



MT793X IoT SDK for Audio User Guide

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Version History

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1.0	2021-04-29	Xuan xu	First official release
1.1	2021-07-30	Xuan xu	Add audio interface info
1.2	2021-11-18	Jason Chang	Add quick start

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1 Quick Start

1.1 Voice Assistant test

In this chapter, we provide a simple way to test the voice assistant and assume the project demo image has been burned to the device. For more details, please refer to MT793X IoT SDK for Hands on Training document.

User can get audio response from MT7933 by saying trigger word and command word, the procedure will be introduced in next section.

1.2 Set up the reference board

1. Change jumper **J24** and **J6** to switch speaker mode
2. Connect Audio cable
3. Plug in Micro USB CON8 for supplying 5V power and FTDI debug board for CM33 UART communication
4. After finishing step 3, the reference board will be power on and LED will light up

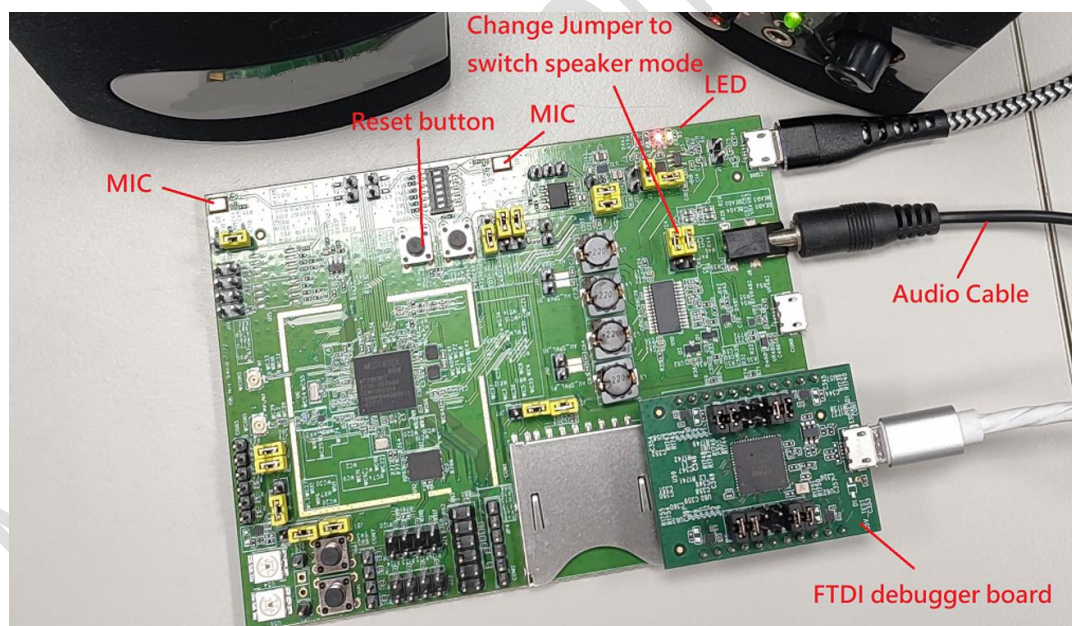


Figure 1-1. Jumpers and connectors on the MT7933 HDK

1.3 Test voice assistant

1. Open terminal and set 921600 baud, select last Comport and press reset button
2. Check terminal shows log and can type command
3. ADSP enable
 - `aud_dbg cset ADSP_Enable 1 1`
4. Start VA program
 - `aud_dbg va -v 1`
5. Say "Hey siri" and hear response
6. Say example command words
7. Repeat Step 5.

Trigger word : "Hey Siri"

Command word : "Open Camera", "Take a picture", "Play music", "Stop music", "Previous Song", "Next Song", "Volume Louder", "Volume Down"

```
$ aud_dbg cset ADSP_Enable 1 1
[amixer_cset_cmd]:2479: msg: value[1] = 0
[amixer_cset_cmd]:2481: msg: param_num = 1
[adsp_enable_put]:755: msg: set_adsp_enable
```

Figure 1-2. ADSP Enable

```
$ aud_dbg va -v 1
[add_new_dpcm]:70: msg: ADSP_HOSTLESS_VA<-->ADSP_UL9_IN BE:1
[add_new_dpcm]:70: msg: ADSP_VA_FE<-->ADSP_UL9_IN BE:1
[add_new_dpcm]:70: msg: ADSP_UL9_IN BE<-->INTADC in:1
[add_new_dpcm]:70: msg: ADSP_UL9_IN BE<-->GASRC0_C:1
[add_new_dpcm]:70: msg: GASRC0_C<-->dummy_end_c:1
[dpcm_be_dai_startup]:61: msg: dummy_end_c endpointer
[mt7933_afe_gasrc_startup]:3650: msg: [0] capture
[dpcm_be_dai_startup]:61: msg: INTADC in endpointer
[mt7933_adsp_be_startup]:1147: msg: mt7933_adsp_be_startup
```

