# AT85C51SND3B Firmware

# User's Guide

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# Section 1

# Introduction

The AT85C51SND3Bx is a low power single-chip highly-integrated digital audio decoder/encoder for applications such as audio players, recorders, cell phones, toys…

The AT85C51SND3Bx MP3 Player firmware is part of the AT85DVK-07 development kit or the AT85RFD-07 reference design dedicated to the AT85C51SND3Bx microcontroller.

This document is the User's Guide of the AT85C51SND3Bx MP3 Player firmware.

The topics covered are:

- the functional features and options that the firmware brings
- how the firmware source code files are organized
- the firmware architecture
- how to configure the firmware
- the MMI layer

The AT85C51SND3Bx firmware described in this document has been developed to run on the AT85DVK-07 as well as the AT85RFD-07.

For more information on the AT85DVK-07 development board, refer to the documents "AT85DVK-07 Hardware User's Guide" and "AT85DVK-07 Demonstration Firmware User's Manual", available on the Atmel web site.
For more information on the AT85RFD-07 development board, refer to the documents "AT85RFD-07 Hardware User's Guide" and "AT85RFD-07 Demonstration Firmware User's Manual", available on the Atmel web site.

# Section 2

# Firmware Features

The following sections describe the AT85C51SND3Bx firmware features and options. Some of the firmware options are not supported by the AT85DVK-07 (e.g. image viewer) or by AT85RFD-07 (e.g. MMC support).

## 2.1 MMI Manager

This module allows customers to easily develop their own MMI applications.

### 2.1.1 Features

- Application management
  - execute
  - kill
- Mailbox management
  - send command to system drivers
  - get event from system drivers or MMI applications
  - forward event to MMI applications
- Software timers
- Animated icons

### 2.1.2 Configuration

- Applications names
- MMI events creation

## 2.2 Device USB

This module is the USB mass-storage driver.

### 2.2.1 Features

- USB 2.0, High and Full Speed Transfer
- Class provide : Mass Storage, HID, CDC.
- Mass Storage Class :
  - rate performance :
    typical, 10MB/s read - 8MB/s write on NandFlash
    up to 12MB/s on MMC V4 / SD / SD HC
  - Supported hosts : Win XP, Win 2K, Mac OSx, Linux
  - Secure disk option content through password management

### 2.2.2 Configuration

- Connection Speed
  - authorize high or full speed (depending on the host)
  - authorize only full speed
- enable/disable USB Class used (Mass Storage, HID, CDC)
- USB device information (vendor ID, product ID, manufacturer name, ...)
  - product name
  - serial number
- Class description (Class name, ...)
- enable/disable Disk Password Management (for Mass Storage Class)

## 2.3 Host USB

This module is the USB host driver.

### 2.3.1 Features

- Reduced host implementation
- USB 2.0 full speed transfer with USB device
- USB class provide:
  - HUB
  - Mass-storage (e.g. Udisk, multi-card reader)
  - HID
  - CDC

### 2.3.2 Configuration

- enable/disable USB class supported

## 2.4 Audio Player

This module allows the end-user to play some audio stream.

### 2.4.1 Features

- Audio stream
  - MP1, MP2, MP3
  - WMA
  - WAV (PCM, G711, G726)
- Stream management
  - play
  - pause
  - stop
  - next track
  - previous track
  - fast Forward
  - fast Rewind
  - repeat A/B
  - speed Adjust (MP1, MP2, MP3 only)

- Stream Information
  - synchronized play time
  - bit rate
  - sampling frequency
  - number of channels
- Tags
  - ID3 v1.0, v1.1
  - ID3 v2.2 and v2.3
- Stereo volume control
- Sound effects:
  - bass boost
  - spatial sound
- Adjustable 3-band EQ
  - Classic, Pop, Jazz, Rock…

### 2.4.2 Configuration

- DAC Output Selection
  - internal
  - external
- External DAC interface

## 2.5 Audio Recorder

This module allows the end-user to play and record audio streams.

### 2.5.1 Features

- Recording (codec G726)
- Input line in and micro

### 2.5.2 Configuration

- line in gains (analog & digital)
- micro gains (analog & digital)

## 2.6 Image Viewer

This module allows the end-user to display images.

### 2.6.1 Features

- Supported Image Format:
  - BMP
  - JPEG
- Automatic Resize

### 2.6.2 Configuration

None

## 2.7 Settings

This module allows the user to manage user data in the setting segment located in the customer or reserved data area of the Nand Flash.

### 2.7.1 Features

- Management
  - load
  - save
  - update from a file

### 2.7.2 Configuration

- Opened Settings structure content
- Update file name

## 2.8 Update

This module allows the end-user to perform firmware update of its player.

### 2.8.1 Features

- Firmware, codecs, display, fonts update
- No PC tool install required for end-user
- Power failure resistant
- Update file generated by the Atmel In System Programming tool

### 2.8.2 Configuration

- Enable/disable update module
- Enable/disable update auto-start at power-up
- If update auto-start is enable then configuration of “File Location” on Nand Flash or MMC/SD card.
- enable/disable file erase after update (always enable in case of update auto-start)

## 2.9 File System

This module allows management of the file system present in the Nand Flash memory the MMC/SD card, the USB host disk, or through SIO, SPI….

### 2.9.1 Features

- FAT12, FAT16, FAT32
- ASCII and/or Unicode
- More than one file/disk opened at a time
- File management
  - file information
  - I/O access
  - create
  - copy
  - paste
  - delete
  - rename
- Directory management
  - directory information
  - enter
  - go to root
  - exit

  - create
  - delete
  - rename
- Disk management
  - disk Information
  - format: FAT12, FAT16, FAT32

### 2.9.2 Configuration

- Supported file systems
- Maximum number of files to manage at same time
- Cache optimization

## 2.10 Nand Flash

This module is the Nand Flash memory library.

### 2.10.1 Features

- Support Nand Flash SLC small or large blocks (16KB or 128KB)
- 10MB read / 7MB write with 1 Nand Flash
- Physical system area
  - code with redundancy
  - codecs with redundancy
  - pictures
  - fonts
- Logical data area
  - proprietary wear-levelling algorithm with ECC management
  - settings segment: user reserved data
  - secure disk segment: mass storage disk for Data disk security management
  - data disk segment: mass storage disk

### 2.10.2 Configuration

- Nand Flash auto-detection (average performance)
- Nand Flash part number (best performance)
- Number of devices: 1, 2, 4

## 2.11 MMC® SD® Cards

This module is the memory card library.

### 2.11.1 Features

- MMC cards:
  - V3 in 1-bit mode at 20 MHz
  - V4 in 4-bit mode at 24 MHz
- SD cards:
  - SD 4-bit mode at 24 MHz
  - SD HC 4-bit mode at 24 MHz

### 2.11.2 Configuration

- Enable/disable
- Bus format:
  - automatic: depends on card type
  - 1-bit

## 2.12 Display

This module is the display management library.

### 2.12.1 Features

-

### 2.12.2 Configuration

- Interface configuration to fit display controller
  - type: I80/6800
  - timings

## 2.13 Keyboard

This module is the keypad driver.

### 2.13.1 Features

- Matrix choice leads to dedicated hardware schematic
- Automatic event generation:
  - key press
  - key release
  - key repeat
  - key long press

### 2.13.2 Configuration

- Matrix size:
  - from 4 keys up to 12 keys
- Keypad timings:
  - debounce
  - auto-repeat start
  - auto-repeat interval
  - long press

## 2.14 Power Manager

This module is the system power driver.

### 2.14.1 Features

- Dynamic power management
- Battery level information
- Power on/off

### 2.14.2 Configuration

- Power source:
  - DC-DC, Regulator…
  - voltage
- Power off

## 2.15 Clock Manager

This module is the system clock driver

- Oscillator Frequency
- Clock Type:
  - crystal
  - oscillator

## 2.16 System

### 2.16.1 Features

- Memory mapping configurable (code & data)
- Code swap between SND3 and Nand Flash (use system area code)
- Store a large constant data in the NandFlash (use system area font and display)

### 2.16.2 Configuration

- Memory mapping
- Banking code space

# Section 3

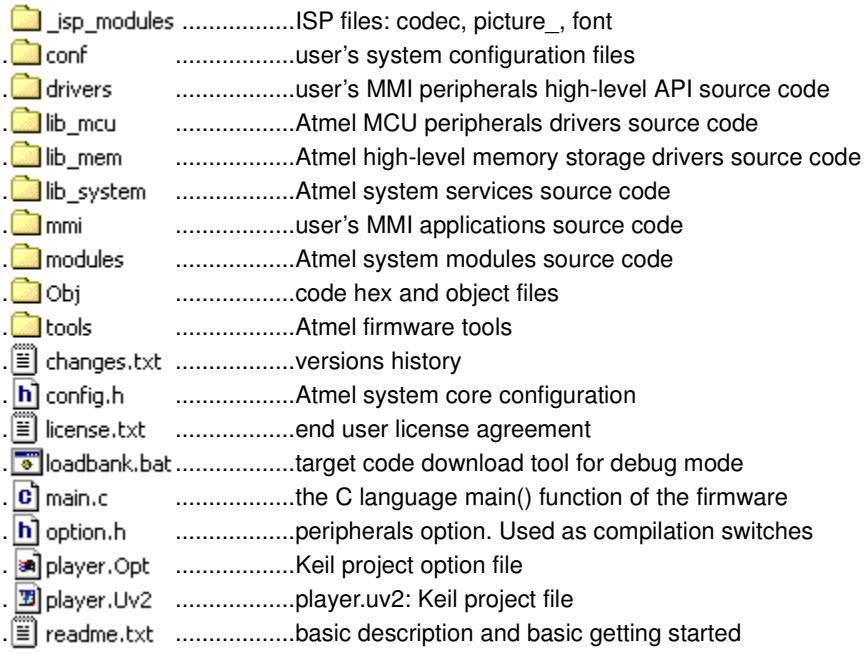
# Source Files Organization

## 3.1 Directory Physical Structure

The AT85C51SND3Bx MP3 player firmware source code is composed of several files. This section describes the directory organization of the firmware package.

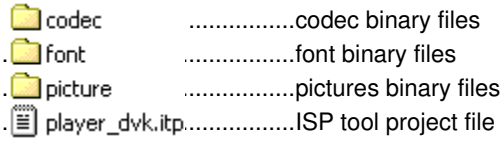
### 3.1.1 snd3b-dvk-x_y_z Directory

The snd3b-dvk-x_y_z directory contains the firmware package where x_y_z is the firmware version.




### 3.1.2 _isp_modules Directory

The _isp_modules directory contains the files used for In System Programming.



### 3.1.3 conf Directory

The conf directory contains header files allowing user to configure the Atmel libraries. Its content is detailed in Section 6.

- conf_access.h .....conf_access.h: configuration of the memory access interfaces
- conf_audio.h .....conf_audio.h: configuration of the audio part (HW and SW)
- conf_clock.h .....conf_clock.h: configuration of the oscillator frequency
- conf_explorer.h .....conf_explorer.h: configuration of the FAT and the navigator
- conf_kbd.h .....conf_kbd.h: configuration of the keyboard (HW and SW)
- conf_lcd.h .....conf_lbd.h: configuration of the LCD (HW and SW)
- conf_mmc.h .....conf_lbd.h: configuration of the SD/MMC interface
- conf_mmi.h .....conf_mmi.h: configuration of the MMI behavior
- conf_nf.h .....conf_nf.h: configuration of the nand-flash
- conf_power.h .....conf_power.h: configuration of power (HW and SW)
- conf_scheduler.h .....conf_scheduler.h: scheduling of the tasks
- conf_update.h .....conf_update.h: configuration of the firmware upgrade
- conf_usb.h .....conf_usb.h: configuration of the USB interface

### 3.1.4 drivers Directory

The drivers directory contains the user's MMI peripherals high-level API source code.

- audio .....user's external DAC drivers
- fm .....user's FM receiver drivers
- lcd .....user's LCD display drivers
- mmi .....user's high-level API source code to display MMI graphical objects

### 3.1.5 lib_mcu Directory

The lib_mcu directory contains the AT85C51SND3Bx core and peripherals drivers source code.

- aup .....Audio Processor driver
- clock .....Clock Manager driver
- dfc .....Data Flow Controller driver
- int .....Interrupt controller driver
- kbd .....Keyboard drivers
- lcd .....Display interface driver
- mmc .....MultiMediaCard drivers
- nfc .....Nand Flash Controller driver
- power .....Power management driver
- psi .....Parallel Slave Interface driver
- sio .....Serial I/O port driver
- swap .....Memory space management driver
- timer .....Timers driver
- usb .....Universal Serial Bus controller driver
- wdt .....WatchDog Timer driver
- compiler.h .....Generic macro-functions define to get rid of compiler specificities
- debug.c .....Routines of debug trace and assert
- debug.h .....Routines of debug trace and assert
- mcu.h .....AT85C51SND3Bx SFR registers description file
- mcu_drv.h .....AT85C51SND3Bx SFR registers description file
- trace.h .....Include file to enable and put traces

Note: mcu_drv.h file defines a list of masks related to peripherals controller and provides a list of macro-functions that maps SFR and pages.
The AT85C51SND3Bx implements a SFR pagination mechanism which allows mapping of high number of peripherals in the SFR space. Four pages are accessible through the PPCON register.

### 3.1.6 lib_mem Directory

The lib_mem directory contains the Atmel high-level memory storage drivers source code.

- mmc ..... MMC/SD memory card driver
- nand_flash ..... Nand-Flash memory driver

### 3.1.7 lib_system Directory

The lib_system directory contains the Atmel system service source code.

- auto_disp ..... automatic display of time-depending graphical objects
- banking ..... code banking load & swap source code
- mailbox ..... inter-process communication library source code
- memory ..... memory manipulation routines
- startup ..... boot sequence source code
- timer_soft ..... software timer library
- unicode ..... unicode management library
- utilities ..... miscellaneous C language manipulation routines

### 3.1.8 mmi Directory

The mmi directory contains the user's MMI application source code.

Note: This directory content may vary from reference-design firmware to development-kit firmware.

- _template ..... MMI module template
- dummy ..... dummy application required for code banking mechanism
- equalizer ..... MMI equalizer control application
- explorer ..... MMI file system explorer application
- games ..... MMI games application
- idle ..... MMI default application
- images ..... MMI display images (fonts & pictures)
- info ..... MMI information & system status display application
- kbd ..... MMI keyboard high-level driver
- lyrics ..... MMI lyrics display application
- mstorage ..... MMI mass-storage application
- player ..... MMI audio player application
- playlist ..... MMI playlist management application
- radio ..... MMI radio application
- recorder ..... MMI recorder MMI control
- scroller ..... MMI contextual menu application
- setting ..... MMI setting management module
- shared ..... MMI shared functions
- startup ..... MMI start-up application
- status ..... MMI status control application
- update ..... MMI firmware update application
- viewer ..... MMI image viewer application
- volume ..... MMI volume control application

### 3.1.9 modules directory

The modules directory contains the Atmel system libraries source code.

