



MathWorks  
AUTOMOTIVE  
CONFERENCE 2018  
May 2 | Plymouth, MI



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

Roopak Ingole

May 2<sup>nd</sup> 2018

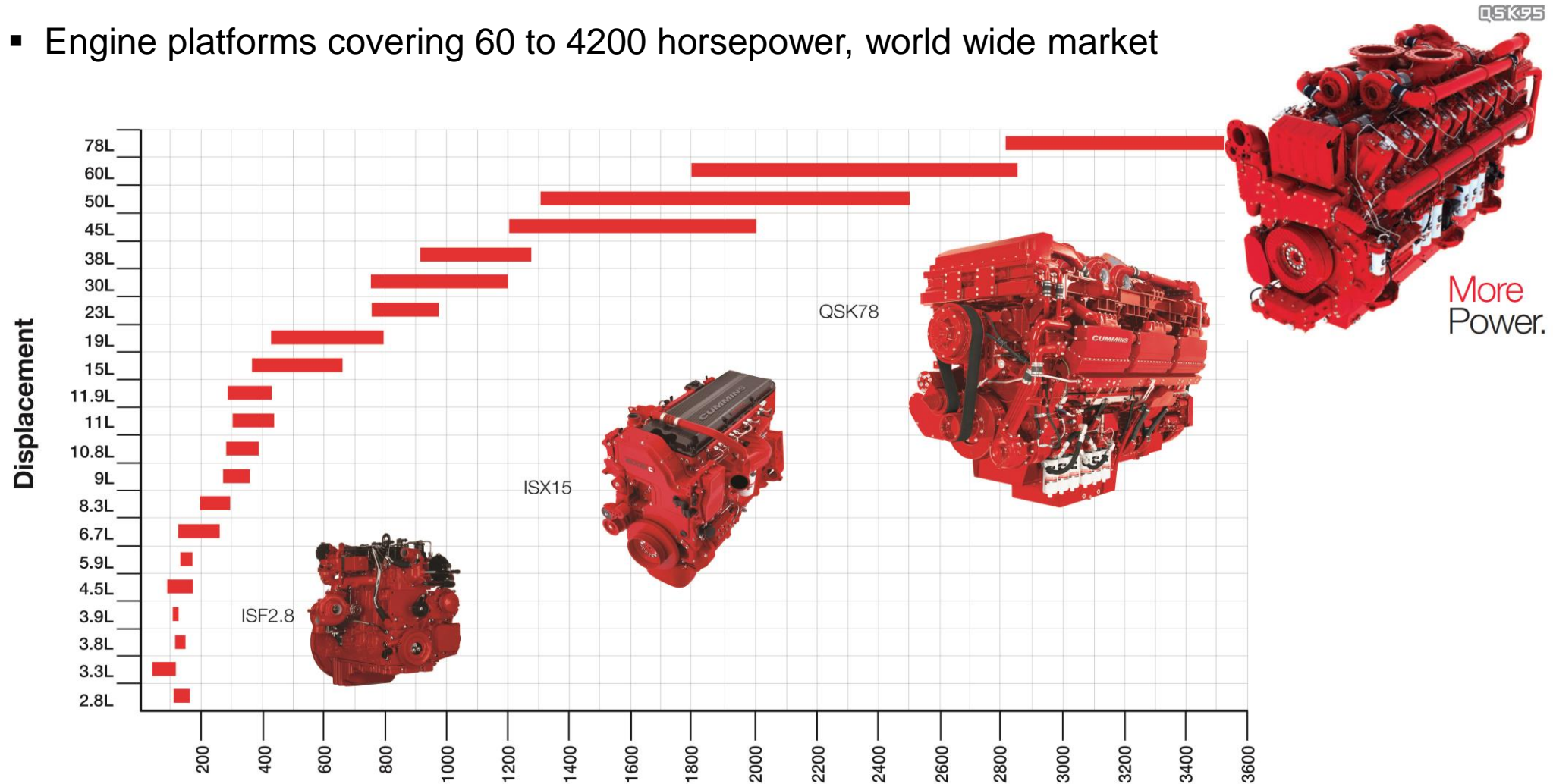
Cummins Data Classification: Public Information

