

AW882XX Android Driver(QCOM)

4PA&8PA -TDM

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1. 驱动说明

驱动源文件	aw882xx_calib.c, aw882xx_calib.h, aw882xx_monitor.c, aw882xx_monitor.h, aw882xx.c, aw882xx.h, aw882xx_device.c, aw882xx_device.h, aw882xx_dsp.c, aw882xx_dsp.h, aw882xx_init.c, aw882xx_init.h, aw882xx_log.h, aw882xx_spin.c, aw882xx_spin.h, aw882xx_data_type.h, aw882xx_bin_parse.c, aw882xx_bin_parse.h
支持的产品（可以校准）	aw88257、aw88258、aw88261、aw88261s、aw88262、 aw88263、aw88263h、aw88263s、aw88264、aw88265、 aw88266、aw88266s、aw88270、aw88274、aw88299、 aw88461、aw88271
支持的产品（不可以校准）	aw88298、aw88298g、aw88266a、aw88230、aw88252 （无需集成校准功能，请忽略 3/4/5 章的集成）
I ² C 地址范围	0x30/0x31/0x32/0x33/0x34/0x35/0x36/0x37

2. RX 驱动移植

2.1 AW882XX 驱动移植

2.1.1 DTS 配置

1) 多 PA 配置

<pre>diff --git a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi index ac2f5b95f3..8a4251fe99 100755 --- a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi +++ b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi @@ -177,3 +177,60 @@ i2c_x { /*x 表示对应的总线号*/ + + /* AWINIC AW882XX Smart PA */ + aw882xx_smartpa_0:aw882xx_smartpa@34 { + compatible = "awinic,aw882xx_smartpa"; + reg = <0x34>; + reset-gpio = <&tlmm 84 0>; /*aw88230,aw88257,aw88261,aw88265 不 能配置*/ + irq-gpio = <&tlmm 136 0x2008>; + sync-load = <1>; /*固件加载方式, qcom 平台默认使用同步加载*/ + sound-channel = <0>; /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/ + aw-tx-topo-id = <0x1000ff00>; + aw-rx-topo-id = <0x1000ff01>; + aw-tx-port-id = <0x1007>; /*根据客户实际所用 tx 的 port id 进行配置*/</pre>	
---	--

```
+      aw-rx-port-id = <0x1006>;          /*根据客户实际所用 rx 的 port id 进行配置*/
+      aw-re-min = <4000>;                /*Re 校准范围最小值 (mOhms) */
+      aw-re-max= <30000>;                /*Re 校准范围最大值 (mOhms) */
+      aw-cali-mode = "none";             /*带 IV 的产品无需配置此项*/
+      status = "okay";
+  };
+  aw882xx_smartpa_1:aw882xx_smartpa@35 {
+    compatible = "awinic,aw882xx_smartpa";
+    reg = <0x35>;
+    reset-gpio = <&tlmm 82 0>;
+    irq-gpio = <&tlmm 143 0x2008>;
+    sync-load = <1>;
+    sound-channel = <1>;                  /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+    aw-tx-topo-id = <0x1000ff00>;
+    aw-rx-topo-id = <0x1000ff01>;
+    aw-tx-port-id = <0x1007>;
+    aw-rx-port-id = <0x1006>;
+    aw-re-min = <4000>;
+    aw-re-max= <30000>;
+    aw-cali-mode = "none";
+    status = "okay";
+  };
+  aw882xx_smartpa_2:aw882xx_smartpa@36 {
+    compatible = "awinic,aw882xx_smartpa";
+    reg = <0x36>;
+    reset-gpio = <&tlmm 60 0>;
+    irq-gpio = <&tlmm 113 0x2008>;
+    sync-load = <1>;
+    sound-channel = <2>;                  /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+    aw-tx-topo-id = <0x1000ff00>;
+    aw-rx-topo-id = <0x1000ff01>;
+    aw-tx-port-id = <0x1007>;
+    aw-rx-port-id = <0x1006>;
+    aw-re-min = <4000>;
+    aw-re-max= <30000>;
+    aw-cali-mode = "none";
+    status = "okay";
+  };
+  aw882xx_smartpa_3:aw882xx_smartpa@37 {
+    compatible = "awinic,aw882xx_smartpa";
+    reg = <0x37>;
+    reset-gpio = <&tlmm 128 0>;
+    irq-gpio = <&tlmm 129 0x2008>;
+    sync-load = <1>;
+    sound-channel = <3>;                  /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+    aw-tx-topo-id = <0x1000ff00>;
+    aw-rx-topo-id = <0x1000ff01>;
+    aw-tx-port-id = <0x1007>;
+    aw-rx-port-id = <0x1006>;
+    aw-re-min = <4000>;
+    aw-re-max= <30000>;
+    aw-cali-mode = "none";
+    status = "okay";
+  };
+  /* AWINIC AW882XX Smart PA End */
+  /*Re 为阻抗值*/
+  /*如配置 8PA, 还需添加 aw882xx_smartpa_4~aw882xx_smartpa_7*/
```

2.1.2 驱动配置

驱动编译分为 ko 编译与内核编译两种方式，根据项目选择配置。

ko 编译配置

驱动 ko 编译配置见附录 [驱动 KO 编译配置](#)。

内核编译配置

defconfig 编译配置选项

```
#add aw882xx smartpa
CONFIG_SND_SMARTPA_AW882XX=y
```

在内核创建 aw882xx 目录，添加 aw882xx 驱动文件

```
aw882xx_calib.c, aw882xx_calib.h, aw882xx_monitor.c,
aw882xx_monitor.h, aw882xx.c, aw882xx.h, aw882xx_device.c,
aw882xx_device.h, aw882xx_dsp.c, aw882xx_dsp.h, aw882xx_init.c,
aw882xx_init.h, aw882xx_log.h, aw882xx_spin.c, aw882xx_spin.h,
aw882xx_data_type.h, aw882xx_bin_parse.c, aw882xx_bin_parse.h
```

Kconfig 配置

```
config SND_SMARTPA_AW882XX
    tristate "SoC Audio for awinic aw882xxseries"
    depends on I2C
    help
        This option enables support for aw882xxseries Smart PA.
```

Makefile 配置

```
#for AWINIC AW882XX Smart PA
obj-$(CONFIG_SND_SMARTPA_AW882XX) += aw882xx/aw882xx.o
aw882xx/aw882xx_monitor.o aw882xx/aw882xx_init.o
aw882xx/aw882xx_dsp.o aw882xx/aw882xx_device.o
aw882xx/aw882xx_calib.o aw882xx/aw882xx_bin_parse.o
aw882xx/aw882xx_spin.o
```

2.1.3 增加与 ADSP 通讯函数

增加 afe 通信接口

请参照 patch 完成对 q6afe.c 的修改：

```
AW882XX_Driver_QCOM_v1.10.0 /*移植包名称 (以V1.10.0为例) */
├── ap
│   └── kernel
│       ├── 0001-Project-AW882XX_COPP.patch
│       ├── 0001-Project-AW882XX_COPP_V2.patch
│       ├── 0001-Project-AW882XX_driver.patch /*q6afe.c V3版本patch*/
│       └── 0001-Project-AW882XX_driver_params_v2.patch /*q6afe.c V2版本patch*/
```

增加 copp 控制接口（默认不合入）

请参照 patch 完成对 copp 控制接口的添加：

```
AW882XX_Driver_QCOM_v1.10.0 /*移植包名称 (以V1.10.0为例) */
├── ap
│   └── kernel
│       ├── 0001-Project-AW882XX_COPP.patch /*V3 版本copp接口添加patch*/
│       ├── 0001-Project-AW882XX_COPP_V2.patch /*V2 版本copp接口添加patch*/
│       ├── 0001-Project-AW882XX_driver.patch
│       └── 0001-Project-AW882XX_driver_params_v2.patch
```

2.1.4 BIN 文件配置

PA 需要配置寄存器等参数才能正常工作，PA bin 文件配置步骤如下：

编译配置

在项目对应位置添加 bin 文件编译选项

```
PRODUCT_COPY_FILES += \
hardware/qcom/audio/configs/xxxx/aw882xx_acf.bin:$(TARGET_COPY_OUT_VENDOR)/firmware
/aw882xx_acf.bin

/*xxxx 为平台路径*/
```

路径配置

在内核 firmware_class.c 中添加 bin 文件在手机中的目录，一般目录为 **vendor/firmware**

```
static const char * const fw_path[] = {
    fw_path_para,
    "/vendor/firmware", /*添加路径*/
    "/lib/firmware/updates/" UTS_RELEASE,
    "/lib/firmware/updates",
    "/lib/firmware/" UTS_RELEASE,
    "/lib/firmware"
};
```

(PS：调试阶段可直接 push bin 文件到/vendor/firmware/)

Bin 文件的选择

请根据平台信号输出格式，PA 数量以及产品名称在移植包 config 目录下选择 bin 文件。

2.2 平台驱动配置

2.2.1 DAI_LINK 配置

不同版本 linux kernel 的 dai_link 配置区分如下：

Kernel 5.4 之前的版本

1) 添加 awinic_codecs，多 PA 配置方法

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -5610,6 +5619,57 @@ static void *def_wcd_mbhc_cal(void)
     return wcd_mbhc_cal;
 }

+struct snd_soc_dai_link_component awinic_codecs[] = {
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-6-34",
+     .name = "aw882xx_smartpa.6-0034",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-6-35",
+     .name = "aw882xx_smartpa.6-0035",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-6-36",
+     .name = "aw882xx_smartpa.6-0036",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-6-37",
+     .name = "aw882xx_smartpa.6-0037",
+ },
+ };
+
+/*如配置 8PA，awinic_codecs[] 中需要再添加 4 组 codecs*/
```

2) 添加 awinic_codecs 到 tdm be dai 中

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
```



```
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -6440,8 +6516,21 @@ static struct snd_soc_dai_link msm_tdm_be_dai_links[] =
{
    .stream_name = "Tertiary TDM0 Playback", /*以 Tertiary TDM0 接口举例*/
    .cpu_dai_name = "msm-dai-q6-tdm.36896",
    .platform_name = "msm-pcm-routing",
+
+#ifdef CONFIG_SND_SMARTPA_AW882XX
+    .num_codecs = ARRAY_SIZE(awinic_codecs),
+    .codecs = awinic_codecs,
+#else
    .codec_name = "msm-stub-codec.1",
    .codec_dai_name = "msm-stub-rx",
+#endif
    .no_pcm = 1,
    .dpcm_playback = 1,
    .id = MSM_BACKEND_DAI_TERT_TDM_RX_0,
```

