Rockchip PulseAudio 开发指南

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前言

概述

本文档主要介绍 Rockchip Linux的PulseAudio功能，内核驱动开发及调试。

产品版本

芯片名称	内核版本
RK 系列芯片	Linux 4.19, Linux 5.10

读者对象

本文档（本指南）主要适用于以下工程师:

技术支持工程师

软件开发工程师

修订记录

日期	版本	作者	修改说明		
2022-04-07	V1.0.0	Jordan Luo	初始版本		

目录

1. Linux PulseAudio 简介

PulseAudio（以前叫*Polypaudio*）是一个跨平台的、可通过网络工作的声音服务，其一般使用于Linux和FreeBSD操作系统。

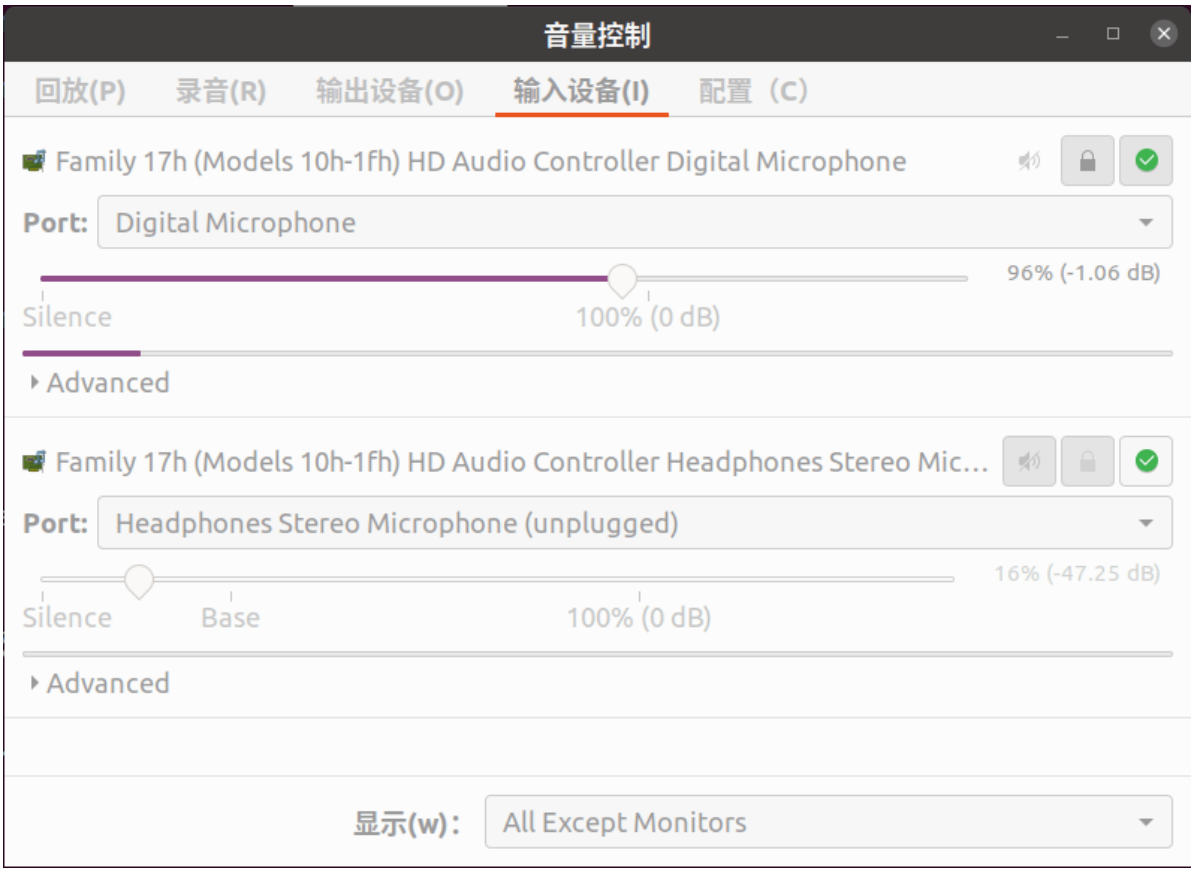
更多的详细的介绍以及使用参见以下链接：

https://wiki.archlinux.org/title/PulseAudio

https://www.freedesktop.org/wiki/Software/PulseAudio/Documentation/User/Modules/

2. PulseAudio UI控制界面 -- pavucontrol

通过pavucontrol 可以选择设备输入输出以及音量等控制。



3. pulseaudio 的配置

3.1 ucm2配置

debian11用pulseaudio-14.2版本的配置用ucm2。

如下是ucm2的配置：

```
3588/debian/overlay/etc/pulse$ tree
.
├── daemon.conf
└── default.pa
```

```
~/3588/debian/overlay/usr/share$ tree
.
├── alsa
│   └── ucm2
│       ├── README.md
│       ├── rockchip-es8388
│       │   ├── HiFi.conf
│       │   └── rockchip-es8388.conf
│       ├── rockchip-hdmi0
│       │   ├── Hdmi.conf
│       │   └── rockchip-hdmi0.conf
│       ├── rockchip-hdmi1
│       │   ├── Hdmi.conf
│       │   └── rockchip-hdmi1.conf
│       └── ucm.conf
```

如下是 rockchip-hdmi0 的配置：

```
~/3588/debian/overlay/usr/share/alsa/ucm2/rockchip-hdmi0$ cat rockchip-hdmi0.conf
Syntax 2

Comment "Rockchip HDMI card"

SectionUseCase."HDMI" {
        File "Hdmi.conf"
