

ESP Series Chips

WFA Certification and Test Guide



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Espressif Systems
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1. Overview

This guide provides instructions for obtaining WFA certificates for ESP series chips, along with QuickTrack for Espressif clients seeking certification for their products.

The firmware and test tool for ESP series chips can be downloaded from https://dl.espressif.com/Authentication/WFA/WFA_TEST.zip.

2. Introduction to WFA Certification

2.1. Certification Paths

Standard process of WFA certification is shown as follows

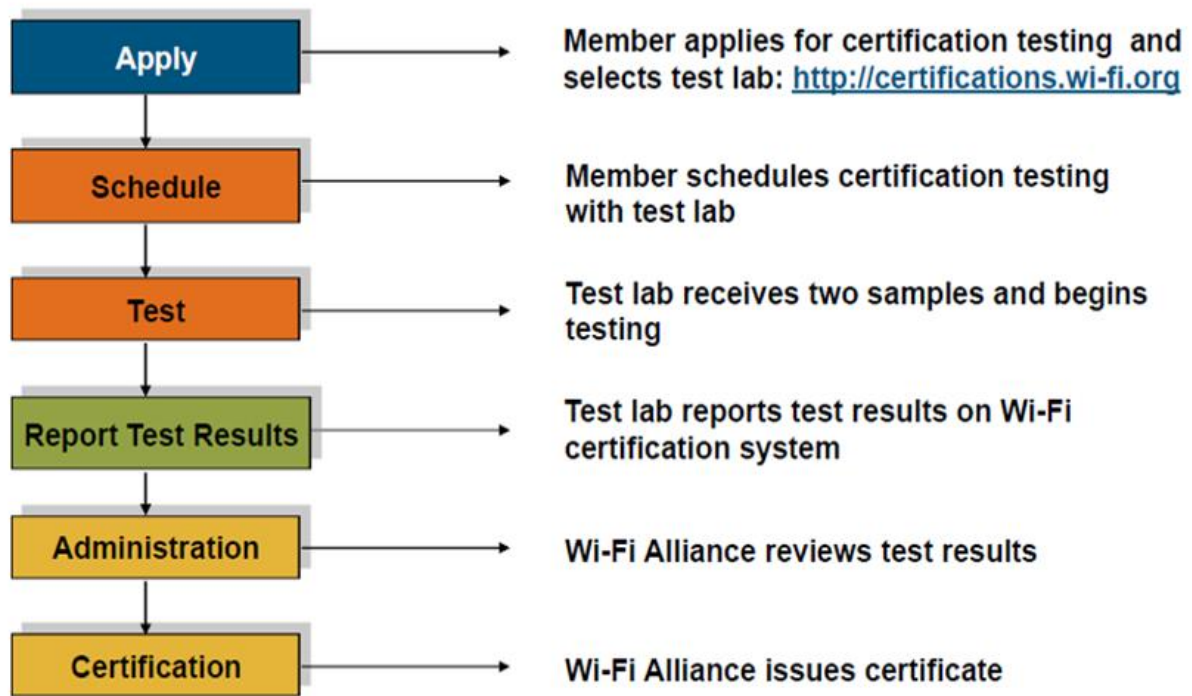


Figure 2-1 Standard process of WFA certification

1. Member submits a testing application to Wi-Fi Alliance and select an authorized test laboratory (ATL) to receive the certification identification number (CID)
2. Member coordinates with ATL to deliver device under test (DUT)
3. ATL performs tests
4. ATL issues test reports
5. Wi-Fi Alliance issues certificates

2.2. Certification Options of Wi-Fi Alliance

1. New Certification

Choose this option if your products have not received Wi-Fi certification.

2. Additional Certification

Select this option if your products have been certified and you want to test new or updated features.

3. Re-Certification

Contributors, sponsors, affiliate members, implements are not eligible for this option. Only members are permitted to apply for re-certification of their existing Wi-Fi certified products. If there have been changes to the firmware or software of a previously Wi-Fi CERTIFIED product, re-certification is necessary. Firmware or software changes encompass the following three scenarios:

- The hardware modifications (with minimal impact) and/or software modifications (operating system or drivers) that affect Wi-Fi operations
- Changes in firmware or minor software adjustments that impact Wi-Fi functionality (inclusive of minor updates and bug fixes, but excluding operating system or drive updates)
- Changes that do not affect Wi-Fi operations will be evaluated by ATL to determine the necessity of testing

4. Derivative Certification

- Membership
All members are eligible to apply for derivative certification.
- Requirements
 - a. This option is based on source certification only, not other derivative product certification.
 - b. Derivative products shall be functionally identical to the source products.
 - c. Members shall provide necessary technical information for derivative products or source certified products to validate certification conformity of derivative products.
- Module requirements
 - a. A tested and Wi-Fi certified module should accurately represent its modular application in both primary and subsequent derivative products.
 - b. Source certification of a Wi-Fi module is exclusively applicable to the module itself and does not extend to the primary derivative products.
 - c. A Wi-Fi module designed for testing may be considered as a derivative product and certified as a primary derivative. Subsequent derivative products may be certified as derivative products if they meet requirements for derivative product certification.

