

The role of physical testing in the CAV engineering lifecycle

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Integrated CAV Test Eco-System

- Public environments
- Virtual environments
- Controlled environments
- Cyber-physical environments



Test distribution

Motivation:

- (1) Test early (Reduce rework cost) (2) Test virtually (Reduce test cost)

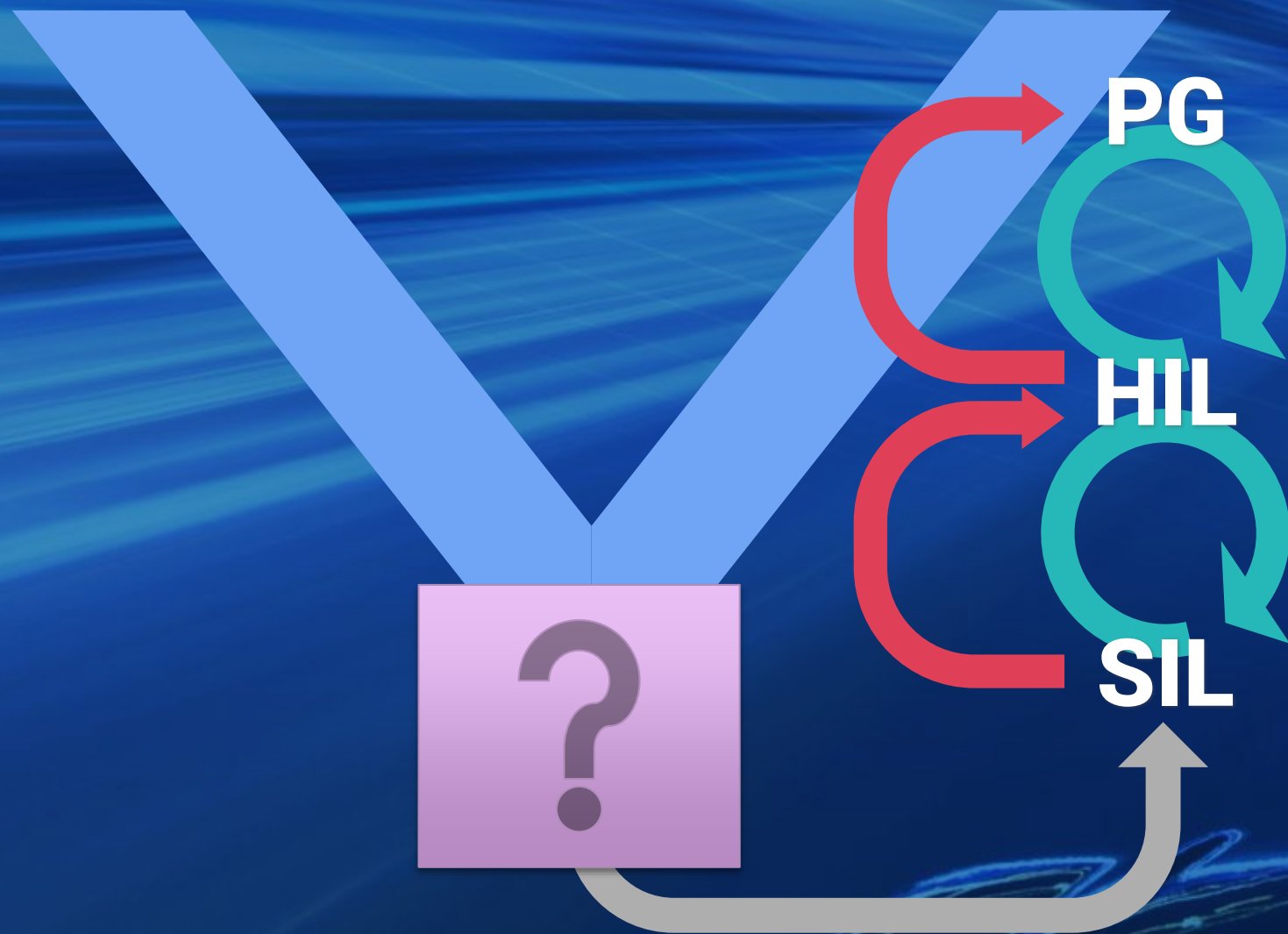
Test Gaps

We can't test all the requirements at this level:

- Test equipment not capable
- System integration level

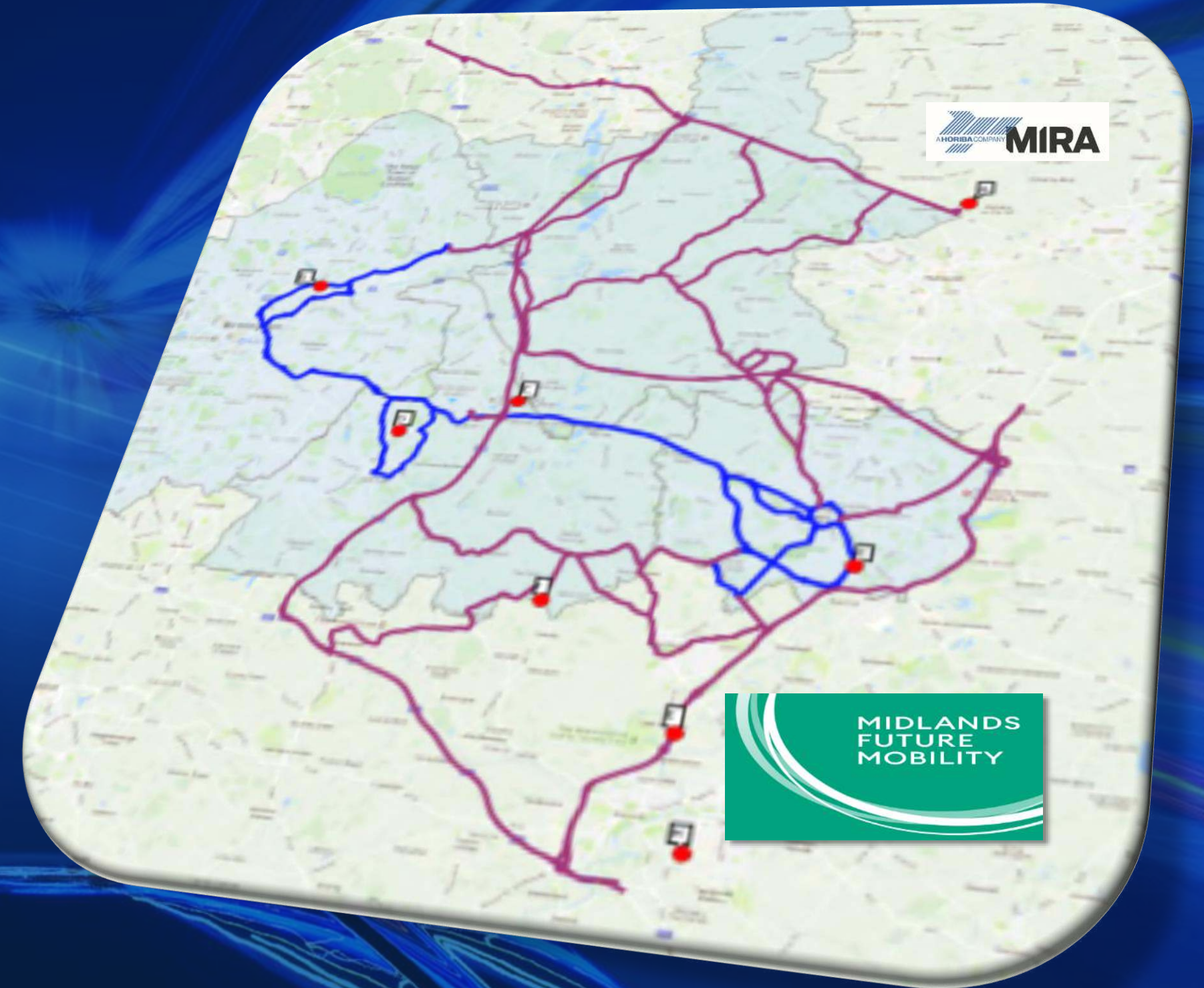
Correlation

Some element of the system or environment was approximated - we devise tests to carry out at later stages to seek correlation



