AN2475
Application note

STR91xFAxxx in-application programming using UART

Introduction

An important requirement for most Flash-based systems is the ability to update firmware while the system is installed in the end product. This is referred to as In-Application Programming (IAP).

STR9 MCUs have the capability of running user-specific firmware to perform In Application Programming of the MCU embedded Flash memory. This feature allows the use of any type of communication protocol for the reprogramming process (for example, CAN, UART, USB). In this application note, UART is used as an example.

This application note outlines general guidelines for creating an IAP application using two different methods: the first one is based on the Ymodem protocol and the second one is based on a customized UART protocol using the free Flash Loader utility provided by ST.

The STR91x evaluation boards have been used to validate the IAP driver.

The IAP Firmware is available on www.st.com.

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1 IAP overview

1.1 Principle

The IAP driver must be programmed by the user in the Flash Bank1 after being remapped in hardware to address 0x00 (Bank0 is hardware remapped at address 0x80000 for 256 or 512 Kbytes devices and at address 0x200000 for 1 or 2 Mbytes devices).

Note: *For 256K, Bank 0 must be at a 256K boundary (Bank 0 base addresses can be: 0x00, ox40000, ox80000, etc.).*

For 512K, Bank 0 must be at a 512K boundary (Bank 0 base addresses can be: 0x00, ox80000, ox100000, etc.).

For 1M, Bank 0 must be at a 1M boundary (Bank 0 base addresses can be: 0x00, 0x100000, 0x200000, etc.).

For 2M, Bank 0 must be at a 2M boundary (Bank 0 base addresses can be: 0x00, 0x200000, 0x400000, etc.).

Programming is performed via JTAG using a Flasher toolset.

1.2 Triggering execution of the IAP driver

In this application note, the pin 4 of port 7 connected to the push button (PB3) on the STR91xFA evaluation board is used as an example. This configuration allows the execution of the IAP driver. By pressing the push button at reset, the user is able to run the IAP driver to reprogram the STR91x internal Flash.

It is not mandatory to use the push button; the user can simply enter a signal on this pin with respect to its corresponding active level.

2 IAP using the Ymodem protocol

Using the UART, the IAP driver loads a binary file from HyperTerminal to the STR91xFA internal Flash bank0, and then jumps to execute it.

2.1 Driver description and code sequence

The IAP driver code size is 7.5K approximately.

It contains a set of source files:

- *main.c*: where the UART initialization and PLL configuration are set. Then, a main menu is executed from the *common.c* file.
- *common.c*: contains display functions and the main menu routine. The main menu gives the choice between loading a new binary file and executing the binary file already loaded.
- *ymodem.c* and *download.c*: they allow all data to be received from the HyperTerminal (using the YMODEM protocol (see note 1 below) then loaded into STR9 internal RAM. In the event of a failure in data reception, the error message 'Failed to receive the file' is displayed in the HyperTerminal window. Otherwise, after successful reception, the data is then programmed into internal Flash at the appropriate address. A comparison between internal RAM and internal Flash contents is performed to check the data integrity. If there is a mismatch, the error message 'Verification failed' is displayed in the HyperTerminal window. Other error messages are also displayed when the image size is higher than the allowed memory space and when there is an abort by the user.

Note: The Ymodem protocol sends data in 1024-byte blocks. Error detection is applied to data blocks transmitted to the STR91xFA internal RAM. This is done through a comparison between the transmitted and received data. Blocks received unsuccessfully are acknowledged with a NAK (Negative Acknowledgement). For more details about the Ymodem protocol, please refer to the existing literature.

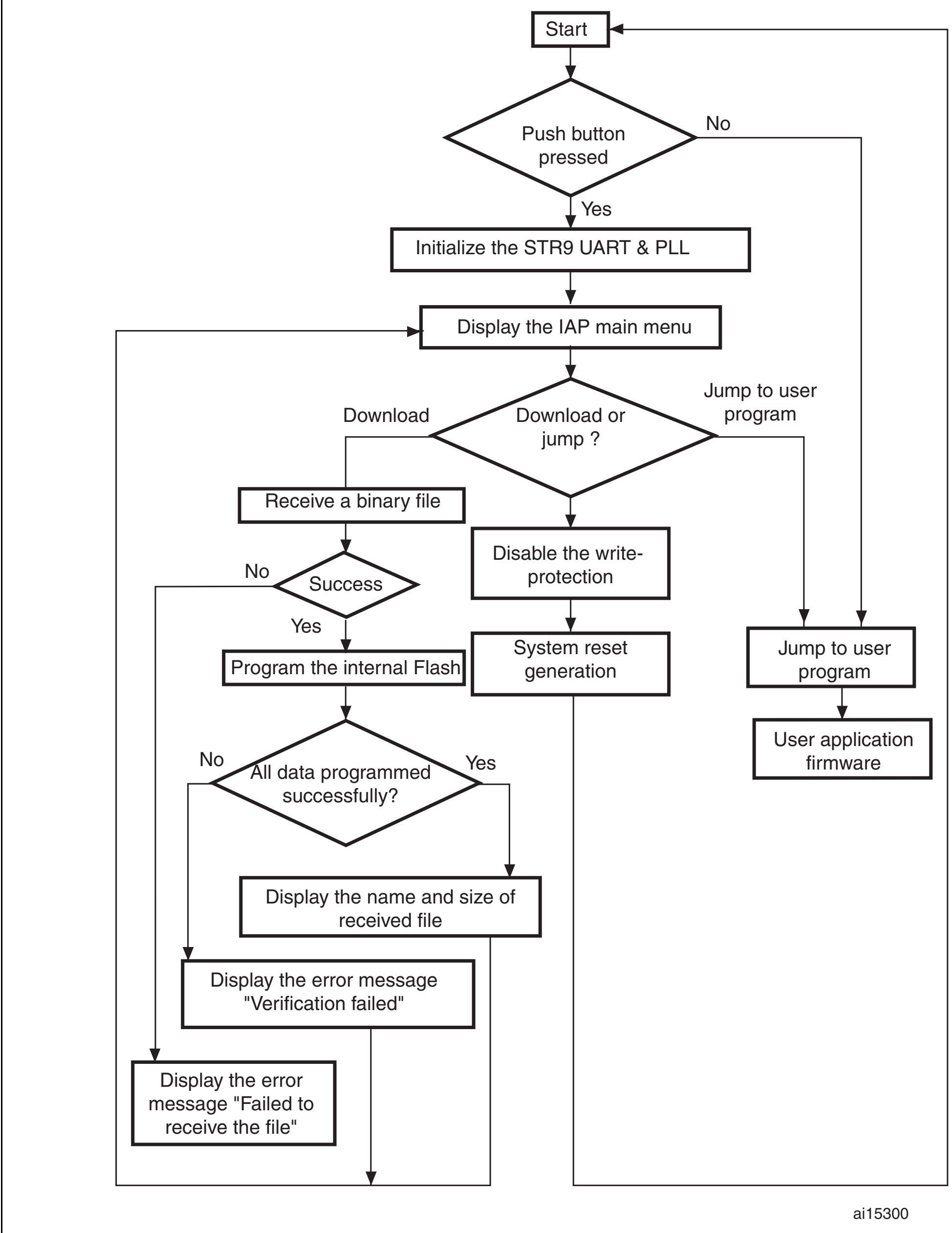
- Some STR91xFA firmware library source files and header files
  - *91x_fmi.c* and *91x_fmi.h*
  - *91x_gpio.c* and *91x_gpio.h*
  - *91x_scu.c* and *91x_scu.h*
  - *91x_uart.c* and *91x_uart.h*
  - *91x_lib.h*
  - *91x_map.h*
  - *91x_type.h*
  - *91x_it.c*
  - *91x_it.h*

A pin connected to a push button is used to select between jumping to the user application and executing the IAP for reprogramming purposes:

- At reset, the push button is pressed: the IAP main menu is displayed
- At reset, the push button is not pressed: Jump to the user application.

Figure 1 shows the IAP flowchart.

Figure 1. Flowchart of the IAP using the Ymodem protocol driver


Start
Push button pressed
No
Yes
Initialize the STR9 UART & PLL
Display the IAP main menu
Download
Download or jump ?
Jump to user program
Receive a binary file
Disable the write-protection
No
Success
Yes
Program the internal Flash
System reset generation
Jump to user program
User application firmware
No
All data programmed successfully?
Yes
Display the name and size of received file
Display the error message "Verification failed"
Display the error message "Failed to receive the file"
ai15300

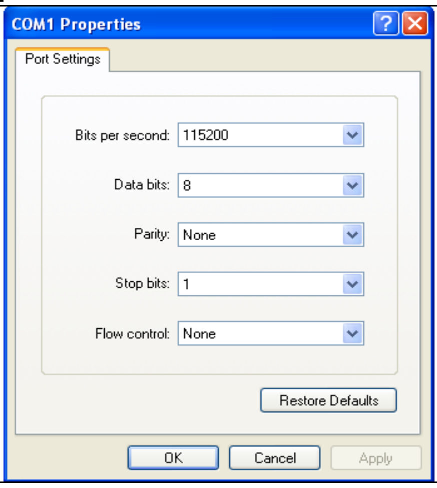
2.2 Running the IAP driver

On STR91xFA devices, the IAP driver is programmed in Bank1 which is remapped in hardware to address 0x00.

2.2.1 HyperTerminal configuration

The IAP requires a PC running HyperTerminal with the following settings:

Figure 2. COM Port Properties



COM1 Properties

Port Settings

Bits per second:	115200
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

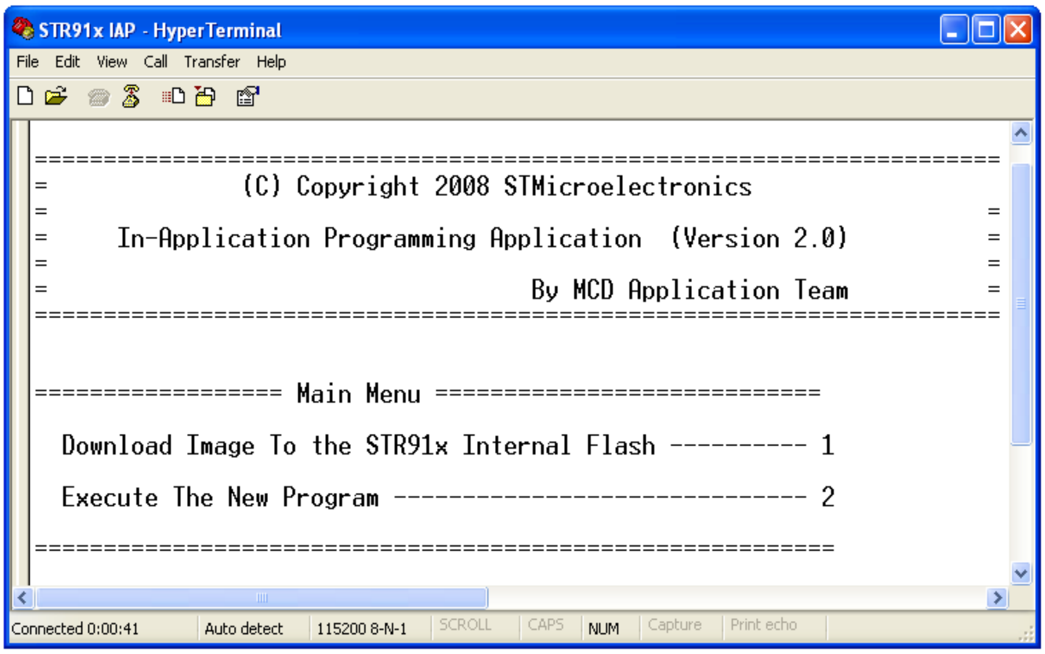
Note: *A baud rate value of 115200 bps is used as an example.*

Care should be taken when selecting the system clock frequency. Ensure that with the system clock frequency used in the application, a baud rate equal to 115200 bps can be generated in order to guarantee successful communication via UART.

2.2.2 IAP driver menu

The execution of the IAP firmware results in the following menu displayed in the HyperTerminal window.

