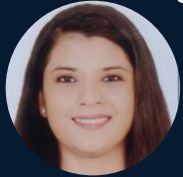


# KPII

## Accelerating Automotive Software Defect Detection via Shift-Left with Virtual ECU Testing

Priyanshi Gupta- SME,  
Virtual Engineering



Aditi Tiwari- Technology  
Marketer, Virtual Engineering



MathWorks  
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# What are we going to cover..

**Industry Shift: Rising Complexity in Automotive Software**

**Validation Bottlenecks in Traditional Validation Approaches**

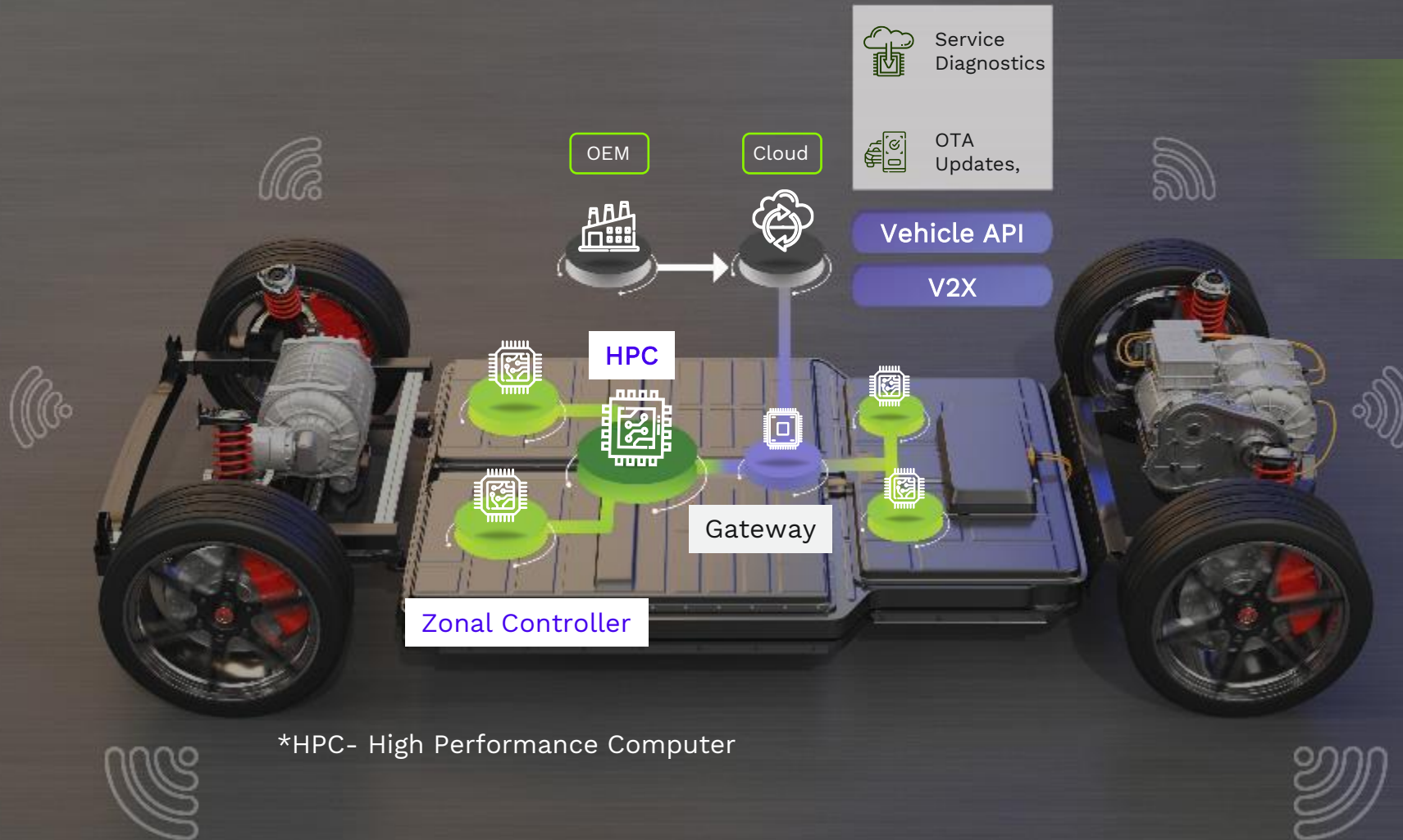
**Strategic Direction: Enabling Shift-Left Validation with Virtual Platform**