2.3. What Products Should be Wi-Fi Certified?

Wi-Fi Alliance Certification is applicable to products that operate in the Wi-Fi 802.11a/b/g/n modes, which commonly span the 2.4 GHz UHF or 5 GHz SHF ISM frequency bands. The certification

encompasses an array of products, ranging from wireless routers, smartphones, home appliance, computers, network infrastructure, and consumer electronics.

3. Certification for ESP Series Products

3.1. Certification Schemes

- ESP series modules adopt the New Certification scheme for their certification process.
- For clients using ESP series chips, it is recommended to use the QuickTrack scheme.

The relationship between the two schemes is as follows:

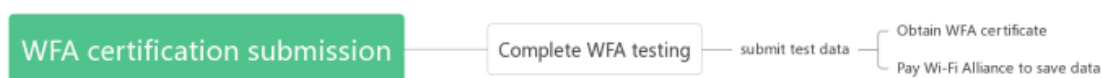


Figure 3-1 New Certification and QuickTrack

When a new ESP series module has passed New Certification testing, Espressif undertakes the payment to Wi-Fi Alliance for preserving the test data and generate qualified solutions. Consequently, Espressif clients gain the flexibility to select this solution and apply the QuickTrack scheme.

3.2. Introduction to New Certification for ESP Series Modules

The test items for ESP series modules are shown in Figure 3-2.

WFA test includes two parts, WTS and QTT. WTS test includes test items related to sigma tool, and QTT test covers the test items related to QuickTrack tool. They contain some of the same test items, but the specific test cases are different.

3.3. Introduction to QuickTrack

QuickTrack is a new Wi-Fi certification scheme.

As one of three new certification schemes introduced by Wi-Fi Alliance, QuickTrack aims at the products built on Qualified Solutions. In other words, for products designed based on modules and chipsets that have already passed prerequisite tests or other solutions, Wi-Fi Alliance will make it easier to certify them, thereby reducing test cost as well as certification cost and time.

