

# Zebra FTM Wi-fi Location



**ZEBRA**

## **Best Practices Guide**

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## Revision History

**Table 1** Revisions

Change	Date	Description
-01EN Rev. A	12-9-2020	Initial Release
-02EN Rev. A	3/2021	Updates to Best Practices Device Configuration chapter, add Common Recommendations and Aruba Recommendations chapters.

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# About This Document

## Introduction

This guide provides information about best practices for Fine Timing Measurement (FTM). It provides information about the recommended device configuration, AP configuration, product default configuration settings and recommended FTM deployments. This document provides the usage of the location APIs and a sample code snippet that enables the customer to use Zebra Location services.



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## Chapter Descriptions

Topics covered in this guide are as follows:

- [Overview](#) provides an overview of Fine Timing Measurement (FTM) - Wi-Fi Round Trip Time (RTT).
- [Best Practices Device Configuration](#) provides information on infrastructure configuration.

## Notational Conventions

The following conventions are used in this document:

- **Bold** text is used to highlight the following:
  - Dialog box, window and screen names
  - Drop-down list and list box names
  - Check box and radio button names
  - Icons on a screen
  - Key names on a keypad
  - Button names on a screen.
- Bullets (•) indicate:
  - Action items
  - Lists of alternatives
  - Lists of required steps that are not necessarily sequential.
- Sequential lists (such as those that describe step-by-step procedures) appear as numbered lists.

### Icon Conventions

The documentation set is designed to give the reader more visual clues. The following graphic icons are used throughout the documentation set. These icons and their associated meanings are described below.



**NOTE:** The text here indicates information that is supplemental for the user to know and that is not required to complete a task.



**IMPORTANT:** The text here indicates information that is important for the user to know.



**CAUTION:** If the precaution is not heeded, the user could receive minor or moderate injury.



**WARNING:** If danger is not avoided, the user CAN be seriously injured or killed.

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- Model number or product name
- Software/firmware type or version number

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# Overview

Fine Timing Measurement (FTM), mostly known as Wi-Fi Round Trip Time (RTT) is a time-based measurement protocol (80211mc) to measure the distance between Wi-Fi Access Point (AP) and a device within 1 to 2 meters of accuracy. Once distances are measure between the device and multiple APs (with known location), the location of the device can be determined.

The FTM protocol defines a round trip time measurement procedure between an initiating and responding 802.11mc compatible entities. An Initiating entity such as the Client (also known as STA), called Initiator, sends the FTM request frame to the corresponding entity, such as an AP. The AP that supports the FTM procedure as a responding device, also called as Responder, starts sending the FTM Response frames to the Initiating Client STA. For better accuracy, the Client STA needs to send FTM Request frames to the set of APs. The ranging response of the APs are combined/averaged several frames to get a good reading.

## Scope

The scope of the document defines the location solution for indoor navigation by using FTM as a dedicated provider in Google Location Manager Service APIs. Zebra defines an additional parameter for accessing the device location using FTM. This document provides the API details and the parameters needed to access the FTM solution, as well as the recommended device configuration.

## Solution Goal

Currently, Android provides only base FTM protocol APIs exposed via Google Wi-Fi RTT service APIs. Location apps can use these APIs to get their distance from any Wi-Fi RTT Access Points. Android also provides Location Manager service and Fused Location service APIs to get location updates from providers like Network, Cellular, WLAN based on RSSI and Sensor data.

At present, Google has not incorporated FTM as a provider in either Location Manager / Fused Location services. The only way to get an indoor location using FTM is by using the low-level APIs exposed by Google in the Wi-Fi RTT service. But these RTT APIs will only give the device distance from the AP's and application needs to be further modified to incorporate location algorithm to locate the device within the floor area.

Due to the above limitations, Zebra enables a dedicated FTM provider called RTT provider which can be accessed via the Location Manager service APIs. Zebra customers can directly use the existing Google Location Manager service APIs and pass RTT as a provider to get dedicated indoor location updates using FTM 80211mc APs.

## Use Cases and Benefits

Using the Zebra Location Solution Customer can locate the device in the RTT enabled AP environment and be able to perform indoor navigation.



