



MathWorks
AUTOMOTIVE
CONFERENCE 2018
May 2 | Plymouth, MI



Rapid Engine Control Prototyping using Simulink Real-Time and Speedgoat Target Hardware

Roopak Ingole

May 2nd 2018

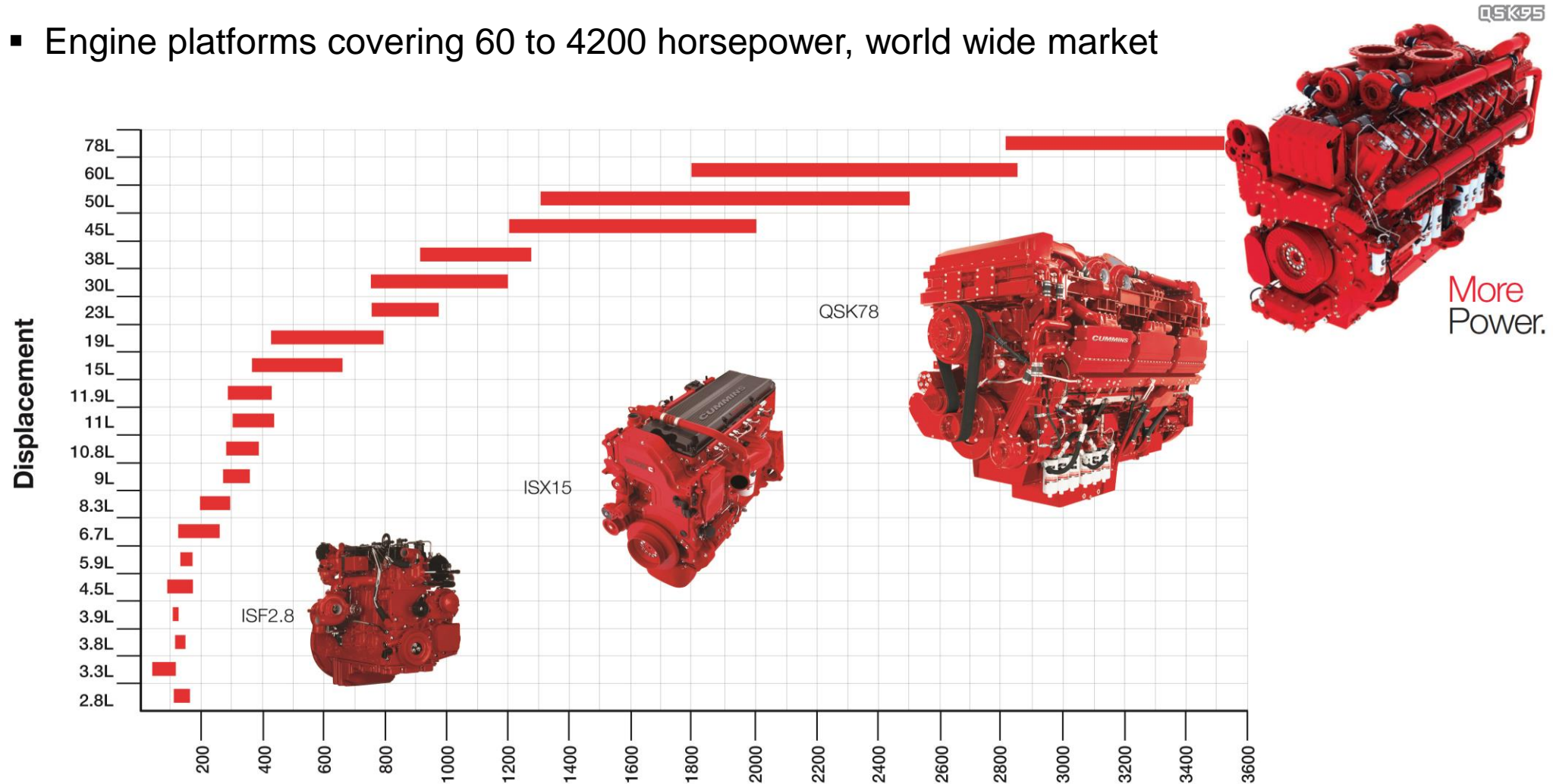
Cummins Data Classification: Public Information

Agenda

- Introduction to Cummins
- Model-Based Design @ Cummins
- Rapid Engine Control Prototyping
- Simulink Real-Time & Speedgoat
- Summary