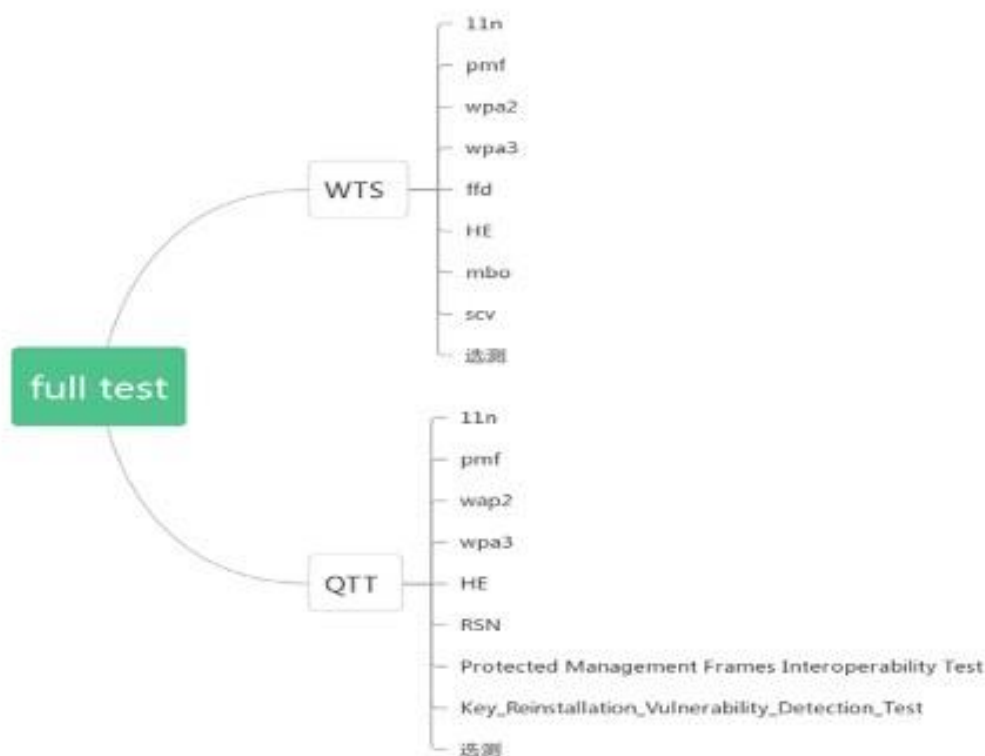


Figure 3-2 Test items of full-test

Specifically, a company should select a component or solution that meet its requirements and design among multiple alternative qualified solutions to build the product, and then complete a conformance test between the product and the selected solution to ensure that the component or solution used in the product is indeed a qualified solution. Then the company can conduct the test itself or through an authorized laboratory and submit the test result to the certification system. During the test, the company can set up the test environment using the hardware and software testing tools provided by Wi-Fi Alliance. After the test result has been confirmed by Wi-Fi Alliance, the product can be Wi-Fi CERTIFIED.

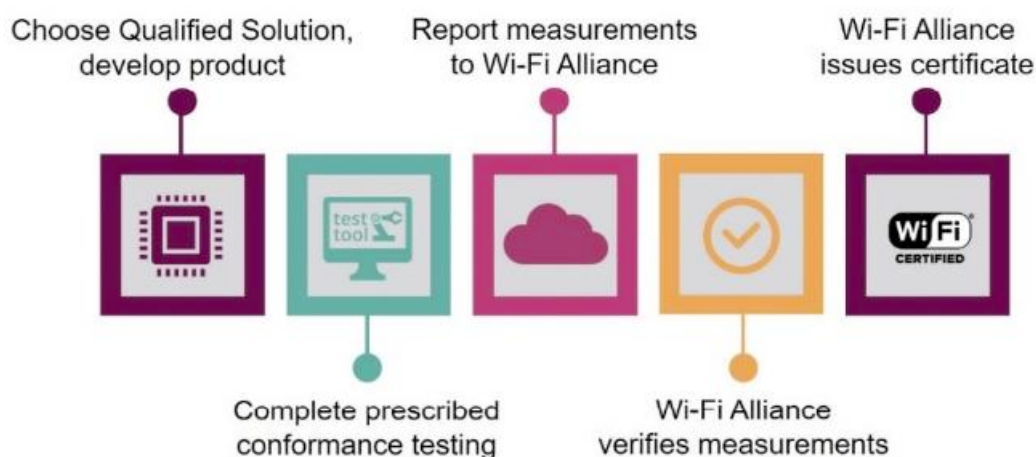


Figure 3-3 QuickTrack certification process summary

3.4. Advantages of QuickTrack

The QuickTrack scheme is featured by reducing test cost, certification cost, and test time, so that product can pass WFA certification more quickly.

We will explain it in detail with ESP32-C2 as an example.

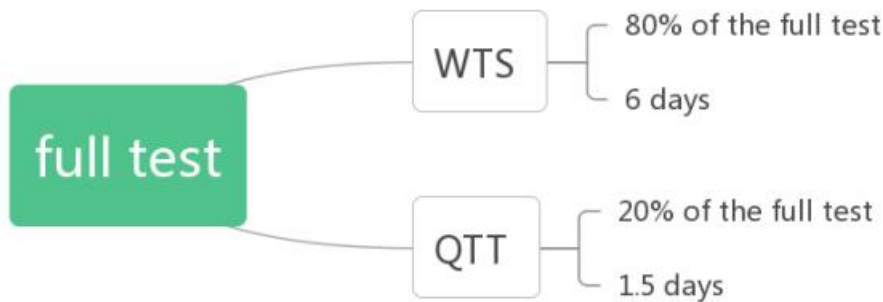


Figure 3-4 Test time of full-test

The full test for ESP32-C2 module takes about 7.5 days.

If customers of the ESP32-C2 modules select the QuickTrack scheme, first they need to confirm the following product information:

Wireless Chipset ESP32-C2	Wi-Fi Component Operating System Free RTOS		
Wi-Fi Component Firmware Version A	Physical Interface UART		
Driver V7.0	RF Components RF matching, RF switch connector		
	Antenna PCB Antenna		
RF Architecture			
Bands Supported 2.4 GHz	<table><tr><td>Transmit (Tx) 1</td><td>Receive (Rx) 1</td></tr></table>	Transmit (Tx) 1	Receive (Rx) 1
Transmit (Tx) 1	Receive (Rx) 1		

Figure 3-5 Product information

- If the product information is same with that of ESP32-C2 without any changes, the product does not need to do any testing. The company can get the certification after paying fees.
- If the product information is different from ESP32-C2, the product only needs to pass the QTT test and does not need to perform the WTS test. It only takes 1.5 days for the product to complete certification.