## Supported Products and Default Configuration

### Supported Product List with Android 10 or Later

- PS20
- TC52/TC52HC
- TC57
- TC72
- TC77
- MC93
- TC8300
- VC8300
- EC30
- ET51
- ET56
- L10
- CC600/CC6000
- MC3300x
- MC330x
- TC52x
- TC57x
- EC50 (LAN and HC)
- EC55 (WAN)
- WT6300

### Product Default FTM Configuration

- FTM feature is enabled by default.
- Zebra Location Service is enabled by default.
- FTM Infrastructure Deployment is set to Standard Mode where AP supports inbuilt 11mc.
- FTM AP source is set to use Location XML.
- FTM XML file Deployment path - default set to /sdcard path.



**NOTE:** Use FileMgr CSP to place the file in the sdcard path (see [Deploying XML Using FileMgr CSP](#)). If the new path is chosen (within sdcard path) then replace the default path with new path.

# Best Practices Device Configuration

**Table 2** Default, Supported and Recommended FTM Location Settings

Feature	Default Configuration	Supported Configuration	Recommended for FTM Location
11k	Enabled	<ul style="list-style-type: none"><li>• Enable</li><li>• Disable</li></ul>	As default
Location	Enabled	<ul style="list-style-type: none"><li>• Enable</li><li>• Disable</li></ul>	As default
Wi-Fi Scanning	Enabled	<ul style="list-style-type: none"><li>• Enable</li><li>• Disable</li></ul>	As default
11ac	Enabled	<ul style="list-style-type: none"><li>• Enable</li><li>• Disable</li></ul>	As default
Zebra Location Service	Enabled	<ul style="list-style-type: none"><li>• Enable</li><li>• Disable</li></ul>	As default

## Sample Code Sequence

### Android Location Manager API List

- Public void requestLocationUpdates (String provider, long minTime, float minDistance, LocationListener listener)  
Provider: The name of the provider with which to register. This value must never be null.  
minTime: Minimum time interval between location updates, in milliseconds.  
minDistance: Minimum distance between location updates, in meters.  
Listener: A LocationListener whose LocationListener#onLocationChanged method will be called for each location update This value must never be null.
- Public void removeUpdates (LocationListener listener): Removes all location updates for the specified LocationListener.
- Public Location getLastKnownLocation (String provider): Returns a Location indicating the data from the last known location fix obtained from the given provider.

## Application Code Snippet

- The application gets the location manager object using an Android existing API.

```
LocationManager manager = (LocationManager) getSystemService(LOCATION_SERVICE).
```

To request location updates using RTT as provider.

```
manager.requestLocationUpdates("rtt", 5000, 1, listener);
```

By default, Android provides two providers – GPS and Network provider. Zebra enables a dedicated FTM provider called RTT provider which can be accessed via Location Manager service API's. Android provides API to query the list of providers supported. Application developers can use the API to get the list of providers supported in the product. [getAllProviders].

- Here, the Listener is Android's existing listener named LocationListener.

```
LocationListener listener = new LocationListener()
{
    @Override
    public void onLocationChanged(Location location) { location.getLongitude();
location.getLatitude(); }
}
```

- Applications get notifications about location updates via LocationListener (Android's existing).
- To get the last known location, one should use the below Android's existing API:
- Location loc = manager.getLastKnownLocation("provider name"); (Argument is the provider name, in our case RTT)

## FTM Configuration with Tools Supporting Zebra MX

This section describes available FTM configuration options with using Zebra Mobility Extensions (MX) based tools. For example; a centralized Device Management or Enterprise Mobility Management system already integrated with MX Configuration Service Packages (CSPs), staging tools such as Zebra's StageNow, or other on-device agents and applications which may have privileged access to the MX framework.

The tool used for the FTM configuration option must have an MX version of 10.2 or above.

For more information, refer to the following links for MX/CSP information, and the specific FTM option in this chapter:

- [techdocs.zebra.com/](http://techdocs.zebra.com/)
- [techdocs.zebra.com/mx/wifi/](http://techdocs.zebra.com/mx/wifi/)

During FTM trial staging and testing, it is convenient to use the Zebra's StageNow tool and deploy configuration directly to trial devices, with a scanned-barcode or other StageNow methods.

