High Level Audio API and Policy Proposal

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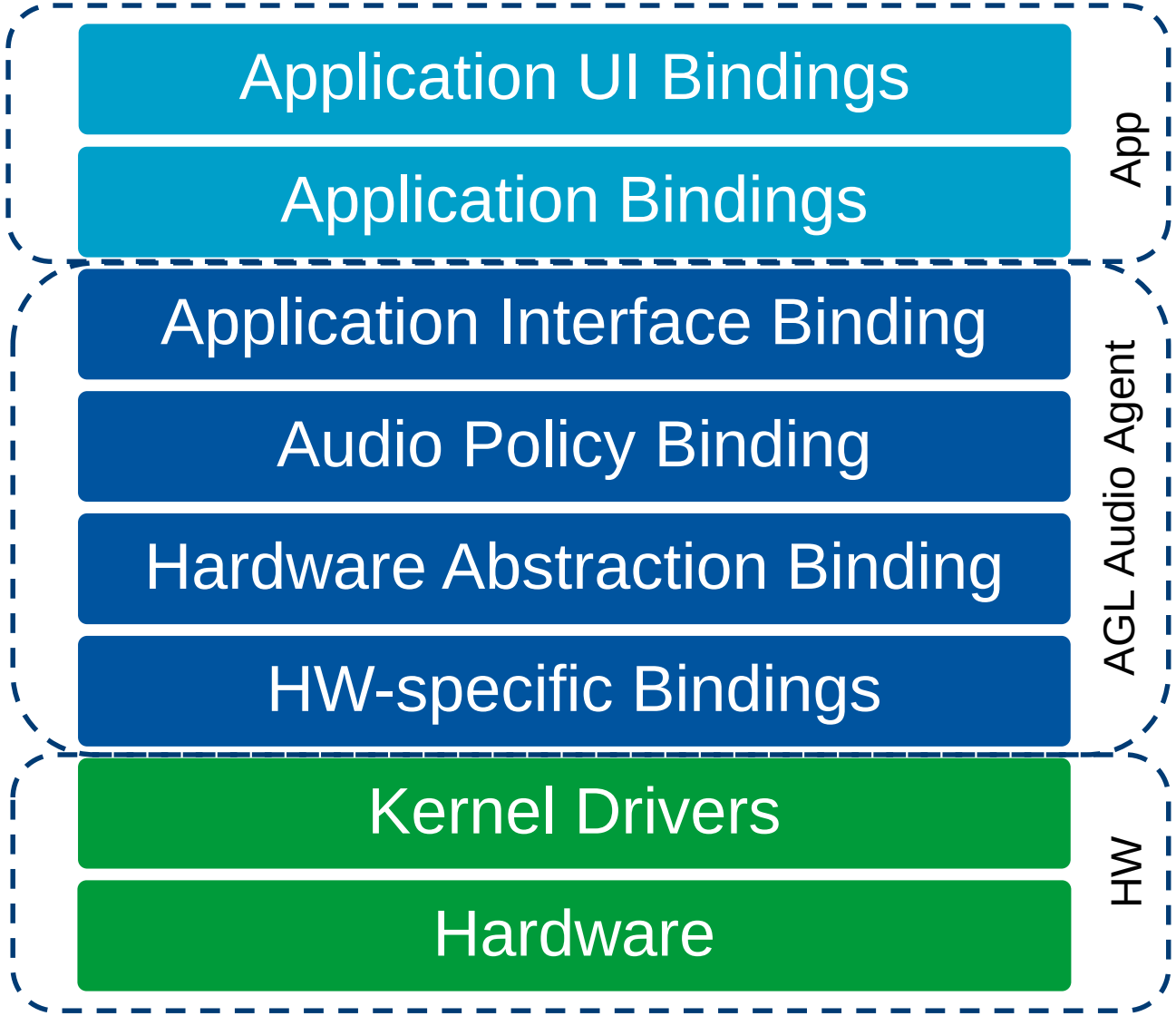
Audio Architecture Proposal Overview



