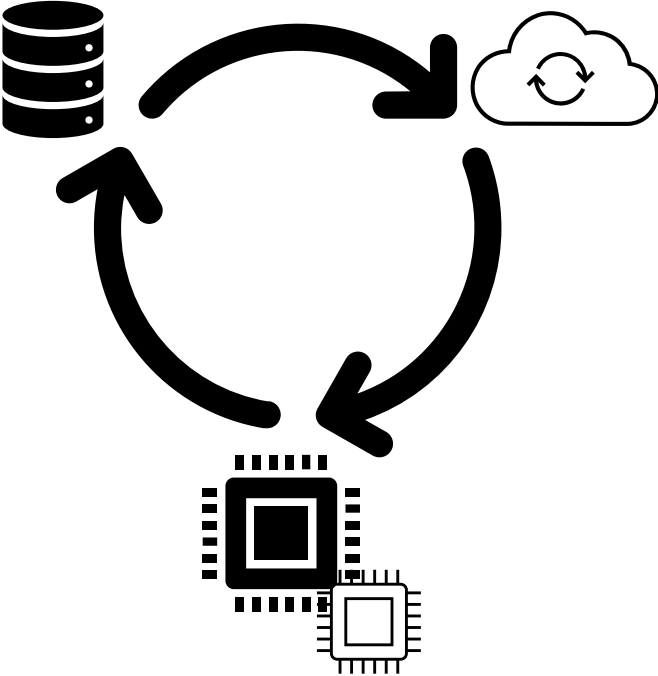




QNX Sound

DongJoo Lee
Sr. Field Application Engineers, Acoustics

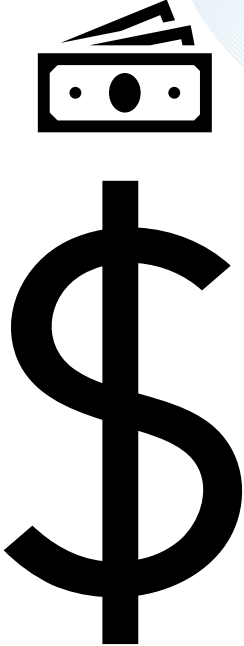
SDV Topics



Scalability /
Portability



Optimized Dev &
maintenance
with standard



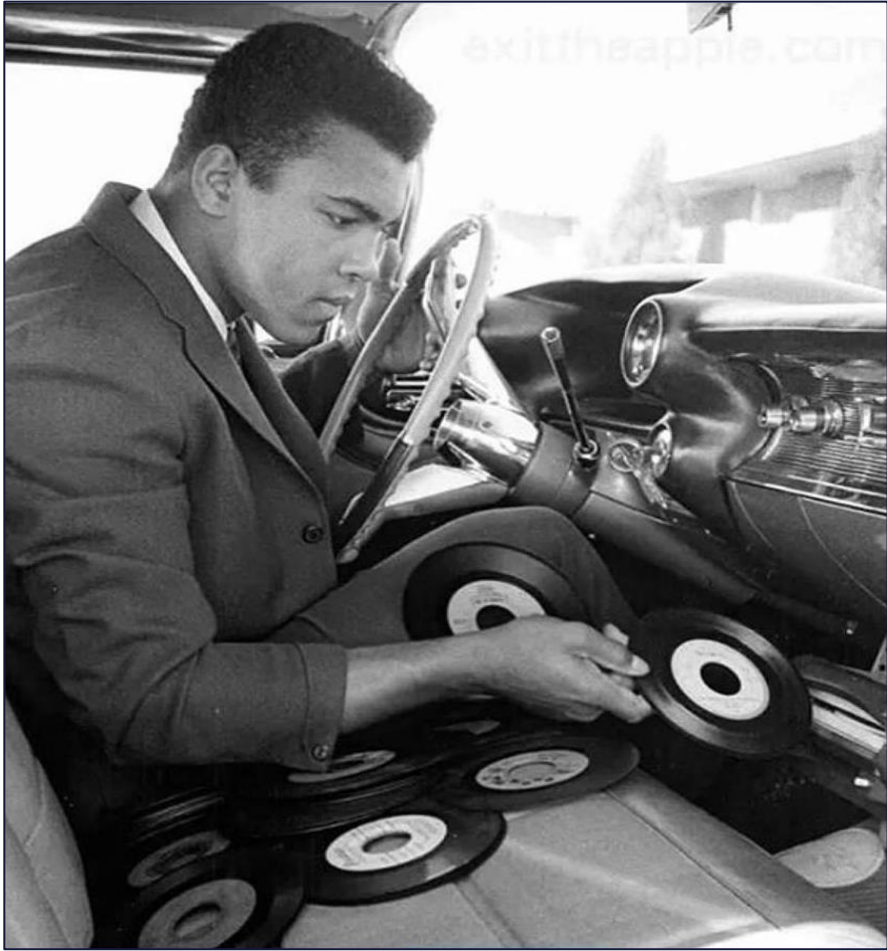
Cost / Revenue

SDV Topics

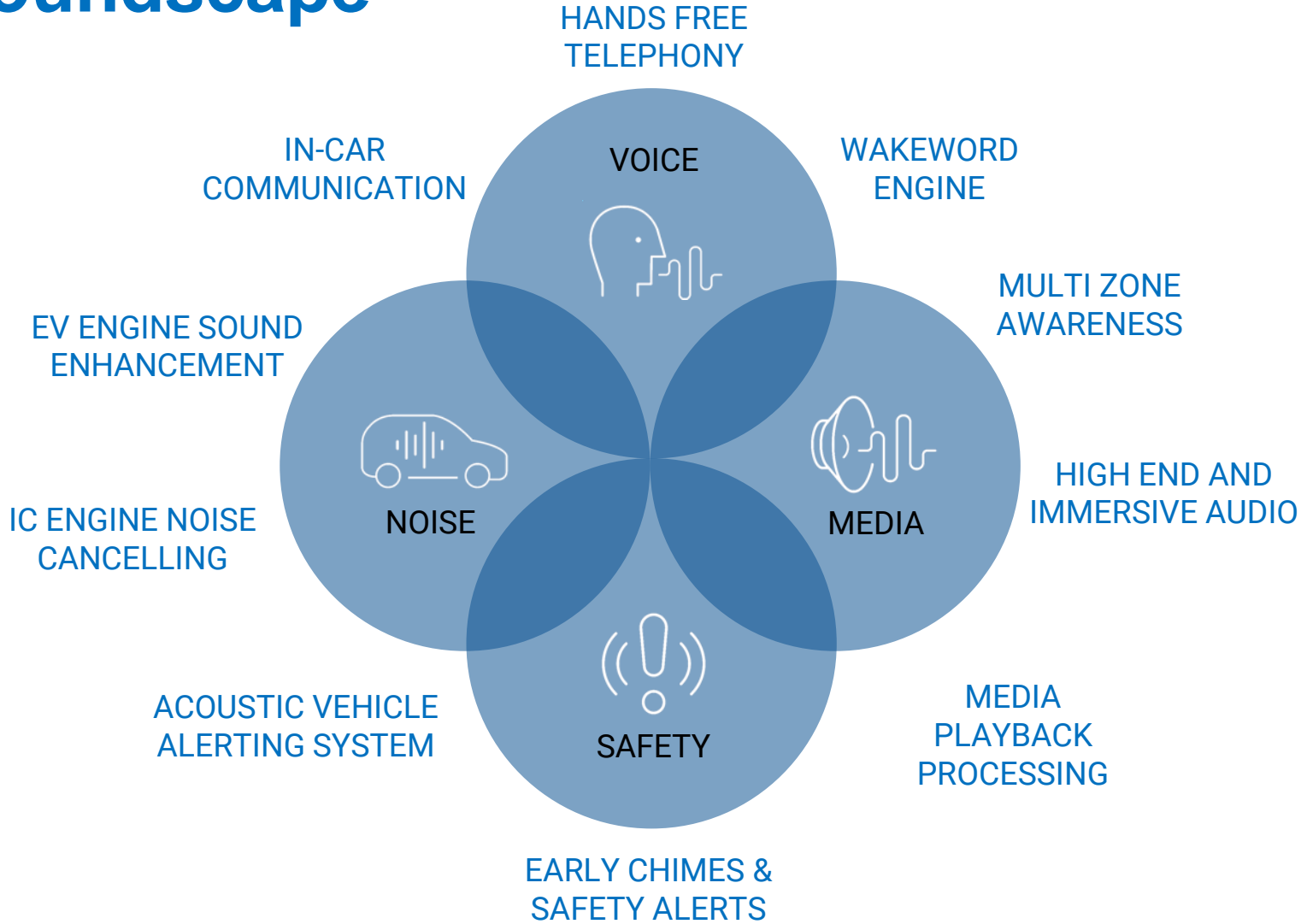


SDV Challenges
into
Opportunity with **QNX Sound SDA** (Software Defined Audio)

