

INTRODUCTION

The Serial to Wi-Fi application supports multiple methods of provisioning the device to connect to the infrastructure (i.e. Access Point)

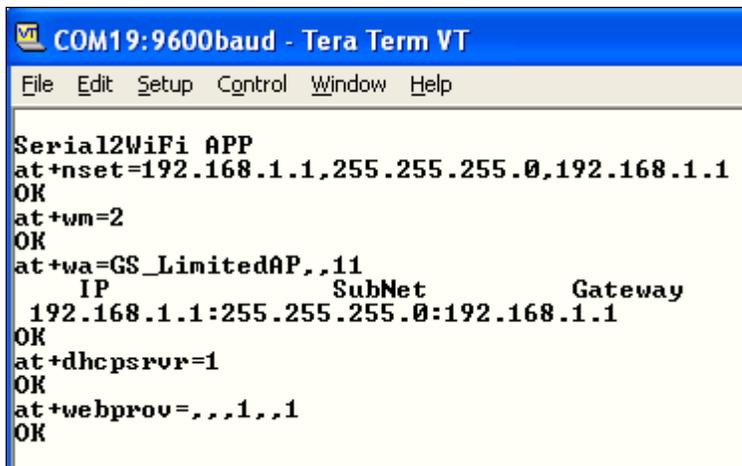
- a) Web Provisioning using Limited AP Provisioning Mode
- b) Wi-Fi Protected Setup (WPS)
- c) Web Provisioning over Ad-hoc

Web Server based provisioning allows users to scan and choose a Wi-Fi Access point to connect to using a web browser either on their PC or handheld. The GainSpan (GS) Module based device may either generate an Ad Hoc Network or an Infrastructure Network for the PC or Handheld to join and launch the embedded web browser. The user may then select an access point and input the security pass code to connect to the AP.

Wi-Fi Protected Setup (WPS) enables users to connect their GS Module based device to their WPS enabled access point without having to input any pass codes. This method requires the AP to support WPS and have enabled either push-button method or pin method for association and authentication.

SETTING UP WEB PROVISIONING USING LIMITED AP PROVISIONING MODE

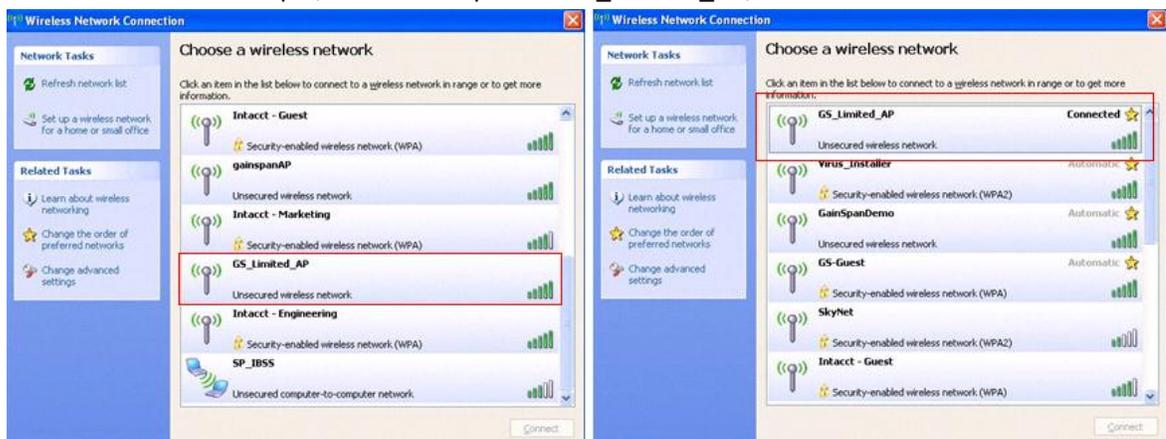
In the S2W application, user may also access the embedded web pages by putting the device into the Limited AP Provisioning Mode. In this mode, the device acts as an access point for other devices, such as smart phones, etc., to connect as a client and provision the device. In the Tera-term window, where AT commands are being entered, execute the following. (*Please note that parameters, such as IP addresses, etc. are for example purposes only.*)



```

COM19:9600baud - Tera Term VT
File Edit Setup Control Window Help
Serial2WiFi APP
at+nset=192.168.1.1,255.255.255.0,192.168.1.1
OK
at+wm=2
OK
at+wa=GS_LimitedAP,,11
   IP      SubNet      Gateway
192.168.1.1:255.255.255.0:192.168.1.1
OK
at+dhcprvr=1
OK
at+webprov=,,,1,,1
OK
  
