MAIN_WLAN_AUTH        M2M_WIFI_SEC_WPA_PSK /* < Security manner */
#define MAIN_WLAN_PSK         "12345678" /* < Password for Destination SSID */
```

– Configure the MQTT module. You can set the timer instance and register callback for MQTT messages.

```
/* Initialize the MQTT service. */
configure_mqtt();
```

```
static void configure_mqtt(void)
{
    ...
    mqtt_get_config_defaults(&mqtt_conf);
    /* To use the MQTT service, it is necessary to always set the buffer and the
timer. */
    mqtt_conf.timer_inst = &swt_module_inst;
    mqtt_conf.recv_buffer = mqtt_buffer;
    mqtt_conf.recv_buffer_size = MAIN_MQTT_BUFFER_SIZE;

    result = mqtt_init(&mqtt_inst, &mqtt_conf);
    result = mqtt_register_callback(&mqtt_inst, mqtt_callback);
```

– Setup the user name first and then the topic value will be set with MAIN_CHAT_TOPIC + user name.

```
    /* Setup user name first */
    printf("Enter the user name (Max %d characters)\r\n", MAIN_CHAT_USER_NAME_SIZE);
    scanf("%64s", mqtt_user);
    printf("User : %s\r\n", mqtt_user);
    sprintf(topic, "%s%s", MAIN_CHAT_TOPIC, mqtt_user);
```

– Initialize the socket module and register socket callback function.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

– Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

– After the device is connected to the AP, call the `mqtt_connect()` function to connect the socket.

```
static void wifi_callback(uint8 msg_type, void *msg_data)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    ...
    /* Try to connect to MQTT broker when Wi-Fi was connected. */
    mqtt_connect(&mqtt_inst, main_mqtt_broker);
}
```

– MQTT callback will receive the `MQTT_CALLBACK_SOCK_CONNECTED` message and then start sending a CONNECT message to the MQTT broker.

```
static void mqtt_callback(struct mqtt_module *module_inst, int type, union
mqtt_data *data)
{
    ...
    case MQTT_CALLBACK_SOCK_CONNECTED:
    {
    mqtt_connect_broker(module_inst, 1, NULL, NULL, mqtt_user, NULL, NULL, 0, 0, 0);
```

– MQTT callback will receive the `MQTT_CALLBACK_CONNECTED` message and then register subscription with a specific topic.

```
static void mqtt_callback(struct mqtt_module *module_inst, int type, union
mqtt_data *data)
```

```
{
    ...
    case MQTT_CALLBACK_CONNECTED:
    {
        mqtt_subscribe(module_inst, MAIN_CHAT_TOPIC "#", 0);
```

– If another device sends a message with this topic, then MQTT callback will receive a `MQTT_CALLBACK_RECV_PUBLISH` message.

```
static void mqtt_callback(struct mqtt_module *module_inst, int type, union
mqtt_data *data)
{
    ...
    case MQTT_CALLBACK_RECV_PUBLISH:
```

– If the user inputs a string via a terminal, MQTT publishes the following message:

```
static void check_usart_buffer(char *topic)
{
    if (uart_buffer_written >= MAIN_CHAT_BUFFER_SIZE) {
        mqtt_publish(&mqtt_inst, topic, uart_buffer,
        MAIN_CHAT_BUFFER_SIZE, 0, 0);
        uart_buffer_written = 0;
    }
```

2. Build the program and download it into the board.
3. Start the application.
4. On the terminal window, enter the user name through the terminal window.
5. After chatting initialization completes, you can chat.
   Note:
   - Initialization may take longer than a few minutes depending on the network environment.
   - The application is now programmed and running. The following information will be displayed on the terminal window.

Note: The maximum message length should be shorter than 128 bytes. If the server connection is unstable, it may not be operate normally.

5.5.2 Demo Console Log

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Preparation of the chat has been completed.
Enter the user name (Max 64 characters)
User : demo_user
Wi-Fi connected
Wi-Fi IP is xxx.xxx.xxx.xxx
Preparation of the chat has been completed.
demo_user >> hi!
demo_user >> anybody there?
other_user >> I'm here
other_user >> hi
```

Note: The user name should not contain any blank spaces.