StageNow version 5.0 is required. It includes the required MX 10.2.

Download StageNow at: [techdocs.zebra.com/stagenow](http://techdocs.zebra.com/stagenow)

## Configuration Options

- **FTMEnable:** Select whether to Enable/Disable Zebra Location service (Value Add). This setting applies only to products that have FTM Feature Enabled by default.
  - **Enable:** Enables Zebra Location service

- **Disable (Default):** Disables Zebra Location service (which means a user can only get base RTT functionality provided by Google).
- **FTMDeployment\_Mode:** Select Fine Timing Measurement (FTM) Deployment Mode. Supported modes include Standard (AP Supports inbuilt FTM feature) and Enhanced Infra (Infra needs an additional FTM AP to support indoor location).
  - **Standard (FTM-Enabled):** Choose Standard mode for Enterprise Wireless Deployment where the controller-based Infrastructure APs have an inbuilt 80211mc functionality that enables the location functionality.
  - **Enhanced-Infra (FTM Enabled):** Choose Enhanced mode if the deployment needs an additional 80211mc APs for enabling location solution. In this case, the primary AP network that the device is connecting to does not have built-in 11mc support, and a different set of APs support 11mc.
  - **Standard (FTM-enabled)** is the default configuration when FTMEable is set to Enable.
- **FTM AP Source:** For getting the position of the device within the floor, Zebra Location Service needs to know the 11mc AP's location coordinates. The location of AP can be in WGS format (GPS) which is part of LCI and LCR IE frames / in user-specific format (meters/feet) which is hard-coded in the XML file.

Supported Modes are Location via XML & Location via AP (LCI, LCR).

- **Location XML:** Choose this option if AP cannot broadcast its location coordinates. Admin must manually enter all the 11mc AP's coordinates in an XML file. [AP location is calculated from a reference point in the floor] The sample XML file is provided at the end of this section.

Selecting this option will enable the FTM Deployment File option for the user to enter the Floor XML path.



**NOTE:** The floor map XML file needs to be pushed in the device SDcard path using FileMgr CSP (see [Deploying XML Using FileMgr CSP](#)).

- **The location from API (LCR/LCI):** Choose this option if APs can broadcast its coordinates LCI and LCR information as part of 80211mc frames.
- Location XML is the default configuration when FTMEable is set to Enable.
- **FTMDeployment\_File:** This option is available only if the Location XML option is chosen from the FTM AP source configuration. Once the FTM deployment file is pushed through FileMgr CSP to the device in the SDcard path, the same path must be specified. (See [Deploying XML Using FileMgr CSP](#).)

## Deploying XML Using FileMgr CSP

The File Manager (FileMgr) allows an application to manage files on the device. In this case, the use for FTM is to copy the XML file from local or remote locations to the device.

1. File Action: Select Transfer/Copy File.
2. Target Path and File Name: Enter the full path of the file to be located on the device.

Example: /sdcard/FloorMap.xml

3. Source Path and File Name: Enter the details of the file to push to device.

Example: C:\Users\Username\Downloads\FloorMap.xml

4. Click Continue to finish the process and generate a barcode.
5. Click Complete profile. Select the type of barcode and click Test to view the barcode in a pdf.

## Sample XML File Format

```
<?xml version='1.0' encoding='UTF-8' standalone='yes'?>
<FloorInfo>
<floor>
<Id>1</Id>                                <!-- Id represent the floor Number -->
<DeviceHeight>0.9144</DeviceHeight><!-- DeviceHeight represent the device height(in mts) -->
                                        <!-- from the ground level-->

<AP>
<MAC>1c:f2:9a:97:fd:aa</MAC>              <!-- FTM AP BSSID info-->
<XYZ>24.1,21,4</XYZ>                      <!-- AP (x,y,z) coordinates (in meters) -->
</AP>
<AP>
<MAC>1c:f2:9a:97:ff:f1</MAC>
<XYZ>1.9,21,1.5</XYZ>
</AP>
</floor>
<floor>
<Id>2</Id>
<DeviceHeight>0.9144</DeviceHeight>
<AP>
<MAC>b0:2a:43:dd:6c:17</MAC>
<XYZ>26.95,1.5,3.2</XYZ>
</AP>
<AP>
<MAC>3C:28:6D:C9:3C:E1</MAC>
<XYZ>0,0.9,4.5</XYZ>
</AP>
</floor>
</FloorInfo>
```