**How KPIT is enabling the Shift-Left?**

**Use Case Spotlight: Enabling Virtual ECU Capabilities in MBD**

**Outcomes & Roadmap**

# Industry Shift: Rising Complexity in Automotive Software



\*HPC- High Performance Computer

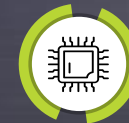
In OEMs SDV journey, Operational reality to be dealt with



3000-5000 Engineers  
(Global, Multiparty)

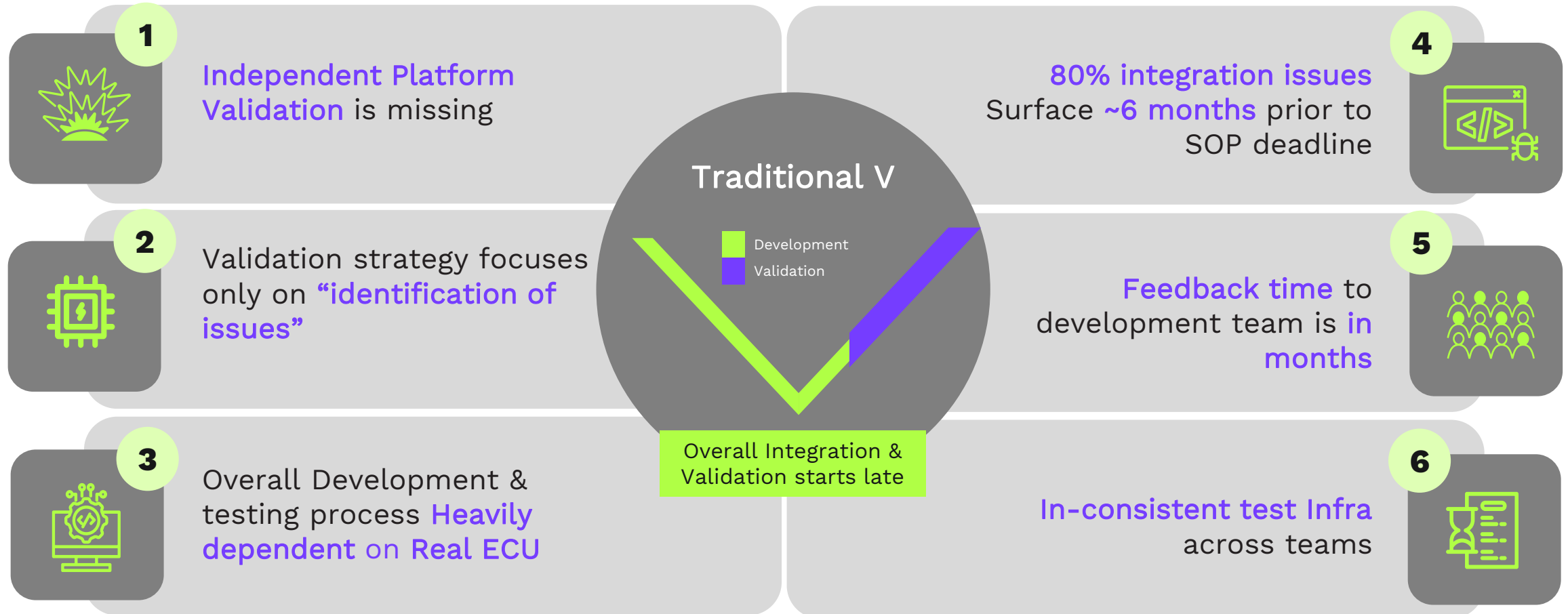


7000+ Applications /  
Features  
(new, migrated, 3<sup>rd</sup> Party  
components)