```

1. Set the Static IP address on the Evaluation Board:
AT+NSET=192.168.1.1,255.255.255.0,192.168.1.1
2. Set the wireless mode to limited AP so that the adapter can act as a limited wireless AP:
AT+WM=2
3. Set the AP network (example creating using SSID GS_Limited_AP on channel 11)
AT+WA=GS_Limited_AP,,11
IP SubNet Gateway
192.168.1.1: 255.255.255.0: 192.168.1.1
4. Start the DHCP server.
AT+DHCSRVR=1
5. Enable provisioning through web pages. Enable saving profile and starting new NCM(network connection manager).
AT+WEBPROV=,,1,,1
6. Associate the PC acting as the configuring device to provision the Evaluation Board.
7. On the PC, go to Start -> Connect To -> Wireless Network Connection. Select the Wireless Network created in Step 3, in this example it is GS_Limited_AP, and click Connect.



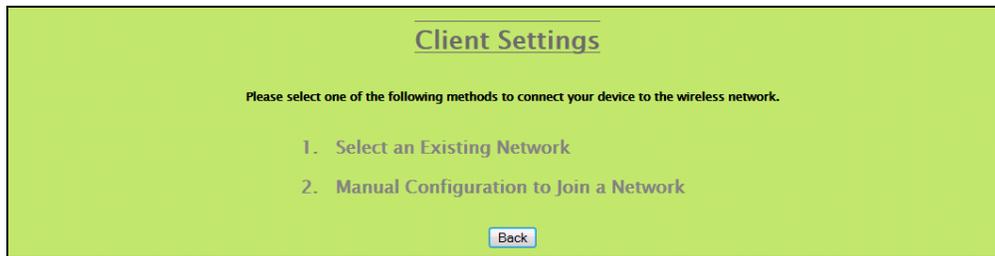
8. Once the connection is established, open the web browser and enter the URL (<http://192.168.1.1/gsclient.html>). The IP address 192.168.1.1 was set in the previous steps.
9. This will launch the web provisioning page from the evaluation board.



- 10. From here, you may navigate to different pages
 - a. Wireless and Network Configuration (Proceed to Step 12)
 - b. Administrator setting (Skip to Step 14)

11. Wireless and Network Configuration

You can connect to Wireless network by one of the following methods.



- a. Select an Existing Network:

By selecting this option, the Node will start scanning and the displays the available APs. By clicking on Select button you can connect to the Selected AP by providing required credentials (Passphrase).

Number	SSID	Signal Strength (dBm)	Security Mode	Channel	
1	spadoc	-16	No Security	1	Select
2	LSCC-GUEST	-14	WPA/WPA2 Personal	1	Select
3	wep	-34	WEP	1	Select

After entering passphrase you can select the advanced options, which will displays the selection methods for obtaining IP address. You can get the IP address in two ways.

1. DHCP.
2. Static IP.

The screenshot shows the 'Client Settings' page with the following fields and options:

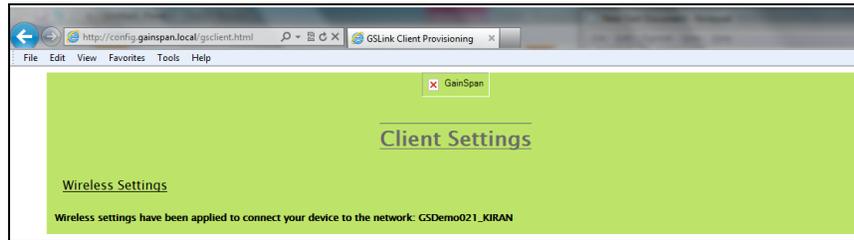
- SSID:** LSCC-GUEST
- Channel:** 1
- Security:** WPA/WPA2 Personal
- Passphrase:** [Redacted]
- Confirm Passphrase:** [Redacted]
- Advanced Options**
- Select a method to obtain or set the IP address.
- Acquire IP Address automatically (DHCP)
- Static IP Address Configuration
- Back** and **Next** buttons.

- b. Click Next to navigate to Wireless configuration summary page. This page displays the information about the SSID, Channel and Security type and provides an option to save and apply the settings.

