AN14714

Wi-Fi Firmware Download Modes for FreeRTOS

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Document information

Information	Content
Keywords	AN14714, FreeRTOS, WLAN, synchronous download mode, asynchronous download mode
Abstract	This document introduces the firmware download process and configuration for Synchronous and Asynchronous download modes.

1 Introduction

NXP Wi-Fi firmware is released in binary and must be downloaded from host to Wi-Fi chip before using Wi-Fi feature and function. MCUXpresso SDK provides two modes to download Wi-Fi firmware:

- Synchronous download mode
- Asynchronous download mode

This document introduces the firmware download process and configuration for these two modes.

1.1 Supported products

The supported products are as follows:

- 88W8987
- 88W8997
- IW416
- IW610
- IW611
- IW612
- RW610
- RW612

2 Firmware download modes

This chapter describes the workflow of two different Wi-Fi firmware download modes.

2.1 Asynchronous download mode

In asynchronous download mode, application calls `wlan_init_nb` API to download Wi-Fi firmware and initialize Wi-Fi function. This function creates a dedicated task `wlcmgr_nb_task` to manage Wi-Fi firmware download and returns immediately once task is created. It allows the application to continue other subsequent tasks without delay.

The `wlcmgr_nb_task` is assigned same priority with application `main_task`. It ensures that application execution is not preempted and blocked. Once Wi-Fi firmware download is completed and the Wi-Fi subsystem initializes successfully, the `wlcmgr_nb_task` gets terminated to free memory to system.

Figure 1 illustrates the workflow of the asynchronous firmware download process.

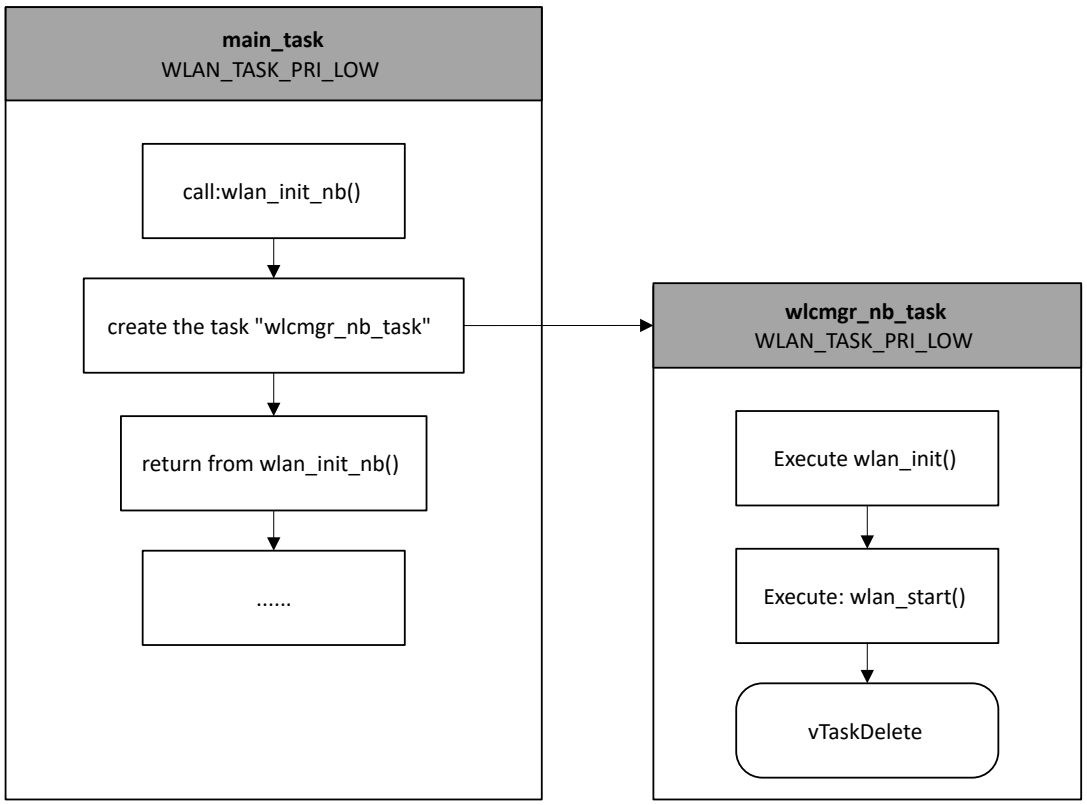

Figure 1. Asynchronous firmware download workflow

2.2 Synchronous download mode

In synchronous download mode, application calls `wlan_init` and `wlan_start` API within `main_task` to download Wi-Fi firmware and initialize Wi-Fi function. The application continues subsequent operations after Wi-Fi firmware download and Wi-Fi subsystem initiation complete. In this way, it avoids creating extra task.