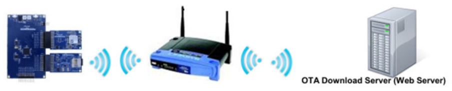
5.6 OTA Firmware Upgrade

This example demonstrates how to upgrade the ATWINC1500 firmware via OTA. It downloads the ATWINC1500 firmware from OTA download server, which is a web server. You can upload a new firmware image and download it to your device.

It uses the following hardware:

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

Figure 5-14. OTA Firmware Upgrade Demo Setup



5.6.1 Execution

`main.c` - Initialize devices and set the server information. It then connects to the OTA Download Server.

1. Set your OTA download server.
2. Upload the OTA firmware binary to the root folder in your server. (e.g. `http://192.168.0.137/m2m_ota.bin`).
3. Code summary.
   – Configure the below code in `main.h` for AP information to be connected. The default port number is 80. If the user application uses a different port number, update it in the URL. `"http://192.168.0.137:5050/m2m_ota.bin"`.

```
#define MAIN_WLAN_SSID          "DEMO_AP"
#define MAIN_WLAN_AUTH          M2M_WIFI_SEC_WPA_PSK
#define MAIN_WLAN_PSK           "12345678"
#define MAIN_OTA_URL            "http://192.168.0.137/m2m_ota.bin"
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – Initialize the OTA function.

```
m2m_ota_init(OtaUpdateCb, OtaNotifCb);
```

   – After the device is connected to the AP, the `m2m_ota_start_update()` function will be executed in the `wifi_cb()` function.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
        m2m_ota_start_update((uint8_t *)MAIN_OTA_URL);
```

   – If successfully downloaded, the `m2m_ota_switch_firmware()` function will be called through `OtaUpdateCb()`.

```
static void OtaUpdateCb(uint8_t u8OtaUpdateStatusType, uint8_t u8OtaUpdateStatus)
{
    m2m_ota_switch_firmware();
}
```

   After that, a message will display: “OTA Success. Press reset your board.”
4. Build the program and download it into the board.

5. Start the application.
   When you receive the IP address, then OTA will start.
6. You can find firmware version and build time information.
```
(3)NMI M2M SW  VERSION xx.xx.xx
(3)NMI MIN DRV VERSION xx.xx.xx
(3)Built at xxx xx xxxx xx:xx:xx
```
7. Once connected to the OTA server, the following text will appear on the terminal window:
```
(770)(M2M)(OTA) Invalidate RB Image
Start Writing.. at 40000 Size 204380
(809)STATS    0   0   5  25   0, err: 16 - stuck: 0
(809)!@#$ Rate DN (48.0 Mbps) !@#$
(910)!@#$ Rate DN (MCS-4) !@#$
(1079)(M2M)Verification OK 204380
(1080)(M2M)(OTA) Update image done successfully
(1080)(M2M)Socket 6 Closed
(1083)(M2M)(OTA) SWap image done successfully
(1084)(M2M)(OTA) Switching firmware done.
```
8. After the successful OTA firmware upgrade, the following text will appear on the terminal window:
```
Wi-Fi IP is xxx.xxx.xxx.xxx
OtaUpdateCb 1 0
OtaUpdateCb m2m_ota_switch_firmware start.
OtaUpdateCb 2 0
OTA Success. Press reset your board.
```
9. The application reads data from the serial interface.
```
(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  = xx:xx:xx:xx:xx:xx
(3)NMI M2M SW  VERSION xx.xx.xx
(3)NMI MIN DRV VERSION xx.xx.xx
(3)Built at xxx xx xxxx xx:xx:xx
(3)__ROM_FIRMWARE__
```

The OTA download procedure is:

1. Download the ATWINC1500 driver version 19.4.4 OTA application from ASF.
2. Use any HTTP server or hfs.exe from http://www.rejetto.com/hfs/
3. Run the hsf.exe
4. Add the OTA firmware from the "\src\Tools\firmware\ota_firmware\m2m_ota_3a0.bin" 19.5.2 release package to the root folder in the hfs.exe tool.
5. Change the MAIN_OTA_URL "http://192.168.1.138:5050/m2m_ota.bin" to the IP address in the hfs tool. The IP address is the HTTP server IP address and the user can use their own port number or port number 80.
6. Program the MCU with the OTA application available in the ASF (19.4.4) after compiling these changes.
7. Run the application and wait for it to complete.