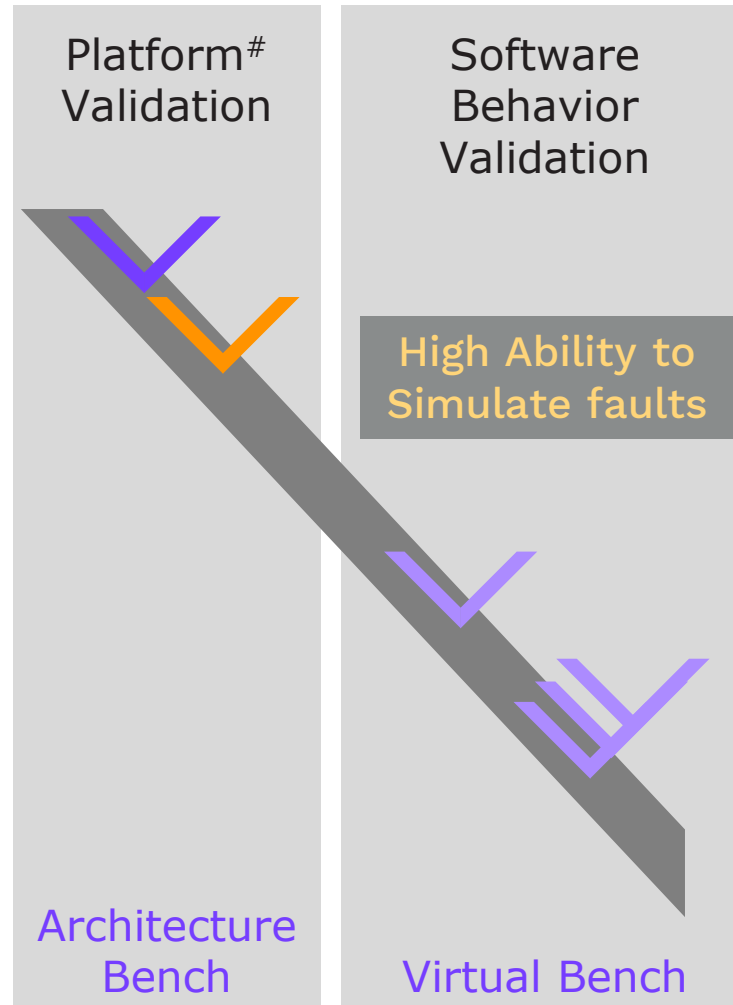


Limited physical test  
setup  
(HIL, Devp Test)

# Validation Bottlenecks in Traditional Validation Approaches



# Strategic Direction: Enabling Shift-Left Validation with Virtual Platform



- Use Virtual Platform
- Test Behavior early in the development cycle
- Simulate faults