The comparison between the QuickTrack scheme and the normal scheme is shown as follows.

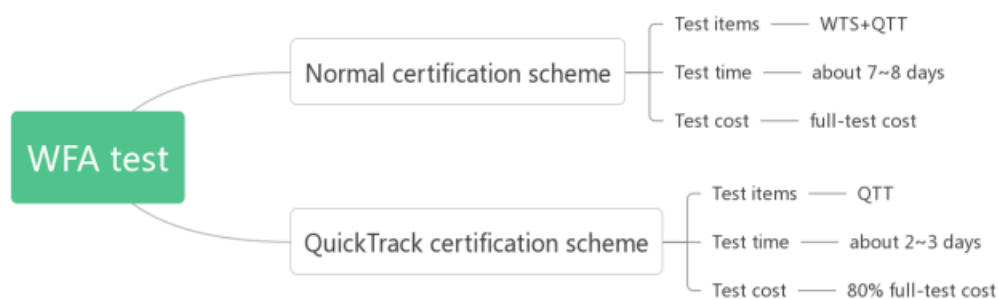


Figure 3-6 Comparison between normal scheme and QuickTrack

Note: The test time here is not the completion time of WFA certification, but the time only for testing itself, which depends on the laboratory schedule. The time required by a whole WFA certification has been stated in subsection 2.1. For ESP32-C2, it takes 40 days to finish the WFA certification (the normal scheme), whereas it takes only 10 days for the QuickTrack scheme, saving about 70% time.

3.5. Status of QuickTrack Scheme for ESP series chips

Currently, ESP32-C2 and ESP32-C6 can adopt the QuickTrack scheme for WFA certification.

4. WFA Test

4.1. Filling in CID Information

You can fill in the test information according to your own requirements by referring to the [guidance](#) on CID provided by Wi-Fi Alliance or [CID guidance](#) related to ESP series modules.

4.2. Flashing Firmware

4.2.1 Windows System

1. ESP32 Series Chips

- Open flash_download_tool_3.9.2.exe.
- Select “ESP32” for chipType, and select “develop” for workMode, and then click OK.
- Select the firmware, fill in the flash position, select the port number, set baud rate to 115200, and then click START to start flashing.

Locations of firmware:

- bootloader.bin 0x1000
- espsigma.bin 0x10000
- partition.bin 0x8000

2. ESP32-C3, ESP32-C2, ESP32-C6

- Open flash_download_tool_3.9.2.exe.
- Select the desired chip name (ESPXX) for chipType, select “develop” for workMode, and then click OK.
- Select the firmware, fill in the flash position, select the port number, set baud rate to 115200, and then click START to start flashing.

Locations of firmware:

- bootloader.bin 0x0
- espsigma.bin 0x10000
- partition.bin 0x8000

After flashing the firmware, you can see “finish” on the webpage.