- audio .....audio controller library
- control_access .....memory access and data transfer libraries
- file_system .....FAT file system library
- mmi_manager .....MMI manager library
- player .....audio player library
- power .....power management library
- recorder .....audio recorder library
- scheduler .....firmware scheduler library
- update .....firmware update library
- usb .....USB management library
- viewer .....Picture viewer library

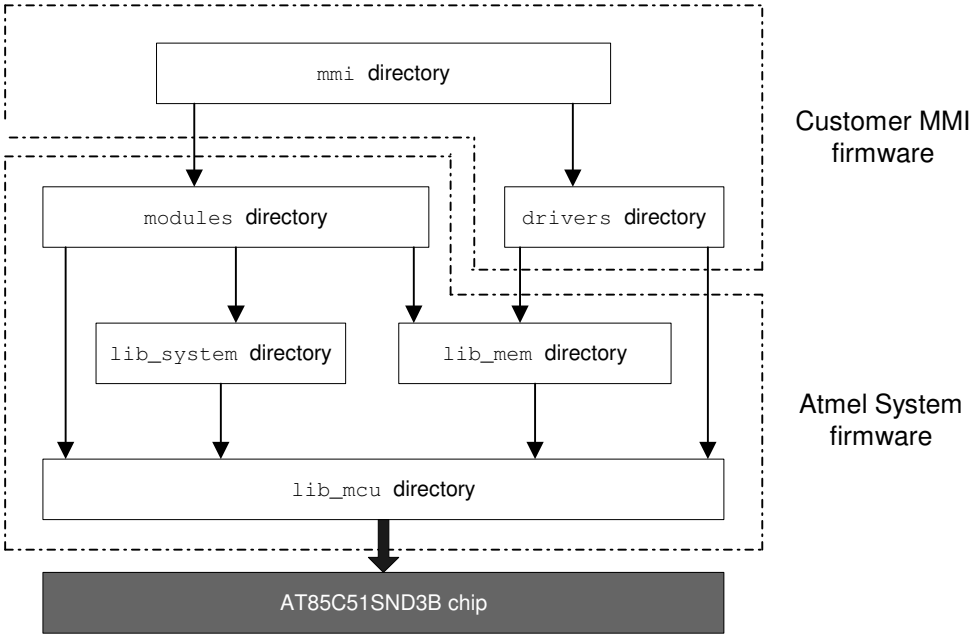
### 3.1.10 Tools directory

The tool directory contains the Atmel image converter as well as the project images.

- picture_maker .....MMI pictures and image converter tool
- SND3B_Security .....Windows® USB drive secure executable

## 3.2 Directories Logical Organization

This purpose of this view is to show the logical links between the directories.




These source file directories can be grouped into two firmware parts:

– the customer MMI firmware

– the Atmel system firmware

The customer MMI firmware is the code source you have to develop and customize from the software platform delivered with this package. Indeed, this layer is dedicated to interface the user with the high-level services provided by the Atmel core firmware and the AT85C51SNDA chip. See Firmware Architecture Section 5.

The Atmel system firmware is the code source you should not modify since this layer has been designed to provide full and high-performance services from a low cost chip. Only the configuration files are to set in order to configure this layer to your application requirements. See Firmware Configuration Section 6.

# Section 4

# Code & Data Management

## 4.1 Principle

The SND3 chip permits:

- to customise the memory organisation
- to use a code swap feature (= code banking)
- to store a large constant data in the NandFlash

Reminder: The C51 core use different memory space (code, data, xdata). The size of data space is 256B. The size of code space is limited at 64KB and xdata space is limited at 64KB.

### 4.1.1 Custom memory organisation

The AT85C51SND3B chip uses a 64KB of RAM to store the data and code, this particularity permits to configure the memory size according to your needs.

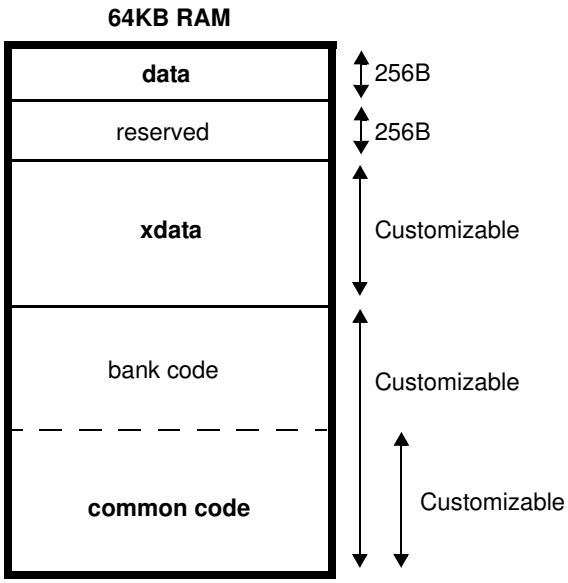
#### 4.1.1.1 Rules

xdata space size + code space size = 64KB – 512B

code space size = code common size + code bank size*

xdata space size, code common size and code bank size* shall be a modulo 512B.

***Figure 4-1.*** Memory organisation




Note: *code bank size is optional, see “Code swap”

#### 4.1.1.2 How to configure

You must change the configuration in the « option.h » header file by defining following constants:

- XDATA_LENGTH
- CODE_BANKING
- BANK_START_ADDRESS

Note: There are no « code size » #define, because this one is automatically computed using XDATA_LENGTH.

You must modify the UV2 project according to « option.h » header file;

***Figure 4-2.*** options are in 'Options for Target' pop-up in Target tab

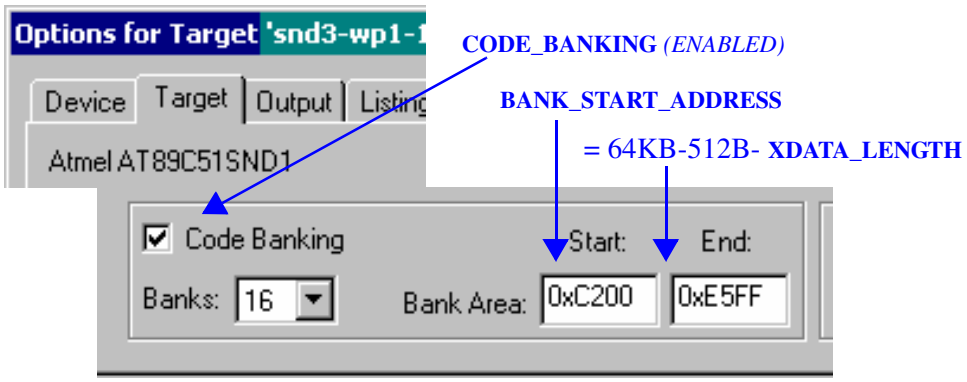



***Figure 4-3.*** options are in 'Options for Target' pop-up in BL51 Misc tab (linker file player.lin)

**player.lin**

```
BankArea(0xC200,0xE5FF)
PRINT(".\List\player.m51") RAMSIZE(256)
DISABLEWARNING (15)
BANK10(?CO?FILE(0xC200),?PR?ROUTINE?FILE,?PR?ROUTINE2?FILE)
…
BANK01(?CO?FILE2(0xC200),?PR?ROUTINE?FILE2,?PR?ROUTINE2?FILE2)
OVERLAY( main!(?CO?MMI_LYRICS,…))
CODE( 0x0000-0xE5FF )
XDATA( 0x0000-0x17FF )
```

BANK_START_ADDRESS  XDATA_LENGTH  64KB-512B- XDATA_LENGTH

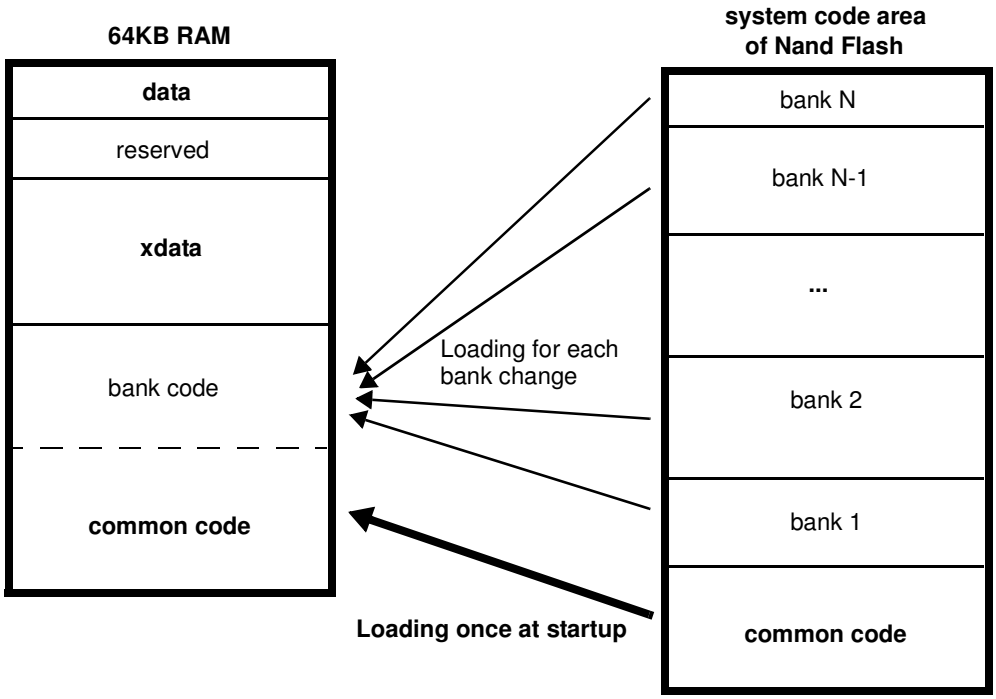
**WARNING :** At compile time, there are no automatic coherency check between « UV2 project option » and « option.h » (no error and no warning). The execution code may be corrupted if a difference exists.

### 4.1.2 Code swap

#### 4.1.2.1 Principle

The code load swap consists in the downloading of temporary codes in a part of the microcontroller code section to be executed immediately. When this temporary code has been completely run, the microcontroller automatically runs back on the permanent code or a previous temporary code. This makes it possible to have a code memory space share for temporary codes, expanding then the total code beyond the 64KBytes. Indeed, the downloading of code with deciphering produces a non-insignificant overhead time (above 0.1s). The critical code section, that is the system part, must react as quick as possible with the hardware layer. Also, the code load swap must be rarely executed to not load the CPU with overhead routines to the detriment of the system reactivity.

***Figure 4-4.*** Code load swap representation




#### 4.1.2.2 Mechanism

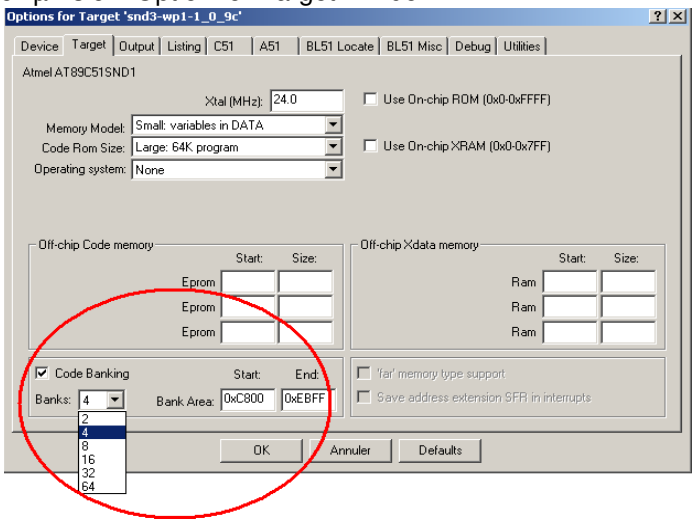
The code load swap mechanism is based on the code banking frame available under the environment Keil µVision. Indeed, the assembly file “lib_system\banking\l51_bank.a51” has been deeply customized by Atmel to link code-load-swap routines to the code banking frame. Also, the debugger has been reworked to support the code load swap and the downloading of code banks will be transparent for you in debugging mode in a future software delivery.

Thus, the code-load-swap mode is fully supported under the environment Keil µVision enabling you to develop software beyond the 64K of the code memory space without difficulty.

#### 4.1.2.3 How to activate code banking?

Code banking enable are in the ‘Option for Targets’ pop-up in the Target tab.

***Figure 4-5.*** Keil µVision ‘Option for Target’ window




– Check the box “Code Banking” and select the maximum number of banks that your application may have to support. For information, the banking frame code size increases with the number of available banks. This number must be reported in the file “lib_system\banking\l51_bank.a51” at the following definition “?B_NBANKS EQU 4”.

– Check that the “Bank Area Start” value matches with the one defined in the file “option.h” as follows: “#define BANK_START_ADDRESS 0xC800”. This value defined in the file “option.h” should not be modified since this common code (not banked) is mainly the one of the Atmel system firmware.

– Check that the “Bank Area End” value matches with the code range end address defined in the tab “BL51 Locate”. This value, incremented by 1, must be also reported in the file “option.h” at definition “#define XDATA_LENGTH …”.

The files building generates as many binary files as banks used with the following extensions:

– B00, B01, B02, … for binary bank files

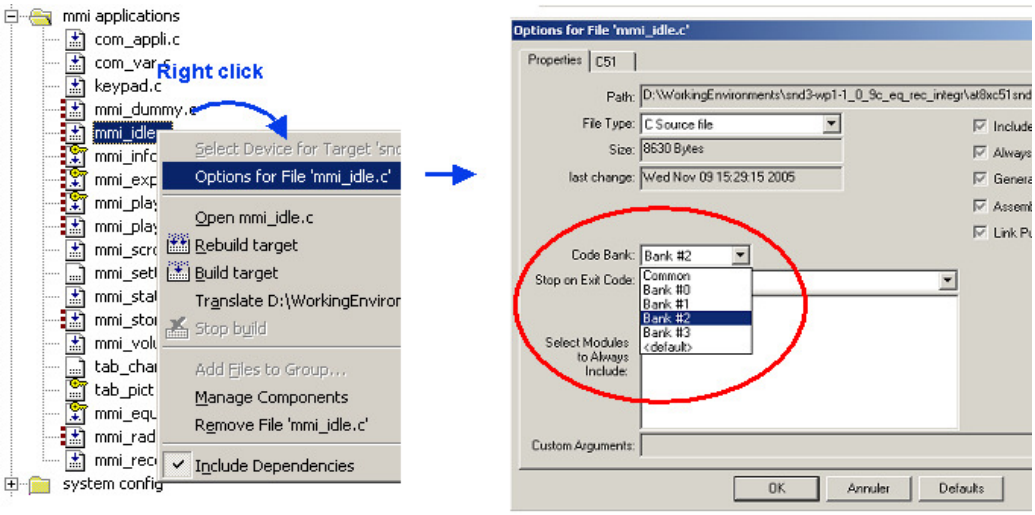
– H00, H01, H02, … for hex bank files

– All the binary bank files are created in a 64K code space including the duplicated common code.