AGL Audio Agent Layers Proposal

High Level Audio Binding

- Single entry point for all audio applications needs with simple, stable interface
- Expose all device capabilities in uniform way to applications
- Allow fine grain security permissions control, policy enforcement and provide isolation between different application audio stream controls
- Priority-based and audio role specific endpoint selection / stream routings (automatic or explicit) and aggregation of different audio domains (ALSA, Pulse)
- Audio stream and endpoint controls (volume, mute, state, properties)

Audio Policy Binding

- Customized audio business logic (audio role specific ducking rules, interrupt behaviors, …)
- Implement audio actions influenced by vehicle information (e.g. ALC)
- Dispatch policy actions to different low-level audio frameworks

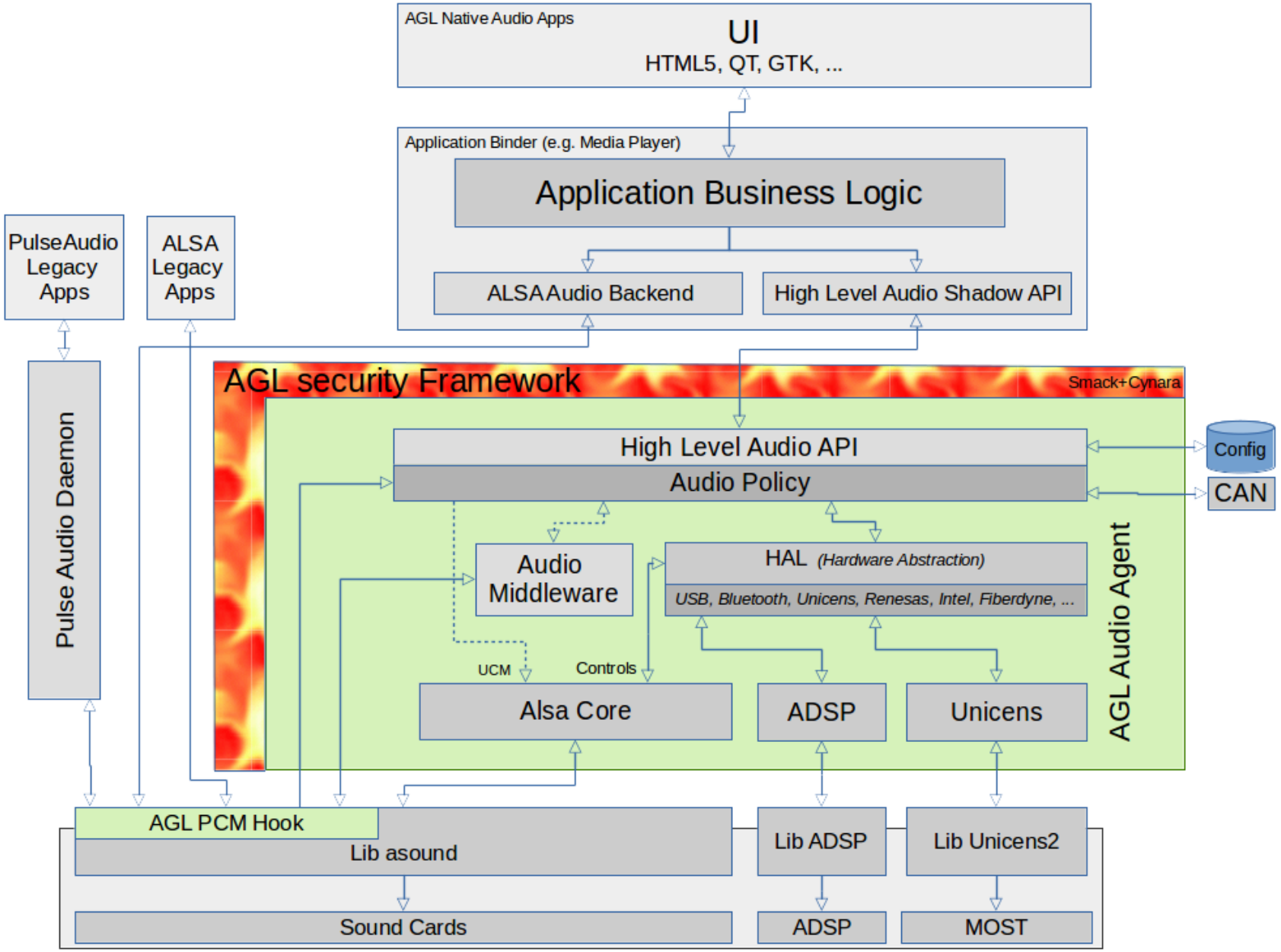
HW Abstraction Binding

- Provide portability of audio implementation across different audio hardware
- HW control ID mappings to expose standard control set
- Dispatch to HW specific binding for additional functionalities