Kernel 5.4 及之后的版本

1) 添加 awinic_codecs, 多 PA 配置方法

```
SND_SOC_DAILINK_DEFS(tert_tdm_rx_0, /*以 tert_tdm_rx_0 接口为例*/
    DAILINK_COMP_ARRAY(COMP_CPU("msm-dai-q6-tdm.36896")),
    /*以 I2C 总线为 0x6, 地址为 0x34, 0x35, 0x36, 0x37 举例*/
    DAILINK_COMP_ARRAY(COMP_CODEC("aw882xx_smartpa.6-0034", "aw882xx-aif-6-34"),
    COMP_CODEC("aw882xx_smartpa.6-0035", "aw882xx-aif-6-35"),
    COMP_CODEC("aw882xx_smartpa.6-0036", "aw882xx-aif-6-36"),
    COMP_CODEC("aw882xx_smartpa.6-0037", "aw882xx-aif-6-37")),
    DAILINK_COMP_ARRAY(COMP_PLATFORM("msm-pcm-routing")));

/*如配置 8PA, DAILINK_COMP_ARRAY 中需要再添加 4 组 COMP_CODEC */
```

2.3 平台通路配置

2.3.1 RX 通路配置

1) 配置对应的 pinctl 为 TDM 模式

```
diff --git a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio-
overlay.dtsi b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio-
overlay.dtsi
index 602cc3a5fa..d5e6a69922 100755
--- a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio-overlay.dtsi
+++ b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio-overlay.dtsi
@@ -308,6 +308,9 @@
&kona_snd {

    qcom,cdc-dmic01-gpios = <cdc_dmic01_gpios>;
    qcom,cdc-dmic23-gpios = <cdc_dmic23_gpios>;
    qcom,cdc-dmic45-gpios = <cdc_dmic45_gpios>;
```

```
+ qcom,tert-mi2s-gpios = <&tert_tdm_gpios>; /*以 tert_tdm 为例*/
asoc-codec = <&stub_codec>, <&bolero>, <&ext_disp_audio_codec>;
asoc-codec-names = "msm-stub-codec.1", "bolero_codec",
                  "msm-ext-disp-audio-codec-rx";

};

@@ -376,6 +379,18 @@
&q6core {

    tx_swr_gpios: tx_swr_clk_data_pinctrl {
        compatible = "qcom,msm-cdc-pinctrl";
        pinctrl-names = "aud_active", "aud_sleep";
        pinctrl-0 = <&tx_swr_clk_active &tx_swr_data1_active
                    &tx_swr_data2_active>;
        pinctrl-1 = <&tx_swr_clk_sleep &tx_swr_data1_sleep
                    &tx_swr_data2_sleep>;
        qcom,lpi-gpios;
        qcom,tlmm-gpio = <147>;
    };
+   tert_tdm_gpios: tert_tdm_pinctrl {
+       status = "ok";
+       compatible = "qcom,msm-cdc-pinctrl";
+       pinctrl-names = "aud_active", "aud_sleep";
+       pinctrl-0 = <&tert_tdm_clk_active &tert_tdm_ws_active
+                   &tert_tdm_din_active &tert_tdm_dout_active>;
+       pinctrl-1 = <&tert_tdm_clk_sleep &tert_tdm_ws_sleep
+                   &tert_tdm_din_sleep &tert_tdm_dout_sleep>;
+   };
};
```

2) 增加/修改 TDM RX 音频数据信号格式配置

```
diff --git a/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
b/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
index 52d08e3577..729d3954d4 100755
--- a/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
+++ b/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
@@ -537,10 +537,12 @@
&soc {

    tdm_tert_rx: qcom,msm-dai-tdm-tert-rx { /*以 tert_tdm_rx_0 为例*/
        compatible = "qcom,msm-dai-tdm";
        qcom,msm-cpudai-tdm-group-id = <37152>;
        qcom,msm-cpudai-tdm-group-num-ports = <1>;
        qcom,msm-cpudai-tdm-group-port-id = <36896>;
        qcom,msm-cpudai-tdm-clk-rate = <1536000>;
        qcom,msm-cpudai-tdm-clk-internal = <1>;
-       qcom,msm-cpudai-tdm-sync-mode = <1>;
+       qcom,msm-cpudai-tdm-sync-mode = <0>; /*设置 sync-mode 为 short sync bit*/
        qcom,msm-cpudai-tdm-sync-src = <1>;
        qcom,msm-cpudai-tdm-data-out = <0>;
        qcom,msm-cpudai-tdm-invert-sync = <0>;
        qcom,msm-cpudai-tdm-data-delay = <1>;
        dai_tert_tdm_rx_0: qcom,msm-dai-q6-tdm-tert-rx-0 {
```

```
compatible = "qcom,msm-dai-q6-tdm";
qcom,msm-cpudai-tdm-dev-id = <36896>;
qcom,msm-cpudai-tdm-data-align = <0>;
};
};
};
```

/*tdm-sync-mode 可选 3 种方式 (0:short sync bit mode; 1: long sync mode; 2: short sync slot mode) */

/*tdm-data-delay 可选 3 种方式 (0:0bit clock cycle; 1:1bit clock cycle; 2:2bit clock cycle) */

/*tdm-sync-mode, tdm-data-delay 与 PA bin 配置需保持一致*/

3) 修改 kona_tdm_snd_hw_params 函数, 设置下发的 slot 数

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -4593,7 +4596,8 @@ static int kona_tdm_snd_hw_params(struct
snd_pcm_substream *substream,
struct snd_soc_dai *cpu_dai = rtd->cpu_dai;
int ret = 0;
int slot_width = TDM_SLOT_WIDTH_BITS;
- int channels, slots = TDM_MAX_SLOTS;
+ //int channels, slots = TDM_MAX_SLOTS; /*8PA 配置 slot:TDM_MAX_SLOTS 为 8*/
+ int channels, slots = 4; /*4PA 配置 slot 为 4*/
unsigned int slot_mask, rate, clk_freq;
unsigned int *slot_offset;
struct tdm_dev_config *config;
```

4) 修改 TDM slot 对应的 RX offset config 配置

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -537,9 +537,11 @@ static struct tdm_dev_config
sec_tdm_dev_config[MAX_PATH][TDM_PORT_MAX] = {
},
};
static struct tdm_dev_config tert_tdm_dev_config[MAX_PATH][TDM_PORT_MAX] = {
{ /* TERT TDM */
- { {0, 4, 0xFFFF} }, /* RX_0 */
+ { {0, 4, 8, 12, 0xFFFF} }, /* RX_0 */ /*以 tert_tdm_rx_0,4PA 配置为例*/
+ { {8, 12, 0xFFFF} }, /* RX_1 */
+ { {16, 20, 0xFFFF} }, /* RX_2 */
+ { {24, 28, 0xFFFF} }, /* RX_3 */
```

```
/*8PA 配置时, RX_0 修改如下*/
+ { {0, 4, 8, 12, 16, 20, 24, 28} }, /* RX_0 */
```

2.3.2 XML 配置

Mixer_paths_xxx.xml 文件修改

1) 增加初始化控件,根据实际需求更改位宽及采样率

```
diff --git a/mixer_paths_qrd.xml b/mixer_paths_qrd.xml
index 1567458..182e239 100644
--- a/mixer_paths_qrd.xml
+++ b/mixer_paths_qrd.xml
@@ -177,6 +177,25 @@
<ctl name="MultiMedia1 Mixer TERT_MI2S_TX" value="0" />
<ctl name="MultiMedia2 Mixer TERT_MI2S_TX" value="0" />
<!-- fm end -->
+ <!--以 TERT_TDM_RX_0 接口为例-->
+ <ctl name="TERT_TDM_RX_0 Format" value="S32_LE" />
+ <ctl name="TERT_TDM_RX_0 SampleRate" value="KHZ_48" />
+ <ctl name="TERT_TDM_RX_0 Channels" value="Four" /> /*8PA 时改为"Eight"*/
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia1" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia2" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia3" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia4" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia5" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia6" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia7" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia8" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia10" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia11" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia12" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia13" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia14" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia15" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia16" value="0" />
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia26" value="0" />

<!-- Multimode Voice1 -->
<ctl name="WSA CDC DMA RX 0 Voice Mixer VoiceMMModel" value="0" />
```

2) 修改所有 usecase 的输出接口, 以下以 deep-buffer-playback speaker 为例

```
diff --git a/mixer_paths_qrd.xml b/mixer_paths_qrd.xml
index 1567458..182e239 100644
--- a/mixer_paths_qrd.xml
+++ b/mixer_paths_qrd.xml
@@ -514,7 +533,8 @@
</path>

<path name="deep-buffer-playback">
- <ctl name="WSA_CDC_DMA_RX_0 Audio Mixer MultiMedia1" value="1" />
+ <!--ctl name="WSA_CDC_DMA_RX_0 Audio Mixer MultiMedia1" value="1" /-->
```

```
+ <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia1" value="1" />
  </path>

  <path name="deep-buffer-playback handset">
```

3) 注释 path name="speaker"的内容

```
@@ -1884,7 +1901,7 @@
  </path>

  <path name="speaker">
-   <path name="speaker-lineout" />
+   <!--path name="speaker-lineout" /-->
  </path>    <path name="speaker-mono">
```