5.6.2 OTA Firmware Upgrade Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
```

```
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
```

The following text will appear on the terminal window of the ATWINC1500 debug UART interface:

```
(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  = xx:xx:xx:xx:xx:xx
(3)NMI M2M SW  VERSION xx.xx.xx
(3)NMI MIN DRV VERSION xx.xx.xx
(3)Built at xxx xx xxxx xx:xx:xx
(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
(8)Reset MAC
(9)>> Sleep clk src <= Int. osc
(9)>> wakeup_delay = 1500 us
(9)>> pds = [652 652 6526 1957 3 ]
(9)----------------------------------------
(489)MAC State <3>
(494)MAC State <4>
(494)Join on 11
(494)>> sta_wait_join 179
(494)MAC State <5>
(494)MAC State <6>
(495)Init Auth.
(495)MAC State <7>
(495)MAC State <9>
(495)MAC State <10>
(496)MAC State <1>
(496)!@#$ Rate DN (MCS-5) !@#$
(496)Assoc Success.
(498)(M2M)WIFI Connected
(499)(DHCP)<- DISCOVER
(500)Tsf join
(510)Tsf join Done
(532)(DHCP)-> OFFER
(563)(DHCP)-> ACK
(563)(DHCP)Self IP         : "xxx.xx.xxx.xxx"
```

5.7 Serial Bridge

This application is used to download the firmware into the ATWINC1500 using the host MCU. This application resides in the host MCU and the *image_downloader.exe* tool communicates with the ATWINC1500 using a serial bridge application.

- The SAM D21 Xplained Pro

- The ATWINC1500 on the EXT1 header

It is possible to use this application to port into a different Microchip MCU or other vendor MCU as well.
Note: For more detail about using the serial bridge application, refer to the Firmware upgrade application notes.

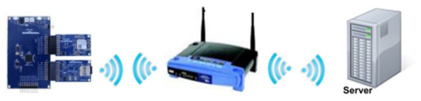
5.8 SSL Client Connection

This example demonstrates how to set up an SSL connection.

It uses the following hardware:

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

Figure 5-15. SSL Client Demo Setup



5.8.1 Execution

`main.c` - Initialize the devices and connect to a server using SSL.

1. Code summary.
   – Configure the below code in `main.h` for AP and the server information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                        "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                        M2M_WIFI_SEC_WPA_PSK /**< Security manner */
#define MAIN_WLAN_PSK                         "12345678" /**< Password for Destination
SSID */

/** All SSL defines */
#define MAIN_HOST_NAME                        "www.google.com"
#define MAIN_HOST_PORT                        443
```

   – Initialize the socket module and create the UDP server socket.

```
socketInit();
registerSocketCallback(socket_cb, resolve_cb);
```

   – Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   – After the device is connected to the AP, the `gethostbyname()` function will be executed.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_REQ_DHCP_CONF:
    {
        /* Obtain the IP Address by network name */
        gethostbyname((uint8_t *)MAIN_HOST_NAME);
```

   – In the main loop, try to connect to the SSL server after resolving the domain host name.

```
if (sslConnect() != SOCK_ERR_NO_ERROR) {
    gu8SocketStatus = SocketInit;
}
```

– If successfully connected, the `socket_cb()` function will be called with the SOCKET_MSG_CONNECT message.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    switch (u8Msg) {
    case SOCKET_MSG_CONNECT:
        if (pstrConnect && pstrConnect->s8Error >= SOCK_ERR_NO_ERROR)
            printf("Successfully connected.\r\n");
    break;
```

– You can receive data in the `socket_cb()` function with the `SOCKET_MSG_RECVFROM` message when a client device sends data. (Use the “UDP Client” example.)

