- **Explosion of features** leading to **Expensive & Complex** Distributed E&E architecture

- New **Eco system** & Players

- New **Business Models**: Pay what you use

- Safety & Security Concerns

SDV revolution mimics the smartphone industry transformation

Bhupesh Tekade
Deputy Vice president –
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1

Software Defined Vehicle
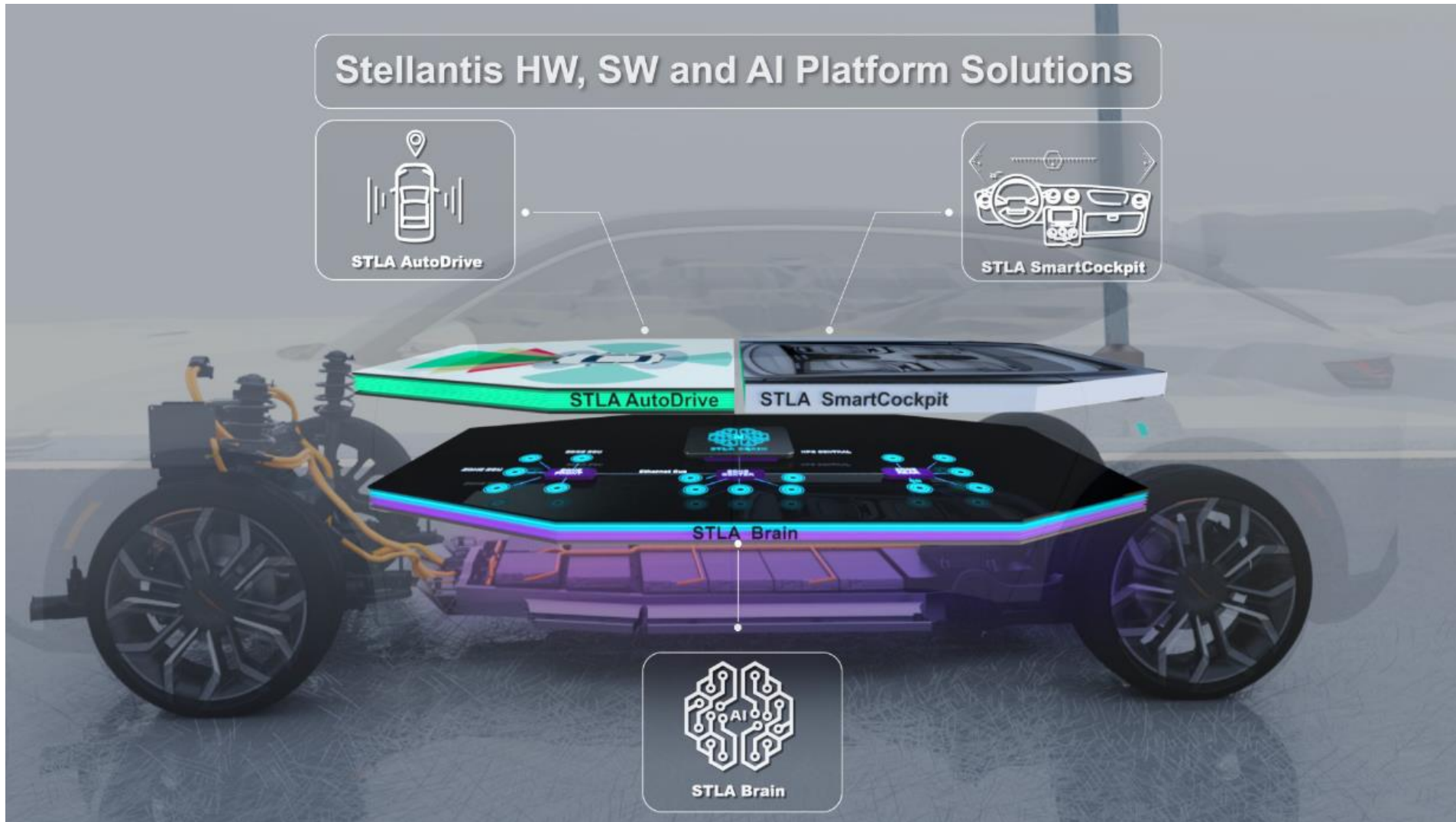
Hariharan Lakshminarayanan