Figure 3. IAP driver menu



```
==================================================================
=               (C) Copyright 2008 STMicroelectronics
=                                                                =
=     In-Application Programming Application  (Version 2.0)      =
=                                                                =
=                                 By MCD Application Team        =
==================================================================


================= Main Menu ==========================

  Download Image To the STR91x Internal Flash ---------- 1

  Execute The New Program ----------------------------- 2

=======================================================
```

2.2.3 Download image to internal Flash

To download a binary file via HyperTerminal to the STR91xFA internal Flash, follow the procedure below:

- Press “**1**” on the keyboard to choose the menu “**Download image to internal Flash**”

Then, in the Transfer menu, select *“***Send file**”:

- In the **filename** field, type the name and the path of the binary file to be sent.
- In the protocol list, choose the **Ymodem** protocol,
- Click the “**Send**” button.

Following these steps, the IAP driver loads the binary file into the STR91xFA internal Flash from Bank0 sector0 base address and displays the binary file name and file size in the HyperTerminal window.

2.2.4 Execute the new program

After loading the new program from HyperTerminal by selecting the **“Download image to internal Flash**” menu, the code can be executed by selecting the **“Execute the new program**” menu by pressing “**2**” from the keyboard.

3 IAP using the ST Flash loader

ST provides a free Flash loader utility allowing the program of the STR91xFA internal Flash Bank0 using an IAP driver to be loaded in the Flash Bank1.

3.1 IAP code sequence

The IAP driver code size is approximately 6 Kbytes.

It contains a set of source files:

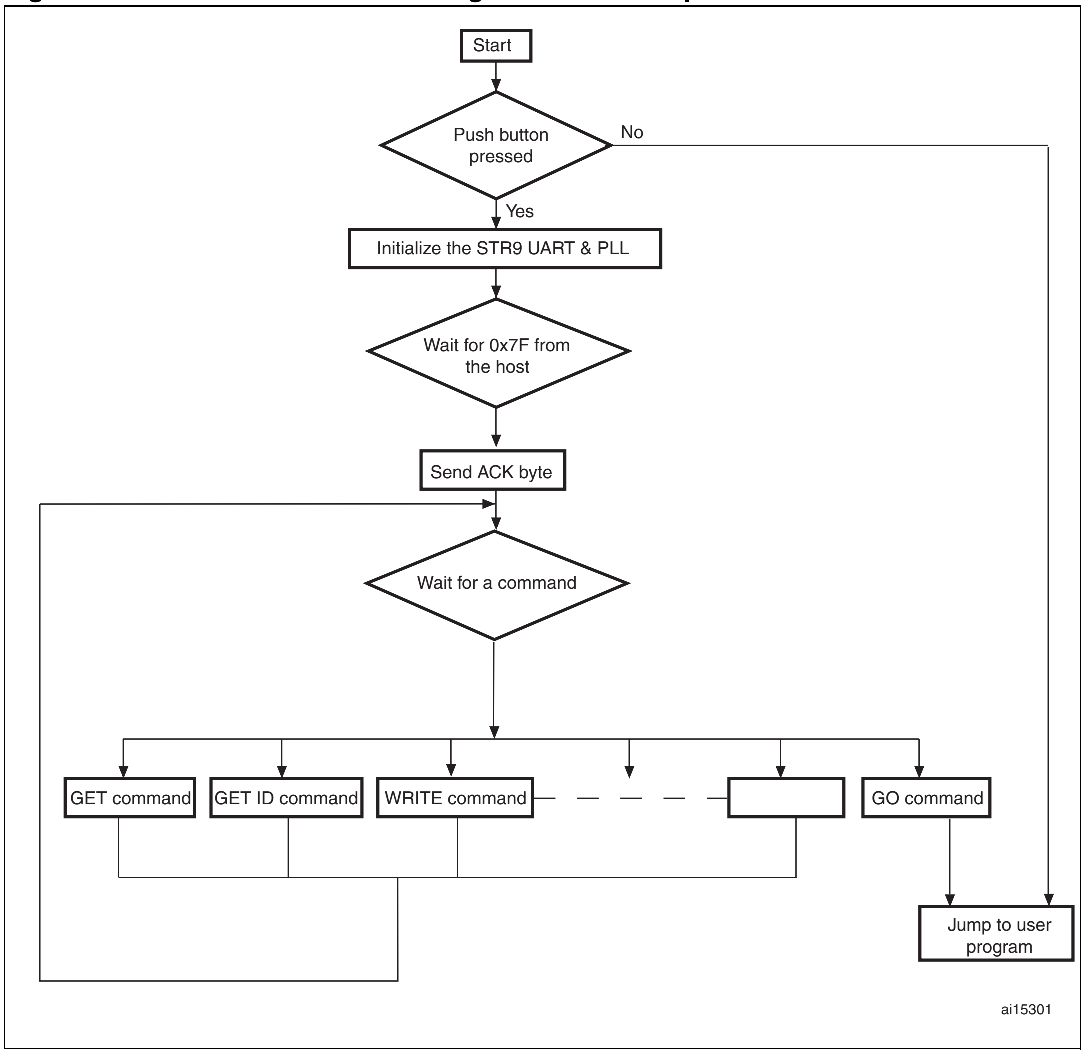
- *main.c*
- *iap.c*
- Some STR91xFA firmware library source files and header files
  - *91x_fmi.c* and *91x_fmi.h*
  - *91x_gpio.c* and *91x_gpio.h*
  - *91x_scu.c* and *91x_scu.h*
  - *91x_uart.c* and *91x_uart.h*
  - *91x_lib.h*
  - *91x_map.h*
  - *91x_type.h*
  - *91x_it.c and 91x_it.h*

A pin connected to a push button is used to select between jumping to the user application and executing the IAP for reprogramming purposes:

- At reset, the push button is pressed: connection to the ST Flash Loader.
- At reset, the push button is not pressed: Jump to the user application.

The figure below shows the IAP flowchart.

Figure 4. Flowchart of the IAP using the bootloader protocol driver



Once the push button is pressed, the IAP code begins to scan the UART0_RX line, waiting to receive 0x7F data from the host: one start bit, 0x7F data bits, even parity bit and one stop bit.

Next, the code initializes the serial interface (115200 bps, Even Parity, One Stop bit). Then, the STR91xFA returns an acknowledge byte (0x79) to the host, signaling that it received the 0x7F byte and it is ready to receive user commands.

3.2 Command set description

The supported commands are listed in the table below. Each command is further described in this section.

Table 1. Command list

Command	Command code	Command description
GET	0x00	Get the version and the allowed commands.
GET ID	0x02	Get the Chip ID.
WRITE	0x31	Write maximum 256 bytes to the Flash Bank0 starting from an address specified by the user.
READ	0x11	Read up to 256 bytes of Flash Bank0 starting from an address specified by the user.
ERASE	0x43	Erase from one to all the Bank0 sectors.
WRITE UNPROTECT	0x71	Write Unprotect all Bank0 sectors.
GO	0x21	Jump to Bank0 base address specified by the user to execute a loaded code.

Communication safety

All communication from the programming tool (PC) to the device is verified in the following ways:

1. Checksum: all received bytes are XORed. A byte containing the computed XOR of all previous bytes is added at the end of each communication (Checksum byte). By XORing all received bytes (data + Checksum), the result, at the end of the packet, must be 0x00.
2. For each command, the host sends a byte and its complement (XOR = 0x00).
3. UART: a parity check is active (even parity).

Each packet is either accepted (ACK answer) or discarded (NACK answer).

- ACK = 0x79
- NACK = 0x1F

3.2.1 Get command

The Get command allows the user to get the version of the IAP and the supported commands. When the STR91xFA receives the Get command, it transmits the version and the supported command codes to the host, as described in *Figure 5*.

Figure 5. Get command host side

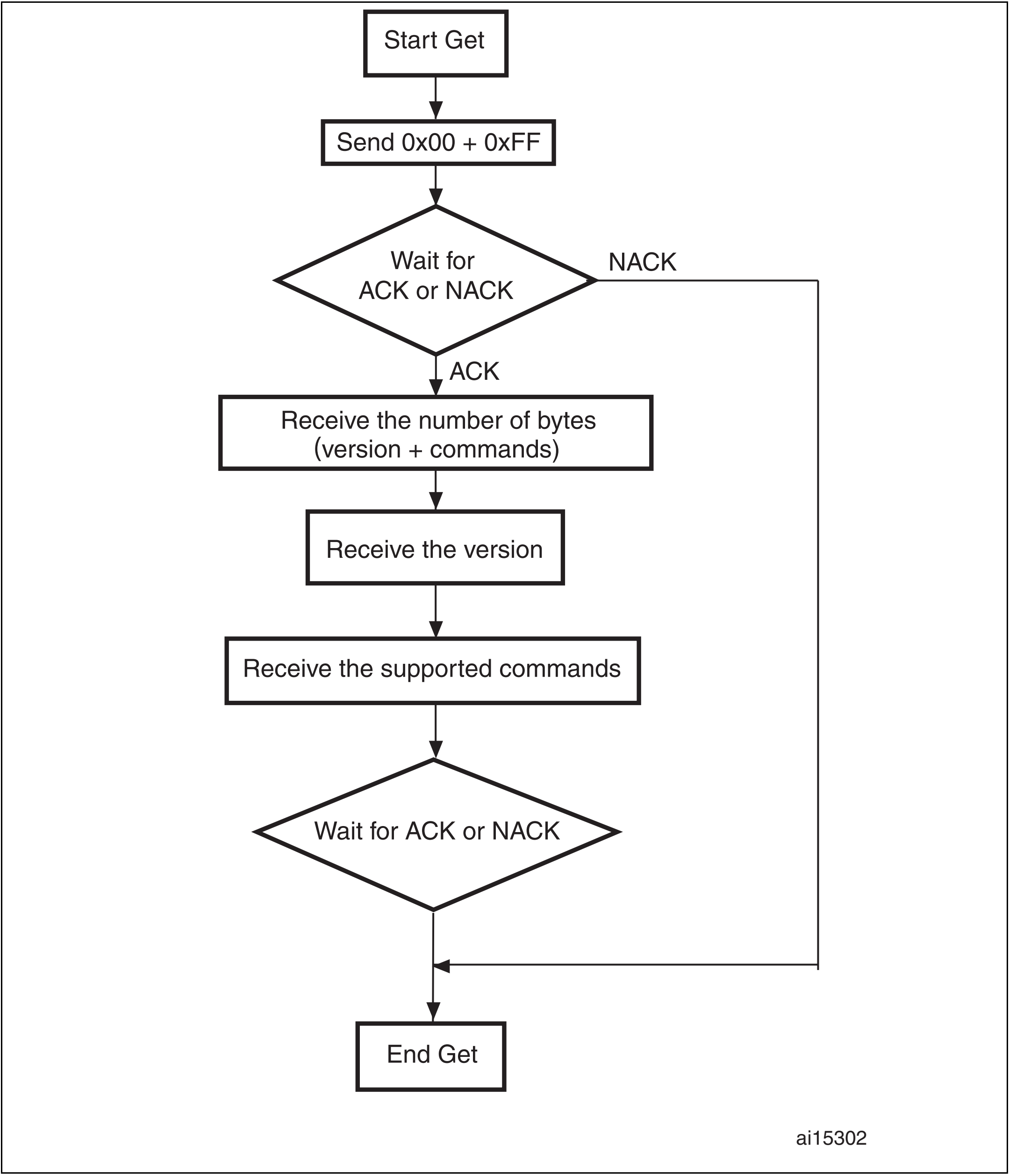
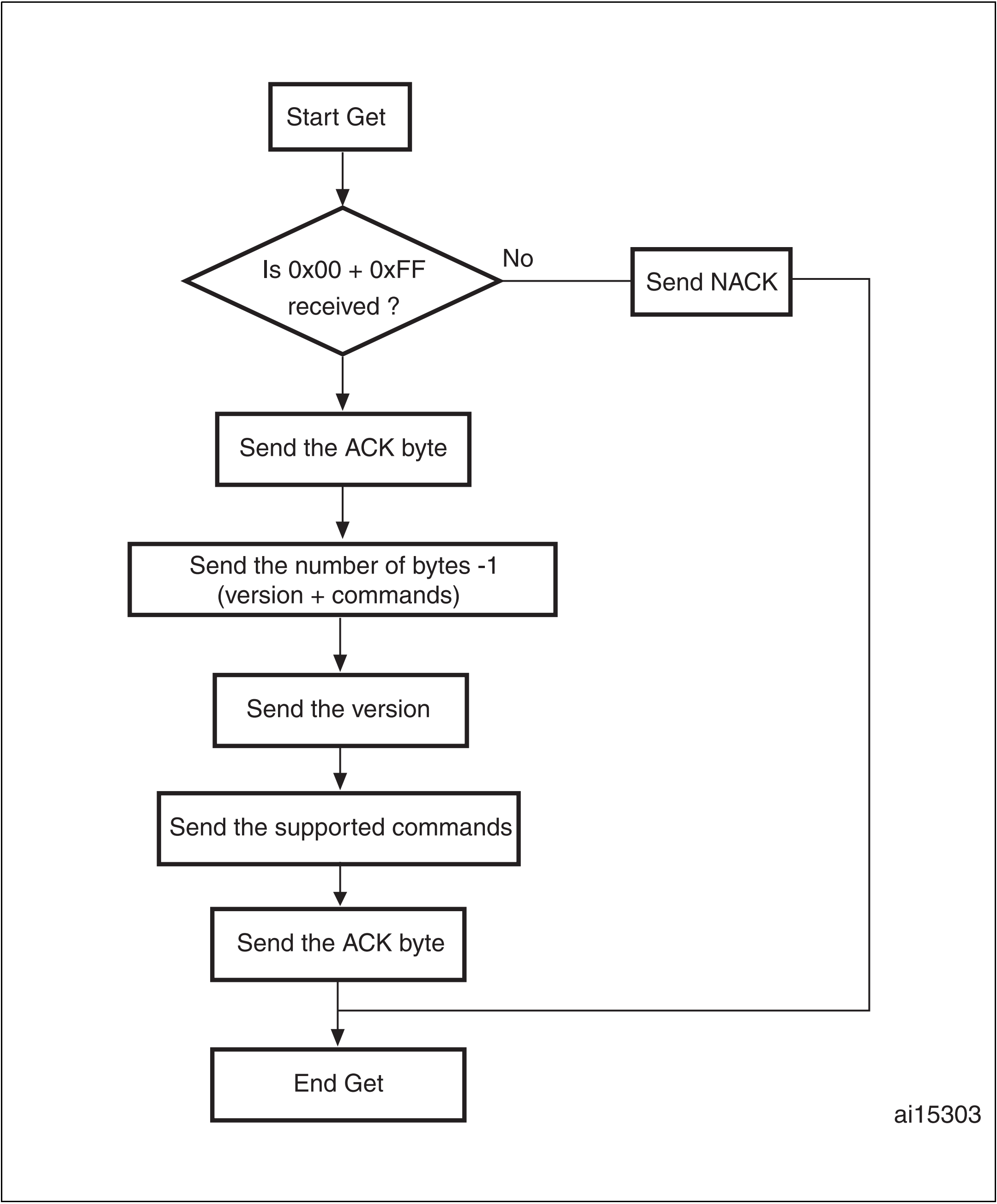


