

S32K146 OTA solutions for customer



SECURE CONNECTIONS
FOR A SMARTER WORLD

Customer OTA Requirements

- Customer OTA Requirements:
 - ✓ APP A/B update APP B/A successful and swap to APP B/A
 - ✓ APP A/B running can download APP B/A and not affect performance

S32K146/8 OTA HW Resources

- APP A/B swap
 - ✓ S32K146/8 have not hardware registers for swap APP A/B. So, when APP A/B updated APP B/A should re-enter bootloader mode, bootloader jump to the APP B/A.
- APP A/B running update APP B/A
 - ✓ S32K146 Flash 2 partitions for P-flash. Every partition P-flash is 512K. 1 partition running APP, erase/program another partition P-flash and not affect running APP performance.

Customer Requirements VS NXP OTA Solution

- Customer OTA Solution Description

- ✓ Customer OTA solution is bootloader A/B + APP A/B. when update APP through HW registers for swap APP A/B. As figure 1, bootloader A & APP A can update bootloader B & APP B each other.

- NXP OTA Solution Description

- ✓ NXP OTA solution is Bootloader + APP A/B. Bootloader responsibility is:
 1. Update APP A/B
 2. Mange APP and jump to APP A/B

When power on/reset MCU, MCU enter bootloader and through bootloader jump to APP.

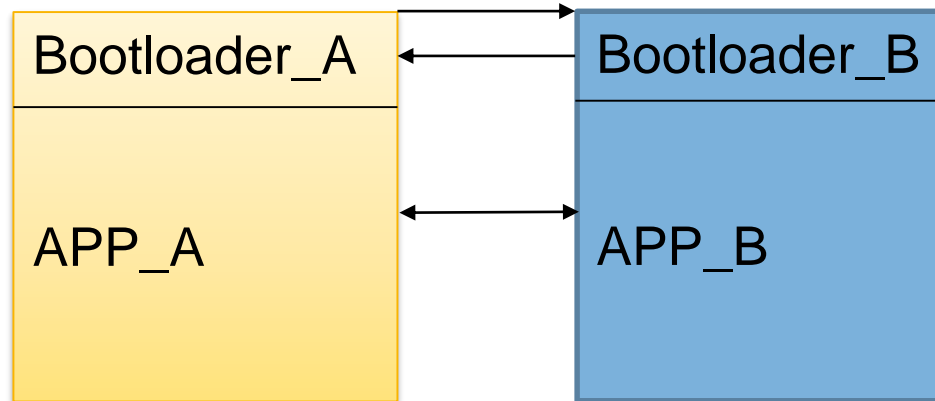


Figure 1

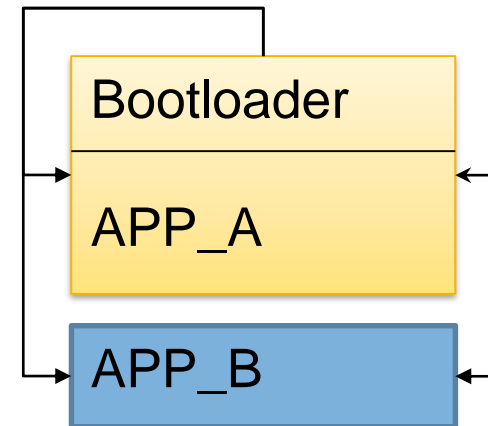


Figure 2

NXP OTA Solution

- How to manage APP version in Bootloader
 - ✓ Every APP should have APP information. The information are include: APP version(option), counter index APP update times, APP image CRC (option) and APP information CRC etc. When enter bootloader, bootloader should check APP information and jump to the newest APP.
- APP Requirements for OTA
 - ✓ When APP A/B update APP B/A successful, APP A/B(running) should update APP B/A information. It should renew counter and APP information CRC at least. The renew counter is equal APP A/B(running) counter + 1.

bootloader

APP_A info
APP_A

APP_B info
APP_B

How to swap APP A/B in bootloader

- How to swap APP A/B

For achieve swap APP/B, bootloader and APP should exchange information. After APP A/B updated APP B/A, should update APP information and trigger watchdog reset. In bootloader check APP validity, if APP is valid and jump to newest APP through check APP information storage counter which is newest.