Principal Software development manager – India and Asia Pacific , Stellantis

SDV - Driving Forces

USER AND BUSINESS DEMANDS

> Customer Experience

> Value-add functionality

> Additional Revenue
  Streams

Chennai, October 10th 2023, version 1.0

Motivation for Software Defined Vehicles (SDV)

Owners of Vehicle

- Feature on Demand
- Pay as per Usage
- Continuous Upgrade
- Ease in Use
- Available on a Click

OEMs

- Monetization from Features
- Revenue maximize through License model
- Software Ownership
- Reduce Cost with ECU Hardware Consolidation
- Monetization from Data

Communities

- Usage of Platform (App based Feature)
- Users contribute to Apps
- Common Platform Approach
- Standardization
- Data Reuse

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A

One Function – One ECU

DCU - Merger of ECUs

Vehicle Computer
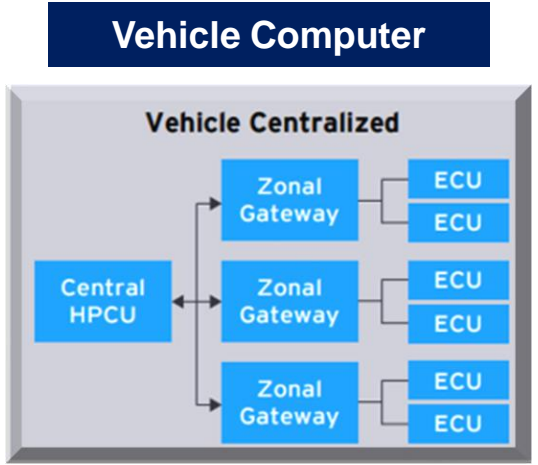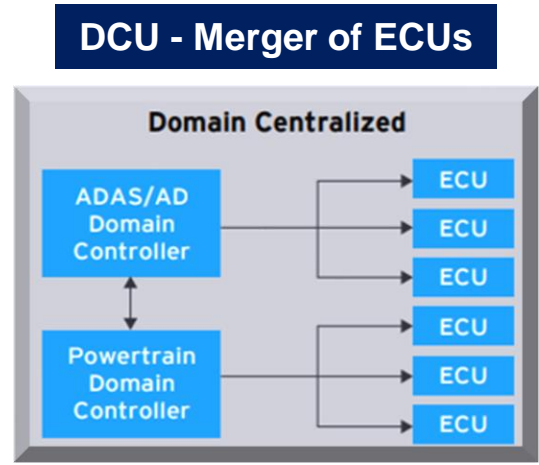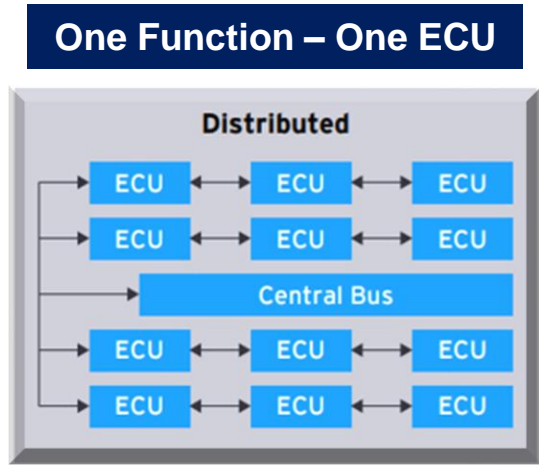
B

