Cisco WLAN Passpoint Configuration Guide

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Overview

The purpose of this document is to describe the necessary set-up procedures for demonstrating an automated network discovery and connection using WiFi Alliance Passpoint Certified Access Point and client devices. Using this document's instructions, you will be able to configure Cisco APs/WLCs as Passpoint 1.0 certified system. Access Points (APs) and phone client devices that are certified for WiFi Alliance's Passpoint 1.0 specification are able to work together providing the functionality listed in this document. This is achieved by AP which supports IEEE 802.11u-based network information and the phone client device that gathers necessary information by using Access Network Query Protocol (ANQP) messages.

The 802.11u enabled phone client devices discover and select target AP based on the information gathered during the pre-association stage from an 802.11u-enabled AP/Wireless LAN Controller (WLC). A phone client device has pre-provisioned network information such as home OI Information, realm name and domain name, presented as configuration file inside the phone client device. In addition, the phone client device may obtain home network information using the IMSI data derived from the inserted SIM/USIM card.

The 802.11u AP provides various information listings that provide the HotSpot owner details, roaming partners, realm list, 3GPP cellular information, and domain name. The realm list also provides listings of the realm name and its associated EAP authentication type mappings. Knowing this information is essential for the phone client device so that correct EAP credential exchange may take place.

Currently, there are many WiFi Passpoint Certified devices, such as Samsung Galaxy-S4 and Intel Centrino 6230 WiFi chipset, and various types of phone client devices. This document uses Galaxy S4 (OS v4.2.2) as the device to demonstrate a "Wi-Fi CERTIFIED Passpoint" device, as well as an iPhone 5 running iOS7 to demonstrate its configuration according to the Wi-Fi Alliance Hotspot 2.0 Specification.

The procedures described in this document provide a means of demonstrating the advantage of a seamless authentication process between the Passpoint supported phone client device and AP in an intra- or inter-operator roaming environment. Through this hassle free process, an end user will experience the same ease of use regarding network connectivity as is present and expected with 3G or cellular-based services.

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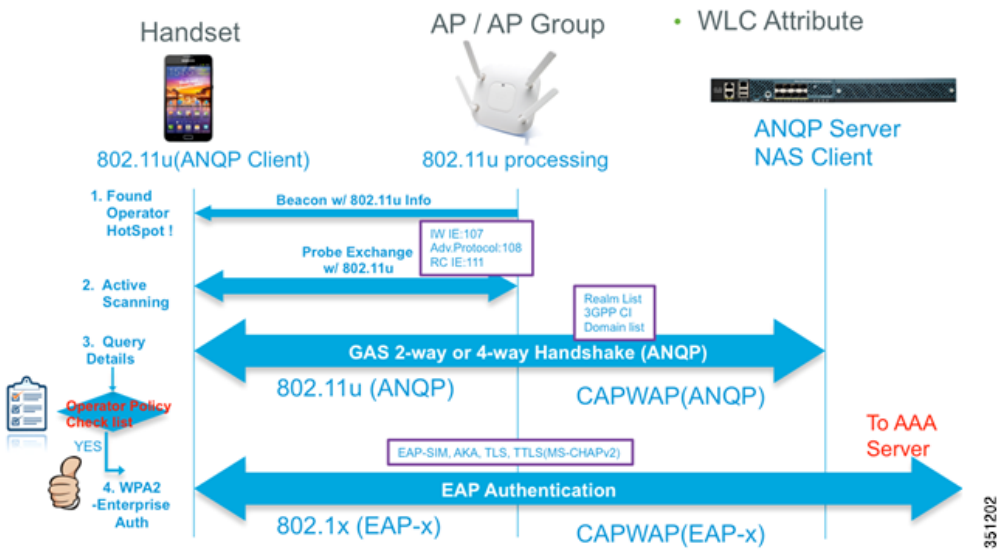
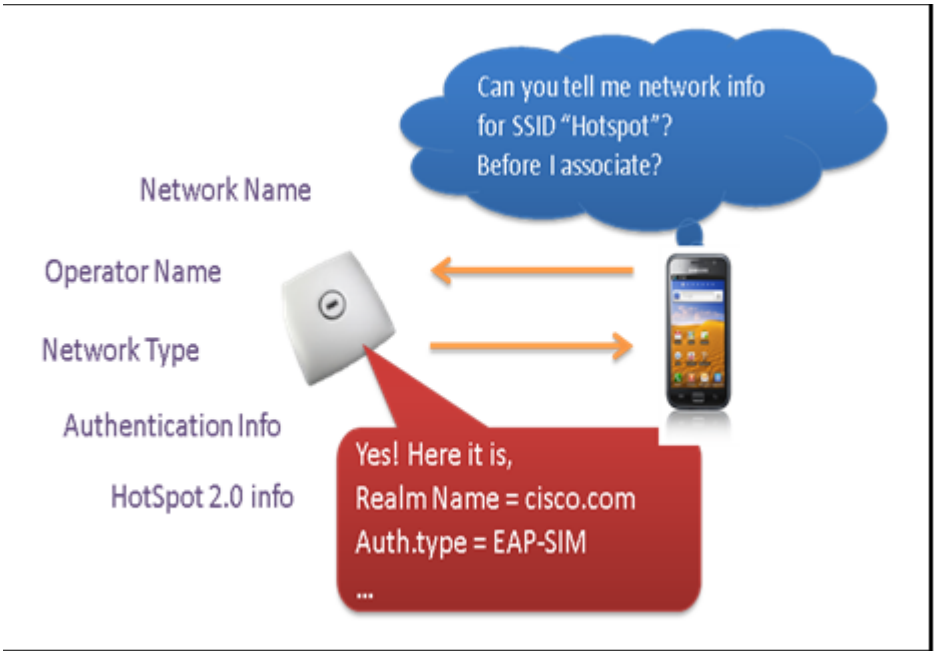
One of the other benefits of Passpoint is hardened security from Rogue APs. During the network discovery process, the legitimacy of the service provider AP is identified preventing phone client devices from attaching to rogue APs. The information present in the validation process specific to the Passpoint device prevents inadvertent connection to rogue devices such as ad-hoc and other malicious APs broadcasting falsely labeled SSIDs. There are several other technics and methods introduced by Passpoint system to make WPA2-Enterprise security even stronger. GTK randomization is one such technic that is introduced to mitigate WPA2-"hole-196" vulnerability and for more wide usage of P2P blocking at the public WiFi hotspot.

The configuration described in this document lists in sequence the steps necessary to demonstrate and test the functionality. In this demonstration, through the WLAN configuration of the Wireless LAN Controller (WLC), single SSID and multiple SSID will be configured with necessary Passpoint information. This additional Passpoint information will be added on beacon or probe response information, so that Passpoint-enabled phone client device can detect and query AP to get further information. During the query process, standard protocol format called ANQP–Access Network Query Protocol–is followed. Here, the protocol describes the standard 2-way or 4-way handshake process to get enough information from the AP and ANQP server to determine the best AP that the phone client device can authenticate and associate with. This handshake process is called GAS–Generic Advertisement Service–protocol that is defined on IEEE 802.11u standard.

Figure 1 Basic Passpoint behavior



Throughout the query process, the phone client device will gather information beyond just SSID, such as name of the actual venue, name of the actual HotSpot operator and realm name that can be used as the key element to identify its authentication eligibility. There are many other parameters and information that can be used as criteria to initiate auto connection from the phone client device. In this document, we will go through different use cases and configuration in detail.



The phone client device starts the auto discovery process by reading 802.11u information from the beacon or probe response of the 802.11u/HotSpot 2.0 capable AP. Once a phone client device recognizes and identifies neighboring AP's Passpoint capability, the phone client device starts an ANQP query to get the 3GPP Cellular Information (3GPP CI) or realm name and domain name information. The 3GPP CI & Realm name will reveal the list of service providers that the phone client device may initiate authentication request. The ANQP response also contains a domain name list. The domain name list will provide information if responding AP in the hotspot venue is operating as the home network or visitor (roaming) network. Once the phone client device gathers all of the required information, and if the phone client device successfully passes its own connection criteria, which is defined as Passpoint configuration file called "Cred.conf" in its user directory, the phone client device begins the 802.1x/EAP authentication process to establish a secure connection to the AP. In this example, the "Cred.conf" file name is unique to Samsung Galaxy S4. If there are any other Passpoint 1.0 certified devices, it can have a different name or format of the client configuration file

Requirements

The following topics contain equipment matrices, drawings, configurations, and steps necessary to implement Passpoint configuration, using Cisco AP/WLC infrastructure.

Passpoint Tested Equipment

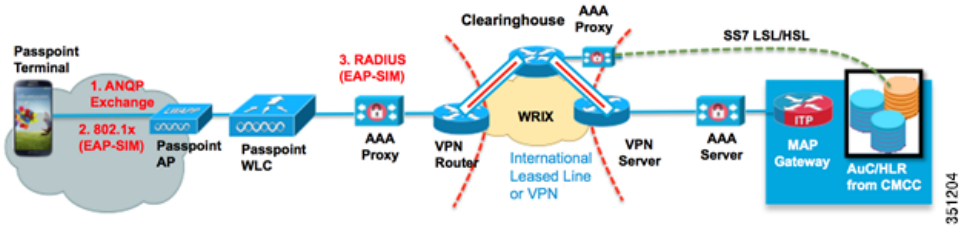
Type of devices	Supported devices	Software	Notes
Wireless LAN controller	CT5508 WISM2 CT8510 CT7510 CT2504 vWLC	7.3.112 and above	This document is based on 7.5
Access Point	LAP1042, LAP1142, CAP1602, CAP2600, CAP3502, CAP3602, CAP1552	Same as above	Supports Local / FlexConnect / Mesh mode
Phone Client Device	Samsung Galaxy-S4	Default shipping OS	Android OS 4.2.2

Systems Diagram

The following are examples for the connectivity in the demonstration cases covered in this document.

Visitor Network in International Roaming Case via Third Party Clearing House

Figure 2 Visitor network connection using Passpoint



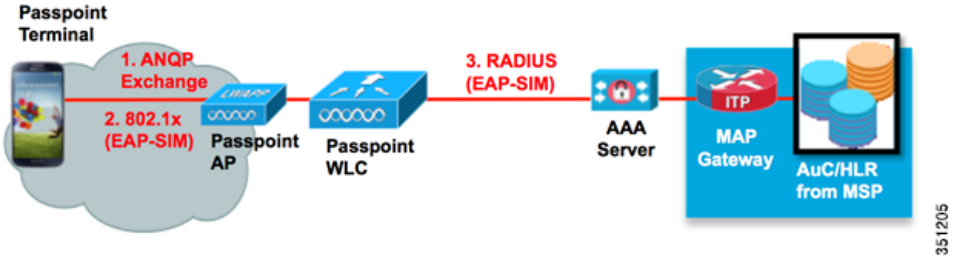
In the case of visitor network, Passpoint-configured WLC at a hotspot has network information of its roaming partner network and this network information is provided in multiple ways.

Realm name is the most typical case that single SSID can include multiple realm name information up to 32 realm names. Each realm name is an indicator of available subscription from a user device. Similarly, if a user has a SIM or USIM card with active subscription, the user device can query 3GPP

Cellular information to retrieve its roaming partner using 3GPP carrier identifier, which is a combination of MCC (Mobile Country Code) and MNC (Mobile Network Code). In this type of user case, 802.11u IEs (Interworking Information element and Roaming Consortium Information elements) are mostly used.

Domestic AP Auto Discovery and Connection (No Inter-WiFi Operator Roaming)

Figure 3 Home network connection using Passpoint



Passpoint connection is mainly useful for the best AP selection among multiple APs. This involves an AP selection process that provides most air capacity (less number of connected user, low amount of RF utilization), backhaul speed and capacity, and network service (IPsec, VoIP, VPN and so on) availability. In the above scenario, HS2.0 IE is mostly used.

Configuration

Case 1–Third Party Clearing House

Configuration Overview

This configuration uses third party clearing house's private network address. Administrator may need to configure VPN network to connect third party hubbing network. For a quick start, see Initial WLC Configuration guide.

