ATWILC1000/ATWILC3000

Wi-Fi Link Controller RTOS Driver Release Notes

Introduction

This release note describes the software deliveries and features of the ATWILC baremetal driver/firmware.

Deliveries are tested on SAM4S as host MCU using lwIP network stack and FreeRTOS as real time operating system using SPI and SDIO buses for both the ATWILC1000 and the ATWILC3000 chip.

Note: The ATWILC RTOS Driver Release 4.5 is supported in ASF starting version 3.48 and later.
All references to the ATWILC module includes all the devices listed below, unless otherwise noted:

- ATWILC1000
- ATWILC3000

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1. ATWILC Host Driver Architecture

The ATWILC host driver software is a C library, which provides the host MCU application with necessary APIs to perform Ethernet operations.

The BLE stack communicates with the ATWILC using standard HCI over UART. The ATWILC host driver initializes the BLE core and firmware, and the BLE stack handles all BLE data and controller paths.

The following figures show the architecture of the ATWILC host driver software which runs on the host MCU.

Figure 1-1. Host Driver Software Architecture for Wi-Fi only Chipsets

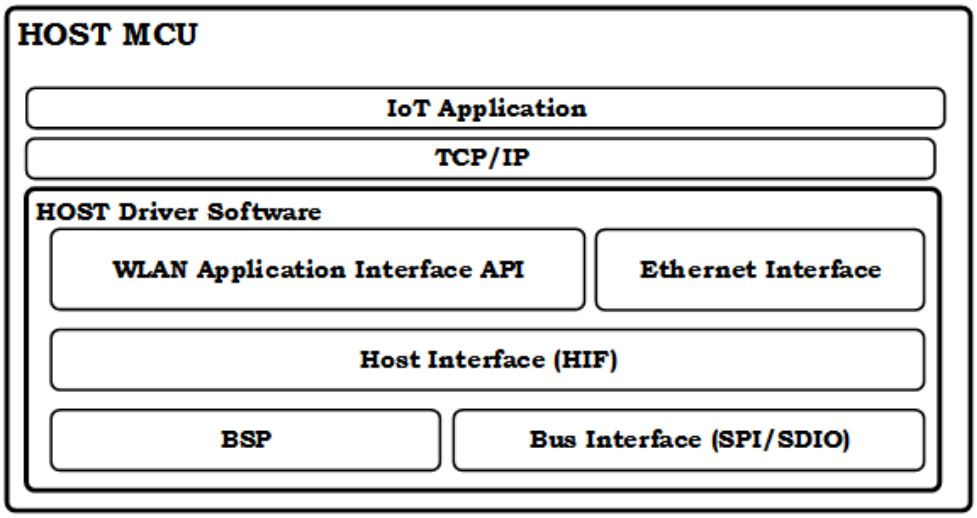
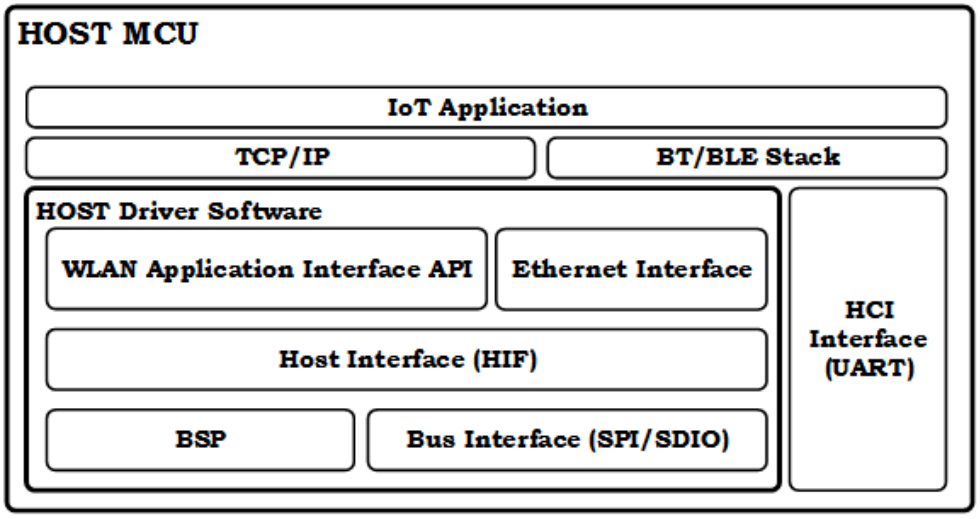


