TN1199
Technical note

STM32F4 Audio Processing

Introduction

This document gives an overview of the whole audio processing modules available and how they can be connected together to fulfill some audio Use Cases. It is intended to the programmer who integrates the audio modules into a main program.

Examples of supported audio processing chains are also provided.

Table 1. Applicable products

Type	Reference products
Microcontrollers	STM32-AUDIO100A

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1 Description

1.1 List of products supported by the audio processing modules

All listed audio libraries are designed to run on a Cortex M4 core with FPU usage, so it can be integrated and run on any STM32F40xx, STM32F41xx, STM32F42xx, or STM32F43xx platforms.

2 Audio Modules Integration Overview

2.1 Supported Audio Modules

In table below are listed all the audio processing modules available for integration. All these modules are libraries generated using EWARM tool chain, with internal 32-bits processing and supporting either 16 or 32 bits I/O buffers.

Table 2. Available audio processing list

Modules	User Manual	Features
SRC236	UM1641	Sampling Rate Converter supporting ratios 2, 3, 6, 1/2, 1/3, 1/6, 3/2 and 2/3
SRC441	UM1640	Sampling Rate Converter for specific 44.1->48 kHz conversion (10 ms framing)
OmniSurround Stereo Widener	UM1633	Audio virtualization for a 1.0/2.0 input stream to a widened 2.0 output stream
OmniSurround Multichannel Virtualizer	UM1655	Audio virtualization for 5.1/7.1 input stream to a virtualized 2.0 output stream
GrEq	UM1798	10-bands graphical equalizer for 48 kHz input signal
BIQ	UM1625	Generic Biquad filtering library
BAM	UM1778	Bass Manager (including compressor + limiter)
SVC	UM1642	Smart Volume Control (including compressor)
GAM	Under Dev	Gain manager
Panning	Under Dev	Handles panning, balancing and sweet spot for Car Audio UC (4.0 output)
Beeper	Under Dev	Chimes generation for Car Audio UC

Please refer to corresponding User Manuals for more information on each audio module.

2.2 Audio Modules APIs overview

All audio modules are optimized and packaged in generic audio APIs:

- xxx_reset(): Resets modules and initializes static memory.
- xxx_setParam(): Sets module static parameters.
- xxx_getParam(): Gets module static parameters values.
- xxx_setConfig(): Sets module dynamic parameters.
- xxx_getConfig(): Gets module dynamic parameters values.
- xxx_process(): Process routine to be called at each frame.

“xxx” refers to any module prefix (BAM for Bass Manager for instance).

2.3 Audio Modules Integration

First of all, all the static and dynamic memory used by each module must be allocated by the integration framework. Dynamic and static structures are hidden to the integration framework, but their sizes are exported as constant in xxx_glo.h file, so memory allocation can be done as written below:

```
/* xxx memory structure memory allocation */
void *static_mem_ptr = malloc(xxx_static_mem_size);
void *dynamic_mem_ptr = malloc(xxx_dynamic_mem_size);
```

Then, it is needed to allocate memory for input and output audio buffers.

All audio modules are HW protected to lock their usage on STM32 platforms so before calling any xxx_reset() routine, it is needed to enable platform CRC-32 and reset it, as shown with below lines:

```
RCC->AHB1ENR |= RCC_AHB1ENR_CRCEN;
CRC->CR |= CRC_CR_RESET;
:
error = xxx_reset(xxx_static_mem_ptr, xxx_dynamic_mem_ptr);
```

In a Cube environment, it could be:

```
__CRC_CLK_ENABLE();
__HAL_CRC_DR_RESET(hcrc);            // with CRC_HandleTypeDef *hcrc
:
error = xxx_reset(xxx_static_mem_ptr, xxx_dynamic_mem_ptr);
```

xxx_reset() routines as well as all other APIs can now be called by the integration framework.