1. Bootloader Requirements

Before Bootloader jump to APP should:

- ✓ Check APP information validity through calculate APP information CRC and storage CRC
- ✓ Check APP A and B information for judge which APP version is newest through table 1/2
- ✓ Check APP validity through calculate APP image CRC and storage APP image CRC ([option](#))

Bootloader update APP requirements

- ✓ Before bootloader update APP, bootloader should known that which APP is running. Check APP running status through read APP information counter. When bootloader updated APP, bootloader should read APP information counter(running) and storage counter + 1 in new APP information.

How to swap APP A/B in bootloader

- How to swap APP A/B

2. APP requirements

- ✓ APP A/B updated APP B/A successful, should read APP A/B (running) information counter and storage counter + 1 in APP B/A information at the same time update CRC
- ✓ Have a scenario is roll back APP version. When APP A/B(running) received roll back APP version command, APP A/B (running) should read self APP information counter and storage counter + 1 in APP B/A information at the same time update CRC

Note: Bootloader and APP should have the same CRC algorithm for access APP information.

How to swap APP A/B in bootloader

Bootloader check which APP running truth table

| APP A valid? | APP B valid? | Counter | Execute |
|--------------|--------------|----------------|--------------------------|
| Y | N | N/A | APP A |
| N | Y | N/A | APP B |
| N | N | N/A | bootloader |
| Y | Y | APP A(Table 2) | APP A |
| Y | Y | APP B(Table 2) | APP B |
| Y | Y | Error(Table 2) | Option (customer define) |

Table 1



How to swap APP A/B in bootloader

As below is the condition for found newest APP. Counter is a 8 bit value, the max is 0xFE, 0xFF is invalid.

| No. | Counter (8 bit – unsigned char) | Execute |
|-----|---|---------|
| 1 | (Counter_A == Counter_B + 1 && Counter_A > Counter_B && Counter_A != 0xFF) (Counter_A == Counter_B + 2 && Counter_A < Counter_B && Counter_B == 0xFE) | APP A |
| 2 | (Counter_B == Counter_A + 1 && Counter_B > Counter_A && Counter_B != 0xFF) (Counter_B == Counter_A + 2 && Counter_B < Counter_A && Counter_A == 0xFE) | APP B |
| 3 | Other condition enter error status | Error |

Table 2

NXP OTA Solution: APP project limit

- APP Project Limit

Usually MCU OTA should re-map APP execute address. It's mean that APP storage address and execute address is different. Customer's APP project have only link file. Due to S32K14x not support re-map all the APP execute address. For achieve the OTA feature:

- ✓ Customer's project should have 2 link file over S32DS(GCC). Customer every release version should release APP A and B. Server should hand shake with bootloader or APP for update which APP version (A/B). For every release APP A and B, just have storage different address.

NXP OTA Solution: Max Code Size

- NXP S32K146 OTA Solution: Max Code Size
 - ✓ S32K146 have 2 P-Flash partition. Every partition is 512KB. So, Bootloader + APP A info+ APP A <= 512KB. APP B info + APP B + not used <= 512KB.