        Comment "HDMI/Display Port 1 Stereo"
}
```

```
~/3588/debian/overlay/usr/share/alsa/ucm2/rockchip-hdmi0$ cat Hdmi.conf
# Usecase for device HDMI0/Display Port stereo playback on rockchip platforms
# For Audio in I2S mode

SectionDevice."HDMI0" {
        Comment "HDMI/Display Port 1 Stereo"

        Value {
                PlaybackPriority 300
                PlaybackPCM "hw:${CardId}"
                If.1 {
                        Condition {
                                Type ControlExists
```

```
                                Control "iface=CARD,name='rockchip-hdmi0 Jack'"
                        }
                        True {
                                JackControl "rockchip-hdmi0 Jack"
                        }
                        False {
                                JackControl "rockchip-hdmi0 Jack"
                        }
                }
        }
}
```

JackControl "rockchip-hdmi0 Jack" 是 liunx 的标准的Jack检测机制。

对应的配置是arch/arm64/boot/dts/rockchip/rk3588-evb.dtsi：

```
        hdmi0_sound: hdmi0-sound {
                status = "disabled";
                compatible = "rockchip,hdmi";
                rockchip,mclk-fs = <128>;
                rockchip,card-name = "rockchip-hdmi0";
                rockchip,cpu = <&i2s5_8ch>;
                rockchip,codec = <&hdmi0>;
                rockchip,jack-det;
        };
```