Cummins Introduction

- Engine platforms covering 60 to 4200 horsepower, world wide market



Application Diversity

Truck



Bus



On-Highway
RV



Emergency



Hybrid



Agriculture



Marine



Defense



Mining



Railroad



Power Gen



Construction

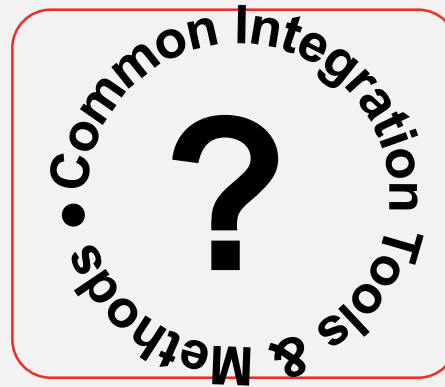


Oil & Gas



Operator
characteristics

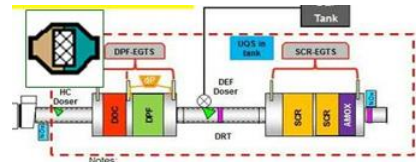
Duty/drive
cycles



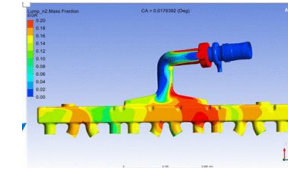
Environment
characteristics

Powertrain
components

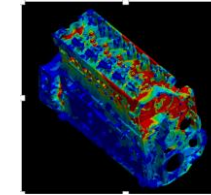
Powerplant Level Simulation Framework



Aftertreatment (AT)