Sound does matters



Vehicle Soundscape



Underneath the Soundscape : complexity with risk

To → From ↓	Handsfree Send	ICC	ANC-EOR	ESE	Media	Alerts & Warnings	Speech Input
Handsfree Receive		Receive speech distortion	Low Risk	Low Risk	Low Risk	Alerts inaudible	ASR errors & false wake up
ICC	Far End Echo		Low Risk	Modified ESE	Distorted Media	Distortion of alerts	ASR errors
ANC-EOR	Far end noise & mic saturation risk	Noise & saturation risk		cancellation of ESE	Distortion risk	Low risk	ASR errors, input saturation
ESE	Far end noise	Induced noise	Increased boom, stability risk		Distortion risk	Alerts inaudible	ASR errors, input saturation
Media	Receive audio inaudible	Media reinforced, delayed, distorted.	Distortion Risk	Distortion Risk		Alerts inaudible	False wake-up, ASR errors
Alerts & Warnings	Call interference	ICC interference	Low Risk	Low Risk	Media inaudible		ASR errors, input saturation
Navigation & Speech	Call interference	ICC interference	Low Risk	Low Risk	Media inaudible	Alerts inaudible	ASR errors & no barge-in

Negative interaction

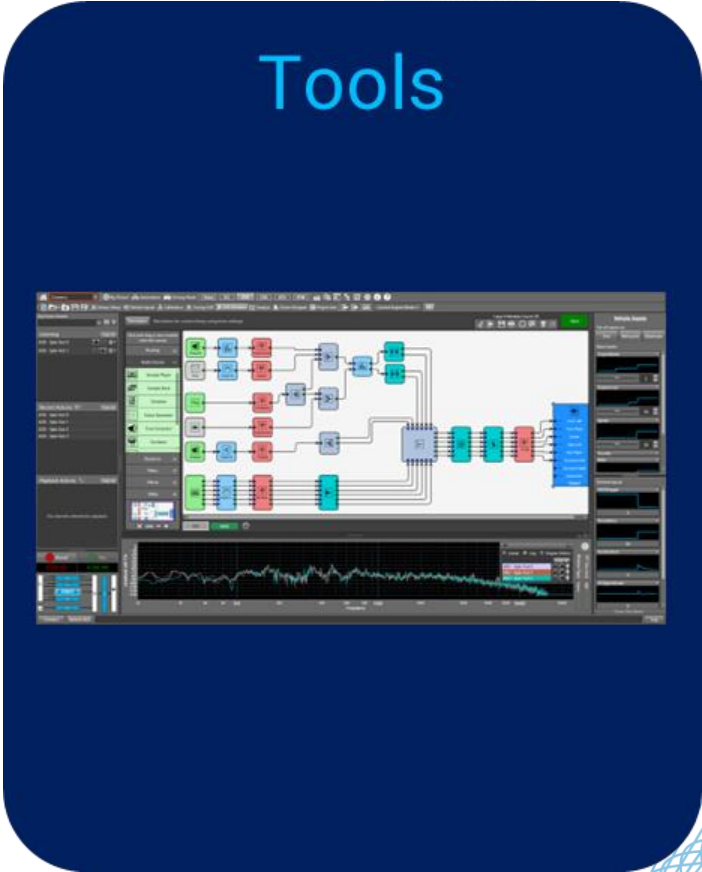
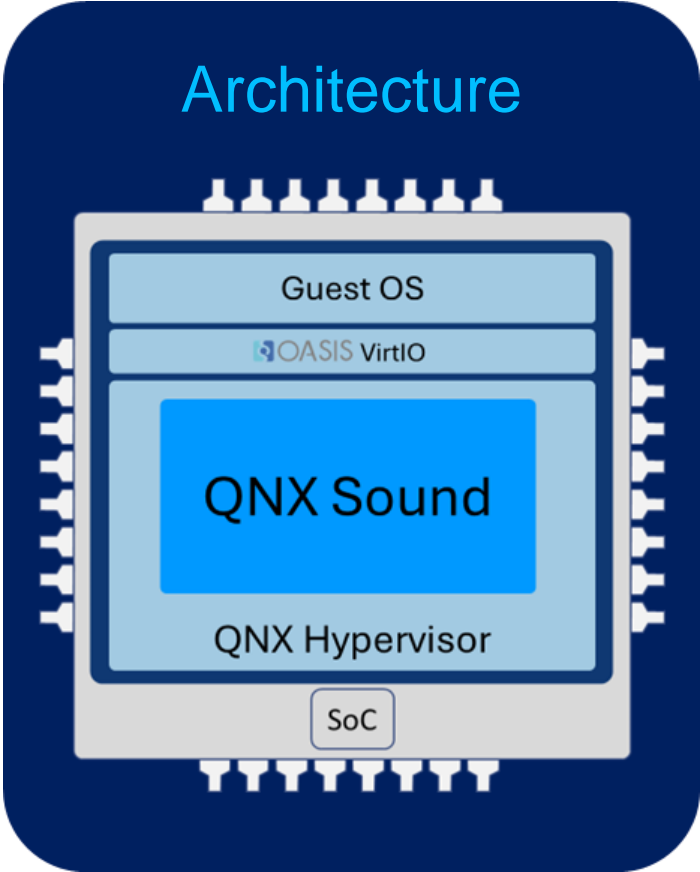
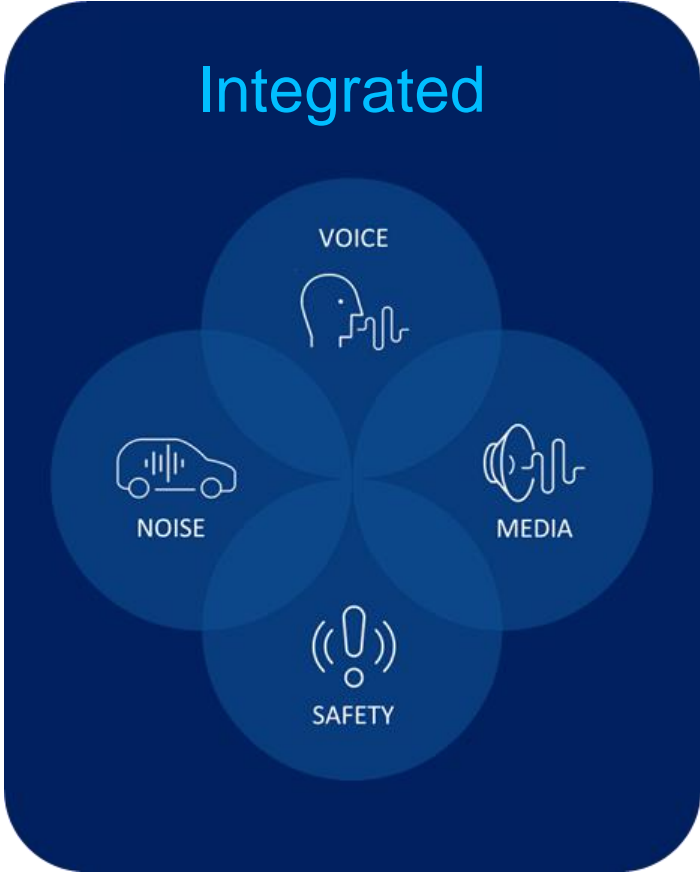
Risk of negative interaction