# Agenda

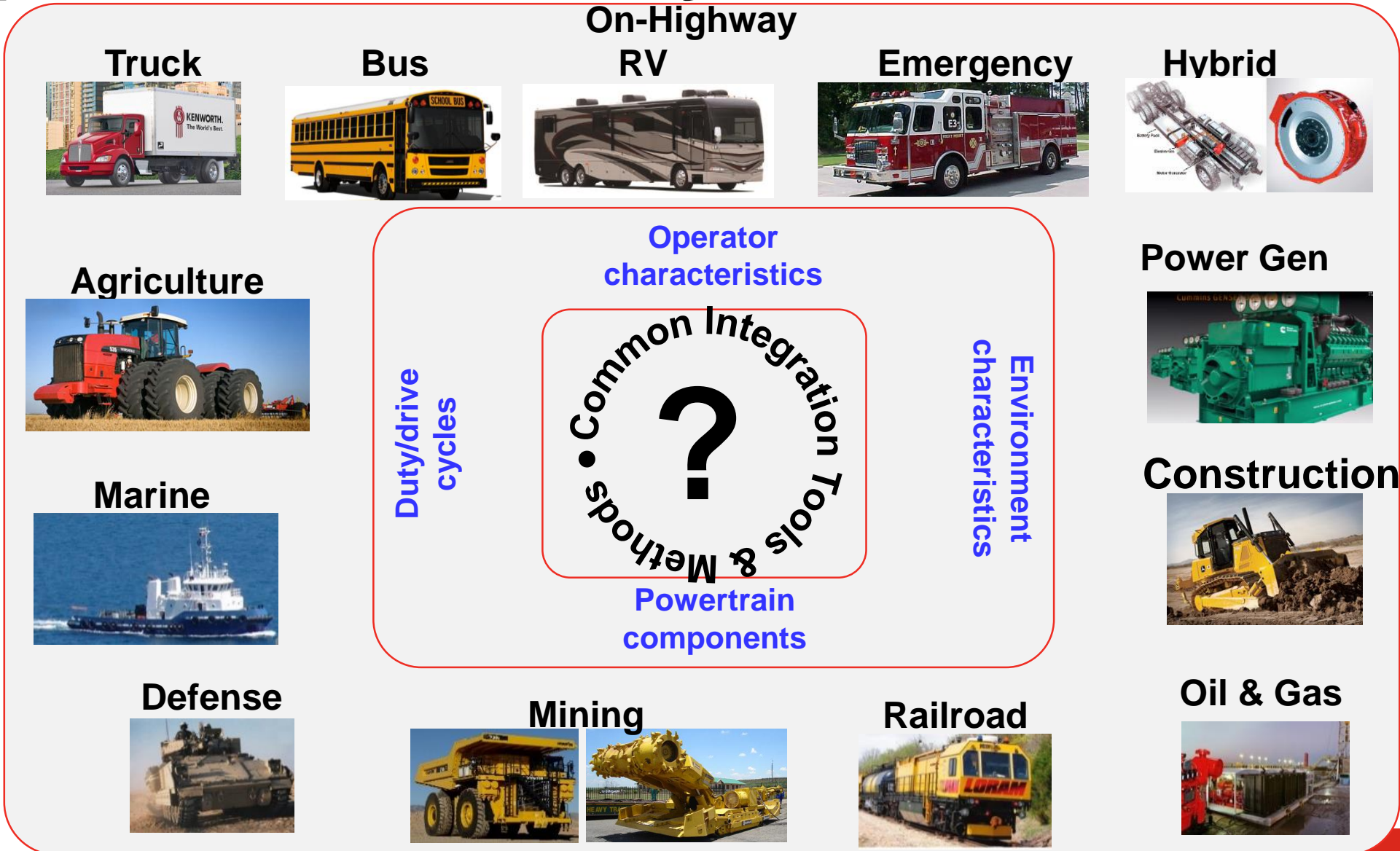
- Introduction to Cummins
- Model-Based Design @ Cummins
- Rapid Engine Control Prototyping
- Simulink Real-Time & Speedgoat
- Summary