WLC Configuration

Current Cisco's Passpoint certification is implemented in Controller-based Architecture, which uses WLC as central configuration and AP management hub. All Passpoint configuration is done at WLC or Cisco PI (Prime Infrastructure).

Configuration can be done via Console, ssh, telnet or GUI using Web Browser, as well as central NMS (using Cisco Prime Infrastructure 1.4 or above). In this guide, we will use CLI and Web-based interface from WLC to explain how to configure Cisco Wireless infrastructure to configure Passpoint setup.

Figure 4 Cisco Passpoint AP/WLC used in this guide

WLC1

```
config wlan create 2 profile_hs20 HS20_TEST
```

//config wlan create <WLAN id> <profile name> <SSID>

```
config wlan hotspot dot11u enable 2
```

//Enables dot11u mode on WLAN 2

```
config wlan hotspot hs2 enable 2
```

//Enables hotspot 2.0 IE

```
config wlan hotspot dot11u 3gpp-info add 1 310090 2
```

//3gpp CIs for EAP-SIM authentication. Add MCC-MNCs for home and roaming partner networks on WLAN 2.

```
config wlan hotspot dot11u roam-oi add 2 1 004096 1
```

//Adds OI 004096 in the beacon and probe response on WLAN 2

```
config wlan hotspot dot11u nai-realm add realm-name 2 1 realm.com
```

//Adds realm name “realm.com” for EAP-TLS & TTLS auth on WLAN 2, as realm index 1

```
config wlan hotspot dot11u nai-realm add eap-method 2 1 1 3
```

//Adds EAP-TLS as EAP-method in the realm name on WLAN 2

```
config wlan hotspot dot11u nai-realm add eap-method 2 1 2 6
```

//Adds EAP-TTLS as EAP-method type in the realm name on WLAN 2

```
config wlan hotspot dot11u nai-realm add auth-method 2 1 2 1 1 4
```

//Adds MS-CHAPv2 as auth-method of EAP-TTLS EAP-method in the realm name on WLAN 2

```
config wlan hotspot dot11u domain add 21 home.com
```

//Adds domain name “home.com” as domain name for home operator on WLAN2

```
config wlan hotspot hs2 operator-name add 2 1 "ACME-operator" eng
```

//Adds operator name “NGH-operator name” as operator name

```
config wlan enable 1
```

//Enables WLAN(indexed as 1)

```
config radius auth add 1 192.168.1.11 1812 ascii 12345678
```

//Adds RADIUS authentication server `config radius auth add <index> <server_ip_address> port# {ascii | hex} shared_secret`

```
config radius acct add 1 192.168.1.11 1813 ascii 12345678
```

//Adds RADIUS accounting server `config radius acct add <index> <server_ip_address> port# {ascii | hex} shared_secret`

Cisco WLAN infrastructure supports Passpoint certified 802.11u IEs and HotSpot 2.0 IEs. The current targeted phone client device checks the existence of .11u IE and hotspot 2.0 IE from the beacon or probe response to start further ANQP process. If .11u and hotspot 2.0 IE information in the beacon passes the device's auto connection criteria, the device can select an AP and go ahead to the 802.1x process without going to the ANQP process. For example, if common HESSID is used among single mobility domain, the device may not need to make ANQP query for every APs located in the same area.

`(Cisco Controller) >config wlan create 2 profile_hs20 HS20_TEST`

This command will create a new WLAN that has “HS20_TEST” as SSID. This new WLAN will be referred as WLAN index 2 for the future command. SSID “HS20_TEST” will not be enabled or broadcasted until network administrator explicitly enables it by typing **`config wlan enable 2`** or clicking the Web GUI interface, [ ] Enabled check box under **WLANs > Edit**.

`(Cisco Controller) >config wlan hotspot dot11u enable 2`

This command will enable 802.11u services in WLAN index 2. Dot11u service should be enabled as prerequisite of hotspot2 service.

`(Cisco Controller) >config wlan hotspot hs2 enable 1`

This command will enable HotSpot2 services in WLAN index 2.

`(Cisco Controller) >config wlan hotspot dot11u 3gpp-info add 1 310 090 2`

This command will add 3GPP Cellular Information in WLAN index 2; in this example, 310 is used as MCC (Mobile Country Code) and 090 is mapped to MNC (Mobile Network Code). MCC and MNC is a unique value for each operator and is available from UICC Card in the phone client device. The phone client device will read the Home PLMN number from the UICC card, and extract MCC/MNC from PLMN. The phone client device will compare its MCC/MNC number with the AP’s 3gpp cellular information using HotSpot 2.0 ANQP and select an AP to initiate EAP-SIM authentication.

If MNC consist of only two digits, use two digits instead of three in your configuration. For example, if MCC/MNC is 520/99, then use 99 in the MNC area. When the phone client device finds a match at the 3GPP-CI value, the phone client device will device either EAP-SIM or AKA based on its provisioned definition.

```
(Cisco Controller) >config wlan hotspot dot11u roam-oi add 2 1 004096 1
```

This command will add OI (Organizational Identifier) information to beacon and probe response. “004096” was used as an example and this will be also unique for an operator.

OI information will be registered from IEEE Registration Authority and can submit application from IEEE Home page (http://standards.ieee.org/develop/regauth/oui/public.html)

Having an OI value is not a mandatory condition; it is another AP selection criterion from the phone client device.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add realm-name 2 1 realm.com
```

This command will add realm name information to the NAI Realm list. “realm.com” is used as an example here. Once the phone client device gathers the realm name from AP using ANQP, the phone client device will compare with its own provisioned realm name in the phone’s HS2.0 profiles. Realm name is unique per operator and usually used in authentication as part of user identity field after an “@” delimiter. A single SSID can have multiple realms defined, the maximum is 32 realm names per SSID. The realm configuration doesn’t separate home realm or roamed realm by the Realm list itself.

This Realm name will be sent along with EAP auth type as roaming consortium information element that will be defined from the next command.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add eap-method 2 1 1 3
```

This command will add EAP authentication information, which will give information of the required EAP protocol per realm. This particular line of command describes adding EAP-TLS protocol as an EAP method in the second WLAN index, first realm index, as first EAP method.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add eap-method 2 1 2 6
```

This command will add EAP authentication information, which will give information of the required EAP protocol per realm. This particular line of command describes adding EAP-TTLS protocol as an EAP method in the second WLAN index, first realm index, as second EAP method.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add auth-method 2 1 2 1 1 4
```

This command will add Auth-Method information, which will give information of the required authentication types per EAP protocol. This particular line of command describes MS-CHAPv2 auth.type in the second WLAN index, first realm index, EAP-TTLS as EAP method (2), as first auth-index, Non-EAP Inner Method(4).

```
(Cisco Controller) >config wlan hotspot dot11u domain add 2 1 home.com
```

Adds domain name “home.com” as domain name for Home Service Provider. This is used to verify whether current AP connection is a home or roamed (visitor) network.

```
(Cisco Controller) >config wlan hotspot hs2 operator-name add 2 1 "ACME-operator" eng
```

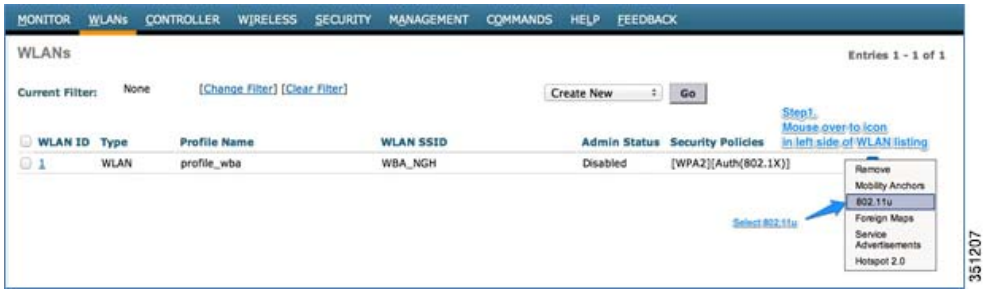
Adds operator name field on HotSpot 2.0 IE. If an administrator wants to add SPACE character, use double quotation mark to wrap the operator name field. Also language code can be 2 or 3 bytes.

```
(Cisco Controller) >config wlan enable 2
```

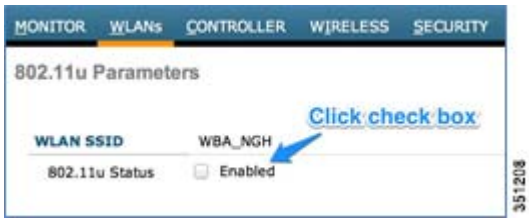
Finally, enables wlan to start service.

Same goal can be achieved using Cisco WLC’s GUI. Complete the steps:

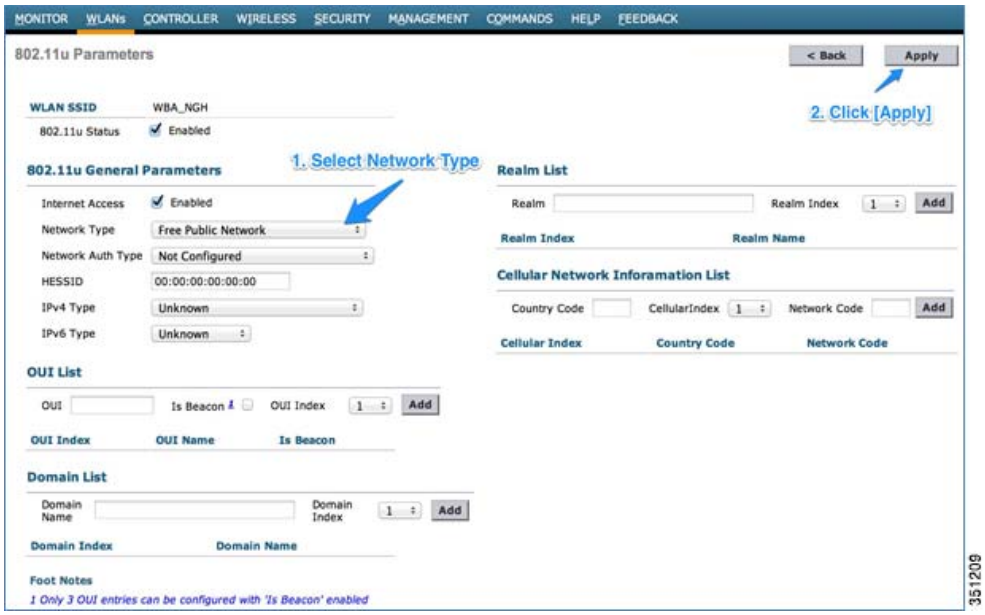
Step 1 Access to 802.11u config screen in WLANs.



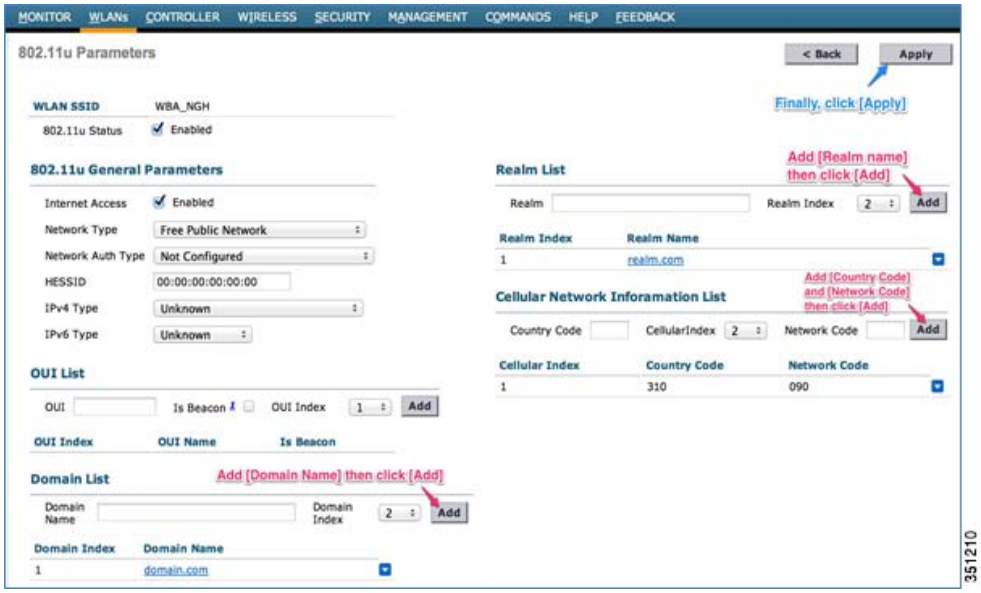
Step 2 Enable 802.11u.