Figure 1-3. Start VA program

```

ipi id:2 len:20
ipi id:2 len:20

$      Say trigger word
$
$ [mt7933_adsp_pcm_va_notify]:462: msg: [mt7933_adsp_pcm_va_notify]get local command type(2) idx(0) notify.
[notify_va_upload] Local_cmd Trigger[0][Hello Aircon].
[alarm_play], begin, alert index:0
[add_new_dpcm]:70: msg: track0<-->INTDAC out:1
[dpcm_be_dai_startup]:61: msg: INTDAC out endpointer
[dpcm_be_dai_hw_params]:187: msg: INTDAC out endpointer
[mtk_afe_fe_hw_params]:1199: msg: phys_buf_addr = 0xa0348040
[mtk_afe_fe_hw_params]:1200: msg: buffer_size = 0x4000
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[snd_pcm_drain]:605: msg: drain timeout
[snd_pcm_hw_free]:526: msg: state:1
[dpcm_be_dai_hw_free]:625: msg: INTDAC out endpointer
[dpcm_be_dai_shutdown]:689: msg: INTDAC out endpointer
[find_dpcm]:45: msg: track0<-->INTDAC out:0
[alarm_play], end
#### Alert Count 1 ####
[mt7933_adsp_pcm_va_notify]:462: msg: [mt7933_adsp_pcm_va_notify]get local command type(2) idx(0) notify.

```

Figure 1-4. Say trigger word

2 Compilation

2.1 Project Compile

2.1.1 Makefile

./project/mt7933_hdk/apps/bga_sdk_demo/GCC/Makefile

```
# AUDIO driver files
ifeq ($(MTK_MT7933_AUDIO_DRIVER_ENABLE),y)
include $(SOURCE_DIR)/middleware/MTK/audio_services/driver/mt7933/module.mk
CFLAGS += -DMTK_MT7933_AUDIO_DRIVER_ENABLE
endif
```

Figure 2-1. Makefile

2.1.2 Feature.mk

./project/mt7933_hdk/apps/bga_sdk_demo/GCC/feature.mk

```
#Audio driver
MTK_MT7933_AUDIO_DRIVER_ENABLE .....=y
MTK_MT7933_AUDIO_CODEC_ENABLE .....=y
```

Figure 2-2. Audio enable

```
#HIFIXDSP
MTK_HIFI4DSP_ENABLE .....=y
```

Figure 2-3. ADSP enable

2.2 Audio Compile

2.2.1 Makefile

./middleware/MTK/audio_services/driver/mt7933/module.mk

Note: Do not change the configuration unless necessary

2.2.2 Feature.mk

./middleware/MTK/audio_services/driver/mt7933/feature.mk

Note: Do not change the configuration unless necessary

3 FreeRTOS Startup

3.1 Main Function

The main function is the entrance to the FreeRTOS system.

./project/mt7933_hdk/apps/bga_sdk_demo/src/main.c

3.2 Activated Modules

- system
- gpio
- low power
- cli
- wdt
- usb
- gcpu
- **audio**
-

```
#ifdef MTK_MT7933_AUDIO_DRIVER_ENABLE
    printf("AUDIO DRIVER INIT\n");
    extern void audio_init(void);
    audio_init();
#endif
```

Figure 3-1. audio init

audio_init is mainly used for the setting of audio driver, including power/CG/register.

4 Audio Interfaces

Audio Interface	Feature
DMIC	Supports 4-channel DMIC (in one wire mode); 8, 16, 32, 48 kHz; 24 bits
I2S Out (2 st)	2 channels, 192 kHz, 32 bits (M)
I2S In (2 nd)	2 channels, 192 kHz, 32 bits (M/S)
TDM In (1 st)	8 channels, 48 kHz, 32 bits (M)
Internal Audio Codec	2-channel DAC. Support up to 48 kHz 3-channel ADC. Support up to 48 kHz

5 CLI Instruction

5.1 CLI Register

./project/mt7933_hdk/apps/bga_sdk_demo/src/cli_cmds.c

```
static cmd_t _cmds_normal[] = {
    { "mem", "show memory type of <addr>", _cmd_mem_type, NULL },
    { "s", "search <addr> <len> <pat>", _cmd_find_mem, NULL },
    { "d", "dump memory <addr> <len>", _cmd_dump_mem, NULL },
    { "f", "fill memory", _cmd_fill_mem, NULL },
    { "rr", "read reg", _cmd_read_reg, NULL },
    { "wr", "write reg", _cmd_write_reg, NULL },
    PSRAM_CMDS
#ifdef BRINGUP_WIFI_ENABLE
    { "wifi", "wifi commands", NULL, wifi_init_cli },
    { "iwpriv", "WiFi iw command", iwpriv_cli, NULL },
#endif
#ifdef MTK_IPERF_ENABLE
    IPERF_CLI_ENTRY
#endif
#ifdef BRINGUP_BT_ENABLE
    { "bt", "BT commands", NULL, &_cmds_bt[0] },
#endif
#ifdef BRINGUP_DSP_ENABLE
    ADSP_CLI_ENTRY
#endif
#ifdef GOTO_TEST_MODE_CLI_ENTRY
    MINICLI_NORMAL_MODE_CLI_CMDS
#endif
#ifdef OS_CLI_ENTRY
    OS_CLI_ENTRY
#endif
#ifdef MTK_UT_ENABLE
    UT_CLI_ENTRY
#endif
#ifdef MTK_MT7933_AUDIO_DRIVER_ENABLE
    { "aud_dbg", "audio driver debug common", NULL, &audio_drv_debug_cmds[0] },
#endif
};
```