Figure 6. Get command STR91xFA side


Start Get
Is 0x00 + 0xFF received ?
No
Send NACK
Send the ACK byte
Send the number of bytes -1 (version + commands)
Send the version
Send the supported commands
Send the ACK byte
End Get
ai15303

The STR91xFA sends the bytes as follows:

- Byte 1: ACK
- Byte 2: N = 7 = the number of bytes to follow – 1 except current and ACKs.
- Byte 3: Version (0 < Version ≤255): 10 = Version 1.0
- Byte 4: 0x00 – Get command
- Byte 5: 0x02 – Get ID
- Byte 6: 0x11 – Read Memory command
- Byte 7: 0x21 – Go command
- Byte 8: 0x31 – Write Memory command
- Byte 9: 0x43 – Erase command
- Byte 10: 0x71 – Write Unprotect command
- Last byte (11) – ACK

3.2.2 Get ID command

This command allows the user to get the Chip ID. When the STR91xFA receives the Get ID command, it transmits to the host the Product ID.

Figure 7. Get ID command host side

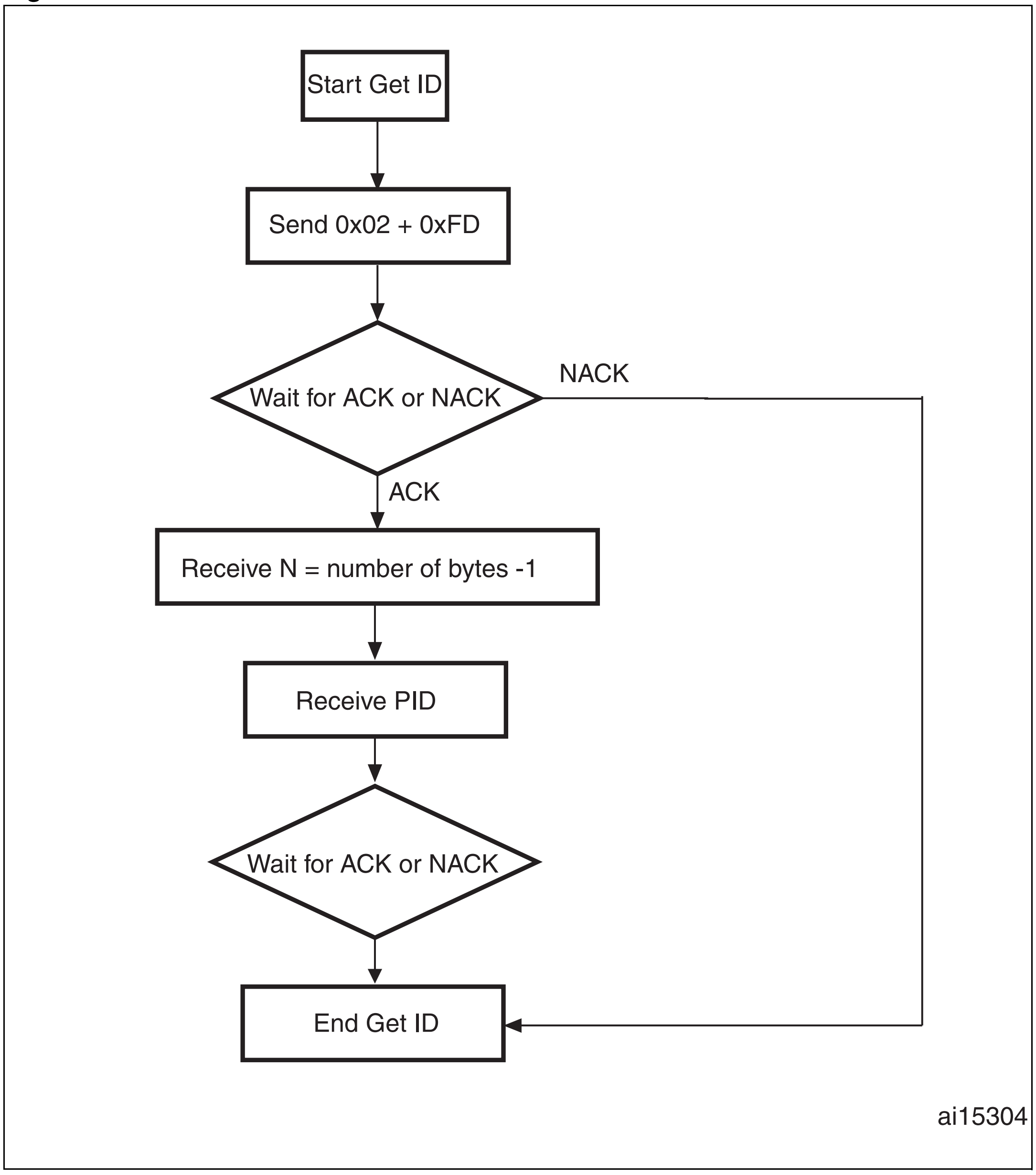
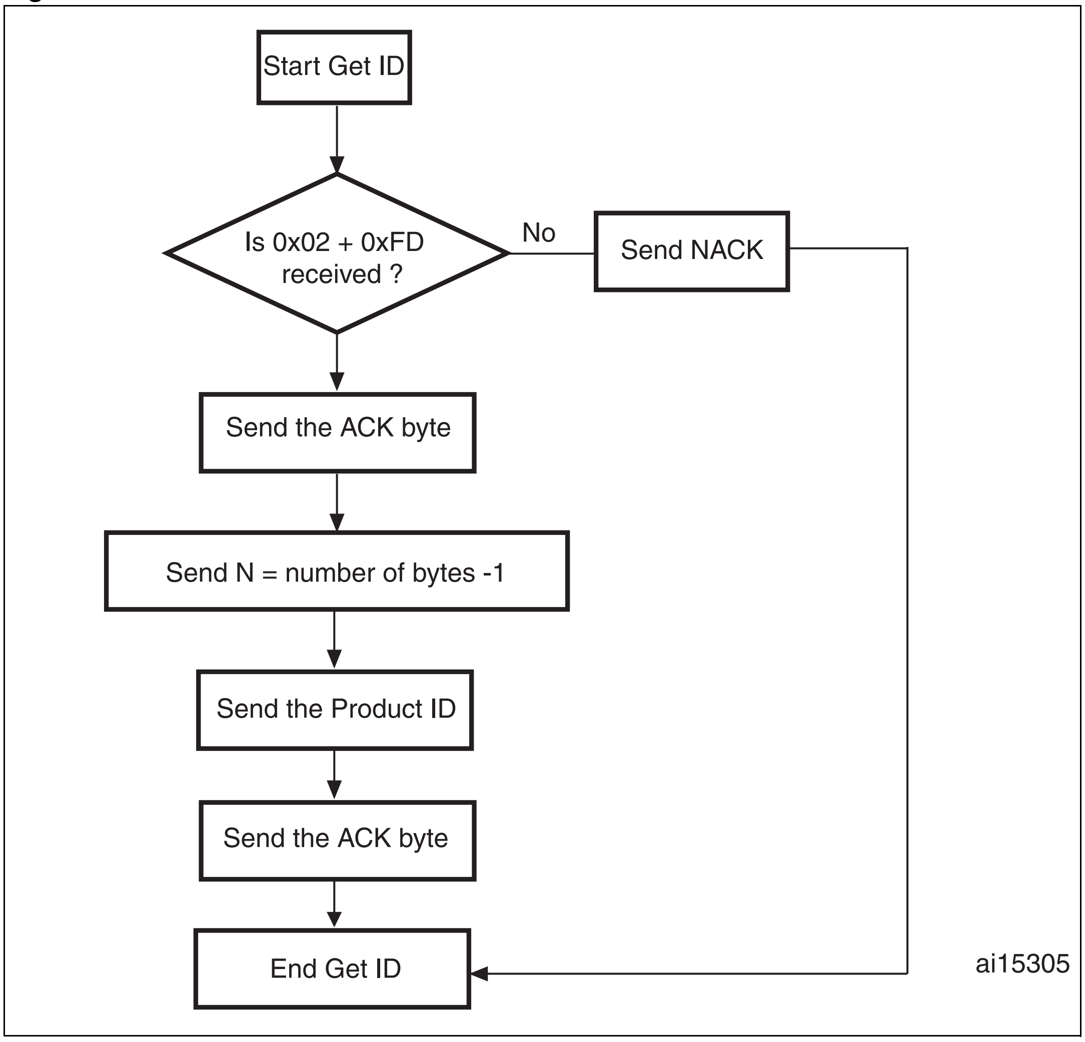


Figure 8. Get ID command STR91xFA side



The STR91xFA sends the bytes as follows:

- Byte 1: ACK
- Byte 2: N = the number of bytes – 1 (N = 3), except for current byte and ACKs.
- Bytes 3-6 (corresponding to the PID): byte 3 = 25, byte 4 = 96, byte 5 = 60, byte 6 = 41

Note: *PID is the product ID. For STR91xFA products, it is the same as the JTAG ID.*

3.2.3 Go command

This command allows the user to execute the downloaded code or any other code in Bank0 after being remapped to address 0x00. This address is checked: if the address is valid and checksum is OK, the STR91xFA transmits an ACK byte, otherwise it transmits a NACK byte and exits from the command. When the address is valid and checksum is OK, a software remapping is performed and the program counter of the CPU jumps automatically to address 0x00.