Audio_platform_info_xxx.xml 配置

所有使用的 device 都需要增加, 以 SND_DEVICE_OUT_SPEAKER 为例

```
diff --git a/audio_platform_info_qrd.xml b/audio_platform_info_qrd.xml
index ddebfbcb..b7a14c7 100644
--- a/audio_platform_info_qrd.xml
+++ b/audio_platform_info_qrd.xml
@@ -176,7 +176,8 @@
  <device name="SND_DEVICE_OUT_VOICE_TTY_VCO_HEADPHONES"
  backend="headphones" interface="RX_CDC_DMA_RX_0"/>
  <device name="SND_DEVICE_OUT_VOICE_TTY_VCO_HEADSET" backend="headset"
  interface="RX_CDC_DMA_RX_0"/>
  <device name="SND_DEVICE_OUT_HANDSET" backend="handset"
  interface="RX_CDC_DMA_RX_0"/>
-  <device name="SND_DEVICE_OUT_SPEAKER" interface="WSA_CDC_DMA_RX_0"/>
+  <!--device name="SND_DEVICE_OUT_SPEAKER" interface="WSA_CDC_DMA_RX_0"/-->
+  <device name="SND_DEVICE_OUT_SPEAKER" interface="TERT_TDM_RX_0"/>
  <device name="SND_DEVICE_OUT_SPEAKER_EXTERNAL_1"
  interface="WSA_CDC_DMA_RX_0"/>
  <device name="SND_DEVICE_OUT_SPEAKER_EXTERNAL_2"
  interface="WSA_CDC_DMA_RX_0"/>
  <device name="SND_DEVICE_OUT_SPEAKER_REVERSE"
  interface="WSA_CDC_DMA_RX_0"/>
/*以 TERT_TDM_RX_0 接口为例*/
```

2.4 RX 驱动移植有效性验证

按如上操作完成 RX 驱动移植, 通过以下驱动 log 确认移植有效。

I2C 通信成功:

```
[Awinic][6-0034]aw882xx_dai_drv_append_suffix: dai name [aw882xx-aif-6-34]
[Awinic][6-0034]aw882xx_dai_drv_append_suffix: pstream_name name [Speaker_Playback-6-34]
[Awinic][6-0034]aw882xx_dai_drv_append_suffix: cstream_name name [Speaker_Capture-6-34]
[Awinic][6-0034]aw882xx_i2c_probe: dev_cnt 1
```

声卡注册成功:

```
[Awinic] [6-0034] aw882xx_codec_probe: enter
[Awinic] [6-0034] aw882xx_add_codec_controls: enter
[Awinic] [6-0034] aw882xx_request_firmware: load [aw882xx_acf.bin] , file size: [2016]
[Awinic] aw_dev_parse_check_acf_by_hdr: project name [A2113]
[Awinic] aw_dev_parse_check_acf_by_hdr: custom name [Awinic]
```

bin 文件加载成功:

```
[Awinic] [6-0034] aw_monitor_parse_vol_data_v_0_1_1: ==parse vol end ==
[Awinic] [6-0034] aw_dev_parse_skt_type: enter
[Awinic] [6-0034] aw_dev_parse_skt_type: get dsp data prof cnt is 0
[Awinic] [6-0034] aw_dev_parse_get_vaild_prof: get vaild profile:2
[Awinic] [6-0034] aw_dev_parse_acf: parse cfg success
[Awinic] [6-0034] aw_dev_soft_reset: soft reset done
[Awinic] [6-0034] aw_dev_reg_fw_update: amppd_st=0x0000
```

播放音乐, PA 发声:

```
[Awinic] [6-0034] aw_dev_set_intmask: done
[Awinic] [6-0034] aw_monitor_start: enter
[Awinic] [6-0034] aw_check_bop_status: enter
[Awinic] [6-0034] aw_check_bop_status: check done! bop status is 0
[Awinic] [6-0034] aw_device_start: done
[Awinic] [6-0034] aw882xx_start_pa: start success
```

3. 算法集成

请参考 Awinic 提供的算法集成文档进行集成。

3.1 算法认证功能

PA 工作时, 若出现规律播放白噪的情况, 时序如下: 播放音源 10s-->播放 3s 白噪-->播放音源 10s-->播放 3s 白噪-->.....

以上现象说明 awinic 算法认证失败, 请使能驱动中对应功能重新编译。

```
diff --git a/aw882xx_dsp.h b/aw882xx_dsp.h
index 998fa55..bce2a75 100644
--- a/aw882xx_dsp.h
+++ b/aw882xx_dsp.h
@@ -19,7 +19,7 @@

-/*#define AW_ALGO_AUTH_DSP*/
+#define AW_ALGO_AUTH_DSP

/*factor form 12bit(4096) to 1000*/
#define AW_DSP_RE_TO_SHOW RE(re) (((re) * (1000)) >> (12))
```

4. TX 驱动移植

4.1 平台通路配置

4.1.1 TX 通路配置

1) 增加/修改 TDM TX 信号格式配置

```
diff --git a/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
b/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
index 52d08e3577..729d3954d4 100755
--- a/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
+++ b/vendor/qcom/proprietary/devicetree-4.19/qcom/msm-audio-lpass.dtsi
@@ -556,10 +558,10 @@
&soc {

    tdm_tert_tx: qcom,msm-dai-tdm-tert-tx {                /*以 tert_tdm_tx_0 为例*/
        compatible = "qcom,msm-dai-tdm";
        qcom,msm-cpudai-tdm-group-id = <37153>;
        qcom,msm-cpudai-tdm-group-num-ports = <1>;
        qcom,msm-cpudai-tdm-group-port-id = <36897>;
        qcom,msm-cpudai-tdm-clk-rate = <1536000>;
        qcom,msm-cpudai-tdm-clk-internal = <1>;
-       qcom,msm-cpudai-tdm-sync-mode = <1>;
+       qcom,msm-cpudai-tdm-sync-mode = <0>;
        qcom,msm-cpudai-tdm-sync-src = <1>;
        qcom,msm-cpudai-tdm-data-out = <0>;
        qcom,msm-cpudai-tdm-invert-sync = <0>;
        qcom,msm-cpudai-tdm-data-delay = <1>;
        dai_tert_tdm_tx_0: qcom,msm-dai-q6-tdm-tert-tx-0 {
            compatible = "qcom,msm-dai-q6-tdm";

};
/* TDM mode 和 TDM data-delay 需与 PA bin 配置保持一致*/
```

2) 修改 TDM 4slot 对应的 TX offset config 配置

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -549,7 +551,8 @@ static struct tdm_dev_config
tert_tdm_dev_config[MAX_PATH][TDM_PORT_MAX] = {
    { {0xFFFF} }, /* RX_7 */
},
{
-   { {0, 4, 0xFFFF} }, /* TX_0 */
+   { {0, 4, 8, 12, 0xFFFF} }, /* TX_0 */ /*以 tert_tdm_tx_0, 4PA 配为例*/
+   { {8, 12, 0xFFFF} }, /* TX_1 */
+   { {16, 20, 0xFFFF} }, /* TX_2 */
+   { {24, 28, 0xFFFF} }, /* TX_3 */

/*8PA 配置时, TX_0 修改如下*/
+   { {0, 4, 8, 12, 16, 20, 24, 28} }, /* TX_0 */
```

3) 修改 kona.c, 增加 tert_tdm fe dai 到 msm_common_dai_links 数组中

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -6143,6 +6203,22 @@ static struct snd_soc_dai_link msm_common_dai_links[] =
{
    .codec_dai_name = "snd-soc-dummy-dai",
    .codec_name = "snd-soc-dummy",
},
+
+ {
+     .name = "Tertiary TDM0 TX_Hostless",
+     .stream_name = "Tertiary TDM0 Hostless Capture",
+     .cpu_dai_name = "TERT_TDM_TX_0_HOSTLESS",
+     .platform_name = "msm-pcm-hostless",
+     .dynamic = 1,
+     .dpcm_capture = 1,
+     .trigger = {SND_SOC_DPCM_TRIGGER_POST,
+                 SND_SOC_DPCM_TRIGGER_POST},
+     .no_host_mode = SND_SOC_DAI_LINK_NO_HOST,
+     .ignore_suspend = 1,
+     .ignore_pmdown_time = 1,
+     .codec_dai_name = "snd-soc-dummy-dai",
+     .codec_name = "snd-soc-dummy",
+ },
+
};
```

4) 修改 msm-pcm-routing-v2.c, 添加 tx 控件及 route, 以 TERT_TDM 为例进行添加

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/msm-pcm-routing-v2.c
b/vendor/qcom/opensource/audio-kernel/asoc/msm-pcm-routing-v2.c
index 66a38fb224..cc34c9e193 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/msm-pcm-routing-v2.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/msm-pcm-routing-v2.c
@@ -23258,6 +23265,17 @@ static const char * const mi2s_rx_vi_fb_tx_mux_text[] = {
    "ZERO", "SENARY_TX"
};
+static const char * const tert_tdm_rx_vi_fb_tx_mux_text[] = {
+    "ZERO", "TERT_TDM_TX_0"
+};
+
static const char * const int4_mi2s_rx_vi_fb_tx_mono_mux_text[] = {
    "ZERO", "INT5_MI2S_TX"
};

@@ -23287,6 +23305,17 @@ static const int mi2s_rx_vi_fb_tx_value[] = {
    MSM_BACKEND_DAI_MAX, MSM_BACKEND_DAI_SENARY_MI2S_TX
};
+static const int tert_tdm_rx_vi_fb_tx_value[] = {
+    MSM_BACKEND_DAI_MAX, MSM_BACKEND_DAI_TERT_TDM_TX_0
+};
static const int int4_mi2s_rx_vi_fb_tx_mono_ch_value[] = {
    MSM_BACKEND_DAI_MAX, MSM_BACKEND_DAI_INT5_MI2S_TX
};
```



```
};

@@ -23320,6 +23349,19 @@ static const struct soc_enum mi2s_rx_vi_fb_mux_enum =
    ARRAY_SIZE(mi2s_rx_vi_fb_tx_mux_text),
    mi2s_rx_vi_fb_tx_mux_text, mi2s_rx_vi_fb_tx_value);
+static const struct soc_enum tert_tdm_rx0_vi_fb_mux_enum =
+    SOC_VALUE_ENUM_DOUBLE(0, MSM_BACKEND_DAI_TERT_TDM_RX_0, 0, 0,
+    ARRAY_SIZE(tert_tdm_rx_vi_fb_tx_mux_text),
+    tert_tdm_rx_vi_fb_tx_mux_text, tert_tdm_rx_vi_fb_tx_value);
static const struct soc_enum int4_mi2s_rx_vi_fb_mono_ch_mux_enum =
    SOC_VALUE_ENUM_DOUBLE(0, MSM_BACKEND_DAI_INT4_MI2S_RX, 0, 0,
    ARRAY_SIZE(int4_mi2s_rx_vi_fb_tx_mono_mux_text),