Figure 4-1. cli_cmds

./middleware/MTK/audio_services/driver/mt7933/test/audio_test.c

```
cmd_t audio_drv_debug_cmds[] = {
    { "loglevel", "set log level", set_loglevel_cmd, NULL },
    { "play", "play music", audio_play_cmd, NULL },
    { "capture", "capture music", audio_capture_cmd, NULL },
    { "loopback", "play the recorded data directly", audio_loopback_cmd, NULL },
    { "cget", "amixer cget", amixer_cget_cmd, NULL },
    { "cset", "amixer cset", amixer_cset_cmd, NULL },
    { "dsp_r", "dsp read", dsp_read_cmd, NULL },
    { "dsp_rw", "dsp read and write", dsp_read_write_cmd, NULL },
    { "reg_read", "read register", audio_register_read_cmd, NULL },
    { "reg_write", "write register", audio_register_write_cmd, NULL },
#ifdef VA_TEST_SUPPORT
    { "va", "va", va_main_cmd, NULL },
    { "va_stop", "va_stop", va_stop_cmd, NULL },
    { "va_dump", "va_dump", va_dump_cmd, NULL },
#endif
#ifdef FILE_SYS_SUPPORT
    { "play_file", "play pcm file", audio_play_file_cmd, NULL },
    { "capture_file", "capture pcm file", audio_capture_file_cmd, NULL },
    { "ff", "ff file", audio_ff_cmd, NULL },
#endif
    { NULL, NULL, NULL, NULL } // end of table
};
```

Figure 4-2. audio_cli

```

COM13 - Tera Term VT
文件(F) 编辑(E) 设置(S) 控制(O) 窗口(W) 帮助(H)

$ ?
mem      - show memory type of <addr>
s        - search <addr> <len> <pat>
d        - dump memory <addr> <len>
f        - fill memory
rr       - read reg
wr       - write reg
psram   - psram init
wifi     - wifi commands
iwpriv  - Wifi iw command
iperf   - iperf
bt       - BT commands
adsp    - adsp cli commands
en       - enter test mode
reboot  - reboot
ver      - f/w ver
log      - log control
config  - user config read/write/reset/show
ble     - bluetooth ble related cmd
mesh    - bluetooth mesh related cmd
picus   - bt picus command
iwpriv  - Wifi iw command
wifi    - Wifi Init CLI
ping    - ping <addr> <count> <pkt_len>
iperf   - iperf
ip       - ip config
stat    - show statistics
wifitest - Wifi Test Tool
wpa_cli - wpa_cli for wpa_supp
thermal - thermal test
ps       - ps info
aud_dbg - audio driver debug common

```

Figure 4-3. cli

5.2 CLI -- loglevel

aud_dbg loglevel [val]

```

enum AUD_LOG_LEVEL {
    AUD_LOG_ERR = 1,
    AUD_LOG_WARN,
    AUD_LOG_MSG,
    AUD_LOG_DBG,
    AUD_LOG_DEV,|
};

```

Figure 4-4. loglevel

```

$ aud_dbg loglevel 2
New loglevel 2
$ aud_dbg play 1 2 32 48000 4 960 4
$ aud_dbg loglevel 3
New loglevel 3
$ aud_dbg play 1 2 32 48000 4 960 4
[audio_play_cmd]:1988: msg: params[0] = 1
[audio_play_cmd]:2003: msg: play_type = 1
[audio_play_cmd]:2004: msg: channel_num = 2
[audio_play_cmd]:2005: msg: bitdepth = 32
[audio_play_cmd]:2006: msg: sample_rate = 48000
[audio_play_cmd]:2007: msg: time_len = 4
[audio_play_cmd]:2008: msg: period_size = 960
[audio_play_cmd]:2009: msg: period_count = 4
[dmlm_intdac]:211: msg: data_src = 0x1042a860, data_size = 0x7800
[add_new_dpcm]:70: msg: track0<-->INTDAC out:1
[dpcm_be_dai_startup]:61: msg: INTDAC out endpointer
[dpcm_be_dai_hw_params]:187: msg: INTDAC out endpointer
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[dpcm_be_dai_prepare]:343: msg: INTDAC out endpointer
[snd_pcm_drain]:605: msg: drain timeout
[snd_pcm_hw_free]:526: msg: state:1
[dpcm_be_dai_hw_free]:625: msg: INTDAC out endpointer
[dpcm_be_dai_shutdown]:689: msg: INTDAC out endpointer
[find_dpcm]:45: msg: track0<-->INTDAC out:0

```

Figure 4-5. loglevel test

5.3 Tinypcm

./middleware/MTK/audio_service/sound/include/tinypcm.h

API:

- snd_pcm_open
- snd_pcm_writei
- snd_pcm_readi
- snd_pcm_hw_params
- snd_pcm_sw_params
- snd_pcm_start
- snd_pcm_prepare
- snd_pcm_hw_free
- snd_pcm_drop
- snd_pcm_drain
- snd_pcm_close
- snd_pcm_avail

5.4 CLI -- Play

aud_dbg play [play_type] [channel] [bitdepth] [rate] [time len] [period size] [period count]