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
    } else if (u8Msg == SOCKET_MSG_RECVFROM) {
    tstrSocketRecvMsg *pstrRx = (tstrSocketRecvMsg *)pvMsg;
    if (pstrRx->pu8Buffer && pstrRx->s16BufferSize) {
        printf("socket_cb: received app message.(%u)\r\n", packetCnt);
    /* Prepare next buffer reception. */
    recvfrom(sock, gau8SocketTestBuffer, MAIN_WIFI_M2M_BUFFER_SIZE, 0);
```

2. Build the program and download it into the board.
3. Start the application.

Note: To set up an SSL connection, a root certificate must be installed.

5.8.2 SSL Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window. The device is connected to a server using SSL.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxx
socket_cb: bind success!
Host IP is 173.194.127.115
Host Name is www.google.com
Successfully connected
```

5.9 SSL Server Connection

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to test the TLS1.2 TCP server.

It uses the following hardware:

- The SAM D21 Xplained Pro
- The ATWINC1500 on the EXT1 header
- TLS1.2 supported TCP client Linux machine or software tool

Figure 5-16. SSL Server Demo Setup

5.9.1 Execution

`main.c` - Initialize the Wi-Fi module and test the TLS1.2 TCP server.

1. Code summary.
   – Configure the below code in `main.h` to start the ATWINC1500 AP and DHCP server IP address information.

```
/** AP mode Settings */
#define MAIN_WLAN_SSID                                  "WINC1500_WPA" /* < SSID */
#define MAIN_WLAN_AUTH                                  M2M_WIFI_SEC_WPA_PSK /* < Security
manner */
#define MAIN_WLAN_CHANNEL                               M2M_WIFI_CH_1 /* < Channel number
*/
#define MAIN_WLAN_SSID_MODE                             SSID_MODE_VISIBLE
#define MAIN_WLAN_DHCP_SERVER_IP                        {192, 168, 1, 1}
#define MAIN_WLAN_WPA_KEY                       "atmel123"

/*WEP Key Settings*/
#define MAIN_WLAN_WEP_KEY                               "1234567890" /* < Security Key in
WEP Mode */
#define MAIN_WLAN_WEP_KEY_INDEX                         (0)
#define MAIN_WLAN_WEP_SIZE                              WEP_40_KEY_STRING_SIZE

#define MAIN_WIFI_M2M_PRODUCT_NAME         "NMCTemp"
#define MAIN_WIFI_M2M_SERVER_PORT          (443)
```

   – Initialize the socket module.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = 0;
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

   – Start the ATWINC1500 AP with the `m2m_wifi_enable_ap()` API and the `tstrM2MAPConfig` structure information.

```
/* Initialize AP mode parameters structure with SSID, channel and OPEN security
type. */
tstrM2MAPConfig strM2MAPConfig = {
    MAIN_WLAN_SSID,                 /* Access Point Name. */
    MAIN_WLAN_CHANNEL,              /* Channel to use. */
    MAIN_WLAN_WEP_KEY_INDEX,        /* Wep key index. */
    MAIN_WLAN_WEP_SIZE,             /* Wep key size. */
    MAIN_WLAN_WEP_KEY,              /* Wep key. */
    MAIN_WLAN_AUTH,                 /* Security mode. */
    MAIN_WLAN_SSID_MODE,            /* SSID visible. */
    MAIN_WLAN_DHCP_SERVER_IP ,      /* DHCP Server IP */
    MAIN_WLAN_WPA_KEY
};

    /* Bring up AP mode with parameters structure. */
    ret = m2m_wifi_enable_ap(&strM2MAPConfig);
```

   – After the device is started as an AP, create a TCP SSL server socket with the flag `SOCKET_FLAGS_SSL` and bind it in the main loop.

```
if (tcp_server_socket < 0) {
/* Open TCP server socket */
    if ((tcp_server_socket = socket(AF_INET, SOCK_STREAM, SOCKET_FLAGS_SSL)) < 0) {
        printf("main: failed to create TCP server socket error!\r\n");
        continue;
    }
/* Bind service*/
    bind(tcp_server_socket, (struct sockaddr *)&addr, sizeof(struct sockaddr_in));
}
```