Figure 9. GO command host side

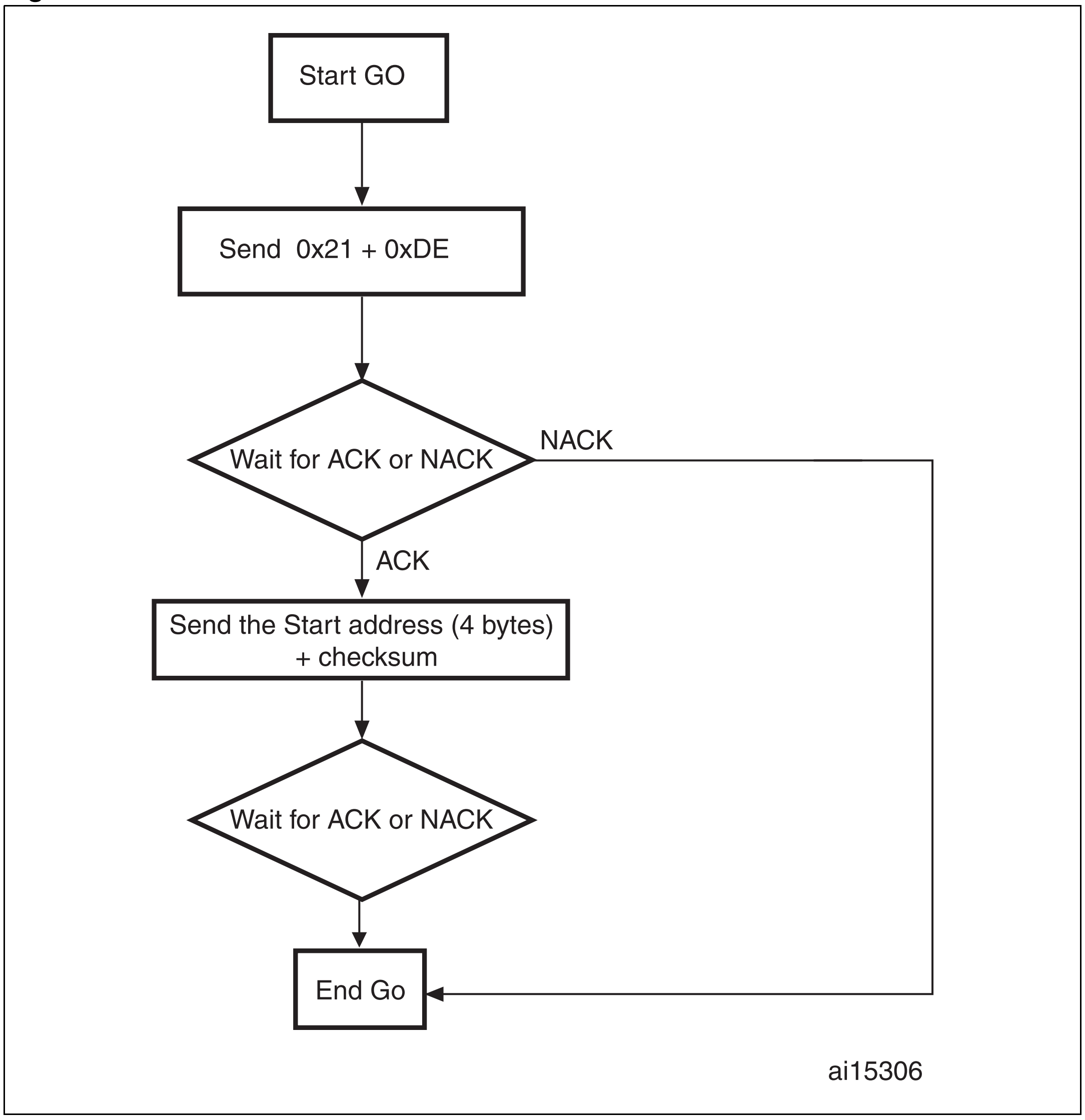
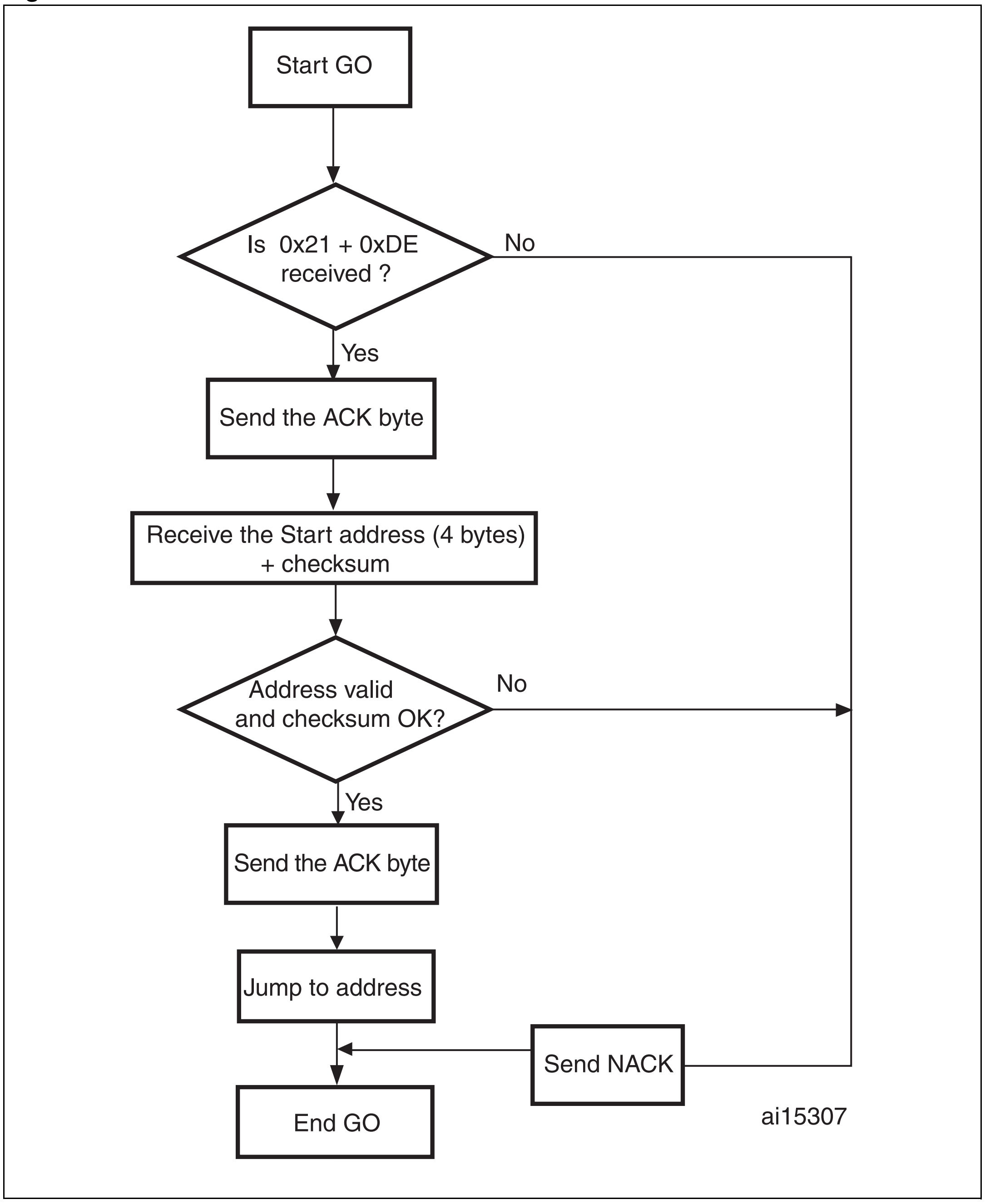


Figure 10. GO command STR91xFA side


Start GO
Is 0x21 + 0xDE received ?
No
Yes
Send the ACK byte
Receive the Start address (4 bytes) + checksum
Address valid and checksum OK?
No
Yes
Send the ACK byte
Jump to address
Send NACK
End GO
ai15307

The host sends the bytes to the STR91xFA as follows:

- Byte 1: 0x21
- Byte 2: 0xDE
- Wait for ACK
- Byte 3 to Byte 6: start address (byte 3: MSB and byte 6: LSB)
- Byte 7: checksum: XOR (byte 3, byte 4, byte 5, byte 6)

3.2.4 Write command

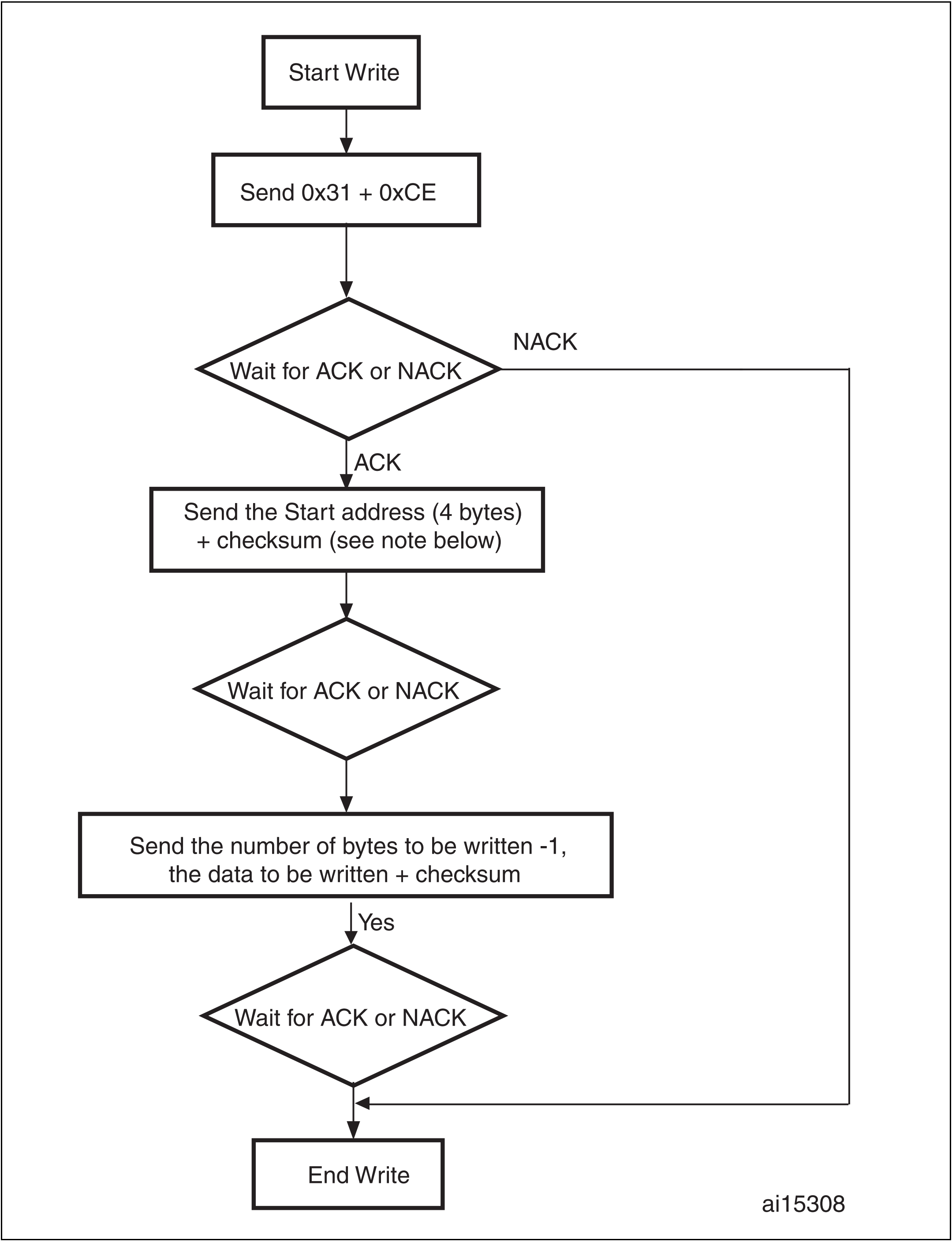
This command allows the user to write a data to any address in Flash Bank0. When the STR91xFA receives the Write Memory command, it transmits the ACK byte to the user. Once the ACK byte is transmitted, the STR91xFA waits for an address (4 bytes, byte 1 is the MSB and byte 4 is LSB of the address) and a checksum byte. This address is checked: if it is valid and checksum is OK, the STR91xFA transmits an ACK byte, otherwise it transmits a NACK byte and exits from the command. When the address is valid and checksum is OK, the STR91xFA:

- Gets a byte, N - 1, where N = the number of data bytes to be received,
- Receives the user data (N bytes) and the Checksum (XOR of the first byte (N-1) and of all data bytes which follow).
- If checksum is correct, the user data are programmed to Flash Bank0 starting from the received address which is 0x80000 for 256/512Kbytes devices or 0x200000 for 1/2Mbytes devices.

