Model-Based Hyper Scalable Assessment of Automated Vehicle Functions

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DSA = Device Solutions Americas

Samsung @ the Heart of Everything
Unparalleled Product Breadth & Technology Leadership
Samsung in Automotive

2017 JAN
Press Release
Samsung’s Exynos Processors Selected to Revolutionize Audi’s Next-Generation In-Vehicle Infotainment
January 19, 2017

2018 OCT

Press Release
Samsung Expands Exynos and ISOCELL Brands to Include Automotive-Grade Solutions
October 16, 2018

2019 JAN
Press Release
Samsung’s Exynos Auto V9 to Power Next-generation Platform for Audi’s In-vehicle Infotainment System
January 3, 2019

2019 MAY
Press Release
Samsung Enhances Functional Safety to its Automotive Semiconductors with ISO 26262 Certification
May 13, 2019

Press Release
Samsung’s Exynos Auto 8890 Powers In-Vehicle Infotainment System in the New Audi A4 and Upcoming Models
May 30, 2019

Source: Samsung Newsroom
Global Map

San Jose

Munich

Israel

Seoul
Consistent SoC Strategy

- High Throughput
- CPU Efficiency & Safety
- Optimized Programmable NPU
- Enhanced ISP for Detection Performance
- Vision Processing w/ Programmability & Acceleration
- GPU
- ASIL B Compliant

Advanced Process Node of 7nm. ASIL D Safety Island.
Roadmap ADAS/AD

<table>
<thead>
<tr>
<th>2023</th>
<th>202x</th>
<th>202y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Assist Package</td>
<td>Valet Parking Package</td>
<td>Urban Fenced Chauffeur</td>
</tr>
<tr>
<td>L2</td>
<td>L4</td>
<td>Package</td>
</tr>
<tr>
<td>Safety Package</td>
<td>Commuter Assist Package</td>
<td>Advanced Commuter</td>
</tr>
<tr>
<td>L1</td>
<td>L3</td>
<td>Package</td>
</tr>
<tr>
<td>Info Package</td>
<td>Advanced Driver Assist Package</td>
<td>L4</td>
</tr>
<tr>
<td>L0</td>
<td>L2</td>
<td></td>
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<tr>
<td>ADAS Platform</td>
<td>Autonomous Platform</td>
<td>Autonomous Platform</td>
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<tr>
<td>Gen 1 SoC L2 Solution</td>
<td>Gen 2 SoC L3/L4 Solution</td>
<td>Gen 3 SoC L4 Solution</td>
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<td>Gen 3 SoC L4 Solution</td>
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Matlab Expo 2019
A Three-Pillar Solution

**DRVLINE Metal**

Consistent Exynos SoC strategy to meet computational needs of each car line w/ efficient scale out.

Designed for safety applications up to ASIL D.

**DRVLINE Liquid**

Middleware that operates multiple SoCs as one.

Enables SW development by OEMs and Tier 1s to easily integrate functions.

**DRVLINE Air**

Cloud-based ecosystem w/ seamless integration of “in-car” collected data.

Improved accuracy of ACC, LKA, Road Model, AEB.
DRVLINE FRAMEWORK. Modular approach

Open and flexible Approach architected to allow third-party Integration
### DRVLINE Middleware

<table>
<thead>
<tr>
<th>Source Manager</th>
<th>World Model Manager</th>
<th>Virtual CAN BUS</th>
<th>ACT Manager</th>
<th>Maps Manager</th>
<th>LOG Manager</th>
<th>STREAM Recorder</th>
<th>HEALTH Monitor</th>
<th>SECURITY Manager</th>
<th>EXEC Manager</th>
</tr>
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<td><img src="image1.png" alt="Source Manager Icon" /></td>
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<td><img src="image5.png" alt="Maps Manager Icon" /></td>
<td><img src="image6.png" alt="LOG Manager Icon" /></td>
<td><img src="image7.png" alt="STREAM Recorder Icon" /></td>
<td><img src="image8.png" alt="HEALTH Monitor Icon" /></td>
<td><img src="image9.png" alt="SECURITY Manager Icon" /></td>
<td><img src="image10.png" alt="EXEC Manager Icon" /></td>
</tr>
</tbody>
</table>

#### Data Synchronization Layer

- Interprocess Communication Layer synchronizes source and object data.
- Subscriptions to data sources that are on other SoCs are transparent to modules.
- Software modules can be distributed across SoCs.
- Adaptive Autosar and Autosar difficult to use for developers.
- DRVLINE provides Adaptive Autosar with easy to use IDL and pub/sub mechanism familiar for ROS developers.
Samsung, as part of its Exynos Auto product family, offers its customers a comprehensive toolset to accelerate development, verification and validation.