#### 4.1.2.4 How store a file in a bank ?

To store all routines from a C file in a bank , you must set a bank number in file options in KEIL.

***Figure 4-6.*** Banking a C file




Note: The bank #0 is not to be used, it is reserved for the proper working of the code load swap mechanism. Indeed, it's the MMI application "mmi_dummy" that takes up this bank although the application does nothing. This configuration must not be modified.

If the constant code present in C file banked are used only in C file, then you can bank the constant code in the same bank. Add the line "?CO?FILE_NAME" in the corresponding bank field in player.lin file, e.g. :

BANK7(?CO?FAT_UNUSUAL(0xBE00),?CO?SETTING)

Note: It is not autorized to bank constant code if the file is not banked.

#### 4.1.2.5 How store a routine in bank ?

To store a routines in a bank, add the line "?PR?ROUTINE?FILE_NAME" in a bank field in player.lin file, e.g. :

BANK7(...(0xBE00),?PR?NAV_FILE_RENAME?NAVIGATION)

#### 4.1.2.6 Banking organisation in ATMEL firmware

The Atmel firmware stores in the same bank all modules which are used for the same mode.

e.g. :
in BANK 2, there are the file mmi_player.c, srv_player.c, player.c which are call only in player mode. The player_task.c isn't banked because is call always by scheduler in all modes.

All MMI and service files are stored in bank space excepted the MMI files low level which are dedicated to translate hardware or system events in actions or informations to the other MMI applications that are in charge to supervise the functional modes (Ex.: mmi_status, mmi_info, ...).

If a routines or modules don't correponding at a specific mode but there are few call or never call, then ATMEL firmware store this one in a bank.

e.g.:
BANK7(?CO?FAT_UNUSUAL(0xBE00),?PR?NAV_FILE_RENAME?NAVIGATION)

# Section 5
# Architecture

## 5.1 Overview

The AT85C51SND3Bx firmware is a software platform that provides full and high-level easy to use services. The architecture was carefully designed for both quick chip configuration and easy customizing.

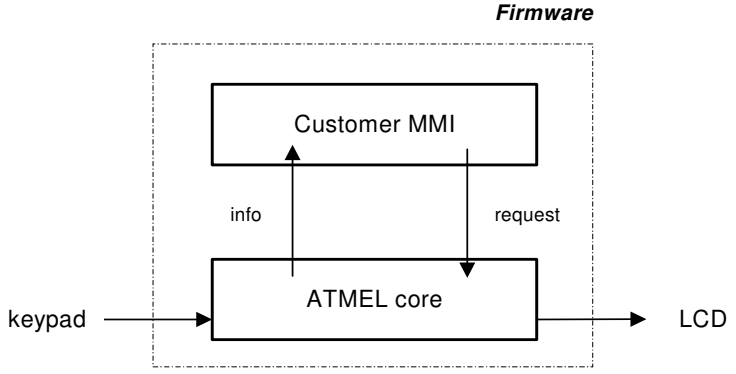
This achievement is due to the splitting of the firmware in two parts:

- The Atmel core firmware:
  - provides full and high-level services (USB management, power management, audio management, keyboard management, file explorer, …),
  - provides API functions making deep abstraction of chip hardware
  - manages the advanced running of the customer MMI applications
  - must not be modified
  - must be only configured with the help of configuration files

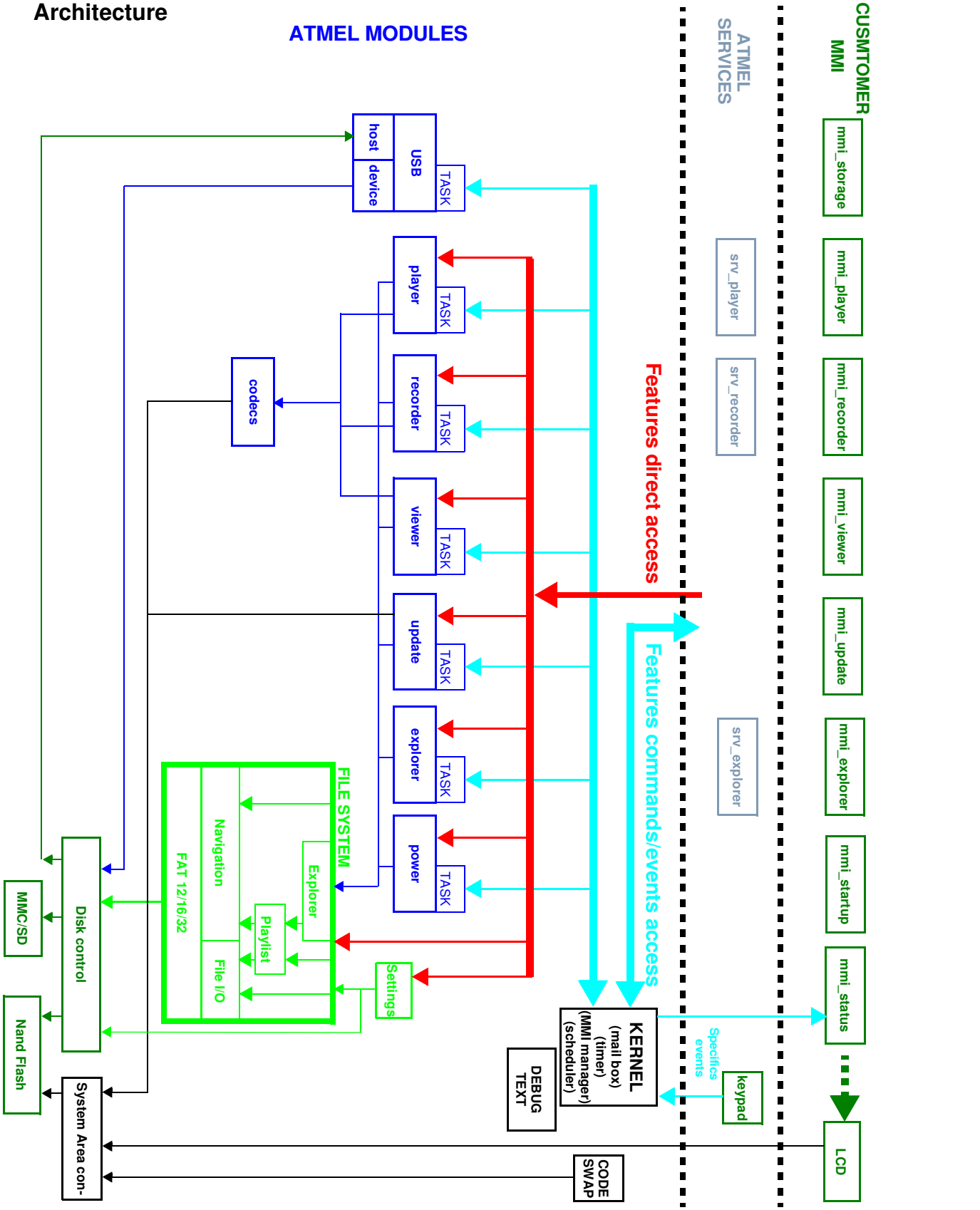
  In a nutshell, the firmware core acts as a multimedia Operating System
- The Customer MMI firmware:
  - interfaces the external custom MMI devices (Keyboard, LCD)
  - provides high-level features to the user (audio control, player control, file exploring), thanks to the Atmel core firmware services
  - gets the Atmel core firmware services with the help of requests and feedbacks

  The Figure 5-1 gives an overview of this firmware organization and how it fits within its environment.

***Figure 5-1.*** Firmware architecture overview



## 5.2 Architecture

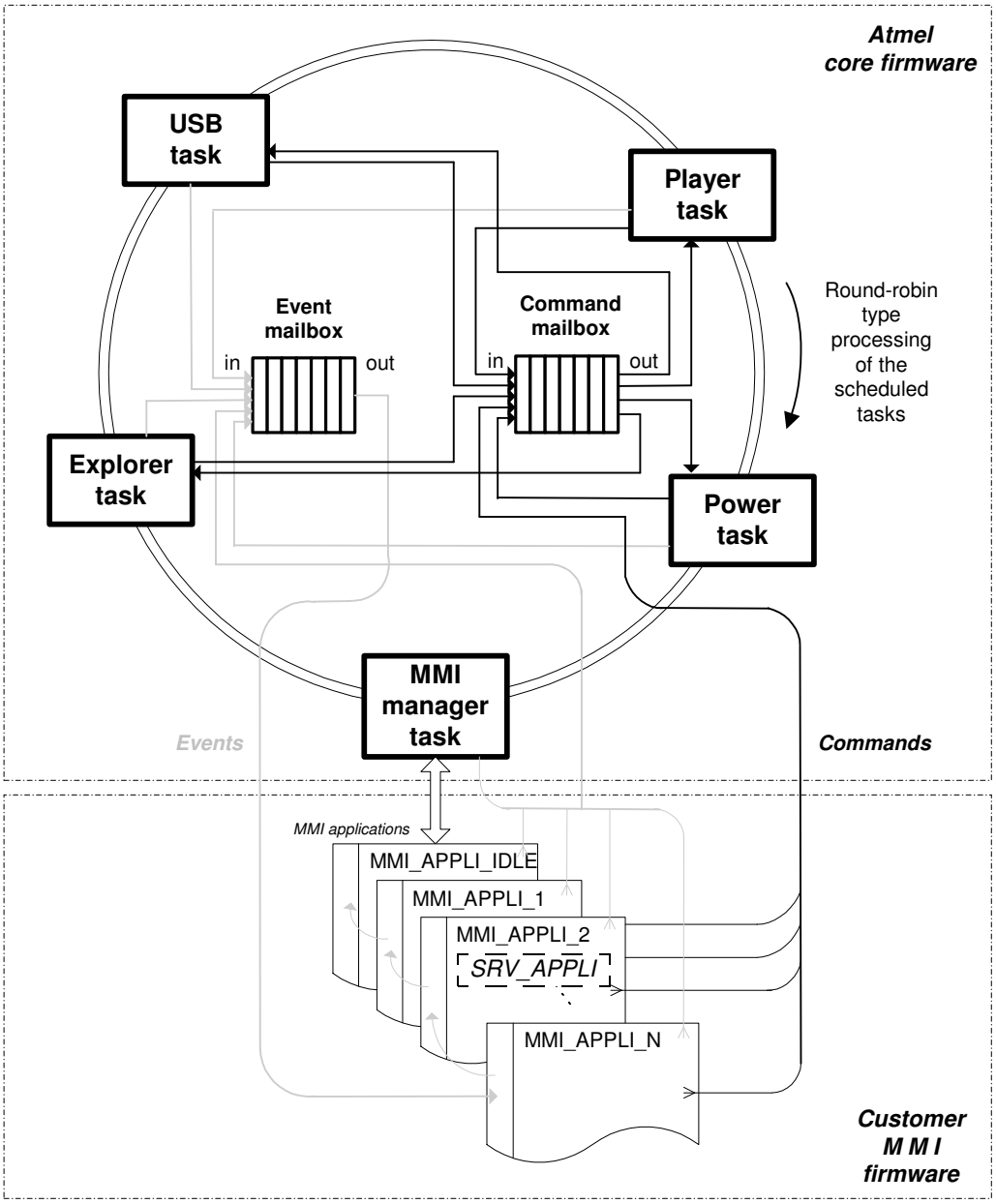


## 5.3 KERNEL

Figure 5-2 presents the execution process of the firmware, this one includes:

- a task scheduler to run many tasks simultaneously
- a communication based on message to manage the no foreeable commands and events
- an MMI manager task to manage an MMI applications stack

***Figure 5-2.*** Firmware architecture: worm's eyes view



### 5.3.1 The Scheduler

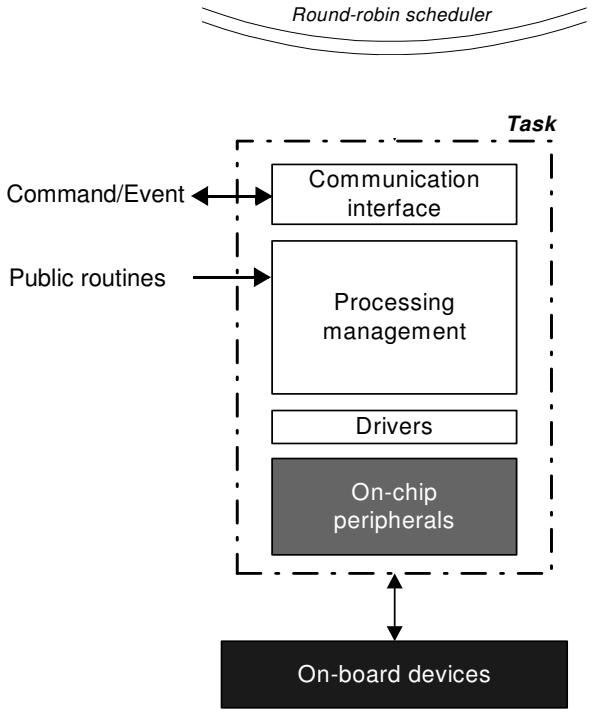
The firmware system is driven by an endless scheduler which activates tasks, one at a time, in a round robin manner. The scheduler loops on a static list. Refer to Section 6.2.12 for configuring the scheduler.

Note that each task executes “at will”, i.e. the duration of their execution is not limited. Thus, in order to have the system running smoothly, each task should perform its duty for the shortest amount of time.

### 5.3.2 The Tasks

Task is a generic entity that provides well-defined services to the Customer MMI layer. It integrates the on-chip peripherals and the software layer that controls them and provides high-level information.

***Figure 5-3.*** Inner task logic representation.




The Atmel demo firmware implements 8 tasks:

- MMI manager task
- Power task
- USB task
- Player task
- Recorder task
- Viewer task
- Explorer task
- Update task

### 5.3.3 The Inter-Task Communication

The bi-directional communication system between tasks is based on the management of two kind of messages: “command” and “event”.

- “command” is a request that a task does a specific action. The “command” messages can be mailed by tasks or MMI applications. They are destined to all tasks except the MMI manager task.

- "event" is an information dedicated to MMI applications, sent by a task to inform on its status or to give feedback of a previously executed command.

These messages are mailed in two separate mailboxes, based on FIFO stacks.

The uni-directional communication system is the direct access at the public routines provide by modules.

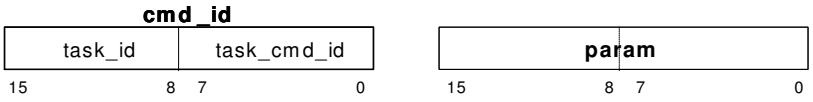
#### 5.3.3.1 Message Format

Command and event messages are composed of 2 words:

- a unique ID
- an optional 16-bit parameter

- Command message format

***Figure 5-4.*** Command message format



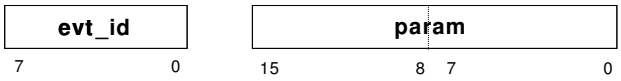

The command message ID is composed of two bytes that define:

- the task to which this message is dedicated ("task_id")
- the ID of one of the task commands to execute ("task_cmd_id")

Command messages are defined in the file "lib_system\mailbox\mail_cmd.h".