Figure 1-2. Host Driver Software Architecture for BLE Capable Chipsets



2. ATWILC Release Content

The ATWILC devices RTOS driver software release includes the following:

Table 2-1. ATWILC Release Content

Folder Name	Description
Documents	Software design guide and release notes
Examples	ASF projects demonstrating how to use and port ATWILC RTOS. • `weather_concurrent_bt_demo` – STA/AP concurrent demo that uses both interfaces to pull weather information from the internet through the STA interface, and push it to a connected third party STA through the AP interface using HTTP. The demo also initializes BLE for ATWILC3000. • `iperf` – demo implementing iperf server for throughput measurement.
Firmware Binary	**wilc1000_wifi_firmware.h:** Wi-Fi station-P2P-AP concurrency firmware for ATWILC1000. **wilc3000_ble_firmware.h:** BTDM firmware for ATWILC3000. **wilc3000_ble_firmware.h:** BTDM firmware for ATWILC3000. **wilc3000_wifi_firmware.h:** Wi-Fi station-P2P-AP concurrency firmware for ATWILC3000 CA module(default) **wilc3000_wifi_firmware_ua.h:** Wi-Fi station-P2P-AP concurrency firmware for ATWILC3000 for the UA module.(Rename the file to wilc3000_wifi_firmware.h for UA modules) Alternatively, you can generate a new WILC3000 FW for the UA module using the gain builder from tools and the UA module gain sheet to patch the existing default wifi FW. For ex: `gain_builder.exe -hp wilc3000_UA_gain_setting_zones.csv -fh wilc3000_wifi_firmware.h`
Host Driver	Host driver source code
Tools	• Characterization GUI – GUI used for RF testing. • Gain builder – tool used to patch firmware header files with custom digital gains.

3. ATWILC RTOS Features

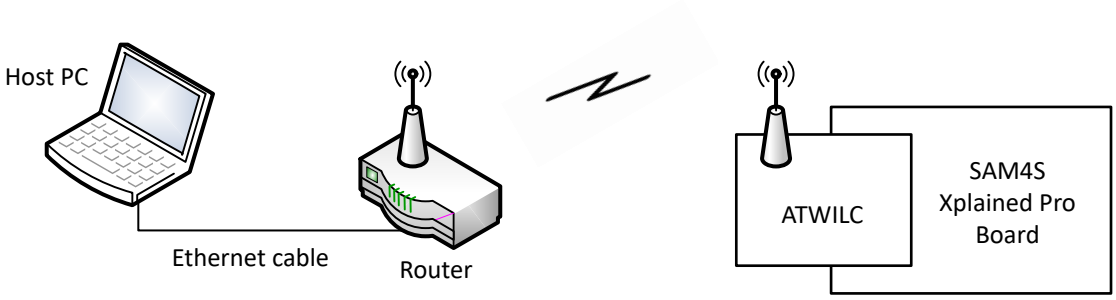
The ATWILC module supports the following features.

1. Wi-Fi Station (STA)
   - IEEE 802.11 b/g/n
   - Open, Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA)/WPA2 personal
   - (WPA)/WPA2 Enterprise security (ATWILC1000 only)
     - Authentication mode – EAP-TTLS with MsChapv2.0
     - Encryption Types – TLS_RSA_WITH_AES_128_CBC_SHA and TLS_RSA_WITH_AES_128_CBC_SHA256
2. Wi-Fi Access Point (AP)
   - IEEE 802.11 b/g/n
   - Open, WEP, WPA/WPA2 personal security
   - Supports eight stations
3. Wi-Fi Protected Setup (WPS)
   - PBC
   - PIN code
4. Wi-Fi direct
   - P2P Client (PBC/PIN security modes)
5. Concurrent modes
   - STA- AP
   - STA- P2P Client
   - AP- P2P Client
6. Bluetooth (ATWILC3000 only)
   - Bluetooth Low Energy (BLE) 4.0 support
   - Modes of operation: Central and peripheral support
   - Number of Connections: Supports seven clients
   - Adaptive frequency hopping
   - Coexistence with Wi-Fi
7. Power save
   - Beacon monitoring mode
   - Low- power mode when disconnected
8. RF version number 01.1
   Note: RF version number format is xx.y, where xx: "Major" and y: "Minor". Changes in Major number requires re-tests and possibly re-certification.

