CAM Testbed UK

Six world leading facilities to take your CAM development from concept to reality

camtestbed.uk

CAM TESTBED UK

CAM Testbed UK

Our Mission

CAM Testbed UK are leading the move towards a safer, more inclusive and productive mobile future.

The UK is the only place worldwide with the capability to take connected and automated mobility technologies from concept to development, both virtually and physically, all within 3 hours drive and less than 150km.

At the core of the UK's offer is CAM Testbed UK, a comprehensive and coordinated set of six world-leading facilities for the modelling, simulation, testing and trial deployment of connected and automated mobility solutions. All backed by globally significant players.

Our Values

Collaborative, working transparently together.

Focused, in accelerating the adoption of CAM technologies.

Co-ordinated, specialising in everything from real world urban and rural testing to simulation, cyber security and data analytics.

A

ASSURED CAV

Urban parking
Limit of controllability
Connected and configurable

B

MIDLANDS FUTURE MOBILITY

Highly connected
real-world and digital
environments

convex

Data
Virtual

C

CAVWAY

Controlled environments
Configurable junctions
Flexible connectivity

D

UTAC
Millbrook – Culham

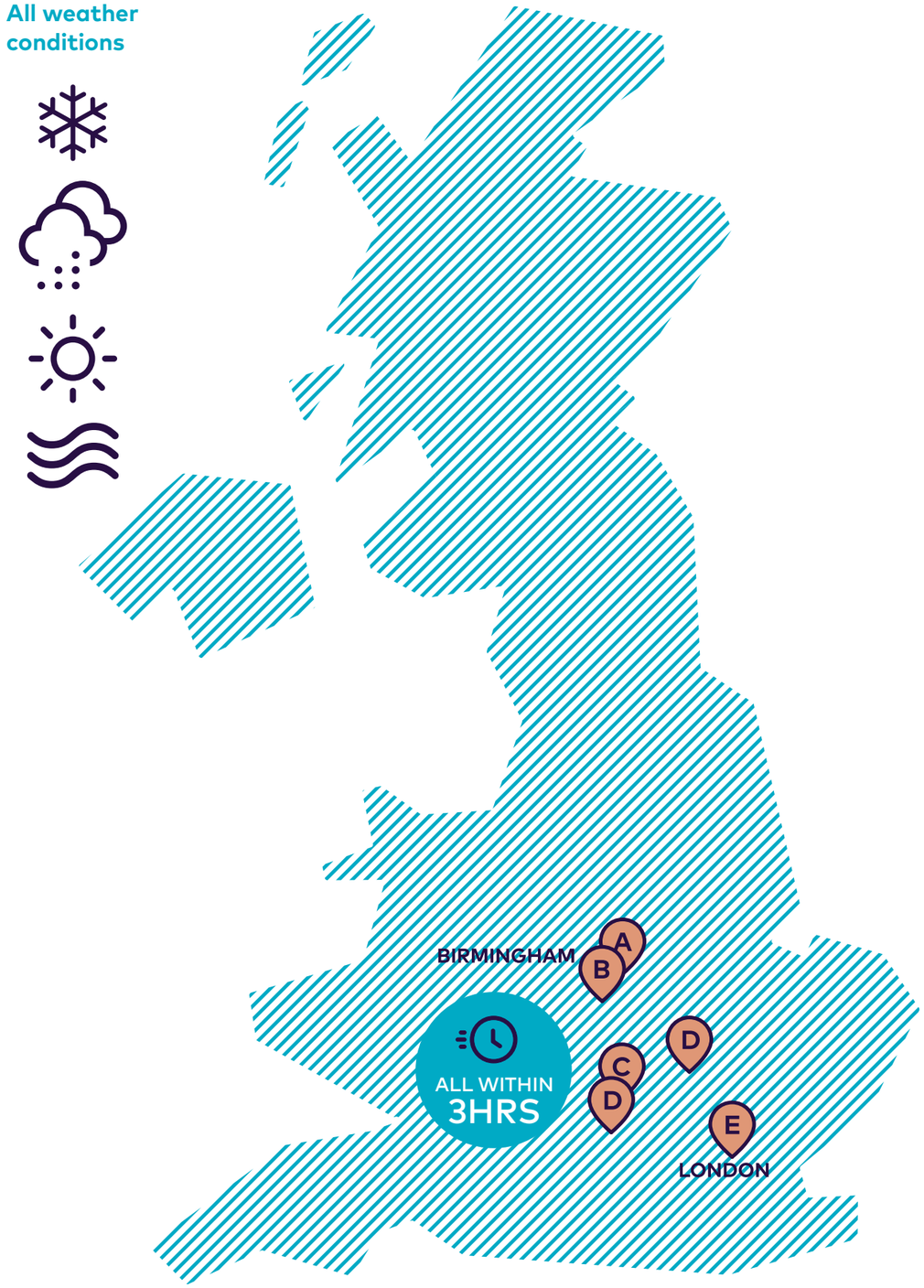
Secure site
Controlled and
semi-controlled