Features on Demand

Frequent Product / SW / Cyber Security upgrades

2026 2027 2028

Residual Value Improvement

Customer Loyalty

Evolution of Development Process, Methods & Tools - Safe Agile / DevOps / Virtualization

Bhupesh Tekade
Deputy Vice president – Embedded
SW development , RNTBCI

5

SDV – The Magic Middleware
CONNECTS THE APP WITH THE VEHICLE HARDWARE
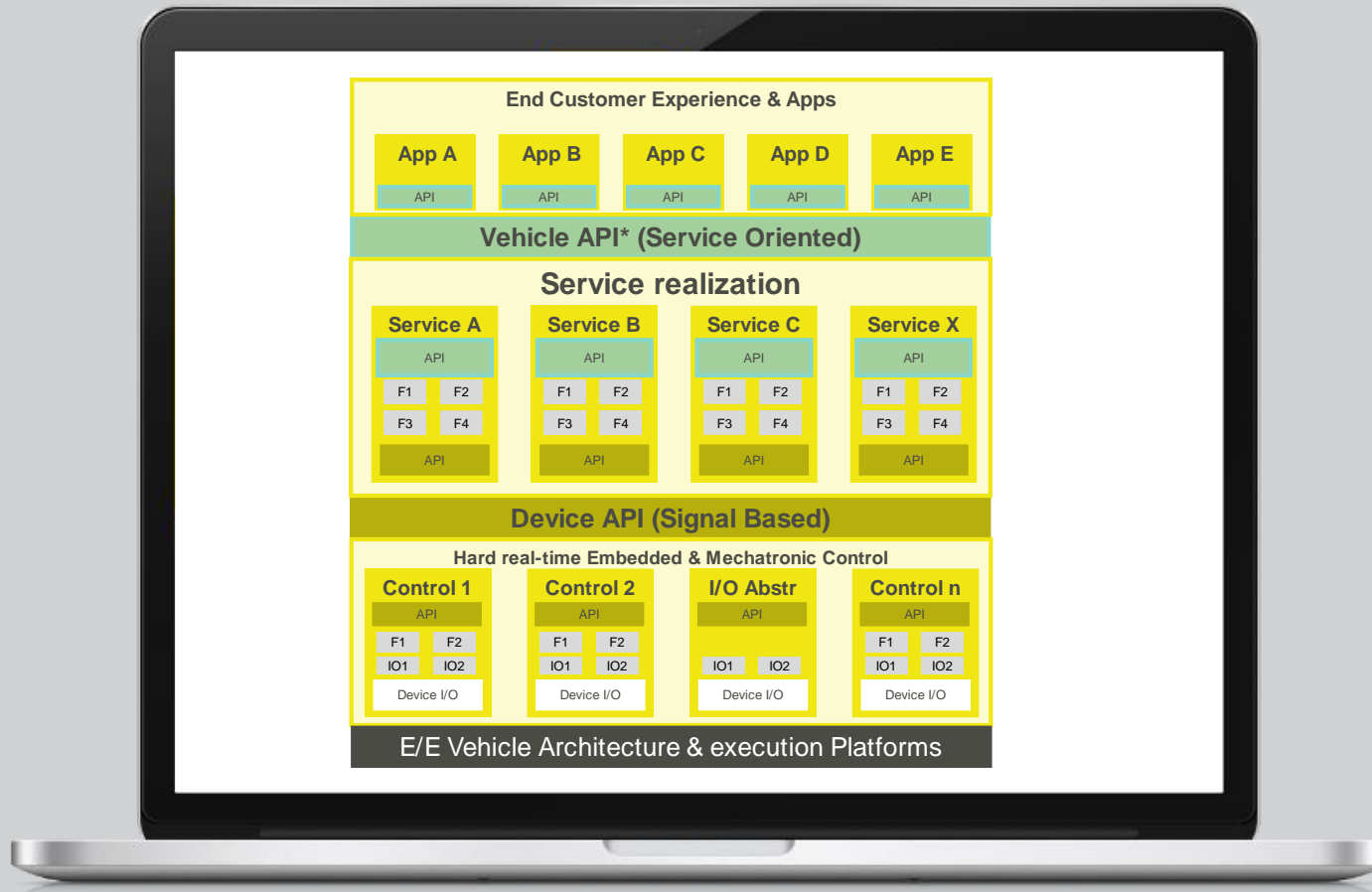
The E/E and SW Technology Stacks