Step 3 In 802.11u IE configuration screen, under 802.11u General Parameters, select [Network Type] and click **Apply.**

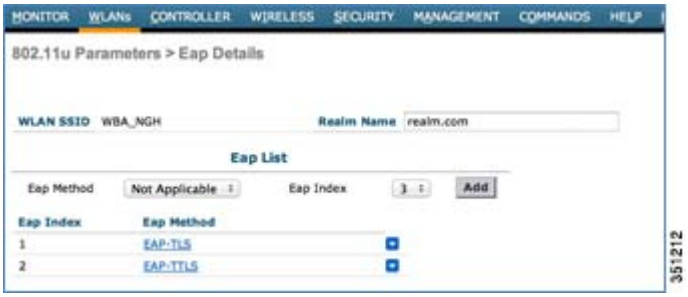


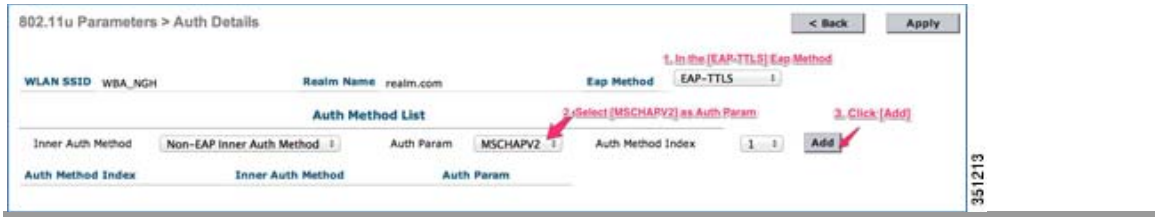
Step 4 Enter 3GPP CI, Realm name and Domain name and click **Apply**.



Step 5 Configure EAP per Realm.

Step 6 Add EAP protocol and Auth type in the 802.11u GUI.





Phone Devices

The WFA Passpoint certified phone is recommended. In this configuration guide, we will use Samsung Galaxy-S4 stock device as the client machine. The device takes network information from two different locations:

The first location is the UICC (Universal Integrated Circuit Card) Card. The UICC card (SIM or USIM Card) has IMSI (International Mobile Subscriber Identity) information containing 15-digit long number that starts from MCC and MNC. This number will be extracted and used with 3GPP CI comparison. Optionally, an administrator can manually configure 3GPP-CI provision inside the phone's Passpoint configuration file. The second location is a static realm definition file, located at "/storage/emulated/0". It is not stored by default, the cred.conf file must be created separately using text editor or similar tools. Currently, auto creation of default profile is not supported.

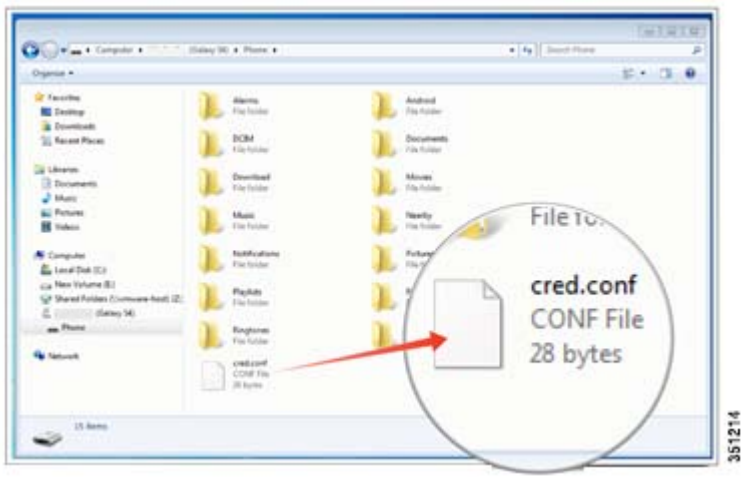
Below is an example of a typical Passpoint/EAP-SIM based authentication configuration file "cred.conf" on SGS4,

```
cred={
imsi= "?"
eap=SIM
}
```

There are a couple of methods to create this "cred.conf" file and save it on /storage/emulated/0 folder.

Method 1

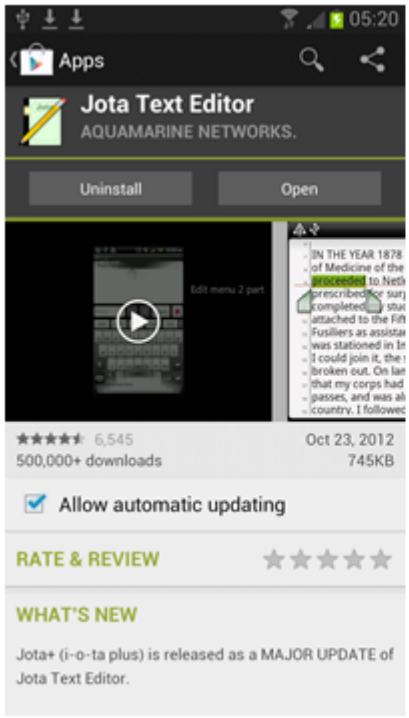
A Windows PC is required to apply this method. You must connect the phone to your PC by using a USB cable. Configure the phone as removable disk. Once the phone is recognized, you will find a disk copy of "cred.conf" file in the root directory.

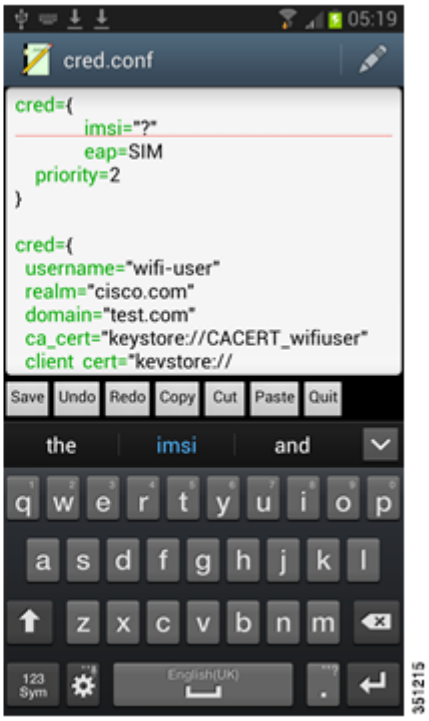


Method 2

You can use the Text Editor available in Android and create a "cred.conf" file and save it directly in your phone device.

1. Go to Google "Play Store" and search for a text editor.
2. Download "Jota Text Editor" or a similar text editor.
3. Open Text Editor and type the below message as shown in the screenshot.
4. Save the file as "cred.conf" in /storage/emulated/0 folder.

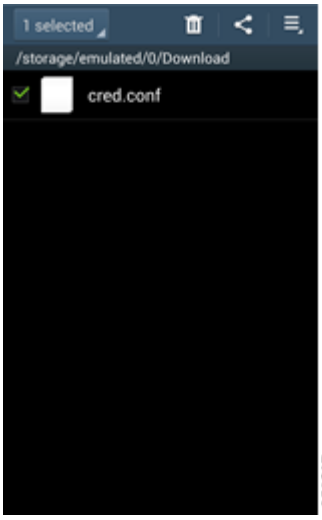




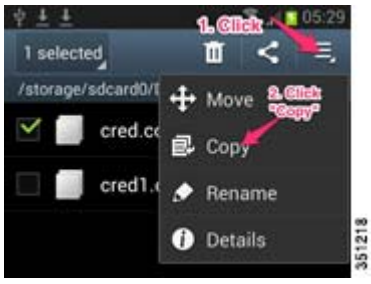
Method 3

1. Write a config file from a different machine, such as PC or MAC and save it as "cred.conf" file.
2. Send an email to the test phone with the “cred.conf” file attached.
3. Open the default Gmail reader or Email reader and open the received email folder and click the attachment to save the file in the phone device. Use the default save location “/storage/emulated/0/Download”.
4. Select the “My Files” App.

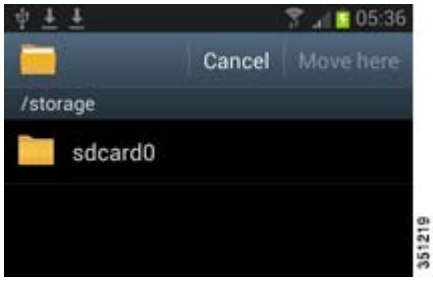
5. Go to **All Files > Download** and select “cred.conf”.



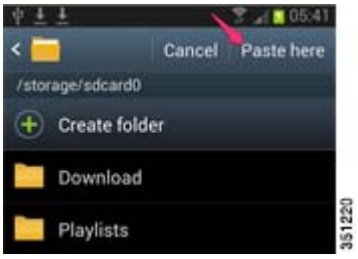
6. Select the “=” icon on the top right corner of your phone screen or long press cred.conf file. Select the Copy or Move option.



7. Select the “/storage/emulated/0” folder



8. Click the “Paste here” (or “Move here”) button to complete the copy (or move) process



Method 4

1. Same as Method 3, an external editor is used to create the config file. Save the file name as "cred.conf".
2. Copy the file to an external memory card (microSD Card).
3. Insert the microSD card to the phone device.
4. Run the "My files" application.
5. Navigate to /extSdCard and confirm if the "cred.conf" file is available (copied into the external memory card at step 2).
6. Long key press "cred.conf" file until the Copy menu is displayed.
7. Select "Copy" and paste the file to the parent folder /sdcard0.

If Passpoint system is configured for EAP-TLS, CA certificate and User certificate must be copied using microSD card. The files can also be sent as emails because PKCS#12 SGS4 support multiple certificate encoding formats. ".p12" formatted certificate is generally recommended.

Case 2–Standalone Demo Configuration Without using Third Party AAA Server

This topic does not cover cases where Operator is using third party AAA.

AAA Configuration using Cisco CAR

Add WLC as RADIUS Phone

To add WLC as RADIUS phone:

CAR

```
cd /radius/phones          // cd to RADIUS phone section
add hs20wlc                //Add WLC as RADIUS phone
cd hs20wlc/                //cd to WLC setup
IPAddress = 10.11.23.102   //WLC_mgmt_ip
Sharedsecret = cisco123    //WLC_radius_secret
save                       //Save configuration
```

Define ITP MAP Gateway as Remote Server

To define ITP MAP Gateway as remote server:

CAR

```
cd /Radius/RemoteServers      //cd to Remote AAA server – pointing to ITP MAP GW router
add itp1                      //Add ITP MAP gateway. Name "itp1" as remote server
cd itp1/                      //cd to itp1 setup
Protocol = map-gateway        //Set the protocol as map-gateway
IPAddress = 10.11.24.11       //map-gateway IP address
Port = 12345
ReactivateTimerInterval = 300000
Sharedsecret = itpmap1
MaxTries = 3
Initial Timeout = 45000
save
```

Define EAP-SIM Service

To define EAP-SIM service:

CAR

```
cd ..
add eap-sim
cd eap-sim
set Type eap-sim
cd RemoteServers/
add 1 itp1
save
```

Define Rule for EAP-SIM Realm Based Authentication

To define rule for EAP-SIM realm based authentication:

CAR

```
cd /radius/Rules                    //Navigates to Rules directory
add sim-operator1.com               //Add new rule name using the add command
set Script ExecRealmRule            //Set ExecRealm Rule
cd Attributes/                      //Go to Attributes sub-directory
Set Authentication-service eap-sim  //Define eap-sim as authentication method
Set Authorization-service auth-local //Define local as authorization method
Set realm @sim-operator1.com        // Set realm name
save                                // Save configuration
```

Define Policy for EAP-SIM Realm based Authentication

To define policy for EAP-SIM Realm based authentication:

CAR

```
cd /radius/Policies
add SelectPolicy                    // Added Policy
Set Grouping sim-operator1.com //Set grouping to the name of rules
save                                //save configuration
```