@@ -23357,6 +23399,19 @@ static const struct snd_kcontrol_new mi2s_rx_vi_fb_mux
=
    mi2s_rx_vi_fb_mux_enum, spkr_prot_get_vi_lch_port,
    spkr_prot_put_vi_lch_port);
+static const struct snd_kcontrol_new tert_tdm_rx0_vi_fb_mux =
+    SOC_DAPM_ENUM_EXT("TERT_TDM_RX0_VI_FB_MUX",
+    tert_tdm_rx0_vi_fb_mux_enum, spkr_prot_get_vi_rch_port,
+    spkr_prot_put_vi_rch_port);
static const struct snd_kcontrol_new int4_mi2s_rx_vi_fb_mono_ch_mux =
    SOC_DAPM_ENUM_EXT("INT4_MI2S_RX_VI_FB_MONO_CH_MUX",
    int4_mi2s_rx_vi_fb_mono_ch_mux_enum, spkr_prot_get_vi_lch_port,

@@ -25033,6 +25093,17 @@ static const struct snd_soc_dapm_widget
msm_qdsp6_widgets_tdm[] = {
    ARRAY_SIZE(sen_tdm_rx_3_port_mixer_controls)),
    /* lsm mixer definitions */
    /* Virtual Pins to force backends ON atm */
+    SND_SOC_DAPM_MUX("TERT_TDM_RX0_VI_FB_MUX", SND_SOC_NOPM, 0, 0,
+    &tert_tdm_rx0_vi_fb_mux),
};
#endif

@@ -26463,6 +26534,12 @@ static const struct snd_soc_dapm_route intercon[] = {
    {"TX_CDC_DMA_TX_5", NULL, "BE_IN"},
    {"PRI_SPDIF_TX", NULL, "BE_IN"},
    {"SEC_SPDIF_TX", NULL, "BE_IN"},
+    {"TERT_TDM_RX_0", NULL, "TERT_TDM_RX0_VI_FB_MUX"},
+    {"TERT_TDM_RX0_VI_FB_MUX", "TERT_TDM_TX_0", "TERT_TDM_TX_0"},
};

#ifdef CONFIG_AUXPCM_DISABLE
```

4.2 HAL 层移植

4.2.1 HAL 代码移植

1) 复制 aw882xx_feedback.c 文件到 audio_extn 目录中:



2) 修改 Android.mk 文件

```

diff --git a/hal/Android.mk b/hal/Android.mk
index 94c21bd..5a963fa 100644
--- a/hal/Android.mk
+++ b/hal/Android.mk
@@ -79,6 +79,10 @@ LOCAL_C_INCLUDES +=
$(TARGET_OUT_INTERMEDIATES)/KERNEL_OBJ/usr/include
LOCAL_C_INCLUDES +=
$(TARGET_OUT_INTERMEDIATES)/KERNEL_OBJ/usr/techpack/audio/include
LOCAL_ADDITIONAL_DEPENDENCIES += $(TARGET_OUT_INTERMEDIATES)/KERNEL_OBJ/usr

+#awinic add
+#LOCAL_CFLAGS += -DANDROID_R /*只有在 Android R 及以上版本才需要添加*/
+#LOCAL_CFLAGS += -DAWINIC_SMARTPA_ENABLE
+#LOCAL_SRC_FILES += audio_extn/aw882xx_feedback.c
+
ifeq ($(strip $(AUDIO_FEATURE_ENABLED_DLKM)),true)
LOCAL_HEADER_LIBRARIES += audio_kernel_headers
LOCAL_C_INCLUDES += $(TARGET_OUT_INTERMEDIATES)/vendor/qcom/opensource/audio-
kernel/include

```

3) 修改 audio_extn.h 文件, 增加 Awinic 函数接口

```

diff --git a/hal/audio_extn/audio_extn.h b/hal/audio_extn/audio_extn.h
index d3e7a5f..6785c10 100644
--- a/hal/audio_extn/audio_extn.h
+++ b/hal/audio_extn/audio_extn.h
@@ -1106,4 +1105,13 @@ void audio_extn_ffv_check_and_append_ec_ref_dev(char
*device_name);
snd_device_t audio_extn_ffv_get_capture_snd_device();
void audio_extn_ffv_append_ec_ref_dev_name(char *device_name);
#endif
+

```

```
+int audio_extn_aw882xx_start_feedback(struct audio_device *adev, snd_device_t
snd_device);
+void audio_extn_aw882xx_stop_feedback(struct audio_device *adev, snd_device_t
snd_device);
+
#endif /* AUDIO_EXTN_H */
```

4) 根据客户实际需求修改所需支持的设备类型

```
diff --git a/platform.c b/platform.c
index 1b6b5e0..7f48c4b 100644
--- a/platform.c
+++ b/platform.c
@@ -7506,16 +7506,25 @@ bool
platform_can_enable_spkr_prot_on_device(snd_device_t snd_device)
{
    bool ret = false;

+   ALOGV("%s [Awinic] %d\n", __func__, snd_device);
    if (snd_device == SND_DEVICE_OUT_SPEAKER ||
        snd_device == SND_DEVICE_OUT_SPEAKER_REVERSE ||
+       snd_device == SND_DEVICE_OUT_SPEAKER_WSA ||
        snd_device == SND_DEVICE_OUT_SPEAKER_VBAT ||
        snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_VBAT ||
+       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_2_VBAT ||
+       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_STEREO ||
        snd_device == SND_DEVICE_OUT_VOICE_SPEAKER ||
-       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_2) {
+       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_2 ||
+       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_WSA ||
+       snd_device == SND_DEVICE_OUT_VOICE_SPEAKER_2_WSA ||
+       snd_device == SND_DEVICE_OUT_VOIP_SPEAKER) {
        ret = true;
    }

+   if (ret) {
+       ALOGV("%s [Awinic] snd_device_out id %d is supported iv feedback\n",
+           __func__, snd_device);
+   } else {
+       ALOGV("%s [Awinic] unsupport snd_device_out id: %d\n",
+           __func__, snd_device);
+   }
    return ret;
}
```

5) 增加对 audio_extn_aw882xx_start_feedback 以及 audio_extn_aw882xx_stop_feedback 函数的调用

```
diff --git a/hal/audio_hw.c b/hal/audio_hw.c
index 3e3f72f..6574566 100644
--- a/hal/audio_hw.c
+++ b/hal/audio_hw.c
@@ -1096,7 +1096,8 @@ int enable_snd_device(struct audio_device *adev,
```

```

    }
    audio_extn_dev_arbi_acquire(snd_device);
    audio_route_apply_and_update_path(audev->audio_route, device_name);
-
+ /*Awinic Add*/
+ audio_extn_aw882xx_start_feedback( adev, snd_device );
    if (SND_DEVICE_OUT_HEADPHONES == snd_device &&
        !adev->native_playback_enabled &&
        audio_is_true_native_stream_active(adev)) {
@@ -1157,6 +1158,7 @@ int disable_snd_device(struct audio_device *adev,
        disable_snd_device(adev, new_snd_devices[i]);
    }
} else {
+ audio_extn_aw882xx_stop_feedback( adev, snd_device);
    audio_route_reset_and_update_path(audev->audio_route, device_name);
}

```

4.2.2 XML 修改

Mixer_paths_xxx.xml 文件修改

在初始化列表中添加 IV 反馈的相关控制控件，根据实际需求更改位宽及采样率

```

diff --git a/mixer_paths_qrd.xml b/mixer_paths_qrd.xml
index 182e239..3206acb 100644
--- a/mixer_paths_qrd.xml
+++ b/mixer_paths_qrd.xml
@@ -180,6 +180,10 @@
    <ctl name="TERT_TDM_RX_0 Format" value="S32_LE" />
    <ctl name="TERT_TDM_RX_0 SampleRate" value="KHZ_48" />
    <ctl name="TERT_TDM_RX_0 Channels" value="Four" />
+   <ctl name="TERT_TDM_RX0_VI_FB_MUX" value="ZERO" />
+   <ctl name="TERT_TDM_TX_0 Format" value="S32_LE" />
+   <ctl name="TERT_TDM_TX_0 SampleRate" value="KHZ_48" />
+   <ctl name="TERT_TDM_TX_0 Channels" value="Four" /> /*8PA 时改为"Eight"*/
    <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia1" value="0" />
    <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia2" value="0" />
    <ctl name="TERT_TDM_RX_0 Audio Mixer MultiMedia3" value="0" />

```

2) 修改 path name="spkr-vi-record"为 TERT_TDM 接口

```

diff --git a/mixer_paths_qrd.xml b/mixer_paths_qrd.xml
index 182e239..3206acb 100644
--- a/mixer_paths_qrd.xml
+++ b/mixer_paths_qrd.xml
@@ -2631,6 +2635,7 @@
    </path>

    <path name="spkr-vi-record">
+   <ctl name="TERT_TDM_RX0_VI_FB_MUX" value="TERT_TDM_TX_0" />
    </path>

    <!-- These are actual sound device specific mixer settings -->

```

Audio_platform_info.xml 文件修改

1) 增加 TERT_TDM 配置

```
diff --git a/audio_platform_info_qrd.xml b/audio_platform_info_qrd.xml
index b7a14c7..298dea5 100644
--- a/audio_platform_info_qrd.xml
+++ b/audio_platform_info_qrd.xml
@@ -273,7 +274,8 @@
     <device name="SND_DEVICE_IN_QUAD_MIC" interface="TX_CDC_DMA_TX_3"/>
     <device name="SND_DEVICE_IN_HANDSET_STEREO_DMIC"
interface="TX_CDC_DMA_TX_3"/>
     <device name="SND_DEVICE_IN_SPEAKER_STEREO_DMIC"
interface="TX_CDC_DMA_TX_3"/>
-     <device name="SND_DEVICE_IN_CAPTURE_VI_FEEDBACK"
interface="WSA_CDC_DMA_TX_0"/>
+     <!--device name="SND_DEVICE_IN_CAPTURE_VI_FEEDBACK"
interface="WSA_CDC_DMA_TX_0"/-->
+     <device name="SND_DEVICE_IN_CAPTURE_VI_FEEDBACK"
interface="TERT_TDM_TX_0"/>
     <device name="SND_DEVICE_IN_CAPTURE_VI_FEEDBACK_MONO_1"
interface="WSA_CDC_DMA_TX_0"/>
     <device name="SND_DEVICE_IN_CAPTURE_VI_FEEDBACK_MONO_2"
interface="WSA_CDC_DMA_TX_0"/>
     <device name="SND_DEVICE_IN_VOICE_SPEAKER_DMIC_BROADSIDE"
interface="TX_CDC_DMA_TX_3"/>
```

2) 如下图操作，在 xml 中对 USECASE_AUDIO_SPKR_CALIB_TX 进行 pcm id 的配置 pcm id 确认方法如下：