- Event message format

***Figure 5-5.*** Event message format




The event message IDs are 8-bit values. One of the tasks are frozen and defined in the file "lib_system\mailbox\mail_evt.h".

Event messages can be defined by the customer to make possible specific communications between MMI applications. These must be defined in the custom file "mmi\common\com_evt.h".

- Message parameter

The optional "param" is a 16-bit argument being able to pass data of different types:

- one or two single bytes with the help of the macros LSB(), MSB():

```
LSB(param) = byte1; MSB(param) = byte2;
```

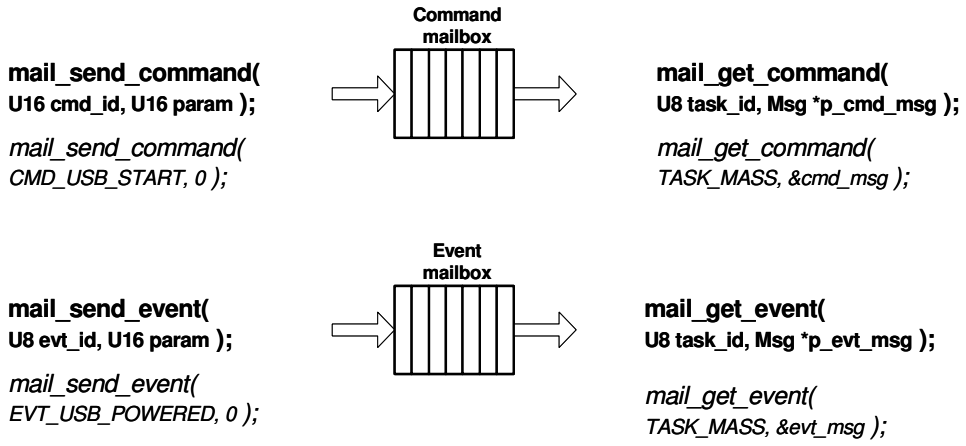
- the address of data, on 16 bits only although supplementary bits are required to get the complete address of data. Thus, the memory type to which the data belongs must be known at the delivering of this kind of message to point properly the data.

```
// Preparation in message mailing
xdata U8 table[10];
param = U16( &table[0] );
// Message delivery
_MEM_TYPE_SLOW_ U8* ptr_table;
ptr_table = (xdata U8*) param;
```

#### 5.3.3.2 Messages Management

The following functions located in file “lib_system\mailbox\mail.c” make it possible the mailing and the delivery of messages.

***Figure 5-6.*** Mailbox interface functions




These two mailboxes can store up to 8 messages according to the configuration done in file “config.h”.

### 5.3.4 MMI Manager task

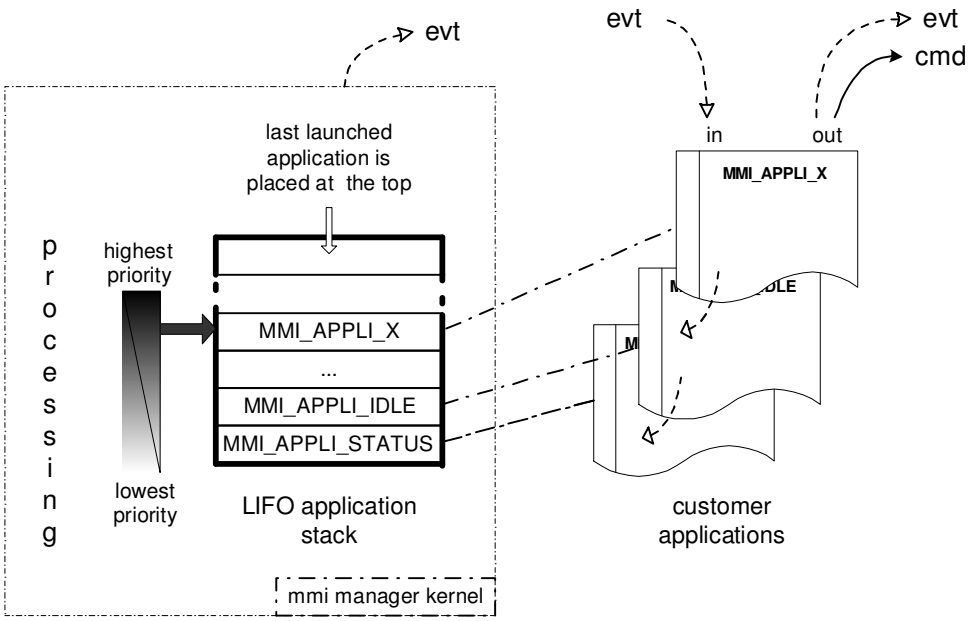
The MMI Manager task (also named “mmgr_kernel”) is dedicated in the management of the MMI applications. It can be split into three processes:

- Keyboard management: filters key bouncing and mails event messages when actions on keys
- Software timers: are 32-bit timers dedicated to MMI applications and mails event messages when the timer overflows
- Application manager: manages the execution of MMI applications running at the same time and mails some events

#### 5.3.4.1 Application Manager Principles

The management of MMI applications is based on a LIFO stack that keeps in memory the applications launched and runs them in the order in which they have been launched. Thus, the last application launched (being at the top of the stack) is the first executed to treat the input event. If this event was not dedicated to the top application, it is forwarded to the following one stacked. Thus, several applications can be launched and run independently at the same time, making easy and flexible the development of the custom MMI layer. See Figure 5-7.

***Figure 5-7.*** MMI manager principle




The MMI application “status” is loaded first in the application stack at the initialization of the MMI manager task. So, it’s always the first MMI application executed since it temporarily manages the start-up and then is in charge of managing the status of hardware devices commonly shared with the majority of MMI applications.

The MMI application “status” has also launched the application “idle”. Indeed, some functions and macros make it possible to launch the MMI applications from other ones and request their finalization.

## 5.4 MMI Applications

MMI applications are source code executed under the control of the MMI manager kerel. To achieve this control and to offer flexibility, they organized in modules, are based on a template and are associated to IDs. This one can be use a services MMI which include a usual code sequence to use provided by ATMEL.

### 5.4.1 Application IDs

Two kinds of 8-bit ID are associated to MMI applications:

- Module ID

ID making statically reference to a MMI application, defined by the customer. It's with the help of this ID that a MMI application can be executed.

- Process ID

ID dynamically linked to a MMI application at the time of its pushing in the stack and kept until it is terminated by an action. This ID enables an application to know if the launched application is still activated or placed at the top of the stack. As the process ID is unique contrary to the module ID, several applications of the same type can run at the same time without problem of identity usurpation.

### 5.4.2 Generic Modules

All MMI applications must integrate the following rules to keep the actual and new code readable ("***custom***" is to replace with the functionality name of new MMI application to develop):

- Source code files
  - named as "mmi_***custom***.c/h
  - located in a new folder "mmi***custom***"
  - template available at location "mmi_template"
- Application module ID
  - label definition with a unique value: #define MMI_APPLI_***CUSTOM*** value
  - located in "mmi\shared\com_appli.h"
  - used to launch the application ***custom***
- Interface function with the MMI manager kernel
  - prototype to declare in the common MMI application file "mmi\shared\com_appli.h": void ***custom***_mmi_appli(U8 event, U16 param);
  - definition to do in "mmi_***custom***.c"
  - reference to integrate in the switch-case of the function "call_mmi_appli()" in the file "mmi\shared\com_appli.c"
- Internal processing of the interface function

– a “switch-case” processes all in-coming events

***Figure 5-8.*** internal switch-case processing

```
void custom_mmi_appli( U8 event, U16 param )
{

   switch( event )
   {

      case EVT_START_APPLI:    // First event posted to MMI applications
                               // once at the time of their launching
         break;

      case EVT_APPLI_KILLED:   // Event informing that the MMI application
                               // just above it in the stack has just been killed
         break;

      case EVT_BACK_TO_TOP:    // Event informing that this MMI application
                               // is at the top in the stack
         break;

      default:                                 // Event forwarded to
         Mmgr_krn_forward_current_event();     // the MMI application just below it
         break;                                // since not catched this far
   }

}
```

This minimal structure to respect is to get a proper control of all new MMI applications by the MMI manager kernel.

The three basic system events “EVT_START_APPLI”, EVT_APPLI_KILLED”, EVT_BACK_TO_TOP” and others are defined in “lib_system\mailbox\mail_evt.h”.

### 5.4.3 Useful Functions and Macro-functions

A set of functions and macros enabling the MMI applications to interface to the MMI manager kernel are listed in the two separate tables for requests and status.

- Requests

The request table Table 5-1 gives precisely the running priority of the requests since they are not executed in the order of their calls. Indeed, the MMI manager kernel translates all requests into events, treated with more or less delay according as they are mailed or not.

A non-mailed event is executed immediately by the MMI manager kernel when it takes control led by MMI applications.

A mailed event is a commonly treated after the scheduler has completed a cycle. It shall be executed just after the all non-mailed events are treated in order to maintain the event mailbox half empty before giving back control to the system firmware.

***Table 5-1.*** Requests from MMI applications to MMI manager kernel

| Functions or Macro-functions | Description | Run Prior. | Event | |
|---|---|---|---|---|
| | | | Name | Mailed |
| mmgr_activate_mmi_appli( U8 id_appli, U16 param ) | Launches an MMI application by pushing it in the application stack with the help of two arguments:<br>- id_appli: the module id defined by the developper in file “mmi\shared\com_appli.h”<br>- param: extra 16-bit parameter.<br>The application is normallyexecuted after a scheduler round.<br>Returns the associated unique id delivered by the application stack. | 3(4)[1] | EVT_START_APPLI | yes |
| Mmgr_krn_forward_current_event() | Forwards the current event since not caught by the current application.<br>This immediately gives control to the following stacked application with the help of this event. | 2 | Current event: EVT_ … | no |
| Mmgr_kill_this_mmi_appli()<br><br>Mmgr_kill_this_mmi_appli_with_ret_val( U8 val ) | Terminates the current application by popping the MMI application out of the application stack.<br>This immediately gives control to the following stacked application with the help of a specific non-mailed event “EVT_APPLI_KILLED”.<br>Idem as “Mmgr_kill_this_mmi_appli()” but additional information is stored in the 16-bit parameter of the event “EVT_APPLI_KILLED”:<br>killed application process ID in the MSB<br>8-bit data in the LSB | 1<br>4(3)[1] | EVT_APPLI_KILLED<br>EVT_BACK_TO_TOP | no<br>yes |
| Mmgr_krn_this_mmi_appli_is_full_screen() | Informs the MMI manager kernel that this current application has a graphical full screen (Partial screen by default).<br>This information enables the MMI manager kernel to manage the automatic screen refreshing.<br>This macro is to execute once in the “EVT_START_APPLI” code section. | -[2] | No event | - |
| Mmgr_set_id_appli_not_defined() | Sets a custom variable containing the process id of a running application to the value “MMI_APPLI_NOT_DEFINED” when this application does not run anymore (not stacked). | -[2] | No event | - |

Notes: 1. Run priority between these two requests depends on the call order
2. No impact on MMI application execution order

- Status

***Table 5-2.*** Status on MMI applications being executed by the MMI manager kernel

| Functions or Macro-Functions | Description |
|---|---|
| Mmgr_is_this_appli_at_the_top() | Macro called by a MMI application to test if is at the top in the application stack. Mainly used for drawing. |
| mmgr_is_appli_at_the_top(U8 id_process ) | Function with a parameter “id_process”, value only returned by “mmgr_activate_mmi_appli()”. Called by MMI applications to know if such an application is at the top or not. Mainly used for drawing. |

### 5.4.4 Automatic Screen Refreshing

The automatic screen refreshing consists in the redrawing of application screens when a top application has just been terminated. This mechanism is linked to the event EVT_BACK_TO_TOP.

The automatic screen refreshing is done in two steps:

– First, the first application that has the feature “full screen” is searched from the top of the stack.

– Secondly, from this application up to the top one, their screens are redrawn one after the others.

Thus, this mechanism makes it possible to redraw superimposed non-full-screen windows automatically.

### 5.4.5 Automatic display

The automatic display module is charged with managing the display of time-related graphical objects. It enables to make easily animations from pictures placed in a special directory “tools\picture_maker\pictures_demo_default\Animations”. The basic pictures composing a future animation picture must be named as follows:

*animationpicturename__index*.bmp

*index* can be digits and letters: it is useful to define the integration order.

The animation pictures are generated at the same time as the other ordinary pictures by the picture maker tool. Make live animation pictures in the firmware with the following functions and macros:

***Table 5-3.*** Functions and macros controlling the automatic display

| Functions or macros | Description |
|---|---|
| ad_allocate (U8 obj_type, Ad_p_prm _MEM_TYPE_SLOW_ *p_param_struct) | Allocates one of the graphical object slots still available and returns a 8-bit ID. The ID is equal to “UNDEF_AD_OBJ” if failure in allocation.<br>If success, this ID is to store by the MMI application in order to control the object with the help of the other functions and macros below.<br>Note: No risk of object identity usurpation after a cold reset since the value of “UNDEF_AD_OBJ” is 0.<br>Parameters:<br>Only object type is currently supported: AD_ID_ANIMATION.<br>The parameter structure “Ad_p_prm _MEM_TYPE_SLOW_” configured the object in its appearance and its behavior. As the only one object type actually supported is animation, the structure “Ad_p_prm” is always “Ad_prm_animation” as follows:<br>`typedef struct`<br>`{`<br>`  U8  x;  // x-coordinate`<br>`  U8  y;  // y-coordinate`<br>`  U32 IDP;  // ID of the animation picture`<br>`  U8  time_10ms;  // Time with 10ms granularity`<br>`  U8  mode;  // Repeat: AD_SINGLE or AD_FOREVER`<br>`}Ad_prm_animation;` |
| ad_start( U8 id ) | Starts the graphical object running |
| ad_pause( U8 id ) | Suspends the graphical object in running |
| ad_stop( U8 id ) | Stops the graphical object running and resets its state machine |
| ad_refresh( U8 id ) | Requests the display refresh of the graphical object |
| Ad_free( U8 id ) | Releases one of the graphical object and sets the variable storing the id to the value “UNDEF_AD_OBJ” in order to prevent from identity usurpation. |

Note: Event EVT_ANIMATION with parameter ANIMATION_END is mailed when animation stops in mode AD_SINGLE.

### 5.4.6 Software Timers

The software timers are data structures integrating a 32-bit register. Their static values are compared to the value of the tick counter every scheduler round. If the tick counter value has reached a software timer time register, an overflow timer message is mailed once.