Standard development framework · + Standardized basic services/Middleware · + Automotive specific off-board platform · + White-label infotainment system · + Standard Level 3+ AD stack

ONBOARD

	Powertrain/Chassis	ADAS/AD	IVI/Cockpit	Body/comfort	OFFBOARD Backend
Functions/features	Applications	Applications	Applications	Applications	Applications
Platform	Middleware / OS	Middleware / OS	COMMUNICATION LAYER — Middleware — OS (safe) / OS (IVI[1])	Middleware / OS	PaaS[2]

COMMUNICATION LAYER

| **Electronics hardware** | DCU | DCU | DCU | DCU | Level of centralization (central core ECU, zonal, domain oriented) can be discussed |

Zone computers — Front left — Front right — Back right — Back left

DECENTRAL ECUs/SENSORS/ACTORS (I/O LAYER)

(Cloud) Infrastructure

| **Standard SW development framework** | Process, Methods, Tools, e.g., CI/CD[3], SDKs[4], Version Management, automated testing |

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Cloud-based development

Strategy is structured around developing open platforms that will continuously evolve

- Platforms where software cycles are disconnected from hardware cycles,

- Platforms that are designed around their capabilities, features can be continuously updated and added over the year.

- Platforms that will become better over time

Hariharan Lakshminarayanan

Principal Software development manager
– India and Asia Pacific , Stellantis

Self Service platform for engineer

Faster time to market

End to end developer experience

Virtual Workbench

SDV enablement

Standardized automotive toolchain

Customizable and scalable environment
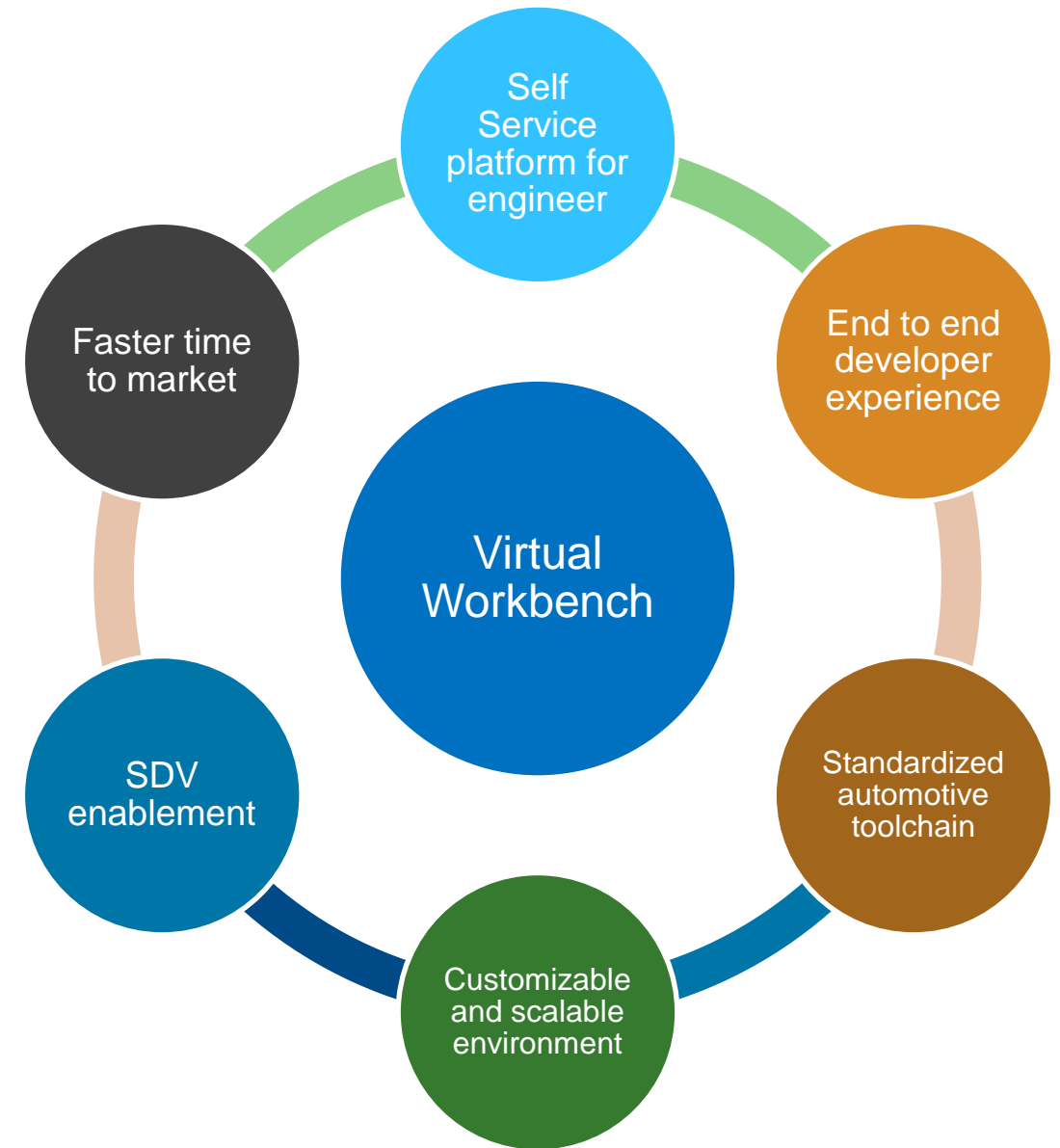
Virtualization techniques