```
kona:/ # cat proc/asound/pcm /*执行命令*/
00-00: MultiMedia1 (*) : : playback 1 : capture 1
00-01: MultiMedia2 (*) : : playback 1 : capture 1
00-02: VoiceMMModel (*) : : playback 1 : capture 1
00-03: VoIP (*) : : playback 1 : capture 1
00-04: MultiMedia3 (*) : : playback 1
00-05: AFE-PROXY RX msm-stub-rx-5 : : playback 1

00-30: CDC_DMA Hostless (*) : : playback 1 : capture 1
00-31: TX3_CDC_DMA Hostless (*) : : capture 1
00-32: Tertiary MI2S TX Hostless Capture (*) : : capture 1
00-33: Tertiary TDM0 Hostless Capture (*) : : capture 1 /*对应pcm id为33*/
00-34: WSA CDC DMA0 Capture wsa_macro_vifedback-34 : : capture 1
00-35: MultiMedia6 (*) : : playback 1 : capture 1
00-36: USB Audio Hostless (*) : : playback 1 : capture 1
00-37: SLIMBUS_7 Hostless (*) : : playback 1 : capture 1
00-39: SLIMBUS_8 Hostless (*) : : playback 1 : capture 1
00-40: TX CDC DMA5 Capture tx_macro_tx3-40 :
```

配置 USECASE_AUDIO_SPKR_CALIB_TX，配置为实际对应的 pcm id:

```
diff --git a/audio_platform_info_qrd.xml b/audio_platform_info_qrd.xml
index b7a14c7..298dea5 100644
--- a/audio_platform_info_qrd.xml
```

```
+++ b/audio_platform_info_qrd.xml
@@ -78,6 +78,7 @@
     <usecase name="USECASE_AUDIO_PLAYBACK_FM" type="in" id="32"/>
     <usecase name="USECASE_AUDIO_SPKR_CALIB_RX" type="out" id="30"/>
     <usecase name="USECASE_AUDIO_SPKR_CALIB_TX" type="in" id="33"/>
+    <!--usecase name="USECASE_AUDIO_SPKR_CALIB_TX" type="in" id="33"/-->
     <usecase name="USECASE_AUDIO_PLAYBACK_AFE_PROXY" type="out" id="5"/>
     <usecase name="USECASE_AUDIO_RECORD_AFE_PROXY" type="in" id="6"/>
     <usecase name="USECASE_AUDIO_RECORD_LOW_LATENCY" type="in" id="13" />
```

4.3 TX 驱动移植有效性验证

播放音乐，logcat 抓取日志，确认配置是否正确：

E.g. Pcm tx start success

```
04-14 08:07:47.118 D/audio_hw_primary( 856): enable_audio_route: apply mixer and
update path: spkr-vi-record
04-14 08:07:47.118 D/audio_route( 856): Apply path: spkr-vi-record
04-14 08:07:47.142 D/audio_hw_awinic_feedback( 856):
audio_extn_aw882xx_start_feedback:[Awinic] the pcm id uc_info->id = 52, tx_pcm_id
= 33
04-14 08:07:47.242 I/SDM ( 910): HWCDisplayBuiltIn::GetOptimalRefreshRate:
active_refresh_rate_: 60
```

(PS: tx_pcm_id=33 对应的 stream_name = "Tertiary TDM0 Hostless Capture")

E.g. Pcm tx start failed

```
logcat
04-14 06:15:27.459 D/audio_hw_awinic_feedback( 856):
audio_extn_aw882xx_start_feedback:[Awinic] the pcm id uc_info->id = 52, tx_pcm_id
= 33
04-14 06:15:27.472 E/audio_hw_awinic_feedback( 856):
audio_extn_aw882xx_start_feedback:[Awinic] pcm start for TX failed
```

5. 校准功能

5.1 校准目的

针对喇叭保护需求，AW882XX 驱动支持在产线对 speaker 进行校准，并将符合要求的 speaker 的 re 值写入到手机的 persist 分区中。在开机加载芯片配置时，驱动会将 persist 分区中读到的校准值写入保护算法中，达到喇叭保护的作用。

5.2 校准适配

5.2.1 校准文件保存路径适配

驱动（aw882xx_calib.c）中定义了保存校准值文件的路径如下：

```
#ifndef AW_CALI_STORE_EXAMPLE
/*write cali to persist file example*/
#define AWINIC_CALI_FILE "/mnt/vendor/persist/factory/audio/aw_cali.bin" /*保存校准值文件的路径*/
#define AW_INT_DEC_DIGIT 10
```

请确认手机中是否存在相同路径，无对应路径时会导致校准失败：

```
msm8996:/ # cd /mnt/vendor/persist/factory/audio/
msm8996:/mnt/vendor/persist/factory/audio # pwd
/mnt/vendor/persist/factory/audio
msm8996:/mnt/vendor/persist/factory/audio # ls
aw_cali.bin
msm8996:/mnt/vendor/persist/factory/audio #
```

5.3 校准方式

awinic 提供了三种校准的方式，分别是 class、misc 和 attr 三种。

5.3.1 Class 方式（推荐使用）

1) 节点功能

节点	功能
/sys/class/smartpa/cali_time	1.可配置校准 re 的延时时间 2.读取当前校准 re 的延时时间
/sys/class/smartpa/re25_calib	1.单独开启 re 校准 2.设置 re 值
/sys/class/smartpa/f0_calib	单独开启 f0 校准
/sys/class/smartpa/re_show	校准结束后获取 Re 值
/sys/class/smartpa/f0_show	校准结束后获取 f0 值
/sys/class/smartpa/re_range	获取校准 re 值有效范围

2) 校准步骤

- 播放静音文件；
- 校准 re:

```
msm8996:/sys/class/smartpa #
msm8996:/sys/class/smartpa # cat re25_calib
pri_l:6428 m0hms pri_r:6280 m0hms
msm8996:/sys/class/smartpa #
```

- 校准 f0:

```
msm8996:/sys/class/smarta #
msm8996:/sys/class/smarta # cat f0_calib
pri_l:832 pri_r:980
msm8996:/sys/class/smarta #
```

5.3.2 Misc 方式

AW882XX 驱动 misc 校准通过可执行文件来实现。按照以下步骤进行：

1) 获取可执行文件

```
AW882XX_Driver_QCOM_v1.10.0 /*移植包根目录 (以V1.10.0为例) */
├── ap
│   └── smartpa_cali
│       ├── aw882xx_cali_32 /*32位系统校准可执行文件*/
│       └── aw882xx_cali_64 /*64位系统校准可执行文件*/
└── example_source_code
    ├── aw882xx_cali_attr_multi_mode.c
    ├── aw882xx_cali_attr_single_dev_mode.c
    └── aw882xx_cali_class_example.c
```

2) 配置可执行文件

```
C:\Users\AW882XX_Driver_QCOM_v1.10.0\ap\smartpa_cali>adb push aw882xx_cali_32 /system/bin/
aw882xx_cali_32: 1 file pushed. 0.6 MB/s (34504 bytes in 0.052s)

C:\Users\AW882XX_Driver_QCOM_v1.10.0\ap\smartpa_cali>adb shell chmod 0777 /system/bin/aw882xx_cali_32
```

3) 指令介绍

```
msm8996:/ # aw882xx_cali_32 /*执行命令*/
Calibration executables version: v0.3.10 /*文件版本号*/

./aw882xx_cali [dev_name] cmd [optional params] /*命令格式*/

./aw882xx_cali [dev_name] cali [cali_re_time(ms)] /*校准re、f0*/

./aw882xx_cali [dev_name] cali_re [cali_re_time(ms)] /*校准re*/

./aw882xx_cali [dev_name] cali_f0 [noise] /*校准f0*/

./aw882xx_cali [dev_name] get_spkr_status /*获取实时re、te、f0*/

./aw882xx_cali [dev_name] get_spkr_st /*获取实时re、te*/

./aw882xx_cali [dev_name] set_cali_re re_value1 [re_value2] /*设置校准re值*/

./aw882xx_cali [dev_name] cali_f0_q [noise] /*校准f0、q*/

./aw882xx_cali [dev_name] cali_all [cali_re_time(ms)] /*校准re、f0、q*/

./aw882xx_cali [dev_name] get_re_range /*获取校准re值有效范围*/

./aw882xx_cali dev_name set_params params_file /*设置算法参数*/
```


参数解释（注：[]代表该选项可不填）

dev_name	用于校准单个设备，不同设备所用的 dev_name 与其在 dts 中配置的 sound-channel 相对应，其对应关系如下： 0: aw882xx_smartpa_l 1: aw882xx_smartpa_r 2: aw882xx_smartpa_sec_l 3: aw882xx_smartpa_sec_r 不填写时默认校准所有设备。
noise	填写 noise 参数用于校准 f0 时播放白噪； 若客户选择自行播放白噪，则无需填写该参数。
cali_re_time	用于设置校准 re 值的时间，单位（ms），最少不得小于 1000ms； 不填写时将会使用默认校准时间 3000ms。
re_value1	需要设置到系统的校准电阻值（单位：mohm）。
params_file	算法参数对应的路径。

4) 校准步骤

- 播放静音文件；
- 启动校准：

```
msm8996:/ # aw882xx_cali_32 start_cali
[aw882xx_smartpa_l]cali_RE = 6429
[aw882xx_smartpa_r]cali_RE = 6346
[aw882xx_smartpa_l]cali_f0 = 836
[aw882xx_smartpa_r]cali_f0 = 979
```

5.3.3 Attr 方式

1) 节点路径

以 I2C 总线为 0x6，地址为 0x34 为例：