Base Engine



Combustion

Electronic Controls



Fuel Systems



Air-handling system



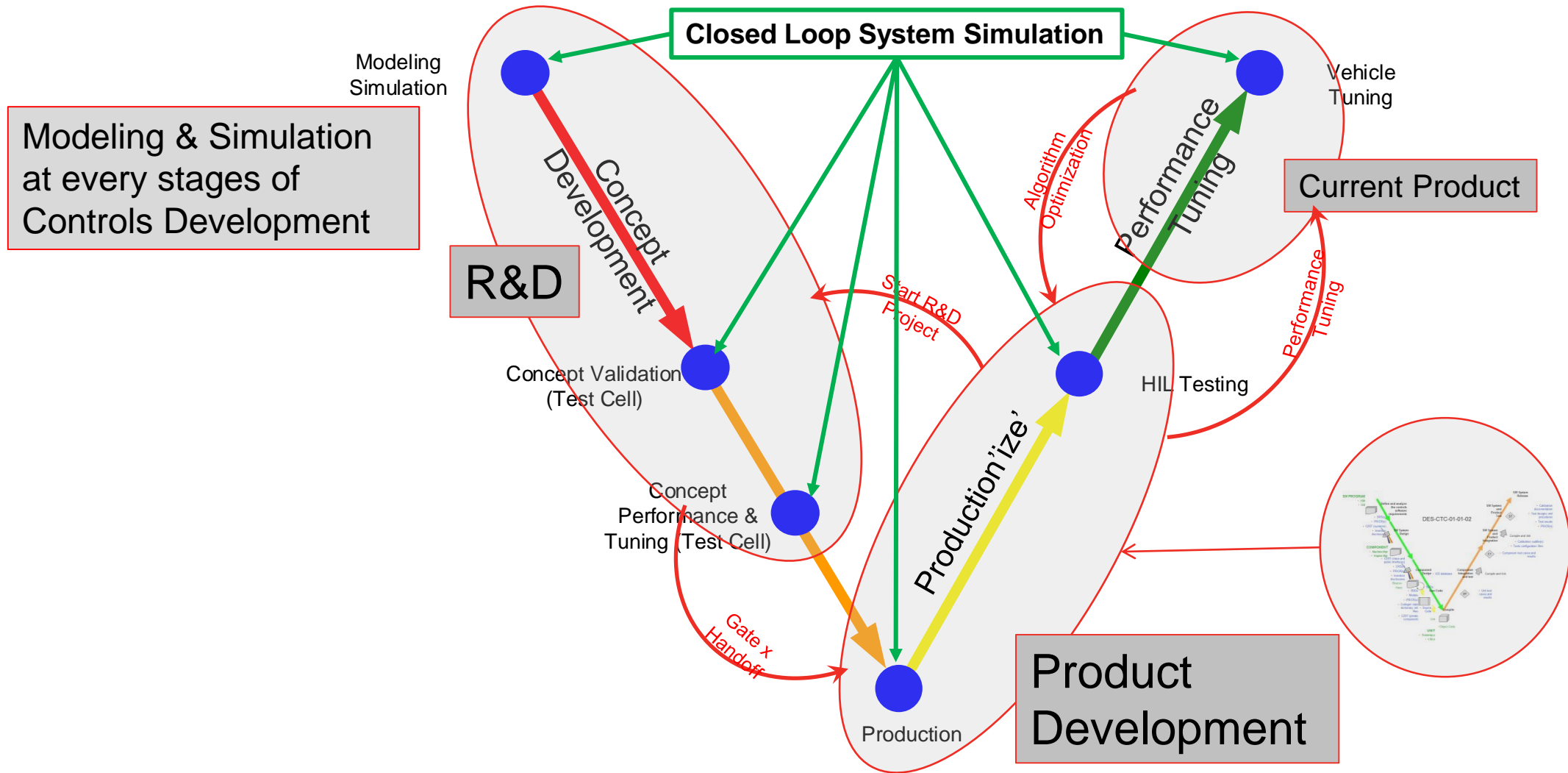
Waste Heat Recovery



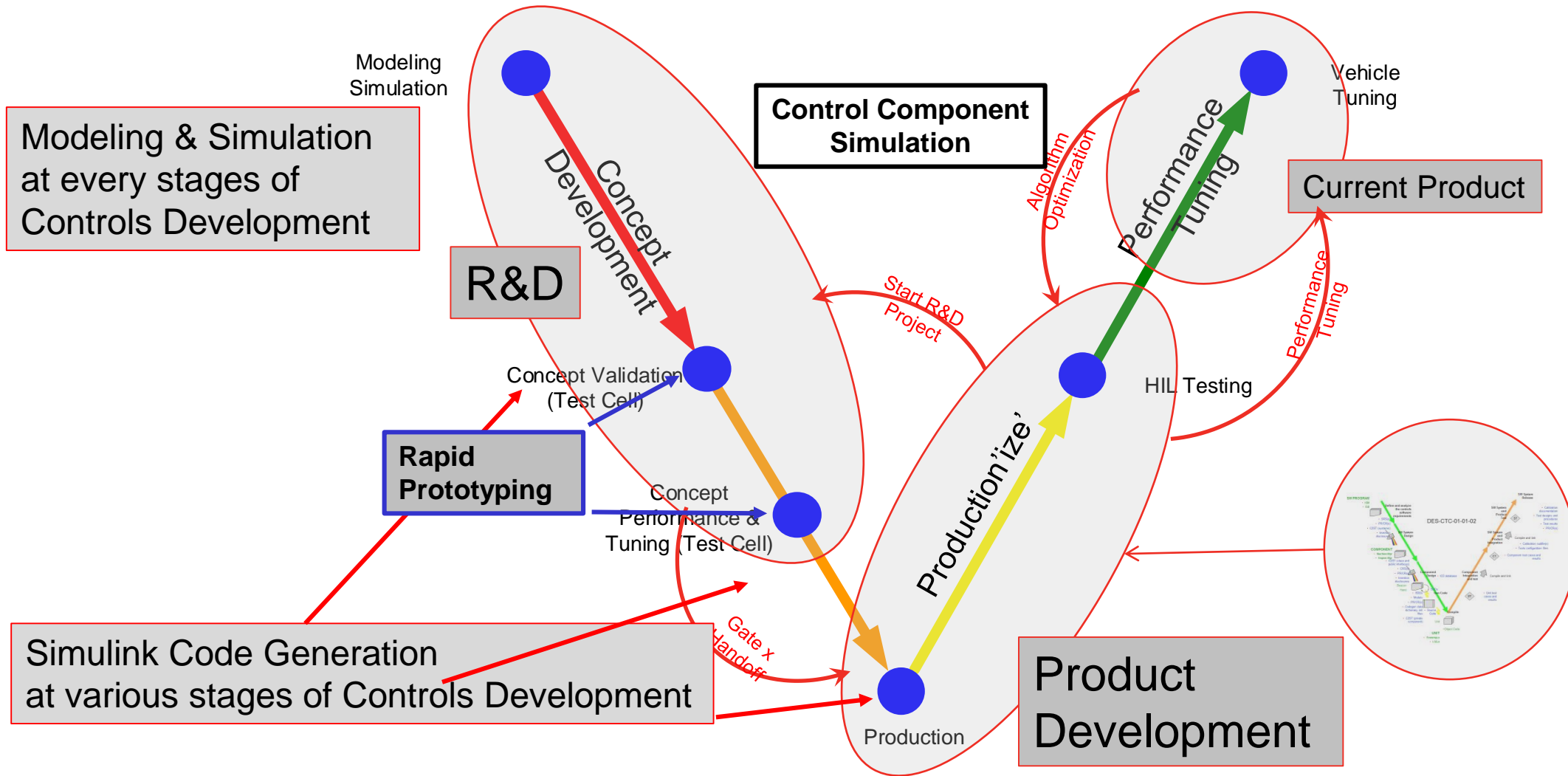
0D, 1D, 2D, 3D
Co-Simulation

Effective Integration