The screenshot shows the 'Wireless Configuration Summary' page with the following information:

- SSID:** LSCC-GUEST
- Channel:** 1
- Security:** WPA/WPA2 Personal
- Click on "Save and Apply" to confirm your settings, and then re-connect using the new wireless settings.
- Back** and **Save And Apply** buttons.

Click on “Save and Apply”. Wireless settings will be applied to connect the GainSpan device to the LSCC-GUEST network.



The GainSpan device will now reset and connect to the LSCC-GUEST network and start a network connection.

```

COM19:9600baud - Tera Term VT
File Edit Setup Control Window Help

Serial2WiFi APP
at+nset=192.168.1.1,255.255.255.0,192.168.1.1
OK
at+wm=2
OK
at+wa=GS_LimitedAP,,11
      IP          SubNet          Gateway
      192.168.1.1:255.255.255.0:192.168.1.1
OK
at+dhcprvr=1
OK
at+webprov=,,,1,,1
OK

APP Reset-APP SW Reset
      IP          SubNet          Gateway
      192.168.3.104:255.255.255.0:192.168.3.1
NWCONN-SUCCESS
    
```

12. Manual Configuration:

On this page you may configure the Wi-Fi related setting SSID, Channel, Security and Passphrase.

Client Settings

Configure Wireless and Network Settings

SSID:

Channel:

Security:

Passphrase:

Confirm Passphrase:

Advanced Options

And you also have Advanced Options, where you can obtain the IP address either by DHCP or by STATIC IP CONFIGURATION.

SSID:

Channel:

Security:

Passphrase:

Confirm Passphrase:

Advanced Options

Select a method to obtain or set the IP address.

Acquire IP Address automatically (DHCP)

Static IP Address Configuration

IP Address:

Subnet Mask:

Gateway:

DNS Server:

Click on Next navigate to Wireless configuration summary page

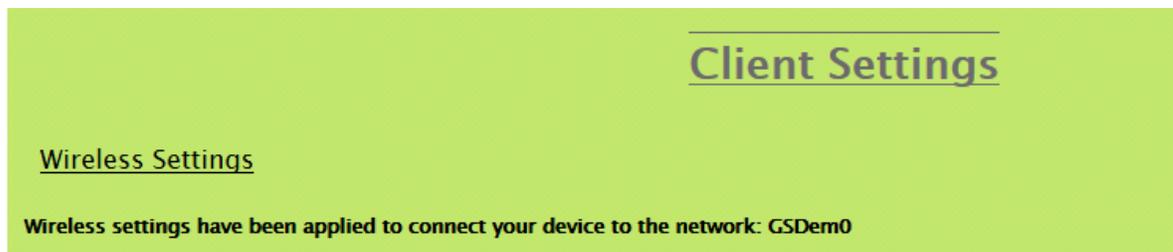


The screenshot shows a web interface with a light blue background. At the top right, the text "Client Settings" is displayed in a large, bold, blue font. Below this, the heading "Wireless Configuration Summary" is underlined. A list of configuration parameters is shown in a table-like format:

SSID:	GSDem0
Channel:	All
Security:	WPA/WPA2 Personal
IP Address:	192.168.21.100
Subnet Mask:	255.255.255.0
Gateway:	192.168.21.1
DNS Server:	0.0.0.0

Below the table, a text instruction reads: "Click on 'Save and Apply' to confirm your settings, and then re-connect using the new wireless settings." At the bottom of the section, there are two buttons: "Back" (with a blue border) and "Save And Apply" (with a grey border).

Click on "Save and Apply", the selected wireless settings will be applied to connect the GainSpan device to the new network. The GainSpan device will now reset and connect to the new network and start a network connection.



The screenshot shows the same "Client Settings" page. The heading "Client Settings" is at the top right. Below it, the heading "Wireless Settings" is underlined. A confirmation message is displayed: "Wireless settings have been applied to connect your device to the network: GSDem0".