The number of available software timers is set to 10 using the macro “NB_TIMER_SOFT”. The tick period is set to 2ms using the macro TICK_PERIOD. These macros are defined in “config.h” and should not be modified.

The software timers are dedicated to MMI applications and dynamically attributed by the software timer management. Some functions and macros enables the MMI applications to control these kind of timers.

***Table 5-4.*** Functions and macros controlling the software timers

| Functions or macros | Description |
|---|---|
| ts_alloc() | Allocates one of the software timers still available and returns a 8-bit ID. The ID is equal to “UNDEFINED_TIMER” if failure in allocation. If success, this ID must be stored by the MMI application in order to control its attributed timer(s) and to identify from which timers the event comes from.<br>Note: No risk of timer identity usurpation after a cold reset since the value of “UNDEFINED_TIMER” is 0. |
| ts_set_time(U8 id, U32 delay) | Sets the 32-bit delay value, multiple of 2ms (tick period), with the id of the software timer to configure. |
| ts_stop(U8 id) | Stops the time comparison and the software timer. This prevents the delivery of overflow events from this timer.<br>Can only be reactivated with the help of the function “ts_set_time()”. |
| Ts_free(id) | Releases one of the software timers and sets the variable storing the id to the value “UNDEFINED_TIMER” in order to prevent from identity usurpation. |

***Table 5-5.*** Event returned from the software timers

| Event | Description |
|---|---|
| EVT_TIMER | Returns the 8-bit ID of the software timer that has just overflowed |

### 5.4.7 Keyboard Management

The keyboard management is charged with the debouncing and the generation of events from actions on keys. It is located in the file “mmi\kbd\keypad.c” and can be configured differently with the help of the file “conf\conf_kbd”.

Only one keyboard event is mailed “EVT_KEY_PRESSED” but its associated parameter qualify the key actions:

– macro KEY_STATUS(param) gets the changing status of a key (KBD_KEY_PRESSED, KBD_KEY_REPEAT, …).

– macro KEY_ID(param) identifies the key whose status has just changed (For key definition, refer to Section 6.2.6).

***Table 5-6.*** Keyboard messages

| 8-bit parameter value | Description |
|---|---|
| KBD_KEY_PRESSED | Key has just been pressed |
| KBD_KEY_REPEAT | Key has been pressed long enough to enter in the repeat mode. This message is periodically sent while this key stands pressed. |
| KBD_KEY_LONGPRESSED | Key has been pressed long enough to send this message once. |
| KBD_KEY_RELEASED | Key has just been released after a key pressed. |
| KBD_KEY_REPEAT_RELEASED | Key has just been released from a repeat mode. |

Figure 5-9 gives a graphical representation of the keypad behavior.

***Figure 5-9.*** Keyboard timings and events

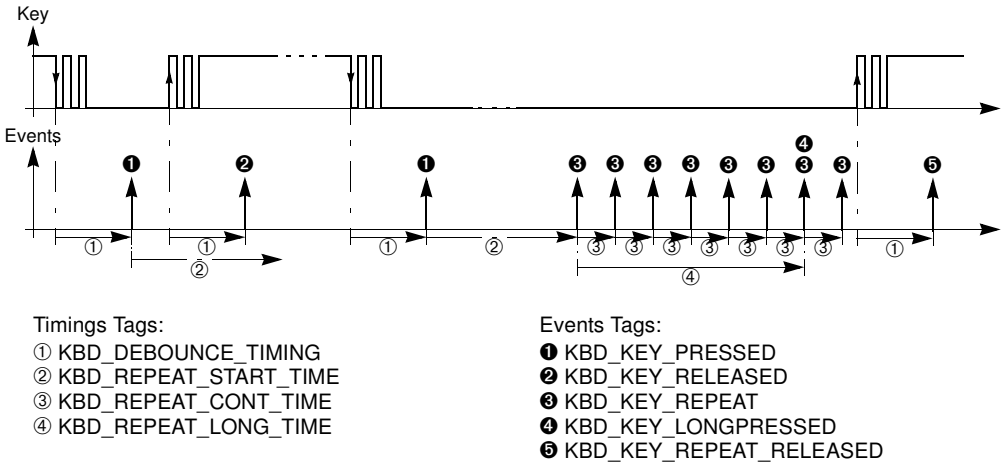



***Figure 5-10.*** Example of a key processing in MMI applications

```
case EVT_KEY_PRESSED:

   if( KBD_KEY_PRESSED == KEY_STATUS(param) )
   {
      switch( KEY_ID(param) )
      {
         case KBD_MMI_SELECT:
            // Launch the application selected
            ...
         break;
      }
   }
   if( 0 != (KEY_STATUS(param) & (KBD_KEY_PRESSED|KBD_KEY_REPEAT)) )
   {
      switch( KEY_ID(param) )
      {
         case KBD_MMI_PREV:
            // Update the selection of the current application
            ...
            break;

         case KBD_MMI_NEXT:
            // Update the selection of the current application
            ...
            break;
      }
      // Only display on KBD_KEY_PRESSED and KBD_KEY_REPEAT
      // to avoid glitching on KBD_KEY_RELEASED
      ...
   }
   break;
```

## 5.5 Services

The services are provide by Atmel and include the usual MMI sequences. This one permits to reduce the code in MMI Applications.

### 5.5.1 Player service

The player service provides a MACRO to start MMI_PLAYER with different options.

***Table 5-7.*** Macro to start MMI_PLAYER

| Fonctions | Description |
|---|---|
| Start_mmiplayer_resume() | Restore last variables of player service, to play the last played item |
| Start_mmiplayer_from_saving_options() | Restore all values of player service<br>Change the explorer values to play the current music file selected |
| Start_mmiplayer_on_disks() | Restore all values of player service<br>Change the explorer values to play all disks and start at the current position |
| Start_mmiplayer_on_disk() | Restore all values of player service<br>Change the explorer values to play one disk and start at the current position |
| Start_mmiplayer_on_dirsub() | Restore all values of player service<br>Change the explorer values to play the current dir with sub directory |
| Start_mmiplayer_on_dir() | Restore all values of player service<br>Change the explorer values to play the current dir without sub directory |
| Start_mmiplayer_one_file() | Restore all values of player service<br>Change the explorer values to play the current file only |
| Start_mmiplayer_on_playlist() | Restore all values of player service<br>Change the explorer values to play the current play list |
| Start_mmiplayer_on_playlist_at() | Restore all values of player service<br>Change the explorer values to play the current play list at a specific position |

***Table 5-8.*** Player services

| Fonctions | Description |
|---|---|
| srvplayer_restore() | Copy player field from setting datas to the service variables<br>Note: it must be called before the other routines of player service. |
| srvplayer_save() | Copy player field from service variables to the setting datas |
| srvplayer_explorer_init() | Initialize the explorer module which permits to play many files in many modes (repeat, random).<br>Note: Don't use this one, if you play a file include it in a specific list. |
| srvplayer_explorer_close() | Close explorer module |
| srvplayer_switch_on() | Turn ON the player modue |
| srvplayer_switch_off() | Turn OFF the player modue |
| srvplayer_file_getinfos() | Get static information about file (name, ID3) |
| srvplayer_play() | Start play of current file selected at beginning or at specific time position |
| srvplayer_update_bitrate() | Update bitrate information<br>Note: The codec type, channel type, sampling frequency, and bitrate informations are avialable only when file is played. |
| srvplayer_gettime() | Get current time play |
| srvplayer_stop() | Stop play file |
| srvplayer_volume_send() | Send at player module the volume value<br>Note: Change "srvplayer_g_arg.volume" value before |
| srvplayer_volume_change() | Increment or decrement "srvplayer_g_arg.volume" value and send its. |

| Fonctions | Description |
|---|---|
| srvplayer_set_eq() | Send to player module the equalizer value |
| srvplayer_eq_modify_predef() | Copy the predefine ambiance in the user ambiance definition |
| srvplayer_set_bassboost() | Send toplayer module the bassboost state |
| srvplayer_set_vsurround() | Send toplayer module the virtual surround state |
| srvplayer_set_speed() | Send toplayer module the speed level |
| srvplayer_pause() | Pause the play of current file |
| srvplayer_ffw() | Start fast foward |
| srvplayer_frw() | Start fast rewind |
| srvplayer_restart_play() | Restart play after a pause/ffw/frw |
| srvplayer_set_marker_A() | Set a marker A on current play |
| srvplayer_set_marker_B() | Set a marker B on current play and start repeat AB |
| srvplayer_stop_repeatAB() | Stop repeat AB |
| srvplayer_rqt_bargraph() | Send a request to get a bargraph data |

### 5.5.2 Recorder Service

***Table 5-9.*** Recorder services

| Fonctions | Description |
|---|---|
| srvrec_init() | Initialize the source of record (micro or line-in) |
| srvrec_start() | Create a file to record the sound (NandFlash\record\recordxxx.wav")<br>Note: The fonction search a free name between record000.wav to record100.wav<br>Start record after file create |
| srvrec_stop() | Stop the recording |

### 5.5.3 Explorer service

The explorer service provide a fonctions to manage a disk list or file list from a directory with a extension filter. In this list, the fonctions manage a display list.

***Table 5-10.*** Explorer services

| Fonctions | Description |
|---|---|
| srvexp_init() | This one initializes the list, It is the first function to call. Paramater is the filter extension of list, the size of DISPLAY list, and eventualy init the position of list at the current position of current navigator |
| srvexp_list_init() | Reinitialize the position of list at the current position of current navigator |
| srvexp_list_check() | This fonction check if the disk of current list is always available.<br>If list no available then the fonction reinit the list with disk list. |
| srvexp_list_build() | Force the list rebuild, so use this one after list modification (e.g. file delete) |
| srvexp_list_beguinning() | Go to the begining of list. the DISPLAY list corresponding at the beginning of file list |
| srvexp_list_end() | Go to the end of list. the DISPLAY list include the end of file list |
| srvexp_list_up() | Move up the DISPLAY list in file list |
| srvexp_list_down() | Move down the DISPLAY list in file list |
| srvexp_list_getname() | Get a file name of file selected in DISPLAY list |

| Fonctions | Description |
|---|---|
| srvexp_list_getname_parent() | Get the name of directory or disk correponding at file list |
| srvexp_enter() | Enter in a disk/directory selected in DISPLAY list<br>Note: A new list is create and DISPLAY list corresponding at the beginning of list |
| srvexp_gotoparent() | Go to parent directory/disk<br>Note: A new list is create and DISPLAY list include the previous parent dir |
| srvexp_format() | Format the disk selected in DISPLAY list |
| srvexp_delete() | Delete a directory/file selected in DISPLAY list |
| srvexp_playlist_default_exist() | Ask if a default playlist exist |
| srvexp_playlist_select_in_list() | The file selected in DISPLAY list is the new default playlist |
| srvexp_playlist_select() | Select or create a new default playlist (“NandFlash\playlist\palylistxxx.mu3”) |
| srvexp_playlist_add() | Add the directory/file selected in DISPLAY list |
| srvexp_copy() | Select a file in DISPLAY list as source file for the futur paste action |
| srvexp_paste() | Paste the file, selected by previous copy action, in directory corresponding at current list |
| srvexp_paste_abort() | Abort paste |
| srvexp_select_pos() | Update current file system navigator at the position selected in DISPLAY list |

### 5.5.4 Ebook service

The ebook service support the text file multilanguage (ASCII, UTF16LE, UTF16BE, UTF8)

***Table 5-11.*** Ebook services

| Fonctions | Description |
|---|---|
| srvebk_open() | Open the current file selected in current file system navigator |
| srvebk_read() | Read the next line |
| srvebk_close() | Stop the recording |

## 5.6 Modules

Atmel provides the system modules which permit to use the SND3 chip feature.
The modules are USB, player, recorder, viewer, power, explorer and update.
The USB modules offers its services to the MMI applications with the help of commands/events or public routines. The following parts decribes the interfaces of each module.

### 5.6.1 USB Interface

The USB module controls the USB device/host mode.

***Table 5-12.*** USB commands

| Command Label | Description |
|---|---|
| CMD_USB_START | Enable the USB controller |
| CMD_USB_STOP | Disable the USB controller |
| CMD_DEVICE_START | Start the device mode |
| CMD_DEVICE_STOP | Stop the device mode |
| CMD_HOST_START | Start the Host mode |
| CMD_HOST_STOP | Stop the Host mode |
| CMD_USB_FORCE_HIGH_SPEED | Force high speed in USB device mode |

***Table 5-13.*** USB events

| Event Label | Description |
|---|---|
| EVT_USB_CTRL_POWERED | Voltage level on VBUS present |
| EVT_USB_CTRL_UNPOWERED | Voltage level on VBUS not present |
| EVT_USB_DEVICE_START | USB controller is entered in USB device mode |
| EVT_USB_DEVICE_STOP | USB controller is exit of USB device mode |
| EVT_USB_DEVICE_ENUM_HIGH | USB device mode enumerated in hight speed detected |
| EVT_USB_DEVICE_ENUM_FULL | USB device mode enumerated in full speed detected |
| EVT_USB_DEVICE_SUSPEND | Suspended state has been detected on USB bus |
| EVT_USB_DEVICE_WAKE_UP | Wake-up state has been detected on USB bus |
| EVT_USB_DEVICE_RESUME | Resume state has been detected on USB bus |
| EVT_USB_DEVICE_RESET | Reset state has been detected on USB bus |
| EVT_USB_DEVICE_SEND | USB device Class has sent data |
| EVT_USB_DEVICE_RECEIV | USB device Class has received data |
| EVT_USB_DEVICE_MS_STARTED | USB device Class mass storage has started |
| EVT_USB_HOST_START | USB controller is entered in USB host mode |
| EVT_USB_HOST_EXIT | USB controller is exit of USB host mode |
| EVT_USB_HOST_LIMITATION_HW | USB host module can't install new device because a hardware limitation is detected (product limitation). |
| EVT_USB_HOST_LIMITATION_SW | USB host module can't install new device because a software limitation is detected (change low configuration in conf_usb.h). |
| EVT_USB_HOST_MS_CHANGE | A Mass Storage device has been detected or disconnected. |
| EVT_USB_HOST_HUB_CHANGE | A HUB device has been detected or disconnected. |
| EVT_USB_HOST_HID_CHANGE | A HID device has been detected or disconnected. |
| EVT_USB_HOST_HID_MOUSE_BTN1 | USB host has receiv a event "clic bouton 1" via a HID device. |

| Event Label | Description |
|---|---|
| EVT_USB_HOST_HID_MOUSE_BTN2 | USB host has received an event “clic bouton 2” via a HID device. |
| EVT_USB_HOST_HID_MOUSE_BTN3 | USB host has received an event “clic bouton 3” via a HID device. |
| EVT_USB_HOST_HID_MOUSE_MOVE | USB host has received an event “mouse move” via a HID device. |
| EVT_USB_HOST_HID_KB_KEY | USB has received an event “key press” via a HID device. |
| EVT_USB_HOST_CDC_CHANGE | A CDC device has been detected or disconnected. |

The USB module does not include public routines.