of complex systems
requires Model-Based
Design Integration

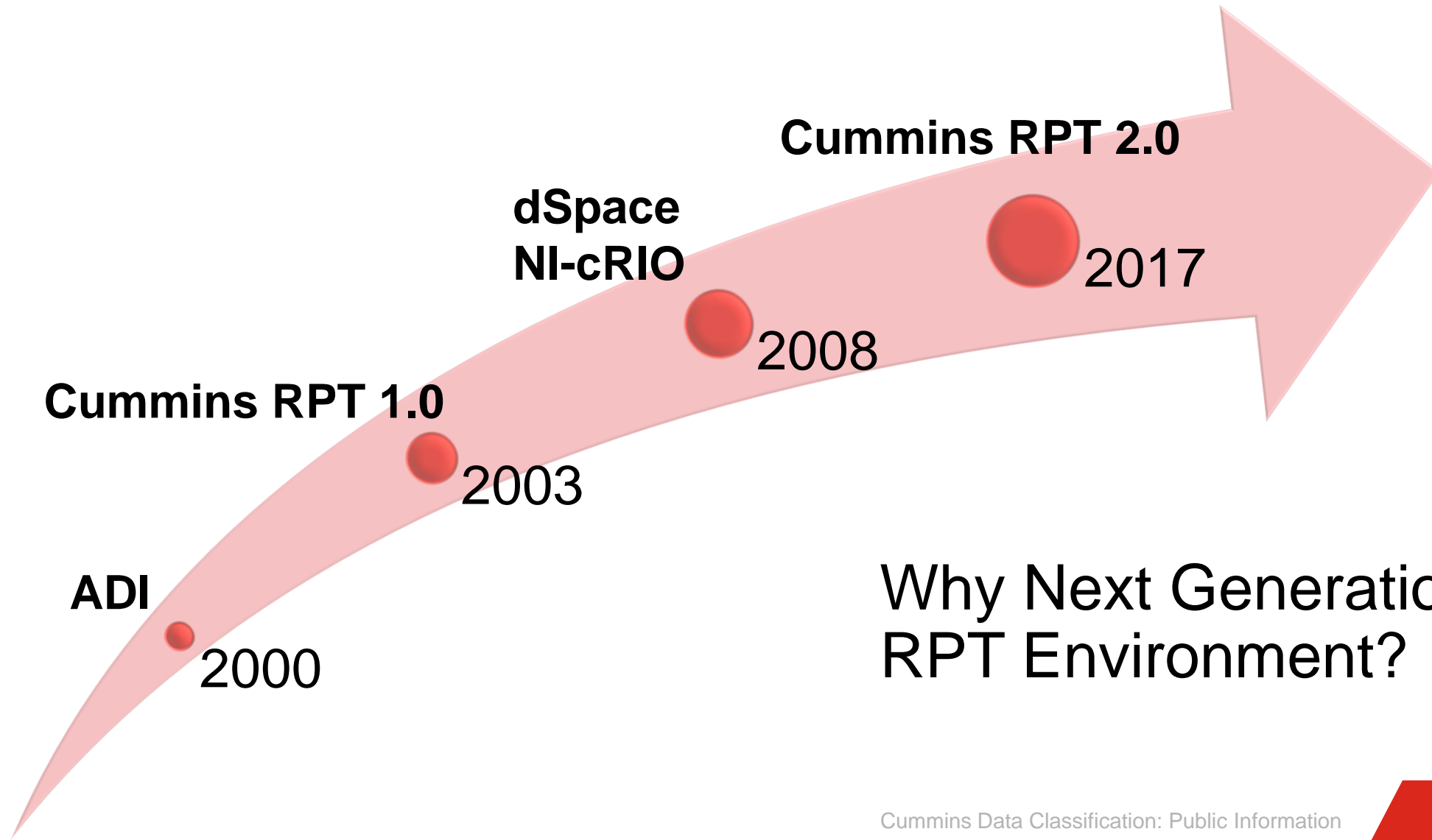
Model-Based Development at Cummins



Model-Based Development at Cummins



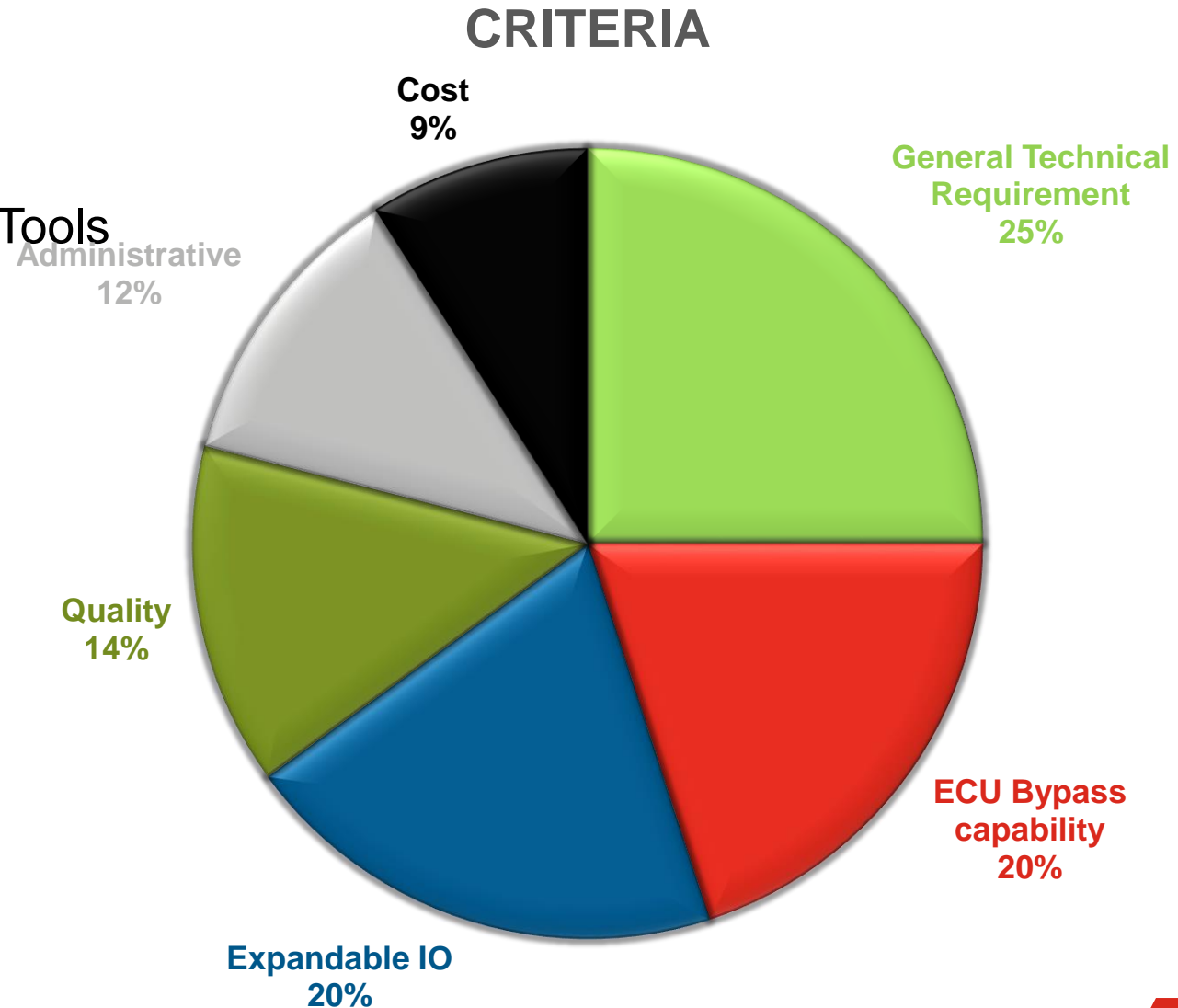
Rapid Control Prototyping