# Cummins Introduction

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

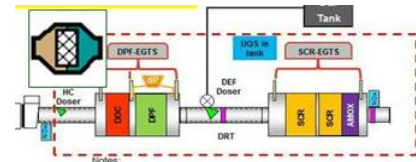


# Application Diversity

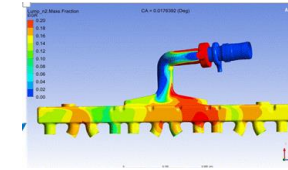




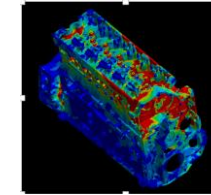
# Powerplant Level Simulation Framework



Aftertreatment (AT)



Base Engine



Combustion

Electronic Controls



Fuel Systems



Air-handling system



Waste Heat Recovery



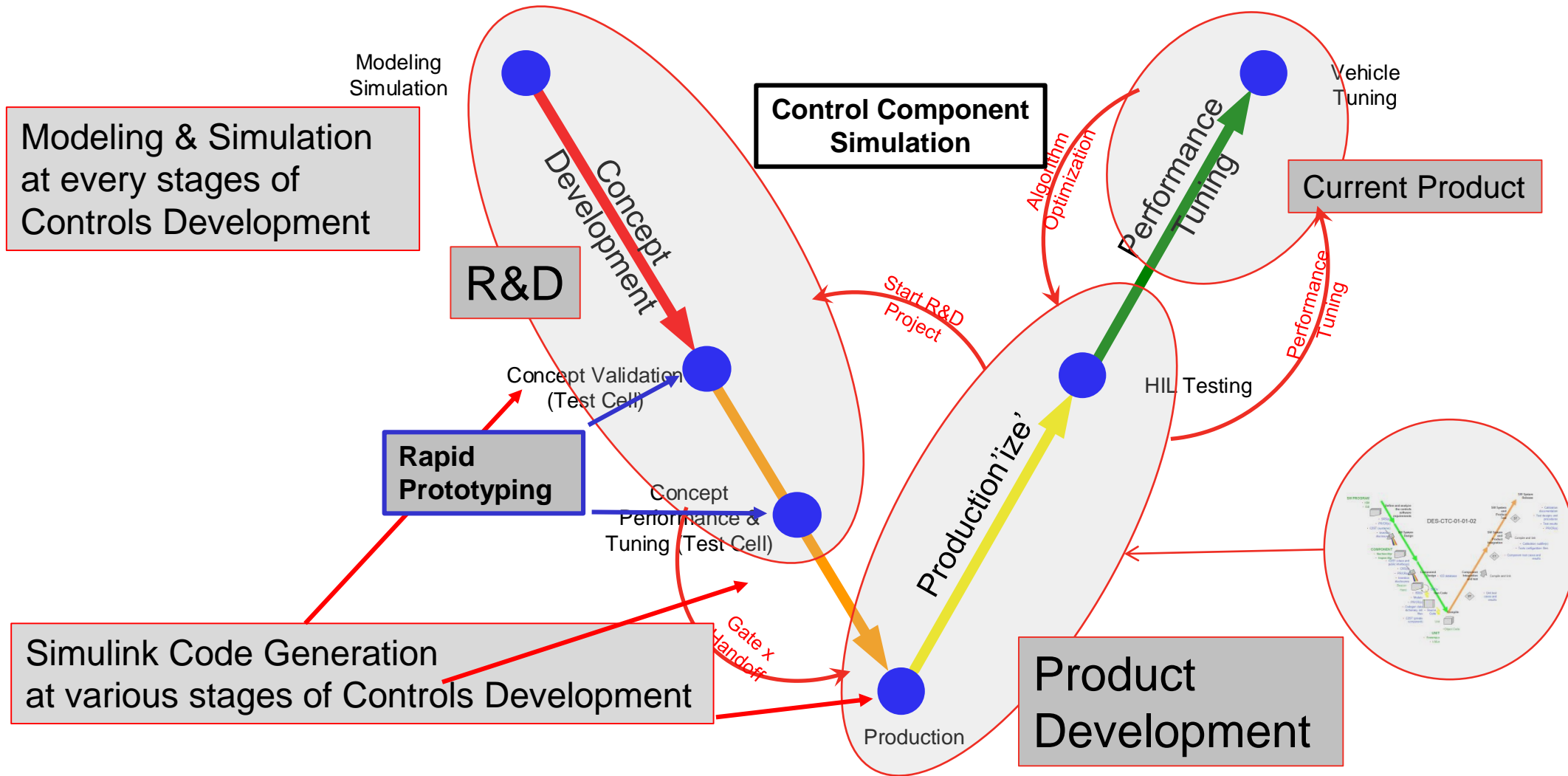
0D, 1D, 2D, 3D  
Co-Simulation

Effective Integration  
of complex systems  
requires Model-Based  
Design Integration