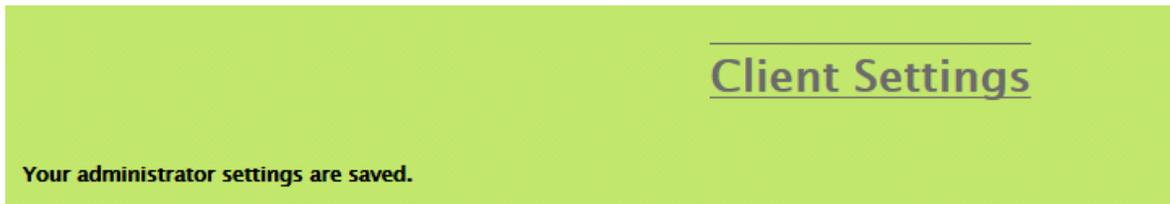
13. Administration Settings

Here you can change the Username and Password of the node.



The screenshot shows a web interface for "Client Settings" with a sub-section for "Administration Settings". The page has a light green background. The title "Client Settings" is in a large, bold, dark green font. Below it, "Administration Settings" is underlined. A note says "To disable web server security, please leave the following fields empty." Below this note is a red-bordered box containing three input fields: "Username:" with the text "GS_USER", "Password (at least 4 characters):" with six dots, and "Confirm Password:" with six dots and a cursor. At the bottom of the box are two buttons: "Back" (blue) and "Save & Apply" (grey).

Click on “Save and Apply”, the selected information will be sent to Host processor and reset the Module. Now Host Processor has to send this information back to Module for Provisioning.



The screenshot shows a confirmation message on a light green background. The title "Client Settings" is in a large, bold, dark green font. Below it, the message "Your administrator settings are saved." is displayed in a bold, dark green font.

User can now continue using the various “AT” commands to step a serial to Wi-Fi Bridge and transfer data as showed in application Note AN025. Also, see the Serial to Wi-Fi Adapter Guide for details on the usage of the “AT” commands and the various features supported by the Serial to Wi-Fi Application

SETTING UP WPS BASED PROVISIONING

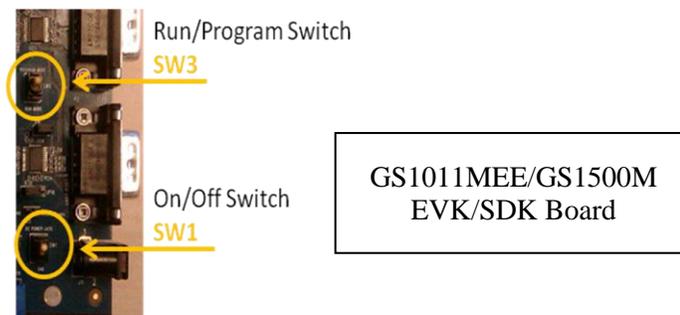
Wi-Fi Protected Setup (WPS)

In order to simplify the process of establishing a secure network, the Wi-Fi Alliance™ has defined a simplified Wi-Fi Protected Setup protocol allowing credentials to be exchanged between a client and AP without the need for manual creation, entry of the SSID or PSK. Two modes of operation are provided: *Personal Information Number* (PIN) and *Push Button Configuration* (PBC).

In PIN operation, a unique PIN number can be permanently associated with a client device or entered at the time of use. The PIN must be entered in the AP within a short time of device activation. In PBC mode, button on the Access Point must be pressed within a 2-minute period of providing the command to enable WPS on the client (either via button press or AT command). In both cases, an exchange then takes place between the client and AP providing the SSID and randomly-generated passphrase that can thereafter be used for secure communications. In both cases, security is, in part, dependent on the low likelihood of interception during the brief initial setup period.

To evaluate WPS, you have to load the serial to Wi-Fi application that supports WPS. Use the `gs_flashprogram` utility provided in the tools directory and the binaries from the `\\GainSpan\EvalKit->2_x_x->userapps->Serial to Wi-Fi (S2W) -> bin->Wi-Fi Protected Setup (WPS)` directory that was installed with the evaluation kit software. Below are the steps to flash the module FLASH memory.

1. Power off the Evaluation Board using power switch (SW1=OFF).
2. Move the SW3 switch(s) to program position to put the module in program mode.