5.4.1 dlm_gsrc_intdac

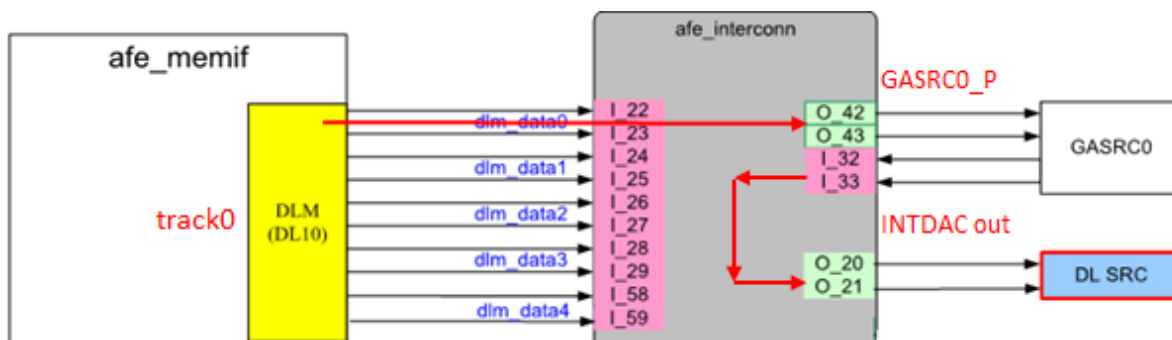


Figure 4-6. dlm_gsrc_intdac path

```
connect_route("track0", "GASRC0_P", 1, CONNECT_FE_BE);
connect_route("GASRC0_P", "INTDAC out", 1, CONNECT_FE_BE);
connect_route("I_22", "O_42", 1, CONNECT_IO_PORT);
connect_route("I_23", "O_43", 1, CONNECT_IO_PORT);
connect_route("I_32", "O_20", 1, CONNECT_IO_PORT);
connect_route("I_33", "O_21", 1, CONNECT_IO_PORT);
```

Figure 4-7. dlm_gsrc_intdac route

./middleware/MTK/audio_services/driver/mt7933/mt7933/mt7933-machine.c

You also need to fix the playback format of DAC.

```
static int mt7933_int_dac_fixup(struct snd_soc_pcm_runtime *rtd, struct msd_hw_params *params)
{
    // params->rate = 48000;
    // params->channels = 2;
    return 0;
}
```

Figure 4-8. dlm_gsrc_intdac fixup

5.4.2 dlm_intdac

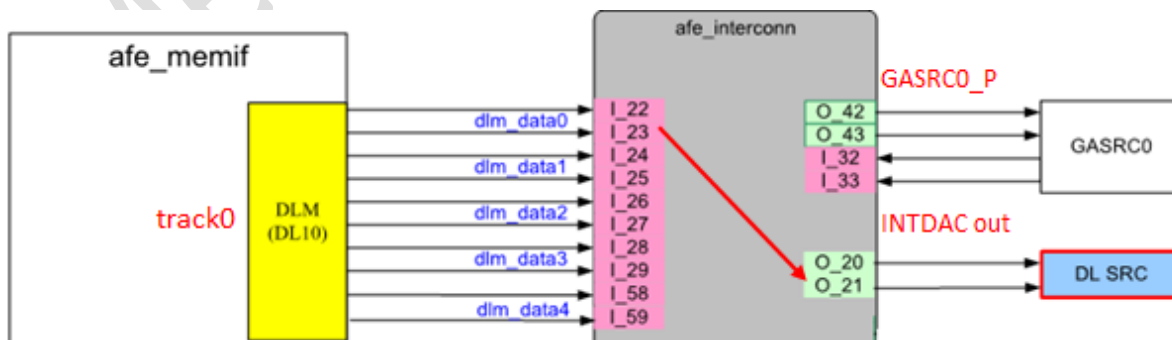


Figure 4-9. dlm_intdac path

```
connect_route("track0", "INTDAC out", 1, CONNECT_FE_BE);
connect_route("I_22", "O_20", 1, CONNECT_IO_PORT);
connect_route("I_23", "O_21", 1, CONNECT_IO_PORT);
```

Figure 4-10. dlm_intdac route

5.4.3 dlm_etdmout2

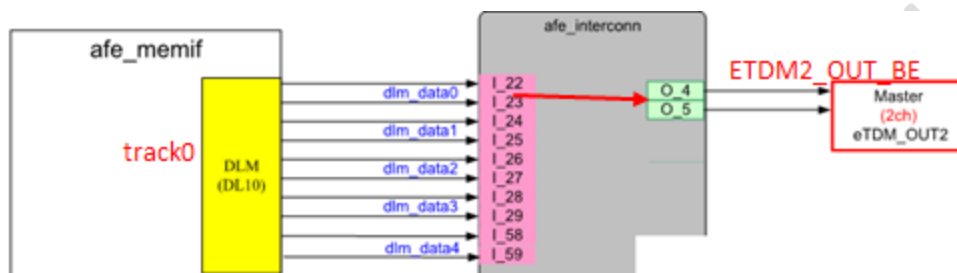


Figure 4-11. dlm_etdmout2 path

```
connect_route("track0", "ETDM2_OUT_BE", 1, CONNECT_FE_BE);
connect_route("I_22", "O_04", 1, CONNECT_IO_PORT);
connect_route("I_23", "O_05", 1, CONNECT_IO_PORT);
```