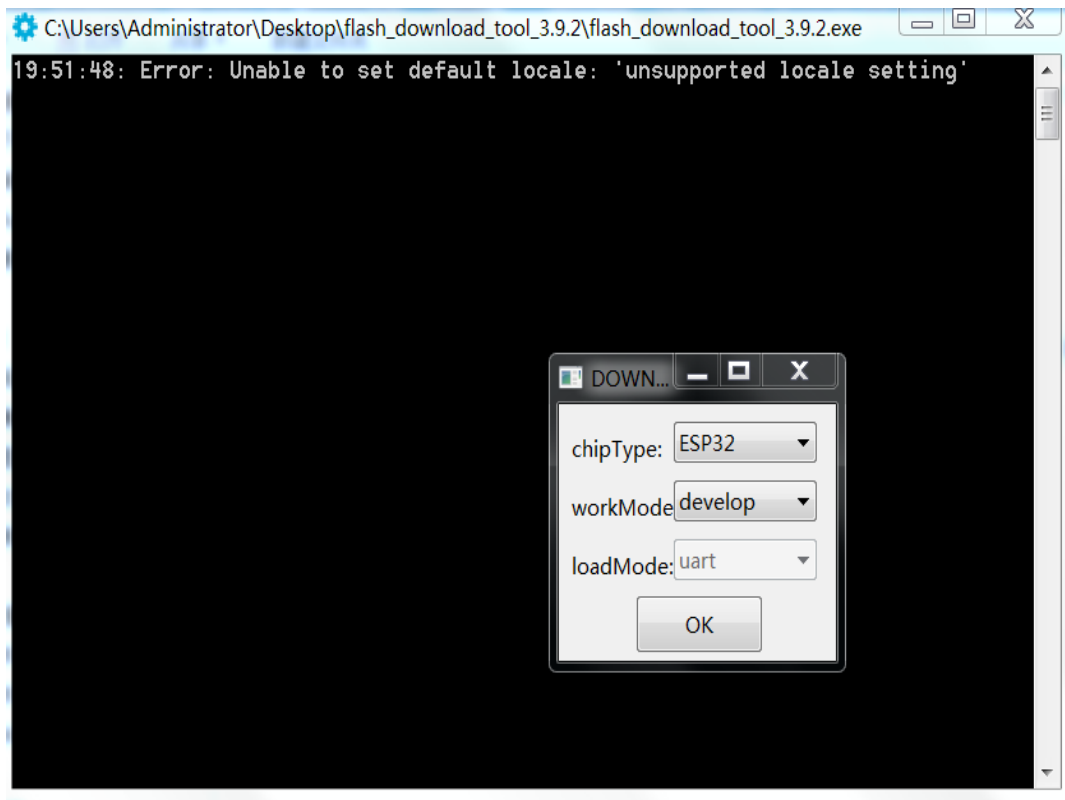


Figure 4-1 Flash configuration

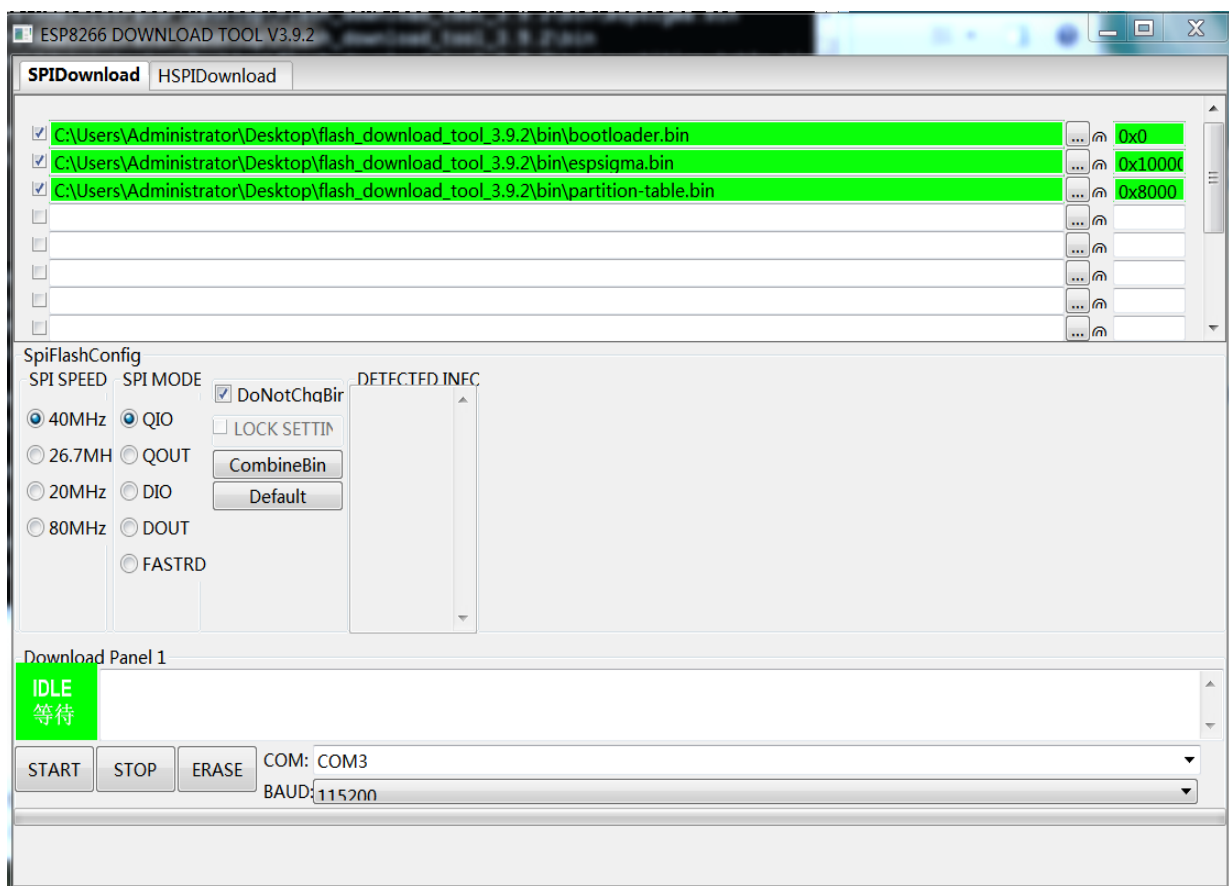


Figure 4-2 Flashing firmware

4.2.2 Ubuntu

- Install python3.7

```
cd espsigma_qt/espsigma
./tools/setup/setup_pyenv_python.sh
source ~/.pyenv/activate
```

- Install flash tool

```
pip install esptool
```

- Flash firmware

```
esptool.py -p /dev/ttyUSB0 --chip=auto write_flash 0x0 bootloader.bin 0x8000 partition-
table.bin 0x10000 espsigma.bin
```

Note: 0x0 bootloader.bin 0x8000 partition-table.bin 0x10000 espsigma.bin You need to fill in the information based on your chip type and firmware location.

4.3. Configure Environment

1. The test computer should be installed with Ubuntu 16.04 or newer version
2. Install Python3.7

```
cd espsigma_qt/espsigma
./tools/setup/setup_pyenv_python.sh
source ~/.pyenv/activate
```

After installing it, input “python -v” to check the Python version.

4.4. Test

1. WTS Test
 - Open Command Prompt

```
cd /espsigma_qt/espsigma/esp_sigma_ca
```

- Input the following command

```
python espsigma.py --dut /dev/ttyUSB*
```

Note: * indicates the serial port number.

```
→ esp_sigma_ca git:(merging_c6_ax_changes) ✗ python esp_sigma.py --dut /dev/ttyUSB1 -v
[scmd] version
[console] version
IDF Version:v5.2-dev-151-g9cfc9757b9-dirty
Chip info:
  model:Unknown
  cores:1
  feature:/802.11bgn/BLE/External-Flash:2 MB