NXP OTA Solution: Hand Shake Requirements

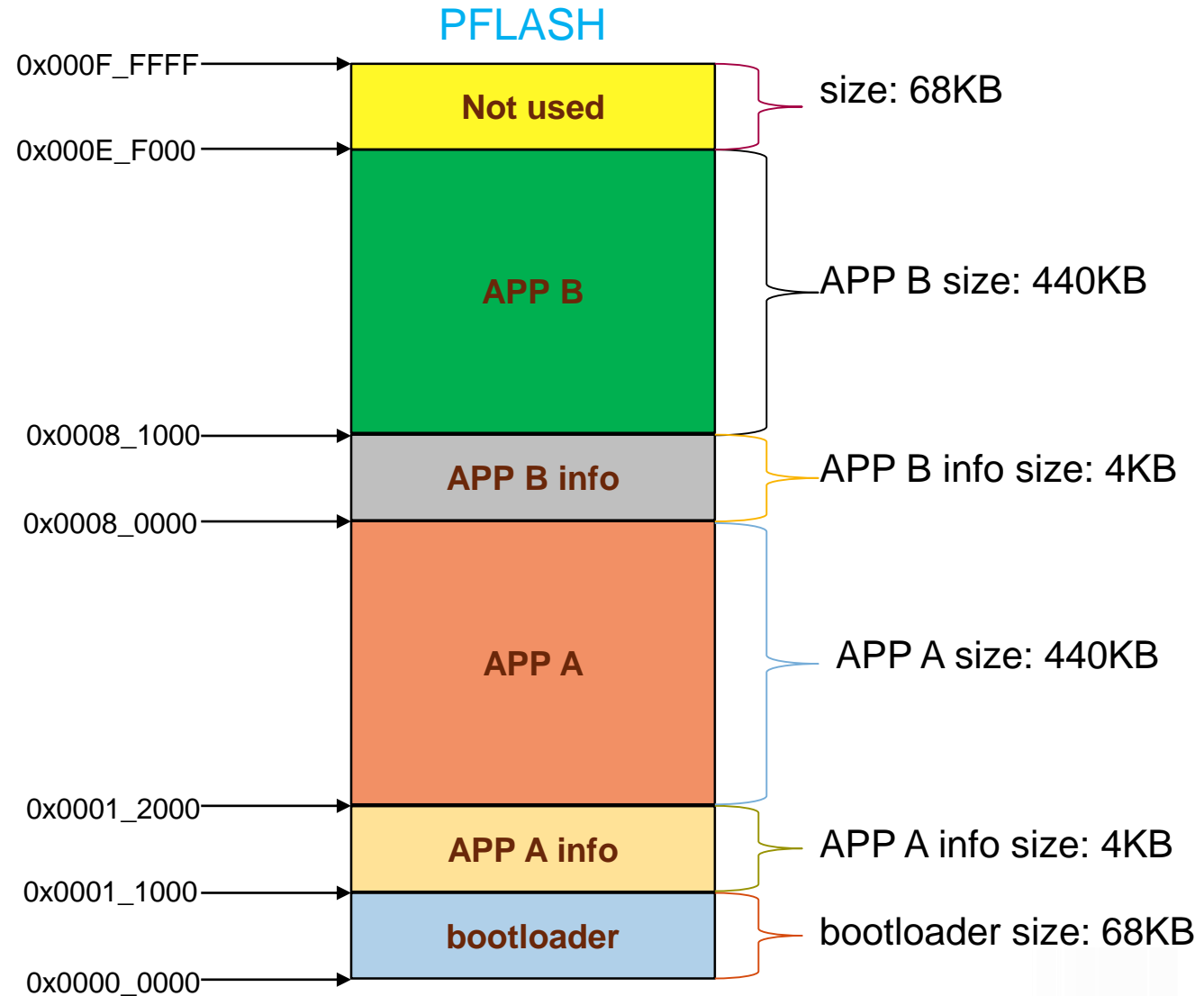
- MCU OTA Hand Shake Requirements

Server should hand shake with bootloader or APP for get which APP (A/B) version is running. And server will transfer the APP B/A image to bootloader or APP A/B.