Low Interaction

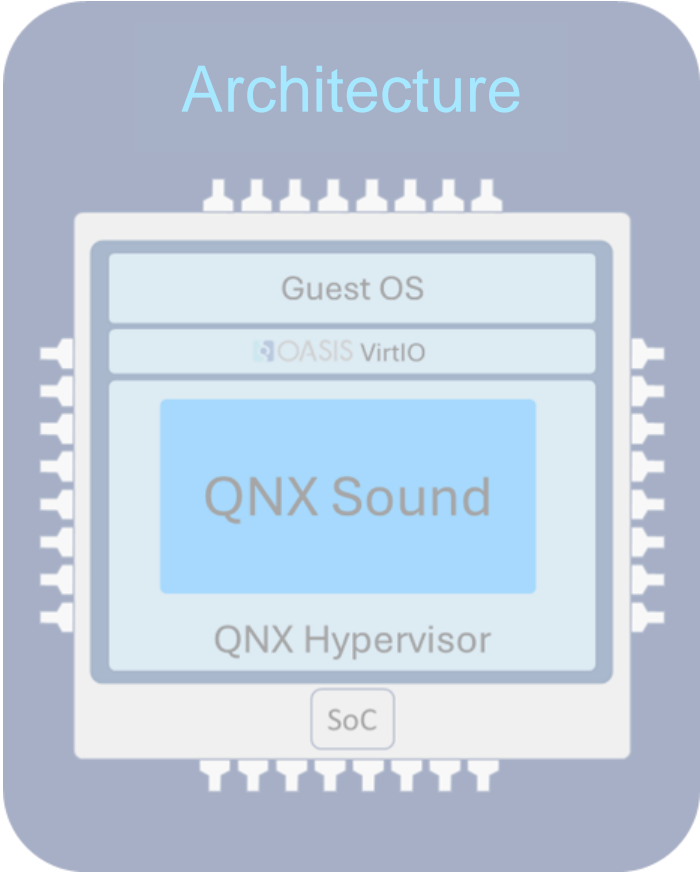
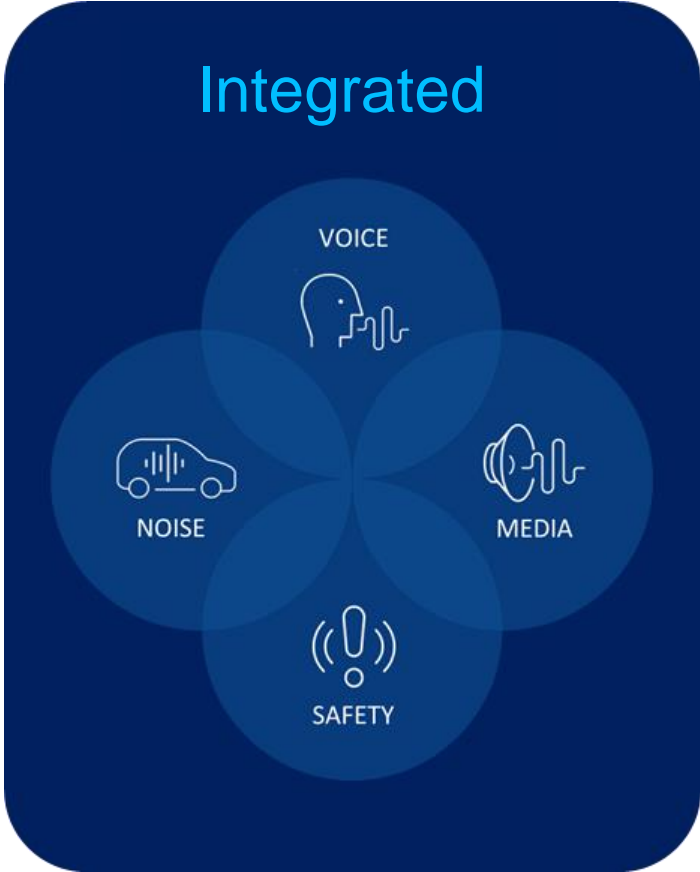
The Solution: Centralized Audio Management on QNX Sound

To → From ↓	Handsfree Send	ICC	ANC-EOR	ESE	Media	Alerts & Warnings	Speech Input
Handsfree Receive		Correct Reference Routing	Low Risk	Low Risk	Low Risk	Priority Mixing & Reference Mgmt	Mutual Exclusion
ICC	Correct Reference Routing		Low Risk	Correct Reference Routing	Correct Reference Routing	Priority Mixing & Reference Mgmt	AEC on Speech Input
ANC-EOR	Headroom Management	Tuning & Mic Placement		Managed within ASD module	Headroom Management	Low risk	Tuning & Mic Placement
ESE	Configurable in Tuning	Correct Reference Routing	Managed within ASD module		Headroom Management	Priority Mixing	Tuning & Mic Placement
Media	Mutual Exclusion	Correct Reference Routing	Headroom Management	Headroom Management		Priority Mixing	AEC on Speech Input
Alerts & Warnings	Configurable in Tuning	Correct Reference Routing	Low Risk	Low Risk	Priority Mixing		AEC on Speech Input
Navigation & Speech	Configurable in Tuning	Correct Reference Routing	Low Risk	Low Risk	Priority Mixing	Priority Mixing	Support Barge-In with AEC

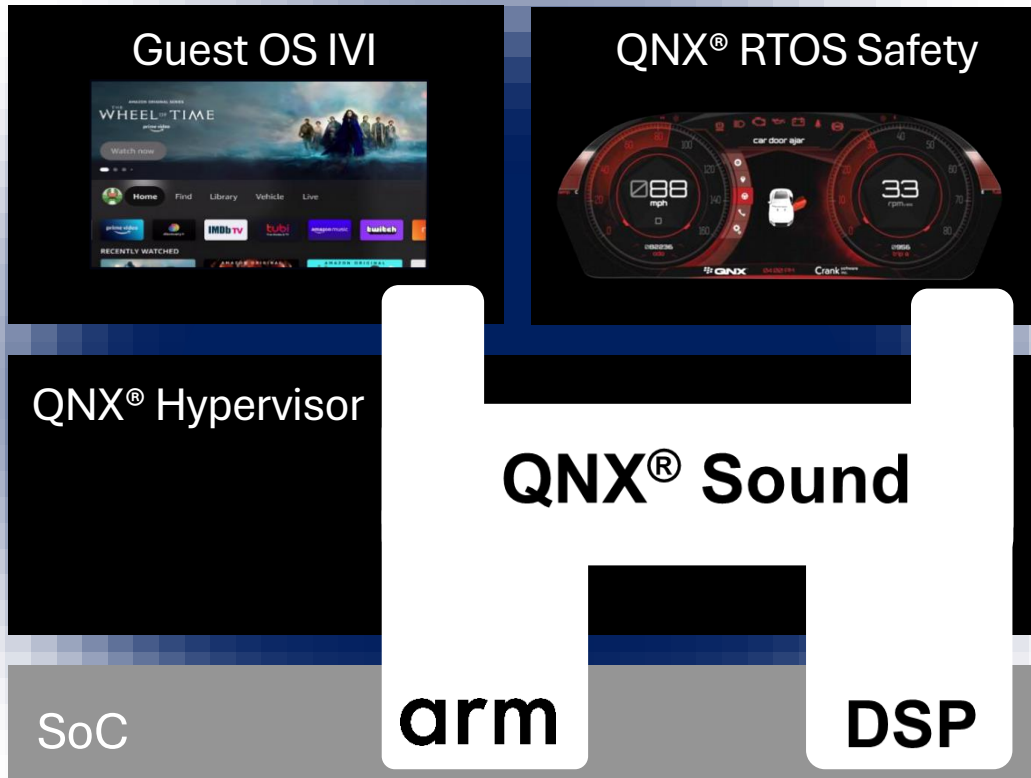
QNX Sound



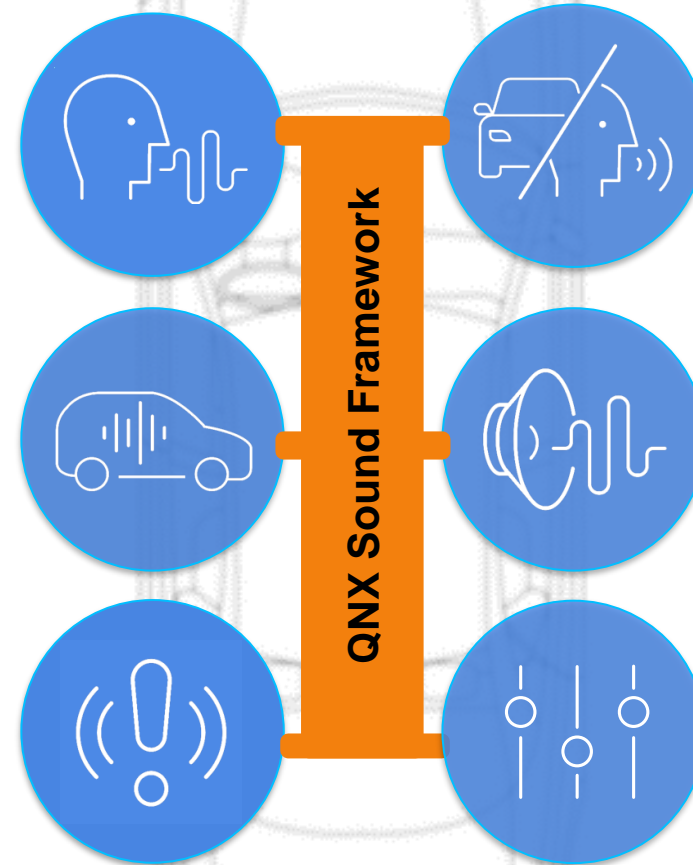
QNX Sound



QNX Sound: Integrated Framework



- QNX® Echo Cancellation**
“Quieting the cabin”
- QNX® ACTIVE SOUND DESIGN**
“Creating vehicle sounds”
- QNX® CHIMES**
“Warning sounds”



