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RAPID PROTOTYPING FOR AUTOMOTIVE SOUND DESIGN

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AGENDA



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- 1** INTRODUCTION

 - 2** HARMAN AND HALOSONIC TECHNOLOGY

 - 3** HARMAN'S ESS INTEGRATION INTO NVH SIMULATOR

 - 4** USING NVH SIMULATOR IN AGILE PRODUCT DEVELOPMENT

 - 5** OBSERVATIONS

 - 6** NEXT STEPS

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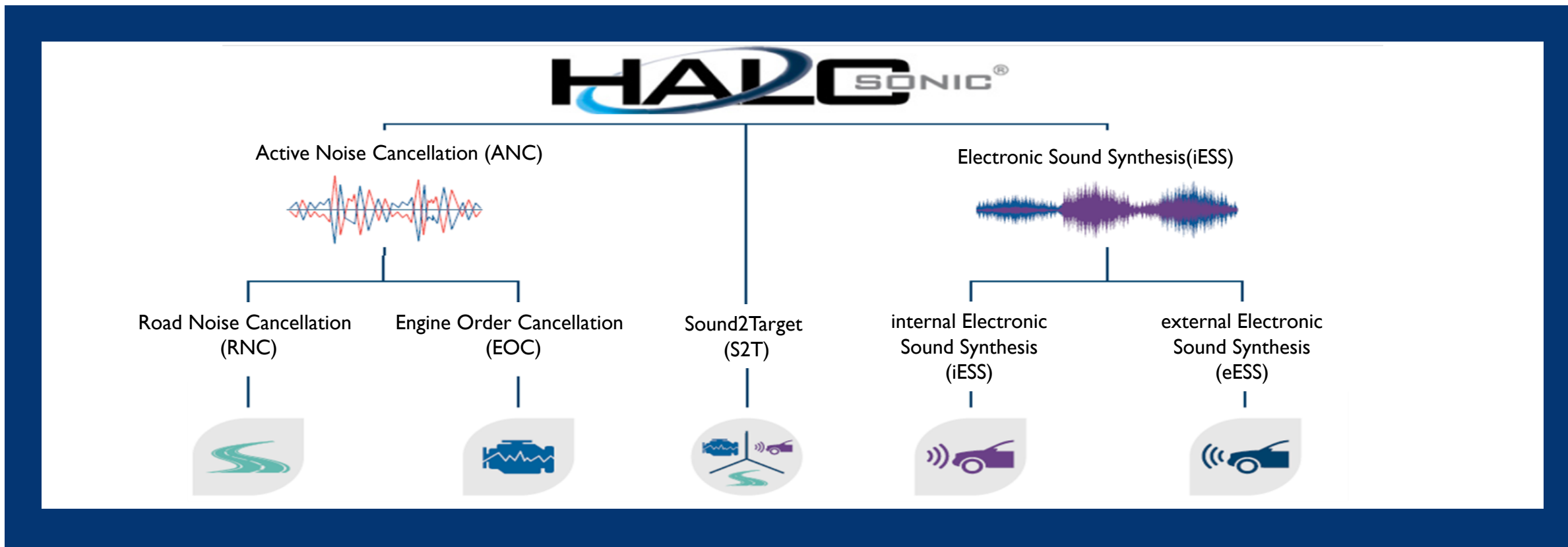


HARMAN Automotive is bringing great consumer-driven product for exceptional in-cabin experiences.

Our Ready **products** meet consumer demand and rigorous automotive standards. HARMAN Automotive Intelligence seamlessly integrates into our products, software and **partnerships**, transforming the in-cabin experience.

Consumer Experiences. Automotive Grade.

Your I-Stop Acoustic Solutions Partner, Offering Active Noise Cancellation & Sound Synthesis to Enhance the Audio Experience