### 5.6.2 Player Interface

The Player module controls the audio features of the chip:

– it interfaces the audio processor

– it manages the playing of audio files (play, stop, pause, …)

In player module, only the bargraph feature can’t be immediatly executed, then this must be executed via a command and event.

***Table 5-14.*** Player commands

| Command Label | Description |
|---|---|
| CMD_PLAYER_GET_BARGRAPH | Ask a bargraph data.<br>The result is sent by player task via a event. |

The player task sends only one event “EVT_PLAYER” with differents arguments.

***Table 5-15.*** Player event arguments

| Arguments of “EVT_PLAYER” | Description |
|---|---|
| PLAYER_BOF | Beginning of the played file reached.<br>Note: player_task_stop() is automaticly executed. |
| PLAYER_EOF | End of the played file reached, the player is stopped.<br>Note: player_task_stop() is automaticly executed. |
| PLAYER_ERROR_UNDERRUN | Under-run occurred but play continues |
| PLAYER_ERROR_SYNCH | Audio processor synchronization lost but play continues |
| PLAYER_START_AB | Play of the AB track has restarted |
| PLAYER_EOF_AB | End of the played AB track, start the research of A position |
| PLAYER_BARGRAPH | Bargraph resultat of command CMD_PLAYER_GET_BARGRAPH |

***Table 5-16.*** Player publics routines

| Routines | Description |
|---|---|
| player_on() | Turn the audio controller on |
| player_off() | Turn the audio controller off |
| player_play_file()* | Play the music file selected on current file system navigator |
| player_restart_play()* | Restart playing at beginning |
| player_pause()* | Pause the ongoing play |
| player_stop()* | Stop a playing file and close file |
| player_fast_foward()* | Fast-forward the ongoing play |
| player_fast_rwd()* | Fast-rewind the ongoing play |
| player_set_marker_A() | Set the marker A at the current position in the ongoing play |
| player_set_marker_B() | Set the marker B at the current position in the ongoing play and start AB repeat |
| player_stop_repeat_AB()* | Stop playing the AB track |
| player_set_speed() | Change the speed of the play (normal/slow) |
| player_linein_on() | Enable ouput audio from line-in |
| player_linein_off() | Disable ouput audio from line-in |
| player_set_volume() | Change the output volume level |
| audio_surround() | Set the virtual surround on/off |
| audio_bassboost() | Set the bass boost on/off |
| audio_set_vol_equalizer() | Set the bass/medium/treble band volume |
| player_get_time() | Get the elapsed time of the ongoing play |
| player_get_timetotal() | Get the total time of a song to play |
| player_channel_type() | Get information channel type on the current stream. |
| player_sampling_freq() | Get information sampling frequence on the current stream. |
| player_bitrate() | Get information bitrate on the current stream. |
| player_get_codec_type() | Get the codec type currently used. |
| player_task_start() | Enable player task (it must be call after player_play_file() successfull) |
| player_task_stop() | Disable player task (it must be call after player_stop() successfull) |

Note: * If the resultof this routine is successful, then you must wait a confirmation via specific routine player_evt().

### 5.6.3 Recorder Interface

The Recorder module takes in charge the control of the audio recorder features of the chip:

- it interfaces the audio processor
- it manages the recording of audio files (start, stop)

The recorder module does not include a command, but one event "EVT_RECORDER" with different arguments.

***Table 5-17.*** Recorder event arguments

| Arguments of "EVT_RECORDER" | Description |
|---|---|
| RECORD_EOF | End of recording because of destination memory access fail.<br>Note: recorder_task_stop() is automaticly executed. |

***Table 5-18.*** Recorder public routines

| Routines | Description |
|---|---|
| record_on() | Initialize the record with:<br>- microphone or line-in as input.<br>- current file selected on current file system navigator. |
| record_off() | Stop the recording and close file |
| record_start() | Start the recording |
| record_gettime() | Get the recording time |
| recorder_task_start() | Enable recorder task (it must be call after record_start() successfull) |
| recorder_task_stop() | Disable recorder task (it must be call after record_off() successfull) |

### 5.6.4 Viewer Interface

The Viewer module takes controls the picture decoder features of the chip:

– it interfaces the decoder processor

– it manages the decoding of picture files (start, stop)

The viewer module does not include a command.

***Table 5-19.*** Viewer events

| Events | Description |
|---|---|
| EVT_VIEWER_EOF | End of picture decoding.<br>Note: viewer_task_stop() is automaticly executed. |
| EVT_VIEWER_FAIL | Error during picture decoding.<br>Note: viewer_task_stop() is automaticly executed. |
| EVT_VIEWER_ERR_ACCESS_FILE | Error during access file<br>Note: viewer_task_stop() is automaticly executed. |

***Table 5-20.*** Viewer public routines

| Routines | Description |
|---|---|
| viewer_set_width() | Set the width of the viewer display area.<br>Note: initialization mandatory before call viewer_on() |
| viewer_set_height() | Set the height of the viewer display area.<br>Note: initialization mandatory before call viewer_on() |
| viewer_set_x0() | Set the x0 of the viewer display area.<br>Note: initialization mandatory before call viewer_on() |
| viewer_set_y0() | Set the y0 of the viewer display area.<br>Note: initialization mandatory before call viewer_on() |
| viewer_config() | Config the viewer.<br>Note: initialization mandatory before call viewer_on() |
| viewer_on() | Start the picture file decoding. Use the current file selected on current file system navigator. |
| viewer_off() | Stop the recording and close file |
| viewer_task_start() | Enable viewer task (it must be call after viewer_on() successfull) |
| viewer_task_stop() | Disable viewer task (it must be call after viewer_off() successfull) |

### 5.6.5 Power Interface

The Power module controls the power management of the device:

- automatically jumps in idle mode to reduce power consumption,
- provides battery level information,
- provides power-off control,
- provides alarm mechanism on a specified low battery level.

***Table 5-21.*** Power commands

| Command Label | Description | Returned Events |
|---|---|---|
| CMD_POWER_OFF | Turn the power off (CPU and peripherals stopped). Exit from this hardware state by any key pressed. | |
| CMD_AUTO_POWER_OFF_ENABLE | Enable to turn power off automatically when no key pressed during a well-defined time (see Section 6.2.11) | |
| CMD_AUTO_POWER_OFF_DISABLE | Disable the auto power off | |
| CMD_BATTERY_CHARGE_ENABLE | Enable battery charging | |
| CMD_BATTERY_CHARGE_DISABLE | Disable battery charging | |
| CMD_GET_VBUS_STATE | Test if there is power on the USB | EVT_POWER_VBUS_STATE with boolean state |
| CMD_POWER_SETTING_LOADED | Initialize the power off timeout with the value present in setting data.<br>Note: Execute this command after setting init or load. | |

***Table 5-22.*** Power events

| Event Label | Description |
|---|---|
| EVT_POWER_ON | The chip must restart after a power-down mode executed by command CMD_POWER_OFF. |
| EVT_BATTERY_CHARGING | Signal battery charging activation or disactivation (status in parameter) |
| EVT_BATTERY_LEVEL | Return the battery charge level with the help of the parameter formatted as follows: LSB(U16) = 8-bit battery charge level<br>Periodically sent according to the configuration (see Section 6.2.11) |
| EVT_BATTERY_LEVEL_ALERT | Signals that the battery charge level is low |
| EVT_POWER_VBUS_STATE | Give the VBUS state after a VBUS change or command CMD_GET_VBUS_STATE |
| EVT_BACKLIGHT_OFF | Signal that backlight is disabled.<br>Note: This event is sent by lcd module. |
| EVT_POWER_ENTER_IN_POWEROFF | Inform that chip have no activity and may be set in power off. |

### 5.6.6 Explorer Interface

The Explorer module is basically the entry point to the file system and proposes the following services:

- Drive/Partition navigation and control (mount, format, get space...)
- directory navigation and control (cd, setcwd, deldir, mkdir, getcwd…)
- file list (= files in directory) navigation (next, previous, search...)
- file list control (get size, create, rename, delete, …)
- file list I/O (getc, putc, read_buf, ...)
- copy/paste file
- playlist management (open, create, mdoification, ...)
- explorer API to permit a simple filter navigation :
  - in disk, directory only, directory and subdirectory, playlist
  - the feature is previous, next, repeat, random

In this document, only the commands and events are described, because a specific document on FileSystem Atmel exists.

These services are available through public routines, only the copy/paste features may be use via a commands/event to not break the scheduler.

The following commands and events replace the direct access at the routine “nav_file_paste_state()”.

***Table 5-23.*** Paste commands

| Command Label | Description |
|---|---|
| CMD_EXP_PASTE_ENABLE | Enable the task paste, it must be call after nav_file_paste_start(). |
| CMD_EXP_PASTE_DISABLE | Abort the task paste. |

***Table 5-24.*** Paste events

| Event Label | Description |
|---|---|
| EVT_EXP_PASTE_FINISH | The paste is finish. |
| EVT_EXP_PASTE_FAIL | The paste is finish because a error has occurs. |

***Table 5-25.*** Specific events

| Event Label | Description |
|---|---|
| EVT_EXP_MEMORY_MMCSD_CHANGE | A MMC or SD card is plug or unplug. |

### 5.6.7 Update Interface

The Update module controls the firmware update.

***Table 5-26.*** Update commands

| Command Label | Description |
|---|---|
| CMD_UPDATE_START | Start the update process |

***Table 5-27.*** Update events

| Event Label | Description |
|---|---|
| EVT_UPDATE_START | The update process start status |
| EVT_UPDATE_PROGRESSING | The update process is in progress |
| EVT_UPDATE_FINISHED_FAIL | The update process failed |
| EVT_UPDATE_ERR_COMMAND | An unknown command has been received |

## 5.7 Debug trace text

The TEXT TRACE feature is available only in OCD mode because the text trace is sent to KEIL IDE via OCD dongle.

To use it, you must:

- uncomment line 14 "#define _TRACE_ (ENABLE)" in debug.c
- include following lines in C file to debug

```
#include "config.h"
#define _TRACE_ (ENABLE)
#include "lib_mcu\debug.h"
```

- use debug routines provide in debug.c, e.g. :

```
trace("u8_toto=");
trace_hex( u8_toto );
trace("\n");
```

- in case of code commun too large, you can comment the debug routines not use in debug.c , e.g. :

```
/*
void trace_u32( )
{...}
*/
```

When you execute the firmware in OCD mode on KEIL, the trace are displayed in the tab "Command" from "Output Window".

# Section 6

# Firmware Configuration

## 6.1 Overview

Several files have been implemented to help the software developer to quickly configure the firmware.

The configuration files “conf_*.h” are all under the conf directory of the firmware package (see Section 3.1.1). There are four kinds of configuration files:

- Files configuring the Customer MMI layer only

  The file conf_mmi.h configures exclusively the Customer MMI layer and more precisely the MMI applications organized in modules (see Section 3.1.8).

- Files configuring both the Customer MMI and the Atmel system layers

  These files are the ones that configure the source code of custom MMI peripherals:

  – conf_kbd.h: configures both the keyboard driver of the system firmware system and the key affectation dedicated to the MMI modules using the keyboard.

  – conf_lcd.h: configures the lcd driver of the system firmware system, the API of the LCD driver and the mmi_manager module.

  – conf_audio.h: configures both the custom audio firmware module for external DAC implementation and the audio part of the player module.

  – conf_update.h: configures both the application MMI update and the update firmware module.

- Files configuring the Atmel system layer only

  – conf_access.h: enables the implementation of memory access interfaces only required in your custom application. It mainly configures the source code files of the control access firmware module.

  – conf_clock.h: configures the oscillator frequency which depends all the lib_mcu drivers: clock, lcd, timer, memory controllers, …

  – conf_explorer.h: configures the file_system module and the playlist module.

  – conf_nf.h: configures the nand_flash memory module and the Nand Flash controller driver.

  – conf_power.h: configures the power module, the audio module and the API of the lcd driver.

  – conf_scheduler.h: configures the scheduling of the system task.

  – conf_usb.h: configures the USB controller driver (see Section 3.1.5), the USB module and the SCSI decoder module.

- Files configuring the global firmware

  Two files are under the top-level directory of the firmware package:

  – config.h: configures the system. ***Should not be modified***.

  – option.h: configures (de-)activation of peripherals. Also, defines compilation switches.

## 6.2 Configuration Files

This section describes feature by feature the available configuration. In the following tables, the default parameters values are marked in square brackets.

### 6.2.1 Control Access

The “conf_access.h” file is used to configure the access control of all the system memories. The source code of each access interface and logical unit are compiled only if enabled.

***Table 6-1.*** Access interface configuration

| Definition Label | Description | Values |
|---|---|---|
| ACCESS_CODEC | Codec input under control access | [ENABLE]<br>DISABLE |
| ACCESS_DISPLAY | Display input under control access | [ENABLE]<br>DISABLE |

***Table 6-2.*** Logical unit configuration

| Definition Label | Description | Values |
|---|---|---|
| MEM_NF | Nand Flash memory access | [ENABLE]<br>DISABLE |
| MEM_MMC | MMC memory access | ENABLE<br>[DISABLE] |
| MEM_USB | USB memory access (available in USB host mode only) | ENABLE<br>[DISABLE] |

***Table 6-3.*** Global protection in writing of all memories (no implemented)

| Definition Label | Description | Values |
|---|---|---|
| GLOBAL_WR_PROTECT | Global write protect support | ENABLE<br>[DISABLE] |

### 6.2.2 Audio Features

The “conf_audio.h” file is used to configure the audio features of the firmware.