Define EAP-SIM Subscriber

To define EAP-SIM subscriber:

CAR

```
cd /Radius/UserLists/subscribers-local     // cd to local subscriber
add 1102030405060708       // Add new user name based on IMSI with a prefix of 1
set AllowNullPassword TRUE                 // Allow Null password for EAP-SIM user
save                                       // save configuration
```

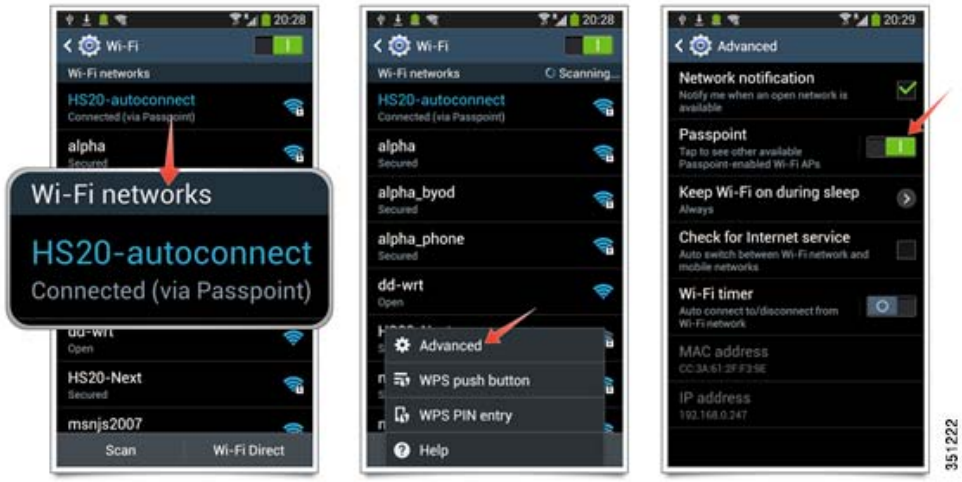
Repeat the above steps for each user.

WLC Configuration

Same as AAA Configuration using Cisco CAR but the IP address can be different per assigned local addressing.

Handset Configuration

By default, the phone's Passpoint module is disabled. To enable it, go to [Settings] and in Connections Tab, select Wi-Fi option and Click Menu button (left side of home button) and enable Passpoint feature.



1. Complete “cred.conf” file based on operator’s roaming partnership and copy the file into the /storage/emulated/0 folder.
2. Use “cred.conf” file content in topic Phone Devices for EAP-SIM.
3. EAP-TLS/TTLS will require pre-loaded certificate definition and user ID/password information inside of cred.conf, the file insertion method is the same.

   Actual Importing of certificate can be done by manual certification copy and install or using Gmail in your phone to import the certificates.

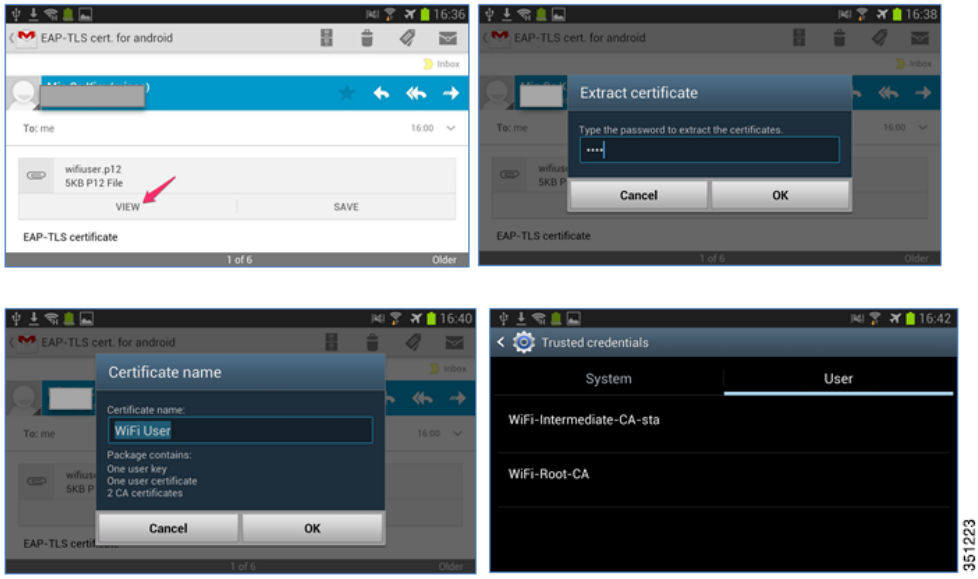
Using Gmail in your Phone

a. Send certificate as attachment of an email to the phone’s registered Gmail address.

b. Open Gmail from your Android phone device and open the email where the certificate is attached.

c. Click [View] button

d. Type Password to Extract certificate if it has one



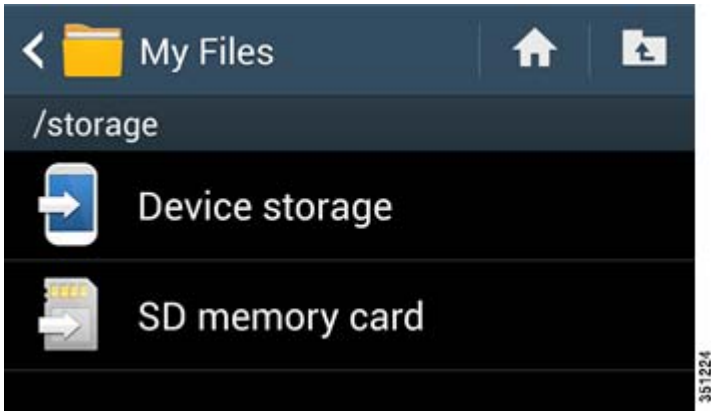
Installed Certificate can be verified from **[Settings] > [More] > [Security] > [Trusted Credential] > Select [User] Tab**

e. Administrator may be prompted to enable the security PIN or code to enable Certificate usage if it's the first time that the certificate is being inserted.

Manual Certification File Copy using microSD Card.

This process can be done by using the external microSD card:

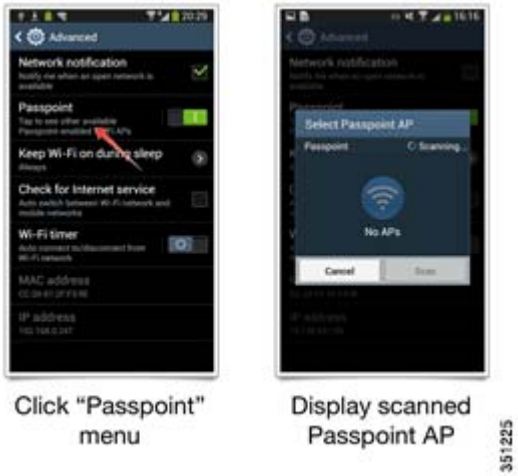
a. External microSD card can be accessed from the "MyFiles" app as "SD memory card"



b. Select the EAP-TLS certificate and copy it under the root folder of [Device storage] /storage/emulated/0 folder.

c. Navigate to **[Settings] > [more] > [Security] > [Install from device storage]**

4. Once all the settings have been configured, turn on WiFi interface. If the phone device discovers auto-connect eligible HotSpot 2.0 AP, it will automatically proceed to 802.1x authentication process that is included in "cred.conf" file, which matches with AP's 11u value where EAP auth type and realm name is defined. The phone device will not show any particular indicator for Passpoint-enabled SSID unless the user is successfully authenticated and connected.
5. At any time, if the user turns off the Passpoint feature, auto-connected SSID will be disconnected.
6. If you click the [Passpoint] toggle menu from the advance menu, the phone device will display the scanned Passpoint APs.



Configuration Guide per Test Case

Power Device with Wi-Fi Radio Turned On

Pre-Provisioned Case for EAP-SIM

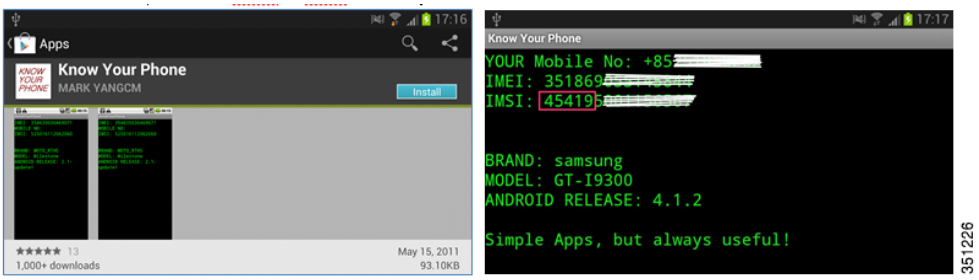
When configuring from a phone device, you must create “cred.conf” file as given in the below format:

```
cred={imsi= "mncmcc-simno"
eg.domain=home.com}
cred={imsi= "19454-simno"
domain=home.com}
```

“mncmcc” part is a combination of two or three digit MNC and three digit MCC. After MNCMCC number, add “–(dash)simno(string “simno”). Optionally, “cred.conf” file can have a domain definition which is used for validating roaming (Visitor) network by comparing domain name in ANQP response from AP and the phone’s pre-configured information. If the domain name from AP (received by ANQP query result) is matched with cred.conf file’s domain name, the AP will be considered as Home network. If imsi value is matched but is not a domain name, it will be considered as Visited (roamed) network. The sequence of MCC and MNC is reversed at the AP/WLC's 3GPP CI information tab.

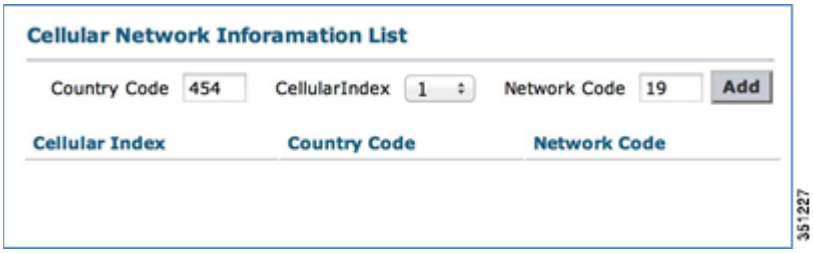
WLC

WLC must know the 3GPP CI information of the SIM Card which is being tested. To get this information, administrators must load the IMSI reader utility on the Phone. IMSI reader utility is downloadable from Google Play Store by searching the keyword “imsi” from the Play Store search text box. A list of result is displayed, select the “Know Your Phone” App.



In the above example, “454” is recognized as the Mobile Country Code(MNC) and “19” is recognized as the Mobile Network Code (MCC). This value will be loaded by the Passpoint module in the phone client device and will be used to compare 3GPP CI from WLC as ANQP query result.

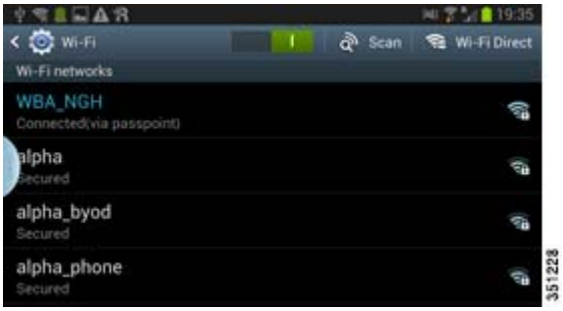
WLC can be configured to have matching MCC and MNC value, you can do this by configuring MCC as 454 and MNC as 19 in the 3GPP CI section of 802.11u config screen.



From CLI

Use the command: `(Cisco Controller) >config wlan hotspot dot11u 3gpp-info add 1 454 19 1`

Once the phone client device is connected successfully, a message Connected (via Passpoint) is displayed.



Provisioned SIM for EAP-AKA

Configuration from Phone

EAP-AKA is not very different from EAP-SIM case. When configuring from phone, you must create “cred.conf” file as given in the below format:

```
cred={imsi= “mncmcc-simno”

eg. eap=AKA

domain=home.com}

cred={imsi= “19454-simno”

eap=AKA

domain=home.com}
```

“mncmcc” part is a combination of three digit MCC and two or three digit MNC. After MNCMCC number, add “–(dash)simno(string “simno”). The phone's IMSI sequence is MNC-MCC. WLC's 11u 3GPP CI sequence is MCC-MNC.