E

Smart Mobility Living Lab London

Public and private
London roads
Digital and
real-world testing

All weather conditions



Testing capabilities

Data | Parking | Rural | Highways | Urban | Physical | Virtual

CAM TESTBED UK

Why the UK?

The UK aims to lead the global transport revolution – take advantage of a complete testing network in the best pace globally to support CAM technology development.

World's only co-ordinated eco-system

World class academic community and research institutions

An open regulatory approach to testing on UK roads

Expertise in data and cyber security

Easy connections with supportive partners

Growing technology clusters
(Motorsport Valley, Silverstone Technology Cluster etc)

Simulation & modelling with physical testing to accelerate validation and verification

Well funded Research and Development base

Take ideas from concept to commercialisation in CAM Testbed UK

CAM Testbed UK is the world's number one location for the development and testing of CAV and CAM technologies.

CAM TESTBED UK

Assured CAV

Scan here to watch a short film on what Assured CAV can do for you

Testing to the limit of controllability

A globally unique facility allowing CAM vehicles to be pushed to their limits in a controlled, configurable and connected environment to ensure they are safe and secure. Integrated CAM ecosystem enabling seamless transition from virtual to controlled, to public test environments. Located at Horiba Mira.

horiba-mira.com/assured-cav

Midlands Future Mobility

Scan here to watch a short film on what Midlands Future Mobility can do for you

Real-world testing and development across the Midlands region

The MFM route for trialling of CAM solutions offers a combination of campus (mini-city), urban, rural and highways roads on which trials can be supported. Across the 200 mile route and 12 partners we offer a range of CAM development and trialling services, from initial virtual development through to real-world trials and market deployment.

midlandsfuturemobility.co.uk

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CAVWAY

Scan here to watch a short film on what CAVWAY can do for you

Testbed focused on road junctions

The 1st new automotive proving ground to be constructed in the UK for over 50 years, CAVWAY is a unique facility for supporting CAV testing and is focussed on both road junctions and flexible connectivity. Designed for maximum flexibility including a multifunctional platform allowing junctions of many different configurations to be simulated. Due Q1 2023.