```
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # /*节点路径*/
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # ls
algo_ver cali_f0 dbg_prof dsp_re modalias name print_dbg reg uevent
awrw cali_re driver f0_show monitor phase_sync re_range rw
cali cali_time drv_ver fade_step monitor_update power re_show subsystem
```

2) 节点功能

节点	功能
cali_time	1.可配置校准 re 的延时时间； 2.读取当前校准 re 的延时时间。
cali	开启 re 和 f0 校准。
cali_re	1.单独开启 re 校准； 2.设置 re 值。
cali_f0	单独开启 f0 校准；
re_show	校准结束后获取 Re 值。
f0_show	校准结束后获取 f0 值。

re_range

获取校准 re 值有效范围

1) 校准步骤

a. 播放静音文件;

b. 校准 re:

```
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 #  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # cat cali_re  
pri_l:6371 mOhms pri_r:6380 mOhms  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 #
```

c. 校准 f0:

```
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 #  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # cat cali_f0  
pri_l:830 pri_r:980  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 #
```

5.4 校准有效性验证

1) 多次校准, 确认校准 re 是否在有效范围内, 且值不恒定(re 有效范围与硬件同事确认), 以 attr 方式校准两次为例:

```
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # cat cali_re  
pri_l:6909 mOhms pri_r:6796 mOhms  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 # cat cali_re  
pri_l:6855 mOhms pri_r:6802 mOhms  
msm8996:/sys/bus/i2c/drivers/aw882xx_smartpa/6-0034 #
```

2) 查看 re 值是否写入文件中:

```
msm8996:/ # cat mnt/vendor/persist/factory/audio/aw_cali.bin  
6855 6802  
msm8996:/ #
```

3) **播放音乐状态下**, 查看 dsp_re 节点, 确认 dsp_re 节点 re 值与上述校准值相同:

```
msm8996:/ # cat sys/bus/i2c/drivers/aw882xx_smartpa/6-0034/dsp_re  
6854  
/*从dsp中读取re值时需要经过定点化运算, 故存在误差, 误差值为1*/  
msm8996:/ # cat sys/bus/i2c/drivers/aw882xx_smartpa/6-0037/dsp_re  
6801  
/*从dsp中读取re值时需要经过定点化运算, 故存在误差, 误差值为1*/  
msm8996:/ #
```

4) 重启手机, 播放音乐, 再次查看 dsp_re 节点, 确认 dsp_re 节点中的值与文件中的 re 值相同。

5.5 校准示例代码

AW882XX 驱动提供了 attr、class 校准节点调用示例代码, 可供参考。

```
AW882XX_Driver_QCOM_v1.10.0 /*驱动移植包根目录 (以V1.10.0为例) */
├── ap
│   └── smartpa_cali
│       ├── aw882xx_cali_32
│       └── aw882xx_cali_64
│           └── example_source_code
│               ├── aw882xx_cali_attr_multi_mode.c /*attr多设备同时校准方式示例代码*/
│               ├── aw882xx_cali_attr_single_dev_mode.c /*attr单设备校准方式示例代码*/
│               └── aw882xx_cali_class_example.c /*class校准方式示例代码*/
```

6. 调试接口

6.1 设备节点

AW882XX Driver 创建多个设备节点可供调试，路径是 `sys/bus/i2c/drivers/aw882xx_smartpa/*-00xx`，其中*为 I2C bus number，xx 为 I2C address。

reg

节点名字	reg
功能描述	用于读写 aw882xx 的所有寄存器
使用方法	读寄存器值: <code>cat reg</code> 写寄存器值: <code>echo reg_addr reg_data > reg</code> (16 进制操作)
参考例程	<code>cat reg</code> (获取所有可读寄存器上的值) <code>echo 0x04 0x0241 > reg</code> (向 0x04 寄存器写值 0x0241)

rw

节点名字	rw
功能描述	用于读写 aw882xx 的单个寄存器
使用方法	读寄存器值: <code>echo reg_addr > rw</code> (16 进制操作) <code>cat rw</code> 写寄存器值: <code>echo reg_addr reg_data > rw</code> (16 进制操作)
参考例程	<code>echo 0x04 > rw</code> (读取 0x04 寄存器值) <code>cat rw</code> <code>echo 0x04 0x0241 > rw</code> (向 0x04 寄存器写值 0x0241)

driver_ver

节点名字	driver_ver
功能描述	用于获取驱动版本号

使用方法	获取版本号: cat driver_ver
------	-----------------------

dsp_re

节点名字	dsp_re
功能描述	用于设置或者获取算法中设定的 re 值
使用方法	获取 re: cat dsp_re 设置 re: echo 7000 > dsp_re

fade_step

节点名字	fade_step
功能描述	设置淡入淡出步进
使用方法	设置步进: echo step > fade_step 获取步进: cat fade_step
参考例程	echo 6 > fade_step (设置步进为 6) cat fade_step (获取当前淡入淡出步进)

dbg_prof

节点名字	dbg_prof
功能描述	场景切换 dbg 节点
使用方法	打开场景切换功能: echo 1 > dbg_prof 关闭场景切换功能: echo 0 > dbg_prof 获取节点状态: cat dbg_prof

phase_sync

节点名字	phase_sync
功能描述	相位同步功能开关节点
使用方法	打开相位同步功能: echo 1 > phase_sync 关闭相位同步功能: echo 0 > phase_sync 获取节点状态: cat phase_sync

print_dbg

节点名字	print_dbg
功能描述	i2c 写功能 dbg 打印节点
使用方法	i2c 写打印功能打开: echo 1 > print_dbg i2c 写打印功能关闭: echo 0 > print_dbg

	获取节点状态: cat print_dbg
--	-----------------------

algo_ver

节点名字	algo_ver
功能描述	获取算法版本号
使用方法	获取算法版本号: cat algo_ver

monitor

节点名字	monitor
功能描述	用于开关 monitor 保护功能
使用方法	开启保护功能: echo 1 > monitor 关闭保护功能: echo 0 > monitor 保护模式获取: cat monitor

monitor_update

节点名字	monitor_update
功能描述	更新 monitor bin
使用方法	更新 monitor bin: echo 1 > monitor_update

6.2 Kcontrol 控件

Kcontrol	功能	实例
aw_dev_0_prof	模式选择	tinymix aw_dev_0_prof Music 选择 Music 模式 tinymix aw_dev_0_prof Receiver 选择 Receiver 模式
aw_dev_0_switch	开关芯片	tinymix aw_dev_0_switch Enable 开启芯片 tinymix aw_dev_0_switch Disable 关闭芯片
aw_dev_0_monitor	开关 monitor	tinymix aw_dev_0_monitor Enable 开启 monitor tinymix aw_dev_0_monitor Disable 关闭 monitor
aw882xx_rx_switch	开关 mec	tinymix aw882xx_rx_switch 0 关闭 mec tinymix aw882xx_rx_switch 1 开启 mec
aw882xx_tx_switch	开关 tx	tinymix aw882xx_tx_switch 0 关闭 tx tinymix aw882xx_tx_switch 1 开启 tx
aw882xx_spin_switch	设置旋转角度	tinymix aw882xx_spin_switch spin_90 旋转 90 度 tinymix aw882xx_spin_switch spin_180 旋转 180 度

aw882xx_fadein_us	设置淡入步进时间	tinymix aw882xx_fadein_us 500 设置淡入步进时间为 500
aw882xx_fadeout_us	设置淡出步进时间	tinymix aw882xx_fadeout_us 500 设置淡出步进时间为 500

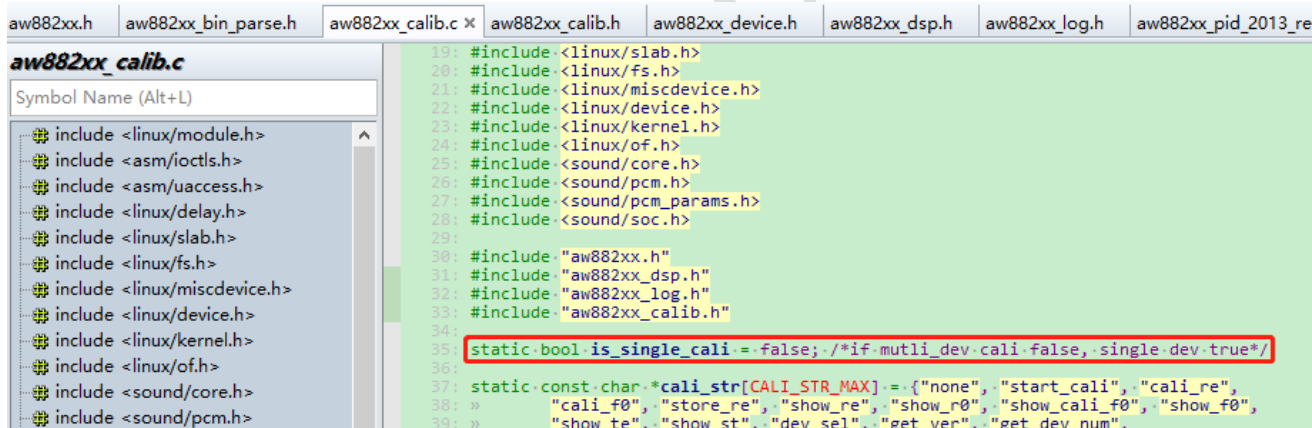
7. 附录

7.1 关于校准

Awinic 提供了 misc ioctl 节点校准，device attr 节点校准以及 class 节点校准方式；

名称	说明
/dev/aw882xx_smartpa	支持多 PA 同时校准
/sys/class/smartpa	支持多 PA 同时校准
/sys/bus/i2c/drivers/aw882xx_smartpa/x-xx/	支持单个 PA 或者多个 PA 同时校准

代码默认 misc/class 多 PA 同时校准，device attr 节点既可以支持单个 PA 校准又可以支持多个 PA 校准；通过配置 aw882xx_calib.c 中的全局变量 is_single_cali 设置，FAE 或者客户可以根据需要设置：



如果只有单个 PA，所有节点均是单 PA 校准；

7.2 常见 tx_switch 失效问题排查（apr 通信失败）

如出现 tx_switch 控件失效，无法控制 TX 的问题。请检查驱动发送的 instance id（adsp 通讯版本 v3）与 acdb 中 tx 模块的 instance id 设置是否一致。

以下示例中驱动发送的 instance id 为 0x0，acdb 中 tx 模块的 instance id 为 0x8000。二者设置的 instance id 不一致，导致 kernel 向 dsp 发送消息后，dsp 无返回数据，apr 通信出错，最终导致 tx_switch 控件失效。

驱动中发送的 instance id 为 0x0：