Why Next Generation RPT Environment?

NextGen RPT – Selection Criteria and Process

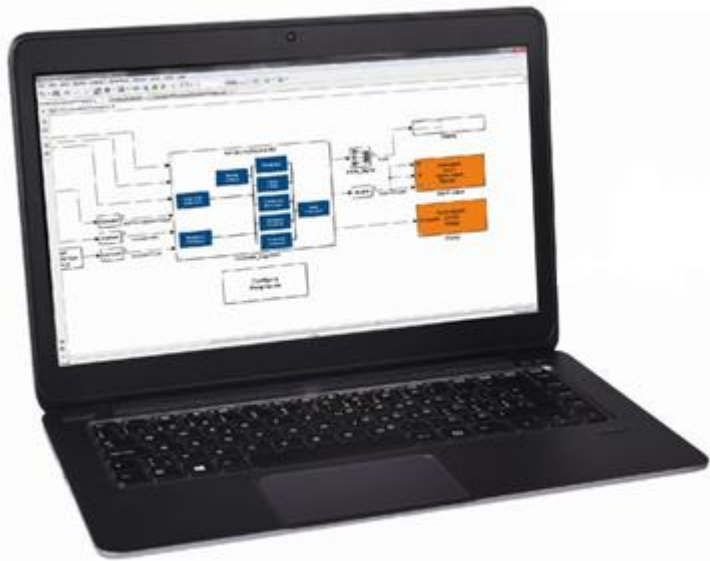
- Process
 - Using variation of 6Sigma Tools
 - C&E/Pugh Style Scoring
 - VOC (Cummins Internal)