Hardware Control Bindings

- ALSA core → generic ALSA hardware controls
- Implement/expose additional hardware capabilities (e.g. ADSP or Unicens)

AGL Audio Agent Architecture Proposal



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High-level Audio Binding API Concepts

- Audio roles (e.g. entertainment, warning, communications, etc.)
- Audio endpoints (source and sink endpoints)
  - Provide applications display name for device (e.g. UI selection)
  - Provide applications device URI to stream to selected endpoint
  - Automatically retrieve associated volume control for ALSA softvol URI
  - Volume and properties (numeric (e.g. balance, EQ), or string (e.g. preset))
- Audio streams (audio role assignment)
  - Stream state (e.g. idle/running/suspended)
  - Stream mute state
- Sound events (audio role assignment)
  - Integrate sound generation with audio stream management
    - Connect to a custom renderer (e.g. HMI events, startup/ending sound, etc., AVAS, …)

High Level Audio Binding Audio Routings

- Audio role specific audio endpoint enumeration and monitoring
- Device routings (automatic or explicit)
  - Provided with audio role and endpoint type
  - Selected according to config priority (and optionally current state/concurrency information)
  - Return appropriate device URI to application
  - Return target endpoint for volume/property changes
- Dynamic device handling and re-routing currently missing

High-level Audio Binding Configuration

Simple audio role based configuration

- Preferred routings (for automatic endpoint selection)
- Interrupt behaviors
- Role priorities
- Supported events

```
"policy_module": "AudioPolicy_v1",
"audio_roles": [
    {
        "name": "Warning",
        "id": 0,
        "description": "Safety-relevant or critical alerts/alarms",
        "priority": 100,
        "output": [
            "alsa.plug:Warning_Main",
            "alsa.plug:Warning_DriverHR"
        ],
        "events": [
            "emergency_brake",
            "collision_warning",
            "blind_spot_warning"
        ],
        "interupt_behavior": "pause"
    },
```

Permissions, Role Privileges and Access Controls

API verbs permissions

- Stream control → Stream start/pause/resume/mute/unmute,…
- Audio streaming → Stream open/close
- Sound event → Trigger/notify about audio asset playback
- Currently monitoring is allowed for everyone (but can be changed)

Role privileges

- Different levels of privileges based on roles also possible

Access controls

- Application can only control/affect stream and endpoints on which they have ownership
  - Reduce potential side effects, enforce role of policy