Figure 4-12. dlm_etdmout2 route

5.5 CLI -- Capture

5.5.1 ul3_intadc

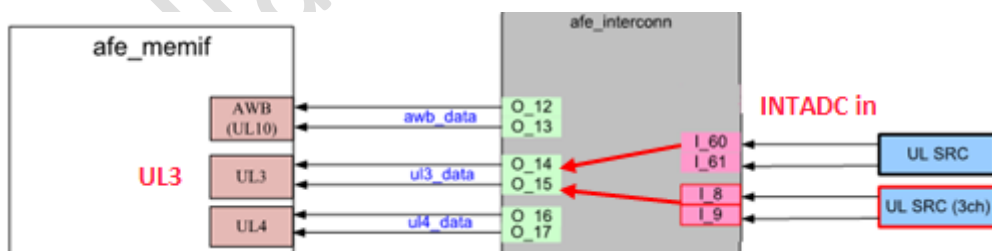


Figure 4-13. ul3_intadc path


```

connect_route("UL3", "INTADC in", 1, CONNECT_FE_BE);
#ifdef PINMUX_QFN_DEFAULT
connect_route("I_60", "O_14", 1, CONNECT_IO_PORT);
connect_route("I_61", "O_15", 1, CONNECT_IO_PORT);
#elif defined PINMUX_BGA_DEFAULT
connect_route("I_60", "O_14", 1, CONNECT_IO_PORT);
connect_route("I_08", "O_15", 1, CONNECT_IO_PORT);
#endif

```

Figure 4-14. ul3_intadc route

5.5.2 ul3_dmic

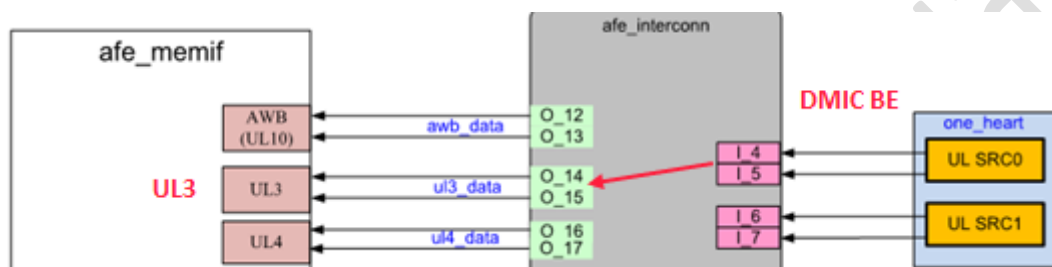


Figure 4-15. ul3_dmic path

```

connect_route("UL3", "DMIC BE", 1, CONNECT_FE_BE);
connect_route("I_04", "O_14", 1, CONNECT_IO_PORT);
connect_route("I_05", "O_15", 1, CONNECT_IO_PORT);

```

Figure 4-16. ul3_dmic route

5.5.3 ul9_intadc

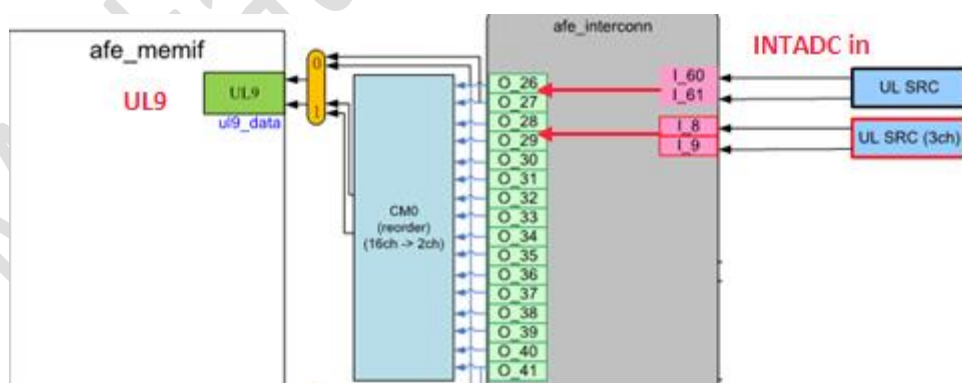


Figure 4-17. ul9_intadc

```

connect_route("UL9", "INTADC in", 1, CONNECT_FE_BE);
connect_route("I_60", "O_26", 1, CONNECT_IO_PORT);
connect_route("I_61", "O_27", 1, CONNECT_IO_PORT);
connect_route("I_08", "O_28", 1, CONNECT_IO_PORT);
connect_route("I_09", "O_29", 1, CONNECT_IO_PORT);

```

Figure 4-18. ul9_intadc route

5.5.4 ul9_etdmin2

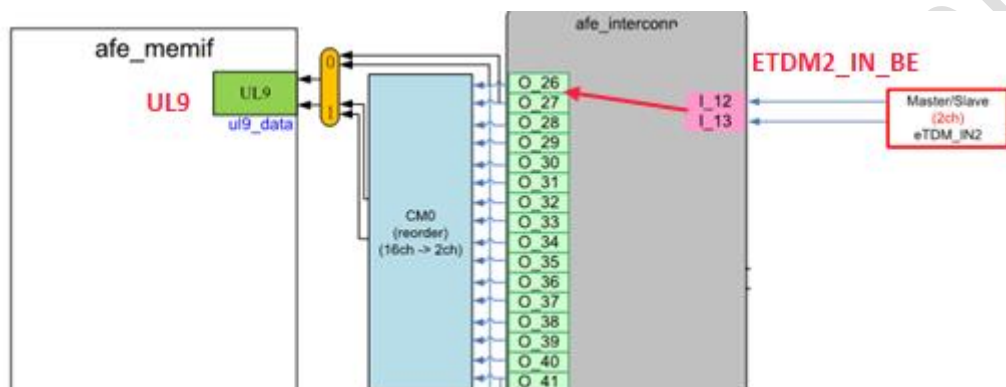


Figure 4-19. ul9_etdmin2 path

```

connect_route("UL9", "ETDM2_IN_BE", 1, CONNECT_FE_BE);
connect_route("I_12", "O_26", 1, CONNECT_IO_PORT);
connect_route("I_13", "O_27", 1, CONNECT_IO_PORT);