Similar to EAP-SIM, “cred.conf” file can optionally include domain definition which can be used for validating roaming (Visitor) network by comparing domain name in ANQP response from AP and phone’s pre-configured information.

EAP-TLS

Configuration from the Phone

The phone client device must have pre-provisioning certificates–CA certificate (if the testing environment uses private CA or Root CA that is not in the factory default certificate on android), Server certificate, and a phone certificate.

Android OS 4.1.2 can support *.p12, *.pfx and *.cer formatted certificate as importing certificate. A single *.p12 file can package multiple certificates and key files.

The “Cred.conf” file must adopt different type of credentials:

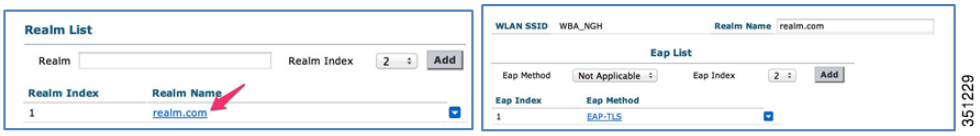
```
cred={
username="user-name"
realm="realm.com"
domain="home.com" #mandatory for home identification
ca_cert="keystore://CACERT_certificate-name-installed"
phone_cert="keystore://USRCERT_certificate-name-installed"
private_key="keystore://USRPKEY_privatekey-name-used"
}
```

Configuration from the WLC

Administrators can use the same configuration steps as WLC Configuration

From GUI

Navigate to [WLANs][802.11u] Setup Screen



From CLI

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add realm-name 1 1 realm.com
(Cisco Controller) >config wlan hotspot dot11u nai-realm add eap-method 1 1 1 3
```

EAP-TTLS

Configuration from the Phone

The phone client device must have pre-provisioning certificates–CA certificate (if the testing environment uses private CA or Root CA that is not in the factory default certificate on android), Server certificate, User ID, and password.

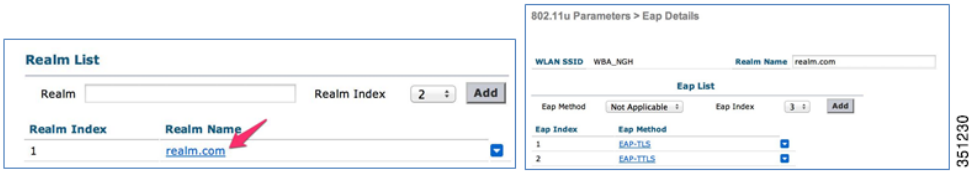
```
cred={
username="user-name"
password="password"
realm="realm.com"
domain="home.com" #mandatory for home identification
ca_cert="keystore://CACERT_certificate-name-installed"
}
```

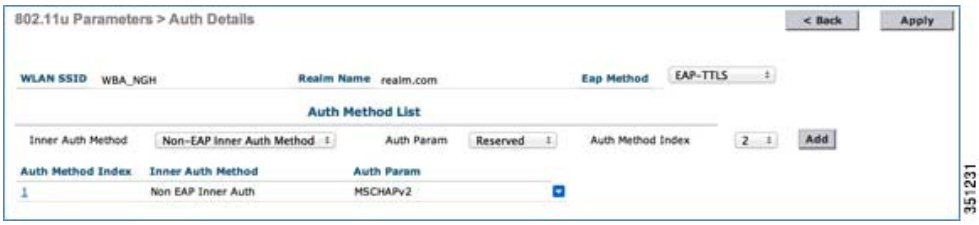
Configuration from the WLC

Administrators can use the same configuration steps as WLC Configuration.

From GUI

Navigate to [WLANs][802.11u] Setup Screen





From CLI

Follow the same configuration steps as WLC Configuration.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add eap-method 1 1 2 6
```

//Adds EAP-TTLS as EAP-method type in the realm name.

```
(Cisco Controller) >config wlan hotspot dot11u nai-realm add auth-method 1 1 2 1 1 4
```

//Add MS-CHAPv2 as auth-method of EAP-TTLS EAP-method in the realm name.

Non-Provisioned EAP-SIM

Configuration from the Phone

In the assumed SIM card case, the phone client device reads the 3GPP Cellular Information (3GPP CI) on the SIM card and automatically populates the necessary MCC/MNC information. The phone client device will then use the SIM card's information and make comparison with AP's 3GPP CI ANQP query result. There is no explicit or pre-defined IMSI information required at the phone client device's configuration file. If the AP responds with identical 3GPP CI values, the phone client device will make an automatic EAP-SIM connection. Since there is no home domain definition, every auto connection is considered as roaming network.

Currently, the phone client device does not generate the default "cred.conf" file from the off-the-shelf package. Manual creation of the minimum skeleton config is still required.

Here is the required "cred.conf" file content.

```
cred={

imsi= "?"

eap=SIM

}
```

Configuration from the WLC

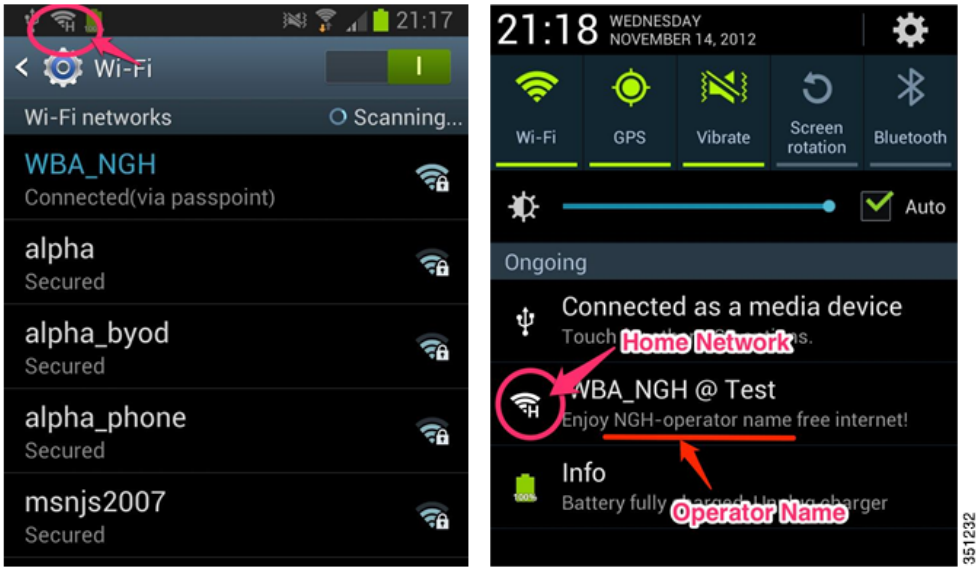
Same as first test case –WLC Configuration.

Non-Provisioned EAP-AKA

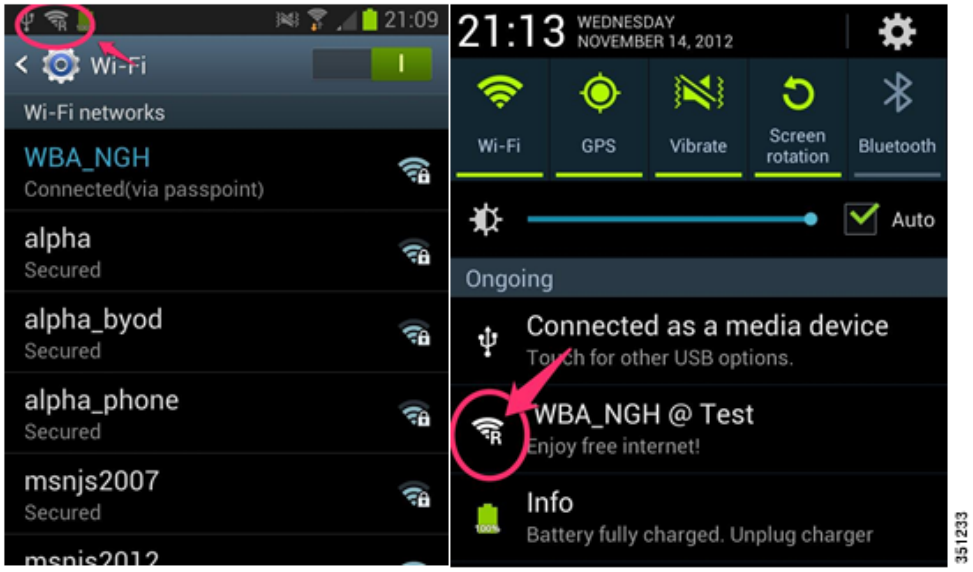
EAP-AKA is not different from EAP-SIM case, except for the eap type definition given below:

```
cred={
imsi= "?"
eap=AKA
}
```

Result Screen for Home Network Connection



Result Screen for Roamed Network Connection



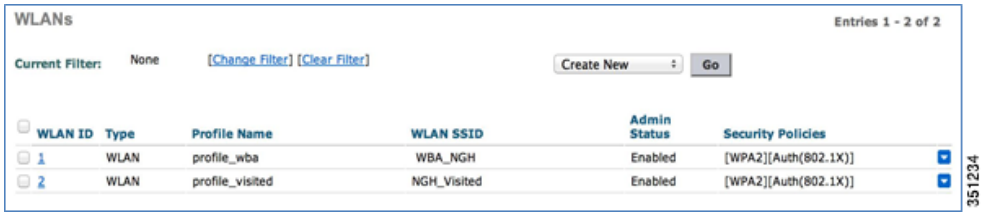
Home Network Prioritization over Visited Network (No Pre-Provisioning of Realms)

Configuration of Phone

Since there is no pre-provisioning of realms, connection should be done over 3GPP CI using pre-provisioned domain name field to validate HSP or Visited Network.

Configuration of WLC:

Create two Passpoint-enabled SSIDs and configure the same 3GPP CI on both SSID. You must define “home.com” domain name in one SSID and leave other as no domain name. SSID that has “home.com” domain name IE will become HSP and the other with no domain name becomes a Visited Network.



As the current handset’s observation, the phone client device does not break the current established connection on Visited Network even if HSP network comes back online.

Debug

Debug from the Controller

Use the following commands to debug from the controller:

```
(Cisco Controller) >debug hotspot event enable
```

//Displays HS 2.0 event debug information.

```
(Cisco Controller) >debug hotspot packet enable
```

//Displays HS 2.0 packet debug information.

Configuring Hotspot 2.0 on iOS7

With the release of the new version of the iOS7 Operating System, Apple announced support for the "Wi-Fi Alliance Hotspot 2.0 Specification" on their recent products such as iPhone 5, iPad mini, and later iDevices. Because only those products that have completed and passed Wi-Fi certification to the Hotspot 2.0 test plan may use the Passpoint name; in Apple's iDevice context, the term used will be "Hotspot 2.0" or HS2.0, but not "Passpoint".

The key strength of Apple's HS2.0 implementation is integrating it into their existing and proven framework of "Configuration Profiles" (previously known as "iPhone Configuration Profiles").

A configuration profile is simply an XML file containing a number of settings, including:

- Wi-Fi settings (HS2.0 settings were introduced to this section)
- Credentials and keys
- Restrictions on device features
- VPN settings
- Email server settings
- Exchange settings
- LDAP directory service settings
- CalDAV calendar service settings
- Web clips

By leveraging a method already familiar to network administrators around the world, Apple was able to scale the adoption of HS2.0 from day one. The scalability of Configuration Profiles has been proven over the years. Distributing Configuration Profiles can be done via any of the following five ways:

- Using Apple Configurator (iOS only)
- In an email message
- On a web page
- Over-the-Air Profile Delivery and Configuration
- Over the air using a Mobile Device Management Server

In this document, we will be using the “Apple Configurator” to illustrate the minimum required steps to create and push a HS2.0 Configuration Profile. The profile we create will demonstrate authentication using EAP-TLS and EAP-SIM on an iPhone 5.