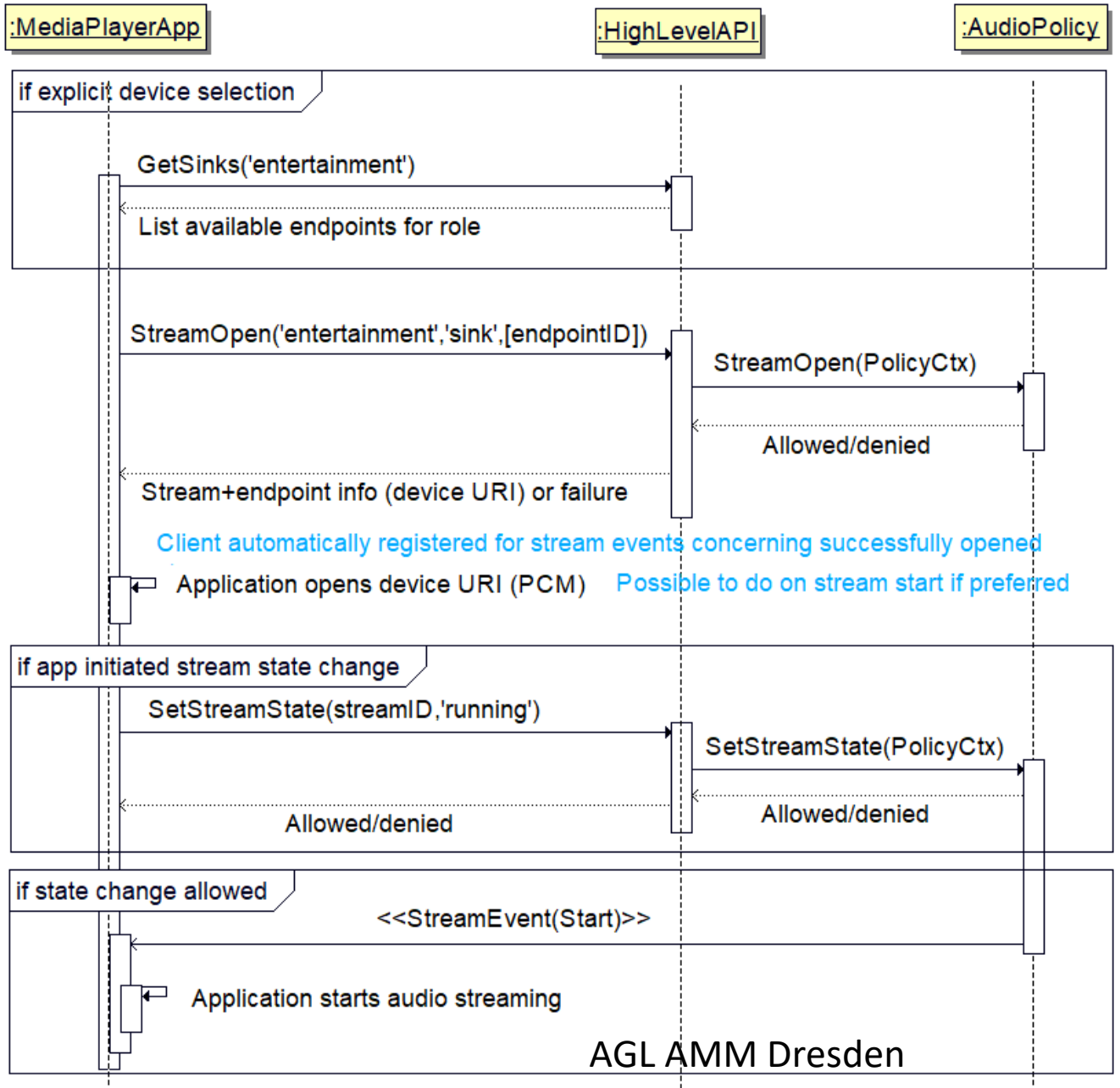
High-level Audio Binding Policy Module

- Audio role specific priorities and interrupt behaviors provided by high-level binding config file
- HLB expose relevant state information to policy module
- API verbs that affect state of audio streams or endpoints must go through policy first
  - Policy can accept or reject the change
- Policy implements custom business logic e.g.
  - ducking, state changes, forbidden behaviors etc.
- Policy actions are dispatched to appropriate low-level technology

