NRC7394 Evaluation Kit User Guide

(Memory Map)

Ultra-low power & Long-range Wi-Fi

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NEWRACOM, Inc.

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Ultra-low power & Long-range Wi-Fi

Office
NEWRACOM, Inc.
505 Technology Drive, Irvine, CA 92618 USA
http://www.NEWRACOM.com

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1 Introduction

This document provides an in-depth analysis of the NRC7394 flash memory map and RAM (Random Access Memory) allocation specifically for user applications in standalone mode. It covers two configurations: one with 2MB of flash memory and another with 4MB. By examining the memory map within this context, readers will gain valuable insight into optimizing resource utilization for their applications.

2 Memory Map

The flash memory map is a vital part of the device's memory management system, defining the organization and utilization of flash memory. It offers a structured layout for storing critical data, including firmware, configuration settings, and user-specific content. A thorough understanding of the flash memory map is essential for ensuring efficient operation, seamless firmware updates, and effective data management.

Key components of the flash memory map typically include:

- SF_BOOTLOADER

  This component acts as the entry point for firmware execution. It begins by checking the FOTA_INFO section to determine if a Firmware Over-the-Air (FOTA) update is available. If an update is found, the FOTA binary is copied to the firmware (FW) area. If no FOTA update is present, the system verifies the integrity of the existing firmware by comparing the calculated CRC (Cyclic Redundancy Check) with the CRC stored in FW_INFO. If the CRC's do not match, the existing FOTA firmware is copied to the firmware area. When the CRC's match, the firmware execution proceeds from the firmware address, initiating the main application.

- MEM_MAP

  This area is intended for use with the modified memory map. Developers must execute a migration script to relocate the 'sys_config' and 'rf_cal' data as part of the setup. It is important to note that this feature is disabled by default.

- SF_FW (Software Firmware)

  This section is designated for the storage and execution of software firmware.

- SF_FW_INFO

  This section stores essential information about the firmware, including its size and CRC (Cyclic Redundancy Check) value.

- SF_CORE_DUMP

  This segment stores and manages core dump data, serving as a critical resource for troubleshooting and debugging.

- SF_USER_CONFIG_1 - SF_USER_CONFIG_4

  These sections are allocated for storing user-specific configuration data. They utilize the NVS (Non-Volatile storage) library to ensure efficient management and retrieval of user configurations.

- SF_SYSTEM_CONFIG

  This section contains essential system configuration data, including the MAC address, module type, hardware version, external PA (Power Amplifier) information, and other critical parameters. These fields are populated during the manufacturing process using the MFGT tool.

- SF_RF_CAL

  This section is reserved for storing radio frequency calibration data, which is essential for optimizing the performance and reliability of the device's RF components.

- SF_FOTA

  This section is dedicated to managing Firmware Over-the-Air (FOTA) updates and serves as the storage area for FOTA firmware.

- SF_DEVICE_INFO

  This section stores device-specific information, including essential details and metadata unique to the device, which supports effective identification and customization. This field can be read from and written to within the application.

- SF_USER_DATA

  This section is allocated for storing user application data. It allows users to read and write data within this field through the application.

- SF_FOTA_INFO

  This section acts as a repository for information related to the Firmware Over-the-Air (FOTA) firmware, including details such as its size and CRC (Cyclic Redundancy Check) Value.

2.1 2MB Flash Memory

The diagram below presents an overview of the memory map for an NRC7394 device, which allocates 2MB of program memory for applications. In the default factory configuration, 916KB of memory is available for firmware. When building the firmware image, developers should reference the linker script setting for ‘FLASH_SIZE’ to ensure proper allocation.

2.1.1 Profiles

Multiple profiles are available for developers to select when creating the firmware, each offering different memory allocations and configurations. Refer to Figure 1.2, “2MB Flash memory Map.” For the details on these profiles.

- factory: FOTA and 100KB_developer_DATA (The previous MFGT board default)
- profile1: FOTA and 8KB_developer_DATA
- profile2: FOTA and NO_developer_DATA
- profile3: NO_FOTA and 8KB_developer_DATA
- profile4: NO_FOTA and NO_developer_DATA