***Table 6-4.*** Miscellaneous settings

| Definition Label | Description | Values |
|---|---|---|
| AUDIO_FF_SPEED_1 | Fast forward speed during the first 4 seconds | [CODEC_CMD_FAST_FWD]<br>CODEC_CMD_FAST_FWD2<br>CODEC_CMD_FAST_FWD3 |
| AUDIO_FF_SPEED_2 | Fast forward speed after the first 4 seconds | CODEC_CMD_FAST_FWD<br>[CODEC_CMD_FAST_FWD2]<br>CODEC_CMD_FAST_FWD3 |
| AUDIO_FF_SPEED_3 | Fast forward speed after the first 8 seconds | CODEC_CMD_FAST_FWD<br>CODEC_CMD_FAST_FWD2<br>[CODEC_CMD_FAST_FWD3] |
| AUDIO_RECORD | Nand Flash memory access | ENABLE<br>[DISABLE] |

***Table 6-5.*** Play behavior

| Definition Label | Description | Values |
|---|---|---|
| AUDIO_TIME_FOR_SONG_REPLAY | Define the time from which song replay is done | 0->[4]->59 |

***Table 6-6.*** Audio output settings

| Definition Label | Description | Values |
|---|---|---|
| AUDIO_OUT_TYPE | Internal (on-chip) or external audio DAC | INTERNAL_DAC<br>[EXTERNAL_DAC] |
| AUDIO_OUT_DRIVE | Impedance drive of the internal audio DAC:<br>- high impedance (50kΩ)<br>- low impedance (32Ω) | LINE_OUT_DRIVE (50kΩ)<br>[INTERNAL_HEADSET_DRIVE] (32Ω)<br>EXTERNAL_HEADSET_DRIVE (50kΩ) |
| AUDIO_EXT_HEAD_AMP_ON | Output enabling the switch on/off of the external headphone amplifier | [P1_6]<br>I/O pins mnemonics are defined in mcu.h file (See Section 3.1.5). |
| EXT_DAC_OVERSAMP | External audio DAC oversampling ratio | OVERSAMP_128X<br>[OVERSAMP_256X]<br>OVERSAMP_348X |
| EXT_DAC_IF_TYPE | Interface type of the external audio DAC | [DAC_IF_I2S]<br>DAC_IF_PCM |
| EXT_DAC_NB_BITS | Bit number of the external audio DAC | From [16] up to 32 |

***Table 6-7.*** Audio input settings

| Definition Label | Description | Values |
|---|---|---|
| MIC_BIAS_CTRL | Microphone output bias voltage: 1.5V or 2.0V.<br>Related to the power level voltage or forced | NO_MIC_BIAS (no microphone)<br>[POWER_SELECTED_BIAS] (related)<br>V2_0_BIAS (forced)<br>V1_5_BIAS (forced) |
| AUDIO_IN_MIC_GAIN | Microphone input analog amplifier gain | AUP_INPUT_GAIN_0DB<br>AUP_INPUT_GAIN_6DB<br>AUP_INPUT_GAIN_12DB<br>AUP_INPUT_GAIN_18DB<br>[AUP_INPUT_GAIN_24DB] |
| AUDIO_IN_MIC_DIGITAL_GAIN | Microphone input digital amplifier gain | AUP_INPUT_GAIN_DIG_1<br>AUP_INPUT_GAIN_DIG_2<br>AUP_INPUT_GAIN_DIG_4<br>AUP_INPUT_GAIN_DIG_8<br>AUP_INPUT_GAIN_DIG_12<br>AUP_INPUT_GAIN_DIG_16<br>AUP_INPUT_GAIN_DIG_20<br>AUP_INPUT_GAIN_DIG_24 |
| AUDIO_IN_LINE_GAIN | Input line analog amplifier gain | AUP_INPUT_GAIN_0DB<br>AUP_INPUT_GAIN_6DB<br>[AUP_INPUT_GAIN_12DB]<br>AUP_INPUT_GAIN_18DB<br>AUP_INPUT_GAIN_24DB |
| AUDIO_IN_LINE_DIGITAL_GAIN | Input line digital amplifier gain | AUP_INPUT_GAIN_DIG_1<br>AUP_INPUT_GAIN_DIG_2<br>AUP_INPUT_GAIN_DIG_4<br>AUP_INPUT_GAIN_DIG_8<br>AUP_INPUT_GAIN_DIG_12<br>AUP_INPUT_GAIN_DIG_16<br>AUP_INPUT_GAIN_DIG_20<br>AUP_INPUT_GAIN_DIG_24 |
| AUDIO_LINE_BACK_GAIN | Input line preamplifier gain | [AUP_INPUT_GAIN_6DB]<br>AUP_INPUT_GAIN_12DB |

### 6.2.3 Clock

The “conf_clock.h” file is used to configure the clock that drives the chip.

***Table 6-8.*** Clock settings

| Definition Label | Description | Values |
|---|---|---|
| FOSC | Oscillator frequency | From [12000] up to 26000 (unit in KHz) |
| CLK_DRIVE | Oscillator type:<br>- Crystal connected on X1/X2 pins<br>- External oscillator drives X1 input | [CLK_CRYSTAL]<br>CLK_GENERATOR |

### 6.2.4 File System

The “conf_explorer.h” file is used to configure the file system modules.

***Table 6-9.*** File System configuration

| Definition Label | Description | Values |
|---|---|---|
| FS_FAT_12 | 12-bit FAT support | [ENABLED]<br>DISABLED |
| FS_FAT_16 | 16-bit FAT support | [ENABLED]<br>DISABLED |
| FS_FAT_32 | 32-bit FAT support | [ENABLED]<br>DISABLED |
| FS_ASCII | Ascii file name support | [ENABLED]<br>DISABLED |
| FS_UNICODE | Unicode fiel name support | [ENABLED]<br>DISABLED |
| FS_MULTI_PARTITION | Multiple partition support (no implemented) | ENABLED<br>[DISABLED] |
| FS_NB_CACHE_CLUSLIST | Cache to increment the speed during navigation and open file, but use more data space. | 1 to 256 |
| FS_LEVEL_FEATURES | File system features: implementation or not of some functions.<br>FSFEATURE_READ_COMPLET: all read functions<br>FSFEATURE_READ: all read functions except “getc()” and “eof()”<br>FSFEATURE_WRITE_NAV: “nav_formatdrive()” and “nav_delfile()” available<br>FSFEATURE_WRITE_NAV_COMPLET: FSFEATURE_WRITE_NAV + “nav_mkdir()” and “nav_rename()” available<br>FSFEATURE_WRITE_FILE: “file_create()”, “file_open(MODE_WRITE)”, “file_write()”, “file_putc()” available<br>FSFEATURE_WRITE_FILE_COMPLET: FSFEATURE_WRITE_FILE + “nav_set_date()”, “nav_set_attribut()”, file_getc() functions are available<br>FSFEATURE_ALL: all above features available. | [FSFEATURE_READ]<br>FSFEATURE_READ_COMPLET<br>FSFEATURE_WRITE_NAV<br>[FSFEATURE_WRITE_NAV_COMPLET]<br>FSFEATURE_WRITE_FILE]<br>FSFEATURE_WRITE_FILE_COMPLET |
| FS_NB_NAVIGATOR | Maximum number of navigators used | [3] |
| FS_NAV_ID_PLAYLIST | ID of the navigator dedicated to the playlist.<br>NB: the explorer always works with the navigator ID 0.<br>Could be set to 0 to have the same navigator than the explorer. | [1] |
| FS_NAV_ID_COPYFILE | ID of the navigator dedicated to the file copy.<br>“copy file” is opened with this ID but “paste file” is opened with the ID 0 | [2] |
| FS_NAV_ID_KARAOKE | ID different than both explorer and playlist’s IDs | [2] |
| FS_NAV_ID_ID3 | ID different than both explorer and playlist’s IDs | [2] |
| FS_NAV_ID_UPDATEFILE | ID of the navigator dedicated to the update mode.<br>NB: the explorer always works with the navigator ID 0. | [1] |
| FS_NAV_ID_STATUSFILE | ID of the navigator dedicated to the update file status. | [2] |
| PL_UNICODE | Format of playlist use (enable=UTF16BE, disable=ASCII) | ENABLED<br>[DISABLED] |

| Definition Label | Description | Values |
|---|---|---|
| EXP_MAX_RANGE_RAND | Size of the list to random (option of explorer module) | 1 to 100 (unit 8 files) |
| EXP_GET_RAND | Process use to get a random value (option of explorer module) | use TL0 register |

### 6.2.5 Setting

The “conf_explorer.h” file is used to configure the setting modules.

***Table 6-10.*** Setting configuration

| Definition Label | Description | Values |
|---|---|---|
| SETTING_AREA_FAT | The setting area (disk) include file system (enable) or not (disable) | ENABLED<br>[DISABLED] |
| SETTING_AREA_ACCESS_NAV | The setting area (disk) access is possible via SRV_EXPLORER | ENABLED<br>[DISABLED] |
| SETTING_AREA_ACCESS_USB | The setting area (disk) access is possible via USB device mass storage | ENABLED<br>[DISABLED] |
| SETTING_AREA_SIZE | Size of setting area (disk) | 1 to disk limitation |
| SETTING_CASE_SENSITIVE | Ignore the case for FILE_SETTING and UPDATE_SETTING_PATH define. | TRUE<br>[FALSE] |
| SETTING_STRING_UNICODE | The FILE_SETTING and UPDATE_SETTING_PATH define are in unicode format. | TRUE<br>[FALSE] |
| FILE_SETTING | File name of setting file<br>Only use if the SETTING_AREA_FAT is enable. | Patch ASCII or UNICODE |
| UPDATE_SETTING_PATH | File path used to update setting via a external file | Patch ASCII or UNICODE |

### 6.2.6 Keyboard

The “conf_kbd.h” file is used to configure the keypad matrix driver.

- Keypad driver implementation

***Table 6-11.*** Keypad decoding policy

| Definition Label | Description | Values |
|---|---|---|
| KBD_DECODE_POLICY | Decoding policy: by interrupt or by polling | [KBD_INT_DECODE]<br>KBD_POLL_DECODE |

- Keypad timing configuration

***Table 6-12.*** Keypad timings

| Definition Label | Description | Values |
|---|---|---|
| KBD_DEBOUNCE_TIME | Debounce time (unit in ms) | [50] |
| KBD_REPEAT_START_TIME | First repeat event delay (unit in ms) | [500] |
| KBD_REPEAT_CONT_TIME | Repeat event period | [200] |
| KBD_REPEAT_LONG_TIME | Long-press event delay | [2000] |

Refer to Figure 5-9 to have a clear view of what these parameters represent.

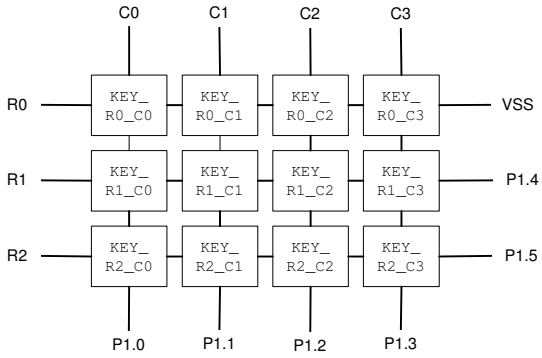
- Keypad layout configuration:

The keyboard driver can support 5 kinds of matrices up to 12 keys as detailed in the following figures.

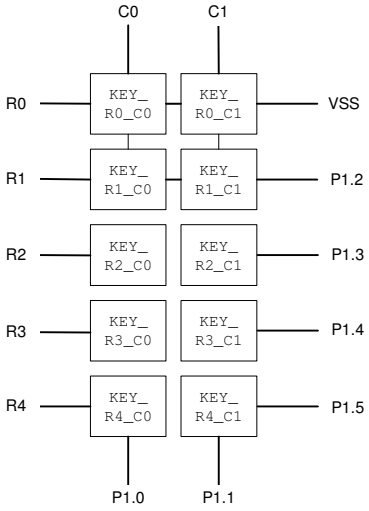
***Table 6-13.*** Keypad Layout

| Definition Label | Description | Values |
|---|---|---|
| KBD_USE_NB_KEYS | Number of key leads to a dedicated matrix layout | [KBD_12_KEYS]<br>KBD_10_KEYS<br>KBD_9_KEYS<br>KBD_6_KEYS<br>KBD_4_KEYS |

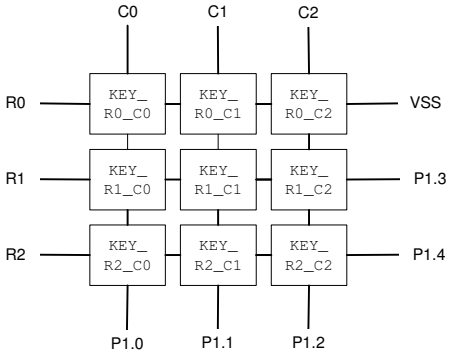
– KBD_12_KEYS: a 4x3 matrix keyboard organization



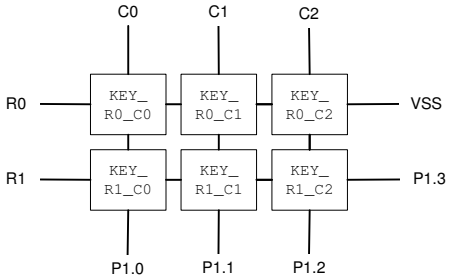

– KBD_10_KEYS: a 2x5 matrix keyboard organization



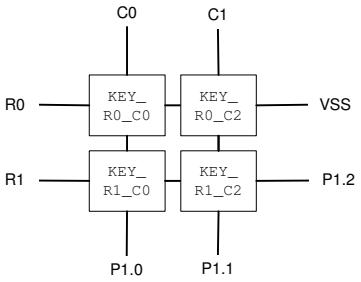
– KBD_9_KEYS: a 3x3 matrix keyboard organization




– KBD_6_KEYS: a 3x2 matrix keyboard organization




– KBD_4_KEYS: a 2x2 matrix keyboard organization




- Keypad Power-On Key Configuration:

***Table 6-14.*** Keypad power-on key

| Definition Label | Description | Values |
|---|---|---|
| KBD_USE_POWER_KEY | Use of the on-chip DC-DC power-on key | TRUE<br>[FALSE] |

- Standard Key definition:

standard keys used in MMI applications are mapped here onto the keyboard matrix:

***Table 6-15.*** Standard key definition for the AT85DVK07 board version 0.0.1

| Standard key Labels | Matrix key Labels |
|---|---|
| KEY_LOCK | KEY_R1_C1 |
| KEY_MENU | KEY_R0_C3 |
| KEY_CENTER | KEY_R2_C2 |
| KEY_RIGHT | KEY_R2_C3 |
| KEY_LEFT | KEY_R2_C1 |
| KEY_UP | KEY_R1_C2 |
| KEY_DOWN | KEY_R0_C2 |
| KEY_INC | KEY_R1_C0 |
| KEY_DEC | KEY_R2_C0 |
| KEY_SPARE1 | KEY_R0_C0 |
| KEY_SPARE2 | KEY_R0_C1 |

### 6.2.7 LCD Display

The “conf_lcd.h” is used to configure the LCD driver. It is divided in two sections:

- Common general settings

  This section sets the common general parameters.

***Table 6-16.*** Miscellaneous settings

| Definition Label | Description | Values |
|---|---|---|
| LCD_PRESENT | Player has got a LCD | [TRUE]<br>FALSE |

***Table 6-17.*** Backlight settings

| Definition Label | Description | Values |
|---|---|---|
| BACKLIGHT | Backlight control support | ENABLED<br>[DISABLED] |
| BACKLIGHT_CTRL_PIN | Output controlling the backlight switched on/off | [P1_7]<br>I/O pins mnemonics are defined in mcu.h file (See Section 3.1.5). |
| LOW_LEVEL_BACKLIGHT_ON | Low level to drive the backlight on? | [TRUE]<br>FALSE |

***Table 6-18.*** Common features

| Definition Label | Description | Values |
|---|---|---|
| LCD_WIDTH | Width of LCD screen matrix | Up to 255 for current LCD drivers (unit in pixels) |
| LCD_HEIGHT | Height of LCD screen matrix | Up to 255 for current LCD drivers (unit in pixels) |

***Table 6-19.*** Main features

| Definition Label | Description | Values |
|---|---|---|
| EMBEDDED_CODE_FONT | Allow local font usage in code | ENABLED<br>[DISABLED] |
| TEXT_SCROLLING | Implement or not the code to have the text scrolling available | [ENABLED]<br>DISABLED |
| IMAGE_SUPPORT | Implement or not the functions to display JPEG pictures | ENABLED<br>[DISABLED] |

- LCD interface configurations

  This section configures the on-chip LCD interface for each LCD module to support.