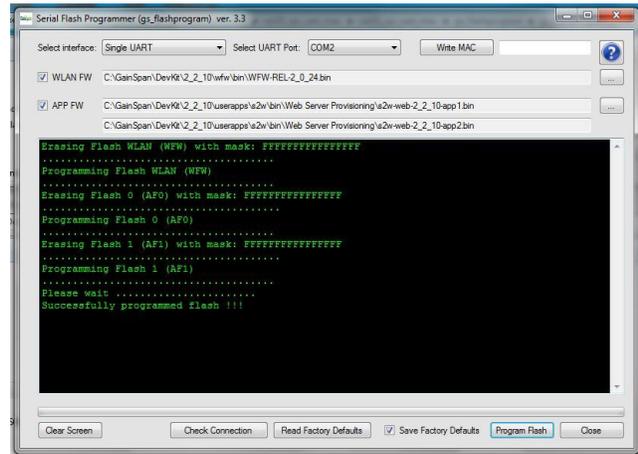
3. Power on the Evaluation Board using power switch (SW1 = ON)
4. Close the Tera Term Window.

5. Open a DOS window and go to the directory:

```
\GainSpan\EvalKit\2_x_x\tools\Flash_Program
```

6. Program the module flash using the `gs_flashprogram` with the binaries in the Wi-Fi protected Setup directory as shown below. *Please note that illustrations and file names may differ. Illustrations are for example purposes only.*

After launching the application, use the “Select Port” pull down menu to display all available Ports. Select the COM port from the list that is connected to the GainSpan Board. To program the flash, select the APP FW0 and APP FW1 banks and select the APP binaries are located in the GainSpan\EvalKit->2_x_x->userapps->Serial to Wi-Fi (S2W) -> bin->Wi-Fi Protected Setup (WPS) directory. Press the “Program Flash” button to transfer the binary files to the GainSpan node flash memory. This procedure erases flash sector by sector prior to programming.



7. Once the programming is done, power off the Evaluation Board moving switch SW1 to OFF position.
8. On the Evaluation Board move the SW3 switch(s) to RUN mode
9. Launch the tera-term application and select the serial port that is being used
10. Turn on the evaluation board by moving switch SW1 to ON position
11. After “Serial2Wi-Fi APP” shows on Tera Term, Evaluation Board is ready to be provisioned using WPS.

For PBC Mode:

Issue the AT command for starting the WPS process.

```
AT+WWPS=1
```

“1” indicates the Push button mode.

Once the S2W receives the “at” command, it scans all the available radio channels looking for beacons whose Selected Registrar flag are set. The AP corresponding to each such beacon is stored. If the board finds a second Selected Registrar AP it stops scanning, having detected a session overlap. (This is a precaution to prevent connection to the wrong AP; it is presumed that the user has only pressed one button, so a second AP may belong to a different network or even be an attacker). If at the end of scanning all the channels, the S2W Evaluation Board has found a single Selected Registrar AP, it will connect to that AP to perform WPS registration.

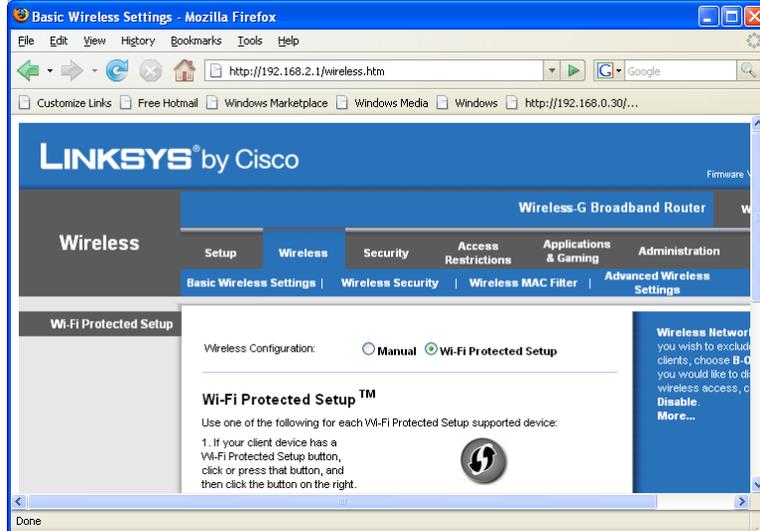


Figure 5: example of virtual button push (Linksys AP)

Once the connection is complete, this message is sent to the host processor:

SSID= <SSID of the associated AP>

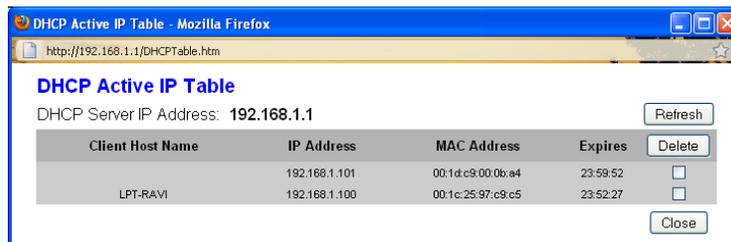
CHANNEL= <Channel number of the associated AP>

PASSPHRASE= <Passphrase of the associated AP>

OK: the status

If the connection is not success, then an “ERROR” message is sent to host processor.