对应的驱动代码是sound/soc/rockchip/rockchip_hdmi.c。

通过rockchip,jack-det属性来支持Jack， jack name 就是rockchip,card-name。

如下是rockchip-es838 的配置：

```
~/3588/debian/overlay/usr/share/alsa/ucm2/rockchip-es8388$ ls
HiFi.conf  rockchip-es8388.conf
~/3588/debian/overlay/usr/share/alsa/ucm2/rockchip-es8388$ cat rockchip-
es8388.conf
Syntax 2

Comment "Rockchip ES8388 card"

SectionUseCase."HiFi" {
        File "HiFi.conf"
        Comment "Default"
}
~/3588/debian/overlay/usr/share/alsa/ucm2/rockchip-es8388$ cat HiFi.conf
SectionVerb {
        Value {
                MinBufferLevel "512"
        }

        EnableSequence [
                cset "name='Speaker Switch' off"
                cset "name='Headphone Switch' off"
```

```
                cset "name='Headset Mic Switch' off"
                cset "name='Main Mic Switch' off"
                cset "name='Speaker Switch' off"
                cset "name='Headphone Switch' off"
                cset "name='Headset Mic Switch' off"
                cset "name='Main Mic Switch' off"
                cset "name='PCM Volume' 192"
                cset "name='Output 1 Playback Volume' 27"
                cset "name='Output 2 Playback Volume' 27"
                cset "name='Capture Digital Volume' 192"
                cset "name='Left Channel Capture Volume' 3"
                cset "name='Right Channel Capture Volume' 3"
                cset "name='Left Mixer Left Playback Switch' on"
                cset "name='Right Mixer Right Playback Switch' on"
                cset "name='Capture Mute' off"
                cset "name='Right PGA Mux' DifferentialR"
                cset "name='Left PGA Mux' DifferentialL"
        ]
}

SectionDevice."Speaker" {
        Comment "Speaker"

        ConflictingDevice [
                "Headphones"
        ]

        Value {
                PlaybackPriority 100
                PlaybackPCM "hw:${CardId}"
        }

        EnableSequence [
                cset "name='Speaker Switch' on"
        ]

        DisableSequence [
                cset "name='Speaker Switch' off"
        ]
}

SectionDevice."Mic" {
        Comment "Internal Microphone"

        ConflictingDevice [
                "Headset"
        ]

        Value {
                CapturePriority 100
                CapturePCM "hw:${CardId}"
        }

        EnableSequence [
                cset "name='Differential Mux' Line 2"
```

```
                cset "name='Main Mic Switch' on"
        ]

        DisableSequence [
                cset "name='Main Mic Switch' off"
        ]
}

SectionDevice."Headphones" {
        Comment "Headphones"

        ConflictingDevice [
                "Speaker"
        ]

        Value {
                PlaybackPriority 200
                PlaybackPCM "hw:${CardId}"
                JackControl "Headphone Jack"
                JackHWMute "Speaker"
        }

        EnableSequence [
                cset "name='Headphone Switch' on"
        ]
        DisableSequence [
                cset "name='Headphone Switch' off"
        ]
}

SectionDevice."Headset" {
        Comment "Headset Microphone"

        ConflictingDevice [
                "Mic"
        ]

        Value {
                CapturePriority 200
                CapturePCM "hw:${CardId}"
                JackControl "Headset Mic Jack"
                JackHWMute "Mic"
        }

        EnableSequence [
                cset "name='Differential Mux' Line 1"
                cset "name='Headset Mic Switch' on"
        ]

        DisableSequence [
                cset "name='Headset Mic Switch' off"
        ]
}
```

从配置上可以看出配置了两个jack，"Headphone Jack" 和 "Headset Mic Jack"。

"Headphone Jack" 耳机检测的jack， 用来区分喇叭/耳机播放；

"Headset Mic Jack" 耳机mic检测的jack， 用来区分主板上的mic/耳机mic录音。

对应配置：

```
        es8388_sound: es8388-sound {
                status = "okay";
                compatible = "rockchip,multicodecs-card";
                rockchip,card-name = "rockchip-es8388";
                hp-det-gpio = <&gpio1 RK_PD5 GPIO_ACTIVE_LOW>;
                io-channels = <&saradc 3>;
                io-channel-names = "adc-detect";
                keyup-threshold-microvolt = <1800000>;
                poll-interval = <100>;
                spk-con-gpio = <&gpio1 RK_PD3 GPIO_ACTIVE_HIGH>;
                hp-con-gpio = <&gpio1 RK_PD2 GPIO_ACTIVE_HIGH>;
                rockchip,format = "i2s";
                rockchip,mclk-fs = <256>;
                rockchip,cpu = <&i2s0_8ch>;
                rockchip,codec = <&es8388>;
                rockchip,audio-routing =
                        "Headphone", "LOUT1",
                        "Headphone", "ROUT1",
                        "Speaker", "LOUT2",
                        "Speaker", "ROUT2",
                        "Headphone", "Headphone Power",
                        "Headphone", "Headphone Power",
                        "Speaker", "Speaker Power",
                        "Speaker", "Speaker Power",
                        "LINPUT1", "Main Mic",
                        "LINPUT2", "Main Mic",
                        "RINPUT1", "Headset Mic",
                        "RINPUT2", "Headset Mic";
                pinctrl-names = "default";
                pinctrl-0 = <&hp_det>;
                play-pause-key {
                        label = "playpause";
                        linux,code = <KEY_PLAYPAUSE>;
                        press-threshold-microvolt = <2000>;
                };
        };
```