QNX® IN-CAR COMMUNICATIONS

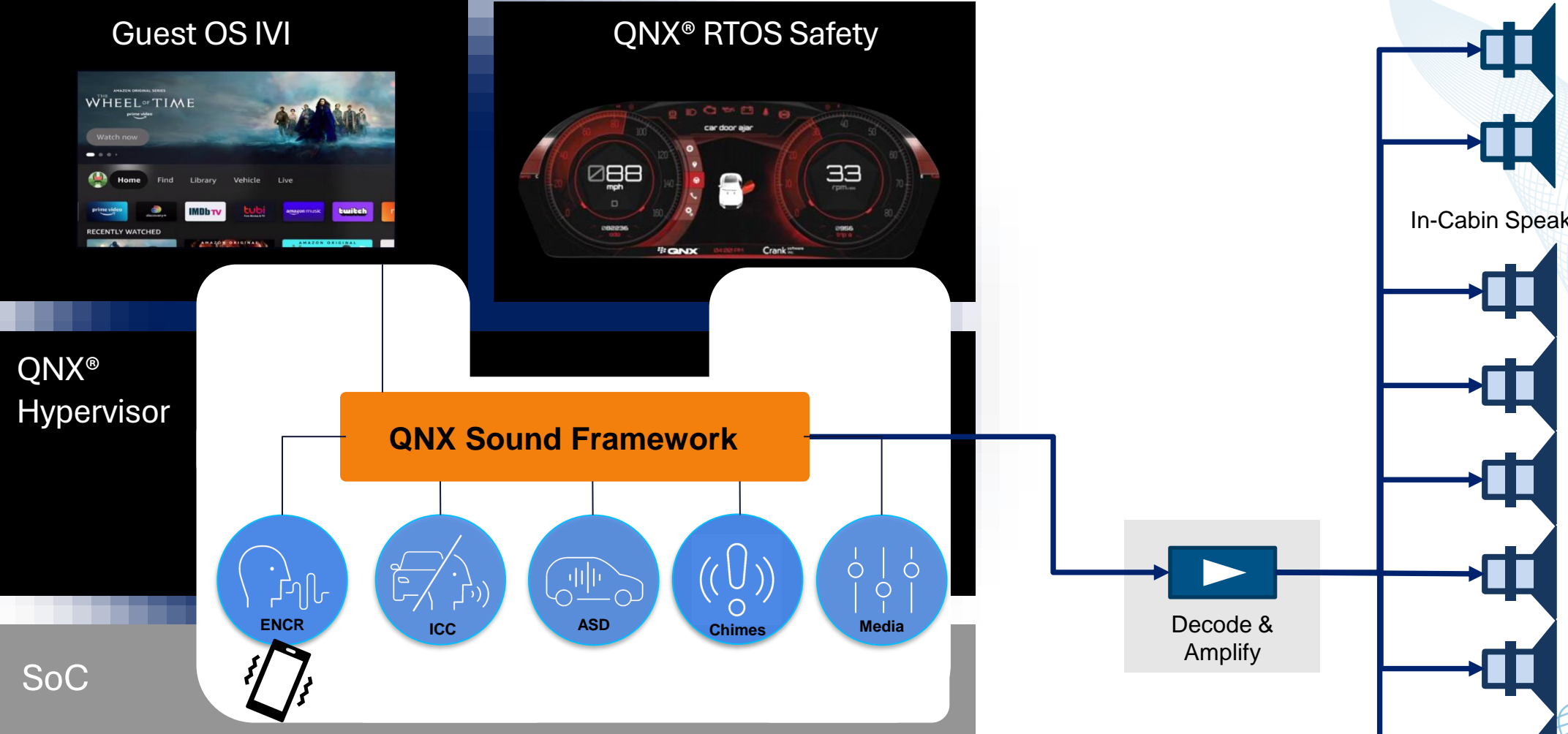
“Improving communication in cabin”

QNX® SOFTWARE AUDIO MANAGEMENT

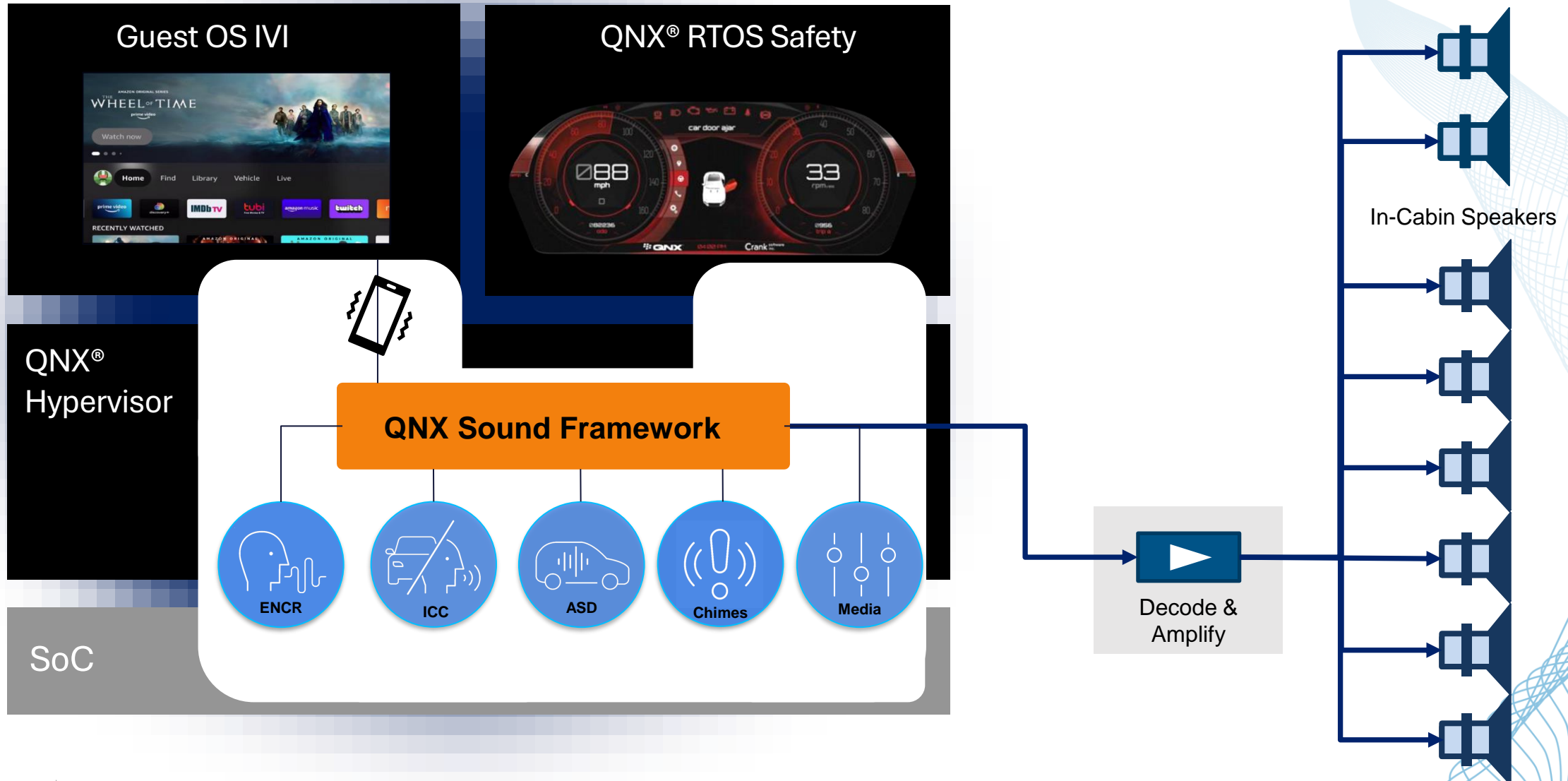
“Managing audio sources, policies”