Figure 2 illustrates the workflow of the synchronous firmware download process.

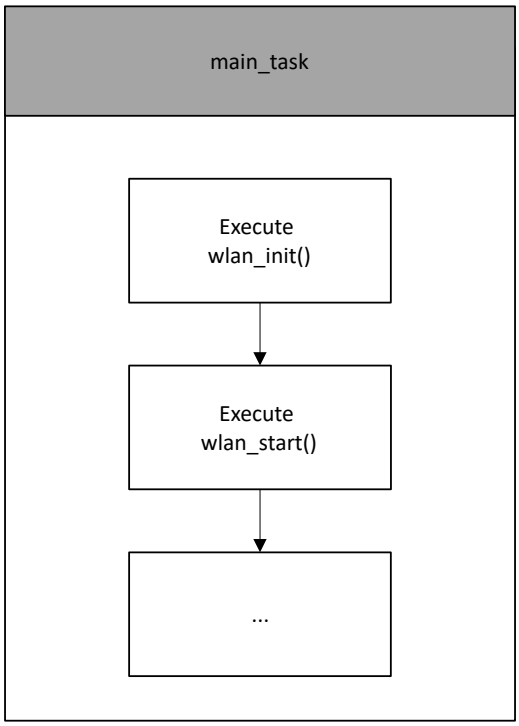

Figure 2. Synchronous firmware download workflow

3 Wi-Fi firmware download mode configuration

Wi-Fi firmware download mode is selected by configuring single macro `CONFIG_FW_DNLD_ASYNC` in *wifi_config.h* in application source code directory.

- Enable asynchronous download mode:

```
#define CONFIG_FW_DNLD_ASYNC 1
```

- Enable synchronous download mode:

```
#define CONFIG_FW_DNLD_ASYNC 0
```

3.1 Execution time of Wi-Fi driver init function

`OSA_GetTimestamp` API is added within `wlan_driver_init` function before and after Wi-Fi initialization to calculate the execution time of `wlan_driver_init` in different firmware download mode.

```
int wlan_driver_init(void)
{
    int result = 0;
    PRINTF("==== wlan_driver_init start: %d ns====\n", OSA_GetTimestamp());
#if defined(CONFIG_FW_DNLD_ASYNC) && (CONFIG_FW_DNLD_ASYNC == 1)
    result = wlan_init_nb(wlan_fw_bin, wlan_fw_bin_len, wlan_event_callback);
#else

    /* Initialize WIFI Driver */
    result = wlan_init(wlan_fw_bin, wlan_fw_bin_len);

    assert(0 == result);

    result = wlan_start(wlan_event_callback);
    assert(0 == result);
#endif
    PRINTF("==== wlan_driver_init end: %d ns====\n", OSA_GetTimestamp());
    return result;
}
```

Figure 3. Test code for execution-time calculation

3.1.1 Asynchronous download mode

The total execution time of `wlan_driver_init` is less than 1 second as Wi-Fi firmware download and initialization are handled in a separate task, which allows main_task to proceed.

The following is the console output of RT1060 and IW610 for asynchronous firmware download mode:

```
[2025-07-21 18:29:34]  wifi cli demo
[2025-07-21 18:29:34]  ========================================
[2025-07-21 18:29:34]  Initialize CLI
[2025-07-21 18:29:34]  ========================================
[2025-07-21 18:29:34]  CLI Build: Jul 21 2025 [18:25:44]
[2025-07-21 18:29:34]  Copyright  2024  NXP
[2025-07-21 18:29:34]  MCU Board: MIMXRT1060-EVKB
[2025-07-21 18:29:34]  ========================================
[2025-07-21 18:29:34]  Initialize WLAN Driver
[2025-07-21 18:29:34]  ========================================
[2025-07-21 18:29:34]  ==== wlan_driver_init start: 22132 ns====
[2025-07-21 18:29:34]  ==== wlan_driver_init end: 25862 ns====
[2025-07-21 18:29:35]  STA MAC Address: 78:F5:05:7B:CA:7C
[2025-07-21 18:29:39]  board_type: 0, board_type mapping:
[2025-07-21 18:29:39]  0----CSP
[2025-07-21 18:29:39]  1----QFN
[2025-07-21 18:29:39]  board_type: 0, board_type mapping:
[2025-07-21 18:29:39]  0----CSP
[2025-07-21 18:29:39]  1----QFN
[2025-07-21 18:29:39]  app_cb: WLAN initialized
[2025-07-21 18:29:39]  ========================================
[2025-07-21 18:29:39]  WLAN CLIs are initialized
[2025-07-21 18:29:39]  ========================================
[2025-07-21 18:29:39]  ENHANCED WLAN CLIs are initialized
[2025-07-21 18:29:39]  ========================================
[2025-07-21 18:29:39]  CLIs Available:
[2025-07-21 18:29:39]  ========================================
```