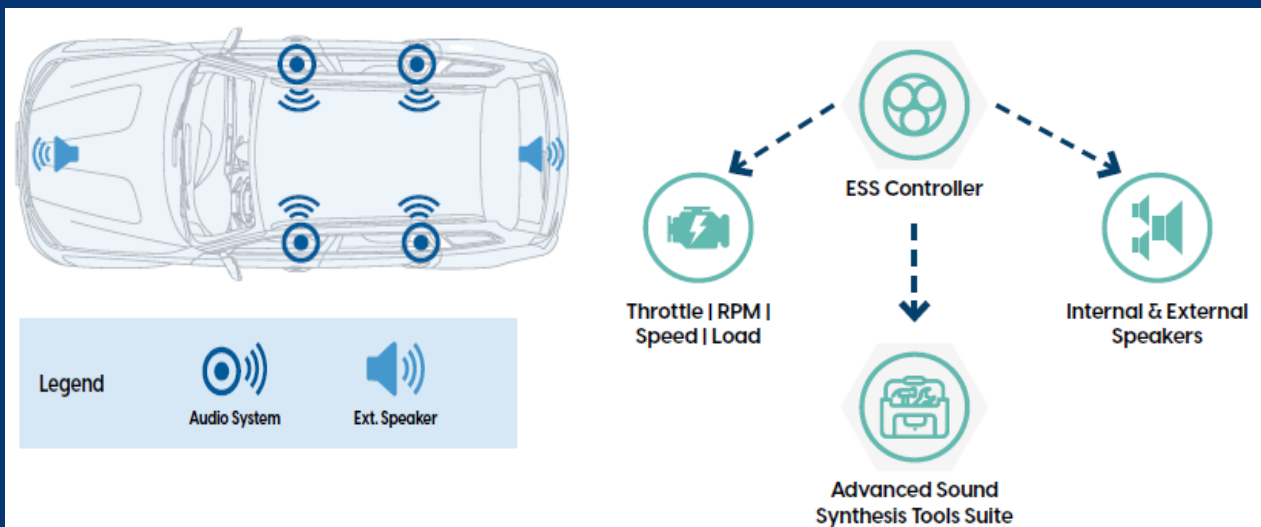


Technologies offered as stand-alone or in combination with another:
head unit | amplifier | stand-alone module | all-in-one box

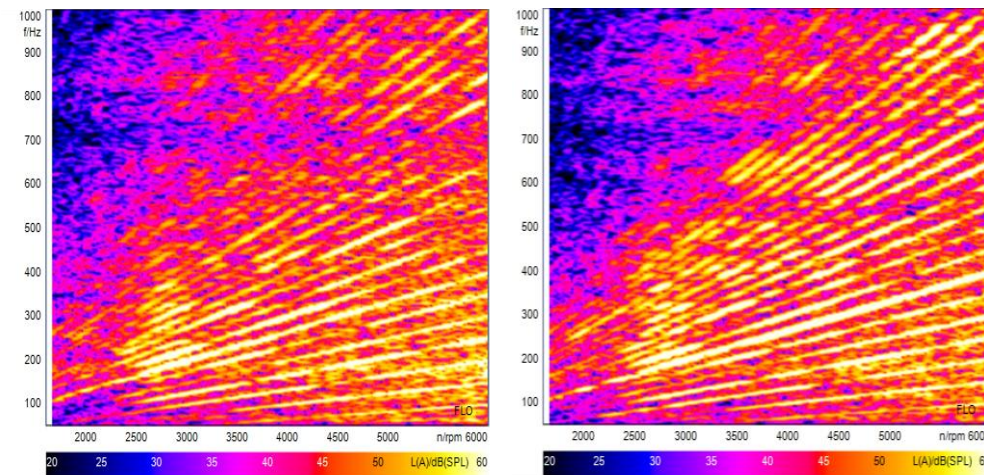
RNC: Road Noise Cancellation
EOC: Engine (& Motor) Order Cancellation
iESS/eESS: internal/external Electronic Sound Synthesis
S2T: Sound2Target