```
int aw_send_afe_cal_apr(uint32_t param_id, void *buf, int cmd_size, bool write)
{
    int32_t result = 0, port_id = AFE_PORT_ID_AWDSP_RX;
    int32_t module_id = AFE_MODULE_ID_AWDSP_RX;
    uint32_t port_index = 0;
    uint32_t payload_size = 0;
    size_t len;
    struct rtac_cal_block_data *aw_cal = &(this_afe.aw_cal);
    struct mem_mapping_hdr mem_hdr;
    struct param_hdr_v3 param_hdr;

    pr_debug("%s: enter\n", __func__);

    if (param_id == AFE_PARAM_ID_AWDSP_TX_SET_ENABLE) {
        port_id = AFE_PORT_ID_AWDSP_TX;
        module_id = AFE_MODULE_ID_AWDSP_TX;
    }

    if (aw_cal->map_data.dma_buf == 0) {
        goto err;
    }

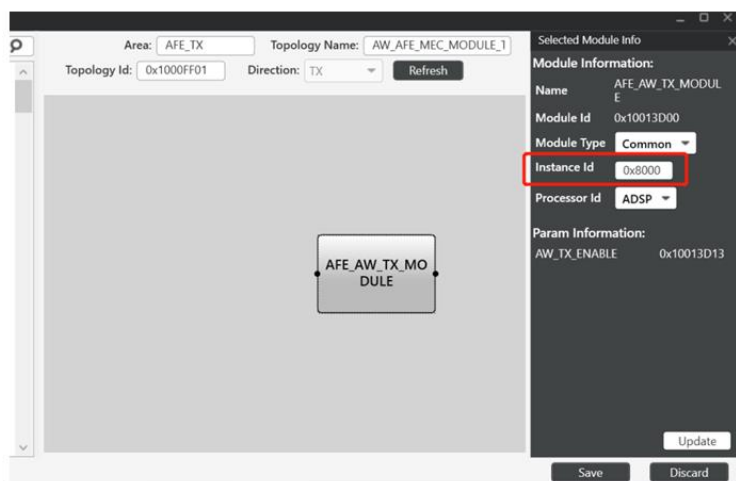
    /* Pack message header with data */
    param_hdr.module_id = module_id;
    param_hdr.instance_id = INSTANCE_ID_0;
    param_hdr.param_size = cmd_size;

    if (write) {
        param_hdr.param_id = param_id;
    }
}
```

0x10013d00

0x0

acdb 中 tx 模块的 instance id 设置为 0x8000:



上述问题将 acdb 中 tx 模块的 instance id 改为 0x0000，apr 通信即可成功。

7.3 驱动 ko 编译配置

7.3.1 添加驱动文件

在 vendor/qcom/opensource/audio-kernel/asoc/codecs 路径下创建 aw882xx 文件夹，添加驱动源码。

7.3.2 添加 Android.mk 和 Kbuild

在 aw882xx 路径下创建 Android.mk 和 Kbuild 文件，以下基于 sdm450 平台配置举例，具体请参考平台其他模块 Android.mk 与 Kbuild。

Android.mk 配置

```
# Android makefile for audio kernel modules
```

Assume no targets will be supported

AUDIO_CHIPSET := audio

Build/Package only in case of supported target

ifeq (\$(call is-board-platform-in-list,msm8953 msm8937 sdm710 qcs605),true)

LOCAL_PATH := \$(call my-dir)

This makefile is only for DLKM

ifneq (\$(findstring vendor,\$(LOCAL_PATH)),)

ifneq (\$(findstring opensource,\$(LOCAL_PATH)),)

AUDIO_BLD_DIR := \$(ANDROID_BUILD_TOP)/vendor/qcom/opensource/audio-kernel

endif # opensource

DLKM_DIR := \$(TOP)/device/qcom/common/dlkm

Build audio.ko as \$(AUDIO_CHIPSET)_audio.ko

#####

This is set once per LOCAL_PATH, not per (kernel) module

KBUILD_OPTIONS := AUDIO_ROOT=\$(AUDIO_BLD_DIR)

We are actually building audio.ko here, as per the

requirement we are specifying <chipset>_audio.ko as LOCAL_MODULE.

This means we need to rename the module to <chipset>_audio.ko

after audio.ko is built.

KBUILD_OPTIONS += MODNAME=aw882xx_dlkm

KBUILD_OPTIONS += BOARD_PLATFORM=\$(TARGET_BOARD_PLATFORM)

KBUILD_OPTIONS += \$(AUDIO_SELECT)

#####

include \$(CLEAR_VARS)

LOCAL_MODULE := \$(AUDIO_CHIPSET)_aw882xx.ko

LOCAL_MODULE_KBUILD_NAME := aw882xx_dlkm.ko

LOCAL_MODULE_TAGS := optional

LOCAL_MODULE_DEBUG_ENABLE := true

LOCAL_MODULE_PATH := \$(KERNEL_MODULES_OUT)

include \$(DLKM_DIR)/AndroidKernelModule.mk

#####

endif # DLKM check

endif # supported target check

Kbuild 配置

```
# We can build either as part of a standalone Kernel build or as
# an external module. Determine which mechanism is being used
ifeq ($(MODNAME),)
    KERNEL_BUILD := 1
else
    KERNEL_BUILD := 0
endif

ifeq ($(KERNEL_BUILD), 1)
    # These are configurable via Kconfig for kernel-based builds
    # Need to explicitly configure for Android-based builds
    AUDIO_BLD_DIR := $(ANDROID_BUILD_TOP)/kernel/msm-4.9
    AUDIO_ROOT := $(AUDIO_BLD_DIR)/techpack/audio
endif

ifeq ($(KERNEL_BUILD), 0)
    ifeq ($(CONFIG_ARCH_SDM845), y)
        include $(AUDIO_ROOT)/config/sdm845auto.conf
        export
        INCS += -include $(AUDIO_ROOT)/config/sdm845autoconf.h
    endif
    ifeq ($(CONFIG_ARCH_SDM670), y)
        include $(AUDIO_ROOT)/config/sdm710auto.conf
        export
        INCS += -include $(AUDIO_ROOT)/config/sdm710autoconf.h
    endif
    ifeq ($(CONFIG_ARCH_SDM450), y)
        include $(AUDIO_ROOT)/config/sdm450auto.conf
        export
        INCS += -include $(AUDIO_ROOT)/config/sdm450autoconf.h
    endif
endif

# As per target team, build is done as follows:
# Defconfig : build with default flags
# Slub      : defconfig + CONFIG_SLUB_DEBUG := y +
#            CONFIG_SLUB_DEBUG_ON := y + CONFIG_PAGE_POISONING := y
# Perf      : Using appropriate msmXXXX-perf_defconfig
#
# Shipment builds (user variants) should not have any debug feature
# enabled. This is identified using 'TARGET_BUILD_VARIANT'. Slub builds
# are identified using the CONFIG_SLUB_DEBUG_ON configuration. Since
# there is no other way to identify defconfig builds, QTI internal
```

```
# representation of perf builds (identified using the string 'perf'),
# is used to identify if the build is a slub or defconfig one. This
# way no critical debug feature will be enabled for perf and shipment
# builds. Other OEMs are also protected using the TARGET_BUILD_VARIANT
# config.

##### UAPI #####
UAPI_DIR := uapi
UAPI_INC := -I$(AUDIO_ROOT)/include/$(UAPI_DIR)

##### COMMON #####
COMMON_DIR := include
COMMON_INC := -I$(AUDIO_ROOT)/$(COMMON_DIR)

##### AW882XX #####
# for AW882XX PA
ifdef CONFIG_SND_SOC_AW882XX
    AW882XX_PA_OBJS += aw882xx.o //添加 aw882xx 相关驱动的所有.c 文件
endif

LINUX_INC += -linclude/linux

INCS += $(COMMON_INC) \
        $(UAPI_INC)

EXTRA_CFLAGS += $(INCS)

CDEFINES += -DANI_LITTLE_BYTE_ENDIAN \
            -DANI_LITTLE_BIT_ENDIAN \
            -DDOT11F_LITTLE_ENDIAN_HOST \
            -DANI_COMPILER_TYPE_GCC \
            -DANI_OS_TYPE_ANDROID=6 \
            -DPTT_SOCK_SVC_ENABLE \
-Wall\
-Werror\
-D__linux__

KBUILD_CPPFLAGS += $(CDEFINES)

# Currently, for versions of gcc which support it, the kernel Makefile
# is disabling the maybe-uninitialized warning. Re-enable it for the
# AUDIO driver. Note that we must use EXTRA_CFLAGS here so that it
# will override the kernel settings.
ifeq ($(call cc-option-yn, -Wmaybe-uninitialized),y)
EXTRA_CFLAGS += -Wmaybe-uninitialized
```

```
endif
#EXTRA_CFLAGS += -Wmissing-prototypes

ifeq ($(call cc-option-yn, -Wheader-guard),y)
EXTRA_CFLAGS += -Wheader-guard
endif

ifeq ($(KERNEL_BUILD), 0)
KBUILD_EXTRA_SYMBOLS +=$(OUT)/obj/vendor/qcom/opensource/audio-
kernel/ipc/Module.symvers
KBUILD_EXTRA_SYMBOLS +=$(OUT)/obj/vendor/qcom/opensource/audio-
kernel/dsp/Module.symvers
KBUILD_EXTRA_SYMBOLS +=$(OUT)/obj/vendor/qcom/opensource/audio-
kernel/asoc/Module.symvers
KBUILD_EXTRA_SYMBOLS +=$(OUT)/obj/vendor/qcom/opensource/audio-
kernel/asoc/codecs/Module.symvers
KBUILD_EXTRA_SYMBOLS +=$(OUT)/obj/vendor/qcom/opensource/audio-
kernel/soc/Module.symvers
endif

# Module information used by KBuild framework

obj-$(CONFIG_SND_SOC_AW882XX) += aw882xx_dtlm.o
aw882xx_dtlm-y := $(AW882XX_PA_OBJS)

# inject some build related information
DEFINES += -DBUILD_TIMESTAMP=\"$(shell date -u +%Y-%m-%dT%H:%M:%SZ)\"
```

7.3.3 定义编译选项