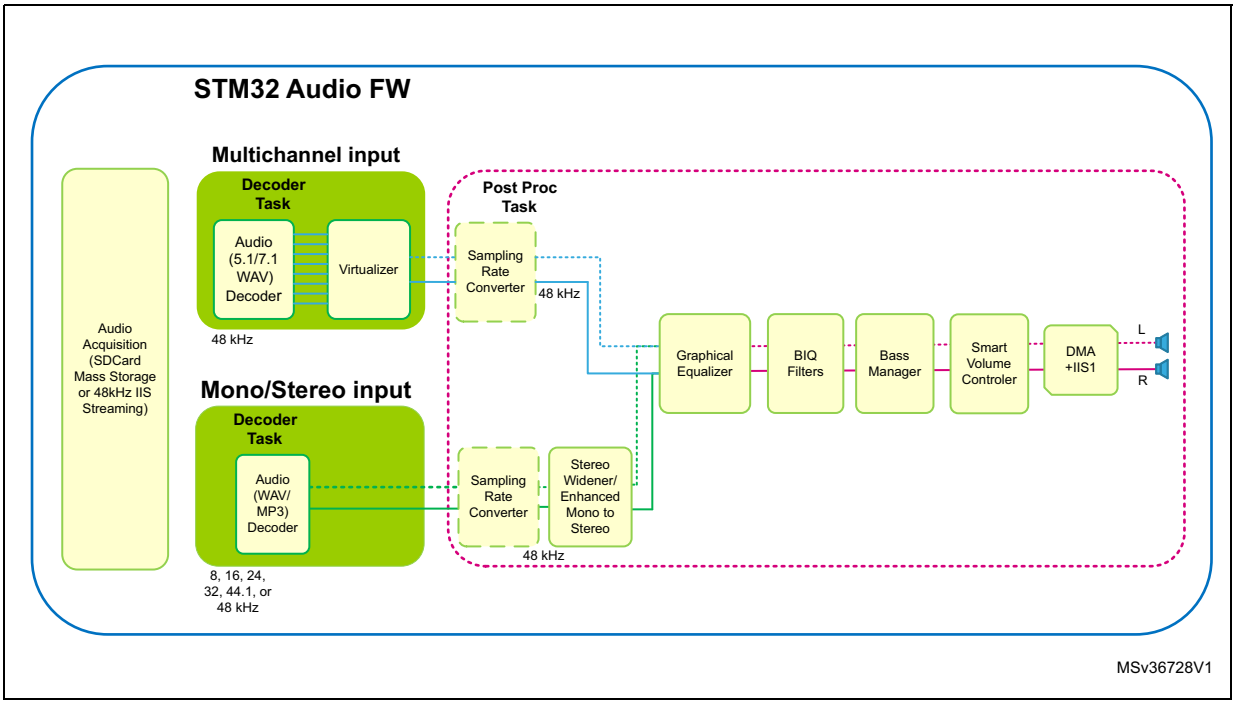
3 Audio Chains Examples

Please find below two audio chains as example of integration of audio processing modules, both of them being controlled with our Audio Tuning Tool. Thanks to contact your local support to help handling such demos.

3.1 Home Audio Demo

This Demo runs on a STM3240G-Eval board, with SDCard Mass Storage input.

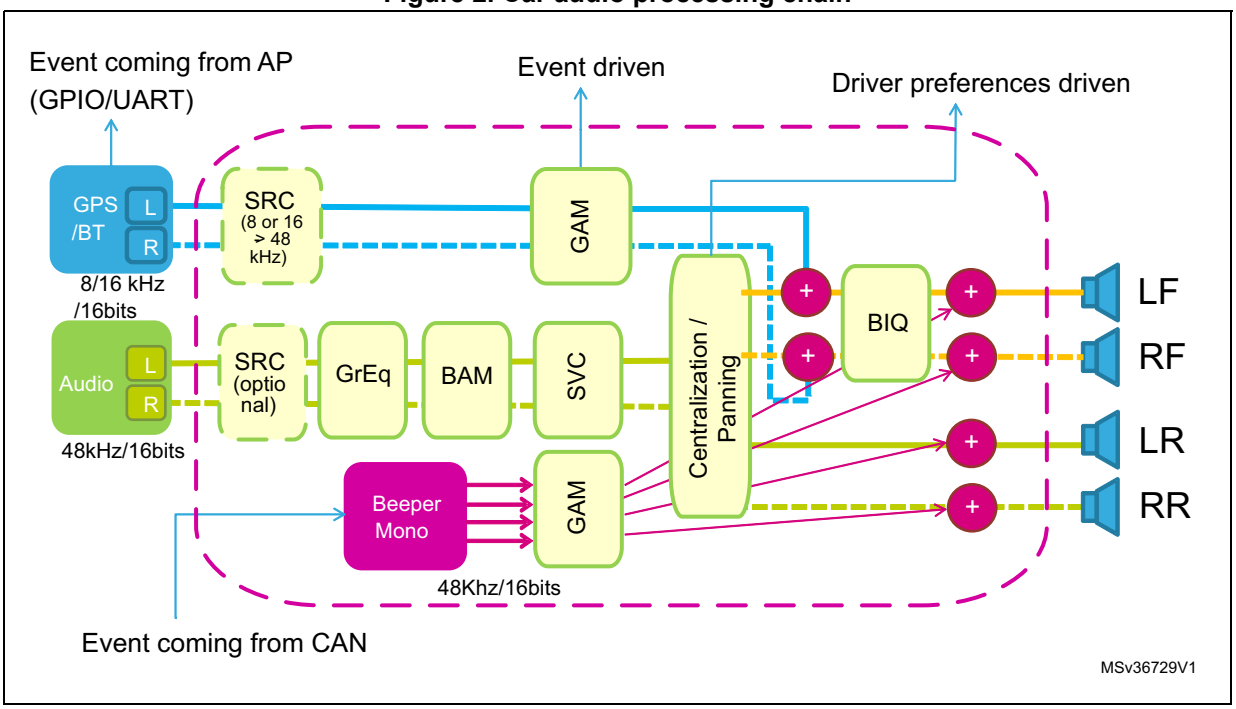
Figure 1. Home audio processing chain



3.2 Car Audio Demo

This Demo runs on a modified STM324x9I-Eval board, with some extension boards to handle external audio amplifiers.

Figure 2. Car audio processing chain



4 Revision history

Table 3. Document revision history

Date	Revision	Changes
07-Jan-2015	1	Initial release