ELECTRONIC SOUND SYNTHESIS

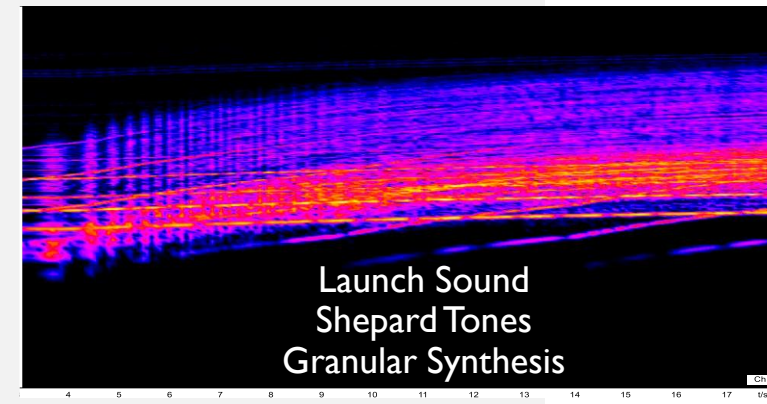
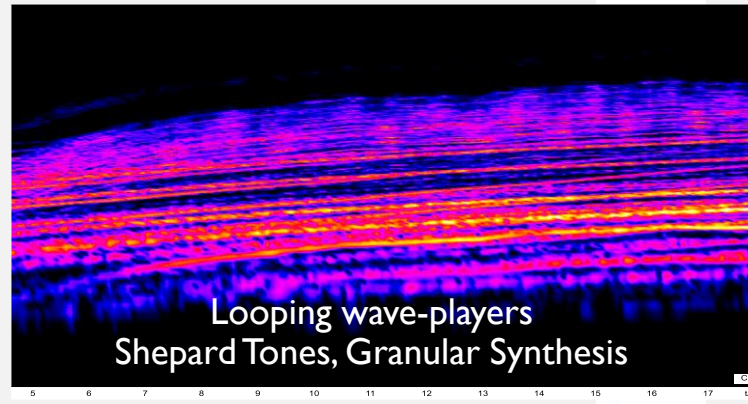
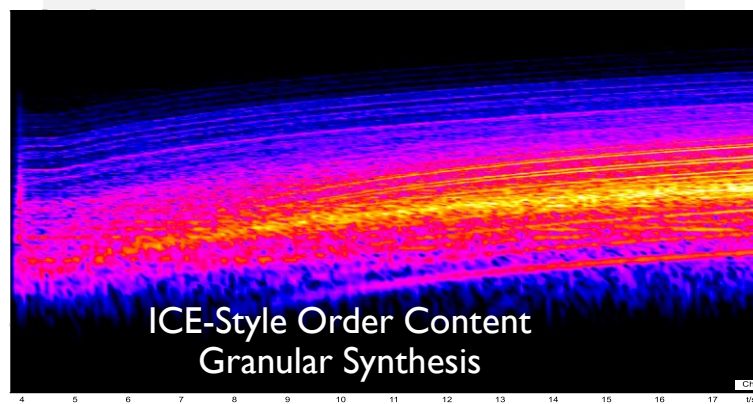
Optimizing Sound Quality to Enhance Vehicle Brand Character