## Configure Various FTM Deployments

### Configure FTM for Standard Mode of Deployment (XML Method)

#### Prerequisites

- The product supports FTM feature.
- Infrastructure AP has an inbuilt 11mc feature and the feature is Enabled.
- Preference is 11k and 11ac enabled in the infrastructure (see [Common Recommendations for Infrastructure to Support FTM](#)).
- XML file containing 11mc APs BSSID and its corresponding x, y coordinate related to the floor map.

#### Configuration

To configure FTM for Standard Mode of Deployment (XML method):

1. Select **FTM Enable** for enabling Zebra Location Service which helps to locate the device within the floor.
2. Select **Standard (FTM Enabled)** from FTM Deployment Mode option. Ensure that 11k and 11ac is enabled in the device and infra.
3. Select the AP coordinate source. Select option **Location XML**.

4. After selecting Location XML, push the XML file. The XML file (for example, floormap.xml) should have all 11mc APs BSSID and its x, y coordinates hard coded in the file (see [Sample XML File Format](#)).  
The admin must push the XML file on to the device to sdcard path using **FileMgr CSP** (see [Deploying XML Using FileMgr CSP](#)).
5. Specify the XML file path in the **FTM Deployment file** (device sdcard path).  
Deploy the above configuration using StageNow. The device is ready for indoor navigation.
6. See the [Application Code Snippet](#) and modify the location application by using the Android Location Manager API to get location updates.

### Configure FTM for Standard Mode of Deployment (LCI/LCR Method)

#### Prerequisites

- The product supports FTM feature.
- Infrastructure AP has an inbuilt 11mc feature and the feature is enabled.
- Preference is 11k and 11ac enabled in the infrastructure (see [Common Recommendations for Infrastructure to Support FTM](#)).
- Infrastructure AP should have LCI and LCR configurable and broadcast the same in FTM action frames.

#### Configuration

To configure FTM for Standard Mode of Deployment (LCI/LCR method):

1. Select FTM Enable for enabling Zebra Location Service which helps to locate the device within the floor.
2. Select Standard (FTM Enabled) from FTM Deployment Mode option. Ensure that 11k and 11ac is enabled in the device and infra.
3. Select Location from AP option (AP is capable of configuring LCI, LCR parameters and able to broadcast as part of FTM Action frames).  
Deploy the above configuration using StageNow. The device is ready for indoor navigation.
4. See the [Application Code Snippet](#) and modify the location application by using the Android Location Manager API to get location updates.

### Configure FTM for Enhanced Infra Mode of Deployment

Enhanced Infra Mode means that the AP network that the device is connecting to might not have a built-in 11mc capability, and the deployment is enhancing the infrastructure with separate set of AP network supporting 11mc, which the device is not connecting to.

In this case, if the Enhanced Infra satisfies the same above mentioned pre-requisites respective to XML or LCI/LCR methods, then the same above mentioned configuration steps of respective XML or LCI/LCR methods enable the Device's FTM locationing inter-operated with that Enhanced Infrastructure.

### Notes on Location Updates in Mobility and Idle Scenarios

Android Power Management and Zebra's additional device optimizations influence the location updates.