INTEGRATING BRANDED / NONBRANDED AUDIO

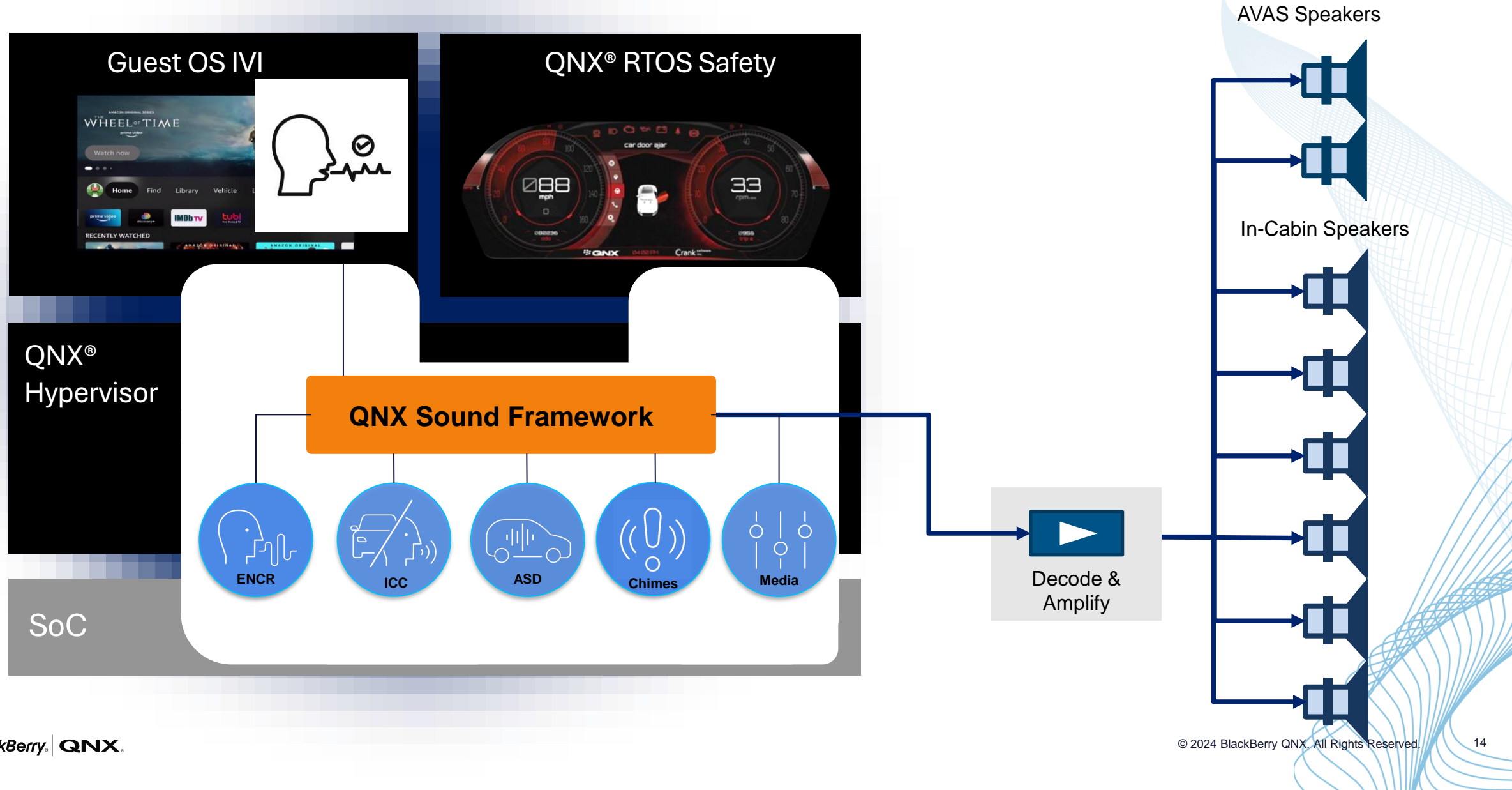
Scenario 1: BT Handsfree Call Initiated



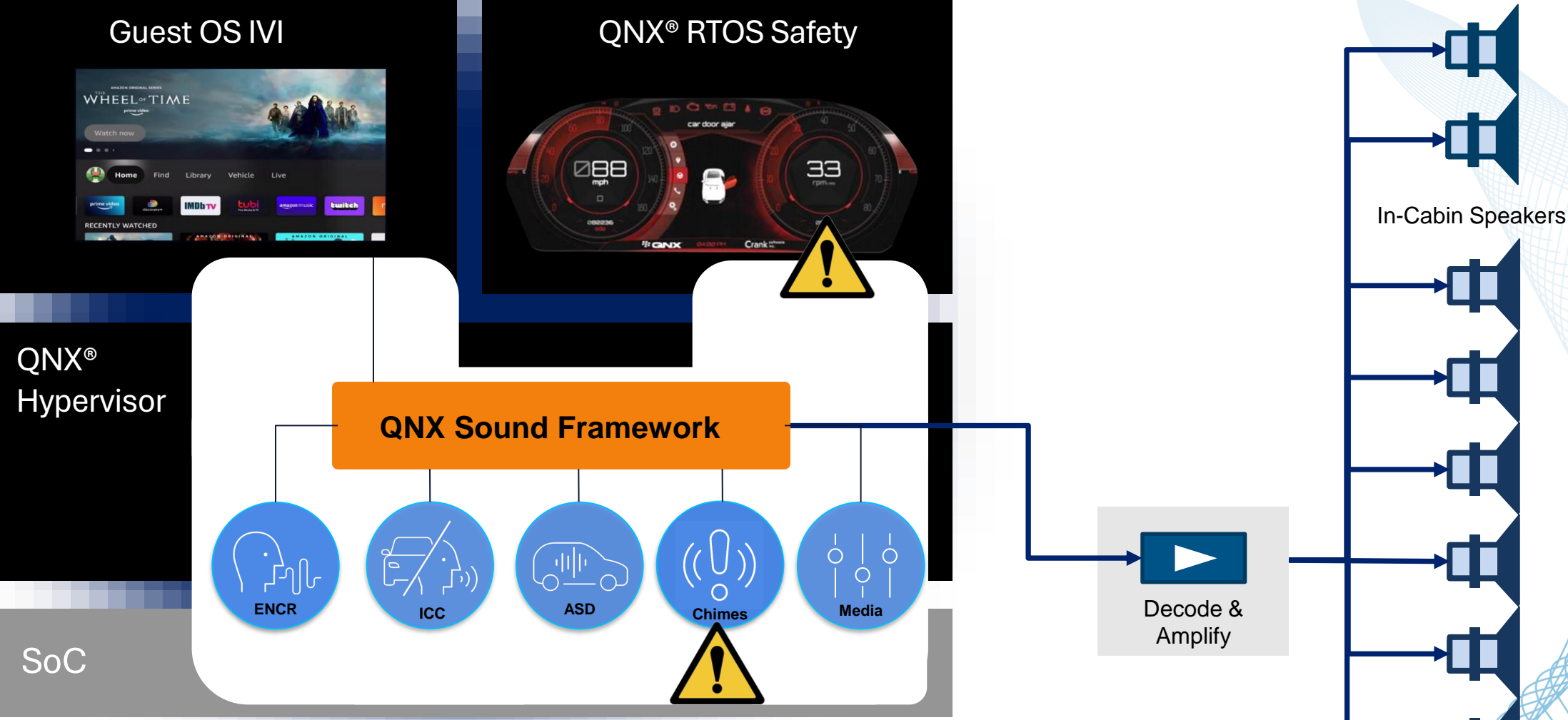
Scenario 2: VoIP Call Initiated from Android



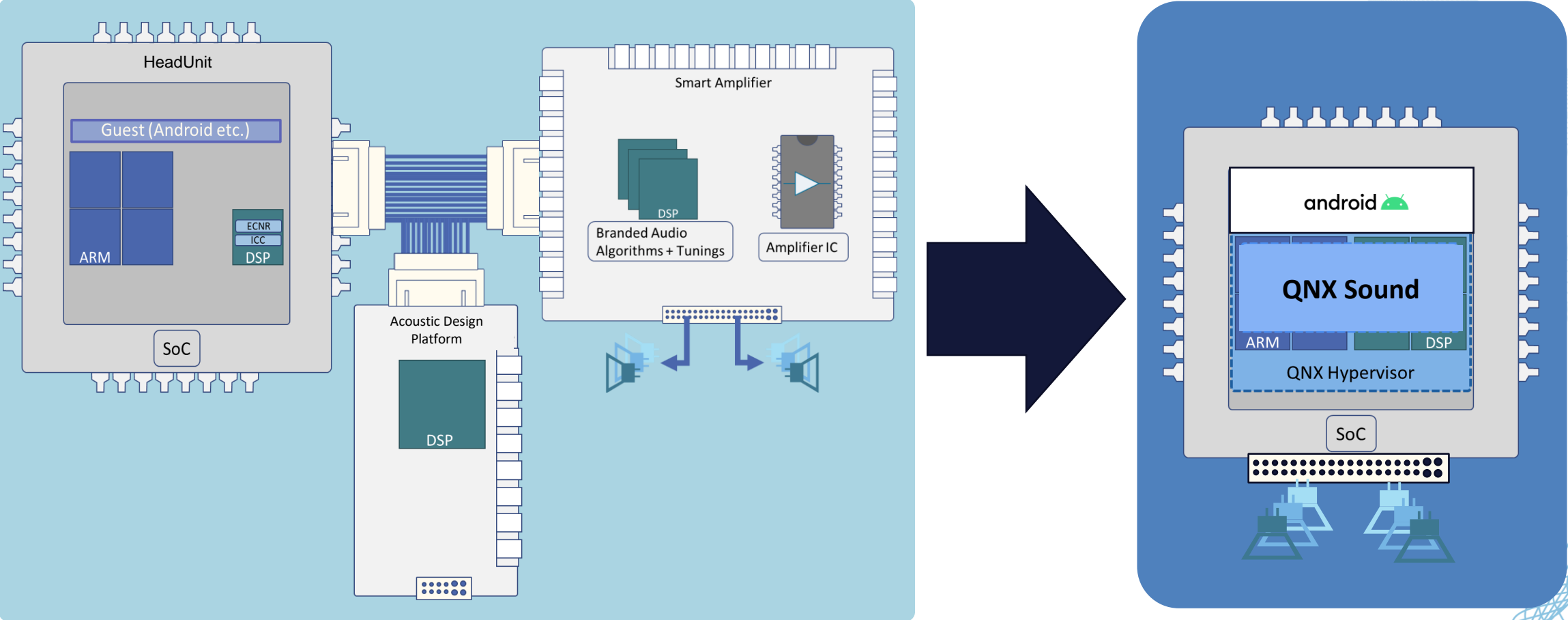
Scenario 3: Wake-Up-Word for Voice Assistant Issued from any Seat