NextGen RPT Hardware



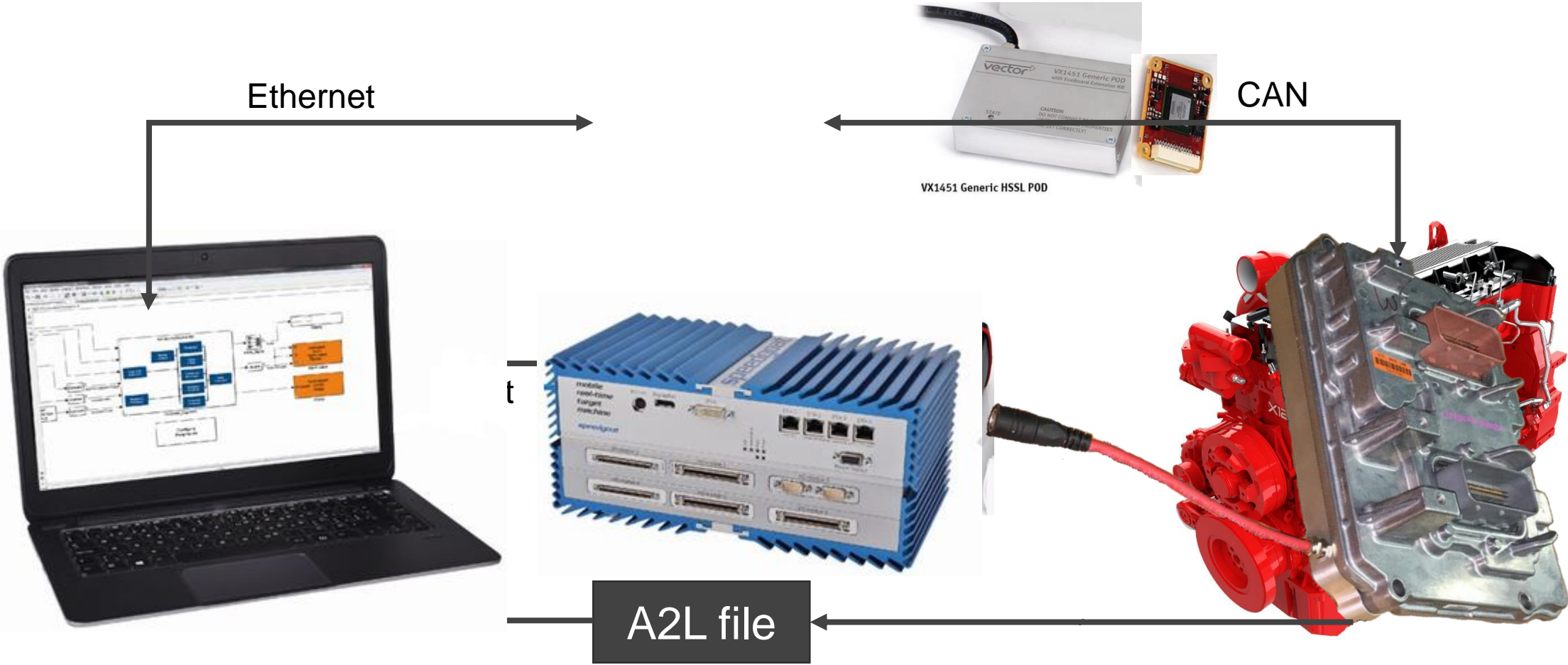
MATLAB/Simulink
Simulink Real-Time



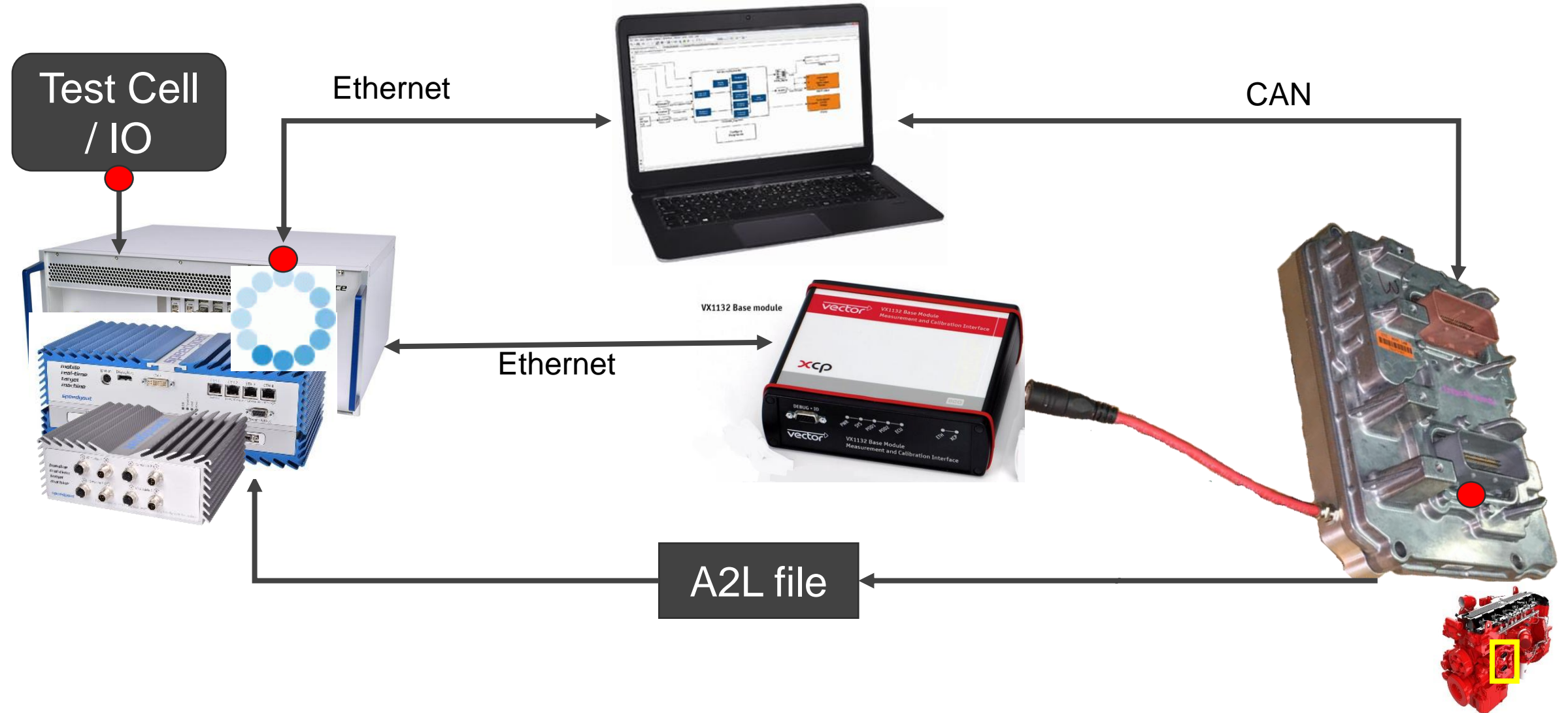
Rapid Control Prototyping



Rapid Control Prototyping - ECM Bypass



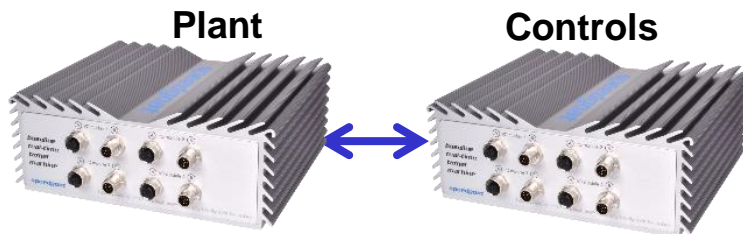
Unified, Robust, Fast Logging