Virtual Test Environment | IVI Workspace | Dashboard

Project: M127 -

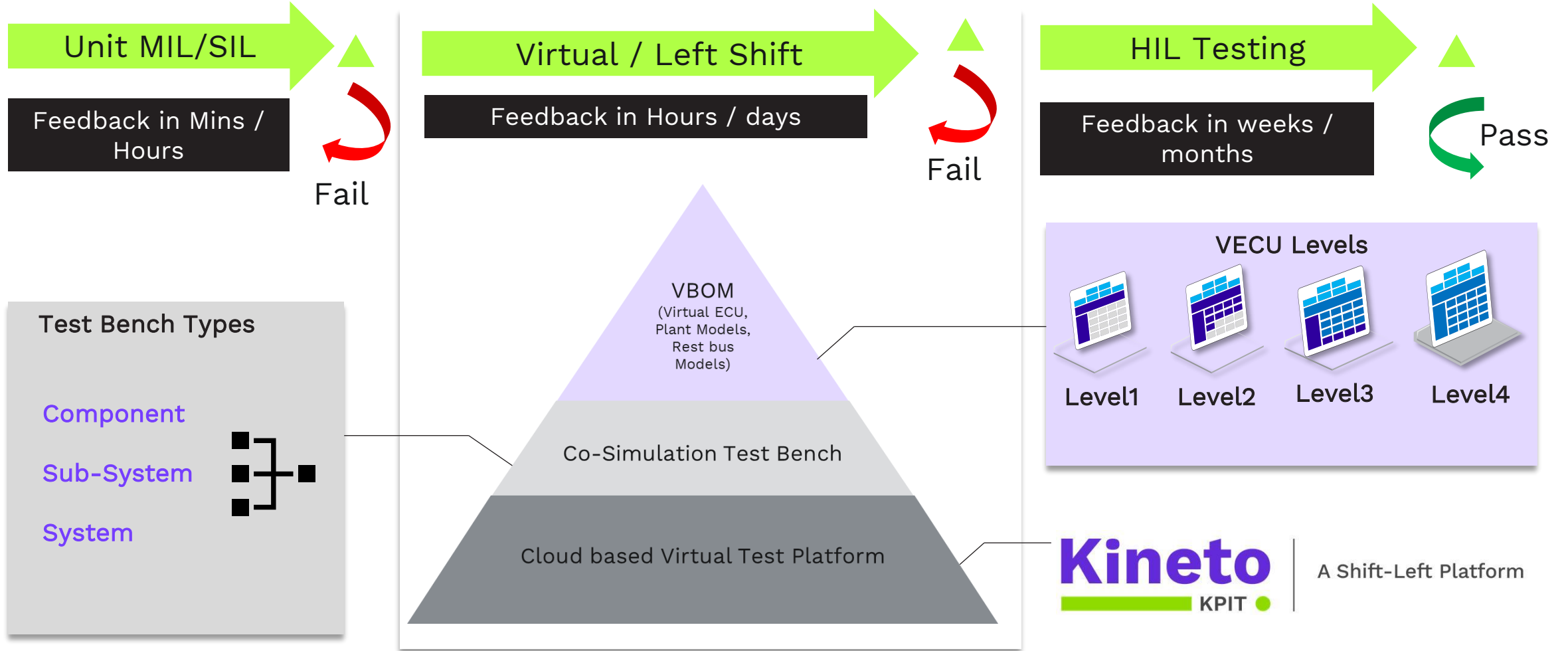
Vehicle Feature Details And Readiness Status

Name	25CW19	25CW20	25CW21	25CW22	25CW23	25CW24	25CW25	25CW26	25CW27	25CW28	25CW29	25CW30	25CW31	25CW32	25CW33	25CW34
Trunk Control	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
In Vehicle Infotainment	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Adapt Postural Comfort	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
HVAC	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
V2X Vehicle to Everything	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
WiFi Hotspot	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Smartphone Integration	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
NLP Voice Assistant	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
OTA updates	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Cloud connectivity	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Adaptive Headlights	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Automatic High Beam	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
LED Daytime Running lights	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
LED turn signals	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Ambient lighting	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Fog lighting	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Switch on/off low beam	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Flash to pass	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Lock/Unlock car with keyFOB	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Open/close doors	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
check and warn traction battery level	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Wireless charging	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Customizable drive modes	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
start vehicle mobility	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█

# Platform = MW + OS + HW + NW

# Right test in Right environment for Purpose, ROI, Isolation

a) Detect and Fix ~100% SW defect early | b) Enable Isolation of cause in case of defect



The background features a glowing blue and orange digital environment. A car is shown driving on a road that appears to be composed of circuit traces. In the foreground, a large, detailed microchip is visible, surrounded by intricate circuit patterns. The overall aesthetic is high-tech and futuristic.