cavway.co.uk

UTAC Millbrook – Culham

Scan here to watch a short film on what UTAC Millbrook – Culham can do for you

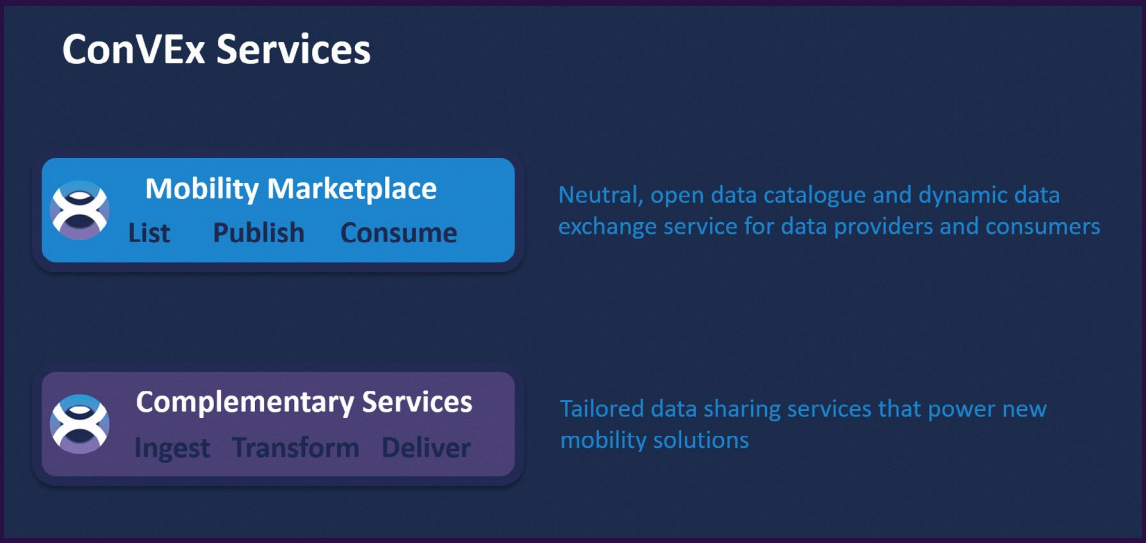
Controlled and semi-controlled CAM testing

Investment by the Millbrook-Culham Urban Testbed in 5G, data storage, vehicles and simulation, together with unique access to a 2,000 person adult population in a secure site, enables testing to capture human aspects of real-world operation for CAM, including Mobility as a Service (MaaS).

utac.com

CAM TESTBED UK

Convex



Scan here to watch a short film on what Convex can do for you

UK's Mobility Data Exchange

An open platform for the commercial exchange of data to enhance and accelerate the development of new mobility products and services. The facility will aggregate data from a diverse range of sources such as vehicles, infrastructure and traffic control.

convex.uk.com

Smart Mobility Living Lab: London

Scan here to watch a short film on what Smart Mobility Living Lab: London can do for you

UK's most advanced connected urban testbed

Using public and private roads in London to safely develop and validate new transport technologies in a real-world connected environment. SMLL offers an urban living lab and semi controlled test environments , plus support for simulation-based testing.