```
--- a/config/sdm450auto.conf
+++ b/config/sdm450auto.conf
@@ -39,3 +39,4 @@ CONFIG_SND_SOC_ANALOG_CDC=m
CONFIG_SND_SOC_DIGITAL_CDC_LEGACY=m
CONFIG_SND_SOC_MSM_HDMI_CODEC_RX=m
CONFIG_WCD_DSP_GLINK=m
+++CONFIG_SND_SMARTPA_AW882XX=m

diff --git a/config/sdm450autoconf.h b/config/sdm450autoconf.h
index 1aca114..b01004e 100644
--- a/config/sdm450autoconf.h
+++ b/config/sdm450autoconf.h
@@ -55,3 +55,4 @@
#define CONFIG_SND_SOC_MSM_HDMI_CODEC_RX 1
#define CONFIG_COMMON_CLK 1
```

```
#define CONFIG_WCD_DSP_GLINK 1
+++define CONFIG_SND_SMARTPA_AW882XX 1
```

7.3.4 添加编译选项

1) 在编译目录中添加新增的驱动目录

```
--- a/Android.mk
+++ b/Android.mk
@@ -13,6 +13,7 @@ $(shell rm -rf
$(PRODUCT_OUT)/obj/vendor/qcom/opensource/audio-
kernel/asoc/codecs/wcd934x/Module.symvers)
+$(shell rm -rf
$(PRODUCT_OUT)/obj/vendor/qcom/opensource/audiokernel/asoc/codecs/aw882xx/
Module.symvers)
@@ -22,6 +23,7 @@ include $(MY_LOCAL_PATH)/soc/Android.mk
include $(MY_LOCAL_PATH)/asoc/codecs/wcd934x/Android.mk
+include $(MY_LOCAL_PATH)/asoc/codecs/aw882xx/Android.mk
```

2) 在 device/qcom/XXX 目录下 (XXX 代表 ODM/OEM 的工程名) 添加相关配置:

BoardConfig.mk

```
BOARD_VENDOR_KERNEL_MODULES := $(KERNEL_MODULES_OUT)/audio_aw882xx.ko
```

XXX.mk

```
AUDIO_DLKM += audio_aw882xx.ko
```

init.target.rc 文件中添加编译出的 **audio_aw882xx.ko** 文件

```
/vendor/bin/modprobe -a -d /vendor/lib/modules audio_q6_pdr audio_q6_notifier
audio_snd_event audio_apr audio_adsp_loader audio_q6 audio_native audio_usf
audio_pinctrl_wcd audio_pinctrl_lpi audio_swr audio_platform audio_hdmi audio_stub
audio_wcd_core audio_wsa881x audio_bolero_cdc audio_wsa_macro audio_va_macro
audio_rx_macro audio_tx_macro audio_wcd938x audio_wcd938x_slave audio_machine_kona
audio_aw882xx
```

7.4 平台 I2C 总线动态变更

若平台 I2C 总线号会发生变更, I2C 总线号的动态变更会导致 dai_link 匹配失败, 可通过修改设备树配置与 dai_link 配置解决。

7.4.1 DTS 配置

驱动节点增加 rename-flag 属性, 并配置属性值为 1。

1) 多 PA 配置

```
diff --git a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi
b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi
index ac2f5b95f3..8a4251fe99 100755
```

```

--- a/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi
+++ b/vendor/qcom/proprietary/devicetree-4.19/qcom/kona-audio.dtsi
@@ -177,3 +177,60 @@
    i2c_x { /*x 表示对应的总线号*/
+
+        /* AWINIC AW882XX Smart PA */
+        aw882xx_smartpa_0:aw882xx_smartpa@34 {
+            compatible = "awinic,aw882xx_smartpa";
+            reg = <0x34>;
+            reset-gpio = <&tlmm 84 0>; /*aw88230,aw88257,aw88261,aw88265 不
能配置*/
+            irq-gpio = <&tlmm 136 0x2008>;
+            sound-channel = <0>; /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+            aw-tx-topo-id = <0x1000ff00>;
+            aw-rx-topo-id = <0x1000ff01>;
+            aw-tx-port-id = <0x1007>; /*根据客户实际所用 tx 的 port id 进行配置*/
+            aw-rx-port-id = <0x1006>; /*根据客户实际所用 rx 的 port id 进行配置*/
+            aw-re-min = <4000>; /*Re 校准范围最小值 (mOhms) */
+            aw-re-max= <30000>; /*Re 校准范围最大值 (mOhms) */
+            aw-cali-mode = "none"; /*带 IV 的产品无需配置此项*/
+            rename-flag = <1>;
+            status = "okay";
+        };
+        aw882xx_smartpa_1:aw882xx_smartpa@35 {
+            compatible = "awinic,aw882xx_smartpa";
+            reg = <0x35>;
+            reset-gpio = <&tlmm 82 0>;
+            irq-gpio = <&tlmm 143 0x2008>;
+            sound-channel = <1>; /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+            aw-tx-topo-id = <0x1000ff00>;
+            aw-rx-topo-id = <0x1000ff01>;
+            aw-tx-port-id = <0x1007>;
+            aw-rx-port-id = <0x1006>;
+            aw-re-min = <4000>;
+            aw-re-max= <30000>;
+            aw-cali-mode = "none";
+            rename-flag = <1>;
+            status = "okay";
+        };
+        aw882xx_smartpa_2:aw882xx_smartpa@36 {
+            compatible = "awinic,aw882xx_smartpa";
+            reg = <0x36>;
+            reset-gpio = <&tlmm 60 0>;
+            irq-gpio = <&tlmm 113 0x2008>;
+            sound-channel = <2>; /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+            aw-tx-topo-id = <0x1000ff00>;
+            aw-rx-topo-id = <0x1000ff01>;
+            aw-tx-port-id = <0x1007>;
+            aw-rx-port-id = <0x1006>;
+            aw-re-min = <4000>;
+            aw-re-max= <30000>;
+            aw-cali-mode = "none";
+            rename-flag = <1>;
+            status = "okay";
+        };
+        aw882xx_smartpa_3:aw882xx_smartpa@37 {
+            compatible = "awinic,aw882xx_smartpa";
+            reg = <0x37>;

```

```
+ reset-gpio = <tlmm 128 0>;
+ irq-gpio = <tlmm 129 0x2008>;
+ sound-channel = <3>; /*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/
+ aw-tx-topo-id = <0x1000ff00>;
+ aw-rx-topo-id = <0x1000ff01>;
+ aw-tx-port-id = <0x1007>;
+ aw-rx-port-id = <0x1006>;
+ aw-re-min = <4000>;
+ aw-re-max = <30000>;
+ aw-cali-mode = "none";
+ rename-flag = <1>;
+ status = "okay";
+ };
+ /* AWINIC AW882XX Smart PA End */
+ /*Re 为阻抗值*/
+ /*如配置 8PA, 还需添加 aw882xx_smartpa_4~aw882xx_smartpa_7*/
```

7.4.2 DAI_LINK 配置

codec_name 与 codec_dai_name 修改后缀为 sound-channel, 不同版本 linux kernel 的 dai_link 配置区分如下:

Kernel 5.4 之前的版本

2) 添加 awinic_codecs, 多 PA 配置方法

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
index 77519e2ae1..2d51f6bb8b 100644
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c
@@ -5610,6 +5619,57 @@ static void *def_wcd_mbhcal(void)
    return wcd_mbhcal;
}
/*修改后缀为 dts 节点对应的 sound-channel */
+struct snd_soc_dai_link_component awinic_codecs[] = {
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-0",
+     .name = "aw882xx_smartpa_0",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-1",
+     .name = "aw882xx_smartpa_1",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-2",
+     .name = "aw882xx_smartpa_2",
+ },
+ {
+     .of_node = NULL,
+     .dai_name = "aw882xx-aif-3",
+     .name = "aw882xx_smartpa_3",
+ },
+ },
```

```
+};  
/*如配置 8PA, awinic_codecs[]中需要再添加 4 组 codecs*/
```

2) 添加 awinic_codecs 到 tdm be dai 中

```
diff --git a/vendor/qcom/opensource/audio-kernel/asoc/kona.c  
b/vendor/qcom/opensource/audio-kernel/asoc/kona.c  
index 77519e2ae1..2d51f6bb8b 100644  
--- a/vendor/qcom/opensource/audio-kernel/asoc/kona.c  
+++ b/vendor/qcom/opensource/audio-kernel/asoc/kona.c  
@@ -6440,8 +6516,21 @@ static struct snd_soc_dai_link msm_tdm_be_dai_links[] =  
{  
    .stream_name = "Tertiary TDM0 Playback", /*以 Tertiary TDM0 接口举例*/  
    .cpu_dai_name = "msm-dai-q6-tdm.36896",  
    .platform_name = "msm-pcm-routing",  
+  
+#ifdef CONFIG_SND_SMARTPA_AW882XX  
+    .num_codecs = ARRAY_SIZE(awinic_codecs),  
+    .codecs = awinic_codecs,  
+#else  
    .codec_name = "msm-stub-codec.1",  
    .codec_dai_name = "msm-stub-rx",  
+#endif  
    .no_pcm = 1,  
    .dpcm_playback = 1,  
    .id = MSM_BACKEND_DAI_TERT_TDM_RX_0,
```

Kernel 5.4 及之后的版本

1) 添加 awinic_codecs, 多 PA 配置方法

```
SND_SOC_DAILINK_DEFS(tert_tdm_rx_0, /*以 tert_tdm_rx_0 接口为例*/  
    DAILINK_COMP_ARRAY(COMP_CPU("msm-dai-q6-tdm.36896")),  
    /*修改后缀为 dts 节点对应的 sound-channel */  
    DAILINK_COMP_ARRAY(COMP_CODEC("aw882xx_smartpa_0", "aw882xx-aif-0")),  
    COMP_CODEC("aw882xx_smartpa_1", "aw882xx-aif-1"),  
    COMP_CODEC("aw882xx_smartpa_2", "aw882xx-aif-2"),  
    COMP_CODEC("aw882xx_smartpa_3", "aw882xx-aif-3")),  
    DAILINK_COMP_ARRAY(COMP_PLATFORM("msm-pcm-routing")));  
  
/*如配置 8PA, DAILINK_COMP_ARRAY 中需要再添加 4 组 COMP_CODEC */
```