4. Wi-Fi Throughput

This section provides the results of throughput test for different Wi-Fi modes. The following illustration is the performance test setup for ATWILC.

Figure 4-1. Performance Test Setup



4.1 ATWILC SDIO Throughput

This section provides the results of throughput test for different Wi-Fi modes on the SDIO interface.

Table 4-1. mixed-mode Throughput

mixed-mode		
Protocol	**Uplink**	**Downlink**
TCP	14.4	9.33
UDP	22.1	7.87

Table 4-2. b-mode Throughput

b-mode		
Protocol	**Uplink**	**Downlink**
TCP	4.66	5.33
UDP	5.85	3.55

Table 4-3. g-mode Throughput

g-mode		
Protocol	**Uplink**	**Downlink**
TCP	15	11.1
UDP	22.9	8.74

Table 4-4. n-mode Throughput

n-mode		
Protocol	**Uplink**	**Downlink**
TCP	14.4	9.33
UDP	22.1	7.87

4.2 ATWILC SPI Throughput

This section provides the results of throughput test for different Wi-Fi modes on the SPI interface.

Table 4-5. mixed-mode Throughput

mixed-mode		
Protocol	**Uplink**	**Downlink**
TCP	8.96 Mbps	10.4 Mbps
UDP	10.7 Mbps	3.82 Mbps

Table 4-6. b-mode Throughput

b-mode		
Protocol	**Uplink**	**Downlink**
TCP	4.75 Mbps	5.16 Mbps
UDP	5.95 Mbps	3.51 Mbps

Table 4-7. g-mode Throughput

g-mode		
Protocol	**Uplink**	**Downlink**
TCP	6.58 Mbps	10.8 Mbps
UDP	6.81 Mbps	19.2 Mbps

Table 4-8. n-mode Throughput

n-mode		
Protocol	**Uplink**	**Downlink**
TCP	9.37 Mbps	10.3 Mbps
UDP	11.1 Mbps	1.26 Mbps

5. Release Revision History

5.1 ATWILC Baremetal v4.7

The following are the bug fixes:

1. Fix WILC1000: SDIO failures on some parts when power save is enabled
2. Fix problem in retrieving TCP frames: Fixed handling of Block-Ack timer events
3. Fix WILC3000: Sdio bus issues when Power Save mode is enabled
4. Fix BLE advertising issues under some application command sequence
5. Fix BLE advertisement fails after repeated connect/disconnect
6. Fix BLE FW Assert locks up
7. Fix Provided an driver API for applications to disable 11n HT mode

5.2 ATWILC Baremetal v4.6

The following are the new features:

1. WILC3000: Change Gain with Temperature to avoid in-band spurs

The following are the bug fixes:

1. STA fails to reconnect to AP moving to adjacent channel
2. Enabling mcast filter fails after enabling sleep mode.
3. WILC RTOS host driver possible lock up.
4. AP SSID broadcasts while P2P mode is connected.
5. Fix BLE Sweyntooth Vulnerability

5.3 ATWILC Baremetal v4.5

1. Third party STA with 802.11b only mode fails to connect to the ATWILC AP.
2. Connection to WPA-PSK with UTF-8 encoding fails.
3. Dynamic antenna switching is not performing as expected.
4. Some APs deny connection from the ATWILC STA if short preamble is disabled. Regression from v4.4.
5. The ATWILC AP disconnects connected clients when the ATWILC STA is connecting, even if both are on the same channel.
6. CF-end Packets retransmitted continuously when multiple ATWILC stations are connected to same AP.
7. Advertise support for 11n rates in AP’s beacons
8. Unable to Connect to ATWILC AP After hours of Interference and high throughput traffic
9. Failure to reconnect to P2P device after hard reset.
10. Modify Krack Attack fix for APs that doesn’t change key index during re-keying
11. Firmware doesn't report disconnection to host in case of P2P/WPS failure
12. ATWILC3000 Low Rx performance
13. Faster P2P connection for ATWILC3000
14. Iperf stalls during longevity test
15. Failure to wake some parts up through SPI

5.4 ATWILC Baremetal v4.4

- New features:

  - Antenna Diversity
  - Support for UTF-8 in reference application
  - P2P PIN security mode
  - Capability to scan single channel specified by the application
  - ATWILC3000 BLE power save mode
  - Wi-Fi idle and connected modes for the power save mode
  - Characterization GUI to change BLE UART baud rate
- Improve transmission performance in noisy environment
- P2P fails to connect with Huawei P9, SAMSUNG J7, and Pixel 2
- Seventh and eighth clients fails to connect to AP interface when six clients are connected
- Enhance transmission PER with significant changes in temperature
- Avoid reporting hidden APs to the application layer
- Fix for mistakenly reporting enterprise APs with CCKM AKM suite support as WEP
- Fix for failure to connect in P2P-STA concurrency when STA is in the open mode
- Gain builder – fix for failure to patch firmware when magic number is at the end of line in the firmware
- Fixed SDIO block transfer issues for SAM V71 Xplained Ultra evaluation kit

5.5 ATWILC Baremetal v4.3

- Fix regressions from RC2

The following are bug fixes and enhancements for RTP:

- WFA certification
  - DUT not connecting to AP configured in enterprise security
  - Code legal statement is out of date
  - P2P Client not broadcasting SSID as “DIRECT-“
  - Align driver folder structure with ASF’s structure
  - Update information on how to generate WPA enterprise certificate and example code
  - Updated WPA enterprise capabilities
  - Failure to connect to AP in 802.11n only mode
  - ATWILC1000 not connecting with customer AP with 4.3 RC2 build
  - WFA 5.2.45 - Ping fails if RIFS is enabled in AP
  - WFA 5.2.52 - ATWILC advertises HT capabilities when connecting to AP with WEP and HT
  - WFA 5.2.17-5.2.18 - No Deauthentification frame after three MIC attacks
  - WFA 5.2.38 - A-MSDUs not delivered correctly to stack
- Wi-Fi disconnects when BLE starts its activity
- Increase Wi-Fi Tx power levels granularity
- Enable pullups for unused GPIOs
- Characterization GUI to choose serial bridge’s com port number
- Characterization GUI to use the serial bridge’s port to send HCI commands
- Updated `m2m_wifi_set_tx_power()` API

5.6 ATWILC Baremetal v4.2

- New features:
  - Notify host with connection attempts to the AP interface with wrong password
  - Updated the error codes associated with the 802.11 MAC specifications
- Fixed WPA security hole issue
- Fixed the issue with P2P mode on channel 6
- Updated Software Design Guide and APIs cleanup

- Eliminate Spurious Emissions in ATWILC1000 Wifi/BLE Coexistence mode
- Fixed WPS connection issue
- Removed support for Bluetooth Classic

The following are bug fixes and enhancements for RTP:

- Eliminate Coex spurs
- Workaround for deauth reason code 0x0002 IoP issue
- Remove AP from scan results if connection timed out
- DUT is not reconnecting when router changes channel while restarting
- WPS not working with release v4.1
- Updated Softwaer Design Guide and APIs cleanup
- Notify host of connection attempts with incorrect password to AP interface
- Merge autorate improvements from ATWINC1500
- Investigate, replicate and mitigate 'krakattack' M3 replay vulnerability
- ATWILC1000 RTOS driver 4.1 returning unknown error codes from the firmware
- ATWILC1000 RTOS driver version 4.1 warnings
- P2P mode is not connecting in channel 6
- Failure to bridge host Tx packets if it has different MAC address
- Intermittent WPS failures
- Count packets that fails all retransmission for autorate

5.7 ATWILC Baremetal v4.1

- New features:
  - Control beacon intervals from application layer
  - APIs to enable/disable multicast filtering
  - API to limit the number of supported stations
- Fix for disabling AP that was broken in 4.0
- Fix for bug where all clients are disconnected from ATWILC1000 AP when one client is disconnected
- Option to run ATWILC1000 firmware from internal flash when using ATWILC1500/ATWINC3400 hardware
- Fix for P2P client
- Fix for ATWILC AP to support eight stations
- Design guide update and API cleanup

The following are bug fixes and enhancements for RTP:

- ATWILC sometimes does not advertise
- Wi-Fi disable AP does not support ATWILC1000 4.0
- Adapt new PS mechanism from ATWINC
- Add SPI Enhancements from ATWINC1500
- STA disconnects from ATWILC1000 AP, when another STA is disconnected
- Adjust SDIO internal pull ups
- Unreliable connection of hidden SSID networks
- Ping operation with more than 1536 packet size breaks the ATWILC1000+ SAMV71
- Fix to meet EVM specifications on CH10
- ETSI Certification support to implement per channel Rx RSSI offset
- AP MAC_CONNECTED notification is inconsistent
- Change ATWILC1000 Gains for customer only
- Log firmware SVN revision number
- Set maximum Tx rate
- Optimize monitor mode path
- Run ATWILC firmware from ATWINC1500/ATWINC3400 internal flash