Finally, at the end of the command, the STR9 transmits the ACK byte if the write operation is completed successfully, otherwise a NACK byte is transmitted to the user and the command is exited.

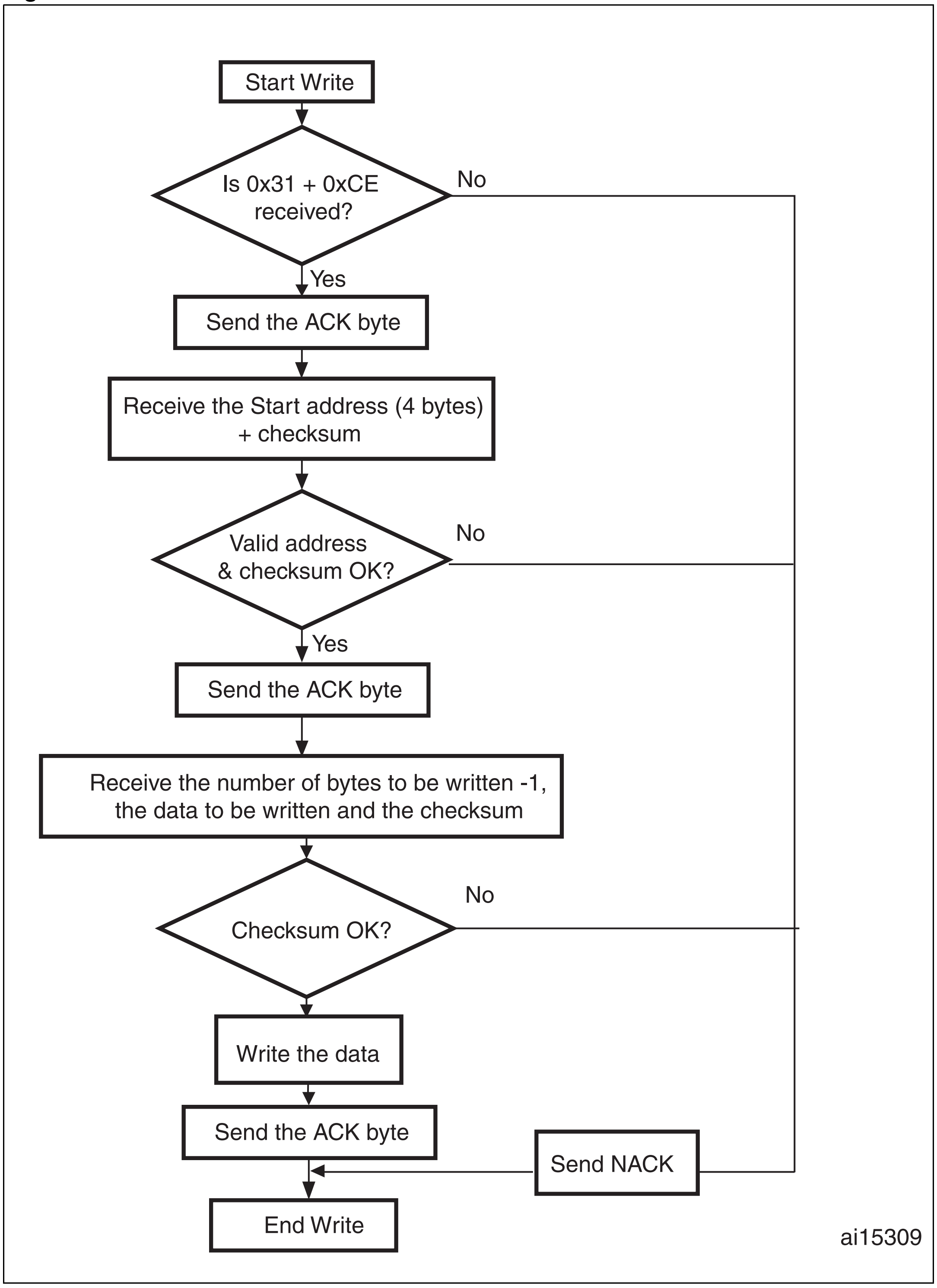
Note: The maximum length of the block to be written is 256. If N is higher than the maximum length, the command will be NACKed.

Figure 11. Write command host side


Start Write
Send 0x31 + 0xCE
Wait for ACK or NACK
NACK
ACK
Send the Start address (4 bytes) + checksum (see note below)
Wait for ACK or NACK
Send the number of bytes to be written -1, the data to be written + checksum
Yes
Wait for ACK or NACK
End Write
ai15308

Note: *The Start address to be sent by the user is the Flash Bank0 base address i.e. 0x80000 for 256/512Kbytes devices and 0x200000 for 1/2 Mbytes devices.*

Figure 12. Write command STR91x side


Start Write
Is 0x31 + 0xCE received?
No
Yes
Send the ACK byte
Receive the Start address (4 bytes) + checksum
Valid address & checksum OK?
No
Yes
Send the ACK byte
Receive the number of bytes to be written -1, the data to be written and the checksum
Checksum OK?
No
Write the data
Send the ACK byte
Send NACK
End Write
ai15309

The host sends the bytes to the STR91xFA as follows:

- Byte 1: 0x31
- Byte 2: 0xCE
- Wait for ACK
- Byte 3 to byte 6: start address
- Byte 3: MSB and byte 6: LSB
- Byte 7: Checksum: XOR (byte 3, byte 4, byte 5, byte 6)
- Wait for ACK
- Byte 8: Number of bytes to be received ($0 < N \leq 255$)
- N +1 data bytes: (max. 256 bytes)
- Checksum byte: XOR (N, N+1 data bytes)
- Wait for ACK

3.2.5 Read command

This command allows the host to read the Flash Bank0 locations. When the STR91xFA receives the Read Memory command, it transmits the ACK byte to the host. After the transmission of the ACK byte, the STR91xFA waits for an address (4 bytes: byte 1 is the MSB and byte 4 is LSB of the address) and for a checksum byte. This address is checked: if the address is valid and checksum is OK, it transmits an ACK byte, otherwise it transmits a NACK byte and exits from the command. When the address is valid and checksum is correct, the STR91xFA sends an ACK byte and waits for the information on the number of bytes to be transmitted (N-1 value) and for its complement (checksum). If the checksum is correct then it transmits to the user the needed data (N bytes) starting from the received address, otherwise it sends a NACK before exiting from the command.

Figure 13. Read command host side

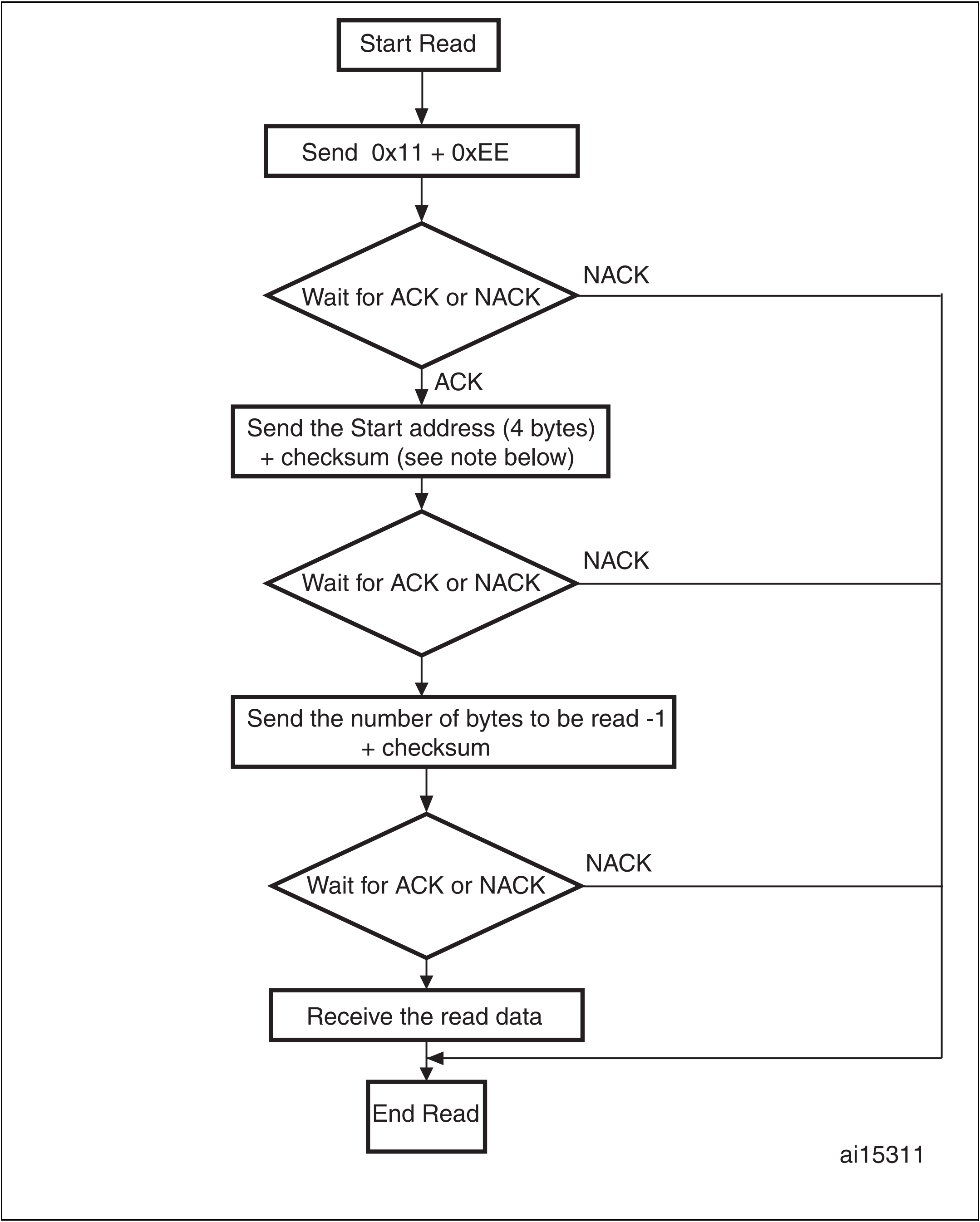
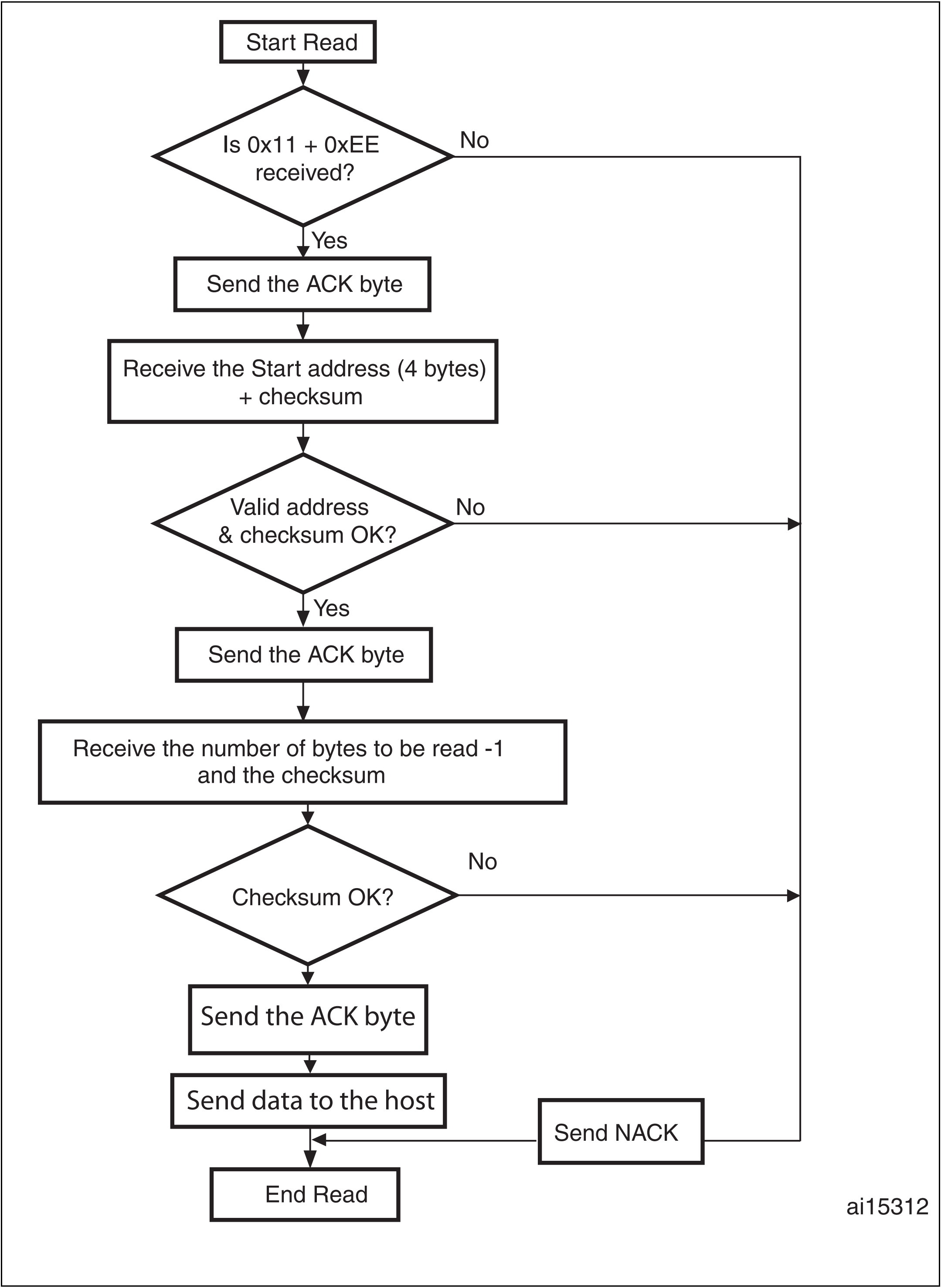