smartmobility.london

CAM TESTBED UK

High level CAM testing capability

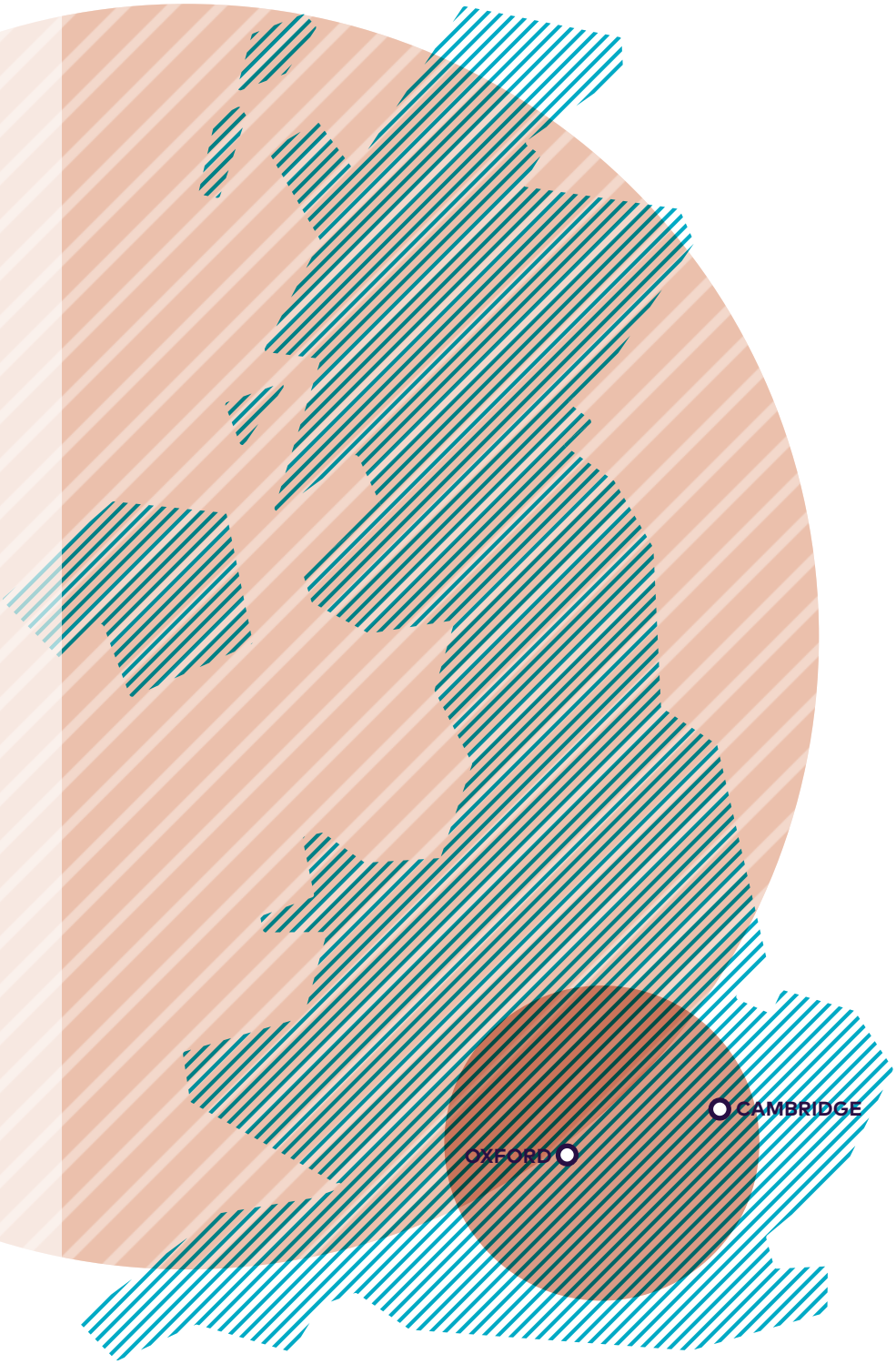
		Smart Mobility Living Lab London	UTAC Millbrook – Culham	CAVWAY	MIDLANDS FUTURE MOBILITY	ASSURED CAV	CONVEX
		Public Environment	Controlled Environment	Controlled Environment	Publc Environment	Controlled Environment	Data Exchange
		• Urban • Inter-urban	• Urban • Inter-urban	• Urban • Inter-urban • Junctions	• Inter-urban	• Urban • Inter-urban • High speed / Limit handling • Parking	
Controlled environment	Urban		✓	✓		✓	✓
	Rural		✓	✓		✓	✓
	Inter-urban		✓	✓		✓	✓
	High speed		✓	✓ (to 160km/h)		✓	✓
	Limit handling		✓	✓		✓	✓
	Parking					✓	✓
	Tunnels						✓
	Connectivity		✓	✓		✓	✓
	Weather testing		✓	✓		✓	✓
	Dedicated freight / Logisitcs testing					✓	✓
	Sensor testing		✓	✓		✓	✓
	Construction zones						✓
	Rail crossing						✓
Public environment	Urban	✓			✓	✓	✓
	Rural				✓	✓	✓
	Highways	✓			✓	✓	✓
	Inter-urban	✓			✓	✓	✓
	Parking				✓		✓
	Tunnels	✓			✓		✓
	Connectivity	✓			✓		✓
	Weather testing						✓
	Freight / Logistics	✓			✓		✓
	Simulated Testbed	✓	✓	✓	✓	✓	✓
	Virtual Validation	✓	✓	✓	✓	✓	✓
	Data Exchange	✓			✓		✓
	Interoperability / National coordination	✓	✓	✓	✓		✓
	Cyber security			✓	✓	✓	✓
	SME Support (testing)	✓	✓	✓	✓		✓