- Control beacon interval as application input
- Add API to enable/disable multicast filtering
- Add API to limit the number of supported stations
- Verify P2P client connection
- Failure to connect to some APs in WPA/WPA2 mixed mode
- ATWILC baremetal driver version 4.0: SoftAP supports only four associated stations
- AP acknowledges packets after being disabled

5.8 ATWILC Baremetal v4.0

The following are bug fixes and enhancements for RTP:

- Support for dual MAC addresses for concurrency
- Optimized firmware/hardware interface with single DMA transaction per packet, instead of three
- Support HT capabilities when connecting to 802.11n APs
- Support for WEP security
- Support for WPA/WPA2 security for AP interface
- Support for ATWILC1000 SDIO
- Support for ATWILC3000D2 parts
- Support hidden SSID for AP interface
- Eliminated lint errors from Wi-Fi firmware
- Phased out ATWILC1000 RevA parts
- Use second hardware MAC address on supported Application-Specific Integrated Circuit (ASIC)
- Use second hardware MAC address
- Driver/firmware interface enhancement
- Driver/firmware interface enhancement - Rx path
- Driver/firmware interface enhancement - Tx path
- Eliminate buffer copying in Tx path
- Integrate Rx and Tx path enhancements
- Implement OTP MAC address API
- HT capabilities are not parsed from association request
- Failure to enable WPA2 AP
- WEP Security is not supported
- Connection failed with WEP-Shared with WEP-40 and WEP-104 key configurations
- SDIO support for ATWILC1000
- Modify `m2m_wifi_get_mac_address()` API to comply with using two MAC addresses
- Add support for PCLint Static Code Analysis tool
- Fix firmware lint errors
- ATWILC transmitted beacons are malformed when using two mac addresses
- (ATWILC3000) Disable Coex Null frames when Wi-Fi enters the Sleep mode
- Failure in STA and AP interfaces when using ATWILC3000 SPI wing boards with power-save enabled
- Exclude CTS failures from autorate calculations
- Apply FCC gain settings from ATWILC3000
- Firmware download sequence is not correct
- Use DMA buffer for block transfers
- Set Tx Power API is not working correctly
- Recognize ATWILC3000D2 parts
- Phase out ATWILC1000 RevA (RTOS)
- Apply new PMU settings to ATWILC3000D2 boards
- Change register 0x1ea0 to 0xc7e for ATWILC3000D2

- Apply action items from ATWILC3000/ATWINC3400 regarding dump comparison
- Remove legacy options WILC_DISABLE_PMU, WILC_EXT_PA_INV_TX_RX and M2M
- Use fixed point calculations
- AP hidden SSID

5.9 ATWILC Baremetal v3.6

- Added BLE only firmware

The following are bug fixes and enhancements for RTP:

- Apply FCC gain settings from ATWILC3000
- Change Dgain LUT by patching the firmware
- Use XO offset from effuse
- Apply 11b transceiver settings
- STA disconnects during 72 hours Rx test
- Clock status check for ATWILC1000 SDIO is not correct
- Merge RF settings from ATWILC1000 Linux
- Update RF and Phy settings to match ATWINC1500 and ATWILC1000 Linux
- Big endian support for `m2m_wifi` APIs

5.10 ATWILC Baremetal v3.5

The following are bug fixes and enhancements for RTP:

- Fix scan while AP is started
- Fix firmware when stopped at error 12
- Fix wrong percentage in Rx stats logging
- Aligning host DMA buffers in SDIO layer
- Added BT/BLE Tx power control HCI command (ATWILC3000 only)
- Added BLE only FW. Config flags CONF_BT_MODE_BTDM and CONF_BT_MODE_BLE_ONLY should be used to select which FW to use (ATWILC3000 only)
- BT/BLE FW: Changed manufacturer’s name to Atmel (ATWILC3000 only)
- Fixed bugs for certification (ATWILC3000 only)
- Avoid disconnect after GATT request timeout
- Avoid disconnection after GATT request timeout
- Frame spacing interval fails

5.11 ATWILC Baremetal v3.4

The following are bug fixes and enhancements for RTP:

- SDIO porting example for SAM4s
- BLE/BT Firmware download and start
- Implemented `m2m_coex_set_mode(tenuCoexMode enuCoexMode)` to switch the tuner between:
  - `M2M_COEX_MODE_WIFI` - tuner operates in Wi-Fi only mode
  - `M2M_COEX_MODE_BT` - tuner operates in BT/BLE only mode
  - `M2M_COEX_MODE_COMBO` - tuner arbitrates access to the tuner between Wi-Fi and BT/BLE
- Add error handling in the SPI if the command does not equal the response till the timeout
- Added SDIO interface support for SAM4S MCU
- Fix unaligned buffers issue for SDIO
- Download and start BLE firmware
- Implement Wi-Fi/BLE Coexistence

5.12 ATWILC Baremetal v3.3

The following are bug fixes and enhancements for RTP:

- Fix regression starts on release 3.0 on connection to open security AP
- Send fixed data lengths to the host for the same frame regardless of the security of the AP in the parsed option of the Monitor mode
- Fix connection issue when one ATWILC in station mode tries to connect to another ATWILC in AP mode
- Send the correct MAC address in the connect notification in case of SoftAP secured mode

5.13 ATWILC Baremetal v3.1

The following are bug fixes and enhancements for RTP:

- Fix the issue with version mismatch
- Add the API to change channel in the monitor mode
- Enable the PS (Power Save) mode

5.14 ATWILC Baremetal v3.0

The following are bug fixes and enhancements for RTP:

- Added support for enterprise security in the station mode

5.15 ATWILC Baremetal v2.5

The following are bug fixes and enhancements for RTP:

- Supports to receive the frames in the monitor mode with the MAC 802.11 header

5.16 ATWILC Baremetal v2.4

The following are bug fixes and enhancements for RTP:

- Fixed error in the request enumeration base numbers
- Added support for the monitor mode

5.17 ATWILC Baremetal v2.3

The following are bug fixes and enhancements for RTP:

- Send interrupt on each transmitted packet from the host to firmware
- Add an API to set the scan list
- Filter APs from the scan result that are seen off the user channel list

5.18 ATWILC Baremetal v2.1

The following are bug fixes and enhancements for RTP:

- Added support for P2P group connect - To connect to an existing established group, enable the P2P and then use the normal connect API with security type set to open
- Added support for P2P device search - To search for P2P devices and GOs, enable the P2P and then use the scan API `m2m_wifi_request_scan_ssid` with ssid set to "DIRECT-" , a new parameter is added in the structure `tstrM2mWifiscanResult` which is `au8DeviceName` to distinguish between different peers who all have the same SSID "DIRECT-"
- Events are not implemented for the concurrent mode (STA + AP)

5.19 ATWILC Baremetal v2.0

The following are bug fixes and enhancements for RTP:

- Added support to station WPS
- Added concurrent P2P client feature
- Fixed a bug in sending probe responses in the station mode
- Added an API to get the connection information in the softAP mode

5.20 ATWILC Baremetal v1.1

The following are bug fixes and enhancements for RTP:

- Added new API to scan for a specific SSID
- Fixed missing AP from scan result that filters the ATWILC1000 MAC address
- Fixed connect-disconnect issue
- Fixed corrupted print on serial debug
- Fixed a bug on SoftAP mode that causes data frames to send with zero MAC address in source address

5.21 ATWILC Baremetal v1.0

The following are bug fixes and enhancements for RTP:

- Support for the Station mode
- WEP-40, WEP-104, WPA-CCMP, WPA-TKIP, WPA2-CCMP, WPA2-TKIP security modes
- Support for the SoftAP mode
- Support all security modes in SoftAP mode: Open, WEP, and WPA2
- Supports up to eight associated stations in the SoftAP mode
- Supports single channel concurrent operation Station-Station or Station-AP

6. Limitations

- Multichannel concurrency is not supported. Concurrent modes must run on the same channel.
- STA WPA Enterprise Security mode is not supported for the ATWILC3000.
- P2P GO mode is not supported.
- AP WPS security mode is not supported.
- iPerf throughput is not optimized for the ATWILC3000 SPI and SAMv71. Buffer overrun is observed.
- P2P connection issues are observed with specific mobile devices.
- Enterprise security is not supported for the ATWILC3000.
- Limitation to download only small files (<30 MB) for file download application.

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