Figure 14. Read command STR91xFA side



The host sends the bytes to the STR91xFA as follows:

- Bytes 1-2: 0x11+ 0xEE
- Wait for ACK
- Bytes 3 to 6: start address (byte 3: MSB and byte 6: LSB)
- Byte 7: Checksum: XOR (byte 3, byte 4, byte 5, byte 6)
- Wait for ACK
- Byte 8: The number of bytes to be read – 1 ($0 < N \leq 255$);
- Byte 9: Checksum: XOR byte 8 (complement of byte 8)

3.2.6 Erase command

This command allows the host to erase the sectors of the Flash Bank0. When the STR91xFA receives the Erase command, it transmits the ACK byte to the host. Once the ACK byte is transmitted, the STR91xFA receives the number of bytes to be received - 1 (number of sectors to be erased - 1), the Bank0 sector codes and a checksum byte. If the checksum is correct, then the erase operation is performed, an ACK byte is sent to the host, otherwise a NACK byte is sent to the host and the command is exited. The Erase command proceeds as follows:

1. Receive one byte, N-1 (where N = number of sectors to be erased). The value 0xFF is reserved for global erase request.
2. Receive N bytes, each byte containing a sector code.

Figure 15. Erase command host side

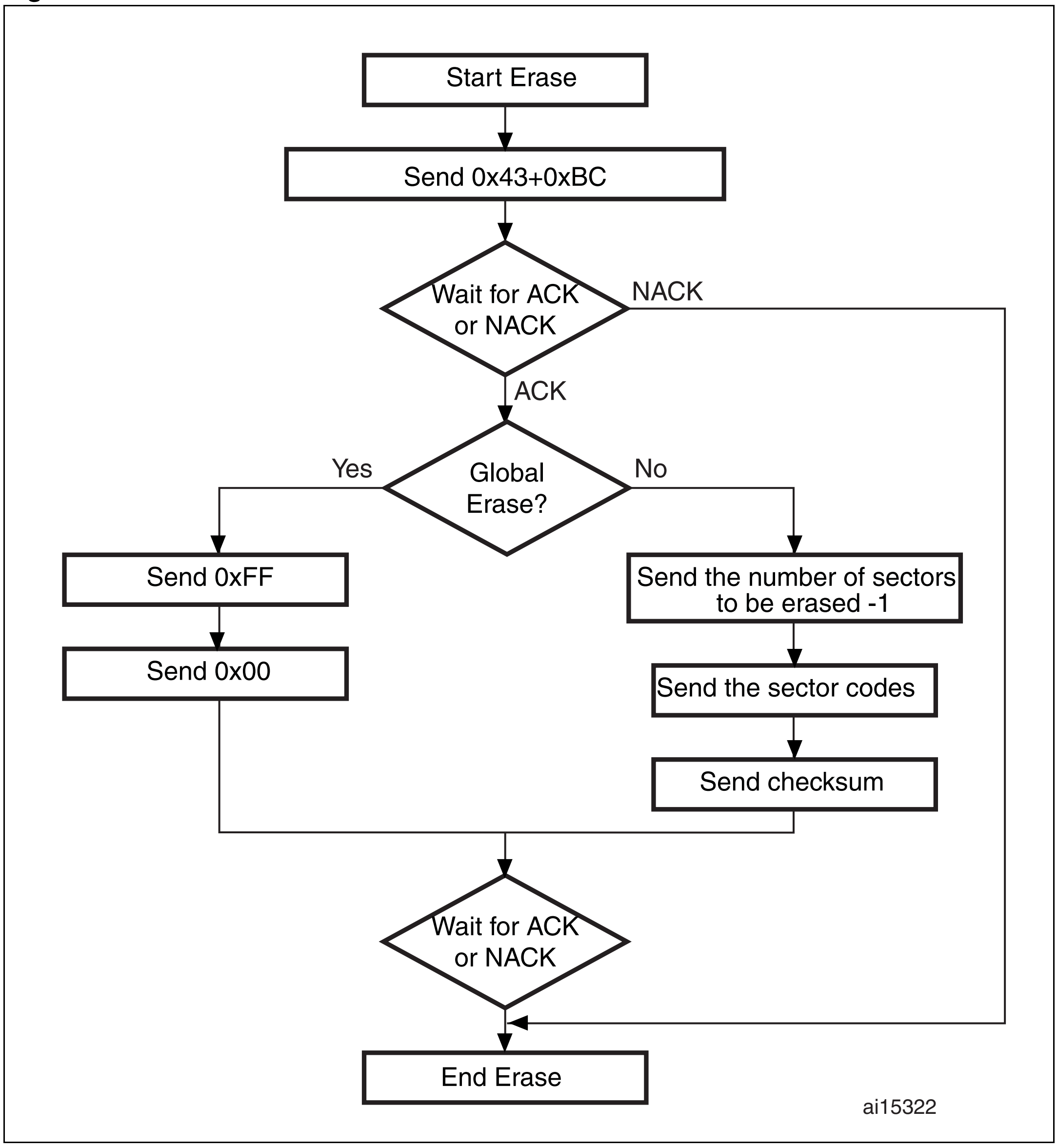
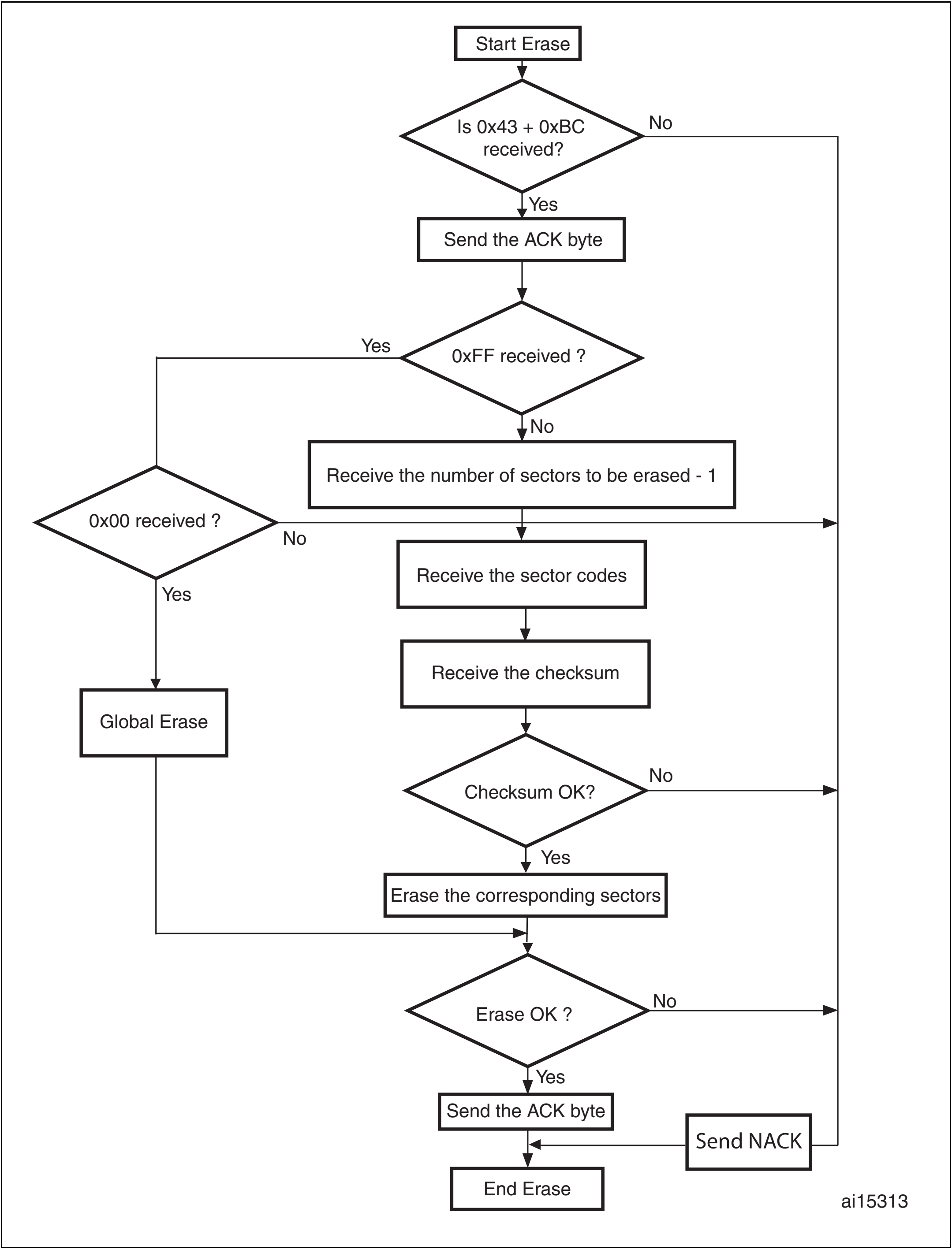


Figure 16. Erase command STR91xFA side



The host sends the bytes to the STR91xFA as follows:

- Byte 1: 0x43
- Byte 2: 0xBC
- Wait for ACK
- Byte 3: 0xFF or number of sectors to be erased - 1 (N = number of sectors)
- Byte 0x00 or (N + 1 bytes (sector codes) and then the checksum for byte 3 and the following bytes)

3.2.7 Write Unprotect command

This command allows the user to disable the write protection for all Bank0 sectors. When the STR91xFA receives the write unprotect command, it transmits the ACK byte to the host. Once the ACK byte is transmitted, the write protection for all Bank0 sectors is disabled. Finally, at the end of the command, the STR91xFA transmits the ACK byte if the unprotection is completed successfully, otherwise a NACK byte is transmitted to the host.