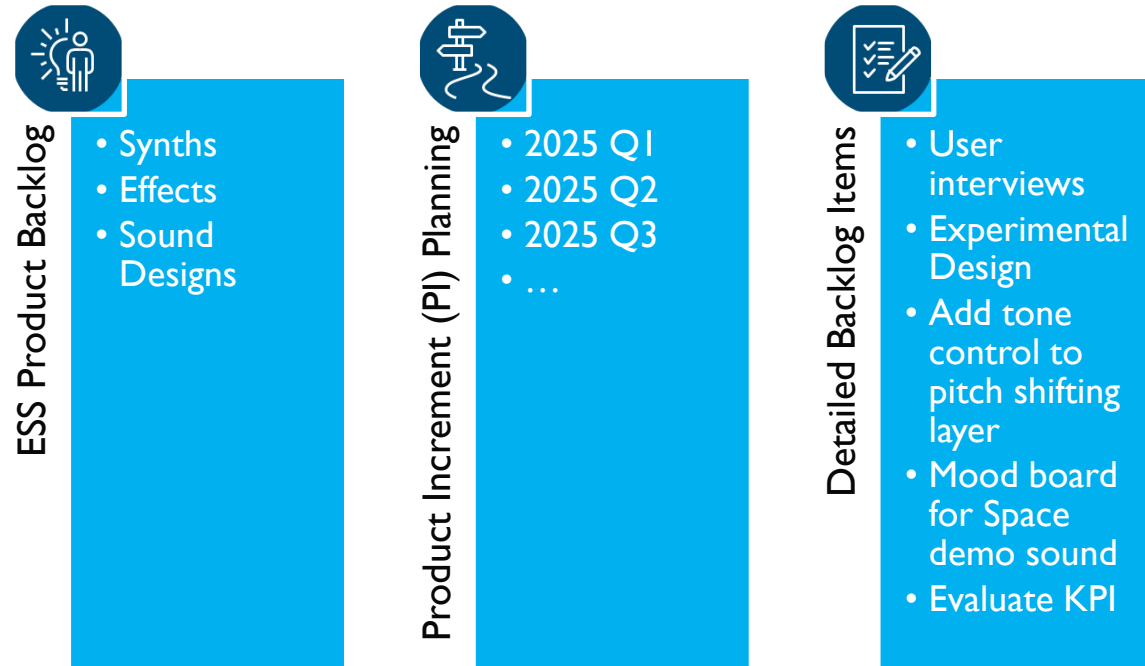
Case Study: ICE Application



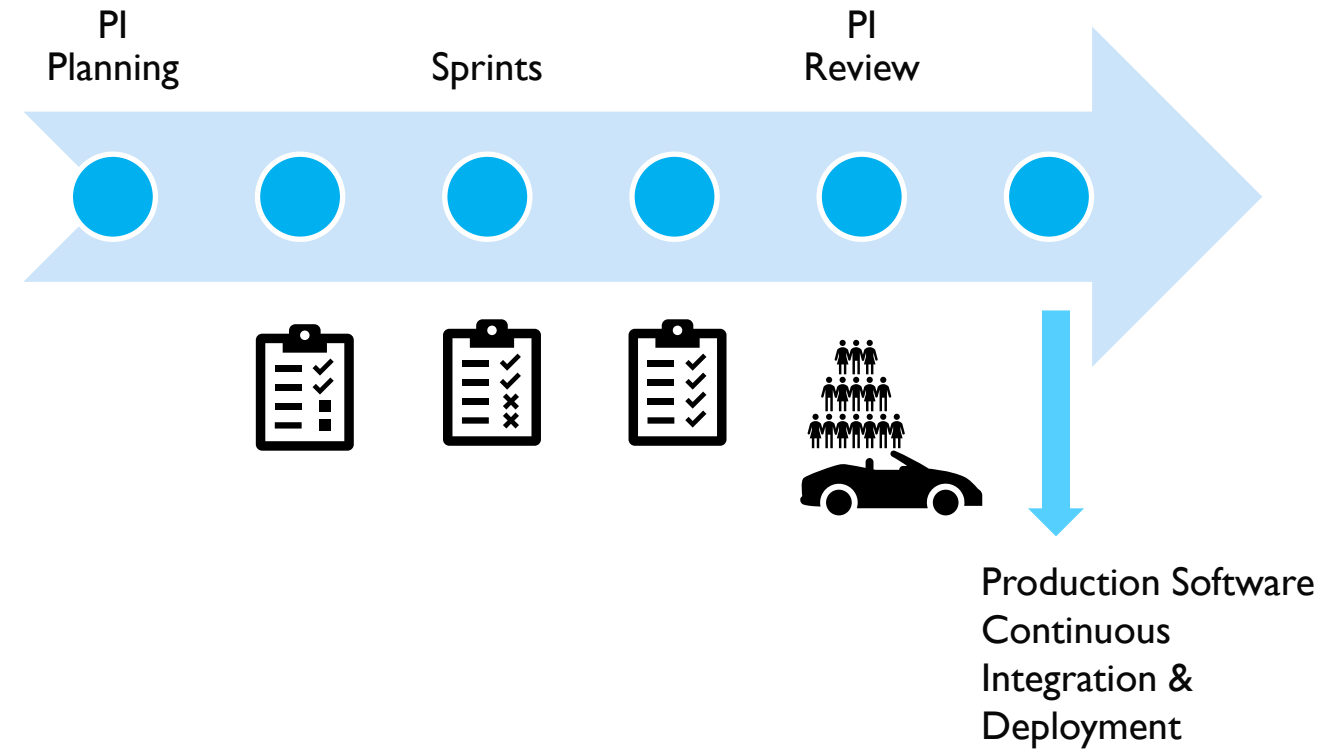
Case Study: Electric Vehicle Application (multiple sound characters)