  revision number:0
esp_sigma>
esp_sigma>
Got Response for version as version
IDF Version:v5.2-dev-151-g9cfc9757b9-dirty
Chip info:
  model:Unknown
  cores:1
  feature:/802.11bgn/BLE/External-Flash:2 MB
  revision number:0
esp_sigma>
esp_sigma>
[lcmd] git rev-parse --abbrev-ref HEAD
[resp] merging_c6_ax_changes

[lcmd] git rev-parse HEAD
[resp] 8e7cf533396db323e92cb835ba8055f3bd1d55bc

[scmd] settime 1685098860
[console] settime 1685098860
set time: 0
esp_sigma>
esp_sigma>
Got Response for settime 1685098860 as settime 1685098860
set time: 0
esp_sigma>
esp_sigma>

System Time set to : 2023-05-26 11:01:00.053476
[scmd] set_prog --program any
[console] set_prog --program any
I (4797) wifi:ifx:0, phymode(new:0x3, nvs:0x5)
cmd_wifi.c set_prog: Sta set BW to 40 Mhz
esp_sigma>
esp_sigma>
Got Response for set_prog --program any as set_prog --program any
I (4797) wifi:ifx:0, phymode(new:0x3, nvs:0x5)
cmd_wifi.c set_prog: Sta set BW to 40 Mhz
esp_sigma>
esp_sigma>
*****
Espressif Wi-Fi Alliance Sigma DUT Agent

WFA PROGRAM      : WPA3
DUT PORT         : /dev/ttyUSB0
IDF Version      : v5.2-dev-151-g9cfc9757b9-dirty
SIGMA CA         : merging_c6_ax_changes (8e7cf53)
```

Figure 4-3 WTS test

2. QuickTrack Test

- Open Command Prompt

```
cd /esp_sigma_qt/esp_sigma/esp_sigma_ca
```

- Input the following command

```
python esp_sigma.py --quicktrack --dut/dev/ttyUSB*
```