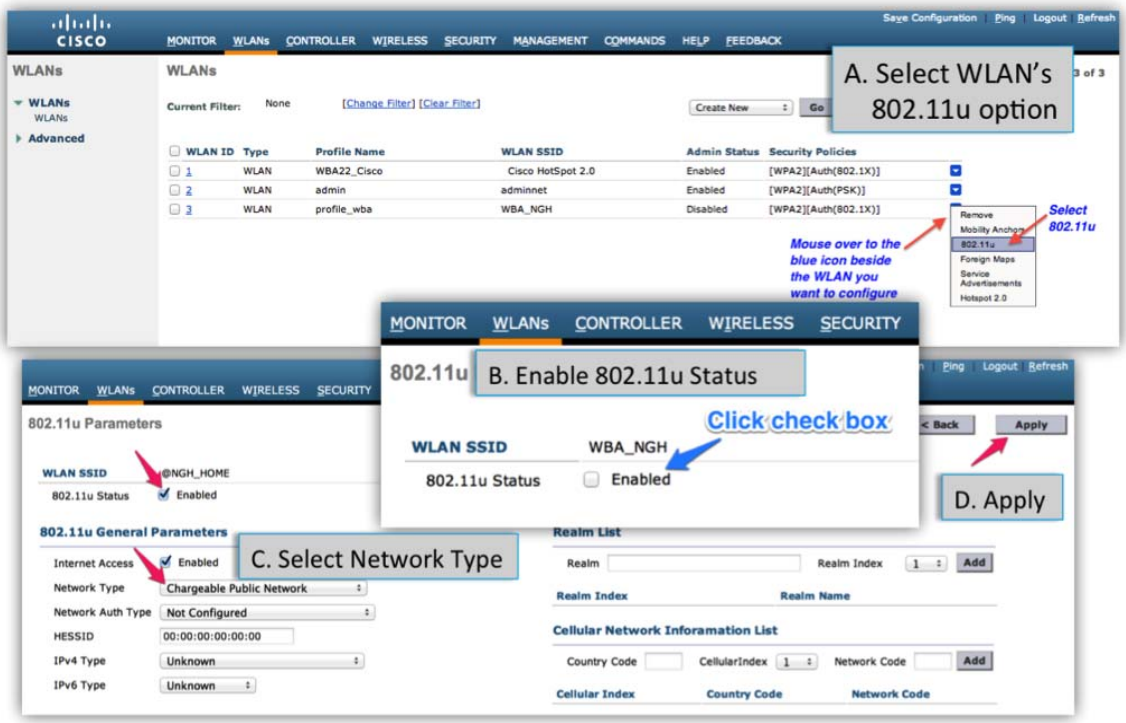
The Apple Configurator app is available for free from the App Store (currently, only available for MAC OS). Apple Configurator version 1.4.2 or later is recommended.

For more information on the Apple Configurator, we recommend watching the instructional video at http://www.apple.com/education/tutorials/#introduction-to-apple-configurator and for a reference on Configuration Profiles refer to https://developer.apple.com/library/ios/featuredarticles/iPhoneConfigurationProfileRef/Introduction/Introduction.html

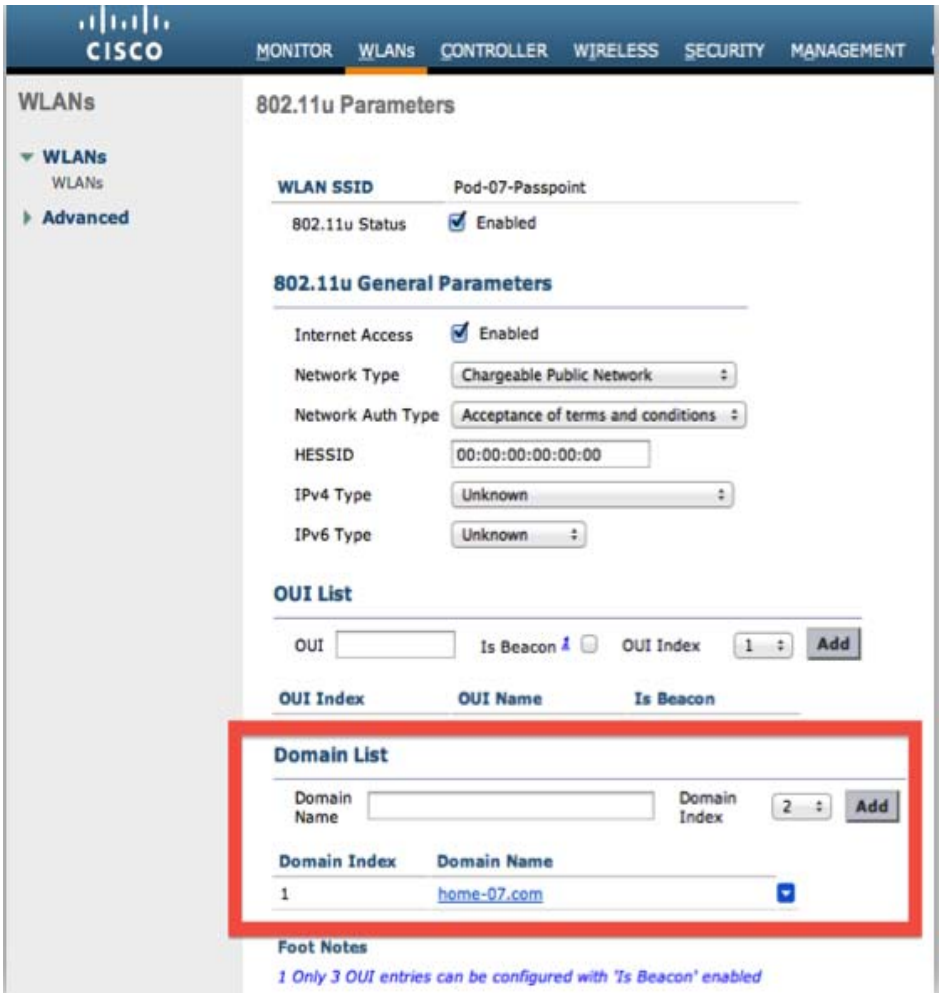
Note On the WLC side, the minimum configuration required is as follows:

1. Create a WLAN with default L2 security settings (WPA2, 802.1x), and define the external RADIUS handling the EAP-TLS and/or EAP-SIM in our example.
2. Enable the 802.11u for the WLAN, set the **Network type** to any value.

.



3. Define at least one Domain Name in the **Domain List** to match that set for the iDevice (more details will be provided in later sections).

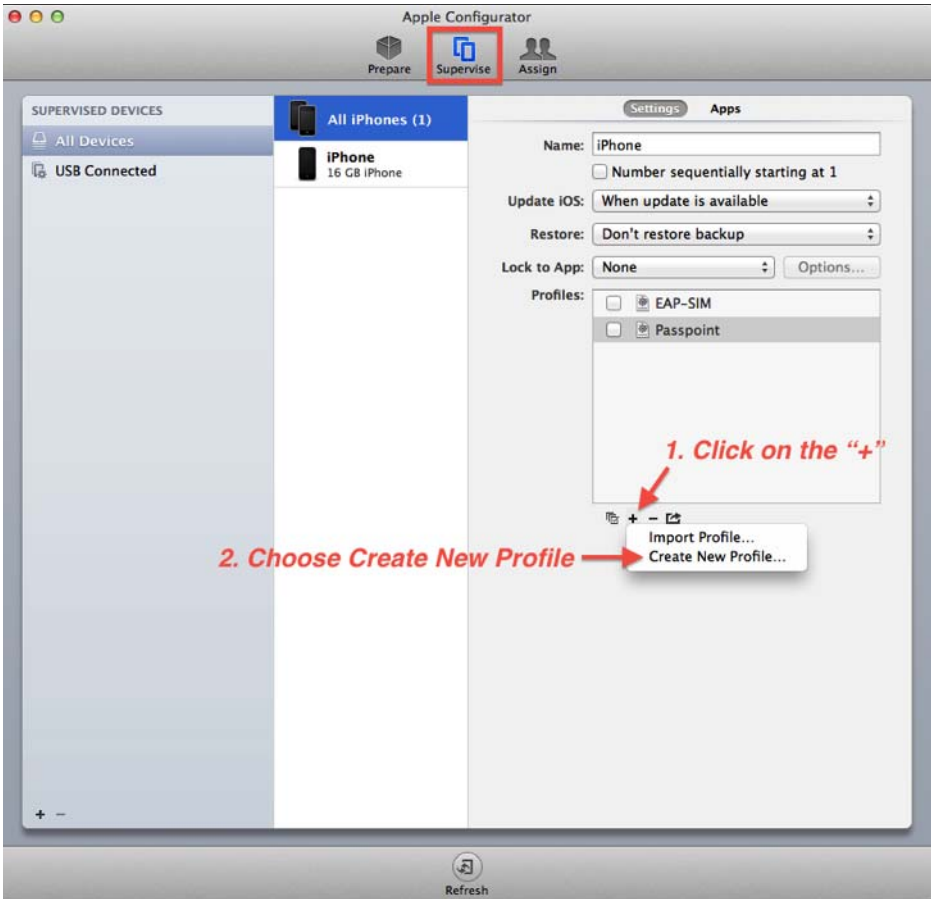


4. Enable the check mark for “Hotspot 2.0” (the default settings are sufficient).

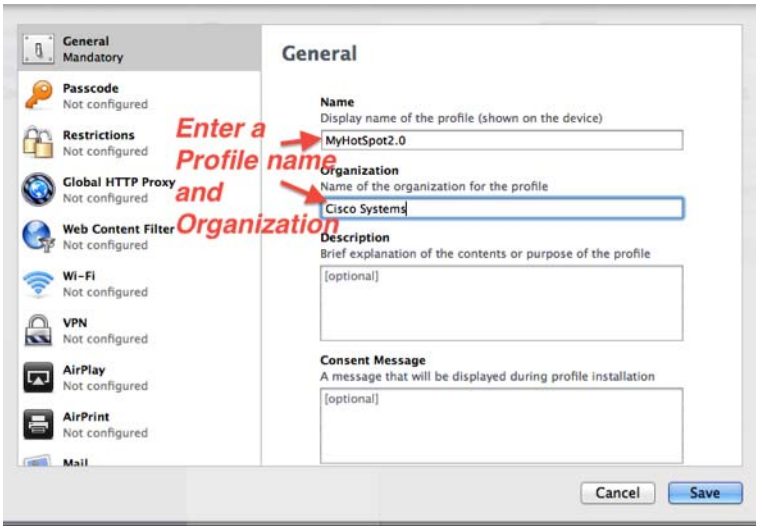
The Apple Configuration

No configuration is required on the device itself (ex: the iPhone). All Hotspot 2.0 configuration will be done on the Apple Configurator App.

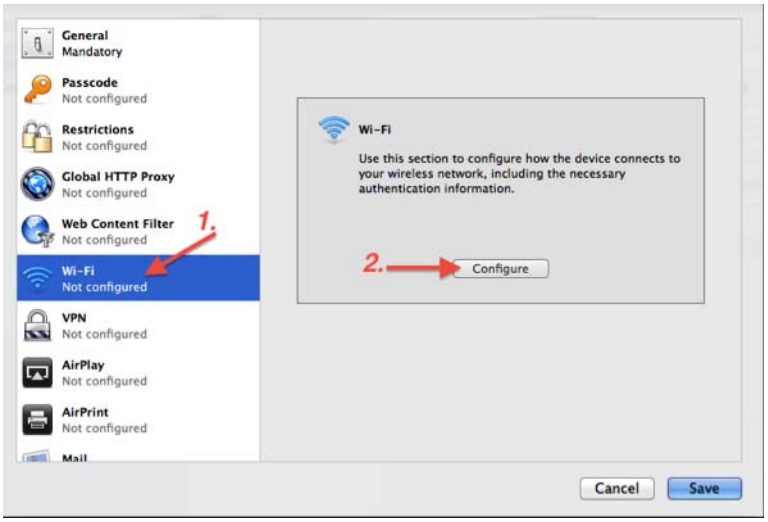
Open the Apple Configurator App and choose **Supervise** from the top menu. In the new screen, under the **Profiles** list, click the "+" button to create a new Profile.



The **General** settings tab will open. Enter the Profile information as you would like it to be displayed on the iDevice.