```

Figure 4-20. ul9_etdmin2 route

5.5.5 ul9_intadc_and_dlm

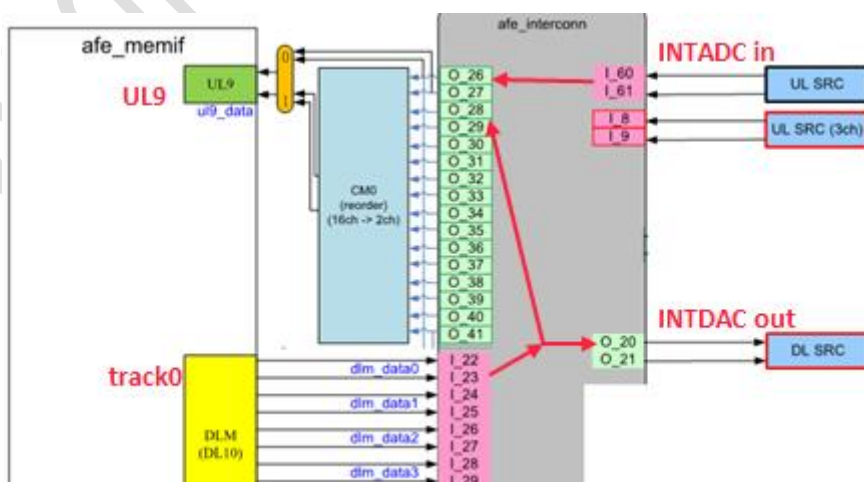


Figure 4-21. ul9_intadc_and_dlm path

```

connect_route("track0", "INTDAC out", 1, CONNECT_FE_BE);
connect_route("I_22", "O_20", 1, CONNECT_IO_PORT);
connect_route("I_23", "O_21", 1, CONNECT_IO_PORT);
connect_route("I_22", "O_28", 1, CONNECT_IO_PORT);
connect_route("I_23", "O_29", 1, CONNECT_IO_PORT);
connect_route("UL9", "INTADC in", 1, CONNECT_FE_BE);
connect_route("I_60", "O_26", 1, CONNECT_IO_PORT);
connect_route("I_61", "O_27", 1, CONNECT_IO_PORT);

```

Figure 4-22. ul9_intadc_and_dlm route

5.6 CLI – Playback and Capture Audio File

5.6.1 Setting

./middleware/MTK/audio_services/driver/mt7933/feature.mk

```

# Audio Feature Option Configuration
#####
CFG_MTK_AUDIODSP_SUPPORT      = y
CFG_WRAP_CAPTURE_SUPPORT      = n
CFG_FILE_SYS_SUPPORT          = y
CFG_DSP_BOOT_RUN              = n
CFG_VA_TEST_SUPPORT           = y
CFG_VA_TASK_SUPPORT           = y
CFG_RECORD_TASK_SUPPORT       = n
CFG_IPC_SUPPORT               = y

```

Figure 4-23. File system feature

ff mount SD:/

```

$ ff mount SD:/
Vol(0)FF_MAX_SS: 512
SD init frequency: 13000
PIO mode
[FS]: Mount OK!
$ 00-00 02:56:46.422 100 E -----SD init Run -----

00-00 02:56:46.423 100 I set clk final:390, request: 400, sclk: 50000, MSDC_CFG = 0x02002019 MSDC_PS: 0x010f0002

00-00 02:56:46.423 100 I init hardware done cfg:0x0200209b

00-00 02:56:46.423 100 I set clk final:390, request: 400, sclk: 50000, MSDC_CFG = 0x0200209b MSDC_PS: 0x010f0002

00-00 02:56:46.623 100 I set clk final:12500, request: 13000, sclk: 50000, MSDC_CFG = 0x02000119 MSDC_PS: 0x010f0002

00-00 02:56:46.623 100 I set clk final:12500, request: 13000, sclk: 50000, MSDC_CFG = 0x02000199 MSDC_PS: 0x010f0002

```

Figure 4-24. ff mount

5.6.2 Operation

aud_dbg play_file [play_type] [channel] [bitdepth] [rate] [time len] [period size] [period count] [file_name]

```
0: dlm_gsrc_intdac  
1: dlm_intdac  
2: dlm_etdmout2
```

Figure 4-25. play type -- file system

aud_dbg capture_file [capture_type] [channel] [bitdepth] [rate] [time len] [period size] [period count]
[file_name]

```
0: ul3_intadc
```

Figure 4-26. capture type -- file system

6 DSP Introduction

6.1 DSP Features

Cadence Tensilica HiFi 4 DSP

- Xtensa DSP architecture
- Single HiFi 4 DSP 300/600MHz in the MT7933
 - Tool Chain: RI-2019.1
 - IDE: Xtensa Xplorer 8.0.10