The CAM Testbed UK region

Industry, Government and Academia are working together to make the UK the best place in the world to develop, test and deploy CAM technologies.

The CAM Testbed UK region offers access to an advanced, comprehensive and coordinated CAM testing ecosystem, a world-class academic research comminity, a growing industry cluster and an impressive talent base.

- Acccess a **comprehensive set of environments** and capabilities for the testing and development of connected and self-driving vehicle technologies.
- Integrate with a **rapidly growing and exciting research and innovation intensive custer** enabling you to take ideas from conception to reality.
- Capitalise on a **wide choice of incubation and soft landing platforms in close proximity to testing facilities** to set up with dedicated collaborative space for you, industry and academia
- Gain direct access to a **core of highly-skilled CAM related students, professionals and capabilities** necessary to create integrated CAM solutions.
- Exploit **competitive labour and commercial property costs;** lower than other key markets such as Germany, France and Sweden.
- Plug into a **growing connected and automated mobility cluster** and benefit from significant government and sector support.

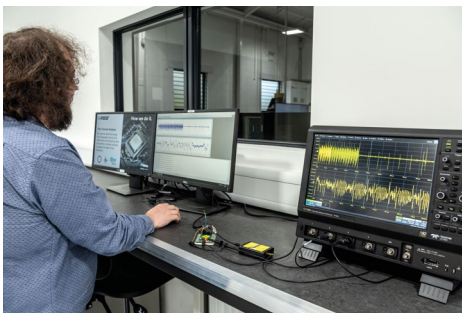


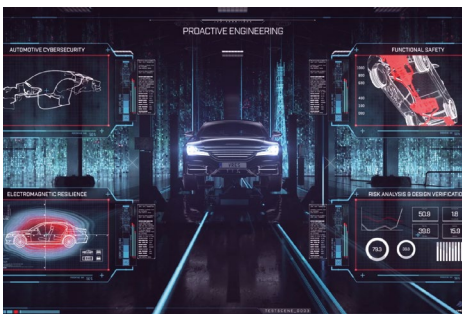
Unique facilities within a 3 hour drive

CAM Testbed UK in action

One of CAM Testbed UK's unique offerings is its interoperability, which enables customers to navigate smoothly through the different capabilities of the testbeds, using them to test, verify and validate their products and services in these world leading facilities.

These real-life case studies demonstrate the interoperability of the testbeds and how companies have used multiple testbeds to progress their product and services offerings.





01

AI/Computer Vision

Testbeds Utilised:

A ASSURED CAV

B MIDLANDS FUTURE MOBILITY

E Smart Mobility Living Lab London

What was the aim?

To build robust and cost-effective vision software for safe transport solutions specifically targeted at autonomous driving applications.

To further test and validate their technology on real roads - to accelerate market deployment and increase the opportunity to build relationships with customers.

SMLL London - Functional testing

The first requirement of the testing strategy is to test and validate the robustness of a 'monocular depth estimation module' at SMLL London's Greenwich and Queen Elizabeth Olympic Park locations.

The SMLL testbed offers more than 1,000 unique and characterised road features, each presenting different challenges and enabling targeted research.

It represents modern cities well, with many static and dynamic features to enable thorough testing of autonomous vehicles and software, diverse testing scenarios on London's busy urban streets, featuring a complex array of roads, junctions and intermodal connections that allow advanced testing and trials in real-world environments across various weather situations and road conditions.