- Complexity of E/E architectures in modern vehicles has been increasing rapidly for years.

- In the context of SDVs (Autonomous Driving), the need for validation by means of "virtual testing" becomes a necessity

- Extremely large number of tests performed in this context can no longer be executed using only real test drives or Hardware-in-the-Loop systems.
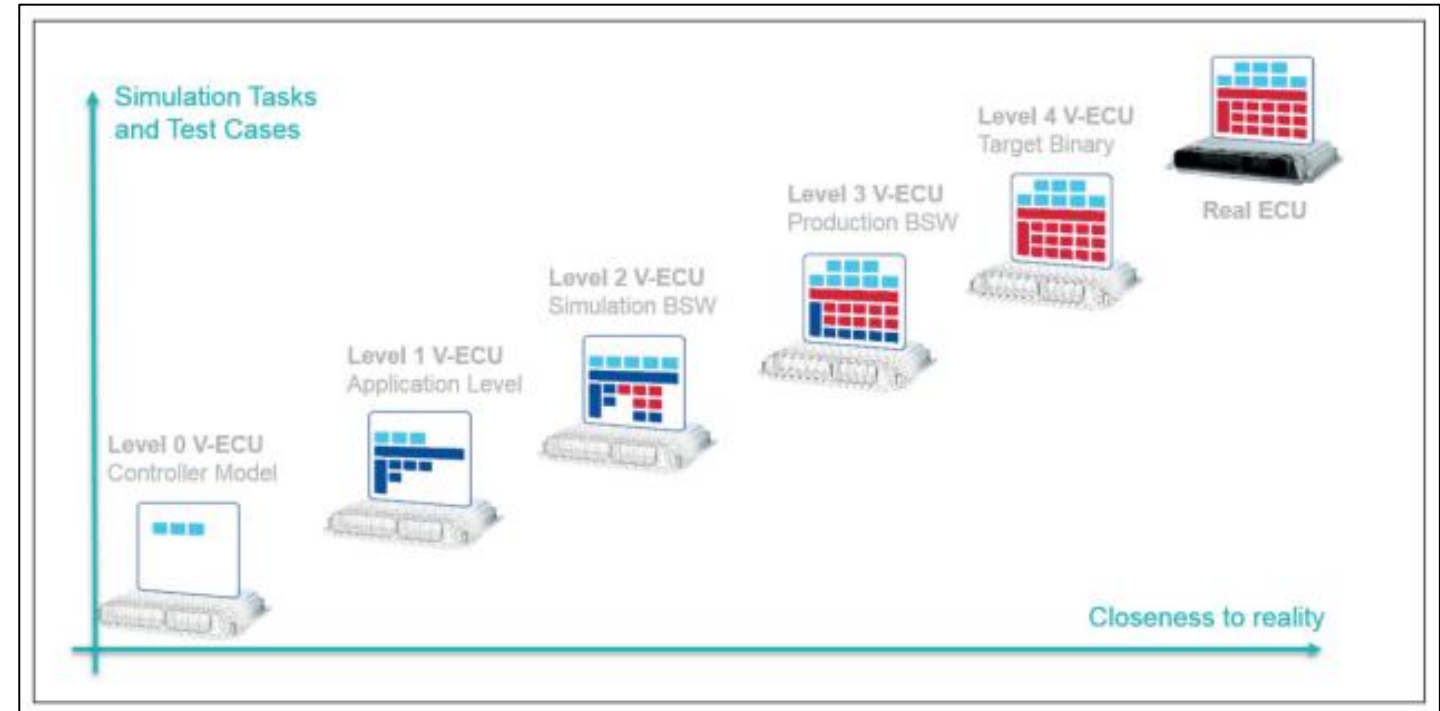

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Infrastructure Set up

Component Library (Virtual BOM)
- Virtual ECUs (Level 1-4)
- Soft ECUs
- Restbus and Plant models
- Supplier Virtual ECU (SIL/Chip)
- Calibration Data Sets
- Drive and Environment Scenario models
- Test Assets

Virtual test bench configurations
- Pre-Configured Simulation Test setup library
- Vehicle, Domain configurations Library
- Test Suite - Test adaptation & Automation

Scaled Simulation Platform
- Desktop tools & Interface
- Command Line Interface
- Engineering Dashboard & Analysis
- Web Interface

Virtual ECU Generation — dSPACE, EMU, VECTOR, SYNOPSYS, WIND
Plant Modelling — SIEMENS, GT, ANSYS, AVL, fmi, MathWorks
Rest Bus and Requirement Modelling — dSPACE, VECTOR, ETAS, MathWorks, ENTERPRISE ARCHITECT

Virtual Communication Bus (Network, HWIO, Signals) Co-simulation Control and Synchronization

Adaptors (XCP, Bus Monitoring, XIL, SW update)

Environment/Scenario Modelling — carsim, IPG
Test Automation — OEM In-house Test Frameworks, dSPACE, VECTOR
Measurement & Calibration — dSPACE, VECTOR, ETAS

dSPACE
- Step Sync
- Signal Exchange
- CAN/LIN/Ethernet
- XCP
- ASAM XIL

- CI/CD
- License Manager
- Report
- Config Builder

- Error Handler
- Queue Manager
- Log Manager
- Application monitor
- Infrastructure Monitor
- Platform Diagnostics

Orchestration and Deployment engine

Azure | aws | **Cloud Platform** | Google Cloud | HYBRID CLOUD

Enterprise app Integration
- Test management
- Issue management
- CI/CD
- Git / Version control
- Artifactory – Binary artefacts