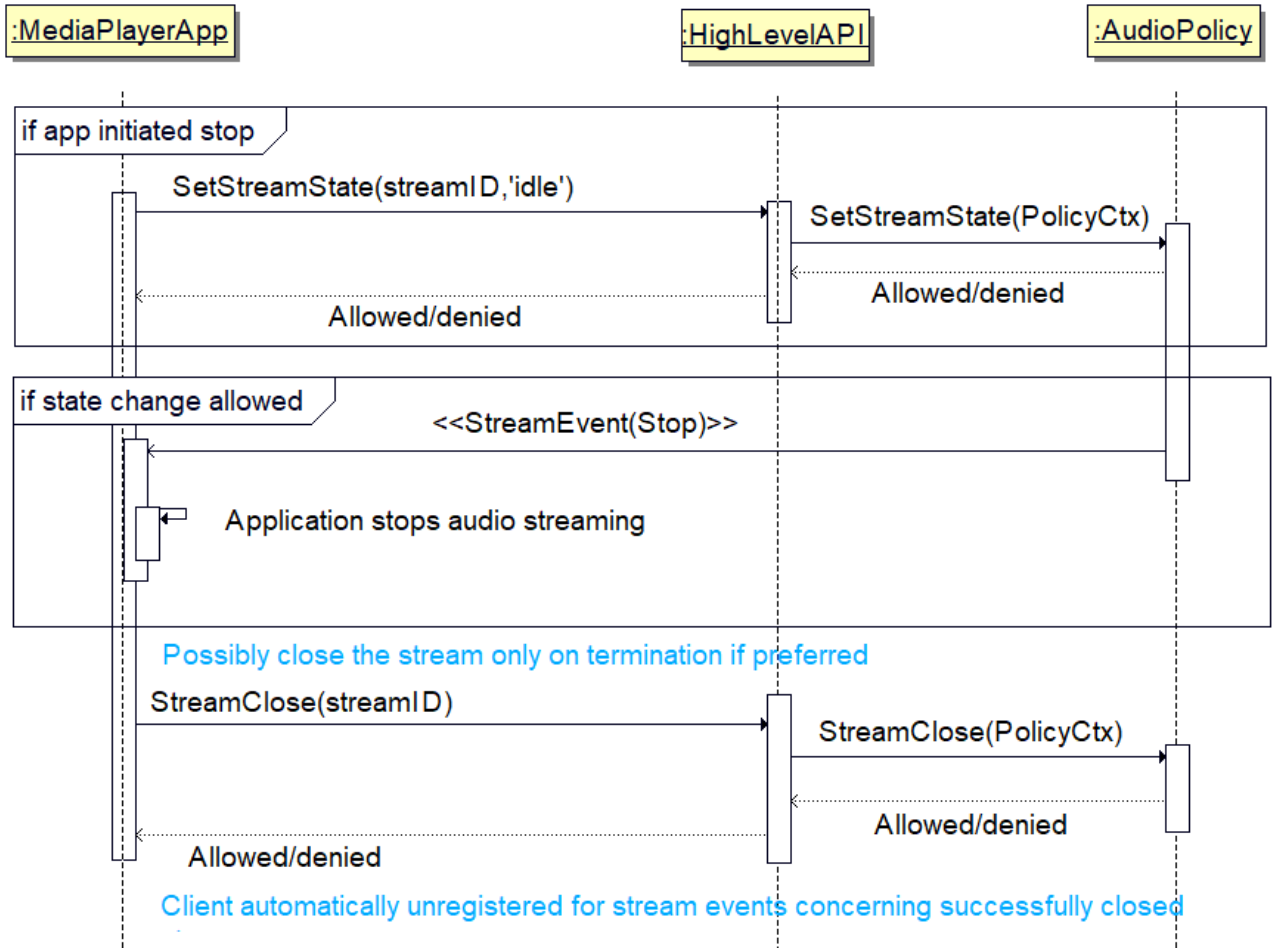
API Overview

- Endpoint enumeration
  - GetSources / GetSinks → for explicit routing
- Stream and routing management
  - StreamOpen / StreamClose → application streaming (e.g. media player)
  - Stream open with source and sink can be used for routings (e.g. handsfree)
- Stream control
  - Get/SetStreamState → Transitions from idle, running, suspended
  - Get/SetStreamMute
- Endpoints (source or sinks)
  - Set/Get Volume
  - Set/Get Properties
  - GetListProperties → capabilities
- Sound events
  - PostSoundEvent → Sound generation services
  - GetListEvents → Configuration defined available audio events
- Events
  - Endpoints volume/status/property changes (e.g. from policy application)
  - Endpoint availability changes
  - Audio streaming changes (start/stop/pause/resume, etc.)
  - Stream/routing activity changes (endpoint URI changes)

Simple API Usage (Start Playback)