The facilities at SMLL London ensure that the technology can be tested, and performance observed from every angle.

With the support of SMLL London, it is possible to test complex and interesting London urban scenes as well as diverse scenarios to show how the solution works with a number of edge cases.

Midlands Future Mobility (MFM) - Technology benchmarking

The second requirement was to test integrating the software solution onto a vehicle platform to perform a number of ADAS manoeuvres, including adaptive cruise control in an open, real-world environment. MFM is the obvious choice for this testing requirement as the routes for trialling CAM solutions offer a unique combination of campus (mini-city), urban, rural and highway roads (over 300 miles in total) on which trials can be supported. This includes CCTV, weather stations, communications units and highly accurate GPS coverage.

ASSURED CAV

Testing at HORIBA MIRA focused on tests critical to achieving key qualifications needed to offer the solution to the connected and autonomous mobility market, testing and validating the technology.

Successes + Next Steps

The testing plan enables the company to continue the optimisation of its solutions, using new insight and data gained from these testing scenarios. As a secondary benefit to working with the Testbeds, the company is also now focusing on scaling alongside their new customers, so they've begun expanding the team to accelerate product delivery.

Testbeds Utilised:

A ASSURED CAV

D UTAC Millbrook - Culham

E Smart Mobility Living Lab London

What was the aim?

This is high-precision antenna technology, which enables resilient and accurate geo-positioning, even in multi-path or urban canyon environments.

The test plan is to explore the merits of various accuracy enhancement services and to test GNSS correction services with no sources of interference from signal reflection.

UTAC Millbrook – Culham

Two UTAC tracks – the high-speed circuit and the alpine route - provided different environments and scenarios: one constant, the other dynamic and utilised repeated circuits of both. This gave the team an opportunity to gather data in two different scenarios that wasn't influenced by external factors or interference and offered the ability to replicate the data gathering exercise multiple times, which wouldn't otherwise be possible in a 'real world', constantly changing situation.

SMLL London

Real world testing - The objective was to test and compare the GNSS antenna with a traditional patch antenna in urban driving environments, specifically to test performance in multi-path environments 'urban canyons' and areas where there was a lack of sky view, such as underpasses and tunnels.

The antennas were first installed onto SMLL London's own vehicle, pinpointing specific areas, such as the Walkie Talkie building, which pose challenges for geo-positing.

This allows the team to thoroughly test their solution and harness large quantities of valuable data to further assess and thus remove inconsistencies in future testing.

ASSURED CAV

Testing with HORIBA MIRA included a static test in an RF enclosed chamber, providing a controlled environment from which to monitor the antenna's response. This information was then partnered with the UTAC and SMLL London data to give another level of understanding of how signals perform in the context of the antenna on the vehicle.

Successes + Next Steps

The result of the testing programme has been the generation of meaningful test results, at least nine months ahead of the original schedule.

"We wouldn't have been able to make progress at the rate that we have done without access to these facilities via the introductions provided by the CAM Scale Up Programme. This has helped to accelerate our understanding of the environment that we operate in, and how our antennas perform in that environment."

The immediate next steps for the team is to work closely with the new investors and leads the CAM Scale-Up programme has helped them attract. The team will also continue working with both Smart Mobility Living Lab: London and UTAC.

03

Software

Testbeds Utilised:

A ASSURED CAV

D UTAC Millbrook - Culham

What was the aim?

This test plan looks to tackle the issue of poor connectivity by providing an end-to-end, high performance connected vehicle solution. With an integrated system, the focus is to raise the bar of consumer expectations for connected car experiences. For example, reducing the latency of remote commands to under half a second, as well as improving cellular connection robustness.