Once the board is associated with the AP, user can issue the AT (at+ndhcp=1) command to get the IP address from DHCP server running or set the IP address statically using at+nset command. At this point, it should be possible to communicate with the board from the AP’s network. Use the AP’s Active Client list (shown next page) to discover the IP address the new device has received and confirm the device is connected to the AP. You should be able to issue a PING command from node to AP and to node IP address from any host computer in the same subnet.



Example of Active Client list (Linksys AP)

If the connection is subsequently lost, a “Disassociation Event” message is sent to the host processor. Now it is up to the host processor to decide if it wants to establish the connection using WPS or through normal association process as the host processor has already received the information from the AP while previous association through WPS.

For PIN Mode:

Set a valid PIN <12345670> to the AP which supports the WPS and you want the node to associate with.

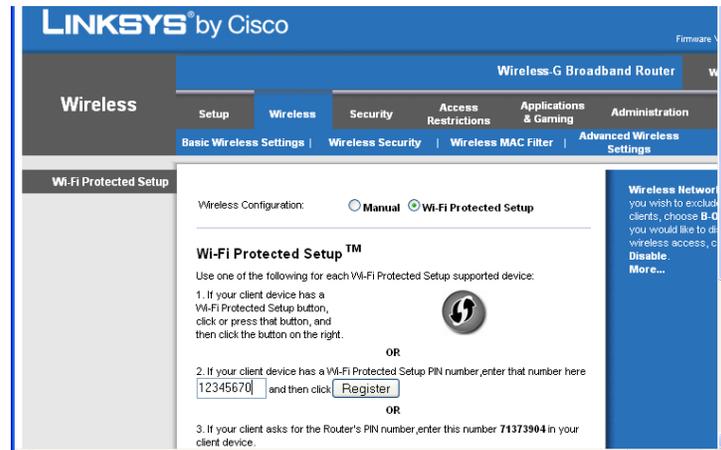


Figure 7: Example of PIN entry (Linksys AP)

Issue the AT command for starting the WPS process.

```
AT+WWPS=2,12345670
```

Here: 2, indicates the PIN mode. And the second parameter is the WPS PIN.

Once the connection is complete, the below said message is sent to the host processor:

```
SSID= <SSID of the associated AP>
```

```
CHANNEL= <Channel number of the associated AP>
```

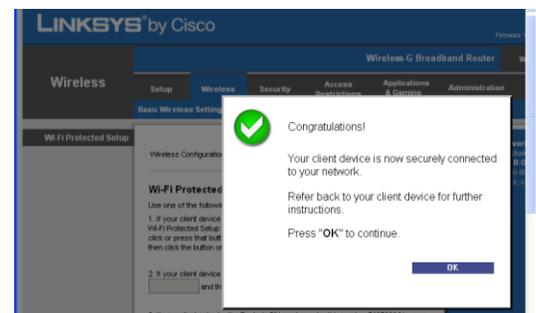
```
PASSPHRASE= <Passphrase of the associated AP>
```

```
OK: the status
```

If the connection is not success an “ERROR” message is sent to host processor.

The AP interface will generally inform the user when a client device has been successfully configured and connected. A specific example is depicted in figure below. Other APs may have differing GUI, messages, etc.

You can always check the DHCP client table of the AP to ensure that the device is properly connected. Once the board is associated with the AP, users may issue the AT (at+ndhcp=1) command to get the IP address from DHCP server running or set the IP address statically using at+nset command. At this point, it should be possible to communicate with the board from the AP’s network. Use the AP’s Active Client list to discover the IP address the new device has received. You should be able to issue a PING command directed to that IP address from any host computer in the same subnet.

