Android Audio System Introduction

Outline

- Background
- Android Audio System
- Audio Framework
- Audio HAL

Background

Background

- Information about this slide
  - Software
    - Android 4.0/4.2

Android Audio System

Architecture Audio System

- The complexity of android audio system
  - Soft real-time requirement
  - Large number of usage scenarios
    - Software
      - phone/media player/…
      - different volume setting/…
    - Hardware
      - earpiece/speaker/hdmi/…
      - mic/bluetooth/…
  - Flexibility design
    - good design pattern
    - performance (Java/JNI/binder/…)

Architecture Audio System

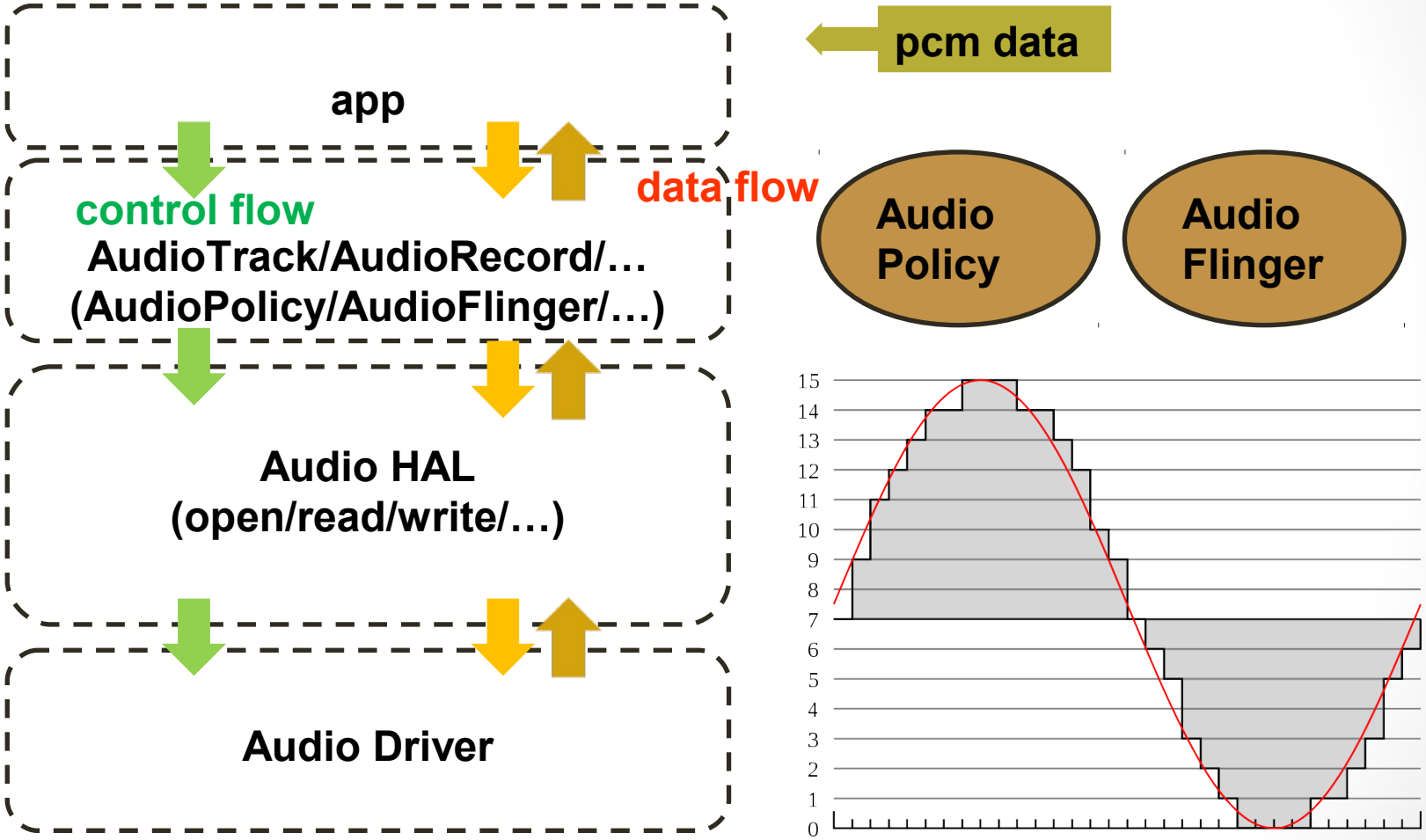
Java App

Android Framework

Audio HAL

Linux Driver

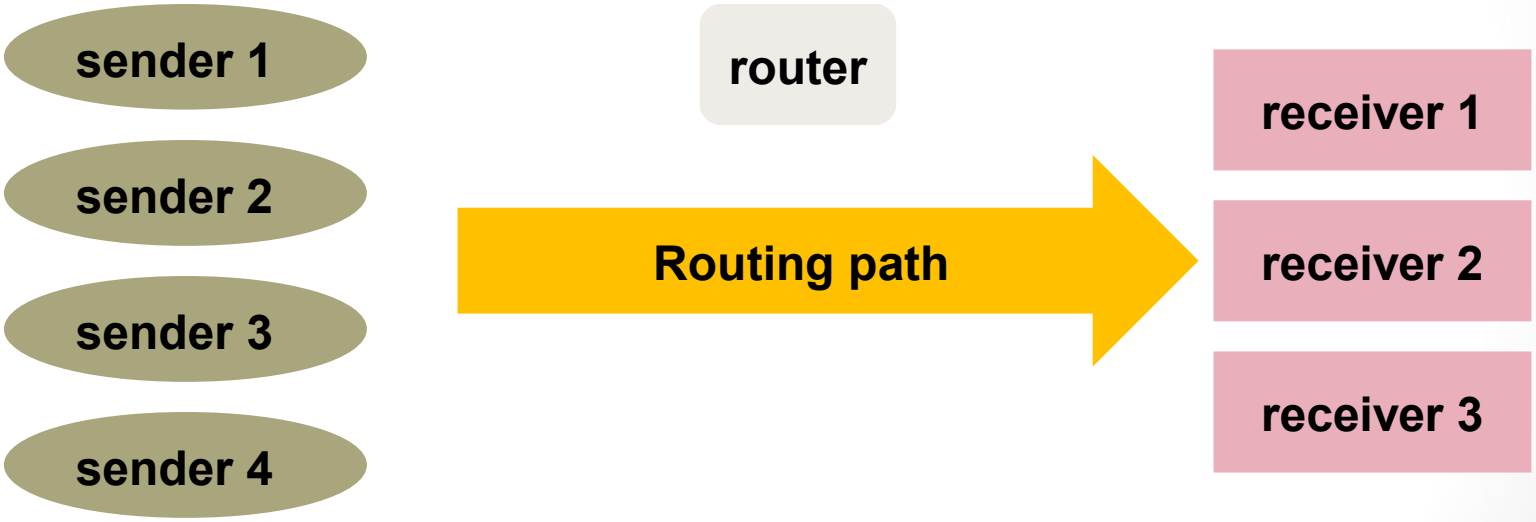
Android Audio System



Audio Framework

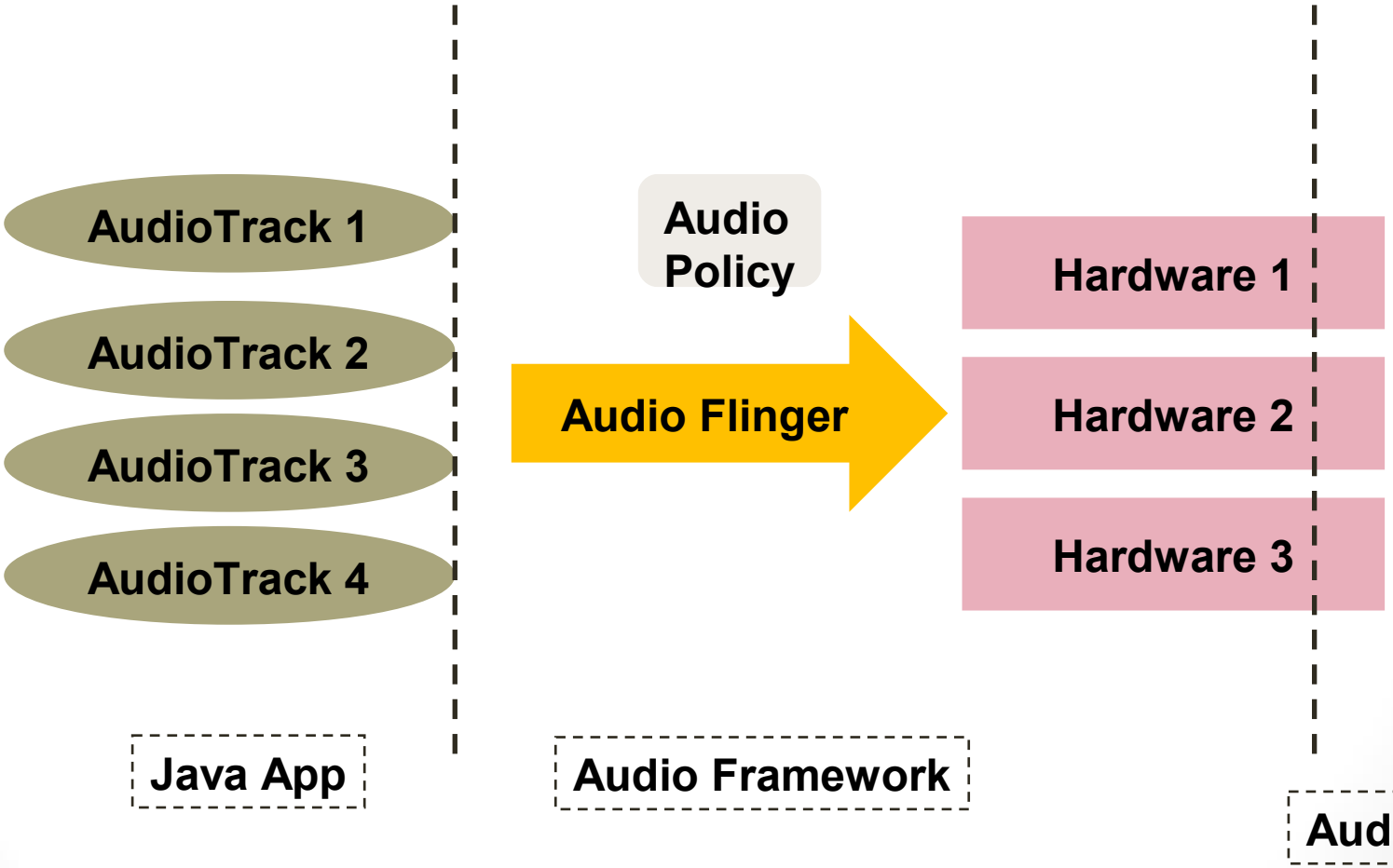
Audio Framework

Network Packet Routing



Audio Framework

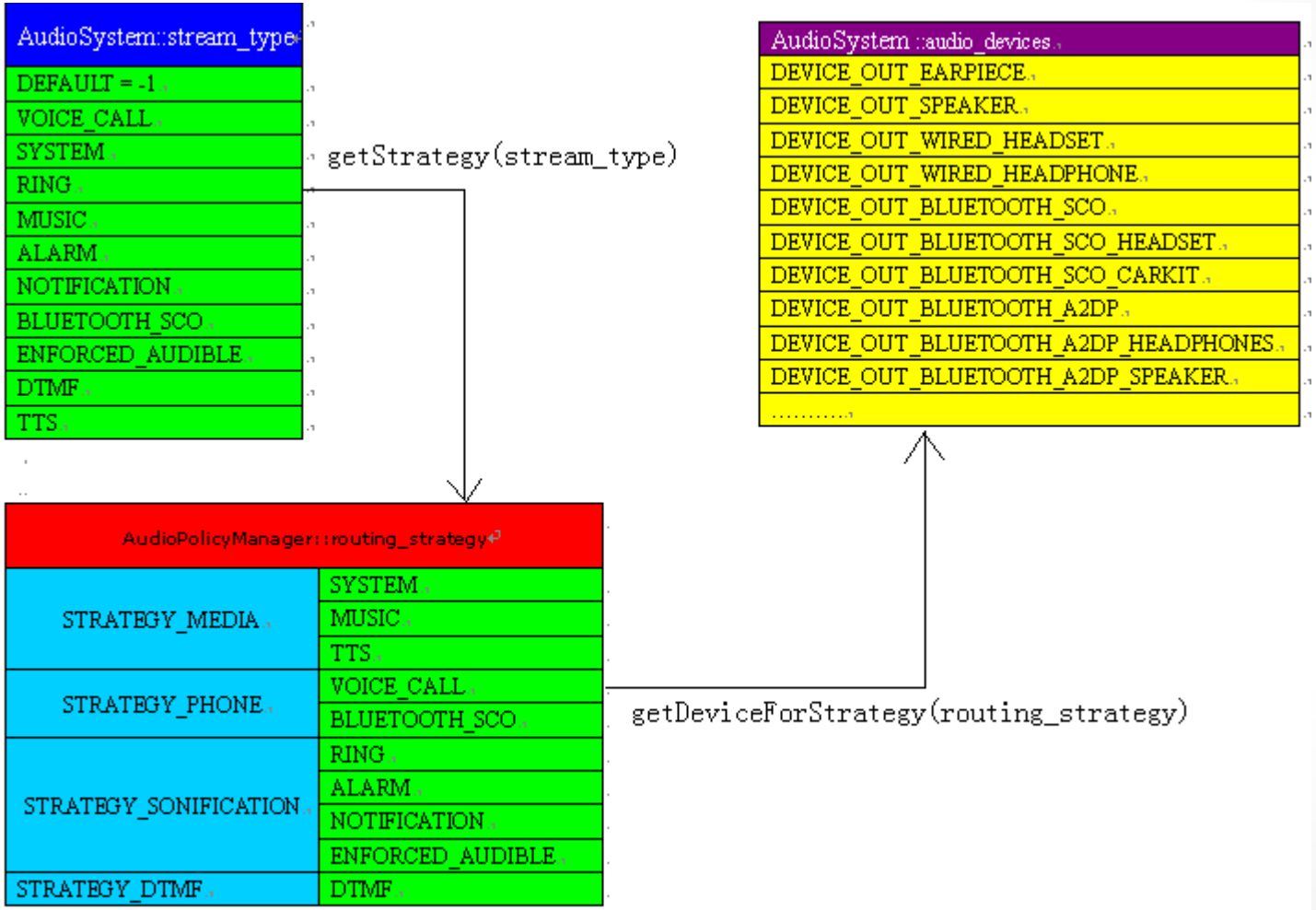
Audio Routing (play audio)



Audio Policy

- Decide which thread in AudioFlinger should sound be attached.
  - stream → strategy → output
    - stream : VOICE_CALL, TTS, MUSIC, …
    - strategy : PHONE, MUSIC, …