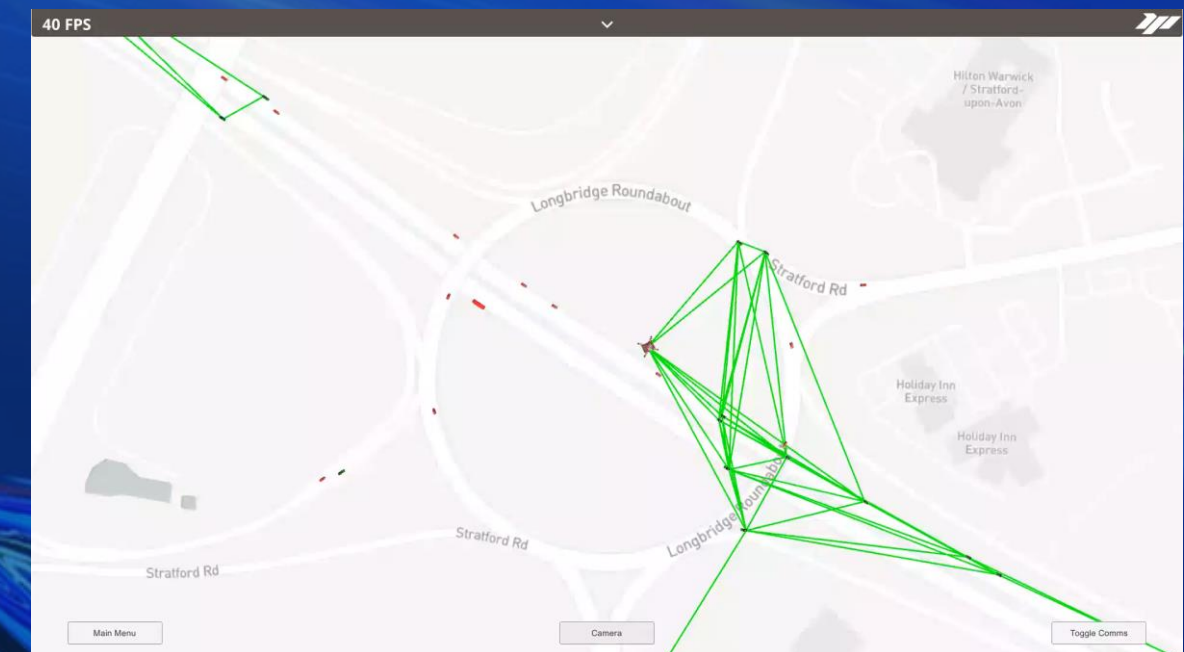
Public environment

- Capture real scenarios and failure modes
 - Particularly for perception systems
- Highly automated driving trials (SAE L4) already live – under UK Code of Practice
- Not a viable means for safety assessment
 - Billions of miles to make a statistical argument about system failure rates*



Virtual

- Required to address the volume of test scenarios
- Accuracy and realism of models can be a limiting factor
- Different levels of abstraction for different test activities



Controlled environments

- Characterise models, and demonstrate correlation of simulation results
- Validate system integration and demonstrate functionality in controlled conditions



Proving ground developments (Park-IT and TIC-IT)



Urban, interurban, highway and controllability scenarios



Proving ground test automation



Proving ground test automation



A hybrid approach: Vehicle-in-the-loop



Cooperative Merge Scenario



Cooperative Platoon Emergency Stop Scenario

Acknowledgements



Centre for Connected
& Autonomous Vehicles

Innovate UK

ZENZIC²
SELF-DRIVING REVOLUTION

UKAutodrive

HUMAN
DRIVE

TIC-IT
Trusted Intelligent CAV

UK **CITE**
CONNECTED INTELLIGENT TRANSPORT ENVIRONMENT

MIDLANDS
FUTURE
MOBILITY

Park-IT

VERICAV
VERIFICATION OF CONNECTED AND AUTONOMOUS VEHICLES

SAVVY

Summary

- All test activities have limitations and dependencies, which need to be addressed collectively
 - Simulation is critical - only practical way to address scale - but still just one piece of the puzzle
 - New test tools, assets, and facilities to exercise CAV technologies at component, system and vehicle level – in simulation, laboratory and proving ground conditions
 - New processes for test planning, allocation, correlation and validation

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