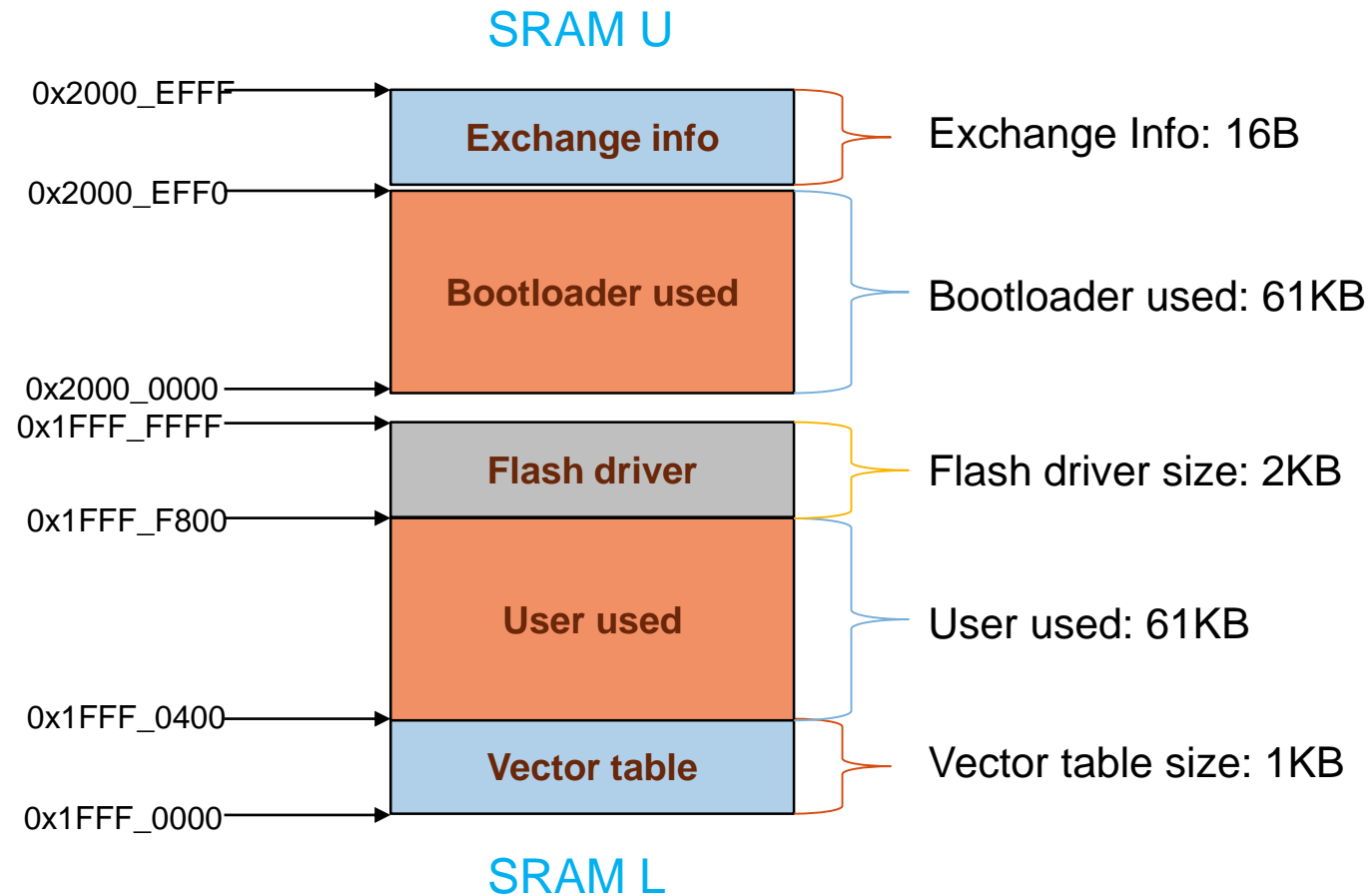
NXP OTA Solution: bootloader, APP P-Flash (S32K146)