    - output : a thread in AudioFlinger
  - strategy : bridge between software data stream and hardware

Audio Policy



Audio Policy

- IOProfile (audio_policy.conf)
  - Content
    - Define all the possible I/O devices
    - Define default I/O device
  - Hierarchical structure
    - hardware module
    - profile
      - sampling_rates/channels/formats/devices/flags
  - With IOProfile, audio policy gets better OO structure.

Audio Policy

```
primary {
  outputs {
    primary {
      sampling_rates 48000
      channel_masks AUDIO_CHANNEL_OUT_STEREO
      formats AUDIO_FORMAT_PCM_16_BIT
      devices AUDIO_DEVICE_OUT_SPEAKER
      flags AUDIO_OUTPUT_FLAG_PRIMARY
    }
    garmin_navigation {
      sampling_rates 16000
      channel_masks AUDIO_CHANNEL_OUT_STEREO
      formats AUDIO_FORMAT_PCM_16_BIT
      devices AUDIO_DEVICE_OUT_WIRED_HEADPHONE
      flags AUDIO_OUTPUT_FLAG_DIRECT
    }
    garmin_handsfree {
      sampling_rates 8000
      channel_masks AUDIO_CHANNEL_OUT_STEREO
      formats AUDIO_FORMAT_PCM_16_BIT
      devices AUDIO_DEVICE_OUT_BLUETOOTH_SCO_HEADSET
      flags AUDIO_OUTPUT_FLAG_DIRECT
    }
  }
```