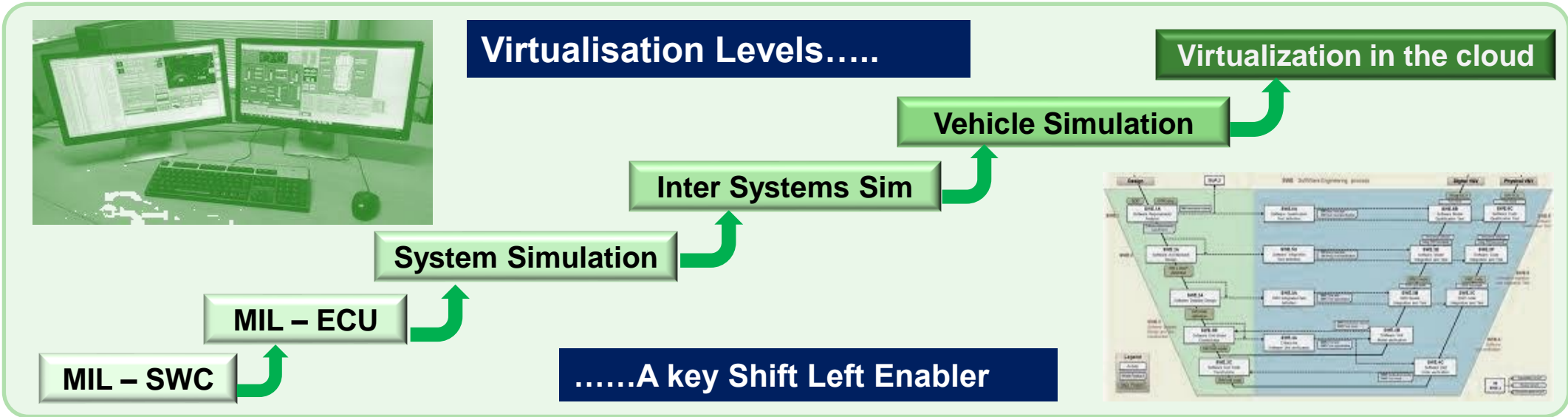| Single sourced Development, implementation partner | Bringing platform IP components– for faster roll out | Test setup migration, automation and correlation with HIL results | Integration with OEM enterprise applications | CICD Pipeline (Beyond Build), BOM generation | Support, Maintenance, Monitoring |

SDV – Development Virtualization

> Time Reduction & Increased Coverage

> Accurate Models and Interactions
  for Trustable Results

> Adaptation of Release Processes

MBD Offers ……	Leading to …….
Ease of Reusability	Productivity improvement
Rapid Prototyping	Quicker conceptualization
Ease of Interface & Integrate Models	Unit, Component, ECU & System level virtual testing
Shift Left / Virtualisation	Faster Time to Market
Collaboration between different teams	Eases understanding of complex systems

Virtualisation Levels…..

Virtualization in the cloud

Vehicle Simulation

Inter Systems Sim

System Simulation

MIL – ECU

MIL – SWC

……A key Shift Left Enabler

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SDV – Development Virtualization

PROVEN VIRTUAL TECHNOLOGIES MEET AUTOMOTIVE

> Standardization vs. USP

> Partnering vs. Competition

> One-time Product Price vs. Revenue Streams

Upskilling and reskilling of workforce to be prepared for the SDV journey

Technical Skills	Overarching Skills
System Engineering	Software Quality
New OS entrant in Automotive Android	Guidelines and Standards
RUST	Design Principles
Cloud driven SW development	Architecture and Algorithmic Skills
Virtual Validation	
DevOps Driven HIL Validation	
New Semiconductor Platform	

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Need of Collaboration – Horizontal Approach

- SDV needs diverse Technologies – Vehicle systems, Software, High Performance Computing, Car OS, Android, Cloud, etc
- Each Technologies have big Tech players in their own fields
- Utilize & Build on own proven track records
- Shared investment & Lower risk due to partnership

Benefits:

- Co-develop solutions - Faster development time
- Keep focus & control on core Competencies
- Efficient Program Management
- Revenue generation by offering solutions for Open Market

Software Factory

Google

Qualcomm

Valeo

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