Property	Value	Description
hp-det-gpio	phandle	耳机检测pin，通过中断来检测耳机拔插状态
spk-con-gpio	phandle	功放喇叭控制pin
hp-con-gpio	phandle	耳机控制pin
io-channels	phandle	adc检测通道用来区分3/4段耳机， 以及耳机按键
poll-interval	int	adc 轮询时间间隔默认100ms
keyup-threshold-microvolt	int	adc 按键电压
play-pause-key	phandle	这里定义了播放暂停按键， 可以根据需求定义其他按键
rockchip,audio-routing	string	声卡的 routing

gpio1_d5 低电平插入耳机检测，gpio1_d2使能耳机 ，gpio1_d3 高电平使能喇叭。

adc3 来区分3/4段耳机， 同时支持耳机线上的播放暂停按键。

Headphone 对应es8388 的 LROUT1，通过Headphone Power 控制gpio1_d2。

Speaker 对应es8388 的 LROUT2，通过Speaker Power 控制gpio1_d3。

LINPUT 对应es8388 的 Main Mic， RINPUT对应Headset Mic。

3.2 ucm 的配置

debian10用pulseaudio-13.99.x版本的配置是用ucm。

如下是ucm 的配置:

```
alsa$ tree
.
├── ucm
│   ├── rockchip,hdmi
│   │   ├── HDMI.conf
│   │   └── rockchip,hdmi.conf
│   ├── rockchip,rk618-hdmi
│   │   ├── HDMI.conf
│   │   └── rockchip,rk618-hdmi.conf
│   ├── rockchip,rk809-codec
│   │   ├── HiFi.conf
│   │   └── rockchip,rk809-codec.conf
```

```
alsa$ cat ucm/rockchip,hdmi/rockchip,hdmi.conf
SectionUseCase."HDMI" {
        File "HDMI.conf"
        Comment "Rockchip HDMI/Display Port Stereo."
}
alsa$ cat ucm/rockchip,hdmi/HDMI.conf
# Use case for devices on rockchip,hdmi card.
```

```
SectionDevice."HDMI1" {
        Comment "Rockchip HDMI/Display Port Stereo"

        EnableSequence [

        ]

        DisableSequence [

        ]

        Value {
                PlaybackPCM "hw:rockchiphdmi"
                PlaybackChannels "2"
                PlaybackPriority "5800"
                JackControl "rockchip,hdmi Jack"
        }
}
```

```
alsa$ cat ucm/rockchip,rk618-hdmi/rockchip,rk618-hdmi.conf
SectionUseCase."HDMI" {
        File "HDMI.conf"
        Comment "RK618 HDMI/Display Port Stereo."
}
alsa$ cat ucm/rockchip,rk618-hdmi/HDMI.conf
# Use case for devices on rockchip,rk618-hdmi card.

SectionDevice."HDMI2" {
        Comment "RK618 HDMI/Display Port 2 Stereo"

        EnableSequence [

        ]

        DisableSequence [

        ]

        Value {
                PlaybackPCM "hw:rockchiprk618hd"
                PlaybackChannels "2"
                PlaybackPriority "5900"
                JackControl "rockchip,rk618-hdmi Jack"
        }
}
```

```
alsa$ cat ucm/rockchip,rk809-codec/rockchip,rk809-codec.conf
SectionUseCase."HiFi" {
        File "HiFi.conf"
        Comment "Play HiFi quality Music."
}
alsa$ cat ucm/rockchip,rk809-codec/HiFi.conf
# Use case for devices on rockchip,rk809-codec card.
```

```
SectionVerb {
        EnableSequence [
                cdev "hw:rockchiprk809co"
        ]

        DisableSequence [
                cdev "hw:rockchiprk809co"
        ]
}

SectionDevice."Headphone" {
        Comment "Headphones Playback"

        EnableSequence [
                cdev "hw:rockchiprk809co"

                cset "name='Playback Path' HP"
        ]

        DisableSequence [
                cdev "hw:rockchiprk809co"