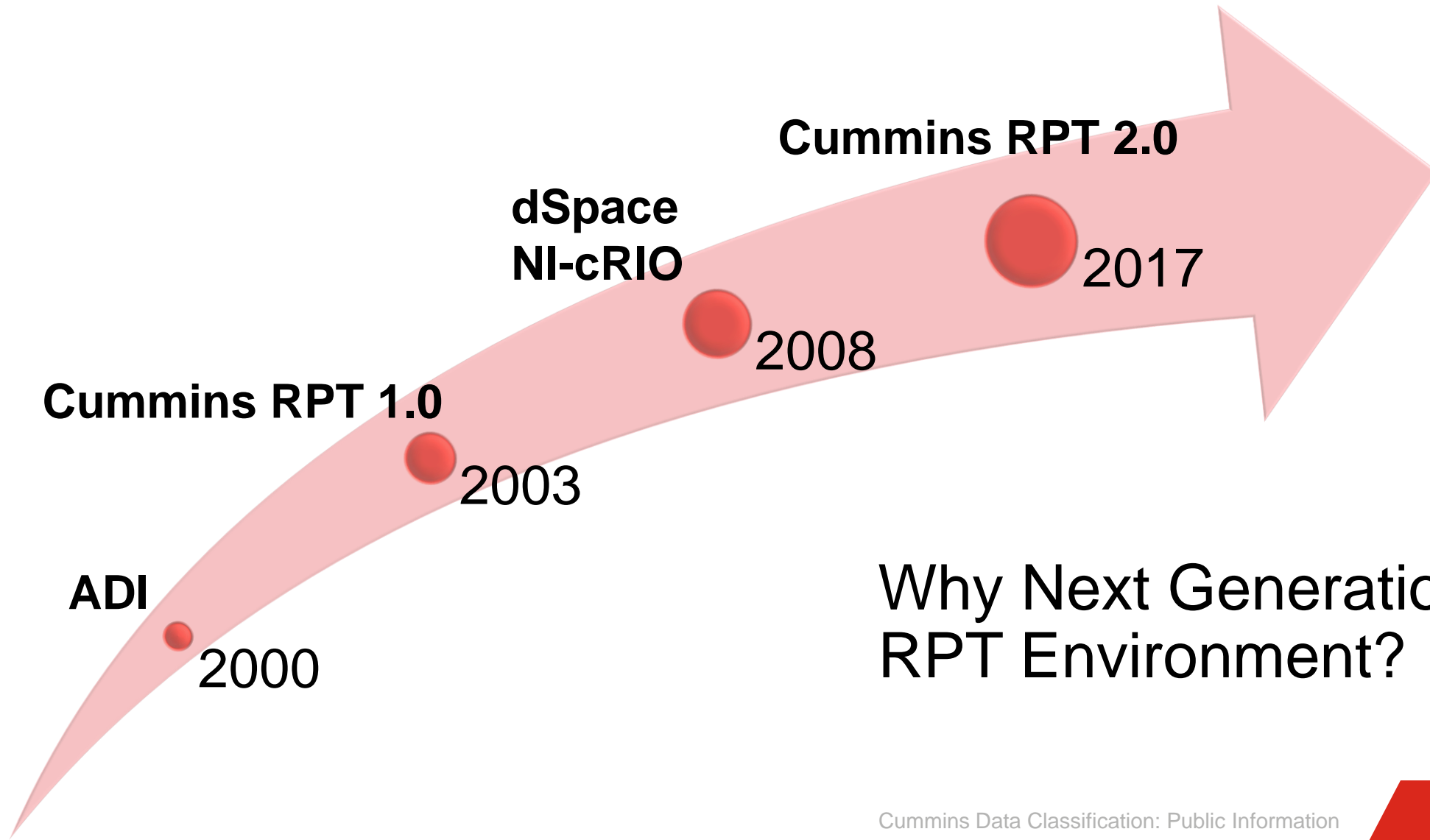


# Model-Based Development at Cummins