The following points need to be considered:

- The location updates operate based on fresh Wi-Fi RTT-Scanning and per the configured interval, in the following scenarios:
  - Whenever the device is moving.
  - When the device is not moving and the Battery Optimizations settings of the App/Service using the Location API is set to Don't Optimize.
  - When the WLAN Infrastructure has 802.11k enabled and the device has its 802.11k enabled (default).
    - This capability of fresh scans under this configuration even without satisfying the above two conditions, is specific to Zebra's enhancements.
- The location updates operate based on cached Wi-Fi RTT-Scanning (older scans) and per the configured interval, when the device is not moving and nothing is holding-off Android from optimizing the battery. This condition is sometimes referred as Doze mode.
- When the device is entering a state of Preferred Network Offload (PNO) and is not moving; for example when the display screen times-out when device is sitting on the table, then the location updates are provided for around one hour based on the fresh Wi-Fi RTT-Scanning and per the configured interval, and thereafter - Android forces periodical and sensory-triggering based logics of going in and out of Doze mode for purpose of saving battery life. In the sub periods of the Doze mode the location updates operate based on cached Wi-Fi RTT-Scanning (older scans), as explained above.
- It is advised to upgrade the device to the latest LifeGuard Update, where optimization for High Ceiling is applicable, and XML characteristics are introduced to support DeviceHeight and ApHeight, and coordinates are provided with additional Z-axis.

# Common Recommendations for Infrastructure to Support FTM

This section describes general AP guidelines and limitations for FTM responder support.

These guidelines are typically the default parameters of the infrastructure configuration, however they should to be examined to make sure that it is indeed the case, and/or consider the respective compromises of FTM performance.

## Bandwidth

Recommending using  $\geq 80$  MHz, while 11ac remains enabled. This is because location results are best at higher bandwidth due to better measurement precision.

## Channels

During testing, it is better to use non DFS 80 MHz channel. The actual deployment may use all available 80 MHz channels including DFS.

## 802.11k

802.11K can be enabled to make it easy for clients to discover neighbors of the currently associated AP as well as their FTM Responder capability. This can be potentially used by clients in their roaming and FTM ranging decisions.

## AP Density for Ranging

Line of Sight (LoS) range measurements have greater accuracy and lower error spread. The current recommendation is to continue to deploy for capacity indoors (with an AP every 25 to 30 feet) and leverage the AP density to get enough quality Line Of Sight ranging measurements at the client anywhere on the floor plan.

## AP Deployment

A grid like deployment wherever possible, since range measurements from collinear APs with some error can affect the position estimation greater than measurements from APs uniformly spread.

## MCS Rates

Leave MCS0 available to be used for 11mc ranging frames.



# Aruba Recommendations for Infrastructure to Support FTM

## Limitations for SSID Configuration

If the WLAN infrastructure has any SSID, configured with Not Supported parameter combinations mentioned as Not Supported in the table below, then FTM is not-supported on the AP. This holds true to any Standard Mode mentioned in [Configure Various FTM Deployments](#), in both connected and non-connected states of the device.

In the Not Supported configurations, the device can still facilitate FTM via the Enhanced Infrastructure method (see [Configure Various FTM Deployments](#)), whereby a different set of APs (of same AP model but without any of those SSID combinations, or otherwise different APs vendor model altogether) will provide FTM support.

	SSID	FTM Support
1	WPA3 SSID - OWE, SAE, WPA3 Enterprise	Not supported
2	WPA2 AES + Tunnel + MFP (For 11ax AP only)	Not supported
3	Open, WEP, WPA/WPA2-Personal, WPA/WPA2-Enterprise (Tunnel, Decrypt-Tunnel and Bridge)	Supported

For basic testing, IT is preferred to use a single SSID on the radio for basic testing.

## Enabling FTM Under Virtual-AP Profile

To enable FTM using the WebGUI:

1. Navigate to **Configuration > System > Profiles > Wireless LAN > Virtual AP**.
2. Select the Virtual AP under test.
3. Click the **Advanced** drop-down list.

**Virtual AP profile: Aruba\_FTM**

- > General
- > RF
- ▼ **Advanced**
  - Cellular handoff assist:
  - Openflow Enable:
  - Fine Timing Measurement (802.11mc) Responder Mode:
  - Authentication Failure Blacklist Time:  sec
  - Blacklist Time:  sec
  - Deny inter user traffic:
  - Deny time range:  ▼
  - DoS Prevention:
  - HA Discovery on-association:
  - Mobile IP:
  - Preserve Client VLAN:
  - Remote-AP Operation:  ▼
  - Station Blacklisting:
  - Strict Compliance:
  - VLAN Mobility:
  - WAN Operation mode:  ▼

4. Check the box next to **Fine Time Measurement (802.11mc) Responder Mode**.
5. Click **Pending Changes** on top right section.