ASSURED CAV

The first part of the test plan is a focus on cyber security, including a threat modelling exercise and cyber security testing with HORIBA MIRA. Being a connected vehicle solution, cyber security is a core element, and the solution must be robust.

The second part was on electrical and radio frequency (RF) compliance. This resulted in a hardware performance test in HORIBA MIRA's labs, to ensure the system performs as expected under the right electrical loads.

UTAC Millbrook – Culham

Level three of the testing programme was to get the system integrated and tested on private tracks utilising UTAC's dedicated and secure cellular network. This tested a number of network variables without the unpredictability of consumer mobile networks. UTAC offers it's own proprietary 4G/5G cellular network which is not connected to consumer networks that can evidence bottlenecks and connection stability issues. The system was integrated into existing vehicles offered by the UTAC Millbrook – Culham testing facility with the aim to prove that in the first instance, the solution is flexible and easy to integrate into multiple, differing types of vehicles. Once integrated, the team were able to prove the robustness of the system, demonstrating a solution that can hold up to real-world road testing.

Successes + Next Steps

The results of the testing went above and beyond the team's hopes. The test plan output provides hard data to support business development activities and conversations with customers regarding the system which is now been tested and is ready for market.

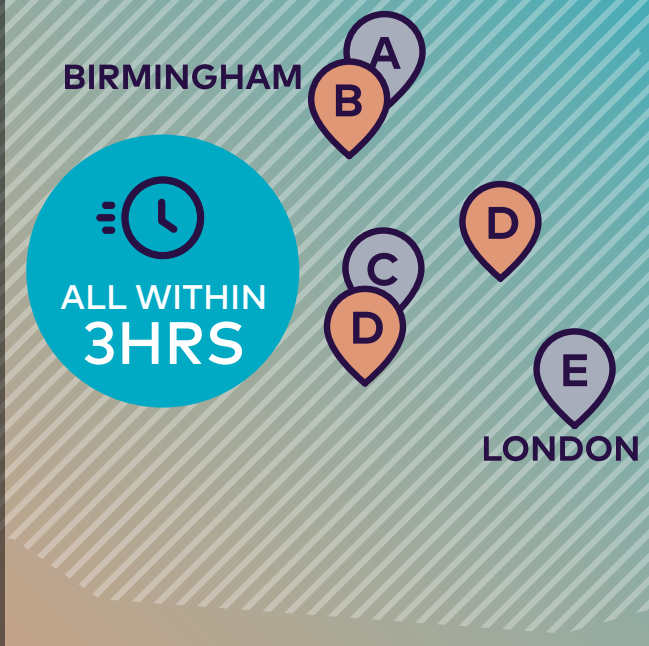
04

Cyber Security

Testbeds Utilised:

A ASSURED CAV

D UTAC Millbrook - Culham



What was the aim?

An innovative cyber security specialist providing hardware-based solutions for managing cyber security risks in machine-to-machine communication. Rather than focusing on managing network vulnerabilities, this technology physically attaches to the machine/device.

The mission here was to test the security, performance and functional safety of the software and hardware.

ASSURED CAV

The first part of the test plan was a cyber security assessment designed and undertaken with the ASSURED CAV team to test the resilience of the software. Testing included integrating the technology into off the shelf commercial ECUs in ASSURED CAV's vehicle network.

UTAC Millbrook – Culham

The second part of the testing journey is with UTAC-Culham, on the Culham testbed. The tests consist of a dynamic traffic routing trial, using three vehicles in a real-life city environment. By retrofitting both the RACE roadside units and the autonomous vehicles, the team creates trusted zones between the vehicles, allowing for fully-protected communication.

Successes + Next Steps

The testing highlight was validating the cyber resilience of the device authentication technology against a myriad of cyber-attacks at HORIBA MIRA. Going on to test the interoperability of the technology with new and old ECU's allowed the team to prove they can retrofit older vehicles – a USP for the company.

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Suppored by:

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Centre for Connected & Autonomous Vehicles