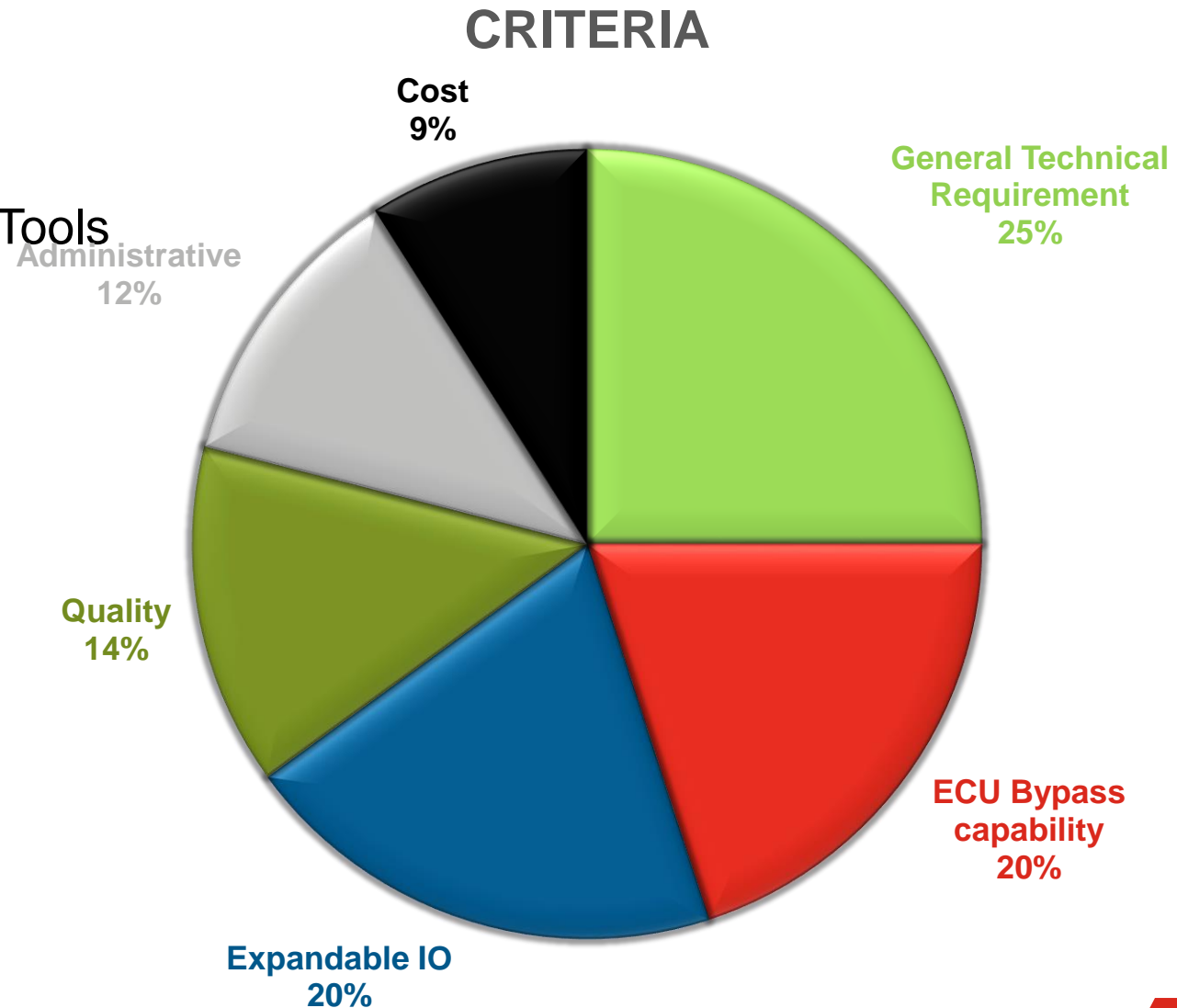
# Rapid Control Prototyping



Why Next Generation RPT Environment?