Pending Changes

Pending Changes for 1 Group

[Mobility Controller > Aruba7010\\_47\\_03\\_E2](#)

6. Click **Deploy Changes**.

## Enable FTM using CLI

This section shows how to enable the FTM as responder using command line interface.

```
(Aruba7010_47_03_E2) [mynode] (config) #wlan virtual-ap [ssid name]
(Aruba7010_47_03_E2) [mynode] (Virtual AP profile "ssid name") #ftm-responder-enable
(Aruba7010_47_03_E2) [mynode] (Virtual AP profile "ssid name") #end
(Aruba7010_47_03_E2) [mynode] #write mem
```

Use below command to verify state of FTM:

```
#show wlan virtual-ap [ssid name]
```

```
(Aruba) [mynode] #configure terminal
Enter Configuration commands, one per line. End with CNTL/Z

(Aruba) [mynode] (config) #wlan virtual-ap Aruba_FTM
(Aruba) [mynode] (Virtual AP profile "Aruba_FTM") #ftm-responder-enable
(Aruba) [mynode] (Virtual AP profile "Aruba_FTM") #end
(Aruba) [mynode] #write mem

Saving Configuration...

Configuration Saved.
(Aruba) [mynode] #show wlan virtual-ap Aruba_FTM

Virtual AP profile "Aruba_FTM"
-----
Parameter                                     Value
-----
AAA Profile                                   Aruba_FTM_aaa_prof
802.11k Profile                               default
Hotspot 2.0 Profile                           default
Virtual AP enable                             Enabled
VLAN                                           3
Forward mode                                  tunnel
SSID Profile                                  Aruba_FTM_ssid_prof
Allowed band                                   all
Allowed 5G radio                              all
Band Steering                                 Disabled
Cellular handoff assist                       Disabled
Openflow Enable                               Enabled
Fine Timing Measurement (802.11mc) Responder Mode Enabled
Steering Mode                                 prefer-5ghz
Dynamic Multicast Optimization (DMO)          Disabled
Dynamic Multicast Optimization (DMO) Threshold 6
Drop Broadcast and Multicast                  Disabled
Convert Broadcast ARP requests to unicast     Enabled
Authentication Failure Blacklist Time         3600 sec
Blacklist Time                                3600 sec
Deny inter user traffic                       Disabled
Deny time range                               N/A
DoS Prevention                                Disabled
HA Discovery on-association                    Enabled
Mobile IP                                     Enabled
Preserve Client VLAN                          Disabled
Remote-AP Operation                           standard
Station Blacklisting                          Enabled
Strict Compliance                             Disabled
VLAN Mobility                                  Disabled
WAN Operation mode                            always
FDB Update on Assoc                           Disabled
Pure UAC BSS Deferred Deletion Delay         10 min
WMM Traffic Management Profile                 N/A
Anyspot profile                               N/A
```

## Provisioning of LCI Coordinates in the Aruba Controller

Use the following commands, shown as examples, to configure GPS Location Coordinates of AP.



**NOTE:** This section provides commands to configure the LCI parameters (Latitude, Longitude & Altitude).

```
Aruba[mynode] (config) #provision-ap
Aruba[mynode] (config-submode)# read-bootinfo ap-name AP515-1
Aruba[mynode] (config-submode)#latitude "37 22 08.75 N"
Aruba[mynode] (config-submode)#longitude "122 02 34.29 W"
Aruba[mynode] (config-submode)#altitude 20
Aruba[mynode] (config-submode)#write mem
```

```
Aruba[mynode] (config-submode)#reprovision ap-name AP515-1
```

```
Aruba[mynode] (config-submode)#end
```