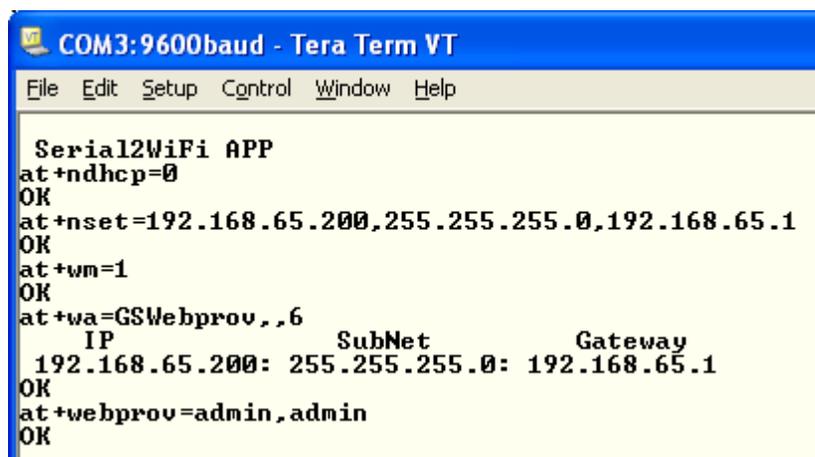


SETTING UP WEB PROVISIONING OVER AD-HOC

Serial to Wi-Fi firmware on the Evaluation Board includes a web-server and provisioning web-pages pre-loaded into the flash. Using AT commands, the Evaluation Board may be setup to be provisioned using the embedded web-server and web pages. This application note provides the steps to deploy the embedded web server and connect to the web pages via a browser.

Note: The steps below assume you have already followed the steps in the Serial to Wi-Fi Evaluation Kit Startup Guide and installed the necessary software and drivers.

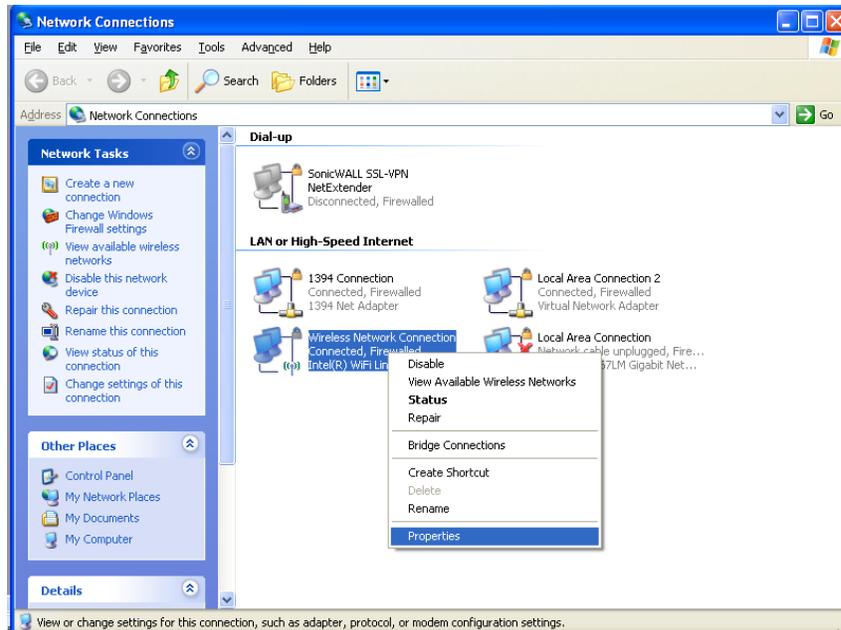
The current method of accessing the embedded web pages is to use an Ad Hoc wireless network connection and a static IP on the Evaluation Board and PC. In the Tera-term window, where AT commands are being input, execute the following. *Please note that parameters, such as IP addresses, etc. are for example purposes only.*