# NextGen RPT – Selection Criteria and Process

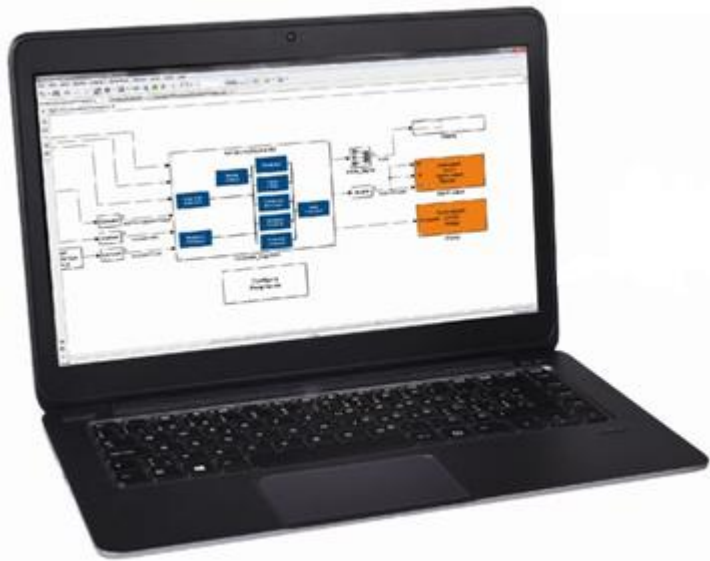
- Process
  - Using variation of 6Sigma Tools
    - C&E/Pugh Style Scoring
  - VOC (Cummins Internal)