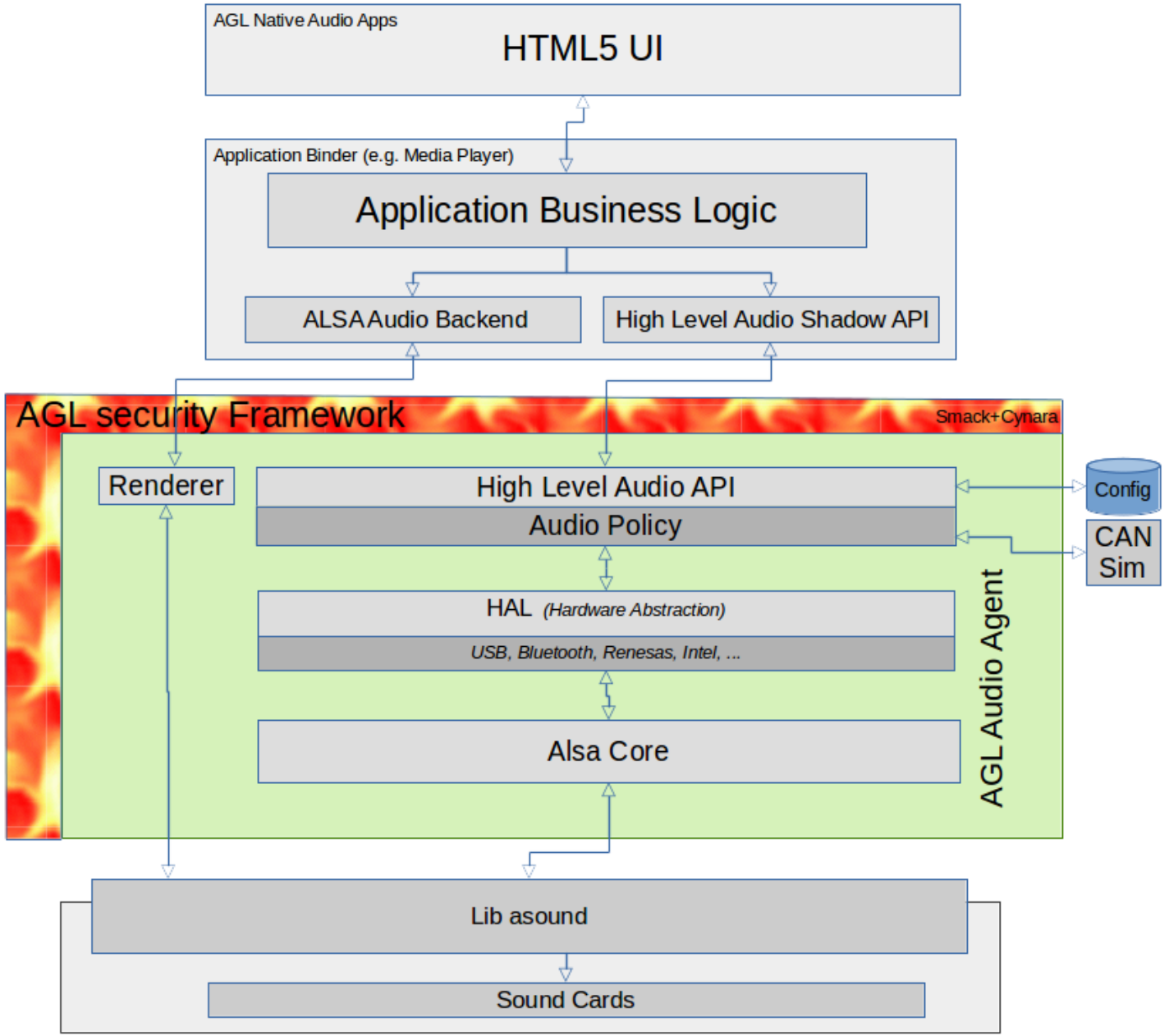


Simple API Usage (Stop Playback)



Pause/Resume sequences would be similar (without stream close)

Demo Architecture



Demo

- Use of audio role specific software volume controls
- Endpoint / zone selection with configurable device priorities
- Audio role priorities (ducking and interrupt behaviors)
- Sample policy
  - Volume management
  - Volume acceleration
  - Active source change
  - Active source locking
  - Source interrupts

Requirements and scenarios from
https://wiki.automotivelinux.org/eg-ui-graphics-req-audiorouting

Q&A

High-level audio binding and sample policy

https://github.com/Audiokinetic-Automotive/afb-audiohighlevel

Sample configuration and demonstration UI and assets

https://github.com/Audiokinetic-Automotive/ak-demo

Demonstration audio back-end (simple ALSA renderer)

https://github.com/Audiokinetic-Automotive/afb-audiobackend

Some changes and additional HAL implementation for demo

https://github.com/huetaivuong/afb-aaaa

Please provide feedback!