Note: *Wi-Fi function is still not available when* `wlan_init_nb` *returns in asynchronous download mode. Application has to start Wi-Fi operation after Wi-Fi initialization-done event arrival in* `wlan_event_callback`*.*

Figure 4 shows the place of Wi-Fi initialization callback.

```
/* Callback Function passed to WLAN Connection Manager. The callback function
 * gets called when there are WLAN Events that need to be handled by the
 * application.
 */
int wlan_event_callback(enum wlan_event_reason reason, void *data)
{
    int ret;
    struct wlan_ip_config addr;
    char ssid[IEEEtypes_SSID_SIZE + 1] = {0};
    char ip[16];
    static int auth_fail                        = 0;
#if CONFIG_NXP_WIFI_SOFTAP_SUPPORT
    wlan_uap_client_disassoc_t *disassoc_resp = data;
#endif
    int i;

    switch (reason)
    {
        case WLAN_REASON_INITIALIZED:
            (void)PRINTF("app_cb: WLAN initialized\r\n");
            printSeparator();

            ret = wlan_basic_cli_init();
            if (ret != WM_SUCCESS)
            {
                (void)PRINTF("Failed to initialize BASIC WLAN CLIs\r\n");
                return 0;
            }

            ret = wlan_cli_init();
            if (ret != WM_SUCCESS)
            {
```

Figure 4. Wi-Fi initiation event

3.1.2 Synchronous download mode

The total execution time of `wlan_driver_init` is approximately 4.5 seconds during which `main_task` remains blocked until Wi-Fi firmware download and Wi-Fi subsystem initialization complete.

The following is the console output of RT1060 and IW610 for synchronous firmware download mode:

```
[2025-07-21 18:22:57]  ========================================
[2025-07-21 18:23:47]  wifi cli demo
[2025-07-21 18:23:47]  ========================================
[2025-07-21 18:23:47]  Initialize CLI
[2025-07-21 18:23:47]  ========================================
[2025-07-21 18:23:47]  CLI Build: Jul 21 2025 [18:09:52]
[2025-07-21 18:23:47]  Copyright  2024  NXP
[2025-07-21 18:23:47]  MCU Board: MIMXRT1060-EVKB
[2025-07-21 18:23:47]  ========================================
[2025-07-21 18:23:47]  Initialize WLAN Driver
[2025-07-21 18:23:47]  ========================================
[2025-07-21 18:23:47]  ==== wlan_driver_init start: 22275 ns====
```

```
[2025-07-21 18:23:47]  STA MAC Address: 78:F5:05:7B:CA:7C
[2025-07-21 18:23:51]  board_type: 0, board_type mapping:
[2025-07-21 18:23:51]  0----CSP
[2025-07-21 18:23:52]  1----QFN
[2025-07-21 18:23:52]  board_type: 0, board_type mapping:
[2025-07-21 18:23:52]  0----CSP
[2025-07-21 18:23:52]  1----QFN
[2025-07-21 18:23:52]  ==== wlan_driver_init end: 4872058 ns====
[2025-07-21 18:23:52]  app_cb: WLAN initialized
[2025-07-21 18:23:52]  ========================================
[2025-07-21 18:23:52]  WLAN CLIs are initialized
[2025-07-21 18:23:52]  ========================================
[2025-07-21 18:23:52]  ENHANCED WLAN CLIs are initialized
[2025-07-21 18:23:52]  ========================================
[2025-07-21 18:23:52]  CLIs Available:
[2025-07-21 18:23:52]  ========================================
[2025-07-21 18:23:52]
```

4 Acronyms

Table 1 lists the acronyms used in this document.

Table 1. Acronyms

Terms	Definition
API	Application Program Interface
FW	Firmware
CLI	Command-line Interface
WLAN	Wireless Local Area Network

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6 Revision history

Table 2 summarizes the revisions to this document.

Table 2. Revision history

Document ID	Release date	Description
AN14714 v.1.0	8 January 2026	Initial release

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Tables

Tab. 1. Acronyms 7
Tab. 2. Revision history 8

Figures

Fig. 1. Asynchronous firmware download workflow 3
Fig. 2. Synchronous firmware download workflow 4
Fig. 3. Test code for execution-time calculation 5
Fig. 4. Wi-Fi initiation event 6

Contents

1 Introduction 2
1.1 Supported products 2
2 Firmware download modes 2
2.1 Asynchronous download mode 2
2.2 Synchronous download mode 3
3 Wi-Fi firmware download mode configuration 4
3.1 Execution time of Wi-Fi driver init function 4
3.1.1 Asynchronous download mode 5
3.1.2 Synchronous download mode 6
4 Acronyms 7
5 Note about the source code in the document 7
6 Revision history 8
Legal information 9