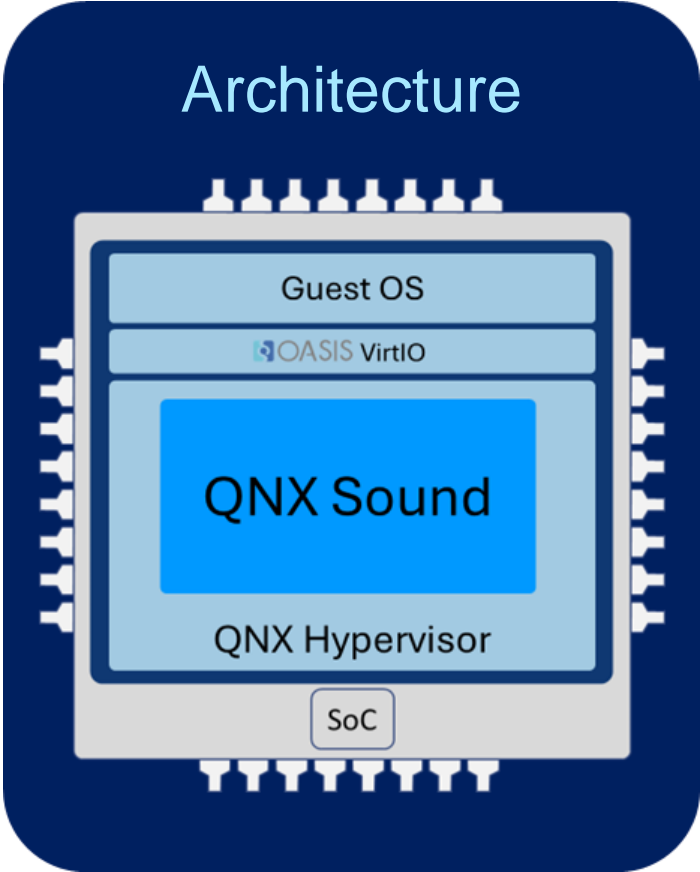
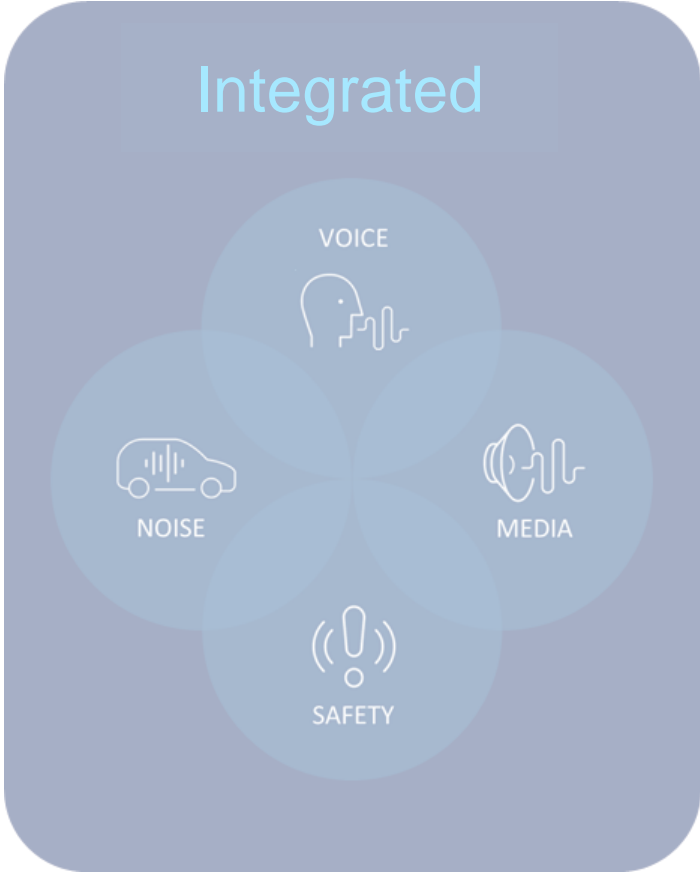
Scenario 4: ADAS Alert Inaudible due to Loud Music



QNX Sound: Integrated Architecture



QNX Sound

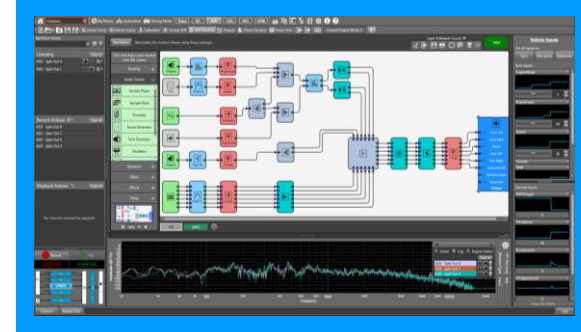
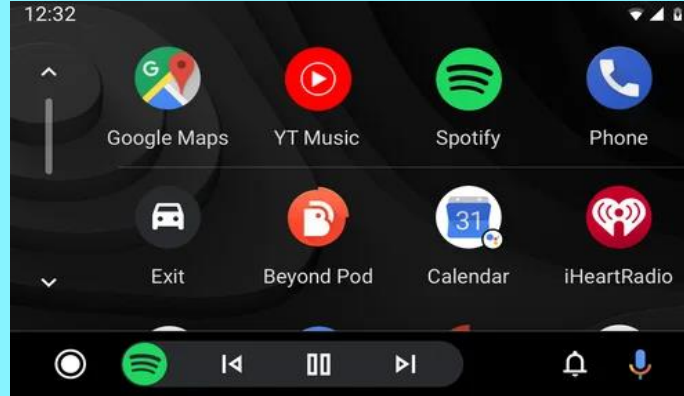