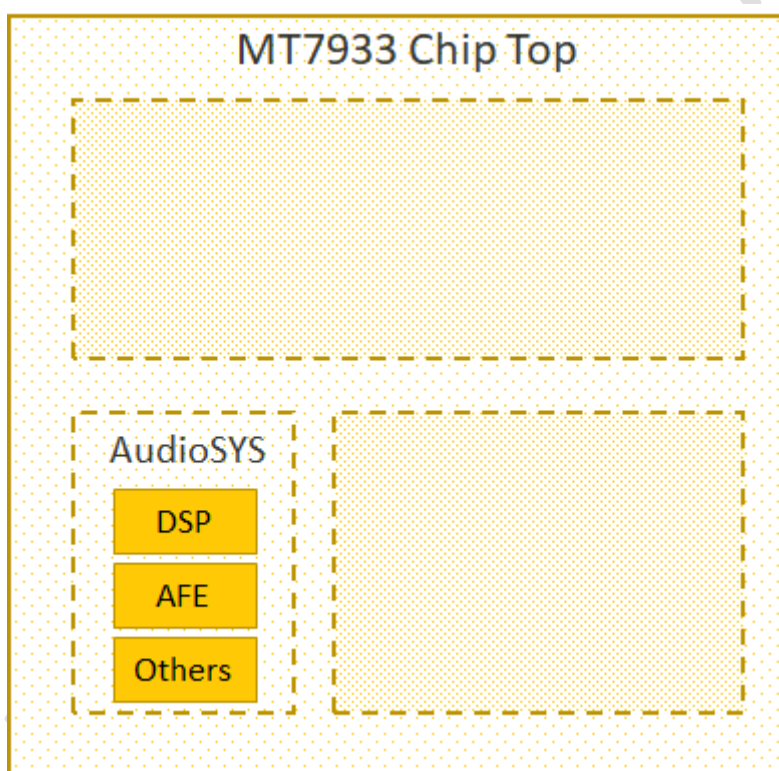


Figure 5-1. MT7933 Chip Top

6.2 Hello, DSP

6.2.1 Auto Boot Up

`./middleware/MTK/audio_services/driver/mt7933/feature.mk`

```

CFG_MTK_AUDIODSP_SUPPORT      = y
CFG_WRAP_CAPTURE_SUPPORT      = n
CFG_ETL_EVS_SUPPORT           = y
CFG_DSP_BOOT_RUN              = n
CFG_VA_TEST_SUPPORT           = y
CFG_VA_TASK_SUPPORT           = y
CFG_RECORD_TASK_SUPPORT       = n
CFG_IPC_SUPPORT               = y
CFG_GPIO_SUPPORT              = y
CFG_DRV_MUSIC_DATA_EN         = n

```

Figure 5-2. auto boot up dsp

6.2.2 Cli on CM33 uart

aud_dbg cset ADSP_Enable 1 1

```

(201105_12:12:16.020) [0.000]FreeRTOS V10.2.0 b900ff
(201105_12:12:16.021) [0.003][systemer] ostimer_init_cycle = 0x8A746DC at 13MHz.
(201105_12:12:16.021) [0.008]adsp_info = 0xa003fc00
(201105_12:12:16.021) [0.011]adsp_send_obj = 0xa003fc20
(201105_12:12:16.021) [0.014]adsp_rcv_obj = 0xa003fd40
(201105_12:12:16.021) [0.017]adsp_rcv_obj->share_buf = 0xa003fd50
(201105_12:12:16.021) [0.021]in platform_init
(201105_12:12:16.021) [0.023][D]+audio_init(), Heap free/total = 125844/134144
(201105_12:12:16.021) [0.028][D]+audio_driver_init
(201105_12:12:16.021) [0.031][D]-audio_driver_init
(201105_12:12:16.021) [0.033][D]-audio_init(), Heap free/total = 125752/134144
(201105_12:12:16.021) [0.038]dsp_hw_res_init [time:38670307]

```

Figure 5-3. enable dsp

6.3 Start Voice Detection

Cli on CM33 uart: **aud_dbg va -v 1**



Figure 5-4. Start voice detection

The diagram illustrates the audio processing flow between the HIFI4 ADSP and the AP CPU:

- HIFI4 ADSP (Green Box):**
 - Audio Driver (Blue):** Receives input from the Audio AFE.
 - 4ch Buffer (Green):** Receives data from the Audio Driver.
 - Pre_Process (FFP) (Green):** Processes the buffered data.
 - 1ch Buffer (Green):** Receives data from the Pre_Process block.
 - VAD (Yellow):** Voice Activity Detection block, connected to the Audio Driver and the 4ch Buffer.
 - WWE (Yellow):** Wakeup Word Engine block, connected to the 1ch Buffer.
- AP CPU (Blue Box):**
 - Audio Driver (Blue):** Receives data from the 1ch Buffer in the HIFI4 ADSP.
 - APP (Blue):** Application layer, connected to the Audio Driver.
- Audio AFE (Pink Box):** Receives input from two microphones (represented by icons) and outputs "2ch mic + 2ch reference" to the HIFI4 ADSP's Audio Driver.
- Inter-System Communication:** A signal labeled "Wakeup AP Detect Trigger" is sent from the WWE block in the HIFI4 ADSP to the AP CPU.