Note: * indicates the series port number.

```

test@FA000610: ~/espc6 x test@FA000610: ~/espc6 x test@FA000610: ~ x
→ esp_sigma_ca git:(merging_c6_ax_changes) X python3 espsigma.py --quicktrack --dut /dev/ttyUSB0 -v
[scmd] version
[console] version
IDF Version:v5.2-dev-151-g9cfc9757b9-dirty
Chip info:
    model:Unknown
    cores:1
    feature:/802.11bgn/BLE/External-Flash:2 MB
    revision number:0
espsigma>
espsigma>
Got Response for version as version
IDF Version:v5.2-dev-151-g9cfc9757b9-dirty
Chip info:
    model:Unknown
    cores:1
    feature:/802.11bgn/BLE/External-Flash:2 MB
    revision number:0
espsigma>
espsigma>
[lcmd] git rev-parse --abbrev-ref HEAD
[resp] merging_c6_ax_changes

[lcmd] git rev-parse HEAD
[resp] c097929210d94c2bc502293f052f98e8ffef827

[scmd] settime 1675189801
[console] settime 1675189801
set time: 0
espsigma>
espsigma>
Got Response for settime 1675189801 as settime 1675189801
set time: 0
espsigma>
espsigma>

System Time set to : 2023-01-31 18:30:01
Terminal prog --program any
[console] set_prog --program any
I (97658) wifi:ifx:0, phymode(new:0x3, nvs:0x5)
cmd_wifi.c set_prog: Sta set BW to 40 Mhz
espsigma>
espsigma>
Got Response for set_prog --program any as set_prog --program any
I (97658) wifi:ifx:0, phymode(new:0x3, nvs:0x5)
cmd_wifi.c set_prog: Sta set BW to 40 Mhz
espsigma>
espsigma>
*****
Espressif Wi-Fi Alliance QuickTrack Test Tool Sigma DUT Agent

WFA PROGRAM      : WPA3
DUT PORT         : /dev/ttyUSB0
IDF Version      : v5.2-dev-151-g9cfc9757b9-dirty
SIGMA CA         : merging_c6_ax_changes (c097929)

*****
>Info: ESP Sigma listening at /tmp/socket_test.s

```

Figure 4-4 QuickTrack test-1

- Open another Command Prompt

```
cd /espsigma_qt/controlappc-2.0.0.9
```

- Input the following command

```
./app -p*
```

Note: * indicates the QTT port, for example, 9005

```

→ espigma_qt git:(merging_c6_ax_changes) X cd controlappc-2.0.0.9
→ controlappc-2.0.0.9 git:(merging_c6_ax_changes) X ./app -p 9004
Welcome to use QuickTrack Control App DUT version 2.1.0.42.

Use default interface parameters 2:wlan0,2:wlan1,5:wlan0,5:wlan1.

wlans_bridge = br-wlans.
Jun 06 15:59:34 controlappc. info QuickTrack control app running at: 9004
Jun 06 15:59:34 controlappc. info Wireless Interface:
Jun 06 15:59:34 controlappc. info interface_count=4
Jun 06 15:59:34 controlappc. info Interface Name: wlan0, Band: 2.4GHz, identifier -1
Jun 06 15:59:34 controlappc. info Interface Name: wlan1, Band: 2.4GHz, identifier -1
Jun 06 15:59:34 controlappc. info Interface Name: wlan0, Band: 5GHz, identifier -1
Jun 06 15:59:34 controlappc. info Interface Name: wlan1, Band: 5GHz, identifier -1
Jun 06 15:59:34 controlappc. info hostapd Path: /usr/local/bin/WFA-Hostapd-Supplicant/hostapd (hostapd)
Jun 06 15:59:34 controlappc. info wpa_supplicant Path: /usr/local/bin/WFA-Hostapd-Supplicant/wpa_supplicant (wpa_supplicant)
Jun 06 15:59:34 controlappc. info Hostapd Global Control Interface: /var/run/hostapd-global
Jun 06 15:59:34 controlappc. info Hostapd Control Interface: /var/run/hostapd/wlan0
Jun 06 15:59:34 controlappc. info WPA Supplicant Control Interface: /tmp/socket_test.s
^CJun 06 19:02:54 controlappc. info Signal 2 received - terminating

```

Figure 4-5 QuickTrack test-2

Refer to following figures when setting QuickTrack configurations.