– Five operations (bind/listen/accept/recv/send) will be executed sequentially in the `socket_cb()` function.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    ...
    case SOCKET_MSG_BIND:
    {
        tstrSocketBindMsg *pstrBind = (tstrSocketBindMsg *)pvMsg;
        if (pstrBind && pstrBind->status == 0){
            printf("socket_cb: bind success!\r\n");
            listen(tcp_server_socket, 0);
        }
    }
    case SOCKET_MSG_LISTEN:
    {
        tstrSocketListenMsg *pstrListen = (tstrSocketListenMsg *)pvMsg;
        if (pstrListen && pstrListen->status == 0){
            printf("socket_cb: listen success!\r\n");
            accept(tcp_server_socket, NULL, NULL);
        }
    }
    case SOCKET_MSG_ACCEPT:
    {
        tstrSocketAcceptMsg *pstrAccept = (tstrSocketAcceptMsg *)pvMsg;
        if (pstrAccept) {
            printf("socket_cb: accept success!\r\n");
            tcp_client_socket = pstrAccept->sock;
            recv(tcp_client_socket, gau8SocketTestBuffer, ..., 0);
        }
    }
    case SOCKET_MSG_RECV:
    {
        tstrSocketRecvMsg *pstrRecv = (tstrSocketRecvMsg *)pvMsg;
        if (pstrRecv && pstrRecv->s16BufferSize > 0)
            printf("socket_cb: recv success!\r\n");
            send(tcp_client_socket, &msg_wifi_product, sizeof(t_msg_wifi_product),
SOCKET_FLAGS_SSL);
    }
    case SOCKET_MSG_SEND:
    {
        printf("socket_cb: send success!\r\n");
        printf("TCP Server Test Complete!\r\n");
        printf("close socket\n");
        close(tcp_client_socket);
        close(tcp_server_socket);
    }
```

2. Build the program and download it into the board.
3. Start the application.

5.9.2 SSL Server Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED: CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF: IP is xxx.xxx.xxx.xxx
(APP)(INFO)Socket 0 session ID = 1
```

```
socket_cb: bind success!
socket_cb: listen success!
socket_cb: accept success!
socket_cb: recv success!
socket_cb: send success!
TCP Server Test Complete!
Close socket
```

Note:

- On Linux/Ubuntu: Make sure openssl is installed or install openssl with *sudo apt-get install openssl*.
- Connect to the ATWINC1500 in AP mode "WINC1500_WPA" from the Linux machine.
- Open a terminal window on Ubuntu and enter openssl Type s_client -connect 192.168.1.1:443.
- Type "hello" or any message.
- `MAIN_WIFI_M2M_PRODUCT_NAME` will display on the terminal window.

5.10 Weather Client

This example demonstrates the use of the ATWINC1500 with the SAM D21 Xplained Pro board to retrieve weather information from a weather server (openweathermap.org).

It uses the following hardware:

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

Figure 5-17. Weather Client Demo Setup

5.10.1 Execution

`main.c` - Initialize the chip and retrieve information.

1. Code summary.
   – Configure the below code in `main.h` for AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                        "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                        M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                         "12345678" /**< Password for Destination
SSID */
```

   – Initialize the socket module and register socket callback function.

```
/* Initialize socket address structure. */
addr.sin_family = AF_INET;
addr.sin_port = _htons(MAIN_WIFI_M2M_SERVER_PORT);
addr.sin_addr.s_addr = _htonl(MAIN_WIFI_M2M_SERVER_IP);
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, NULL);
```

   – Get the MAC address and set the device name with the MAC address.

```
m2m_wifi_get_mac_address(gau8MacAddr);

set_dev_name_to_mac((uint8_t *)gacDeviceName, gau8MacAddr);
set_dev_name_to_mac((uint8_t *)gstrM2MAPConfig.au8SSID, gau8MacAddr);
m2m_wifi_set_device_name((uint8_t *)gacDeviceName, ...);
```

– Start provision mode.

```
m2m_wifi_start_provision_mode((tstrM2MAPConfig *)&gstrM2MAPConfig,
        (char *)gacHttpProvDomainName, 1);
```

– When your mobile device sends configuration information, the `wifi_cb()` function will be called with the `M2M_WIFI_RESP_PROVISION_INFO` message and you can connect to the AP with the given information.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    case M2M_WIFI_RESP_PROVISION_INFO:
        tstrM2MProvisionInfo *pstrProvInfo = (tstrM2MProvisionInfo *)pvMsg;
        if (pstrProvInfo->u8Status == M2M_SUCCESS) {
        m2m_wifi_connect((char *)pstrProvInfo->au8SSID,
                strlen((char *)pstrProvInfo->au8SSID),
                pstrProvInfo->u8SecType,
                pstrProvInfo->au8Password, M2M_WIFI_CH_ALL);
    }
```