# NextGen RPT Hardware



MATLAB/Simulink  
Simulink Real-Time



# Rapid Control Prototyping

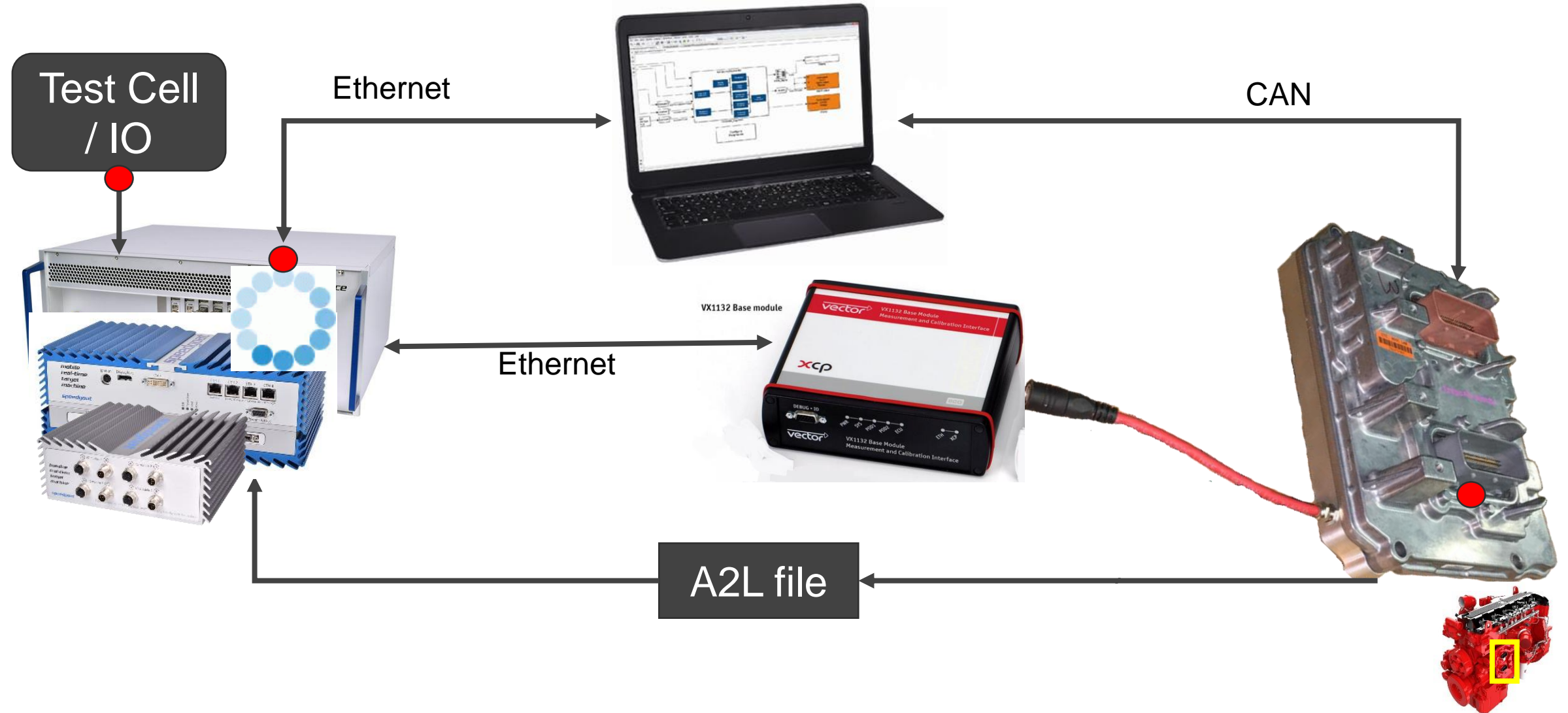


# Rapid Control Prototyping - ECM Bypass





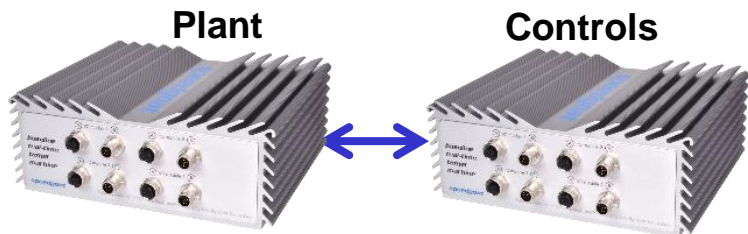