Product Backlog Example



Agile Product Development



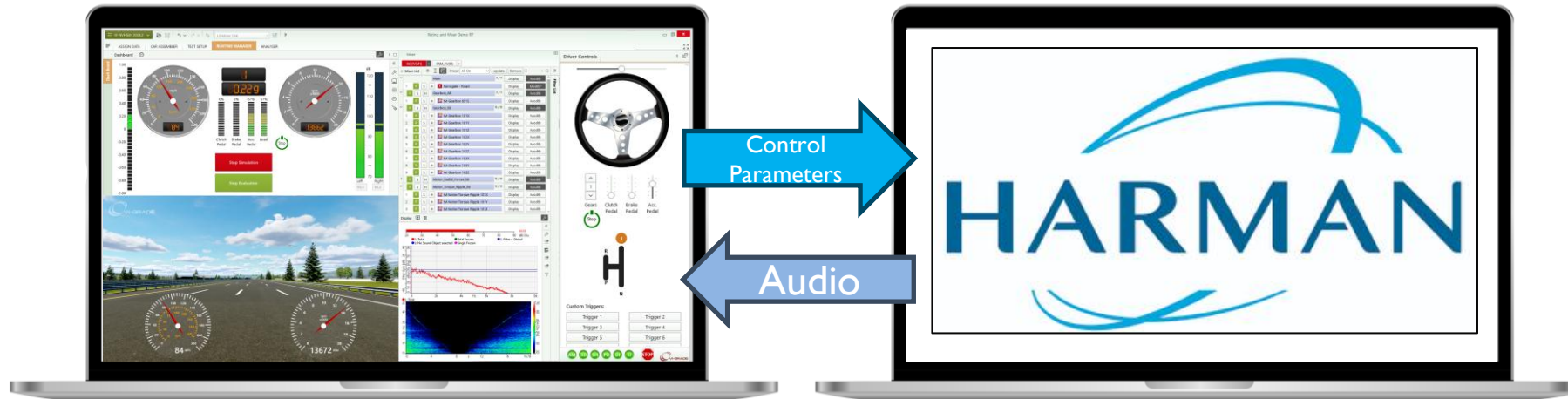
Design the right sound for the vehicle, in concert with active sound design solutions



VI-NVHSim – NVH Virtual Prototypes

- Rapid development and initial evaluation of concepts
- **Sounds in context** with masking sounds
- **Utilize 3rd Party Sound Design Tools*** with VI-NVHSim Virtual Prototypes
- **Tune** the interior & exterior sound design **on the desktop** using VI-NVHSim
- **Verify** the active sound design **on the vehicle** using VI-NVHSim On-Road Simulator