**Use Case Being Discussed Today**

**Enabling VECU Capabilities To Application  
Software Developers In Model Based  
Development Process**

# Overview of FMI/FMU

## Functional Mock-Up Interface

FMI is an open standard that defines an interface for models to be exported and imported between different tools and platforms

## Functional Mock-Up Unit

A Functional Mock-up Unit (FMU) is a software component that implements the FMI standard

## Key Features

Model  
Encapsulation

Standardized  
Interface

Platform  
Independence



Key  
Benefits

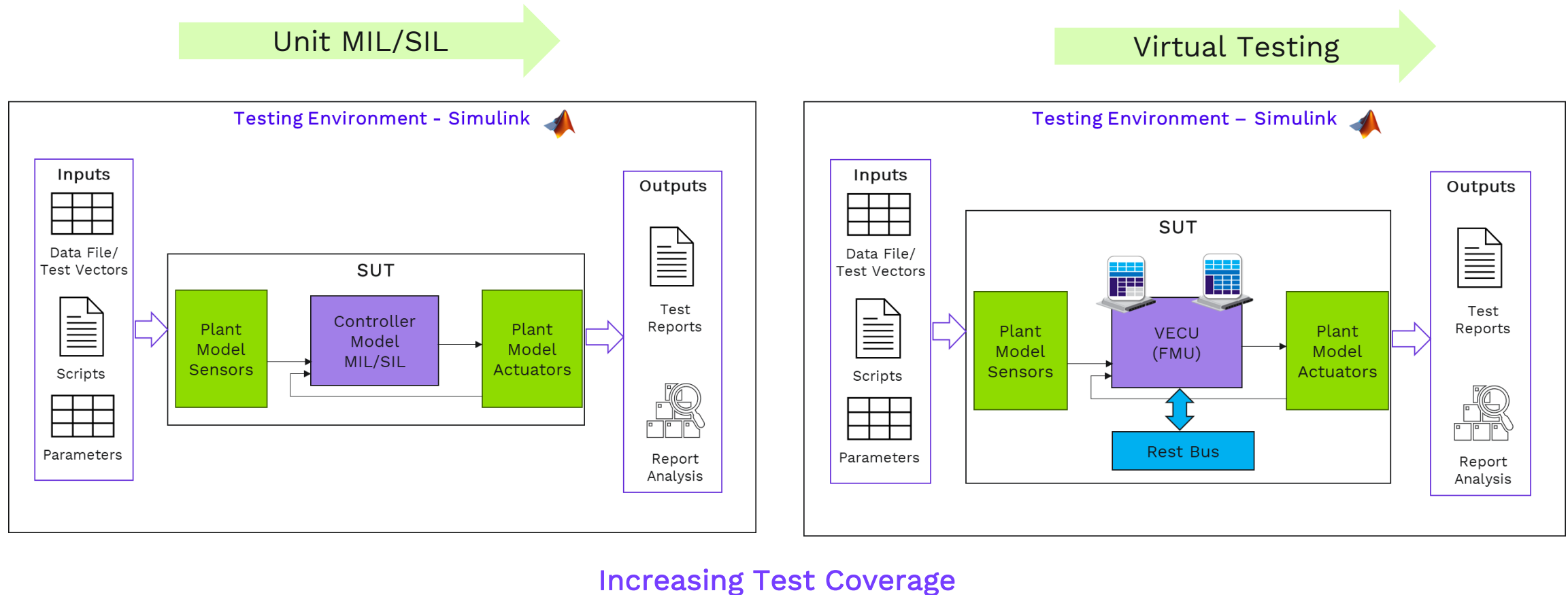


Improved  
Collaboration

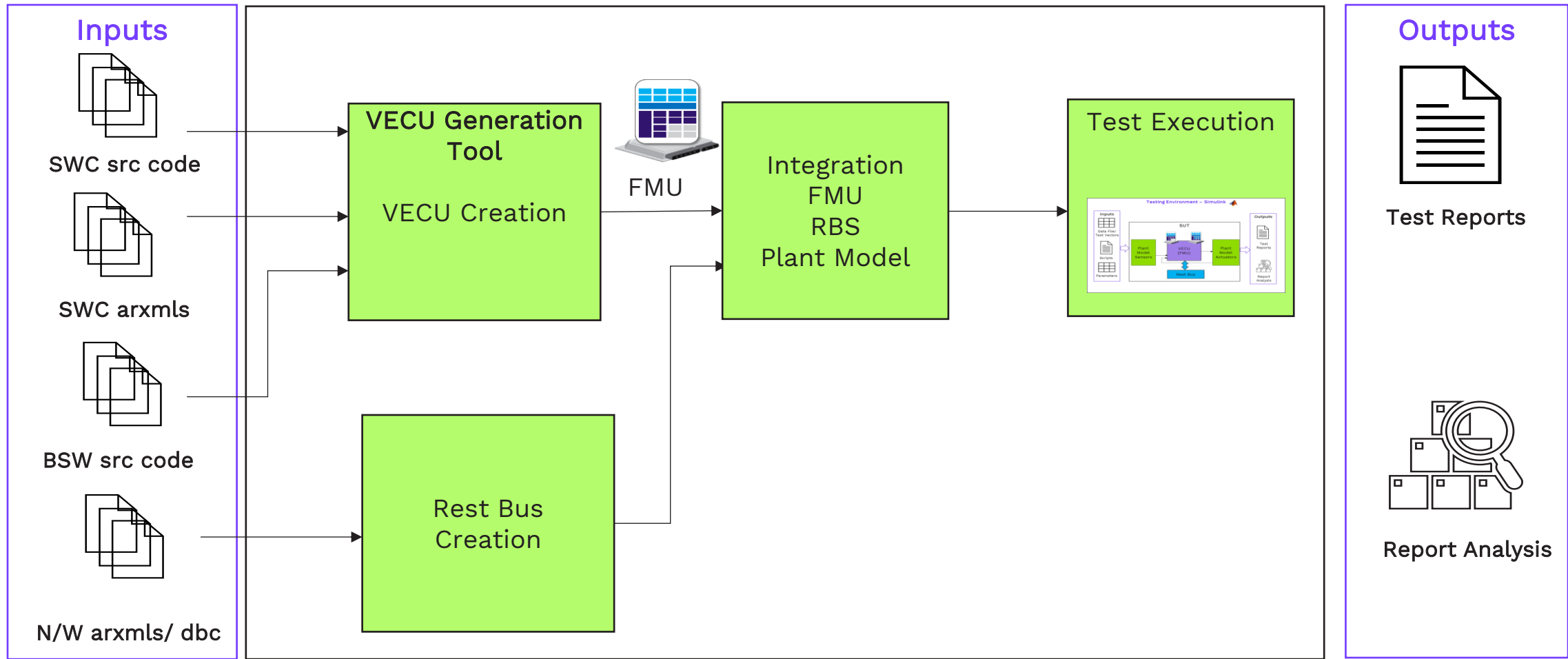
Increased  
Efficiency

Improved  
Accuracy

# Virtual ECU + Simulink: Enabling Seamless Transition from MIL/SIL to FMU

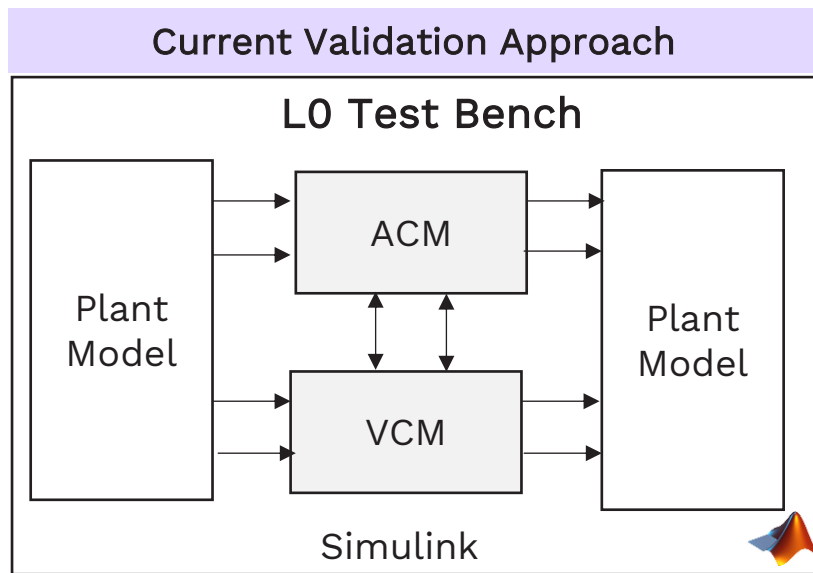


# Validation Workflow: End-to-End Co-Simulation Using FMU in Simulink



# Use Case: Enabling