The toolchain is optimized for the DRVLINE™ ADAS Framework and currently consists of five components:

- simulation framework (DRVLINE™ Sim)
- perception development kit (DRVLINE™ Perception Tool)
- functions development kit (DRVLINE™ Functions Tool)
- data management toolchain (DRVLINE™ Data)
- DRVLINE™ Viewer 2019

These services are available through an online portal, which includes the DRVLINE™ Dashboard, showing an overview of continuous improvement (CI/CD/CV), KPIs, and more.
ADAS SDK User Analysis

Objective: develop Functions like AEB/LKAS based on results from perception. Unit/Module Testing.

Need: Model-Based Design Tools, object-level simulation, ...

Function Engineer

Test Engineer

Objective: validate ADAS system solution and detect bugs.

Need: Debug, Profile, Use of Certified Testing Solutions, Automation, Test Case Generation, ...

Perception Engineer

Objective: develop perception algorithms to detect objects, segmentation based on NN or classic CV. Unit/Model Testing.

Need: real data, annotations, high-res synthetic data, sensor modeling, KPI measurement, ...
Tools Landscape

ADAS Tools Portal with DRVLINE™ Dashboard

- DRVLINE™ Viewer
- DRVLINE™ Data
- DRVLINE™ Perception Tool
- DRVLINE™ Function Tool (including DRVLINE Toolbox for Simulink)
- DRVLINE™ Sim

Real Data
Annotated Data

Simulated Scenarios,
Simulated Vehicles

Perception
Functions

Middleware
BSP
Exynos Auto A

Matlab Expo 2019
DRVLINE™ V&V Strategy – SiL, HiL, ViL Continuity
Problems we are solving

› Rapid prototyping and requirement validation
  › Stateflow, Automated Driving Toolbox
› Fast and ”inexpensive” verification
  › Driving Scenario Designer (Automated Driving Toolbox)
› Automatic code generation
› Address needs of multiple stakeholders with different approaches to development
› Mitigate development dependencies while framework is under active development
› Our approach:
  develop a DRVLINE Toolbox for Simulink and distribute / deploy it in containers
DRVLINE Toolbox Architecture

DRVLINE ADAS Framework

- Sensor Data
- Object Stream
- Actuation Manager

MATLAB Simulink

- DRVLINE Sensor lib
- DRVLINE Object lib
- DRVLINE Actuation lib
LDW model using DRVLINE Toolbox
DRVLINE Toolbox for verification and validation

› DRVLINE SW & infrastructure allows validation at scale using
› Headless simulation
› Parameterization of driving scenarios
› “Smart” validation using
› Parameter optimization
› Data augmentation
DRVLINE Toolbox in V&V
Containerized Model in the Loop

Developer Workflow

V&V Workflow

./setup
Model in the Loop

Diagram showing the integration of various tools and processes, including DRVLINE toolbox, AD toolbox, Model, Driving Scenarios, and Simulink.
Software in the Loop
Enhanced Model in the Loop

Parameterization

Simulation Engine

DRVLINE framework

DRVLINE toolbox

Model

Scenarios

Test Cases

Samsung's ADAS Solutions

Matlab Expo 2019
DRVLINE toolbox example
Conclusions

› We presented a modern approach & framework to prototype, develop and test Automated Vehicle Functions

› MATLAB, Simulink, Automated Driving Toolbox, Stateflow can be integrated thru the DRVLNE Toolbox for Simulink

› Facilitated development for different stakeholders

› Scalability on all stages even for MBD

› More efficient testing on early stage of the development