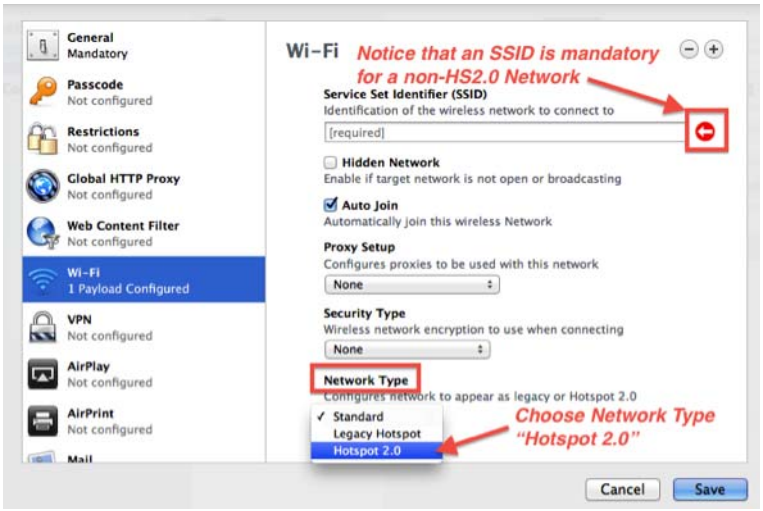
Notice all the various configuration options to the left of the menu; in this guide we will only be using the **Wi-Fi** tab and then later on the **Certificates** tab to add the required certificates for EAP-TLS.



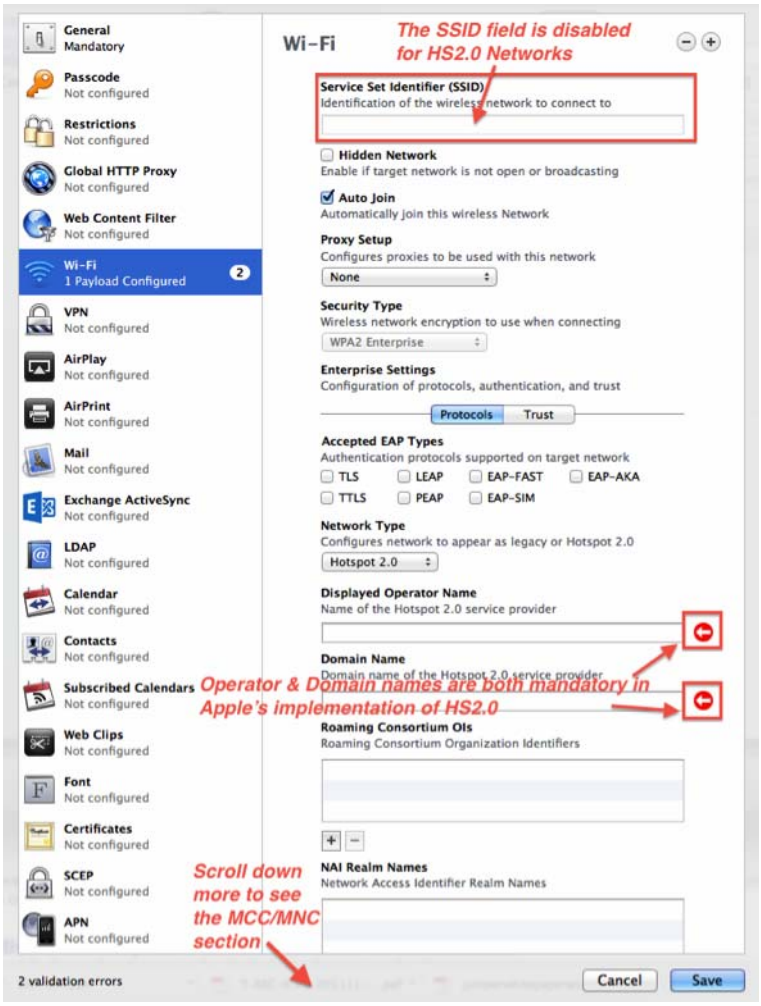
In the **Wi-Fi** configuration menu, the default **Network Type** is **Standard** (for example, entering an SSID value is mandatory as indicated by the small arrow shown in the screenshot).

To access the full "Hotspot 2.0" configuration options, from the **Network Type** drop-down list, choose **Hotspot 2.0**.

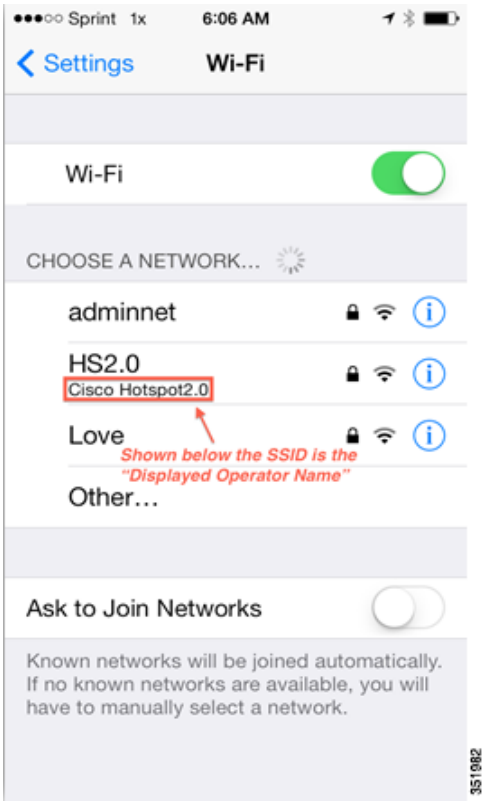
Note You can add, mix, and match multiple Wi-Fi configuration instances (Payloads) within the same configuration profile by clicking the "**+**" button at the top right-hand side of the Wi-Fi configuration screen.



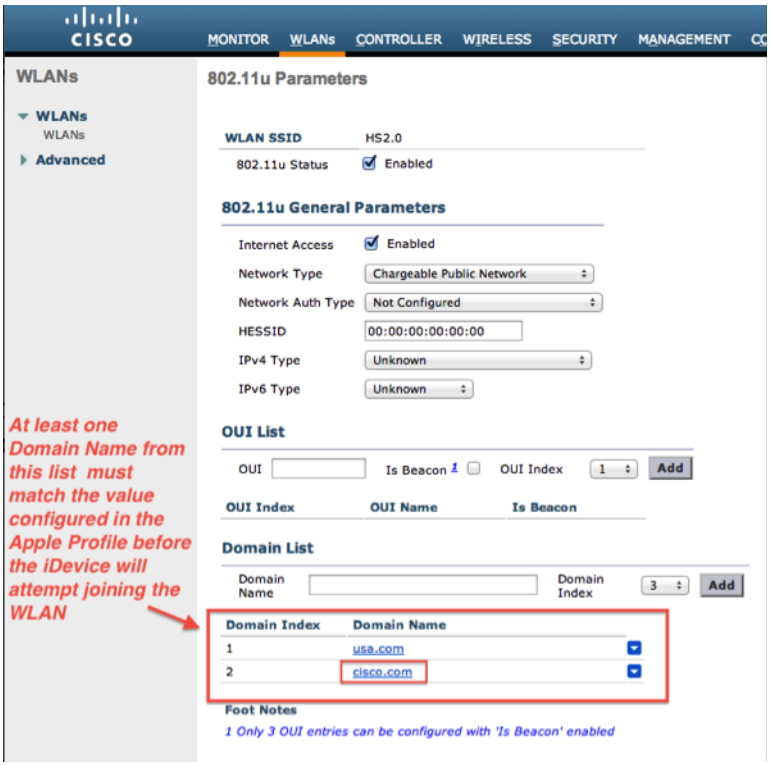
Notice that the SSID field is now disabled, and new configuration options pertaining to HS2.0 have now become available. Apple's Hotspot 2.0 implementation requires both the **Displayed Operator Name** and **Domain Name** to be configured.



The **Displayed Operator Name** is simply the value displayed below the SSID's name on the iDevice as shown in the following screenshot of an iPhone 5.



Note The **Domain Name** value set in the Apple Configuration Profile must match at least one of the configured domains advertised by the WLC as set in the 802.11u configuration screen for that WLAN.

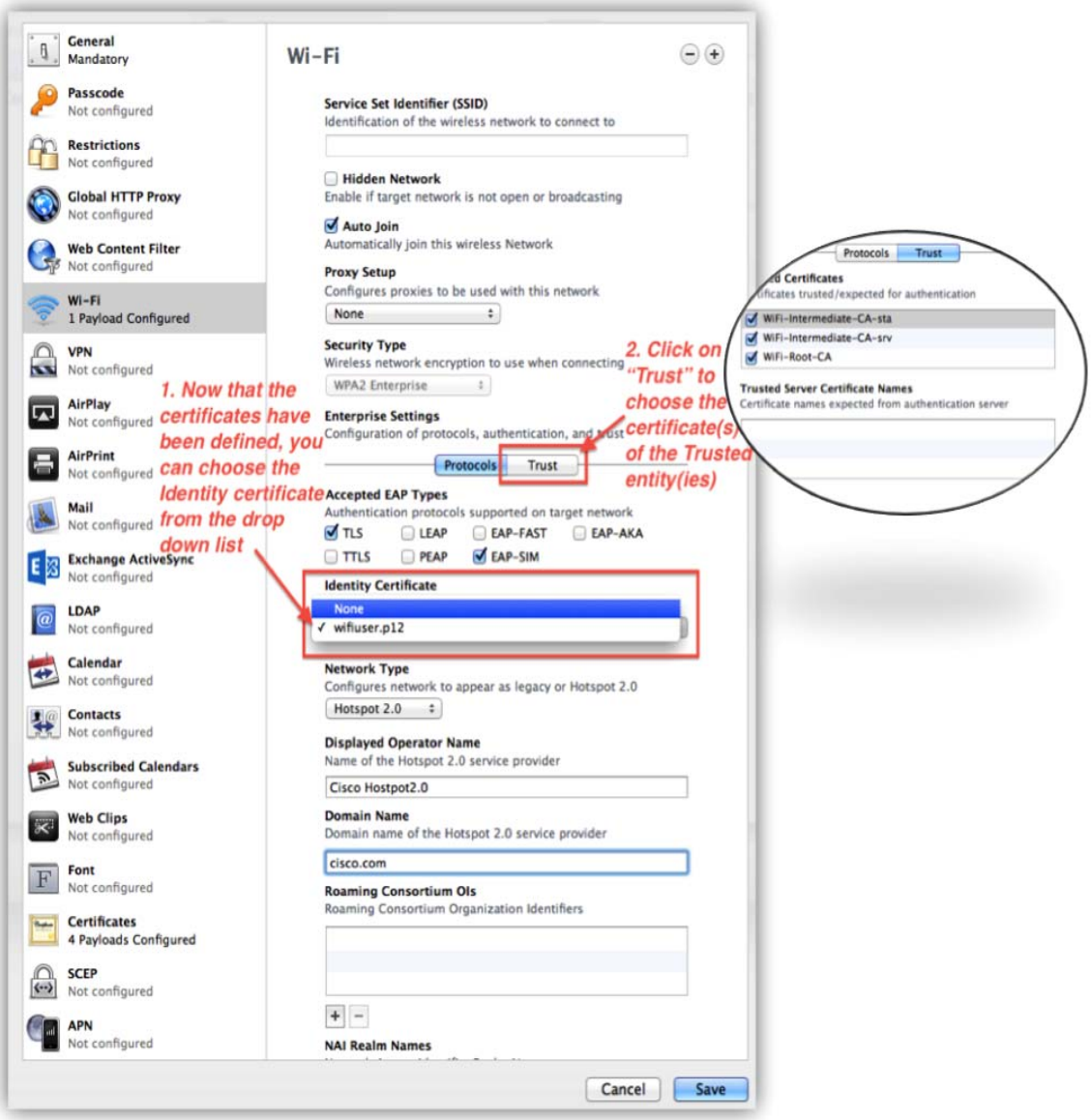


Next, select the EAP types for this profile, in our case we will select EAP-TLS and EAP-SIM.