Figure 17. Write Unprotect command host side

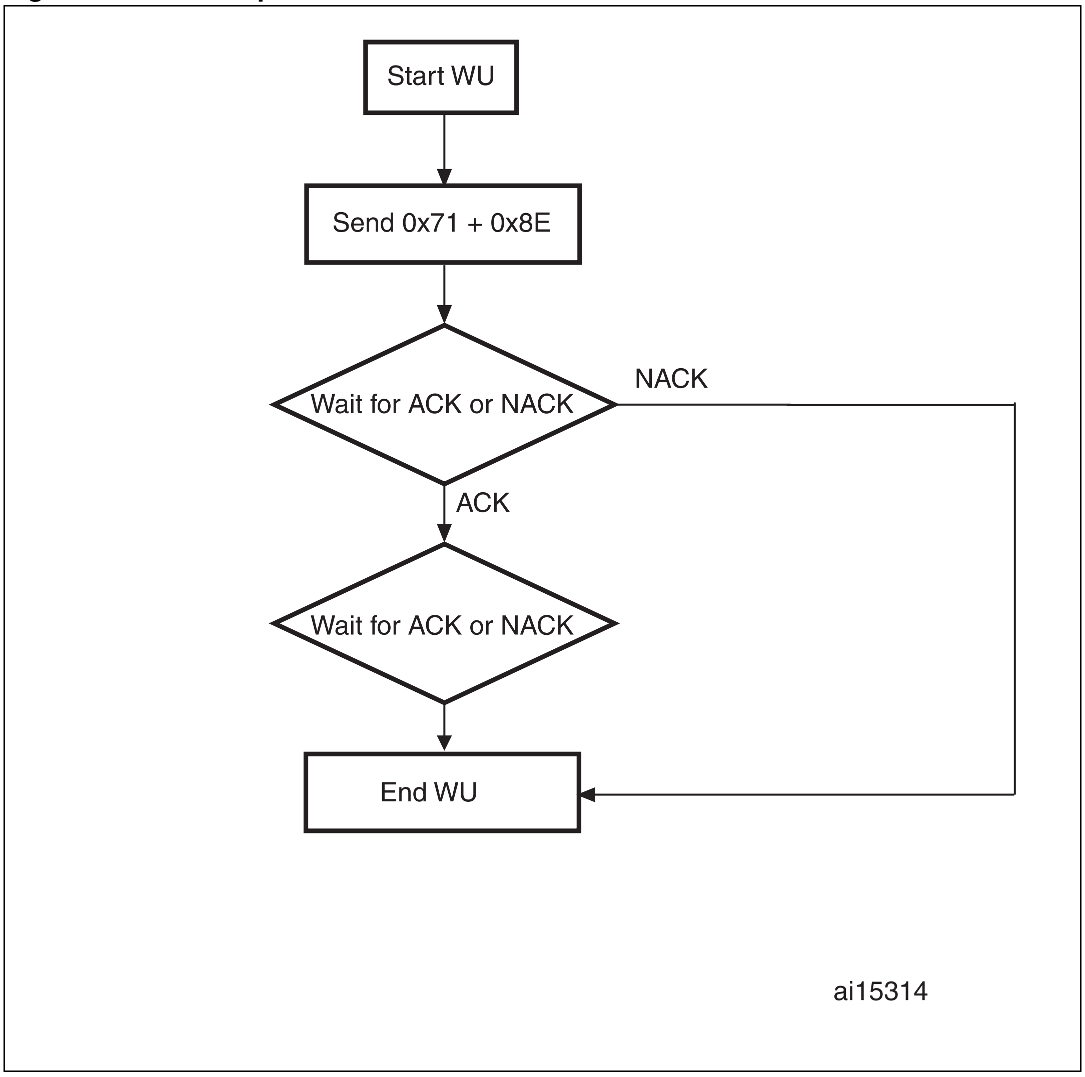
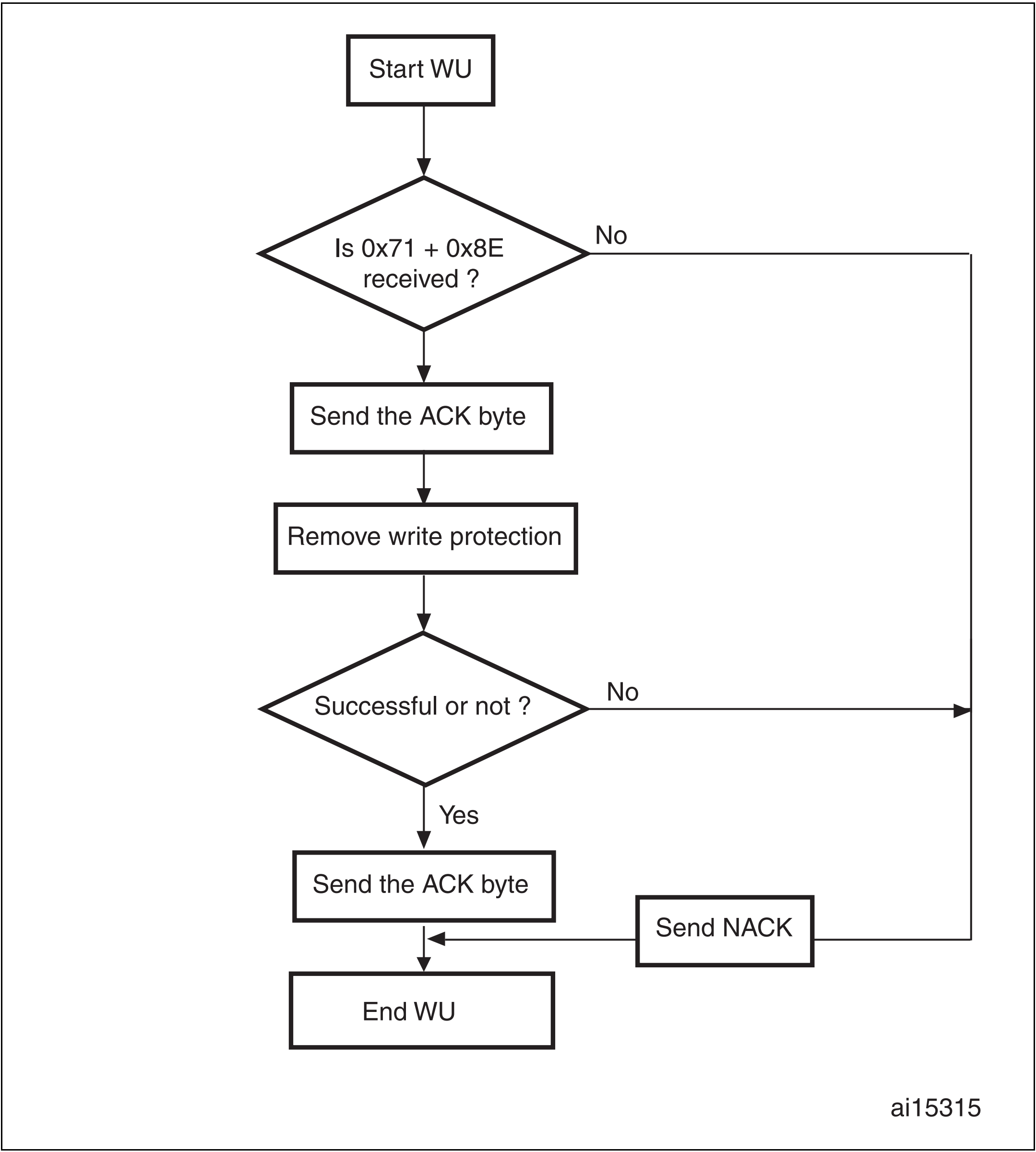


Figure 18. Write Unprotect command STR91xFA side



3.3 Running the IAP driver firmware using the Flash loader

The IAP driver is programmed in Bank1 which is remapped in hardware at address 0x00.

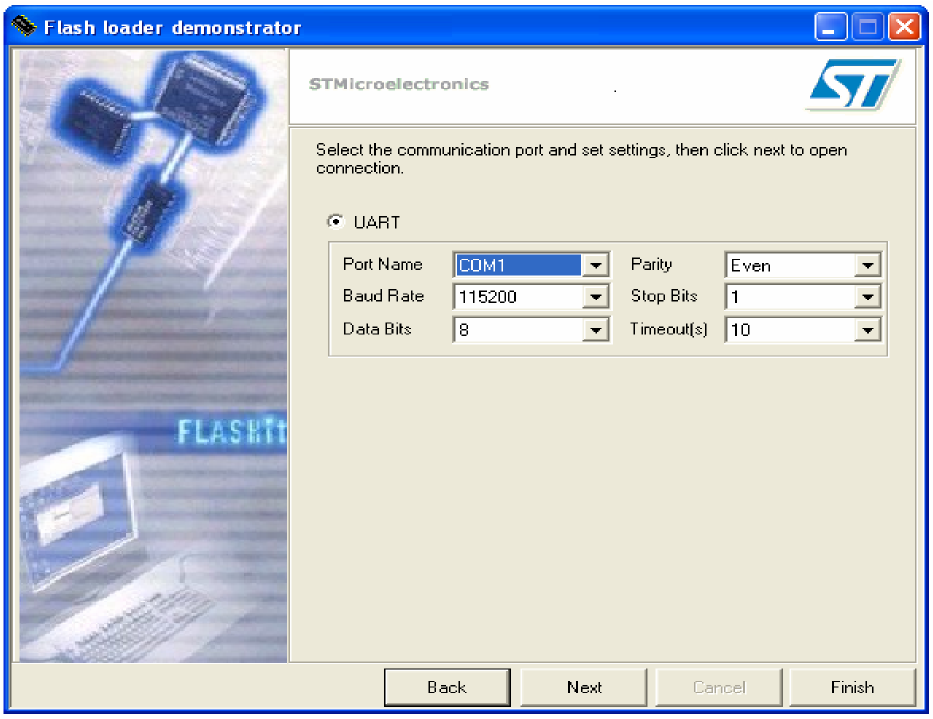
ST provides a free tool (Flash loader) that performs the IAP commands previously listed in *Section 3.2: Command set description*.

For more details, please refer to next sections and to the Flash loader user manual.

3.3.1 Serial communication set-up

When launching the Flash Loader, the following figure appears:

Figure 19. Communication port selection and set-up



Select the communication port and set settings, then click next to open connection.

(●) UART

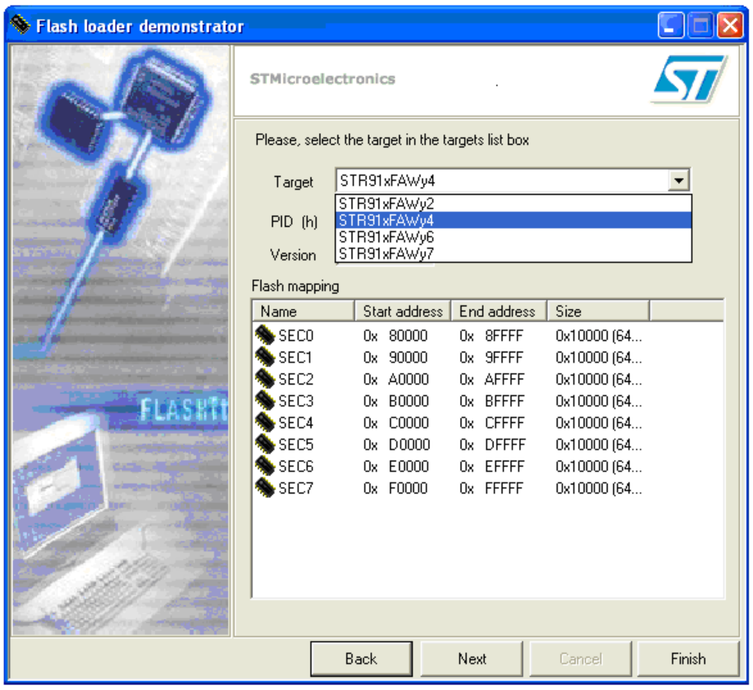
Port Name	COM1	Parity	Even
Baud Rate	115200	Stop Bits	1
Data Bits	8	Timeout(s)	10

- Configure the serial communication as shown in the figure above.
- Click Next

3.3.2 STR91x FA target device selection

The following figure appears:

Figure 20. Device selection



Please, select the target in the targets list box

Target: STR91xFAWy4

STR91xFAWy2
STR91xFAWy4
STR91xFAWy6
STR91xFAWy7

Flash mapping

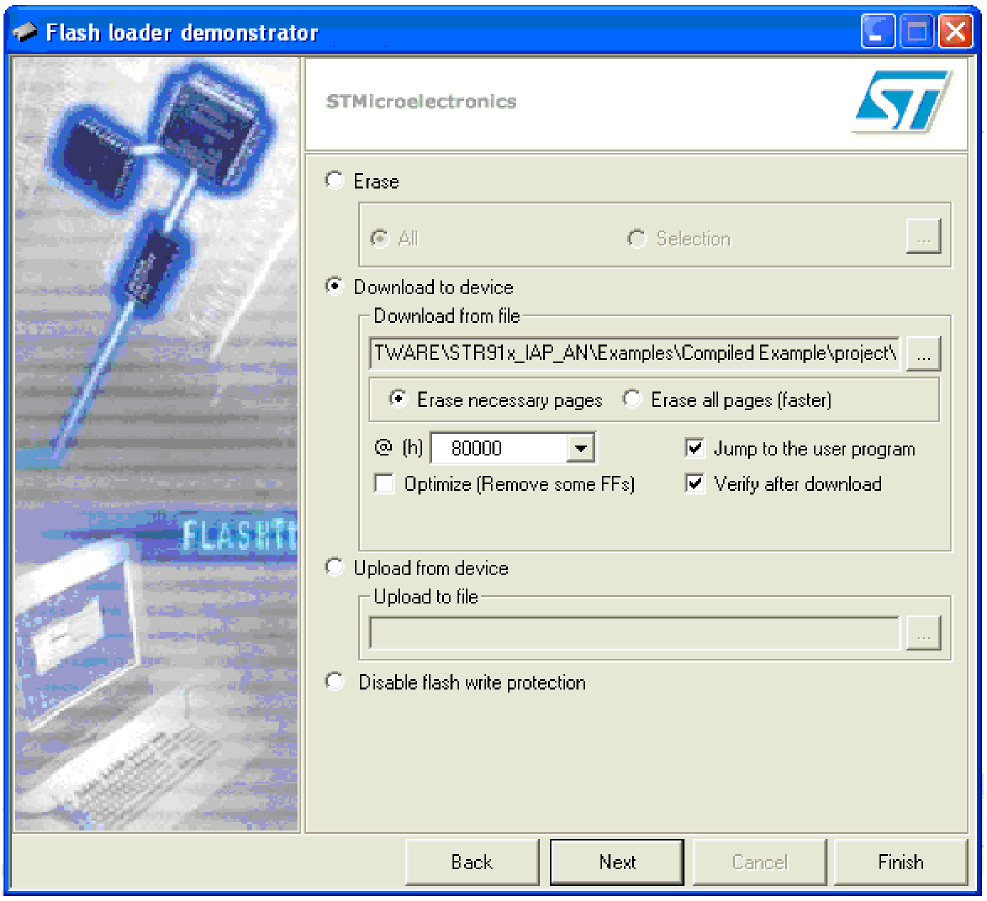
Name	Start address	End address	Size
SEC0	0x 80000	0x 8FFFF	0x10000 (64...
SEC1	0x 90000	0x 9FFFF	0x10000 (64...
SEC2	0x A0000	0x AFFFF	0x10000 (64...
SEC3	0x B0000	0x BFFFF	0x10000 (64...
SEC4	0x C0000	0x CFFFF	0x10000 (64...
SEC5	0x D0000	0x DFFFF	0x10000 (64...
SEC6	0x E0000	0x EFFFF	0x10000 (64...
SEC7	0x F0000	0x FFFFF	0x10000 (64...

- Select the STR91xFA target device to be used
- Click Next

3.3.3 Download image to internal Flash

The following figure appears:

Figure 21. Download image



Erase [ ]
[✓ All] Selection [ ]

[✓ Download to device]
Download from file: TWARE\STR91x_IAP_AN\Examples\Compiled Example\project\
[✓ Erase necessary pages] Erase all pages (faster) [ ]
@ (h) 80000
Optimize (Remove some FFs) [ ]
Jump to the user program [✓]
Verify after download [✓]

Upload from device [ ]
Upload to file:

Disable flash write protection [ ]

You can perform any other operation: erase all the Flash, erase some sectors, read the Flash content...

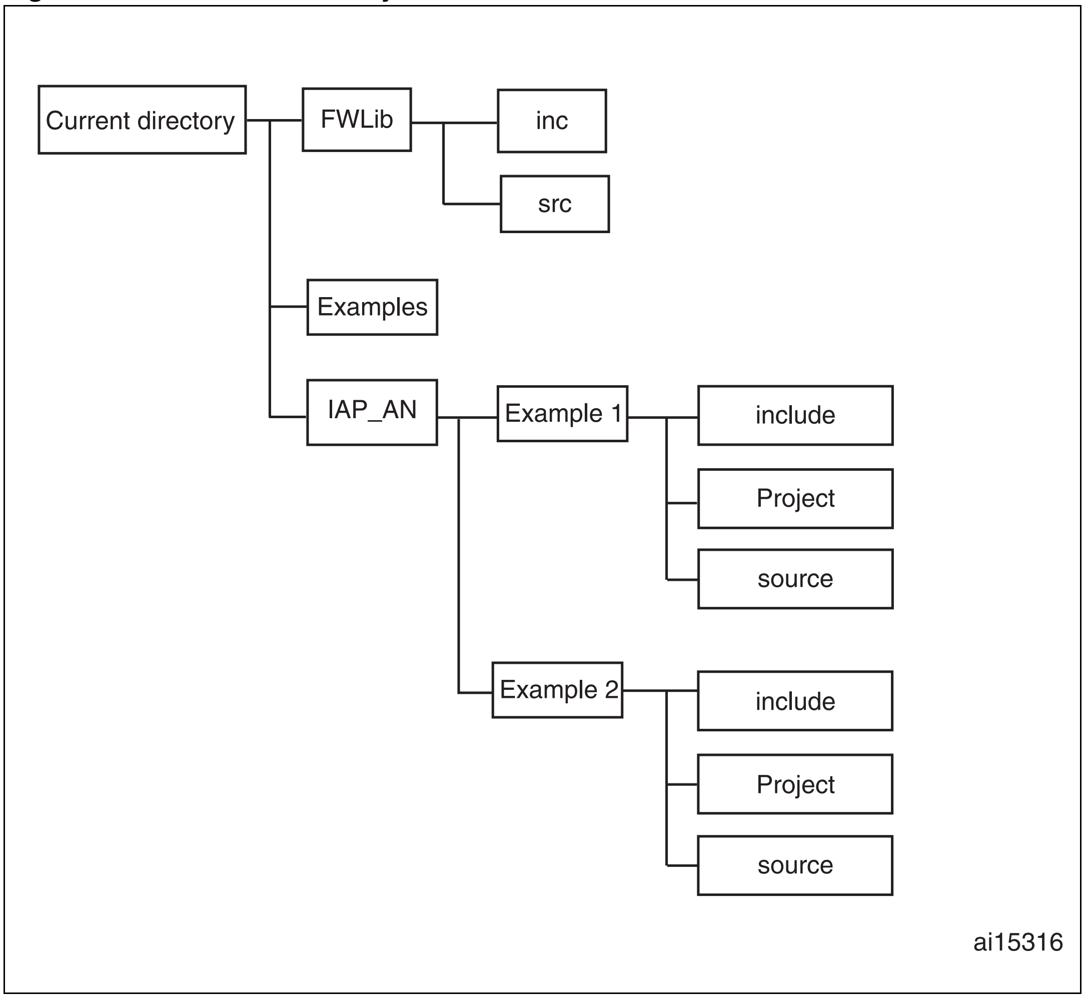
4 How to use the IAP drivers

The IAP package consists of an archived file containing 3 subfolders:

- **IAP_AN**: This contains two subfolders:
  - Example 1: shows IAP based on the Ymodem protocol.
  - Example 2: shows IAP based on the customized UART protocol using the Flash Loader utility.
- **FWLib**: This contains the STR91xFA standard library files.
- **Examples**: The compiled examples are provided to show the project settings of a user program to be loaded in the STR91xFA internal Flash.

The file structure is described in the following figure:

Figure 22. IAP driver directory structure



To use the IAP drivers properly, please follow the different steps below:

- Remap the Bank0 to address 0x80000 or 0x200000 (depending on the STR91xFA device being used) and remap Bank1 to address 0x00.

The drivers delivered with the application note support the STR91xFA with 512Kbytes. In order to adapt them to another target device (256 Kbytes or 1 Mbyte or 2 Mbytes), just:

- in 91x_init.s start-up file, uncomment "#define Flash_256KB_Bank1_Boot" or "#define Flash_512KB_Bank1_Boot" or "#define Flash_2MB_Bank1_Boot" or "#define Flash_1MB_Bank1_Boot".
- in 91x_conf.h, uncomment "#define Flash_512KB_256KB" or "#define Flash_2MB_1MB" (and "#define Flash_512KB" or "#define Flash_256KB" or "#define Flash_1MB" or "#define Flash_2MB" in common.h for IAP based on the Ymodem protocol only)
- Download the IAP driver to the STR91xFA internal Flash via JTAG using a Flasher toolset (see note below).

Note: Be careful when re-downloading IAP in Bank1 using the toolset: when the user application (loaded using IAP) is being executed (Bank0 at 0x00) and you try to re-download the IAP, the user application will be erased. To avoid this, make sure you are in IAP mode (that is, push button pressed at reset) when downloading the IAP in Bank1.

When using IAP with the ST Flash loader:

- Keep the push button pressed at reset.
- Connect to the Flash loader using the settings already defined in *Section 3.3.1: Serial communication set-up*
- Launch any operation you want: download an application, upload the Flash content etc... (for more details, please refer to the ST Flash Loader user manual).

When using IAP based on the Ymodem protocol:

- Open a HyperTerminal window with the settings already defined in *Section 2.2.1: HyperTerminal configuration*
- To run the IAP driver, keep the push button pressed at reset. The IAP main menu will be displayed on the HyperTerminal window.
- To download an application, press 1 and use the YMODEM protocol as described in *Section 2.2.3: Download image to internal Flash*.

5 Software remapping and user application interrupts

A software remapping, of Bank0 at 0x00 and Bank1 at 0x80000 (or 0x200000) is performed before jumping to the user application at address 0x00. The user application containing interrupts (IRQ, FIQ etc…) is then executed without constraints.

In case the STR91x revision is different from revision H, a system reset does not execute the IAP nor the user application (please refer to the STR91xFA erratasheet, section 2.3 Flash memory remapping). In this case, a jump to the user application mapped at 0x80000 or at 0x200000 (depending on the device) should be performed instead.

If no software remapping is performed, to execute interrupts, please consider the following points:

- In the 91x_vect.s start-up file,

`

```
LDR     PC, Undefined_Addr
LDR     PC, SWI_Addr
LDR     PC, Prefetch_Addr
LDR     PC, Abort_Addr
NOP                             ; Reserved vector
LDR     PC, IRQ_Addr
```

`

is replaced by

`

```
LDR     PC, =0x80004 (or 0x200004)
LDR     PC, =0x80008 (or 0x200008)
LDR     PC, =0x8000C (or 0x20000C)
LDR     PC, =0x80010 (or 0x200010)
NOP                             ; Reserved vector
LDR     PC, IRQ_Addr
LDR     PC, =0x8001C (or 0x20001C)
```

`

In this case, for the interrupt request (IRQ), there is no problem in the IAP (the IAP provided by ST does not contain interrupts) or in the user application. FIQ, SWI etc… in the user application are executed properly but if the IAP application requires SWI or FIQ, they will not be executed.

- If the IAP is using the ST FWLib v2.0 and the user application is using the ST FWLib v1.x, then the IRQ interrupts will not be managed properly.

6 STR9 IAP implementation summary

A summary of the STR91x IAP implementation using both methods is described in the table below:

Table 2. IAP implementation

IAP parameters	IAP based on the Ymodem protocol	IAP using the ST Flash Loader
IAP code size	7.5K	6K
IAP driver location	Bank 1	
User application location	Bank 0	
Flash remapping	By default, Bank0 is mapped at address 0x00. If the IAP driver must be located in Bank1 and the user application is located in Bank0, you must remap the banks (remap Bank1 to address 0x00 and Bank0 to address 0x80000 for 512 Kbytes and 256 Kbytes and address 0x200000 for 1 Mbyte and 2 Mbytes).	
Flash routines	All Flash routines are executed from internal SRAM.	
Push button	P7 (pin 4): Push button	
UART used and communication settings	UART0 115200 bps, 8-Bit data, No parity, 1 Stop bit	UART0 115200 bps, 8-Bit data, Even parity, 1 Stop bit
Maximum loaded image size	The maximum size of the image to be loaded in the STR91xFA Internal Flash is limited by the size of Bank0, i.e. 256 Kbytes, 512 Kbytes, 1 Mbyte or 2 Mbytes.	
Downloading time of an image 256K	33 s	62 s
Downloading time of an image 512K	64 s	121 s
Downloading time of an image 1M	124 s	238 s
Downloading time of an image 2M	247 s	469 s
Speed (bit/s)(1)	65325	34461

1. The speed is calculated by dividing the size by the downloading time.
Example of 256K: Speed = 256 x 1024 x 8/33 = 63550 bits/s (with downloading time = erasing time + verifying time)

7 Revision history

Table 3. Revision history

Date	Revision	Description of changes
12-Jan-2007	1	Initial release.
01-Sep-2008	2	Updated for 256 Kbyte, 1 and 2 MByte Flash sizes. A second method of IAP added.