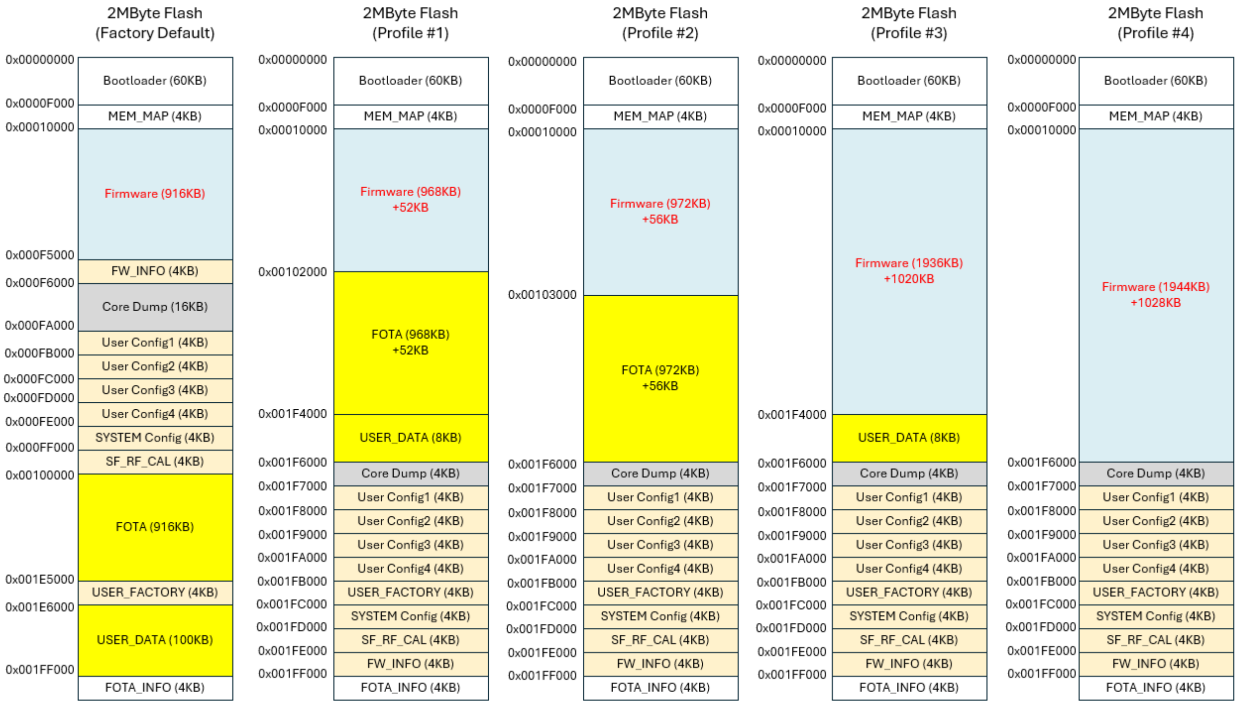

Figure 2.1 2MB Flash Memory Map

2.2 4MB Flash Memory

The diagram below provides an overview of the memory map for an NRC7394 device, where 4MB of program memory is allocated for applications. The default firmware memory available is 1940KB. For build the firmware image, the developer should check linker script related to ‘FLASH_SIZE’.

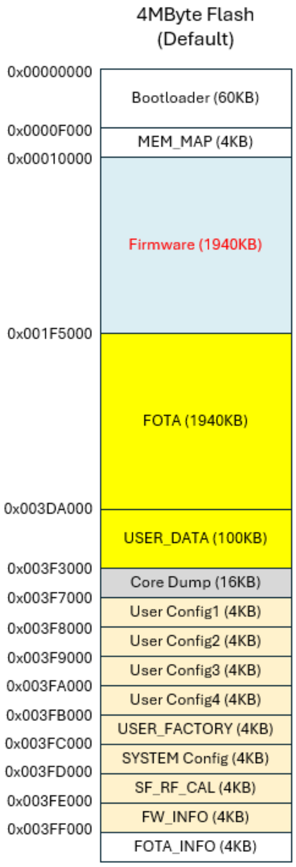

Figure 2.2 4MB Flash Memory Map

3 Available Memory Size

Users can manage both flash memory and RAM for HEAP and STACK. The available memory size can be estimated based on the memory footprint of a basic program such as 'hello_world.' Additionally, we provide the 'sample_tcp_client' program for reference. The firmware size depends on application code usage. If it uses multiple libraries such as MQTT, HTTP and SSL, its size will be increased.

Starting with SDK v1.3, the default memory profile is set to profile 1, allowing a maximum firmware size of 968 KB within a 2MB Flash.

3.1 Available Flash Memory Size

[Hello_world]

		MAX Firmware Size	Firmware Size	Available size
Flash memory	2MB	968 KB	808 KB	160 KB
	4MB	1940 KB	808 KB	1132 KB

[sample_tcp_client]

		MAX Firmware Size	Firmware Size	Available size
Flash memory	2MB	968 KB	856 KB	112 KB
	4MB	1940 KB	856 KB	1084 KB

3.2 Available RAM Memory Size

In standalone mode, the NRC7394 emplys Execute in Place (XIP), a technique that allows programs to execute directly from non-volatile memory rather than being copied into RAM first. This approach minimizes the memory footprint in embedded systems, freeing up additional RAM for dynamic data storage.

The NRC7394 has a total RAM capacity of 880KB, allocated as follows: 32KB for bootloader, 8KB for the stack, and 48KB for retention memory. Wi-Fi functionality uses approximately 670KB for BSS, data, buffer pools, and other needs. This usage may vary depending on the SDK version and 3rd party libraries. As a result, developers typically have around 120KB available, though this amount can fluctuate with different SDK versions and application requirements. Developers can refer to these values as general guidelines.

[hello_world]

	MAX SIZE	USED HEAP	Available size
HEAP	370 KB	62 KB	308 KB

Available RAM size = 126 KB

[sample_tcp_client]

	MAX SIZE	USED HEAP	Available size
HEAP	370 KB	68 KB	301 KB

Available RAM size = 123 KB

In the NRC7394, the HEAP for FreeRTOS is allocated within the BSS area. Developers can adjust the HEAP size by modifying the value defined in the Makefile (specifically, Makefile.NRC7394.sdk.release). It is important to note that increasing the HEAP size will reduce the available RAM.

- DEFINE+= -DconfigTOTAL_HEAP_SIZE= 370000

To monitor the available heap size, developers can use memory-related FreeRTOS API's, such as xPortGetFreeHeapSize() and xPortGetMinimumEverFreeHeapSize(). These APIs provide information on the current and minimum available heap size within the application.

4 Revision History

Revision No	Date	Comments
Ver 1.0	11/06/2024	Initial version Updated 2MB partition profiles (1, 2, 3, 4). Update available RAM and flash memory size.