Settings	Test Setup Configuration	Test Case Global Configuration	Test Case Specific Configuration	Advanced Configuration
Settings	Tool Mode	Pre-Certification		
Certification Configuration	Band Selection	2.4GHz		
Test Cases	6 GHz Band Support	False		
Help/Info	Debug Log Level	BASIC		
	U-NII-2 Band Support	False		
	2.4 GHz Channel Preferred	6		
	5 GHz Channel Preferred	36		
	6 GHz Channel Preferred	37		
	SSID *	QuickTrack		
	API Retry Count *	1		
	Data Packet Type	ICMP		

Figure 4-6 QuickTrack configuration-1

Settings	Test Setup Configuration	Test Case Global Configuration	Test Case Specific Configuration	Advanced Configuration
Settings	6 GHz Band Support	False		
Certification Configuration	Debug Log Level	BASIC		
Test Cases	U-NII-2 Band Support	False		
Help/Info	2.4 GHz Channel Preferred	6		
	5 GHz Channel Preferred	36		
	6 GHz Channel Preferred	37		
	SSID *	QuickTrack		
	API Retry Count *	1		
	Data Packet Type	ICMP		
	Packet Time Interval (seconds)*	1		
	Packet Payload Size (bytes)*	1000		
	Manual DUT Mode	False		

Figure 4-7 QuickTrack configuration-2

Pre-Certification mode testing

QuickTrack Test Tool
Version (2.1.0.42)

Test Setup Configuration | Test Case Global Configuration | **Test Case Specific Configuration** | Advanced Configuration

Settings
Certification Configuration
Test Cases
Help/Info

Test Case Specific

Role: Station

PHY Capabilities: Wi-Fi 4

Security Capabilities: WPA2-PMF, WPA3-Personal, RSN

- ☒ Trigger unicast protected disconnect from GUI
- ☒ PMK Caching support when disconnect triggered from STAUT
- ☐ Support WEP default key 0 simultaneously with a pairwise key in a TSN network
- ☐ Support Joint Multi-band RSN
- ☐ Support PeerKey handshake
- ☐ Support signaling and payload protected (SPP) A-MSDU's transmission and reception
- ☐ Only allow SPP A-MSDU's transmission and reception
- ☐ Support protected block ack agreement capability (PBAC)
- ☐ Support Extended Key ID for individually addressed frames

Figure 4-8 QuickTrack configuration-3

Pre-Certification mode testing

QuickTrack Test Tool
Version (2.1.0.42)

Test Setup Configuration | Test Case Global Configuration | Test Case Specific Configuration | **Advanced Configuration**

Settings
Certification Configuration
Test Cases
Help/Info

Advanced Configuration

- ☐ Support protected WUR
- ☐ Support secure LTF
- Require MFP for preassociation ranging: No
- ☐ Support protected block ack agreement capability (PBAC) as defined after 802.11-2020
- ☐ Support signaling and payload protected (SPP) A-MSDU transmission and reception as defined after 802.11-2020
- WPA3 Supported DH Groups: 19

Additional Capabilities:

Enterprise

Authentication Server(AAA) IP Address: 127.0.0.1

EAP-Method: EAP_TLS

► STA configurations

► Certificate path

Figure 4-9 QuickTrack configuration-4

Pre-Certification mode testing

QuickTrack Test Tool
Version (2.1.0.42)

Test Setup Configuration | Test Case Global Configuration | Test Case Specific Configuration | **Advanced Configuration**

Settings
Certification Configuration
Test Cases
Help/Info

Advanced Configuration

Command Timeout (seconds)*: 30

Script Timeout (seconds)*: 500

Capture Frame Timeout (seconds)*: 15

STA Complete Connection Timeout (seconds)*: 30

► API command timeout

Figure 4-10 QuickTrack configuration-5

Note: The Python version should be 3.7 or newer. Install and activate Python 3.7 if your version does not satisfy the requirement.

4.5. Common Issues

1. How can I get the USB port number?

You can get it by inputting “ls /dev/ttyUSB*” in the command line.

2. How can I get the MAC address of the DUT?

- Enter minicom and operate the command “minicom -D /dev/ttyUSB*”
- Input the command “query”, and the printed dut_mac is the MAC address of the DUT.

3. How can I flash enterprise certificate?

The certificate has been included in the firmware and you do not need to flash it.

4. Why is the tool not starting?

Please check the Python version and ensure the toolchain is complete.

5. Why is the tool script unable to monitor UCC command after being started?

Please ensure that the IP address is correctly configured on the computer.

6. What steps should be taken if the DUT displays garbled content and is unresponsive to read or write operations?

Please verify whether the DUT has been flashed with the appropriate bin files and ensure that the power supply is functioning normally.

4.6. Test Data

After completing the test, ATL will store the test data and submit it to Wi-Fi Alliance. Following a thorough review of the data, the product can obtain the WFA certification.

If your test fails and you need to debug, please provide the test log, which should include UCC, DUT, and sniffer details. The path to dut_log is “espesigma_qt/espsigma/esp_sigma_ca/logs”.

Revision History

Date	Version	Release Notes
2023.08	v1.0	Initial release



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