***Table 6-20.*** Interface type

| One of definition Labels to define | Description |
|---|---|
| LCD_INTERFACE_TYPE_8080<br>LCD_INTERFACE_TYPE_6800 | Access cycle type to communicate with the LCD module:<br>8080 or 6800. |
| LCD_INTERFACE_CYCLE_NORMALIZED<br>LCD_INTERFACE_CYCLE_NOT_NORMALIZED | Chip Select selects the LCD device (NORMALIZED) strictly or performs R/W operations directly (NOT NORMALIZED). |

***Table 6-21.*** Cycle timings

| Definition Labels | Description |
|---|---|
| LCD_INTERFACE_ADDR_SETUP_TIME | Address set-up time of the LCD module (unit in ns) |
| LCD_INTERFACE_ADDR_HOLD_TIME | Address hold time of the LCD module (unit in ns) |
| LCD_INTERFACE_RD_PULSE_WIDTH | Access width time in reading (unit in ns) |
| LCD_INTERFACE_WR_PULSE_WIDTH | Access width time in writing (unit in ns) |
| LCD_INTERFACE_FULL_ACCESS_CYCLE_TIME | Access cycle time optimized (TRUE) or set as being the doubled time of the Access width time (FALSE) |
| LCD_INTERFACE_CYCLE_TIME | Full access cycle time taken into account only if the Access cycle time is set optimized (unit in ns) |

***Table 6-22.*** Automatic busy process

| Definition Labels | Description |
|---|---|
| LCD_INTERFACE_BUSY_MASK | Bits that return the busy status of the LCD module.<br>Set at 0, the busy check is disabled |
| LCD_INTERFACE_BUSY_ACTIVE_LEVEL | High level for busy bits active (TRUE / FALSE) |

***Table 6-23.*** Read / write operations

| Definition Labels | Description |
|---|---|
| LCD_INTERFACE_INSTRUCTION_REG_PIN_LEVEL | High level on pin A0/RS to select the instruction/status register (TRUE / FALSE) |

### 6.2.8 MMC / SD Card

The”conf_mmc.h” is used to configure the MMC/SD card driver.

The following configuration is taken into account only if MMC/SD is enabled in “conf_access.h”.

***Table 6-24.*** Settings

| Definition Label | Description | Values |
|---|---|---|
| MMC_CARD_SECU_FUNC | Secured functions | ENABLE<br>[DISABLE] |
| SD_4_BIT | 4-bit data bus | [ENABLE]<br>DISABLE |

### 6.2.9 MMI Applications

The “conf_mmi.h” file is used to configured the user’s MMI applications.

***Table 6-25.*** Features activation

| Definition Label | Description | Values |
|---|---|---|
| GAME_SNAKE | Enable the GAME MMI | ENABLE<br>[DISABLE] |
| EBOOK | Enable the ebook MMI | [ENABLE]<br>DISABLE |
| RADIO | Enable the radio MMI | [ENABLE]<br>DISABLE |
| USB_DEVICE_AUTO_LAUNCH | Auto start USB device at startup if USB power detected | [ENABLE]<br>DISABLE |
| USB_DEVICE_AUTO_STOP | Auto stop USB device if USB activie stop during USB_ACTIVITE_TIMEOUT | [ENABLE]<br>DISABLE |

- Delay definitions used in MMI applications are based on software timer macros:
  - TIMER_MS(x) to wait 'x' milli-seconds (minimum is 2ms, the period tick)
  - TIMER_S(x) to wait 'x' seconds
  - TIMER_MIN(x) to wait 'x' minutes.

The timer granularity is equal to the tick period: 2 ms.

***Table 6-26.*** Delay definitions

| Definition Labels | Description |
|---|---|
| SPLASH_TIME | Display duration of the splash screens in MMI application Status |
| PLAYER_TIME | Period of the screen refreshing in MMI application Player |
| STORAGE_ARROW_TIMER | Refresh delay of the USB R/W animation in MMI application Storage |
| VOLUME_DELAY | Display duration of the volume window in MMI application Volume |
| EQUALIZER_DELAY | Display duration of the equalizer window in MMI application Equalizer |
| TIME_BACKLIGHT_ON | Duration of the backlight being on |
| PROPERTIES_DELAY | Display duration of the properties window in MMI application Properties |
| INFO_DELAY | Display duration of the info window in MMI application Info |

- Key mnemonics renaming: the standard keys defined in conf_kbd.h is renamed here to ease the readability of the MMI applications source code.

***Table 6-27.*** Key mnemonics renaming

| MMI Key Labels | Default associated driver key Labels |
|---|---|
| KBD_LOCK_SWITCH | KEY_LOCK |
| KBD_MMI_F | KEY_MENU |
| KBD_MMI_SELECT | KEY_CENTER |
| KBD_MMI_NEXT | KEY_RIGHT |
| KBD_MMI_PREV | KEY_LEFT |
| KBD_MMI_UP | KEY_UP |
| KBD_MMI_DOWN | KEY_DOWN |
| KBD_MMI_VOL_HIGH | KEY_INC |
| KBD_MMI_VOL_LOW | KEY_DEC |
| KBD_MMI_FFW | KEY_RIGHT |
| KBD_MMI_FRW | KEY_LEFT |

### 6.2.10 Nand-Flash Memory

The”conf_mmc.h” is used to configure the Nand Flash memory driver.

- Nand Flash Type

NF_TYPE_*: defines the label of one of the NF supported by the system firmware

The list of supported Nand Flash is available on ATMEL site (Supported-Nand-Flash.pdf)

If an auto-detection of the NF is required, please put in comments this define and set to TRUE either the following defines:

***Table 6-28.*** Auto-detect configuration

| Definition Label | Description | Values |
|---|---|---|
| NF_AUTO_DETECT_2KB | 2 Kilobytes page size Nand Flash | TRUE<br>[FALSE] |
| NF_AUTO_DETECT_512 | 512 Bytes page size Nand Flash | TRUE<br>[FALSE] |

- Number of on-board devices

***Table 6-29.*** Read / write operations

| Definition Label | Description | Values |
|---|---|---|
| NF_N_DEVICES | Number of devices | [1]<br>2<br>4 |

### 6.2.11 Power Management

The “conf_power.h” file is used to configure the power features of the system.

***Table 6-30.*** Power type

| Definition Label | Description | Values |
|---|---|---|
| POWER_SOURCE | The power level under which the system has to run: very low (1.8V) or low (3.3V) | INTERNAL_VLV_DC_DC<br>EXTERNAL_VLV_REGULATOR<br>[EXTERNAL_LV_DC_DC]<br>EXTERNAL_LV_REGULATOR |
| POWER_EXT_DC_ON | External DC-DC control pin | [P3_4]<br>I/O pins mnemonics are defined in mcu.h file (See Section 3.1.5). |
| POWER_TYPE | Type of power use | [POWER_LOW_VOLTAGE]<br>POWER_VERY_LOW_VOLTAG E |
| POWER_OFF_AUTO | Automatic power-off | [ENABLE]<br>DISABLE |
| POWER_BATTERY_SCAN_PERIOD | Battery level scan period | Value in seconds |
| POWER_BATTERY_LEVEL_ALERT | Battery alert level | 0 to 16 |

### 6.2.12 Scheduler module

The “conf_scheduler.h” file is used to configure the system scheduler.

The firmware system holds 6 tasks:
MMI manager, power management, USB, player, explorer and update.

The scheduler module of the firmware is in charge of executing each of these tasks in a token ring manner. Tasks could be added or removed with the help of this file that maps or not their functions.

- Task functions mapping:

The scheduler can manage up to 8 tasks. Each task should have both:

  – one initialization function

  – one task function

The scheduler controls the tasks by referring to them with the help of existing definition labels implemented in the scheduler module:

  – scheduler_task_?_init: definition label to associate the init function of a task to implement

  – scheduler_task_?: definition label to associate the main fuction of a task to implement

Default task implementation:

```
// ***** Task init *****
#define Scheduler_task_1_init mmgr_task_init     //Init MMI manager task
#define Scheduler_task_2_init power_task_init    //Init Power task
#define Scheduler_task_3_init usb_task_sch_init  //Init USB task
#define Scheduler_task_4_init player_task_init   //Init Player task
#define Scheduler_task_5_init explorer_task_init //Init Explorer task
#define Scheduler_task_6_init update_task_init   //Init Update task
// ***** Task definition *****
#define Scheduler_task_1      mmgr_task          // MMI manager task
#define Scheduler_task_2      power_task         // Power task
#define Scheduler_task_3      usb_sch_task       // Mass storage task
#define Scheduler_task_4      player_task        // Player task
#define Scheduler_task_5      explorer_task      // Explorer task
#define Scheduler_task_6      update_task        // Update task
```

- Type of scheduler (SCHEDULER_TYPE): only SCHEDULER_FREE is actually supported.

### 6.2.13 USB Module

The “conf_usb.h” file is used to configure the USB module. There are two level of configuration HIGH (customer) and LOW (expert). This is the HIGH options of configuration :

***Table 6-31.*** Generic device mode configuration

| Definition Label | Description | Values |
|---|---|---|
| USB_DEVICE_FEATURE | Include feature device mode | [ENABLED]<br>DISABLED |
| USB_DEVICE_MS | Include class MassStorage in device mode | [ENABLED]<br>DISABLED |
| USB_DEVICE_HID | Include class HID in device mode | ENABLED<br>[DISABLED] |
| USB_DEVICE_CDC | Include class CDC in device mode | ENABLED<br>[DISABLED] |
| USB_DEVICE_SPEED_HIGH | Autorize HIGH speed in device mode | [ENABLED]<br>DISABLED |
| USB_DEVICE_VENDOR_ID | 16-bit vendor ID | [0xXXXX]<br>(Atmel vendor ID: 0x03EB) |
| USB_DEVICE_PRODUCT_ID | 16-bit product ID | [0xXXXX]<br>(Atmel Mass Storage: 0x2036) |
| USB_DEVICE_RELEASE_NUMBER | 16-bit release number | [0x0100] |
| USB_DEVICE_MANUFACTURER_NAME | Manufacturer name (ASCII) | “ATMEL” |
| USB_DEVICE_PRODUCT_NAME | Product name (ASCII) | “AT85DVK-07” |
| USB_DEVICE_SERIAL_NUMBER | Serial number (ASCII) | “12345” |
| USB_DEVICE_MAX_POWER | Max power in device mode | [50] (unit 2mA) |

***Table 6-32.*** Device mass-storage class configuration

| Definition Label | Description | Values |
|---|---|---|
| USB_DEVICE_MS_NAME_INTERFACE | Name of class interface | "mass storage ATMEL" |
| USB_DEVICE_MS_VENDOR | USB enumeration vendor string | {'A','T','M','E','L',' ',' ',' '}<br>8 Bytes mandatory (padding with space) |
| USB_DEVICE_MS_PRODUCT | USB enumeration product string | {'A','T','8','5','D','V','K','-','0','7',' ','M',' ','S',' ',' '}<br>16 Bytes mandatory (padding with space) |
| USB_DEVICE_MS_REVISION | USB enumeration revision string | {'1','.','0','0'}<br>4 Bytes mandatory |
| USB_PWD_FEATURE | Securization disk access mechanism via specific mass storage command | ENABLED<br>[DISABLED] |
| USB_PWD_FORMAT | Automatique format after PWD_NB_BAD_LOG login try (don’t care if USB_PWD_FEATURE disable) | ENABLED<br>[DISABLED] |

***Table 6-33.*** Device HID class configuration

| Definition Label | Description | Values |
|---|---|---|
| USB_DEVICE_HID_NAME_INTERFACE | Name of class interface | "HID ATMEL" |
| USB_DEVICE_HID_MODE | Select mouse or keyboard HID | USB_DEVICE_HID_MODE_MOUSE<br>USB_DEVICE_HID_MODE_KBD |

***Table 6-34.*** Device CDC class configuration

| Definition Label | Description | Values |
|---|---|---|
| USB_DEVICE_CDC_DATA_NAME_INTERFACE | Name of CDC data class interface | "CDC DATA ATMEL" |
| USB_DEVICE_CDC_COM_NAME_INTERFACE | Name of CDC com class interface | "CDC COM ATMEL" |
| USB_DEVICE_CDC_COM | Implement the CDC com interface for CDC | [ENABLED]<br>DISABLED |

***Table 6-35.*** Generic host mode configuration

| Definition Label | Description | Values |
|---|---|---|
| USB_HOST_FEATURE | Include feature host mode | [ENABLED]<br>DISABLED |
| USB_HOST_HUB_SUPPORT | Include driver for class HUB in host mode | [ENABLED]<br>DISABLED |
| USB_HOST_MS_SUPPORT | Include driver for class MassStorage in host mode | [ENABLED]<br>DISABLED |
| USB_HOST_HID_SUPPORT | Include driver for class HID in host mode | ENABLED<br>[DISABLED] |
| USB_HOST_CDC_SUPPORT | Include driver for class CDC in host mode | ENABLED<br>[DISABLED] |

### 6.2.14 Firmware update

The “conf_update.h” file is used to configure both the application MMI update and the update firmware module.

***Table 6-36.*** Update configuration

| Definition Label | Description | Values |
|---|---|---|
| FUNC_UPDATE | Update feature control | [ENABLE]<br>DISABLE |
| UPDATE_AUTO_UPDATE | Auto-update feature control | [ENABLE]<br>DISABLE |
| UPDATE_ERASE_UP_FILE | Erase update file after update | [ENABLE]<br>DISABLE |
| UPDATE_CREATE_DIRECTORY | Create update directory(ies) if not created | ENABLE<br>[DISABLE] |
| UPFILE_LUN | Default LUN of the update file in case of auto-update | [LUN_ID_NF_DISKMASS]<br>LUN_ID_MMC_SD |
| UNICODENAME_UPDATE_FILE_DIRECTORY | Update file path | {'U','p','d','a','t','e','\0'} |
| UPFILE_NB_DIRECTORY | Update file path size: number of directory in the path | [1]<br>2… |
| UNICODENAME_UPDATE_FILE_NAME | Update file name | {'P','l','a','y','e','r','_','d','v','k','.','a','t','m','\0'} |
| UPDATE_FILE_EXT | Update file extension for explorer filtering | {“atm”} |

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