## Enable Advertise AP Location and Advertise AP Name

```
(Aruba) [mynode] #configure terminal
Enter Configuration commands, one per line. End with CNTL/Z

(Aruba) [mynode] (config) #wlan ssid-profile Aruba_FTM_ssid_prof
(Aruba) [mynode] (SSID Profile "Aruba_FTM_ssid_prof") #advertise-location
(Aruba) [mynode] (SSID Profile "Aruba_FTM_ssid_prof") #advertise-ap-name
(Aruba) [mynode] (SSID Profile "Aruba_FTM_ssid_prof") #end
(Aruba) [mynode] #write mem

Saving Configuration...

Configuration Saved.
```

```
(Aruba) [mynode] #show wlan ssid-profile Aruba_FTM_ssid_prof

SSID Profile "Aruba_FTM_ssid_prof"
-----
Parameter                                     Value
-----
SSID enable                                   Enabled
ESSID                                         Aruba_FTM
WPA Passphrase                               *****
Encryption                                   wpa2-psk-aes
Opmode transition                            Enabled
Enable Management Frame Protection (for WPA2 opmodes) Disabled
Require Management Frame Protection (for WPA2 opmodes) Disabled
DTIM Interval                                1 beacon periods
802.11a Basic Rates                           6 12 24
802.11a Transmit Rates                       6 9 12 18 24 36 48 54
802.11g Basic Rates                           1 2
802.11g Transmit Rates                       1 2 5 6 9 11 12 18 24 36 48 54
Station Ageout Time                          1000 sec
Station Refresh Direction                    bidirectional
Max Transmit Attempts                        8
RTS Threshold                                2333 bytes
Short Preamble                               Enabled
Max Associations                              64
Wireless Multimedia (WMM)                   Disabled
Wireless Multimedia U-APSD (WMM-UAPSD) Powersave Enabled
WMM TSPEC Min Inactivity Interval            0 msec
WMM DSCP Mapping Control                     Enabled
DSCP mapping for WMM voice AC (0-63)         N/A
DSCP mapping for WMM video AC (0-63)         N/A
DSCP mapping for WMM best-effort AC (0-63)   N/A
DSCP mapping for WMM background AC (0-63)   N/A
WMM Access Class of EAP traffic              default
Multiple Tx Replay Counters                  Enabled
Hide SSID                                    Disabled
Deny_Broadcast Probes                       Disabled
Local Probe Request Threshold (dB)           0
Auth Request Threshold (dB)                  0
Disable Probe Retry                           Enabled
Battery Boost                                Disabled
WEP Key 1                                    N/A
WEP Key 2                                    N/A
WEP Key 3                                    N/A
WEP Key 4                                    N/A
WEP Transmit Key Index                       1
WPA Hexkey                                   N/A
Maximum Transmit Failures                     0
EDCA Parameters Station profile               N/A
EDCA Parameters AP profile                   N/A
BC/MC Rate Optimization                      Disabled
Rate Optimization for delivering EAPOL frames Enabled
Strict Spectralink Voice Protocol (SVP)      Disabled
High-throughput SSID Profile                 default
High-efficiency SSID Profile                 default
802.11g Beacon Rate                          default
802.11a Beacon Rate                          default
Video Multicast Rate Optimization            default
Advertise QBSS Load IE                       Disabled
Advertise Location Info                      Enabled
Advertise AP Name                            Enabled
Traffic steering from WLAN to cellular        Disabled
802.11r Profile                              N/A
Enforce user vlan for open stations           Disabled
Enable OKC                                   Enabled
Enable Agile Multiband (MBO)                 Disabled
Advertise Cellular Data Capability attribute of MBO Disabled
```

## Enable Advertise AP Name from GUI

1. Navigate to **Configuration > System > Profiles > Wireless LAN > SSID**.
2. Select the SSID profile under test.
3. Click on **Advanced** drop-down list and scroll down to **Advertise Location Info** and **Advertise AP name**.

4. Select the **Advertise Location Info** checkbox.
5. Select the **Advertise AP Name** checkbox.

6. Click **Pending Changes** on top right section.
7. Click **Deploy Changes**.

## Aruba Recommended WLC and AP Models for FTM

Supported Aruba AP type with AOS 8.7.1 and above: AP504/AP505, AP514/AP515, AP503H, and AP505H.

Supported Aruba AP type with AOS 8.8 and above: all the above APs plus - AP534/AP535, and AP555.