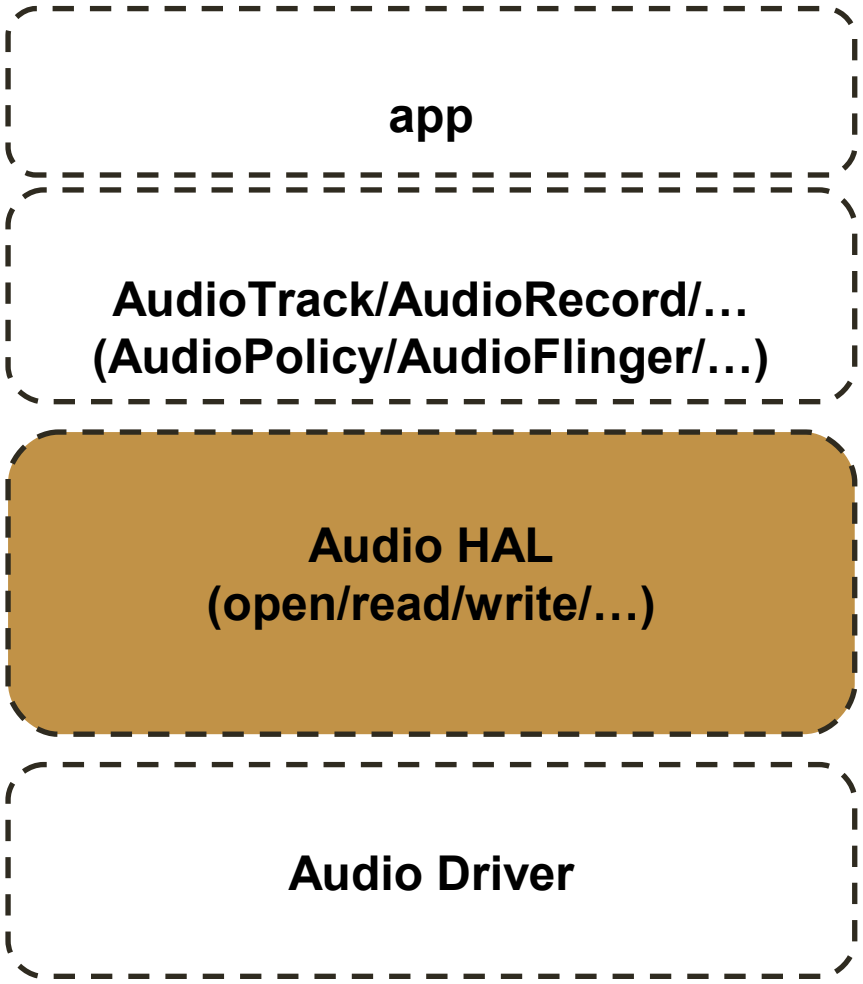
```
inputs {
  primary {
    sampling_rates 8000|11025|16000|22050|32000|44100|48000
    channel_masks AUDIO_CHANNEL_IN_MONO|AUDIO_CHANNEL_IN_STEREO
    formats AUDIO_FORMAT_PCM_16_BIT
    devices AUDIO_DEVICE_IN_BUILTIN_MIC
  }
  garmin_handsfree {
    sampling_rates 8000
    channel_masks AUDIO_CHANNEL_IN_MONO|AUDIO_CHANNEL_IN_STEREO
    formats AUDIO_FORMAT_PCM_16_BIT
    devices AUDIO_DEVICE_IN_BLUETOOTH_SCO_HEADSET
  }
}
```

Audio Flinger

- Several thread to read/write data
  - Create thread by AudioPolicy
    - mixer thread
    - duplicating thread
    - direct output thread
  - Resampler
  - Non-blocking audio I/O
  - AudioWatchdog

Audio HAL

Audio HAL


app
AudioTrack/AudioRecord/…
(AudioPolicy/AudioFlinger/…)
Audio HAL
(open/read/write/…)
Audio Driver

Audio HAL

- ALSA (Advanced Linux Sound Architecture)
  - unified interface/SMP/thread-safe/…
  - usespace library
    - alsa-lib
    - tinyalsa
  - tinyplay/tinycap/ tinymix
- Audio HAL interface
  - volume setting
  - I/O function
  - …