Bootloader size: 68KB
APP A info: 4KB
APP A: 440K

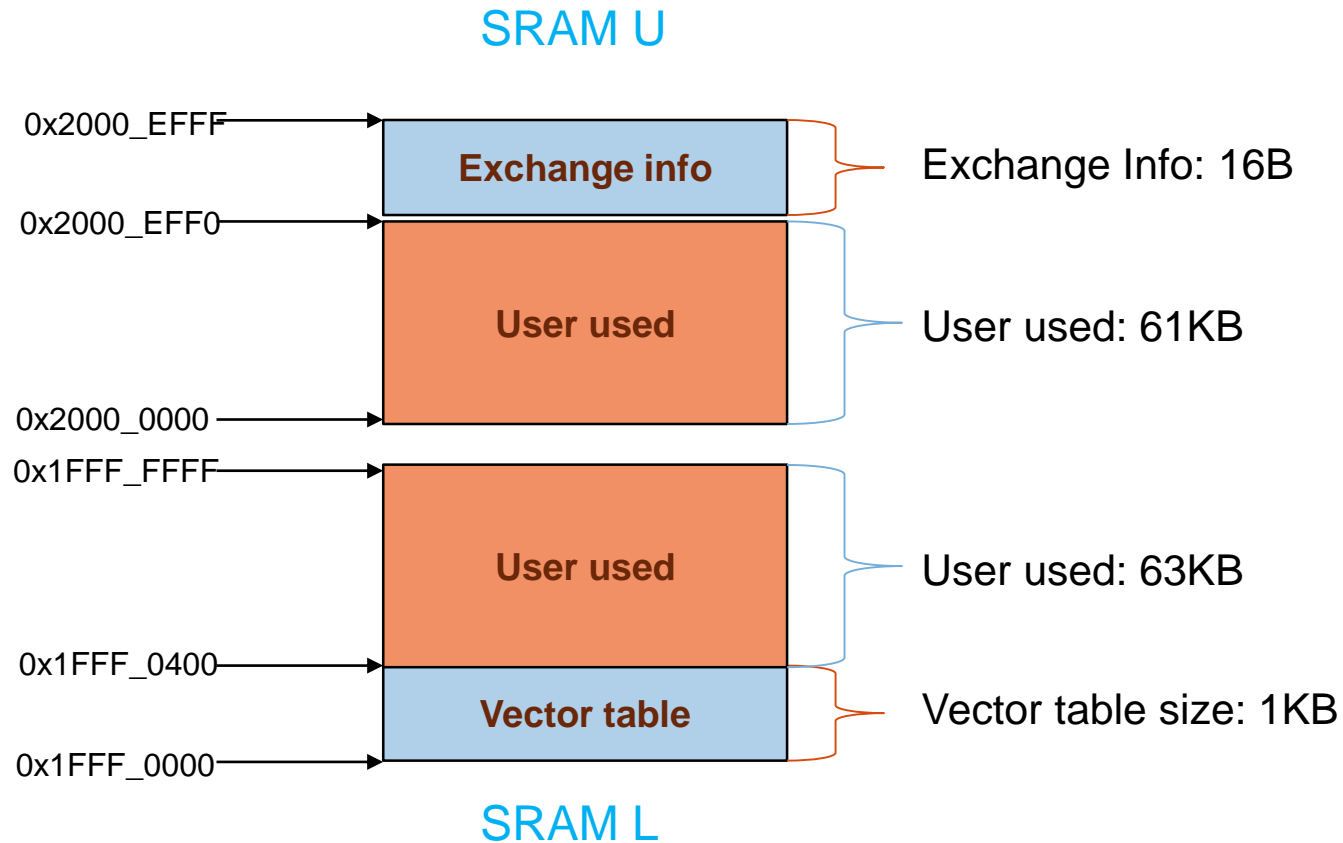
For bootloader and APP size can modify. But the APP info is must set a sector size(4KB).



NXP OTA Solution: bootloader RAM (S32K146)



NXP OTA Solution: APP RAM (S32K146)





SECURE CONNECTIONS
FOR A SMARTER WORLD

www.nxp.com