– After the device is connected to the AP, the `gethostbyname()` function will be called.

```
static void wifi_cb(uint8_t u8MsgType, void *pvMsg)
{
    ...
    case M2M_WIFI_REQ_DHCP_CONF:
    {
    ...
    gbConnectedWifi = true;
    gethostbyname((uint8_t *)MAIN_WEATHER_SERVER_NAME);
    }
    ...
}
```

– Create a TCP client socket and connect to the server in the main loop.

```
if (gbConnectedWifi && !gbTcpConnection) {
    if (gbHostIpByName) {
    if (tcp_client_socket < 0) {
        if ((tcp_client_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
        continue;
            }
        }
    if (connect(tcp_client_socket, ...) != SOCK_ERR_NO_ERROR) {
        continue;
    }
    gbTcpConnection = true;
    }
}
```

– The socket callback function will receive the `SOCKET_MSG_CONNECT` message and then it requests weather information from the server with a city name.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    case SOCKET_MSG_CONNECT:
    sprintf(gau8ReceivedBuffer, ..., MAIN_CITY_NAME, ...);
    ...
    send(tcp_client_socket, gau8ReceivedBuffer, ...);
    recv(tcp_client_socket, (struct sockaddr *)&addr_in, sizeof(struct
sockaddr_in));
    break;
}
```

– The socket callback function will receive a `SOCKET_MSG_RECV` message with weather information. You can also get the current temperature via an IO1 sensor board as shown below.

```
static void socket_cb(SOCKET sock, uint8_t u8Msg, void *pvMsg)
{
    case SOCKET_MSG_RECV:
    ...
    /** From the received Josan format buffer City Name, Temperature, Weather
Number will be parsed */
    /* Get city name. */
    pcIndxPtr = strstr((char *)pstrRecv->pu8Buffer, "name=");
    printf("City: ");
    ...
    /* Get temperature. */
    pcIndxPtr = strstr(pcEndPtr + 1, "temperature value");
    printf("Temperature: ");
   ...
    /* Get weather condition. */
    pcIndxPtr = strstr(pcEndPtr + 1, "weather number");
    if (NULL != pcIndxPtr) {
        printf("Weather Condition: ");

}
```

2. Build the program and download it into the board.
3. Start the application.
4. Connect your mobile device to the ATWINC1500 AP [WINC1500_XX:XX].
5. Browse the webpage (www.microchip.com) to setup the AP, populate the page and press Connect.
6. ATWINC1500 will be connected to the AP that you entered.
7. The weather info will be printed.

Note: If the server connection is unstable, it may not operate normally.

5.10.2 Weather Client Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Provision Mode started.
Connect to [atmelconfig.com] via AP[WINC1500_08:CA] and fill up the page.
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
Weather Condition: sky is clear

Temperature from sensor : 27 degrees
Temperature from server : 3 degrees
Temperature difference : 24 degrees
```

5.11 Wi-Fi Serial

This example demonstrates how to emulate serial ports between two devices. It reads input data from the serial interface and sends it via a Wi-Fi connection and the terminal window will display the messages which you typed or received. It can be useful for chatting or controlling a remote device. It uses the following hardware and you need to prepare two pairs of SAM D21 and ATWINC1500 boards.

It uses the following hardware:
- The SAM D21 Xplained Pro
- The ATWINC1500 on the EXT1 header

Figure 5-18. Wi-Fi Serial Demo Setup

5.11.1 Execution

`main.c` - Initialize devices and the USART interface. Create the TCP sockets, send/receive messages and display them on the terminal window.