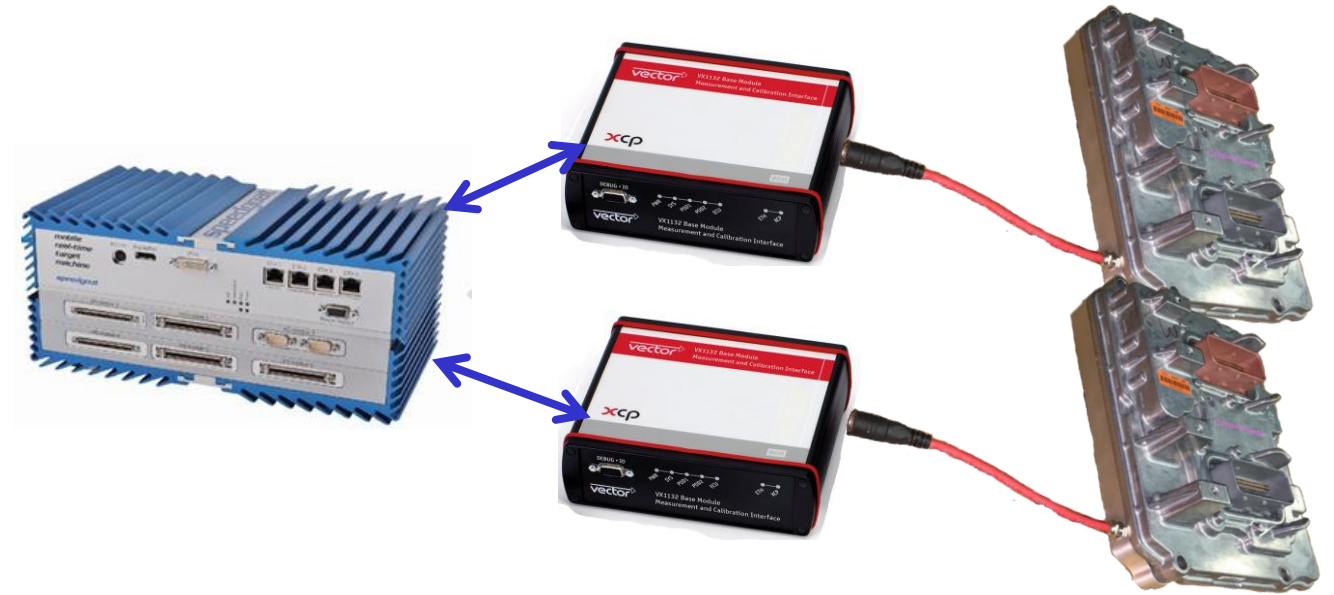
Future use cases



HIL Setup



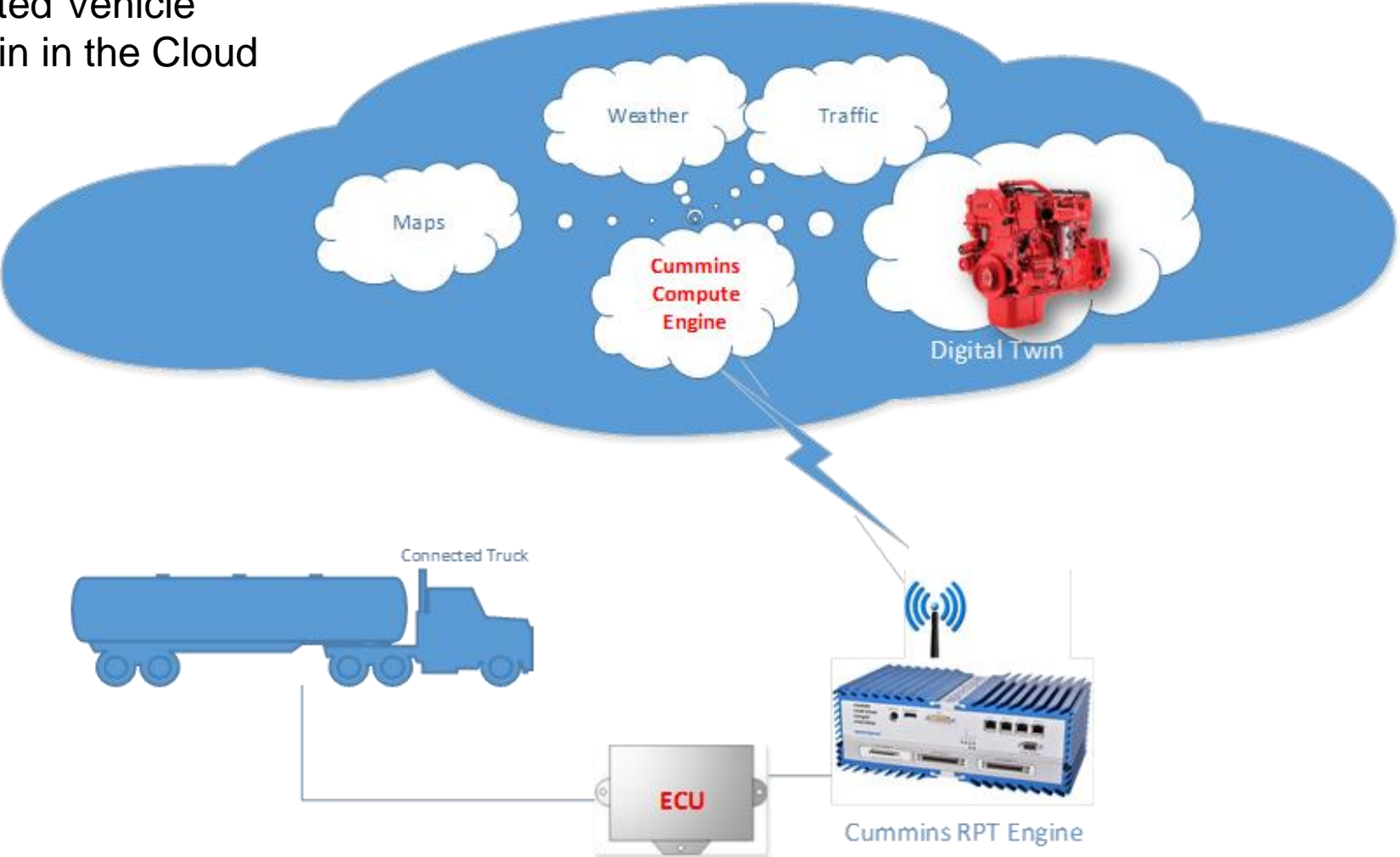
Component Model



Multiple ECU Bypass

Future use cases

Cloud Connected Vehicle
with Digital Twin in the Cloud



Summary

- After 15 months of continued effort and excellent support from MathWorks & Speedgoat, we established good Rapid Prototyping framework to be used across company.
- Invested in 8+ hardware systems supporting 5 different programs.
- Lastly, MATLAB/Simulink, Simulink Real-time and Speedgoat hardware enabled us to fulfil the goal of Digital Twin.

Q+A