**Available in
VI-NVHSim 2025.1 SP1**

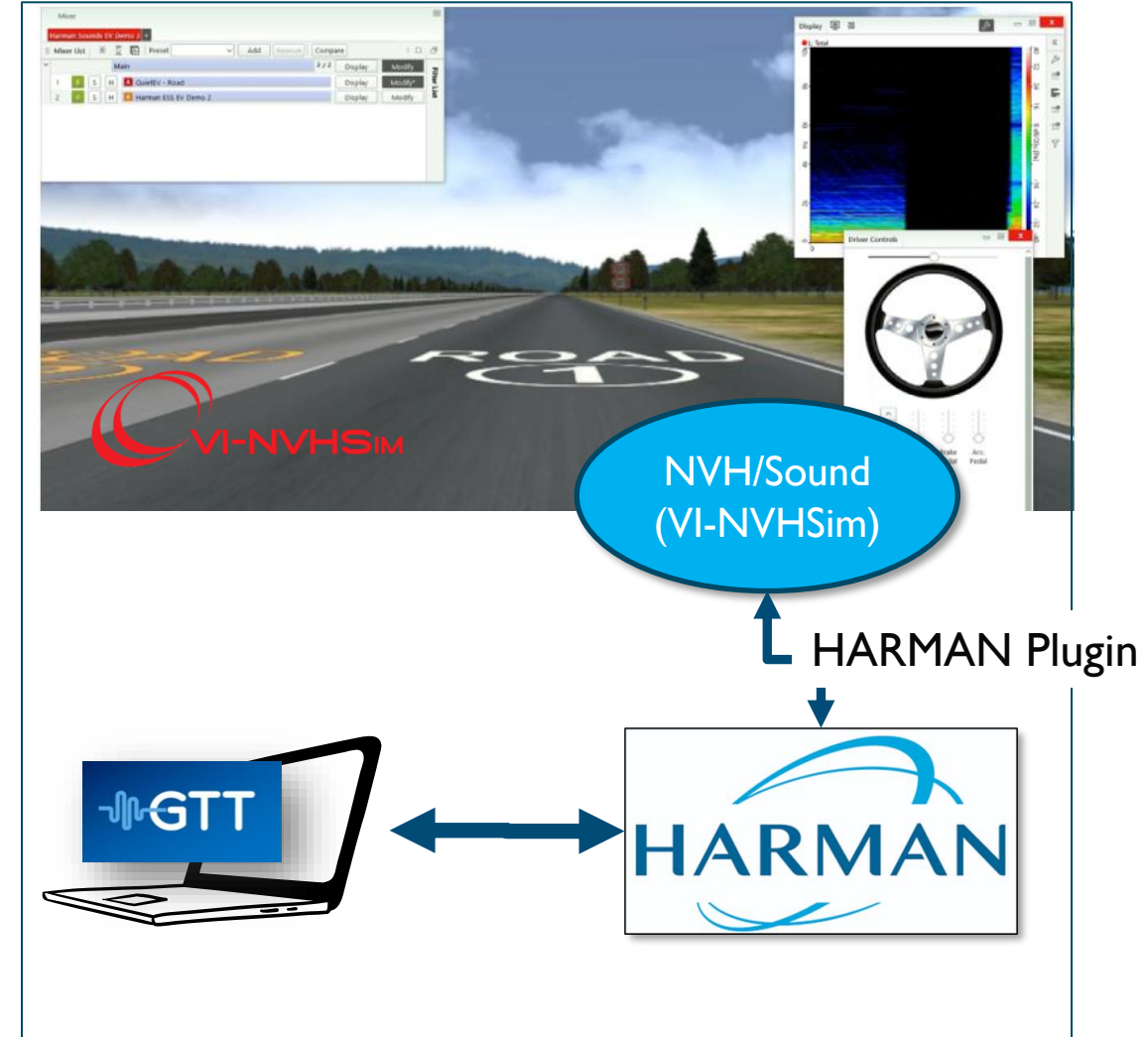
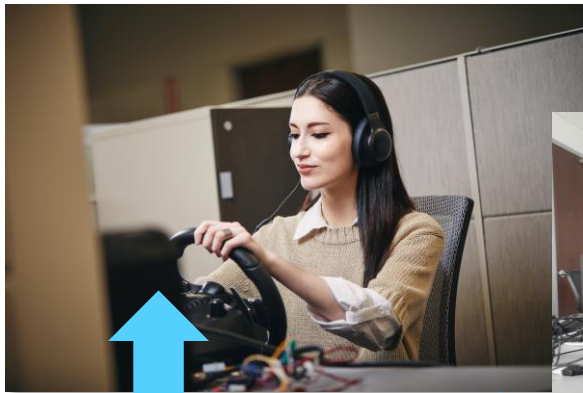


*Sound Design integrations require 3rd party software applications licensed by the 3rd party provider