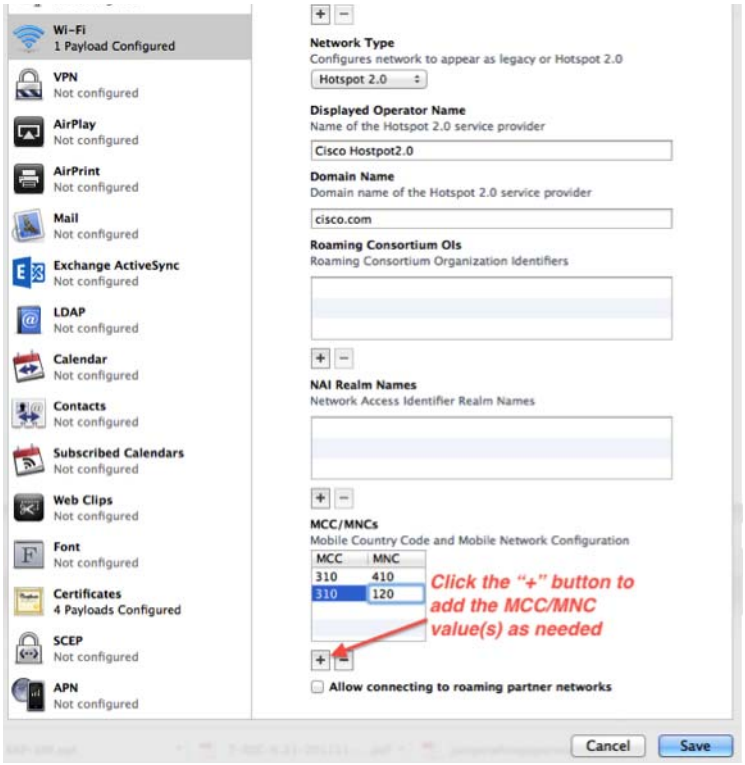
Notice that upon selecting the EAP-TLS check box, the **Identity Certificate** configuration option becomes available (marked with a red arrow). However, the drop-down list is currently empty because no certificates are defined for the Profile that we have just created. So, the next step is to click the **Certificates** tab on the left menu to define the **Identity Certificate**, and if required the certificate(s) for the Trusted server(s).

In the **Certificates** menu, add the Identity Certificate to be used by this device and then click the "**+**" button at the top-right-hand side of the screen to add the Trusted Servers as needed. Once done, we can now return to the Wi-Fi tab where these certificates will now be available to use for our EAP-TLS configuration.

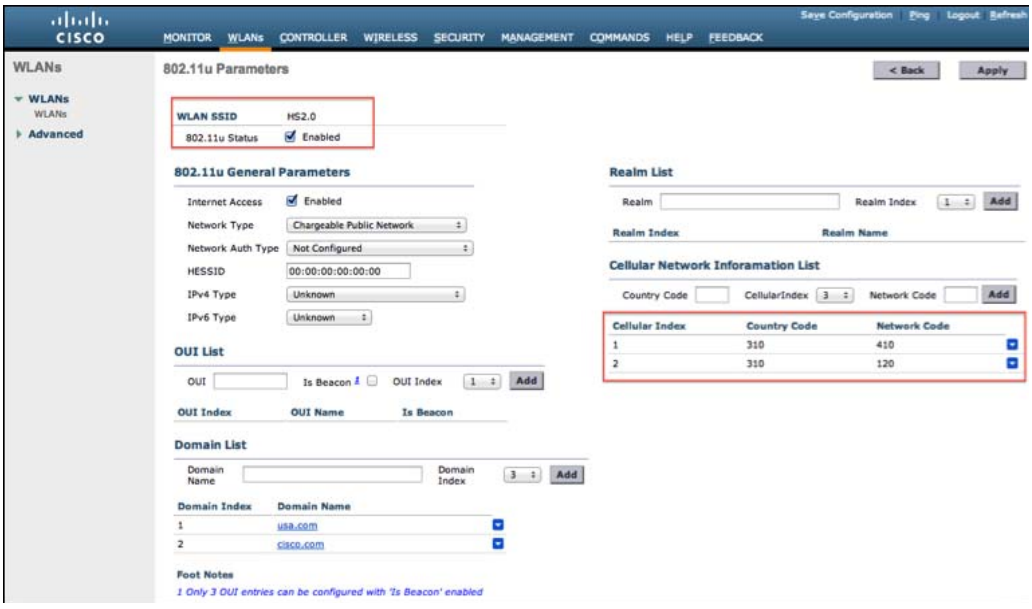
Select the **Identity Certificate** and then click the **Trust** tab to select the trusted servers. This concludes the minimum required configuration for EAP-TLS.



For EAP-SIM, it is possible to define the MCC/MNC values for the operator(s) as shown in the following screen:

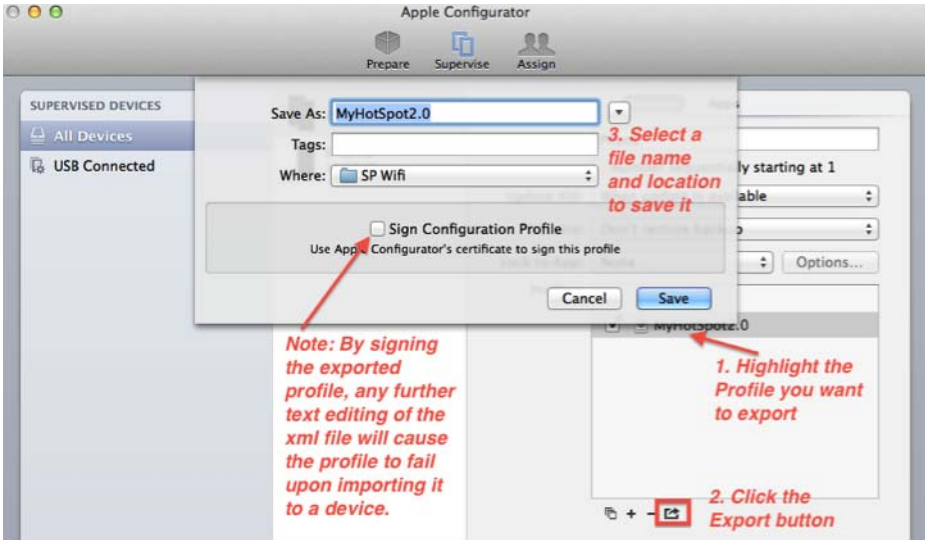


On the WLC, the MCC/MNC values are defined under the 3GPP CI as shown in the following screen:

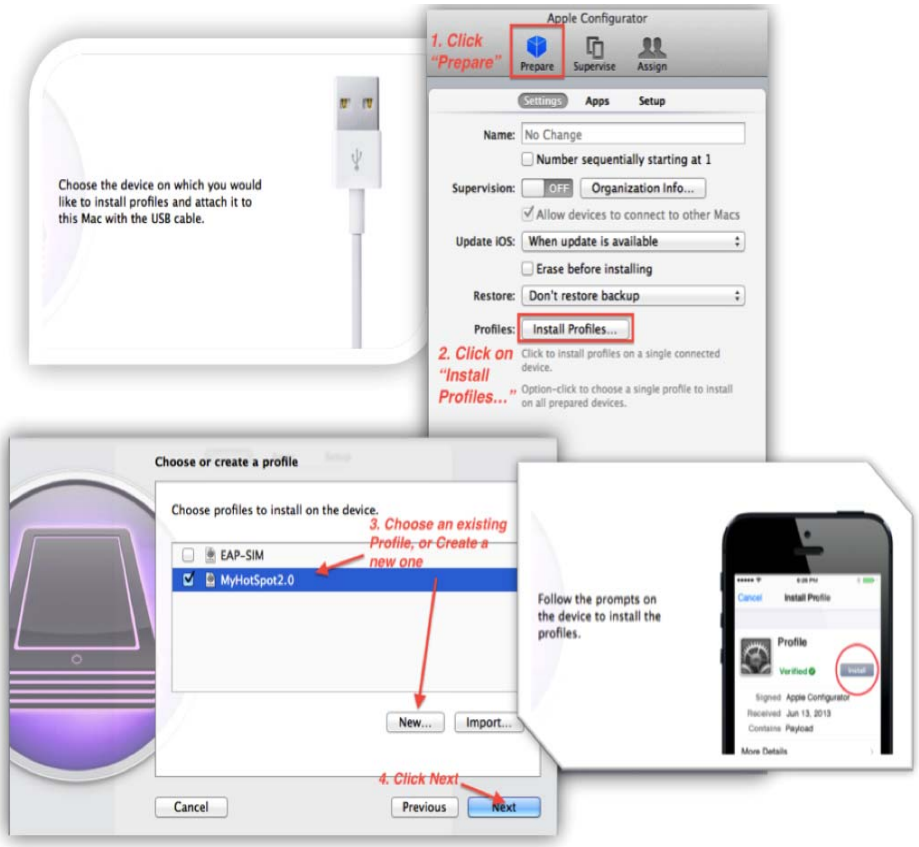


Finally, to import the Profile into the iPhone 5, you can use any of the five methods described earlier in this section. Two of the simplest methods available are via email or USB.

The following screenshot illustrates how to export the Profile created into an XML file, and then later email it to the device.

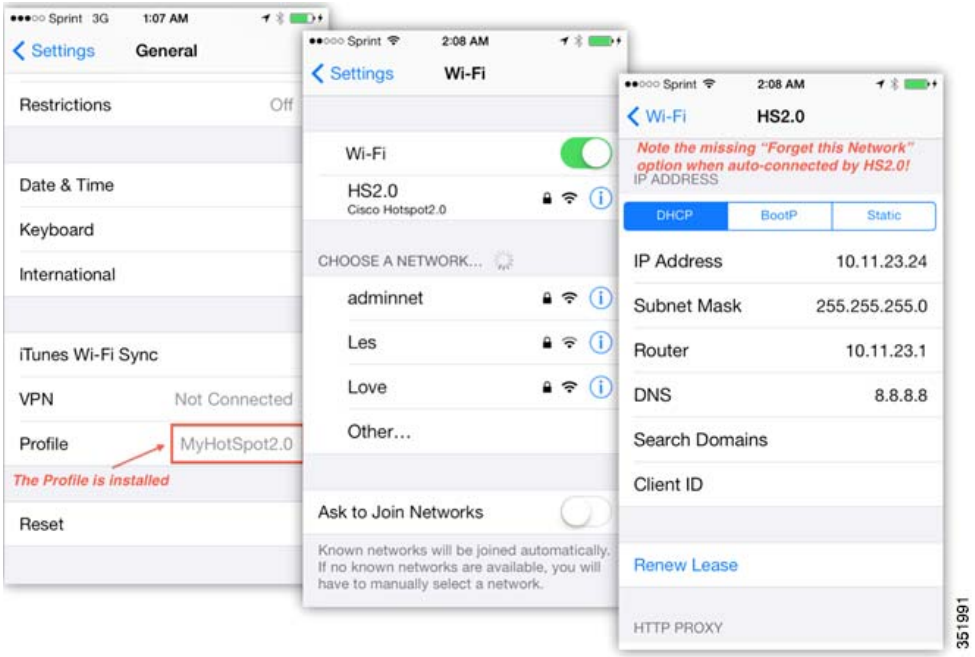


Below is an illustration of how to use a USB connection to push the Profile to an iPhone 5.



The imported Profiles on the device can be viewed from **Settings > General > Profile**. Once the Profile has been imported to the iPhone 5, and if no remembered user-defined Wi-Fi networks are in range, the general operation of an Apple device configured to auto join a HS2.0 wireless network is as follows:

1. The device performs an active scan.
2. BSSIDs with HS2.0 IE in the probe response are queried using ANQP.
3. The device compiles a list of the BSSIDs for which it has credentials, then it authenticates the best candidate based on home operator versus roaming partner (NAI, 3GPP, or Roaming OI).
4. Within each category the device will make a decision similar to non HS2.0 legacy networks based on the band and RSSI.



Note Unlike the Samsung implementation, the Apple device will not show a special icon indicating if the connection is to a home versus a roaming partner network. Furthermore, the only clues of the connection being connected via Hotspot 2.0 is the "Displayed Provider Name" message below the SSID, and lack of the "Forget the Wireless Network" option if the user displays the details of the connected WLAN.