# Unified, Robust, Fast Logging



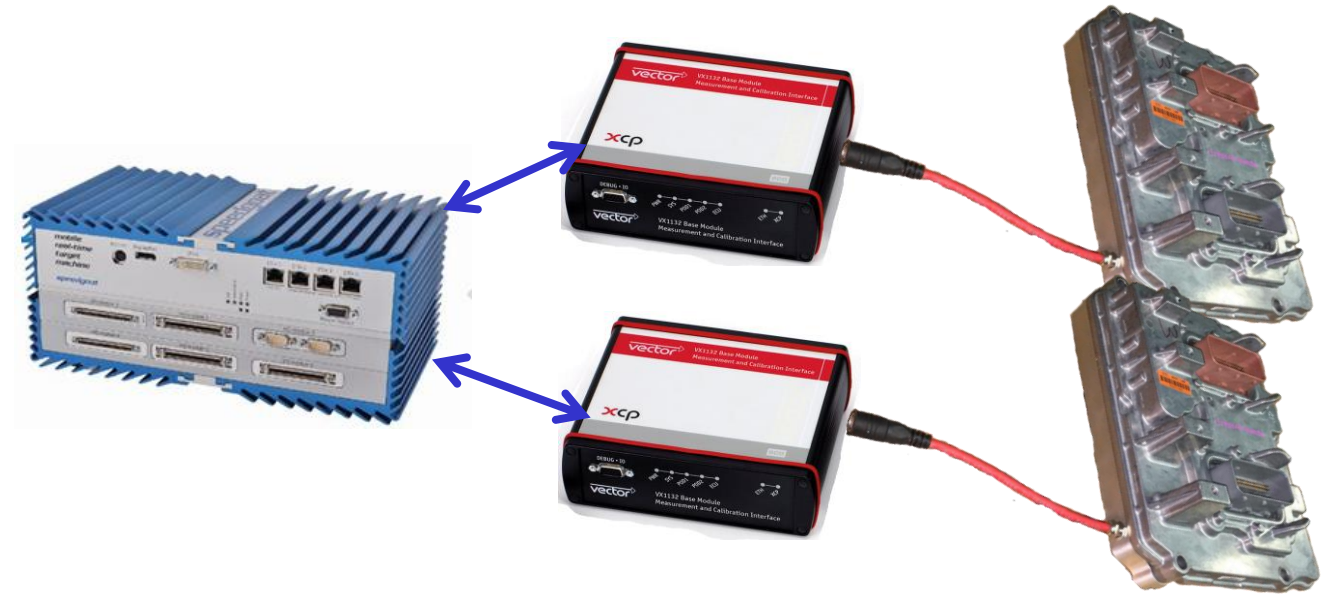
# Future use cases



HIL Setup



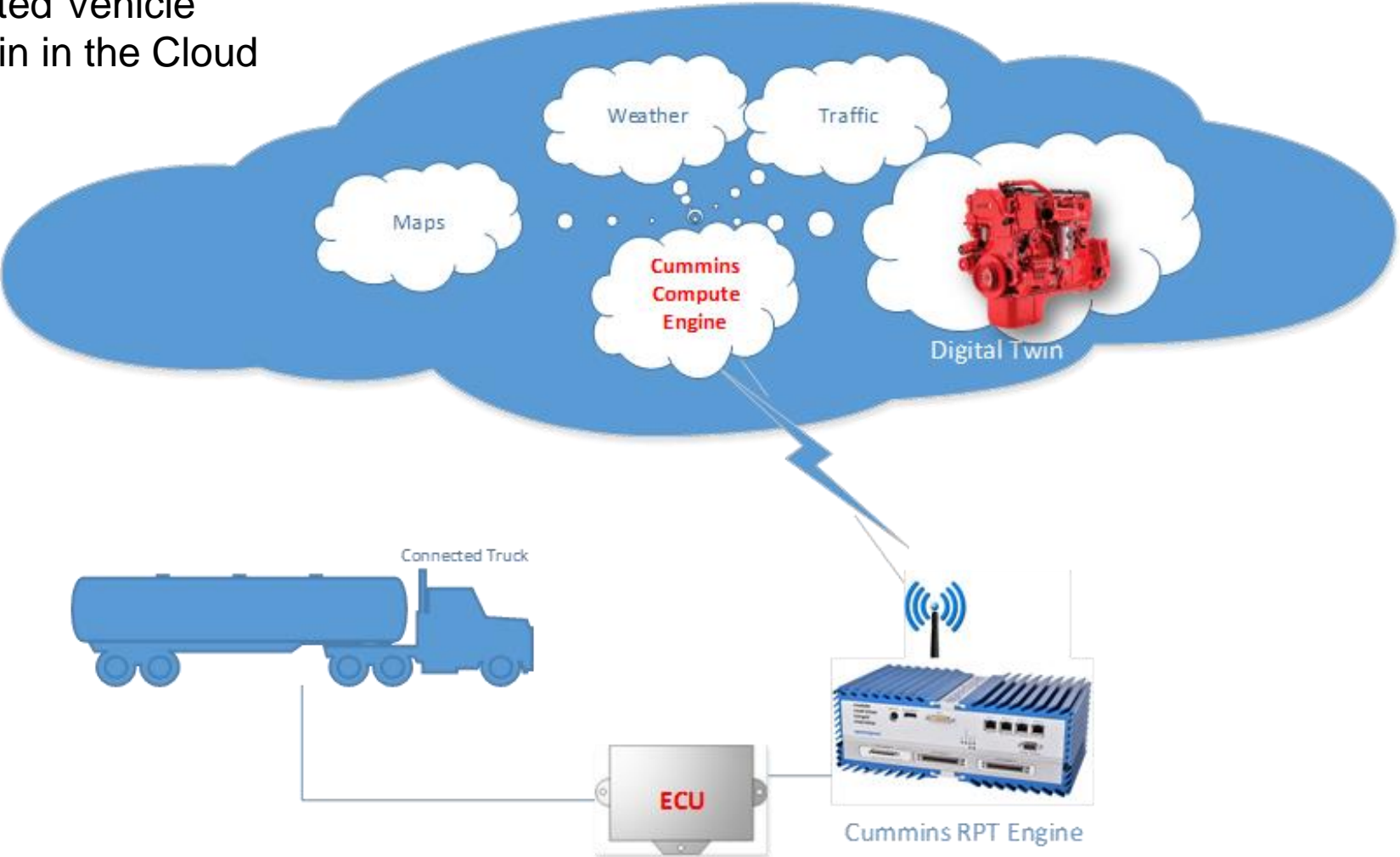
Component Model



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