Pre-integrated on QNX OS/HV

Instrument Cluster - QNX® RTOS Safety



In-Vehicle Infotainment- Android



HAL

OASIS VirtIO

QNX® Hypervisor

QNX Sound

IO-snd

Audio IP Library

Control Server

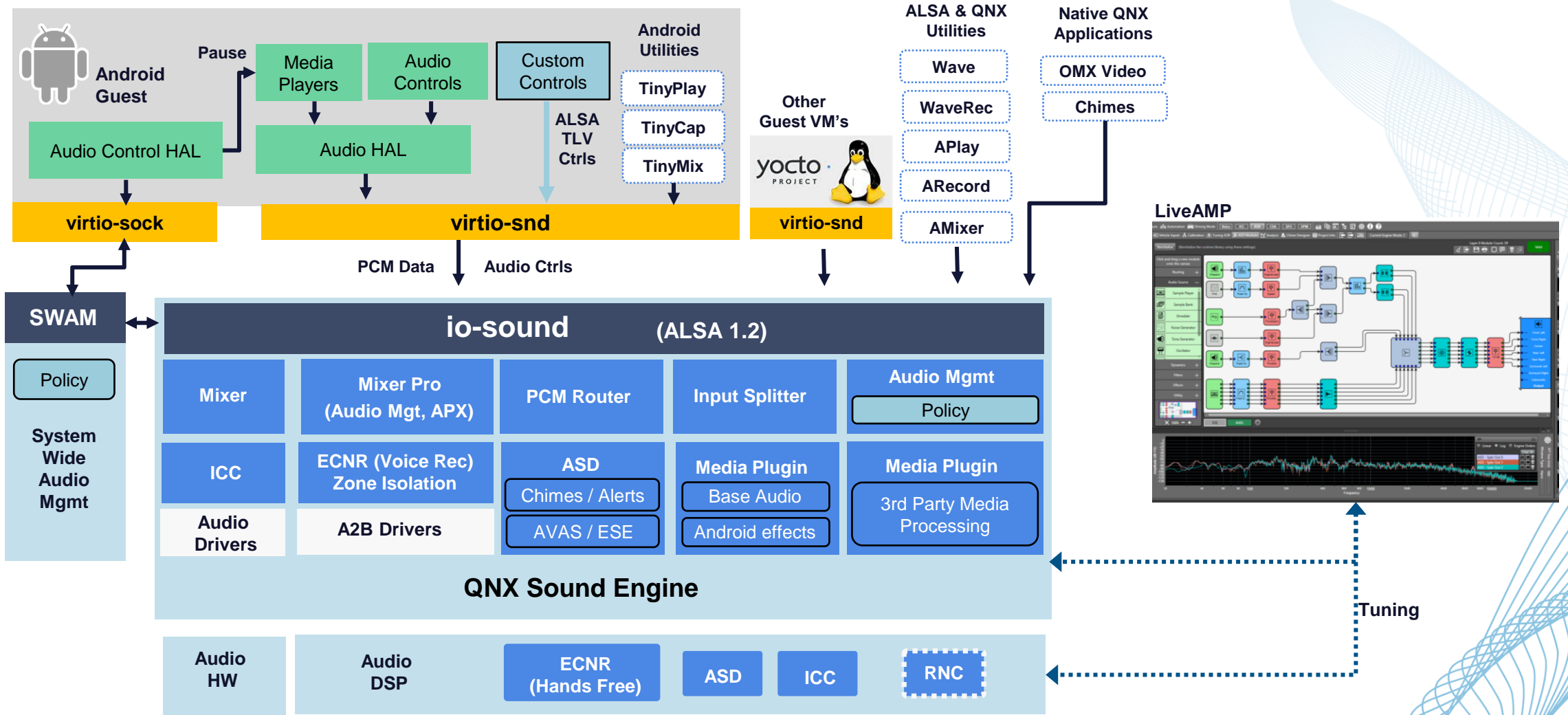
Native Audio Driver

In-SoC DSPs

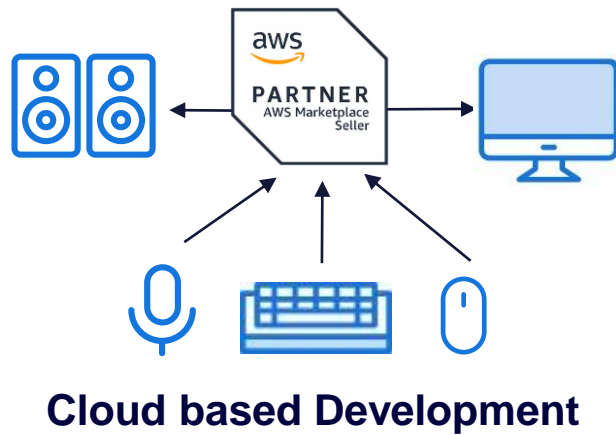
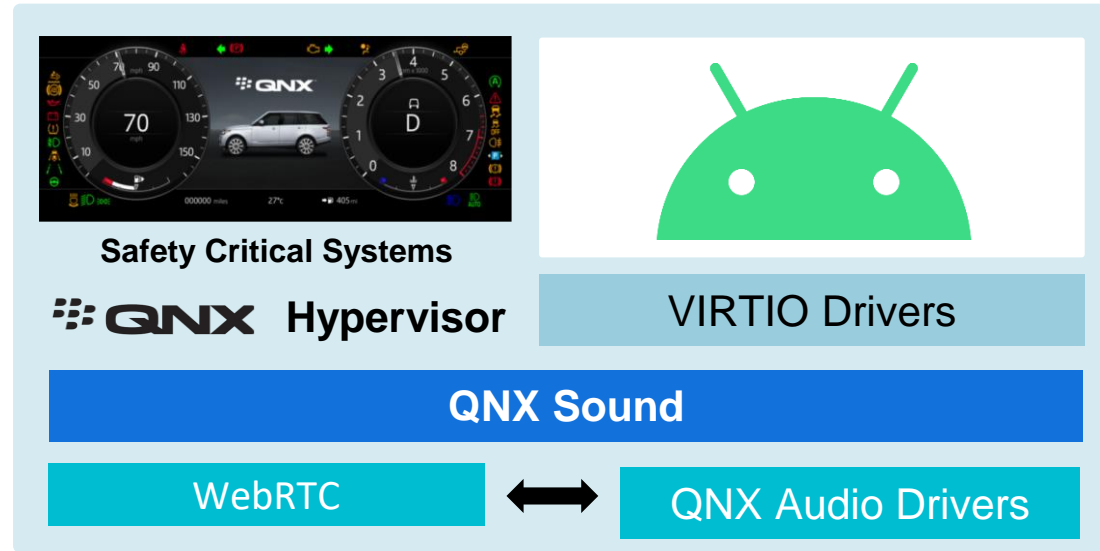
Audio IP Library

Audio Hardware interfaces (Mics, Speakers, Bluetooth,...)

QNX Sound SW architecture

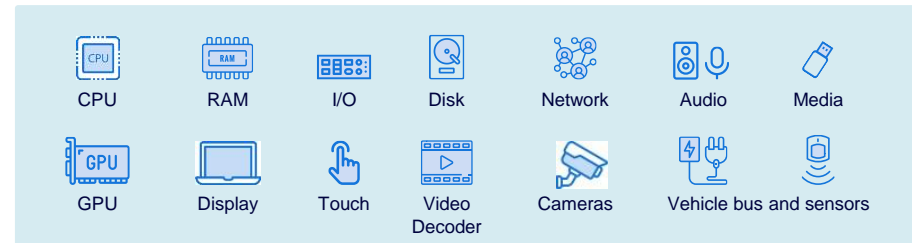


Cloud enabled



or

Digital Cockpit Hardware – ARM/DSP

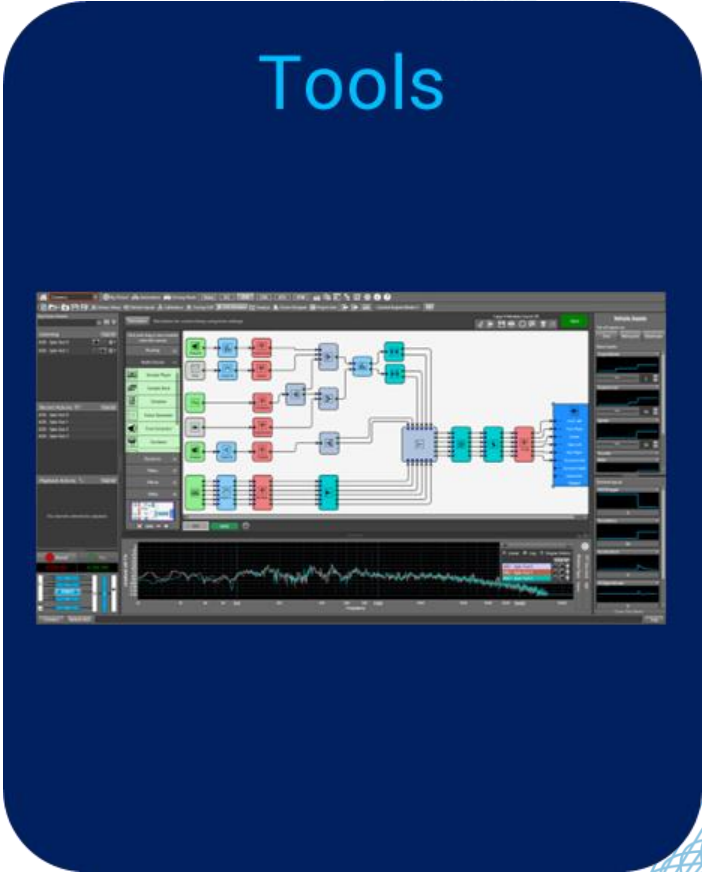
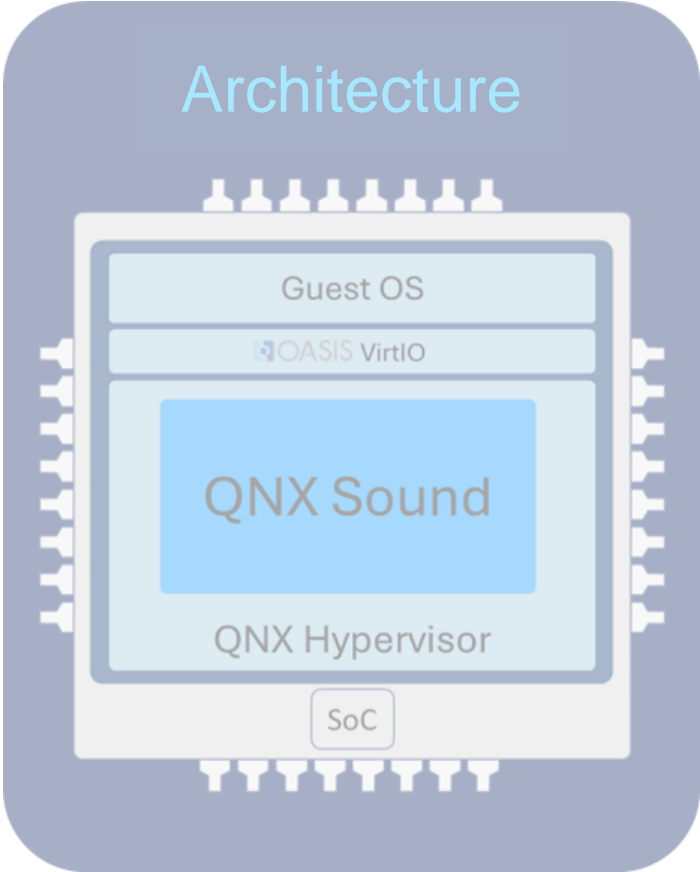
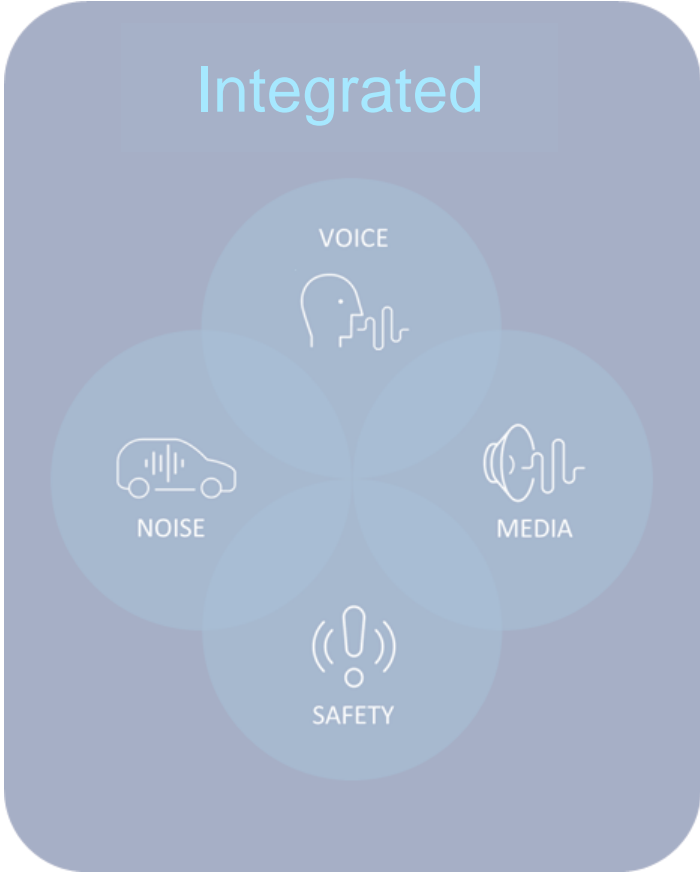