Figure 5-5. VA flow

id:ADSP_LOCAL_RECORD
Machine

id:ADSP_AP_RECORD
Machine

id:ADSP_VA_FE
Machine

id:ADSP_HOSTLESS_VA
Machine

id:VA_UL2 In
type:INPUT

id:BE_UL2_IN Capture
type:DAI_OUT

id:VA_UL9 In
type:INPUT

id:BE_UL9_IN Capture
type:DAI_OUT

id:FE_HOSTLESS_VA
type:DAI_OUT

id:FE_VA
type:DAI_OUT

id:FE_AP_RECORD
type:DAI_OUT

Interconn
O26 ~ O27

id:VA_UL2_IO
type:mixer

Interconn
O26 ~ O27

id:VA_UL9_IO
type:mixer

Used to start VA detect

Used to record data from ADSP VA

Used to do normal audio record

snd_pcm_open -> startup
snd_pcm_hw_param -> hw_params
snd_pcm_prepare -> prepare
snd_pcm_start -> trigger
snd_pcm_drop -> trigger
snd_pcm_hw_free -> hw_free
snd_pcm_close -> shutdown

snd_pcm_open -> startup
snd_pcm_hw_param -> hw_params
snd_pcm_prepare -> prepare
snd_pcm_start -> trigger
snd_pcm_read -> copy
snd_pcm_drop -> trigger
snd_pcm_hw_free -> hw_free
snd_pcm_close -> shutdown

Figure 5-6. VA route

./middleware/MTK/audio_services/driver/mt7933/test/va.c

```
#ifdef VA_TEST_SUPPORT
{ "va", "va", va_main_cmd, NULL },
{ "va_stop", "va_stop", va_stop_cmd, NULL },
{ "va_dump", "va_dump", va_dump_cmd, NULL },
#endif
```

Figure 5-7. VA cli

```
void va_main(int argc, char *argv[])
{
    int ret = 0;
    struct va_task *p_va_task = task_constructor();
    struct msd_hw_params *params = (struct msd_hw_params *)p_va_task->priv;

    ret = va_cmd_parser(argc, argv, params);
    if (ret < 0)
        return;

    connect_route("ADSP_HOSTLESS_VA", "ADSP_UL9_IN BE", 1, CONNECT_FE_BE);
    connect_route("ADSP_VA_FE", "ADSP_UL9_IN BE", 1, CONNECT_FE_BE);
    connect_route("ADSP_UL9_IN BE", "INTADC in", 1, CONNECT_FE_BE);
    connect_route("ADSP_UL9_IN BE", "GASRC0_C", 1, CONNECT_FE_BE);
    connect_route("GASRC0_C", "dummy_end_c", 1, CONNECT_FE_BE);
    connect_route("I_60", "O_26", 1, CONNECT_IO_PORT);
    connect_route("I_08", "O_27", 1, CONNECT_IO_PORT);
    connect_route("I_22", "O_28", 1, CONNECT_IO_PORT);
    connect_route("I_23", "O_29", 1, CONNECT_IO_PORT);

    xTaskCreate(va_capture_loop,
               "ap_aud_t_va",
               p_va_task->thread_stack_dep,
               (void *)p_va_task,
               p_va_task->thread_priority,
               &p_va_task->thread_handler);
}
```

Figure 5-8. VA route code

6.6 Buffer Flow

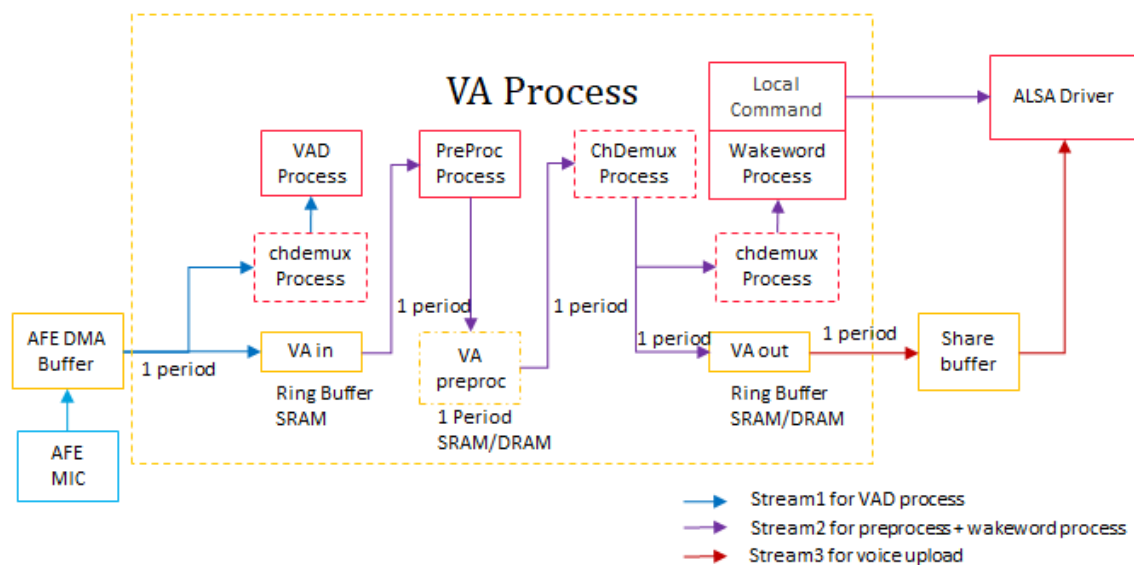


Figure 5-9. VA process buffer flow

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