1. Code summary.
   - Configure the below code in `main.h` for AP information to be connected.

```
/** Wi-Fi Settings */
#define MAIN_WLAN_SSID                          "DEMO_AP" /**< Destination SSID */
#define MAIN_WLAN_AUTH                          M2M_WIFI_SEC_WPA_PSK /**< Security manner
*/
#define MAIN_WLAN_PSK                           "12345678" /**< Password for Destination
SSID */
```

   - Configure the USART module to read user input data.

```
static void configure_console(void)
{
    ...
    stdio_serial_init(&cdc_uart_module, CONF_STDIO_USART_MODULE,&usart_conf);
    /* Register USART callback for receiving user input. */
    usart_register_callback(&cdc_uart_module, uart_callback,
SART_CALLBACK_BUFFER_RECEIVED);
    usart_enable_callback(&cdc_uart_module, USART_CALLBACK_BUFFER_RECEIVED);
    usart_enable(&cdc_uart_module);
}
```

   - Initialize the socket module and the register socket callback function.

```
/* Initialize socket module */
socketInit();
registerSocketCallback(socket_cb, resolve_cb);
```

   - Connect to the AP.

```
/* Connect to router. */
m2m_wifi_connect((char *)MAIN_WLAN_SSID, sizeof(MAIN_WLAN_SSID),
        MAIN_WLAN_AUTH, (char *)MAIN_WLAN_PSK, M2M_WIFI_CH_ALL);
```

   - After the device is connected to the AP, create the TCP server socket and bind it in the main loop.

```
if ((tcp_server_socket = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
    continue;
}
...
bind(tcp_server_socket, (struct sockaddr *)&addr, sizeof(struct sockaddr_in));
```

   - If there is user input data, then the `handle_input_message()` function in the main loop calls the `parse_command()` function to parse the user data and execute the handler function according to the command.

```
uint8_t parse_command(char *buffer, uint8_t remote)
{
    for (i = i_st; i < i_ed; i++) {
        if (!strcmp(cmd_list[i].cmd_string, cmd_buf)) {
            cmd_list[i].cmd_handler(buffer + strlen(cmd_list[i].cmd_string) + 1);
            break;
        }
    }
```

– Or the `handle_input_message()` function prints user data in the terminal window and sends it to the remote device.

```
void handle_input_message(void)
{
    ...
    if (tcp_connected == 1) {
        PRINT_LOCAL_MSG(uart_buffer);
        send(tcp_client_socket, uart_buffer, msg_len + 1, 0);
    }
```

– When receiving data from the remote device, it handles the received message to display it or execute a proper command.

– There are several commands for Wi-Fi serial functionality in this example.

2. Build the program and download it into the board.
3. Start the application.
4. Check the IP address of each board and execute the connection on one device by typing the `<<connect xxx:xxx:xxx:xxx` command on the terminal window with the other device's address. Use prefix "<<" to execute local commands.
5. When connected, the `socket_cb:connect success`message will appear:
6. Type messages on the terminal window and you will see the sent/received messages.
7. You can control the LED on the remote device by typing the following command. Use prefix ">>" to execute remote commands.
8. The application reads data from the serial interface. User commands can be modified to execute various actions.

5.11.2 Wi-Fi Serial Demo Console Log

The application is now programmed and running. The following information will be displayed on the terminal window.

```
-- WINC1500 chip information example --
-- XXXXX_XPLAINED_PRO --
-- Compiled: xxx  x xxxx  xx:xx:xx --
(APP)(INFO)Chip ID 1503a0
(APP)(INFO)Firmware ver   : xx.x.x Svnrev xxxxx
(APP)(INFO)Firmware Build xxx  x xxxx  Time xx:xx:xx
(APP)(INFO)Firmware Min driver ver : xx.x.x
(APP)(INFO)Driver ver: xx.x.x
(APP)(INFO)Driver built at xxx  x xxxx  xx:xx:xx
Connecting to DEMO_AP.
wifi_cb: M2M_WIFI_RESP_CON_STATE_CHANGED : CONNECTED
wifi_cb: M2M_WIFI_REQ_DHCP_CONF : IP is xxx.xxx.xxx.xxxsocket_cb: bind
success!
socket_cb: bind success.
socket_cb: listen success.
<<connect xxx.xxx.xxx.xxx
(Local device)
Connecting to [xxx.xxx.xxx.xxx] ...
socket_cb: connect success.
(Remote device)
socket_cb: accept success.
>>control ledon
(Or)
>>control ledoff
```

6. Document Revision History

Rev A - 04/2017

Section	Changes
Document	• Updated from Atmel to Microchip template. • Assigned a new Microchip document number. Previous version is Atmel 42418 revision B. • ISBN number added.

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