Hardware based Development

QNX Sound: Pre-Integrated with Digital Cockpit

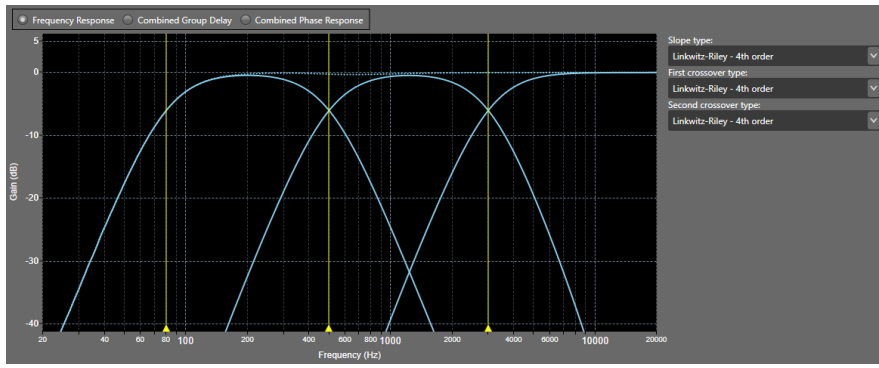


QNX Sound

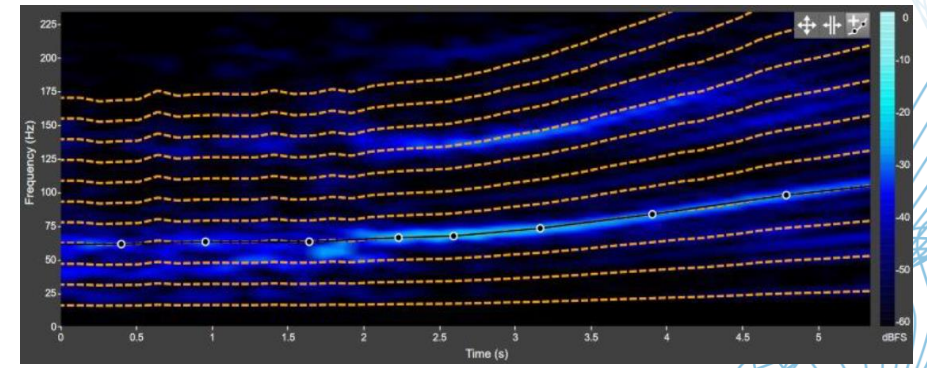


The screenshot displays the QNX audio engine software interface. The main workspace shows a signal flow graph with various modules like Shepard, Fixed Hz, Throttle, and EngineLoad. On the left, there are panels for 'Listening' (ASD - Splr Out 0-3), 'Record Actions', and 'Playback Actions'. The bottom section features a frequency response plot showing Amplitude (dB FS) vs Frequency (Hz) for three outputs. The right side includes a 'Vehicle Inputs' panel with sliders for parameters like EngineMode, EngineLoad, Speed, Throttle, and RPM, along with a 'Derived Inputs' section.

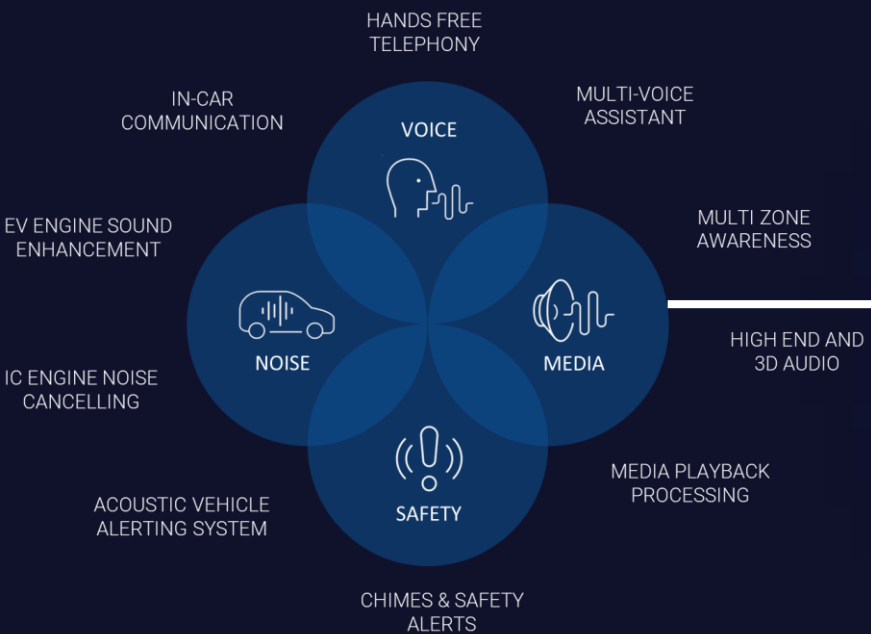
This screenshot shows detailed control panels for the audio engine. At the top, there are frequency response graphs for 'Frequency Response', 'Combined Group Delay', and 'Combined Phase Response'. Below these are 'Reverb' controls with knobs for Intensity, Feedback, Spread, and Dry / Wet Mix. A 'Gain' section includes a 'Fixed Gain' dropdown and a vertical slider. The bottom part of the image features a 'Gain (%)' vs 'Angle (degrees)' graph with multiple colored lines representing different outputs (Output 0-7). A 'Show/Hide All' button is located at the bottom left of this graph.



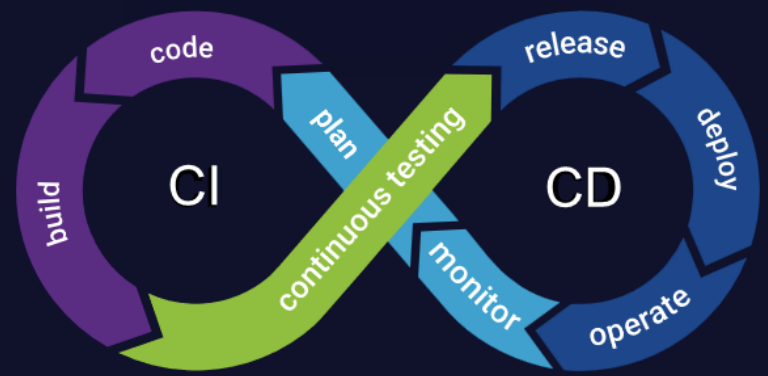
The 'Azimuth Input' control panel includes several knobs and a visual indicator. It features 'Renderer Strength' (Gain Panning Effect % and Left-Right Absolute Delay μ s), 'Shadow Effect' (Left-Right Shadow Effect % and Front-Back Shadow Effect %), and a 'Current Position' dial showing a top-down view of a car's speaker layout.



Integration



OASIS VirtIO



QNX Sound demo car – industry 1st full SDA implementation



Presented at 2024
AES 5th
Automotive Audio,
conference



In collaboration with:



Ecosystem Partners

 **DIRAC**  **Dolby**  **McIntosh Group**

 **BOSE**  **HaleyTek**  **YAMAHA**

 **HEAD acoustics**

 **VI-GRADE**

 **aws**

Thank you