DEMONSTRATE INCREMENTAL PROGRESS

Enable Virtual Vehicle development for developers and designers

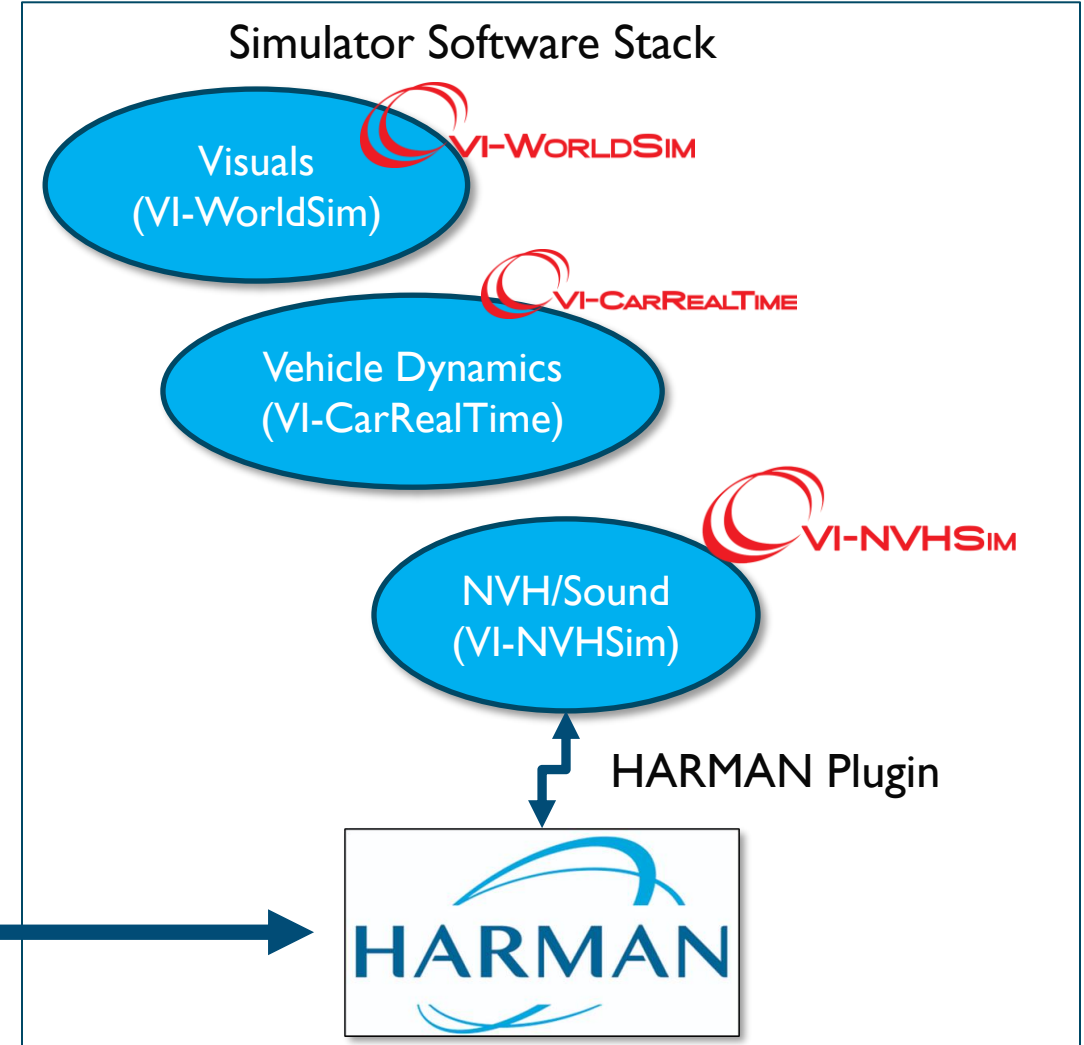
- Manage multiple configurations (versions, project, variant)
- Share working simulations for deeper evaluation using Pack&Go
- Test over a wide variety of use-cases
 - Fixed Driving
 - Free Driving



DEMONSTRATE FEATURES AND GATHER FEEDBACK

Enables stakeholders to have 1st hand experience of product features

- More immersive than desktop
 - Visuals, Environment, and Vehicle Dynamics
- Safer and more efficient compared to in-vehicle demo!



HARMAN ESS Demonstration in VI-Grade NVH Sim Sprint Review Demonstration



HARMAN ESS Demonstration in Static Simulator Product Increment Demonstration



Reduce Vehicle Time by Improving the Fidelity of the Simulation

Vehicle / Powertrain Models

Improve the Powertrain model to avoid adjusting in-vehicle

Active Sound Tuning is very sensitive to gain/load tables

Target System

Transition to the Target System (e.g. HIL) configuration in the Simulator

Use more representative Audio System or virtual audio

Driving Scenarios

Test Across a wider range of scenarios

E.g. Parking lot maneuvers, uphill, downhill, light/heavy traffic

Audio Latency

Latency scales with audio buffer size (5-10ms)

May vary from target systems (control and audio)

Data Modeling

Many vehicle guiding signals are noisier than the simulator

Can mix free-driving with fixed-driving playback to cover more use-cases

Driving style

Driving behavior may differ compared to vehicle

SUMMARY AND NEXT STEPS

KEY BENEFITS...

...of using VI-Grade software for
Automotive Sound Design

- Collaborate across software and sound design domains on new feature development
- Demonstrate sound designs and new Active Sound features to stakeholders in a safe environment
- In the simulator environment, we can test, evaluate, tune in a rapid way, with a greater variety of test conditions



NEXT STEPS

- Expand use of virtual prototypes across product teams at HARMAN
- If you are in the Active Sound Design space, I'd be happy to follow up with you on our latest HARMAN ESS features – enabling quickly going from concept to prototype



CONTACT US

For more info:

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