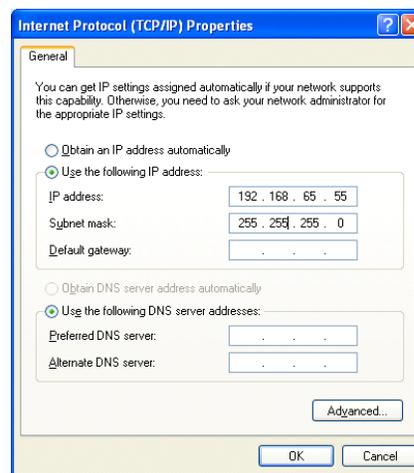
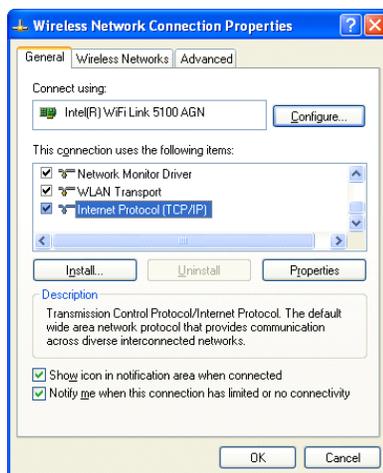
```
COM3:9600baud - Tera Term VT
File Edit Setup Control Window Help

Serial2WiFi APP
at+ndhcp=0
OK
at+nset=192.168.65.200,255.255.255.0,192.168.65.1
OK
at+wm=1
OK
at+wa=GSWebProv,,6
      IP      SubNet      Gateway
192.168.65.200: 255.255.255.0: 192.168.65.1
OK
at+webprov=admin,admin
OK
```

1. Set the Static IP address on the Evaluation Board:
AT+NDHCP=0
AT+NSET=192.168.65.200,255.255.255.0,192.168.65.1
2. Set the Mode to adhoc mode:
AT+WM=1
3. Create the Adhoc network (example creating using SSID GSWebProv on channel 6)
AT+WA=GSWebProv,,6
IP SubNet Gateway
192.168.65.200: 255.255.255.0: 192.168.65.1
4. Start the web provisioning mode.
AT+WEBPROV=admin,admin
5. Associate the PC acting as the configuring device to provision the Evaluation Board.
6. Setup the PC wireless network connection to a static IP in the same subnet as the Evaluation Board in Step 3.
7. On the PC go to Start->Connect to -> Show All Connections.



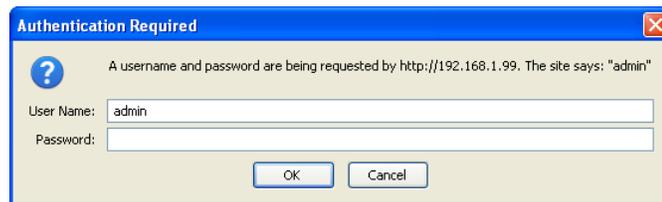
8. Select the wireless adapter and right click and select properties
9. Select the TCP/IP and select properties. Choose use the following IP address and set the IP address to a static IP address that is in the same subnet as the IP was generated in Step 1. Click OK.



10. Go to Start -> Connect To -> Wireless Network Connection. Select the Wireless Network created in Step 3, in this example it is GSWebprov, and click Connect.



11. Once connection is established, open your web browser and type URL (for example, <http://192.168.65.200/gsclient.html>). This will prompt request for User Name and Password.



12. Type the username and password used in Step 4 and press enter. This will launch the web provisioning page from the evaluation board.



13. From here, you may navigate to different pages
 - a. Wireless and Network Configuration
 - b. Administrator setting

NOTE: FOR EXPLORING DIFFERENT PAGES REFER TO "SETTING UP WEB PROVISIONING USING LIMITED AP PROVISIONING MODE" ON THE FIRST PAGE OF THIS DOCUMENT.

ADDITIONAL REFERENCES:

Serial to Wi-Fi Evaluation Kit Startup Guide.pdf

Serial to WiFi_Adapter_Guide.pdf

Detail description of the AT commands supported

Serial to WiFi_Command_Reference.pdf

List of the various AT commands supported

Serial to Wi-Fi Bridge App Note AN025.pdf

Example of how to use the GS1011/GS1500M as a transparent bridge to carry serial (UART) traffic over an 802.11 wireless link

Firmware Update over Wi-Fi Interface using S2W App Note AN038.pdf

This document details the necessary steps and processes required for performing a firmware update over the Wi-Fi interface with the Serial2Wi-Fi Application.

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Specifications, features, and availability are subject to change without notice.

Version	Date	Remarks
1.0	9-Nov-10	GA
1.1	16-Dec-10	Added MEE artwork
1.2	6-Jun-11	Added Setting up web provisioning using limited AP Provisioning Mode
1.3	9-Jun-11	Updated for GS1500
1.4	19-Oct-11	Updated artwork
1.5	6-Dec-11	Added navigation instructions for accessing different pages Added Wireless and Network Configuration instructions Added Administrator Settings instructions

SP-1.5