uses of existing simulation infrastructure for execution of new VECU methods

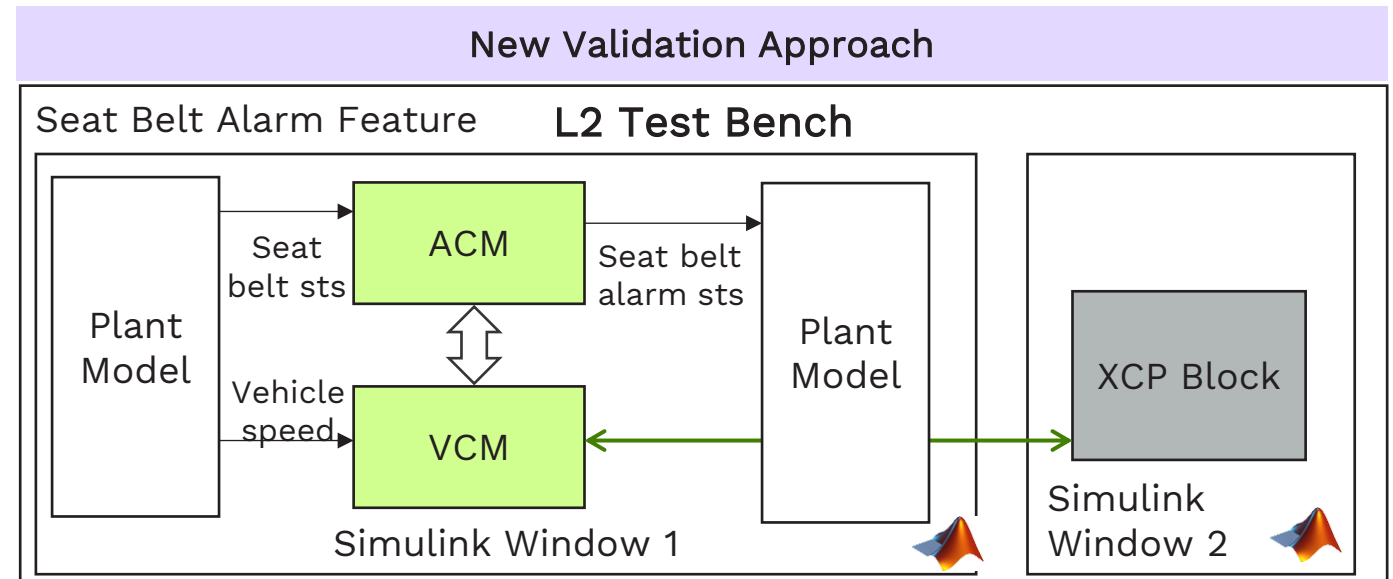
**Objective:** Create a multi-VECU test bench by integrating and validating vehicle features, leveraging the existing SIL/MIL framework for scalable and modular testing of automotive systems



**Use Cases**

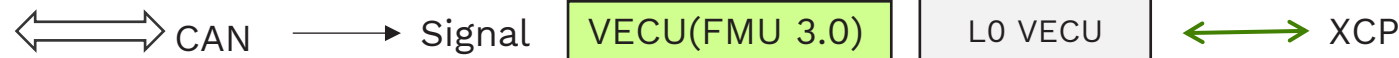
- Functional unit tests
- Control software functionality
- Components interface tests