                cset "name='Playback Path' OFF"
        ]

        Value {
                PlaybackPCM "hw:rockchiprk809co"
                PlaybackChannels "2"
                PlaybackPriority "1"
                JackControl "Headphones Jack"
                JackHWMute "Speaker"
        }
}

SectionDevice."Speaker" {
        Comment "Speaker Playback"

        EnableSequence [
                cdev "hw:rockchiprk809co"

                cset "name='Playback Path' SPK"
        ]

        DisableSequence [
                cdev "hw:rockchiprk809co"

                cset "name='Playback Path' OFF"
        ]

        Value {
                PlaybackPCM "hw:rockchiprk809co"
                PlaybackChannels "2"
                PlaybackPriority "2"
        }
}
```

```
SectionDevice."Headset" {
        Comment "Headset Mic"
        ConflictingDevice [
                "MainMic"
        ]
        EnableSequence [
                cdev "hw:rockchiprk809co"
                cset "name='Capture MIC Path' Hands Free Mic"
        ]

        DisableSequence [
                cdev "hw:rockchiprk809co"
                cset "name='Capture MIC Path' MIC OFF"
        ]

        Value {
                CapturePCM "hw:rockchiprk809co"
                CaptureChannels "2"
                JackControl "Mic Jack"
                JackHWMute "MainMic"
        }
}

SectionDevice."MainMic" {
        Comment "Main Mic"
        ConflictingDevice [
                "Headset"
        ]
        EnableSequence [
                cdev "hw:rockchiprk809co"
                cset "name='Capture MIC Path' Main Mic"
        ]

        DisableSequence [
                cdev "hw:rockchiprk809co"
                cset "name='Capture MIC Path' MIC OFF"
        ]

        Value {
                CapturePCM "hw:rockchiprk809co"
                CaptureChannels "2"
        }
}
```

4. 查看JACK 状态

通过cat 获取card 的ID， 然后再 amixer -c id contents 查看 jack status。

例如:

```
root@linaro-alip:/# cat /proc/asound/cards
 0 [rockchipes8388 ]: rockchip-es8388 - rockchip-es8388
                      rockchip-es8388
 1 [rockchiphdmiin ]: rockchip_hdmiin - rockchip,hdmiin
                      rockchip,hdmiin
 2 [rockchiphdmi0  ]: rockchip-hdmi0 - rockchip-hdmi0
                      rockchip-hdmi0
 3 [rockchiphdmi1  ]: rockchip-hdmi1 - rockchip-hdmi1
                      rockchip-hdmi1
```

例如: rockchip-hdmi0没有接入hdmi0:

```
root@linaro-alip:/# amixer -c 2 contents
numid=2,iface=CARD,name='rockchip-hdmi0 Jack'
  ; type=BOOLEAN,access=r-------,values=1
  : values=off
```

例如: rockchip-es8388下面状态表示耳机(Headphone)插入，同时也有耳机 mic (Headset Mic)插入。

```
root@linaro-alip:/# amixer -c 0 contents
numid=26,iface=CARD,name='Headphone Jack'
  ; type=BOOLEAN,access=r-------,values=1
  : values=on
numid=27,iface=CARD,name='Headset Mic Jack'
  ; type=BOOLEAN,access=r-------,values=1
  : values=on
```