Seamless transition from MIL/SIL to Virtual testing

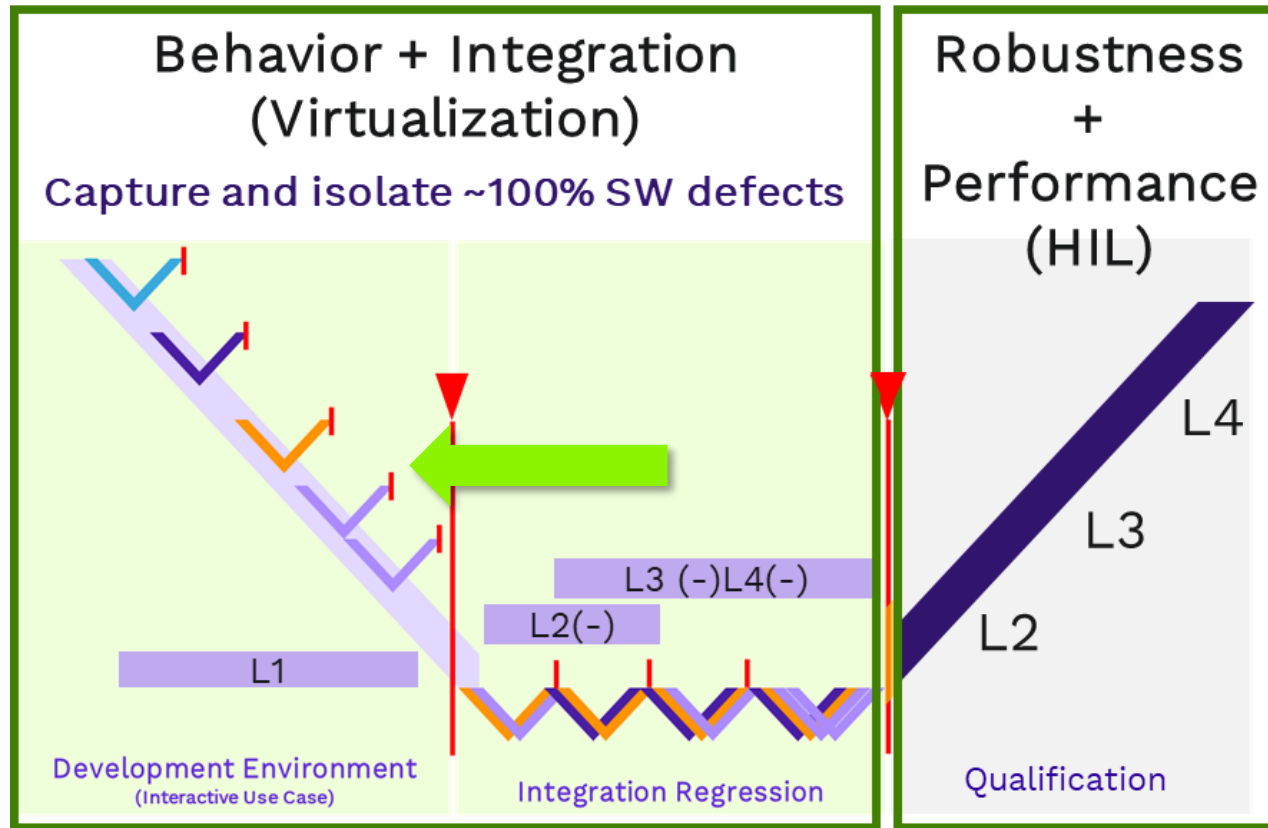


**Use Cases**

- Sensor, actuator, node ECUs integration Functionality
- Communication data integrity across network
- ASW-BSW interface tests
- Calibration & Measurement



# Summary



## Key Takeaways

- Early Accessibility
- Easy to use
- Common Validation Platform
- Scalability
- Early Bug identification
- Cost Effective

- Development
- Validation
- Feature Requirements
- SW Platform#
- Vehicle Features
- EE Arch, Network, Gateway
- Coverage & **Quality Gates with KPI** at every Artifacts & Every stage

# What's Next: Roadmap & Scaling Potential



## CI/CT Framework

- Foundation to onboard pipelines across development and test cycle
- Enables Quality gates, pipeline chaining



## Automated Workflow

- Automated Regression from software change to software integration and functional validation



## Scaled Simulation

- Scaled Test Execution Environment on Cloud

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India

**KPII**

**Thank you**



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